Injuries to the distal radius

Introduction

The distal radius includes the metaphysis, formed mainly of cancellous bone, supporting the articular surface (*Figure 1*). This articular surface is biconcave, allowing articulation with the proximal carpal row (the radio-carpal joint) and has a sigmoid notch for articulation with the distal ulna (the distal radio-ulnar joint (DRUJ)).

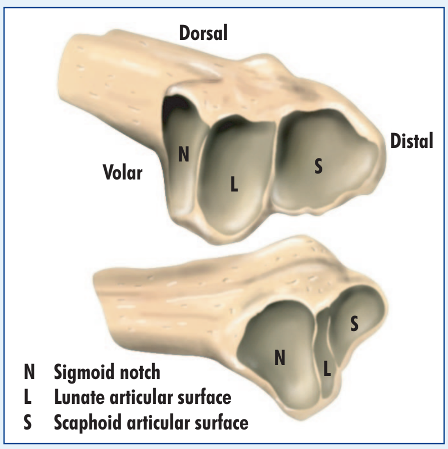
The radius supports 80% of axial load, the remaining 20% being supported by the ulna and triangular fibrocartilage complex. This force transmission is dependant on the normal anatomical relationships of the radio-carpal joint and DRUJ remaining intact.

The distal radius is the site of insertion of numerous ligaments. These often remain intact following fracture, aiding reduction through ligamentotaxis. Of the numerous neurovascular structures that traverse this region to supply the hand, particular attention should be paid to the median nerve when assessing injuries to the distal radius.

Mechanisms of injury

The commonest mechanism of injury to the distal radius is a fall onto the outstretched hand, with the wrist between 40 and 90° of dorsiflexion. Axial force applied to the wrist in this position initially leads to the volar aspect of the distal radius failing in tension. As the fracture propagates, the dorsal aspect is compressed, leading to dorsal comminution. Impaction of the cancellous metaphysis leads to further dorsal instability, with the addition of shearing forces often leading to articular surface involvement. This type of low-energy fracture should be distinguished from high-energy injuries, such as those resulting from road traffic accidents, which can lead to significantly displaced, highly comminuted and highly unstable fractures.

Figure 1. Anatomy of the distal radius.



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Clinical presentation

Typically patients present with pain localized to the distal forearm and wrist together with deformity. The nature of the deformity will depend on the displacement of the fracture. With dorsal angulation, the typical 'dinner fork' deformity is seen (*Figure 2*). The wrist will be swollen, with bruising, tenderness and a painful range of motion.

Clinical examination should include a careful neurovascular assessment. Radial and ulnar pulses should be palpated. Ulnar, radial and median nerves should be examined thoroughly, paying particular care to the median nerve. This travels through the carpal tunnel to supply motor innervation to the muscles of the thenar eminence and sensory fibres to the lateral three and a half digits. It is vulnerable to injury at this point through traction at the time of injury, direct trauma from fracture fragments, or increase in local pressure through haematoma formation or oedema. Symptoms of entrapment include paraesthesia in the thumb, index and middle fingers, and evidence of this should be sought in both history and examination.

Figure 2. Dinner fork deformity of the distal radius.

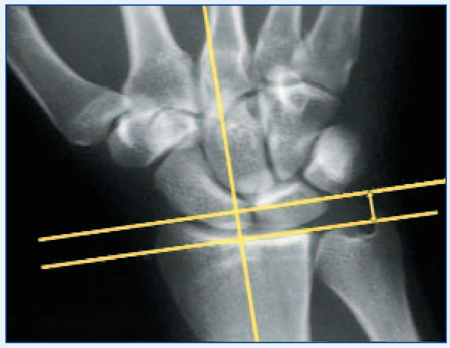

Figure 3. Radial length: two lines are drawn perpendicular to long axis of the radius. The first line intersects the tip of radial styloid and the second intersects the distal articular surface of the ulnar head. The distance between the two lines, the radial length, should be 11–12 mm.

The initial assessment should include examination of the ipsilateral elbow and shoulder to rule out associated injuries. Any suspicion should be investigated through the requesting of appropriate radiographs.

Initial radiographic assessment should include anteroposterior (AP) and lateral views of the wrist. Radiographs should be examined for:

- Articular involvement – requesting oblique views may help in assessing radiocarpal involvement
- Radial shortening – measured on the AP view (*Figure 3*)
- Radial angulation – measured on the lateral view (*Figure 4*)
- Radial inclination – measured on the lateral view (*Figure 5*)
- Comminution

Figure 4. Volar tilt: one line is drawn perpendicular to the long axis of the radius, and one line is drawn along the articular surface. Normal volar tilt measures between 0 and 22° (mean 11–14.5°).

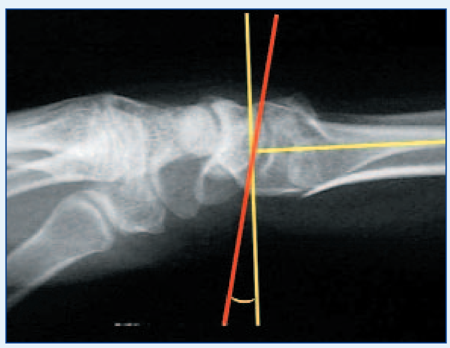

Figure 5. Radial inclination: one line is drawn from the tip of the radial styloid to the ulnar corner of the articular surface, and one line is drawn perpendicular to the long axis of the radius. Average radial inclination is 16–23°.

Table 1. Frykman's classification of Colles fractures

Type	Radius	Ulna	Radiocarpal	Radioulnar
I	Extra-articular	Absent	Absent	Absent
II	Extra-articular	Present	Absent	Absent
III	Intra-articular	Absent	Present	Absent
IV	Intra-articular	Present	Present	Absent
V	Intra-articular	Absent	Absent	Present
VI	Intra-articular	Present	Absent	Present
VII	Intra-articular	Absent	Present	Present
VIII	Intra-articular	Present	Present	Present

From Frykman (1967)

- Stability – the tendency of the fracture to redisplace following reduction. Stable fractures tend to be extra-articular with mild to moderate displacement.

These measurements help to assess the deformity caused by any fracture, and plan for reduction if indicated. The most important factor governing outcome following treatment is the amount of articular depression, with any step-off greater than 2 mm leading to a poorer outcome and an increased probability of post-traumatic osteoarthritis (Knirk and Jupiter, 1986).

Classification

Accurate classification aids communication between clinicians, and the application of the correct classification system allows accurate assessment of the injury.

Descriptive classification of the injury is often adequate and preferable to inaccurate use of classification systems. When describing the injury, the following should be noted:

- Open *vs* closed
- Displacement
- Angulation
- Comminution
- Loss of radial length
- Articular involvement.

Several eponyms are associated with distal radial injuries. Colles first described distal radial fracture following low-energy trauma occurring in the elderly population. A Colles' fracture is now accepted as being a low-energy injury in osteopenic bone, occurring in the over 50-year-old population. The fracture typically shows a combination of dorsal angulation (*Figure 6*), dorsal displacement, radial shift and radial shortening. While initially applied exclusively to extra-articular injuries, this term is now extended to intra-articular injuries as well. The Frykman classification (*Table 1*) subdivides this type of fracture according to whether the ulna styloid is avulsed, and whether the radiocarpal, distal radioulnar or both joints are involved.

A Smith's fracture (*Figure 7*) describes injuries with volar angulation of the distal radial fragment.

A Barton's fracture (*Figure 8*) is a fracture-dislocation, or subluxation of the radiocarpal joint. A rim of the distal radius remains associated to the carpus and displaces with it. Volar angulation is more common than dorsal, and both types are usually unstable, requiring operative treatment to maintain adequate reduction.

Management

Having fully assessed the injury, together with patient factors such as age, hand dominance, occupation and level of physical activity, a decision must be made as to the appropriate management. The goal should be to provide the patient with the most comfortable and functional wrist possible.

Figure 6. A Colles' type fracture showing dorsal angulation of the distal radial fragment.

Figure 7. A Smith's fracture with volar angulation of the distal radial fragment.

Figure 8. A Barton's fracture showing dorsal subluxation of the radiocarpal joint.

Stable, non-displaced or minimally displaced fractures may be amenable to closed reduction and immobilization in a cast. A number of anaesthetic options are available:

- Local anaesthetic via a haematoma block
- Regional anaesthesia via a Biers block
- Sedation and analgesia.

The choice of method will depend largely on local protocols. Whichever method is selected, it should ensure the ability to manipulate the fracture with a minimum of discomfort, allowing maintenance of reduction while a cast is applied.

Adequate reduction is achieved when the deformity is reversed to within normal limits, assessing the post reduction radiograph in a similar manner to the initial film. A neurovascular examination should follow manipulation, once again paying particular attention to the median nerve. Persistent symptoms should warrant consideration for operative decompression of the carpal tunnel. All patients should be reviewed at regular intervals, with initial review at 1 week, to confirm maintenance of adequate reduction.

Operative management is reserved for those fractures which are unstable or in which adequate reduction cannot be achieved through closed methods.

Operative management

The choice of appropriate operative management is governed by the pattern of injury. A number of procedures are available to the surgeon, including:

- External fixation – bridging and non-bridging devices
- Closed reduction and percutaneous wiring
- Open reduction and internal fixation – with or without bone grafting.

Unstable extra-articular fractures can be treated by closed reduction guided by fluoroscopy, and fixation through percutaneous wires. The Kapandji technique (Kapandji, 1987) is often used in the treatment of dorsally angulated fractures (*Figure 9*). Here, two wires are passed through the fracture site itself and used to lever the dorsally angulated fragment into the correct position.

Volar angulation and comminution is more difficult to control with percutaneous techniques, and open reduction and internal fixation are often required to gain and maintain adequate reduction (*Figures 10* and *11*).

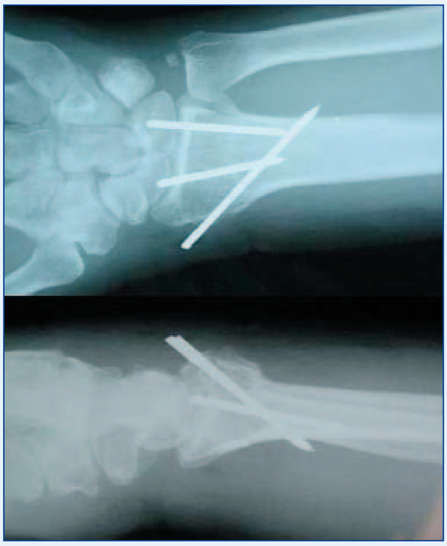

Figure 9. Dorsally angulated distal radial fracture treated by Kapandji wire fixation.

Conclusions

Fractures to the distal radius are a common injury seen in the accident and emergency department. It is important to differentiate between low-energy fractures in osteopenic bone seen in older patients and high-energy injuries in younger patient groups. Accurate assessment of articular involvement and deformity is vital in deciding on appropriate management. Manipulation under sedation or local or regional anaesthesia followed by immobilization in an appropriate cast will suffice for the majority of extra-articular injuries.

Figure 10. Anteroposterior fluoroscopy image of internal fixation using a volar plate.

Figure 11. Lateral fluoroscopy image of internal fixation using a volar plate.

Intra-articular injuries, especially in younger patients, will often require operative treatment. BJHM

Conflict of interest: none.

Frykman G (1967) Fracture of the distal radius including sequelae-shoulder-hand-finger syndrome, disturbance in the distal radio-ulnar joint and impairment of nerve function. A clinical and experimental study. *Acta Orthop Scand Suppl* **108:** 3

Kapandji A (1987) Internal fixation by double intrafocal pinning. Functional treatment of non articular fractures of the lower end of the radius. *Ann Chir Main* **6:** 57–63

Knirk JL, Jupiter JB (1986) Intra-articular fractures of the distal end of the radius in young adults. *J Bone Joint Surg* **68A:** 647–59

KEY POINTS

- Injuries to the distal radius are commonly encountered in the accident and emergency department.
- Accurately assessing displacement of the involved fragments will aid selection of appropriate treatment.
- Treatment should be aimed at maximizing comfort and function.
- Extra-articular, dorsally angulated fractures may well be treated by closed manipulation and immobilization in a plaster cast.
- Other types of fractures may require operative management.