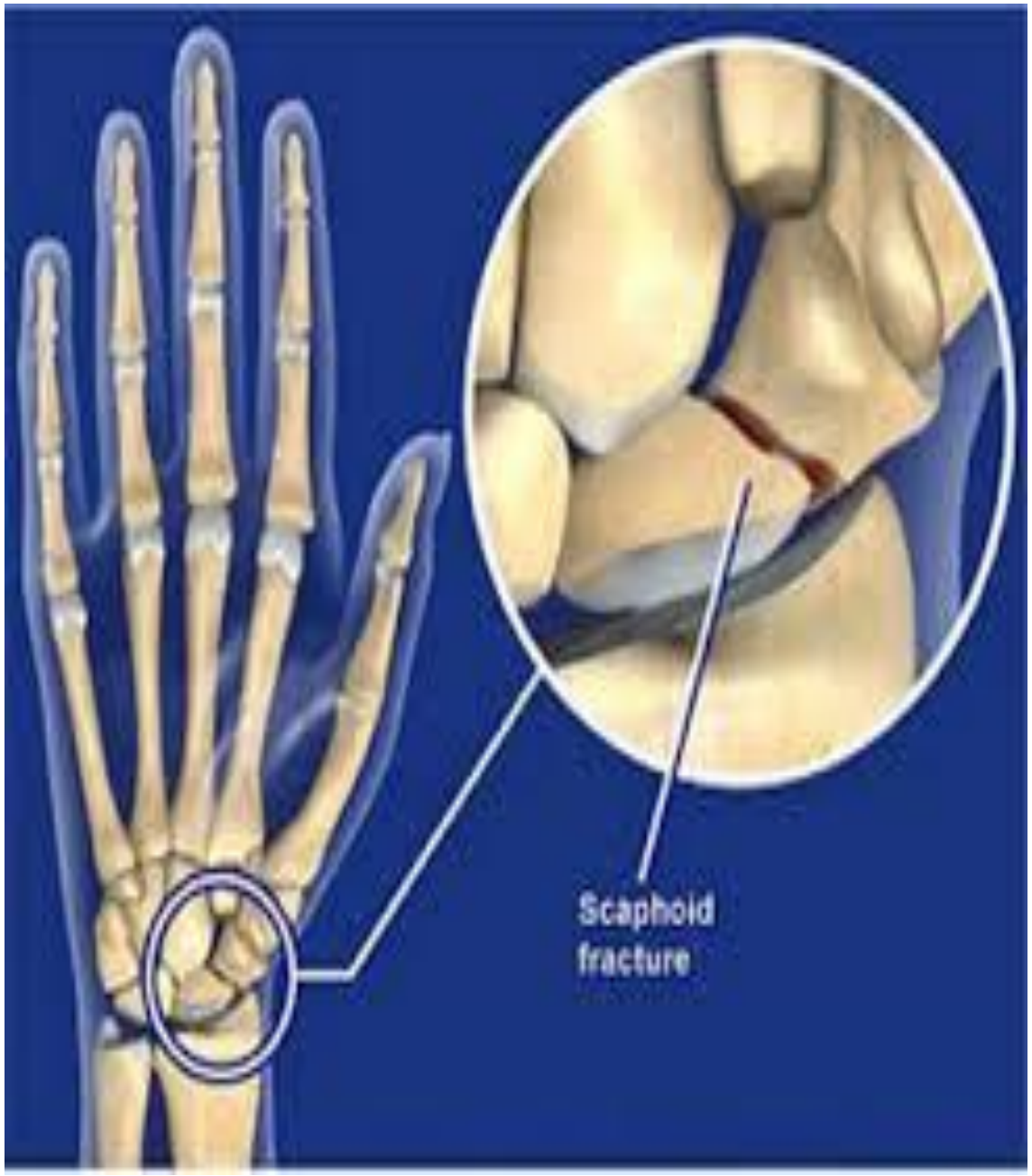
PLEASE CLICK ON THE FOLLOWING LINK TO WATCH THE LECTURE ONLINE:-

https://www.youtube.com/watch?v=5QehWPT9Sns&list=PLuBRb5B7fa_fRRpcuUO-I1JFGuAGVF9Qy&index=8

Scaphoid fractures management

Mr Ghandi Almanasir MD, MRCSEd
Orthopeadic senior specialist
Royal medical services



What to do ?

Outlines

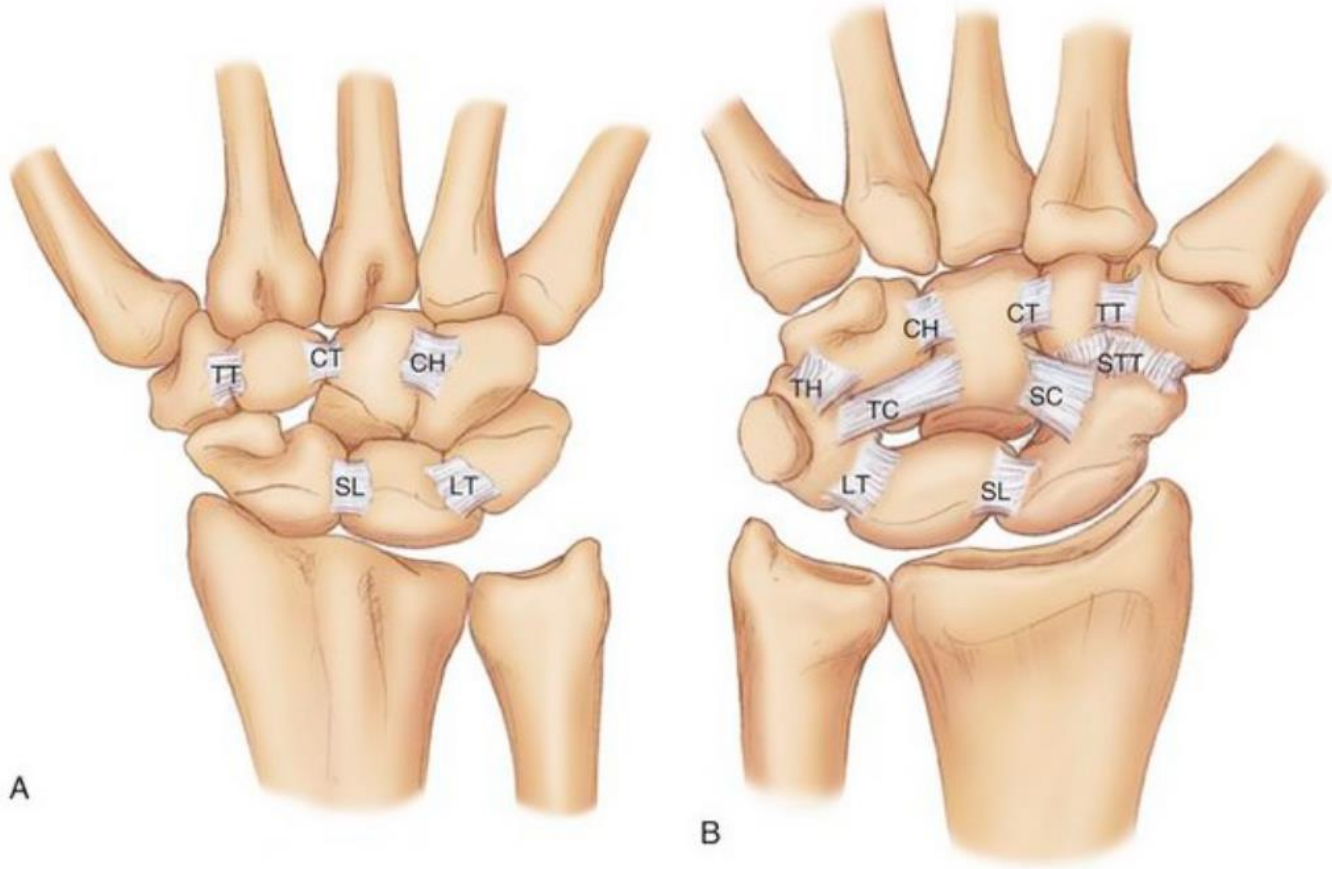
- Epidemiology
- Relevant anatomy
- Relevant biomechanics
- Diagnosis: History, Physical examination and radiology
- Classification
- Treatment options
- Complications
- Dealing with the complications

Rule of 70's for scaphoid

- 70% of all **carpal fractures** occur at scaphoid.
- 70% of blood supply is by the **dorsal branch** of the radial artery.
- 70% of fractures occur at the **waist** of scaphoid.
- 70% of the scaphoid fractures **unite** .
- 70 % of the bone covered with **cartilage**
- 70 % of scaphoid fractures patients are **males**

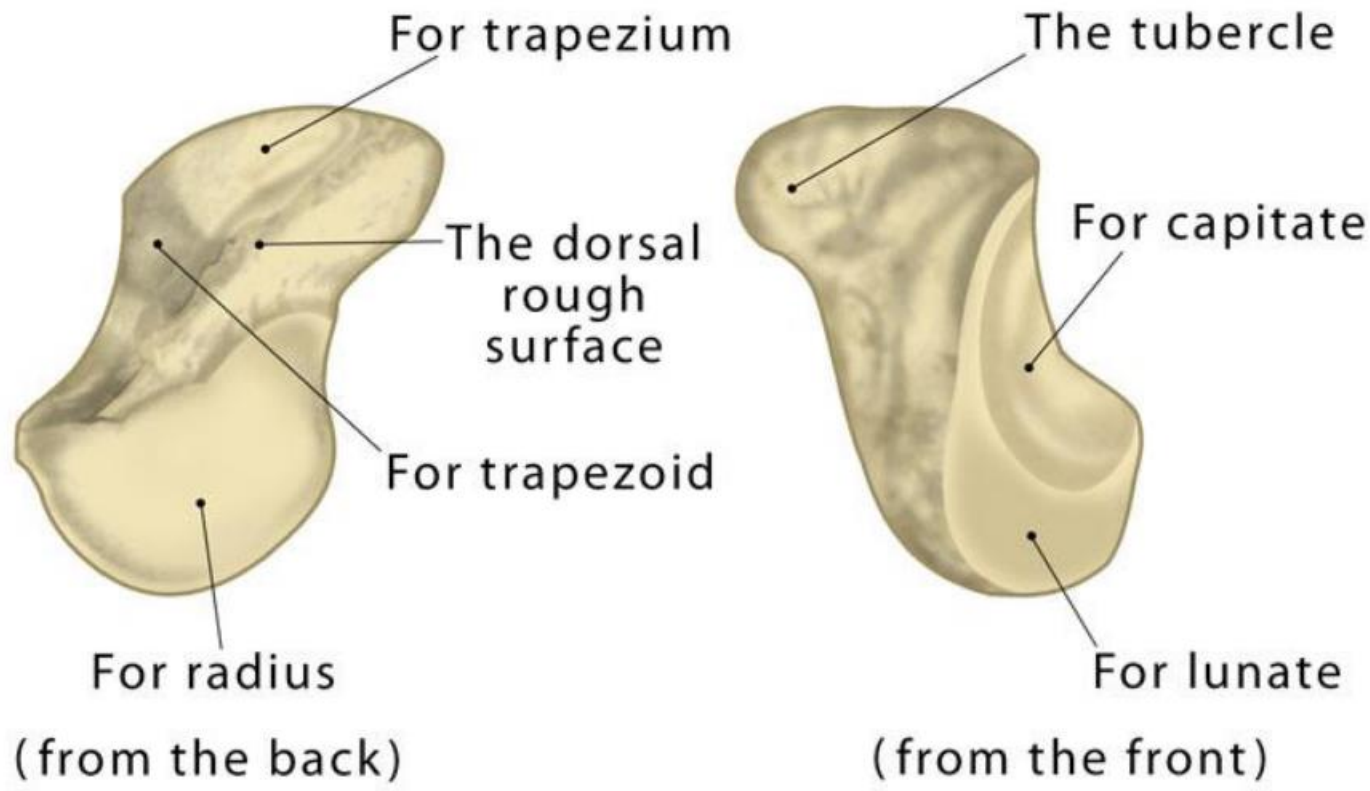
Relevant Anatomy

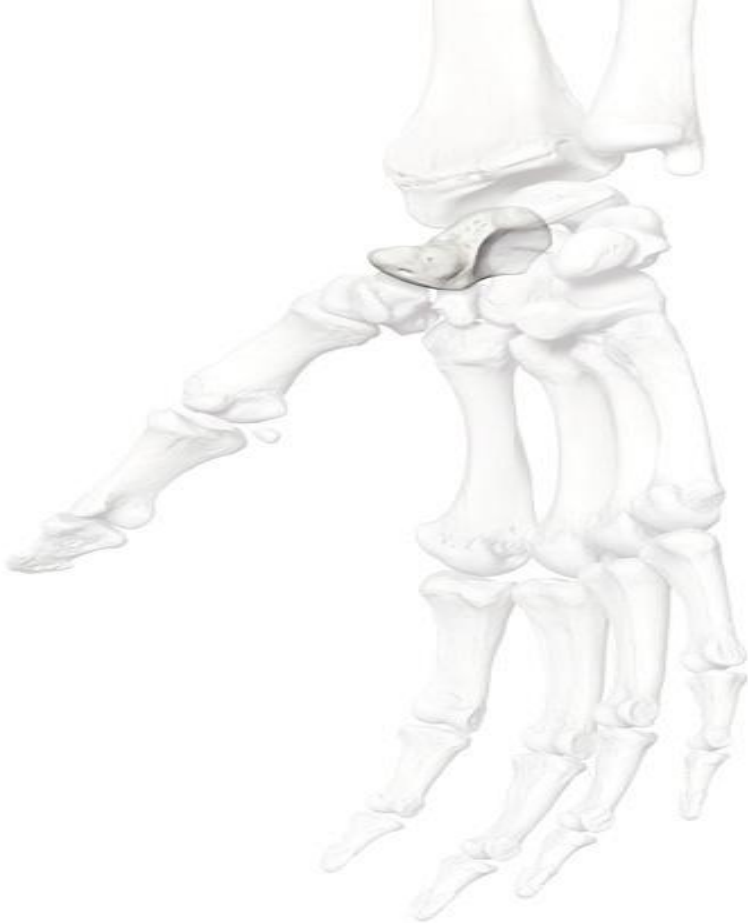
- Articulation
- Wrist intrinsic ligaments
- SL is just distal to Lister's tubercle

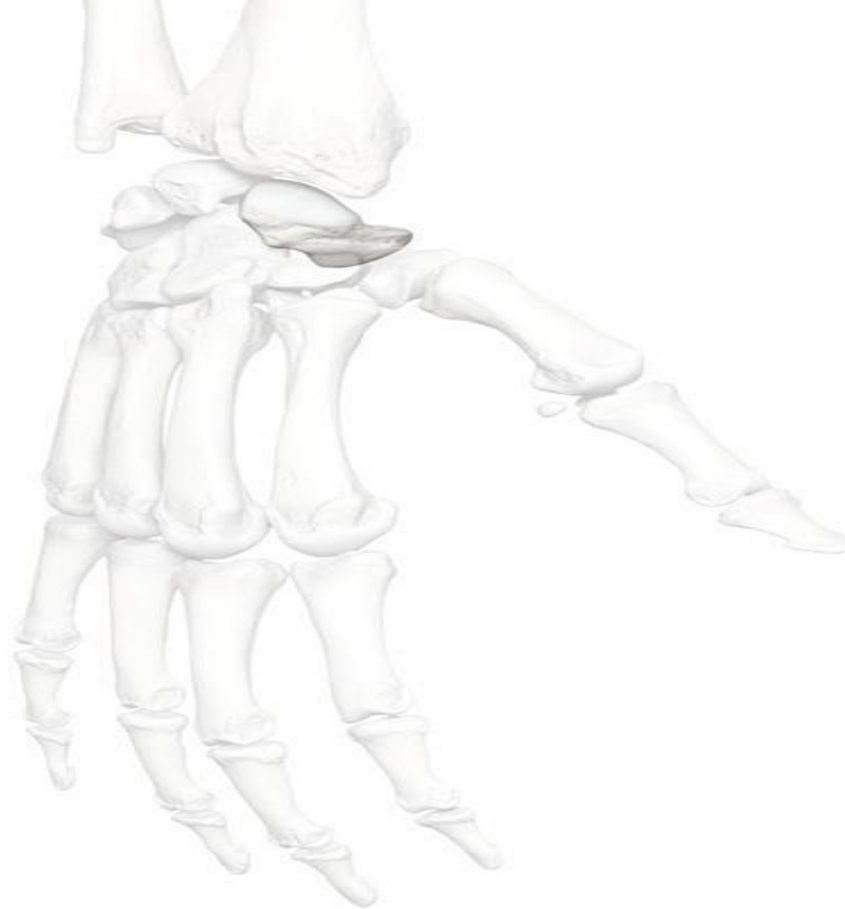


Relevant Anatomy

- Boat-shaped bone (skaphos), navicular (Navis)
- Irregular **twisted** peanut







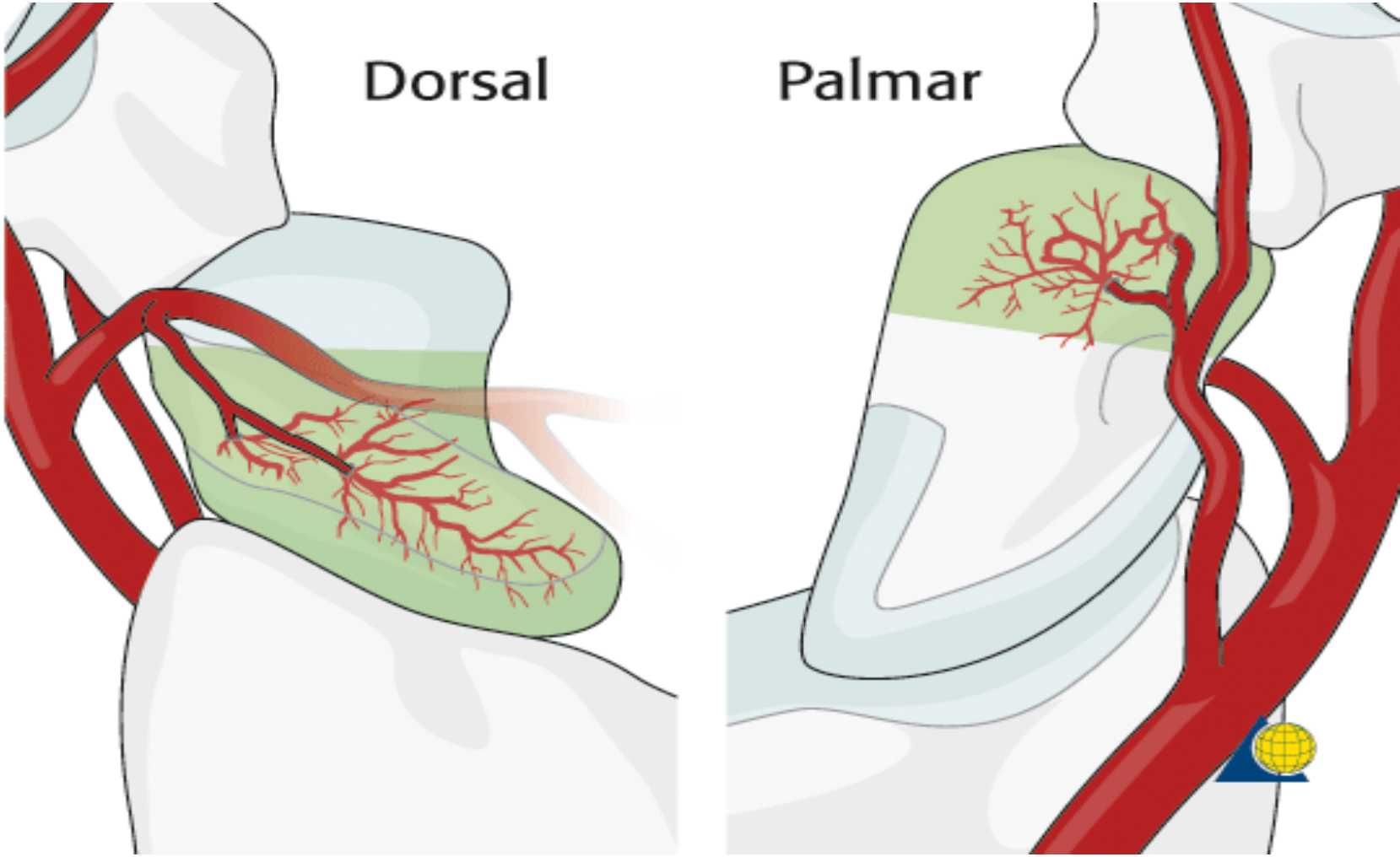
os scaphoideum
oblique palmar view

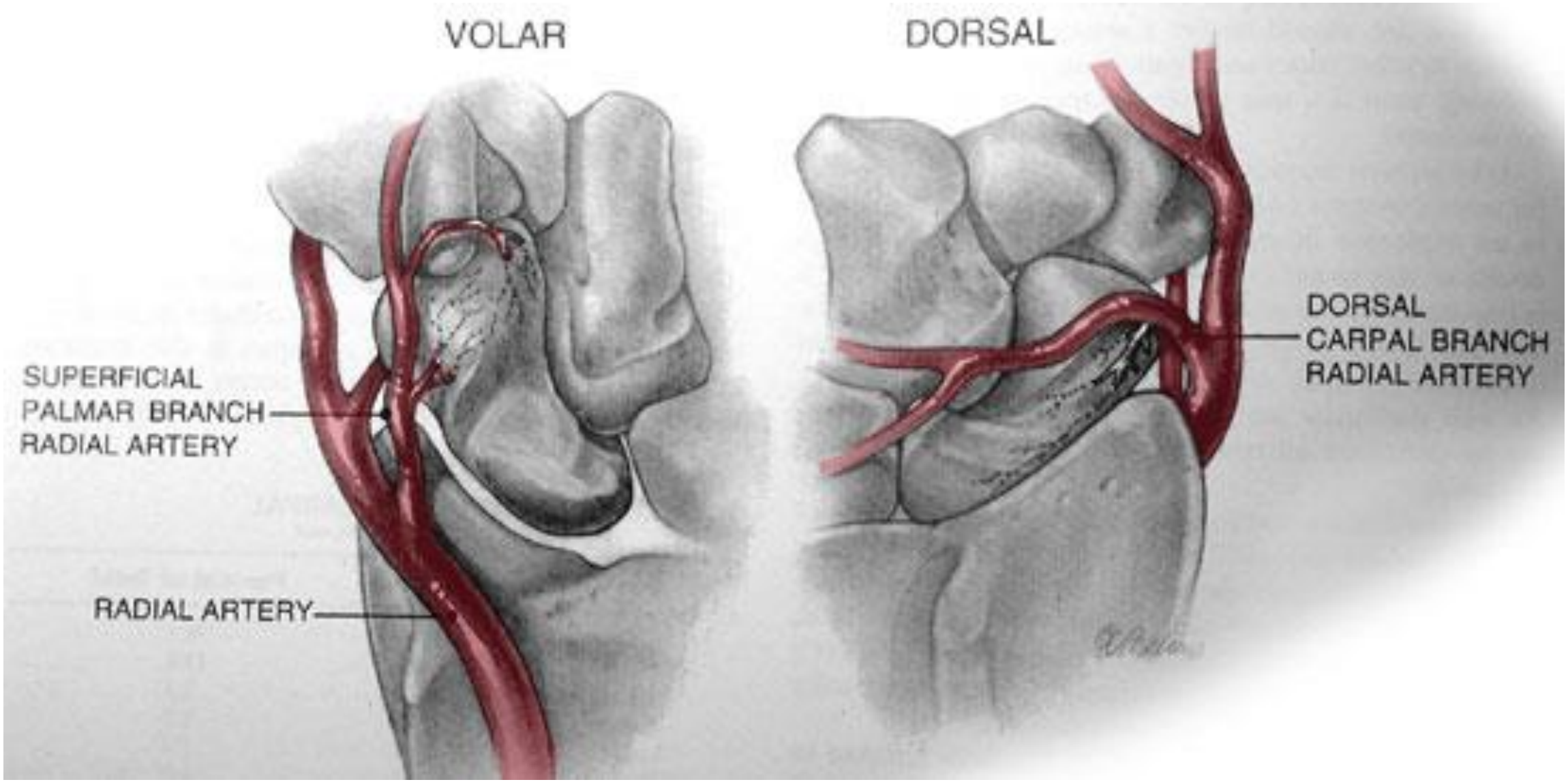
os scaphoideum
lateral view

os scaphoideum
oblique dorsal view

Blood supply

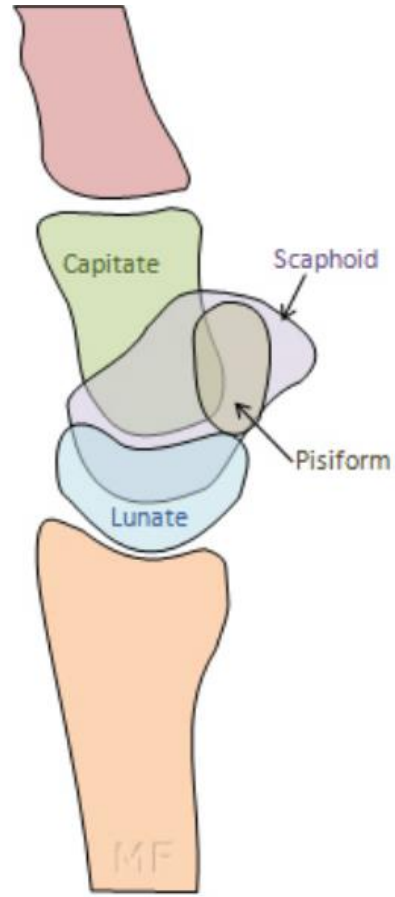
- Retrograde
- No anastomosis




VOLAR
DORSAL
SUPERFICIAL
PALMAR BRANCH
RADIAL ARTERY
RADIAL ARTERY
DORSAL
CARPAL BRANCH
RADIAL ARTERY

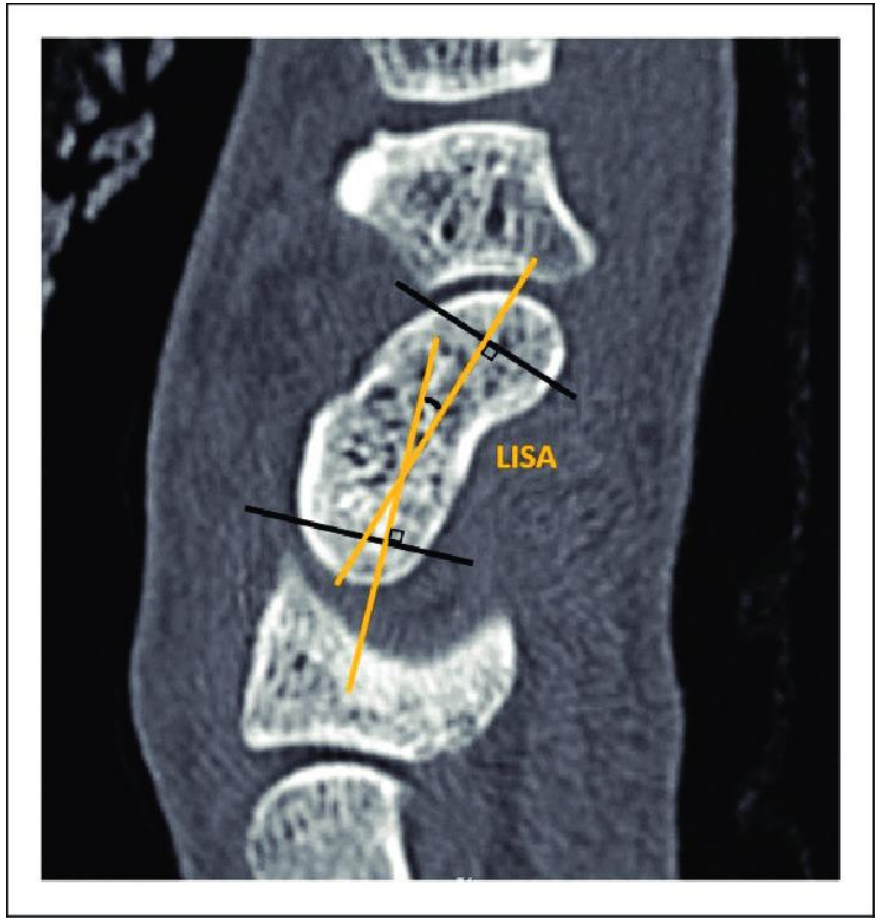
Relevant Anatomy

- Volar tilt



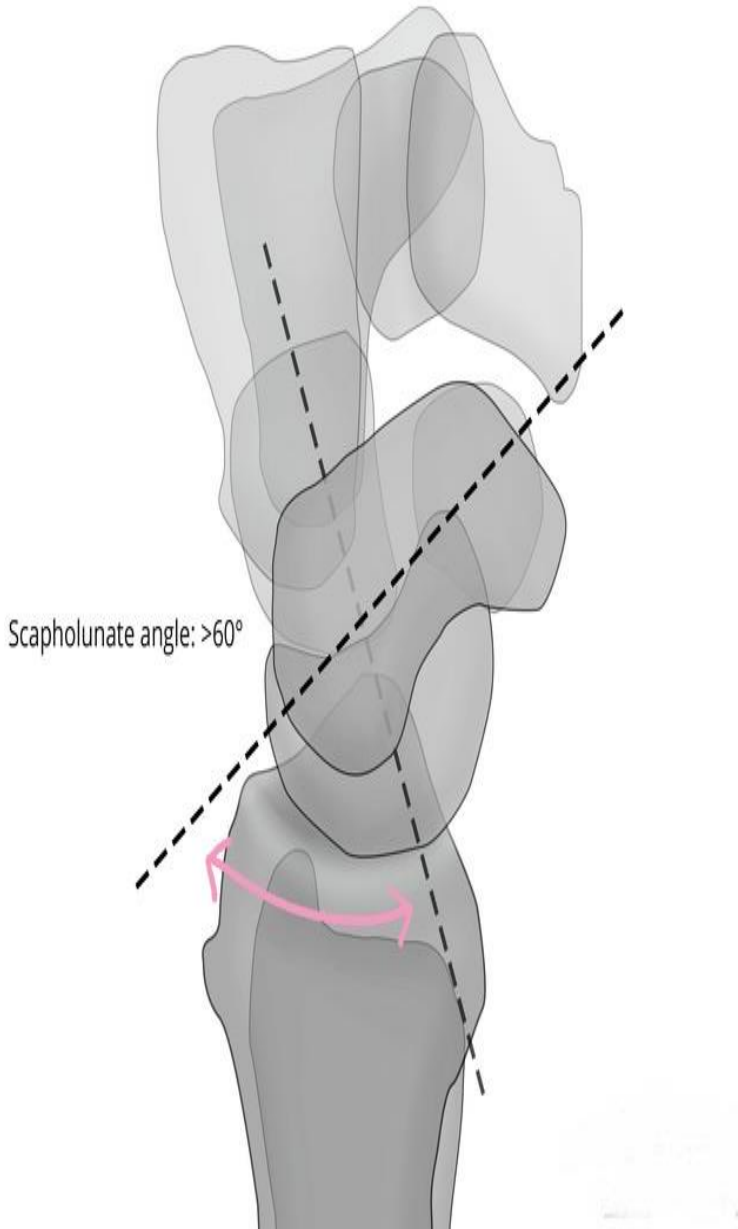
Lateral IntraScaphoid Angle (LISA)

- Sagittal CT as the angle between the perpendicular lines on the distal and proximal articular surfaces of the scaphoid.
- (24-30)°
- < 35°

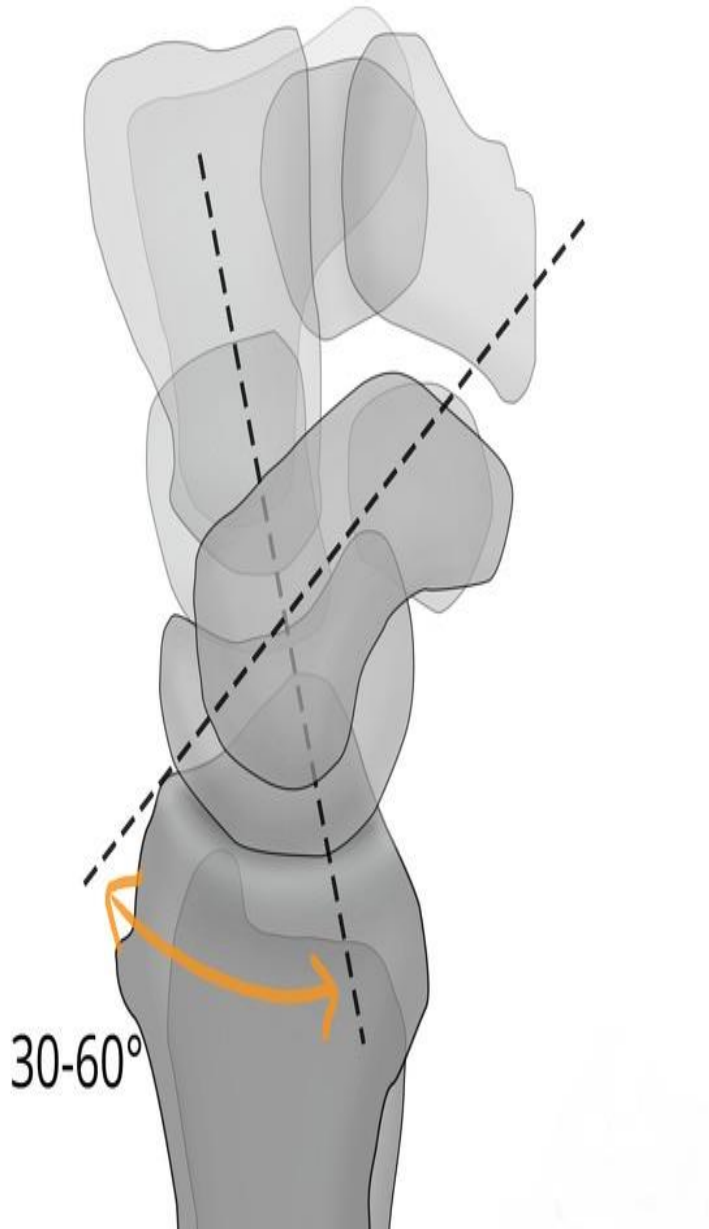



Normal 25°
Malunion >45°

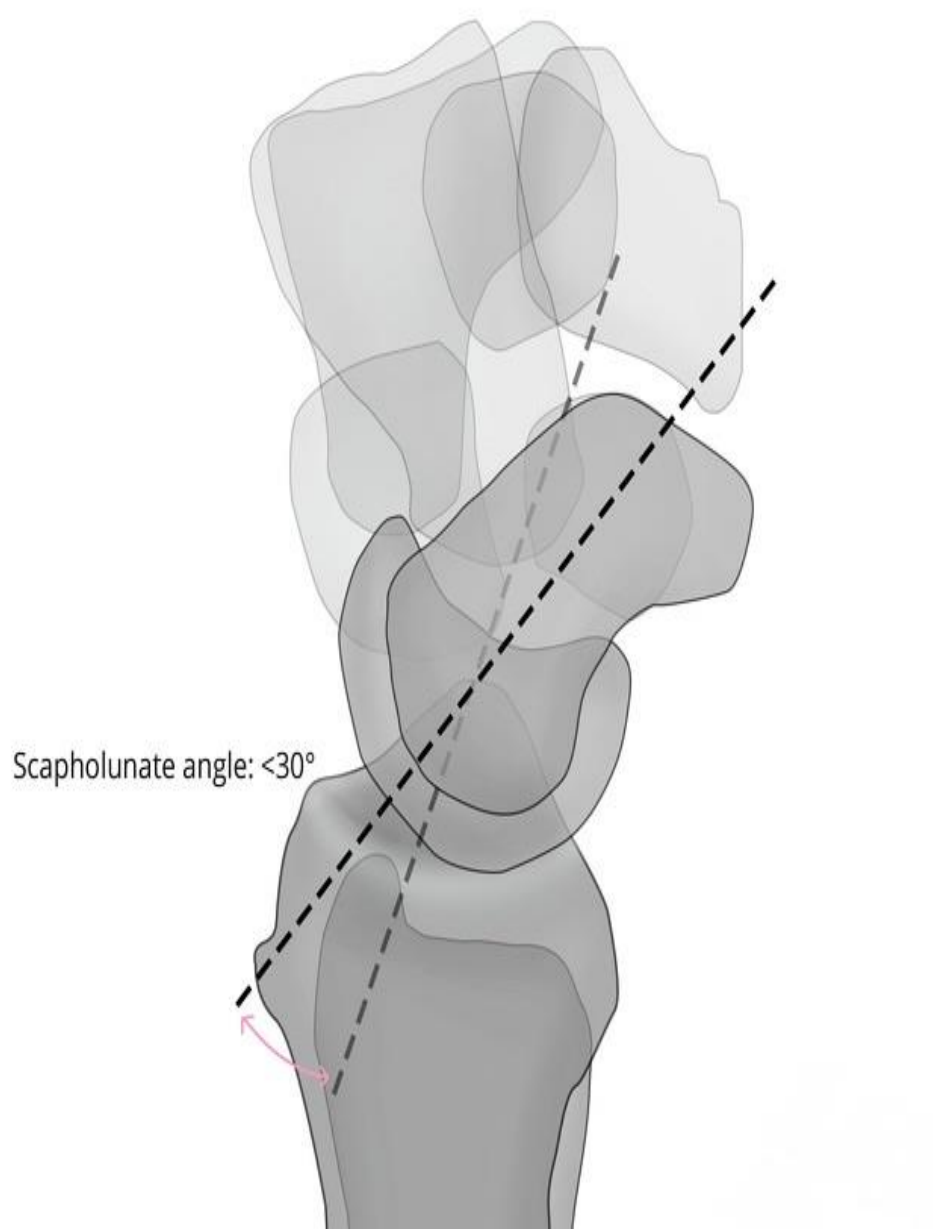
Dorsal intercalated segment instability



Normal scapholunate angle



Volar intercalated segmental instability



Biomechanics

- Scaphoid links the proximal and distal rows, it **affects both**
- Scaphoid flexes with wrist flexion & radial deviation
- Scaphoid extends with wrist extension & ulnar deviation

difficult to immobilize

Biomechanics

- Scaphoid is bony block to dorsiflexion , fracture during fall on outstretched hand.

- With scaphoid waste fracture:

  distal scaphoid tends to flex

  proximal scaphoid tends to extend

- Angulation occurs at fracture site, **humpback** deformity

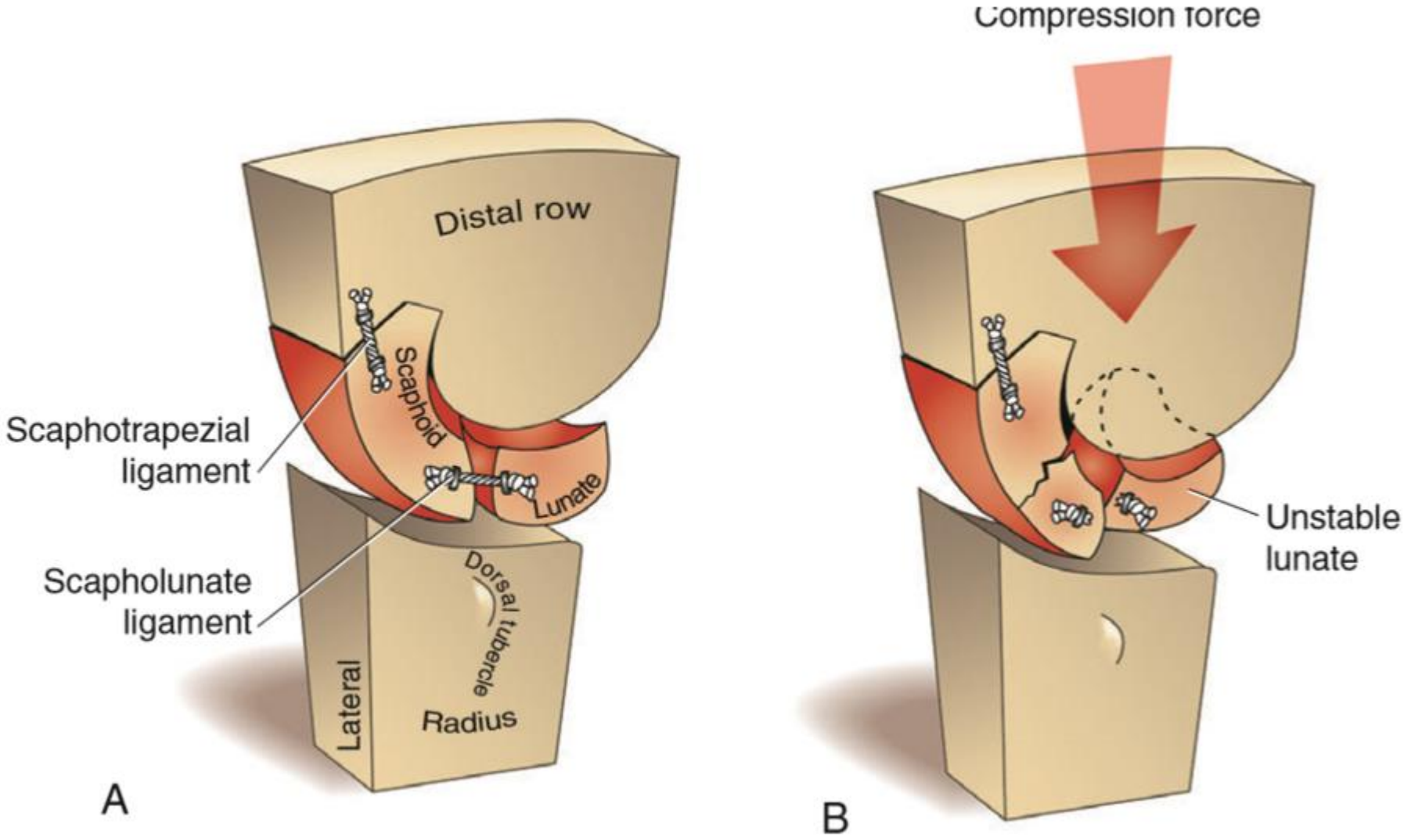
Mechanism of injury

Two different mechanisms

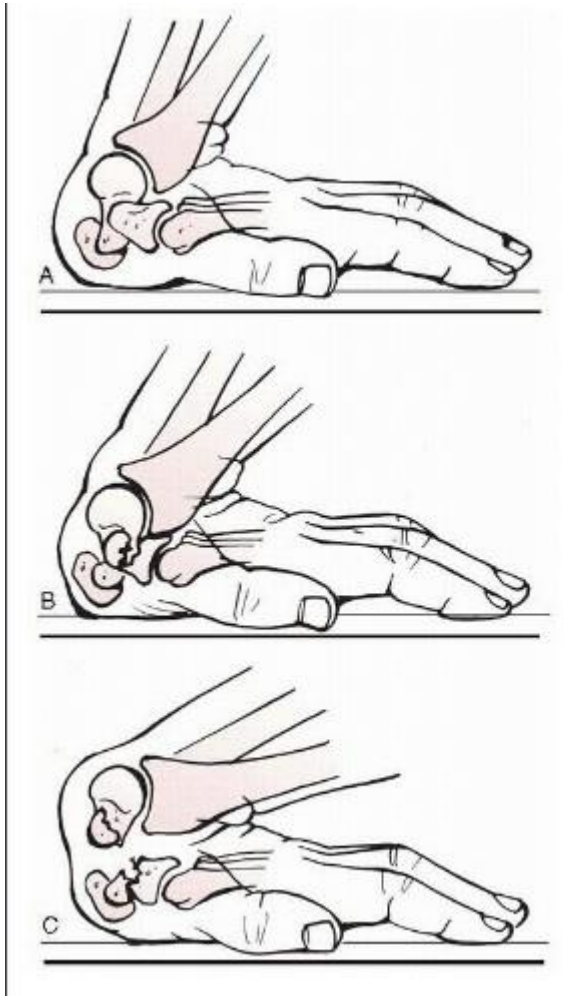
1. Compression injury :
   usually results in non displaced fx

2. Hyperextension bending injury :
   usually results in displaced fx

Compression injury



Hyperextension bending injury



Fall on outstretched hand

↓

Forced dorsiflexion of wrist(beyond 95degree)

↓

Compression occurs dorsally and tension on palmar surface of wrist.

↓

Bending forces applied to waist and distal pole of scaphoid as proximal pole is tightly held between capitate,dorsal lip of radius and taut palmar capsule.

↓

Leads to fracture scaphoid most commonly waist

Diagnosis

- A strong index of suspicion is the key to early diagnosis
- The diagnosis should be based on :
  1. History
  2. Clinical examination
  3. Radiographic evaluation.

History

- Occurs after a fall on an outstretched hand, athletic injury, or Motor Vehicle accident
- Usually happens in young adult men
- Pain and swelling at the radial side of the wrist
- Inability or difficulty in moving the involved wrist
- Any Associated injuries.

Palpable Anatomy

Proximal pole – dorsum of wrist

Lister's tubercle

↓

Sulcus (radiocarpal joint)

↓

Prominence
(scapholunate joint)

↓

Move radial for proximal pole

Waist of Scaphoid

Dorsal : distal to rim of distal radius towards styloid

Distal pole

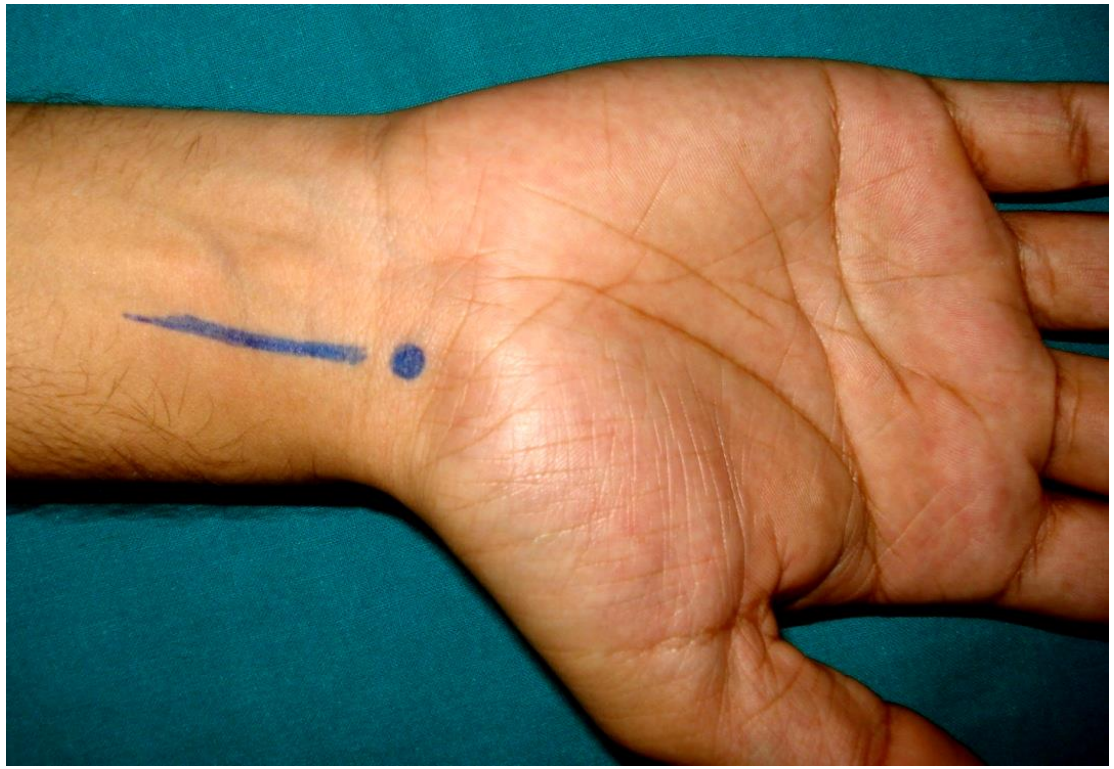
- Dorsal : between EPL and ECRL

Distal pole

- **Lateral : proximal to radial artery in anatomical snuff box with wrist in neutral position.**

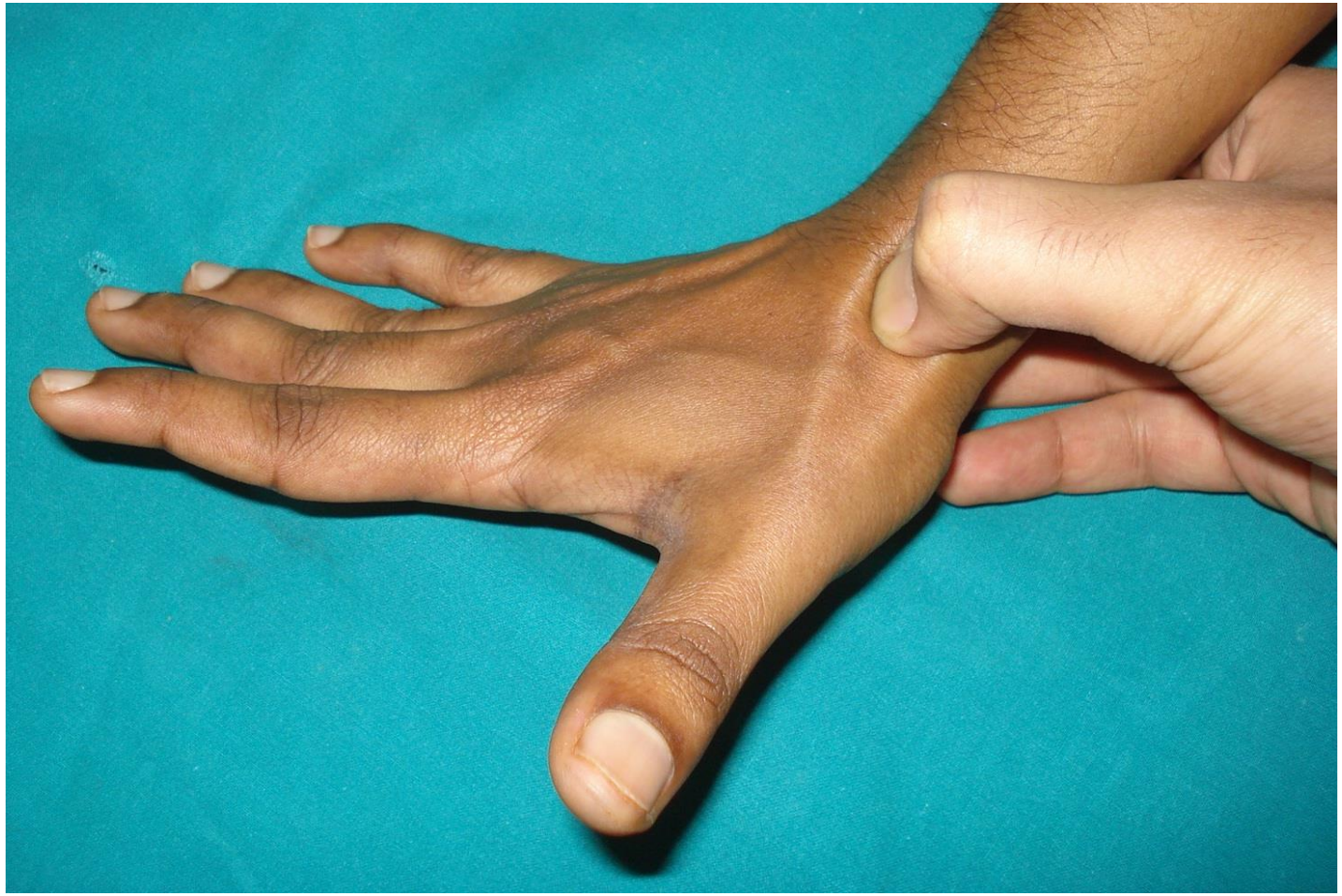
Distal pole

- **Volar : along with FCR as it enters fibro-osseous tunnel**

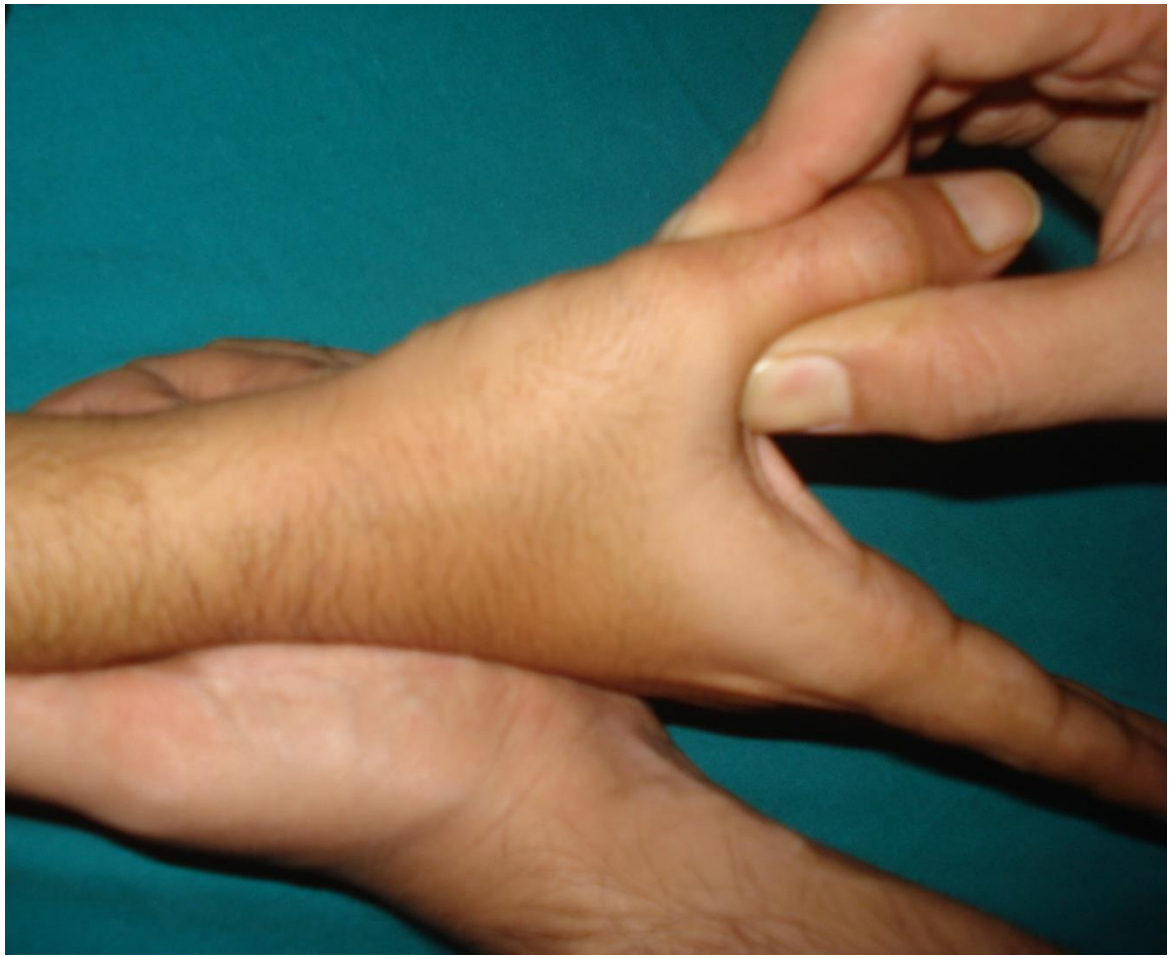


Provocative tests

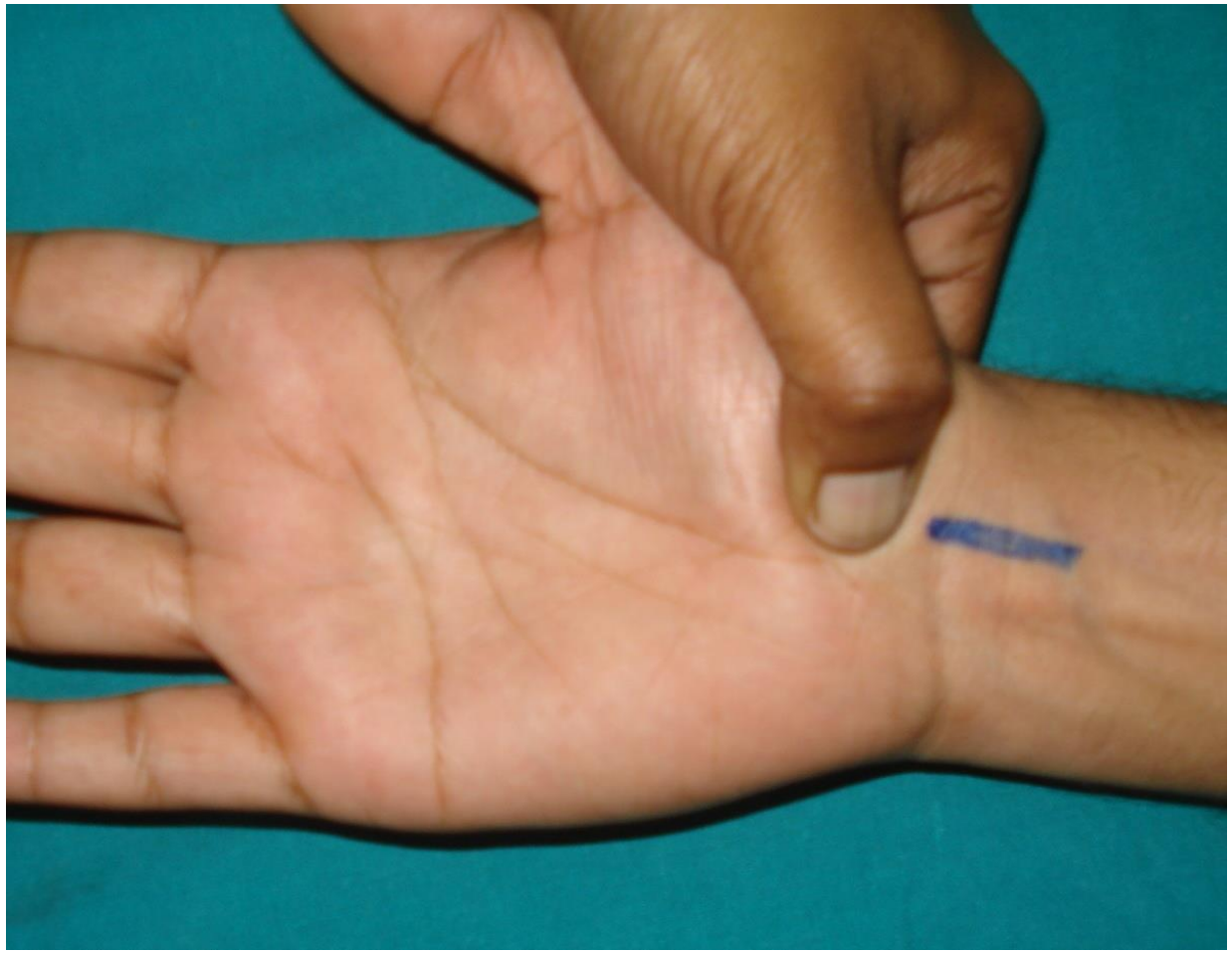
Snuff box tenderness



Scaphoid compression test

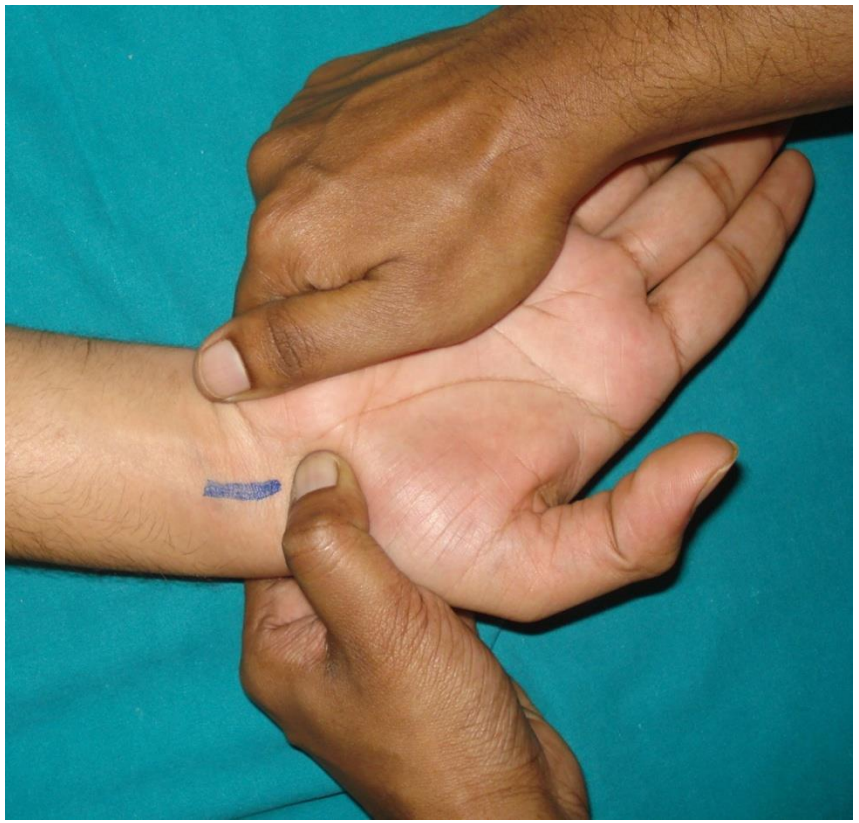


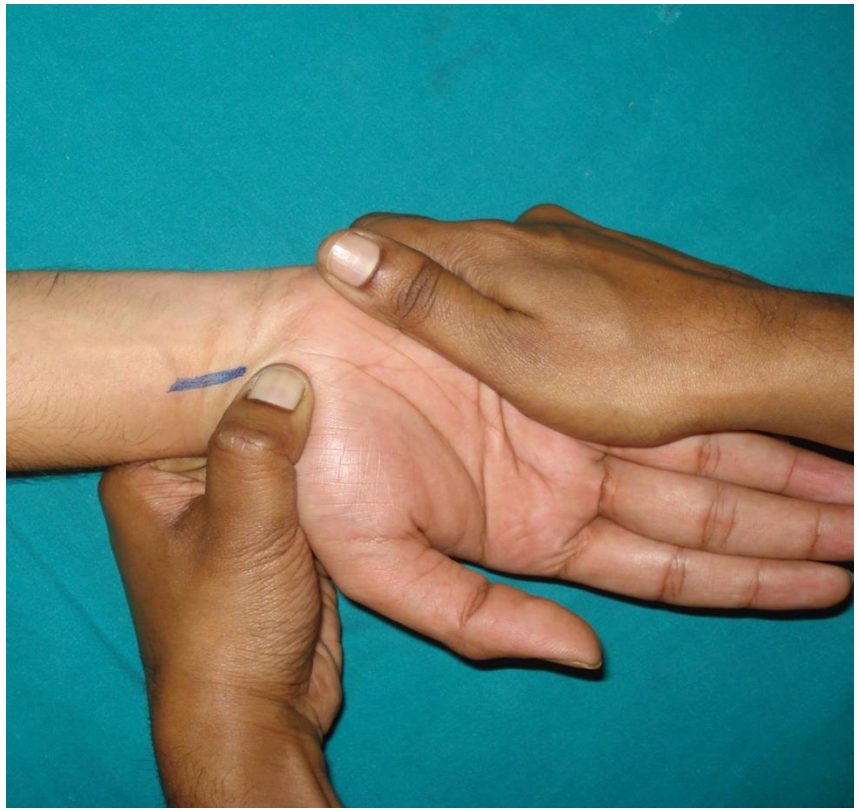
Scaphoid tubercle tenderness



Painful resisted pronation

Painful attempted Scaphoid shift test





Physical examination

- Snuff box tenderness
- Scaphoid tubercle tenderness

} 100% sensitivity, 20% specific

- Adding Scaphoid compression test :

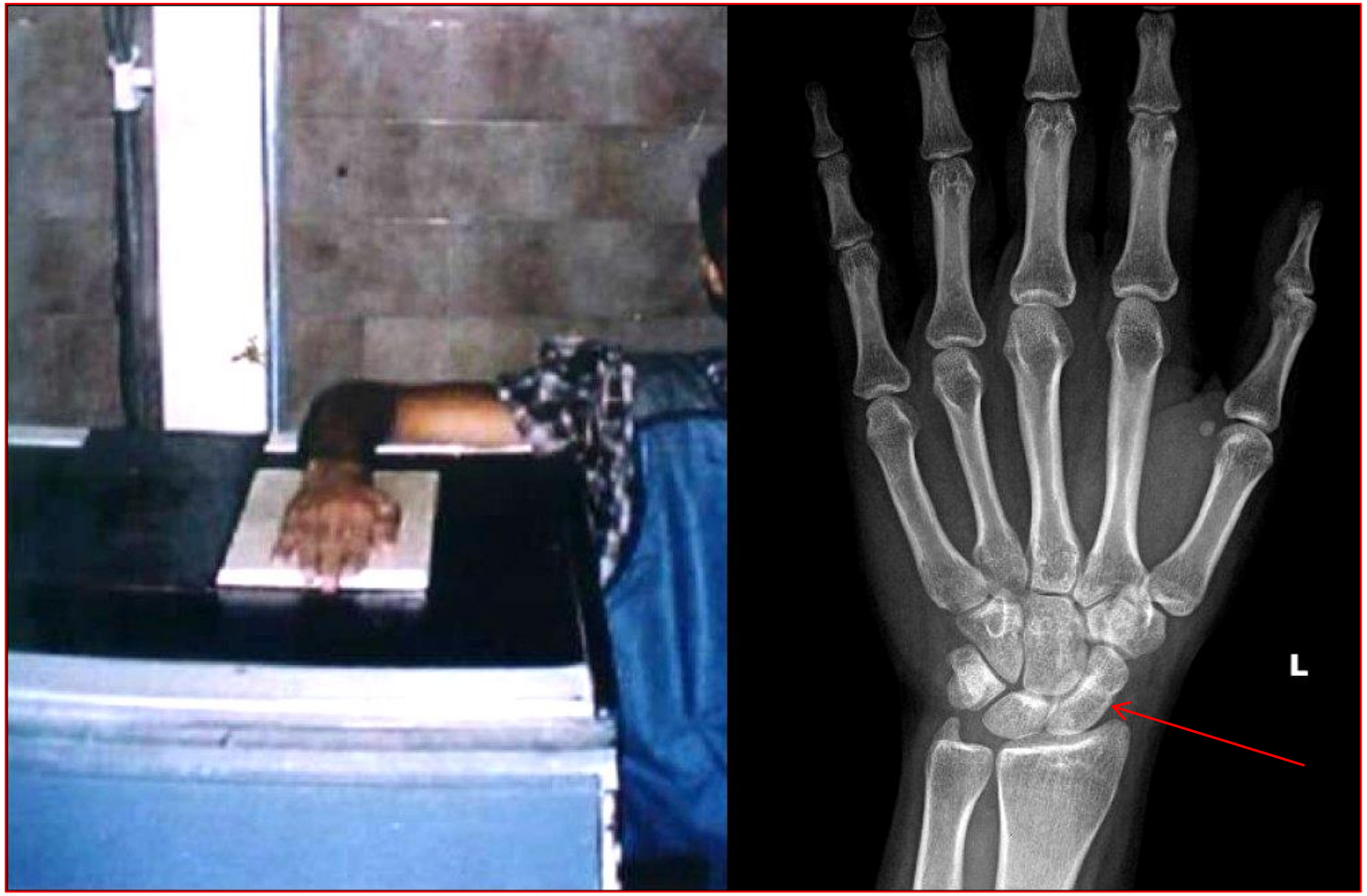
  Specificity reaches 74%

Radiographic evaluation

Radiographic evaluation

- Wrist PA, Lateral, Oblique, Scaphoid views
- 45 degrees pronated and supinated oblique views
- 5 views increased sensitivity and specificity to almost 100%

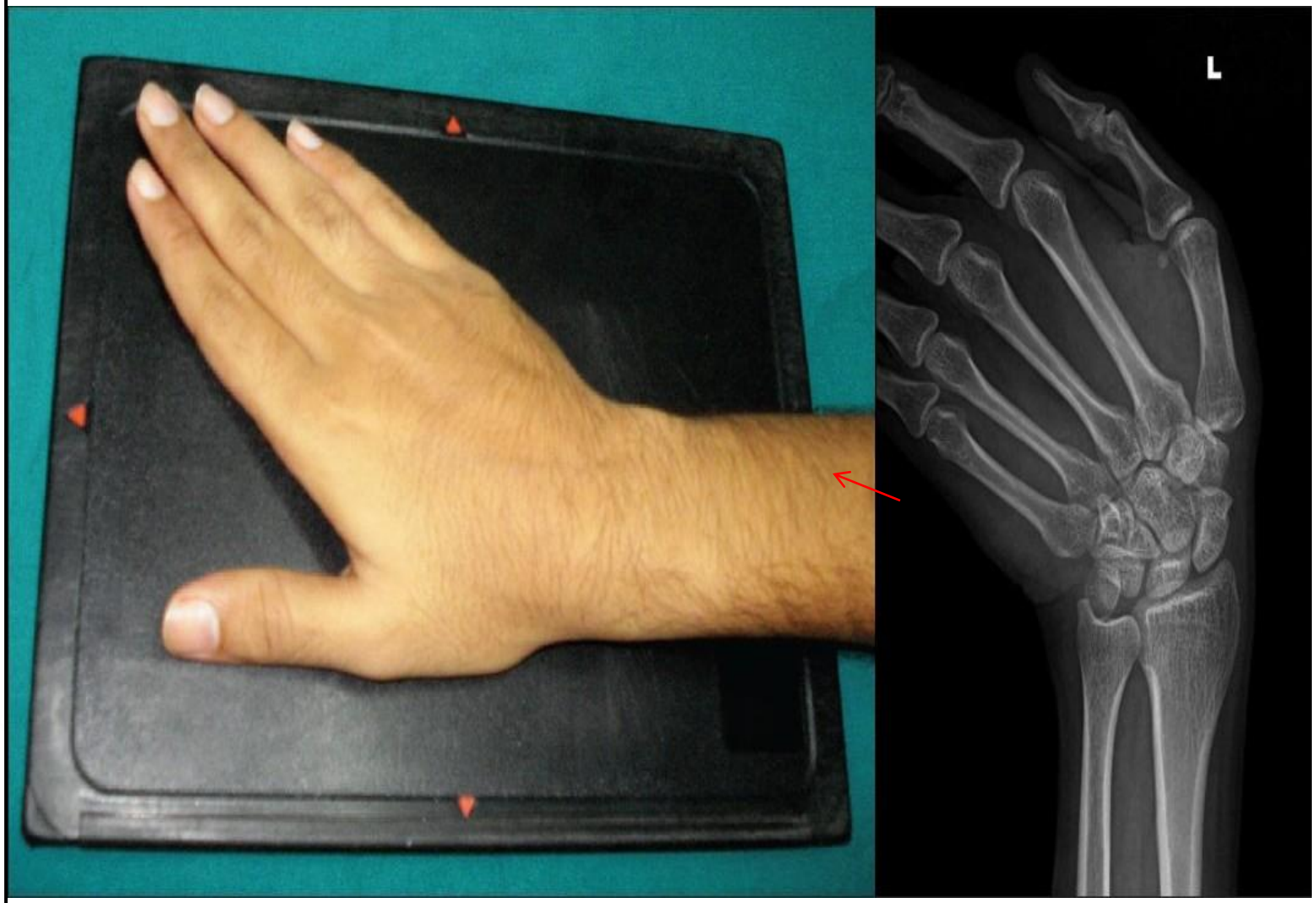
Wrist PA



Wrist lateral

FIGURE 16.7 Scaphoid view. The subject makes a fist and places the forearm and fist pronated palm side down with the wrist in ulnar deviation. (Courtesy of Steve K. Lee, MD.)

Scaphoid view



Supinated Oblique

Pronated Oblique

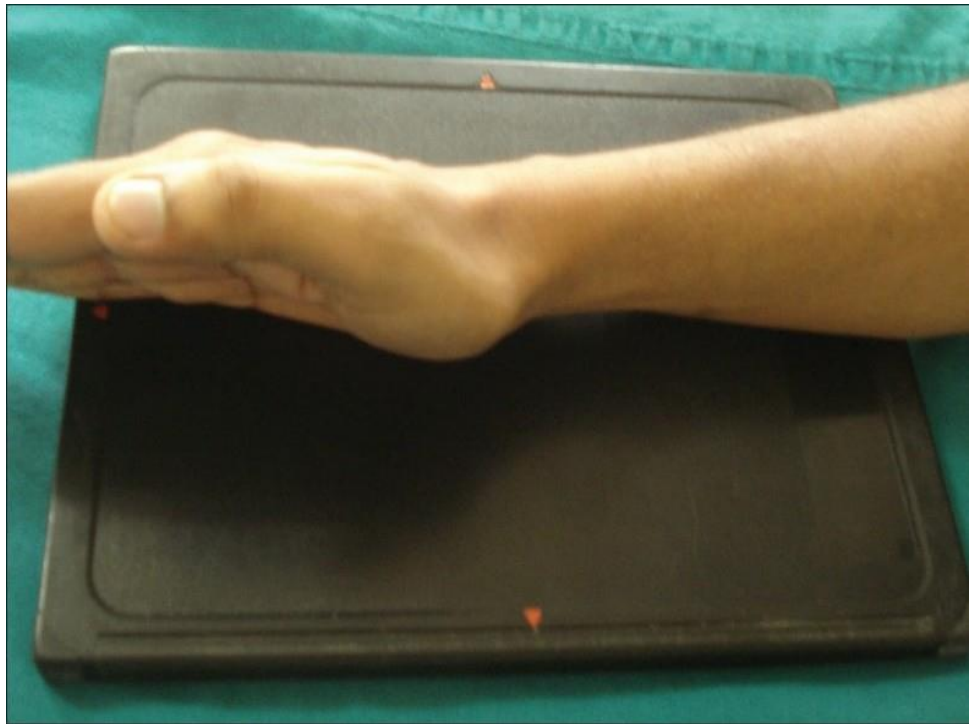


TABLE 29-1 Radiologic Views for Detection and Assessment of Scaphoid Fractures

Radiologic View	Advantages/Disadvantages
Neutral AP	Can be misleading because of tubercle overhang
Ulnar-deviated AP	Especially useful for proximal pole fractures
Ulnar-deviated AP with 20-degree tube angulation to the elbow	Good for waist fractures as beam at right angles to long axis; patterns oblique to beam poorly visualised
45-degree oblique (semipronated) AP	Best for oblique sulcal fractures but also shows waist and tubercle fractures; shows displacement particularly of waist fractures
45-degree oblique (semisupinated) AP	Best for proximal pole fractures
Lateral	Poor for fracture detection. Used for assessment of alignment, mainly demonstration of carpal collapse.

What if radiographs are inconclusive?

Bone Scan-Scintigraphy

- **Fast and reliable diagnostic tool**
- **100% Sensitivity**

<u>Disadvantages:</u>

- **Lacks specificity**
- **Little information regarding locatio**
- **15% False positive**

Computed Tomography

- Scan oriented to longitudinal axis of scaphoid for hump back deformity
- For surgical planning & assessment of healing
- To diagnose additional bony injuries

<u>Disadvantages</u>

- False positives in diagnosing occult fractures.

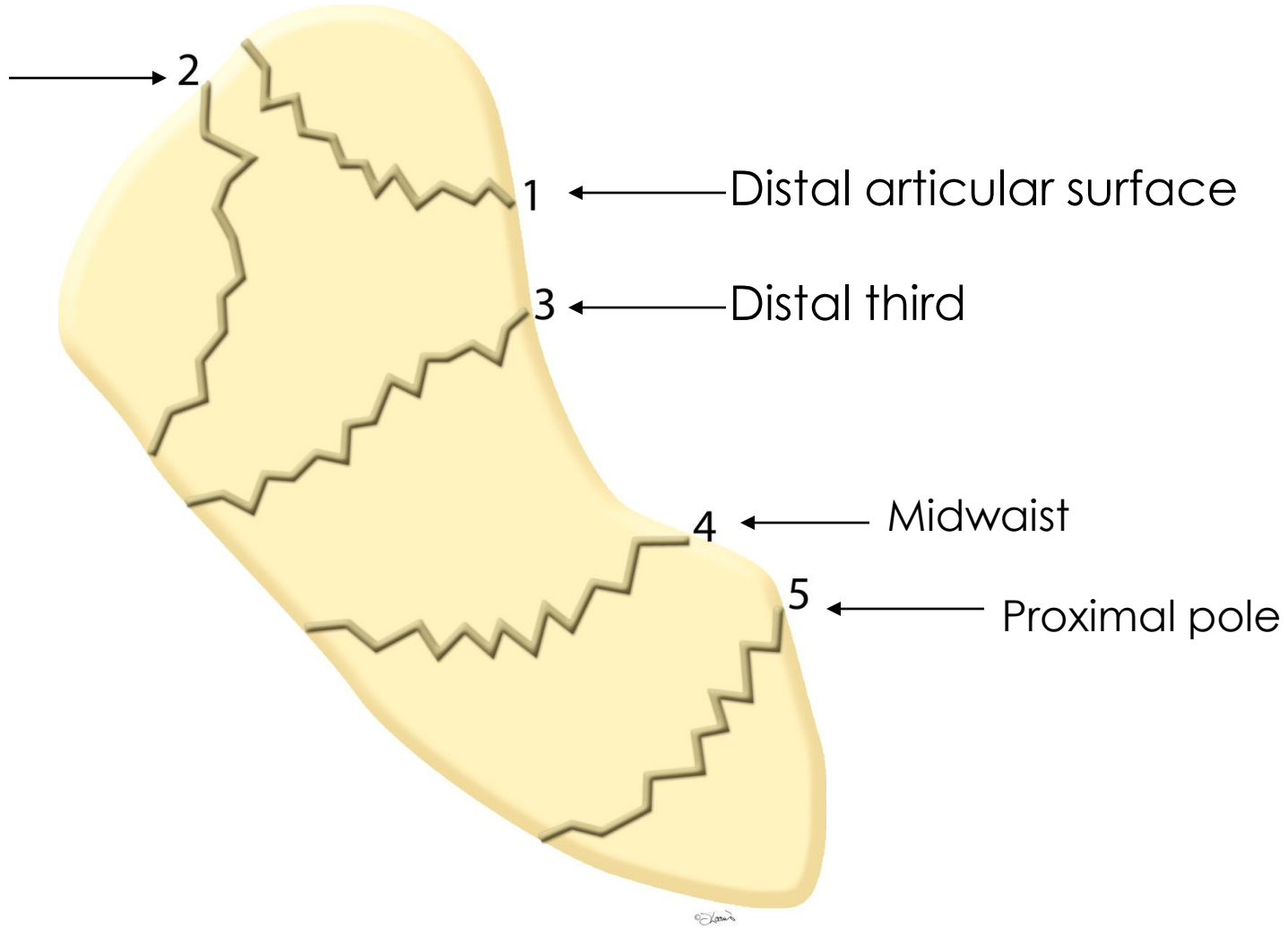
MRI

- 2nd line test in negative radiographs
- Identifying fractures of other carpal bones, ligament injuries
- Highest sensitivity and specificity

Classifications

Mayo Classification

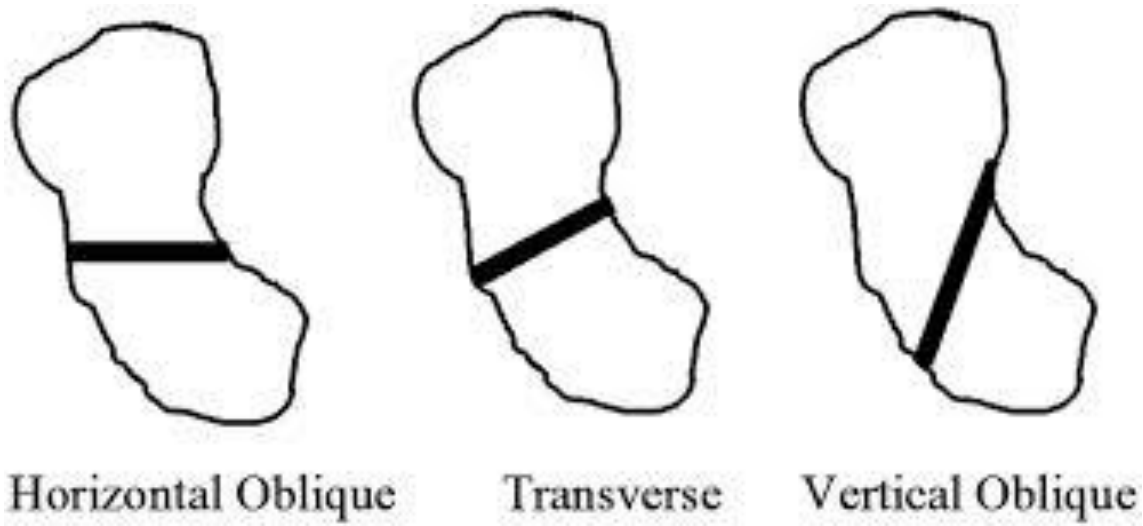
tubercle



MAYO CLINIC


MAYO CLINIC

Russe’s classification



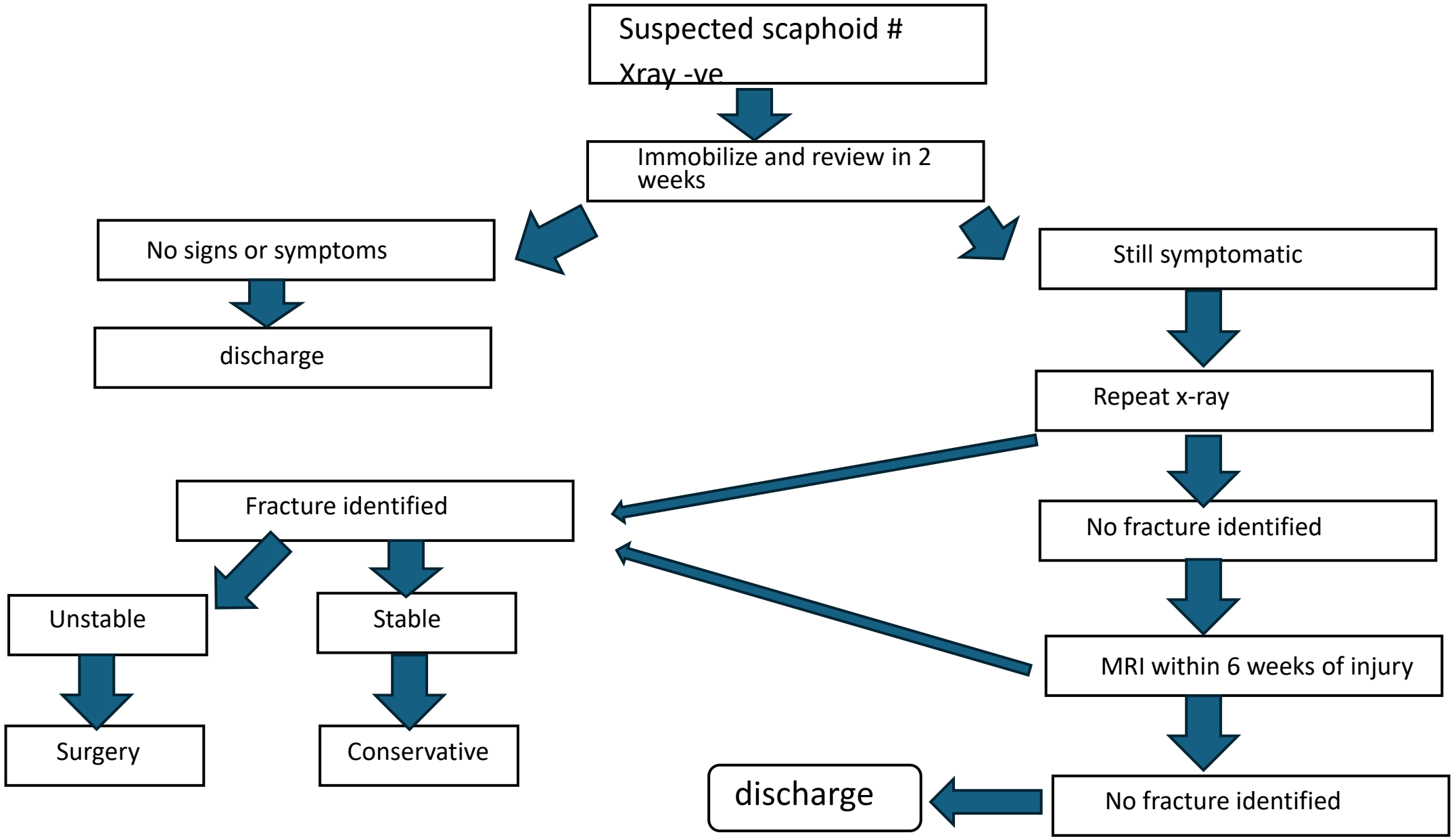
Functional

- Stable ---- undisplaced
- Unstable ---- displaced

  - 1 mm gap
  - intrascaphoid angle of > 35°
  - scaphoid fractures associated with perilunate dislocation, (DISI)
  - comminuted fractures
  - vertical or oblique fractures

Treatment

- Have we diagnosed it yet?


Suspected scaphoid #
Xray -ve
Immobilize and review in 2 weeks
No signs or symptoms
discharge
Still symptomatic
Repeat x-ray
No fracture identified
MRI within 6 weeks of injury
No fracture identified
discharge
Fracture identified
Unstable
Stable
Surgery
Conservative

Conservative (Cas

- contraversies:
  - The position of the wrist in the cast
  - The need to include joints other than the wr
  - The duration of the immobilization.
- Above elbow casts… shorter time to unio
- the union rate is the same for below or a
  (duration not position)
- The current recommendation is to use a short arm thumb spica with the thumb interphalangeal joint free and mcp joints of other fingers free. The wrist is placed in radial deviation i.e. **the glass holding position**
- Long arm cast is recommended for nondisplaced proximal pole fractures.

- **Average time to healing by location :**
  - Distal third fracture heals in 6-8 weeks
  - Middle third fracture 8-12 weeks
  - Proximal third fracture 12-24 weeks
- A 95 % union rate can be expected with this management.
- Prognosis is excellent in undisplaced, stable fractures if diagnosed and immobilized early

Surgery (Screw fixation)

A. Herbert screw

B. Herbert Whipple cannulated screw

C. Acutrak screw

D. Twin-Fix two-part variable screw

E. AO cannulated (3.5 mm)

Headless … cannulated …. double compression

Approaches

- **Volar approach** -- is most of the time the preferred approach to limit the injury to the blood supply of the scaphoid

This approach is indicated for the following injuries:

-Irreducible, displaced scaphoid fractures, in the distal two thirds

-Comminuted fractures

- **Dorsal approach** – will be used to address the fractures of the proximal pole

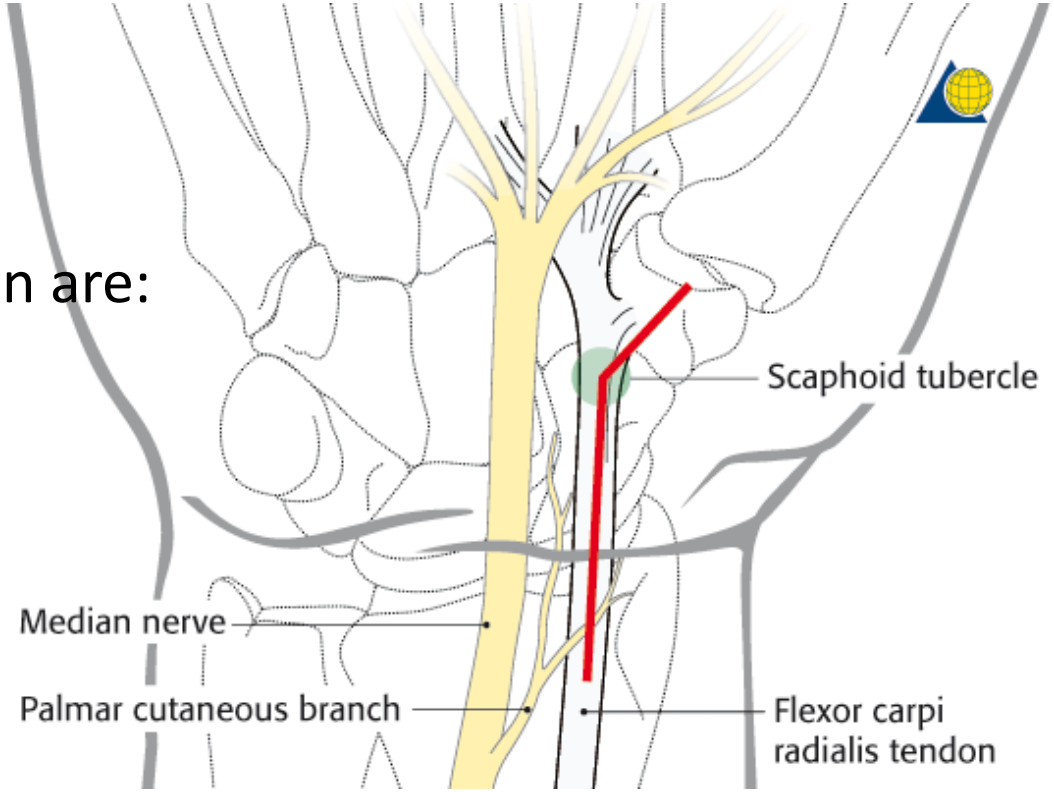
Volar Approach

Angled skin incision

The landmarks for this incision are:

- The scaphoid tubercle
- The flexor carpi radialis (FCR) tendon

Retrograde screw fixation

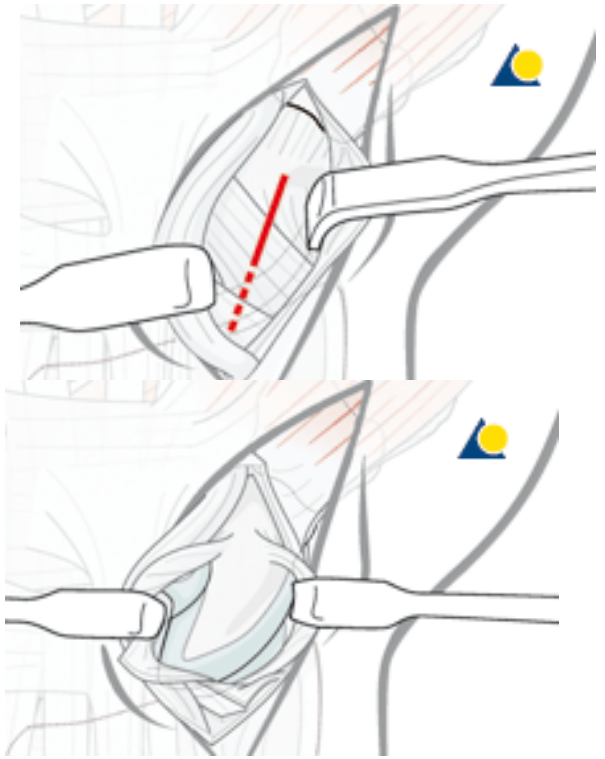


Exposure of the wrist capsule
The capsule is then incised obliquely from the tubercle distally towards the palmar rim of the radius proximally.

Preserve as much of the palmar ligament complex.

Expose the scaphoid
Retract the divided radioscaphocapitate ligament to expose the scaphoid.

If it is necessary to expose the proximal part of the scaphoid, divide the long radiolunate ligament, proximally as far as the palmar rim of the radius.



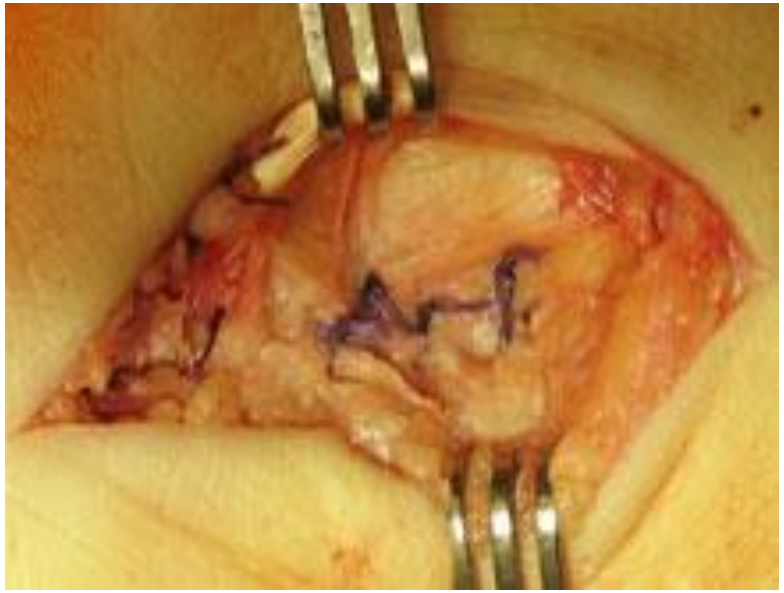
Wound closure

The divided palmar ligaments (radioscaphocapitate/long radiolunate) must be repaired with fine interrupted sutures in order to prevent secondary carpal instability.

Approximate the soft tissues over the scaphotrapezial joint.

Test the integrity of the soft-tissue repair by passive wrist motion.

Finally, the FCR tendon sheath is repaired and covered with subcutaneous tissue.

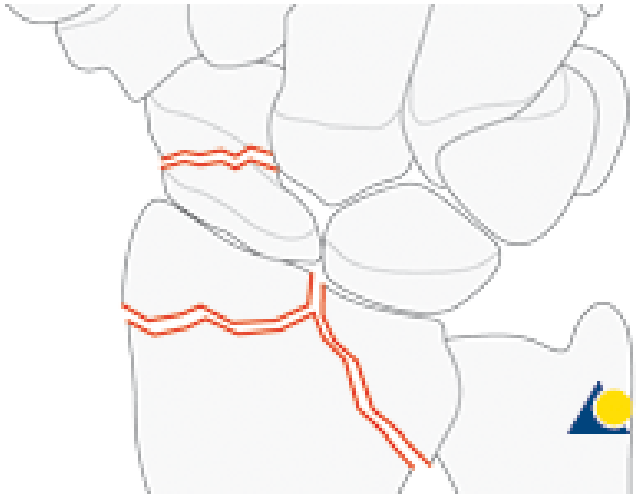


Proximal Pole Fractures

- Dorsal approach allows direct visualization of the fracture
- Antegrade screw fixation

Dorsal approach

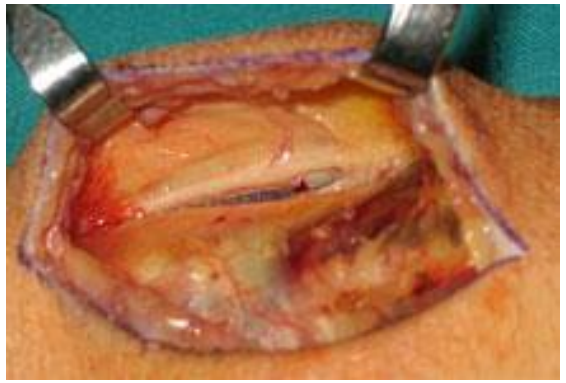
- **Indications**
  - Proximal pole fractures
  - Complete scapholunate (SL) ligament rupture
  - Scaphoid fractures, or complete SL ligament ruptures with concomitant distal radial fractures



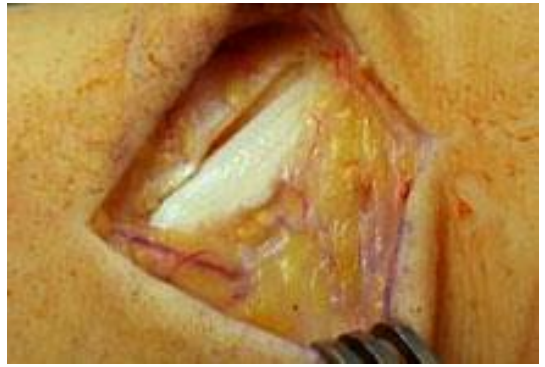
Straight skin incision
Make a straight dorsal skin incision starting over Lister's tubercle…

and extending for about 4 cm distally.

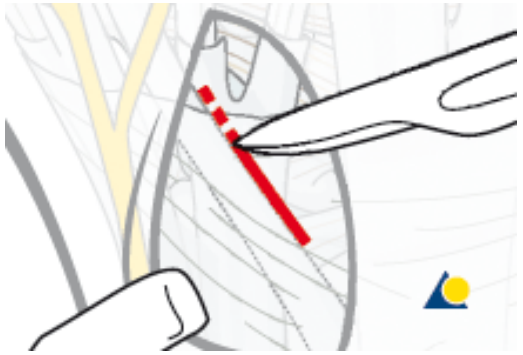
Identify the radial nerve
Identify and preserve the dorsal superficial branch of the radial nerve, which runs in the radial skin flap of the wound.



Incise the retinaculum
Incise the extensor retinaculum over the extensor pollicis longus (EPL) tendon



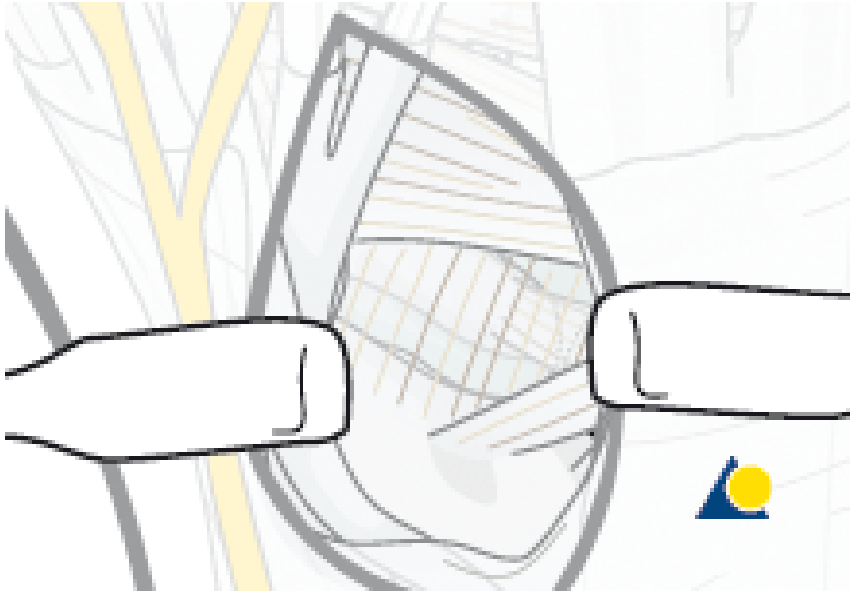
opening the distal part of the third extensor compartment

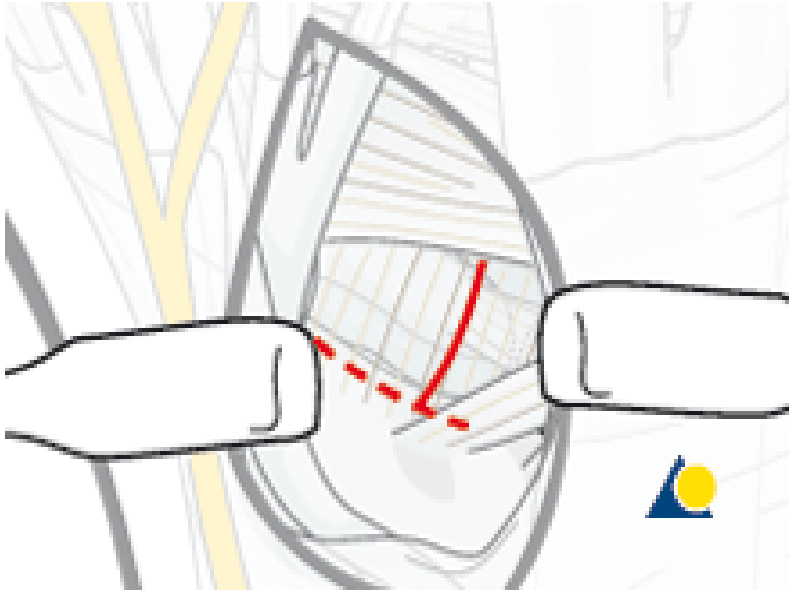


Retraction of the tendons
EPL retracted radially

The fourth extensor compartment (EDC & EIP) Retracted ulnary.

Opening the capsule
Make a longitudinal or inverted T-shaped incision, starting at the dorsal rim of the distal radius, extending to the dorsal intercarpal ligament.





Expose the scaphoid

Wrist flexion

SL ligament identified

Wound closure

Close the capsule with interrupted sutures

Close the extensor retinaculum

Leave EPL free

Post op care

- Immobilization with cast
- Duration varies according to many factors:
  - comminution
  - Fixation stability
  - location
  - cyst
- 6-12 weeks (till you see element of healing)

COMPLICATIONS OF SCAPHOID FRACTURES:

- 1. Delayed union (middle 1/3rd, 20%).
- 2. Malunion.
- 3. Non union.
- 4. AVN (Proximal l/3rd, 15-40%).
- 5. OA of radiocarpal or intercarpal joint

Avascular necrosis AVN

- Is commonly seen it proximal pole fractures due to inadequate blood supply prevalence Is 35%.
- Can be detected at earliest by MRI followed by CT and plain Xrays.
- Seen as patchy sclerosis on X-rays.

Treatment-

- Prolonged immobilization could be tried ?
- Operative revascularization if early detected or symptomatic patient .

CT -Scan

- CT –scan is a better option than plain radiograph.
- Proximal pole fracture with dense sclerosis of proximal pole

MRI

- MR imaging has been shown to be highly sensitive for AVN as compared to plain radiograph.
- Decrease in the marrow signal intensity in T1 weighted images is suggestive of AVN.

Non union of scaphoid

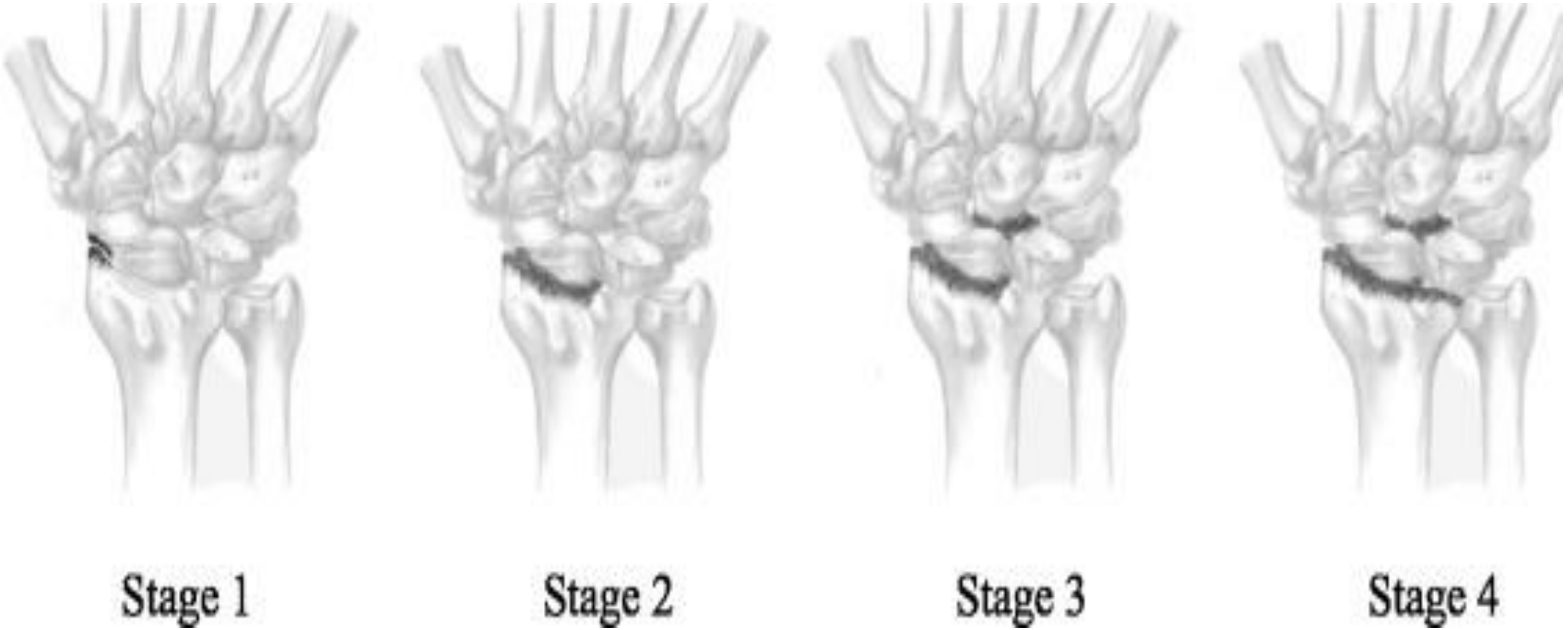
- A scaphoid fracture becomes a non-union when it fails to unite for any reason within 6 months of injury.
- Age: 2nd and 3rd decade (Common) 12% rate of non-union.
- Etiology:
    - Severity of initial injury.
    - Fracture pattern and location. (Proximal l/3rd and vertical oblique)
    - Displacement of fracture fragments > 1mm.
    - Associated ligamentous and carpal injury.
    - DISI(distal intercalated segment instabilty)
    - Inadequate immobilization.
    - Delayed treatment.
    - Smoking

- Nonunion is expected more often if the scaphoid # is untreated for 4 or more weeks.
- This can result in nonunion rate of 88%.

Symptoms:

- Wrist pain
- Loss of motion - especially dorsiflexion
- Weakness of grip.

Scaphoid Nonunion Advanced Collapse (SNAC)



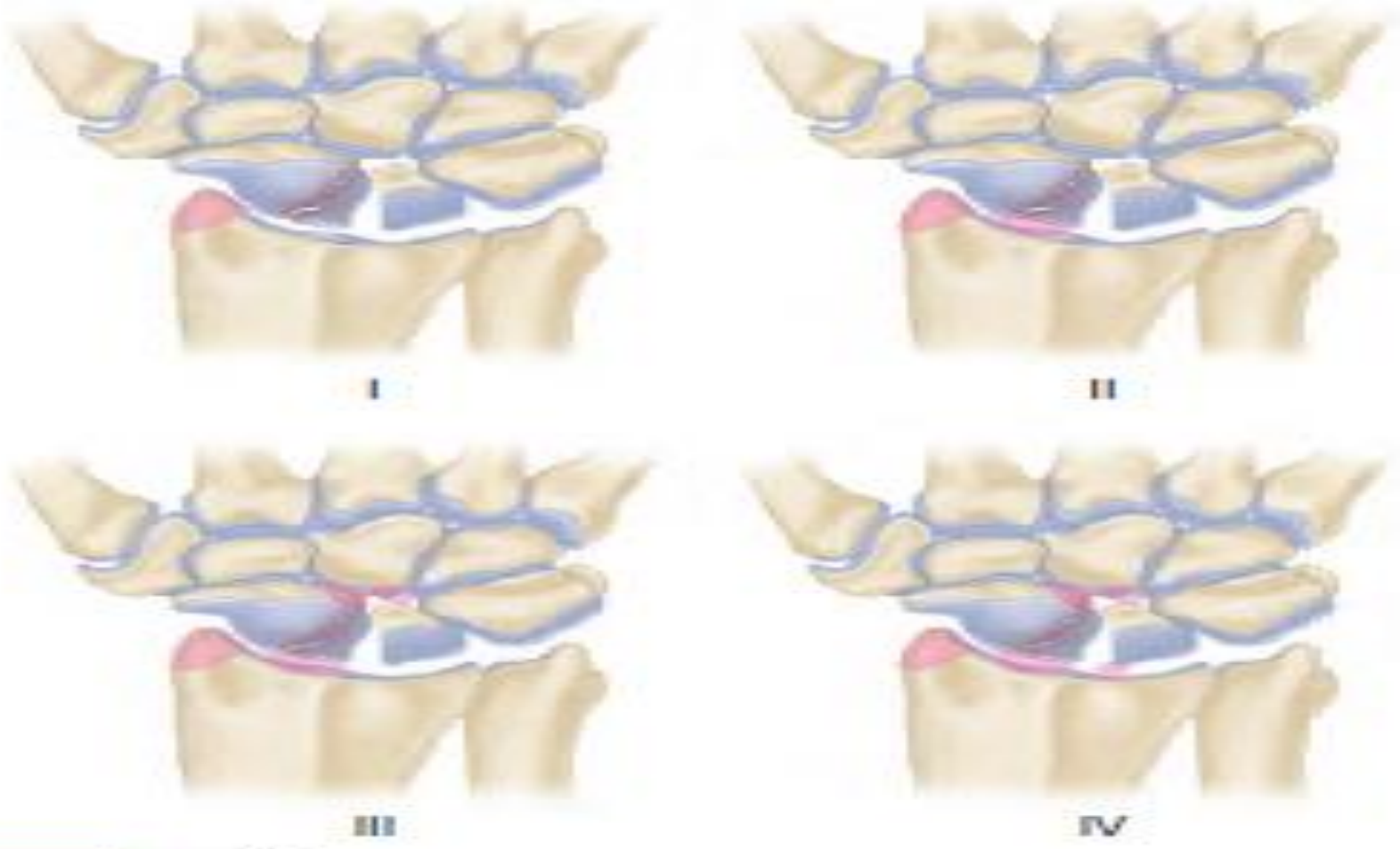


FIGURE 69-33 Stages of scaphoid nonunion advanced collapse. Stage I, arthritis at radial styloid. Stage II, scaphoid fossa arthritis. Stage III, capitolunate arthritis. Stage IV, diffuse arthritis of carpus.

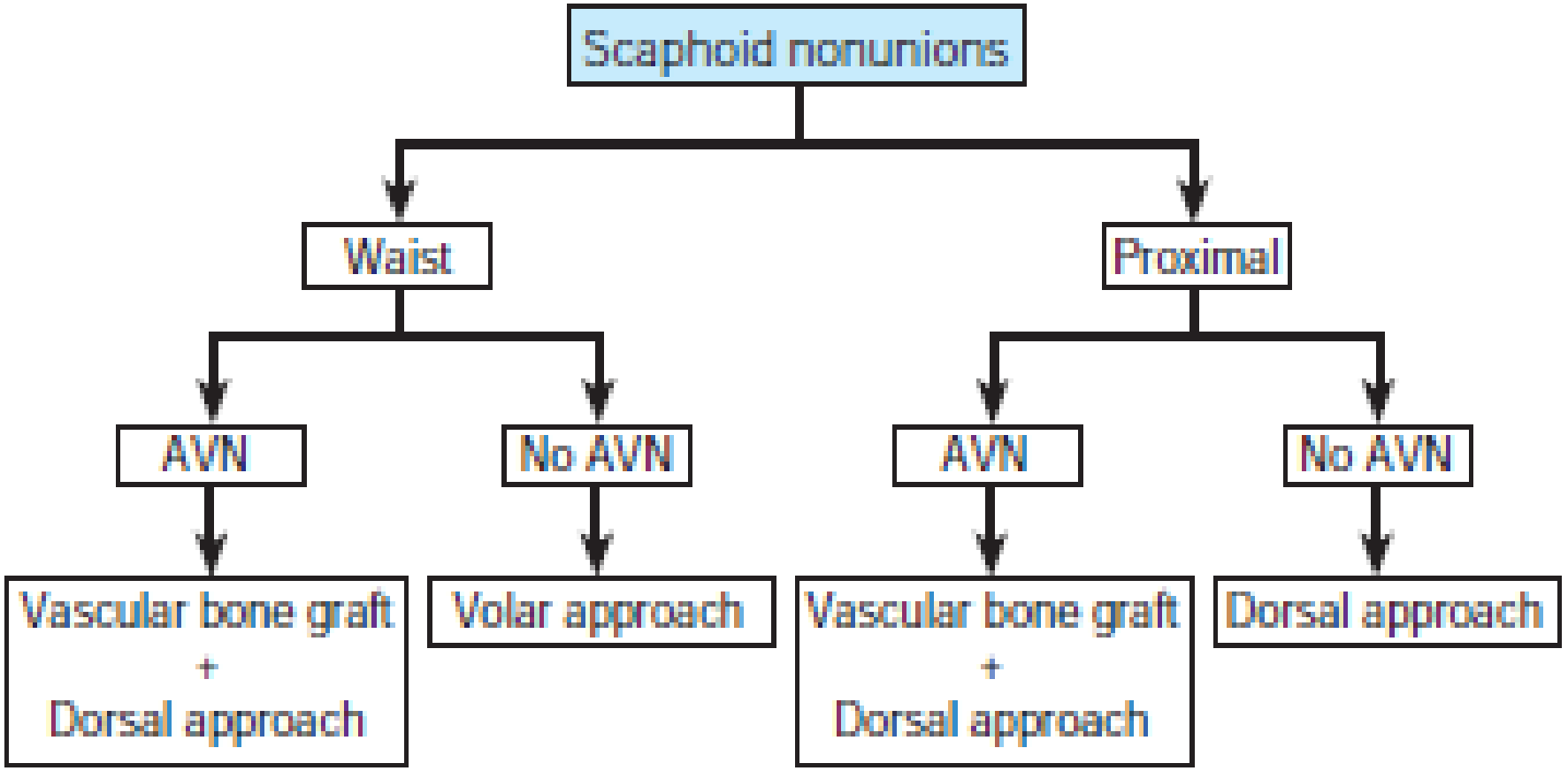

A
B
H

Treatment

Treatment principle:

- 1. Preservation of blood supply
- 2. Bone apposition by a graft
- 3. Internal fixation for fracture stability
- 4. Correction of carpal instability.

- Following operations are done at different stages:
    - ORIF with non vascularised bone grafting
    - ORIF with vascularised Bone grafting
    - Radial styloidectomy and distal pole excision
    - Excision of proximal fragment
    - Proximal row carpectomy
    - Partial or total arthrodesis of wrist.


Scaphoid nonunions
Waist
Proximal
AVN
No AVN
AVN
No AVN
Vascular bone graft
+
Dorsal approach
Volar approach
Vascular bone graft
+
Dorsal approach
Dorsal approach

ORIF with Bone grafing operations

Three basic types of bone grafting:

- In situ inlay grafts - best for undisplaced stable non union.
- Interposition grafts - for displaced non union to correct angulation secondary to volar resorption.
- Vascularized bone grafts - most appropriate for specific circumstances like longstanding nonunion, AVN and in which conventional grafting is likely to fail.

Inlay grafting

FIGURE 69-38 Matti-Russe technique of bone grafting for non-union of carpal scaphoid. SEE TECHNIQUE 69-13.

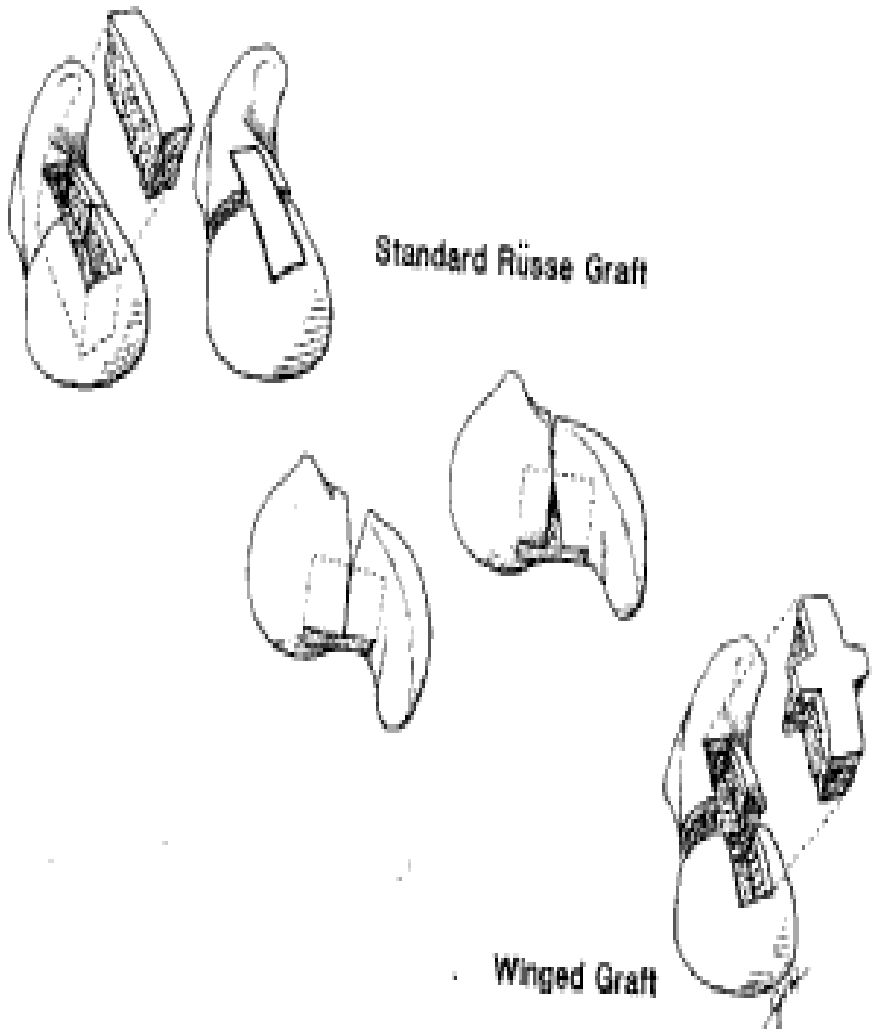
- The scaphoid is exposed and sclerotic bone ends are freshened and cavity is formed by removing a sclerotic bone.
- A corticocancellous graft from the distal radius or iliac crest is taken and shaped according to the cavity and the graft is placed.
- Two K-wires are passed from distal to proximal.
- Long arm thumb spica cast is applied for 6 weeks.

Matti & Russe procedure (Inlay grafting)

- Used for fracture nonunion of scaphoid that donot have associated shortening or angulation
- **Procedure –**

  -fracture site exposed

- ***Sclerotic bone ends freshened***
- ***- cavity formed with high speed burr***
- ***-corticocancellous bone graft taken from iliac crest & shaped in such a way that it fit into preformed cavity***
- ***Fragments stablised with k wire***



Fernandez procedure (Interposition graft)

- Used for fracture nonunion with resorption of cortex & angulation.
- *Due to resorption or comminution, shortening and angulation, with its convexity dorsal and radial occurs in non union fractures of scaphoid leading to "**humpback**" deformity*
- *The deformity includes extension of the proximal pole of the scaphoid, resulting extension of the lunate, and a form of dorsal intercalated instability pattern seen on lateral plain radiographs*

Procedure-

- Preoperatively size of graft and angular deformity calculated
- Bone is resected from distal and proximal fragment
- Flexion deformity and shortening is corrected
- Corticocancellous graft of proper shape and size harvested from iliac crest
- Graft is correctly inserted into defect and fixed with kwires.

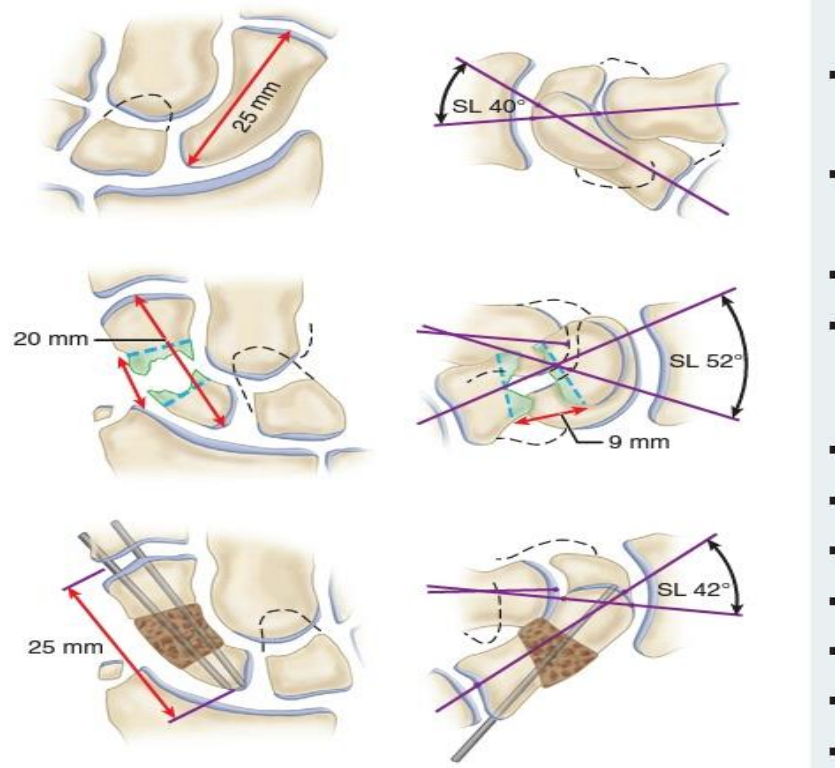
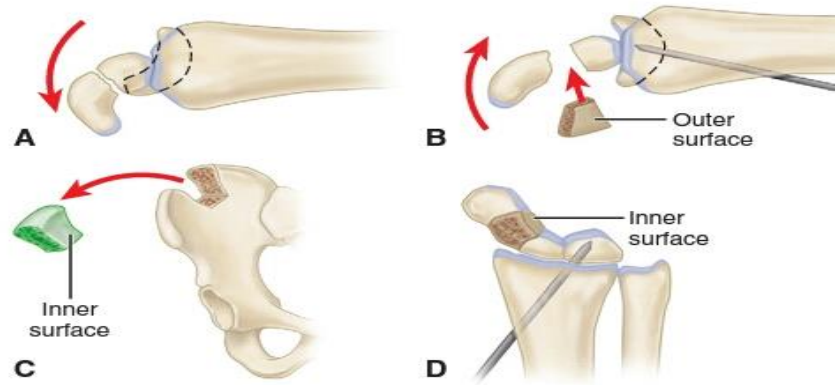


FIGURE 69-40 Preoperative planning. **Top,** Tracing of uninjured wrist and measurement of scaphoid length and scapholunate (SL) angle. **Middle,** Calculation of size of resection area and form of graft. **Bottom,** Definitive diagram of operation. SEE TECHNIQUE 69-14.



VASCULARISED BONE GRAFTS

- **Effective method for treating**

  -Nonunions with an avascular proximal pole

  -Nonunion with failed previous procedures

SOURCES:

- Pronator quadratus pedicle graft from the distal radius
- Distal dorsolateral radius pedicle bone grafts based on the 1,2 intercompartmental supraretinacular artery. 1,2ICSR
- ***Presence established radiocarpal arthrosis may compromise functional outcome.***

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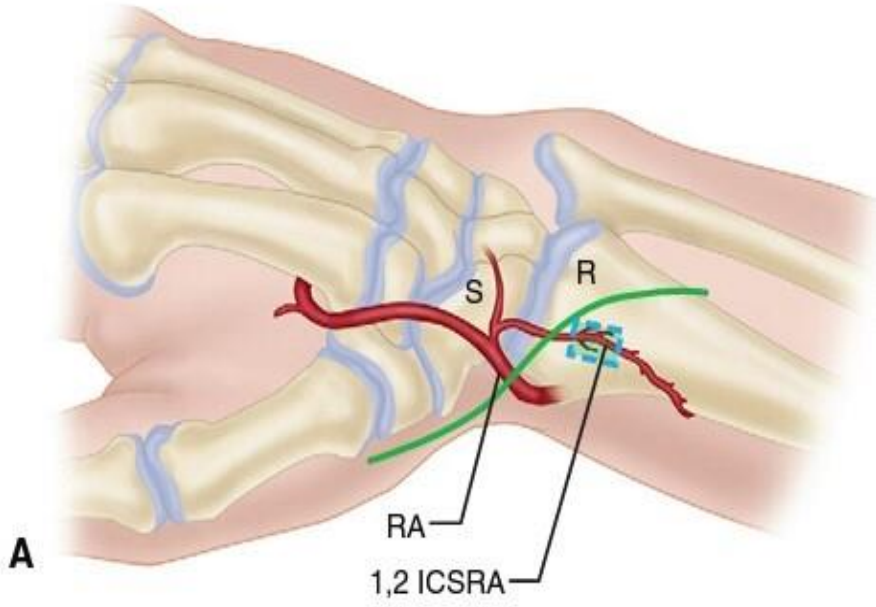
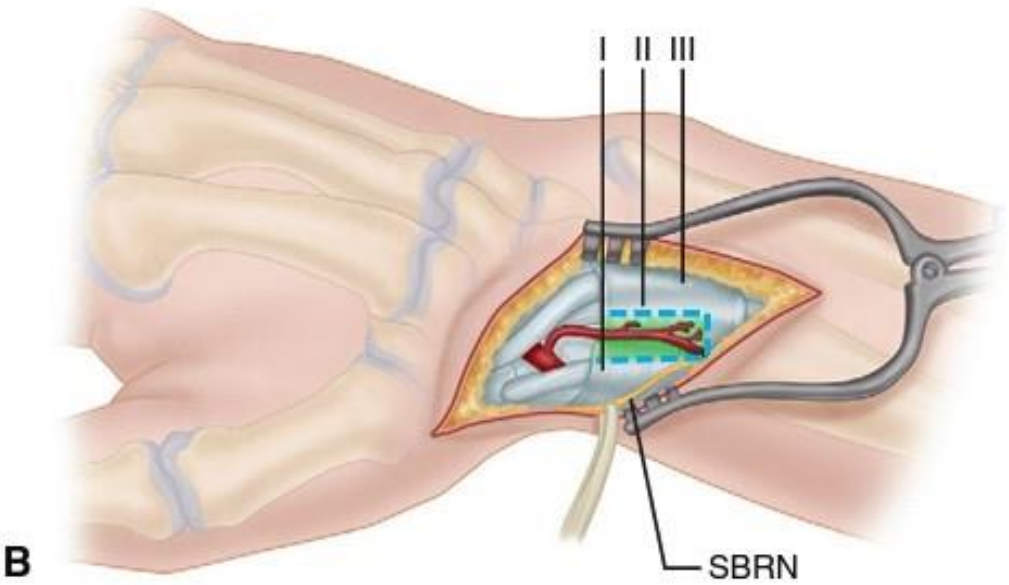
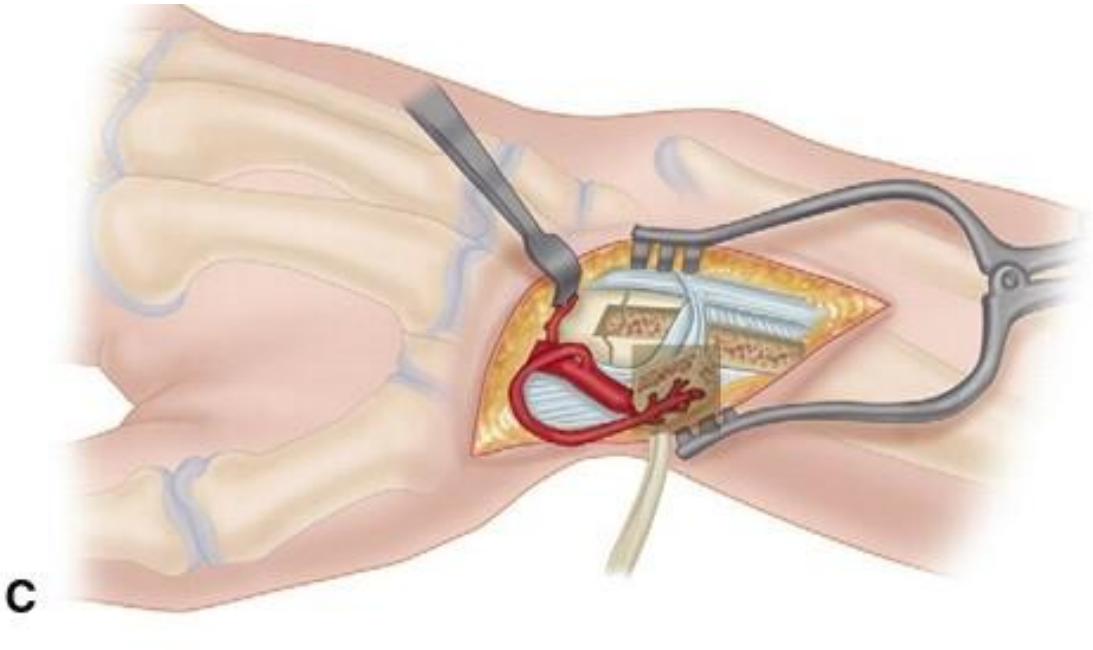
- Oblique incision on dorsoradial side
- Scaphoid and bone graft donor site exposed
- On distal radial periosteum longitudnal course of ascending irrigating branch of radial artery identified



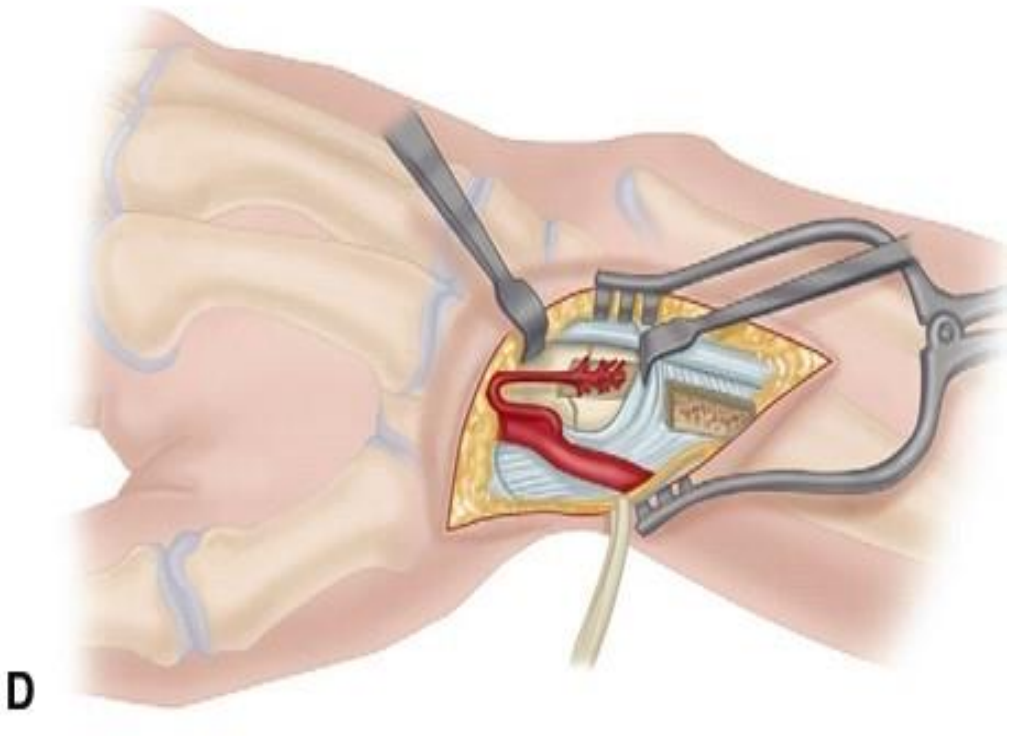
- Branches of superficial branch of radial nerve identified and protected



- Bone graft is harvested with longitudnal vessels at it centre
- Scaphoid nonunion site is exposed & sclerotic bone ends are freshen up & then fracture is reduced
- A 15 to 20 mm trough in scaphoid is made along it’s aixs.



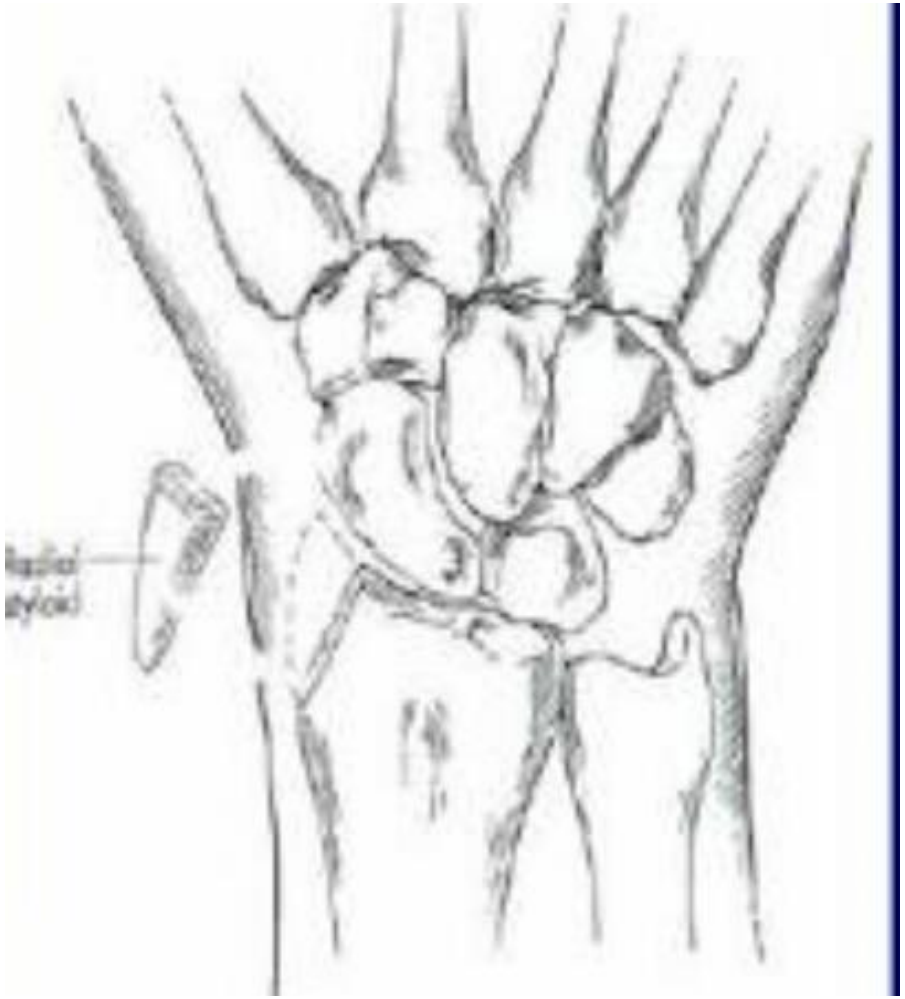
- Harvested bone graft is transposed to the defect in scaphoid
- Stablized with k wires



Salvage procedures

Radial styloidectomy and distal pole excision

- It is done when arthritic changes involve only scaphoid fossa of radiocarpal joint.
- In older patients with radioscaphoid arthritis .
- SNAC 1 and 2
- Can be done alone or in conjunction with any grafting procedure of scaphoid



Proximal row carpectomy

- Proximal row carpectomy is used as a reconstructive procedure for posttraumatic degenerative conditions in the wrist, especially conditions involving the scaphoid and lunate.
- Excision of Scaphoid, lunate and triquetrum
- Alternative to arthrodesis.

- It is considered to be a satisfactory procedure in patients who have limited requirements, desire some wrist mobility, and accept the possibility of minimal persistent pain

Salvage procedures

- **Limited wrist arthrodesis**
  - Midcarpal joint degeneration.
  - SNAC Stage 3
- **Total wrist arthrodesis**
  - Involvement of radiolunate joint
  - SNAC Stage 4

Complete arthrodesis of wrist

- Treatment of choice for scaphoid nonunion with advanced degenerative arthritis of wrist.

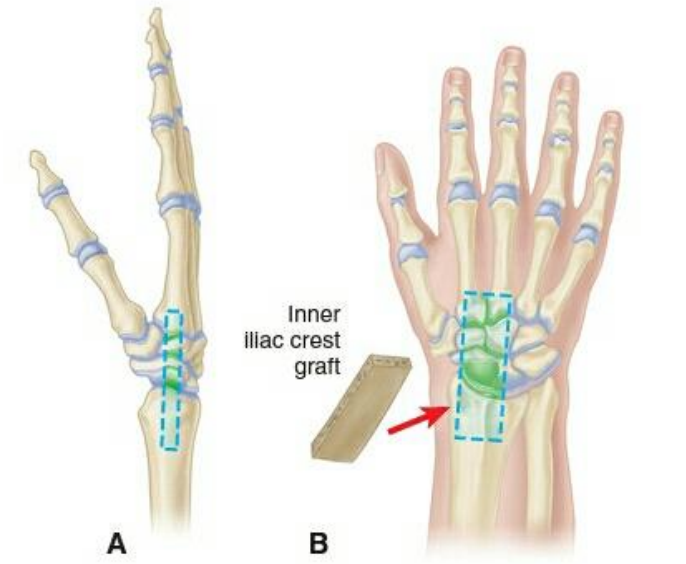


FIGURE 69-80 Haddad and Riordan arthrodesis of wrist. **A,** Radial view showing slot cut in distal radius, carpal bones, and bases of second and third metacarpals. **B,** Dorsal view showing shape of graft and its final position *(broken line)* in slot. **SEE TECHNIQUE 69-39.**

FIGURE 69-81 Arthrodesis of wrist with lag screw and dynamic compression plate fixation. **SEE TECHNIQUE 69-40.**

Malunion

- Occurs when a displaced or angulated fracture is allowed to heal without anatomic reduction.
- resulting in a fixed humpback deformity :
  - pain
  - decreased of motion
  - decreased grip strength
- Treatment in a young patient includes osteotomy, volar wedge bone graft, and internal fixation
- Once degenerative arthritis has begun ,treatment is limited to a salvage procedure such as proximal row carpectomy,intercarpal arthrodesis,or complete wrist fusion

TAKE HOME MASSEGE

- Scaphoid is twisted irregular bone, special x-ray views
- Index of suspicion, physical examination and carful evaluation
- Stable fracture, the glass holding position cast till radiological healing
- Surgery is for unstable fracture
- Dorsal approach for proximal pole and waist #
- Volar approach for distal and waist #
- Non union (SNAC) and AVN treated with bone graft
- Salvage procedures for cases associated with OA