Carpal Fractures and Dislocations

The wrist is the most commonly injured joint in the body.[1] Carpal bone fractures make up a significant proportion of injuries to the wrist. The complex bone shape and articulations make diagnosis more difficult and missed injuries more common. It is important to suspect and recognise carpal injuries, as they are difficult to diagnose and can cause permanent disability if untreated.[2]

The usual mechanism of injury causing a carpal fracture is either a fall on to the outstretched hand, or direct trauma to the wrist area. Higher-impact injuries from falls or severe road traffic accidents can lead to dislocations of the carpal bones. A hard blow to the wrist during high-speed contact sports or from a projectile (eg, a ball, bat or club) may also cause fracture.[2]

It is important to have patients describe the injury; acting out the traumatic event if possible. The physician must consider the age of the patient when evaluating the mechanism of injury. For example, the injury resulting from a fall on to the outstretched hand with the wrist extended will vary depending on the patient’s age, typically causing a greenstick fracture in a toddler, a growth plate fracture in an adolescent, a scaphoid fracture in a young adult, and a Colles’ (distal radius) fracture in an older adult with osteoporosis.[3]

Athletes form an important subgroup of patients experiencing this injury. 3% to 9% of all athletic injuries occur to the hand or wrist. Hand and wrist injuries are more common in adolescent athletes than in adults.[4]

The incidence of wrist fractures among women increases gradually with age from the age of 50 years. They are most likely to occur in women over 65 years old. In men, fracture rates remained low until later in life. Only 15% of wrist fractures occur in men and this rate does not increase much with age.[5]

Anatomy
- There are eight carpal bones in the region of the wrist, arranged in two rows and tightly interwoven with each other by intrinsic and extrinsic wrist ligaments:
• The proximal row consists of the scaphoid, lunate, triquetrum and pisiform. These bones are closely approximated to the distal radius, with the scaphoid located most radially.
• The distal row consists of the hamate, capitate, trapezoid and trapezium. This row is closely approximated to the metacarpal bones. The trapezium is located most radially.
• The scaphoid links the two rows of carpals.

• The lunate acts as a central anchor for the carpal bones.
• The carpal bones are bound to each other by short intercarpal ligaments - for example, the scapholunate and the triquetrolunate.

Articulations
• The distal radius articulates with the bones of the proximal carpal row (except the pisiform and triquetrum) at the radiocarpal joint. The radiocarpal and intercarpal ligaments support this joint.
• The proximal carpal row articulates with the distal row at the carpocarpal joints. The intercarpal ligaments support these joints.
• The distal carpal row articulates with the proximal end of the metacarpal bones at the carpometacarpal joints.

Carpal bone fractures
• Carpal bone fractures can be difficult to detect on conventional X-ray and may require CT for diagnosis.
• Fractures involving the carpal bones account for 18% of hand fractures.[6]
• Over 80% of carpal fractures involve the scaphoid; the second most common carpal bone to fracture is the triquetrum.[7] Other carpal bones are much less commonly fractured. Capitate fractures are especially rare because the capitate bone sits in a protected position.[8]
• Where carpal fracture is suspected, X-rays in the anteroposterior (AP), lateral and oblique views are needed. Bone scans and CT scans are sometimes helpful if the fracture is not obvious on plain X-ray and should be considered where fracture is still suspected.[1]
• The management of carpal fractures depends on prompt diagnosis, stable and anatomic alignment of the involved carpal bone, protective immobilisation of the injury, and careful rehabilitation.[4]

Scaphoid fracture
This is discussed in the separate article Wrist Fractures.

Triquetrum fracture
The triquetrum lies just distal to the ulnar styloid in the proximal carpal row.[9] It lies under the pisiform bone so is difficult to palpate. To allow palpation, the hand must be radially deviated, exposing the triquetrum from beneath the ulnar styloid. Fractures can either be of a peripheral chip or through the body.
• Usual mechanism of injury: direct blow to the dorsum of the hand or a fall resulting in extreme dorsiflexion of the wrist.
• Diagnosis: if there is a fracture, point tenderness is usually found. X-ray confirms diagnosis.
• Management: uncomplicated fractures can usually be treated with immobilisation in a cast and physiotherapy after cast removal. Displaced fractures through the body require closed reduction and pinning or open reduction and internal fixation.

Lunate fracture
The lunate articulates proximally with the radius and distally with the capitate. It is palpable just distal to the radial tubercle.[10]

• Usual mechanism of injury: either a direct blow to the wrist, or following chronic recurrent trauma. The recurrent trauma is thought to cause microfractures and lead to avascular necrosis of the lunate (Kienböck's disease). This may result in eventual collapse of the lunate and associated arthritis. See separate article Kienböck's Disease.
• Diagnosis: local tenderness to palpation is usual following an acute fracture. Suspect Kienböck's disease in someone who complains of central dorsal wrist pain, reduced grip strength and reduced wrist movement.
• Management: immobilisation, stress reduction, revascularisation and lunate replacement are management options, depending on the severity and pattern of fracture.

Hamate fracture
The hook or the body of the hamate bone may be fractured.

• Usual mechanism of injury: may be caused by a fall on to the outstretched hand. Often occurs when the patient falls while holding an object and the object lands between the ground and the ulnar side of the palm. Can follow direct trauma to the hypothenar eminence; for example, while gripping the handle of a racquet, bat or golf club, with an abnormal swing causing the handle to impact against the bone.
• Diagnosis: pain is usually felt on the ulnar aspect of the palm or dorsoulnar aspect of the wrist, and is worsened by gripping. Grip strength may be reduced. Test the ulnar nerve as this is closely associated. Carpal tunnel X-ray view may be needed to detect hook fractures. CT scanning is also helpful.
• Management: non-displaced fractures are treated conservatively by cast immobilisation for six weeks. Displaced fractures usually require open reduction and internal fixation. Displaced fractures of the hook of the hamate are managed by early excision. There may otherwise be avascular changes after hook fractures which can lead to necrosis and non-union of the hamate hook.[4,11]
Trapezium fracture
This is the third most common carpal fracture.

- **Usual mechanism of injury**: direct blow to the dorsum of the hand or a fall on to a radially deviated closed fist.
- **Diagnosis**: point tenderness over the trapezium. The patient complains of a weak and painful pinch grip. Carpal tunnel X-ray views may be needed.
- **Management**: treated conservatively if non-displaced. A thumb spica cast is usually used. Displaced fractures are usually treated surgically. Trapezial ridge fractures may require surgical intervention.[4]

Other carpal bone fractures
Other carpal bones are very rarely fractured. Fracture can occur with a powerful direct force, and multiple fractures are possible. Undisplaced fractures are usually treated conservatively. Surgery is often required for displaced fractures. Comminuted pisiform fractures require early excision to promote uncomplicated recovery.[4]

Complications of carpal bone fractures
Most carpal bone fractures heal without complication. Early complications include:

- Stiffness, pain or aching which is usually (but not always) short-lived.
- Carpal osteoarthritis, which can be a late complication.
Carpal dislocations

- These are rare but devastating injuries. They can be associated with a carpal fracture. Fracture dislocations are twice as common as pure ligamentous dislocations. Isolated carpal dislocations are rare.[12]
- They include perilunate dislocations, trans-carpal fracture dislocations, radiocarpal dislocations, axial or longitudinal dislocations, and the rare isolated carpal bone dislocations.
- The most common carpal dislocations are the lunate, the lunate with a scaphoid fracture, and perilunate dislocation.
- Perilunate dislocations result from dislocation of the distal carpal row. Scaphoid fractures often accompany perilunate dislocation.[13]
- Carpal dislocations can lead to chronic pain and wrist instability. They are difficult to diagnose and are often missed.

Usual mechanism of injury

- They most often result from high-energy trauma such as a motor vehicle accident, high-impact falls from a height onto an outstretched hand with rotation/wrist deviation, or industrial-related accidents.

Examination

- Patient may just have diffuse wrist pain and diffuse tenderness to palpation. There may be associated swelling.
- Vascular and neurological integrity of the hand should be checked and documented.

Investigations

AP X-ray view

When looking at the AP view to diagnose carpal dislocations, one approach is to imagine three arcs:

- The first arc is formed by connecting the proximal articular margins of the proximal carpal row (the scaphoid, lunate and triquetrum).
- The second arc is formed by connecting the distal articular margins of the same proximal carpal row.
- The third arc is formed by joining the proximal articular margins of the capitate and hamate.
- Any disruption of these parallel lines indicates subluxation or dislocation of the carpal bones.

Lateral X-ray view

There is normally a column seen with the radius below, then the lunate sitting in the radius cup and the capitate sitting in the lunate cup. If this column alignment is lost, it can mean a lunate or perilunate dislocation.

Management

- The wrist should be rapidly immobilised with a cast, even if no injury is obvious on X-ray. Splinting should be to the fingertips.
- Where carpal dislocation has occurred, or is suspected, urgent referral for orthopaedic opinion is necessary. Adequate analgesia should be given.
- Minor dislocations may be treated by closed reduction; more complex injuries usually require open reduction and internal fixation.
- Closed reduction is performed acutely, followed by open reduction and ligamentous and bony repair with internal fixation.[13]

Complications

- Complications include post-traumatic arthrosis, median nerve dysfunction, complex regional pain syndrome, tendon problems, and carpal instability.
- Despite appropriate treatment, loss of wrist motion and grip strength is common, as is persistent pain.[13]

Further reading & references

8. Capitate; Wheeless’ Textbook of Orthopaedics
9. Triquetrium; Wheeless’ Textbook of Orthopaedics
10. Lunate; Wheeless’ Textbook of Orthopaedics
11. Hamate; Wheeless’ Textbook of Orthopaedics

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