Management of Acute Scaphoid Fractures

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Conflict of Interest Statement

- I have no relevant conflict/ disclosures regarding this presentation and it's content

Scaphoid Fractures

- Introduction
- Anatomy
- Biomechanics
- History
- Clinical examination
- Radiographic evaluation
- DDx
- Classification
- Treatment
- Complications

Scaphoid fractures Introduction

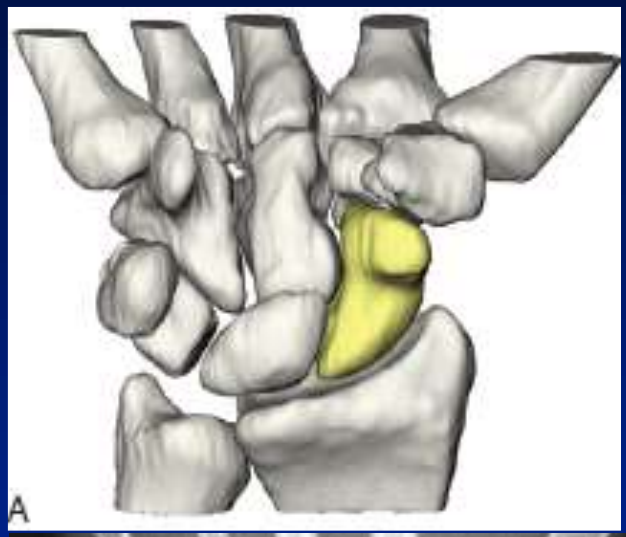
- Scaphoid fractures constitute 60-70 % of all carpal bone fractures
- Second only to the distal radius in frequency
- Due to the importance of scaphoid in wrist mechanics and because of the frequency of the fracture in young adult male, it has an economic as well as physical significance
- Uncommon in children because the physis of distal radius fails first

Anatomy

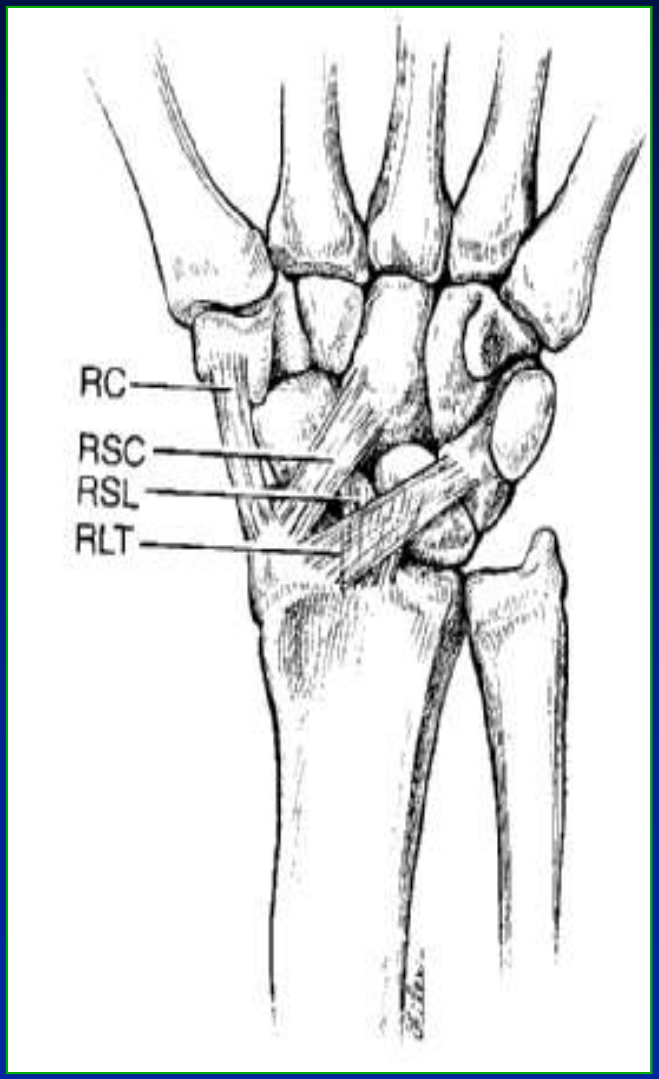
- Also called **Navicular**
- An irregular shaped bone ,more resembling a twisted peanut than the boat for which it is named
- Scaphoid represents floor of the anatomic snuff box

Scaphoid Fractures Anatomy

- 80% surface area covered by articular cartilage
- Limiting ligamentous attachments & vascular supply
- Articulates with 5 bones
  - *Proximal pole:* scaphoid fossa of radius
  - *Ulnar border concavity:* capitate
  - *Distal tubercle:* trapezium and trapezoid
  - *Lunate fossa:* lunate



Anatomy -ligaments



Anatomy

Blood Supply

- Major blood supply comes from the scaphoid branches of the radial artery entering the dorsal ridge at or just distal to waist area and supplying 70-80 % of the bone including the entire proximal pole - in a retrograde fashion

- Second group of vessels, arise from palmar & superficial palmar branches of radial artery & enter the distal tubercle, it perfuses distal 20-30 % of bone, including tuberosity

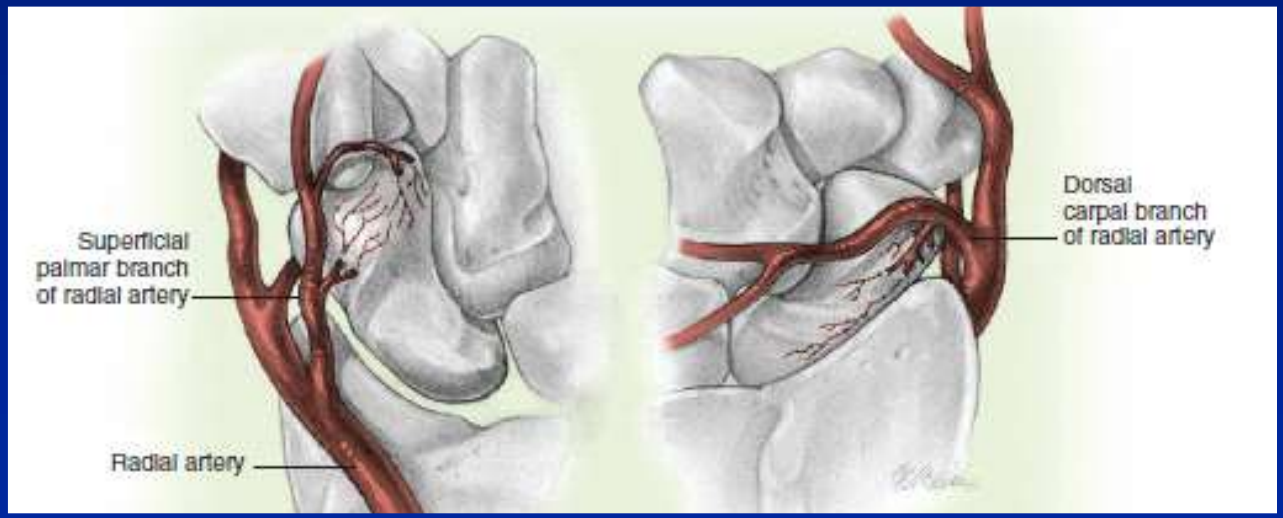
Blood Supply

- There are no anastomoses between the dorsal and palmar vessels
- Vessels enter thru dorsal ridge in 79 %, distal to waist in 14 %, & proximal to waist in 7 %
- Fractures across scaphoid may destroy blood supply to its proximal part

Anatomy

Blood supply from *radial artery branches*

- Dorsal carpal branch
  - - Enter via narrow dorsal ridge along waist
  - - Perfuses 70% of scaphoid, including proximal pole
- Superficial palmar branch
  - - Enter via distal tubercle
  - - Perfuses 30% of scaphoid, including tuberosity



Scaphoid Fractures Anatomy

Gelberman RH, Menon J: The vascularity of the scaphoid bone, **J Hand Surg [Am]** *5:508-513, 1980*

Biomechanics

- Mechanically scaphoid links the proximal and distal rows
- Scaphoid spans both carpal rows and therefore has less mobility than other carpal bones
- Scaphoid carries the compressive loads from the hand across the wrist to the distal forearm

Biomechanics

- Scaphoid flexes with wrist flexion & extends with wrist extension
- It also flexes during radial deviation & extends during ulnar deviation
- These factors make immobilization of scaphoid fractures difficult especially when there is displacement

Biomechanics

- Scaphoid is a principal bony block to dorsiflexion of hand & wrist , and is susceptible to frx during fall on outstretched hand
- With scaphoid fx, distal scaphoid tends to flex, & proximal scaphoid extends with the proximal carpal row ,, because of this, angulation occurs at fx site, which gradually leads to a **humpback** deformity

Mechanism of injury

Two different mechanisms

1. **Compression injury :**
   usually results in non displaced fx
2. **Hyperextension bending injury :**
   usually results in displaced fx

Diagnosis

- A strong index of suspicion is the key to early diagnosis
- The diagnosis should be based on :

  History

  Clinical examination

  Radiographic evaluation

History

- Occurs after a fall on an outstretched hand, athletic injury, or MVA
- Usually happens in young adult men
- Pain at the radial side of the wrist
- Associated injuries

Clinical Examination

- Should demonstrate tenderness in the anatomic snuff box
- Tenderness to palpation over scaphoid tuberosity and/or proximal pole just distal to Lister's tubercle
- Tenderness with axial compression of thumb toward the snuff box
- Tenderness as patient supinates forearm against resistance

Clinical Examination

- Radial & ulnar deviation results in pain on radial side of wrist
- Forced dorsiflexion usually elicits significant tenderness
- There is usually pain at extremes of motion
- Limitation of wrist motion – but not dramatically
- Swelling – usually not present

Scaphoid tenderness may be identified through palpation dorsally within the anatomical snuffbox.

Tenderness also may be identified palmarly at the scaphoid's tuberosity, radial to the flexor carpi radialis tendon at the proximal wrist crease. The wrist should be extended.

Acute Scaphoid Fractures
Case example

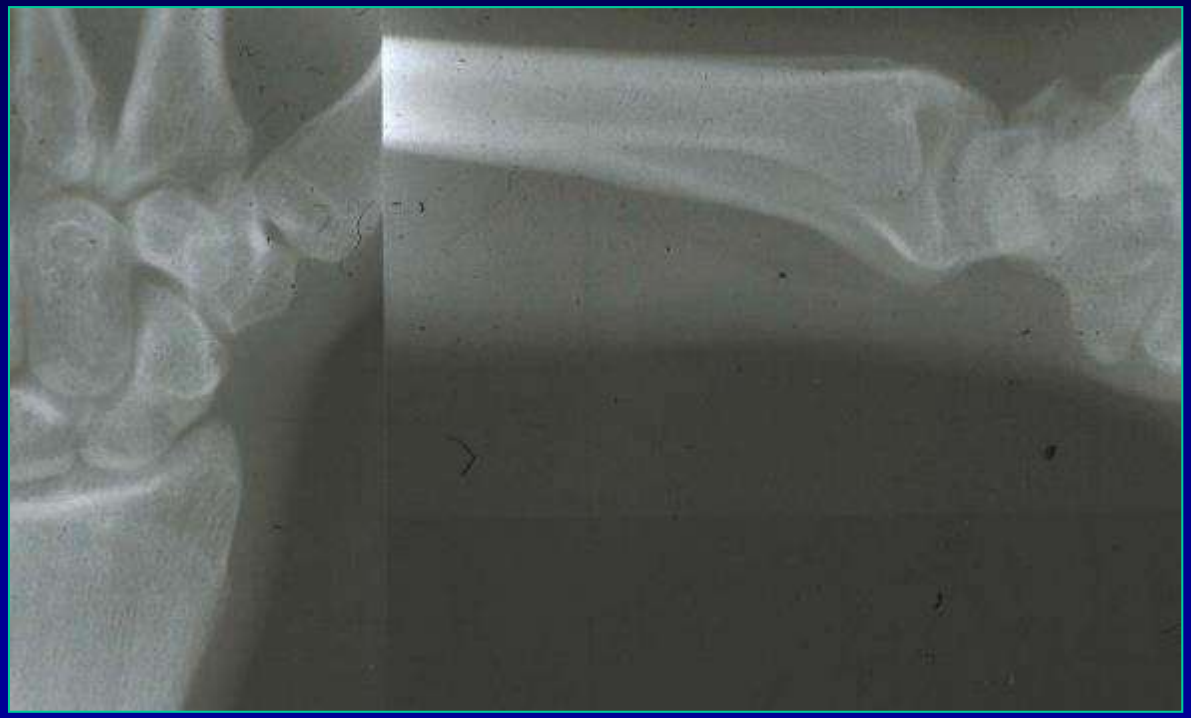
- 17 yr old student & football player
- Injury 04/13
- CC: pain in wrist
  - Rt hand dominant
  - Pain with activity
  - Splinting but allowed to play

Acute Scaphoid Fractures

- Continued pain in June, 2013
  - Clinical exam 2 mos later
    - Painful wrist motion
    - Reduced grip strength
    - Tenderness in “snuffbox”
    - X-ray films show scaphoid fx

Acute Scaphoid Fracture

>Acute Fracture: Any evidence of a fracture?



Acute Scaphoid Fracture

Stress Views: Displacement??

Acute Scaphoid Fracture

: Imaging of wrist

- **Options:**

  - **Computed Tomography**
  - **MRI**
  - **Bone Scan**

Acute Scaphoid Fracture

- CT of wrist selected
  - Wide S-L interval
  - Scaphoid nonunion
  - Mild DISI deformity
  - Mild proximal scaphoid density

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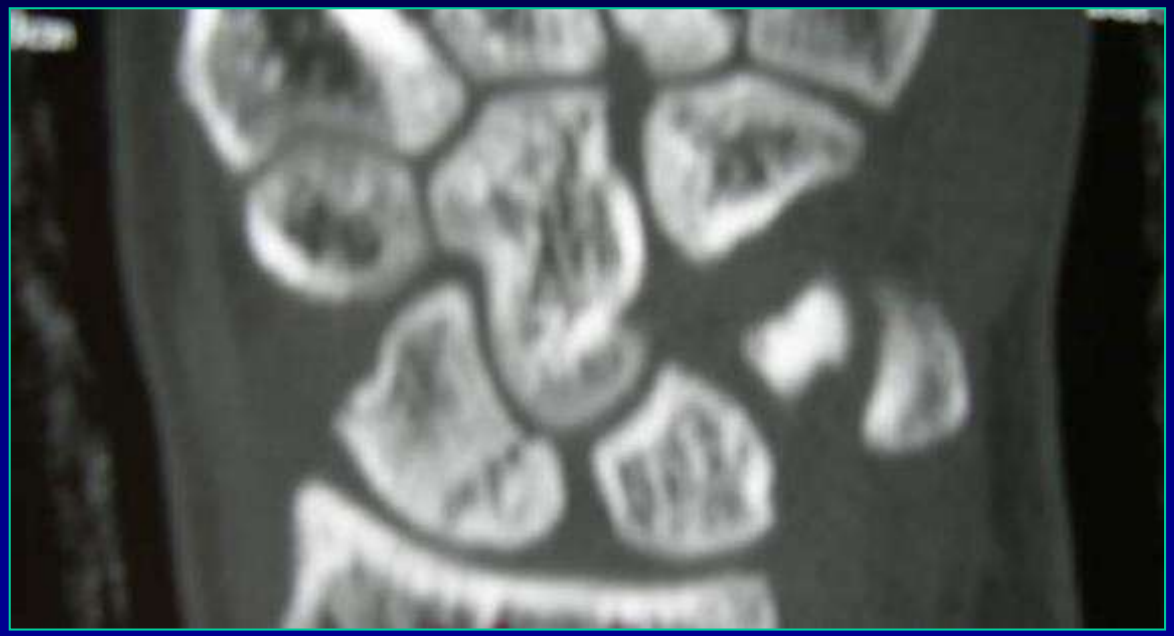
Acute Scaphoid Fracture

Wrist CT
Proximal 1/3
fracture



Acute Scaphoid Fracture

Wrist CT

Acute Scaphoid Fracture

- **Treatment Options:**
  - **Long arm cast**
  - **ORIF with K-wires**
  - **ORIF with K-wires and bone graft**
  - **ORIF with compression screw**
    - **With bone graft (Cancellous)**

Acute Scaphoid Fracture

Proximal

Herbert Screw Insertion

Acute Scaphoid Fractures

Buried Herbert Screw

Acute Scaphoid Fractures

Intra operative Image

Biomechanics

- **Hyperextension of the wrist >95%**

- Cadaveric study, wrists placed in extreme dorsiflexion and ulnar deviation produced fractures through the scaphoid *waist* as the scaphoid impinged on the dorsal rim of the radius.
- *Proximal scaphoid fractures* resulted from dorsal subluxation during forced hyperextension.

Weber ER, Chao EY: An experimental approach to the mechanism of scaphoid waist fracture, *J Hand Surg [Am]* 3:142-148, 1978

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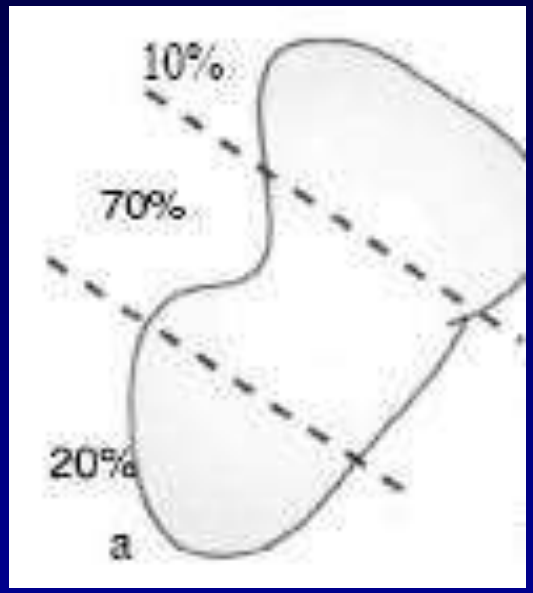
Scaphoid Fractures

- Anatomic location
  - 70% waist
  - 20% proximal pole
  - 10% distal pole



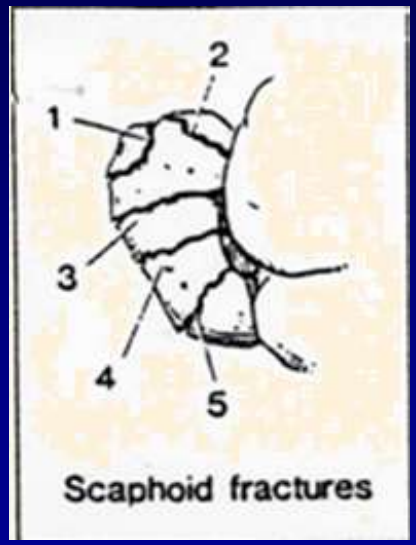
Acute Scaphoid Fractures

- **Classification of Scaphoid Fractures**

  - **Mayo Classification: fracture localization**
  - **Russe classification: fracture plane**
  - **Herbert & Fisher: stability**

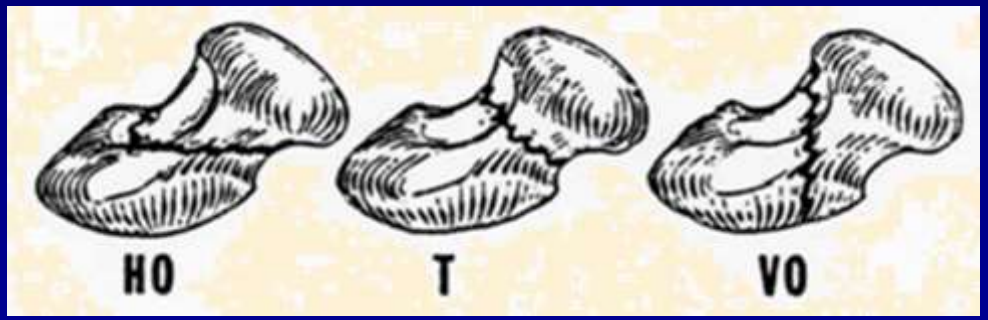
Classification

- Mayo classification
  - Based on fracture location
    - 1- Tuberosity
    - 2- Distal articular surface
    - 3- Distal third
    - 4- Waist, middle third
    - 5- Proximal pole



Classification

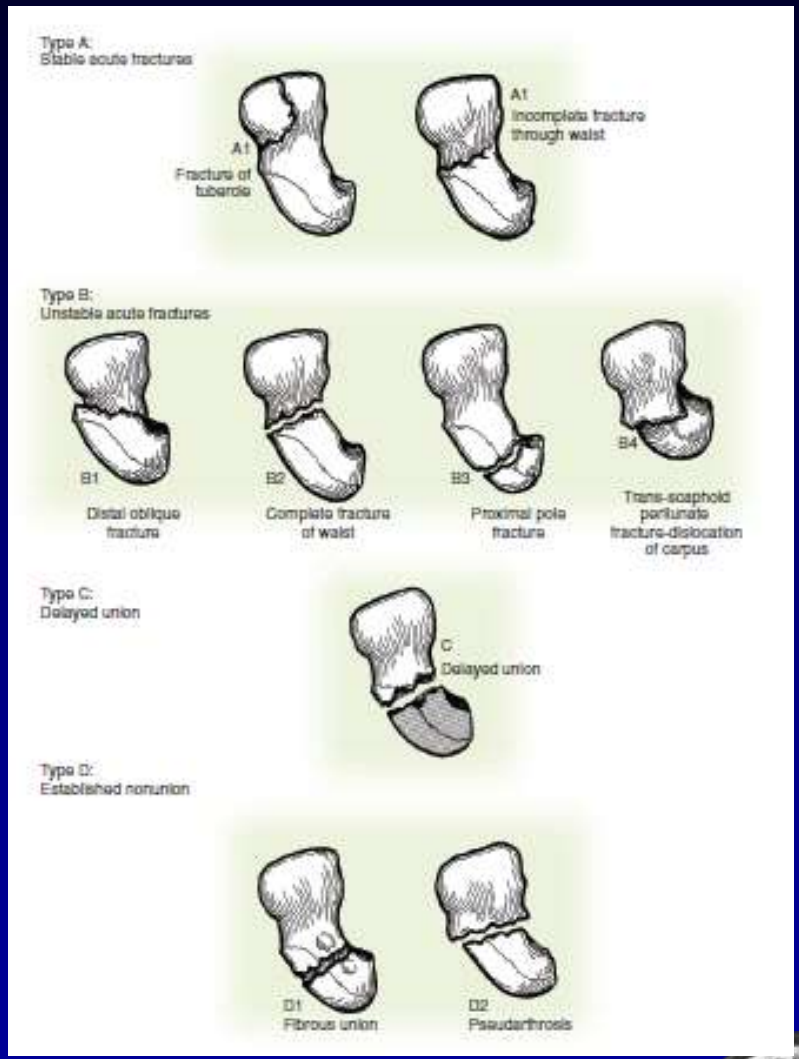
- **Russe classification**
  - **Fracture line relationship to long axis of scaphoid**
  - **Increasing obliquity = worse prognosis**



HO= Horizontal oblique, T= Transverse, VO= Vertical oblique

Classification

- Herbert Classification
  - Based on fracture anatomy, stability, and history
  - A – stable
  - B – unstable
  - C- delayed union
  - D – established nonunion



Classification

- **Cooney et al. further modified fracture classification by identifying unstable injuries.**
  - ***- fractures > 1 mm of displacement***
  - ***- lateral intrascaphoid angle > 35 degrees***
  - ***- bone loss or comminution***
  - ***- Perilunate fracture-dislocation***
  - ***- DISI alignment***
  - ***- proximal pole fractures.***

- **He advocated open surgical fixation for all unstable injuries.**

- **Rationale for Operative Treatment**
  - **Nonunion rate- 15-40%**
  - **Malunion rate - 10-30%**
  - **Delayed healing- cast 3-6 mos**

- Scaphoid bone with a large articular surface has a greater risk of non-union, no external collar of fracture callus is formed to stabilize bone.

- The purpose of implants is to stabilize the fracture site to prevent shearing that disrupts the internal healing process.

Acute Scaphoid Fractures

- The Role of Limited Open Reduction and Internal Fixation
- Indications
  - Minimal displaced
    - Compression

Acute Scaphoid Fractures

- **Assumption: all acute scaphoid fractures are unstable.**

Acute Scaphoid Fractures

Diagnosis of Fracture

- ☆ Clinical Exam
- ☆ Radiographic Confirmation

Acute Scaphoid Fracture

- **Imaging Studies**
  - Ultrasound (70%sensitivity, low specificity)
  - Bone Scan (90% sensitivity; 92% specificity)
  - MRI (95% sensitivity, 100% specificity)
  - Tomography (95% sensitivity & specificity)

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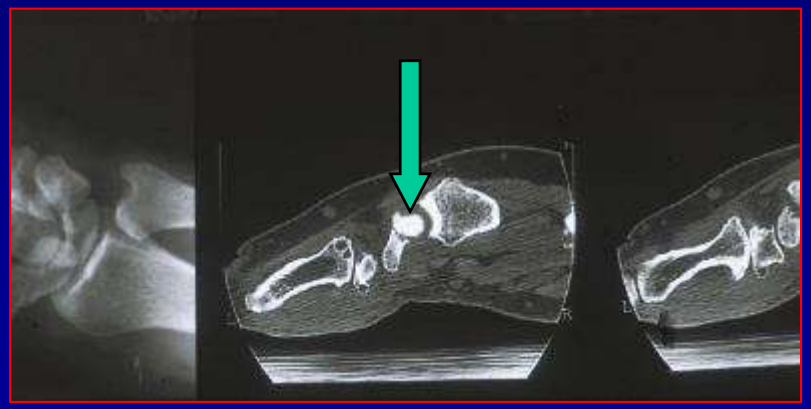
Acute Scaphoid Fractures

- **Bending Fractures with**
  - **1mm of articular step-off**
  - **60* scapho-lunate angle**
  - **30* intra-scaphoid angle**

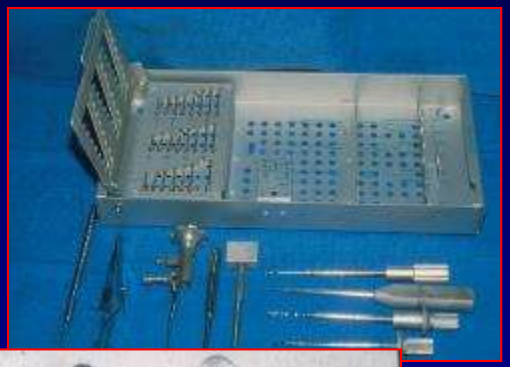


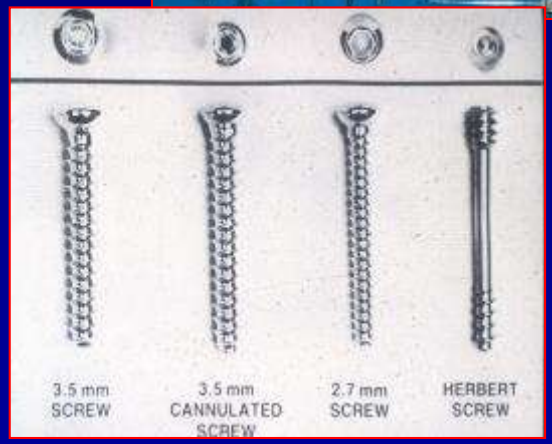
Acute Scaphoid Fractures

- **Bending Fractures with Angulation**
  - **Best treated with**
    - **Open reduction**
    - **Screw fixation**

Acute Scaphoid Fractures

- **Options for Internal Fixation**
  - **Herbert Screw**
  - **AO-ASIF Screw**
  - **Twin Fix Screw**
  - **Herbert Cannulated**
  - **Accutrac**





Acute Scaphoid Fractures

Percutaneous Pin Fixation: What are the Indications?

Displaced Fracture

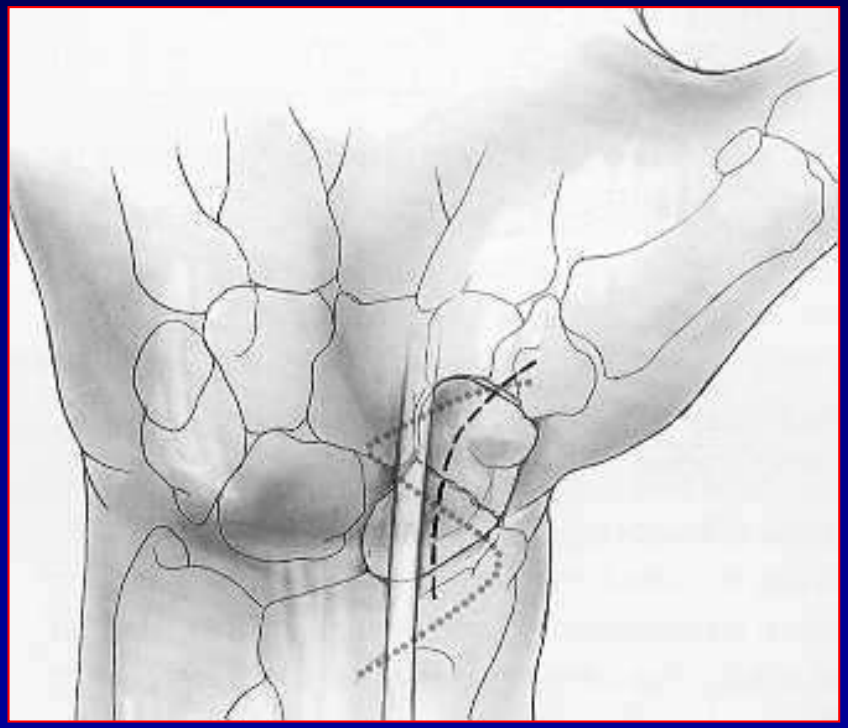
Acute Scaphoid Fractures

Percutaneous
Screw
Insertion

Limited
Exposure

Acute Scaphoid Fractures

Surgical technique with a palmar approach



Acute Scaphoid Fractures

- **Current Preference- Internal Fixation**
  - **Cannulated Herbert type Screw**

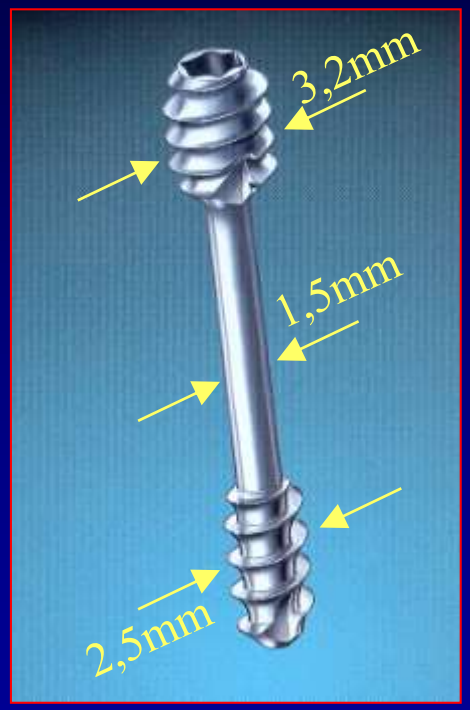
Acute Scaphoid Fractures

Both threads are self-cutting

- Use with Heune Jig

-Free-Hand-Length: 1mm steps from 10mm-30mm

- Material: Ti6AL4V-Titanium



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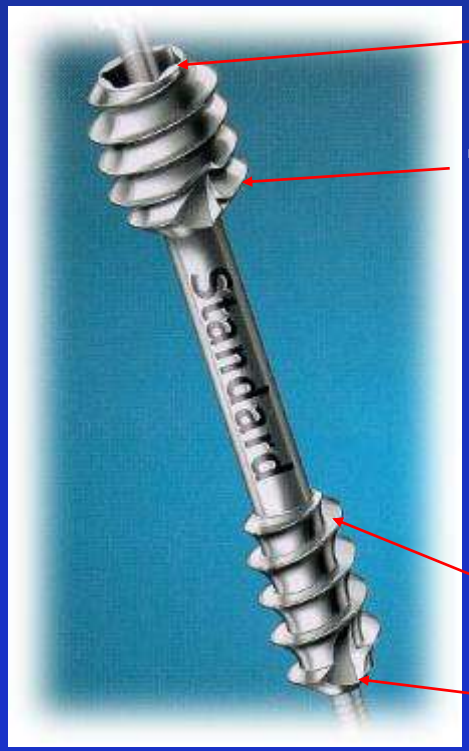
Acute Scaphoid Fractures

New Cannulated Herbert Screw



Diam. 3.9mm

Thread pitch 1.0mm

Cannulation for 1.0mm K-wire

Thread pitch 1.5mm

Diam. 2.9mm

Acute Scaphoid Fractures

New Cannulated Herbert Screw

Countersink beneath bone/cartilage

Retrograde or Antegrade placement

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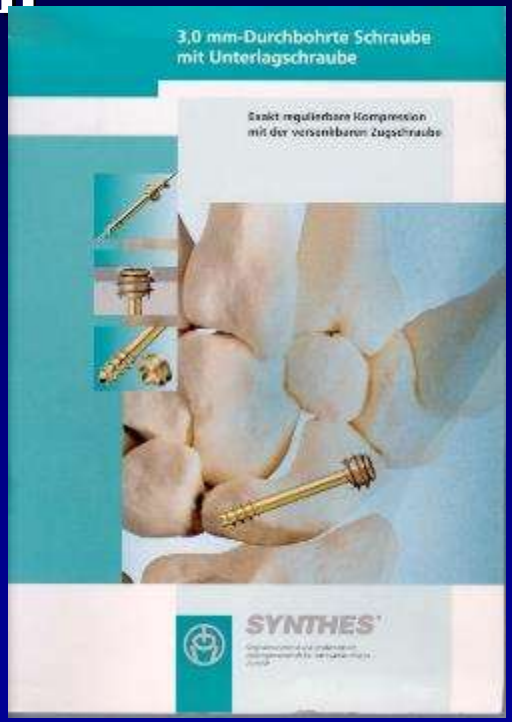
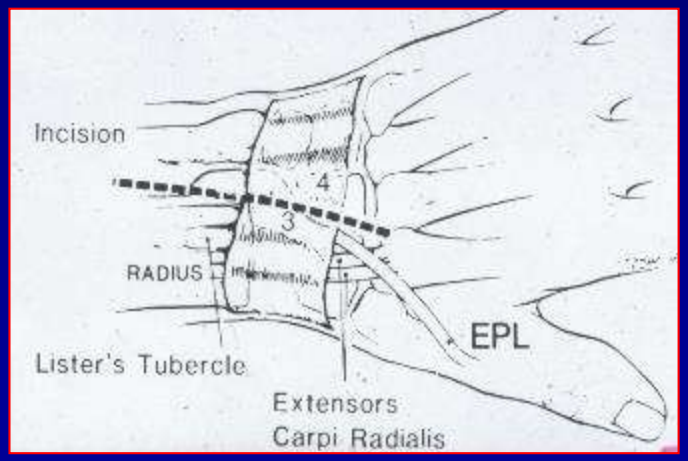
Acute Scaphoid Fractures

- **Options for Internal Fixation**
  - **Herbert Screw****
  - **AO-ASIF Screw**
  - **Herbert- Whipple**
  - **Twin Fix**

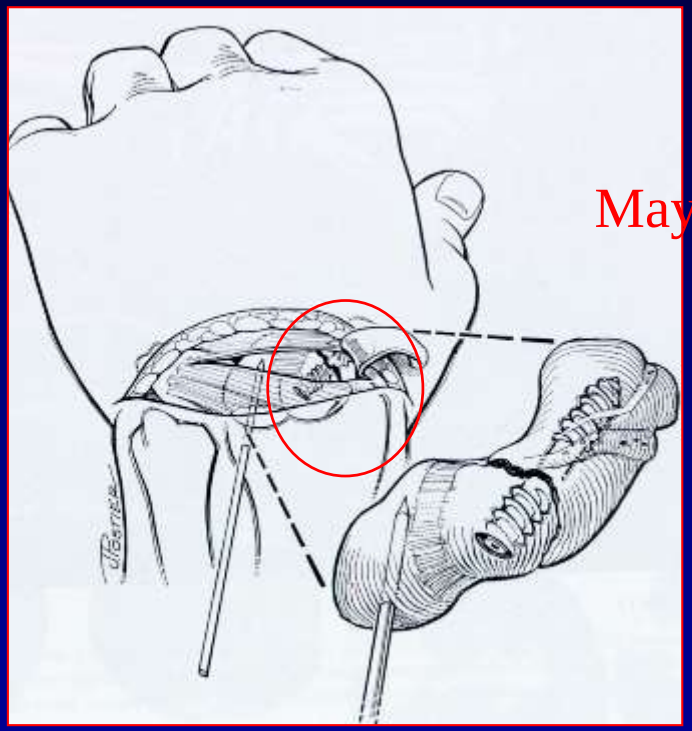


Acute Scaphoid Fracture

- **Operative Approach-preferred**
  - **Dorsal: proximal 1/3 fracture**
  - **Palmar : distal 1/3 fracture**
  - **Palmar: mid 1/3 fracture**



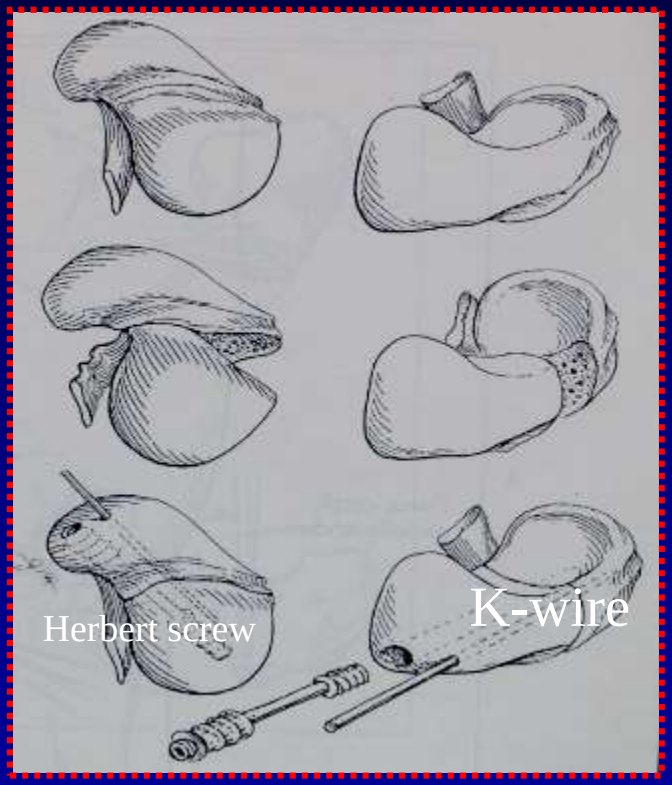
Acute Scaphoid Fractures



Mayo capsular flap

Retrograde Screw Placement

Acute Scaphoid Fractures



- >Dorsal Approach
- >Reduce 3-D displacement
- >Retrograde Screw Insertion
- >Stabilize with K-wire

Acute Scaphoid Fractures

PROBLEMS

Incorrect insertion

Acute Scaphoid Fractures

PROBLEMS- Collapse

Oversized screw
Collapse and
Catastrophe

Screw size too long

Acute Scaphoid Fractures

- **Controversial Areas**
  - ***Should ORIF of scaphoid be routine?***
  - ***What is role of percutaneous screw fixation - considering three degree displacement?***
  - *Should we accept Scaphoid malunions?*

Acute Scaphoid Fractures

- **Controversial Areas**
  - *Accepting some degree of scaphoid malunion !! Clinical results OK*
  - *Immobilization post surgical fixation*
    - *Not required- Herbert*
    - *Required - Mayo; Barton/Dias*
  - *Associated S-L disassociation: repair and k-wire fixation*
  - *Athletic Injuries: early return to play*

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Acute Scaphoid Fractures

Summary

Assume All Scaphoid Fractures are Displaced

>ORIF all displaced Fractures
- >percutaneous
- >open

>Operative approach based on
- > displacement
- > location of fracture

Acute Scaphoid Fractures

- *Strategy*
  - Minimal Displaced: Percutaneous Fixation
  - Displaced: Open Reduction
  - Proximal third : Dorsal
  - Distal third: Volar
  - ORIF by screw fixation

Acute Scaphoid Fractures

Fracture Treatment

Undisplaced: short arm cast/thumb spica vs Percutaneous screw fixation

Displaced (min): Percutaneous screw

Displaced (mod): Arthroscopic reduction/screw vs open reduction and internal fixation

ALGORITHM FOR ACUTE SCAPHOID FRACTURE MANAGEMEN

Type of Fracture	Treatment
Stable Fractures, Nondisplaced	
Tubercle fracture	Short arm cast for 6 to 8 weeks
Distal third fracture/incomplete fracture	Short arm cast for 6 to 8 weeks
Waist fracture	Long arm thumb spica cast for 6 weeks, short arm cast for 6 weeks or until CT confirmed healing, especially for Pediatric patients Sedentary or low-demand patients Preference for nonoperative treatment
	Percutaneous or open internal fixation, especially for Active, young, manual worker Athlete, high-demand occupation Preference for early range of motion
Proximal pole fracture, nondisplaced	Percutaneous or open internal fixation
Unstable Fractures Displacement >1 mm Lateral intrascaphoid angle >35° Bone loss or comminution Perilunate fracture-dislocation Dorsal intercalated segmental instability alignment	Dorsal percutaneous/open screw fixation

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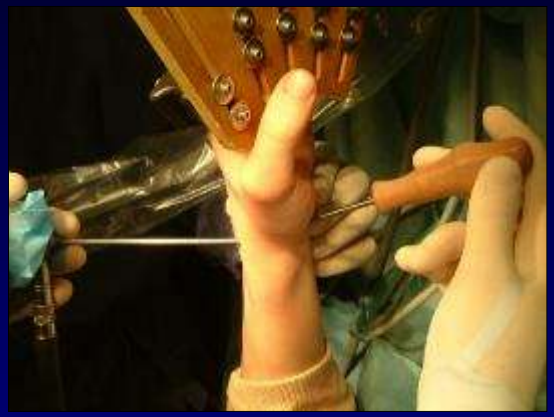
Immobilization

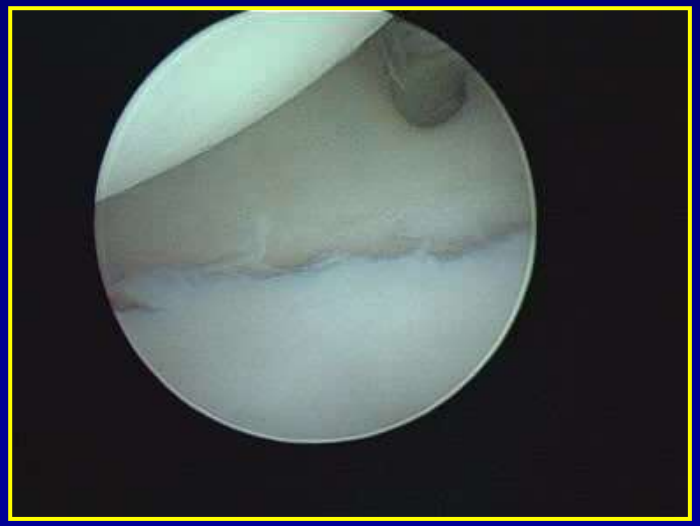
"*There is enough lack of uniformity to suggest that immobilization itself is important rather than the position in which the limb is placed".*

Taleisnik 1985

AARIF- scaphoid fracture

Displaced scaphoid fracture





Displaced scaphoid fracture

Correct position of the screw in RC joint

Summary

- Common fracture
- Vast majority heal without complications
- Displaced and/or proximal fractures require more aggressive treatment
- Associated injuries common

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THANK YOU!

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