SCAPHOID FRACTURE

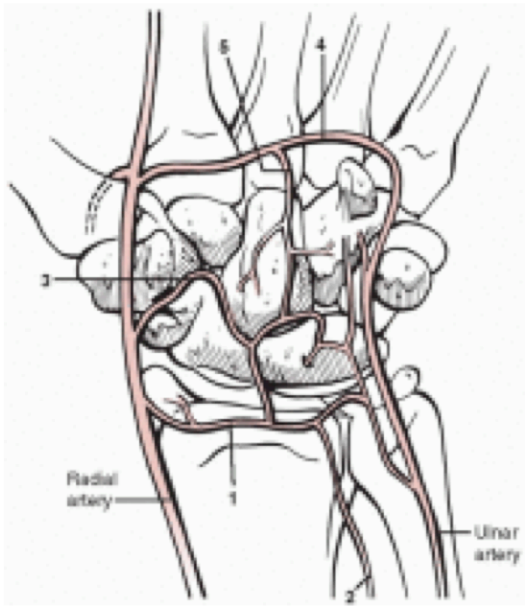
Relevant antomy

The proximal row consists of the **scaphoid**, the lunate, and the triquetrum.
The proximal carpal row is regarded as an "intercalated segment"
The keystone in the coordination of motions of the wrist as well as in the control of forces.

The distal row, which is more stable and moves as a unit, consists of the trapezium, the trapezoid, the capitate, and the hamate. The distal row forms a rigid, supportive transverse arch upon which the five metacarpals of the hand are supported. The trapezium articulates with the first metacarpal, the trapezoid with the second, and the capitate with the third one. The capitate and trapezoid are tightly connected to the metacarpals, whereas there is 30 to 40 degrees of flexion-extension and rotation at the metacarpotrapezial joint. The hamate articulates with the fourth and fifth metacarpal. The radioscaphoid ligament that inserts into the tuberosity of the **scaphoid** is the radial expansion of the radioscaphocapitate ligament.

The distal portions of the radiocapitate and ulnocapitate ligaments do not attach to the head of the capitate, but form a support sling commonly referred to as the "arcuate ligament." Between these two rows of ligaments is a thinned area called the space of Poirier.

Neurovascular Anatomy



Circulation of the wrist is obtained through the radial, ulnar, and anterior interosseous arteries and the deep palmar arch. An anastomotic network of three dorsal forms the extraosseous arterial pattern and three palmar arches.

The intrinsic blood supply to the carpal bones is an important factor in the incidence of avascular necrosis.

1. The **scaphoid**, capitate, and about 20% of all lunates are supplied by a single vessel
and thus are at risk for avascular necrosis.

2. The trapezium, triquetrum, pisiform, and 80% of lunates receive nutrient arteries
through two nonarticular surfaces and have consistent intraosseous anastomoses.
AVN is therefore rare.

3.The trapezoid and hamate lack an intraosseous anastomosis and, after fracture, can
have avascular fragments.

With fracture-dislocations of the wrist, the palmar radiocarpal arch usually remains intact, because the dislocation is distal through the space of Poirier.

Mechanism
An axial compression force applied with the wrist in hyperextension.

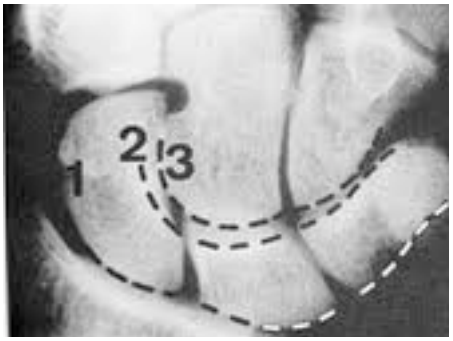
Normally, in the coronal plane, the center of rotation of the wrist is located within a small area in the capitate neck. A line drawn through the axis of rotation parallel with the anatomic axis of the forearm will, with the hand in neutral position, pass

Special Imaging Techniques

Normal on wrist X ray: The longitudinal axes of the long finger metacarpal, capitate, lunate, and the radius all fall in the same line.

The scapholunate angle averages 45 degrees, and ranges from 30 to 60 degrees in normal wrists. An angle greater than 70 degrees suggests instability, and one greater than 80 degrees is almost certain proof of carpal instability or displacement. A capitolunate angle of more than 20 degrees is also strongly suggestive of carpal instability.

Gilula's lines



Gilula's lines (three smooth radiographic arcs) Arthrography, magnetic resonance (MR) wrist arthrography, videoradiography, and arthroscopy can assist in the diagnosis of carpal ligament injuries. Computed tomography (CT) scans are helpful in evaluating carpal fractures, malunion, nonunion, and bone loss. Three-dimensional imaging is of use in planning reconstructive

Bone scans can be helpful in confirming occult fractures and avulsion injury

MRI

Pearls and Pitfalls

Standard **scaphoid** views detect most carpal injuries.

A DISI pattern is most commonly observed with displaced **scaphoid** fractures and SLD.

A VISI pattern is more likely to be associated with LTD.

MRI scans are useful in detecting occult fractures, AVN of the carpal bones, and ligamentous injuries.

Perilunate dislocations are easily missed if the continuity of Gilula's line is not assessed.

SCAPHOID FRACTURES

Scaphoid fractures account for 2.9% of all fractures

70% of all carpal injuries

The average time for healing of a nondisplaced **scaphoid** fracture in a cast is 8 to 12 weeks, accounting for a considerable loss of time and productivity in this young

Anatomy

It resembles a deformed peanut or a boat (in Greek, skaphos means boat).

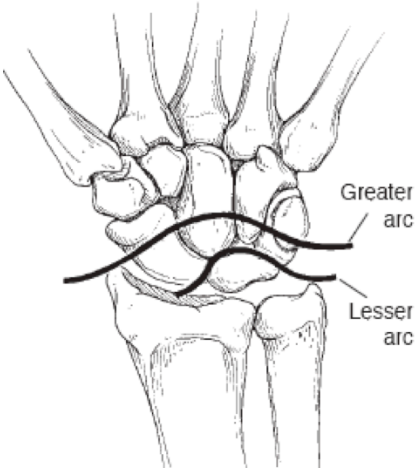
80% of its surface being covered by articular cartilage

Biomechanics and mechanism

The **scaphoid** acts as a link across the midcarpal joint.

Any shear strain that occurs across the midcarpal joint is transferred through the **scaphoid** and may cause fractures and dislocations. Through its stout proximal and distal ligamentous connections, the **scaphoid** serves to coordinate and

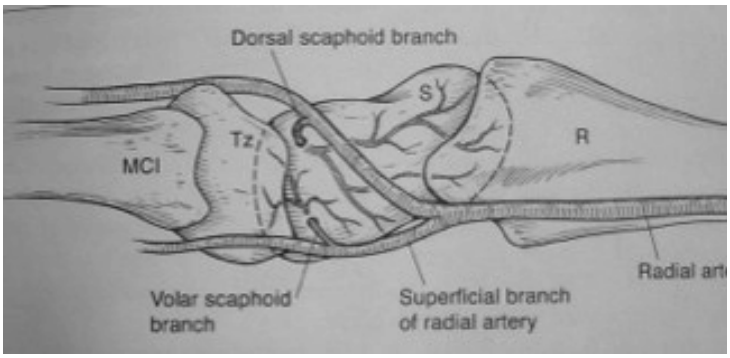
by an intact **scaphoid**.



The mechanism of fracture is usually considered to be bending with compression dorsally and tension on the palmar surface, due to forced dorsiflexion of the wrist. When the wrist is extended beyond 95 degrees, the proximal pole of the **scaphoid** is tightly held between the capitate, the dorsal lip of the radius, and the taut palmar capsule. Fracture of the **scaphoid** occurs at the waist which is exposed to the maximal bending movement

Vascularity of the scaphoid

1. Volar: enters the **scaphoid** tubercle and supplies its distal 20% to 30%
2. Dorsal: The dorsal **scaphoid** branch of the radial artery. The dorsal ridge vessels enter through numerous small foramina along the spiral groove and dorsal ridge. This source accounts for about 80% of the blood supply.



Because of its unusual retrograde vascular supply, the **scaphoid** has a high risk of nonunion and AVN after fracture. Temporary interruption of the blood supply to the proximal fragment is virtually certain with proximal pole fractures but, if stabilized, the proximal pole has the capacity to revascularize and heal.

Signs and Symptoms

Usually complain of wrist pain after a fall on the outstretched hand.
90% of patients recalling a hyperextension injury
Tenderness over the snuff box
Swelling and pain are usually apparent in acute fractures
The Kirk-Watson test

Missed diagnosis is not uncommon and often results in additional morbidity from secondary changes, including nonunion, collapse deformity, and degenerative arthritis.

Why scaphoid fracture wrongly diagnosed on X ray?

1. The dorsal lip of the radius overlapping the scaphoid may form a dark line.
2. The presence of a white line formed by the proximal end of the **scaphoid** tuberosity
3. The dorsal ridge of the **scaphoid** may appear bent on the semisupinated view.
4. Fracture line may not be visible

Clinical studies have shown that **scaphoid** and pronator fat stripe signs are poor predictors of the presence or absence of underlying occult fractures. If there is clinical suspicion but radiographs are negative, a **scaphoid** cast is applied and another set of **scaphoid** views is performed after 10 days.

MRI scans are the most effective way of diagnosing **scaphoid** fractures. It has been shown that an MRI performed as early as 48 hours after the injury has a sensitivity and specificity approaching 100%.

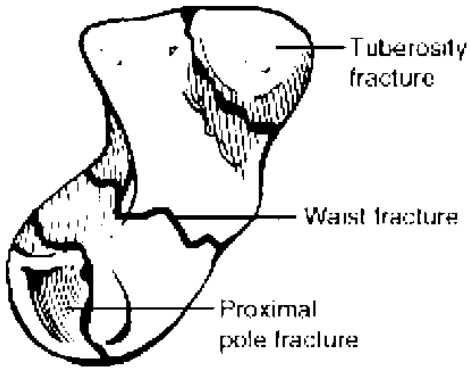
Differentiation between an acute **scaphoid** fracture and a **scaphoid** nonunion is important for planning

1. Not uncommonly, a second injury will draw attention to a minimally symptomatic nonunion
2. A single line through the bone, occasionally with dorsoradial comminution and dorsal angulation, represents the acute scaphoid fracture. 3. Late presentation of a fracture or an established nonunion may show resorption at the fracture site, subchondral sclerosis, and displacement.

The longer the time since injury, more the secondary changes: the greater the cystic resorption, the denser the sclerosis, the more prominent the shortening of the **scaphoid**, and the greater the loss of carpal height. Secondary degenerative changes are **usually present by 10 to 15 years**.

Associated Injuries

1. Fractures of the distal radius
2. Perilunate dislocation
3. Ligament damage



Classification

Waist fractures account for 65%
Proximal pole 26%
The tuberosity 9%

Herbert Classification

Gelberman confirmed earlier studies by demonstrating that the major blood supply comes from the **scaphoid** branches of the radial artery which enter the dorsal ridge and supply 70% to 80% of the bone.

100% of tuberosity and distal third **scaphoid** fractures will heal
80% to 90% of waist fractures
60% to 70% of proximal pole fractures will heal.

Type A stable

. Fracture appears incomplete (only one cortex involved)
. Union normally rapid
. Minimal treatment required

Type A1: Fracture of Tuberosity
Type A2: Incomplete Fracture through Waist

Type B: Unstable Acute Fractures
Fracture likely to displace in plaster
Delayed union common
Internal fixation is the treatment of choice

Type B1: Distal Oblique Fracture
Type B2: Complete Fracture of Waist
Type B3: Proximal Pole Fracture
Type B4: Transscaphoid-Perilunate Fracture-Dislocation of Carpus
Type B5: Comminuted Fractures

Type C: Delayed Union
Widening of the fracture line
Development of cysts adjacent to the fracture
Relative density of the proximal fragment

Type D: Established Nonunuion

Type D1: Fibrous Union
Type D2: Pseudarthrosis

Occult Scaphoid Fractures

Undisplaced fissures and fractures of the **scaphoid** might not be visible on the initial set of radiographs. Patients with wrist injuries are usually seen in the emergency department by less experienced doctors who are aware of the dangers of missing a **scaphoid** fracture and who know that up to 30% of all **scaphoid** fractures might not be detected on initial radiographs. To avoid missing a few occult fractures of the **scaphoid**, some patients are immobilized for prolonged periods of time without a diagnosis being made before being seen by a senior

surgeon.

Diagnosis of Occult Scaphoid Fractures

MRI has a higher sensitivity and specificity in the diagnosis of occult fractures of the **scaphoid** compared to other methods. Because of its high sensitivity and specificity, MRI is the criterion standard in the diagnosis of occult fractures of the wrist.

Only 30% of all **scaphoid** fractures are truly occult, but 85% of all other carpal fractures are true occult fractures. About 66% of carpal avulsion fractures and distal radial fractures are detectable on the initial set of **scaphoid** views.

Current Treatment Options

I Occult Fractures

A simple Colles forearm cast should be used for 4 to 6 weeks.
Check radiographs should be obtained at the time of cast removal.
If there are still clinical and radiologic signs of a **scaphoid** fracture, another cast is applied for an additional 2 weeks.

If MRI is not available and there is clinical suspicion of an occult fracture of the **scaphoid**, a Colles cast should be applied. Patients with a suspected occult **scaphoid** fracture and negative radiographs are treated by the application of a Colles cast for 10 to 14 days.

II Fractures of the Tubercle (Type A1)

These are benign fractures and represent an avulsion injury. Splinting or cast for 4 weeks.

III Undisplaced Scaphoid Fractures (Type A2)

If there is doubt about the fracture type and the presence of displacement, a CT scan is recommended with the treatment being based on the findings.

Most authors suggest that cast immobilization is the method of choice for the primary treatment for undisplaced fractures of the **scaphoid.**

Type of cast

Above-Elbow Casts: Studies have shown no advantage to the use of above-elbow casts.
Scaphoid Casts: Böhler proposed the use of a the cast to include the proximal phalanx of the thumb. This method of treatment quickly became accepted and is still used in many hospitals.

Colles cast: Clay in a large prospective randomized study, showed that there was no difference in union rates whether the thumb was immobilized or not. For this reason, the use of Colles or forearm casts, rather than **scaphoid** casts, is advocated.

There is a general consensus that most stable **scaphoid** fractures unite in 6 to 8 weeks with cast immobilization. However, bone consolidation can take 12 to 16 weeks and some fractures will not have healed even after this time.

significantly better results and a significantly lower rate of nonunion together with shorter times to return to work and sports when
compared to conservative treatment. Other surgeons have corroborated these findings.

IV. Displaced fracture: ORIF

A displaced fracture is defined as one with more than 1 mm of step-off or more than 60 degrees of SL or 15 degrees of lunatocapitate angulation as observed on either plain radiographs or CT scans.

There were advantages in the operated group in early return of movement, better early patient-orientated outcome measures, and a maintained improvement in grip strength throughout the period of review.

Ten patients in the cast group developed nonunion compared to none in the operated group. The disadvantage of open reduction and internal fixation were minor problems with the scar. Despite these findings, the authors concluded that **scaphoid** waist fractures should be treated in a cast.

My Preference

Percutaneous Screw Fixation

Majority of young high-demand patients, where can be well reduce.
The method is relatively easy.
In compliant, patient can be allowed without cast immobilization.
The advantage of this minimally invasive method is early return to sports and work.
No serious complications

Volar percutaneous fixation:
AO cannulated 3.5 screw or Acutrak screw.

1. Position: Folded towel to dorsiflexion and ulnar deviation the wrist

2. I.I: AP and Lateral

3. Stab incision over the scaphoid tuberosity and confirm on I.I. Spread the soft tissue with blunt dissection

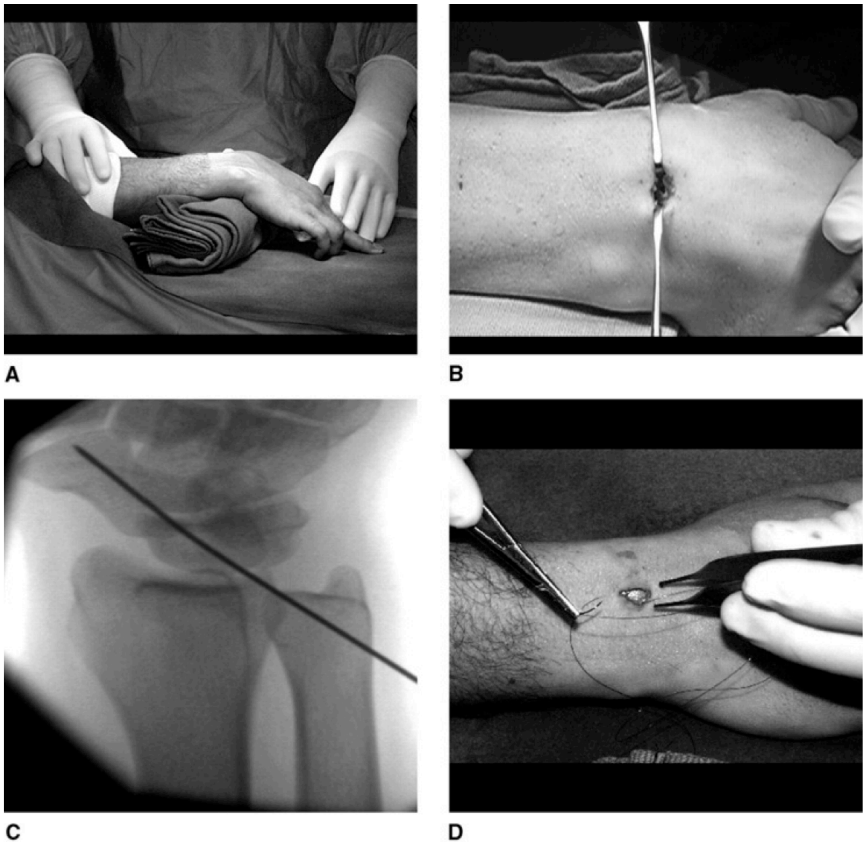
4. Wire is inserted to support the fracture site and avoid rotational deformity.[Derotation wire]

5. II wire is the guide wire in the centre of the scaphoid. K wire at 45° to the forearm in the coronal and sagittal planes. Should be in the centre

6. The length of the screw is then measured and approximately 3 mm subtracted from the length to avoid prominence at either end.

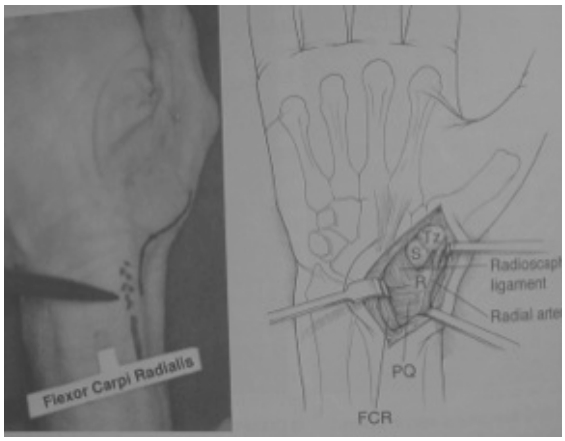
6.A central position of the screw without joint penetration at the radiocarpal joint or prominence at the scaphotrapezial joint should be confirmed with AP, lateral and supinated and pronated views of the wrist.

Dorsal Percutaneous fixation



Unstable and Displaced Fractures (Type B2)

1. Dorsal or volar approach



2. Two pins should be inserted, one in each fragment, and these pins are used as joysticks to reduce the fracture. A temporary Kirschnerwire (K-wire) can be inserted to maintain the reduction, and the guidewire for the screw is then introduced.

Volar Approach
1.Volar approach
Curvilinear incision
Lateral to FCR [retracted ulnar words]
Dissect through FCR bed
Preserve as much radioscaphocapitatae ligament
Correct Hump back [joy stick]
Do not disrupt dorsal cortex; use small osteotome or burr
2 K wires [derotation wire]
Correction of Hump back corrects DISI to some extent
Union rate 90%

2. Dorsal approach
Longitudinal incision in the midline over the Radiocarpal joint
The sheath of EPL is released [III compartment]
L shaped incision incision on the capsule: capsule taken from radial side
Dissect capsule on either side close to the bone
Define S-L articulation
Needle under I.I to identify NU site [as it is difficult]
Remove necrotic bone with small curette
Acutrak screw
Vascularised bone graft described by Zaidemberg

Proximal Pole Fractures (Type B3)
Proximal pole fractures : Always treated operative.

Transscaphoid-perilunate dislocation