Spondylolysis & Spondylolisthesis Surgery in the Pediatric and Adolescent Patient

Position Statement

Diagnosis and Clinical Evaluation

Spondylolysis is relatively common in children and adolescents. The term spondylolysis is derived from the Greek words for vertebra (spondylo) and defect (lysis). The anatomic feature of spondylolysis is a defect in the pars interarticularis, and alone implies that there is no forward slippage of the superior vertebra. The term spondylolisthesis describes the forward displacement of the superior vertebra. Both conditions can coexist, thus they are intertwined when assessing the literature.

Spondylolysis and spondylolisthesis occur in both children and adults. While the anatomy is similar, the clinical presentation, physical exam findings, pathophysiology, natural history, and treatments are different in children and adolescents compared to older adults.

This position statement focuses on spondylolysis and spondylolisthesis in children, adolescents and young adults (<21 years old).

Spondylolysis is often described as secondary to trauma, and has not been found in non-ambulatory adults. It is more common in athletes involved in sports which require repetitive loading, twisting, flexion, and extension of the spine. Spondylolysis is cited as the most common identifiable cause of low back pain in the teenage athlete.

Spondylolisthesis is a relatively common condition of the lower lumbar spine. The term listhesis describes a slip as being an integral part of the condition. In children, the amount of slip can be low grade, in which the upper vertebra is slipped forward less than 50%, or high grade, in which the amount of upper vertebral slip is greater than 50% or associated with kyphotic angulation. Low grade slips can be asymptomatic or painful, and in rare cases can progress to a higher grade of slip. High grade slips can also be asymptomatic, but frequently are painful, and associated with hamstring tightness, pelvic and spine imbalance, and neural dysfunction. High grade slips are likely to progress, even to the point where the slipped vertebra is 100% displaced, which is known as spondyloptosis. The most dreaded complication of a high grade slip is cauda equina syndrome, which results in paralysis and/or bowel and bladder dysfunction.

Both spondylolysis and spondylolisthesis can cause disabling low back pain. Often symptoms are exacerbated by hyperextension movements of the lower back. Hamstring spasm/contractures and neurologic findings of radiculopathy may be present on physical exam.
**Radiographic Evaluation of Spondylolysis and Spondylolisthesis**

The defect of the lumbar pars may or may not be visible on the lateral and/or oblique radiographs. MRI is useful for ruling out other pathology, diagnosing occult or stress fractures of the pars, localizing neural compression in symptomatic patients, and offer essential anatomical detail for preoperative planning in high grade spondylolisthesis. Bone scan with SPECT imaging is a sensitive tool for diagnosis. CT scanning is also implemented to detail the bony anatomy of spondylolysis and spondylolisthesis, however, it requires radiation and does not illuminate soft-tissue or neural elements well.

**Treatment**

**Non-operative treatment** is successful in relieving symptoms in the majority of cases of acute symptomatic spondylolysis and mild spondylolisthesis. **Conservative measures** include activity modification, physical therapy, immobilization with a brace, and pharmacologic interventions for pain control.

**Reference/ Evidence**


A **brace** may be used to relieve significant pain; however, it is less likely to heal a chronic spondyloytic lesion. If there is documentation of an acute or recent injury, a brace may be tried to facilitate healing of the lesion/fracture. A brace does not improve or correct forward slippage of the vertebra.

**Reference/ Evidence**


2. Sairyo K, Sakai T, Yasui N. Conservative treatment of lumbar spondylolysis in


**Indications for Surgery: Spondylolysis**

**Surgical treatment** for spondylolysis (without significant spondylolisthesis) is indicated for the patient with significant pain and disability who is not responsive to a comprehensive conservative treatment program.

**Reference/ Evidence:**


**Surgical management.**

Surgical options for symptomatic spondylolysis (without significant spondylolisthesis), which has failed conservative intervention, are an instrumented spondylolysis repair or a single level fusion.
Reference/ Evidence:

1. Westacott DJ, Cooke SJ. Functional outcome following direct repair or intervertebral fusion for adolescent spondylolysis: a systematic review. *J Pediatr Orthop B*. Jun 1 2012. Systematic review of 9 studies comparing pars repair (80 pts) vs fusion (108 pts) found no significant different between groups. **Level of Evidence: IV**


3. Debnath UK, Freeman BJ, Grevitt MP, Sithole J, Scammell BE, Webb JK. Clinical outcome of symptomatic unilateral stress injuries of the lumbar pars interarticularis. *Spine (Phila Pa 1976)*. Apr 20 2007;32(9):995-1000. 42 patients with unilateral spondylolisthesis were followed prospectively with initial conservative care x 6 months. 8 patients failed conservative care and required surgery with one patient with spina bifida having a persistent nonunion. ODI scores improved in all patients after surgery. **Level of Evidence: III**


**Indications for Surgery: Spondylolisthesis**
Indications for surgical treatment for spondylolisthesis include patients with significant pain and disability not responsive to a comprehensive conservative treatment program, patients (including asymptomatic patients) who show progression of the slip, and those with greater than a 50% slip.

**Reference/ Evidence**

   **Level of Evidence:** III

   **Level of Evidence:** III (Conflicts in part with recommendation: Findings included similar quality of life scores in subjects with high grade spondylolisthesis who were treated operatively and non-operatively. While, the non-operative group was less functionally impaired initially, there was no worsening quality of life observed with follow-up.)

   **Level of Evidence:** III (Conflicts in part with recommendation: Subjects with grade III and IV slips at presentation were found to have similar long-term outcomes with non-operative and operative management.)

   **Level of Evidence:** III (Conflicts with recommendations: Findings were that risk of slip progression increased with worse slip percentage at initial presentation but risk of slip progression was not different between subjects receiving non-operative therapy and those receiving surgery. However, notable differences in slip percentage between the two groups existed at presentation.)

   **Level of Evidence:** IV

   **Level of Evidence:** IV
   **Level of Evidence: IV**

   **Level of Evidence: V**

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An instrumented one or two level fusion, with or without slip reduction, is reported to have a high rate of clinical success in preventing further slip progression and improving pain. When slippage is progressive, surgery should be undertaken without delay, before a large amount of forward slippage is allowed to occur. Surgery for high grade slips, particularly for those patients with spondyloptosis, is technically demanding. The procedure frequently involves nerve decompression and exploration, posterior pedicle fixation, anterior interbody support, vertebral reduction and posterior fusion.

**Outcomes of Spondylolysis and Spondylolisthesis surgery**

Commonly used tools to assess the efficacy of spine surgery include clinical outcome measures and postoperative radiographic images to assess fusion, alignment, and surgical instrumentation. Numerous studies in the medical literature report good clinical and radiographic success with surgical intervention, as high as 95%. Patients with high grade, severe spondylolisthesis are the group with the highest complication rate. Complications can include nerve root injury, dural tears, loss of fixation, implant breakage or failure, non union, progression of the deformity, need for revision surgery, pelvic or spinal imbalance, or infection.

**Summary**

The majority of patients with spondylolysis and mild spondylolisthesis do not require surgery.

The current standard of care for surgical intervention includes symptomatic spondylolysis not responsive to non-operative therapies, spondylolisthesis not responsive to non-operative therapies, documented progression of spondylolisthesis slippage (with or without symptoms), and high grade spondylolisthesis (with or without symptoms).
References (previously placed in the statement)


