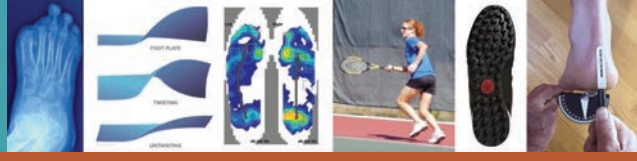

Pediatric Sports Injuries: An Overview

It's important to understand how these conditions affect children.

BY MAGGIE FOURNIER, DPM

Introduction

The health benefits of regular exercise are well known. This is especially important in younger children, during a time when childhood obesity rates have been increasing. During the past 30 years, there has been a significant increase in the number of children and adolescents participating in sports, influenced by the evolution of organized sports. This brought a new trend of focusing on a single sport, oftentimes practicing and competing year-round at high intensity level, with little to no rest period. This new development has also led to an increase in sports-related overuse injuries that were once exclusively diagnosed in adult athletes. The podiatric physician must therefore have a thorough knowledge of pediatric sports-specific injuries, especially since this number will most likely continue to rise. Pediatric sports injuries are particularly unique because of the developing nature of the musculoskeletal system. An understanding of 1) athletic injuries, 2) unique pediatric physiology, 3) developing musculoskeletal system and 4) specific demands of the individual sport is necessary for successful treatment and management.

Unique Physiology

The child's and young adult's developing musculoskeletal system is prone to sports injuries of a different type than their adult counterparts, making those injuries sometimes challenging to diagnose and treat. The long bone's physis (growth plate) is a weak point leading to a unique fracture pattern. In addition, the cortex is more malleable than that of adults and undergoes plastic deformation before failure, also known as torus fracture. It is also important to recognize that extreme joints and ligaments laxity is a known characteristic of children and the growing skeleton and have important roles in overuse injuries. As the child ages, there is a gradual loss of flexibility, with the greatest loss occurring at puberty. This leads to imbalances and stresses between the muscles and the tendons, especially in the lower extremity's growing skeleton. This reduction in flexibility combined with a growing skeleton has an important role in overuse injury and needs to be recognized.

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Sports Specialization

Youth sports have evolved from child-driven recreational free play for enjoyment to adult-driven highly structured practice for sports-specific skill development. It is estimated that 60 million children ages 6 through 18 participate in organized sports, while 16 million of those children participate exclusively in one sport year-round. There is no evidence that intense training and specialization (defined as year-round participation in a single sport) before puberty are necessary to achieve elite status. Risks of early sports specialization include increased rates of injury and burnout. Just as with their adult counterparts, higher training volume and intensity lead to greater risks for injuries. Recommendations in sports specialization in young athletes and adolescents include: 1) limiting the training to no more hours/week than age in years, 2) not playing a single sport more than 8 months out of the year, 3) participating only in one sport at a time.

Epidemiology

In the U.S. alone, it is reported that 3.5 million youth under the age of 15 years old received medical care each year for sports injuries, with football having the highest injury rate, followed by soccer. Injuries to

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the lower extremity were most common (42%) followed by those of upper extremities (30%), and the head and neck region (16%). Overall, we see a higher injury rate and severity in males between the ages of 5–14 years. Males are more susceptible to apophysis and articular cartilage injuries, while females sustain more bone and tendon injuries. It is also well established that women athletes of any age are more susceptible to developing REDS (relative energy deficiency in sport) than their male counterparts. Furthermore, children under the age of 10 years old will sustain a greater number of contusions, sprains, and growth plate injuries, while ligamentous injuries are more prevalent after skeletal maturity.

Overuse Injuries of the Lower Extremities

Overuse injuries occur when repetitive forces of a specific sport's demands overwhelm the ability of the body to repair itself. Just like an adult, a child can be placed under those stresses. It occurs when there is either a rapid increase in training duration, increase in intensity, change in the training surfaces, training in worn-out gear, or a combination of those factors. Overuse injuries can also be caused by intrinsic or biomechanical factors such as lower extremity rotational malalignment, genu varum or valgum, excessive subtalar joint pronation, and residual metatarsus adductus. Careful biomechanical examination should be performed in order to determine those factors and, therefore, not only help treat the actual injury, but also correct its underlying cause.

Bones in children have a higher healing potential and occurs more rapidly than in the adult counterpart, so more frequent monitoring for healing is necessary.

Stress Fractures

Stress fractures in athletes occur when repetitive stress on a bone occurs at a greater rate than what the bone can sustain. The pathophysiology of stress fractures in the pediatric population is again no different than that in adults and its cause is often multifactorial, as previously described under overuse injuries. The tibia remains the most common location for both the pediatric and adult population (50%). However, the second most common location differs, being the distal fibula in the pediatric population (20%) and the second metatarsal in the adult (14%). It is also to be noted that the overall incidence of stress fractures increases with age during the development years. Bones in children have a higher healing potential and and this occurs more rapidly than in the adult counterpart, so more frequent monitoring for healing is necessary.

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The patient will present with an insidious onset of pain, without direct trauma, which usually increases during physical activity and is relieved by rest. Plain radiographs remain the first line of imaging and can be useful in ruling out other pathological processes. MRI can also be valuable in evaluating stress fractures and can avoid a delay in treatment by providing an earlier diagnosis. It outlines the precise location of the stress fracture, which can also lead to a different management plan depending on the location of the fracture. It is to be noted that symptoms of medial tibial stress syndrome (MTSS), also known as "shin splints", can be similar to a tibial stress fracture. The pain is typically linear and not focal, without any lingering or throbbing pain when the triggering activity is stopped. MRI findings of MTSS typically involve a longer segment of the tibia and show no underlying bone marrow abnormality. It is important to distinguish between the two, since their treatments differ. MTSS is treated symptomatically, with rest, ice physical therapy, and bracing, while stress fracture treatment may involve a period of complete non-weight bearing, bracing, and rest.

One should also be aware of so-called "high risk" stress fractures, based on hypovascular anatomical area, which can lead to high risks of complications such as non-union, delayed union, and complete fracture. These include the anterior cortex of the tibia, medial malleolus, navicular, base of the second metatarsal, and sesamoids. These specific fractures should be treated aggressively, with a period of complete non-weight bearing and periodical radiologic evaluation to monitor healing. Patients should only return to sports when there is clinical and radiologic evidence of healing.

Apophysitis vs Osteochondrosis vs. Avulsion fracture

The apophysis is defined as a growth plate that provides a point for a muscle to attach. The apophysis is two to five times weaker than the surrounding muscle, ligament, and bones. Traction apophysitis of the calcaneus, also known as Sever's disease, is one of the most common overuse injuries. It is the second most common apophyseal disorder seen in the developing child after Osgood-Schlatter disease. The connection between the Achilles tendon and the calcaneal apophysis is weaker than the underlying bone, and repetitive stresses from the Achilles creates a painful traction at the posterior aspect of the calcaneus.

It essentially represents a Salter-Harris type I injury and can be accompanied by erythema and edema. It is most commonly seen in boys between the ages of 10 to 12, and presents with pain at the posterior aspect of the heel. There are no reliable radiologic signs, and its diagnosis is purely clinical. Rest, ice, and heel lifts are the treatment of choice, and return to activity can be resumed once the patient is able to run and hop pain-free. Another example of common apophysitis seen in the sports medicine clinic would be iselin disease, which is a traction injury of the

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peroneus brevis from the base of the fifth metatarsal. It affects boys at a younger age than girls and is caused by repetitive traction of the peroneal brevis tendon on the apophysis.

This should not be confused with an avulsion fracture, which occurs as a result of an acute injury. In the pediatric population, most avulsion fractures occur through a secondary apophysis, seen with sudden contracture of a muscle. These are very rare in the foot and ankle, as they occur mainly at the pelvis. The sports medicine physician should be familiar with secondary ossification occurring at the foot and ankle since in the pediatric population it can be mistaken as a possible fracture.

Unlike apophysitis, osteochondrosis is caused by a temporary disruption of the blood supply at the bone-cartilage interface, and not by mechanical traction. The most commonly seen in the foot is Freiberg disease. It is considered an idiopathic avascular necrosis of the lesser metatarsals seen most commonly in females, with a female to male ratio of 5:1. Initial evaluation should include weight-bearing radiographs which may show flattening of the involved metatarsal head, sclerosis, and bone spurs. Initial management must include protective weight-bearing and offloading, while surgical intervention may be needed for advanced stages.

Tarsal Coalition

Although tarsal coalition is not a sports injury, it can become symptomatic during athletic activities, during skeletal growth. A coalition, being the failure of segmentation of two ossific centers, creates an abnormal connection between two joints, thus reducing the overall range of motion across that joint. It is most commonly seen between the talus and the calcaneus, but may involve virtually any joints of the rearfoot and midfoot. The lack of proper range of motion caused by tarsal coalition will prevent the adequate naturally occurring compensation mechanism for high lower extremity stresses brought on by physical activity and sports. These can be easily missed and demand a higher degree of suspicion. Computer tomography remains the radiographic imaging of choice if a coalition is suspected after plain radiograph are obtained. Symptomatic, conservative management should be attempted, such as bracing and icing, but if the patient continues to be symptomatic and cannot resume a previous level of activity, then surgical excision is indicated.

Acute Injury

Acute sports-related injuries in children account for 20% of Emergency Department visits. Acute muscle and tendon injuries occur in the pediatric athlete but are less frequent than in the adult. One of the most common acute injuries are ankle sprains. Unlike as in its adult counterpart, ankle sprains may result as osseous injuries rather than soft tissue injury. The open physis of the developing skeleton becomes a weak link between the underlying bone and its attaching ligaments. Ankle sprains may manifest as Salter-Harris I injuries of the distal fibular physis, but have only radiographic findings of soft tissue swelling. A comparison weight-bearing radiograph of the uninjured ankle might be necessary to help with the diagnosis. When widening of the physis is suspected, it might be prudent to treat it as a Salter Harris I injury with cast immobilization, and close follow-up of the symptoms.

An ankle sprain can also present itself as a bone avulsion injury, creating a fracture seen at the medial aspect of the distal fibula, at the level of the ankle joint, called Tillaux fracture. It is seen in patients between the ages of 12 and 14, and is caused by an avulsion from the distal talofibular ligament. Cast immobilization typically is effective for its management, and gradual weight-bearing can be resumed after a period of immobilization of 6 to 8 weeks. CT scan imaging should be ordered, as any displacement over 2mm is an indication for surgical management.

Another type of fibula fracture associated with ankle sprains may be occasionally seen at the lateral surface of the lateral malleolus, representing an avulsion fracture of the peroneal retinaculum. It indicates that the peroneal tendons can now freely subluxate. Again, cast immobilization and a period of non-weight bearing is recommended, for a minimum of 4 weeks, with gradual return to full weight-bearing and regular activity.

There is currently a lack of quality studies evaluating the safety and effectiveness of orthobiologics injections in the pediatric population.

Injections in Pediatric Sports Medicine Treatment

There has been a great increase in availability and development of biologically derived substances used to treat sports injuries in the adult, referred to as orthobiologics. While commonly used, their indications and evidence for effectiveness are conflicting. There is currently a lack of quality studies evaluating the safety and effectiveness of orthobiologics injections in the pediatric population. Despite presenting low risks, further investigation is needed to determine their effectiveness in the pediatric population. Intra-articular corticosteroid injections can also provide relief and treat chronic synovitis as well as other intra-articular pathology such as chronic osteochondral lesions. While intra-articular cortisone injections in juvenile idiopathic arthritis is frequently used, its indication for chronic sports injuries has not been well studied. Therefore, its utilization should be used with precautions.

Conclusion

There has been a significant increase in childrens' participation in

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sports over the past decades, with a global trend towards sports-specific, high-intensity training in younger children. This new involvement unfortunately has led to an increase in pediatric overuse injuries. The podiatric physician should be astute in detecting those injuries, leading to an effective and timely treatment plan. Preventive programs should also focus on modifiable injury risk factors, such as performing appropriate warm-ups, using adequate sports facilities, performing sports-specific physical preparation, adapting the training load to the athlete's ability, performing injury-preventive activities, performing sports techniques under the supervision of a sports coach, and exercising with adequate sports equipment. **PM**

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