Common Sports-related Musculoskeletal Injuries presenting to the Emergency Department

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ABSTRACT

Young athletes are specialising in sports at a younger age, placing the developing musculoskeletal system under considerable stress. Overuse injuries such as apophysitis are chronic in nature and account for a large proportion of musculoskeletal injuries suffered by young athletes, however with an increased emphasis on success in sport, tendinopathy and fatigue fractures are now being reported with increasing frequency, in the adolescent population. Correct diagnosis and early protection, rest, ice, compression, and elevation (PRICE) therapy is critical, along with supervised rehabilitation an expert in paediatric and adolescent sports medicine. Acute traumatic knee injury and ankle sprain account for most acute injuries. Although most are soft-tissue in nature, radiography may be useful in specific situations before early initiation of PRICE therapy. These injuries will also require follow-up by an expert in paediatric and adolescent sports medicine to confirm the diagnosis and instigate ongoing rehabilitation and/or orthopaedic referral. Many of these injuries are preventable and due consideration should be given to simple prevention strategies.

Key words: athlete, musculoskeletal, overuse, soft-tissue, sprain

Key Points

1. Many sports injuries in children are the result of early specialisation and excessive training load.
2. Overuse injuries are best treated initially with PRICE therapy and referral to sports medicine for further evaluation and rehabilitation.

3. If an acute sports injuries is determined to be soft-tissue in nature, due consideration should be given to imaging i.e. plain x-ray to exclude occult fracture, with referral to sports medicine for follow-up.

INTRODUCTION

Throughout Australia, children participate in team sports and likely many more are involved in individual sports. Although little data exists documenting the extent of participation within this population, it is clear that large numbers of children do not limit their sports to a given season and are involved throughout the calendar year.[1] Further, with an increased emphasis on competitive success that seemingly has become widespread at younger ages in youth sports, pressure exists for youth to begin training with greater frequency and intensity at younger ages than in the past. This, sometimes coupled with parental hopes of securing state and national team selections, and even professional careers, has led to participation far beyond traditional school-based and community-supported programs. This emphasis on year-round training, competition, single-sport specialisation and competitive success sets the stage for injury. Many children and adolescents with a sports injury initially present to the emergency department for assessment. It is therefore important for emergency physicians to understand how these injuries may occur, what initial treatment is appropriate and who should be referred for specialist evaluation. This article will focus on the three most common musculoskeletal sports injuries that present to the emergency department: overuse injuries, acute traumatic knee injuries and ankle sprains.

EPIDEMIOLOGY

In Australia, surveillance programs for high school sports found football to be the riskiest sport as well as netball, basketball, and soccer – this is likely related to the type of sport as

well as the number of participants per sport. [1,2] Girls accounted for 45% of all injuries among children.[3] Approximately half of the injuries were acute, and half were chronic. Sixty-two percent of acute injuries were soft tissue injuries (muscle, tendon, or ligament sprains, strains, or contusions). Most of the chronic injuries (53%) involved epiphyseal and apophyseal growth plates and articular cartilage. The occurrence of growth plate injuries is unique to the paediatric population.[4]

MUSCULOSKELETAL DEVELOPMENT

Children's musculoskeletal system has significant differences over adults e.g. high water/lower mineral content, less brittle bones, thicker periosteum and richer blood supply in pediatric bone. The physis (growth plate) is a cartilaginous structure that is weaker than bone, predisposed to injury (particularly during rapid growth phases). Ligaments in children are functionally stronger than bone therefore children are more likely to sustain fractures rather than sprains. Active bone growth precedes muscle and tendon lengthening, requiring each muscle tendon unit to lengthen or stretch out to keep up with the bone growth. Limited muscle and tendon flexibility predisposes to increased overuse injuries in puberty.[5]

OVERUSE INJURIES

Anatomic structures that are subjected to repetitive loading during sport participation incur micro trauma. With sufficient recovery between exposures, the tissue (e.g., bone or tendon) can remodel and adapt to the imposed stresses. Overuse injuries develop when repeated mechanical loading exceeds the remodelling capability of the structure under

stress. Injury can occur with moderate intensity loading over extended periods when recovery time is not sufficient. Alternatively, injury may develop with repeated high-intensity, short-duration loading even when recovery is planned and provided. [5,6,7]

Apophysitis

Apophyseal injuries occur at immature tendon-bone attachment sites (see table 1). The weakness of the growth cartilage relative to the tendon together with decreased flexibility, is thought to create increased traction at the apophyseal insertion of the tendon, and has been proposed as a factor in apophyseal injury development. [8,9]

Diagnosis of apophysitis is based on physical examination and history. The typical clinical presentation is the active child who complains of pain at the affected site that is worsened with activity or painful after stopping activity. Examination will specifically reveal tenderness at the location of apophyseal injury, figure 1. Range of motion is often normal, but pain can be elicited with stretching or strength testing of the muscle tendon unit. Patients with the suspicion of appophysitis do not need radiography because the diagnosis is a clinical one. However if radiographs obtained widening of the apophysis may be evident as well as apophyseal hypertrophy or ossicle formation. A general approach to treatment can be seen in table 2. [10]

Acute avulsion at the site of the apophysis presents with sudden onset of pain during sporting activity.[12] Patients are generally very tender over this site and unable to hold

distal structure against gravity (e.g. lower leg in tibial tuberosity avulsion) X-ray in these cases is essential to confirm an avulsion. Surgical repair is required in some cases (e.g. tibial tuberosity) but not in others (ASIS / AIIS / Iliac crest / Ischial tuberosity).

Tendinopathies in the Young Athlete [17,18]

In athletes of all ages (mainly teens through to 30yr olds), vigorous and repetitive physical activity that leads to excessive loading of tendons is considered as the primary pathological cause of degeneration. The response to continuous tendon overload in the young is specifically inflammation of the tendon, which is reversible. If the adolescent continues unabated with the offending activity over time this may be followed by degeneration which is more chronic and difficult to treat. Inflammation and degeneration can occur separately or in concert. If cumulative microtrauma persists without adequate rest from activity, then worsening degeneration or tendon rupture may occur (rarely).

With an increased emphasis on success in sport in the young athlete, tendinopathy is now more commonly seen, e.g. in overhead activity such as throwing or racquet sports (i.e. cricket and tennis) and running or jumping activity (i.e. basketball or dancing). The common sites are summarized in table 3[19,20]

Making the diagnosis of a tendinopathy relies on history and physical examination. The child will present with prolonged pain in the affected area, likely related to overuse and worsened with activity. X-rays are often normal; however MRI and/or ultrasound can be useful in making the diagnosis in difficult cases. The principles of management are

outlined in table 4. Refractory cases may benefit from referral to an expert in paediatric and adolescent sports medicine (e.g. paediatrician with an interest in sports medicine, sports physician or physiotherapist) who will provide a structured rehabilitation program.[21]

Stress or fatigue fractures in the young athlete

Stress fractures are overuse injuries as distinct from acute fractures in which bone injury occurs after a single traumatic event. This is a weakening of bone that occurs from repetitive compressive or tensile stresses on the bone.[23]

Making the diagnosis of a stress fracture relies on history and physical examination. The patient usually presents with focal pain in the affected area that is worse with activity or even walking. The hallmark on physical examination is point tenderness on the bone. X-rays are useful if a fracture or callus is visible, but may be normal in the first 3-4 weeks. Bone scan or MRI is commonly used to diagnose stress fractures. These investigations are mandatory in high-risk fractures. Stress fractures in the young athlete should be referred to an expert in paediatric and adolescent sports medicine for a structured rehabilitation program.[24]

The nature of treatment for stress fractures in the young athlete is usually conservative. In the emergency department this consists of non-weight bearing and immobilisation of the affected site in either a plaster or walking boot with follow-up review in 2 weeks. Certain stress fractures do not have the capacity to heal with conservative measures (see table 5).[24] These high-risk stress fractures should be referred early an expert in paediatric and

adolescent sports medicine or orthopaedics for potential surgical consideration. The ongoing management for all of the other stress fractures is composed of crutches, walking boot, modification of training regimens, and analgesia.

Patellofemoral pain syndrome (PFPS)

This is a very common condition in the young athlete. As with other overuse injuries patellofemoral pain is multifactorial in origin. In atheltes of all ages, vigorous and repetitive physical activities leads to excessive loading of the patellofemoral joint as the primary pathology leading to patella pain. [25]

The diagnosis of patellofemoral pain syndrome relies on history and examination. The patient usually presents with diffuse anterior knee pain that is worse with activity or walking. The hallmark of examination is point tenderness on the patellar facets (ie move patella sideways and feel under the medial and lateral sides of the patella). Pain may also be elicitied by compressing the patella against the femur with the leg in extension (patellar grind test). The nature of treatment for patellofemoral pain syndrome is usually conservative following the relative rest and PRICE (Protect from further injury, Rest, Ice, Compresion and Elevation) principles. More refractory cases should be referred to an expert in paediatric and adolescent sports medicine for a structured rehabilitation program.[26]

ACUTE TRAUMATIC KNEE INJURY

This is a very common presentation to the emergency department often following an acute event on the sports field. In most cases this will result in a traumatic haemarthrosis with rapid onset of swelling, pain and limited range of motion. The following should be considered; complete or partial tear of the anterior cruciate ligament (ACL), meniscal injury (medial or lateral- usually delayed in onset) and in many cases an acute patella dislocation which has self reduced. The physician should also consider the possibility of a fracture (eg tibial spine or tibial tuberosity avulsion). Isolated lateral collateral ligament (LCL) and Posterior Cruciate Ligament (PCL) injuries are rare in children and will not be discussed. [27,28]

The mechanism of injury is important as it usually gives the clinician a good idea of what structures have been injured, see table 6. Patients can report instability (giving way or collapse) and this is commonly related to ACL rupture or patellar instability. A report of locking is usually associated with limitations in knee extension and may have an intra-articular loose body, torn mensicus, avulsed ligament fragments, or bony fragment. An audible pop is usually heard with serious ligament injury in particular ACL tear or a fracture. A ripping sensation may represent a mensical injury or a patella dislocation. A cracking sound can be caused by bone injury or patellar dislocation. Swelling that occurs quickly (within a few hours) may be the result of an ACL tear, intra-articular fracture or patella dislocation. [29,30] If the mechanism is unclear then other causes of knee pain should be considered, table 7.

On examination, the presence or absence of an effusion is important. If possible deciding if there is focal tenderness is also helpful. Medial tenderness of the patella is seen in patella dislocation, medial or lateral joint line tenderness is seen in meniscal or ligamentous injury. Stressing of the medial or lateral ligament may also produce pain. A positive lachmans test (with the knee in approximately 30^0 of flexion there is a clear increase in laxity compared with the uninjured knee when the tibia is pulled forward or the end point for the ACL on the injuried knee is not distinct / soft) occurs in ACL tear or tibial spine fracture. However in the acute setting this test may be hard to achieve due to the swelling and degree of pain. [27,28]

X-ray is important to rule out a fracture, particularly in the skeletally immature patient as a fracture is more common than ligament injury.[32] A Segond fracture (an avulsion fracture of the knee which involves the lateral aspect of the tibial plateau) has a high association with disruption of the ACL, figure 2. In suspected patella dislocation a skyline view should also be included to exclude a significant avulsion fracture of the patella or lateral condyle. An MRI is generally required to make the diagnosis of an ACL or meniscal tear. Urgency of this investigation is not time critical.

Once a diagnosis of one of the big four soft tissue injuries is made the approach to the treatment of acute traumatic knee injury (with some minor variation) is much the same. Initial treatment includes, PRICE, with protection in a knee splint and non-weight bearing using crutches. In the acute setting, selective arthrocentesis to drain a tense effusion can relieve distension pain, and allowing for easier examination. The patient should then be

referred to **an expert in paediatric and adolescent sports medicine** for repeat examination in 2 weeks to confirm the diagnosis and implement definitive treatment.

In patients with chronically painful knee with insidious onset of pain keep in mind potential for tumour near the knee, inflammatory arthritis, hip pathology such as SCFE or an infection.

ANKLE SPRAIN

Ankle sprains are the most frequently seen musculoskeletal injury encountered in emergency departments. Ankle sprains account for up to 40% of all athletic injuries, especially in basketball, soccer, cross-country running, dance, and ballet. Older children with closed growth plates get ankle sprains more frequently than their younger counterparts. [33]

The three main mechanisms of injury of the ankle are inversion, eversion, and dorsiflexion. The most common is inversion injury (95%), which is responsible for lateral ankle sprains. Medial ankle sprain, which affects the deltoid ligament, is usually caused by plantar flexion with eversion. The last major type of ankle sprain is the infamous syndesmosis, or "high" ankle sprain. This injury occurs with rapid dorsiflexion, eversion and external rotation and is often seen when a child jumps from a considerable height or from sliding (e.g. baseball). This is the most serious type of ankle sprain because it leaves the ankle mortis unstable.[34,35]

In general, the more extensive the ligament injury, the more difficult it is to bear weight, the more swelling noted acutely, and the more ecchymosis that develops over a few days, see table 8. Most of the pain is usually localized over the area of the ATFL, the most commonly injured ligament in lateral ankle sprain. Effusion above the ankle capsule may signify a syndesmotic or high ankle sprain.

The Low Risk Ankle Rule (LRAR) states that if a child with an ankle injury has a low-risk examination (i.e., tenderness and swelling isolated to the distal fibula and/or adjacent lateral ligaments distal to the tibial anterior joint line), radiographs are not required.[36] These patients should be treated as for a sprain even though they may have a small distal fibula fracture.

Therapy for ankle sprain in the acute setting should focus on the PRICE principles - this being an established treatment protocol. The patient with a significant ankle sprain (Grade 2-3) should be referred to a sports medicine service for functional rehabilitation. A brief period of immobilisation with a below knee cast leads to speedier recovery in patients with severe ankle sprain and this should be considered in the emergency department before referring an expert in paediatric and adolescent sports medicine . [37]

THE EMERGENCY PHSICIAN AND INJURY PREVENTION

The emergency physician is an important interface between parents and the sports medicine specialist in terms of prevention. Talking to parents at the time of injury about

simple prevention strategies can have a profound impact on reducing further injury. By encouraging children not to "play through" pain or injury, emphasising the importance of sport diversification at younger ages and encouraging children to experiment with different activities to develop skills and interest and to prevent burnout and injury. Finally the emergency physician should encourage parents to ensure the young athlete has plenty of rest and recovery following activity (1-2 days free of sport per week) and being cautious about having their children competing on more than one team at the same time.

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Figure 1 A **-** Pain is well localized in apophysitis as seen here in a child with Osgood-Schlatter's disease, B- Anatomic site of the apophysis is the tibial tubercle in a case of Osgood-Schlatter's disease

Figure 2 Segond fracture

Table 1 Common Apophyseal Injury sites in Young Athletes

Location	Site of Apophyseal Injury	Muscle / Tendon Involved
Knee	Tibial tubercle (Osgood-Schlatter's disease[9]); lower pole of Patella (Sinding-Larsen-Johansson disease)	Quadriceps
Foot	Calcaneus[10] (Sever's disease); fifth metatarsal[11] (Iselin's disease)	Achilles Peroneus Brevis
Elbow	Medial epicondyle (Little League elbow)	Ulnar collateral ligament
Pelvis	Ischial tuberosity; Anterior superior or inferior iliac spine (ASIS, AIIS); Iliac crest	Hamstring Rectoris Femoris / Sartorius Rectus Abdominus

ASIS, Anteriosuperior Iliac Spine; AIIS, Anteroinferior Iliac Spine

Table 2- Treatment of Apophysitis in the Young Athlete [13,14]

Diagnosis	Treatment Option
INITIAL TREATMENT	Relative rest (no pain with movement), Icing the affected site and analgesia, Graduated return to sport with minimal pain.
SPECIFIC TREATMENT	
Osgood-Schlatter's disease; Sinding-Larsen-Johanson disease	Patella tendon knee strap or knee pad, SSEP
Sever's disease	Heel cups, SSEP[15,16]
Iselin's disease	Lace-up ankle brace or lateral heel wedge, SSEP

SSEP, Stretching and strengthening exercise program

Table 3- Tendinopathies in the Young Athlete

Location	Site of Tendon injury
Shoulder	Rotator cuff
Hip/pelvis	Hip flexors; iliotibial band
Knee	Patella tendon; quadriceps tendon
Ankle	Achilles' tendon; posterior tibialis tendon; peroneal tendon

Table 4- Treatment for Specific Tendinopathies in the Young Athlete

Diagnosis	Treatment Option
INITIAL TREATMENT	Relative rest, icing the affected site and analgesia for all tendinopathies, ESSEP[22]
SPECIFIC TREATMENT	
Achilles' tendonitis	Achilles strap,
Posterior tibialis tendonitis	Arch supports
Peroneal tendonitis	Lateral heel wedge
Patellar tendonitis	Patella tendon knee strap
Lateral epicondylitis	Counterforce strap

ESSEP, Eccentric stretching and strengthening exercise program

Table 5- Common Stress Fractures in the Young Athlete

Location	Site of Fracture	High Risk Types
Hip/pelvis	Femoral neck, pubic ramus	Anterior femoral neck
Thigh	Femoral shaft	
Shin	Tibia, fibula	Anterior Tibia
Ankle	Medial / Lateral Malleolus / Talus	Medial Malleolus
Foot	Navicular, metatarsals, calcaneus, cuboid	Navicular / Base 5th MTP
Elbow	Capitellum, radial head	Capitellum

MTP, Metatarsus proximal

Table 6- Mechanism of Injuries and associated injuries

Mechanism	Suspected Injury
Blow to outside of knee (valgus stress)	MCL sprain
Blow to inside of knee (varus stress)	LCL sprain
Hyperextension of knee	ACL sprain
Twisting of knee after sudden stop	ACL sprain +/- meniscus tear
Knee went “out of joint”	Patellar dislocation/subluxation
Pivoting after jumping or twisting	Patellar dislocation/subluxation or mensical tear
Fall / struck on tibia with knee flexed	PCL

MCL, Medial Collateral Ligament; LCL, Lateral Collateral Ligament; ACL, Anterioal Cruciate Ligament; PCL, Posterior Cruciate Ligament

Table 7- Common causes of Knee pain

Acute injury	Semi-acute condition	Chronic condition
Fracture (femur/tibia/patella) Dislocation patella Mensical tear (torn discoid mensicus) Anterior cruciate ligamanet tear Medial collateral ligament tear Soft tissue contusion Bone bruising	Osteochondritis dissecans SCFE Loose Body Tumour (bone / blood) Infection (osteomyelitis / Septic Arthrits)	Inflammatory arthritis Apophysitis Anterior Knee pain (PFPS / impingement Hoffa's fat Pad) Tendonitis (Quadriceps / Patella tendons)

Slipped capital femoral epiphysis (SCFE), Patellofemoral Pain Syndrome (PFPS)

Table 8- Functional Classification of Ankle Sprains

Severity	Signs and Symptoms	Disability
Grade 1 (mild)	Minimal swelling (clear definition of Achilles tendon; small area of tenderness; little/no haemorrhage; minimal decreased ROM	Minimal loss; little/no limp with walking; difficult hopping; expected recovery 7-10 days with optimal rehabilitation
Grade 2 (moderate)	Moderate swelling (margin of Achilles tendon less defined); more generalised tenderness; some haemorrhage; decreased ROM	Limping with walking or can walk only a few steps; unable to run; unable to hop; unable to do toe raise; expected recovery 2-4 weeks with optimal rehabilitation
Grade 3 (severe)	Diffuse swelling (no clear margins of Achilles tendon); diffuse swelling; haemorrhage is evident; pronounced decreased ROM	Unable to bear weight; involuntary guarding with exam; expected recovery 5-10 weeks with optimal rehabilitation

ROM- Range of Motion

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