Forearm fractures

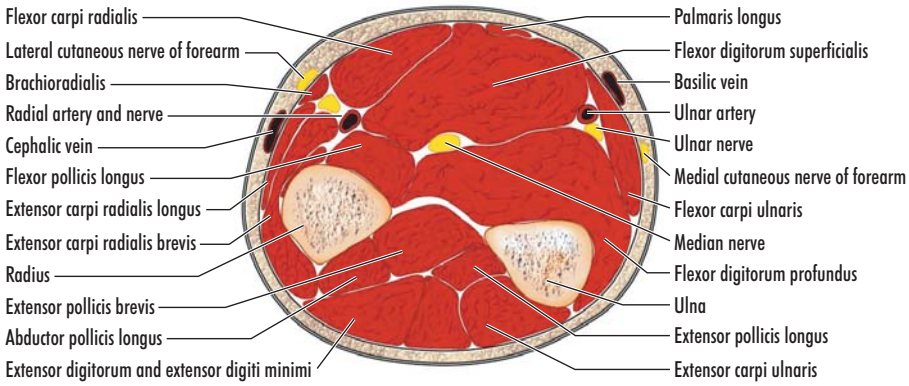

Figure 1. Compartments of the forearm.

Anatomy and function

The forearm contains two bones, the radius and ulna.

The radius is the lateral bone in the forearm. Its upper end articulates with the humerus at the elbow joint and with the ulna in the superior radioulnar joint. Its lower end articulates with the scaphoid and lunate bones of the carpus at the wrist joint and the ulna at the inferior radioulnar joint. It has a sharp interosseous border medially for the attachment of the interosseous membrane that binds the radius and ulna together.

The ulna is the medial bone of the forearm. Its articulations are with the elbow and the radius above as described, and the radius inferiorly.

The forearm is enclosed in a sheath of deep fascia which is attached to the periosteum of the posterior subcutaneous border of the ulna. The fascial sheath, together with the interosseous membrane and fibrous intermuscular septa, divide the forearm into anterior and posterior compartments (*Figure 1*).

The anterior compartment contains the deep and superficial flexor muscles, the radial and ulnar arteries, superficial radial nerve, ulnar nerve, median nerve and their branches.

The posterior compartment contains the extensor muscles, the posterior interosseous nerve and artery (distally joined by the anterior interosseous artery).

The main movements of the forearm are pronation (0–95°) and supination (0–85°). These movements are only possible because of the unique anatomy of the bones and the interosseous membrane, annular ligament, radioulnar ligaments and the triangular fibrocartilage complex at the wrist, binding them together, giving the bones the features of a linked parallelogram.

It is important to bear in mind the attachment of certain muscles (e.g. pronator teres) and the normal appearance of the bones on standard anteroposterior and lateral radiographs.

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Mechanisms of injury

Direct violence

Either of the forearm bones may be fractured, especially the ulna when in a fall the shaft strikes a sharp edge or in self-defence the forearm is used as a shield for the head and the shaft is struck with a hard object (night-stick injury).

Indirect violence

More commonly the forearm is injured as a result of a fall onto the back or front of an outstretched hand. The force of impact on the hand stresses the forearm bones; commonly both bones fracture (*Figure 2*).

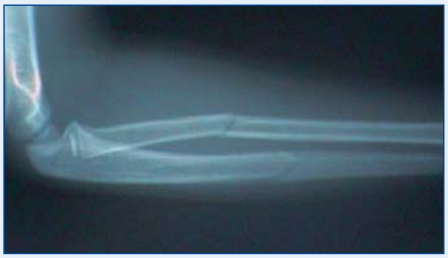


Figure 2. Both bone forearm fracture.

Fracture dislocations

If one forearm bone is seen to be fractured and angulated, it has inevitably become relatively shorter. If its attachments to the wrist and humerus are intact, the other forearm bone must be dislocated. The commonest type of fracture-dislocation of this type is a fracture of the ulna with dislocation of the radial head – Monteggia fracture (Galeazzi, 1934) (*Figure 3*).

The same pattern of injury occurs in the Galeazzi (1934; Rang, 1968) fracture-dislocation (*Figure 4*); here a dislocation of the distal ulna accompanies a radial shaft fracture. One should never accept fracture of a single forearm bone as an entity.

Axial rotation

When the radius fractures, contrary to the ulna, in addition to angulation one fragment may rotate relative to the other. A discrepancy in widths of the fragments at fracture level illustrates the presence of axial rotation. Pronator quadratus tends to pronate the distal fragment in all radial

Figure 3. Monteggia fracture.

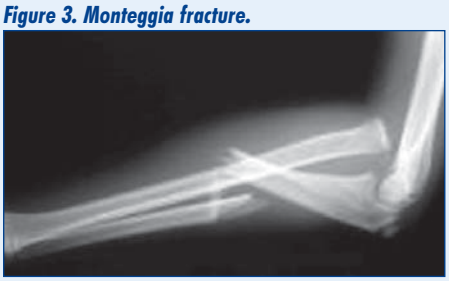
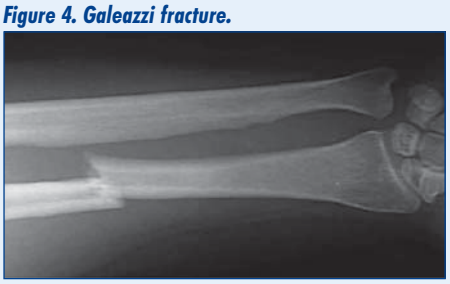


Figure 4. Galeazzi fracture.



shaft fractures. In all proximal third radius fractures, pronator teres helps to pronate the distal fragment assisting pronator quadratus. The proximal fragment in this situation is fully supinated by the biceps. In fractures of the distal third, the biceps is opposed so the proximal fragment tends to lie in the mid (neutral) position. Axial rotation of the ulna is rare. One should check that in the lateral radiograph, olecranon, coronoid process and styloid process should all be visible.

Greenstick fractures

In children any intact periosteum on the original concave surface of the fracture exerts a constant force which may cause angulation if the plaster slackens (*Figure 5*). Reduction of these fractures requires manipulation only in the majority of cases. If there is off ending, then shortening and instability are more likely and the reduction is more difficult.

Clinical picture and investigations

Deformity, pain and swelling are the commonest presenting complaints in association with one of the mechanisms described above. History and examination are just as important as in any other medical scenario. The examination must assess and document neurovascular status of the affected limb. Take note of whether the injury is open or closed and treat accordingly with antibiotics and appropriate dressings if open. Radiographs must include the elbow and wrist joint and two views (anteroposterior and lateral) must be obtained.

Accident and emergency management

Following history, examination and assessment of X-rays, if there is angulation and displacement or shortening of a single bone fracture, or fracture of both bones with or without rotation and angulation, referral to the orthopaedic team must be made. Analgesia must be given. Reduction must not be attempted in the accident and emergency setting. If an open injury has occurred it is best to allow the orthopaedic surgeon to see the open wound before immobilization is applied. Above elbow back-slab plaster of Paris is the most appropriate form of immobilization for these types of fractures in patients of all ages. Isolated ulna fractures can be immobilized in a below elbow cast but if in doubt, apply an above elbow plaster. Non-compliant children may be placed in a broad-arm sling, having discussed this with the orthopaedic surgeon and provided definitive treatment will take place in the near future.

Figure 5. Greenstick fracture of the radius and ulna.

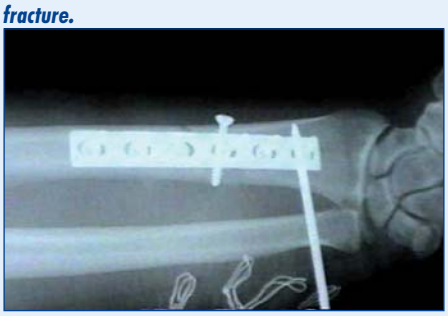
Further management

Single bone greenstick fractures and the majority of radius and ulna fractures in children can be managed by manipulation under anaesthetic and a well moulded cast. Only occasionally in severely displaced and unstable fractures is fixation required. In adults, non-displaced ulna shaft fractures can be treated conservatively although non-union and delayed-union are recognized complications.

Both bone fractures with minimal displacement and angulation may be manipulated and assessed for stability in theatre; stable fractures may be treated in plaster alone. Monteggia, Galeazzi, or both bone displaced, shortened or rotated fractures often require open reduction and internal fixation. The radius is often reduced and fixed first. If dislocation of the radial head has occurred this may relocate closed but occasionally requires open reduction; radioulnar joint dislocation may need stabilization with K-wires (*Figure 6*).

Cast application is paramount in all cases. The distal fragment (distal forearm) must be orientated to match the proximal; therefore in adult proximal radius fractures, the distal forearm must be supinated to match the proximal fragment as biceps brachii is the major deforming force. The more distal the fracture the more towards neutral rotation the distal fragment (forearm) may be placed to align the fracture. In children, posterior angulation should be placed in full supination and anterior angulated fractures in full pronation. Six to 8 weeks in plaster is normally adequate especially if internal fixation has been performed. Longer periods may be needed in the elderly and shorter periods (4–6 weeks) for children with greenstick-type fractures. This is often followed by a period of physiotherapy and rehabilitation which may take several months depending on the severity of the initial injury. **BJHM**

Figure 6. Plating of radius and K-wire fixation of diastasis of distal radi ulnar joint for Galeazzi fracture.



Conflict of interest: none.

Galeazzi R (1934) Uber ein Besonderes Syndrom bei Verltzunger im Bereich der Unterarmknochen. *Arch Orthop Unfallchir* **35:** 557–62

Rang M (1968) *Anthology of Orthopaedics.* E & S Livingstone, Edinburgh

KEY POINTS

- The forearm is divided into two compartments: anterior and posterior.
- The main movements of the forearm are pronation and supination.
- It is important to bear in mind the attachment of certain muscles and the normal appearance of the bones on standard anteroposterior and lateral radiographs.
- Mechanisms of injury include direct violence (commonly the ulna), indirect violence, fracture dislocation (Monteggia and Galeazzi fractures), axial rotation (mainly the radius) and greenstick fractures in children.
- History and examination are just as important as in any other medical scenario. The examination must assess and document neurovascular status of the affected limb and note whether the fracture is open or closed.
- Radiographs must include the elbow and wrist joint and two views (anteroposterior and lateral) must be obtained.
- Referral to the orthopaedic team must be made if there is angulation and displacement or shortening of a single bone fracture, or fracture of both bones with or without rotation and angulation.