

Evaluation and management of lower back pain in young athletes

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Abstract: Lower back pain in young athletes is a common problem. The prevalence of back pain from different causes in adolescent age group is between 20% and 30%. However, the incidence of low back pain in young athletes varies widely in different sports. Overuse injuries are the most common cause of low back pain in young athletes. In case of overuse injuries, the cause and effect relationship between back pain and specific condition is often difficult to establish. In adolescent athletes, the most common underlying identified cause of low back pain is lumbar spondylolysis. During adolescent growth spurt, the severity of the pain generally correlates with adolescent growth spurt. Participation in sports starting at an early age and for a longer duration tends to increase the risk for back pain. Numerous conditions cause low back pain in athletes. These include acute trauma, chronic overuse or repetitive trauma, and referred pain. Our focus in here will be on selected conditions that cause recurrent or chronic low back pain.

Keywords: Scoliosis; Scheuermann disease; spondylolysis; disc herniation; apophyseal ring fracture; sacroiliac joint dysfunction

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Introduction

A recent increase in the intensity and volume of physical conditioning exercises or sports participation is the most common predisposing factor for low back pain. A number of causes should be considered in the differential diagnosis of lower back pain in young athletes (*Table 1*) (1-7). Sports with a relatively higher incidence of low back pain are listed in *Table 2* (8-12). It is useful to understand the normal biomechanics of spine movements (2,5,11). During flexion of the thoracolumbar spine there is increased pressure on the intervertebral disks. This increases the tension on the nerve root and the dural sac, and the relative size of the intervertebral canal and foramen. On the other hand, during extension of the thoracolumbar spine, the effects are opposite; there is a decreased tension on the nerve root and dural sac, and the relative size of the intervertebral canal and foramen. Different sports impart different types

of biomechanical stresses to the spine. For example, there is compression of the spine in vertical plane in American football and weight lifting; rotational (torque) or shear force in horizontal plane in throwing sports, golf and baseball; and tensile stress from repetitive motion in gymnastics, ballet and cheerleading. Hyperextension of the lumbar spine in American football and gymnastics has been associated with spondylolysis. Incidence is higher with higher levels of competition and floor exercises, the balance beam, uneven parallel bars, flips, and vaulting dismounts are associated with spondylolysis in gymnasts. In throwing sports, such as pitching in baseball, musculotendinous avulsions may occur from sudden and forceful muscle contractions.

Lifting with spine in flexion, and moving from flexion to extension causes significant stress to the spine. Improper lifting techniques may cause injuries in ballet and figure skating. Twisting motions in tennis can cause musculotendinous strains and avulsions. Chronic poor

Table 1 Causes of back pain in adolescents

Intrinsic causes of back pain
Acute pain
Acute fractures of the thoracolumbar spine
Acute musculotendinous strains and sprains
Acute spondylolysis
Muscle contusions
Disk herniation
Insidious pain
Lumbar spondylolysis and spondylolisthesis
Postural
Psychosomatic
Hypermobility syndrome
Scheuermann disease
Diskitis and vertebral osteomyelitis
Idiopathic juvenile osteoporosis
Lumbarization or sacralization
Spina bifida occulta
Facet joint syndrome
Benign and malignant tumors of the spine or cord
Sacroiliac joint pain
Extrinsic causes of low back pain
Referred pain
Abdominal or pelvic neoplasms
Acute appendicitis
Pancreatitis
Pyelonephritis
Renal stones
Urinary tract infection
Pelvic inflammatory disease
Pelvis osteomyelitis with or without abscess
Systemic disease
Leukemia
Inflammatory bowel disease
Spondyloarthropathy
Ankylosing spondylitis
Rheumatoid arthritis
Metabolic diseases
Neuromuscular disease
Myopathy

Table 2 Sports with higher prevalence of back pain

American football
Basketball
Cheerleading
Dancing
Diving
Fast bowling in cricket golf
Gymnastics
Ice hockey
Racquet sports
Rowing
Rugby
Running
Weight lifting
Wrestling

posture may result in chronic ligamentous strain.

Clinical presentation

History should include the mechanism of injury and detailed history characterizing the pain. Pain should be characterized by onset, location, duration, progression, exacerbating factors and relieving factors. Is there night pain? Is there radiation of pain in legs? Ascertain past history of back pain or injury. Has the athlete sought any previous medical care?

Athlete will present with a history of back pain following acute trauma or activity related chronic or recurrent pain. Back pain in a young child must be thoroughly investigated for specific etiology that may include infection, tumors or developmental anomalies of the spine.

Localization of pain may indicate possible etiology. Scheuermann disease is the most common identifiable cause of thoracic back pain (13). Spondylolysis most commonly affects the lower lumbar spine (11). Constitutional symptoms such a fever, rash, other joint pain, loss of appetite and weight loss suggest systemic disease. Family history and psychosocial history are essential in all adolescents to assess psychosomatic pain syndrome which is common in this age group. Although neurological injuries are rare, it is important to recognize symptoms and signs that indicate neurological injury that

Table 3 Indications for referring to orthopedics

Acute back pain with neurological symptoms and signs
Acute disk herniation with neurological signs
Apophyseal fractures
Diskitis and osteomyelitis
Fractures of thoracolumbar spine
High grade spondylolisthesis
Scheuermann kyphosis
Scoliosis of 20 degree or more in during peak growth
Significant scoliosis, progressive curve, atypical scoliosis
Spondylolysis not responding to conservative treatment
Tumors of spine and cord

should prompt appropriate imaging and referral for definitive diagnosis and treatment.

General physical examination should focus on detecting signs that indicate systemic etiology. Sexual maturity rating or Tanner stage should be assessed and both lower extremities should be carefully examined. A systematic examination of the back and thoracolumbar spine as well as neurological exam should be conducted in all athletes with back injuries and pain.

AP, lateral and oblique X-rays of the spine are the initial study of choice to assess back thoracolumbar spine injuries and pain (5,9,11). Other imaging studies such as bone scan; computed tomography (CT) scan or magnetic resonance imaging (MRI) scan may be indicated in the evaluation of specific conditions. The most useful screening laboratory studies are a complete blood count and erythrocyte sedimentation rate.

Management

Management of the athlete with thoracolumbar back injury and pain depends upon the specific condition. Conservative modalities include rest, pain management, therapeutic exercises, bracing, orthotics, improving biomechanics, improving sport techniques, and appropriate conditioning and training. Most athletes will respond to conservative treatment depending up on the nature of the specific condition causing the back pain; a few will need further orthopedic consultation (*Table 3*). Some signs and symptoms are of particular concern and include the following: back pain in a child younger than

10 years of age, pain that wakes up the patient from sleep, pain that lasts more than 2 months, rapidly progressive pain, continuous pain, pain at rest, pain associated with focal neurological findings, and pain associated with systemic symptoms and signs (3,6,7,11).

Acute soft tissue sprains, strains, and muscle contusions

Acute soft tissue trauma is the most common back injury and cause of back pain in adolescent athletes. The athlete with acute back strain or sprain, who is otherwise in good health, should expect full recovery within few days. Absolute bed rest is not recommended. The athlete should be allowed to carry on daily activities as tolerated. Analgesics and muscle relaxants may help relieve pain during the acute phase. As the pain and general mobility improve, a back rehabilitation exercise program is started in consultation with a sports physical therapist. The goals of rehabilitation for acute back strains and sprains are to regain normal pain-free range of motion, improve core strength and stability, correct abnormal posture, improve biomechanics, and improve sport techniques.

Thoracic Scheuermann disease (Juvenile disk disease)

Scheuermann disease, seen in adolescents, is characterized by fixed kyphotic deformity of the spine. The normal range of thoracic spine curve in sagittal plane is between 20 and 40 degrees and a kyphotic deformity exceeding 45 degrees is considered abnormal (13-15). Males are affected more often than females and most cases are seen between ages 10 and 15 years (13). Most have a positive family history of kyphosis. The reported incidence ranges between 0.4% and 10% during adolescence (13-15). No studies have reported specific incidence or prevalence in athletes. Scheuermann disease is the most common identified cause of thoracic back pain in adolescents. The exact etiology is not known. Postulated contributing factors include genetic predisposition, hormonal abnormalities, collagen defects, juvenile osteoporosis, vitamin deficiencies and repetitive microtrauma from sport participation or other physical stress to the spine (13-15).

Clinical presentation

Many adolescents initially remain asymptomatic and may first present with poor posture and kyphotic deformity.

Table 4 Sorensen radiographic criteria for Scheuermann disease

Anterior wedging exceeding 5 degrees of 3 consecutive vertebrae in the apex of the kyphosis
Irregular vertebral apophyseal lines with flattening and wedging of the apophysis
Disk space narrowing
Schmorl's nodes may be present

However most present with dull aching thoracic back pain located between scapulae that is aggravated by physical activity, prolonged sitting, standing and forward flexion (13). Pain tends to diminish as the adolescent approaches skeletal maturity. The severity of pain and progressive worsening of the kyphosis have poor correlation.

Many adolescents in the early stage may only have back pain for several weeks to months before progressive kyphosis develops; therefore, Scheuermann disease should be considered in any adolescent who presents with chronic or recurrent thoracic back pain. Occasionally the pain is of sudden onset. The kyphosis should be differentiated from adolescent postural round back that disappears when the athlete hyperextends the back while prone. Patients also have decreased flexibility of hamstrings and exacerbated lumbar lordosis.

Diagnostic imaging

X-ray findings include vertebral end plate irregularities, narrowing of the intervertebral disk space, anterior wedging and decreased height of the vertebrae, and Schmorl nodes (protrusion of nucleus pulposus into the vertebral body anteriorly) (13). Sorenson's radiographic criteria are listed in *Table 4*. The diagnostic wedging is not seen before 10 years of age (14). In the classic presentation the apex of the kyphotic deformity is at T7–T8 level (13).

Treatment

Therapeutic exercises to improve flexibility (especially of hamstrings and lumbodorsal muscles and fascia) and core strength are recommended for all patients (15). Pain can be managed as needed by use of analgesics. More definitive treatment is guided by the severity of the deformity and the remaining growth potential of the patient based on skeletal maturity. Patients with kyphosis less than 50 degrees can

be managed conservatively with rehabilitation exercises and regular clinical and radiographic monitoring until they reach skeletal maturity (13–15). Orthopedic consultation should be obtained in all cases of Scheuermann disease. Adolescents who are skeletally immature and have kyphosis that exceeds 50 degrees, bracing is considered (13–15). Curves that exceed 70 degrees, severe persistent pain, and progression of the curve are indications for considering surgical treatment (13–15).

Athletes with curves less than 50 degrees who have undergone rehabilitation and are asymptomatic may return to sports without restrictions (13–15). Athletes being treated with bracing may be allowed to participate in sports, with brace removed for the duration of game or practice, once they have started the rehabilitation and are pain free. Recurrent, activity related back pain and restriction of some back extension are long term problems seen in some patients; however, overall functional outcome has been reported to be very good.

Thoracolumbar (atypical) Scheuermann disease

Thoracolumbar Scheuermann disease is seen in adolescents who participate in sports that require repeated flexion and extension movements such as gymnastics (15). It has also been reported in adolescents who participate in wrestling, football, weight lifting, rowing, tennis, and bicycle racing. It is seen most commonly in male athletes with a peak incidence between 15 and 17 years of age (13).

Because of wedging of the vertebrae at the thoracolumbar spine there is a loss of lumbar lordosis and the back appears straight or mildly kyphotic. Other clinical features are similar to the thoracic type. Thoracolumbar Scheuermann disease generally is nonprogressive and treated with exercise and conditioning program and restriction of sport until the athlete is pain free. Most athletes are able to return to sports after a period of about 6 months of conservative treatment. Bracing for a period anywhere from 3 to 12 months has also been used allowing athletes to return to sports within 2–3 months once pain free (13).

Adolescent idiopathic scoliosis

Scoliosis is defined as a lateral curvature of the spine greater than 10 degrees as measured by using the Cobb method on a standing posteroanterior radiograph of the spine (16). Vertebral rotation is associated with the lateral curvature. In Cobb method, a line is drawn through the superior surface of the uppermost vertebra of the curve. Another is drawn



Figure 1 Adam test. Have the standing patient bend forward as far as he or she can, with both upper extremities extended and palms held together hanging down. Observe from the front of the patient for a thoracic hump on one side indicating scoliosis.

through the inferior surface of the lowermost vertebra of the curve. The angle at the intersection of lines drawn perpendicular to the above two lines is the Cobb angle or the curvature of the scoliosis. The reported prevalence of adolescent scoliosis is between 0.5% and 3% (16-21).

The exact mechanism or etiology of adolescent scoliosis is not known but believed to be multifactorial with strong genetic predisposition (21-24). During adolescent years, curve progression occurs in about 10% of cases of adolescent idiopathic scoliosis (25). Curve progression is a function of gender, remaining skeletal maturity at the time of diagnosis, and the magnitude of the curve at the time of diagnosis (25,26).

Clinical presentation

Adolescent idiopathic scoliosis can be asymptomatic. Pain and deformity may become apparent with larger curves and with progression of the curve (16). Spine should be examined at all preventive visits during adolescent years, typically once a year. Measure leg length (from anterior superior iliac spine to medial malleolus) to rule out leg length inequality. Have the standing patient bend forward as far as he or she can, with

both upper extremities extended and palms held together hanging down. Observe from the front of the patient for a thoracic hump on one side indicating scoliosis. This is called Adam's test (*Figure 1*). Also observe the spine from side to side to note any kyphosis. Determine the sexual maturity rating of the patient. Some studies have shown that overweight and obese children and adolescents are more likely to initially present with more severe curve and at a higher degree of skeletal maturity at the time of the presentation (16).

Diagnostic imaging

A scoliosis series is indicated to assess the degree of scoliosis as measured by Cobb angle. Periodic radiographic evaluation is indicated based on the initial degree and risk of progression of the scoliosis.

Treatment

Adolescents with idiopathic scoliosis at sexual maturity rating of 2 with curves more than 20 degrees should be referred to pediatric orthopedic or spine specialist (21). Those whose curves are less than 20 degrees, and are less likely to progress as determined by gender and remaining skeletal maturity can be followed every 6 months with clinical and radiologic evaluation to assess the curve (24,25). Exercise programs are not effective in altering the progression of the curve.

Several studies have shown effectiveness of bracing if done appropriately and when the patient is adherent to the treatment protocol (17-20). Surgery is considered in rapidly progressive curves, and curves more than 45 degrees (22).

Asymptomatic athletes are allowed unrestricted sport participation. Participation decision should be individualized in consultation with orthopedic or spine surgeon for those with painful high degree curves, those being treated with bracing, and those who had surgical correction.

Lumbar spondylolysis

Spondylolysis refers to stress fracture of the pars interarticularis (isthmic type), most lesions are bilateral (80%) and affect L5 (95%) (27-29). It is one of the most common and significant conditions that causes back pain in adolescent athletes, reported in almost 50% of cases of sport related low back pain in adolescents (30,31). The incidence of spondylolysis is 6% in the general population compared with 50% in gymnasts, 40% in Alaskans and 13%

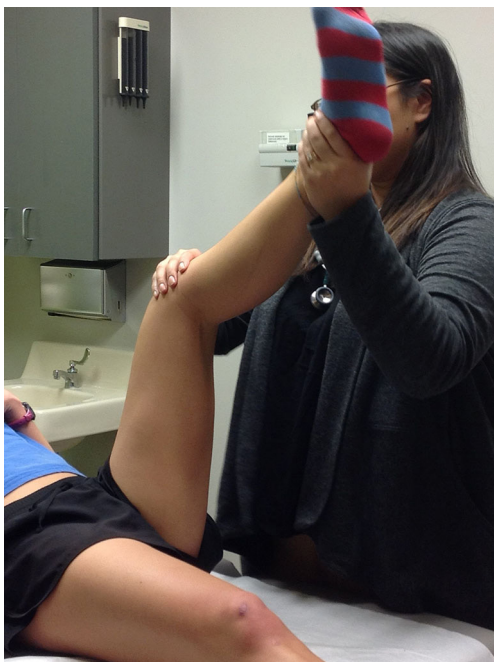


Figure 2 Examination for hamstring flexibility. With the athlete supine on the examination table, flex the hip and knee to 90 degrees. Then extend the knee and measure the popliteal angle. Typically, the knee should be able to extend to 180 degrees.

in Eskimos (30-33). A higher incidence is seen in ballet, gymnastics, competitive cheerleaders, American football linemen, weight lifting, wrestling, diving, volleyball, and fast bowlers in cricket (32,33). The mean age at diagnosis in athletes is around 15–16 years, but can occur at earlier age. Repetitive axial loading and rotation, especially in an extended lumbar spine, is the most important contributing mechanism leading to fatigue fracture of the pars interarticularis (33-35).

Clinical presentation

Many athletes with spondylolysis are asymptomatic and may or may not progress to symptomatic lesions. Athletes with symptomatic spondylolysis generally present with insidious onset, recurrent, activity associated, low back pain (31). Athlete may also present with a history of sudden onset of pain with acute spondylolysis as reported in competitive cheerleading and gymnastics. The pain is localized to low back, non-radiating, and dull aching to sharp. Pain is also reported in buttocks and back of the thigh. Patients do not have any neurological symptoms or signs.



Figure 3 One-legged hyperextension test. With the athlete standing on one leg, have her extend the back. Repeat the same for each leg. In cases of pars interarticularis defect, pain is elicited on hyperextension of the back.

Decreased flexibility of the hamstrings (*Figure 2*) and lumbodorsal muscles and fascia is seen in almost all symptomatic athletes and may be the only and/or initial presenting sign. Increased lumbar lordosis and a relative weakness of abdominal muscles are also common findings. Lower back pain can be reproduced or exacerbated by one-leg hyperextension movement of the lumbo-sacral spine (*Figure 3*).

Diagnostic imaging

There is no universally accepted consensus for imaging protocol, and the decision to proceed with any particular imaging study and its timing should be determined on an individual basis based on the findings on clinical evaluation and particular circumstances of the athlete.

Plain films are initial study of choice and should include anteroposterior, lateral, and oblique views of the lumbosacral spine. In a typical lesion the characteristic pars

Table 5 Wiltse-Newman classification of spondylolisthesis

Dysplastic
Isthmic
Disruption of the pars interarticularis due to stress fracture
Elongation of the pars without disruption due to repetitive healed microfractures
Acute fracture of the pars interarticularis
Degenerative
Traumatic
Pathologic

defect is most evident on the oblique view, and described as the scotty dog with a collar appearance (32). Like other stress fractures, X-rays may not be positive until after 1–2 weeks. Plain films are useful to detect any associated anomalies such as spina bifida occulta and other congenital vertebral anomalies, as well as spondylolisthesis.

The need for and appropriateness of additional imaging studies should be ideally considered in consultation with the radiologist locally. A bone scan or a single photon emission computed tomography (SPECT) scan are highly sensitive in the diagnosis if the plain films are normal, and to determine the acuity of the fracture; and a CT scan is useful to delineate the defect. The bone scan and SPECT scan require injection of radiographic dye, and radiation exposure which is also a consideration for CT scan. Increasingly, magnetic imaging resonance scan is being used as a next step in cases where initial X-rays are negative. MRI scan is useful in detecting early or acute lesions, delineating the anatomic nature of the pars defect, and detect any spinal or soft tissue pathology (32).

Treatment

Most athletes with spondylolysis can be managed conservatively. Symptomatic athletes should refrain from sports and hyperextension activities until pain free, which may take a few days to several weeks (30–35). Athletes should work with knowledgeable sports physical therapist or athletic trainer for rehabilitation program focused on core stabilization, strengthening, and flexibility exercises. Return to sport is allowed once the athlete is pain free, has normal examination, and has undergone rehabilitation. Failure of conservative treatment and recurrent or persistent pain is an

indication for orthopedic consultation.

Spondylolisthesis

Spondylolisthesis is characterized by forward slippage of a vertebra over the one just below it, most commonly of L5 over S1 (30). Spondylolisthesis is a common complication of bilateral spondylolytic lesions. Wiltse-Newman classification of types of spondylolisthesis is described in *Table 5* (30). Isthmic type is the most common type seen in adolescent athletes. The overall incidence and epidemiologic characteristics are similar to those of spondylolysis. The basic mechanism is similar to that of spondylolysis, and generally occurs as a complication of bilateral spondylolytic defects at the same vertebral level.

Clinical presentation

Athlete presents with gradual onset, aching pain in the lower back, buttocks or the posterior thigh. The pain is aggravated with physical activities, especially those involving repeated flexion, extension, and rotation. In some cases, spondylolisthesis is asymptomatic. Patient often assumes characteristic posture while standing or walking with increased hip and knee flexion or crouched posture (known as the Phalen-Dickson sign) (30). On examination there is hamstring tightness (80% of patients), and exacerbated lumbar lordosis and a step-off over the lumbar spine may be palpated (30,31). Lumbar radicular symptoms are rare, and may be present in high grade spondylolisthesis. Lower limb strength, sensation, and reflexes should be tested.

Diagnostic imaging

Lateral X-ray of the lumbosacral spine is sufficient in most cases to diagnose and assess the degree of slippage. Meyerding classification of the degree of slippage is as follows: grade 1—less than 25%; grade 2—26–50%; grade 3—51–75%; and grade 4—75–99% (30–32). MRI scan is indicated if the patient has neurological symptoms or signs to evaluate for other causes such as disk herniation in conjunction with spondylolisthesis.

Treatment

The risk for progression is higher for younger athletes and

they should be followed regularly until skeletal maturity. Initial treatment of patients with low grade (grade I and II) spondylolisthesis without neurological signs is similar to that of patients with symptomatic acute spondylolysis that includes restriction of sports until asymptomatic, physical therapy, and bracing (30). All patients with high grade lesions and those with neurological signs should be referred to orthopedic surgeon for definitive further evaluation and treatment that includes different surgical options.

Disk herniation

Herniation of the intervertebral disk into the spinal canal is rare in children and adolescents with a reported incidence of between 0.8% and 3.2% (36-39). The incidence is generally equal between males and females. Most commonly affected levels are L4-L5 and L5-S1 (36). Weight lifting, gymnastics, wrestling and collision sports are high risk sports for disk herniation (36).

Disk herniation can result either from acute or repetitive trauma. In skeletally immature adolescents, compression force during forward flexion can result in disk herniation and may involve herniation of the disk vertically through the end plate. In many adolescents with disk herniation, other congenital spine anomalies are found such as spina bifida occulta, transitional vertebra or congenital spinal stenosis (36).

Clinical presentation

Athlete may present with a history of sudden onset pain related to a particular activity or insidious onset, intermittent activity related pain of several weeks or months duration. A clear history of acute trauma is elicited in only 40–50 % of the patients (36,37). The most common presenting symptoms are back and leg pain and stiffness that are exacerbated with activity. The pain may or may not radiate to legs and generally neurological signs are absent in most children and adolescents (36-38). Pain is also exacerbated by coughing, sneezing or sitting. In some athletes, lumbar radicular signs may be elicited. Most have limitation of lumbosacral spine movement and mild scoliosis may be detected in some patients. Positive straight leg raise sign is the most common finding present in almost all patients. Listing toward the side of herniation may also be present. Hamstring tightness is common and early sign of disk herniation.

Diagnostic imaging

MRI is the study of choice to detect disk herniation and any neurological compromise. Positive MRI scan findings must be correlated with clinical findings because many individuals have abnormalities on MRI scan that are of no clinical significance.

Treatment

In the absence of neurological signs, the initial treatment is conservative with relative rest, restriction from sports and initiating physical therapy. Most adolescents respond well to conservative treatment over a period of several weeks, typically 6–12 weeks. Failure of clinical improvement with conservative treatment and presence of any neurological signs (initially or later) are indications for surgical consultation for definitive treatment. Studies show a more favorable outcome in adolescents following surgical treatment (37,38). Prognosis in young athletes is excellent for return to full sport participation following appropriate treatment.

Slipped vertebral apophysis (fracture of ring apophysis)

A fracture through the weak osteocartilaginous junction between the vertebral body and its apophysis results in displacement and protrusion into the spinal canal of the fractured segment along with the associated intervertebral disk (40). This injury is unique to adolescents, more common in males, and most commonly involves the inferior apophysis of L4 (40). Most cases are reported in wrestling and gymnastics. Apophyseal fractures and displacement can result from either acute or repetitive trauma from compressive loads applied to the spine during flexion.

Clinical presentation

In general, symptoms and signs are similar to that of acute central disk herniation. The athlete typically presents with acute lumbar pain with onset during activity usually weight lifting or other sports that require hyperflexion of lumbar spine (40). Pain may be described as burning and radiate into the leg. The pain is exacerbated by sitting, coughing and sneezing. Pain is also elicited by contralateral straight leg raise. Because of posterior central protrusion, lumbar radicular signs may be elicited on examination; however,



Figure 4 Gaenslen test. With athlete supine on the examination table, ask her to fully flex both at knees and hips. Then have her move to the edge of the table and slowly extend the hip and lower leg over the edge of the table. Repeat on the opposite side. Pain in sacroiliac joint will be elicited with SI pathology.

neurological findings are uncommon in most adolescents and that may delay diagnosis (40).

Diagnostic imaging

AP and lateral X-rays of the lumbar spine may or may not show the bony avulsion. A CT scan and/ or MRI scan may be indicated to further delineate the injury.

Treatment

Athletes should be restricted from sports and referred to orthopedics for definitive treatment. Most consider surgical excision of the fractured fragment as the treatment of choice.

Fractures of the thoracolumbar spine

Acute fractures of the thoracolumbar spine are uncommon in youth sports; most are due to motor vehicle accidents, falls or abuse in the very young child and about 25%

may be associated with neurological injury (1-3). Fractures of the thoracolumbar spine have been reported in adolescents participating in collision sports such as American football, ice hockey, and rugby. Most are seen in adolescents more than 16 years of age in whom the fracture characteristics are similar to those seen in adults. The most frequently injured area is from T4 to T12 (1,2,5). Spinal cord injury without a bony fracture (spinal cord injury without radiographic abnormality), most affecting the cervical spine, is a unique injury seen mostly in very young children whereas vertebral apophyseal and endplate injuries are unique to adolescents (1-7).

The key mechanisms for spine fractures include (I) sudden hyperflexion of the spine with or without vertebral body compression; (II) distraction of the spine; and (III) shearing force (1-7). Axial loading or compression of the flexed or straight spine can cause a vertebral body compression or a burst fracture seen in sports. Fracture of the apophysis of the spinous process, mostly of the thoracic spine, can result from sudden distraction force.

The athlete typically is injured in a collision sport and presents with a history of acute onset back pain with or without neurological findings. Most will present on the field or in the emergency department following the injury and should be further evaluated and treated by physicians with expertise in the management of spinal trauma.

Pediatric athletes with acute traumatic spine fractures should be referred to orthopedic surgeon for further evaluation and definitive management with long term follow up.

SI joint pain

SIJ is a diarthrodial joint with minimal movements in transverse or longitudinal planes not exceeding 2–3 degrees (41). The prevalence of low back pain directly related to SIJ in young athletes is not known. SIJ pain has been reported in most commonly in rowing and cross country skiing. Pain may be in the lower back, buttocks, back of thighs or pelvis. Tenderness may be localized over the SIJ and pain may be elicited or exacerbated with some provocative tests such as flexion-abduction-external rotation (FABER) of the hip and Gaenslen (*Figure 4*). The diagnosis is mainly based on history and examination findings. Imaging studies may be indicated to exclude other causes of pain. Chronic SIJ pain may be difficult to treat. In addition to relative rest, modification of activities, and use of non-steroidal anti-inflammatory drugs (NSAIDs), various other

treatment modalities have been reported with variable success in individual cases (41-45). These include manual or manipulative treatment, prolotherapy, intraarticular injections of local anesthetics and corticosteroids, and radiofrequency neurotomy (41-45). Athletes with significant chronic pain should be referred to experts with experience in treating SIJ pain and dysfunction.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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