2013 POSNA ANNUAL MEETING

MAY 1–4, 2013

WELCOME

POSNA Upcoming Meetings

10th Annual International Pediatric Orthopaedic Symposium

December 4–7, 2013
Presented by POSNA and AAOS
Orlando, Florida

POSNA Specialty Day

March 15, 2014
New Orleans, Louisiana

POSNA 2014 Annual Meeting and One Day Course

April 30–May 3, 2014
Loews Hollywood Hotel
Hollywood, California

POSNA
ACKNOWLEDGMENTS

The Pediatric Orthopaedic Society of North America gratefully acknowledges the following for their generous financial support during 2013

Howard Steel Foundation
St. Giles Foundation
Angela S.M. Kuo Memorial Fund

Double Diamond Level

K2M*
Medtronic*
OrthoPediatrics*
Stryker*

Diamond Level

DePuy Synthes*

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Shriners Hospitals for Children

Gold Level

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Medicrea USA*
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NuVasive, Inc.*
Pega Medical*
Transgenomic, Inc.*

THANK YOU...

*Provided financial support for the pre-course and annual meeting.

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General Meeting Information

Learning Objectives

Upon completion of this program, participants should be able to:
1. Discuss 3 new developments in pediatric orthopaedic surgery.
2. Implement 2 new techniques in the participants' practice of pediatric orthopaedic surgery.
3. Describe the impact of advances in basic molecular and biomechanical sciences and discuss their likely impact upon the practice of pediatric orthopaedic surgery.
4. Acquire a better understanding of the natural history of pediatric orthopedic disease.

Accreditation

This Annual Meeting of the Pediatric Orthopaedic Society of North America has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Academy of Orthopaedic Surgeons and POSNA.

The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

Continuing Medical Education

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the American Academy of Orthopaedic Surgeons and the Pediatric Orthopaedic Society of North America. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of **23.75 AMA PRA Category 1 Credits™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FDA Statement (United States)

Some drugs or medical devices demonstrated at this Annual Meeting may not have been cleared by the FDA or have been cleared by the FDA for specific purposes only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

Academy policy provides that "off label" uses of a drug or medical device may be described in the Academy's CME activities so long as the "off label" use of the drug or medical device is also specifically disclosed (i.e., it must be disclosed that the FDA has not cleared the drug or device for the described purpose). Any drug or medical device is being used "off label" if the described use is not set forth on the product's approval label.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (ie., the drug or medical device is being discussed for an "off label" use

Disclaimer

The material presented at the Annual Meeting has been made available by the Pediatric Orthopaedic Society of North America for educational purposes only. The material is not intended to represent the only, nor necessarily best, method or procedure appropriate for the medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty which may be helpful to others who face similar situations.

POSNA disclaims any and all liability for injury or other damages resulting to any individual attending the Annual Meeting and for all claims which may arise out of the use of the techniques demonstrated therein by such individuals, whether these claims shall be asserted by physician or any other person.

Disclosure

Each faculty member in this meeting has been asked to disclose if he or she has received something of vault from a commercial company or institution, which relates directly or indirectly to the subject of their presentation. The Academy has identified the options to disclose as follows:

1. Royalties from a company or supplier;
2. Speakers bureau/paid presentations for a company or supplier;
3. (A)Paid employee for a company or supplier, (B) Paid consultant for a company or supplier, (C) Unpaid consultant for a company or supplier;
4. Stock or stock options in a company or supplier;
5. Research support from a company or supplier as a PI;
6. Other financial or material support from a company or supplier;
7. Royalties, financial or material support from publishers;
8. Medical/Orthopaedic publications editorial/governing board;
9. Board member/committee appointments for a society;

n. No conflicts;

An indication of the participant's disclosure appears after his or her name as well as the commercial company or institution that provided the support.

The Academy and POSNA do not view the existence of these disclosed interests or commitments as necessarily implying bias or decreasing the value of the author's participation in the meeting.

POSNA Antitrust Policy

It shall be the policy of the Pediatric Orthopaedic Society of North America (POSNA) to be in strict compliance with all Federal and State Antitrust laws, rules and regulations. Therefore: These policies and procedures apply to all membership, board, committee, and all meetings attended by representatives of the POSNA.

Discussions at POSNA meetings often cover a broad range of topics pertinent to the interests or concerns of orthopaedic surgeons. As a general rule, except as noted below, discussions at POSNA meetings can address topics without raising antitrust concerns if the discussions are kept scrupulously free of even the suggestion of private regulation of the profession. However, a number of topics that might be (and have been) discussed at POSNA meetings may raise significant complex antitrust concerns. These include:

- Membership admissions, rejections, restrictions, and terminations;
- Method of provision and sale of POSNA products and services to non-members;
- Restrictions in the selection and requirements for exhibitors at the POSNA Annual Meeting or in CME activities;
- Collecting and distributing certain orthopaedic practice information, particularly involving practice charges and costs;
- Obtaining and distributing orthopaedic industry price and cost information;
- Professional certification programs;
- Group buying and selling; and
- Inclusions or exclusion of other medical societies in organizational activities or offerings.

When these and related topics are discussed, the convener or members of the POSNA group should seek counsel from its General Counsel.

POSNA urges its Board, committees and members not to participate in discussions that may give the appearance of or constitute an agreement that would violate the antitrust laws. Notwithstanding this reliance, it is the responsibility of each of each POSNA Board or member to avoid raising improper subjects for discussion. This policy has been prepared to ensure that POSNA members and other participants in POSNA meetings are aware of this obligation.

Photographs

Registration and attendance at, or participation in, POSNA activities constitutes an agreement by the registrant to allow POSNA to use and distribute (both now and in the future) the registrant's or attendee's image in POSNA member communications and promotional materials.

No Reproductions

No reproductions of any kind, including audiotapes and videotapes, may be made of the presentations at this meeting without the prior written permission of POSNA. POSNA reserves all of its rights to such material and commercial reproduction is specifically prohibited. Cameras or video cameras may not be used in any portion of the meeting.

POSNA extends sincere appreciation to K2M for a restricted grant in support of printing of this final program.

POSNA / IFPOS COMBINED HALF-DAY PRE-COURSE
MAY 1, 2013
SHERATON CENTRE, TORONTO, ONTARIO, CANADA

Care for the Young Patient with a Complex Orthopaedic Problem:

A Global Perspective

On May 1, 2013, at the POSNA Annual Meeting in Toronto, The Half-Day Pre-Course, co-sponsored by IFPOS, is entitled, "Care for the Young Patient with a Complex Orthopaedic Problem: A Global Perspective." An international faculty will present lectures on early onset scoliosis, hip problems, upper extremity, lower extremity and gait, and lively panel discussions will review cases of trauma and spine deformity. Additionally, we will discuss aspects of the Children's Orthopaedics in Underserved Regions (COUR) Program and health care delivery around the world. Please join us for what is sure to be a colorful and interactive program with noted experts from around the world.

POSNA
The Pediatric Orthopaedic Society of North America

ifpos
international federation paediatric orthopaedic societies

Objectives and goals of the course:
At the end of the course, the registrant will:

1. Be familiar with current concepts of the growing spine and treatment alternatives for early onset scoliosis.
2. Ascertain the relative merits of in situ screw fixation or surgical dislocation of a high grade, acute slipped capital femoral epiphysis.
3. Understand some of the late reconstructive options for brachial plexus palsy.
4. Learn aspects of management of traumatic injuries to a child's upper and lower extremity through case-based learning.
5. Be able to recommend options for hip reconstruction in cerebral palsy and lower extremity congenital deformities.
6. Have an understanding of international health care delivery.

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Continuing Medical Education

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of **4.75 *AMA PRA Category 1 Credits*™.** Physicians should claim only the credit commensurate with the extent of their participation in the activity.

POSNA / IFPOS COMBINED HALF-DAY PRE-COURSE

7:30 AM – 7:35 AM	**Opening Welcome** POSNA President: *Peter O. Newton, MD, San Diego, California* IFPOS President: *Carlo Milani, MD, Sao Paulo, Brazil*
7:36 AM – 7:40 AM	**Objectives And Announcements** Co-Chairs: *Suken A. Shah, MD, Wilmington, Delaware* *Patricia M.B. Fucs, MD, Sao Paulo, Brazil*
7:40 AM – 8:54 AM	**Session I – Spine Deformity** Moderator: *David Aronsson, MD, Burlington, Vermont* Presider: *B. Stephens Richards, MD, Dallas, Texas*
7:40 AM – 7:49 AM	**What Is The Current Evidence That What We're Doing In EOS Works?** *Michael Vitale, MD, New York, New York*
7:50 AM – 7:59 AM	**Anterior And Posterior Growth Sparing Methods** *Scott Luhmann, MD, St. Louis, Missouri*
8:00 AM – 8:09 AM	**The Latest Techniques For Severe Deformities** *Stephen Lewis, MD, Toronto, Ontario, Canada*
8:10 AM – 8:19 AM	**Revision Surgery: Obstacles And Pitfalls** *Muharrem Yazici, MD, Ankara, Turkey*
8:20 AM – 8:29 AM	**DISCUSSION**
8:30 AM – 8:54 AM	**International Expert Panel – Discussion Of Cases** Leader: *Gerard Bollini, MD, Marseille, France* Panel: *Firoz Miyanji, MD, Vancouver, British Columbia, Canada;* *Laurel Blakemore, MD, Washington, District of Columbia;* *Claudio Fernandez, MD, LaPlata, Argentina;* *Reinhard Zeller, MD, Toronto, Ontario, Canada*
8:55 AM – 9:29 AM	**Session II – Hip Controversies** Moderator: *In Ho Choi, MD, Seoul, Korea* Presider: *Rui Maciel, MD, Sao Paulo, Brazil*
8:55 AM – 9:04 AM	**Surgical Hip Dislocation: Techniques For Success** *Ernest L. Sink, MD, New York, New York*
9:05 AM – 9:29 AM	**Debate: Acute, High Grade SCFE**
9:05 AM – 9:11 AM	**In Situ Fixation** *Dennis Wenger, San Diego, California*

9:12 AM – 9:18 AM	**Surgical Hip Dislocation And Reduction** *Dan Sucato, MD, Dallas, Texas*
9:19 AM – 9:23 AM	**Debate Rebuttal/Summation**
9:24 AM – 9:29 AM	**DISCUSSION**
9:30 AM – 10:05 AM	**Session III – Upper Extremity Update** Moderator: *Eva Ponten, MD, Stockholm, Sweden* Presider: *Patricio Gonzalez, MD, Buenos Aires, Argentina*
9:30 AM – 9:39 AM	**Late Reconstruction Of Brachial Plexus Palsy** *Michelle James, MD, Sacramento, California*
9:40 AM – 10:05 AM	**International Expert Panel Discussion Of Upper Extremity Trauma Cases** Leader: *Peter Waters, MD, Boston, Massachusetts* Panel: *Kaye Wilkins, MD, San Antonio, Texas;* *David L. Skaggs, MD, MMM, Los Angeles, California;* *Eric Edmonds, MD, SanDiego, California;* *Eiffel Dobashi, MD, San Paulo, Brazil*
10:05 AM – 10:30 AM	**BREAK**
10:30 AM – 11:35 AM	**Session IV – Lower Extremity Deformity And Reconstruction** Moderator: *Alain Dimeglio, MD, Montpellier, France* Presider: *Unni Narayanan, MD, Toronto, Ontario, Canada*
10:30 AM – 10:39 AM	**Salvage Hip Procedures In Cerebral Palsy** *Patricia M.B. Fucs, MD, Sao Paulo, Brazil*
10:40 AM – 10:49 AM	**Reconstruction Of Late-Presenting Congenital Deformities** *Gamal Hosny, MD, Cairo, Egypt*
10:50 AM – 10:59 AM	**Update On Lengthening In Children** *Franz Grill, MD, Vienna, Austria*
11:00 AM – 11:05 AM	**DISCUSSION**
11:06 AM – 11:35 AM	**International Expert Panel Discussion Of Lower Extremity Trauma Cases** Leader: *Jeff Sawyer, MD, Germantown, Tennessee* Panel: *Juan Couto, MD, Buenos Aires, Argentina;* *Jonathan Phillips, MD, Orlando, Florida;* *Jack Flynn, MD, Philadelphia, Pennsylvania;* *Richard Kruse, DO, Wilmington, Delaware*
11:36 AM – 12:15 PM	**Session V – International Health Care Delivery** Moderator: *Richard Schwend, MD, Kansas City, Missouri* Presider: *Walterio Palma, MD, Hermosillo, Mexico*

11:36 AM – 11:46 AM	**Development Of Children´s Orthopedics As A Specialty In Europe** *Andre Kaelin, MD, Switzerland*
11:47 AM – 11:55 AM	**COUR Update And Projects** *Sanjeev Sabharwal, MD, Newark, New Jersey*
11:56 AM – 12:06 PM	**Health Care Delivery: Is There An Ideal Model?** *James Kasser, MD, Boston, Massachusetts*
12:07 PM – 12:14 PM	**DISCUSSION**
12:15 PM	**Announcements/Adjourn** Co-Chair: *Suken A. Shah, MD, Wilmington, Delaware*

OPENING CEREMONY

WEDNESDAY, MAY 1, 2013

Sheraton Centre Hotel, Toronto, Ontario, Canada

6:30 PM – 6:40 PM	**Welcome: POSNA President – Peter O. Newton, MD** Local Hosts – *Benjamin A. Alman, MD and Sevan Hopyan, MD*
6:40 PM – 6:50 PM	**Introductions Distinguished Guests** • *International Presidents* • *Distinguished Achievement Award Recipient* • *Presidential Guest Speaker* • *EPOS Traveling Fellows* • *COUR Visiting Scholars*
6:55 PM – 7:00 PM	**Shriners Hospitals for Children Award** *Peter Armstrong, MD*
7:00 PM – 7:05 PM	**Presentation of the St. Giles Young Investigator Award** *Mr. Richard Arkwright and Dr. Donald Huene*
7:05 PM – 7:10 PM	**Presentation of the Arthur H. Huene Award** *Mr. Richard Arkwright and Dr. Donald Huene*
7:10 PM – 7:15 PM	**Presentation of Angela S.M. Kuo Memorial Award** *Ken Kuo, MD*
7:15 PM – 7:25 PM	**Presentation of the Humanitarian Award** *Peter O. Newton, MD*
7:20 PM – 7:25 PM	**Presentation of the Special Effort and Excellence Award** *Peter O. Newton, MD*
7:25 PM – 7:40 PM	**Recognition of Industry Sponsors** *Peter O. Newton, MD*
7:40 PM	**Introduction Steel Lecturer** *Peter O. Newton, MD*
7:40 PM – 8:00 PM	**Steel Lecture – "How We Fly"** *Justin Hines*
8:00 PM – 9:30 PM	**Welcome Reception**

Levels of Evidence for Primary Research Questions

Types of Studies				
	Therapeutic Studies—Investigating the Results of Treatment	**Prognostic Studies—Investigating the Effect of a Patient Characteristic on the Outcome of Disease**	**Diagnostic Studies—Investigating a Diagnostic Test**	**Economic and Decision Analyses—Developing an Economic or Decision Model**
Level I	• High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals • Systematic review[2] of Level-I randomized controlled trials (and study results were homogeneous[3])	• High-quality prospective study[4] (all patients were enrolled at the same point in their disease with ≥80% follow-up of enrolled patients) • Systematic review[2] of Level-I studies	• Testing of previously developed diagnostic criteria in series of consecutive patients (with universally applied reference "gold" standard) • Systematic review[2] of Level-I studies	• Sensible costs and alternatives; values obtained from many studies; multiway sensitivity analyses • Systematic review[2] of Level-I studies
Level II	• Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization) • Prospective[4] comparative study[5] • Systematic review[2] of Level-II studies or Level-I studies with inconsistent results	• Retrospective[6] study • Untreated controls from a randomized controlled trial • Lesser-quality prospective study (e.g., patients enrolled at different points in their disease or <80% follow-up) • Systematic review[2] of Level-II studies	• Development of diagnostic criteria on basis of consecutive patients (with universally applied reference "gold" standard) • Systematic review[2] of Level-II studies	• Sensible costs and alternatives; values obtained from limited studies; multiway sensitivity analyses • Systematic review[2] of Level-II studies
Level III	• Case-control study[7] • Retrospective[6] comparative study[5] • Systematic review[2] of Level-III studies	• Case-control study[7]	• Study of nonconsecutive patients (without consistently applied reference "gold" standard) • Systematic review[2] of Level-III studies	• Analyses based on limited alternatives and costs; poor estimates • Systematic review[2] of Level-III studies
Level IV	Case series[8]	Case series	• Case-control study • Poor reference standard	• No sensitivity analyses
Level V	Expert opinion	Expert opinion	Expert opinion	Expert opinion

1. A complete assessment of the quality of individual studies requires critical appraisal of all aspects of the study design.
2. A combination of results from two or more prior studies.
3. Studies provided consistent results.
4. Study was started before the first patient enrolled.
5. Patients treated one way (e.g., with cemented hip arthroplasty) compared with patients treated another way (e.g., with cementless hip arthroplasty) at the same institution.
6. Study was started after the first patient enrolled.
7. Patients identified for the study on the basis of their outcome (e.g., failed total hip arthroplasty), called "cases," are compared with those who did not have the outcome (e.g., had a successful total hip arthroplasty), called "controls."
8. Patients treated one way with no comparison group of patients treated another way.

This chart was adapted from material published by the Centre for Evidence-Based Medicine, Oxford, UK. For more information, please see. www.cebm.net.

2013 DISCLOSURE LISTING

Name	Disclosure	Presentation Type
Aadalen, Richard J.	n-none	Paper #102
Abbott, Matthew D.	n-none	e-Poster #14
Abelin-Genevois, Kariman	n-none	e-Poster #26
Abraham, Edward	n-none	IFPOS Paper #31; Hand Subspecialty Day
Abzug, Joshua M.	n-none	Paper #32; Hand Subspecialty Day
Accousti, William K.	2-Medtronic; 3B-Orthopediatrics	Poster #25
Achan, Pramod	n-none	IFPOS Paper #10
Acharya, Jay	n-none	Paper #66
Ackerson, Richard	n-none	Hand Subspecialty Day #9
Adamczyk, Mark J.	n-none	Paper #50
Adedapo, Akinwanda	n-none	Hip Subspecialty Day #6
Adelizzi-Delany, Judith	n-none	Poster #14
Adib, Farshad	n-none	Paper #22
Agashe, Mandar	n-none	e-Poster #54
Agur, Anne	n-none	e-Poster #74
Ahmed, Mubashshar	n-none	Hip Subspecialty Day #6
Ahn, Tae-Young	n-none	e-Poster #5
Aiona, Michael D.	8-Gait and Posture, Journal of Bone and Joint Surgery-American, Journal of Pediatric Orthopaedics; 9-American Academy for Cerebral Palsy and Developmental Medicine, POSNA	Paper #65
Ajuwon, Ademola A.	n-none	Paper #68
Akbarnia, Behrooz A.	1-DePuy Spine, Nuvasive; 2-Nuvasive, K2M, Ellipse; 3B-Nuvasive, K2M, Ellipse, K Spine, DePuy, A Johnson & Johnson Company; 4-Nuvasive, Ellipse, K Spine, Nocimed; 5-K2M, DePuy Spine, Nuvasive; 8-Journal of Orthopaedic Science, Spine, Spine Deformity (SRS Journal); 9-Growing Spine Foundation, Scoliosis Research Society, Pediatric Orthopaedic Society, San Diego Spine Foundation	Paper #36♦; e-Poster #23♦; Evidence Based Medicine Symposium; IFPOS Paper#1♦,29♦; Spine Subspecialty Day #3

Disclosure Key: The codes are identified as: 1-Royalties from a company or supplier; 2-Speakers bureau/paid presentation for a company or supplier; 3-(a) paid employee or (b) paid consultant or (c) unpaid consultant for a company or supplier; 4-Stock or stock options in a company or supplier; 5-Research support from a company or supplier as a PI; 6-Other financial or material support from a company or supplier; 7-Royalties, financial or material support from publishers; 8-Medical/orthopaedic publications editorial/governing board; 9-Board member/committee appointments for a society; n-No conflicts; ♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use). For full information, refer to page 4. **Boldface** indicates member of POSNA Board of Directors.

Name	Disclosure	Presentation Type
Al Kork, Samer	n-none	IFPOS Paper #31
Al-Aubaidi, Zaid	n-none	Paper #45
Albiñana, Javier	n-none	Paper #15
Albright, Jay C.	1-Biomet; 2-Arthrex	Sports Subspecialty Day
Aleem, Ilyas S.	n-none	Paper #33
Alian, Aymen A.	n-none	IFPOS Paper #30
Alman, Benjamin A.	4-ScarX; 8-Journal of Orthopaedic Research, Journal of Orthopaedic Research, PLoS One; 9-Shriners Research Advisory Board, Orthopaedic Research Society	eModerator; Paper #45,70,78; Poster #19; Lower Extremity/ Neuromuscular Subspecialty Day
Alonso, Maria	n-none	Paper #42
Alpert, Hilary W.	n-none	e-Poster #31
Alshryda, Sattar	n-none	Poster #19; Hip Subspecialty Day #6
Altiok, Haluk	n-none	e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7
Amirouche, Farid	n-none	IFPOS Paper #31
Anadio, Jennifer M.	n-none	Paper #48 Spine Subspecialty Day #4
Anderson, Allen F.	1-Orthopediatrics; 8-Editorial Board for the American Journal of Sports Medicine; 9-ISAKOS Knee Committee	Paper #84
Anderson, Mary	n-none	Paper #9
Anderson, Richard C.E.	2-AO Spine North	Spine Subspecialty Day #3
Anderson, Terrence D.	n-none	Paper #112 ♦
Andras, Lindsay M.	n-none	Paper #34 ♦
Andrysek, Jan	n-none	Sports Subspecialty Day #1
Anglen, Jeffrey O.	8-Journal of the American Academy of Orthopaedic Surgeons, 9-AAOS, American Board of Orthopaedic Surgery, American College of Surgeons	e-Poster #14
Angsanuntsukh, Chanika	n-none	Paper #14
Anthony, Alison	n-none	Hand Subspecialty Day #6
Antonacci, M. Darryl	n-none	e-Poster #70
Aoki, Chie	n-none	IFPOS Paper #16

Name	Disclosure	Presentation Type
Aoki, Stephen K.	3B-Arthrocare, Pivot Medical; Smith & Nephew	e-Poster #20
Apel, Peter J.	n-none	Paper #11
Arami, Amir	n-none	Paper #79
Archibald-Seiffer, Noah	n-none	Paper #86
Arizola, Juan Leonel	n-none	Paper #62
Arkader, Alexandre	3B-Biomet Trauma	Paper #116; IFPOS Paper #19
Armaghani, Sheyan	n-none	e-Poster #28
Armstrong, Douglas G.	9-American Board of Orthopaedic Surgery, POSNA	Paper #5; Poster #2
Armstrong, Jen	n-none	IFPOS Paper #14
Armstrong, Peter F.	3B-OrthoPediatrics; 4-OrthoPediatrics	Moderator
Asghar, Jahangir	3B-DePuy, A Johnson & Johnson Company	Paper #46; e-Poster #70; Spine Subspecialty Day #10
Ashraf, Ali	n-none	Paper #87
Astudillo, Cesar F.	n-none	e-Poster #12
Astur, Nelson	n-none	e-Poster #13
Ata, Yurika	n-none	IFPOS Paper #16
Atteya, Gourg	n-none	IFPOS Paper #30
Augsburger, Sam	n-none	e-Poster #64
Aynardi, Michael C.	n-none	Disaster Response Symposium #1
Ayoubian, Leila	n-none	IFPOS Paper #42
Ayyala, Haripriya	n-none	Poster #4
Babyn, Paul S.	n-none	Paper #66
Bachrach, Steven	n-none	Paper #60 ♦
Bae, Donald S.	4-cubist, Optimer, osiris; 7-Lippincott Williams & Wilkins; 9-ASSH, POSNA	Moderator; Paper #2,82,88; Poster #1; IFPOS Paper #41; Sports Subspecialty Day #7
Bagley, Anita	n-none	Paper #89 ♦
Baird, Glen O.	n-none	Paper #95,106; e-Poster #75
Bari, Omar	n-none	Paper #117
Balasubramanian, Sriram	n-none	e-Poster #32
Baldwin, Keith D.	4-Pfizer; 7-Journal of Bone and Joint Surgery-American	Poster #1; e-Poster #7
Ballock, R. Tracy	5-Musculoskeletal Transplant Foundation; 9-POSNA, Shriners Hospitals for Children, Orthopaedic Research and Education Foundation	Program Committee

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Name	Disclosure	Presentation Type
Balog, Todd P.	n-none	e-Poster #75
Banskota, Ashok K.	n-none	Paper #96
Banskota, Bibek	n-none	Paper #96
Bar-On, Elhanan	8-Journal of Pediatric Orthopaedics, Journal of Children's Orthopaedics	Paper #79
Barbarita, Cait	n-none	Paper #11
Barlow, Brian	n-none	e-Poster #54
Barsi, James	n-none	Spine Subspecialty Day #9
Basci, Onur	n-none	Poster #7
Bastrom, Tracey P.	n-none	Paper #1,46,93; e-Poster #18,48; Spine Subspecialty Day #10
Bathen, Mary	n-none	e-Poster #48
Baucom, Sidney	n-none	e-Poster #22
Bauer, Andrea S.	8-Journal of Bone and Joint Surgery-American	Paper #90; COUR Symposium; Hand Subspecialty Day #7
Baulesh, David	n-none	Spine Subspecialty Day #9
Beaton, Dorcas	n-none	Paper #12
Beaty, James H.	7-Wolters Kluwer Health-Lippincott Williams & Wilkins, Saunders/Mosby-Elsevier; 8-Journal of Bone and Joint Surgery; 9-Orthopaedic Research and Education Foundation	Poster #22; e-Poster #67
Beebe, Allan C.	n-none	Paper #73♦,91,109
Beguiristain, José Luís	n-none	Paper #40
Berhand, Caleb J.	n-none	Paper #44; e-Poster #41
Bent, Melissa	n-none	Paper #5
Beran, Matthew	n-none	Paper #91
Berglund, Lisa M.	n-none	e-Poster #56
Bernstein, Robert M.	n-none	COUR Symposium
Betz, Randal R.	1-DePuy Synthes Spine, Medtronic; 2-DePuy Synthes Spine; 3B-DePuy Synthes Spine, Orthocon, SpineGuard, Medtronic; 3C-Orthobond; 4-SpineGuard, MiMedx, Orthocon, Orthobond; 7-Thieme; 9-Chest Wall and Spine Deformity Study Group	e-Poster #70; Spine Subspecialty Day #10
Bible, Jesse	n-none	e-Poster #28
Biggar, W. Douglas	n-none	Paper #70
Birke, Oliver	2-DePuySynthes	IFPOS Paper #6
Birnbaum, Mark A.	n-none	e-Poster #15

Name	Disclosure	Presentation Type
Bittersohl, Bernd	n-none	e-Poster #55,62
Blackledge, Marcella	n-none	Paper #114
Blakemore, Laurel C.	3B-K2M, Stryker, Medtronic; 5-K2M; 8-Spinal Deformity Journal; 9-Scoliosis Research Society, POSNA	Spine Subspecialty Day
Blanco, John S.	n-none	e-Poster #27
Blumstein, Gideon	n-none	Spine Subspecialty Day #7
Boachie-Adjei, Oheneba	2-K2M, Trans1; 3B-DePuy, K2M, Trans1; 3C-DePuy, K2M, Trans1; 5-Medtronic/Osteotech, DePuy, K2M; 6-DePuy, K2M, Trans1	e-Poster #27
Bober, Michael B.	n-none	IFPOS Paper #9
Bomar, James D.	n-none	Paper #115; e-Poster #50,54,55,62
Bompadre, Viviana	n-none	Paper #103,114
Booker, Rashad	n-none	Sports Subspecialty Day #5
Born, Christopher T.	3B-Stryker Orthopaedics, Illuminoss, 4-Illuminoss, 5-Airlift foundation, Stein/Bellet Foundation, 9-FOT, OTA	Disaster Response Symposium #4
Boutis, Kathy	n-none	Paper #3
Bradish, Christopher	n-none	Hip Subspecialty Day #1
Bravo, Christian	n-none	Paper #15
Bray, Christopher C.	n-none	Hand Subspecialty Day #2
Brighton, Brian K.	9-POSNA	Paper #31; Evidence Based Medicine Symposium
Brockmeyer, Douglas L.	n-none	Spine Subspecialty Day #3
Browd, Samuel	n-none	e-Poster #22
Browne, Richard H.	n-none	Paper #20
Bruce, Robert W.	n-none	Paper #111
Bueche, Matthew J.	9-POSNA	Presider
Bugbee, William D.	1-DePuy, A Johnson & Johnson Company, Zimmer Biologics, Smith & Nephew; 3B-DePuy, A Johnson & Johnson Company, Smith & Nephew, Zimmer; Joint Restoration Foundation, Moximed; 4-Moximed, OrthAlign, Alexandria Research Technologies; 5-OrthAlign, Alter-G, Joint Restoration Foundation	Poster #21
Burgess, Ronald C.	n-none	Hand Subspecialty Day #5

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Name	Disclosure	Presentation Type
Busch, Michael T.	3B-Orthopediatrics	Moderator; Sports Subspecialty Day
Bylski-Austrow, Donita I.	3C-SpineForm; 6-SpineForm; DePuy, A Johnson & Johnson Company	Paper #42
Byrne, Stefan	n-none	e-Poster #17
Cabral, Cristina	n-none	POSNA Staff
Cage, J. Matthew	n-none	e-Poster #16
Cahill, Patrick J.	2-DePuy Synthes Spine, A Johnson & Johnson Company; 3B-DePuy Synthes Spine, A Johnson & Johnson Company; 5-DePuy Synthes Spine, A Johnson & Johnson Company; 6-DePuy Synthes Spine, A Johnson & Johnson Company; 8-Orthopaedics Spine Deformity; 9-AAOS; Scoliosis Research Society; POSNA	e-Poster #70
Caiafa, Jordana	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Caird, Michelle S.	9-POSNA, University of Michigan Medical Center Alumni Society, Orthopaedic Research and Education Foundation, University of Michigan Medical School Alumni Foundation	e-Poster #31
Caliskan, Emrah	n-none	Poster #7
Camacho, Alejandra	n-none	IFPOS Paper #28
Campbell, Robert M.	n-none	e-Poster #32
Canto, Ileana-Patricia	n-none	IFPOS Paper #28
Capdevila, Roman L.	9-Sociedad Mexicana Ortopedia Pediatrica (President)	Paper #10,62; e-Poster #35
Cardoso, Michelle S.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Carey, James L.	8-Editorial board for the American Journal of Sports Medicine, 9-AAOS Evidence Based Practice Committee	Paper #84
Carnahan, Heather	n-none	e-Poster #74
Carrigan, Robert B.	3A-GlaxoSmithKline; 4-GlaxoSmithKline	Moderator; Hand Subspecialty Day #1,4
Carroll, Kristen L.	n-none	Paper #16
Carry, Patrick M	n-none	Paper #51; e-Poster #69; Hand Subspecialty Day #9
Carty, Caitriona	n-none	e-Poster #17
Caskey, Paul M.	n-none	Paper #95,106; e-Poster #75
Caspi, Liora	n-none	Paper #97; e-Poster #30

Name	Disclosure	Presentation Type
Cassidy, Jeffrey A.	n-none	Spine Subspecialty Day #6 ♦
Cassis, Nelson	n-none	IFPOS Paper #28,32
Castañeda, Pablo	8-Revista Mexicana de Ortopedia Pediátrica; 9-Sociedad Mexicana de Ortopedia Pediátrica, Sociedad de Especialistas en Cirugía Ortopédica del Centro Médico ABC	Paper #23; e-Poster #60; IFPOS Paper #7
Cates, Justin M.M.	n-none	e-Poster #58
Caudill, Angela	n-none	Paper #94
Chambers, Henry (Hank) G.	3B-Allergan, Orthopediatrics; 8-Developmental Medicine and Child Neurology, Gait and Posture; 9-AAOS, American Academy for Cerebral Palsy and Developmental Medicine, POSNA	Paper #84; Hip Subspecialty Day; Sports Subspecialty Day
Chan, Gilbert	n-none	Paper #61
Chang, Anthony A.	n-none	e-Poster #27
Chang, Benjamin	n-none	Hand Subspecialty Day #1
Chang, Frank M.	n-none	e-Poster #25,69
Chaplinski, Kate L.	n-none	Poster #14
Charles, Michael	n-none	Paper #93
Chen, Austin	n-none	IFPOS Paper #46
Chen, Christopher	n-none	Sports Subspecialty Day #6
Chiari, Catharina	n-none	IFPOS Paper #11 ♦
Cho, Tae-Joon	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; IFPOS Paper #12,20,23; Lower Extremity/ Neuromuscular Subspecialty Day #3
Choi, In Ho	n-none	Paper #54, 58; Poster #15; e-Poster #43,45,68; IFPOS Paper #12,20,23; Lower Extremity/ Neuromuscular Subspecialty Day #3
Choi, Paul D.	2-Stryker; 3B-Stryker, Integra	Poster #12
Choi, Young	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; Lower Extremity/ Neuromuscular Subspecialty Day #3,

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Name	Disclosure	Presentation Type
Christophersen, Christy	n-none	Paper #87; Sports Subspecialty Day #
Chung, Chin Youb	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; IFPOS Paper #20,23; Lower Extremity/ Neuromuscular Subspecialty Day #3
Church, Chris	n-none	e-Poster #42
Ciafaloni, Emma	n-none	e-Poster #41
Cidambi, Krishna R.	n-none	e-Poster #4; IFPOS Paper #2
Clarke, Howard	n-none	Hand Subspecialty Day #6
Clarke, Nicholas M.P.	n-none	e-Poster #60; IFPOS Paper #7
Clements, David H.	3B-DePuy Synthes Spine	e-Poster #70
Clinton, Rebecca	n-none	e-Poster #65
Clohisy, John C.	3B-Biomet, Pivot Medical; 5-Wright Medical Technology, Zimmer; 8-Journal of Bone and Joint Surgery-American	Paper #26; e-Poster #56
Cohen, Randolph B.	n-none	Practice Management Symposium
Cole, Heather	n-none	Poster #13♦; e-Poster #58
Collins, DeRaan	n-none	Paper #21
Complex Spine Study Group	5-K2M	IFPOS Paper #29♦
Connolly, Paul	n-none	e-Poster #1
Connolly, Suan	n-none	Hip Subspecialty Day #3
Conrad, Ernest U.	3B-Zimmer; 3C-Stryker; 6-LifeNet Health Northwest Tissue Division	Paper #29
Cook, Stephen R.	n-none	e-Poster #39
Cooper, Timothy M.	n-none	Paper #29
Cooperman, Daniel R.	1-Orthopediatrics; 6-Zimmer	Paper #68
Copley, Lawson A.	n-none	Moderator
Coral, Ramon	n-none	IFPOS Paper #28
Cordill, Ronda	n-none	Paper #106
Cornwall, Roger	n-none	Paper #90; e-Poster #46; Hand Subspecialty Day #8
Corominas, Laura	n-none	IFPOS Paper #13
Costanzo, James A.	n-none	Disaster Response Symposium #1
Couto, Juan Carlos	n-none	IFPOS Paper #39

Name	Disclosure	Presentation Type
Crawford, Alvin H.	3C-DePuy, A Johnson & Johnson Company; 5-OREF; 9-J. Robert Gladden Society	Paper #42,48; Spine Subspecialty Day
Crespo, Marcos	n-none	IFPOS Paper #39
Crosby, Samuel N.	n-none	IFPOS Paper #24
Cruz, Jacobo S.	n-none	Paper #62, IFPOS Paper #28
Cummings, Donald	n-none	Paper #63
Cundy, Peter	n-none	IFPOS Paper #7
Cunningham, Matthew E.	n-none	e-Poster #27
Cuomo, Anna V.	9-POSNA	Paper #3
Curtis, Chris	n-none	Hand Subspecialty Day #6
Da Silva, Trevor	n-none	Sports Subspecialty Day #1
Dabaghi, Alejandro	n-none	e-Poster #35
Dabney, Kirk W.	3B-DePuy, A Johnson & Johnson Company, Medtronic	IFPOS Paper #5,37; Spine Subspecialty Day #2
Daniels, Alan H.	n-none	Disaster Response Symposium #4
Danino, Barry	n-none	Poster #18
Daram, Shiva	n-none	Paper #71
Dashe, Jesse	n-none	Paper #6
Davidsen, Michael	n-none	Paper #69
Davidson, Richard S.	1-Biomet; 2-Biomet; 3B-Biomet; 3C-Medsonics; 4-Abbott, Bristol-Myers Squibb, GlaxoSmithKline, Merck, Pfizer, ZimmerHoldings	eModerator
Davies, Katherine F.	n-none	e-Poster #69
Davis, Alan T.	n-none	Disaster Response Symposium #2
Dayer, Romain	n-none	e-Poster #66
de Guise, Jacques A.	1-EOS; 4-Emovi, EOS; 5-Emovi, EOS, ORS, Siemens	IFPOS Paper #42
De La Cruz, Matthew	n-none	e-Poster #44
De La Rocha, Adriana	n-none	Paper #20,21; e-Poster #52,53; Hip Subspecialty Day #7,9
Deanehan, Julia K.	n-none	Paper #110
Dehghan, Pegah	n-none	Paper #22
Deignan, Brian J.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #5
Deimling, Steven	n-none	Paper #80
del Rio, Javier	n-none	Paper #40

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Dela Torre, Katrina	n-none	Paper #18
Delbello, Damon	n-none	e-Poster #49
Dempsey, Molly	9-Society for Pediatric Radiology Board of Directors, Society for Pediatric Radiology Research and Education Foundation Board of Directors	Hip Subspecialty Day #7
Denning, Jamie Rice	n-none	e-Poster #65
Devin, Clinton J.	n-none	e-Poster #28
Devito, Dennis P.	1-medicrea; 2-mazor, medicrea; 3B-medicrea, mazor; 5-biomet	Paper #111
Dhawale, Arjun	n-none	IFPOS Paper #4,5
Diab, Michel G.	n-none	e-Poster #63
Dierauer, Stefan	n-none	e-Poster #59,61
Dietrich, Lindsey	n-none	e-Poster #34
Dietz, Frederick R.	n-none	Paper #94
Dillon, Peter W.	n-none	Paper #31
DiMauro, Jon Paul	n-none	Paper #4; e-Poster #9
Ditro, Colleen P.	n-none	IFPOS Paper #9
Doan, Joshua	n-none	Paper #76; IFPOS Paper #2
Dobbs, Matthew	1-D-Bar Enterprises; 3B-D-Bar Enterprises, Pfizer; 8-Clinical Orthopaedics and Related Research; 9-AAOS, American Orthopaedic Association, Association of Bone and Joint Surgeons, Missouri State Orthopaedic Assosication, Orthopaedic Research and Education Foundation, POSNA	Moderator; Lower Extremity/ Neuromuscular Subspecialty Day
Dodwell, Emily	n-none	IFPOS Paper #33
Donovan, Jason	n-none	Sports Subspecialty Day #5
Donovan, Skye	n-none	Paper #22;
Doo, David	n-none	e-Poster #34
Dormans, John P.	7-Elsevier, Mosby, Brooke's Publishing; 8-Journal of Pediatric Orthopaedics; 9-POSNA, SICOT USA, Scoliosis Research Society, SICOT Foundation, World Orthopaedic Concern	NP/PA Symposium; Spine Subspecialty Day #5
Doughty, Kathryn	n-none	Poster #19
Downey-Zayas, Timothy	n-none	Sports Subspecialty Day #8
Drummond, Kate	n-none	Paper #29
Du, Jerry	n-none	Paper #74
Duart-Clemente, Julio	n-none	Paper #40
Dubiel, Matthew	n-none	IFPOS Paper #27
Dubowsky, Susan	n-none	Spine Subspecialty Day #2
Duker, Angela L.	n-none	IFPOS Paper #9

Name	Disclosure	Presentation Type
Dumont, Guillaume	n-none	Poster #16
Dunkley, Mia	n-none	IFPOS Paper #14
Duquin, Thomas R.	n-none	e-Poster #6
Dwek, Jerry	n-none	Paper #115
Eamsobhana, Perajit	n-none	e-Poster #72
Eastwood, Deborah M.	2-Biomarin	IFPOS Paper #14; Hip Subspecialty Day #1
Eberhardt, Oliver	8-JCO	IFPOS Paper #18
Eberson, Craig P.	1-Globus Medical; 2-Stryker Spine; 3B-Orthofix; 8-Journal of the American Academy of Orthopaedic Surgeons	Disaster Response Symposium #4
Edmonds, Eric W.	2-Arthrex; 9-AAOS, POSNA	Paper #6,84; Poster #17; e-Poster #4,18,48; Sports Subspecialty Day
Egan, Ciara	n-none	e-Poster #1,17
Eismann, Emily A.	n-none	Paper #48,90; IFPOS Paper #43; Hand Subspecialty Day #8
El-Hawary, Ron	3B-Halifax Biomedical; 5-DePuy, A Johnson & Johnson Company, Synthes, Medtronic	Poster #8
Ellis, Henry B.	n-none	Paper #85; e-Poster #53; Poster #16; Hand Subspecialty Day #10; Sports Subspecialty Day #1,9
Emans, John B.	1-Synthes; 3B-Medtronic Sofamor Danek, Synthes; 3C-Medtronic Sofamor Danek, Synthes; 8-Journal of Children's Orthopaedics	Paper #34♦,36♦,47; Spine Subspecialty Day #3
Engelman, Glenn	n-none	e-Poster #25
Epps, Howard R.	8-AAOS Now; 9-American Orthopaedic Association, POSNA, Texas Orthopaedic Association	e-Poster #12
Erickson, Mark A.	6-Spineform	Paper #41; Spine Subspecialty Day #3,9
Erol, Bulent	n-none	Poster #7
Errico, Thomas J.	1-K2M, Fastenfix; 2-Depuy, K2M; 5-Paradigm Spine	Spine Subspecialty Day #1
Escott, Benjamin G.	n-none	Paper #12,66
Evans, Kristin A.	n-none	e-Poster #39
Exner, Ulrich G.	n-none	Hip Subspecialty Day #4
Ezaki, Marybeth	7-Wolters Kluwer Health-Lippincott Williams & Wilkins; Journal of Bone and Joint Surgery-American; 8-Journal of Bone and Joint Surgery-American; Journal of Hand Surgery-American; 9-American Board of Orthopaedic Surgery, American Board of Medical Specialties	Paper #92; Hand Subspecialty Day #7

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Fabricant, Peter D.	n-none	Sports Subspecialty Day #8
Fader, Lauren M.	n-none	Hand Subspecialty Day #8
Faloon, Michael	n-none	e-Poster #27
Farley, Frances A.	4-Medtronic;5-Medtronic, DJ Orthopaedics, Johnson & Johnson, Genzyme, Pfizer, Stryker, Wright Medical Technology, Zimmer, Synthes; 8-Journal of Pediatric Orthopaedics; 9-POSNA	e-Poster #31
Farnsworth, Christine L.	n-none	Paper #76; e-Poster #4
Faulk, Leonard W.	n-none	e-Poster #69
Faust, John R.	n-none	Paper #44; e-Poster #39
Feldman, David S.	n-none	e-Poster #63; Spine Subspecialty Day #1
Felton, Kevin	n-none	Paper #72
Fenoglio, Amy	n-none	e-Poster #58
Fernandez, Francisco F.	n-none	IFPOS Paper #25
Ferris, Andrea G.	n-none	Paper #42
Filho, Mauro Cesar De Morais	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Fineberg, Naomi S.	n-none	e-Poster #34
Fishman, Felicity G.	n-none	Hand Subspecialty Day #3
Flanagan, Ann	n-none	Paper #94; e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7
Flanagan, Jill C.	n-none	e-Poster #10
Fletcher, Nicholas D.	2-Stryker, Medtronic Sofamor Danek; 3B-Medtronic; 9-POSNA	Paper #111
Flick, Randall	n-none	Special Topics Forum
Flynn, John (Jack) M.	1-Biomet; 7-Wolters Kluwer Health-Lippott Williams & Wilkins; 8-Orthopaedics Today; 9-POSNA, Scoliosis Research Society, AAOS	eModerator; Paper #14,49; Poster #1; e-Poster #7; Young Members Forum; Spine Subspecialty Day #3,5
Fornari, Eric	9-POSNA	Paper #6
Forness, Michael J.	n-none	Paper #59 ♦
Forriol, Francisco	9-Sociedad Española de Cirugia Ortopedica y Traumatologia, Spanish Society of Orthopaedic Surgeons	Paper #15
Foster, Bruce K.	9-Bone Growth Foundation (Australia)	e-Poster #60

Name	Disclosure	Presentation Type
Freiman, Moti	n-none	Hip Subspecialty Day #3
Freitas, Joana	n-none	e-Poster #62
Frick, Steven L.	9-J. Robert Gladden Society, POSNA, Apaedic Society of North America	Board of Directors
Fu, Eric C.	n-none	Paper #88
Fuentes, Alex	3A-Emovi; 4-Emovi	IFPOS Paper #42
Gabos, Peter G.	3B-DePuy, A Johnson & Johnson Company	IFPOS Paper #4
Gaby, Julie	n-none	e-Poster #2
Gadomski, Stephen P.	n-none	e-Poster #28
Gaines, Robert W.	1-DePuy, A Johnson & Johnson Company; 3C-K2; 9-Scoliosis Research Society	Spine Subspecialty Day
Gala, Raj	n-none	Paper #43
Ganley, Theodore J.	3B-Orthopediatrics	eModerator; Paper #84; e-Poster #19,20; Sports Subspecialty Day #10
Gans, Itai	n-none	Paper #14
Gantelius, Stefan	n-none	IFPOS Paper #38,40
Gao, Xu	n-none	Paper #48
Garcia, Michael J.	2-Osteomed	Hand Subspecialty Day
Garcia, Nancy L.	n-none	Paper #95
Garg, Sumeet	n-none	Paper #41,51; e-Poster #25; Spine Subspecialty Day #9
Gelfer, Yael	n-none	Paper #17; IFPOS Paper #14
Ghadakzadeh, Saber	n-none	Paper #78
Gibbons, Paul	n-none	IFPOS Paper #6
Gilbert, Claire J.	n-none	Paper #24
Gilbert, Shawn R.	9-AAOS, POSNA	e-Poster #34
Gilsanz, Vicente	n-none	Paper #116
Glaser, Diana Andreeva	4-MAKO Surgical, mankind, Alphatec; 5-EOS Imaging, Scoliosis Research Society, Growing Spine Foundation, KCI, K2M, Naval Medical Center San Diego, POSNA, Riverside County Regional Medical Centers	IFPOS Paper #2,29♦; Paper #76
Glotzbecker, Michael P.	5-Synthes, Via Chest Wall and Spinal Deformity Study Group	Paper #4,47,113; e-Poster #9; IFPOS Paper #34; Spine Subspecialty Day #3

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Goldberg, Michael J.	8-Journal Children's Orthopaedics, Journal of Pediatric Orthopaedics; 9-AAOS	Presider, Moderator; Paper #29; Evidence Based Medicine Symposium; Hand Subspecialty Day
Goldfarb, Charles	7-Wolters Kluwer Health-Lippincott Williams & Wilkins	Hand Subspecialty Day
Golembeski, Thomas	n-none	IFPOS Paper #30
Gomez, Everlyn	n-none	Paper #97
Goodwin, Ryan C.	3B-Stryker	Presider
Gordon, Christopher L.	n-none	Paper #66
Gordon, J. Eric	1-Orthopediatrics; 3B-Orthopediatrics; 9-POSNA	Disaster Response Symposium
Gornitzky, Alex	n-none	Hand Subspecialty Day #1,4
Gothard, M. David	n-none	Paper #50
Gotter, Maria P.	n-none	IFPOS Paper #39
Gottliebsen, Martin	n-none	Paper #69; IFPOS Paper #10
Gourineni, Prasad	4-G2Healthcare	IFPOS Paper #44,46
Grady, Maureen	n-none	Spine Subspecialty Day #4
Graf, Adam	n-none	Paper #94; e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7
Graham, H. Kerr	3C-Allergan; 9-Developmental Medicine and Child Neurology; Journal of Pediatric Orthopaedics, Journal of Children's Orthopaedics	Lower Extremity/ Neuromuscular Subspecialty Day
Granberry, William	2-Arthrex; 5-Biomimetic	Paper #98
Green, Daniel W.	1-Pega Medical; 2-Arthrex; 7-Current Opinion in Pediatrics; 8-Current Opinion in Pediatrics; 9-AAOS, American College of Surgeons, New York County Medical Society, POSNA, Scoliosis Research Society	e-Poster #27; Sports Subspecialty Day #8
Green, Neil E.	3B-Biomimetic; 4-Biomimetic	IFPOS Paper #24
Greenbaum, Virginia	n-none	e-Poster #10
Griffet, Jacques	n-none	e-Poster #26
Grimard, Guy	3B-EMOVI; 4-EMOVI	Poster #9; IFPOS Paper #42
Grimm, Nathan L.	n-none	Paper #84,86; e-Poster #20
Growing Spine Study Group	n-none	Paper #34♦,36♦;
Gugenheim, Joseph J.	n-none	e-Poster #12
Gum, Jeffrey L.	n-none	Paper #61

Name	Disclosure	Presentation Type
Gunderson, Melissa	n-none	Hand Subspecialty Day #1
Guo, Nai Wen	n-none	IFPOS Paper #26
Gustafson, Peter	n-none	IFPOS Paper #27
Gutierrez-Farewik, Elena	n-none	IFPOS Paper #40
Gyr, Bettina M.	n-none	Paper #11
Haces, Felipe	n-none	Paper #62; e-Poster #35
Hagströmer, Maria	n-none	IFPOS Paper #38
Hah, Raymond J.	n-none	Spine Subspecialty Day #8
Halanski, Matthew A.	3C-Orthopaediatrics; 5-Biomet, Stryker; 7-MTDS; 8-pediatric section review board for the upcoming OKU, Reviewer for CORR	Presider; Paper #59♦; Poster #3,23; Disaster Response Symposium #2; e-Poster #71; Spine Subspecialty Day #6♦
Hall, Bruce L.	9-American College of Surgeons	Paper #31
Hamdy, Reggie C.	8-BMC Musculoskeletal Disorders; 9-Limb Lengthening Research Society	Paper #65; e-Poster #66
Hardesty, Christina K.	n-none	Paper #43
Harms Study Group	5-Setting Scoliosis Straight Foundation	Paper #46; Spine Subspecialty Day #10
Harper, Benjamin L.	n-none	Disaster Response Symposium #2
Harris, Gerald	n-none	Paper #94
Harris, Matthew	n-none	IFPOS Paper #11♦,21
Harrison, Barb C.	n-none	Paper #95
Harston, Andrew	n-none	Paper #61
Hassan, Nabil	n-none	Spine Subspecialty Day #6♦
Hassani, Sahar	n-none	Paper #94; e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7
Haus, Brian M.	n-none	Paper #117
Hedden, Douglas M.	n-none	Spine Subspecialty Day
Hedequist, Daniel	9-AAOS, POSNA	Paper #4,39♦,47; e-Poster #9
Held, Michael	n-none	Paper #105
Heller, Snir	n-none	Paper #79
Hellfritzsch, M. B.	n-none	Paper #69
Hemo, Yoram	n-none	Poster #18
Henley, John	1-Motion Analysis	e-Poster #42

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Name	Disclosure	Presentation Type
Hennrikus, William L.	9-POSNA, Society of Military Orthopaedic Surgeons	Paper #5,31,108; Poster #2; Disaster Response Symposium; Sports Subspecialty Day
Hennrikus, William P.	n-none	Poster #1
Hensinger, Robert	n-none	e-Poster #31
Herman, Amir	n-none	Paper #79
Hernandez, Melia D.	n-none	e-Poster #2
Herrera-Soto, Jose A.	1-Biomet; 2-Biomet; 3B-Biomet; 5-Biomet; 9-POSNA, Scoliosis Research Society, Spine Form Device Monitoring Committee	Paper #75; e-Poster #15; IFPOS Paper #7
Herring, J. Anthony	1-Medtronic Sofamor Danek; 3C-Orthopediatrics; 7-Elsevier; 8-Journal of Pediatric Orthopaedics, Spine, Journal of Bone and Joint Surgery-American, Journal of Children's Orthopaedics	Paper #74; Hip Subspecialty Day
Herzenberg, John E.	3C-Ellipse Technologies: Smith & Nephew, Orthofix; 5-Medtronic Sofamor Danek, OHK Medical, Ellipse Technologies; 6-Stryker, Orthofix, Biomet, Katzen Eye Group, Salient Surgical Technologies, Hemaclear, Surpreme Orthopedic Systems, Medevations, Surgi-care, Smith & Nephew, Orthofix, Brainlab, Synthes, The MHE Coalition	Paper #64
Hetzel, Scott	n-none	Spine Subspecialty Day #6♦
Heyworth, Benton E.	9-POSNA	Paper #2,82,84; Sports Subspecialty Day #7
Hilmes, Melissa	n-none	e-Poster #58
Hisamitsu, Junshiro	n-none	IFPOS Paper #8
Ho, Christine A.	n-none	e-Poster #8; Hand Subspecialty Day #10
Ho, Emily	n-none	Hand Subspecialty Day #6
Ho, Jin-Tzer Jimmy	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #9
Hoffinger, Scott A.	2-Orthopediatrics; 3B-Orthopediatrics; 4-Orthopediatrics, Smith & Nephew; 9-American Academy for Cerebral Palsy and Developmental Medicine, AAOS	Lower Extremity/ Neuromuscular Subspecialty Day
Holland, Courtney Allen	n-none	Paper #41
Holmes, Laura	n-none	e-Poster #24
Holmes, Laurens	n-none	IFPOS Paper #4,5,15,37; Spine Subspecialty Day #2

Name	Disclosure	Presentation Type
Hopyan, Sevan	9-POSNA	Paper #80; Hand Subspecialty Day #6
Hosalkar, Harish S.	2-Synthes; 3B-Allergan; Synthes; 4-GlaxoSmithKline; Johnson & Johnson, Pfizer; 7-Journal of Bone and Joint Surgery – American	Moderator; Paper #115; e-Poster #50,54,55, 60,62; IFPOS Paper #7; Hand Subspecialty Day #2
Hosny, Gamal A.	n-none	e-Poster #51
Hosseinzadeh, Pooya	n-none	Paper #100
Hotchkiss, Mark	n-none	e-Poster #47,69
Howard, Andrew W.	n-none	Paper #3,12,45; Evidence Based Medicine Symposium; Lower Extremity/ Neuromuscular Subspecialty Day #6
Howard, Jason	n-none	Poster #8
Howard, Krista	n-none	Poster #16
Hresko, Michael T.	3B-Abbott; 4-Johnson and Johnson; 6-Biogen Idec; 9-American College of Rheumatology, Arthritis Foundation	Paper #39♦,47
Hu, Liangjun	n-none	e-Poster #46
Huang, Ming Tung	n-none	IFPOS Paper #26
Huang, Shier-Chieg	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #9
Huhnstock, Stefan	n-none	Paper #25
Hui, Chi-chung	n-none	Paper #80
Humphries, Paul	n-none	Paper #17
Hunter, Lindsay	n-none	Paper #87
Hvid, Ivan	n-none	Paper #69
Hyatt, Brad T.	n-none	e-Poster #39
Hyman, Joshua E.	5-OMEGA, OREF, SRS; 9-La Societe Internationale de Chirurgie Orthopedique et de Traumatologie	IFPOS Paper #36
Ibrahim, David A.	n-none	Poster #12; IFPOS Paper #19
Ilharreborde, Brice	3B-Zimmer Spine	Paper #27; Lower Extremity/ Neuromuscular Subspecialty Day #4
Illés, Tamas	n-none	e-Poster #26

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Name	Disclosure	Presentation Type
Inaba, Yutaka	2-Stryker, Smith & Nephew	IFPOS Paper #16
Irion, Bjorn	n-none	e-Poster #47
Ishiguro, Naoki	n-none	Paper #19
Iwinski, Henry J.	n-none	Paper #100; Poster #13♦; e-Poster #64
Jackson, Deborah	n-none	IFPOS Paper #14
Jackson, Gregory	n-none	Paper #92
Jacobs, John C.	n-none	Paper #86; e-Poster #19,20; Sports Subspecialty Day #4,6
Jain, Amit	n-none	Paper #38; Poster #24; Hip Subspecialty Day #8
Jain, Viral V.	n-none	Paper #42
James, Kyle	n-none	IFPOS Paper #6
James, Michelle A.	8-Journal of Bone and Joint Surgery-American; 9-American Board of Orthopaedic Surgery, Ruth Jackson Orthopaedic Society, Shriners Hospitals for Children Association of Specialty Physicians, Perry Initiative	Paper #89♦; COUR Symposium; Hand Subspecialty Day
Janicki, Joseph A.	4-Pfizer; 9-POSNA	Paper #10,13; e-Poster #33
Jarvis, James G.	2-Synthes; 8-Journal of Pediatric Orthopaedics; 9-Royal College of Physicians and Surgeons Canada	e-Poster #24
Jastifer, James	n-none	IFPOS Paper #27
Jeans, Kelly A.	n-none	Paper #63
Jeong, Changhoon	n-none	IFPOS Paper #23
Johanson, James E.	n-none	Paper #102
Johnston, Charles E.	1-Medtronic Sofamor Danek; 7-Saunders/Mosby-Elsevier; 8-Orthopaedics, Journal of Childrens Orthopaedics; 9-Scoliosis Research Society, POSNA	e-Poster #23♦; Lower Extremity/ Neuromuscular Subspecialty Day
Johnston, Jeffrey T.	n-none	Sports Subspecialty Day #4
Joiner, Elizabeth R.A.	n-none	Paper #34♦
Jones, Chalanda E.	n-none	Poster #14
Jones, Christopher R.	n-none	Hip Subspecialty Day #5♦
Jones, Eric T.	3B-Globus Medical; 8-Journal of Pediatric Orthopaedics; Journal of Bone and Joint Surgery-American	e-Poster #11
Jones, John S.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #8

Name	Disclosure	Presentation Type
Jones, Kerwyn C.	3B-Orthopediatrics	Paper #5; Practice Management Symposium
Kabirian, Nima	n-none	Paper #36 ♦; IFPOS Paper #29 ♦
Kadhim, Amjed	n-none	IFPOS Paper #15
Kadhim, Muayad	n-none	IFPOS Paper #3,15
Kaewpornsawan, Kamolporn	n-none	e-Poster #72
Kakizaki, Jun	n-none	IFPOS Paper #8,17
Kalish, Leslie A.	n-none	IFPOS Paper #41
Kamegaya, Makoto	n-none	IFPOS Paper #8,17
Kamiya, Nobuhiro	n-none	Paper #77; e-Poster #21
Kandiah, Nishanthi	n-none	IFPOS Paper #30
Kane, Patrick M.	n-none	Disaster Response Symposium #4
Kaneko, Hiroshi	n-none	Paper #19
Karatas, Ali F.	n-none	IFPOS Paper #5,9
Karlen, Judson W.	n-none	Paper #75
Karlin, Lawrence I.	6-K2M	Paper #47
Karol, Lori A.	7-Journal of the American Academy of Orthopaedic Surgeons; Saunders/Mosby-Elsevier; 8-Journal of the American Academy of Orthopaedic Surgeons	Paper #21,63,72
Kasser, James R.	7-Wolters Kluwer Health-Lippincott Williams & Wilkins; 8-Journal of Pediatric Orthopaedics; 9-American Board of Orthopaedic Surgery	Paper #101; IFPOS Paper #7; Hip Subspecialty Day
Kaufman, Adam	n-none	Hip Subspecialty Day #5 ♦
Kawamura, Cátia M.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Kay, Robert M.	4-Medtronic, Zimmer, Johnson & Johnson, Pfizer	Paper #57; e-Poster #3; Lower Extremity/ Neuromuscular Subspecialty Day #1
Kean, John R.	4-Nektar Theraputics	Paper #91,109
Kebaish, Khaled M.	n-none	Poster #24
Kecshemethy, Heidi	n-none	Paper #60 ♦
Kelley, Simon P.	9-International Hip Dysplasia Institute	Paper #66; e-Poster #60
Kelly, Bryan T.	3B-Pivot Medical; 4-Pivot Medical	Paper #24
Kelly, Derek M.	9-POSNA	Poster #22; e-Poster #13,67
Kemppainen, John W.	n-none	Paper #50; Poster #20
Kessler, Jeffrey I.	9-POSNA	Sports Subspecialty Day #2

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Name	Disclosure	Presentation Type
Khoshbin, Amir	n-none	Paper #97; e-Poster #30
Khoury, Joseph G.	n-none	e-Poster #34
Kifle, Yemiserach	n-none	Paper #114
Kim, Elliot J.	n-none	IFPOS Paper #24
Kim, Harry K.W.	5-Ipsen, Pfizer	Paper #74,77; e-Poster #21; Young Members Forum; Evidence Based Medicine Symposium; Hip Subspecialty Day
Kim, Hui Taek	n-none	e-Poster #5; Hip Subspecialty Day #2
Kim, Hyun Woo,	n-none	IFPOS Paper #23
Kim, Ok-Hwa	n-none	IFPOS Paper #23
Kim, Wook-Cheol	n-none	e-Poster #73
Kim, Young Jo	3B-Arthrex; 3C-Siemens Heath Care; 5-Siemens Health Care; 6-Siemens Health Care; 8-Osteoarthritis and Cartilage	e-Poster #57
Kimia, Amir A.	n-none	Paper #110
King, Andrew G.S.	9-Scoliosis Research Society	Poster #25
King, Susan	n-none	IFPOS Paper #31
King, Wendy	n-none	e-Poster #41
Kipper, Emily	n-none	Paper #51
Kissel, John	3B-Alexion and Cytokinetics	e-Poster #41
Kitoh, Hiroshi	n-none	Paper #19
Klamar, Jan E.	n-none	Paper #91,109
Klingele, Kevin E.	n-none	Presider; #91,109
Knapp, D. Raymond	1-Biomet	e-Poster #15
Knapp, Sarah	n-none	Paper #24
Knox, Jeffrey B.	n-none	e-Poster #16
Kocher, Mininder S.	1-Biomet; 3B-Best Doctors, Biomet, Gerson Lehrman Group, OrthoPediatrics; 3C-Smith & Nephew Endoscopy; 4-Fixes 4 Kids, Pivot Medical; 7-Saunders/Mosby-Elsevier; 9-AAOS, ACL Study Group, American Orthopaedic Society for Sports Medicine, Harvard Medical School, Harvard School of Public Health, POSNA, PRISM, Steadman Philippon Research Institute	Paper #2,82,84,117; IFPOS Paper #34; Sports Subspecialty Day #7
Koehler, Daniel M.	n-none	IFPOS Paper #24
Kohanchi, David	n-none	Poster #20
Kong, Heather	n-none	Disaster Response Symposium #5
Kostyk, Meghan C.	n-none	e-Poster #33

Name	Disclosure	Presentation Type
Kozin, Scott H.	8-Journal of Hand Surgery-American; Journal of Hand Surgery-American; 9-American Society for Surgery of the Hand	Paper #90
Krach, Linda	2-Medtronic; 4-Medtronic; 5-Medtronic	Paper #56
Krajbich, J. Ivan	5-K2M; 9-Association of Children's Prosthetic and Orthotic Clinics	IFPOS Paper #22
Kramer, Dennis	n-none	Paper #82; IFPOS Paper #34; Sports Subspecialty Day #7
Krengel, Walter F.	4-Medtronic; 9-Scoliosis Research Society, Washington State Orthopaedic Association	e-Poster #22
Kruse, Richard W.	n-none	Disaster Response Symposium #1
Krych, Aaron J.	n-none	Sports Subspecialty Day #7
Krzak, Joseph	n-none	Paper #94; e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7
Kubo, Toshikazu,	n-none	e-Poster #73
Kulkarni, Vedant,	n-none	Paper #74
Kuo, Ken N.	n-none	Paper #94; IFPOS Paper #26; Lower Extremity/ Neuromuscular Subspecialty Day #9
Kusakabe, Torao	n-none	e-Poster #73
Kwak, Juliann Lee	n-none	Paper #7
Labelle, Hubert H.L.	2-DePuy, A Johnson & Johnson Company, Medtronic Sofamor Danek; 4-Spinologics; 9-Scoliosis Research Society	Spine Subspecialty Day
LaGreca, Jaren	n-none	Paper #41,51
LaMont, Lauren E.	n-none	Paper #24; e-Poster #27
Langendoerfer, Michael	2-Smith & Nephew	IFPOS Paper #18,25
Laor, Tal	n-none	Hand Subspecialty Day #8
Larsen, Nicholas	n-none	Poster #22
Larson, Jill E.	n-none	Paper #13
Lasko, Colin E.	3A-Arthrocare	Paper #68
Lattanza, Lisa L.	3B-Tornier, Acumed; 4-Mylad; 9-Ruth Jackson Orthopaedic Society Perry Initiative	Hand Subspecialty Day
Latz, Kevin H.	n-none	Sports Subspecialty Day
Lau, Karlee	n-none	Paper #20
Law, Peggy W.	n-none	Paper #97; e-Poster #30

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Lawless, Stephen	n-none	Paper #30
Lebel, David	n-none	Paper #70; e-Poster #24
Lee, Jong-Seo	n-none	e-Poster #5; Hip Subspecialty Day #2
Lee, Kyoung Min	n-none	Paper 54,58,106; Poster #15; e-Poster #43,45,68,75; Lower Extremity/ Neuromuscular Subspecialty Day #3
Lee, Nicolas	n-none	Paper #98
Lee, Seung Yeol	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; Lower Extremity/ Neuromuscular Subspecialty Day #3
Lee, Tae Hoon	n-none	Hip Subspecialty Day #2
Legakis, Julie E.	n-none	e-Poster #11
Lening, Christopher	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #1
Lenk, Mary Anne	n-none	Spine Subspecialty Day #4
Lenke, Lawrence G.	1-Medtronic; 5-DePuy, A Johnson & Johnson Company, Axial Biotech; 7-Quality Medical Publishing; 8-Spine, Journal of Spinal Disorders & Techniques, Scoliosis, Backtalk (Scoliosis Assn), Journal of Neurosurgery, Spine, Spine Deformity Journal, iscoliosis.com, spineuniverse.com; 9-Scoliosis Research Society	Spine Subspecialty Day #3,8
Lennartsson, Anna	n-none	IFPOS Paper #40
Lennon, Nancy	n-none	e-Poster #42
Leung, Regina	n-none	e-Poster #74
Leveille, Lise	n-none	e-Poster #50
Leveno, Kenneth	n-none	Paper #92
Lewallen, Laura W.	1-Zimmer; 2-Osteotech; 3B-Pipeline Biomedical; 4-Pipeline Biomedical; 5-Zimmer	Poster #17, Sports Subspecialty Day #3
Lewis, Stephen J.	2-Medtronic Sofamor Danek, Stryker; 3B-Medtronic Sofamor Danek, Stryker; 6-Medtronic Sofamor Danek, Stryker; 9-Scoliosis Research Society	Paper #45; Spine Subspecialty Day #3; e-Poster #24,74
Lewis, Thomas Roy	n-none	Paper #26
Li, Danyi	n-none	Paper #80
Li, Ying	n-none	e-Poster #31

Name	Disclosure	Presentation Type
Lin, Chii Jeng	n-none	IFPOS Paper #26
Lind, Allison	n-none	NP/PA Symposium
Lipkus, Marc	n-none	e-Poster #24
Little, David Graham	2-Eli Lilly, Amgen; 3B-Eli Lilly; 5-Amgen, Acceleron, Clegene, Norvartis; 7-IBMS BoneKey; 8-IBMS BoneKey, Journal of Children's Orthopaedics; 9-Australain Orthopaedic Research Foundation	IFPOS Paper #6
Little, Kevin J.	7-Oakstone Publishing	Hand Subspecialty Day #8
Liu, Raymond W.	9-POSNA	Paper #68
Llombart, Rafael	n-none	Paper #40
Lochab, Jasjit	n-none	Paper #53
Loder, Randall T.	3C-Orthopediatrics; 7-Hodder Publishing, UK; 8-Journal of Pediatric Orthopaedics; 9-POSNA	e-Poster #14
Londono, Irène	n-none	Poster #9
Lonner, Baron S.	1-DePuy, A Johnson & Johnson Company; 2-DePuy, A Johnson & Johnson Company; 3B-DePuy, A Johnson & Johnson Company; 4-K2M, Paradigm, Depuy Spine; 5-DePuy, A Johnson & Johnson Company; 8-SRS Spine Deformity Journal; 9-Depuy Spine	IFPOS Paper #3
Lopes, José Augusto Fernandes	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Louden, Emily	n-none	Paper #90
Lourie, Gary M.	n-none	Hand Subspecialty Day #3
Lovejoy, Steven A.	n-none	Paper #104, Poster #6; IFPOS Paper #24
Lozano-Calderon, Santiago	n-none	e-Poster #49
Lu, Amanda	n-none	Paper #74
Luhmann, Scott J.	1-Globus Medical; 2-Medtronic Sofamor Danek, Stryker; 3B-Medtronic Sofamor Danek, Watermark Research; 5-Medtronic Sofamor Danek; 9-POSNA, Scoliosis Research Society	Paper #34♦,35♦; Spine Subspecialty Day #3; Sports Subspecialty Day #5
Lundine, Kristopher M.	n-none	Paper #45
Lykissas, Marios N.	n-none	Paper #48; IFPOS Paper #43
Mac-Thiong, Jean-Marc	1-MMDS Medical; 2-Spinologics; 3A-Spinologics; 3B-Spinologics, DePuy, A Johnson & Johnson Company; 3C-Spinologics; 4-Spinologics; 5-Medtronic, DePuy, A Johnson & Johnson Company; 6-Spinologics	e-Poster #26
Machida, Jiro	n-none	IFPOS Paper #16

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MacKenzie, William G.	3C-DePuy, A Johnson & Johnson Company; 9-POSNA	Paper #30,65; IFPOS Paper #9; Spine Subspecialty Day
MacWilliams, Bruce	n-none	Paper #16
Mader, Shelly L.	n-none	Paper #95
Madhuri, Vrisha	n-none	Hip Subspecialty Day
Mahan, Susan T.	3A-Pfizer; 4-Pfizer	Paper #101
Mahdavi, Saboura	n-none	Paper #17
Makholm, Linda	n-none	Poster #3
Mallet, Cindy	n-none	Paper #27; Lower Extremity/ Neuromuscular Subspecialty Day #4
Mangion, Jeremy E.	n-none	e-Poster #49
Mansour, Alfred A.	n-none	e-Poster #47
Mansour, Shaun	n-none	e-Poster #23 ♦
Maples, Dayle L.	4-Stryker	Paper #59 ♦
Margiotta, Michael S.	n-none	Spine Subspecialty Day #1
Marks, Michelle C.	3B-DePuy, A Johnson & Johnson Company; 9-Setting Scoliosis Straight Foundation	Evidence Based Medicine Symposium
Marks, Noah C.	n-none	Poster #25
Martin, Benjamin D.	n-none	Poster #4
Martus, Jeffrey E.	9-POSNA	Paper #104; Poster #6; IFPOS Paper #24
Marx, Robert G.	8-Clinical Orthopaedics and Related Research, HSS Journal, Knee Surgery, Sports Traumatology, Arthroscopy; 9-International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine	Sports Subspecialty Day #8
Masako, Kikuchi	n-none	IFPOS Paper #16
Matheney, Travis H.	9-POSNA	Presider, Paper #28,55,75; e-Poster #60; Hip Subspecialty Day #3
Mathur, Sunita	n-none	e-Poster #74
Matlow, Anne G.	n-none	Paper #33
Matsumoto, Hiroko	n-none	IFPOS Paper #1 ♦,36; Spine Subspecialty Day #3
Matsushita, Masaki	n-none	Paper #19
May, Megan	n-none	Sports Subspecialty Day #6
Mayerson, Joel L.	n-none	Paper #73 ♦

Name	Disclosure	Presentation Type
Mazda, Keyvan	3C-Zimmer/Implanet	Paper #27; e-Poster #26; Lower Extremity/ Neuromuscular Subspecialty Day #4
Mazur, John M.	n-none	Paper #9
McCalla, Daren J.	n-none	IFPOS Paper #1 ♦
McCarthy, James	4-Fixes 4 Kids; 7-Wolters Kluwer Health-Lippincott Williams & Wilkins, Orthopaedics; 9-Limb Lengthening Research Society, POSNA	Board of Directors
McCarthy, Richard E.	1-Medtronic; 2-Medtronic; 3B-Medtronic, Synthes; 9-Scoliosis Research Society	Paper #34 ♦,35 ♦
McClemens, Emily	n-none	Paper #67
McClung, Anna	n-none	Paper #37
McCormack, Damian	n-none	e-Poster #1
McHale, Kathleen A.	9-AAOS	Disaster Response Symposium #3
McIlvaine, Christopher P.	n-none	Disaster Response Symposium #3
McIntosh, Amy L.	3B-Synthes	Paper #87; Poster #17; Sports Subspecialty Day #3
McKay, Scott D.	9-POSNA	Sports Subspecialty Day #6
McKinney, Kailtin	n-none	POSNA Staff
McLeod, Lisa M.	n-none	Paper #49; Spine Subspecialty Day #3,5
McMulkin, Mark L.	n-none	Paper #95
McNair, Bryan	n-none	Paper #41; e-Poster #25
McPartland, Thomas G.	n-none	SharePoint Tutorial
Medeiros, Milton	n-none	e-Poster #41
Meier, Joshua W.	n-none	Paper #61
Ménard, Anne-Laure	n-none	Poster #9
Mencio, Gregory A.	6-3M, Covidien/Kendall, Ethicon Medical Mission Assistance Program; 9-AAOS, Board of Specialty Societies, POSNA, Tennessee Orthopaedic Society	Program Committee; Paper #104; Poster #6; e-Poster #28; IFPOS Paper #24
Méndez, Alfonso	n-none	Paper #23
Menge, Travis	n-none	Paper #104; Poster #6
Mezghani, Neila	n-none	IFPOS Paper #42
Micheli, Lyle	9-AOOSM, FIMS	IFPOS Paper #34
Michnick, Stuart	n-none	Paper #107
Mignemi, Megan	n-none	Paper #104; Poster #6

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Name	Disclosure	Presentation Type
Mihailidis, Alex	n-none	e-Poster #74
Milbrandt, Todd A.	8-Wolters Kluwer Health-Lippincott Williams & Wilkins; 9-AAOS, POSNA, Scoliosis Research Society	Program Committee; eModerator; Paper #100; Poster #13♦; e-Poster #64
Mildes, Rob D.	n-none	Paper #95
Milewski, Matthew D.	n-none	Paper #110
Miller, Benjamin	n-none	e-Poster #15
Miller, Freeman	1-Motion Analysis Corp; 7-Springer; 8-Gait and Posture, Journal Children's Orthopaedics, Journal of Pediatric Orthopaedics	Paper #60♦; e-Poster #42; IFPOS Paper #5,37; Spine Subspecialty Day #2
Miller, Nancy H.	8-Spine, Spine Deformity	Hand Subspecialty Day #9
Miller, Patricia	n-none	Paper #4,55
Millis, Michael B.	7-Saunders/Mosby-Elsevier; 8-Saunders/Mosby-Elsevier, Springer	e-Poster #57; Hip Subspecialty Day
Mills, Janith K.	n-none	Paper #92; Hand Subspecialty Day #7
Minhas, Shobhit Vishnoi	n-none	Paper #10; e-Poster #33
Misaghi, Amirhossein	n-none	e-Poster #4
Mishima, Kenichi	n-none	Paper #19
Mitchell, Philip M.	n-none	Paper #111
Miyanji, Firoz	3B-DePuy, A Johnson & Johnson Company; 5-DePuy, A Johnson & Johnson Company	Paper #52; Spine Subspecialty Day
Moisan, Alice	n-none	Poster #22
Moldovan, Florina	n-none	Poster #9
Moller-Madsen, Bjarne	5-Ceramisys; 9-European Paediatric Orthopaedic Society, Nordic Orthopaedic Federation	Paper #69,81; IFPOS Paper #10
Monazzam, Shafagh	n-none	Paper #115; e-Poster #54
Monroe, Kirstin	n-none	Poster #23
Montgomery, Richard	3C-Strawberry Medical UK; 9-Royal College of Surgeons of Edinburgh UK	Hip Subspecialty Day #6
Montpetit, Kathleen	n-none	Paper #65
Moon, Hyuk J.	n-none	IFPOS Paper #12
Moor, Molly	n-none	Paper #1,93; Hand Subspecialty Day #2
Moore, Gregory H.	n-none	Paper #37
Moraleda, Luis	n-none	Paper #8,15
Morcuende, Jose	9-AAOS, USBJI, POSNA	Presider; Paper #94
Morita, Mituaki	n-none	IFPOS Paper #8,17
Morris, Michael R.	n-none	Disaster Response Symposium #2

Name	Disclosure	Presentation Type
Morris, Susan H.	5-Globus Medical, POSNA	Poster #8
Morrison, Martin J.	n-none	e-Poster #7
Morscher, Melanie	n-none	Paper #50,99
Mosca, Vincent S.	8-Journal of Pediatric Orthopaedics, Journal of Children's Orthopaedics	Moderator
Moseley, Colin F.	3B-Orthopaediatrics; 8-Journal of Pediatric Orthopaedics; 9-International Pediatric Orthopaedic Think Tank	Evidence Based Medicine Symposium
Motoo, Hosokawa	n-none	e-poster #73
Mubarak, Scott J.	4-Rhino Pediatric Orthopedic Designs	Poster #20; Practice Management Symposium; IFPOS Paper #7; Young Members Forum; Hand Subspecialty Day #2
Muchow, Ryan D.	n-none	Paper #100; e-Poster #8
Muhamad, Abd R.	n-none	e-Poster #62
Mulpuri, Kishore	9-Canadian Orthopaedic Association, International Hip Dysplasia Institute, POSNA	e-Poster #50,60; Evidence Based Medicine Symposium; IFPOS Paper #7
Murdock, Elizabeth	n-none	Paper #86
Murnaghan, M. Lucas	n-none	Paper #84; Sports Subspecialty Day #1
Murphy, Michael	n-none	Poster #17
Murphy, Robert F.	n-none	e-Poster #67
Murphy, Ryan T.	n-none	Poster #21
Murray, Kathleen A.	n-none	Paper #16
Murray, Kerri	n-none	e-Poster #57
Myung, Karen	n-none	e-Poster #23 ♦
Nakamura, Naoyuki	n-none	IFPOS Paper #16
Nakase, Atsushi	n-none	e-Poster #73
Nakase, Masashi	n-none	e-Poster #73
Narayanan, Unni G.	9-American Academy for Cerebral Palsy and Developmental Medicine, POSNA	Moderator; Paper #3,53,65,66; IFPOS Paper #7; Sports Subspecialty Day #1; Lower Extremity/ Neuromuscular Subspecialty Day #6; Spine Subspecialty Day
Nasreddine, Adam Y.	n-none	Paper #117
Neal, Kevin M.	1-Orthopediatrics	Paper #9

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Name	Disclosure	Presentation Type
Needle, Scott M.	n-none	Disaster Response Symposium
Neiss, Geraldine	n-none	IFPOS Paper #4
Nelson, Scott C.	3B-Orthofix	Disaster Response Symposium
Nemeth, Blaise A.	6-Biomet	Poster #3,23; e-Poster #71; Disaster Response Symposium #2
Neves, Daniella Lins	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #2
Newton, Meadow	n-none	Paper #99
Newton, Peter O.	1-DePuy, A Johnson & Johnson Company; 2-DePuy, A Johnson & Johnson Company; 3B-DePuy, A Johnson & Johnson Company; 4-Nuvasive; 5-DePuy, A Johnson & Johnson Company, Biopspace Med, Orthopaedic Research & Education Foundation, POSNA, Scoliosis Research Society, Harms Study Group Foundation, Setting Scoliosis Straight Foundation, Childrens Specialist Foundation, 7-Theime Publishing; 9-POSNA, Setting Scoliosis Straight Foundation, Childrens Specialist Foundation	Paper # 46,52,76,93; Evidence Based Medicine Symposium; IFPOS Paper #2,3; Young Members Forum; Spine Subspecialty Day #3,10
Nguyen, Amy K.	n-none	Hand Subspecialty Day #9
Nigrovic, Lisa E.	n-none	Paper #110
Niiler, Tim	n-none	e-Poster #42
Nikizad, Hooman	n-none	Sports Subspecialty Day #2
Nikolaou, Sia	n-none	e-Poster #46
Nissen, Carl W.	2-Genzyme	Paper #83,84
Noonan, Kenneth J.	1-Biomet; 3B-Biomet; 5-Biomet; 9-POSNA	Poster #3,23; e-Poster #71
Novacheck, Tom F.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #6
Nowicki, Philip	n-none	IFPOS Paper #27
Nowlin, Miranda	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #8
Nualart, Luis	n-none	Poster #10
Nyquist, Ann-Christine	n-none	Spine Subspecialty Day #3
O’Callaghan, Jamie	n-none	Hand Subspecialty Day #6
O’Driscoll, Shawn W.	1-Acumed, Tornier, Aircast (DJ); 2-Acumed	e-Poster #6

Name	Disclosure	Presentation Type
O'Hara, Emily	n-none	Paper #83
O'Rear, Lynda	n-none	Paper #105
O'Toole, Robert	2-AONA; 9-OTA	Paper #32
Obeid, Ibrahim	2-Medtronic, Depuy Spine, 3B-Medtronic, Depuy Spine, 3C-Medtronic, Depuy Spine	e-Poster #26
Ochiai, Derek	1-Smith & Nephew; 2-Smith & Nephew; 3B-Smith & Nephew Travanti; 4-Tenex Health; 7-International Medical Publishing; 9-Virginia Orthopaedic Society	Paper #22
Oda, Jon Edward	4-Smith & Nephew	IFPOS Paper #4
Oetgen, Matthew E.	9-AAOS, POSNA, Scoliosis Research Society	Poster #4
Oh, Chang-Wug	2-Synthes; 3C-Zimmer; 5-Synthes	IFPOS Paper #23
Oishi, Scott N.	n-none	Paper #92
Oka, Yoshinobu	n-none	e-Poster #73
Okafor, Louis	n-none	e-Poster #39
Okusanya, Olanrewaju	n-none	Paper #53
Okuzumi, Shigeharu	n-none	IFPOS Paper #16
Olmos, Matías Alfonso	n-none	Paper #40
Olson, Casey	n-none	Paper #113
Omar, Rumana	n-none	Paper #17
Ostenso, Karen	n-none	Paper #56
Oswald, Timothy S.	2-Medtronic, Stryker; 3B-Medtronic	Paper #111
Otsuka, Norman Y.	8-Journal of Children's Orthopaedics, Journal of Orthopaedic Surgical Advance, Journal of Pediatric Orthopedics, Part B; 9-American Academy of Pediatrics, Bone and Joint Decade, USA, POSNA	IFPOS Paper #35
Oxendine, Ila	n-none	Paper #77; e-Poster #21
Paley, Dror	1-Smith & Nephew, Ellipse Technologies, Pega Medical, Ellipse Technologies; 3B-Ellipse Technologies; 7-Springer	IFPOS Paper #11 ♦,21
Paloski, Michael	n-none	Paper #38; Poster #24; e-Poster #29 ♦; Hip Subspecialty Day #8
Paradise, Scott	n-none	Paper #20, 37
Paraison, Lauren	n-none	Paper #37
Parent,Stefan	3B-DePuy, A Johnson & Johnson Company, Medtronic Sofamor Danek; 4-Spinologics; 5-Biospace Med; 9-Scoliosis Research Society	Presider; e-Poster #26
Parikh, Shital N.	7-Orthopaedic Clinics of North America; 8-Orthopaedic Clinics of North America	e-Poster #20; IFPOS Paper #43,45
Park, Howard Y.	n-none	IFPOS Paper #1 ♦,

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Name	Disclosure	Presentation Type
Park, Moon Seok	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; IFPOS Paper #20,23; Lower Extremity/ Neuromuscular Subspecialty Day #3
Park, Sung Sup	n-none	IFPOS Paper #23
Parker, Richard	1-Zimmer, PSI Uni ZUK; 3B-Zimmer, Smith & Nephew Endoscopy	Sports Subspecialty Day #4
Parnell, Evette	n-none	IFPOS Paper #14
Parnell, Shawn E.	n-none	Paper #114
Paryavi, Ebrahim	n-none	Paper #32
Pashos, Gail	4-GlaxoSmithKline	Paper #26; e-Poster #56
Passanante, Marian	n-none	e-Poster #37,38
Patel, Anay R.	n-none	Paper #13
Patel, Neeraj	n-none	Poster #1
Patel, Nitesh V.	n-none	IFPOS Paper #35
Patrick, Brittany C.	n-none	Paper #10
Patterson, Karen	n-none	Poster #3
Patthanacharoenphon, Cameron	n-none	Paper #59 ♦
Paul, Justin	n-none	Spine Subspecialty Day #1
Pawelek, Jeff	n-none	Paper #36 ♦
Peljovich, Allan E.	n-none	Hand Subspecialty Day #3
Penneçot, Georges-Francois	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #4
Pennock, Andrew T.	n-none	Paper #1,6,93,115; Poster #20,21; e-Poster #18, 55
Perez, Juan-Carlos	n-none	IFPOS Paper #28
Petrini, Maria E.	n-none	Poster #14
Phillips, Jonathan H.	1-Biomet; 2-Biomet; 3B-Synthes; Biomet; 5-Biomet; 8-Journal of the Southern Orthopaedic Association; 9-Scoliosis Research Society; OrthoPaediatrics	e-Poster #2,15
Pinero, Joseph R.	n-none	e-Poster #63

Name	Disclosure	Presentation Type
Podeszwa, David A.	9-POSNA, AAOS	eModerator; Paper #21; e-Poster #52,53; Hip Subspecialty Day #7,9
Poe-Kochert, Connie	n-none	Paper #43
Polley, Nathan	n-none	Paper #61
Polousky, John D.	n-none	Paper #84; e-Poster #19,20; Sports Subspecialty Day #10
Pomo, Sandra	n-none	IFPOS Paper #38
Pontén, Eva	n-none	IFPOS Paper #38,40
Popalisky, Jean	n-none	Paper #29
Popkin, Charles	n-none	Poster #19
Pourtaheri, Sina	n-none	Spine Subspecialty Day #2
Powell, Dustin S.	n-none	Paper #55
Powell, K. Patrick	n-none	Poster #13♦
Presedo, Ana	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #4
Pressel, David M.	n-none	Poster #14
Pretell, Juan Augusto	n-none	e-Poster #67
Price, Charles T.	1-Biomet, Halo Innovations; 4-Institute for Better Bone Health; 5-Wright Medical Technology; 8-Institute for Better Bone Health, Journal of Pediatric Orthopaedics	Paper #18; IFPOS Paper #7; e-Poster #60
Prince, Daniel E.	n-none	IFPOS Paper #21
Pripp, Are Hugo	n-none	Paper #25
Pritchard, Breanna M.	n-none	e-Poster #69; Hand Subspecialty Day #9
Protopapa, Evangelia	n-none	Paper #17; Poster #11; Hip Subspecialty Day #1
Pun, Stephanie Y.	n-none	e-Poster #57
Rabinovich, Remy	n-none	IFPOS Paper #35
Raggio, Cathleen	5-Amgen Co; 9-Orthopaedic Research Society; POSNA; Scoliosis Research Society; OIF	eModerator
Rahbek Ole	n-none	Paper #69,81
Rajbhandary, Tarun	n-none	Paper #96
Ramachandran, Manoj	3B-Pivot Medical; 4-Pivot Medical, Cotera; 5-Pivot Medical; 7-Elsevier, Hodder Arnold; 8-Journal of The Royal Society of Medicine	IFPOS Paper #10
Ramirez, Rey	n-none	e-Poster #7
Ramo, Brandon A.	n-none	Paper #20,37; e-Poster #52
Ramseier, Leonhard E.	n-none	e-Poster #59,61

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Name	Disclosure	Presentation Type
Ramski, David E.	n-none	Poster #1
Raney, Ellen M.	9-AAP SoOR, WOA	Paper #65
Rappaport, David I.	n-none	Poster #14
Rasmusson, Douglas D.	n-none	Poster #8
Rathjen, Karl E.	3C-Orthopaediartrics; 8-Journal of Pediatric Orthopaedics, Spine; 9-Limb Lengthening Research Society, POSNA, Scoliosis Research Society	e-Poster #52,65
Ratner, Joshua	n-none	Hand Subspecialty Day #3
Ravi, Bheeshma	n-none	Paper #66
Rawlins, Bernard A.	5-Medtronic/Sofamor-Danek	e-Poster #27
Raymond, Melody	n-none	POSNA Staff
Reddy, Rohit	n-none	Sports Subspecialty Day #9
Reddy, Silpa	n-none	e-Poster #32
Regmi, Rabindra	n-none	Paper #96
Reid, Daniel	n-none	e-Poster #34
Reischman, Diann	n-none	Spine Subspecialty Day #6 ♦
Rendon, Juan Sebastian	n-none	e-Poster #66
Rethlefsen, Susan	n-none	Paper #57; Lower Extremity/ Neuromuscular Subspecialty Day #1
Reyes, Jose Manuel	n-none	Poster #10
Reynolds, Joe	3A-SpineForm	Paper #42
Rhodes, Jason T.	9-POSNA	e-Poster #47,69
Riccio, Anthony I.	2-Synthes	e-Poster #8,16
Ricciuti, Anthony J.	n-none	Paper #83
Richard, Heather M.	n-none	Hip Subspecialty Day #9
Richards, B. Stephens	4-Pfizer; 7-Wolters Kluwer Health-Lippincott Williams & Wilkins; 8-Journal of Pediatric Orthopaedics; 9-Scoliosis Research Society	Moderator; Paper #112♦; Spine Subspecialty Day #3
Ridout, Deborah	n-none	Hip Subspecialty Day #1
Riedel, Matthew D.	n-none	Spine Subspecialty Day #3
Riley, Scott A.	n-none	Hand Subspecialty Day #5
Riordan, Anne	n-none	e-Poster #40; Lower Extremity/ Neuromuscular Subspecialty Day #7

Name	Disclosure	Presentation Type
Rios, Gilberto	n-none	IFPOS Paper #32
Risoe, Petter	n-none	IFPOS Paper #33
Ritterman, Scott A.	n-none	Disaster Response Symposium #4
Ritzman, Todd F.	3C-Apto Orthopaedics / Austin Bioinnovation Institute of Akron	Paper #50
Roach, James W.	4-Abbott; 8-Spine Deformity Journal; 9-POSNA, Scoliosis Research Society	Paper #16
Roberts, David W.	n-none	Paper #37
Robinson, Lucy	n-none	e-Poster #32
Robles, Alex	n-none	Sports Subspecialty Day #8
Rogers, Kenneth J.	n-none	Paper #60♦; Poster #14; IFPOS Paper #5,9,37
Roland, Sandy	n-none	Hip Subspecialty Day #9
Romine, Spencer E.	n-none	Poster #13♦
Romney, Elizabeth	n-none	IFPOS Paper #36
Roocroft, Joanna H.	n-none	Paper #1; e-Poster #18
Roposch, Andreas	n-none	Paper #17; Poster #11; Hip Subspecialty Day #1
Rosenfeld, Scott B.	3C-Orthopediatrics; 9-POSNA	Paper #71,107
Rosentraub, Erica L.	n-none	Hip Subspecialty Day #9
Ross, Patrick	n-none	Spine Subspecialty Day #7
Roy-Beaudry, Marjolaine	n-none	e-Poster #26
Roye, Benjamin D.	3B-Stryker; 5-SRS, POSNA, OMeGA; 8-Journal of Bone and Joint Surgery-American; Journal of the American Academy of Orthopaedic Surgeons	IFPOS Paper #36
Roye, David P.	3B-Stryker; 5-OREF, CWSDRF, SRS, POSNA; 6-OMeGA, Biomet; 8-Journal of Bone and Joint Surgery-American, Journal of the American Academy of Orthopaedic Surgeons	IFPOS Paper #1♦,36; Spine Subspecialty Day #3
Rubery, Paul T.	5-AP Spine	Paper #44
Ruder, John A.	n-none	e-Poster #2
Ryan, Deirdre D.	n-none	e-Poster #3
Saad, Christina	n-none	Paper #59♦
Sabatini, Coleen S.	9-J. Robert Gladden Society	COUR Symposium
Sabharwal, Sanjeev	5-Smith & Nephew; 8-Journal of Bone and Joint Surgery-American; 9-POSNA, Limb Lengthening & Reconstruction Society	Paper #67; e-Poster #37,38; Disaster Response Symposium #5

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Name	Disclosure	Presentation Type
Sachleben, Brant	n-none	Hand Subspecialty Day #6
Saiman, Lisa	3B-Norvartis, Vertex, Transave; 5- Johnson & Johnson; 8-Archives of Pediatric and Adolescent Medicine, The Journal of the Pediatric Infectious Diseases, Infection Control & Hospital Epidemiology	Spine Subspecialty Day #3
Saisu, Takashi	n-none	IFPOS Paper #8,17
Saito, Tomoyuki	n-none	IFPOS Paper #16
Sakamoto, Sara M.	n-none	Paper #67;
Sala, Debra A.	n-none	e-Poster #63; Spine Subspecialty Day #1
Saluan, Paul M.	2-Arthrex; 3C-Triatrix; 5-Zimmer	Presider; Sports Subspecialty Day #4
Samade, Richard	n-none	e-Poster #28
Samara, Eduardo J.	n-none	IFPOS Paper #39
Samdani, Amer F.	2-Depuy Spine, Synthes, Spineguard; 3B-Depuy Spine, Synthes, Spineguard	Paper #52; e-Poster #70; Spine Subspecialty Day #10
Samora, Julie Balch	n-none	Paper #91
Samora, Walter P.	n-none	Paper #91,109
Samuels, Paul	n-none	Paper #42
Sanders, James O.	4-Abbott, GE Healthcare, Hospira; 8-Journal of Pediatric Orthopaedics; 9-AAOS, POSNA, Scoliosis Research Society	Moderator; Paper #44; e-Poster #39,41; Evidence Based Medicine Symposium; Spine Subspecialty Day
Sankar, Wudbhav N.	7-Wolters Kluwer Health-Lippincott Williams & Wilkins	Paper #14,75
Sanpera-Trigueros, Ignacio	n-none	IFPOS Paper #13
Saran, Neil	n-none	e-Poster #66
Sawyer, Jeffrey R.	7-Mosby, Wolters Kluwer Health-Lippincott Williams & Wilkins; 9-AAOS, POSNA, Campbell Foundation	Poster #22; e-Poster #13,67; Practice Management Symposium
Schaffzin, Joshua	n-none	Spine Subspecialty Day #4
Schiffern, Alison	n-none	Paper #16
Schilling, Peter	n-none	e-Poster #31
Schmale, Gregory A.	n-none	Paper #103
Schmitz, Matthew R.	9-AAOS	e-Poster #55,62
Schmitz, Michael L.	3B-Stryker	e-Poster #10
Schneider, John E.	n-none	e-Poster #16

Name	Disclosure	Presentation Type
Schoenecker, Jonathan G.	5-ISIS Pharmaceuticals	Paper #104,105; Poster #6,13 ♦; e-Poster #58; IFPOS Paper #24
Schoenecker, Perry L.	8-Journal of Pediatric Orthopaedics Journal of Children's Orthopaedics; 9-POSNA	Paper #26; e-Poster #56; Hip Subspecialty Day
Schrader, Tim	2-Harvest Technologies	Hip Subspecialty Day #5 ♦
Schroth, Mary	n-none	Poster #3
Schub, David	n-none	Sports Subspecialty Day #4
Schulz, Jacob	n-none	Paper #1,46
Schwartz, Joshua	n-none	e-Poster #42
Schwend, Richard M.	6-K2M; 9-POSNA, American Academy of Pediatrics, Project Perfect World, Miracle Feet	Disaster Response Symposium
Scott, Allison C.	4-Hospira	Presider; Paper #98; Poster #5
Scott, Francis A.	n-none	Hand Subspecialty Day #9
Seehausen, Derek A.	n-none	e-Poster #3; Spine Subspecialty Day #7,8
Sees, Julieanne P.	n-none	Paper #60 ♦
Segal, Eduardo	n-none	IFPOS Paper #39
Segal, Lee S.	8-Clinical Orthopaedics and Related Research; 9-POSNA	Paper #5; Lower Extremity/ Neuromuscular Subspecialty Day #8
Segawa, Yuko	n-none	IFPOS Paper #8,17
Segev, Eitan	n-none	Poster #18
Seo, Sang Gyo	n-none	IFPOS Paper #23
Shabtai, Lior	n-none	Poster #18
Shafer, Sasha	n-none	Paper #77; e-Poster #21
Shah, Apurva S.	9-POSNA, American Society for Surgery of the Hand	Paper #88; Spine Subspecialty Day #3; IFPOS Paper #41; Hand Subspecialty Day
Shah, Suken A.	1-Arthrex DePuy Synthes Spine; 3B-DePuy Synthes Spine; 3C-K Spine OrthoPediatrics; 4-Globus Medical; 5-DePuy Synthes Spine; 9-AAOS, Scoliosis Research Society, POSNA, Setting Scoliosis Straight Foundation	Paper #30,52; Poster #14; e-Poster #70; IFPOS Paper #3,4; Spine Subspecialty Day #2,3

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Name	Disclosure	Presentation Type
Shaheen, Michael B.	n-none	Disaster Response Symposium #2
Shapiro, Jay	n-none	Board of Directors
Shau, David N.	n-none	e-Poster #28
Shaw, Brian A.	4-Johnson & Johnson, Merck, Medtronic, Pfizer, Biomet, Zimmer, Stryker; 9-American Academy of Pediatrics, POSNA	Paper #5
Shea, Kevin G.	9-AAOS, American Orthopaedic Society for Sports Medicine, POSNA	Moderator; Paper #84,86; e-Poster #19,20; Evidence Based Medicine Symposium; Sports Subspecialty Day #2,
Shelley, Kirk	n-none	IFPOS Paper #30
Shieh, Alvin	n-none	e-Poster #18
Shiels, William E.	1-Smiths Medical, Shiels Intussusception Air Reduction System	Paper #73♦
Shiguetomi Juan Manuel	n-none	Paper #81
Shim, Jong Sup	n-none	IFPOS Paper #23
Shirley, Eric D.	3A-Depomed; 7-Orthobullets.com	Paper #9
Shore, Benjamin J.	n-none	Paper #4,55; e-Poster #9; IFPOS Paper #34
Shourbaji, Nader	n-none	Paper #111
Shrader, M. Wade	9-Arizona Medical Association, American Academy for Cerebral Palsy and Developmental Medicine	Lower Extremity/ Neuromuscular Subspecialty Day #8
Shrestha, Om P.	n-none	Paper #96
Shufflebarger, Harry L.	1-DePuy Spine, A Johnson & Johnson Company; 2-DePuy Spine, Axial Biotech; 3B-DePuy Spine; 5-DePuy Spine, Axial Biotech; 8-Journal of Pediatric Orthopaedics; Spine	Paper #46; IFPOS Paper #3; Spine Subspecialty Day #10
Sides, Brenda A.	n-none	Spine Subspecialty Day #8
Silva, Mauricio	2-Baxter Corporation; 3B-Baxter Corporation; 9-World Federation of Hemophilia	Paper #7
Simcock, Xavier C.	n-none	Paper #82
Singh, Avreeta	n-none	Hand Subspecialty Day #7
Singhal, Kunal	n-none	Paper #63
Sink, Ernest L.	3B-Pivot; 9-POSNA	Program Committee; Paper #18,24; Hip Subspecialty Day
Sitoula, Prakash	n-none	Paper #60♦; IFPOS Paper #37
Sjostrom, Rebecca	n-none	e-Poster #47

Name	Disclosure	Presentation Type
Skaggs, David L.	1-Biomet, Medtronic; 2-Medtronic, Stryker, Biomet; 3B-Medtronic, Stryker, Biomet; 6-Medtronic, Biomet; 7-Wolters Kluwer Health-Lippincott Williams & Wilkins; 8-Journal of Childrens Orthopaedics; 9-POSNA, Growing Spine Study Group, Scoliosis Research Society	eModerator; Paper #34♦,36♦; Poster #12; e-Poster #3,23♦; IFPOS Paper #1♦; Spine Subspecialty Day #3,7,8
Slough, Jennifer	n-none	Poster #2
Smith, Brian G.	9-POSNA	Paper #110, IFPOS Paper #30; Young Members Forum
Smith, John T.	1-Synthes, Synthes; 3B-Synthes, Synthes; 5-Chest Wall and Spine Deformity Research Foundation; 9-Chest Wall and Spine Deformity Research Foundation	Spine Subspecialty Day #3
Smith, Peter A.	n-none	Paper #94
Snyder, Brian D.	9-POSNA, Scoliosis Research Society	Paper #55,113; NP/PA Symposium
So, Jeannette P.	n-none	Paper #33
Sobh, Ali	n-none	e-Poster #11
Sofulu, Omer	n-none	Poster #7
Song, Hae Ryong	n-none	IFPOS Paper #23
Song, Kwang Soon	n-none	IFPOS Paper #23
Song, Mi-Hyun	n-none	IFPOS Paper #20
Soriano, Sulpicio	n-none	Special Topics Forum
Sotiropoulos, Chris	n-none	Paper #80
Specht, Stacy C.	n-none	Paper #64
Spence, David D.	n-none	Paper #4; e-Poster #9,67
Spencer, Samantha A	9-AAOS, Massachusetts Orthopaedic Association, POSNA	e-Poster #9
Spiegel, David A.	8-Global Journal of Surgery; 9-POSNA; AAOS	Paper #96
Sponseller, Paul D.	1-Globus Medical, DePuy, A Johnson & Johnson Company; 3B- DePuy, A Johnson & Johnson Company; 5-DePuy, A Johnson & Johnson Company; 7-Journal of Bone and Joint Surgery, Oakstone Medical; 8-Journal of Bone and Joint Surgery; 9-Scoliosis Research Society	Paper #34♦,36♦,38,52; Poster #24; e-Poster #23♦,29♦,70; IFPOS Paper #3; Hip Subspecialty Day #8; Spine Subspecialty Day #3
Standard, Shawn C.	3B-Ellipse Technologies; 5-Ellipse Technologies; 6-Smith & Nephew; Orthofix, Brainlab, Synthes, The MHE Coalition	Paper #64; Lower Extremity/ Neuromuscular Subspecialty Day
Stans, Anthony A.	9-POSNA	Program Committee; eModerator
Stech, Teri	n-none	POSNA Staff

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Name	Disclosure	Presentation Type
Steiner, Robert	n-none	Paper #100
Steinman, Suzanne E.	n-none	Paper #29
Stephens, Derek	n-none	Paper #97; e-Poster #30
Sterling, Robert	n-none	Paper #32
Stevens, Wilshaw	n-none	Paper #21
Stewart, Jaime R.	n-none	e-Poster #47
Stødkilde-Jørgensen, H.	n-none	Paper #81
Strantzas, Samuel	n-none	e-Poster #24
Strauss, Kevin R.	3A-K2M; 4-K2M,	IFPOS Paper #29 ♦
Streit, Jonathan J.	n-none	Paper #68
Sturm, Peter F.	3B-DePuy, A Johnson & Johnson Company; 4-Pioneer Surgical; 5-DePuy, A Johnson & Johnson Company; 8-Journal of Children's Orthopaedics; 9-Scoliosis Research Society, POSNA	Paper #52; Spine Subspecialty Day #4,10
Stutz, Christopher	n-none	Paper #104; Poster #6
Sucato, Daniel J.	3C-Orthopaediatrics; 7-Saunders/Mosby-Elsevier; 9-AAOS, POSNA, Scoliosis Research Society	Paper #20,21,37; e-Poster #53; Evidence Based Medicine Symposium; Hip Subspecialty Day #9; Spine Subspecialty Day #3
Sullivan, Elroy	n-none	Paper #98
Sumko, Michael J.	n-none	Poster #2
Sund, Sarah A.	n-none	Poster #3, 23
Sung, Ki Hyuk	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; Lower Extremity/ Neuromuscular Subspecialty Day #3
Suppan, Catherine A.	n-none	Paper #2, 117
Sussman, Michael D.	n-none	Lower Extremity/ Neuromuscular Subspecialty Day
Svenningsen, Svein	n-none	Paper #25
Swaroop, Vineeta	7-Up to Date, American Academy for Cerebral Palsy and Developmental Medicine, POSNA	Lower Extremity/ Neuromuscular Subspecialty Day
Swartz, Fran	n-none	Paper #83
Szymanski, Deborah A.	n-none	Paper #26; e-Poster #56
Takahashi, Ayuko	n-none	Paper #113
Takashi, Yoshida	n-none	e-Poster #73

Name	Disclosure	Presentation Type
Talusan, Paul G.	n-none	Paper #110
Talwalkar, Vishwas R.	n-none	Moderator; Paper #100; Poster #13♦; e-Poster #64
Tan Tanny, Sharman P.	n-none	Paper #110
Tareen, Naureen	n-none	Sports Subspecialty Day #9
Taylor, Daveda	n-none	e-Poster #42
Teneria, Jorge	n-none	IFPOS Paper #28
Terjesen, Terje	n-none	Paper #25
Tetik, Cihangir	n-none	Poster #7
Thacker, Mihir M.	9-POSNA	e-Poster #36; IFPOS Paper #15
Thomas, Ronald	n-none	e-Poster #11
Thompson, George H.	3A-Innovative Iinterventions; 3C-K2M, OrthoPediatrics, SpineForm; 6-Innovative Interventions; 8-Journal of Pediatric Orthopaedics; 9-Societe Internationale de Chirurgie Orthopedique et de Traumatologie	Paper #36♦,43; e-Poster #23♦
Thompson, John	n-none	Hip Subspecialty Day #8
Thornton, Rian	n-none	e-Poster #10
To, Teresa	n-none	Paper #12
Tobert, Dan	n-none	IFPOS Paper #36
Toledo, Alfredo	n-none	IFPOS Paper #39
Tompkins, Bryan J.	9-POSNA, AAOS	Paper #95,106; e-Poster #75; SharePoint Tutorial
Topkar, Mert Osman	n-none	Poster #7
Torres-Gomez, Armando	2-Pfizer; 3B-Pfizer, Smith & Nephew; 3C-Smith & Nephew; 9-Mexican Society of Pediatric Orthopaedics, National Medical Center, Mexico, ABC Medical Center, Mexico, American College of Surgeons	IFPOS Paper #28,32
Triantafillou, Konstantinos	n-none	Disaster Response Symposium #1
Truong, Walter	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #6
Tsang, Kai	n-none	Hip Subspecialty Day #6
Tuason, Dominick	n-none	Paper #37
Tulchin-Francis, Kirsten	9-Gait and Clinical Movement Analysis Society	Paper #21
Turgeon, Isabelle	n-none	e-Poster #26

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Name	Disclosure	Presentation Type
Tuten, H. Robert	1-Amedica; 4-Amedica Doctors Research Group	Lower Extremity/ Neuromuscular Subspecialty Day #5
Tyson, Kesley	n-none	Sports Subspecialty Day #7
Upasani, Vidyadhar V.	n-none	Paper #47
Vakamudi, Sudha	4-Hospira	Poster #5
Valencia, Maria	n-none	Paper #8
Valteau, Barthélémy	n-none	Poster #9
Valvano, Joanne M.	n-none	e-Poster #69
van Bosse, Harold J.P.	n-none	Presider; Paper #65
Van Heest, Ann	n-none	Paper #89 ♦
Van Houten, Heather	n-none	Paper #86
Vanderhave, Kelly L.	n-none	Paper #75; e-Poster #31
Vanitcharoenkul, Ekasame	n-none	e-Poster #72
Velkes, Steven	n-none	Paper #79
Vidal, Armando F.	2-Musculoskeletal Transplant Foundation; 6-Stryker, Smith & Nephew; 9-American Orthopaedic Society for Sports Medicine	e-Poster #47
Villas, Carlos	n-none	Paper #40
Villemure, Isabelle	n-none	Poster #9
Virostek, Donald	n-none	Paper #72
Vitale, Michael G.	n-none	Program Committee; eModerator; e-Poster #23 ♦; IFPOS Paper #1 ♦,36; Spine Subspecialty Day #3,8
Vitztum, Coley	n-none	NP/PA Symposium
Walker, Janet	9-Association of Children's Prosthetic and Orthotic Clinics	e-Poster #64 Paper #100; Poster #13 ♦
Walker, Kevin R.	5-Medtronic	Paper #56; e-Poster #74
Wall, Eric J.	3B-Orthopediatrics; 3C-SpineForm, Stryker; 6-SpineForm; 9-POSNA	Paper #42,84; IFPOS Paper #45
Wall, Lindley B.	n-none	Paper #92
Wallace, Juanita	n-none	e-Poster #64
Walrath, Jessica	n-none	Paper #108
Walters, Michele M.	n-none	Hip Subspecialty Day #3
Wang, David	n-none	e-Poster #74
Wang, Ting-Ming	9-Taiwan Pediatric Orthopaedic Society	Lower Extremity/ Neuromuscular Subspecialty Day #9
Ward, James P.	n-none	Spine Subspecialty Day #1

Name	Disclosure	Presentation Type
Warhoover, Tracy	n-none	Poster #13 ♦
Warner, William C.	3C-Medtronic Sofamor Danek; 7-Saunders/Mosby-Elsevier; 9-Clinical Orthopaedic Society	Moderator; Poster #22; e-Poster #13,67
Waters, Peter M.	4-Celgene, Sangamo; 7-Wolters Kluwer Health-Lippincott Williams & Wilkins; 8-Wolters Kluwer Health-Lippincott Williams & Wilkins; 9-American Society for Surgery of the Hand, POSNA	eModerator; Paper #28,88; Poster #1; IFPOS Paper #41; Hand Subspecialty Day
Watkins, Summer	n-none	IFPOS Paper #44
Wattenbarger, J. Michael	n-none	Presider
Weatherford, Brian	n-none	Paper #13
Weathermon, Adam C.	n-none	Paper #66
Webb, Jonathan E.	n-none	Sports Subspecialty Day #3
Wedge, John H.	4-Procter & Gamble, Johnson & Johnson; 8-Journal of Pediatric Orthopaedics	IFPOS Paper #7; Hip Subspecialty Day
Weekley Holly,	n-none	e-Poster #46
Weiner, Dennis S.	n-none	Paper #99
Weinstock, Peter H.	n-none	Paper #28
Weir, Shannon	n-none	Paper #53
Weiss, Jennifer M.	9-AAOS, California Orthopaedic Association, POSNA	Paper #84; Sports Subspecialty Day #2
Wells, Lawrence	9-Philadelphia Orthopaedic Society	Sports Subspecialty Day
Wenger, Dennis R.	7-Wolters Kluwer Health-Lippincott Williams & Wilkins; 8-Journal of Pediatric Orthopaedics Journal of Children's Orthopaedics	Moderator
Werler, Martha M.	n-none	Paper #101
Wetzel, Robert J.	n-none	Paper #10
Wheeler, Lesley C.	n-none	Paper #72,92
Whetstone, Heather	n-none	Paper #78
White, Gregory R.	2-Medtronic Sofamor Danek	Lower Extremity/ Neuromuscular Subspecialty Day #8
White, Hank	n-none	e-Poster #64
White, Klane K.	2-Shire HGT, Biomarin Pharmaceuticals; 5-Biomarin Pharmaceuticals; 7-UptoDate; 9-POSNA	Paper #114
Whitlock, Patrick W.	n-none	Paper #11
Wicks, Eric D.	n-none	Paper #99
Widmann, Roger F.	9-POSNA	e-Poster #27; Sports Subspecialty Day #8
Wiemann, John	n-none	e-Poster #15
Wientroub, Shlomo	n-none	Poster #18

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Name	Disclosure	Presentation Type
Wiesman, Kathryn D.	n-none	Paper #74
Wiig, Ola	n-none	Paper #25
Willick, Stuart E.	n-none	Paper #86
Willis, Leisel M.	n-none	Paper #73♦,91,109
Wilson, Philip	7-Elsevier	Paper #85; Poster #16; e-Poster #53; Hand Subspecialty Day #10; Sports Subspecialty Day #9
Wimberly, Robert L.	n-none	e-Poster #8,16
Wirth, Thomas	8-Journal of Children's Orthopaedics; 9-German Orthopaedic Paediatric Society, European Paediatric Orthopaedic Society	IFPOS Paper #18,25
Wise, Kelsey	n-none	Paper #85; Poster #16; Hand Subspecialty Day #10; Sports Subspecialty Day #9
Wise, Michelle	n-none	Paper #105
Wong, Lilian	n-none	e-Poster #30
Woon, Regina P.	n-none	Paper #116
Wren, Tishya A.L.	5-Ultraflex; 9-Gait & Clinical Movement Analysis Society	Paper #57; Lower Extremity/ Neuromuscular Subspecialty Day #1
Wright, James G.	7-Journal of Bone and Joint Surgery-American, Saunders/Mosby-Elsevier; 8-Journal of Bone and Joint Surgery-American	eModerator; Paper #33,97; e-Poster #30; NP/PA Symposium; IFPOS Paper #33
Wright, Margaret L.	n-none	Spine Subspecialty Day #8
Wright, Rick	n-none	Paper #84
Wu, Chia H.	n-none	Paper #49
Wu, Kuan-Wen	n-none	Lower Extremity/ Neuromuscular Subspecialty Day #9
Wylie, Christopher	n-none	e-Poster #46
Yamada, Naotake	n-none	e-Poster #73
Yamaguchi, Kent	n-none	e-Poster #23♦; Spine Subspecialty Day #8
Yamamoto, Yohei	n-none	IFPOS Paper #8
Yasmeh, Siamak	n-none	Paper #57

Name	Disclosure	Presentation Type
Yaszay, Burt	1-Orthopediatrics; 2-DePuy, A Johnson & Johnson Company; K2M; 3B-K2M, Orthopaediatrics; DePuy, A Johnson & Johnson Company; 5-DePuy, A Johnson & Johnson Company; 9-Scoliosis Research Society, POSNA	Presider; Paper #46; IFPOS Paper #29 ♦; Spine Subspecialty Day #10
Yavor, Ariela	n-none	Poster #18
Yazdy, Mahsa M.	n-none	Paper #101
Yazici, Muharrem	2-K2M, DePuy, Johnson & Johnson; 3B-K2M; 8-Acta Orthopaedica Traumatologica e Turcica; 9-European Pediatric Orthopaedic Society	e-Poster #23 ♦; IFPOS Paper #29 ♦
Yen, Yi-Meng	3A-Agios Pharmaceuticals; 3B-Smith & Nephew, Orthopediatrics, Arthrex; 4-Agios Pharmaceuticals	e-Poster #57; Hip Subspecialty Day #7
Yngve, David A.	n-none	e-Poster #44
Yokota, Shumpei	n-none	IFPOS Paper #16
Yoo, Won Joon	n-none	Paper #54,58; Poster #15; e-Poster #43,45,68; IFPOS Paper #12,20,23; Lower Extremity/ Neuromuscular Subspecialty Day #3
Yorgova, Petya	n-none	IFPOS Paper #4
Yoshihara, Hiroyuki	n-none	e-Poster #25
Young, Megan L.	n-none	e-Poster #52; Hip Subspecialty Day #7
Zabjek, Karl	n-none	e-Poster #74
Zaltz, Ira	3B-Pivot Medical; 5-DePuy, A Johnson & Johnson Company	Presider; Hip Subspecialty Day
Zaps, Daniela	n-none	e-Poster #55,62
Zeller, Reinhard D.	1-Spinevision; 3C-Paradigm Spine; 8-Journal of Children's Orthopaedics; Maitrise Orthopedique, Spine Deformity, European Spine Journal; 9-Scoliosis Research Society	e-Poster #74; Spine Subspecialty Day #3
Zhang, Wei	n-none	Sports Subspecialty Day #6
Zhao, Caixia	n-none	Paper #67; e-Poster #37
Zimmerman, Catherine	n-none	e-Poster #71
Zlotolow, Dan A.	3B-Arthrex, Osteomed; 5-Arthrex; 6-Arthrex; 7-Saunders/Mosby-Elsevier; 9-American Society for Surgery of the Hand	Hand Subspecialty Day
Zurakowski, David	n-none	Paper #82; IFPOS Paper #34

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WEDNESDAY, MAY 1, 2013

1:00 PM – 1:09 PM **Introduction and Opening Remarks**

TRAUMA

Moderator: William C. Warner, MD
Presider: Travis H. Matheney, MD
eModerator: David A. Podeszwa, MD

1:10 PM – 1:14 PM **Functional and Radiographic Outcomes after Non-Operative Treatment of Displaced Adolescent Clavicle Fractures**
1 *(page 81)*
Jacob Schulz, MD; *Molly Moor, MPH; Joanna H. Roocroft, MA; Tracey P. Bastrom, MA; Andrew T. Pennock, MD*
Rady Children's Hospital, San Diego, California

1:15 PM – 1:19 PM **Trends in the Volume of Operative Treatment of Clavicle Shaft Fractures in Children and Adolescents**
2 *(page 82)*
Benton E. Heyworth, MD; *Catherine A. Suppan, BA; Mininder S. Kocher, MD; Donald S. Bae, MD*
Boston Children's Hospital, Boston, Massachusetts

1:20 PM – 1:24 PM **Evidence Into Practice: Short Arm Splints for Distal Radius Fractures**
3 *(page 83)*
Andrew W. Howard, MD; *Unni G. Narayanan, MD, FRCSC; Anna V. Cuomo, MD; Kathy Boutis*
The Hospital for Sick Children, Toronto, Ontario, Canada

1:25 PM – 1:33 PM Discussion

1:35 PM – 1:39 PM **Avascular Necrosis after Femoral Neck Fracture: Analysis of Risk Factors**
4 *(page 84)*
David D. Spence, MD; *Jon Paul DiMauro; Patricia Miller, MS; Michael P. Glotzbecker, MD; Daniel Hedequist, MD; Benjamin J. Shore, MD*
Boston Children's Hospital, Boston, Massachusetts

1:40 PM – 1:44 PM **The Role of Computed Tomography in the Classification and Treatment of Pediatric Pelvic Fractures—Revisited**
5 *(page 85)*
Melissa Bent, MD; ***William L. Hennrikus Jr, MD;*** *Douglas G. Armstrong, MD; Brian A. Shaw, MD; Kerwyn C. Jones, MD; Lee S. Segal, MD*
Penn State College of Medicine, Hershey, Pennsylvania

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See pages 15 – 57 for financial disclosure information.

WEDNESDAY, MAY 1, 2013 (cont.)

1:45 PM – 1:49 PM
6 *(page 87)*
Results of Displaced Tibial Spine Fractures: A Comparison between Open, Arthroscopic, and Closed Management
Jesse Dashe, MD; Eric Fornari, MD; Andrew T. Pennock, MD; ***Eric W. Edmonds, MD***
Rady Children's Hospital, San Diego, California

1:50 PM – 1:58 PM Discussion

2:00 PM – 2:04 PM
7 *(page 88)*
The Outcome of Non-Operative Treatment of Medial Epicondyle Fractures in the Pediatric Population
Juliann Lee Kwak, MD; *Mauricio Silva, MD*
Los Angeles Orthopaedic Hospital, Los Angeles, California

2:05 PM – 2:09 PM
8 *(page 89)*
Long Term Functional Result of Neurological Complications of Paediatric Supracondylar Fractures
Maria Valencia, MD; ***Luis Moraleda, MD, PhD***
Hospital Universitario La Paz, Madrid, Spain

2:10 PM – 2:14 PM
9 *(page 90)*
Screw Fixation of Lateral Condyle Fractures: Results of Treatment
Eric D. Shirley, MD; *Mary Anderson, BS; Kevin M. Neal, MD; John M. Mazur, MD*
Nemours Children's Clinic, Jacksonville, Florida

2:15 PM – 2:23 PM Discussion

2:25 PM – 2:29 PM
10 *(page 91)*
Current Practice in the Management of Type I Open Fractures in Children
Robert J. Wetzel, MD; Shobhit Vishnoi Minhas, BS; Brittany C. Patrick, MPH; ***Joseph A. Janicki, MD***
Ann & Robert H. Lurie Children's Hospital of Chicago, Northwestern University, Chicago, Illinois

2:30 PM – 2:34 PM
11 *(page 93)*
Protein and Vitamin D Malnutrition in Pediatric Orthopaedic Trauma Patients
Bettina M. Gyr, MD; *Cait Barbarita, BS; Peter J. Apel, MD, PhD; Patrick W. Whitlock, MD, PhD*
Wake Forest Baptist Health, Winston-Salem, North Carolina

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

2:35 PM – 2:39 PM **Childhood Fracture Begets Childhood Fracture: A Population-based Study of Longitudinal Fracture Patterns in Ontario Children**
12 *(page 94)*

Benjamin G. Escott, MBBS; Teresa To; Dorcas Beaton, PhD; ***Andrew W. Howard, MD MSc, FRCSC***

The Hospital for Sick Children, Toronto, Ontario, Canada

2:40 PM – 2:48 PM Discussion

2:50 PM – 3:10 PM Break

HIP

Moderator: Harish Hosalkar, MD
Presider: Ira Zaltz, MD
eModerator: Anthony A. Stans, MD

3:10 PM – 3:14 PM **Timing of Pavlik Harness Initiation: Can We Wait?**
13 *(page 96)*

Anay R. Patel, MD; Jill E. Larson, MD; Brian Weatherford, MD; ***Joseph A. Janicki, MD***

Ann & Robert H. Lurie Children's Hospital, Northwestern University, Chicago, Illinois

3:15 PM – 3:19 PM **Abduction Bracing for Infants with Residual Acetabular Dysplasia: Practice Dogma or Effective Treatment?**
14 *(page 98)*

Wudbhav N. Sankar, MD; *John (Jack) M. Flynn, MD; Itai Gans, BS; Chanika Angsanuntsukh, MD*

Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

3:20 PM – 3:24 PM **Does the Orientation of the Femoral Head Affect Acetabular Developmet? An Experimental Study in Lambs**
15 *(page 99)*

Luis Moraleda, MD, PhD; *Christian Bravo, MD; Francisco Forriol, MD, PhD; Javier Albiñana, MD, PhD*

Hospital Universitario La Paz, Madrid, Spain

3:25 PM – 3:33 PM Discussion

3:34 PM – 3:39 PM **Hip Pathology in Relatives of Probands with Developmental Dyspalsia of the Hip**
16 *(page 100)*

Kristen L. Carroll, MD; *Alison Schiffern, MD; Kathleen A. Murray, MD; Bruce MacWillams, PhD; James W. Roach, MD*

Shriners Hospital Salt Lake City, Salt Lake City, Utah

3:40 PM – 3:44 PM **A Re-Evaluation of Commonly Accepted Risk Factors for Developmental Dysplasia of the Hip: Preliminary Results of a Population Based Cohort Study**
17 *(page 101)*

Andreas Roposch, MD, MSc, FRCS; *Sabovra Mahdavi; Evangelia Protopapa; Yael Gelfer; Paul Humphries; Rumana Omar*

Great Ormond Street Hospital for Children, London, United Kingdom

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WEDNESDAY, MAY 1, 2013 (cont.)

3:45 PM – 3:49 PM
18 *(page 102)*

Do Infant Risk Factors for DDH Predict Hip Dysplasia Presenting in Adolescents and Adults?

Ernest L. Sink, MD; *Katrina Dela Torre, RN, MSN; Charles T. Price, MD*

Hospital for Special Surgery, New York, New York

3:50 PM – 3:58 PM Discussion

3:59 PM – 4:03 PM
19 *(page 103)*

Long-Term Outcome of Gradual Reduction with Overhead Traction for Developmental Dysplasia of the Hip in Children Over Six Months of Age

Hiroshi Kaneko, MD, PhD; *Hiroshi Kitoh, MD, PhD; Kenichi Mishima, MD; Masaki Matsushita, MD; Naoki Ishiguro, MD, PhD*

Nagoya University School of Medicine, Nagoya, Aichi, Japan

4:04 PM – 4:08 PM
20 *(page 104)*

Preoperative Traction Does Not Improve the Success of Closed Reduction or Limit AVN in Developmental Dysplasia of the Hip

Daniel J. Sucato, MD, MS; *Adriana De La Rocha, MS; Karlee Lau, BS; Brandon A. Ramo, MD; Scott Paradise; Richard H. Browne, PhD*

Texas Scottish Rite Hospital for Children, Dallas, Texas

4:09 PM – 4:13 PM
21 *(page 105)*

Increased Self-reported Pain and Gait Dysfunction at 20 Years Post Hip Fusion as an Adolescent

David A. Podeszwa, MD; *Kirsten Tulchin-Francis, PhD; Adriana De La Rocha, MS; Wilshaw Stevens Jr, BS; DeRaan Collins, BS; Lori A. Karol, MD; Daniel J. Sucato, MD, MS*

Texas Scottish Rite Hospital for Children, Dallas, Texas

4:14 PM – 4:22 PM Discussion

4:23 PM – 4:27 PM
22 *(page 106)*

Comparing of Twist Test (A New Test for Hip Labral Pathology) To Arthroscopy

Farshad Adib, MD; *Skye Donovan, PT, PhD, OCS; Pegah Dehghan, MD; Derek Ochiai, MD*

Nirschl Orthopedic Center, Arlington, Virginia

4:28 PM – 4:32 PM
23 *(page 107)*

The Incidence of Femoroacetabular Impingement after an Innominate Osteotomy for Acetabular Dysplasia

Pablo Castañeda, MD; *Alfonso Méndez, MD*

Shriners Hospital for Children, Mexico City, Mexico

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

4:33 PM – 4:37 PM **Revision Hip Preservation Surgery following Treatment for Femoroacetabular Impingement**
24 *(page 108)*

Lauren E. LaMont, MD; Sarah Knapp, BA; Claire J. Gilbert, MS; Bryan T. Kelly, MD; ***Ernest L. Sink, MD***

Hospital for Special Surgery, New York, New York

4:38 PM – 4:46 PM Discussion

4:47 PM – 4:51 PM **Early Dysplastic Acetabular Changes have a Prognostic Significance in Legg-Calvé-Perthes Disease**
25 *(page 109)*

Stefan Huhnstock, MD; *Svein Svenningsen; Are Hugo Pripp; Terje Terjesen; Ola Wiig*

Oslo University Hospital, Oslo, Norway

4:52 PM – 4:56 PM **Combined Bernese Periacetabular Osteotomy (PAO) and Surgical Hip Joint Dislocation (SHD) for Correction of Symptomatic Perthes Hip Joint Deformity**
26 *(page 110)*

Perry L. Schoenecker, MD; *Thomas Roy Lewis, MD; Gail Pashos, BS; Deborah A. Szymanski, RN; John C. Clohisy, MD*

Shriners Hospital for Children, St. Louis, St. Louis, Missouri

4:57 PM – 5:01 PM **Slipped Capital Femoral Epiphysis Treated by Anterior Wedge Osteotomy without Hip Dislocation**
27 *(page 111)*

Brice Ilharreborde, MD,PhD; *Cindy Mallet, MD; Keyvan Mazda, MD*

Hôpital Robert Debré, Paris, France

5:02 PM – 5:10 PM Discussion

THURSDAY, MAY 2, 2013

8:00 AM – 8:04 AM **Welcome and Remarks**

SPECIAL TOPICS FORUM

8:05 AM – 8:25 AM **Anesthetic Induced Developmental Neurotoxicity-Evidence from the Laboratory**

Sulpicio Soriano, MD, Boston, Massachusetts

8:25 AM – 8:45 AM **Anesthetic Related Neurotoxicity in the Young: Clinical Evidence**

Randall Flick, MD, Rochester, Minnesota

8:45 AM – 9:05 AM *Questions/Discussion*

QUALITY, SAFETY AND VALUE

Moderator: Kevin G. Shea, MD
Presider: J. Michael Wattenbarger, MD
eModerator: Benjamin A. Alman, MD, FRCSC

9:06 AM – 9:10 AM **Team Training in Pediatric Orthopaedic Surgery Via High Fidelity Simulation at the Point of Care: Proof of Concept**
28 *(page 112)*

Travis H. Matheney, MD; *Peter H. Weinstock, MD PhD; Peter M. Waters, MD*

Boston Children's Hospital, Boston, Massachusetts

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THURSDAY, MAY 2, 2013 (cont.)

9:11 AM – 9:15 AM **Do Patient Safety Checklists Improve Patient Safety?**
29 *(page 113)*
Suzanne E. Steinman, MD; *Timothy M. Cooper, MHA, MT(ASCP); Kate Drummond MS, MPA; Jean Popalisky, DNP, RN; Ernest U. Conrad III, MD; Michael J. Goldberg, MD*
Seattle Children's Hospital, Seattle, Washington

9:16 AM – 9:20 AM **Comprehensive Program Aligning Structure, Processes and the Electronic Medical Record Improves Quality and Safety of Complex Spinal Deformity Surgery in Children**
30 *(page 114)*
Suken A. Shah, MD; *Stephen Lawless, MD MBA; William G. Mackenzie, MD*
Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

9:21 AM – 9:29 AM Discussion

9:30 AM – 9:34 AM **Outcomes in Pediatric Orthopaedic Surgery: Analysis of the 2010-2011 American College of Surgeons National Surgical Quality Improvement Program-Pediatric Data**
31 *(page 115)*
Brian K. Brighton, MD, MPH; *Peter W. Dillon, MD, MSc, FACS; William L. Hennrikus Jr, MD; Bruce L. Hall, MD, PhD, MBA, FACS*
Levine Children's Hospital at Carolinas Medical Center, Charlotte, North Carolina

9:35 AM – 9:39 AM **"Pop Quiz" of Orthopaedic Residents Performing Tasks that are Typically Performed in an Unsupervised Setting**
32 *(page 116)*
Joshua M. Abzug, MD; *Ebrahim Paryavi, MD; Robert O'Toole, MD; Robert Sterling, MD*
University of Maryland School of Medicine, Baltimore, Maryland

9:40 AM – 9:44 AM **Antimicrobial Prophylaxis and Rates of Surgical Site Infection in Children**
33 *(page 117)*
Ilyas S. Aleem, MD; Jeannette P. So, MSc; Anne G. Matlow, MSc, MD; ***James G. Wright, MD, MPH***
The Hospital for Sick Children, Toronto, Ontario, Canada

9:45 AM – 9:53 AM Discussion

9:54 AM – 10:09 AM **Distinguished Achievement Award**

10:10 AM – 10:40 AM Break

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

CONCURRENT SESSION I: SPINE

Moderator: James O. Sanders, MD
Presider: Stefan Parent, MD
eModerator: Michael G. Vitale, MD, MPH

10:41 AM – 10:45 AM
34 ***(page 118)***

♦ **Early Onset Scoliosis Treated with Growing Rods has More Spinal Growth, Better Cobb Correction, but More than Twice the Number of Surgeries Compared to Shilla**

Lindsay M. Andras, MD; *Elizabeth R. A. Joiner, BS; Richard E. McCarthy, MD; Scott J. Luhmann, MD; Paul D. Sponseller, MD; John B. Emans, MD; David L. Skaggs, MD, MMM; Growing Spine Study Group*

Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

10:46 AM – 10:50 AM
35 ***(page 119)***

♦ **A Comparison Of SHILLA™ GROWTH GUIDANCE SYSTEM and Growing Rods in the Treatment of Spinal Deformity in Children Less than 10 Years of Age**

Richard E. McCarthy, MD; ***Scott J. Luhmann, MD***

Washington University School of Medicine, Department of Orthopaedics, St. Louis, Missouri

10:51 AM – 10:55 AM
36 ***(page 120)***

♦ **Five To Sixteen-Year Results of 201 Growing Rod Patients: Is there a Difference between Etiologies?**

Behrooz A. Akbarnia, MD; *Nima Kabirian, MD; Jeff Pawelek; George H. Thompson, MD; John B. Emans, MD; Paul D. Sponseller, MD; David L. Skaggs, MD, MMM; Growing Spine Study Group*

San Diego Center for Spinal Disorders, La Jolla, California

10:56 AM – 11:04 AM Discussion

11:05 AM – 11:09 AM
37 ***(page 122)***

Incidence and Risk Factors for Surgical Site Infection in Neuromuscular Scoliosis: A 30 Year Experience at a Single Institution

Dominick Tuason, MD; *David W. Roberts, MD; Brandon A. Ramo, MD; Anna McClung, BSN, RN; Scott Paradise; Lauren Paraison, BS; Gregory H. Moore; Daniel J. Sucato, MD, MS*

Texas Scottish Rite Hospital for Children, Dallas, Texas

11:10 AM – 11:14 AM
38 ***(page 124)***

Thromboembolic Complications in Children with Spinal Fusion Surgery

Amit Jain, MD; Michael Paloski; ***Paul D. Sponseller, MD***

Johns Hopkins Orthopaedic Surgery, Baltimore, Maryland

11:15 AM – 11:19 AM
39 ***(page 126)***

♦ **Complications in Pediatric Cervical Spine Surgery Using Modern Instrumentation**

Daniel Hedequist, MD; *Michael T. Hresko, MD*

Children's Hospital, Harvard Medical School, Boston, Massachusetts

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11:20 AM – 11:28 AM Discussion

THURSDAY, MAY 2, 2013 (cont.)

11:29 AM – 11:33 AM **Serum Metal Levels Implication in Stainless Steel Spinal Posterior Instrumentations Corrosion: Before and After Removal Study**
40 *(page 128)*

Julio Duart-Clemente, MD, PhD; *Rafael Llombart; Javier Del-Rio; Matias Alfonso Olmos, Carlos Villas; José Luis Beguiristain*

Navarra Hospital Complex, Pamplona, Spain

11:34 AM – 11:38 AM **Predicting Failure Of Iliac Fixation In Neuromuscular Spine Deformity**
41 *(page 129)*

Sumeet Garg, MD; *Courtney Allen Holland, MD; Jaren LaGreca, BS; Bryan McNair, MS; Mark A. Erickson, MD*

Children's Hospital Colorado, Aurora, Colorado

11:39 AM – 11:43 AM **A Prospective Clinical Trial on a Scoliosis Growth Modulation Clip/Screw Device: Initial Safety Results**
42 *(page 131)*

Eric J. Wall, MD; *Joe Reynolds; Viral V. Jain, MD; Donita I. Bylski-Austrow, PhD; Andrea G. Ferris, BS; Paul Samuels, MD; Maria Alonso, MD; Alvin H. Crawford, MD*

Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

11:44 AM – 11:52 AM Discussion

Moderator: B. Stephens Richards III, MD
Presider: Burt Yaszay, MD
eModerator: David L. Skaggs, MD, MMM

11:53 AM – 11:57 AM **Success of Risser Casting in the Treatment of Scheurmann's Kyphosis**
43 *(page 133)*

Raj Gala, BS; ***Christina K. Hardesty, MD;*** *Connie Poe-Kochert, CPNP; George H. Thompson, MD*

Rainbow Babies and Children's Hospital, Cleveland, Ohio

11:58 AM – 12:02 PM **Is Casting for Infantile Scoliosis Better than the Natural History?**
44 *(page 134)*

John R. Faust, MD*; Caleb J. Behrend, MD; Paul T. Rubery, MD; James O. Sanders, MD*

University of Rochester, Rochester, New York

12:03 PM – 12:07 PM **Patient Outcomes in the Operative and Non-Operative Management of High-Grade Spondylolisthesis in Children**
45 *(page 136)*

Kristopher M. Lundine, MD; ***Stephen J. Lewis, MD, MSc;*** *Zaid Al-Aubaidi, MD, MB.CH.B; Benjamin A. Alman, MD, FRCSC; Andrew W. Howard, MD*

The Hospital for Sick Children, Toronto, Ontario, Canada

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

12:08 PM – 12:16 PM Discussion

12:17 PM – 12:21 PM **Selective Thoracic Fusion in Adolescent Idiopathic Scoliosis Curves with a C Lumbar Modifier: Which Rules Can be Broken?**
46 *(page 138)*

Jacob Schulz, MD; *Jahangir Asghar, MD; Tracey P. Bastrom, MA; Harry L. Shufflebarger, MD; Peter O. Newton, MD; Burt Yaszay, MD; Harms Study Group*

Rady Children's Hospital, San Diego, California

12:22 PM – 12:26 PM **Spinal Deformity Progression after Modern Segmental Instrumentation and Fusion: Is this Crankshaft?**
47 *(page 139)*

Vidyadhar V. Upasani, MD; *Michael P. Glotzbecker, MD; Daniel Hedequist, MD; Michael T. Hresko, MD; Lawrence I. Karlin, MD; John B. Emans, MD*

Children's Hospital Boston, Boston, Massachusetts

12:27 PM – 12:31 PM **Sagittal Plane Alignment following Spinal Fusion of Adolescent Idiopathic Scoliosis: A Case-Matched Analysis of All-Pedicle Screw vs. Hybrid Instrumentation**
48 *(page 140)*

Xu Gao; Marios N. Lykissas, MD, PhD; Emily A. Eismann, MS; Jennifer M. Anadio, MA; ***Alvin H. Crawford, MD***

Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

12:32 PM – 12:40 PM Discussion

12:41 PM – 12:45 PM **Cost Effectiveness of Surgical Treatment for Adolescent Idiopathic Scoliosis**
49 *(page 141)*

Chia H. Wu; ***John (Jack) M. Flynn, MD;*** *Lisa M. McLeod, MD, MSCE*

The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

12:46 PM – 12:50 PM **Evaluation of Limited Screw-Density Pedicle Screw Constructs in Posterior Fusions for Adolescent Idiopathic Scoliosis**
50 *(page 143)*

John W. Kemppainen, MD; Melanie Morscher, BS; M. David Gothard, MS; Mark J. Adamczyk, MD; ***Todd F. Ritzman, MD***

Children's Hospital Medical Center of Akron, Akron, Ohio

12:51 PM – 12:55 PM **Are Routine Post-operative Radiographs Required during the First Year following Surgery for Idiopathic Scoliosis?**
51 *(page 144)*

Sumeet Garg, MD; *Emily Kipper; Jaren LaGreca, BS; Patrick M. Carry, BA*

Children's Hospital Colorado, Aurora, Colorado

12:56 PM – 1:04 PM Discussion

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THURSDAY, MAY 2, 2013 (cont.)

CONCURRENT SESSION II: NEUROMUSCULAR AND LOWER EXTREMITY

NEUROMUSCULAR

Moderator: Unni G. Narayanan, MD, FRCSC;
Presider: Allison C. Scott, MD

10:41 AM – 10:45 AM **Hip Subluxation, Pelvic Obliquity, and Scoliosis in the CP Population: A Random Triad or a Predictable Relationship?**
52 *(page 145)*
Firoz Miyanji, MD, FRCSC; *Amer F. Samdani, MD; Peter F. Sturm, MD; Suken A. Shah, MD; Paul D. Sponseller, MD; Peter O. Newton, MD*
British Columbia Children's Hospital, Vancouver, British Columbia, Canada

10:46 AM – 10:50 AM **The CPCHILD Questionnaire is Sensitive to Change following Hip Reconstructive Surgery in Children with Severe Cerebral Palsy**
53 *(page 146)*
Unni G. Narayanan, MD, FRCSC; *Jasjit Lochab, BSc, MBBS; Olanrewaju Okusanya, MD, FRCSC; Shannon Weir, MSc*
The Hospital for Sick Children, Toronto, Ontario, Canada

10:51 AM – 10:55 AM **Long Term Outcome of Single Event Multi-level Surgery Including Distal Hamstring Lengthening in Spastic Diplegia**
54 *(page 147)*
Seung Yeol Lee, MD*; Chin Youb Chung, MD; Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Moon Seok Park, MD*
Seoul National University Bundang Hospital, Kyungki, Korea

10:56 AM – 11:04 AM Discussion

11:05 AM – 11:09 AM **Acetabular Remodeling after Varus Derotational Osteotomy in Cerebral Palsy: Do We Need to Do the Pelvis?**
55 *(page 148)*
Benjamin J. Shore, MD; *Dustin S. Powell, BS; Patricia Miller, MS; Travis H. Matheney, MD; Brian D. Snyder, MD, PhD*
Boston Children's Hospital, Boston, Massachusetts

11:10 AM – 11:14 AM **Intrathecal Baclofen and Neuromuscular Scoliosis: Natural History vs. Cause and Effect**
56 *(page 149)*
Kevin R. Walker, MD*; Karen Ostenso, PT; Linda Krach, MD*
Gillette Children's Specialty Healthcare, St. Paul, Minnesota

11:15 AM – 11:19 AM **Repeat Hamstring Lengthening in Children with Cerebral Palsy**
57 *(page 150)*
Robert M. Kay, MD; *Susan Rethlefsen, PT, DPT; Siamak Yasmeh, MD; Tishya A.L. Wren, PhD*
Children's Hospital, Los Angeles, Los Angeles, California

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

11:20 AM – 11:28 AM Discussion

11:29 AM – 11:33 AM **Calcaneal Lengthening for the Planovalgus Foot Deformity in Patients with Cerebral Palsy**
58 ***(page 151)***

Moon Seok Park, MD; *Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Seung Yeol Lee, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Chin Youb Chung, MD*

Seoul National University Bundang Hospital, Kyungki, Korea

11:34 AM – 11:38 AM ♦**A Lower Age Limit for Patellar Tendon Advancement? The Effects of Patellar Tendon on Proximal Tibial Growth**
59 ***(page152)***

Cameron Patthanacharoenphon, MD; *Dayle L. Maples, MD; Christina Saad, MD; Michael J. Forness, DO; Matthew A. Halanski, MD*

Helen DeVos Children's Hospital Department of Pediatric Orthopaedics, Grand Rapids, Michigan

11:39 AM – 11:43 AM ♦**Pamidronate Treatment to Prevent Reoccurring Fractures in Children with Cerebral Palsy**
60 ***(page 154)***

Julieanne P. Sees, DO; *Prakash Sitoula, MD; Kenneth J. Rogers, PhD; Heidi Kecskemethy, RD; Steven Bachrach, MD; Freeman Miller, MD*

Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

11:44 AM – 11:52 AM Discussion

LOWER EXTREMITY

Moderator: Vishwas R. Talwalkar, MD
Presider: Harold J.P. van Bosse, MD

11:53 AM – 11:57 AM **Evaluation of In-Toeing at a Tertiary Pediatric Orthopedic Specialty Center**
61 ***(page 155)***

Jeffrey L. Gum, MD; Nathan Polley, MD; Andrew Harston, MD; ***Joshua W. Meier, MD;*** *Gilbert Chan, MD*

Children's Orthopaedics of Louisville, Louisville, Kentucky

11:58 AM – 12:02 PM **Ankle Disarticulation (Syme) and Transtibial Amputation as a Treatment for Pelvic Limb Deficiencies: Which is Better?**
62 ***(page 156)***

Jacobo S. Cruz, MD; ***Roman L. Capdevila, MD;*** *Juan Leonel Arizola, MD; Felipe Haces, MD*

Shriners Hospital for Children, Mexico City, Mexico

12:03 PM – 12:07 PM **A Comparison Of Syme and Trans-tibial Amputee Gait in Children**
63 ***(page 157)***

Kelly A. Jeans, MS; Donald Cummings, CP/LP; Kunal Singhal, PT; ***Lori A. Karol, MD***

Texas Scottish Rite Hospital for Children, Dallas, Texas

12:08 PM – 12:16 PM Discussion

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THURSDAY, MAY 2, 2013 (cont.)

12:17 PM – 12:21 PM **Limb Lengthening in Children with a New, Controllable, Internal Device**
64 *(page 158)*

John E. Herzenberg, MD; Stacy C. Specht, MPA; ***Shawn C. Standard, MD***
Sinai Hospital of Baltimore, Baltimore, Maryland

12:22 PM – 12:26 PM **Botulinum Toxin Type A Injection in Alleviating Post-Operative Pain and Improving Quality of Life in Lower Extremity Limb Lengthening and Deformity Correction**
65 *(page 159)*

Reggie C. Hamdy, MD; *Kathleen Montpetit, MSc,BScOT; Michael D. Aiona, MD; Harold J.P. van Bosse, MD; William G. Mackenzie, MD; Unni G. Narayanan, MD, FRCSC; Ellen M. Raney, MD*
Shriners Hospital for Children, Montreal, Quebec, Canada

12:27 PM – 12:31 PM **EOS Low-dose Biplanar Radiography: The New Gold Standard in Radiographic Assessment of Lower Limb Lengths**
66 *(page 161)*

Benjamin G. Escott, MBBS; Beeshma Ravi, MD; Adam C. Weathermon, MASc, MD; Jay Acharya, BSc; Christopher L. Gordon, PhD; Paul S. Babyn, MD; Simon P. Kelley, MBChB, FRCS; ***Unni G. Narayanan, MD, FRCSC***
The Hospital for Sick Children, Toronto, Ontario, Canada

12:32 PM – 12:40 PM Discussion

12:41 PM – 12:45 PM **Do Children with Blount Disease Have Lower Body Mass Index following Lower Limb Realignment?**
67 *(page 162)*

Sanjeev Sabharwal, MD, MPH; *Caixia Zhao, MD; Sara M. Sakamoto, MD; Emily McClemens, PA-C*
UMDNJ-New Jersey Medical School, Newark, New Jersey

12:46 PM – 12:50 PM **The Relationship between Angular Knee Deformity and Degenerative Disease of the Hip and Knee**
68 *(page 163)*

Raymond W. Liu, MD; *Jonathan J. Streit, MD; Colin E. Lasko; Ademola A. Ajuwon, BS; Daniel R. Cooperman, MD*
Case Western Reserve University, Cleveland, Ohio

12:51 PM – 12:55 PM **No Superiority of Tension Band Plating Compared to Stapling: A Randomized Clinical Trial on Treatment of Idiopathic Genu Valgum**
69 *(page 164)*

Bjarne Moeller-Madsen, MD, PhD; *Martin Gottliebsen; Ole Rahbek; Ivan Hvid; Michael Davidsen; M.B. Hellfritzsch*
Dept of Children's Orthopaedics, Aarhus University Hospital, Aarhus, Denmark

12:56 PM – 1:04 PM Discussion

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See pages 15 – 57 for financial disclosure information.

FRIDAY, MAY 3, 2013

8:00AM – 8:09AM **Welcome and Updates**

CLINICAL AWARD PAPERS

Moderator: Dennis R. Wenger, MD
Presider: Matthew J. Bueche, MD
eModerator: John (Jack) M. Flynn, MD

8:10 AM – 8:14 AM **Long Term Effects of Glucocorticoid Treatment in Duchenne Muscular Dystrophy on Scoliosis**
70 *(page 165)*

Benjamin A. Alman, MD; *David Lebel, MD; W. Douglas Biggar, MD*
The Hospital for Sick Children, Toronto, Ontario, Canada

8:15 AM – 8:19 AM Discussion

08:20 AM – 08:24 AM **Predicting the Presence of Adjacent Musculoskeletal Infections in Septic Arthritis**
71 *(page 166)*

Shiva Daram, BS; ***Scott B. Rosenfeld, MD***
Texas Children's Hospital, Houston, Texas

8:25 AM – 8:29 AM Discussion

8:30 AM – 8:34 AM **The Effect of Compliance Monitoring on Brace Use and Success in Patients with AIS**
72 *(page 168)*

Lori A. Karol, MD; *Donald Virostek, CPO; Kevin Felton, CPO; Lesley Wheeler, BS*
Texas Scottish Rite Hospital, Dallas Texas

8:35 AM – 8:39 AM Discussion

8:40 AM – 8:44 AM **♦Percutaneous Doxycycline Therapy of Juxtaphyseal Aneurysmal Bone Cysts**
73 *(page 169)*

William E. Shiels, II, DO; ***Allan C. Beebe, MD;*** *Joel L. Mayerson, MD; Leisel Willis, BS*
Nationwide Children's Hospital, Columbus, Ohio

8:45 AM – 8:49 AM Discussion

8:50 AM – 8:54 AM **Can Perfusion MRI Performed in the Early Stages of Legg-Calvé-Perthes Disease Predict Lateral Pillar Involvement?**
74 *(page 170)*

Kathryn D. Wiesman; Vedant Kulkarni; Amanda Lu; Jerry Du; J. Anthony Herring, MD; ***Harry K.W. Kim, MD****; Perthes Study Group*
Texas Scottish Rite Hospital for Children, Dallas, Texas

8:55 AM – 8:59 AM Discussion

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FRIDAY, MAY 3, 2013 (cont.)

9:00 AM – 9:04 AM **The Modified Dunn Procedure for Unstable SCFES: A Multi-center Perspective**
75 *(page 171)*
Wudbhav N. Sankar, MD; *Kelly L. Vanderhave, MD; Travis H. Matheney, MD; Jose A. Herrera-Soto; Judson W. Karlen*
Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

9:05 AM – 9:09 AM Discussion

BASIC SCIENCE

Moderator: Matthew Dobbs, MD
Presider: Matthew A. Halanski, MD
eModerator: Cathleen Raggio, MD

9:10 AM – 9:14 AM **3D Visualization of the Vertebral Growth Plate: The Effects of Growth Modulation**
76 *(page 172)*
Peter O. Newton, MD; *Joshua Doan, MEng, OBRC; Diana Andreeva Glaser, PhD, OBRC; Christine L. Farnsworth, MS*
Rady Children's Hospital, UCSD, San Diego, California

9:15 AM – 9:19 AM **Acute BMP-2 Response following Induction of Ischemic Osteonecrosis in Immature Femoral Head**
77 *(page 174)*
Nobuhiro Kamiya, MD, PhD; *Sasha Shafer; Ila Oxendine; Harry K.W. Kim, MD*
Texas Scottish Rite Hospital for Children, Dallas, Texas

9:20 AM – 9:24 AM **Improving Bone Healing in Neurofibromatosis: A Study In Mice**
78 *(page 175)*
Saber Ghadakzadeh, MD; Heather Whetstone, MSc; ***Benjamin A. Alman, MD, FRCSC***
The Hospital for Sick Children, Toronto, Ontario, Canada

9:25 AM – 9:33 AM Discussion

9:34 AM – 9:38 AM **Guiding Femoral Rotational Growth in an Animal Model**
79 *(page 176)*
Amir Arami, MD; ***Elhanan Bar-On, MD, MPH****; Amir Herman, MD,PhD; Steven Velkes, MD; Snir Heller, MD*
Schneider Children's Medical Center, Petah Tikva, Israel

9:39 AM – 9:44 AM **Developmental and Genetic Etiology of Tibial Hemimelia in Mouse and Human**
80 *(page 177)*
Danyi Li, MSc; Steven Deimling, PhD; Chris Sotiropoulos; Chi-chung Hui, PhD; ***Sevan Hopyan, MD***
The Hospital for Sick Children, Toronto, Ontario, Canada

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

9:44 AM – 9:48 AM **Thermal Epiphysiodesis Made with Radio Frequency Ablation, RFA in a Porcine Model**
81 (*page 178)*

Bjarne Moeller-Madsen, MD, PHD; *Juan Manuel Shiguetomi-Medina; Ole Rahbek; H. Stødkilde-Jørgensen*
Aarhus University Hospital, Aarhus, Denmark

9:49 AM – 9:57 AM Discussion

9:58 AM – 10:00 AM **Introduction of Presidential Speaker**

10:00 AM – 10:20 AM **Presidential Speaker**
Health Care Delivery in France with Special Attention on Pediatric Orthopaedics

10:20 AM – 10:40 AM Break

SPORTS

Moderator: Michael T. Busch, MD
Presider: Paul M. Saluan, MD
eModerator: Theodore J. Ganley, MD

10:41 AM – 10:45 AM **Revision Rate following Arthroscopic Shoulder Stabilization in Patients Under 21 Years of Age**
82 *(page 179)*

Xavier C. Simcock, MD; David Zurakowski, PhD; Mininder S. Kocher, MD; Dennis Kramer, MD; Benton Heyworth, MD; ***Donald S. Bae, MD***
Boston Children's Hospital, Boston, Massachusetts

10:46 AM – 10:50 AM **Efficacy of Pre-operative Regional Anesthesia in Patients Age 10-18: A Randomized, Prospective Study**
83 *(page 180)*

Carl W. Nissen, MD; *Anthony J. Ricciuti, PA, ATC; Fran Swartz, DO; Emily O'Hara, MSc*
Elite Sports Medicine, Connecticut Children's Medical Center, Farmington, Connecticut

10:51 AM – 10:55 AM **Reliability of the ROCK Osteochondritis Dissecans Knee Arthroscopy Classification System – Multi-center Validation Study**
84 *(page 182)*

James L. Carey, MD, MPH; Eric J. Wall, MD; ***Kevin G. Shea, MD;*** *Nathan L. Grimm, BS; Allen F. Anderson, MD; Eric W. Edmonds, MD; Henry (Hank) G. Chambers, MD; Benton E. Heyworth, MD; Mininder S. Kocher, MD; M. Lucas Murnaghan, MD; Carl W. Nissen, MD; John D. Polousky; Jennifer M. Weiss; Rick Wright MD; Theodore J. Ganley, MD*
University of Pennsylvania, Philadelphia, Pennsylvania

10:56 AM – 11:04 AM Discussion

11:05 AM – 11:09 AM **Prevalence of Discoid Meniscus During Arthroscopy for Isolated Lateral Meniscal Pathology in the Pediatric Population**
85 *(page 183)*

Henry B. Ellis Jr, MD; *Kelsey Wise, BA; Philip L. Wilson, MD*
Children's Medical Center, Dallas, Texas

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FRIDAY, MAY 3, 2013 (cont.)

11:10 AM – 11:14 AM **Knee Injury in Downhill Skiers: Comparison of Adults and Children Injury Mechanisms**
86 *(page 184)*

Kevin G. Shea, MD; *Noah Archibald-Seiffer; Nathan L. Grimm, BS; Stuart E. Willick, MD; John C. Jacobs Jr; Elizabeth Murdock, MS; Heather Van Houten, BS*

St. Luke's Health System, Boise, Idaho

11:15 AM – 11:19 AM **Acute Complications of Pediatric and Adolescent Knee Arthroscopy**
87 *(page 185)*

Ali Ashraf, MD; Christy Christophersen; Lindsay Hunter; ***Amy L. McIntosh, MD***

Mayo Clinic Department of Orthopedics, Rochester, Minnesota

11:20 AM – 11:28 AM Discussion

UPPER EXTREMITY

Moderator: Robert B. Carrigan, MD
Presider: Charles Goldfarb, MD
eModerator: Peter M. Waters, MD

11:29 AM – 11:33 AM **Growth Disturbance following Intra-articular Distal Radius Fractures in the Skeletally-Immature Patient**
88 *(page 187)*

Eric C. Fu, MD; ***Apurva S. Shah, MD, MBA;*** *Peter M. Waters, MD; Donald S. Bae, MD*

Boston Children's Hospital, Boston, Massachusetts

11:34 AM – 11:38 AM ♦ **Correlation between Standard Upper Extremity Impairment Measures and Activity-Based Function Testing in Hemiplegic Cerebral Palsy**
89 *(page 188)*

Michelle A. James, MD*; Ann Van Heest, MD; Anita Bagley PhD, MPH*

Shriners Hospital for Children, Northern California, Sacramento, California

11:39 AM – 11:43 AM **Parent Reports of Function following Neonatal Brachial Plexus Palsy are Influenced by Medical Malpractice Litigation**
90 *(page 189)*

Emily A. Eismann, MS; Andrea S. Bauer, MD; Scott H. Kozin, MD; Emily Louden, MPH; ***Roger Cornwall, MD***

Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

11:44 AM – 11:52 AM Discussion

11:53 AM – 11:57 AM **Pediatric Forearm Fractures: Is There Still a Place for Cast Wedging?**
91 *(page 191)*

Julie Balch Samora, MD, PhD, MPH; Kevin E. Klingele, MD; Allan C. Beebe, MD; John R. Kean, MD; Jan E. Klamar, MD; Matthew Beran, MD; Leisel Willis, BSc; ***Walter P. Samora III, MD***

Nationwide Children's Hospital, Columbus, Ohio

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

11:58 AM – 12:02 PM **Prognostic Effect of Clavicular Fractures on Obstetric Brachial Plexus Injuries**
92 *(page 192)*

Lindley B. Wall, MD*; Janith K. Mills, MPAS; Kenneth Leveno, MD; Gregory Jackson, MD; Lesley C. Wheeler, BA; Scott N. Oishi, MD; Marybeth Ezaki, MD*

Texas Scottish Rite Hospital, Dallas, Texas

12:03 PM – 12:07 PM **Potential Causes of Loss of Reduction in Supracondylar Humerus Fractures**
93 *(page 194)*

Andrew T. Pennock, MD; *Michael Charles, BS; Molly Moor, MPH; Tracey P. Bastrom, MA; Peter O. Newton, MD*

Rady Children's Hospital, San Diego, California

12:08 AM – 12:16 AM Discussion

SATURDAY, MAY 4, 2013

8:00 AM – 8:09 AM **Welcome and Updates**

FOOT AND ANKLE

Moderator: Vincent S. Mosca, MD
Presider: Jose Morcuende, MD
eModerator: Richard S. Davidson, MD

8:10 AM – 8:14 AM **Long Term Outcomes in Adults of Comprehensive Surgical vs. Ponseti Treated Clubfoot**
94 *(page 195)*

Peter A. Smith, MD; *Adam Graf, MS; Sahar Hassani, MS; Joseph Krzak, PT, PCS; Angela Caudill, MPT; Ann Flanagan, PT, PCS; Ken N. Kuo, MD; Fredrick Dietz, MD; Jose Morcuende, MD; Gerald Harris, PhD, PE*

Shriners Hospital for Children, Chicago, Illinois

8:15 AM – 8:19 AM **Functional Outcomes of Children Treated as Infants with the Ponseti and Dimeglio Methods at Five Years of Age**
95 *(page 197)*

Glen O. Baird, MD*; Nancy L. Garcia, PT; Bryan J. Tompkins, MD; Paul M. Caskey, MD; Mark L. McMulkin, PhD; Rob D. Mildes, PT; Barb C. Harrison, PT; Shelley L. Mader, PT*

Shriners Hospital for Children, Spokane, Washington

8:20 AM – 8:24 AM **Ponseti Method for Untreated Idiopathic Clubfoot Presenting between 5 and 10 Years of Age**
96 *(page 199)*

Bibek Banskota; Ashok K. Banskota, MD; Rabindra Regmi, MS; Tarun Rajbhandary; Om P. Shrestha; ***David A. Spiegel, MD***

Hospital and Rehabilitation Centre for Disabled Children, Banepa, Nepal

8:25 AM – 8:33 AM Discussion

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SATURDAY, MAY 4, 2013 (cont.)

8:34 AM – 8:38 AM **Long-term Functional Outcomes of Resected Tarsal Coalitions**
97 *(page 200)*
Amir Khoshbin; Peggy W. Law; Liora Caspi; Everlyn Gomez; Derek Stephen; ***James G. Wright, MD***
The Hospital for Sick Children, Toronto, Ontario, Canada

8:39 AM – 8:43 AM **Simultaneous Tarsal Coalition Resection with Calcaneal Lengthening Osteotomy**
98 *(page 201)*
Nicolas Lee, MD; William Granberry, MD; Elroy Sullivan, PhD; ***Allison C. Scott, MD***
Shriners Hospital for Children, Houston, Texas

8:44 AM – 8:48 AM **Non-Union after Triple Arthrodesis in Children: Does it Really Matter?**
99 *(page 202)*
Eric Wicks, MD; Meadow Newton, BS; Melanie Morscher, BS; ***Dennis S. Weiner, MD***
Akron Children's Hospital, Akron, Ohio

8:49 AM – 8:57AM Discussion

8:58 AM – 9:02 AM **Initial Correction Predicts the Need for Secondary Achilles Tendon Procedures in Patients with Idiopathic Clubfoot Treated with Ponseti Casting**
100 *(page 203)*
Robert Steiner, MD; ***Pooya Hosseinzadeh, MD****; Vishwas R. Talwalkar, MD; Janet Walker, MD; Henry J. Iwinski, MD; Ryan D. Muchow, MD; Todd A. Milbrandt, MD*
Shriners Hospitals for Children, Lexington, Kentucky

9:03 AM – 9:07 AM **Is it Worthwhile to Routinely Screen Children with Clubfoot for Hip Dysplasia?**
101 *(page 204)*
Susan T. Mahan, MD, MPH*; Mahsa M. Yazdy, MPH; James R. Kasser, MD; Martha M. Werler, ScD*
Boston Children's Hospital, Boston, Massachusetts

9:08 AM – 9:12 AM **Leg Length Discrepancy in Children with Unilateral Clubfoot Deformity**
102 *(page 205)*
Richard J. Aadalen, MD; *James E. Johanson, MD*
Shriners Hospitals for Children-Twin Cities, Minneapolis, Minnesota

9:13 AM – 9:21 AM Discussion

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

INFECTION

Moderator: Lawson A. Copley, MD
Presider: Kevin E. Klingele, MD
eModerator: Todd A. Milbrandt, MD

9:22 AM – 9:26 AM
103 *(page 206)*
Aspirations of the Ilium and Proximal Femur Increase the Likelihood of Culturing an Organism in Patients with Presumed Septic Arthritis of the Hip
Gregory A. Schmale, MD; *Viviana Bompadre, PhD*
Seattle Children's Hospital, Seattle, Washington

9:27 AM – 9:31 AM
104 *(page 207)*
Novel Approach to Diagnoses and Management af Hip Pericapsular Pyomyositis
Travis Menge, MD; Megan Mignemi, MD; Gregory A. Mencio, MD; Jeffrey E. Martus, MD; Stephen A. Lovejoy, MD; Christopher Stutz, MD; ***Jonathan G. Schoenecker, MD, PhD***
Vanderbilt University Medical Center, Nashville Tennessee

9:32 AM – 9:36 AM
105 *(page 208)*
Stuffed Animals in the Operating Room: A Reservoir of Bacteria?
Jonathan G. Schoenecker, MD, PhD; *Michael Held; Michelle Wise; Lynda O'Rear*
Vanderbilt University Medical Center, Nashville, Tennessee

9:37 AM – 9:45 AM Discussion

9:46 AM – 9:50 AM
106 *(page 210)*
Effectiveness of MRSA Screening in Pediatric Orthopaedic Surgery
Kyong S. Min, MD; ***Glen O. Baird, MD****; Ronda Cordill, MS; Bryan J. Tompkins, MD; Paul M. Caskey, MD*
Shriners Hospital for Children, Spokane, Washington

9:51 AM – 9:55 AM
107 *(page 211)*
Can an Algorithm Predict MRSA vs. MSSA Osteomyelitis?
Stuart Michnick, BS; ***Scott B. Rosenfeld, MD***
Texas Children's Hospital, Houston, Texas

9:56 AM – 10:00 AM
108 *(page 212)*
The Prevalence of MRSA Nasal Carriage in Pre-Operative Pediatric Orthopaedic Patients
Jessica Walrath, BS; ***William L. Hennrikus Jr, MD***
Penn State College of Medicine, Hershey, Pennsylvania

10:00 AM – 10:15 AM **POSNA Annual Meeting 2014**

10:16 AM – 10:26 AM **Presidential Transfer**

10:27 AM – 10:47 AM Break

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SATURDAY, MAY 4, 2013 (cont.)

MISCELLANEOUS

Moderator: Peter F. Armstrong, MD
Presider: Ryan C. Goodwin, MD
eModerator: James G. Wright, MD, MPH, FRCSC

10:48 AM – 10:52 AM **Management of Orthopedic Trauma Cases: An Evaluation of three Different Models at a Level I Pediatric Trauma Center**
109 *(page 213)*

Allan C. Beebe, MD; *Leisel M Willis, BSc; Jan E. Klamar, MD; Kevin E. Klingele, MD; Walter P. Samora III, MD; John R. Kean, MD*

Nationwide Children's Hospital, Columbus, Ohio

10:53 AM – 10:57 AM **Children with Knee Monoarthritis in Lyme Disease Endemic Areas: Who Needs Arthrocentesis?**
110 *(page 214)*

Julia K. Deanehan, MD; Amir A. Kimia, MD; Sharman P. Tan Tanny, MedSc; ***Matthew D. Milewski, MD;*** *Paul G. Talusan, MD; Brian G. Smith, MD; Lise E. Nigrovic, MD, MPH*

Division of Emergency Medicine, Boston Children's Hospital and Harvard Medical School, Boston, Massachusetts

10:58 AM – 11:02 AM **Clinical and Economic Implications of Early Discharge following Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis**
111 *(page 215)*

Nicholas D. Fletcher, MD; *Nader Shourbaji, MD; Philip M. Mitchell, BA; Timothy S. Oswald, MD; Dennis P. Devito, MD; Robert W. Bruce, MD*

Emory University Department of Orthopaedics, Atlanta, Georgia

11:03 AM – 11:11 AM Discussion

11:12 AM – 11:16 AM **♦The Use of rhBMP-2 in Congenital Pseudarthrosis of the Tibia**
112 *(page 216)*

Terrence D. Anderson, MD; *B. Stephens Richards III, MD*

Texas Scottish Rite Hospital for Children, Dallas, Texas

11:17 AM – 11:21 AM **Expansion Thoracoplasty: Is Earlier Better? Evaluation Using a Rabbit Model of TIS**
113 *(page 217)*

Casey Olson; Michael P. Glotzbecker, MD; Ayuko Takahashi; ***Brian D. Snyder, MD, PhD***

Boston Children's Hospital, Boston, Massachusetts

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

11:22 AM – 11:26 AM
114 *(page 219)*
Polysomnographic Screening in Children with Achondroplasia: There is No Correlation between Sleep Disordered Breathing and Foramen Magnum Stenosis

Klane K. White, MD, MSc; *Shawn E. Parnell, MD; Yemiserach Kifle, MD; Marcella Blackledge, BA; Viviana Bompadre, PhD*

Seattle Children's Hospital, Seattle, Washington

11:27 AM – 11:35 AM Discussion

11:36 AM – 11:40 AM
115 *(page 220)*
At What Age do Cam and Pincer Morphology Become Apparent: An Analysis of 225 Pediatric and Adolescent CT Scans

Shafagh Monazzam, MD; James D. Bomar, MPH; Jerry Dwek, MD; Harish S. Hosalkar, MD; ***Andrew T. Pennock, MD***

Rady Children's Hospital, San Diego, California

11:41 AM – 11:45 AM
116 *(page 221)*
Can Sub-clinical Rickets Cause SCFE? A Prospective, Pilot Study

Alexandre Arkader, MD*; Regina P. Woon, MPH; Vicente Gilsanz, MD*

Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

11:46 AM – 11:50 AM
117 *(page 222)*
Treatment of Snapping Scapula Syndrome In Pediatric and Adolescent Patients

Brian M. Haus, MD; *Adam Y. Nasreddine, MA; Omar Badri, BA; Catherine A. Suppan, BA; Mininder S. Kocher, MD, MPH*

Boston Children's Hospital, Boston, Massachusetts

11:51 AM – 11:59 AM Discussion

11:59 AM – 12:00 PM **Awards**

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Functional and Radiographic Outcomes after Non-operative Treatment of Displaced Adolescent Clavicle Fractures

Jacob Schulz, MD; *Molly Moor, MPH; Joanna H. Roocroft, MA; Tracey P. Bastrom, MA; Andrew T. Pennock, MD*

Rady Children's Hospital, San Diego, California

† LOE-Therapeutic Level IV

Purpose: Studies on adult patients suggest that non-operative treatment of clavicle fractures may result in functional disability but this has not been demonstrated in adolescents. The purpose of this study was to determine the functional outcomes after non-operative treatment of displaced, shortened, mid-shaft clavicle fractures in adolescents.

Methods: Adolescents age 10-18 with isolated, completely displaced, shortened, mid-shaft clavicle fractures sustained between 2009-2011 were recruited for this IRB approved study. Injury and final radiographs were assessed for displacement, shortening and clavicle length. Maximal and endurance strength testing using the Baltimore Testing Equipment (BTE) machine was performed using the un-injured shoulder as an internal control. Shoulder range-of-motion and clavicle length were assessed clinically and patient oriented outcomes obtained.

Results: 16 patients (4 female) with an average age of 14.2 ± 2 years and a mean follow-up of 2 ± 1 years were included in the study. 15 were right-hand dominant and 1 was ambidextrous, with 81% of fractures occurring in the non-dominant limb. Compared to the uninjured limb, no differences were noted in range of motion or strength except for an 8% decrease in maximal external rotation strength (p=0.04) and a 12% loss of abduction endurance strength (p=0.04). Radiographs demonstrated a 100% union rate but significant shortening compared to the uninjured clavicle (p≤0.001). SANE, QuickDash and Constant scores were similar between sides. 94% of patients were satisfied with the appearance of their clavicle and 100% of patients returned to full activity.

Conclusion: In this group of 16 adolescent patients treated non-operatively for displaced, shortened clavicle fractures, a 12% loss of abduction endurance strength and an 8% loss of external rotation strength were noted. Otherwise, no differences were found with respect to pain, strength, range of motion, or subjective outcome scores regardless of patient age, sports participation and final clavicle shortening. All patients, including overhead athletes, returned to the same level of sport and reported no deficits.

Significance: While these results do support non-operative management, further study is necessary to determine the sub-population that might benefit most from operative treatment of these common fractures.

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Trends in the Volume of Operative Treatment of Clavicle Shaft Fractures in Children and Adolescents

Benton E. Heyworth, MD*; Catherine A. Suppan, BA; Mininder S. Kocher, MD; Donald S. Bae, MD*

Boston Children's Hospital, Boston, Massachusetts

† LOE-Other Analysis Level IV

Purpose: Traditionally, midshaft clavicle fractures in children have been treated conservatively. While recent literature on fixation of midshaft clavicle fractures in the adult population has suggested there may be a greater role for surgical management, this concept remains largely unexplored in the pediatric population. The purpose of this study was to examine institutional and national trends in the volume of operative plate fixation for midshaft clavicle fractures in children and adolescents.

Methods: Medical records, identified through a departmental database and cross-referenced for accuracy against billing records using ICD-9 codes, were retrospectively reviewed to identify patients 10-18 years-old who presented with a clavicle shaft fracture between 1999-2011 at a single tertiary-care pediatric hospital. Demographic data, fracture characteristics and treatment details were analyzed. Annual volumes were determined for the overall number of clavicle fractures, midshaft clavicle fractures, and midshaft fractures that underwent operative fixation. Additionally, data reported to the Pediatric Health Information System (PHIS) from 43 U.S. pediatric hospitals was used to assess national clavicle fracture trends and practice patterns from 2007-2011. Kendall's Tau-b was used to assess the relationship between case volume and time for the volumes listed above.

Results: From 1999-2011, a total of 882 patients were seen at our institution with a diaphyseal clavicle fracture (mean age: 14.3), 644 (73%) of which were midshaft. Overall, there was a significant increase in the number of midshaft clavicle fractures seen annually over that period, from 20/yr to 85/yr ($r=0.80$, $p<0.0001$). However, the *percent* of midshaft clavicle fractures treated with plate fixation also increased significantly from 5% to 25% ($r=0.84$, $p<0.0001$). Based on national database volumes, there was a threefold increase in the number of clavicle fractures that underwent elective surgery in the ambulatory surgery setting from 2007 to 2011($r=0.80$, $p=0.05$), while inpatient cases remained stable over the same period.

Conclusion: Both the volume and frequency of operative plate fixation of midshaft clavicle fractures appear to be increasing in the pediatric population.

Significance: More evidence is needed to justify the growing trend towards surgery for midshaft clavicle fractures in children.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Evidence into Practice: Short Arm Splints for Distal Radius Fractures

Andrew W. Howard, MD; Unni Narayanan MD, FRCSC; Anna V. Cuomo MD; Kathy Boutis
The Hospital for Sick Children, Toronto, Ontario, Canada

† LOE-Prognostic Level II

Purpose: To determine the extent to which paediatric orthopaedic surgeons apply randomized trial evidence regarding treatment of distal radius metaphyseal fractures. Randomized trial evidence shows that removable splints are superior to short arm casts for buckle fractures (1), removable splints are equally effective as short arm casts for minimally displaced fractures (2), and short arm casts are equally effective as long arm casts for displaced fractures requiring reduction (3,4).

Methods: Online survey of POSNA membership. Radiographs of distal radii with buckle fractures, minimally displaced greenstick fractures, and minimally displaced transverse fractures were provided and the preferred treatment was sought. Separate questions assessed reasons against using splints.

Results: At the time of abstract writing 437 USA and 35 Canadian POSNA members had responded to the survey. For a distal radius buckle fracture, 60% of respondents preferred a short arm cast and 20% preferred a removable splint. For a minimally displaced greenstick fracture, 15% preferred a long arm cast, 58% a short arm cast, and only 2.2% a removable splint. For a minimally displaced transverse fracture, 46% preferred a long arm cast, 26% a short arm cast, and only 0.4% a removable splint. 89% of respondents had a very low or low level of concern about long term consequences of the fracture. The reported reasons for not using a splint were concern about patient compliance (57%), complications (40%), medicolegal concerns (18%), cost/reimbursement issues (13%), did not feel evidence is strong enough (11%), and splints not available (9%). (Percentages add greater than 100 because multiple responses were permitted)

Conclusions: The level one evidence supporting removable splints for buckle fractures and minimally displaced distal radius metaphyseal fractures is not widely applied by POSNA members. Indeed, the most popular treatment for a minimally displaced transverse fracture is a long arm cast (46%) despite the publication of back to back randomized trials in JBJS in 2006 showing that long arm casts are not necessary (3,4).

Significance: Simple, effective treatment for distal radius fractures would free up resources for more important paediatric problems. We as a community are contributing to costly and inefficient health care.

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Avascular Necrosis after Femoral Neck Fracture: Analysis of Risk Factors

David D. Spence, MD*; Jon Paul DiMauro, MD; Patricia Miller, MS; Michael Glotzbecker, MD; Daniel Hedequist, MD; Benjamin J. Shore, MD, FRCSC*

Boston Children's Hospital, Boston, Massachusetts

† LOE-Therapeutic Level IV

Purpose: Avascular necrosis (AVN) is a serious complication following femoral neck fracture in children. The purpose of this study was to identify risk factors for developing AVN after femoral neck fracture.

Methods: We preformed an IRB approved, retrospective analysis of a consecutive series of 71 patients (41 boys and 30 girls) treated for a femoral neck fracture between 2000 and 2011 at a single Level 1 pediatric trauma center. Records were reviewed to determine fracture type (Delbet), displacement, age, treatment method, capsular decompression, time to treatment, mechanism of injury and incidence of AVN. Univariable and multivariable logistic regression modeling was performed to identify factors associated with the development of AVN.

Results: The average age at injury was 12.3 years (range 1.3 to 18.1 years), with a mean follow-up of 31.9 months (range 2.8 to 106.5 months). Nineteen out of 71 fractures developed AVN (26.7%) with an average time to AVN of 11.6 months (range 2.7 to 31.4 months). According to Delbet, there were 4 type I (5.6%), 31 type II (43.7%), 30 type III (42.3%) and 6 type IV (8.4%) fractures within the cohort. The majority of the fractures were displaced (76%, 54/71) and 33% of all displaced fractures (18/54) developed AVN. Displacement ($p<0.029$), capsular decompression ($p<0.047$), fixation within 24 hours ($p<0.022$) and performance of a reduction ($p<0.028$) were all found to be statistically significant independent predictors for developing AVN. However, logistic regression analysis determined that displacement, fixation within 24 hours and fracture type were the only significant predictors of AVN. Displaced fractures were 10.5 times more likely to develop AVN than nondisplaced fractures (95% CI 1.91-113.8). Type III fractures were 79% less likely to develop AVN (OR=0.21, 95% CI 0.05-0.74) and type IV fractures were 96% less likely to develop AVN (OR=0.04, 95% CI 0.0003-0.47) when compared to type I and type II fractures combined. AVN rates by Delbet class were I = 50%, II = 35%, III = 20%, and IV = 0%.

Conclusion: Femoral neck fractures are serious injuries in children and carry a high risk of AVN, which appears to be directly related to degree of fracture displacement and fracture grade.

Significance: This is currently the largest single center report on pediatric femoral neck fractures in the literature. Identification of predictors for AVN will aid surgeons in the future treatment of femoral neck fractures.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

The Role of Computed Tomography in the Classification and Treatment of Pediatric Pelvic Fractures - Revisited

Melissa Bent, MD; ***William L. Hennrikus Jr, MD;*** *Douglass G. Armstrong, MD; Brian A. Shaw, MD; Kerwyn C. Jones MD; Lee S. Segal MD*

Penn State College of Medicine, Hershey, Pennsylvania

† LOE-Diagnostic Level III

Purpose: In the pediatric population, physicians are re-assessing the necessity for computerized tomography (CT) scans in an effort to reduce radiation exposure to as low as reasonably achievable. The purpose of this study is to compare inter-observer and intra-observer reliability in classifying pediatric pelvic fractures using plain radiographs compared to CT scans and to determine the indications for use of CT.

Methods: Thirty consecutive pediatric patients with pelvic fractures with an open tri-radiate cartilage were identified via our trauma registry. All 30 had an AP plain radiograph and a CT scan performed. CT scans were ordered routinely by our trauma surgeons in the workup of every pelvic fracture. The CT scans included axial images of the pelvis with bony windows of 3-5 mm cuts. Inlet, outlet, and oblique views were only per formed in 4 patients and were therefore not utilized in this study. Three orthopedic attending that had not seen the plain radiographs or CT scans before the study independently reviewed the AP radiographs and classified the injury via the Torode and Zeig classification system (types 1-4). One month later, the three attending reviewed the CT scans and the plain radiographs and classified the injury again. The attending were also asked at each session to select a treatment option for the injury including: Non-weight bearing, partial weight bearing, weight bear as tolerated, and surgery—internal or external fixation.

Results: The average age of the patients was 7 years (range 1-13 years). 17 were male and 13 were female. The Kappa coefficient was used to statistically determine reliability. A Kappa of 1 indicates perfect agreement while a Kappa of 0 indicates agreement equivalent to chance. The average change in classification for each attending was 15% and the average change in management was 3 %. The Kappa values for intra-observer agreement comparing radiographs to CT were 0.13, 0.13, and 0.36 for attending 1,2 and 3. The Kappa values for inter-observer agreement comparing radiographs was 0.45 and comparing CT scans was 0.40. Only 1 child in this study (3%) required operative intervention.

Conclusions: The results of this study failed to demonstrate any significant difference in either inter-observer or intra-observer reliability when correctly classifying pediatric pelvic fractures on an AP pelvis radiograph compared to CT scans. Our results confirm Silber's (JPO 2001) findings that plain radiographs alone can be used to classify and manage most pediatric pelvic fractures. CT scans should be utilized on a case by case basis. For example, less than 5% of children with pelvic fractures require surgery—CT scans may be indicated in select cases undergoing surgery.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Significance: In 2007 the Alliance for Radiation Safety in Pediatric Imaging launched the 'Image Gently" campaign to change practice by raising awareness of opportunities to lower radiation dose in the imaging of children. The results of this study demonstrate that plain radiographs alone can determine fracture classification and management in most pediatric pelvic fractures with an open triradiate cartilage. CT scans should not be ordered routinely. Selective use of CT reduces radiation, reduces cost, and improves quality.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Results of Displaced Tibial Spine Fractures: A Comparison between Open, Arthroscopic, and Closed Management

Jesse Dashe, MD; Eric Fornari; MD, Andrew T. Pennock, MD; ***Eric W. Edmonds, MD***

Rady Children's Hospital, San Diego, California

† LOE-Therapeutic Level IV

Purpose: Displaced tibial spine avulsions are most frequently treated with surgical reduction and fixation. This study was performed to compare fragment reduction and adverse outcomes between open arthrotomy, arthroscopy, and closed management.

Methods: A retrospective review was performed on all children treated for tibial spine fractures from 2003 to 2011. Exclusion criteria included: Meyers and McKeever type I (non-displaced) fractures, and other proximal tibia fracture. Patients were categorized into three groups: arthroscopic (AAIF), open (ORIF), and closed (CMC). Demographics, mechanism of injury, radiographic measures (plain film and CT), treatment, duration of immobilization and follow-up, final range of motion, and complications were recorded.

Results: 76 children (mean age 12.4 years) met criteria with 29 ORIF, 28 AAIF, and 19 CMC. Measures were compared between x-ray and CT scans for the same patients and the mean error was 1 mm (SEM = 1.33 mm; ICC=0.977, $p<0.001$). Initial fracture displacement was similar between operative groups (AAIF and ORIF), 10.3 ± 4.4 mm and 10.8 ± 3.9 mm; but, less in the CMC group (5.3 ± 2.6 mm). The mean reduction in displacement on plain films was 8.6 ± 4.7 mm, 9.1 ± 4.0 mm, and 2.3 ± 2.6, respectively. A Bonferroni post hoc analysis revealed a difference in the ability to reduce the fragment between the surgical and non-operative groups ($p<0.001$), but not between AAIF and ORIF ($p=0.9$). Arthrofibrosis was the main complication in both surgical groups, occurring with equal frequency (AAIF 12.5%, ORIF 11.1%); whereas, no cases of arthrofibrosis were found in the CMC group. Yet, the CMC group resulted in a 16.7% risk for re-operation secondary to instability, loose bodies, or impingement. Finally, the meniscus was entrapped in 32% of operative cases.

Conclusions: Operative treatment of displaced tibial spine fractures affords a better method of fracture reduction as compared to closed management, but with a risk for subsequent arthrofibrosis regardless of the surgical approach. Closed management and casting may play a role for fractures that do not require a significant amount of reduction, or in children that have a delayed presentation to the treating surgeon. Pre-operative CT imaging does not augment understanding of fracture displacement compared to x-ray, nor does it delineate the presence of an entrapped meniscus.

Significance: An operative approach should be the treatment of choice for these displaced articular injuries when an anatomic reduction is desired; but, there is no difference (other than surgeon comfort) regarding open arthrotomy versus arthroscopy.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

The Outcome of Non-operative Treatment of Medial Epicondyle Fractures in the Pediatric Population

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† LOE-Therapeutic Level III

Introduction: The treatment of pediatric medial epicondyle fractures (PMEF) of the humerus is controversial.

Methods: We retrospectively analyzed clinical and radiographic information on fifty-one PMEF that were included prospectively in our pediatric elbow fracture database, from April 2007 through September 2011. The fifty-one fractures were seen in 36 boys and 15 girls, with an average age of 11 years (4-16 years). Forty-one of the fractures (80.4%) were treated non-operatively, with the use of a long arm cast. For comparison, the data on ten fractures (19.6%) that were treated surgically (open reduction and internal fixation) was analyzed. The indication for surgery was an intra-articular incarceration of the medial epicondyle in five patients, and family preference in five patients. The presence of clinical (infection, vascular, neurologic, of otherwise) or radiographic (non-union) complications, and the recovery of range of motion were compared between groups.

Results: The mean follow-up was 25 weeks (6-121 weeks). The mean fracture displacement for the non-operative group was 4.7 mm (0-21 mm), as compared to 14.1 mm (2.1-36 mm) for the operative group ($p<0.00001$). Incarceration of the medial epicondyle was seen in 50% of the cases in which there was an associated elbow dislocation. The length of cast immobilization was of 21 days (6-33 days) in the non-operative group, as compared to 17 days (8-35 days) in the surgical group ($p=0.04$). No complications were seen in either group. At their latest follow-up, all fractures were clinically and radiographically healed, either by fibrous or bony union. All patients were asymptomatic, with no complains of late ulnar nerve symptoms. At the latest follow-up, the range of motion of the affected elbow, as compared to the normal, contralateral side, was of 93% in the non-operative group and 89% in the operative group ($p=0.16$). While there are no significant differences between the two groups, the main limitation for motion at the latest follow-up was a lack of recovery of terminal extension.

Conclusions: Non-operative treatment is a viable alternative for most pediatric medial epicondyle fractures. The results of this study suggest that, even for displaced fractures, conservative management can result in adequate outcomes. There are certainly specific indications for surgical treatment, including the intra-articular incarceration of the medial epicondyle after an elbow dislocation. In order to better understand the long-term outcomes of the treatment of medial epicondyle fractures, a randomized controlled trial is necessary.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Long Term Functional Result of Neurological Complications of Paediatric Supracondylar Fractures

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† LOE-Prognostic Level II

Purpose: It has been reported that most neurologic injuries after a supracondylar fracture will usually resolve spontaneously in the first few months; however, studies are lacking regarding the influence of these injuries in the upper limb functionality in the long-term follow-up.

Materials and Methods: 436 children with a supracondylar humeral fractures were reviewed. Patients with a neurological injury were included. Data regarding age at the time of fracture, sex, side involved, dominancy and pinning site were recorded. Patients returned for clinical evaluation: grip and pinch test score and a thorough examination of sensibility. Clinical outcomes were described according to the Mayo Elbow Performance Score (MEPS) and Flynn's criteria. Patients were asked to complete the quick-DASH questionnaire.

Results: There were 29 patients with supracondylar humeral fracture with a neurological injury (6.6%). 16 patients came back for clinical evaluation (15 with a Gartland type-3 fracture and one with a flexion-type fracture). The average age at the time of fracture was 7.5±1.9 years and the average follow-up was 8.6±4.8 years (3.4 to 17.4). The relation left to right was 2.2, with the non-dominant side being involved in 13 cases. The ulnar nerve was injured in 8 patients (4 with a medial pin), the median nerve in 7 patients, and the radial nerve in 5 patients. The average grip strength was 20.9±6.7 Kg. for the injured side and 24.4±8 Kg. for the uninjured side. The average pinch strength was 6.2±4.4 Kg. for the injured side and 7.3±6 Kg. for the uninjured side. Discriminatory sensation was normal (5 mm) in the territory of the median, ulnar and radial nerves in 12 patients. Seven patients referred paresthesias (6 in the ulnar nerve territory and 1 in the median nerve territory). A medial pin was used in 5 of the 16 patients and two of them presented with paresthesias in the ulnar nerve territory. The average score was 4±3 (median 4) for the DASH questionnaire, 3±4.2 (median 0) for the DASH-sports questionnaire and 96±7 for the MEPS. According to Flynn's criteria, results were satisfactory in 10 cases (5 being excellent).

Conclusion: Functional results in the long-term follow-up were excellent in the majority of patients with a neurological lesion after a supracondylar humeral fracture. Grip and pinch strength, as well as discriminatory sensation were in normal values. However, half of the patients referred paresthesias, mostly in the ulnar nerve territory.

Significance: Neurological complications of supracondylar fractures recover well.

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Screw Fixation of Lateral Condyle Fractures: Results of Treatment

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Purpose: Fixation of lateral condyle distal humeral fractures has traditionally been achieved with K-wires. Screw fixation provides the advantage of compression across the fracture site. The results of screw fixation and risk of iatrogenic physeal damage are not well defined. This study was designed to evaluate the efficacy of screw fixation for lateral condyle fractures.

Methods: A retrospective study of patients treated with lateral condyle elbow fractures using screw fixation at a single institution was undertaken. Patients ages 12 years and under with isolated fractures were included. Clinical notes were examined for residual symptoms, alignment, range of motion, and complications. Radiographs were reviewed for healing and growth arrest.

Results: 95 patients treated over a 7-year period met inclusion criteria. Mean patient age was 5.8 years, range 2-12. 53 patients required open reduction, 42 patients underwent a closed reduction. Mean follow up was 148 days, range 34-802. The overall complication rate was 19%, with a 5% rate when lateral overgrowth was excluded as a complication. Initial fracture union was achieved in 99% of patients, as one patient required revision fixation with bone grafting. Hardware was symptomatic with prominence or loss of flexion in 4% of patients. There were no cases of growth arrest or alterations of the carrying angle. For patients with final follow-up > 12 months, the mean extension loss was 2° (range, 0-25°) and the mean loss of flexion was 8° (range, 0-25°).

Conclusion: Screw fixation of lateral condyle fractures results in satisfactory union with minimal risk of growth plate complications at early follow-up. Small degrees of motion loss may occur, with flexion deficits larger than extension deficits.

Significance: This study demonstrates the safety of screw fixation of lateral condyle fractures in the short-term, which has not been well established in the literature.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Current Practice in the Management of Type I Open Fractures in Children

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Purpose: Pediatric type I open fractures are common but the treatment is often controversial. While there is little debate regarding the need for operating room (OR) irrigation and débridement (I&D) of type II and III open fractures, centers have reported good success with emergency room (ER) treatment of low-energy (type I) open pediatric fractures. The purpose of this study was to ascertain the attitudes and preferences of pediatric orthopaedic surgeons in the treatment of type I open fractures. We hypothesize that surgeons will have different management protocols of these fractures and that there will not be a consensus of the preferred treatment location (OR vs. ER).

Methods: A paper questionnaire was given to POSNA members at the 2012 annual meeting. Demographic questions inquired about surgeon's practice environment and experience while clinical questions queried opinions regarding the typical treatments and past experiences with open fractures. Clinical scenarios questioned preferred management of open fractures.

Results: One hundred eighty one surveys were collected from the 503 POSNA members in attendance (36%). Years in practice were well represented with 34% <10 yrs, 37% 10-19 yrs, and 29% >20 yrs. Most respondents' practices comprised over 80% pediatric patients (86%), were academic (68%), and worked with residents (77%).

After initial treatment for an open fracture, 86% of respondents admitted patients for IV antibiotics and 57% will give home antibiotics. There was no consensus regarding the amount or type of irrigation preferred, use of antibiotics in the irrigation, or whether the bone ends are delivered during I&D. Soft tissue infections and delayed union were noted respectively by 13% and 8% of respondents in type I open fractures treated in the ER and in 16% and 30% treated in the OR.

While 100% of respondents would choose OR management of type II open fractures, 19-31% of respondents chose an ER treatment scenario for type I open fractures. When queried if Level 1 evidence existed that demonstrated equivalent results between ER and OR management, 92% of respondents would change their practice. Furthermore, 75% of surgeons would be interested in participating in a prospective, randomized trial on pediatric type I open fracture management.

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Conclusion: In this survey representative of POSNA membership, the treatment of type I open fractures has some variability. A significant portion of surgeons prefer to treat type I open fractures in the ER as opposed to the classically utilized OR I&D. Moreover, there is considerable interest in membership participation in a randomized clinical trial.

Significance: Based on this survey, either children are going to the OR when ER treatment would be adequate or they may be receiving inadequate care when they avoid operating room management. This survey establishes the equipoise necessary for a randomized, prospective trial comparing ER and OR management in the treatment of pediatric type I open fractures.

Protein and Vitamin D Malnutrition in Pediatric Orthopaedic Trauma Patients

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Purpose: Protein and vitamin malnutrition are known to negatively affect fracture healing and are modifiable risk factors for poor outcomes following trauma. The prevalence of protein and vitamin D malnutrition in pediatric trauma patients is unknown. The purpose of this study was to determine the incidence of protein and vitamin D malnutrition in a pediatric trauma population and to identify physical or demographic characteristics that are risk factors for protein and vitamin D malnutrition.

Methods: Patients were prospectively enrolled at a Level 1 Pediatric Trauma Center from June 2011 through September 2012. Patients with a fracture requiring operative stabilization were invited to participate. Two hundred and thirty patients were eligible, 45 declined, leaving 185 enrolled patients. Demographic information including age, BMI, ethnicity and insurance class were collected at the time of enrollment. Serum was collected in the operating room at the time of surgery and analyzed for prealbumin and vitamin D levels. There was incomplete follow-up for 25 patients, leaving 160 patients (85%) included for analysis.

Results: The average age of the enrolled patients was 8.1 years (+/- 3.9 years). There were 96 males and 64 females. Average BMI was 19.3 (+/- 5.8). There were 102 (64%) Caucasian, 33 (21%) Hispanic, 20 (12.5%) African-American and 4 (2.5%) other patients. Sixty-four patients (40%) had private insurance and 92 (57.5%) had Medicaid. Four (2.5%) had no insurance. Sixteen (10%) patients were vitamin D deficient (<20ng/dL) and 86 (55%) were borderline (20-32ng/dL). Sixty-four (40%) patients had prealbumin levels below normal (<16mg/dL) and 67 (42%) patients had borderline levels (16-19mg/dL). There was a significant correlation between age, BMI and prealbumin, with the older and higher BMI patients having higher prealbumin levels. Neither age nor BMI had a significant relationship with vitamin D levels. However, race was a significant predictor of vitamin D levels, with the highest levels seen in Caucasians, followed by Hispanics and African-Americans. Insurance class did not significantly predict either prealbumin or vitamin D levels.

Conclusion: Protein and vitamin D malnutrition are common in pediatric patients presenting with acute fractures. Race is a predictor of vitamin D malnutrition, while age and BMI are predictors of protein malnutrition.

Significance: The surgeon caring for operative fractures in children should consider the nutritional status of the patient and if needed, recommend protein and vitamin D supplementation.

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Childhood Fracture Begets Childhood Fracture: A Population-based Study of Longitudinal Fracture Patterns in Ontario Children

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† LOE- Economic and Decision Level II

Purpose: To determine if the occurrence of a fracture in childhood is associated with an increased risk of having a future childhood fracture.

Methods: This was a population-based retrospective cohort study using Ontario health administrative data. All fractures among children aged 0 to 15 years presenting to any Ontario Emergency department were captured for the years 2003/04 through 2010/11. Children who experienced a fracture in 2003/2004 were assembled into 15 age cohorts and their 7 year follow-up fracture rates were compared to those of their peers who had not fractured in 2003/04. Associations between predictors and future fracture were assessed using Poisson and Cox proportional hazard regression. Analyses were stratified by age and adjusted for sex, rural vs. urban, head injury, and soft tissue injury diagnoses.

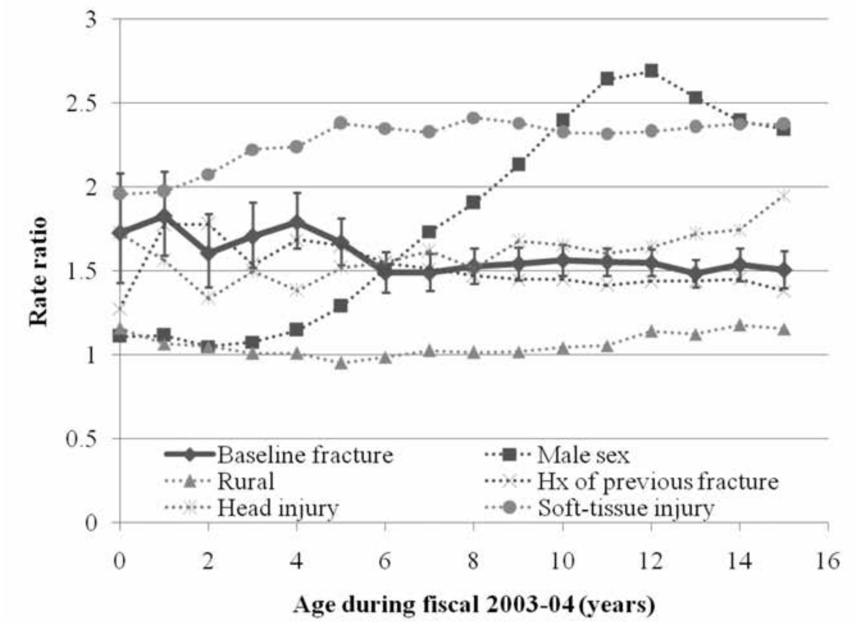

Figure: Multivariable Poisson regression of the 7-year fracture rate (2004-2005 to 2010-2011) by age during fiscal 2003-2004 (error bars represent 95%CIs)

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Results: During fiscal year 2003-2004 43,154 Ontario children experienced a fracture and 2,419,410 did not. (17.5 per 1000 child years). 23.0% of children with a baseline fracture suffered a fracture during the 7-year follow-up period compared to 11.3% of children with no baseline fracture. Children with a baseline fracture had a 60% higher rate (95%CI: 46 to 75%) of fracture during the 7-year follow-up period after adjustment for sex, rurality, and the occurrence of head injury and soft-tissue injury.

Conclusions: The occurrence of a baseline fracture is associated with a 60% increased rate of future fracture irrespective of age at time of baseline fracture.

Significance: Bone mass and strength is attained during childhood. Some children with fractures are not attaining their genetic potential for bone strength. Individual and population level interventions to improve bone quality in childhood may prevent childhood fractures and also fractures during older adult life.

Timing of Pavlik Harness Initiation: Can We Wait?

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Purpose: Developmental dysplasia of the hip (DDH) can be effectively treated with a Pavlik Harness (PH) within the first 6 months of life. It has been noted that over 80% of hips which are unstable in the newborn period will stabilize naturally by 2 months of age. Despite this, many advocate the initiation of PH treatment in the newborn nursery. The diagnosis and treatment of DDH is often a stressful adjustment for parents with a newborn and the appropriate use of a PH may hinder the formation of a strong parent/infant bond. If there is no difference in the effectiveness of initiating PH treatment at 1 week compared to 6 weeks of age, waiting may allow the hips to naturally stabilize and avoid treatment entirely. Meanwhile this will limit newborn period interventions and its social impact. The purpose of this study is to evaluate whether the timing of Pavlik Harness implementation affects its effectiveness in the treatment of DDH.

Methods: A retrospective review of medical records between 2004 and 2010 was completed. Patients were included if they were prescribed PH therapy for hip instability or dislocation. Baseline data included age at presentation, age at Pavlik Harness initiation, sex, bilaterality and operative procedures. PH failure was defined as requiring any operative procedures for definitive management of a congenital hip instability. Groups were divided and compared based on the age at which the PH was initiated – Group1=<18 days, Group 2= 30-60 days, Group 3=>60 days.

Results: A total of 178 children were included based on initiation of PH treatment at or before 6 months of age with 40 (22.4%) failing PH treatment. The mean age initiating PH was 1.3 months (SD=1.3) in the successfully treated children and 1.3 months (SD=1.2) in the failures (p=0.91). There was also no difference in the percentage of females (82% Success, 75% Failure, p=.335), or breech positioning (37% Success, 23% Failure, p=.135). Bilateral hip involvement approached significance (30% Success, 45% Failure, p=0.07).

There was no difference in the failure rates by age with Group 1=21% (17/81), Group 2= 22.5% (9/40) and Group 3=25% (11/33) (p=.88). In addition, there was no failure in PH treatment in 14 patients who presented with instability prior to 18 days of age, were observed for natural stabilization, and then ultimately needed PH treatment after one month of age.

Conclusion: Patients who had PH initiation before 18 days of age were no more or less likely to fail than when PH initiation was after 1 month of age. Early initiation does not correlate with decreased failure rates, suggesting there is no urgency to initiate PH treatment prior to 8 weeks of age.

† LOE – Level of Evidence – Please see page 14 for details.

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Significance: Parents can be counseled that waiting until after 4 weeks of age is appropriate prior to PH implementation. By avoiding swaddling during this period, the hips may stabilize without treatment. In addition, older, larger children may actually fit better into the harness. The parental-infant bond may form more completely prior to implementation of PH.

Abduction Bracing for Infants with Residual Acetabular Dysplasia: Practice Dogma or Effective Treatment?

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Purpose: Part-time abduction bracing is often used to treat residual acetabular dysplasia in infants whose acetabular indices (AI) exceed 30° after 6 months of age. However, little data exists to support this practice. The purpose of this study was to determine the efficacy of abduction bracing by comparing a cohort of braced infants with a cohort of un-braced infants.

Methods: We performed a retrospective review of a consecutive series of patients with developmental dysplasia of the hip (DDH) treated at our institution over a 4 year period. Children with stable, treated DDH but residual acetabular dysplasia (AI ≥ 30°) at 6 months of age were identified; those with available AP pelvic radiographs at approximately 6 months and 1 year of age were included. Patients who required surgical reduction and those with syndromic or neuromuscular diagnoses were excluded. Based on practice variations at our institution, some orthopedists start bracing when the 6 month radiograph shows AI ≥ 30° while others do not; we compared these two cohorts. Braced patients were instructed to wear a standard abduction orthosis during nights and naps until follow-up at 1 year of age. The AI at 6 months and 1 year of age for both cohorts were then measured by a single observer and the differences statistically compared.

Results: 70 hips in 48 patients were identified with residual dysplasia on the 6 month radiograph. 39 hips (27 patients) were un-braced and 31 hips (21 patients) were braced. The mean acetabular index at 6 months of age was 34.5° ± 2.6° in the un-braced cohort and 31.5° ± 2.1° in the braced cohort. Over the next 6 months, the braced cohort had significantly better improvement in the AI (5.3° ± 2.8°) compared to the un-braced cohort (1.1° ± 1.7°) [$p<0.001$]. 6 hips in 4 patients initially treated with observation had AIs that worsened and subsequently started treatment with abduction bracing at 9 months of age.

Conclusion: In this comparative analysis of infants with residual acetabular dysplasia treated with either abduction bracing or observation, part-time bracing significantly improved the acetabular index between 6 and 12 months of age.

Significance: Part-time use of an abduction orthosis is effective for improving residual acetabular dysplasia in infants with DDH.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Does Orientation of The Femoral Head Affect Acetabular Development? An Experimental Study in Lamb

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Purpose: Surgical treatment of developmental dysplasia of the hip or Legg-Calve-Perthes disease includes an alteration of the femoral neck-shaft angle or the femoral version. However, the existence of a deformity of the proximal femur among these diseases remains controversial. The purpose of this study is to investigate the effect of the femoral head orientation in acetabular development morphology.

Materials and Methods: A proximal femoral osteotomy was performed in 21 lambs aged three months: 5 varus osteotomies (110º), 4 valgus osteotomies (150º) and 12 derotation osteotomies (7 cases with 30º of augmented anteversion and 5 cases with 30º of decreased anteversion). There was a control group (5 animals). Osteotomy was fixed with a screw-plate device. Version was controlled intra-operatively with k-wires. Animals were sacrified 3 motnhs after the surgical procedure. A morphometric study of both proximal femur and acetabulum was performed, including deepness, volume and diameters of the acetabulum, neck-shaft angle and femoral version.

Results: The average neck-shaft angle for the normal, anteversion and retroversion groups was 129º, while it was 110º for the varus group and 149º for the valgus group. The average femoral version for the normal, valgus and varus groups was 21º of anteversion, while it was 38º of anteversion for the *anteversion* group and 17º of retroversion for the retroversion group. Nor the neck-shaft angle, nor the femoral version correlated with the acetabular antero-posterior diameter (p=0.698, p=0.6 respectively), the acetabular infero-superior diameter (p=0.083, p=0.451 respectively) or the acetabular deepness (p=0.14, p=0.371 respectively). The neck-shaft angle correlated significantly with acetabular volume (p=0.023), so that the lower the neck-shaft angle, the higher the acetabular volume (r=-0.453). The femoral version did not correlated with acetabular volume (p=0.381).

Conclusion: A varus femoral osteotomy provokes an increase in acetabular volume, while a valgus femoral osteotomy provokes the opposite. A change in the femoral version does not correlate with changes in the acetabular geometry.

Significance: The benefit of the varus femoral osteotomy in the treatment of DDH or LCPD could be caused by its influence on the acetabular volume and not because of the existence of any proximal femoral deformity.

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Hip Pathology in Relatives of Probands with Developmental Dyspalsia of the Hip

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† LOE-Prognostic Level II

Purpose: This study evaluated 121 people from 19 families known to have at least one member with surgically treated DDH. Each individual's functional outcome scores and pelvic radiographs were assessed for hip symptoms or pathology.

Method: Using the Utah Population Database and Shriners Hospital patient population, 19 families with high rates of DDH were identified. All family members (n=121) underwent physical examination, radiographic assessment, and completion of outcome instruments (AAOS Hip and Knee, Harris Hip score (HHS) and WOMAC). Radiographs were measured by 3 pediatric orthopaedic surgeons and a pediatric radiologist using Orthoview ® software.

Results: The 121 subjects ranged from 1 to 84 years old, 34 had orthopedically treated DDH. Of the remaining 87 supposedly normal subjects, 23 (26%) had 'silent' acetabular dysplasia as defined by Center Edge Angle (CEA) less than 20 and/or a Severin score of III or greater. Sixty percent of the 87 individuals were less than 30 years and 40% were older than 30. Five individuals of the 87 (6%) had radiographic evidence of femoral acetabular impingement (FAI). Outcomes comparisons were made between those hips that were radiographically abnormal (DDH, silent dysplasia, or FAI) and those that were radiographically normal. Outcome scores of the treated DDH patients (AAOS, HHS and WOMAC) were worse on the involved side regardless of age and for individuals over 30 years of age, these differences reached statistical significance for WOMAC and AAOS outcome tools (P<.05). Hips with radiographic evidence of FAI had slightly lower functional scores in all three measurements which were not statistically significant. There was no difference in the outcomes scores for FAI comparing individuals whose age was under 30 years to those over 30 but the numbers were very small. Over age 30 individuals with 'silent dysplasia' had statistically significant decreases in their AAOS Hip and Knee and WOMAC scores on the dysplastic side but their HHS scores were not significantly different.

Conclusion: Twenty six percent of first and second degree relatives of patients with DDH had unsuspected radiographic acetabular dysplasia in our study. After age 30, many of these patients developed symptoms. Six percent of these subjects also had radiographic evidence of FAI with mild functional symptoms.

Significance: In families with a significant history of DDH, radiographic screening of siblings of patients with DDH to define early dysplasia may be prudent.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

A Re-evaluation of Commonly Accepted Risk Factors for Developmental Dysplasia of the Hip: Preliminary Results of a Population Based Cohort Study

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Purpose: To determine risk factors for DDH using newly developed diagnostic criteria based on international consensus.

Methods: In this population-based cohort study, 9904 babies born at a secondary care unit (2010-2012) received a standardized examination (usually within 24 hours postpartum) in which we prospectively ascertained the presence of the common risk factors for DDH (breech, family history, etc). Infants exhibiting ≥1 factor were eligible and underwent ultrasound testing within 8 weeks. Alpha angles were measured by surgeon/radiologist in consensus and blinded to risk factors and age. Using multivariable methods we evaluated the association of the risk factors and ultrasonographic DDH using criteria based on international consensus.

Results: 1766 (18%) newborns exhibited ≥1 risk factor for DDH. Of these 1489 (84%) infants participated. To date, 1296 (87%) completed the ultrasound at a mean age of 8±3 weeks. Of the 1296, 55 (4%) patients exhibited alpha <55° and 43 (3%) exhibited alpha <50°. Of all risk factors, only female gender was associated with an alpha <55° (RR=2; 95% CI = 1.1, 3.5; p=.01). In contrast, abnormal clinical examination findings of the hip were strongly associated with DDH (p<.0001).

Conclusion: In a prospective study using robust case definitions, commonly known risk factors were not clinically important markers of DDH when DDH was defined by consensus criteria.

Significance: Given the generally poor and conflicting evidence on risk factors for DDH, our preliminary results suggest a new approach is needed in the risk prediction of DDH.

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Do Infant Risk Factors for DDH Predict Hip Dysplasia Presenting in Adolescents and Adults?

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† LOE-Diagnostic Level IV

Purpose: Hip dysplasia (DDH) is a common cause of hip osteoarthritis in the young adult population. Screening for hip dysplasia in the newborns has been recommended to decrease the operative rate for dysplasia in children. Selective ultrasound screening in newborn patients with risk factors for dysplasia has been recommended by the American Academy of Pediatrics. The purpose of this study is to review a consecutive series of skeletally mature patients with a diagnosis of hip dysplasia such that corrective osteotomy was recommended and determine the percentage of patients that had risk factors warranting screening for DDH had they been born in 2012.

Methods: We reviewed a consecutive series of skeletally mature patients from February 2011 to September 2012 with symptomatic DDH (lateral CE angle <24, anterior CE angle <24) where a periacetabular osteotomy was recommended or performed. At the time of initial consultation all patients completed a questionnaire regarding their neonatal risk factors for DDH: family history DDH, whether they were breech, and their birth order. They were excluded if they could not confirm their birth history and risk factors, had treatment for DDH as infants, or neuromuscular dysplasia.

Results: Fifty-one patients, all females, were identified. The average age was 26 years (13-47 years). Six patients (12%) were confirmed breech. A family history of DDH was present in 2 patients (4%). Therefore, current guidelines would have recommend ultrasound screening in 8/51patients (16%) of this cohort. There were 26 that were first born and a family history of hip pain or osteoarthritis was present in 15 (29%) of patients, but DDH was only confirmed in two. It is unclear whether those patients first born or family history of hip pain would have been screened since they were not breech and DDH was not confirmed.

Discussion: Hip dysplasia is a common cause of hip pain and osteoarthritis in the young adult population. In a consecutive series of skeletally mature hips with symptomatic hip DDH only 8/51 (16%) would be evaluated as infants by current screening recommendations with a stable hip exam. Therefore, DDH in this cohort would be undetected by current screening in 84% of these patients with symptomatic dysplasia at skeletal maturity.

Significance: Although current screening may decrease the operative treatment rate for infant dysplasia and hip instability, selective screening may have little impact on the incidence of DDH and surgical treatment in skeletally mature patients.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Long-Term Outcome of Gradual Reduction with Overhead Traction For Developmental Dysplasia of the Hip in Children Over Six Months of Age

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Purpose: In children over six months of age with developmental dysplasia of the hip (DDH), achieving a concentrically reduced hip while avoiding avascular necrosis (AVN) is challenging. Gradual reduction (GR) with traction is one of the treatment options for DDH but has insufficient evidence. The purpose of this study is to report the long-term outcome of GR with overhead traction (OHT).

Methods: We retrospectively reviewed 67 patients with DDH (75 hips) who underwent GR with OHT. The traction method consisted of three phases: horizontal traction, vertical traction in hip flexion with gradually increasing abduction, and above-knee traction in hip flexion and abduction with the knees moving freely. The age at reduction ranged from seven months to four years. All patients were followed up until skeletal maturity with a mean duration of 15.6 years. Pelvic radiographs were used to assess AVN, acetabular development, and Severin classification. We investigated the factors affecting the radiological outcome at skeletal maturity.

Results: Seventy-two hips (96%) were successfully reduced by GR with OHT alone, two required subsequent closed reduction, and one underwent open reduction. AVN occurred in two hips (2.7%). No redislocation occurred. Among 48 hips (64%) with residual acetabular dysplasia, 31 were treated with Salter innominate osteotomy (SIO) at preschool age. Finally, 62 hips (82.7%) showed satisfactory outcome (56 in Severin class I and six in class II), whereas 13 showed unsatisfactory outcome (class III). Although we found no significant factors affecting the final outcome, most of the hips treated with SIO were included in the satisfactory group.

Conclusion: GR with OHT combined with SIO showed a very favorable long-term outcome in patients over six months of age.

Significance: GR with OHT can achieve a truly atraumatic spontaneous reduction and minimize the risk of developing AVN in patients with DDH over six months of age.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Preoperative Traction Does Not Improve the Success of Closed Reduction or Limit AVN in Developmental Dysplasia of the Hip

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Purpose: Preoperative traction prior to closed reduction (CR) in DDH remains controversial and its success has not been specifically reported in a large patient cohort.

Methods: This is an IRB-approved retrospective study of all patients (age <3 years) treated with CR for idiopathic DDH from 1980-2009. Successful CR was defined as a hip which remained reduced and did not require repeat CR or open reduction (OR). Patients were grouped by age and rates of successful CR were compared between groups with significance set at p<0.05.

Results: 342 hips were included with mean age at the time of CR of 0.9 years (0.2-2.8 years) and mean follow-up of 10.4 years (2.0-27.7years). There were 269 hips with fixed dislocations and 73 Ortolani-positive hips. Preoperative traction was used in 276 hips for an average of 2.9 weeks (0.9-7.4) and 66 hips were treated without traction. There was no difference in traction utilization in the 3 age groups (<1 yr, <1.5 yrs, <2 yrs) for either Ortolani + hips (69% vs 65% vs 63%, p=.947) or fixed dislocations (92% vs 91% vs 88%, p=.943). Fixed dislocations were more likely to undergo traction (p<0.001). For all patients, there was no difference in achieving a successful CR comparing traction (60.9%) and no-traction groups (60.6%) (p=1.00). For Ortolani positive hips, traction did not improve the incidence of a successful CR for any age group: <1yr: 80% vs 61% (p= 0.19); <1.5yrs: 81% vs 65% (p=0.23); <2yrs: 82% vs 69% (p= 0.25). Similarly, fixed dislocation patients had no apparent benefit: <1yr: 59% vs 55% (p= 0.76); <1.5yrs: 60% vs 57% (p=0.82); <2yrs: 58% vs 55% (p= 0.85), 1-2yrs: 58% vs 59% (p=1.00); 1-1.5yrs: 65% vs 67% (p=1.00). Fixed dislocation patients had significantly lower rates of requiring further pelvic surgery when traction was used: <1yr: 19% vs 64% (p=0.002); <1.5yrs: 27% vs 57% (p=0.01); <2yrs: 29% vs 61% (p=0.001). There was no significant difference in the rate of AVN between the traction (19%) and no traction (10%) groups for all patients (p=.53).

Conclusions: Preoperative traction does not improve the chance of achieving a successful CR for all patients with a DDH. Traction had no protective effect on the incidence of AVN but may reduce the need for further pelvic osteotomies for fixed dislocation patients.

Significance: Preoperative traction does not improve the incidence of achieving a successful closed reduction in patients with DDH and does not appear to protect against avascular necrosis (AVN).

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Increased Self-reported Pain and Gait Dysfunction at 20 Years Post Hip Fusion as an Adolescent

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Purpose: Adolescents with severe hip arthrosis have few reconstructive options. Hip fusion (HF) provides reliable symptomatic relief but may result in contralateral joint pain and dysfunction. This study evaluates the long-term self-reported functional outcomes and gait analysis following hip fusion as an adolescent.

Methods: 17 patients returned at an average 21±10 years post HF (range, 7-38 yrs). Average age at time of HF was 14.2±2.2 years (range, 9.9-18.7years). Initial diagnoses included: SCFE (5), septic hip (4), traumatic dislocation (5), idiopathic chondrolysis (2), and Perthes disease (1). All completed self-reported health surveys, including the SF-12, Harris Hip Score (HHS, max 100), and a general hip outcome assessment. 3 patients subsequently underwent conversion to a total hip arthroplasty (THA), resulting in 14 HF subjects. Gait analysis included walking speed and gait deviation index (GDI).

Results: The overall average SF-12 Physical was 37.3±10.1 (50 max) and SF12 Mental was 43.9±10.8. The patients' self-reported current health: excellent (1), good (9), and fair with ongoing medical problems which require treatment (7). Pain was reported in 88% of the affected hips (9 moderate to extreme) and in 41% of unaffected hips. 88% of patients reported ipsilateral knee pain (9 moderate to extreme) with 35% experiencing it daily. 53% reported ipsilateral ankle pain and 41% reported contralateral ankle pain. All patients reported back pain: moderate (59%), severe (12%), extreme (29%) with 47% experiencing back pain daily. Pain relief following HF was fair to poor in 47% of patients. The HHS was greatly increased in the THA group (85.4±4.0) compared the HF group (53.5±20.7). Gait analysis demonstrated an average walking speed for the THA (n=3) group was 88±13% of normal vs. 73±11% of normal in the HF group (n=10). The THA group had a more normal gait pattern with a GDI of 72±16 vs. 59±8 in the HF group.

Conclusions: All patients at intermediate to long-term follow-up complained of back pain and the majority complained of significant knee, hip, and ankle pain. HF patients demonstrated significant gait dysfunction. The patients converted to a THA reported a higher function and demonstrated improved gait relative to the HF patients. Treatment with a THA at an earlier age without previous HF may increase the quality of life and prevent back and lower extremity complaints.

Significance: At an average 21 years follow-up, a decreased quality of life with increased pain and gait dysfunction is common in adult patients treated with a HF in adolescence.

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Comparing of Twist Test (A New Test for Hip Labral Pathology) to Arthroscopy

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Purpose: To describe and validate a new test for hip labral pathology, the Twist test.

Methods: Twist test was performed in functional weight-bearing position and consists of unilateral and bilateral standing phases. Between June 2009 and August 2010, in 371 patients the result of Twist test was compared with MR arthrogram (MRA) and arthroscopy as gold standard.

Results: Among 160 patients with positive twist test, 154 patients had positive MRA and 6 had negative MRA. Among 87 patients with negative twist test, 72 had positive MRA and 15 had negative MRA. In comparison with MRA, the sensitivity and specificity of twist test for labral injury were 68.14% and 71.5% respectively. Positive predictive value (PPV, precision) of twist test for diagnosis of labral lesion was 96.25% and the accuracy was 68.4%. Then the sensitivity of the Twist test was compared with arthroscopy results. Of the 110 patients underwent surgical intervention, 100% exhibited labral tears. Of those 110 patients with surgically confirmed labral tears, 80 of them exhibited a positive Twist test, resulting in a sensitivity of 72.7%.

Conclusions: This study shows that Twist Test can support clinical decision making when considering hip labral pathology as a differential diagnosis because of its high PPV (96.25%), so this test can be beneficial for ruling in labral pathology.

Significance: Twist test is the only clinical test for hip Labral pathology that is done in the functional standing position and is quick to perform, so it could be incorporated into a general sports physical screening examination.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

The Incidence of Femoroacetabular Impingement after an Innominate Osteotomy for Acetabular Dysplasia

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Purpose: To determine the incidence of clinically relevant femoroacetabular impingement (FAI) after an innominate osteotomy for the treatment of acetabular dysplasia, and determine risk factors for the development of FAI.

Methods: 154 hips (132 patients) who had undergone an innominate osteotomy for acetabular dysplasia were evaluated at a minimum follow-up of 10 years (mean = 12.2). Mean age at the time of surgery was 2.8 years, 114 hips had a concomitant open reduction, 54 hips also had femoral shortening. 108 hips had a Salter osteotomy and 46 had a Pemberton osteotomy. Radiographs were analyzed to determine the lateral center edge angle (CE angle), and the presence of a crossover sign. The diagnosis of FAI was established when the CE angle was greater than 40°, there was a positive crossover sign and the patient had groin pain when flexing the hip less than 90°. Statistical analysis was carried out with the Student T test, considering a p value less than 0.05 as statistically significant.

Results: The mean CE angle was 32°, 42 patients had a CE angle greater than 40° and the same 42 patients had a crossover sign, of these 42 patients only 18 had groin pain on flexion of the hip below 90°. According to our criteria 18 of 154 hips had FAI (incidence = 11.6%). Of the 18 patients with FAI 10 had undergone a Pemberton osteotomy and 8 a Salter osteotomy. The mean postoperative acetabular index after the osteotomy for the entire cohort was 25.3°, for the group with FAI it was 20.3° whereas for the group without FAI it was 26.8° (p=0.04). The mean Iowa Hip Score for the group with FAI was 84.6 whereas for those without FAI it was 92.7 (p=0.03).

Conclusion: FAI is not common after an innominate osteotomy for the treatment of acetabular dysplasia, however overcorrection is related to a higher incidence. When FAI is present it can affect the outcome.

Significance: Overcorrection should be avoided when performing an innominate osteotomy for the treatment of acetabular dysplasia as it can create iatrogenic FAI and have an adverse effect on outcome.

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Revision Hip Preservation Surgery following Treatment for Femoroacetabular Impingement

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Purpose: The purpose of this study was to analyze a consecutive series of adolescent patients undergoing revision hip preservation surgery (arthroscopy, periacetabular osteotomy, surgical hip dislocation) in a hip specialty center over a two year period and to describe the procedures required during revision, and therefore provide insight into the reasons for failure of the index procedure.

Methods: This study entailed a review of prospectively collected data in the institution's hip preservation registry of a consecutive series of 449 patients less than 21 years who had hip preservation surgery over a two-year period. Patients who had revision surgery over this 2-year period were analyzed. Demographic and radiographic data, and the procedures at revision were recorded. Pre-revision radiographic measurements were analyzed: alpha angle on CT to quantify cam lesion (>50°), lateral center edge angle (LCE) on plain radiograph to measure dysplasia (<24°), and femoral torsion on CT (<10° mild retroversion, >20° mild anteversion). Patients with a diagnosis of SCFE or Perthes disease were excluded.

Results: Revision surgeries comprised 37 hips of 449 total arthroscopic and open hip procedures in the same population during the two-year study period (6%). The average age at revision was 18.5 years (range 13.9- 20.9). Revision surgeries performed were arthroscopy (N=33), open surgical dislocation (N=2), and periacetabular osteotomy (PAO) (N=2). 35 hips had arthroscopy as the primary procedure while 2 had surgical hip dislocation. 2 of 4 hips undergoing open procedures at revision had more than one prior arthroscopy. 33 of 37 revisions (89.2%) addressed residual cam deformity; the average pre-revision alpha angle was 66.7° for males and 52.1° for females. 2 PAOs were performed to treat dysplasia. Two surgical dislocations included treatment for extra-articular impingement. The percentage of femoral anteversion was greater in the revision group. Revisions were statistically more common in females (p-value 0.047).

Discussion: A residual cam deformity was the most commonly treated pathology necessitating revision. Most surgeries were revisions of prior arthroscopies, but 89% could be treated arthroscopically, while 11% required open surgical management. The incidence of extra-articular impingement and dysplasia suggest these factors should be considered when determining the appropriate surgical procedure for revision patients. Female hips and those with mild anteversion should be treated with caution with arthroscopy.

Significance: This is a large consecutive series of open and arthroscopic adolescent hip preservation procedures that specifically looked at revision surgery. Unresected cam lesion is the most common reason for revision surgery.

† LOE – Level of Evidence – Please see page 14 for details.

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Early Dysplastic Acetabular Changes have a Prognostic Significance in Legg-Calvé-Perthes Disease

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Purpose: It is still unclear which impact early radiological changes of acetabulum have on the development of the hip in Legg-Calvé-Perthes Disease (LCPD).

The objective of this study was to clarify if there were any relation between early radiogical acetabular changes and a modified 3 group Stulbergs classification of the hip 5 years after diagnosis.

Methods: In a multicentre study, 425 LCPD patients were registered with radiographs taken at time of diagnosis, 1 year and 5 years follow-up. We included all patients with unilateral involvement, femoral head necrosis > 50%, age of diagnosis ≥ 6 years and adequate exposure of acetabular landmarks (n=122).

Changes in Sharp`s angle (SA), Acetabular depth-width ratio (ADR), lateral acetabular inclination (LAI) and the acetabular retroversion (Ischial-Spine-Sign, ISS) at time of diagnosis and 1 year were related to the modified 3 group Stulberg classifaction at 5 years follow-up.

Statistical analysis was performed with one-way ANOVA or chi-square test and a multivariable ordinal regression model was used to estimate odds ratio for worse outcome with selected clinical predictor variables.

Results: Changes in ADR at time of diagnosis showed a significant relation to the modified Stulberg classification at 5 years follow-up. High ADR values indicated a worse radiological outcome (flat femoral head) whereas low values indicated a better outcome (OR=1,012, p=0,016)

The same tendency could be observed for ADR values measured at 1 year follow-up in relation to the radiological outcome at 5 years. (OR=1,008, p=0,082)

Conclusions: Early dysplastic changes in the acetabulum indicate a better radiological outcome at 5 years follow-up. This may indicate that a wide and shallow acetabulum deforms the femoral head to a lesser degree.

Significance: The study shows that early changes in the acetabulum have a prognostic significance in LCPD.

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Combined Bernese Periacetabular Osteotomy (PAO) and Surgical Hip Joint Dislocation (SHD) for Correction of Symptomatic Perthes Complex Hip Joint Deformity

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Purpose: Following the occurrence of Perthes disease and an initial satisfactory functional outcome in late childhood, it is not uncommon for patients to subsequently experience the onset of problematic hip pain with functional limitations in late -adolescence/early adulthood, secondary to femoral acetabular impingement (FAI) and/or instability. Purpose of this study is to investigate the correction obtained and early clinical outcomes of a combined surgical hip dislocation (SHD) and a periacetabular osteotomy (PAO) in the treatment of symptomatic post Perthes hip joint deformity in older adolescent and young adult.

Methods: Sixteen consecutive skeletally mature patients (16 hips) with problematic post Perthes hip joint deformities were treated with a combined SHD and PAO. The average follow-up for these 16 patients was 33 months (range 22-52). All hips were analyzed retrospectively. All were treated with SHD, femoral head neck osteochondroplasty, trochanteric advancement and a PAO. Additionally, ten patients were treated with a relative neck lengthening, eleven with a labral resection/repair and/or chondroplasty. Radiographic correction was evaluated with established methods in clinical outcome/hip function measured with the Harris hip score (HHS).

Results: All periacetabular and trochanteric osteotomies healed. Radiographic correction was profound with average LCEA improvement was 22o, ACEA 23o and acetabular inclination (Tonnis angle) 11o. The trochanter was transferred distally an average of 11 mm. The clinical outcome to date has been encouraging; HHS increased from 62 pre-op to 90 at a mean 33 months of follow-up, indicating an average 26 points of improvement. Complication included one infection.

Conclusion: Combined SHD and PAO can achieve satisfactory correction of the post Perthes symptomatic hip joint deformity. Patients have noted a marked decrease in pain, increase in hip joint mobility and improvement in daily function. Combined SHD and PAO achieves correction of both the components of FAI and instability.

Significance: Comprehensive surgical correction of both symptomatic impingement and instability associated with long-standing Perthes hip joint deformity can be achieved with combined PAO and SHD. The very positive improvement noted by our patients strongly suggests that a comprehensive correction should be considered as the procedure of choice in attempting to provide lasting clinical improvement for the young patient with problematic post Perthes hip joint deformity.

† LOE – Level of Evidence – Please see page 14 for details.

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Slipped Capital Femoral Epiphysis Treated by Anterior Wedge Osteotomy without Hip Dislocation

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Purpose: The major risk of corrective procedures in slipped capital femoral epiphysis (SCFE) is femoral head osteonecrosis. Therefore, in situ fixation is often advocated, but residual deformity can lead to secondary osteoathritis. The goal of this study was to report the results of anterior wedge osteotomy, without hip dislocation, in the treatment of severe SCFE.

Methods: 30 children with severe (i.e slip angle > 45°) SCFE, stable or unstable, were prospectively included. All patients were treated by anterior wedge osteotomy, resection of the hump responsible for femoro-acetabular impingement, and screw fixation. The posterior periosteum was respected intraoperatively. MRI was performed preoperatively and at 3 months postoperative to assess femoral head perfusion. Weight bearing was allowed after three months. Clinical and radiological outcomes were evaluated, with a minimum 1-year follow-up.

Results: 27 patients had excellent clinical and radiographic outcomes, with normal MRI postoperatively and return to daily activities. No difference was found between stable and unstable hips. Mean operative time averaged 118 minutes. One patient (3.3%) with unstable SCFE developed osteonecrosis with poor outcome, but the lack of perfusion was already present on the preoperative MRI. Two cases of chondrolysis (6.6%) were reported, one at initial presentation and one during follow-up. No intraoperative complication was reported but one patient required early revision for loss of correction. Mean slip angle of the femoral head was reduced from 54° preoperatively to 5° at latest follow-up. The mean flexion and internal rotation postoperatively were 95° and 30° respectively, without significant difference with the contralateral hip. The foot progression angle was back to normal in all cases.

Conclusion: The anterior wedge osteotomy without hip dislocation allows the restoration of the proximal femoral anatomy, while reducing the risk of osteonecrosis. The complication rate from this procedure was very low, but longer follow-up is required.

Significance: Anterior wedge osteotomy without hip dislocation can be considered in SCFE with high slip angle.

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Team Training in Pediatric Orthopaedic Surgery via High Fidelity Simulation at the Point of Care: Proof of Concept

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Purpose: Medical simulation has become increasingly prominent in surgical specialties to teach teamwork, improve communication, and train participants in crisis resource management (CRM) principles. We sought to: (1) develop and implement a pilot curriculum utilizing *in situ*, high-fidelity simulation that teaches teamwork and CRM skills to pediatric orthopaedic operating room team and (2) determine whether participation could positively influence participants' understanding and comfort with CRM principles.

Methods: Three 5-hour courses were completed over a 6 month period. Nine participants were enlisted for each course including: 2 pediatric orthopaedic surgeons with one fellow, a pediatric anesthesiologist and fellow, 2 OR nurses, an anesthesia technician, and an OR assistant. Each video-taped course included a didactic session on CRM and adult learning principles, followed by three simulation scenarios (one in a simulated emergency room and two in a main hospital operating room suite). Scenarios utilized a high-fidelity training mannequin to allow performance of nearly all procedures required to treat a patient in an emergency setting. Clinical changes were made in real time that required team modifications of care urgently. Scenarios were followed by standard simulation debriefing. Pre- and post-course evaluations were completed by each participant that surveyed their impressions regarding course organization, realism, debriefing, and relevance to current and future practice.

Results: Twenty-seven participants completed this pilot program between June and December 2011. Utilization of a main OR suite achieved a sense of reality for all participants. Simulations allowed use of equipment and interaction with team members typical in their daily work. Participant responses were wholly positive rating average 4.66 out of 5, with 5 = strongly agree. They stated that the training received would be helpful in their own practice and specifically, the additional training in closed-loop communication and the ability to debrief following the stress-inducing case scenarios was 'outstanding'. Moreover, all felt that regular training through simulation should be mandated.

Conclusion: We developed a pediatric orthopaedic CRM training program utilizing high-fidelity trainers carried out in our main operating rooms that provided a realistic environment for participants to test their skills in CRM principles. Further work is necessary to determine whether participation in this program will yield an objective improvement in team functioning and outcomes during actual surgical crises.

Significance: Surgical simulation is a new priority for both the AAOS and POSNA for future trainees and potentially surgeon re-certification. This is the first published program of its type for pediatric orthopaedic simulation.

† LOE – Level of Evidence – Please see page 14 for details.

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Do Patient Safety Checklists Improve Patient Safety?

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Purpose: Patient safety checklists have been designed to prevent complications, reduce medical errors and reduce practice variation. A checklist was developed at our institution from the AAOS evidence based Clinical Practice Guidelines (CPG) for pediatric distal humerus supracondylar fractures. The goal of this study was to evaluate compliance in completing the checklist by resident and attending surgeons in an academic center, to asses occurrence of medical errors and practice variation, and to assess compliance with the practice guidelines.

Methods: Prospective data was collected from the three patient safety checklists (pre-op, post-op and discharge) embedded in our electronic medical record from August 2011 thru August 2012 for all operative supracondylar humerus fracture. Analysis included resident and attending compliance with completing the checklists; agreement of resident and attending physical examinations; compliance with the CPG regarding fracture treatment; and occurrence of medical errors and variation in treatment.

Results: During the collection period, 142 supracondylar humerus fractures were treated at our institution by 9 pediatric orthopedic surgeons for a total of 398 activated checklists. Compliance rate for checklist activation by residents was 94%. Compliance rate for attending attestation of resident activated checklist was 90%. There was 2.3% disagreement rate between the attending and the resident pre and post-operative patient evaluations including imaging and physical examination. There were 2 potential errors averted because the checklist was used including a potential vascular injury and a fracture requiring treatment. There was variation from the CPG recommendation to use 2 to 3 lateral pins for fixation in 20 (14%) of our patients with a combination of either medial and lateral pins or 4 lateral pins utilized. The primary reason for the divergence from the recommendations was fracture instability.

Conclusion: A patient safety checklists for supracondylar fractures is a viable tool with excellent compliance rates amongst our residents and surgeons. We were able to identify problems such as missed neurologic injuries and potential vascular injury. There continues to be variation of treatment of supracondylar humerus fractures in the face of the CPG.

Significance: Patient safety checklists can be reliably used to help improve patient care and to follow treatment variations.

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Comprehensive Program Aligning Structure, Processes and the Electronic Medical Record Improves Quality and Safety of Complex Spinal Deformity Surgery in Children

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Purpose: To investigate results of a comprehensive program implemented to improve surgical outcomes and reduce re-admission rates after complex pediatric spinal deformity surgery.

Introduction: Pediatric spinal deformity surgery is being performed on an increasingly medically complex patient population. Unplanned readmission rates, infections and other complications can influence patient/family satisfaction, surgical outcomes and perhaps reimbursement under upcoming health care laws.

Methods: A comprehensive program aligning structure, process and the electronic medical record (EMR) was implemented in 2011 for all scoliosis patients at our institution. This involved multiple facets including: presurgical assessment by a specialized pediatrician at least 2 months prior to surgery, a second assessment by anesthesia prior to surgery, medication reconciliation, proper documentation of preoperative antibiotic administration and timing, modified WHO checklist, critical care pathways and a formalized discharge process requiring medication reconciliation, discharge and follow up appointment instructions and nursing follow up calls within 48 hours.

Results: 272 children underwent spinal deformity surgery from 2011 to June 2012 for AIS, neuromuscular, syndromic or congenital scoliosis with significant medical co-morbidities. There were no unplanned readmissions within 30 days during the study period of a full year after implementation. There was a significant decrease in infection rates (3.75% vs. 2.75%), length of stay and reoperation rates to better-than-benchmark rates. Antibiotic administration and documentation at least 30 minutes prior to incision improved from 72% to 98%. Medicine reconciliation rates improved from 71% to 80% preoperatively and to 100% at the time of surgery. Nursing follow-up calls within 48 hours of discharge improved from 50% to 91%.

Discussion: A comprehensive program to improve outcomes in a complex pediatric spinal deformity practice, utilizing the EMR in a meaningful way, resulted in zero unplanned admissions, reduced infection rates and length of stay with better patient satisfaction.

Significance: Meaningful use documentation on the chart to inform other practioners of risks and the system and processes implemented have resulted in significantly improved outcomes without additional expense or personnel.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Outcomes in Pediatric Orthopaedic Surgery: Analysis of the 2010-2011 American College of Surgeons National Surgical Quality Improvement Program-Pediatric Data

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† LOE-Prognostic Level II

Purpose: The American College of Surgeons National Surgical Quality Improvement Program Pediatric (ACS NSQIP-P) is a multi-institutional, multi-specialty program designed to measure outcomes in children's surgical care to facilitate quality improvement efforts. The purpose of this study is to summarize the initial data in this program related to pediatric orthopedic surgical care.

Methods: Using the 2010 and 2011 ACS NSQIP-P data reports, we analyzed the pediatric orthopedic cases and reviewed the specific variables and outcomes as collected by the ACS NSQIP-P. The number of procedures, overall mortality rate and frequency of postoperative occurrences were reported.

Results: In 2010, there were a total of 37,141 pediatric patients from 29 hospitals and 46,281 patients from 43 hospitals in 2011. In 2010, there were a total of 6,484 pediatric orthopaedic patients representing 17.5% of the total cases and 7547 (16.3%) in 2011. In both data sets, 3 procedures were among the 25 most common overall procedures reported: removal of a deep implant, posterior arthrodesis for spinal deformity 7-12 vertebral segments, and posterior arthrodesis for spinal deformity 13 or more vertebral segments. The most common pre-existing conditions were neuromuscular disorders (14%) and cerebral palsy (12%). The overall mortality rate in 2010 was 0.03% and in 2011 was 0.09%. The postoperative occurrence rate in 2010 was 12.3% and in 2011 was 5.47%. The annual surgical site infection rate was 1.56% in 2010 and 1.45% in 2011.

Conclusions: Pediatric Orthopedic surgery patients comprise a significant population in the surgical care of children. Overall mortality and morbidity rates in these patients are very low and equivalent to outcomes in our children's surgical specialties.

Significance: This report represents the first analysis of prospectively collected multi-institutional outcomes data for pediatric orthopedic surgery in ACS NSQIP-P. With the refinement of outcome variables, the use of procedural groupings, and risk-adjusted statistical modeling, the ACS NSQIP-P will serve as a multi-institutional effort to address surgical quality improvement in the pediatric orthopedic population.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

"Pop Quiz" of Orthopaedic Residents Performing Tasks that are Typically Performed in an Unsupervised Setting

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Purpose: Many patient care tasks are routinely performed by orthopaedic residents while not being directly supervised by attending physicians. It is thought that most of these tasks have been taught to the residents during interaction with attending physicians, interaction with more senior residents, or formal teaching sessions. However, it is unknown if the residents are performing these tasks in an acceptable manner. The purpose of this study was to formally evaluate 3 pediatric orthopaedic procedures commonly performed without attending supervision to assess the ability of the resident to perform the task in an acceptable manner.

Methods: All orthopaedic residents (n=20) were excused from clinical activity one morning and asked to complete 3 procedures (placement of a short arm cast, aspiration of a knee joint, and compartment pressure checks of a leg) under direct attending supervision. A checklist for each procedure had been made indicating the appropriate steps that should be performed as well as criteria to assess the final product. Scores were derived from these checklists and means and standard deviations were calculated. Change in score by PGY level was determined by simple linear regression.

Results: The mean score for short arm cast application was 6.15 out of a total possible score of 9, with an average 1.07 increase per year of training ($p<0.001$). Uneven cast padding application and a lack of full thumb motion were the most common reasons for losing points. Knee joint aspiration had an average score of 6.15 out of 7 with an average increase of 0.33 per year in training ($p=0.046$). A lack of having equipment prepared and donning gloves sterilely were the most common reasons for losing points. Measure of leg compartment pressures had an average score of 9.68 out of 12 with an average increase of 0.47 per increasing year of training ($p=0.087$). Injecting an inappropriate amount of fluid and not recording measurements were the most common reasons for losing points.

Conclusions: The ability of a resident to appropriately perform certain tasks without direct supervision improves with advancing level of training. Junior residents may not appropriately be placing short arm casts, aspirating knee joints, or checking compartment pressures of the leg.

Significance: Formal education and direct supervision of junior residents performing all tasks may be required until it is directly observed that the individual can appropriately perform the task without direct supervision.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Antimicrobial Prophylaxis and Rates of Surgical Site Infection in Children

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† LOE-Therapeutic Level III

Purpose: Surgical site infections (SSI) are a major cause of post-operative morbidity and mortality. Despite numerous studies in adults, the benefit of antimicrobial prophylaxis (AP) in preventing SSI after most procedures in children is unknown.

Methods: Multi-faceted interventions were implemented over a 5-year period to improve adherence with evidence-based AP guidelines. All cardiovascular, neurosurgical, orthopaedic, general surgery, otolaryngologic, plastic surgery, and urologic procedures performed over a 15-month period (April 2009-June 2010) were reviewed. Cases with pre-existing infection, or that involved the oral cavity, endoscopes, or foreign body removal, were excluded. A total of 8588 procedures were analyzed, and AP indication, antibiotic administration, and timing were recorded for each procedure. Compliance was defined as antibiotics given when indicated and within 60 minutes prior to incision. Subsequent development of SSI was documented using the Center for Disease Control criteria and the International Classification of Diseases, Tenth Revision (ICD-10-CA) diagnosis coding. Separate logistic regression analyses, when prophylaxis was and was not indicated, evaluated the following potential factors: guideline compliance, wound classification, inpatient or outpatient status, and surgical subspecialty.

Results: Of 4676 patients for whom antibiotics were indicated, 3361 (71.9%) were compliant with the guidelines and 115 (3.4%) developed SSIs. Of the 1315 (28.1%) non-compliant cases, 91 (6.9%) developed SSIs ($p<0.001$; OR 0.48, 95% CI 0.36-0.63). Of 3912 patients for whom AP was not indicated, 793 (20.3%) received antibiotics and 35 (4.4%) developed SSIs. Of the 3119 (79.7%) patients for whom AP was not indicated and did not receive antibiotics, 98 (3.1%) developed SSIs ($p=0.079$, OR 0.70, 95% CI 0.47-1.04). Multi-variable analyses demonstrated in cases where antibiotics were indicated, the following factors were associated with lower risk of SSI: compliance with AP guidelines (OR 0.54, 95% CI 0.40-0.72), and clean (OR 0.20, 95% CI 0.06-0.63) or clean-contaminated wound (OR 0.29, 95% CI 0.09-0.93). In surgeries where AP was not indicated, the following factors were associated with lower risk of SSI: outpatient status (OR 0.31, 95% CI 0.18-0.52) and clean (OR 0.13, 95% CI 0.03-0.48) or clean-contaminated wound (OR 0.20, 95% CI 0.05-0.75).

Conclusion: For procedures with AP indications, appropriate compliance with antimicrobial prophylaxis in the paediatric surgical patient is associated with almost 50% decreased likelihood of developing SSI.

Significance: Compliance with AP guidelines has the potential to significantly decrease surgical morbidity, mortality, and healthcare costs in children. Efforts should focus on comprehensive implementation of AP guidelines.

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♦Early Onset Scoliosis Treated with Growing Rods has more Spinal Growth, Better Cobb Correction, but more than Twice the Number of Surgeries Compared to Shilla

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† LOE-Therapeutic Level III

Purpose: The purpose of this study is to compare treatment of early onset scoliosis with Shilla versus dual growing rods.

Methods: A multi-center retrospective review of patients with early onset scoliosis treated with an index surgery of Shilla instrumentation or dual spine-spine growing rods (GR) from 1995-2009 was performed. Radiographic outcomes and complications were recorded. 37 Shilla patients were matched with 37 GR patients from the Growing Spine Study Group database by age at index surgery (±1 year), preoperative Cobb angle (±15°), and diagnosis (neuromuscular, congenital, idiopathic, syndromic).

Results: Comparing pre-operative to latest follow-up (mean > 4yrs) change in average Cobb angle was from 72 to 37degrees in the GR group versus 69 to 45degrees in the Shilla group (p=0.019). T1-S1 length increased 8.5cm in patients treated with GR compared to 6.4cm in Shilla patients (p=0.031). The Shilla group had significantly fewer surgeries (2.8 procedures/patient) than the GR group (7.0 procedures/patient) (p<0.001) but had a higher rate of unplanned surgeries for implant complications (Shilla = 1.4 surgeries/patient, GR = 0.6 surgeries/patient; p = 0.016). When revisions for implant complications done at the time of scheduled lengthenings were included, the two groups did not differ significantly in number of procedures for implant complications (p = 0.2395). Average follow up did not differ significantly between groups (GR=4.1 yrs, Shilla=4.6 yrs; p=0.148). The overall complication rate did not differ significantly between groups (p = 0.7145).

Conclusion: The GR group had a significantly greater improvement in Cobb angle and a greater increase in T1-S1 length than Shilla. GR patients had more surgeries, but Shilla patients had more unplanned procedures. The rate of complications overall did not differ significantly between the two groups.

Significance: This study suggests that although Cobb angle correction and T1-S1 growth are superior in patients treated with dual GR, GR patients undergo more procedures compared to Shilla patients.

	Growing Rod	Shilla	P- value
Average change in T1-S1	**8.5 cm**	6.4 cm	0.031
Average change in cobb angle	**-36 degrees**	-23 degrees	0.019
Total # of surgeries per patient	7.0	**2.8**	<0.001

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

♦ A Comparison of SHILLA™ GROWTH GUIDANCE SYSTEM and Growing Rods in the Treatment of Spinal Deformity in Children Less than 10 Years of Age

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† LOE-Therapeutic Level III

Purpose: The purpose of this study was to compare the outcomes of the SHILLA™ GROWTH GUIDANCE SYSTEM (SGGS) and growing rods (GR) in the treatment of children (<10 years of age) with progressive spinal deformity.

Methods: This was a multi-center retrospective study of the SGGS used as an alternative treatment to GR to support an HDE submission for FDA approval. Inclusion criteria were progressive scoliosis in a patient less than 10 years of age at index procedure. The study population consisted of 19 SHILLA™ and 6 GR patients whose mean age was 6.1y and 5.8y, respectively. Group demographics were similar between the two groups.

Results: Mean operative time for the index procedures: SHILLA™5.2 hrs, GR 4.4 hrs. Mean intraoperative EBL: SHILLA™ 389cc, GR 235cc. Mean hospital stay: 5.1 days SHILLA™, 6.7 GR days. The initial major curve magnitude was 70.3 deg. for SHILLA™ and 68.3 deg. for GR, which decreased postoperatively to 22.4 deg. (66.9% improvement) and 32.2 deg. (59.7% improvement). During the first four years the correction for SHILLA™ varied from 40.5% to 53.4% and for GR from 40.9% to 56.9%. Preop T1-S2 length was 28.7 cm for SHILLA™ and 29.0 cm for GR. At last f/u T1-S2 length was 32.9 cm for SHILLA™ (4.2 increase) and 34.0 cm (5.0 cm increase) for GR. Average growth per month from T1-S2: SHILLA™ 0.14 cm, GR 0.11 cm. Sagittal T2-T12 preoperatively was 36.3 deg. for SHILLA™ and 30.0 deg. for GR. At 3 yr f/u SHILLA™ was 51.0 deg. (14.7 deg. increase) and GR 35.5 deg. (5.5 deg. increase). Sagittal T12-S1 preoperatively was -44.6 deg. for SHILLA™ and -55.0 deg. for GR. At 3 yr f/u SHILLA™ was -57.0 deg. (12.4 deg. increase) and GR 52.0 deg. (3.0 deg. decrease). There were 29 reoperations in 12 of the 19 SHILLA™ patients (63.2%) and 43 reoperations in all 6 of the GR patients (100%) related to the index procedure.

Conclusion: The SHILLA™ GROWTH GUIDANCE SYSTEM compares favorably with traditional GR constructs in terms of correction of the major curve, spinal length and growth, and maintenance of sagittal alignment. The greater than four-fold decrease in additional surgeries makes the SGGS an attractive alternative to minimize comorbidities associated with additional surgeries.

Significance: The SHILLA™ GROWTH GUIDANCE SYSTEM compares favorably with traditional GR constructs in terms of correction of the major curve, spinal length and growth, and maintenance of sagittal alignment.

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♦ Five to Sixteen-Year Results of 201 Growing Rod Patients: Is There a Difference between Etiologies?

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† LOE-Prognostic Level IV

Purpose: A novel classification of Early-Onset Scoliosis (C-EOS) has identified the etiology as a core component of this classification. The purpose of this study was to compare long-term results of GR treatment between etiologies in a large cohort of patients.

Materials and Methods: Out of 574 GR patients from a multicenter database, 201 patients had minimum 5-year follow-up (F/U) and data available for analysis. Etiologic diagnoses were grouped into four categories: Congenital/Structural (C), Neuromuscular (M), Syndromic (S) and Idiopathic (I) based on C-EOS. Latest F/U is the most recent F/U prior to final fusion (FF). T1-S1 gain ratio is gain in T1-S1 (mm) from post-index GR surgery to latest F/U divided by total T1-S1 gain from pre-index to latest F/U. Annual T1-S1 gain is total T1-S1 gain divided by length of F/U. T1-S1 gain and Cobb correction were compared between patients with (FF+) and without (FF-) final fusion.

Results: There were 47 (24%) C patients, 49 (24%) M patients, 62 (31%) S patients, and 43 (21%) I patients. A summary of results is shown in Table 1.

	C	M	S	I
Age at Pre-Index Surgery (years)	4.7	6.1	4.9	5.8
Mean Length of F/U (years)	7.0	7.2	7.0	7.2
Mean # of Lengthenings	5.1	4.6	6.2	5.0
Mean # of Revisions	3.1	2.6	2.1	1.4
Cobb Correction: Pre- to Post-Index	33%	46%	47%	47%
Cobb Corection: Post-Index to Latest F/U	-29%	-17%	-26%	5.40%
T1-S1 Gain: Pre- to Post-Index	29 mm	45 mm	38 mm	38 mm
T1-S1 Gain Ratio	68%	48%	60%	57%
Annual T1-S1 Gain	12.8 mm	12.6 mm	13.9 mm	12.7 mm

	C		M		S		I	
	FF-	*FF+*	*FF-*	*FF+*	*FF-*	*FF+*	*FF-*	*FF+*
Total Cobb Correction	27%	20%	38%	39%	51%	28%	56%	41%
Total T1-S1 Gain	90 mm	76 mm	91 mm	86 mm	100 mm	82 mm	99 mm	98 mm

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Conclusion: Across all etiologies the majority of Cobb correction was achieved at initial GR surgery. Non-idiopathic etiologies lost up to 30% of their initial correction at the latest F/U and did not regain it at final fusion. C patients had the lowest initial Cobb correction and the highest correction loss at latest F/U. M patients had the highest initial T1-S1 gain at index GR surgery while they had the lowest final T1-S1 gain ratio. There was comparable annual T1-S1 gain across all etiologies with S patients having the highest annual T1-S1 gain.

Significance: Despite different outcomes of GR treatment between etiologies, some general trends are observed which may give the patients and treating physician clues about final prognosis. Regardless of etiology, the GR has resulted in expected annual T1-S1 gain in all patients.

Incidence and Risk Factors for Surgical Site Infection in Neuromuscular Scoliosis: A 30 Year Experience at a Single Institution

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† LOE-Prognostic Level II

Purpose: Surgical site infection (SSI) is a serious complication of spinal fusion more frequent in neuromuscular scoliosis, with reported incidence of deep infection of 4.3-19.2%. The purpose of this study is to determine the incidence of deep infection after spinal fusion for neuromuscular scoliosis at a single institution and identify patient- and treatment-related risk factors.

Methods: Retrospective review was performed of children who underwent posterior spinal fusion with instrumentation (PSFI) for neuromuscular scoliosis from 1980 to 2009. Multivariate statistical analysis was performed, and relative risk (RR) for SSI was calculated for significant variables ($P<0.05$).

Results: 451 consecutive children underwent PSFI for neuromuscular scoliosis. Average age was 13.2 years and preoperative curve magnitude 75.5 degrees. Deep infections occurred in 10.0% (45/451); nearly half (43%) involved Gram-negative organisms, and 40% were polymicrobial. Infection rates were higher in the 1980s (17.6%) than in the 1990s (7.3%) or 2000s (9.0%) ($P=0.04$). SSI was more frequent in myelodysplasia (20.3%) than other diagnoses (cerebral palsy 8.3%, muscular dystrophy 9.4%, spinal muscular atrophy 10.0%, syndromic/chromosomal 0.0%, other 9.7%) ($P=0.02$). The other significant patient-related factor was lack of bladder/bowel control (RR 1.9, $P=0.03$). Ambulatory status, curve magnitude, ASA level, BMI, hemoglobin, albumin, lymphocyte count, and zinc levels were not significant. Treatment-related factors associated with SSI were combined anterior-posterior approach (RR 1.8, $P=0.05$), fixation to pelvis (RR 2.3, $P=0.01$), number of levels fused (RR 1.25 per level, $P=0.0005$), and prophylactic antibiotic regimen (RR 1.8 for multiple/alternative agents vs. single cephalosporin alone, $P=0.04$). On logistic regression, decade of surgery ($P=0.001$) and levels fused ($P=0.03$) remained significant. The following treatment-related factors were not significant: type of construct (wires vs. hooks/screws), rod size, implant material (stainless steel vs. titanium), total fixation points, curve correction, allograft, iliac crest autograft, blood loss, surgical time, intraoperative temperature, anti-fibrinolytic use, intraoperative blood salvage, blood transfused, skin preparation, timing and dosage of preoperative antibiotics, intraoperative antibiotic redosing, duration of postoperative antibiotics, drain use, drain output, and timing of dressing change.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Conclusion: Patient-related risk factors for SSI after PSFI for neuromuscular scoliosis include diagnosis of myelodysplasia and lack of bladder/bowel control. Treatment-related risk factors include combined anterior-posterior approach, fixation to pelvis, number of levels fused, and prophylactic antibiotic regimen.

Significance: Incidence of SSI after PSFI for neuromuscular scoliosis has decreased over time but remains relatively high. This study identified risk factors which can be modified in the treatment of this challenging patient population.

Thromboembolic Complications in Children with Spinal Fusion Surgery

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† LOE-Prognostic Level II

Purpose: The incidence of venous thromboembolic complications (VTE): deep venous thrombosis (DVT) and pulmonary embolism (PE) after pediatric spinal fusion surgery is unknown. The aim of this study is to report the incidence of DVT and PE after pediatric spinal fusion surgery and to analyze the association with patient characteristics, in order to formulate preventive recommendations.

Methods: Using the Nationwide Inpatient Sample database, we identified children ≤18 years from 2000 through 2008, who developed DVT or PE after pediatric spinal fusion. Chi-square and linear regression tests were used to analyze the effect of discrete and continuous variables on DVT and PE rates. Significance was set at $P<0.05$.

Results: From 2000 through 2008, 174 (0.19%) patients developed VTE after spinal fusion surgery: 0.16% developed DVT and 0.05% developed PE. There was no significant increase in VTE incidence over the study period ($p= 0.8$).

Mean age at development of VTE was 15.3 years (range: 9 to 18 years). From 10 to 18 years, the odds of developing VTE increased 1.3-fold for each additional year of age ($p<0.01$). Male patients had a 1.7-fold rate of development of VTE compared to female patients ($P<0.01$). Caucasian children were 1.8-fold more likely to develop VTE compared to African American children (0.21% vs. 0.12% respectively, $p<0.05$). There was no significant difference in VTE development between patients who underwent ASF vs. PSF ($p=0.3$).

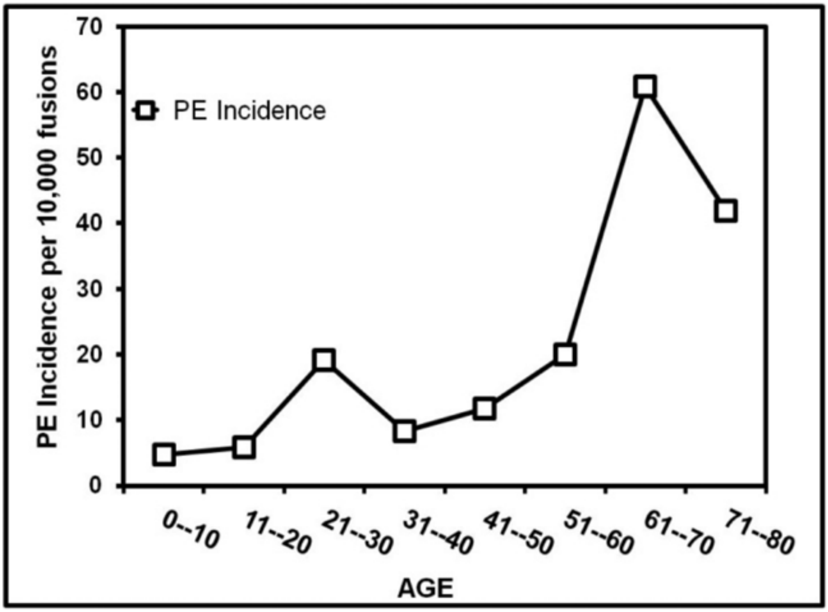
There was a significant difference in rate of development of VTE by patient diagnosis ($p<0.01$): 1.16% in patients with thoracolumbar vertebral fractures, 0.15% with congenital scoliosis, 0.1% with spondylolisthesis, and 0.07% with AIS.

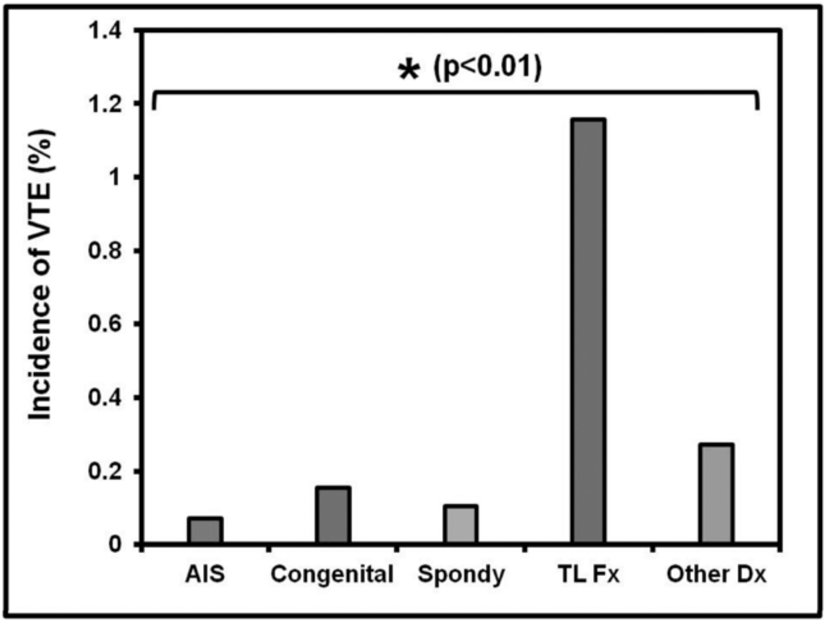
Conclusions: The incidence of developing thromboembolic complications after pediatric spinal fusion surgery is about 0.19%; higher rates are associated with older age in adolescence, male gender, and thoracolumbar vertebral fractures. Incidence of PE after routine spinal fusion in patients with AIS is 3.5 per 10,000 operations.

Significance: The incidence of developing thromboembolic complications after pediatric spinal fusion surgery is about 0.19%, and varies with patient age, gender and diagnosis. Incidence of PE after routine spinal fusion in patients with AIS is 3.5 per 10,000 operations.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.





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♦ Complications in Pediatric Cervical Spine Surgery Using Modern Instrumentation

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† LOE-Therapeutic Level IV

Purpose: To determine the complications associated with modern cervical spinal instrumentation in pediatric cervical spine surgery.

Methods: A retrospective radiographic and chart review of pediatric patients who were treated with modern cervical spine instrumentation between 2002 and 2010. Demographic, clinical, and radiologic data collection was done. Complications related to spinal instrumentation were recorded.

Results: 66 patients underwent a cervical spine operation with modern segmental instrumentation. The mean age of the patients was 10 years of age (3 to 17). The diagnoses were: 16 instability, 14 fracture, 10 tumor, 10 deformity, 9 congenital, and 7 os odontoideum. 48 patients underwent a posterior procedure, 14 a circumferential procedure, and 4 an anterior procedure. All were treated with modern screw and/or plate fixation, 18 patients had occipital plates with screw fixation. The mean number of levels fused was 4 (2 to 7). 51 patients with 204 screws were evaluated with CT scan. The mean length of follow-up in this series was 35 months (13 to 102). There were no intraoperative complications related to screws or plates and no post-operative implant failures. There were no screw related neurologic, vertebral artery, or dural injuries. There was one intraoperative vertebral artery injuries unrelated to screw placement. One patient with Down syndrome and severe upper cervical deformity had a vertebral artery injury during dissection which was controlled intraoperatively and underwent subsequent instrumentation and fusion without difficulty. There was one deep infection in a patient with post-radiation kyphosis requiring debridement and intravenous antibiotics and one superficial infection in a patient with Down Syndrome requiring local wound care. One patient with Down syndrome had an unrecognized dural leak requiring return to the operating room and one patient with Down syndrome required return to operating room for a sterile BMP-induced seroma. Two patients with Down syndrome required return to the operating room for repeat bone grafting after graft resorption without implant failure or loosening, both subsequently fused. One patient with Gorham's disease had a pseudarthrosis requiring revision with circumferential surgery and ultimately healed without further sequelae. Analysis of CT scans revealed no medial or lateral breeches with complete containment of all screws. Statistical analysis revealed the presence of a complication was most likely related to the diagnosis of Down syndrome. Age, number of screws, location of surgery, type of implants used, and length of fusion did not correlate to the occurrence of a complication.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Conclusion: Pediatric cervical spine surgery using modern screw and/or plate fixation is associated with a low complication rate. There were no direct screw/implant related complications in this series. Cervical spine surgery in Down syndrome remains a challenging problem despite the rigid benefits of screw fixation.

Significance: This is the largest reported series of modern instrumentation techniques in pediatric cervical spine surgery and the first reported series looking at associated complications. Modern instrumentation techniques should be employed by pediatric orthopedic spine surgeons. The complications seen in this series are commensurate with the associated difficult problems encountered in this population.

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Serum Metal Levels Implication in Stainless Steel Spinal Posterior Instrumentations Corrosion: Before and After Removal Study

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† LOE-Diagnostic Level III

Purpose: To study the behaviour of serum metal levels in the diagnosis of stainless steel spinal posterior instrumentations corrosion and after instrumentation removal.

Material and methods: Eleven asymptomatic patients, with radiological signs of corrosion of their stainless steel spinal instrumentations, were studied by performing determinations of nickel and chromium in serum and urine. Those levels were compared to the levels of 22 patients with the same kind of instrumentation but without evidence of corrosion and to a control group of 22 volunteers without any metallic implants. We measured the serum metal levels in a group of patients, whose spinal implants were removed due to corrosion. The Friedman test has been used for statistical analysis.

Results: Statistical analysis of our results revealed that the patients with spinal implants without radiological signs of corrosion have increased levels of chromium in serum and urine ($p<0.001$) compared to volunteers without implants. Corrosion significantly raised metal levels, including nickel and chromium in serum and urine when compared to patients with no radiological signs of corrosion and to volunteers without metallic implants ($p<0.001$). Metal levels measured in serum have high sensibility and specificity (area under the ROC curve of 0,981). By combining the levels of nickel and chromium in serum we were able to identify all the cases of corrosion in our series of patients. Nine patients accepted undergoing spinal implant removal surgery. Two patients were lost in follow-up. Cr-s median prior to surgery was 11 µg/L (2,2-33,5), 11 µg/L (3,8-15,5) one month after surgery and 8 µg/L (2,1-10,6) after four months. Ni-s median prior to surgery was 3,5 µg/L (1,5-5,6), 1 µg/L (1-1,4) after one month, and 1 µg/L (1-1,4) after 4 months. An average descends of 11,02 µg/L in Cr-s and 2,33 µg/L in Ni–s has been observed after four months. We found statistically significant differences ($p<0,05$) in Cr-s after 4 months and in Ni-s the first month after removal.

Conclusion: The results of our study confirm that metal levels in serum and urine are useful in the diagnosis of corrosion of stainless steel spinal posterior instrumentations and may be helpful in defining the role of corrosion in recently described clinical entities such as late operative site pain or late infection of spinal implants. After stainless steel spinal posterior instrumentation removal chromium and nickel serum levels decrease. Nickel serum levels decrease early to the minimum level of detection.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Predicting Failure of Iliac Fixation in Neuromuscular Spine Deformity

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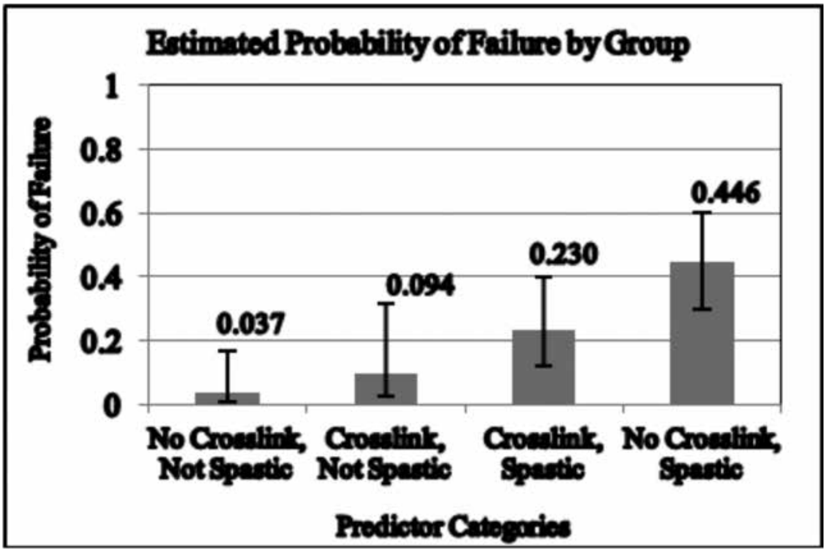
† LOE-Therapeutic Level IV

Purpose: Failure of iliac screw fixation in long posterior spinal fusion constructs in patients with neuromuscular scoliosis is common. The purpose of this study was to determine whether any patient or surgeon factors result in a higher risk of iliac fixation failure.



Methods: After IRB approval, all children from 2001-2009 undergoing posterior spinal fusion from the upper thoracic spine to the sacrum for neuromuscular scoliosis were identified using an institutional surgery database. 90/139 patients had two year follow-up and were analyzed. Charts, operative records, and radiographs were reviewed for patient and surgeon factors that may be related to failure of iliac fixation. These included diagnosis, tone (spastic vs. flaccid), GMFCS level, BMI, gender, diameter and material of iliac screws, number of distal fixation points (L4, L5, S1, ilium), use of distal crosslink, magnitude of pelvic obliquity correction, and overall coronal deformity correction. Iliac fixation failure was identified on radiographs as a broken screw, disengagement of screw to connector or connector to rod, or set plug failure. Lucency around iliac screws is expected and was not considered as a failure.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Results: There were 37 female and 53 male patients with an average age of 13.9 years (range 7-21) and follow-up of 5.5 years (range 2.1 – 9.6 years). Coronal correction averaged 58% and pelvic obliquity 62%. 23/90 (26%) patients had failure of iliac fixation. Lucency around iliac screws occurred in 50/90 (55%) of patients, but only 9 had associated fixation failure. Using a single predictor logistic regression model; diagnosis, GMFCS, BMI, gender, iliac screw diameter and material, number of distal fixation points, ambulatory status, magnitude of pelvic obliquity correction, overall coronal deformity correction, were not significant predictors of iliac fixation failure. Presence of distal crosslink and flaccid tone reduced the risk of iliac fixation failure and were studied in a multivariable logistic regression analysis. Only flaccid diagnosis was found to be protective in this model.

Conclusion: Iliac fixation failure is common with use of iliac screws in neuromuscular scoliosis. Patients with flaccid tone have a lower risk of failure. Use of a distal crosslink had a trend towards protective effect.

Significance: Alternatives to iliac screw pelvic fixation should be considered for long posterior spinal fusion constructs in children with neuromuscular scoliosis due to high failure rate of standard iliac screws. If using iliac screws with a connector to the main rod, consider use of a distal crosslink.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

A Prospective Clinical Trial on a Scoliosis Growth Modulation Clip/Screw Device: Initial Safety Results

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Purpose: Non-fusion growth modulation is an emerging minimally invasive technology developed to prevent instrumented spinal fusion for progressive idiopathic scoliosis. We present the initial safety results of a prospective first human use FDA Investigational Device Exemption (IDE) clinical trial on a Clip/Screw device that is designed to treat children with late juvenile and adolescent idiopathic scoliosis (www.clinicaltrials.gov Identifier: NCT01465295).

Methods: Five patients with progressive idiopathic scoliosis underwent endoscopic placement of a flexible Clip/Screw device in a prospective FDA IDE clinical trial following IRB approval. Inclusion criteria were Lenke 1A and 1B single thoracic curves with Cobb angle between 25°-40°, and Cobb levels between T3-L1. All patients were > 10 years, with open triradiate cartilage and Risser stage 0. Bone age was between 8+10-13 years for females and 10-15 years for males. Thoracic kyphosis was < 40°. Females were pre-menarchal. Under these criteria all patients were at high risk for scoliosis progression to >50° and the need for instrumented spinal fusion (Sanders 2008, Dimeglio 2005).

Results: One patient had a procedure-related mucous plug secondary to single lung ventilation that resolved after bedside bronchoscopy. Another patient had a chylous effusion that resolved with a pigtail catheter and a nonfat diet. Minor immediate postoperative AEs included nausea, dizziness, pain, atelectasis, small pneumothorax and pleural effusion that resolved with observation. There was no device misplacement in the spinal canal or in the disc space, no neuromonitoring changes or neurological deficits, and no device breakage, loosening or migration. Hospital stay following surgery averaged less than 4 days, and surgical implantation time averaged 90 minutes with a range of 57 to 124 minutes. Estimated blood loss averaged less than 75 cc. Preoperative major curve Cobb angles averaged 34.4° with a range of 29 to 37°. The first postoperative standing radiographs Cobb angle averaged 24.6° with a range of 12° to 35° which was significantly decreased over preoperative Cobb angle ($p<0.05$).

Conclusions: A titanium Clip/Screw device was prospectively tested in an FDA IDE clinical trial to redirect the spine growth of children with scoliosis. No device failure, or device misplacement were encountered in this initial safety study. Blood loss was minimal and surgical times were low.

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Significance: This is the first spine specific compression based growth modulation procedure approved for human study in a USA FDA IDE clinical trial. Data from this prospective study may help make growth modulation a viable alternative to spinal fusion for children with scoliosis.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Success of Risser Casting in the Treatment of Scheurmann's Kyphosis

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† LOE-Therapeutic Level III

Purpose: Assess demographic differences between patients who were initially treated with Risser casting for Scheurmann's kyphosis and those treated surgically. We also sought to demonstrate that Risser casting successfully decreased kyphosis and maintained it through final follow up as well as improved surgical outcomes in those who ultimately required surgery.

Methods: A retrospective review of our pediatric spinal deformity database from 1992 to 2012. Patients with Scheurmann's kyphosis who were treated with surgery, casting, or bracing were included. We collected demographic data and measurements of thoracic kyphosis as well as lumbar lordosis before treatment, during treatment, and at final follow-up. We recorded the number of surgical procedures and complications.

Results: The casting group (those who were treated with Risser casting alone or followed by bracing or surgery) included 18 patients compared to 17 patients who were initially treated with surgery. The casting group began treatment with a mean Risser sign of 2.3 ± 1.6 (range 0-4) and mean age of 13.4 ± 1.1 (range 11-15), while those who were initially treated with surgery had a mean Risser sign of 4.88 ± 0.34 (range 4-5) and mean age of 16.6 ± 1.5 (range 15-21). The mean pretreatment kyphosis was 79.3 ± 10.6 (range 60-100) in the casting group and 91.0 ± 13.5 (range 70-118) for the surgery group. Casting reduced the mean kyphosis to 48 ± 11.3 (range 40-56) while surgery decreased it to 51.3 ± 6.7 (range 42-65). At final follow-up, the mean thoracic kyphosis of casted patients was 59.1 ± 9.1 (range 43-71) and 60.7 ± 9.1 (range 44-77) for surgery patients. The number of surgical procedures and complications were higher in the surgery group.

Conclusions: Risser casting is an effective method to decrease thoracic kyphosis in patients with Scheurmann's kyphosis, and that reduction can be maintained with continued casting or bracing as successfully as surgery. The patients who were treated with surgery initially had higher Risser signs and were generally older. Patients treated with surgery also underwent more procedures and had more complications.

Significance: Risser casting is an effective way to manage Sheurmann's kyphosis in a younger population with a lower Risser sign.

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Is Casting for Infantile Scoliosis Better than the Natural History?

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Purpose: In infantile scoliosis spontaneous resolution is common. For the minority of children with a progressive curve the natural history may result in significant deformity and thoracic insufficiency. Serial casting with extension-derotation-flexion (EDF) technique is an option for the initial treatment of progressive infantile scoliosis, but randomized studies are not feasible to compare it to the natural history. The purpose of this study is to compare EDF casting to the published natural history.

Methods: A search identified 4 papers classifying infantile scoliosis using the rib-vertebra angle difference (RVAD) and reported the subsequent resolution or progression of the curve before treatment was initiated. For each, we recorded the number of patients in each of three groups of infantile scoliosis expected to progress: 80% of single curve with RVAD ≥20 and phase 1 ribs; all single curve with phase 2 ribs; and all double curves. The actual incidence of progression was recorded. This historical cohort was compared to the results of patients with progressive infantile scoliosis treated with serial EDF casting.

Results: In the historical cohort, we identified were 89 single curves with an RVAD ≥20 and phase 1 ribs, 71 of these curves progressed (79.8%) and 18 resolved (20.2%). Because all the authors indicated all phase-2 single curve patients progressed, they do not provide a denominator for these curves. There were 91 double curves, 90 of these progressed and 1 resolved. In the casting group, no patients with rib phase 1 and an RVAD ≥20 progressed (0/19). Single curves with phase 2 ribs progressed in 8/48 (16.6%). 0 of 4 double curves progressed.

Conclusions: The results for the casting group were improved over the historical control group. Because untreated progressive infantile scoliosis has an unacceptable outcome, RCT of treated to untreated patients is not appropriate. This prevents any new comparative effectiveness research from using an observational cohort to demonstrate the benefit of treatment. Therefore comparing the results of any treatment must use historical controls. By using consistent criteria to categorize each of the three groups of progressive curve we have attempted to compile uniform cohorts for our comparison. Comparing the results of serial casting against this historical control group shows that serial casting improves the natural history of progressive infantile scoliosis.

Significance: This is the first study to compare the results of serial casting to a control group and demonstrate that casting improves the natural history of progressive infantile scoliosis.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Progression Rate in EOS Historic compared to EDF Casting			
	Single Curves, RVAD ≥20°, Rib phase 1	**Single Curves, Rib Phase 2**	**Double Curves**
Historic	71/89 (80%)	“100%”	90/91 (98.9%)
Current EDF Casting	0/19 (0%)	8/48 (16.6%)	0/4 (0%)

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Patient Outcomes in the Operative and Non-Operative Management of High-Grade Spondylolisthesis in Children

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Purpose: The optimal management of high-grade spondylolisthesis in the growing child is controversial. Some authors have advocated for surgery in all cases regardless of symptoms. Surgical intervention results in a greater than 10% risk of complications with increased risk of neurological injury associated with slip reduction maneuvers. There is a paucity of literature regarding non-operative management in this setting. This study sought to obtain quality of life outcome measures in pediatric patients with high-grade spondylolisthesis managed either operatively or non-operatively.

Methods: Database review was performed to identify patients with a high-grade (Meyerding grade III-V) spondylolisthesis managed either operatively or non-operatively. Retrospective radiographic and chart review was performed. Patients were contacted by phone to obtain current quality of life measurements using the SRS-30 questionnaire.

Results: Fifty-three patients were identified for inclusion in the study and 49 were contacted for a 92% follow-up rate. Twenty-four patients were initially treated with operative intervention. Twenty-five patients were initially treated non-operatively, but 10 of these went on to require surgical intervention. Mean age at presentation was 12.6 years (range 8-17) and mean age at follow-up time was 20.1 years (range 10-29). Seventy-one percent of patients were female. There were no outcome differences between groups with mean SRS-30 scores of 119 ± 22 (surgical group) and 121 ± 11 (non-operative group). Regression analysis revealed that a more kyphotic slip angle was associated with worse SRS-30 outcome scores across all groups. In the non-operative group, the slip angle was significantly larger in patients who failed conservative treatment (34 ± 17 degrees) than in those who remained non-surgical at final follow-up (20 ± 14 degrees). The slip angle in the operative group was 27 ± 14 degrees. In patients who underwent surgery, an older age at surgery was associated with better SRS-30 outcome scores.

Conclusions: Non-operative management of the minimally symptomatic child with a high-grade spondylolisthesis is safe. Operative intervention for the symptomatic patient achieves similar long-term results compared with patients whose symptoms do not warrant surgery, though the optimal surgical technique is still unclear. Delayed surgical intervention does not result in worse outcomes. Regardless of treatment modality, patients with a more kyphotic slip angle tend to have poorer outcome scores.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Significance: In the setting of a growing child with high-grade spondylolisthesis, treatment decisions are reasonably made based on symptom severity rather than radiological parameters. The slip angle appears to be an important radiographic tool to help guide prognosis.

Selective Thoracic Fusion in Adolescent Idiopathic Scoliosis Curves with a C Lumbar Modifier: Which Rules Can be Broken?

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† **LOE-Prognostic Level II**

Purpose: Utilizing previously established criteria for optimal selective thoracic fusion (STF) outcomes, we tested rules for performing a STF (as defined in the literature) to determine the likelihood of attaining desired post-op outcomes.

Methods: Prospectively collected cases from a multi-center database were reviewed. Lenke 1-4C AIS patients who underwent STF with minimum 2yrs f/u were included. Based on prior study, successful 2 year outcome was defined as: lumbar Cobb <26°, lumbar percent correction >37%, C7-CSVL deviation <2cm, DFQ<4, trunk shift <1.5cm, lumbar prominence <5°. For each pre-op rule, AVT ratio >1.2, curve magnitude ratio >1.2, lumbar curve magnitude >45°, lumbar curve bending >25°, patients were divided into 2 groups based on whether they adhered to the rule. Chi-squared analysis was used to determine if implementation of the rule increased the chance of attaining the pre-defined successful outcome.

Results: 106 patients were analyzed. Neither AVT ratio >1.2 nor Cobb ratio >1.2 predicted greater success with regards to any target outcome parameters. Pre-op lumbar curve <45° lead to optimal DFQ (p<0.001) and lumbar curve size (p=0.06) outcomes. Following the lumbar Cobb<45° rule, resulted in a DFQ<4 and post-op lumbar cobb<26° 66% and 72% of the time. Lumbar bend <25° was associated with increased success for DFQ (p<0.001), lumbar curve size (p<0.001), and C7-CSVL deviation (p=0.05).). Following the lumbar bend<25 rule resulted in DFQ<4, Lumbar cobb <26°, and C7-CSVL<2cm 66%, 73%, and 81% of the time, respectively. While the lumbar bend <25° rule was not associated with increased optimal outcome for trunk shift, patients who were more flexible (12 vs 18°, p<0.005) were more likely to attain an ideal post-op trunk shift (<1.5 cm (p<0.05).

Conclusion: Predicting which AIS curves will respond well to STF remains a challenge. Our study suggests that performing a STF in patients with a pre-op lumbar curve size <45° or a pre-op lumbar bend less than 25° will increase one's chance in attaining these pre-defined successful outcome parameters. Considering outcomes depend on multiple factors, no rule guarantees success or a poor outcome.

Significance: The current study tested recommendations found in the literature for performing a STF against the changes of attaining pre-defined outcome parameters, and found that only lumbar curve magnitude <45° and lumbar curve bending <25° resulted in any success.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Spinal Deformity Progression after Modern Segmental Instrumentation and Fusion: Is this Crankshaft?

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Purpose: To assess for spinal deformity progression after modern segmental instrumentation and fusion in the treatment of idiopathic scoliosis, and to analyze variables associated with progression after fusion.

Methods: Retrospective review of a consecutive series of idiopathic scoliosis patients with major thoracic curves (Lenke 1-4) treated with modern segmental instrumentation (primarily pedicle screws) and fusion with minimum 2 year follow-up from a single institution. Deformity progression was defined as a 10 degree increase in Cobb angle between the first erect (4-6 week post-operative) and 2-year post-operative radiographs. Clinical and radiographic data between the two cohorts (deformity progression vs control) were analyzed to determine the variables associated with deformity progression.

Results: Eighty-one patients were in the control cohort (14M/67F; pre-op Cobb: 58.9°) and 16 patients were in the deformity progression cohort (3M/13F; pre-op Cobb: 55.3°). Patients in the control group had an average deformity correction of 58% with a 22.5° residual main thoracic curve, while patients in the deformity progression group had an average deformity correction of 55% with a 16.7° residual main thoracic curve. The patients in the deformity progression group had a significantly greater increase in Cobb (14.5°±4.5° vs 4.0°±2.5°; p<0.001), upper (7.2°±4.6° vs 4.2°±3.8°; p=0.009) and lower (6.8°±4.4° vs 3.8°±2.6°; p=0.004) instrumented vertebral angulation, and apical vertebral translation (11.2 mm±10.7 mm vs 4.3 mm±9.3 mm; p=0.044) at 2 years post-op. SRS-22 scores in the appearance domain were also significantly worse in the deformity progression group (4.04±0.65 vs 4.42±0.51; p<0.001). There was a significant association between deformity progression and change in height between the one- and two-year post-operative periods (3.1 cm±2.7 cm vs 0.9 cm±2.9 cm; p=0.007). There was a trend towards younger patients in the deformity progression group (12.9±2.8 years vs 14.2±2.1 years; p=0.073); however Risser grade and state of the tri radiate cartilage were not significantly different between the two groups. Deformity progression occurred within the instrumented segment in 10 patients and distal to the instrumented segment in 6 patients.

Conclusion: Deformity progression either due to crankshaft or distal adding-on does occur with modern segmental instrumentation. Although no patients required revision surgery for deformity progression, patient determined measures in the SRS-22 appearance domain were significantly affected.

Significance: Although modern posterior segmental instrumentation provides three-column fixation, deformity progression can occur in immature patients with remaining growth potential.

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Sagittal Plane Alignment following Spinal Fusion of Adolescent Idiopathic Scoliosis: A Case-Matched Analysis of All-Pedicle Screw vs. Hybrid Instrumentation

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Purpose: The purpose of this study is to investigate the effect of instrumentation type on the restoration and maintenance of sagittal balance following posterior spinal fusion in adolescent idiopathic scoliosis patients.

Methods: The medical records of 63 adolescent idiopathic scoliosis patients who underwent instrumented posterior spinal fusion between January 2000 and December 2009 were retrospectively reviewed. All patients had Lenke Type I spinal deformities, and were instrumented with either an all-pedicle screw or hybrid hook-screw construct by the same surgeon. Patients were matched according to gender, age at surgery, Risser sign, maturity of triradiate cartilage, and pre-operative flexibility. Thoracic kyphosis, lumbar lordosis, global sagittal alignment, proximal kyphosis angle, thoracolumbar kyphosis, and pelvic tilt were measured pre-operatively, immediately after surgery, and two years after surgery and were compared between the two instrumentation groups using Mann-Whitney tests.

Results: Patients in the two instrumentation groups were similar in gender (p=0.32), age (p=0.62), and pre-operative flexibility (p=0.67). Although patients instrumented with the all-pedicle screw construct demonstrated greater correction in global sagittal balance from before to immediately after surgery (p=0.05), they were unable to retain this correction for two years after surgery when compared to patients who received the hybrid hook-screw construct (p=0.045). All-pedicle screw construct patients showed a greater decrease in apical lumbar vertebra translation after two years as well (p=0.032). Patients instrumented with hybrid instrumentation, however, demonstrated greater immediate post-operative kyphosis correction (p=0.015) and retained that correction through final follow-up (p=0.04) when compared to the all-pedicle screw patients.

Conclusion: All-pedicle screw instrumentation offers better curve correction in the coronal plane. In the sagittal plane, hybrid hook-screw instrumentation demonstrated significantly better immediate correction and maintenance of thoracic kyphosis, global sagittal balance, and apical lumbar vertebra translation up to two years.

Significance: This is the first carefully matched study that focuses on the effect of the instrumentation type on post-operative sagittal alignment.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Cost Effectiveness of Surgical Treatment for Adolescent Idiopathic Scoliosis

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† LOE- Other Analysis Level IV

Purpose: Increasingly, government and payers are scrutinizing the cost effectiveness of medical and surgical treatments of various diseases. Previous studies calculated the cost and health-related quality-of-life (HRQL) of adolescent idiopathic scoliosis (AIS) fusion separately. The aim was to evaluate the cost effectiveness of surgical treatment for AIS.

Methods: We conducted a literature review comparing preoperative versus postoperative HRQL. The difference in HRQLs at 2 year follow-up was multiplied by remaining life span of the matching patient group, yielding the maximum QALYs gained. This estimate is very conservative because untreated severe (>50°) AIS is known to progress and cause pulmonary decline, which we could not estimate. QALYs are then adjusted by discount rate of 3%. The hospital cost was determined by weighing variable cost of surgery by Lenke curve type prevalence. Professional fees (surgeon and anesthesiologist) were calculated using CPT code 22802 (PSF 7-12 levels), 22843 (posterior segmental instrumentation 7-12 levels), and 00670 (anesthesia for extensive spine procedure) as published by CMS. This fee source was used because it is standardized and represents cost from society's perspective. Total direct cost, including hospital and professional fees, was divided by adjusted QALYs gained.

Results: PSF for severe scoliosis has been shown to increase HRQL (SRS-22) from .764 to .843. The difference between life expectancy and age at operation is 60 years, yielding a maximum of 2.221 QALYs gained when conservatively discounted at 3%. Hospital cost, weighted by Lenke curve type, is $32,029. Surgeon's fee is $2,113 (CPT 22802, 22843). Anesthesiologist's fee is $822 (CPT 00670). The total cost of $34,963 divided by 2.221 QALYs yields $15,744 per QALY.

Procedure	Cost / QALY
PKU screening	$1,100
CABG for left main disease	$9,050
PSF for AIS with Segmental Instrumentation	**$15,744**
TKA	$18,700
ORIF for midshaft clavicle fracture	$28,150
Ambulatory peritoneal dialysis	$101,000

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Conclusion: For AIS surgical candidates, surgery costs $15,744 per QALY. This compares well with procedures such as CABG ($9,050) or TKA ($18,700), as the gain in HRQL is carried over a longer time period due to relatively younger age at initial operation (see table).

Significance: This is the first study to examine the costs per QALY for posterior spine fusion in adolescent idiopathic scoliosis.

Evaluation of Limited Screw-Density Pedicle Screw Constructs in Posterior Fusions for Adolescent Idiopathic Scoliosis

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† LOE-Therapeutic Level III

Purpose: Posterior spinal fusion (PSF) with pedicle screw instrumentation is the mainstay of surgical treatment for adolescent idiopathic scoliosis (AIS). Uncertainty exists regarding the number of pedicle screws required for optimal curve correction and arthrodesis, and there are potential cost and safety considerations that favor utilization of fewer screws. This study examines radiographic outcomes of pedicle screw constructs of differing screw densities.

Methods: An IRB approved review of PSF for AIS performed by four surgeons over a 2.5 year period identified a cohort of patients treated with high screw-density constructs (n=27) and a comparable sequential cohort of patients treated with limited screw-density constructs (n=16). The limited screw-density construct consisted of a pair of bilateral screws at the base of the construct with alternating screws proximally. High density constructs consisted of screws at every level on the concavity and nearly every level on the convexity. All curve types, excluding Lenke 5, were included in the review. Radiographic measurements (Cobb angles, coronal balance, translation of apical vertebrae, and sagittal alignment) were compared preoperatively, two weeks postoperatively, and at the patient's most recent follow-up. Construct characteristics and surgical data were also evaluated.

Results: At most recent follow-up (average 2 years), there were no significant differences between groups in the coronal Cobb angle of the major curve, loss of correction, sagittal alignment, coronal balance, translation of the major apical vertebra, or operative blood loss ($p>0.05$). Based on non-linear regression analysis, screw density did not affect the ability to maintain correction of the major curve. There was also no effect of screw density on the ability to attain correction beyond a density of 0.6 screws/pedicle. Compared to the limited group, the high density group utilized significantly more pedicle screws (avg. 16.4 vs. 11.4, $p < 0.001$), had longer operative times (avg. 320 vs. 267 minutes, $p = 0.002$), and larger preoperative coronal Cobb angles of the major curve (avg. 59.9 vs. 52.8 degrees, $p = 0.013$).

Conclusion: Excellent curve correction, stability, and balance can be achieved using fewer screws than commonly used in posterior spinal fusions. Surgical time is reduced, and risk and cost are decreased with the use of limited screw-density constructs.

Significance: This study demonstrates that limited screw-density constructs can safely and effectively be used for PSF in AIS over a wide range of curve types with moderate magnitude; sparing cost, risk and operative time without compromising correction, stability, or balance.

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Are Routine Post-operative Radiographs Required during the First Year following Surgery for Idiopathic Scoliosis?

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† LOE-Diagnostic Level II

Purpose: Radiographs are routinely taken at our institution at almost every post-operative visit following surgery for idiopathic scoliosis (IS). The goal of this study was to determine if clinically useful information is obtained by these radiographs

Methods: After IRB approval, consecutive patients between the ages of 10-21 having surgery for IS at our institution from 2004-2010 were identified. 235 patients (198 female, 37 male) were included. All charts were reviewed to determine patient reported clinical symptoms. These were grouped into categories: pain greater than expected, implant prominence, and sensory or motor disturbance. Radiology reports and surgeon interpretation of radiographs were reviewed to identify implant failure and change in curvature. Statistical analysis was done to evaluate whether patients with clinical symptoms had higher rates of implant failure.

Results: Study subjects had an average of 3.4 visits (range 2-10) and 6.2 radiographs (range 2-12) during the first year after surgery. 76% had pedicle screw constructs and 24% had hybrid constructs. Pain was the most common clinical symptom, occurring in 14% of patients. Neurologic symptoms (12%) and implant prominence (4%) were less common. Implant failure was identified in 3 subjects (1%), but only 2 had revision surgery. Curve progression >5° occurred in 26 patients (11%), 6 in instrumented curve, 14 in uninstrumented curve, and 6 in both. No patient had change in treatment due to curve progression. Pain was the only clinical symptom associated with implant failure in univariate logistic regression analysis ($p=0.0005$). Presence of any one symptom of pain, neurologic symptoms, or implant prominence was also associated with implant failure ($p<0.0040$). 175/235 patients did not have any symptoms and none of these required revision surgery. The incidence of need for revision surgery was 1.4/1000 radiographs [95% CI 0.15 to 4.96]. Sensitivity of pain for implant failure was 100%, specificity 87%, positive predictive value 9%, negative predictive value 100%.

Conclusion: Radiographic abnormalities leading to need for revision surgery are uncommon during the first year after surgery for IS. After obtaining baseline post-operative standing radiographs, routine radiographs during the first year after surgery for IS may not be required in the absence of clinical symptoms.

Significance: Reducing the number of scoliosis radiographs taken during the first year after surgery for IS in patients without symptoms can reduce radiation exposure to patients and health care costs without affecting treatment.

† LOE – Level of Evidence – Please see page 14 for details.

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Hip Subluxation, Pelvic Obliquity, and Scoliosis in the CP Population: A Random Triad or a Predictable Relationship?

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† LOE-Prognostic Level II

Purpose: Neuromuscular scoliosis in patients with CP more often involves the pelvis, with the pelvic deformity being postulated as having a significant effect on the femoral-acetabular relationship. The correlation between scoliosis, pelvic obliquity (PO) and hip subluxation in CP however remains unclear. The purpose of our study was to determine the association of hip subluxation, PO, and the severity of scoliosis in CP, and secondarily to analyze any potential predictors of PO in this population.

Methods: Patients enrolled in a prospective longitudinal multi-center study evaluating operative outcomes of scoliosis in CP were included in the analysis. Pre-op hip subluxation, as measured by the Reimer's Migration Index (RMI), PO, and curve magnitude were the primary outcomes studied. Multivariate linear regression was used to identify potential predictors influencing PO.

Results: 115 subjects with a mean age of 14.2+2.7 years were included. There were 66 males and 49 females. The majority of the patients were GMFCS 4 (17%) and 5 (69%). The mean major Cobb was 81.5°± 28.4°. PO on average measured 63.3°+14.7°, and was directly related to the magnitude of the scoliosis. The RMI had no correlation to curve magnitude (r=0.25) and was also poorly associated with PO (r= -0.36). 69% of the hips were normal. Age, sex, and GMFCS level were not associated with curve severity or PO.

Conclusions: The triad of hip deformity, PO, and scoliosis does not appear to be significantly correlated in CP. Although PO was associated with larger curves, the relationship with hip subluxation/dislocation was poor suggesting that factors beyond spino-pelvic deformity affect hip pathology in this population.

Significance: Although pelvic obliquity in the setting of CP historically has been postulated as having a significant effect on femoral-acetabular relationship, we found a poor correlation suggesting that factors beyond spino-pelvic deformity affect hip pathology in this population.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

The CPCHILD Questionnaire is Sensitive to Change following Hip Reconstructive Surgery in Children with Severe Cerebral Palsy

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† LOE-Therapeutic Level II

Purpose: Children with severe (non-ambulant) cerebral palsy (CP) undergo major interventions to preserve or improve comfort, ease of caregiving, health and/or quality of life. The Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) questionnaire was developed to evaluate the effectiveness of these interventions to achieve these goals. We studied whether the CPHILD is responsive (sensitive to change) to reconstructive surgery for hip displacement in children with severe CP.

Methods: Parents of 40 children with severe CP (GMFCS IV & V) and progressive and/or symptomatic hip displacement, from 4 centres completed the CPCHILD questionnaire at baseline. 20/40 children (Cases) underwent hip reconstructive surgery, and the CPCHILD administered at 3, 6 and 12 months post-operatively. For the 20/40 (Controls) who did not undergo surgery (waitlisted or declined), the CPCHILD was completed 12 months after baseline. Change in CPCHILD scores from baseline was evaluated and responsiveness analyzed by Paired t-test of the pre-post scores; Standardized Response Means (SRM); and Effect Sizes (ES) of the change over 12 months.

Results: Cases and controls were comparable at baseline for age; gender; GMFCS level; co-morbidities; migration percentage; and mean (SD) Total CPCHILD scores: 46.8(14.6) and 46.5(10.3) respectively ($p = 0.93$). For Cases the total CPCHILD score was 50.6(12.1) at 3 months; 54.4(12.6) at 6 months; and 59.2(10.5) at 12 months after surgery. For Controls at 12 months, the total CPCHILD score was 48.4(11.9), unchanged from baseline. At 12 months there were significant improvements (mean differences of +2.3 to + 18.4 points) in 4 of 6 subscales of the CPCHILD for Cases; whereas subscale scores remain unchanged or deteriorated in Controls. The SRM was 0.95 for the total CPCHILD score (0.18 to 1.44 for the subscales); ES was 0.85 for the total score (0.16 to 1.32 for the subscales).

Conclusion: The CPCHILD is sensitive to change following hip reconstructive surgery for children with severe CP. The CPCHILD identifies large improvements in total scores and in the expected subscales, 6 and 12 months after surgery. In a comparable group that did not undergo surgery, scores remained stable or declined at 12 months.

Significance: The CPCHILD is recommended as the primary outcome measure for use in clinical trials or cohort studies of hip intervention strategies for children with non-ambulant CP. This is the first prospective controlled study to show benefits of hip surgery for non-ambulant CP using a validated measure of health related quality of life.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Long Term Outcome of Single Event Multi-level Surgery Including Distal Hamstring Lengthening in Spastic Diplegia

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Purpose: Distal hamstring lengthening (DHL) is a commonly performed procedure in flexed knee gait. However, the necessity of this procedure has been challenged due to the concerns on adverse effects in long-term follow-up. This retrospective study was undertaken to investigate the long-term outcome of single event multilevel surgery (SEMLS), including bilateral DHL, in ambulatory patients with cerebral palsy using 3D gait analysis.

Methods: Twenty-nine ambulatory patients with spastic diplegic cerebral palsy (GMFCS level I-III) who had undergone SEMLS including bilateral DHL were included. 3D gait analysis was performed preoperatively, 1 year postoperatively and over 10 years postoperatively. Preoperative temporal parameters, kinematics and GDI were compared with values obtained 1 and 10 year follow-up visits.

Results: The mean age of patients at time of first surgery was 8.3 years (range, 5.4 to 16.3 years), and mean time from first surgery to last 3D gait analysis was 11.8 years (range, 10.0 to 13.3 years). Mean pelvic tilt was not changed significantly after SEMLS including DHL. Mean knee flexion at initial contact decreased from 31.1˚ preoperatively to 26.0˚ at 1 year postoperatively (p=0.065), and then decreased significantly to 23.6˚ at 10 years postoperatively (p=0.038) versus the preoperative value. For the ankle, mean dorsiflexion at initial contact and peak dorsiflexion in the swing phase slightly increased from 1.8˚ and 9.8˚ preoperatively to 7.1˚ and 14.5˚ at 1 year postoperatively (p=0.059 and 0.469), respectively. However, these kinematic parameters significantly decreased to 1.2˚ and 7.1˚, respectively, 10 years postoperatively. Rotational kinematic parameters such as mean hip rotation and mean foot progression in stance consistently improved over 10 years postoperatively. Mean GDI score significantly improved from 69.4 preoperatively to 77.9 at 1 year postoperatively (p=0.003) and continuously improved to 82.2 at 10 years postoperatively (p=0.017).

Conclusion: Sagittal knee kinematics, such as, knee flexion at initial contact and knee flexion in terminal swing consistently improved over 10 years postoperatively without increasing mean pelvic tilt. The present study demonstrates that GDI, which represents overall gait pathology, consistently improved after SEMLS, whereas ankle kinematic parameters such as ankle dorsiflexion at initial contact and peak ankle dorsiflexion in swing, slightly improved at 1 year postoperatively and then deteriorated beyond their preoperative values.

Significance: Single event multilevel surgery including DHL provides a favorable outcome 10 years postoperatively in patients with spastic diplegic cerebral palsy.

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Acetabular Remodeling after Varus Derotational Osteotomy in Cerebral Palsy: Do We Need to Do the Pelvis?

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Purpose: Proximal femoral varus derotation osteomy (VDRO) is a well-established procedure in the management of hip displacement associated with cerebral palsy (CP). The purpose of this study was to investigate the degree of acetabular and femoral remodeling after isolated VDRO in children with CP.

Methods: We preformed an IRB-approved, retrospective review of 56 children with CP (103 hips) who underwent VDRO for hip displacement between January 1994 and December 2007. Patients undergoing pelvic osteotomy were excluded from this analysis. Age, gender and GMFCS level were analyzed. Migration percentage (MP), center edge angle (CEA), acetabular index (AI) and neck shaft angle (NSA) were recorded annually for each hip over a mean follow up of 7.8 years (range 5-11 years). Linear mixed models were developed for the four radiographic indices to measure change over time. Age and GMFCS were then used as interaction terms against radiographic measures.

Results: According to GMFCS there were 18 GMFCS II, 11 GMFCS III, 19 GMFCS IV and 8 GMFCS V level patients. Average age at index surgery was 7.7 years + 3.6. CEA, NSA, MP all demonstrated significant changes from preoperative to postoperative values (p<0.001). AI did not demonstrate a significant change from preoperative to postoperative. However, over time there was a significant linear *decrease* in AI (mean preop17°, mean postoperative 17°, 7 year postoperative 12°, p<0.001). In comparison, a significant linear *increase* in CEA (mean preoperative 7°, mean postoperative 14°, 7 year postoperative 17°, p<0.001) as well as for NSA (mean preoperative 151°, mean postoperative 127°, 7 year postoperative 133°, p<0.01) was seen over time. MP demonstrated a gradual increase from postop but did not follow a significant trend (preoperative 38°, postoperative 18°, 7 year postoperative 27°). Age was found to be a significant interaction term with AI only. Patients <=6 years were found to have a significantly higher rate of AI decrease compared to those >6 years (p<0.001).

Conclusion: Femoral osteotomy without pelvic osteotomy does result in a mild improvement of acetabular index and center edge angle over time, with greater rates of correction seen in children six years and younger.

Significance: In the setting of mild to moderate hip displacement, early femoral osteotomy (<6) can afford a modest improvement in acetabular morphology without the addition of pelvic osteotomy.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Intrathecal Baclofen and Neuromuscular Scoliosis: Natural History vs. Cause and Effect

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Purpose: To compare prevalence and progression of neuromuscular scoliosis in a group of patients with cerebral palsy (cp) who received intrathecal baclofen (ITB) ("subjects") with a group of patients with cp who did not receive ITB ("controls").

Methods: This is an IRB-approved, case-matched, retrospective review.

Results: 104 skeletally immature cp patients receiving ITB via an implantable, programmable pump were identified along with 104 case-matched controls. Control patients were matched for gender, Gross Motor Functional Classification System (GMFCS) Level and age at time of pump implantation. At baseline there was no difference between groups regarding prevalence of scoliosis, curve pattern or magnitude of curve. Subjects were followed for a mean of 5.6 (SD 2.1) years; controls for a mean of 6.8 (SD 3.5) years. At the time of the final visit, 91.3% of subjects and 78.8% of controls had scoliosis (p=0.011). The magnitude of the largest curve was greater for subjects (mean=46 degrees [SD 28]) compared with controls (mean =37 degrees [SD 30]) (p=0.02). For subjects, the mean progression of the curve was 6 degrees per year (SD 7) compared with 3 degrees per year (SD 8) for controls (p=.009). Spinal fusions were performed for 47 subjects (45%) compared with 31 controls (30%) (p=0.022). At baseline 60.3% of patients with GMFCS level V had scoliosis, compared to 37% of patients with GMFCS level IV and 34.2% of patients with GMFCS Levels II and III combined. A logistical regression analysis found that the GMFCS level was the biggest contributor to the presence of scoliosis at follow-up. Of those patients who did not have scoliosis at baseline, 72% of controls and 86% of subjects developed scoliosis (p=0.077)

Conclusion: Patients with cp who receive ITB therapy have an increased prevalence of neuromuscular scoliosis as well as an increased rate of progression of the scoliosis compared with cp patients who do not receive ITB therapy. This may lead to an increased rate of spinal fusions. Those patients with GMFCS level V are at greatest risk.

Significance: While many care-givers express satisfaction with ITB therapy, they should be aware of the potential impact on neuromuscular scoliosis. Patients receiving ITB therapy should be followed closely for the development or progression of scoliosis. This is a retrospective study. Further investigation is warranted to better identify which patients are at greatest risk. A prospective trial would be beneficial.

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Revision Hamstring Lengthening in Children with Cerebral Palsy

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Purpose: To determine the results of repeat hamstring lengthening in children with cerebral palsy (CP), and to compare them to those of primary hamstring lengthening.

Methods: An IRB-approved, retrospective cohort study was undertaken in patients with bilateral CP who had undergone hamstring lengthening and pre- and post-operative gait analysis between 1992 and 2011. Of the 45 patients, 21 had undergone primary hamstring lengthening (HSL group) and 24 repeat hamstring lengthening (rHSL group).

Results: The HSL group was younger than the rHSL group, though the difference was only statistically significant ($p = 0.02$) at the time of post-operative gait analysis. The time from surgery to post-operative gait analysis was also significantly greater (3.9 vs 1.6 years, $p = 0.002$) in the rHSL group. At baseline, the range of motion (ROM), manual motor testing and kinematic data were not significantly different in the two groups for most measures, though hip flexion contracture (15 vs 10°, $p = 0.05$), knee flexion at initial contact (45 vs 36°, $p = 0.04$), and minimum hip flexion in stance (15 vs 8°, $p = 0.05$) were worse in the HSL group pre-operatively. There was more improvement post-operatively in the HSL group in many measures compared to the rHSL group, including improvement in knee flexion at initial contact (17 vs 2°, $p = 0.0001$), minimum knee flexion in stance (18 vs -2°, $p < 0.0002$), minimum hip flexion in stance (4 vs -5°, $p = 0.02$), popliteal angle (18 vs 1°, $p = 0.001$), knee flexion contracture (5 vs 0°, $p = 0.04$), hip flexion contracture (10 vs 2°, $p = 0.02$). These measures improved significantly in the HSL group, but not in the rHSL group. 71% (15/21) in the HSL group improved minimum knee flexion in stance ≥ 10°, compared to 33% (8/24) in the rHSL group. There were no variables which showed more improvement in the rHSL group.

Conclusion: The current study shows significant improvements in many static and dynamic measures following primary hamstring lengthening, but no such improvement following repeat hamstring lengthening.

Significance: This study casts doubt on the efficacy of repeat hamstring lengthening in CP, suggesting consideration of osseous procedures in such children with recurrent crouch following hamstring lengthening.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Calcaneal Lengthening for the Planovalgus Foot Deformity in Patients with Cerebral Palsy

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Purpose: This study was performed to investigate the amount of correction after calcaneal lengthening of the treatment for planovalgus foot deformity in patients with cerebral palsy, and to provide a guide of indications for this procedure in terms of the severity of the deformity.

Methods: Seventy-five consecutive patients with cerebral palsy, who underwent calcaneal lengthening for planovalgus foot deformity, were included. Seven radiographic indices, which were anteroposterior talus-first metatarsal angle, calcaneal pitch angle, talocalcaneal angle, lateral talus-first metatarsal angle, naviculocuboid overlap, relative calcaneal length and calcaneocuboid subluxation, were measured on preoperative and latest follow-up weight-bearing foot radiographs. Three orthopaedic surgeons assessed the inter-observer reliability of the radiographic measurements.

Results: The mean age of the patients at the time of surgery was 11.0 ± 5.2 years and the mean duration of follow-up was 3.1 ± 2.2 years. In terms of the inter-observer reliability, all of the radiographic measurements showed good-to-excellent reliability for clinical use. All of the radiographic measurements, except the calcaneocuboid subluxation, showed significant improvements after calcaneal lengthening. Anteroposterior talus-first metatarsal angle, lateral talocalcaneal angle, lateral talus-first metatarsal angle and naviculocuboid overlap were improved beyond the values of normal alignment. However, calcaneal pitch angle did not reached the value of normal alignment. The cut-off values of preoperative measurements between the corrected and the under-corrected groups were 23° of Anteroposterior talus-first metatarsal angle, 36° of lateral talus-first metatarsal angle and 72% of naviculocuboid overlap.

Conclusions: Calcaneal lengthening with concomitant peroneus brevis lengthening is the effective procedure for correcting planovalgus foot deformity in patients with cerebral palsy. However, for the patients with more than 23° of anteroposterior talus-first metatarsal angle, more than 36° of lateral talus-first metatarsal angle, and more than 72% of naviculocuboid overlap, the additional procedures should be considered, due to the possibilities of under-correction with calcaneal lengthening alone.

Significance: This study demonstrated that calcaneal lengthening osteotomy with concomitant peroneus brevis lengthening was an effective treatment modality for the mild to moderate planovalgus foot deformity in patients with CP.

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♦ A Lower Age Limit for Patellar Tendon Advancement? The Effects of Patellar Tendon on Proximal Tibial Growth

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Purpose: This study examines the short-term effects of patellar tendon advancement on the proximal tibial slope in the skeletally immature patient.

Methods: A retrospective comparative cohort design study of children with cerebral palsy and crouched gait undergoing single event multilevel surgery including a patellar tendon advancement was performed. Koshino Indices, tibial slopes, and tibial tubercle closures were assessed pre-operatively and at the last available post-operative film. Comparisons were then made between pre- and post-operative measurements, between patients less than or greater than 11 years of age, and with age and sexed matched controls.

Results: Nine children with seventeen patellar tendon advancements were analyzed for changes in Koshino indices. Sixteen of the seventeen tibae had radiographs available for changes in tibial slope and were also compared with controls. While slight differences in pre-operative Koshino indices were observed 1.1+0.2 (<11 years old) versus 1.3+0.1 (>11 years old) p=0.03, both cohorts experienced a significant change in these measurements post-operatively 0.94+0.1 and 0.99+0.1 (p<0.01). No significant differences between the cohorts post-operative Koshino indices (0.94+0.1 versus 0.99+0.1) p=0.3, or change in Koshino indices were noted (0.2+0.18 versus 0.3+0.1) p=0.3. Children < 11 years of age had a greater initial posterior tibial slope (69.8+3.5 degrees) than age matched controls (80.3+2.8 degrees) p<0.001 or than older operative children >11 (76.5+6.3) p=0.02. At an average of 1.6 years follow-up, a greater change (decrease) in posterior slope was seen in these younger patients (average change of 10.3+4.8 degrees) than their older counterparts (2.8+2.5 degrees) p=0.002. While this brought the tibial slope of these younger patients closer to the age matched controls, seven out of nine of the apophyses in children <11 years of age had undergone premature closure.

Conclusion: Patellar tendon advancement appears to have an un-reported effect on the proximal tibial growth in the young patient (<11 years old). These patients appear susceptible to apophyseal closure resulting in subsequent loss of posterior tibial slope. Surgeons should be aware of this effect and monitor younger patients (<11 years old) with subsequent radiographs if performing this procedure.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Significance: Patellar tendon advancements corrected patella alta in patients with crouched gait. However, patellar tendon advancement caused a loss of posterior tibial slope and premature tibial tubercle closure in children <11 years of age. This change in sagittal alignment following patellar tendon advancements has not yet been reported and may result in an unreported benefit or detriment on future gait.

♦ Pamidronate Treatment to Prevent Reoccurring Fractures in Children with Cerebral Palsy

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Purpose: Some children with severe cerebral palsy have frequent fractures due to low bone mineral density and require treatment with the intravenous bisphosphonate, Pamidronate. Our review evaluates fracture pattern, distribution and rates in these children before, during and after treatment with Pamidronate.

Methods: This is a retrospective cohort study of 36 patients (15 girls and 21 boys) with cerebral palsy, Gross Motor Function Classification Scale (GMFCS) level III (2 patients), IV (3 patients) and V (31 patients), treated over 1-year with 5 courses of Pamidronate (3 day infusions) for low bone mineral density. Those with at least two years of follow-up post- therapy were included in the study. Data were collected on demographics, number of pre-treatment, during treatment, and post-treatment fractures, time-frame between first fracture and first infusion, time-frame between treatment completion and fracture, bone involved, region of bone, fracture pattern, and mechanism of injury. Frequency and percentages as well as Wilcoxon rank-sum tests were used to summarize the data and to assess the post-treatment difference in number of fractures respectively.

Results: The mean age at treatment was 11.5 years (range 3.6 to 19.6 years) and the mean follow-up post-treatment was 3.7 years. There were 106 fractures (mean duration 2.5 years) pre-treatment and 33 fractures post-treatment (mean duration 3.7 years). There was statistically significant decrease in the number of fractures during the follow-up assessment, $z = 5.0$ and $p = <0.001$. The rate of fracture was reduced to 0.16 per year from pre-treatment rate of 2.52 fractures per year. Femur was the most common bone fractured both pre-treatment (54%) and post-treatment (66.7%). The distal third femur comprised 71.4% of femur fracture pre-treatment and 81% post-treatment and there was no statistically significant change in pattern. There were 11 fractures during 1-year Pamidronate treatment at a rate of 0.31 fractures per year. Only 13 patients (39.4%) sustained fracture post-treatment. No correlation with fracture pattern or occurrence was found with patient age, number of pre-treatment fractures, or gender. Most fractures were caused by low energy injuries and majority of them were managed non-operatively.

Conclusion: In cerebral palsy patients with disuse osteoporosis, the fracture rate was significantly reduced after Pamidronate treatment.

Significance: Reoccurring fractures from disuse osteoporosis in children with cerebral palsy can be effectively treated medically to interrupt the fracturing tendency.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Evaluation of In-toeing at a Tertiary Pediatric Orthopedic Specialty Center

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Purpose: Intrauterine positioning produces a typical lower extremity rotational profile at birth of femoral anteversion and internal tibial torsion. Usually, spontaneous correction occurs after ambulation and childhood growth. This dynamic change in the lower extremity profile results in a wide, age-dependent, range of physiologic normal. Occasionally, slight deviations persist and in-toeing becomes concerning. Most commonly this is due to femoral anteversion, internal tibial torsion, and/or metatarsus adductus. In-toeing is one of the most common parental concerns urging a pediatric orthopedic evaluation. Rarely, is-toeing a pathologic problem or a cause of functional limitation and operative treatment is almost never required. The goal of this study is to evaluate the usefulness of tertiary orthopedic referral for the three most common diagnoses leading to pediatric in-toeing: (1) femoral anteversion, (2) internal tibial torsion, and (3) metatarsus adductus.

Methods: A retrospective chart review identified 1085 patients from 2007 to 2011 with CPT codes 755.63 (FA), 736.89 (ITT), and 754.53 (MA). Coding data was analysed for diagnosis, treatment, follow-up and cost determination.

Results: Over a 5 year interval (2007-2011), patients evaluated for the presenting complaint of in-toeing comprised 7.6% (1085/14180) of new patients at a tertiary pediatric orthopedic center with at least one of the following diagnoses femoral anteversion (693, 63.8%), internal tibial torsion (453, 41.7%), or metatarsus adductus (125, 11.5%) Only 18.8% (204) were recommended to follow-up with an average total cost to the patient of 943 dollars. The average total cost for patients not recommended to follow-up (881) was 268 dollars. Only 26 (2.39%) patients had a corrective osteotomy for persistent, functionally limiting in-toeing.

Conclusion: The necessity of tertiary orthopedic referral for in-toeing appears questionable. The dynamic change in the lower extremity profile results in a wide, age-dependent, range of physiologic normal that can be appropriately managed and counselled at the primary care level.

Significance: In an era of cost-consciousness, referral patterns of patients from primary care physicians will be under close observation. Increased awareness of over utilization of pediatric orthopaedic tertiary referral combined with appropriate primary care physician education can optimize the need for specialty evaluation.

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Ankle Disarticulation (Syme) and Transtibial Amputation as a Treatment for Pelvic Limb Deficiencies: Which is better?

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Objective: To analyze the institutional statistics, functional outcomes, complications and the benefits using transtibial amputation and Syme amputation.

Material and Methods: We retrospectively reviewed the records of all patients undergoing these types of surgeries. Data were collected including epidemiological values, preoperative medical condition, postoperative complications, need for revision surgery, prosthetic repair and adaptability. Test were evaluated by unpaired Student t test for continuous variables achieving p values.

Results: There were 66 patients (41 male and 23 female patients) who underwent either of ablative procedures. Of these, 40 patients underwent 41 Symes amputations and 24 to 25 transtibial amputations, with an mean age at the time of the procedure very similar to Syme 5.8 and 6.3 for transtibial. The discrepancy in limb length on average for patients with Syme amputations was 132 mm and 118 mm for transtibial amputees. The three most common diagnosis in this patients was fibular deficiency, femoral hypoplasia and tibial hypoplasia. Both age and length discrepancy were not statistically significant (p .81, p .38). There were only 4 complications transsurgical or mediate for all amputations alterations consisted of healing in two cases for Syme and major bleeding and dehiscence for transtibial amputations. Patients undergoing Syme were clearly benefited the procedure because the average is of .175 reoperations per patient, 5 average repair in time of monitoring and complications about .53 for socket use. Unlike patients undergoing ablation transtibial wherein the ratio is .83 reoperations, requiring repairs on average 12 and .68 track usage complications socket. The p value in reoperations was .0004 considered extremely significant. The p value of the prosthesis need of repair or adjustment is .0012 which is considered highly significant

Conclusion: We conclude that Syme amputation procedure is clearly superior in terms of measurable parameters such as ablative surgery analyzed here against the transtibial.

Significance: The theory stated already years ago that ablation of Syme is more advantageous because the risk to life is smaller, better stump can be established and the member may be more useful for mobilization. This is evident in our results, and based on this is that Syme ablation has been adopted as the method of choice for susceptible diseases use.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

A Comparison of Syme and Trans-Tibial Gait in Children

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Purpose: Preservation of limb length following amputation is theorized to maximize gait efficiency. The purpose of this study was to determine if there are gait differences in children with Syme or Boyd (Syme) or trans-tibial (TT) amputations and if residual tibial length (RTL) and prosthetic foot type influence outcome.

Methods: 64 children (mean 10.9yrs; range 5-19yrs) with unilateral below-knee prostheses (41 Syme; 23 TT) underwent gait analysis, clinical exam and the PODCI. RTL was measured and per cent difference determined. Component analysis included 13 different prosthetic feet categorized into 3 activity levels: *High, Medium and Low*. 9% of patients were fit with *High* energy returning feet, 60% with *Medium* level dynamic feet, and 31% with *Low* activity (Sach) feet. Statistical analysis included student t-Tests, ANOVA and Pearson's correlation.

Results: RTL were Syme 66% (+10%) and TT 36% (+12%). Kinematic differences between Syme and TT groups were less than 4° in prosthetic ankle motion (13.0°+5.1° and 16.7°+7.2°; p=0.0216) and 8° in external hip rotation (9.9°+10° and 1.4°+7.5°; p=0.0007). No differences were found in knee kinematics, cadence parameters or PODCI scores.

When comparing foot types, ankle power was significantly higher in *High* performing feet (1.5 W/kg) than *Medium*(0.9W/kg) and *Low* feet(1.0W/kg)(p=0.013), while the PODCI *Happiness* score was higher in *Low* than *Medium* feet (p=0.034).

Significant correlations were made between RTL and ankle plantar-flexion (R= -0.311; p=0.031), external hip rotation (R= 0.374; p=0.003), single-support-time (R=0.275; p=0.028) and PODCI *Sport/Physical Function* score (R=0.267; p=0.041).

Conclusions: Small differences in prosthetic ankle motion but not ankle power were found between Syme and TT amputations. RTL weakly correlated with ankle plantar-flexion, external hip rotation and the PODCI *Sport/Physical Function* domain. Ankle push-off-power was highest in *High* level dynamic response feet.

Significance: Minimal gait differences exist between children with a Syme or TT amputation. However, despite greater ankle push-off power in *High* performing dynamic feet, this is not reflected in better PODCI *Sport/Physical Function* or *Happiness* scores.

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Limb Lengthening in Children with a New, Controllable, Internal Device

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† LOE-Therapeutic Level IV

Purpose: The ISKD (Orthofix) has been available in the U.S. since 2001, but it is difficult to control the rate of lengthening with this rod. A new internal lengthening rod, the Precice system (Ellipse Technologies), became available in the U.S. in late 2011. The lengthening is controlled with an external remote control (ERC). We report our preliminary clinical results.

Methods: Ten limb segments (9 femora, 1 tibia) in 8 children with an average age of 13 years (range, 7-16 years) underwent insertion of the internal rod between January and July 2012. Average goal of lengthening was 4.3 cm (range, 3.0-6.5 cm). Etiology was proximal femoral focal deficiency/fibular hemimelia (6), Ollier disease (1), and achondroplasia (1).

Results: All limbs successfully lengthened and healed. Target lengths programmed into the ERC (average, 4.3 cm) closely matched radiographic measurements (average, 4.6 cm). Pain was minimal and satisfactory range of motion was maintained. All complications resolved (one revision of a prominent screw, one peroneal nerve entrapment treated with decompression). Four of 8 children had prior lengthenings with external fixation. They uniformly reported that the internal lengthening method was much less painful.

Conclusion: Although our data are preliminary, the Precice appears to offer a practical alternative to traditional methods requiring external fixation in the pediatric population. A larger sample size and more follow-up are needed.

Significance: The Precice internal lengthening rod offers an attractive alternative to lengthening with external fixation. Current size availability (10.7-mm diameter rod with bone reamed 12.0 to 12.5 mm) may be a rate limiting factor in applicability to small-boned children.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Botulinum Toxin Type A Injection in Alleviating Post-Operative Pain and Improving Quality of Life in Lower Extremity Limb Lengthening and Deformity Correction

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Purpose: Post-operative pain and discomfort during limb lengthening can be significant, affecting mobility, child and family well-being and often requiring prolonged medication use. Surgeons have reported anecdotally the use of Botulinum Toxin type A (BtX-A) to reduce pain and spasm during the distraction phase. Studies have investigated the anti-nocioceptive actions of this agent yet scientific evidence for its use in this population is limited. A randomized clinical trial (RCT) was conducted to determine if BtX-A reduces post-operative pain, associated medication use, and improves quality of life in children undergoing limb lengthening or deformity correction.

Methods: 125 subjects (mean age=12.5 years, range = 5-20 years) recruited from 6 sites were randomized to receive either a single dose of Btx-A or a saline solution (placebo group) intraoperatively. Primary outcomes were set as post-operative pain; measured by the Faces Pain Scale-revised, required pain medication and quality of life using the PedsQL. Outcomes were assessed at baseline, mid distraction, end distraction, mid consolidation, pre and 3 months post frame removal. Adverse events were reported for all patients and classified as minor or major.

Results: Analyses for medication use are underway demonstrating trends in favor of the BtX-A group. Maximum pain scores on day one post op were lower in the BtX-A group compared to placebo (4.04 versus 5.30 respectively, p= 0.029). Trends towards less pain in the BtX-A group at end distraction were also noted however did not reach statistical significance. No differences in mean quality of life scores as reported by child and parent were found at any timepoint. The BtX-A group experienced a lower incidence of total adverse events compared to the placebo group (55% versus 73% respectively, p=0.04) and fewer pinsite infections (27% versus 42% respectively, p=0.08). All adverse events were expected complications of the lengthening process. No adverse event was considered serious or related to the BtX-A injection.

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Conclusions: Our findings indicated not only a trend for beneficial clinical effects of less pain, pain medication, and pinsite infections in the BtX-A group but also a lower incidence of total adverse events which was statistically significant. No differences were found in quality of life scores between groups.

Significance: Despite the challenges and costs associated with multi center RCTs, this methodology provides the scientific evidence conducive to defining standards of practice. These results support the use of BtX-A as an adjunctive treatment to the lengthening process.

EOS Low-dose Biplanar Radiography: The New Gold Standard in Radiographic Assessment of Lower Limb Lengths

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Purpose: Children with lower limb-length discrepancy (LLD) require repeated radiographic assessment for monitoring and to guide management. The need for accurate assessment of length and alignment is balanced by the need to minimize radiation exposure. We compare the accuracy, reliability and radiation dose of EOS, a novel low-dose upright biplanar radiography imaging system at two different settings, with that of conventional radiography (CR) using teleoroentgenogram and CT scanograms, for the assessment of limb length.

Methods: A phantom limb in a standardized position was imaged ten times with each of four different imaging modalities (CR, CT scanograms, EOS-Slow, EOS-Fast). A radiation dosimeter was placed on the phantom limb, on a portion closest to the radiation source for each modality, to measure skin entrance radiation dose. Standardized measurements of bone lengths were made off each image by consultant orthopaedic surgeons and residents, and assessed for their accuracy and reliability.

Results: The mean (percentage) absolute difference from the true length of the femur was significantly lower (most accurate) on EOS-Slow [2.6 mm; -0.5%] and EOS-Fast [3.6 mm; -0.8%], compared with CT scanograms [6.3 mm; -1.3%, p<0.0001], and CR [42.2mm; +8.8%, p<0.0001]. There was no significant difference between the accuracy of the EOS-Slow and EOS-Fast [p=0.36] protocols. The mean radiation dose was significantly lower for EOS-Fast [0.68mrad; 95%CI: 0.60-0.75], compared with EOS-Slow [13.52mrad; 95%CI: 13.45-13.60, p<0.0001], CT scanograms [3.74mrad; 95%CI: 3.67-3.82; p<0.0001] and CR [29.01mrad; 95%CI: 28.94-29.09; p<0.0001]. Intra-class correlation coefficients showed excellent (>0.90) agreement for CR, EOS-Slow and EOS-Fast.

Conclusions: Upright EOS using a faster speed and lower current is more accurate than CT scanograms and CR for the assessment of length, and also utilizes a significantly lower radiation exposure.

Significance: This technology images subjects standing upright making it ideal to assess limb alignment in the weight bearing position, and has the potential to become the new standard for repeated assessment of lower limb lengths and alignment.

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Do Children with Blount Disease have Lower Body Mass Index following Lower Limb Realignment?

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Introduction: Children with Blount disease are typically obese. However, it is unknown whether the severity of genu varum impedes their ability to lose weight. The goal of our study was to assess if children with Blount disease had lower BMI following surgical correction of their lower limb deformity.

Methods: A surgical data base was used to identify children with Blount disease. Demographic information including age of disease onset, ethnicity, health insurance status and laterality was noted. Preoperative and most recent BMI values were documented. Using full-length standing radiographs, the mechanical axis deviation (MAD) and leg length discrepancy (LLD) were measured pre–operatively and at latest follow-up. The relationship of the change in BMI with various demographic and radiologic parameters was evaluated.

Results: Fifty-one children (32 males, 19 females) with Blount disease (23 early-onset, 28 late-onset) affecting 70 lower extremities (32 unilateral and 19 bilateral) underwent a variety of surgical procedures. All 47 children who had gradual correction with external fixation also underwent nutritional counseling while receiving inpatient rehabilitation. At an average follow-up of 48 months, MAD improved from 80.5 mm medial to 16.1 mm medial ($p<0.0001$) and LLD improved from 19.6 mm to 10.9 mm ($p=0.0002$). During the same time period, the BMI increased from 35 (95% CI, 32-37) to 38 (95% CI, 35-41) ($p=0.0006$). Compared to their pre-operative BMI, 76% of the children had an increase in their BMI at the latest follow-up. There was no association of the change in the patient's BMI with their age of disease onset, gender, ethnicity, health insurance status, final MAD or LLD. There was a tendency for the patient's BMI to increase with longer follow-up ($p=0.002$). Using multivariate analysis, only the length of follow-up was associated with an increase in BMI ($p=0.026$).

Conclusion: Despite improvement in limb alignment and leg length discrepancy following surgery, the BMI of the majority of children with Blount disease increased over time.

Significance: Besides surgical realignment of the lower extremity, other strategies may be necessary to address obesity amongst children with Blount disease.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

The Relationship between Angular Knee Deformity and Degenerative Disease of the Hip and Knee

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LOE-Other Analysis Level V

Purpose: Angular deformity of the knee is commonly quantified using the mechanical lateral distal femoral angle (mLDFA) and the medial proximal tibial angle (MPTA), both of which have normative ranges of 85o-90o. With recent advances in guided growth surgery, angular knee deformity can be corrected more precisely. However, the amount of deformity that justifies surgical treatment remains unclear.

Methods: We studied 471 well-preserved cadaveric skeletons ranging from 40 to 79 years of age at death. Specimens with obvious traumatic, infectious, rheumatologic or endocrine abnormalities were excluded. Photographs of the femur and tibia in the standard anatomic position were measured for mLDFA and MPTA. The angular values were converted to grades, with 0 representing a value between 85o and 90o, and an increase in one representing each 2.5o increment out of this range. Degenerative disease of the acetabulum, proximal femur, distal femur and proximal tibia were then each graded from 0 to 3. Multiple regression analysis was performed to determine the relationship between age, mLDFA grade, MPTA grade, combined mLDFA and MPTA grade, and degenerative disease of the ipsilateral hip and knee.

Results: Mean age was 56±10 years, mean mLDFA was 87.8o±2.2o, and mean MPTA was 86.9o±2.5o. Multiple regression analysis demonstrated strong correlations between age and degenerative disease of the hip and knee (standardized Beta coefficients 0.498 and 0.449, P<0.0005 for both). mLDFA, MPTA and their combination were not correlated with hip disease (standardized Beta range 0.010-0.051, P=0.078-0.836), and only the combined value was correlated with knee disease (standardized Beta 0.085, P=0.005). When the varus and valgus subgroups of the combined value were analyzed, varus knees were significantly related to knee disease (standardized Beta 0.112, P<0.0005), while valgus knees were not (standardized Beta 0.028, P=0.427). In the varus subgroup, we found unstandardized Beta values of 0.067 for age, and 0.248 for the combined grade, indicating that each 2.5o increment in knee deformity equates to approximately 4 years of age in terms of risk of degenerative knee disease.

Conclusion: Combined mild varus deformity of the knee (mLDFA>90o and/or MPTA<85o) was significantly related to degenerative disease of the knee, but not the hip in our study. In contrast, mild valgus deformity was not related to degenerative disease of the hip or the knee. The strong correlation between degenerative disease and age validates the ability of our classification to detect graded changes in degenerative disease.

Significance: This study suggests that mild varus deformity of the knee can predispose a patient to degenerative joint disease of the knee, while mild valgus deformity does not. Based on this data, guided growth correction of mild varus deformities should be more strongly considered, while guided growth correction of mild valgus deformity should be more reserved.

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No Superiority of Tension and Plating Compared to Stapling: A Randomized Clinical Trial on Treatment of Idiopathic Genu Valgum

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Purpose: In children, with excessive angulating deformities of the lower limbs, guided growth can be used to achieve better alignment before skeletal maturity. Traditionally hemiepiphysiodesis has been performed with stapling technique. The tension band plating technique was introduced in 2007 and has theoretical advantages compared to stapling. The benefit of the tension band plating technique has not yet been proven in randomized clinical studies. A randomized clinical trial was designed to compare the clinical and radiological effects of stapling with those of tension band plating in a group of children with idiopathic genu valgum.

Methods: Children with bilateral idiopathic genu valgum were randomized to stapling or tension band plating hemiepiphysiodesis (n=26). Time needed to correct deformity was recorded. The lower limb mechanical axis was analysed on long standing x-rays. Pain score using visual analogue scale (VAS) was performed for 72 hours postoperatively as well as registration of analgesics taken.

Results: 20 children were eligible for analysis (10 in each group). Mean treatment time between staples (349 days) and tension band plating (340 days) did not differ. Furthermore, no differences were found between groups in relation to age, intermalleolar distance and measured radiographic values on long standing x-rays. VAS score and consumption of analgesics postoperatively did not differ between groups. No hardware failure or wound related infections were observed.

Conclusions: There seem to be similar effect of tension band plating and staples in relation to correction of genu valgum. We cannot rule out that we have made a type II error and that our study is underpowered. However, we do not believe that smaller differences found in larger studies will be of clinical significance.

Significance: This study may affect current clinical practice.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Long Term Effects Of Glucocorticoid Treatment In Duchenne Muscular Dystrophy on Scoliosis

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Purpose: Duchenne muscular dystrophy, a progressive muscle disorder that occurs only in males, causes a gradual decline in ambulatory ability, pulmonary and cardiac function. The progressive decline in strength is associated with the development of scoliosis. Previous short and medium term studies showed that the use of high dose glucocorticoids slows the progression of scoliosis among patients. Here we examined the long-term results to determine if prolonged treatment would significantly decrease the **prevalence of scoliosis**.

Methods: 54 ambulatory boys diagnosed with Duchenne muscular dystrophy were enrolled in a non-randomized prospective study of the glucocorticoid deflazacort. 30 of the boys' families elected to use steroid treatment while 24 did not. The boys were matched for important baseline characteristics including age and pulmonary function. They were followed for 15 years and none were lost to follow-up. Every four to six months, they were examined for the development of scoliosis using radiography. Since surgery was recommended for spinal curves measuring more than 20 degrees, a curve of this magnitude was used as the definition for a patient developing scoliosis.

Results: Four boys in the non-treatment group (17%) and one in the steroid treatment group (3%) died. At the most recent follow-up, six boys in the steroid treatment group (20%) and all of the boys in the non-treatment group (24) who survived developed a scoliosis of at least 20 degrees and underwent spinal surgery. After fifteen years of follow up, the survivorship analysis (avoiding surgery) among deflazacort treated patients was 78% (95% confidence interval (CI) was 57-89), where is in the non-treatment group the survival was 8.3% (95% CI of 0.8-28). Statistical significance was calculated with Log Rank and Chi-square tests (p=5.8*e-7). The chance of developing a curve plateaued after skeletal maturity, and none of the patients in the treatment group developed scoliosis after reaching skeletal maturity.

Conclusion: The long-term use of the glucocorticoids past skeletal maturity result in a substantial decreased need for spinal surgery. 78% of boys in the steroid treatment group have not developed curves into their mid to late twenties, while all of the surviving boys in the non-treatment group did.

Significance: The use of long-term steroids results in a significant long term improvement in the outcome for boys with Duchenne muscular dystrophy. All boys with Duchenne muscular dystrophy should be offered this treatment approach soon after the diagnosis is made.

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Predicting the Presence of Adjacent Musculoskeletal Infections in Septic Arthritis

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† LOE-Prognostic Level III

Purpose: The gold standard for treatment of septic arthritis is urgent surgical debridement. Preoperative MRI may identify osteomyelitis, subperiosteal abscess, and intramuscular abscess which frequently occur with septic arthritis. If these adjacent infections are not initially recognized, initial treatment may be inadequate. The purpose of this study is to develop a prediction algorithm to distinguish septic arthritis with adjacent infections from isolated septic arthritis in order to determine which patients should undergo preoperative MRI.

Methods: An IRB approved retrospective review of 87 children treated for septic arthritis was performed. All patients underwent MRI. 51 patients had adjacent infections, and 36 patients had isolated septic arthritis. Septic arthritis was confirmed by joint fluid aspiration showing positive cultures, WBC>50,000, or organisms on gram stain. Sixteen variables (age, gender, temperature, WBC, CRP, ESR, ANC, hematocrit, platelet count, heart rate, systolic blood pressure, diastolic blood pressure, symptom duration, weight bearing status, prior antibiotic therapy, and prior hospitalization) were reviewed. Infants less than one year old and patients with incomplete data were excluded. Variables were compared using univariate and multivariate regression analysis. Optimal cutoff values were determined for each variable and a prediction algorithm was created.

Results: Five significant (p<0.5) independent multivariate predictors were identified with optimal cutoff values: age>4 years (odds ratio 7.3), CRP>8.9 (odds ratio 6.6), duration of symptoms>3 days (odds ratio 5.4), platelet count <310 (odds ratio 3.8), and ANC>7.2 (odds ratio 3.3).

0	25% (1)	4	100%	0%	58%
1	14% (1)	7	98%	8%	61%
2	17% (3)	18	96%	25%	67%
3	55% (12)	22	90%	67%	80%
4	89% (17)	19	67%	94%	78%
5	100% (17)	17	33%	100%	60%

Table 1. Probability of Adjacent Infection Based on Number of Predictors

† LOE – Level of Evidence – Please see page 14 for details.

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Conclusion: Age, CRP, duration of symptoms, platelet count, and ANC were predictive of adjacent infections. As a patient with septic arthritis has more positive factors, the likelihood of an adjacent infection increases. Using 3 predictors as the threshold correctly classifies the most patients and provides the best combination of sensitivity and specificity.

Significance: Patients with 3 or more positive predictors should undergo preoperative MRI in their workup of septic arthritis to evaluate for adjacent infections.

The Effect of Compliance Monitoring on Brace Use and Success in Patients with AIS

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Purpose: Previous studies have shown poor compliance with bracing in patients with AIS. The purpose of this study was to determine if physician counseling using compliance monitors improves brace use and decreases curve progression in AIS.

Methods: 226 patients have been prospectively enrolled in this study. All patients were Risser 0, 1, or 2, were < 1 year postmenarchal, and had curves between 25 and 45° at the time of brace prescription. Patients were placed into 2 groups: Group 1 were aware of the compliance monitor in their brace and were counseled at each visit regarding the downloaded brace usage. Group 2 were not told the purpose of the monitor in their brace, and physican, orthotist, and patient were blinded to downloaded compliance data. This report analyzes the comparative data on the first 100 patients enrolled.

Results: 40 patients in the counseled and 32 patients in the noncounseled group completed bracing or underwent surgery. Patients in the counseled group wore their orthoses an average of 15.2 hrs/day throughout their management, while patients in the noncounseled group wore their braces an average of 11.97 hours/day. Patients in the counseling group wore their braces more hours per day at the 30 day, 6 month, 1 year, and overall time intervals than the noncounseled group did. In the counseled group that had finished bracing, 70.2% did not progress > 5°, while 21.3% underwent surgery. In the noncounseled group, 52.8% did not progress > 5°, while 27.8% have progressed to 50° or surgery. Eighteen patients who underwent surgery wore their braces only 10.28 hours/day (for the patients with available data, as 2 surgical patients "lost" their braces or did not return them at followup).

Conclusions: Providing patients compliance feedback and counseling improves brace wear in patients with AIS. Patients who wore their braces more hours/day experienced less curve progression. Patients in both groups who progressed to 50° or surgery wore their braces fewer hours over the course of bracing than their successful counterparts.

Significance: Compliance monitoring and counseling should become part of the clinical orthotic management of patients with AIS.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

♦ Percutaneous Doxycycline Therapy of Juxtaphyseal Aneurysmal Bone Cysts

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Purpose: To evaluate clinical efficacy and outcomes of percutaneous imaging-directed therapy of juxtaphyseal aneurysmal bone cyst (ABC) in children with doxycycline as a multimodal (antitumoral, MMP inhibition, and osteoblastic stimulation) antineoplastic therapy.

Methods: From an ABC database of 67 patients, a retrospective outcomes analysis was performed of sixteen children with juxtaphyseal ABC (biopsy proven) ages 2-15Y (Mean=7.1Y) who treated percutaneously for ABC. Doxycycline microfoam was percutaneously injected into cystic and solid tumoral elements with US, CT, or fluoroscopic directed guidance (Mean dose=300 mg/session). Bone graft substitute was injected into cystic spaces to facilitate osteoblastic ingrowth. The primary endpoint was bony healing of lytic foci, with stability during surveillance. Analysis included evaluation of the morphology of the growth plate, symmetrical physeal growth, presence/absence of physeal bars, juxtaphyseal deformity, and movement of the healing ABC scar away from the physis.

Results: ABCs of the humerus (9), tibia (3), fibula (2), ulna (1), and femur (1) were treated in 102 percutaneous sessions (Mean = 6.4 sessions per patient). All patients have completed or are completing the percutaneous ABC protocol; follow-up 12-62 months (Mean = 39 months). Boney healing response was present in 16/16 patients; remodeling to normal or near-normal morphology was documented in 16/16 patients, with visible boney scar in16/16 (100%) migrating distal from the physis. Physeal growth was symmetrical in 16/16 patients, without physeal bars or deformity. One case of focal skin necrosis was noted; no other complications.

Conclusion: Directed antitumoral therapy with Doxycycline microfoam is feasible, safe, and effective for percutaneous treatment of juxtaphyseal ABC in the long bones of children.

Significance: When compared to literature references of 71% recurrence following open surgical treatment of juxtaphyseal ABC, percutaneous doxycycline therapy offers a promising new line of therapy for juxtaphyseal long bone ABC, as well as other sites of ABC.

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Can Perfusion MRI Performed in the Early Stages of Legg-Calvé-Perthes Disease Predict Lateral Pillar Involvement?

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Lateral pillar classification cannot be applied at the early stages (Waldenstrom stage I or IIa) of LCPD. One must delay classifying until the maximum fragmentation stage, which is suboptimal since significant deformity of the femoral head can occur by this time. Gadolinium MRI (Gd-MRI) evaluating the perfusion of the femoral epiphysis may provide earlier prognostic information about the hip before significant deformity occurs.

Purpose: To determine if Gd-MRI measurements of the epiphyseal perfusion obtained at the early stages of LCPD can predict the lateral pillar involvement at the maximum fragmentation stage.

Methods: 26 patients were prospectively enrolled. All patients had Gd-MRI at stage I or IIa and were radiographically followed. Gd-MRIs with subtraction technique that enhances the visualization of gadolinium were analyzed by 2 independent observers using a MRI analysis software, HipVasc. Total and lateral third epiphyseal perfusion were measured. Inter/intra-observer agreements were also assessed. Lateral pillar classification of the radiographs obtained at the max. fragmentation stage was performed by a consensus of 3 observers. Intraclass correlation coefficient and logistic regression were used for statistical analysis.

Results: Of 26 patients/29 affected hips, 18 hips were in stage I and 11 hips were in stage IIa at the time of Gd-MRI. Mean age at diagnosis was 7.6 ± 1.6 years (range 5.1-11.3). The mean interval between the time of Gd-MRI and the time of max. fragmentation was 5.9 ± 2.2 months. Logistic regression showed that % perfusion of the whole and the lateral third of the epiphysis were significant predictors of lateral pillar involvement (p=0.002). In the hips that developed lateral pillar A, B, or C, the mean % perfusion of the lateral third of epiphysis was 85%, 57%, and 38%, respectively. Inter/intra-observer agreements of MRI measurements ranged from 0.92 to 0.95. At the perfusion level of 75% in the lateral third, the odds ratio of developing lateral pillar A vs. B or C was 26. At the perfusion level of 45% in the lateral third, the odds ratio of developing lateral pillar C vs A or B was 16. Similar results were obtained using total epiphyseal perfusion.

Conclusion: The total and the lateral third epiphyseal perfusion measurements obtained at the early stages of LCPD using Gd-MRI were predictive of lateral pillar involvement at the maximum fragmentation stage.

Significance: Perfusion MRI obtained at the initial stage may yield prognostic information regarding lateral pillar involvement.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

The Modified Dunn Procedure for Unstable SCFEs: A Multi-center Perspective

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Purpose: Although the modified Dunn procedure (open subcapital realignment through a surgical dislocation approach) has rapidly gained popularity as a treatment for the unstable slipped capital femoral epiphysis (SCFE), limited data exists regarding its safety and efficacy. The purpose of this study was to present results and complications following this procedure in a large multi-center series.

Methods: We reviewed a consecutive series of patients who underwent the modified Dunn procedure by 5 surgeons from different tertiary-care institutions. All slips were defined as unstable according to the criteria of Loder. Patients with follow-up < 1 year and those with underlying endocrinopathies or syndromes were excluded from the series. Every operation was performed by a pediatric orthopaedic surgeon who had specific training in the modified Dunn technique. Operative reports, outpatient records, and follow-up radiographs were used to determine demographic information, type of fixation, final slip angle, presence of AVN, and any additional complications. Standardized surveys were administered to determine pain level (0-10 scale), satisfaction (0-100 scale), function (modified Harris hip score, 0-91), and activity level (UCLA activity scale, 0-10) at most recent follow-up.

Results: Twenty-seven patients (27 hips) met inclusion criteria with a mean follow-up of 22.3 months (range 12-48). Four patients (15%) had broken implants at 3-18 weeks after surgery and required revision fixation. Seven patients (26%) developed AVN at an average of 21.4 weeks (range 10-39); each surgeon had at least one case of osteonecrosis. At final follow-up, mean slip angle was 6° [95% CI 2°, 11°]. Patients who healed without AVN had significantly better clinical results compared to those who developed AVN as demonstrated by a lower mean pain score (0.3 vs. 3.1, p=0.002), higher level of satisfaction (97.1 vs. 65.8, p=0.001), higher modified Harris hip score (88.0 vs. 60.0, p=0.001), and higher UCLA activity level (9.3 vs. 5.9, p=0.031)

Conclusion: We report the largest series of unstable slips treated with the modified Dunn technique. The incidence of failed fixation was 15% and AVN was 26%, which is comparable to previous studies on unstable slips, but larger than previous reports using the modified Dunn technique. Clinical and radiographic results were excellent if AVN did not develop.

Significance: This multi-center report demonstrates that the modified Dunn procedure is an effective technique for restoring anatomy and preserving function after unstable SCFE, but that implant complications and avascular necrosis can and do occur.

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3D Visualization of the Vertebral Growth Plate: The Effects of Growth Modulation

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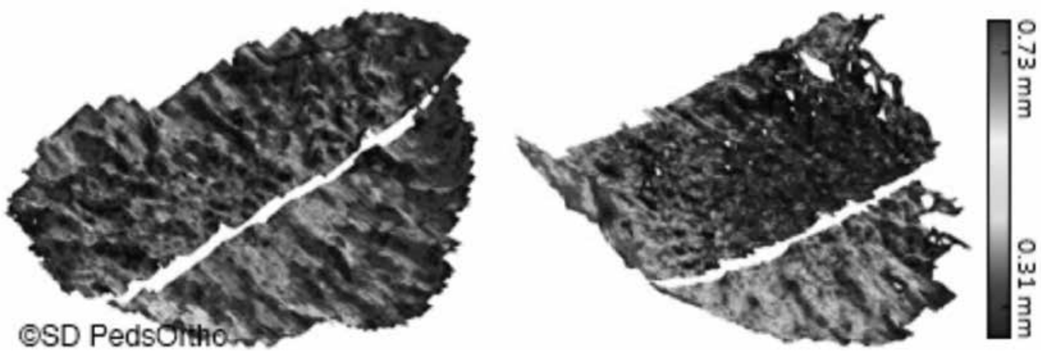
† LOE-Other Analysis Level II

Purpose: Spinal growth modulation is an attractive alternative to arthrodesis for scoliosis correction, as it may achieve correction without sacrificing motion and future growth. Growth modulation requires open/functioning physes to achieve correction. Standard physeal evaluation uses histology, reducing complex three-dimensional (3D) geometries to a single planar sample. This study evaluated the effect of anterolateral tethering on 3D vertebral physeal morphology in a rapidly growing bovine model.

Methods: Five-week old calves received right-sided anterolateral flexible spinal tethers (**Tether Group**) or sham surgeries (**Sham Group**); n=6 each. Following six months of growth, individual motion segments (n=9 segments, each group) were imaged by microtomograph (36µm). Physeal-space thickness maps were generated from surface reconstructions (Figure). Normalized thickness differences were compared between right (instrumented) and left (contralateral) sides and between tether and sham groups. Significance was assessed using ANOVA (significance set to $p<0.05$). Physeal closure percentage was estimated: regions of bony bridging were marked as "closed."

Results: Tethering caused significant physeal thickness reduction on the right side compared to the left (7.6±2.0%, p=0.0002). Physeal wedging was greater in the tethered group than in the sham group (p=0.003) which demonstrated no thickness differences between sides (0.8±3.7%, p=0.60). Small regions of physeal closure were observed in the tether group (median of 1.4%, maximum of 6.8% closed) and the sham group (median of 0.1%, maximum of 2.7% closed).



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See pages 15 – 57 for financial disclosure information.

Conclusion: Tethering resulted in thinner physes on the tethered side without notable growth plate closure. Since no such reduction was observed in the sham group, it would appear that tethering increased compressive forces on the instrumented side of the physis as desired. Producing consistently oriented and positioned histological samples is a difficult task, and misaligned slices can cause undulated physes to appear falsely thicker, thinner, or asymmetrical. Evaluating the entire physeal surface using 3D methods as was done in this study eliminates the problems associated with histological sampling and produces more robust results.

Significance: In the future, growth modulation may play an important role in the treatment of spinal deformities in children with years of remaining growth. The 3D physeal analysis performed in this study provided new insight into the efficacy of tethering and may find further application in the fields of physeal fractures and epiphyseal disease (examples: dysplasia, SCFE).

Acute BMP-2 Response following Induction of Ischemic Osteonecrosis in Immature Femoral Head

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† LOE-Other Analysis Level I

Purpose: Juvenile ischemic osteonecrosis of the femoral head (IOFH) is one of the most serious hip conditions that causes the femoral head deformity. In our immature pig IOFH model, we found acute BMP2 increase in the femoral head cartilage 24 hours after ischemia induction surgery. While BMP2 is well characterized as a potent bone inducer, little is known about the pathophysiological role of BMP2 in ischemic osteonecrosis. The purpose of this study was to investigate the mechanisms responsible for the acute increase in BMP2 following ischemic osteonecrosis.

Methods: We analyzed BMP2 expression in piglet femoral head cartilage after ischemia surgery using microarray and quantitative RT-PCR. We also established a novel mouse model of ischemic osteonecrosis by microsurgery and analyzed BMP2 expression and BMP signaling using reporter mice. In vitro experiments using chondrocytes and cartilage explants under hypoxia (1% O2) and normoxia (21% O2) were performed to confirm the in-vivo data. Since low oxygen activates hypoxia inducible factor 1 (HIF1), we investigated HIF1 activation as a mechanism for the BMP-2 increase using HIF1activator, desferroxamine (DFO) and HIF1 silencing (siHIF1). Since hypoxia is also known to induce the production of free oxygen radicals, which are converted to hydrogen peroxide (H2O2) by superoxide dismutase 2 (SOD2), we investigated the effect of H2O2/SOD2 production as an alternative mechanism for the acute BMP2 increase following ischemic osteonecrosis.

Results: BMP2 expression and BMP signaling were enhanced in the cartilage surrounding the necrotic bone in our ischemic osteonecrosis pig and mouse models. BMP2 was increased in chondrocytes and cartilage explants under hypoxia compared with normoxia. HIF1 activator DFO significantly increased BMP2 while HIF1 silencing only partially reduced BMP2, suggesting that other mechanisms for the BMP2 increase may also be present. Under hypoxia, chondrocytes produced significantly greater level of H2O2. Adding H2O2 to chondrocyte culture also significantly increased BMP2. SOD2, which produces H2O2, was dramatically increased in the ischemic pig cartilage after ischemic surgery and in chondrocytes/cartilage explants under hypoxia. Addition of SOD2 protein to the chondrocyte culture also significantly increased BMP2.

Conclusion: The acute BMP2 increase in chondrocytes after ischemic osteonecrosis appears to be through the H2O2 production and the HIF1 activation with the former playing a more dominant role.

Significance: This study will advance the understanding of mechanisms of BMP2 increase following ischemic osteonecrosis and lead to a better biological treatments for IOFH.

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Improving Bone Healing in Neurofibromatosis: A Study in Mice

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† LOE-Other Analysis Level I

Purpose: Patients with Neurofibromatosis (NF1) exhibit deficient bone healing, which can lead to "congenital" pseudarthrosis of the tibia (CPT). The cause of poor bone healing in NF1 is unclear, and pharmacologic approaches to improve bone repair are lacking. Beta-catenin is a protein that regulates osteoblasts during bone healing. When beta-catenin protein level is high, it prevents osteoblast differentiation, and undifferentiated fibroblast-like cells persist at the fracture site, resulting in a pseudarthrosis. In this study, we used mice with lacking the *Nf1* gene to study the role of beta-catenin in tibial bone healing.

Methods: Genetically engineered mice in which the *Nf1* gene can be deleted when cells are exposed to Cre-Recombinase were studied. An adenovirus expressing Cre-Recombinase was injected to the fracture site to knock out the gene. Mice in which the beta-catenin gene can be knocked out by exposure to Cre-Recombinase were used to decrease beta-catenin during fracture repair. As an additional method to inhibit beta-catenin, Nefopam, a drug that inhibits beta-catenin was administered orally in select mice An open tibial fracture, fixed with an intramedullar pin, was used to study fracture healing..] Eight mice were studied in each group at each time point, and fracture repair assessed at three and six weeks using micro-CT and histology. Human CPT tissue and adjacent normal bone were obtained from patients undergoing surgery, and beta-catenin levels tested using Western analysis

Results: Beta-catenin protein level in human CPT and during fracture repair in mice lacking the *Nf1* gene measured five times higher than normal (P<0.01). Mice lacking *Nf1* gene showed deficient fracture repair, with no osteoblasts at the fracture site 3 weeks after fracture. In contrast, mice lacking *Nf1* gene, but that also express a low level of beta-catenin healed their tibia fracture quicker and with more bone as measured using both radiographic and histologic parameters. Mice lacking the *Nf1* gene that were treated with Nefopam also healed their fracture faster and with more bone formation, showing a similar healing process as observed in normal (wild-type) mice.

Conclusion: Beta-catenin protein is elevated during fracture repair in mice lacking *Nf1* and in human CPT. Inhibition of beta-catenin genetically or pharmacologically can improve the quality of the bone repair process.

Significance: Inhibition of beta-catenin, perhaps using the drug Nefopam, might be an effective and safe way to improve bone healing in patients with NF1, and could be useful adjunct in the treatment of conditions such as CPT.

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Guiding Femoral Rotational Growth in an Animal Model

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† LOE-Therapeutic Level I

Purpose: Guided growth is most commonly utilized around the knee for the correction of coronal plane deformities by using plates positioned perpendicular to the physis. Sagittal plane deformity correction has been described as well.

The purpose of our study was to examine the ability to affect axial-rotational growth. Our hypothesis was that placement of plates in an oblique orientation relative to the physis can induce a rotational growth deformity.

Methods: Our hypothesis was tested on a mathematical model and subsequently on the distal femur in a rabbit model. 13 rabbits at 6 weeks of age underwent a rotational guided growth procedure of the right distal femur with a sham procedure performed on the left side. Two plates were positioned in oblique orientation relative to the physis medially and laterally perpendicular to each other. The rabbits were sacrified 6 weeks after the surgery. Femoral rotational profile was assessed by CT scans of the dissected femurs and the growth plates were examined histologically.

Results: A significant effect on the rotational profile of the femurs was found in the operated group. The rotational profile comparing right and left femurs when the plates were positioned in order to guide external rotation was significantly higher in the study group (29.0 vs. 11.3 degrees respectively; p=0.008). There was a linear correlation between the right-left difference in rotational profile and the difference in inter-plate angle (p value=0.001). The percent of explained variance was (R2) 0.72. Every one degree of inter-plate angle difference equals 0.367 degrees of rotational profile difference (p=0.001). Histologically, a swirling effect of the physeal cell columns was seen on the operated femurs.

Conclusions: Guided growth by plates can be used in order to alter axial-rotational growth in a predictable fashion.

Clinical relevance: Guided growth by plates may be used for correction of rotational and multiplanar deformities.

† LOE – Level of Evidence – Please see page 14 for details.

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Developmental and Genetic Etiology of Tibial Hemimelia in Mouse and Human

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Purpose: Tibial hemimelia is a difficult congential problem that often results in lifelong disability. The embryonic origin of the defect is unknown, and very few human mutations have been described, especially for sporadic cases. We wished to uncover the developmental basis of this condition using a mouse model and determine whether human tibial hemimelia shares the same genetic etiology.

Methods: We focused on genes that are expressed in the region of the early embryonic limb bud from which the tibia is derived. We knocked out *Iroquois (Irx) 3* and *Irx5*, two homeobox genes, in the mouse to test their function, and analyzed the resulting skeletal phenotypes. Conditional inactivation of genes at different time points during development was undertaken to determine the sequence of development of the different limg segments. Evaluation of genomic deletions and duplications was undertaken from human tibial hemimelia samples using the *Cytoscan* array.

Results: In mice with inactivated *Irx3* and *Irx5*, the tibia is largely absent as is digit one and sometimes digit two. The missing skeletal elements are derived from a distinct progenitor population in the anterior region of the limb bud at a very early stage of embryogenesis. Irx3/5 proteins normally drive expression of an important gene called *Gli3* in the limb. In 3 human cases of tibial hemimelia, an Irx binding site for this interaction is deleted.

Conclusion: The tibia and digit one are derived from a population of progenitor cells that express Irx3/5. A key function of these proteins is to regulate *Gli3*. Our findings suggest when this regulation is disrupted in mice or humans, cells destined to become the tibia and digit one do not organise properly.

Significance: We identified one of the first mutations described for sporadic human tibial hemimelia. This information will facilitate genotype/phenotype analysis to dissect the heterogeneity of the condition. Analyzing mouse models in concert with human mutational screening is a powerful method to dissect the etiology of congenital anomalies.

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Thermal Epiphysiodesis Made with Radio Frequency Ablation, RFA in a Porcine Model

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Introduction: Anisomelia is often treated with epiphysiodesis. Epiphysiodesis has become the most commonly used procedure for leg length equalization. Current techniques involve opening cortical windows, usage of staples or tension devices, and destruction with curettes or drills. Complications such as breaching of the cortex, damage to the metaphysis, and vascular or nerve injury have potentially serious consequences. Therefore, RFA may be a method which neutralizes these complications. RFA involves the application of energy in the radio wave frequency resulting in local thermal coagulative necrosis. It has been shown to be a reliable technique for creating thermally induced coagulation necrosis. The experience with this technique has been reported as a clinical success and complications are rare.

Objective: Development of a new technique for epiphysiodesis using RFA in an experimental porcine model.

Methods: Six 35 kg pigs and two 25 kg non-mature pigs were used. A control leg was randomly selected and the contralateral physis was treated at two ablation sites (lateral and medial) identified using a C-arm. Under general anesthesia, a probe was inserted and the ablation performed. T1, T2 and water content MR images were obtained right after the procedure; 12 weeks later for 6 animals, and 6 months later for the last 2 ones. The length of both tibiae was measured immediately after the ablation and at the end of the study.

Results: Both legs were equal at the beginning of the study and, overall, there was a leg length difference (P=0.006) in average of 4.8mm (SD=2.25, Median=3.88) at the end. For the 12 week follow-up we found an average leg length difference of 3.9mm (SD=1.286, Median=3.666, P=0.014), and for the 6 month one we found a difference of 8.11mm in average. No damage to the surrounding cartilage structures was found. The animals could walk normally after the anesthesia and no signs of pain or discomfort were presented during the follow-up period.

Discussion and Conclusion: Epiphysiodesis using RFA is an innovative technique that may represent an alternative way of treatment that potentially involves less scarring, less exposure to X-rays, and reduces the risk of injuring the surrounding structures compared to current methods. These results show that this technique can arrest growth in a safe and effective way. However, studies must be performed to obtain more evidence of both the safety and effectiveness of the procedure.

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Revision Rate following Arthroscopic Shoulder Stabilization in Patients Under 21 Years of Age

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Purpose: While younger patients with shoulder instability commonly undergo arthroscopic stabilization, there is little information regarding recurrent instability after surgical treatment. The purpose of this study was to quantify the rate of revision surgery following arthroscopic stabilization of traumatic shoulder instability and possible risk factors in young, active patients.

Methods: A retrospective study of 161 shoulders in patients under 21 years of age who underwent arthroscopic stabilization for unidirectional traumatic shoulder instability between 1999 and 2010 was performed. Mean age of patients was 17 years; median follow-up was 40 months. Eighteen percent had surgery after their first dislocation, while the remaining 82 % of patients had multiple instability events prior to surgery. Risk factors for revision surgery were evaluated, with variables including age, gender, hand dominance, mechanism of injury, age at initial dislocation, age at time of arthroscopic stabilization, physeal status, involvement in contact sports, number of anchors, presence of concomitant ALSPA, Hill Sachs, HAGL, and glenoid fracture, number of previous instability events, time from initial dislocation to surgery, and total of arc of labral tear. Univariate and multivariate logistic regression, chi-square and Kaplan-Meier time to event analyses were used to assess factors associated with revision.

Results: The overall rate of revision surgery was 14.2 %. Eleven of the 23 revisions were secondary to a repeat traumatic mechanism while playing sports (6.8%). The majority of revision procedures were conducted arthroscopically, with only one patient undergoing secondary open revision. Younger patient age at time of stabilization was suggestive of increased revision rate. Chi square analysis comparing revision rates for ages 13-16 and 17-20 year olds showed a significant difference ($p=0.03$, 21% versus 9% respectively). First time dislocators who underwent surgery did not have a statistically significant different revision rate. No other risk factors were associated with increased rates of revision surgery.

Conclusion/Significance: While arthroscopic stabilization is successful in the majority of patients under 21 years with traumatic unidirectional instability, 14% of patients have recurrent symptoms requiring revision stabilization. Half of the recurrent cases resulted from new traumatic injuries sustained during sports. While younger patients were more likely to undergo revision procedures, history of multiple dislocations and greater severity of injury did not correlate with higher rates of revision.

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Efficacy of Pre-operative Regional Anesthesia in Patients Age 10-18: A Randomized, Prospective Study

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† LOE-Therapeutic Level I

Purpose: There has been a shift to find ways to increase the duration and quality of pain control for surgical patients. One area of improvement is the increased utilization of regional anesthesia. The efficacy and benefits of regional anesthesia has been reported as well as certain specific risks, including numbness and tingling and paresthesia lasting longer than 24 hours. Review of the literature revealed that most studies on regional anesthesia have been performed in adults with few subjects younger than 18 years old. The purpose of the current study was to evaluate the safety and efficacy of pre-operative regional anesthesia in an outpatient sports medicine population in children ages 10-18. We expected that: (1) there would be no increased risks associated with regional anesthesia compared to general anesthesia alone, (2) when comparing these two groups, pre-operative regional anesthesia would be successful in reducing gastrointestinal side effects, (3) patient self-reported oral narcotic medication use and pain rating would be decreased in the first 48 hours post-operatively.

Methods: Participants were approached during their pre-operative appointment at a sports medicine outpatient clinic. Participants, ages 10-18 years (m=15.10, sd=2.85), were randomized into either a treatment group (N=38) receiving both regional and general anesthesia or a control group (N=44) receiving only general anesthesia. Participants completed pill count and pain questionnaires out to 48 hours post-operatively.

Results: The findings support no increased risks associated with regional anesthesia compared to general anesthesia. No significant differences were found post-operatively between the treatment and control groups among gastrointestinal side effects. Significant pain differences were noted between the groups at the time of their discharge from the post-operative care unit (PACU) (treatment group mean=1.7, control group=3.9, p=0.001, range 0-8 on 10-point scale). This pain increased at 4 hours post discharge (treatment group 2.4, control = 5.1, p=0.002, range 0-9). There was no difference during the first post-operative day but a difference in pain reappeared on post-operative day #2 (treatment = 3.8, control = 5.3, p=0.02, range 0-8). No significant differences were found between the patient's arrival in the PACU and day 2 post-operatively in pill counts.

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Conclusions: Our findings support that regional anesthesia in conjunction with general anesthesia can be a safe procedure within orthopaedic sports medicine settings, particularly among a pediatric population. In the outcomes that we looked at, we did see a difference between the use or not of regional anesthesia when used in conjunction with general anesthesia at several time points until their first post-operative visit. This difference was significant at the time of PACU discharge and then again at day #2 post-operatively.

Significance: The current study contributes to our knowledge regarding the safe use of regional anesthesia with general anesthesia among pediatric orthopedic surgical populations. Research regarding additional benefits to the use of regional anesthesia within this population is warranted.

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Reliability of the ROCK Osteochondritis Dissecans Knee Arthroscopy Classification System – Multi-center Validation Study

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Purpose: Current non-operative and operative treatment of knee osteochondritis dissecans has a 30%-50% failure rate based on complete radiographic healing outcome. Very few predictors of healing have been identified to help guide OCD treatment decisions for patients, families and physicians. For staging systems to be useful, there must be agreement among observers of each stage. Although arthroscopic staging systems exist, none have been tested for intra-observer and inter-observer reliability. The ROCK OCD study group developed an arthroscopy classification system for OCD of the knee. The purpose of this study was to determine the reliability of an OCD classification system in a multicenter study group.

Methods: We developed a classification system for arthroscopic evaluation of OCD of the knee based on the experience of a 13 centers experienced in the care of OCD. The classification system produced 6 arthroscopic categories (Cue Ball, Cartilage Wrinkle, Intact Trampoline, Locked Door, Trap Door, and Crater). A training module including arthroscopic photos, iconic sketches, and representative videos was developed to describe each stage. A total of 30 representative arthroscopic videos were viewed by 10 orthopedic surgeons who had not participated in the video case selection and preparation. After 60 days, the 30 videos were reviewed a second time in a new, randomly selected order and classified. A inter-rater reliability assessment was performed using the intra-class correlation method.

Results: The intra-class correlation coefficient was 0.92, indicating a very good to excellent reliability of this classification system amongst orthopedic surgeons within the ROCK group.

Conclusion: The ROCK OCD Knee arthroscopy classification system demonstrated high reliability. This classification system will facilitate multi-center studies for OCD.

Significance: Relatively rare conditions will require multi-center study groups to perform high quality outcome studies. The ROCK arthroscopy classification has a high reliability and each stage may now be tested to determine healing prognosis and response to treatment.

† LOE – Level of Evidence – Please see page 14 for details.

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Prevalence of Discoid Meniscus during Arthroscopy for Isolated Lateral Meniscal Pathology in the Pediatric Population

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Introduction: The purpose of this study was to review and evaluate all the isolated lateral meniscus pathology that required arthroscopic treatment in a pediatric sports medicine practice.

Methods: We performed a retrospective review of all isolated lateral meniscus arthroscopic procedures from 2005 to 2011 in a high volume pediatric sports practice. Presentation, radiographs, and intraoperative findings were reviewed. The prevalence and clinical findings of a discoid meniscus in this population and amongst all age groups were compared to those with a meniscus tear occurring in a normal meniscus.

Results: One hundred and eighty-six arthroscopies were performed for symptomatic isolated lateral meniscus pathology. Of these, 69% were discoid in nature; the remainder was tears occurring in normal menisci. All patients (100%) with lateral meniscus pathology under the age of 13 had a discoid meniscus and 57% presented with no injury. There was a transition within the population at 14 years of age, with a rise in the incidence of normal meniscal body tears. Even after this transition point, meniscal pathology incidence remained notable; forty-six percent of isolated lateral meniscus pathology in patients between the ages of 14-16 years old was a discoid meniscus. MRI criteria for discoid meniscus (3 consecutive sagittal cuts or coronal midline measure) were unreliable after the age of 13 years old. The ratio of complete to incomplete discoid in all age groups is four to three.

Conclusion: Discoid meniscus has a high prevalence in the pediatric population with isolated lateral meniscus pathology.

Significance: A clinician should have a high index of suspicion for a discoid meniscus when treating lateral meniscal pathology in the pediatric population.

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Knee Injury in Downhill Skiers: Comparison of Adults and Children Injury Mechanisms

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Purpose: Several mechanisms of adult skier knee injuries have been proposed. The purpose of this study was to identify the most common knee injury mechanism in young skiers (<18 years) and compare the injury distribution patterns to adults.

Methods: IRB approval was obtained for this prospective study. Over six ski seasons at 4 western ski resorts, a total of 443 adult, and 75 youth skiers with acute knee injuries completed a survey. The skiers selected one of 6 injury classifications (valgus external rotation, hyperextension, boot induced, phantom foot, collision, other). Other factors were also recorded, including age, sex, height, weight, years of experience, and ski binding release. The injury distribution was compared to that distribution of an established database of adults.

Results: Of the 75 youth skiers, 37% were female and 63% were male. The injury distribution percentages for children compared to adults were: valgus external rotation (33 and 32%), phantom foot (25 and 23%), hyperextension (20 and 19%), boot induced (4 and 8%) collision (0 and 3%), and other (12 and 10%). There was no significant difference between the distribution of injuries among the six different mechanisms between children and adults. Both adult and youth skiers who were self-identified as "advanced" had a significantly higher incidence of valgus external rotation than less experienced skiers. During injury, bindings released in 19.3% percent in adults, and 48.2% percent in youths, a significant difference ($P<0.01$).

Conclusion: Children and adults have similar mechanisms and distribution for skier knee injuries. In both youth and adults skiers, the valgus external rotation mechanism is the most common injury. Advanced skiers have the highest frequency for the valgus external rotation injury. The number of reported injuries was significantly higher for males compared to females in this cohort ($P<0.01$). Binding release was more likely to occur in youth skiers in comparison to adults. The number of adult injuries was higher than youth injuries.

Significance: This study compared the most common knee injury patterns between children and adults. We found a similar distribution of knee injuries mechanisms in children and adults, although the pattern of binding release is different for these age groups. Future research into binding design may consider these biomechanical patterns to reduce the risk of injury.

† LOE – Level of Evidence – Please see page 14 for details.

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Acute Complications of Pediatric and Adolescent Knee Arthroscopy

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† LOE-Therapeutic Level IV

Purpose: Arthroscopic knee procedures are commonly performed in pediatric/adolescent patients. Reported complications following these procedures are low, however, no childhood specific data exists. Therefore, the purpose of this study is to determine the acute complications (within 6 months) of arthroscopic knee procedures in patients aged 17 years or less.

Methods: This is a retrospective review of patients aged 17 years or less who underwent an arthroscopic knee procedure from 1997 to 2009 at a single institution. Demographic and surgical data was collected, in addition to specific data on intra-operative and post-operative complications. Minor complications included peripheral nerve block failure, regional anesthesia failure requiring conversion to general anesthesia, superficial wound infection/dehiscence, persistent knee effusion requiring aspiration, and sensory nerve dysesthesia. Major complications included death, major medical complication, septic arthritis, wound requiring repeat closure, arthrofibrosis, equipment failure, and revision surgery.

Results: 1015 patients (555 males (54.7%), 460 females (45.3%)) with average age 15.3 (range 4-17) years were analyzed. The average operative time was 133.9 minutes (range 14-520). 467 (46%) underwent ACL reconstruction, 465 (45.8%) underwent synovectomy, treatment of an OCD lesion, meniscal treatment, or lateral release, 52 (5%) had a medial patellofemoral ligament reconstruction +/- tibial tubercle transfer, 17 (1.7%) arthroscopic fixation of a tibial eminence fracture, and 14 (1.4%) other ligament reconstruction.

There were 178 (17.5%) total complications recorded. Major complications occurred in 52 (5.1%) of patients and minor complications in 126 (12.4%) of patients.

Major complications included: intra-articular instrument breakage in 1(0.098%), septic arthritis in 4 patients (0.394%), 9 wounds requiring repeat closure (0.886%), arthrofibrosis in 5 patients (0.492%), unplanned subsequent surgical procedure in 32 patients (3.15%), and death in 1 patient (0.098%). 2 patients were readmitted to the hospital (1 DIC, 1 a-fib and syncope). There were no pulmonary emboli or DVTs, and no vascular injuries. No patients developed CRPS.

Minor complications included: 5 patients (0.492%) sensory nerve paresthesias, 10(0.985%) patients with failed regional anesthetic, 16 (1.57%) patients with post-operative pain pump that required early discontinuation, 18(1.77%) patients with superficial wound infection/irritation, 60 (5.91%) patients with persistent effusion/hemarthrosis requiring arthrocentesis, and 17(1.67%) patients had medical problems that required intervention (asthma exacerbation, urinary retention).

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Conclusions/Significance: Major complications following knee arthroscopy in children and adolescents are relatively low 5.1%. Minor complications are more common (12.4%) but did not alter the post-operative course or recovery. DVT, PE, and CRPS did not occur in this patient cohort.

Growth Disturbance following Intra-articular Distal Radius Fractures in the Skelatally-Immature Patient

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† LOE-Therapeutic Level IV

Purpose: The goal of this investigation is to define the rate of premature physeal arrest associated with intraarticular distal radius fractures in skeletally-immature patients. The study also characterizes the fracture pattern, treatment, and radiographic and functional outcomes in this patient population.

Methods: A retrospective investigation of all pediatric patients with intraarticular distal radius fractures between 1997 and 2012 at a single institution was performed. Fractures in skeletally-mature patients and pathologic fractures were excluded. Twenty-nine patients (24 males, 5 females), with a mean age of 13.9 years (range 6.3-17.2 years) and mean follow-up of 17.7 months (range 1-138 months), met the inclusion criteria. Fractures were categorized according to the Salter-Harris classification, and all radiographs were assessed for evidence of physeal disturbance. Information regarding treatment and early clinical results were obtained from medical record review. Functional outcomes using the Disabilities of the Arm, Shoulder, and Hand (DASH) and Modified Mayo Wrist Score (MMWS) were collected. Fisher's exact test was used to compare incidence of physeal arrest in the study population to previously published rates of physeal arrest in fractures involving the distal radius.

Results: Of the 29 patients included, 9 (31%) sustained Salter-Harris III fractures and 20 (69%) sustained Salter-Harris IV fractures. Premature physeal arrest occurred in 10 (34%) patients, comprised of 7 Salter-Harris IV fractures and 3 Salter-Harris III fractures. All 4 children age 10 years or younger had growth arrests that required subsequent procedures to address deformity. Surgical treatment consisted of combinations of ulnar shortening osteotomies (n=4), ulnar epiphysiodeses (n=2), radial physeal bar resections (n=2), intraarticular corrective radial osteotomy (n=1), and radial lengthening (n=1). Following these procedures, mean ulnar variance was + 1.7 mm (range -1.44 – 5.11), with two of the patients having fishtail deformities of the distal radius articular surface.

Conclusion/Significance: Intraarticular distal radius fractures in skeletally-immature patients have a considerably higher rate of physeal growth arrest than extraarticular physeal fractures. Follow-up radiographs should be obtained to evaluate for physeal arrest in this cohort. Patients and families should be counseled regarding the high rate of growth disturbance and the potential need for deformity correction in the future, particularly in younger children.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

♦Correlation between Standard Upper Extremity Impairment Measures and Activity-Based Function Testing in Hemiplegic Cerebral Palsy

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† LOE-Diagnostic Level I

Purpose: Children with hemiplegic cerebral palsy (CP) have postural deformities of the upper extremity (UE) due to abnormal muscle tone. These have been traditionally treated according to well-accepted indications based on active range of motion (standard impairment measures).[1-4] Recently, validated function tests based on activity measures have been used to assess hand function in UECP. We do not know whether range of motion (ROM) measurements correlate with activity-based measures.

Methods: As part of a randomized, controlled trial of treatment of UECP, 38 children who met standard indications for improving forearm, wrist and thumb position [1-4] also underwent a battery of activity measurements, including the PODCI, the Box and Blocks test, the Shriners Hospital for Children Upper Extremity Evaluation (SHUEE), and the Assisting Hand Assessment (AHA). We investigated whether the standard impairment measures correlated with the activity measures, using Pearson (parametric) and Spearman (non-parametric) tests ($p<0.05$).

Results: Active forearm rotation was associated with SHUEE dynamic positional analysis (DPA), and active wrist extension and SHUEE wrist task scores were also associated. SHUEE DPA scores correlated with Box and Blocks and AHA scores, but not with the PODCI. Thumb function could not be well visualized on the video-scored SHUEE and AHA.

Conclusion: Standard impairment measures as indicators for UE reconstruction in CP are correlated with activity measures, especially the SHUEE. Better measures of thumb function are needed.

Significance: This study supports the use of impairment measures as indicators for surgery in UECP by comparing them with validated activity measures, which play a complementary role by determining the impact of treatment on the child's ability to accomplish tasks.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Parent Reports of Function following Neonatal Brachial Plexus Palsy are Influenced by Medical Malpractice Litigation

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† LOE-Other Analysis Level III

Purpose: Patient/parent-reported outcome measures are important in clinical care and research for neonatal brachial plexus palsy (NBPP). NBPP often leads to medical malpractice litigation against obstetricians, yet the effect of litigation on patient/parent perceptions of function, analogous to the impact of worker's compensation claims on patient-reported hand function, has not been investigated. The present multicenter study tests the hypothesis that litigation negatively confounds parents' reports of patient function, independent of injury severity.

Methods: We retrospectively reviewed patients 2-18 years of age with NBPP, seen at one of three tertiary brachial plexus referral centers between 1990 and 2011, whose parents had completed the Pediatric Outcomes Data Collection Instrument (PODCI). The Raimondi Scale of Hand Function and Mallet Classification were used as physician measures of injury severity. Demographic information and previous treatments were recorded. Public county court records were searched online for medical malpractice litigation details. Variables found to significantly differ between litigation/non-litigation cohorts were used to create case-control matching groups for comparison of PODCI scores.

Results: Of 334 patients from 18 states, 75 (22%) were plaintiffs in medical malpractice lawsuits. Parents who filed lawsuits reported their child to have worse sports/physical function (84.4 vs. 89, p=0.012) and global function (84.5 vs. 88.1, p=0.020) than parents who had not filed a lawsuit. Since patients in lawsuits had worse injury severity, as measured by Raimondi (p=0.076) and aggregate Mallet (p=0.001) scores, than patients not in lawsuits, case-control matching cohorts were created to control for these variables. When patients were matched on Raimondi score and age within one year (n=64 pairs), parent reports of sports/physical function (p=0.002) and global function (p=0.031) remained worse for patients in lawsuits. Similarly, when looking specifically at patients with predominantly upper plexus injuries (Raimondi 4, 5), subsequently matched within one aggregate Mallet point (n=41 pairs), parent reports of upper extremity function (p=0.030) and sports/physical function (p=0.001) were still worse for patients in lawsuits. Furthermore, among patients involved in lawsuits, patients' pain was rated significantly worse by parents during litigation than after the close of litigation, independent of age, Mallet and Raimondi scores (p=0.046).

Conclusion: Litigation is associated with worse parent perceptions of their child's function following NBPP, independent of injury severity.

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Significance: The use of parent-reported outcomes in NBPP care and research must account for litigation status. Patients involved in litigation may require additional support to optimize function and quality of life.

Pediatric Forearm Fractures: Is There Still a Place for Cast Wedging?

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Purpose: Forearm fractures are some of the most common skeletal injuries in childhood and can usually be treated non-operatively with closed reduction and casting. Trends toward increasing operative treatment of these fractures have emerged. The objectives of this study are to demonstrate the safety and efficacy of cast wedging for treatment of pediatric forearm fractures.

Methods: This is a prospective chart review of patients with forearm fractures, including distal radius (DR) fractures, treated with cast wedging at a single large pediatric hospital from June 2011 to September 2012. Inclusion criteria specified open distal radial physes, closed injury, loss of acceptable reduction and increase in angulation from initial reduction films, and availability of clinical and radiographic data from injury to cast removal. Exclusion criteria included pathologic fractures, neurovascular injury, fracture-dislocations, open fractures, re-fractures, and closed DR physes. All reductions were performed and patients followed according to standard protocol at our institution, including placement into long arm casts, initial follow-up visit within 7-10 days post-injury, and weekly visits thereafter. If alignment was deemed unacceptable at either the first or second visit, cast wedging was utilized according to previously published protocols. Radiographic measurements of alignment included both radius and ulna on the injury film, post-reduction, pre-wedge, post-wedge, and final films. Radiographic technique was standardized, with repeatability testing demonstrating a precision of ±4°.

Results: Over fifteen months, our hospital treated 2,124 forearm or DR fractures with closed reduction and casting. There were 60 forearm or DR fractures treated either with percutaneous fixation (36) or open treatment (24). A total of 76 forearm or DR fractures were treated with cast wedging secondary to loss of reduction; this included 28 females and 48 males at an average age of 8.4 (range 3-14) years. Improvement in angulation from pre-wedge to final films was seen in both bones on AP (6° radius and 5° ulna) and lateral films (12 ° and 2°, respectively). There were no complications.

Conclusion: Cast wedging is a simple, safe, non-invasive and effective method for treatment of excessive angulation in pediatric forearm fractures.

Significance: This is a large case series describing radiographic outcomes of pediatric forearm fractures that successfully underwent cast wedging.

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Prognostic Effect of Clavicular Fractures on Obstetric Brachial Plexus Injuries

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Purpose: Large babies are more likely to sustain trauma during delivery. The most common injuries are clavicle fractures and brachial plexus palsy (BPP). The newborn with a weak arm may have a fracture of the clavicle, a BPP, or both. While the documented resolution of an isolated BPP injury is approximately 65%, we hypothesized that a concomitant clavicle fracture at birth has a protective effect on the plexus, and is a positive prognostic sign for recovery of obstetric brachial plexus injury. The purpose of this study is to determine the relationship between these two conditions by examining the incidence in a large population of newborn infants, and determining the outcomes in infants with residual neurologic deficits.

Methods: Birth records for Dallas County, discharge data from Parkland Memorial Hospital (PMH), and medical records for all patients with arm weakness and ipsilateral clavicular fracture at birth seen at our institution between January 1, 1988 and August 31, 2012 were reviewed. For the patients with residual plexus palsy at final follow-up, a functional score was obtained; modified Mallet or AMS score depending on patient age and ability to cooperate. Treatment details were reviewed.

Results: Between January 1988 and August 2012, 392 patients were referred to our institution for BPP and concomitant clavicle fractures, including 320 born at the County hospital, PMH, and referred from the newborn nursery. Seventy-two patients (nineteen from the county hospital, 27 from elsewhere in Dallas County, and 46 from outside the County) were evaluated at an average age of 2 months if there were still concerns about the limb. Fifty-two of the infants who were seen for neurologic concerns at 2 months had full spontaneous recovery. Twenty children had residual neurologic deficit at final follow-up of 53 months (range 5 to 288 months). No child has residual complaints related to the clavicle fracture.

During this period of time there were a total of 913,587 born in Dallas County, and of these, 366,408 babies were born at PMH. Babies born at the PMH with a clavicle fracture and a brachial plexus palsy are referred to our clinic. We track the referring physicians of our patients and have worked closely over the past three decades with the County pediatricians. By knowing the referral patterns and origins for our patients, we determined that the risk of residual brachial plexus dysfunction at two months of age when there was also an ipsilateral clavicle fracture is 1 in 20,000.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

Conclusion: BPPs with concomitant ipsilateral clavicle fractures have a markedly higher rate of spontaneous resolution than BPP without clavicle fracture.

Significance: Newborn infants with a BPP and an ipsilateral clavicle fracture have a better prognosis for neurological recovery than those with BPP alone.

Potential Causes of Loss of Reduction in Supracondylar Humerus Fractures

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Purpose: While recent biomechanical studies have evaluated the stability of various pin constructs for supracondylar humerus fractures, limited clinical data exists as to whether these constructs are associated with improved clinical outcomes. The goal of this study was to review the surgical management of Gartland type II and III supracondylar fractures to see if certain pin configurations increase the likelihood of post-operative loss of reduction.

Methods: In this IRB approved retrospective study, 192 patients treated with a displaced supracondylar fracture over a 5 year period were evaluated. Patients were excluded if treated with an open reduction or if they failed to have adequate radiographs. Loss of reduction was defined as a change > 10°in either plane from its intra-operative reduction. Fracture classification, comminution, and location were documented. Intra-operative films were assessed for number of pins, location of pins both medial and lateral, bicortical purchase, pin spread at the fracture site, and pin divergence. Statistical analysis was performed and significance was set at $p<0.05$.

Results: A total of 192 patients met the inclusion criteria. Ninety-four patients had type II fractures and 98 had type III fractures. The average patient age was 5.7 ± 2.3 years and 41% of the population was male. Extension type injuries represented 98% of fractures and 91% of fractures were at the level of the olecranon fossa. Loss of reduction was noted in 4.2% of patients. Patient demographics such as age ($p=0.48$) and gender ($p=0.61$) were not associated with loss of reduction. Fracture characteristics including type ($p=.85$), comminution ($p=0.99$), and location ($p=0.88$), were not associated with loss of reduction. Fractures treated with lateral-only pins or with two pin constructs were no more likely to lose reduction ($p=0.88$ and $p=0.91$). Pin convergence was not associated with a case of lost reduction. Pin spread at the fracture site was associated with loss of reduction with less spread increasing the likelihood of failure ($p=0.02$). Fractures that lost reduction had an average pin spread of 9.7(95% CI: 6.3-13.2) mm compared to 13.7 (95% CI: 13-14.4) mm for those that remained aligned.

Discussion: Loss of reduction after percutaneous fixation of supracondylar fractures occurs relatively infrequently at a rate of 4.2%. Fortunately, none required additional treatment. While technical errors at the time of surgery have been previously reported to be a cause of lost reduction, this study suggests spacing the pins at the fracture site widely is an important factor associated with preventing loss of reduction.

Significance: The pinning strategy chosen for a given supracondylar humerus should allow for the pins to cross the fracture site with at least 13 mm of spacing between the pins.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Long Term Outcomes in Adults of Comprehensive Surgical vs. Ponseti Treated Clubfoot

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Purpose: This study compared the long term biomechanical function and outcomes at adulthood of two types of clubfoot treatment, comprehensive surgical release and the Ponseti method, to healthy young adults controls.

Methods: Participants were recruited from a consecutive series of patients who underwent treatment between 1983–1987. Twenty-four subjects who underwent comprehensive surgical release using a Cincinnati incision ("Surgical Group," 17M, 7F; 21.8 +/- 2.3 years; 11 unilateral and 13 bilateral clubfeet) were included in this IRB approved study. All surgeries were performed by the same surgeon. Eighteen subjects who received Ponseti treatment at the University of Iowa ("Ponseti Group," 8M, 10F; 29.2+/- 5.5 years; 5 unilateral and 13 bilateral clubfeet) during the same time period agreed to participate. Both groups were compared to 48 adults without foot or gait pathologies matched for age and gender ("Control group", 29M, 19F; 23.2 +/- 2.4 years).

All participants were analyzed with foot and ankle motion analysis (Milwaukee Foot Model). Goniometric ROM measurements were taken at the ankles and feet. Isokinetic peak ankle torque plantarflexor strength was measured using the Biodex System 3. The Foot Function Index (FFI), SF-36, and Turco scores were measured. Wilcoxon Kruskal-Wallis tests were used to determine differences among the groups with $p<0.05$.

Results: Gait analysis showed differences in the morphology of the foot compared to controls for both clubfoot groups, with increased hindfoot plantarflexion and midfoot dorsiflexion. The Surgical Group failed to achieve peak hindfoot plantarflexion and forefoot varus during push off. Both clubfoot groups had significantly less ROM and strength, as well as, more pain than the Control Group. However, the Ponseti Group had significantly less pain (SF-36); greater plantarflexion ROM; and greater strength than the Surgical Group.

Conclusion: Both treatment groups presented with deficits in most measured parameters compared to controls including reduced foot ROM, ankle strength, increased pain and gait parameters. Comparisons between treatment groups revealed that, at the age range studied, the Ponseti Group performed significantly better than the Surgical Group, particularly in the presence of pain and weakness.

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Significance: These findings indicate that the Ponseti method of casting is preferable to surgical releases at an early age in the treatment of idiopathic clubfoot, a finding which may not be evident until young adulthood. Pain, limitations in ROM and strength are common findings in young adults who had clubfoot treatment, and continued research may identify better methods to improve care.

Functional Outcomes of Children Treated as Infants with the Ponseti and Dimeglio Methods at Five Years of Age

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Purpose: Neglected or mistreated clubfoot can result in significant functional impairment and disability. Current treatment techniques correct this deformity with the goal of improving function and decreasing disability in the long term. This study evaluates and compares the functional outcomes at age five years of children treated as infants with the Ponseti and French (Dimeglio) methods for idiopathic clubfoot, and compares them with an age matched non-clubfoot cohort.

Methods: This was a longitudinal, prospective case controlled study. Study subjects began treatment with either the Ponseti or Dimeglio method by three months of age and were evaluated at age 5 years with four functional measures: a standardized physical examination accessing active foot/ankle ROM, the Bruininks-Oseretsky Test of Motor Proficiency (BOT2), 3-D computerized gait analysis, and a standardized parent reported outcome tool (PODCI). The Ponseti group was 14 subjects (23 feet), the Dimeglio group was 16 subjects (22 feet). These were compared to an age matched cohort of normal non-clubfoot children, consisting of 15 subjects (30 feet).

Results: Active ROM: No differences were noted between all groups for inversion. Both Ponseti and Dimeglio groups showed decreased eversion, plantarflexion, and dorsiflexion compared to normals. No differences were observed between Ponseti and Dimeglio for plantarflexion and eversion. Ponseti had decreased dorsiflexion compared to Dimeglio.

BOT2: No differences were noted between all groups for measured motor skills (speed & agility, balance, strength).

Kinematics/Kinetics: Ponseti and Dimeglio groups had decreased peak ankle power, plantarflexion moment, dorsiflexion moment, dorsiflexion ROM, peak dorsiflexion in swing, and increased internal foot progression ($p<.02$) when compared with the cohort. There were no differences between the clubfoot groups.

PODCI: No differences were seen between all groups for upper extremity and transfers/ mobility. No differences were seen between Ponseti and Dimeglio groups for sports, pain and global function. Both Ponseti and Dimeglio sports and global function scores were lower than cohort. Dimeglio pain scores were lower than cohort. Ponseti pain scores were not significantly different than the cohort.

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Conclusions: The Ponseti and Dimeglio techniques resulted in equivalent outcomes for functional quantitative analysis in clubfoot patients at age five years. The clubfoot patients differed compared to a non-clubfoot group in some metrics analyzed, but overall the study groups appeared to function at a similar level as the cohort.

Significance: The functional abilities of children at 5 years of age treated for clubfoot with the Ponseti and Dimeglio method are equivalent and differ little from their non-clubfoot peers.

Ponseti Method for Untreated Idiopathic Clubfoot Presenting Between 5 and 10 Years of Age

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Purpose: Our goal was to evaluate the application of Ponseti's principles of deformity correction in untreated, idiopathic clubfeet presenting between five and ten years of age.

Methods: From Feb 2008 through Feb 2009, 42 pt (66 feet) matched our inclusion criteria, and 36 pt (55 feet, 83%) could be located for follow-up. Data included age, gender, side, pre-treatment Pirani and DiMeglio scores, and treatment course. Follow-up data included passive range of motion, foot alignment (standing), gait videos, and a short parental questionnaire.

Results: The average age at presentation was 7.4 years (5-10 years) and the average follow-up was 31.5 months (24-40 months). The average pre-treatment DiMeglio score was 15.9 (11-20). The average number of casts was 9.5 (6-11), and 94% were treated as inpatients. All patients required surgical intervention after a plateau had been reached with casting, including percutaneous release or open tendoachilles lengthening (49%), posterior release (34.5%), PMR (14.5%), and osteotomy (2%). The average ankle dorsiflexion was 90 (0-150) and abduction was 26.5° (0-40°). When standing, the forefoot was neutral (51%) or adducted (<100 in 36%, >100 in 13%), and the hindfoot was neutral or mild valgus (43%), varus < 10° (35%), and varus >100 (22%). Observational gait analysis revealed heel-toe gait (86%, 20% walk on lateral border), dynamic supination (14%), and knee hyperextension (14%). All patients could squat (70% "modified" squat), and 78% could do 10 toe raises. 75% of parents were completely satisfied, 22% were somewhat satisfied, and 3% were not satisfied. Parents reported that their child had improved self-confidence (94%), ADL's (100%), ability to walk long distances (100%), and anticipated better opportunities for employment (91%) and marriage (94% overall, 100% of females) in the future. None of the patients had any additional treatment at the time of review.

Conclusion: A plantigrade foot was achieved in 84% without an extensive soft tissue release or bony procedure, however mild undercorrection (or relapse) was common at 31.5 months follow-up. The implications of undercorrection remain to be determined, and longer term follow-up is required to reach more definitive conclusions. Recognizing these limitations, we suggest that the Ponseti method be considered as the initial treatment approach in patients presenting up to 10 years of age.

Significance: Adequate correction was achieved in a significant percentage of this older cohort using Ponseti's method. Even when full correction cannot be achieved, this approach may limit the extent of surgery required.

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Long-term Functional Outcomes of Resected Tarsal Coalitions

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† LOE-Prognostic Level III

Background: Tarsal coalition commonly requires surgical resection but there are few long term evaluations as adults. The purpose of this study was to compare the outcome of patients following resection of calcaneonavicular (CN) and talocalcaneal (TC) bars and to determine the relationship of the extent of a coalition with the outcome of resection.

Methods: Patients less than 18 years receiving resection for symptomatic tarsal coalition at SickKids Hospital in Toronto (1991 to 2004 inclusive) were eligible. Patients were reviewed to determine demographics, age at time of surgery, type of coalition(s), procedure(s) performed, post-operative course and/or complications. Previous radiographs and computed tomography (CT) scans were used to verify the type and size of the coalition(s). Two validated functional outcome scales were utilized: a) the AAOS Foot and Ankle Module, including the Foot and Ankle Core Scale (FACS) and Shoe Comfort Scale (SCS), and b) the Foot Function Index (FFI).

Results: A total of 26 patients, with a combined 34 operative tarsal coalition resections (19 CN feet and 15 TC feet) were included in this study. The mean age of all patients at the time of resection was 11.7 + 1.8 years (range 8.0-15.0 years) and the average follow-up period was 14.3 + 4.0 years (range 6.9-20.3 years). There was no statistical difference between the CN and TC groups at follow-up with respect to: post-operative range of ankle motion (plantar-flexion and dorsi-flexion) and post-operative clinical hind-foot alignment. Post-operative sub-talar motion (inversion and eversion) was significantly less for TC feet compared to CN feet [6.7 + 4.4° vs. 10.9 + 4.5° (p=0.02) and 5.4 + 3.3° vs. 8.2 + 3.5° (p=0.04) respectively]. No statistical difference was noted between the CN and TC groups with respect to outcome questionnaires [AAOS-FACS (100=best outcomes): 83.7 + 17.7 vs. 83.9 + 8.9 (p=0.98), AAOS-SGS (100=best outcomes): 79.5 + 29.4 vs. 78.0 + 33.2 (p=0.89) and FFI (100=poorest outcomes): 19.5 + 19.5 vs. 17.2 + 13.9 respectively (p=0.72)].

Five patients with TC coalitions >50% (mean coalition size of 73.7+21.6%) had AAOS-FACS scores of 85.2 + 12.0 and FFI scores of 14.6 + 15.0. Five patients who had resections and coalitions less than 50% (mean coalition size of 37.2 + 7.5%), their AAOS-FACS score were 84.6 + 5.0 and their FFI were 21.0 + 15.8. No correlation was noted between size of TC coalitions and AAOS-FACS scores or FFI scores (R^2=0.02 and R^2=0.10 respectively).

Conclusion: CN and TC resected bars behave similarly in the long term with respect to function and patient satisfaction.

Significance: Favourable long term results can be attained when resections are performed on TC coalitions that are larger than 50%.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Simultaneous Tarsal Coalition Resection with Calcaneal Lengthening Osteotomy

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† **LOE-Therapeutic Level IV**

Purpose: Symptomatic tarsal coalitions with associated planovalgus deformity that fail nonoperative management are usually treated with resection of the coalition and interposition of a soft tissue graft. Postoperatively, patients often are dissatisfied due to continued symptoms associated with the foot deformity. This study reports the results of simultaneous calcaneal lengthening osteotomy to address planovalgus deformity combined with tarsal coalition resection.

Methods: A retrospective review was conducted evaluating eleven children and adolescents (sixteen feet) who underwent a single stage tarsal coalition resection with interposition of a soft tissue graft in combination with a calcaneal lengthening osteotomy. All patients had failed nonoperative treatment. Mean age at time of surgery was 13.0+2.7 years. The average BMI % was 91 and all but one subject was above the 80%. Three feet had calcaneonavicular coalitions and thirteen had talocalcaneal coalitions. Data was collected on clinical exam and radiographic exam pre and postoperatively. Seven feet had pre and postoperative pedobarographic studies completed. Preoperative and postoperative comparisons were made using Student *t* test.

Results: On clinical examination, 14/16 feet (88%) did not have any pain at an average of 3.4 years postoperatively (range 4 months to 8 years). The two painful feet had pain only with standing for long periods of time. All radiographic measurements had significant changes towards normal values. The average lateral talo-first metatarsal angle decreased by 9.4^0 ($p = 0.002$), the lateral talo-horizontal angle decreased by 5.7^0 ($p = 0.013$), the calcaneal pitch increased by 4.0^0 ($p > 0.001$), and the anterior posterior talonavicular coverage angle decreased by 4.9^0 ($p=0.011$). Pedobarographically, there was a significant lateral shift of peak plantar pressures. The medial midfoot peak plantar pressure distribution decreased by 5.4% ($p = 0.044$), the lateral midfoot peak plantar pressure distribution increased by 3.2% ($p = 0.033$) and the lateral forefoot pressure increased by 8% ($p = 0.01$). The most common complication was symptomatic hardware in 7 feet with resolution of symptoms after hardware removal in 6 feet.

Conclusions: Single stage tarsal coalition resection combined with calcaneal lengthening osteotomy was a reliable procedure to alleviate pain and correct deformity. In addition to subjective improvement, more typical radiographic and pedobarographic parameters were observed in short to midterm follow up.

Significance: Deformity correction should be considered in conjunction with excision of symptomatic tarsal coalition. This technique may decrease the need for arthrodesis, particularly for talocalcaneal coalitions.

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Non-Union after Triple Arthrodesis in Children: Does it Really Matter?

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Purpose: Triple arthrodesis is a commonly performed salvage procedure to correct hindfoot deformity resulting from a myriad of diagnoses. The surgery is performed in both children and adults. Non-union is considered an undesirable radiographic outcome; however, the clinical ramifications of radiographic non-union are not as well-defined, especially in children. The purpose of this study is to determine the incidence of partial or complete radiographic non-union after triple arthrodesis in children and characterize the clinical consequences. In addition, we will try to determine if there are any statistically significant risk factors that may lead to this non-union.

Methods: An IRB approved retrospective review of triple arthrodesis surgeries in patients less than 16 years of age performed by a single surgeon from 1971 to 2006 identified 159 cases meeting inclusion criteria. Cases were included if there was radiographic evidence of union or if radiographic follow-up was greater than one year, a time deemed sufficient for union to occur. All charts were reviewed for the following outcomes: pain, return to activity, and subsequent hindfoot surgeries, including surgery for consequences of non-union or clinical symptoms. Descriptive statistics were used to analyze factors that may lead to non-union.

Results: Of the 159 cases included in the study, only 14 cases (9%) did not achieve complete radiographic union. The complete fusion and non-union groups had similar outcomes. All patients returned to their previous activities and approximately 85% had no or only occasional pain with prolonged activities. Although many patients underwent other forefoot and midfoot surgical procedures, only one patient required surgery for sequelae of symptoms arising from a pseudoarthrosis related to the triple arthrodesis. The groups were similar in terms of age at surgery, pin and cast removal time, and gender; however, they differed slightly in the time at which weightbearing was allowed, previous surgical history, and the underlying diagnosis.

Conclusion: This is one of the largest case series (159 cases) of pediatric triple arthrodesis surgeries presented in the literature with a relatively low rate of radiographic non-union (9%). This study demonstrated that good clinical outcomes (return to previous activity levels, no pain, and only one revision surgery) can be achieved despite non-union after triple arthrodesis surgery in children.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Initial Correction Predicts the Need for Secondary Achilles Tendon Procedures in Patients with Idiopathic Clubfoot Treated with Ponseti Casting

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Purpose: Recurrence of some elements of the clubfoot deformity after initial casting with Ponseti technique may need surgical treatment in 20-30% of patients. Equinus is one of those recurring elements. The purpose of our study was to evaluate predictive value of initial correction on need for repeat procedures on Achilles tendon. Our hypothesis was that less initial correction as seen on post-tenotomy photographs would be correlated to a higher recurrence rate.

Methods: A retrospective chart review of procedures done at our institution from 2005- 2010 with children undergoing general anesthesia for primary percutaneous Achilles tenotomy for the treatment of idiopathic clubfoot using the Ponseti casting method was performed (101 patients, 148 feet). All patients were followed for at least two years postoperatively (2-7.5yrs, Average 3.5yrs). The patients were divided into two groups: group NR with no repeat procedures on Achilles tendon and group SR with a secondary procedure on Achilles tendon (Including open and percutaneous procedures). We looked at postoperative equinus correction via the use of post-operative measurements on digital images using a goniometer. The amount of postoperative dorsiflexion at the initial procedure was compared between the two groups.

Results: A total of 101 patients (148 feet) were evaluated. 72 patients (106 feet) were included in the single procedure group (group NR). 29 patients (42 feet) underwent a repeat Achilles tendon procedure (group SR), in the form of repeat tenotomy or Achilles tendon lengthening. The NR and SR groups differed in amount of post-operative dorsiflexion (14.0 vs. 5.1 $p<0.05$).

Patients in which at least 10° of dorsiflexion was achieved after the initial tenotomy had only a 12% rate of repeat Achilles tendon procedures. Patients with neutral or less than neutral dorsiflexion had 64% chance of repeat Achilles tendon procedures.

Conclusion: Analysis of our data showed postoperative dorsiflexion of 10° or more, correlated with a significantly lower likelihood of repeat Achilles procedures and patients with neutral and less dorsiflexion are at high risk for recurrence of equinus.

Significance: Based on post-tenotomy dorsiflexion achieved, our study helps surgeons predict the likelihood of needing repeat Achilles tendon procedures on patients with idiopathic clubfoot. Patients with neutral or less dorsiflexion after the first procedure may benefit from serial casting before placing in foot abduction orthosis vs. open capsular release.

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Is it Worthwhile to Routinely Screen Children with Clubfoot for Hip Dysplasia?

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† LOE-Other Analysis Level III

Purpose: Patients with idiopathic clubfoot are thought to be at increased risk for having developmental dysplasia of the hips (DDH). However, the studies showing this association have been relatively small and retrospective in nature. Many clinicians who treat idiopathic clubfoot, however, routinely screen the hips of these patients with ultrasound screening due to the concerns of possible increased risk of DDH. We wish to evaluate a large clubfoot population to determine their risk of having DDH and compare this to a similar population of children without idiopathic clubfoot. We also evaluated if the clubfoot patients found to have hip dysplasia would have been discovered by standard infant hip dysplasia screening.

Methods: We identified infants in three states (MA, NY, NC) who were reported to each state's birth defects registry as having a clubfoot. Mothers of these children were contacted and invited to be included in the study, and a computer-assisted telephone interview was administered by one of the study nurses, including questions about treatment of hip dysplasia. The child's median age at interview was 7 months. Follow-up contact at mean age of 3.3 years was also done. Medical records confirmed the diagnosis of clubfoot and treatment for DDH. A second cohort of mothers of infants without clubfoot were also identified and interviewed as a control group.

Results: Families of 667 patients with clubfoot and 2037 controls were interviewed. 5/667 (0.75%) patients with clubfoot and 5/2037 (0.25%) controls reported having their infant treated with a brace or harness for hip problems (odds ratio 3.07, 95% CI 0.88 to 10.64). Of the patients with clubfoot, two of them probably did not need treatment for their DDH and two would have been discovered by standard hip screening. Follow-up study at 3.3 years of age found no serious late hip dysplasia.

Conclusions: Treatment of hip dysplasia was uncommon in all children; the higher proportion in infants with clubfoot was not statistically different than control infants. Of the patients with clubfoot and DDH, standard hip screening would have been appropriate and others did not need treatment. The clubfoot population had increased scrutiny by pediatric orthopaedist, thus increasing the likelihood that DDH would have been found compared to the control population.

Significance: This data suggests that routine hip ultrasound screening of idiopathic clubfoot patients is not necessary unless indicated by the standard infant hip screening.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Leg Length Discrepancy in Children with Unilateral Clubfoot Deformity

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Purpose: The purpose of this study is to report our experience of using a single radiograph to evaluate the functional LLD in children with unilateral clubfoot treated surgically and by the Ponseti method and to stress the necessity of follow up until skeletal maturity.

Methods: 139 children with unilateral clubfoot treated from 1995 to 2012 at the Shriners Hospitals for Children in Twin Cities were reviewed retrospectively to evaluate LLD clinically and radiographically. The digital measurements within the PAC system were used to determine the severity and incidence of LLD. We also looked at different age groups to determine if the LLD was progressive during growth.

Results: Eight (26%) out of 31 children < 5 years of age (**Group I**) at follow-up who were treated by the Ponseti method were lost to follow-up.

In children who were 5 to < 10 years of age, (**Group II**), 23 patients were treated by Ponseti, 3 patients treated surgically and there were no patients with LLD > 2.5 cm.

In children age ≥ 10 (**Group III**) at follow up, nine out of 35(26%) required surgical treatment for LLD, one had LLD of > 2.5 cm that was not treated and ten children out of 35(29%) had a predicted or measured significant LLD. In children treated by the Ponseti method, at follow-up, three out of 8(38%) required surgical treatment for LLD and six out of 28(21%) children who were treated surgically for clubfoot, required treatment of LLD.

In children who were age ≥ 15 (**Group IV**) at follow up, 13(42%) out of 31 required surgical treatment for LLD and 20 out of 31(65%) had predicted or measured significant LLD.

Conclusion: LLD in children with unilateral clubfoot deformity was measured to include the functional LLD. The frequency of LLD in our experience is greater than previously reported. The LLD appears to be progressive with growth through the adolescent growth spurt and can occur after Ponseti treatment as well as surgical treatment for unilateral clubfoot.

Significance: Children with unilateral clubfoot deformity should be followed for possible LLD until skeletal maturity regardless of the method of treatment for the clubfoot and a standing AP x-ray of the lower extremities is useful for that purpose.

Level of Evidence: 3

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Aspirations of the Ilium and Proximal Femur Increase the Likelihood of Culturing an Organism in Patients with Presumed Septic Arthritis of the Hip

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Purpose: To establish the added value of periarticular aspirations of metaphyseal bone about the hip in children with presumed septic arthritis of the hip.

Methods: This is a consecutive series of 35 patients with presumed septic arthritis of the hip based on clinical exam and serum inflammatory markers who underwent aspirations of hip synovial fluid as well as blood from the ilium and proximal femur. The gold standard for a septic arthritis of the hip was set as an aspirate of greater then 50,000 white blood cells or a positive tissue culture from the hip joint capsule. Culture results from aspirates of synovial fluid and bone were compared to determine the sensitivities and specificities of a synovial aspirate alone vs. synovial aspirate plus aspirates of ilium and proximal femur to detect infection.

Results: The sensitivity of hip joint synovial fluid aspirates to detect infection via positive culture was only 38%, though this increased to 53% when the results of cultures of aspirates of the ilium and proximal femur were included. The addition of culture results from bone lowered the specificity of aspirations, (from 79% to 53%) likely because in some instances the bone culture results included cases of periarticular osteomyelitis without septic arthritis.

Conclusion: Obtaining aspirates of the ilium and proximal femur at the time of hip joint synovial fluid aspiration increases the likelihood that the procedure will return an infectious organism. This increased likelihood of a positive culture result must be balanced against the costs of obtaining and processing the additional cultures.

Significance: At a time when the virulence of infectious organisms may vary widely, having positive culture results from a patient with a septic hip can be lifesaving in efficiently and effectively guiding antibiotic treatment. Adding a routine aspiration of the ilium and proximal femur substantially increases the likelihood that aspirates obtained will return a positive culture in the setting of a septic arthritis of the hip.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

Novel Approach to Diagnoses and Management of Hip Pericapsular Pyomyositis

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Purpose: Children with hip pericapsular pyomyositis present with a constellation of symptoms that mimic septic hip arthritis, including fever, refusal to bear weight, and elevated inflammatory markers. The aims of this study were to i) detail the clinical findings that help differentiate hip pericapsular pyomyositis from septic arthritis, ii) highlight a treatment algorithm based on advanced imaging and c-reactive protein (CRP) and iii) introduce a novel minimally-invasive surgical technique for those with advanced disease.

Methods: An IRB-approved retrospective cohort study was performed of children ages 0-18 years who presented with clinical findings concerning for septic hip over a two-year period at a tertiary care children's hospital. Statistical analysis was performed using paired t-tests.

Results: Fifty-three patients initially presented with clinical symptoms concerning for septic hip. Of these, 34% had pericapsular pyomyositis confirmed by MRI. 80% of these had involvement of the obturator musculature. Treatment with antibiotics alone was successful in 36%, while surgical debridement was required in 64%. CRP was significantly elevated in children requiring surgery compared to conservative management (mean 126mg/L vs. 25.3mg/L, p=0.004). Temperature (p=0.32), ESR (p=0.40), WBC (p=0.44), and weight-bearing status (all non-weightbearing) were not significant in guiding treatment. Surgical debridement was performed on children with abscess formation or those who did not improve clinically with intravenous antibiotics. A modified medial approach to the hip joint was performed by reflecting the adductor longus anteriorly, approaching the obturator externus trans-adductor brevis, and gaining exposure of the obturator internus through the obturator foramen. Our described technique resulted in resolution of symptoms in children who underwent surgical debridement without any associated complications.

Conclusion: Hip pericapsular pyomyositis, particularly the obturator internus, represents an important differential in the workup for septic hip, and its incidence is more common than previously reported. We found that the most useful clinical tools for diagnosis and guiding treatment were serial physical exam, MRI and CRP. In children with abscess formation or those who do not improve with intravenous antibiotics alone, a modified medial approach can be safely utilized with good results.

Significance: In children presenting with symptoms concerning for septic hip, pericapsular pyomyositis represents a potential 'mimic" of septic hip that can be diagnosed by serial MRI and clinical response followed by trending CRP values. Treatment consists of intravenous antibiotics, with surgical debridement through a modified medial approach indicated when an abscess develops or clinical improvement is not seen.

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Stuffed Animals in the Operating Room: A Reservoir of Bacteria?

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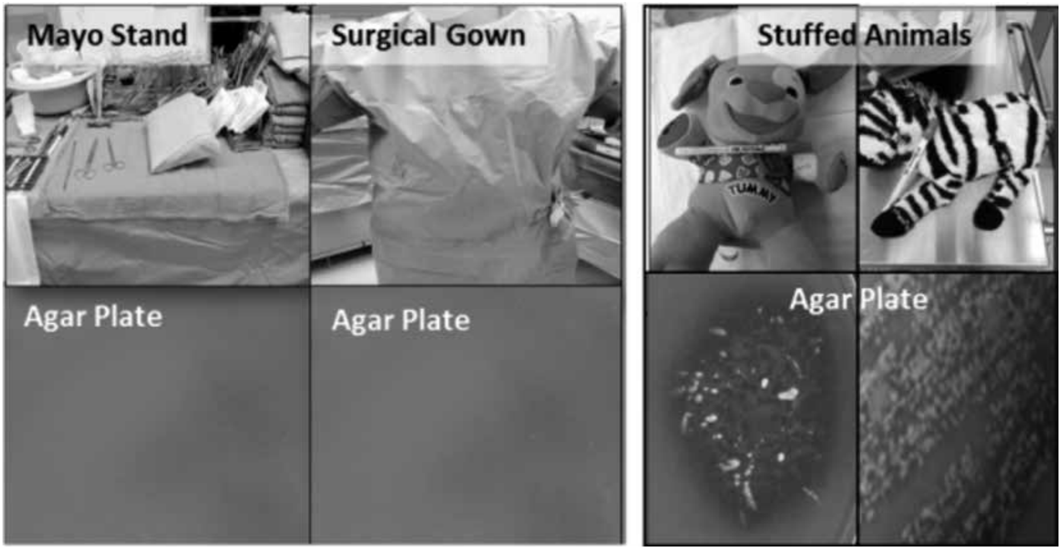
Purpose: For every 100 patients that undergo surgery 4.7 patients develop a surgical site infection (SSI) that can range from minor skin infections to infected hardware and bone. Therefore, SSI preventative protocols have been implemented with the aim of ensuring sterility of the operating room and the surgical site. Despite implementation of these protocols SSI have not been eliminated leading us to hypothesize that either current measures are not effective or there are alternative sources of bacterial exposure to the surgical wound. In this study we tested the hypothesis that i) items intended to be sterile in the operating room were indeed sterile and ii) stuffed animals or other items allowed to accompany pediatric patients to the operating room as a way to ease anxiety may represent a reservoir of bacteria.

Methods: To determine potential sources of bacteria three items intended to be sterile (sterile surgical gowns/gloves, mayo stands and a C arm drapes – n=3 for each item), 'clean' hospital beds, and a population of 15 (n=15) stuffed animals brought into the operating room by pediatric patients were swabbed and plated on blood agar at 37˚C. After incubation period of 48 hours, the bacterial colonies were observed and counted.

Results: All items intended to be sterile in the operating room did not grow bacterial colonies within 48 hours (Figure 1). The railings of the 'clean' hospital beds demonstrated light growth of bacteria. All 15 of the stuffed animals showed light and heavy bacteria growth (Figure 1). Two of the stuffed animals grew bacteria that lysed the agar plate.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.



Conclusion: These results indicate that a sterile environment can be produced around the surgical patient but that other items brought into the operating room may represent a causative source of SSI.

Significance: In order to further reduce the incidence of SSI it is essential to identify and eliminate potential sources of bacteria. Although we believe that there are many additional sources of bacteria brought into the operating room, these findings clearly demonstrate that items of comfort, such as stuffed animals, brought into the operating room with benevolent purpose may represent a reservoir of bacteria which could lead to unwanted SSI. Future studies will be needed to determine a correlation between 'culture positive' stuffed animals and SSI or if providing a child with a 'sterile' stuffed animal reduces SSI.

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Effectiveness of MRSA Screening in Pediatric Orthopaedic Surgery

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Purpose: Many hospitals are moving towards screening all patients for Methicillin-resistant *Staphylococcus aureus* (MRSA); however, there is a paucity of research evaluating universal screening. The purpose of this study is to present the prevalence of MRSA colonization and its association with surgical site infections (SSI) in pediatric orthopaedic patients.

Methods: In 2010-2011 pediatric patients undergoing elective orthopaedic surgery at our institution were screened for MRSA following a universal screening protocol. From 2006-2009 only patients considered high risk for MRSA were screened: those undergoing spine, chest, or hip procedures, patients who were previously hospitalized within 3 months of the procedure, or patients with indwelling devices (e.g. G-Tubes, tracheostomies, etc.). Patients were screened via nasal swabs taken preoperatively. Identified carriers were treated preoperatively with intranasal 2% mupirocin ointment and a shower with 2% chlorhexidine. MRSA carrier and MRSA SSI rates were determined and compared between the two groups. Additionally, the overall (MRSA + non-MRSA) SSI rates were determined.

Results: During the universal screening period 1496 surgical procedures were performed and 1377 patients were screened for MRSA (screening rate 92%). Twenty eight patients were identified as MRSA carriers (2.0%). Nine of the 28 met the high risk criteria. Two MRSA and 10 non- MRSA SSIs were identified for an overall infection rate of 0.80%. During the high risk screening period 1964 procedures were performed. One MRSA and 9 non –MRSA SSIs were identified for and overall infection rate of 0.51%. MRSA screening was limited to 195 patients that met high risk criteria. Eighteen were identified as MRSA carriers (9.2%), and 1 developed a MRSA SSI. The 3 patients with MRSA SSI had negative MRSA screens preoperatively, and all met the high risk criteria. No SSIs were identified among the MRSA carriers. The MRSA carrier rate was significantly greater in the high risk group compared to the universal screening group ($p<0.01$). There was no significant difference in overall SSI rate when comparing the universal screening period with the high risk screening period (P value=0.28).

Conclusions: The prevalence of MRSA carriers was 2% in our elective pediatric orthopaedic surgery population, and significantly higher in patients considered high risk for MRSA infection (9.2%). No SSIs occurred in identified MRSA carriers.

Significance: Identifying and decolonizing MRSA carriers may help decrease the incidence of MRSA infection. Focusing screening on patients considered high risk for MRSA SSI may be as effective as universal screening in preventing infections.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

Can an Algorithm Predict MRSA vs. MSSA Osteomyelitis?

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† LOE-Prognostic Level III

Background: A recent study used clinical factors to develop a prediction algorithm that distinguishes MSSA from MRSA osteomyelitis. This was performed in a patient population with a low prevalence of MRSA. The purpose of this project is to test the validity of this algorithm in a region with a higher prevalence of MRSA and if possible generate a new algorithm that is more applicable to this population.

Methods: We performed a retrospective review of 283 consecutive children treated for either MRSA or MSSA osteomyelitis. 131 (46.3%) patients had MRSA and 152 (53.7%) patients had MSSA. Variables including age, temperature, hematocrit, WBC, CRP, ESR, ANC, platelet count, systolic blood pressure, and diastolic blood pressure were collected. To test the previous algorithm the number of predictive factors met (temperature >37°C, hematocrit <34, WBC >12,000 and CRP >13) was counted. We developed a new algorithm using logistic regression to identify independent multivariate predictors of MRSA osteomyelitis.

Results: Test of the previously described algorithm using our population showed a sensitivity of 14.5% and specificity of 98.7% when using a threshold of 4 criteria. Using the threshold of at least one criterion, sensitivity was 89.3% and specificity was 29.6%. Logistic regression of factors in the new population determined three variables to be independent predictors of MRSA osteomyelitis (CRP >6.8, WBC >9,500, ESR >44). Using a threshold of 1 positive factor yielded a sensitivity of 97.7% and a specificity of 22.4%. A Threshold of 3 yielded a sensitivity and specificity of 43.5% and 78.2%, respectively.

Conclusions: The previously described algorithm for predicting MRSA osteomyelitis performed poorly when applied in a region where MRSA is more prevalent. Using 4 factors as the threshold missed 85% of patients with MRSA. Using 1 factor as the threshold still missed 11% of patients with MRSA and misclassified 70% of patients with MSSA. The best algorithm we could create for our population performed poorly as well. Using 1 factor as the threshold missed 43% and a threshold of 3 misses 38% of MRSA positive patients.

Significance: The two algorithms we studied failed to reliably differentiate between MRSA and MSSA osteoemyelitis. In areas with a high prevalence of MRSA, we recommend commencing therapy with broad spectrum antibiotic coverage until cultures return identifying the organism.

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The Prevalence of MRSA Nasal Carriage in Pre-operative Pediatric Orthopaedic Patients

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Purpose: Pre-operative nasal carriage of Methicillin-Resistant Staphylococcus aureus (MRSA) potentially increases the risk of post-surgical infection. Surgical site infections (SSI) result in increased morbidity and mortality, increased length of stay, and added health care costs. SSI due to MRSA is particularly problematic. The purpose of this study is to determine the prevalence of MRSA nasal carriage in pre-operative pediatric orthopaedic patients and to determine if MRSA nasal carriage is a predictor of post-operative infection.

Methods: 699 consecutive pediatric patients (age < 18 years old) were retrospectively studied who had undergone MRSA nasal screening prior to orthopaedic or orthopaedic/neuro /spine surgery. Post-operative clinical cultures and infections, total surgical site infections (SSI), epidemiological and surgical prophylaxis data were abstracted from the charts. No special pre-operative interventions were performed in patients with positive MRSA nasal screening in this patient population.

Results: Forty-one of 699 patients (6%) screened positive for MRSA isolates from the anterior nares. Post-operatively, eight of the 41 patients (20%) that screened positive for MRSA had a subsequent surgical site infection compared to 1.6% of the 658 patients that screened negative for nasal MRSA ($p<0.05$). Twenty-seven of 41 patients (66%) that screened positive for MRSA were male. 203 of the 699 patients (29%) had spina bifida. All 8 patients with a surgical site infection had the diagnosis of spina bifida. Ten of the 33 patients (30%) that screened positive for MRSA and did not have a subsequent SSI also had spina bifida. Overall 18 out of 203 patients (9%) with spina bifida screened positive for MRSA and 8 out of 203 (4%) of spina bifida patients had an SSI. 87% of the MRSA positive and SSI positive patients had at least one previous hospitalization compared to 70% of the MRSA positive but SSI negative patients and 52% of the MRSA negative patients. No patient with an SSI had received vancomycin as a pre-operative antibiotic. All patients with an SSI received betadine skin prep prior to surgery.

Conclusion: The prevalence of MRSA nasal carriage was 6%. Asymptomatic nasal carriage of MRSA was predictive of post-operative infection. Children with spina bifida were at the highest risk for having a positive MRSA nasal carriage and for developing a subsequent SSI.

Significance: Carriage of MRSA by children with spina bifida and potentially by household members has implications for infection control and treatment strategies. Future studies should target this high risk group of pediatric orthopaedic patients.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Management of Orthopedic Trauma Cases: An Evaluation of Three Different Models at a Level I Pediatric Trauma Center

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Introduction: In the past decade, surgeons responsible for call duties within the Department of Orthopedics at our institution have implemented three different staffing models, including a traditional call schedule (cases placed on an 'add-on' list), a scheduled half-day of operating time reserved for trauma cases following call, and a full day dedicated to trauma following the day of call. We reviewed these models, determining which is most efficient at caring for patients with regards to delay to procedure start and Orthopaedic support staffing at time of surgery.

Methods: We performed a retrospective query of all patients undergoing emergent surgical procedures admitted to the Orthopedics service at our institution June 2002-August 2009. The query returned a total of 951 cases over three distinct, comparable time intervals. These intervals are consistent with staffing patterns relevant to our review: traditional call model queried October 2001-September 2002, half-day of blocked operating time queried August 2003-July 2004, and full-day of blocked operating time queried October 2008 -September 2009. Variables surveyed included Admission type, date of injury, Hospital arrival date/time, time from Admission to OR, and OR procedure start time.

Results: Of 260 patients admitted under the traditional call model, 68% of cases were operated on within the conventional work week. Of these cases, 41% had a procedure start time during hours of maximal staffing (07:00-17:00) with an average wait time of 17:40 from presentation. Of 282 half-day and 401 full-day OR block cases, those seen during the work week accounted for 76% and 68% of their respective patient populations with 95% and 98% of procedures beginning during hours of maximal staffing (average wait times 15:10 and 15:09, respectively).

Conclusion: Surgical interventions performed after hours are associated with greater complication rates adversely affecting length of stay, overall cost of treatment, and mortality rates. Dedicating blocked time for trauma cases resulted in a significant increase in the number of cases operated on during hours of maximal staffing while reducing the average wait time from presentation to procedure start.

Significance: We propose evidence-based recommendations for design of the call model best suited to addressing the needs of our pediatric patient population.

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Children with Knee Monoarthritis in Lyme Disease Endemic Areas: Who Needs Arthrocentesis?

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† LOE-Diagnostic Level II

Purpose: As Lyme and septic arthritis may present similarly, we sought to identify children with knee monoarthritis at low risk for septic arthritis who may not require arthrocentesis.

Methods: We performed a retrospective study of children with knee monoarthritis presenting to one of two pediatric centers, both located in Lyme disease endemic areas. Septic arthritis was defined by a positive synovial fluid culture or synovial fluid pleocytosis with a positive blood culture. We defined Lyme arthritis as positive Lyme serology or physician-documented erythema migrans rash. All other children were considered to have other inflammatory arthritis. We derived a clinical prediction model using recursive partitioning to identify children at low risk for septic arthritis and externally validated this model.

Results: We identified 673 patients with knee monoarthritis of which 19 (3%) had septic, 343 (51%) had Lyme and 311 (46%) had other inflammatory arthritis. We identified the following predictors of knee septic arthritis: absolute neutrophil count (ANC) > 10 x 10^3 cells/mm^3 and an erythrocyte sedimentation rate (ESR) > 40 mm/hour. In the validation population, no child with a peripheral blood ANC < 10 x 10^3 cells/mm3 and an ESR < 40 mm/hour had septic arthritis [sensitivity 6/6 (100%), 95% confidence interval (CI) 54-100%; specificity 87/160 (54%), 95% CI 46-62%]. Overall, none of the 19 children with septic arthritis were classified as low risk (0%, 95% CI 0-17%).

Conclusions: Laboratory criteria identify children with knee monoarthritis at low risk for septic arthritis who may not require diagnostic arthrocentesis.

Significance: A clinical prediction model that identifies children with knee monoarthritis in a Lyme disease endemic area that are low risk for septic arthritis may help some children avoid unnecessary arthrocentesis in the appropriate clinical context.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

Clinical and Economic Implications of Early Discharge following Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

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Purpose: Postoperative stay following posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS) averages 5.2 - 6.5 days nationally despite a healthy patient population with little evidence of untoward events following earlier discharge. The purpose of this study was to evaluate the clinical and economic impact of an accelerated postoperative protocol following posterior spinal fusion.

Methods: A retrospective review of patients treated at two institutions within the same hospital system between 2006-2008 with PSF for AIS was performed. One institution implemented a protocol to expedite discharge (ED) following PSF while the other maintained a traditional discharge (TD) protocol. The ED protocol included widespread nursing education and emphasized admittance to the floor with early mobilization, early transition to oral narcotics, and discharge prior to complete return of bowel function. Patient charts were reviewed for demographic data and to determine length of surgery, number of fusion levels, estimated blood loss (EBL) ASA score, length of hospital stay, and any subsequent complications. Hospital charges were divided by charge code to determine hospital charges for room, pharmacy, physical therapy, and blood products.

Results: 279 of 365 patients (76.4%) treated with PSF carried a diagnosis of AIS and had completed one year clinical and radiologic follow up, a period of time deemed adequate to assess early complications. There was no significant difference between groups in age at surgery, sex, number of levels fused, or length of follow up. Patients managed under the ED protocol averaged 1.36 (31.8%) fewer days of inpatient stay. Operative time was also associated with a shorter length of stay, with each additional hour of surgery adding 0.23 days to the hospital stay. Multiple regression analysis did not find a correlation between length of stay and EBL or ASA score. Fewer patients required ICU admission under the ED protocol (3 vs 8 patients, $p=0.01$) There was no difference in medical readmissions or wound related complications between groups at one year follow up. Hospital charges for room and board were significantly less in the ED group (\$1885 vs \$2779, $p<0.001$).

Conclusions: A protocol aimed to expedite discharge following PSF for AIS decreased hospital stay by nearly a third without any increase in complication rate, a rate as much as 55% faster than the national average. A small but significant decrease in hospital charges was seen following early discharge.

Significance: Early discharge following PSF for AIS may be achieved without increased risk and while providing a small cost savings.

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♦The Use of rhBMP-2 in Congenital Pseudarthrosis of the Tibia

Terrence D. Anderson, MD*; B. Stephens Richards III, MD*

Texas Scottish Rite Hospital for Children, Dallas, Texas

† LOE-Therapeutic Level IV

Purpose: This IRB-approved retrospective study was performed to determine the efficacy of rhBMP-2 use in the treatment of congenital pseudarthrosis of the tibia (CPT), and its safety in this patient population.

Methods: We retrospectively reviewed 23 patients with CPT whose treatment over a 12-year span (1999-2010) included BMP-2. Twenty-two patients had intramedullary fixation (Williams rod or TEN) and one had external fixation. In addition to tibial stabilization, all patients underwent autogenous bone graft and BMP administered on a collagen sponge. Average age at the time of surgery was 6.6 yrs (range 1.2-14.4). Average follow-up was 5.2 years. Neurofibromatosis (NF1) was the primary diagnosis in 16/23 patients. Five of the 23 patients had prior unsuccessful tibial surgery.

Results: Radiographic healing was achieved in 16 of the 23 patients at an average of 9 months postop (7/7 idiopathic and 9/16 NF). Of these 16 patients, those with fixation across the ankle had no refractures, whereas three of six patients whose fixation did not cross the ankle subsequently refractured. The overall refracture rate was 25% in these 16 patients (included the one external fixation patient). Two of these four refracture patients subsequently healed, one persisted, and one had amputation. Of the 7 patients who did not heal after this first operation using BMP, three healed after revision, two had persistent nonunions, and 2 had subsequent amputations. Those patients with prior unsuccessful surgery all healed primarily. Three cases were complicated by deep infection (2 at tibia, 1 at iliac crest). No adverse effects attributable to BMP were encountered.

Conclusion: The authors conclude that BMP-2 enables healing at an earlier time than shown in previous reports without BMP-2. This physician-directed use of BMP-2 for the treatment of CPT appears to be safe in this pediatric population.

Signficance: The use of BMP-2 in the surgical treatment of CPT results in shorter times to radiographic union when compared to previous studies without the use of BMP-2.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

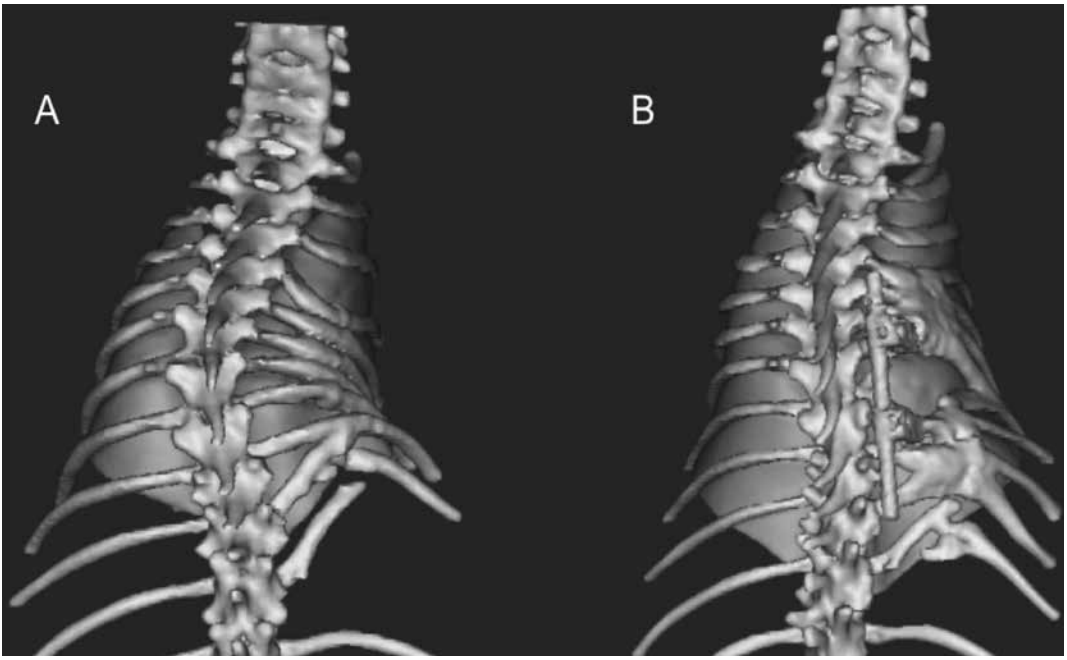
Expansion Thoracoplasty: Is Earlier Better? Evaluation using a Rabbit Model of TIS

Casey Olson; Michael P. Glotzbecker, MD; Ayuko Takahashi; ***Brian D. Snyder, MD, PhD***
Boston Children's Hospital, Boston, Massachusetts

† LOE-Therapeutic Level I

Purpose: Use rabbit model of Thoracic Insufficiency Syndrome (TIS) to evaluate the timing of expansion thoracoplasty (ET) on correcting spinal deformity and pulmonary function.

Methods: Progressive constriction of the right hemi-thorax (TIS) was induced in 4 week-old NZ rabbits (N=22) by tethering ribs 2-10. At age 7 weeks (EARLY, n=7) or 11 weeks (LATE, n=7), rabbits underwent ET stabilized with a rib distracter (Figure 1). EARLY group had repeat lengthening of the rib distracter at age 11 weeks. Treated rabbits were compared to untreated (TIS, n=8) and NORMAL rabbits (n=6). All rabbits were weighed and imaged with serial breath-hold trans-axial CT of the thorax at incremental inspiratory pressures 0-5, 5-15, 15-25 cm H_2O to determine total lung capacity (TLC), right to left lung volume ratio (R:L), respiratory compliance and scoliosis @ 6, 10, 14, & 28 weeks. All volume measures were normalized by weight. Outcome variables were compared among the groups using ANOVA with Bonferroni post-hoc analysis.



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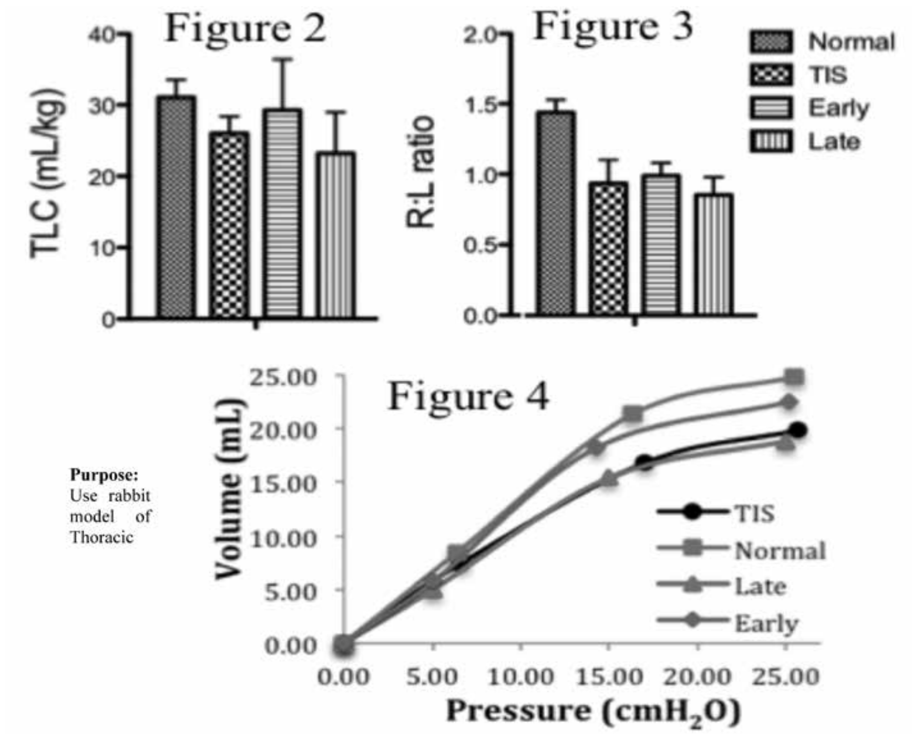
Results: There were no significant differences in growth among groups. TIS rabbits did not show failure to thrive. Tethering the right ribcage induced a convex left scoliosis of 40°. ET corrected the scoliosis ($p<0.001$): there was 15° overcorrection for EARLY group and 6° residual scoliosis for LATE group. At completion of growth, the TLC for the TIS group was reduced 17% relative to NORMAL while the TLC of the EARLY group was reduced by only 6%. However TLC of LATE group was decreased 25% relative to NORMAL, worse than TIS group (Figure 2). Right lung volume was 40% greater than left for NORMAL group, such that R:L lung volume ~1.4 (Figure 3). In contrast, for TIS, EARLY and LATE groups, the R:L lung volume <1 ($p<0.0001$). This metric reflects constricted growth of the right lung and compensatory hypertrophy of the left. Respiratory compliance ($\Delta V/\Delta P$) was calculated from the slope of the inspiratory pressure-volume curves for each group (Figure 4). The compliance during tidal breathing (5-15 cmH_2O) was compared: EARLY was equivalent to NORMAL and significantly greater than TIS ($p<0.01$). Compliance of LATE group was not different from TIS.



Conclusion: When ET is performed earlier, there is greater improvement in pulmonary function. However, ET performed either early or late corrected the kyphoscoliosis.

Significance: The benefit of ET depends on the timing of the procedure relative to the growth remaining of the lungs and thorax.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 –57 for financial disclosure information.

Polysomnographic Screening in Children with Achondroplasia: There is No Correlation between Sleep Disordered Breathing and Foramen Magnum Stenosis

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† LOE-Diagnostic Level III

Purpose: The relationship between disordered sleep and foramen magnum stenosis in patients with achondroplasia is poorly understood. Central sleep apnea is thought to be caused by cervicomedullary junction compression of spinal cord, leading to death. Magnetic resonance imaging (MRI) of the cervical spine and craniocervical junction has become a standard screening procedure in infants born with achondroplasia in many institutions. Our institutional standard is to perform a screening polysomnogram to evaluate for central sleep apnea as a proxy of foramen magnum stenosis. We have reviewed our patients with achondroplasia that have undergone polysomnography and magnetic resonance imaging to better delineate this relationship.

Methods: This study is a retrospective analysis of patients identified through an IRB approved skeletal dysplasia registry. All patients identified with a diagnosis of achondroplasia, having had a both MRI and polysomnography were enrolled in the study. A chart review of correlating clinic visits for each patient was performed. Polysomnography results and MRI results were evaluated for correlates of foramen magnum stenosis.

Results: We identified 25 patients with polysomnography and an MRI of the brain and spine. 19 patients were ultimately evaluated. The average age was 5.5 years, including 10 patients under 1 year of age. An abnormal apnea –hypopnea index was found in 18/19 patients, with central sleep apnea found in 4/19 (all four were under 18 months of age). One of these four had mild cord compression, and none required surgical decompression. Four other patients required foramen magnum decompression, all demonstrating significant cord compression on MRI, two demonstrating cord signal change on T2 sequences, and one demonstrating the presence of a syrinx. None of these four demonstrated central sleep apnea. Overall, we found the counterintuitive finding that obstructive sleep apnea was associated with greater foramen magnum diameter (r= 0.81) and anterior CSF space (r=0.62). The overall apnea-hypopnea index was negatively correlated with the presence of abnormal T2 cord signal change on MRI. We found no statistically significant correlation between central sleep apnea and abnormal MRI findings suggestive of foramen magnum stenosis.

Conclusion: Sleep disordered breathing is common in pediatric patients with achondroplasia and can include both obstructive and central sleep apnea. Polysomnography is a critical component of care in these patients but does not appear to correlate with MRI findings of foramen magnum stenosis.

Significance: Polysomnography is important for children with achondroplasia, but an MRI is also required to evaluate for foramen magnum stenosis.

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At What Age do Cam and Pincer Morphology Become Apparent: An Analysis of 225 Pediatric and Adolescent CT Scans

Shafagh Monazzam, MD; James D. Bomar, MPH; Jerry Dwek, MD; Harish S. Hosalkar, MD; ***Andrew T. Pennock, MD***

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† LOE-Prognostic Level III

Purpose: We use standardized pelvic CT's to determine: 1) the variation of acetabular and femoral measurements between infancy and skeletal maturity 2) the prevalence of cam morphology during growing years and the age at which children start developing this morphology 3) the prevalence of pincer morphology during growing years and the age at which children start developing this morphology.

Methods: We retrospectively reviewed 236 consecutive abdominal CT scans in patients age 2-19 obtained for non-orthopedic complaints. Patients with previous hip or major global developmental diseases were excluded. A total of 225 CT scans (244 female and 206 male hips) met the inclusion criteria. All CT images were reconstructed in 3D and re-oriented to create standardized 2D images with neutral pelvic tilt and inclination. Tonnis angle, acetabular depth ratio, and center-edge angle were measured on the coronal slice corresponding to the center of the acetabulum. Acetabular version was measured both at the center of the femoral head and at the superior one fourth of the acetabulum. Alpha angle was measured on the axial oblique image. Linear regression analysis was performed and odds ratios were calculated.

Results: Tonnis angle and alpha angle showed a progressive decrease as a function of age ($p<0.001$). Acetabular version, center-edge angle and acetabular depth ratio showed a progressive increase as a function of age ($p<0.001$). The odds of having cam morphology defined as, α angle $\geq 55°$, are 3.9 (CI: 1.76 to 8.57, $p = 0.001$) times greater for males over the age of 10 than the rest of the population. Pincer morphology defined as Tonnis angle $<0°$, center edge$\geq 40°$, and/or acetabular retroversion with at least center edge$\geq 30°$, was 11.52 (CI: 4.45 to 29.8, $p < 0.001$) times greater for patients over the age of 12 compared to those under 12. The earliest age at which cam morphology occurred in this study cohort was 10 years, and the earliest pincer morphology occurred at the age of 12.

Conclusions: Acetabular measurements demonstrated increased acetabular coverage with age and/or progressive ossification of the acetabulum. By adolescence, the incidence of FAI morphology is similar to that reported in the adult literature.

Significance: FAI morphology as detected by CT occurs in early adolescence (age 10-14) around the time of the proximal femoral growth plate closure. Future studies looking at the etiology of FAI will need to target this "at risk" age group.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Can Sub-clinical Rickets Cause SCFE? A Prospective, Pilot Study

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† LOE-Prognostic Level I

Purpose: Slipped capital femoral epiphysis (SCFE) etiology remains unknown, however, most patients are obese and have increased BMI. Vitamin D is a major regulator of bone homeostasis and calcium metabolism. Vitamin D deficiency is one of the major causes of rickets, and rickets has been associated with SCFE. Children with high BMI are known to have lower vitamin D levels. Therefore, we hypothesize that children who develop SCFE may have a sub-clinical rickets predisposing physeal disease.

Methods: This was a pilot, prospective study designed to determine the relationship between vitamin D, bone, muscle and fat in patients with SCFE. We aimed to enroll 20 patients with unilateral SCFE between the ages of 8 and 16 years. Upon diagnosis, vitamin D, PTH, T4, and TSH levels were obtained. A single CT scan of the midshaft femur was performed to obtain cortical bone density (CBD). Subjects were excluded if they had endocrynopathies or did not complete the CT scan. Demographics, BMI and the results obtained were compared to generate a relationship between vitamin D levels and SCFE.

Results: 20 patients were enrolled, 13 males and 7 females, at an average age of 12 years (range, 9-14), and mean BMI was 26.3 (range, 20.9-34.1). There were 17 stable and 3 unstable SCFE. 18 of the 20 patients met all criteria. Overall, mean and SD values for Vitamin D were within the normal range (46.5 ± 21.7). We found no difference in values in Vitamin D between 6 subjects who were non-obese (BMI < 95%) and the 9 subjects who were obese (BMI > 95%); (34.8 ± 16.8 vs. 51.6 ± 22.4, P = .144). Moreover, we found no difference in CBD between these two groups (1126 ± 33.1 vs. 1147 ± 41.2; P = .333). There were also no differences in vitamin D and CBD between 17 stable and 3 unstable SCFE.

Conclusion: Although obese children are known to have a decrease in their vitamin D level and although SCFE has been associated with high BMI in the past, we did not show a clear correlation between low vitamin D and development of SCFE in this subset of patients.

Significance: The etiology of SCFE is still unknown. In this prospective pilot study, we failed to show a relationship between sub-clinical rickets and development of SCFE.

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Treatment of Snapping Scapula Syndrome in Pediatric and Adolescent Patients

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Boston Children's Hospital, Boston, Massachusetts

† LOE-Therapeutic Level III

Purpose: The purpose of this study was to review two separate cohorts of young patients treated for snapping scapula: those treated surgically and those managed non-operatively.

Methods: A retrospective IRB-approved review was conducted on 18 pediatric aged patients. (19 shoulders); 12 patients (average age 13.3) were treated non-operatively, 6 patients (average age 15.4) (7 shoulders) were treated operatively. Demographic and clinical data was collected from medical records and two questionnaires for; level of activity, return to sport, subjective satisfaction from treatment and preoperative/postoperative levels of pain. The American Shoulder and Elbow Society (ASES) score was measured for both groups.

Results: Mean follow-up for non-operative patients was 49.6 months. Pre-treatment subjective pain levels were 5.2 (scale 1-10), post-treatment were 1.5. There was a 67% return to play rate, and an overall 75 % satisfaction rate. Post-treatment ASES scores were 90.0. Mean follow-up for surgical patients was 112.0 months. Pre-treatment subjective pain level was 8.6, post-treatment was 0.75. There was a 67% return to play rate and an overall 100% satisfaction rate. There were no complications. Post-treatment ASES scores were 92.6.

Conclusion: Outcomes for non-operative treatment of snapping scapula are good for young patients. Surgical management of snapping scapula is a safe and viable treatment option for patients who fail non-operative treatment.

Significance: There is sparse literature regarding the outcomes of treatment for snapping scapula in pediatric and adolescent patients. The present study show that patients treated non-operatively and those treated operatively both had successful outcomes with level of activity, return to play and subjective pain.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Disaster Response Symposium

Thurs., May 2, 2013 • 1:30 PM – 3:00 PM • Room: Dominion North

Chair: *William L. Hennrikus Jr, MD*

Faculty: *Scott C. Nelson, MD; Scott M. Needle, MD, FAAP; J. Eric Gordon, MD; Richard M. Schwend, MD; Richard W. Kruse, DO; Michael R. Morris, MD; Kathleen A. McHale, MD; Craig P. Eberson, MD; Sanjeev Sabharwal, MD; Eric W. Edmonds, MD*

This 90 minute break out symposium is designed to update pediatric orthopaedic surgeons about unique patient care requirements presented by the austere environments of disaster. Valuable information will be presented for personal and team preparation to effectively handle the physical, emotional, and care management skills needed to treat injured children in areas affected by catastrophic events.

At the conclusion of this symposium the leaner should be able to:

- Identify the challenges of caring for pediatric victims of disaster in an austere environment.
- Describe injuries commonly encountered in the disaster environment.
- Discuss personal and team preparation for serving as a member of a disaster response team.

1:30 PM – 1:32 PM **Introductions**
William L. Hennrikus Jr, MD, Hershey, Pennsylvania

1:32 PM – 1:52 PM **Pediatric Orthopaedics in Disaster - Improvise Don't Compromise**
Scott C. Nelson, MD, Loma Linda, California

1:52 PM – 2:12 PM **Update on the American Academy of Pediatric efforts in Disaster Preparation**
Scott M. Needle, MD, FAAP, Naples, Florida

2:12 PM – 2:30 PM **Panel Discussion Q/A**
Moderator: J. Eric Gordon, MD, St. Louis, Missouri
Panelists: Scott C. Nelson, MD, Loma Linda, California; Richard M. Schwend, MD, Kansas City, Missouri; Richard W. Kruse, DO, Wilmington, Delaware

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DISASTER RESPONSE/TRAUMA PAPERS

Moderator: *Eric W. Edmonds, MD, POSNA Trauma Committee, Chair, San Diego, California*

2:30 PM – 2:34 PM **Ankle-Brachial Index is Reliably Measured by Physician and Non-Physician Pediatric Healthcare Professionals**

Konstantinos Triantafillou, MD; Michael C. Aynardi, MD; James A. Costanzo, MD; ***Richard W. Kruse, DO***

Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

2:34 PM – 2:38 PM **The Effect of Education on Orthopedic Surgery Residents' Ability to Evaluate Compartment Syndrome**

Michael R. Morris, MD*; Benjamin L. Harper, MD; Michael B. Shaheen, MD; Alan T. Davis, PhD; Blaise A. Nemeth, MD, MS; Matthew A. Halanski, MD*

Helen DeVos Children's Hosiptal/Spectrum Health, Grand Rapids, Michigan

2:38 PM – 2:42 PM **"Quiet" Compartment Syndrome: Silent Compartment Syndrome in Kids – Four Illustrative Cases and Review of the Literature**

Kathleen A. McHale, MD; *Christopher P. McIlvaine, BS*

Uniformed Services University for the Health Sciences Bethesda, Maryland and Inova Health System Falls Church, Virginia

2:42 PM – 2:46 PM **Temporizing Management of Pediatric Femur Fractures Utilizing J-Splints**

Scott A. Ritterman, MD; Alan H. Daniels, MD; Patrick M. Kane, MD; ***Craig P. Eberson, MD;*** *Christopher T. Born, MD*

Alpert Medical School of Brown University, Providence, Rhode Island

2:46 PM – 2:50 PM **External Fixation in Pediatric Femur Fractures: Where Are We Now?**

Heather Kong, MD; ***Sanjeev Sabharwal, MD, MPH***

UMDNJ-New Jersey Medical School, Newark, New Jersey

2:50 PM **PANEL: QUESTIONS & DISCUSSION**

3:00 PM **Adjourn**

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Ankle-Brachial Index is Reliably Measured by Physician and Non-Physician Pediatric Healthcare Professionals

Konstantinos Triantafillou, MD; Michael C. Aynardi, MD; James A. Costanzo, MD; ***Richard W. Kruse, DO***

Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

† LOE-Diagnostic Level II

Purpose: The ankle-brachial index (ABI) has been validated as a noninvasive means to diagnose arterial injury associated with extremity trauma. The literature lacks consensus regarding which health care professionals perform the most reliable measurements in the acute pediatric trauma setting. This study seeks to determine intra- and inter-observer variability of ABI measurements among different categories of healthcare professionals. The authors propose that there will be no significant difference when comparing physician measurements to the measurements of the other healthcare providers.

Methods: 20 pediatric healthcare employees trained in proper technique for recording an ankle- brachial index (7 physicians, 4 physician's assistants, 5 registered nurses, and 4 medical assistants) were enrolled for participation in this prospective investigation. After obtaining IRB approval, ABIs were obtained from one control subject during this investigation. Measurements were taken using a cuff 40% larger than the limb, inflated to suprasystolic pressure and assessed with Doppler ultrasound using an 8-Mhz Doppler transducer using the radial and posterior tibial arteries. Each measurement was recorded on the left side for convention, at the level of the heart, and in a quiet room after resting for 5 minutes. Measurements were repeated for each clinician at three separate intervals and recorded. ABIs were then calculated and analyzed.

Results: The mean ABI recorded by the 20 healthcare providers was 1.20 ± 0.087 with a 95% Confidence Interval of 1.16 to 1.24. The inter-observer variability was 7.21%. A comparison of physician's ABI recordings to the remaining healthcare providers, 1.22 ± 0.12 vs. 1.18 ± 0.06 confidence interval (-0.05 to 0.13), failed to reveal a statistical difference between the two groups (p=0.342). Lastly, there was no statistical difference detected between each observers individual measurements (p=0.844).

Conclusion and Significance: The use of the ABI for assessment of vascular dysfunction in the adult population has been investigated in greater detail; few studies exist evaluating traumatic vascular injury in the pediatric literature. The inter- and intra- observer reliability of ABI measurement between healthcare providers of various levels of training is high. Future studies can confidently use the measurements provided by physician and auxiliary staff in conducting research regarding the assessment of the dysvascular limb in pediatric extremity trauma.

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The Effect of Education on Orthopedic Surgery Residents' Ability to Evaluate Compartment Syndrome

Michael R. Morris, MD; *Benjamin L. Harper, MD; Michael B. Shaheen, MD; Alan T. Davis, PhD; Blaise A. Nemeth, MD, MS; Matthew A. Halanski, MD*

Helen DeVos Children's Hosiptal, Grand Rapids, Michigan

† LOE-Diagnostic Level II

Purpose: Acute compartment syndrome is a serious and often devastating condition. As a clinical diagnosis, evaluation proves difficult in pediatric and obtunded patients. Use of pressure-monitoring devices aids in diagnosis, but requires appropriate use and acceptable accuracy of measurements. This study aims to demonstrate the effect of an educational program on resident-performed intra-compartmental pressure measurement.

Methods: Twenty-four orthopedic surgery residents, PGY1-5, were observed on the use of an intra-compartmental pressure monitor before and after an educational session on five steps (Assembly, Purging of air, Zeroing, Injection, Stabilization) and accuracy of reading. Adequate performance of each step was based on manufacturer instructions. A clinically significant difference in readings was considered to be > 5 mm Hg. All steps and measurements were performed on the anterolateral compartment of a porcine limb receiving a saline infusion at a constant pressure as measured by a blinded indwelling pressure monitor. Statistical analysis on each subject's successful performance of the five steps before and after teaching was assessed using McNemar testing, and differences in measurements between that of the learner and the indwelling catheter were assessed using paired t-test. Error in measurement was assessed using the Wilcoxon rank sums test. IRB approval was not required due to the educational nature of the study.

Results: The total number of technical errors decreased across all five steps assessed from before vs. after teaching: 1. Assembly (4 vs.1), 2. Purge (13 vs. 1), 3. Zeroing (15 vs. 2), 4. Injection (14 vs. 2), 5. Stabilization (13 vs. 3) ($p<0.01$). The mean difference in measurements before and after teaching was 21.9+12.7 (mean+SD) mm Hg and 0.9+8.3, respectively ($p<0.001$). The median error before and after teaching was 21 and 5 mm Hg, respectively ($p<0.001$).

Conclusion: Didactic teaching and use of model simulation decrease the number of errors in intra-compartmental pressure monitor use and increase the accuracy of pressure measurements by orthopedic residents.

Significance: Resident physicians are often the first-line evaluators of patients with potential compartment syndrome but rarely receive formal training on the use of intra-compartmental pressure monitors. This study demonstrates the significant errors that may occur with inexperienced and untrained practitioners measuring compartments.

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See pages 15 – 57 for financial disclosure information.

"Quiet" Compartment Syndrome: Silent Compartment Syndrome in Kids – Four Illustrative Cases and Review of the Literature

Kathleen A. McHale, MD; *Christopher P. McIlvaine, BS*

Uniformed Services University for the Health Sciences Bethesda, Maryland and Inova Health System Falls Church, Virginia

† LOE-Therapeutic Level IV

Introduction: Compartment syndrome is infrequent in children but has been reported with forearm and tibia fractures and less with elbows. Silent or unrecognized compartment syndrome is particularly devastating, and certain circumstances may make children's symptoms less apt to point to the diagnosis. This paper reports 4 cases of pediatric silent compartment syndrome which illustrate the various reasons for the difficulty in detection.

Materials and Methods: Four children had non-classic presentation of compartment syndrome without pain. An 8 year old bipolar male sustained an open fracture dislocation of the ankle and underwent irrigation, debridement, and provisional fixation; wounds were left open. A "second look" was done at 48 hours. The need for pain medicine was negligible. On the fourth post-operative day, the patients' blood pressure averaged 200/100 with tachycardia. The foot was swollen despite bulky compressive dressings. Compartment pressures of the foot (not leg) were severely elevated; fasciotomy of foot compartments was performed. The intrinsic foot muscles are atrophied at 4 years post-op. A 13 year old male with multiple hereditary exostoses (MHE) underwent removal of several lesions of the proximal tibia and distal femur; local wound infiltration with marcaine was done at the end of the case without formal nerve block. His immediate post-operative course was unremarkable; sensation and motor function of the extremity were intact. Twelve hours after surgery, nurses noted that the patient had no sensation in his foot. Compartment pressure of all four leg compartments were normal. To rule out hematoma, CT scan was done and showed changes consistent with compartment syndrome. The patient was taken to the OR at about 20 hours post-op. Four compartment fasciotomy relieved pressures of 40 and above. All compartments were opened. The anterior tibialis muscle was non-contractile. After multiple debridements and negative pressure treatment, the wound was closed; there was very little return of the anterior compartment muscles. Over time, it was revealed that the patient was on a "summer medication break" from several behavioral control medications. Because of the abnormal amount of wound drainage, clotting studies were performed. Factor VII was low which has been reported in MHE. A 12 year old underwent a flexible nailing of his both bones of the forearm fracture the day of the fracture. The patient was admitted overnight and was noticed to have intermittently high blood pressure for age. Approximately 22 hours post-operatively, although pain on passive extension of the fingers was minimal, he refused to move his fingers. He had not complained of pain, but his parent insisted that he be given pain medicine every 4 hours. He underwent compartment release with eventual return of all muscles. A 96 hour newborn was transferred with a cool, swollen left upper extremity; initial diagnosis was arterial insufficiency.

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Compartment pressures were extremely elevated, and full release of arm, forearm, and hand was done with repeated dressings. Intrinsic muscle loss to the hand with partial amputation of the little finger resulted. **Results:** The above cases illustrate some classic causes silent compartment syndrome, i.e. known psychiatric disorder, bleeding diastheses, and non-verbal patients. The forearm fracture illustrates the higher incidence of compartment syndrome when intramedullary fixation is performed right after injury. The tibia case shows the previously reported possibility of gradual onset but also shows that not all pediatric compartment syndrome cases do well as the literature seems to indicate. These cases also bring to light other situations that make diagnosis difficult: undeclared psychological disorders that the parents are ashamed to report; "medication holidays"; parental overmedicating the child; and unfamiliarity of the primary and nursing staff as to the signs of compartment syndrome.

Conclusion: Particular attention to medication states both pre- and post-operatively may speed clinical thinking and diagnosis. Changes in vital signs serve as tips to investigate.

Signifigance: Vigilance for compartment syndrome in even the most routine of pediatric cases is mandatory.

Temporizing Management of Pediatric Femur Fractures Utilizing J-Splints

Scott A. Ritterman, MD; Alan H. Daniels, MD; Patrick M. Kane, MD;
Craig P. Eberson, MD; *Christopher T. Born, MD*

Alpert Medical School of Brown University, Providence, Rhode Island

† LOE-Therapeutic Level IV

Purpose: Pediatric femur fractures are common injuries encountered by pediatric orthopaedists. While much has been written regarding definitive management of these fractures, little has been devoted to the acute temporizing management of these injuries. The purpose of our study was to evaluate the utility of the J-splint in temporizing management of pediatric femur fractures, specifically in relation to pain management and fracture angulation.

Methods: IRB approval was obtained prior to initiation of this study. Data from 18 consecutive pediatric patients with femur fractures temporized with J-splinting was retrospectively collected. Patient age, weight in kilograms (kg), fracture location, pre-splinting fracture angulation as measured on anteroposterior (AP) and lateral radiographs, post-splinting angulation on AP and lateral radiographs, and definitive treatment method were recorded. Pre and post-splinting pain ratings were recorded using either the FLACC or Wong Baker FACES scoring systems. Paired T-tests were performed to evaluate the differences between pre and post-splinting fracture angulation for both AP and lateral radiographs as well as pre and post-splinting pain ratings.

Results: The mean age of patients treated in the J-splint was 6 years of age (range: 1y10m - 11y). The mean patient weight was 21.1 kg (range: 10kg - 57kg). No complications associated with J-splinting were recorded. Initial pre-splinting AP fracture angulation averaged 12.3° while lateral angulation averaged 8.8°. Average post-splinting AP fracture angulation improved to 8.2° while lateral angulation was 9.2°, although these differences were not statistically significant ($p>0.074$, $p>0.84$ respectively). Pain ratings were significantly reduced from a pre-splinting average of 6.0 to a post-splinting average of 1.0 ($p<0.0001$). Narcotic and anxiolytic pain medication use were reduced once splinting was completed.

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Discussion: The J-splint technique for temporizing management of pediatric femur fractures appears to be a reliable, simple, and rapidly applied splint that can effectively stabilize most pediatric femur fractures. While we did not find a significant difference in pre- to post-splinting fracture angulation, there was a trend towards improvement. More importantly, there was a significant reduction in pain ratings following splinting. Additionally, once J-splinting was completed, there was decreased narcotic administration. The J-splint appears to be a cost-effective, reliable, and safe method for temporizing pediatric femur fractures that can rapidly be applied in the emergency department with minimal sedation which can stabilize a patient until definitive management or transfer to a higher level of care.

Significance: The J-splint should be used for temporizing management of selected pediatric patients with femur fractures. It can effectively and reliably provide fracture stabilization and pain relief until patients can be transferred to a high level of care or until definitive care can be delivered. There were no complications due to J splint application in this small series.

External Fixation in Pediatric Femur Fractures: Where Are We Now?

Heather Kong, MD; ***Sanjeev Sabharwal, MD, MPH***

UMDNJ-New Jersey Medical School, Newark, New Jersey

† LOE-Therapeutic Level IV

Purpose: Recent advances in external fixation technique and pin design including Hydroxyapatite coating have minimized complications such as pin site infection and loosening. This study examines the clinical outcome of a cohort of pediatric patients with femur fractures treated with external fixation using contemporary techniques.

Methods: Records of children who underwent external fixation for a femur fracture from 1997-2012 by a single surgeon were retrospectively reviewed. Demographic data, type of external fixator used, fracture pattern, location, and angulation were documented. Follow-up radiographs were examined for fracture alignment, limb length discrepancy, and lateral distal femoral angle (LDFA). Any complications or unplanned surgeries were noted.

Results: 20 patients met the inclusion criteria. The mean age at the time of injury was 10 (range 4-15) years. Indications for external fixation were length unstable fracture (9), metadiaphyseal location (5), and underlying metabolic bone disease (5). The remaining patient had a refracture after premature removal of intrameduallry elastic nails. Three patients had an underlying diagnosis of Osteogenesis Imperfecta (OI) and two had spastic quadriplegia with Cerebral Palsy (CP). Five patients underwent monolateral external fixation, ten hybrid fixators, one circular frame, and four had fixator-augmented intramedullary nailing (2 OI, 2 CP). Mean time in external fixator was 14.4 (range 4-24) weeks.

At an average follow-up of 23 (range 1-78) months, mean fracture angulation was 1.9° (range 0-5.2°) and LDFA was 88.3° (range 82.8-93.2°). One patient with OI treated without supplemental intramedullary nailing developed an angular deformity requiring surgical correction. There were no cases of non-unions. Two patients (10%) sustained refracture through the original fracture site and none through pin sites. At final follow-up, no patients had a clinical leg length discrepancy >1 cm. Three children had radiographic leg length discrepancy >2 cm, although 2/3 had sustained additional lower extremity fractures. There were no pin site infections that required readmission, IV antibiotics, or additional surgery.

Conclusion: This study cohort demonstrated no cases of non-union or clinically significant pin related complications. Refracture and angular deformity did occur in three subjects, and were largely preventable.

Significance: When used for selective indications, external fixation using contemporary techniques is a viable option for treating pediatric femoral shaft fractures. With modifications in surgical technique and post-operative protocol, there is a potential for further improvement in clinical outcome.

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NP/PA (POPS) Symposium

Thurs., May 2, 2013 • 1:30 PM – 3:00 PM • Room: Grand East

Co-Chairs: *Coley Vitztum, RN, CCNS, RNFA and Allison Lind, RN, MN, MPH, CPNP*

Faculty: *John P. Dormans, MD, James G. Wright, MD, Brian D. Snyder, MD, PhD*

This 90 minute symposium will delve into the latest research and trends in the assessment, diagnosis and evidence-based treatment of bone cysts and tumors. Dr. James Wright from Toronto Sick Kids will discuss evidence-based treatment and outcomes for unicameral bone cysts, and Dr. Brian Snyder from Boston Children's will present on biomechanics of bone cysts and the prophylactic treatment of impending fractures. Dr. James Dormans from The Children's Hospital of Philadelphia will conclude the discussion by presenting on the evaluation and treatment of bone tumors. The presentations will be followed by a panel discussion.

THE ASSESSMENT, DIAGNOSIS AND EVIDENCE-BASED TREATMENT OF BONE CYSTS AND TUMORS

I. Evidence-based treatment and outcomes for unicameral bone cysts
James G. Wright, MD (Hospital for Sick Children, Toronto, Ontario, Canada)

II. Biomechanics of bone cysts and the prophylactic treatment of impending fractures
Brian D. Snyder, MD, PhD (Boston Children's Hospital, Boston, MA)

III. Evaluation and Treatment of Bone Tumors (benign vs. malignant) and Infection
John P. Dormans, MD (Children's Hospital of Philadelphia, Philadelphia, PA)

IV. Panel Discussion

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Practice Management Symposium

Thurs., May 2, 2013 • 1:30 PM – 3:00 PM • Room: Grand West & Center

Co-Chairs: *Jeffrey R. Sawyer, MD; Kerwyn C. Jones, MD*

Faculty: *Randolph B. Cohen, MD; Kerwyn C. Jones, MD; Scott J. Mubarak, MD; Jeffrey R. Sawyer, MD*

ENHANCING EFFICIENCY AND REVENUE IN PEDIATRICS ORTHOPAEDIC PRACTICE

Due to changing practice patterns including fewer general orthopaedists taking care of children, the emergence of large pediatric hospitals and concerns about medicolegal liability, the volume and complexity of children needing orthopaedic care continues to grow. At the same time, health care reform including increased regulation and declining reimbursement is also occurring. The purpose of this symposium is to learn strategies to deal with these challenges by improving efficiency and enhancing revenue production while providing high quality care to children with orthopaedic conditions.

1:30 PM – 1:35 PM	**Introduction** *Kerwyn C. Jones, MD, Akron Children's Hospital;* *Jeffrey R. Sawyer, MD, Campbell Clinic-University of Tennessee, Memphis, Tennessee*
1:35 PM – 1:45 PM	**Negotiating with Hospitals/Payers and Increasing Referrals and Revenue via Branding** *Randolph B. Cohen, MD, Joe DiMaggio Children's Hospital, Hollywood, Florida*
1:45 PM – 1:55 PM	**Discussion**
1:55 PM – 2:05 PM	**Use of Toyota LEAN Principles in Medical Practice** *Kerwyn C. Jones, Akron Children's Hospital, Akron, Ohio*
2:05 PM – 2:15 PM	**Discussion**
2:15 PM – 2:25 PM	**Use of Mid-level Providers in Pediatric Orthopaedics** *Scott J. Mubarak, MD, Rady Children's Hospital, San Diego, California*
2:25 PM – 2:35 PM	**Discussion**
2:35 PM – 2:45 PM	**Revenue Generating Strategies** *Jeffrey R. Sawyer, MD, Campbell Clinic-University of Tennessee, Memphis, Tennessee*
2:45 PM – 2:55 PM	**Discussion**
2:55 PM – 3:00 PM	**Wrap Up** *Kerwyn C. Jones, MD, Akron Children's Hospital;* *Jeffrey R. Sawyer, MD, Campbell Clinic-University of Tennessee, Memphis, Tennessee*

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SharePoint Training POSNA 2013

Thurs., May 2, 2013 • 3:15 PM – 4:45 PM • Room: Dominion North

POSNA SHAREPOINT TUTORIAL

Chair: *Bryan J. Tompkins, MD*

Faculty: *Bryan J. Tompkins, MD, Spokane, Washington;*
Thomas G. McPartland, MD, Princeton, New Jersey; Internet Committee Members

In the coming year, POSNA will be introducing Microsoft SharePoint Foundation, a powerful online collaboration tool for members. Committees and groups within POSNA will be able to leverage this platform to build online communities, manage tasks, store documents and media and other collaborative features. This workshop is designed for members to learn the basic tools and skills necessary to use and manage SharePoint. This interactive workshop is designed for committee leaders who wish to develop their own SharePoint site and POSNA members who want learn how to contribute to existing sites. NO advanced computer knowledge is required.

3:15 PM – 3:30 PM **INTRODUCTION TO SHAREPOINT**

- What is SharePoint?
- How to Login
- Workspace Basics and Navigation
- POSNA SharePoint Helpdesk
- The Sandbox
- Questions?

3:30 PM – 4:10 PM **CONTENT MANAGEMENT**

- Understanding Lists and Libraries
- Document Management
    - Basics
    - Integration with Microsoft Office
    - Alerts and Versioning
- Collaboration Features
    - Calendars
    - Contacts
    - Discussion Groups
    - Announcements
- Questions?

4:10 PM – 4:20 PM **ADVANCED FEATURES**

- Reporting Modules
- Setting Security
- Wikis
- Blogs
- Custom Modules (Maps)
- Workflows

4:20 PM – 4:30 PM **DESIGNING A SITE FOR YOUR COMMITTEE/PROJECT**

4:30 PM – 4:45 PM **QUESTIONS/DISCUSSION**

Live demonstration of the POSNA SharePoint site will be used during most talks to provide a real world working version of the site experience. We also hope to have a "sandbox" site to allow users to play around with SharePoint to upload and edit documents, create events, navigate workspaces, etc. without the worry of harming an actual site during the conference.

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COUR Symposium

Thurs., May 2, 2013 • 3:15 PM – 6:00 PM • Room: Grand East

DEVELOPING AND MAINTAINING A PEDIATRIC ORTHOPAEDIC OUTREACH PROGRAM

3:15 PM – 4:45 PM

SCHOLAR PRESENTATIONS

4:45 PM – 6:00 PM

Faculty: *Michelle A. James, MD, Sacramento, California;*
Robert M. Bernstein, MD, Los Angeles, California;
Coleen S. Sabatini, MD, San Francisco, California;
Andrea S. Bauer, MD, Shriners Hospital, Sacramento California

The COUR symposium will focus on *Developing and Maintaining a Pediatric Orthopaedic Outreach Program*. Topics pertinent to POSNA members interested in volunteer activities in resource challenged environments will be highlighted. Themes including developing and maintaining an outreach program, the role of U.S. and local trainees, feasibility of performing complex surgeries and getting informed consent in austere environments will be discussed by a panel of speakers with a broad range of experience in overseas medical missions. This session will be moderated by Michelle A. James. Other members of the panel are Matt Bernstein, Coleen S. Sabatini and Andrea S. Bauer.

Immediately following this symposium, there will be a short presentation by each of the visiting COUR scholars. All are invited to attend and meet these emerging leaders of pediatric orthopedic in the international community.

TOPICS:

1. Developing and Maintaining an Outreach Program
2. The Roles of US and Local Trainees
3. Planning and Performing Surgery for Complex Conditions
4. Learning from Local Surgeons and Health Care Workers
5. Ethical Issues: Informed Patient Consent, Follow-up Care, Outcomes Research

POSNA extends sincere appreciation to Medtronic for an educational grant in support of this session

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Evidence Based Medicine/Clinical Trials Symposium

Thurs., May 2, 2013 • 3:15 PM – 4:45 PM • Room: Grand West & Center

Co-Chairs: *Kishore Mulpuri, MD; Brian K. Brighton, MD, MPH*

Faculty: *James O. Sanders, MD; Colin F. Moseley, MD; Andrew W. Howard, MD; Michael J. Goldberg, MD; Peter O. Newton, MD; Daniel J. Sucato, MD; Kevin G. Shea, MD; Behrooz A. Akbarnia, MD; Harry K.W. Kim, MD; Kishore Mulpuri, MD; Michelle C. Marks, PT, MA*

The Evidence Based Medicine and Clinical Trials Symposium includes an outstanding faculty who will focus our discussion on the current state of evidence based medicine, the application of clinical practice guidelines in practice, and provide update on clinical trials. The second half of the program features leaders in our society who are actively involved in and leading national / international study groups with particular focus on pediatric spinal deformity, pediatric and adolescent hip conditions and sports medicine. Members from each study group will be presenting an overview and structure of their study groups, research activities, and also discuss some of key points that make their study groups successful and what challenges and directions they face going forward. It is indeed an exciting time for all of us as POSNA members and POSNA as a society continues to strive and advance the field through ongoing research and provide the most relevant information on pediatric musculoskeletal health related conditions.

SESSION I: WHERE ARE WE WITH EVIDENCE TODAY?

3:15 PM – 3:21 PM **Evidence Based Medicine in Pediatric Orthopedics**
James O. Sanders, MD, Rochester, New York

3:21 PM – 3:27 PM **Decisions in the Dark**
Colin F. Moseley, MD, Los Angeles, California

3:27 PM – 3:35 PM **Discussion**

3:35 PM – 3:41 PM **Clinical Trials in Pediatric Orthopedics in 2012-13**
Andrew W. Howard, MD, Toronto, Ontario

3:41 PM – 3:47 PM **Clinical Practice Guidelines in Pediatric Orthopedics**
Michael J. Goldberg, MD, Seattle, Washington

3:47 PM – 3:55 PM **Discussion**

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SESSION II: CURRENT STUDY GROUPS: WHAT ARE WE DOING RIGHT AND WHAT CAN WE DO TO MAKE THINGS BETTER?

3:55 PM – 4:00 PM **Harms Study Group**
Peter O. Newton, MD, San Diego, California

4:00 PM – 4:05 PM **Spinal Deformity Study Group**
Daniel J. Sucato, MD, Dallas, Texas

4:05 PM – 4:10 PM **ROCK Study Group**
Kevin G. Shea, MD, Boise, Idaho

4:10 PM – 4:15 PM **Growing Spine Study Group**
Behrooz A. Akbarnia, MD, La Jolla, California

4:10 PM – 4:18 PM **Discussion**

4:18 PM – 4:23 PM **International Perthes Study Group**
Harry K.W. Kim, MD, Dallas, Texas

4:23 PM – 4:28 PM **International Hip Dysplasia Institute**
Kishore Mulpuri, MD, Vancouver, British Columbia

4:28 PM – 4:35 PM **Study Coordination and Data Monitoring of Multi-Centre Study**
Michelle C. Marks, PT, MA

4:35 PM – 4:40 PM **Discussion**

4:40 PM – 4:45 PM **Conclusion and Thanks**
Kishore Mulpuri, MD, Vancouver, British Columbia
Brian K. Brighton, MD, MPH, Charlotte, North Carolina

2013 IFPOS
THURS., MAY 2, 2013

International Federation of Paediatric Orthopaedic Societies (IFPOS)
6th Triennial Congress

Thurs., May 2, 2013 • 1:15 PM-6:15 PM • Room: Civic Ballroom

Program Chairs: *Patricia M.B. Fucs, MD; George H. Thompson, MD*

Note: CME Credit is not available for this session.

I. SPINE AND HIP

Moderators: David D. Aronsson, MD; John P. Dormans, MD

1 1:15 PM – 1:19 PM ♦Correction and Complications in the Treatment of EOS: Is there a Difference between Spine vs. Rib-Based Proximal Anchors?
Michael G. Vitale, MD; Howard Y. Park, BA; Hiroko Matsumoto; Daren J. McCalla, BS; ***David P. Roye Jr, MD;*** *David L. Skaggs, MD, MMM; Behrooz A. Akbarnia, MD*
Columbia University Medical Center, New York, New York

2 1:19 PM – 1:23 PM Normal Sagittal Alignment of the Spine: A Patient Specific Model
Krishna R. Cidambi; Josh Doan; Peter O. Newton, MD; ***Diana Andreeva Glaser, PhD***
Rady Children's Hospital, San Diego, California

1:23 PM – 1:27 PM DISCUSSION

3 1:27 PM – 1:31 PM Choosing the Lower Instrumented Vertebra in Scheuermann's Kyphosis: Revisited
Suken A. Shah, MD; *Muayad Kadhim, MD; Baron S. Lonner, MD; Harry L. Shufflebarger, MD; Paul D. Sponseller, MD; Peter O. Newton, MD*
Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware

4 1:31 PM – 1:35 PM Ponte Osteotomies with Pedicle Screw Instrumentation in the Treatment of Adolescent Idiopathic Scoliosis
Suken A. Shah, MD; *Arjun Dhawale; Jon Edward Oda, MD; Petya Yorgova; Geraldine Neiss, PhD; Laurens Holmes Jr, PhD; Peter G. Gabos, MD*
Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware

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	1:35 PM – 1:40 PM	DISCUSSION ***Moderators: Rui Maciel, MD; Dennis R. Wenger, MD***
5	1:40 PM – 1:44 PM	Radiographic, Pain and Functional Quality of Life Outcomes after Hip Reconstruction in Cerebral Palsy: A 20 Year Follow-up Study ***Freeman Miller Jr, MD;*** *Ali F. Karatas, MD; Arjun Dhawale; Laurens Holmes, PhD; Kenneth Rogers; Kirk W. Dabney, MD* *Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware*
6	1:44 PM – 1:48 PM	Subcapital Re-alignment Procedure for Severe Scfe with Intra-operative Monitoring of Femoral Head Perfusion and Post-operative Bone Scan: 45 Consecutive Cases *Kyle James, MD; Paul Gibbons; David Graham Little, MBBS;* ***Oliver Birke*** *The Children's Hospital at Westmead, Sydney, Australia*
	1:48 PM – 1:52 PM	DISCUSSION
7	1:52 PM – 1:56 PM	Reliability of a New Radiographic Classification of Developmental Dysplasia of the Hip *Harish S. Hosalkar, MD; Charles T. Price, MD; Pablo Castañeda, MD; Nicholas M. P. Clarke, ChM FRCS; Jose A. Herrera-Soto, MD; James R. Kasser, MD; Scott J. Mubarak, MD; Kishore Mulpuri, MD; John H. Wedge, MD; Peter Cundy, MD;* ***Unni G. Narayanan, MD, FRCSC*** *The Hospital for Sick Children, Toronto, Ontario, Canada*
8	1:56 PM – 2:00 PM	Our Surgical Management for Severely Involved Perthes' Disease *Makoto Kamegaya, MD; Junshiro Hisamitsu; Takashi Saisu, MD; Yuko Segawa; Jun Kakizaki, MD; Yohei Yamamoto;* ***Morita Mitsuaki*** *Chiba Child & Adult Orthopaedic Clinic, Chiba City, Chiba, Japan*
	2:00 PM – 2:04 PM	DISCUSSION ***Moderators: Joseph Benjamin, MD; Shlomo Weintraub, MD***
9	2:04 PM – 2:08 PM	Hip Pathology in Majewski Osteodysplastic Primordial Dwarfism Type II ***William G. Mackenzie, MD;*** *Ali F. Karatas, MD; Michael B. Bober; Kenneth J. Rogers, PhD; Angela L. Duker; Colleen P. Ditro* *Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

10 2:08 PM-2:12 PM Comparison of Outcomes and Complications of Hip Arthroscopy for Mixed Hip Disorders Between Adolescents and Adults: A Prospective Cohort Study

Pramod Achan; Martin Gottliebsen; Bjarne Moeller-Madsen; ***Manoj Ramachandran***

St. Bartholomew's and The Royal London Hospitals, London, England, United Kingdom

2:12 PM – 2:17 PM DISCUSSION

11 2:17 PM – 2:21 PM ♦ Can Bmp2 Combined with the Superhip Procedure Lead to Ossification of the Unossified Femoral Neck and Lower Recurrence of Coxa Vara in Severe Congenital Femoral Deficiency?

Matthew Harris; Catharina Chiari, MD; ***Dror Paley, MD***
Paley Advanced Limb Lengthening Institute, West Palm Beach, Florida

12 2:21 PM – 2:25 PM Predictive Probability of Stulberg Classes after Conservative and Surgical Containment Treatments for Perthes Disease. Conditional Inference Tree Analysis

Hyuk J. Moon; Tae-Joon Cho, MD; Won Joon Yoo, MD; ***In Ho Choi, MD***

Seoul National University Children's Hospital, Seoul, Korea

2:25 PM – 2:30 PM DISCUSSION

II. SPECIAL TOPICS/LOWER EXTREMITY/ CONGENITAL SYNDROMES

Moderators: Michael J. Goldberg, MD; Toshio Fujii, MD

13 2:35 PM – 2:39 PM Changes after Removal of Hemiepiphysiodesis: A Preliminary Report

Ignacio Sanpera-Trigueros, MD; *Laura Corominas, MD*

Hospital Universitari Son Espases, Palma de Mallorca, Spain

14 2:39 PM – 2:43 PM Assessment of the Relationship between Radiographic and Clinical Measurements following Correction of Idiopathic and Non-Idiopathic Clubfoot

Mia Dunkley; Deborah Jackson; Jen Armstrong; Evette Parnell; Deborah M. Eastwood, MD; ***Yael Gelfer, MD, PhD***

Great Ormond Street Hospital, London, United Kingdom

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15	2:43 PM – 2:47 PM	Unicameral Bone Cyst Treatment: Meta-Analysis *Laurens Holmes, PhD; Muayad Kadhim, MD; Amjed Kadhim; Mihir M. Thacker, MD;* ***Larry Holmes Jr, PhD, Dr Ph*** *Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware*
	2:47 PM – 2:52 PM	DISCUSSION ***Moderators: Patricio Gonzalez, MD; Jan Poul, MD***
16	2:52 PM – 2:56 PM	Disease Characteristics and Clinical Outcome of 11 Cases with Chronic Non-bacterial Osteomyelitis *Yutaka Inaba; Chie Aoki; Kikuchi Masako; Naoyuki Nakamura; Jiro Machida; Shigeharu Okuzumi; Shumpei Yokota; Tomoyuki Saito;* ***Yurika Ata, MD*** *Yokohama City University, Yokohama City, Kanagawa, Japan*
17	2:56 PM – 3:00 PM	Endoscopic Surgery for Osteomyelitis Extending Across the Physis *Jun Kakizaki, MD; Yuko Segawa, Mituaki Morita, MD; Makoto Kamegaya, MD;* ***Takashi Saisu, MD*** *Chiba Children's Hospital, Chiba, Japan*
	3:00 PM – 3:04 PM	DISCUSSION ***Moderators: In Ho Choi, MD; Darko Anticevic, MD, PhD***
18	3:04 PM – 3:08 PM	Limb Lengthening by Remote Controlled Magnetical Nail *Thomas Wirth, MD, PhD; Oliver Eberhardt;* ***Michael Langendoerfer*** *Olgahospital, Stuttgart, Germany*
19	3:08 PM – 3:12 PM	Delayed Peroneal Nerve Palsy following Limb Salvage for Primary Bone Sarcoma Around the Knee *David Ibrahim, MD;* ***Alexandre Arkader, MD*** *Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California*
	3:12 PM – 3:16 PM	DISCUSSION ***Moderators: J. Richard Bowen, MD; Gamal A. Hosny, MD***
20	3:16 PM – 3:20 PM	Effects and Complications of Percutaneous Epiphysiodesis Using Transphyseal Screws in the Management of Leg Length Discrepancy ***Mi-Hyun Song, MD;*** *Moon Seok Park; Won Joon Yoo, MD; Chin Youb Chung, MD; In Ho Choi, MD; Tae-Joon Cho, MD* *Seoul National University Children's Hospital, Seoul, Korea*

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21	3:20 PM – 3:24 PM	A New Implantable Lengthening Device *Matthew Harris; Daniel E. Prince, MD;* ***Dror Paley, MD*** *Paley Advanced Limb Lengthening Institute, West Palm Beach, Florida*
	3:24 PM – 3:28 PM	DISCUSSION ***Moderators: Nando DeSanctis, MD; Alain Dimeglio, MD***
22	03:28 PM – 03:32 PM	Rotationplasty as a Salvage of Failed Primary Limb Reconstruction ***J. Ivan Krajbich, MD, FRCS(C)*** *Shriners Hospitals for Children Portland, Portland, Oregon*
23	03:32 PM – 03:36 PM	Comparison of Orthopaedic Manifestations of Multiple Epiphyseal Dysplasia Caused by Matn3 vs. Comp Mutations *Sang Gyo Seo, MD; Hae Ryong Song, MD; Hyun Woo Kim; Won Joon Yoo, MD; Jong Sup Shim, MD; Chin Youb Chung, MD; Moon Seok Park; Chang-Wug Oh, MD; Changhoon Jeong, MD; Kwang Soon Song, MD; Ok-Hwa Kim, MD; Sung Sup Park, MD; In Ho Choi, MD;* ***Tae-Joon Cho, MD*** *Seoul National University Children's Hospital, Seoul, Korea*
	3:36 PM – 3:40 PM	DISCUSSION
	3:40 PM – 3:55 PM	BREAK

III. TRAUMA/BASIC SCIENCE/FOOT AND ANKLE

Moderators: Ruxie Ma, MD; William G. Mackenzie, MD

24	3:55 PM – 3:59 PM	Twenty-Year Experience with Rigid Intramedullary Nailing of Skeletally Immature Femur Fractures *Samuel N. Crosby, MD; Elliot J. Kim, BA; Daniel M. Koehler, MD; Gregory A. Mencio, MD; Neil E. Green, MD; Steven A. Lovejoy, MD; Jonathan G. Schoenecker, MD, PhD;* ***Jeffrey E. Martus, MD*** *Vanderbilt University, Nashville, Tennessee*
25	3:59 PM – 4:03 PM	Minimal Invasive Reduction of Chronic Monteggia Lesions by Hexapod Frame *Francisco F. Fernandez; Thomas Wirth, MD, PhD;* ***Michael Langendoerfer*** *Olgahospital, Stuttgart, Germany*
26	4:03 PM – 4:07 PM	Fractures of Children Under 18 Years of Age: Nationwide Policy-Making Analysis for Prevalence, Seasonal Trend and Choice of Medical Providers *Ming Tung Huang, MD; Nai Wen Guo, PhD; Ken N. Kuo, MD;* ***Chii Jeng Lin, MD*** *National Cheng Kung University (NCKU), Tainan, Taiwan*

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	4:07 PM – 4:12 PM	DISCUSSION ***Moderators: Alexandre Lourenço, MD; Franz Grill, MD***
27	4:12 PM – 4:16 PM	Biomechanical Effects of Tibialis Anterior Tendon Transfers *James Jastifer, MD; Matthew Dubiel, MD; Peter Gustafson, PhD;* ***Philip Nowicki, MD*** *Western Michigan University School of Medicine, Kalamazoo, Michigan*
28	4:16 PM – 4:20 PM	Genic Variations in Hox-Genes in Patients with Congenital Idiopathic Clubfoot *Alejandra Camacho, MD, MSc; Ileana-Patricia Canto, MD, PhD; Juan-Carlos Perez, BS; Jacobo Saleme, MD; Jorge Teneria, BS; Nelson Cassis, MD, FACS; Ramon Coral, PhD;* ***Armando Torres-Gomez, MD, MSc, FACS*** *ABC Medical Center; Shriners Hospital for Children, Mexico City*
29	4:20 PM – 4:24 PM	♦Biomechanical Evaluation of 4 Different Foundation Constructs Commonly Used in Growing Spine Surgery: Are Rib Anchors Comparable to Spine Anchors? ***Behrooz A Akbarnia, MD;*** *Burt Yaszay, MD; Muharrem Yazici, MD; Nima Kabirian, MD; Kevin R. Strauss, ME; Diana Andreeva Glaser, PhD; Complex Spine Study Group* *Rady Children's Hospital, San Diego, California*
	4:24 PM – 4:29 PM	DISCUSSION ***Moderators: James W. Roach, MD; Ken N. Kuo, MD***
30	4:29 PM – 4:33 PM	Plethysmographic and Arterial Waveform Analysis during Spinal Fusion Surgery Using Frequency Analysis as a Method of Detecting Changes in Pre-Load (Venous) Volume Status *Gourg Atteya, MD; Nishanthi Kandiah, MD; Thomas Golembeski, MD; Kirk Shelley, MD, PhD; Aymen A. Alian, MD;* ***Brian G. Smith, MD*** *Yale University School of Medicine, New Haven, Connecticut*
31	4:33 PM – 4:37 PM	Experimental Posterior Elbow Dislocation In Two Primate Models *Samer Al Kork, PhD; Farid Amirouche, PhD; Susan King, HT;* ***Edward Abraham, MD*** *University of Illinois at Chicago, Department of Orthopedics, Chicago, Illinois*
	4:37 PM – 4:42 PM	DISCUSSION ***Moderators: Ismat Ghanem, MD; Matthew Dobbs, MD***

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See pages 15 – 57 for financial disclosure information.

32	4:42 PM – 4:46 PM	Postero-Medial Release In Patients With Clubfoot Treated with the Ponseti Method. *Gilberto Rios, MD; Nelson Cassis, MD, FACS;* ***Armando Torres-Gomez, MD, MSc, FACS*** *ABC Medical Center, Shriners Hospital for Children, Mexico City*
33	4:46 PM – 4:50 PM	A Prospective Determination of Environmental Factors Associated with Clubfoot *Petter Risoe, MD, PhD; James G. Wright, MD, MPH, FRCSC;* ***Emily Dodwell, MD, MPH*** *Hospital for Special Surgery, New York, New York*
34	4:50 AM – 4:54 PM	Operative Management of Osteocondritis Dissecans of The Ankle in Children *Benjamin J. Shore, MD; Michael P. Glotzbecker, MD; Dave Zurakowski, Mininder S. Kocher, MD; Lyle Micheli, MD;* ***Dennis Kramer, MD*** *Boston Children's Hospital, Boston, Massachusetts*
	4:54 PM – 4:59 PM	DISCUSSION

IV. NEUROMUSCULAR/UPPER EXTREMITY/SPORTS

Moderators: Freeman Miller, MD; Juan C. Cuoto, MD

35	5:05 PM – 5:09 PM	The Relationship between the School Function Assessment and the Gross Motor Function Classification System in Ambulatory Cerebral Palsy Patients *Remy Rabinovich; Nitesh V. Patel;* ***Norman Y. Otsuka, MD*** *NYU Langone Medical Center, Hospital for Joint Diseases, New York, New York*
36	5:09 PM – 5:13 PM	An Urgent Need for Multidisciplinary, Transitional and Adult Care in Cerebral Palsy: National and Single Institution Trends *Hiroko Matsumoto, MA; Dan Tobert, BS; Elizabeth Romney, BA; Joshua E. Hyman, MD; Michael G. Vitale, MD; David P. Roye Jr, MD;* ***Benjamin D. Roye, MD MPH*** *Columbia University Medical Center, New York, New York*
37	5:13 PM – 5:17 PM	Long-term Outcome of Early Spine Fusion for Scoliosis in Children with Cerebral Palsy *Kirk W. Dabney, MD; Freeman Miller, MD; Kenneth J. Rogers; Laurens Holmes, PhD;* ***Prakash Sitoula, MD*** *Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware*

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	5:17 PM – 5:22 PM	DISCUSSION ***Moderator: Deborah M. Eastwood, MD; Unni G. Narayanan, MD, FRCSC***
38	5:22 PM – 5:26 PM	Botulinum Toxin Injections in Lower Extremities Increase Physical Activity in Upper Extremities in Children with Cerebral Palsy *Sandra Pomo; Maria Hagströmer; Eva Pontén, MD, PhD;* ***Stefan Gantelius, MD*** *Karolinska Institutet, Stockholm, Sweden*
39	5:26 PM – 5:30 PM	Selective Motor Control in Diplegic Patients and its Relation with Functional Classification Systems *Alfredo Toledo, PhD; Marcos Crespo, BME; Maria P. Gotter, MD; Eduardo Segal, MD; Eduardo J. Samara, MD;* ***Juan Carlos Couto, MD*** *FLENI, Fundación para la Lucha contra las Enferemedades Neurológicas en la Infancia - Buenos Aires, Argentina*
	5:30 PM – 5:34 PM	DISCUSSION ***Moderator: Eva Poten, MD; Andre Kaelin, MD***
40	5:34 PM – 5:38 PM	Volumetric Motion Analysis: A Simple and Accurate Way of Measuring 3-Dimensional Reach in Children *Anna Lennartsson; Eva Pontén, MD, PhD; Elena Gutierrez-Farewik;* ***Stefan Gantelius, MD*** *Karolinska Institutet, Stockholm, Sweden*
41	5:38 PM – 5:42 PM	Predictors of Microsurgical Reconstruction in Brachial Plexus Birth Palsy *Apurva S. Shah, MD, MBA; Donald S. Bae, MD; Leslie A. Kalish, DSc;* ***Peter M. Waters, MD;*** *Treatment and Outcomes of Brachial Plexus Injuries (TOBI) Study Group* *Children's Hospital, Boston, Massachusetts*
	5:42 PM – 5:46 PM	DISCUSSION ***Moderator: Hakan Omeroglu, MD; Patricia M.B. Fucs, MD***
42	5:46 PM – 05:50 PM	Impact of Anterior Cruciate Ligament Reconstruction in Adolescence on 3D Knee Kinematic Variability *Leila Ayoubian; Alex Fuentes; Jacques A. de Guise; Neila Mezghani;* ***Guy Grimard, MD*** *CHU Sainte-Justine, Montreal, Quebec, Canada*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

43	5:50 PM – 5:54 PM	The Trend of Pediatric Sports and Recreational Injuries in the US in the Last Decade *Marios N. Lykissas, MD, PHD; Emily A. Eismann, MS;* ***Shital N. Parikh, MD*** *Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio*
44	5:54 PM – 5:59 PM	Current Indications and Complications of Hip Arthroscopy in Children *Summer Watkins, ANP;* ***Prasad Gourineni, MD*** *Advocate Children's Hospital, Oak Lawn, Illinois*
	5:59 PM – 6:03 PM	DISCUSSION ***Moderator: Yi-Meng Yen, MD; Makoto Kamegaya, MD***
45	6:03 PM – 6:07 PM	Medial Patellofemoral Ligament Reconstruction for Patellar Instability in Skeletally Immature Patients *Eric J. Wall, MD;* ***Shital N. Parikh, MD*** *Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio*
46	6:07 PM – 6:11 PM	Arthroscopic Femoral Neck Osteoplasty In Slipped Capital Femoral Epiphysis *Austin Chen;* ***Prasad Gourineni, MD*** *Advocate Children's Hospital, Oak Lawn, Illinois*
	6:11 PM – 6:15 PM	DISCUSSION

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YOUNG MEMBERS FORUM

Thursday, May 2, 2013 • 5:00 PM – 6:30 PM • Room: Dominion North

5:00 PM – 5:10 PM **I: Negotiation In Practice: How To Get Both What You Need And What You Want**
Scott J. Mubarak, MD

5:10 PM – 5:20 PM **II: Managing Research And Practice: Securing And Using Protected Time Effectively**
Harry K.W. Kim, MD

5:20 PM – 5:30 PM **III: A Professional Life In Balance: Time Management For Pedi Orthopods**
John (Jack) M. Flynn, MD

5:30 PM – 5:35 PM **IV: How POSNA Can Help Your Career**
Peter O. Newton, MD

5:35 PM – 6:00 PM **Questions and Answers**
Moderator: Brian G. Smith, MD

6:00 PM – 6:30 PM **Networking/Socializing**

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Hip Subspecialty Day

Fri., May 3, 2013 • 1:00 PM – 5:15 PM • Room: Dominion North

Co-Chairs: *Michael B. Millis MD; Ira Zaltz MD*

PERIOD 1

DDH

1:00 PM – 1:04 PM	**Welcome and Introduction** *Michael B. Millis, MD, Boston, Massachusetts;* *Ira Zaltz, MD, Royal Oak, Michigan*
1:05 PM – 1:25 PM	**Keynote Address** **Avascular Necrosis and Redislocation Following Closed and Open Reduction** *John H. Wedge, MD, FRCS, Toronto, Ontario, Canada*
1:26 PM – 1:35 PM	**Pavlik Harness: Pearls for Success, When to Bail Out and What Else to Do When the Pavlik Isn't Working?** *James R. Kasser, MD, Boston, Massachusetts*
1:36 PM – 1:46 PM	**Open Reduction for the Dislocated Hip Under 9 Months: Anterior, Medial, How?** *J. Anthony Herring, MD, Dallas, Texas*
1:47 PM – 1:57 PM	**Acetabuloplasty in the Walking Age Child. Which One? How?** *Andreas Roposch, MD, MSc, FRCS, London, United Kingdom*
1:58 PM – 2:15 PM	**Questions and Cases**
2:16 PM – 2:30 PM	**Break**

PERIOD 2

2:30 PM – 3:45 PM

PERTHES

2:30 PM – 2:40 PM	**Perthes Update: Pathogenesis and Emerging Therapies, What We Learn from Bench Research** *Harry K.W. Kim, MD, Dallas, Texas*
2:40 PM – 2:46 PM	**Non-operative Treatment for Lateral Column B/C and C Hips** *Perry L. Schoenecker, MD, St. Louis, Missouri*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

2:47 PM – 2:55 PM **Containment in 2013: Who Should Receive Treatment?**
David A. Podeszwa, MD, Dallas, Texas

2:56 PM – 3:04 PM **The Non-containable Hip Still in the Active Phase: What to Do? Nothing? Shelf? Valgus Osteotomy?**
Michael B. Millis, MD, Boston, Massachusetts

3:05 PM – 3:13 PM **Impingement in Healed Perthes: Various Types and How to Treat**
Ernest L. Sink, MD, New York, New York

3:14 PM – 3:22 PM **The Symptomatic Osteochondral Fragment in healed Perthes: Treatment Options**
Ira Zaltz, MD, Royal Oak, Michigan

3:23 PM – 3:33 PM **Chondrolysis: Pathophysiology and Treatment**
Vrisha Madhuri, Prof., Vellore, India

3:34 PM – 3:45 PM **Discussion and Cases**

3:45 PM – 4:00 PM **Break**

PERIOD 3

4:05 PM – 5:05 PM

FREE PAPERS

4:05 PM – 4:09 PM **Testing Newly Developed Standardized Diagnostic Criteria for DDH in Consecutive Patients Referred to a Paediatric Orthopaedic Unit**
Andreas Roposch, MD; *Evangelia Protopapa; Deborah Ridout; Deborah M. Eastwood, MD; Christopher Bradish*
Great Ormond Street Hospital for Children, London, United Kingdom

4:10 PM – 4:14 PM **The Factors Related to Result in the Developmental Dislocation of the Hip with Widened Joint Space after Primary Treatment**
Hui Taek Kim, MD; Tae Hoon Lee, MD; ***Jong-Seo Lee, MD***
Pusan National University, Pusan, Korea

4:15 PM – 4:19 PM **Diffusion-Weighted MRI of the Femoral Head in Developmental Dysplasia of the Hip: Initial Comparison to Gadolinium-Enhanced MRI Perfusion Imaging**
Travis H. Matheney, MD; *Moti Freiman, PhD; Michele M. Walters, MD; Susan Connolly, MD*
Boston Children's Hospital, Boston, Massachusetts

4:20 PM – 4:27 PM **Discussion**

4:28 PM – 4:32 PM **Periacetabular Triple Innominate Osteotomy for Improved Containment of Hips with Poor Prognosis after Legg-Calvé-Perthes-Waldenstroem (LCPW)**
G. Ulrich Exner, MD
Orthopaedie Zentrum Zuerich, Klinik Hirslanden, Zürich, Switzerland

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4:33 PM – 4:37 PM	♦ **Intraoperative Monitoring of Epiphyseal Perfusion in Slipped Capital Femoral Epiphysis** ***Tim Schrader, MD;*** *Christopher R. Jones, MD; Adam Kaufman, MD* *Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia*
4:38 PM – 4:42 PM	**Severe Slipped Upper Femoral Epiphysis; Fish Osteotomy versus Pinning In Situ: An Eleven-Year Perspective** ***Sattar Alshryda, MD;*** *Kai Tsang; Mubashshar Ahmed; Akinwanda Adedapo; Richard Montgomery, MD* *The James Cook University Hospital, Middlesbrough, United Kingdom*
4:43 PM – 4:50 PM	**Discussion**
4:51 PM – 4:55 PM	**The Cross Table Lateral Radiograph Results In Significantly Increased Effective Radiation Dose** ***Megan L. Young, MD;*** *Molly Dempsey, MD; Andriana De La Rocha, MS; David A. Podeszwa, MD* *Texas Scottish Rite Hospital for Children, Dallas, Texas*
4:56 PM – 5:00 PM	**Pediatric Implant Related Fracture after Proximal Femoral Osteotomy: Blade Plates vs. Screw and Side Plate Constructs** *Amit Jain, MD; John Thompson; Michael Paloski, MD;* ***Paul D. Sponseller, MD*** *Johns Hopkins, Baltimore, Maryland*
5:01 PM – 5:05 PM	**Adolescents with Hip Pain May be at Risk for Anxiety and Depression Prior to Hip Preservation Surgery** *Heather M. Richard, PsyD; Erica L. Rosentraub, PhD;* ***David A. Podeszwa, MD;*** *Andriana De La Rocha, MS; Sandy Roland, PhD; Daniel J. Sucato, MD, MS* *Texas Scottish Rite Hospital for Children, Dallas, Texas*
5:06 PM – 5:13 PM	**Discussion**

† LOE – Level of Evidence – Please see page 14 for details.

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Testing Newly Developed Standardized Diagnostic Criteria for DDH in Consecutive Patients Referred to a Paediatric Orthopaedic Unit

Andreas Roposch, MD; *Evangelia Protopapa; Deborah Ridout; Deborah M. Eastwood, MD; Christopher Bradish*

Great Ormond Street Hospital for Children, London, United Kingdom

† LOE-Diagnostic Level II

Aim: To determine the validity of newly developed standardized diagnostic criteria for DDH in infants aged 1-8 weeks.

Methods: In this retrospective cohort study, we included a series of 44 consecutive infants (mean age, 3.3±1.9 weeks) referred to any one of three senior surgeons for a possible diagnosis of DDH. One investigator reviewed the patient records for the presence/absence of 5 standardized diagnostic criteria for DDH: Ortolani, Barlow, abduction limitation, first-degree family history, and alpha angle. Based on only these criteria, we calculated a probability of DDH for each patient using weights from a previously established logistic regression model. We compared these probabilities with the "true" diagnosis that these infants had received in the actual clinical setting by the surgeons.

Results: The three senior surgeons diagnosed 27 (61%) infants with DDH requiring treatment. The probability of DDH predicted by the standardized criteria was moderately correlated with the "true" diagnosis (r=0.64, p <.001). The standardized criteria predicted the correct diagnosis in 37 (84%) of cases (p<.001), with a positive predictive value of 86% (95% CI, 66-95) and a negative predictive value of 81% (95% CI, 54-95). Our diagnostic model had a sensitivity of 89% (95% CI, 70-97) and a specificity of 76% (95% CI, 50-92).

Conclusion: In 44 consecutive patients, the diagnoses made with use of standardized diagnostic criteria were predominantly consistent with those made by senior surgeons in the actual clinical setting. We interpret this as further evidence of validity.

Significance: Newly developed standardized diagnostic criteria seem promising for use in the clinical setting. They have the potential to improve the consistency of the diagnosis of DDH, thereby leading to more effective treatment.

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The Factors Related to Result in the Developmental Dislocation of the Hip with Widened Joint Space after Primary Treatment

Hui Taek Kim, MD; Tae Hoon Lee, MD; ***Jong-Seo Lee, MD***

Pusan National University Hospital, Pusan, Korea

† LOE-Therapeutic Level III

Purpose: To evaluate the factors related to good or poor results in DDH patients who show a widened joint space due to acetabular cartilage hypertrophy after primary treatment.

Methods: We retrospectively reviewed 19 cases of DDH: 1) who showed a widened joint space on postoperative radiographs after primary treatment, 2) whose MRI showed that the widened joint space was caused by acetabular cartilage hypertrophy, and 3) who were followed up for more than 10 years. The mean age at the time of MRI was 26.9 months. 6 patients underwent primary treatment only (open reduction and capsulorrhaphy) and 13 patients underwent secondary surgery (pelvic and/or femoral osteotomy). Acetabular index, CE angle, center-head distance discrepancy, head coverage, neck shaft angle, medial and superior joint gap ratio, acetabular depth (ACM angle), tear drop shape (absent/V-shape/widened U-shape), and tear drop width ratio were measured from radiographs. Final results were classified using a modified Severin classification (Groups I, II: satisfactory, Groups III, IV: unsatisfactory). Kruskall-Wallis, Fisher's exact test, ROC analysis were used for statistical analysis.

Results: All 6 patients who underwent primary treatment only showed satisfactory results. Results for 13 patients who underwent secondary treatment were unsatisfactory in (69.2%) and satisfactory in 4 (30.8%). Statistically significant factors necessitating secondary surgical treatment were low acetabular index (p=0.0277), poor acetabular coverage (p=0.0232), and low CE angle (p=0.0202). Factors associated with poor outcomes of secondary treatment were abnormal tear drop shape (p=0.0070) and high tear drop width ratio (p=0.0340) before the second surgery.

Conclusion: In DDH patients who show a widened hip joints with acetabular cartilage hypertrophy after primary treatment, an abnormal tear drop and/or a wide tear drop are poor prognostic factors for secondary treatment.

Significance: Acetabular cartilage hypertrophy from any cause leads to a shallow acetabulum. Lateralization of the femoral head should be prevented at the time of the primary treatment of DDH.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Diffusion-Weighted MRI of the Femoral Head in Developmental Dysplasia of the Hip: Initial Comparison to Gadolinium-Enhanced MRI Perfusion Imaging

Travis H. Matheney, MD; *Moti Freiman, PhD; Michele M. Walters, MD; Susan Connolly, MD,*

Boston Children's Hospital, Boston, Massachusetts

† LOE-Other Analysis Level IV

Purpose: Avascular necrosis (AVN) of the femoral head is a well-described complication following surgical treatment of developmental hip dysplasia (DDH). Post-operative gadolinium-enhanced MRI (GE-MRI) has been proposed as one method to assess global deficiency in femoral head perfusion, correlated with the development of AVN. Diffusion-weighted MRI (DW-MRI) is being utilized successfully to assess regional vascular differences in Legg-Calve-Perthes disease. As the administration of contrast agents in the very young patient is always a concern, the purpose of this study was to determine whether DW-MRI could be utilized to assess regional vascular differences in the immature femoral head and whether it would directly compare to perfusion results of GE-MRI.

Methods: In spica GE- and DW-MRI sequences were obtained following operative reductions for infant DDH in 14 hips (7 scans of 4 patients, none bilateral). Average age of patients was 7.4 months (range 3-12months). There were 3 girls and 1 boy. DW-MRI was acquired with multiple b-value in the range of 0-500 s/mm2. GE-MRI and DW-MRI were interpreted independently by two experienced radiologists who were blinded to each other's interpretation. Quantitative DW-MRI analysis was performed by means of Intra-Voxel Incoherent Motion (IVIM) analysis of slow- (D) and fast-diffusion (D*) and the fractional contribution of each to the DW-MRI signal decay (f).

Results: Review of GE-MRI found segmental abnormalities in 7 femoral heads. DW-MRI and IVIM analysis of these segments also found they were receiving abnormal blood flow. f values were larger in the abnormal segments (mean=8.1, std=6 vs. mean=7.1, std=5.1). Slow diffusion (D) values were larger in the abnormal segments (mean=2.6, std=3.1 vs. mean=1.4, std=0.8 μm2/ms), and faster diffusion (D*) values were lower in the abnormal segments (mean=8.9, std=7.1 vs. mean=14.9, std=24 μm2/ms). No segment had zero diffusion. While these findings demonstrate a trend toward agreement with GE-MRI, none of the differences in f, D, or D* between normal and abnormal segments reached significance in this initial evaluation.

Conclusion: Diffusion-weighted imaging of cartilage in DDH hips with quantitative Intra-Voxel Incoherent Motion (IVIM) analysis shows promise as a non-contrast MRI method to demonstrate defects in vascularity. Further work and follow-up are required to confirm whether the diffusion MRI review and quantitative analysis are capable of predicting AVN.

Significance: AVN from surgical reduction of infant hip dislocations is the most significant complication. Improving our ability to visualize problems early, ideally without utilizing contrast agents, and predicting outcomes can aid in counseling families.

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Periacetabular Triple Innominate Osteotomy for Improved Containment of Hips with Poor Prognosis after Legg-Calvé-Perthes-Waldenstroem (LCPW)

G. Ulrich Exner, MD

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† LOE-Therapeutic Level IV

Introduction: Patients with LCPW who develop hip contracture and decentration of the femoral head usually have a poor prognosis.

In 1992 we began to use periacetabular triple osteotomies in selected patients with lateralization of the femoral head and secondary dysplastic development of the acetabulum to reconstitute containment of the femoral head within the acetabulum. Functional arthrograms were performed before surgery to exclude severe hinge abduction, which is considered a contraindication.

Patients and Methods: 14 patients (16 hips) with a f/u of at least 6 years with CLPW and lateral extrusion of the femoral head and secondary dysplastic development of the acetabulum have been treated by triple innominate osteotomy (TIO) for lateralization and dysplastic acetabular development with a subinguinal adductor approach. Age at triple osteotomy ranged from 4 to 11 years (avg. 6.8y). Besides standard radiographs the indication was based on dynamic standard radiographic or MRI arthrograms. The more recent cases were pre- and postoperatively studied by quantitative CT. The TIO was performed at 9 to 30 months (avg. 18 months) after the first symptoms.

Results: All hips at follow-up (6 to 18 years, avg. 10 years after surgery) have developed concentrically and in most cases sphericity was regained or improved. All patients at present are painfree and follow the same activities as their peers.

Conclusions: Triple innominate osteotomy is a procedure with high potential to improve the prognosis for hips with a spontaneous poor development after LCPW, if appropriately indicated. We want to stress, that the TIO addresses the secondary dysplastic development of the acetabulum and not the LCPW itself, which takes its natural course.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

♦ Intraoperative Monitoring of Epiphyseal Perfusion in Slipped Capital Femoral Epiphysis

Tim Schrader, MD; *Christopher R. Jones, MD; Adam Kaufman, MD*

Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia

† LOE-Diagnostic Level III

Purpose: The purpose of this study is to evaluate an innovative method of monitoring femoral head (epiphyseal) perfusion in patients with slipped capital femoral epiphysis intra-operatively and to compare those results with the subsequent development of avascular necrosis.

Method: Standard percutaneous SCFE screw fixation technique utilizing a radiolucent table and supine positioning is utilized. A fully threaded stainless steel 7.0-mm Richards (Smith and Nephew, Memphis, TN) screw is inserted past the physis into the epiphysis. The guide wire is then removed and a sterile Integra Camino ICP probe (Integra Neurosciences, Plainsboro, NJ) is placed through the screw such that the tip is in the epiphyseal bone past the tip of the screw. Intra-operative epiphyseal perfusion pressure and waveform are recorded. Based on clinical and intra-operative data, a hip capsulotomy is performed. The ICP probe is then removed and the cannulated screw is then advanced to its final seating depth. Radiographs are monitored for the development of AVN.

Results: We have utilized the above technique in twelve patients including stable and unstable SCFE. No complications from the use of the ICP monitor have occurred. No avascular necrosis has developed. Waveforms recorded intra-operatively are similar to arterial tracings. Initial pressure readings range from 0 mmHg to 50 mmHg and the average pulse pressure is 12 mm Hg. Most stable and unstable SCFE patients had femoral head perfusion pre- and post-capsulotomy. Our series includes unstable SCFE patients with poor flow pre-capsulotomy and subsequent increased perfusion post-capsulotomy. All patients left the operating room with measurable femoral head flow and no patient has subsequently developed AVN of the femoral head.

Conclusion: Femoral head perfusion in patients with SCFE can be measured intra-operatively using this technique. Demonstrating perfusion before leaving the operating room has correlated with the absence of AVN post-operatively.

Significance: Our technique of intra-osseous pressure monitoring has potential application far beyond SCFE; it is particularly applicable in the orthopaedic trauma setting for fracture sites such as the talar neck, femoral neck, proximal humerus and proximal scaphoid. By utilizing our technique, real time representation of blood flow could be obtained allowing the surgeon to tailor the operative plan appropriately (i.e. hemiarthroplasty for an elderly patient with a femoral neck fracture as opposed to cannulated screw fixation).

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Severe Slipped Upper Femoral Epiphysis; Fish Osteotomy versus Pinning in Situ: An Eleven-Year Perspective

Sattar Alshryda, MD; *Kai Tsang; Mubashshar Ahmed; Akinwanda Adedapo; Richard Montgomery, MD*

The James Cook University Hospital, Middlesbrough, United Kingdom

† LOE-Therapeutic Level IV

Purpose: Slipped upper femoral epiphysis (SUFE) is not common with a reported incidence of 10 per 100 000. The management of SUFE is controversial and evolving, with advancing surgical skills and expertise. The infrequency of cases, the various classifications in use, the various surgical treatments, and lack of robust evidence for outcomes, has resulted in the lack of clear, evidence-based recommendations for treatment. Although mild slip can be treated with pinning-in-situ (PIS) with predictably good outcome, moderate and severe slips present a challenge for the treating surgeons. It is logical to reduce the slip to near anatomical position; however, this desire has always been tempered by concerns about the potentially devastating complications of AVN and Chondrolysis

Methods: This is a single centre, retrospective study comparing (PIS) and Fish femoral neck osteotomy. Seventy four children presented with SUFE (90 hips). The mild and the moderate groups were treated with a single pin-in-situ (PIS). The severe group had either a surgical reduction by Fish femoral neck osteotomy or PIS. The study was approved by the regional and local ethic committee. Demographic data, clinical findings, radiographic features, the Oxford Hip Score (OHS) and The European Quality of Life Measures (EuroQol) were collected.

Results: Avascular necrosis of the femoral head (AVN) was the primary outcome. There were 11 cases of AVN (12.2%): 3/41(6.9%) in the stable group compared to 7/22 (31.8%) in the unstable group, statistically significant [P<0.001]. In the severe slip group, the AVN rate was 33.3% in the PIS group and 26.6% in the Fish osteotomy (P=0.539). This is not statistically significant, but the trend favours surgical reduction. OHS, EQ-5D and EQ-VAS favour Fish osteotomy, however, this did not reach statistical significant (P=0.55, 0.54 and 0.59) respectively.

Conclusions: Then reduction of the deformity is valuable. The majority of cases that do not suffer AVN will benefit by reduction of the deformity; those who are destined to develop AVN are still better off with the femoral head in a reduced position.

Significance: The unstable slip is more likely to be severe and more likely therefore to receive surgical reduction than a stable and less severe hip. The implication here is that the osteotomy might not be the cause of the AVN; it is the vascular damage due to the instability of the slip that is responsible.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

The Cross Table Lateral Radiograph Results in Significantly Increased Effective Radiation Dose

Megan L. Young, MD; *Molly Dempsey, MD; Adriana De La Rocha, MS; David A. Podeszwa, MD*

Texas Scottish Rite Hospital for Children, Dallas, Texas

† LOE-Diagnostic Level IV

Purpose: A lateral radiograph of the proximal femur is critical in the evaluation of patients with suspected femoroacetabular impingement (FAI). Positioning patients for a cross table lateral (XTL) radiograph is difficult which may result in repeat exposures and increased cumulative radiation. Alternatively, the 45° Dunn (Dunn) and single frog lateral (SFL) views have been shown to accurately reveal proximal femoral abnormalities in FAI. The purpose of this study was to compare the effective radiation doses (ERD) for three lateral hip projections that provide similar diagnostic information.

Methods: Patients aged 10-24 years presenting to the adolescent hip clinic with an indicated exam were evaluated with one of three lateral hip radiographs: XTL (n=18), Dunn (n=17), or SFL (n=27). The technical exposure parameters for each study were used to calculate the ERD after multiplying by age-specific tissue weighting factors derived from published reference data for an anteroposterior (AP) pelvic radiograph. The mean ERD and standard deviation were calculated for each lateral view. A simple Pearson-r correlation test was completed to determine the relationships between body mass index (BMI), age, and ERD. The rate of repeat exposures performed per study was determined from a radiology database where the number of saved and rejected images was recorded over a nine-month period.

Results: The average BMI and age were similar between groups. BMI showed a moderate positive correlation (r=0.34) with ERD, and age showed a negative correlation (r=-0.27) with ERD. When the ERD was adjusted for the linear effects of BMI and age, the average doses (mSv) were 0.83 + 0.98, 0.37 + 0.15, and 0.22 + 0.11 for the XTL, Dunn, and SFL respectively. The ERD for a cross table lateral image was significantly greater than either the Dunn or SFL ($p<0.05$). Repeat exposures were performed in 10.4% of the XTL studies compared to 4% of the Dunn and 6% of the SFL studies.

Conclusions: The ERD for a single study is significantly higher for the XTL compared to the Dunn and SFL radiographs. The XTL is also most likely to be repeated potentially adding to the overall radiation exposure. Thus, the XTL should be avoided whenever possible.

Significance: The use of the Dunn or SFL for imaging the adolescent hip may minimize lifetime cumulative radiation exposure, reaching a more optimal balance between diagnostic benefit and risk to the patient.

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Pediatric Implant Related Fracture after Proximal Femoral Osteotomy: Blade Plate vs. Screw and Side Plate Constructs

Amit Jain, MD; John Thompson; Michael Paloski, MD; ***Paul D. Sponseller, MD***

Johns Hopkins, Baltimore, Maryland

† LOE-Therapeutic Level III

Purpose: Implant design may affect risk of fracture, especially in the proximal femur where the highest risk of implant-related fracture (IRF) has been shown. We compared the rate of IRF in children undergoing proximal femoral osteotomy (PFO) using blade plates vs. screw and side plate constructs to determine whether one implant had a lower fracture rate.

Methods: We retrospectively reviewed clinical and radiographic records from a single pediatric orthopaedic practice from 1995 through 2009. 729 children from 2 through 18 years of age were identified who received proximal femoral osteotomy with either a blade plate (475 patients, mean age: 8.6 ± 4.1 years) or a screw and side plate (254 patients, mean age: 9.6 ± 4.2 years). Manufacture and style of implants were consistent throughout this period. The two groups were compared with respect to rate of IRF development, as well as rate and timing of implant removal.

Results: The overall rate of IRF with proximal femoral osteotomy was 4.0%. IRF rate in patients who received a blade plate was 4.4%, and IRF rate in patients who received a screw and side plate was 3.2%; the difference in IRF rate between the two groups was not statistically significant (P= 0.4).

The rate of implant removal after surgery in the entire PFO population was 58%: 57.7% patients in the blade plate group and 58.7% patients in the screw and side plate group had their plates removed; the difference in removal rate between the two groups was not significant (P=0.8). Overall, the average time to plate removal was 2.3±2.2 years. In the blade plate group, the average time to removal was 2.6±2.5 years, and in the screw and side plate group, the average time to removal was 1.5±1.2 years; the difference in removal time was significant (P<0.01).

Conclusion: There is a substantial risk of IRF development in children after proximal femoral osteotomy. There is no significant difference between blade plates and screw and side plates with respect to developing IRF. Majority of children have their implants removed after surgery, most often within 1 to 3 years of surgery.

Significance: There is no significant difference between blade plates and screw and side plates in development of implant related fractures after pediatric proximal femoral osteotomies.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Adolescents with Hip Pain May be at Risk for Anxiety and Depression Prior to Hip Preservation Surgery

Heather M. Richard, PsyD; Erica L. Rosentraub, PhD; ***David A. Podeszwa, MD;*** *Adriana De La Rocha, MS; Sandy Roland, PhD; Daniel J. Sucato, MD, MS*

Texas Scottish Rite Hospital for Children, Dallas, Texas

† LOE-Diagnostic Level II

Purpose: Chronic pain is associated with increased anxiety and depression and may have a negative impact on surgery outcome. We hypothesized that adolescents with chronic hip pain selected for hip preservation surgery (HPS) would demonstrate increased anxiety and depression compared to same-age peers. The purpose of this study is to document the patient's pre-operative psychological state as perceived by the patient and parent.

Methods: We prospectively evaluated 58 patients (23 males, 35 females), average age 16.5 years (range 11-19) who were scheduled for HPS for the following diagnoses: femoroacetabular impingement (FAI) (n=25), acetabular dysplasia(16), Perthes disease(11), SCFE(6). Psychological questionnaires included patient and parent completed Behavioral Assessment System for Children (BASC), Beck Youth Inventory (BYI), and Resiliency Scales. Self-reported functional questionnaires included the Harris hip score (HHS, max 100) and the UCLA activity score. Psychological scores were compared between diagnosis and procedure performed (Ganz osteotomy, surgical hip dislocation, hip arthroscopy, combined Ganz/SDH) with a student t-test and ANOVA.

Results: All patients reported pain, 52 (90%) reported pain >6 months with 28 >1 year. 44 patients (76%) reported moderate or severe pain. All reported decreased function: average UCLA 7.21 (range 2-10), average HHS 66.5 (42.9-92.4). At presentation, 10 patients (17.2%) were receiving psychological intervention and 30% had a family history of mental illness. Average T-scores (>60= at-risk behavior) for the BYI anxiety and depression scales averaged 48.2 (range 10-70, n=8 [14%] >60) and 45.5 (7-67, n=4 [7%] >60), respectively. Similarly, average BASC anxiety and depression T-scores were 49.8 (34-83, n=9 [16%] >60) and 45.3 (39-70, n=4 [7%] >60). Resiliency scales did not suggest overall poor coping. There were no significant correlations between any psychological score and diagnosis or procedure. Parents reported significantly more patient depression and internalization of problems than the patients reported.

Conclusions: Pre-operative evaluation identified 16% (9/58) of patients were at-risk for depression even though, on average, adolescents did not report significant anxiety or depression at the time of HPS despite chronic pain and self-reported decreased function. Additional studies, including all adolescent hip pain patients, will be important to document the incidence and severity of at-risk psychological symptoms. Post-operative evaluation will also be critical to determine if the scores are maintained and to compare to post-operative self-reported function.

Significance: Pre-operative psychological evaluation should be considered prior to surgery selection as mental health conditions may be undiagnosed and will likely influence functional outcomes.

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SPINE SUBSPECIALITY DAY

Fri., May 3, 2013 • 1:00 PM – 5:15 PM • Room: Dominion North

Co-Chairs: *Firoz Miyanji, MD; Lawrence G. Lenke, MD*

Period 1

1:00 PM – 2:15 PM

Moderator: *Firoz Miyanji, MD*

DEBATES:

a. Neuromuscular Scoliosis (CP) – When and Whom to Operate On?

1:00 PM – 1:07 PM **"Prophalactic" Approach is Best**
Paul D. Sponseller, MD, Baltimore, Maryland

1:07 PM – 1:14 PM **"Reactive" Surgery is Better**
Unni G. Narayanan, MD, FRCSC, Toronto, Ontario, Canada

b. Growth Modulation in Idiopathic Scoliosis – The Fusionless Frontier

1:14 PM – 1:21 PM **You Fuse, You Lose**
Randal Betz, MD, Philadelphia, Pennsylvania

1:21 PM – 1:28 PM **It's Only a Matter of Time…to Fusion**
Alvin H. Crawford, Cincinnati, Ohio

1:28 PM – 1:37 PM **Case Presentations/Panel Discussion (incl Audience Response)**
Moderator: *Firoz Miyanji, MD, Vancouver, British Columbia, Canada*
Panel: *Paul D. Sponseller, MD, Baltimore, Maryland;*
Unni G. Narayanan, MD, FRCSC, Toronto, Ontario, Canada;
Randal Betz, MD, Philadelphia, Pennsylvania;
Alvin H. Crawford, MD, Cinncinati, Ohio;
Douglas M. Hedden, MD, Edmonton, Alberta, Canada;
Burt Yaszay, MD, San Diego, California

c. The Thoracolumbar (Lenke 5) Curve:

1:37 PM – 1:44 PM **I Still Do Anterior Approach**
B. Stephens Richards III, MD, Dallas, Texas

1:44 PM – 1:51 PM **I Only Do Posterior Approach**
Lawrence G. Lenke, MD, St. Louis, Missouri

d. High Grade Spondylolisthesis:

1:51 PM – 1:58 PM **The Case for Postural Reduction and In Situ Fusion**
Hubert H.L. Labelle, MD, Montreal, Quebec, Canada

1:58 PM – 2:05 PM **The Case for Reduction and Interbody Fusion**
Robert W. Gaines Jr, MD, Columbia, Missouri

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

2:05 PM – 2:14 PM **Case Presentations/Panel Discussion (incl Audience Response)**
Moderator: *Firoz Miyanji, MD, Vancouver, British Columbia, Canada*
Panel: *Hubert H. L. Labelle, Montreal, Quebec, Canada;*
Robert W. Gaines Jr, MD, Columbia, Missouri;
Lawrence G. Lenke, MD, St. Louis, Missouri;
B. Stephens Richards III, MD, Dallas, Texas;
Stephen J. Lewis, MD, Toronto, Ontario, Canada

2:15 PM – 2:30 PM **Break**

PERIOD 2

Moderators: *Lawrence G. Lenke, MD; Firoz Miyanji, MD*

2:35 PM – 2:39 PM **Wound Closure in Non-idiopathic Scoliosis: Does Closure Matter?**
David S. Feldman, MD; *James P. Ward, MD; Justin Paul, MD, PhD; Debra A. Sala, MS, PT; Thomas J. Errico, MD; Michael S. Margiotta, MD*
NYU Hospital for Joint Diseases, New York, New York

2:40 PM – 2:44 PM **Assessment for Deep Wound Infections Following Pediatric Scoliosis Surgery**
Sina Pourtaheri, MD; ***Freeman Miller, MD;*** *Kirk W. Dabney, MD; Suken A. Shah, MD; Susan Dubowsky, PA-C; Laurens Holmes Jr, PhD, DrPH*
Nemours/Alfred I. duPont Hospital for Children, Wilimington, Delaware

2:45 PM – 2:49 PM **Building Consensus: "Best Practice Guideline" for High Risk Pediatric Spine Surgical Site Infection**
Michael G. Vitale, MD, MPH; *Matthew D. Riedel, BA; Lisa Saiman, MD, MPH; Hiroko Matsumoto, MA; Michael P. Glotzbecker, MD; John B. Emans, MD; Mark A. Erickson, MD; John (Jack) M. Flynn, MD; Behrooz A. Akbarnia, MD; Richard C.E. Anderson, MD; Douglas L. Brockmeyer, MD; Lawrence G. Lenke, MD; Scott J. Luhmann, MD; Stephen J. Lewis, MD; Peter O. Newton, MD; B. Stephens Richards III, MD; Daniel J. Sucato, MD; Suken A. Shah, MD; David L. Skaggs, MD, MMM; John T. Smith, MD; Paul D. Sponseller, MD; Reinhard D. Zeller, MD; Ann-Christine Nyquist, MD, MSPH; Lisa M. McLeod, MD, MSCE; David P. Roye Jr, MD*
Columbia University, New York, New York

2:50 PM – 2:54 PM **A Pre-operative Surgical Site Infection Prevention Bundle with Patient Adherence Components for Spinal Fusion Patients**
Joshua Schaffzin, MD, PhD; Jennifer M. Anadio, MA; Mary Anne Lenk, BS; Maureen Grady, RN II; The Pre-Operative Surgical Site Infection Team; ***Peter F. Sturm, MD***
Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

2:55 PM – 3:02 PM **Discussion**

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3:03 PM – 3:07 PM **Antifibrinolytic Use in Pediatric Scoliosis Surgery: Does Recent Practice Reflect Evolution of the Evidence?**
Lisa M. McLeod, MD; *John (Jack) M. Flynn, MD; John P. Dormans, MD*
Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

3:08 PM – 3:12 PM **♦ Amicar versus Tranexamic Acid in Pediatric Spinal Deformity Surgery: A Prospective Randomized Double Blinded Study**
Matthew A. Halanski, MD; *Jeffrey A. Cassidy, MD; Scott Hetzel, MS; Diann Reischman, PhD; Nabil Hassan, MD*
Spectrum Health/Helen DeVos Children's Hospital, Grand Rapids, Michigan

3:13 PM – 3:17 PM **Tranexamic Acid and Intrathecal Morphine are Synergistic in Reducing Transfusion Requirements in Non-idiopathic Scoliosis Patients Undergoing Posterior Spinal Fusion**
Gideon Blumstein, MS; Derek A. Seehausen, BA; Patrick Ross, MD; ***David L. Skaggs, MD, MMM***
Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

3:18 PM – 3:25 PM **Discussion**

3:26 PM – 3:30 PM **Leveling the LIV in Selective Fusions for Lenke "C" Modifiers is Associated with a Smaller Uninstrumented Lumbar Cobb Angle but Does Not Affect Decompensation**
Derek A. Seehausen, BA; Kent T. Yamaguchi Jr, BA; Raymond J. Hah, MD; Brenda A. Sides, MA; Margaret L. Wright, BS; Michael G. Vitale, MD, MPH; Lawrence G. Lenke, MD; ***David L. Skaggs, MD, MMM***
Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

3:31 PM – 3:35 PM **Intraoperative and Postoperative LIV-tilt and Disc Angle in Patients with Idiopathic Scoliosis**
James Barsi, MD; *Sumeet Garg, MD; Bavid Baulesh, BA; Mark A. Erickson, MD*
Stony Brook University Medical Center, Stony Brook, New York

3:36 PM – 3:40 PM **Determining Optimal Post-operative Coronal Parameters for Selective Thoracic Fusion**
Burt Yaszay, MD; *Jahangir Asghar, MD; Tracey P. Bastrom, MA; Amer F. Samdani, MD; Peter F. Sturm, MD; Randal R. Betz, MD; Harry L. Shufflebarger, MD; Peter O. Newton, MD; Harms Study Group*
Rady Children's Hospital, San Diego, California

3:40 PM – 3:44 PM **Discussion**

3:45 PM – 4:00 PM **Break**

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

PERIOD 3

4:00 PM – 5:15 PM

SURGICAL TECHNIQUES:

Moderator: *Lawrence G. Lenke, MD*

a. Derotation: My Preference is…

4:00 PM – 4:05 PM **En Bloc**
Scott J. Luhmann, MD, St. Louis, Missouri

4:05 PM – 4:10 PM **Segmenta**
Suken A. Shah, MD, Wilmington, Delaware

4:10 PM – 4:15 PM **Differential Rod Contouring**
Peter O. Newton, MD, San Diego, California

4:15 PM – 4:20 PM **Simultaneous Rod Insertion**
Laurel C. Blakemore, MD, Washington, District of Columbia

b. Pelvic Obliquity Correction…

4:20 PM – 4:25 PM **Luque/Unit Rods**
James O. Sanders, MD, Rochester, New York

4:25 PM – 4:30 PM **Iliac Wing Screws**
Paul D. Sponseller, MD, Baltimore, Maryland

4:30 PM – 4:35 PM **Intra-op Halo-femoral Traction**
Stephen J. Lewis, MD, Toronto, Ontario, Canada

4:35 PM – 4:40 PM **Intra-op Direct Rib/Spine to Pelvis Distraction**
David L. Skaggs, MD, MMM, Los Angeles, California

PEDIATRIC CERVICAL SPINE:

Moderator: *Firoz Miyanji, MD*

4:40 PM – 4:50 PM **a. My Approach to the Down Syndrome Patient**
William G. Mackenzie, MD, Wilmington, Delaware

4:50 PM – 5:00 PM **b. My Approach to OS Odontoideum**
John B. Emans, MD, Boston, Massachusetts

5:00 PM – 5:15 PM **Case Presentations/Panel Discussion**
Moderator: Firoz Miyanji, MD
Panel: *William G. Mackenzie, MD, Wilmington, Delaware;*
John B. Emans, MD, Boston, Massachusetts;
John P. Dormans, MD, Philadelphia, Pennsylvania;
Suken A. Shah, MD, Wilmington, Delaware

POSNA extends sincere appreciation to Medtronic for an educational grant in support of this session

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Wound Closure in Non-idiopathic Scoliosis: Does Closure Matter?

Debra A. Sala, MS, PT; ***David S. Feldman, MD;*** *James P. Ward, MD; Justin Paul, MD, PhD; Thomas J. Errico, MD; Michael S. Margiotta, MD*

NYU Hospital for Joint Diseases, New York, New York

† LOE-Therapeutic Level III

Purpose: Post-operative wound complications after posterior spinal fusion is a difficult complication to manage. The incidence in the non-idiopathic patient population is significantly higher than the adolescent idiopathic population. The effect of complex flap closure at the time of the index procedure on the overall infection rate has not been previously evaluated.

Methods: We performed a retrospective chart review of 76 patients with a primary diagnosis of scoliosis associated either with a syndrome or neuromuscular disease who underwent a posterior spinal fusion for scoliosis. We compared a standard closure performed by an orthopedic surgeon with that of a plastic surgeon which included muscle mobilization and flap elevation as a means of wound closure.

Results: The wound complication rate in the standard closure patients was 19% (8/42) compared with 0% (0/34) for the flap closure arm ($p = 0.007$). The unanticipated return to the operating room rate in standard closure patients was 11.9% (5/42) compared with 0% (0/34) for the flap closure arm ($p = 0.061$).

Conclusion: The use of primary complex flap closure in this patient population should be considered in an effort to decrease post-operative wound complications.

Significance: We believe this association may be causative and that this manner of wound closure should be considered in this patient population in an effort to lower the substantial complication rate associated with this diagnosis and procedure. Future prospective studies would better define this association and potentially identify other operative techniques to reduce the complication rate in patients with neuromuscular scoliosis.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Assessment for Deep Wound Infections following Pediatric Scoliosis Surgery

Sina Pourtaheri, MD; ***Freeman Miller, MD;*** *Kirk W. Dabney, MD; Suken A. Shah, MD; Susan Dubowsky, PA-C; Laurens Holmes Jr, PhD, DrPH*

Nemours / Alfred I. duPont Children Hospital, Wilmington, Delaware

† LOE-Prognostic Level IV

Purpose: Prevention of surgical site infection (SSI) in pediatric spine deformities surgery is a crucial task. Recent data have shown antibiotic-loaded allograft and proper timing of pre-operative antibiotics decrease SSI's. However, there are controversies about appropriate pre-operative antibiotic selection. The purpose of this study was to characterize deep wound infection and the potential factors related to SSI in pediatric spinal deformity surgery. Particular attention was focused on the cultures of the SSIs and the antibiotics chosen to treat the infections, as well as timing of antibiotics administration.

Methods: A retrospective review of 851 pediatric spinal fusion surgeries for deformity from 2006-2010 by 5 surgeons at a single institution was performed. In this sample all cases that required an operative irrigation and debridement (I&D) within 6 months of the index surgery were investigated. Chi-squared statistic, Fisher's exact, and single sample t tests were used to analyze the data.

Results: Twenty four patients had an SSI (prevalence rate = 2.8%: 3 adolescent idiopathic scoliosis, 14 cerebral palsy, 3 non-cerebral palsy neuromuscular scoliosis and 3 syndromic scoliosis). For the SSI group, the mean age at surgery was 13.8 years (SD± 4.5), mean length of surgery was 7.5 hours (SD± 3.1), median EBL was 2482 cc (IQR 3289.5), and mean units transfused was 4.1(SD± 3.9). The following were prognostic for SSI events: 67% bladder incontinence, 25% baclofen pump, 21% use of oral baclofen, 12% history of seizures, and 10% had a g-tube. The wound status within 3 days of surgery was: 37.5% intact wound, 29.2% significant wound drainage, and 33.3% wound dehiscence. MRSA and S. Epidermis (oxacillin resistant) were associated with intact wounds, while gram negative and polymicrobial pathogens were seen in dehisced or draining wounds, c2(df) = 40.9 (18), Fisher's exact <0.001. In the SSI group, the median time for pre-operative antibiotic to incision was 64 minutes (IQR 21 minutes). Only eight percent of patients had pre-operative antibiotics within the protocol (< 30 minutes) (t= 2.7, p=0.0001) and 20.8% within one hour (t=0.06, p =0.08). All 3 AIS cases had stainless steel instrumentation.

Conclusion: Prolonged pre-operative antibiotics to incision time were observed in this sample, while gram negative pathogens were related to compromised wounds.

Significance: Proper timing of pre-operative antibiotics, meticulous wound closures, strict mechanical barrier isolation of wounds and early surgical management for comprised wounds are recommended.

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Building Consensus: "Best Practice Guideline" for High Risk Pediatric Spine Surgical Site Infection

Michael G. Vitale MD, MPH; *Matthew D. Riedel, BA; Lisa Saiman, MD, MPH; Hiroko Matsumoto, MA; Michael P. Glotzbecker, MD; John B. Emans, MD; Mark A. Erickson, MD; John (Jack) M. Flynn, MD; Behrooz A. Akbarnia, MD; Richard C.E. Anderson, MD; Douglas L. Brockmeyer, MD; Lawrence G. Lenke, MD; Scott J. Luhmann, MD; Stephen J. Lewis, MD; Peter O. Newton, MD; B. Stephens Richards III, MD; Daniel J. Sucato, MD; Suken A. Shah, MD; David L. Skaggs, MD, MMM; John T. Smith, MD; Paul D. Sponseller, MD; Reinhard D. Zeller MD; Ann-Christine Nyquist, MD, MSPH; Lisa M. McLeod, MD, MSCE; David P. Roye Jr, MD*

Columbia University, New York, New York

† LOE-Therapeutic Level V

Purpose: Surgical site infection (SSI) following pediatric scoliosis instrumentation is a complication that imposes a tremendous burden on patient health and carries a significant cost to the healthcare system. The development of a "Best Practice Guideline" (BPG) is part of a larger effort to reduce SSI in our population and improve patient outcomes. The purpose of this study is to develop a BPG for infection prevention in high-risk patients undergoing spine surgery.

Methods: After thorough literature review, a survey was administered to 20 pediatric spine surgeons and 3 infectious disease experts assessing use of infection prevention techniques and willingness to adopt these techniques in high-risk patients. We defined high-risk patients as any patient with non-idiopathic scoliosis or any patient with significant medical comobidities, regardless of scoliosis etiology. The results were presented to all participants, and the nominal group technique was used to assess agreement with the use of each prevention strategy. Agreement over 80% was considered consensus and items near consensus were re-discussed and followed by repeated ARS.

Results: Consensus was reached to support the following 14 prevention strategies; 1. Chlorhexidine skin wash the night before surgery, 2. Pre-operative urine cultures, 3. Pre-operative Patient Education Sheet, 4. Pre-operative nutritional assessment, 5. Clipping hair is preferred to shaving, 6. Peri-operative IV Cefazolin given within 60 minutes prior to incision, 7. Peri-operative IV prophylaxis for gram negative bacilli, 8. Monitor adherence to peri-operative antimicrobial regimens, 9. Limit OR access, 10. UV lights need NOT be used in the OR, 11. Intra-operative wound irrigation, 12. Vancomycin powder in the bone graft and/or surgical site, 13. Impervious dressings are preferred post-operatively, and 14. Minimize dressing changes. All participants agreed to implement the BPG.

Conclusions: Drawing from the literature and experience of 20 surgeons and 3 infectious disease specialists, a Best Practice Guideline for SSI prevention in high risk patients was developed. 14 infection prevention measures were included in the final guideline; 4 pre-operative measures, 8 peri-operative measures, and 2 post-operative measures.

Significance: This is an initial tool to reduce variability in practice and reduce SSI in a vulnerable population. Future efforts will study the effect of its implementation on SSI rates and patient outcomes.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

A Pre-operative Surgical Site Infection Prevention Bundle with Patient Adherence Components for Spinal Fusion Patients

Joshua Schaffzin, MD, PhD; Jennifer M. Anadio, MA; Mary Anne Lenk, BS; Maureen Grady, RN II; The Pre-Operative Surgical Site Infection Team; ***Peter F. Sturm, MD***

Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

† LOE-Therapeutic Level IV

Purpose: Surgical site infections (SSIs) increase patient morbidity and mortality and facility costs significantly. Current SSI prevention bundles focus on perioperative care only, and have reduced but not eliminated SSIs. The purpose of this study is to test the effect of a pre-operative SSI prevention bundle (including patient adherence, as well as staff adherence components) on SSI rates for spinal procedures.

Methods: Based on literature review and expert consensus, we developed a discrete set of actions to take place prior to a patient's surgery, beginning in the outpatient setting, after surgery is scheduled, and ending at the time of operating room transfer. A single tracking document was designed to document all activities, allowing easy communication of pre-operative and day-of-surgery findings to pertinent clinic staff. Patient and staff adherence were documented as all-or-nothing measures. Individual component failures were tabulated to identify areas in need of attention. Data was analyzed using statistical process control methods.

Results: The bundle was initiated in July 2012 with 11 staff components and expanded to 12 components in September 2012. Components included screening for bleeding risk, MRSA colonization, nutritional status, metal allergy, and other skin healing issues; bowel regimen; skin antisepsis; patient warming on the pre-operative unit; and storing of patient belongings prior to transfer. Additionally, there are 6 patient components, including adherence to skin and ORSA treatment if required, dynahex bathing with a bathing sponge the night before and morning of surgery, bowel regimen adherence, and a chlorhexidine wipe the morning of surgery. July 2012 staff adherence was 65.4% and increased to approximately 95% through September 2012. Patient adherence was 88.5% and decreased to approximately 68.4%.

Conclusion: Staff and patient components are both necessary for a complete pre-operative surgical site infection bundle. Patient adherence requires dedicated tracking, follow-up, and intensive pre-operative education. There have not been any SSIs since the bundle was implemented, however; as there are only three months of data thus far, the effect on SSI rates is yet to be determined.

Significance: To date, there are no studies centered on a robust pre-operative surgical site infection patient adherence bundle. The study of further SSI reduction is currently a vital topic with the anticipation that in the next 2-3 years, Medicaid will no longer reimburse for hospital-acquired conditions, including SSI treatment, presenting a potentially large expense that will be absorbed by medical centers.

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Antifibrinolytic Use in Pediatric Scoliosis Surgery: Does Recent Practice Reflect Evolution of the Evidence?

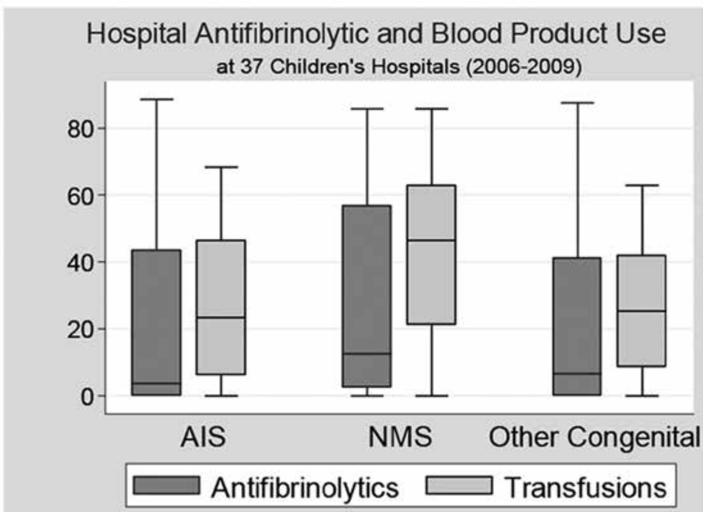
Lisa M. McLeod, MD, MSCE; *John (Jack) M. Flynn, MD; John P. Dormans, MD*

Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

† LOE-Therapeutic Level IV

Purpose: To describe contemporary practice for the use of lysine-analogue antifibrinolytics for blood conservation in pediatric spinal surgeries at 37 US Children's Hospitals.

Methods: A retrospective cohort study using the Pediatric Health Information Systems (PHIS) database involving children 6 months-18 years of age with ICD9 codes indicating a clean spinal fusion procedure and diagnosis of scoliosis discharged from 37 US children's hospitals between 7/1/2006-6/30/2009. We used validated ICD9 codes to categorize children as adolescent idiopathic scoliosis (AIS), neuromuscular scoliosis (NMS), and other congenital. Patients with diagnoses indicating trauma, malignancy, or coagulation disorders were excluded. Itemized billing records were used to identify antifibrinolytic agents administered on the day of the procedure and blood products given during the hospitalization.



Results: A total of 5,858 AIS, 3,058 NMS, and 2,651 other index surgeries were included. Twenty-six percent of AIS, 41% of NMS and 27% of other children received blood transfusions. Overall, tranexemic acid was used in 1,106 (10%) and e-aminocaproic acid was used in 1,428 (13%) of operations. Children with AIS were less likely to receive one of these two drugs (figure). Use of lysine- analogues doubled between 2006 and 2009 (15-30%), likely due to 2007 FDA restrictions on aprotinin. However, while 13 (35%) hospitals used a lysine-analogue for >40% of all procedures, nearly half used no antifibrinolytics for the majority of procedures, including those performed on high risk children with neuromuscular disease.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Conclusion: The incidence of blood transfusions in pediatric scoliosis operations is high; yet there is currently no standard practice for the use of antifibrinolytic drugs for blood conservation.

Significance: Significant blood loss in scoliosis surgeries is common, and is associated with greater risk of allogenic blood transfusions, surgical site infection, and death. Current evidence suggests that antifibrinolytic therapy with lysine-analogues such as tranexemic acid, and e-aminocaproic acid is safe, and significantly reduces blood loss in children undergoing spinal procedures. The lower cost of these drugs, particularly for e-aminocaproic, make them a high value alternative to other methods of blood conservation in children who are at greatest risk of major hemorrhage complications. Multi-center prospective studies comparing the impact of lysine-analogue use on cost and clinically important outcomes such as blood loss volume need to be performed.

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♦ Amicar versus Tranexamic Acid in Pediatric Spinal Deformity Surgery: A Prospective Randomized Double Blinded Study

Matthew A. Halanski, MD; *Jeffrey A. Cassidy, MD; Scott Hetzel, MS; Diann Reischman, PhD; Nabil Hassan, MD*

Spectrum Health/Helen DeVos Children's Hospital, Grand Rapids, Michigan

† LOE-Therapeutic Level I

Purpose: Amicar and transexamic acid (TXA) have been shown to decrease blood loss in pediatric spinal deformity cases when compared with controls. We prospectively compared the use of Amicar to TXA in pediatric patients undergoing posterior spinal fusion.

Methods: A prospective randomized, double-blinded trial was initiated in which patients were randomized to receive either Amicar or TXA during their scoliosis surgery. Baseline demographic and deformity comparisons were collected. Intraoperative comparisons included: estimated and calculated blood loss, number of levels instrumented, number of osteotomies, and operative time, and allogenic transfusion. Pre and postoperative hemoglobin, platelets, PT, PTT, INR, and fibrinogen were followed.

Results: Forty-seven patients were enrolled with data available for review (N=25 Amicar, N=22 TXA). No difference in cohorts was found in demographics, preoperative hemoglobin, platelets, PT, PTT and INR, initial cobb angle, average number of levels fused, number of patients with osteotomies, average number of osteotomies, operative time, and final cobb angles. Estimated blood loss was significantly less (~200 ml) than the calculated blood loss in both groups ($p<0.001$). Estimated blood loss 1094 ml vs. 726 ml was higher in the Amicar group ($p=0.05$), while a similar trend was noticed in the calculated blood loss 1385 ml and 903 ml ($p=0.11$). While no difference in allogenic transfusion rates (20% vs 14%) was observed, average volumes transfused were significantly higher in the Amicar cohort (1014 ml vs 461 ml) $p=0.03$. The TXA cohort demonstrated a statistically significant smaller change in INR, a lower PTT and greater fibrinogen levels post-operatively.

Conclusion: Estimating blood loss consistently under-estimates actual blood loss. Compared with Amicar, TXA use was associated with lower allogenic transfusion volumes and less alteration of post-operative clotting cascade.

Significance: In the pediatric spinal deformity population, TXA may offer a slight advantage over Amicar in minimizing blood loss.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Tranexamic Acid and Intrathecal Morphine are Synergistic in Reducing Transfusion Requirements in Non-idiopathic Scoliosis Patients Undergoing Posterior Spinal Fusion

Gideon Blumstein, MS; Derek A. Seehausen, BA; Patrick Ross, MD;
David L Skaggs, MD, MMM

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† LOE-Therapeutic Level III

Purpose: To determine whether tranexamic acid (TXA) or intrathecal morphine (ITM) reduce blood transfusion requirements in the peri-operative period in patients with non-idiopathic scoliosis undergoing posterior spinal fusion (PSF).

Methods: A retrospective review of consecutive cases of non-idiopathic (neuromuscular, syndromic) scoliosis patients treated with PSF at a single institution was performed. Inclusion criteria included diagnosis of neuromuscular or syndromic scoliosis, a minimum of 10 levels of fusion, and posterior spinal fusion with segmental instrumentation. Multivariate regression analysis and paired t-tests were utilized to determine significance.

Results: 342 patients with an average age 14 years (7-24) and 15 levels fused (10-19) met inclusion criteria. ITM reduced the transfusion rate 13% (p = 0.6) and TXA reduced the transfusion rate 22% (p = 0.08), neither of which reached statistical significance. However, those patients who received a combination of ITM and TXA were 78% less likely (OR: 0.22 95% CI: 0.094 – 0.497) to require transfusion of any kind (p = 0.001).

Conclusion: While neither ITM nor TXA reached statistical significance in reducing the transfusion rate, the use of TXA and ITM together is associated with a 78% reduction in transfusion requirements in non-idiopathic scoliosis patients undergoing PSF.

Significance: This is the first study demonstrating that the combined use of TXA and ITM appears to act synergistically and significantly reduces transfusion rates by 78% (p = 0.001) in non-idiopathic posterior spine fusions.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Leveling the LIV in Selective Fusions for Lenke "C" Modifiers is Associated with a Smaller Uninstrumented Lumbar Cobb Angle but Does Not Affect Decompensation

Derek A. Seehausen, BA; Kent T. Yamaguchi Jr, BA; Raymond J. Hah, MD; Brenda A. Sides, MA; Margaret L. Wright, BS; Michael G. Vitale, MD, MPH; Lawrence G. Lenke, MD; ***David L. Skaggs, MD, MMM***

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† **LOE-Therapeutic Level IV**

Purpose: When correcting adolescent idiopathic scoliosis (AIS) with selective thoracic fusion, the surgeon can attempt to level the lowest instrumented vertebra (LIV) relative to the horizontal or leave the LIV tilted into the lumbar curve. The purpose of this study is to determine the effect of LIV tilt on radiographic outcome.

Methods: This was a multicenter retrospective chart review of 48 AIS patients between 1992 and 2009 who underwent selective thoracic fusion. Patients with Lenke types 1-4 with a type C lumbar modifier and a minimum of 2 years follow-up were included.

Results: At final follow-up, larger LIV tilt significantly correlated with larger lumbar cobb angle (r=0.400, p=0.009), but did not significantly correlate with coronal balance (r=0.196, p=0.231). Larger LIV tilt also significantly correlated with increased horizontal translation of the thoracic apical vertebra from the C7 plumb line (C7PL) (r=0.505, p=0.001), as well as higher Nash-Moe grade of rotation of the thoracic apical vertebra (r=0.445, p=0.003). LIV tilt did not significantly correlate with translation of the LIV, translation of the lumbar apical vertebra from the center sacral vertebral line (CSVL), rotation of the lumbar curve apical vertebra, sagittal balance (C7PL from sacral promontory), distal junctional kyphosis, or number of revision surgeries (p>0.05).

Conclusion: Larger LIV tilt significantly correlates with larger lumbar cobb angle, increased horizontal deviation of the thoracic curve, and higher grade of rotation of the thoracic curve at final follow up. LIV tilt did not significantly correlate with coronal balance or any other radiographic parameters measured in this study.

Significance: Leveling of the LIV in selective thoracic fusions in AIS with Lenke Type C modifiers is associated with improvement of the uninstrumented lumbar Cobb angle, no effect on coronal decompensation, and no recognized negative sequelae.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Intraoperative and Postoperative LIV-tilt and Disc Angle in Patients with Idiopathic Scoliosis

James Barsi, MD; *Sumeet Garg, MD; David Baulesh, BA; Mark A. Erickson, MD*

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† LOE-Diagnostic Level II

Purpose: Selection of an appropriate lowest instrumented vertebra (LIV) in patients with adolescent idiopathic scoliosis (AIS) who have structural lumbar curves undergoing posterior spinal fusion (PSF) is important. Spinal balance, progression of deformity, and the number of remaining motion segments in the lumbar spine are impacted by the LIV. The purpose of this study was to determine if LIV-tilt and disc wedging measured intra-operatively are correlated to their respective values on standing radiographs at intermediate follow-up.

Methods: After IRB approval, a consecutive series of patients with AIS and structural lumbar curves treated with PSF at a single institution between 2007 and 2010 was identified. 166 patients with AIS underwent PSF during this time period, of which 17 had fusion of structural lumbar curves with adequate imaging and minimum two-year follow-up. The LIV-tilt and disc angle below the LIV was measured on the pre-operative standing, intra-operative supine fluoroscopy, and postoperative standing radiographs, and coronal balance was measured on the preoperative and post-operative standing radiographs using a standardized method separately by two authors.

Results: The curve distribution was as follows: Lenke 3 (29%), Lenke 5 (47%) and Lenke 6 (23%). L3 was chosen as LIV in 68% of patients while L4 was chosen in 32%. There was agreement on radiographic measurements between the two authors with a correlation coefficient of 0.99 for coronal balance, 0.91 for LIV-tilt and 0.75 for disc angle. LIV-tilt improved from 21° preoperatively to 4° intra-operatively. At minimum two year follow-up LIV had on average progressed to 9°. The disc angle improved from 6° preoperatively to 3° intra-operatively. This improvement was maintained at two years (3°). Coronal balance also improved during the post-operative period from 18 mm immediately following surgery to 11 mm at the last follow-up.

Conclusion: Disc wedging below LIV remains stable at two years post-surgery in patients with AIS undergoing PSF including structural lumbar curves, while LIV-tilt improvement is not maintained.

Significance: Intraoperative fluoroscopy provides a reliable measure of disc wedging below LIV two years after surgery on standing radiographs.

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Determining Optimal Post-operative Coronal Parameters for Selective Thoracic Fusion

Burt Yaszay, MD; *Jahangir Asghar, MD; Tracey P. Bastrom, MA; Amer F. Samdani, MD; Peter F. Sturm, MD; Randal R. Betz, MD; Harry L. Shufflebarger, MD; Peter O. Newton, MD; Harms Study Group*

Rady Children's Hospital San Diego, California

† LOE-Therapeutic Level III

Purpose: The purpose of this study was to define optimal post-op coronal parameters with which rules for selective thoracic fusions (STF) can be developed/tested.

Methods: A prospectively enrolled multi-center database of selectively fused Lenke 1- 4C curves with >2 year FU was reviewed. Post-op parameters recorded were lumbar Cobb, trunk shift, coronal balance, % lumbar correction, and deformity-flexibility quotient (DFQ, residual lumbar Cobb/# unfused segments). The upper 95% confidence interval for each parameter was calculated (Queried Data Threshold) and set as the upper limit of optimal outcomes. To verify these thresholds, an independent surgeon survey (Surgeon Derived Threshold) was performed. Four experienced AIS surgeons reviewed unmeasured radiographs and photos of 60 STF patients and identified patients with "optimal" outcomes. In those patients where the surgeons had unanimous agreement of success, the upper 95% confidence interval was similarly determined (Surgeon Derived Threshold). SRS-22 scores were compared between those above and below the target outcomes to add an objective outcomes validation.

Results: 106 STF patients with were identified. Target post-op parameters as determined by queried data (Queried Data Threshold) and surgeon survey (Surgeon Derived Threshold) were similar (Table). The parameters were rounded to a clinically measurable number (Target Outcome). When SRS scores were compared, patients below the Target Outcome had significantly better satisfaction scores for DFQ (p=0.03), coronal balance (p=0.04), percent correction (p=0.04) and trended better for lumbar Cobb (p=0.07), confirming the established targets have clinical relevance.

Conclusions: When performing a STF, our study proposes that the optimal post-op outcome should include a lumbar Cobb <26°, balance within 2 cm, a DFQ of <4, a lumbar correction > 37% and a trunk shift within 1.5 cm. Guidelines for selective thoracic fusion can now be made or tested with these actual target outcomes defining success.

Significance: Many studies provide recommendations for when to perform a STF, but do so without providing parameters as their target outcome. The current study defined target post-op outcomes when performing a STF.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

	Queried Data Thresholds	Surgeon Derived Threshold	Target Outcome
DFQ	4.18	4	4
Lumbar Cobb (°)	26.1	23.44	26
% correction	37		37
Coronal balance (cm)	1.86	1.69	2
Trunk shift (cm)	1.56	1.58	1.5

Sports Subspecialty Day

Fri., May 3, 2013 • 1:00 PM – 5:15 PM • Room: Dominion North

Co-chairs: *Jennifer M. Weiss, MD; Kevin G. Shea, MD*

PERIOD 1

1:00 PM – 2:15 PM

The Most Memorable "Difficult Case" from the Faculty Members

1:00 PM – 1:08 PM	**Arthrofibrosis Post Tibial Spine fracture** *Benton E. Heyworth, MD, Boston, Massachusetts*
1:09 PM – 1:17 PM	**Osteochondritis Dissecans** *John D. Polousky, MD, Centennial, Colorado*
1:18 PM – 1:25 PM	**A Difficult Sports Case and What I Learned From It** *Jay C. Albright, MD, Orlando, Florida*
1:26 PM – 1:34 PM	**Patellar Instability** *Henry (Hank) G. Chambers, MD, San Diego, California*
1:35 PM – 1:43 PM	**A Difficult Upper Extremity Sports Case and What I Learned From It** *Kevin H. Latz, MD, Kansas City, Misourri*
1:44 PM – 1:52 PM	**A Difficult Hip Sports Case and What I Learned From It** *M. Lucas Murnaghan, MD, Toronto, Ontario, Canada*
1:53 PM – 2:15 PM	**Question and Answer**
2:15 PM – 2:30 PM	**Break**

PERIOD 2

2:30 PM – 3:45 PM

FREE PAPERS

Moderator: *Jennifer M. Weiss, MD, Los Angeles, California*

2:30 PM – 2:34 PM	**Biomechanical Validation of the Unloading Knee Brace in Juvenile Osteochondritis Dissecans Using Gait Analysis** ***Henry B. Ellis Jr, MD;*** *Jason Donovan, MBChB, FRACS; Trevor Da Silva, BSc, CO(c); Jan Andrysek, PhD; Unni G. Narayanan, MD, FRCSC; M. Lucas Murnaghan, MD, Med, FRCSC* *The Hospital for Sick Children, Toronto, Ontario, Canada*
2:34 PM – 2:38 PM	**The Demographics and Epidemiology of Osteochondritis Dissecans of the Knee in Children** ***Jeffrey I. Kessler, MD;*** *Hooman Nikizad, MD; Kevin G. Shea, MD; John C. Jacobs Jr, Jennifer M. Weiss, MD* *Kaiser Permanente Southern California, Los Angeles, California*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

2:38 PM – 2:42 PM	**Clinical Outcome of Internal Fixation of Unstable Juvenile Osteochondritis Dissecans Lesions of the Knee** *Jonathan E. Webb, MD; Laura W. Lewallen, MD; Christy Christophersen; Aaron J. Krych, MD;* ***Amy L. McIntosh, MD*** *Mayo Clinic, Rochester, Minnesota*
2:42 PM – 2:53 PM	**Discussion**
2:53 PM – 2:57 PM	**Return to Sports after Surgical Treatment of Meniscus Tears in the Pediatric And Adolescent Population** ***Paul M. Saluan, MD;*** *Jeffrey T. Johnston, MD; David Schub, MD; Richard Parker, MD* *Cleveland Clinic, Cleveland, Ohio*
2:57 PM – 3:01 PM	**Discoid Lateral Meniscus: Is Meniscal Instability Over-Diagnosed?** ***Scott J. Luhmann, MD;*** *Rashad Booker, MD* *Washington University School of Medicine, Department of Orthopaedics, St. Louis, Missouri*
3:01 PM – 3:05 PM	**Increase in Outpatient Arthroscopy in the Pediatric Population (<18)** ***Scott D. McKay, MD;*** *Christopher Chen, BA; Megan May, MD; Wei Zhang, PhD* *Texas Children's Hospital / Baylor College of Medicine, Houston Texas*
3:05 PM – 3:16 PM	**Discussion**
3:16 PM – 3:20 PM	**SLAP Lesions in Adolescent Athletes: Do they Really Exist?** ***Benton E. Heyworth, MD;*** *Donald S. Bae, MD; Yi-Meng Yen, MD, PhD; Kesley Tyson, MS; Mininder S. Kocher, MD, MPH; Dennis K. Kramer, MD* *Boston Children's Hospital, Boston, Massachusetts*
3:20 PM – 3:24 PM	**Development and Validation of an Activity Scale for Children and Adolescents** *Peter D. Fabricant, MD, MPH(c); Alex Robles, BS; Timothy Downey-Zayas, BS; Robert G. Marx, MD, MSc; Roger F. Widmann, MD,* ***Daniel W. Green, MD, MS*** *Hospital for Special Surgery, New York, New York*
3:24 PM – 3:28 PM	**Medial Patellofemoral Ligament Reconstruction: Early Outcomes and Failure Characteristics** *Rohit Reddy, BA; Kelsey Wise, BA; Henry B. Ellis Jr, MD;* ***Philip L. Wilson, MD;*** *Naureen Tareen* *Texas Scottish Rite Hospital, Dallas, Texas*
3:28 PM – 3:32 PM	**Anatomical Dissection and CT Imaging of the Posterior Cruciate and Lateral Collateral Ligaments in Skeletally Immature Cadaver Knees** ***John D. Polousky, MD;*** *Kevin G. Shea, MD; John C. Jacobs Jr; Theodore J. Ganley, MD* *St. Luke's Health System, Boise, Idaho*
3:32 PM – 3:45 PM	**Discussion**
3:45 PM – 4:00 PM	**Break**

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PERIOD 3

4:00 PM – 5:10 PM

Moderator: *Kevin G. Shea, MD, Boise, Idaho*

4:00 PM – 4:20 PM **Tibial Spine (Case Debate)**

a) Suture Fixation
Michael T. Busch, MD, Atlanta, Georgia

b) Screw Fixation
Theodore J. Ganley, MD, Philadelphia, Pennsylvania

4:20 PM – 4:40 PM **Medial Epicondyle: Fix or Not to Fix? (Case Debate)**

a) Do Not Fix
Lawrence Wells, MD, Philadelphia, Pennsylvania

b) Fix
Eric W. Edmonds, MD, San Diego, California

4:40 PM – 5:10 PM **Patellofemoral Instability**
Moderator: Jennifer Weiss, MD, Los Angeles, California

a) Approach To Patellofemoral Instability in the Child and Adolescent
William L. Hennrikus, MD, Hershey, Pennsylvania

b) Repair vs. Reconstruction
Amy L. McIntosh, MD, Rochester, Minnesota

POSNA extends sincere appreciation to OrthoPediatrics for an educational grant in support of this session

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Biomechanical Validation of the Unloading Knee Brace in Juvenile Osteochondritis Dissecans Using Gait Analysis

Henry B. Ellis Jr, MD; *Jason Donovan, MBChB, FRACS; Trevor Da Silva, BSc, CO(c); Jan Andrysek, PhD; Unni G. Narayanan, MD, FRCSC; M. Lucas Murnaghan, MD, Med, FRCSC*

The Hospital for Sick Children, Toronto, Ontario, Canada

† LOE-Therapeutic Level II

Purpose: Osteochondritis dissecans (OCD) is a common diagnosis in children and adolescents. The non-operative treatment of stable juvenile OCD is controversial, and one treatment is an unloading knee brace. This study will evaluate the biomechanical effect of the knee unloading brace and its ability to unload the affected compartment in stable juvenile OCD.

Methods: Consecutive subjects (ages 8-14) treated for stable symptomatic medial femoral condylar OCD with a knee unloading brace were asked to enroll in this study. Exclusion criteria included unstable lesions and subject who had received previous treatment for an OCD of the knee. After subjects used the custom fitted knee unloading brace for at least two weeks, they underwent gait analysis for three conditions including no brace, a partially active brace, and a fully active brace with a valgus load. Kinematic, kinetic, and applied force from the brace was collected during standard gait analysis trials. Continuous data were compared using a Student t-test between the three conditions.

Results: Seven subjects with a mean age 12 years (range 11-14; 5 Male 2 Females) underwent gait analysis. All patient has some relief of symptoms while wearing the brace, while three of seven reported complete resolution of knee pain. No subject reported discomfort with the brace. Decrease maximum knee flexion was seen throughout the stance phase between a no brace and a fully active brace condition (65 versus 60.6 degrees, p=0.007). The average maximum knee valgus during stance without the brace was 17.5 degrees compared to 25.2 degrees with a fully active brace (p=0.003). Although there was a trend for an increase in maximum knee valgus moment, this was not statistically significant. However, a statistically significant decrease was seen in overall knee varus moment between the braced condition and fully active brace condition (16.3 versus 13.5 Nm, p=0.001). Difference between a partially active and fully active brace were variable and not statistically significant.

Conclusion: The knee unloading brace demonstrates biomechanical evidence of decreasing the overall varus moment on the knee of a juvenile with osteochondritis dissecans. This finding supports the distribution of force away from the medial compartment to allow for healing of stable OCD lesions.

Significance: The unloader knee brace is a well-tolerated intervention, which provides symptomatic relief in treating stable juvenile OCD. This study demonstrates that the brace does decrease the varus moment during ambulation in a pediatric population.

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The Demographics and Epidemiology of Osteochondritis Dissecans of the Knee in Children

Jeffrey I. Kessler, MD; *Hooman Nikizad; Kevin G. Shea, MD; John C. Jacobs Jr; Jennifer M. Weiss, MD*

Kaiser Permanente Southern California, Los Angeles, California

† LOE-Prognostic Level III

Purpose: To assess the demographics and epidemiology of osteochondritis dissecans (OCD) of the knee in patients age 2-19.

Methods: IRB approval was obtained. A retrospective EMR chart review of an integrated health system was done on OCD between 2007 and 2011. Inclusion criteria included OCD of the knee and patients aged 2-19, with approximately 1 million patients in this cohort. Exclusion criteria included the co-existence of any other intra-articular lesions or OCD of another joint. Lesion location, laterality, and all patient demographics were recorded. OCD incidence was determined for the group as a whole and by age group (divided into age 2-5, group A=6-11, group B=12-19).

Results: 192 patients with a total of 206 OCD lesions fit the inclusion criteria. No OCD lesions were found in 2-5 year olds. 53.4% of lesions were right-sided, 46.6% left-sided. The medial femoral condyle was the most commonly affected location with 63.6% of the knee OCD lesions, followed by the lateral femoral condyle with 32.5%. Lesions of the femoral trochlea, patella, and lateral tibial plateau represented less than 4% of the total combined.

No OCD lesions were found in the 2-5 year-olds. The incidence of knee OCD for patients aged 6-19 was 9.6 per 100,000 for all patients, and 15.7 and 3.3 per 100,000 for males and females, respectively. Group B represented the vast majority of OCD, with an incidence of 21.8 per 100,000 in 12-19 year olds versus 8.7 in group A. Females in group A and B had an incidence of 4.6 and 13.3 per 100,00, respectively, while males had an incidence of 12.5 and 30.1 per 100,00 for group A and B, respectively. The overall male/female ratio for knee OCD was 3.7/1.

Conclusions: In this population-based cohort study of pediatric OCD in nearly 1 million children, males had a much greater incidence of OCD and the majority were right sided lesions. Teenagers had nearly 3 times the incidence of OCD as compared to the 6-11 year old group. Although most OCD lesions were located on the medial femoral condyle, lateral femoral condyle lesions were also common. The incidence of OCD in this study was similar to a smaller Swedish study 40 years previously.

Significance: This is the largest epidemiologic/demographic study of OCD of the knee in children ever reported.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Clinical Outcome of Internal Fixation of Unstable Juvenile Osteochondritis Dissecans Lesions of the Knee

Jonathan E. Webb, MD; Laura W. Lewallen, MD; Christy Christophersen; Aaron J. Krych, MD; ***Amy L. McIntosh, MD***

Mayo Clinic, Rochester, Minnesota

† LOE-Therapeutic Level IV

Purpose: Osteochondritis dissecans (OCD) lesions of the knee are a common cause of knee pain in skeletally immature patients. Currently, there is little data on the outcomes of internal fixation procedures for unstable lesions. We sought to determine the radiographic healing rates following fixation of these lesions, the risk factors associated with failure to heal, the overall clinical and functional outcomes of patients who underwent internal fixation for unstable OCD lesions.

Methods: We conducted a retrospective review of 20 knees in19 skeletally immature patients who underwent internal fixation of OCD lesions from 1999 to 2009. All patients' pre-operative x-rays were assessed and deemed immature. The size and location of the lesion, type of internal fixation, Ewing and Voto classification, and need for further interventions were evaluated. Utilizing the Tegner and Lysholm validated scoring systems, functional activity was evaluated at each patients final follow-up. Healing was assessed by the treating surgeon assessment of follow-up radiographs.

Results: The average patient age was 14.5 and consisted of 14 males and 6 females with postoperative follow-up of 2.5 years and with long-term survey follow-up of 6.9 years. There were five Grade 2 (25%), nine Grade 3 (45%) and six Grade 4 (30%) lesions. Higher lesion grade was seen with increased lesion size (p=0.003). Lateral condylar lesions were seen in 11 or 20 knees while 9 of 20 knees had medial sided lesions. A variety or bioabsorbable and non-bioabsorbable fixation methods were used. Osseous integration was evident in 15/20 knees (75%), with the 5 unhealed lesions located on the lateral condyle. Average Tegner activity scores improved from 3.3 pre-operatively to 5.6 at final follow-up with Lysholm scores of 88 at the time of final follow-up. Further operative intervention was required in 11/20 knees with 50% of patients requiring hardware removal and 3 patients undergoing subsequent osteochondral allograft transplantation.

Conclusion: Unstable OCD lesions in the juvenile population are an increasing entity as children and adolescents are involved in higher levels of sports activities. In our series, outcomes of surgical intervention resulted in osseous integration of 75% and improved outcome scores and return to activity at 2.5 years and even 6.9 years after surgical intervention. However, 55% of patients with unstable OCD lesions did require multiple operations.

Significance: Surgical treatment with internal fixation for OCD lesions in skeletally immature patients results in improved functional outcomes, though patients often require multiple surgical interventions to improve their outcomes.

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Return to Sports after Surgical Treatment of Meniscus Tears in the Pediatric and Adolescent Population

Paul M. Saluan, MD; *Jeffrey T. Johnston, MD; David Schub, MD; Richard Parker, MD*

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† LOE-Therapeutic Level IV

Purpose: Meniscus injuries in the young athlete present a therapeutic challenge for orthopaedic surgeons. Several factors, such as patient demographics, motivation, injury characteristics, surgical treatments, and post-surgical rehabilitation choices may influence patient outcomes and return to activity. This study aims to identify these factors.

Methods: All the patients of two orthopaedic surgeons at one institution who underwent meniscus surgery at age 18 and under were identified and contacted via either telephone or mail. Informed consent was obtained, and the patients (or legal guardian) were provided with a novel Return to Sports Questionnaire and the Marx Sports Activity Scale

Results: A total of 67 patients were surveyed, 29 male and 38 female. Average age at surgery was 16 years and at survey was 19 years, with an average follow-up of 3.3 years. Patients who underwent meniscectomy (MY) took longer to return to their desired level of sport than after meniscus repair (MR) or combined MY/MR, and more often did not return to that level at all. Compared to patients who had MR alone, those who underwent concurrent anterior cruciate ligament reconstruction (ACLR) took significantly longer to return to their desired level of sports, but more often reached that level and did not feel limited by their knee. There were no significant differences between those who underwent MY and combined MY/ACLR in this regard. The highest percentage of patients from all groups took over 1 year to return to their desired level of sports activity. The average Marx Sports Activity Scale score was 10.5, with no significant differences between the surgical groups. On average, patients who planned to return to collegiate level sports, including scholarship level athletes, took longest to return to their desired activity level and more often felt limited by their operative knee than those at lower levels of competition. Patients who described themselves as extremely motivated returned faster on average than those who reported lesser motivation. Both female gender and obesity trended towards diminished results as these groups described more activity limitations related to their knee, and a longer time to return to sports than men and those with lower BMI for age percentile.

Conclusions: Return to sports after meniscus surgery in the young athlete is affected by a multitude of factors, including patient demographics, injury type, surgical choices, motivation to return, and desired level of activity.

Significance: These findings characterize many factors that play role in return to activity after meniscus surgery, and therefore may help guide treatment plans as well as provide information to counsel patients on expectations.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Discoid Lateral Meniscus: Is Meniscal Instability Over-Diagnosed?

Scott J. Luhmann, MD; *Rashad Booker, MD*

Washington University School of Medicine, Department of Orthopaedics, St. Louis, Missouri

Purpose: The purpose of this study is to report the frequency of meniscal instability and the need for meniscal repair in patients <18 years of age with a discoid lateral meniscus.

† LOE-Therapeutic Level III

Method: A surgical database was queried to identify all patients who had undergone arthroscopic treatment of a discoid lateral meniscus from 5/2000-7/2012 by a single surgeon. Inclusion criteria were: complete or incomplete discoid meniscus, treated with arthroscopic surgery, and adequate data. Surgical data focused on meniscal morphology, presence and type of meniscal tear, treatment type, meniscal stability and post-treatment meniscal integrity (presence of adequate meniscus with an intact peripheral meniscal rim). A total of 71 knees were identified which satisfied the inclusion criteria, 6 were excluded due to inadequate medical record information and 2 were Wrisberg-variants, leaving 63 knees for analysis.

Results: There were 42 females and 21 males. Mean age was 10.3 years (4.2 to 17.9). There were 22 left knees, 23 right knees and were 18 bilateral. The menisci were classified as complete in 45 and incomplete in 18. All knees (n=63) underwent arthroscopic treatment which included saucerization. Tears were present in 28 menisci at the time of surgery (44%) but only 3 had tears which were amenable to repair. After surgical treatment the lateral meniscus was classified as adequate in 53 knees (84%) and inadequate in 10 knees. There was no correlation of adequacy of the remaining menisci with age at surgery (adequate 10.8 y; inadequate 11.3 y) or type (adequate 70% complete vs. inadequate 72%). There was a higher frequency of meniscal tears in the inadequate group (90% vs. 36%). Secondary surgery was performed in 4 knees: 2 underwent repeat saucerization d/t recurrent symptoms, and 2 had meniscal repairs for new-onset menisco-synovial tears. Overall a total of 5 knees (3 at initial and 2 at secondary) underwent meniscal repair (8%). There was no meniscal instability documented in any knee (0%) that did not have a meniscal tear.

Conclusion: Arthroscopic treatment of discoid lateral menisci is able to create near-normal meniscal anatomy in 84% of knees. In contrast to previous reports the frequency of meniscal instability without concomitant tear was 0% and the need for meniscal repair was only 8%. Arthroscopic evaluation likely over-estimates meniscal mobility and the need for meniscal repair/stabilization.

Significance: Meniscal repair or stabilization was infrequently necessary in the treatment of discoid lateral menisci, 0% frequency without meniscal tears and 8% with meniscal tears.

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Increase in Outpatient Arthroscopy in the Pediatric Population (<18)

Scott D. McKay, MD; *Christopher Chen, BA; Megan May, MD; Wei Zhang, PhD*

Texas Children's Hospital/Baylor College of Medicine, Houston Texas

† LOE-Prognostic Level II

Purpose: Anecdotally, the field of pediatric orthopedics has seen an increase in arthroscopy conducted in the ambulatory setting over the past 10-15 years. The purpose of this study is to quantify these trends for patients under the age of 18 in the United States over the past decade.

Methods: The National Survey of Ambulatory Surgery, administered by the Centers for Disease Control and Prevention, is a collection of diagnoses and procedures performed in the outpatient setting. Data with procedure coding indicative of arthroscopy was analyzed for pediatric patients. A design based statistical analysis was performed to estimate the total number of arthroscopic procedures performed on patients 18 and under each year in the United States.

Results: The number of pediatric arthroscopic procedures increased by 62% between 1996 and 2006. Approximately 60,109 (95% confidence interval, 53,203 to 67,014) arthroscopic procedures were performed on pediatric patients in 1996, compared to 97,092 (95% confidence interval, 73,636 to 12,548) in 2006. The largest increases were seen in the 15-18 and 12-15 year old age groups. Knee and shoulder arthroscopy accounted for much this of the overall increase while the number procedures performed on the elbow, wrist, and ankle decreased. The overall number procedures increased by 24% in male patients and 212% in female patients. In 2006, females accounted for 56% of pediatric arthroscopic procedures. The number of arthroscopic procedures conducted in freestanding ambulatory surgery centers increased from 16% in 1996 to 60% in 2006. Between 1996 and 2006, the top 4 diagnoses requiring arthroscopic intervention remained unchanged, including medial meniscus tears, lateral meniscus tears, cruciate ligament strains, and chondromalacia of the patella. Finally, the use of topical, IV, and nerve block anesthesia increased in the past decade.

Conclusions: Our study found that the use of arthroscopy for pediatric injuries in the outpatient setting, especially for the knee and shoulder, is on the rise. In particular, the use of arthroscopic surgery has increased dramatically in the adolescent and female populations. Meniscal tears continue to be the most common indication for arthroscopic surgery, accounting for approximately 40% of all diagnoses in 1996 and 29% of all diagnoses in 2006.

Significance: This study confirms the observation that more arthroscopy is being performed in freestanding ambulatory surgery centers in this particular age group. Additionally, this study illustrates the dramatic increase in procedures performed for female patients.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

SLAP Lesions in Adolescent Athletes: Do they Really Exist?

Benton E. Heyworth, MD; *Donald S. Bae, MD; Yi-Meng Yen, MD, PhD; Kesley Tyson, MS; Mininder S. Kocher, MD, MPH; Dennis K. Kramer, MD*

Boston Children's Hospital, Boston, Massachusetts

† LOE-Therapeutic Level IV

Introduction: The frequency and clinical significance of pathologic tears of the superior labrum anterior to posterior (SLAP) remain subjects of continuing controversy, particularly in young patients.. The purpose of this investigation is to determine the incidence, risk factors, surgical characteristics, and post-operative outcomes of adolescents with arthroscopically confirmed SLAP tears.

Methods: A procedural database at a tertiary care pediatric hospital was utilized to review all cases from 2003 to 2010 of type II or type IV SLAP lesions identified arthroscopically in athletes between 10 and 18 years of age with greater than 1 year clinical follow-up. Predisposing factors for isolated SLAP repair were analyzed with logistic regression.

Results: Among 177 adolescents who underwent shoulder arthroscopy, SLAP tears were identified/repaired in 23 (13%) patients (mean age 16.5 years, range 14-18.8), 6 of which (3%) were deemed isolated SLAP tears. The other 17 SLAP repairs were performed in conjunction with instability procedures (13 anterior, 1 posterior, 3 multidirectional). Baseball pitchers (odds ratio = 15.0, p = 0.02) and patients with pain as the primary symptom (p=0.002) were more likely to have an isolated SLAP tear. Mean time of return to sports was 3 months (range 2-7 months) postoperatively. In the instability subset, 3 of 17 patients underwent reoperation for recurrent traumatic dislocations, with no superior labrum procedure. In the isolated SLAP group, 2 patients required later capsulorrhaphy for atraumatic instability and 1 pitcher required revision SLAP repair for supero-posterior tear extension.

Conclusion: SLAP tears are rare in adolescents and are most commonly associated with glenohumeral instability pathology. Isolated tears are more commonly seen in overhead athletes and patients with pain as their primary symptom. These patients may have subtle instability patterns, requiring close assessment to optimize results.

Significance: Though seen with overhead sports and glenohumeral instability, SLAP tears requiring surgical treatment are uncommon in adolescents.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Development and Validation of an Activity Scale for Children and Adolescents

Peter D. Fabricant, MD, MPH(c); Alex Robles, BS; Timothy Downey-Zayas, BS; Robert G. Marx, MD, MSc; Roger F. Widmann, MD, ***Daniel W. Green, MD, MS***

Hospital for Special Surgery, New York, New York

† LOE-Diagnostic Level I

Purpose: Having reliable, validated, and simple outcome measures is vital to conducting high quality outcomes research in the field of orthopaedic surgery. There is a paucity of high quality, simple, validated musculoskeletal assessment questionnaires and functional outcomes instruments in children and adolescents who are otherwise healthy and athletically active. In addition to frequency and intensity of athletic activity, level of play (e.g. recreational, junior varsity, varsity) and coach/trainer supervision are important variables unique to children and adolescents that are not otherwise captured in similar adult scoring systems. The purpose of this study was to create and validate a concise, comprehensive, and novel activity questionnaire for athletically active children and adolescents ages 10-18 years old. This instrument would be an invaluable tool for pediatric orthopaedic outcomes research in high functioning athletic children.

Methods: Item generation was performed with 20 adolescent athletes and a panel of 3 pediatric and sports orthopaedic surgeons. Item reduction and questionnaire refinement was performed using a separate sample of 20 subjects resulting in a final 8-item outcome instrument. Validation (51 subjects) and test-retest reliability (41 subjects) were performed using existing methodology. The Flesch-Kincaid score was calculated at a 7.8 grade reading level (approximately 13 years old); therefore although all subjects provided their own answers, parents were allowed to assist children with the questionnaire who were younger than 13 years old.

Results: Test-retest reliability was high (ICC, k=0.89), and there were no floor or ceiling effects. Divergent validity testing was performed with positive correlation noted between the novel questionnaire and level of competition in athletic activity (e.g. recreational, club, JV, varsity, elite) and number of reported hours of athletic activity per week. Concurrent construct validity was assessed and showed positive correlation between the novel questionnaire and existing adult (e.g. Tegner, Marx, Noyes) and pediatric (e.g. Pediatric Activity Questionnaire) scales. The 8-item questionnaire took approximately one minute for participants to complete.

Conclusions: This 8-item questionnaire is a simple, reliable, and valid metric to assess activity in children and adolescents 10-18 years old.

Significance: This activity scale is the first of its kind developed and validated in children and adolescents. It can be used to evaluate activity level as a prognostic variable for clinical research studies. By using this instrument for child and adolescent athletes, outcomes after treatment can be better evaluated.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Medial Patellofemoral Ligament Reconstruction: Early Outcomes and Failure Characteristics

Rohit Reddy, BA; Kelsey Wise, BA; Henry B. Ellis Jr, MD; ***Philip L. Wilson, MD;*** *Naureen Tareen*

Texas Scottish Rite Hospital, Dallas, Texas

† LOE-Therapeutic Level IV

Introduction: The purpose of this study was to evaluate the short term clinical outcomes, failures, and risk factors for failure of a medial patellofemoral ligament (MPFL) reconstruction in the young athlete with recurrent patellar instability.

Methods: Data was collected on thirty-nine consecutive MPFL reconstructions in patients less than 19 years of age with recurrent patellar instability by a single surgeon between the years 2009-2011. Preoperative and radiographic data were retrospectively reviewed with emphasis evaluating evidence of patellar alta, genu valgum, trochlear dysplasia, and rotational abnormalities, including femoral anteversion and tibial torsion. Rotational abnormalities were calculated on MRI or CT scan using both the tibial tubercle-trochlear groove distance (TT-TG) and the tibial tubercle-posterior cruciate ligament distance (TT-PCL). Failures, a Kujala outcome score, and a Tegner activity scale were collected prospectively at a minimum of one year follow up.

Results: Of thirty-nine consecutive MFPL reconstructions (age range 5-18, median 15 years), three (7.7%) had recurrent patellar instability and were considered failures. Of the non-failures, the average Kujala score was 90 and the average Tegner activity score was 7.8. Patella alta did not seem to be a risk factor for failure of this procedure. Failures were more likely to have genu valgum (p=0.04), a trend for trochlear dysplasia (mean sulcus angle; failures 149 vs. non-failures 141, p=0.07), and an increase in rotational abnormalities (TT-PCL distance; failures 28 mm versus non-failures 24 mm, p=0.002). The medial facet length was smaller in the failures compared to the non-failures (6.5 versus 10.85, p=0.001) indicating, perhaps, another anatomic marker as a risk factor for a failure of this soft tissue procedure. All three failures had genu valgum, trochlear dysplasia (medial facet length of less than 10 mm), and a TT-PCL greater than 26 mm.

Conclusion: A medial patellofemoral ligament reconstruction is a successful procedure with good outcomes in the short term. Failures of this procedure are likely to have evidence of more than one type of bony dysplasia.

Significance: Recurrent patella instability can be successfully treated with a medial patellofemoral reconstruction with a low failure rate.

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Anatomical Dissection and CT Imaging of the Posterior Cruciate and Lateral Collateral Ligaments in Skeletally Immature Cadaver Knees

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† LOE-Other Analysis Level IV

Purpose: Injury of the ligaments of the PCL and postero-lateral corner of the knee is becoming more frequent in the skeletally immature. Understanding the relationship of the PCL and LCL to the physis is important for surgical reconstruction and avoiding physeal injury. The purpose of this study was to identify the origin and insertion of the PCL and LCL in skeletally immature knee cadaveric specimens, and determine their position relative to the physis.

Methods: Seven skeletally immature cadaveric knee specimens were examined through gross dissection. These specimens were divided into two groups: Infants-1 month,11 months,11 months, and Children: 8 years,10 years,11 years,11 years. Metallic markers were placed at the femoral origins of the PCL and LCL, and at the tibial insertion of the PCL. CT scans with 1 mm slices were obtained for each specimen and analyzed using Osirix Imaging Software. The PCL insertion width was measured, in addition to the distance from the insertion midpoint to the tibial physis. The distance from the PCL femoral origin midpoint to the physis was measured. The distance from the LCL origin midpoint to the physis was measured.

Results: The mean width of the PCL tibial insertion was 0.52 cm for infants and 0.91 cm (0.67-1.11 cm) for children. The mean distance from the PCL insertion midpoint to the proximal tibial physis was 0.31 cm (0.0-0.57 cm) and 0.58 cm (0.25-0.89 cm) proximal to the physis for infants and children, respectively. The mean distance from the PCL origin midpoint to the distal femoral physis was 1.11 cm (1.06-1.17 cm) and 1.88 cm (1.82-1.92 cm) distal to the physis for infants and children, respectively. The mean distance from LCL origin midpoint to the distal femoral physis was 0.56 cm (0.40-0.64 cm) and 0.28 cm (0.0-0.55 cm) distal to the physis for infants and children, respectively.

Conclusion: The relationship of the PCL and LCL's origin and insertion to physeal structures is not well described in the literature. As pediatric cadaver tissue is very difficult to locate, this dissection with CT scan correlation provides unique information on the location of ligament attachments in relation to the physis. The landmarks may help guide drill hole placement during reconstruction.

Significance: This cadaveric dissection and CT scan analysis helps define the relationship of the ligaments and the physis. This information may help surgeons avoid significant physeal injury during reconstructions in skeletally immature patients.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Hand Subspecialty Day

Fri., May 3, 2013 • 1:00 PM – 5:15 PM • Room: Dominion North

Co-Chairs: *Donald S. Bae, MD; Charles A. Goldfarb, MD*

PERIOD 1

1:00 PM – 2:15 PM

Post-Traumatic Reconstruction: Case-Based Consults

Moderator: *Donald S. Bae, MD, Boston, Massachusetts*

1:00 PM – 1:10 PM	**Welcome**
1:10 PM – 1:16 PM	**How to Treat Lateral Condyle Nonunion and Malunion** *Andrea S. Bauer, MD, Sacramento, California*
1:16 PM – 1:22 PM	**Indications and Techniques of Post-Traumatic Elbow Contracture Release:** *Lisa L. Lattanza, MD, San Francisco, California*
1:22 PM – 1:28 PM	**How to Treat the Chronic Monteggia Lesion** *Robert B. Carrigan, MD, Philadelphia, Pennsylvania*
1:30 PM – 1:50 PM	**Trauma Cases and Panel Discussion** *Andrea S. Bauer, MD, Sacramento, California;* *Lisa L. Lattanza, MD, San Francisco, California;* *Robert B. Carrigan, MD, Philadelphia, Pennsylvania;* *Joshua M. Abzug, MD, Timonium, Maryland*
1:50 PM – 1:56 PM	**Distal Radius Growth Arrest** *Apurva S. Shah, MD, MBA, Wilmington, Delaware*
1:56 PM – 2:02 PM	**Late Presenting Phalangeal Neck Fractures** *Roger Cornwall, MD, Cincinnati, Ohio*
2:02 PM – 2:15 PM	**Trauma Cases and Panel Discussion** *Apurva S. Shah, MD, MBA, Wilmington, Delaware;* *Roger Cornwall, MD, Cincinnati, Ohio;* *Allan E. Peljovich, MD, Atlanta, Georgia*
2:15 PM – 2:30 PM	**Break**

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PERIOD 2

2:30 PM – 3:45 PM
CONGENITAL HAND AND UPPER LIMB

Moderator: *Charles A. Goldfarb, MD, St. Louis, Missouri*

2:30 PM – 2:36 PM	**RLD: Argument for Distraction and Centralization** *Allan E. Peljovich, MD, Atlanta, Georgia*
2:36 PM – 2:42 PM	**RLD: Case for Observation and Soft Tissue Rebalancing** *Charles A. Goldfarb, MD, St. Louis, Missouri*
2:42 PM – 2:55 PM	**Congenital Cases and Panel Discussion** *Allan E. Peljovich, MD, Atlanta, Georgia;* *Michael J. Garcia, MD, Tampa, Florida;* *Charles A. Goldfarb, MD, St. Louis, Missouri*
2:55 PM – 3:01 PM	**Arthrogryposis: Treatment of Elbow Contracture** *Michelle A. James, MD, Sacramento, California*
3:01 PM – 3:07 PM	**Arthrogryposis: Indications and Techniques for Wrist and Thumb Surgery** *Dan A. Zlotolow, MD, Philadelphia, Pennsylvania*
3:07 PM – 3:20 PM	**Neuromuscular Cases and Panel Discussion** *Michelle A. James, MD, Sacramento, California;* *Dan A. Zlotolow, MD, Philadelphia, Pennsylvania;* *Scott A. Riley, MD; Lexington, Kentucky*
3:20 PM – 3:26 PM	**Exostoses of the Forearm: Indications and Techniques of Excisions and Osteotomies** *Michael J. Garcia, MD, Tampa, Florida*
3:26 PM – 3:32 PM	**Exostoses of the Forearm: When and How to Do a One-Bone Forearm** *Peter M. Waters, MD, Boston, Massachusetts*
3:42 PM – 3:45 PM	**Miscellaneous Cases and Panel Discussion** *Scott A. Riley, MD, Lexington, Kentucky;* *Peter M. Waters, MD, Boston, Massachusetts;* *Dan A. Zlotolow, MD, Philadelphia, Pennsylvania*
3:45 PM – 4:00 PM	**Break**

PERIOD 3

4:00 PM – 5:15 PM

PAPERS

4:05 PM – 4:09 PM	**Referral Patterns of Emergent Pediatric Hand Transfers to a Tertiary Care Center** *Melissa Gunderson, BA; Alex Gornitzky; Benjamin Chang, MD;* ***Robert B. Carrigan, MD*** *Children's Hospital of Philadelphia, Philadelphia, Pennsylvania*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

4:10 PM – 4:14 PM **Steroid Injection for Unicameral Bone Cysts of the Proximal Humerus in the Skeletally Immature**
Christopher C. Bray, MD; Harish S. Hosalkar, MD; Molly Moor, MPH
Scott J. Mubarak, MD
Rady Children's Hospital, San Diego, California

4:15 PM – 4:19 PM **Outcomes of Operative Treatment of Triangular Fibrocartilage Tears in Pediatric and Adolescent Athletes**
Felicity G. Fishman, MD; ***Allan E. Peljovich, MD;*** *Gary M. Lourie, MD; Joshua Ratner, MD*
Pediatric Hand & Upper Extremity Center of Georgia, PC / Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia

4:20 PM – 4:24 PM **Diagnostic Utility of Wrist MRI in the Pediatric Population**
Alex Gornitzky; ***Robert B. Carrigan, MD***
Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

4:33 PM – 4:37 PM **Two-Stage Correction of Wrist Flexion Contracture in Amyoplasia**
Ronald C. Burgess, MD; ***Scott A. Riley, MD***
Shriners Hospital for Children, Lexington, Kentucky

4:38 PM – 4:42 PM **Functional Evaluation of Forearm Pronation Osteotomy for Supination Contracture Due to Brachial Plexus Birth Palsy**
Brant Sachleben, MD; *Jamie O'Callaghan, MBBS; Alison Anthony; Emily Ho; Chris Curtis; Howard Clarke; Sevan Hopyan, MD*
The Hospital for Sick Children, Toronto, Ontario, Canada

4:43 PM – 4:47 PM **Obesity in Children with Brachial Plexus Birth Palsy**
Avreeta Singh, BS; Janith K. Mills, PA-C; ***Andrea S. Bauer, MD;*** *Marybeth Ezaki, MD*
Shriners Hospital for Children Northern California, Sacramento, California

4:56 PM – 5:00 PM **Assessment of Radiocapitellar Line Accuracy during Skeletal Maturation Using Magnetic Resonance Imaging**
Lauren M. Fader, BS; Emily A. Eismann, MS; ***Kevin J. Little, MD;*** *Roger Cornwall, MD; Tal Laor, MD*
Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

5:01 PM – 5:05 PM **Intra-articular Radial Head Fractures in the Skeletally Immature Patient: Complications and Management**
Richard Ackerson, MD; Amy K. Nguyen MS, Patrick M. Carry BS; Breanna M. Pritchard BS; Nancy H. Miller MD; ***Francis A. Scott, MD***
Children's Hospital Colorado, Aurora, Colorado

5:06 PM – 5:10 PM **Pathologic Features and Elbow Arthroscopy in Trochlear Osteonecrosis: An Analysis of 17 Cases**
Henry B. Ellis Jr, MD; Kelsey Wise, BA; Chrisine Ho, MD;
Philip L. Wilson, MD
Texas Scottish Rite Hospital, Dallas, Texas

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Referral Patterns of Emergent Pediatric Hand Transfers to a Tertiary Care Center

Melissa Gunderson, BA; Alex Gornitzky; Benjamin Chang, MD; ***Robert B. Carrigan, MD***

Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

† LOE- Economic and Decision Level III

Purpose: Several studies have suggested that there is ineffective use of health care resources when orthopaedic patients are transferred to a pediatric tertiary care hospital. We sought to identify common characteristics among patients with hand injuries who were transferred from a community hospital to a pediatric tertiary care hospital for definitive treatment.

Methods: A retrospective review of pediatric hand injuries transferred to our institution from July 1st, 2009 to June 30th, 2011 identified patients which were treated by our three hand surgeons. We excluded all oncologic transfers as well as injuries proximal to the forearm, with the exception of neurovascular injuries. We abstracted demographic and transfer data from the medical record including age, sex, injury type, day and time of transfer, and hospital of origin. The hospital of origin was then contacted to determine if they had 24/7 hand surgery emergency room coverage and if they were able to admit and operate on children at their institution. Analysis consisted of using the binomial test with an expected outcome of 25% for each of the four categories regarding hospital emergency room hand coverage and ability to admit children. Time and date of transfer was analyzed using a matched t-test.

Results: 169 patients, who met criteria, were transferred to our institution for hand injuries. There was no statistical difference noted in the day of transfer or time of transfer (p-value < 0.05). We observed a greater number of referrals from transferring institutions that did not have the ability to admit children, regardless of hand surgery emergency room coverage status. Of the 169 patients who were transferred, 59 (35%) were admitted for definitive care, of which 51 (86%) needed a surgical intervention within 24 hours of presentation. Of the remaining 110 (65%) patients who were discharged from the emergency room, 27 (25%) needed surgical intervention to be performed electively within two weeks of discharge. The most common diagnosis among the 169 transferred patients was fracture (73 patients), the most common body part injured was the finger (71 patients).

Conclusion: Patients who were initially seen at a community emergency room which did not have the ability to admit children were more likely to be transferred to our institution for management of their hand injuries. Most patients who were transferred were discharged the same day and did not need an operation. There was not an increased likelihood that patients would be transferred on the weekend or at night.

Significance: Effective use of emergency room facilities will play a greater role in future of healthcare. Understanding referral patterns may help provide better utilization of resources.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Steroid Injection for Unicameral Bone Cysts of the Proximal Humerus in the Skeletally Immature

Christopher C. Bray, MD; Harish S. Hosalkar, MD; Molly Moor, MPH;
Scott J. Mubarak, MD

Rady Children's Hospital, San Diego, California

† LOE-Therapeutic Level IV

Purpose: Unicameral bone cysts (UBC's) are the most common benign bone lesion in children representing 3% of all primary bone lesions in the growing child. Most present with pathologic fracture and many require subsequent intervention. The purpose of our study was to determine the rate of healing of unicameral bone cysts treated with intralesional methylprednisolone injection and to determine the associated factors related to healing.

Methods: A retrospective chart review was performed at a single institution for patients treated for a solitary bone cyst of the humerus between January 2003 and July 2011. All patients treated for a unicameral bone cyst of the humerus with intralesional steroid injection were included. Any patient with an incomplete chart was excluded. 73 patients were identified as having a bone cyst of the humerus. 49 patients were treated with steroid injection. 9 patients were excluded due to incomplete charts leaving 40 patients available for review. Primary outcome was cyst healing as defined by Cole's modification of the Neer criteria. Secondary outcomes included refracture rate and complication rate.

Results: 95% of the patients presented with a pathologic fracture. The mean age at presentation was 9.5 years old. The mean follow up was 3.9 years (+/-2.9 years). The median number of injections was 2. 60% of the lesions were adjacent to the physis. Healing rate was 65% defined as Grade 3 or 4 by Cole's modification of the Neer Criteria. No significant differences were found between healed (Grade 3 and 4) and not healed (Grade 1 and 2) groups for age, years to skeletal maturity, follow up, number of injections, cyst location, cyst size / volume (cm3), presence of a venogram, and the presence of lattice on CT if available ($p>0.05$). Refracture rate was 17.5%. Cysts with refracture had an average initial volume of 66.3 cm3 compared to 31.7 cm3 in cysts without refracture ($p<0.05$). Rate of physeal bar formation was 10%.

Conclusion: Intralesional steroid injection leads to acceptable healing rates (65% in our review) for the treatment of unicameral bone cysts of the humerus in skeletally immature patients. Refracture rate is associated with higher cyst volumes. Complications include refracture and physeal bar formation with documented limb length discrepancy.

Significance: These results demonstrate healing rates comparable to other modes of treatment reported in the literature, with a reduced rate of refracture as compared to the rate within untreated UBC's as reported in previous studies.

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Outcomes of Operative Treatment of Triangular Fibrocartilage Tears in Pediatric and Adolescent Athletes

Felicity G. Fishman, MD; ***Allan E. Peljovich, MD;*** *Gary M. Lourie, MD; Joshua Ratner, MD*

Pediatric Hand & Upper Extremity Center of Georgia, PC / Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia

† LOE-Therapeutic Level IV

Purpose: Triangular Fibrocartilage (TFC) tears have been treated with increasing frequency in pediatric/adolescent patients over the past decade. There is little information on these injuries in young athletes and a sparsity of data on their ability to return to pre-injury levels of athletic participation. Excellent outcomes have been previously reported following the surgical treatment of TFC injuries in younger patients. The purpose of this study was to review the outcomes of pediatric/adolescent athletes with operatively treated TFC tears and to determine their ability to return to their pre-operative level of activity.

Methods: A retrospective chart review was performed for all patients who underwent operative treatment of a TFC tear between 2006-2012 within one Upper Extremity practice. Patients were included if they were actively participating in school/club sports, unable to currently participate secondary to wrist pain and desired to return to their sport. All operative patients had imaging studies and clinical findings consistent with TFC injury as the primary source of their activity-limiting pain and had failed non-operative management prior to surgery. Patients without at least three months of documented postoperative follow up were excluded

Results: Twenty-three of 30 total patients met the inclusion criteria. Average age at surgery was 14 years old and average postoperative follow up was 6.3 months. Two patients had previous distal radius fractures. There were 7 Palmer Class 1A tears, 15 1B tears and 5 1D tears. Seven of 23 patients additionally underwent ulnar shortening osteotomies. There were no major complications reported postoperatively. Thus far, 19 of the 23 documented athletes were approved by the surgeon to return to their preoperative level of activity. We have not yet determined if the remaining 4 patients have returned to their respective sports and are continuing to collect this data.

Conclusion: Majority of the patients in our study had traumatic TFC injuries and a minority were related to previous distal radius fractures. Approximately 30% of the patients were ulnar positive on preoperative radiographic evaluation and underwent ulnar shortening osteotomies. Thus far, 83% the athletes in this study were approved to return to the equivalent level of activity at an average of 5.4 months postoperatively. We feel that operative treatment of TFC injuries in pediatric/adolescent athletes allows them to return to their preoperative athletic endeavors.

Significance: Operative treatment of TFC tears in pediatric/adolescent patients results in generally favorable outcomes and allows the patient to return to their preoperative athletic activities.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Diagnostic Utility of Wrist MRI in the Pediatric Population

Alex Gornitzky; ***Robert B. Carrigan, MD***

The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

† LOE-Diagnostic Level III

Purpose: To the best of our knowledge, no studies have explored the clinical utility of magnetic resonance imaging (MRI) in the clinical workup of pediatric patients presenting with wrist conditions. We sought to examine the usefulness of wrist MRI in evaluating a variety of pediatric wrist conditions.

Methods: We retrospectively collected 313 consecutive wrist MRIs ordered at our institution during a five-year period, from 2007 to 2012. We reviewed the clinical history and grouped the reason for obtaining the MRI into five categories, delineation of a mass, evaluate for arthropathy, rule out fracture, rule out osteomylitis, and evaluate for generalized wrist pain. We recorded demographic data including age, sex, referring physician, and prior diagnostic studies. The final impression of the MRI was also recorded and graded with regard to clinical impact (0-normal, 1-minimal clinical impact, 2 moderate clinical impact, 3 definitive diagnosis). Final variables associated with number of patients were analyzed by the Chi-square test based on the expectation of equality between the genders. All other variables were analyzed through confidence intervals.

Results: We found that MRI was most useful in delineation of a mass (average clinical score 2.46, 0% normal studies), evaluating for arthropathy (average clinical score 1.72, 11% normal studies) and evaluating osteomylitis (average clinical score 2.07, 7% normal studies). MRI was least useful in diagnosing generalized wrist pain (average clinical score 1.14, 33% normal studies Females were 1.6 times more likely to present for evaluation of generalized wrist pain and 2.5 times more likely to have a normal study. No differences in average clinical score or percent normal studies were noted between the departments of the referring physicians.

Conclusion: Based on these results we feel that wrist MRI is best utilized to exclude or confirm a specific diagnosis. MRI provides little useful clinical information for the evaluation of generalized wrist pain.

Significance: MRI is a limited health care resource, our results suggest MRI is best used to confirm or exclude a specific diagnosis, not as a screening tool.

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Two-Stage Correction of Wrist Flexion Contracture in Amyoplasia

Ronald C. Burgess, MD; ***Scott A. Riley, MD***

Shriners Hospital for Children, Lexington, Kentucky

† LOE-Therapeutic Level IV

Purpose: Amyoplasia is a syndrome of multiple congenital joint contractures, with a typical upper extremity presentation of adducted, internally rotated shoulders; elbows fixed in extension, and flexion deformity of the wrists. There have been many surgical procedures described for treating a wrist flexion contracture in arthrogryposis. The reported outcomes for many of these techniques are limited by small case numbers and some of the outcomes have been unsatisfactory. The purpose of this study is to present a retrospective evaluation for a two-stage soft tissue correction of the wrist flexion contracture in arthrogryposis.

Methods: Thirteen wrists in nine patients with arthrogryposis were corrected with a two-stage procedure. In the first stage, an Ilizarov external fixator frame is applied with its hinges centered at the proximal pole of the capitate. Gradual correction of the contracture is accomplished over several weeks of stretching. In the second stage, the fixator is removed and the extensor carpi ulnaris is transferred to either the extensor carpi radialis brevis or the radial wrist capsule.

Results: Pre-treatment passive wrist range of motion averaged 38 degrees. There was no active wrist extension observed in these patients. At an average post-treatment follow up of 5.3 years (minimum of 2 years) the mean passive range of wrist motion was 63 degrees and the mean active range of wrist motion was 46 degrees.

Conclusion: This two-stage procedure offers a method for correcting the wrist flexion contracture as well as providing for some active wrist extension in the typical wrist flexion deformity seen in arthrogryposis. With this treatment method, no osteotomies or bone excision was required. This technique can avoid the potential problems that can be seen with soft tissue releases, bone resection or bone shortening procedures.

Significance: A two-stage, soft tissue surgical procedure which preserves the bony anatomy of the wrist was used to treat the wrist flexion deformity seen in patients with amyoplasia.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Functional Evaluation of Forearm Pronation Osteotomy for Supination Contracture Due to Brachial Plexus Birth Palsy

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† LOE-Therapeutic Level III

Purpose: Severe forearm supination contracture is a disabling feature of some patients with brachial plexus birth palsy. For rigid contractures, osteotomy to position the forearm in neutral or modest pronation is the primary surgical option. However, comparative data confirming the functional value of this treatment are lacking. Our aim is to compare functional outcome and patient satisfaction among two cohorts with supination contracture who did or did not undergo osteotomy.

Methods: We applied a newly validated Brachial Plexus Outcome Measure (BPOM), which includes hand function scores based on activities such as mouse use and drum play as well as visual analog scales of appearance, to two cohorts of ten patients with supination contracture. Active Movement Scale (AMS) and range of motion values were also documented. Proximal ulnar and distal radial pronation osteotomies fixed with plates were employed for all surgical cases. Presentation, pre- and one year post-operative values were recorded.

Results: Mean presentation age (0.9 vs. 1.2 y), sex (M:F 5:5 vs. 5:5), mid-point of forearm rotation (20 vs. 9 deg. supination), and duration of occupational therapy before the decision to operate or not (9.1 vs. 8.8 y) were the same in cases and controls as per the Mann-Whitney test. Supination progressed and became more rigid over time (86 vs. 45 deg.), though BPOM and AMS scores were the same at the operative decision point in cases and controls. One year following surgery, fixed supination was decreased (3 vs. 49 deg.), BPOM hand function, limb appearance visual analog values and AMS scores were improved in cases vs. controls.

Conclusion: Supination deformity occurs progressively during the juvenile years. Both bone forearm pronation osteotomy for fixed supination deformity improves hand function and patients' perspective of limb appearance. In these cases, surgery is more effective than persistent therapy intended to optimise adaptive behaviours.

Significance: The BPOM is a useful tool for both objective and subjective hand assessment. Wider comparative application of this scale to other surgical contexts will help to refine surgical indications in brachial plexus birth palsy.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Obesity in Children with Brachial Plexus Birth Palsy

Avreeta Singh, BS; Janith Mills, PA-C; ***Andrea S. Bauer, MD;*** *Marybeth Ezaki, MD*

Shriners Hospital for Children Northern California, Sacramento, California

† LOE-Prognostic Level III

Purpose: Brachial plexus birth palsy (BPBP) occurs at a rate of approximately 1.5 per 1000 live births within the United States. Amongst the reported obstetrical risk factors for BPBP, fetal macrosomia (birth weight 4500 grams or more) is associated with a 14-fold increased risk. Furthermore, fetal macrosomia may be an independent predictor of obesity later in childhood. The purpose of this study was to identify the relationships between BPBP, fetal macrosomia, and childhood obesity, and to interpret their effects on quality of life.

Methods: We collected data on demographics, injury severity (as measured by the Narakas grade), birth weight, current height and weight, and quality of life (as measured by the Pediatric Outcomes Data Collection Instrument (PODCI)). The Body Mass Index (BMI) for age percentile was used to measure obesity. Children between the eighty-fifth and ninety-fifth percentile are considered overweight, and those over the ninety-fifth percentile are considered obese.

Results: Seventy-three children from Hospital A and 141 from Hospital B were included. The average age was 8 years, 48% were boys, and 53% had a Narakas 1 type BPBP (C5 and C6 roots affected). The hospitals differed on ethnicity (Hospital A 46% White, 20% Hispanic, 18% Black; Hospital B 25% White, 38% Hispanic, 28% Black). Obesity also differed between hospitals, with a higher rate of overweight (25%) and obesity (32%) at Hospital B. Overall, 49% of children were normal weight, 22% overweight, and 29% obese. Of the children with a history of fetal macrosomia, 41% were obese; a statistically significant increase over those with birth weights less than 4500 grams. In a multivariate analysis of PODCI scores, obesity was related to increases in the domains of Upper Extremity Function and Mobility at Hospital B, and decreases in the domains of Sports and Physical Function and Global Function at Hospital A

Conclusion: The obesity rate in our BPBP population (29%) was higher than the national average of 17%, and children with both BPBP and fetal macrosomia had a greatly increased rate of obesity at 41%. The effect of obesity on PODCI scores was conflicting.

Significance: Children with BPBP have an increased risk of being overweight or obese during childhood, especially if the child is more than 4500 grams at birth. Given the sequelae of childhood obesity, this study offers an area of potential health intervention for these at-risk children.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Assessment Of Radiocapitellar Line Accuracy during Skeletal Maturation Using Magnetic Resonance Imaging

Lauren M. Fader, BS; Emily A. Eismann, MS; ***Kevin J. Little, MD;*** *Roger Cornwall, MD; Tal Laor, MD*

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† LOE-Diagnostic Level III

Purpose: This study evaluates the pattern of development of the capitellum ossific nucleus and the corresponding accuracy of a radiocapitellar line (RCL) drawn through the center of the radial neck and head to the maturing capitellum.

Methods: We retrospectively evaluated elbow MRI studies at our institution from 2005-2012. Patients between 1-8 years of age, with at least 3 males and 3 females in each integer age group, were included. Patients with trauma to the proximal radius or capitellum, chronic infections or arthropathy were excluded. Using PACS software, the RCL was drawn by bisecting the radial neck and head on sagittal and coronal T2 FSE or MPGR images. On both sagittal and coronal views, the geometric center of the elliptical capitellar ossific nucleus (CON) was identified, and the perpendicular distance from this point to the RCL was recorded and normalized to the size of the CON. This percent offset was measured in the medial/lateral plane on the coronal view and anterior/posterior and proximal/distal planes on the sagittal view in elbow extension and flexion, respectively.

Results: On the sagittal view, the CON initially begins anterior to the RCL in elbow extension and proximal to the RCL in elbow flexion, while on the coronal view, the CON begins medial to the RCL. During maturation, the CON progresses posteriorly and distally toward the RCL on the sagittal view (Fig 1). On the coronal view, however, the CON ossifies medially beyond the lateral/ulnar border of the proximal radioulnar joint into the emerging trochlear ossification center, such that the center of the CON does not approach the RCL (Fig 2). Although not statistically significant, the CON developed approximately 1 year faster in females than males in both planes.

Conclusion: The RCL is not an accurate tool for assessing bony alignment of the pediatric elbow due to the initially eccentric ossification of the capitellar ossific nucleus. However, with skeletal maturation, this normalizes on the sagittal plane more robustly than on the coronal plane.

Significance: Evaluation of the radiocapitellar line does not substitute for careful clinical examination and radiographic interpretation, especially in young children.

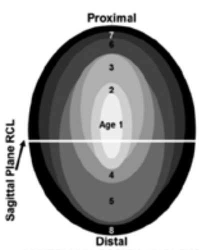

Fig 1. Sagittal Plane

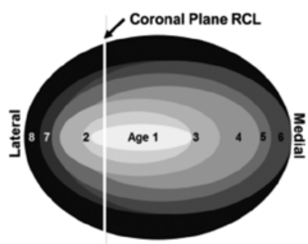

Fig 2. Coronal Plane

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Intra-articular Radial Head Fractures in the Skeletally Immature Patient: Complications and Management

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† LOE-Therapeutic Level III

Purpose: Intra articular radial head (IARH) injuries are known to have devastating consequences in adults but are much less recognized in pediatric patients. Through retrospective data collection this study aims to identify the incidence of IARH fractures while identifying particular trends, outcomes, and complications associated with these injuries in children.

Methods: Current-Procedural Terminology (CPT) codes were used to identify patients presenting IARH fractures between 2003 and 2011 from an electronic medical record database. The relative incidence of IARH fractures was recorded. Demographic variables were obtained along with fracture type, treatment method, complications, need for physical/ occupational therapy and subsequent surgery. Mid-P exact tests and logistic regression analyses were used to compare the incidence of complications, need for physical therapy (PT) and need for revision surgery between the intra and extra-articular fracture groups.

Results: 311 patients with radial head and neck fractures. 299 (96.14%) were extra-articular and 12 (3.86 %) were intra-articular. Mean age at time of injury was 11.46(±3.09) and 8.32(±3.31) years for intra- and extra-articular injuries, respectively. The incidence of complications was significantly higher in the IARH group ($p < 0.0001$, see Table 1). A significantly ($p<0.0001$) greater proportion of the subjects with IARH fractures also required surgery (25% intra-articular vs. 0%, extra-articular) and physical therapy (50% intra- vs. 19.59% extra-articular).

Table 1. Incidence of Complications among Intra and Extra Articular Radial Head Fractures

	Incidence per 100	Lower CI	Upper CI	P-value
Intra	60	21.91	130.6	p <0.0001
Extra	1.34	0.36	3.43	

Conclusion: This study comprises the largest known sample size of pediatric radial head and neck fractures. This cohort demonstrates significantly higher rates of complications, need for physical therapy and need for revision surgery in IARH fractures as compared to their extra articular counterparts. Although IARH fractures are relatively rare injuries, increased attention should be given to proximal radius fractures to rule out possible intra-articular involvement.

Significance: The significant complication rate associated with pediatric IARH fractures necessitates an increased awareness of this fracture pattern with more directed diagnostic and treatment modalities.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Pathologic Features and Elbow Arthroscopy in Trochlear Osteonecrosis: An Analysis of 17 Cases

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† LOE-Prognostic Level IV

Purpose: The purpose was to review the clinical presentation, radiographic imaging, and arthroscopic findings of trochlear osteonecrosis.

Methods: We performed a retrospective chart review of patients who presented to our practice from 2005-2012 with posttraumatic osteonecrosis of the trochlea. Indications for arthroscopy included failure of conservative management with continued mechanical symptoms and pain. Patients who underwent an arthroscopy had debridement of grossly unstable cartilage and loose body removal, synovectomy, and anterior capsular release and an excision of the olecranon tip when indicated.

Results: Seventeen patients were identified who presented with post-traumatic trochlear osteonecrosis at a mean age of 10.6 years old (range 6-16 years). All subject had a history of previous elbow trauma (10 supracondylar fractures, 2 lateral condyle fractures, 2 other elbow fracture, 3 elbow contusion without known fracture) at least 6 months prior to diagnosis of trochlear osteonecrosis (range 8 months – 9 years). The average time of presentation for symptoms associated with trochlear osteonecrosis was 4.7 years after the injury; however, those with a less than 100 degrees of total elbow motion presented earlier than those with a functional arc of motion, although this was not statistically significant (3.97 versus 5.2 years, p=0.2). Sixteen of the seventeen (94.2%) patients were classified as Type A osteonecrosis with only one (5.8%) Type B.

All twelve patients who underwent elbow arthroscopy had a large unstable chondral flap overlying the trochlea. Four patients had evidence of grade III/ IV chondral changes on the capitellum or the radial head. Patients with significant lateral column changes presented an average of 2 years later than the initial injury compared those who did not (6 versus 4.1 years). Eleven of twelve patients had resolution of their mechanical symptoms and improved pain in the early post operative period. Three of these patients had a decrease in arc of motion (>20 degrees) following elbow arthroscopy, while only one patient had significant improvement in their range of motion (>20 degrees) after the procedure.

Conclusions: Post traumatic trochlear osteonecrosis (‘fishtail’ deformity) is a rare entity with a wide range of preceding injuries and presentations. During elbow arthroscopy, severe chondral changes are seen on the trochlea and, with delayed presentation, in the lateral compartment. In the short term, elbow arthroscopy may alleviate mechanical symptoms, however, will not improve motion.

Significance: Trochlear osteonecrosis presents with a high rate of chondral injury and potential long term elbow morbidity and dysfunction.

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Lower Extremity and Neuromuscular Subspecialty Day

Fri., May 3, 2013 • 1:00 PM – 5:15 PM • Room: Dominion North

Co Chairs: *Henry (Hank) G. Chambers, MD; Scott A. Hoffinger, MD*

PERIOD 1

1:00 PM – 2:15 PM **Free Papers and Discussion**

1:00 PM – 1:04 PM **Welcome**

1:05 PM – 1:09 PM **Impact of Gait Analysis on Correction of Excessive Internal Hip Rotation in Ambulatory Children with Cerebral Palsy**
Robert M. Kay, MD; *Christopher Lening, MD; Susan Rethlefsen, PT, DPT; Tishya A.L. Wren, PhD*
Children's Hospital Los Angeles, Los Angeles, California

1:10 PM – 1:14 PM **Gait Patterns In Diplegic Spastic Cerebral Palsy: A Classification Based at 1805 Cases**
Mauro César de Morais Filho, MD; *Cátia M. Kawamura; José Augusto Fernandes Lopes; Daniella Lins Neves; Michelle S. Cardoso; Jordana Caiafa*
AACD, São Paulo, Brazil

1:15 PM – 1:19 PM **Relationships Between Isometric Muscle Strength, Gait Parameters, and Gross Motor Function Measure in Patients with Cerebral Palsy**
Seung Yeol Lee, MD; *Chin Youb Chung, MD; Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Moon Seok Park, MD*
Seoul National University Bundang Hospital, Korea

1:20 PM – 1:27 PM **Discussion**

1:28 PM – 1:32 PM **Dega Acetabuloplasty in the Treatment of Spastic Hips: Results at Skeletal Maturity**
Cindy Mallet, MD; *Brice Ilharreborde, MD,PhD; Ana Presedo, MD; Georges-François Penneçot, MD, PhD; Keyvan Mazda, MD*
Hôpital Robert Debré, Paris, France

1:33 PM – 1:37 PM **An Alternative Method for Femoral Varus Derotational Osteotomy in Spastic Cerebral Palsy: The Rush Rod**
Brian J. Deignan, MD; *H. Robert Tuten, MD*
Virginia Commonwealth University, Richmond, Virginia

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

1:38 PM – 1:42 PM **Should Routine Proximal Femoral Hardware Removal be Performed in Children with Cerebral Palsy?**
Walter Truong, MD; *Tom F. Novacheck, MD;*
Andrew W. Howard, MD, MSc; Unni G. Narayanan, MD, FRCSC
Gillette Children's Specialty Healthcare, St. Paul, Minnesota

1:43 PM – 1:50 PM **Discussion**

1:51 PM – 1:55 PM **Spinal Deformity Correction in Conjunction with Tethered Cord Release**
Haluk Altiok, MD; *Anne Riordan, BA; Sahar Hassani, MS; Adam Graf, MS;*
Joseph Krzak, PT; Ann Flanagan, PT
Shriners Hospital for Children, Chicago, Illinois

1:55 PM – 1:59 PM **Are We Undermedicating Patients with Neuromuscular Scoliosis after Posterior Spinal Fusion?**
M. Wade Shrader, MD; Miranda Nowlin, PA-C;
Gregory R. White, MD; John S. Jones, MD; ***Lee S. Segal, MD***
Phoenix Children's Hospital, Phoenix, Arizona

2:00 PM – 2:04 PM **Pronator Teres Transfer for Forearm and Wrist Deformity in Cerebral Palsy Children**
Jin-Tzer Jimmy Ho, MD; *Ting-Ming Wang, MD, PhD; Kuan-Wen Wu, MD;*
Shier-Chieg Huang, MD, PhD; Ken N. Kuo, MD
National Taiwan University Hospital, Taipei City, Taiwan

2:04 PM – 2:11 PM **Discussion**

2:15 PM – 2:30 PM **Break**

PERIOD 2 – LOWER EXTREMITY

2:30 PM – 2:40 PM **Clubfeet / Vertical Talus – How to Prevent and Manage Failures (Pearls / Pitfalls)**
Matthew Dobbs, MD, St. Louis, Missouri

2:45 PM – 2:55 PM **Congenital Pseudarthrosis of the Tibia**
Charles E. Johnston, MD, Dallas, Texas

3:00 PM – 3:10 PM **The Effect of BMP's on Pseudarthrosis and Bone Repair**
Benjamin A. Alman, MD, FRCSC, Toronto, Ontario, Canada

3:15 PM – 3:25 PM **Extended Limb Lengthening in Dwarfism**
Shawn C. Standard, MD, Baltimore, Maryland

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PERIOD 3 – NEUROMUSCULAR

3:35 PM – 3:45 PM	**Muscular Dystrophy – Management in 2013 – 2020** *Michael D. Sussman, MD, Portland, Oregon*
3:45 PM – 4:00 PM	**Break**
4:00 PM – 4:10 PM	**Myelomeningocele – Management in 2013 – 2020** *Vineeta Swaroop, MD, Chicago, Illinois*
4:15 PM – 4:25 PM	**Cerebral Palsy – Classification by GMFCS / FMS, Treating GMFCS I and II** *H. Kerr Graham, MD, FRCS, North Balwyn, Victoria, Australia*
4:30 PM – 4:40 PM	**Mechanical Definition of Crouch Gait / Lever Arm Dysfunction** *Scott A. Hoffinger, MD, Moraga, California*
4:45 PM– 4:55 PM	**Management of GMFCS III Patients** *Henry (Hank) G. Chambers, MD, San Diego, California*
5:00 PM – 5:10 PM	**Management of Non-ambulatory GMFCS V Patients** *Freeman Miller, MD, Wilmington, Delaware*
5:15 PM – 5:25 PM	**Regenerative Medicine / Stem Cells / Cord Blood** *Scott A. Hoffinger, MD, Moraga, California*

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Impact of Gait Analysis on Correction of Excessive Internal Hip Rotation in Ambulatory Children with Cerebral Palsy

Robert M. Kay, MD; *Christopher Lening, MD; Susan Rethlefsen, PT, DPT; Tishya A.L. Wren, PhD*

Children's Hospital Los Angeles, Los Angeles, California

† LOE-Diagnostic Level I

Purpose: To determine the impact of computerized gait analysis in patients with cerebral palsy and excessive hip internal rotation during gait.

Methods: An IRB-approved, randomized control trial (RCT) was performed in ambulatory children with cerebral palsy. All patients underwent orthopaedic surgery and pre- and post-operative gait analysis. In the gait report group (GR group), the surgeons received the gait report pre-operatively; in the control group, they did not. 156 children completed follow-up, 83 in the GR group and 73 controls. The current report examines all patients in whom external femoral derotation osteotomy (FDRO) was recommended in the pre-operative gait report. FDRO was recommended in 44 children (65 limbs) pre-operatively, including 26 children (39 limbs) in the GR group and 18 children (26 limbs) in the control group. One-year postoperative and pre- to postoperative change in femoral anteversion, mean hip rotation in stance, and mean foot progression angle were compared between groups.

Results: There were no significant differences between the GR and control groups ($p > 0.39$). However, the recommendation for FDRO was followed in only 7/39 limbs (18%) in the GR group. There were significantly better outcomes in the GR group in patients in whom the recommendation for FDRO was followed. These limbs showed greater changes in femoral anteversion (-30.7 vs -12.2°, $p=0.04$), dynamic hip rotation (-25.5 vs -7.6°, $p=0.003$), and foot progression (-36.2 vs -12.4°, $p=0.01$) than the control group and more normal post-operative values (anteversion 26.4 vs 40.6°, $p=0.05$), hip rotation (-2.8 vs 16.6°, $p=0.003$), and foot progression (-5.4 vs 6.4°, $p=0.22$).

Conclusion: There were only modest improvements when treatment was either rendered without the gait report or when the recommendations of the gait report were not followed. In contrast, there were significant improvements when the gait report was available and its recommendations were followed.

Significance: Gait analysis provides a positive impact on surgical outcomes, but only when its recommendations are followed. (Level I Evidence)

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Gait Patterns in Diplegic Spastic Cerebral Palsy: A Classification Based at 1805 Cases

Mauro César de Morais Filho, MD; *Cátia M. Kawamura; José Augusto Fernandes Lopes; Daniella Lins Neves; Michelle S. Cardoso; Jordana Caiafa*

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† LOE-Other Analysis Level III

Purpose: Identify the gait patterns described by Sutherland and Davids in 1993 in a large group of cerebral palsy (CP) patients and characterize each group according age, GMFCS level, GDI and previous surgical procedures.

Methods: A search was done in gait laboratory database for diplegic spastic CP patients. Only the first gait analysis of each patient was considered and 1805 individuals met inclusion criteria. Patients were divided according Sutherland and Davids classification in the 4 classic groups (jump knee, stiff knee, crouch and recurvatum) and more 3 new groups (mixed pattern, asymmetric and non-classified). Mean age, GMFCS levels, GDI and previous surgical procedures were identified in each group and the results were compared. Statistical analysis was applied using ANOVA test.

Results: Six hundred and sixty five patients (36.9%) were classified in the 4 classic groups (jump knee 9.3%, stiff knee 1.8%, crouch 21.9% and recurvatum 3.9%) and they exhibited same pattern at both sides. Eight hundred and eighty one individuals (48.8%) had different classic patterns among right and left sides (asymmetric group) and 31 (1.7%) shown more than one classic pattern (mixed pattern group). Finally, 228 (12.6%) were not able to be classified according the parameters described by Sutherland and Davids. The jump knee (9.6 years) and recurvatum (9.4 years) had mean age lower than other groups. The highest GDI (64.12) was observed in the non-classified group whereas the lowest (43.58) was noted in crouch group. The GMFCS level III was more frequent in crouch and mixed groups, while level II was in the others. Previous surgical procedures at triceps surae were more frequent in stiff knee and mixed groups, and less, at jump knee and recurvatum. Jump knee group received less and stiff knee group more surgical procedures at hamstrings than others. Finally, previous rectus femoris transfer was more prevalent at crouch gait group than asymmetric, jump knee and non-classified groups.

Conclusion: In a large group, 87.4% of patients were able to be classified according classic patterns described by Sutherland and Davids. The asymmetrical cases were more frequent even in a diplegic group. The crouch group was characterized by lowest GDI, prevalence of GMFCS III and previous rectus femoris transfer, while stiff knee group had received more surgical hamstrings lengthening than other groups.

Significance: Gait abnormalities in cerebral palsy can be multiple and variable. Identification and characterization of most frequent patterns are crucial for understand natural history and plan the treatment approach.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Relationships Between Isometric Muscle Strength, Gait Parameters, and Gross Motor Function Measure in Patients with Cerebral Palsy

Seung Yeol Lee, MD; *Chin Youb Chung, MD; Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Moon Seok Park, MD*

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† LOE-Diagnostic Level II

Purpose: This prospective study was performed to investigate the correlation between isometric muscle strength, gross motor function, and gait parameters in ambulatory patients with spastic CP.

Methods: Twenty-five ambulatory patients (mean age 11.5 years) with spastic cerebral palsy (GMFCS level I–III) who were scheduled for single event multilevel surgery, including distal hamstring lengthening, were included. Peak isometric muscle strength was measured using a handheld dynamometer for the hip flexor, hip extensor, knee flexor, and knee extensor muscle groups preoperatively. 3D gait analysis and gross motor function measure (GMFM) scoring were performed preoperatively. Correlations between peak isometric strength in each muscle group and GMFM, gait kinematics, and gait kinetics were analyzed.

Results: Peak isometric muscle strength of all muscle groups was not related to the GMFM score and the GMFCS level. Peak isometric strength of the hip extensor and knee extensor was significantly correlated with the mean pelvic tilt (r=-0.581, p=0.003 and r=-0.420, p=0.037, respectively) and maximum pelvic obliquity (r=-0.463, p=0.023 and r=-0.433, p=0.031, respectively). There was a significant correlation between the peak isometric strength of hip extensor and maximum hip flexion in swing (r=-0.543, p=0.006). Peak isometric strength of the knee extensor was related to the knee flexion at initial contact (r=0.496, p=0.012), minimum knee flexion in stance (r=0.449, p=0.025), and knee flexion at terminal swing (r=0.468, p=0.018). There were significant correlations between peak isometric strength of the knee extensor and peak knee extensor moment in early stance (r=0.430, p=0.032) and in terminal stance (r=0.416, p=0.038). Peak knee absorption power in terminal swing was significantly related to isometric strength of all included muscle groups (r=0.440, 0.447, 0.474, and 0.435, respectively).

Conclusions: There is no correlation between muscle strength and gross motor function. However, higher muscle strength, especially the extensor muscle group of the hip and knee joint, stabilizes the pelvic motion and makes walking more energy-efficient in flexed knee gait.

Significance: Higher muscle strength stabilizes the pelvic motion and makes walking more energy-efficient in flexed knee gait.

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Dega Acetabuloplasty in the Treatment of Spastic Hips: Results at Skeletal Maturity

Cindy Mallet, MD; *Brice Ilharreborde, MD, PhD; Ana Presedo, MD; Georges-François Penneçot, MD, PhD; Keyvan Mazda, MD*

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† LOE-Therapeutic Level IV

Introduction: Hip subluxation is common in children with cerebral palsy (CP). Surgery is indicated in case of pain or progressive increase of Reimers index on radiographs. Dega acetabuloplasty is one of the numerous operative techniques available, but results at skeletal maturity remain unclear. The purpose of this study was to report the long-term results of this procedure.

Materials and Methods: 22 hips (21 children) were retrospectively evaluated at skeletal maturity. Mean age at surgery was 8 years old (3 to 15 years) and follow-up averaged 8 years. All patients underwent a Dega acetabuloplasty combined with a femoral osteotomy, without open reduction. Reimers index, acetabular angle and neck-shaft angle were measured and compared on preoperative, early post-operative and latest follow-up radiographs.

Results: The acetabular angle significantly improved (mean gain 18°), and the correction remained stable at maturity. The neck-shaft angle significantly decreased postoperatively (154° to 114°), but recurrence of the valgus deformity (129°) of the proximal femur occurred at maturity. Reimers index significantly decreased postoperatively (from 61% to 4%) but significantly progressed at follow-up (14%). No case of osteonecrosis was reported but two hips dislocated during follow-up.

Conclusion: Dega osteotomy without hip dislocation is an efficient and safe procedure to correct the acetabular dysplasia with long-lasting results. The progressive recurrence of the valgus deformity of the proximal femur, explained by the adductors spasticity and gluteus medius weakness, was responsible for a significant increase of the Reimers index. However, the coverage remained greater than 70% at maturity in 86 % of the hips.

Significance: Dega osteotomy without hip dislocation is a long-lasting efficient procedure to treat spastic hips in CP patients.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

An Alternative Method for Femoral Varus Derotational Osteotomy in Spastic Cerebral Palsy: The Rush Rod

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Virginia Commonwealth University, Richmond, Virginia

† LOE-Therapeutic Level III

Purpose: To present the clinical and radiographic data collected from patients who were treated with a VDRO using Rush rod fixation and compare this to published norms of outcomes using blade plate fixation.

Methods: A retrospective chart and radiograph review was conducted after identifying patients who underwent VDRO with Rush rod fixation at our institution between 2006 and 2011. We identified 22 patients with 29 hips who underwent the procedure. Information from follow-up clinic visits was gathered and any complications were noted. The patient's preoperative, postoperative and subsequent radiographs were analyzed to measure specific parameters such as neck-shaft angle, center-edge angle, and acetabular index.

Results: All patients had soft tissue releases and an open reduction of the hip performed at the time of surgery; all but three patients (four hips) had Dega acetabular osteotomies performed as well. The average preoperative neck-shaft angle was measured at 161 degrees (range 128-180) with postoperative neck-shaft angles measuring 120 degrees (range 90-167). Acetabular index improved from an average of 44.1 degrees (range 10-70) to 29.2 (range 8-60). Postoperative Center-Edge Angle measured 24.5 degrees (range 5-45).

A review of the literature of VDRO performed with blade plate fixation yielded postoperative radiographic parameters as follows: neck-shaft angles of 116-134 degrees, acetabular indices of 18-40 degrees, and center-edge angles of 8-30 degrees. Our correction was well within these published norms. These studies also revealed a complication rate of 9-58% with a reoperation rate of 44-74%, higher when surgery is performed in a younger patient population.

Seven of our twenty-nine hips had a complication (rate of 24.1%). Six hips had another surgery performed (reoperation rate of 20.7%). Four of these were due to painful hardware, requiring removal. There was one instance each of resubluxation and redislocation. One hip progressed to nonunion, which was repaired and bone grafted, and then went on successful union.

Conclusion: We present an alternative method for performing varus derotational osteotomy of the proximal femur in children with cerebral palsy using the Rush rod. Developed initially as a method of revising previously failed blade plate fixation, this method was carried over to primary VDRO after observing less prominent hardware and shorter surgical times. In our retrospective analysis of 29 hips undergoing this procedure we present comparable radiographic outcomes with similar complication rates.

Significance: Varus derotational osteotomy using a rush rod for internal fixation appears a viable alternative to conventional blade plate fixation.

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Should Routine Proximal Femoral Hardware Removal be Performed in Children with Cerebral Palsy?

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† LOE- Economic and Decision Level III

Purpose: The reasons reported for routine hardware removal in children include concerns for late infections, later reconstructive surgeries, and fractures. However, there are concerns about costs and complications related to routine hardware removal and nonambulatory children with neuromuscular disorders are at increased risk. We hypothesize that the complication rate related to hardware retention is relatively low and would not justify routine removal of proximal femoral hardware in children with cerebral palsy (CP).

Methods: Children ages 16 years or less with CP and proximal femoral hardware placement from 1991-2010 were categorized into two groups: 1. Early Group (<2 years), and 2. Late/Retained Group (>2 years). Patients were excluded if they had < 2 years follow-up. Possible major complications were defined as fractures, deep infections, complications related to anaesthesia, and inability to completely remove implant. Patient risk factors for complications were defined and assessed in each group.

Results: Charts for 683 patients with CP and proximal femoral osteotomies were reviewed. 586 patients and 1,005 hips met criteria for this study. Average follow-up was 74 months (24-208). Group 1 included 291 patients and 517 hips while Group 2 included 295 patients and 488 hips. Both groups were similar in age, presence of seizure disorder, index procedure complications and length of follow-up. Group 2 was slightly older (8.5 vs 7.7) and slightly higher GMFCS level (4.0 vs 3.3). Major complication rates per patient were similar with Group 1 at 3.1% (n=9) and Group 2 at 4.7% (n=14) (P=0.307). Early group complications included infection (5), fracture (3), aspiration pneumonia, C. Difficile infection (1). Late/retained group complications included infection (2), fracture (10), aspiration pneumonia (1), incomplete removal of implant (1). The average facility cost of proximal femoral hardware removal alone in children with CP was $25,525 in 2011. Total estimated group 1 cost is $7,427,940 for routine removal alone in the 291 patients ($25,525/patient). 57 removals were eventually done in group 2. Including the estimated cost of treating the complications encountered in those 295 children, the estimated total cost is $1,695,754 ($5,748/patient).

Conclusion: In children with CP and proximal femoral hardware, there are similar complication rates when comparing routine early hardware removal (<2 years) to late removal or retention > 2 years. There is an estimated savings of $20,000/patient, when plates are retained > 2 years, rather than routinely removed.

Significance: This study represents the first level III study on this topic.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Spinal Deformity Correction in Conjunction with Tethered Cord Release

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† LOE-Prognostic Level III

Purpose: Scoliosis occurs in greater than 80% of children with myelodysplasia by the 10th year of life. It is considered to be multifactorial and progressive in nature. Symptomatic tethered cord (TC) following primary myelomeningocele repair occur in 11-27% of the patients. New onset / progressive scoliosis can be the first sign of symptomatic TC. Untethering of the spinal cord could help to stabilize the scoliosis. Existing literature agrees on the need of further evaluation to determine whether early untethering is beneficial stabilizing the spinal curvature long enough to allow skeletal maturity.

This study was designed to describe the progression of spine deformity following TC release in a group of patients who presented with new onset/progressive scoliosis.

Methods: Medical charts of 96 patients with history of myelomeningocele who underwent TC release between 1980 and 2010 were reviewed in a retrospective IRB approved study. Of the 33 patients that presented with a chief complaint of progressive spine deformity, 12 (group A) underwent TC release just before definitive spinal fusion (avg. age at release 11.3 yrs. and at fusion 11.6 yrs., all had cobb angle ≥ than 50°) after the TC was released while 21 (group B) were managed conservatively (avg. age 6.2 yrs. at release) after the TC was released.

Results: In group A, none of the patients had any functional change following definitive spine surgery. One patient had wound infection and one had a change in bladder function. In group B, 14 patients had curves 46° while 7 had ≤45° at the time of TC release. 6 patients were thoracic, 14 were L1-L4, one was L5+ functional level. Average follow up in group B was 3.8 years (1 yr. to 6.4 yrs.). 10/21(47.6%) patients in group B ultimately required definitive spinal surgery. TC release delayed definitive spine surgery an average of 3.2 years.

Conclusions: The results demonstrated that TC release without additional corrective spine surgery could be able to adequately stabilize spinal deformity in patients with myelodysplasia and could be a temporary measure to "buy time" in young patients before the definitive spine surgery.

Significance: Scoliosis is an important indicator of tethered cord in myelomeningocele patients. TC release may to stabilize the curve and delay the definitive surgery.

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Are We Undermedicating Patients with Neuromuscular Scoliosis after Posterior Spinal Fusion?

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† LOE-Prognostic Level III

Purpose: The purpose of this study is to compare the pain management for patients with neuromuscular (NM) scoliosis undergoing posterior spinal fusion (PSF) to patients with adolescent idiopathic scoliosis (AIS) undergoing the same procedure.

Methods: This was a retrospective, case-control study of patients undergoing PSF. A consecutive series of patients with NM scoliosis was matched for age, gender, and weight with a group of patients with AIS. The total narcotic used (TNU) was determined by summing all narcotics given during the hospital stay (oral and intravenous), and converting them to morphine equivalent units (mg of morphine-equivalents, normalized by body weight). The data from these two groups were then analyzed to determine differences in TNU.

Results: 25 patients with NM scoliosis (mean age 15.4) were included in the study. This group was matched with 25 patients with AIS scoliosis (mean age 15). Only those AIS patients undergoing PSF for more than 13 spinal segments were used for comparison, to increase the degree of similarity between the matched pairs. The TNU for the NM group was 1.2 mg morphine/kg (range, 0.28 to 4.21), while the TNU for the AIS group was 3.52 mg morphine/kg (range, 0.71 to 15.51). Using the Student's t-test, this difference was highly significant ($p<0.0000001$).

Conclusion: In this case-control retrospective analysis, patients with AIS undergoing PSF received more than twice the amount of narcotic compared to an age and weight-matched group of patients with NM scoliosis. Pain control in a NM population can be extremely difficult, due to inherent communication and cognitive deficits in these patients. This data suggests that these NM patients' pain is under-treated compared to our AIS patients. The reasons for these findings are likely multifactorial, but more study is indicated to investigate pain assessment and pain control in this vulnerable patient population.

Significance: Posterior spinal fusion for children with severe neuromuscular scoliosis carries a significant risk of complications. The appropriate assessment of pain is crucial; under-treatment of pain leads to patient and family anxiety, while over-treatment in this medically fragile patient population can lead to respiratory depression. In this study, patients with AIS undergoing PSF received significantly more narcotic pain medication as compared to patients with NM scoliosis.

† LOE – Level of Evidence – Please see page 14 for details.

See pages 15 – 57 for financial disclosure information.

Pronator Teres Transfer for Forearm and Wrist Deformity in Cerebral Palsy Children

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† LOE-Therapeutic Level IV

Purpose: Forearm pronation and wrist flexion contracture can be a disability for daily living care in cerebral palsy children. It is imperative to improve their hand function. The purpose of the study is to evaluate the outcome of pronator teres transfer for forearm and wrist deformity.

Methods: There were 17 patients (13 males, 4 females) who had pronator teres transfer between 2004 and 2012 for forearm pronation and wrist flexion contracture. The average age at the surgery was 12 years 5 months. The mean follow up period was 42 months. Surgical procedures included releasing pronator teres at radius insertion and advanced to the dorsum of forearm where it is sutured to extensor carpi radialis brevis and/or longus. All patients had a clinical evaluation pre- and post-operatively, included modified Ashworth scale, active forearm range of motion, wrist motion arc, grasp strength, and forearm functional position. Furthermore, three basic daily living skills were evaluated for hand dexterity and functional improvement. Statistically, we used paired T-test with p value less than 0.05 as significant.

Results: The average supination gained 60° ($p< 0.05$). The average wrist extension gained 40° ($p< 0.05$). The average grasp strength gained 10 kg ($p< 0.05$). The average forearm functional positioning changed from 40° pronation to 10° pronation ($p <0.05$). The three basic daily living skills test also showed great improvement after the procedure.

Conclusion: The forerarm pronation and wrist flexion contracture could be simultaneously eliminated by transferring pronator teres to wrist extensors. In well selected cases- especially that whose hand function was reduced by the deformity- it is an additional armamentarium in management of disability of upper extremity in cerebral palsy children.

Significance: The pronator transfer in our cases improved the functional outcome in supination and wrist extension as well as grasping strength.

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Monteggia Fractures in Children: A Multi-center Examination of Treatment Strategy and Outcomes

David E. Ramski, BS, BM; William P. Hennrikus, BA; ***Donald S. Bae, MD;*** *Keith D. Baldwin, MD; Neeraj M. Patel, MBS; Peter M. Waters, MD; John (Jack) M. Flynn, MD*

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Measurement of Radiation Exposure when Using the Mini C-Arm to Reduce Pediatric Upper Extremity Fractures

Jennifer Slough; ***William L. Hennrikus Jr, MD****; Michael J. Sumko, DO; Douglas Armstrong, MD*

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Spinal Muscular Atrophy Needs Assessment: Evaluating Survey Results of Healthcare Providers and Families

Matthew A. Halanski, MD*; Karen Patterson, PT, MS, PCS; Sarah A. Sund, BS, MT, CCRC; Linda Makholm, MT, CCRC; Blaise A. Nemeth, MD; Kenneth J. Noonan, MD; Mary Schroth, MD*

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Paper Poster #04 *(page 325)*

Treatment of Hip Subluxation in Skeletally Mature Patients with Cerebral Palsy

Benjamin D. Martin, MD; *Haripriya Ayyala; Matthew E. Oetgen, MD*

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The Use of an Adrenergic Agonist in Post-operative Pain Control after SEMLS for Cerebral Palsy

Allison C. Scott, MD*; Sudha Vakamudi, MD*

Shriners Hospital for Children, Houston, Texas

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High Incidence of Pyomyositis among "Septic Hip" Consults: A Two-Year Epidemiological Study

Megan Mignemi, MD; Travis Menge, MD; Gregory A. Mencio, MD; Jeffrey E. Martus, MD; Stephen A. Lovejoy, MD; Christopher Stutz, MD; ***Jonathan G. Schoenecker, MD, PhD***

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Biological Reconstruction with Vascularized Fibular Graft after Bone Sarcoma Resections In Extremities

Bulent Erol, MD; *Cihangir Tetik; Onur Basci; Mert Osman Topkar; Emrah Caliskan; Omer Sofulu*
Marmara University Hospital, Istanbul, Turkey

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Validity of Somatosensory Evoked Potentials as Early Indicators of Neural Compromise in Rat Model of Spinal Cord Compression

Susan H. Morris, PhD; ***Ron El-Hawary, MD****; Jason Howard, MD; Douglas D. Rasmusson, PhD*
IWK Health Centre, Halifax, Nova Scotia, Canada

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Anne-Laure Ménard, B.Ing; Barthélémy Valteau, MASc; Irène Londono, PhD; Florina Moldovan, MD, PhD; ***Guy Grimard, MD****; Isabelle Villemure, PhD*
Sainte-Justine University Hôspital Center, Montreal, Quebec, Canada

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Roman L. Capdevila, MD*; Luis Nualart; Jose Manuel Reyes*
Shriners Hospital for Children, Mexico City, Mexico

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Andreas Roposch, MD, MSc, FRCS*; Evangelia Protopapa, MSc*
Great Ormond Street Hospital for Children, London, United Kingdom

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Is Abduction Bracing after Failed Pavlik Harness Really Effective?

David A. Ibrahim, BA; ***David L. Skaggs, MD, MMM****; Paul D. Choi, MD*
Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

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K. Patrick Powell, MD; *Spencer E. Romine, MD; Tracy Warhoover, NP; Heather Cole; Henry J. Iwinski Jr, MD; Vishwas R. Talwalkar, MD; Janet Walker, MD; Todd A. Milbrandt, MD, MS; Jonathan G. Schoenecker MD, PhD*

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Pediatric Hospitalist Co-management Impact on the Care of Medically Complex Children Undergoing Spinal Surgery

David M. Pressel, MD, PhD; David I. Rappaport, MD; Judy Adelizzi-Delany, MSN, CPNP; Kenneth J. Rogers, PhD, ATC; Chalanda E. Jones, MD; Maria E. Petrini, MD; Kate L .Chaplinski, MD; ***Suken A. Shah, MD***

Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

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Moon Seok Park, MD; *Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Seung Yeol Lee, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Chin Youb Chung, MD*

Seoul National University Bundang Hospital, Kyungki, Korea

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Henry B. Ellis Jr, MD*; Kelsey Wise, BA; Guillaume Dumont, MD; Krista Howard, PhD; Philip L. Wilson, MD*

Children's Medical Center, Dallas, Texas

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Eric W. Edmonds, MD*; Laura W. Lewallen, MD; Michael Murphy, MD; Amy L. McIntosh, MD*

Rady Children's Hospital, San Diego, California

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The Predictive Value of Feet Radiology in the Need for Additional Surgery and Functional Outcome in Clubfeet Treated According to Ponseti Protocol

Eitan Segev, MD; Lior Shabtai, MD; Ariela Yavor, BPT; ***Barry Danino, MD;*** *Shlomo Wientroub, MD; Yoram Hemo, MD*

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Kathryn Doughty, MD; Sattar Alshryda, MD; Charles Popkin, MD; ***Benjamin A. Alman, MD, FRCSC***
The Hospital for Sick Children,Toronto, Ontario, Canada

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Scott J. Mubarak, MD; *John Kemppainen, MD; David Kohanchi, BS; Andrew T. Pennock, MD*
Rady Children's Hospital, San Diego, California

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Osteochondral Allografts for Knee Lesions in the Pediatric and Adolescent Population
Andrew T. Pennock, MD*; Ryan T. Murphy; William D. Bugbee, MD*
Scripps Clinic, La Jolla, California

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Nicholas Larsen, MD; Alice Moisan, BSN; Jeffrey R. Sawyer, MD; William C. Warner Jr, MD; James H. Beaty, MD; ***Derek M. Kelly, MD***
University of Tennessee-Campbell Clinic, Germantown, Tennessee

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Matthew A. Halanski, MD; ***Kirstin Monroe DNP, RN;*** *Sarah A. Sund BS, MT, CCRC;*
Blaise A. Nemeth, MD; Kenneth J. Noonan, MD
American Family Children's Hospital, University of Wisconsin, Madison, Wisconsin

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Factors Associated with the Use of BMP during Pediatric Spinal Fusion Surgery:
An Analysis of 4817 Patients
Amit Jain, MD; Khaled M. Kebaish, MD; Michael Paloski, MD; ***Paul D. Sponseller, MD***
Johns Hopkins Orthpaedic Surgery, Baltimore, Maryland

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Postoperative Continuous Paravertebral Anesthetic Infusion for Pain Control in Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis
William K. Accousti, MD*; Noah C. Marks, MD; Andrew G. S. King, MD*
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Monteggia Fractures in Children: A Multi-center Examination of Treatment Strategy and Outcomes

David E. Ramski, BS, BM; William P. Hennrikus, BA; ***Donald S. Bae, MD;***
Keith D. Baldwin, MD; Neeraj M. Patel, MBS; Peter M. Waters, MD;
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Purpose: Monteggia fractures remain challenging pediatric injuries, due to difficulties in diagnosis, propensity for instability, and complexity of late reconstruction. The objective of this investigation was to assess the efficacy of a treatment strategy based upon ulnar fracture pattern: closed reduction (CR) for plastic/greenstick, intramedullary (IM) wire fixation for transverse/short oblique, and open reduction and internal fixation (ORIF) for long oblique/comminuted ulnar fractures.

Methods: 113 acute Monteggia fracture patients were analyzed from two level 1 pediatric trauma centers from 2000-2011. Mean age was 6.9 +- 2.9 years; 55% were male. Mean follow-up was 23.7 weeks. Ulnar fracture patterns were classified, and patients were divided according to whether the fracture was or was not fixed according to the treatment strategy outlined above. Fisher exact tests and odds ratios were used to compare pain and range-of-motion outcomes, rates of complication, and rates of failure between the two groups. "Failure" was defined as recurrent subluxation or dislocation of the radial head or unacceptable ulna alignment during follow-up.

Results: None of the patients treated according to the ulna fracture pattern strategy had recurrent instability or loss of ulnar alignment. In contrast, 7 of 57 patients (12.3%) who deviated from the treatment strategy demonstrated recurrent radiocapitellar instability (n=5) or late ulnar fracture displacement (n=3). Failure rate was significantly higher in the group that did not follow the ulnar fracture pattern based strategy (p=0.02). Of all patients who experienced failure, 6/7 (85.7%) had either a transverse or short/long oblique pattern initially treated non-operatively. Comminuted fractures required open reduction of the radiocapitellar joint more frequently than all other fracture types (p<0.01). Complications of treatment included 1 case of ulnar nonunion after ORIF and open reduction of the radiocapitellar joint, 2 cases of compartment syndrome, 3 patients with nerve palsy/neuropraxia, and 2 patients with persistent elbow pain or stiffness at final follow-up. Complications were essentially equally distributed between both treatment groups.

Conclusion: In this series of 113 acute pediatric Monteggia fractures, treatment based on ulnar fracture pattern yielded excellent results. Recurrent instability only occurred in patients that were not treated according to this strategy. Complete transverse and oblique ulnar fracture patterns have a higher risk of failure without initial operative treatment.

Significance: Treatment based on an ulnar fracture pattern strategy yielded superior results for acute Monteggia fractures. Recurrent instability is more common in transverse and oblique fractures treated non-operatively.

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Measurement of Radiation Exposure when Using the Mini C-Arm to Reduce Pediatric Upper Extremity Fractures

Jennifer Slough; ***William L. Hennrikus Jr, MD****; Michael J. Sumko, DO; Douglas Armstrong, MD*

Penn State College of Medicine, Hershey, Pennsylvania

Purpose: Lee (JBJS 2011) reported that use of the mini C- arm in the ED can improve the quality of pediatric fracture reduction, decrease the need for repeat reductions, decrease orthopaedic consultation time, and decrease the radiation exposure to the patient and surgeon compared to plain radiographs. Lee estimated the radiation dose for each reduction from the number of paper images that the resident printed and saved during the fracture reduction. Lee did not tabulate the number of actual fluoroscopic images used throughout the entire reduction process. The purpose of this study is to report the amount of radiation exposure during fracture reductions using a mini c-arm that records the amount of Kilovolts, Milliamps, and the number of seconds of foot pedal use.

Methods: 86 consecutive pediatric patients undergoing upper extremity fracture reduction in the emergency department were studied. The fractures were reduced using conscious sedation administered and monitored by the ED physician and nurse. The orthopaedic resident, PGY2 or PGY3, performed manipulative reduction and casting of the fracture with use of the mini c-arm (Hologic Insight Fluoroscan, Inc.; Bedford, MA). Post-reduction, in cast, mini C-arm AP and lateral images were saved to the computerized radiology system. The mini C-arm recorded the amount of Kilovolts, Milliamps, and the number of seconds that the foot pedal was used for each reduction. A radiology physicist (SK) calculated the amount of millirem (mR) exposure for each reduction from this data.

Results: 86 fracture reductions were studied during a 1 year period. 60 patients were males and 26 were female. The average age was 9 years old (range 1-16). 30 fractures (34%) involved the physis. 73 fractures (85%) involved the radius and or ulna, 6 (7%) were elbow fractures, 4 (5%) were hand fractures, and 3 (3%) were Monteggia fractures. Nine patients (10%) were transferred from an outside hospital to outside ED for their reduction. 79 patients (92%) were discharged home after the reduction. 7 patients (8%) were admitted: 2 (2%) for orthopedic fracture care in the OR and 5 (6%) for concomitant pediatric surgery care for additional injuries. 84 cases (97%) had a successful fracture reduction. The resident using the mini C arm and the fracture pattern affected the amount of radiation exposure. Less experienced PGY2 residents had a higher mR exposure per reduction compared to PGY3 residents ($P < 0.05$). The average mini C-arm mR exposure for distal radius fractures was 63 mR; forearm 109 mR; elbow 53 mR; and hand 69 mR. For comparison, conventional AP/Lateral forearm radiographs emit an average of 20 mR. Fracture reductions were performed from 5 pm to midnight in 53 cases (62%); from 7 am to 5 pm in 28 cases (32%); and from midnight to 7 am in 5 cases (6%). Reductions were most common in September (19 cases)

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and least common in February (3 cases).

Conclusions: In the present study, radiation exposure was not estimated but was accurately measured. Radiation from the mini C-arm exceeded that from conventional radiographs in most cases. Training prior to use of the mini c-arm is imperative. Lead aprons should be worn by the patient, the physician and any family members.

Significance: Radiation exposure when using the mini C-arm for reduction of pediatric fractures has been under estimated in previous literature.

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Spinal Muscular Atrophy Needs Assessment: Evaluating Survey Results of Healthcare Providers and Families

Matthew A. Halanski, MD; *Karen Patterson, PT, MS, PCS; Sarah A. Sund, BS, MT, CCRC; Linda Makholm, MT, CCRC; Blaise A. Nemeth, MD; Kenneth J. Noonan, MD; Mary Schroth, MD*

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Purpose: A multi-center, multi-disciplinary database is being constructed to utilize evidence based medicine to improve the care of children with Spinal Muscular Atrophy (SMA). The first step in establishing this database was to define the issues of importance to families and healthcare professionals involved in the care of these patients.

Methods: A multi-disciplinary team caring for patients with SMA developed a list of nine important topics impacting the care of this population. An electronic survey was then constructed in which patients, families, and healthcare professionals (HCP) could rank their top five topics in order of importance. Respondents could add additional topics by free text in the survey. The survey was then distributed electronically to an informal SMA interest group, presented at the Families of SMA (FSMA) national meeting, and was distributed electronically to the FSMA list serve.

Results: Seventy-seven patients/families (53parents, 13 friend/relatives, and 11 affected individuals, 30 with SMA I and 36 with SMA II, 11 with SMA III) and eighty-nine HCP (including 17 pulmonologists, 10 physical, speech, & occupational therapists, 19 orthopaedic surgeons, 12 neurologists, 13 nurses, 10 nutritionists, and 8 others) completed the survey. Breathing issues, impact of diet, impact of disease on the family, spinal deformity treatment, and all surgical interventions were the five most frequently identified topics in order of importance to the patients/families. The five most frequently identified topics were similar for the HCP and in order of importance were breathing issues, impact of disease on family, spinal deformity treatment, impact of diet, and impact of medications. Eighteen additional free-text topics not included in the survey were added. Additional topics identified by families included issues of fatigue, isolation, anxiety, contractures, disease progression rates, and cures. HCP additional topics included rehab and therapy needs, learning and stimulation, independence issues, and counseling needs.

Conclusion: Breathing issues, impact of diet, impact of disease on the family, spinal deformity treatment, surgical interventions, and impact of medications on disease were the most important topics to patient/families and HCP. Topics of importance were similar between patients/families and HCP.

Significance: This is the first investigation to define the healthcare needs of patients with SMA that includes input from families, patients, and HCP. This knowledge is crucial moving forward to ensure proper data capture in the >30+ institution, multi-center, multi-disciplinary database now being constructed.

See pages 15 – 57 for financial disclosure information.

Treatment of Hip Subluxation in Skeletally Mature Patients with Cerebral Palsy

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Purpose: Hip subluxation in children with spastic cerebral palsy (CP) is common. While there is agreement that intervention is needed to maintain hip reduction in young children with CP, controversy exists in the treatment of skeletally mature patients with CP. Our goal was to assess the efficacy and complications of surgical interventional for hip subluxation in skeletally mature patients with spastic CP.

Methods: We performed a retrospective review of all patients with CP who underwent hip surgery for subluxation between 2005 and 2011. 20 patients were found to be skeletally mature and composed our study group. Charts were reviewed for the procedure performed and the pre-operative and most recent radiographs were reviewed to measure the acetabular index (AI), migration index (MI), and neck shaft angle (NSA). We also compared those patients who had all of their abnormal pre-operative radiographic findings addressed at surgery (acetabular osteotomy for AI > 25, open reduction for MI > 50%, and proximal femoral varus osteotomy for NSA > 135) vs those who did not, to evaluate the success of their procedure (defined as MI < 25% at final follow up).

Results: All patients had a GMFCS score of ≥4. The average follow up was 2.2 years. The average MI for the entire group improved from 57 to 20 ($p<0.0001$). Of those patients who had all radiographic abnormalities addressed at surgery, 91% had a final MI of < 25%. In those patients who did not have all radiographic abnormalities addressed, only 33% had a MI < 25% at final follow up. There were no intra-operative complications, however 13 patients had at least one post-op complication (6: persistent hip pain, 5: skin ulceration, 2: heterotopic ossification, 1: post-op fracture).

Conclusion: Hip subluxation in skeletally mature patients with cerebral palsy is difficult to successfully treat and is associated with a significant incidence of post-operative complications. We found the likelihood of a successful outcome was directly related to the appropriateness of the surgical procedure performed. When all pre-operative radiographic abnormalities were addressed during surgery the chance of a successful outcome at final follow up was much higher then when a less comprehensive surgical intervention was performed.

Significance: In skeletally mature patients with CP associated spastic hip subluxation, the final radiographic success of surgical intervention appears to be directly related to the appropriateness of the surgical procedure with all pre-operative radiographic abnormalities needing to be addressed during surgery.

The Use of an Adrenergic Agonist in Post-operative Pain Control after SEMLS for Cerebral Palsy

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Purpose: Single event multilevel surgery (SEMLS) often causes significant pain and muscle spasm in children with spastic cerebral palsy. Pain control with intravenous (IV) narcotics and muscle relaxants risks respiratory depression and aspiration from conditions associated with prematurity and poor oral motor control. The purpose of this paper is to review initial results of postoperative use of dexmedetomidine after SEMLS for spastic cerebral palsy.

Methods: The charts of 10 consecutive patients with spastic cerebral palsy who had undergone soft tissue SEMLS were reviewed retrospectively. Each had between five and seven procedures including adductor tenotomies, hamstring lengthenings, rectus femoris lengthenings or transfers and gastrocnemius lengthenings. Postoperative pain was managed with 24 hours of IV dexmedetomidine at 2 mcg/kg/hour, scheduled oral narcotics (hydrocodone/acetaminophen combination) and the use of diazepam as needed after the dexmedetomidine was discontinued. Rehabilitation was initiated on postoperative day (POD) 1 with the goal of obtaining ambulation with a walker on POD 2. Charts were reviewed for efficacy of pain control, ability to participate in rehabilitation, length of stay, need for additional pain relief agents and complications of pain management.

Results: The average age of the patients was 10.25 years (range 7-16 years). The average length of stay was 2.6 days (range 2-5 days). In the 48 hours following surgery, the average number of oral hydrocodone doses given was 7 (range 8-10) and the average number of diazepam doses given was 2.5 (range 1-4). Three patients required additional pain medication: one had two doses of ketorolac, one had one dose and a third received a single dose of morphine. No complications associated with pain control were recorded. Patients and caregivers reported that pain relief was excellent.

Physical therapy for range of motion was initiated on POD 1 and successfully tolerated by all patients. 9 of 10 patients were able to ambulate with a walker on POD 2.

Conclusions: A postsurgical protocol consisting of 24 hours of IV dexmedetomidine combined with oral narcotics was effective in controlling pain in spastic children undergoing SEMLS. Physical therapy was initiated on POD 1 and the majority of patients were ambulatory on POD 2. No complications associated with treatment for pain were reported.

Significance: Children with cerebral palsy can be at risk for respiratory depression and aspiration with use of IV opioids. Rehabilitation and pain control were facilitated after soft tissue SEMLS in these children using an adrenergic agonist.

See pages 15 – 57 for financial disclosure information.

High Incidence of Pyomyositis among "Septic Hip" Consults: A Two-Year Epidemiological Study

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Purpose: Children frequently present in the pediatric emergency department with refusal to bear weight, fever, and elevated inflammatory markers. The most important diagnosis to rule out with these constellations of symptoms is septic arthritis. Infectious and non-infectious processes that mimic septic arthritis confound this diagnosis and many algorithms have been proposed with the hope of differentiating between the pathologies. The purpose of this study was to analyze the epidemiology of hip pathology from "septic hip" consults over a two-year time period.

Methods: An IRB-approved retrospective chart review was performed on orthopaedic surgery consults placed by the pediatric emergency department on children ages 0-18 years over a two-year time period at a tertiary care children's hospital. Standard algorithms were used to work up patients with the addition of non-sedated MRI with repeat scans performed on patients with worsening clinical symptoms.

Results: Of the 53 consults placed only 13% were found to be a culture positive septic hip arthritis (Fig. 1). The most frequent diagnosis was transient synovitis (38%), followed by pericapsular pyomyositis (34%). Children diagnosed with transient synovitis had the lowest overall levels of systemic inflammation, while those with septic hip arthritis and pericapsular pyomyositis had the highest. The group diagnosed with pericapsular pyomyositis had the highest average c-reactive protein (CRP) upon presentation (114.7mg/L), while children presenting with septic hip arthritis had the highest average temperature (101°F). The use of serial MRI was essential in differentiating pathologies and determining the anatomic location of the infection. A CRP of >40mg/L at presentation was noted to correlate with a need for surgical intervention at some point during the hospital stay

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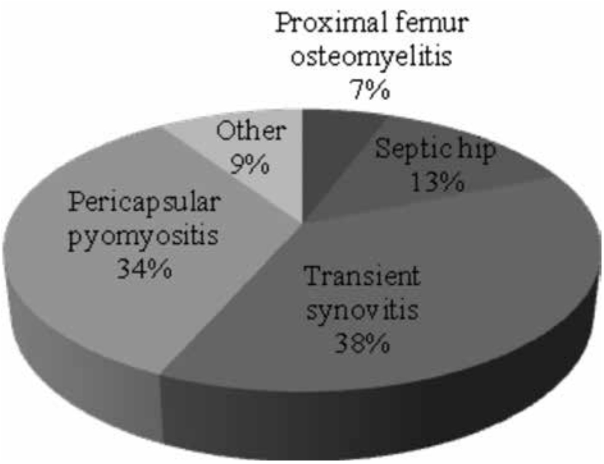
Conclusion: Unexpectedly, at our institution, pericapsular pyomyositis and transient synovitis occur three times more often than culture positive septic arthritis of the hip. Using common algorithms to diagnosis septic hip, pericapsular pyomyositis was indistinguishable from septic hip. Serial non-sedated MRI proved to be essential in determining the anatomic site of infection. CRP appears to be the most useful value to predict which children will need surgical intervention regardless of the diagnosis.

Significance: This is the first epidemiological study of septic joint consults at a North American major children's hospital that identified a higher incidence of hip pericapsular pyomyositis than septic hip. We believe that these findings do not represent a shift in pathology but rather more readily available non-sedated, rapid hip MRI allowing for serial evaluation of the pericapsular soft tissue structures.



Biological Reconstruction with Vascularized Fibular Graft after Bone Sarcoma Resections In Extremities

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Purpose: Prospective evaluation of patients who underwent biological reconstruction with vascularized fibular graft (VFG) after wide resection of bone sarcomas in respect to oncological outcomes, complications and function.

Methods: Between 2005-2011, wide resection and biological reconstruction was performed to 19 children (11M/8F) who underwent limb salvage surgery for conventional osteosarcomas(8) and Ewing's sarcomas(11). Average age of patients at surgery was 14.5 years (range, 6-19 years), and 17 were skeletally immature. Diaphyseal and diaphyseal-metaphyseal regions of femur(11), humerus(5) and tibia(3) were involved. All patients received neoadjuvant/adjuvant chemotheraphy, and 2 children with Ewing's sarcoma had radiotherapy for close but negative surgical margins. Surgical procedure included wide resection followed by reconstruction of the defect with VFG and internal fixation with single or double reconstruction plates. VFG was used in combination with a strut femoral allograft in 6 cases. Most reconstructions required a massive VFG with an average length of 16.5 cm (range, 9-24 cm). Following 2 proximal humerus resections, VFG transferred with fibular head. ROM exercises were started in the early postoperative period for upper and lower extremity lesions and partial weight bearing generally was allowed at postoperative third month and increased gradually to full weight at about 1 year. Average follow-up was 4 years (range, 1.5-7 years) and performed clinically and radiographically; extremity function scoring of MSTS and union and integration of the reconstruct were followed. In addition oncological status of patients in regard to disease relapse and survival was recorded.

Results: A good bone healing was achieved in all patients: union of VFG with the host bone started at 6 months and a significant VFG hypertrophy associated with integration between VFG-structural allograft-host bone was achieved between 1-1.5 years. Complications included a nondisplaced fracture of VFG which was followed, and an implant failure at postoperative 9.month, a superficial wound infection and a hematoma formation in the early postoperative period which all managed surgically. Mean MSTS score was found good based on final follow-up with better results following diaphyseal resections. In follow-up, 2 patients died for pulmonary metastases (at 3.-4. years) and 2 patients had pulmonary metastatectomy, with overall and disease-free survival of 4.5 and 3.5 years respectively.

Conclusions: Massive intercalary bone defects were successfully reconstructed with VFG providing good bony healing-integration and functional outcomes.

Significance: Biological reconstruction should be the preferred reconstruction technique for massive intercalary defects following wide resection of bone sarcomas in children.

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Validity of Somatosensory Evoked Potentials as Early Indicators of Neural Compromise in Rat Model of Spinal Cord Compression

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Purpose: To determine the percentage change in somatosensory evoked potential amplitude and the duration of spinal cord compression that can be tolerated intraoperatively in a rat model before there are significant post-operative functional deficits.

Methods: 32 adult male Wistar rats were divided into four groups according to the percentage of induced SSEP signal loss; all animals had pre-operative functional testing. Following surgical placement of a balloon catheter in the thoracic sub-laminar space, SSEPs were recorded while the spinal cord was compressed by inflation of the balloon. The recordings were terminated after a different percentage loss of SSEP amplitude in each group. Functional behavioral testing was repeated after 24 hours.

Results: Only the group wherein the catheter was left inflated for 15 minutes after a complete (100%) loss of SSEP amplitude showed a significant deterioration in functional testing as compared to pre-operative baseline values. Functional testing remained normal for the groups in which termination of spinal cord compression occurred immediately after a decrease of SSEP amplitude to 50% or 100%.

Conclusions: SSEP loss of up to 100% can be tolerated in a rat model of spinal cord compression as long as the compression is terminated immediately after the SSEP decrease is detected. Prolonged spinal cord compression, with concomitant SSEP decrease, can result in post-operative functional deficits despite mitigating procedures to remove the compression.

Significance: This study is an important first step in providing basic science evidence for the establishment of acceptable “alarm criteria” during spinal surgery.

See pages 15–57 for financial disclosure information.

Influence of Dynamic Compression Parameters on Bone Growth Modulation

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Purpose: Bone growth modulation refers to the process by which bone growth rate increases or decreases due to mechanical loading. This principle is used in the design of novel implants for the treatment of pediatric deformities. This in vivo study aims at investigating the effects of dynamic compression parameters on bone growth modulation.

Methods: Thirty-two rats (28 d.o.) were divided into four different groups: control (n=6), sham (n=6), static (n=6), dynamic (n=14). An air-compressed device was implanted on the 6th and 8th caudal vertebrae, therefore loading the 7th caudal vertebra with an averaged 0.2 MPa compression for 15 days. Sustained loading was used in the static group. The three dynamic groups had sinusoidal loading: (a) 0.1Hz and 30% (n=6); (b) 0.1Hz and 100% (n=4); (c) 1.0Hz and 30% (n=4). The sham group was operated but no loading was applied. Growth rates and histomorphometry of the growth plate were measured and compared. Loaded rats were compared with shams.

Results: Growth rates (μm/day) of the static (30.5) and dynamic (a:30.4; b:29.2; c:29.4) groups showed no significant differences but were all reduced compared with shams (37.8). Regarding histomorphometric parameters, growth plate heights (μm) decreased for static (150.9) and dynamic (a: 168.9; c: 167.5) groups but increased significantly (185.5) in dynamic group (b) compared with shams (175.5). Hypertrophic cell heights (μm) decreased significantly in the static (23.1) and all dynamic (a: 25.9; b: 25.2; c: 24.4) groups compared with shams (28.6). Proliferative cell densities did not show any significant difference in the loaded groups (static and dynamic) versus shams.

Conclusion: Static and dynamic loadings, with similar average compressive stresses, produced the same growth reductions. However, dynamic loading modulated growth with fewer damages of the growth plate biological integrity. Among dynamic parameters, increasing magnitude was less detrimental than increasing frequency.

Significance: Understanding growth plate mechanobiology is of the utmost importance for the design of novel implants to correct deformities based on optimized bone growth modulation. These results will be leveraged for new fusionless intervention for the early treatment of moderate adolescent idiopathic scoliosis or for the treatment of angular deformities in the lower limbs.

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Closed Wrist Centralization in Radial Club Hand

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Objective: To evaluate the clinical outcome of patients who underwent centralization technique designed Shriners hospital deformity of the radial club hand.

Methods: We try 46 forearms with radial club hand in 33 patients with centralization, 1997 to 2012. Informed consent was obtained from the relatives of all patients. All patients were managed with the same technique since its inception with external fixator placement monotube type yellow and after centralization of the wrist.

Results: Of the 33 patients seen had a mean age of 11.4 years (range 2.6-19 years) follow-up was the principal for 12 years. The average preoperative angle 57° (rango110a 26 degrees). Centralization angulation improved leading to a final angulation at the last visit of 22 degrees (range 80-6 degrees). We evaluated the degree of disability with Quick Dash system with 10% disability in 29 patients (87%), 20% in 3 patients (9.09%) and 30% of disability in one patient (4%). There was an improvement of 87.8% in 29 patients treated.

Conclusion: A good preoperative preparation time, a successful surgery and finally a comprehensive postoperative management could lead to satisfactory results in patients with radial club hand.

See pages 15 – 57 for financial disclosure information.

A Validation Study of Clinical and Ultrasonographic Diagnostic Criteria for DDH Established by International Consensus

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Aim: To develop a novel diagnostic index for DDH in infants 1-8 weeks old that models the diagnostic practices of expert clinicians.

Methods: 7 clinical and 7 ultrasound findings associated with DDH in infants 1-8 weeks old had been ranked previously in order of diagnostic importance based on consensus among members of European Paediatric Orthopaedic Society (EPOS). The criteria were placed in all possible combinations to create unique case vignettes. 30 randomly selected vignettes, each including clinical and ultrasonographic criteria, were rated by 2 expert groups. 33 experts rated each vignette for the presence of DDH using a binary response. Based on this rating, a logistic regression model was developed and the probability of DDH was calculated for each vignette. A separate group of 27 experts rated the same vignettes using a VAS response. VAS ratings were compared with the predictions derived from the regression model.

Results: The correlation between the probability of DDH predicted by the regression model and the expert panel was 0.63 ($p<0.01$). Predictive of DDH were: Ortolani/Barlow (beta = 2.6, $p<0.001$), abduction limitation (-0.4, $p=0.1$), first degree family history (0.7, $p=0.004$), alpha <55 (0.9, $p=0.008$), alpha <50 (1.8, $p<0.001$), alpha <45 (3.2, $p<0.001$).

Conclusion: Clinical and ultrasound criteria as developed in an EPOS consensus study produced consistent results in the judgements of 2 separate groups of experts. Five criteria were found to be predictive of DDH, of which only one related to ultrasound.

Significance: We developed a mathematical equation that, with further evidence of validity, has the potential to enable non-expert clinicians establishing the probability of DDH in a manner approaching the practice of clinical experts.

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Is Abduction Bracing after Failed Pavlik Harness Really Effective?

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Purpose: Previous studies have reported that the use of abduction bracing after Pavlik harness failure in patients with developmental dysplasia of the hip (DDH) is usually effective in achieving hip reduction. The purpose of this study is to determine if previous reports of success are repeatable in others hands.

Methods: A retrospective, 5-year, review of consecutive patients with DDH first treated with a Pavlik harness at a single institution was conducted. Inclusion criteria included DDH with an Ortolani and/or Barlow positive hip, failed Pavlik harness treatment, and subsequent abduction bracing. Patients with neurologic, teratologic, syndromic, or other non-idiopathic conditions were excluded.

Results: 7 hips met inclusion criteria. Mean age at Pavlik harness initiation was 2.1 months (range, 1 day-6 months), and patients spent an average of 1.2 months (range, 0.4-2.7 months) in the harness. After ultrasound demonstrated a persistently dislocated hip, patients were transitioned to abduction bracing and spent an average of 1.3 months (range, 0.1-3 months) in the brace. 100% (7/7) of hips treated with an abduction orthosis failed to reduce and required subsequent treatment; 4 required closed reduction and spica casting, and 3 required open reduction. Patients were followed for an average of 33.6 months (range, 10-60 months), and all patients had stable hips at latest follow-up.

Conclusion: In contrast to previous studies, abduction bracing provided no additional benefit in the treatment of DDH after failed Pavlik harness treatment. All patients who failed Pavlik harness treatment required closed reduction and spica casting under general anesthesia, or open hip reduction.

Significance: Abduction bracing may unnecessarily prolong the time to closed reduction, and may contribute to Pavlik harness disease.

See pages 15 – 57 for financial disclosure information.

♦ Incidence of Hypertension in Obese Pediatric Tibia Vara and Slipped Capital Femoral Epiphysis Populations

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Purpose: Slipped capital femoral epiphysis (SCFE) and tibia vara are associated with childhood obesity. As growth abnormalities, such as premature longitudinal growth, are caused by obesity, our overarching hypothesis is that obesity induced metabolic syndrome imposes pathologic changes within the physis. We believe that these changes render the physis susceptible to SCFE and tibia vara. In the initial test of our hypothesis we set out to determine the incidence of hypertension, the first physiologic manifestation of metabolic syndrome in obese children, in patients with SCFE and tibia vara.

Methods: Forty-four patients (age 3-17) with tibia vara (infantile-19) or (adolescent-25) and 126 patients(age 5-17) with SCFE were identified retrospectively from electronic medical records over a five year period in an IRB-approved EBM/Level III study. Body mass index (BMI) adjusted for age percentiles from the CDC were used to define percentile rank. Using the normative distribution of blood pressures in healthy children based on age, sex and height, each patient was designated according to an established percentile interpretation as pre-hypertensive(≥90th to < 95th percentile), hypertensive(≥95th percentile) or normotensive(<90th percentile).

Results:

			Systolic Blood Pressure Percentile		
Diagnosis	**n**	**BMI Percentile**	**>90th**	**>95th**	**<90th**
Tibia Vara	44	38.3 (17.3-60.6)	63%	36%	37%
SCFE	126	28.7 (14.2-47.7)	62%	49%	38%

Conclusion: Although it is estimated that only 3-5% of all children has hypertension; we determined that 63% of patients with tibia vara and 62.4% with SCFE have either pre-hypertension or hypertension.

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Significance: As a public health issue, our data indicate that hypertension, and potentially metabolic syndrome, is a major comorbidity associated with SCFE and tibia vara. Considering that 30% of children with hypertension are known to already have vascular disease and ventricular pathology at the time of diagnosis, these data suggest that these patients should be followed more closely for hypertension related disease.

Additionally, recent research has demonstrated that the hormone leptin, released by fat cells, directly stimulates growth plate chondrocytes causing premature skeletal growth and resistance to normal hormonal regulation of the growth plate. Considering that hyperleptinemia is a major component of metabolic syndrome and thought to cause hypertension in obese children, these data suggest that the patients with SCFE and tibia vara are likely hyperleptinemia and further research will be required to determine if excessive leptin contributes to the physeal pathology observed in these patients.

See pages 15–57 for financial disclosure information.

Pediatric Hospitalist Co-management Impact on the Care of Medically Complex Children Undergoing Spinal Surgery

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Purpose: To study outcomes of hospitalist co-management of medically complex children undergoing spinal fusion surgery for neuromuscular scoliosis.

Introduction: The inpatient and post-surgical care of children undergoing spinal fusion surgery is increasingly complex. Specially trained pediatricians can facilitate the perioperative care of these patients by focused attention to their medical co-morbidities, nonsurgical complications and issues.

Methods: A pediatric hospitalist co-management program was implemented at a children's hospital for all patients undergoing spinal fusion surgery for non-idiopathic scoliosis. We conducted a retrospective case series study to compare clinical outcomes for 90 control patients (before implementation of hospitalist co-management), 46 patients during a partially implemented program, and 88 patients during a fully implemented program.

Results: Patients co-managed under the fully implemented program had shorter mean length of stay after transfer out of the PICU compared to patients before program implementation (8.0 vs. 11.3 days) (P=0.06). When compared to patients before program implementation, fully co-managed patients were fed earlier (4.1 vs. 5.2 days, P=0.03), required fewer days of parenteral nutrition (3.8 vs. 8.5 days, P=0.003), had fewer returns to the OR (3.4% vs. 14.4%, P=0.03) and had fewer laboratory studies (2.5 vs. 6.6, P<0.001) and unplanned studies (0.8 vs. 1.5, P=0.03) performed on the inpatient unit. Co-managed patients had a decrease in complication rates and 30-day readmission but a trend towards higher total hospital charges in the initial phase of the program.

Conclusion: A fully staffed pediatric hospitalist program to co-manage medically complex children undergoing spinal fusion surgery for neuromuscular scoliosis can significantly impact the care of these children by improving outcomes and reducing complications; but, initial medical costs may increase.

Rate of Correction after Asymmetrical Physeal Suppression in Valgus Deformity: Analysis Using a Linear Mixed Model Application

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Purpose: This study was performed to estimate the rate of angular correction after asymmetrical physeal suppression and analyze the factors that influence the rate of correction by using a linear mixed model application.

Methods: 175 physes (72 distal femoral, 70 proximal tibial, and 33 distal tibial) from 78 consecutive patients with valgus angular deformity of the lower limb who underwent asymmetrical physeal suppression were included. The anatomic lateral distal femoral angle, the anatomic lateral proximal tibial angle, and the anatomic lateral distal tibial angle were measured from the teleroentgenograms of the patients' preoperative visit and periodic follow-ups. The rate of angular correction was adjusted by multiple factors by using a linear mixed model with age, gender, and surgical method as the fixed effects and each subject as the random effect. In building a linear mixed model, the estimates were fitted using the restricted maximum likelihood estimation method. The final model included the age and surgical method specific rate and sex and surgical method specific intercept. Multivariate analysis was performed for this model.

Results: In younger children (boys<14 years and girls<12 years), the rate of correction of valgus deformity at the distal femur, proximal tibia, and distal tibia was 0.71˚/month (8.5˚/year), 0.40˚/month (4.8˚/year), and 0.48˚/month (5.8˚/year), respectively. In older children, the rate of correction of valgus deformity at the distal femur, proximal tibia, and distal tibia was 0.39˚/month (4.7˚/year), 0.29˚/month (3.5˚/year), and 0.48˚/month (5.8˚/year), respectively. The rate of correction at the distal femur was significantly lower in older children (p=0.025). There was no significant difference in the rate of correction according to the surgical methods used at the distal femur and distal tibia.

Conclusions: In this study, no significant difference was seen in terms of the rate of correction of valgus deformity between the staple group, screw group, and permanent group at the distal femur and distal tibia. This study demonstrated that the speed of correction of valgus deformity at the distal femur was significantly faster in younger children

Significance: Asymmetrical physeal suppression with staples, percutaneous transphyseal screws, and permanent method all are effective methods for treating valgus deformity in growing children. When we treat valgus deformity in growing children, we should take into consideration the fact that the rate of correction at the distal femur is lower in older children.

See pages 15 – 57 for financial disclosure information.

Does Socioeconomic Status Affect the Timing of Anterior Cruciate Ligament Reconstruction in the Adolescent Athlete?

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Purpose: The purpose of this study is to evaluate the role of socioeconomic status, measured by type of medical coverage, in the timing of presentation and treatment of an anterior cruciate ligament (ACL) tear in the adolescent age group.

Methods: We performed a retrospective review of previously collected data in 325 consecutive adolescent athletes (<19 years old) with either commercial insurance or a form of government medical coverage who underwent ACL reconstruction by a single surgeon within a regional tertiary childrens' hospital. Patients were excluded from the study if they presented for a revision reconstruction, or had no medical coverage and did not qualify for an indigent government program. Subjects were also excluded if had a 2 year or greater delay in their treatment for an ACL tear. Univariate analyses were used to compare patients with commercial insurance (n=85) to those with government insurance (n=240). Sequential multivariate linear regression and binary logistic regression analyses were used to determine key factors associated with delay in presentation and surgery.

Results: Patients with private insurance were younger (14.3 versus 15.2 years old), weighed less (64.0 vs. 72.1 pounds), and more likely to be Caucasian (51.8% vs. 30.8%) than those with government insurance ($p<0.001$, $p=0.001$, $p=0.001$ respectively). Patients with commercial insurance presented an average of 48.2 days following injury and time to surgery averaged 105.4 days. This is in contrast to those with government insurance who presented an average of 87.1 days from injury and averaged 160 days from injury to surgery ($p<0.001$ and $p<0.001$, respectively). While controlling for demographic factors, government medical coverage was an independent predictor for delay in presentation. Compared to commercially insured, government insured patients were 3.1 times more likely to delay more than 90 days from injury to surgery. A prediction model for likelihood to undergo surgery > 90 days from injury indicates that patients with government medical coverage are 2.7 times more likely, Hispanics are 2.3 times as likely, and African-Americans are twice as likely to have this delay.

Conclusions: Socioeconomic status is significantly associated with primary delays in presentation and thus surgery for ACL reconstruction for young athletes. Specifically, indigent patients with government-sponsored insurance coverage have greater delays in treatment, unrelated to demographic factors, compared to those with private insurance.

Significance: Young athletes with ACL injuries and government medical coverage present latter for treatment, which increases the risk of concomitant injuries to the knee.

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Acute Complications of Pediatric and Adolescent Shoulder Arthroscopy

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Purpose: Shoulder arthroscopy is uncommon in the pediatric and adolescent population, but the frequency appears to be on the rise with children engaging in competitive athletics at younger ages. Reported complications following these procedures in the general population are low; yet, there is no childhood specific data. This study was performed to determine the incidence of acute complications of arthroscopic shoulder surgery in children.

Methods: A retrospective review was performed identifying patients aged 17 years or less who underwent an arthroscopic shoulder procedure from 1997 to 2009 at one institution and 2007 to 2010 at another tertiary care center. Exclusion criteria included: open procedures and missing records. Demographic and surgical data was collected, including: intra-operative and post-operative complications during the first 6 months. The complications were divided into minor (no secondary treatment) and major (secondary treatment rendered).

Results: 200 children, mean age 15.9 years, met criteria and 73% were boys. Although all procedures were performed under general anesthesia, 51% had inter-scalene regional anesthesia. There were 18 (9.0%) total complications recorded. Major complications occurred in 5 (2.5%) of patients and minor complications in 13 (6.5%) of patients. Major complications, included: two children with tendinitis/bursitis that required injections, 1 broken pain pump catheter that required an accessory portal to retrieve, 1 readmission for pain control, and 1 laceration of the cephalic vein that required ligation. The minor complications, included: 3 allergic reactions (contact dermatitis [metal and iodine] and antibiotic reaction), 2 transient hand dysasthesia, 2 post-operative headaches, and one of each bronchitis, syncope, transient hypotension, uvula swelling, intra-operative suture breakage, and a delay in procedure intra-operatively awaiting equipment. There were no deaths, septic arthritis, DVT, or CRPS reported.

Conclusions: Minor complications account for most of the acute complications following shoulder arthroscopy in children. Although we found no seriously deleterious outcomes in this cohort, it is important to recognize that an additional service was rendered for 2.5% of children undergoing shoulder arthroscopy – be it readmission, in-office steroid injections, or additional incisions at the index surgery.

Significance: Even utilizing very strict criteria for complications, there were very few identified in this youthful population. No child sustained a recurrent instability event or required a return to the operating room during the first six months post-operatively.

See pages 15–57 for financial disclosure information.

The Predictive Value of Feet Radiology in the Need for Additional Surgery and Functional Outcome in Clubfeet Treated According to Ponseti Protocol

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Aim: The success of the Ponseti technique has transformed clubfoot treatment from surgical to mainly conservative mode. The Ponseti protocol is based on clinical and functional parameters.

We performed routine X-rays to our clubfeet patients (mean age of 2 years) and correlated standard radiological parameters with the need for additional surgery and functional outcome.

Patients and Methods: Nine different angles were measured in 218 club feet (of 279) treated in our department, between 2000-2010; minimum follow up was 2 years. Thirty six of 279 feet had surgery (12.9%). The need for surgery and the functional outcome in this cohort of patients was correlated to radiological measurements.

Results: Three radiological parameters were identified to have predictive values with statistical significance (P <= 0.01).

The lateral tibiocalcaneal angle with the ankle in maximal dorsiflexion (measuring fixed equinus) was bigger in the operated group (77.9 deg +/- 12) compared to the non operated group (66.6 deg +/- 14); functional outcome increased with smaller angles.

The lateral talocalcaneal angle with the ankle in maximal dorsiflexion (measuring foot rigidity) was smaller (28.9 deg +/- 7) in the operated group compared to the non operated group (34.4 deg +/- 9); functional outcome increased with larger angles.

The lateral talo-1st metatarsus angle with the ankle in maximal plantar flexion (measuring foot cavus) was bigger in the operated group (31.4 deg +/-13) compared to the non operated group (21.8 deg +/- 11); functional outcome was not correlated with the size of the radiological angle.

Conclusion: Radiological parameters in operated clubfeet are significantly different from non operated clubfeet, and are correlated to functional outcome.

Significance: Radiological assessment in the early stages of clubfoot treatment by the Ponseti protocol has predictive value in the need for additional surgery and in the final functional outcome (Ezra scale).

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A Hybrid Growing Rod for Proximal Femoral Defomity in Fibrous Dysplasia

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Purpose: Fibrous dysplasia in the proximal femoral can lead to a "shepherd's crook" deformity. This is associated with varus of the proximal femur, a trendelenburg gait, limited mobility, and pain. A proximal femoral osteomoty can correct the deformity, but effective methods to internally fix and hold the correction in the growing child, in whom the fibrous dysplasia extends along the femoral shaft are lacking. Here we describe a technique using a hybrid of an adolescent trochanteric entry nail and the distal end of a growing rod as an effective technique to internally fix this deformity in growing children, and report early results.

Methods: Radiographs and charts were reviewed for children treated with a hybrid growing rod construct. Six children were identified. After the corrective osteomoty, the distal growing rod construct was placed through the osteotomy site. A trochanteric entry reconstruction rod was then inserted in the proximal fragment and the hollow center of the rod placed over the distal growing rod. Proximal fixation screws were placed in the trochantric entry rod in the femoral neck, ending just adjacent to the growth plate. The radiographs and charts were reviewed on the patients, and they were followed for at least two years.

Results: The age at surgery ranged from nine to fourteen years of age. Radiographic analysis after two years showed that the bone continued to grow in the children, and that the growing rod expanded as the femur grew. One child developed valgus deformity at the distal femur, and this was corrected with an osteotomy, leaving the rod in place, and using a plate to hold the correction. The proximal femoral growth plate continued to grow in these children, and in one patient, the proximal screws will be replaced with longer screws. There was no loss in deformity correction in these patients.

Conclusion: A hybrid growing rod construct can be used to hold and maintain deformity correction of the proximal femur in children with fibrous dysplasia. The complication rate is low, and this approach has the advantage of providing strong fixation of the proximal correction, something that is lacking in many other fixation techniques.

Significance: This is a safe technique that can be used to hold and maintain correction of a proximal femoral deformity in growing children with fibrous dysplasia.

See pages 15–57 for financial disclosure information.

Does Portable Intraoperative CT Scan Improve the Quality of Talocalcaneal Coalition Resections?

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Purpose: Intraoperative assessment of talocalcaneal (TC) coalition resection can be challenging for the treating surgeon, with no reliable plain radiographic view available for evaluation. Therefore, in March of 2011, we began using the CereTom® portable CT scanner to assess the quality of our TC coalition resections intraoperatively. The purpose of this study was to evaluate the use of intraoperative CT during surgical resection of TC coalitions.

Methods: This study compares two groups of patients with TC coalitions treated by a single surgeon from 2008-2012. Patients treated without (Group 1, n=11 feet) and with (Group 2, n=10 feet) intraoperative CT scan were retrospectively compared. All patients received a preoperative and postoperative (minimum 3 months post-op) CT scan with 3D reconstructions. Two blinded pediatric orthopedic surgeons then assessed quality of resection, rating the resections as "excellent", "fair", or "poor". "Excellent" resections showed no evidence of residual coalition on post-operative CT. A rating of "fair" was given if no clear residual coalition was seen, but areas of possible connection at the previous coalition existed. "Poor" resections showed areas that were highly suspicious for residual coalition. Medical records were reviewed to evaluate pain and range of motion.

Results: Substantial agreement was found between blinded reviewers (Kappa=0.65, 76% absolute agreement). Both groups of patients had a similar distribution of type and severity of bony talocalcaneal coalitions involving the middle facet. Quality of resection was improved in the intraoperative CT group (Group 2), with 50% percent resulting in an excellent outcome compared to 27% in non-intraoperative CT patients (Group 1). Patients in Group 2 were 2.7 times more likely to have a complete resection as compared to patients in Group 1, however, this was not significant (p>0.05, 95% confidence interval: 0.43 – 16.4). Intraoperative CT altered surgical decision making in 30% of feet in Group 2, leading to further resection. There was one reoperation in Group 1 for continued pain and a second patient with a residual bony coalition who has not yet had reoperation. In Group 2 there have been no reoperations. Two patients in Group 1 and one patient in Group 2 reported no improvement in pain and had residual coalition on postoperative CT. All others reported improved pain levels and subtalar range of motion.

Conclusion: The use of a portable CT scanner to assess the quality of talocalcaneal coalition resection intraoperatively alters surgical decision making and increases the chances of obtaining a complete resection. It allows immediate radiographic assessment of the resection. If available, this imaging device should be employed for talocalcaneal coalition surgery.

Significance: Intraoperative CT provides immediate multi-dimensional assessment of TC coalition resections, improving the quality of resection over direct visualization alone.

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Osteochondral Allografts for Knee Lesions in the Pediatric and Adolescent Population

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Introduction: Osteochondral allografts may be the only salvage procedure for large ostechondral lesions of the knee. The purpose of this study was to describe our 30 year experience with osteochondral allografts in patients under 18 years of age with a focus on subjective outcome measures, return to activities, and allograft survivorship.

Methods: This retrospective IRB approved study evaluated all patients under the age of 18 who underwent an osteochondral allograft between 1983 and 2010. In all cases, the surgery was preformed using either a dowel or shell technique with fresh allograft tissue. Clinical evaluation was performed preoperatively and postoperatively using the modified D'Aubigne and Postel Scale (18 point scale), the International Knee Documentation Committee (IKDC) score, the Knee Society function (KS-F) score, and satisfaction. Failure was defined as need for a revision osteochondral allograft or conversion to an arthroplasty.

Results: Thirty-nine patients, representing 43 knees, underwent an osteochondral allograft. The mean age of the cohort was 16.4 years (range, 11.1 to 17.9) and the etiologies of the lesions were osteochondritis dissecans (60.5%), avascular necrosis (16.3 %), traumatic fractures (18.7%), and degenerative chondral lesions (4.7%). Thirty-four patients (79.1%) underwent a previous surgery (mean number 1.5).The mean graft area was 8.4 cm2 (range, 2.2 to 20.8). The medial femoral condyle was grafted in 41.9% of cases, the lateral femoral condyle in 34.9%, the patella in 7.0%, the trochlea in 4.7%, the tibial plateau in 2.3%, and the remaining patients had multiple sites grafted. At an average follow up of 7.3 years (range 2.0-27.1), the IKDC score had improved from 42 to 74. The KS-F score improved from 69.3 to 87.9.

Furthermore, using the modified D'Aubigne and Postel Scale 83.9% of patients had a "good" or "excellent" score post-operatively, compared to 17% pre-operatively. Patient satisfaction was 88.2%. Kaplan-Meier survivorship analysis showed an 88.6% survivorship at 10 years and a 73.8% survivorship at 20 years. Five failures occurred which were all salvaged with a revision allograft.

Conclusion: Osteochondral allografts can be successfully employed to salvage complex knee chondral and osteochondral pathology in patients under 18 years of age. This procedure yields improved function, pain, and satisfaction at an average follow-up of 7 years and even in cases with more than 25 years of follow up. Failure rates are relatively low and when they do occur they can be successfully revised with a second allograft procedure.

Significance: Pediatric and adolescent patients treated with an osteochondral allograft have good subjective outcomes, return to activities, and allograft survivorship.

See pages 15 – 57 for financial disclosure information.

Medial Ulnar Collateral Ligament Origin in Children and Adolescents: An MRI Anatomical Study

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Purpose: The Medial Ulnar Collateral Ligaments (MUCL) are the primary stabilizers to valgus stress on the elbow. The anatomy of the three bundles of the Medial Ulnar Collateral Ligaments (MUCL) have been well studied in the adult population; however, our review of the English literature found no study evaluating the origin of the ulnar collateral ligaments in the skeletal immature elbow as it relates to the medial epicondylar physis.

Methods: MRI evaluation of 44 skeletally immature elbows (ages 5-17) was conducted by two independent musculoskeletal radiologists, a board certified, fellowship trained pediatric orthopedic surgeon, and an orthopedic surgery resident using T1-coronal images. The location of the origin as well as its distance from the medial epicondylar physis was measured.

Results: All 44 skeletally immature elbows imaged showed the anterior bundle of MUCL attached either on or medial to the medial epicondylar physis. The average origin for the anterior bundle of the MUCL was 3.1 mm medial to the physis. There was no significant correlation between age and location of MUCL insertion relative to the physis (p=.183).

Conclusions: In the skeletally immature elbow, the anterior bundle of the MUCL originates from the medial epicondylar apophysis. This information may be helpful in the treatment of medial epicondyle fractures in skeletally immature patients.

Significance: Treatment of displaced medial epicondyle fractures in the skeletally immature remains controversial and further study of the clinical significance of this anatomic relationship is needed.

Cast Saw Injuries: Assessing Blade to Skin Contact During Cast Removal

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Purpose: To determine the number of times a cast saw blade comes in contact with the skin during cast removal and to evaluate whether education can decrease this occurrence.

Method: As part of a quality initiative to improve cast application and removal techniques at a single institution, participants were required to apply and remove casts on a model constructed capable of recording when participants touched the "skin" of the model with the cast saw blade and record the temperature of the blade during these touches. In addition, a single educator evaluated proper cast saw technique. Skills at baseline and after participation in an educational module were assessed.

Results: Twenty staff members in nine different occupational roles completed in the study. At baseline 18/20 participants touched the skin at least one time during removal. Twelve clinically relevant touches defined as those >1 second in duration occurred 12 times by six participants at baseline. While 100% of participants demonstrated proper cast removal technique, holding the blade at 90° to the cast and utilizing in-and-out method following the training program, 16/20 participants continued to touch the blade to the skin during cast removal, with four participants producing 12 clinically relevant touches. Thus no significant difference between pre- and post- education cast saw touches was observed (p >0 .05). Due to technical difficulties, temperature data during cast removal could not be analyzed.

Conclusions: Using this model, the majority of healthcare professionals removing casts inadvertently touched the "patient's skin" during removal. The educational module did not significantly decrease inadvertent touches. Even after education, twenty percent of participants had potentially clinically relevant touches.

Significance: This is the first study to demonstrate the number of times a cast saw blade touches the underlying skin during cast saw removal. It highlights the potential for injury during cast saw removal.

See pages 15 – 57 for financial disclosure information.

Factors Associated with the Use of BMP during Pediatric Spinal Fusion Surgery: An Analysis of 4817 Patients

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Purpose: Our goal was to investigate whether the use of recombinant human bone morphogenetic protein (BMP) during pediatric spinal fusion surgery has been increasing and how patient, surgical, and hospital characteristics influence BMP use.

Methods: Using the Nationwide Inpatient Sample database, we identified 4817 children eighteen years old or younger who underwent spinal fusion surgery with the use of BMP from 2003 through 2009. Chi-square test, analysis of variance, and logistic regression models were used for statistical analysis; significance was set at $p < 0.05$.

Results: There was a 3.4-fold increase in BMP use during pediatric spinal fusion – from 2.7% in 2003 to 9.3% in 2009 – an average 16% per year increase ($p < 0.01$). For each additional year of age, the odds of receiving BMP increased 1.16-fold ($p < 0.01$). There was a significant difference in the rate of BMP use among diagnoses ($p < 0.01$): adolescent idiopathic scoliosis, 4.4%; congenital scoliosis, 5%; Scheuermann's kyphosis, 6.4%; thoracolumbar fractures, 14.5%; and spondylolisthesis, 21%. Patients with private insurance were 1.8-fold more likely to receive BMP than those with public insurance ($p < 0.01$). Surgeries involving anterior spinal fusion had 1.3-fold higher rate of BMP use than those involving posterior-only fusion ($p < 0.01$). Surgeries without bone autograft involvement had 1.45-fold higher rate of BMP use than those involving autograft ($p < 0.01$). The rate of BMP use was 2.4-fold higher at nonteaching hospitals than at teaching hospitals ($p < 0.01$); it differed significantly by hospital bed capacity ($p < 0.01$) and across hospital geographic location ($p < 0.01$): West, 8.2%; Midwest, 8.0% ; South, 6.5%; and Northeast; 4.0%.

Conclusion: Use of BMP during pediatric spinal fusion has increased significantly over the last few years. Patient factors (age, diagnosis, insurance), surgical factors (approach, autograft use), and hospital factors (teaching status, bed capacity, location) influenced the variation in BMP use.

Significance: Use of BMP during pediatric spinal fusion has increased from 2.7% in 2003 to 9.3% in 2009. Patient factors (age, diagnosis, insurance), surgical factors (approach, autograft use), and hospital factors (teaching status, bed capacity, location) influenced the variation in BMP use.

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Postoperative Continuous Paravertebral Anesthetic Infusion for Pain Control in Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

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Purpose: To determine the efficacy of continuous paravertebral postoperative anesthetic infusion in patients undergoing posterior spinal fusion and instrumentation for adolescent idiopathic scoliosis (AIS).

Methods: We undertook a retrospective chart review of a consecutive series of patients who underwent instrumentation and fusion for AIS. There were 40 patients who received continuous subfascial bupivacaine infusion via a self-contained, commercially available elastomeric pump and micro-perforated silver ion impregnated infusion catheters inserted prior to wound closure. There were 25 patients in the control group who did not receive the infusion pump. Data collected included visual analog pain scores, diazepam and narcotic usage over the first 3 postoperative days, nausea/vomiting, length of stay, time to mobilization, time to discontinue PCA, and other demographic data.

Results: Patients receiving the continuous local anesthetic infusion had 39% less pain in the immediate postoperative period (POD 0), 24% less on POD 1, and 34% less pain on POD 2. These findings were all statistically significant ($p < .05$). Control patients showed an increase usage of narcotics and diazepam. This was calculated using mean oral morphine equivalents per day (76.58mg vs. 66.91mg, $p < .05$) and oral diazepam (8.39mg vs. 6.73mg, $p < .05$) compared to the infusion group. The infusion group also demonstrated decreased episodes of nausea and vomiting and an earlier discontinuation of the PCA. These findings were also statistically significant. There were no significant differences in key demographic data (type of instrumentation, number of levels fused). There were no complications related to the use of the pump.

Conclusion: Patients receiving a continuous local anesthetic infusion had significantly lower pain scores and used significantly less narcotics and diazepam than patients who did not receive the device. These patients also had significantly less nausea and/or vomiting during their hospitalization. The results suggest that a continuous infusion of local anesthetic in a subfascial paraspinal location is safe and efficacious in decreasing postoperative pain in this group of patients

Significance: Postoperative pain as well as nausea and vomiting can be significantly reduced using a continuous bupivacaine infusion pump in patients undergoing posterior spinal fusion for scoliosis.

See pages 15–57 for financial disclosure information.

2013 POSNA e-POSTER PROGRAM

e-Poster #01 ***(page 361)***
Significance of the Presence of Acetabular Notching at Primary X-Ray in Developmental Dysplasia of the Hip

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Single Event Multi-level Surgery in the Spastic Cerebral Palsy Upper Extremity: Review of the Expanded Green Transfer

Melia D. Hernandez; John A. Ruder; Julie Gaby, MPA, OTR/L, ATP; ***Jonathan H. Phillips, MD***

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Sterile Foam as a Means to Obviate Ninety Percent of Cast Splitting in Supracondylar Humerus Fractures

Derek A. Seehausen, BA; Robert M. Kay, MD; Deirdre D. Ryan, MD; ***David L. Skaggs, MD, MMM***

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Validation of a Novel Radiographic View for Evaluating Proximal Humerus Fractures

Amirhossein Misaghi, MD; Krishna R. Cidambi, MD; Christine L. Farnsworth, MS;

Eric W. Edmonds, MD

Rady Children's Hospital, San Diego, California

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Does Surgeon Experience Improve Results in the Treatment of Chronic Radial Head Dislocation? A Comparison of Results from the Same Surgeon

Hui Taek Kim, MD*; Tae Young Ahn, MD; Jong-Seo Lee, MD*

Pusan National University Hospital, Pusan, Korea

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Retrograde Drilling for the Treatment of Capitellar Osteochondritis Dissecans

Thomas R. Duquin, MD; ***Shawn W. O'Driscoll, PhD, MD***

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Plate or Nail? A Systematic Review of Fixation Strategies in Pediatric Both Bone Forearm Fractures
Keith D. Baldwin, MD; ***Martin J. Morrison III, MD;*** *Rey Ramirez, MD; John (Jack) M. Flynn, MD*
Children's Hospital of Philadelphia, Philadelphia, Pennsylvania

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Ryan D. Muchow, MD; Christine A. Ho, MD; Anthony I. Riccio, MD; ***Robert L. Wimberly, MD***
Children's University Hospital Dallas, Dallas, Texas

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Jon Paul DiMauro, MD*; David D. Spence, MD; Michael P. Glotzbecker, MD;*
Samantha A. Spencer, MD; Daniel Hedequist, MD; Benjamin J. Shore, MD, FRCSC
Boston Children's Hospital, Boston, Massachusetts

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Jill C. Flanagan, MD; Virginia Greenbaum, MD; Rian Thornton, BS; ***Michael L. Schmitz, MD***
Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia

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Ali Sobh, BS; Julie E. Legakis, PhD; Ronald Thomas, PhD; ***Eric T. Jones, MD, PhD***
Children's Hospital of Michigan, Detroit Medical Center, Detroit, Michigan

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Cesar F. Astudillo, MD; ***Howard R. Epps, MD****; Joseph J. Gugenheim, MD*
Texas Children's Hospital, Houston, Texas

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Traumatic Atlanto-Occipital Dislocation in Children: Evaluation, Treatment, and Outcomes
Nelson Astur, MD; Jeffrey R. Sawyer, MD; Derek M. Kelly, MD; ***William C. Warner Jr, MD***
University of Tennessee-Campbell Clinic, Memphis, Tennessee

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Comparison of Sub-Muscular and Open Plating of Pediatric Femur Fractures:
A Retrospective Review

Matthew D. Abbott, MD; *Randall T. Loder, MD; Jeffrey O. Anglen, MD*
Indiana University School of Medicine, Indianapolis, Indiana

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Pulseless Extremities Post Type III Supracondylar Humerus Fracture: Is the Direction of the Displacement a Clue?

John Wiemann, MD; Benjamin Miller, MD; Jonathan H. Phillips, MD; D. Raymond Knapp, MD; Mark A. Birnbaum, MD; ***Jose A. Herrera-Soto, MD***
Arnold Palmer Hospital for Children, Orlando, Florida

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Jeffrey B. Knox, MD; John E. Schneider, MD; J. Matthew Cage, MD; Robert L. Wimberly, MD; ***Anthony I. Riccio, MD***
Children's Medical Center, Dallas, TX

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Post Traumatic Dysesthesia in Children

Ciara Egan, MBBCh; *Caitriona Carty, MISCP; Stefan Byrne, FRCS*
Children's University Hospital, Dublin, Ireland

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Alvin Shieh, MS; Tracey P. Bastrom, MA; Joanna H. Roocroft, MA; Eric W. Edmonds, MD; ***Andrew T. Pennock, MD***
Rady Children's Hospital, San Diego, California

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Anatomical Dissection and CT Imaging of the Anterior Cruciate and Medial Collateral Ligaments in Skeletally Immature Cadaver Knees

Kevin G. Shea, MD; *John D. Polousky; John C. Jacobs Jr; Theodore J. Ganley, MD*
St. Luke's Health System, Boise, Idaho

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The Relationship of the Femoral Physis and the Medial Patellofemoral Ligament in Children: A Cadaveric Study

Kevin G. Shea, MD; *John D. Polousky, MD; John C. Jacobs Jr; Theodore J. Ganley, MD; Stephen K. Aoki, MD; Nathan L. Grimm, BS; Shital N. Parikh, MD*

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High-Dose BMP2 Reduces Cell Proliferation and Increases Apoptosis in Human Primary Periostem-derived Cells

Nobuhiro Kamiya, MD, PhD; *Sasha Shafer; Ila Oxendine; Harry K.W. Kim, MD*

Texas Scottish Rite Hospital for Children, Dallas, Texas

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Utility of Flexion, Extension, AP and Open Mouth Views in Assessment of Down Syndrome Patients

Walter F. Krengel III, MD; *Sidney Baucom, MD; Samuel Browd, MD*

Seattle Children's Hospital, Seattle, Washington

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♦Are Proximal Rib Anchors Protective Against Rod Breakage in Distraction-Based Growing Rods?

Kent T. Yamaguchi Jr, BA; ***David L. Skaggs, MD, MMM***; *Shaun Mansour, BA; Karen Myung, MD, PhD; Muharram Yazici, MD; Charles E. Johnston II, MD; George H. Thompson, MD; Paul D. Sponseller, MD; Behrooz Akbarnia, MD; Michael G. Vitale, MD, MPH*

Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, California

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Responding to Neuromonitoring Changes in Three-Column Posterior Spinal Osteotomies for Rigid Pediatric Spinal Deformities

James G. Jarvis, MD; Samuel Strantzas, MSc; Laura Holmes, BScH; David Lebel, MD, PhD; Marc Lipkus, BSc; ***Stephen J. Lewis, MD, MSc, FRCS(C)***

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The Relationship of GMFCS Level and Hip Dysplasia on the Pattern and Progression of Scoliosis in Children with Cerebral Palsy

Sumeet Garg, MD; *Hiroyuki Yoshihara, MD, PhD; Glenn Engelman, BA; Bryan McNair, MS; Frank M. Chang, MD*

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Stefan Parent, MD, PhD; *Jean-Marc Mac-Thiong, MD, PhD; Kariman Abelin-Genevois, MD; Ibrahim Obeid, MD; Jacques Griffet, MD; Keyvan Mazda, MD; Tamas Illès, MD; Isabelle Turgeon; Marjolaine Roy-Beaudry, MSc*

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Long Term (10 year) MRI Follow-up of Paraspinal Muscle Quality after Posterior Fusion for Adolescent Idiopathic Scoliosis

Michael Faloon, MD; Lauren E. LaMont, MD; ***Daniel W. Green, MD;*** *Anthony Chang, MD; Roger F. Widmann, MD; John S. Blanco, MD; Matthew E. Cunningham, MD, PhD; Bernard A. Rawlins, MD; Oheneba Boachie-Adjei, MD*

Hospital for Special Surgery, New York, New York

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Utility of Post-operative Scoliosis Radiographs in Children: Correlating History and Physical Exam with Radiographic Findings

David N. Shau BS; Jesse E. Bible, MD; Stephen P. Gadomski, BS; Richard Samade, PhD; Sheyan Armaghani, MD; Clinton J. Devin, MD; ***Gregory A. Mencio, MD***

Monroe Carrel Jr. Children's Hospital, Vanderbilt University Medical Center, Nashville, Tennessee

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♦Is there an Optimal Time Interval to Distract Dual Growing Rods?

Michael Paloski, DO, MBA; *Paul D. Sponseller, MD, MBA*

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Amir Khoshbin; Lilian Wong; Peggy W. Law; Liora Caspi; Derek Stephens;
James G. Wright, MD, MPH, FRCSC

The Hospital for Sick Children, Toronto, Ontario, Canada

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Robert M. Campbell Jr, MD
Drexel University School of Bioengineering, Philadelphia, Pennsylvania

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The Children's Hospital of Alabama, Birmingham Alabama

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Shriners Hospital for Children Mexico, Mexico City, Mexico

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UMDNJ-New Jersey Medical School, Newark, New Jersey

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Sanjeev Sabharwal, MD, MPH*; Marian R. Passannante, PhD*
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John R. Faust, MD; *Kristin A. Evans, MS; Louis Okafor, BS; Brad Hyatt, MD; James O. Sanders, MD; Stephen R. Cook, MD, MPH*

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Haluk Altiok, MD*; Anne Riordan, BA; Sahar Hassani, MS; Adam Graf, MS; Joe Krzak, PT; Ann Flanagan, PT*

Shriners Hospitals for Children, Chicago, Illinois

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Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware

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David A. Yngve, MD*; Matthew De La Cruz, BS*

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Sia Nikolaou, PhD; Liangjun Hu, MS; Holly Weekley, BS; Christopher Wylie, PhD;
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Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

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Gamal A. Hosny, MD

Benha Faculty of Medicine, Egypt

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Megan L. Young, MD*; David A. Podeszwa, MD; Adriana De La Rocha, MS; Brandon Ramo, MD; Karl E. Rathjen, MD*

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Adriana De La Rocha, MS; Philip L. Wilson, MD; David A Podeszwa, MD; Daniel J. Sucato, MD; ***Henry B. Ellis Jr, MD***

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Harish. S Hosalkar, MD*; Shafagh Monazzam, MD; Brian Barlow, MD; James D. Bomar, MPH; Mandar Agashe, MD*

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Matthew R. Schmitz, MD; *Bernd Bittersohl, MD; Daniela Zaps, MD; James D. Bomar, MPH; Andrew T. Pennock, MD; Harish S. Hosalkar, MD*

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Children's Hospital Boston, Boston, Massachusetts

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Heather Cole, BS; Amy Fenoglio, MD; Justin M.M. Cates, MD, PhD; Melissa Hilmes, MD;

Jonathan G. Schoenecker, MD, PhD

Vanderbilt University Medical Center, Nashville, Tennessee

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Leonhard E. Ramseier; *Stefan Dierauer*

University Children's Hospital, Zurich, Switzerland

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International Hip Dysplasia Institute, Orlando, Florida

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Leonhard E. Ramseier, *Stefan Dierauer*

University Children's Hospital, Zurich, Switzerland

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David S. Feldman, MD*; Michel G. Diab, MD; Joseph R. Pinero, BA; Debra A. Sala, MS, PT*
NYU Hospital for Joint Diseases, New York, New York

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Romain Dayer, MD; ***Neil Saran, MD, FRCSC, MHSc****; Juan Sebastian Rendon, MD; Reggie C. Hamdy, MD, ChB, FRCSC, MSc*
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Derek M. Kelly, MD; *Juan Augusto Pretell, MD; Robert F. Murphy; James H. Beaty, MD; William C. Warner Jr, MD; Jeffrey R. Sawyer, MD; David D. Spence, MD*
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Seung Yeol Lee, MD; *Chin Youb Chung, MD; Kyoung Min Lee, MD; Ki Hyuk Sung, MD; Young Choi, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Won Joon Yoo, MD; Moon Seok Park, MD*
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University of Wisconsin Madison, School of Medicine and Public Health, Madison, Wisconsin

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Naotake Yamada, MD*; Wook-Cheol Kim, MD, PhD; Hosokawa Motoo, MD, PhD; Yoshida Takashi, MD, PhD; Yoshinobu Oka, MD, PhD; Masashi Nakase, MD; Atsushi Nakase, MD; Torao Kusakabe, MD, PhD; Toshikazu Kubo*
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Significance of the Presence of Acetabular Notching at Primary X-Ray in Developmental Dysplasia of the Hip

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Purpose: The purpose of this study is to compare the relationship between patients who present with acetabular notching and those who do not.

Methods: One hundred consecutive cases with a complete series of X-Rays were retrospectively obtained from the radiology database. Presence of acetabular notching was recorded. The presence of femoral head growth disturbance was noted. The Acetabular Index (AI)was also measured.

Results: Seventy one percent of patients had evidence of notching on initial X-Ray. Twenty six percent of these patients also had a concurrent femoral head growth abnormality (13 delay in appearance of ossific nucleus, 5 delayed development. The average AI was31.8 (range: 24-41deg, median 33) at presentation in this group and improved to an average AI of 27.5 (range: 22-33, median 27) at the eighteen month visit. Twenty-nine percent of patients had dysplasia with no evidence of notching. 3 of those patients (10%) had delay in appearance of the ossific nucleus on the affected side. The average AI was 28(range 24-33,median 28) at presentation in this group and improved to an average AI of 21(range: 17-24, median 21) at the eighteen month visit. 55% of patients in the group with notching required a pelvic osteotomy, 10% of patients in the group with no notching required a pelvic osteomy. The relative risk (RR) of requiring surgery if there was notching on the initial X-Ray was 5.3 (p=0.0027)

Conclusions: In this study, patients who showed acetabular notching on their initial X-Ray had more dysplastic hips on presentation and a higher risk of surgery than those who do not (RR: 5.3).

Significance: This may allow us to counsel parents more accurately on the possibility of the need for future surgical intervention in their children.

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Single Event Multi-level Surgery in the Spastic Cerebral Palsy Upper Extremity: Review of the Expanded Green Transfer

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Purpose: The review of the expanded Green Transfer determined if a single event multi-level surgery including the Green Transfer provided benefit to patients when not adhering to Green's criteria to operate.

Methods: A retrospective study of patient charts, OT evaluations, and operative reports for 46 patients who underwent the Green Transfer from 1997-2011 were reviewed. A single surgeon was the source of all patient data. A sub-group of ten patients had pre and post-operative OT evaluations. Mean age at surgery was 10.4 (range 6 to 15). No patients had previous surgery of the upper extremity. Nine were hemiplegic with 1 quadriplegic. Functional status was determined using the Green and Banks rating scale as modified by Samilson and Morris as well as cosmesis, functional skills, and environmental usage. A novel set of criteria assessed functional variety, frequency of use, and efficiency of care.

Results: There were a total of 111 procedures in addition to the Green Transfer. Three patients needed revision surgery. Six patients needed additional surgery. Using the Green and Banks rating scale, pre-operatively there were 4 poor, 4 fair, 2 good and no excellent. Post-operatively there were 1 poor, 6 fair, 3 good and no excellent. Cosmesis improved an average of 2.4 points with all patients showing improvement. Environmental usage improved an average of 0.1. One patient showed improvement, 8 showed none. Functional variety improved an average of 0.3 points, frequency of use improved an average of 0.5 points, and efficiency of care improved an average of 0.3 points.

Conclusion: Cerebral Palsy is a debilitating disease causing severe impairment in daily functioning. The Green Transfer as part of a multi-level surgical approach in the spastic upper extremity provides an opportunity to improve position, cosmesis, and functional use of the involved limb.

Significance: This study found improvement in patients who did not meet the Green criteria for surgery. In absence of fulfillment of Green's criteria patient's quality of life can still improve with improved cosmesis and functional skills. More liberal patient selection criteria are warranted.

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Sterile Foam as a Means to Obviate Ninety Percent of Cast Splitting in Supracondylar Humerus Fractures

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Purpose: Due to the risk of compartment syndrome following surgical reduction of supracondylar humerus fractures, various post operative casting protocols designed to accommodate soft tissue swelling have been used. Some surgeons in our institution have used sterile foam as the first layer of the cast. This study compares results of traditional casts without foam versus those using sterile foam.

Methods: This was a retrospective chart review of patients aged 0-14 years old undergoing surgical fixation (closed or open reduction and percutaneous pinning) of supracondylar humerus fractures between 01/01/2003 and 5/24/2012. Variables studied included age, fracture type, pre- and post-operative neurovascular status, cast type, complications, cast-splitting, loss of reduction, and return to the OR.

Results: 294 consecutive patients were included, of whom 52% (154/294) had foam padding in the cast. Of those with foam padding, 2.6% (4/154) had casts split, compared with 22.9% (32/140) of patients without ($p<0.001$). Type 3 and 4 fractures were more likely to receive foam than type 2 (69% versus 55%, $p=.017$). Multivariate analysis showed that the only significant contributor to splitting a cast was whether or not the cast had foam padding ($p<0.001$). Age, gender, and fracture type did not significantly contribute to whether or not the cast was split ($p>0.05$). No patient required recasting or reoperation due to cast-related issues or loss of reduction.

Conclusion: When 1/2" thick sterile foam padding is used as the first layer in a post-operative cast following operative reduction of supracondylar humerus fractures, the cast is 10 times less likely to require splitting ($p<.001$), with no increased risk of loss of reduction.

Significance: The use of sterile foam placed as an initial layer of the post-operative cast following reduction of a supracondylar humerus fracture is associated with dramatically reduced clinical need to split the cast, as it may allow for swelling, and potentially plays a role in preventing compartment syndrome.

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Validation of a Novel Radiographic View for Evaluating Proximal Humerus Fractures

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Purpose: To determine which radiographs: AP in external rotation (ER), AP in internal rotation (IR), true axillary lateral (AX), transthoracic lateral (TRANS), scapular-Y (SY), or the newly described "clear" view (CL) best demonstrate proximal humerus fracture translation and angulation.

Methods: A previously unpublished x-ray projection, taken 90° to the SY (Figure) obtaining a true orthogonal view to the proximal humerus AP was evaluated by five pediatric orthopedic surgeons, four pediatric orthopedic fellows and two orthopedic surgery residents who were asked to evaluate angulation, translation, and apex location of three proximal humerus fractures. Two fractures were in cadaver specimens with fractures introduced representing *in vivo* fracture patterns. The third was in a 16-year-old patient. All three fractures underwent the traditional radiographic series plus a 3D computed tomography (CT). In addition, the CL was obtained of the two cadaver fractures. Seventeen total radiographs were evaluated. Physician measurements were compared to "true" values obtained from 3D CT scan reconstructions.

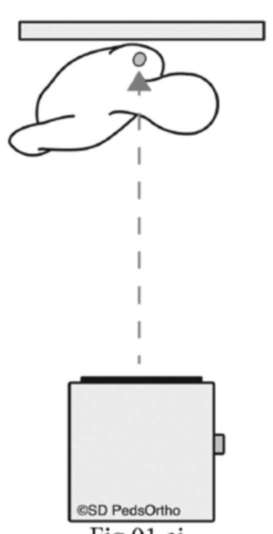

Fig 01.ai

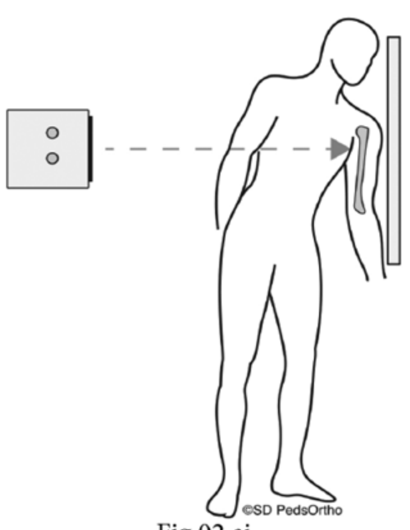

Fig 02.ai

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Results: True fracture angulation was underestimated a majority (>75%) of the time in all radiographic views. However, measures of translation in CL, IR, and AX views were equally underestimated and overestimated, while TRANS, SY, and ER primarily led to underestimation. TRANS ($p<0.001$) and AX ($p<0.049$) views had the least amount of error in measuring angulation when compared to IR, however they had the most error compared to IR and ER when measuring translation. The most accurate measures of translation were obtained with IR, ER, and CL views. The ICC was greater than 0.7 for all measures of angulation and translation.

Conclusion: Obtaining orthogonal radiographs of the proximal humerus is challenging due to the patients' body mass impeding a quality lateral view. Also, some views are painful for patients and positioning may lead to further fracture displacement. Our study demonstrates that fracture angulation is often underestimated and that translation is difficult to measure. However, the Clear View offers a better measure of translation than AX or TRANS, while clinically offering a more comfortable imaging position for patients than axillary view.

Significance: In isolation, conventional radiology underestimates the angulation and translation of proximal humerus fractures; however, the combination of an AP in external rotation and a clear view provides a comfortable method to obtain orthogonal views with slightly more accurate measures of fracture translation and angulation.

Does Surgeon Experience Improve Results in the Treatment of Chronic Radial Head Dislocation? A Comparison of Results from the Same Surgeon

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Purpose: We evaluated whether the clinical and radiological results for surgical correction of congenital and traumatic chronic radial head dislocation improve as the surgeon's experience increases.

Methods: We extracted data from medical records for patients treated during 2 periods: 1) group 1, from 1991 to 1999 (15 elbows in 14 patients; 12 traumatic and 3 congenital with 1 bilateral; the mean age at the time of surgery, 9.5 years, congenital 11.3 years, traumatic 9.1 years) and 2) group 2, from 2000 to 2010 (27 elbows in 25 patients; 17 traumatic and 10 congenital with 2 bilateral; the mean age at the time of surgery, 9.5 years, congenital 7.2 years, traumatic 11.9 years). Surgery included open reduction, annular ligament reconstruction, radial shortening, rotational osteotomy, radial head arthroplasty, ulnar flexion osteotomy, and proximal radioulnar joint notchplasty. Outcomes were evaluated radiographically and clinically by comparing range of motion and an elbow performance score covering 4 parameters (deformity, pain, motion, and function). We compared the results between both groups using Mann-Whitney U test.

Results: In both periods, all traumatically dislocated radial heads were reduced successfully but most of the congenitally dislocated heads showed subluxation. In group 1, patients showed a decrease in the total elbow arc (4.5%) and an increase in the elbow performance score (25.5%) in the congenital heads and an increase in arc and performance in the traumatic heads (9.4% and 37.3%). In group 2, mean total elbow arc decreased 7.6% in the congenital heads and increased in 2.2% in the traumatic heads, while elbow performance score improved 35.5% in the congenital heads and 41.8% in the traumatic heads. The results between both groups have no significant difference statistically. The number of major complications during both periods was similar: in the earlier group, 10 loss of pronation and 1 of proximal radioulnar synostosis, and in the latter group, 18 loss of pronation and 1 of proximal radioulnar synostosis.

Conclusion: If the surgeon follows basic procedures for correction of chronic radial head dislocation, surgeon experience does not greatly affect the final outcome.

Significance: Radial head reduction in both congenital and traumatic radial head dislocation provides satisfactory results although the fromer show worse results than the latter.

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Retrograde Drilling for the Treatment of Capitellar Osteochondritis Dissecans

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Purpose: Osteochondritis dissecans of the capitellum is a condition that results in cavitation of the subchondral bone and can lead to subsequent damage to the overlying articular cartilage. The true etiology is unknown but it is our contention that the lesion is a non-union of a stress fracture. Therefore our preferred method of treatment for a non-displaced lesion is to stimulate a bone healing response by using an arthroscopic assisted retrograde drilling technique. The goal of this study is to report our technique and review the initial series of patients treated in this manner.

Methods: Arthroscopic assisted retrograde drilling was performed in 5 elbows of 4 patients with a non-displaced OCD of the capitellum that had failed non-operative management. All 4 patients were active in sports that involved impact loading of the radiocapitellar joint and had a mean age of 13 years (range 11-14). Outcome was measured using physical examination, Mayo elbow performance (MEP) and SOD scores, and radiographic imaging of lesions was performed to confirm healing.

Results: At a mean of 25 months follow up (range 12-34 months) all 4 patients were satisfied with the procedure and reported no pain with return to full activity including participation in sports without limitation. All lesions were healed on CT scans between 9 and 12 months after surgery. Physical examination revealed full strength in all patients with an average rage of motion of 10 to 145 degrees of flexion/extension and 90 degrees of supination and 85 degrees of pronation. All patients had MEP scores of 100 and rated their elbow as "normal" or "almost normal" on the SOD scale.

Conclusion: Retrograde drilling of capitellar OCD lesions resulted in successful healing of five out of five patients this case series. This alternative technique resulted in a rapid healing response of the subchondral bone but the large drill track had still not completely healed at 1 year follow up.

Significance: This technique is a safe and reasonable treatment option to stimulate healing of the subchondral bone without disruption of the articular cartilage. Further study of the optimal surgical technique and long-term outcome is required but the initial results of retrograde drilling for OCD lesions of the capitellum are encouraging.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Plate or Nail? A Systematic Review of Fixation Strategies in Pediatric Both Bone Forearm Fractures

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Background: Over 70% of pediatric both bone forearm fractures are managed non-operatively. When an operative indication exists, debate also exists as to the optimal fixation strategy. The purpose of this review was to determine which method of operative fixation, plate and screw or intramedullary fixation, is superior for pediatric both bone forearm fractures (BBFF).

Methods: We performed a systematic review of the English literature from 1980-2011 using PubMed, EMBASE, and Cochrane databases. We selected for detailed review all studies with children or adolescents and comparative data (or individual patient data) for BBFF fixed with intramedullary fixation (IMN) or open reduction internal fixation (ORIF) with plates and screws (P&S). Selected studies also required outcomes of interest including fracture union, complications, functional outcome, cosmesis and need for hardware removal. Data were extracted from each study; publication bias was assessed using funnel plots and Egger's statistic. Study quality was assessed using the standardized method described by Zaza et. al. A Der Simonian and Laird Random effects model was used to assess differences between dichotomous variables. A continuity correction was applied in cases of zero events. A sensitivity analysis was performed with studies that separated out older children and adolescents.

Results: Twelve studies were assembled for review. The summed results from these studies failed to show a difference between fixation strategies in terms of union, complication rate, or functional outcomes. Fluoroscopy time was greater with IM nailing, but implant cost was greater with plate and screw constructs. Three studies examined cosmesis and found IM nailing to be associated with superior cosmetic outcomes. However, four studies which examined hardware removal showed that IM nailing results required hardware removal whereas only about half of the plate and screw constructs were removed.

Conclusion: Outcomes were excellent in nearly 9/10 patients regardless of fixation strategy. Delayed unions and non-unions were rare and slightly more common in IMN though the difference was not statistically significant. These results suggest that complication rates are similar, though the type of complication may vary. IMN provides improved cosmesis, but in general requires a second operation to remove hardware.

Significance: IMN and P&S constructs are acceptable options in the fixation of pediatric BBFF. The literature fails to demonstrate a compelling difference between IMN and P&S constructs.

See pages 15–57 for financial disclosure information.

Ipsilateral Supracondylar Humerus and Forearm Fractures in a Pediatric Population

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Purpose: To evaluate the acute complications associated with ipsilateral supracondylar humerus and forearm fractures in pediatric patients.

Methods: We performed an IRB approved query of our institution's trauma registry and billing records using ICD-9 codes for all pediatric patients with supracondylar humerus fractures and ipsilateral forearm fractures treated at a single institution from January 2001 through December 2010. The presence of acute neurologic and vascular injuries on all patients was documented and the incidence of neurovascular injury was compared to a previously reported cohort of operative isolated supracondylar humerus fractures from the same institution.

Results: 150 pediatric patients, average age 6+9, sustained supracondylar humerus fractures (SCHFX) associated with an ipsilateral forearm fracture (FFX). 22 patients had peri-operatively identified neurologic injury (14.7%) and 6 presented without a documentable pulse (4%). There were no cases of compartment syndrome. A previously presented control group of 1228 isolated, operatively managed, Gartland 2 or 3 SCHFX treated over a four year period revealed neurologic injuries in 96 patients (7.8%), pulseless extremities in 50 (4.1%), and one compartment syndrome. The patients with ipsilateral SCHFX and FFX injuries were significantly more likely to have associated peri-operative neurologic deficits than isolated operative SCHFX patients (p=.006). 73 of the 150 patients (48.6%) with an ipsilateral FFX had isolated distal radius fractures and the remaining had more complex forearm fractures. A closed reduction and/or instrumentation was required in 95/150 (63%) of FFX. Of the 22 peri-operatively identified neurologic anomalies, 18 (81.8%) of these patients' ipsilateral FFX required manipulation and/or instrumentation. The neurologic injuries in the ipsilateral SCHFX and FFX group consisted of 9 anterior interosseous nerve palsies, 8 posterior interosseous nerve palsies, 3 ulnar nerve palsies, and 2 patients with combined nerve injuries. 5 of 6 patients presenting without pulses improved to palpable upon reduction of the fracture while the sixth maintained a pink, perfused hand. No patients had vascular reconstruction.

Conclusion: The combination of SCHFX with an ipsilateral FFX significantly increases the incidence of an identified peri-operative neurologic injury when compared to isolated, operative SCHFX.

Significance: One should carefully evaluate all patients with ipsilateral SCHFX and FFX and diligently document neurovascular findings.

External Fixation for Pediatric Diaphyseal Tibia Fractures: A Comparison between Taylor Spatial Frame and Uniplanar External Fixation

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Purpose: The purpose of this study was to compare the results between uniplanar (UNI) and taylor spatial frame (TSF) external fixation for unstable tibial diaphyseal fractures in a pediatric population.

Methods: We performed an IRB approved, retrospective review of 44 diaphyseal tibial fractures in 42 children treated with external fixation (16 TSF and 28 UNI) between 2003 and 2011, at a single Level 1 pediatric trauma center. Records were reviewed to assess fracture pattern, stability, age, type of external fixation, time to union, time in fixator, complications and radiographic alignment at final follow-up. Paired t tests, Fisher's exact tests and a cost analysis comparison were used to assess the differences between the two groups.

Results: The mean age in both groups was 13 years (range 5-17 years TSF, 10-17 years UNI). Mean follow-up was 11 months (TSF) and 12 months (UNI). According to the AO classification there were 28 type A, 13 type B and 3 type C fractures with no significant difference between the two groups. Total time in the fixator was not different between the two groups (UNI 14 weeks, TSF 12 weeks) but time to union was less in the TSF group (UNI 17 weeks, TSF 13 weeks, $p<0.01$). Alignment in the TSF group was improved in the coronal plane ($p<0.04$), but no difference was found in the sagittal plane. The UNI group experienced more complications [7 pin site infections and 9 reoperations (2 TSF conversions, 3 dynamizations and 4 revision UNI frames)] compared to 4 pin site infections and 2 repeat operations (foot plate for equinus contracture) in the TSF group. A cost analysis demonstrated a significantly different cost for equipment between the two groups [UNI frame = $5,074 vs. TSF frame = $10,675 ($p<0.0001$)]; however when all the direct hospital costs were summed together there was no significant difference between the two groups [UNI = $15, 601 vs. TSF= $16, 906 ($p<0.48$)]. A corrected cost analysis with calculated return to the operating room revealed the total UNI cost at $20,526 compared to TSF at $18,281.

Conclusions: While the equipment cost of using TSF for diaphyseal tibia fractures is increased, this is offset by the increased rate of repeat operations in the UNI group.

Significance: Although an initial cost difference exists between the TSF and UNI, the increased reoperation rate associated with Uniplanar fixation make the cost difference between the two implants negligible.

See pages 15–57 for financial disclosure information.

Is Age the Best Predictor for Non-Accidental Trauma in Pediatric Patients with Femur Fractures?

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Purpose: In 2009, the American Academy of Orthopaedic Surgeons released guidelines on the treatment of pediatric diaphyseal femur fractures. The first guideline strongly recommended that children under 36 months of age be evaluated for non-accidental trauma (NAT). Prior to this recommendation, it was the authors' experience that ambulation status was a better predictor than age for NAT, with those pre-ambulatory children with femur fractures at high suspicion for being a victim of abuse. After the recommendations, it has become standard at our institution for every child under age 3 to be reviewed by a child advocacy physician. The purpose of this study is to determine if age or ambulatory status is a better predictor of NAT in patients with femur fractures.

Methods: Since the AAOS recommendations in 2009, all children under age 3 presenting to the ED with a femoral shaft fracture have been evaluated for non-accidental trauma by a child advocacy physician. Data including age, ambulatory status, and likelihood of abuse based upon a validated scoring method, was collected prospectively. These children were then compared to a cohort from 2007-2009 to determine if there was any changes in the incidence of abuse with the addition of the child advocacy physician.

Results: There were 21% of children in the prospective study (22/106) and 14% (20/142) in the retrospective that were found to have injuries consistent with NAT ($p= 0.16$). Both age and ambulation status were strong predictors for abuse ($p < 0.001$). Using an age of < 7 months, this was 64% sensitive and 94% specific to predict abuse while non-ambulatory status was 83% sensitive and 79% specific to predict NAT.

Conclusion: We recommend that every non-ambulatory child presenting with a femur fracture be evaluated for NAT. This will be more cost-effective than age < 3 years to utilize resources such as a child advocacy team along with the work-up they typically recommend including a skeletal survey, ophthalmology consultation, and head CT. We also recommend that a social worker review the chart of every young child presenting with a femur fracture prior to discharge. This will prevent potentially abused ambulatory children with femur fractures from being missed.

Significance: Rather than screening all children under 3 years of age presenting with a femur fracture unnecessarily, by utilizing ambulation status as a criterion, this will focus costly resources on the children who need them most.

Four Weeks in a Hip Spica for Femoral Shaft Fractures is Enough

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Purpose: A retrospective study comparing treatment for 3-4 weeks in an ambulatory single-leg hip spica cast (one-leg) to 6-8 weeks in a standard double-leg hip spica cast (two-leg) for femoral shaft fractures. We evaluated fracture alignment, limb-length discrepancy, skin complications and need for cast change or change in treatment for the two groups.

Methods: The medical records of patients with femoral shaft fractures treated with a hip spica cast over a 2 ½ year period were examined. After exclusions, 99 patients were included in the study. After approval by the IRB, patient records were examined, noting age, weight, type of cast, time in cast, and complications. For assessment of acceptable alignment, standard guidelines were followed. The casts were applied by four orthopaedic surgeons at a single institution.

Results: The patients were grouped according to cast type, with 61 patients in the one-leg group and 38 patients in the two-leg group. The two groups were demographically similar, with an average age of 2 years, 70.7% of patients were male, and 45.5% were black and 34.3% white. When complications were evaluated, both groups had similar low rates of complications including loss of reduction and malunion. However, the two-leg group had a significantly higher incidence of limb length discrepancy or unacceptable alignment (8/38, 21.1%), compared to 1/61 or 1.6% for the one-leg group, p=0.002. In addition, the two-leg group also had significantly more skin problems (11/38, 28.9%) when compared to patients in a one-leg cast (6/61, 9.8%), p=0.026. When ability to walk in the cast was recorded, we found that 17 patients, all in the one-leg group, were able to walk compared to no patients in the two-leg group.

Conclusions: Patients treated with a one-leg spica cast for four weeks had fewer complications than patients treated in a traditional two-leg cast. Femoral shaft fractures in patients less than five years old can be treated in a one-leg spica cast, allowing ambulation, for 4 weeks or less with acceptable results.

Significance: Children in hip spica casts have a major impact on families. The less time children spend in the cast, in particular if the child can walk, the less impact there will be on the family.

See pages 15–57 for financial disclosure information.

Ilizarov External Fixation: A Novel Treatment for Pediatric T-condylar Humerus Fractures

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Purpose: T-condylar fractures of the humerus in the pediatric population are rare and surgical treatment is challenging. The standard of care is open reduction with internal fixation, which requires a large incision, extensive soft tissue stripping, and sometimes an olecranon osteotomy. We have successfully used the Ilizarov external fixator to manage this difficult fracture. The purpose of this study is to report our results with this technique, which to the best of our knowledge has not been previously described.

Methods: We performed a retrospective review of all children and adolescents with T-condylar humerus fractures treated by two surgeons with the Ilizarov external fixator. Medical records and radiographs were reviewed for mechanism of injury, operative times, duration of time in the frame, and complications. Patients returned for clinical examination, x-rays of the elbow, and completion of the PODCI or Upper Limb-DASH outcome instruments. Patients required a minimum of one year follow-up for inclusion.

Results: Fifteen patients (11 males and 4 females) met the inclusion criteria. The mean age at injury was 11.5 years (range 8-15 years). Mean follow-up was 5.5 years. According to the OTA Fracture Classification, 85% were C1.1 fractures, 7% C2.1 fractures, and 7% C2.2 fractures. Three patients had ipsilateral upper extremity fractures. There was one Grade I open fracture. The mean operative time was 113 minutes (range 60-150 minutes). The mean time in frame was 57 days (range 35-115 days). Complications included persistent serous drainage from pin sites (3), loss of flexion (2), loss of extension (1), transient ulnar neuropraxia (1), and cubitus varus (1). Mean values for elbow range of motion were: flexion 127°, extension 3°, pronation 85°, supination 90°. Mean carrying angle was 3° valgus. Mean lateral distal humeral angle was 89°, and the anterior humeral line intersected the capitellum in all patients except one. Mean PODCI global function score was 92, and the mean Upper Limb-DASH score was 0.

Conclusion: The Ilizarov external fixator can safely and effectively manage T-condylar humerus fractures in children and adolescents. The technique is minimally invasive, yet achieves restoration of the articular surface and rigid fixation for early range of motion exercises.

Significance: These results should broaden the conversation regarding treatment of this challenging injury and stimulate future comparative studies.

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Traumatic Atlanto-Occipital Dislocation in Children: Evaluation, Treatment, and Outcomes

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Purpose: Because of advancements in emergency care and diagnostic methods, the number of children who survive atlanto-occipital dislocation (AOD) is steadily increasing. Most studies of AOD are case reports or small case series with few survivors. To determine long-term outcomes of survivors of AOD we reviewed our results at a regional pediatric hospital. Our study represents one of the largest pediatric series with prolonged follow-up.

Methods: Patients aged 0 to 16 years with a diagnosis of AOD treated from 1991 through 2011 were identified. Inclusion criteria included complete radiographic and clinical records and follow-up of at least six months. Basic patient characteristics, mechanism of injury, associated injuries, neurological impairment, surgical treatment and type of implant used for fixation, complications, and clinical and radiographic outcomes were recorded.

Results: Fourteen patients (seven male, seven female) with a mean age at injury of 5.2 years were included in the study. Motor vehicle accidents were the most common mechanism of injury. Associated injuries were present in 93% of patients, with brain injury in 78.5%. Half suffered a spinal cord injury. According to the Traynelis classification, eight patients had a type II (longitudinal) AOD, five had type I (anterior), and one had type III (posterior). All patients had a posterior occipito-cervical fusion with internal fixation, eleven with U-shaped rods and sublaminar wires and three with sublaminar wires alone. The mean follow-up was 75.4 months. The most common postoperative complication was hydrocephalus (28%). Spinal fusion occurred in all patients in 4 to 6 months. After at least 6 months of clinical follow-up, half of the patients still had some neurological impairment.

Conclusion: More patients with AOD now survive their initial trauma, although most have associated injuries and neurological impairment. We favor early occipitocervical fusion and stabilization and discourage the use of halo stabilization alone. If there is neurologic decline after spinal fixation, obstructive hydrocephalus should be suspected.

Significance: AOD is a survivable injury in children with early and appropriate treatment, but nearly a third of patients may have postoperative hydrocephalus and half will have some long-term neurological impairment.

See pages 15–57 for financial disclosure information.

Comparison of Sub-Muscular and Open Plating of Pediatric Femur Fractures: A Retrospective Review

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Purpose: The purpose of this study was to compare submuscular bridge plating to open plating of pediatric femur fractures.

Methods: We retrospectively reviewed 79 patients (80 treated femur fractures) between 1999 and 2011 that underwent either open plating (58 femur fractures) or submuscular bridge plating (22 femur fractures). The outcome measures evaluated were operative time, estimated blood loss, malunion, leg length discrepancy, time to union, infection, unplanned return to the operating room, and length of hospital stay following surgery.

Results: Among our outcome measures, there was no difference between the two groups in terms of operative time, leg length discrepancy, time to union, infection, or length of hospital stay following surgery. There was greater estimated blood loss in the open plating group (p=<0.0001) and greater rotational asymmetry in the submuscular bridge plating group (p=0.005). There was a trend of increased unplanned return to the operating room in the open plating group (5/58 vs. 0/22) although not statistically significant (p=0.32).

Conclusion: In this study, open plating had an increase in estimated blood loss and a trend of more unplanned returns to the operating room, while submuscular bridge plating had an increase in asymptomatic rotational asymmetry.

Significance: Submuscular bridge plating and open plating appear to be equally viable options for the management of pediatric diaphyseal femur fractures.

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Pulseless Extremities Post Type III Supracondylar Humerus Fracture: Is the Direction of the Displacement a Clue?

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Introduction: Vascular compromise associated with supracondylar humerus fractures has been estimated to be between 3-16%. The purpose of this study is to document the incidence of vascular compromise, as well as to correlate fracture displacement with specifics of vascular involvement.

Materials: 243 patients with type II and type III/IV supracondylar humerus fractures and adequate demographic data. We also included any patient with absent preoperative films but with documentation of being a type III injury. Eighty-six patients were type II and eleven flexion type, no vascular injuries.

Results: 145 fractures were displaced extension type. 40 displaced posteromedial, 62 (43%) displaced posterolateral and 36 (25%) were directly posterior; abnormal preoperative vascular exam in nineteen children (13%). Of the completely pulseless extremities 13/17 (76%) were displaced posterolateral, one posteromedial and one posterior, faint pulses in two (both posterolateral). Six presented directly to our ER with documented absent pulse, 8 patients presented to outside ER with a pulse, which were lost during transport to our facility. Two patients presented with a pulse, but went on to lose it during the perioperative period.

Conclusion: Recent reports demonstrated that these can be done the next morning with minimal to no complications. However, we have identified a subgroup of patients that have lost their pulse either in transit from the referring facility or during the overnight admission. Most of these were fractures with a posterolateral displacement. This causes the medial bony spike to stretch or tear the brachial artery. Vigilance is recommended for this specific type of injury.

Significance: Posterolaterally displaced supracondylar humerus fractures have an increased likelihood of vascular compromise. Recognition of the vascular risk from this fracture pattern should be emphasized to treating physicians at all levels of care.

See pages 15–57 for financial disclosure information.

Spine Trauma in Very Young Children: A Study of 186 Patients Presenting to a Level 1 Pediatric Trauma Center

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Purpose: The immature spine has anatomic and biomechanical properties that are unique and does not complete its anatomic maturation until 8 years of age. While anatomic variations of the immature spine may result in distinct injury patterns, little research has focused on differences in spinal injuries in the very young. The purpose of this study is to assess the epidemiology and characteristics of spinal column trauma in children under the age of 4 as compared to children between 4 and 8 years old.

Methods: A review of all patients treated for spinal injury at a single large Level I pediatric trauma center between 2003 and 2011 was conducted. Demographic data, injury mechanism, neurologic status and details of any associated injuries were compiled. Radiographic studies were reviewed to determine injury location and fracture classification. The patient population was divided into two groups: the Infantile (I) group (ages 0 to 3 years) and the Young (Y) group (4 to 8 years). Data was compared between these groups using Fisher's exact test to identify differences in injury characteristics.

Results: 186 patients were identified. 57 patients were between 0 and 3 years of age and 129 were aged 4 and 8 years. Motor vehicle collision caused the majority of injuries in both groups with I patients more often properly restrained during injury (61%) than Y patients (29%) [$p=0.0001$]. Non-accidental trauma was also a common cause of injury in I patients comprising 19% of all spinal injuries. Injuries in both groups were most often located in the cervical spine but more frequently in I patients (75%) than Y patients (36%) with I patients demonstrating a significantly higher rate of atlantooccipital injuries [$p<0.05$]. Head trauma was common in both groups with more Y patients sustaining significant facial [$p<0.05$], extremity [$p<0.05$], and hollow viscus [$p<0.01$] injuries. Mortality rate was much higher in the I group (25%) than the Y group (9%) [$p<0.05$].

Conclusions: This study demonstrates many significant differences in the characteristics of spinal injury in children under 4 years of age when compared to older patients. These differences can help guide initial management as well as future prevention efforts.

Significance: Children under 4 years of age with spinal trauma represent a unique subgroup of patients with regards to fracture location, mechanism, associated injuries and mortality rate.

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Post Traumatic Dysesthesia in Children

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Purpose: We noted an increase in children complaining of soft tissue pain after trivial injuries. None of the patients reached the full criteria for Chronic Regional Pain Syndrome (CRPS) however we feel that they did show signs of an abnormal response to trauma.

Method: We retrospectively reviewed the cases of abnormal soft tissue pain post trivial injury which were referred to our physiotherapy department over a six month period.

Results: There were 10 patients who fit our criteria. There were 7 female, 3 male. 3 of the cases had an undisplaced fracture confirmed on X-Ray. 3 cases had no inciting events. 6/10 patients had pain that woke them from sleep, however analgesia was given regularly in only 5 cases. In 4 out of the 5 the analgesia brought relief. Duration of symptoms prior to presentation showed a median of 3 weeks (1-52). All patients complained of allodynia on presentation. 3/10 had colour changes, 3/10 had temperature changes, 5/10 had sensory changes but none of the 10 fulfilled the required diagnostic criteria for CRPS. Median time to referral to physiotherapy was 21 days (range: 3-56 days) .Median treatment appointments required as an outpatient with physiotherapy was 2 with the majority of patients obtaining resolution of their symptoms. 2 patients required in-patient treatment.

Conclusion: We describe an abnormal response to trivial trauma in children which does not fit the diagnostic criteria for CRPS.

Significance: Further research is needed to identify this group of children early in order to facilitate early referral for appropriate physiotherapy modalities.

See pages 15–57 for financial disclosure information.

Arthroscopic Evaluation of Meniscus Tear Patterns in Pediatric and Adolescent Patients

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Purpose: Meniscus tear patterns in the pediatric and adolescent population have not been well described. The purpose of this study was to describe meniscus tears and their reparability assessed at the time of surgery in this patient population.

Methods: We retrospectively reviewed charts of all pediatric and adolescent patients between the ages of 10 and 19 who underwent arthroscopic surgery for meniscus pathology between 2008 and 2012. Patients who had undergone previous meniscus procedures were excluded. Patient demographic data was documented, including age, gender, BMI, mechanism of injury, and time from injury to surgery. Operative reports and intraoperative photographs were used to assess tear type, location, as well as all concomitant procedures and pathology. Tears were classified as discoid, vertical, bucket-handle, radial, oblique, horizontal, fray, root detachment, and complex. ANOVA and Chi-square analysis were performed to determine associations between tear patterns and pre-operative data.

Results: Of the 302 patients reviewed, 201 (67%) had lateral meniscus tears, 68 (23%) had medial meniscus tears and 33 (11%) had tears to both menisci, giving a total of 335 torn menisci. There were 48 discoid tears, representing 14% of the cohort. The mean age of the patients with discoid tears (12.7) was lower than that of non-discoid tears (15.7) ($p<0.0001$) with a lower BMI (22.1 vs. 26.5, $p<0.0001$) and a female preponderance (56% to 44%). Of the non-discoid tears, the most frequent tear pattern was complex (33%) followed by vertical (19%), bucket-handle (16%), radial (11%), horizontal (9%), oblique (7%), fray (4%), and root detachment (2%). The posterior horn was involved in 74% of the non-discoid tears, the body in 47%, and the anterior horn in 21%. Surgical repair was performed in 47% of all non-discoid cases. Complex tears were more likely to occur in males, patients with higher BMI ($p<0.04$), and those with greater time from injury to surgery ($p<0.1$) and only a minority could be repaired.

Conclusions: Meniscus tears in adolescent and pediatric patients are more complex, preferentially affect the lateral meniscus, and are often less repairable than previously reported in the literature. Factors associated with greater tear complexity include male gender, obesity, and greater time from injury to surgery.

Significance: Because complex meniscus tears have a lower repair rate, these results suggest that earlier treatment of meniscus tears may increase the likelihood of repair in younger patients.

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Anatomical Dissection and CT Imaging of the Anterior Cruciate and Medial Collateral Ligaments in Skeletally Immature Cadaver Knees

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Purpose: Combined anterior cruciate ligament (ACL) and medial collateral ligament (MCL) are increasingly recognized. Although most MCL injuries heal, some may require reconstruction. The purpose of this study was to identify the origin and insertion of the ACL and MCL, and determine the attachment locations in relation to the physes in skeletally immature knees.

Methods: Seven skeletally immature cadaver knee specimens were dissected. These specimens were divided into two groups: Infants (ages-1,11, and 11 months), and Children (ages 8,10, 11, and 11 years). Metallic markers were placed at the midpoint of the femoral origins and tibial insertions of the ACL and MCL. CT scans with 1mm slices were obtained for each specimen and were analyzed using Osirix Imaging Software. The distance from both the ACL and MCL femoral origin midpoints to the distal femoral physis was measured. The distance from the ligaments' insertion midpoints to the proximal tibial physis was measured.

Results: The mean distance from the ACL origin midpoint to the femoral physis was 0.63 cm (0.58-0.68 cm) and 0.85 cm (0.75-0.97 cm) distal to the physis for infants and children, respectively. The mean distance from the MCL origin midpoint to the lowest point of the femoral physis was 0.78 cm distal to the physis for one infant. For 2/3 children, this measurement was 0.60 cm distal to the physis, and 0.37 cm proximal to the physis for one child. In three specimens, this measurement could not be taken. The mean distance from ACL insertion midpoint to the proximal tibial physis was 0.39 cm (0.62-1.15 cm) and 1.74 cm (1.46-2.15 cm) proximal to the physis for infants and children, respectively. The mean distance from the MCL insertion midpoint to the tibial physis was 0.76 cm (0-2.28 cm) and 3.52 cm (2.29-4.60 cm) distal to the physis for infants and children, respectively.

Conclusion: Surgical reconstruction is a common treatment for ACL injury, and occasionally for MCL injury. Pediatric cadaver tissue is very difficult to obtain, and this cadaveric dissection with CT scan clarifies the location of the ACL and MCL with respect to the femoral and tibial physes.

Significance: This information may be useful to help surgeons avoid physeal injury during ACL/MCL reconstructions in skeletally immature patients.

See pages 15–57 for financial disclosure information.

The Relationship of the Femoral Physis and the Medial Patellofemoral Ligament in Children: A Cadaveric Study

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Purpose: The medial patellofemoral ligament (MPFL) is the primary soft tissue restraint to lateral patellar translation. In skeletally immature patients, the MPFL femoral origin and its location compared to the distal femoral physis is unclear. The purpose of this study was to identify the origin and insertion of the MPFL and determine the origin's location in relation to the distal femoral physis in skeletally immature cadaver knees.

Methods: Six skeletally immature cadaver knee specimens were examined through gross dissection. These specimens were divided into two groups: Infants-1 month,11 months,11 months, and Children: 8 years,10 years,11 years. Metallic markers were placed at the femoral origin and patellar insertion of the MPFL. CT scans with 1mm slices were obtained for each specimen and were analyzed using Osirix Imaging Software. In the sagittal view, MPFL origin and insertion widths were measured. On the coronal view, the vertical distance from the MPFL midpoint of the femoral origin to the most inferior point of the physis was measured.

Results: The mean width of the MPFL at the femoral origin was 0.70 cm (0.48-1.09 cm) and 1.12 cm(1.03-1.29 cm) for infants and children, respectively. The mean distance from the midpoint of the MPFL origin to most inferior aspect of the distal femoral physis was 0.68 cm (0.21-1.19 cm) distal to the physis for infants. This measurement was 0.18 cm distal to the physis in one child (age 8), at the level of the physis in one child (age 10), and 0.26 above the physis in one child (age 11).

Conclusion: The relationship of the MPFL origin to the distal femoral physis in the skeletally immature is not well understood. Imaging studies using MRI and x-ray techniques have reached different conclusions about the position of the origin with respect to the femoral physis. Although pediatric cadaver tissue is very difficult to locate, these dissections may be useful to surgeons performing MPFL reconstructions in skeletally immature patients. In this study, the 4 subjects under the age of 10 were found to have an MPFL origin below the physis. The two subjects over 10 years of age had MPFL midpoints occurring at or above the physis.

Significance: The relationship between the origin/insertion of ligaments of the pediatric knee and the physis has not been well described. This study provides new information to help define this relationship.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

High-Dose BMP2 Reduces Cell Proliferation and Increases Apoptosis in Human Primary Periostem-derived Cells

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Purpose: BMP2 is a potent osteogenic factor used clinically in certain cases of spinal fusion and fracture non-union. Recently, some complications related to BMP2 therapy have been reported. This may be due to a high concentration of BMP2 used in clinical settings. It is notable that a clinical concentration is much higher (>1000 micro g/ml) than that used in experimental studies (100 – 300 nano g/ml). The purpose of this study was to compare the effects of low and high doses of BMP2 on cell proliferation and apoptosis using human periosteum-derived cells, since BMP2 is generally applied around the periosteum to stimulate osteogenesis.

Methods: This study was approved by the local IRB. We isolated human primary periosteum-derived cells from surgical discard tissues and investigated the effects of a high dose of BMP2 on cell proliferation and apoptosis in comparison to a low dose. To investigate the mechanism that can potentially affect cell proliferation and apoptosis, we measured Wnt signaling which is important for bone remodeling and analyzed critical molecules in Wnt signaling such as SOST and DKK1.

Results: Cell proliferation assessed by MTT activity was significantly reduced by a high-dose of BMP2 (2000 nano g/ml). In contrast, such a reduction was not observed with a low-dose (100 nano g/ml). Apoptotic cell death assessed by caspase activity was significantly increased by a high-dose of BMP2 but unchanged by a low-dose. BMP2 treatment significantly reduced Wnt signaling activity with a dramatic increase in Wnt inhibitors, DKK1 and SOST with the high-dose treatment. Addition of DKK1 or SOST protein to the cell culture significantly reduced cell proliferation and increased cell apoptosis. Silencing the DKK1 or SOST expression using the siRNA technique normalized cell proliferation and apoptosis in the cells exposed to a high dose of BMP2.

Conclusion: A high-dose of BMP2 adversely affects periosteum-derived cell proliferation and increases apoptotic cell death via an increase of Wnt inhibitors, DKK1 and SOST.

Significance: These results stress the potential importance of investigating the effects of different doses of BMP2 on cell function and clinical outcome.

See pages 15–57 for financial disclosure information.

Utility of Flexion, Extension, AP and Open Mouth Views in Assessment of Down Syndrome Patients

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Introduction: Patients with Down Syndrome (DS) develop atlantoaxial instability that has potential to create spinal cord injury. Most authors suggest lateral flexion/extension films prior to surgery or sports participation, as clinical evaluation for myelopathy or AAI is difficult in DS patients. The aim of this study is to determine the utility of flexion/extension x-rays versus neutral lateral x-rays for the detection of radiographic signs of instability in patients with DS.

Method: Retrospective review of patients with DS and cervical spine radiographs between 1/1/2007 and 9/30/2011. Atlantodens interval (ADI), space available for the cord (SAC), basion – axial interval (BAI), and Weisel- Rothman (WR) measurements were made on all films; the measurements were recorded to 0.01 mm, and rounded to the nearest 0.1 mm. At-Risk radiographic criteria were based on previous literature review, and included the presence of Os Odontoideum, SAC < 14 mm, ADI > 6 mm, BAI of >12 mm, or Weisel-Rothman measure increasing > 4 mm between extension and flexion.

Results: Studies in 106 patients were reviewed, 43 females and 63 males. Age ranged from 1.5 to 18.7 with average being 8.6. 84 patients had a neutral lateral x-ray, and 61 of these also had measurable flexion and extension x-rays. Os Odontoideum was visible in 2 patients. 2 patients with probable clinically significant instability (SAC < 14, ADI of > 6 mm and BAI of > 12 mm) showed these abnormalities on the neutral lateral x-ray. No additional patients meeting these criteria were identified on flexion-extension views. 2 additional studies showed ADI >= 6 mm only on flexion views, but neither had SAC <=14 mm, or BAI >=12 mm. 9 studies showed BAI > 12 mm in flexion only, but none showed SAC <=14 mm, or ADI > 6 mm. 9 studies showed > 4 mm of posterior translation in extension using the WR measurement. None demonstrated SAC < 14 mm or ADI > 6 mm.

Summary: DS patients at high risk of spinal cord compromise (ADI >6mm AND SAC <14mm, OR Os Odontoideum) are identified on neutral lateral Cervical Spine X-rays. Flexion extension X-rays are very unlikely to identify additional patients with clinically significant AAI. Increased movement at the Atlanto-occipital joint seen on Flexion-Extension views in DS patients is of little clinical significance except when planning the upper level of stabilization if surgery is indicated for AAI. We recommend only an upright lateral cervical spine x-ray is needed for DS cervical spine screening. Additional evidence of instability is not likely to be obtained from flexion-extension views.

♦ Are Proximal Rib Anchors Protective Against Rod Breakage in Distraction-Based Growing Rods?

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Purpose: Rod breakage is a known complication of distraction-based growing rod instrumentation. We compare the rates of rod breakage between distraction-based growing rods with proximal spine vs. rib anchors.

Methods: A retrospective multi-center study of 175 patients with inclusion criteria of: a minimum of 2 years of follow-up; under 9 years of age at index surgery; and known anchor locations of spinal instrumentation. We excluded patients with Vertical Expandable Prosthetic Titanium Rib (VEPTR) instrumentation and Jeune's and Jarcho-Levin syndromes. Mean follow-up was 55 months (24-152). We performed statistical survival analysis via the Cox proportional hazards model, in order to account for varying lengths of follow-up. Univariate analyses on each variable (growing rod type, preoperative Cobb Angle, # growing rods, age, and # of levels instrumented) were performed, followed by multivariate analyses of significant variables affecting rod breakage ($p<0.05$).

Results: 33 patients had rib-anchored growing rods and 142 patients had spine-anchored growing rods. Univariate analysis found that proximal spine-anchored growing rods have 3.6x increased risk of lifetime rod breakage than rib-anchored growing rods ($p=0.045$). However, this result did not reach statistical significance after adjusting for preoperative Cobb Angle ($p=0.074$), as higher preoperative Cobb angles are also associated with an 18% increased risk of breakage per 10° increase in Cobb angle ($p=0.013$).

Conclusions: Our results suggest that proximal rib-anchored growing rods may be protective against rod breakage, though our limited sample size did not reach significance on multivariate analysis. We postulate that the rib-anchored growing rod systems may be associated with less rod breakage as the system is less rigid as a result of some "slop" at the hook-rib interface, as well as the normal motion of the costovertebral joint.

Significance: Multicenter study showing proximal spine-anchored growing rods have 3.6x increased risk of lifetime rod breakage than rib-anchored growing rods.

See pages 15–57 for financial disclosure information.

Responding to Neuromonitoring Changes in Three-Column Posterior Spinal Osteotomies for Rigid Pediatric Spinal Deformities

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Purpose: The purpose of this study is to highlight the high risk steps during performance of cord level three column spinal osteotomies for the correction of severe spinal pediatric deformities and to describe actions taken to avert major neurological injury in these cases.

Methods: Retrospective review of prospectively collected data was performed on neuromonitoring changes recorded during a consecutive series of cord level 3 column osteotomies between 2005 and 2012. A decrease in SSEPs and transcranial MEPs greater than 50% of baseline was considered an alert. Alerts were classified chronologically as Type I: prior to decompression, Type II: occurring during decompression, Type III: occurring following osteotomy closure.

Results: 37 three column, cord level, spinal osteotomies were performed in 28 patients-congenital (17), syndromic (12), neuromuscular (5), or juvenile (3). SSEP alerts occurred in 3 patients, all of whom had significant MEP alerts. There were 2 type I, 15 type II, and 6 type III MEP alerts. Increasing blood pressure improved MEP in all, with the exception of 8 Type II and 4 Type III. The unresponsive Type II alerts were treated with osteotomy closure with the expectation that spinal shortening will improve spinal cord bloodflow. The unresponsive 4 Type III alerts all responded to re-opening, manipulation and subsequent re-closure of the osteotomy either with a cage or less correction. There were 5 immediate post-operative motor deficits, all transient, and all resolved completely. No patient had a permanent deficit.

Conclusion: Significant MEP changes are common during the performance of three column, cord level, posterior spinal osteotomies in children. Changes unresponsive to increasing blood pressure occurring during decompression and bone resection (Type II) responded well to osteotomy closure. Unresponsive changes during osteotomy closure (Type III) were treated successfully with opening the osteotomy, cage adjustment and less correction.

Significance: The real time intraoperative MEP information provided the necessary information to direct key surgical decisions. Osteotomy closure in the presence of MEP changes occurring during decompression and bone resection, provides decompression of the spinal cord and was associated with return of MEP signal. MEP changes occurring following osteotomy closure responded well to reopening of the osteotomy and reclosure with either less correction or adjustment of the anterior column support. In our series, continuing on with the procedure was associated with good neurological outcomes following these guidelines.

The Relationship of GMFCS Level and Hip Dysplasia on the Pattern and Progression of Scoliosis in Children with Cerebral Palsy

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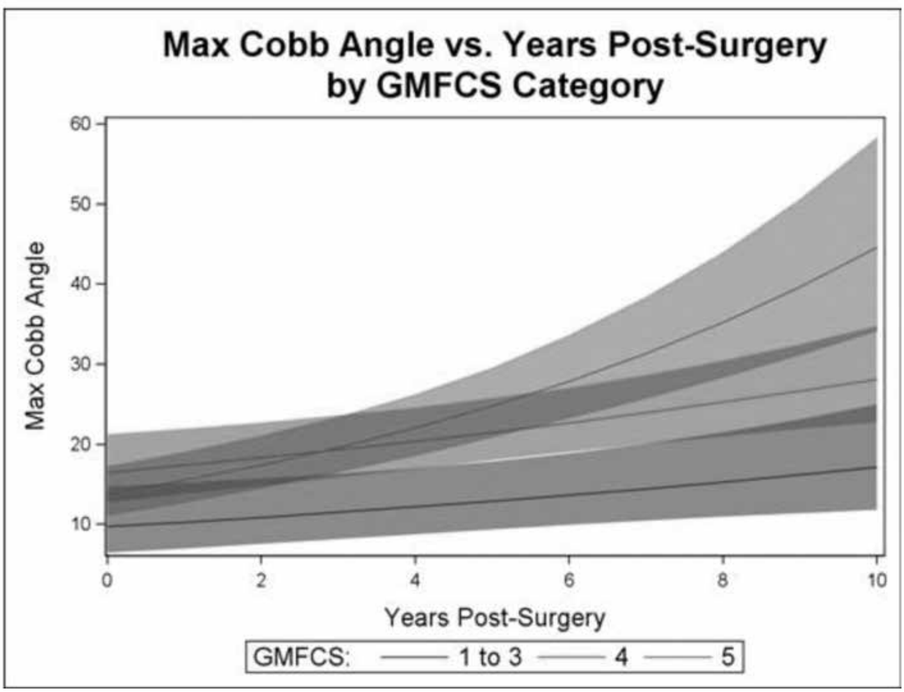
Purpose: Although scoliosis is prevalent in patients with cerebral palsy (CP), its relationship to GMFCS and the relationship between hip dysplasia and laterality of scoliosis has not been well studied. The primary aim of the study is to determine if progression and magnitude of scoliosis was related to gross motor functional classification scale (GMFCS) and whether laterality (and associated pelvic obliquity) of the spinal curvature affected severity of recurrent hip subluxation.

Methods: IRB approval was obtained for this retrospective study. A total 115 patients underwent VDRO surgery at a single institution between 1980 and 2001. Adequate longitudinal scoliosis radiographs were available for 98 patients (55 male, 43 female). Average age at the time of VDRO was 6.5 years. The average duration of follow up post-VDRO was 8.2 years. Children were divided into lower severity (GMFCS 1-3, 13 patients), high severity (GMFCS 4, 42 patients) and highest severity (GMFCS 5, 43 patients). The major Cobb angle and laterality of curvature was recorded for all upright scoliosis radiographs using standard techniques by a single author. A separate observer measured hip migration index on all pelvis radiographs.



See pages 15–57 for financial disclosure information.

Results: An examination of the association between GMFCS scores, coronal deformity, and their trend over time revealed significant increases in coronal deformity over time in each GMFCS category ($p<0.0001$). The GMFCS=1-3 and GMFCS=4 groups had nearly identical time trends, each increasing at a little over 5.5% each year, while the GMFCS=5 group increased by 12.5% per year ($p=0.0153$). Increasing Cobb angle was not a significant predictor of severity of recurrent subluxation as measured by migration index. Furthermore, there was no significant difference in the severity of recurrent hip subluxation evaluating hips based on whether they are on the same side as the concavity or convexity of the scoliosis (i.e. high or low side of pelvic obliquity).

Conclusion: The relationship between GMFCS and rate of scoliosis progression differed between the groups. Severity of hip subluxation did not increase significantly over time after VDRO, nor was it significantly related to magnitude or laterality of scoliosis in children in this cohort.

Significance: Treatment decisions regarding hip subluxation and scoliosis in patients with cerebral palsy can likely be made independent of each other. Progressive scoliosis does not lead to uniform deterioration of the results of VDRO surgery in children with CP.

What is the Impact of Adding 3D Information to Pre-operative Fusion Level Determination?

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Purpose: Selection of fusion levels remains a difficult process that relies heavily on surgeon's experience, expert opinions and published rules. Surgeons rely therefore heavily on spinal imaging to determine the best fusion levels. With the advent of new imaging system giving access to 3D reconstruction, more information is available to the surgeon to make a decision. The objective of this study was to evaluate the impact on the selection of fusion level by adding 3D information to the standard imaging performed pre-operatively.

Methods: Five pediatric spine surgeons reviewed the radiographic images of 28 patients with AIS. A first set of images containing the PA, lateral and bending radiographs was used (2D) to determine the levels of fusion for each patient on two different occasions. The 3D dataset was composed of the same images but with the addition of 3D data provided under the form of 3D representations in different planes of view as well as a 3D object that the user could rotate in space. Vertebral axial rotations as well as top-view representation were also made available. These images were reviewed twice over a two weeks interval. Kappa statistics was used to determine intra-observer agreement for 2D and 3D level selections and to evaluate agreement between 2D and 3D level determination. Fusion length (# of fused levels) was finally compared between the 2D and 3D readings.

Results: Intra-rater agreement was high for 6 out of 7 surgeons both for 2D and 3D. This level of agreement decreased when comparing 2D and 3D fusion levels. Fusion length was on average 0.5 levels longer in the 3D group for 5 observers, unchanged for another one, and decreased by almost one level for the last reviewer. Factors affecting level selection included PA radiograph (53.6%) Bendings (20.2%) and CSVL (17.3%) for the 2D dataset. When using the 3D dataset, observers reported that the 3D PA images (26.4%), bendings (11.0%), CSVL (15.8%), the 3D frontal view (22.2%), the top view (11.6%) and vertebral rotation (10.4%) played an important role in level selection.

Conclusion: The addition of 3D images does affect the perception of clinicians as to what their fusion levels should include.

Significance: This study highlights the need for new guidelines to determine fusion levels using 3D information.

Long Term (10 year) MRI Follow-up of Paraspinal Muscle Quality after Posterior Fusion for Adolescent Idiopathic Scoliosis

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Purpose: The posterior lumbar paraspinal musculature is believed to be the primary stabilizers of spine.

Posterior muscle splitting approaches for spinal fusion are the most commonly performed surgery for adolescent idiopathic scoliosis (AIS). Little evidence exists regarding the long term effects on posterior paraspinal musculature in the literature. Here we evaluated the effects of the traditional subperiosteal midline posterior approach on lumbar paraspinal musculature at greater than 10 years follow-up.

Methods: This study was a retrospective review of sixty three consecutive AIS pts offered participation via mail invitation. All the patients involved in this study had a posterior only surgery through a midline muscle splitting approach. All patients involved in the study had at least 10 yrs follow-up. MRI imaging was reviewed with a single fellowship trained musculoskeletal radiologist who analyzed axial MRI images at each level distal to the fusion mass. The iliocostalis, longissmus, and spinalis muscles were graded for symmetry, muscle quality & fatty infiltration according to the Goutallier classification for each side respectively. The iliopsoas muscle was used as an internal control.

Results: In total thirty-three AIS patients were eligible and twenty patients consented to the study. The group included one male and nineteen females mean age 26 years (19-32). Patients had a mean follow-up of 11.8 years (9.8-15.1). These patients had a preoperative mean major curve of - 55° (+11) and a post-operative mean major curve - 25° (+9). The average fusion length performed was 10.8 levels (9-13). The lowest instrumented vertebra in these patients was T12 in 3 patients, L1 in 9 patients, L2 in 2 patients, and L3 in 6 patients. In total 49 levels were graded for changed. This revealed 13 pts (65%) with no qualitative abnormalities across 34 levels (69.4%), 7 pts (35%) had abnormalities. Of those patients with abnormalities, five had unilateral greater than grade 2 right sided changes and two had grade 4 changes in the spinalis muscle.

Conclusion: The open posterior muscle splitting approach for spinal fusion in AIS demonstrates very little qualitative fatty degeneration distal to the fusion mass on MRI at 10 years follow-up. Significant muscle grade changes were seen in two cases limited to the spinalis muscle where excessive rod length was seen

Both grade 4 Goutallier degenerative changes were unilateral and limited to the spinalis muscle which could be attributed to excessive rod length.

Significance: Patients surgically corrected with open posterior muscle stripping fusions for AIS had very little fatty degeneration of lumbar para-spinal musculature seen on MRI at 10-year follow-up.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Utility of Post-operative Scoliosis Radiographs in Children: Correlating History and Physical Exam with Radiographic Findings

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Background: Post-operative radiographs are routinely obtained following scoliosis surgery in children despite lack of evidence supporting such practice. The purpose of this study is to evaluate the utility of routine post-operative radiographs in pediatric scoliosis patients.

Methods: A total of 1969 clinic notes from 451 consecutive scoliosis patients (ages 10-18) who underwent surgical correction over a 10-year period at a single institution were retrospectively reviewed. Etiology (idiopathic, neuromuscular, or other), preoperative curve characteristics, and surgical procedures performed were recorded. All post-operative clinic notes and radiographs were reviewed for abnormalities and changes in treatment course. It was then determined if clinical signs/symptoms and/or an abnormal radiograph led to a change in treatment course. This was defined as a therapeutic intervention (i.e. reoperation) or further diagnostic testing (labs, CT, MRI, or bone scan).

Results: Of the 451 scoliosis patients in this study (average age of 14.7±2.4 years), 73% had adolescent idiopathic curves, 23% neuromuscular curves, and 4% other underlying pa gy. Overall, a change in treatment course occurred in 42 patients (2.1% follow-up visits), all of who had symptomatic findings on history and physical exam and only 15 (0.8%) of who had supportive abnormal radiographs. Curve etiology yielded no impact on radiographic utility. A statistically significant increase in utility was seen in radiographs obtained at visits ≥1 year compared to <1 year post-operatively (1.7% vs. 0.3%, p=0.001). The overall sensitivity, specificity, positive and negative predictive values of routine post-operative radiographs in determining treatment course were 35.7%, 98.1%, 28.9%, and 98.6%, respectively.

Conclusions: Routine radiographs provided low utility in guiding treatment course in asymptomatic patients following scoliosis surgery in children, regardless of the etiology. The results of this study indicate that factors such as worsening symptoms and time since surgery should be considered prior to obtaining radiographs during post-operative visits following scoliosis surgery in adolescent patients. Such changes in practice could potentially reduce radiation exposure and medical costs without compromising care.

See pages 15–57 for financial disclosure information.

♦ Is there an Optimal Time Interval to Distract Dual Growing Rods?

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Purpose: To determine if there is a significant difference in final T1-S1 coronal height, instrumented level height, or final Cobb angle related to the time interval between surgical distractions of dual growing rods for early onset scoliosis.

Methods: Using retrospectively collected cohort data from the Growing Spine Study Group database, we are including patients in this study if they meet the criteria of treatment with dual growing rods beginning at age >18 months with at least 4 distraction surgeries or progression to final fusion, whichever came later. The data will be split into two groups: one whose average lengthening interval was <9 months and one whose average interval was >9 months. We are comparing, via ANOVA, primary Cobb angles, the overall height from T1-S1, and the instrumented segment length, as measured from the immediate post-operative radiographs after each distraction directly compared with the time interval between each surgery.

Results: To date, we have identified 46 patients in the database who matched our inclusion criteria. Average initial primary Cobb angle was 78.04 degrees (range, 25-128), T1-S1 length was 242.19mm (range, 145-310mm), and instrumented length was 223.41mm (range, 87.64-358mm). The number of surgical distractions ranged from 1 to 13 over a period of 4 to 8 years. Data analysis results shows trends toward similar outcomes when growing rods are distracted at intervals >9 months compared to those with constructs distracted at intervals <9 months when comparing improvement of primary Cobb angle, T1-S1 height, and instrumented segment height.

Conclusion: Our data shows that increasing time between distractions of dual growing rods in early onset scoliosis does not result in a reduced overall T1-S1 spine height or instrumented segment height, and does not result in a decreased ratio of final to initial primary Cobb angle when comparing those constructs distracted, on average, >9 months to those distracted at intervals <9 months.

Significance: Currently, the trend in dual growing rods is to perform distractions at 6-month intervals. Due to patient health, psychosocial issues, or other uncontrollable situations, these distractions may not occur at routine times. By increasing the average time between distractions, patients may undergo fewer procedures and achieve similar final outcomes.

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Long-term Functional Outcomes of Operative vs. Non-operative Spina Bifida Scoliosis

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Background: Up to 90% of myelomeningocoele (MMC) children will develop scoliosis. Although many undergo spinal fusions, the benefits remain uncertain. The goal of this study was to determine the quality of life (QOL) of adults with MMC, who had either had operative or non-operative treatment for scoliosis as children.

Methods: All patients with MMC scoliosis (Cobb angle>50o) at SickKids Hospital in Toronto (1991-2007 inclusive) were eligible. Of 161 eligible contacted patients, 30 patients participated; a)operative (N=24) or b)non-operative (N=6). In addition to clinical and radiological assessments, QOL outcomes utilized were: a)Spina Bifida Spine Questionnaire (SBSQ) and b)SF36 (SF-36).

Results: No differences existed between the two groups at baseline with respect to: age and sex, home situation, Hoffer Classification, NML, medical co-morbidities, kyphosis, lordosis and pelvic obliquity. Patients who had, compared to those who did not have surgery were more likely to have: a)larger Cobb angles (91.2+19.3° vs.57.5+5.1°, p=0.01), b)larger coronal imbalance (44.9+30.6 mm *vs.* 17.1+17.9 mm, p=0.04) and c)larger shoulder tilt (13.2+8.9 mm vs. 2.8+4.8 mm, p=0.01). The mean age at surgery was 12.7+2.1 years, with 83.3% (N=20) receiving a combined anterior and posterior approach; 58.3% (N=14) of the constructs were combined sublaminar wires, rods and pedicle screws. A total of 5 early and 3 late infections occurred. The pseudoarthrosis rate (back pain, motion on X-ray or fixation failure) was 16.7% (N=4) and 20.8% (N=5) received hardware removal. Residual post-operative Cobb angles were 47.6+16.7°. The average follow-up was 13.5+3.8 years. At follow-up, operative patients were more likely to have: a)smaller Cobb angles (49.5+22.0° *vs.*72.5+20.6°, p=0.03) and b)slower Cobb progression (0.1+1.4°/year *vs.*1.6+2.0°/year, p=0.04). No differences existed between the groups for Hoffer Classification, NML, pelvic obliquity, coronal imbalance, shoulder tilt and sitting balance. All patients, when compared to national gender and age specific SF-36 means, were statistically lower with respect to a) physical functioning and b)physical component scale. No differences existed between the groups for a)all SF-36 domains, b)SF-36 physical and mental component scale, and c)SBSQ score. At follow-up, Cobb angles in both groups had no correlation with QOL measures (R^2=0.074 and 0.432).

Conclusion: Spinal fusion in MMC scoliosis corrects coronal deformity and stops progression.

Significance: While spinal instrumentation and fusion improved the long term radiographic parameters, there was no overall effect on physical function and QOL.

See pages 15–57 for financial disclosure information.

Outcomes following Removal of Instrumentation after Posterior Spinal Fusion

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Purpose: Although there is good evidence to support removal of instrumentation for infection following posterior spinal fusion (PSF), few studies have reported outcomes following removal for late operative site pain. The purpose of this study was (1) to determine whether removal of instrumentation following PSF resolves preoperative pain, (2) to determine whether indolent infection not detected prior to removal of instrumentation is related to late operative site pain, and (3) to determine whether curve progression differs when instrumentation is removed for infection versus late operative site pain.

Methods: A retrospective study of consecutive patients aged 10-23 years who underwent removal of instrumentation after PSF over a 10-year period was conducted. Patient demographics, preoperative and postoperative imaging, laboratory studies and operative findings were reviewed. All patients had a minimum of 2 years follow-up. Statistical analysis was performed using 2 sample t-test, bivariate analysis and multivariate logistic regression models.

Results: Seventy-five patients (39 females, 36 males) were included. The mean age at time of surgery was 15.9 years (range, 10-23). Fifty seven percent were idiopathic, 39% neuromuscular and 4% congenital. Indications for removal of spinal instrumentation were pain (57%), overt infection (28%), hardware failure (8%) and prominent hardware (7%). The mean time from index fusion to removal of instrumentation was 2.8 years (range, 0.8-12 years). The average loss of curve correction following complete hardware removal was 23.1^0 (range, 4-46^0). Patients who underwent removal of instrumentation for infection had more curve progression than those without infection (mean, 34^0 vs. 19^0). Of the 43 patients with preoperative pain, only 40% reported relief of their symptoms following removal of instrumentation. Sixteen of these 43 patients had positive intraoperative cultures. The most common organism was *P. Acnes*.

Conclusions: Patients that undergo removal of instrumentation after PSF for pain may not get complete relief. There is risk for curve progression following removal of instrumentation.

Significance: Back pain may be an indicator of indolent infection, and intraoperative cultures should be obtained when removing instrumentation. Removal of instrumentation for overt infection results in greater loss of correction.

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Quantification of the Normative and Scoliotic Adolescent Ribcage to Characterize Anatomic Differences

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Purpose: Normal and scoliotic adolescent rib cage geometric anatomy is poorly characterized in the literature. Thoracic cage anatomy of normal and AIS subjects was studied by analysis of CT scans.

Methods: Retrospectively, chest CT scans were obtained of 17 skeletally-normal adolescent males (10 years: n=5,12 and 13 years: n=5, 15 and 16 years: n=7),within 5^{th} and 95^{th} percentiles of height, weight and BMI, and 4 AIS subjects (12-14 years, 3 female and 1male, average Cobb angle: 64.5° at T6-L1). 3D reconstructions were performed using Mimics image analysis software (Materialise Inc., Belgium) and rib length, normalized rib length by subject standing height, rib apparent curvature along each 10% increment of rib length (10% = posterior rib head (PRH), 90% = anterior end of rib (AER)), and rib enclosed area were computed using a custom MATLAB (The MathWorks Inc., Natick, MA) code. SPSS software (IBM, Armonk, NY) was used to perform non-parametric matched pair t-tests and correlation analysis, comparing left and right ribs across appropriate groups for interpretation of bilateral rib symmetry trends.

Results: For both normative and AIS groups, no significant bilateral differences and absolute bilateral differences were observed in rib length, rib enclosed area, and normalized rib length. There were clinically small but significant differences in bilateral apparent rib curvature at rib increment 10% (PRH) through 90% (AER) within the normative groups. Although for AIS subjects significant differences of apparent rib curvature on the convex side were seen for ribs 7-9 at the 10% rib length posterior increment, clinically there was only a small downward angulation of the posterior neck of the rib, with small clinical differences also for ribs 2, 7, 9 and 12, at 40%, 60%, 20%, and 90%, respectively, along rib length.

Conclusion: No bilateral rib pair differences were observed in rib length, enclosed area and normalized length for skeletally normal and AIS subjects. However, in the area of the rib hump, ribs 7-9, the posterior neck of the rib is slightly inclined downward in these scoliosis patients.

Significance: While increase in sample size is needed, these results suggest that a rib hump in scoliosis cannot be simply explained by gross angulation of the ribs on the convex side, so the patho-anatomy of rib hump remains complex and ill-defined, and deserves more study so reversal of this deformity by surgery can be more evidence-based.

See pages 15–57 for financial disclosure information.

Bone Health in Children: Results of a Survey of Risk Factors for Low Bone Density

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Purpose: Low bone density has been linked to numerous risk factors including family history, gender, diet, weight, exercise, and history of previous fractures. It has been hypothesized that adult osteoporosis has its origins during the pediatric period. The purpose of this study was to collect cross sectional data from a cohort of healthy children in the Chicago area to determine the baseline rate of risk factors for low bone density and to determine which are most associated with a history of fractures in these children.

Methods: Surveys were distributed to children ages 5 to 18 and their parents in community outpatient pediatric clinics in Chicago, Chicago suburbs, and in the Lurie Children's Orthopaedics subspecialty clinic. The questions asked for "yes/no" responses regarding the following poor bone health risk factors: previous fractures, family history of osteoporosis, calcium (Ca)/dairy intake, low physical activity, being overweight, sunlight exposure, and chronic disease. The children who answered "yes" to whether they had a chronic disease were excluded from analysis.

Results: Four hundred ninety-four eligible surveys were completed, with 120 (24%) having a fracture history. Characteristics of the cohort included 56% male, 9.3% with a family history of osteoporosis, 26% having <3 Ca servings/day, 11% physically active <1 hr/day, 6% overweight, 19% having sunlight <1 hr/day. Children had an association with fractures if they had < 3 servings of Ca/day (Odds Ratio (OR) =2.18, 95 % Confidence Interval (CI) =1.40-3.41, p=0.0006), if they were physically active for < 1 hr/day (OR=2.89, CI=1.63-5.13, p=0.0003), and if they were male (OR=1.57, CI=1.02-2.41, p=0.04). Children with both low Ca intake and low physical activity had a significant risk of fracture history (OR=4.81, CI=2.18 to 10.61, p=0.001). A family history of osteoporosis, low sunlight exposure and being overweight did not significantly correlate with a fracture history although overweight children approached significance (OR=2.03, p=0.07).

Conclusion: Healthy children who have self or parent reported low physical activity levels and low Ca diets are associated with a history of fractures. Fortunately, baseline data found a relatively low rate of these and other risk factors questioned in our bone health survey.

Significance: This study gives us a baseline pediatric population data of risk factors for poor bone health which can be compared to other populations including children with specific chronic diseases and in different geographic areas, socioeconomic categories and age groups. However, pediatricians should target children with low calcium diets and low physical activity as they are associated with fracture and may be at increased risk for future low bone density.

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Factors Predicting MRSA vs. MSSA in Pediatric Acute Hematogenous Osteomyelitis

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Purpose: An evidence based prediction algorithm has been reported to predict methicillin resistant *Staph. Aureus* (MRSA) in patients with acute hematogenous osteomyelitis (1). This study identified temperature, WBC, hematocrit and C-reactive protein as predictors of MRSA. The prevalence of MRSA in the study population was 9%. We sought to determine whether these or other presenting factors could predict MRSA (or conversely methicillin sensitive *Staph. Aureus* (MSSA)) in our patient population with high prevalence of MRSA.

Methods: IRB approval was obtained. A retrospective chart review was performed. Consecutive cases of acute hematogenous osteomyelitis with positive blood or bone cultures were identified from discharge diagnosis codes and procedural codes associated with debridement at a single children's hospital. Presenting features were recorded including duration of symptoms, weight-bearing, prior antibiotic use, vital signs, complete blood count, ESR and CRP. Univariate comparison was made between the groups with MRSA and MSSA. Continuous variables were compared with t tests and discrete variables were compared using Fisher's exact test. Logistic regression was performed using a backwards stepwise regression to develop a model to predict MRSA.

Results: 49 patients formed the study group, and 59% had MRSA (29 MRSA, 20 MSSA). Temperature, respiratory rate, heart rate, ESR and CRP were significantly higher in MRSA cases while platelets were lower. Logistic regression resulted in a model utilizing platelets, heart rate and ESR (CRP was highly correlated with other variables). This model correctly predicted 88% of cases (90% of MRSA and 85% of MSSA).

Conclusion: A logistic regression model incorporating platelets, heart rate and ESR correctly predicts methicillin resistance of *Staph. aureus* in 88% of cases. The model differs from one developed at an institution with a low rate of MRSA.

Significance: Prediction of MRSA could help direct antibiotic management while prediction of MSSA could help prevent overuse of antibiotics directed against MRSA.

See pages 15–57 for financial disclosure information.

Is There a Difference in Functional Outcome and Satisfaction in Primary Transtibial Amputation vs. Multi-Operated?

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Purpose: To determine if there is a difference in the functional outcome and satisfaction in patients with transtibial amputations primary vs multi operated.

Methods: We evaluated 62 patients with transtibial amputations of which 27 were treated primary with an amputation and 35 with multiple reconstruction procedures before amputation. We determine by means of the clinical chart the etiology of the amputation, the number of surgeries previous to the amputation and the complication rate. We also analyzed the need of additional surgery after prosthetic use was initiated and by means of the Pediatric Outcome Data Collection Instrument (PODCI) and Trinity Amputation Prosthetic Experience Scale (TAPES) determined the satisfaction with the use of prosthetics and the functional outcome as well as the adjustment to having a prosthetic. A t Student test for non-paired groups was used for the statistical analysis.

Results: A statistical difference was found in patients with multiple operations before the amputation in the subscales of transfers, pain and global function compared with patients with a primary amputation. We also found that the multi operated group had significant lower values in the adjustment to limitation than those with a primary treatment.

Conclusions: There is still controversy on which is the best initial treatment for patients with deformities on the lower extremities. By having found that there are differences in the outcome of multi operated patients decisions regarding the initial treatment of patients with limb deformities can be more critical in terms of the consequences of a failed treatment.

Significance: By means of this study we found that patients with multiple operations before an amputation have more pain and a lower global functional score, as well as an adjustment to limitation to having a prosthetic than those with a primary amputation.

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Osteoid Osteomas of the Foot: Unusual Presentations

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Purpose: Osteoid osteomas are common benign tumors that are usually seen in long bones. The typical clinical presentation is that of night pain relieved by NSAID's. Radiographically these are characterized by the presence of a nidus with surrounding sclerosis. The bones of the foot are not commonly affected. The purpose of this report is to report the uncommon presenting features of osteoid osteomas in the foot.

Methods: We retrospectively studied the clinical and radiographic findings in three patients with histologically proven osteoid osteomas of the foot.

Results: There were two boys (age 11 and 15 years) and one girl (age 14 years). The boys presented with painful macrodactyly of the toe (Figures 1, 2) of several months duration and the girl with a peroneal spastic flat foot. All three patients were misdiagnosed initially and two of the three had a prior failed surgical procedure and the third had been recommended surgery. Radiographically, the osteoid osteomas were located in the distal phalanx in one case, middle phalanx in another case and in the calcaneus in the subchondral bone at the angle of Gissane (Figure 3). All patients had a CT scan and one had an MRI as well. Two of the three patients had no sclerosis around the nidus. The time to appropriate diagnosis from the onset of symptoms was 12 to 18 months. All patients had surgical excision of the nidus with full relief of symptoms and resolution of the macrodactyly of the toes.

There were no complications from surgery and no recurrences were noted.

Conclusion: Osteoid osteomas of the foot can present with atypical clinical and radiographic features and mimic other pathologic entities such as painful macrodactyly and peroneal spastic foot. They may have a prolonged duration of symptoms, initial misdiagnosis is common.

Significance: Treating surgeons need to be familiar with the atypical presentations of osteoid osteomas in the foot in order to avoid misdiagnosis and to initiate appropriate treatment.

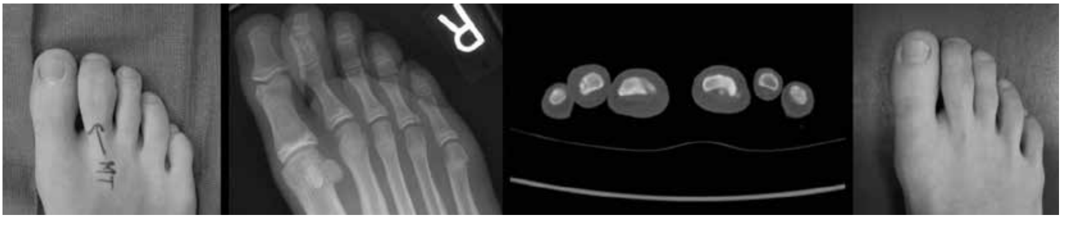
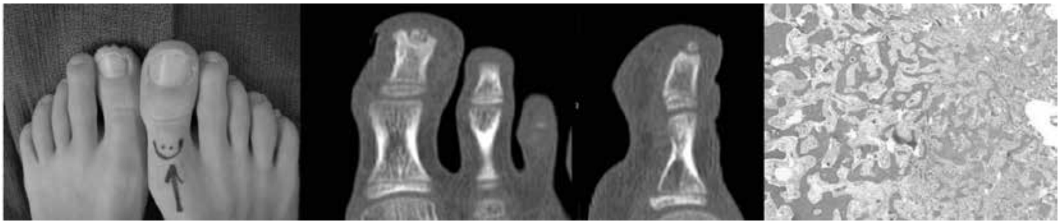


Figure 1.



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Venous Thromboembolism in Children: Details of 46 Cases Based on a Follow-up Survey of POSNA Members

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Introduction: Based on a recent online survey sent to active members of the Pediatric Orthopedic Society of North America (POSNA), 59% of the respondents acknowledged having encountered at least one child with the diagnosis of venous thromboembolism (VTE) in their practice. The current survey sought further information including patient demographics, underlying diagnosis, presence of certain risk factors for VTE and the clinical outcome.

Methods: A follow-up web-based survey was sent to 121 active POSNA members who had provided their contact information in the prior survey. Thirty-eight respondents provided clinical details on 46 pediatric patients.

Results: The mean age of the affected children was 14.3 (95% CI, 13.3 to 15.3) years and 61% were males. The average BMI was 28 (95% CI, 25-31) and 65% were Caucasian. 44% of patients were diagnosed with DVT, 26% with PE and 30% with both DVT and PE. Majority of the children had DVT involving the popliteal area or thigh (16 cases each). Most (93%) of the reported cases had more than one potential risk factor for VTE. Lower extremity surgery (29 cases, including osteotomies, internal fixation of long bone fractures, ACL reconstruction and resection of osteochondroma around the knee) and adolescence (28 cases) were the two most commonly cited associations. Other cases were noted with spinal surgery (8 children) and musculoskeletal infections (7 children). Three patients developed a post-phlebitic syndrome, one had recurrent DVT and two children died. Both deceased children were diagnosed with DVT and PE, including a 9 year old male with a positive family history of antithrombin-3 deficiency that was not noted pre-operatively.

Conclusion: While uncommon, VTE can occur amongst children with a variety of musculoskeletal ailments. Children with multiple risk factors, including lower extremity surgery and adolescence may have a higher predisposition for VTE.

Significance: Further investigation is warranted to ascertain the role of prophylaxis against VTE amongst children in an orthopedic practice.

See pages 15–57 for financial disclosure information.

Venous Thromboembolism in Children: A Survey of Pediatric Orthopaedic Society of North America (POSNA) Members

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Background: The term venous thromboembolism (VTE) includes deep venous thrombosis (DVT) of the extremity and pulmonary embolism (PE), a potentially fatal clinical entity. While the prevalence of VTE may be lower in children compared to adults, recent reports suggest a possible rise in this diagnosis among pediatric patients, especially in association with certain risk factors. We assessed the clinical experience and practice of members of the Pediatric Orthopaedic Society of North America (POSNA) related to VTE amongst their pediatric patients.

Methods: A 36-question online survey was sent to all 636 active POSNA members. The proportion of surgeons who had encountered at least one child with VTE and the respondents' practice of using thromboprophylaxis in children (<18 years old) was assessed. The relationship of responders' experience with VTE amongst pediatric patients with various practice characteristics was evaluated.

Results: The response rate was 56% (354/636). More than half (55%) (95% CI, 50-60%) of the respondents could recall at least one (median 2 cases/ member) pediatric patient with DVT and 29% (95% CI, 24-34%) could recall one or more child with PE. Approximately one-quarter (23%) (95% CI, 18-27%) of all respondents reported never using mechanical prophylaxis and almost one half (45%) (95% CI, 40-50%) of respondents reported never using pharmacologic prophylaxis against VTE in children. Only 16% (95% CI, 12-20%) of the respondents had a thromboprophylaxis protocol for pediatric patients. Respondent characteristics such as being in clinical practice <5 years (OR 0.42, p=0.01) and having a surgical volume of <100 cases/year (OR 0.33, p=0.03) were associated with a lower likelihood of encountering a pediatric patient with VTE.

Conclusions: More than half of active POSNA members reported having at least one case of VTE amongst pediatric patients in their practice. The routine use of VTE prophylaxis for children is uncommon amongst pediatric orthopedists. Further studies aimed at determining the prevalence of VTE and developing specific guidelines for prophylaxis amongst pediatric patients seeking orthopaedic care are warranted.

Significance: Further studies aimed at determining the prevalence of VTE and developing risk-stratified guidelines for prophylaxis amongst pediatric patients seeking orthopaedic care are warranted.

The Risk of Slipped Capital Femoral Epiphysis and Adolescent Tibia Vara Depends on Where You Live

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Purpose: Slipped capital femoral epiphysis (SCFE) and adolescent tibia vara (ATV) occur more frequently in obese children. To understand the role that the food environment plays in the risk of SCFE and ATV, we examined their association with increases the retail food environment index (RFEI), a ratio of unhealthy-to-healthy retail food outlets near an individual's home.

Methods: The records of all patients treated for SCFE/ATV from 2000-2009 were reviewed. After excluding patients with a metabolic bone disorder and those for whom the RFEI could not be calculated, 24 cases of SCFE/ATV were included. As a control group, 127 gender/age-matched patients with a distal radius-ulna fracture were randomly selected. Retail food outlet locations were obtained from the state department of agriculture and markets and the county health department and mapped, along with children's home addresses, using geographic information system software. Each child's RFEI was calculated by dividing the number of fast-food restaurants and convenience stores by the number of grocery stores, produce vendors, and farmer's markets around their home. Multivariate analysis and logistic regression were used to determine the risk of SCFE/ATV associated with the RFEI.

Results: There were no differences in the mean age or gender of the cases and controls. The rate of obesity was higher among cases of SCFE/ATV (83.3%) than among controls (29.1%, $p<0.0001$). The difference between the mean RFEI for patients with SCFE/ATV (11.5, SD=6.4) and the control group (6.6, SD=4.8) was statistically significant ($p<0.01$). After multivariate analysis controlling for BMI, age, gender, race, and urban residence, there was still a statistically significant increase in the risk of SCFE/ATV associated with an increase in RFEI (OR: 1.13, 95% CI: 1.02–1.26).

Conclusions: There is an association between an unhealthy RFEI score and the risk of SCFE/ATV independent of a child's BMI. Because the RFEI risk factor is independent of weight, we suspect the increased risk from living in areas with a high ratio of unhealthy-to-healthy food choices is due to factors beyond just increased calories and may be related to other nutritional or environmental factors.

Significance: Our study is the first to evaluate the association of the local retail food environment in childhood obesity-related musculoskeletal disorders. These findings suggest that health policies aimed at improving the food environment must be an important aspect in changing the prevalence of obesity and the risk of associated musculoskeletal health complications.

See pages 15–57 for financial disclosure information.

Spinal Deformity Correction in Conjunction with Tethered Cord Release

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Purpose: Scoliosis occurs in greater than 80% of children with myelodysplasia by the 10th year of life. It is considered to be multifactorial and progressive in nature. Symptomatic tethered cord (TC) following primary myelomeningocele repair occur in 11-27% of the patients. New onset/progressive scoliosis can be the first sign of symptomatic TC. Untethering of the spinal cord could help to stabilize the scoliosis. Existing literature agrees on the need of further evaluation to determine whether early untethering is beneficial stabilizing the spinal curvature long enough to allow skeletal maturity.

This study was designed to describe the progression of spine deformity following TC release in a group of patients who presented with new onset/progressive scoliosis.

Methods: Medical charts of 96 patients with history of myelomeningocele who underwent TC release between 1980 and 2010 were reviewed in a retrospective IRB approved study. Of the 33 patients that presented with a chief complaint of progressive spine deformity, 12 (group A) underwent TC release just before definitive spinal fusion (avg. age at release 11.3 yrs. and at fusion 11.6 yrs., all had cobb angle ≥ than 50°) after the TC was released while 21 (group B) were managed conservatively (avg. age 6.2 yrs. at release) after the TC was released.

Results: In group A, none of the patients had any functional change following definitive spine surgery. One patient had wound infection and one had a change in bladder function. In group B, 14 patients had curves ≥ 46° while 7 had ≤ 45° at the time of TC release. 6 patients were thoracic, 14 were L1-L4, one was L5+ functional level. Average follow-up in group B was 3.8 years (1 yr. to 6.4 yrs.). 10/21(47.6%) patients in group B ultimately required definitive spinal surgery. TC release delayed definitive spine surgery an average of 3.2 years.

Conclusions: The results demonstrated that TC release without additional corrective spine surgery could be able to adequately stabilize spinal deformity in patients with myelodysplasia and could be a temporary measure to “buy time” in young patients before the definitive spine surgery.

Significance: Scoliosis is an important indicator of tethered cord in myelomeningocele patients. TC release may to stabilize the curve and delay the definitive surgery.

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Fat Embolism Syndrome in Patients with Duchenne Muscular Dystrophy

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Purpose: Patients with Duchenne muscular dystrophy (DMD) are at increased risk for low energy fractures due to immobilization and corticosteroids. Fat embolism syndrome (FES) is not a well-recognized complication in DMD.

Methods: We identified 8 DMD boys age 14 to 20, 1 ambulatory, 7 in wheelchair, 5 on prednisone and 2 on deflazacort, all with underlying osteopenia, who presented with acute encephalopathy and hypoxia after a low energy fall and describe their courses.

Results: Five fell on their knees from the wheelchair, 2 had a minor fall during transferring from shower chair to wheelchair and 1 fell while walking. All patients had nondisplaced distal femur fractures. In 2, the fracture was missed at the time of initial presentation. Visual symptoms were reported in 2 patients; dilated eye exam showed Purtscher retinopathy with fat emboli in the vasculature in one. Altered mental status ranged from agitation and confusion to coma. All had tachycardia and leucocytosis. 2 had a petechial rash. Chest CTs showed diffuse ground glass opacifications, nodular densities and atelectasis. Brain MRI showed cortical and subcortical hyperintense foci in diffusion weighted MRI (DWI). Outcome included death in 3, permanent ventilator dependence with a persistent vegetative state in 1 and complete recovery in 4.

Conclusion: FES should be considered in all DMD patients who present with acute mental status changes or respiratory decompensation. In these patients, low energy fractures may occur from even minor falls or from manipulation during transfers and can be overlooked.

Significance: We suspect that FES is an under recognized cause of sudden death in DMD. As the natural history of DMD continues to change with more prolonged survival and ambulation and longer use of corticosteroids, FES and other morbidities not well recognized will likely be seen more often. Because orthopedists may be the first to see these patients, their improved awareness should lead to more prompt recognition and appropriate treatment for this cause of morbidity and death in DMD. Further, as this patient population expands and survival is extended, bone density and fracture prevention must be better addressed.

See pages 15–57 for financial disclosure information.

The Effect of Plantarflexor Lengthening on Foot Pressure in Children with Cerebral Palsy

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Purpose: Tendo-achilles and gastrocnemius lengthenings are often performed in children with cerebral palsy (CP) to correct equinus. Foot deformities are common in children with CP and can be associated with plantarflexor weakness or contracture. Pedobarographs quantify dynamic foot pressure and can be used to identify varus and valgus foot postures underlying equinus and to evaluate surgical outcomes. The purpose of this study was to assess the effects of plantar flexor lengthenings on dynamic foot pressures of children with CP using pedobarograph.

Methods: Ninety-seven children with CP were recruited in this Level II IRB approved prospective longitudinal comparison study. Of the 97, 13 children (8 unilaterally, 5 bilaterally involved) underwent plantarflexor lengthening (17 legs) and were evaluated with pedobarograph and physical exam at preoperative, short-term (within 14 months of surgery), and long-term (between 14 and 27 months from surgery) post-operative visits. The average age at surgery was 4.9±2.0 years. Results were compared to age-matched normative data, and a control group of children with CP who did not have surgery and were matched for age and pattern of involvement. Outcome measures included the coronal plane pressure index (CPPI), and the impluse from the heel, medial midfoot, lateral midfoot, medial forefoot, and lateral forefoot.

Results: Significant equinus correction was observed with increases in heel impulse and dorsiflexion passive range of motion ($p<0.05$) in children with CP that underwent plantar flexor lengthening surgery. CPPI and medial midfoot impulse increased and lateral forefoot impulse decreased ($p<0.05$) demonstrating an increase in valgus foot posture post-operatively. No significant changes in foot pressure were noted in the matched control group with CP. When separated by pre-operative presentation, children presenting with varus initially moved toward valgus ($p<0.01$), while those patients initially in valgus demonstrated no significant change in varus/valgus foot posture.

Conclusion: In addition to obtaining a plantigrade foot during gait, significant increases in CPPI, medial midfoot impulse and a significant decrease in lateral forefoot impulse show that plantar flexor lengthening has a significant effect on foot pressure and creates a trend from varus to valgus in children with cerebral palsy.

Significance: Plantarflexor lengthening procedures are common in children with CP. In children with CP with equinus, varus or valgus foot deformities are often present. Surgical correction of the equinus will usually drive the foot toward valgus. In young children there should be great caution to avoid over treating varus at the time of equinus correction to avoid overcorrection.

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How Much Degree Do Torsional Structural Deformities Determine Rotational Gait Parameters in Patients with Diplegic Cerebral Palsy?

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Purpose: This study was to investigate the degree of contribution of torsional bony deformities to rotational gait parameters in patients with dipegic cerebral palsy(CP). The relationship between torsional bony deformities and rotational gait parameters has not been sufficiently investigated.

Methods: Thirty three legs from 33 consecutive ambulatory patients (average age 9.5 years, SD 6.9 years; 20 males and 13 females) with diplegic CP who underwent preoperative three dimensional gait analysis, foot radiographs, and computed tomography(CT) were included. Adjusted foot progression angle (FPA) was retrieved from gait analysis by correcting pelvic rotation from conventional FPA, which represented the rotational gait deviation of the lower extremity from the tip of the femoral head to the foot. Correlations between rotational gait parameters (FPA, adjusted FPA, average pelvic rotation, average hip rotation, and average knee rotation) and radiologic measurements (acetabular version, femoral anteversion, knee torsion, tibial torsion, and anteroposterior talo-first metatarsal angle) were analyzed. Multiple regression analysis was performed to identify significant contributing radiographic measurements to adjusted FPA.

Results: Anteroposterior talo-first metatarsal angle showed the highest interobserver reliability (ICC=0.967), and acetabular version the lowest (ICC=0.426). Adjusted FPA was significantly corrected with FPA ($r=0.837$, $p<0.001$), contralateral FPA ($r=0.492$, $p=0.004$), pelvic rotation during gait ($r=-0.489$, $p=0.004$), knee rotation during gait ($r=0.376$, $p=0.031$), and femoral anteversion ($r=0.350$, $p=0.046$). In multiple regression analysis, femoral anteversion ($p=0.026$) and tibial torsion ($p=0.034$) were found to be the significant contributing structural deformities to the adjusted FPA (R2=0.247).

Conclusions: Femoral anteversion and tibial torsion were found to be the significant structural deformities that could affect adjusted FPA in patients with diplegic CP. Femoral anteversion and tibial torsion could explain only 24.7 % of adjusted FPA.

Significance: Adjusted foot progression angle, which corrects the effect of pelvic rotation, appeared to be clinically more relevant than foot progression angle in patients with diplegic cerebral palsy. Furthermore, femoral anteversion and tibial torsion were found to be the significant structural deformities that could affect adjusted foot progression angle.

See pages 15–57 for financial disclosure information.

Pain Reduction following Cerebral Palsy Surgery

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Purpose: To determine pain relief following minimally invasive interventions with the Selective Percutaneous Myofascial Lengthening (SPML) techniques in patients with communication difficulties.

Methods: All patients with preoperative and one year followup pain scores who had SPML techniques were included. Of the 23 patients, 14 were nonverbal and 9 had a few or some words. None could rate their own pain on a scale of 1 to 10. Age ranged from 2 to 19 years. Patients had GMFCS II (3), III (2), IV (1), and V (17). The Paediatric Pain Profile was used. This is a 20 item behavior rating scale designed to assess pain in children with severe neurological disability. It has been determined to be reliable and valid. Questions relate to factors such as cheerfulness, crying, disturbed sleep, grinding teeth, and spasms. Each item is scored 0, 1, 2 or 3 with 60 being the highest possible score. Scores of 14 or higher are considered indicative of significant pain. Our patients had preoperative pain scores ranging from 0 to 45. The operative techniques used were as follows. 22 patients had lengthening that included hip adductors and/or hamstrings and/or gastrocnemius. 18 patients had ethanol nerve blocks of obturator and/or tibialis posterior nerves. 5 of 7 patients with widely dislocated hips had intraarticular ethanol hip joint injections for treatment of painful dislocations.

Results: The mean pain score was 16 preoperatively and 11 postoperatively (p=0.006). 15 of 23 children had lower pain scores one year following surgery. Of the 12 with preoperative scores of 14 or higher, indicative of significant pain, 10 showed improvement. Four questions had a significant change between pre and postoperative. They related to 1) grinding teeth, 2) tensing/stiffening/spasming, 3) twisting and turning/tossing head/writhing/arching back, 4) involuntary movements/stereotypical movements/jumpiness/startling/seizures.

Conclusion: Minimally invasive techniques can decrease pain at one-year follow-up in nonverbal and minimally verbal children with cerebral palsy. The pain relief was seen both in the group with significant pain and the group with less than significant pain.

Significance: Chronic pain is a problem for many children with cerebral palsy. In addition to aiding in ease of care and sitting, minimally invasive techniques can decrease pain.

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Conflict of Interest in the Assessment of Botulinum Toxin A Injections in Patients with Cerebral Palsy: A Systematic Review

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Purpose: The efficacy of using botulinum toxin A injections in cerebral palsy is controversial. The financial conflict of interest related to medical research can affect the conclusion of an evidence-based review. This study was performed to determine what proportion of studies on botulinum toxin A injections in patients with cerebral palsy was sponsored by the industry and whether the assessments of botulinum toxin injection in cerebral palsy were associated with industry support.

Methods: Studies were identified with a search of the PubMed database (January 1991-November 2011). All prospective, comparative, English-language studies on use of botulinum toxin A injections in patients with cerebral palsy were included. A total of 374 articles were screened, 128 potentially eligible full articles were retrieved, and 66 studies met our inclusion criteria. The funding sources of the articles were reviewed, and qualitative conclusions regarding the effect of botulinum toxin A injection were classified as being either favorable, neutral, or unfavorable.

Results: Of sixty-six eligible articles, 28 were funded by the industry, and 25 were not. The other 13 studies did not include information on the funding source. A significant association was observed between the funding source and qualitative conclusions ($p = 0.042$). Fifteen (53.6%) of the 28 industry-sponsored studies had favorable conclusions, whereas only five (20%) of the 25 non-industry-sponsored studies had favorable conclusions. Twenty-two (78.6%) of the 28 industry-sponsored studies had results that confirmed the primary hypothesis, compared to 13 (52%) of the 25 non-industry sponsored studies ($p=0.041$).

Conclusions: The majority of studies on the effect of botulinum toxin A in cerebral palsy are sponsored by the industry. This systematic review revealed that the qualitative conclusions in those studies had a significant association with the funding source. Clinicians should be aware of an industry-related conflict of interest regarding a report on the efficacy of botulinum toxin A injections in patients with cerebral palsy.

Significance: Given the finding that qualitative conclusions in studies on the effects of botulinum toxin A in cerebral palsy are associated with a funding source, clinicians should be aware of an industry-related conflict of interest regarding a report on the efficacy of botulinum toxin A injections in patients with cerebral palsy.

See pages 15–57 for financial disclosure information.

Ciliary Neurotrophic Factor Mitigates Denervation-Induced Muscle Growth Impairment following Neonatal Brachial Plexus Injury

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Purpose: Contractures following neonatal brachial plexus injury (NBPI) have recently been shown to be associated with impaired longitudinal growth of denervated muscle, characterized by increased sarcomere elongation under stretch. This study tests the hypothesis that this denervation-induced growth impairment can be mitigated by the exogenous administration of ciliary neurotrophic factor (CNTF), based in its ability to mitigate denervation atrophy in adult muscle.

Methods: Extraforaminal global (C5-T1) brachial plexus injuries were surgically created in 5-day-old CD-1 mice. Biceps and brachialis muscles were harvested immediately following NBPI and at four weekly intervals for immunohistochemical identification of CNTF receptors (CNTFRα, LIFRβ and gp130) in muscle satellite cells by 100X confocal microscopy. An additional 31 mice, immediately following global NBPI, received 10 daily subcutaneous injections of either placebo (PBS) or CNTF (0.5mg/kg). Animals were sacrificed 4 weeks post-operatively. Elbow passive range of motion was measured with a validated digital photography technique while blinded to treatment group. The biceps and brachialis muscles from 14 mice (7 CNTF; 7 PBS) were harvested and stained with Masson's Trichrome for histologic cross-sectional area (CSA) measurement. The forequarters from the remaining 17 mice (9 CNTF, 8 PBS) were removed and fixed in formalin at 90° elbow flexion. Following fixation, the biceps and brachialis were removed, stained with 25% Lugol's solution and imaged by MicroCT for muscle volume and stretched CSA, and then dissected into fiber bundles for sarcomere length measurements under 40x oil DIC microscopy.

Results: CNTFRα, LIFRβ and gp130 receptors were expressed in biceps and brachialis muscle satellite cells during the 4 weeks following NBPI. CNTF administration following NBPI significantly reduced the denervation-induced increase in brachialis sarcomere elongation under stretch when compared to placebo (CNTF: mean 2.55μm; PBS: mean 2.70μm; p=0.011, unpaired t-test). This improvement of longitudinal growth was more robust than the nearly significant improvement in stretched CSA (CNTF: mean 0.66mm$^{2;}$ PBS: mean 0.58mm^2; p=0.073, unpaired t-test). However, at this dose, the mitigation of longitudinal muscle growth impairment did not statistically reduce the severity of elbow flexion contractures. CNTF caused no significant effects on biceps growth, either in sarcomere elongation or cross-sectional area.

Conclusion: CNTF mitigates the denervation-induced longitudinal growth impairment of the brachialis following NBPI. Investigation is warranted regarding dosing and administration to translate this effect on brachialis muscle growth into clinically appreciable effects on contractures.

Significance: The present study demonstrates the potential for medical mitigation of the growth-related component of NBPI-induced contractures.

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Incidence of Meniscal Tears and Chondral Pathology in Anterior Tibial Spine Fractures of Children

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Purpose: The study aim was to determine the incidence of meniscus and cartilage injuries in cases of pediatric anterior tibial spine fracture. The hypothesis was anterior tibial spine fractures in pediatric patients are frequently associated with concomitant injuries to menisci or cartilage.

Methods: Retrospective review of single tertiary referral children's institution's charts from 1996 to 2012. Inclusion criteria: patients aged 5-18 years, documented anterior tibial spine fracture, MRI of affected knee and/or underwent arthroscopic surgery. Surgery and/or MRI must have been performed ≤ 35 days from injury. Operative reports were reviewed for documentation of: meniscal or intermeniscal ligament entrapment, meniscal tear with location and laterality, or chondral pathology. Each MRI was reviewed by a pediatric radiologist and pediatric orthopaedic surgeon. McKeever classification of avulsion fracture was then used to group analyses into concomitant injuries, demographics, and mechanism of injury. The study consisted of 1332 charts: 49 patients with arthroscopic surgical intervention and 16 patients with MRI of the knee.

Results: There was noted to be a male predominance with tibial spine fractures type 2 and 3 of 60%. Most common mechanisms of injury causing type 2 and 3 tibial spine avulsion fractures were football, soccer, skiing and bicycling. Meniscus tears were noted in 26.5% of all tibial spine fractures, meniscus entrapment in 40.8% and chondral injuries in 8.2%. When the meniscus was torn it was the lateral meniscus in 78% of cases. Overall concomitant injuries were noted in 63.3% of all tibial spine avulsion fractures type 2 or 3.

Anterior Tibial Spine Fracture Study
Incidence of Concomitant Injury by Fracture Type

Fracture type	N	Meniscus Tears	Chondral Injuries	Meniscus Entrapment	Meniscus Tear + Chondral Injury
Type I	0	NA	NA	NA	NA
Type II	25	9 (36%)	2 (8%)	8 (32.0%)	11 (44%)
Type III	24	4 (16.7%)	2 (8.3%)	12 (50%)	6 (25%)
All	49	13 (26.5%)	4 (8.2%)	20 (40.8%)	17 (28.6%)

Concomitant Injury (all comers) 31/49 = 63.3%

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Conclusion: Due to the high incidence of concomitant injuries found in pediatric patients with tibial spine fractures we recommend obtaining an MRI for all McKeever type 2 and 3 patterns or treatment with arthroscopic evaluation and treatment of tibial spine fracture and associated injuries.

Significance: There is a no consensus in the literature with respect to concomitant injuries associated with anterior tibial spine fractures. These efforts help clarify the correlation between tibial eminence fractures and meniscal injuries of the knee. Such knowledge will improve clinical management of anterior tibial spine fractures.

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Normal Parameters of Skeletally Immature Knees: Developmental Changes on Magnetic Resonance Imaging

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Purpose: A child's knee undergoes significant morphologic changes during development. Age-specific normal parameters have not been previously described. The purpose of this study was to delineate the changes that occur with growth utilizing magnetic resonance imaging (MRI).

Methods: A retrospective review of a radiologic database of MRI knees, ages 4 to 18 years, was undertaken using "normal" diagnosis codes, including: knee pain, plicae, septic arthritis, jumper's knee, growing pains, benign neoplasm, and osteomyelitis. 19 osseous parameters were measured, plus their cartilaginous counterparts, if different. Spearman's rho correlations were calculated between age and MRI measures.

Results: 132 MR images were reviewed. Significant correlation with age was observed in all but MPFL insertion on the sagittal view for the osseous measurements ($p<0.05$). Similarly, the cartilage measures all demonstrated significant correlation with age except MPFL insertion on the sagittal view, but also the Notch-Width index, and trochlear morphology. The magnitude of correlation was significantly different between the osseous and cartilage measures for all but 3 of the variables: osseous and cartilage Insall-Salvati ratios, and insertion of MPFL on the femur. Osseous patella height stabilizes by age 10 with values ranging from 0.9-1.2 until age 18. Cartilage patella height demonstrates a modest linear increase with age (rho=0.352). MPFL insertion on the sagittal view remains stable with age (rho=0.036, $p>0.05$) and the mean insertion remains below the growth plate (11.5 mm to 4.9 mm). On the coronal view, MPFL insertion modestly increases with age (rho=0.33, $p<0.001$) starting below the growth plate on average (4.3 mm to 2.6 mm), until age 7 when the mean insertion appears to be at or above the growth plate.

Conclusion: Most of the studied parameters follow a clear trend of growth and change in size that correlates with maturity. However, the normal Insall-Salvati ratio that delineates patella alta does not appear to be within the normal range until age 10. Furthermore, the discrepancy in the literature concerning the location of the MPFL insertion on the femur in relation to the physis may be attributed to migration of the insertion site during maturation.

Significance: This evaluation of the normal development of the child's knee indicates that the Insall-Salvati ratio does not normalize until age 10; and that, the MPFL insertion is below the physis until age 7 when it inserts at or above the physis.

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Medial Patellofemoral Ligament Reconstruction and Semitendinosus to Patella Transfer in Skeletal Immature Patients

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Purpose: The most important stabilizing structure of the patella is the medial patella femoral ligament (MPFL), which provides between 50 and 80% of the restraining force to lateral displacement of the patella. In patients with ligamentous laxity, bony malalignment, and patellar instability, MPFL reconstruction alone can fail over time. Distal realignment may be necessary. We describe a technique for treating skeletally immature patients with an elevated Q angle and generalized ligamentous laxity resulting in chronic patellar instability.

Methods: A series of 7 patients are reported following MPFL reconstruction and semitendinosus transfer. After knee arthroscopy and lateral release, a medial incision is made overlying the medial tibial condyle. The semitendinsosus tendon is harvested leaving the distal attachment in intact. The graft is passed transosseously from the distal pole of the patella to the medial border of the patella through an oblique drill hole. The graft is then sutured in place at the medial border of the patella. The free end of the semitendinosus graft is passed to the medial epicondyle and fixed with an interference screw in a horizontal drill hole placed just above Blumenstadt's line.

Results: 7 Cases are reported with age ranges from 7 to 13 years old. All patients have returned to full activity with normal patellar tracking and no pain. In one case, knee flexion was limited to 90 degrees at 3 months. In another case the MPFL reconstruction was augmented with a gracilis tendon due to inadequate length of the semitendinosus tendon during harvest. One patient, at 6 months post-op, continued to have some quadriceps weakness requiring strengthening. A 13 year old patient developed a wound infection post-operatively requiring re-admission for debridement. The graft was not involved and by 3 months the patient was doing well without signs of infection

Conclusion: The surgical technique in this case series was applied to patients suffering from patellar instability due to high Q angles, diffuse ligamentous laxity, and alterations from normal osseous anatomy. All patients in this series have done well subjectively without recurrence of instability.

Significance: Medial patellofemoral ligament reconstruction using semitendinosus autograft and semitendinosus to patella transfer is a viable treatment option for skeletally immature patients with patellar instability. This technique can be used in patients with elevated Q-angles and diffuse ligamentous laxity.

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Guided Growth for Angular Deformities About the Knee in Skeletally Immature Patients: A Systematic Review of Literature to Identify Successful Correction and Associated Complications

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Purpose: Guided growth using different modalities has become an accepted modality of treatment for angular deformities in growing children. Various centers advocate different techniques (with different implants) despite limited evidence to prove the superiority of one over the other. A systematic review was performed to assess the effectiveness and safety of guided growth using various modalities for correction of coronal plane angular deformities about the skeletally immature knee.

Methods: We performed a systematic review of the medical literature using the search terms "guided growth", hemiepiphysiodesis, "tension band plate", "8 plate", "eight plate", "physeal adj3 stapling", "hemiepiphyseal adj3 stapling", "epiphyseal adj3 stapling", "transphyseal screw" and "transphyseal screws". EMBASE and MEDLINE databases were used and the search was limited to human subjects and English language. Two reviewers selected articles in an independent, stepwise manner. Studies investigating guided growth for the correction of angular deformity in the coronal plane about the knee were included. Exclusion criteria included inadequate follow-up, less than 10 subjects in a given study, and outcome data not clearly separated by surgical technique.

Results: 153 articles were identified. 23 studies were included for data extraction after full text review. These studies include 1196 angular deformities. Both pathologic and idiopathic etiologies of genu varum and genu valgum were included. The average age was 10.5 years (range 2.7-17) with 31 months follow-up (range 5 to 168). Documented successful correction was achieved in 86% of deformities (range 67-100%), with a higher incidence of failure in pathologic physes. Complications included hardware failure (16), post-operative infection (4 deep), overcorrection (13), hardware migration (25), limb length deformity (4), nerve palsy (1) and stiffness (1). Combined complication rate was 5.4% (64/1196). Rebound deformity was reported in 48 extremities but the incidence could not be calculated due to inconsistent documentation of follow-up after hardware removal. There was one reported case of physeal arrest with a medial femoral stapling in a pathologic physis.

Conclusion: Guided growth with tension band plate, transphyseal screw, or staple constructs was found to be effective for deformity correction about the knee in skeletally immature patients. Clinicians should be aware of complications inherent to the device and the procedure. Prospective multi-center studies will be necessary to identify the incidence of rebound deformity and potential for physeal damage/arrest.

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Recurrent Blount Disease

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Blount disease is a developmental condition characterized by disordered endochondral ossification of the medial part of the proximal tibial physis resulting in multi-planar deformities of the lower limb [Sabharwal, 2009]. Tibia vara has been classified as infantile, juvenile, and adolescent, the infantile form occurring before the age of 4, the juvenile form between 4 and 10 years of age and the adolescent form after 10 years. We report treatment of recurrent severe cases.

Patients and Methods: From 1998 till 2009 31 cases with recurrent Blount disease were referred to us. 14 cases were early onset and 17 cases were late onset. Infantile cases were type V or VI Langskiold classification. Age of patients ranged from 7 – 16.5 years. There were 4 bilateral cases.

Operative technique: For infantile cases: Acute medial plateau elevation, metaphyseal osteotomy, application of Ilizarov Fixator and gradual correction of all deformities. For late onset recurrent cases: metaphyseal osteotomy, gradual correction by Ex Fix & correction of the secondary lower femoral deformities by guided growth method. Laxity of the lateral ligament was treated indirectly by differential lengthening. The patients were evaluated clinically and radiographically to investigate: pain, ROM, functional activity level, mechanical axis deviation.

Results: Follow-up ranged from 2 – 9 years. There was improvement of LDF angle from 93 to 88 & the MPT angle from 73 to 88. Magnitude of lengthening ranged from 1 to 5.5 cm. Recurrence developed in 4 cases.

Complications: Some sort of pin track infection in all cases, fracture of the regenerate in one case, DVT in one case.

Conclusion: Treatment of recurrent cases with blount disease is difficult to treat using a single method. Acute elevation of the medial part of the plateau and gradual correction from the metaphyseal osteotomy using a circular fixator proved to correct all deformities in recurrent severe early onset cases of Blount disease. Gradual correction with distraction osteogenesis is an effective means of achieving an accurate multi-planar correction, especially in patients with late-onset disease.

Significance: Treatment of all elements of deformity in recurrent cases can minimize the rate of recurrence.

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Correlation of Long-Term Functional and Radiographic Outcome in Developmental Dysplasia of the Hip

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Purpose: Previous classification systems for developmental dysplasia of the hip (DDH) lacked objective criteria and validation to predict functional outcome in adulthood after treatment in childhood. We aimed to establish inter- and intra-observer reliability for various radiographic indices describing the skeletally mature dysplastic hip and to identify a set of parameters that would correlate with clinical outcome scores.

Methods: Patients >18 years treated for idiopathic DDH with a minimum of 10-year follow-up returned for evaluation with standing anteroposterior (AP) pelvis and false profile (FP) views. The following parameters were measured: acetabular inclination (AI), lateral (LCEA) and ventral (VCEA) center edge angle, lateral (LHS) and vertical (VHS) femoral head subluxation, peak-to-edge distance (PE), femoral head extrusion index (FHEI) and roundness ratio (RR). Radiographs were reviewed for presence of crossover sign, intact Shenton's line, congruency, and osteoarthritic changes using the Tönnis system. Three orthopaedic surgeons independently reviewed radiographs of 30 hips on two separate occasions. Inter- and intra-observer agreement was measured using the kappa coefficient and the intra-class correlation coefficient (ICC). Patients completed the WOMAC functional questionnaire.

The student t-test and Fisher exact test were used to identify radiographic variables that correlated with a good WOMAC score (<15). A backward selection logistic regression analysis was used to find the smallest set of candidate variables such that each was significant ($p<0.05$). An estimated probability of 0.5 or greater for the occurrence of a good WOMAC score was used to determine the effectiveness of the logistic regression.

Results: Eighty-eight patients with average follow-up of 22 years (range 10-54) completed the study. ICC values suggested strong interobserver (0.75-0.98) and intraobserver (0.74-0.96) agreement for all objective measurements except PE. Kappa values showed only a fair to moderate interobserver (0.3-0.63) agreement for subjective measures Regression analysis indicated only the AI ($r=0.5$), LCEA ($r=-0.4$), and VCEA ($r=-0.4$) correlated with WOMAC scores. An AI of less than 10° correlated with a good WOMAC score 85% of the time. An LCEA and VCEA of 20-30° predicted a low WOMAC score 79 and 77% of the time, respectively.

Conclusion: Reliability is much stronger for measuring objective radiographic indices compared to interpreting subjective parameters. The AI, LCEA, and VCEA correlated with WOMAC scores in skeletally mature patients previously treated for DDH.

Significance: Previously published normal values for AI, LCEA, and VCEA were predictive of good self-reported functional outcomes and may serve as a quantifiable method for classifying radiographic outcome for DDH.

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Can Patients Expect to Have the Same Activity Level following a Periacetabular Osteotomy?

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Purpose: The purpose of this study was to review the activity level following a Ganz Periacetabular Osteotomy (PAO) and compare it to pre-operative activity levels using the UCLA activity score.

Methods: A retrospective review of prospectively collected data was performed on forty-five consecutive PAOs in forty-one patients for symptomatic hip dysplasia. All surgeries were performed by one of two surgeons. Standard radiographic parameters and the modified Harris Hip Score (mHHS) were compared pre and postoperatively. The UCLA activity score was used to compare pre-operative activity level with post-operative activity level. Demographic, perioperative data, and complications were reviewed. Continuous and categorical data were compared using a Student t-test and a Chi square test, respectively. Differences between activity groups at different time periods were analyzed using ANOVA with alpha <0.05.

Results: The mean age at surgery was 15.8 years (10.2 – 21.8 years) with an average follow-up of 14 months. Mean pre-operative and post-operative lateral center edge angles, ventral center edge angles, and acetabular indices improved from -3° to 28°, -6 to 25°, and 27° to 7°; respectively. The average pre-operative UCLA score of 7.2 was not statistically different from the post-operative score of 7.6 (p=0.414). The patients were stratified into three groups based on change in activity level: increased in 18, no change in 11 and decreased in 16. Nine of twenty (45%) high-level athletes (UCLA 9 or 10) and thirteen of twenty-seven (48%) athletes (UCLA 7-10) returned to the same or a higher level of activity. There was no difference in type or severity of dysplasia (p=0.362), estimated surgical blood loss (p=0.740), or surgical time (p=0.972) amongst the three groups. The pre-operative, post-operative, or change (improvement) in mHHS score was not different between the three groups. More complications were seen in those with decreased UCLA scores (n=3) than those who had an increase in UCLA score (n=0) (p=0.054).

Conclusions: The average activity scores following a Ganz PAO are the same. Two-thirds of patients return to their pre-operative activity level following a PAO for hip dysplasia. Those involved at a higher level of activity can expect to have at least a 45% chance of returning to the same level of activity. Complications following a PAO can negatively impact return to activity.

Significance: A Ganz PAO for hip dysplasia can be performed with improved symptoms and a majority of patients returning to the same or improved level of activity.

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In-Situ Stabilization with Primary Osteochondroplasty for Mild Slipped Capital Femoral Epiphysis: Pilot Study with Early Results

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Purpose: In-situ stabilization is the most widely accepted treatment method for mild slipped capital femoral epiphysis (SCFE). We started a new technique of in-situ pinning with primary open osteochondroplasty (POCP) that stabilizes the physis and also addresses the proximal femoral morphology. We questioned whether this approach can: 1) substantially decrease the head neck offset as quantified by the alpha angle? 2) allow for continued maintenance of motion obtained intra-operatively with eventual return to full activities.

Methods: Nine cases of mild SCFE (mean age: 12.8 years) were treated with in-situ pinning and POCP. A five cm incision using the central part of modified Gibson approach was used in the lateral position, using the interval between the gluteus medius and iliocapsularis to reach the anterior hip. After in-situ pinning under direct visualization, a high-speed burr was used to perform the POCP. Alpha angle was measured on both preoperative and postoperative lateral radiographs. Forward flexion (of 120°) and internal rotation (of 40°) was assessed intra-operatively before completing the procedure. Average patient follow-up was 5 months (range 3-9 months).

Results: Preoperative alpha angle (mean 70.4°) decreased by an average of 24.4° postoperatively (mean 46.2°). Preoperatively all patients had restricted hip flexion with obligatory external rotation. At most recent follow-up hip flexion was maintained at 120° (mean) and internal rotation was 30° (mean). At most recent follow-up all patients were pain-free, all except one (3 month post-op) had returned to their pre-injury activities without pain and there were no wound healing or major complications.

See pages 15–57 for financial disclosure information.

Conclusions: SCFE is known to be a significant risk factor for the development of femoroacetabular impingement (FAI) and early osteoarthritis (OA) and in-situ stabilization is likely a temporary solution to an ongoing problem. Our approach of addressing stabilization and impingement morphology primarily has shown good early results. Whether longer follow-up will show stable epiphysis with lack of symptomatic FAI, remains to be seen.

Significance: Restoring head-neck offset and range of motion with SCFE stabilization and POCP creates the environment to possibly improve the long-term outcomes in these patients without subjecting them to a major procedure like open reduction. Further studies with will be needed to confirm the long-term success of this treatment option.

Previously Described Radiographic Parameters of Femoroacetabular Impingement are Common in Asymptomatic Patients

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Purpose: The purpose of this study was to document the prevalence of radiographic femoroacetabular impingement (FAI) morphology in adolescents with no symptomatic hip problems.

Methods: Alternating between male and female, 45 anterior posterior (AP) pelvis images (90 hips) of consecutive patients were obtained. Patients were included if: both femurs were visualized to the level of the lesser trochanter, the pelvis was within acceptable limits of rotation and inclination, and they had no pre-existing congenital hip problems or previous history of hip surgery. Another age-matched cohort (90 hips) of patients with scoliosis was evaluated. Images were analyzed for previously described radiographic features of FAI: coxa profunda, protrusio acetabuli, Tonnis angle, anterior alpha angle, center-edge angle, acetabular cross over, ischial-spine sign, and neck-shaft angle.

Results: 92.8% of hips showed evidence of at least one parameter suggesting impingement morphology while 52.2% showed at least two. 81.7% of hips had evidence of coxa profunda, while 31.1% had negative Tonnis angles and 15.0% had center edge angles indicative of acetabular over coverage. 27.2% of hips had an acetabular cross over sign while 5.6% male hips and 6.7% female hips had an abnormal anterior alpha angle. Statistical analysis revealed that abnormal alpha angles ($p=0.029$), cross over signs ($p=0.029$), and ischial spine signs ($p=0.026$) were more common in our non-scoliosis cohort, and coxa profunda was more common in females ($p=0.034$).

Conclusions: There was a high prevalence of radiographic impingement morphology beyond the spectrum of normal in this double-cohort study of adolescents with no hip related symptoms. FAI remains a dynamic problem and we caution the use of hard-set static radiographic parameters when evaluating FAI.

Significance: This study raises the important question of what morphology should be defined as abnormal, when some form of abnormal morphology is noted in such a large segment of the population. Based on normative data obtained, reference values for radiographic parameters of FAI morphology should be redefined. In addition, surgical indications should be tailored to the entire clinical assessment including physical exam findings and not just radiographic findings alone.

See pages 15–57 for financial disclosure information.

Periacetabular (Bernese) Osteotomy in the Treatment of Hip Dysplasia in Ambulatory Patients with Cerebral Palsy

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Purpose: Obtaining satisfactory correction of acetabular deficiency in the comprehensive surgical treatment of symptomatic hip instability in skeletally mature ambulatory patients with cerebral palsy can be technically challenging. This is a report of our experience with a surgical approach that includes performing a Bernese PAO in the treatment of selected patients with problematic acetabular hip dysplasia associated with cerebral palsy.

Methods: Between 1997 and 2011, 11 ambulatory or potentially ambulatory patients (12 hips) with functionally limiting unstable hip dysplasia associated with cerebral palsy were treated with a periacetabular osteotomy. The average age at surgery was 19 years (range 13-29). Seven patients had spastic diplegic cerebral palsy and four patients had spastic hemiplegic cerebral palsy. Eight patients required additional procedures at the time of PAO, three femoral osteochondroplasties, five open adductor tenotomies and four proximal femoral osteotomies. Pre and postoperative history, clinical exam and radiographic findings were evaluated.

Results: The Bernese PAO was very effective for us in obtaining correction of the acetabular deficiency. Lateral center-edge angle improved from a preoperative mean of -3.6 degrees to mean of 31.6 degrees postoperatively. Average anterior CEA before surgery was 6.4 degrees compared to 37.1 degrees after surgery. The average Tonnis angle before surgery 29.6 degrees and 11.7 degrees after surgery. Migration index was 50.2% preoperatively and 13.4% postoperatively. Average follow-up was 54 months (range 12-92 months). Noted functional improvement (including regaining variably independent ambulation) was achieved in all patients. The mean preoperative modified Harris hip score (HHS) (difficult to apply to this group of neuromuscular patients) was 57 (range 37-81) and the postoperative mean HHS 71 (range 60-93).

Conclusion: Incorporating the Bernese PAO into our surgical treatment protocol of the unstable neuromuscular CP hip in older ambulatory patients has proven to be very efficacious in predictably obtaining comprehensive surgical correction of painful hip instability. Improved functional outcome has been achieved in all patients.

Significance: To be successful, surgical treatment of unstable CP hip dysplasia in the adolescent and young adult must satisfactorily correct not only soft tissue contracture and muscle imbalance but also bony (acetabular and at time femoral) deformities. By combining the Bernese PAO with, as needed, adjunctive procedures, we have been able to both restore static hip stability and soft tissue balance. Notable functional improvement has been documented in all of our patients to date.

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Periacetabular Osteotomy to Antevert and Uncover the Hip: Uncommon Variations on a Common Procedure

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Purpose: Periacetabular osteotomy (PAO) is a versatile procedure that can be used in different clinical situations to reorient the acetabulum. We describe the indications, surgical technique, and early results of periacetabular osteotomy to antevert and reduce femoral head coverage in symptomatic hips secondary to acetabular over-coverage and retroversion.

Methods: The case logs of the senior authors (MBM and YJK) were reviewed to identify patients who had undergone PAO for symptomatic acetabular over-coverage and retroversion. All patients had atypical intraoperative reduction of the acetabular fragment with anteversion, with or without flexion and abduction. Data prospectively collected included demographics, WOMAC scores, and radiographic measurements consisting of the lateral center edge angle (LCEA), Tonnis angle (TA), anterior center edge angle (ACEA), and cross-over sign (COS). Pre-operative and post-operative data were compared.

Results: Between 2004-2012, 27 hips in 22 patients met the inclusion criteria. Of these, 14 hips had minimum 2-year followup. There were 9 females and 5 males. 6 were left and 8 were right hips. Average age at the time of surgery was 19.5 years. Average length of followup was 24.5 months. Average preoperative LCEA was 33.2, TA was 2.8, and ACEA was 35.9. Average postoperative LCEA was 34.1, TA was 2.9, and ACEA was 34.3. Preoperatively, 12 of 14 hips had presence of COS, whereas postoperatively, only 1 hip had a small, cranial COS. Average WOMAC pain score decreased from 9.1 preoperatively to 5.64 postoperatively. Average WOMAC stiffness score decreased from 3.1 preoperatively to 2.2 postoperatively. Average WOMAC function score improved from 24.9 preoperatively to 13.4 postoperatively. Complications included 1 patient with postoperative femoral nerve palsy.

Conclusion: The primary aim of an anteverting and "reverse" PAO is to decrease anterior impingement and increase posterior stability of the hip. The fragment is internally rotated, flexed, and abducted; it may medialize excessively and pose danger to the femoral nerve. Adequate reduction of the fragment, especially acetabular version, is difficult to quantify radiographically. Alterations in radiographic parameters may be small on average, but the clinical improvement reflected in WOMAC scores supports the utility of periacetabular osteotomy for acetabular over-coverage or retroversion.

Significance: Anteverting and "reverse" periacetabular osteotomies are technically challenging procedures that can provide clinical improvement in patients with symptomatic anterior impingement secondary to acetabular over-coverage or retroversion.

See pages 15–57 for financial disclosure information.

Physeal Bar in the Setting of Proximal Femoral Avascular Necrosis: A Paradox of Epiphyseal Revascularization?

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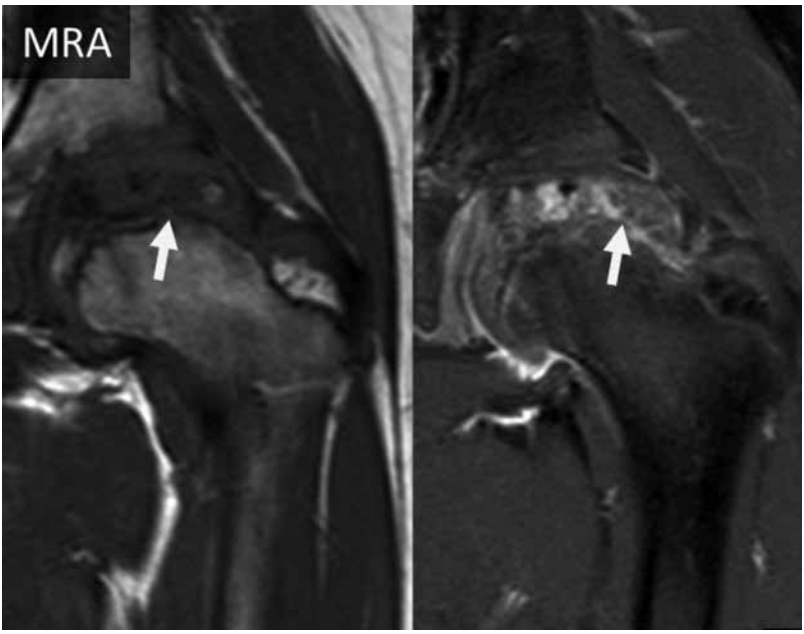
Purpose: In the developing epiphysis, blood vessels are segregated from the vascularity of the metaphysis by the physis. During skeletal growth the epiphysis is uniquely susceptible to occlusion resulting in avascular necrosis. The capital femoral epiphysis is particularly vulnerable to AVN. Although AVN of the epiphysis can spontaneously resolve with little or no consequence, an associated formation of a partial physeal growth arrest often leads to morphologic changes in hip. AVN is thought to be a cause of Perthes disease and is associated in the treatment of developmental dysplasia of the hip (DDH), septic arthritis, trauma, and a SCFE.



MRA shows avascular necrosis of the epiphysis (left image) with the development of a trans-physeal vessel (right image). This vascular invasion correlates with the developing physeal bar (yellow arrow).

The etiology of the physeal bar resulting from epiphyseal AVN is unknown. Our overarching hypothesis is that physeal bars occur as a result of vascular invasion of the growth plate by metaphyseal vessels in an effort to revascularize the epiphysis. The purpose of this project was to determine if a physeal bar of the proximal capital femoral epiphysis was associated with a transphyseal vessel.

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Methods: Five cases of AVN from both DDH and Perthes are evaluated by radiographs and magnetic resonance angiography (MRA). Additionally, femoral head sections were examined by gross and histological methods following head reduction osteochondroplasty in two patients.

Results: The five cases presented demonstrate a physeal bar by radiograph and MRA. In all cases, a blood vessel can be seen by MRA emanating from the metaphysis and extending through the area of the physeal bar into the epiphysis. By histology, both cases presented with physes that were disorganized with chondrocyte clustering and no discernible physeal zones. Multiple areas of ossification can be seen extending from the metaphysis through the physis in conjunction with vascular channels.

Conclusion: We have demonstrated histologically and with MRA imaging an association between the formation of a physeal bar in AVN and newly formed blood vessels deriving from the metaphysis that penetrate the growth plate to supply the epiphysis.

Significance: We hypothesize that the disruption of the highly regulated vascular system inherent in the growing skeleton may be a causative factor of AVN. As it known that chondrocytes of the growth plate must remain avascular during development and vascularization of cartilage results in ossified bone, we hypothesized that the focal areas of premature physeal closure may be an unregulated attempt to revascularize AVN of the capital femoral epiphysis.

See pages 15–57 for financial disclosure information.

Persisting Growth after Prophylactic Single Screw Epiphysiodesis in Upper Femoral Epiphysis

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Background: Prophylactic fixation of the contralateral hip in cases of slipped upper femoral epiphysis is controversial in North America, although in Europe it is more common. Using a single cannulated screw has been therefore widely accepted. However differing reports exist about the occurence of persisting growth after prophylactic epiphysiodesis. The aim of this retrospective study was to evaluate the presence of persisting growth of the upper femoral epiphysis after prophylactic fixation.

Methods: From 2006 until 2009 eleven children underwent prophylactic pinning using a single cannulated 6.5 mm cancellous screw. Time to fusion, persisting growth as well as overgrowing of the screw was measured on plain radiographs taken postoperatively and at least after the growth plate was fused.

Results: All patients except one (91%) showed a persisting growing of the epiphysis and in 2 cases therefore actually a hardware replacement was necessary. The mean increase of the femoral neck length was 8.2% (sem 1.46%). Mean follow up was 37 months (range 12 – 49 months). All patient had a risser sign grade 0 at the time of surgery, and equal or less than grade 2, when the growth plate was fused.

Conclusions: Despite previous reports that a prophylactic fixation using a single cannulated cancellous screw is unproblematic and safe we showed that growth persistence is the rule and in some cases the physeal overgrowth necessitates a hardware replacement. Careful follow-up until fusion of the growth plate should be obligatory. Adjustment of the technique may be helpful to minimize further surgeries.

Presentation and Management of Children <18-Months-Old with DDH: Observations from an International Multi-center Study Group

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Introduction: Little information exists concerning the variability of presentation and differences in treatment methods for Developmental Dysplasia of the Hip (DDH) in children < 18 months. The inherent advantages of prospective multi-center studies are well-documented and data from different centers can have significant differences, potentially introducing bias or questioning the validity of results.

Purpose: To determine if there is a difference in baseline data among the centers affiliated with the International Hip Dysplasia Institute (IHDI).

Methods: A multi-center prospective hip dysplasia study database was analyzed from 2010 to 2012. Baseline data (patient demographics, diagnosis, swaddling history, initial treatment, and baseline IHDI classification) were compared between all seven centers.

Results: 361 patients were enrolled with site enrolment ranging from 11 to 106. There were five categories of diagnosis: <6 months dislocated and reducible or irreducible, 6-18 months dislocated and reducible or irreducible, and 6-18 months dysplastic. The number of patients in each category ranged from 26 (7.4% of total enrolled) in the 6-18 months dislocated but reducible to 194 (55.6% of total enrolled) in the < 6 months dislocated but reducible group. Across all centers, the left hip was more commonly affected with 136 patients (42%). Bilaterality was the second most common finding with 114 patients (35.2%). Approximately one third of all patients enrolled have a history of swaddling. The group with the highest rate of swaddling was the <6 months dislocated but reducible group with 46 patients (43.4% of total swaddled). When looking at the rate of swaddling across centers, Toronto had the highest rate of swaddling with 65% of their patients and then Adelaide with 59% of their patients. Conversely, Mexico had the lowest rate of swaddling with only 4% of their patients. Of the patients who were born in the winter months (November – March), Toronto had the highest incidence of swaddling at 56%. The IHDI classification for patients 6-18 months of age varied across sites, with San Diego having the highest number of grades 1 and 2, comprising 40-47% of total patients classified. The most commonly used brace across centers for initial treatment was the Pavlik harness (243 patients, 89% of those initially treated with an orthosis, 73% overall).

See pages 15 –57 for financial disclosure information.

Conclusion: This multi-center, prospective, database observational study, confirms that the baseline data between centers is different across many variables. Surgeon factors, center variability, and patient preferences should be controlled for when analyzing the data in the future.

Significance: This is the first large, prospective, multi-center study, comparing baseline data. By comparing across centers the methods and outcomes for treatment of children < 18 months with DDH, uniform guidelines for treatment can be developed.

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Not Fully Centered Femoral Head after Closed Reduction in Children with Developmental Dysplasia of the Hip: Immediate Re-reduction Is Not Necessary

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Introduction: Subluxed and fully luxated hips can be treated by closed reduction followed by immobilization in a spica cast. For these patients, avascular necrosis of the femoral head is a serious complication. The incidence for avascular necrosis after this treatment varies between 6 and 47%. We present a series treated by spica cast that were at the initial MRI not fully reduced, but centred spontaneously over a period of two weeks.

Material and Methods: Between 2008–2010, 16 patients (17 hips, 13 girls, Graf: D, IIA/b or IV) underwent closed hip reduction and application of a spica cast in our clinic. Age at time of reduction was between 5 days and 5 months (mean 2 months). MRI control was made on the same day to confirm the reposition. If a correct and centered position was seen, spica cast was left for 4 weeks. After removal, a sonographic control was done Further treatment was a Düsseldorfer-splint for several weeks. If after primary closed reduction, a not optimal centering of the femoral head, without interposed labrum, was found, the position was tolerated. In those cases, a follow up MRI was done 2 weeks later.

Results: In 6 patients MRI showed a fully centred femoral head after first closed reduction. In 3 patients it was not possible to successfully perform a closed reduction. There was a persistent inadequate centering because of interposed labrum. In 7 patients, a not fully centered femoral head without interposed labrum was seen in the control MRI after closed reduction. The femoral head was in a slightly dorso-cranial subluxated position. This position was tolerated. A follow up MRI was performed 2 weeks later that showed now in all 7 hips a fully centred position of the femoral head. At latest f-up (6 - 27 months) no avascular necrosis was found.

Discussion: Closed reduction is a safe and noninvasive method. Successful closed reduction could be done in the first attempt in 6 of 16 patients (38%). Only 3 patients (19%) had an open reduction due to interposed labrum. The most remarkable observation however was seen in those 7 patients (43%) who did not have a completely centered femoral head after the first closed reduction. The slight dorso-cranial subluxed position was 2 weeks later seen in a spontaneously re-reduced perfect position while wearing the same spica cast. The follow-up examinations over a period of 6 - 27 months showed up to now no evidence of complications, in particularly such as avascular necrosis of the femoral head.

Conclusion: We showed that after closed reduction in DDH and initially not optimal centering of the femoral head, an immediate re-reduction is not mandatory given to the fact that obviously a spontaneous re-reduction can occur if no soft tissue is interposed. In none of our 16 patients was any clinical or radiological evidence of avascular necrosis of the femoral head.

See pages 15–57 for financial disclosure information.

EOS Imaging of Human Pelvis: Reliability, Validity, and Controlled Comparison with Plain Radiography

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Purpose: We performed a pilot study to evaluate the validity and reliability of EOS® technique for assessing gross pelvic and acetabular morphology.

Methods: A human cadaveric pelvis model was utilized to perform consecutive conventional and EOS® radiographs in 5° intervals of sagittal tilt and axial rotation (range: -15° to 15°). Within each image, six measurements were obtained: 1) vertical- and 2) horizontal distance between mid-point of sacrococcygeal joint and mid-point of the upper border of the symphysis, 3) inter-ASIS distance, 4) inter-facetal distance at S1, 5) Sharp's, and 6) Tönnis angle. In addition, coxa profunda and cross-over signs were identified. Findings with both imaging techniques were correlated with each other and with true linear measurements taken from the pelvis. For reproducibility assessment, all measurements were performed by two independent investigators and one observer repeated all measurements. Both investigators were blinded to the true linear measurements obtained from the cadaver model.

Results: We noted a strong correlation between conventional and EOS® radiography (Pearson correlation range: 0.644 - 0.998) and high intra-/inter-observer reproducibility for both modalities (intra-class-correlation range: 0.795 - 1.000). The coxa profunda evaluation reached 100 % agreement for intra- and inter-observer whereas the agreement on the presence of cross-over-sign was marginally less with the intra-observer (96.2 %) and the inter-observer (92.3 %) comparison. Due to distortion caused by magnification with conventional radiographic imaging we also noted significant differences between the two modalities affecting linear measurements (P-values < 0.05).

Conclusions: The EOS® imaging technique is reliable for assessing gross pelvic and acetabular morphology, thus proving to be a serious alternative to plain radiography for primary imaging in the pediatric population and potentially adults as well. This work does not evaluate the ability of EOS to detect subtle radiographic anatomic abnormalities.

Significance: This pilot study provides the basis for further prospective in-vivo studies that are essential to substantiate current plain radiographic indices, parameters and grading systems.

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Equinovalgus Deformity Correction in Children and Adolescents: Outcomes after Modified Evans Procedure

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Purpose: The purposes of this study were to evaluate the outcome of Modified Evans procedure in severe pediatric flatfoot deformities caused by flexible flatfoot (FFF), flexible flatfoot with short tendo-Achilles (FFF-STA), and peroneal spastic or rigid flatfoot.

Methods: In a retrospective study, 34 severe, symptomatic valgus deformities of the hindfoot in twenty-six children, corrected with calcaneal lengthening osteotomy described by Evans and modified by Mosca, were evaluated clinically post-operatively with Oxford Ankle Foot Questionnaire© and radiologically pre- and post-operative with foot radiography. Symptoms included activity-related pain, early fatigue, disability to run or play and medial foot calluses. All patients had failed a conservative treatment, which consisted of bracing, custom shoe wear or casting. None of the deformities were secondary to an underlying neuromuscular disorder. The calcaneal lengthening was combined with management of the soft tissue as described by Mosca including peroneal brevis lengthening and tibialis posterior tendon advancement to balance the muscle forces.

Results: The patients ranged in age from 11 to 23 years at the time of the operation. The duration of follow-up ranged from 11 to 96 months after the operation. Post-operative evaluation was conducted with the Oxford Foot and Ankle Questionnaire©, which evaluated the following items: difficulty walking, running, prolonged standing, pain in foot/ankle, sore legs after walking, tired due to foot/ankle, foot stops play w/others on the playground, foot stops play w/others in park, foot stops participation in PE, other school activities, bothered by look of foot, bothered by the way they walk, embarrassed by foot/ankle, others unkind to child due to foot and difficulty with shoe types. Satisfactory clinical correction was achieved in all questionnaire components but the running, attending PE classes and wearing specific types of shoes (females > males). Satisfactory radiographic correction of all components of the deformity of the hindfoot and midfoot was achieved in all but the most severely deformed feet.

Conclusion: Modified Evans procedure is effective for the correction of severe, intractably symptomatic valgus deformities of the hindfoot and midfoot in children and adolescents. Most of our patients had improvement in their feet problems associated with the deformity.

Significance: When treating severe symptomatic flatfeet deformities in the pediatric population, modified Evans procedure should be considered to correct these deformities.

See pages 15–57 for financial disclosure information.

Comparing Pedobarographs in Children with Uninvolved Feet and Clubfeet with or without Anterior Tibialis Tendon Transfer over Time

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Purpose: Anterior tibialis tendon transfer surgery (ATT) in clubfeet is an effective method of correcting excessive lateral weight bearing due to overpull of the tibialis anterior. Pedobarography objectively measures changes in foot shape and pressure parameters over time. Our hypothesis was that statistically significant difference between uninvolved, clubfeet with ATT, and unilateral clubfeet without ATT would be found for at least one of the measures related to the lateral and medial forces of the pedobarograph due to both time and the ATT surgery.

Methods: Pedobarographs for 28 children with 40 clubfeet that underwent ATT were retrospectively assessed pre and post-operatively. In addition, 31 age matched children with unilateral clubfeet without ATT and the corresponding uninvolved side were assessed at two time points. Parameters related to geometry, pressure, force, time, and area were assessed using the Novel® Emed Platform and a ten area mask.

Results: Twelve of the 117 pedobarographic parameters demonstrated statistically significant changes due to both time and surgical intervention.

Lateral mid foot- peak and maximal mean pressures, contact time, force and pressure-time integrals, and instant of peak pressure.

3rd-5th Metatarsals- peak pressure

Lateral vs. Medial side of the entire foot- lateral force-time integral, lateral force: medial force, and lateral-medial force-time integral index

Entire foot-peak pressure and pressure-time integral

For all three groups, increases in the lateral and medial force-time integrals occurred. The clubfeet that underwent ATT had the smallest percent increase in the lateral force-time integral and the largest percent increase in the medial force-time integral, indicating the ATT surgery resulted in a more balanced foot. Preoperatively the measures of pressure, pressure-time integral and the instant of peak pressure of the lateral midfoot all show a significant difference between the uninvolved foot and the clubfoot with ATT surgery. Post-operatively, these measures were not statistically different.

Conclusions: Correcting the dynamic pull of the anterior tibialis tendon resulted in improvements in parameters of t he pedobarographs compared to the uninvolved side.

Significance: Foot pressure analysis is an effective method to objectively document changes over time, due to growth and surgical intervention. For children with clubfeet, this may require measuring complex variables of pressure, force and time to distinguish significant differences.

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Review of Triple Arthrodesis for the Treatment of Foot Deformity in Patients with Myelomeningocele

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Purpose: Triple arthrodesis is controversial in the treatment of foot deformity in patients with myelomeningocele. Surgeons are sometimes deterred from this procedure because of published failure rates up to 33%. The purpose of this study was to assess the results of triple arthrodesis with particular attention to recurrent foot ulceration and postoperative complications.

Methods: We performed a retrospective chart review of 33 feet in 27 patients who had triple arthrodesis for a rigid foot deformity associated with myelomeningocele. Data collection included: ambulatory status (pre- and post-operative), level of neurologic impairment, type of fixation for triple arthrodesis, minor complications (skin problem or superficial infection with outpatient treatment, avascular necrosis [AVN], fracture), and major complications, (recurrence of deformity, ulceration or deep infection treated with surgery, surgery for dorsal bunion or amputation).

Results: After initial wound healing 23/33 (70%) had no complications, 4/33 (12%) had minor and 6/33 (18%) had major complications. Minor complications included 3 feet with skin problems treated with outpatient dressing changes and 1 foot with asymptomatic avascular necrosis. Major complications included dorsal bunion (1 foot) and recurrence of deformity (1 foot) requiring surgery, recurrence of deformity leading to ulceration and ultimate below-knee amputation (1 foot), and 3 feet with deep ulceration/infections requiring operative debridement. The average age of patients with major complications was 11.9 years, whereas the average age without a major complication was 12.9 years. Seven of 10 (70%) patients who ambulated without a brace or crutches developed a complication, while only 2 of 14 (17.7%) patients who ambulated with an AFO and/or crutches had a complication (Fisher exact test, p=0.0127). The sacral-level myelomeningocele patients had more complications (6/10) than lumbar or thoracic level patients (4/17), p=0.1008. Zero of 24 feet with internal fixation and 2/9 feet with only cast immobilization after arthrodesis had recurrence of deformity, p=0.068. At an average of 3.4 years follow-up, 89% of patients maintained or improved their ambulatory status.

Conclusion: In this study 82% of patients had no further surgery, 70% had no complications and 89% maintained or improved ambulatory status.

Significance: Foot deformity in myelomeningocele can be effectively treated with triple arthrodesis. Patients with more neurologic and ambulatory function may be more likely to require repeat surgery after triple arthrodesis. Internal fixation may decrease recurrence of deformity after triple arthrodesis.

See pages 15–57 for financial disclosure information.

Radical Plantar Release of Pediatric Cavus Foot and the Transmalleolar Projection Radiograph

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Introduction: Many treatment options for cavus feet have been described with some authors recommending primarily bony correction. Our approach continues to utilize a radical plantar release with selective posterior tibial tendon transfer in order to obtain as much correction as possible prior to performing osteotomies. Additionally, we have been utilizing two different lateral projection radiographs to quantify the cavus: the foot lateral which is the standard radiograph used and an ankle lateral (transmalleolar) view. The objectives of this study were to assess our radiographic outcomes and our complication profile as well as to assess if the segmental radiographic measurements of foot deformity differ between the two lateral projections.

Methods: A retrospective review was performed. 29 feet with a minimum of 2 year follow up were included for a radiographic assessment of outcomes as well as chart review for mid term complications. 53 feet were included for a radiographic comparison of the various parameters of foot deformity between foot lateral and ankle lateral radiographs as well as for assessment of early postoperative wound complications.

Results: Overall correction was to near normal radiographic parameters, which were maintained over the course of a mean follow-up of 4 years. There were 4 feet (7.5%) with residual symptoms at final follow-up, including one overcorrection. Asymptomatic navicular AVN was noted in one foot. 8 feet (15.1%) required additional surgery: 5 for claw toes, 2 for recurrence of cavus and 1 for a calcaneal spur causing a plantar ulcer. There were 4 postoperative wound complications (7.5%) none of which required additional surgery. Tibiotalar, talocalcaneal, and lateral talo-first metatarsal angles; naviculocuboid overlap; metatarsal stacking angle; and medial-lateral column ratio were all significantly different between the foot lateral and transmalleolar radiographs.

Conclusions: This treatment protocol yields a good correction with a low rate of wound complication and overcorrection. Transmalleolar and foot-lateral radiographs revealed different values for almost all the radiographic segmental parameters. Forefoot parameters should most probably be assessed on the foot-lateral while hindfoot parameters should be measured on the transmalleolar projection.

Significance: Radiographic quantification of cavus is dependent on the lateral projection chosen. It is likely that the transmalleolar projection overestimates the amount of cavus truly present.

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Surgical Treatment of Symptomatic Accessory Navicular in Children and Adolescent: Is Simple Excision Enough?

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Purpose: Describe the demographics, outcomes and complications of surgical treatment in children and adolescents with symptomatic accessory navicular (AN) and identify potential factors affecting a negative outcome.

Methods: Retrospective chart review of patients under 18 years of age who were surgically treated due to a symptomatic accessory navicular in our institution from 1991-/. Medical records and digital images were reviewed to determine demographic information, length of symptoms before surgery, type of AN and follow up time. Preoperative variables such as pain location and character, difficulty with shoe wear, presence of Achilles tendon tightness and associated flat foot were included. A simple excision was performed and the posterior tibial tendon was treated either by a Kidner procedure or split and repair. Additional procedures for flat foot reconstruction were recorded. Functional outcome, complications and re-operations were also noted. Treatment failure was defined either by persistence of pain localized in: medial arch, lateral ankle, posterior ankle/calf, difficulty wearing shoes or re-operation to address flat foot and/or tendo-achilles tightness.

Results: 27 patients (22 girls)/32 feet with an average of 13.2 years at surgery were identified. Mean post-operative follow up time was 8.4 months. In bilateral cases, 20% who presented with pain in one foot, required a future surgery. 56% of cases were associated with flat feet. No statistically significant difference between Kidner procedure and split and repair of posterior tibial tendon: complications (p=0.714), re-operations (p=0.714), functional status (0.429) or failure of treatment (p=0.429). In one patient with symptomatic flat foot, strayer as well as lateral column lengthening was performed with excellent functional result. Three failures of treatment in patients with symptomatic flat feet. All re-operations were (4) due to painful scars.

Conclusions: Associated flat foot deformity should be evaluated and treated if symptomatic. Kidner procedure is not superior to split and repair of the posterior tibial tendon in terms of complications, re-operations, failure of treatment or functional outcomes. In bilateral cases in which only one foot is symptomatic, 20% of patients will require future surgery. Scar issues could be a reason for re-operations.

Significance: AN most commonly becomes symptomatic in childhood or early adulthood.. Simple excision has been reported to have excellent/good results; however, flat feet are a common entity associated and there is no clear approach on how to manage this association.

See pages 15–57 for financial disclosure information.

Determining the Best Treatment for Simple Bone Cyst: A Decision Analysis

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Purpose: The treatment of simple bone cyst (SBC) in children varies significantly among physicians and institutions. This study examined which procedure is better for the treatment of SBC in children, using a decision analysis based on current published evidence.

Methods: A decision tree focused on five treatment modalities of SBC: observation, steroid injection, autologous bone marrow injection, decompression, and curettage with bone graft. Each treatment modality was further branched, according to the presence and severity of the complication. The complication was composed of surgical wound infection, anesthesia-related complication, and injected material-related complication. Clinical outcomes of each treatment modalities were categorized into three groups: 1) Healed, 2) No changing or Progression or Recurrence, and 3) Pathologic fracture or Positive symptom. Each 'utility', which meant clinical outcome in the decision tree was estimated by first procedure of the each surgical intervention. The probabilities of all cases were obtained by literature review. A roll back tool was utilized to determine the most preferred treatment modality. One-way sensitivity analysis was performed to determine the threshold value of the treatment modalities. Two-way sensitivity analysis was also utilized to examine the joint impact of changes in probabilities of two parameters.

Results: The decision model favored autologous bone marrow injection. The expected value of autologous bone marrow injection was 0.9445, while that of observation, steroid injection, decompression, and curettage and bone graft was 0.9318, 0.9400, 0.9395, and 0.9342, respectively. One-way sensitivity analysis showed that autologous bone marrow injection was better than that of decompression, in the expected value when the rate of pathologic fracture or positive symptom of SBC after autologous bone marrow injection was lower than 20.4%. Two-way sensitivity analysis showed that autologous bone marrow injection was better than decompression in the expected value.

Conclusion: In our decision analysis model, autologous bone marrow injection is the best choice as the treatment of SBC. However, the results were sensitive to the rate of pathologic fracture after the treatment of SBC. Physicians should consider the possibility of pathologic fracture when they determine the treatment method of SBC.

Significance: Bone marrow injection is the best choice as the treatment of SBC in our decision model.

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Effect of an Adapted Skiing and Snowboarding Program on the Physical Performance Measures among Children with Cerebral Palsy

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Purpose: To examine the longitudinal influence of an adaptive skiing/snowboarding program on measures of physical performance among children with cerebral palsy (CP).

Methods: Physical measurements were taken pre- and post-season from 13 children between ages 8-18 yrs. old who participated in a disabled skiing program. The program consisted of five, eight-hour ski days with individualized instruction. Physical measurements were obtained two months prior the ski season and three weeks after the season. The measurements included the Timed Up and Go test (TUG), the functional reach test, and isometric quadriceps strength as measured with a hand-held dynamometer. Multiple linear regression analyses were used to examine the relationship between diagnosis (hemiplegic CP vs diplegic CP) and the change (pre – post season) in the three physical performance measures. The number of ski days the subject participated in was included in all the statistical models to control for the potential effect of this covariate. Only subjects that completed both the pre- and post-season analysis were included in the study.

Results: The cohort consisted of 6 (46.15%) male and 7 (53.85%) female subjects aged 13.23 years (±2.83). The subjects participated in an average of 3.9 ski days (range 3-5). The number of ski days was not significantly related to changes in TUG [p = 0.9490], reach [p = 0.2751], or strength [p = 0.5874]. After the season, there were no significant changes in the functional reach test scores in either group (see table 1). There was a significant deterioration in TUG scores in both groups. The change in TUG scores were not significantly different between groups [p = 0.8544]. There was, however, a significant improvement in strength for the diplegic group. The change in strength was significantly [p = 0.0233] greater in the diplegic group compared to the hemiplegic group.

Conclusion: Although there was a significant deterioration in TUG performance, the changes were less than 1.1 seconds and thus, not clinically relevant. The adaptive ski program had a significant positive effect on knee extensor strength in the diplegic group. Overall, when averaged across both groups, strength improved by 23.4%. However, the improvements in strength were on average 15.11 kg [95% CI: 2.58 to 27.65 kg] greater in the diplegic group compared to the hemiplegic group.

Significance: An adaptive ski program had a positive effect on knee extensor strength. The greatest improvements in strength were observed in the diplegic group.

See pages 15–57 for financial disclosure information.

Skeletal Maturity in Patients with Cerebral Palsy

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Purpose: Spinal deformity is a common feature of cerebral palsy (CP), with an incidence reported to be as high as 68%. Scoliosis in this population has an earlier onset than in adolescent idiopathic scoliosis (AIS), with curves often reaching surgical magnitude before skeletal maturity. The risks of performing the surgery before maturity to prevent progression must be weighed against the risk of crankshaft phenomenon and lost trunk length in adulthood. We wished to study the age and rate of skeletal maturation in patients with CP compared with a control group of patients with AIS.

Methods: A multicenter retrospective database was compiled on 163 patients who underwent surgery for scoliosis related to an underlying diagnosis of CP. A prospective multicenter database of 1,550 patients with AIS was used as the control. All patients had a minimum of 2 years of follow-up. We excluded analysis of Risser signs 0 and 5 due to the unbounded nature of these groups. An analysis of variance (ANOVA) was performed to investigate the significance of the difference between the two groups at each Risser sign.

Results: The Risser sign was noted on 45 available preoperative x-rays in patients with CP and 1,102 from the AIS group. There were 3 patients with CP at Risser 1, 13 at Risser 2, 10 at Risser 3, and 19 at Risser 4. There were 84 patients with AIS at Risser 1, 191 at Risser 2, 260 at Risser 3, and 567 at Risser 4. The average age of a Risser 1 patient with AIS is 13.6 years old and in CP is 12.3 (p=0.17). The average age of a Risser 2 patient with AIS is 14.2 and in CP is 13.2 (p=0.05). The average of a Risser 3 patient with AIS is 14.6 and in CP is 13.2 (p= 0.0006). The average of a Risser 4 patient with AIS is 15.1 and in CP is 14.9 (p=0.73). On average, a patient with CP will take 2.6 years to progress from Risser 1 to 4, while a patient with AIS will take 1.5 years.

Conclusions: CP is associated with a slightly different age and rate of skeletal maturation compared to AIS. The iliac apophysis begins to close earlier, but the process of closing takes longer. Skeletal maturity is reached at a similar age in CP and AIS.

Significance: Surgeons can predict when patients with CP will reach skeletal maturity and plan the timing of surgery appropriately. Also, surgeons may elect to alter their surgical plan to avoid crankshaft in patients with CP who have not reached maturity by utilizing a combined anterior/posterior approach or an all pedicle screw posterior construct since these patients take longer to reach full skeletal maturity than patients with AIS with a similar Risser sign.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and/or medical device for the use described (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 4.

Radiographic Measures in Infants with Clubfoot Treated with the Ponseti Method: Are They Reliable and Can They Predict Outcome?

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Purpose: The complex clubfoot has been identified as a typical clubfoot that resists treatment with the Ponseti method, and has residual equinus and mid-foot breech that can be quantified on radiographs. This study aims were: 1) To determine if radiographic measures can be reliably made in children being treated with the Ponseti method 2) Determine if these radiographic measures could predict recurrence and poor outcome.

Methods: A retrospective review was performed on clubfeet treated with the Ponseti method at a single institution over a ten-year period. Other criteria include a forced dorsiflexion lateral foot radiograph prior to, and after heel cord tenotomy. To test reliability; the dorsiflexion, tibio-calcaneal, talo-calcaneal, and talo-first metatarsal angles were measured in triplicate by 5 independent reviewers. Intra- and inter- reader reliability was assessed and statistical analysis was done via Intra-rater correlation coefficient (ICC) calculated from one-way and two-way ANOVA. Review of records identified patients who failed the Ponseti method if an additional tenotomy or other operative procedure was performed. The Bonferroni test analyzed whether any radiographic measure could predict outcome.

Results: Forty-seven subjects (58 feet) were available for study. The median clinical follow-up was 4.54 years. The ICC was as follows: dorsiflexion 0.925 to 0.992, tibio-calcaneal 0.977 to 0.994, talo-calcaneal 0.966 to 0.989 and talo-first metatarsal 0.976 to 0.995. The ICC for each of the measured angles pre/post-tenotomy, ranged from 0.933 to 0.995 and 0.864 to 0.995 respectively. Similarly, the inter-reader reliabilities pre/post-tenotomy were dorsiflexion 0.871 and 0.933, tibio-calcaneal 0.897 and 0.910, talo-calcaneal 0.727 and 0.925, and talo-first metatarsal 0.934 and 0.950 respectively. The mean differences between pre/post-tenotomy radiographs were: dorsiflexion increase of 16.8 degrees; tibio-calcaneal angle increase of 19.1 degrees; talo-calcaneal angle increase of 9.3 degrees and the talo-first metatarsal angle increase of 9.9 degrees (p-value <0.01 for all measurements). Eleven feet failed at a median of 4.4 years. No significant radiographic differences were found between relapsing and non-relapsing feet.

Conclusion/Significance: We determined that reliable radiographic measures could be made from lateral dorsiflexion radiographs of clubfeet treated with the Ponseti method. In this small cohort of patients we noted some trends that may predict outcome, but could not be proven in this sample size. With this validate measure, we will perform a multivariate analysis in a larger group of patients as we believe these measures can quantitate mid foot breech and equinus seen in complex clubfoot.

See pages 15–57 for financial disclosure information.

Residual Deformity Affecting Walking in Arthrogryposis Multiplex Congenita

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Propose: Arthrogryposis Multiplex Congenita (AMC) is a multiple deformity affected lower and upper limb affected activity of daily living, multiple operations were need to corrected limbs deformity in order to promote walk ability. This study is work to find the most affected residual deformity that make patients non ambulate.

Method: During 2000-2010, 51 patients was included in this study, 14 patients was non ambulatory. Procedures and number of operation, residual deformity and walking ability are recorded. Residual deformity included, Hip flexion more than 20 degrees, knee flexion contracture more than 30 degrees, scoliosis, hip dysplasia and dislocation, knee extension and recurvatum, upper limb involvement were evaluated. Statistical analysis was used to evaluate factor that statistical significant to walking ability of AMC patient.

Result: Statistic analysis of all factors were analyzed and the results were significant with $p < 0.037$ in knee flexion contracture>30degrees with odd ratios 4.58 and hip flexion contracture>20 degrees was trend toward significant with P 0.058 and odd ratio 4.53. Multivariated analysis shows knee flexion contracture is significant with Exp 4.58 (95%CI 1.01-20.6)

Conclusion: Arthrogryposis Multiplex Congenita is a rare disease and cause disability, multiple surgeries to correct the deformity is need. Our study is very helpful interm of walking prognosis. This study shows that residual knee flexion contracture is the most valuable for walking prognosis and surgery to correct can promote walking in AMC patients.

♦ Indicates those faculty presentations in which the FDA has not cleared the drug and / or medical device for the use described (i.e., the drug or medical device is being discussed for an “off label” use). For full information, refer to page 4.

Use of a Rugby Helmet Brace for Postoperative Treatment of Muscular Torticollis

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Purpose: Prior to 1992, our postoperative management for congenital muscular torticollis consisted of either plaster cast immobilization or no immobilization, depending on the patient's age and the degree of contracture. However, some patients required further surgery and developed complications. In 1992, we produced rugby helmet braces for postoperative management. The purpose of this study was to compare the clinical results of the previous postoperative management with the results achieved using rugby helmet braces.

Methods: Indications for surgery included patients aged 1 year or older with classic torticollis, restricted range of motion (ROM) of the cervical spine (lateral flexion/ rotation), abnormalities of the sternocleidomastoid muscle, and 2-dimensional scoliosis. Twenty-five children aged younger than 6 years underwent caudal partial resection of the sternocleidomastoid muscle. Twelve children aged 6 years and older underwent cranial tenotomy. These 37 patients were divided into 2 groups: no immobilization or plaster immobilization (group A; n=19) and rugby helmet braces (group B; n=18). Canale's method was used for evaluation of clinical results.

Results: In group A, the results were good in 12 patients, fair in 4, and poor in 3, whereas all 18 patients in group B had good results (Table 1). There was a statistically significant difference between group A and group B in terms of the results. Regarding complications, 2 patients in group A required further surgery, and complications were observed in 5, consisting of generalized pruritus in 4 patients, alopecia areata in 1, headache in 1, and insomnia and mild impairment of food intake in 1. In group B, alopecia areata was observed in 1 patient. No patient refused to wear the rugby helmet brace.

Conclusion: The following 4 reasons for recurrence postoperatively were described: (1) incomplete correction of the contracted structures; (2) inadequate postoperative immobilization in a position of overcorrection; (3) a tendency to assume the tilted position of the head because of habit; and (4) temporary interference with binocular vision after correction of the torticollis position because of adaptation of the eyes to the tilted position of the head. To overcome these problems, particularly numbers 2 through 4 above, we produced the rugby helmet brace, which was comfortable for patients to wear and allowed them to effectively carry out physiotherapy while the brace was being worn. It provides a useful method of postoperative management for congenital muscular torticollis.

Significance: This presentation could be one of the good strategies of congenital muscular torticollis.

See pages 15–57 for financial disclosure information.

Haptic Feedback for Pedicle Screw Insertion Simulation: Proof of Concept

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Purpose: Pedicle screw insertion is a difficult technique especially in pediatric scoliotic deformities. The "free hand technique" has proven to be a reliable and safe procedure. However recent research has demonstrated that for an apprentice at least 60 pedicle placements under the direction of an experienced surgeon are needed before being able to insert thoracic pedicle screws independently. In order to reduce the obvious risks of such a learning process, we intend to create an augmented reality pedicle screw insertion simulator. As the "free hand technique" relies heavily of tactile feedback, we focused our research on haptic feedback. The objective of the first phase of our project was to identify the specific vibration (amplitude and frequency) components of a pedicle probe entering the pedicle, and vibration produced by the progression of the pedicle probe over the cancellous elements of the pedicle. This knowledge informed the objective of the second phase that aimed to develop a simulator to test the capacity of seniors, fellows and residents to identify a consistent pattern of tactile sensation during the rotation of a simulated pedicle probe.

Methods: Phase 1: A cadaver study was devised using a pedicle probe containing a force/torque transducer permitting the quantification of the amplitude and frequency characteristics during progression of the probe inside and outside the pedicle.

Phase 2: A prototype of a haptic simulator was designed: the user rotates a probe handle that is mounted to the shaft of a motor. The device provides 1 DOF torque feedback to the user around the axis of the probe to simulate the vibration effects observed in phase 1. The simulator incorporates parameters that are individually tuned by the user, and permits the identification of patterns of tactile sensation. A proof of concept study was then undertaken comparing the results of 7 surgeons of varying expertise: according to their level of professional experience this group was subdivided into "experts" and "novices". They were asked to adjust the parameters to create the most realistic haptic sensations felt during the progression of a probe inside of the pedicle.

Results: Phase 1: Frequency analysis revealed a low frequency (< 10 Hz) signal present during the progression of the probe inside of the pedicle. The signal disappeared when the probe was breaching the pedicle or progressing outside of the pedicle.

Phase 2: Emerging differences were found within the haptic parameters between "experts" and "novices" (eg: Viscous Coefficient, Frequency of Vibration). Where Figure 1a presents the box whisker plot (median, min, max) of the entire group, and Figure 1b presents the 'novice' and 'expert' groups.

Conclusions: Low frequency vibrations are present during probe insertion into the pedicle. Experienced surgeons are able to identify these haptic sensations in a consistent way. Novices need to acquire this sensation during their training.

Clinical Significance: This proof of concept study revealed the feasibility of simulating haptic effects related to pedicle screw insertion. Importantly, it also demonstrated the need for more haptical training among trainees in "free hand" pedicle screw insertion. A virtual reality simulator introducing haptic rendering should enhance patient safety and improve procedural skills.

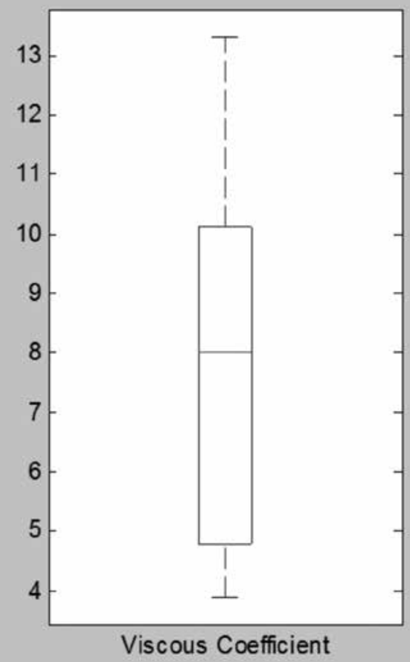

Figure 1a: Viscous Coefficient

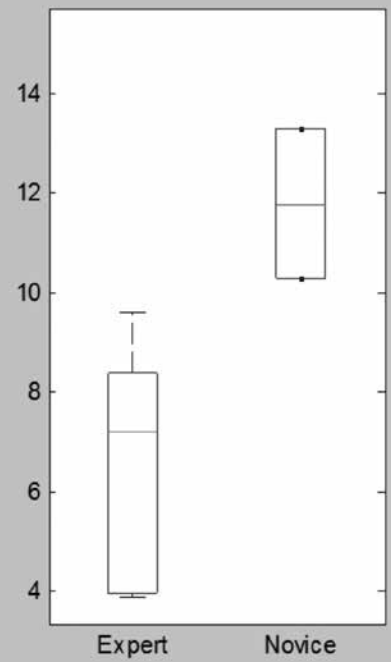

Figure 1b: Viscous Coefficient

Radiation Exposure from Post-reduction Computed Tomography in Children with Hip Dysplasia

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Purpose: To determine the amount of radiation absorbed by pediatric patients undergoing post-reduction CT scans for developmental dysplasia of this hip (DDH) using a low-dose protocol in a hip-spica cast.

Methods: An IRB-excluded study was performed. Infant phantom models made from ballistic gel and containing microdot dosimeters underwent standard low-dose CT scans after placement in plaster(PL), fiberglass(FIB), or combination plaster/fiberglass(PL/FIB) hip-spica casts. The Scans were performed 4 hours after casting (wet cast) or two days later (dry cast). One phantom was scanned without a cast. AP pelvic radiographs were performed on one casted and one uncasted phantom. Two iterations of each study were performed and the values from the dosimeters were averaged.

Results: CT Data: mRad (mR)

#	Cast Type	Wet/Dry	Average (mR)
1.	None	NA	555
2.	PL	Wet	398
3.	PL/FIB	Wet	425
4.	PL	Dry	397
5.	PL/FIB	Dry	397
6.	FIB	Dry	464

X-Ray Data

#	Cast Type	Average (mR)
1.	None	131
2.	PL/FIB (Dry)	102

The amount of radiation absorbed from a single low-dose CT scan in a spica cast was equivalent to the cumulative amount of radiation from approximately 4 AP pelvis radiographs. The addition of a hip-spica cast reduced the radiation exposure between 21-28% depending upon cast material. Plaster casts absorbed more radiation than fiberglass casts resulting in less radiation absorbed by the phantom. There was no significant difference between the wet and dry casts.

Conclusion and Significance: This study measures directly the radiation exposure to an infant undergoing a CT scan following hip reduction and spica casting. The CT exposure is equivalent to about 4 AP pelvis radiographs. A hip-spica cast blocks the equivalent exposure of about one AP pelvis radiograph.

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2012 HONOREE

James H. Beaty, MD

For excellence in Leadership in the pediatric and general orthopaedic community as president of POSNA, AAOS, and ABOS. For dedication to education as author and editor of Orthopaedic Texts, Including Operative Pediatric Orthopaedics, Selected Bibliography of Pediatric Orthopaedics, Fractures in Children, and Campbell's Operative Orthopaedics. For advancement of Pediatric Orthopaedic Knowledge through his contributions to original research and peer-reviewed literature.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Differences between Reported and Measured Wear-rates in Clubfoot Bracing via a Novel Pressure Sensor

Aaron Morgenstein, MD; Neeley Buhr, MS; Rebecca Davis, MS; Vishwas R. Talwalkar, MD; Henry J. Iwinski, MD; Janet Walker, MD; ***Todd A. Milbrandt, MD****;*
Shriners Hospital for Children, Lexington, Kentucky

OUTSTANDING BASIC SCIENCE PAPER

Effects of Non-weight Bearing on the Femoral Head following Ischemic Osteonecrosis

Olumide Aruwajoy, MS; Jeffrey Stetler; Alec Christian Stall, MD; ***Harry K.W. Kim, MD****;*
Texas Scottish Rite Hospital for Children, Dallas, Texas

OUTSTANDING POSTER

Biomechanics of Direct Transverse Plane Vertebral Derotation at the Bone Screw Interface: Do Bicortical Pedicle Screws Make a Difference?

William F. Lavelle, MD; Nathaniel R. Ordway, ME, PE; Yushek Pun, BS; Stephen A. Albanese, MD;
SUNY Upstate, Syracuse, New York

OUTSTANDING E-POSTER

A Physiotherapist-led Ponseti Service for the Management of Idiopathic and Non-idiopathic Clubfoot Deformity

Yael Gelfer, MD, PhD*; Mia Dunkley; Deborah Jackson; Cristina Rafter; Jennifer Armstrong; Evette Parnell; Deborah Eastwood, MD; Great Ormond Street Hospital for Children, London, England*

POSNA 2012 Awards Continued

SPECIAL EFFORT & EXCELLENCE AWARD

Michael G. Vitale, MD

In recognition of His Special Service to further the Mission of POSNA, especially his leadership on the Industrial Relations Committee in fostering increased sponsorship of our educational and research programs; For his leadership on spine research with the Quality, Safety nad Value Initiative; For organizing our 2012 annual meeting and our transition to more subspecialty education; For taking over our IPOS educational program.

HUMANITARIAN AWARDS

Shafique P. Pirani, MD

In Recognition of His Outstanding Service to the Underserved Children of Uganda with clubfeet through the Uganda Sustainable Clubfoot Project: For his training of countless health professionals on the Ponsetti method' For his outstanding organizational skills to mobilize both Canada and Uganda to support and sustain these meritorious efforts; For the expansion of these programs beyond the boundaries of Uganda to Cure Clubfoot Worldwide; For his and his families' sacrifices for a higher medical purpose.

J. Norgrove Penny, MD

In Recognition of His Outstanding Service to the Underserved Children of the World with musculoskeletal disorders especially through CBM International and the Uganda Clubfoot project in Africa; For the expansion of the Uganda project to Cure Clubfoot Worldwide; For his training of allied health professionals throughout the world to bring improved care to these needy children; For his and his families' sacrifices for a higher medical purpose.

2011 HONOREE

Charles Price, MD

For his outstanding service to the organization, especially as President 2003-2004. For his direction and expansion of the International Pediatric Orthopaedic Symposium. For his contributions to the education of orthopaedic surgery residents and fellows.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Closed Treatment of Overriding Distal Radius Fractures without Reduction in Pediatric Patients

Scott N. Crawford, MD, Lorrin S.K. Lee, MD, Byron Izuka, MD, University of Hawaii, Honolulu, Hawaii

OUTSTANDING BASIC SCIENTIFIC PAPER

Local Administration of Bisphosphonate and BMP-2 Stimulates Bone Formation and Decreases Femoral Head Deformity Following Ischemis Necrosis of the Immature Femoral Head

Jacob S. Vandermeer, Nobuhiro Kamiya, MD, PhD, James Aya-ay, Amanda Garces, Richard Browne, PhD, Harry K.W. Kim, MD, MSc, Center for Excellence in Hip Disorders, Texas Scottish Rite Hospital for Children, Dallas, Texas

OUTSTANDING POSTER

Referral Patterns To a Pediatric Orthopaedic Clinic: Pediatric Orthopaedic Surgeons are Primary Care Musculoskeletal Medicine Physicians

William Hennrikus, MD, John Kobilis, Jane Hamp, RN

OUTSTANDING E-POSTER

Operative Management of the Severe Genu Valgum Deformity in the Ellis-van Creveld Syndrome

Dennis S. Weiner, MD, Jason C. Tank, MD, David K. Jonah, MA, Steven E. Kopits (deceased), MD, William C. Schrader, MD

SPECIAL EFFORT & EXCELLENCE AWARD

Todd Milbrandt, MD

In recognition of His Special Service to further the Mission of POSNA, while still a Candidate Member, he designed and implemented the new POSNA website, thereby saving POSNA over One Hundred Thousand Dollars.

HUMANITARIAN AWARD

Kaye E Wilkins, MD

In Recognition of His Efforts to Improve the Orthopaedic Care of the World's Children; For His Special Commitment to the Education of the Physicians and the Care of the Children of Haiti; For Providing Orthopaedic Education in More Than Fifty Three Countries; For His Refusal to be Intimidated by Political Unrest, Natural Disasters, or State Department Watch Lists.

POSNA
Award for Distinguished Achievement

2010 HONOREE

Stuart Weinstein, MD

For his Peerless Contributions to Orthopaedic Research, in Particular for his Commitment to Documentation of the Long-Term Outcomes of Pediatric Orthopaedic Conditions and their Treatments. For his leadership and service in The Pediatric Orthopaedic Society of North America, The American Orthopaedic Association, The American Board of Orthopaedic Surgery, and The American Academy of Orthopaedic Surgeons. For excellence in writing and editing orthopaedic texts and atlases, especially those related to pediatric orthopaedics and pediatric spinal surgery.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Brace Treatment Controls Progression in Adolescent Idiopathic Scoliosis

Donald E. Katz, CO; John A. Herring, MD; Richard H. Browne, PhD; Derek M. Kelly, MD; John G. Birch, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Muscle Stem Cells are Major Contributors to Open Fracture Repair and Traumatic Bone Formation

Renjing Liu, PhD; Lauren Peacock; Kathy Mikulec; Alyson Morse, BSc(Hon); Aaron Schindeler, PhD; David G. Little, FRACS (Orth), PhD

OUTSTANDING POSTER

Muscle Derived Stem Cell for Limb Lengthening in Rabbit Model

Andy Wee, MBBS; James Hoi Po Hui, FRCSE; Eng Hin Lee, MD, FRCSC

OUTSTANDING E-POSTER

Risk Factors for Failure after Open Reduction for DDH: a Matched Cohort Analysis

Wudbhav N. Sankar, MD; Wudbhav N. Sankar, MD; Charles R. Young, MD; Abraham Lin, MD; Scott A. Crow, MD; Keith D. Baldwin, MD, MSPT, MPH; Colin F. Moseley, MD (Children's Hospital of Philadelphia)

2009 HONOREE

Vernon Thorpe Tolo, MD

For leadership in his advocacy for Pediatric Orthopaedics as President of the Pediatric Orthopaedic Society of North America, as President of The Scoliosis Research Society, and as President of the American Academy of Orthopaedic Surgeons. For his leadership as researcher, as author, and as Deputy Editor for Pediatric Orthopaedics of The Journal of Bone and Joint Surgery. For his leadership in establishing premier Pediatric Orthopaedic Centers at The Johns Hopkins Hospital and at Children's Hospital Los Angeles, and in inspiring and training many future leaders.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Limb Salvage Reconstruction or Amputation for Severe Fibular Deficiency: A Two-center Comparison of Psychosocial Adjustment, Quality of Life, Patient Satisfaction and Physical Function

John G. Birch, MD; Dror Paley, MD; Anne A. Morton, PhD; Stacey Specht, MPA

OUTSTANDING BASIC SCIENTIFIC PAPER

Epiphyseal Cartilage Plays an Important Role in Revascularization of the Femoral Head Following Ischemic Osteonecrosis

Haikuo Bian, MD; James Aya-ay, MS; Amanada Garces; Elise F. Morgan, PhD; Shawn R. Gilbert, MD; Harry K. W. Kim, MD, FRCSC

OUTSTANDING SCIENTIFIC POSTER

Motor Vehicle Transportation in Hip Spica Casts: Are Our Patients Safely Restrained?

Evgeny E. Krynetskiy, MD; Martin J. Herman, MD

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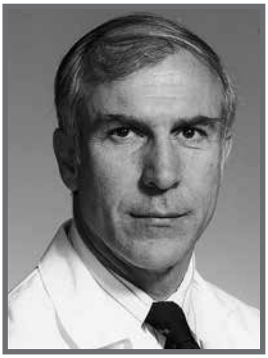


2008 HONOREE

Tony Herring, MD

For development of the Texas Scottish Rite Hospital for Children into one of the premier centers of Pediatric Orthopaedic Care in North America. For his leading role in the training of over 100 Pediatric Orthopaedic Fellows from North America and over 30 Fellows from abroad. For editing and revising the third and fourth editions of Tachdjian's Pediatric Orthopaedics as well as bringing together the stellar team of authors.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Cotrel Derotation Casting for Progressive Infantile Scoliosis

James O. Sanders, MD; Marcie L. Fitzgerald, PA-C; Joseph G. Khoury, MD; Shyam Kishan, MD; Aaron Wallace, MD; Mary Jane Smalley, CRNP; Kathy Oathout, RN; Shelly Mennini

OUTSTANDING BASIC SCIENTIFIC PAPER

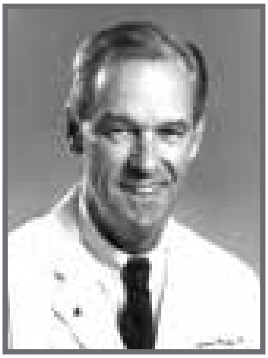
Cellular and Molecular Events During Staple Epiphyseodesis Recovery

Todd A. Irwin, MD; Gary Gibson, PhD; Marcus Haemmerle, MD; Bingbing Zhang, PhD; Maozhou Yang, PhD; Ira Zaltz, MD

OUTSTANDING SCIENTIFIC POSTER

Change of Hip Joint Contract Pressure Distribution after Various Realignment Osteotomies for Slipped Capital Femoral Epiphysis (SCFE)

Ki Hyeong Rhuy, MD; In Ho Choi, MD; Tae-Joon Cho, MD; Chin Youb Chung, MD; Won Joon Yoo, MD



2007 HONOREE

Raymond Morrissy, MD

For his commitment to updating and improving one of the seminal texts of Pediatric Orthopaedics, and for developing its accompanying atlas. For his dedication to the education of Pediatric Orthopaedic Fellows. For his leadership and vision in the expansion of the Atlanta Scottish Rite Hospital into a premier full-service pediatric hospital.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Surgical Dislocation with Open Reduction and Internal Fixation for Unstable Slipped Capital Femoral Epiiphysis: Early Promising Results

Daniel J. Sucato, MD; David A. Podeszwa, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

The Paradoxic response of Human Osteoblasts in Patients with Osteogenesis Imperfecta to Alendronate

Arabella I. Leet, MD; Tamara Kazarian, BS; Jay Shapiro, MD; Edward McCarthy, MD; Neal Fedarko, PhD

OUTSTANDING SCIENTIFIC POSTER

Avascular Necrosis of the Trochlea of the Humerus Revisited: Long-term Follow-up

Kaye E. Wilkins, MD; Nott V. Eric, MD; Sri Ram K, MD

OUTSTANDING SCIENTIFIC E-POSTER

Steroid-induced Avascular Necrosis of the Femoral Head in Children: Early Results of Endoscopic Demcompression with Bone Grafting

Harish S. Hosalkar, MD, MBMS, FCPS, DNB; Gilbert Chan, MD; Eileen Crawford, BA; John Dormans, MD; Lawrence Wells, MD

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2006 HONOREE

Ignacio V. Ponseti, MD

For his long-term work as an international orthopaedist. For his commitment to clinical and basic research in orthopaedics. For his tireless efforts to revolutionize the treatment of clubfoot in infants worldwide.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Excision of Partial Physeal Arrest Followed to Skeletal Maturity: A Report of 100 Cases

Anthony A. Stans, MD; Rudolph A. Klassen, MD; Hamlet A. Peterson, MD; William J. Shaughnessy, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

RANKL Inhibition: A Novel Strategy to Decrease Femoral Head Deformity Following Ischemic Necrosis

Harry Kim, MD, MSc, FRCSC; Stephanie Morgan-Bagley; Paul Kostenuik, PhD

OUTSTANDING SCIENTIFIC POSTER

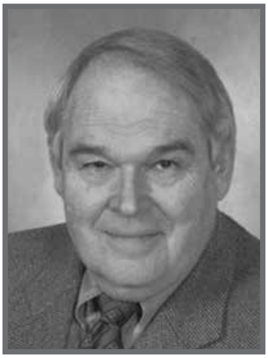
Three-Dimensional Shape Analysis in Legg-Calve-Perthes Disease

Vishwas Talwalkar, MD; Chester Tylkowski, MD; JoAnne Resig, MS; David Pienkowski, PhD; Christin Minter, MA

OUTSTANDING SCIENTIFIC E-POSTER

Overgrowth after Mid-Femoral Fracture: Altered mRNA Expression in the Rat Physis

Steven L. Frick, MD; Nomaan Ashraf, MD; Martha Meyer; Ralph Meyer, PhD



2005 HONOREE

Robert Hensinger, MD

For his pioneering work as a pediatric orthopaedist and member of POSG. For his long-term and distinguished role as a member and President of the Pediatric Orthopaedic Society of North America. For his long-term commitment to teaching and clinical research. For his outstanding editorial work for the Journal of Pediatric Orthopaedics.

OUTSTANDING CLINICAL SCIENTIFIC PAPERS

Volume of Scoliosis Surgery Among Surgeons with Spine versus Pediatric Orthopaedic Fellowship Training in the States of New York and California

Michael G. Vitale, MD, MPH; Mark Vitale, MPH; Bento Heyworth, BA; David L. Skaggs, MD, MMM; David Roye, MD; Carter Lipton, MD, MBA, MPH

OUTSTANDING BASIC SCIENTIFIC PAPER

OP-1 and Zoledronic Acid Act Synergistically to Increase Bone Volume and Strength in a Rat Critical Defect Model

David Graham Little; Negin Amanat, BE

OUTSTANDING SCIENTIFIC POSTER

Superhip Procedure for Correction of Hip Deformities of Congenital Femoral Deficiencies

Dror Paley, MD, FRCSC

OUTSTANDING SCIENTIFIC E-POSTER

**Correction of Tarsal Deformities in Congenital Clubfoot with Ponseti Treatment:
When and How Does It Occur - A 3D MRI Analysis**

Shafique P. Pirani, FRCSC; David Hodges, FRCPN; Richard Brand, MD; William Morrison, MD; Sorin Siegler, PhD; Jayaram Udupa, PhD; Ignacio Ponseti, MD

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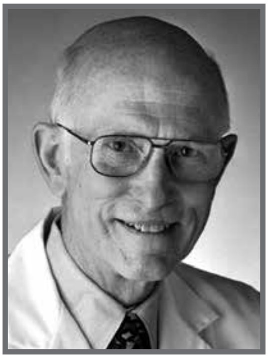


2004 HONOREE

Marc A. Asher, MD

For his pioneering work as a pediatric orthopaedist. For his long-term and distinguished role as a member and officer of the Pediatric Orthopaedic Society of North America. For his long-term commitment to teaching and clinical research. For his outstanding work in the field of spinal deformity surgery with innovations in instrumentation, three dimensional correction and surgical outcomes.

OUTSTANDING CLINICAL SCIENTIFIC PAPERS

A Comparison of Short and Long-Arm Plaster Casts for Displaced Distal-Third Pediatric Forearm Fractures: A Prospective Randomized Trial

Robert D. Galpin, MD, FRCS; C. Gavin R. Webb, MD; Douglas G. Armstrong, MD; Daniel Schlatterer, DO

OUTSTANDING BASIC SCIENTIFIC PAPER

Botulinum Toxin as an Adjunct to Serial Casting in Children with Cerebral Palsy

Robert M. Kay, MD; Susan A. Rethlefsen, PT; Ana Fern-Buneo, MD, PT; Tishya A. Wren, PhD; David L. Skaggs, MD, MMM

OUTSTANDING SCIENTIFIC POSTER

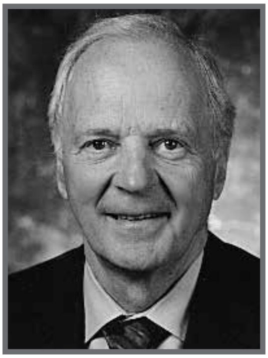
Ibandronate Decreases Femoral Head Deformity Following Ischemic Necrosis of the Capital Femoral Epiphysis (CFE) in Immature Pigs

Harry K.W. Kim, MD; Tim Randall, BSc; Haikuo Bian, MD; Joseph Jenkins, BSc; Amanda Garces; Frieder Bauss, PhD

OUTSTANDING SCIENTIFIC E-POSTER

Concerns, Desires & Expectations of Surgery for Adolescent Idiopathic Scoliosis: A Comparison of Patients', Parents' and Surgeons' Perspectives

Unni G. Narayanan, MD; James G. Wright, MD, MSc, FRCSC; Douglas M. Hedden, MD, FRCSC; Benjamin Alman, MD FRCSC; Andrew Howard, MD, MSc; Brian Feldman, MD, MSc; Hillary A. Llewellyn-Thomas, PhD; Morgan Slater, BASc; Sandra Donaldson, BA



2003 HONOREE

Hamlet A. Peterson, MD

For his pioneering work as a pediatric orthopaedist. For his long-term and distinguished role as founding member of the Pediatric Orthopaedic Study Group and the Pediatric Orthopaedic Society of North America. For his long-term commitment to teaching and clinical research. For his outstanding work in the field of growth plate injury and the treatment of growth arrest.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Posterior Shoulder Dislocation in Infants with Neonatal Brachial Plexus Palsy

Didier Moukoko, MD; Marybeth Ezaki, MD; Peter Cartel; MD; David Wilkes, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Experimental Approach to the Pathogenesis of Congenital Constriction Band Syndrome

Jean Michel Clavert, MD; Philippe Gicquel, MD; Claude Karger; MD; Marie-Christine Giacomelli, MD

OUTSTANDING SCIENTIFIC POSTER

Assuming the Burden of Pediatric Fracture Care in a Children's Medical Center… Efficiently! A Model for a Pediatric Fracture Clinic

John T. Smith, MD; Sohrab Gollogly, MD; Nicole Clarke

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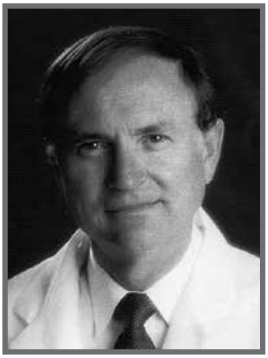


2002 HONOREE

Lynn T. Staheli, MD

Dedicated international teacher and mentor in pediatric orthopaedics. Founding member, co-chair and president of the Pediatric Orthopaedic Study Group. Instrumental in the development of a subspecialty journal for pediatric orthopaedics. Described a standardized acetabular shelf procedure. Active in developing low cost orthopaedic texts for use in third-world countries. Consummate gentleman and colleague.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Nerve Injuries Associated with Limb Lengthening

Dror Paley, MD; M.P. Noguiera, MD; A. Bhave, PT; J.E. Herzenberg, MD, FRCSC; A. Herbert, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

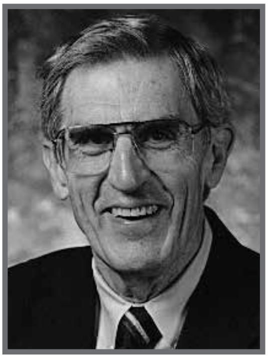
Surgical Lengthening of the Triceps Surae: An Anatomical and Biomechanical Study

Gary Nattrass, MD; H. Kerr Graham, MD; Marinis Pirpiris, MD, Richard Bakerm, PhD, ND

OUTSTANDING SCIENTIFIC POSTER

Autologous Bone Marrow Aspiration in Children: The Influence of Aspiration

Suzanne Marie Yandow, MD, Sherrie Perkins, MD; Jeanne Siebert, RN, Heather Gagon



2001 HONOREE

Kaye E. Wilkins, MD

For his long-term distinguished role in the Pediatric Orthopaedic Study Group and the Pediatric Orthopaedic Society of North America. For his role as a teacher and compassionate clinician, especially in the care of children with fractures. For his role in outreach to care for children in third-world countries and to teach those orthopaedists who work there. For his long-term authorship on children's fracture care in an effort to promote the best possible treatment for children.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Interobserver Variability of Gait Analysis in Cerebral Palsy
Ken J. Noonan, MD; Richard Browne, PhD; Suzzane Halliday, PhD; Kosmos Kayes, MD; Shana O'Brien, MS

OUTSTANDING BASIC SCIENTIFIC PAPER

Piglet Model of Ischemic Necrosis of Capital Femoral Epiphysis (CFE): Reliability, Deformity, and Revascularization
Harry K.W. Kim, MD, FRCSC; Phi-Huynh Su, BSc

OUTSTANDING SCIENTIFIC POSTER

Histologic Features of Physeal Bar Formation in Physeal Fractures
J. Michael Wattenbarger; MD; Laura Phieffer; MD; Helen Gruber; PhD

2000 HONOREE

Mercer Charles Rang, MD

For his role as a teacher and compassionate clinician, especially in the care of children with cerebral palsy. For his ability to raise serious issues masked in gentle and entertaining humor. For his uniquely recognizable authorship of books on children's fractures and the history of medicine. And for his enthusiastic and devoted vision of internationalism which sees children worldwide as the scope of pediatric orthopedic surgery.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Pubital Peak Irradiate Cartilage and Apophysis of the Greater Trochanter
Alain Dimeglio, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

The Molecular Etiology of Enchondromatosis and Implications for Therapy
Benjamin Alman, MD; Sevan Hopyan, MD; Raynond Poon, MSc; William G. Cole, MBBS, PhD, FRCSC; Robert Bell, MD, FRCSC; Irene Andrulis, PhD; Jay Wunder, MD, FRCSC; Nalan Gokgoz, MSc

OUTSTANDING SCIENTIFIC POSTER

The Technique and Results of the Ponseti Method for Treatment of Congenital Clubfoot
Frederick Dietz, MD; S.L. Weinstein, MD; I.V. Ponseti, MD

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1999 HONOREE

Newton C. McCollough III, MD

For his guidance and leadership in the formative years of POSNA and especially for his wisdom and vision in molding the Shriners Hospitals for Children into a formidable force for the betterment of children with orthopedic problems.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

The Demographics of Atypical and Idiopathic Slipped Capital Femoral Epiphysis (SCFE): The Age-Weight Test and Implications for Further Diagnostic Evaluation

Randall Loder, MD; Mary Lou V.H. Greenfield, MPH

OUTSTANDING BASIC SCIENTIFIC PAPER

Regulation of Chondrocyte Hypertrophy Occurs Through Local Induction of Bone Morphogenetic Proteins

R. Tracy Ballock, MD; Lynn Mink, MS; Daniel Chen, MS

OUTSTANDING SCIENTIFIC POSTER

Non-operative Clubfoot Treatment Comparing the French Technique to Serial Casting-Early Results

B. Stephens Richards, MD; Holly Wilson, PT; Charles E. Johnston, MD

1998 HONOREE

Paul P. Griffin, MD

For his enormous impact as a teacher and his vision which led to the creation of the Pediatric Orthopaedic Society. That vision played a major role in establishing the entire field of pediatric orthopaedic surgery as a separate specialty within orthopaedics.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

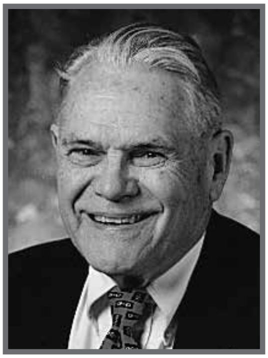
Management of Posttraumatic Chronic Radial Head Dislocation in Children

Hamlet A. Peterson, MD; Michael J. Seel, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Histomorphic Analysis of the Development of the Pars Interarticularis and its Association with Isthmic Spondylolysis

James G. Jarvis, MD; Claude Sagi, MD; Hans K. Uhthoff, MD



1997 HONOREE

Howard Steel, MD

For his enormous impact on pediatric orthopaedics as a teacher, thinker and scientist. His imaginative ideas have stimulated and provoked a whole generation of orthopaedic surgeons. He has worked tirelessly to encourage young surgeons to expand beyond the horizons of orthopaedics. Above all, he has done this with infectious good humor.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Surgical versus Conservative Treatment of Polls Paraplegia in Children
Vicente Gomez, MD; Julyn Aguilar; MD; Rogelio Espina, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

The Effect of Increasing the Frequency of Distraction During Limb Lengthening on Soft Tissues in an Animal Model
Vincent F. Deeney, MD; Jeffrey S. Shilt, MD; Kevin McKinley, MD; Cheryl Quinn, PhD

1996 HONOREE

Robert B. Salter, MD

For his enormous impact on pediatric orthopaedics by integration of scientific research with clinical practice. He has had a world-wide influence on the treatment of children with hip disease, epiphyseal fractures, and the healing of damaged joint cartilage using continuous passive motion. Above all, he has been a tireless and powerful teacher in his lectures and writing.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Is Biceps Recovery a Reliable Prognosticator for Brachial Plexus Birth Palsy
Peter M. Waters, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Cultured Chondrocyte Transfers in the Treatment of Partial Growth Arrest
Eng Hin Lee, MD; F. Chen; J. Chan

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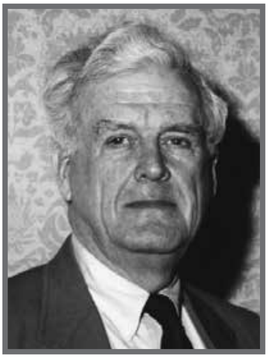


1995 HONOREE

G. Dean MacEwen, MD

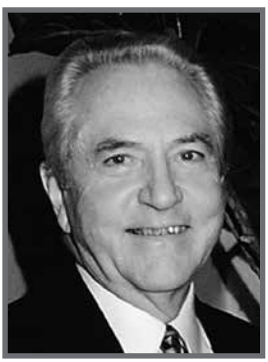
For the many significant contributions to the literature of pediatric orthopaedics in its widest scope; for directing a multitude of young surgeons to pursue a career in the specialty of pediatric orthopaedics both by direct encouragement and by his example as an outstanding role model; and for his broad vision of orthopaedics whereby he has spent countless days traveling the world to teach the principles of pediatric orthopaedics.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Avascular Necrosis Following Treatment of DDH: The Protective Influence of the Ossific Nucleus
Lee Segal, MD; Danielle Boal, MD; Laura Borthwick; Edwards P. Schwentker; MD, BA; Mary Williams Clark, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Condroprotective Effect of Betamethasone in Lapine Pyogenic Arthritis
Stephen J. Stricker; MD; Philip R. Lozman, MD; Annalena Makowski, HTL; Zeenat Gunja-Smith, PhD



1994 HONOREE

Sherman S. Coleman, MD

For influencing many to enter the field of Pediatric Orthopaedics and continue his tradition of enthusiasm, dedication to patient care, and advancement of pediatric orthopaedics science.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Metal Removal Following in situ Fixation for Slipped Capital Femoral Epiphysis
Raymond T. Morrissy, MD

OUTSTANDING BASIC SCIENTIFIC PAPERS

Longitudinal Growth of the Rabbit Tibia after Callotasis
Duk Yong Lee, MD; In Ho Choi, MD

Familial Protein C and S Deficiency and Hypofibrinolysis: Common Causes of Legg-Perthes Disease
C.J. Glueck; A. Crawford, MD; D. Roy, H.I. Glueck; D. Stroop; A. Kahn; R. Freiberg; T. Tracy

1993 HONOREE

David H. Sutherland, MD

For his pioneering work in the development of gait analysis in children and for major contributions to the orthopaedic management of children with cerebral palsy and congenital hip dysplasia.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Opening Wedge Osteotomies in Long Bones of Children

Hamlet A. Peterson, MD; Mark Scheffer, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Hemichondrodiatasis - Is Bridge Resection Necessary?

E.H. Lee, MD; K. Rose, MBBS; J.W.K. Chan

1992 HONOREE

John E. Hall, MD

Known for his unusually broad knowledge and skill in every area of pediatric orthopaedics and for his far reaching influence as a teacher of pediatric orthopaedic surgery.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Calcaneal Neck Lengthening for Severe Abducto-Valgus (Flat) Hindfoot Deformity

Vincent S. Mosca, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

The Effect of Limb Lengthening on Articular Cartilage: An Experimental Study

Deborah F. Bell, MD

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1991 HONOREE

Walter P. Blount, MD

Dedicated to Walter P. Blount, M.D. exemplary citizen, orthopaedic scientist and teacher. Known for his innovations in the treatment of children's' fractures, tibia vara (Blount's disease), angular deformities of the knee, and scoliosis.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Congenital Muscular Torticollis: Sequelae of Intra-Uterine Compartment Syndrome
Dennis R. Wenger, MD; Scott J. Mubarak, MD; Jon R. Davids, MD

Has Ultrasound Changed Treatment Patterns in Developmental Dysplasia of the Hip?
John B. Emans, MD; Donald H. Hangen, MD; James R. Kasser, MD; Frank Rand, MD; Michael Millis, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Distraction Osteogenesis: A Comparison of Corticotomy Techniques
Kamal N. Ibrahim, MD; Michael A. Frierson, MD; Mark Boles, MD; Herb Bote

1990 HONOREE

Alvin J. Ingram, MD

Pediatric Orthopaedic Surgeon, Extraordinary Leader in Organized Medicine, Sixth President of the Pediatric Orthopaedic Society.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Aggressive Fibromatosis: Diagnosis, Effectiveness of Therapy and Biochemical Considerations
Michael J. Goldberg, MD; Benjamin A. Alman, MD; Hubert A. Wolfe, MD; Stephen Nabor, MD, PhD

OUTSTANDING BASIC SCIENTIFIC PAPER

Measurement of Femoral Head Circulation by Laser Doppler Flowmetry in the Mini-Pig
George S. Bassett, MD; David Apel, MD; Vernon T. Tolo, MD

1989 HONOREE

Wood W. Lovell, MD

Pediatric Orthopaedic Surgeon, Scholar, Author of "Pediatric Orthopaedics," Teacher and Mentor, Caring Physician to Children and their Parents, Founding Member of the Pediatric Orthopaedic Society.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Long-Term Follow-up of Slipped Capital Femoral Epiphysis
Stuart L. Weinstein, MD; Brian Carney, MD; Jeffrey Noble, MD

OUTSTANDING BASIC SCIENTIFIC PAPER

Isolation of Cell Populations with Different Kinetic Characteristics from the Murine Distal Femoral Chondroepiphysis
David J. Zaleske, MD; Michael H. Jofe, MD; Michael G. Ehrlich, MD; Henry F. Mankin, MD

1988 HONOREE

Burr H. Curtis, MD

Pioneer Pediatric Orthopaedic Surgeon, Champion of Multidisciplinary Clinics and Dedicated Children's Hospitals, Founding Member and Second President of the Pediatric Orthopaedic Society.

OUTSTANDING CLINICAL SCIENTIFIC PAPER

Breast Cancer Risk in Scoliotic Women Exposed to Multiple Diagnostic X-rays
John Lonstein, MD; Dan Hoffman, PhD; Michele Morin, MS; John Boice Jr, ScD; Wendy Visscher; EMPH; Benjamin S.H. Harris III

OUTSTANDING BASIC SCIENTIFIC PAPER

The Long Term Results of the Remodeling Potential of Growth Plate versus Angular Osteotomy of Long Bones in Baboons
Edward Abraham, MD

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ARTHUR H. HUENE MEMORIAL AWARD

The May 1991 meeting of our Society marked the inauguration of the Arthur H. Huene Memorial Award for excellence and promise in Pediatric Orthopaedics. The award consists of a commemorative certificate and a monetary award of $30,000, generously provided by the St. Giles Foundation, intended to be applied by the recipient to continuing work in Pediatric Orthopaedics. The award is made to an individual who has made an outstanding contribution to the field of Pediatric Orthopaedics and who offers the potential of continuing that contribution in the future.

THE ST. GILES FOUNDATION

More than one hundred years ago, in 1891, the House of St. Giles the Cripple was founded by Sister Sara, an Episcopalian nun, with the goal of bringing the finest orthopaedic and rehabilitation care to children of every race, religion and color. Her work began with three children in a house in Brooklyn.

Although payment was accepted from parents who could afford it, care was provided irrespective of finances with additional support for the hospital coming from federal, state and city funds, private insurers and contributions from many sources. The hospital was governed by a Board which was, at first, very closely linked to the Episcopalian Church, and was supported by the medical profession in the persons of a number of orthopaedic surgeons beginning with Dr. Burr Mosher at the turn of the century and ending most recently with Dr. J. William Fielding.

St. Giles Hospital reached the pinnacle of its growth during the 1916 polio epidemic with an inpatient census of 100 patients and thousands of visits to the Outpatient Department. Following the conquest of polio, however, the need for the hospital declined and, faced with soaring deficits and heavy capital outlays mandated by the State of New York, the House of St. Giles was closed in November 1977 and converted into a Foundation. Arthur H. Huene, after whom our award is named, was the President of the hospital from 1948 to 1971, and was then awarded the status of President Emeritus. He was important in the deliberations that led to the conversion of the hospital to a Foundation.

The St. Giles Foundation is an active one. It continues to receive charitable donations and to support work dedicated to the same goals as the original hospital, namely the benefit of disabled and weakened children.

The Arthur H. Huene Memorial Award already occupies an important position in the world of Pediatric Orthopaedics and reflects well upon the St. Giles Foundation and our Society.

2013 WINNER
Unni Narayanan, MD

"Evaluation of Outcomes of Hip Interventions for Children with Cerebral Palsy –An International Multi-centre Prospective Longitudinal Comparative Cohort Study"

PAST WINNERS

2012 - Michael G. Vitale, MD
2011 - Lori Karol, MD
2010 - R. Tracy Ballock, MD
2009 - James O. Sanders, MD
2008 - George Thompson, MD
2007 - Harry K.W. Kim, MD
2006 - Robert Campbell, MD
2005 - Paul D. Sponseller, MD
2004 - Dr. L. Andrew Koman
2003 - Dr. Benjamin Alman
2002 - Dr. John Anthony Herring
2001 - Dr. James G. Wright
2000 - Dr. Michael D. Sussman
1999 - Dr. Robert N. Hensinger
1998 - Dr. Michael G. Ehrlich
1997 - Dr. Michael J. Goldberg
1996 - Dr. Hamlet A. Peterson
1995 - Dr. James Aronson
1994 - Dr. Stuart L. Weinstein
1993 - Dr. Frederic Shapiro
1992 - Dr. Robert R. Salter
1991 - Dr. William G. Cole

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ST. GILES YOUNG INVESTIGATOR AWARD

The May 2000 meeting saw the first St. Giles Young Investigator Award, sponsored by the St. Giles Foundation, given to a deserving member of the Pediatric Orthopaedic Society of North America. The Award is to be used for educational or research endeavors, including travel to centres of excellence to learn new techniques and skills.

2013 WINNER
Benjamin Shore, MD

"Validity and Reliability of the Pediatric Evaluation Disability Inventory –Computer Adaptive Test (PEDI-CAT) in Children with Cerebral Palsy"

PAST WINNERS

2012 - Matthew Halanski, MD
2011 - Firoz Miyanji, MD
2010 - Eric Edmonds, MD
2009 - Shawn R. Gilbert, MD
2008 - Donald Bae, MD
2007 - Christopher Iobst, MD
2006 - Siobhan Murphy-Zane, MD
2005 - James McCarthy, MD
2004 - Arabella Leet, MD
2003 - Harry K.W. Kim, MD
2002 - Norman Y. Otsuka, MD
2001 - Frances A. Farley, MD
2000 - David L. Skaggs, MD, MMM

POSNA

ANGELA S.M. KUO MEMORIAL AWARD

The first Angela S.M. Kuo Memorial Award was presented at the 2003 annual meeting.

Through the OREF, Dr. Ken Kuo established an endowment fund with a challenge grant in memory of his late wife, Angela. The current objective of the award is to provide recognition of an outstanding young investigator who is a member of POSNA, and to provide funds to help promote a long-term research career for that individual.

2013 WINNER
Daniel Sucato, MD

"Twenty-year Functional and Radiographic Follow-up of Operative Legg-Calve-Perthes Disease"

PAST WINNERS

2012 - Donald S. Bae, MD
2011 - Klane K. White, MD
2010 - Joseph A. Janicki, MD
2009 - Sevan Hopyan, MD
2008 - Kishore Mulpuri, MD
2007 - Michael Vitale, MD
2006 - Unni Narayanan, MD
2005 - Jeffrey Shilt, MD
2004 - Mininder S Kocher, MD
2003 - Shafique P. Pirani, MD

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THE ALFRED R. SHANDS JR. CIRCLE

The Alfred R. Shands Jr. Circle is OREF 's highest-level recognition society. Established in 1994, the Shands Circle was created to recognize those individuals who contribute a minimum of $20,000 in cash or securities or a minimum of $50,000 using life insurance, will, or trust, or to the OREF endowment. POSNA thanks its members who have joined the Shands Circle.

Drs. Behrooz Akbarnia and Nasrin Owsia
Margaret R. Albanese, MD
Dr. and Mrs. Stephen A. Albanese
Michael C. Albert, MD
Benjamin A. Alman, MD
Dave and Linda Aronsson
Dr. Marc and Mrs. Ellie Asher
Dr. and Mrs. George S. Bassett
Dr. and Mrs. James H. Beaty
Randal R. Betz, MD
Laurel C. Blakemore, MD
Dr. and Mrs. Oheneba Boachie-Adjei
Jennette L. Boakes and Mr. David Rives
Gary T. Brock, MD
Dr. and Mrs. Robert W. Bruce Jr
Dr. and Mrs. Robert B. Cady
Robert M. Campbell Jr, MD
S. Terrance Canale, MD
Dr. Hank and Mrs. Jill Chambers
Dr. and Mrs. Henry R. Cowell
Alvin H. Crawford, MD
John P. Dormans, MD, FACS
Denis S. Drummond, MD
Drs. John B. and S. Jean Emans
Dr. Howard and Mrs. Phyllis Epps
Dr. Robert Bucholz and Dr. Marybeth Ezaki
Frances Farley, MD and Darryl Snabes
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Dr. Steven and Mrs. Lisa Frick
Keith R. Gabriel, MD
Theodore J. Ganley, MD
Drs. Mark and Paulette Gebhardt
Dr. and Mrs. Walter B. Greene
Dr. and Mrs. Lawrence L. Haber
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William L. Hennrikus Jr, MD
Mr. John C. Herklotz
Dale and Stevie Hoekstra
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Dr. Gregory and Mrs. Madelyn Mencio
Dr. Todd A. Milbrandt and Ms. Mary Beth Magyar
Dr. Scott and Mrs. Sandy Mubarak
Dr. Peter and Mrs. Cathy Newton
Dr. Ken Noonan and Mrs. Carrie Askew Noonan
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Jay Shapiro, MD
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Eric J. Wall, MD
William C. Warner Jr
Peter M. Waters, MD
Dr. and Mrs. Stuart L. Weinstein
David S. Weisman, MD
Lawrence Wells, MD
Dr. R. Baxter and Mrs. Susan Willis

Bold = New Members
* = Deceased

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POSNA DIRECT FUND

Established in 2011, the POSNA Direct Fund helps POSNA accomplish a variety ofeducational, research and patient care efforts. POSNA thanks those who have generously supported POSNA Direct as of March 2013.

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Kevin M. Neal, MD
Jeffrey B. Neustadt, MD
Peter O. Newton, MD
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**In Memory of Daniel Morrison

PRESIDENTIAL GUEST SPEAKERS

1985 Clement B. Sledge, MD
"Adult Sequellae of Childhood Hip Disease"

1986 Clement B. Sledge, MD

1987 Martin Barkin, MD
"Funding for Health Care in North America"

1988 I.V. Ponseti, MD
"Fifty Years of Orthopaedics"

1989 Mr. Anthony Catterall
"Art and Science in the Practice of Children's Orthopaedics"

1990 Anders Langenskiold, MD
"A Survey of Forty Years Research on the Growth Plate"

1991 Richard L. Cruess, MD
"Locke, Tousseau, and the Modern Surgeon"

1992 Sherman S. Coleman, MD
"Quo Vadis" Pediatric Orthopaedic Surgery

1993 G.D. MacEwen, MD
"Pediatric Orthopaedics Approaching the 21st Century"

1994 Howard H. Steel, MD
"Creation, Discovery, Invention and Other Things"

1995 Mercer Rang, MD
"What's Important about Children's Orthopaedics"

1996 R. Mervyn Letts, MD
"Prevention-An Olympian Goal"

1997 Robert H. Hensinger, MD
"The Challenge of Growth: The Fourth Dimension of Pediatric Care"

1998 Bruce Latimer, PhD
"The Peris of Being Bipedal"

1999 Vernon Tolo, MD
"And Miles to Go Before We Sleep"

2000 Norris C. Carroll, MD
"The Wound I Believe is a Disease"

2001 Stuart L. Weinstein, MD
"Societal Role in The Bone and Joint Decade"

2002 Clifford J. Tabin, PhD
"Signals Controlling the Development of the Skeletal System During Embryogenesis"

2003 Peter F. Armstrong, MD
"Shriners Hospital for Children; The Past, The Present and The Future"

2004 Lynn Staheli, MD
"Beyond Orthopaedics"

2005 Dennis R. Wenger, MD
"The Geneology of Children's Orthopaedic Training in North America"

2006 Michael J. Goldberg, MD
"Acts of Loving Kindness"

2007 Alvin Crawford, MD
"Vision"

2008 Colin F. Moseley, MD
"Evidence Based Medicine: The Dark Side"

2009 J. Anthony Herring, MD
"Who Are We?"

2010 Scott Mubarak, MD
"Hawaii, First Contact"

2011 Kaye E. Wilkins, MD
"Pediatric Orthopedics: Our New Global Reality

2012 James Kasser, MD
"It's Hard to Learn with Your Mouth Open"

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1971 Chicago, IL (June)
Newington, CT (Sept.)

1972 Rochester, MN

1973 Sturbridge, MA

1974 Absecon, NJ

1975 Sea Island, GA

1976 Palm Springs, CA

1977 Palm Beach, FL

1978 Phoenix, AZ

1979 New Orleans, LA

1980 Rancho Santa Fe, CA

1981 Palm Beach, FL

1982 Carmel, CA

PEDIATRIC ORTHOPAEDIC STUDY GROUP

1974 Rochester, MN

1975 Atlanta, GA

1976 Ann Arbor-Detroit, MI

1977 San Antonio, TX

1978 Rochester, MN

1979 Seattle, WA

1980 Montreal, QC CANADA

1981 Nashville, TN

1982 San Diego, CA

JOINT

1983 Charlottesville, VA

1984 Vancouver, BC CANADA

PEDIATRIC ORTHOPAEDIC SOCIETY OF NORTH AMERICA

1985 May 15–18
Four Seasons Hotel
San Antonio, Texas
Kay Wilkins, MD (Host)

1986 May 4–7
Westin Copley Place Hotel
Boston, Massachusetts
Michael Ehrlich, MD (Host)

1987 May 17 – 20
Hilton Harbor Castle Hotel
Toronto, Ontario, CANADA
Colin F. Moseley, MD (Host)

1988 May 5 – 8
Broadmoor Hotel
Colorado Springs, Colorado
Robert Eilert, MD (Host)

1989 May 17 – 20
Westin Resort
Hilton Head, South Carolina
Michael D. Sussman, MD (Host)
E. William Schmitt, MD (Host)

1990 May 6 – 9
Hyatt on Union Square
San Francisco, California
Malvin Barer, MD (Host)

1990 September 7–8
(EPOS) Montreal Meridien
Montreal, Quebec, CANADA
Morris Duhaime, MD (Host)

1991 May 12–15
Loew's Anatole
Dallas, Texas
John A. Herring, MD (Host)

1992 May 6–9
Newport Marriott
Newport, Rhode Island
John M. Roberts, MD (Host)

1993 May 2–5
The Greenbriar
White Sulphur Springs, West Virginia
Eric T. Jones, MD (Host)

1994 May 11–14
The Peabody Hotel
Memphis, Tennessee
S. Terry Canale, MD (Host)

1995 May 1–4
Sheraton Bal Harbor
Miami, Florida
Chester M. Tylkowski, MD (Host)

Pediatric Orthopaedic Society of North America Meetings (cont.)

1996 May 11–13
Pointe Hilton at South Mountain
Phoenix, Arizona
Richard J. Haynes, MD (Host)

1997 May 15–18
Banff Springs Hotel
Banff, Alberta, CANADA
Gerhard N. Kiefer, MD (Host)

1998 May 5–9
Renaissance Cleveland Hotel
Cleveland, Ohio
George H. Thompson, MD (Host)

1999 May 15–19
Wyndham Palace Resort & Spa
Lake Buena Vista, Florida
Charles T. Price, MD (Host)

2000 May 1–4
Hotel Vancouver
Vancouver, British Columbia, CANADA
Stephen J. Tredwell, MD (Host)

2001 May 1–5
Hilton Cancun Beach & Golf Resort
Cancun, MEXICO
Jose DeLa Garza, MD (Host)

2002 May 2–5
Grand
America Hotel
Salt Lake City, Utah
Peter Stevens, MD (Host)

2003 May 2–5
Amelia Island Plantation
Amelia Island, Florida
R. Jay Cummings, MD (Host)

2004 April 27–May 1
Adam's Mark Hotel
St Louis, Missouri
Perry Schoenecker, MD (Host)

2005 May 12–15
Ottawa Convention Centre
Ottawa, Ontario, CANADA
James Jarvis, MD (Host)

2006 May 3–6
Manchester Grand Hyatt San Diego
San Diego, California
Henry Chambers, MD (Host)

2007 May 23–26
Westin Diplomat Resort & Spa
Hollywood, Florida
Michael Jofe, MD (Host)

2008 April 30–May 3
Albuquerque Convention Center
Albuquerque, New Mexico
Elizabeth Szalay, MD (Host)

2009 April 29–May 2
Boston Marriott Copley Place
Boston, Massachusetts
Mininder S. Kocher, MD (Host)
James R. Kasser, MD (Co-Host)

2010 May 4–7
Hilton Waikoloa Village
Waikoloa, Hawaii
Ellen Raney, MD (Host)

2011 May 11-14
Fairmont Queen Elizabeth Hotel
Montreal, Quebec, CANADA
Francois Fassier, MD (Host)
Hubert Labelle, MD (Co-host)

2012 May 16-19
Hyatt Regency Hotel
Denver, Colorado
Mark A. Erickson, MD (Host)
Ernest L. Sink, MD (Co-host)

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Charles T. Ryder, MD
Robert L. Samilson, MD
Frank H. Stelling III, MD
Mihran O. Tachdjian, MD

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1973	Frank H. Stelling III
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1975	Alvin J. Ingram
1976	Mihran O. Tachdjian
1977	Paul P. Griffin
1978	Sherman S. Coleman
1980	John E. Hall
1981	Douglas W. McKay
1982	Anthony J. Bianco Jr
1983	Eugene E. Bleck

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1971	Douglas W. McKay
1974	Robert B. Winter
1978	Hugh G. Watts

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1971	Paul P. Griffin
1974	Wilber G. Westin
1978	David H. Sutherland
1981	Hamlet A. Peterson

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1975	John C. Wilson
	Albert B. Ferguson Jr
1976	Seymour Zimbler
	John C. Wilson
1977	Henry R. Cowell, MD
	Seymour Zimbler, MD
1978	Lynn T. Staheli, MD
	Henry R. Cowell, MD
1979	Robert N. Hensinger, MD
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1980	Mervyn R. Letts, MD
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1981 – 82	Marc A. Asher, MD
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CHAIR

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1979	Hamlet Peterson, MD

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1981	Dennis Lyne, MD
1982	Dennis Drummond, MD
1983	E. William Schmitt Jr, MD

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1975-1979	E. William Schmitt Jr, MD
1980-1983	Kaye E. Wilkins, MD

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(as of March 2013)

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Stanley M.K, Chung, MD, 1998
Charles H. Herndon, MD, 1998
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Paul Campbell, MD, 2004
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Keisha M. DePass, MD, 2010
Saul Bernstein, 2010
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Kenneth "Van" Jackman, MD, 2010
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Daniel Morrison, DO, 2012
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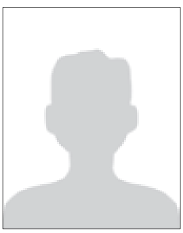

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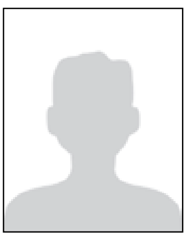

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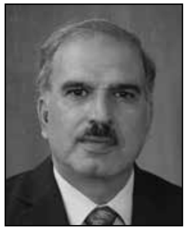

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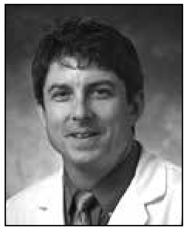

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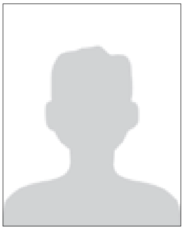

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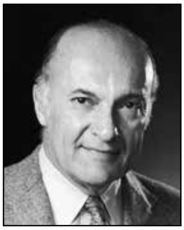

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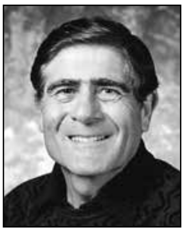

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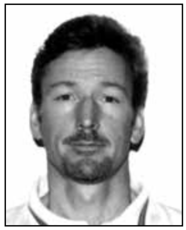

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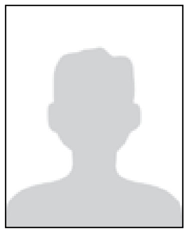

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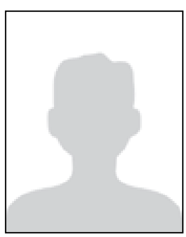

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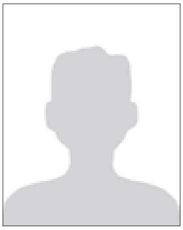

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Univ Klinik fur Orthopadie
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SENI 1983

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CAND 2010

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ACTI 1997

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ACTI 1986

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SENI 1983

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ACTI 1998

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ACTI 2000

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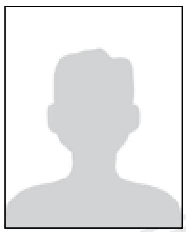
ACTI 2001



Bell, Michael
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SENI 1996

Bellflower, Joseph F *(Anita)*
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ACTI 2005

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CAND 2011

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ACTI 1996

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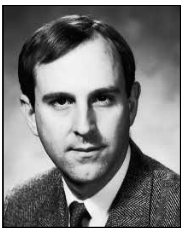
ACTI 2004



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CAND 2010

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CAND 2012

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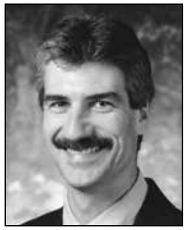
ACTI 1997



Bertrand, Styles Leslie *(Mary)*
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ACTI 1994

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ACTI 1986

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ACTI 1994

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ACTI 1985

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ACTI 1996

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ACTI 1986

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ACTI 1993

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ACTI 2000

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ACTI 1992

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CAND 2009

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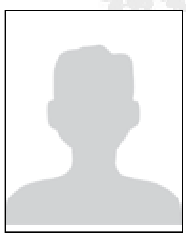
ACTI 1986



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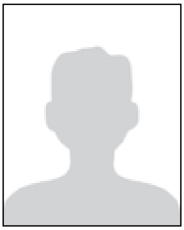
ACTI 1995



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SENI 1983

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CAND 2011

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CAND 2011

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ACTI 2005

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ACTI 1987

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ACTI 1983

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ACTI 2003

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ACTI 2005

Bratt, Henry D *(*Hank*)*
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SENI 1996

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ACTI 2006

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800 Washington St 206
Boston, MA 02111
Phone: (617)636-7920
Fax: (617)636-9107
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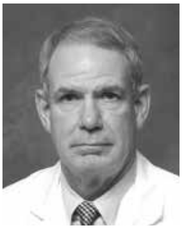
ACTI 2005



Bray, Edward W *(Rosemarie)*
Greenville Hospital System
University Med Ctr
701 Grove Rd
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SENI 1994

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SENI 1983

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CAND 2011

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SENI 1983

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CAND 2008

Brock, Gary
7401 S Main
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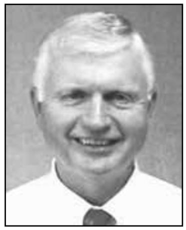
ACTI 1994



Brown, Hugh P *(Judy)*
979 East Third St Ste C220
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SENI 1983

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ACTI 1984

Brown, T Desmond *(Karen)*
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ACTI 1994

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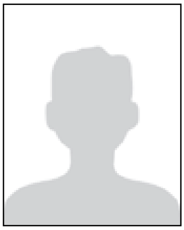
SENI 1983



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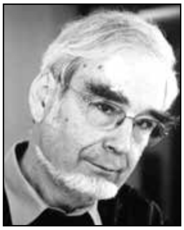
ACTI 1998



Brunner, Christian F (Chris)
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ACTI 1993

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CAND 2006

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ACTI 1983

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ACTI 1998

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ACTI1990

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CAND 2007

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ACTI 2005

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ACTI 2006

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ACTI 1987

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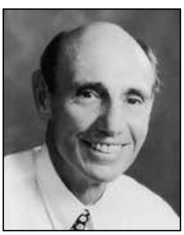
ACTI 1998



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CAND_CORR 2010

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CORR 2009

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ACTI 2001

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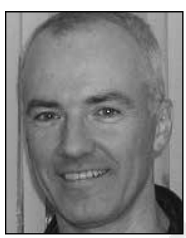
ACTI 2000



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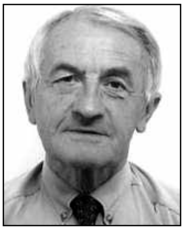
ACTI 1993



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SENI 1983

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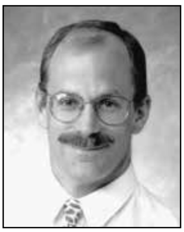
ACTI 1987



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ACTI 2003

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ACTI 1993

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ACTI 1999

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CAND 2009

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ACTI 2006

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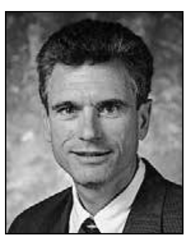
CAND 2009



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ACTI 2008

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CORR 2005

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CAND 2008

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CORR 1988

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CAND 2010

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CORR 1997

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CORR 1991

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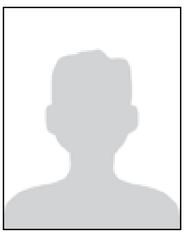
CAND 2007



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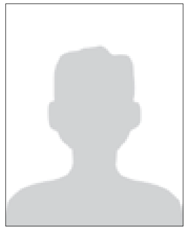
ACTI 1989



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ACTI 2000

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ACTI 1986

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ACTI 1994

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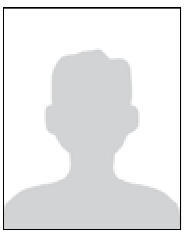
CORR 2002



Cowell, Henry Richard (Harry)
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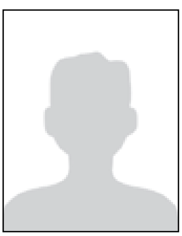
SENI 1983



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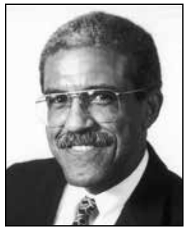
ACTI1983



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ACTI 2006

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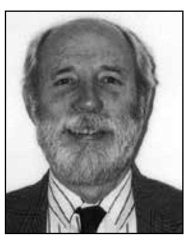
CAND 2009



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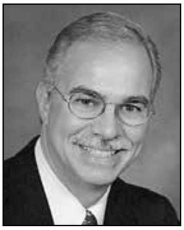
SENI 1984



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CAND 2011

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ACTI 1983

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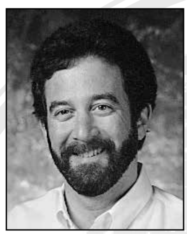
ACTI 2000



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ACTI 1994

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CAND 2009

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ACTI 1987

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ACTI 1997

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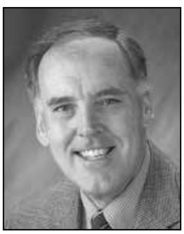
CAND 2011



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ACTI 1986

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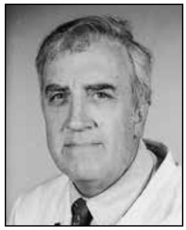
CORR 1986



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ACTI 1995

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ACTI 1989

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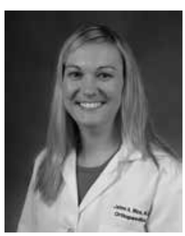
SENI 1984



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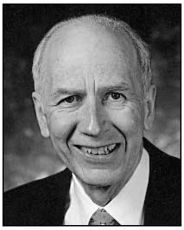
CAND 2010



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CORR 2002

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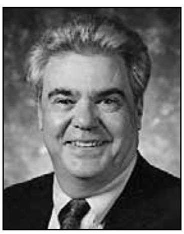
CAND 2009



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CAND 2009

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ACTI 1998

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SENI 1983

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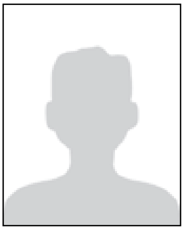
ACTI 1983

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



Dick, Harold M *(Joyce Geller)*
622 W 168th St, PH-11th Fl
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SENI 1984

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CAND 2011

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CORR 1983

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ACTI 2000

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ACTI 2002

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CAND 2009

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ASSO 2003

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ACTI 1993

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CAND 2009

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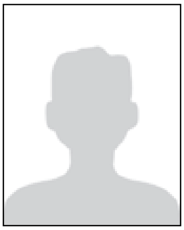
ACTI 1996



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ACTI 2001

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ACTI 2003

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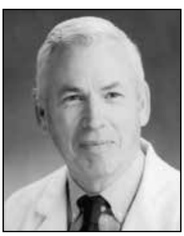
SENI 1983



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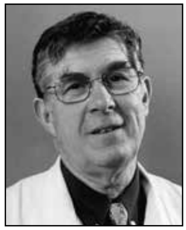
ACTI 1988



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ACTI 2000

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ACTI 2003

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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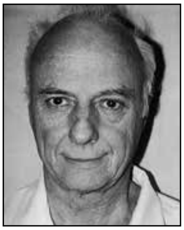
ACTI 2002



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SENI 1984

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SENI 1986

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CAND 2006

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CORR 1998

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ACTI 2002

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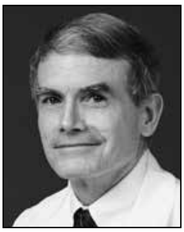
CAND 2011



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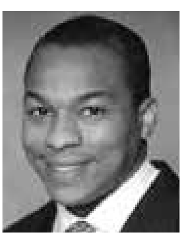
ACTI 2002



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ACTI 1998

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ACTI 1986

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CORR 1996

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ACTI 1994

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ACTI 2011

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CORR 2011

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ACTI 1993

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ACTI 1996

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ACTI 1985

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ACTI 1998

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SENI 1983

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CAND 2009

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CORR 2011

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CAND 2009

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SENI 1987

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ACTI 2000

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ACTI 2004

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ACTI 2011

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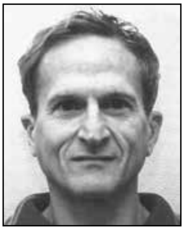
CAND 2009



Fink, Edward P
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ACTI 2006

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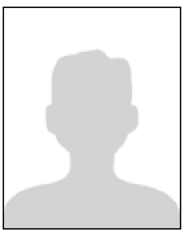
CAND 2009



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SENI 1984

Fisk, John R *(Diane)*
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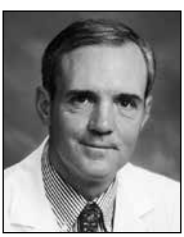
SENI 1983



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ACTI 1987

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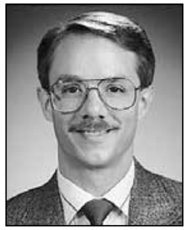
CAND 2011



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ACTI 1993

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CAND 2009

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SENI 1986

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ACTI 2000

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CAND 2010

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ACTI 2001

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ACTI 2010

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CORR 1986

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ACTI 1999

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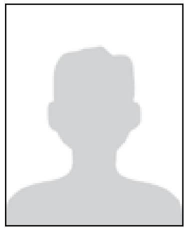
CAND2011



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SENI 1988

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ACTI 1988

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ACTI 1998

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ACTI 2005

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SENI 1983

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SENI 1983

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CORR 2003

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ACTI 1989

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CAND 2009

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ACTI 2000

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CAND 2009

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ACTI 1987

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CAND 2009

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ACTI 1996

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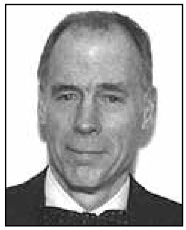
CAND 2011



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ACTI 1987

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ACTI 1990

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ACTI 1993

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ACTI 2000

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ASSO 2009

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ACTI 2009

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CAND 2011

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ACTI 1998

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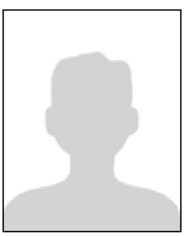
ACTI 2002



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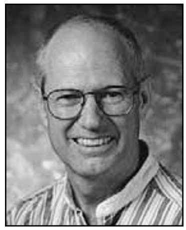
SENI 2000



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SENI 2003

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ASSO 2011

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ACTI 2008

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CORR 2006

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ACTI 1998

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CAND 2010

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HONO 2005

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SENI 1987

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ACTI 1998

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ACTI 1993

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ACTI 2000

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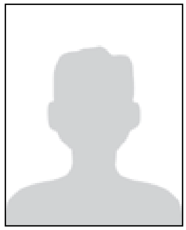
SENI 1983



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SENI 1983

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ACTI 2000

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SENI 1983

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SENI 1983

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SENI 2005

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ACTI 2010

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ACTI 1986

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ACTI 1991

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SENI 1983

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SENI 1983

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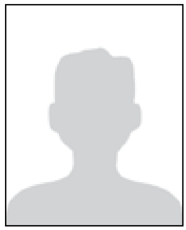
ACTI 2000



Gruber, Martin A *(Edie)*
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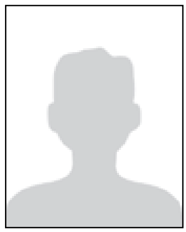
SENI 1987



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Phone: (412)692-6746
Fax: (412)692-6088
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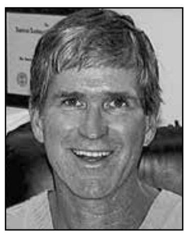
ACTI 1993



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ACTI 1989

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CAND 2011

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ACTI 2004

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ACTI 2000

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SENI 1983

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CAND 2006

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CAND 2007

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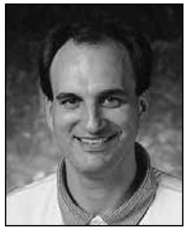
ACTI 2003



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ACTI 1995

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ACTI 2000

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CORR 2002

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ACTI 2009

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ACTI 2003

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ACTI 2000

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ACTI 2004

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CAND 2008

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SENI 1983

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ACTI 2002

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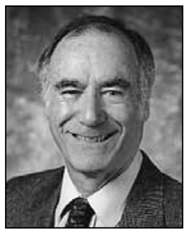
SENI 1983



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SENI 1983

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CAND 2006

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CAND 2010

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ACTI 2001

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ACTI 1999

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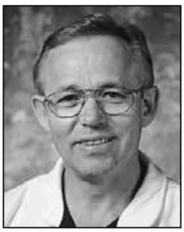
HONO 1993



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ACTI 2009

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ASSO 2010

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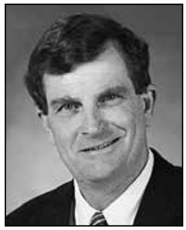
ACTI 2006



Haynes, Richard J *(Sherril)*
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SENI 1990

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CAND 2009

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ACTI 2008

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ACTI 2002

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CAND 2011

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ACTI 1992

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ACTI 2006

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ACTI 1989

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CAND 2008

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ACTI 1995

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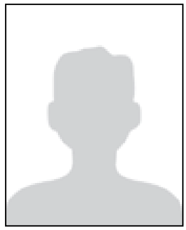
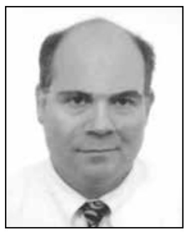
SENI 1983



Herklotz, John
24701 Raymond Way SPC 221
Lake Forest, CA 92630-4724
HONO 2002



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ACTI 2000

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ACTI 1983

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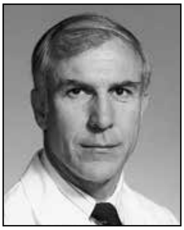
ACTI 2004



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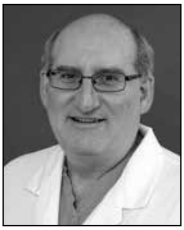
ACTI 1983



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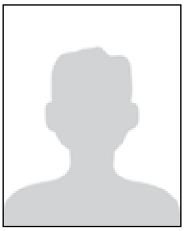
ACTI 1987



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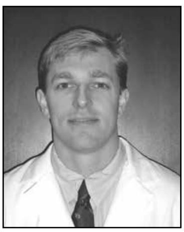
ACTI 1988



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SENI 1984

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SENI 1986

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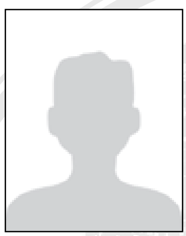
ACTI 1992



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CAND 2011

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CAND 2006

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CAND 2007

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SENI 1983

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CAND 2011

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ACTI 1997

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CAND 2010

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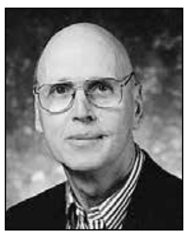
CAND 2008



Hotchkiss, Brian L *(Gerry)*
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SENI 1983

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ACTI 1999

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ACTI 2009

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ACTI 2004

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ACTI 1993

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SENI 1983

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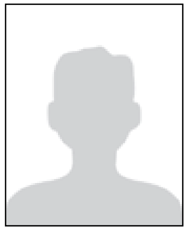
ACTI 2003



Huene, Donald R
201 N Valeria
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HONO 2002

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SINGAPORE
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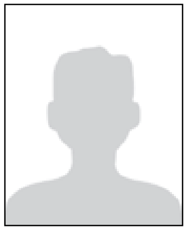
CORR 2008



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ACTI 2008

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CAND 2010

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ACTI 2007

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ACTI 2004

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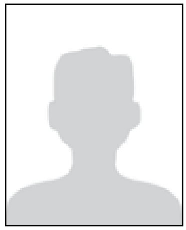
CORR 1989



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SENI 1983

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ACTI 2009

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SENI 1990

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ACTI 1993

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ASSO 2006

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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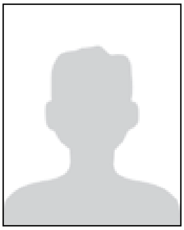
ACTI 1993



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CAND 2006

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ACTI 1994

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ACTI 1986

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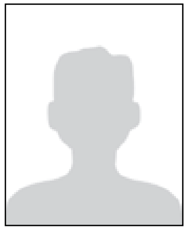
CORR 2011



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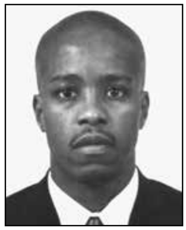
CORR 2006



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ACTI 2002

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CAND 2010

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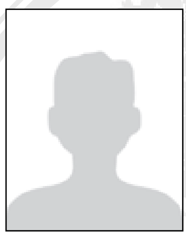
CAND 2009



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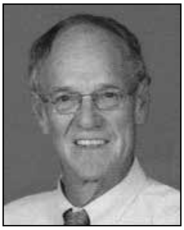
CAND 2011



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ACTI 1986

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SENI 1984

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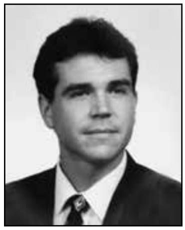
ACTI 1983



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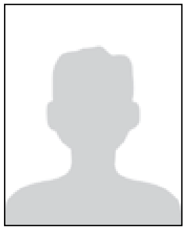
ACTI 2001



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CORR 1995

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ACTI 2000

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CORR 1999

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ACTI 1997

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ASSO 2003

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CAND 2010

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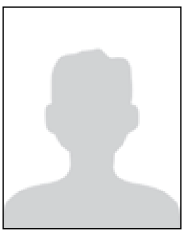
CAND 2008



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ACTI 1984

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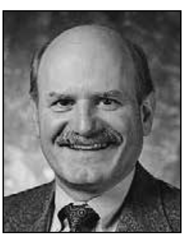
ACTI 1994



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ACTI 2005

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ASSO 1993

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ACTI 2001

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ACTI 1988

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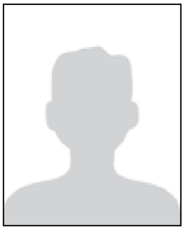
CAND 2008



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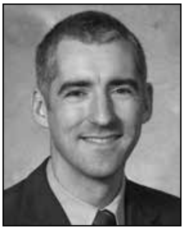
SENI 1984



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CAND 2009

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CAND 2008

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CAND 2011

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ACTI 2002

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ACTI 2006

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CORR 1998

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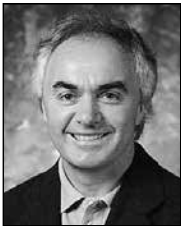
CTI 2001



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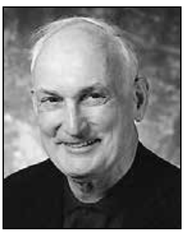
ACTI 1985



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SENI 1983

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CAND 2009

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ACTI 2004

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ACTI 1997

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ACTI 2003

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ACTI 2001

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CAND 2009

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CORR 1998

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ACTI 1984

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ACTI 2003

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ACTI 1988

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ACTI 2006

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ACTI 1985

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ACTI 2000

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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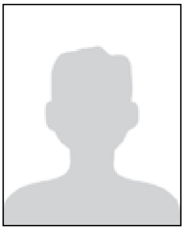
ACTI 2011



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ACTI 1997

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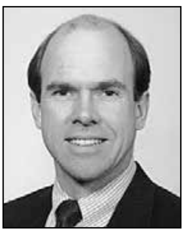
CAND 2007



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ACTI 1994

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CAND 2010

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CAND 2009

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SENI 1983

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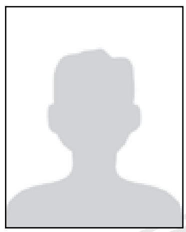
ASSO 2008



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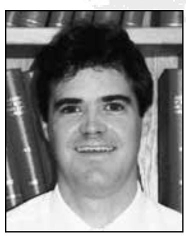
CAND 2010



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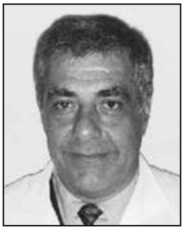
ACTI 2000

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



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CORR 2005

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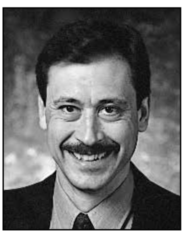
ACTI 1997



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CORR 1996

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CAND 2008

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CAND 2008

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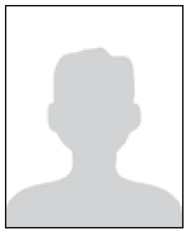
CORR 2011



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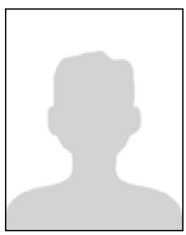
ACTI 1995



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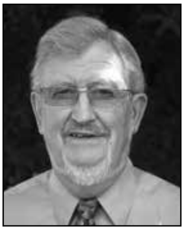
CAND 2008



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CAND 2010

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SENI 1986

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SINGAPORE
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CORR 1988

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CAND 2009

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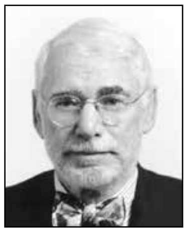
ACTI 2000



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SENI 1983

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ACTI 1987

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ACTI 2005

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ACTI 2003

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ACTI 2002

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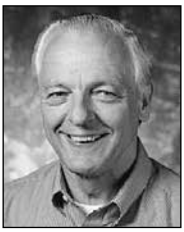
ACTI 2000



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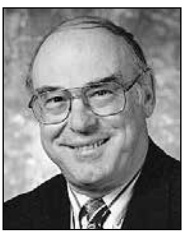
SENI 1986



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SENI 1983

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CAND 2009

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ACTI 2001

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CAND 2008

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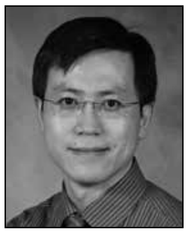
CAND 2009



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ACTI 2000

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CORR 2006

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CORR 2008

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CORR 1993

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ACTI 2004

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ACTI 2003

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ACTI 1993

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CAND 2010

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ACTI 1999

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SENI 1983

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CAND 2007

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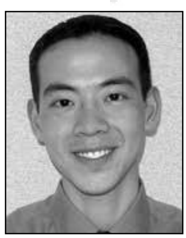
CAND 2011



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CAND 2008

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CORR 2007

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ACTI 2000

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CAND 2011

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ACTI 2009

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SENI 1983

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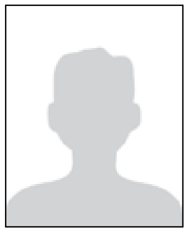
SENI 1986



Love, Harry P *(Martha)*
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SENI 1992

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SENI 1992

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CAND 2006

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ACTI 2003

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ACTI 1996

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ACTI 1984

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ACTI 2003

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ACTI 2000

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SENI 1983

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ACTI 1996

MacEwen, G Dean *(Marilyn)*
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SENI 1983

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CAND 2009

Maciel, Maureen J *(Daniel)*
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ACTI 2008

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Hartford, CT 06106
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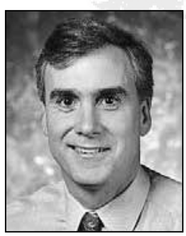
ACTI 2002



Mackenzie, William G *(Martha)*
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for Children
1600 Rockland Rd
PO Box 269
Wilmington, DE 19803
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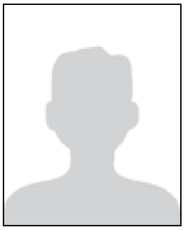
Email: wmackenz@nemours.org
ACTI 1990

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



Macy, Neil J *(Rosalind)*
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ACTI 1988

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ACTI 1985

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ACTI 2004

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ACTI 1999

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ACTI 1990

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CORR 2006

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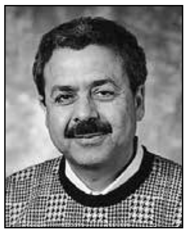
ACTI 2006



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ACTI 1986

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ACTI 2003

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ACTI 2001

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SENI 1990

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CAND 2009

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ACTI 1989

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CORR 2006

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ACTI 1995

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SENI 1983

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CAND 2010

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SENI 1984

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ACTI 2003

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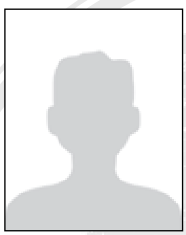
ACTI 2006



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ACTI 1983

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SENI 1990

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ACTI 1994

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CAND 2006

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CAND 2009

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ACTI 2004

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SENI 1984

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SENI 1983

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SENI 1983

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ACTI 2000

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ACTI 1984

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ACTI 2005

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ACTI 1993

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CAND 2009

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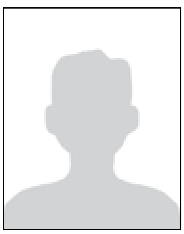
CAND 2006



McIntyre, William M J (Bill)
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CANADA
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SENI 1983

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CANADA
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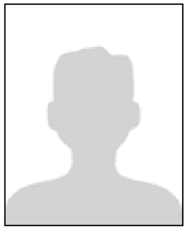
ACTI 1986



McKay, Douglas W (Doug)
(Elinor)
33 Baldwin Head Rd
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SENI 1983

McKay, Scott D *(Jessica)*
Texas Childrens Hospital
6701 Fannin
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CAND 2009

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CAND 2011

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ACTI 1995

McKeon, John J (Jack) *(Rita)*
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SENI 1985

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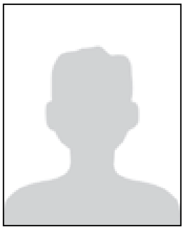
CAND 2011



McManus, Frank *(Susan)*
71 Eccles St
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IRELAND
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SENI 1986

McNerney, Neal P *(Rose Ann)*
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ACTI 2002

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CAND 2008

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CANADA
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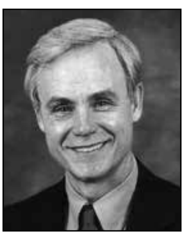
ACTI 1991



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ACTI 1999

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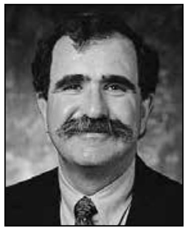
ACTI 2011



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ACTI 1988

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ACTI 1992

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ACTI 2004

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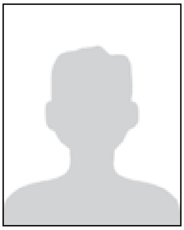
Email: stephen.mendelson@chp.edu
ACTI 1999

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



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CANADA
Phone: (418)623-1610
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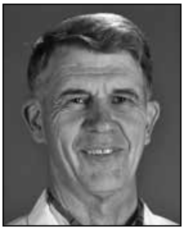
ACTI 1986



Messer, Larry D *(Sharon)*
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ACTI 1991

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ACTI 2001

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ACTI 1996

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ACTI 2006

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ACTI 2005

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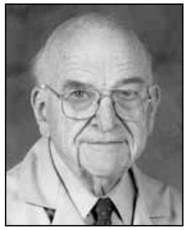
CAND 2011



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ACTI 1990

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ACTI 1994

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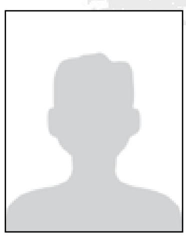
ACTI 1993



Milliner, Stephen *(Melanie)*
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SENI 1989


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ACTI 1983


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ACTI 1999


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ACTI 2003


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ACTI 2011


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SENI 1983


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CAND 2006


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CORR 2011


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ACTI 2000


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CORR 1998


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SENI 1983


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SENI 1983


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ASSO 2010

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ACTI 1996

Moorefield, William G
(Jackie)
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SENI 1986

Moraleda, Novo Luis
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Plaza Jose Maria Soler7
Madrid, 28016
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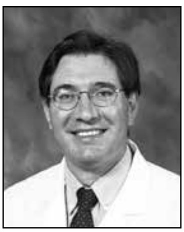
CAND 2009



Morcuende, Jose A
(Ulpiana Gonzalez)
University of Iowa Hospital
& Clinics
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200 Hawkins Dr-01023 JPP
Iowa City, IA 52242
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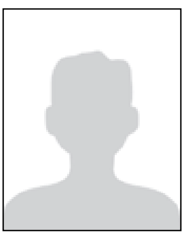
ACTI 1995



Morden, Mary L
329 W Huron Ave
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SENI 1983

Moreau, Marc J *(Barbara)*
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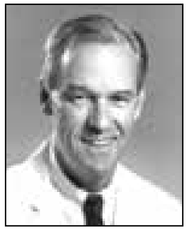
ACTI 1983



Morrissy, Raymond T (Ray)
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SENI 1983

Mortimer, Errol *(Lorraine Cote)*
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ACTI 2000

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ACTI 1988

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SENI 1983

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ACTI 2001

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ACTI 1989

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SENI 1983

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CAND 2010

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ASSO 2006

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ASSO 2011

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SENI 1984

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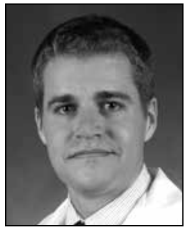
CAND 2010



Murnaghan, M Lucas
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CAND 2008

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ACTI 2001

Murray, Travis N *(Andrea)*
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ACTI 2011

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CAND 2009

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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CORR 2001

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ACTI 2000

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ACTI 2005

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ACTI 2006

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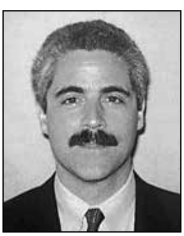
ASSO 2006



Neustadt, Jeffrey B
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ACTI 1993

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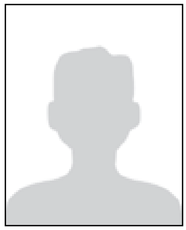
ACTI 1997



Nicastro, Joseph F
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SENI 1986

Nichols, L Reid Boya *(David)*
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CAND 2010

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ACTI 2008

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ACTI 1990

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CORR 1988

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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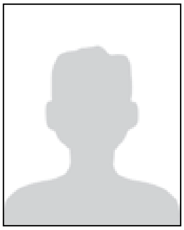
CAND 2009



Nogi, Jay *(Sandi)*
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SENI 1983

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ACTI 2000

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ACTI 1995

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CAND 2011

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CAND 2011

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ACTI 2002

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CAND 2009

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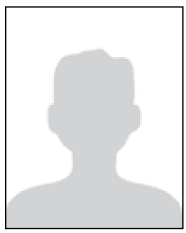
ACTI 1984



O'Brien, Timothy
(Mary Jennings)
The Children's Hospital
Temple St
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SENI 1989

Oda, Jon Edward *(Roberta)*
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ACTI 2008

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CAND 2008

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SENI 2006

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ACTI 1991

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ASSO 2009

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ACTI 1996

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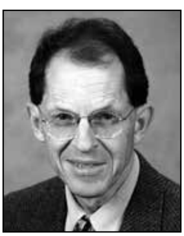
SENI 1983



Osebold, William R *(Patricia)*
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SENI 1992

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ACTI 2003

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ACTI 1998

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ACTI 1997

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CAND 2010

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ACTI 2002

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ACTI 1988

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ACTI 1984

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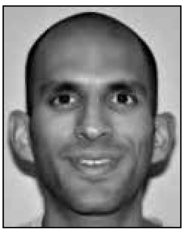
CAND 2011



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CAND 2009

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SENI 1983

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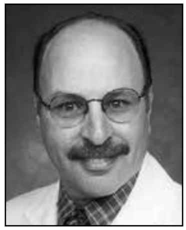
CAND 2006



Parenti, John M *(Cindy)*
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ACTI 1988

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ASSO 2009

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SENI 1983

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ACTI 2006

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CAND 2011

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ACTI 2004

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CAND 2010

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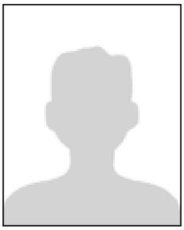
ACTI 2006



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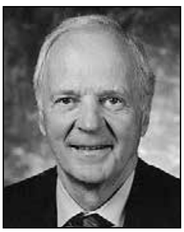
CAND 2011



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SENI 1983

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ACTI 1991

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ACTI 1997

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ACTI 1987

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ACTI 2001

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ACTI 1996

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ACTI 2002

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ACTI 2003

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ACTI 2002

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SENI 1983

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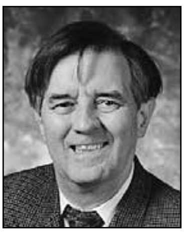
ACTI 2002



Poitras, Benoit P *(Brigitte)*
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SENI 1983

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ACTI 2001

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SENI 1983

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ACTI 2008

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ASSO 2011

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CAND 2010

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ACTI 2005

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SENI 1984

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CAND_CORR 2011

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ACTI 1995

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SENI 1983

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ACTI 1998

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ACTI 2006

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ACTI 2005

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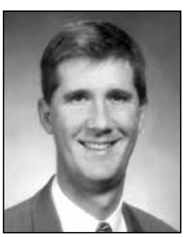
CAND 2010



Puffinbarger, William R
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Rm 2MR2000
Oklahoma City, OK 73104
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ACTI 2000

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ACTI 1984

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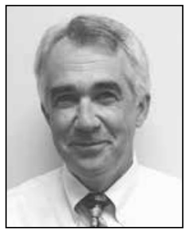
ACTI 1994



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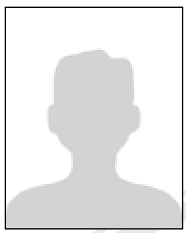
SENI 1984



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ACTI 1993

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ACTI 2000

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CAND 2009

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ACTI 1996

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ACTI 1999

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ACTI 2008

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ACTI 1995

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ACTI 2007

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ASSO 2009

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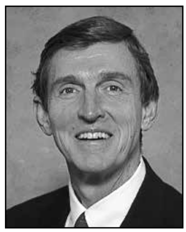
SENI 1983



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ACTI 2000

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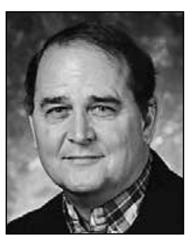
ACTI 1983



Reinker, Kent A
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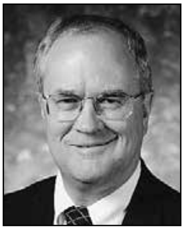
SENI1985

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



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SENI 1983

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ACTI 2003

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ACTI 1994

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ACTI 2006

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ACTI 2006

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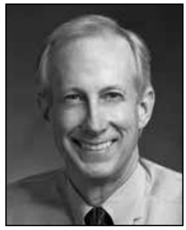
ACTI 1990



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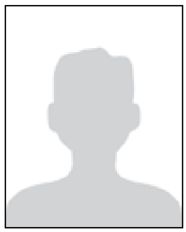
ACTI 1995



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ACTI 1984

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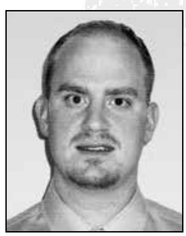
ACTI 2008



Ritzman, Todd F
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CAND 2006

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SENI 1983

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ACTI 1983

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ACTI 2008

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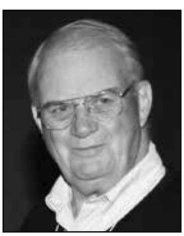
CAND 2011



Roberts, John M *(Edith)*
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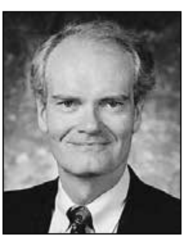
SENI 1983



Robertson, William W (Bill)
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SENI 1983

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CAND 2006

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ACTI 1998

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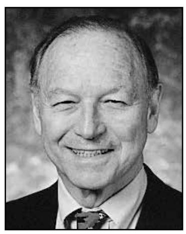
ACTI 1996



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ACTI 1983

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CAND 2009

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ACTI 1992

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CAND 2008

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SENI 1983

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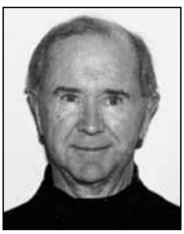
ACTI 1985



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84 Raymond
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SENI 1983

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ACTI 2004

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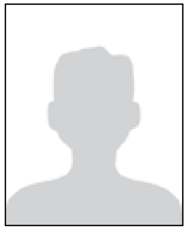
ACTI 1986



Rozansky, Alison J *(David)*
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CAND 2007

Ruda, Richard J *(Ann Marie)*
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SENI 1993

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CAND 2009

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ACTI 2006

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CAND 2008

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ACTI 2000

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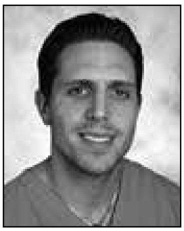
ACTI 2004



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SENI 1989

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ACTI 2004

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ACTI 2000

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CAND_CORR 2011

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SENI 1987

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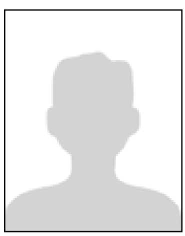
ACTI 1995



Sanderson, Ronald A (Ron)
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SENI 1983

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ACTI 2002

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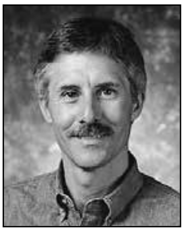
ACTI 2006



Santora, Stephen D *(Jane Ann)*
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ACTI 1995

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CAND 2008

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CAND 2007

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ACTI 1989

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ACTI 2000

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ACTI 2005

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CAND 2011

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ACTI 2001

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ACTI 1999

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Prevea Clinic
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ACTI 2002

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CAND 2011

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ACTI 2009

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CAND 2009

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1310 W Stewart Dr Ste 508
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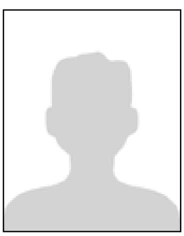
ASSO 2006



Schlesinger, Iris E
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ACTI 1993

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ACTI 2005

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SENI 1984

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SENI 1983

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CAND 2010

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ACTI 2000

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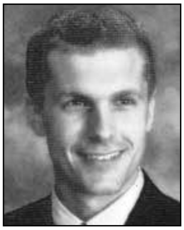
ACTI 1997



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CAND 2006

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ACTI 1983

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ACTI 1990

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Phone: (404)255-1933
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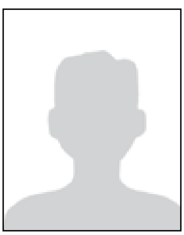
ACTI 2002



Schrader, William C *(Nancy)*
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ACTI 1992

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CAND 2010

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ACTI 2009

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ACTI 1984

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ACTI 1997

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SENI 1983

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SENI 1983

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ACTI 1998

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ACTI 1999

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ACTI 1995

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SENI 1989

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ACTI 2000

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CAND 2011

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ACTI 2001

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CAND 2011

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ACTI 1993

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ACTI 1983

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ACTI 1993

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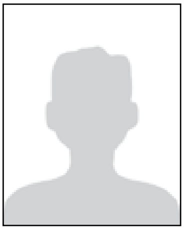
CAND 2010

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate



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CAND_CORR 2006

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ACTI 1993

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ACTI 1993

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ACTI 2000

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ACTI 2010

Shelton, Yvonne A *(Michael)*
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ACTI 2010

Shenava, Vinitha R *(Rajesh)*
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CAND 2007

Sherman, Frederick (Fred)
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SENI 1983

Shilt, Jeffrey
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ACTI 2000

Shindell, Richard L *(Mary)*
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ACTI 1994

Shirley, Eric D
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807 Childrens Way
Jacksonville, FL 32207
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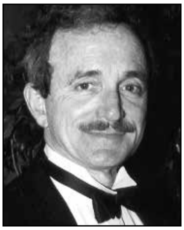
CAND 2006



Shively, James L (Jim) *(Wendi)*
781 Old Jonas Hill Rd
Lafayette, CA 94549
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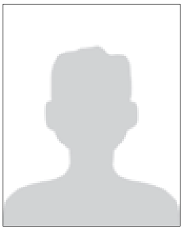
SENI 1983



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ACTI 1988

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CAND 2008

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ACTI 1997

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ACTI 2010

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SENI1983

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ACTI 2010

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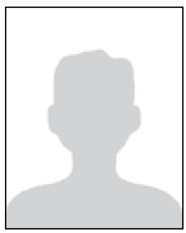
ACTI 2003



Siffert, Robert S (Miriam)
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SENI 1983

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ASSO 2009

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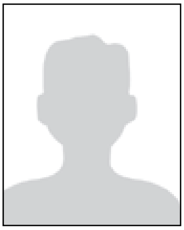
ACTI 2000



Simmons, J Walt *(Janie)*
18626 Hardy Oak Blvd, Ste 300
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ASSO 2002

Simon, Sheldon R (Shelly) *(Arlene)*
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SENI 1983

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2401 Gillham Rd
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ACTI 2001

Singh, Krishna Anjali *(Thomas Hansen)*
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ACTI 2008

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Phone: (212)606-1268
Fax: (212)606-1685
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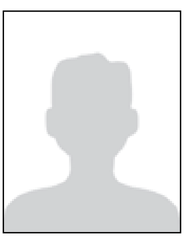
ACTI 2001



Sirkin, Robert B
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CANADA
SENI 1990

Skaggs, David L *(Valerie Ulene)*
4650 Sunset Blvd MS #69
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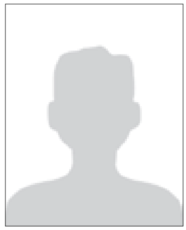
ACTI 1999



Skinner, Stephen R (Steve) (Marilyn)
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ACTI 1985

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ACTI 2000

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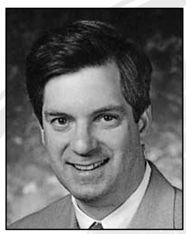
ASSO 2009



Smith, Brian G *(Holly)*
800 Howard Ave
New Haven, CT 06510
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ACTI 1994

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SENI 1983

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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ACTI 1990

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ACTI 1993

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ACTI 1998

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ACTI 2003

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ACTI 1995

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CORR 2000

Song, Kit M *(Kwi Lee)*
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ACTI 1995

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CORR 1997

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ACTI 2006

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ASSO 2010

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CAND 2011

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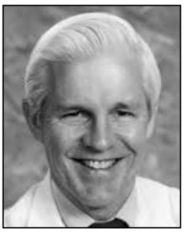
ACTI 2002



Speer, Donald P *(Isabell Speer, MD)*
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SENI 1983

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CAND 2011

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300 Longwood Ave
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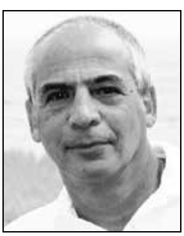
ACTI 2006



Spero, Charles R *(Rozann)*
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SENI1990

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Philadelphia, PA 19104
Phone: (215)590-1527
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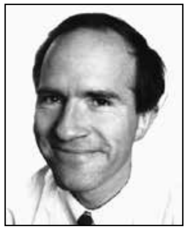
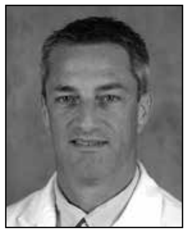
ACTI 2001



Sponseller, Paul D *(Amy)*
Bloomberg Children's Center
1800 Orleans St, Ste 7359 A
Baltimore, MD 21287
Phone: (410)955-3136
Fax: (410)502-6816
Email: psponse@jhmi.edu
ACTI 1990



Spurdle, Craig J *(Mijanou)*
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3100 SW 62nd Ave
Miami, FL 33155-3009
Phone: (305)662-8366
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CAND 2010

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ACTI 1988

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171 Kempsville Rd, Ste 201
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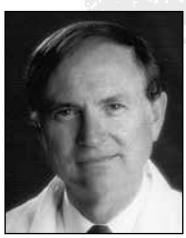
ACTI 2006



Staheli, Lynn T *(Lana)*
2318 Fairview East #2
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SENI 1983

ACTI–Active CORR–Corresponding SENI–Senior ASSO–Associate HONO–Honorary CAND–Candidate

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CAND 2010

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SENI 1983

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SENI 1988

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SENI 1984

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ACTI 2000

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ACTI 1986

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ACTI 1995

Stazzone, Enrico J *(Madelyn)*
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and Sports Medicine
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ACTI 2001

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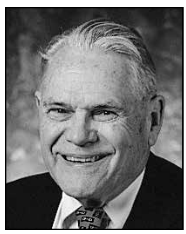
SENI 1983



Steel, Howard H *(Betty Jo)*
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SENI 1983

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ACTI 2001

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CAND 2008

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SENI 1985

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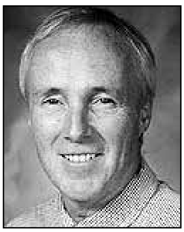
SENI 1983



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ACTI 1985

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ACTI 2008

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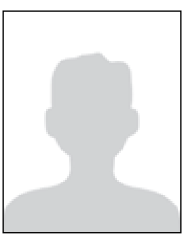
ACTI 2002



Strassberg, Joshua Aaron
218 Ridgedale Ave, Ste 104
Cedar Knolls, NJ 07927
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CAND 2008

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ACTI 1985

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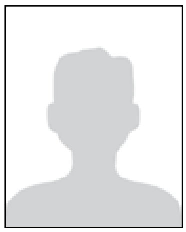
ACTI 1990



Strong, Munro *(Olga)*
411 Walnut St #2254
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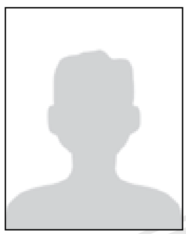
SENI 1988



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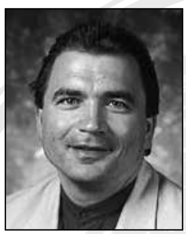
ACTI 1990



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CORR 1994

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ACTI 1993

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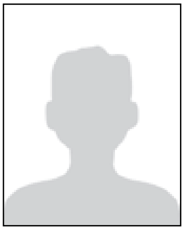
ACTI 2000



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ACTI 1992

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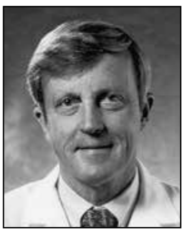
SENI 1983



Sullivan, Robert C (Bob) *(Joy)*
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SENI 1985

Sundberg, Stephen B *(Ann)*
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ACTI 1994

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ACTI 2006

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ACTI 1988

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ACTI 2000

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ACTI 2000

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CORR 1996

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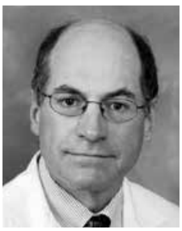
ACTI 2004



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ACTI 1992

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CAND 2011

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ASSO 2006

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ASSO 2008

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CAND_CORR 2008

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ACTI 1993

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ACTI 1992

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CORR 2008

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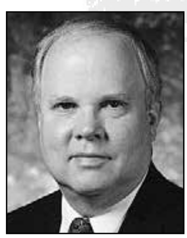
ACTI 1990



Thompson, George H *(Janice)*
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Children's Hosp
11100 Euclid Ave
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SENI 1983

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ACTI 2003

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ACTI 1992

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ACTI 2008

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ACTI 1993

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ACTI 2006

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CORR 1989

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ACTI 1983

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ACTI 2006

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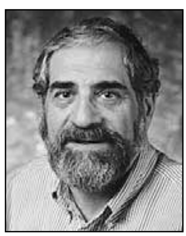
ACTI 2011



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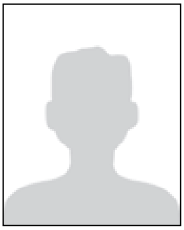
SENI 1984



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CORR 1992

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CORR 2011

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ACTI 1987

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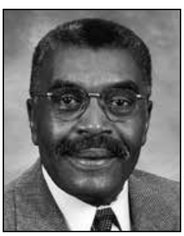
ACTI 2011



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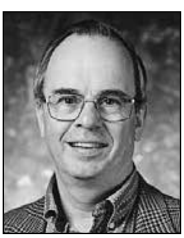
Email: draytowns@aol.com
SENI 1989



Tredwell, Stephen J (Steve)
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SENI 1983

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ACTI 1993

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CAND 2010

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ACTI 1993

Tully, William P *(Susan)*
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SENI 1989

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ACTI 1994

Tuten, Hans Robert *(Kathy)*
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ACTI 2008

Tylkowski, Chester M *(Chet)*
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SENI 1983

Tzimas, Nicholas A (Nick)
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SENI 1984

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SENI 1985

Upasani, Vidyadhar S V *(Priya)*
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CAND 2011

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Concord, NH 03301
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ACTI 1996

Valencia, Francisco G *(Marty)*
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ACTI 1997

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ACTI 2000

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ACTI 2006

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Roan Mountain, TN 37687-0409
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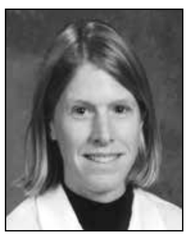
SENI 1983



Vanderhave, Kelly *(Kenneth)*
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Ann Arbor, MI 48109-4241
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ACTI 2004

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ACTI 2011

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CORR 2005

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CAND 2009

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ACTI 1994

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CAND 2010

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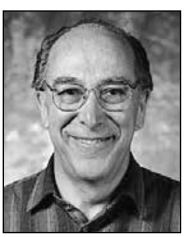
ACTI 2003



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SENI 1986

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ACTI 2005

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ACTI 2010

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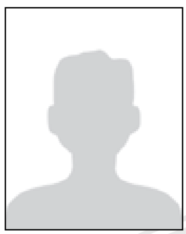
ACTI 2004



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SENI 1984

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CAND 2009

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CAND 2009

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CAND 2006

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ACTI 1991

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ACTI 2001

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ACTI 1996

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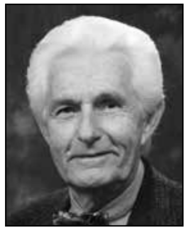
ACTI 2001



Wallace, Sidney L (Sid) *(Linda)*
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SENI 1985

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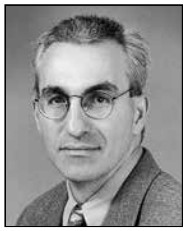
ACTI 2004



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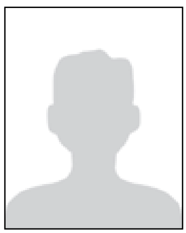
ACTI 1987



Warman, Jeffrey R *(Kati)*
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ACTI 1997

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ACTI 1993

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CAND 2008

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ACTI 1992

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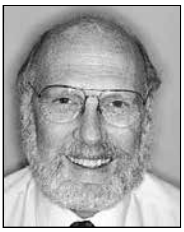
ACTI 1997



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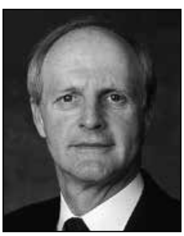
ACTI 2010



Wedge, John H *(Patty)*
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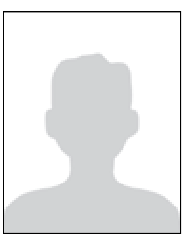
SENI 1983



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CAND 2007

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Akron, OH 44302-1821
Phone: (330)543-7725
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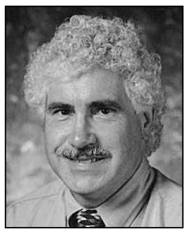
ACTI 1983



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ACTI 1985

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ACTI 1983

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ACTI 1999

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ACTI 2005

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SENI 1990

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ACTI 2004

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ACTI 1983

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ACTI 2004

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CAND 2008

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ACTI 2010

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ACTI 2006

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ACTI 1998

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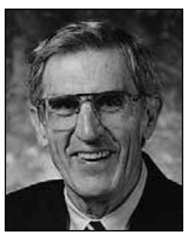
SENI 1988



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ACTI 1995

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SENI 1983

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CAND 2011

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ACTI 1983

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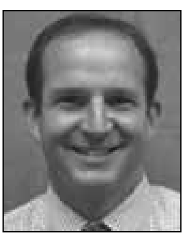
ACTI 2005



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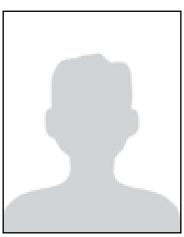
ACTI 2005



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ACTI 2009

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SENI 1983

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ACTI 1993

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ASSO 2005

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CAND 2008

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ACTI 1994

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ACTI 1995

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ACTI 2002

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CAND 2009

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ACTI 1985

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CAND 2008

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CAND 2011

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CAND 2011

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SENI 1983

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ACTI 2011

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ACTI 1984

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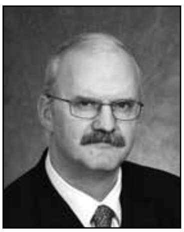
ACTI 2001



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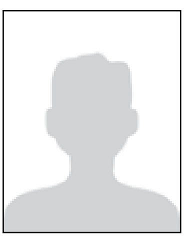
CORR 2007



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ACTI 1988

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ACTI 1989

Zorer, Gazi *(Sennur)*
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CORR 1998

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Gilbert, Shawn R., MD . . . . . Birmingham
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Killian, John T., MD . . . . . Birmingham
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Dempsey, Thomas R., MD . . . . . Mobile
Handwerger, Adam . . . . . Mobile
Nimityongskul, Prasit . . . . . Mobile

Alaska

Speer, Donald P., MD . . . . . Anchorage

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Fink, Edward P., MD . . . . . Glendale
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Georgia

Bruce, Robert W., MD .... Atlanta
Busch, Michael T., MD .... Atlanta
Culotta, Brad A., MD .... Atlanta
De, Sayan .... Atlanta
Devito, Dennis P., MD .... Atlanta
Fabregas, Jorge Amelio .... Atlanta
Flanagan, Jill C., MD .... Atlanta
Fletcher, Nicholas D .... Atlanta
Kunes, Justin R., MD .... Atlanta
Love, Harry P., MD .... Atlanta
Martin, Stephanie S., MD .... Atlanta
Montero, Robert J., MD .... Atlanta
Oswald, Timothy S., MD .... Atlanta
Schmitt, E. William, MD .... Atlanta
Schmitz, Michael L., MD .... Atlanta
Schrader, Tim .... Atlanta
Willimon, Samuel Clifton, MD .... Atlanta
Bailey, Thomas E., MD .... Augusta
Bertrand, Styles Leslie, MD .... Augusta
Cearley, David M., MD .... Augusta
Priola, Michael James, MD .... Fort Stewart
Lincoln, Eric D., MD .... Macon
Meehan, Peter L., MD .... Roswell
McCartney, Donald K., MD .... Savannah

Hawaii

Izuka, Byron Hideo, MD .... Aiea
Barry, Mark A., MD .... Haiku
Burkhalter, William E., MD .... Honolulu
Durkin, Robert C., MD .... Honolulu
Jones, Donald A., MD .... Honolulu
Leet, Arabella I., MD .... Honolulu
Ono, Craig M., MD .... Honolulu
Pellett, Jonathan B., MD .... Honolulu
Reinker, Kent A., MD .... Honolulu

Idaho

King, Howard A., MD .... Boise
Robison, Jason F., MD .... Boise
Shea, Kevin G., MD .... Boise
Shilt, Jeffrey .... Boise
Showalter, Larry D., MD .... Boise

Illinois

Abraham, Edward . . . . Chicago
Ackman, Jeffrey D., MD . . . . Chicago
Altiok, Haluk . . . . Chicago
Bielski, Robert J., MD . . . . Chicago
Dias, Luciano . . . . Chicago
Finlayson, Craig. . . . . Chicago
Grayhack, John J., MD . . . . Chicago
Janicki, Joseph . . . . Chicago
King, Erik C., MD . . . . Chicago
Kuo, Ken N., MD. . . . . Chicago
LaBella, Cynthia R., MD . . . . Chicago
Millar, Edward A., MD . . . . Chicago
Sagan, Michelle L., MD . . . . Chicago
Sarwark, John F., MD . . . . Chicago
Smith, Peter A., MD . . . . Chicago
Sullivan, Christopher M., MD. . . . . Chicago
Swaroop, Vineeta. . . . . Chicago
Kramer, Andrea S., MD . . . . Des Plaines
Lemke, Laura M., MD . . . . Geneva
Cappello, Terri . . . . Maywood
Mardjetko, Steven M., MD. . . . . Morton Grove
Bueche, Matthew J., MD. . . . . Naperville
Lindell, Ernest B., MD . . . . Naperville
Gourineni, Prasad . . . . Oak Lawn
Ibrahim, Kamal N., MD . . . . Oakbrook Terrace
Knuth, Albert E., MD . . . . Park Ridge
Simmons, Todd . . . . Park Ridge
Delucia, Tracey . . . . Pekin
Ferry, Scott . . . . Rockford
Fisk, John R., MD . . . . Springfield
Gabriel, Keith R., MD. . . . . Springfield
Singh, Krishna Anjali, MD. . . . . Springfield
Ibrahim, Denise T., DO . . . . Western Springs

Indiana

Bellflower, Joseph F., MD . . . . Indianapolis
Caltoum, Christine Beth, MD . . . . Indianapolis
Didelot, William P., MD. . . . . Indianapolis
Gantsoudes, George D., MD . . . . Indianapolis
Kayes, Kosmas J., MD. . . . . Indianapolis
Kishan, Shyam . . . . Indianapolis
Kling, Thomas F., MD. . . . . Indianapolis
Lindseth, Richard E., MD . . . . Indianapolis
Loder, Randall T., MD . . . . Indianapolis
Peck, Kathryn. . . . . Indianapolis
Brown, Lorin M., MD. . . . . Munster
Armstrong, Peter F., MD . . . . Warsaw

Iowa

Dietz, Frederick R., MD . . . . Coralville
Farber, Jeffrey M., MD . . . . Des Moines
Ferguson, Teresa Mosqueda, MD . . . . Des Moines
Dolan, Lori . . . . Iowa City
Ilgenfritz, Ryan M., MD . . . . Iowa City
Morcuende, Jose A., MD . . . . Iowa City
Shah, Apurva . . . . Iowa City
Weinstein, Stuart L., MD . . . . Iowa City
Lindaman, Lynn M., MD . . . . West Des Moines

Kansas
Asher, Marc A., MD . . . . Kansas City
Gupta, Ganesh G., MD . . . . Overland Park
Schmidt, Thomas L., MD . . . . Prairie Village
Bartal, Ely . . . . Wichita
Hakala, Brian E., MD . . . . Wichita

Kentucky
Stetten, Maynard L., MD . . . . Hillview
Iwinski, Henry J., MD . . . . Lexington
Milbrandt, Todd A., MD . . . . Lexington
Muchow, Ryan D., MD . . . . Lexington
Stevens, David B., MD . . . . Lexington
Talwalkar, Vishwas R., MD . . . . Lexington
Tylkowski, Chester M., MD . . . . Lexington
Walker, Janet . . . . Lexington
Brey, Jennifer M.B., MD . . . . Louisville
Gabriel, Shari R., MD . . . . Louisville
Meier, Joshua W., MD . . . . Louisville

Louisiana
Creekmore, Tina . . . . Baton Rouge
Fisher, Luther C., MD . . . . Folsom
McKay, Douglas W., MD . . . . Lafayette
Accousti, William . . . . New Orleans
Bennett, James T., MD . . . . New Orleans
Gonzales, Joseph Anthony, MD . . . . New Orleans
Heinrich, Stephen D., MD . . . . New Orleans
King, Andrew G.S., MD . . . . New Orleans
Patel, Prerana . . . . New Orleans
Southern, Edward P., MD . . . . New Orleans
Waldron, Sean . . . . New Orleans
Gates, Philip E., MD . . . . Shreveport
McCall, Richard E., MD . . . . Shreveport
Pickvance, Elizabeth A., MD . . . . Shreveport

Maine
Greene, James M., MD . . . . Bangor
Waanders, Nicholas . . . . Bangor
Roberts, John M., MD . . . . Ellsworth
Turi, Mario . . . . Greenville
Gause, Robert W., MD . . . . Winterport

Maryland
Ain, Michael . . . . Baltimore
Herzenberg, John E., MD . . . . Baltimore
Lazar-Antman, Meredith Anne, MD . . . . Baltimore
Leu, David Dirk, MD . . . . Baltimore
Sponseller, Paul D., MD . . . . Baltimore
Tis, John E., MD . . . . Baltimore
Jex, Jefferson W., MD . . . . Bethesda
Robertson, William W., MD . . . . Bethesda
Bright, Robert W., MD . . . . Glen Burnie
Abramowitz, Andrew J., MD . . . . Mount Airy
Belthur, Mohan V. . . . . Mount Airy

Diamond, Liebe S., MD . . . . Pikesville
Masciuch, Wallace . . . . Rockville
Abzug, Joshua M., MD . . . . Timonium

Massachusetts

Albright, Maurice . . . . Boston
Bae, Donald S., MD . . . . Boston
Banks, Henry H., MD . . . . Boston
Braun, Stuart V., MD . . . . Boston
Brown, T. Desmond, MD . . . . Boston
Emans, John B., MD . . . . Boston
Gebhardt, Mark C., MD . . . . Boston
Gholve, Purushottam A., MD . . . . Boston
Glotzbecker, Michael P., MD . . . . Boston
Grottkau, Brian E., MD . . . . Boston
Hall, John E., MD . . . . Boston
Hedequist, Daniel . . . . Boston
Heyworth, Benton E., MD . . . . Boston
Hill, Jaclyn . . . . Boston
Hresko, Michael T., MD . . . . Boston
Karlin, Lawrence I., MD . . . . Boston
Kasser, James R., MD . . . . Boston
Kim, Young Jo, MD . . . . Boston
Kocher, Mininder S., MD . . . . Boston
Kramer, Dennis . . . . Boston
Mahan, Susan T., MD, g MPH . . . . Boston
Matheney, Travis . . . . Boston
Melkonian, Gregory J., DVM, MD . . . . Boston
Millis, Michael B., MD . . . . Boston
Pace, James Lee, MD . . . . Boston
Rosenthal, Robert K., MD . . . . Boston
Shapiro, Frederic . . . . Boston
Shore, Benjamin J., MD . . . . Boston
Snyder, Brian D., MD, PhD . . . . Boston
Spencer, Samantha Anne, MD . . . . Boston
Upasani, Vidyadhar S.V., MD . . . . Boston
Waters, Peter M., MD . . . . Boston
Yen, Yi-Meng . . . . Boston
Zimbler, Seymour . . . . Boston
Cowell, Henry Richard, MD . . . . Norfolk
Drvaric, David M., MD . . . . Springfield
Masso, Peter D., MD . . . . Springfield
Lapinsky, Anthony S., MD . . . . Worcester
Mortimer, Errol . . . . Worcester
Pappas, Arthur M., MD . . . . Worcester
Shelton, Yvonne A., MD . . . . Worcester

Michigan

Forness, Michael J., DO . . . . Ada
Caird, Michelle S., MD . . . . Ann Arbor
Craig, Clifford L., MD . . . . Ann Arbor
Farley, Frances A., MD . . . . Ann Arbor
Hensinger, Robert N., MD . . . . Ann Arbor
Li, G. Ying, MD . . . . Ann Arbor
Mendelow, Michael J., MD . . . . Ann Arbor
Tenfelde, Allison . . . . Ann Arbor
Morden, Mary L., MD . . . . Bad Axe
Jones, Eric T., MD . . . . Detroit

Michigan, continued

Reynolds, Richard A., MD . . . . . Detroit
Yassir, Walid . . . . . Detroit
Cassidy, Jeffrey A., MD . . . . . Grand Rapids
Hotchkiss, Brian L., MD . . . . . Grand Rapids
Maples, Dayle L., MD . . . . . Grand Rapids
Nowicki, Philip D., MD . . . . . Grand Rapids
Lyne, E. Dennis, MD . . . . . Kalamazoo
Clark, Mary Williams, MD . . . . . Lansing
Settecerri, Jeff . . . . . Royal Oak
Zaltz, Ira . . . . . Royal Oak

Minnesota

Gordon, David G., MD . . . . . Duluth
Trombino, Laura J., MD . . . . . Duluth
Luedtke, Lael Marie, MD . . . . . Fairmont
Guidera, Kenneth J., MD . . . . . Minneapolis
Johanson, James Eugene, MD . . . . . Minneapolis
Lonstein, John E., MD . . . . . Minneapolis
Mielke, Cary H., MD . . . . . Minneapolis
Zaleske, David J., MD . . . . . Minneapolis
Bianco, Anthony J., MD . . . . . Rochester
Klassen, Rudolph A., MD . . . . . Rochester
Larson, A. Noelle, MD . . . . . Rochester
McIntosh, Amy . . . . . Rochester
Peterson, Hamlet A., MD . . . . . Rochester
Shaughnessy, William J., MD . . . . . Rochester
Stans, Anthony A., MD . . . . . Rochester
England, Stephen P., MD, MPH . . . . . Saint Louis Park
Gage, James R., MD . . . . . Saint Paul
Guillaume, Tenner J., MD . . . . . Saint Paul
Healy, Michael T., MD . . . . . Saint Paul
Koop, Steven E., MD . . . . . Saint Paul
Laine, Jennifer C., MD . . . . . Saint Paul
Li, Mengnai . . . . . Saint Paul
Novacheck, Tom F., MD . . . . . Saint Paul
Novak, Benjamin . . . . . Saint Paul
Quanbeck, Deborah S., MD . . . . . Saint Paul
Schiffern, Alison . . . . . Saint Paul
Sundberg, Stephen B., MD . . . . . Saint Paul
Truong, Walter Lam Huu, MD . . . . . Saint Paul
Weber, Elizabeth West, MD . . . . . Saint Paul
Winter, Robert B., MD . . . . . Saint Paul
Jacobsen, F. Stig, MD . . . . . St Paul
Walker, Kevin R., MD . . . . . St Paul

Mississippi

Haber, Lawrence L., MD . . . . . Jackson
McCluskey, William P., MD . . . . . Jackson
Purvis, John M., MD . . . . . Jackson
Robbins, Craig A., MD . . . . . Jackson
Wright, Patrick B., MD . . . . . Jackson
Hopper, William Clayton, MD . . . . . Oxford

Missouri

Hoernschemeyer, Daniel G., MD . . . . Columbia
Anderson, John T., MD . . . . Kansas City
Berglund, Lisa . . . . Kansas City
De Roode, Carolien P., MD . . . . Kansas City
Jarka, Dale E., MD. . . . . Kansas City
Latz, Kevin H., MD . . . . Kansas City
Olney, Bradford W., MD . . . . Kansas City
Pacicca, Donna M., MD . . . . Kansas City
Price, Nigel J., MD. . . . . Kansas City
Schwend, Richard M., MD. . . . . Kansas City
Sinclair, Mark R., MD . . . . Kansas City
Anderson, David J., MD . . . . Saint Louis
Bassett, George S., MD . . . . Saint Louis
Dobbs, Matthew, MD . . . . Saint Louis
Engel, Elizabeth . . . . Saint Louis
Goldfarb, Charles . . . . Saint Louis
Gordon, J. Eric, MD . . . . Saint Louis
Keeler, Kathryn A., MD . . . . Saint Louis
Lenke, Lawrence G., MD . . . . Saint Louis
Luhmann, Scott J., MD . . . . Saint Louis
Meyers, Laura L., MD . . . . Saint Louis
Otis-Petersen, Stephanie A., MD . . . . Saint Louis
Rich, Margaret Mary, MD . . . . Saint Louis
Schoenecker, Perry L., MD . . . . Saint Louis
Stazzone, Enrico J., MD . . . . Saint Louis
Strecker, William B., MD . . . . Saint Louis

Montana

Kehl, Douglas Keith, MD . . . . West Yellowstone

Nebraska

Sheehan, John . . . . Boys Town
Esposito, Paul W., MD . . . . Omaha
Ginsburg, Glen M., MD . . . . Omaha
Hasley, Brian . . . . Omaha
Huurman, Walter W., MD . . . . Omaha
Jenson, Mark Layne, MD . . . . Omaha
Scherl, Susan A., MD . . . . Omaha

Nevada

Ratnarathorn, Monthakan . . . . Las Vegas
Stewart, David G., MD . . . . Las Vegas
Thomas, Michael D., MD . . . . Las Vegas
O'Mara, Timothy J., MD . . . . Reno

New Hampshire

Urbanek, Paul . . . . Concord
Aadalen, Richard J., MD. . . . . Stoddard

New Jersey

Lin, David Cedar Knolls
McKeever, Meira Yeger, MD . . . . Cedar Knolls
Rieger, Mark A., MD. . . . . Cedar Knolls
Strassberg, Joshua Aaron, MD. . . . . Cedar Knolls
Bowe, J. Andrew, MD . . . . East Brunswick
Harnly, Heather Withington, MD. . . . . East Brunswick
Laufer, Samuel J., MD . . . . East Brunswick
McKeon, John J., MD . . . . East Brunswick

New Jersey, continued
McPartland, Thomas G., MD . . . . East Brunswick
Therrien, Philip J., MD . . . . East Brunswick
Weisman, David S., MD . . . . East Brunswick
Tareco, Jennifer M., MD . . . . Flemington
Liggio, Frank J., MD . . . . Millburn
Friedman, Samara . . . . Morristown
Minkowitz, Barbara . . . . Morristown
Adolfsen, Stephen . . . . Neptune
Bloom, Tamir . . . . Newark
Sabharwal, Sanjeev . . . . Newark
Snyder, Ronald D., MD . . . . Paramus
Strongwater, Allan M., MD . . . . Patterson
Avella, Douglas G., MD . . . . Ridgewood
Baldwin, Keith D., MD . . . . Sicklerville
Altongy, Joseph F., MD . . . . Summit
Nuzzo, Roy M., MD . . . . Summit
Holden, Candice . . . . Voorhees
Macy, Neil J., MD . . . . Woodland Park

New Mexico
Drennan, James C., MD . . . . Albuquerque
Eberle, Charles F., MD . . . . Albuquerque
Hoekstra, Dale Vandermeer, MD . . . . Albuquerque
Mital, Mohinder A., MD . . . . Albuquerque
Szalay, Elizabeth A., MD . . . . Albuquerque
Sherman, Frederick . . . . Corrales
Copeland, Randolph . . . . Gallup

New York
Ferrick, Michael R., MD . . . . Amherst
Galpin, Robert D., MD . . . . Amherst
Amaral, Terry D., MD . . . . Bronx
Fornari, Eric . . . . Bronx
Schulz, Jacob . . . . Bronx
Seimon, Leonard . . . . Bronx
Karamitopoulos, Mara S., MD . . . . Brooklyn
Gambacorta, Peter . . . . Clarence Center
Polisner, Stuart Barry, MD . . . . Commack
Dutkowsky, Joseph P., MD . . . . Cooperstown
Carrion, Wesley V., MD . . . . E Setauket
Barsi, James . . . . East Setauket
Albanese, Stephen A., MD . . . . East Syracuse
Katz, Danielle A., MD . . . . East Syracuse
Gaffney, John . . . . Garden City
Lewis, Ronald . . . . Huntington
Godfried, David H., MD . . . . Manhasset
Gruber, Martin A., MD . . . . Mineola
DiMauro, Jon Paul . . . . New Hyde Park
Handelsman, John E., MD . . . . New Hyde Park
Laplaza, F. Javier, MD . . . . New Hyde Park
Poon, Selina . . . . New Hyde Park
Allen, Abigail Kincaid, MD . . . . New York

Arkwright, Richard T. . . . . New York
Blanco, John S., MD . . . . New York
Boachie-Adjei, Oheneba. . . . . New York
Bohne, Walther Hartmuth, MD . . . . New York
Burke, Stephen W., MD . . . . New York
Chorney, Gail S., MD . . . . New York
Chu, Alice . . . . New York
Denton, John R., MD . . . . New York
Dick, Harold M., MD . . . . New York
Dodwell, Emily . . . . New York
Doyle, Shevaun M., MD . . . . New York
Edobor-Osula, Folorunsho . . . . New York
Feldman, David S., MD . . . . New York
Frances, Jenny M., MD . . . . New York
Grant, Alfred D., MD . . . . New York
Green, Daniel W., MD . . . . New York
Hyman, Joshua E., MD . . . . New York
Lehman, Wallace B., MD . . . . New York
Lonner, Baron S., MD . . . . New York
Lykissas, Marios N., MD, PhD . . . . New York
Otsuka, Norman Y., MD . . . . New York
Phillips, Donna P., MD . . . . New York
Price, Andrew E., MD. . . . . New York
Raggio, Cathleen L., MD . . . . New York
Rawlins, Bernard . . . . New York
Root, Leon . . . . New York
Roye, Benjamin D., MD . . . . New York
Roye, David P., MD . . . . New York
Scher, David M., MD . . . . New York
Siffert, Robert S., MD . . . . New York
Simon, Sheldon R., MD . . . . New York
Sink, Ernest . . . . New York
Tzimas, Nicholas A., MD . . . . New York
Ulin, Richard I., MD . . . . New York
Vitale, Michael . . . . New York
Widmann, Roger F., MD . . . . New York
Blum, Craig E., MD. . . . . Orchard Park
Tucci, James J., MD . . . . Pearl River
Spero, Charles R., MD . . . . Pomona
Cristofaro, Robert L., MD . . . . Purchase
Cook, P. Christopher, MD . . . . Rochester
Sanders, James O., MD . . . . Rochester
Tebor, Gary B., MD . . . . Rochester
Wallach, David M., MD . . . . Stonybrook
Slavin, James A., MD . . . . Troy
Albanese, Margaret R., MD . . . . Utica
Cady, Robert B., MD . . . . Watertown
DelBello, Damon . . . . White Plains
Schlesinger, Iris E., MD . . . . White Plains

North Carolina

Hooker, Jennifer A., MD . . . . Asheville
Raustol, Ole Anton, MD. . . . . Asheville
Campion, Edmund R., MD . . . . Chapel Hill
DeRosa, G. Paul, MD . . . . Chapel Hill
Henderson, Richard C., MD . . . . Chapel Hill
Brighton, Brian K., MD, MPH . . . . Charlotte
Casey, Virginia F., MD . . . . Charlotte

North Carolina, continued

Clark, Christian	Charlotte
Moorefield, William G., MD	Charlotte
Paloski, Michael	Charlotte
Vanderhave, Kelly	Charlotte
Wattenbarger, J. Michael, MD	Charlotte
Fitch, Robert D., MD	Durham
Lark, Robert K., MD	Durham
Greene, Walter B., MD	Fayetteville
Garcia-Ariz, Manuel C., MD	Flat Rock
Mankin, Keith P., MD	Raleigh
Vining, Neil C., MD	Raleigh
Frino, John	Winston-Salem
Gyr, Bettina M., MD	Winston-Salem
Koman, L Andrew, MD	Winston-Salem
Nicastro, Joseph F., MD	Winston-Salem

North Dakota

Haasbeek, Jeffrey F., MD	Grand Forks

Ohio

Adamczyk, Mark J., MD	Akron
Bono, Kenneth	Akron
Fleissner, Paul R., MD	Akron
Jones, Kerwyn C., MD	Akron
Riley, Patrick M., MD	Akron
Ritzman, Todd F., MD	Akron
Schrader, William C., MD	Akron
Weiner, Dennis S., MD	Akron
Handler-Matasar, Sheryl	Boardman
Gurd, Alan R., MD	Chagrin Falls
Cornwall, Roger	Cincinnati
Crawford, Alvin H., MD	Cincinnati
Jain, Viral V., MD	Cincinnati
Little, Kevin J., MD	Cincinnati
McCarthy, James	Cincinnati
Mehlman, Charles T., DO	Cincinnati
Parikh, Shital N., MD	Cincinnati
Sambandam, S. Thirugnana, MD	Cincinnati
Sharma, Vivek	Cincinnati
Sorger, Joel I., MD	Cincinnati
Sturm, Peter F., MD	Cincinnati
Tamai, Junichi	Cincinnati
Thawrani, Dinesh	Cincinnati
Wall, Eric J., MD	Cincinnati
Weimann, Richard L., MD	Cincinnati
Ballock, R. Tracy, MD	Cleveland
Gilmore, Allison	Cleveland
Goodwin, Ryan C., MD	Cleveland
Gurd, David P., MD	Cleveland
Hardesty, Christina K., MD	Cleveland
Kuivila, Thomas E., MD	Cleveland
Liu, Raymond W., MD	Cleveland

Saluan, Paul M., MD . . . . . Cleveland
Son-Hing, Jochen . . . . . Cleveland
Thompson, George H., MD . . . . . Cleveland
Beebe, Allan C., MD . . . . . Columbus
Kean, John R., MD . . . . . Columbus
Klamar, Jan E., MD . . . . . Columbus
Klingele, Kevin E., MD . . . . . Columbus
Torch, Martin A., MD . . . . . Columbus
Albert, Michael C., MD . . . . . Dayton
Lehner, James T., MD . . . . . Dayton
Mikutis, Jeffrey L., DO . . . . . Dayton
Shank, Craig . . . . . Dayton
Abaza, Hadeel . . . . . Toledo
Buerk, Aaron . . . . . Toledo
Munk, Richard L., MD . . . . . Toledo
de Swart, Robert J. . . . . . Westlake
Chicorelli, Anne Marie, DO . . . . . Wooster

Oklahoma

Anderson, John W., MD . . . . . Oklahoma City
Davey, Joseph . . . . . Oklahoma City
Herndon, William A., MD . . . . . Oklahoma City
Lewis, Thomas Roy, MD . . . . . Oklahoma City
Puffinbarger, William R., MD . . . . . Oklahoma City
Sullivan, J. Andy, MD . . . . . Oklahoma City

Oregon

Aiona, Michael D., MD . . . . . Portland
Barmada, Adam . . . . . Portland
Bauer, Jeremy P., MD . . . . . Portland
d'Amato, Charles R., MD . . . . . Portland
Halsey, Matthew F., MD . . . . . Portland
Haralabatos, Susan S., MD . . . . . Portland
Krajbich, J. Ivan, MD . . . . . Portland
Lawley, Michael G., MD . . . . . Portland
Raney, Ellen M., MD . . . . . Portland
Renwick, Stephen E., MD . . . . . Portland
Roy, Dennis R., MD . . . . . Portland
Sussman, Michael D., MD . . . . . Portland
Turker, Ronald . . . . . Portland

Pennsylvania

Fernandez, Meagan M., DO . . . . . Danville
Mirenda, William M., MD . . . . . Danville
Parenti, John M., MD . . . . . Danville
Frankovitch, Karl F., MD . . . . . Erie
Armstrong, Douglas G., MD . . . . . Hershey
Fortuna, Kristine . . . . . Hershey
Hennrikus, William L., MD . . . . . Hershey
Schwentker, Edwards P., MD . . . . . Hershey
Alburger, Philip David, MD . . . . . Philadelphia
Betz, Randal R., MD . . . . . Philadelphia
Binitie, Omohodion . . . . . Philadelphia
Cahill, Patrick John, MD . . . . . Philadelphia
Campbell, Robert M., MD . . . . . Philadelphia
Carrigan, Robert B., MD . . . . . Philadelphia
Davidson, Richard S., MD . . . . . Philadelphia
Dormans, John P., MD . . . . . Philadelphia

Pennsylvania, continued

Drummond, Denis S., MD. . . . . Philadelphia
Flynn, John (Jack) M., MD . . . . . Philadelphia
Franklin, Corinna C., MD . . . . . Philadelphia
Ganley, Theodore J., MD . . . . . Philadelphia
Gattuso, Alison . . . . . Philadelphia
Herman, Martin J., MD . . . . . Philadelphia
Horn, David B., MD . . . . . Philadelphia
Horstmann, Helen. . . . . Philadelphia
Kozin, Scott H., MD . . . . . Philadelphia
Kwon, Michael S., MD . . . . . Philadelphia
Lawrence, J. Todd, MD, PhD . . . . . Philadelphia
MacEwen, G. Dean, MD . . . . . Philadelphia
Pizzutillo, Peter D., MD . . . . . Philadelphia
Pretell, Juan Augusto, MD . . . . . Philadelphia
Realyvasquez, Juan A., MD . . . . . Philadelphia
Rosenblatt, Joseph . . . . . Philadelphia
Safier, Shannon David, MD . . . . . Philadelphia
Sankar, Wudbhav N., MD . . . . . Philadelphia
Scoles, Peter V., MD . . . . . Philadelphia
Spiegel, David A., MD . . . . . Philadelphia
van Bosse, Harold J.P., MD . . . . . Philadelphia
Wells, Lawrence . . . . . Philadelphia
Winell, Jennifer . . . . . Philadelphia
Bosch, Patrick . . . . . Pittsburgh
Deeney, Vincent F., MD . . . . . Pittsburgh
Ferguson, Albert B., MD . . . . . Pittsburgh
Green, William T., MD. . . . . Pittsburgh
Grudziak, Jan S., MD . . . . . Pittsburgh
Mendelson, Stephen A., MD . . . . . Pittsburgh
Roach, James W., MD . . . . . Pittsburgh
Sangimino, Mark J., MD. . . . . Pittsburgh
Schneck-Jacob, Stephanie L., MD . . . . . Pittsburgh
Ward, W. Timothy, MD . . . . . Pittsburgh
Kaweblum, Moises . . . . . Plains
Guille, James T., MD. . . . . Pottstown
Clancy, Michael . . . . . Rydal
Steel, Howard H., MD. . . . . Villanova

Puerto Rico

Fernandez-Feliberti, Rafael . . . . . Guaynabo
Ramirez-Lluch, Norman . . . . . Mayaguez
Fernandez-Lopez, Samuel A., MD . . . . . San Juan
Flynn, John M., MD . . . . . San Juan
Guzman, Humberto . . . . . San Juan
Foy, Christian. . . . . Santurce

Rhode Island

Eberson, Craig P., MD . . . . . Providence
Ehrlich, Michael G., MD . . . . . Providence
Schiller, Jonathan R., MD. . . . . Providence
Solga, Patricia M., MD . . . . . Providence

South Carolina

Reing, C. Michael, MD . . . . . Anderson
Gross, Richard H., MD . . . . . Charleston
Mooney, James F., MD . . . . . Charleston
Stanitski, Carl L., MD . . . . . Charleston
Stanitski, Deborah F., MD . . . . . Charleston
Horan, Michael Patrick . . . . . Columbia
Locke, Mark D., MD . . . . . Columbia
Piehl, Frederick C., MD . . . . . Columbia
Gilpin, Albert T., MD . . . . . Florence
Allen, Benjamin L., MD . . . . . Greenville
Beckish, Michael L., MD . . . . . Greenville
Bray, Edward W., MD . . . . . Greenville
Gibson, Thomas Whitney, DO . . . . . Greenville
Stasikelis, Peter J., MD . . . . . Greenville
Westberry, David E., MD . . . . . Greenville
Renshaw, Thomas S., MD . . . . . Hilton Head Island
Samberg, L. Carl, MD . . . . . Hilton Head Island
Reed, Frederick (Rick) E., MD . . . . . Mount Pleasant
Morrissy, Raymond T., MD . . . . . Sheldon
Griffin, Paul P., MD . . . . . Travelers Rest

South Dakota

Carlson, Walter O., MD . . . . . Sioux Falls
Haft, Geoffrey F., MD . . . . . Sioux Falls

Tennessee

Brown, Hugh P., MD . . . . . Chattanooga
Coddington, Robert C., MD . . . . . Chattanooga
Moses, Wendell MS, MD . . . . . Chattanooga
Kelly, Derek M., MD . . . . . Collierville
Austin, Susan M., MD . . . . . Germantown
Sawyer, Jeffrey R., MD . . . . . Germantown
Warner, William C., MD . . . . . Germantown
Crawford, John Jay, MD . . . . . Knoxville
Madigan, Robert R., MD . . . . . Knoxville
Sears, Cameron J., MD . . . . . Knoxville
Wallace, Sidney L., MD . . . . . Knoxville
Beaty, James H., MD . . . . . Memphis
Canale, S. Terry, MD . . . . . Memphis
Christofersen, Mark R., MD . . . . . Nashville
Green, Neil E., MD . . . . . Nashville
Lovejoy, Steven A., MD . . . . . Nashville
Martus, Jeffrey E., MD . . . . . Nashville
Mencio, Gregory A., MD . . . . . Nashville
Schoenecker, Jonathan G., MD . . . . . Nashville
Vanden Brink, Keith D., MD . . . . . Roan Mountain

Texas

Hamilton, Hinton H., MD . . . . . Arlington
Dehne, Robert . . . . . Austin
Gottschalk, Hilton . . . . . Austin
Kahn, Anthony . . . . . Austin
Murdock, Ryan C., MD . . . . . Austin
Prince, Michelle . . . . . Austin
Sargent, Mary Catherine, MD . . . . . Austin
Shapiro, Jay . . . . . Austin
Williams, John J., MD . . . . . Austin

Texas, continued

Yandow, Suzanne M., MD . . . . Bryan
Comstock, Christopher . . . . Corpus Christi
Timperlake, Roger W., MD . . . . Corpus Christi
Birch, John G., MD . . . . Dallas
Copley, Lawson A., MD . . . . Dallas
Denning, Jaime Rice, MD . . . . Dallas
Ezaki, Marybeth . . . . Dallas
Gill, Corey . . . . Dallas
Herring, John Anthony, MD . . . . Dallas
Ho, Christine . . . . Dallas
Johnston, Charles E., MD . . . . Dallas
Karol, Lori A., MD . . . . Dallas
Kim, Harry K.W., MD . . . . Dallas
Podeszwa, David A., MD . . . . Dallas
Ramo, Brandon A., MD . . . . Dallas
Rathjen, Karl E., MD . . . . Dallas
Riccio, Anthony . . . . Dallas
Richards, B. Stephens, MD . . . . Dallas
Roberts, David W., MD . . . . Dallas
Sackett, James R., MD . . . . Dallas
Saran, Neil . . . . Dallas
Sucato, Daniel J., MD . . . . Dallas
Wimberly, Robert Lane, MD . . . . Dallas
Wise, Carol . . . . Dallas
Abdelgawad, Amr Atef, MD . . . . El Paso
Bagg, Raymond J., MD . . . . El Paso
Heydemann, Jacob S., MD . . . . El Paso
Holland, Courtney Allen, MD . . . . El Paso
Machen, M. Shaun, MD . . . . El Paso
Schmitz, Matthew R., MD . . . . Fort Sam Houston
Walick, Kristina S., MD . . . . Fort Sam Houston
Burke, Ron G., MD . . . . Fort Worth
Douglas, Gary L., MD . . . . Fort Worth
Gray, David W., MD . . . . Fort Worth
Kennedy, Jason . . . . Fort Worth
Messer, Larry D., MD . . . . Fort Worth
Schuster, Richard David, MD . . . . Fort Worth
Vara, Christopher S., MD . . . . Fort Worth
Carmichael, Kelly D., MD . . . . Galveston
Yngve, David A., MD . . . . Galveston
Johnson, Lyle O., MD . . . . Horseshoe Bay
Antekeier, David P., MD . . . . Houston
Antekeier, Shannon . . . . Houston
Barnes, Douglas A., MD . . . . Houston
Brock, Gary . . . . Houston
Epps, Howard R., MD . . . . Houston
Gerow, Frank T., MD . . . . Houston
Horowitz, Kevin . . . . Houston
Mansour, Alfred A., MD . . . . Houston
May, Megan . . . . Houston
McKay, Scott D., MD . . . . Houston

Phillips, William A., MD . . . . . Houston
Rosenfeld, Scott B., MD . . . . . Houston
Scott, Allison C., MD . . . . . Houston
Shenava, Vinitha R., MD . . . . . Houston
Younas, Shiraz A., MD . . . . . Houston
Diab, Michel G., MD. . . . . . Lubbock
Gutheil, James P., MD . . . . . Lubbock
Schutt, Robert C., MD . . . . . Lubbock
Thompson, J. David, MD . . . . . McKinney
Ellis, Henry Bone . . . . . Plano
Wilson, Philip . . . . . Plano
Ruda, Richard J., MD . . . . . Randolph A F B
Davino, Nelson A., MD . . . . . Richmond
Edeen, John . . . . . San Antonio
Gledhill, Robert B., MD . . . . . San Antonio
Koeck, William . . . . . San Antonio
Magnabosco, Elizabeth L., MD . . . . . San Antonio
Murray, Travis N., MD . . . . . San Antonio
Palmer, Patrick M., MD . . . . . San Antonio
Ritchie, Eric R., MD . . . . . San Antonio
Simmons, J. Walt, DO, PhD . . . . . San Antonio
Stall, Alec Christian, MD . . . . . San Antonio
Stanley, Earl A., MD . . . . . San Antonio
Stefko, Raymond M., MD . . . . . San Antonio
Warman, Jeffrey R., MD . . . . . San Antonio
Wilkins, Kaye E., MD . . . . . San Antonio
Yount, Ira M., MD . . . . . San Antonio

Utah

Von Stein, Diane . . . . . Coalville
Carroll, Kristen L., MD . . . . . Salt Lake City
D'Astous, Jacques L., MD . . . . . Salt Lake City
Hennessey, Theresa A., MD . . . . . Salt Lake City
Holmes, Stephanie M., MD . . . . . Salt Lake City
Klatt, Joshua Bendz, MD . . . . . Salt Lake City
Ogilvie, James W., MD . . . . . Salt Lake City
Santora, Stephen D., MD . . . . . Salt Lake City
Smith, John T., MD . . . . . Salt Lake City
Stevens, Peter M., MD . . . . . Salt Lake City
Stotts, Alan K., MD . . . . . Salt Lake City
Woiczik, Marcella . . . . . Salt Lake City

Vermont

Aronsson, David D., MD . . . . . Burlington
Lisle, Jennifer W., MD. . . . . . Burlington
Molloy, Maureen K., MD, JD . . . . . Shelburne
Carney, Brian T., MD . . . . . White River Junction

Virginia

McHale, Kathleen A., MD . . . . . Alexandria
Bulkeley, Julia . . . . . Blue Ridge
Abel, Mark F., MD . . . . . Charlottesville
Romness, Mark J., MD . . . . . Charlottesville
Langloh, John T., MD . . . . . Lancaster
Cardelia, J. Marc, MD . . . . . Norfolk
Crepeau, Allison E., MD . . . . . Norfolk
Fox, John A., MD . . . . . Norfolk
Gillingham, Bruce L., MD . . . . . Norfolk

Virginia, continued

Novick, Cara D., MD . . . . . Norfolk
St. Clair, H. Sheldon, MD. . . . . Norfolk
St. Remy, Carl. . . . . Norfolk
Wagner, John S., MD . . . . . Norfolk
Williamson, Sterling R., MD . . . . . Norfolk
Slakey, Capt Joseph, MD . . . . . Portsmouth
Aarons, Chad . . . . . Richmond
Atkins, Susan E., MD . . . . . Richmond
Kuester, Victoria . . . . . Richmond
Nogi, Jay . . . . . Richmond
Sharps, Chester H., MD . . . . . Richmond
Tuten, Hans Robert, MD . . . . . Richmond

Washington

Moen, Kathleen . . . . . Issaquah
Conrad, Ernest U., MD. . . . . Seattle
Dales, Mark C., MD . . . . . Seattle
Davidson, Darin J., MD . . . . . Seattle
Goldberg, Michael J., MD . . . . . Seattle
Lindberg, Antoinette W., MD . . . . . Seattle
Mosca, Vincent S., MD. . . . . Seattle
Mowery, Carol . . . . . Seattle
Schmale, Gregory A., MD . . . . . Seattle
Staheli, Lynn T., MD. . . . . Seattle
Steinman, Suzanne E., MD . . . . . Seattle
White, Klane K., MD . . . . . Seattle
Baird, Glen O., MD. . . . . Spokane
Caskey, Paul M., MD . . . . . Spokane
Lester, Edward L., MD . . . . . Spokane
Osebold, William R., MD. . . . . Spokane
Tompkins, Bryan . . . . . Spokane
Rajacich, Nicholas . . . . . Tacoma

West Virginia

Lubicky, John P., MD . . . . . Morgantown

Wisconsin

Harris, Gerald F., PhD . . . . . Brookfield
Black, Brian E., MD . . . . . Greenfield
Schick, Patricia McDougall, MD. . . . . Hobart
Wintersteen, Virginia G., MD . . . . . La Crosse
Halanski, Matthew . . . . . Madison
Mann, David C., MD . . . . . Madison
Nemeth, Blaise. . . . . Madison
Noonan, Kenneth J., MD . . . . . Madison
Jaglan, Samarjit S., MD. . . . . Marshfield
Breed, Alan L., MD . . . . . McFarland
Lyon, Roger M., MD . . . . . Milwaukee
Tassone, J. Channing, MD . . . . . Milwaukee
Thometz, John G., MD . . . . . Milwaukee
Van Valin, Scott E., MD . . . . . Milwaukee

INTERNATIONAL

ARGENTINA

Couto, Juan Carlos, MD . . . . . Buenos Aires
Gonzalez, Patricio . . . . . Buenos Aires
Groiso, Jorge . . . . . Buenos Aires
Lampropulos, Mario . . . . . Buenos Aires
Allende Nores, Victoria . . . . . Cordoba
Fernandez, Claudio Alfredo . . . . . La Plata

ARMENIA

Koloyan, Garen . . . . . Yerevan

AUSTRALIA

New South Wales

Bates, Edward H., MD . . . . . Sydney

South Australia

Foster, Bruce K., MD, MBBS, FRACS . . . . . North Adelaide

Victoria

Balakumar, Jitendra . . . . . Parkville

AUSTRIA

Bauer, Rudolf . . . . . Innsbruk
Graf, Reinhard . . . . . Stolzalpe
Grill, Franz . . . . . Wien

BELGIUM

Allington, Nanni . . . . . Liege
Moens, Pierre . . . . . Pellenberg

BRAZIL

Sao Paulo

Fucs, Patricia Moraes Barros, MD . . . . . Sao Paulo

CANADA

Alberta

Brauer, Carmen . . . . . Calgary
Harder, James . . . . . Calgary
Joughin, V. Elaine, MD . . . . . Calgary
Kiefer, Gerhard N., MD . . . . . Calgary
Cole, William G., MD . . . . . Edmonton
Dulai, Sukhdeep . . . . . Edmonton
Hedden, Douglas M., MD . . . . . Edmonton
McIvor, John B., MD . . . . . Edmonton
Moreau, Marc J., MD . . . . . Edmonton

British Columbia

Sanderson, Ronald A., MD . . . . . Black Creek
Terry, Warren F., MD, FRCSC . . . . . Maple Ridge
Pirani, Shafique P., MD . . . . . New Westminster
Alvarez, Christine M., MD . . . . . Vancouver
Beauchamp, Richard D., MD, FRCSC . . . . . Vancouver
Bell, Michael . . . . . Vancouver
Brown, Kenneth L.B., MD . . . . . Vancouver
Miyanji, Firoz . . . . . Vancouver
Mulpuri, Kishore . . . . . Vancouver
Reilly, Christopher W., MD . . . . . Vancouver
Tredwell, Stephen J., MD . . . . . Vancouver
Penny, J. Norgrove, MD . . . . . Victoria

Manitoba
Black, G. Brian, MD . . . . Winnipeg
McPherson, John A.M., MD . . . . Winnipeg
Monson, Ronald C., MD . . . . Winnipeg
Pollet, Virginie . . . . Winnipeg
Thompson, Susan . . . . Winnipeg

New Brunswick
Forsythe, Caroline . . . . Riverview

Nova Scotia
El-Hawary, Ron . . . . Halifax
Howard, Jason . . . . Halifax
Hyndman, John C., MD . . . . Halifax
Logan, Karl J., MbChB, FRCS . . . . Halifax

Ontario
Mah, Jung Y., MD . . . . Hamilton
Martin, Robert F., MD . . . . Hamilton
Missiuna, Paul . . . . Hamilton
Ashworth, M. Anthony, MD . . . . Kingston
Carey, Timothy P., MD . . . . London
Cashin, Megan S., MD, FRCSC . . . . London
Jarvis, James G., MD . . . . Ottawa
Kontio, Ken K. . . . . Ottawa
Lawton, Louis J., MD . . . . Ottawa
Leitch, Khristinn Kellie, MD . . . . Ottawa
Letts, R. Mervyn, MD . . . . Ottawa
McIntyre, William M.J., MD . . . . Ottawa
Willis, R. Baxter, MD . . . . Ottawa
Alman, Benjamin A., MD, FRCSC . . . . Toronto
Carroll, Norris C., MD . . . . Toronto
Hopyan, Sevan . . . . Toronto
Howard, Andrew W., MD . . . . Toronto
Kelley, Simon P., MD . . . . Toronto
Murnaghan, M. Lucas, MD . . . . Toronto
Narayanan, Unni G., MD, FRCSC . . . . Toronto
Sachleben, Brant . . . . Toronto
Wedge, John H., MD . . . . Toronto
Wright, James G., MD, MPH, FRCSC . . . . Toronto
Zeller, Reinhard D., MD, ScD, FRCSC . . . . Toronto
Viviani, Guillermo Richard, MD . . . . Waterdown

Quebec
Benaroch, Thierry E., MD . . . . Montreal
Cantin, Marie-Andree . . . . Montreal
Duhaime, Morris A., MD . . . . Montreal
Fassier, Francois . . . . Montreal
Glavas, Panagiotis . . . . Montreal
Grimard, Guy . . . . Montreal
Hamdy, Reggie C., MD . . . . Montreal
Labelle, Hubert H L., MD . . . . Montreal
Parent, Stefan . . . . Montreal
Poitras, Benoit P., MD . . . . Montreal

Rivard, Charles H, MD . . . . Montreal
Gallien, Roger . . . . Quebec
St-Cyr, Yvan . . . . Quebec
Mercier, Pierre . . . . Quebec City
Roy, Louis Jean, MD . . . . St Oencs

Saskatchewan

Allen, Lauren . . . . Saskatoon

CHILE

Baar Zimend, Alejandro K., MD. . . . . Santiago

CHINA

Zhao, Li . . . . Shanghai
Yang, Jian-Ping . . . . Tianjin

COLOMBIA

Gallon, Luis Alfonso, MD . . . . Cali

CROATIA (rvatska)

Anticevic, Darko . . . . Zagreb

DENMARK

Moeller-Madsen, Bjarne. . . . . Aarhus C

DOMINICAN REPUBLIC

Ruggles, Daniel K., DO . . . . Santo Domingo, DR

EGYPT

Tarraf, Yehia . . . . Cairo
El Lakkany, Mohamed Reda, MD . . . . Mansoura

FRANCE

Canavese, Federico . . . . Clermont Ferrand
Dimeglio, Alain . . . . Montpellier
Badelon, Olivier. . . . . Neuilly dur Seine
Dubousset, Jean . . . . Paris
Carlioz, Henri . . . . Sceaux

GERMANY

Stuecker, Ralf D., MD . . . . Hamburg
Parsch, Klaus . . . . Stuttgart

GREECE

Kanellopoulos, Anastasios . . . . Marousi,

HONDURAS

Vasquez, Gustavo A., MD . . . . San Pedro Sula

HONG KONG

Cheng, Jack Chun Y., MD . . . . Shatin

IRAN (Islamic Republic Of)

Shahcheraghi, Gholam Hossain, MD. . . . . Shiraz
Javid, Mahzad . . . . Tehran

IRAQ

Al-Hilli, Ali Bakir AbdulHussian, MD. . . . . Baghdad

IRELAND

O'Brien, Timothy . . . . Dublin
Fogarty, Esmond E., MD . . . . Dublin 2
McManus, Frank . . . . Dublin 7

ISRAEL

Bialik, Viktor . . . . Herzliya
Porat, Shlomo. . . . . Jerusalem
Atar, Dan Omer
Bar-On, Elhanan . . . . Petah Tikva
Wientroub, Shlomo. . . . . Tel Aviv

ITALY

Ippolito, Ernesto . . . . Rome

JAPAN

Kamegaya, Makoto . . . . Chiba City
Nishiyama, Kazuo . . . . Tokyo

KOREA, Republic of

Kim, Hui Taek, MD. . . . . Busan
Chung, Chin Youb, MD . . . . Gyeonggi-Do
Choi, In Ho, MD . . . . Seoul
Song, Hae Ryong, MD . . . . Seoul
Song, Kwang Soon. . . . . Taegu
Lee, Duk Yong, MD . . . . Yongin

KUWAIT

Fahmy, Mohamed A Lotfy, FRCSEd. . . . . Safat

MEXICO

Distrito Federal

Castaneda, Pablo . . . . Del Coyoacan
Cassis, Nelson . . . . Del Coyoacan
Haces, Felipe . . . . Mexico City
Torres-Gomez, Armando. . . . . Mexico City
Torres, Rodolfo Ruiz, MD . . . . Tlalpan

Estado de Mexico

Capdevila, Roman L., MD . . . . Mexico City

Nuevo Leon

De La Garza, Jose Fernando, MD . . . . Monterrey

NEW ZEALAND

Crawford, Haemish A., MD. . . . . Greenlane

PAKISTAN

Anjum, Javed Iqbal . . . . Lahore, Punjab

PALESTINIAN TERRITORY

Ahmad, AlaaEldin Azmi, MD. . . . . Albireh

PHILIPPINES

Gomez, Vicente . . . . Makati

POLAND

Napiontek, Marek . . . . Poznan

PORTUGAL

Alves, Cristina . . . . Coimbra
Alegrete da Silva, Nuno Paulo. . . . . Porto

RUSSIAN FEDERATION
Chochiev, Guram M., MD . . . . Vladimir

SAUDI ARABIA
Jawadi, Ayman H., FRCSI . . . . Riyadh

SINGAPORE
Hui, James Hoi Po, FRCSE . . . . Singapore
Lee, Eng Hin, MD., FRCSC . . . . Singapore
Lim, Kevin B.L., FRCS . . . . Singapore
Mahadev, Arjandas S., MD . . . . Singapore

SOUTH AFRICA
Ashberg, Lyall . . . . Cape Town

SPAIN
Moraleda Novo, Luis . . . . Madrid
de Pablos, Julio . . . . Pamplona

SWITZERLAND
Kaelin, Andre J., MD . . . . Chêne-Bougeries
Lascombes, Pierre . . . . Geneva 14
Brunner, Christian F. . . . . St Gallen
Exner, Ulrich G., MD . . . . Zuerich

TAIWAN
Lin, Chii Jeng, MD . . . . Tainan
Liu, Shih-Chia Jason, MD . . . . Taipei
Chang, Chia-Hsieh . . . . Taoyuan

THAILAND
Limpaphayom, Noppachart . . . . Bangkok

TRINIDAD AND TOBAGO
Toby, David . . . . Port of Spain

TURKEY
Marangoz, Salih . . . . Ankara
Zorer, Gazi . . . . Bakirkoy Istanbul

UNITED ARAB EMIRATES
Al-Hemrani, Eisa R., MD . . . . Dubai

UNITED KINGDOM
Duffy, Catherine . . . . Belfast
Thomas, Simon . . . . Bristol
Catterall, Anthony . . . . London
Clarke, Nicholas M.P., ChM FRCS . . . . Romsey

POSNA BYLAWS

ARTICLE I
NAME

The name of this corporation shall be the Pediatric Orthopaedic Society of North America.

ARTICLE II
OBJECTIVES AND PURPOSE.

The objective of this society shall be the advancement of pediatric orthopaedic surgery. Pediatric orthopaedic surgery is the medical specialty that includes the investigation, preservation, restoration and development of the form and function of the musculoskeletal system and associated structures by medical, surgical and physical methods through the period of growth and development.

This Society is devoted to the enhancement of care for children with musculoskeletal problems. Therefore, the purposes of this Society are exclusively to foster, promote, support, augment, develop and encourage investigative knowledge of pediatric orthopaedic surgery; to develop and encourage methods of prevention of disorders of the musculoskeletal system, to develop and encourage by teaching and education and by developing education materials; to promote specialized training for medical personnel in pediatric orthopaedic surgery; to foster, promote, support, augment, develop and encourage education of non-medical personnel engaged in scientific endeavors relating to the field of pediatric orthopaedic surgery; to augment, develop and encourage standardization of nomenclature and the evaluation of results; and to foster, promote, support, develop and encourage charitable, scientific or literary purposes -- provided, however, that no part of the net income of the Society shall inure to the benefits of any private shareholder or individual, no substantial part of the activities of the shareholder shall be the carrying-on of propaganda or otherwise attempting to influence legislation; and the Society shall not participate in, or intervene in (including the publishing or distribution of any statements) any political campaign on behalf of any candidate for public office.

ARTICLE III
OFFICES

The Board of Directors of the Society may establish and maintain an Office, which may be within or without the state of incorporation, for the administration of the affairs of the Society. The Board of Directors may employ or retain an Executive Secretary, who shall provide general administrative business management support for the Society, and, as such, shall manage the Office. Additional administrative personnel and consultants shall be employed or retained as directed by the Board of Directors. The Executive Secretary and Office staff shall be under the direction and supervision of the President of the Society, and subject to control of the Board of Directors. The registered agent shall be the Executive Director and the registered office, the office of the Pediatric Orthopaedic Society of North America.

ARTICLE IV
MEMBERSHIP

Section 1. *Definition of Membership:* Membership in the Pediatric Orthopaedic Society of North America is a privilege, not a right, and is contingent upon continuing compliance with the Articles of Incorporation and the Bylaws of the Society, as well as active participation on the part of the member. No person shall be elected or remain a member of the Society unless he or she is of high ethical character and adheres to the principles of professional ethics.

Section 2. *Classes of Membership:* There shall be nine classes of membership in the Pediatric Orthopaedic Society of North America; namely, Active membership, Senior membership, Corresponding membership, Associate membership, Honorary membership, Inactive membership, Candidate active, associate or corresponding membership. All duly elected members may be issued a certificate signifying his/her election as a member.

Section 2A. *Active Membership:* An Active member is one who has been admitted by application (Article IV, Sections 3 and 4). Active members may vote, serve on appointed committees, and hold elected office. This membership is limited to those orthopaedic surgeons who reside and practice within the United States or Canada, who are certified by the American Board of Orthopaedic Surgeons or Royal College of Physicians and Surgeons of Canada or the American Osteopathic Board of Orthopedic Surgery, and who devote at least seventy-five percent of their professional time (clinical and research) to pediatric orthopaedic surgery. Active membership will be maintained by compliance with dues, fees, and assessments, and by attendance of at least one annual meeting every four (4) years. A member's failure to attend one in four (4) consecutive annual meetings will constitute resignation from the Society and termination of the membership. Active members who fail to attend one of four consecutive annual meetings, but who otherwise are in good standing, may apply for reinstatement of membership within one year of termination of membership. Documentation of maintenance of qualifications for active membership and attendance at the next annual meeting are required for reinstatement. Active members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year

Section 2B. *Senior Membership:* A Senior member is an Active, Corresponding or Associate member who has retired from active medical practice and, upon reaching age 65, has requested transfer to Senior status. In addition, an Active, Corresponding or Associate member may request Senior member status if for medical reasons, he/she is fully and permanently disabled from clinical duties regardless of age. Senior members are exempt from paying dues but may vote and serve on appointed committees, but may not hold elected office including service on the Nominating Committee. There is no attendance requirement.

Section 2C. *Corresponding Membership:* A Corresponding member is an orthopaedic surgeon from a country other than the U.S.A. and Canada who has been admitted by application. Candidates must devote at least seventy-five percent of their professional time (clinical and research) to pediatric orthopaedics. The application for corresponding membership can be made no earlier than three (3) years following the successful completion of orthopaedic residency training and not earlier than two (2) years following completion of a pediatric orthopaedic fellowship. The corresponding member must be board certified by the regulating board of their country if one exists. Candidates for corresponding membership must have attended at least one Annual Meeting prior to applying for Corresponding membership. A candidate's application shall be supported by two letters of sponsorship, one from active or senior members of the Society, and one from the candidate's country of practice. Candidates for corresponding membership should be contributors in the field of Pediatric Orthopaedics in their country and demonstrate credentials and commitment which are equivalent to those submitted by North American applicants to POSNA. Corresponding membership shall be contingent upon attendance of a meeting of the Society at least once every five years. A member's failure to attend one of five (5) consecutive annual meetings will constitute resignation from the society and termination of the membership. Corresponding members who fail to attend one of five consecutive annual meetings, but who otherwise are in good standing, may apply for reinstatement of membership within one year of termination of membership. Documentation of maintenance of qualifications for Corresponding membership and attendance at the next annual meeting are required for reinstatement. Corresponding members will pay dues at a reduced rate to be determined by the Board of Directors to cover the cost of correspondence. Corresponding members may vote and serve on appointed committees but may not hold elected office. Those corresponding members relocating to the United States or Canada must request a change of status.

Section 2D. *Associate Membership:* An Associate member is one who has been admitted by application (ARTICLE IV, Sections 3 and 4). Associate membership may be conferred on M.D.'s, D.O.'s, or Ph.D.'s, who in the opinion of the Society are actively engaged in a profession that directly relates to pediatric orthopaedic surgery either clinically or in the field of research. This membership is limited to those individuals who reside and work within the United States and Canada. Application for associate membership can be made no earlier than two (2) years following successful completion of either a pediatric orthopaedic fellowship or other advanced training related to the field of pediatric orthopaedics. Activities of associate members must fit within the Objectives and Purpose of the Society as stated in Article II. Application and Election procedures for this class of membership shall be those of Article IV, Section 3 and 4. Associate members may not hold elected office but may vote, serve on appointed committees and otherwise participate fully in the activities of the Society. Dues and attendance requirements shall be the same as for active members.

Section 2E. ***Honorary Membership:*** Honorary membership shall be conferred by the Board of Directors to honor an individual who has made significant contributions to pediatric orthopaedics. There are no attendance or dues requirements. Honorary members do not have to meet the practice profile requirement for membership as delineated in Article IV, Section 3 and 4. Honorary members may not hold elected office vote or serve on appointed committees.

Section 2F. ***Inactive Membership:*** Members may request a leave of absence by written application to the Membership Committee. Inactive membership shall normally not exceed three (3) years, but can be extended for one (1) additional year by written application to the Membership Committee. Return to Active status shall be by written request to the Membership Committee. Dues for such Inactive membership shall be established at the discretion of the Board of Directors.

Section 2G –
(a) ***Candidate Active Membership.***
Candidate membership shall be conferred by the Board of Directors to encourage early, active involvement of younger pediatric orthopaedic surgeons in the activities of POSNA. A candidate member is one who has been admitted by application (Article IV, Sections 3 and 4). This membership is limited to those orthopaedic surgeons who reside and practice within the United States or Canada, and who will meet the requirements for the American Board of Orthopaedic Surgeons or Royal College of Physicians and Surgeons of Canada or the American Osteopathic Board of Orthopedic Surgery. An individual may apply for candidate membership during residency training by providing confirmation of acceptance for a Pediatric Orthopedic Fellowship. He/she shall become a Candidate member as long as he or she devotes at least fifty percent (50%) of his/her professional time to pediatric orthopaedics after residency and fellowship. Candidate membership will consist of a single non-renewable six (6) year term of membership with no guarantee of advancement to active membership and will be maintained by compliance with dues, fees, and assessments, and by attendance of at least two annual meetings within the six (6) year term of membership. Failure to meet these requirements will result in termination of the membership. Candidate members will pay dues at a reduced rate to be determined by the Board of Directors. Candidate members may not vote, serve on elected committees or hold elected office. Application for active membership may be submitted prior to the end of the six (6) year term. Candidate members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments, or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.

(b) ***Candidate Associate Membership***
Candidate associate membership shall be conferred by the Board of Directors to encourage early, active involvement in the activities of POSNA by M.D.'s, D.O.'s or Ph.D.'s training in fields clinically related to pediatric orthopaedics or in the field of pediatric orthopaedic research. Applicants for candidate associate membership shall fit within the Objectives and Purpose of the Society as stated in Article II. A candidate member is one who has been admitted by application (Article IV, Sections 3 and 4). This membership is limited to those individuals who reside and work within the United States and Canada. Candidate membership will consist of a single non-renewable six (6) year term of membership with no guarantee of advancement to associate membership and will be maintained by compliance with dues, fees, and assessments, and by attendance of at least two annual meetings within the six year term of membership. Failure to meet these requirements will result in termination of the membership. Candidate members will pay dues at a reduced rate to be determined by the Board of Directors. Candidate members may not vote, serve on elected committees or hold elected office. Application for associate membership may be submitted prior to the end of the six (6) year term if all requirements for associate membership have been met. Candidate members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments, or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.

(c) ***Candidate Corresponding Membership***
Candidate corresponding membership shall be conferred by the Board of Directors to encourage

early, active involvement of younger pediatric orthopaedic surgeons from countries other than the USA and Canada in the activities of POSNA. A candidate member is one who has been admitted by application (Article IV, Sections 3 and 4). An individual may apply for candidate corresponding membership during or after a Pediatric Orthopaedic Fellowship. He/she shall become a candidate member as long as he or she devotes at least fifty percent (50%) of his/her professional time to pediatric orthopaedics after fellowship. Candidate membership shall consist of a single non-renewable six (6) year term of membership with no guarantee of advancement to corresponding membership and will be maintained by compliance with dues, fees and assessments, and by attendance of at least two annual meetings within the six (6) year term of membership. Failure to meet these requirements will results in termination of the membership. Candidate members will pay dues at a reduced rate to be determined by the Board of Directors. Candidate members may not vote, serve on elected committees or hold elected office. Application for corresponding membership may be submitted prior to the end of the six (6) year term if all requirements for corresponding membership have been met. Candidate members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments, or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.

Section 3. ***Application and Election Procedures:*** Each eligible applicant must complete an application form (obtainable from the secretary), and be sponsored by three Active or Senior members. It is necessary for at least one of the three sponsors to be knowledgeable about the candidate's current practice activities. The completed application must be in the possession of the secretary six months prior to the next annual meeting.

The procedures of the Membership Committee shall be as follows:

(a) Upon receipt of a completed application for membership from the secretary, the Membership Committee shall consider the applicant and shall perform whatever investigation of credential verification that it deems necessary to determine his/her qualifications. A site visit of the applicant's practice by a neutral and appropriate member appointed by the Membership Committee may be requested by the committee.

(b) One (1) month prior to the annual meeting the Chair of the Membership Committee shall forward to the secretary a list of satisfactory applicants. The secretary will distribute the list to the membership by mail prior to the annual meeting.

(c) The list of applicants shall be presented to the members at the first business meeting of the next annual meeting. The members shall vote to accept, defer, or reject each application. Election to membership in any category shall be by three-quarter (3/4) majority of the members present and voting. The secretary shall inform the applicants of the decision:

1) If the applicant is accepted, he/she shall be invited to attend the next annual meeting.

2) If an applicant is deferred for two (2) years after initial proposal, he/she shall be removed from the list of active applicants.

3) If an applicant for membership has been rejected, he/she may not be proposed again until a lapse of three (3) years has occurred.

In the event of an adverse recommendation or action by the Membership Committee, Board, or membership, no applicant or sponsor shall be entitled to question the decision.

Section 4. ***Confidentiality of Application:*** The entire contents of any application for membership in the Society shall be privileged and confidential, and shall not be subject to publication for public dissemination whether voluntary, involuntary, or by operation of law. Said application shall be forwarded only to the Membership Committee for consideration pursuant to the bylaws.

Any investigation/inquiries made by, or responses received by the Membership Committee or the Board of Directors, along with all procedures of and testimony received by the Membership Committee and the Board of Directors, shall likewise be privileged and confidential, and shall not be subject to publication or public dissemination whether voluntary, involuntary, or by operation of law.

Every application for membership in the Society shall be deemed to contain an agreement by and between the applicant and the Society, and separately signed by the applicant. The agreement is to contain substantially the following language:

"It is specifically agreed by the undersigned that in consideration of the Pediatric Orthopaedic Society of North America's treatment of the entire contents of this application, as well as all inquiries or investigations made pursuant thereto, as privileged and confidential material, and not subject to publication or operation of law, that the undersigned specifically authorizes the Pediatric Orthopaedic Society of North America to make whatever inquiries or investigations it deems necessary to verify the credentials, professional standing, and moral and/or ethical character of the undersigned. The undersigned further agrees that he/she will not cause or attempt to cause any public disclosure of the contents of any application for membership in the Pediatric Orthopaedic Society of North America or any proceedings of the Membership Committee or the Board of Directors pursuant thereto, whether said public disclosure be by operation of law or otherwise."

Section 5. *Transfer Procedure:* Requests for change in classification of membership shall be forwarded by the secretary to the Membership Committee for review and recommendations. Any change in classification of membership shall require two-thirds (2/3) majority vote of the members present and voting.

Section 6. *Alliance Society member who relocates to the United States or Canada.* An Alliance Society member who relocates to the United States or Canada must apply for either Active, Senior or Associate membership status.

ARTICLE V

ETHICS AND DISCIPLINE

Section 1. *Membership Requirement:* The Board of Directors may censor, reprimand, suspend, expel, or otherwise discipline any member of the Society for cause.

Section 2. *Standards of Ethics:* As a condition for continued membership in the Society, a member shall demonstrate: (a) Continued compliance with the requirements for active membership as contained in Article IV, Section 2. (b) Continued compliance with all Bylaws and Policy Statements as may be adopted by the membership or the Board of Directors. (c) Maintenance of a full and unrestricted license to practice medicine in a province, state, district, territory, or foreign country or practice medicine in a branch of the federal government which does not require licensure. (d) Continued adherence to the principles of high medical ethics, maintenance of good reputation and good standing within his/her community and high ethical character and professional repute. (e) Compliance with dues, fees and assessment requirements established from time to time by the Board of Directors. (f) Continued compliance with Article IV of the Bylaws.

Section 3. *Grounds for Disciplinary Action:* A member of the Society may be disciplined for any of the following reasons: (a) Failure to comply with the requirements contained in Article V, Section 2, Standards for Continued Membership, the Bylaws, the rules, regulations or policy statements of the Society adopted by the membership or Board of Directors. (b) Violation of the principles of high medical ethics. (c) Failure to continually comply with the requirements for membership of the particular classification of membership which the individual possesses, except as otherwise permitted by these Bylaws. (d) Conviction of a criminal offense involving moral turpitude. (e) Being in arrears in dues, fees and/or assessment for one year.

Section 4. *Complaints:* All complaints or requests for disciplinary action of a member of the Society shall be made in writing and addressed to the President of the Society. After due deliberation, the President may refer the complaints and charges to the Membership Committee which shall consider them and conduct any investigation deemed necessary. After investigation, the Membership Committee shall submit its written documents to the Board of Directors along with all reports and documentary evidence used by the Membership Committee in its deliberation.

Prior to formulating its recommendations, the Membership Committee shall meet to consider the matter and the member in question shall be notified at least thirty (30) days in advance by certified mail of the date, place, and time of the meeting. The notification shall include the nature of the complaint or charges and request for disciplinary action. The individual and/or personal representative and/or counsel shall also be invited to appear before the Membership Committee to submit such relevant evidence or rebuttal as the individual may deem proper.

Before action is taken by the Board of Directors with respect to a member, written notice shall be sent by certified mail to such member not less than thirty (30) days prior to the meeting of the Board of Directors at which the matter is to be considered, informing the individual that he/she may appear in person, and/or by his/her personal representative and/or counsel before the Board of Directors.

Disciplinary action against any member of the Society shall require the affirmative vote of not less than three-fourths (3/4) of the members of the Board of Directors.

Should disciplinary action result, the Secretary shall, within five (5) days thereafter, cause notice of the disciplinary action taken to be sent to the individual by certified mail stating the basis of the disciplinary action.

The status of such member shall be unaltered during the proceedings.

Section 5. *Confidentiality of Disciplinary Proceedings:* All disciplinary proceedings, whether said proceedings result in disciplinary action or not, shall be privileged and confidential as previously outlined in Article IV, Section 4.

ARTICLE VI

INDEMNIFICATION

(a) POSNA will indemnify any person who was or is a party, or is threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative (other than an action by or in the right of the corporation) by reason of the fact that he or she is or was a director, officer, employee or agent of POSNA, or who is or was serving at the request of POSNA as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against expenses (including attorneys' fees), judgments, fines and amounts paid in settlement actually and reasonably incurred by such person in connection with such action, suit or proceeding, if such person acted in good faith and in a manner he or she reasonably believed to be in, or not opposed to, the best interests of POSNA, and, with respect to any criminal action or proceeding, had no reasonable cause to believe his or her conduct was unlawful. The termination of any action, suit or proceeding by judgment, order, settlement, conviction, or upon a plea of nolo contendere or its equivalent, shall not, of itself, create a presumption that the person did not act in good faith and in a manner which he or she reasonably believed to be in or not opposed to the best interests of POSNA or, with respect to any criminal action or proceeding, that the person had reasonable cause to believe that his or her conduct was unlawful.

(b) POSNA will indemnify any person who was or is a party, or is threatened to be made a party to any threatened, pending or completed action or suit by or in the right of POSNA to procure a judgment in its favor by reason of the fact that such person is or was a director, officer, employee or agent of POSNA, or is or was serving at the request of POSNA as a director, officer, employee or agent of another corporation, partnership, joint venture, trust or other enterprise, against expenses (including attorneys' fees) actually and reasonably incurred by such person in connection with the defense or settlement of such action or suit, if such person acted in good faith and in a manner he or she reasonably believed to be in, or not opposed to, the best interests of POSNA, provided that no indemnification shall be made in respect of any claim, issue or matter as to which such person shall have been adjudged to be liable for negligence or misconduct in the performance of his or her duty to POSNA, unless, and only to the extent that the court in which such action or suit was brought shall determine upon application that, despite the adjudication of liability, but in view of all the circumstances of the case, such person is fairly and reasonably entitled to indemnity for such expenses as the court shall deem proper.

(c) To the extent that a present or former director, officer or employee of a Society has been successful, on the merits or otherwise, in the defense of any action, suit or proceeding referred to in subsections (a) and (b), or in defense of any claim, issue or matter therein, such person shall be indemnified against expenses (including attorneys' fees) actually and reasonably incurred by such person in connection therewith, if that person acted in good faith and in a manner he or she reasonably believed to be in, or not opposed to, the best interests of the corporation.

(d) Any indemnification under subsections (a) and (b) (unless ordered by a court) shall be made by POSNA only as authorized in the specific case, upon a determination that indemnification of the present or former director, officer, employee or agent is proper in the circumstances because he or she has met the applicable standard of conduct set forth in subsections (a) or (b). Such determination shall be made with respect to a person who is a director or officer at the time of the determination: (1) by the majority vote of the directors who are not parties to such action, suit or proceeding, even though less than a quorum, (2) by a committee of the directors designated by a majority vote of the directors, even through less than a quorum, (3) if there are no such directors, or if the directors so direct, by independent legal counsel in a written opinion, or (4) by the members entitled to vote, if any.

(e) Expenses (including attorney's fees) incurred by an officer or director in defending a civil or criminal action, suit or proceeding may be paid by the Society in advance of the final disposition of such action, suit or proceeding, as authorized by the board of directors in the specific case, upon receipt of an undertaking by or on behalf of the director or officer to repay such amount, unless it shall ultimately be determined that such person is entitled to be indemnified by the Society as authorized in this Section. Such expenses (including attorney's fees) incurred by former directors and officers or other employees and agents may be so paid on such terms and conditions, if any, as the Society deems appropriate.

(f) The indemnification provided by the Section shall not be deemed exclusive of any other rights to which those seeking indemnification may be entitled under any bylaw, agreement, vote of members or disinterested directors, or otherwise, both as to action in his or her official capacity and as to action in another capacity while holding such office, and shall continue as to a person who has ceased to be a director, officer, employee or agent, and shall inure to the benefit of the heirs, executors and administrators of such a person.

(g) POSNA may purchase and maintain insurance on behalf of any person who is or was a director, officer, employee or agent of the Society, or who is or was serving at the request of the Society as a director, officer, employee or agent of another Society, partnership, joint venture, trust or other enterprise, against any liability asserted against such person and incurred by such person in any such capacity, or arising out of his or her status as such, whether or not the Society would have the power to indemnify such person against such liability under the provisions of this Section.

(h) If POSNA indemnifies or advances expenses under subsection (b) of this Section to a director or officer, the Society shall report the indemnification or advance in writing to the members entitled to vote with or before the notice of the next meeting of the members entitled to vote.

ARTICLE VII
BOARD OF DIRECTORS

Section 1. *General Powers:* The affairs of the Society shall be managed by the Board of Directors.

Section 2. *Number, Tenure and Qualifications:* The Board of Directors shall consist of twelve (12) members and shall be composed of the officers of the Society, as hereinafter described, namely: President, President-Elect, Vice President, Secretary, Treasurer, Immediate Past President, second Past President of the Society, and five (5) At Large members. Two (2) At Large Members shall be elected at the annual meeting each year, and three (3) the alternate years. In years where two at large members are elected , one At Large Member will serve a two (2) year term and be elected from the membership at large. The other will be elected from the previous five (5) years new members. In years where 3 at large members are elected, two at large members will be elected from the membership at large and will serve a two year term. The other will be elected from the previous five years new members. The At Large member elected from the previous five years new members will serve on the Board of Directors two (2) years and the next year will serve on the Long Range Planning Committee.

The Historian, the Chairperson of the Orthopaedic Section of the American Academy of Pediatrics, the Chair of the International Pediatric Orthopaedic Symposium (IPOS), the Chairs of the Research Council, Health Care Delivery Council, Communications Council and Education Council shall serve as ex-officio non-voting members of the Board of Directors.

Section 3. *Regular Meetings:* The Regular Meetings of the Board of Directors shall be held prior to the annual meeting of the Society and at such other times as the Chairman may designate for the transaction of such business that may come before the meeting. The Board of Directors may provide by resolution the time and place for the holding of additional regular meetings of the Board without other notice than such resolution.

"Robert's Rules of Order Revised" shall be the parliamentary authority for all matters of procedure not specifically covered by the Bylaws of the Society or any special rules or procedures adopted by the Society for the meeting of the Board of Directors.

Section 4. ***Special Meetings:*** Special Meetings of the Board of Directors may be called by or at the request of the Chairman of the Board of Directors or any two (2) Directors. The person or persons authorized to call a Special Meeting of the Board may fix any place as the place for holding any Special Meeting of the Board called by them.

Section 5. ***Notice:*** Notice of any Special Meeting of the Board of Directors shall be given at least seven (7) days prior thereto by written notice delivered personally or sent by mail or telegram to each Director at his/her address as shown on the records of the Society. If mailed, such notice shall be deemed to be delivered when deposited in the United States mail in a sealed envelope so addressed with postage thereon prepaid. If notice be given by e-mail , such notices shall be deemed to be delivered when requested response to the e-mail is received. Any Director may waive notice of any meeting. The attendance of a Director at any meeting shall constitute a waiver of notice of such meeting for the expressed purpose of objecting to the transaction of any business because the meeting is not lawfully called or convened. Neither the business to be transacted at, nor the purpose of, any Regular or Special Meeting of the Board need be specified in the notice of such meeting, unless specifically required by law or by these Bylaws.

Section 6. ***Quorum:*** A simple majority of the Board of Directors is necessary to constitute a quorum for opening a meeting of the Board of Directors and the transaction of business.

Section 7. ***Manner of Acting:*** The act of a majority of the Directors present at a meeting at which a quorum is present shall be the action of the Board of Directors except where otherwise provided by law or by these Bylaws.

Section 8. ***Officers of the Board of Directors:*** The President of the Society (or President-Elect in his/her absence) shall serve as Chairman of the Board of Directors. The Secretary of the Society (or designate from the Board of Directors in his/her absence) shall serve as the Secretary of the Board of Directors.

Section 9: ***Compensation:*** Directors shall not receive compensation for their services, but by an action of the Board of Directors, expenses of attendance may be allowed for the attendance of each regular or special meeting of the Board-provided that nothing herein contained shall be construed or preclude any Director from serving the Society in any other capacity and receiving compensation therefor.

Section 10. ***Informal Action by Directors:*** Unless specifically prohibited by the Articles of Incorporation or by these Bylaws, any action required to be taken at a meeting of the Board of Directors, or any other action which may be taken at a meeting of the Board of Directors, may be taken without a meeting if a consent in writing, setting forth the action to be taken, shall be signed by all Directors entitled to vote with respect to the subject matter thereof. Any such consent signed by all Directors shall have the same effect as a unanimous vote.

ARTICLE VIII
OFFICERS

Section 1. ***Officers:*** The Officers of the Society shall be as follows: President, President-Elect, Vice President, Secretary, Treasurer, Treasurer-Elect, when appropriate, and Historian (ex-officio). Said Officers shall serve for terms as hereinafter specified.

Section 2. ***Election Procedure:*** The Nominating Committee shall each year prepare a list of nominees selected for the following officers. Vice President, two or three At Large Members of the Board of Directors, one should be from the previous 5 years new membership, one Member for the Membership Committee and each three years a member for the Treasurer Committee and the Long Range Planning Committee, for the office of the Secretary and for the office of Historian. In the year prior to which the office of Treasurer is to be vacated, the Nominating Committee shall select a candidate for the office of Treasurer Elect.

During the one-year term of the Nominating Committee, the committee may solicit, and the membership may submit, names of candidates for office. The Nominating Committee may, at its discretion, request information from, and interview candidates to assess qualifications and interest in the position. The Nominating Committee shall prepare a list consisting of one individual nominee for each eligible office. This list of nominees shall be presented to the Board of Directors at a scheduled board meeting at least 60 days prior to the annual meeting. The Board of Directors does not have authority to alter any of the nominations but may send comments to the Nominating Committee.

The Nominating Committee shall present its recommended nominees to the membership at the first business session of the annual meeting for consideration of those in attendance. Additional nominations may be made from the floor.

Election of Officers shall be held by vote of those members present at an annual meeting of the

Society and the majority shall elect. No proxy vote by a member otherwise entitled to vote, who is not present at said business session shall be allowed. Each member who is present at said business session shall be entitled to one (1) vote for each Officer or Member of the Board of Directors to be elected. Cumulative voting, placing all votes for one (1) particular candidate is specifically prohibited.

The term of office for those elected at an annual meeting shall commence at the close of said meeting.

Section 3. ***President:*** The President shall be the principal executive officer of the Society and shall, in general, supervise and control all the business affairs of the Society for one (1) year. He/She shall preside at all general meetings of the Society and of the Board of Directors. He/She may sign, with the Secretary or any other proper officer of the Society authorized by the Board of Directors, any deeds, mortgages, bonds, contracts or other instruments that the Board of Directors has authorized to be executed, except in cases where the signing and execution thereof shall be expressly delegated to the Board of Directors. He/She is authorized to act in the event of any contingency or emergency not covered by the Bylaws. He/She shall, in general, perform all duties incident to the office of the President and such duties as may be prescribed by the Board of Directors from time to time.

Section 4. ***President-Elect:*** In the absence of the President or in the event of his death, inability or refusal to act, the President-Elect shall perform the duties of the President and when so acting have the powers of and be subject to all restrictions upon the President. The President-Elect shall succeed to the office of President at the annual meeting at which the current President's term expires, or immediately in the event of death, inability or refusal to act of the President. In the event that the President-Elect succeeds to the office of President by reason other than natural succession by expiration of the current President's term of office, the President-Elect shall serve the remaining unfulfilled term of the replaced President for which He/she was elected and the subsequent term for which he/she was elected.

Section 5. ***The Vice President:*** The Vice President will serve in this office for one year or until the President-Elect becomes President at which time he/she becomes President-Elect. He/She will be a member of the Board of Directors. He/She will assist the President and President-Elect.

Section 6. ***Secretary:*** The Secretary shall keep the minutes of all meetings of the Society and the Board of Directors see that all notices are duly given in accordance with the provisions of these Bylaws or as required by law, be custodian of the Corporate records and of the Seal of the Society and see that the Seal of the Society is affixed to all documents, the execution of which on behalf of the Society under its Seal is duly authorized in accordance with the provisions of these Bylaws.

He/She shall keep a register of the Post Office address of each Member which shall be furnished to the Secretary by such Member. He/She shall maintain the Correspondence of the Society. He/She shall keep a record of the names of the members, guests, and visitors in attendance at any meeting of the Society. He/She shall prepare for publication of the Proceedings of the Business sessions of the Society and the Board of Directors.

He/She shall notify candidates of their election to membership in the Society and notify nominees of their election to office or of their appointment to Committees.

The Secretary shall serve one three (3) year term of office and shall be ineligible to succeed him/herself.

Section 7. ***Treasurer:*** The Treasurer shall be in charge and have custody of and be responsible for any and all funds and securities of the Society and other assets of the Society and shall post a bond at the expense of the Society for the faithful discharge of his duties in said sum and with such surety or sureties as the Board of Directors shall determine. He/She shall receive and give receipts for monies due and payable to the Society from any source whatsoever and deposit all such monies in the name of the Society in such banks, trust companies or other depositories as shall be selected in accordance with the provision of Article XIV of these Bylaws.

Specifically allocated funds, such as research grants and specified contributions, shall be kept separate from the general fund.

All routine expenditures, not to exceed the limits established by the Board of Directors, shall be paid by the Treasurer out of the general fund. Any expenditure exceeding said limit shall require prior approval of the Board of Directors.

The Accounts of the Treasurer may be audited annually by a certified Public Accountant for the current fiscal year if the Board of Directors shall direct. The Treasurer shall keep itemized accounts of receipts and expenditures and present a report at the annual meeting. H/she shall be responsible for the preparation of an annual budget for submission to the Board of Directors.

The Treasurer shall serve one three (3) year term of office and shall be ineligible to succeed him/herself.

Section 8. ***Treasurer Elect:*** The Treasurer Elect shall be elected one year prior to the fulfillment of the term of office of the then present Treasurer of the Society. The Treasurer Elect shall be a non-voting ex officio member on the Board of Directors.

Section 9. ***Historian:*** The Historian shall keep all records pertaining to the history of the Society and shall keep in good order all reports, papers, and records presented at these meetings, preparing and preserving an Annual Historical Account of the meeting of the Society. The Historian shall hold office for a term of three (3) years after nomination by the Nominating Committee and election by a simple majority of the members of the Society present and voting. The Historian may succeed himself/herself in office for a further term of-three (3) years if nominated by the Nominating Committee and elected by a simple majority vote of the members of the Society present and voting at the annual meeting. After serving the second term of three (3) years, He/she is ineligible for reelection.

Section 10. ***Vacancies:*** A vacancy in any office because of death, resignation, refusal to act, removal, or disqualification, or otherwise, may be filled by the Nominating Committee and the Board of Directors as soon as practical after such a vacancy occurs. The Nominating Committee shall recommend to the Board of Directors a qualified individual to fill the vacancy. Following Board approval the individual will serve for the remaining term of office, unless otherwise provided by these Bylaws.

ARTICLE IX

MEETING AND VOTE OF THE MEMBERSHIP

Section 1. ***Time and Place:*** The annual meeting of the Society shall take place on the date and in the place designated by the Board of Directors.

Section 2. ***Annual Meeting:*** The annual meeting shall consist of scientific sessions, discussions and at least two (2) business sessions.

Section 3. ***Other Meetings:*** Other meetings may be held with the approval of the Board of Directors.

Section 4. ***Induction of New Members:*** Induction of any new members shall take place at each annual meeting.

Section 5. ***Quorum:*** A quorum shall consist of those members present and capable of voting at any regular or special business session of the Society, but in no event shall a quorum consist of less than one-third (1/3) of those members capable of voting. Except in cases as otherwise provided in these Bylaws, majority of the affirmative or negative vote will constitute a determination of an issue upon which a vote is taken.

Section 6. ***Vote of Membership:*** Voting rights as specified by these Bylaws shall be exercised by the member in person. No proxy vote by a member otherwise entitled to vote, who is not present in person at the business session or committee meeting, shall be allowed. Cumulative voting, to place all votes for a particular candidate or a particular issue, is specifically prohibited. Whenever within these Bylaws a member of a Committee is specified to be Ex-Officio, it is specifically understood that said Ex-Officio member shall not have the right to vote unless otherwise specified by the Board of Directors. Only Committee Members duly appointed by the President of the Society or elected by the Membership shall be entitled to vote within said Committee. Any adjunct Committee Member or Consultant shall not have the right to vote unless specified by the Board of Directors.

Section 7. ***Guests:*** Guests will be allowed at the annual meeting. Each member, including corresponding members, may invite one guest to a meeting. Guests will not give presentations. They will be welcome to all the social functions, but will not attend the business meetings.

Section 8. ***Notice of members' meetings:*** Written notice stating the place, day, and hour of the meeting and, in the case of a special meeting, the purpose or purposes for which the meeting is called, shall be delivered not less than 5 nor more than 60 days before the date of the meeting, or in the case of a removal of one or more directors, a merger, consolidation, dissolution or sale, lease or exchange of assets not less than 20 nor more than 60 days before the date of the meeting, by or at the direction of the president, or the secretary, or the officer or persons calling the meeting, to each member of record entitled to vote at such meeting.

ARTICLE X

AMENDMENTS

Proposed amendments to these Bylaws or to the Articles of Incorporation of the Society must be submitted in writing by any Active Member to the

Secretary of the Board of Directors not less than one hundred twenty (120) days prior to the next annual meeting. The Secretary shall forward such proposed amendment(s) to the Bylaws Committee for its review and recommendations. A copy of the proposed amendment(s) to the Bylaws shall be sent by the Secretary to each member at least one (1) month preceding the annual meeting at which time the proposed amendment(s) shall be voted upon. The Bylaws Committee shall formulate its recommendations concerning said amendment(s) and forward these to the Board of Directors. At a business session at the annual meeting, the proposed amendment shall be submitted for vote of those in attendance, along with the recommendation of the Bylaws Committee. Amendment(s) to these Bylaws or to the Articles of Incorporation of the Society must be approved by the affirmative vote of two-thirds (2/3) of those members present and voting at said business sessions.

ARTICLE XI
FEES AND DUES

Section 1. ***Annual Dues:*** Annual dues shall be paid by Active members, Associate members, Corresponding members and all Candidate members. The amount of these dues shall be determined by the Board of Directors, ratified by two-thirds (2/3) majority vote of the members at the business meeting. Dues will be paid to the treasurer at such time as he/she may demand. Failure to pay dues will lead to termination of membership.

Section 2. ***Exemption from Dues:*** Exemption from dues (for example "prolonged illness") shall be determined by the Board of Directors.

Section 3. ***Registration Fee:*** A registration fee for each annual meeting shall be paid by non-dues paying members (i.e. Senior & Corresponding), and guests in the amount of which shall be determined by the Board of Directors. A registration fee for each annual meeting shall be paid by attending Active members in the amount of which shall be determined by the Board of Directors.

Section 4. ***Special Assessments:*** Special assessments shall be determined by the Board of Directors and shall be paid by the classes of membership as determined by the Board of Directors.

Section 5. ***Currency:*** All dues, fees, and assessments shall be paid in United States currency.

ARTICLE XII
COMMITTEES

Section 1. ***Classification and Organization:*** The Standing Committees shall be Membership, Nominating, and Treasurer's.

Said Committees shall initiate programs and submit them to the Board of Directors for approval and shall consider such matters as may be referred to them by the Board of Directors.

Section 2. ***Membership Committee:*** The Membership Committee shall consist of five (5) elected active members each of whom shall serve for a five (5) year term. The senior committee member is the chairman. At each annual meeting, the senior elected active member shall be retired to be succeeded by an active member elected for a five year term.

The procedures of the Membership Committee shall be as follows: (a) Upon receipt of a completed application for membership from the Secretary, a personal interview with the candidate shall be conducted if the Membership Committee deems it necessary. (b) Appropriate investigation, if deemed necessary by the Membership Committee, shall be undertaken to verify the candidate's credentials and determine his/her qualifications. (c) Four (4) months prior to the annual meeting, the Chairman of the Membership Committee shall forward to the President a list of candidates with their recommendations for their consideration. Such recommendation may be to accept, reject, or defer the application. (d) If, after consideration of a candidate's qualifications by the Membership Committee for two (2) years after initial proposal, the candidate is not accepted, he/she shall be removed from the list of active candidates. (e) If a candidate for membership has been removed from consideration, he/she may not be proposed again until a lapse of three (3) years has occurred.

Section 3. ***Nominating Committee:*** The Nominating Committee shall consist of five (5) active members, four (4) of whom shall be elected at the second business session of each annual meeting by a majority of the voting members present at the session. The four (4) elected members shall be those receiving the most votes from a slate of at least eight (8) candidates nominated from the floor during the first business meeting at the same annual meeting. The term of each member of the Nominating

Committee shall be one year. If an elected member of the Nominating Committee is unable to complete the one year term, the nominated candidate with the fifth (5th) highest number of votes shall fill the vacancy. No elected members of the Nominating Committee may be a current member of the Board of Directors. The fifth member, who shall be the Chairman, shall be selected by the President with the approval of the Board of Directors. The Chairman may be a current member of the Board of Directors. No member may serve two (2) consecutive years on the Nominating Committee. Members of the Nominating committee are not eligible to be nominated for office during their time on the committee.

The procedure of the Nominating Committee shall be in accordance with Article VIII, Section 2 of these Bylaws.

Section 4. ***Treasurer's Committee:*** The Treasurer's Committee shall consist of the Treasurer as Chair (three (3) year term), the Immediate Past Treasurer (for a two (2) year term) the two (2) most Immediate Past Presidents, the Treasurer- Elect (one (1) year term following election and prior to becoming Treasurer) and one (1) member of the Society elected by the Society (for a three year term) at its annual meeting. The Nominating Committee will provide one (1) nominee to be considered at the time of election.

The Committee shall formulate all investment policies of the Society subject to the approval of the Board of Directors.

The Committee shall insure that the Treasurer implement such approved policies with regard to management, supervision, and control of all financial affairs of the Society.

The Committee shall meet at least annually as well as at the request of the Chairman of the Board of Directors to review the financial affairs of the Society and shall submit a report of the Board of Directors.

Section 5. ***Other Committees:*** The Board of Directors may create both Ad-hoc and Standing Committees when it is deemed necessary to attend to the affairs of the Society. The President shall appoint members to these committees as specified by the Board of Directors.

Section 6. ***Vacancies:*** Any vacancy in any Committee Membership due to death, resignation, refusal to act, removal, disqualification, or otherwise, may be filled by the President with approval of the Board of Directors, to complete the yet un-expired term of the replaced committee member.

Section 7. ***Ex-Officio Members:*** A member of the "Presidental Line" (President, President Elect, Vice President) of the Board of Directors shall be members ex-officio of all committees except the Nominating and Membership Committees. The Secretary of the Board of Directors shall be an ex-officio member of the Membership and Bylaws Committees.

Section 8. ***Quorum:*** Unless the appointment by the board of directors requires a greater number, a majority of any committee shall constitute a quorum, and a majority of committee members present and voting at a meeting at which a quorum is present is necessary for committee action. A committee may act by unanimous consent in writing without a meeting and, subject to the provisions of the bylaws or action by the board of directors, the committee by majority vote of its members shall determine the time and place of meetings and the notice required therefore.

Section 9. ***Limitations of committees:***

A committee may not:

(1) Adopt a plan for the distribution of the assets of the corporation, or for dissolution;

(2) Approve or recommend to members any act these bylaws require to be approved by members, except that committees appointed by the board or otherwise authorized by the bylaws relating to the election, nomination, qualification, or credentials of directors or other committees involved in the process of electing directors may make recommendations to the members relating to electing directors;

(3) Fill vacancies on the board or on any of its committees;

(4) Elect, appoint or remove any officer or director or member of any committee, or fix the compensation of any member of a committee;

(5) Adopt, amend, or repeal the bylaws or the articles of incorporation;

(6) Adopt a plan of merger or adopt a plan of consolidation with another corporation, or authorize the sale, lease, exchange or mortgage of all or substantially all of the property or assets of the corporation; or

(7) Amend, alter, repeal or take action inconsistent with any resolution or action of the board of directors when the resolution or action of the board of directors provides by its terms that it shall not be amended, altered or repealed by action of a committee.

ARTICLE XIII
DISSOLUTION

In the event of the termination, dissolution, or formal anticipated dissolution of the affairs of this Society in any matter or reason whatsoever, the remaining assets, if any, shall be distributed to (and only to) one or more organizations described in Section 501 (c) (3) of the Internal Revenue Code.

ARTICLE XIV
CONTRACTS, CHECKS, DEPOSITS & FUNDS

Section 1. *Contracts:* The Board of Directors may authorize any office or officers, agent or agents of the Society, in addition to the officers so authorized by these Bylaws, to enter into any contract or execute and deliver any instrument in the name of and on behalf of the Society and such authority may be general or confined to specific instances.

Section 2. *Checks, Drafts, Etc.:* All checks, drafts, or other orders for the payment of money, notes or other evidence of indebtedness issued in the name of the Society shall be signed by such officer or officers, agent or agents of the Society and in such manner as shall be determined by action of the Board of Directors.

Section 3. *Deposits:* All funds of the Society shall be deposited to the credit of the Society in banks, trust companies, or other depositories as the Board of Directors may select.

Section 4. *Gifts:* The Board of Directors may accept on behalf of the Society any contributions, gift, bequest or device for the general purposes or for any special purpose of the Society.

ARTICLE XV
BOOKS AND RECORDS

The Society shall keep correct and complete books and records of accounts and shall also keep minutes of the proceedings of any business session, Board of Directors and Committee Meetings having any of the authority of the Board of Directors and shall keep at the register or principal office a record of giving the names and addresses of all members and their category of Membership.

ARTICLE XVI
FISCAL YEAR

The Fiscal Year of the Society shall coincide with the calendar year.

ARTICLE XVII
SEAL

The Board of Directors shall provide a corporate seal and shall have inscribed thereon the name of the Society.

ARTICLE XVIII
WAIVER OF NOTICE

Whenever any notice whatever is required to be given under the provisions of the General Not-For-Profit Corporation Act of Illinois or under the provisions of the Articles of Incorporation of the Bylaws of the Society, a waiver thereof in writing signed by the person or persons entitled to such notice, whether before or after the time stated therein, shall be deemed equivalent to the giving of such notice.

ARTICLE XIX
RULES OF ORDER

"Roberts Rules of Order Revised" shall be parliamentary authority on all matters of procedures not specifically covered by the Bylaws of the Society or any special rules of procedures adopted by the Society.

ARTICLE XX
NONPARTISANSHIP

The Pediatric Orthopaedic Society of North America is nonpartisan and therefore, partisan politics, sex, color, or religion shall not influence the activities of the Society.

ARTICLE XXI
EMERGENCY AMENDMENTS

Any change in the corporate or tax status of the Society caused by modification, repeal, or amendment of any currently existing tax or corporate legislation, whether Federal, State, or Local, which at the discretion of the Board of Directors, requires immediate compliance of the Society, shall be put in effect to insure compliance without prior approval of the voting membership, even if this compliance is at variance with the Bylaws of the Society. This action must be communicated to the Society membership as soon as possible and the action confirmed by a three-fourths (3/4) vote of those present and voting at the annual meeting.

Amended May 17, 2012

POSNA BYLAWS
PROPOSED CHANGES MAY 2013

ARTICLE IV
MEMBERSHIP

Section 2. *Classes of Membership*: There shall be ~~nine~~ ten classes of membership in the Pediatric Orthopaedic Society of North America; namely, Active membership, Senior membership, Corresponding membership, Adjunct membership, Associate membership, Honorary membership, Inactive membership, and Candidate Active, Associate or Corresponding membership. All duly elected members may be issued a certificate signifying his/her election as a member.

Section 2A. *Active Membership*: An Active member is one who has been admitted by application (Article IV, Sections 3 and 4). Active members may vote, serve on appointed committees, and hold elected office. This membership is limited to those orthopaedic surgeons who reside and practice within the United States or Canada, who are certified by the American Board of Orthopaedic Surgery, the Royal College of Physicians and Surgeons of Canada or the American Osteopathic Board of Orthopedic Surgery, and who devote at least seventy-five percent of their professional time (clinical and research) to pediatric orthopaedic surgery. Active membership will be maintained by compliance with dues, fees, and assessments, appropriate board certification and by attendance of at least one annual meeting every four (4) years. A member's failure to attend one in four (4) consecutive annual meetings or maintain certification will constitute resignation from the Society and termination of the membership. Active members who fail to attend one of four consecutive annual meetings, but who otherwise are in good standing, may apply for reinstatement of membership within one year of termination of membership. Documentation of maintenance of qualifications for active membership and attendance at the next annual meeting are required for reinstatement. Active members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.

Section 2B. *Senior Membership*: A Senior member is an Active, Corresponding, ~~or~~ Associate member or Adjunct member who has retired from active medical practice *and*, upon reaching age 65, has requested transfer to Senior status. In addition, an Active, Corresponding, ~~or~~ Associate or Adjunct member may request Senior member status if for medical reasons, he/she is fully and permanently disabled from clinical duties regardless of age. Senior members are exempt from paying dues but may vote and serve on appointed committees, yet they may not hold elected office including service on the Nominating Committee. There is no attendance requirement.

Section 2C. *Corresponding Membership*: A Corresponding member is an orthopaedic surgeon from a country other than the U.S.A. and Canada who has been admitted by application (Article IV, Sections 3 and 4). Candidates must devote at least seventy-five percent of their professional time (clinical and research) to pediatric orthopaedics. The application for corresponding membership can be made no earlier than three (3) years following the successful completion of orthopaedic residency training and not earlier than two (2) years following completion of a pediatric orthopaedic fellowship. The corresponding member must be board certified by the regulating board of their country if one exists. Candidates for corresponding membership must have attended at least one Annual Meeting prior to applying for Corresponding membership. ~~A candidate's application shall be supported by two letters of sponsorship, one from active or senior members of the Society, and one from the candidate's country of practice.~~ Candidates for corresponding membership should be contributors in the field of Pediatric Orthopaedics in their country and demonstrate credentials and commitment which are equivalent to those submitted by North American applicants to POSNA. Corresponding membership shall be contingent upon attendance of a meeting of the Society at least once every five years. A member's failure to attend one of five (5) consecutive annual meetings will constitute resignation from the society and termination of the membership. Corresponding members who fail to attend one of five consecutive annual meetings, but who otherwise are in good standing, may apply for reinstatement of membership within one year of termination of membership. Documentation of maintenance of qualifications for Corresponding membership and attendance at the next annual meeting are required for reinstatement. Corresponding members will pay dues at a reduced rate to be determined by the Board of Directors to cover the cost of correspondence. Corresponding members may vote and serve on appointed committees but may not hold elected office. Those corresponding members relocating to the United States or Canada must request a change of status.

Section 2D. *Associate Membership:* An Associate member is one who has been admitted by application (ARTICLE IV, Sections 3 and 4). Associate membership may be conferred on M.D.'s, D.O.'s, or Ph.D.'s, who in the opinion of the Society are actively engaged in a profession that directly relates to pediatric orthopaedic surgery either clinically or in the field of research. This membership is limited to those individuals who reside and work within the United States and Canada. Application for associate membership can be made no earlier than two (2) years following successful completion of either a pediatric orthopaedic fellowship or other advanced training related to the field of pediatric orthopaedics. Activities of associate members must fit within the Objectives and Purpose of the Society as stated in Article II. Application and Election procedures for this class of membership shall be those of Article IV, Section 3 and 4. Associate members may not hold elected office but may vote, serve on appointed committees and otherwise participate fully in the activities of the Society. Dues and attendance requirements shall be the same as for active members. Associate members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.

Section 2G (c) **Candidate Corresponding Membership** Candidate corresponding membership shall be conferred by the Board of Directors to encourage early, active involvement of younger pediatric orthopaedic surgeons from countries other than the USA and Canada in the activities of POSNA. A candidate member is one who has been admitted by application (Article IV, Sections 3 and 4). An individual may apply for candidate corresponding membership during or after a Pediatric Orthopaedic Fellowship. He/she shall become a candidate member as long as he or she devotes at least fifty percent (50%) of his/her professional time to pediatric orthopaedics after fellowship. Candidate membership shall consist of a single non-renewable six (6) year term of membership with no guarantee of advancement to corresponding membership and will be maintained by compliance with dues, fees and assessments, and by attendance of at least two annual meetings within the six (6) year term of membership. Failure to meet these requirements will results in termination of the membership. Candidate members will pay dues at a reduced rate to be determined by the Board of Directors. Candidate members may not vote, serve on elected committees or hold elected office. Application for corresponding membership may be submitted prior to the end of the six (6) year term if all requirements for corresponding membership have been met. ~~Candidate members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments, or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.~~

Section 2H. Adjunct Membership: *An Adjunct member is one who has been admitted by application and two letters of recommendation; one from the Sponsoring POSNA member and one other POSNA member (all other provisions of ARTICLE IV, Sections 3 and 4 will apply). Adjunct membership may be conferred on advanced healthcare providers (Nurse Practitioner or Physician Assistant) or researchers with Masters level education, who in the opinion of the Society are actively engaged in a profession that directly relates to pediatric orthopaedic surgery. Activities of Adjunct members must fit within the Objectives and Purpose of the Society as stated in Article II. This membership is limited to those individuals who reside and work within the United States and Canada. In order to obtain and maintain membership, Adjunct members must work directly with a sponsoring Active Member of POSNA. Application for Adjunct membership can be made after successful completion of advanced training (Masters level education or greater), and* *after two (2) years of collaborative clinical work with a sponsoring POSNA Active member as a licensed Nurse Practitioner, licensed Physician Assistant or in the field of pediatric orthopaedic research. There is no Candidate Adjunct membership. Application and Election procedures for this class of membership shall be those of Article IV, Section 3 and 4. Adjunct members may not hold elected office and may not vote. They may serve on appointed committees and otherwise participate fully in the activities of the Society. Dues shall be the same as for Candidate members and attendance requirements will be the same as Associate members. Adjunct members serving in the US or Canadian military may have the meeting attendance requirement waived during any year they cannot attend because of military commitments, or are deployed overseas for active duty. Members requesting a waiver require a letter from their superior officer documenting the commitment or deployment for that calendar year.*

Section 3. *Application and Election Procedures*: Each eligible applicant must complete an application form (obtainable from the secretary), and be sponsored by three Active or Senior members. It is necessary for at least one of the three sponsors to be knowledgeable about the candidate's current practice activities. The completed application must be in the possession of the secretary six months prior to the next annual meeting. Exceptions to the above include, a Corresponding or Candidate Corresponding application, which shall be supported by two letters of sponsorship, one from active or senior members of the Society, and one from the candidate's country of practice. Candidates for Adjunct membership must complete an application and submit two letters of recommendation; one from the sponsoring POSNA member and one from another Active or Senior POSNA member.

The procedures of the Membership Committee shall be as follows:

(a) Upon receipt of a completed application for membership from the secretary, the Membership Committee shall consider the applicant and shall perform whatever investigation of credential verification that it deems necessary to determine his/her qualifications. A site visit of the applicant's practice by a neutral and appropriate member appointed by the Membership Committee may be requested by the committee.

(b) One (1) month prior to the annual meeting the Chair of the Membership Committee shall forward to the secretary a list of satisfactory applicants. The secretary will distribute the list to the membership by mail prior to the annual meeting.

(c) The list of applicants shall be presented to the members at the first business meeting of the next annual meeting. The members shall vote to accept, defer, or reject each application. Election to membership in any category shall be by three-quarter (3/4) majority of the members present and voting. The secretary shall inform the applicants of the decision:

1) If the applicant is accepted, he/she shall be invited to attend the next annual meeting.

2) If an applicant is deferred for two (2) years after initial proposal, he/she shall be removed from the list of active applicants.

3) If an applicant for membership has been rejected, he/she may not be proposed again until a lapse of three (3) years has occurred.

In the event of an adverse recommendation or action by the Membership Committee, Board, or membership, no applicant or sponsor shall be entitled to question the decision.

ARTICLE IX

MEETING AND VOTE OF THE MEMBERSHIP

~~**Section 7. *Guests*:** Guests will be allowed at the annual meeting. Each member, including corresponding members, may invite one guest to a meeting. Guests will not give presentations. They will be welcome to all the social functions, but will not attend the business meetings.~~

POSNA

The Pediatric Orthopaedic Society of North America

POSNA 2013 NOTES