

Evaluation of the Injured Wrist

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The Case of the Sprained Wrist

A nineteen-year-old male gymnast landed on his dorsiflexed wrist after falling from the horizontal bar during practice. The athletic trainer suspects that he has sprained his wrist and immediately ices it. He advises the athlete to continue icing that evening and use over the counter NSAIDs if needed for pain. The next morning, he is referred to your your sports medicine clinic after re-evaluation in the training room. He presents with a painful, swollen wrist which he is unable to move without significant discomfort.



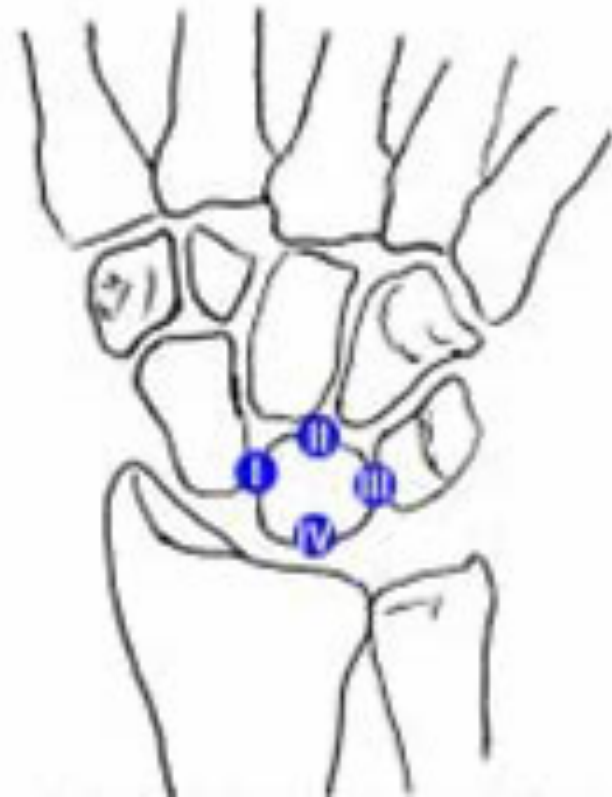


THE FALL ON AN OUTSTETCHED HAND

FOOSH INJURIES



Fall On an Outstretched Hand (FOOSH) Mechanism of Injury



Mayfield Classification of Injury

- Stage I - Scapholunate dislocation resulting from a tear in the scapholunate interosseous ligament and radiolunate ligament
- Stage II - Lunate-capitate subluxation resulting from injury to the capitoulunate joint
- Stage III - Lunate-triquetral dislocation resulting from injury to the triquetrolunate interosseous ligament
- Stage IV - Lunate dislocation resulting from dorsal radiolunate ligament injury

Mayfield JK et al. *J Hand Surg Am* 1980;5(3):226-41.



FOOSH Injury Patterns

- Scaphoid fracture
- Scapholunate dissociation
- Trans-scaphoid perilunate dislocation
- Perilunate dislocation
- Lunate dislocation
- Isolated lunotriquetral injury (radial deviation)

Scaphoid Fracture

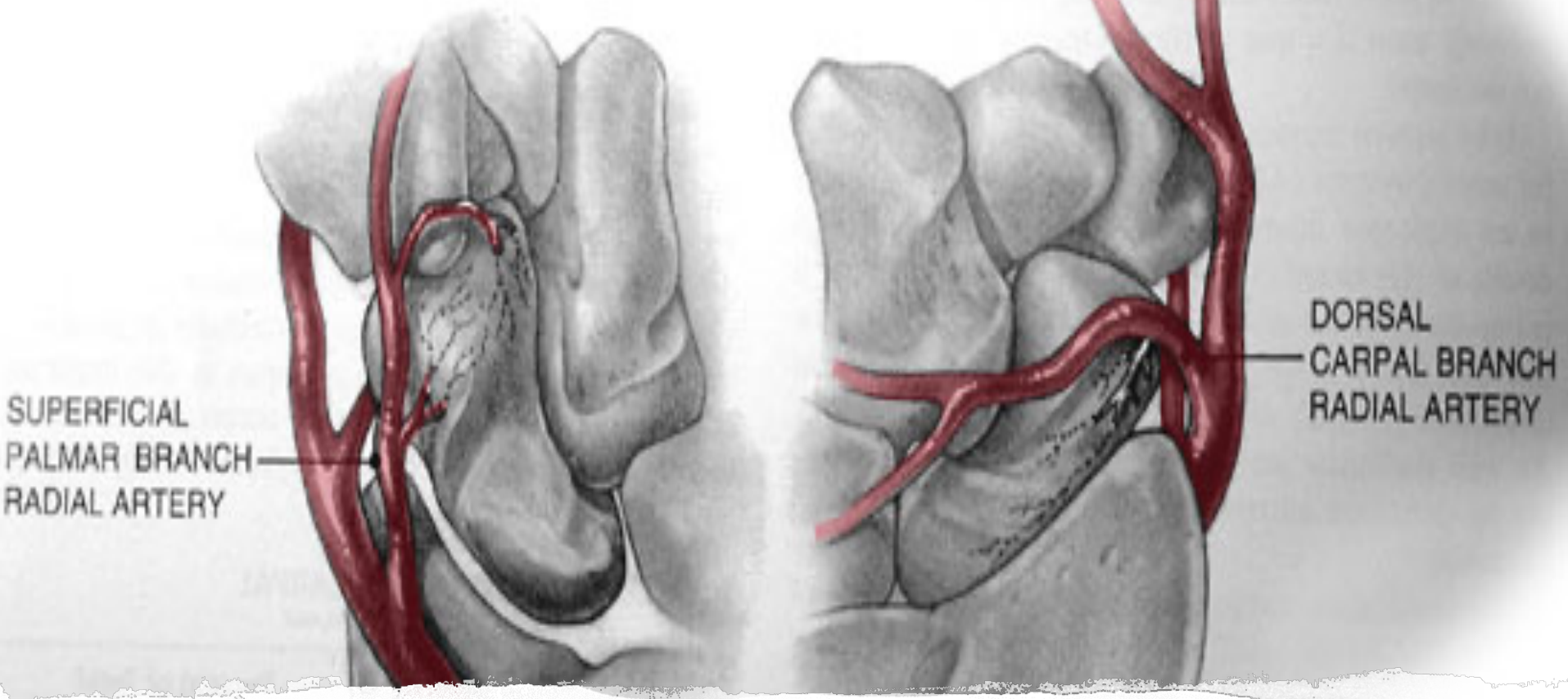
Most common carpal fracture (60%)

65% of fractures occur at the waist; 25% proximal third; 10% distal third

Transverse fracture patterns more stable than vertical or oblique patterns

Blood supply retrograde from distal to proximal pole

Incidence of avascular necrosis (AVN) 100% for proximal fifth and 33% for proximal third fractures



Scaphoid Fracture

Vascular Supply

- Primary: Dorsal carpal branch of the radial artery
- Secondary: superficial palmar branch of volar radial artery

Scaphoid Fracture

Physical Examination

Wrist swelling

Ecchymosis, hematoma or gross deformity seen rarely

Pain with resisted pronation

Anatomic snuff box tenderness dorsally

Scaphoid tubercle tenderness volarly

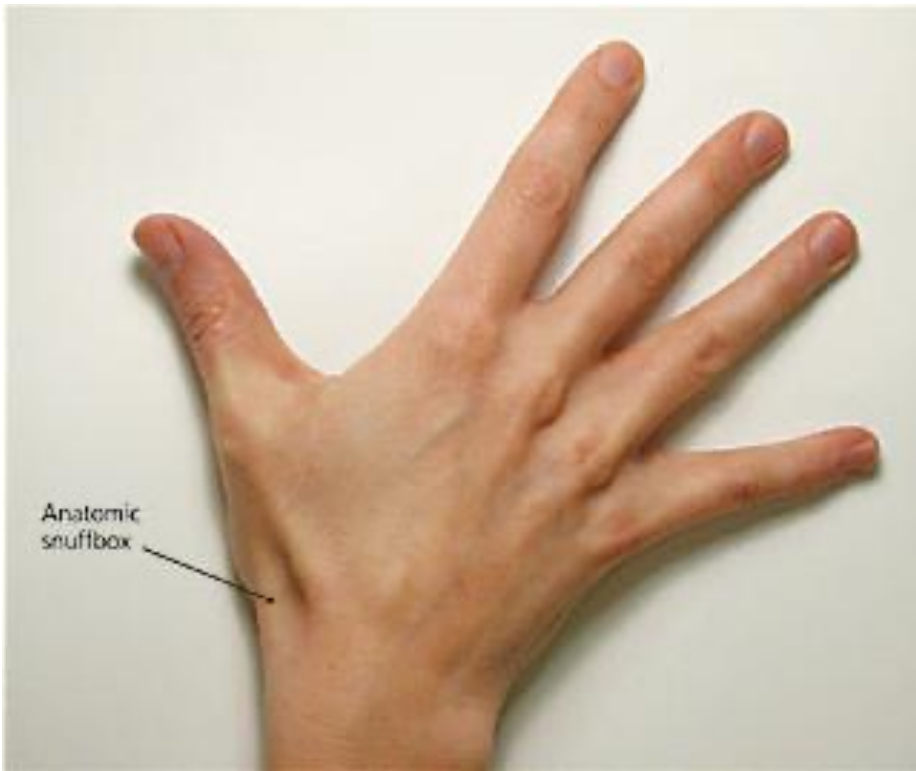
Axial loading through thumb MC produces pain
(Scaphoid Compression Test)

Scaphoid Fracture

Physical Examination

Anatomic Snuff Box

Scaphoid Tubercle



Scaphoid Fracture Imaging

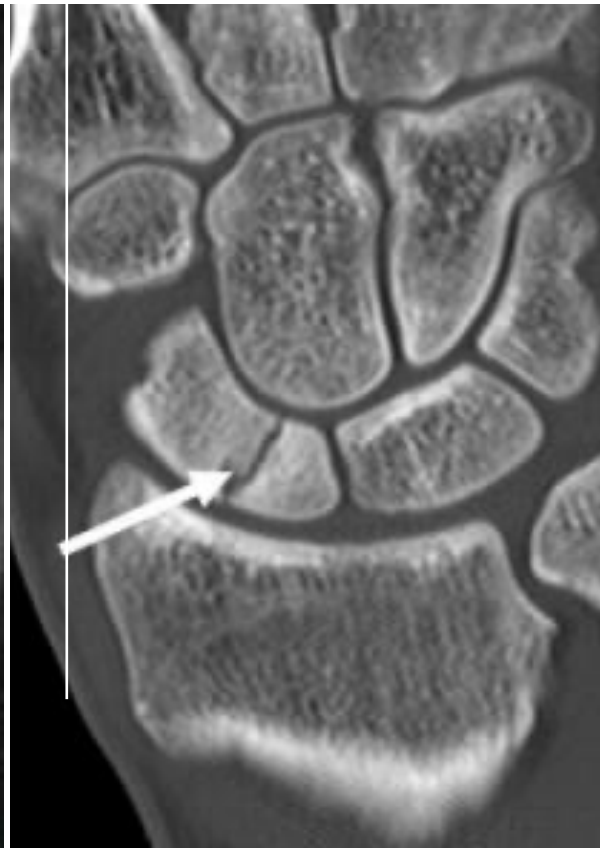
- Standard wrist radiographs with scaphoid view (wrist in 30° extension and 20° of ulnar deviation)
- MRI useful if initial radiographs are negative in the athlete allowing early return to play if no fracture identified
- CT scan best modality to evaluate fracture location, angulation, displacement, fragment size, and progression of nonunion or union after surgery



Scaphoid Fracture Advanced Imaging

MRI: sensitivity and specificity approach 100% for occult fractures

CT: 62% sensitivity and 87% specificity for determining stability and fracture



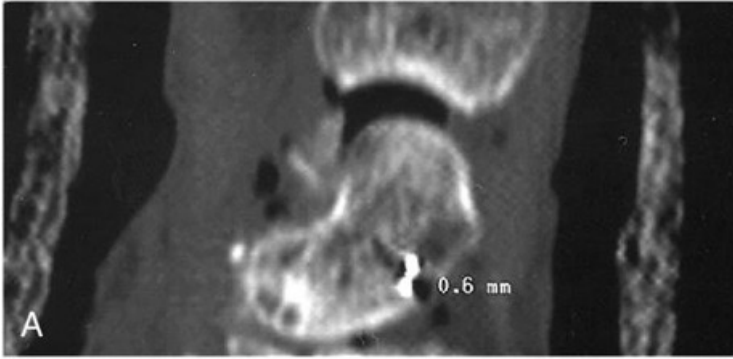
Scaphoid Fracture

Nonoperative Treatment

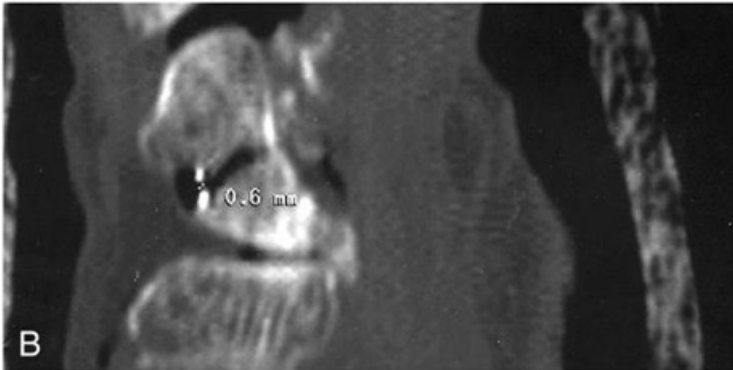
- Stable non-displaced fractures
- Union rate of 90-95% with less than 1mm displacement
- Minimal motion at fracture site with short arm cast (McAdams TR et al. *Clin Ortho Rel Res* 2003; 411:255-259)
- Randomized controlled trial (Clay NR et al. *J Bone Joint Surg [Br]* 1991;73:828-32) and systematic review (Tait MA et al. *JBJS* 2016; 4[9]) demonstrate no difference in healing rates for SAC vs. short arm thumb spica cast

Scaphoid Fracture

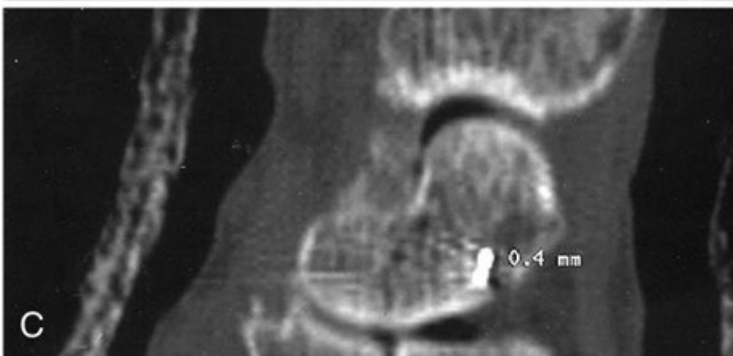
Nonoperative – Short Arm Cast



Neutral



Pronation



Supination



Scaphoid Fracture

Percutaneous Screw Fixation

- Proximal pole fractures
- Displaced fractures without significant angulation or deformity
- Nondisplaced waist fractures when faster return to work or sports is desired
- Union rates 90-95%

Scaphoid Fracture Open Reduction Internal Fixation

- Significantly displaced fracture patterns
- 15° scaphoid humpback deformity
- Radiolunate angle > 15° (DISI)
- Intrascaphoid angle of > 35°
- Scaphoid fractures associated with perilunate dislocation
- Comminuted fractures
- Unstable vertical or oblique fractures

Scaphoid Nonunion Advanced Collapse (SNAC Wrist)

- Advanced collapse and progressive arthritis of the wrist associated with scaphoid nonunion
- Begins at the radioscaphoid articulation and advances to midcarpal/pancarpal arthritis
- Patients with > 5 years of scaphoid nonunion or proximal pole AVN have worse outcomes



Scapholunate Dissociation

Scapholunate interosseous ligament
critical for carpal stability

- c-shaped structure connecting the dorsal, proximal and volar surfaces of the scaphoid and lunate
- dorsal component provides the greatest constraint to scapholunate translation
- proximal fibers have minimal mechanical strength

SLIL tearing will position the scaphoid in flexion and lunate in extension



Scapholunate Dissociation Physical Examination

- Pain in the anatomical snuff box and/or over dorsal scapholunate interval
- Pain increases with the wrist moved into exaggerated extension and radial deviation
- Watson Test



Scapholunate Dissociation Watson Test



- Pressure applied over the scaphoid tubercle while wrist is moved from ulnar to radial deviation
- Positive test – “clunk” as the proximal pole of the scaphoid subluxes dorsally over the radius
- Specific, but not a sensitive, test



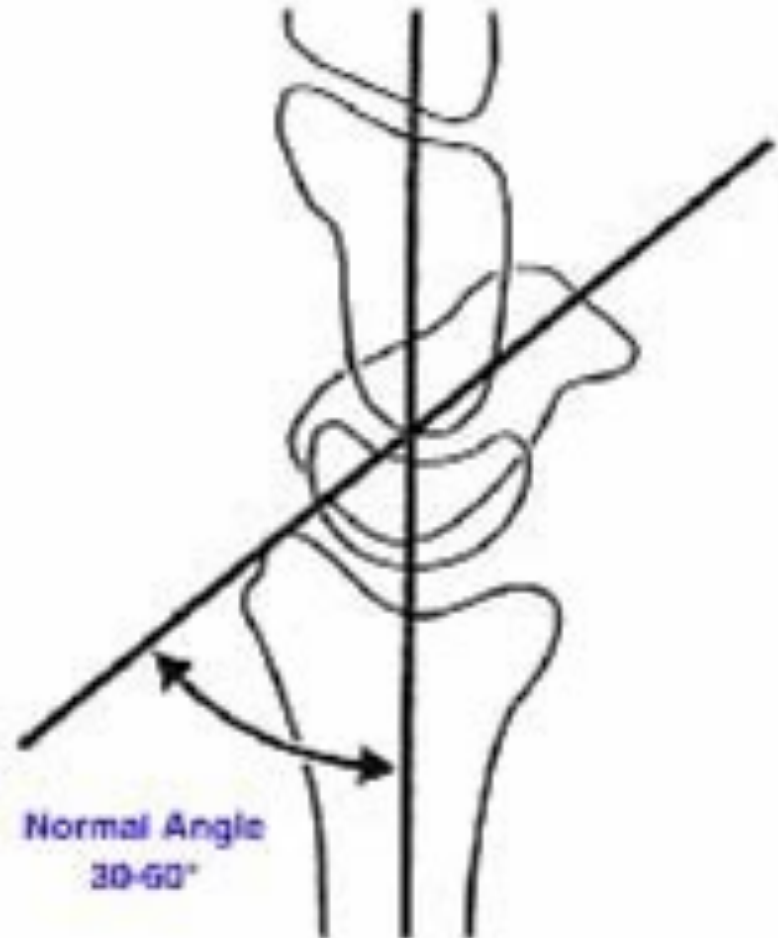
**Scapholunate Dissociation
AP Radiographs**



**Scapholunate
Dissociation
Lateral
Radiograph**

Scapholunate Angle

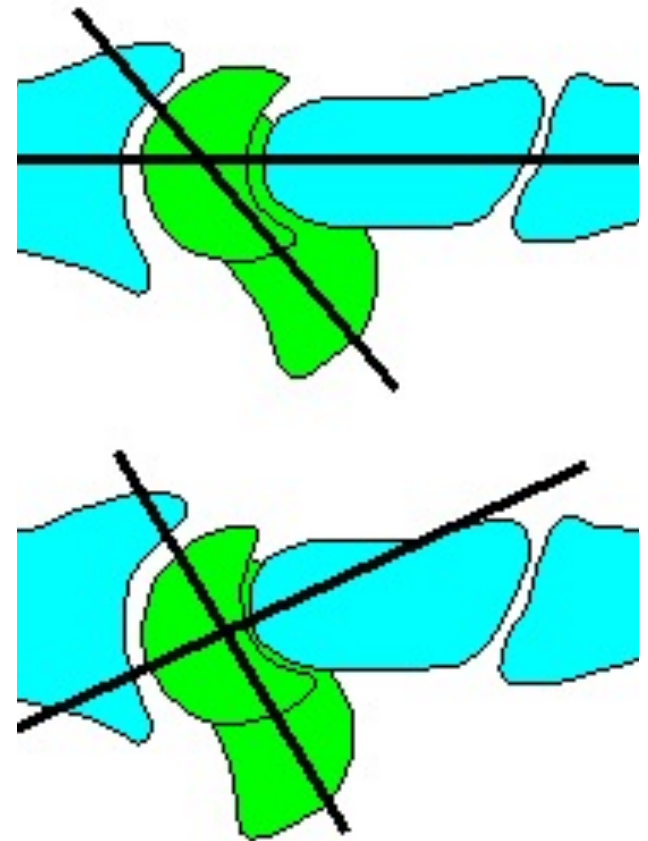
- Normal = $30-60^{\circ}$
- (Average = 47°)
- Dorsal Intercalated Segment Instability (DISI) = $>70^{\circ}$
- Volar Intercalated Segment Instability (VISI) = $<30^{\circ}$



The Intercalated Segment

- “The term and concept ‘intercalated segment’ appears widely in the medical literature. In the context of wrist mechanics, this concept emphasizes how little direct control is exerted over the proximal carpal row. Rather, the motion of these bones is governed by a host of extraneous factors including the geometry of the articular surfaces, the forces applied, and the integrity of the constraining soft tissues.”

- Gold HP et al. J Hand Surg 2015; 40:2471-72





Scapholunate Dissociation

**DISI
Deformity
Lateral
Radiograph**



Scapholunate Dissociation Treatment

- Cast immobilization
- Scapholunate Interosseous Ligament Repair
- Scapholunate Interosseous Ligament Reconstruction

Scapholunate Advanced Collapse

Stage One



Watson Stages

- **Stage One:** Arthritis between scaphoid and radial styloid
- **Stage Two:** Arthritis between scaphoid and entire scaphoid facet of the radius
- **Stage Three:** Arthritis between capitate and lunate

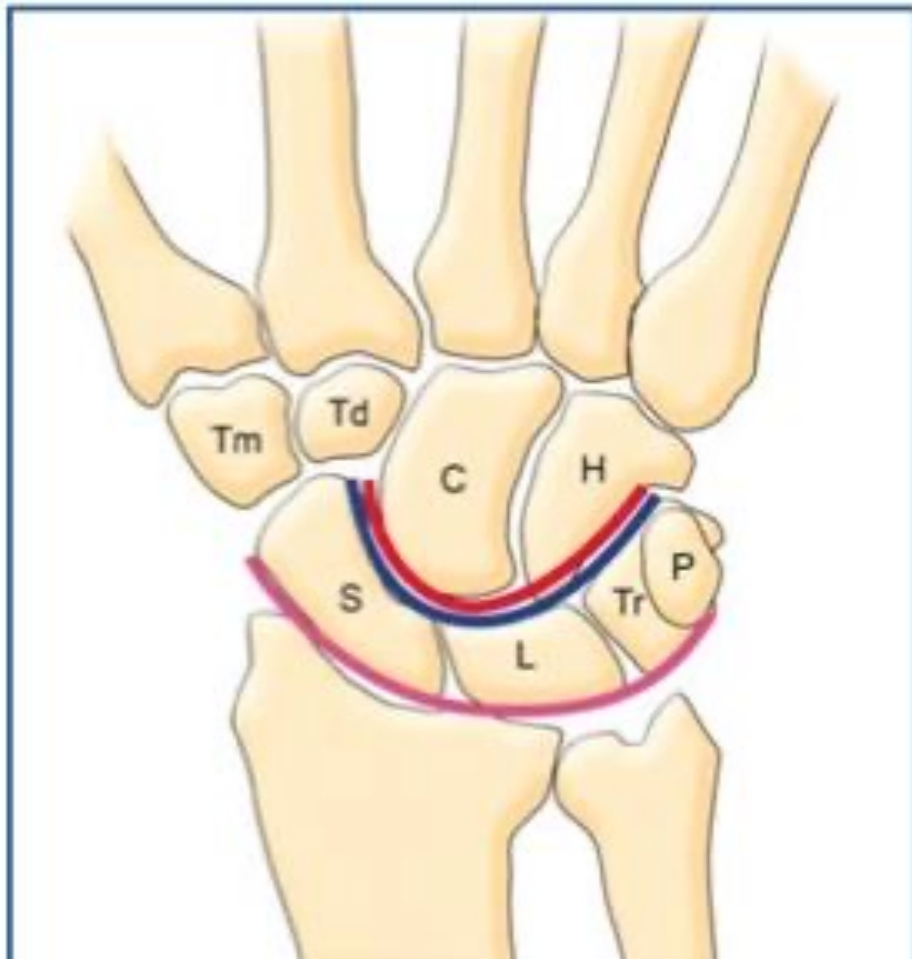


Perilunate Dislocation

PERILUNATE DISLOCATION

Physical Examination

- Perilunate dislocation can appear with considerable swelling.
- A miniature dinner-fork deformity often is present.
- The edge of the capitate may be palpable if the swelling is not profound.
- Snuff box tenderness may be present if the scaphoid was fractured.



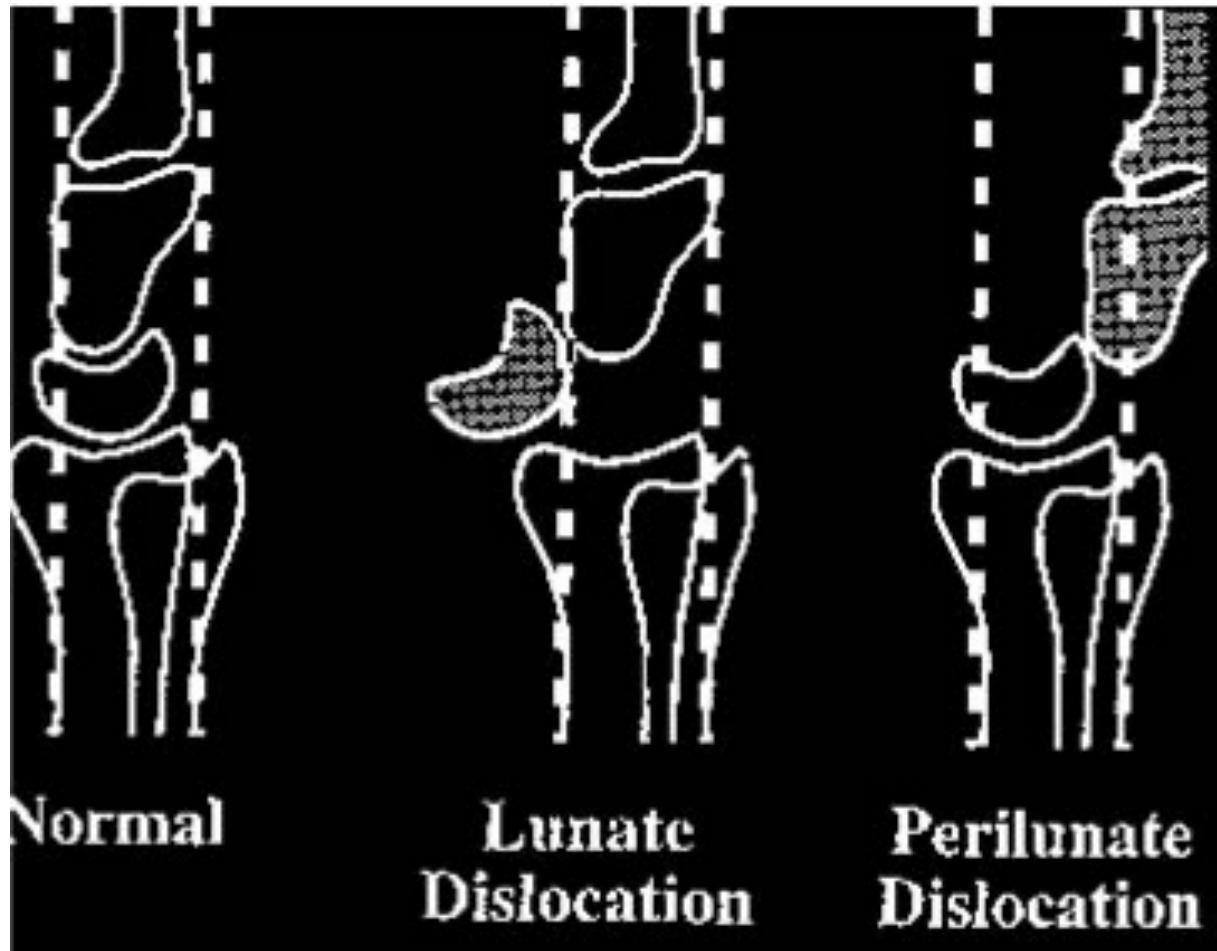
Interpreting Wrist Radiographs

Gilula's Arc

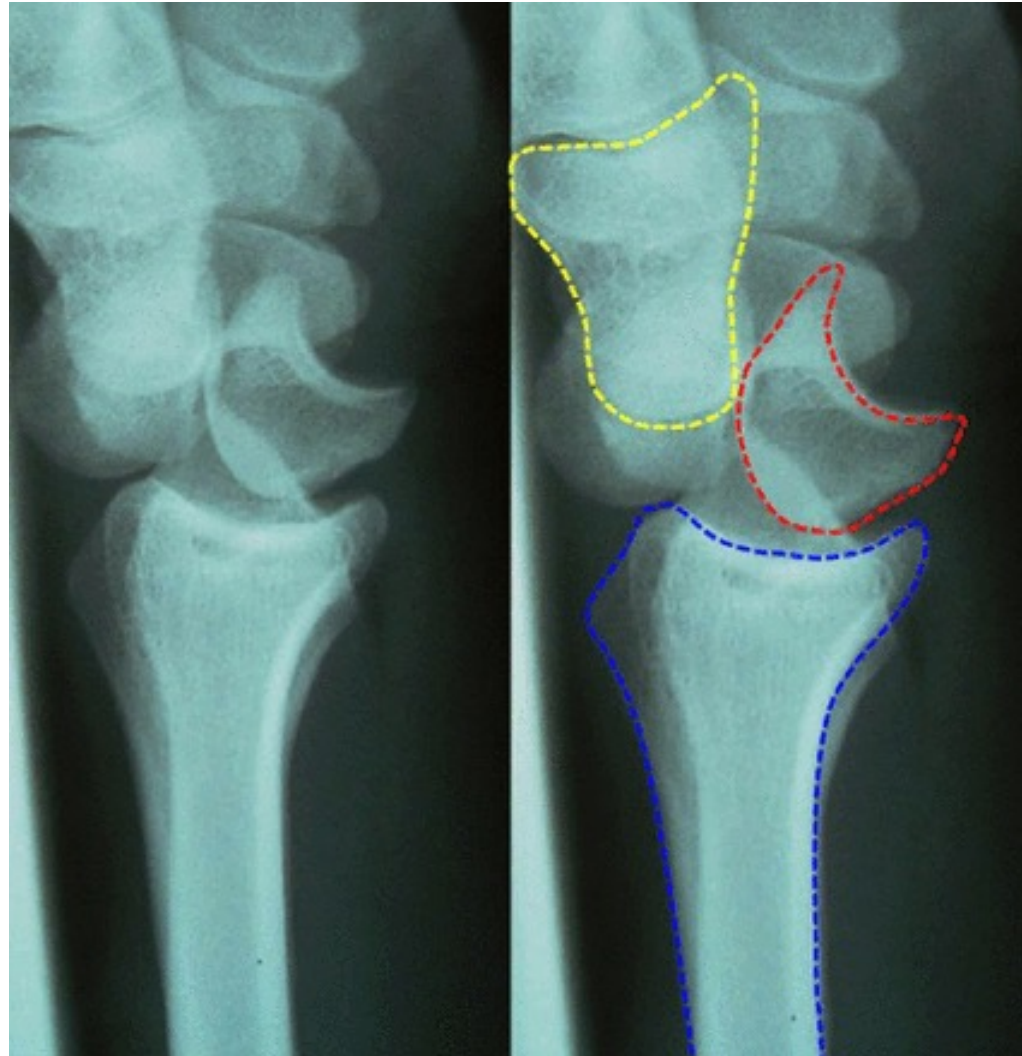
The Four C's



Lunate versus Perilunate Dislocation



Perilunate Dislocation



Perilunate Dislocation



Lunate Dislocation



Lunate Dislocation



Transcaphoid Perilunate Dislocation



CARPAL DISLOCATION

Treatment

- To achieve optimal results, all perilunate dislocations and all perilunate fracture dislocations require accurate open reduction and internal fixation as soon after injury as possible.
- The dislocation should be reduced as soon as possible.
- This may be performed in the emergency department, with delay of the definitive surgical procedure.

CARPAL DISLOCATION

Treatment

- Closed reduction may be attempted after a complete neurovascular examination is performed and proper radiographs are obtained.
- Adequate anesthesia guaranteed with an axillary block or general anesthesia.
- Closed reduction may be difficult if not impossible; the patient should be advised that open reduction may be needed.

CARPAL DISLOCATION

Reduction Techniques

- Perilunate dislocation: initial dorsiflexion, followed by gradual volar flexion. Pronation is then used to reduce the capitate back into the lunate.
- Lunate dislocation: the steps of perilunate reduction are followed by the operators stabilizing the lunate with their thumb as the capitate is brought into palmar flexion.
- With a scapholunate dislocation, the wrist is dorsiflexed and radially deviated.

Perilunate Dislocation

Post Reduction

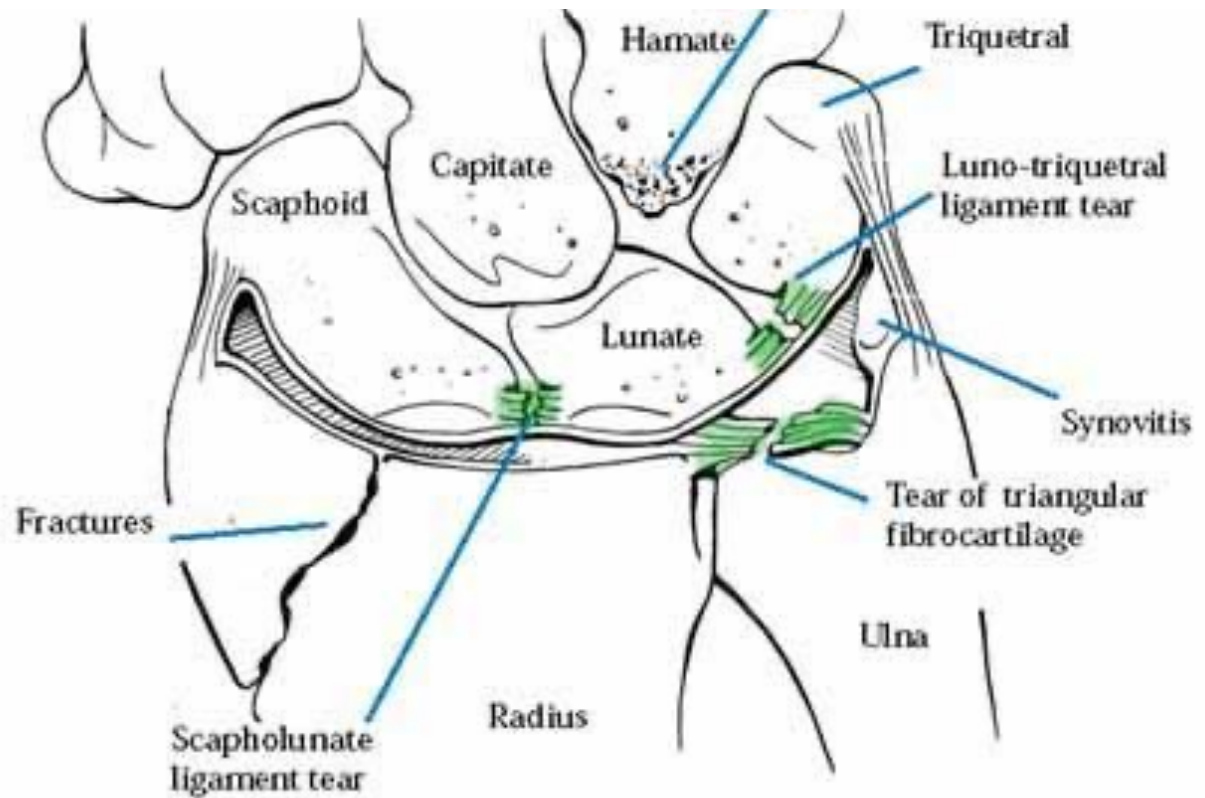


CARPAL DISLOCATION

Treatment

- Once closed reduction is attempted, PA and lateral images are obtained to confirm adequate reduction.
- Once reduced, the extremity is elevated and iced until the definitive procedure is performed.
- If closed reduction cannot be obtained in the emergency department, the patient must be promptly taken to the operating room for open reduction.
- Median nerve palsy is the most common complication following delay in the reduction of perilunate dislocation and perilunate fracture dislocations.

Lunotriquetral Ligament Injuries



Lunotriquetral Ligament Injuries

- Second most common intercarpal ligament injury
- Only one sixth as common as scapholunate ligament injury
- May occur with a FOOSH or twisting injury
- Wrist in hyperextension or extension with radial deviation
- Presents with ulnar sided wrist pain
- Pain worse with pronation and ulnar deviation – power grip
- A click on loading of the wrist may be noted

Lunotriquetral Ligament Injuries

Differential Diagnosis

- Triquetral Fracture
- Distal Ulna Fracture
- Triangular Fibrocartilage Complex (TFCC) Injury
- Pisotriquetral Sprain
- Extensor Carpi Ulnaris Tendonitis

Lunotriquetral Ligament Injuries

Physical Examination

Palpable pain at lunate-triquetral joint dorsally

Positive ballotment or Lunotriquetral shuck test

- grasp the lunate between the thumb and index finger of one hand while applying alternative dorsal and palmar loads across the triquetrum with the thumb and index finger of the other hand
- positive test elicits pain, crepitus or increased laxity, suggesting lunotriquetral interosseous injury

Lunotriquetral Ligament Injuries

Radiographs





**Lunotriquetral
Ligament
Injuries
VISI Deformity**

- Disruption of the dorsal radiocarpal and volar radiolunate ligaments
- Unopposed pull of the scaphoid brings the lunate into flexion
- Scapholunate angle < 30 degrees

**Lunotriquetral
Ligament
Injuries
Treatment**

Eighty percent of injuries without a VISI deformity will heal with conservative treatment – cast immobilization for 6 weeks

Acute instability treated surgically – ligament repair with k-wire fixation

Chronic instability – lunotriquetral fusion