

Back Pain in Children and Adolescents

Understanding and Diagnosing Spondylolysis and Spondylolisthesis

by Lael Luedtke, M.D.

A common belief in pediatrics is that back pain in children is rare. In reality, back pain is common in children – especially among those who are involved in sports and within the growth-spurt ages of 10 to 15. Approximately 10 to 30 percent of children and adolescents experience back pain.

Although most back pain stems from overuse or muscle pain, persistent pain can indicate something more serious. Back pain that is associated with mild trauma but that is improving tends to resolve spontaneously in a few weeks; worsening back pain without a clear cause deserves an aggressive work-up so that appropriate treatment can be employed.

Significant causes of back pain include infections, such as osteomyelitis, diskitis, pyelonephritis, and soft-tissue abscesses; malignant or benign tumors; and inflammatory conditions, such as ankylosing spondylitis.

Spondylolysis and Spondylolisthesis

Pain that radiates from the back into the buttocks can be due to localized musculoskeletal strain. Pain radiating into the lower extremities (thigh area) occurs less commonly and may be due to defects in the vertebrae known as spondylolysis and spondylolisthesis. However, the most common symptom in spondylolysis is low-back pain without radiation.

Spondylolysis

Spondylolysis refers to defects (breaks) in the *pars interarticularis* of the vertebra. The defects can be unilateral (involving one side of the vertebra) or bilateral (involving both sides).

Although such defects can be found at any level of the vertebrae, the most common defect in children and adolescents is at the fifth lumbar vertebra (L5).

Spondylolisthesis

In cases of bilateral spondylolysis, the posterior articulations no longer provide posterior stability, and

anterior slipping of the L5 vertebra over the sacrum can result. This slip, called spondylolisthesis, refers to one vertebra slipping forward onto the next lower vertebra.

There are five grades of slippage that can occur with spondylolisthesis. Grade V is the most severe.

Grade I: < 25-percent slippage of one vertebra on top of another vertebra

Grade II: 25- to 50-percent slippage

Grade III: 50- to 75-percent slippage

Grade IV: > 75-percent slippage

Grade V: 100-percent slippage (the vertebra falls off). This is called spondyloptosis, and it can lead to neurological damage if not treated.

Typically, a spondylolysis will occur before a spondylolisthesis. Confusion can occur when spondylolisthesis develops without spondylolysis, as happens with dysplastic (type I) spondylolisthesis. About one-third of symptomatic patients have spondylolisthesis without spondylolysis. Once vertebral growth is complete (at about 15 years of age), it is rare to see a

spondylolisthesis progress to a more severe condition such as spondyloptosis.

There are five types of spondylolisthesis, but only two – dysplastic and isthmic – occur in children and adolescents. Dysplastic spondylolisthesis happens when a congenital deficiency in the L5-S1 facet joints allows a slippage to occur. A defect in the *pars interarticularis* leads to isthmic spondylolisthesis, which is the most common type.



The area marked with Xs indicates the *pars interarticularis*, the area where the fracture occurs in spondylolysis.

Case Study:

An athletic 11-year-old girl presented with a several-month history of low-back pain. She was premenarchal and unable to maintain activity restrictions placed on her by her primary physician. She had subtle urinary incontinence symptoms as well.



This radiograph demonstrates a spondylolysis with a Grade IV spondylolisthesis. The patient underwent a fusion *in situ* to prevent progression of the spondylolisthesis and to relieve her pain.

Isthmic spondylolisthesis (type II) can be divided into three groups:

- Lytic fracture of the *pars*
- Elongated but intact *pars*
- Acute *pars* fracture

Etiology of Spondylolysis and Spondylolisthesis

The exact etiology of spondylolysis and spondylolisthesis is unknown, but various theories relate it to:

Hereditary factors. A common belief is that spondylolysis is an inherited defect of the *pars interarticularis*. Surveys have shown that asymptomatic spondylolysis was present in 4 to 6 percent of school children. In certain racial groups, such as Eskimos, the incidence of spondylolysis is as high as 40 percent, suggesting a genetic factor. Dysplastic spondylolisthesis with elongated *pars* has a strong familial pattern and is associated with congenital abnormalities in the lumbosacral area.

Posture. Spondylolisthesis has never been reported in patients who are unable to walk because of neuromuscular disabilities, or in newborns, pointing to the mechanical effects of upright posture in its etiology.

Growth. There is evidence that *pars interarticularis* defects do not occur in newborns. The incidence of the disorder reaches 4 percent by 6 years of age and rises to adult levels (6 percent) by 14 years of age. There also is an increase in the amount of slippage during the adolescent growth spurt.

Trauma. Many cases of spondylolysis develop after a traumatic episode. It is unclear whether the trauma is the cause of the lesion or whether it makes an asymptomatic defect symptomatic. Acute spondylolysis also has been noted in people who perform heavy physical labor, such as weightlifters and loggers. Increased incidence of this defect is noted in children involved in gymnastics, diving, rowing, hockey, tennis and football (especially front linemen). These sports put a great deal of stress on the bones in the lower back and require the athlete to constantly extend the lumbar spine. In either case, the result is a stress fracture on one or both sides of the vertebrae.

Symptoms of Spondylolysis and Spondylolisthesis

Pain is the most common presenting symptom of spondylolysis and spondylolisthesis in patients, usually 10 to 15 years of age, seeking medical attention. However, it must be emphasized that spondylolysis is rarely symptomatic in an adolescent. Many children with spondylolysis are evaluated medically only because of a postural deformity or abnormal gait resulting from tightness of the hamstrings. The postural changes noted are a flattening of the buttocks, increased lumbar lordosis, and a waddling gait. Occasionally, these cases present with scoliosis. Physicians should be cautious to consider the scoliosis the exclusive cause of symptoms in the back and should, instead, search for other causes of the pain.

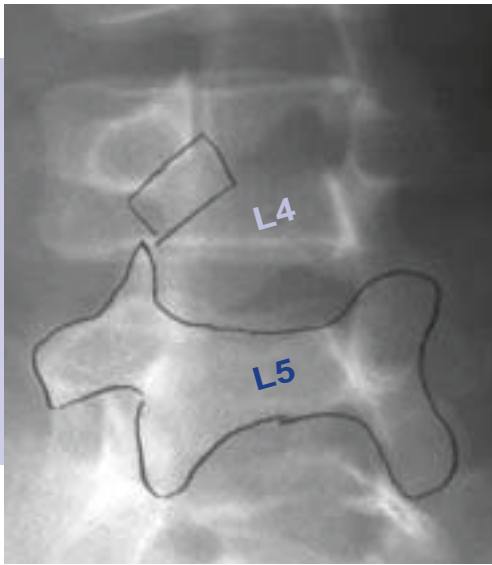
When there is pain, it manifests as a dull, aching low-back discomfort, either localized to the low back or with some radiation into the buttocks and posterior thighs.

The pain can be chronic, exacerbated by sports or other physical activities and relieved by rest or restriction of activities.

Relation of Scoliosis to Spondylolisthesis and Spondylolysis

Scoliosis has been found in up to 48 percent of patients who have symptomatic spondylolisthesis but in only 13 percent of those who have spondylolysis.

A lateral X-ray of the lumbar spine should be performed on a child who has scoliosis and complains of low-back pain or who is found to have tight hamstrings during a physical exam.



The “Scotty dog” appears on the oblique view of the lumbosacral spine and is outlined on the L5 vertebra. In this case, the neck on the “Scotty dog” is white and sclerotic, indicating a chronic stress reaction, which precedes a frank fracture. A fracture would appear as a lucent or dark line along the neck – a collar on the “Scotty dog.” The box on the neck of the L4 vertebra shows what the normal radiographic appearance of the area should be.

Diagnosing Spondylolysis and Spondylolisthesis

Radiographic Evaluations

The initial radiographic evaluation consists of a standing posteroanterior view and a lateral view of the lumbosacral spine. Full-length views also are taken in the presence of scoliosis, and a full-length lateral film is taken with larger degrees of slippage to evaluate the sagittal spine alignment. The spot lateral film usually shows the defect, especially with bilateral *pars* defects, and the degree of slippage in spondylolisthesis can be appreciated.

To visualize the *pars* defect better, oblique views of the lumbosacral area often are necessary. The view is an oblique of the lumbosacral area and not of the lumbosacral spine, so the central spray beam must be at the lumbosacral area and not in the mid-lumbar spine. The *pars* defect is seen as the well-known “collar” on the “Scotty dog.” In cases where the defect is strongly suspected but is not seen on the oblique view, a CT scan can be performed.

The diagnosis may be missed in up to 20 percent of young symptomatic patients if oblique X-rays are not made.

Bone Scans

Spondylolysis that is suspected clinically but cannot be confirmed radiographically, or that is in the stress-reaction stage before fracture (pre-spondylolytic), may be detected initially by radioactive bone scanning. The most effective type of scan is a SPECT scan.

Bone scans can be positive when the clinical history is short, and they can demonstrate increased uptake in patients who have had symptoms for only five to seven days. Later, bone scans are helpful in distinguishing between patients who have an established non-union and those where healing is still progressing and who may benefit from immobilization. Bone scans are not recommended for patients who have had symptoms for more than a year or for those who are asymptomatic; these patients should be referred to an orthopaedic specialist.

Treatment

Non-operative treatment for spondylolysis and spondylolisthesis is, for the most part, the same.

Restriction of Activities

Restriction of vigorous activities and strengthening exercises for the muscles of the back and abdomen are usually successful in controlling symptoms in patients who have mild backaches and tight hamstrings. Activity is restricted until symptoms resolve, at which time gradual resumption of activity is initiated.

Patients who have more severe or persistent complaints may need bed rest, immobilization in a cast or thoracolumbosacral orthosis, and non-narcotic analgesics.

Bracing

If a child has pain, it should be determined whether the symptoms are of recent origin, follow an acute injury, or are of long duration. In cases in which pain follows a definite injury, a bone scan is performed to determine whether the *pars* defect is of recent origin and is an acute fracture. If the scan indicates an acute fracture, immobilization in a cast or brace is used to aid in healing of the *pars* defect. A brace usually is adequate, but extremely painful cases may require immobilization of the area using a body cast with a leg extension.

Healing of the defect takes three to four months and is documented with oblique X-rays or repeated bone scans.

After healing of the defect, or when symptoms have resolved with immobilization, even patients with a persistent *pars* defect may gradually resume all activities.

Surgical Treatments for Spondylolysis and Spondylolisthesis

Surgical treatments would be employed after the noted nonsurgical treatments have failed or in the case of a high grade (III or IV) slip in a pre-adolescent child. The treatments for both of these conditions are generally the same.

In general, orthopaedic surgeons don't try to reduce or correct the position of the vertebrae because there is high risk of nerve injury. The approach is almost always to perform a posterior fusion – fusing where the defect lies. This approach, known as the arthrodesis approach, fuses L4, L5 and S1 together.

When an anterior approach is used, the disc is taken out and the vertebrae fused. The advantage to this approach is that physicians can sometimes fuse L5 to S1, which allows more motion segments to be saved.

Recovery after a fusion procedure averages three months.

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Dr. Luedtke treats children and adolescents who have a wide variety of pediatric orthopaedic conditions. She has a special interest in spine surgery, pediatric trauma and hip disorders.

Dr. Luedtke is a graduate of the University of Minnesota Medical School. After completing her orthopaedic surgery residency there, she completed her pediatric orthopaedic surgery fellowship at Children's Hospital of Philadelphia. She has been practicing at Gillette since 2001.

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