Back Pain in Athletes

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Abstract

The athlete with back pain presents a clinical challenge. Self-limited symptoms must be distinguished from persistent or recurrent symptoms associated with identifiable pathology. Athletes involved in impact sports appear to have risk factors for specific spinal pathologies that correlate with the loading and repetition demands of specific activities. For example, elite athletes who participate in longer and more intense training have higher incidence rates of degenerative disk disease and spondylolysis than athletes who do not. However, data suggest that the recreational athlete may be protected from lumbar injury with physical conditioning. Treatment of athletes with acute or chronic back pain usually is nonsurgical, and symptoms generally are self-limited. However, a systematic approach to the athlete with back pain, involving a thorough history and physical examination, pertinent imaging, and treatment algorithms designed for specific diagnoses, can facilitate symptomatic improvement and return to play. There are no reliable studies examining the long-term consequences of athletic activity on the lumbar spine.

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None of the following authors or the departments with which they are affiliated has received anything of value from or owns stock in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Lawrence, Dr. Greene, and Dr. Grauer.

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J Am Acad Orthop Surg 2006;14:726-735

Back pain is nearly ubiquitous. Epidemiologic studies suggest that back pain is seen in 50% to 80% of the population at any given time and in up to 95% of Americans over the course of their lifetimes.[1] In comparison to the general population, athletes are typically well conditioned, with greater flexibility and higher pain thresholds. These characteristics may serve as protective factors; however, athletes place high demand on the lumbar spine and typically cannot tolerate limitations on their activities.

Although not as common as in the general population, back pain is reported by approximately 30% of athletes.[2] This rate may vary with the sport being played. For example, up to 11% of gymnasts and 50% of football linemen have been described as having back pain. Further, the type of injury producing back pain may be sport-specific. For example, herniated lumbar disks are most common in football players and weight lifters, degenerative disks and spondylolysis most common in gymnasts, and traumatic lumbar spine injuries most common in wrestlers and hockey players.[3]

Back pain may be attributable to a specific traumatic event or, more commonly, can result from repetitive microtrauma, an overuse phenomenon. In the course of competition, the athlete's spine is subjected to extreme demands. Fatigue is common and can result in sprains and strains. Disk herniation is a frequent occurrence, and degenerative changes can be initiated or aggravated.

As with back pain in the general population, the exact source of symptoms in the athlete may not be readily apparent. A careful history, complete neuromuscular physical examination, and appropriate imaging should be performed. Potential pain generators include the intervertebral disks, facet joints, paraspinal musculature, and ligaments. Identification of the precise pain generator may be compounded by deformity, such as Scheuermann's kyphosis or instability resulting from spondylolysis or spondylolisthesis. Most patients with back pain respond well to rest and medication, followed by appropriate physical therapy. When these measures fail, surgery may be considered in selective circumstances.

Some investigators suggest that more specific etiologies for low back pain can be identified in the general pediatric or adolescent population. This finding may be associated with decreased secondary gain issues that otherwise would confound diagnosis in this younger population. In a study comparing a population of 100 young athletes presenting to a sports medicine clinic and 100 adults presenting to a back clinic in an adult hospital, Micheli and Wood[4] noted significantly ($P < 0.05$) greater incidence of defined pathology such as spondylolisthesis and spondylolysis in the younger age group.

Risk Factors for Injury

Several risk factors for lumbar injury and back pain have been described for athletes: prior back injury, decreased range of motion, poor conditioning, excessive or repetitive loading, improper play technique, and abrupt increases in training.

A history of prior lumbar spine injury was found to be the most significant predictor of further lumbar injury in a cohort of 679 varsity athletes studied prospectively.[5] Athletes who reported prior back injury had a risk of injury in the following year three times greater than did those without prior injury.

The influence of lumbar flexibility on the incidence of back pain was noted in a 3-year longitudinal study of 98 adolescents by Kujala et al.[6] Among boys in the study, participation in sports and low maximal lumbar flexion were predictive of low back pain; among girls, significant predictors included decreased lower lumbar range of motion, low maximal lumbar extension, and high body weight ($P = 0.0045$, $P = 0.029$, and $P = 0.11$, respectively, on multivariate analysis). In contrast, authors of another study of top athletes from several different sports found no relationship between mobility in the lumbar spine and back pain.[7]

Goldstein et al[8] evaluated repetitive loading in a cross-sectional study of female gymnasts and swimmers. On magnetic resonance imaging (MRI), the prevalence of lumbar spine abnormalities appeared to be markedly greater in the gymnasts, who had repetitive loading, than in swimmers, who did not undergo such spinal loading. Further, back pain complaints in gymnasts were more common with increased age and level of competition, suggesting that the adolescent spine might be vulnerable to repetitive loads in a dose-dependent fashion.

Anatomic Considerations

The typical lumbar vertebra is composed of the vertebral body anteriorly and pedicles, laminae, facets, and spinous processes posteriorly (Figure 1). Each vertebra has a superior articular process at the cephalad portion of the posterior arch and an inferior articular process at the caudad portion of the posterior arch. These articular processes are bridged by a region termed the pars interarticularis.

The intervertebral disk lies between adjacent vertebral bodies. The disk has two distinct components; the nucleus pulposus is the gelatinous core and the anulus fibrosis is the peripheral, laminated portion. The outer third of the anulus is innervated; the inner two thirds and nucleus are not.[9] This innervation primarily comes from the sinuvertebral nerve, which is formed by branches of the somatic ventral rami and autonomic gray ramus communicans. With encapsulated and unencapsulated nerve endings, both nociceptive (capable of transmitting pain) and proprioceptive stimuli can be detected by both kinds of nerve endings.[10]

The diarthrodial facet joints lie between the posterior arches of adjacent vertebrae. These facilitate vertebral motion and resist compression, shear, and rotational forces. The innervation for these joints comes from the medial branches of the primary dorsal rami, which are also capable of conveying nociceptive and proprioceptive stimuli.

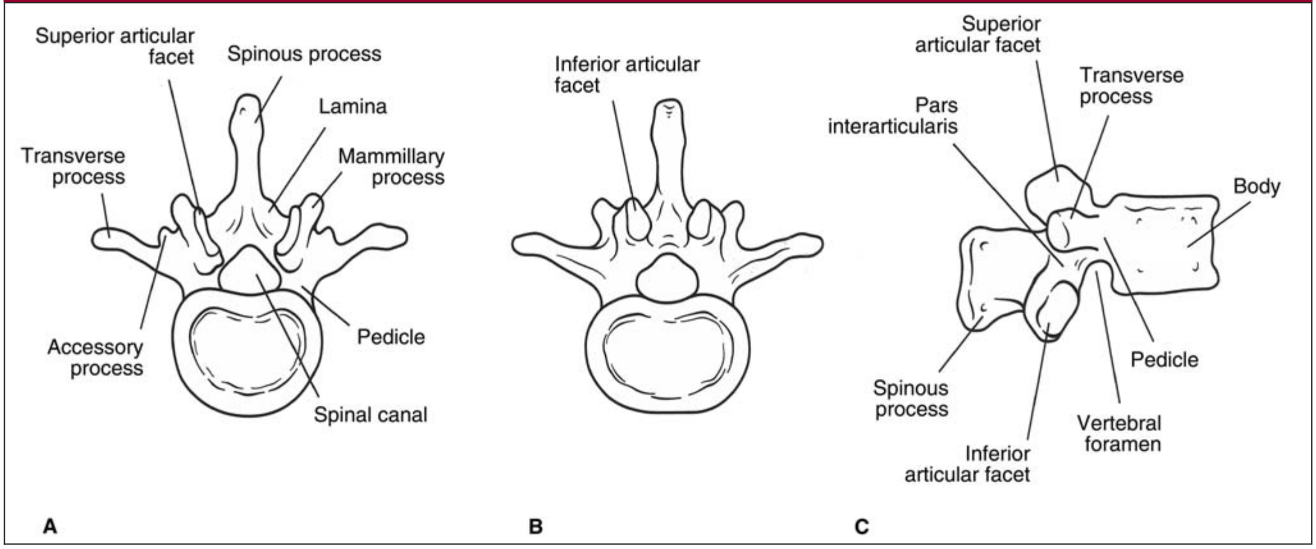
The functional spinal unit is composed of two adjacent vertebrae, the interposed intervertebral disk, and the associated facet joints. The correct interplay of these anatomic structures allows for normal lumbar function; dysfunction of these structures can lead to acute or chronic lumbar problems.

Lumbar spinal motion occurs in several planes—flexion and extension, lateral bending, and axial rotation. Hyperflexion is generally associated with distraction injuries to the posterior elements, such as the interspinous ligaments or compression injuries to the anterior elements. The opposite is true for hyperextension injuries. Compressive loads in the lumbar spine are borne by both the disk and the facet joints. The facets, which normally carry approximately 10% to 15% of the total compressive load, are further loaded with lumbar extension.

General Evaluation

Accurate diagnosis of the athlete with back pain begins with a thorough history. Inquiries address the

Figure 1



Typical lumbar vertebra (L2). **A,** Caudad view. **B,** Cephalad view. **C,** Sagittal view. (Adapted with permission from Fischer MD, Grauer JN, Beiner JM, Kwon BK, Vaccaro AR: Basic anatomy of the cervical, thoracic, lumbar, and sacral spine, in Vaccaro AR (ed): *Core Knowledge in Orthopaedics: Spine*. Philadelphia, PA: Elsevier, 2005, p 5.)

mechanism of injury of the inciting event, including the position of the spine at the time of injury and an estimate of the amount of force applied to the lumbar spine during injury. Other pertinent questions relate to the duration, location, and rate of onset of symptoms. The patient's athletic background should be explored, including types of sports and duration of involvement, as well as previous history of back pain. Any activities that exacerbate or ameliorate pain should be defined. Further questions should address previous treatments by all care providers, including athletic trainers, chiropractors, physical therapists, and other physicians. Finally, a review of systems must be conducted to assess the possibility of systemic illnesses leading to back pain, in particular those with an oncologic, renal, or intraperitoneal cause.

Certain aspects of the history can help guide the clinician toward the correct diagnosis. Patients with symptoms predominantly in the low back are more likely to suffer from mechanical back pain, whereas patients with symptoms predominantly in the legs more commonly suffer from nerve compression/irritation. Pain worsening with forward flexion typically is discogenic in origin, while pain with extension is typically related to the posterior elements.

The physical examination of the athlete with back pain should include inspection for postural abnormalities and presence of kyphosis or scoliosis. Palpation of the lumbar spinous processes and paraspinal regions should be performed to identify areas of focal tenderness or signs of muscle spasm. Range of motion should be assessed. Neurologic examination should include motor and sensory testing, reflex examination, and provocative maneuvers such as the straight leg-raise examination.

Diagnostic imaging may be used in a targeted fashion. The adult patient presenting with recent-onset low back pain without neurologic sequelae may require imaging. With persistent symptoms, standing radiographs may be indicated to rule out structural abnormalities. Oblique views assist in evaluating the pars interarticularis. Flexion/extension radiographs are useful in assessing dynamic instability.

Cross-sectional imaging is not routinely necessary in this population. Computed tomography (CT) helps define bone anatomy when sufficient detail cannot be appreciated from plain radiographs. MRI may be useful in evaluating disks, neural elements, or other soft tissues. MRI also can provide valuable information regarding possible occult fractures or the presence of neoplastic disease. Bone scan may be considered to rule out metabolic activity, such as with a neoplastic lesion, fractures of indeterminate age, or spondylolytic defects.

Strains and Sprains

Background

Sprains are stretch injuries to muscles; strains are stretch injuries to ligaments. Although such injuries are common causes of low back pain in the athletic population, these diagnoses are generally made by exclusion.

Soft-tissue injuries occur when excessive forces are applied. As loads exceed the tolerance of specific structures, tearing can occur. Extremes of motion may be reached with repetitive loading because injury thresholds concurrently decrease with fatigue. Inflammation can be seen as a response to such injuries. This inflammation may be directly correlated with pain or associated with muscle spasm. Despite the common occurrence of these injuries, there are limited biomechanical and clinical studies examining sprains and strains in the lumbar spine.

Evaluation

Athletes with muscular or ligamentous injuries of the spine typically present with reports of back pain. Acute injuries typically cause pain that is greatest in the first 24 to 48 hours and improves with time; chronic strains or sprains may have more gradual onset of symptoms that persist for longer time periods.

On examination, muscle spasm is often noted. The athlete with acute lumbar pain from spasms or strains generally has localized tenderness that worsens with particular motions but has no abnormal neurologic findings. Imaging may be helpful to rule out other defined pathologies but is generally negative for sprains and strains.

Treatment

Treatment of the patient with a lumbar sprain or strain typically involves a brief period of rest. Patient education on proper postural mechanics and review of the daily work or sports activities allows patients to perform daily tasks without further strain on injured structures. Cryotherapy and heat offer benefits in decreasing spasm and pain. Electrical stimulation through high-voltage pulse galvanic stimulation and transcutaneous electric nerve stimulation may offer benefits in the acute stages of recovery, but their efficacy has not been conclusively demonstrated.[11]

Nonsteroidal anti-inflammatory medications offer analgesic as well as anti-inflammatory benefits through their interference in the production of prostaglandins. There appear to be no valid studies demonstrating the efficacy of muscle relaxants in this area; furthermore, side effects (eg, oversedation) can hinder their use.

These initial interventions generally are followed by a targeted physical therapy program to include trunk strengthening, aimed at minimizing exacerbating activities and limiting recurrence of symptoms.[12]

Disk Herniation

Background

Disk herniation results when an annular injury allows nuclear material to escape into the surrounding epidural space. Although its association with trauma is well known, the incidence of disk herniation associated with athletic activities is unknown. Some investigators speculate that the physical demands of the athletic population may predispose this group to acute disk herniation. Using MRI, Ong et al[13] reviewed 31 Olympic athletes presenting with low back pain and sciatica and noted a greater loss in disk signal intensity, an increased loss of disk height, and higher prevalence of disk displacement (most notably at the L5/S1 level) in the athletes compared with a nonathletic control group. However, a cohort of athletes of varied types studied as part of the Northeast Collaborative Group on Low Back Pain failed to show an increased incidence of cervical or lumbar disk herniation in athletes compared with the general population.[14]

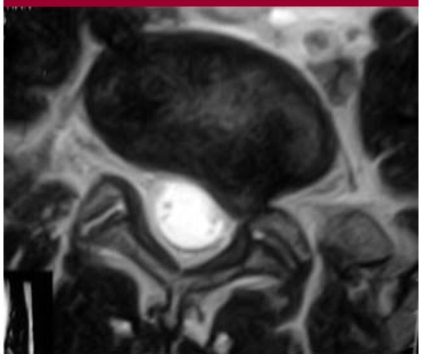
Initially, disk herniation can be associated with low back pain. This is related to injury at the peripheral anulus that is associated with traumatic disruption. This may progress to radicular symptoms if nuclear material escapes to cause irritation around the surrounding neurologic structures.

Evaluation

Classically, the patient with a herniated disk presents with radicular symptoms. Pain generally worsens with flexion or performance of the Valsalva maneuver (coughing or bearing down) and improves with lying supine. Although adults typically can have neurologic deficits associated with pain, they are considerably less common in the pediatric and adolescent population.[15] The most common levels for disk herniation are at L4-5 and L5-S1; together, these two levels account for 90% of symptomatic disk herniations.

Radicular peripheral nerve changes may be appreciated with motor or sensory testing. Patients with disk herniations affecting the L5 nerve root (typically L4-5 herniations) can have demonstrable weakness of ankle dorsiflexion (more commonly L4 than L5) and great toe dorsiflexion. These patients may experience sensory changes over the L5 distribution (the lateral aspect of the lower leg and middorsum of the foot). Patients with disk herniations affecting the S1 root (typically L5-S1 herniations) can have demonstrable weakness in ankle eversion and plantar flexion strength, sensory changes over the S1 distribution (the lateral aspect of the foot), and a decrease in the Achilles tendon reflex. The most specific tests for a disk herniation leading to radicular symptoms are those that produce pain or radiculopathy on stress testing, such as the straight leg–raise examination, which causes pain reproduction as neurologic structures are stretched across the affected disk. Xin et al[16] reviewed 113 patients with lumbar disk herniation and positive straight leg–raise tests who were taken for surgery. They found that the distribution of pain on straight leg raise allowed an accurate prediction of the location of the herniation in 88.5% of patients.

Figure 2



Axial T2-weighted magnetic resonance image demonstrating left posterolateral L5-S1 lumbar disk herniation, with foraminal stenosis affecting the traversing S1 nerve root.

Cauda equina syndrome is an uncommon but important clinical entity in patients presenting with back pain. Although it typically presents in more acute fashion with the characteristic findings of saddle paresthesia, bowel or bladder incontinence or retention, and occasional radiculopathy at the lower lumbar levels, back pain also can be a characteristic finding leading patients to their primary care provider or orthopaedic surgeon.

To fully evaluate disk herniation, plain radiographs can be useful to assess disk height and segmental stability. MRI is the study of choice to define disk anatomy and neural element compression (Figure 2).

Treatment

The patient with acute disk herniation requires rest for a period of several weeks. This should be accompanied by oral anti-inflammatory medication to decrease the degree of nerve root irritation. Although nonsteroidal anti-inflammatory medications are the mainstay of treatment, a corticosteroid dose pack to decrease swelling and reduce inflammation may be considered when symptoms warrant. As symptoms improve, physical therapy with an emphasis on truncal strengthening is generally advocated.

Disk herniations have a very favorable natural history; most symptoms gradually resolve. This reduction in pain is associated with disk resorption and decreased root irritation. When radicular symptoms continue to be a limiting factor, a spinal injection, such as a selective nerve root block, may be considered.

When such interventions are not appropriately tolerated or when significantly limiting symptoms persist, lumbar diskectomy may be considered. Diskectomy has been reported to have a good success rate in the general population.[17] The high demands of the athlete in terms of recovery and return to play may alter surgical outcomes by "raising the bar" of success. However, there have been no controlled trials examining the results of diskectomy in athletes. Watkins et al[18] retrospectively reviewed 60 cases of Olympic athletes (59 patients) treated with microscopic lumbar diskectomy for lumbar disk herniation. Patients were able to return to sport at a high rate (average time to return, 5.2 months; range, 1 to 15 months).

Wang et al[19] reviewed results in 14 elite college athletes who underwent microscopic single- and double-level diskectomies. They described excellent results in terms of return to play, a decrease in levels of medication needed for pain control compared with preoperative levels, and elimination of radiculopathy. Papagelopoulos et al[20] retrospectively reviewed 72 patients ≤16 years of age who had undergone lumbar diskectomy. Although 28% (20 patients) required revision, 92% of the remaining 52 patients noted either no pain or occasional pain with activities.

Degenerative Disk Disease

Background

Disk degeneration itself may lead to low back pain. As with the general population, numerous radiographic and diagnostic imaging studies are available to document the prevalence of lumbar disk degeneration in the elite athlete.

Using MRI, Sward et al[21] studied 24 elite male gymnasts with back pain and a control group of 16 male nonathletes. Their study confirmed a significantly ($P < 0.05$) higher prevalence of signal changes in the thoracolumbar disks of the elite gymnasts (75% versus 31%). Others have noted an increased incidence in disk degeneration in professional volleyball players compared with professional swimmers, suggesting that impact activities may accelerate this process.[22] Gatt et al[23] found that the average loads during routine blocking in American football exceed those determined during fatigue studies to cause pathologic changes in the intervertebral disk and the pars interarticularis.

Kirkaldy-Willis et al[24] described the process of degeneration in the lumbar motion segment. In the initial phase of segmental dysfunction, pain emanates from the facets (synovitis) or the intervertebral disk (circumferential or radial annular tears). This can be associated with muscle spasm and limitation of mobility. In a second phase, instability is observed because of reduced functionality of the anulus and laxity of the facet capsules. In the final phase, restabilization is observed as the result of chronic degenerative disk disease of the facet and discovertebral joints. Restabilization is considerably more common in the older athlete and less typical in the younger patient who presents with back pain.

Evaluation

History and physical examination of athletes with degenerative disk disease is relatively nonspecific. Lumbar disk degeneration typically causes low back pain, with or without referred pain, that is worsened by movements that stress the symptomatic disk. A thorough patient history, physical examination, and review of systems may suggest this pathology. Pain that worsens with flexion activities and improves with extension is characteristic, similar to early annular disk injuries.[25]

Plain radiographs may demonstrate loss of disk space height associated with degenerative changes. CT can help assess the posterior facets, but it does not significantly enhance the understanding of disk degeneration. MRI can be very useful in demonstrating loss of disk hydration on sagittal T2-weighted images, assessing for disk hydration, and highlighting end plate changes (Figure 3).

Treatment

Treatment of discogenic back pain in the athlete is primarily nonsurgical. Educating patients about the natural history of disk degeneration revolves around clarifying the generally self-limited nature of this disease. The majority of patients with acute back pain gain resolution of symptoms within weeks. Younger patients with disk disease are less likely to follow the chronic degenerative course, but few long-term studies exist that describe their outcomes.

Initially, abstinence from practice and competition is recommended. Although prevention of reinjury is certainly important, this must be balanced against the risk of losses in trunk muscle strength and general fitness that occur with periods of inactivity. Anti-inflammatory medications can help limit symptoms, along with other treatment modalities.

The use of lumbosacral corsets or orthoses for discogenic back pain is not conclusively supported in the literature. Although brace treatment may offer benefits in controlling extremes of motion, muscle wasting can occur. In their study examining the use of the Boston brace in adolescent athletes, Micheli et al[26] found bracing treatment to be beneficial in 50% of the patients with discogenic back pain.

Physical therapy with trunk strengthening and sport-specific training is used to facilitate recovery, hasten return to sport, and prevent recurrence.[27] After the initial acute period, patients are encouraged to regain mobility through passive and active stretching exercises. These exercises are followed by isometric exercises, emphasizing the abdominal musculature and the lumbar extensors. Once neutral position can be attained and maintained, more advanced exercises are begun to gain greater strength and coordination of muscle firing. Finally, sport-specific exercises are emphasized.

Spinal fusion is a poor option for back pain in the athlete and should be seriously considered only when all other treatment options have failed. As in the general population, surgical treatment of degenerative disk disease has fewer predictable results than that performed for radicular symptoms. Furthermore, surgery generally has a lengthy postoperative course that is poorly tolerated by most athletes. The techniques for spinal fusion for patients with discogenic back pain include posterolateral; interbody via the anterior, posterior, or transforaminal technique; or anterior/posterior fusion procedures. Because of the common belief that the pain generator in these patients is the disk itself, interbody techniques have become more popular when surgery for this condition is considered.

No reliable data are available examining the rates of return to sport after spinal fusion. The potential role of disk replacement in this population has not yet been evaluated, but the high demands for return to play may prevent its use.

Figure 3

Sagittal T2-weighted magnetic resonance image demonstrating single-level degenerative disk disease at the L3-4 level (arrow). The darkness of the disk reflects relative dehydration.

Spondylolysis and Spondylolisthesis

Background

Spondylolysis is a defect of the pars interarticularis, typically resulting from repetitive extension activities.[28] Fredrickson et al[29] reported the incidence of spondylolisthesis to be 4.4% at age 6 years and 6% in adults. Although spondylolysis is asymptomatic in most patients, some authors have reported long-term pain in as many as 13% of cases.[30] Most bilateral pars defects (85% to 95% of cases) occur at L5, with a smaller percentage at L4.

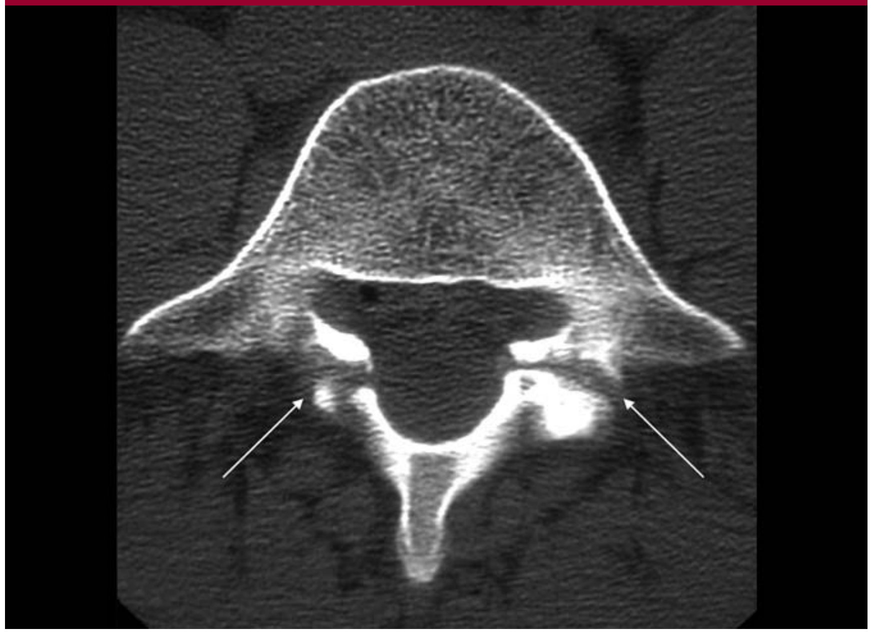
Athletes involved in activities involving repetitive hyperextension, such as gymnasts or football linemen, appear to be predisposed to the development of spondylolysis. The combination of repetitive axial loading with extremes of spine extension is thought to overload the posterior elements and predispose to pars fractures and back pain. Hall[31] used force platforms to evaluate competitive collegiate female gymnasts performing different activities. Maximum lumbar hyperextension was seen with front and back walkovers and back handsprings. These maximum hyperextensions correlated well with impact force measured at the hands or the feet by a force platform.

Some of these patients may have concomitant spondylolisthesis (ie, forward slipping of one vertebra on

Figure 4

Lateral radiograph of an L5 pars fracture (arrow).

Figure 5



Axial computed tomography image demonstrating L5 bilateral pars fractures (arrows).

another). Wiltse et al[32] defined several causes of spondylolisthesis; however, spondylolytic spondylolisthesis is the most common in the athlete.

Evaluation

Patients with pars fractures typically present with low back pain that worsens during periods of activity. The classic gait seen in patients with spondylolysis and spondylolisthesis is described as "stiff-legged," in which stride length is shortened secondary to hamstring spasm and limitation in forward flexion. There may be pain on palpation of the paraspinal muscles secondary to spasm. With severe spondylolisthesis, a palpable step-off may be present at the spinous processes. L5 radiculopathy may be present in the face of the common L5 spondylolysis because of root irritation as it passes under the inflamed tissue of the pars defect.

Standing radiographs of the lumbar spine facilitate the diagnosis of spondylolysis (Figure 4). Although this generally can be detected on a lateral radiograph, oblique radiographs can be used to increase the sensitivity for this diagnosis. The classic collar around the "Scotty dog" neck on such oblique films is pathognomonic of a pars defect. Flexion/extension radiographs are useful to demonstrate concurrent instability. Spondylolisthesis is graded based on the degree of slippage: grade 1, <25% translation; grade 2, <50% translation; grade 3, <75% slippage; and grade 4, <100% slippage.

Additional imaging can be considered when plain radiographs remain inconclusive for this diagnosis. CT can best delineate the bone anatomy (Figure 5). MRI can be useful in evaluating compression of the neural elements and concomitant disk degeneration. Bone scan with single-photon emission computed tomography (SPECT) is the most sensitive study for evaluating stress reactions and impending pars fractures (Figure 6). SPECT allows three-dimensional visualization of radiotracer uptake that reflects metabolic changes in bone. Active lesions are suggestive of acute inflammation or injury. In a study examining 162 young athletes with low back pain suspected to have posterior element pathology, SPECT was positive in 71 patients, only 32 of whom had positive bone scans.[33]

Treatment

Treatment of the patient with spondylosis (with or without grade 1 spondylolisthesis) associated with a recent injury and acute back pain involves hyperextension bracing and restriction of sport activity. The indications for bracing include acute or delayed symptomatic spondylolysis, low-grade spondylolisthesis (grade 1), and unilateral pars fractures. Steiner and Micheli[34] reported on 67 adolescents (average age, 16 years) with spondylolysis or low-grade spondylolisthesis treated for a mean of 2.5 years with a modified Boston brace. They noted good or excellent results in 78% of patients (52) despite a union rate (ie, increased radiodensity on oblique radiographs) of only 25% at follow-up. They noted that both age and delay in treatment did not correlate well with clinical outcome.

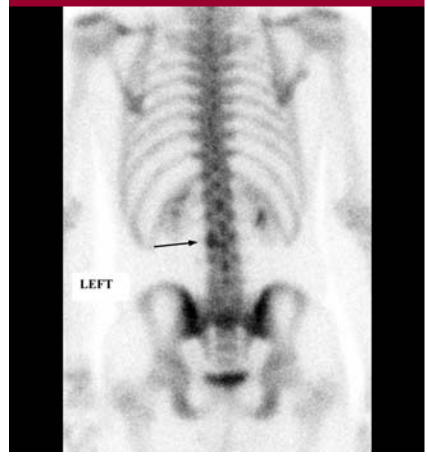
In their study assessing 34 patients with SPECT, Anderson et al[35] found that patients with spondylolysis showing greater signal intensity on SPECT had better outcomes with bracing treatment than did patients with lesions of lower intensity, indicating that early bracing may offer increased benefit compared with delayed treatment in symptomatic patients. Sys et al[36] studied 28 patients with subtle fatigue fractures of the pars diagnosed by SPECT and CT in the presence of normal radiographs. They noted fracture healing with conservative treatment (with bracing) in all 11 athletes with a unilateral lesion, in 5 of the 9 athletes with a bilateral lesion, and in none of the 8 athletes with a "pseudobilateral" lesion (ie, asymmetry in tracer uptake). Twenty-three athletes (82%) rated their outcome as excellent, three (10%) as good, and two (7%) as fair. Twenty-five of the patients (89%) were able to return to competitive athletics within an average of 5.5 months after the onset of treatment. This suggests that osseous union is greater in the presence of unilateral lesions and that a high percentage of patients is able to return to activity with nonsurgical treatment.

Although early rehabilitation is focused on strengthening the lumbar extensors and abdominal musculature, range of motion of the lumbar spine and lower extremities also should be stressed. Similarly, patients with higher-grade spondylolisthesis should be treated with aggressive rehabilitation. However, this population should be closely followed radiographically until skeletal maturation because of the possibility of progression in the young adolescent.[37] Patients with progressive spondylolisthesis, spondylolisthesis >grade 3, persistent back pain refractory to conservative treatment, or neurologic deficits may be considered for surgery.[38]

Surgical repair of the spondylolytic defect is rarely indicated. Repair may be considered for patients unresponsive to nonsurgical treatment for >6 months, with nondegenerative disks, and with inactive bone scans or defects <7 mm.[39] Direct repair involves various techniques, including posterior wiring of the transverse process and spinous processes (Scott wiring), translaminar interfragmentary screws (Buck technique), or pedicle screw-to-hook constructs within the same vertebra. Reitman and Esses[40] reported a retrospective case series of four competitive athletes who underwent direct pars repair for symptomatic spondylolysis. All patients were able to return to their presymptomatic levels of activity and athletics without restriction. Debnath et al[41] had comparable results in 22 similarly treated patients.

When advanced spondylolisthesis is present or disk degeneration is noted, fusion may be considered. Because there are often degenerative changes at L4-5 as well as L5-S1, L4-S1 fusions may have to be considered. Multiple surgical techniques have been proposed for this situation, ranging from noninstrumented posterolateral fusions to anterior/posterior procedures. There are no good data reviewing the outcomes of such procedures in the athletic population.

Figure 6



Single-photon emission computed tomography bone scan demonstrating increased contrast uptake at the site of a left-sided unilateral pars fracture at L2 (arrow) in a 16-year-old baseball pitcher.

Summary

Back pain in the athlete can represent a variety of phenomena, from the common and transient back strain to the rarer spondylolisthesis. Focusing on the patient age, history, and physical examination; obtaining pertinent imaging studies; and understanding the sport-specific biomechanics of athletics can provide both the diagnosis and the pathway to proper recovery.

Many aspects of lumbar pain in the athletic population remain poorly understood and require further investigation. Examples are the true pathology of intervertebral disk degeneration, the proper role of surgery

Additional Resources

Related clinical topics articles available on *Orthopaedic Knowledge Online:* "Adult Spondylolisthesis," by Louis G. Jenis, MD, and Jeremy Shore, MD: http://www5.aaos.org/oko/spine/adult_spondylolisthesis/pathophysiology/pathophysiology.cfm

"Thoracolumbar Burst Fractures," by Alexander R. Vaccaro, MD, L. Erik Westerlund, MD, and Scott D. Dafner, MD: http://www5.aaos.org/oko/spine/thoracolumbar_burst_fx/pathophysiology/pathophysiology.cfm

"Lumbar Disk Herniation" by Rick Delamarter, MD: http://www5.aaos.org/oko/spine/limbar_disc_herniation/pathophysiology/pathophysiology.cfm in the presence of disk herniation, and the long-term implications of athletic activities on the lumbar spine. Given that both the younger and aging populations are participating in athletics at an unprecedented rate, good prospective studies regarding the effects of athletics and their influence on the lower back are needed. Similarly, the roles of physical therapy and surgical intervention must be subjected to the same rigorous scientific method, as well as the particular therapies most suited to individuals with particular disorders of the lumbar spine.

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Citation numbers printed in **bold type** indicate references published within the past 5 years.

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