

Children's fractures 'not to be missed'

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INTRODUCTION

As the title of this article suggests, this is not a comprehensive guide to childhood injury, but rather a selective review of those injuries which are commonly overlooked, misdiagnosed or whose significance tends to be underestimated.

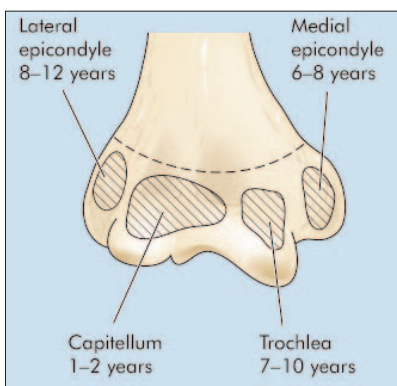
In general, children's bones are forgiving; they heal readily, non-union is rare, and they have the ability to remodel residual deformity (as long as it is not a rotational deformity). However, this knowledge should not be allowed to engender a casual attitude to the diagnosis and management of bone injury in children. For one thing, children's bones have growth plates, and these are easily damaged. Second, radiographs in young children may fail to demonstrate injuries which involve non-ossified cartilage. Finally, fractures heal much more quickly in the child, and a delay in diagnosis and onward referral may make it more difficult to correct an impending malunion.

SPECIFIC INJURIES

Elbow injuries

Fractures around the elbow are commonly missed or misdiagnosed because of a poor appreciation of the anatomy and development of the normal elbow (*Figure 1*). In the young

Figure 1. Age of appearance of ossification centres at distal humerus.



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child, some of the structures may not have yet ossified and are therefore not visible on plain radiographs. The clues are in the clinical presentation; a swollen and bruised elbow in a child usually means that there is a fracture but it may require careful scrutiny. A posterior fat pad sign on the lateral radiograph (*Figure 2*) is also suggestive of an occult fracture (Skaggs and Mirzayan, 1999). It is important that:

- Doctors know their anatomy, including times of appearance of the ossification centres
- Standard radiographs are not accepted; even in a distressed child it should, with care, be possible to obtain a true lateral rather than an oblique view
- Equivalent views of the uninjured contralateral side are considered if there is any doubt.

Fracture of the lateral condyle of the humerus may occur at an age when the centre of ossification is so small that the true nature of the injury is not appreciated. However, with care it is usually possible to see at least a small sliver of metaphyseal bone (*Figure 3*). The importance of this should not be underestimated; the true size of the fracture fragment may be many times the size of this radiodense fragment and even a slight displacement may have serious consequences, including malunion and non-union. Orthopaedic surgeons have a very low threshold for exploring and internally fixing these injuries.

Figure 2. Anterior and posterior fat pads indicative of significant elbow injury.



Forearm injuries

Supracondylar fractures of the humerus are generally easily recognized. However, there is a common failure to detect significant displacement in certain fractures, and label them as undisplaced and therefore not requiring manipulation. Significant extension at the fracture site is indicated by the loss of the normal J-shape or hockey stick configuration of the lateral projection of the distal humerus (*Figure 4*). If this is not manipulated, there will be residual restriction of flexion of the elbow which, contrary to common belief, does not always remodel. Sometimes these impacted fractures also include significant collapse of the medial column of the supracondylar region, resulting in a varus deformity of the elbow. Careful inspection of the radiographs should enable detection of this impaction.

The Monteggia injury is as well known to the legal profession as it is to orthopaedic surgeons. Missing this combination of a radial head dislocation and a fracture of the ulna is indefensible (*Figure 5*). It is usually missed because radiographs of the elbow are not obtained in a case of an apparently isolated ulnar fracture. Occasionally, there

Figure 3. Minimally displaced lateral condyle (not epicondyle) fracture in a 7-year-old.



Figure 4. Loss of J-shape configuration — these are not undisplaced fractures.

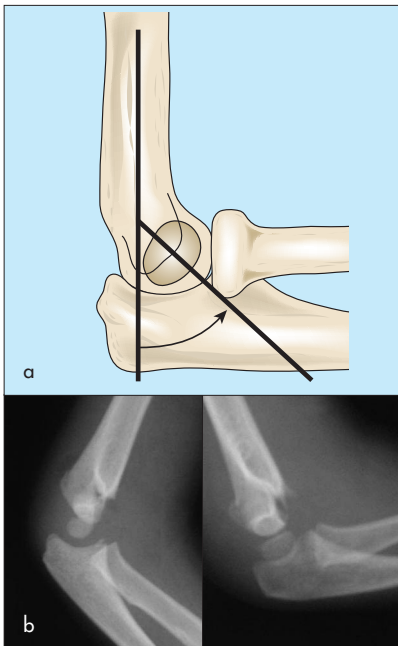


Figure 5. The Monteggia injury: ulnar fracture and dislocated radial head.



may not be an obvious fracture of the ulna but rather a plastic deformation which is responsible for the radial head displacement. Failure to appreciate the true nature of this injury will result in a chronic subluxation or dislocation of the radiohumeral joint which will require complex surgical reconstruction. In an isolated fracture of the ulna, always insist on seeing two views of the elbow to ensure that the radial head and the capitellum of the humerus are aligned normally. Always have radiographs of the joints on either side of a long bone fracture to exclude dislocations.

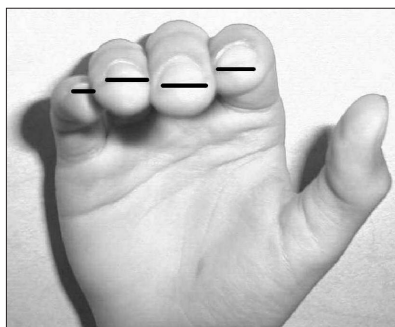
Hand injuries

Phalangeal fractures are very common, but it is important to make sure that the fragments are not rotated with respect to each other. This is more easily done by clinical inspection than on the radiographs. Check that the nails of the extended fingers are aligned before immobilizing the finger in an appropriate splint (Figure 6). If the fracture heals in malrotation it may create an ugly and awkward digit as well as impairing grip — a heavy price to pay for such a simple injury.

Lower limb injuries

The sleeve fracture of the patella occurs through forced flexion of the knee in children between the ages of 8 and 12 years. Figure 7 shows how the extent of the injury is much greater than that suggested by radiographs. The significance of the degree of separation of the small distal pole segment from the body of the patella must be appreciated, and the child referred for reduction and fixation. Failure to do so

Figure 6. Check for rotational alignment in phalangeal fractures.



results in an enlarged patella with an irregular articular surface.

Undisplaced or minimally displaced cracks through the proximal tibia are often missed but these injuries sometimes lead to valgus deformity with subsequent growth. The mechanism by which this occurs is not clear, but certainly this tendency must not be compounded by a failure to recognize the injury and allow the fracture to heal in valgus, as sometimes happens.

GROWTH PLATE INJURIES

All fractures which involve the growth plate or physis need to be taken seriously in view of the potential for subsequent growth arrest and progressive deformity. A fracture taking the line of least resistance through the physis may be easily missed on radiographs, although the clinical signs of swelling, bruising and tenderness indicate the presence of significant injury. These injuries are commonly seen at the wrist and the ankle. Look for the fracture line exiting through either the epiphysis or the metaphysis (Figure 8). As a rule, nothing less than anatomical reduction of such injuries is acceptable.

SPECIAL FRACTURES

There are two special forms of injury which warrant inclusion in an article of this nature — slipped capital (upper) femoral epiphysis (SCFE or SUFE) and non-accidental injury.

Figure 7. Sleeve fracture of the patella.



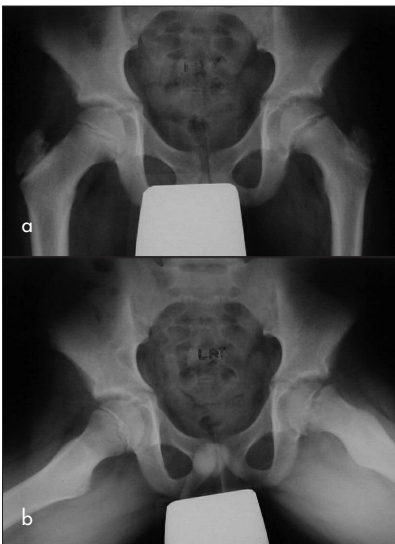


Figure 8. Fracture through growth plate involving both metaphysis and epiphysis: accurate reduction essential.

Slipped capital femoral epiphysis

SCFE is strictly speaking not a fracture but it has been included here because the consequences of missing this particular condition are potentially serious. This condition is really a growth plate failure in which multiple microfractures eventually lead to movement of the head of the femur on the neck. Typically, although not invariably, the patient is an overweight boy in his teens who presents with a painful limp of variable

Figure 9. a. Slip of left upper femoral epiphysis, (b) only seen clearly when a lateral view is requested.



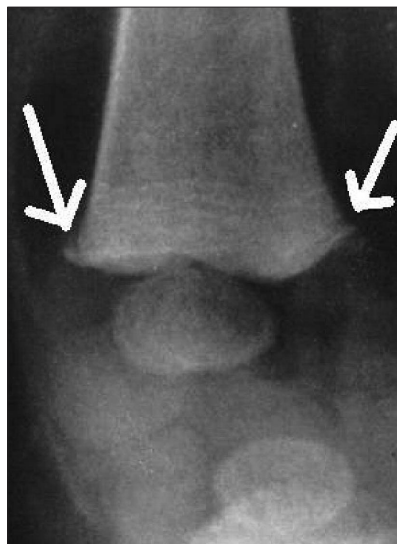
duration. The affected limb lies in external rotation, reflecting the position of the femoral head in relation to the neck. Remember that hip pain may not be a presenting symptom; frequently, the patient complains of knee or thigh pain, and the diagnosis is missed because hip pathology is not considered.

Always request both anteroposterior (and lateral views if a case in this age group presents with a limp even if the pain is confined to the knee. The lateral view is essential as early slips may not be apparent on the anteroposterior radiograph alone (Figure 9). If the slip is picked up at an early stage, fixation of the epiphysis in situ should give a satisfactory outcome. Delay in diagnosis leads to progressive slippage and the risk of requiring open reduction with attendant complications, including avascular necrosis.

Non-accidental injury

Non-accidental injury is unfortunately all too common. Space does not permit a full discussion of this topic but Witherow (1994) has given an excellent overview of the orthopaedic aspects. The skeletal manifestations do not necessarily follow the convenient descriptions given in some textbooks, and it is important to maintain a high level of suspicion whenever confronted by a child with a fracture for which a

Figure 10. Metaphyseal 'corner' fractures in non-accidental injury.



plausible explanation is not forthcoming. These suspicions will be heightened by a delay in presentation and an inappropriate or inconsistent history.

Contrary to popular belief, although multiple fractures in different stages of healing, metaphyseal 'corner' fractures (Figure 10) and spiral fractures are all typical of non-accidental injury, remember that many cases of physical child abuse result in a single diaphyseal fracture (Figure 11). **HM**

Skaggs DL, Mirzayan R (1999) The posterior fat pad sign in association with occult fracture of the elbow in children. *J Bone Joint Surg (Am)* **81-A**: 1429-33

Witherow PJ (1994) Non-accidental injury. In: Benson MKD, Fixsen JA, Macnicol MF, eds. *Children's Orthopaedics and Fractures*. Churchill Livingstone, Edinburgh

Further reading

Rang M (1974) *Children's Fractures*. Lippincott, Philadelphia

Rockwood CA, Wilkins KE, King RE, eds (1984) *Fractures in Children*. Lippincott, Philadelphia

Figure 11. A single fracture does not rule out non-accidental injury.

