Lumbar Spondylolysis in Adolescent Athletes

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Lumbar spondylolysis is a common cause of low back pain in adolescent athletes. The early diagnosis and treatment of this condition will result in decreased morbidity and an earlier return to full activity for most patients. We report a case of lumbar spondylolysis in an adolescent athlete and review current diagnosis and management of this condition.

KEY WORDS. Spondylolysis; adolescent; back pain; athlete. *(J Fam Pract 1998; 46:145-149)*

The national explosion of competitive athletics has led to increasing participation of adolescents in organized team sports. Up to one half of boys and one fourth of girls between the ages of 14 and 17 participate in some form of organized team sport.[1] The increase in the number of adolescent athletes has resulted in more adolescent complaints of low back pain.[2] The lifetime prevalence of low back pain among 11- to 17-year-olds in the United States is reported to be 30.4%.[3] Often, many young athletes with low back pain do not seek medical attention, since the problem is frequently a self-limited condition. However, when the condition persists, these patients may present to their family physician or pediatrician for care. Of the children and adolescents with low back pain who are referred to a specialty clinic, up to 50% will ultimately receive a diagnosis of a spinal disorder.[4,5]

The inclusion of spondylolysis in the differential diagnosis of mechanical low back pain in adolescents should lead to earlier diagnosis, treatment, and return to desired activities. Spondylolysis is a defect of the pars interarticularis of the spine. The lesion may range from a stress fracture to a true fracture with bony separation. Spondylolisthesis occurs when there is forward slippage of one vertebral body on another (Figure 1). The following case report identifies an adolescent athlete who presented with low back pain and was found to have symptomatic spondylolysis. The subsequent discussion will provide an overview of this condition with attention to the evaluation and treatment options for adolescent patients with spondylolysis.

Case Report

A 17-year-old male high-school soccer player presented with complaints of right lower back pain for two weeks which interfered with his ability to play soccer. The onset of the low back pain was insidious, without a history of trauma. At presentation, the pain was described as a sharp, right-sided, lower lumbar and buttock pain brought on during soccer practice while running and kicking, and was relieved with rest. No radicular symptoms were described. The patient denied any previous low back pain. Past medical history was unremarkable.

Physical examination revealed painful palpation of the lower right lumbar spine with bilateral paraspinal muscle spasm. Extension and rotation of the lumbar spine were markedly limited by pain. The one-legged lumbar extension maneuver caused pain when performed on the right side (Figure 2). Straight leg raising produced no leg or back pain. Neuromuscular testing was normal. Lumbosacral radiographs (anterior/posterior [AP], lateral, oblique views, L5-S1 spot view) were obtained and were normal. A bone scan with single photon emission computed tomography (SPECT) images were obtained that same day because of a high index of suspicion for spondylolysis, and revealed uptake in the

FIGURE 1

Spondylolisthesis. A diagrammatic representation, in the sagittal plane, of L4 through the upper sacrum showing the anterior slippage of L5 on S1, described as a spondylolisthesis of L5 on S1.

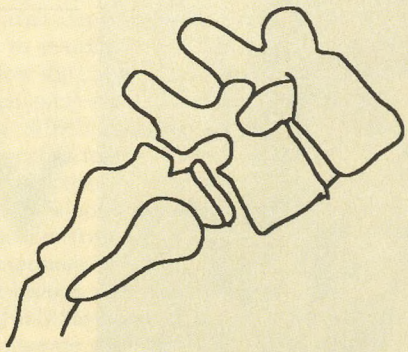

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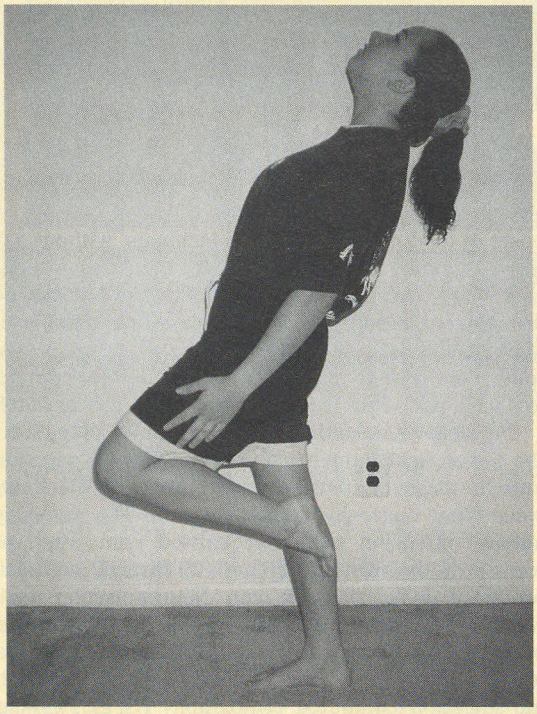
FIGURE 2

The model demonstrates the one-legged lumbar extension maneuver. This test often reproduces the patient's pain when performed on the ipsilateral side of the spondylolytic defect.



right pars interarticularis of L5 (Figure 3). The diagnosis of lumbar (L5) spondylolysis was made. The patient was placed on activity restriction, eliminating soccer and any pain-related activity, prescribed a short course of naproxen (500 mg orally twice a day), and sent to physical therapy for 3 months. Physical therapy involved a dynamic lumbar stabilization protocol, abdominal strengthening, and both hamstring and hip flexor stretching. Follow-up lumbar radiographs were obtained at 6 weeks and 3 months that demonstrated sclerosis of the pars interarticularis on the affected side. As his symptoms subsided he was allowed to increase his activities. After 3 months he was entirely free of symptoms and was released to full activity, including varsity wrestling.

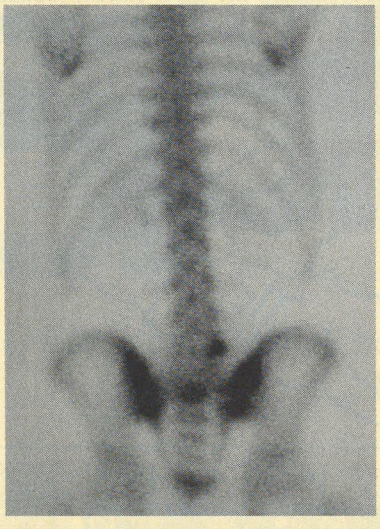
Discussion

Spondylolysis is not an uncommon cause of mechanical low back pain among adolescents. Its occurrence increases remarkably between the ages of 5 to 7 years, during which time the incidence is approximately 5%.[6,7] Among adolescent athletes referred for evaluation of back pain, the prevalence of spondylolysis has been reported to range from 13% to 47%.[4,5]

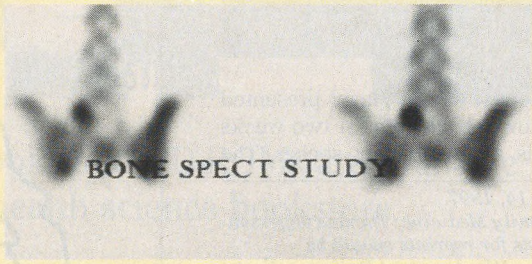
Cause of Spondylolysis

The exact cause of spondylolysis is unclear. It has been described as either hereditary,[8,9] possibly associated with an inherited predisposition to a hypoplastic pars interarticularis, or acquired as the result of repetitive stress and fatigue of the lower lumbar segment leading to a stress reaction and subsequent failure.[10-12] The latter hypothesis has led to postulation that lumbar lordosis is accentuated by the normal flexion contractures of the hip in childhood, which may become exaggerated during the adolescent growth spurt. Clearly, the stress of forces placed on the lumbar spine during athletic training, which involves lumbar extension and rotation, contributes to the development of spondylolysis.[9-11,13,14] As an associated factor, spina bifida occulta occurs in 5% to 10% of the general population,[15] and an apparent increased incidence of spina bifida has been noted in patients with spondylolysis.[14-19] Spina bifida occulta may lead to instability of the lower lumbar segment, predisposing one to the development of pars interarticularis defects.[7,17] A relationship between spondylolysis and the progression to spondylolisthesis has been recently

FIGURE 3



Intense radioactive tracer uptake is noted in the region of the right L5 pars interarticularis as shown in this posterior view of a Tc-99m bone scan *(left)*, and anterior coronal view of a SPECT scan *(below)*.

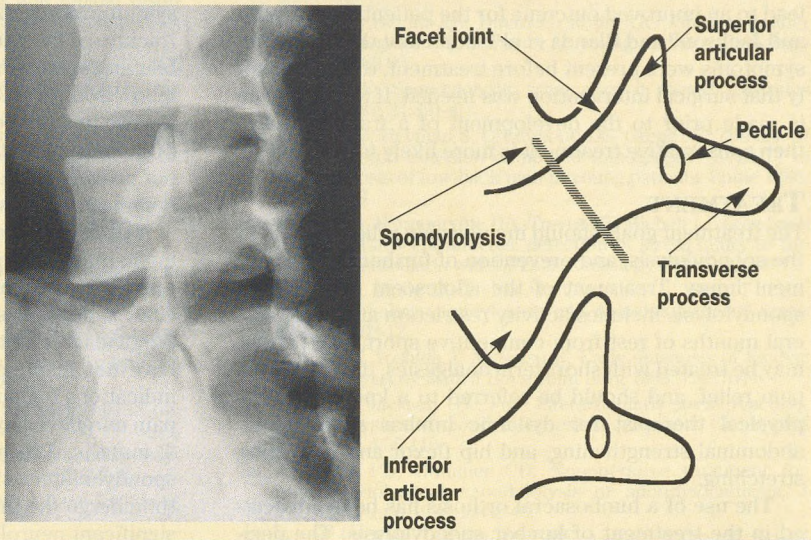


demonstrated by Ikata et al.[20] Their study of 77 adolescent athletes with spondylolysis and spondylolisthesis found that spondylolysis (with bony separation) is a risk factor for the progression to spondylolisthesis.[20]

Spondylolysis may occur in any activity, but those sports which demand repetitive hyperextension and rotation of the lumbar spine, particularly soccer, baseball, tennis, wrestling, gymnastics, football, volleyball, and rugby, have been shown to have a higher incidence of spondylolysis.[7,13,16,21,22] This condition most frequently involves the L5 vertebral level, and occasionally L4.[13,17,21] Steiner and Micheli[23] reported that 88.6% of spondylolysis in adolescent athletes occurred at the L5 level, and Morita et al[13] found 96% of the lesions involving the lower lumbar vertebrae (L4 and L5).

FIGURE 4

Lumbosacral radiographs reveal a fracture through the neck of the "Scottie Dog," or of the pars interarticularis, as seen on the oblique view *(left)*. The mirror image in the diagrammatic representation of the L5 vertebra in the oblique plane *(right)* shows the area of fracture.



Presentation and Examination

Many patients with spondylolysis are asymptomatic, and therefore require no treatment.[6,24] However, athletes with spondylolysis often present initially with pain during certain performance activities. This pain may become a more chronic, dull, midline lumbosacral pain with time. The pain is either unilateral or bilateral, and usually along the beltline. The lumbosacral pain is worsened by extension maneuvers and may radiate into the buttocks or posterior thigh. In one study, up to 98% of adolescent patients with spondylolysis had pain with extension and rotation maneuvers of the lumbar spine.[21] It has also been suggested that the standing one-legged lumbar extension maneuver will reproduce the pain[10] (Figure 2). The patient is frequently noted to have paraspinal muscle spasms, which cause splinting. Hamstring tightness is common, and found in up to 70% of patients.[4,14,15,21,25] Radicular symptoms are uncommon, and rest often alleviates the symptoms.

A careful physical examination of an adolescent athlete with low back pain should include visualization and palpation of the lumbar spine. Dimpling of the skin may signify the presence of spina bifida occulta or a spondylolisthesis. Range of motion should be evaluated and include flexion, extension, and rotation of the lower lumbar spine, as well as the standing one-legged lumbar extension maneuver. Either extension or extension-rotation maneuvers of the lumbar spine that cause pain should raise a physician's suspicion for the presence of spondylolysis. An assessment of hamstring flexibility, reflex testing, motor and sensory examination, and straight leg raising should also be performed.

Diagnosis

A diagnosis of spondylolysis is based upon both the clinical impression and radiographic imaging. Lumbosacral radiographs, including oblique views, should be obtained on all patients in whom this diagnosis is suspected. Spondylolysis can be missed in up to 20% of all cases if oblique views are not obtained.[26] The characteristic broken neck of the "Scottie Dog" of Lachapele, which is the fracture of the pars interarticularis, is the pathognomonic finding (Figure 4). Pierce[27] has reported the sensitivity of different lumbosacral radiographic views in the detection and diagnosis of spondylolysis. He found the AP view to have a sensitivity of 32%, the lateral view 75%, and the oblique view a sensitivity of 77%.[27]

For those patients in whom the radiographs are normal, yet spondylolysis is still suspected, a bone scan or SPECT scan may be ordered. However, the clinician may choose to restrict activity, prescribe physical therapy, and follow the patient for 2 to 3 weeks. If no significant improvement is seen, we recommend obtaining the bone scan or SPECT imaging for further evaluation. The SPECT scan is more sensitive for the detection of early spondolytic changes than either radiographs[28,29] or bone scans[29] and is not limited by resolution capacity. Bellah et al[29] demonstrated that among 71 adolescent athletes with abnormalities of the pars interarticularis on SPECT, only 32 lesions were present using bone scan. SPECT imaging may have limitations, since it may not adequately demonstrate a symptomatic spondylolysis beyond 3 months.[30] Computed tomography and magnetic resonance imaging are also useful radiologic tests for the

diagnosis or confirmation of a spondylolysis.[31] These are not our initial tests of choice, however, and a more detailed discussion of their use is beyond the scope of this article.

The timely diagnosis of an early spondylolysis will lead to an improved outcome for the patient. Both Ciullo and Jackson[32] and Blanda et al[21] found that the longer the symptoms were present before treatment, the more likely that surgical intervention was needed. If the diagnosis is made prior to the development of a frank fracture, then conservative treatment is more likely to succeed.[13,20]

TREATMENT

The treatment goals should include pain relief, healing of the spondylolysis, and prevention of further lumbar segment injury. Treatment of the adolescent athlete with spondylolysis includes activity restriction and often several months of rest from competitive sport. The patient may be treated with short-term analgesics, if required for pain relief, and should be referred to a knowledgeable physical therapist for dynamic lumbar stabilization, abdominal strengthening, and hip flexor and hamstring stretching.

The use of a lumbosacral orthosis has been advocated in the treatment of lumbar spondylolysis. The decision to treat the patient with a lumbosacral orthosis can be based on several variables: the presence of a stress fracture or a true fracture, the presence of a spondylolisthesis, pain control, and patient compliance. The advantage of the lumbosacral orthosis is its limitation of lumbar motion, thereby reducing stress on the injured segment. Currently there are no randomized controlled studies of bracing in patients with spondylolysis, but several authors have demonstrated good results in the treatment of patients with lumbosacral bracing.[13,15,21,23,33-36] The results of bracing may vary from complete healing with resolution of back pain to nonunion, persistence of pain, or progression to spondylolisthesis. Using return-to-sport as the end point, success of bracing ranged widely from 7% to 84%.[21,33,34,36] It has been recommended that individuals with normal lumbosacral radiographs, but positive bone scan or SPECT scans, can be treated without bracing.[10,24] Jackson et al[10] reported that seven of seven adolescent patients with normal radiographs but positive bone scans who were treated without bracing healed completely after a mean of 7.3 months. However, a patient with an acute spondylolysis and spondylolisthesis may be placed in a lumbosacral orthosis to optimize healing.[37] Bracing also provides pain control through the limitation of movement and reduction in stress on the injured segment. It should be considered in those patients for whom activity restriction, analgesics, and physical therapy are inadequate in providing pain relief. It may also be considered in patients who may be noncompliant with activity restriction alone. Braces must be worn for 23 to 24 hours per day and for up to 6 months. Compliance with the use of a brace may contribute to its success.

The authors recommend that for patients with a symptomatic unilateral spondylolysis, but normal radiographs, initial treatment should consist of activity restriction (without bracing) and physical therapy. For symptomatic patients with radiographic evidence of a fracture of the pars interarticularis, or with symptomatic bilateral spondylolysis, treatment should include activity restriction, physical therapy, and the consideration of the use of a lumbosacral orthosis to be worn a minimum of 2 months, particularly if the former interventions do not provide adequate pain relief, or if the patient is noncompliant with the prescribed activity restriction.

For those patients who either fail to respond to treatment, or have persistence of pain for more than 6 weeks, consultation with a primary care sports medicine physician, a physiatrist, or a spine surgeon is appropriate. Surgical intervention may be considered in patients who have not responded to conservative care. The general indications for surgical correction include: (1) persistent pain unrelieved by rest and immobilization for more than 6 months, (2) progression to spondylolisthesis, (3) spondylolisthesis of greater than 50% in a patient about to undergo the preadolescent growth spurt, and (4) any significant neurologic abnormalities.[21,25]

SUMMARY

Spondylolysis is a commonly overlooked cause of low back pain in adolescents. The timely diagnosis of spondylolysis allows for earlier initiation of treatment and decreased morbidity. Patients involved in activities that call for repetitive extension and rotation of the lumbar spine, as well as those with spina bifida occulta, may be at risk for the development of spondylolysis. The physical examination often reveals pain with extension maneuvers and the one-legged hyperextension test. Hamstring inflexibility and paralumbar muscle spasm are often present, while neurologic symptoms are uncommon. Lumbosacral radiographs with oblique views, a bone scan, or a SPECT scan confirm the diagnosis. Treatment regimens should focus on the limitation of aggravating activities, physical therapy for dynamic lumbar stabilization, hip flexor stretching, hamstring stretching and consideration for bracing, if necessary.

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