Differential Diagnosis of Leg Pain in the Athlete

Leg pain in the athlete is common and has many different etiologies. The most common causes include muscle or tendon injury, medial tibial stress syndrome, stress fracture, and exertional compartment syndrome. Less common causes of leg pain include lumbosacral radiculopathy, lumbosacral spinal stenosis, focal nerve entrapment, vascular claudication from atherosclerosis, popliteal artery entrapment syndrome, and venous insufficiency. This article reviews the essential history and physical examination findings and the various causes of leg pain to help the clinician pinpoint the diagnosis and facilitate the athlete’s return to sport participation. (J Am Podiatr Med Assoc 93(4): 321-324, 2003)

Leg pain is a common complaint in the athlete. In general, athletes are more prone to injury because they engage in repetitive activities that predispose their legs to overuse and overload. In runners, particularly, lower-leg injury has been reported as one of the most common injuries, second only to knee injury.1 The differential diagnosis of leg pain, however, is quite broad. By definition, leg pain is pain between the knee and ankle. It is commonly caused by muscle or tendon injury, medial tibial stress syndrome, stress fracture, and exertional compartment syndrome. Less common causes of leg pain include lumbosacral radiculopathy, lumbosacral spinal stenosis, focal nerve entrapment, vascular claudication from atherosclerosis, popliteal artery entrapment syndrome, and venous insufficiency. Because the source of leg pain can be difficult to pinpoint, the importance of a thorough history and physical examination cannot be overemphasized.

History

Obtaining a detailed history from the patient with leg pain is essential.2 As clinical examination may reveal normal or only minimal findings, understanding the technical demands of the sport may help uncover predisposing factors. Determining the exact circumstances surrounding an injury is necessary to obtain a clear description of the symptoms; obtaining a thorough training history is also essential. The focus should be on the onset (acute versus chronic), mechanism of injury, location of pain, associated symptoms, alleviating or aggravating factors, timing of pain, and changes in the training regimen. Acute onset may indicate bony fractures or musculotendinous tears, whereas gradual onset is more suggestive of overuse injuries and inflammation. A history of trauma may correspond with tendon rupture. Identifying the exact location of pain; whether it is discrete, diffuse, or radiating; and its timing in relation to rest and exercise is particularly helpful. Associated symptoms, such as back pain, may indicate a possible spinal pathology. Pain that causes nocturnal awakening is particularly suggestive of a tumor. In the athlete, any rapid changes in the intensity, duration, or frequency of training or a change in training surface, shoes, or equipment can lead to substantial forces that negatively affect the body.

Physical Examination

Complete examination of the patient with leg pain should start with observation of posture and gait and examination of the spine, hip, knee, ankle, and foot.
Muscle or Tendon Injury

Strain or disruption in a muscle or tendon is probably the most common cause of leg pain. Often, this pain involves the calf muscles (the more superficial gastrocnemius and the deeper soleus) or the Achilles tendon. The calf muscles coalesce to form the Achilles tendon, which inserts into the calcaneus. The calf muscles are prone to contusion from contact sports and are susceptible to strains, cramps, and soreness from poor conditioning and overuse. The Achilles tendon is also prone to injury, as it is subjected to large stresses that can reach 6 to 8 times the body weight from repetitive activities.7 “Tennis leg” in the proximal lower leg and Achilles tendinitis or tear in the distal lower leg are two common conditions seen in the athlete.

“Tennis leg” refers to a partial rupture of the medial head of the gastrocnemius muscle and is sometimes mistakenly termed “plantaris rupture.” Often, the athlete will describe a popping sensation and complain of swelling and ecchymosis in the posterior leg. The injury usually occurs with eccentric loading, with the knee in full extension. On physical examination, there may be swelling, crepitation, and a palpable defect in the medial head of the gastrocnemius muscle. Ankle plantarflexion may be weak. As this condition can be confused with deep-vein thrombosis, Doppler ultrasound is helpful when the diagnosis is in doubt. Although magnetic resonance imaging (MRI) can aid in visualizing the extent of injury, it is rarely indicated. Treatment consists of elevation, ice, compressive wrapping, and partial weightbearing. Progressive calf stretching and strengthening is the mainstay of treatment. Surgical repair is not indicated.

Achilles tendinitis occurs in 6.5% to 11.0% of runners.4,5 Injury to the Achilles tendon may lead to peritendinitis, tendinosis, or a tear of the tendon. The athlete may complain of localized pain and may describe the foot as being stiff in the morning and at the start of a run. With peritendinitis, the foot may feel good initially, but pain increases with running. With moderate-to-severe tendinosis or a tear of the tendon, pain may be present throughout the run and even during normal walking. Findings from physical examination vary from diffuse tenderness along the entire length of the Achilles tendon to significant swelling and erythema at the site of injury. Magnetic resonance imaging or ultrasound is helpful in differentiating paratendinous adhesions and swelling from true tendinous degeneration and tears. Treatment initially aims to reduce local pain and inflammation and includes cross-training or decreased mileage, nonsteroidal anti-inflammatory drugs, local ice massage, contrast baths, and ultrasound. The rehabilitative phase focuses on achieving full extensibility and eccentric strength in the Achilles tendon for optimal healing and prevention of future injuries. Stretching, manual soft-tissue therapy, mobilization, and progressive loading are helpful in achieving these goals. Some athletes may require local anesthetic injection, ankle immobilization with a walking cast, or surgery to excise the scar tissue.

Medial Tibial Stress Syndrome (Periostitis)

Medial tibial stress syndrome is also known as tibial periostitis or shin splints. In a large series of 465 injuries causing exertional leg pain, medial tibial stress syndrome and tibial stress fractures accounted for 75% of all injuries.6 Medial tibial stress syndrome may represent the milder end of a spectrum of injury that includes bony stress reaction and stress fracture. Medial tibial stress syndrome and the more severe tibial stress reaction or fracture may be difficult to differentiate clinically; the key distinguishing symptoms of stress fracture are pain persisting after running, pain with daily walking, and focal pain over the tibial shaft with bony percussion.7 On physical examination, there is diffuse tenderness over the posterior medial edge of the tibia. Subtalar position needs careful evaluation, as increased pronation has been associated with the development of medial tibial stress syndrome in the athlete. Pain can be aggravated by testing muscle strength actively against the soleus, posterior tibialis, and flexor digitorum longus muscles. Treatment can range from a few days to 3 weeks for a minor injury and involves temporary cessation of running. Therapy should focus on improving the flexibility of the gastrocnemius and soleus...
Stress Fracture

Stress fracture, a common overuse injury in athletes, is described as accelerated bony remodeling in response to repetitive submaximal stresses. Stress fractures are more likely to occur in sports that involve a substantial amount of running or jumping. Runners, gymnasts, dancers, and racquetball, basketball, football, hockey, and soccer players are particularly at risk for this type of injury. Women with a history of amenorrhea or eating disorders are also at risk. Stress fractures in the lower extremity are common in the bones of the foot. Plain film radiographs, although helpful, may be negative for the first 2 to 4 weeks after injury.8 Radionuclide scanning is a more sensitive but less specific method of imaging bony stress injuries. Alternatively, MRI with a fat-suppression technique has the advantages of multiplanar capability, high sensitivity for pathology, an ability to precisely define the location and extent of bony injury, and a lack of exposure to ionizing radiation. This technique is also noninvasive and requires considerably less imaging time than a triple-phase bone scan.

The clinical history of stress fracture usually involves localized pain that is not present at the start of activity. The pain tends to develop toward the end of activity, and it lingers after cessation of the activity. Physical examination using percussion or the single-legged hop test may reveal focal tenderness or swelling over the involved bone. Treatment depends on the exact location of the fracture, the severity of the fracture, and the determined risk for delayed union, nonunion, fracture displacement, or intra-articular extension. Low-risk fractures in the leg, such as in the posterior or medial tibia, fibula, and lateral malleolus, can be treated conservatively. Conservative treatment takes 4 to 8 weeks and consists of controlling the pain and inflammation; weightbearing as tolerated; discontinuing the offending activity, such as running; and, eventually, gradually returning to the activity. In contrast, high-risk fractures, such as in the anterior midtibia, medial malleolus, navicular, and proximal fifth metatarsal, require more aggressive treatment, such as nonweightbearing immobilization and, occasionally, internal fixation. The athlete with a high-risk fracture can expect a much longer recovery time, and follow-up studies are needed to confirm healing.

Exertional Compartment Syndrome

Compartment syndrome occurs when elevated tissue pressures surpass a critical value and inhibit the blood flow and function of the tissues within a closed fascial space. Exercise can cause a 20% increase in muscle volume,9 which may lead to increased pressure or compromised blood flow and subsequent generation of pain.10 The leg comprises four compartments: anterior, lateral, superficial posterior, and deep posterior. In an athlete who complains of pain over a specific compartment with exercise, the most likely diagnosis is chronic compartment syndrome. The most reliable way of confirming the diagnosis is to measure compartment pressure with a slit or wick catheter. In the presence of the appropriate clinical findings, one or more of the following pressure values can be diagnostic: 1) 15 mm Hg before exercise, 2) 30 mm Hg 1 min after exercise, or 3) 20 mm Hg 5 min after exercise.

Clinically, the athlete may complain of an aching or cramping leg pain, tightness, or even weakness. The symptoms generally begin within 20 min of the onset of exercise and usually resolve shortly after the termination of exercise. The symptoms are often bilateral and may be associated with numbness or tingling in the distribution of a nerve traversing the compartment.11 Results of physical examination are normal. Chronic compartment syndrome can sometimes be treated conservatively with the use of nonsteroidal anti-inflammatory drugs, ultrasound, myofascial release, stretching, shoe modifications, and orthoses. In many athletes, however, pain is likely to recur with activity; therefore, fasciotomy may be the treatment of choice. Several studies12, 13 in the literature reveal an 85% to 92% success rate with fasciotomy.

Less Common Causes of Leg Pain

An atypical presentation or an unsatisfactory response to treatment should lead one to consider the less common causes of leg pain, such as neurovascular conditions, infection, and tumor. Neurologic conditions that cause leg pain include lumbosacral radiculopathy, lumbosacral spinal stenosis, and focal neuropathy. Vascular disorders that cause leg pain include vascular claudication, popliteal artery entrapment syndrome, and venous insufficiency. When evaluating leg pain, it is important to maintain a high index of suspicion for infection, tumor, and deep-vein thrombus, as these conditions can lead to death even in an otherwise healthy athlete.

Leg pain in a dermatomal distribution suggests a neurologic disorder. In an older athlete complaining...
of concurrent low-back pain, lumbosacral radiculopathy and lumbosacral spinal stenosis are likely diagnoses. With lumbosacral radiculopathy, there is compression of the nerve roots at the neuroforamen. Clinically, the athlete will describe a sharp shooting pain that radiates into the leg in a discrete bandlelike pattern. With lumbosacral spinal stenosis, there is central canal narrowing related to either degenerative joint disease or congenital factors. The athlete may describe bilateral claudication-type pain in the calf that improves on sitting down or flexing the spine. Treatment for lumbosacral radiculopathy and lumbosacral spinal stenosis includes nonsteroidal anti-inflammatory drugs, physical therapy, corticosteroid epidural or selective nerve root injection, and occasionally surgical decompression.

Another less common cause of leg pain is focal nerve entrapment. The superficial peroneal nerve, deep peroneal nerve, or sural nerve may be involved, and pain is in the nerve distribution. Treatment for focal nerve entrapment includes nonsteroidal anti-inflammatory drugs, ultrasound, massage, corticosteroid injection, and surgical release. Neuapraxic lesions with persistent sensory disturbances may respond to membrane-stabilizing medications. When evaluating a patient for neurologic conditions, the physician must perform a detailed neurologic examination to assess motor strength, sensation, reflexes, the presence of the Babinski reflex, clonus, and signs of neural tension.

Vascular disorders are another uncommon cause of leg pain in the athlete. These conditions include vascular claudication from atherosclerotic disease, popliteal artery entrapment syndrome, and venous insufficiency. The athlete with atherosclerosis tends to be older and to have other comorbidities. Clinically, there is claudication-type calf pain bilaterally characterized by pain with activity that quickly resolves with rest. Physical examination may reveal decreased lower-extremity pulses. In contrast, popliteal artery entrapment syndrome is more common in young men with a mean age of 28 years.14 It is caused by aberrant anatomy in the popliteal fossa, in which the popliteal artery is compressed by the surrounding myofascial structures. Clinically, there may be claudication-type pain and evidence of ischemia, such as discoloration. For atherosclerosis and popliteal artery entrapment syndrome, the treatment is surgery. Venous insufficiency is rare and has been associated with repetitive muscle use during jogging and possible intimal damage as a result of knee hyperextension during kickboxing.8 Clinically, the athlete may complain of pain with the leg in a dependent position and report improvement with the leg elevated. Venous insufficiency may lead to stasis or thrombosis. The treatment for deep-vein thrombosis is elevation and anticoagulant drugs.

**Conclusion**

Leg pain in the athlete is very common. It can be persistent and can become a great source of frustration for an athlete eager to return to sporting activity. Distinguishing among the various causes of leg pain in the athlete may not be easy, particularly if clinical overlap exists in the presenting symptoms or if the presentation is atypical. Knowledge of the differential diagnosis of leg pain in the athlete will help the astute clinician pinpoint the cause of the pain and facilitate a safe and timely recovery.

**References**