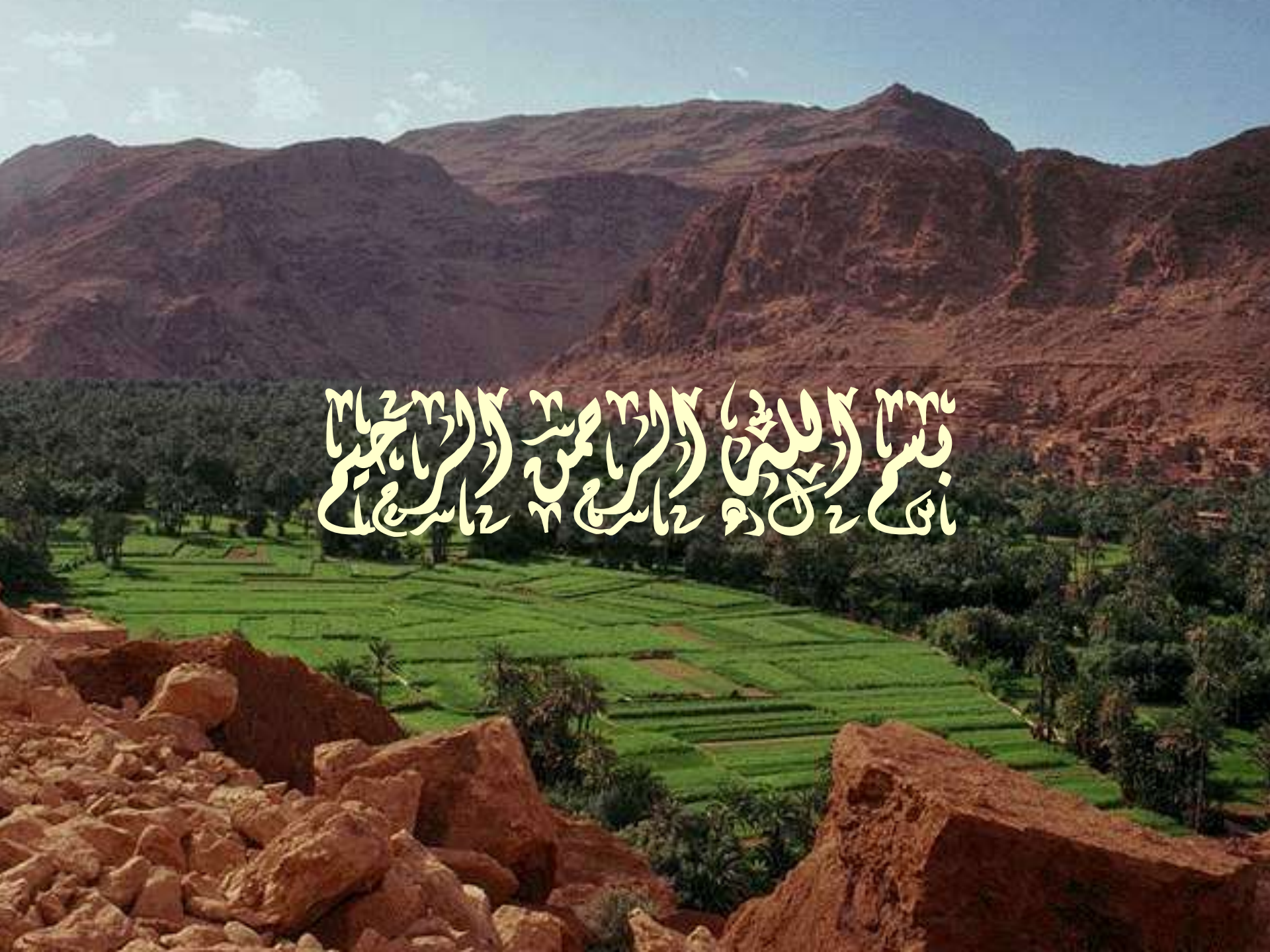

بسم الله الرحمن الرحيم

Wrist Joint
Osseous Structures MRI

Dr. Mohamad Hasan Alkousy
Ass. Professor of Radiology
Sohag University

Normal Relations

Neutral ulnar variance

•coronal MRI.The distal articular surfaces of the radius and ulna are normally at the same level on

Negative ulnar varience

• The articular surface of the ulna is proximal to radius by greater than 2 mm.

• Associated with osteonecrosis of lunate (Kienböck's disease).

Positive ulnar varience

• The articular sutface of the ulna is distal to radius.

• Associated with ulno-lunate impaction syndrome and TFC tears.

It is a

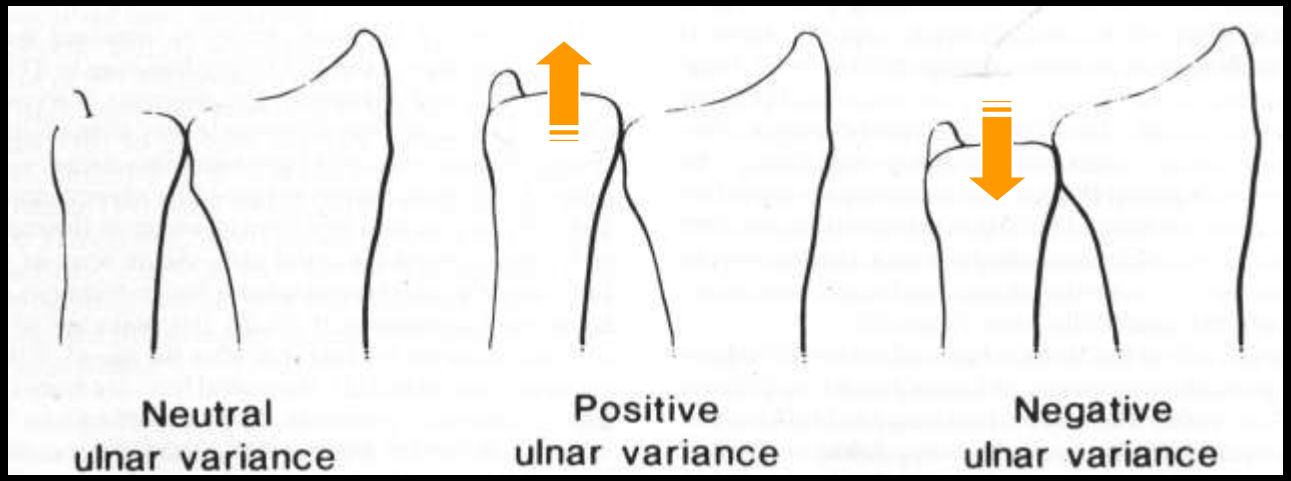
• Congenital variant.

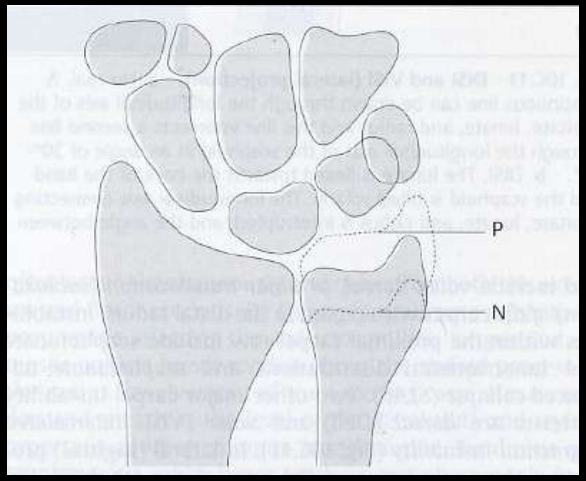
• / develop 2ry to impacted distal radius fracture.

Pitfall

• Ulnar surface is normal curved.

• Diagnose -ve ulnar variance if it is shorter than radius on all coronal images.





Ulnar varience

Neutral varience occurs when the carpal surfaces of radius and ulna are equal.

+ve ulnar varience (P) occurs when the ulna is longer than radius. The condition predisposes to TFC degeneration and tear (ulnar impaction sy).

–ve ulnar varience (N) occurs when the ulna is shorter than radius. The condition predisposes to avascular necrosis of lunate (Kienbock disease).

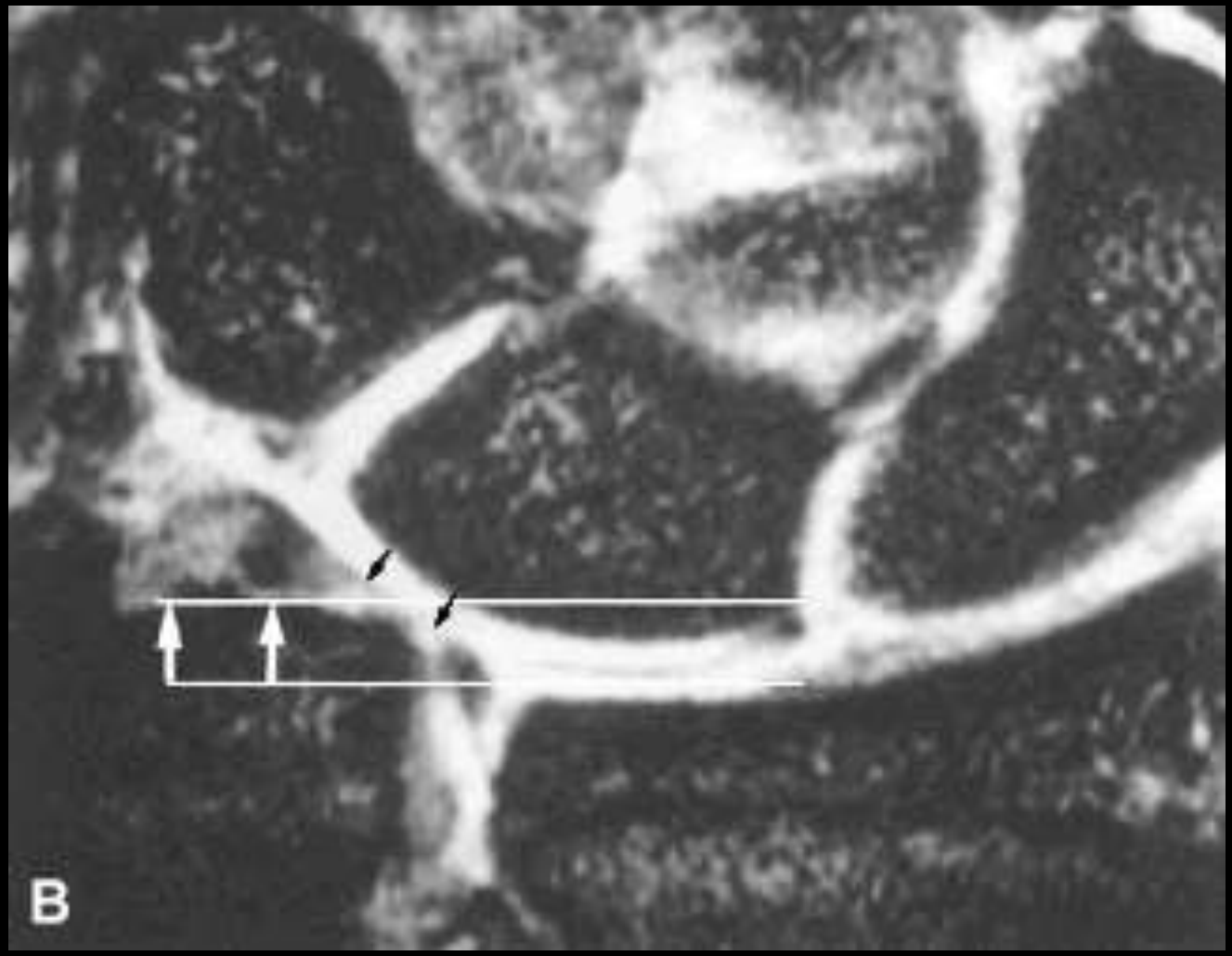
<u>Ulnar variance</u> (Coronal T1)

A, Neutral ulnar variance (distal radius and head of ulna are at the same level (*arrow*), or the ulna is within 2 mm proximal to the radius).

B, Ulnar minus variance (the head of ulna is proximal to distal radius by greater than 2 mm) (*arrow*).

C, Ulnar plus variance (the head of ulna projects distal to radius) (*arrow*). Old impacted radial head fracture deformity is present (*arrowhead*).

D, +ve ulnar variance resulting in TFC tear (*arrowhead*) and impaction on ulna (*arrow*).



+ve ulnar variance with perforation of the TFC

+ve ulnar variance with perforation of the TFC

-ve ulnar variance with degeneration of TFC

Ulnar impaction syndrome

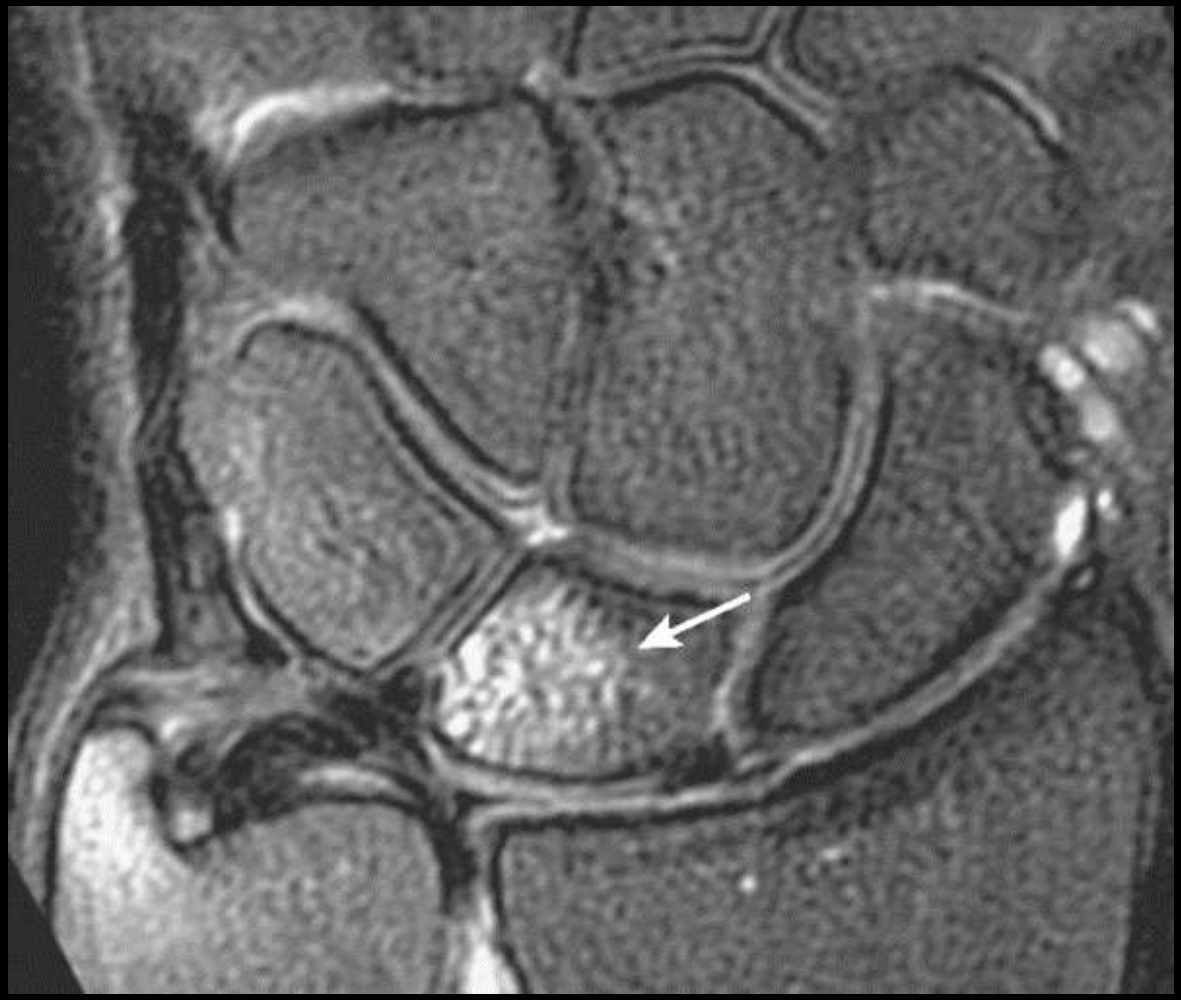
- Excessive ulnar +ve variance.
- Painful compression of the distal ulna on the medial surface of lunate.

MRI

- TFC & lunate cartilages degeneration.
- LT ligament disruption.
- Insatbility.
- BM oedema +/- subchondral cysts / sclerosis in proximal lunate or head of ulna.

+ve ulnar variance with ulnolunate impingement syndrome

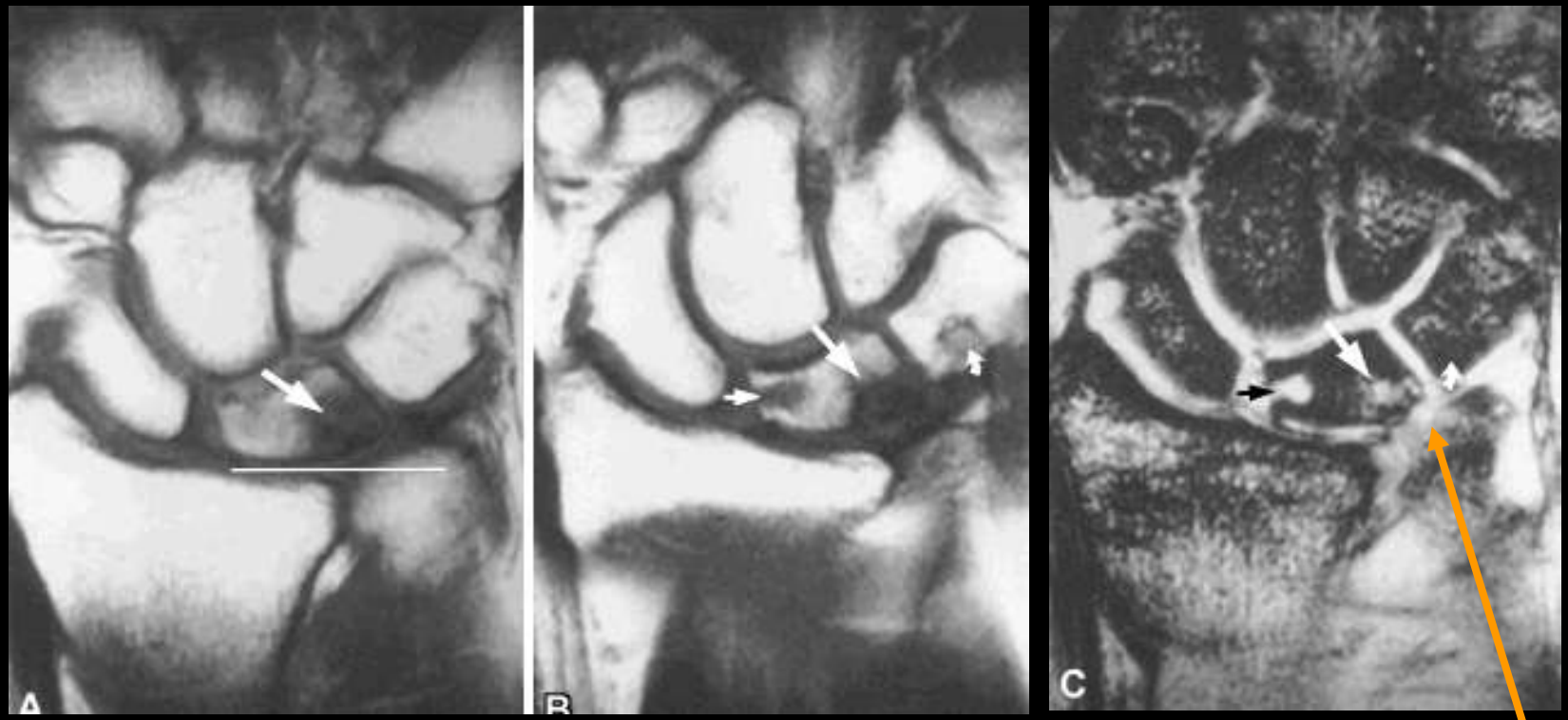
Ulnar impaction syndrome



(Coronal FS T2)

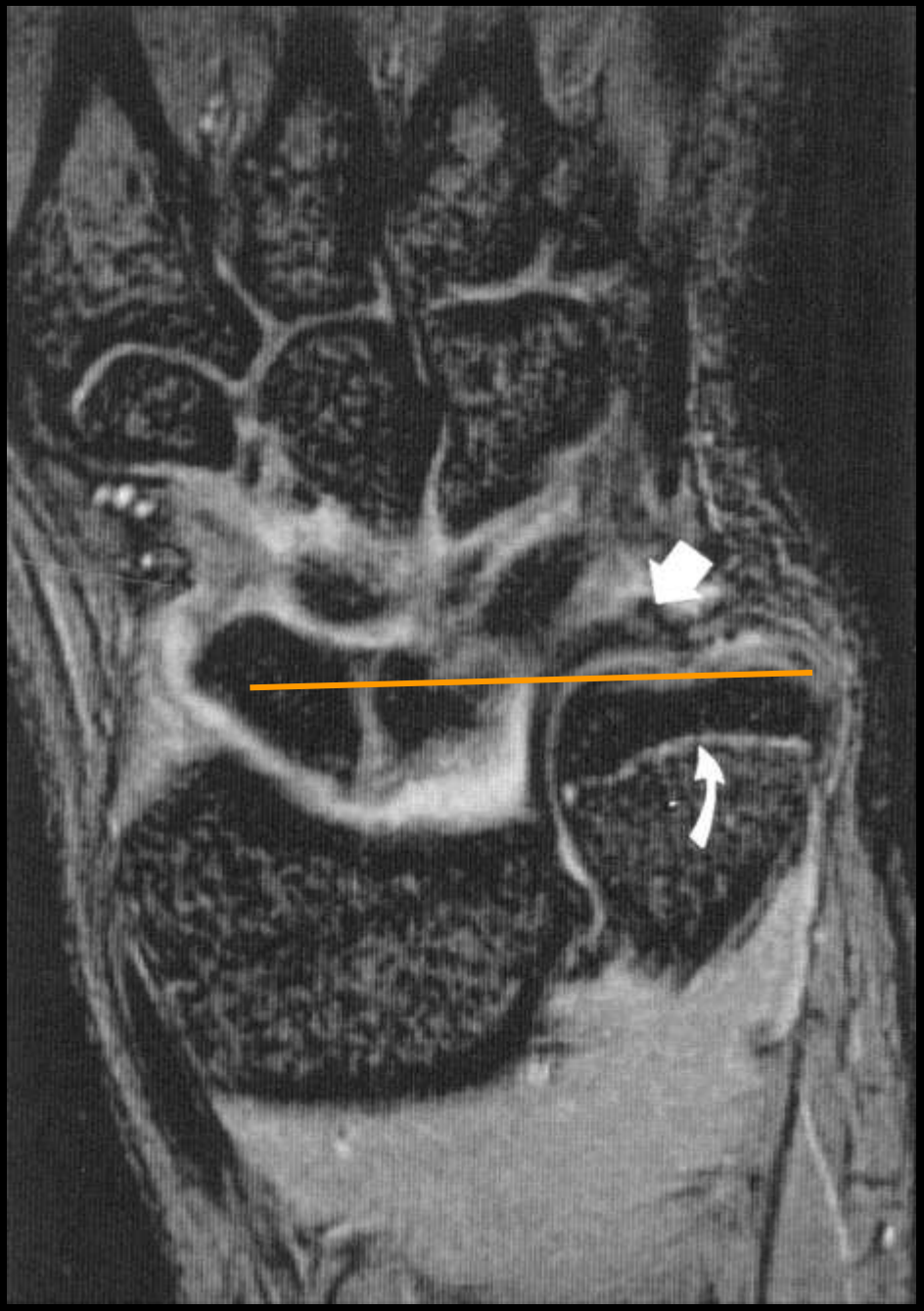
There is ulnar plus variance, a TFC tear, and marrow edema in the lunate (*arrow*).

Ulnar impaction syndrome

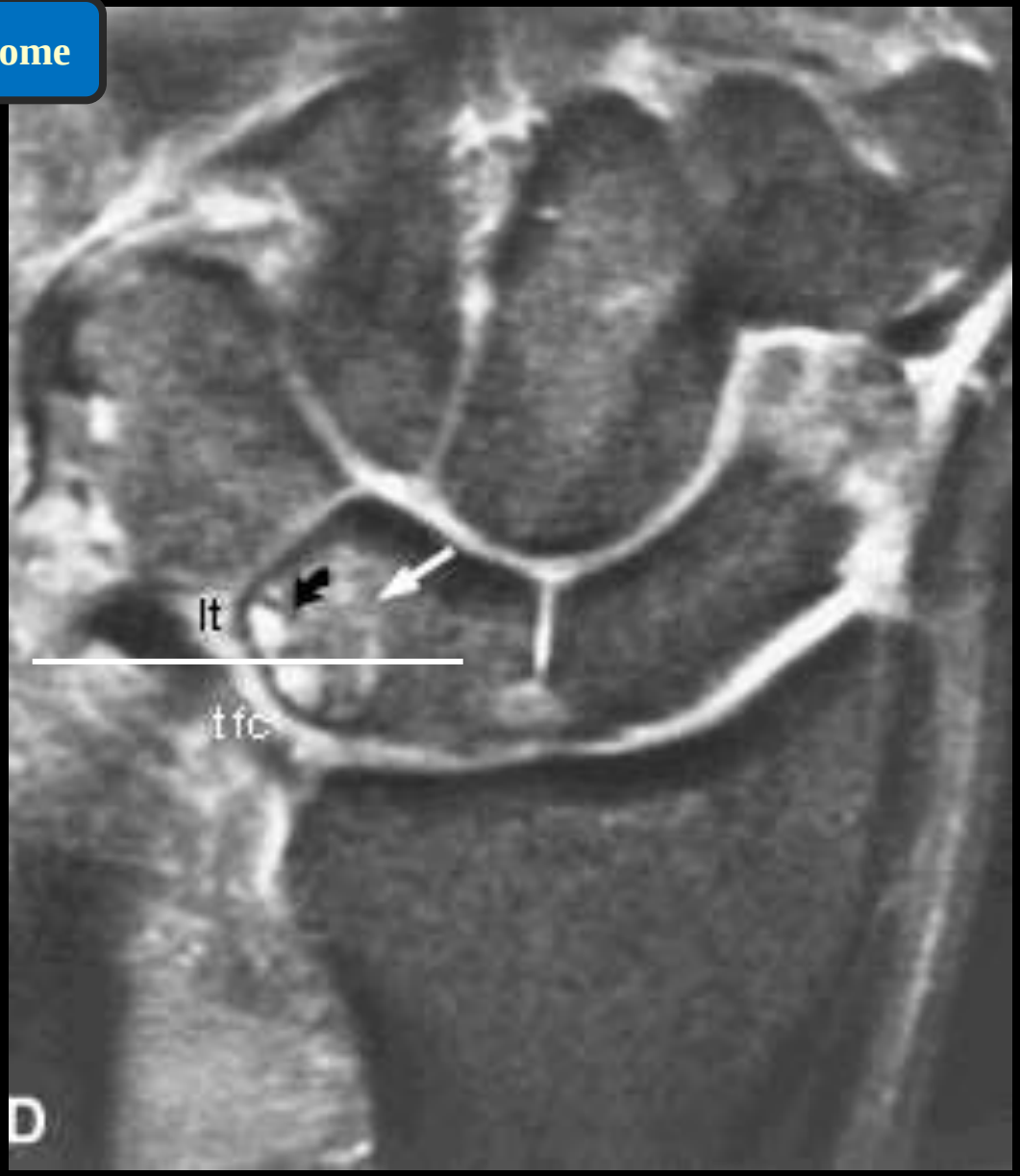


Ulnar impaction syndrome

+ve ulnar variance with TFC deformity



Ulnar impaction syndrome



Subchondral pseudocysts & BM oedema

Torn TFC & LT ligaments.

Ulnar impaction syndrome

(Coronal T1W)

+ve ulnar variance, TFC tear (black arrow), and BM changes in triquetrum. Note fracture of the distal radius (white arrow).

Ulnar impaction syndrome

(Coronal FS T2)

1- +ve ulnar variance, BM changes in the triquetrum (white arrow).
2- +ve ulnar variance, BM changes in the ulnar side of the lunate (white arrow).

Ulnar impaction syndrome

Old fracture of the radius and small subchondral cyst in the triquetrum and lunate.

<u>Ulnar styloid impaction</u> **(**Coronal FS T2)

-ve ulnar variens, enlarged ulnar styloid and BM changes in the triquetrum.

Osseous Abnormalities

Os Styloideum

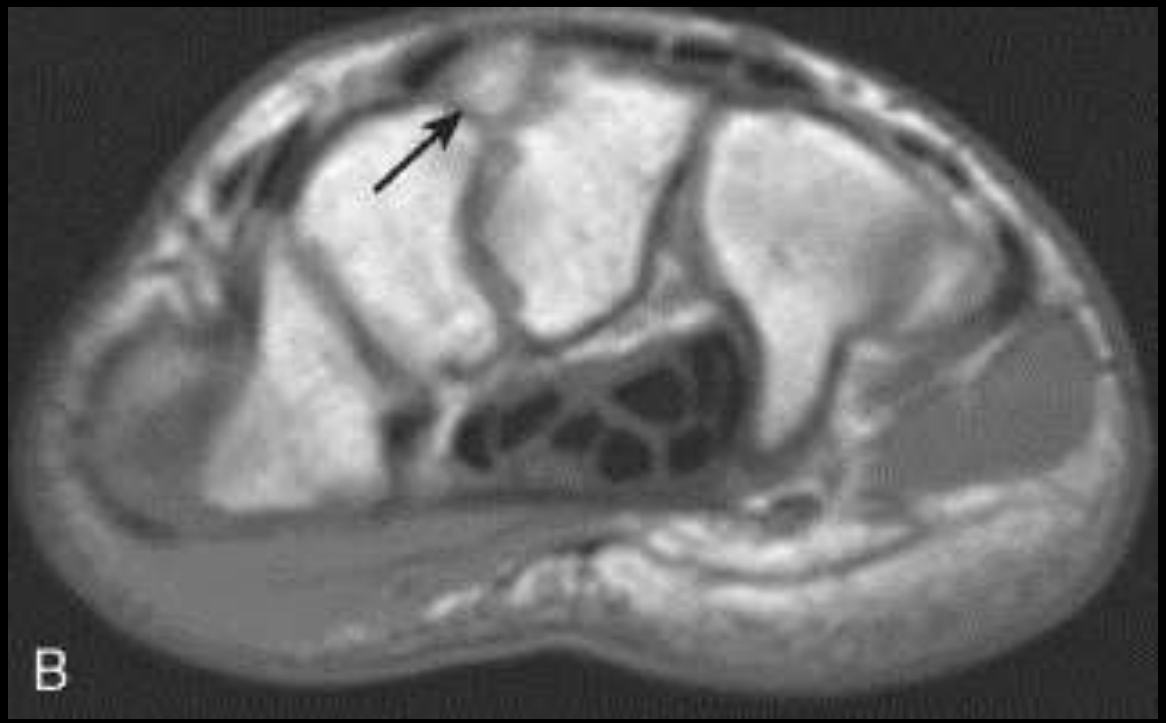
- There are many accessory ossicles in the wrist.
- Os styloideum is associated with pain and be confused with tumor / fracture.
- It is a bony protuberance on the dorsal aspect of the wrist.
- Lies at the base of the 2nd & 3rd metacarpals.

Cause of pain

- Degenerative changes between it and the underlying bones.
- Overlying bursitis / ganglion cyst.

MRI

- Small piece of bone that articulates with the capitate and trapezoid on axial or sagittal images.



Os styloideum

A, Sagittal T1, os styloideum (*arrowheads*) is present on the dorsum of the wrist.

B, Axial T1, the os styloideum (*arrow*) is noted at the base of the 2nd & 3rd metacarpals.

Triquetral Impaction

• Occasionally, after an ulnar styloid fracture malunion, the styloid can impact the triquetrum leading to ulnar-sided wrist pain.

MRI T2

• BM oedema / cystic change in the triquetrum and ulnar styloid.

Carpal Insatbility

Scapho-lunate ligament disruption lead to **(coronal)**

- Increased scapholunate interval (scapholunate dissociation).
- Rotatory subluxation of scaphoid.
- Dorsal tipping of lunate (dorsal intercalated segmental instability). (sagittal)
- Scapholunate advanced collapse wrist (SLAC)
    - Increased scapholunate interval
    - Degenerative changes between scaphoid and radius
    - Proximal migration of capitate between scaphoid and lunate

Luno-triquetral ligament disruption lead to **(coronal)**

- Instability between lunate & triquetrum. (sagittal)
- Volar tilting of lunate (volar intercalated segmental instability).

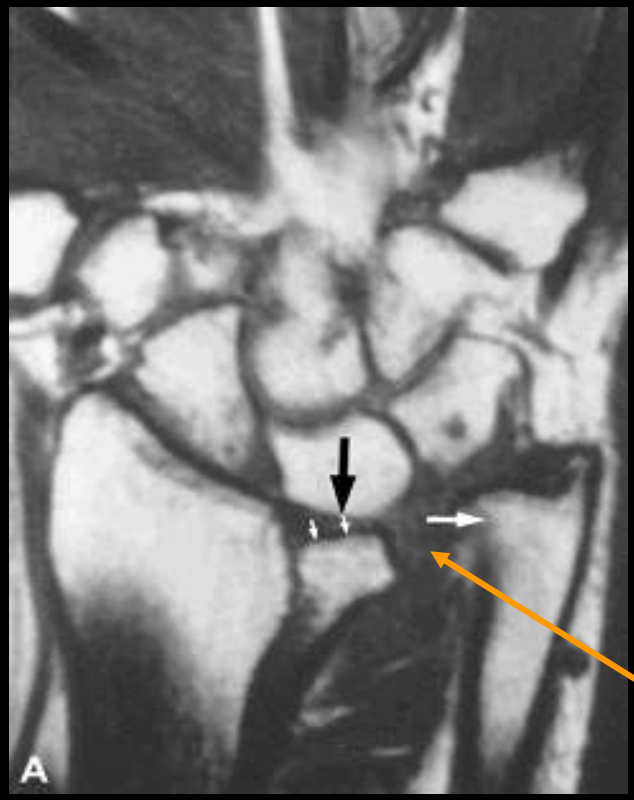
Fractures

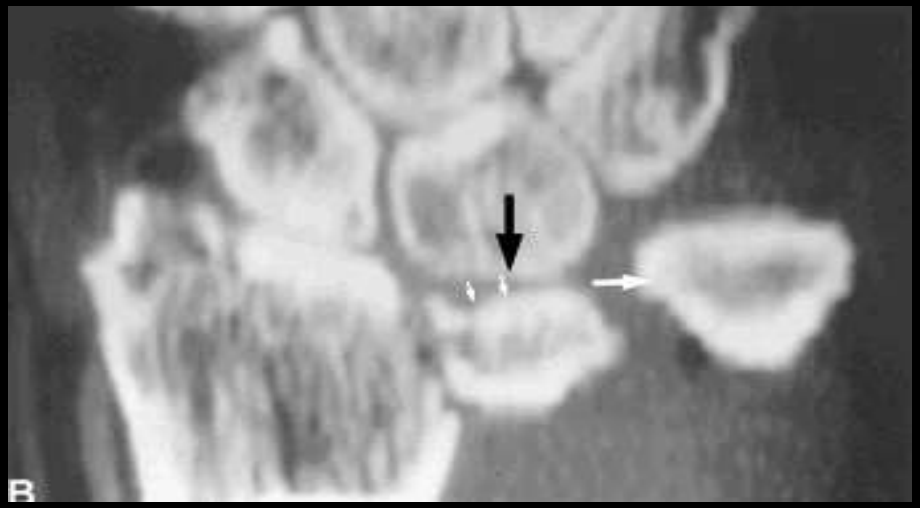
Colles fracture

Distal radius fracture with dorsal angulation & radial shortening.

Note subchondral erosion of lunate in 2.

Ulnar styloid fracture with marrow oedema





Dislocation of DRUJ with torn TFC

Die punch fracture (lunate load fracture)

Depression fracture of lunate fossa with proximal displacement of the lunate.

Die punch fracture (lunate load fracture)

Intraarticular distal radius fracture of the lunate fossa.

Dorsal displacement of the medial fragment.

Dorsal tilt and shortening of the radius.

- Scaphoid is the most commonly fractured carpal bone.
- 70% in the waist.
- Complete fractures are ubstable.

Complications

- Delayed fracture union.
- AVN of proximal fractured fragment.
- Osteoarthritis.
- Carpal tunnel syndrome.

MRI

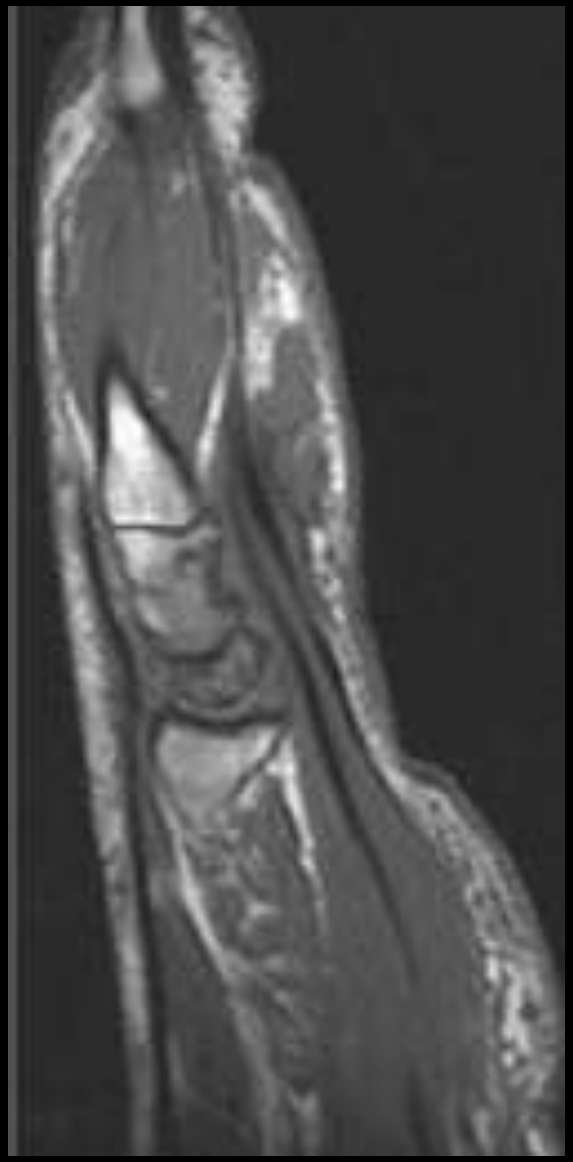
- BM contusion.
- /True linear fracture lines.

<u>Occult carpal fractures</u> (Coronal FS T2)

Scaphoid fracture line seen as linear low signal (*arrow*), and there is diffuse, surrounding edema throughout the bone.

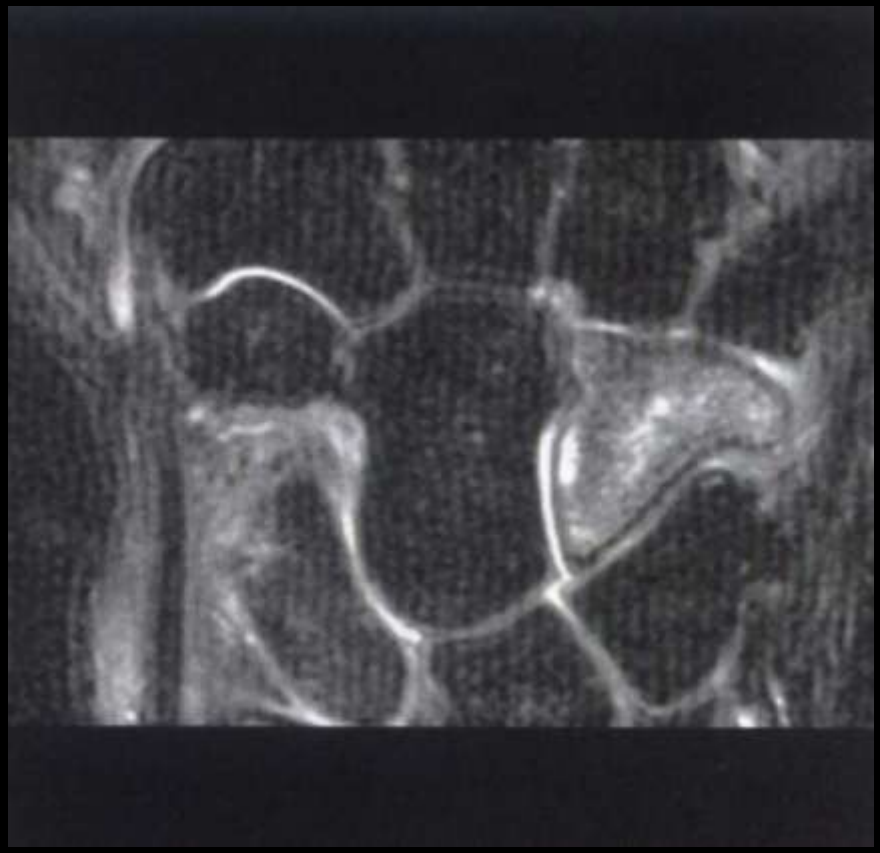
Bone contusions **(Coronal T1)**

Patchy abnormal intermediate signal in scaphoid, capitate, hamate, triquetrum, and lunate from multiple bone contusions without discrete fracture lines.



Bone contusion **(**Sagittal PD)

Low signal of lunate and proximal capitate with fracture line consistent with bone bruise.



Hamate marrow oedema after trauma

Physeal (growth plate) Injuries

May result in growth disturbance due to

- Formation of a fibrous / osseous bridge across the physis.
- Slowing of growth in a portion of the physis.

MRI

- Occult stress fractures.
- Metaphyseal contusions.
- Physeal changes:
    - Physeal cartilage:
        - Initially, cartilage is thickened.
        - Later, persistent cartilaginous foci found in the metaphysis.
    - Physeal bridges:
        - Focal areas of either bone / low signal fibrous material.
        - Extend vertically from the metaphysis to epiphysis traversing the cartilaginous physis.
        - Best seen in GE / STIR.

Osteonecrosis

The two most common sites are

- Proximal pole of scaphoid after a fracture.
- Lunate bone.

- Rarely, proximal portion of capitate after a fracture.

Scaphoid AVN

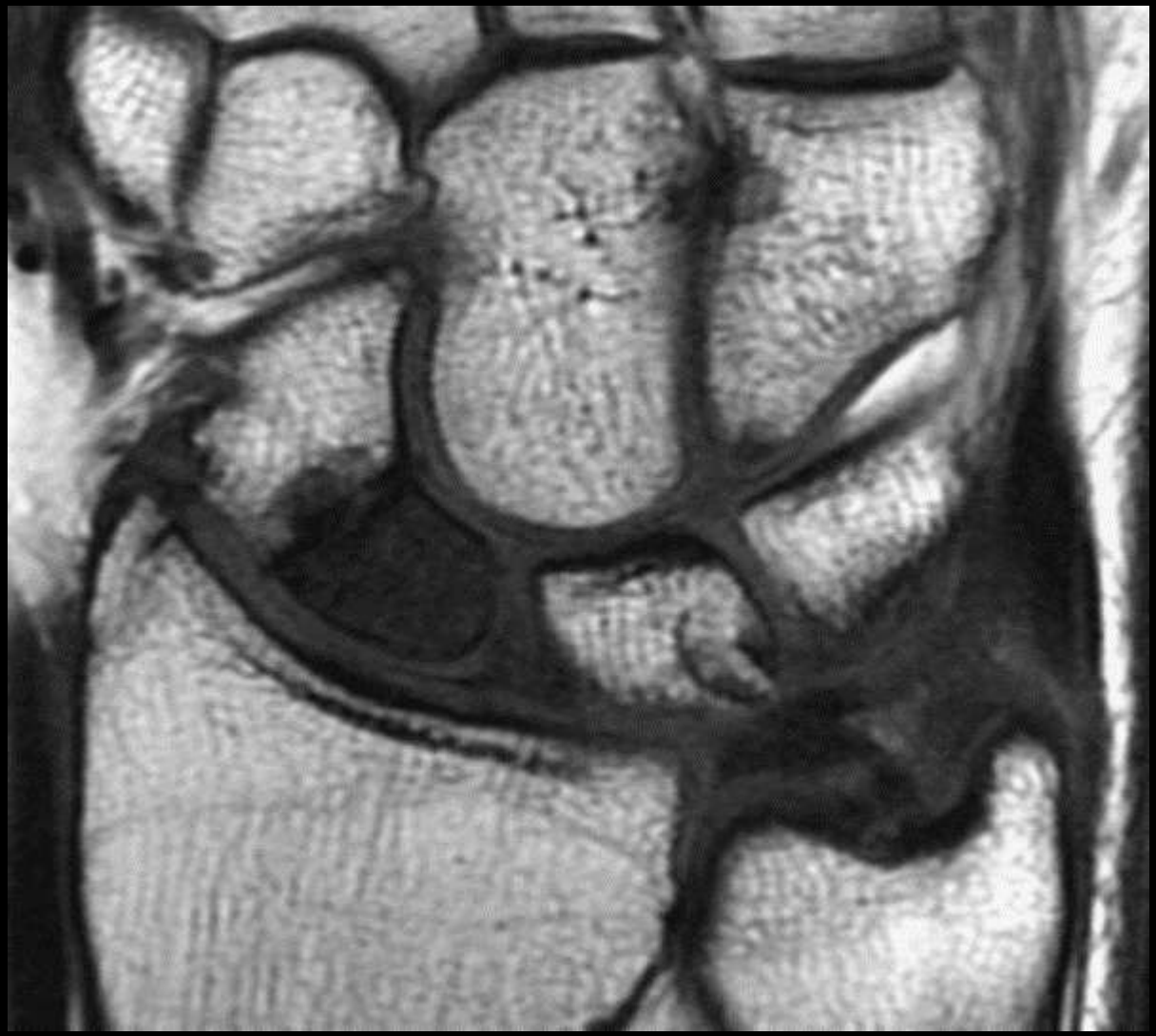
Scaphoid AVN

MRI

- Low on T1 & T2 = osteonecrosis
- Low on T1 & high on T2 = ischemia / marrow edema / healing.
- High on T1 & medium on T2 = normal (fat).
- Gad -- enhancement of hyperamic tissue at fracture edge.

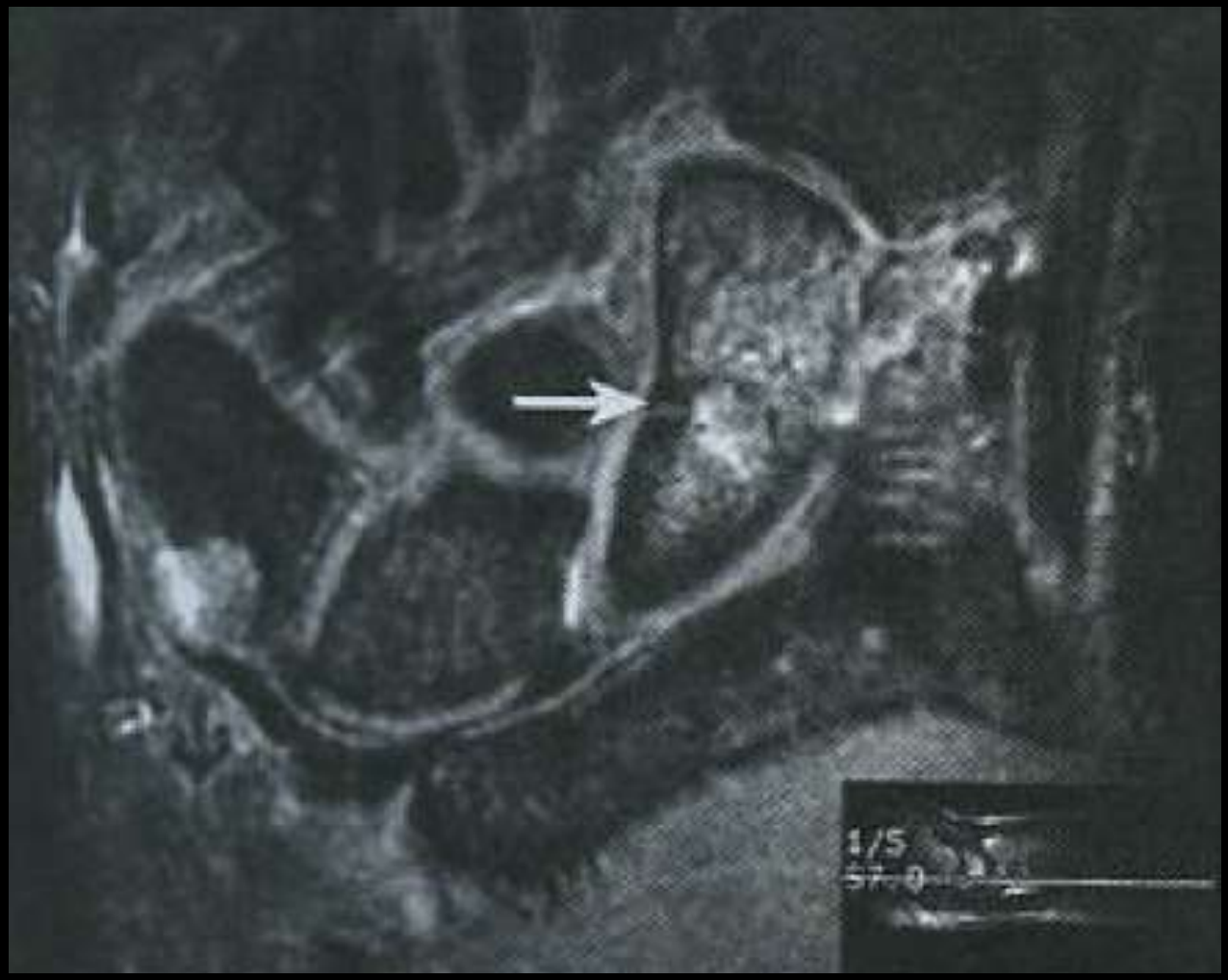
  -- no enhancement of necrotic tissue.

Normal Scaphoid
Coronal & sagittal T2



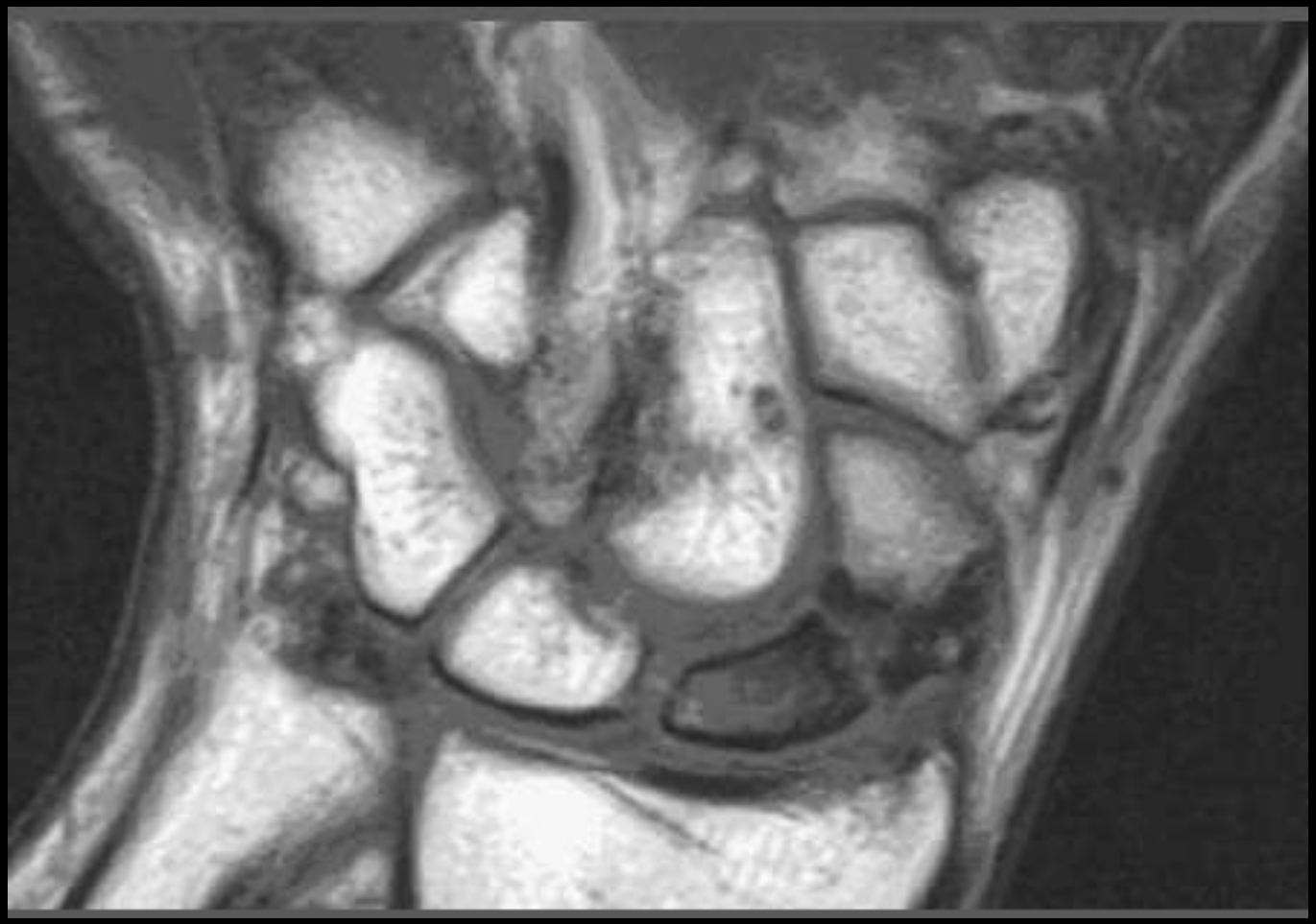
<u>Scaphoid osteonecrosis</u> (Coronal T1)

Osteonecrosis seen as diffuse low signal in the proximal pole of scaphoid without collapse.

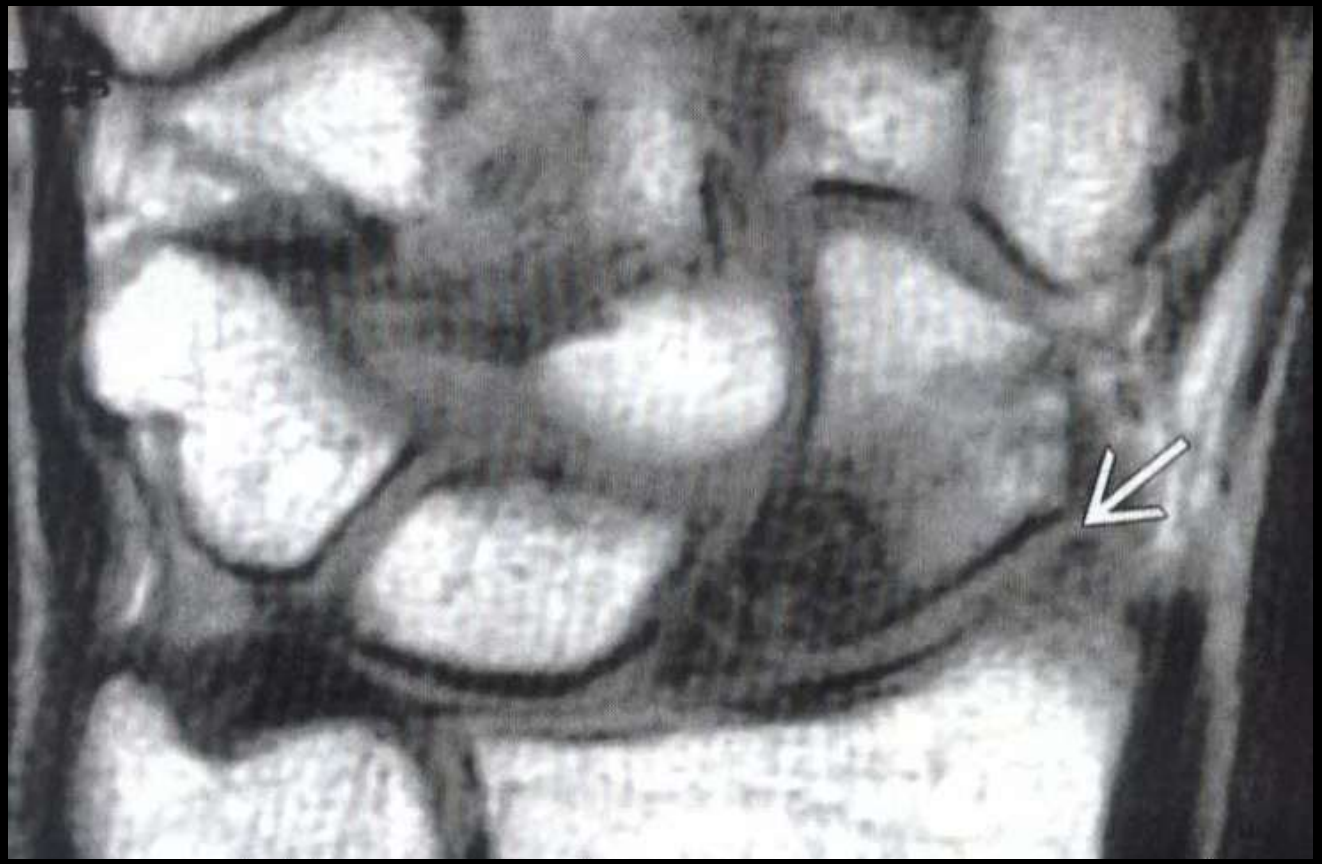


<u>Fibrous nonunion of scaphoid fracture with AVN of proximal fragment</u> (Coronal T2)

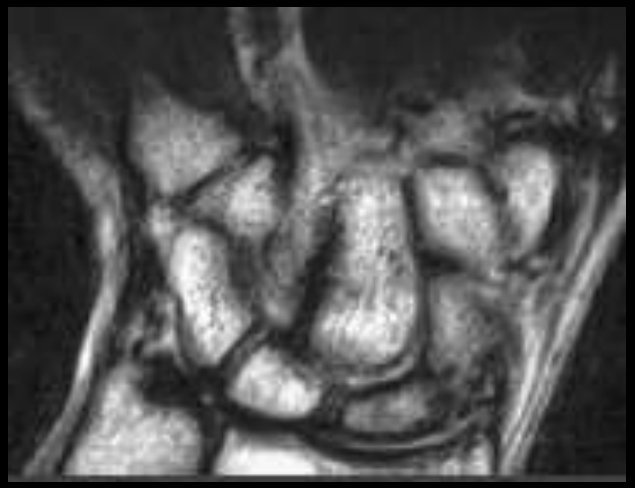
Old scaphoid fracture line seen as low signal line (arrow). The proximal fractured fragment is collapsed and show heterogenous signal.



Scaphoid fracture with AVN
Coronal T1 shows scaphoid fracture with low signal at the proximal fracture fragment (AVN).



Scaphoid fracture with AVN

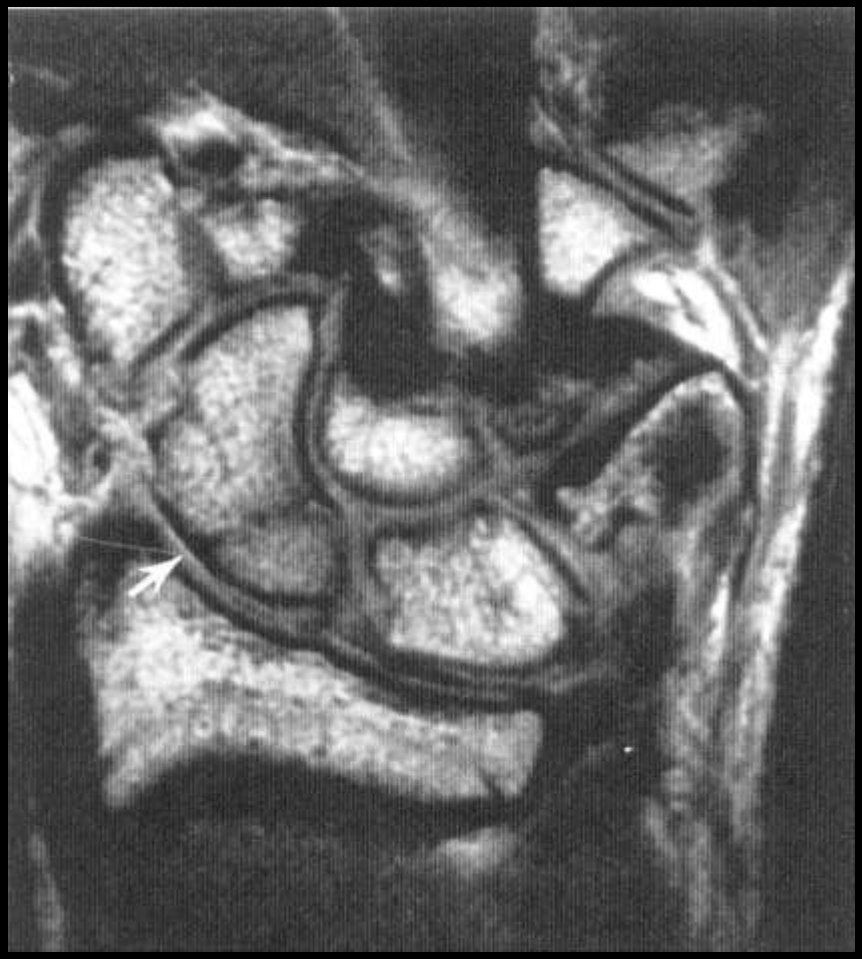


Scaphoid fracture with AVN

AP X-Ray shows scaphoid fracture and sclerosis of proximal fragment with small cystic change at the fracture site.

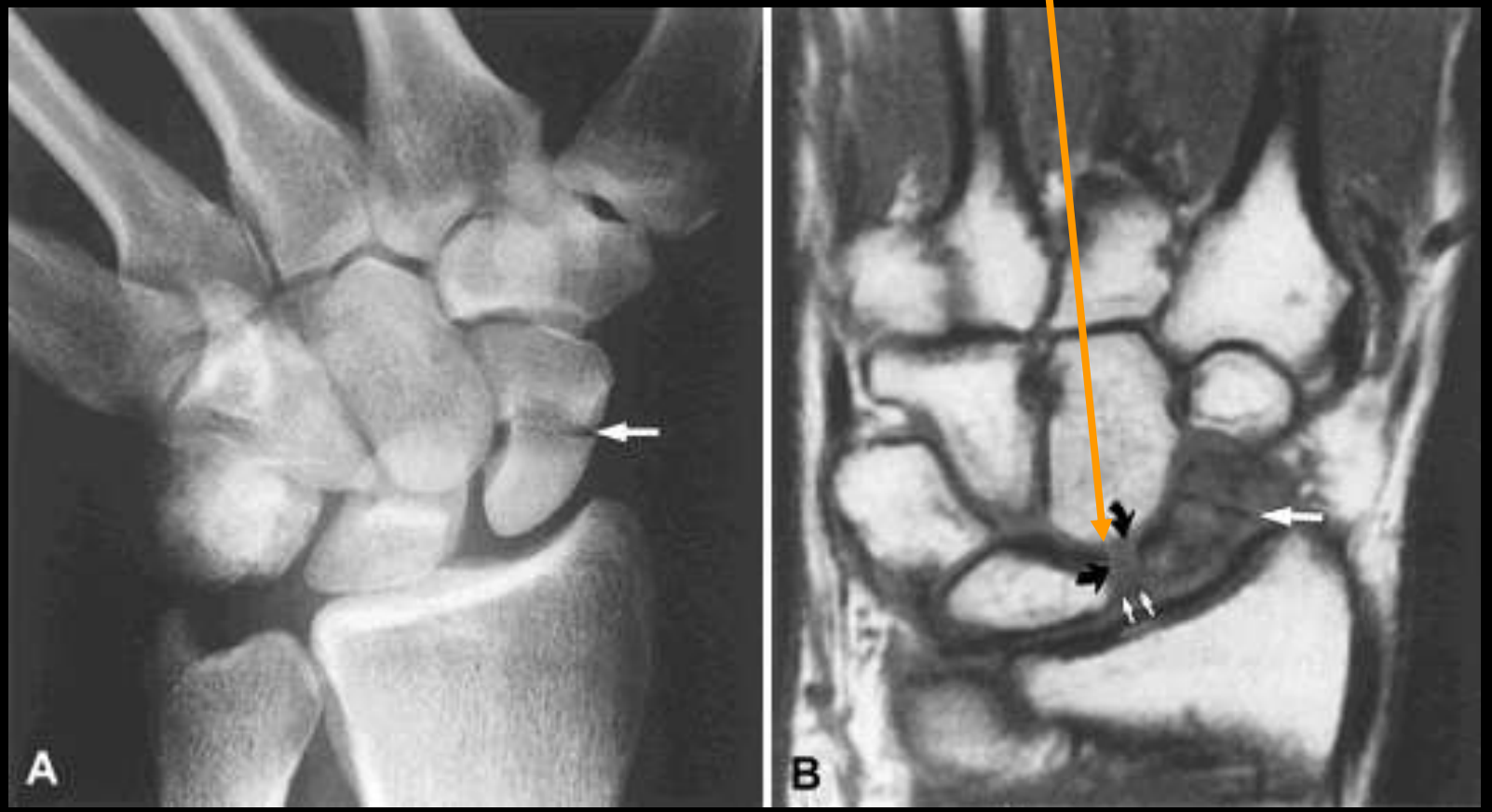
Sagittal & coronal FS T2 show bright signal (marrow edema) in proximal & distal fragments.

Coronal T2 shows mixed signal on fracture fragments.

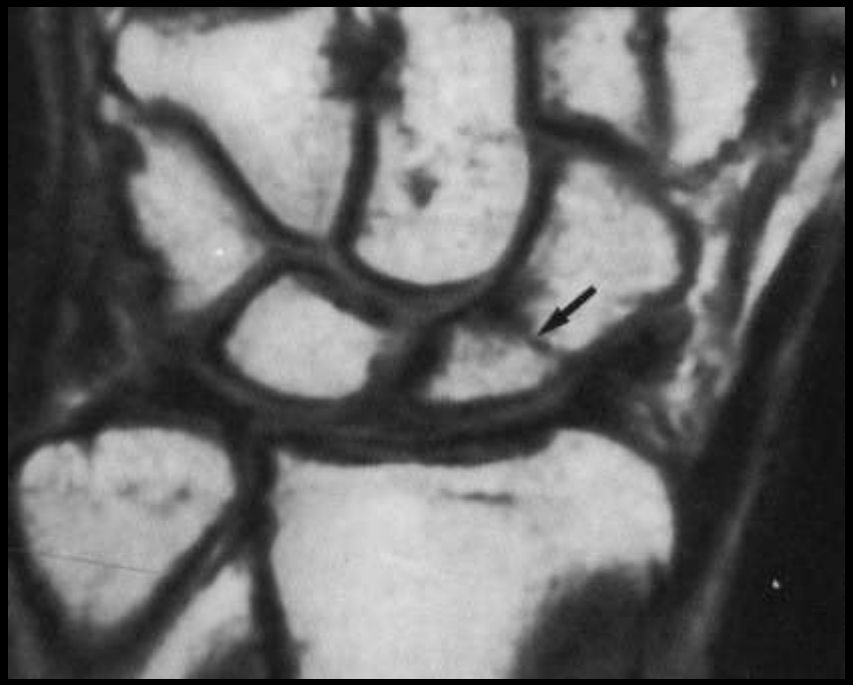


Scaphoid fracture

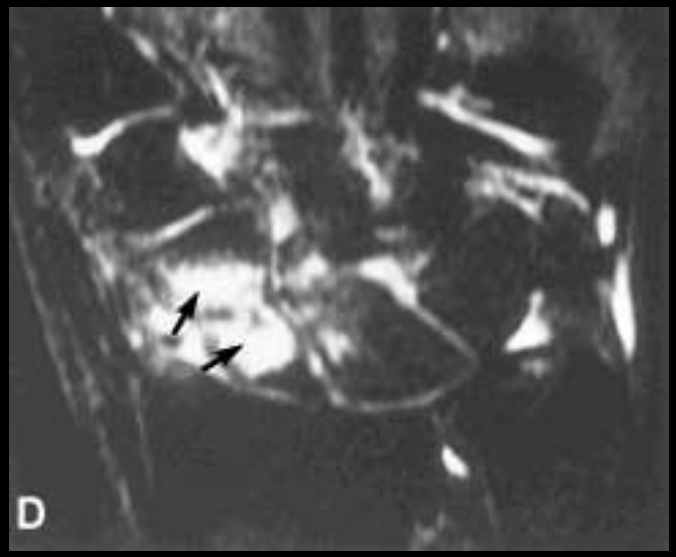
SL ligament is intact with fluid signal around

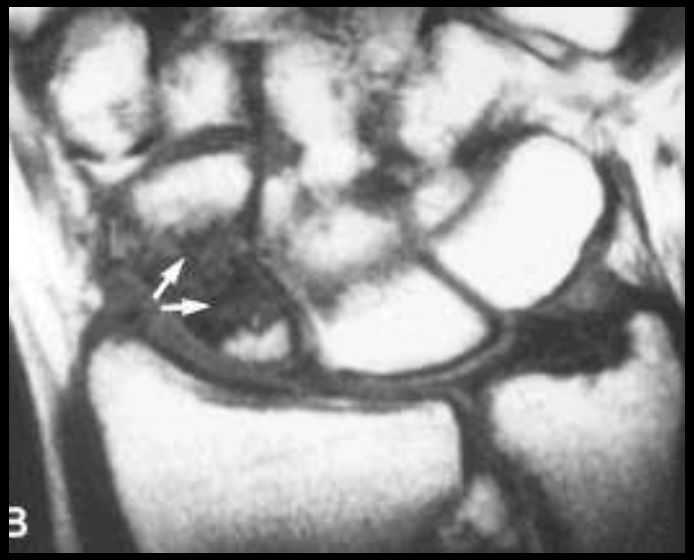


Scaphoid fracture with AVN

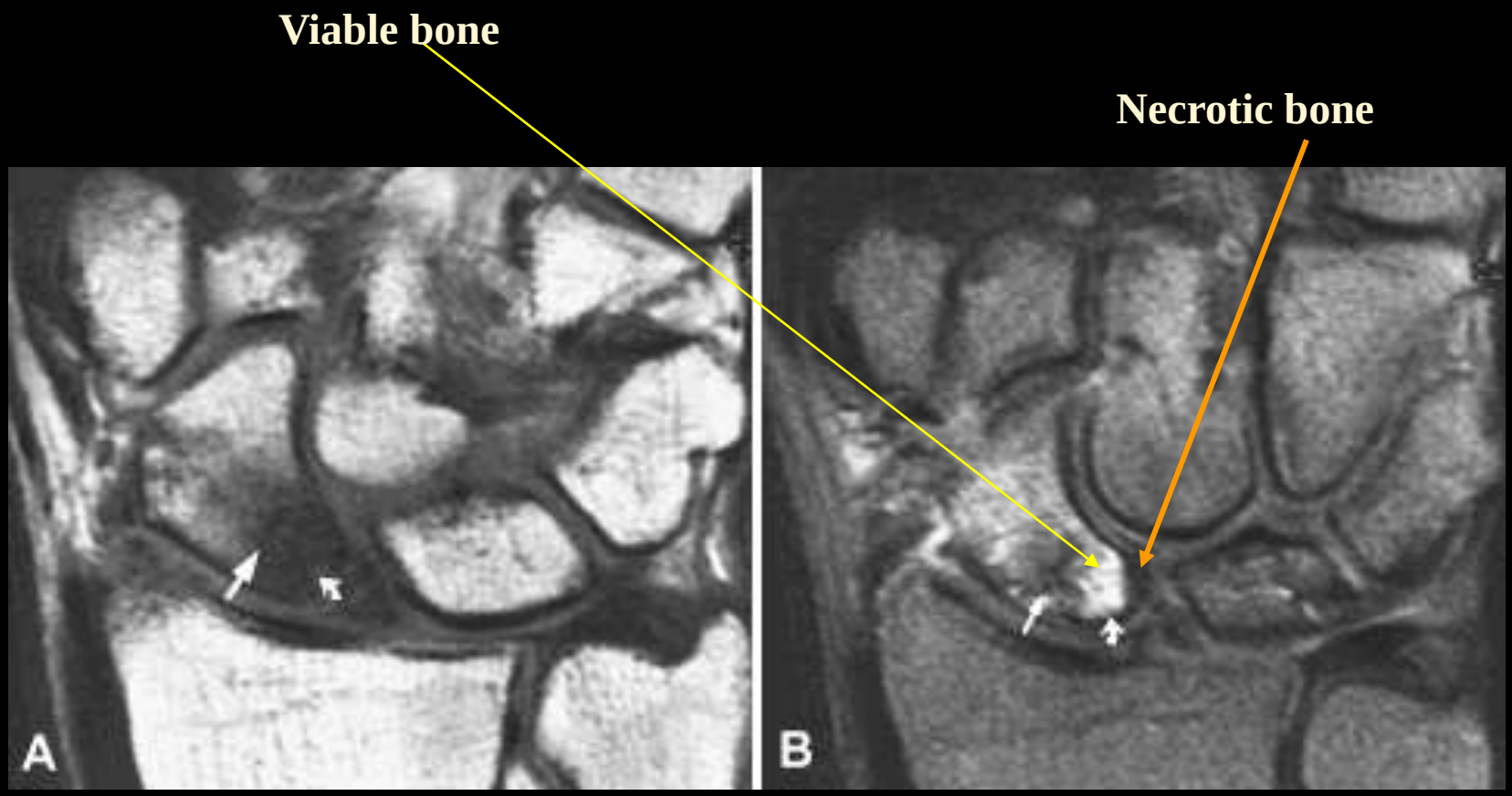


Scaphoid fracture with & without AVN

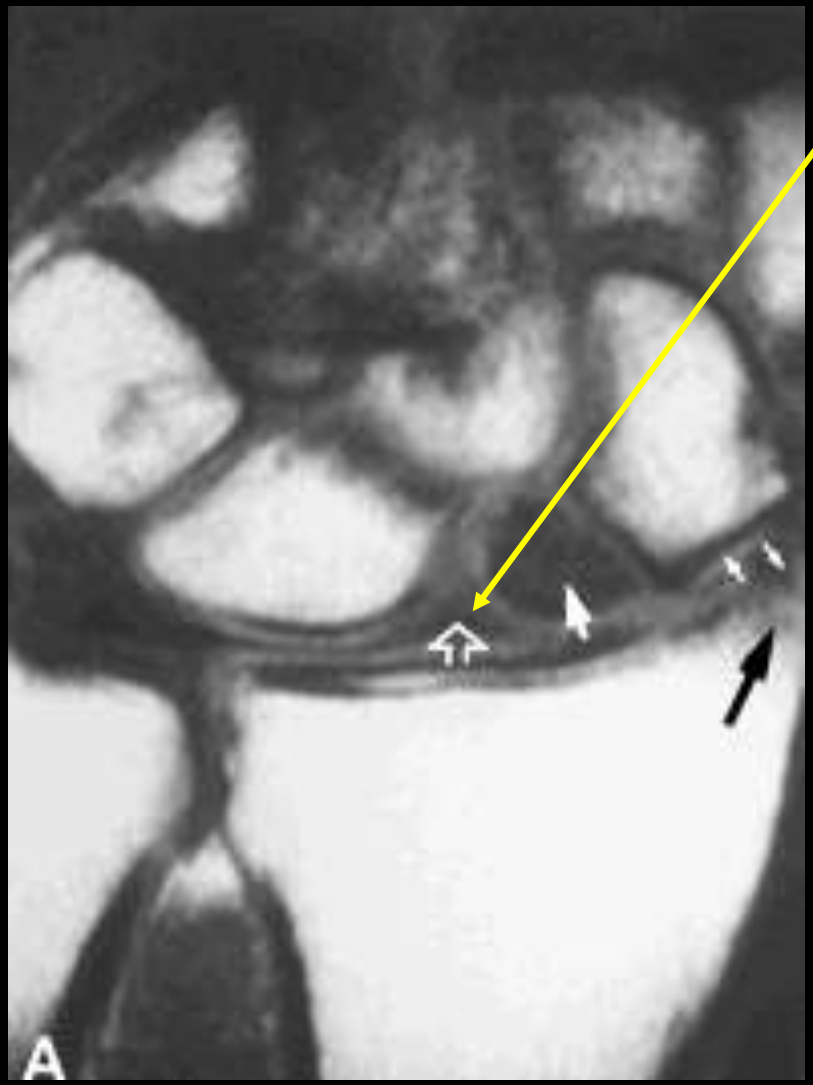




Scaphoid fracture with AVN & marrow oedema



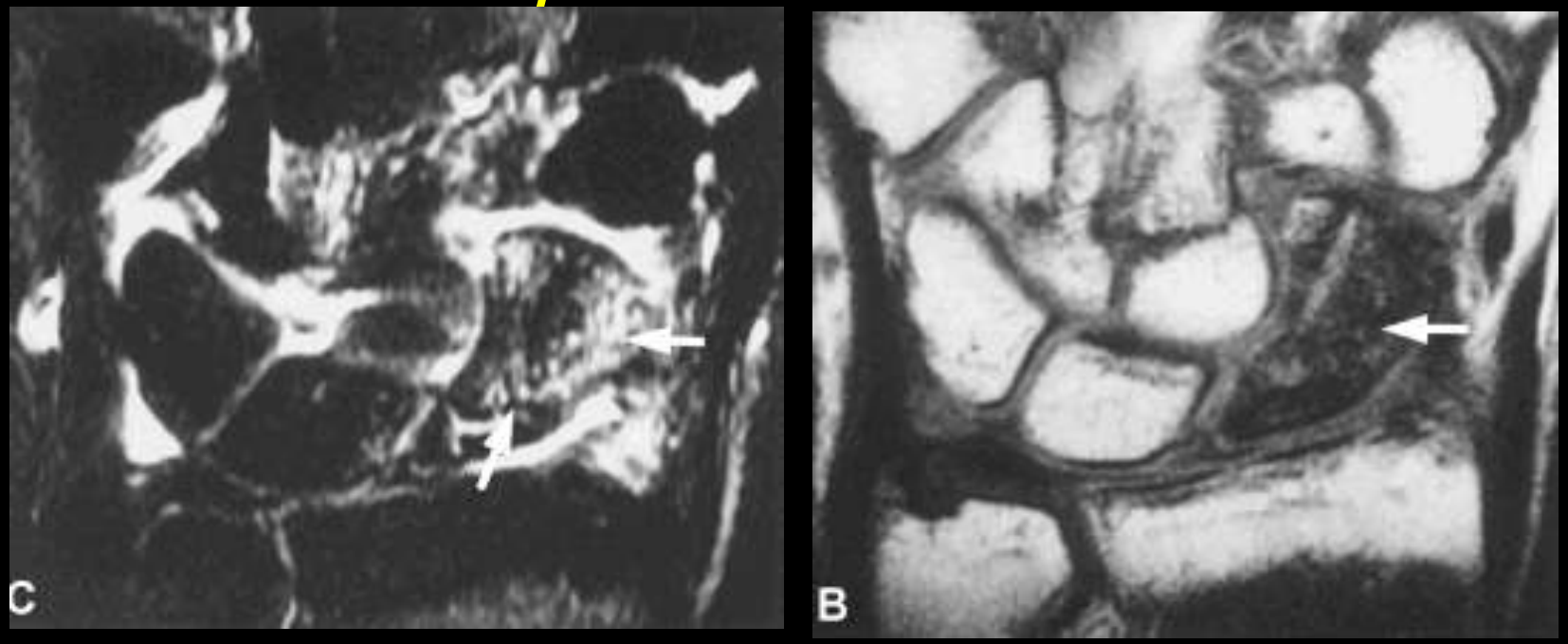
Scaphoid fracture with AVN



Intact scapholunate ligament

Scaphoid AVN with Corner sign of the radial styloid process

Nipple sign (pointing proximal pole)



Scaphoid AVN

Lunate AVN

Lunate AVN (Kienböck's disease)

MRI

- ++ occur with –ve ulnar varience.
- Entire bone is low on T1 & T2 = osteonecrosis.
- Portion of the bone is low on T1 & T2 / low on T1 & high on T2 consider:
    - Early stage of osteonecrosis.
    - Intraosseous ganglion.
    - BM oedema / subchondral cyst from ulno-lunate impaction (look for ulnar plus).

Stages of Lunate AVN

Stage I

- Normal X ray, +ve bone scan.
- Low signal in T1 & T2.

Stage II

- Sclerosis on X ray.
- Diffuse low signal in T1 & T2.
- Flattening of lunate.
- Heterogenous signal on STIR.

Stage III

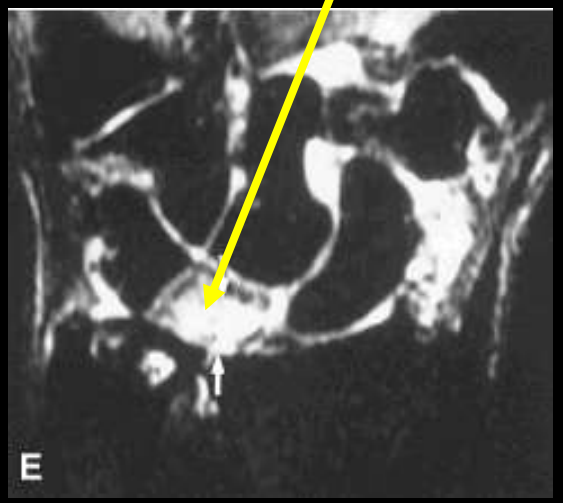
- Sclerosis, collapse, fragmentation.
- Low signal in all pulse sequences.

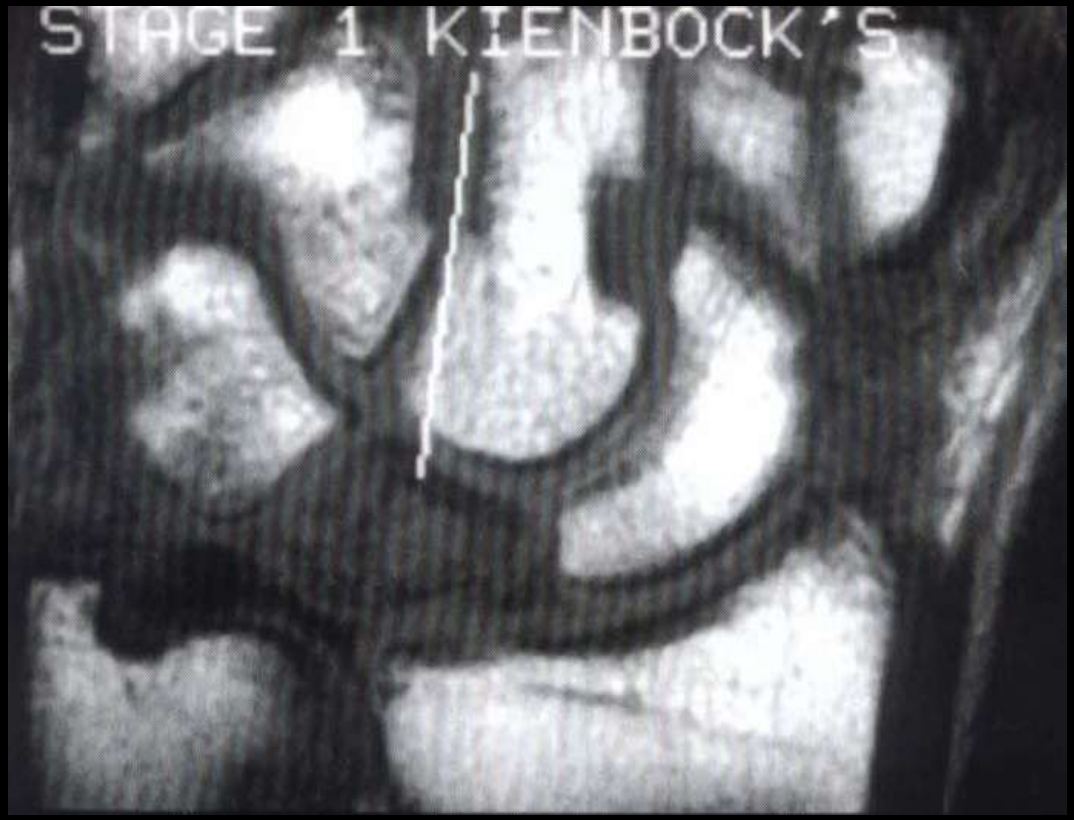
Stage IV

- Stage III + osteoarthritis

Stage I

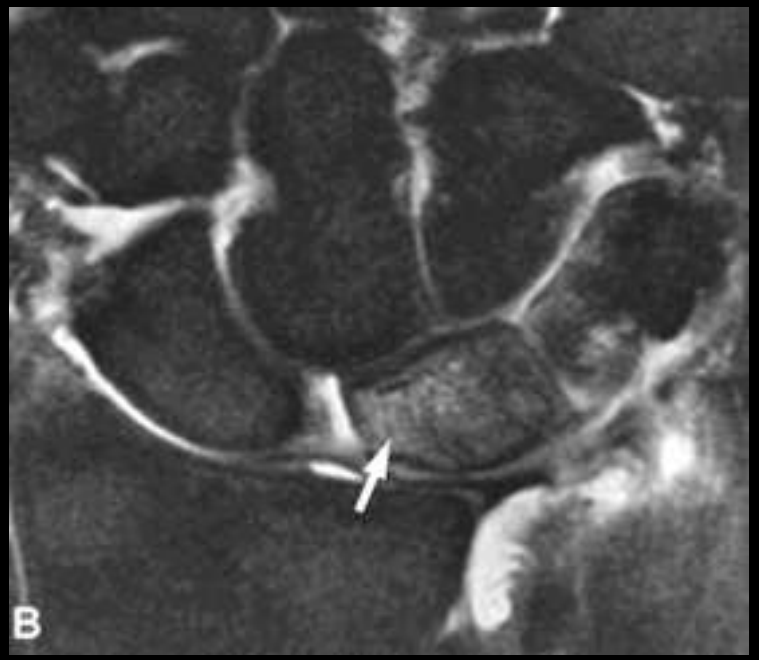
- Normal X ray, +ve bone scan.
- Low signal in T1 & T2.




STAGE 1 KIENBOCK'S

Stage II

- Sclerosis on X ray.
- Diffuse low signal in T1 & T2.
- Flattening of lunate.
- Heterogenous signal on STIR.



<u>Stage II Lunate AVN</u>

Loss of signal

Flattening and elongation

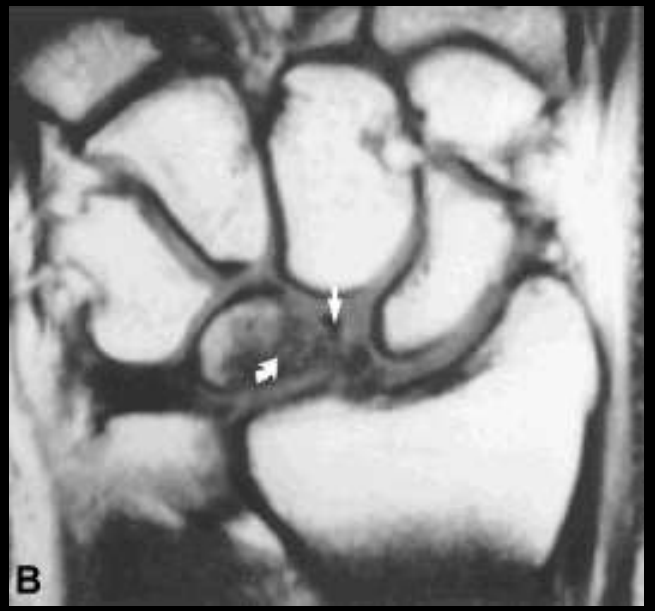
Negative ulnar variance

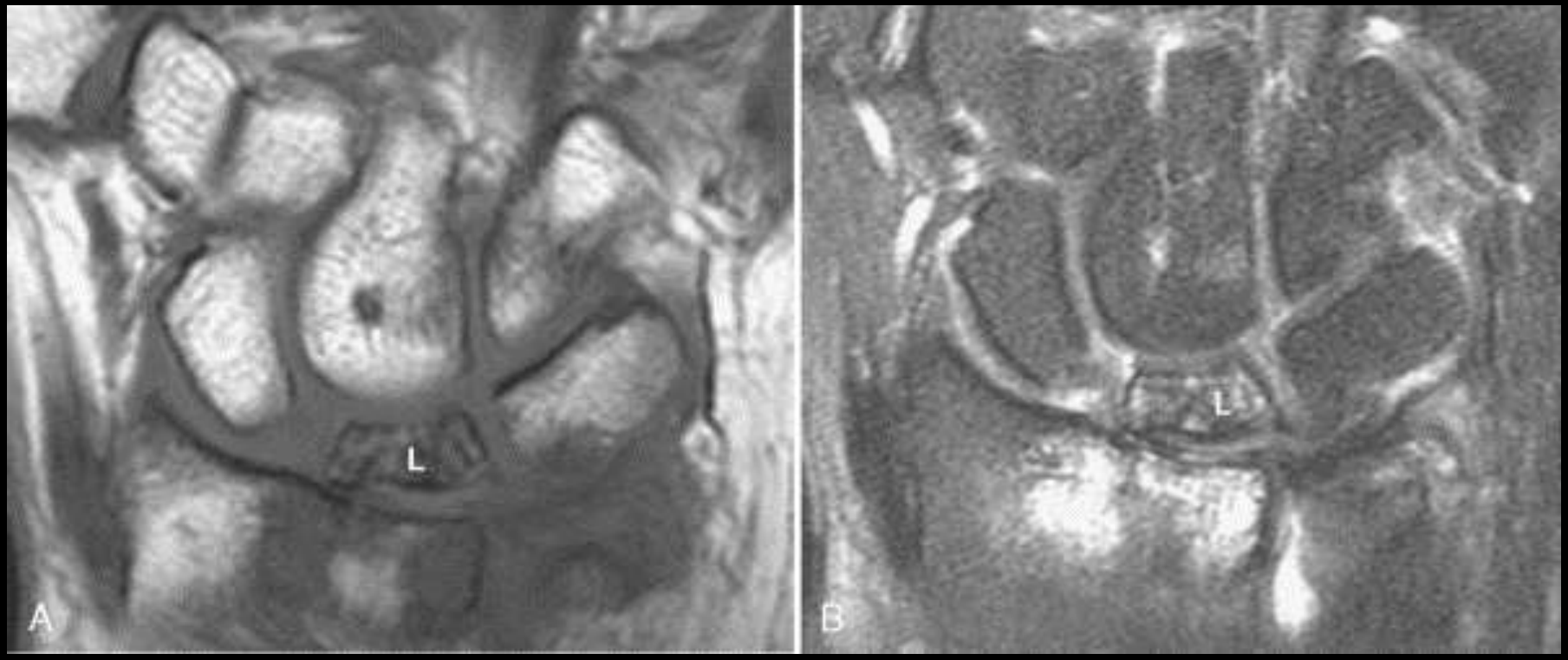
Stage III

- Sclerosis, collapse, fragmentation.
- Low signal in all pulse sequences.

Stage IV

- Stage III + osteoarthritis

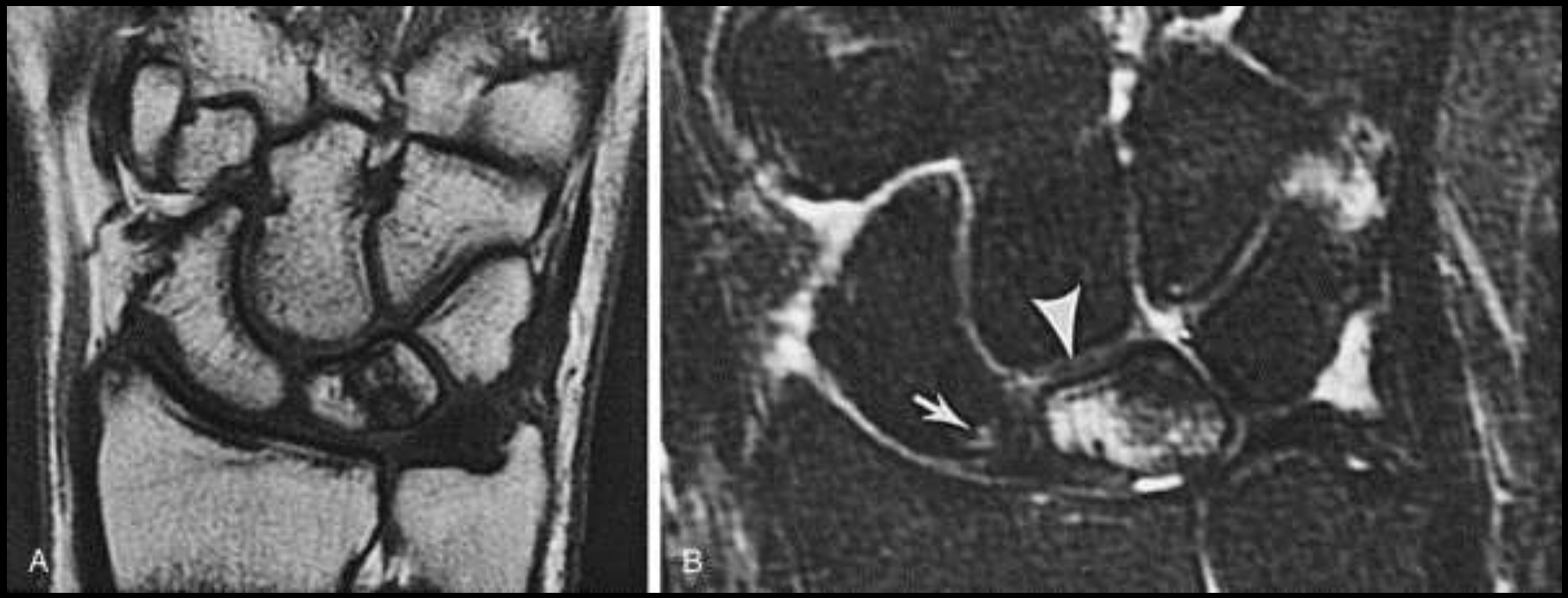




Lunate osteonecrosis

A, Coronal T1, the lunate (L) is diffusely low signal from Kienböck's osteonecrosis.

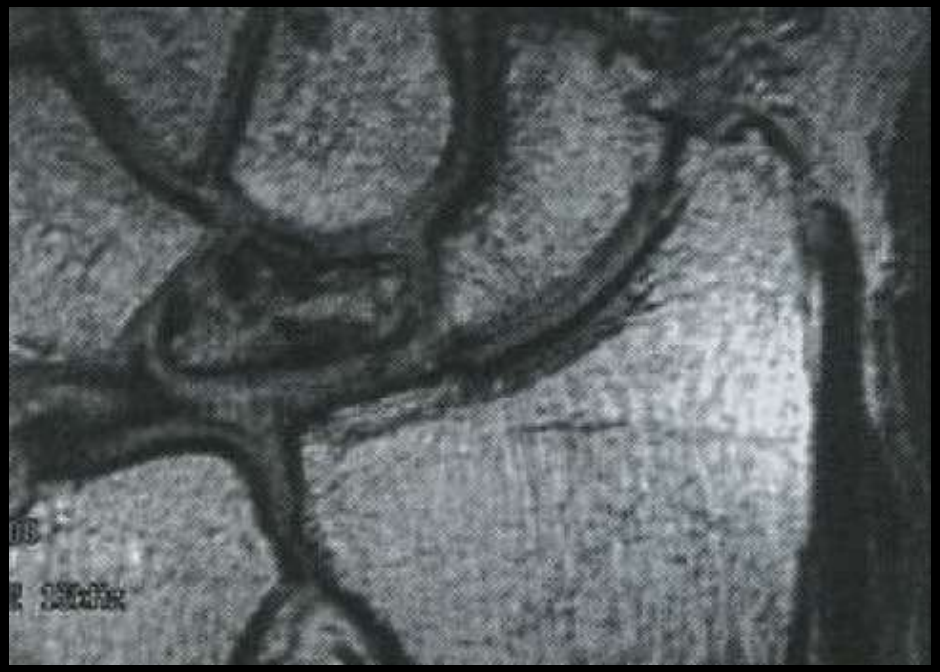
B, Fast FS T2, nearly complete low signal in the lunate (L).

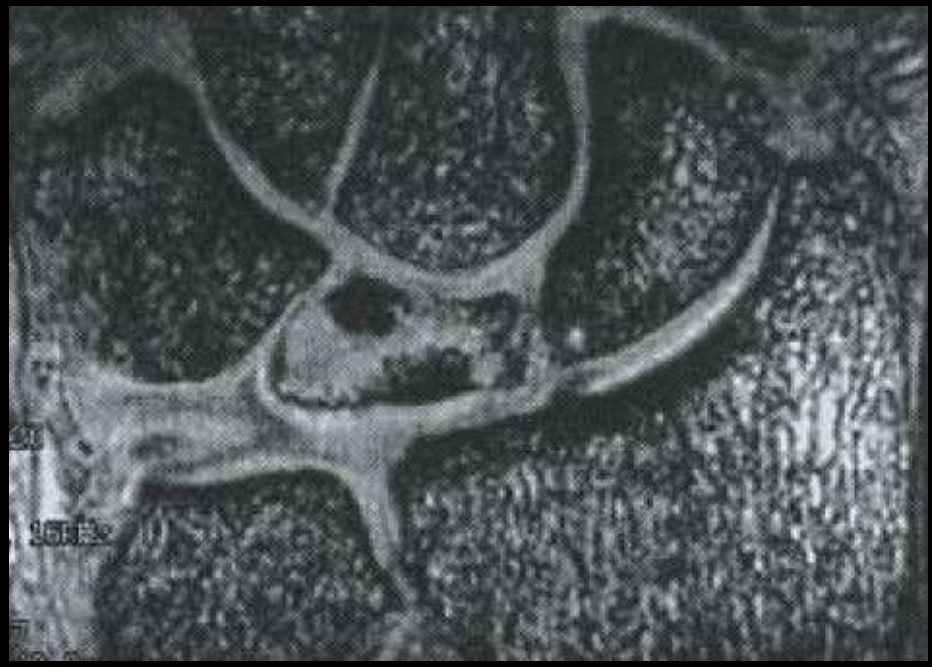


Lunate osteonecrosis - partial involvement

A, Coronal T1, focal low signal in lunate with normal fatty marrow on either side of the abnormality.

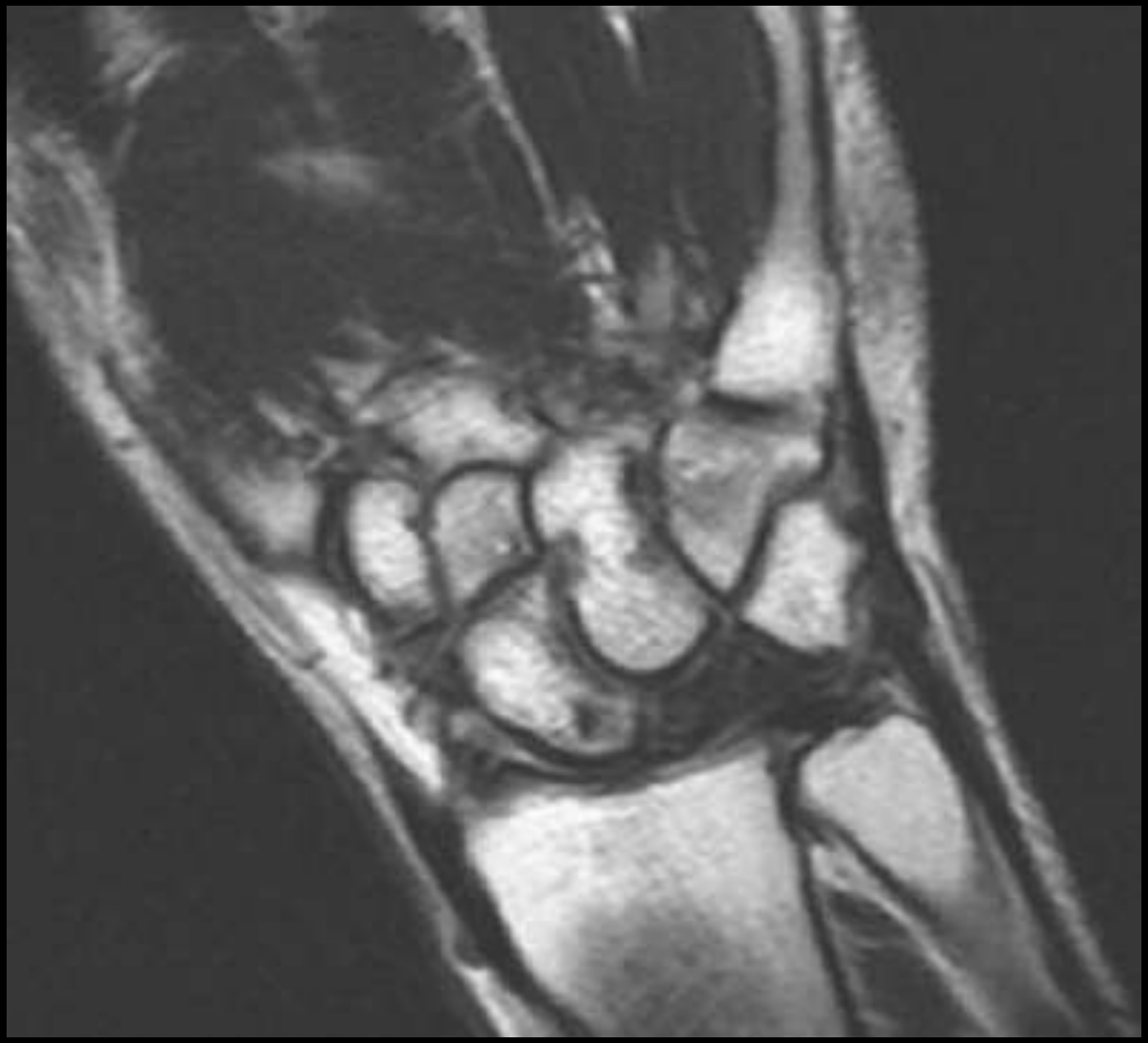
B, Coronal fast FS T2, (different patient), focal high signal in radial side of the lunate (*arrowhead*) and a small area of high signal in the proximal pole of scaphoid (*arrow*).





<u>Kienbock disease</u> (Coronal Coronal PD & GRE T2)

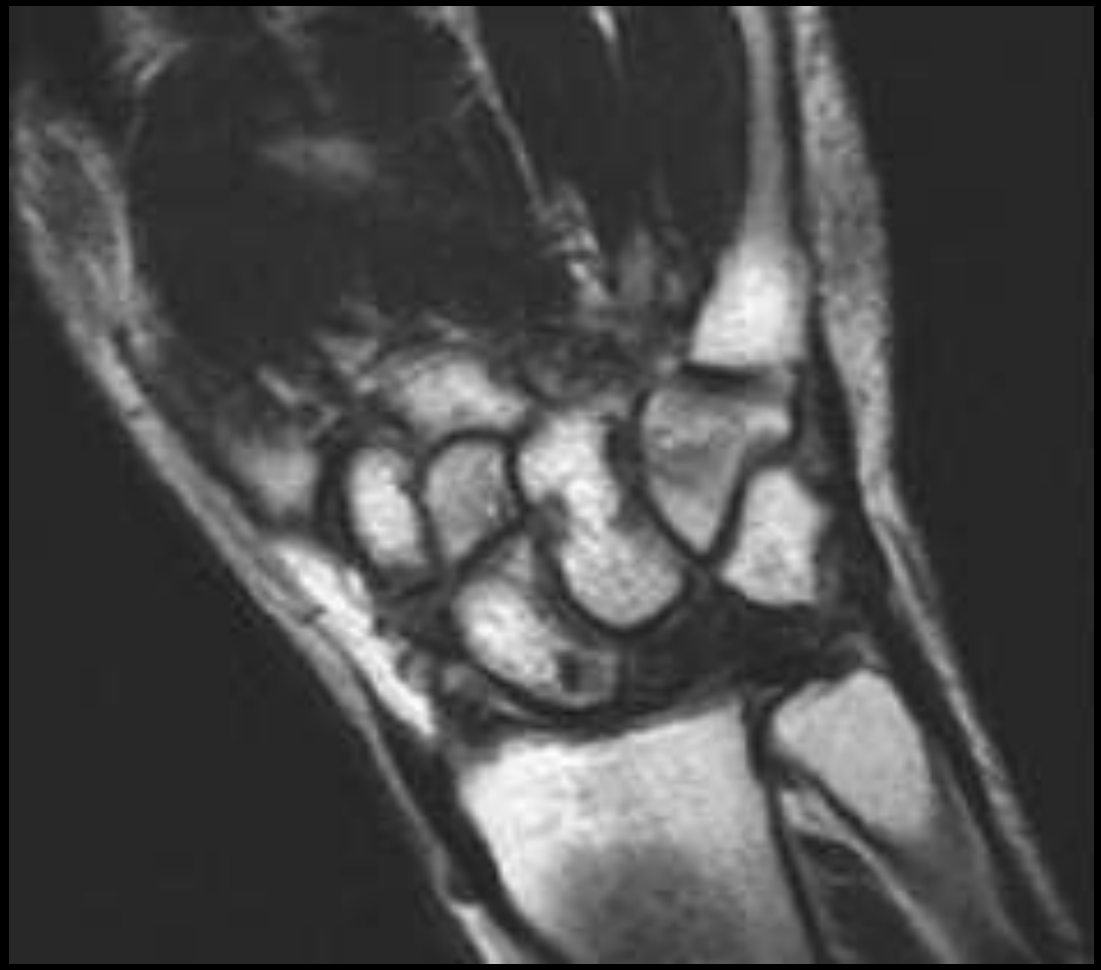
An overall non homogenous low signal in lunate seen on PD and as high irregular signal on T2.



Kienbock's disease (Coronal T1)
AVN of the lunate with diffuse decreased signal intensity.

Kienbock's disease

Sagittal T2 shows AVN of lunate with diffuse decreased signal.
Coronal T1 shows AVN of lunate with heterogeneous signal from focal marrow sparing.



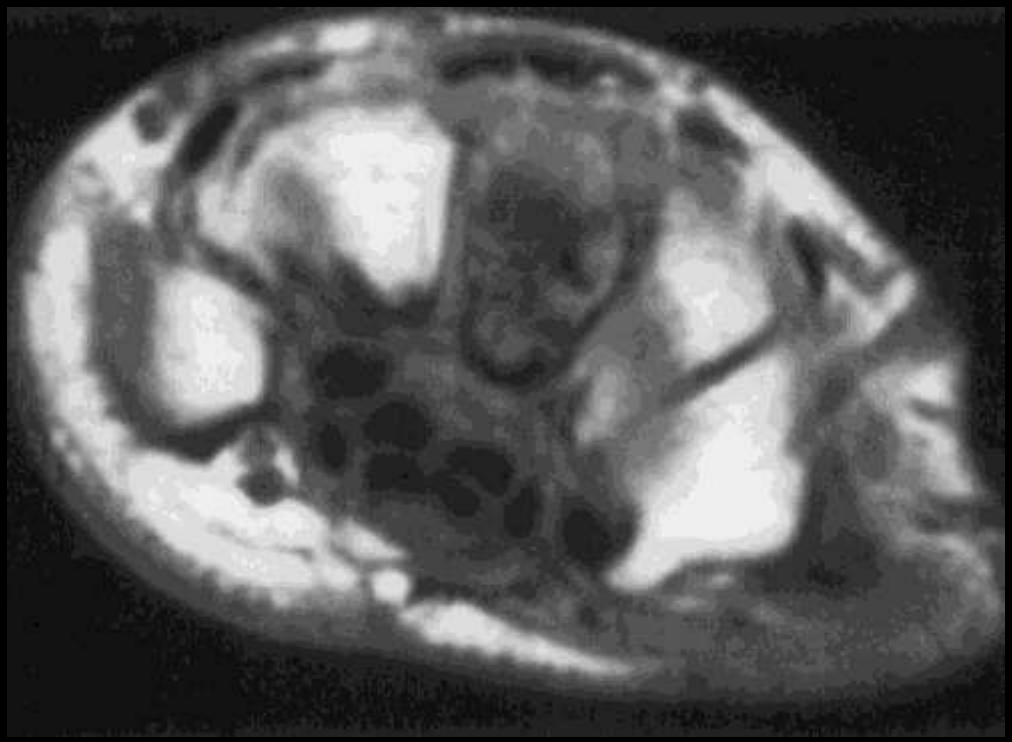
Kienbock disease **(**Coronal SE T2)

Total loss of signal in lunate due to avascular necrosis.

Kienbock disease

Coronal T1 shows low signal in the entire lunate.
X-ray shows a dense lunate with collapse.

Capitate AVN



Congenital Osseous Lesions

•Os styloideum.

•Congenital carpal coalition (++ between lunate & triquetral bones).

•Type II lunate.

Luno-triquetral coalition

•May be osseous / fibrous / cartilaginous.

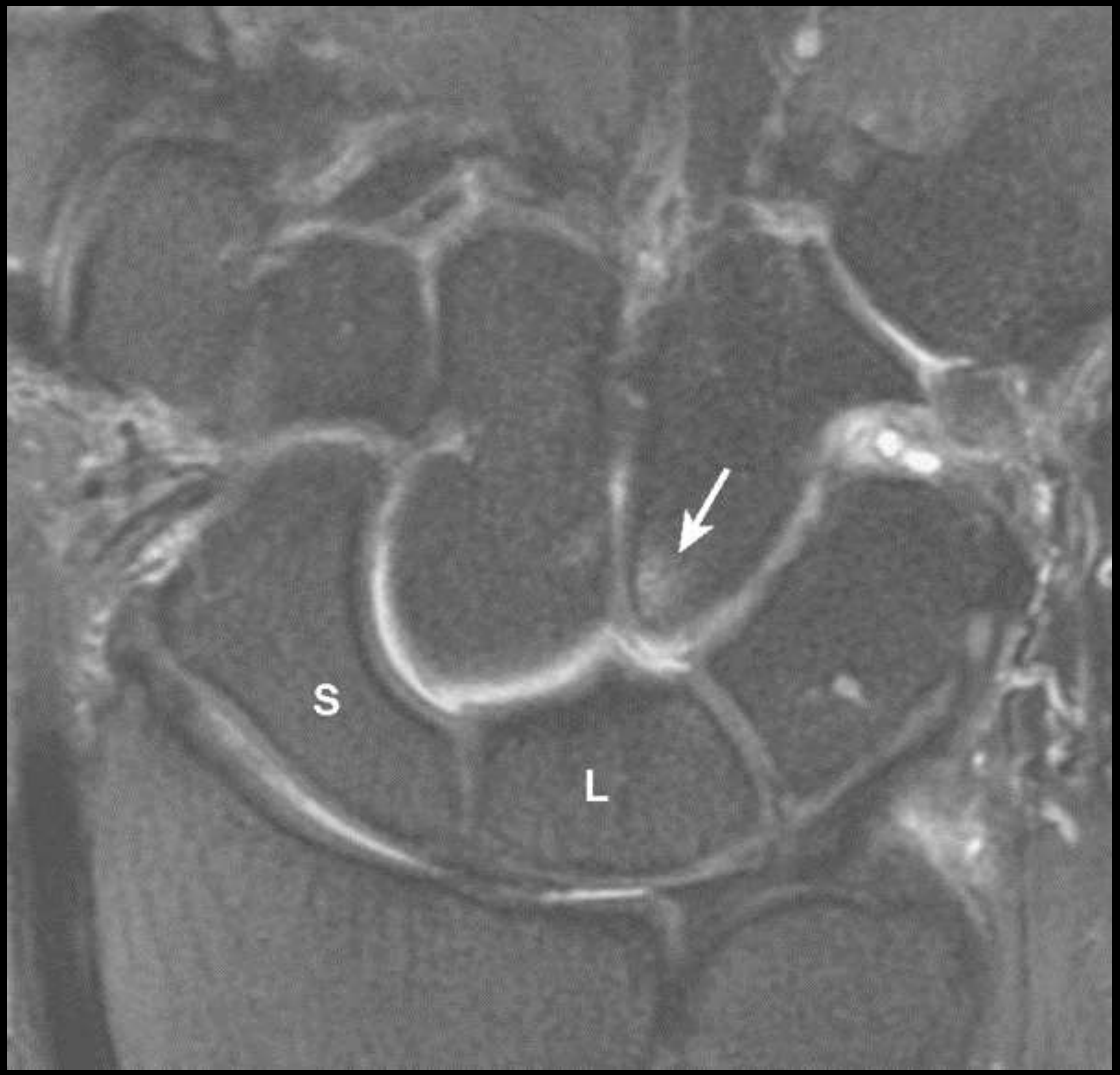
•Fibrocartilaginous coalitions are associated marrow edema / cystic changes adjacent to the coalition (D.D. degenerative joint disease).

Type I & II lunate

•Type I lunate --- articulates only with the capitate.

•Type II lunate

- •Has an extra facet that articulates with the proximal hamate.
- • May lead to cartilage loss of the hamate.
- •MRI --- marrow oedema / subchondral cysts in proximal pole of hamate.



<u>Carpal coalition & type II lunate</u> **(Coronal FS T2)**

he space between lunate (L) and scaphoid (S) is narrow. Abnormal signal in the proximal hamate (*arrow*) 2ry to the type II lunate, which has a facet that articulates with hamate.

Tumors

- Benign bony lesions in the hand & wrist are commoner than malignant.
- The most common are
    - Enchondromas.
    - Intraosseous ganglion cyst.
    - Epidermoid inclusion cyst.

Enchondromas

- Lobulated margins.
- Scalloping of endosteal cortex.
- Lie in the proximal and middle phalanges and in metacarpal bones.
- May have calcifications (++ on X-Ray).
- MRI -- low on T1 & high on T2.

Intraosseous ganglion cysts

• Have dense fibrous wall and a mucoid fluid inside.
• Common in carpal bones (++ in radial aspect of lunate).
• Lie in the subchondral region of bone.

They are either

- Confined to the bone.
- / Due to extension of a soft tissue ganglion cyst into the adjacent bone.

(a small ganglion cyst arising in scapho-lunate ligament commonly erodes the radial aspect of lunate)

MRI

• Can show whether the lesion is confined to bone / due to erosion from an adjacent soft tissue ganglion cyst.

• Small rounded well-circumscribed foci.

• Low on T1 & high on T2.

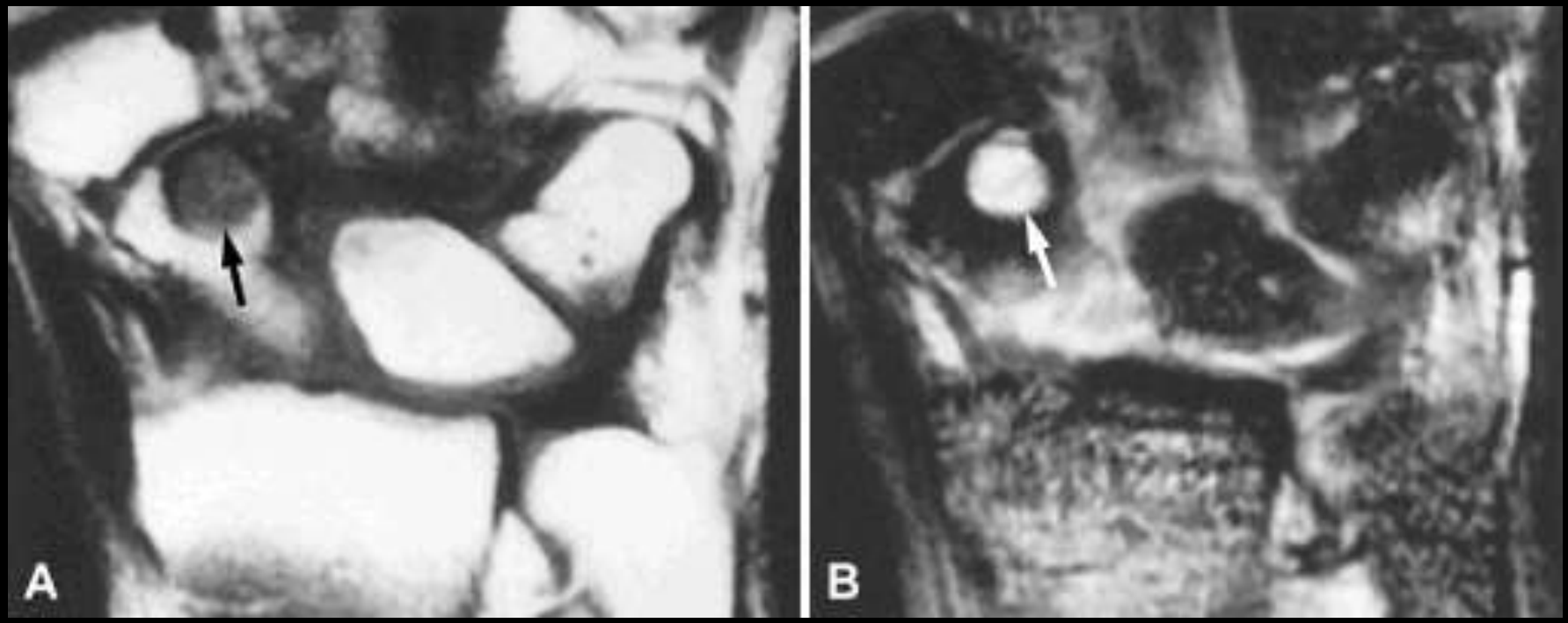
<u>Intraosseous ganglion cyst + scapholunate ligament degeneration</u> (Coronal T2)

Intraosseous ganglion cyst in the radial aspect of lunate (*arrow*) which is in continuity with a ganglion cyst in the scapholunate ligament (*arrowhead*).

<u>Intraosseous ganglion cyst</u> **(**Sagittal T1)

Small rounded low T1 signal lesion of trapezium.

Bone cyst



Scaphoid cyst

Soft Tissue Lesions

The most common soft tissue masses in the hand & wrist are

- Ganglion cysts.
- Giant cell tumors of the tendon sheath.
- Nerve sheath tumors.
- Soft tissue chondromas.
- Glomus tumors.
- Anomalous muscles.

Ganglion cysts

• The 1st common cause of a wrist mass.

• May be attached by a pedicle to a tendon sheath / joint capsule / ligament / within a fascial plane.

• ++ in women in their 30s.

• May erode the adjacent osseous structures.

• It is important to examine the scapho-lunate ligament carefully for small occult ganglion cysts.

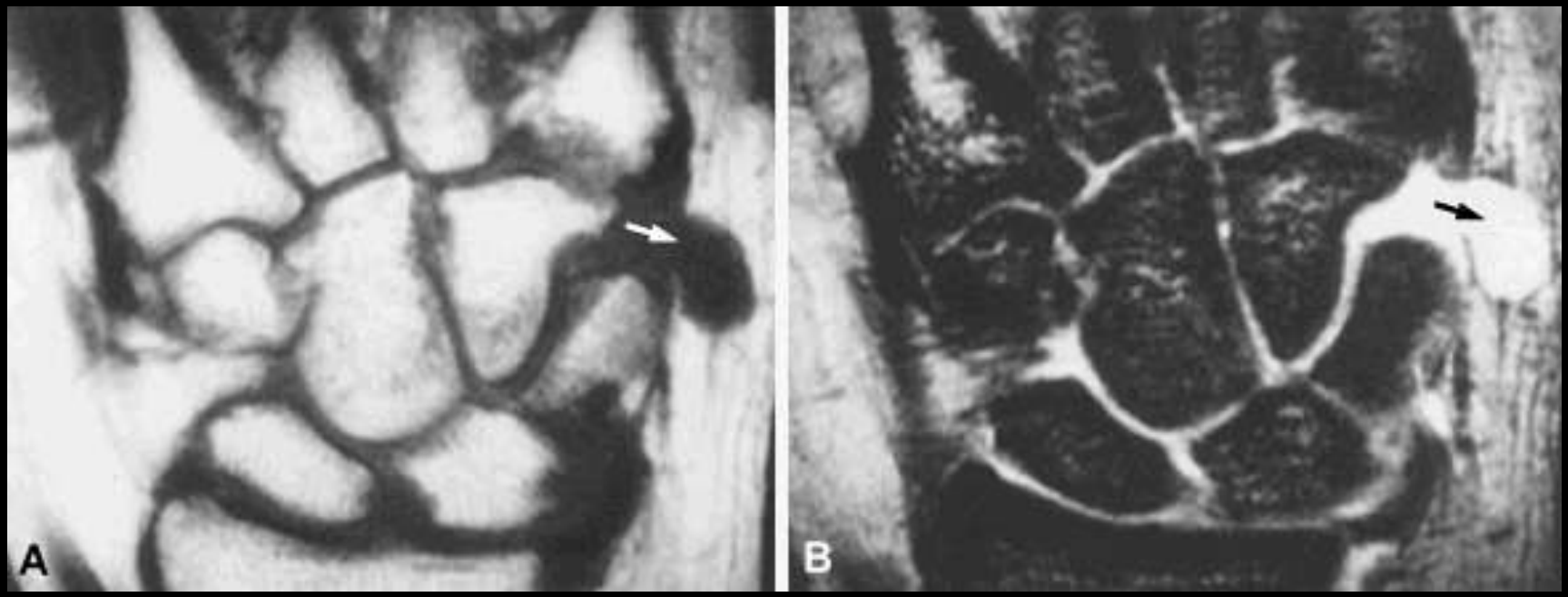
MRI

•Low on T1 (often show higher signal on T1 due to high protein content).

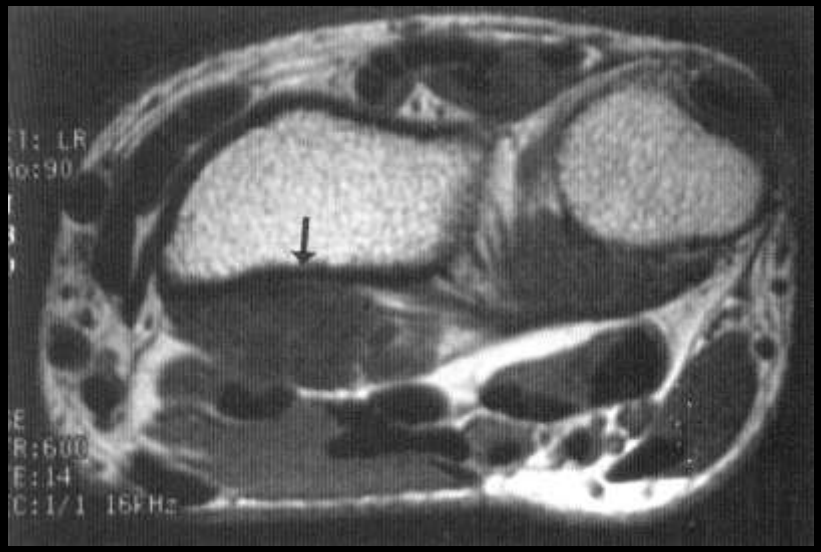
•High on T2.

•Characteristic feature is the presence of thin septations within it (low signal lines on T2).

•The thin fibrous wall and the thin septae enhance.



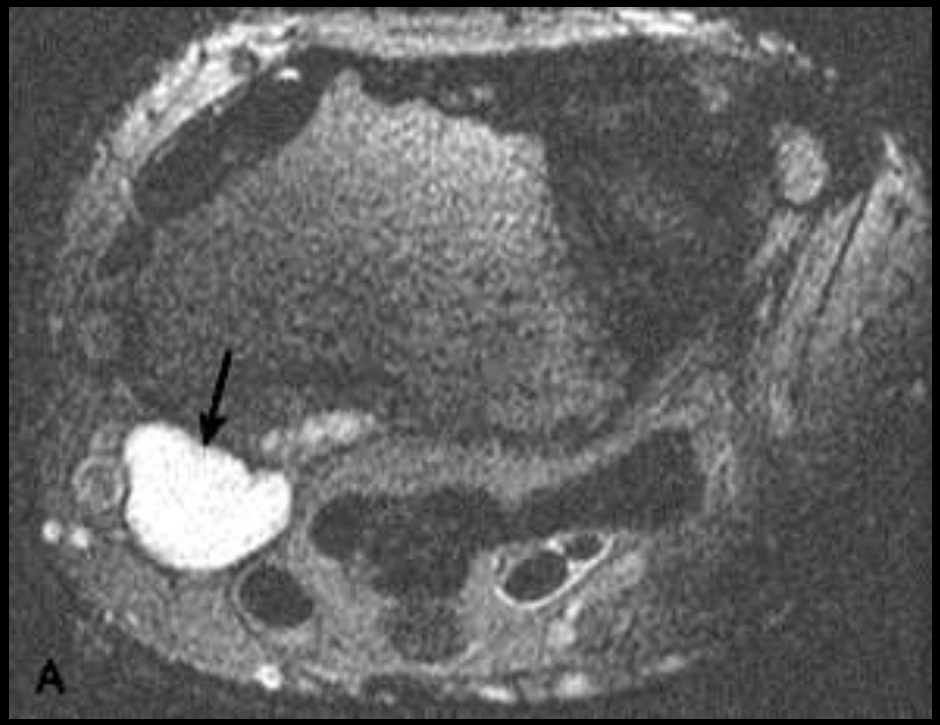
Ganglion cyst at the joint between hamate and triquetrum



Ganglion cyst

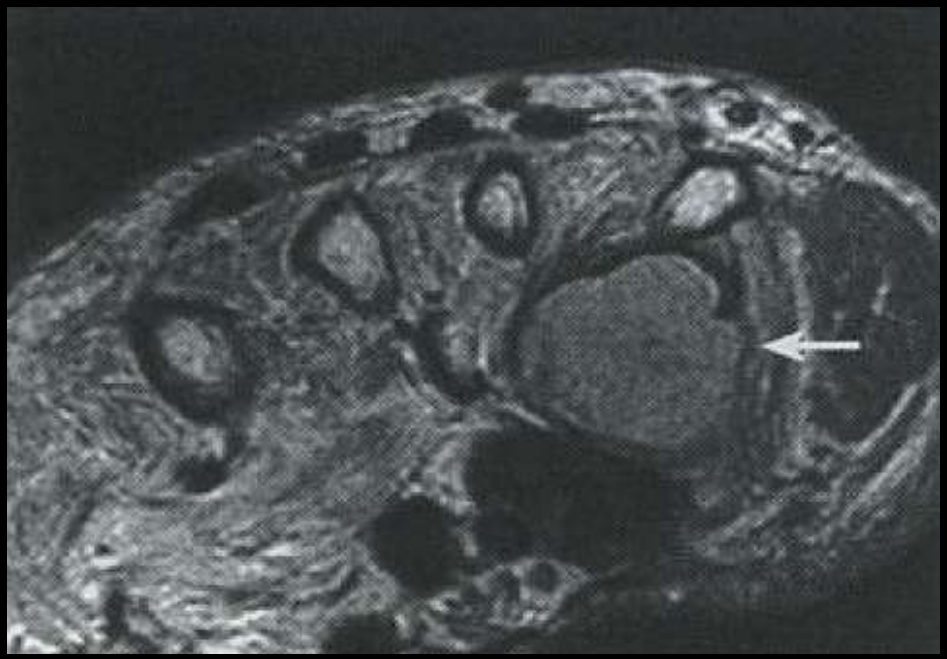
<u>Occult ganglion cyst of scapholunate ligament</u> **(Axial FS T2)**

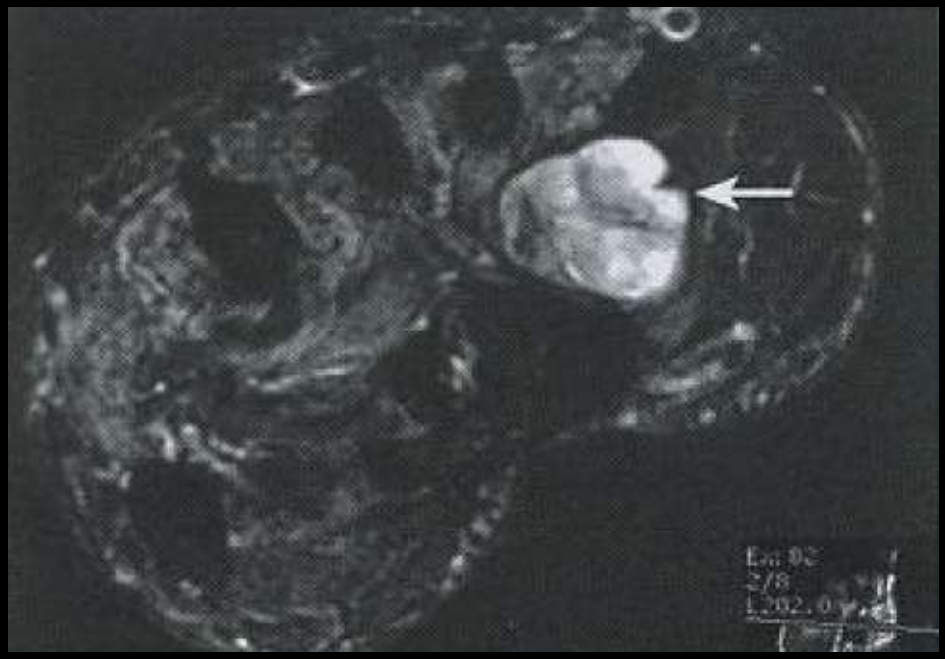
Small high signal mass with septation in it (ganglion cyst) (*arrowhead*). Incidentally noted is an intraosseous ganglion in lunate (*arrow*).



Ganglion cyst

A, Axial T2, ganglion cyst of high signal (*arrow*) on the volar aspect of the wrist. **B**, Coronal T2, the cyst is more completely evaluated (*arrowheads*).





<u>Ganglion</u> (Axial GRE & Axial FS T2)

A large cystic lesion (arrow) is seen between the 5th MC bone and the deep flexor tendons.

Giant cell T. of Tendon Sheath

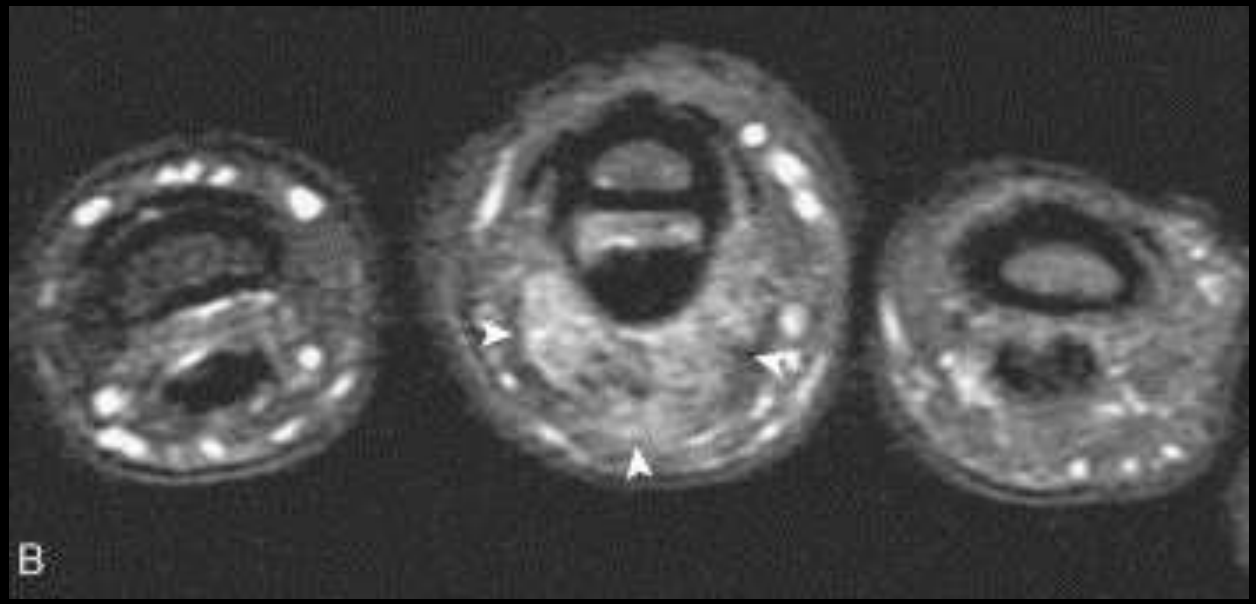
- The 2nd common cause of wrist soft tissue mass.
- It is extra-articular.
- Localized form of pigmented villonodular synovitis.
- Common on volar aspect of the fingers.

MRI

- Low on T1 & T2.

D.D.

- Amyloid deposits.
- Gout tophi.



Giant cell tumor of the tendon sheath

A, Sagittal T2, there is lobulated, medium to low signal mass volar to the flexor tendon of index finger (*arrowheads*).

B, Axial T2, medium to low signal mass around the flexor tendon (*arrowheads*). Signal characteristics are typical of giant cell tumor of the tendon sheath.

<u>Tendon sheath giant cell tumor</u> **(sagittal T1)**

Inhomogenous mass (arrows) iso to muscle seen in the index finger.

Glomus Tumors

• Benign tumors that arise from a neuro-myo-arterial glomus (lies the deepest layer of the dermis throughout the body).

• Glomus bodies are highly concentrated in the fingertips (++ beneath fingernails).

• They lie dorsal to distal phalanges (occasionally lie on volar surface).

• Pressure erosion of adjacent bone.

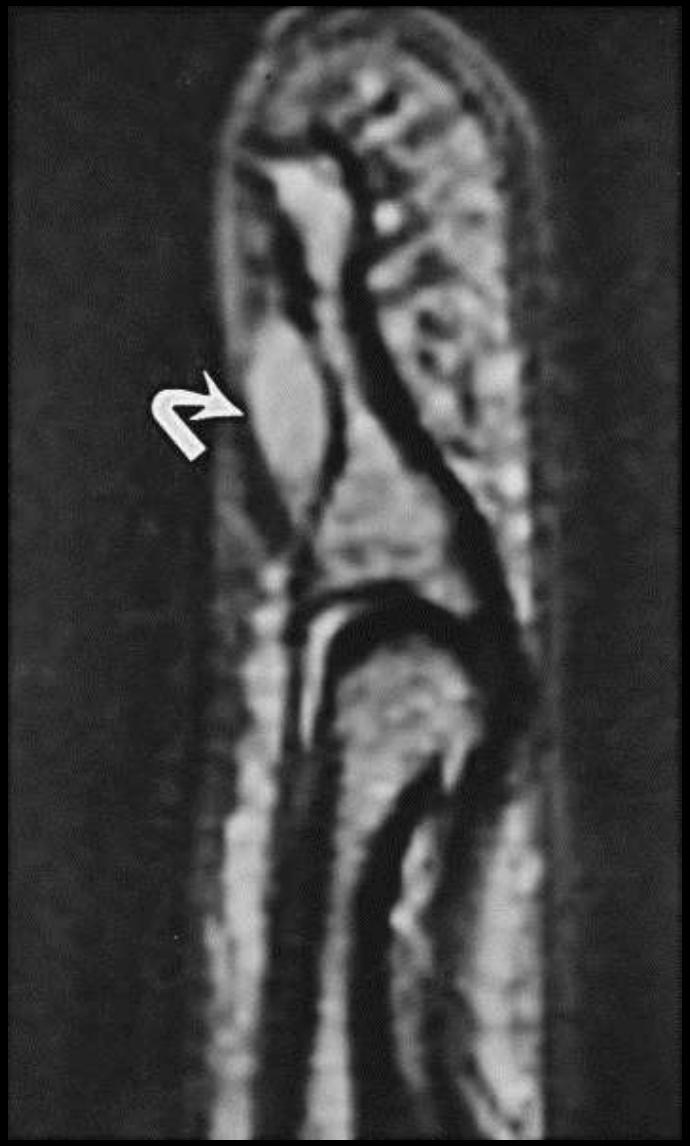
MRI

• Small well defined soft tissue mass.

• Low on T1 & high on T2.

• Strong enhancement.

• A thin capsule may be seen as low signal around the lesion on all sequences.



<u>Glomus tumor</u> (Fast T2)

There is a small high signal mass (*curved arrow*) on the dorsum of the distal phalanx with bone erosion.

Anomalous Muscles

• May manifest as a soft tissue mass / may compress median or ulnar N.

Extensor digitorum manus brevis

• A common anomalous muscle.

• Lie on dorsum of the wrist and hand along the ulnar side of extensor indicis tendon.

MRI

• Documents the presence of muscle.

• Its signal follows that of other skeletal muscle on all sequences.

• Clinical D.D. is ganglion cyst (MRI confirms the diagnosis).

<u>Anomalous muscle</u> **(Sagittal T1)**

A dorsal soft tissue mass (*arrows*) with signal typical of muscle is the extensor digitorum brevis manus.

Arthritis

•MRI shows erosions, subchondral cysts, synovitis, tenosynovitis and other manifestations of arthritis.

Gout **(**Coronal STIR)

High signal erosion and edema of carpal bones.

Synovial Cysts

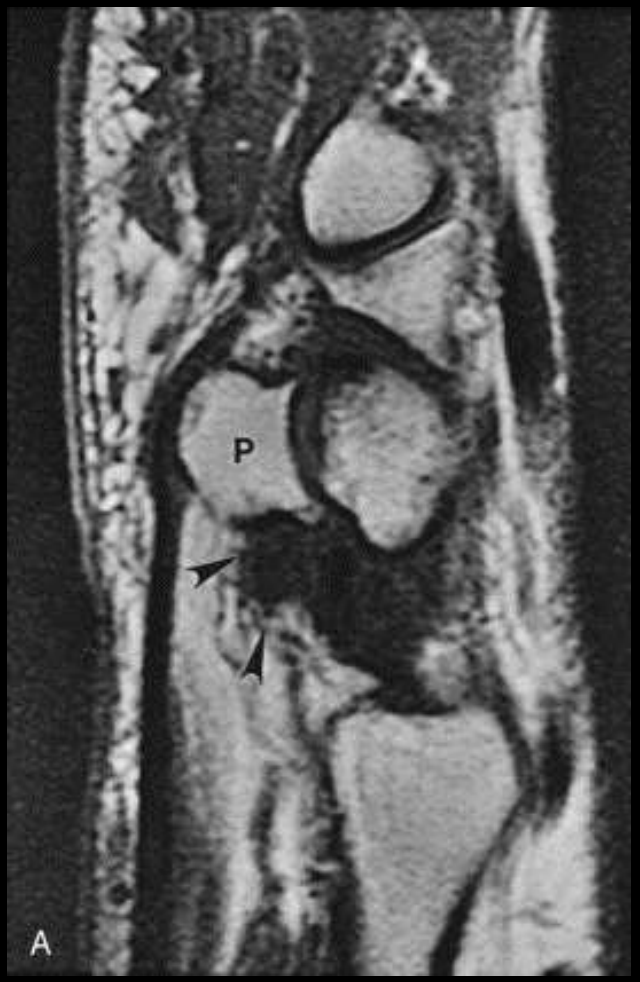
- May be a manifestation of Rht arthritis.

Piso-triquetral synovial cyst

- Normally, small amount of fluid seen in piso-triquetral synovial recess.
- A large amount may cause pain.
- ++ with piso-triquetral degenerative joint disease.
- Similar to a Baker‘s cyst of the knee.

MRI

- Rounded / elongated mass on volar aspect of the wrist.
- Just proximal to the pisiform.
- Low on T1 & high on T2.



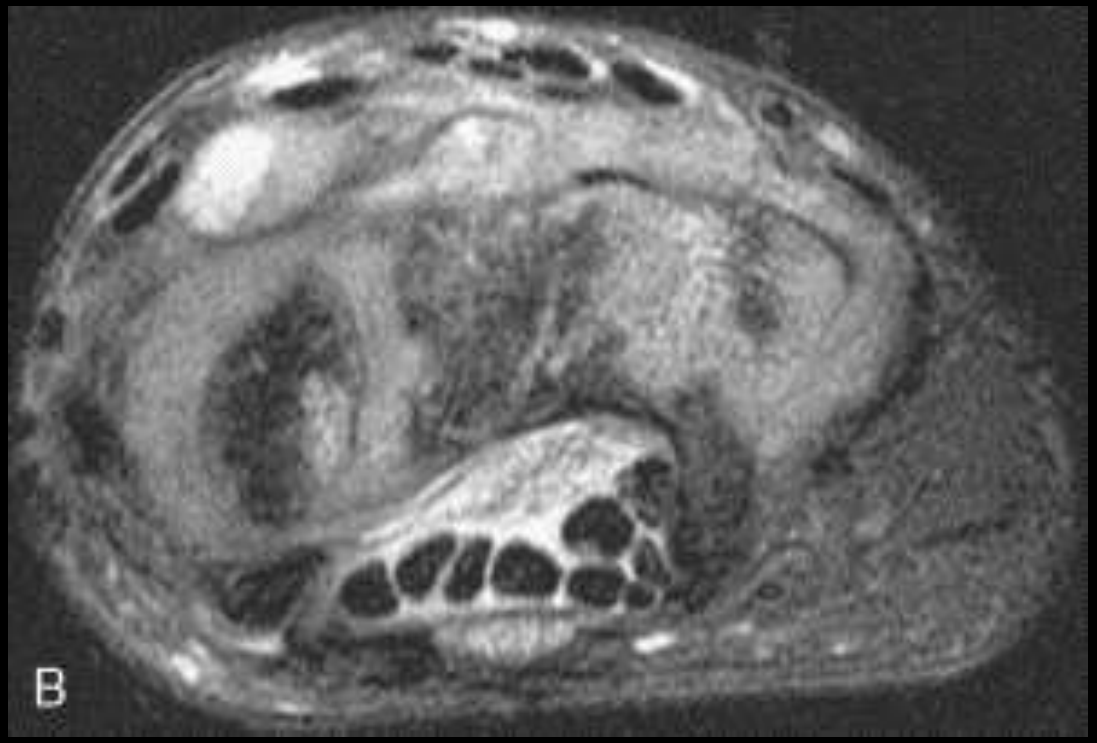
Piso-triquetral synovial cyst

A, Sagittal T1, a low signal mass (*arrowheads*) just proximal topisiform (P) is a synovial cyst from the piso-triquetral joint. Note mild degenerative changes in the joint with osteophytes.

B, Coronal GE, the synovial cyst shows high signal (*arrowhead*) and lies just proximal to pisiform (P).

Infection

- Septic arthritis, abscesses, cellulitis and osteomyelitis.
- MRI findings of infection in hand & wrist are like elsewhere.
- Infection spreads rapidly along compartments and tendon sheaths.
- Fluid in a tendon sheath = tenosynovitis.



Infection

A, Coronal FS T2, diffuse thickening of synovia with bone erosion and BM edema.

B, Axial T2, show lesions, BM edema and synovitis. There also is high signal around the flexor tendons 2ry to infection.

Osteomyelitis **(**Coronal STIR)

Fluid in the joint from septic arthritis and lunate marrow odema consistent with osteomyelitis.


Thank You