

Musculoskeletal consider

Sports physician Dr Tom Cross discusses the more common sport and exercise-related paediatric musculoskeletal conditions, highlighting the differences where they exist to the adult patient.



The clinical assessment of a child can be rewarding and straightforward if a systematic approach is followed.

Fortunately, many of the conditions occurring in children are self-limited and full recovery is the usual outcome. However, more serious conditions may occasionally occur and if these are missed, especially during the rapid pubertal growth phase, the consequences of a missed diagnosis may be significant for the child. To regard all pain in a child as 'growing pain' is folly. If a careful, informed systematic approach is followed, the child with significant pathology will hopefully not be missed.

The clinical approach to the child, in particular the young child, will require a greater emphasis on establishing rapport with the child initially so that an adequate history and examination may be performed. On rare occasions, the clinical assessment of a young child will be very difficult, and for this reason never miss the opportunity to observe the young child in the waiting room and walking into your office, as this may be your last chance!

For the young child, a detailed history taken from the parents is important. Specific questions should address developmental milestones and also family history. If a parent accompanies an older child, the clinician is advised to direct questions to the child first to develop rapport with the child, and later clarify any points with the parent(s).

Special considerations in the child

Children are not 'little adults'. They are different structurally, physiologically, neurologically and psychologically. Furthermore, these developmental characteristics will vary tremendously between children who are the same age. For example, there may be as much as six years' body size (height and mass) difference between children at the chronological age of 13 years.

There are significant differences in the type of injuries sustained by children compared to adults. These are due to the physiology of growing bone. For example, the metaphysis in children is more elastic than adults, and hence fractures are often incomplete (e.g. greenstick fracture; Figure 1).

Injuries in children

Table 1. Injuries in adults compared to children

Site	Mechanism	Injury in Adult	Injury in Child
Knee	Twisting/valgus force	Anterior cruciate ligament (ACL) disruption, +/-meniscal injury	Avulsion tibial spine origin of ACL, fracture distal femoral or proximal tibial epiphysis
Knee	Overuse	Patellar tendinopathy	Osgood-Schlatter, SLJ disease
Shoulder	Fall	Acromio-clavicular joint disruption	Fracture distal clavicle epiphysis
Shoulder	Fall	Dislocated Gleno-humeral joint	Fracture proximal humeral epiphysis
Thumb	Valgus force	Ulnar collateral ligament disruption	Fracture proximal phalangeal epiphysis
Thigh/Hip	Acute flexor/extensor strain	Quadriceps or hamstring strain	Apophyseal avulsion of anterior inferior iliac spine or ischial tuberosity
Heel	Overuse	Achilles tendinopathy	Sever's apophysitis

The 'pubertal (also termed adolescent) growth spurt' is a time of accelerated growth. In general, it occurs two years earlier in girls. This is a time when the growing skeleton is even more susceptible to both overuse and acute injury. With increased height and body mass, the incidence of sport and exercise-related injury unfortunately increases. It is for this reason that sport and exercise-related injury is far less common in primary school children compared to secondary school children.

Apophyses (sites of tendon attachment) are cartilaginous plates that are sites of growth. They are relatively weak and vulnerable to either macro-trauma (acute injury; avulsion, which is rare) or micro-trauma (repetitive

overuse) termed 'apophysitis', which is very common. Therefore, the apophysis is the so-called 'weakest link' in the musculo-tendinous unit in children and is where injury occurs. As a result, a child may avulse an apophysis (e.g. avulsion of the ischial tuberosity off the pelvis; Figure 2) from a certain force, whereas an adult will sustain a muscle strain injury usually at the musculo-tendinous unit (hamstring muscle strain).

The epiphyseal plate (or 'physis') is the growth plate between the metaphysis and the epiphysis. The epiphysis is at the end of the bone, beyond the epiphyseal plate. Both regions are very vulnerable to injury (once again, macro-trauma or micro-trauma). Isolated

ligament injury is rare in children younger than 14 years, as the ligaments are stronger than the physes and epiphyses in this age group. For example, in a child the tibial origin of the anterior cruciate ligament (ACL) may avulse a fragment of bone (Figure 3) whereas the same mechanism of injury in the adult will disrupt the ACL in its mid-substance. Therefore, it should always be remembered trauma resulting in ligament injuries in adults might, in children, result in bone or growth plate fractures (Figure 4) or ligamentous bony avulsions. Therefore, both the spectrum of macro-traumatic and micro-traumatic injuries is different in children (Table 1).



Figure 1



Figure 2



Figure 3

Musculoskeletal considerations in children

The osteochondroses

The osteochondroses deserve particular attention and discussion. The numerous osteochondroses are often named after the individual who first described them (greater than 70 eponyms exist; e.g. Perthes' disease, Sever's disease).

The aetiology of osteochondroses remains unclear although trauma (micro-traumatic and macro-traumatic injury), vascular, and familial causes are hypothesised. These conditions usually present during periods of rapid growth, in particular the adolescent growth spurt. They are becoming more frequent, which is attributed to the increased training/activity level of many children.

Certain osteochondroses characteristically occur at different developmental times, determined mainly by the biological maturation of the affected anatomic site. Therefore, the underlying biology of the developing skeleton is the most important factor to consider. Osteochondroses have been broadly classified into three groups:

1. **Crushing**—for example Perthes' (hip), Kienbock's (lunate), Kohler's (navicular), Panner's (capitellum), Freiberg's (second metatarsal) disease etc.
2. **Splitting**—for example osteochondritis dissecans (OCD), which occurs at the

convex surface of joints and affects the subchondral bone

3. **Pulling/traction apophysitis**—excessive traction from a large tendon may damage an unfused apophysis; for example Osgood-Schlatter (OSD), Sever's, Sinding Larson Johannsen, Iselin's.

Osgood-Schlatter's disease

OSD and Sever's disease are the most common overuse injuries in children. OSD is a traction apophysitis occurring at the tibial tubercle. The diagnosis is usually not difficult as the history and examination are most often typical. The active child (10–14 years) will present with gradual onset of localised pain at the tibial tubercle. The condition is very often bilateral. Running, jumping, squatting and stair climbing will aggravate the active child's pain. On examination, there is marked tenderness at the tibial tubercle with often a bony prominence with overlying soft tissue swelling (best appreciated at 90 degrees; Figure 5). The quadriceps and hamstrings are invariably tight.

X-rays are not indicated, as this is a clinical diagnosis. Treatment includes education and reassurance of the child and parents, relative rest, ice after activity, stretching hamstrings and calves (avoid stretching quadriceps as this may aggravate the pain). The condition is aggravated by activity and improved by

inactivity. Relative rest is the cornerstone of treatment. The active child is educated to 'titrate' their activity level to their symptoms. Activities are 'rationed' so that non-essential sports, activities, training and competitions are omitted and preferred 'essential' activities chosen. The natural history is for the condition to slowly resolve in 0.5–1.5 years.

Surgery is rarely necessary except where X-rays show a separated fragment of bone, which is acutely tender and continues to be in a skeletally mature knee. Simple excision of the fragment often gives a very good result.

Sever's disease

Sever's disease occurs in active children between the ages of nine and 13 years. It is a traction apophysitis of the os calcis and is frequently bilateral. The child complains of discomfort at the posterior aspect of the heel after activity and may limp. Clinically, there is usually no swelling and tenderness is maximal over the calcaneal apophysis posteriorly.

Treatment once again is education and reassurance. There is no role for X-rays. Ice the tender area after activity (ice bathing of heels is a very effective method of icing this site). A viscous gel heel cup and/or orthoses for comfort can be helpful. Ensure a general flexibility program for the lower limbs. Modify activity level according to symptoms as for OSD.



Figure 4



Figure 5



Figure 6

Osteochondritis dissecans

Osteochondritis Dissecans (OCD) is a splitting of osteochondrosis and is defined as a small area of avascular subchondral bone most often on the convex articular joint surface (e.g. knee, elbow, ankle, hip, and talus). The knee is the most commonly affected joint. In the knee, OCD most often affects the lateral aspect of the MFC (most commonly, 75% of cases), the LFC and the PF joint (rarely).

OCD of the knee is more common in boys (3:1) and is bilateral in approximately 25% of cases. OCD usually presents between ages 10 and 20 years. The incidence is four per 1000 males, but this is increasing. The active child presents with poorly localised pain, swelling, catching and/or locking (always remember OCD is the most common cause for a loose intra-articular body in children), and on examination there is usually an effusion and quadriceps wasting. The presentation is most often delayed, with symptoms having been present for months.

Plain radiography usually defines the OCD lesion. It is important to remember a tunnel view of the intercondylar notch (Romberg view) is required to define the lesion, most often on the MFC (Figure 6). Most clinicians now routinely employ MRI to aid in their diagnosis and management of these patients. In most

cases (except the frankly separated fragments and loose bodies), the articular cartilage remains intact (grade 1–2 OCD lesions; Figure 7) and there is a variable degree of separation of a fragment from the surrounding subchondral bone.

The earlier the diagnosis is made, and the child restricted in their activity, the better the prognosis. Unfortunately, most children present late with frank separation of the OCD osteochondral fragment or an intra-articular loose body (stage 3–4 OCD lesions; Figure 8).

The goal of treatment in OCD is to achieve intra-articular congruity with normal viable subchondral bone. Unfortunately, for early-stage lesions, more than 50% of children fail conservative therapy. The reason for this is that most active children do not comply with reduction in their activity level. The management of OCD for most surgeons depends on clinical, radiological and, if necessary, arthroscopic findings. Higher grade (grade 3 and 4) lesions are treated surgically. However, some surgeons are more conservative than others, and when they choose to operate they choose to remove the fragment and perform an osteoplasty/chondroplasty of the OCD 'crater' while other surgeons make every attempt to salvage the fragment and internally fix it back in situ, usually with a interference screw.

The prognosis for OCD lesions diagnosed early is relatively good with most returning to their normal activity level in 4–6 months, and there is a very low incidence of subsequent premature osteoarthritis. For larger lesions that present late, in particular if the child is an older teenager, the prognosis is relatively poor with a high incidence of premature osteoarthritis in adult life.

Conclusion

The management of musculoskeletal injuries and conditions in children requires both an understanding of the biological differences between children and adults, and moreover the age-specific injuries children are 'at risk' of sustaining. Armed with this knowledge, the clinician will gain great satisfaction out of caring for these patients and their families.

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Figure 7

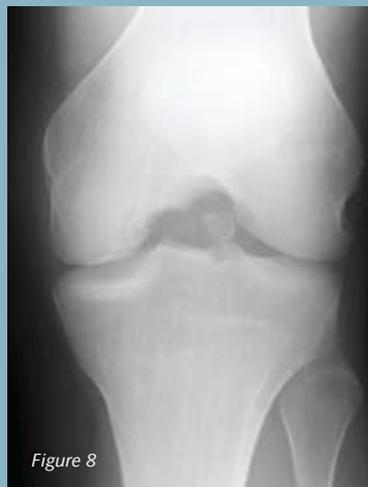


Figure 8