IPOS® 2023 ePOSTERS

Foot

ePoster 1. Ability of the Area Deprivation Index to Predict Idiopathic Clubfoot Recurrence1

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Introduction: Recurrences following initial successful correction of clubfoot deformity by the Ponseti method are high due to the need for strict brace compliance. Previous studies have shown numerous parent-related socioeconomic factors associated with poor brace compliance and eventual clubfoot recurrence. Development of a method for identifying families at high risk for recurrence could lead to early targeted instruction aimed at improving brace compliance and decreasing recurrence. We aim to evaluate a published socioeconomic scoring system to assess its ability to predict clubfoot recurrence.
Methods: A retrospective review was conducted for idiopathic clubfoot patients treated at a single institution from 2011-2018, allowing for at least 4 years follow-up. Patient demographics and treatment data were abstracted. Recurrence of clubfoot deformity was defined as deformity requiring repeat treatment (PT, recasting, or surgery) after initial treatment was concluded. Patient socioeconomic scoring was assessed using the Area Deprivation Index (ADI), a measure created at the University of Wisconsin based on Health Resources and Service Administration data that allows for a ranking of neighborhoods by socio-economic disadvantage in a region of interest. The ADI for each patient was assessed for their state decile (1-10) with a higher score indicating worse area disadvantage.
Results: 204 patients treated by 9 different pediatric orthopaedic surgeons were evaluated. The patients were an average age of 17 days old (range, 10 – 28) at the start of treatment, averaged 5.6 casts, with 82.4% requiring an initial tenotomy and 91 patients (44.6%) requiring subsequent treatment for recurrent deformity (Table). Overall, patients with recurrence had a higher, but nonsignificant state ADI compared to patients without recurrence (4.8 vs 4.2, p=0.065). When assessed using multivariate analysis for each 1 unit increase in state ADI, the risk of recurrence increased by 10% (p=0.034). When the ADI was assessed categorically, patients with a state ADI of 8-10 had a 2.3 times higher risk of recurrence (p=0.007), with recurrence occurring at a significantly shorter time interval (32 vs 67 months, p=0.01, figure).
Conclusion: State ADI appears to be a good predictor of patients at risk for clubfoot recurrence following Ponseti treatment. Patients with a state ADI of 8-10 should be considered as significantly higher risk of recurrence, and early interventions should be targeted to improve brace compliance and hence prevent recurrence.
Significance: Using the state ADI to identify patients at higher risk for clubfoot recurrence at the start of treatment may help with targeted education to lower this risk of recurrence.

Table:

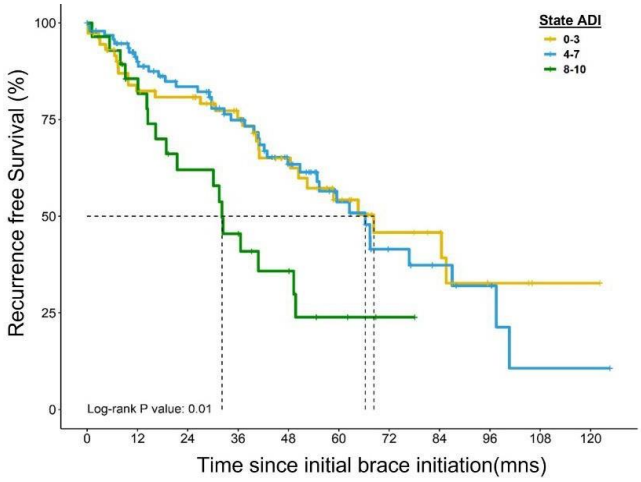
Variables	**Level**	**Overall (N= 204)**	**No Recurrence (N= 113)**	**Recurrence (N= 91)**	**P value**
Age at treatment initiation (days)	Median [IQR]	17.0 [10.0, 28.0]	19.0 [10.0, 30.0]	16.0 [9.8, 24.2]	0.166
Sex, n (%)	Male	170 (83.3)	91 (80.5)	79 (86.8)	0.231
	Female	34 (16.7)	22 (19.5)	12 (13.2)	
Laterality, n (%)	Unilateral	99 (48.5)	65 (57.5)	34 (37.4)	**0.004**

	Bilateral	105 (51.5)	48 (42.5)	57 (62.6)	
State Decile	Mean (SD)	4.5 (2.5)	4.2 (2.3)	4.8 (2.7)	0.065
State decile (category), n (%)	0-3	77 (37.7)	46 (40.7)	31 (34.1)	**0.031**
	4-7	97 (47.5)	57 (50.4)	40 (44.0)	
	8-10	30 (14.7)	10 (8.8)	20 (22.0)	
National percentile	Mean (SD)	24.6 (15.9)	22.3 (13.6)	27.5 (18.1)	**0.020**
National percentile (category), n (%)	0-20 percentile	88 (43.1)	53 (46.9)	35 (38.5)	0.192
	21-50 percentile	104 (51.0)	56 (49.6)	48 (52.7)	
	51-100 percentile	12 (5.9)	4 (3.5)	8 (8.8)	
Number of Casts	Mean (SD)	5.6 (1.4)	5.4 (1.4)	5.9 (1.2)	**0.004**
Number Casts (category), n (%)	1-5 casts	101 (50.2)	65 (57.5)	36 (40.9)	**0.019**
	>5 casts	100 (49.8)	48 (42.5)	52 (59.1)	
Tenotomy, n (%)	No	36 (17.6)	24 (21.2)	12 (13.2)	0.134
	Yes	168 (82.4)	89 (78.8)	79 (86.8)	

*P values were obtained from two-sample t-test test and Mann-Whitney-U test for continuous data and Chi-square/Fisher's exact test for binary and categorical data

*SD= Standard Deviation, IQR= Interquartile Range

Figure:



ePoster 2. Is Computed Tomography Scan Necessary in the Preoperative Evaluation of Calcaneonavicular Tarsal Coalition?

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Background: Despite the importance of CT scan as a crucial tool for pediatric diagnosis, it is of interest to evaluate its necessity to minimize radiation exposure in children. We sought to assess the rates of multiple ipsilateral tarsal coalitions in our patient records to determine whether computed tomography (CT) imaging affected the treatment plan for patients with symptomatic tarsal coalitions beyond what is indicated by physical examination and radiography (XR).
Introduction: The prevalence of tarsal coalition ranges from 1-6% with calcaneonavicular and talocalcaneal coalitions being most common. The standard of care includes a CT scan to characterize the coalition and identify additional coalitions. Multiple ipsilateral coalitions are rare, and literature on the topic is limited.
Methods: After obtaining institutional review board approval, we retrospectively reviewed medical records and XRs of 76 consecutive patients (<20 years) who underwent tarsal coalition resection at our institution from 2006-2021. All the patients underwent preoperative foot XR and CT. We evaluated patients' demographics, surgical data, and whether the diagnosis was made with XR or CT. In the setting of multiple coexisting coalitions, special consideration was given to whether CT results modified the treatment plan.
Results: Patients average age was 12.1±2.4 years and M:F ratio 39:37. 43 patients (56.6%) had bilateral coalitions with 25(32.9%) having bilateral resections. 64 (84.2%) diagnoses were made with XR, compared to 12 (15.8%) with CT. Only 2(2.6%) patients had multiple unilateral coalitions. 1 (1.3%) patient with calcaneonavicular coalitions diagnosed on XR was found to have a unilateral talocalcaneal coalition on CT in the setting of unilateral subtalar stiffness. The treatment plan was affected in this case, as all the coalitions were resected.
Conclusions: The rate of clinically significant multiple ipsilateral tarsal coalitions is extremely low in our patient population. Therefore, if a coalition is readily diagnosed on XR and is consistent with clinical examination, preoperative CT should be considered judiciously. The utility of CT remains important in diagnosing talocalcaneal coalitions that cannot be seen on XR but are suspected clinically.
Significance: CT scans should be performed for diagnosis when there is a high suspicion of talocalcaneal coalitions not seen on XR and for preoperative planning of talocalcaneal coalitions. Patients with XR diagnosis and consistent clinical presentation of calcaneonavicular

tarsal coalition may not benefit from CT. Modifying the previous standard of care would decrease cost, time, and radiation exposure.

Table 1. Demographic, Surgical and Radiographic Characteristics in Total Sample of Tarsal Coalitions (TC) Population and Stratified by the Tarsal Coalition Type, N=76

Variables	Total TC (n=76)	CNC n=54(71.1%)	TCC n=20(26.3%)	CNC+TCC n=1(1.3%)	CNC+TCC/NC n=1(1.3%)	p-value*
Age at Surgery (years)	12.1±2.4	11.8±2.30	12.9±2.58	11.7	12.8	0.3375
Sex, n(%)						0.6049
Female	37(48.7)	25(46.3)	10(50)	1(100)	1(100)	
Male	39(51.3)	29(53.7)	10(50)	0	0	
Bilateral TC, n(%)						0.9999
Yes	43(56.6)	30(55.6)	11(55)	1(100)	1(100)	
Multiple Ipsilateral TC, n(%)						0.0004
Yes	2(2.6)	0	0	1(100)	1(100)	
Total Operative Feet, n(%)						0.2436
One	51(67.1)	38(70.4)	13(65)	0	0	
Two	25(32.9)	16(29.6)	7(35)	1(100)	1(100)	
CT Needed to confirm diagnosis, n(%)						<0.0001
No	64(84.2)	54(100)	10(50)	0	0	
Yes	12(15.8)	0	10(50)	1(100)	1(100)	

ePoster 3. Putting a Better Foot Forward: Prospective Cohort Study of Flatfoot Reconstruction for Painful Pediatric Idiopathic Flexible Flatfoot

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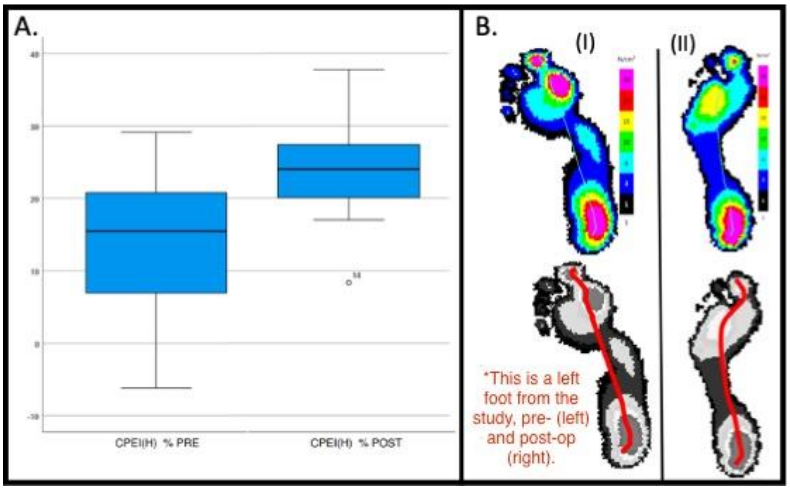
Background: This prospective study was undertaken to report outcomes following reconstructive surgery for patients with painful pediatric idiopathic flexible flatfoot (PIFF).
Methods: Twenty-five patients with PIFF were evaluated pre- and post-flatfoot reconstruction with lateral column lengthening (LCL). All patients had lengthening of the Achilles or gastrocnemius, while 13 patients had medial side soft tissue (MSST) procedures, 7 underwent medial cuneiform plantarflexion osteotomy (MCPO), and 5 had medializing calcaneal osteotomy. Measures of static foot alignment – both radiographic parameters and clinical arch height indices – were compared, as were measures of dynamic foot alignment and loading, including arch height flexibility and pedobarography. Pre- and postoperative PROMIS Pain Interference scores were compared between those treated with or without MSST procedures.
Results: Median subject age was 13.8 years (range 10.3-16.5) at the time of surgery. All radiographic parameters improved with surgery ($p<0.001$) (Table 2). Both mean sitting and standing arch height indices showed modest increases after surgery ($p=0.009$ and $p<0.001$). Arch height flexibility was similar after surgery. Mean center of pressure excursion index (CPEI) increased from 14.1% to 24.0% ($p<0.001$) (Figure 3), and mean 1st metatarsal head (MH) peak pressure dropped ($p<0.001$), while mean 5th MH peak pressure increased ($p=0.018$). The ratio of peak pressure in the 5th MH to peak pressure in the 2nd MH increased ($p=0.010$). The ratio of peak pressure in the 1st MH to peak pressure in the 2nd MH decreased when a MCPO was not used ($p<0.002$), but it remained stable when a MCPO was included (Figure 6). Mean scores in all PRO domains improved ($p<0.001$). Patients treated without MSST procedures showed no difference in PROMIS Pain Interference scores compared to those without MSST procedures.
Conclusion: Flatfoot reconstruction surgery using a LCL with plantarflexor lengthening results in improved PROs. LCL changes but does not normalize the distribution of MH pressure loading. The addition of a MCPO can prevent a significant reduction in load-sharing by the 1st MH.



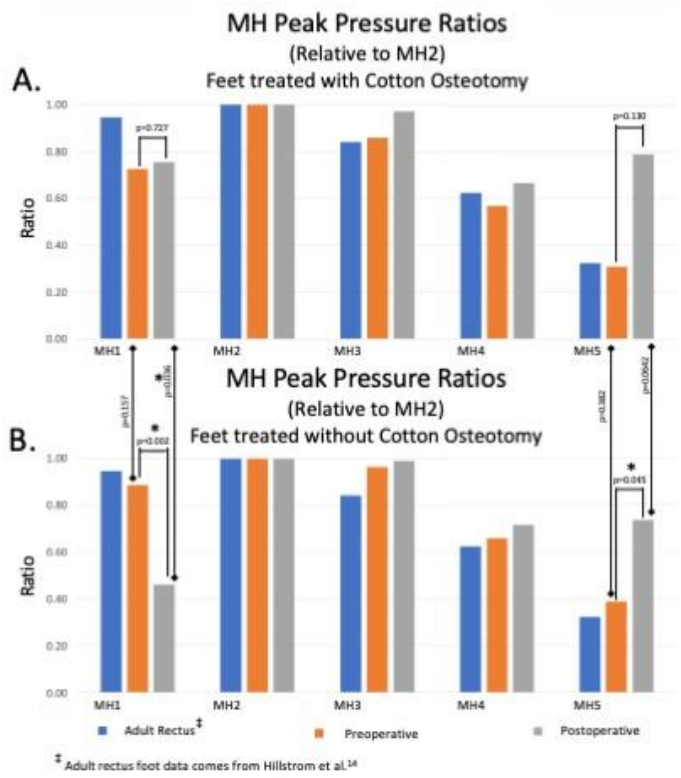


Table 2. Structural Measures

		Mean Mean ± SD (Median*)		
		Preoperative	**Postoperative**	**p-value****
Radiographic Variables (n=25)				
	AP Talus-1st Metatarsal Angle (degrees)	17.6 ± 8.7	7.6 ± 7.8	<0.001
	Talonavicular Uncoverage (%)	33.1 ± 10.1 (35.8)	21.0 ± 9.1	<0.001
	Incongruency Angle (degrees)	43.9 ± 31.9	4.7 ± 29.0 (1.2)	<0.001
	Lateral Talus-1st Metatarsal Angle (degrees)	20.6 ± 8.3	10.9 ± 7.5 (10.3)	<0.001
	Calcaneal Pitch (degrees)	12.0 ± 5.2	16.3 ± 3.8	<0.001
	MC-5MH (mm)	9.1 ± 9.6	12.4 ± 7.5	<0.001‡

		(7.7)		
	HMA (mm)	13.5 ± 6.2	4.9 ± 4.6 (3.5)	<0.001
Arch Height Measures (n=21)				
	Sitting AHI (%)	31.1 ± 2.7	32.9 ± 3.1	0.009
	Standing AHI (%)	27.9 ± 2.0	30.1 ± 2.7	<0.001

Paired t-tests were used to assess for differences from pre- to postoperative
* Median was reported along with mean when the Shapiro-Wilk test for normality indicated non-parametric data sets.
‡ Wilcoxon Signed-Rank Test was used (rather than t-test) where the Shapiro-Wilk test indicated non-normally distributed differences between pre- and postoperative values.
SD: Standard deviation
HMA: Hindfoot moment arm
MC-5MH: Medial cuneiform-5th metatarsal height

ePoster 4. Understanding Clubfoot Recurrence: Insights from a Social Determinants Perspective

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Introduction: Clubfoot recurrence after the Ponseti method occurs in up to 40% of patients. Studied risk factors for recurrence include adherence to abduction braces, severity of initial deformity, and age of treatment initiation. Although it is widely recognized that social determinants of health can influence patient outcomes, the available research on clubfoot recurrence has not thoroughly investigated their effects. Barriers to timely diagnosis, access to specialized clinics, and adherence to post-treatment care may all play a role in recurrence. It is important to understand how parental education, financial constraints, and work-related commitments may impact a family's ability to follow through with the recommended treatment plan for a child. The current study investigates the social determinants of health contributing to clubfoot recurrence.
Methods: This is a retrospective study of children treated for clubfoot between 2018 and 2022. The inclusion criteria were the diagnosis of idiopathic clubfoot, treated by the Ponseti method, and followed up for at least twelve months. A comprehensive medical record search collected recurrence status, adherence to abduction braces, and demographic information. Recurrence was defined as repeat casting, with or without a procedure, despite prescribed brace use. Additionally, a Social Deprivation Index (SDI) was assigned to each patient's zip code. The SDI is a composite score (0-100) of area-level deprivation based on seven demographic characteristics obtained from the American Community Survey, with a positive relationship between the SDI score and the severity of deprivation.
Results: We identified 74 patients who met our inclusion criteria. Forty-three patients (58%) had an SDI>75. Twenty-five patients (34%) experienced a recurrence. Of these, thirteen (52%) had an SDI>75. The proportion of patients who experiences a recurrence with an SDI>75 did not differ from that of the general population of patients (p=0.596). Among the 16 patients who were not adherent to the bracing protocol, 9 (56%) had an SDI>75.
Conclusion: In our cohort, patients from disadvantaged populations did not have an increased rate of non-adherence to the bracing protocol, nor was there an increased proportion of patients who developed a recurrence. These results confirm data from a recent study that local factors, such as accessibility of care and close follow up of patients, may decrease the impact of social deprivation on patient outcomes. Further research is needed in local clubfoot clinics to assess the impact, or lack thereof, of social determinants on health outcomes in patients treated by the Ponseti Method for clubfoot.

Hand & Upper Extremity

ePoster 5. Cubital Tunnel Syndrome in Children and Adolescents: Clinical Presentation and Surgical Outcomes

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Background: Cubital tunnel syndrome (CuTS) is uncommon in children with limited literature on presentation and treatment and mixed outcomes across etiologies. Given this, we sought to describe the clinical presentation of CuTS in a pediatric cohort. We hypothesized the children would return to baseline functionality and remain symptom-free over the duration of follow up.
Methods: A retrospective review was conducted of all patients treated operatively for CuTS at a single institution from 2012-2023, identified by CPT code 64718. We collected demographics, injury characteristics, management, technique, complications, and outcomes. Descriptive statistics were performed in IMB SPSS v29.
Results: 56 patients (27 (48%) males) with 62 involved elbows underwent 64 operations for CuTS at a mean age of 15.7 ± 3.1 years. History of elbow trauma (29/64), including fracture (17/64), and sports overuse (24/64) were the most common etiologies. 17 of the 24 athletes participated in a throwing sport (11 baseball, 5 softball, 1 lacrosse). 4 cases involved snapping triceps. 8 cases (13%) were idiopathic. Common presenting symptoms included pain (78%) and numbness/paresthesias (65%). 16 (25%) cases presented with weakness and 7 (11%) with clawing. The most common positive exam maneuver was Tinel's sign (39/50, 78%) followed by Froment's sign (11) and Wartenberg's sign (5). 18 (28%) patients presented without exam findings. Electromyelography and nerve conduction studies were normal in 14/33 (42%) cases. Demographics, preoperative exam, electrodiagnostic and injury characteristics are further detailed in Tables 1-3. There were 22 (34%) isolated in-situ decompressions, 35 (55%) subcutaneous transpositions, and 7 (11%) submuscular transpositions. 4 patients had an accessory anconeus epitrochlearis that required division. 3 cases involved centralization or resection of a "snapping" medial triceps. Both patients with cubitus valgus underwent supracondylar osteotomies. Of 9 medial epicondyle fracture cases, 7 involved fractures treated operatively; the remaining 2 cases were neurolysis and revision in one child whose fracture was treated nonoperatively with development of a flexion contracture. 58 (90%) cases resulted in full resolution of symptoms. Of the 6 remaining, only 1 had weakness preoperatively. There were no surgical complications by Modified Clavien-Dindo System (M-CDS). Treatment mechanisms, complications and recovery course are further detailed in Table 4.
Conclusions: This series serves to bolster limited literature regarding etiology, presentation, and outcomes of CuTS in pediatric patients. CuTS appears primarily pathology-driven here, deviating from the idiopathic presentation commonly described in adults. Some patients may present with negative exam and electrodiagnostic findings, so suspicion should be exercised in children with history of fracture or athletic overuse. Future work should garner utility of primary neurolysis with medial epicondyle fixation. While the overwhelming majority return to baseline with standard surgical treatment, surgeons should be mindful that further correction may be necessary for those presenting with cubitus valgus or snapping triceps.

Table 1: Patient demographics

Variable	M ± SD or N (%)
Patient demographics (N = 56)	
Age at surgery	15.7 ± 3.1
BMI	21.8 ± 6.1
Sex	
Male	27 (48)
Female	29 (52)
Race	
White	48 (86)
Black	2 (4)
Asian	3 (5)
Other	3 (5)
Ethnicity	
Non-hispanic	47 (98)
Hispanic	1 (2)
Hand dominance	
Right	32 (80)
Left	7 (18)
Ambidextrous	1 (2)

Table 2: Patient presentation and injury characteristics

Variable	M ± SD or N (%)
Patient presentation and injury characteristics (N = 64)	
Operative side	
Right	32 (51)
Left	30 (48)
Both	1 (1)
Etiology	
Trauma	29 (45)
Prior fracture	17 (27)
Medial epicondyle (1 cubitus valgus)	9 (14)
Supracondylar	3 (5)
Radial head	1 (2)
Radial neck (1 cubitus valgus)	1 (2)
Humeral shaft	1 (2)
Proximal humerus	1 (2)
Radial and ulnar shaft	1 (2)
Hyperextension	4 (6)
Laceration	2 (3)
UCL injury	3 (5)
Time from trauma to presentation (months)	31.8 ± 33.3
Athletic overuse	24 (38)
Throwing sport	17 (27)
Non-throwing sport	7 (11)
Snapping triceps syndrome	4 (6)
Revision	5 (8)
After isolated neurolysis (our institution)	2 (3)
After isolated neurolysis (other institution)	1 (2)
After neurolysis with acute fracture	2 (3)
Idiopathic	8 (13)
Congenital radial head subluxation	2 (3)
Paraplegic	1 (2)
Syndromic	5 (8)
Juvenile rheumatoid arthritis	1 (2)
Osteochondritis dissecans	1 (2)
Symptoms	
Pain	50 (78)
Numbness/tingling	42 (65)
Weakness	16 (25)
Clawing	7 (11)
Ulnar nerve subluxation	10 (16)
Symptom duration (months)	15.0 ± 18.4

Table 3: Patient exam and electrodiagnostics

Variable	M ± SD or N (%)
Patient exam and electrodiagnostics (N = 64)	
Elbow range of motion (ROM)	
Full	34 (74)
Deficit	12 (26)
Flexion (degrees)	129.2 ± 21.2
Extension (degrees)	-27.3 ± 22.2
Medical research council (MRC) strength testing	
Full (5/5)	33 (80)
Deficit (<5/5)	8 (20)
Lowest recorded MRC score	3.5 ± 1.0
Froment's sign	
Present	11 (34)
Absent	21 (66)
Wartenberg's sign	
Present	5 (16)
Absent	26 (84)
Tinel sign	
Present	39 (78)
Absent	11 (22)
Elbow flexion compression test	
Positive	12 (60)
Negative	8 (40)
Electromyelography and nerve conduction studies	
Normal	14 (42)
Abnormal	19 (58)

Table 4: Treatment, complications, and recovery course

Variable	N (%)	Duration (weeks)
Treatment, complications, and recovery course (N=64)		
Pre-operative treatment		
Physical/occupational therapy	29 (44)	28.9 ± 42.8
Extension splint	12 (19)	23.0 ± 50.1
Brace	5 (8)	9.3 ± 5.8
Operative treatment		
In-situ decompression only	22 (34)	N/A
+Subcutaneous transposition	35 (55)	N/A
+Submuscular transposition	7 (11)	N/A
M-CDS post-operative complications		
None	64 (100)	N/A
Post-operative treatment		
Physical/occupational therapy	19 (28)	11.2 ± 4.1
Casting	10 (16)	2.8 ± 1.9
Splint	29 (45)	2.3 ± 0.9
Sling	7 (11)	4.0 ± 2.6
Brace	5 (8)	12.0 ± 7.2
Recovery course		
Full elbow ROM	49 (77)	8.8 ± 8.6
Clearance for sports	55 (86)	13.8 ± 9.9
Final symptomatic resolution	58 (90)	17.0 ± 16.0

ePoster 6. Does Fixation Type Affect Symptomatic Implant Removal Rates in Operatively Treated Pediatric Medial Epicondyle Fractures?

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Background/Introduction: Medial epicondyle fractures are a common pediatric injury, comprising between 12-20% of all elbow fractures. The ideal fixation construct for operative management remains unknown, however cannulated partially threaded screws, with or without a washer, are a common choice. When symptomatic, these implants may need to be removed after full healing. There is mixed evidence regarding the influence of a washer on rates of implant removal, and the influence of screw size has not been studied. We aim to determine the rate of symptomatic deep implant removal for each fixation type and identify factors associated with need for removal.
Methods: This was an IRB reviewed, retrospective, case-cohort study. Patients treated at our institution between January 1, 2004 and December 31, 2019, age 18 years old or less, with a medial epicondyle fracture managed operatively with 4.0 or 4.5 mm cannulated screws with or without washers were included. Patients with multiple operative ipsilateral elbow fractures and those who underwent implant removal for reasons other than pain or irritation (e.g. elective, implant failure, nonunion) were excluded. Records were reviewed for patient demographics, removal of symptomatic deep implants, and complications. Removal rates were compared between screw sizes (4.0 vs 4.5 mm) as well as with and without a washer. Sub analysis was performed for each individual screw size used with or without washers.
Results:147 patients were included. Comparing patients who did not undergo implant removal to those that did, patients undergoing implant removal were significantly older (12.4 vs 11.5 yrs, p=0.39). There was no difference between patients undergoing implant removal and those who did not in terms of laterality, body mass index, associated elbow dislocation, or referral to physical therapy, or follow up time. Comparing 4.0 to 4.5 mm screws used both with and without a washer, there was a significant difference in removal rates (31% vs 50%, p=0.029). There was also a significant difference in implant removal rates comparing constructs without and with a washer (29% vs. 50%, p=0.014). Within 4.0 mm screws, the use of a washer was associated with a significantly higher rate of deep implant removal (18% without vs 48% with washer, p=0.001). Within 4.5 mm screws, a washer did not influence rates of removal of deep implants.
Conclusion: Implant removal rates are influenced by screw size and use of a washer. These results may help guide implant choice and counsel families regarding the rate of symptomatic implant removal.

ePoster 7. Does time to surgery impact nerve recovery in supracondylar humerus fractures with nerve injury?

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Background: Supracondylar humerus (SCH) fractures are common and present with associated nerve injuries in 6-16% of cases. Historically, SCH fractures with nerve injuries have warranted urgent surgical treatment.
Introduction: Recent studies have shown no evidence that urgent treatment is needed in patients with anterior interosseous nerve (AIN) palsy nor in patients with a pulseless hand and median nerve palsy. Though indications for urgent treatment are loosening, no studies have evaluated the need for urgent surgical treatment in SCH fractures with any form of isolated nerve injury.
Methods: A retrospective review of 103 patients with surgically managed SCH fractures and concomitant neurologic deficit on presentation was conducted at a single level 1 pediatric trauma hospital from 1997 to 2022. Information on presenting neurologic injury, time from injury to surgery, surgical intervention, and neurologic outcome was recorded. Exclusion criteria included concomitant vascular injury, ipsilateral forearm/wrist fracture, inadequate documentation, open fracture, unknown time of initial injury, pre-existing neurologic deficit, and compartment syndrome.
Results: Sixty-seven patients with an average age of 7 ± 2 years and average time to surgery of 10 ± 6 hours were included. Fractures were Gartland Type II (n =3 [4%]), Type III (n = 57 [85%]), Type IV (n = 3 [4%]), and flexion-type (n = 4 [6%]). Sixty-five patients (97%) were followed to partial neurologic recovery and 39 (58%) were followed to neurologic plateau with 28 (42%) lost to follow-up. Neurologic deficit included median (n = 41 [61%]), radial (n = 24 [36%]), and ulnar (n = 17 [25%]) nerves. Ten patients (15%) had isolated AIN injury. Average time to partial neurologic recovery was 21 ± 24 days and time to full recovery was 100 ± 92 days. There was a statistically significant relationship between time to partial neurologic recovery and time to surgical intervention (p = 0.004), but no relationship between time to full neurologic recovery and time to surgery (p = 0.3). Of patients not lost to follow-up, there were no permanent neurologic deficits.

Conclusion and Significance: Shorter time to fixation of pediatric SCH fractures with isolated nerve injury was associated with slightly earlier partial recovery but not full neurologic recovery. Prioritizing urgent surgery in these patients does not improve their ultimate neurologic recovery.

ePoster 8. Intraoperative Cardiothoracic Intervention Rates During Open Surgery Following Traumatic Posterior Sternoclavicular Joint Injury: A Case Series and Systematic Review

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Background: Posterior sternoclavicular joint injuries are rare, but potentially lethal injuries. Signs of mediastinal compression range from non-specific to neurovascular compromise. Thus, it is crucial to promptly diagnose and treat these injuries to prevent potentially deadly complications.
Introduction: Currently, the orthopaedic community recommends a cardiothoracic surgeon be placed on standby during open surgery for posterior sternoclavicular joint injuries. However, there are no studies reporting how often cardiothoracic intervention is required.
Methods: First, we identified patients by CPT codes 23530 23525, and 23532 from 1/1/2002 to 5/1/2023. Demographic variables and intraoperative cardiothoracic intervention were collected. Second, we systematically reviewed the literature to identify articles on posterior sternoclavicular injury using the PubMed, Embase, and CINAHL databases. Exclusion criteria included conservative treatment, closed reduction, chronic injury (>6 weeks), reviews, and non-available text.
Results: 13 local patients underwent open surgery for a posterior sternoclavicular joint injury, 11 males and 2 females with an average age of 18.2 years (range: 15-32.4). The most common mechanism of injury was motor vehicle accident (n=3). Four (30.5%) patients had either physical or radiographic evidence of mediastinal compression. Six (46.2%) patients had unsuccessful closed reduction attempts. No patients required cardiothoracic intervention. The literature search resulted in 128 articles, yielding 499 open posterior sternoclavicular joint surgeries, 3 of which required intraoperative cardiothoracic intervention [Overall: 3/512 (0.6%)].

> Case 1: 20-year-old hit as a pedestrian. CT showed posterior sternoclavicular dislocation abutting the brachiocephalic vein causing massive bleeding and requiring emergency sternotomy.
> Case 2: 14-year-old tackled in rugby presented with decreased ulnar sensation and radial pulses secondary to a medial clavicular fracture with subclavian artery transection, brachiocephalic artery dissection, carotid artery aneurysm, and compressed trachea. Emergency sternotomy and vascular repair were performed before temporary K-wire fixation of the sternoclavicular joint.
> Case 3: 67-year-old presented with posterior sternoclavicular joint dislocation after a trailer rolled onto him. CT showed active extravasation from a lacerated superior vena cava before he was taken for emergency sternotomy and open fixation of his sternoclavicular joint.

Conclusion: Although expert opinion commonly recommends cardiothoracic surgical backup, the need for intraoperative cardiothoracic surgical intervention has not been well studied. We found an overall rate of intraoperative cardiothoracic intervention of 0.6% and found no reported cases without the presence of poly-trauma and/or, clinical or radiographic findings of neurovascular compromise.
Significance: Based on our local data and systematic literature review, a patient requiring surgery for an isolated sternoclavicular joint injury with no clinical or radiographic findings of neurovascular compromise does not appear to require a cardiothoracic surgeon on standby. Ultimately, the decision to involve cardiothoracic backup for open reduction of acute posterior sternoclavicular injuries should be made on a case-by-case basis, after careful physical and radiographic evaluation of the patient.

ePoster 9. The Relationship between Obesity and Lateral Condyle Fracture Healing

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Background: The prevalence of childhood obesity has been on a continuous rise over the past half century. Studies have shown that obesity is linked to both medical and surgical complications. Pediatric lateral condyle fractures are the second most common elbow fracture treated by the orthopedic surgeon. These fracture patterns are known to have a higher

chance of nonunion/malunion than other fractures of the elbow. However, there have been no studies that question whether obesity increases the risk of complications following fixation of these fractures.
Purpose: To determine if obesity is correlated with an increased risk of surgical complications in pediatric patients that undergo fixation of lateral condyle fractures.
Methods: A retrospective chart review was conducted of 123 patients meeting the inclusion criteria of being less than 18 years old, sustaining a lateral condyle fracture, and having documentation of height and weight at time of injury. BMI-for-age of each patient was calculated and surgical complications that included pin site infection, time to union, malunion, delayed/nonunion, and length of surgery were recorded.
Results and Conclusion: The results showed no correlation of BMI-for-age and the surgical complications in question (pin site infections ($p = 0.627$), time to union ($p = 0.293$), malunion ($p = 0.125$), delayed/nonunion ($p = 0.811$), length of surgery ($p = 0.557$)). We concluded that these results were likely due to the higher prevalence of obesity in the population in the local area. The treating orthopedic surgeon is more familiar with how to address a patient with a higher BMI and is understanding of the proper surgical technique in order to maximize surgical outcomes.

ePoster 10. Who Should See My Kids? Clavicle Fracture Management Across Orthopaedic Subspecialties

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Background: Pediatric clavicle fractures are commonly addressed injuries with rare occurrences of nonunion or other complications. Despite consistent outcomes, there is no universally recommended treatment algorithm. This study aims to assess trends in management of pediatric clavicle fractures within a single multi-specialty orthopaedic surgery practice.
Methods: A retrospective review was of patients aged ≤ 18 years with acute diaphyseal clavicle fractures between January 2018 and July 2023. Exclusion criteria included insufficient radiographs, documentation, or follow-up to ensure clinical union was achieved.
Results: A total of 560 pediatric clavicle fractures were identified, of which 390 met the inclusion criteria. The multi-specialty orthopaedic practice comprised 37 physicians, including 2 pediatric, 8 sports, 7 general, and 11 nonoperative sports medicine physicians. Pediatric orthopedists treated younger patients (average age 8.6 years compared to 10.6 years in other specialties, $p<0.001$). Overall surgery rate was 7.4%. Pediatric orthopaedic operative rates significantly differed from sports medicine (5.8% vs. 15.7%, OR=3.01, $p=0.01$). However, when age (10-18 years) was controlled for, differences in operative rates were no longer significant. Pediatric providers trialed nonoperative management for a great number of days than other specialties (37.5 days vs. 7.1 days, $p=0.005$). Average follow-up for nonoperatively managed clavicle fractures (n=361) was 54.6 days, with an average patient age of 9.9 years. Among nonoperative patients, those seen by pediatric orthopedists had fewer office visits (2.4 vs. 2.9 visits, $p<0.001$) and fewer X-ray views (4.7 vs. 6.0, $p<0.001$). When age was controlled for (10-18 years), office visits and treatment duration were equivalent. On average, >3 cortices were bridged on 2-view radiographs by the third visit (45.6 days) and no clinically relevant radiographic changes occurred after. Average follow up encompassing ortho then in-network well child check with no complaints about clavicle was 619.5 days.
Conclusion: Pediatric orthopaedic surgeons demonstrated clinical efficiency in treating younger pediatric patients, while differences in treatment efficiency are less apparent in the adolescent age range. Pediatric orthopedists are more likely to trial nonoperative management before surgery compared to other orthopaedic specialties.

Hip

ePoster 11. An Investigation into the Public's Most Frequently Asked Questions About Developmental Dysplasia of the Hip and Evaluating Online Information About Management and Treatment

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Background: Online information about pediatric medical conditions helps families learn about management and discover treatment options. Unfortunately, pediatric orthopaedic online information has been shown in previous studies to be poor quality or hard to read.

Introduction: Prior studies have not assessed what families are searching for online regarding pediatric orthopaedic conditions, representing a gap in the knowledge of what concerns families most. This study aimed to evaluate the quality, transparency, and readability of online information for developmental dysplasia of the hip (DDH).
Methods: We found the most frequently asked questions (FAQs) searched for and their associated links using common search terms for DDH. After removing duplicate FAQs, the exclusion criteria included:, websites with restricted access, websites with audiovisual material, PDFs, and FAQs pertaining to hip dysplasia in animals. First, FAQs were classified using Rothwell's Classification of Questions (Table 1). Second, the Journal of the American Medical Association's (JAMAs) Benchmark Criteria were used to assess the transparency of each source through authorship, attribution, currency, and disclosures. Third, the Brief DISCERN quality assessment tool was used to score the quality of the source information (Table 2). Finally, the readability via the Flesch-Kincaid Grade Level Score (FKGLS) of each source was evaluated using Word's readability statistics feature. All data extraction was conducted in a masked, duplicate fashion by two authors, with a third author available for discrepancies.
Results: Our search yielded 41 FAQs, 20 (47.6%) were fact-based questions, specifically about Technical Details (9/20, 45%) and Timeline (6/20, 30%). Fourteen, (33.3%) were policy-based questions, and the most common topic overall was Indications/Management (11/14, 78.6%). The most common answer source type was academic (22/41, 53.7%). Only 13/41 (31.7%) sources met 3 or more JAMA benchmark criteria, with most coming from academic sources 9/13 (69.2%). The overall average Brief DISCERN scores did not statistically differ among source types (p=0.18), the FKGLS score did not differ between sources (p=0.27), and there was no significant association with a source meeting JAMA benchmark criteria for authorship (p=0.09), disclosure (p=0.27), currency (p=0.13) and attribution(p=0.78) and source. The FAQs with each Rothwell Classification, source type, JAMA Benchmark Criteria, and Brief DISCERN Score are in Table 3. Figure 1 displays topic by source.
Conclusions: The most FAQs families are search for online are related to technical details, timeline, and indications/management for treatment of DDH. Most internet sources did not meet the transparency criteria, were of variable quality, and did not meet the standard for readability.
Significance: While physicians should be the main source of information, supplying patients with reliable, pre-approved internet sources such as OrthoInfo and OrthoKids could improve caregivers' understanding of DDH and content quality. Furthermore, online patient materials need to effectively communicate and answer basic, common questions without losing meaning.

Figure 1. Topic by Source

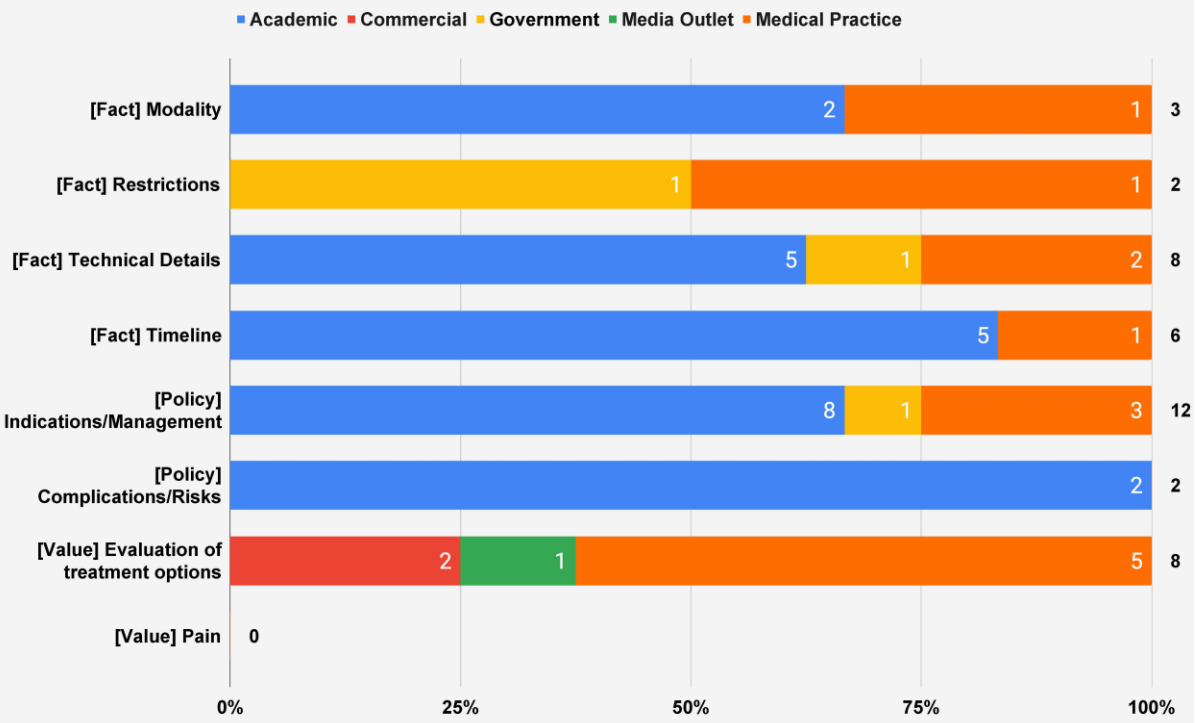

Table 1. Rothwell's Classification of Questions, Question Classification by Topic, and Answer Source Type.	
Rothwell Classification	**Description**
Fact	Asks objective, factual information regarding treatment options for developmental dysplasia of the hip (i.e. How long does it take to walk after hip dysplasia surgery?)
Policy	Asks information on a specific course of action under given circumstances related to the treatment of developmental dysplasia of the hip (i.e. Can hip dysplasia be fixed without surgery?)
Value	Asks to conceptually evaluate treatments of developmental dysplasia of the hip (i.e. What is the best exercise for hip dysplasia?)
Question subclassification by topic	**Description**
Fact	
Modality	Questions regarding a treatment option for developmental dysplasia of the hip (ie. What is the brace for hip dysplasia?)
Restrictions	Questions pertaining to any restrictions patients may have in terms of working or social activities after treatment for developmental dysplasia of the hip (i.e. How long do you have to wear a brace for hip dysplasia?)
Technical Details	Any question which asks how a specific treatment is performed (i.e. How do they fix hip dysplasia?)
Timeline of Recovery	Questions regarding the timeline of recovery (i.e. How long is recovery time for hip dysplasia surgery?)
Policy	
Indications/Management	Seeking information regarding appropriate age to seek treatment or options for treatment based on comorbidities (i.e Can kids grow out of hip dysplasia?)
Complications/Risks	Questions regarding any potential post-treatment issues (i.e What happens if you don't fix hip dysplasia?)
Value	
Pain	Questions about subjective pain experience with treatment options
Evaluation of treatment options	Any question comparing treatment success rates, longevity, or advantages/unique features of a treatment option (i.e. Will steroids help hip dysplasia?)
Answer Source Type	**Description**
Commercial	Organization that publishes medical information that is not otherwise associated with an academic institution, government agency, healthcare system, or non-medical news outlet: i.e. WebMD, Healthline

Table 2. Brief DISCERN Questions and Scoring			
Question	**Low (1) "No"**	**Moderate (2-4) "Partially"**	**High (5) "Yes"**
Is it clear what sources of information were used to compile the publication (other than the author or producer)?	No sources of evidence for the information are mentioned	The sources are clear to some extent and are referenced in text OR in a bibliography	The sources are very clear and are referenced in text AND in a bibliography
Is it clear when the information used or reported in the publication was produced?	No dates have been given	Only the date of the publication itself is clear, or dates for some of but not all acknowledged sources are given	Dates for all acknowledged sources are clear
Does it describe how each treatment works?	None of the descriptions about treatments include details of how it works	The description of some but not all treatments are given OR the details provided are unclear or incomplete	The description of treatment includes details of hot it works
Does it describe the benefits of each treatment?	No benefits are described	A benefit is described for some but not all treatments	A benefit is described for each treatment
Does it describe the risk of each treatment?	No risks are described for any of the treatments.	A risk is described for some but not all treatments.	A risk is described for each treatment.
Does it describe how the treatment choices affect overall quality of life?	There is no reference to overall quality of life in relation to treatment choices.	The publication includes a reference to overall quality of life in relation to treatment choices, but the information is unclear or incomplete.	The publication includes a clear reference to overall quality of life in relation to any of the treatment choices mentioned.

Table 4. List of 41 unique frequently asked questions regarding developmental dysplasia of the hip

Frequently Asked Question	Rothwell Classification	Subclassification	Answer Source	JAMA Bench Mark Criteria (≥3)	Brief DISCERN Score
At what age is hip dysplasia treated?	Policy	Indications	Academic	Yes	22
Can congenital hip dysplasia be fixed?	Policy	Indications	Academic	No	6
Can developmental hip dysplasia be fixed?	Policy	Indications	Goverment	No	10
Can hip dysplasia be fixed without surgery?	Policy	Indications	Academic	No	13
Can kids grow out of hip dysplasia?	Policy	Indications	Medical Practice	No	19
Can you fix hip dysplasia with exercise?	Fact	Modality	Medical Practice	No	23
Can you fix hip dysplasia without surgery?	Policy	Indications	Academic	No	15
Do all babies with hip dysplasia need a brace?	Policy	Indications	Medical Practice	No	23
Do kids grow out of hip dysplasia?	Policy	Indications	Medical Practice	No	17
Does massage help hip dysplasia?	Value	Evaluation of treatment/surgery	Commercial	No	19
Does mild hip dysplasia need surgery?	Policy	Indications	Academic	No	14
How can I help my 2 year old with hip dysplasia?	Policy	Indications	Academic	No	13
How do babies sleep in a Pavlik harness?	Fact	Restrictions	Goverment	No	18
How do doctors fix hip dysplasia?	Fact	Technical details	Academic	Yes	18
How do they fix hip dysplasia in toddlers?	Fact	Technical details	Academic	Yes	18
How do they fix hip dysplasia?	Fact	Technical details	Academic	Yes	18
How do you fix a misaligned hip?	Fact	Technical details	Medical Practice	No	18
How do you fix congenital hip	Fact	Technical details	Goverment	Yes	19

dysplasia?					
How do you fix hip dysplasia in toddlers?	Fact	Technical details	Academic	Yes	18
How do you treat hip dysplasia in a 3 year old?	Fact	Technical details	Academic	No	13
How do you treat hip dysplasia in a 5 year old?	Fact	Technical details	Medical Practice	No	15
How long do you have to wear a brace for hip dysplasia?	Fact	Restrictions	Medical Practice	No	14
How long does it take a child to recover from hip dysplasia surgery?	Fact	Timeline of recovery	Academic	No	15
How long does it take for a baby to recover from hip dysplasia surgery?	Fact	Timeline of recovery	Academic	No	15
How long does it take to recover from congenital hip dysplasia surgery?	Fact	Timeline of recovery	Academic	Yes	21
How long does it take to walk after hip dysplasia surgery?	Fact	Timeline of recovery	Academic	No	19
How long is recovery from hip realignment surgery?	Fact	Timeline of recovery	Medical Practice	No	16
How long is recovery time for hip dysplasia surgery?	Fact	Timeline of recovery	Academic	No	19
Is hip dysplasia a major surgery?	Policy	Complications/Risks	Academic	Yes	19
What age is hip dysplasia treated?	Policy	Indications	Academic	Yes	24
What exercises are good for hip dysplasia?	Value	Evaluation of treatment/surgery	Medical Practice	No	23
What happens if you don't fix hip dysplasia?	Policy	Complications/Risks	Academic	No	16
What is the best exercise for hip dysplasia?	Value	Evaluation of treatment/surgery	Medical Practice	No	23
What is the best sitting position for hip dysplasia?	Value	Evaluation of treatment/surgery	Media Outlet	Yes	25
What is the best sleeping position for hip dysplasia?	Value	Evaluation of treatment/surgery	Commercial	Yes	23
What is the brace for hip dysplasia?	Fact	Modality	Academic	No	20
What is the success rate of hip dysplasia surgery?	Value	Evaluation of treatment/surgery	Medical Practice	Yes	19
What is the treatment for hip dysplasia in babies?	Fact	Modality	Academic	Yes	18
When is hip dysplasia surgery needed?	Policy	Indications	Academic	No	22
Will a hip brace help hip dysplasia?	Value	Evaluation of treatment/surgery	Medical Practice	No	14
Will steroids help hip dysplasia?	Value	Evaluation of treatment/surgery	Medical Practice	No	19

ePoster 12. Colder Weather and Likelihood of Surgical Intervention for Developmental Dysplasia of the Hip within the First 5-Years of Life: A National Database Analysis

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Background: Cold weather in the first few months of life has been suggested as a risk factor for late diagnosis of developmental dysplasia of the hip (DDH) and has been linked with improper swaddling techniques.
Introduction: DDH that is diagnosed early can often be treated non-surgically. However, an infant over 6 months of age requires surgical treatment to adequately correct dysplasia. The purpose of this study is to observe whether rates of surgical intervention in the United States for DDH differ based on states with varying average outdoor temperatures in winter months.
Methods: A retrospective observational study of DDH patients diagnosed from January 2010 to October 2021 in the United States (U.S.) was conducted using a national administrative database. All 50 US States were categorized into five geographic regions based on average temperatures in the coldest quarter of the year: January through March. Rates of DDH-related surgeries were compared across temperature regions with respect to the warmest temperature region. To control for confounders, a multivariable logistic regression was conducted to assess the likelihood of DDH-related surgeries for the varying temperature regions with respect to the warmest temperature region.
Results: In total, 55,911 patients ≤ 5 years old with a DDH diagnosis from 2010-2021 were identified in the database. When compared to the warmest region (Group 5), the coldest region (Group 1) had higher rates of open reduction (4.59% vs. 2.06%, p<0.001), adductor tenotomy (6.95% vs. 2.91%, p<0.001), femoral osteotomy (5.75% vs. 2.04%, p<0.001), pelvic osteotomy (5.27% vs. 2.04%, p<0.001), and total DDH surgeries (11.42% vs. 5.03%, p<0.001). Multivariable logistic regression demonstrated higher odds of all DDH surgeries in all regions (Groups 1-4) compared to Group 5 (all p<0.001).
Conclusion: Children living in states with an average temperature less than -6.17 degrees Celsius have an increased likelihood of requiring surgical intervention for DDH within the first 5 years of life. This may be attributed to swaddling frequency in winter months and improper technique in these regions.
Significance: Pediatricians, especially in these cold states, should be aware of the increased likelihood of surgical management and should consider the utilization of ultrasound for early diagnosis as well as parent counseling on proper swaddling techniques.

Table 1.

Regional Group	**States Included**	**Avg Jan-March temp 2010-2021 (°C)**
Group 1 *(coldest)*	Alaska, North Dakota, Minnesota, Maine, Wisconsin, Vermont, South Dakota, New Hampshire, Michigan, and Montana	**-6.17**

Group 2 *(second coldest)*	Wyoming, New York, Iowa, Idaho, Nebraska, Massachusetts, Colorado, Pennsylvania, Connecticut, Illinois	**-1.37**
Group 3 *(intermediate)*	Ohio, Rhode Island, Indiana, Utah, Washington, New Jersey, West Virginia, Oregon, Kansas, Missouri	**1.70**
Group 4 *(second warmest)*	Nevada, Maryland, Delaware, Kentucky, Virginia, New Mexico, Tennessee, Oklahoma, North Carolina, Arkansas	**5.12**
Group 5 *(warmest)*	Arizona, California, South Carolina, Alabama, Mississippi, Georgia, Texas, Louisiana, Florida, and Hawaii	**12.37**

Table 2. Characteristics of developmental dysplasia of the hip (DDH) patients aged 0-5

	DDH Patients		**Surgical Intervention Age 0-5**		**P-value**
	n	*% of Total*	*n*	*% of Total*	
Total	55,911	100	2,778	100	
Biological Sex					
Male	17,523	31.34	831	29.91	0.114
Female	38,388	68.66	1,947	70.09	

Risk Factor					
Breech Birth	3,294	5.89	54	1.94	<**0.001**
Low Birthweight	1,189	2.13	131	4.72	<**0.001**
Oligohydramnios	145	0.26	14	0.50	**0.016**
Medicaid Insurance	13,643	24.40	673	24.23	0.834
			Mean	*SD*	
Age at Surgery[·]			2.30	1.59	

SD, standard deviation

[·]DDH patients included for analysis at ages 0 to 5, mean age not available as the period of observation is over a window of time greater than one year

Table 3. Rate of surgical intervention for DDH in children aged 0 to 5 years old according to temperature rank, compared to the 10 warmest states.

Percent of DDH patients ages 0-5 treated surgically	**Group 1 (Coldest)**	**Group 2**	**Group 3**	**Group 4**	**Group 5 (Warmest)**
Any Surgery	11.42%	4.56%	5.88%	5.33%	5.03%
Risk Ratio	2.27	0.91	1.17	1.06	1
p-value[·]	**<0.001**	**0.046**	**0.002**	0.37	
Open Reduction	4.59%	1.92%	2.50%	2.50%	2.06%
Risk Ratio	2.23	0.94	1.21	1.22	1
p-value	**<0.001**	0.416	**0.017**	**0.036**	
Adductor Tenotomy	6.95%	2.52%	3.61%	2.94%	2.91%
Risk Ratio	2.39	0.87	1.24	1.01	1
p-value	**<0.001**	**0.034**	**0.001**	0.946	
Femoral Osteotomy	5.75%	1.85%	2.52%	2.23%	2.04%
Risk Ratio	2.82	0.91	1.23	1.1	1
p-value	**<0.001**	0.247	**0.010**	0.371	
Pelvic Osteotomy	5.27%	1.87%	2.60%	2.29%	2.04%

Risk Ratio	2.59	0.92	1.27	1.12	1
p-value	**<0.001**	0.303	**0.003**	0.242	

*Pearson's chi-squared test

Table 4. Adjusted odds of surgical interventions for DDH in children ages 0 to 5 years old according to temperature rank, compared to the 10 warmest states.

Surgical intervention in DDH patients ages 0-5	**Odds ratio**	**95% CI**	**P-value***
1st-10th Coldest States			
Any Surgery	3.05	[2.92, 3.19]	**<0.001**
Open Reduction	2.50	[2.37, 2.64]	**<0.001**
Adductor Tenotomy	3.44	[3.26, 3.63]	**<0.001**
Femoral Osteotomy	3.37	[3.15, 3.61]	**<0.001**
Pelvic Osteotomy	2.72	[2.56, 2.90]	**<0.001**
11th-20th Coldest States			**<0.001**
Any Surgery	1.31	[1.26, 1.36]	**<0.001**
Open Reduction	1.31	[1.25, 1.38]	**<0.001**
Adductor Tenotomy	1.21	[1.15, 1.27]	**<0.001**
Femoral Osteotomy	1.47	[1.38, 1.56]	**<0.001**
Pelvic Osteotomy	1.21	[1.14, 1.29]	**<0.001**
21st-30th Coldest States			**<0.001**
Any Surgery	1.54	[1.48, 1.60]	**<0.001**
Open Reduction	1.35	[1.28, 1.42]	**<0.001**
Adductor Tenotomy	1.72	[1.65, 1.82]	**<0.001**
Femoral Osteotomy	1.61	[1.52, 1.72]	**<0.001**
Pelvic Osteotomy	1.51	[1.43, 1.61]	**<0.001**
31st-40th Coldest States			**<0.001**
Any Surgery	1.15	[1.10, 1.20]	**<0.001**
Open Reduction	1.15	[1.09, 1.22]	**<0.001**
Adductor Tenotomy	1.24	[1.16, 1.31]	**<0.001**

Femoral Osteotomy	1.26	[1.17, 1.36]	<**0.001**
Pelvic Osteotomy	1.25	[1.17, 1.34]	<**0.001**

*Multivariable logistic regression

ePoster 13. Effects of Hip Muscle Fatiguability as Assessed by Surface Electromyography

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Introduction: The goals of this work were to identify which of five pre-selected exercises most consistently and effectively elicited muscle fatigue and determine the relationship between muscle fatigue using sEMG sensors and knee wobble using an IMU device.
Methods: Three sEMG sensors were placed on the gluteus medius, gluteus maximus, and rectus femoris muscles as well as a 6-axis IMU placed on the lateral portion of the knee. Participants were the recruited to perform five exercises, a single leg squat, wall sit, side leg raise, hip extension, and knee raise for 90 seconds.
Results: On average there was a decrease in the sEMG mean frequency for all three muscles as well as an increase in area under the resultant acceleration curve for all five activities. There was a statistically significant decrease in the first ten seconds compared to the last ten seconds for all three muscles in the wall sit (p

ePoster 14. Labral Support Shelf acetabuloplasty for late presenting Perthes disease: Outcomes in Indian Patients

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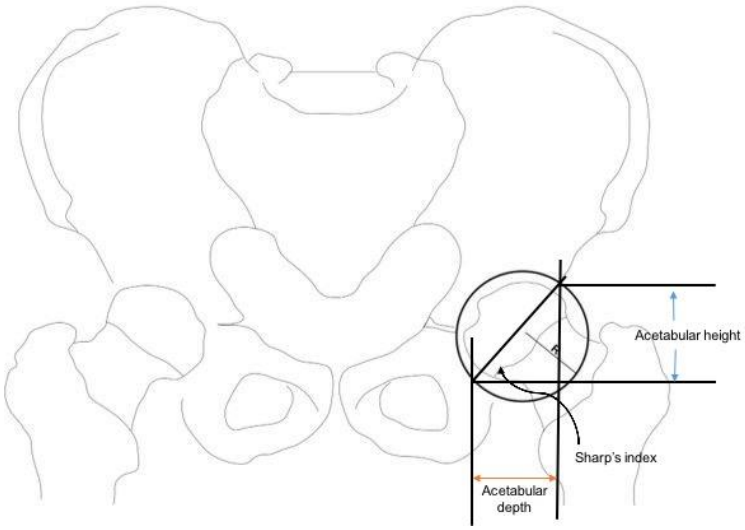
Introduction: The treatment of late-presenting Perthes disease with extrusion is controversial and debatable. One of the options available is the labral shelf acetabuloplasty (LSA).
Purpose: The aim of the study was to evaluate the results of LSA in late-presenting Perthes disease in terms of clinic-radiological outcome measures.
Materials and Methods: A retrospective analysis of prospectively collected data of patients with late presenting Perthes disease (Elizabethtown stage 2B onwards) treated by LSA by 2 experienced paediatric orthopaedic surgeons was performed. Data was collected of clinical parameters like hip range of motion(ROM) and Harris Hip score and radiological parameters like acetabular height, width and volume, shelf width, Centre Edge angle(CEA) and the lateral extrusion.
Results: Thirty-five patients (28 males and 7 females) treated between 2012 to 2019 were analyzed. Majority were in Elizabethtown stage 3A (23) followed by 2B and 3B (12 each). At a mean follow up of 36 months, the hip ROM and the Harris Hip Score (from 65 +/- 3.5 to 81.33 +/- 7.12) improved significantly and there was a statistically significant improvement in terms of all radiological parameters. Majority of the hips were in Stulberg grade 3 (20) followed by grade 1 and 2 (7 each) and Stulberg 4 (1). There were no major complications in any of the patients of the series.
Conclusion: Labral support shelf acetabuloplasty is a valuable surgery for late presenting Perthes disease and helps in maintenance of good coverage and allows restoration of range of motion over time.
Figure - 1A



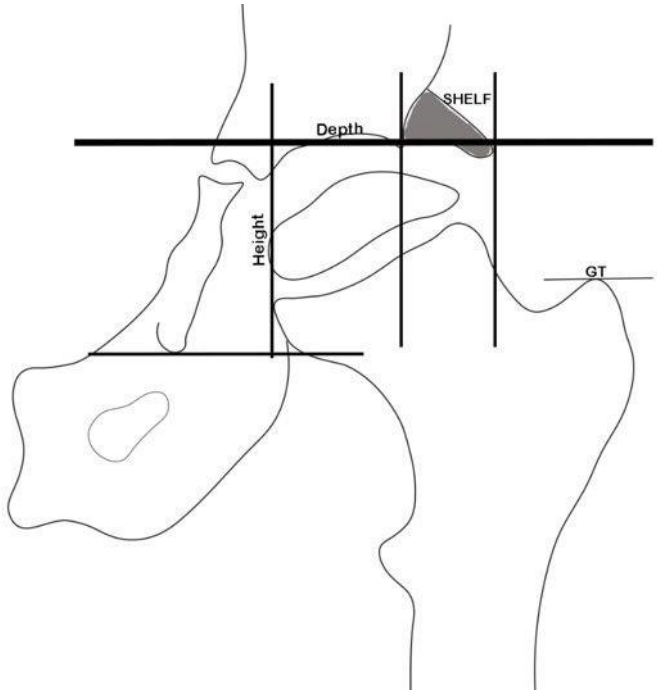
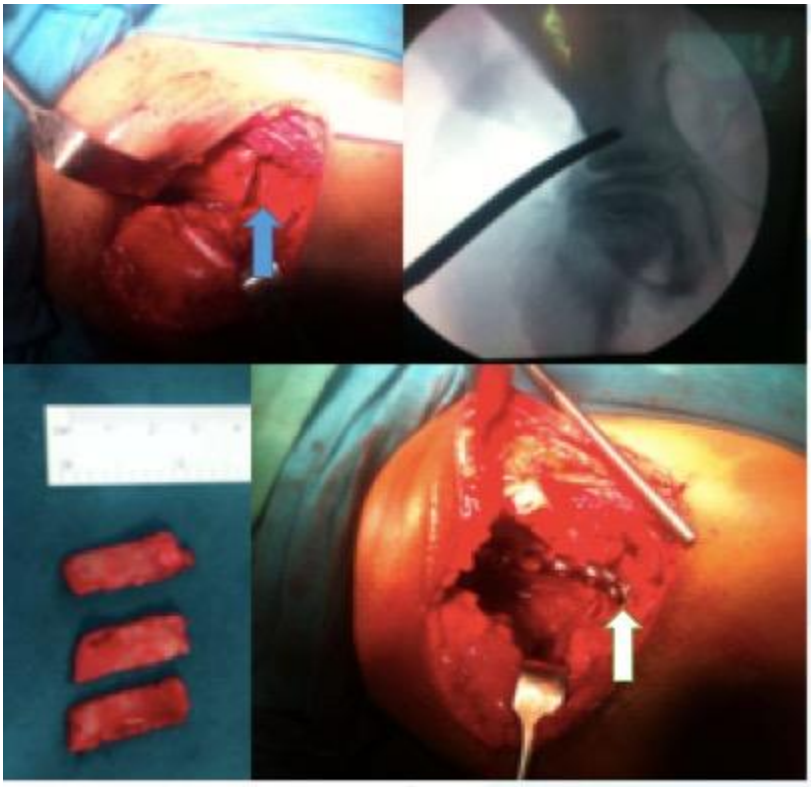


Figure - 1B

Figure - 2



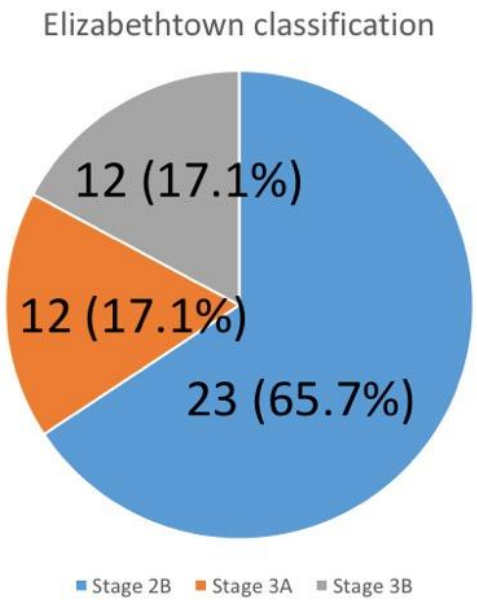
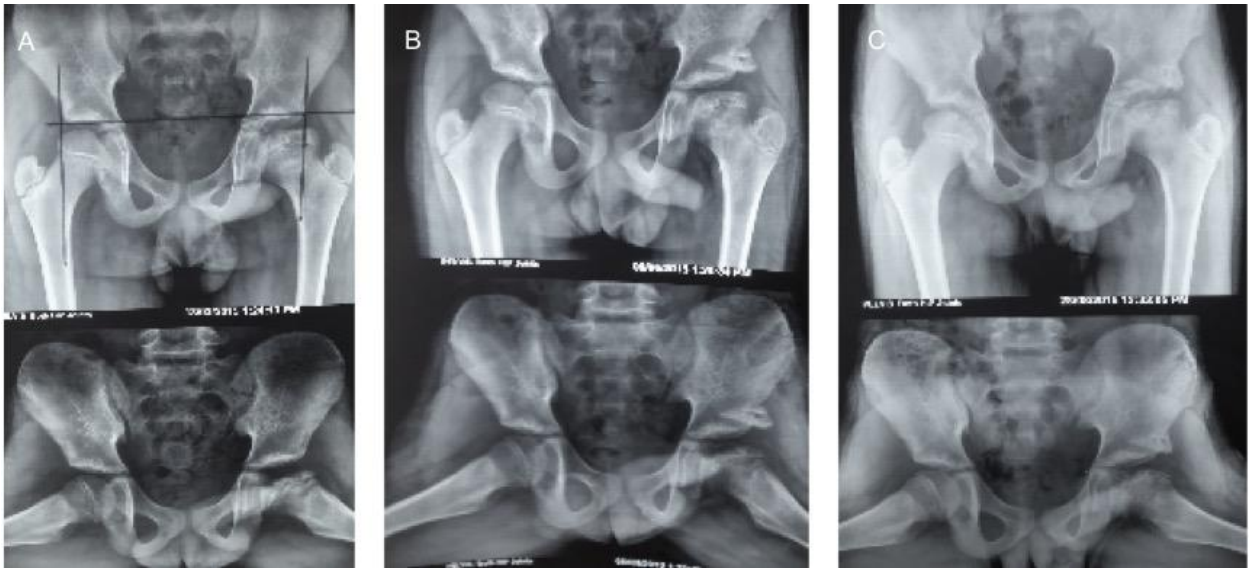


Figure - 3
Figure – 6



ePoster 15. Preliminary Study on the Stabilization of Varus Proximal Femoral Osteotomies using Pediatric LCP Plates in Adults undergoing Combined Correction of Proximal Femoral and Acetabular Dysplasia

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Background: The Bernese periacetabular osteotomy (PAO) was introduced by Ganz and colleagues in 1988 as a surgical acetabular reorientation to improve femoral head coverage for patients with symptomatic acetabular dysplasia. Studies have demonstrated positive outcomes with reduced pain and improved hip function in most patients treated for acetabular dysplasia. A PAO alone may not fully achieve sufficient femoral head coverage in severely deformed hips. Therefore, an adjunctive varus-producing proximal femoral osteotomy (PFO) is indicated to enhance hip congruency, stability, and function and to prevent hip arthrosis.
Introduction: Of the techniques published for stabilizing a varus-producing PFO, the fixed-angle blade plate is the most commonly used implant, with studies showing high union rates in adults. Drawbacks to blade plates include implant prominence, which can lead to discomfort, greater trochanteric bursitis, skin breakdown, and additional surgery for implant removal. The Synthes pediatric LCP (locking compression plate) plate system is an alternative implant designed for use in PFOs. As reported by the manufacturer, it is marketed as having a lower lateral profile than blade plates, which may cause less soft-tissue irritation over the lateral aspect of the proximal femur.
The notion that LCP plates may cause less implant irritation is perpetuated in modern literature; however, this has never been demonstrated conclusively in adult patients. While blade and LCP constructs have been previously compared in pediatric cohorts, surgeons commonly plan for proximal femoral implant removal after the osteotomy has healed regardless of implant choice, given the concern for implant irritation, the difficulty in removing implants in the future due to callus formation, or to facilitate any subsequent femoral surgery. In adult patients, if an implant caused minimal to no discomfort, additional surgery for implant removal could be avoided.
Methods: After institutional review board approval was obtained, the senior surgeon's surgical lists were retrospectively reviewed to identify patients ≥ 18 years old with acetabular dysplasia who underwent combined PAO and PFO with stabilization using a pediatric proximal femoral LCP from 2014 to 2021.
Results: Thirteen hips in 11 patients (all female) with >10 months of follow-up are presented. All patients had improved radiographic parameters, pain, and total Merle d'Aubigné–Postel scores postoperatively. Eleven hips (85%) had the LCP removed an average of 15.8 ± 8.6 months postoperatively, often due to pain over the greater trochanter.
Conclusion: The pediatric proximal femoral LCP is effective for PFO in combined PAO PFO procedures but has a high rate of lateral hip discomfort leading to implant removal.

ePoster 16. Radiological Measure of Femoral Neck Height, Epiphyseal Extrusion, and Greater Trochanter Overgrowth Can Predict Reported Outcomes of Legg-Calve-Perthes Disease in Adulthood

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Introduction: We currently rely on the sphericity and joint congruence of the hip to predict outcomes of Legg-Calvé-Perthes disease (LCPD), but the useful of other radiological parameters that have not been described and that could improve this prediction.
The aim of this study is to analyze the relationship between different radiological parameters of the LCPD and the patient reported outcome measures (PROMs) in order to predict joint function, sports level and quality of life in the adulthood.
Methods: Ambispective observational study of 141 adults (154 hips) who suffered LCPD in childhood. In the last radiograph available in adulthood, we measured: joint sphericity and congruence (Mose and Stulberg classifications), grade of osteoarthritis, leg length discrepancy (LLD), epiphyseal extrusion index (EEI), articulo-throcanteric distance (ATD), acetabular dysplasia (Sharp angle) and neck-shaft angle (NSA).
All the patients complemented Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), modified Harris Hip Score (mHHS), UCLA Activity Level, and 12-Item Short Form Survey (SF-12).
Results: The mean age was 32.4 years (18.8-70.9). 61.7% were men and in 55.2% it was the right hip.
PROMs were better with greater sphericity and joint congruence of the hip (Stulberg I and II) and with a lower degree of osteoarthritis (Tönnis 0 and 1) ($p<0.05$).
The multivariable regression study found that a lower LLD, a lower EEI and a higher ATD were significantly associated with better PROMs ($p<0.05$); In addition, these parameters explained 30% of the variability in joint function, 26.8% in the sporting level, and 21.5% in quality of life (R2 values).
Sharp's angle and NSA did not show a significant association with PROMs ($p>0.05$).
Conclusions and Significance: In addition to hip joint sphericity and congruence, other radiological parameters such as LLD, EEI, and ATD can predict joint function, fitness level, and quality of life in adults who suffered LCPD at childhood. The inclusion of these parameters in the evaluation deformity can improve the prediction of the final result and help in clinical decision making.

ePoster 17. Skeletal Maturity May Not be a Factor in Optimizing Outcome in Total Hip Arthroplasty

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Introduction: Total hip arthroplasty (THA) may rarely be indicated in patients under 21. In these instances, there is concern for implant survival compared to the traditional older population. There has been a steady rise in the use of THA in the pediatric population due to improvements in surgical techniques. While the outcomes in THA for patients 21 and under have been described in the literature, there are no population studies looking at this procedure in a skeletally immature individual. Therefore, the purpose of this study was to compare 10-year implant survivability following primary THA in skeletally mature versus skeletally immature patients.
Methods: Patients who underwent primary THA were identified using a large national (PearlDiver) database. THA patients were then divided into presumed skeletally immature male patients (0-16 years), presumed skeletally mature male patients (17-21 years), presumed skeletally immature females (0-14 years), and presumed skeletally mature females (15-21 years). For all groups, the 10-year cumulative implant survival was described using Kaplan-Meier survival analysis, as defined by the occurrence or lack of revision surgery. Multivariable analysis was conducted using Cox Proportional Hazard modeling to determine differences in the risk of revision for periprosthetic joint infection (PJI), mechanical loosening, dislocation and instability, and periprosthetic fracture (PPF).
Results: In total, 352 male patients and 409 female patients were identified. Compared to skeletally immature females, skeletally mature females had no higher risk of 10-year revision for all-causes , PJI, mechanical loosening, dislocation and instability, or PPF ($P > 0.05$ for all). Compared to skeletally immature males, skeletally mature males had no higher risk of 10-year revision for all-causes, PJI, mechanical loosening, dislocation and instability, or PPF ($P > 0.05$ for all).
Conclusion: Although THA occurred more commonly in patients above the presumed age of skeletal maturity, the lack of significantly different surgical outcomes suggests that younger age and presumed skeletal immaturity may not put

patients at any further risk of implant failure. While further research is needed to understand the impact of age and skeletal maturity on outcomes of THA, these results indicate that the initial age of a THA may not be a factor in optimizing outcomes, and suggests that orthopaedic surgeons need not delay surgery based on age or skeletal maturity alone.

TABLES

Table 1: Demographic and Clinical Comorbidities of Pediatric Patients

	Skeletally Mature Cohort		**Skeletally Immature Cohort**		
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	**P-Value**
Male Patients					
Total (N)	244	-	108	-	**-**
Age (years)	19.10	1.42	13.89	3.28	**<0.001**
Female Patents					
Total (N)	350	-	59	-	**-**
Age (years)	18.71	1.96	12.14	2.86	**<0.001**

Total Male THA <21: N=352

Total Female THA <21: N=409

Total Skeletally Mature Males: N=244 Females: N=350

Total Skeletally Immature Males: N=108 Females: N=59

Table 2: Cumulative Incidence and Risk of 10-Year Revision by Cause of Revision in Pediatric Male Patients: Skeletally Mature versus Immature Patients

	Hazards Ratio	**95% Confidence Interval**	**P-Value**
Males			
All-Cause Revision	1.67	0.35-7.92	0.513
PJI	0	0-inf	0.999
Mechanical Loosening	0.87	0.16-4.75	0.874
Dislocation Instability	0	0-inf	0.999

PPF	0	0-inf	0.999
Females			
All-Cause Revision	0.89	0.11-7.41	0.914
PJI	0	0-inf	0.999
Mechanical Loosening	0	0-inf	0.999
Dislocation Instability	0.41	0.04-3.93	0.437
PPF	0	0-inf	0.999

*PJI = Periprosthetic Joint Infection; PPF = Periprosthetic Fracture

*Hazards Ratio compares skeletally mature to skeletally immature patients

Lower Extremity/Deformity

ePoster 18. A Biomechanical Evaluation of Casting Technique and Cast Core Size Effect

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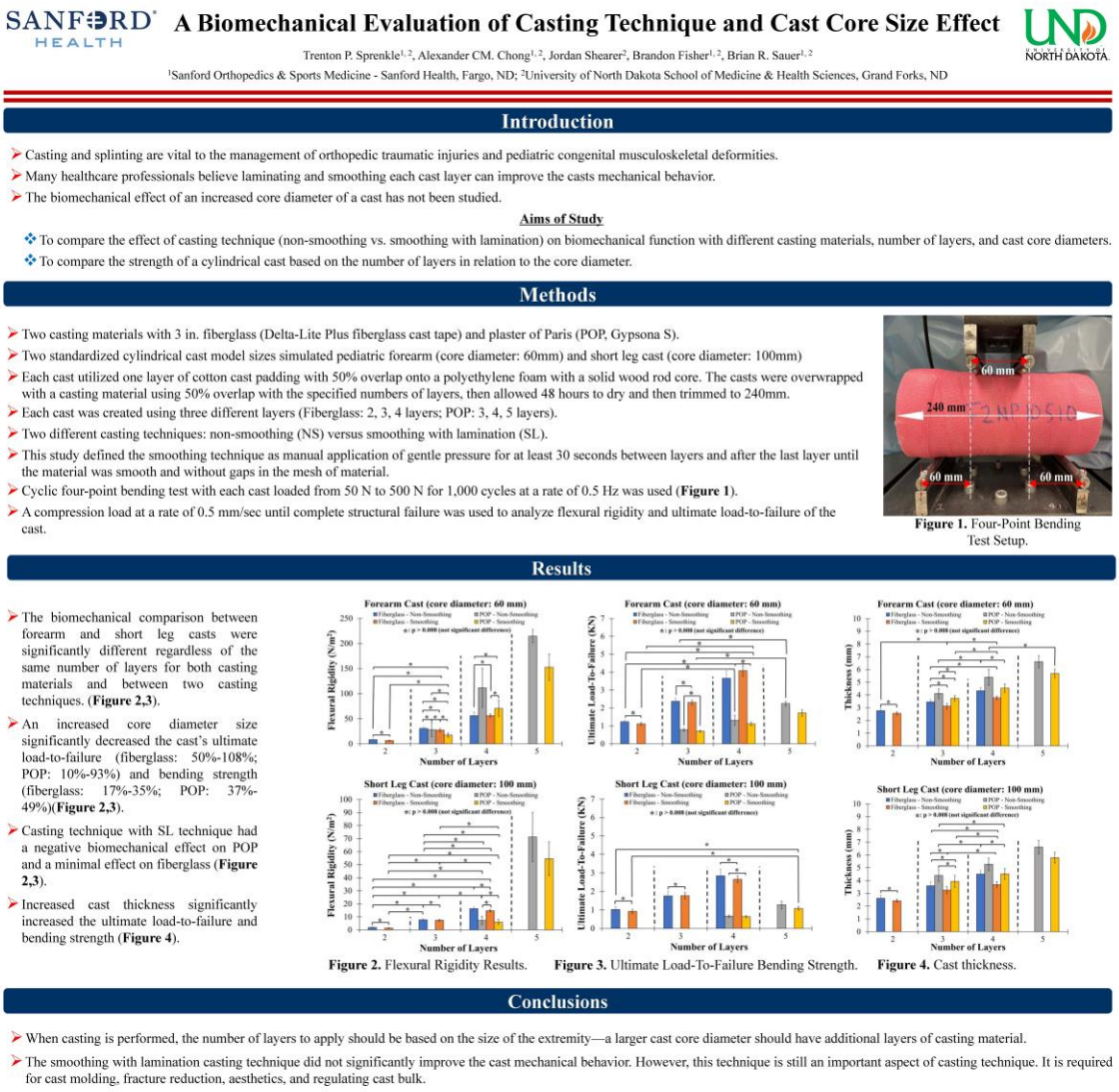
Background and Introduction: Casting and splinting are vital to the management of orthopedic traumatic injuries and pediatric congenital musculoskeletal deformities. The importance of proper cast application and technique cannot be over emphasized. The goals of this study were to, one, compare the effect of casting technique, specifically smoothing and laminating the cast between layers during application, on the biomechanical function of plaster of Paris and fiberglass casts of varying diameter and thickness. The second goal of this study was to compare the strength of a cast based on the number of layers in relation to the core diameter.
Methods: Two standardized cylindrical cast model sizes were used to simulate forearm and short leg casts (core diameter: 60mm, 100mm) with two different casting techniques (non-smoothing [NS] vs. smoothing with lamination [SL]), utilizing two casting materials (fiberglass and Plaster of Paris [POP]). Each cast was created using three different layers (Fiberglass: 2-4 layers; POP: 3-5 layers). Ultimate load-to-failure and flexural rigidity were analyzed via cyclic 4-point bend testing.
Results: The biomechanical comparison between forearm and short leg casts were significantly different regardless of the same number of layers for both casting materials and between two casting techniques. Increased cast thickness significantly increased the ultimate load-to-failure and bending strength. An increased core diameter size significantly decreased the cast's ultimate load-to-failure (fiberglass: 50%-108%; POP: 10%-93%) and bending strength (fiberglass: 17%-35%; POP: 37%-49%). Casting technique with SL technique had a negative biomechanical effect on POP and a minimal effect on fiberglass.
Conclusion and Significance: The number of layers to apply for a cast should be based on the size of the extremity. Smoothing and lamination technique did not significantly improve the casts mechanical behavior. The findings of this study provide valuable evidence, analysis, and supplementary knowledge that helps guide physicians in proper casting technique.



ePoster 19. A Midterm Follow-Up of Trident Fixation Technique for Pediatric Knee Arthrodesis with Recycled Bone Graft

Yu-Min Lin, MD, PhD; Yuan-Ya Liao, MD, PhD
Taichung Veterans General Hospital, Taichung, Taiwan

Background: Trident fixation technique was introduced in 2009 for allograft knee arthrodesis treating high-grade osteosarcoma around the knee by Su et al. We adopted their technique from 2011 for facilitating reduction and fixation for reconstruction after primary bone sarcoma resection.
Methods: From 2011 to 2018, five recycled bone graft and one allograft were performed in patients with osteosarcoma or Ewing's sarcoma in whom Trident fixation techniques were used. All patients underwent neoadjuvant and adjuvant chemotherapy. The average age of index Trident technique was 17.8 years. The recycled bone graft reconstruction was used in arthrodesis in two cases (2 knees), as an intercalary graft in two (both femur and tibia, one femur), as a bone and prosthesis composite in one. One allograft was used as an intercalary graft (one femur).
Results: At an average follow-up of 72 months, two cases died of disease. Stand-alone Trident fixation technique was done in two cases (two arthrodeses). Trident fixation combining with double-plating was used in two cases (one allograft, one irradiated recycled bone graft). Three cases uneventfully united (two arthrodeses and one allograft), but three cases had delayed union or nonunion. Revision was done for two case (one intercalary frozen graft and one arthrodesis) because of resorption.
Discussion: Arthrodesis with irradiated recycled bone graft and fixation with Trident technique healed uneventfully and quickly. Aponte-Tinao et al suggested double plating for massive allograft reconstruction to decrease the nonunion rate.

For diaphyseal region fixation, Trident fixation technique supplemented with double-plating might help decreasing nonunion.
Conclusion: Trident fixation technique is feasible for arthrodesis with irradiated recycled bone graft for knee arthrodesis. However, late complication of recycled bone graft should be carefully monitored.

ePoster 20. Can We Determinate the Degree of External Tibial Torsion on a Simple X-Ray? … Saving Radiation.

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Clara Domenech Bendaña; Miguel Castro Torre
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Introduction: Rotacional deformities of the lower limbs are common reason for medical consultation in our environment. After the assesment of the rotational profile and prior to the surgical indication, the usual imaging method for its quantification is CT. This study involves a considerable amount of ionizing radiation in growing patients.
Purpose: The aim of this study is to assess (and compare with CT) wether the analysis of full-length standing AP XRay (with the patellas centered) is useful to mesuare the degree of external tibial torsion
Methods: To do this, we assess the degree of overlap of the fibula with respect to the tibia at the ankle level to determine the degree of external rotation using the trigonometric formula of alpha cosine (contiguous cathete / hypotenuse). We compared this measurement with that made by the radiologist and ourselves on CT images.
Results: 64 measurements have been made in 32 patients in which the clinical thigh-foot angle (TFA) was on average 21.2º. The condylar malleolus angle and the tibial malleolus in CT by the radiologist was on average 45.3º and 37.9º respectively and that performed by the authors of 38,1º and 34.5º respectively. The measurement of the alpha cosine in simple X-Ray was on average 39,9º
Conclusion: There is a total correlation between the radiological measurement using alpha cosine and the TC study with a difference of less than 5 degrees
Significance: There are no significant differences between TC measurements between the radiologist and the authors.

ePoster 21. Comparing Pediatric Femoral Shaft Fracture Repair Patient Outcomes Between Pediatric and Non-Pediatric Orthopedic Surgeons

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Sean A. Tabaie, MS, MD, FAAOS

Children's National Hospital, Washington, DC

Background: While pediatric femoral shaft fractures account for less than 2% of all fractures in children, they are the most common pediatric fracture requiring hospitalization.
Introduction: Management of pediatric femoral shaft fractures is challenging, with various treatment options relating to severity and patient age. The last few decades have seen an increased supply of pediatric orthopedic surgeons (POS) along with increased referral rates. However, there continues to be a maldistribution of POS throughout the country. This study sought to determine outcomes following femoral shaft fracture repair by POS compared to non-pediatric trained orthopedic surgeons.
Methods: The National Surgical Quality Improvement Program-Pediatric database was queried to identify pediatric patients who underwent open treatment of femoral shaft fracture from 2012 to 2019. Differences in patient demographics, comorbidities, and postoperative complications were assessed and compared between patients who were treated by pediatric subspecialty-trained orthopedic surgeons and those treated by non-pediatric orthopedic surgeons. Bivariate and multivariable regression analyses were utilized.
Results: Of the 5,862 pediatric patients who underwent femoral shaft fracture treatment, 4,875 (83.2%) had their surgeries performed by a POS whereas 987 (16.8%) were operated on by a non-pediatric surgeon. POS were more likely to operate on patients with a higher American Society of Anesthesiologists classification ($p<0.001$) and those with medical comorbidities, including gastrointestinal ($p=0.022$) and neurological ($p<0.001$). After controlling for baseline patient characteristics on multivariable regression analysis, patients treated by non-pediatric orthopedic surgeons are at an increased risk of prolonged hospital stay (OR 2.595; $p<0.001$) when compared to patients operated on by POS.
Conclusion: Femoral shaft fracture surgery performed by pediatric-trained orthopedic surgeons decreased the risk of various postoperative complications as well as prolonged hospital stay when compared to the patients treated by non-pediatric trained orthopedic surgeons. Additionally, pediatric orthopedic surgeons were more likely to operate on more difficult patients who had increased comorbidities but the mean time required to complete the surgery was increased.
Significance: Due to the discrepancies that exist between pediatric and non-pediatric orthopedic surgeons in the treatment of femoral shaft fractures, attempts should be made to pair children with an appropriately trained surgeon so as to maximize postoperative outcomes.

Table 1. Demographics and Clinical Characteristics Among Femoral Shaft Fracture Patients

Variables	**Pediatric Surgeons**	**Non-Pediatric Surgeons**	**P-value**
Total patients, n	4,875	987	
Sex, n (%)			0.100¶
Female	1,319 (27.1)	242 (24.5)	
Male	3,556 (72.9)	745 (75.5)	
Race, n (%)			**0.014**¶
White	2,955 (66.6)	674 (71.9)	
Black or African American	789 (17.8)	146 (15.6)	
Hispanic	567 (12.8)	87 (9.3)	
American Indian or Alaska Native	17 (0.4)	3 (0.3)	
Asian	96 (2.2)	25 (2.7)	
Native Hawaiian or Pacific Islander	12 (0.3)	2 (0.2)	
ASA, n (%)			**< 0.001**¶
I	1,942 (49.7)	417 (54.7)	
II	1,432 (36.7)	293 (38.5)	
III	509 (13.0)	51 (6.7)	
IV	22 (0.6)	1 (0.1)	
Mean age, yrs (SD)	10.01 (3.82)	10.50 (4.28)	**< 0.001****
Mean operation time, mins (SD)	102.67 (53.85)	93.93 (62.05)	**< 0.001****

¶Pearson's chi-squared test
**Analysis of variance
Bolding equals significance $p<0.05$
ASA, American Society of Anesthesiologists; SD, standard deviation

Table 2. Comorbidities Among Femoral Shaft Fracture Patients

Comorbidities	Pediatric Surgeons	Non-Pediatric Surgeons	P-value[1]
Total patients, n	4,875	987	
Cardiac comorbidity, n (%)	110 (2.3)	17 (1.7)	0.293
Pulmonary comorbidity, n (%)	347 (7.1)	55 (5.6)	0.080
Gastrointestinal comorbidity, n (%)	155 (3.2)	18 (1.8)	**0.022**
Biliary comorbidity, n (%)	7 (0.6)	0 (0.0)	0.267
Neurological comorbidity, n (%)	484 (9.9)	60 (6.1)	< **0.001**
Immune disease, n (%)	4 (0.3)	0 (0.0)	0.402
Steroid use, n (%)	22 (0.5)	2 (0.2)	0.265
Nutritional support, n (%)	120 (2.5)	11 (1.1)	**0.009**
Failure to thrive, n (%)	5 (0.5)	0 (0.0)	0.341
Hematologic disorder, n (%)	58 (1.2)	16 (1.6)	0.268
Bleeding disorder, n (%)	5 (0.4)	0 (0.0)	0.349
Prior operation within 30 days, n (%)	7 (1.2)	1 (1.1)	0.927

[1]Pearson's chi-squared test
Bolding equals significance p<0.05

ePoster 22. Computer Prediction of Pediatric Occult Ankle Fracture Using Assessment of Non-Weight Bearing and X-Ray Measures of Acute Swelling

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Introduction: A number of children present to the emergency department (ED) with traumatic ankle injury. It is our experience that about 50% have X-rays not showing a fracture. One-fourth patients with a "normal" X-ray subsequently reveal a fracture on follow-up X-ray a few weeks later. Clinically, patients are assessed on initial ED visit as to weight bearing/non-weight bearing. Traditionally, ankle swelling has not been used clinically to predict occult fractures.
Objectives: The purpose of this retrospective study is to determine if initial ED visit assessment of weight bearing/non-weight bearing and/or magnitude of ankle swelling at site of injury, helps in prediction of occult ankle fracture.
Methods: ED presentation charts for suspected lateral malleolus injury were reviewed for a 1 year span (2021-2022). Soft tissue ankle swelling measurements were measured and whether patient was weight bearing or not.
Fisher's Exact test was used to calculate sensitivity and specificity of each parameter. A computer model (Exact Logistic Regression) used both clinical parameters and also just ankle swelling to predict probability of occult fracture.
Results: 61 children presented with ankle injury, of which 32 had negative initial x-rays. Of these 32, 8 (25%) had occult fracture on follow-up X-ray. Non-weight bearing had sensitivity (75%) and specificity (58%) for occult fracture detection ($p = 0.220$), and for ankle swelling ($p < 0.0001$) with sensitivity and specificity variable based on ankle mm (Figure 1).
The false negative rate (FNR) and false positive rate are shown (Figure 2). From this model, a patient diagnosed as having no fracture with 4 mm ankle swelling would have a FNR (probability of no fracture) of < 5%, but for a patient with 10 mm swelling the FNR would be ~ 35%.
Conclusions: About 1/4 of pediatric patients with ankle injury and normal initial ED X-rays have an occult fracture. ED visit weight-bearing / non-weight bearing as a predictor of occult fracture was relatively imprecise in this study. Measurement of ankle swelling was highly statistically significant for prediction of occult fractures.
A computer model predicts the probability of an occult fracture based on the mm swelling. Addition of weight bearing / non-weight bearing added somewhat (non-statistically significant) to its predictive ability.
The FNR gives the clinician an idea of the percentage of occult fractures that would not be diagnosed based on the mm of swelling. As the FNR increases with increased mm swelling, the FPR (false diagnosis of occult fracture) decreases.
From this small retrospective study, it appears that X-ray measurement of ankle swelling is highly predictive of an occult ankle fracture. The addition of patient weight bearing / non-weight bearing may add to its predictive power; however, our sample size was not large enough to determine its statistical significance.

Figure 1

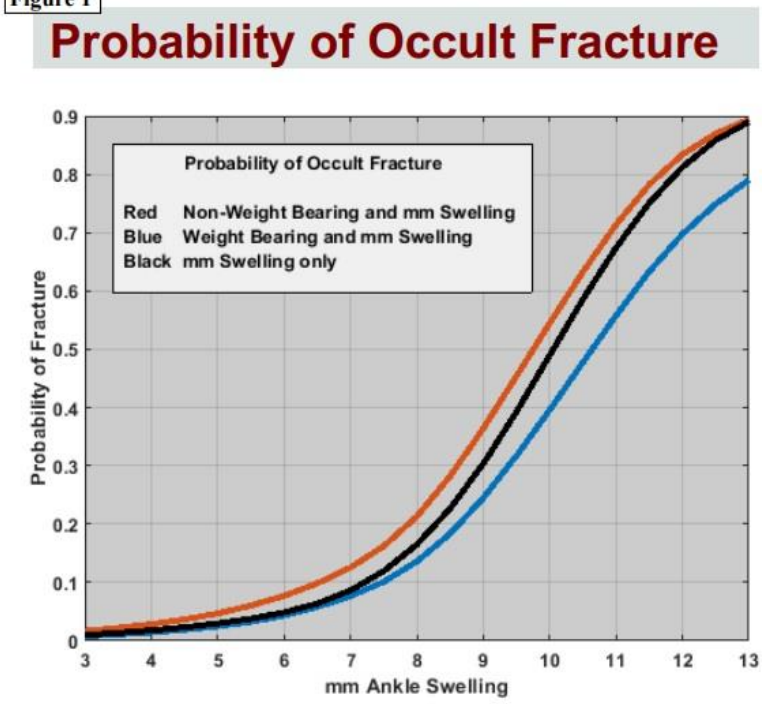
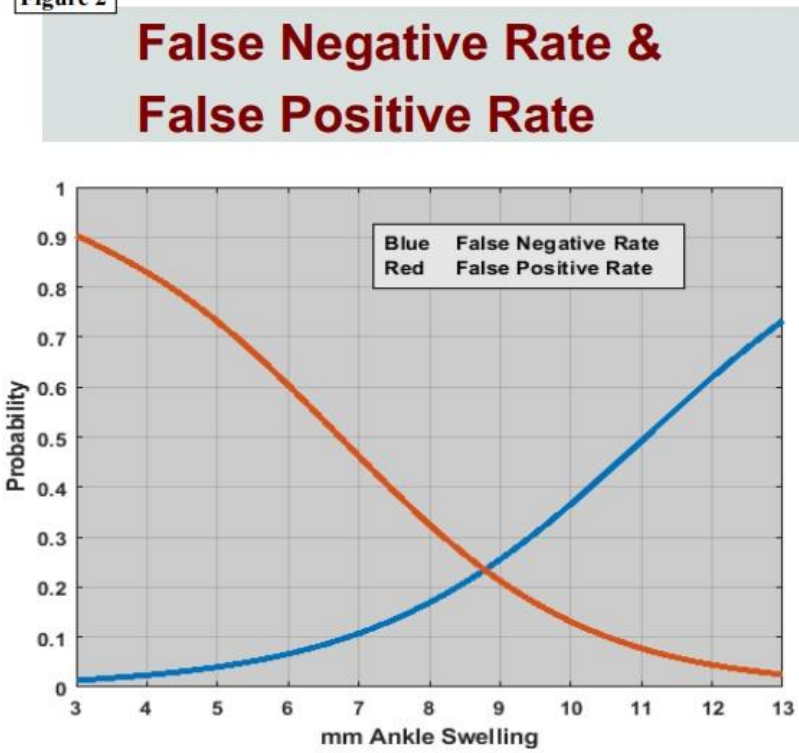


Figure 2



ePoster 23.Evaluation of Compensatory Rotational Gait Kinematics in Children with Pathological Genu Valgum

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Introduction: Pathologic Genu Valgum is commonly seen in Children. These children tend to rotate the legs either internally or externally while walking as a compensation mechanism to achieve a normal Foot progression angle (FPA). The hypothesis of the study was to ascertain if Genu Valgum is associated with transverse plane deformities or are they compensatory during the gait cycle.

Materials and Methods: The study comprised of 21 children with a mean age of 11.4 years, Male: female- 9: 12. These children were evaluated clinically for Q angle, rotational profile, feet deformities, 3D Gait analysis in an instrumented Gait lab and podoscope evaluation.
Results: The clinical data was corelated with the kinematic data. The mean Q angle was 18.7, mean Intermalleolar distance was 20.2. The Q angle and Kinematic Knee Valgus did not corelate. The Gait kinematics was analyzed with 1D-Statistical parametric mapping with a significance level of $p < 0.05$ and MATLAB R2021a.
Kinematics showed significant Hip adduction (midstance, pre swing and mid swing) and significant hip flexion (pre swing). The clinical hip rotations (IR and ER) had no significant corelation with the Hip rotation kinematics. However, the Hip rotation kinematics had significant external deviation ($p<0.001$). The Tibial rotation kinematics was significantly internal during stance phase. Kinematics of Foot rotation (FR) and FPA showed significant deviation externally from the normative. The Thigh foot angle (TFA) corelated significantly with FPA but not with the FR. 17 children had abnormal Clarkes' angle (>30 degrees). The Clarkes angle which is a clinical measure for planovalgoid feet on podoscope had significant corelation with TFA ($p = .003$) and FPA ($p = .016$).
Conclusion: The clinical Genu Valgum gets masked due to compensatory transverse and sagittal plane movements while walking. The hip rotates externally while tibia internally and foot rotates externally causing a malalignment in the transverse plane during gait, while there are no significant fixed torsional deformities.

ePoster 24. Frida Kahlo: The Artist who Turned Pain into Art

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Purpose: The aim of this study is to reflect on our local experience with extraperiosteal tension band plate around the knee and the factors that affect the outcome.
Methods: This is a retrospective review of 21 patients (34 limbs) and involving 35 segments gathered and treated during a period from 2007 to 2018 by a single surgeon employing a standardized technique. The inclusion criteria were all patients with coronal plane deformities around the knee with an open physis, regardless of pathological background. Patients who had previous or concurrent surgeries for the same problem were excluded from the study. Patients' age and body mass index were recorded. Mechanical axis deviation (MAD) distance, tibio-femoral (T-F) angle, mechanical lateral distal femoral angle, and mechanical medial proximal tibia angle were measured from a standing anteroposterior radiograph.
Results: The average age was 6.5 years, and the mean duration of treatment was 13.6 months, with "sick physis" requiring longer durations. The mean rate of correction of T-F angle was 1.5°/month. The MAD distance improved at an average rate of 2.4 mm/month. The distal femur physis improved at a rate of 0.69°/month, while the proximal tibia physis improved at a rate of 0.58°/ month.
Conclusion: The severity of preoperative deformity influenced the rate of correction, and this is further influenced by the pathological background and physis treated, femora faster than tibiae. Patients with more than 3 years of growth remaining showed faster correction.

Frida Kahlo (1907-1954) was a Mexican artist well known for her self-portraits and graphic and intimate portrayals of her passion and pain. Kahlo battled with health issues throughout her life, which greatly influenced her artistic works and career. There is evidence that she was born with spina bifida occulta. She was diagnosed with polio at age 6, which left her bed-ridden for nearly nine months and resulted in a shorter, thinner, and weaker right leg. Kahlo was also involved in a terrible streetcar accident at age 18, which resulted in multiple injuries including fractures of the spine, ribs, pelvis, and extremities. She suffered from chronic pain and underwent multiple surgeries for her spine and right leg throughout her life. This poster highlights several of Kahlo's many works that depict these struggles.

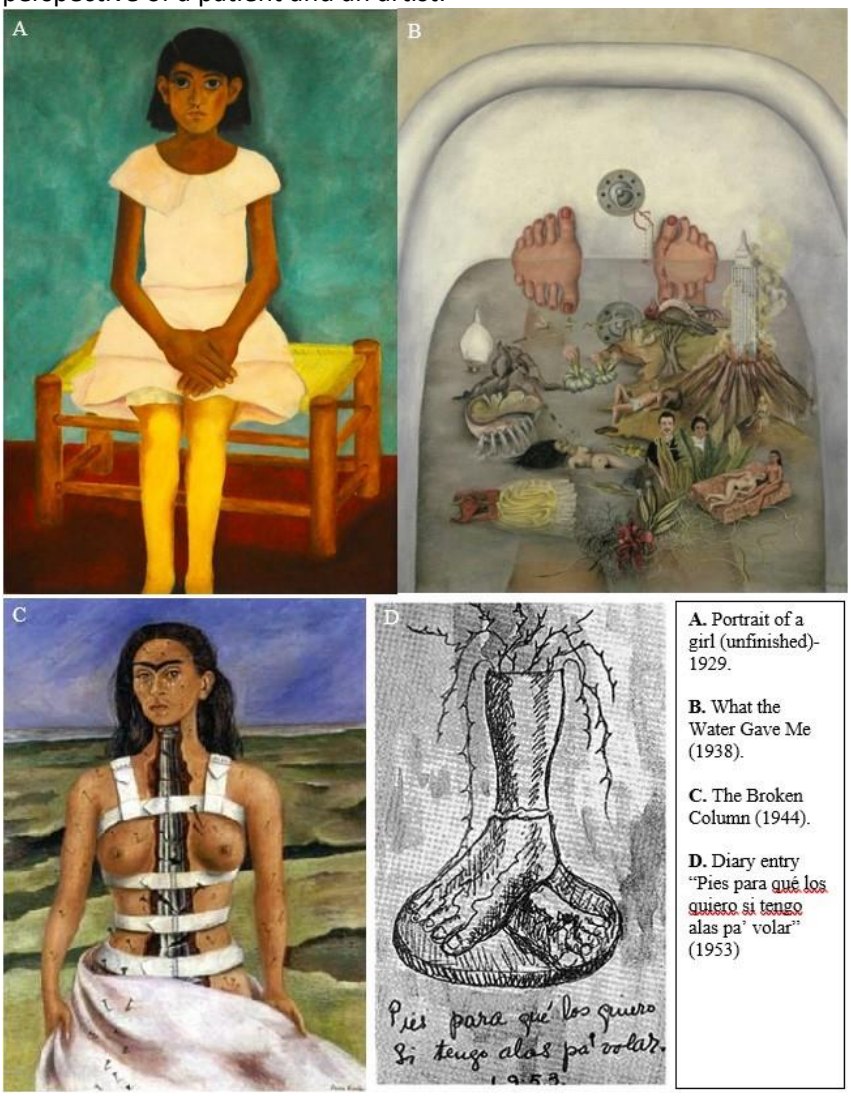
"Portrait of a Girl" (1929), shows a girl with a right leg smaller than the left, leading us to believe this may be a painting of a young Frida after her battle with polio left her with a smaller, thinner right leg.

In "What the Water Gave Me" (1938), Frida depicts herself in a bathtub with both feet extending out of the water and a reflection of her feet on the water surrounded by various events from her life. Her right foot is smaller than the left, with shorter and stubbier toes, a wound between the toes, and a mild hallux valgus deformity.

"The Broken Column" (1944) highlights Frida's struggles with chronic back pain after the tragic streetcar accident left her with multiple spinal fractures.

Frida's diary sketch captioned "Pies para qué los quiero si tengo alas pa' volar" translates to "Feet, what do I need you for if I have wings to fly". The sketch, drawn in 1953 around the time of her below knee amputation, depicts her feet on a pedestal, with thorns growing out of them, and with her right foot detached from the leg at the ankle.

Many artists throughout history have highlighted orthopedic conditions in their works of art. However Frida Kahlo, perhaps more than any other artist, portrays the challenges and realities of suffering from musculoskeletal conditions and their sequelae, whether from congenital, infectious, or traumatic etiologies. She does so in an incredibly graphic, realistic, and personal manner that provides us with a unique outlook on the experience of these conditions from the perspective of a patient and an artist.



A. Portrait of a girl (unfinished)- 1929.

B. What the Water Gave Me (1938).

C. The Broken Column (1944).

D. Diary entry "Pies para qué los quiero si tengo alas pa' volar" (1953)

ePoster 25. Idiopathic Toe Walking: Retrospective Cohort Study Demonstrates Surgery Results in Greatest Resolution Rate and Improvement in Range of Motion (ROM)

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Introduction: Idiopathic toe walking (ITW) typically resolves within the first decade of life. When not self-resolved, historically, PT/orthoses, casting, and surgical tendon lengthening have been used, although evidence is limited to support an optimal treatment method. The primary aim of this study was to determine the proportion of patients with

resolved ITW between casting, surgery and conservative management subcategorized by pre-treatment ankle dorsiflexion (< 0°- severe, 0 - 10°- moderate, > 10° - mild). The secondary aim is to determine the change in ankle dorsiflexion at final follow-up compared to pre-treatment.
Methods: Pediatric patients aged 4.5-11 years treated for ITW at a tertiary hospital between 1/2016-1/2023 were identified. Patients with neuromuscular conditions and less than 6 months of follow-up were excluded. 82 patients were included (44% female, 18.2% Hispanic, mean age 6.1 ± 2.6 years). Treatment arms included observation/PT/orthoses, serial casting, and surgery. Descriptive statistics, chi-squared tests, and t-tests were conducted using SPSS with the level of significance of $p < 0.05$.
Results: In patients with severe contractures, 30/35 (86%) resolved with surgery, 11/19 (34%) resolved with casting, and 0/2 (0%) resolved with observation. For moderate contractures, 7/9 (78%) resolved with surgery, 35/59 (42%) resolved with casting, and 2/32 (6%) resolved with observation. There were significantly greater resolution rates in the severe and moderate groups treated with surgery compared to observation or casting (severe: p=0.002, 0.022; moderate: p= <0.0001, 0.047). Additionally, in the moderate group, there were significantly greater resolution rates for those who underwent casting compared to observation (p= 0.0003). For mild contractures, 0% of patients underwent surgery, 2/4 (50%) resolved with casting, and 2/12 (17%) resolved with observation. There were no significant differences in resolution rates for the mild group between treatments (p=0.18). For patients with severe contractures that resolved, ROM improved 21.4° ± 6.5 with surgery and 20.0° ± 8.9 with casting (p<0.0001, p<0.0001). For moderate contractures that resolved, ROM improved 9.4° ± 7.4 with surgery and 9.3° ± 7.3 with casting (p=0.015, p<0.0001). There were no significant changes in ROM in the moderate contracture group treated by observation (p=0.795). For mild contractures, ROM was not compared due to low resolution rates.
Conclusion: Surgery resulted in the greatest proportion of resolved ITW and greatest improvement in ROM for patients with moderate and severe contractures. Observation rarely resulted in ITW resolution even in those patients with mild contractures.
Significance: Surgical tendon lengthening and casting are effective treatments for ITW with moderate and severe contractures. Casting is a reasonable initial treatment for moderate contractures, with knowledge that treatment will not be effective in all patients. Surgical tendon lengthening should be considered first line treatment for severe contractures and second line treatment for moderate contractures recalcitrant to non-surgical treatment.

Pre-treatment ankle dorsiflexion groups	< 0 degrees	0 – 10 degrees	> 10 degrees
Patient count (total n = 82)	27	47	8
Female sex	12 (44%)	16 (34%)	4 (50%)
Mean age at presentation (months)	87 ± 30	71 ± 29	40 ± 13
Lower extremities (total n = 172)	56	100	16
Management			
Observation (+/- PT/orthotics)	2 (4%)	32 (32%)	12 (75%)
Resolved	0 (0%)	2 (6%)	2 (17%)
Mean pre-treatment dorsiflexion	-	3 ± 0	15.0 ± 0
Mean post-treatment dorsiflexion	-	3.5 ± 2.1	15.0 ± 0
Mean change in dorsiflexion	-	0.5 ± 2.1	0
p-value	-	0.795	-
Un-resolved	2 (100%)	30 (94%)	10 (83%)
Mean pre-treatment dorsiflexion	- 10 ± 0	4.0 ± 4.2	21 ± 2.1
Mean post-treatment dorsiflexion	- 10	3.7 ± 6.1	12.5 ± 5.4
Mean change in dorsiflexion	0	- 0.3 ± 5.7	- 8.5 ± 7.1
p-value	-	0.749	0.004*
Casting	19 (34%)	59 (59%)	4 (25%)
Resolved	11 (58%)	25 (42%)	2 (50%)
Mean pre-treatment dorsiflexion	- 7.3 ± 7.2	4.4 ± 4.4	30.0 ± 0
Mean post-treatment dorsiflexion	12.7 ± 6.1	13.7 ± 5.8	25.0 ± 0
Mean change in dorsiflexion	20.0 ± 8.9	9.3 ±7.3	- 5.0 ± 0
p-value	< 0.0001*	< 0.0001*	-
Un-resolved	8 (42%)	34 (58%)	2 (50%)
Mean pre-treatment dorsiflexion	-9.4 ± 6.8	2.3 ± 2.9	15.0 ± 0
Mean post-treatment dorsiflexion	8.1 ± 2.3	7.2 ± 5.2	10.0 ± 0
Mean change in dorsiflexion	17.5 ± 5.3	4.5 ± 5.7	-
p-value	< 0.0001*	< 0.0001*	-
Surgery	35 (63%)	9 (9%)	0 (0%)
Resolved	30 (86%)	7 (78%)	-
Mean pre-treatment dorsiflexion	- 11.4 ± 7.9	0.6 ± 1.0	-
Mean post-treatment dorsiflexion	10.0 ± 6.4	10.0 ± 8.2	-
Mean change in dorsiflexion	21.4 ± 6.5	9.4 ± 7.4	-
p-value	< 0.0001*	0.015*	-
Un-resolved	5 (14%)	2 (22%)	-
Mean pre-treatment dorsiflexion	- 18 ± 12.0	0 ± 0	-
Mean post-treatment dorsiflexion	10 ± 6.1	10 ± 0	-
Mean change in dorsiflexion	28 ± 7.6	-	-
p-value	0.001*	-	-

Figure 1. Resolution Rates and Mean Changes in Ankle Dorsiflexion After Treatment Subcategorized by Pre-Treatment Ankle Dorsiflexion

ePoster 26. Nailed it! Can Rigid Femoral Nailing be Safely Used for Pediatric Femoral Shaft Fractures in Patients 8-10 Years of Age?

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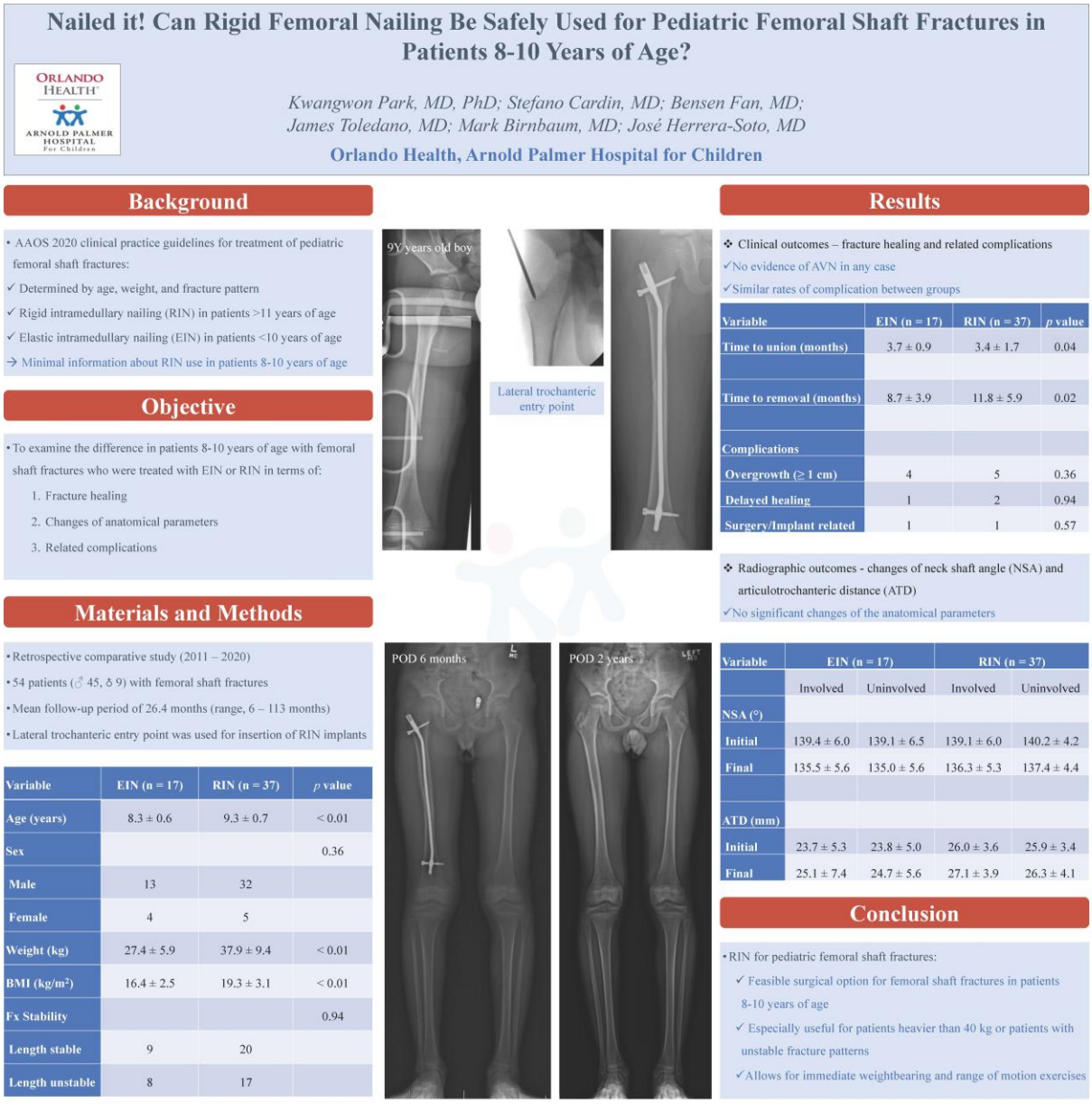
Background: The use of intramedullary nail fixation for treatment of long bone fractures is quite common and increasing in frequency. Its safety when used in the tibia in skeletally immature patients has received little attention.

Introduction: Tibial shaft fractures represent a common adolescent fracture. Elastic intramedullary nails (EIN) or plate and screw constructs are most commonly recommended when surgical fixation is needed in skeletally immature patients. Rigid intramedullary nails (RIMN) require reaming across the anterior proximal tibial physis leading to concern for physeal injury and subsequent development of recurvatum. Currently, there is little evidence evaluating the outcomes of RIMN in skeletally immature patients despite wide adoption in adults. This study aims to determine if RIMN are a safe and effective means of treating tibial shaft fractures in skeletally immature adolescent patients.
Methods: Retrospective chart review was performed of tibial shaft fractures undergoing RIMN within a single pediatric orthopaedic group between January 2012 to September 2022. Patients with closed physes were excluded. Intraoperative medial proximal tibial angle (MPTA) and posterior proximal tibial angle (PPTA), location of implant relative to physis, and follow-up MPTA and PPTA were recorded. Intraoperative and postoperative measurements were compared using a paired sample t-test at a significance level of 0.05. Change in MPTA and PTPA based on implant location was assessed using a two sample t-test at a significance level of 0.05.
Results: Twenty-three patients were included. Mean age at surgery was 14.4 years. Mean follow-up was 14.7 months. There was no statistically significant difference between mean intra and post-operative MPTA (87.348 v. 86.826, p=0.0967) nor between mean intra and post-operative PPTA (81.087 v. 82.000, p=0.352). There was a statistically significant difference in absolute change in PPTA between patients with implant left proximal versus distal to the physis (0.944 v. 5.600, p=0.026). The difference was no longer statistically significant after exclusion of one patient who developed recurvatum after RIMN. The patient's intra-operative MPTA and PPTA were 87 and 83 degrees compared with 85 and 104 degrees at 31 month follow-up.
Conclusions: The use of RIMN in skeletally immature adolescents did not lead to a statistically significant change in MPTA or PPTA indicative of growth disturbance with the exception of one case. One patient developed recurvatum in the sagittal plane after RIMN with the implant placed below the physis.
SIGNIFICANCE: Though RIMN are generally safe and effective in treating tibial shaft fractures in skeletally immature adolescents, we demonstrate a non-zero risk of sagittal recurvatum by including, to our knowledge, the first published incidence of recurvatum following RIMN for an adolescent tibial shaft fracture. Further studies are needed to elucidate risk factors for growth arrest, including final implant position.



ePoster 27. Optimizing Tibial Torsion Measurements in Pediatric Patients

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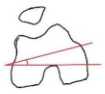
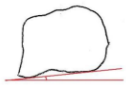
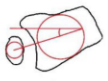
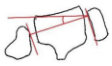
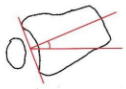
Background: The treatment modalities for pediatric femoral shaft fractures are determined by their age, weight, and fracture pattern. Rigid intramedullary nailing (RIN) is usually recommended for patients >11 years of age, and elastic intramedullary nailing (EIN) has been used for patients under 10 years. However, little is known about the use of RIN in patients aged 8 to 10 years. We examined the differences in patients with femoral shaft fractures who were treated with EIN or RIN in terms of (1) fracture healing; (2) changes of anatomic parameters; and (3) related complications.
Methods: We retrospectively reviewed 54 patients between 8 and 10 years of age, with femoral shaft fractures, who were treated with either EIN or RIN between 2011 and 2020. Lateral trochanteric entry was used for RIN procedure. The mean follow- up period was 26.4 months (range, 6 to 113 mo). There were 17 patients in the EIN group and 37 patients in the RIN group. The mean age at the time of surgery was 1 year younger in the EIN group ($P < 0.01$). The mean weight of the patient was significantly heavier in the RIN group compared with the EIN group.

Results: Complete union of the fracture was achieved slightly faster in the RIN group at 3.4 months compared with 3.7 months in the EIN group (P = 0.04). There were no clinically significant changes of the anatomic parameters in either group, including neck shaft angle and articulotrochanteric distance. There was no evidence of avascular necrosis at the time of final follow-up for either group. There were no significant differences in postoperative complications between the groups.
Conclusion: RIN using lateral trochanteric entry is a feasible surgical option for femoral shaft fractures in patients 8 to 10 years of age that are heavier than 40 kg or with unstable fracture patterns.
Level of Evidence: Level III, retrospective cohort study.

Table 1. Inter-rater ICC and Mean Values of Tibial Torsion Measured with Techniques Utilizing Different Proximal and Distal axes. PCA: Posterior Condylar Axis, Epicondylar Axis, Posterior Tibial Axis.

Landmark Type	Measurement	Technique	Inter-Rater ICC (Surgeon vs. Surgeon)	Mean Resultant Tibial Torsion (Mean ± SD)
Distal	PCA		0.992	8.49 ± 16.51
Distal	ECA		0.971	5.91 ± 16.13
Distal	PTA		0.981	6.41 ± 16.83
Proximal	Jakob		0.986	34.22 ± 19.35
Proximal	Goutallier		0.986	26.65 ± 18.82
Proximal	Madadi		0.962	37.82 ± 20.17

ePoster 28. Orthopedic Fixation of Skeletally Immature Ankle Fractures in Children and Adolescents Using Bio-Integrative Implants

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Background/Introduction: Fractures in skeletally immature children and adolescents pose unique challenges in treatment. Metal-alloy fixation devices have been commonly used for internal fixation; however, their removal is often required to prevent future complications, necessitating a second surgery. However, new bio-integrative fixation devices may present an alternative to metal alloy fixation devices through minimizing device-related complications and eliminating the need for a second surgery. The study aims to compare bio-integrative fixation devices and metal-alloy

fixation devices for treating skeletally immature ankle fractures. It hypothesizes that the bio-integrative devices will exhibit similar rates of fusion and fixation, with fewer complications, surgical interventions, costs, and improved quality of life.
Methods: The study is a retrospective, descriptive, single-center, IRB approved study, which enrolled 35 participants who underwent internal fixation for skeletally immature ankle fractures. 12 patients received bio-integrative devices, while 23 received metal-alloy devices. Patients were followed up for up to 52 weeks post-procedure, and data analysis included visit details, radiographic studies, and treatment courses. The study measured radiographic fracture healing, using a survey-based cross-examination method among attending physicians within the clinic. Device-related complications were analyzed using the Clavien-Dindo classification system. Device removal rates, surgical interventions, cost-efficiency, and quality of life outcomes were measured using statistical medical record and billing analysis techniques.
Results: Radiographic assessment of fracture healing, post-procedure, demonstrates statistically insignificant differences in healing rates between the two patient populations. Metal screws exhibited significantly higher complications rates as well as significantly increased surgical intervention rates. Out-of-pocket costs for patients undergoing internal fixation with bio-integrative screws and metal screws had insignificantly different procedure costs, related to the relatively low incidence of complications in pediatric ankle fracture fixation, producing a low re-operation rate. However, when patients required removal of hardware, out-of-pocket procedure costs for patients averaged approximately $3,030 higher. Patients had statistically insignificant differences in quality of life for the initial operations and improved quality of life after complication rates and hardware removal re-operations are factored in.
Conclusion: Preliminary findings suggest that bio-integrative fixation devices provide comparable effectiveness in treating ankle fractures in skeletally immature patients while outperforming metal screws in terms of complication rates, re-operation rates, cost-efficiency, and quality of life. Further data analysis is required to confirm these findings and support the potential adoption of bio-integrative implants as a viable alternative in orthopedic fixation for children and adolescents with ankle fractures.
Significance: Pediatric patients with ankle fractures often require re-operation to remove metal-alloy fixation devices versus bio-integrative devices, which increases complications and burdens on patients. Therefore, bio-integrative implants may present a valuable solution to these issues by potentially eliminating the need for re-operation, improving patient outcomes, reducing healthcare costs, and enhancing the overall quality of life for these young patients and their families.

ePoster 29. Systematic Review and Reference for Pediatric Physeal Fractures and Premature Physeal Arrests; How Often and When Do They Occur?

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Background: Physeal arrest is a complication in 5-10 % of physeal fractures. The extent and timing of the growth arrest varies based on multiple factors such as location and skeletal maturity. Despite extensive discourse on the management of physeal arrest, there remains a lack of a cohesive, well-structured reference to aid physicians in determining prognosis and establishing appropriate follow-up durations for specific physes after injury.
Introduction: This systematic review aims to offer a comprehensive and easy-to-navigate resource for physicians treating physeal fractures in children, while concurrently highlighting knowledge gaps that could guide future research.
Methods: A systematic review was performed on pediatric physeal fractures to evaluate 3 primary outcomes for each physis of interest in upper and lower extremities: 1. Incidence of PPC, 2. Time from injury to PPC, and 3. Recommended follow-up duration based on time to PPC. Secondary outcomes include level of evidence of each paper, tips for management of specific physeal fractures based on age and location. Appropriate search terms were queried through PubMed, CINAHL, and Web of Science on 12/12/2022. Filters for the search included: 1) pediatric subjects, 2) English, 3) free-full text, 4) peer-reviewed journal, and 5) past 40 years. From the initial 1,803 articles found, we identified 96 relevant articles for review. Two independent reviewers decided on which abstracts were relevant for full-text review and any discrepancies were decided by a third author. Of the 72 full-text reviews, 59 papers were included in this review.
Results: Results are summarized in the included Table.
Conclusion: This article represents a comprehensive reference of frequency and timing of premature physeal arrest after fracture for each long bone physis and type of fracture based on the Salter Classification.

Significance: Several fractures mentioned in this review have very little data such as the medial clavicle or distal fibula. This can help lead the way for future studies in these areas. Furthermore, the data can be used to help clinicians counsel patients and families on prognosis of physeal injury and guide them on follow-up frequency and duration.

Anatomic Area	Growth Contribution	Fracture Incidence	Common Fracture Types	Intervention Recommendations	Incidence/Prevalence of Premature Physeal Closures~~Arrest~~	Recommended Monitoring
Proximal Humerus	80% of humeral growth[9]	0.45% of all pediatric fractures[11]	SH type II[11]	Surgical for patients 12 or older, conservative forunder 12 years old[9]	31.4 per 100,000. Follow-up studies and treatment plans essential for patients > 11 y/o	Minimum of 21 days, increased to 2 years forpatients >11 years old
Distal Humerus	20% of humeral growth[10]	19% of all pediatric elbow fractures[4]	Lateral condyle fractures, Jakob type 3fractures, supracondylar fractures, transphyseal fractures[14]	Varies - plaster of Paris slab after closed reduction, skin traction, overhead skeletal traction, percutaneous pin fixation following closed reduction, internalfixation after open reduction[23]	Lateral condyle - average time of arrest 2.6 years[14], Supracondylar – N/A, Transphyseal - can lead to angular deformity[16]	Annual radiographic and clinical evaluation for 3 years for lateral condyle[14], varies forsupracondylar, and N/A for transphyseal
Proximal Radius	Minor (most radial growth from distal radius)[18]	5-10% of all pediatric elbow fractures, 1% of all pediatric fractures[27]	Radial neck fractures[18]	Varies (exercises for mild deformities, corrective osteotomy forsevere deformities)[20]	Low (approx. 1.5%)[19]	Median time to last scheduledfollow-up for non-operative cases was 1.4 months[3]
Proximal Ulna	N/A	Extremely rare[21]	N/A	N/A	No growth disturbances reported in patients withOI[21]	N/A
Distal Radius	Major (75% of radial growth[10]	One of the most common pediatric fractures[10]	N/A	Varies based on expected growth and sizeof physeal bar	1-7%[10]	Radiography every 3-6 months post-injury and untilnormal growth is observed[24]
Distal Ulna	Major (80% of ulnar growth)[23]	Isolated physeal fractures rare, PPC is a common complication[23]	N/A	Varies (epiphysiodesis if arrest is detected early)	N/A	Radiographically followed until skeletal maturity[25],[26]
Metacarpals	N/A	Physeal fractures account for 33-41% of all hand fractures, with the metacarpal epiphysis involved in 4%[27]	PPC most common complication of metacarpal physeal fractures[28]	Varies (operative reduction after 1-2 unsuccessful attempts atreduction)[28]	N/A	N/A
Phalanges	N/A	48% of phalangeal fractures are physeal fractures[13]	Seymour fractures (open distal phalanx physeal fractures)[28]	Varies (irrigation, debridement, possiblypinning or splinting)[28]	Possible growth arrestdue to late presentationor recognition of Seymour fractures[28]	N/A
Medial Clavicle	N/A	N/A	N/A	N/A	N/A	N/A
Lateral Clavicle	Contributes to 20-30% of clavicular growth[31]	N/A	N/A	N/A	Possible clavicular shortening[33]	3 months follow-up in one study, but longer follow-up is suggested[32]

Area	Growth Contribution	Incidence of Physeal Fracture	Common Fracture Types	Intervention	Physeal Arrest	Monitoring
Proximal Femur	14% of the entire length of the lowerextremity [42]	Rare	Delbet I fractures [43]	Varies (epiphysiodesis if arrest has already occurred and patient is <10 years old or has >2 years of growth remaining) [44-46]	5-65% [43]	Not specified

Distal Femur	70 % of femoral growth [48]	1.2 per 100,000 person-years [49]	SH type II fractures most reported, SH type IV most damaging [47]	Varies (physeal-spanning instrumentation w/ contralateral epiphysiodesisfor high-risk patients) [51]	21-35% [48]	At least a few years, optimally until skeletal maturity [49]
Proximal Tibia	55% of the length of the tibia [52]	5.7 per 100,000 person-years [49]	SH type 2 [49]	N/A	10-25% [49,55]	Until skeletal maturity [56]
Proximal Fibula	60% of fibular length [55]	Isolated fractures rare	N/A	N/A	No reported clinical cases	Not specified
Distal Tibia	45% of tibial growth [56]	14 per 100,000 person-years [49]	SH type 2 [49]	Corrective osteotomies for angular deformity over 10 degrees, and possibly for smaller angular deformitiesif nearing physeal closure [60]	12-15% [58]	Follow-up every 3-4 months for 1 year, thenevery 6 months for a minimum of 2 years [60]
Distal Fibula	40% of fibular length [55]	14 per 100.000 person-years [49]	SH type 2 [49]	N/A	Possible shortening leadingto ankle pain and instability [64]	Frequent follow-up suggested [64]
Metatarsals	Most of foot lengthachieved by age 12 [17]	Isolated fractures to thisphysis are rare	N/A	Avoidance of surgical error critical [65]	Mostly occurs due to surgical error rather than physeal fracture [65]	Not specified
Toe Phalanges	N/A	Extremely rare	N/A	N/A	Not presented clinically in literature	Follow-up for at least 2 years suggested, but moreresearch needed on fractures in younger children [69]

Table 1. Summary of Literature Available for Physeal Fractures and Premature Physeal Closures in the Upper and Lower Extremities

Neuromuscular & Cerebral Palsy

ePoster 30. Differences in School Services Offered and Accessibility for Children with Cerebral Palsy Based on Race, Income, and GMFCS Level

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Introduction: The ethnic disparity among individuals with cerebral palsy is well documented. Multiple population-based studies demonstrate disproportionately higher rates of cerebral palsy (CP) in non-Hispanic Black individuals compared to White. In this study, we seek to determine if there are statistically significant differences in services and accessibility offered in schools regarding an individual's GMFCS level, self-reported race, and the mean income of their zip code of residence.
Methods: A review of questionnaires completed by families of 1,254 school-age children with CP with Gross Motor and Function Classification (GMFCS) I-V at an outpatient clinic and motion analysis center in the Southeastern United States was conducted from 2005-2020. Individuals were divided into groups of race (White versus Non-white) and average household income of their zip code of residence (above or below $33,075 per year). Participants were asked about school services offered including general or special education, adult aide, academic support, physical, occupational, or speech therapy, medical assistance, other services, and total number of services. The survey covered accessibility at the

school including if the school was one-level, had wheelchair access, paved pathways, Braille signage, and the classroom setting.

Results: White children were more likely to be enrolled in general education compared to non-White (62.6% vs 46.1%, p<0.0001) as well as higher-income bracket compared to lower-income bracket (59.6% vs 48.3%, p=0.0027). Conversely, 50.6% of White children were in special education compared to 63.5% of Non-white (p<0.0001), but there was no statistically significant difference regarding income. There were more resources overall for higher income zip-codes (adult aide, academic support, OT, total number of services, one-level, wheelchair access). Non-White children were overall more likely to have therapy services in schools. Differences in general versus special education were seen across all GMFCS categories regarding race, not income, with the exception of GMFCS 4-5: 1-2, more non-Whites in special education (59.7% vs 46.4%); 3, more Whites in general education (62.3% vs 42.4%); 4-5, more Whites and higher-income in general education (38.9% vs 18.3%, 33.7% vs 18% respectively). Across all GMFCS levels, higher-income was more likely to have one-level school (63.3% vs 52%) and wheelchair access (51% vs 42.8%), and Whites were more likely to have Braille signage (2.4% vs 0.6%)

Conclusion: While Non-white individuals tend to have more severe cases of cerebral palsy on the GMFCS scale, there remains a racial gap between representation in special versus general education when examining specific GMFCS levels. Minimal differences were found regarding accessibility.

Significance: Awareness by the orthopedic team as to what school resources are offered to children is important to holistically care for our patients and is directly related to three key social determinants of health: education access and quality, healthcare access and quality, and neighborhood and built environment.

Table 1: Services and Accessibility: Overall

Measure	White	Nonwhite	P value for race	Income > $33,075	Income < $33,075	P value for income
General education	62.6	46.1	***<0.0001****	59.6	48.3	***0.0027****
Special education	50.6	63.5	***<0.0001****	53.9	55.8	0.63
Adult Aide	31.0	28.6	0.41	31.8	22.5	***0.0078****
Academic Support	22.2	15.1	***0.0054****	21.1	14.8	***0.0389****
Occupational Therapy	46.3	52.6	***0.0462****	49.0	44.0	***0.0019****
Physical Therapy	52.5	59.1	***0.0342****	55.7	48.3	0.052
Speech Therapy	34.4	38.6	0.17	35.9	34.5	0.69
Medical Assistance	5.0	7.4	0.09	5.7	5.7	0.98
Other	8.3	4.4	***0.0172****	7.0	8.0	0.63
Total Number	3.1	3.1	0.78	3.2	2.8	***0.0159****
One Level	62.0	60.9	0.73	63.3	52.0	***0.0032****
Wheelchair Access	49.8	49.4	0.91	51.0	42.8	***0.0399****
Pathways	12.3	13.1	0.71	13.0	10.6	0.36
Braille Signage	2.4	0.6	***0.0412****	1.8	2.0	0.83
Classroom Setting	General: 55.3 Special: 36.0	General: 38.8 Special: 53.8	***<0.0001****	General: 51.1 Special: 40.7	General: 46.1 Special: 43.2	0.31

Table 2: Services and Accessibility: GMFCS I and II

Measure	White	Nonwhite	P value for race	Income > $33,075	Income < $33,075	P value for income
General education	67.9	61.9	0.18	67.7	58.7	0.075
Special education	46.4	59.7	***0.0058****	49.9	48.1	0.73
Adult Aide	20.7	24.5	0.34	22.2	18.3	0.38
Academic Support	21.7	20.1	0.69	21.6	19.2	0.59
Occupational Therapy	36.1	48.2	***0.0099****	40.3	32.7	0.14
Physical Therapy	43.7	52.5	0.066	47.0	39.4	0.15
Speech Therapy	30.4	32.4	0.65	31.2	29.8	0.78
Medical Assistance	1.5	4.3	***0.041****	2.3	1.9	0.81
Other	8.0	3.7	0.080	6.5	10.2	0.18
Total Number	2.7	3.1	0.073	2.9	2.6	0.14
One Level	64.4	59.0	0.25	66.1	45.9	***0.0002****
Wheelchair Access	44.9	46.0	0.84	46.6	39.8	0.22
Pathways	11.9	12.6	0.82	12.1	12.1	0.99
Braille Signage	2.8	0	***0.0443****	2.0	3.0	0.49
Classroom Setting	General: 65.0 Special: 28.4	General: 50.7 Special: 44.2	***0.0022****	General: 62.0 Special: 32.2	General: 57.7 Special: 31.7	0.20

Table 3: Services and Accessibility: GMFCS III

Measure	White	Nonwhite	P value for race	Income > $33,075	Income < $33,075	P value for income
General education	62.3	42.4	***0.0074****	59.0	41.2	0.056
Special education	56.1	67.7	0.12	58.1	66.7	0.36
Adult Aide	50.0	28.4	***0.0033****	47.2	23.5	***0.0109****
Academic Support	29.3	13.4	***0.0127****	26.1	14.7	0.15
Occupational Therapy	68.8	56.7	0.088	66.1	58.8	0.42
Physical Therapy	75.2	70.2	0.44	76.3	58.8	***0.0348****
Speech Therapy	39.7	38.8	0.90	40.7	35.3	0.56
Medical Assistance	5.7	6.0	0.94	6.3	2.9	0.45
Other	8.7	4.6	0.28	6.9	9.1	0.66
Total Number	3.9	3.3	***0.0244****	3.8	3.1	***0.0464****
One Level	59.4	59.7	0.97	61.5	50.0	0.21
Wheelchair Access	57.8	50.8	0.35	56.7	46.9	0.31
Pathways	15.4	14.9	0.92	17.4	8.8	0.21
Braille Signage	2.2	1.5	0.73	1.7	2.9	0.64
Classroom Setting	General: 48.1 Special: 42.3	General: 34.4 Special: 51.6	0.17	General: 44.7 Special: 45.3	General: 41.2 Special: 44.1	0.72

Table 4: Services and Accessibility: GMFCS IV and V

Measure	White	Nonwhite	P value for race	Income > $33,075	Income < $33,075	P value for income
General education	38.9	18.3	***0.0004****	33.6	18.0	***0.0307****
Special education	74.4	76.9	0.64	74.5	76.0	0.83
Adult Aide	55.1	40.4	***0.0201****	51.4	36.0	***0.0498****
Academic Support	26.0	12.5	***0.0085****	22.5	10.0	***0.0473****
Occupational Therapy	71.7	71.2	0.92	71.7	68.0	0.60
Physical Therapy	77.4	76.0	0.79	77.6	72.0	0.40
Speech Therapy	53.2	54.9	0.79	54.6	48.0	0.40
Medical Assistance	15.8	14.4	0.76	14.7	18.0	0.56
Other	11.0	6.8	0.25	10.3	6.1	0.37
Total Number	4.2	3.7	***0.0386****	4.1	3.5	0.06
One Level	59.2	59.0	0.97	58.6	59.1	0.95
Wheelchair Access	60.9	56.8	0.55	61.2	47.6	0.11
Pathways	14.3	11.5	0.52	13.8	8.9	0.37
Braille Signage	0.7	0.0	0.42	0.5	0.0	0.64
Classroom Setting	General: 21.3 Special: 66.7	General: 11.3 Special: 80.4	0.058	General: 18.0 Special: 70.9	General: 12.8 Special: 76.6	0.67

Numbers are in percentages except for the number of services. Statistically significant results denoted by an asterix. Insignificant p-values were rounded to the second nearest decimal.

ePoster 31. Improving the Quality of Interpretation of Pelvic Radiographs for Hip Surveillance in Cerebral Palsy – a Quality Improvement Project

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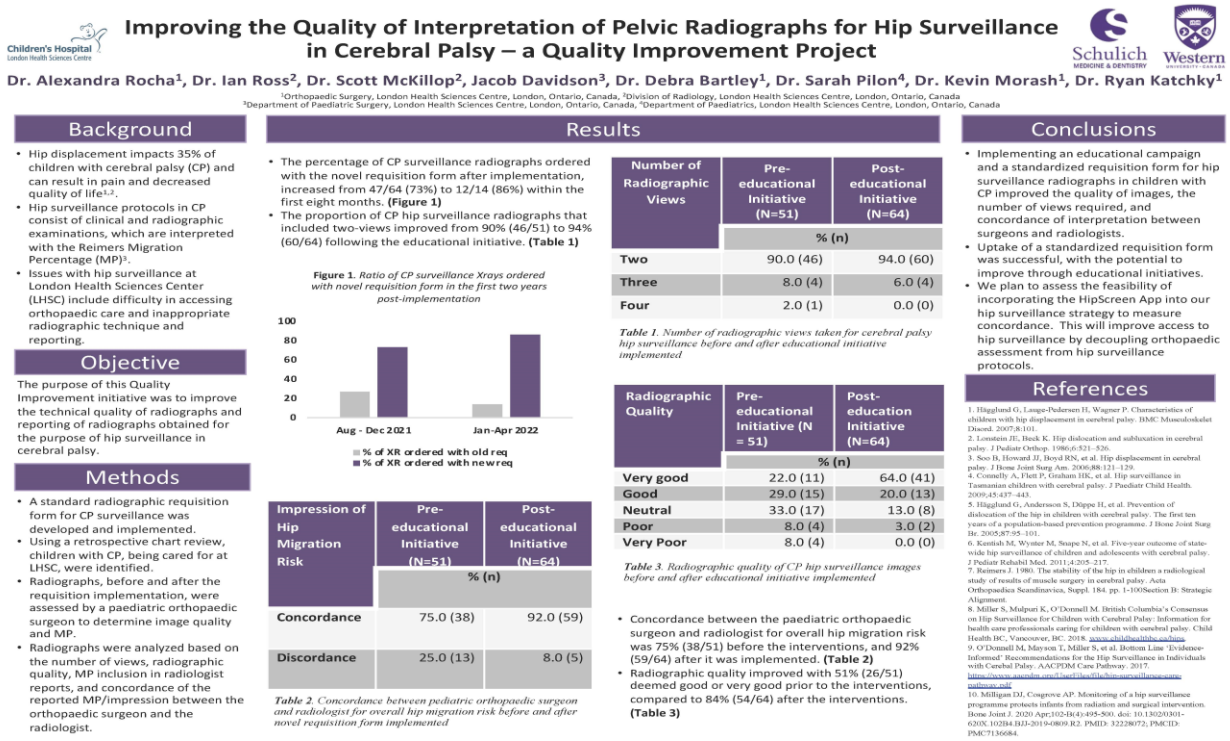
Introduction: Hip displacement impacts 35% of children with cerebral palsy (CP) and can result in pain and decreased quality of life. Hip surveillance protocols in CP are designed to facilitate early diagnosis and treatment of hip migration. These include clinical examinations and pelvic radiographs at regular intervals. Hip migration can be measured and risk of progressive hip displacement assessed using Reimer's Migration Percentage (MP). At the outset of this project, institutional issues with hip surveillance included difficulty in accessing orthopaedic care, inappropriate radiographic technique and inconsistent reporting of MP. The goal of this quality improvement initiative was to improve the technical quality and reporting of hip surveillance radiographs.
Methods: Change ideas were developed, implemented and evaluated using the Institute for Healthcare Improvement's Model for Improvement framework. Change ideas included development and implementation of a standardized radiographic requisition form, as well as educational campaigns focused on reporting of MP. Radiographs were assessed by a paediatric orthopaedic surgeon to determine radiographic quality and MP. Radiographs were analyzed based on the

number of views, MP inclusion in radiologist reports, and concordance of the reported MP/impression between the orthopaedic surgeon and radiologist.

Results: Radiographic quality improved significantly, with 26/51 (51%) deemed good or very good pre-interventions compared to 54/64 (84%) post-interventions. The number of radiographs judged as poor or very poor decreased from 16% (8/51) pre-interventions to 3% (2/64) post-interventions. Concordance between the paediatric orthopaedic surgeon and radiologist for overall hip migration risk increased from 75% (38/51) before the interventions to 92% (59/64) after implementation. The rate of radiographic reporting of MP increased from 10% (5/51) to 94% (60/64) following intervention implementation.

Conclusions: Implementing an educational campaign and a standardized requisition form for hip surveillance radiographs dramatically improved the quality of images and concordance of interpretation between surgeons and radiologists. This will allow 'decoupling' of hip surveillance protocols from the orthopaedic assessment, thereby ensuring that wait times for orthopaedic care do not prevent adherence to hip surveillance protocols.



Improving the Quality of Interpretation of Pelvic Radiographs for Hip Surveillance in Cerebral Palsy – a Quality Improvement Project

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Background

- Hip displacement impacts 35% of children with cerebral palsy (CP) and can result in pain and decreased quality of life[1,2].
- Hip surveillance protocols in CP consist of clinical and radiographic examinations, which are interpreted with the Reimers Migration Percentage (MP)[3].
- Issues with hip surveillance at London Health Sciences Center (LHSC) include difficulty in accessing orthopaedic care and inappropriate radiographic technique and reporting.

Objective

The purpose of this Quality Improvement initiative was to improve the technical quality of radiographs and reporting of radiographs obtained for the purpose of hip surveillance in cerebral palsy.

Methods

- A standard radiographic requisition form for CP surveillance was developed and implemented.
- Using a retrospective chart review, children with CP, being cared for at LHSC, were identified.
- Radiographs, before and after the requisition implementation, were assessed by a paediatric orthopaedic surgeon to determine image quality and MP.
- Radiographs were analyzed based on the number of views, radiographic quality, MP inclusion in radiologist reports, and concordance of the reported MP/impression between the orthopaedic surgeon and the radiologist.

Results

- The percentage of CP surveillance radiographs ordered with the novel requisition form after implementation, increased from 47/64 (73%) to 12/14 (86%) within the first eight months. **(Figure 1)**
- The proportion of CP hip surveillance radiographs that included two-views improved from 90% (46/51) to 94% (60/64) following the educational initiative. **(Table 1)**

Figure 1. *Ratio of CP surveillance Xrays ordered with novel requisition form in the first two years post-implementation*

Number of Radiographic Views	Pre-educational Initiative (N=51)	Post-educational Initiative (N=64)
	% (n)	
Two	90.0 (46)	94.0 (60)
Three	8.0 (4)	6.0 (4)
Four	2.0 (1)	0.0 (0)

Table 1. Number of radiographic views taken for cerebral palsy hip surveillance before and after educational initiative implemented

Radiographic Quality	Pre-educational Initiative (N = 51)	Post-education Initiative (N=64)
	% (n)	
Very good	22.0 (11)	64.0 (41)
Good	29.0 (15)	20.0 (13)
Neutral	33.0 (17)	13.0 (8)
Poor	8.0 (4)	3.0 (2)
Very Poor	8.0 (4)	0.0 (0)

Table 3. Radiographic quality of CP hip surveillance images before and after educational initiative implemented

Impression of Hip Migration Risk	Pre-educational Initiative (N=51)	Post-educational Initiative (N=64)
	% (n)	
Concordance	75.0 (38)	92.0 (59)
Discordance	25.0 (13)	8.0 (5)

Table 2. Concordance between pediatric orthopaedic surgeon and radiologist for overall hip migration risk before and after novel requisition form implemented

- Concordance between the paediatric orthopaedic surgeon and radiologist for overall hip migration risk was 75% (38/51) before the interventions, and 92% (59/64) after it was implemented. **(Table 2)**
- Radiographic quality improved with 51% (26/51) deemed good or very good prior to the interventions, compared to 84% (54/64) after the interventions. **(Table 3)**

Conclusions

- Implementing an educational campaign and a standardized requisition form for hip surveillance radiographs in children with CP improved the quality of images, the number of views required, and concordance of interpretation between surgeons and radiologists.
- Uptake of a standardized requisition form was successful, with the potential to improve through educational initiatives.
- We plan to assess the feasibility of incorporating the HipScreen App into our hip surveillance strategy to measure concordance. This will improve access to hip surveillance by decoupling orthopaedic assessment from hip surveillance protocols.

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ePoster 32. Radiographic Angles after Posterior Medial Lateral Release are Associated with Increased Rates of Reoperation in Neuromuscular Clubfoot

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Background: Congenital talipes equinovarus, or clubfoot, occurs in up to 50% of patients with spina bifida (SB) and 90% with arthrogryposis (AR). Many patients fail serial casting and require surgical intervention with posterior medial lateral release (PMLR). The evaluation of radiographic angles before and after PMLR and their association with long-term outcomes has not been previously reported; thus, we hypothesized that postoperative changes in radiographic indices during the first five years may predict which patients require subsequent operations.

Methods: Retrospective chart review was performed on cases of PMLR in SB and AR patients from 1/1/2007-6/30/2022, including concurrent procedures and reoperations. Subjects were excluded with less than three-year follow-up or incomplete electronic medical records. Lateral and anteroposterior (AP) foot radiographs were analyzed pre- and post-PMLR with Centricity (General Electric Healthcare, Chicago, IL, USA) Picture Archiving and Communication System (PACS). Talocalcaneal (AP), Talo-1st metatarsal (AP), talocalcaneal (lateral), calcaneal-5th metatarsal (lateral), and Meary's (Talo-1st metatarsal (lateral) angle were measured by a single author. Talar head and dome morphology were classified according to Pinto et al. and compared to normal age variants according to the University of California San Diego Musculoskeletal Radiology database (bonepit.com). Statistical analysis included single-factor ANOVA and Chi-square tests.

Results: 51 patients with 79 cases of clubfeet treated with PMLR at a tertiary children's hospital were identified. Of the 54 cases of clubfeet that were included, pre- and post-operative films were available in 29 patients and the time elapsed was an average of 440 days (SD=583 days). Average angles and standard deviation before and after PMLR are shown in Table 1. Greater change in calcaneus-5th metatarsal angle (lateral) was associated with a future need for reoperations of any kind (p=0.040). In patients with AR, a smaller change in talocalcaneal angle (lateral) after PMLR was associated with a future need for talectomy (p=0.048). Greater talo-1st metatarsal angle (AP) after PMLR was associated with a future need for reoperations of any kind (p=0.040) in patients with SB. Neither talar head and dome morphology nor talocalcaneal (AP) and Meary's angles were associated with differences in reoperation or talectomy rate
Conclusion: While PMLR remains a safe and successful treatment in the short term, many neuromuscular clubfeet will require additional procedures, including salvage talectomy. These results suggest that the degree of correction in PMLR, assessed radiographically, may be associated with the need for reoperation or talectomy in the future. This may help orthopaedic surgeons identify intraoperative radiographic goals for correction and counsel patients and families about the long-term prognosis after PMLR.
Significance: To our knowledge, this is the first study assessing the radiographic outcomes associated with PMLR and correlation with long-term outcomes, including talectomy, in the treatment of neuromuscular clubfoot.

Angle	**Spina bifida**		**Arthrogryposis**	
	Pre-PMLR	*Post-PMLR*	*Pre-PMLR*	*Post-PMLR*
Talocalcaneal (AP)	36.5±18.9	36.8±14.7	31.0±18.9	28.0±14.7
Talo-1st MT (AP)	21.7±13.9	14.8±12.4	42.8±13.9	24.3±12.4
Talocalcaneal (lat)	30.2±14.4	28.5±13.5	27.0±14.4	15.6±13.5
Calcaneus-5th MT (lat)	166.7±9.9	161.4±14.3	131.0±9.9	169.5±14.3
Meary's (lat)	22.2±21.7	14.8±10.6	32.4±21.7	12.2±10.6

Table 1: Radiographic angles (in degrees) with the average and standard deviation displayed for patients with spina bifida and arthrogryposis before and after PMLR.

ePoster 33. Trends in Timing of Hip Surgery in Children with Cerebral Palsy: Is Surgery Being Performed Earlier? A National Observational Study from 2010-2020

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Background: Hip instability is a particular concern in pediatric cerebral palsy (CP) patients, occurring due to the combination of abnormal muscle forces, joint laxity, and bony abnormalities. It is estimated that approximately one-third of individuals with CP will develop hip displacement, which can lead to pain, functional limitations, and decreased quality of life. Hip surveillance, consisting of serial physical exams and hip radiographs, plays a critical role in the early detection of hip displacement. Due to the progressive nature of hip displacement in CP, it is thought that earlier surgical interventions may be beneficial. However, the translation of increased hip surveillance practices to earlier surgical intervention on a national scale is not well described in the literature. The purpose of this study was to determine the recent trends in the surgical timing of hip interventions in children with CP.
Methods: A retrospective observational study was conducted using a large national insurance claims database. Patients with a diagnosis of CP during the years of 2010 to 2021 were identified. Patients 10 years of age and younger were included. Those who underwent surgical hip procedures including open reduction, adductor tenotomy, and pelvic

osteotomy were identified. Patients were categorized by their age on the date of surgery and year of the procedure. Patients aged 1-4 years and patients aged 5-10 years were analyzed as separate age categories. Ordinary least squares linear regression analysis on temporal trends was conducted. The threshold of significance was set at $p<0.05$. Finally, the compounded annual growth rate (CAGR) was calculated to quantify the overall annualized changes based on year 2021 compared to the year 2010.

Results: A total of 309,677 CP patients ages 10 years old or less were identified. For CP patients aged 1-4 years old, the percentage treated with a surgical hip procedure increased from 10.2% in 2010 to 19.4% in 2021. In the 5-10 year-old age group, the surgery rate peaked at 14.9% in 2016 and steadily declined to 11.5% in 2021. The overall compounded annual growth rate (CAGR) from 2010 to 2021 was +6.03% for the 1-4 year-old group and +0.88% for the 5-10 year-old group. Linear regression demonstrated a significant association between year and the percentage of operations for patients ages 1-4 ($R2=0.792$, $p<0.001$), but not ages 5-10 ($R2=0.019$, $p=0.704$).

Conclusion: Rates of surgical hip procedures in 1-4 year-old CP patients have been increasing since 2010, whereas the rate in 5-10 year-old CP patients has been decreasing since 2016.

Significance: Our results suggest CP patients are undergoing surgical hip interventions at younger ages in recent years. Further research is needed to determine if a causal relationship exists between hip surveillance practices and the rise in earlier hip surgeries in CP patients.

Table 1. Cerebral Palsy Patients Identified, By Age and Year

	Patient Age in Years:										
Year	**Total**	**<1**	**1**	**2**	**3**	**4**	**5-6**	**7-8**	**9-10**	**<5**	**5 to 10**
Total	309,667	3,029	17,541	30,799	38,139	41,502	59,606	59,924	59,127	131,010	178,657
2010	31,303	420	1,990	3,026	3,354	3,242	6,512	6,321	6,438	12,032	19,271
2011	33,517	355	1,858	3,110	3,623	3,722	7,274	6,909	6,666	12,668	20,849
2012	35,049	391	1,919	3,021	3,690	3,957	7,873	7,265	6,933	12,978	22,071
2013	37,283	370	1,907	3,111	3,745	4,022	8,715	8,013	7,400	13,155	24,128
2014	37,660	317	1,749	3,008	3,622	4,055	8,744	8,398	7,767	12,751	24,909
2015	36,705	280	1,654	2,873	3,478	3,773	8,275	8,589	7,783	12,058	24,647
2016	36,347	235	1,449	2,693	3,406	3,687	8,059	8,579	8,239	11,470	24,877
2017	35,061	191	1,290	2,474	3,191	3,589	7,767	8,124	8,435	10,735	24,326
2018	32,523	166	1,253	2,333	2,891	3,209	7,145	7,529	7,997	9,852	22,671
2019	31,918	135	1,083	2,215	2,916	3,137	6,996	7,628	7,808	9,486	22,432
2020	27,229	131	776	1,644	2,350	2,824	6,082	6,640	6,782	7,725	19,504
2021	24,153	38	613	1,291	1,873	2,285	5,658	6,038	6,357	6,100	18,053

Table 2. Yearly Percent Prevalence of Hip Surgery in Cerebral Palsy Patients by Age in the United States from 2010 to 2021

Procedure and Age Group	**Average**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**CAGR**
Open Reduction of Hip Dislocation (%)														
<5	0.3	0	0.3	0.4	0.4	0.3	0.2	0.4	0.4	0.3	0.3	0.2	0.6	*

5 to 10	0.4	0.4	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	**0.0%**
Adductor Tenotomy (%)														
<5	6.3	5.1	5.4	5.5	5.8	6.4	6.1	6.4	5.9	6.1	6.8	6.9	8.9	**+5.2%**
5 to 10	6.1	4.9	5.6	5.9	6.4	6.8	6.9	6.9	6.2	6.3	6.1	5.5	5.1	**+0.4%**
Hip Osteotomy (Pelvic or Femoral, %)														
<5	6.6	5.1	5.1	5.2	5.5	6.1	6.4	7.1	6.7	6.5	7.7	8.3	9.9	**+6.2%**
5 to 10	6.7	5.2	6	6.6	7.1	7.3	7.5	7.6	7.2	6.9	6.8	6.6	6.0	**+1.3%**
All Hip Surgeries (%)														
<5	13.2	10.2	10.8	11	11.6	12.9	12.7	13.9	12.9	12.9	14.8	15.4	19.4	**+6.0%**
5 to 10	13.2	10.5	12	13	14	14.6	14.8	14.9	13.9	13.6	13.4	12.5	11.5	**+0.9%**
<1	5.2	6.7	3.4	8.7	3	3.5	3.9	6	6.3	-	-	-	-	**-**
1	12.6	9.8	8.9	7.7	8.9	10.5	11.7	12	12.2	12.1	14	20.6	22.7	**+7.9%**
2	12.6	9.2	10.4	10.3	9.6	11.5	10.9	13.7	12.6	12	14.3	15.4	21.4	**+8.0%**
3	13.4	9.8	11.3	12.3	12.6	13.3	13.1	13.5	13.4	13	14.4	14.7	19.8	**+6.5%**
4	14.5	12.1	12.4	12.2	14.3	15.4	14.8	15.6	13.4	14.3	16.5	15.1	17.4	**+3.4%**
5-6	12.3	10.4	11.9	13.1	12.7	13.1	13.6	13.3	12.3	11.9	12.5	11.7	11.3	**+0.8%**
7-8	13.5	11	12.2	13	14.6	15.5	14.8	15.1	15	14	13.1	12.3	11.2	**+0.1%**
9-10	13.9	10.1	11.8	12.9	14.7	15.3	16.2	16.3	14.3	14.7	14.5	13.5	12.1	**+1.7%**

Hyphens represent value unable to be calculated due to low patient counts limiting database reporting

CAGR, compounded annual growth rate

*Unable to be calculated due to starting value of 0

Table 3. Compounded Annual Growth Rate and Linear Regression Analysis of All Hip Surgeries in Cerebral Palsy Patients Ages Less than 5 Years old versus Ages 5 to 10

	Age Less than 5 Years			Age 5-10 Years		
	Total	**All Hip Surgeries**		**Total**	**All Hip Surgeries**	
Year	*N*	*N*	*Percent*	*N*	*N*	*Percent*
2010	12,032	1,226	10.2%	19,271	2,022	10.5%
2011	12,668	1,372	10.8%	20,849	2,495	12.0%
2012	12,978	1,431	11.0%	22,071	2,871	13.0%
2013	13,155	1,526	11.6%	24,128	3,366	14.0%
2014	12,751	1,647	12.9%	24,909	3,637	14.6%
2015	12,058	1,533	12.7%	24,647	3,658	14.8%

	Age Less than 5 Years			Age 5-10 Years		
2016	11,470	1,593	13.9%	24,877	3,705	14.9%
2017	10,735	1,390	12.9%	24,326	3,377	13.9%
2018	9,852	1,269	12.9%	22,671	3,077	13.6%
2019	9,486	1,406	14.8%	22,432	3,003	13.4%
2020	7,725	1,186	15.4%	19,504	2,441	12.5%
2021	6,100	1,183	19.4%	18,053	2,085	11.5%
Mean ± SD			13.2 ± 2.5%			13.2 ± 1.4%
CAGR			+6.0%			+0.9%
R^2			0.792			0.019
p-value*			**<0.001**			0.704

Bolded values represent significance below threshold of p=0.05

*Linear regression

Figure 1. Yearly Incidence Rates of Hip Surgery in Cerebral Palsy Patients by Age Group in the United States from 2010 to 2021

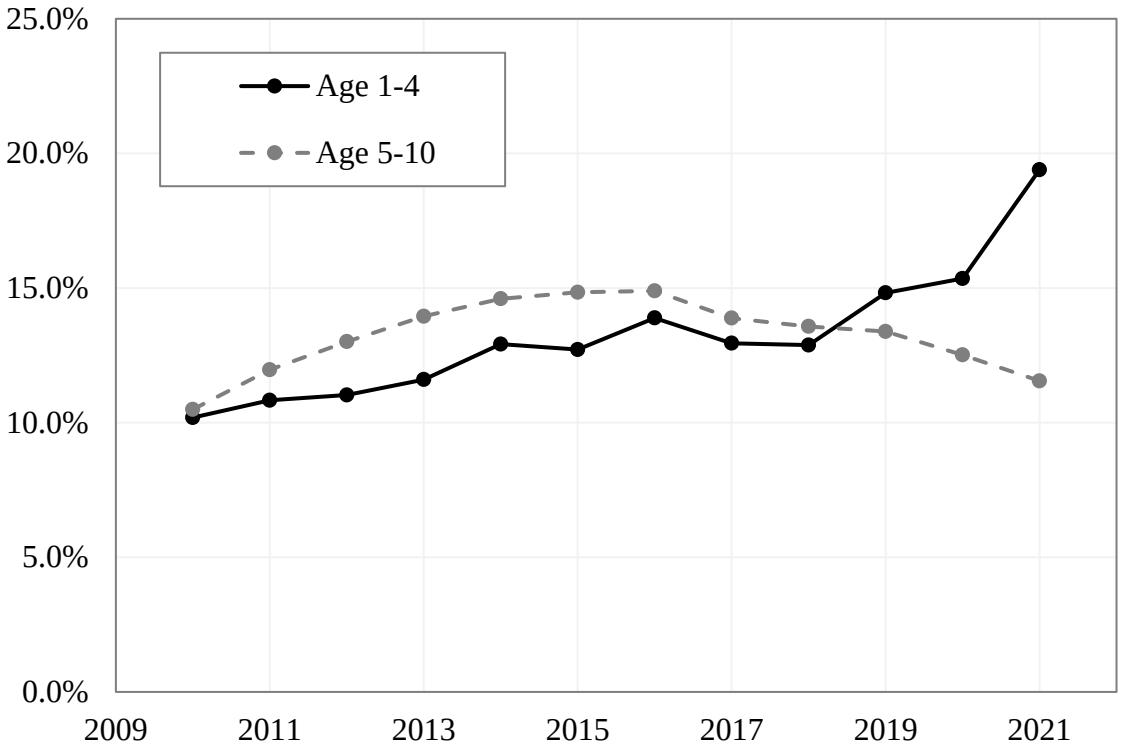
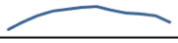
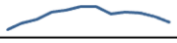


Figure 2. Spark Lines of Trends in Hip Surgery for Cerebral Palsy Patients by Age from 2010 to 2021

Procedure and Age Group	Sparkline	CAGR		Sparkline	CAGR
Open Reduction of Hip Dislocation			*All Hip Surgeries*		
Less Than 5 Years Old		*	**Less Than 5 Years Old**		+6.0%
5 to 10 Years Old		0.0%	**5 to 10 Years Old**		+0.9%
			<1 Year Old		*
Adductor Tenotomy			**1 Year Old**		+7.9%
Less Than 5 Years Old		+5.2%	**2 Years Old**		+8.0%
5 to 10 Years Old		+0.4%	**3 Years Old**		+6.6%
			4 Years Old		+3.4%
Hip Osteotomy (Pelvic or Femoral)			**5-6 Years Old**		+0.8%
Less Than 5 Years Old		+6.2%	**7-8 Years Old**		+0.1%
5 to 10 Years Old		+1.3%	**9-10 Years Old**		+1.7%

CAGR, compounded annual growth rate

*Unable to be calculated due to starting value of 0

Supplemental Table 1. Codes used for patient identification

Group	Codes Used
Cerebral Palsy	ICD-9-D-343.0:ICD-9-D-343.9, ICD-10-D-G800:ICD-10-D-G809
Open Reduction of Hip Dislocation	CPT-27258, CPT-27259
Adductor Tenotomy	CPT-27001
Hip Osteotomy	CPT-27165, CPT-27146, CPT-27147, CPT-27151, CPT-27156

Quality, Safety, Value Indicators

ePoster 34. Can We Screen for Limb Length Discrepancy on Spinal Radiographs of Patients with Scoliosis?

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Background: In evaluating patients with scoliosis, it is important to exclude an associated limb length discrepancy (LLD) since this may contribute a functional component to the structural scoliosis. In many centers today, LLD can only be established or excluded by direct measurements of limb lengths on lower limb radiographs.

Introduction: The aim of this study was to determine whether height differences in the level of the iliac crests or femoral heads on erect spinal radiographs can be used as a proxy for screening and surveillance of limb length discrepancy (LLD) in patients with scoliosis.

Methods

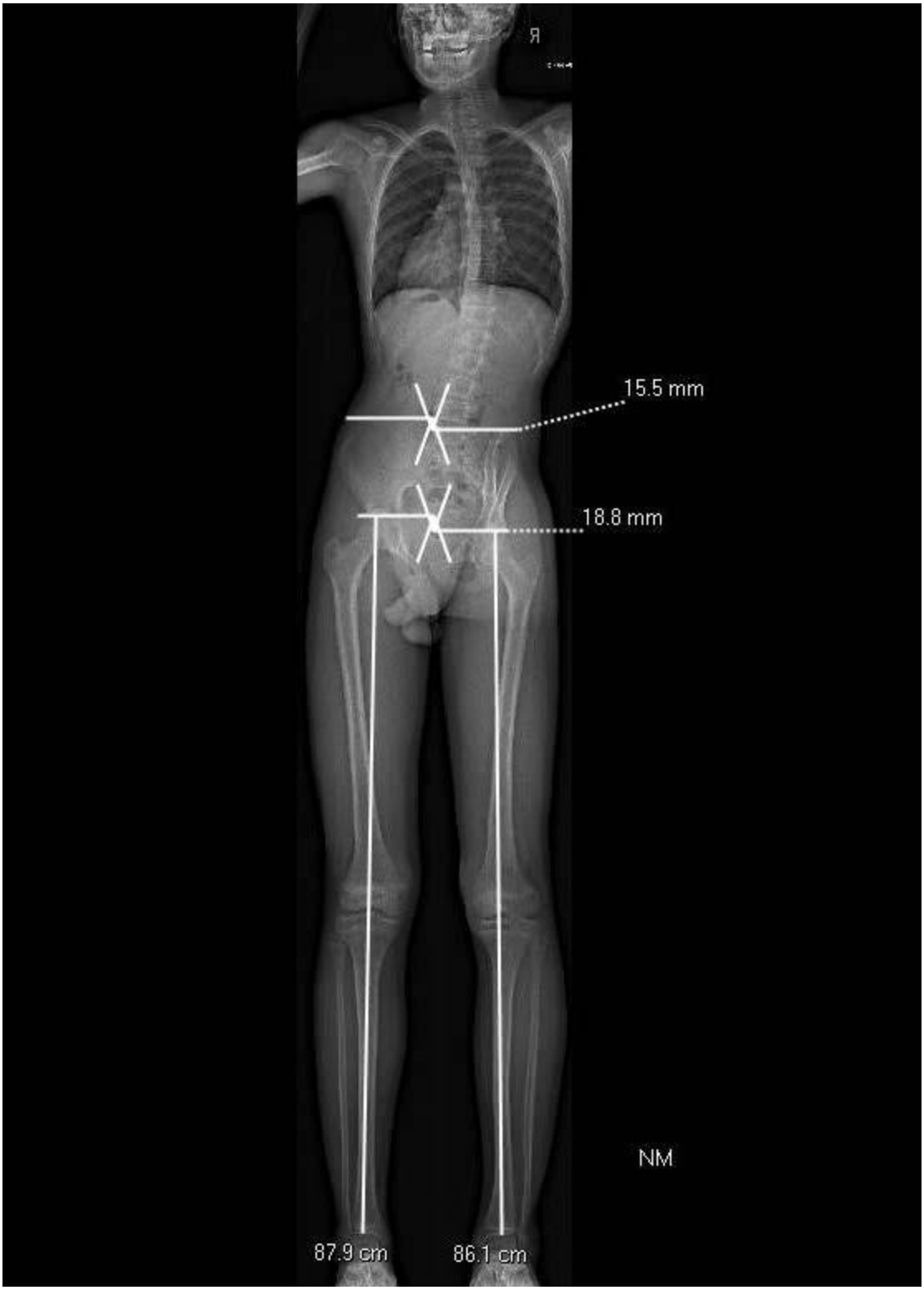
Whole body (spine and lower limbs) PA and lateral standing radiographs of scoliosis patients acquired using slot scanning digital radiography were retrospectively reviewed. Direct measurement of each limb was taken from the top (highest point) of the femoral head to the middle of the tibial plafond; any difference between the sides was recorded as the LLD. In addition, the PACS Software tool to measure height difference was used to determine femoral head height difference (FHHD) and iliac crest height difference (ICHD). The relationships between LLD & FHHD, and LLD & ICHD were analyzed using Pearson's correlation coefficient. Bland-Altman plots were used to measure agreement between LLD & FHHD, and LLF & ICHD respectively.

Results: Over a 6-month period (Nov 2019 - Apr 2020), radiographs of 141 patients (92 females, 49 males) with an average age of 12.0 ± 2.65 years were analyzed. Patients with lower limb contractures or who did not stand with knees fully extended were excluded. A strong correlation ($r=0.730$, $p<0.001$) was found between LLD and FFHD; the correlation between LLD and ICHD was weaker ($r=0.585$, $p<0.001$). Bland-Altman analysis showed good agreements of LLD with FHHD and ICHD.

Conclusion: FHHD and ICHD can be used to screen for LLD on spinal PA radiographs. FHHD has the better correlation and with LLD and should be the preferred indirect measurement.

Significance: Lower limb radiographs may not be necessary to exclude LLD in patients with scoliosis; FHHD and ICHD can be used as indirect measurements or proxies.

FHHD and/or ICHD should preferably be measured at the first clinic visit (index radiograph) to exclude any associated LLD at the outset. These measurements can be also be used for LLD surveillance of mild discrepancies on subsequent radiographs.



ePoster 35. Evaluation of Patient-Reported Outcome Measures (PROMs) in the Pediatric Musculoskeletal Oncology Literature: A Systematic Review Using the EMPRO Tool

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Background: Clinical outcomes have classically been reported from the physician's point of view, which often overlooks the patient's perception of treatment. Patient-reported outcome measures (PROMs) were subsequently developed to

quantify outcomes from the patient's perspective. While pediatric-specific PROMs exist, most PROMs used in pediatric literature are not validated for children and there is no consensus on the ideal PROM for pediatric orthopedics.

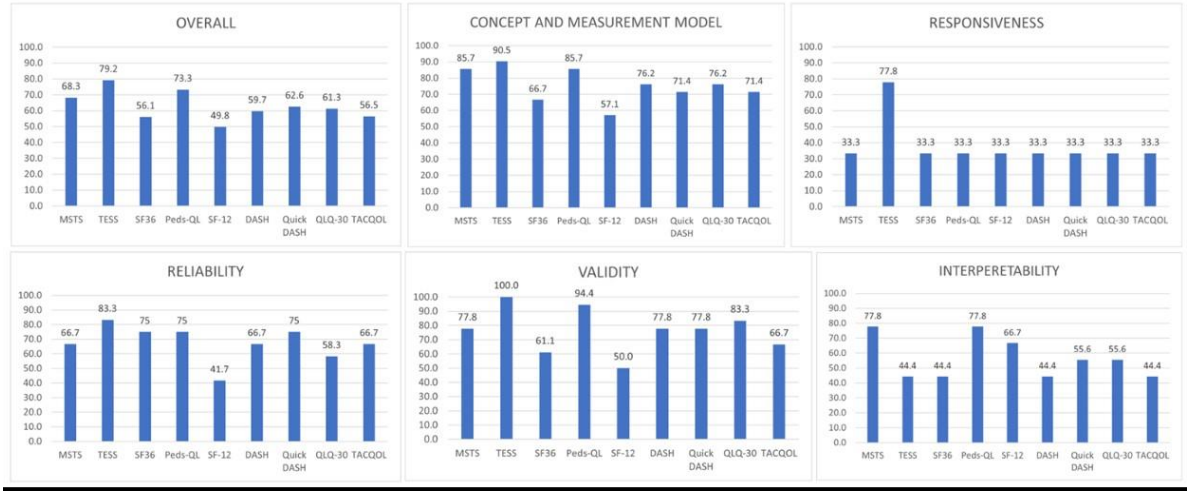
Introduction: In pediatric musculoskeletal oncology, PROMs are particularly important as they measure the impact surgical intervention has on quality of life from the patient's perspective, considering the emotional burden these procedures can impose on patients and their families. Currently, no studies compare existing PROMs used in this context. The goal of this study is to identify PROMs used in the pediatric musculoskeletal oncology literature and assess these instruments using a standardized system.

Methods: A systematic literature review was conducted using PubMed, Cochrane database, and Embase for studies pertaining to the treatment of pediatric musculoskeletal tumors from 2010 to 2020. Only studies that reported the use of PROMs to assess quality of life were included. Adult studies, case reports, conference abstracts, and reviews were excluded. The 10 most frequently used PROMs were evaluated using the EMPRO tool, which is a standardized evaluation method that measures each instrument's validity, reliability, responsiveness, and interpretability.

Results: There were 316 articles that met inclusion criteria, identifying 82 different PROMs used in pediatric musculoskeletal tumor surgery. The Musculoskeletal Tumor Society Score (MSTS) was the most frequently-cited PROM (152 studies), followed by the Toronto Extremity Salvage Score (TESS, 37 studies), Short Form-36 (SF36, 27 studies), Pediatric Quality of Life Questionnaire (Peds-QL, 11 studies), Short Form-12 (SF-12, 6 studies), Disability of the Arm, Shoulder and Hand (DASH, 6 studies), Quick Disabilities of the Arm, Shoulder and Hand (Quick DASH, 5 studies), Quality of Life Questionnaire 30 (QLQ-30, 5 studies) and TNO AZL Children's Quality of Life (TACQOL, 4 studies). Per Figure 1, the TESS performed highest on EMPRO evaluation (79.2/100), followed by the Peds-QL (73.3) then MSTS (68.3). The TESS consistently scored the highest amongst each category assessed by the EMPRO tool.

Conclusion: The MSTS is the most used PROM in the pediatric musculoskeletal oncology literature, while TESS scored higher on validity, reliability, and responsiveness (Table 1). PROMs not validated in the pediatric population are used extensively in the literature and are ideal candidates for validation and improvement to better suit this population.

Significance: This is the first study that categorizes and evaluates PROMs used in pediatric musculoskeletal oncology. MSTS and TESS were the most used PROMs, and both scored highly on EMPRO assessment. However, there is a need for PROMs validated in the pediatric population to improve the assessment and reporting of patient-reported outcomes.



	MSTS	TESS	SF36	Peds-QL	SF-12	DASH	Quick DASH	QLQ-30	TACQOL
Concept and measurement model	85.7	90.5	66.7	85.7	57.1	76.2	71.4	76.2	71.4
1. Concept of measurement stated	++++	++++	++++	++++	++++	++++	++++	++++	++++
2. Obtaining and combining items described	++++	++++	++++	++++	++++	++++	++++	++	++++
3. Rationality for dimensionality and scales	+++	+++	++	++++	++	+++	+++	++++	+++
4. Involvement of target population	+++	++++	+	++	+	+	+	++	+
5. Scale variability described and adequate	++++	++++	++++	++++	++++	++++	++++	++++	++++
6. Level of measurement described	+++	+++	+++	+++	+++	+++	+++	+++	+++
7. Procedures for deriving scores	++++	++++	+++	++++	+	++++	+++	++++	+++
Reliability	66.7	83.3	75	75	41.7	66.7	75	58.3	66.7
Reliability: internal consistency	58.3	75.0	75.0	66.7	41.7	58.3	66.7	41.7	66.7
8. Data collection methods described	++++	++++	++++	++++	++++	++++	++++	++++	++++
9. Cronbach's alpha adequate	+++	++++	++++	++++	+++	++++	++++	++	++
10. IRT estimates provided	+	++	+	+	+	+	++	+	+++
11. Testing in different populations	+++	+++	++++	+++	+	++	++	++	+++
Reliability: reproducibility	66.7	83.3	58.3	75.0	33.3	66.7	75.0	58.3	58.3
12. Data collection methods described	++++	++++	++++	++++	++++	++++	++++	++++	++++
13. Test–retest and time interval adequate	++++	++++	+++	++++	++	++++	++++	++++	++
14. Reproducibility coefficients adequate	+++	++++	+++	++++	+	+++	++++	++	++
15. IRT estimates provided	+	++	+	+	+	+	+	+	+++
Validity	77.8	100.0	61.1	94.4	50.0	77.8	77.8	83.3	66.7
16. Content validity adequate	++++	++++	++	++++	++	++++	++++	+++	++++
17. Construct/criterion validity adequate	++++	++++	++++	++++	++	++++	+++	+++	++
18. Sample composition described	++++	++++	++++	++++	++++	++++	++++	++++	++++
19. Prior hypothesis stated	++	++++	++	++++	+++	++	+++	++++	++
20. Rational for criterion validity	+++	++++	+	++++	++	++++	++++	++++	++++
21. Tested in different populations	+++	++++	++++	+++	++	++	++	+++	++
Responsiveness	33.3	77.8	33.3	33.3	33.3	33.3	33.3	33.3	33.3
22. Adequacy of methods	++++	++++	++++	++++	++++	++++	++++	++++	++++
23. Description of estimated magnitude of change	+	+++	+	+	+	+	+	+	+
24. Comparison of stable and unstable groups	+	+++	+	+	+	+	+	+	+
Interpretability	77.8	44.4	44.4	77.8	66.7	44.4	55.6	55.6	44.4
25. Rational of external criteria	+++	+++	+++	+++	+++	+++	+++	+++	+++
26. Description of interpretation strategies	++++	++	++	++++	++++	++	+++	+++	++
27. How data should be reported stated	+++	++	++	+++	++	++	++	++	++
Overall Score	**68.3**	**79.2**	**56.1**	**73.3**	**49.8**	**59.7**	**62.6**	**61.3**	**56.5**
Burden									
Burden: respondent	55.6	66.7	77.8	77.8	100.0	55.6	55.6	55.6	88.9
28. Skills and time needed	++	+++	+++	++++	++++	+++	++++	++	+++
29. Impact on respondents	+++	+++	+++	+++	++++	+++	+++	++++	++++
30. Not suitable circumstances	+++	+++	++++	+++	++++	++	+	++	++++
Burden: administrative	66.7	83.3	50.0	100.0	25.0	91.7	91.7	91.7	83.3
31. Resources required	++++	+++	+++	++++	++	++++	++++	++++	+++
32. Time required	+++	++++	++++	++++	++	++++	++++	++++	++++
33. Training and expertise needed	++	++++	++	++++	++	++++	++++	++++	++++
34. Burden of score calculation	+++	+++	+	++++	+	+++	+++	+++	+++
Alternative forms of administration	83.3	83.3	83.3	83.3	83.3	83.3	83.3	0.0	83.3
35. Metric characteristics of alternative forms	++++	++++	++++	++++	++++	++++	++++	+	++++
36. Comparability of alternative forms	+++	+++	+++	+++	+++	+++	+++	+	+++

ePoster 36. Nonoperative vs. Operative Management of Pediatric Grade 1 Open Fractures

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University at Buffalo, Buffalo, NY

Background: Postoperative infections jeopardize patient outcomes despite surgical success.
Introduction: We aim to study the characteristics and local epidemiology of infections after pediatric orthopaedic surgery, as a basis for infection prophylaxis and for guiding management.
Methods: Patients younger than 18 years who underwent elective or emergency orthopaedic surgeries at 2 tertiary referral hospitals between 1997 and 2022 were analyzed. Postoperative infections were identified through medical records, positive microbiological culture growth, antibiotic prescriptions, and reoperations. Operations for native musculoskeletal infections, closed reductions without incisions, Botox injections, cast applications and examination or manipulation under anesthesia were excluded. Patient demographics, disease, and microbiological factors were investigated. Analysis was performed by one orthopaedic resident, one orthopaedic specialist and one microbiologist.
Results: 353 (179 girls and 174 boys) out of 7724 patients who had undergone surgery experienced postoperative infections (4.6%). The average age of these patients was 11.50 +/- 4.56 years.
The median time of postoperative infection was 25 days after the index operation.
193 cases involved lower limbs (2.5%), 107 cases in the spine (1.4%), 53 in the upper limbs (0.7%) and 23 in the pelvis (0.3%). 182 cases were deep infections (51.6%) and 171 cases were superficial infections (48.4%), with 253 cases involving implants.

161 of these cases were deformity correction and reconstruction surgeries (2.1%), 85 cases involved lesion and soft tissue excision and debridement (1.1%), 71 cases were fracture fixation and soft tissue repair (0.9%), and 31 cases were implant removal (0.4%). 12 cases were malignancies (0.2%).
Among postoperative infection cases, 99 patients were neurodiverse (28.0%), 44 patients had intellectual disabilities (12.5%) and 19 patients had neuromuscular conditions (5.4%).
135 (1.7%) cases cultured methicillin-sensitive Staphylococcus aureus (MSSA), 73 (0.9%) cases cultured coagulase-negative Staphylococci, 55 (0.7%) cases had polymicrobial growth, 24 (0.3%) cases cultured Enterobacterales, 19 (0.2%) cases cultured Pseudomonas and non-fermenters.
There were 156 cases requiring reoperations (2%) and 147 cases requiring readmission for reoperation (1.9%). The median length of stay for patients requiring readmission for reoperation was 17 days.
Conclusion: Postoperative infection rate was 4.6% in our multicenter cohort over the past 25 years. Patients who are neurodiverse were at higher risk of postoperative infections, possibly due to the difficulty in wound care and compliance to postoperative protocols. Methicillin sensitive Staphylococcus aureus was the culprit in most postoperative infections.
Significance: MSSA and coagulase-negative Staphylococcus coverage should be included for antibiotic prophylaxis against infections in pediatric orthopaedic surgery. Neurodiverse patients are at higher risk of postoperative infection – patients' caregivers counselled accordingly, and clinicians should maintain high vigilance.

Table 2. Antibiotic Characteristics, Clinical Outcomes

Characteristic	Non-operative (n=66)	Operative (n=40)
Received IV Antibiotics (n)		
Yes	6.1% (62)	92.5% (37)
Undocumented	93.9% (4)	7.5% (3)
IV Antibiotic		
Ancef	77.3% (51)	62.5% (25)
Ancef and Gentamycin	3.0% (2)	2.5% (1)
Clindamycin	7.6% (5)	2.5% (1)
Keflex	1.5% (1)	0% (0)
Unasyn	0% (0)	2.5% (1)
Undocumented	10.6% (7)	30% (12)
Received Oral Antibiotics (n)		
Yes	83.3% (55)	52.5% (21)
No	9.1% (6)	20.0% (8)
Undocumented	7.6% (5)	27.5% (11)
Oral Antibiotic		
Bactrim	1.5% (1)	0% (0)
Clindamycin	6.1% (4)	2.5% (1)
Keflex	71.2% (47)	47.5% (19)
Undocumented	21.2% (14)	50.0% (20)
Hospital Admission (n)		
Yes	19.7% (13)	72.5% (29)
No	74.2% (49)	15.0% (6)
Undocumented	6.1% (4)	12.5% (5)
Evidence of Healing (n)		
Yes	87.9% (58)	87.5% (35)
Undocumented	12.1% (8)	12.5% (5)
Deep Infection requiring OR (n)		
Yes	0% (0)	7.5% (3)
No	81.8% (54)	85.0% (34)
Undocumented	18.2% (12)	7.5% (3)
Length of Follow Up (days)	293.43 (±550.39)	458.67 (±754.01)

ePoster 37. Parent Perspectives on Firearm Safety Discussions in a Pediatric Orthopaedic Surgery Clinic

William Allen MD; Emily Wilson; Gabrielle Rauls; Thomas Geiger; Ryan McFadden; William Barfield, PhD; Matthew A. Dow, MD; Robert F. Murphy, MD; Sara Van Nortwick, MD
The Medical University of South Carolina, Charleston, SC

Background: Pediatric orthopaedic surgeons often communicate with general pediatricians to facilitate patient care, but little data exists on communication preferences. This study investigates pediatrician preferences regarding when they would like to receive patient updates from pediatric orthopaedists, which communication modalities they prefer, and what information they like to receive.
Methods: We developed a 19-question email survey to evaluate pediatrician preferences on communication modality, timing, frequency, and what data they deem important as it relates to musculoskeletal patient care.
Results: A total of 96 pediatricians in our geographical region completed the survey. Among the pediatricians, 53.2% preferred fax, 42.6% electronic health record (EHR) inbox message, 20.2% email, 12.8% mail, and 7.4% call/voicemail. The majority (67.4%) preferred information in a traditional note format, while 26.1% preferred a summary in paragraph format. Patient diagnosis and treatment plan for shared patients were the most important pieces of information for pediatricians to receive from pediatric orthopaedists. Of various patient specific scenarios included in the survey, referrals for osteomyelitis concern and developmental dysplasia of the hip requiring treatment were considered most important for pediatric orthopaedists to send updates to the pediatrician. In terms of frequency of communication, over half of the pediatricians (59.6%) desired updates after the first visit. Interestingly, only a minority of pediatricians appreciated communication after care plan changes (48.9%), after discharge (43.6%), and regarding surgery planning/completion (34.0%). Only 30.9% preferred updates after every orthopaedic visit.
Conclusion: Only 45% of pediatricians feel like current communication with pediatric orthopaedic surgeons is “always” or “often” adequate. Most of our surveyed pediatricians preferred occasional SOAP notes via fax as communication from pediatric orthopedic surgeons. The communication deemed most important to pediatricians related to referrals where the pediatrician makes the initial diagnosis and then refers the patient to orthopaedics for a condition with potential long-term patient impacts. Finally, pediatricians felt communication was most important following the first pediatric orthopaedic office visit.

ePoster 38. Preferences for Return to Sport for Patients Undergoing Cast Treatment for Distal Radial Metaphyseal Fractures: A Cross Sectional Survey of Primary Care Orthopedic Physicians and Orthopedic Surgeons

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Background: This study compares results of pediatric type I open fractures treated operatively vs. nonoperatively.
Introduction: Type I open fractures are defined as those with minimal soft tissue damage. In the pediatric population treatment includes prompt administration of intravenous antibiotics and either bedside irrigation with closed reduction and immobilization, or formal irrigation and debridement (I&D) and open reduction internal fixation (ORIF). Previous studies have found no significant difference in infection or other complications comparing treatment modalities.
Methods: Retrospective chart review identified patients via ICD-9 and ICD-10 codes correlating with grade 1 open fractures of long bones excluding femurs at the Buffalo John R. Oishei Children’s Hospital from 2000-2020. Nonoperative management included IV antibiotics, irrigation with sterile saline, application of sterile dressing and closed reduction and immobilization under conscious sedation. Patients admitted overnight for serial neurovascular checks remained on IV antibiotics while admitted. Operative management included formal I&D and ORIF. Patients were followed until healing was confirmed clinically and radiographically. Demographic characteristics, antibiotic administration, admission, and complications including infection were compared between treatment groups using the independent t-test, and chi squared or fisher exact test. Length of follow up was compared via Mann-Whitney U test. Radiographic healing was analyzed on radiograph via any sign of bridging bony callus at last follow up. P values < 0.05 were considered significant.
Results: 209 charts were screened, and patients 106 included (66 treated non-operatively (NO), 40 treated operatively (OR) (Table 1)). Patients were treated with IV antibiotics (NO 93.9%, OR 92.5%), predominately cefazolin (NO 77.3%, OR 62.5%). Nonoperative patients were more likely to be given oral antibiotics (NO 83.3%, OR 52.5%, p value 0.002). Nonoperatively, 74.2% were discharged without admission; 72.5% treated operatively were admitted ($p < 0.001$). There were three deep infections in the operative cohort requiring repeat operative I&D (p value 0.03) (Table 2). Other complications, including nonunion, malunion, superficial infection, unplanned return to the OR etc. are outlined in Table 3 (p value 0.048).

Conclusion: Our results suggest increased risk of infection with operative management of pediatric grade I open fractures. Bony healing appears to favor operative treatment; however, these patients were followed for longer. Overall, this study demonstrates nonoperative management as safe and effective treatment of pediatric grade I open fractures, and highlights benefits including decreased hospital admission, as well elimination of anesthesia risks.
Significance: Type I open fractures are associated with minimal soft tissue damage, and the well vascularized periosteum of the pediatric population allows for increased healing potential. Operative I&D may result in periosteal stripping and devascularization which may contribute in decreased delivery of antibiotics to the fracture site. Future directions of this research include prospective randomized controlled study of nonoperative vs. operative management in this population.

Table 1. Factors Affecting Physician Decision to Allow Return to Sport.

Factors	Reported Yes (N (%))	p-value
Healing time from injury	18 (94.7)	**<0.001**
Age at time of fracture	11 (57.8)	**<0.001**
Degree of fracture healing	10 (52.6)	**<0.001**
1 cortex bridged	2 (10.5)	
2 cortices bridged	6 (31.6)	
3 cortices bridged	1 (5.3)	
Declined	1 (5.3)	
Safe level of competition	13 (68.4)	**<0.001**
Playground/Informal	6 (31.6)	
Recreational/Non-Competitive	6 (31.6)	
Town or City Team/Travel Team	6 (31.6)	
Middle School Team	3 (15.8)	
High School Team	10 (52.6)	
Collegiate Team	9 (47.4)	
State Competition	9 (47.4)	
National Competition	10 (52.6)	
International Competition	10 (52.6)	
Solo Practices (No Competition)	10 (52.6)	
Team Practices (No Competition)	9 (47.4)	
Other	2 (10.5)	
Type of sport	19 (100)	**<0.001**
Baseball	3 (15.8)	
Basketball	2 (10.5)	
Football	9 (47.4)	
Hockey/Field Hockey	2 (10.5)	
Soccer	17 (89.5)	
Track and Field	16 (84.2)	
Tennis	6 (31.6)	
Swimming (racing, diving, etc.)	4 (21.1)	
Fencing	7 (36.8)	
Lacrosse	2 (10.5)	
Wrestling	2 (10.5)	
Ballet/dance	15 (78.9)	
Volleyball	3 (15.8)	
CrossFit/Gym	3 (15.8)	
Yoga/Pilates	11 (57.9)	
Boxing	2 (10.5)	
Gym class	8 (42.1)	
Gymnastics	2 (10.5)	
Playground/informal	9 (47.4)	
Other	5 (26.3)	
Patient quality of life	16 (84.2)	**<0.001**
Effect on team recruitment	12 (63.2)	**<0.001**
Patient request	8 (50)	**0.004**
Parent request	5 (26.3)	0.091

Spine

ePoster 39. Are 3D-Printed Anatomic Haptic Adolescent Idiopathic Scoliosis Spine Models Better Resident Training Tools when Compared to Conventional Training Modalities

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Background: 3D- printed anatomic haptic AIS spine model is a better resident training tool when compared to conventional training tools.

Introduction: Spinal deformity surgery requires a thorough understanding of complex three-dimensional pathoanatomy. Opportunities to directly interact with 3 dimensional (3D) pathoanatomy and surgical practice techniques are limited. 3D printers are able to create models that accurately mimic deformed AIS. Our goal is to determine if a 3D printed anatomic haptic AIS spine model can increase trainee accuracy of screw placement compared to conventional training tools.
Methods: This is a randomized controlled study. Using a historical clinical computed tomography of a patient with 50 degree Lenke 1 AIS, a three-dimensional model from T1-L5 was created. Thirty one orthopaedic trainees from two separate training programs were recruited and randomized into 3 groups. Cadaver (CG) had 10 residents, Sawbones (SG) had 9 and 3D model (3G) had 12 in the initial training cohort where they were taught how to insert pedicle screws in their respective models. A total of 25/31 residents completed the pedicle screw insertion test (CG=6, SG=7, 3G=12) 2-4 weeks post initial training. Breaches were recorded at each session and compared to assess each models' applicability in teaching and improving surgical technique. Trainees were also queried regarding their satisfaction (1-5) with the training model.
Results: The average number of breeches >2mm are shown in Figure 1. Compared to the other 2 methods of teaching, Sawbones had the most number of pedicle breeches. Trainees in the SG also had significantly improved accuracy at the post test session. There were no significant differences in the other 2 groups. When queried, 84% of residents chose to learn on a 3D model compared to sawbones and cadaver. Overall, the residents rated 4.7 for recommending the use of the 3D model in their training program.
A 3D printed anatomic haptic AIS spine model can serve as a resident training tool to help improve accuracy of pedicle screw placement in of AIS. We believe the present study illustrates the utility of having more accurate training tools for residents as they progress in training.

	Pre	Post	Diff	p
>=2mm				
Cadaver	0.83	0.17	-0.66	0.24
Sawbones	4.38	0.63	-3.75	0.001
3D	0.36	0.82	0.46	0.1

Figure 1. Number of resident breaches >=2mm recorded using cadaver, sawbones and 3D models at two different time points. P <0.05 represents statistical significance

ePoster 40. Characterizing the Spectrum of Scoliosis in Autism

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Introduction: Currently, no data exists on whether children with both ASD and adolescent idiopathic scoliosis (AIS) have distinct scoliosis curve types or varying surgical managements compared to neurotypical children. Our retrospective chart review at a single high volume scoliosis center spanning 5 years describes patterns of adolescent idiopathic scoliosis in children with ASD. We hypothesized that adolescents with autism spectrum disorders (ASD) would present with atypical scoliosis curve characteristics compared to neurotypical children.
Methods: Using ICD-10 codes, we constructed an electronic database of adolescents with a diagnoses of both AIS and ASD. We confirmed the diagnosis of ASD through a thorough review of clinician notes. To avoid confounding with syndromic conditions, adolescents with a syndrome independently associated with scoliosis were excluded. All participants were diagnosed with scoliosis between the ages of 10 to 18 consistent with AIS. We excluded other types of scoliosis including neuromuscular and congenital cases. All individuals included had radiographs available for independent interpretation by two fellowship trained pediatric orthopaedic surgeons.
Results: In our study, we describe Lenke curve types, demographics, and radiographic characteristics of 35 patients with both AIS and ASD treated at a single center over a five-year period. An atypical number of patients (23/35 patients; 64%) had sagittal plane abnormalities on radiograph. Sixteen of the 35 patients (46%) had a maximum thoracic kyphosis equal

to or greater than 40 degrees. Five of the 35 patients (14%) exhibited thoracolumbar junctional kyphosis. Of our 35 patients, 15 (43%) were treated surgically. For these patients, we calculated the length between initial appointment and definitive surgery, which ranged from 11 days to 3 years. Social and behavioral barriers limited 3 patients (9%) who were indicated for surgery from receiving surgical treatment.
Conclusion: Sagittal plane abnormalities, especially hyperkyphosis, are more common in ASD patients diagnosed with AIS than expected based on published AIS norms. These results suggest that scoliosis in ASD should potentially be considered a form of syndromic scoliosis rather than true AIS.

ePoster 41. Coronal and Sagittal Spinal Alignment Two Years after Posterior Dynamic Distraction Device (PDDD) Instrumentation for Adolescent Idiopathic Scoliosis

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Background: Instrumented fusion surgery is widely regarded as the gold standard for the treatment of severe adolescent idiopathic scoliosis (AIS). While outcomes are generally very good, spinal flexibility is reduced. The posterior dynamic distraction device (PDDD) has been developed and marketed as a non-fusion, motion-preserving alternative.
Introduction: The PDDD involves short segment pedicle screw-based instrumentation around the apex of the main curve. This device has a ratchet mechanism that allows gradual postoperative device lengthening, this accommodates patient growth and further curve correction in the coronal plane. Post-operatively, the initiation of early post-operative exercises further corrects the spinal deformity by motion-driven rod elongation.
The objective of this study was to determine coronal and sagittal alignment of the spine 2 years after PDDD instrumentation for AIS.
Methods: This is an IRB-approved, retrospective review of a single-surgeon series. Patients with AIS who met the indications and opted for PDDD were included; those with non-idiopathic scoliosis were excluded, as were those who had previous spinal procedures. Clinical and radiological parameters were assessed at baseline, as well as 1 week, and 2 years post-op. Complications if any were recorded.
Results: Between 2020 - 2021, 12 patients underwent PDDD instrumentation at our institution. The average age of the cohort was 14.8 years; 10 were female. There were 6 patients with Lenke 1 curves and an equal number with Lenke 5 scoliosis.
On the coronal plane, the PDDD significantly reduced the Cobb angle of the major curve at 1 week (42.42 ± 4.96° vs. 22.92 ± 4.40°, $p<0.001$) and at 2 years (42.42 ± 4.96° vs. 23.33 ± 5.82°, $p<0.001$).
On the sagittal plane, lumbar lordosis was significantly reduced from baseline at 1-week post-op (49.58 ± 6.27° vs. 40.92 ± 9.61°, $p=0.016$), but this reverted to baseline at 2 years (49.58 ± 6.27° vs. 49.92 ± 17.54°, $p=0.951$). There were no significant post-operative changes to thoracic kyphosis or sagittal vertical axis (SVA) compared to baseline.
9 of the 12 patients (75%) developed sagittal malalignment at 2 years: 8 developed distal junctional issues (5 – DJK; 3 – acute focal lordosis), and 1 developed proximal junctional kyphosis (PJK). The patient who developed PJK had a broken implant and underwent PDDD removal and spinal fusion at the same sitting.
Conclusion: After 2 years, scoliosis correction is maintained by the PDDD, but there is a high proportion of patients who developed troublesome sagittal malalignment issues.
Significance: Patients who opt for the PDDD will need to be counselled on the relatively high incidence of sagittal malalignment issues that develop in the short to medium term, and for which they may require implant removal or conversion to instrumented spinal fusion.

ePoster 42. Early Results from a Prospective Study on a Posterior Dynamic Distraction Device for Adolescent Idiopathic Scoliosis (NCT04296903)

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Introduction: A multicenter prospective study was undertaken to evaluate the safety and effectiveness of a novel Posterior Dynamic Distraction Device (PDDD) for use in adolescent idiopathic scoliosis (AIS) after receiving Humanitarian Use Device (HUD) approval from the US FDA in 2019. This report presents safety data for all patients treated to date and efficacy data for those with a 2-year follow-up.

Methods: 149 patients with AIS (Lenke 1 and 5), major Cobb 35-60°, less than or equal to 30° on side bending, and thoracic kyphosis less than 55°, were prospectively enrolled from 13 US sites between June 2020 and April 2023 per study indications. Demographics, surgical details, and major adverse events for the entire study sample and magnitude of curve correction with the PDDD for patients with a minimum 2-year follow-up were reported.

Results: Safety and perioperative data were available for 149 patients. 68 patients have reached the 2-year follow-up. For the entire cohort, the average age at surgery was 14.8 years and 75% of the patients were female. The mean procedure time was 112±34 minutes and the mean estimated blood loss was 38.1±33.9 ml. The mean preoperative primary Cobb angle was 47.5°±7.3° (range: 34°-61°) with flexibility to 17.6°±6.6° (range: 4°-30°). The mean Cobb angle at the first erect visit was 18.7°±7.0° (range: 7°-40°). The mean hospitalization was 1.3 days (range 1-12 days). Two patients were admitted to the ICU for 1 day.

21 patients (14.1%) had 23 reoperations, which included 14 PDDD revisions (9.4%) and 7 PDDD removals (4.7%). Two patients were converted to posterior spinal fusion (1.3%). The main reasons for reoperation included implant breakage (n=8), curve progression (n=4), infection (n=3), and screw migration or misplacement (n=3). One patient had a dural leak which resolved with treatment. No major neurologic issues were noted.

25 patients had minimum 2-year follow-up X-rays, 16 of them Lenke 1 and 9 Lenke 5. The mean pre-operative Cobb angles, flexibility, and first erect Cobb angles were similar to the entire cohort. (Table 1). At 2 years, curve correction to ≤30° was noted for 92% of the cohort and post-operative correction was maintained at the last follow-up (P=0.629). Five of the 25 patients (20%) had revision surgery, 3 implant revisions and 2 implant removals.

Conclusion: PDDD correction of Cobb angles was significant and durable at 2-year follow-up for the majority of patients, with revision rates similar to those reported for other non-fusion scoliosis procedures. This study suggests that PDDD is effective in avoiding spinal fusion for most patients with AIS and flexible primary curves, but further evidence is needed to determine the true incidence of long-term complications.

Significance: PDDD shows promise in the avoidance of spinal fusion for IS patients with flexible primary curves.

Table 1: Radiographic patient results N=25

	Pre-op	Immediate Post-op	6 months	12 months	24 months	P-value[1]
Primary Cobb Mean±SD (range)	47.5°±7.3° (34°-61°)	19.3°±5.9° (7°-31°)	19.3°±8.3° (4°-33°)	17.9°±8.4° (0°-37°)	20.2°±9.3°[2] (1°-39°)	P<0.005
Secondary Cobb Mean±SD (range)	30.1°±7.8° (14°-45°)	16.9°±10.0° (2°-35°)	18.4°±10.6° (1°-37°)	17.0°±10.7° (1°-36°)	18.2°±11.3° (2°-41°)	P<0.005
Kyphosis (N= 16, Lenke 1 patients) Mean±SD (range)	22.7°±10.1° (2°-42°)	31.3°±8.5° (15°-46°)	35.4°±7.7° (21°-47°)	37.2°±9.3° (17°-51°)	34.8°±8.8° (19°-53°)	P<0.005
Lordosis (N=9,Lenke 5 patients) Mean±SD (range)	59.9°±14.6° (46°-86°)	50.6°±12.3° (37°-73°)	54.3°±13.2° (35°-77°)	52.3°±11.8° (38°-77°)	56.7°±11.8° (38°-71°)	P=0.52

SVA Mean±SD (range)	-5.9±32.5 mm ([-61.7]-[57.8] mm)	-0.6±35.7 mm ([-75.4]-[58.8] mm)	-16.6±34.7 mm ([-89.7]-[52.0] mm)	-16.3±34.4 mm ([-75.2]-[50.0] mm)	-12.9±25.8 mm ([-59.0]-[30.0] mm)	P=0.18
SD, Standard Deviation [1] P-value calculated by paired sample t-test for pre-op and 24 months follow-up. [2] P=0.629, calculated by Friedman Rank Test between immediate and 24 months follow-up.						

ePoster 43. High BMI Limits Initial Correction but Not Growth Modulation After Vertebral Body Tethering

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Background: The scoliosis literature has shown BMI to be an important predictor of complications and outcomes in patients undergoing posterior spinal fusion. However, only one study assessing the relationship of BMI to outcomes in vertebral body tethering (VBT) patients has been performed (Mishreky et al., 2022). This was limited by sample size (58 non-overweight vs. 12 overweight).
Introduction: We utilized a large multicenter database to assess the effects of BMI on radiographic outcomes and complication rates of patients after VBT.
Methods: The HARMS multicenter database was studied for AIS/JIS patients who underwent VBT and had a minimum 2-year follow-up. Patient radiographs were evaluated pre-operatively, at 1st post-operative erect, and at latest available follow-up. Age and gender-adjusted BMI percentiles were used to classify patients into overweight (≥85th percentile) and non-overweight categories (<85th percentile), per CDC definitions. Univariate and multivariate regressions were conducted to assess the effect on complication rates and curve correction at 1st post-operative erect and final follow-up. Gender, Risser score, and pre-operative curve magnitude were controlled for.
Results: Of 271 included patients, 48 (18%) were overweight. Comparing the non-overweight and overweight groups, there were no significant differences in post-operative complication rates. Compared to non-overweight patients, overweight patients had significantly higher major curve degree at 1st post-operative erect (32° vs 26°, $p < 0.001$) and latest follow-up (32° vs. 27°, p-value = 0.020), as well as smaller percent improvement of curve from pre-operative to 1st post-operative erect (35% vs. 46%, $p < 0.001$). Multivariate analysis on percent change of curve from pre-operative to 1st post-operative erect found overweight patients ($\beta = -10.42$, $p < 0.001$) and males to be correlated with less curve correction ($\beta = -8.65$, p-value = 0.002). In addition, a non-zero Risser score ($\beta = 5.31$, p-value = 0.012), and a larger pre-operative curve was found to be correlated with more initial curve correction ($\beta = 0.35$, $p = 0.001$). Multivariate analysis on percent change of curve from 1st post-operative erect to latest follow-up curve found none of these predictors to be significant. Finally, a multivariate analysis on curve magnitude at latest follow-up revealed that overweight patients ($\beta = 4.09$, $p = 0.014$) and a larger pre-operative curve ($\beta = 0.47$, $p < 0.001$) to be correlated with a larger curve at latest follow-up (Table 1).
Discussion: VBT in overweight patients is associated with decreased initial curve correction at 1st post-operative erect and increased final curve magnitude. However, complications and curve correction in the modulation phase do not appear to be significantly different to non-overweight patients. Our findings suggest that surgeons should expect milder overall correction with VBT in overweight patients but similar correction over time after the tether is applied.

Table 1. Linear Regressions on Various Radiographic Measurements

Percent Improvement of Major Curve from Pre-Op to 1st Post-operative Erect	**Coefficient**	**p-Value**	**Confidence Interval**
Male vs. Female (Female ref.)	-8.65	**0.002**	(-14.22, -3.09)
Risser non-0 vs. Risser 0 (Risser 0 ref.)	5.31	**0.012**	(1.18, 9.44)
Pre-operative Curve (cont.)	0.35	**0.001**	(0.14, 0.55)
Overweight vs Non-overweight (Non-overweight ref.)	-10.42	**<0.001**	(-15.6, -5.24)

Percent Improvement of Major Curve from 1st Post-operative Erect to Latest Follow-Up	Coefficient	p-Value	Confidence Interval
Male vs. Female (Female ref.)	14.97	0.273	(-11.85, 41.78)
Risser non-0 vs. Risser 0 (Risser 0 ref.)	0.32	0.522	(-0.67, 1.32)
Pre-operative Curve (cont.)	-3.02	0.766	(-22.94, 16.9)
Overweight vs Non-overweight (Non-overweight ref.)	15.45	0.224	(-9.50, 40.39)
Curve Magnitude at Latest Follow-Up	**Coefficient**	**p-Value**	**Confidence Interval**
Male vs. Female (Female ref.)	2.90	0.105	(-0.61, 6.41)
Risser non-0 vs. Risser 0 (Risser 0 ref.)	-0.47	0.724	(-3.08, 2.14)
Pre-operative Curve (cont.)	0.47	**<0.001**	(0.34, 0.6)
Overweight vs Non-overweight (Non-overweight ref.)	4.09	**0.014**	(0.82, 7.36)

Bolded values have $p < 0.05$

ePoster 44. How Effective is the 'Scolibrace' in the Management of Adolescent Idiopathic scoliosis (AIS)

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Background: The rigid underarm brace is the gold standard for treating AIS of moderate severity in the skeletally immature. The Scolibrace is one variation of the rigid underarm brace.
Introduction
The rigid and lightweight ScoliBrace is customizable using computer-aided design and manufacture (CAD/CAM).
The aim of this study was to evaluate the treatment outcomes of AIS patients treated with the ScoliBrace, specifically the success rate, brace compliance and Scoliosis Research Society (SRS) 22r scores.
Methods: The SRS criteria for bracing in AIS was adopted as inclusion criteria for this study. Patients with congenital, neuromuscular, or syndromic scoliosis were excluded. Cobb angles were measured at each clinic review. Patients who had reached the surgical threshold were recommended for instrumented spinal fusion surgery. Compliance data was recovered from the iButton® thermocron. HRQoL was assessed using SRS-22r scores prior to brace treatment and upon brace discontinuation.
Results: From 2017-8 inclusive, 30 female AIS patients were recruited and prescribed a ScoliBrace.
The mean age of the cohort was 11.85±0.68 years at recruitment. The average major Cobb angle for the cohort was 29.50±3.48°, and this reduced to 20.60±6.30° in-brace (0.73±0.52 months post-recruitment). At brace discontinuation the average major Cobb angle was 25.77±7.10° (42.55±8.12 months); while that for final review was 26.36±6.93° (51.40±7.18 months).
4 patients progressed to the surgical threshold and were recommended PSF; 3 of the 4 patients underwent PSF, while the fourth patient refused surgery. Four subjects were lost to follow-up.
22 of 26 (85%) patients did not reach the surgical threshold at the end of the study period; this was defined as treatment success. 13 (59%) patients had progression of >=5° at the end of the follow-up period but did not reach the surgical threshold. 6 (27%) had <5° curve progression, 1 (5%) maintained baseline Cobb angles, while 2 (9%) had a curve reduction.
Average brace compliance was 15.9±5.43 hrs/day (range: 1.2-29.0). Average compliance of ≥12.0 hrs/day was associated with success rates of 86-100%. The lowest quartile of wear (mean 11.90 hrs/day) had a significantly lower success rate of 57%. Compared to pre-brace treatment, patients reported significantly poorer scores for pain [SRS-22r Pain Domain (4.70±0.41 vs 4.37±0.51, p=0.014), but reported significantly better scores for management satisfaction (3.29±0.88 vs 3.90±0.90, p=0.020).
Conclusion: ScoliBrace treatment was associated with an 85% success rate at skeletal maturity, with success defined as a final Cobb angle of <45 degrees. Brace compliance of >12hrs was associated with favorable outcomes (>86% success). Overall, subjects experienced more pain but were satisfied with the management of their condition.
Significance: The Scolibrace is an effective variation of the rigid underarm brace for AIS; Compliance of >= 12 hours per day is essential for bracing success.

ePoster 45. Is Rib-on-Pelvis Deformity associated with Reported Pain in Neuromuscular Early-Onset Scoliosis?

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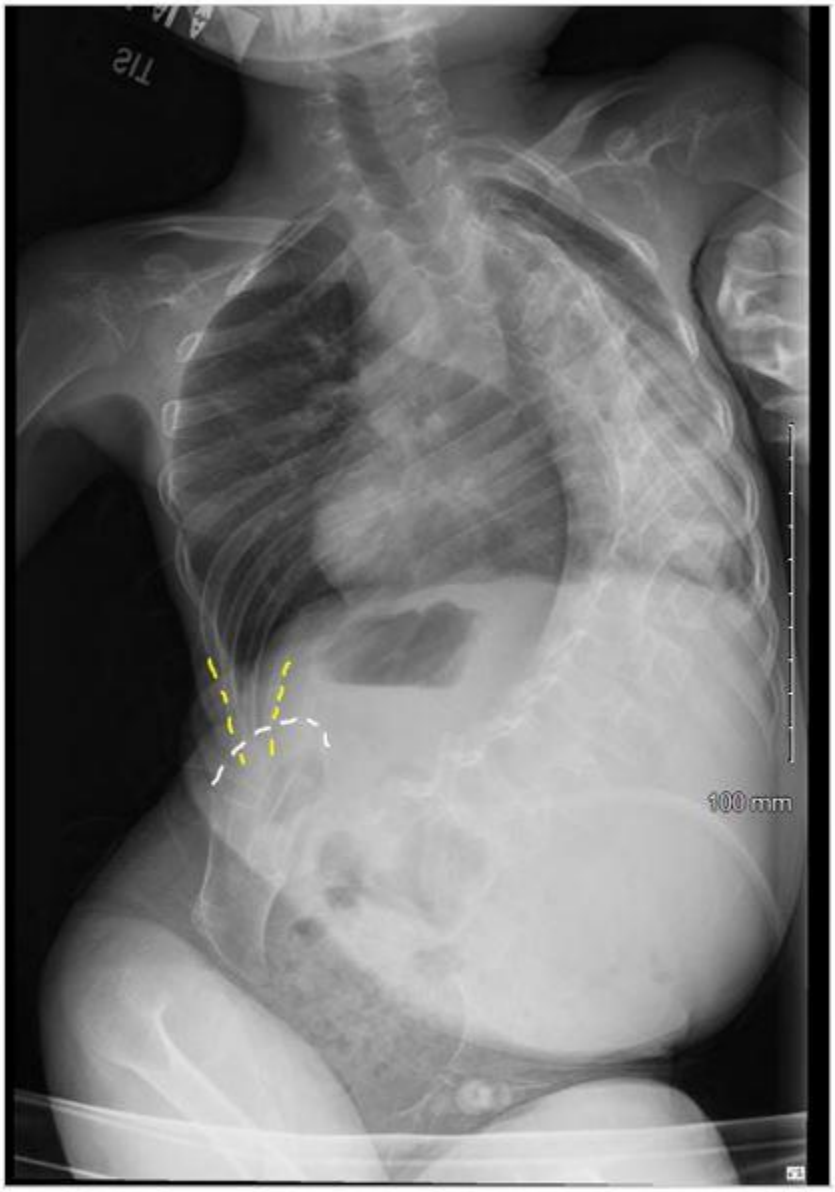
Background: Patients with neuromuscular early-onset scoliosis (EOS) often present with a long sweeping thoracolumbar scoliosis and pelvic obliquity. Concurrent truncal weakness results in the concave ribs resting on the high side of the oblique pelvis (rib-on-pelvis deformity).
Introduction: Rib-on-pelvis deformity may result in costo-iliac impingement (pain associated with the rib-on-pelvis deformity), and can also adversely affect the biomechanics of diaphragmatic excursion, sitting balance, and overall quality of life. In the pediatric patient population, literature is limited regarding reported pain in the setting of rib-on-pelvis deformity. The goal of this study is to evaluate whether rib-on-pelvis deformity is associated with reported pain.
Methods: A both prospectively and retrospectively-collected multicenter registry was queried for all patients with neuromuscular early-onset scoliosis who were non-ambulatory and surgically treated. 151 patients were identified from 2012-2022. Pre-operative variables such as age, gender, diagnosis, major coronal Cobb angle, and pelvic obliquity were collected. Patient-reported pain was collected using the Early Onset Scoliosis 24-Item Questionnaire (EOSQ-24). Rib-on-pelvis deformity was classified as a binary assessment based on evaluation of pre-index procedure upright radiographs. Any patient with a rib distal to the most superior portion of the iliac crest on was classified as having rib-on-pelvis deformity. Statistical analysis was performed using Pearson's Chi-squared test for independence, Fisher's Exact Test, Student's t test, and Mann-Whitney U test.
Results: 40 patients were excluded due to having no pre-index procedure radiographs or EOSQ-24 pain scores available. Of the final 111 patient cohort, 45 were male (41%) and 66 were female (59%). The mean age was 8.0 years, mean coronal Cobb angle was 80.4 degrees, and mean pre-index procedure pelvic obliquity was 17.4 degrees. 38 patients

(34%) had rib-on-pelvis deformity while 73 patients (66%) did not. The pelvic obliquity in the rib-on-pelvis deformity group was significantly greater than the pelvic obliquity in the group without the rib-on-pelvis deformity ($p<0.001$). The mean EOS-Q scores for intensity of pain were 3.39 (SD:0.83) and 3.73 (SD:1.08) for the groups with and without rib-on-pelvis deformity, respectively. The mean EOS-Q scores for frequency of pain were 3.33 (SD:0.82) and 3.63 (SD:0.98) for the groups with and without rib-on-pelvis deformity, respectively. The EOS-Q scores for intensity of pain were significantly associated with rib-on-pelvis deformity ($p=0.03$). Interestingly, rib-on-pelvis deformity did not appear to be associated with the EOSQ-24 frequency of pain scores ($p=0.27$).

Conclusion: Rib-on-pelvis deformity in pediatric patients with early onset neuromuscular scoliosis is associated with a greater intensity of pain via the EOSQ-24 questionnaire. Clinicians must be aware that a rib-on-pelvis deformity corresponds with increased reported pain when deciding whether to pursue surgical management.

Significance: Our study is thus the first to objectively identify rib-on-pelvis deformity as detrimental to early onset neuromuscular patients using the validated EOSQ-24 questionnaire.

Figure 1. Example of neuromuscular EOS with rib on pelvis deformity and corresponding EOSQ-24 pain scores



	Score	Description
EOSQ-24: Severity of Pain	2	Severe
EOSQ-24: Frequency of Pain	3	Some of the time

ePoster 46. Safety and Efficacy of a Novel Technique for Posterior Column Osteotomy in Patients with Adolescent Idiopathic Scoliosis Undergoing Posterior Spinal Fusion

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Background: A novel technique for posterior column osteotomy (PCO) was developed to aid in deformity correction during surgery for patients with adolescent idiopathic scoliosis (AIS). Our current study describes this technique and reports our data to date on the safety and efficacy of this approach. We compare these results to our outcomes during surgery for AIS wherein osteotomies were either not utilized or Ponte osteotomies (PO) were performed.
Introduction: While the stated goal of the surgical management of AIS remains stable fusion to prevent progression, deformity correction remains a primary goal for many surgeons and their patients. Many techniques for deformity correction have been proposed including the use of PCOs. We developed a new technique for PCO whereby the lamina is transected cranial to the ligamentum flavum at the axial level of the intervertebral disk. Here, we aim to report on the safety and efficacy of this novel osteotomy.
Methods: Through retrospective chart review, we collected data on 151 consecutive pediatric patients with AIS undergoing PSF at one institution. Patients were stratified into 3 groups: no osteotomies (NO), traditional PO, and novel PCO (NPCO). Outcomes were compared regarding patient demographics, safety outcome measures (blood loss, OR time, presence of neuromonitoring changes) and clinical efficacy of deformity correction. Radiographic measurements were performed by a single fellowship trained spine deformity surgeon who was not involved in the direct care of the patient cohort and who was blind to the details of the patients' surgical treatment.
Results: Demographic data between the three cohorts was similar. The median age ranged between 14 and 15 years of age and the median Cobb angle measured between 51° and 53° In all three cohorts. No difference was observed regarding neuromonitoring changes between the NO (0/35) and the NPCO (1/67) cohorts (P-value= 1.00). Further, no difference was observed in operative time per level between these two groups (p-value= 0.16). Operative blood loss per fusion level was slightly higher in the NPCO (15.4ml) compared to the NO (13.8ml) cohort (P-value=0.076). Mean coronal plane Cobb angle correction was improved in the NPCO (46.8°) cohort compared to both the NO (39.3°) and PO (41.5°) cohorts. The coronal correction differences between both the NPCO group versus the NO group and between the NPCO group and the PO were both significant (P-value= 0.001 and P-value=0.031 respectively).
Conclusions: Our posterior column osteotomy is a safe alternative to traditional PO and allows for improved deformity correction in the coronal plane.
Significance: This surgical technique is potentially useful in select patients, and has a similar safety profile to established standards of care. Further studies based on 3-dimensional deformity variables are underway and will provide more data on the technique's utility for deformity correction.

Table 1. Baseline Characteristics by Surgery Type

	No Osteotomy (N=35)	Standard Osteotomy (N=51)	Experimental Osteotomy (N=67)
Age at surgery (years)			
Median (Q1, Q3)	15.0 (13.0, 16.5)	14.0 (12.0, 16.0)	14.0 (13.0, 15.0)
Mean (SD)	14.7 (1.9)	14.2 (2.5)	13.9 (2.0)
Range	11.0, 17.8	10.0, 20.0	10.0, 18.0
Gender			
Female	28 (80%)	37 (73%)	50 (75%)
Male	7 (20%)	14 (27%)	17 (25%)
Race			
Asian Indian	0 (0%)	0 (0%)	1 (1%)
Black or African American	5 (14%)	12 (24%)	9 (13%)
Black or African American | White or Caucasian	0 (0%)	1 (2%)	2 (3%)
Japanese	0 (0%)	0 (0%)	1 (1%)
Other Asian	0 (0%)	1 (2%)	0 (0%)
Other Pacific Islander	0 (0%)	0 (0%)	1 (1%)
Some Other Race	11 (31%)	7 (14%)	19 (28%)
White or Caucasian	19 (54%)	30 (59%)	34 (51%)
BMI			
Median (Q1, Q3)	20.7 (19.0, 24.1)	20.5 (19.2, 24.1)	20.7 (18.4, 24.9)
Mean (SD)	22.3 (4.8)	22.4 (5.4)	22.4 (5.8)
Range	15.9, 37.5	15.3, 40.0	13.7, 38.6
Lenke Type			
1A	11 (31%)	22 (44%)	24 (36%)
1B	5 (14%)	2 (4%)	1 (1%)
1C	5 (9%)	8 (16%)	12 (18%)
2A	2 (6%)	4 (8%)	7 (7%)
2B	0 (0%)	0 (0%)	2 (3%)
2C	1 (3%)	1 (2%)	0 (0%)
3B	0 (0%)	0 (0%)	1 (1%)
3C	0 (0%)	0 (0%)	2 (3%)
5A	3 (14%)	4 (8%)	6 (9%)
5B	3 (9%)	4 (8%)	2 (3%)
5C	3 (9%)	2 (4%)	1 (1%)
6B	1 (3%)	0 (0%)	0 (0%)
6C	1 (3%)	4 (8%)	2 (4%)
Risser Sign			
0	1 (3%)	4 (8%)	4 (6%)
1	1 (3%)	2 (4%)	3 (5%)
2	4 (11%)	8 (16%)	9 (13%)
3	3 (9%)	11 (22%)	15 (22%)
4	17 (49%)	17 (33%)	20 (30%)
5	9 (26%)	9 (18%)	16 (27%)
ASA Score			
1	4 (11%)	7 (14%)	6 (9%)
2	28 (80%)	34 (67%)	48 (72%)
3	3 (9%)	10 (20%)	12 (18%)
4	0 (0%)	0 (0%)	1 (1%)
Preoperative Cobb Angle (°)			
Median (Q1, Q3)	51.0 (45.0, 57.5)	51.0 (45.0, 57.5)	53.0 (47.0, 63.5)
Mean (SD)	52.44 (11.41)	53.7 (9.8)	59.9 (12.63)
Range	40.0, 77.0	41.0, 102.0	43.0, 101.0

Table 2. Primary Outcomes: Experimental vs Standard Osteotomy

	Standard Osteotomy (N=51)	Experimental Osteotomy (N=67)	P-value
Intraoperative Neuromonitoring Changes			0.58
No	49 (96%)	66 (99%)	
Yes	2 (4%)	1 (1%)	
Total Blood Loss (mL)			0.91
Median (Q1, Q3)	203.0 (107.0, 300.0)	200.0 (145.5, 274.5)	
Mean (SD)	233.8 (170.1)	214.0 (106.0)	
Range	25.0, 1000.0	50.0, 500.0	
Blood Loss per Level (mL/level)			0.92
Median (Q1, Q3)	15.4 (10.2, 23.5)	15.4 (11.8, 21.7)	
Mean (SD)	19.0 (14.2)	18.0 (9.3)	
Range	3.1, 90.9	5.0, 45.4	
Total OR Time (min)			0.77
Median (Q1, Q3)	196.0 (171.0, 240.0)	204.0 (180.0, 227.5)	
Mean (SD)	214.2 (62.7)	206.8 (38.3)	
Range	120.0, 444.0	121.0, 306.0	
OR Time per Level (min/level)			0.56
Median (Q1, Q3)	16.3 (15.4, 18.6)	17.8 (15.1, 19.0)	
Mean (SD)	17.6 (3.9)	17.4 (3.2)	
Range	12.8, 31.7	10.2, 25.5	
Postoperative Cobb Angle (°)			0.75
Median (Q1, Q3)	8.0 (3.0, 15.0)	10.0 (4.0, 14.0)	
Mean (SD)	10.0 (7.4)	9.3 (6.8)	
Range	0.0, 26.0	-7.0, 32.0	
Postoperative Cobb Angle within Normal Range (< 10°)			0.71
No	24 (47%)	34 (51%)	
Yes	27 (53%)	33 (49%)	
Cobb Angle Change (Pre-Post)			**0.031**
Median (Q1, Q3)	40.0 (30.5, 50.0)	44.0 (38.5, 53.0)	
Mean (SD)	41.5 (25.8)	46.8 (31.3)	
Range	0.0, 80.0	25.0, 81.0	
Postoperative Kyphosis (°)			0.66
Missing	1	0	
Median (Q1, Q3)	32.0 (26.0, 36.0)	33.0 (23.5, 38.0)	
Mean (SD)	30.6 (12.1)	31.7 (10.2)	
Range	0.0, 58.0	4.0, 53.0	
Postoperative Kyphosis within Normal Range (20-40°)			0.85
Missing	1	0	
No	17 (34%)	25 (37%)	
Yes	33 (66%)	42 (63%)	
Kyphosis Change (Pre-Post)			0.76
Missing	1	0	
Median (Q1, Q3)	-2.0 (-11.0, 5.5)	-3.0 (-10.0, 6.0)	
Mean (SD)	-1.3 (13.7)	-2.3 (14.3)	
Range	-24.0, 34.0	-41.0, 46.0	

P-values result from Fisher's exact test (categorical variables) or a Wilcoxon rank sum test (continuous variables).

Table 3. Primary Outcomes: Experimental vs No Osteotomy

	No Osteotomy (N=35)	Experimental Osteotomy (N=67)	P-value
Intraoperative Neuromonitoring Changes			1.00
No	35 (100%)	66 (99%)	
Yes	0 (0%)	1 (1%)	
Total Blood Loss (mL)			0.12
Median (Q1, Q3)	175.0 (117.5, 223.0)	200.0 (145.5, 274.5)	
Mean (SD)	183.5 (102.8)	214.0 (106.0)	
Range	50.0, 500.0	50.0, 500.0	
Blood Loss per Level (mL/level)			0.076
Median (Q1, Q3)	13.8 (10.7, 17.6)	15.4 (11.8, 21.7)	
Mean (SD)	14.8 (7.7)	18.0 (9.3)	
Range	4.5, 35.7	5.0, 45.4	
Total OR Time (min)			**<0.001**
Median (Q1, Q3)	168.0 (149.5, 197.5)	204.0 (180.0, 227.5)	
Mean (SD)	179.0 (40.5)	206.8 (38.3)	
Range	85.0, 275.0	121.0, 306.0	
OR Time per Level (min/level)			**<0.001**
Median (Q1, Q3)	14.4 (13.1, 16.0)	17.8 (15.1, 19.0)	
Mean (SD)	14.6 (2.7)	17.4 (3.2)	
Range	7.7, 21.2	10.2, 25.5	
Postoperative Cobb Angle (°)			0.16
Median (Q1, Q3)	11.0 (6.5, 16.5)	10.0 (4.0, 14.0)	
Mean (SD)	11.7 (7.7)	9.3 (6.8)	
Range	0.0, 32.0	-7.0, 32.0	
Postoperative Cobb Angle within Normal Range (< 10°)			0.41
No	21 (60%)	34 (51%)	
Yes	14 (40%)	33 (49%)	
Cobb Angle Change (Pre-Post)			**0.001**
Median (Q1, Q3)	37.0 (33.0, 46.0)	44.0 (38.5, 53.0)	
Mean (SD)	39.3 (9.3)	46.8 (31.5)	
Range	23.0, 58.0	25.0, 81.0	
Postoperative Kyphosis (°)			0.60
Median (Q1, Q3)	29.0 (24.5, 36.5)	33.0 (23.5, 38.0)	
Mean (SD)	30.8 (10.0)	31.7 (10.2)	
Range	12.0, 50.0	4.0, 53.0	
Postoperative Kyphosis within Normal Range (20-40°)			0.83
No	12 (34%)	25 (37%)	
Yes	23 (66%)	42 (63%)	
Kyphosis Change (Pre-Post)			0.67
Median (Q1, Q3)	-4.0 (-9.5, 3.5)	-3.0 (-10.0, 6.0)	
Mean (SD)	-4.6 (11.4)	-2.5 (14.3)	
Range	-31.0, 16.0	-41.0, 46.0	

P-values result from Fisher's exact test (categorical variables) or a Wilcoxon rank sum test (continuous variables).

ePoster 47. Surgical Site Infection Risk in Neuromuscular Scoliosis Undergoing Long Posterior Spinal Fusion

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Background/Introduction: Surgical site infections (SSI) remain a significant source of morbidity, cost, and readmission / reoperation in patients treated with posterior spinal fusion (PSF) for neuromuscular scoliosis (NMS). Identification of risk factors for SSI are key to advising families and perioperative risk mitigation process development. The purpose of the study was to determine the perioperative risk factors for patients undergoing long posterior spinal fusions in neuromuscular scoliosis.
Methods: The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) pediatric database was queried for patients who underwent PSF for neuromuscular scoliosis and/or cerebral palsy from 2017-2021. Patients with fusion of ≥13 vertebral segments (CPT 22804) were included. Patient characteristics were assessed to determine risk factors for SSI. Statistical analysis was completed utilizing likelihood ratio chi-squared test for categorical factors and median or Wilcoxon rank sum test for quantitative factors.
Results: 102 of the 4,145 patients who underwent PSF for NMS developed a deep surgical site infection (2.5%). Identified risk factors for deep SSI in this population include ASA≥3 (p=0.027, odds ratio 2.4), preoperative steroid intake (p=0.049, odds ratio 2.4), preoperative ostomy (p=0.026, odds ratio 1.6), prolonged anesthetic time (p=0.044), and urinary tract infection (UTI)(p<0.001, odds ratio 4.5). A trend for increased risk was noted in patients with preoperative nutritional support (p=0.074) and patients with prolonged operative time (p=0.080). There was no greater prevalence for SSI for other factors including preoperative platelet count <150, albumin <3.5, white blood cell (WBC) count <4000 or >11,000, supplemental oxygen, tracheostomy/ventilatory support, seizure history, creatinine >1.0, or length of hospital stay (all p>0.05).
Conclusion and Significance: There is a 2.5% incidence of surgical site infection in neuromuscular scoliosis over a 5-year period from 2017-2021 in the NSQIP database. Risk factors for deep SSI include ASA≥3, preoperative corticosteroids, presence of an ostomy, prolonged anesthetic time, and postoperative development of UTI. Although the incidence of deep SSI following PSF for NMS reported in the NSQIP database is lower than reported in literature or registry-based SSI calculators, large multicenter database studies can help identify and stratify risk factors for SSI in this high risk patient population.

ePoster 48. The Effect of Preoperative Mental Health Diagnosis on Pain Management in Patients with Adolescent Idiopathic Scoliosis Undergoing Surgery

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Introduction: Patients with adolescent idiopathic scoliosis (AIS) have been demonstrated to have increased risk of having a mental health diagnosis (MHD) compared to healthy controls. Additionally, preoperative MHD is associated with poorer clinical outcomes after adult lumbar spine surgery including decreased patient-reported quality of life, worse postoperative pain, and failure to return to work after surgery. However, there is paucity of information exploring the effect of an underlying MHD on postoperative outcomes of children treated with spinal fusion for AIS. The purpose of this study was to determine if preoperative mental health diagnoses affect pain management in patients with adolescent idiopathic scoliosis undergoing spinal fusion.
Methods: This was a retrospective study of pediatric patients less than 18 years old with a history of AIS requiring operative treatment with posterior spinal fusion, anterior spinal fusion, or anterior/posterior spinal fusion between January 1, 2010 and January 1, 2020 with a minimum of 2-year follow-up. Patients were divided into two groups: one who had a preoperative diagnosis of a mental health disorder, and a control group who do not have any preoperative MHD. Data extracted chart review included mean pain score measured by visual analog scale during inpatient stay, number of patient controlled analgesia demands during inpatient stay, and use of narcotic pain medication at first follow-up appointment. Patient data was compared using independent student's t-tests and Chi square analysis.
Results: A total of 425 patients were included in the study. 98 patients were included in the MHD group and 327 patients in the control group. The mean ages of the MHD and control cohorts were similar (14.74 years and 14.05 years respectively, p=0.003). There was also a similar amount of male and female patients (69.4% female and 77.1% female respectively, p=0.1228). The mean pain score while inpatient was 3.96 for the MHD group versus 3.34 for the control

group (p=0.0005). The PCA demand during inpatient stay for MHD group was 234.74 compared to 140.61 for control group (p=3.77x10-6). There were a significantly greater number of patients in the MHD cohort (27.6%) still using narcotic pain medication at first follow-up compared to the control group (13.5%) (p=0.00018).
Conclusion: This study suggests that patients with AIS with a pre-operative MHD experience an increased perception of pain after surgery, and as a result require more pain medication during their recovery. This is valuable information for the surgeon to be able to counsel this cohort of patients pre-operatively and set appropriate pain management expectations. Further research is warranted, and additional considerations include involvement of the patient's mental health provider before, during, and after the procedure as this may affect postoperative pain and narcotic use.

ePoster 49. The Link Between a Growth Mindset and Health-related Quality of Life in AIS Patients on Brace Treatment.

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Background: Individuals with a growth mindset believe their abilities can be developed through hard work, good strategies and input from others, while those with a fixed mindset believe their talents are innate, unalterable gifts. Previous studies have shown that students who demonstrated a growth mindset enjoy higher academic achievement, experience lower mental health difficulties, and are more resilient to stressful life events than students with a fixed mindset.
Introduction: Bracing has been shown to be effective in treating AIS patients with moderate scoliosis. Treatment success is influenced by several factors including baseline patient characteristics, stage of skeletal maturity and brace compliance. In the majority of adolescents, compliance with the prescribed hours of bracing can be challenging and stressful. This can significantly affect their mental well-being.
The aim of this study is to establish if having a growth mindset can be a protective factor against psychological stress associated with brace treatment, and consequently a better health-related quality of life (HRQoL) score.
Methods: AIS patients on brace treatment and who completed the 3-item Growth Mindset Scale (Dweck 1999, 2006) were included in this analysis. A score of 0 - 3.9 indicates a fixed mindset, while a score of 4 - 6 indicates a growth mindset. HRQoL was assessed using the SRS-22r form(22 items).
Results: Scores from 237 patients undergoing brace treatment were analysed (13.55 ± 2.04 years of age, 86% females). Those with a growth mindset had higher Management Satisfaction domain scores than those with a fixed mindset (3.66±0.75 vs. 3.41±0.75, p=0.027). Patients with a growth mindset also scored better in domains such as Self-Image (3.50±0.57 vs. 3.40±0.54) and Mental Health (3.90±0.61 vs. 3.79±0.80) but these did not reach statistical significance (p=0.263, p=0.290, respectively).

Conclusion: Adolescents with a growth mindset reported better HRQoL scores compared with those with a fixed mindset.
Those with a growth mindset may have higher levels of self-efficacy or employed more adaptive coping styles during brace treatment, contributing to better HRQoL scores.
Significance: To help AIS patients on brace treatment better cope with the psychological stress of treatment, care providers should invest time to develop or reinforce a growth mindset in these individuals.
Enhancing patients' resilience and self-efficacy levels through simple yet effective interventions may be beneficial in reducing psychological stress during the treatment period, and ultimately improve the quality of life for these individuals.

ePoster 50. Vitamin D Deficiency in Scheuermann's Disease is Associated with Increased Adverse Outcomes

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Introduction: Scheuermann's Disease is a condition of hyperkyphosis that is characterized by anterior wedging of vertebral bodies, irregular vertebral endplates, decreased spinal flexibility, and back pain. The condition is commonly seen in pediatric population and often along with scoliosis. Despite these changes being seen in up to 8% of adolescents in the United States, there is paucity of information regarding risk factors for disease development. Studies have

suggested an association with Vitamin D deficiency in animal models, but no comprehensive analysis has been performed that investigates association between Vitamin D and adverse outcomes in humans. The objective of this study was to analyze the effect of Vitamin D deficiency on adverse outcomes in patients with Scheuermann's Disease.
Methods: We performed a retrospective analysis utilizing the TriNetX database. Patients with Scheuermann's Disease were identified with ICD-10 codes. Vitamin D deficiency was identified using ICD-10 codes. The patients were categorized into those with a diagnosed Vitamin D deficiency and those without a diagnosed Vitamin D deficiency. Cohorts were matched based on age, gender, ethnicity, history of fibromyalgia, myositis, major depressive disorder, and anxiety disorder. Chi-square analysis was performed to determine the relationship between Vitamin D status and adverse outcomes including pain, major depressive disorder, suicide attempt, emergency department (ED) visit, hospital admissions, and surgical procedures on the spine. Odds ratios (OR) were reported with $p<0.05$ considered statistically significant.
Results: A total of 18,188 patients with Scheuermann's Disease were identified in the TriNetX database. Analysis of these patients showed a majority were male (62%) and 31% had a concurrent diagnosis of scoliosis. Only 106 patients (0.6%) were checked for Vitamin D level, but of those, 56 (53%) had low levels. A total of 2,758 (15.16%) patients with Scheuermann's Disease were identified to have a diagnosed Vitamin D deficiency. Patients with Vitamin D deficiency had 1.58 (95% CI 1.334-1.878, $P<0.0001$) times the odds of pain, 1.86 (95% CI 1.699-2.038, $P<0.0001$) times the odds of major depressive disorder, 2.55 (95% CI 1.502-4.337, $P=0.0005$) times the odds of a suicide attempt, 1.1 (95% CI 1.011-1.193, $P=0.0266$) times the odds of ED visits, and 1.55 (95% CI 1.386-1.73, $P<0.0001$) times the odds of hospital admission. No significant association was found between Vitamin D deficiency and surgical procedures on the spine.
Conclusion: The results of the study show a significant association between Vitamin D deficiency and increased odds of pain, major depressive disorder, suicide attempt, ED visits, and hospital admission. Although Vitamin D levels were drawn in a mere fraction of Scheuermann's Disease patients, low levels were found to be associated with a higher risk of detrimental outcomes. Our data suggests there is a need for a better understanding of the role of Vitamin D in Scheuermann's Disease.

Sports

ePoster 51. Comparison of KT-1000 Results in Hamstring and Quadriceps Tendon Graft Types after Adolescent ACL Reconstruction

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Background: Hamstring tendon autograft (HT) and quadriceps tendon autograft (QT) are commonly used graft sources for anterior cruciate ligament reconstruction (ACLR). Despite encouraging outcomes with the use of QT autograft, post-operative knee ligament laxity in this graft type is unknown. The KT-1000 arthrometer provides an objective measurement of anterior tibial translation after ACLR surgery at three different levels of force application, thus providing a quantitative value for knee ligament laxity. Side to side differences of less than 3 millimeters have been reported as representative of non-impaired anterior tibial translation. KT-1000 measurements have not been reported after QT autograft ACLR.
Hypothesis/Purpose: The purpose of this study was to compare ligamentous laxity of QT vs. HT groups utilizing the KT-1000 arthrometer, 6-9 months after ACLR. It is hypothesized that the QT group will have less ligamentous laxity compared to the HT group.
Methods: A retrospective chart review of patients undergoing ACLR from 2013-2021 at Connecticut Children's was conducted. KT-1000 testing was completed by a sports physical therapist as part of routine return to sport testing 6-9 months after surgery. Patient demographics and KT-1000 results were recorded and two-sample T tests were used to compare the HT and QT groups.
Results: 173 subjects met inclusion criteria (99HT, 74QT) and there were no significant differences in age, height, weight and BMI between groups (Table 1). The QT group had significantly greater displacement at 15 pounds and 20 pounds of force for involved and uninvolved limbs (Table 2). The QT group had greater displacement at 30lbs of force for the uninvolved limb (5.59 vs 4.91, $p=0.02$). No significant side to side differences were seen in KT-1000 between graft types at 15, 20 and 30lbs of force, with side to side differences for both groups less then 3 millimeters (Table2).

Conclusion: The QT group had significantly greater measured anterior tibial translation at 15 and 20lbs. However, no significant differences in side to side comparisons of QT or HT autograft. These results suggest that both autograft types are functional in maintaining adequate ligament strength. Differences in anterior displacement between graft type may be due to the tendon grafts properties or surgical fixation devices used at the time of surgery.

Table 1: Patient Demographics of Graft Type

	QT Group (n=74)	HT Group (n=99)	p value
Sex	44M/30F	42M/57F	
Age at Surgery (years)	15.55 ± 1.75	15.68 ± 1.82	0.63
Height (cm)	168.20 ± 8.40	166.91 ± 8.99	0.33
Weight (kg)	65.68 ± 16.98	66.98 ± 14.84	0.60
BMI	23.03 ± 4.67	23.97 ± 4.81	0.20

Values are expressed as mean ± SD; All p values are based on t-test. Abbreviations: QT: quadriceps tendon autograft; HT: hamstring tendon autograft.

Table 2. KT-1000 Results of Graft Type

		QT Group (n = 74)	HT Group (n = 99)	p value
Time since surgery (days)		239.45 ± 48.34	210.34 ± 40.92	**<0.01***
KT-1000 15lbs (mm)	Involved	3.57 ± 1.47	3.03 ± 1.50	**0.02***
	Uninvolved	2.90 ± 1.26	2.15 ± 1.14	**<0.01***
	Side to side difference	1.01± 0.95	1.02 ± 0.98	0.95
KT-1000 20lbs (mm)	Involved	5.10 ± 1.67	4.49 ± 1.82	**0.02***
	Uninvolved	4.16 ± 1.65	3.37 ± 1.41	**<0.01***
	Side to side difference	1.22 ± 1.26	1.34 ± 1.25	0.54
KT-1000 30lbs (mm)	Involved	6.78 ± 2.01	6.24 ± 2.11	0.90
	Uninvolved	5.59 ± 2.05	4.91 ± 1.80	**0.02***
	Side to side difference	1.55 ± 1.45	1.67 ± 1.28	0.58

Values are expressed as mean ± SD; All P values are based on t-test, ***statistically significant, p <0.05.**

ePoster 52. Postoperative Outcomes of Ischial Tuberosity Avulsion Fracture in Adolescents

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Background: Avulsion fractures of the ischial tuberosity (AFIT) are uncommon injuries that sometimes require operative fixation for significant displacement and/or associated neurologic symptoms. Various fixation methods have been utilized including screws, suture anchors and cortical suspensory buttons. The purpose of this study is to review a consecutive series of surgically managed AFITs at a single institution and compare outcomes among fixation strategies. We hypothesized there would be no difference in outcomes between fixation types.
Methods: We conducted a retrospective review of all patients treated operatively at a single institution from 2010-2022 for AFIT identified by CPT code (27215). We collected patient demographics, injury characteristics, Modified Oxford Score, radiographic measures, fracture classification (Type 1 -Lateral vs. Type 2 -Complete), surgical fixation technique (screw, suture anchor, and cortical suspensory button), postoperative complications (Modified Clavien-Dindo-Sink [M-CDS] Complication Classification) and time to return to sport (RTS). Descriptive statistics were performed, and univariate analyses were conducted to compare outcomes of fixation groups. All analyses were performed in IBM SPSS v29.0.
Results: Study criteria identified 15 patients with surgically treated AFITs during the study period who were predominantly male (93%) and had a mean age of 14.8±0.8 years. Injured patients most commonly participated in soccer (40%), with the most common mechanism being running or sprinting (40%). The avulsed fracture fragments were a mean of 41.5mm in size, with maximal displacement of 20.7mm and predominantly Type 1 - Lateral (80%). Surgical constructs included 4 with screw, 5 with suture anchor, 5 with cortical button, and 1 combined (screw and suture anchor). Patient and injury characteristics are further detailed in Table 1. Postoperative complications occurred in nine patients (60%) including seven Type 1, one Type 2, and one Type 3 M-CDS. Within M-CDS Type 1, continued neurologic symptoms occurred in 2 patients (13.3%). No statistically significant difference was found between fixation types among the studied outcome variables (Table 2); however, re-fracture (2 cases [M-CDS Types 2 and 3]) was only observed with suture anchor or combined (screw and suture anchor) constructs.
Conclusions: Findings from this retrospective case series of three surgical techniques serves to bolster the limited literature base regarding the surgical treatment of AFITs in adolescents. Consistent return to sport was achieved across all fixation types. Postoperative complications were not infrequent but were largely low in severity. While clear differences between constructs were not found, the available study sample limited robust analysis. Refracture occurred only with suture anchor or screw/suture anchor constructs.

Table 1. Patient Demographics, Injury and Recovery

Variable	N (%) or Mean ± SD
Demographics and Injury Characteristics *(N = 15 patients)*	
Age	14.8 ± 0.8
Modified Oxford Score	8.2 ± 2.2
Sex	
Male	14 (93)
Female	1 (7)
BMI	20.3 ± 2.4
Race/Ethnicity	
White/Caucasian	13 (87)
Black	1 (7)
Asian	1 (7)
Activity	
Soccer	6 (40)
Track & Field	1 (7)
Baseball	3 (20)
Other Sport	4 (27)
Non-Sport	1 (7)
Mechanism	
Running	6 (40)
Kicking	3 (20)

Fall	5 (33)
Other	1 (7)
Size (mm)	41.5 ± 16.8
Displacement (mm)	20.7 ± 9.9
Fracture Classification	
Type 1- Lateral	12 (80)
Type 2- Complete	3 (20)
Preoperative Neurologic Symptoms	
Yes	4 (27)
No	11 (73)
Postoperative Recovery Course *(N = 15 patients)*	
Weeks until WBAT	6.1 ± 3.3
Weeks of bracing	6.7 ± 1.7
Weeks until patient regained full ROM	10.9 ± 2.6
Weeks until isolated hamstring strengthening permitted	11.7 ± 2.2
Weeks until running/impact activities permitted	16.5 ± 5.3
Weeks until RTS	24.0 ± 7.3

Table 2: Postoperative Outcomes Following ORIF for AFIT

Outcome Variable	**Suture Anchor**	**Screw**	**Screw + Suture Anchor**	**Cortical Button**	**P-value**
Postoperative complications (M-CDS)					
Type 1	1/5 (20%)	3/4 (75%)	0/1 (0%)	3/5 (60%)	.262[f]
Type 2	1/5 (20%)	0/4 (0%)	0/1 (0%)	0/5 (0%)	1.00[f]
Type 3	0/5 (0%)	0/4 (0%)	1/1 (100%)	0/5 (0%)	.488[f]
Return to sport	4/4 (100%)	4/4 (100%)	1/1 (100%)	5/5 (100%)	.920[f]
Continued hamstring pain	1/5 (20%)	0/4 (0%)	0/1 (0%)	1/5 (20%)	.840[f]

f = Fisher's exact test

ePoster 53. Relationship between Early Objective Measures and Patient Reported Outcomes after Adolescent Shoulder Stabilization Surgery

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Background: Shoulder instability and labral tears requiring surgery are common among adolescent athletes, and 18%-31% of Bankart repairs report recurrent instability. Although a return-to-sport (RTS) testing battery is recommended to assist with late-stage rehabilitation decision making, there is no published literature regarding early criteria-based testing benchmarks. Objective testing during early post-operative stages could be used to guide patients through phases of rehabilitation, as a time-only based progression may not be sufficient.
Purpose: To investigate the relationship between measures of shoulder range of motion (ROM), strength, and patient reported outcome measures (PROMs) at three months status post shoulder stabilization in adolescent athletes.
Methods: A retrospective review was conducted on adolescent patients who underwent arthroscopic shoulder stabilization surgery between April 2022 and April 2023. Patient demographics, operative details, shoulder ROM, isometric strength, and PROMs (quickDASH, WOSI) were obtained. Patients with isolated labral repairs were included, excluding bony procedures, biceps tenodesis, and revisions. Passive shoulder flexion difference and total arc ROM difference were recorded by subtracting the total degrees of ROM of the uninvolved limb from the total degrees of the involved limb. Isometric external (ER) and internal rotation (IR) strength were tested on a HUMAC isokinetic dynamometer (CSMi) in a modified seated position with the arm in 40° of scaption, and recorded in peak torque

normalized to body weight (Nm/kg), compared to the uninvolved limb (LSI), and as a ratio between the involved limb's ER to IR. Linear regression and Pearson correlations were used to examine associations between measures of ROM, strength, and PROMs.

Results: Eighteen patients (3 females; 16.6±1.6 years old) completed a three month testing battery 101.5±19.8 days post-operative. Significant negative correlations were found between quickDASH scores and shoulder flexion ROM difference (r=-0.73, p<0.001), total arc ROM difference (r=-0.63, p=0.005), IR peak torque normalized to bodyweight (r=-0.48, p=0.042), and IR LSI (r=-0.60, p=0.009). Shoulder IR peak torque normalized to bodyweight accounted for 23.4% of the variance in quickDASH scores, while IR LSI accounted for 35.5%. WOSI scores in this patient cohort were not significantly correlated with any strength testing outcome (p>0.05).

Conclusion: Restoring symmetrical ROM is correlated with improved PROMs three months after shoulder stabilization in adolescent athletes. Increased IR strength and IR LSI may be more related to improved PROMs than ER strength and ER LSI. Continued investigation of early objective measures is needed to develop criteria-based testing benchmarks.

Tables/Figures:

Table 1

Patient Demographics (n=18)	
Age (years) [a]	16.6 ± 1.2
Height (in) [a]	68.2 ± 2.3
Weight (kg) [a]	78.3 ± 17.6
Time since surgery (days) [b]	101.5 ± 19.8
Type of Arthroscopic Labrum Repair (n)	13 Bankart
	3 SLAP
	2 Posterior

[a]Values are expressed as mean ± SD, [b]Value is expressed as median
SLAP, Superior Labrum Anterior to Posterior

Table 2

Correlation Values Between 3-Month Outcomes and Patient Reported Outcome Measures		
	QuickDASH	WOSI
Flexion ROM Difference [ab]	**-0.73 (0.001)***	**-0.48 (0.043)***
Total Arc ROM Difference [ab]	**-0.63 (0.005)***	-0.42 (0.079)
ER Normalized Peak Torque (Nm/kg) [a]	-0.41 (0.093)	-0.32 (0.191)
ER Peak Torque LSI	-0.36 (0.142)	-0.26 (0.295)
IR Normalized Peak Torque (Nm/kg) [a]	**-0.48 (0.042)***	-0.26 (0.294)
IR Peak Torque LSI	**-0.60 (0.009)***	-0.34 (0.169)
ER:IR Peak Torque Ratio	-0.19 (0.458)	-0.30 (0.235)

[a]Values are expressed as mean (p value), [b] Difference=Involved Limb-Uninvolved Limb
***bold indicates statistical significance set at p≤0.05 a priori**

Table 3

Linear Regression for Shoulder Strength and Patient Reported Outcome Measures			
	QuickDASH		
	R^2	f	P
ER Normalized Peak Torque	16.6%	3.18	0.093
ER Peak Torque LSI	12.9%	2.39	0.142
IR Normalized Peak Torque	**23.4%***	**4.89***	**0.042***
IR Peak Torque LSI	**35.5%***	**8.82***	**0.009***
ER:IR Ratio	3.5%	0.58	0.458

***bold indicates statistical significance set at P≤0.05 a priori**

Syndromes, Dysplasias & Genetic Conditions

ePoster 54. Fidrisertib (IPN60130) for the Treatment of Fibrodysplasia Ossificans Progressiva: Methodology of the Randomized, Double-Blind, Placebo-Controlled Phase II FALKON Trial

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Background: Fibrodysplasia ossificans progressiva (FOP) is an ultra-rare genetic disorder caused by ALK2/ACVR1 mutation and characterized by heterotopic ossification (HO) and progressive disability. Fidrisertib (IPN60130) is a selective ALK2/ACVR1 inhibitor being investigated for FOP treatment.1
Introduction: Here, we describe methodology of the FALKON trial (NCT05039515) designed to compare efficacy and safety of fidrisertib with placebo in patients with FOP.
Methods: Patients will be randomized to oral placebo, or low or high dose fidrisertib for 12 months; patients receiving placebo will be randomized to fidrisertib (low or high dose) for 12 months. All patients will then enter a 36-month extension period and continue with the same fidrisertib dosing regimen. Enrollment criteria include: ≥5 years old, FOP diagnosis with disease-causing mutation, and either a flare-up, new HO or joint ankylosis, or increase in Cumulative Analogue Joint Involvement Scale (CAJIS) score in the prior year. Recruitment is ongoing to enroll 98 patients. The primary efficacy outcome will be annualized change from Baseline in HO volume to Month 12, assessed by low-dose whole-body computed tomography (WBCT; excluding the head). Secondary efficacy outcomes are presented in the Table. Safety will be assessed via adverse event (AE) and serious AE incidence over 63 months.
Conclusion: Results from FALKON will allow evaluation of fidrisertib in FOP.
Reference:
1. Davis A, et al. J Bone Miner Res. 2019;34(suppl 1):290.
Table. Secondary efficacy outcomes

Timeframe, months[a]	**Outcome**	**Comparison**
12	Change from baseline in volume of new HO lesions[b]	Fidrisertib (low and high dose) vs placebo
	Change from baseline in number of HO lesions[b]	
	Flare-up rate[c]; number of flare-up days	
	Number of body regions with new HO	
	Change from baseline in pain intensity	
	Proportion of patients with new HO	
60[d]	Change from baseline in HO volume[b] Change from baseline in CAJIS Change from baseline in FOP-PFQ	Fidrisertib vs placebo and untreated natural history study (NCT02322255) participants

CAJIS: Cumulative Analogue Joint Involvement Scale; FOP-PFQ: Fibrodysplasia Ossificans Progressiva Physical Function Questionnaire; HO: heterotopic ossification.

[a]From baseline up to the month given.

[b]Assessed by low-dose whole-body computed tomography excluding the head.

[c]As confirmed by the investigator.

[d]Across all available timepoints.

ePoster 55. Functional Independence of Children with Arthrogryposis

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Background: Arthrogryposis (AMC) is a descriptive term to characterize a child born with multiple joint contractures. Treatment aims to improve functional independence, yet literature objectively describing functional independence in this population is scarce. This study aimed to describe functional independence of children with AMC through the lens of the Pediatric Evaluation of Disability Inventory-Computer Adaptive Test (PEDI-CAT) and an observational Activities of Daily Living (ADL) tasks.
Methods: Patients with AMC between the ages of 3-12 years participated in this prospective study. Parents completed the PEDI-CAT while a trained occupational therapist observed children as they completed a checklist of functional ADL tasks. Patients were grouped according to developmental age groups: 'preschoolers' (3-5 years), 'early school-age' (6-9 years), and 'late school-age' (10-12 years). Patient's PEDI-CAT normative scores were described, comparing the study population to typically developing children, and differences in each domain were examined between developmental age groups. The observed ADL tasks completed were also described and differences in scores were examined between developmental age groups.
Results: Forty-four patients (mean age of 7 ± 2.86 years) were enrolled. Distribution between age groups was nearly even. Mean Daily Activities T-score for patients with AMC was 25.80 ± 11.98 and mean Mobility T-score was 17.39 ± 9.77. Late school-age children scored significantly lower than preschool-age children in both of these domains (p

Summary of scores achieved for each PEDI-CAT domain by developmental age groups and differences in scores between developmental age groups. Mean normative value is 50.

	Total sample	Preschool	Early school	Late school	**Pre vs. Early**	**Pre vs. Late**	**Early vs. Late**
Daily Activities	25.80 (11.98)	34.44 (8.23)	25.56 (11.03)	14.58 (7.55)	0.009*	<0.001*	0.003*
Mobility	17.39 (9.77)	22.00 (12.70)	17.31 (7.30)	11.33 (3.09)	0.15	0.003*	0.09
Social Cognitive	43.57 (8.90)	43.25 (6.61)	42.63 (7.65)	45.25 (12.86)	0.85	0.57	0.45
Responsibility	42.73 (9.26)	42.00 (9.63)	44.69 (5.89)	41.08 (12.41)	0.42	0.80	0.32

Values displayed as normative T-scores (Mean (SD)).
*Indicates a significant difference between groups at P-value < 0.05 from ANOVA.

ePoster 56. Investigation into the Development and Progression of Coxa Vara after Intramedullary Rodding in Children with Osteogenesis Imperfecta

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Background: Osteogenesis Imperfecta (OI) is a genetic disorder affecting the formation and biosynthesis of type I collagen through mutations in the COL1A1 or COL1A2 gene. OI presents clinically with frequent fractures that lead to observed spinal column and long bone deformities, requiring aggressive surgical and pharmaceutical management to aid in pain, fragility, and anatomical malformation. Surgical intervention utilizing telescoping intramedullary rods are utilized to correct deformities, lower future operation rates, and decrease fracture burden.

Introduction: In more severe types of OI, a common deformity is coxa vara (Figure 1). Bowing of the proximal femur and residual anterolateral varus from impaired bone growth causes a progressive deformity that leads to shortening the lever arm of the hip abductors, resulting in the inability to stabilize the pelvis, increasing incidence of stress fractures, hip pain, and ambulatory difficulties. Repeated non-displaced femoral neck fractures, occurring in isolation or concurrent with the placement of intramedullary devices, predisposes to development of coxa vara. The goal of this study is to determine factors that predispose patients for coxa vara development in order to optimize strategies for treatment and recovery. The null hypothesis exists that after the completion of surgery, the initial anatomical location of the proximal portion of the intramedullary rod has no significant effect on the development of Coxa Vara in patients with OI.

Methods: An IRB-approved study conducted a retrospective chart review of 132 patients with OI, who were treated with surgical intervention of intramedullary rodding on long-bones. Post-operatively the proximal portion of the FD rod was classified utilizing radiographic characteristics of anatomic location in comparison to articular cartilage and proximal epiphysis of the femur. Neck-Shaft-Angle (NSA) was measured as the angle between the axis of the femoral shaft and neck. The development of coxa vara was defined as an NSA value of <120 degrees.

Results: 132 patients with OI were analyzed, of which 26 patients (19.7%) were confirmed to have coxa vara through analysis of radiographic measurements. Data was collected on operations of intramedullary rodding through the shaft of the right (n=215) and left femur (n=221). Coxa vara was noted after 19 surgeries of the left femur (8.6%) and after 27 surgeries on the right femur (12.6%). In the left femur, surgeries where the proximal portion of the rod in "full cartilage fixation" were significantly associated with the development of coxa vara after a Fisher's Exact Test and Bonferroni correction (p=0.025).

Conclusion/Significance: This data will serve as a reference for surgeons performing intramedullary rodding to surgically correct and prevent long bone deformities in patients with OI. Physicians can utilize this data to provide patient-centered care and improve clinical outcomes post-operatively, preventing the development of coxa vara, reducing hip fracture incidence and hip joint degeneration.

Figure 1 (Above):
6-year-old male with type III OI and right hip coxa vara. Note almost 90-degree neck shaft angle pre-operatively. 1 Year post-operative image showing maintenance of the head/neck angle near 135 degrees after coxa-vara surgical correction.

ePoster 57. Radiographic Outcomes and Recurrence Rates of Pediatric Patients Treated with PRO-DENSE for Benign Bone Tumors

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Background: Benign bone tumors frequently occur in children and adolescents. The treatment of these tumors may involve surgical intervention to alleviate pain, prevent fractures, and restore function. This typically involves intralesional curettage and grafting. There are a variety of grafting options, including cancellous allograft as well as several different bone substitutes.
Introduction: Recently, synthetic composites of calcium phosphate and calcium sulfate have been used for grafting after intralesional curettage. However, there are limited studies on the outcomes of patients treated with these graft materials. In this study, we aimed to assess the radiographic outcomes of benign bone tumor patients who underwent intralesional curettage and grafting with PRO-DENSE (Wright Medical Technology, Arlington, Tennessee). Moreover, we wanted to analyze the rates of graft material resorption by measuring the area of bone graft as demonstrated in radiographs taken at distinct time frames.
Methods: For this study, a retrospective electronic medical record search was made to gather pediatric patients treated from 2020-2022 who were diagnosed with benign bone tumors and were subsequently treated with intralesional curettage and grafting with PRO-DENSE. Patient demographics, along with primary significant data such as diagnosis, lesion location, graft implantation date, volume of graft used, recurrence, fracture, and radiographic volumetric measurements. Radiographic analysis was performed utilizing VISAGE imaging software.
Results: Fourteen patients were included in the study with a mean follow up of 12 months. The mean preoperative radiographic tumor volume was 12.68 cm3. The mean volume of PRO-DENSE used in the patients was 15.1 cm3. The mean time for complete graft resorption as demonstrated by radiographic analysis was four months. Three out of the fourteen cases developed local tumor recurrence. All were patients with aneurysmal bone cysts. Furthermore, the percentage of the cavity filled post curettage with bone graft was obtained. For the three patients that recurred, the mean cavity filled with bone graft was 99%. As for the eleven patients that did not recur, the mean was 208%.
Conclusion: The use of PRO-DENSE, a synthetic bone graft, was associated with gradual resorption and effective osteoconductive properties that lead to a successful biological integration in the surgical treatment of benign bone tumors. As for the cases that recurred, it is noteworthy that they were all cases of aneurysmal bone cysts, in which the percentage of cavity fill was less than those that did not recur.
Significance: This study provides add to the data on radiographic outcomes of patients who underwent intralesional curettage and grafting of benign bone tumors in the pediatric population with PRO-DENSE and postulates this bone graft as a viable alternative to other grafts such as cancellous allograft. Further research is needed to determine the relationship between cavity fill and risk of recurrence.

ePoster 58. Understanding the Impact of Fibrodysplasia Ossificans Progressiva on the Quality of Life of Patients and Their Family Members Using an International Burden of Illness Survey: Results From the United States and Canada

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Background: Fibrodysplasia ossificans progressiva (FOP) is an ultra-rare genetic disorder in which progressive heterotopic ossification causes severe, irreversible disability. Loss of joint function has a negative impact on quality of life (QoL),1 but this has not been quantified for specific geographic regions.
Introduction: The purpose of this analysis was to determine the impact of loss of joint function on QoL for individuals with FOP and their family members in the U.S. and Canada. Here, we present the combined results from the United States (U.S.) and Canada from an international burden of illness (BoI) survey (NCT04665323) assessing the QoL impact of FOP on patients and their family members.
Methods: Individuals with FOP (proxy-completed <13 years) and their family members completed the online survey from 18Jan–30Apr 2021. The Patient-Reported Mobility Assessment (PRMA) was completed by all patients and assessed range of motion across 12 joints and 3 body regions (total scores: 0[no limitation]–30[severe limitation]). Total scores were

categorized as: Level 1, 0–6; Level 2, 7–12; Level 3, 13–18; Level 4, ≥19. Patients ≥13 years and their family members completed the EuroQoL health-related QoL questionnaire (EQ-5D-5L; index scores: <0[worst health]–1[full health]) to assess QoL. Descriptive analyses of EQ-5D-5L index scores were performed by population and patients' PRMA level.
Results: 67 individuals with FOP (≥13 years, n=50; proxies for patients <13 years, n=17) and 107 family members (of whom 64 identified as primary caregivers) responded from the U.S. (n=59 individuals with FOP and n=96 family members) and Canada (n=8 individuals with FOP and n= 11 family members). Mean (standard deviation, SD) EQ-5D-5L index score was 0.25 (0.38 [n=48]) for patients ≥13 years, 0.90 (0.15 [n=63]) for primary caregivers, and 0.90 (0.17 [n=106]) across all family members. For patients, mean (SD) EQ-5D-5L score decreased as PRMA level increased; Level 1, 0.67 (0.16 [n=9]); Level 2, 0.43 (0.41 [n=9]); Level 3, 0.19 (0.29 [n=8]); Level 4, 0.05 (0.28 [n=20]). EQ-5D-5L index scores did not appear to vary by the related patient's PRMA level for family members (mean [SD] range: 0.96 [0.07]–0.86 [0.18]) or primary caregivers (mean [SD] range: 0.96 [0.06]–0.83 [0.25]).
Conclusions: Loss of joint function as assessed in a subset of U.S. and Canadian individuals with FOP (PRMA level) has a detrimental impact on QoL (EQ-5D-5L index), aligning with the results from the international population.
Significance: These findings increase our understanding of the QoL impacts of FOP on patients and their family members in the U.S. and Canada. This may allow for targeted support and care for the FOP community in this region.
Reference:
1. Al Mukaddam M, et al. Expert Rev Pharmacoecon Outcomes Res. 2022;22(8):1199-1213.