Radiology of acute wrist injuries

Introduction

One of the most frequent skeletal injuries to the body is a fracture of the distal forearm or wrist. These injuries commonly arise from a fall onto an outstretched hand. Plain radiographs are the mainstay in the initial evaluation of these injuries. Factors affecting injuries to the forearm and wrist depend on the age of the patient, severity of injury, exact mechanism and direction of force to the injury. However, wrist injuries in particular can be subtle on plain radiographs and therefore difficult to identify. It is essential to identify injuries early so that appropriate management is implemented and early recovery of normal function is seen. This article reviews basic anatomy, classical radiological signs and common distal forearm and wrist injuries.

Standard radiographic projections

The films required are:

1. Posteroanterior
2. Lateral
3. Scaphoid series in suspected scaphoid fracture.

Anatomy

The wrist consists of the distal radius, distal ulna and carpal bones. The carpal bones in the wrist consist of eight bones arranged into two rows: the proximal row contains the scaphoid, lunate, triquetral and pisiform, and the distal row contains the hamate, capitate, trapezoid and trapezium.

Three articulations make up the carpus which are held together by strong ligaments:

1. The radiocarpal joint is where the distal radius articulates with the proximal carpal row bones (see above) except the triquetral and pisiform
2. The carpocarpal joint is where the proximal carpal row bones articulate with the distal carpal row
3. The carpometacarpal joints are where the distal carpal row bones articulate with the proximal metacarpals.

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Radiological assessment and classical signs

The ABCS system of radiological assessment is followed for systematic evaluation:

- Adequacy
- Alignment
- Bones
- Congruity
- Soft tissue.

Adequacy

Anteroposterior and lateral radiographs are sufficient for assessment of most wrist injuries. Additional views are done for scaphoid injuries.

Alignment

The articular surface of the radius lies distal to the surface of the ulna in the vast majority of people. A lateral projection should reveal alignment of the distal radius, lunate and capitate all articulating with each other in a straight line. The joint spaces between the carpal bones are uniform, 1–2 mm wide and the adjacent bone margins are congruous. Abnormally wide spaces are likely to represent ligamentous injury. Narrow spaces can be attributed to degenerative change or radiographic projection.

Bones

Fractures are seen as disruption in the continuity of the cortex. In children, there may be buckling of the cortex without an overt break in the cortex. Impacted fractures are also frequently seen in the wrist and displayed as a sclerotic line, particularly in osteoporotic bones of the elderly.

Congruity

This is particularly important in the assessment of dislocations of the carpus, which although rare can be easily missed. The lateral radiograph is important in detection of the dislocations. The alignment and joint space of the proximal and distal rows of carpal bones should be carefully assessed for uniformity.

Figure 1. a. Anteroposterior and (b) lateral radiograph of normal wrist. Two rows of carpal bones are seen in the anteroposterior projection. The capitate sits on the lunate bone on the lateral projection.

Soft tissues

Joint spaces between the carpal bones should not be wider than 1–2 mm. Abnormal wide spaces represent ligamentous injuries and indicate underlying instability. A widened scapholunate joint space is referred to as a 'Terry Thomas' or 'Madonna' sign and represents rupture of the scapholunate ligament.

Pitfalls

1. The site of the physis may persist as a dense line following fusion but this is normal
2. Poor lateral radiographs can lead to missing subtle distal radius fractures or dislocations
3. Accessory ossicles are seen in the wrist and have well-corticated margins unlike fractures.

Figure 2. a. Anteroposterior and (b) lateral radiographs of the wrist showing Colles' fracture. There is fracture of the distal radius with typical dorsal angulation (arrow) and displacement of the distal fragment.

Injuries

Fractures of the radius

Colles' fracture

This is a distal radius fracture with posterior displacement of a distal fragment (*Figure 2*). It is one of the commonest injuries seen in the casualty department. Generally elderly women sustain the injury following a fall onto an outstretched hand.

Smith's fracture

This is a distal radius fracture with anterior displacement of the distal fragment (*Figure 3*). It is less common than the Colles' fracture.

Greenstick fracture

In this there is a discontinuation of the bone cortex on one side while the other side is bent (seen in children).

Torus (or buckle) fracture

This is known as an incomplete fracture and is seen in children, who tend to have softer bones than adults. One side of the bone cortex may buckle upon itself without affecting the other side.

Barton fracture

This is a shearing fracture involving the dorsal margin of the distal radius (*Figure 4*) and its articulating surface. (A reverse

Figure 3. a. Anteroposterior and (b) lateral radiographs of wrist showing Smith's fracture. There is a distal radial fracture with volar angulation (arrow) and displacement of distal fragment. The ossific fragment distal to the ulnar styloid process is either an unfused accessory ossicle or an old non-united fracture.

Figure 4. a. Anteroposterior and (b) lateral radiographs of wrist showing a comminuted distal radius fracture with intra-articular extension. There is a fracture of the dorsal margin of the distal radius indicating a Barton fracture (arrow). Also note the ulnar styloid fracture.

Barton or a volar Barton fracture involves the anterior cortex.) An unstable fracture requires surgical fixation.

Impacted fracture
Obvious bony discontinuity is not seen but instead a slight increase in density or sclerotic line may be visible.

Fractures of the scaphoid

Fractures to the scaphoid can be difficult to identify and therefore a scaphoid series obtaining four different projections aids diagnosis. If a fracture is not visible, then patient follow up is essential with repeat radiographs advised in 7–10 days. Avascular necrosis is the major complication of a scaphoid fracture which is why early detection and management is essential. Blood supply to the scaphoid is distal to proximal and so the proximal pole is susceptible to avascular necrosis. If undetected, then there is a risk that delayed union, non-union or avascular necrosis can result.

Waist fracture
These account for 80% of scaphoid fractures and have a high risk of avascular necrosis (*Figure 5*).

Proximal pole fracture
These constitute 10% of fractures and have a very high risk of avascular necrosis.

Distal pole fractures
These make up 10% of scaphoid fractures and have no risk of avascular necrosis.

Figure 5. Anteroposterior radiograph of the wrist showing fractured waist of scaphoid.

Triquetral fractures

The majority of fractures to the carpal bones involve the scaphoid and triquetral bones. On the lateral projection, a triquetral fracture is identified by a small bony fragment seen lying posterior to the proximal row of the carpal bones (*Figure 6*).

Dislocations

The distal radius, lunate and capitate articulate with each other and lie in a straight line, as seen on the lateral view. There are two main types of dislocations.

Lunate
On a lateral projection the lunate dislocates anteriorly (*Figure 7*), leaving the concavity of the radius empty.

Perilunate
A perilunate dislocation is often associated with a scaphoid fracture (*Figure 8*). On a lateral projection the capitate is displaced posteriorly, the concavity of the lunate is empty and the radius and lunate remain in a straight line.

Subluxations

Distal radio-ulnar joint
The Galeazzi fracture-dislocation is a radius shaft fracture associated with separation of the distal radio-ulnar joint (*Figure 9*).

Carpals
In a case of scapholunate dissociation widening >2 mm in adults between the

Figure 6. a. Anteroposterior and (b) lateral radiographs of wrist demonstrates a bony fragment (arrow) on the dorsal aspect of the wrist indicating a triquetral fracture.

Figure 7. a. Anteroposterior and (b) lateral radiographs showing lunate dislocation. The lunate is dislocated anteriorly.

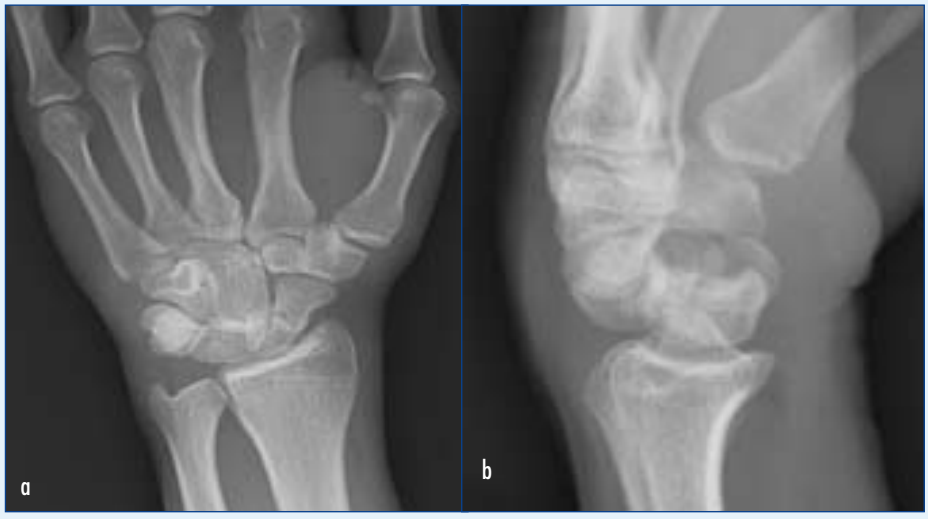

Figure 8. a. Anteroposterior and (b) lateral radiographs showing perilunate dislocation. The lunate is aligned with the distal radius but the capitate is displaced posteriorly.

lunate and scaphoid on a posteroanterior projection indicates ligamentous injury (Madonna sign).

Any widening >2 mm in adults between the intercarpal joints and non-parallel surfaces of the adjacent bones indicates intercarpal subluxation resulting in ligamentous tears or rupture. BJHM

KEY POINTS

- The radial articular surface lies distal to the ulnar.
- The capitate sits in the concavity of the lunate.
- A repeat X-ray of a suspected scaphoid fracture should be performed in 7–10 days if it was normal initially.
- The intercarpal joint surfaces should be congruent with joint spaces not wider than 2 mm.

Conflict of interest: none.

Further reading

Chan O (2007) *ABC of Emergency Radiology.* 2nd edn. Blackwell, Oxford

Hodgkinson DW, Kurdy N, Nicholson DA, Driscoll PA (1994) ABC of Emergency Radiology: the wrist. *BMJ* **308**: 464–8

Raby N, Berman L, Lacey G (2005) *Accident & Emergency Radiology. The Survival Guide.* 2nd edn. Elsevier Saunders, Philadelphia

Figure 9. a. Anteroposterior and (b) lateral radiographs showing Galeazzi fracture dislocation. Both bones of the forearm are fractured and there is dorsal dislocation of the distal ulna.