Common Overuse Injuries in the Young Athlete

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Abstract

Pediatric overuse injury is a common complaint presenting to pediatricians. Overuse injury can affect the soft tissues or bone, and results from an imbalance between training and load to the tissues and recovery time. In the skeletally immature athlete, physeal and apophyseal tissue is particularly vulnerable to overuse resulting in different patterns of injury compared to adults. Awareness of age-dependent patterns of overuse is necessary for proper recognition, treatment, and prevention of injury. This article reviews the most common pediatric overuse injuries with emphasis on risk factors, diagnosis, and treatment. Guidelines for prevention are included, as this is the key component for successful management of overuse injury in pediatric athletes. [Pediatr Ann. 2014;43(12):e297-e308.]
Pediatric overuse injury is a common complaint presenting to pediatricians, representing approximately 50% of all sports injuries seen in clinical practice. Overuse injuries are more common among adolescents than children (ages 5–12 years). Young athletes participating in sports with repetitive overhead motion are at risk for age-specific chronic injuries. The clinician needs to be equipped with the tools to counsel athletes on effective treatment, appropriate return to play, and injury prevention.

Overuse injury results from an imbalance between training and load to the tissues and recovery time. Stress and load can produce adaptive changes in the tissue as long as there is adequate recovery time for the body to repair the cellular damage. However, with inadequate recovery time, cellular damage is not completely repaired before the next load is applied. If this cycle of inadequate recovery time continues, the cellular damage compounds and eventually results in progressive, activity-related musculoskeletal pain with or without impairments of sports performance.

Overuse injury can affect the soft tissues (eg, tendonitis) or bone/growth cartilage (eg, stress fracture, apophysitis). In the skeletally immature athlete, growth cartilage (physes and apophyses) is the tissue that is most vulnerable to injury because unlike the surrounding muscles, tendons, and bone, growth cartilage is not designed to withstand significant load and tensile forces, especially during periods of rapid growth.

The hallmark feature of overuse injury is the insidious onset of pain with repetitive motion activity (Table 1). Pain may be intermittent and occur only with sports participation, or may progress to activity-related musculoskeletal pain with or without impairments of sports performance.

<table>
<thead>
<tr>
<th>Key Assessments for Overuse Injuries</th>
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<tr>
<td>Age, growth spurt history</td>
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<td>Chronic pain versus inciting event</td>
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<td>Duration and frequency of pain (after or during activity, pain at rest)</td>
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<td>Severity of pain</td>
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<td>Location of pain (specific anatomic location, point of maximal tenderness)</td>
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<td>Previous injury and treatment recommendations</td>
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<td>Sport, recent change in training volume, intensity</td>
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<td>Pain associated with activities of daily living</td>
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<tr>
<td>Swelling</td>
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<tr>
<td>Change in performance</td>
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<tr>
<td>Range of motion deficit</td>
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<td>Instability, mechanical symptoms</td>
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<td>Decline in performance</td>
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The diagnosis can be made by physical examination, which typically reveals tenderness at the distal radial physis. Swelling may be present. Range of motion is usually full, but extreme dorsiflexion and axial loading of the wrist are often painful. These findings distinguish it from tendonitis, which produces tenderness along the affected tendon—reproducible discomfort with activation of the corresponding muscle group, and no pain with axial loading of the wrist.

While radiographs may not be necessary to make the diagnosis, they can be helpful to establish the severity of injury. Initially, radiographs are normal or show subtle widening of the physis. Continued stress can lead to more pronounced physeal widening with adjacent sclerosis, irregularity, and reactive cysts (Figure 1). In the most advanced stages, pathologic physeal bridging can occur. Magnetic resonance imaging (MRI) is usually unnecessary, but may be useful to differentiate from tendonitis when the examination and radiographs are unrevealing.

Treatment is absolute rest from weight-bearing on the wrists and other aggravating activities. Immobilization in a fiberglass cast or wrist brace may facilitate the rest period initially. Physical therapy during the rest period can address any underlying biomechanical imbalances that may have contributed to the injury. Mild cases may resolve in 3–4 weeks, but advanced cases usually require several months of rest to ensure resolution of pain and radiographic healing. Return to weight-bearing on upper extremities should be gradual and pain-free. Often, the most difficult aspect of treatment is tempering the gymnast’s desire to resume activity before pain has completely resolved. Physeal arrest of the radius is a well-described complication that can lead to relative ulnar overgrowth (positive ulnar vari-
This deformity can result in chronic wrist pain and dysfunction.

MEDIAL EPICONDYLE APOPHYSITIS (LITTLE LEAGUE ELBOW)

Case 2

A 12-year-old pitcher presents with a 3-week history of medial elbow pain. The pain is only present with throwing. During the overhead throwing motion, valgus forces put tremendous tensile load on the medial epicondyle apophysis. This chronic traction stress on the apophysis from repetitive throwing can cause progressive widening and separation of the apophysis.13,14 Medial epicondyle apophysitis most commonly occurs in baseball pitchers, catchers, and other overhead-throwing athletes between the ages 11-14 years. Risk factors include year-round play, pitching for more than one team per season, poor mechanics, throwing through arm fatigue, throwing breaking pitches before skeletal maturity, and failure to follow recommended pitch count limits and rest days between pitching appearances.13,15

The athlete will complain of throwing-related medial elbow pain that is relieved by rest. Typically, there is no pain with batting or fielding. Examination reveals focal tenderness over the medical epicondyle. There may be swelling, and less commonly, loss of motion.

Early in the condition, radiographs may be normal, but later can demonstrate hypertrophy, widening, and fragmentation of apophysis (Figure 2).10,11 A comparison view can be helpful to clarify the findings and educate the family. The appearance of the medial epicondyle has been shown to be abnormal in a large proportion of youth baseball players, even when they are asymptomatic.16 However, a history of progressive medial elbow pain with characteristic findings on radiographs point toward the diagno-

| TABLE 2. In
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<th>Injury Prevention Counseling</th>
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<td>Risk Factor Assessment</td>
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<td>Prior injury</td>
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<td>Growth spurt</td>
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<td>Medical supervision</td>
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<td>Training load</td>
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<td>Sport specialization</td>
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<td>Coaching</td>
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<td>Preseason conditioning</td>
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<td>Burnout</td>
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Figure 1. (A,B) Distal radius epiphysiolysis: widening of the distal radial physis with sclerosis and irregularity of the adjacent metaphysis and “volar beaking” of physis on lateral view. (C) Normal right wrist.
sis of medial epicondyle apophysitis. MRI is rarely necessary to establish the diagnosis.

Treatment is rest from throwing until tenderness and swelling resolve and motion is full, which usually takes a minimum of 4-6 weeks, but sometimes as long as 3-4 months. Ice and nonsteroidal anti-inflammatory drugs (NSAIDS) may be helpful initially to control pain. Physical therapy can address weakness of the shoulder, posture, core, and lower extremity that may have contributed to the injury. As pain resolves, the athlete may be permitted to return to baseball at a low-demand throwing position such as first or second base. An age-based interval-throwing

<table>
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<th>Maximum Pitch Counts</th>
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<tr>
<td>Age</td>
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<tr>
<td>&lt;10 years</td>
<td>75</td>
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<tr>
<td>11-12 years</td>
<td>85</td>
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<tr>
<td>13-16 years</td>
<td>95</td>
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<tr>
<td>17-18 years</td>
<td>105</td>
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<th>Rest Requirements</th>
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<tr>
<td><strong>Pitch Count (≤14 years)</strong></td>
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<td>1-20</td>
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<td>21-35</td>
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<td>36-50</td>
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<td>51-65</td>
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<td>&gt;66</td>
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Data from Little League Baseball (http://www.littleleague.org/assets/forms_pubs/media/pitchingregulationchanges_bb_11-13-09.pdf)
program focusing on proper mechanics is essential for returning to pitching and should be supervised by a qualified physical therapist or coach.\(^\text{13,18-21}\) Athletes should be educated about the risk factors for this injury and provided with resources for preventing recurrence. The American Academy of Pediatrics’ policy statement, “Baseball and Softball,” includes guidelines about pitch count limits, pitch types, appropriate time off from throwing between pitching appearances, proper throwing mechanics, and protective strength and conditioning programs (Table 3).\(^\text{13}\) The American Sports Medicine Institute publishes a booklet that provides detailed information on preventive and rehabilitative exercises and interval-throwing programs.\(^\text{22}\)

### OSTEOCHONDRITIS DISSECANS OF THE CAPITELLUM

#### Case 3

A 12-year-old female competitive gymnast presents with 6 weeks of lateral elbow pain. She complains of difficulty straightening her elbow. Osteochondritis dissecans (OCD) of the capitellum is a potentially debilitating injury. Although the etiology is likely multifactorial, repetitive microtrauma is thought to be the primary mechanism given the predilection toward competitive gymnasts and baseball pitchers.\(^\text{23,24}\) During upper extremity weight-bearing and overhead throwing, the lateral elbow, specifically the capitellum, is subject to high compressive load, which when repetitive can injure the subchondral bone.\(^\text{13,17}\) As OCD progresses, injury and breach to the overlying cartilage can further compromise the integrity of the joint and limit the potential options for optimal treatment.\(^\text{23,24}\)

The athlete will present with chronic activity-related lateral elbow pain. More concerning symptoms such as sharp pain, swelling, range of motion deficit (particularly extension), locking, and catching can develop as the injury progresses. Physical examination may reveal tenderness in the posterolateral elbow. There may also be a subtle joint effusion. Extension block or deficit in pronation/supination is concerning for more advanced injury. Prompt diagnosis and treatment are key to avoiding an unfavorable outcome.\(^\text{23,24}\) Therefore, radiographs are recommended and will usually identify OCD (Figure 3). However, subtle injury may not be apparent on initial films. Thus, MRI is recommended when there is a high index of suspicion for OCD in the setting of lateral elbow pain with normal radiographs. MRI is also helpful in cases where the OCD is identified on radiographs, as it allows for assessment of the stability of the lesion as determined by the extent of breach of the articular cartilage and the involvement of the subchondral bone.\(^\text{23}\)

Because progression to an unstable lesion and loose body can result in potentially irreversible joint damage, all athletes with OCD should be referred to an orthopedic surgeon or sports medicine specialist capable of providing expert recommendations regarding advanced imaging and treatment.\(^\text{25}\) Treatment is based on the stability of the lesion and the patient’s age.\(^\text{23,24,26}\) In young patients with small, stable lesions, conservative management may be successful. Conservative treatment involves prolonged rest from the irritating activities to allow for sufficient healing of the lesion. Larger, unstable lesions and OCD lesions in skeletally mature athletes are managed surgically. There is a trend toward operative management even in borderline cases due to concerns regarding failure of nonoperative treatment and the long-term outcomes related to disease progression.\(^\text{24}\) OCD has significant com-

![Figure 3](image-url)
Applications even when managed by a skilled orthopedic specialist. Throughout treatment, counseling the athlete regarding appropriate activity limitations is paramount. In the case of advanced OCD, the athlete may need to be counseled not to return to preinjury level of participation.

**PROXIMAL HUMERAL EPhipHYsiOLYSIS (LITTLE LEAGUE SHOULDER)**

**Case 4**

A 14-year-old competitive pitcher presents with lateral shoulder pain for 2 weeks. He is not sure if his coach counts his pitches. Proximal humeral epiphysiolysis occurs due to repetitive rotational torque and distraction forces over the immature physis in overhead throwing athletes, especially baseball pitchers. Other terms used to describe this phenomenon are “Little League Shoulder,” epiphysitis, and a chronic Salter Harris I fracture of the proximal humerus. Epiphysiolysis most commonly occurs between ages 12 and 15 years when hormonal influence on the physis adversely affects its tensile resistive strength. Risk factors include joint laxity, relatively underdeveloped shoulder musculature, excessive throwing/high pitch counts, year-round throwing, throwing through arm fatigue, and poor technique.\(^{15,27,29}\)

Athletes will present with insidious onset of lateral shoulder pain. The hallmark feature is pain with throwing. Batting, fielding, and activities of daily living may not be painful. There is often a recent increase in the throwing volume. Many athletes will have tenderness overlying the physis at the lateral shoulder, which is about 2 or 3 finger breadths below the acromion. There is often pain with resisted shoulder abduction and external rotation, which may be severe enough to limit motion and strength.\(^{27}\) However, physical examination may be normal, and thus cannot rule out epiphysiolysis. The presentation can be confused with a rotator cuff tendinitis as the point of maximal tenderness over the physis is close to the insertion of the rotator cuff, just below the acromion.

Radiographs can be normal early, or may show the classic findings of widening of the physis, lateral fragmentation, and metaphyseal sclerosis.\(^{10,11}\) Comparison views are often helpful (Figure 4). MRI is typically not required, but may be considered when other shoulder pathology is suspected.

Treatment is rest from throwing until it is no longer painful. This typically takes 2-3 months. A sling may facilitate the rest period initially, but should be removed once/day for range of motion exercises to avoid stiffness. NSAIDS may be used initially to control pain. Batting, fielding, and other modified activities are permitted as long these are not painful. Skilled physical therapy is helpful to strengthen the rotator cuff, periscapular, core, and lower extremity muscles.\(^{31}\) Once pain and tenderness are resolved and strength is optimized, it is critical that the athlete complete an age-based progressive throwing program that emphasizes proper mechanics before returning to pitching.\(^{13,22}\) Most pitchers and catchers benefit from returning temporarily to a low-demand throwing position such as first or second base.

A critical component of treatment is counseling the athlete to not throw through with arm fatigue and the importance of following published guidelines for pitch count limits, pitch types, appropriate time off from throwing between pitching appearances, proper throwing mechanics, and protective strength and conditioning programs (Table 3).\(^{13,18-21,32}\)

**SEVER DISEASE**

**Case 5**

An 11-year-old male presents with a 2-month history of bilateral heel pain. There is no history of trauma and the pain is worse with running and soccer. Sever disease, also known as calcaneal apophysitis, occurs from traction of the Achilles tendon on the calcaneal ossification center during preadolescence, and is thought to be the most common apophysitis.\(^{33,34}\) It classically presents as intermittent, activity-related heel pain between ages 9 and 13 years, predictably earlier in females compared to males. Bilateral involvement is common. The
Pain is often relieved by rest. Swelling and bruising are rare.

Diagnosis is made clinically, based on patient age, symptoms, and an examination revealing tenderness at the medial and lateral heel (“calcaneal squeeze test”). There may also be tenderness over the Achilles tendon insertion. Tight calf muscles are thought to be a risk factor.

Radiographs are not necessary to make the diagnosis, but can be helpful to rule out other pathology when the presentation is atypical. Radiographs are usually normal in Sever disease, but may show widening, sclerosis, and fragmentation of the apophysis (Figure 5). Differential diagnosis includes plantar fasciitis and calcaneal stress fracture, both of which are much less common and typically occur in older adolescents. Plantar fasciitis produces tenderness at the inferior aspect of the heel and along the plantar fascia. Stress fractures present as more refractory pain, and tenderness is more proximal over the metaphysis. Radiographs are often normal, and MRI may be needed to confirm the diagnosis (Figure 5).

Treatment focuses on education and management of symptoms. Rest is the most effective method for pain control. In extreme cases, immobilization in a removable walking boot may offer temporary relief of symptoms. Other techniques utilized for pain relief include ice massage, gel heel cups, and NSAIIDs. Heel cord stretches may also help. Long-term complications are not described.34,37

**OSGOOD-SCHLATTER DISEASE**

**Case 6**

A 12-year-old female basketball player presents with a “painful bump” over her anterior knee. The pain is made worse by running and jumping and “hiing” the area of swelling overlying her knee. Osgood-Schlatter disease (OSD), or tibial tubercle apophysitis, occurs from repetitive traction on the tibial tubercle ossification center during the adolescent growth spurt.38 The femur is thought to grow faster than the quadriceps muscles, creating excessive tension on the extensor mechanism. The traction on the immature cartilage tissue results in microavulsion of the tibial tubercle. Healing and repair attempts result in a chronic inflammatory reaction.39

OSD classically presents as activity-related knee pain between ages 11 and 14 years, occurring younger in females as compared to males.38 Pain is intermittent, often provoked by running, jumping, squatting, and kneeling, and it’s relieved with rest. It can be unilateral or bilateral and, when severe, may cause limping and limitation of activities. The classic feature is a “painful bump” at the tibial tubercle. In the skeletally mature age group, athletes may present with persistent pain and sensitivity over the tibial tubercle. This clinical scenario represents “unresolved OSD” due to nonunion or fibrous union of the tibial tubercle as a result of the microavulsions and fragmentation that occurred during the active phase of OSD.40,41

OSD is a clinical diagnosis based on symptoms, age of presentation, and examination revealing tenderness over the tibial tubercle and overlying soft tissue swelling. Inflexibility of the hamstrings and quadriceps are thought to be risk factors. Sinding-Larsen-Johannson (SLJ) disease, or apophysitis of the inferior pole of the patella, is an under-recognized form of apophysitis that can precede OSD by several years, typically occurring in ages 8-11 years.39

Radiographs are not needed for the diagnosis of OSD, but can be helpful to evaluate for tibial tubercle avulsion fracture in cases where there has been a sudden onset of pain after a forceful quadriceps contraction. There is wide variability of radiographic appearance of the tibial tubercle apophysis.42 Irregularity, widening, and fragmentation of the tibial tubercle (Figure 6) may be found in patients without OSD, and thus does not accurately correlate with the severity of symptoms. For persistent pain over the tibial tubercle in skeletally mature patients, radiographs to evaluate for
nonunion should be obtained. In SLJ, fragmentation of the inferior pole of the patella is often identified on plain radiograph (Figure 7). This is often misdiagnosed as a fracture, especially when an acute event irritates the apophysis.

Treatment of OSD and SLJ focuses on education and management of symptoms. Activity modification can be helpful to control pain, but complete rest is not typically required because of the generally benign course of OSD and SLJ. However, when symptoms are severe, a more strict rest plan can be instituted and may include short-term use of a knee immobilizer. Other techniques for pain relief include ice massage, over-the-counter NSAIDs, and a patellar tendon strap. Stretching of the hamstring muscle may reduce pain by relieving tension of the extensor mechanism. Physical therapy may be prescribed to address biomechanical and muscle imbalances that may be contributing. OSD and SLJ have a variable course depending on the athlete and the athletic activity/schedule. Intermittent symptoms often last for at least 1-2 years.41

Long-term complications from OSD, namely painful nonunion, are described, but are not common.40,41 SLJ is not associated with complications. Patients should be educated that the short-term management of OSD may or may not prevent the rare long-term complication. For the rare patient with unresolved OSD, conservative management is recommended. However, surgical excision of the painful ossicle is an option if conservative treatment is unsuccessful.43

ANTERIOR KNEE PAIN
Case 7
A 14-year-old runner presents with 6 months of anterior knee pain, initially only with running but now also with prolonged walking, stairs, and prolonged sitting. She is unable to train to her satisfaction because of the pain. Anterior knee pain (AKP) is the most common cause of nontraumatic knee pain presenting to clinical practice.44 It can occur at any age, but is particularly common in adolescents. AKP may also be referred to as peripatellar pain, patellofemoral pain syndrome, lateral patellar compression syndrome, patellar maltracking, and runner’s knee.44,45 It should be distinguished from more pathologic conditions such as OCD, cartilage disorders, and patellar instability. The pathophysiology underlying AKP is chronic mechanical overload of the anterior knee tissues.45 The tolerance of the load across the knee depends on multiple factors: growth, alignment, neuromuscular control, and absolute cumulative load. The hip muscles can absorb up to 25% of load during landing. Therefore, hip weakness increases load on the anterior knee.46,47 AKP presents as intermittent, activity-related pain in one or both knees. One or more anterior knee structures may be painful and tender. Most athletes have difficulty localizing the pain and will grab the front of their knee to describe the pain location (“grab sign”). Swelling is uncommon. Many patients report popping under the kneecap but true mechanical symptoms of locking and giving way should be absent.

Examination of the knee may be normal or may reveal tenderness over the peripatellar tissues. Diagnosis is based on the classic history and lack of positive findings on exam sug-
gesting other pathology. The entire lower extremity should be examined to identify modifiable contributing factors such as hip and thigh muscle weakness and inflexibility, and pes planovalgus. The assessment of hip strength and stability can be screened using the single-leg squat test (Figure 8). Weakness is indicated by valgus (knock-knee) collapse of the knee and by the pelvis rolling forward. A knee effusion is unusual with AKP and should prompt radiographs to assess for other diagnoses such as OCD. A careful evaluation of the hip in any patient presenting with knee pain is also required to evaluate for referred pain from hip pathology such as Slipped Femoral Capital Epiphysis or Perthes disease (avascular necrosis of the femoral head). Painful or limited hip range of motion, particularly with internal rotation, should prompt anteroposterior (AP) and frog-leg radiographs of the pelvis/hips.

Radiographs are important in the case of anterior knee pain to distinguish this benign condition from other structural or pathologic causes of pain in the knee. Notably, OCD of the femoral condyle can present with a similar history and physical examination. Because treatment is significantly different for OCD, imaging is warranted for AKP particularly when it does not improve with conservative care. Hip radiographs should be included in the evaluation if there is clinical concern that the knee pain is referred from the hip.

Treatment of AKP includes relative rest and physical therapy and neuromuscular re-education tailored to each athlete’s individual risk factors. The most effective physical therapy protocols emphasize pelvic and core stabilization, quadriceps strengthening, and stretching of the hamstrings, gastrocnemius/soleus complex, quadriceps, and IT (iliotibial) band. Initially, rest from the offending activity may be required to re-establish pain-free loading of the joint. However, athletes with mild symptoms, if manageable, may continue to participate in their sport and still have successful outcome with treatment. Cryotherapy and NSAIDS can be used, but the short-term effectiveness has not been consistently proven in systematic reviews. Patellar taping and bracing may be tried but have been shown to have variable effectiveness.

SHIN SPLINTS—MEDIAL Tibial STRESS SYNDROME

Case 8

A 14-year-old cross-country runner presents with bilateral medial shin pain of 4 weeks duration. The pain is present during and after running. “Shin splints” is often used to describe activity-related pain along the medial aspect of the tibia in athletes. Other terms more commonly utilized by clinicians are medial tibial stress syndrome (MTSS), soleus syndrome, tibial stress syndrome, and periostitis. This wide variation in nomenclature reflects the debate over the precise etiology of this overuse syndrome. Predominant theories describe traction on the periosteum by the calf muscles combined with repetitive stress on relatively weak muscles from the bending forces of the tibia. Risk factors include runner inexperience, female
Athletes with MTSS present with activity-induced diffuse pain along the medial shin. Initially, the pain occurs only early in the run and then subsides as the run continues. However, as the condition progresses, the pain persists throughout the entire run and afterwards, often limiting the athlete’s ability to train. Pain at rest can develop, but this is seen more commonly in stress fracture. Swelling is uncommon.

The diagnosis of MTSS can be made clinically with the appropriate history and examination. The most sensitive finding on examination has been shown to be diffuse tenderness on palpation of the posteromedial tibia.52 Physical examination is also useful to identify postural risk factors contributing to the pain syndrome.53

The differential diagnosis includes tibial stress fracture, chronic exertional compartment syndrome, and a nerve entrapment syndrome, all of which are less common in youth athletes compared to MTSS. However, when assessing running athletes, a high suspicion for tibial stress fracture is appropriate. Identifying a single point of maximal tenderness (often unilateral), can point the clinician to the suspicion for stress fracture. Stress fractures in athletes occur when the cumulative load placed on the bone in training exceeds the body’s repair mechanism, resulting in a spectrum of injury ranging from stress reaction to stress fracture. The athlete may describe throbbing and swelling. The pain typically progresses to pain during and after activity to pain with activities of daily living and eventually, pain at rest. Performance is typically significantly limited. Risk factors for tibial stress fractures are similar to MTSS. However, additional risk factors include a prior history of stress fracture, decreased bone density, menstrual irregularity, and inadequate calorie, calcium, and/or vitamin D intake.54

Radiographs are normal in MTSS. They may be obtained if there is a concern for stress fracture. Radiographic signs of stress fracture include localized periosteal reaction, a poorly defined cortical margin, callus, a band-like focal sclerosis, or a radiolucent line/cortical break11 (Figure 9). However, early in the course of a stress fracture, radiographs can be negative and up to 50% of stress fractures are never demonstrated on plain films. If radiographs are normal but suspicion for stress fracture is high, MRI is indicated (Figure 10). Recent protocols for bone stress injury have proven to have high sensitivity and specificity for stress fracture and have virtually
replaced the technetium bone scan and computed tomography scan as the gold standard for diagnosing tibial stress fractures. MRI also reveals the severity of stress injury, which helps guide management.

Treatment of MTSS depends on the severity of symptoms. No interventions have proven to be more effective than rest. Some athletes can simply modify training volume to control the pain, while others require a more strict rest protocol to restore function. A short course of immobilization in a removable walking boot or long-leg air stirrup may be necessary to control pain and allow for tissue healing. Counseling the athlete regarding a calculated and gradual progression back to running after the pain resolves is important to avoid recurrence. Any increase in mileage should be done gradually, with no more than a 10% increase per week.

Treatment for tibial stress fracture depends on the location of the fracture. The length of treatment varies from 2-4 months depending on the severity of the injury. Crutches, a removable walking boot or long-leg air stirrup should be used as needed to achieve pain-free weight-bearing, which can reduce the time to resumption of full activity. Athletes should be educated about optimizing energy availability and calcium and vitamin D intake. Menstrual function should be monitored closely as nutritional status improves to make sure cycles normalize.

During treatment for both MTSS and tibial stress fracture, cross-training with swimming, biking, and limited impact activity is permitted as long as the activity is nonpainful. Physical therapy should be prescribed to address biomechanical imbalances that may have contributed to the stress injury. After sufficient healing has occurred, as evidenced by pain-free ambulation and no tenderness on exam, the athlete may begin a supervised, very gradual return to running program. Over-the-counter arch supports or custom shoe inserts may be helpful for athletes with subtalar overpronation. MTSS has not been shown in the literature to progress to stress fracture.

INJURY PREVENTION

The Preparticipation Physical Evaluation (PPE) provides an ideal opportunity to identify athletes at risk for overuse injury and provide counseling on injury prevention. Previous injury is the predominant risk factor for overuse injury. Therefore, a significant or unresolved injury should be adequately treated before full participation is allowed. This may require referral for rehabilitation or to a sports medicine specialist for further evaluation and treatment. Screening on the PPE may also reveal deficits in range of motion, strength, or sport-specific function, which should be addressed before sports training begins.

The athlete and family should be counseled on appropriate limitations of sport-specific repetitive activity. Recommendations should be individualized, based on age, sport, and prior injury. Many reliable resources and guidelines exist to assist the clinician in counseling the young athlete on prevention of overuse injuries. The American Academy of Pediatrics’ Council on Sports Medicine and Fitness encourages athletes to take 1 to 2 days rest per week from training and 2 to 3 months per year away from sport-specific training. A 2013 critical review of sport specialization concluded that although a few sports may foster success with early specialization, for the majority of sports, specialization should be delayed until late puberty to optimize success and protect from injury. The principles of these resources are summarized in Table 2.

SUMMARY

Skeletally immature athletes are at risk for a unique set of overuse injuries. Early identification of overuse injury facilitates recovery and return to play. Rest and physical therapy are key components of treatment. Athletes should be counseled on how to reduce their risk for injury both in the setting of injury treatment, as well as during the PPE or well-child care visit.

REFERENCES


Table 2

Some athletes can simulate injury. After sufficient healing has occurred, as evidenced by pain-free ambulation and no tenderness on exam, the athlete may begin a supervised, very gradual return to running program. Over-the-counter arch supports or custom shoe inserts may be helpful for athletes with subtalar overpronation. MTSS has not been shown in the literature to progress to stress fracture.


