

# PRACTICAL REPORTING OF MUSCULOSKETAL IMAGING STUDIES: MRI WRIST



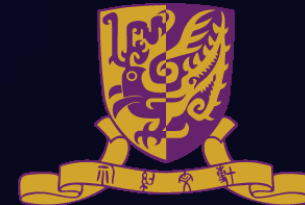
**Dr. Alex Ng**

Consultant, PWH

Clinical Associate Professor (Honorary), CUHK



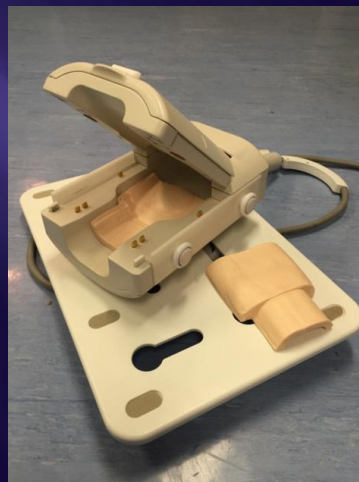
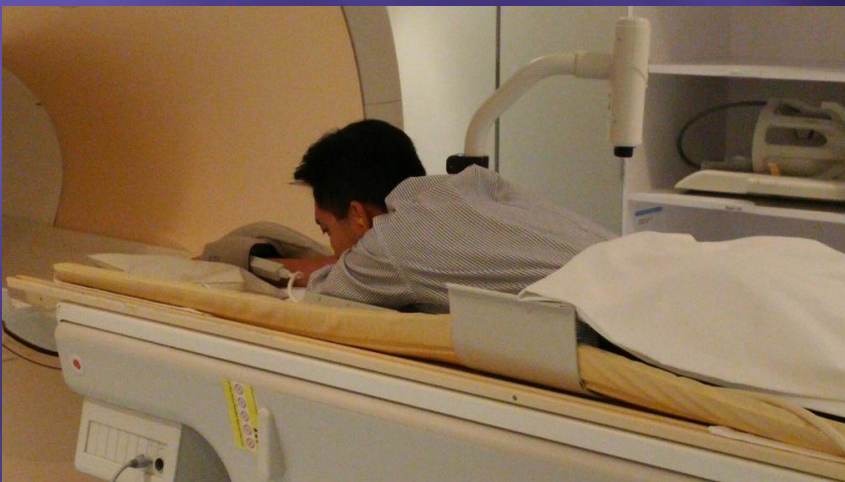
The Chinese University of Hong Kong  
Department of Imaging and Interventional Radiology  
Prince of Wales Hospital



- Date: 7 April 2016, (Thursday)
- Time: 1.00pm -2.00pm
- Venue: Conference Room, 2/F, DIIR, Main Clinical Building, New Block, Prince of Wales Hospital, Shatin
- Topic: Dual Energy CT - MSK Applications
- Speaker: Professor Hugue Ouellette, University of British Columbia, Canada

Ms. Mandy Cheng: 26321189  
For Professor James Griffith  
Department of Imaging and Interventional Radiology  
The Chinese University of Hong Kong

# MRI



Wrist coil

# History

- Where is pain located
- *For how long*
- *Trauma– if so, what and when*

# Grade

- ▣ Don't mention any feature without grading it
- ▣ Qualitative measure:
  - Minimal, mild, moderate, severe
- ▣ Quantitative measure:
  - Small, medium, large (mm wide x mm deep x mm long)

# This talk: outline

## TFCC/Ligaments:

- TFCC injury
- Intrinsic ligament injury (DISI VISI)
- Other carpal ligament (ganglion cyst)

## Muscle and Tendon:

- Tendinosis (Dequervain's disease)
- Tenosynovitis
- Tear

## Bone:

- Scaphoid fracture (SNAC),
- Lunate (Kienbock)
- Ulnocarpal impaction

## Joint and cartilage

- RA/arthritis
- Degeneration/Cartilage

## Nerve and vessels:

- Carpal tunnel syndrome
- Guyon's tunnel syndrome

MRI XXX WRIST:

#### BONES AND CARTILAGE

No bone oedema or subchondral cyst formation in the carpal bones, distal radius and ulna.

The alignment of the carpal bones are unremarkable. No DISI or VISI deformity.

The overlying cartilage is intact.

#### JOINTS

There is a small amount of fluid in the distal radioulnar joint which is within physiological in amount.

No evidence of erosive arthropathy.

No sign to suggest synovitis/synovial hypertrophy.

#### LIGAMENTS and TFCC:

The palmar extrinsic ligaments including radioscaphocapitate, radiolunotriquetral, radiolunate, ulnotriquetral, ulnolunate ligaments are intact.

The dorsal ligaments, including the dorsal intercarpal ligament and dorsal radiocarpal ligament are intact.

The intrinsic ligaments including the scapholunate and lunotriquetral ligaments are unremarkable.

The TFCC is intact.

#### MUSCLES AND TENDONS:

The flexor and extensor tendons are intact. No tear or tenosynovitis seen.

No significant tendon sheath effusion.

No oedema or mass in the muscles.

#### NEUROVASCULAR BUNDLES:

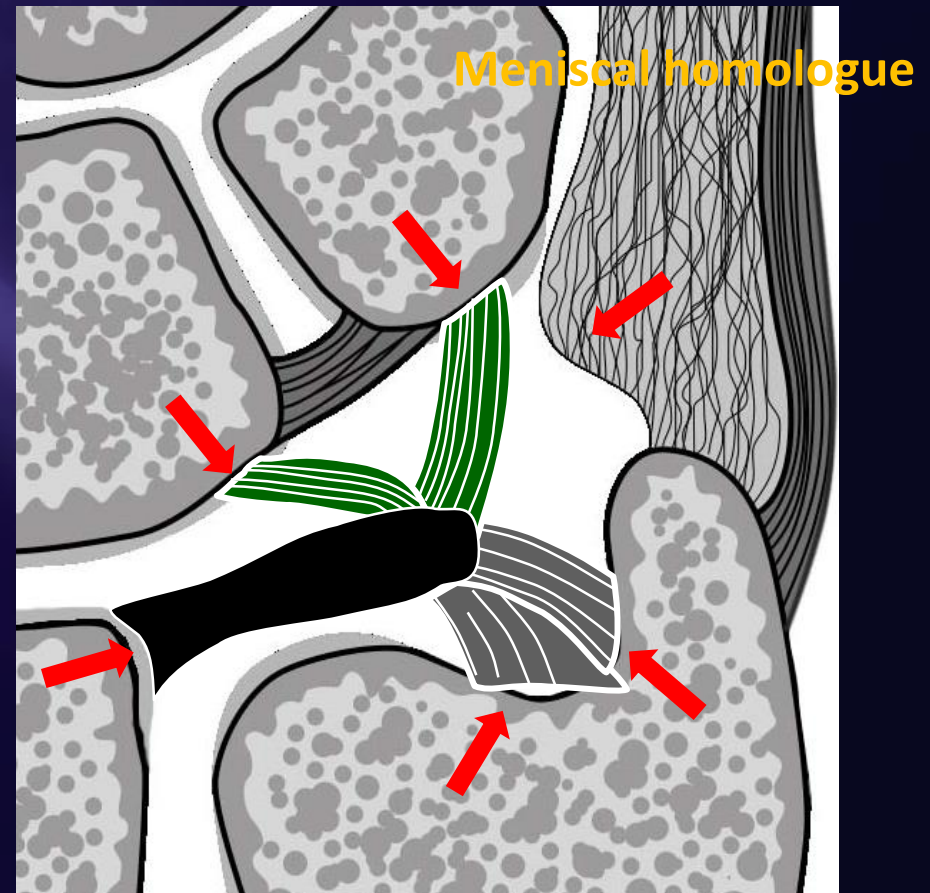
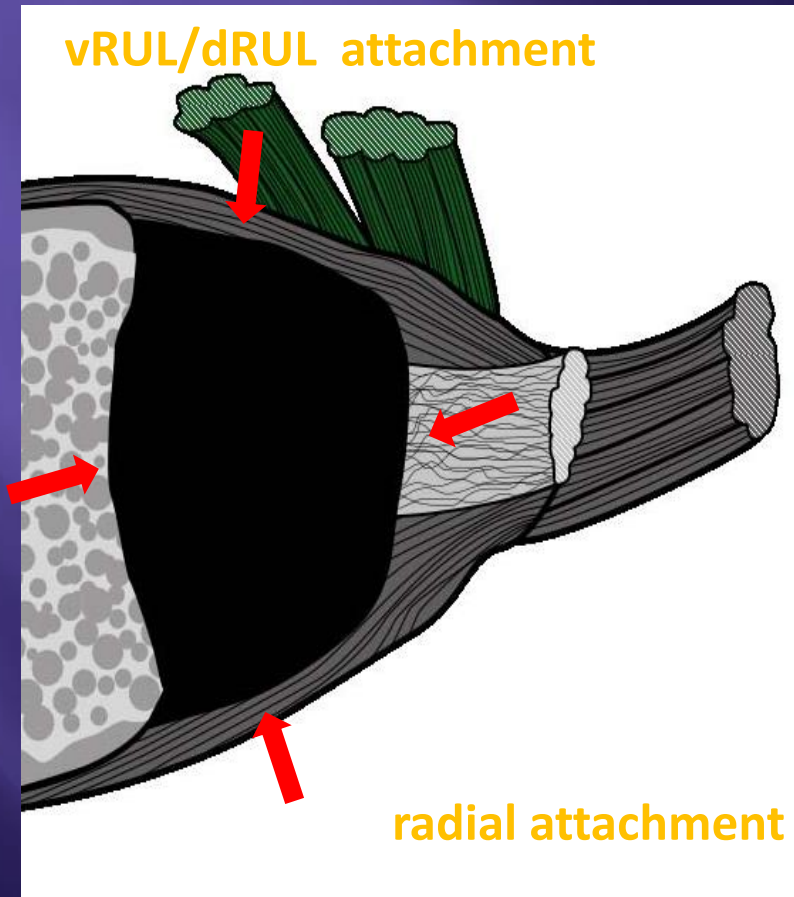
No significant swelling or abnormal signal to suggest carpal tunnel syndrome.

No extrinsic mass in the Guyon's tunnel.

# TFCC: triangular fibrocartilage complex

## Anatomy

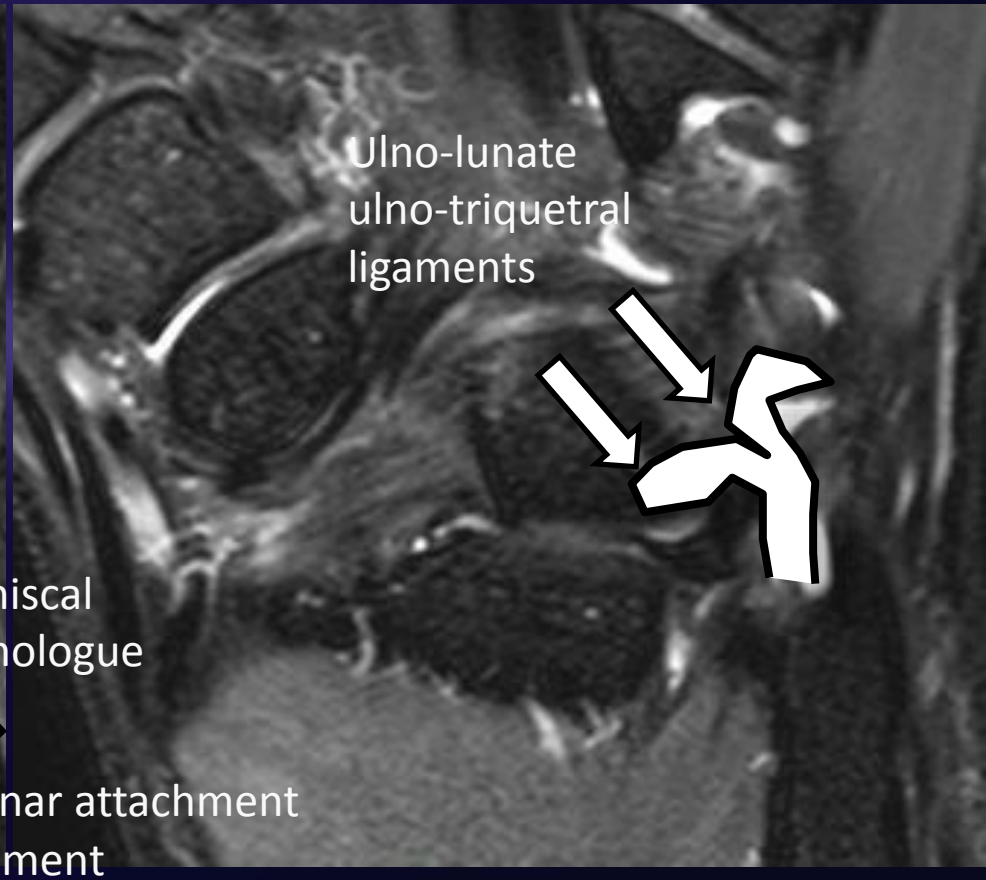
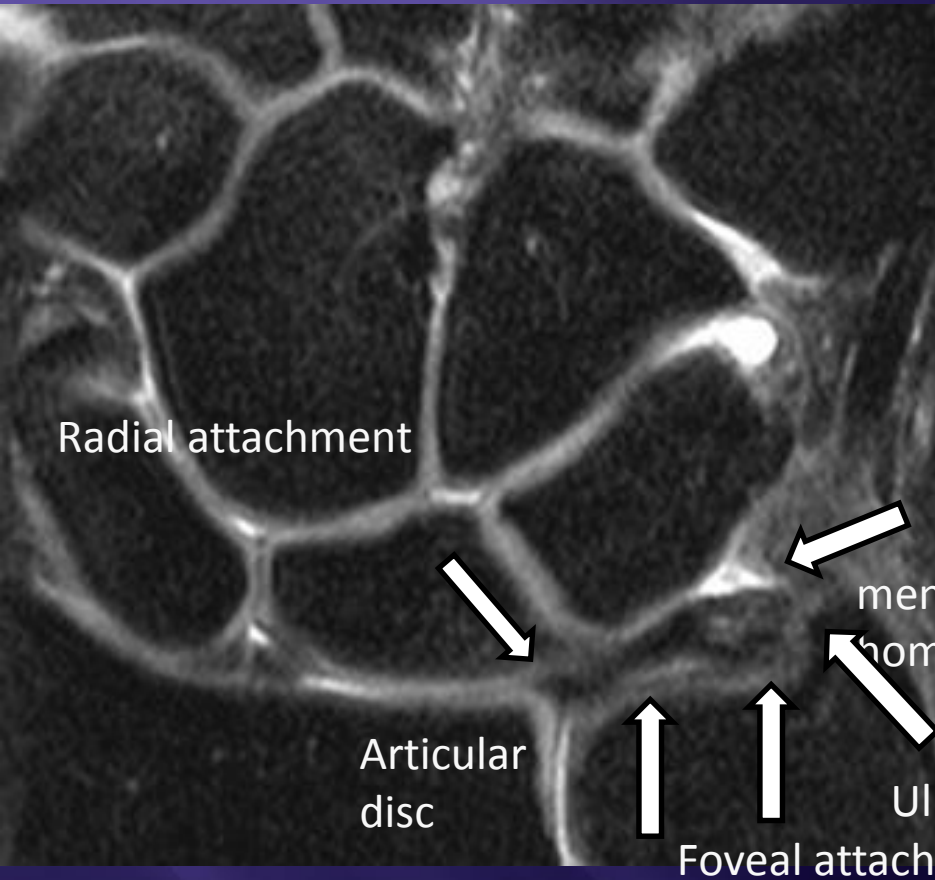
Distal attachment: ulno-triquetral/lunate ligament



Peripheral /proximal attachment:  
Foveal attachment (proximal lamina)  
Ulnar attachment (distal lamina)

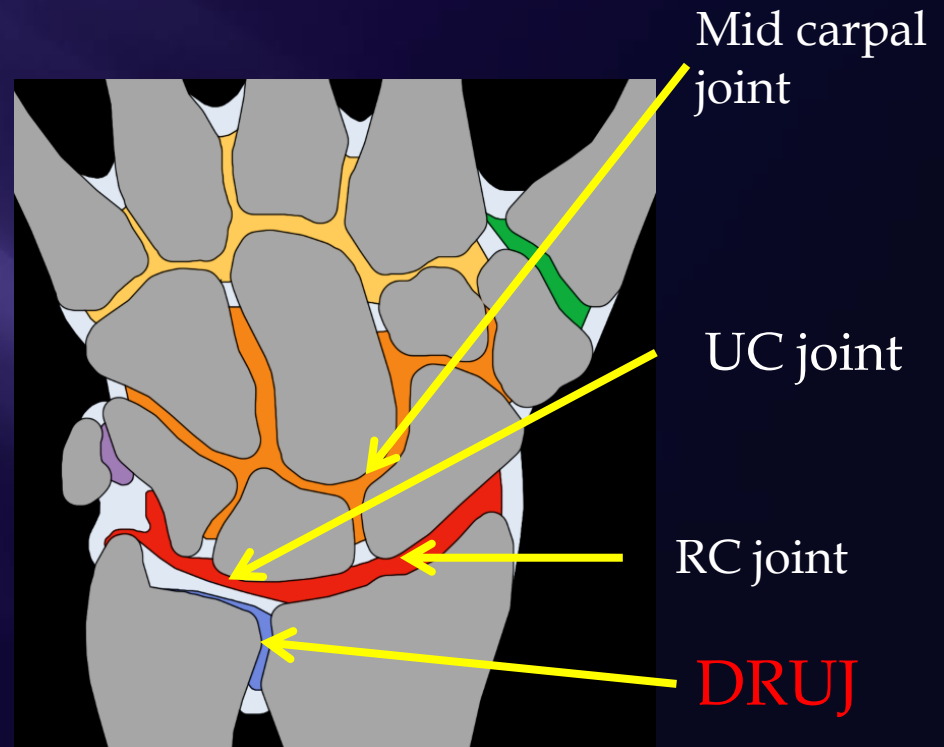


# MRI Anatomy



# TFCC

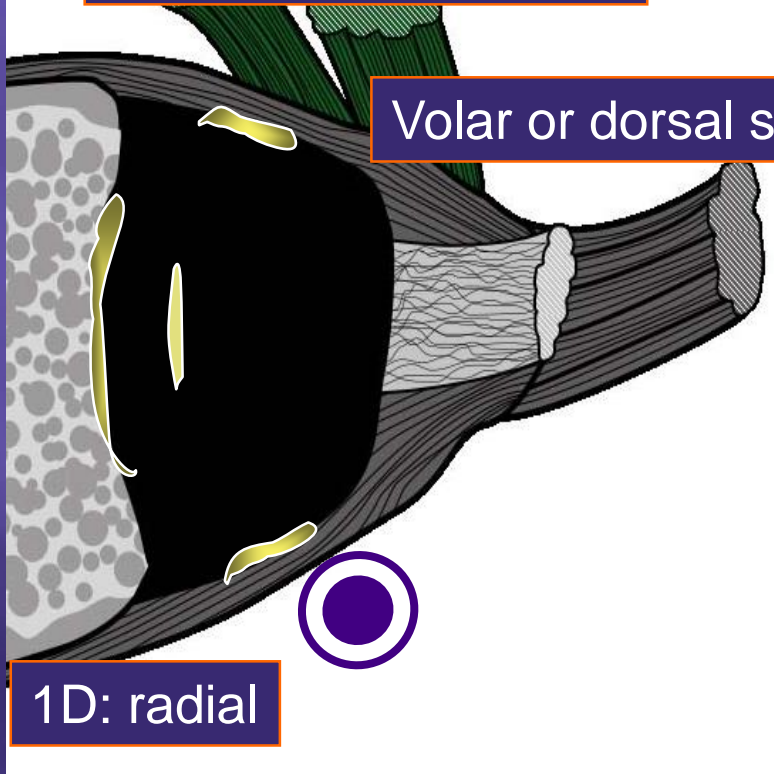
- Maintain the DRUJ stability
  - Prevent sublux when wrist pronate and supinate
- Torn → DRUJ arthritis, UCJ arthritis
- Symptoms: pain, click and Limited range of movement
- Asymptomatic :degenerative tear



# TFCC tear location

## Type 1: Traumatic

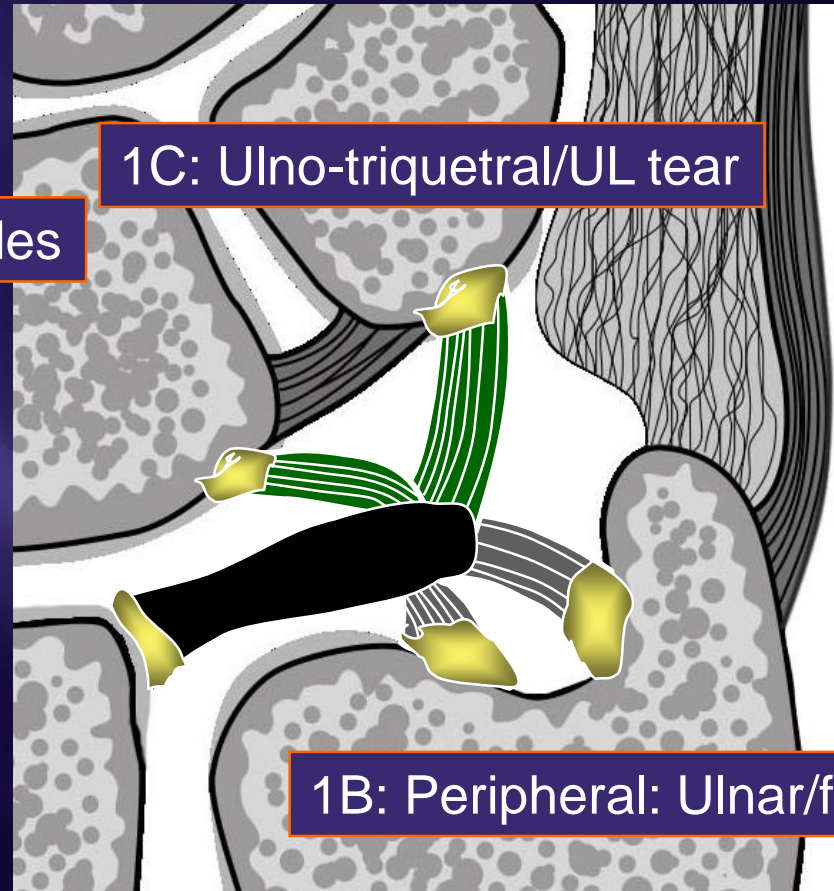
1A: Central/pararadial



1D: radial

Volar or dorsal sides

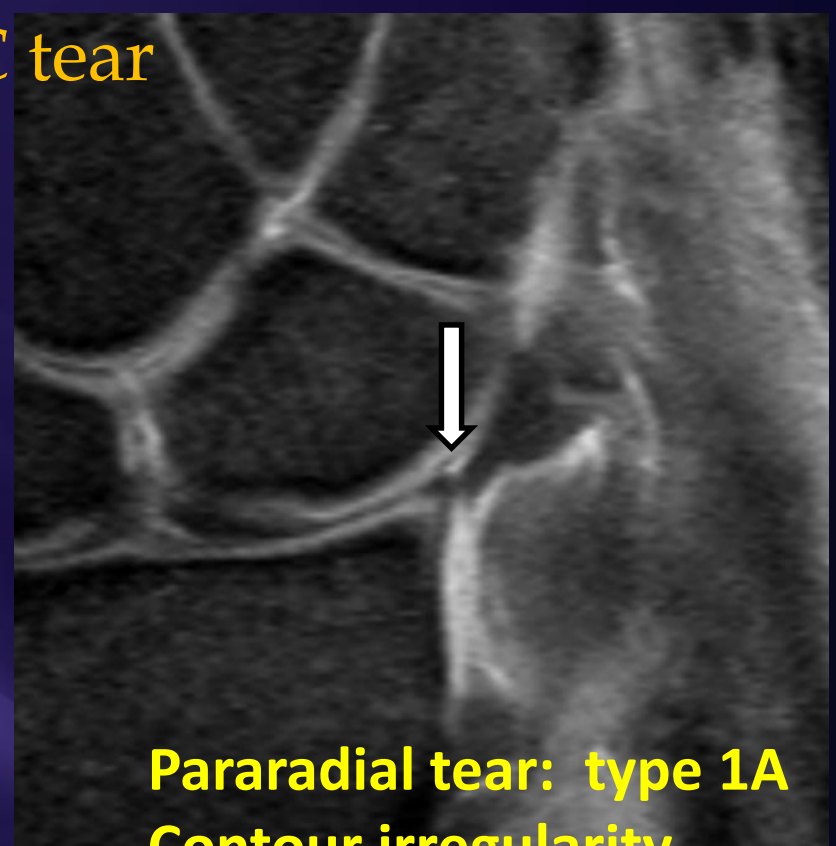
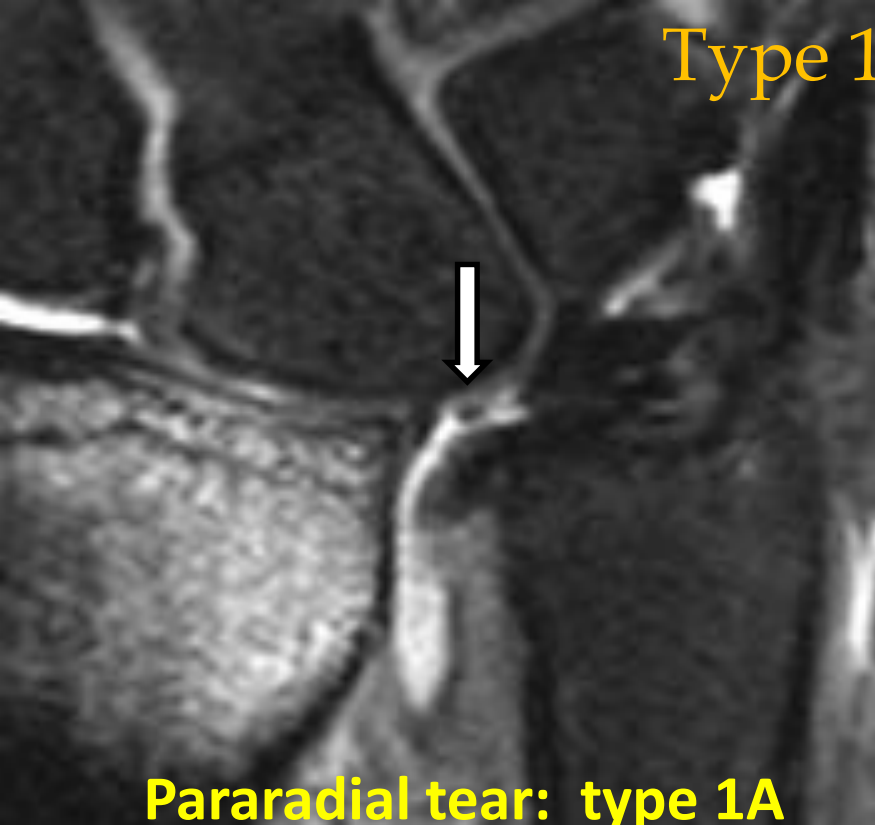
1C: Ulnar-triquetral/UL tear



1B: Peripheral: Ulnar/foveal

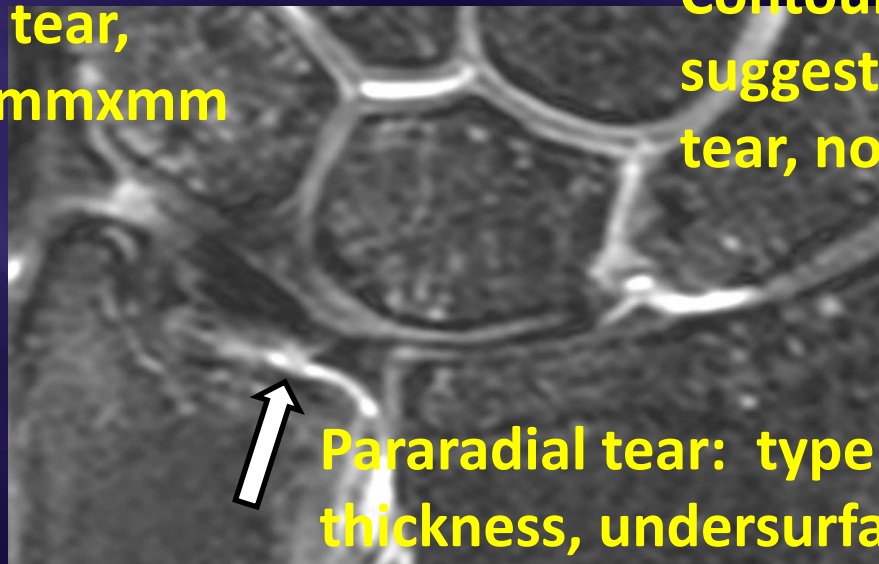
| Type   | Description  |
|--------|--|
| Type 1 | Acute traumatic tears  |
| 1A     | Central TFC perforation  |
| 1B     | Peripheral ulnar side TFCC tear ( $\pm$ ulna styloid fracture) |
| 1C     | Distal TFCC disruption (disruption from distal UC ligaments)   |
| 1D     | Radial TFCC disruption ( $\pm$ sigmoid notch fracture)         |

# Type 1 TFC tear



**Pararadial tear: type 1A**  
**Full thickness tear,**  
**measuring xmmxmm**  
**in size**

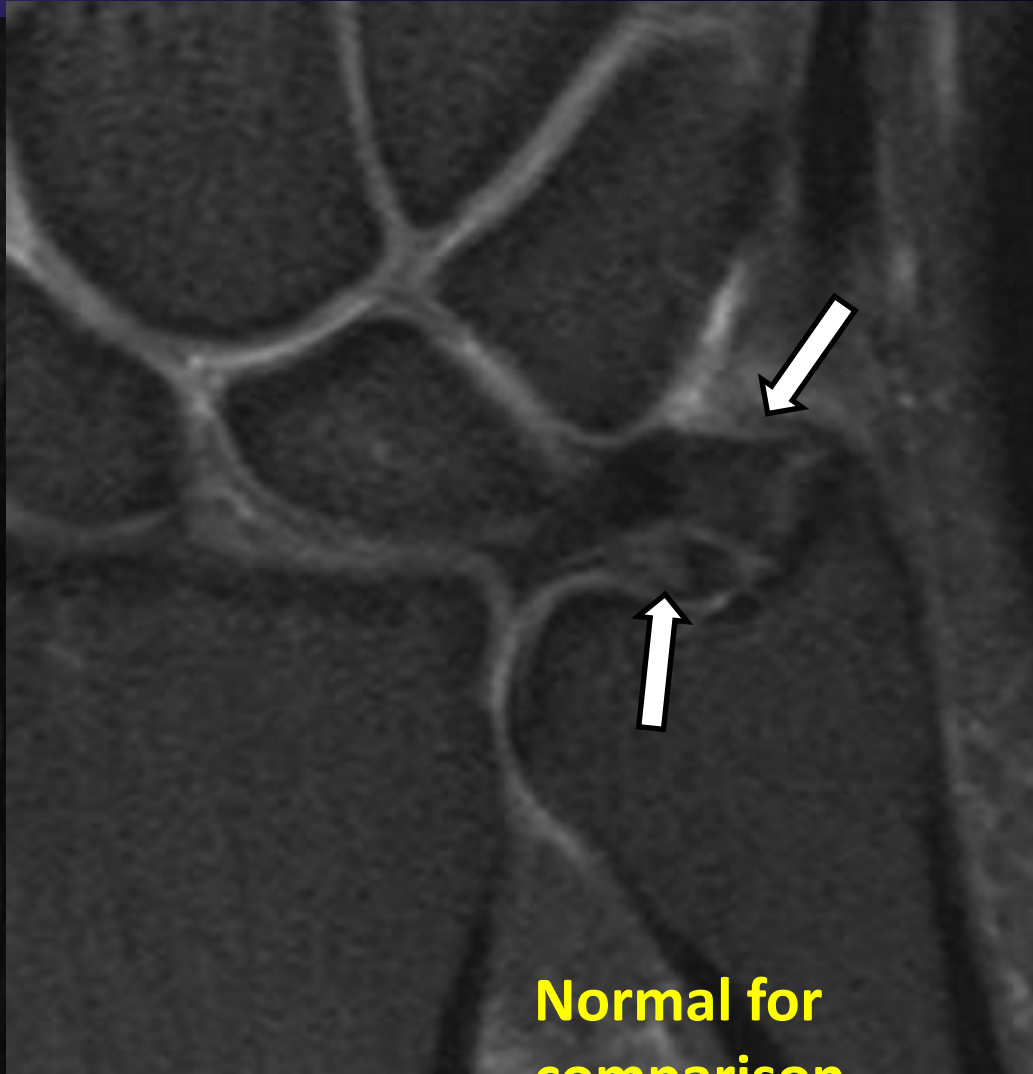
**Pararadial tear: type 1A**  
**Contour irregularity**  
**suggestive of partial**  
**tear, no gap seen**



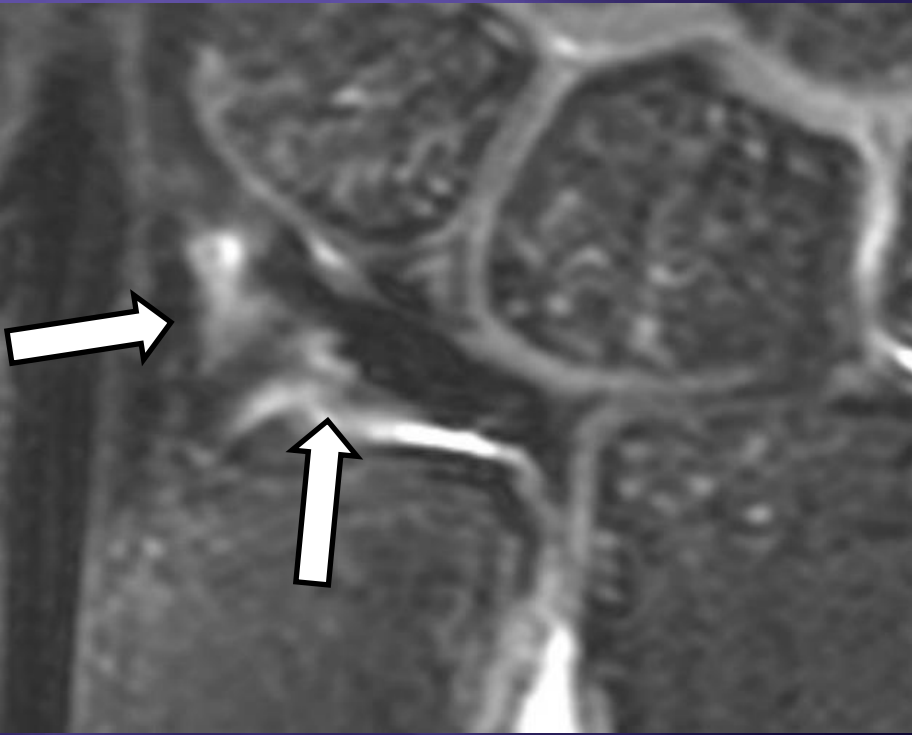
**Pararadial tear: type 1A (partial**  
**thickness, undersurface)**



**Foveal and ulnar tear (type 1B),  
partial tear**



**Normal for  
comparison**



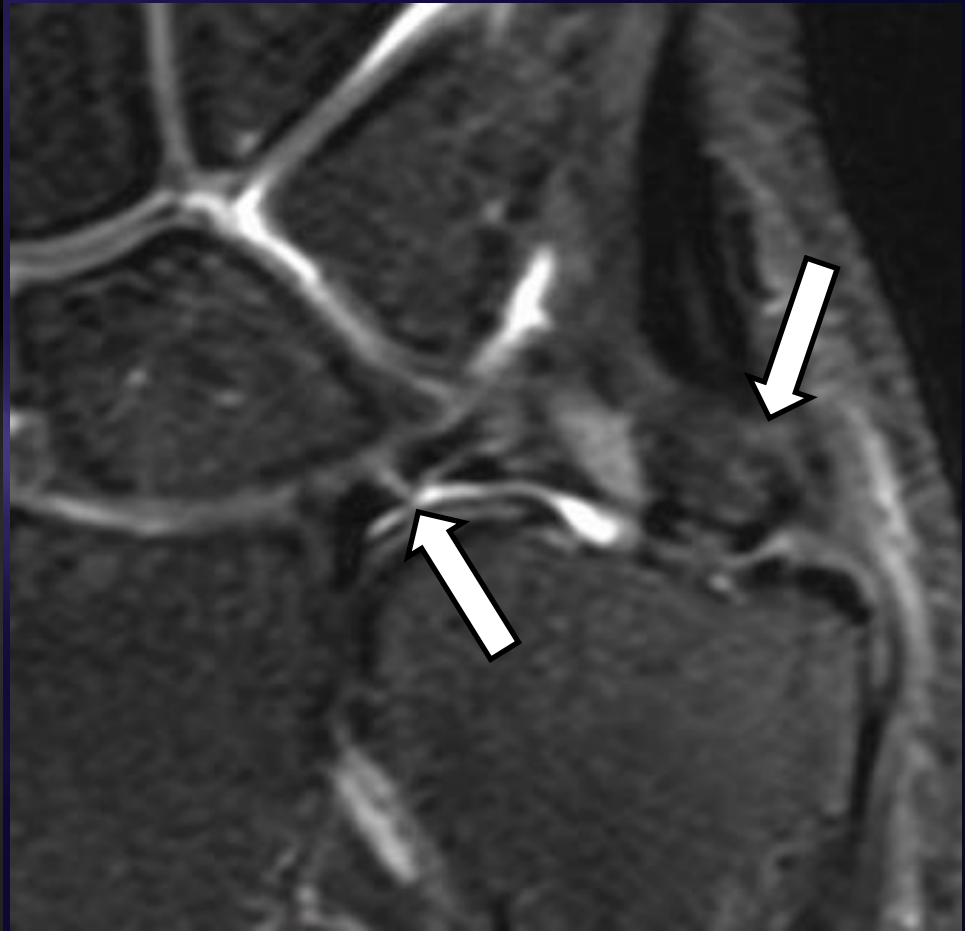
**Foveal and ulnar tear (type 1B)**



**Proximal lamina full thickness tear  
Distal lamina partial tear (type 1B)**

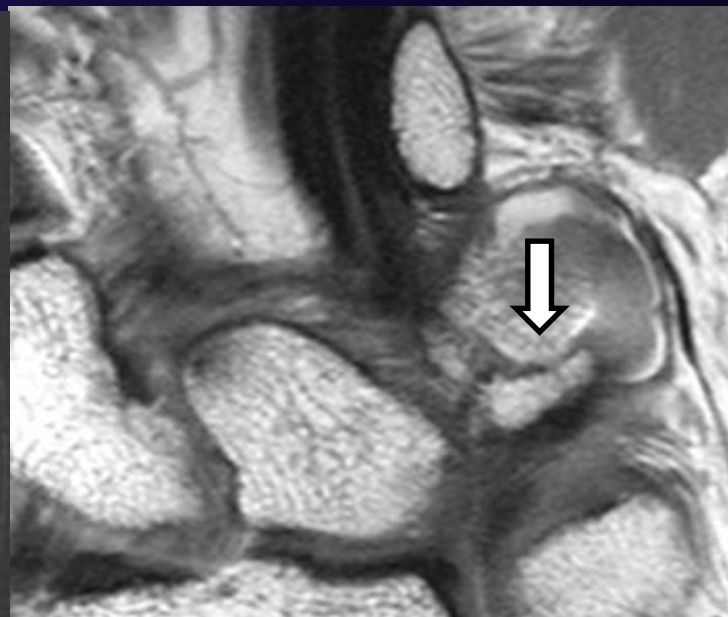
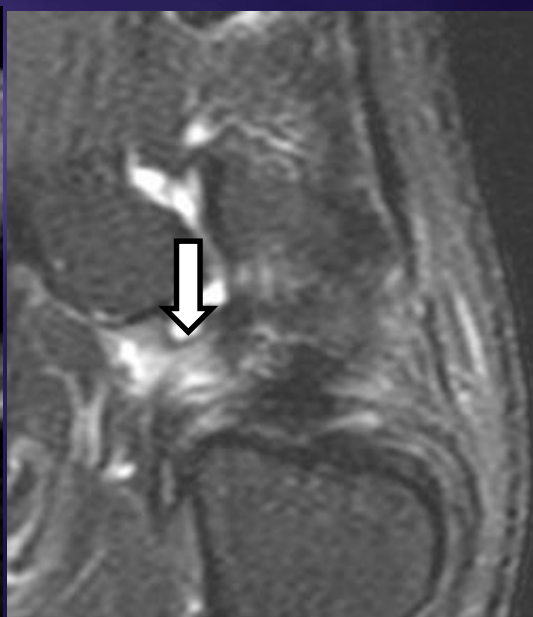
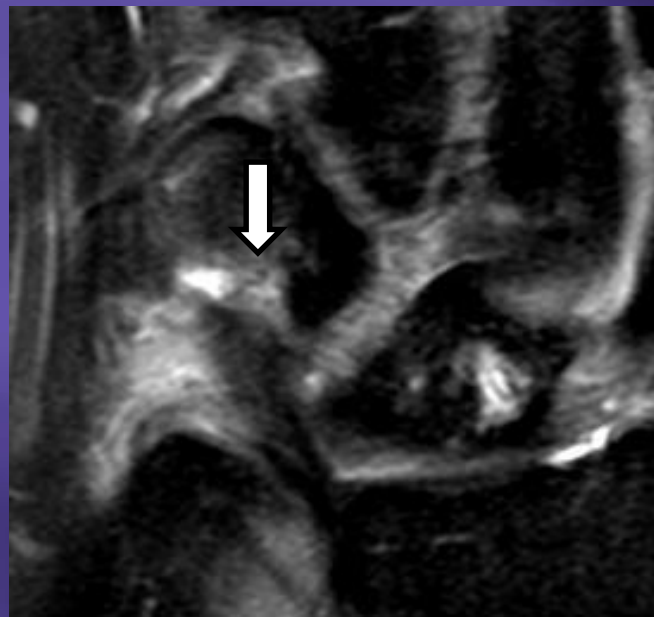


**Non-union of ulnar styloid process**  
**The ulnar attachment of TFCC shows**  
**partial tear (type 1B)**



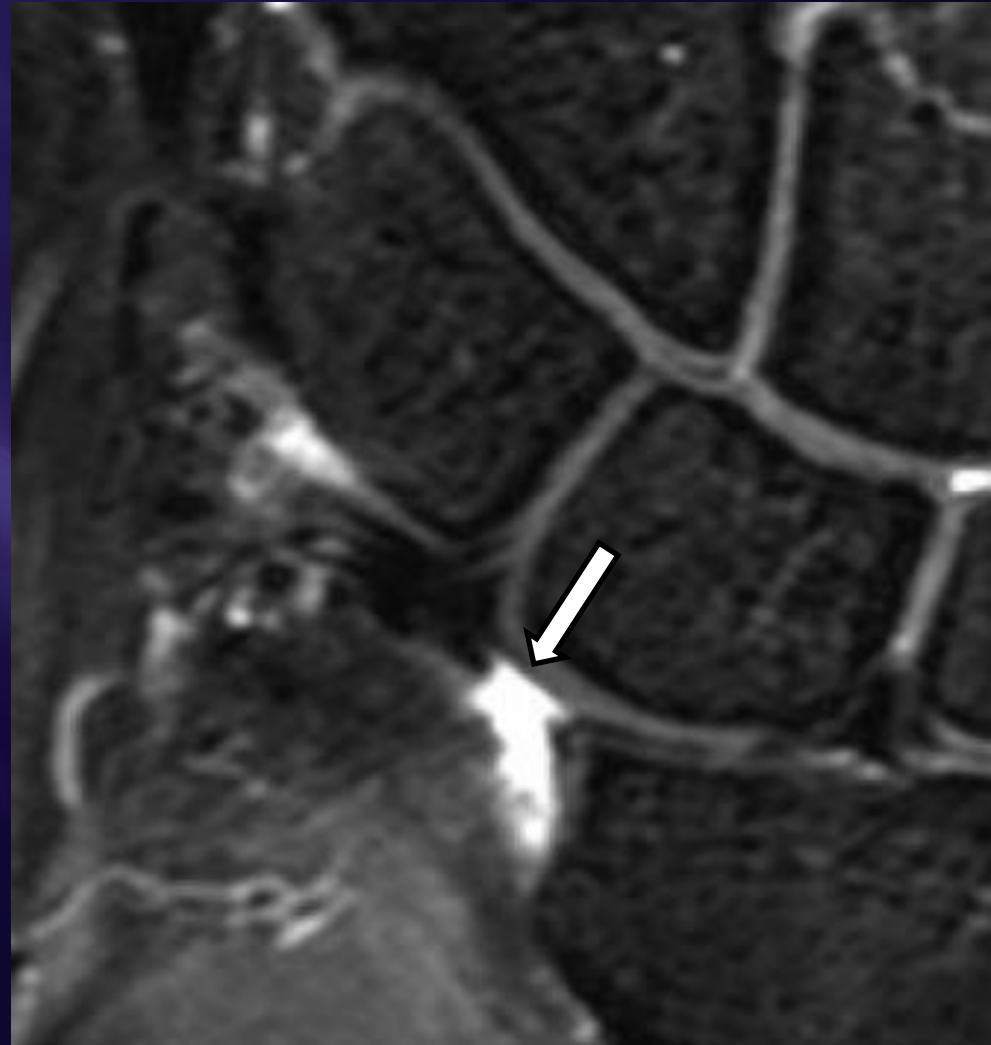
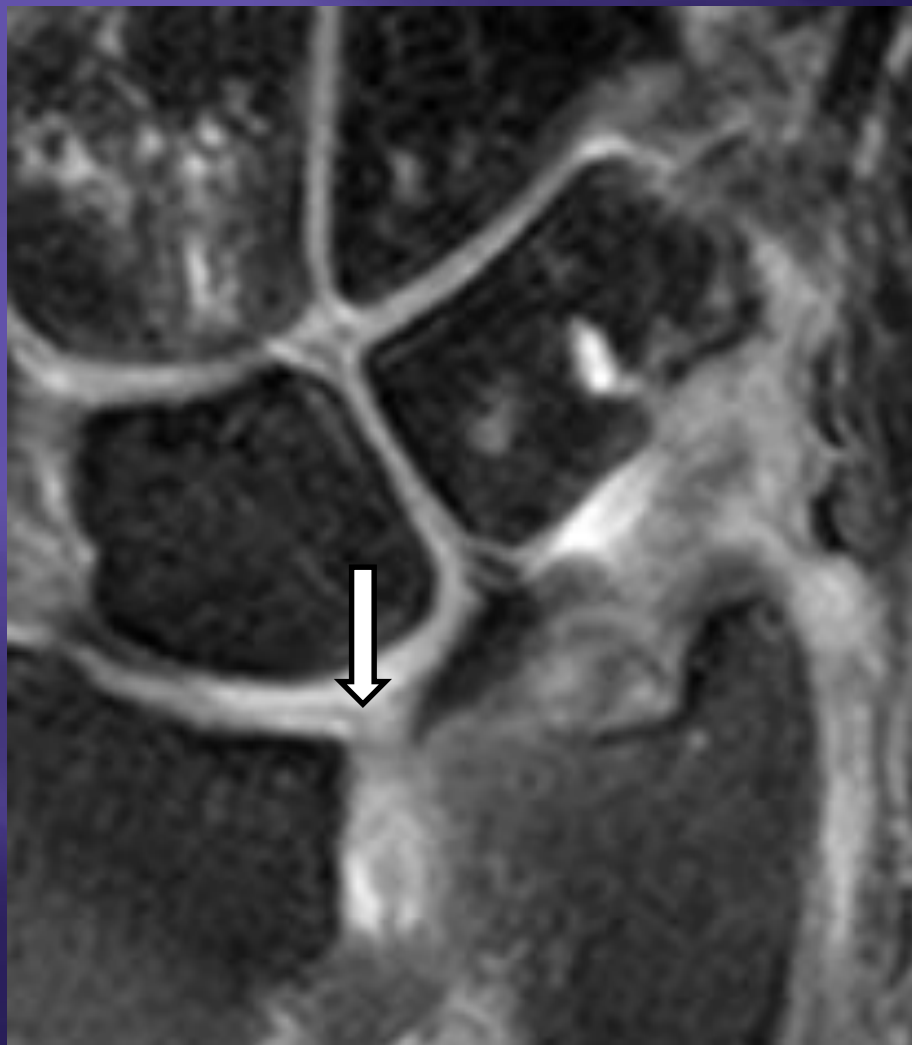
Type 1=Tips: TFCC intact, DRUJ stable  
Type 2=Base of styloid: TFCC disrupted,  
DRUJ unstable

Full thickness tear pararadial region (type 1a)

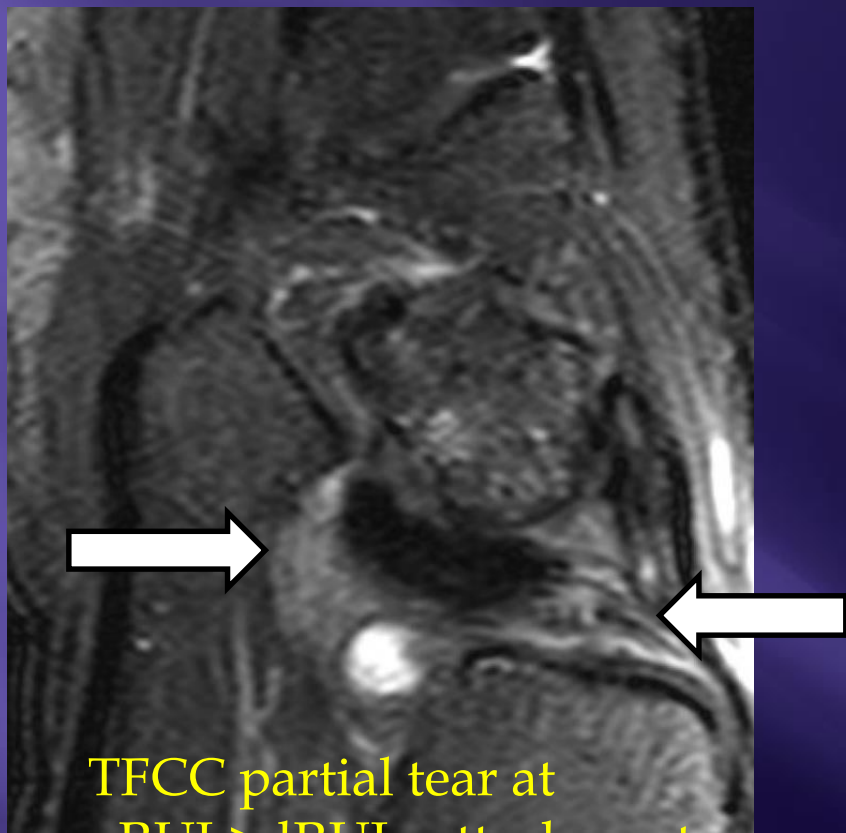


**Distal attachment tear (type 1C)**





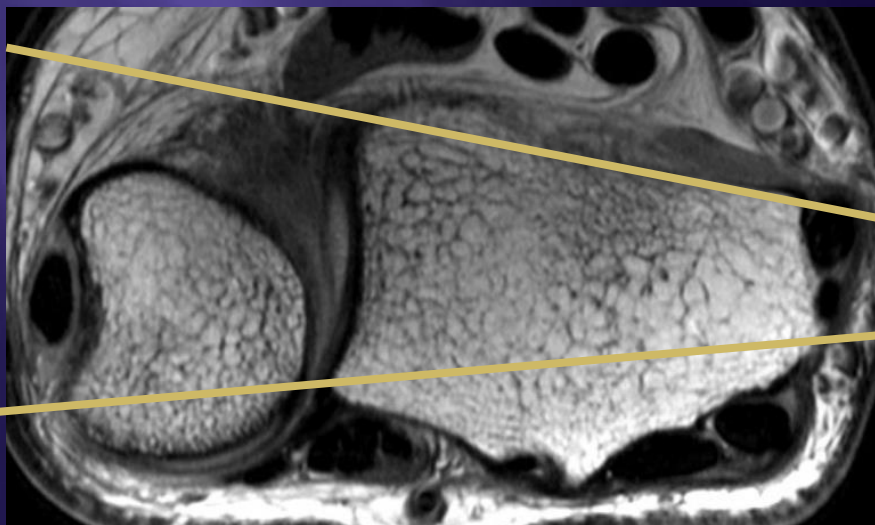
**Large radial avulsion (type 1D), retracted peripherally  
and the gap measures mmxmmxmm  
The TFC is lax (loss of trampoline effect)**



TFCC partial tear at  
vRUL>dRUL attachment



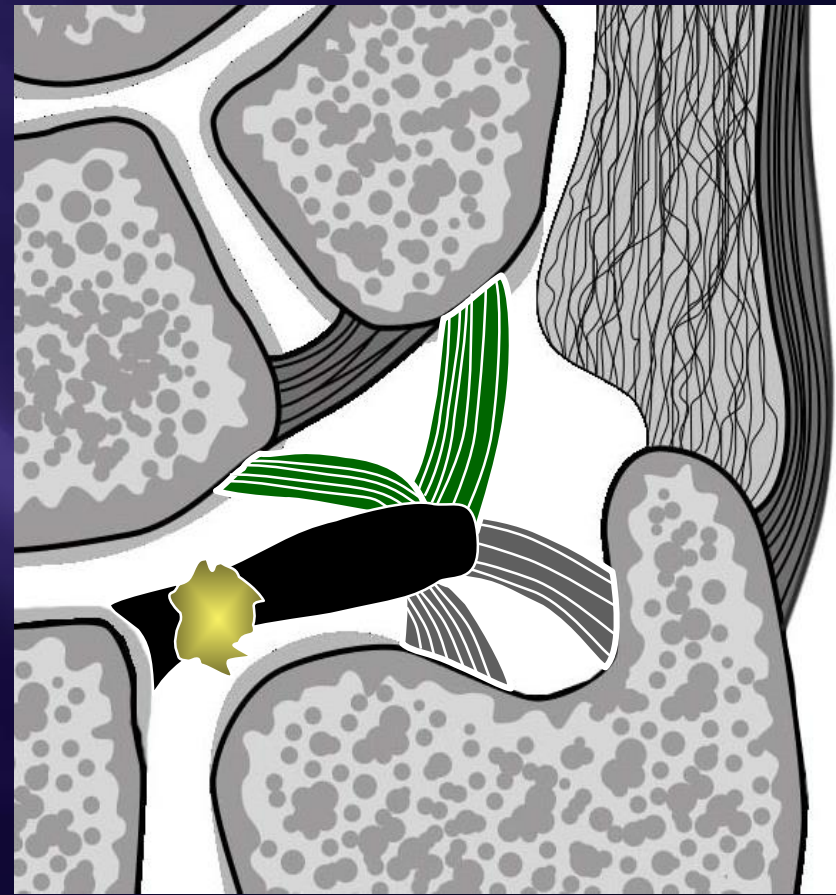
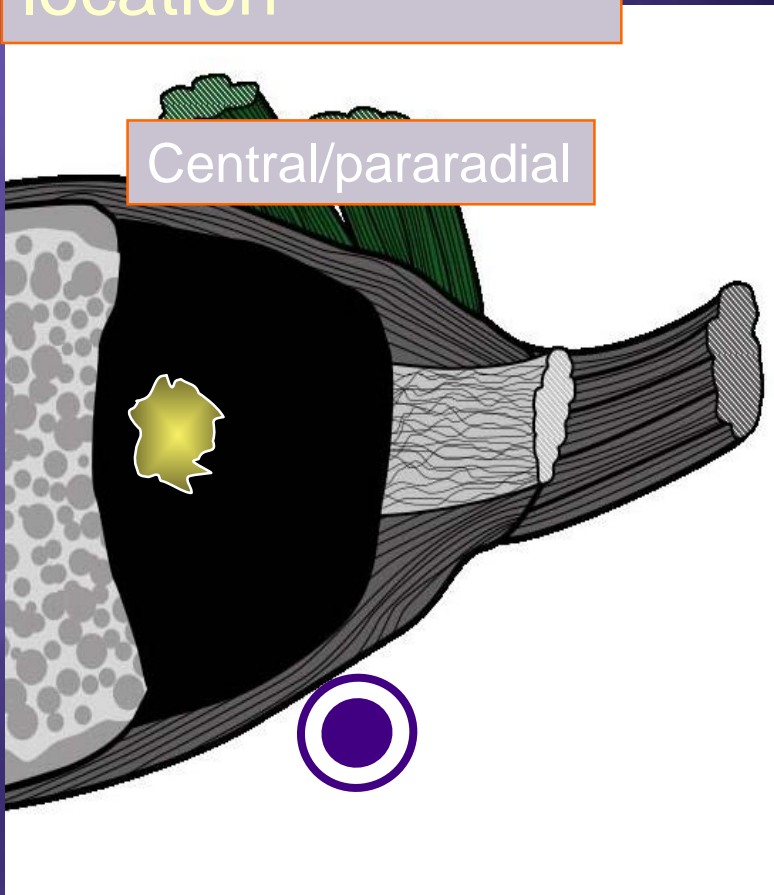
TFCC tear at the  
dorsal attachment  
of the dRUL



Mild dorsal DRUJ subluxation

# TFCC tear location

Type 2: Degenerative



- More irregular versus sharp edge
- TFCC thinning/ degeneration
- Ulnar positive

## Type 2 Degenerative

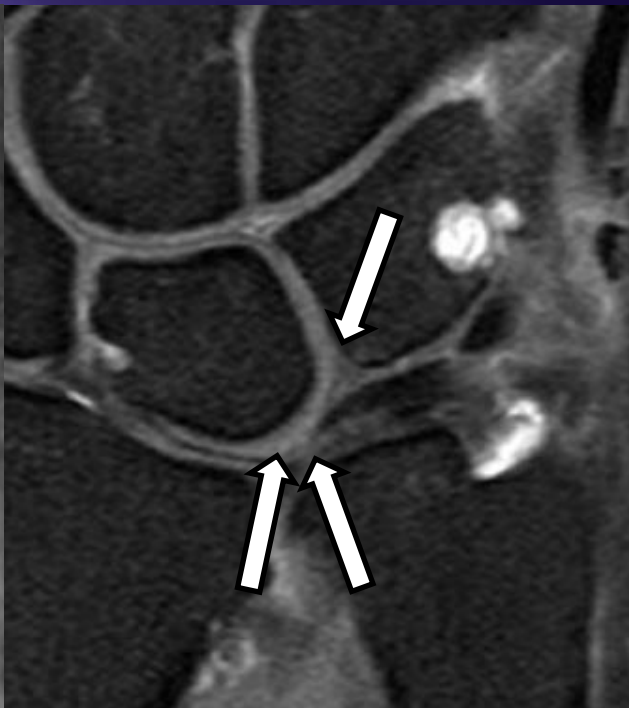
- 2A TFCC wear
- 2B TFCC wear with lunate and/or ulnar chondromalacia
- 2C TFCC perforation with lunate and/or ulnar chondromalacia
- 2D TFCC perforation with lunate and/or ulnar chondromalacia with LTIOL perforation
- 2E 2D + ulnocarpal arthritis

Adapted from Palmer AK Triangular fibrocartilage complex lesions: a classification. J Hand Surg Am 1989 Jul;14(4):594-606

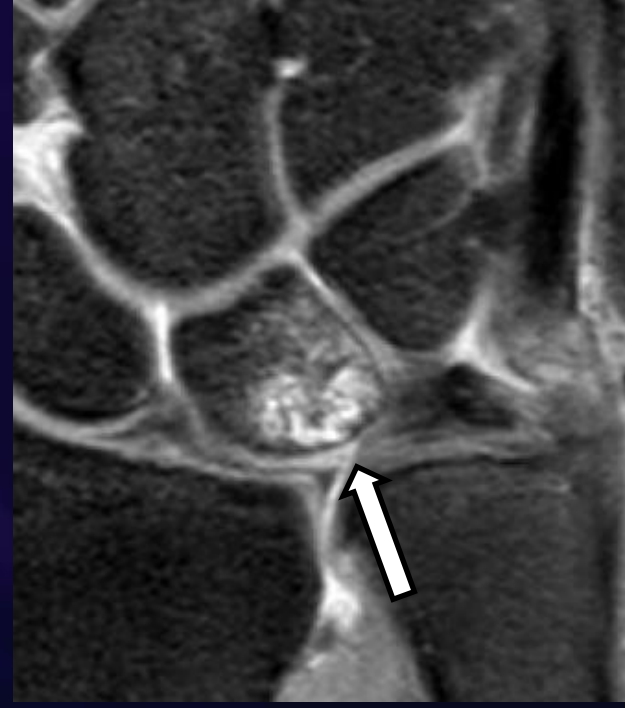
# Type 2 TFC tear



Type 2C



Type 2C/D



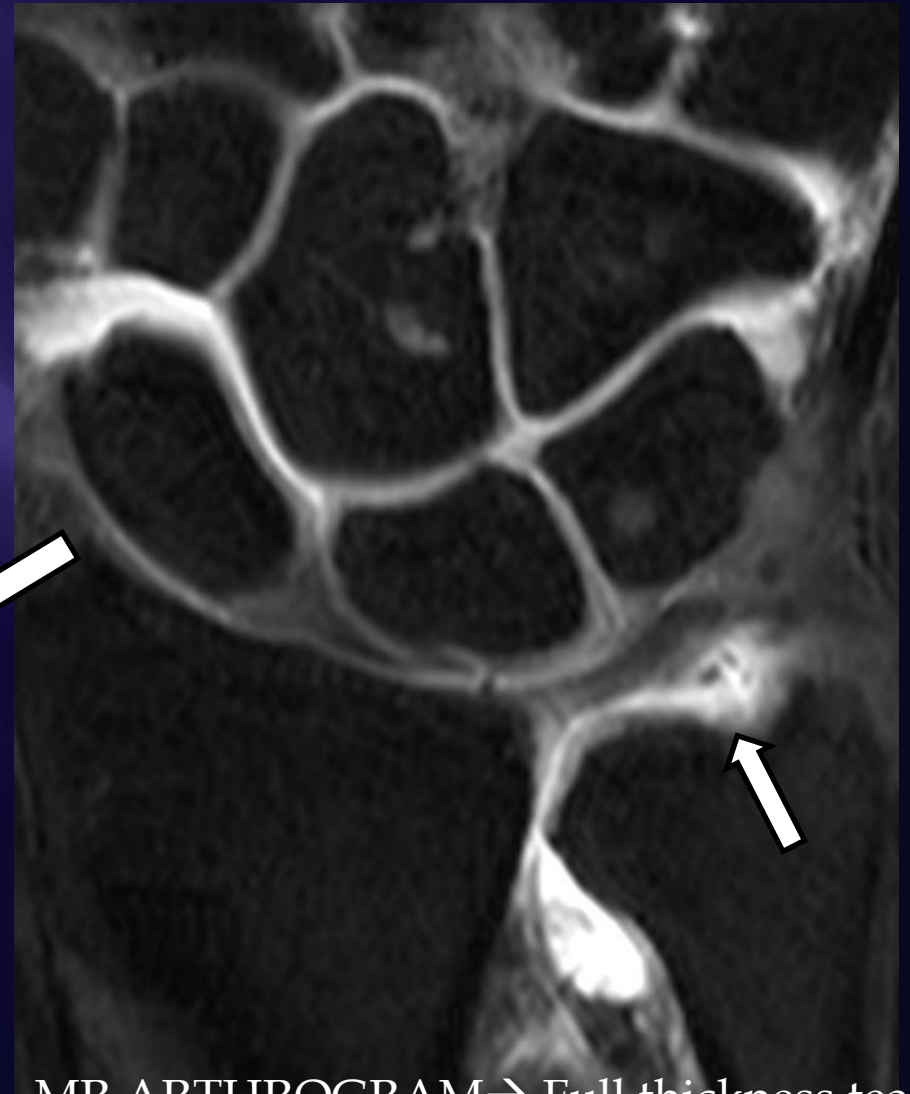
Type 2E

40% perforation in 50+ with NO symptoms

# TFCC TEAR- Limitations

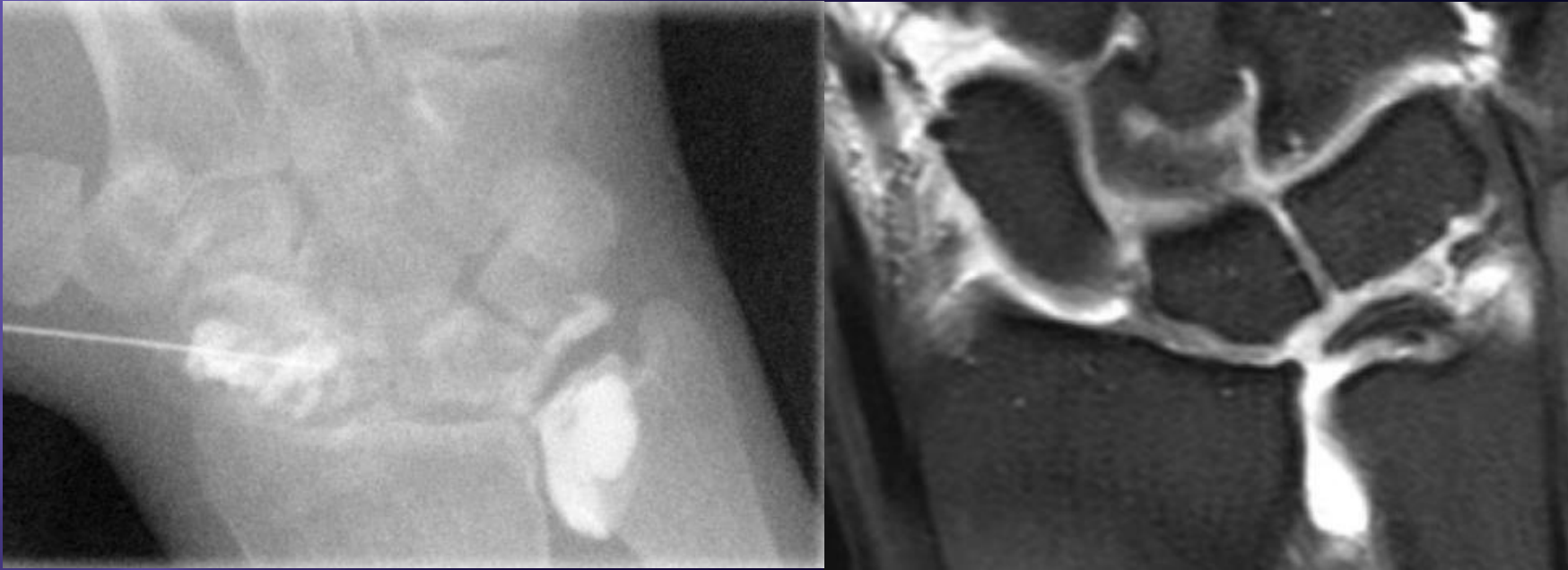


**Foveal and ulnar tear (type 1b)  
?fibrous tissue or partial tear**

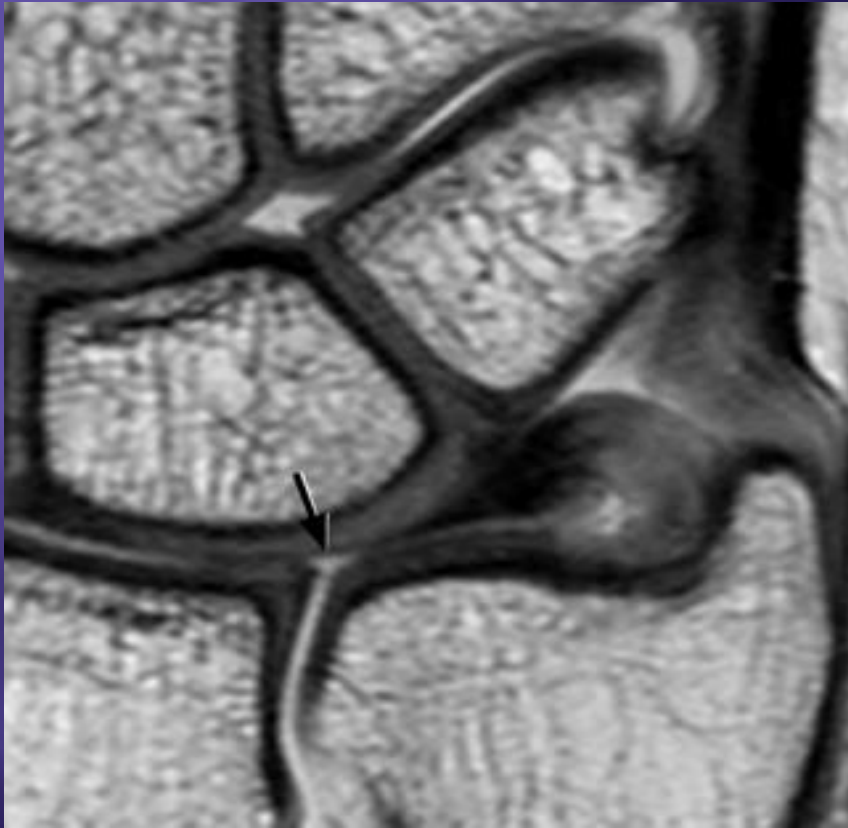


MR ARTHROGRAM → Full thickness tear

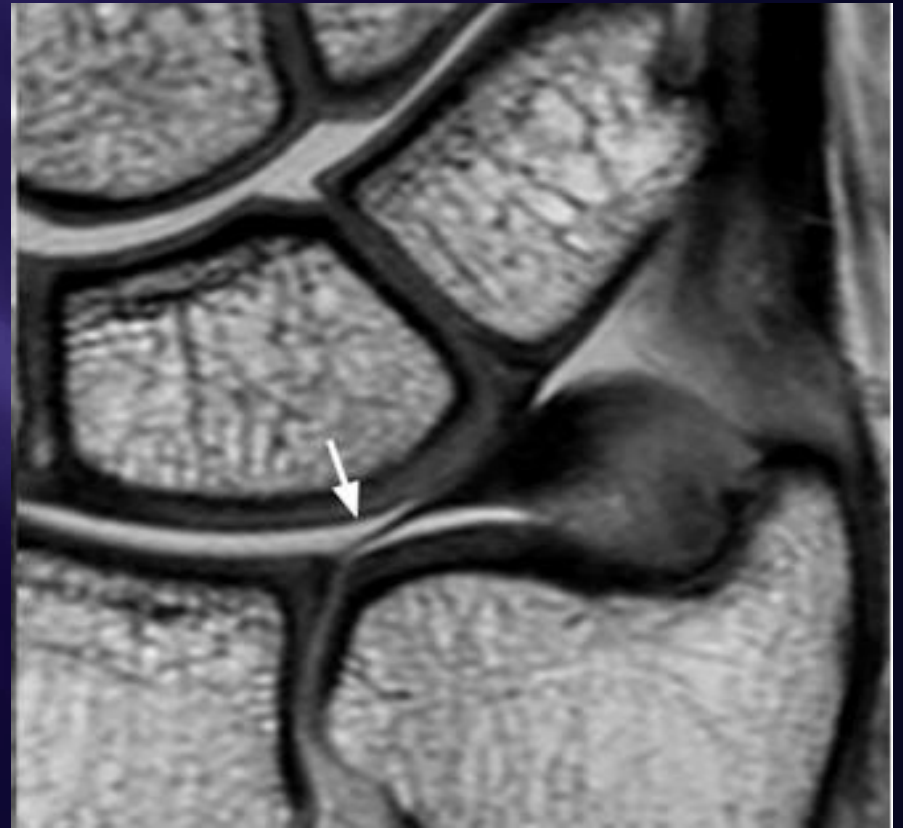
# MR arthrogram



- Injection at RCJ and DRUJ
- Gold standard for communicating (full thickness) tear



Suspicious tear (Type 2C)



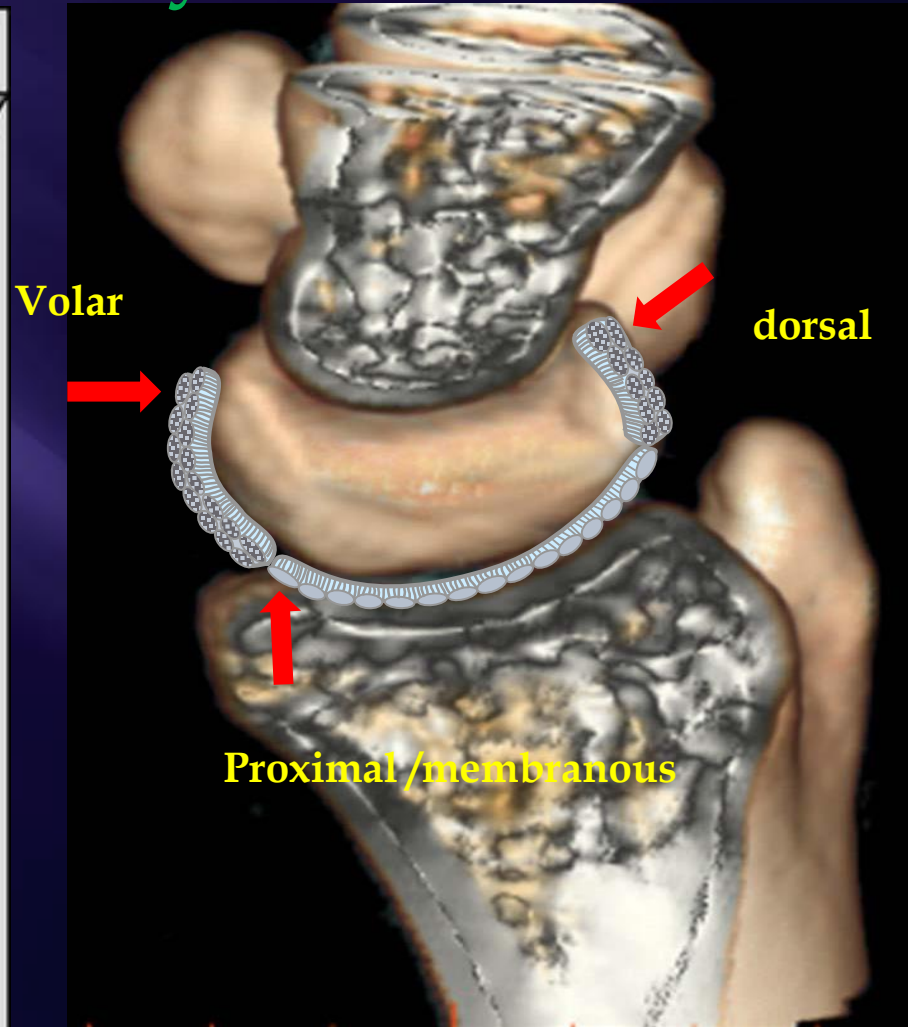
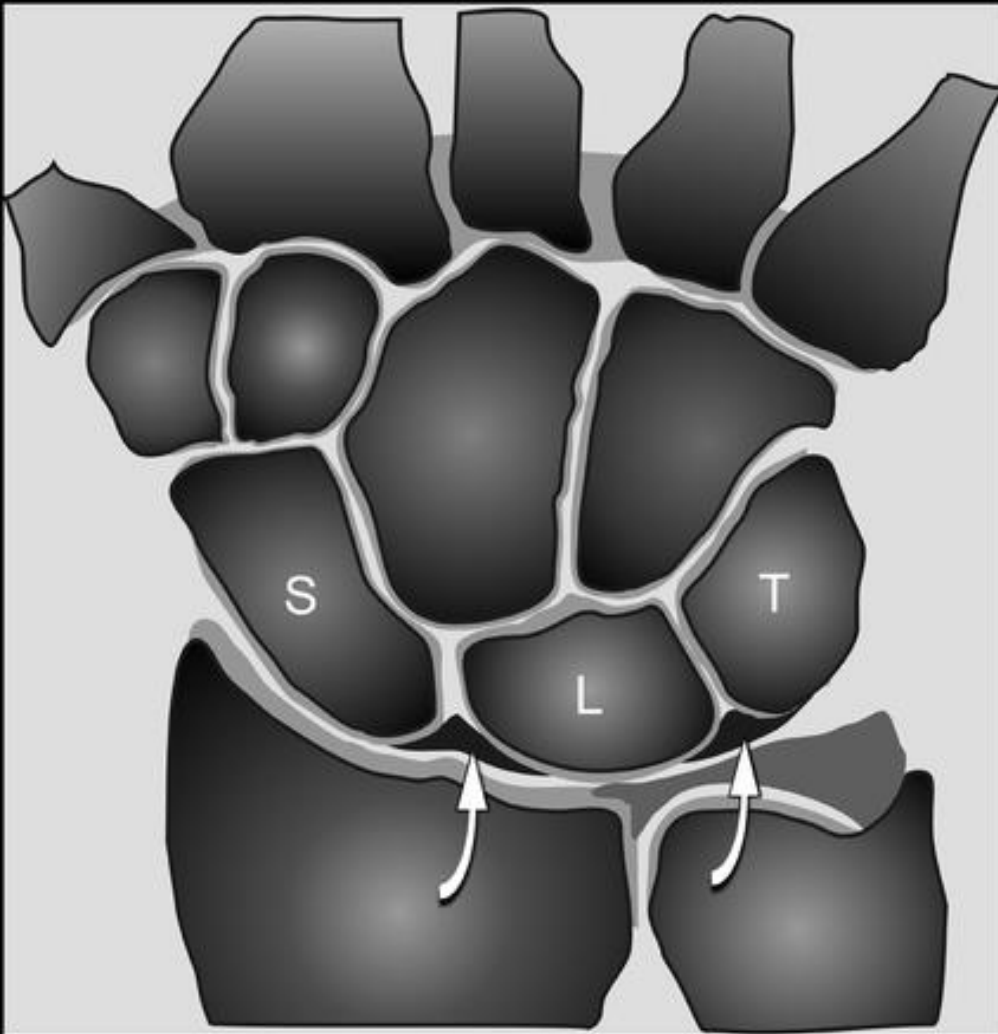
Intact thin disc (→Type 2A)

**Distend the joint or Traction**



# SL AND LT LIGAMENTS

## Anatomy



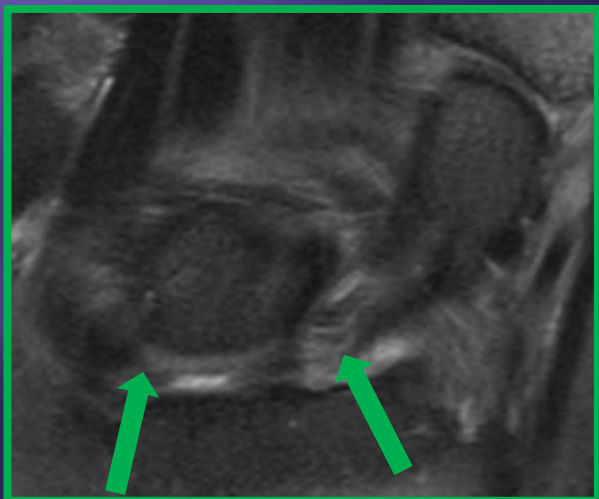
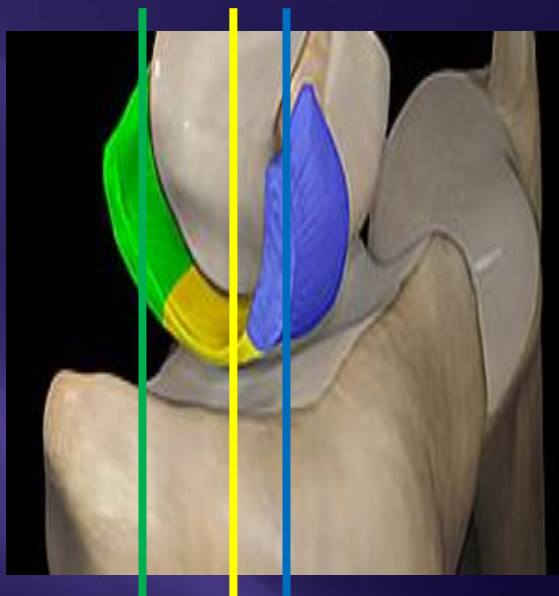
## ▣ INTRINSIC LIGAMENT

- Maintain the stability of the proximal carpal row (SL instability and LT instability)
  - ▣ Torn → Arthritis, pain, click and degeneration

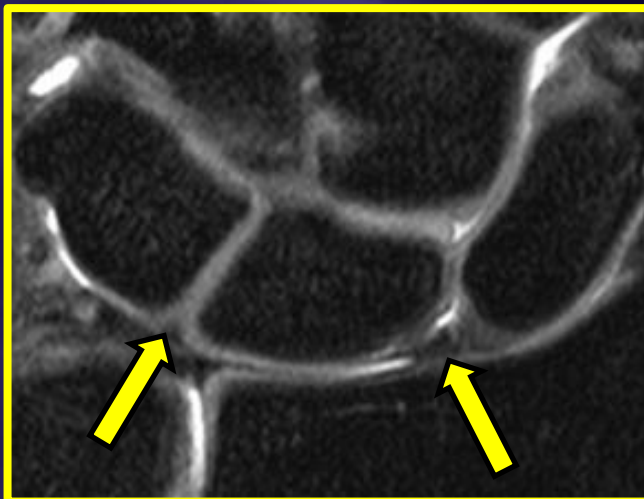
## ▣ Features of torn ligament

- Morphology distortion (thinning, irregularities)
- Abnormal signal (difficult to detect)
- Discontinuity of fibres
- Complete absence of ligament
- Secondary dissociation of SL interval (>3mm)
- Ganglion cyst formation

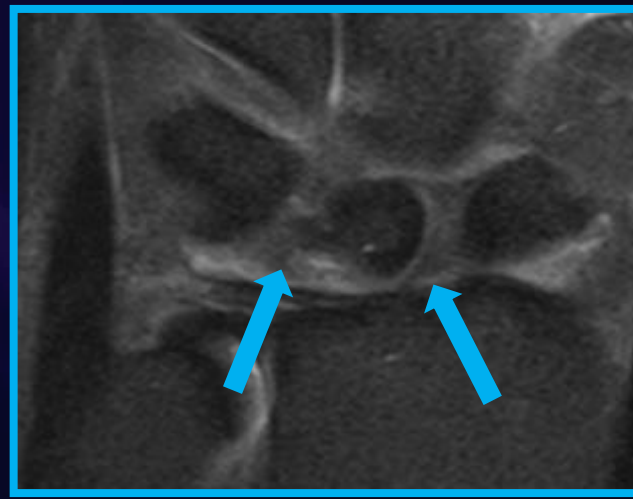
# MRI anatomy



Volar

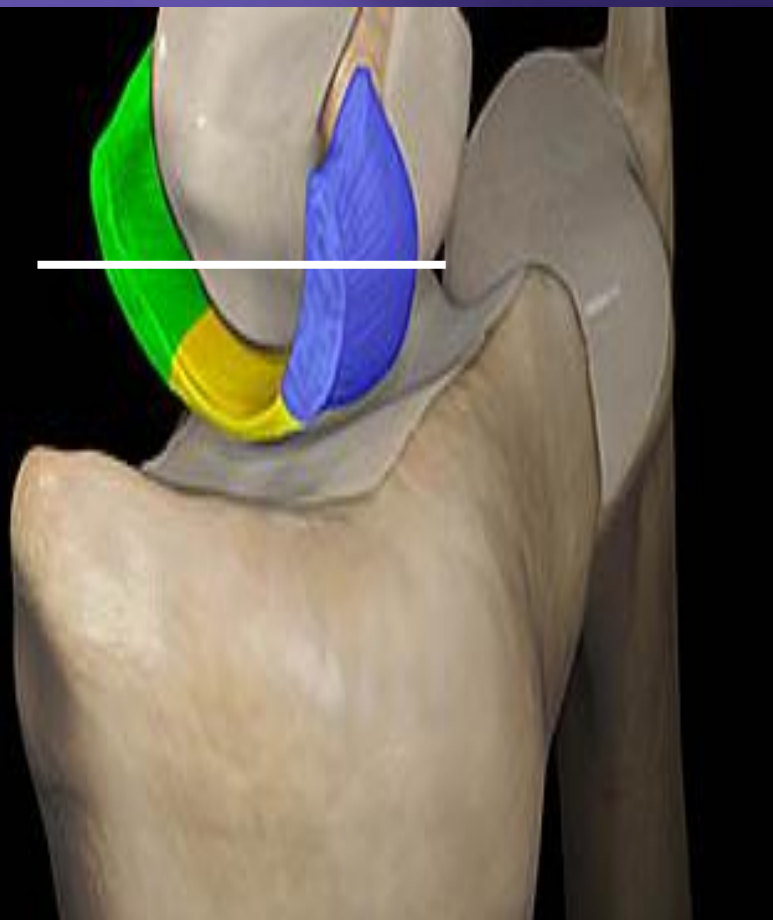


membranous

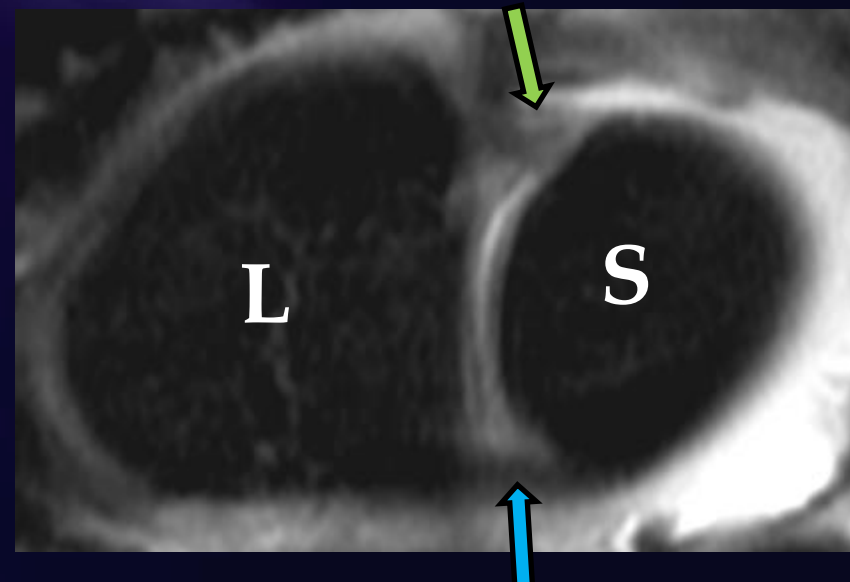
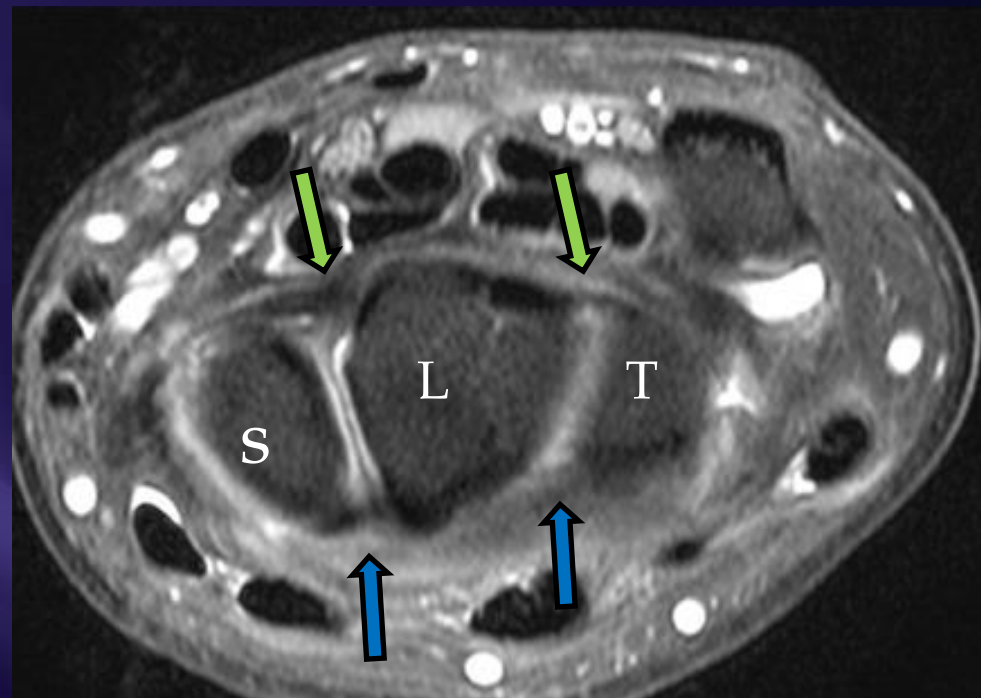


Dorsal

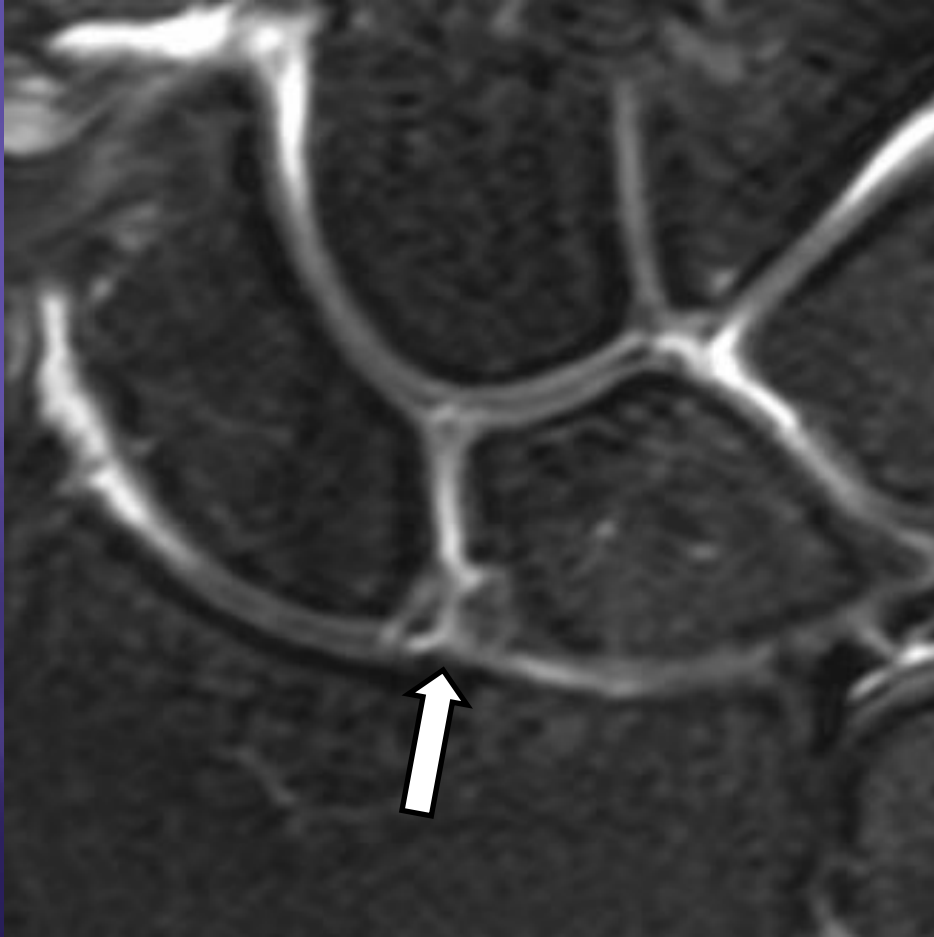
# MRI anatomy



SL: dorsal side stronger  
LT: volar side stronger



# SL tear



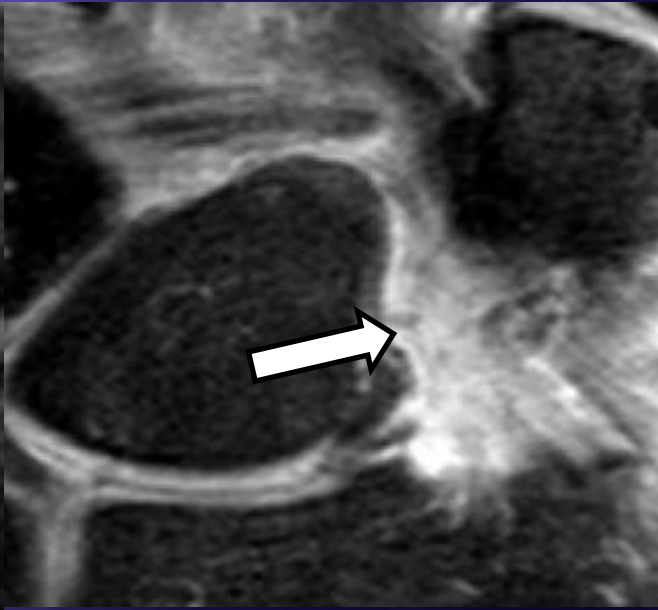
Membranous portion: Central perforation (full thickness) of the SL ligament



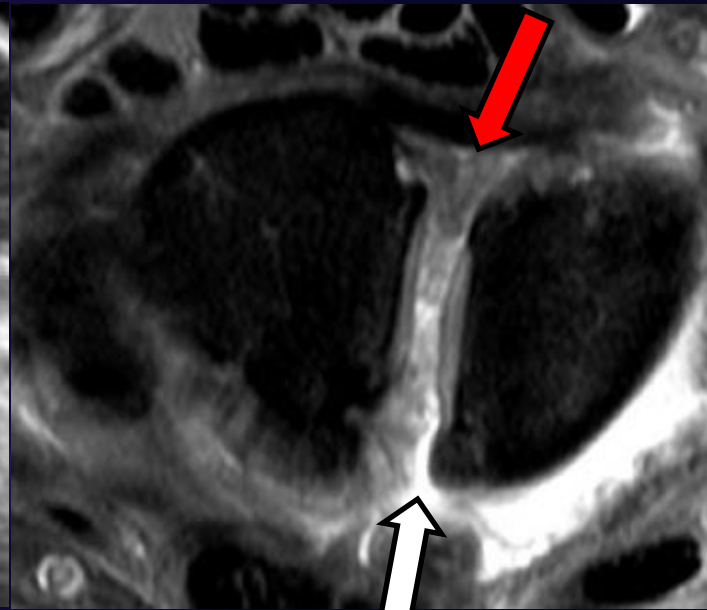
Membranous portion: Flap tear from the scaphoid attachment (full thickness) of the SL ligament



Membranous: full thickness tear



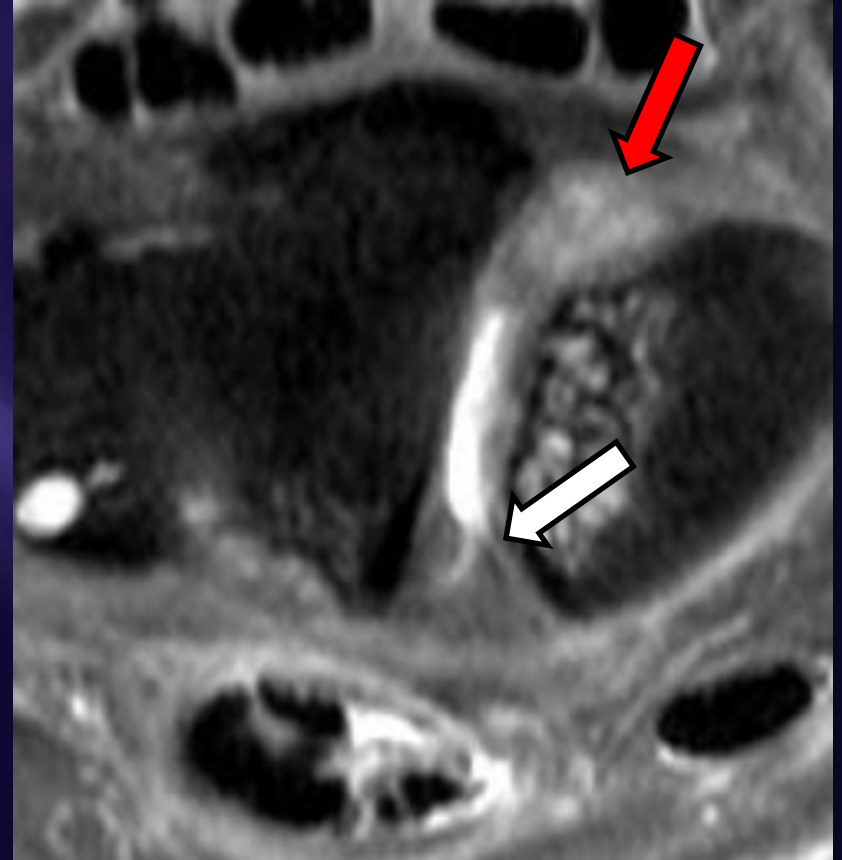
Dorsal : Full thickness tear



Volar side: probably full thickness tear from the scaphoid attachment

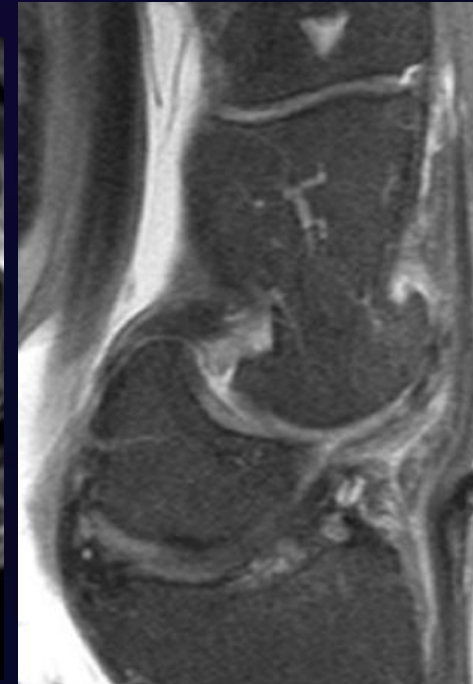
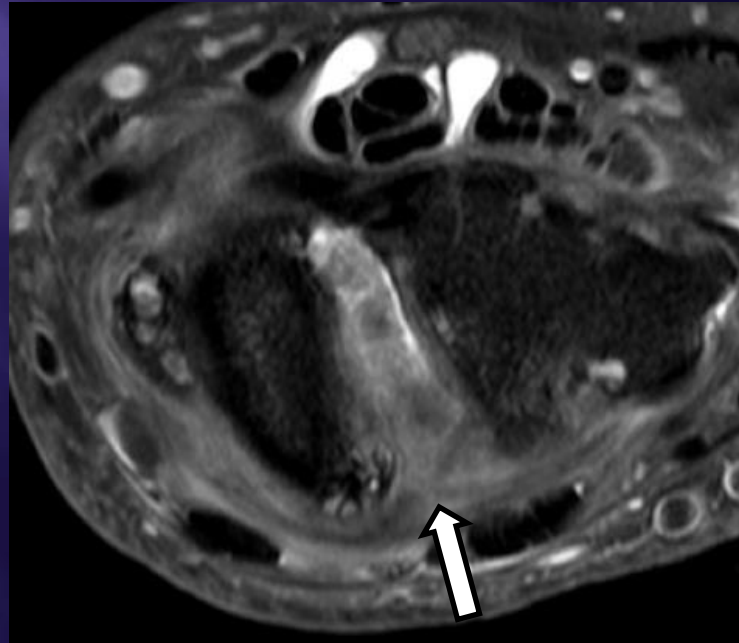


Membranous : full thickness tear



Dorsal component: partial thickness tear  
Volar component: Swollen and distorted  
configuration: partial tear

## DISI deformity ?

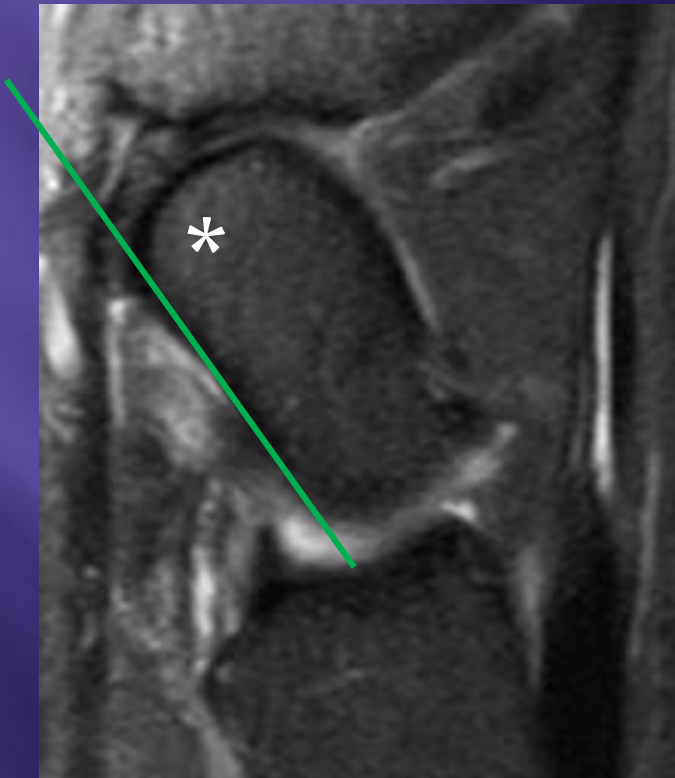


Full thickness tear of the SL ligament in the dorsal and membranous portions  
Secondary dissociation of the SL interval  $>3\text{mm}$

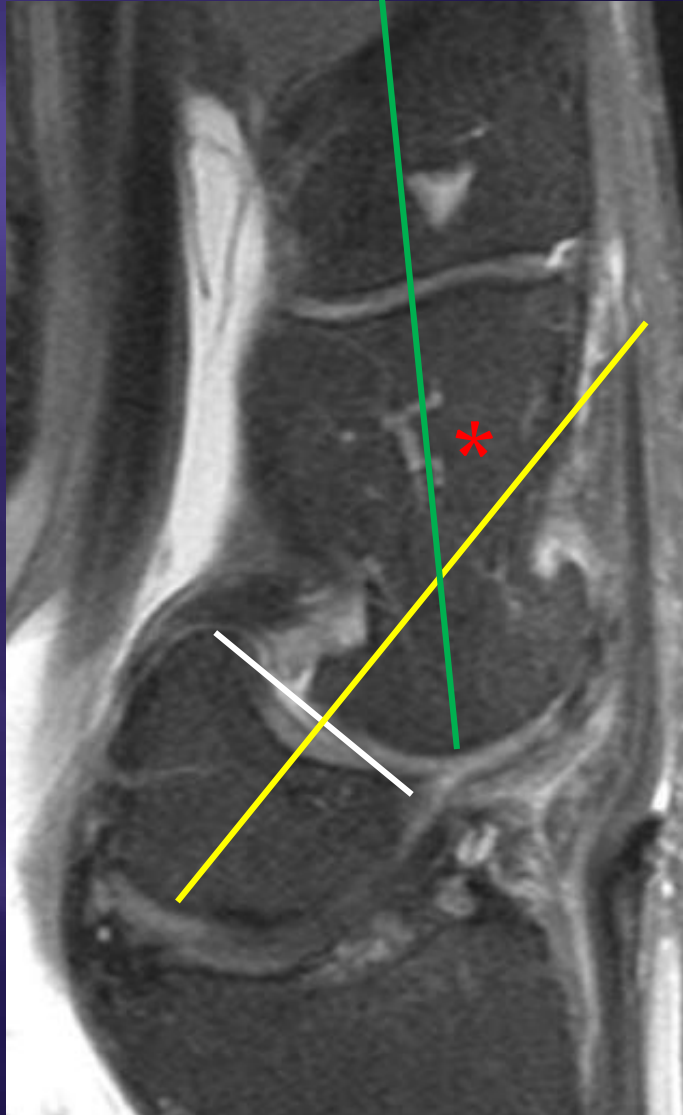


- ▣ DISI= dorsal intercalated segmental instability
- ▣ VISI= Volar
- ▣ SL tear → DISI
  - Scaphoid palmar flex and L-T dorsiflex
- ▣ LT tear → VISI
  - Scaphoid-lunate palmar flex and T dorsiflex

|        | Scapholunate angle     | Capitolunate angle |
|--------|------------------------|--------------------|
| Normal | 30-60                  | 0-30 (20)          |
| DISI   | >60 (60-80 borderline) | >30                |
| VISI   | <30                    | >30                |



DISI = Dorsal intercalated segment instability  
 VISI = Volar intercalated segment instability



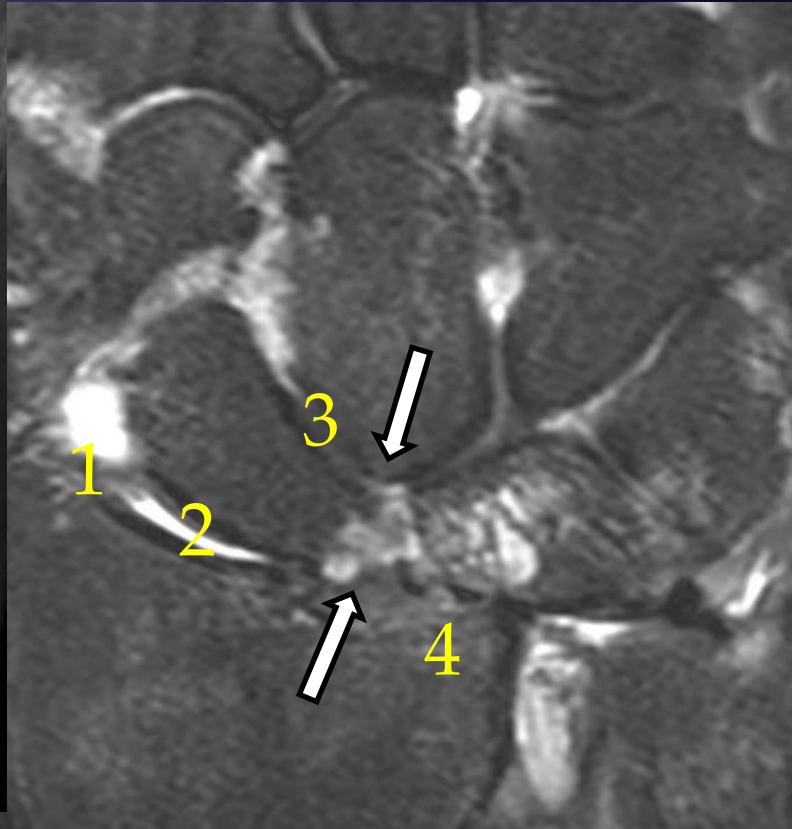
Capitulate angle

0-30 (20)

>30

DISI deformity

# SLAC



SL ligament tear

SLAC

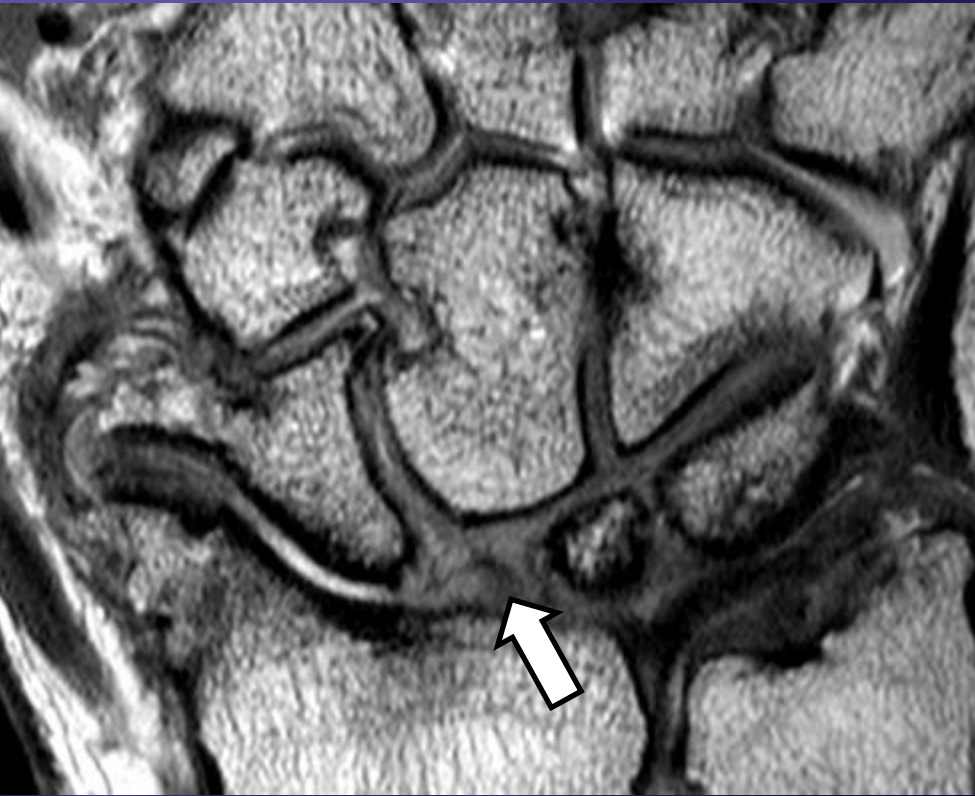
1: radial styloid and distal scaphoid

2: whole RSJ

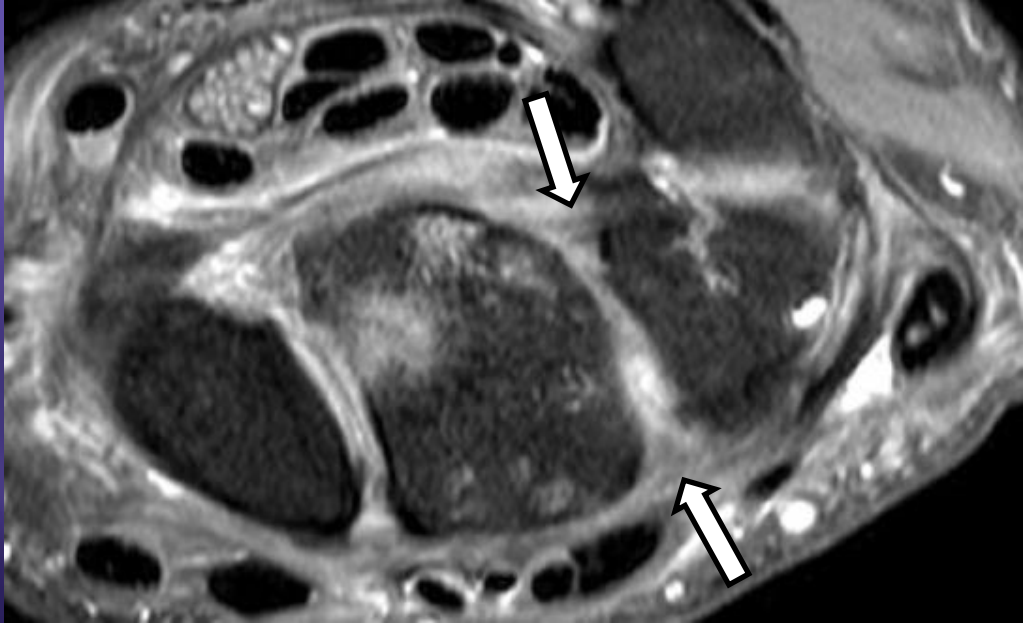
3: Proximal migration of scaphoid and scaphoid-capitate articulation

4: radiolunate articulation

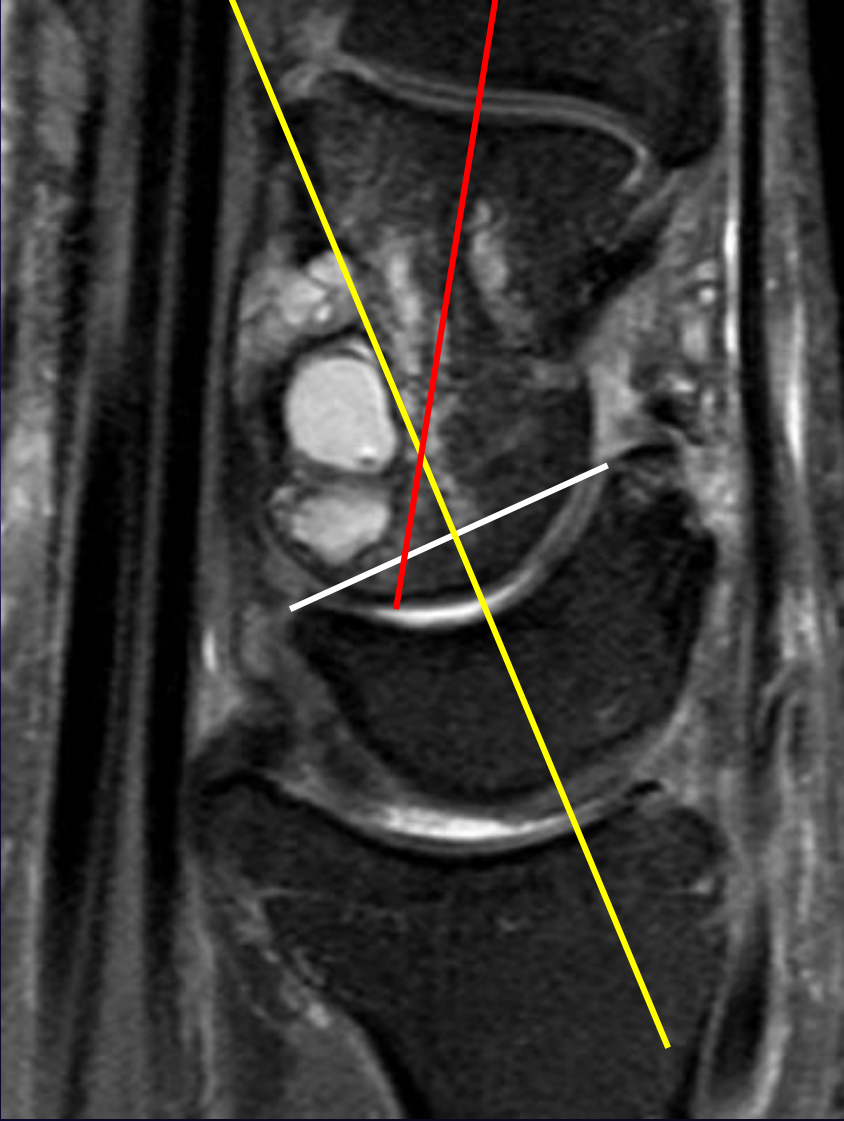
SLAC 4



LT tear



VISI

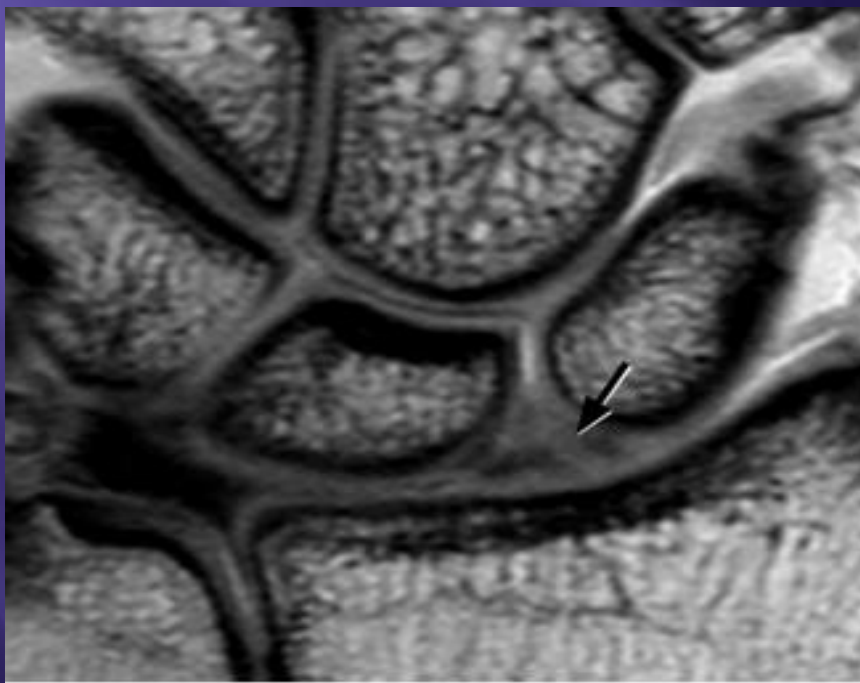


## MRI Pitfall in SL/LT tear

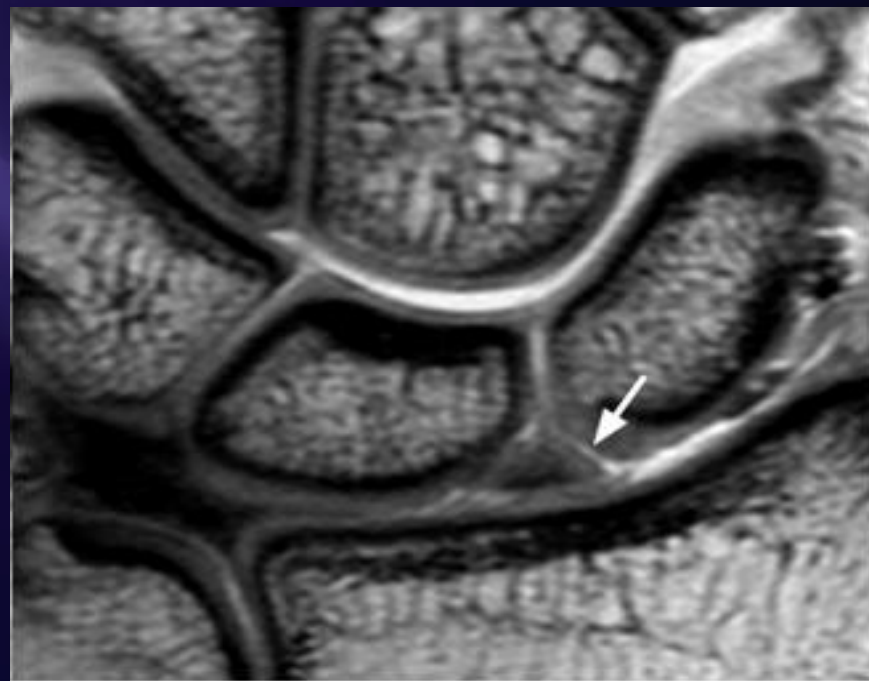
- ▣ MR arthrogram: Most accurate test
- ▣ Communicating tear and non-communicating tear



# MRI Pitfall in SL/LT tear



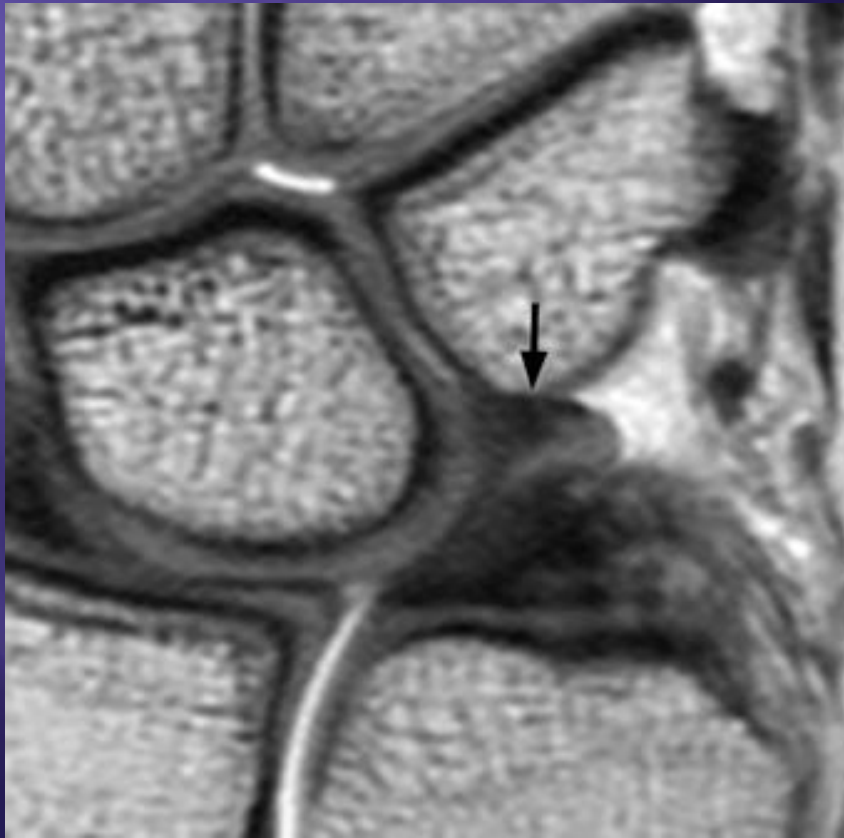
Partial tear



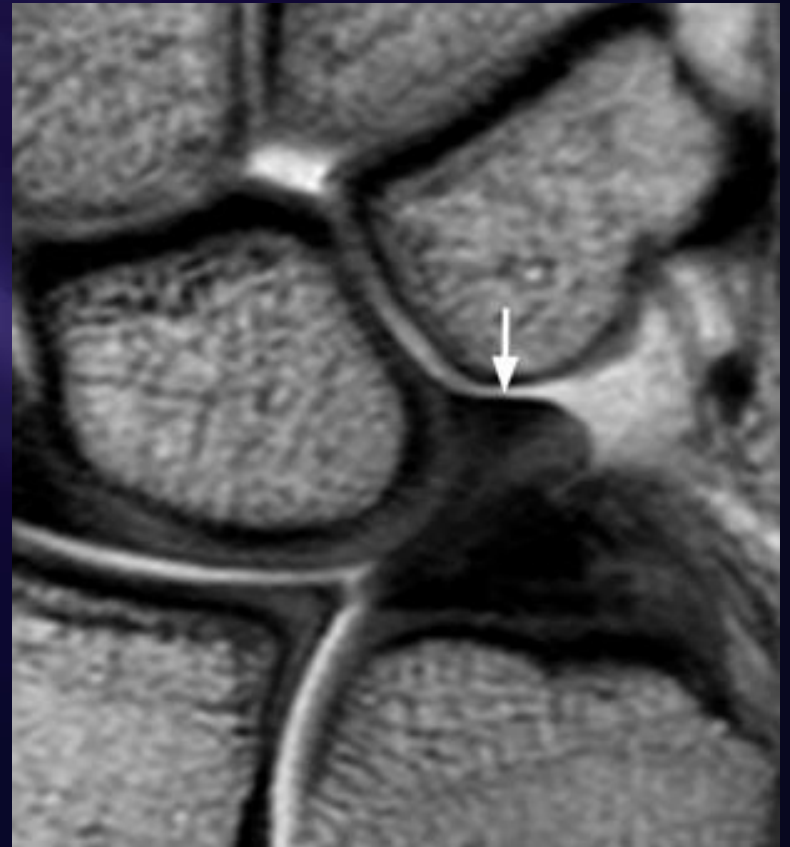
Full thickness tear/communicating tear

**Post-Traction**





Intact

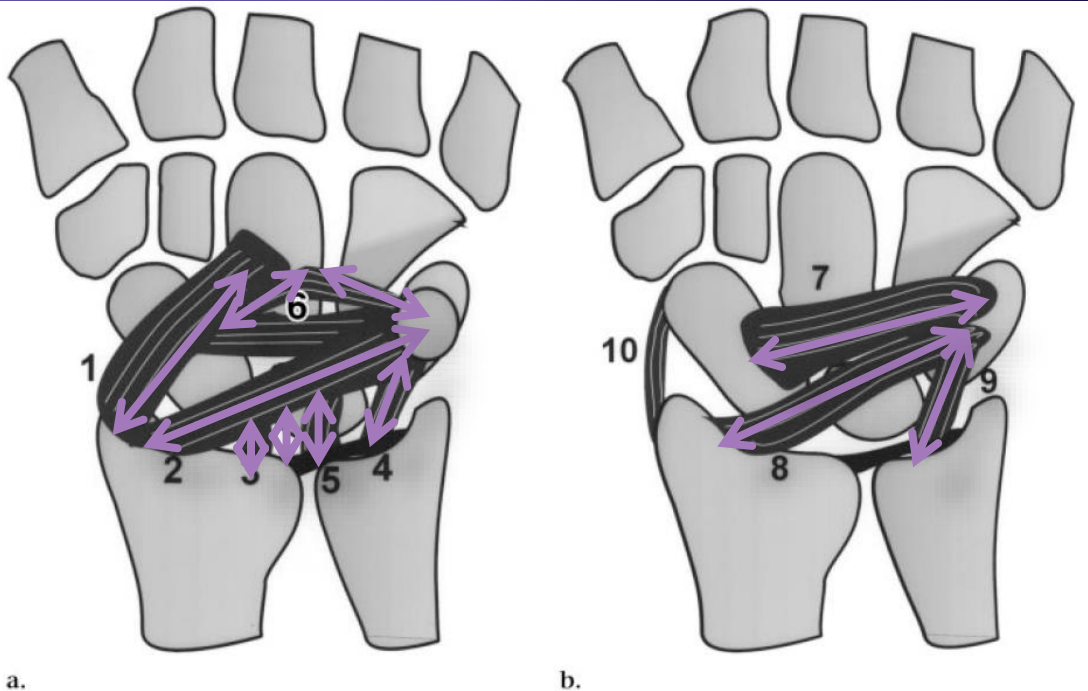


Tear

Post-Traction

# OTHER LIGAMENTS

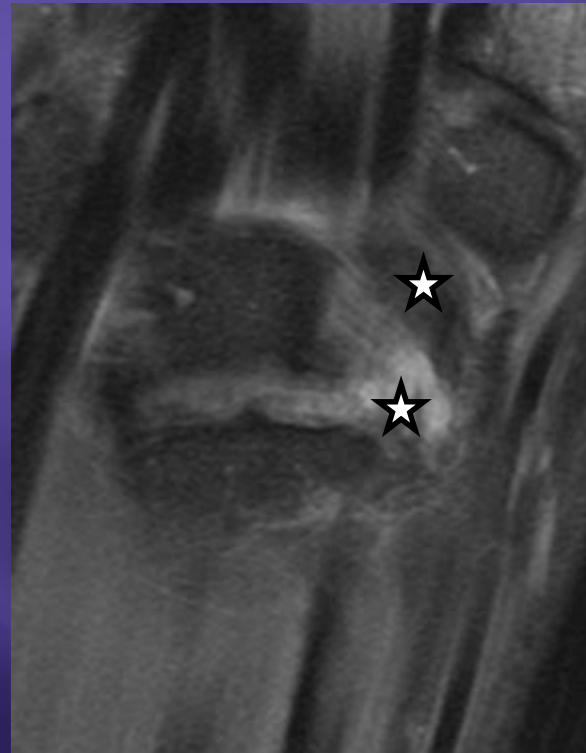
## Anatomy



**Figure 1.** (a) Schematic shows the palmar carpal ligaments (frontal view). 1 = radioscaphocapitate (RSC) ligament, 2 = radiolunotriquetral (RLT) (long radiolunate) ligament, 3 = radioscapholunate ligament, 4 = palmar ulnotriquetral ligament, 5 = ulnolunate ligament, 6 = proximal and distal bands of the palmar scaphotriquetral ligament. The thick black line along the distal surface of the ulna represents the palmar radioulnar ligament. (b) Schematic shows the dorsal carpal ligaments (frontal view). 7 = dorsal scaphotriquetral ligament, 8 = dorsal radiotriquetral ligament, 9 = dorsal ulnotriquetral ligament, 10 = radial collateral ligament. Thick black line represents the dorsal radioulnar ligament.

- ▣ **RSC, RLT**
- ▣ *RSL (not a true ligament; Ligament of Testut)*
- ▣ *Short radiolunate (not much concern)*
- ▣ **UT, UL**
- ▣ **Arcuate/deltoid/V ligament:**
  - Ulnar arm: THC (triquetral-hamate-capitate)
  - Radial arm: SC (scaphoid-capitate)
  - joining the proximal and distal carpal rows
- ▣ **dRCL, DIC, dUTL**

# MRI Anatomy



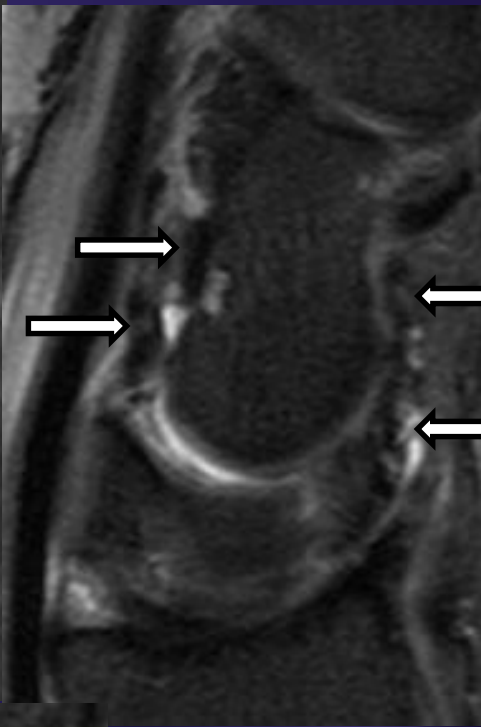
volar



volar



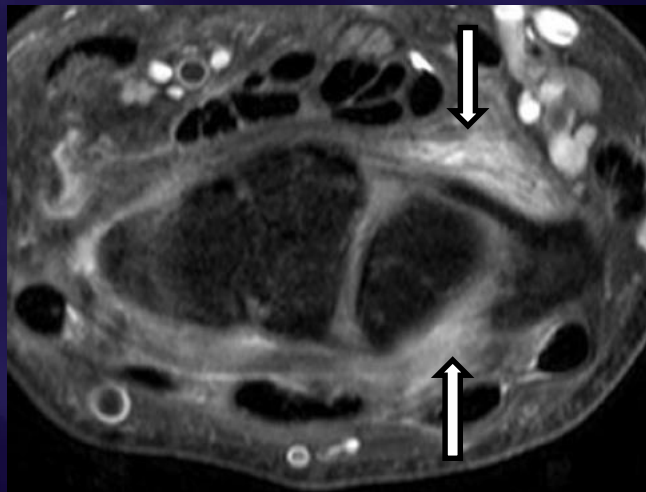
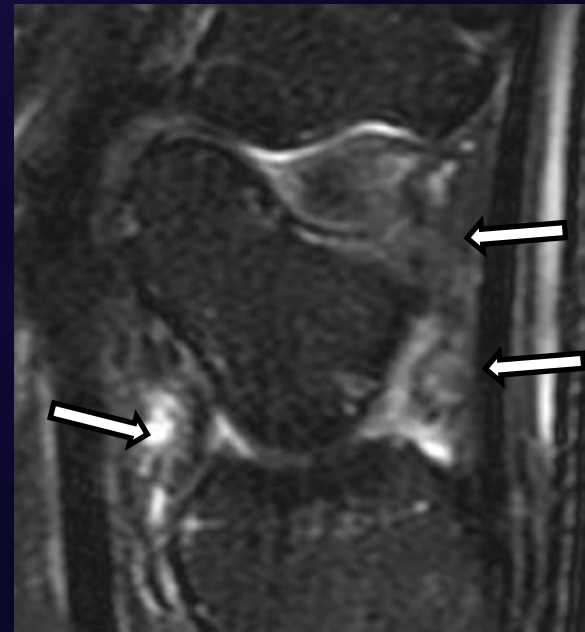
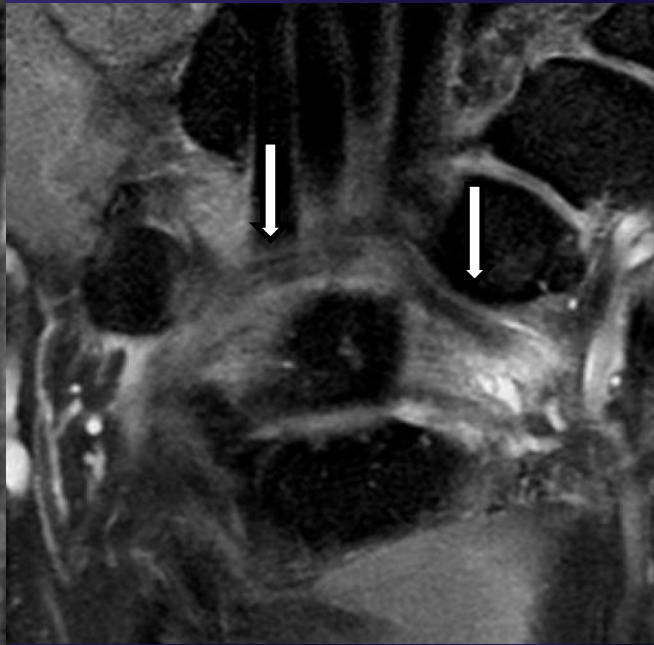
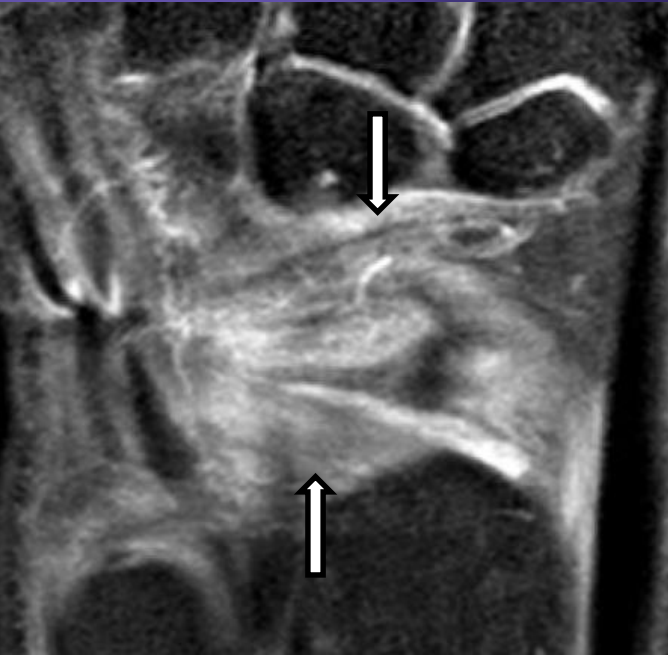
dorsal



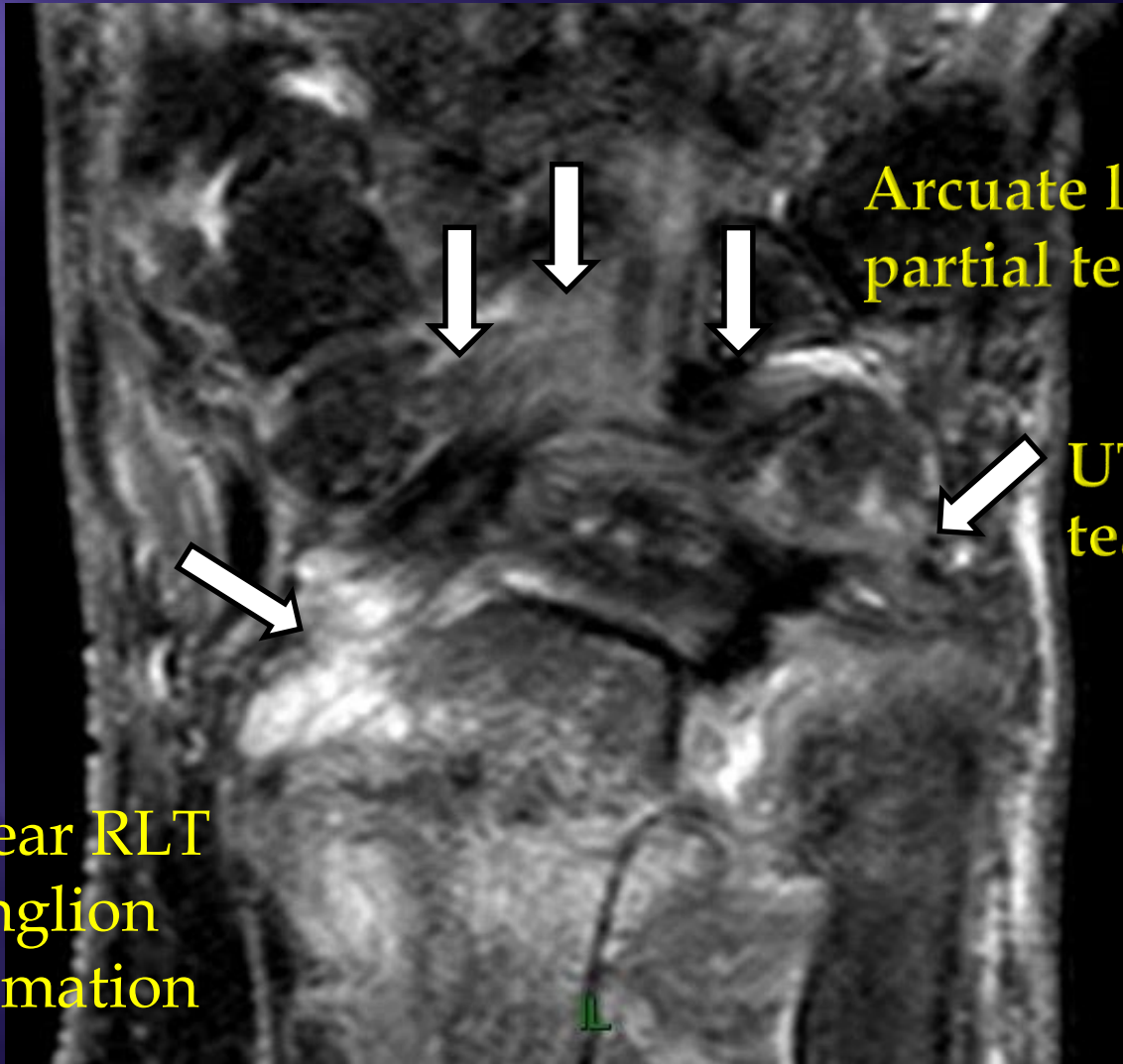
- ▣ Maintain the carpal stability (simplified version)
  - Radiocarpal: mainly **RSC, RLT**
  - Midcarpal : Tear/insufficiency of **Arcuate ligament**
    - ▣ SC ligament and THC ligament (radial arm and ulnar arm)
  - SL, LT instability: **SL/LT ligaments**
  - (DRUJ): **TFCC**

# Abnormalities related to carpal ligament injuries

| <b>Abnormalities</b> | <b>GRADE</b> | <b>BEST TO DESCRIBE</b>  |
|----------------------|--------------|--|
| Acute sprain         | Grade 1      | Periligamentous edema  |
| Partial tear         | Grade 2      | <ul style="list-style-type: none"><li>• Partial tears</li><li>• Weakening with thickening due to periligamentous and intraligamentous edema (sprain??)</li></ul> |
| Complete tear        | Grade 3      | Complete disruptions   |
|                      |              | <i>Traction related avulsive cystic change at site of osseous attachment</i>   |
|                      |              | <i>soft tissue ganglia from capsular injuries or ligament degeneration</i>   |



Carpal ligament partial tear with ganglion cyst

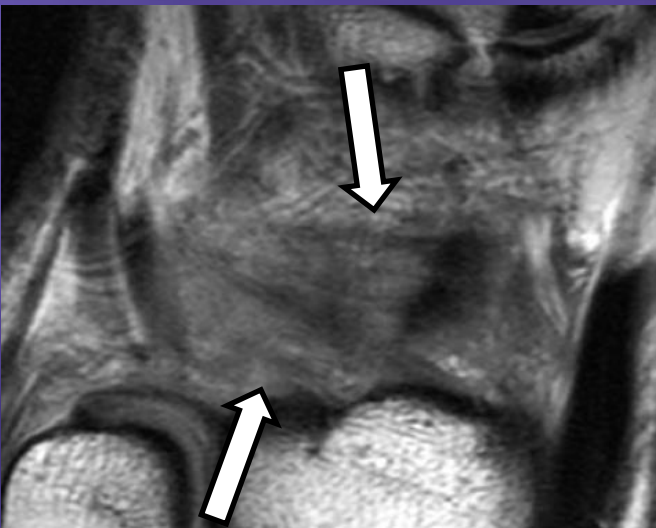


Arcuate ligament  
partial tear

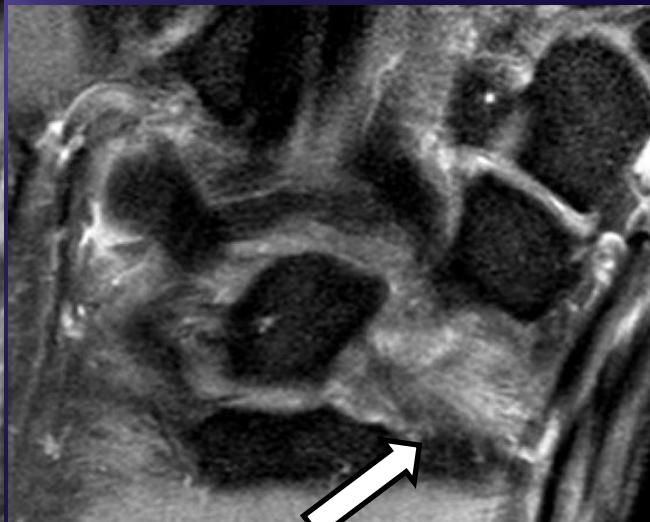
UTL partial  
tear

Partial tear RLT  
with ganglion  
cysts formation

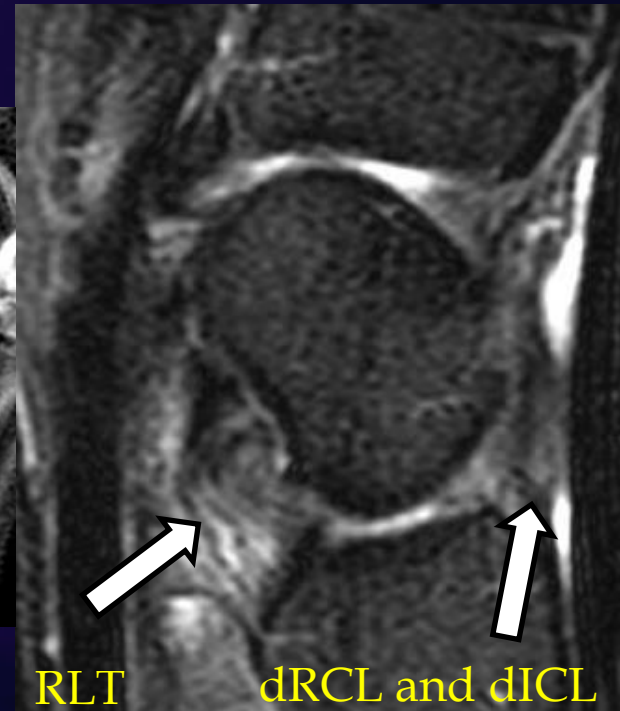




dRCL and dICL



RLT



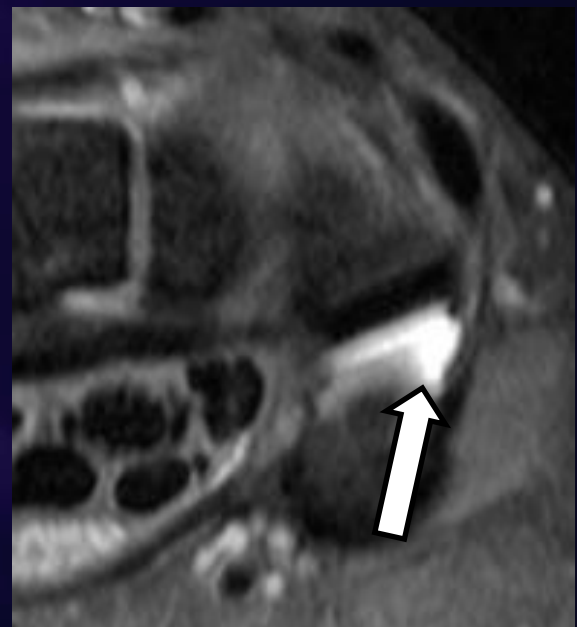
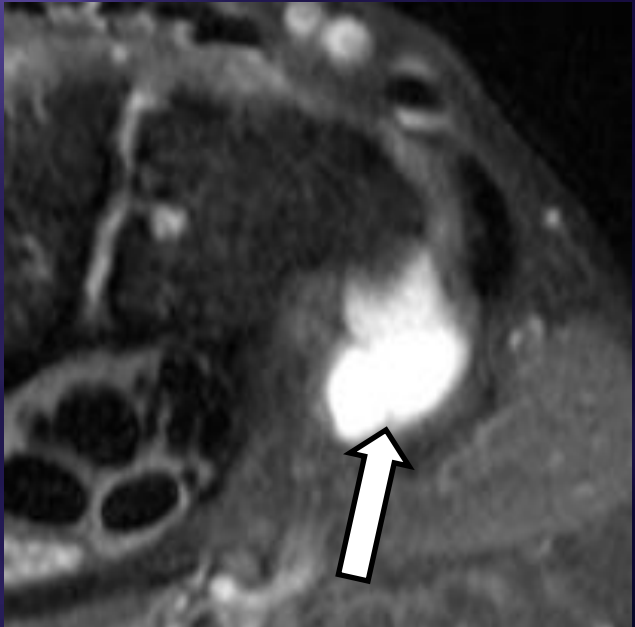
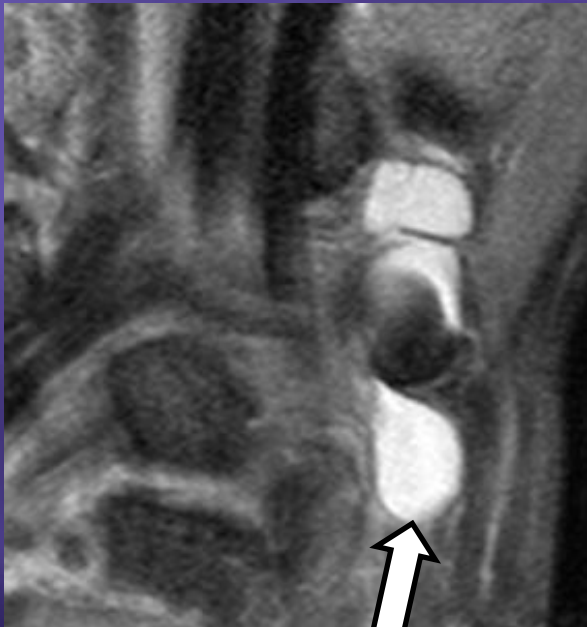
RLT

dRCL and dICL

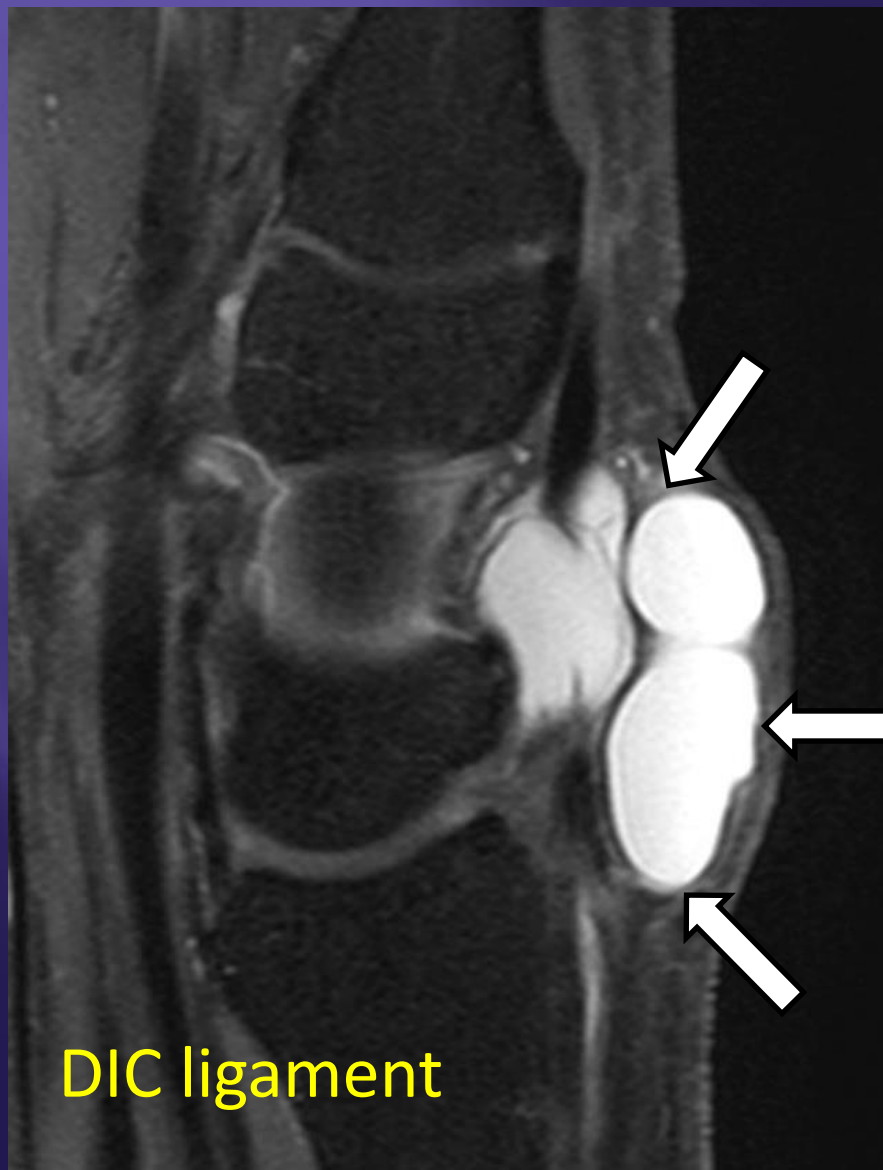
# Ganglion cyst



- Unilocular or multilocular
- Inhomogeneity -mucin
- Narrow stalk/pedicle- joint e.g. PTJ, STT, SL interval- prevent recurrent cyst
- Tendon sheath communication
- Compression on neurovascular bundle



# Carpal ligament tear with ganglion cyst



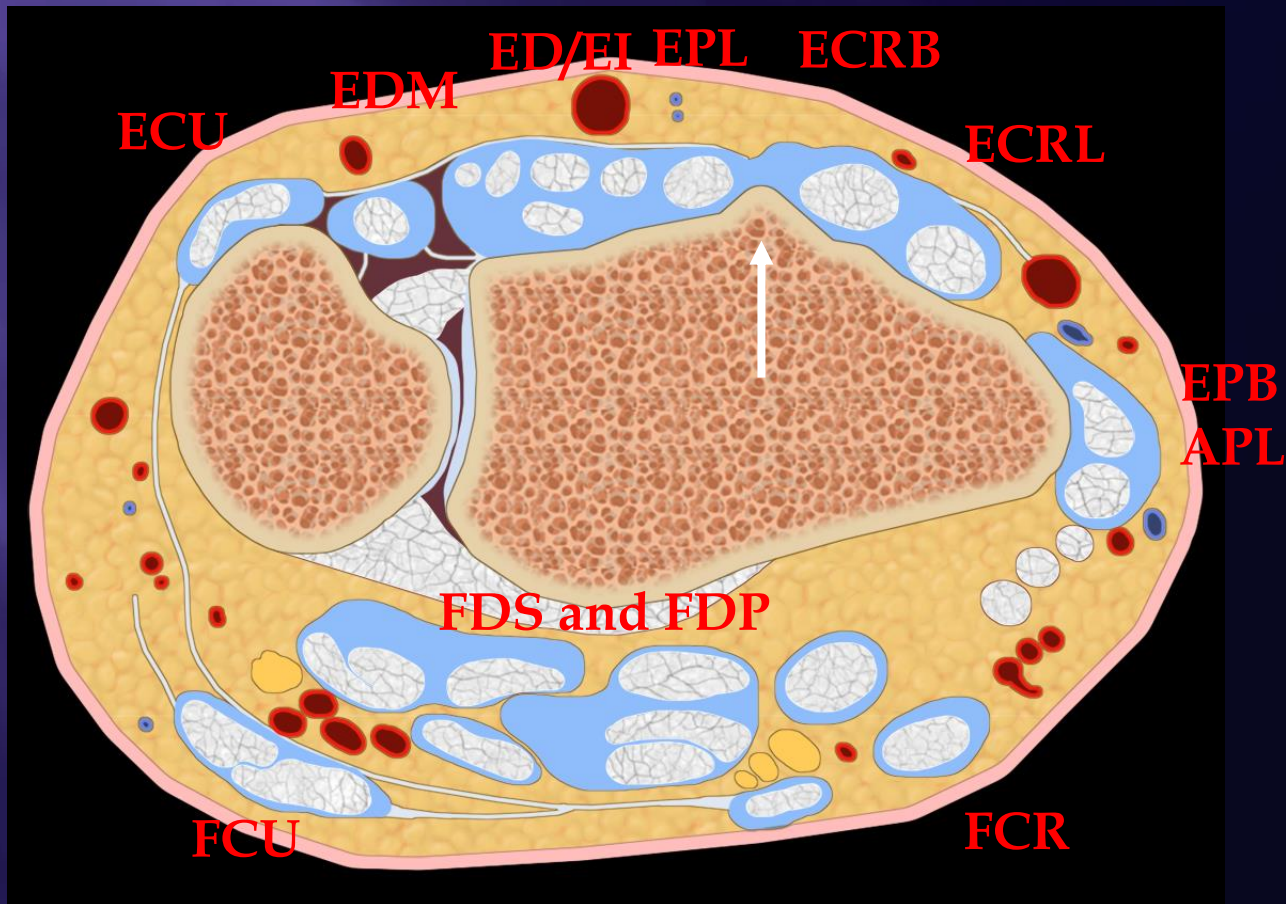
DIC ligament

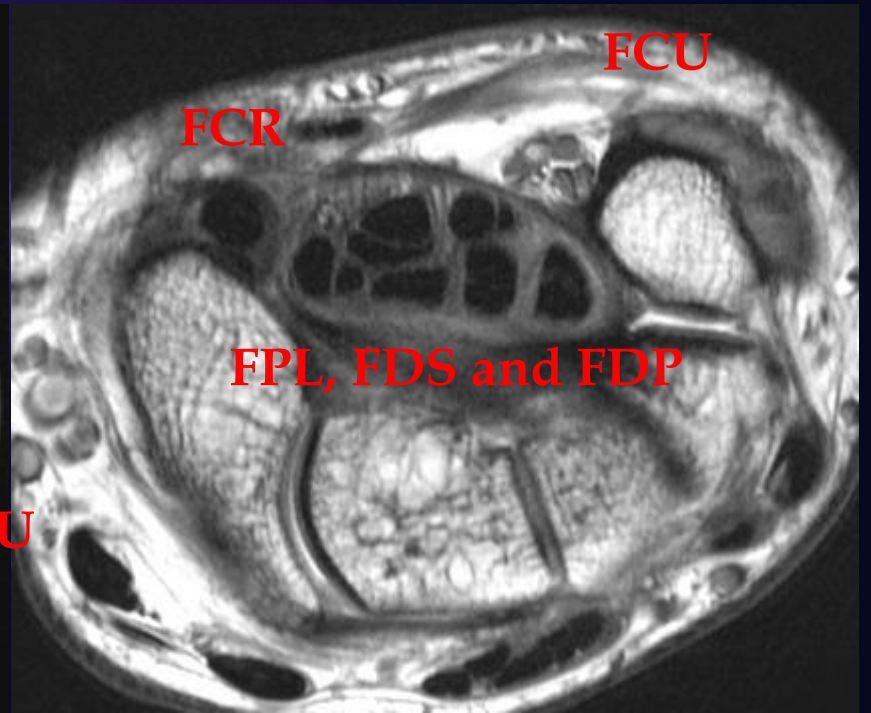
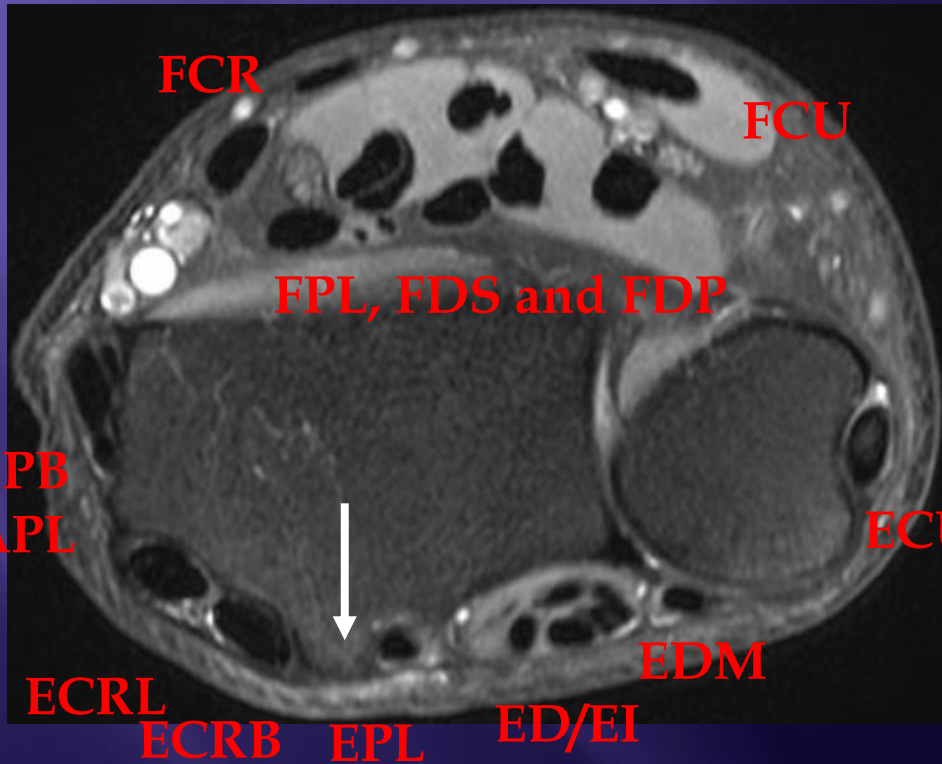


RLT ligament

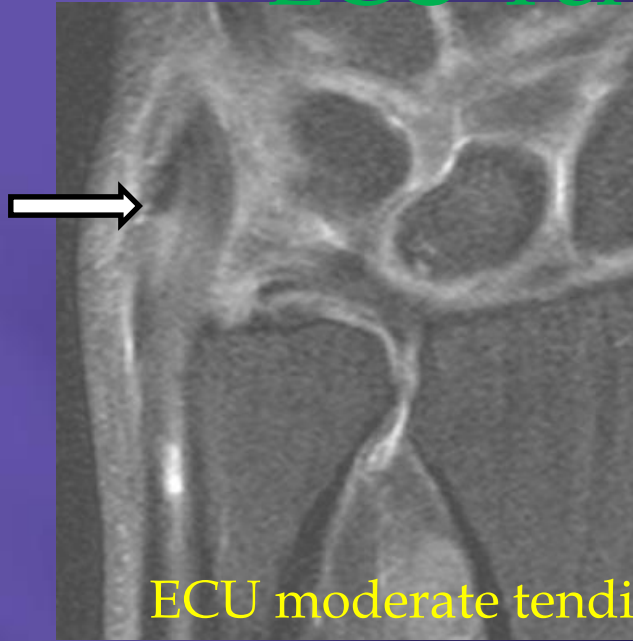
# TENDON

## Anatomy

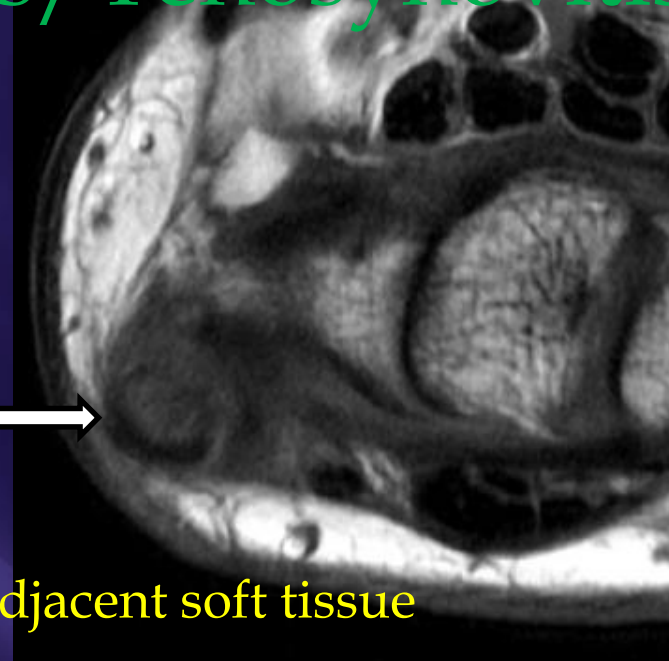




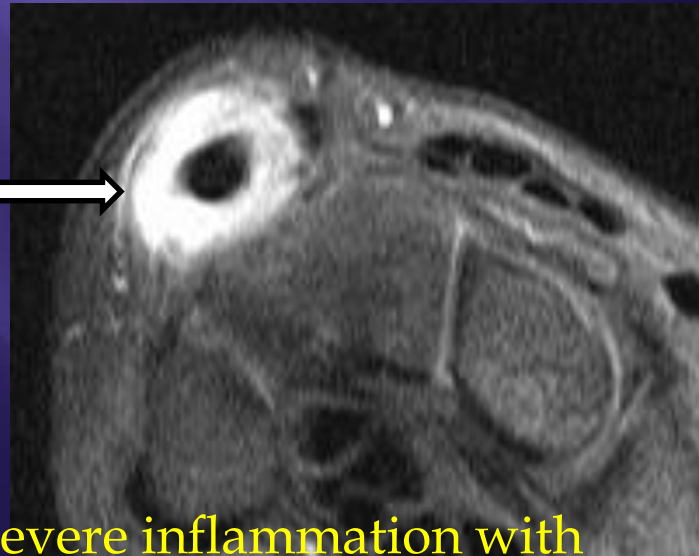
# ECU Tendinosis/Tenosynovitis



ECU moderate tendinosis with adjacent soft tissue inflammation

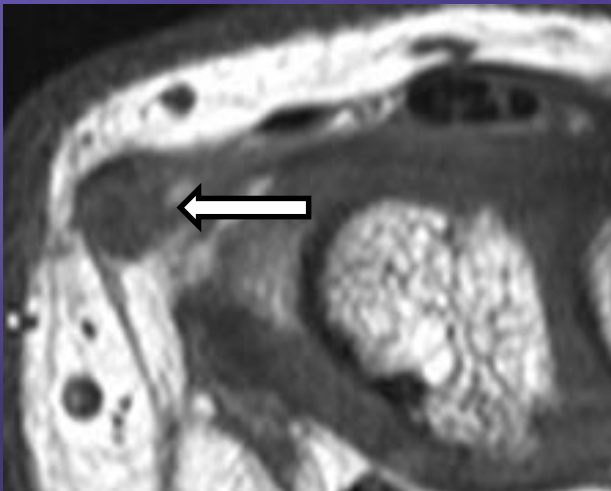


ECU mild tenosynovitis  
Tendon signal within normal limit

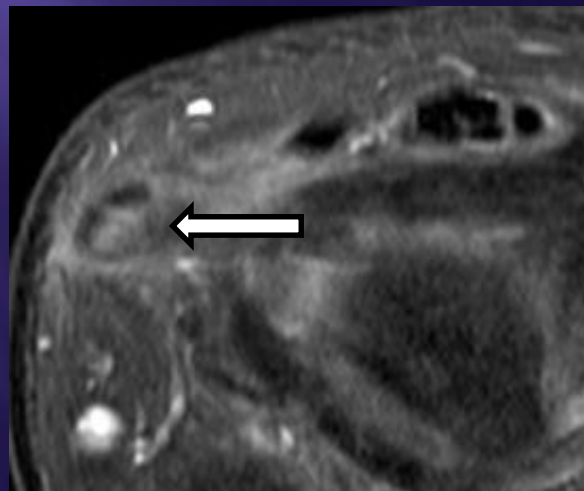


Severe inflammation with enhancement

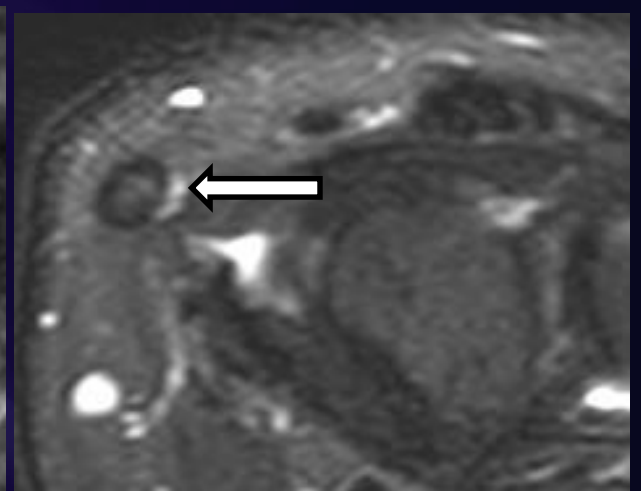
## Normal ECU appearance



Axial T1W



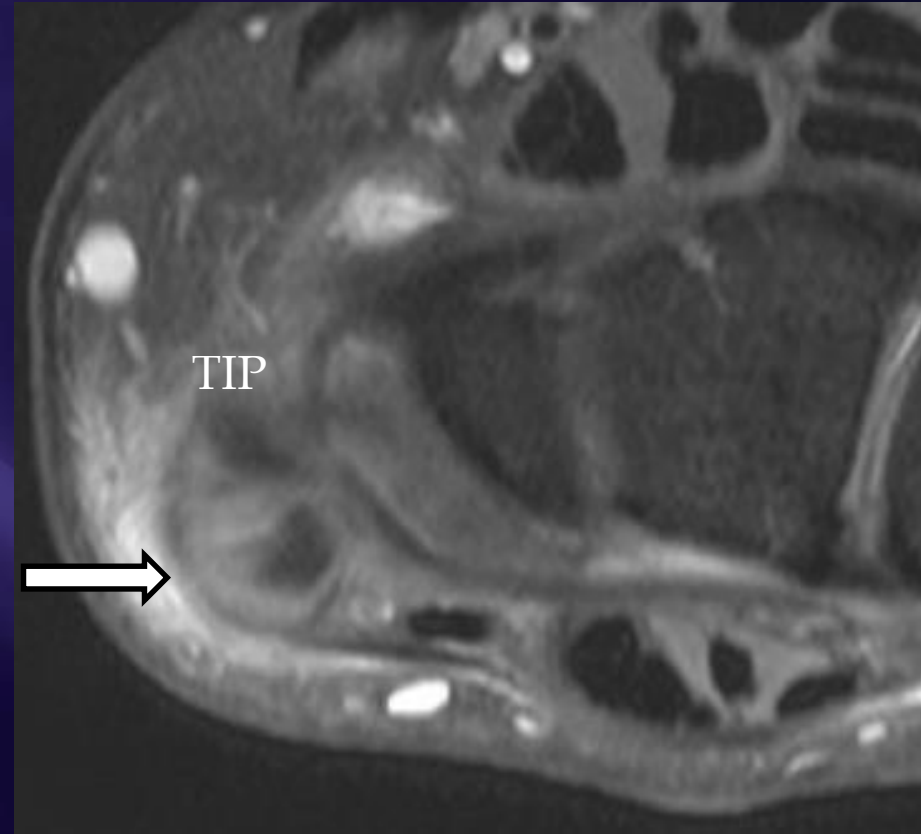
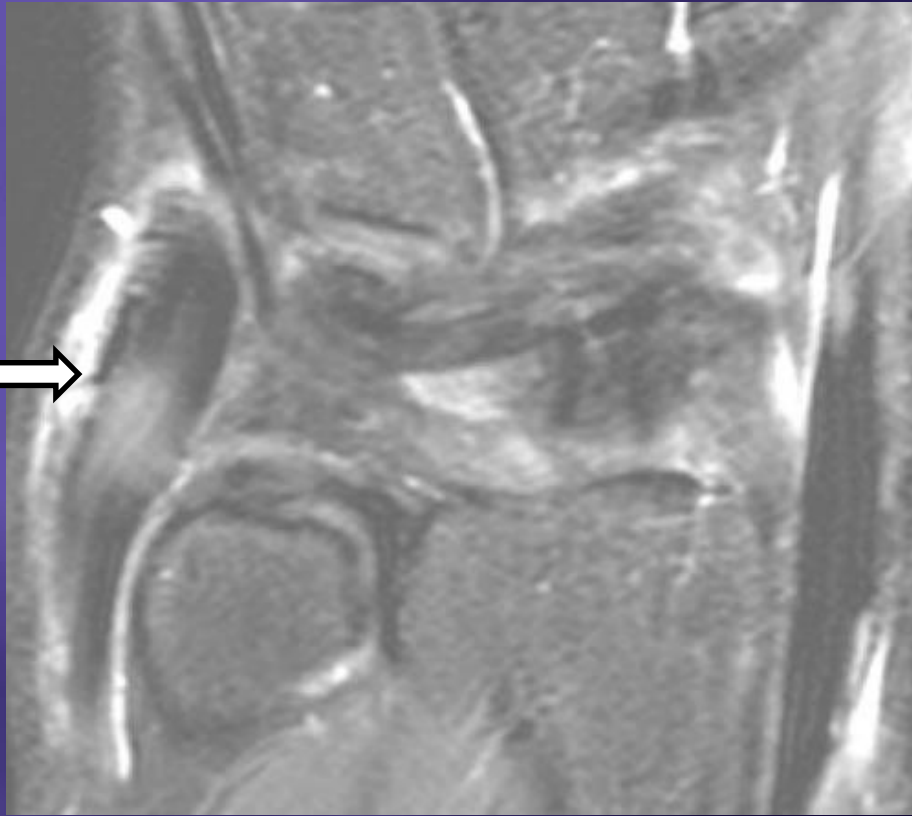
Axial PD FS



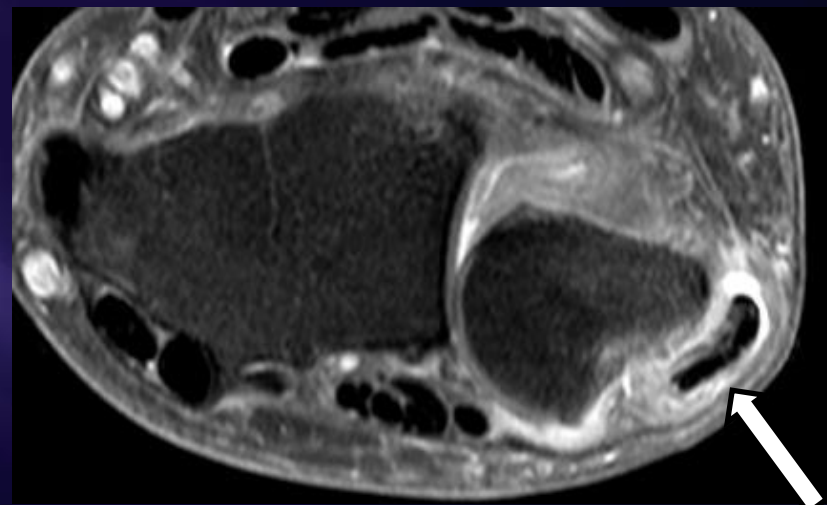
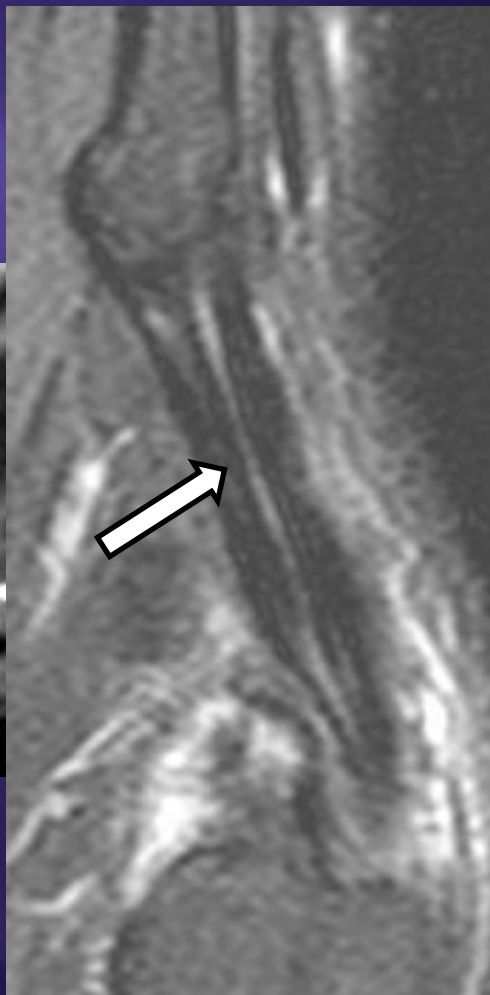
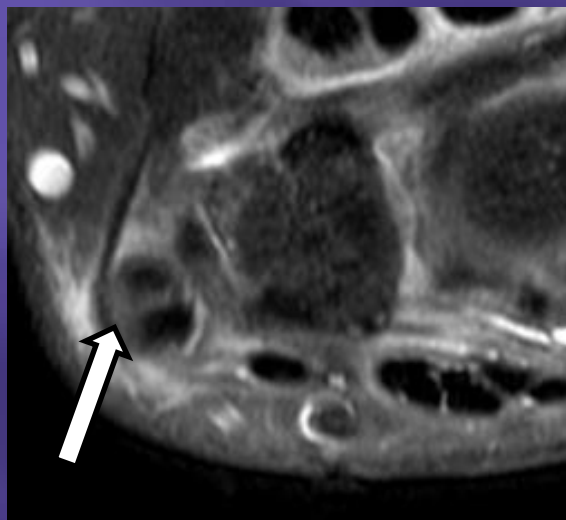
Axial T2W FS

Magic angle phenomenon



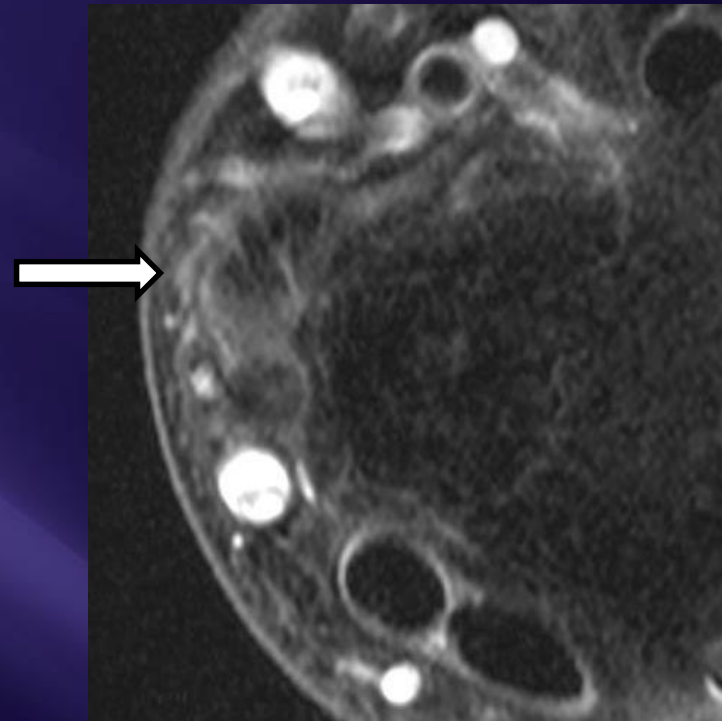
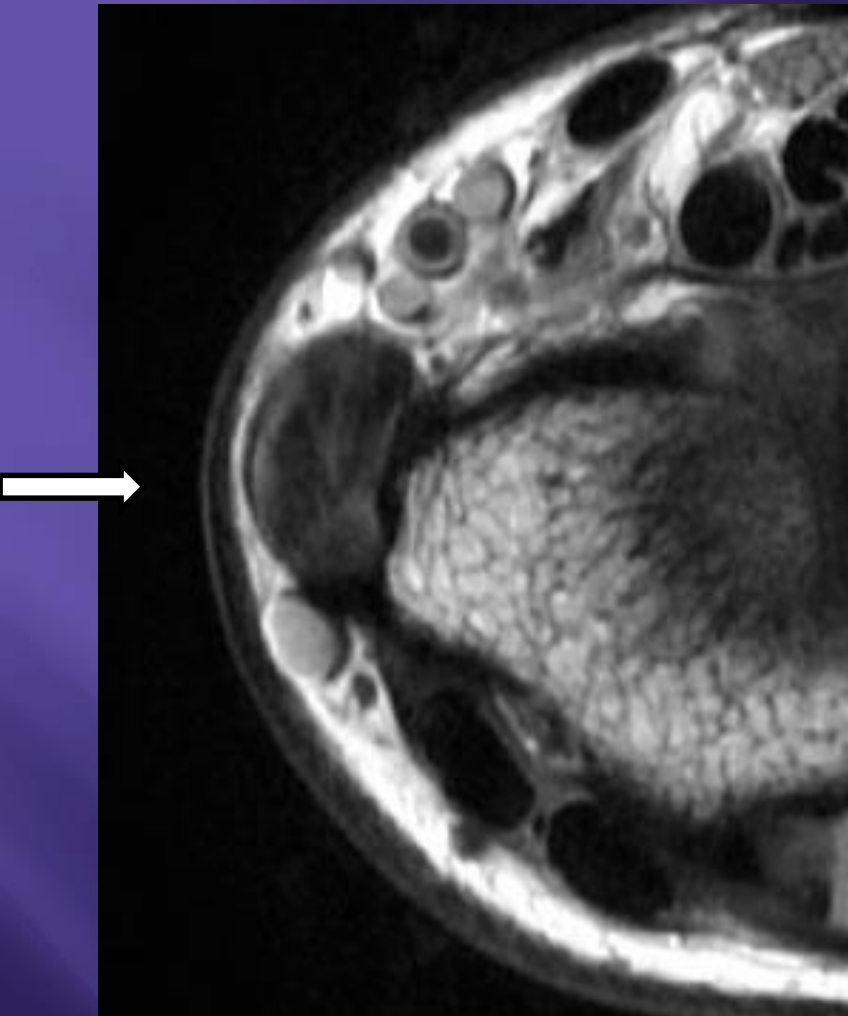


ECU severe tendinosis paratendinous soft tissue inflammation



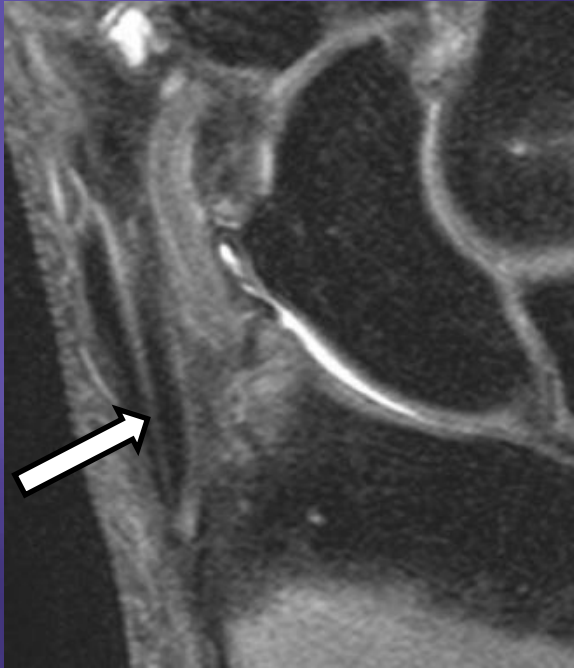
Moderate tendinosis with longitudinal split tear

Dorsal subluxation of the DRUJ  
Subluxation of the ECU

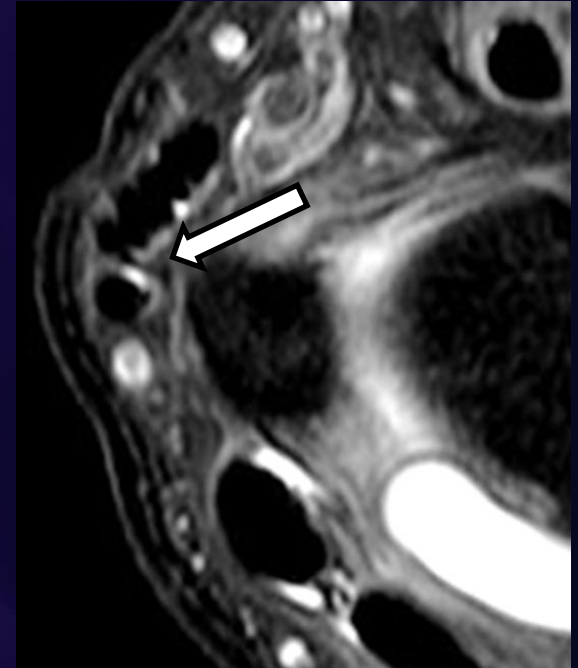
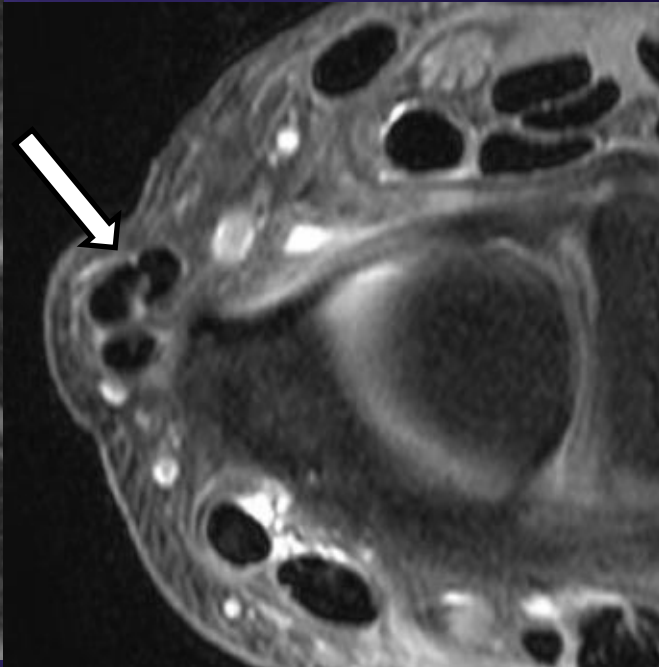


De Quervain's syndrome  
(stenosing tenosynovitis)

- Severe tendon thickening
- Severe extensor retinaculum thickening
- Mild peri/paratendinous inflammation
- Split tears

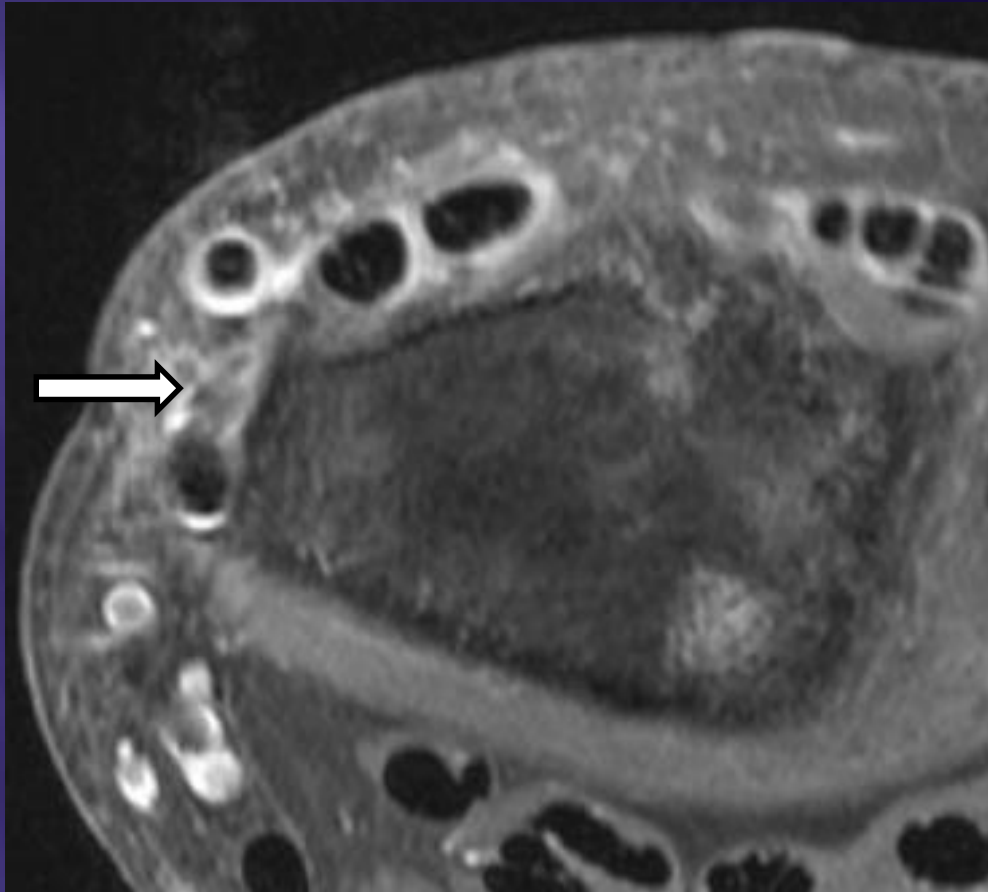


*APL normal two slips  
at the radial styloid*



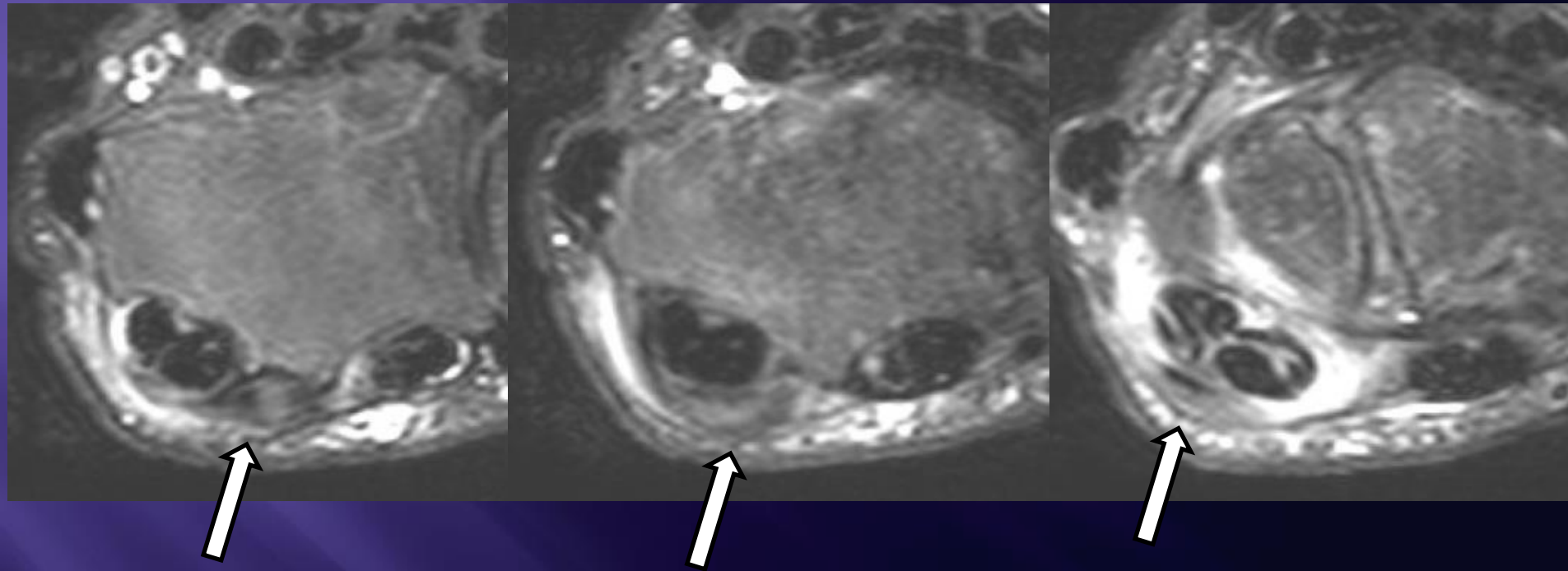
*APL and EPB septum  
→ compartmentalization*

## **Anatomical variation**

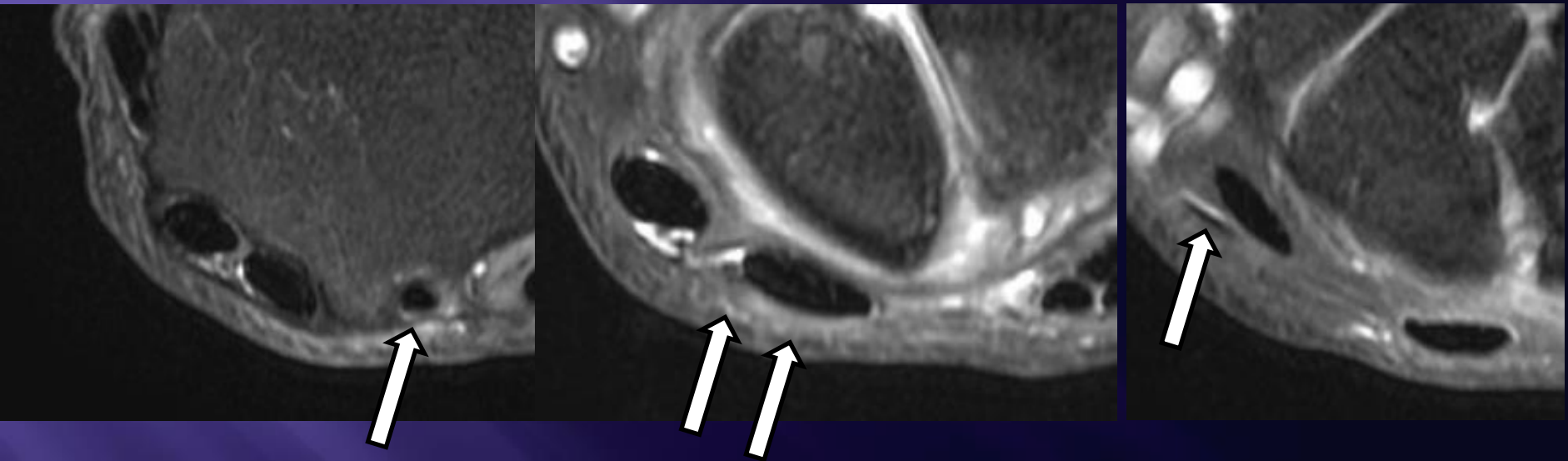


EPB partial tear

# Distal intersection/decussation syndrome



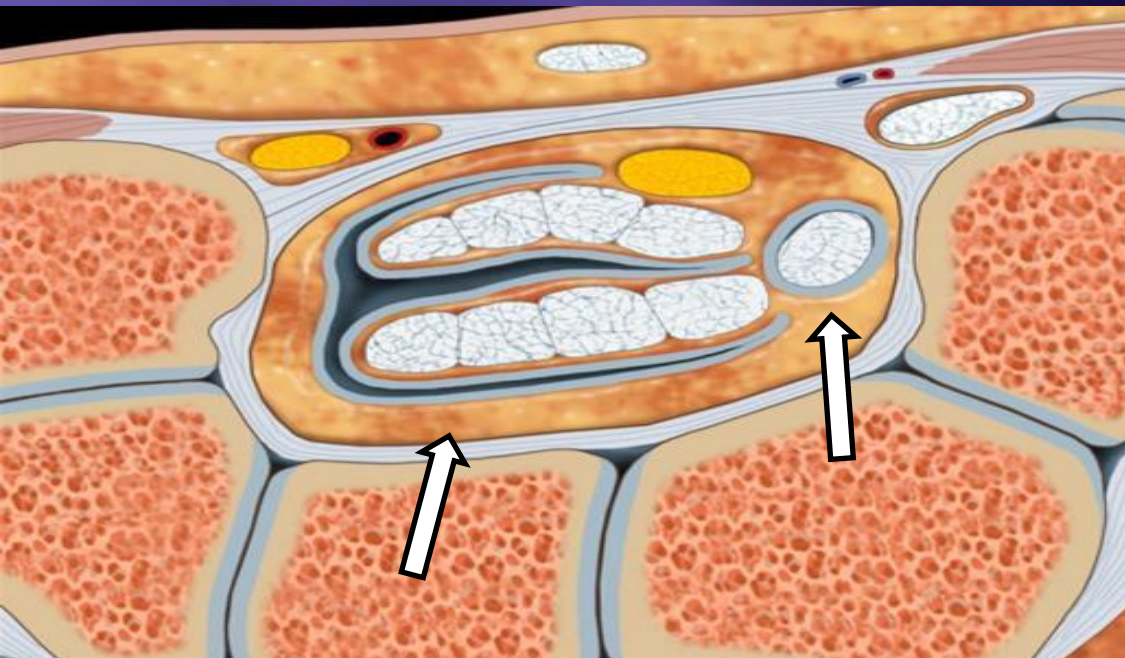
- Compartment 3 crossing the compartment 2 at the wrist level
- Tendinosis- swelling and hyperintense T2W signal
- Paratendinous soft tissue oedema
- Tendon sheath effusion



Normal EPL appearance: magic angle phenomenon

# Flexor compartment tendons

## Radial and ulnar bursa anatomy



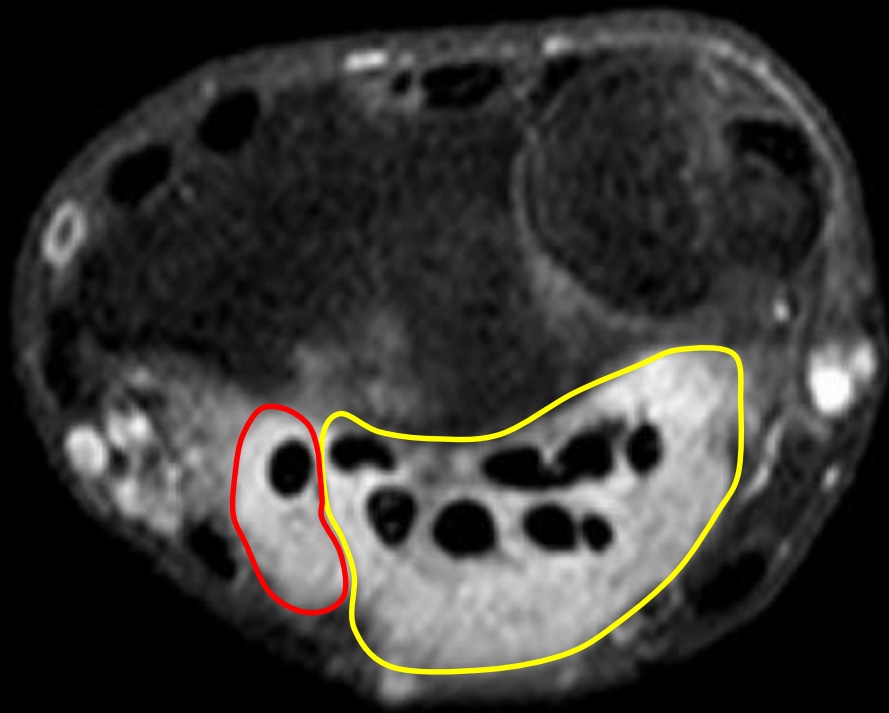
Ulnar bursa

Radial bursa



Communication of flexor tendon sheaths



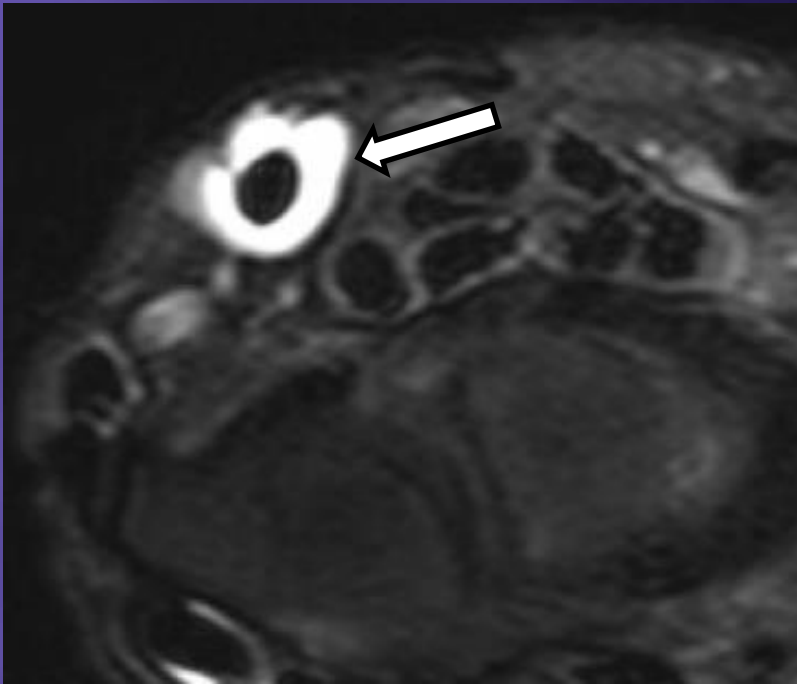


Radial bursa

Ulnar bursa



Tenosynovitis- TB

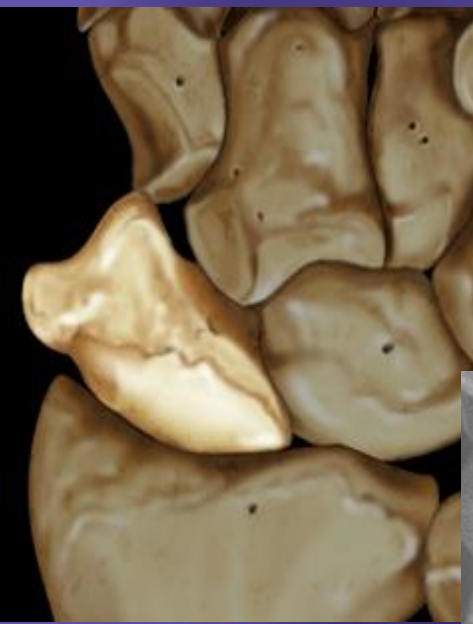


- ▣ **FCR: stenosing tenosynovitis**
  - Focal loculated fluid collection in the tendon sheath
  - Due to chronic friction with the carpal bone
  
- ▣ **Other causes of tenosynovitis:**
  - Inflammatory joint disease
  - Metabolic deposits: gout, pseudogout

# BONE

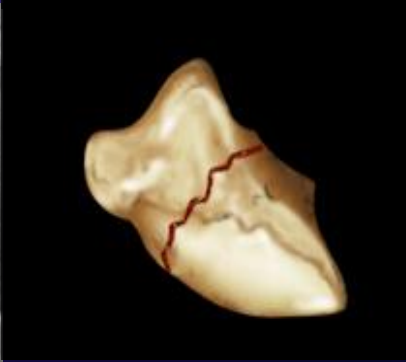
# Scaphoid

## Anatomy and fracture classification

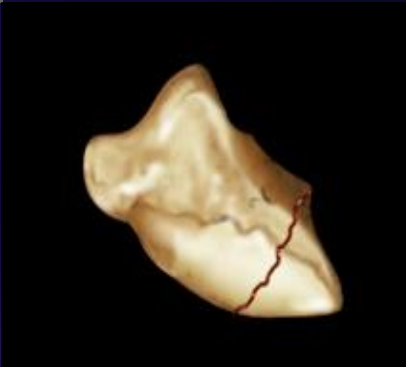


Tuberosity: volar prominence

Distal pole or 1/3=10%



Middle 1/3 (waist)=80%

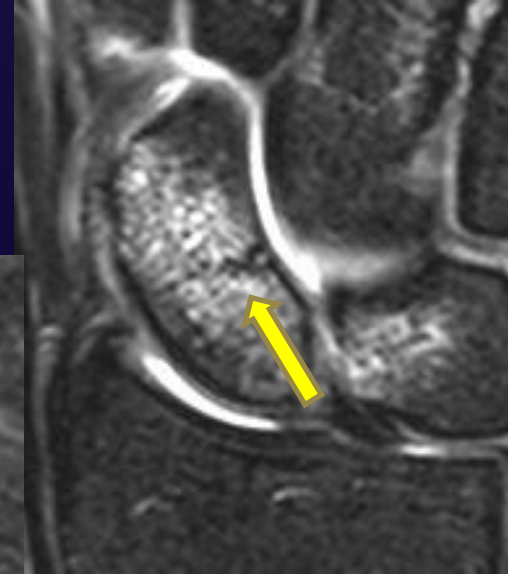


Proximal pole or 1/3=10%

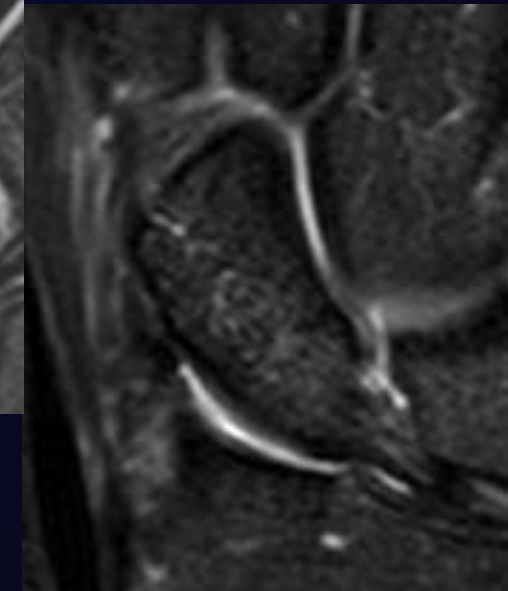
# Occult fracture (10-20%)



Same day



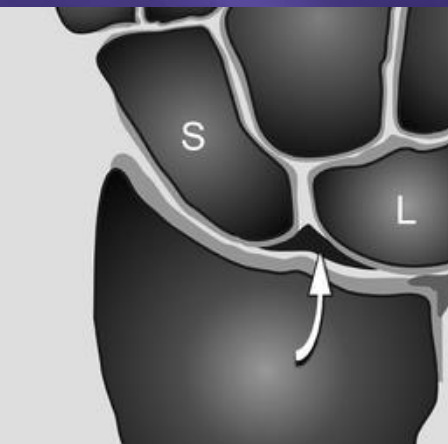
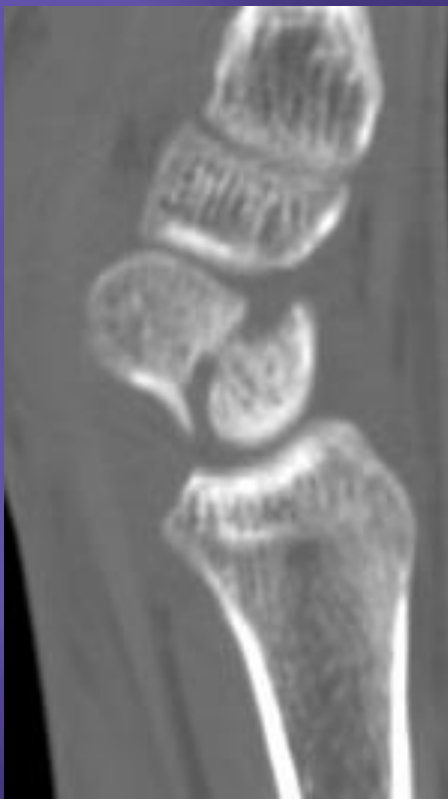
1 month



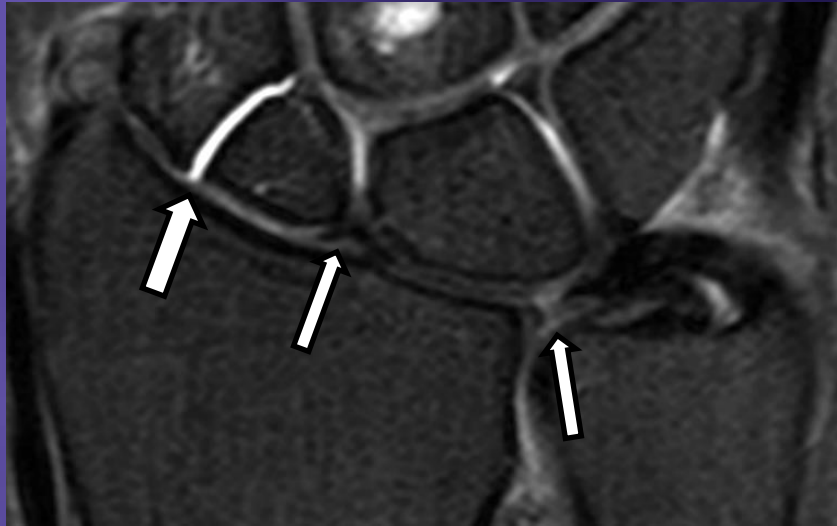
6month

Colleague suspicious of scaphoid bone pain after injury

# Associated injury

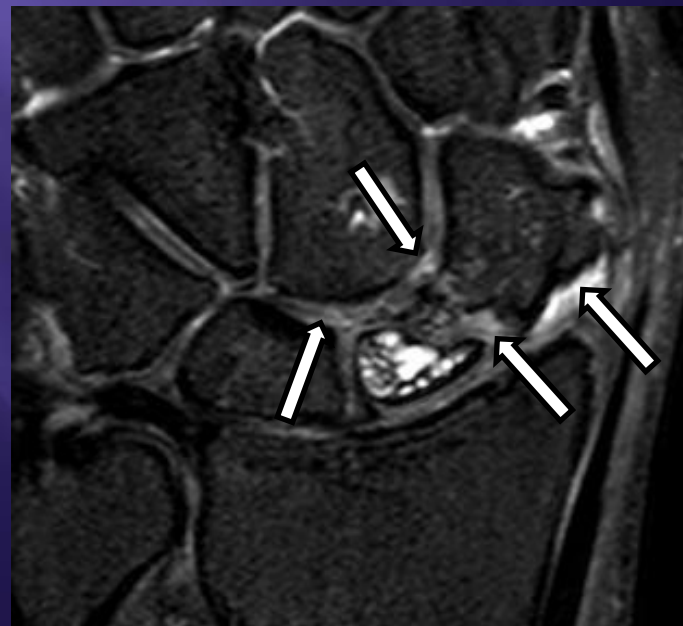


# Scaphoid nonunion and SNAC



Scaphoid non-union (10%)

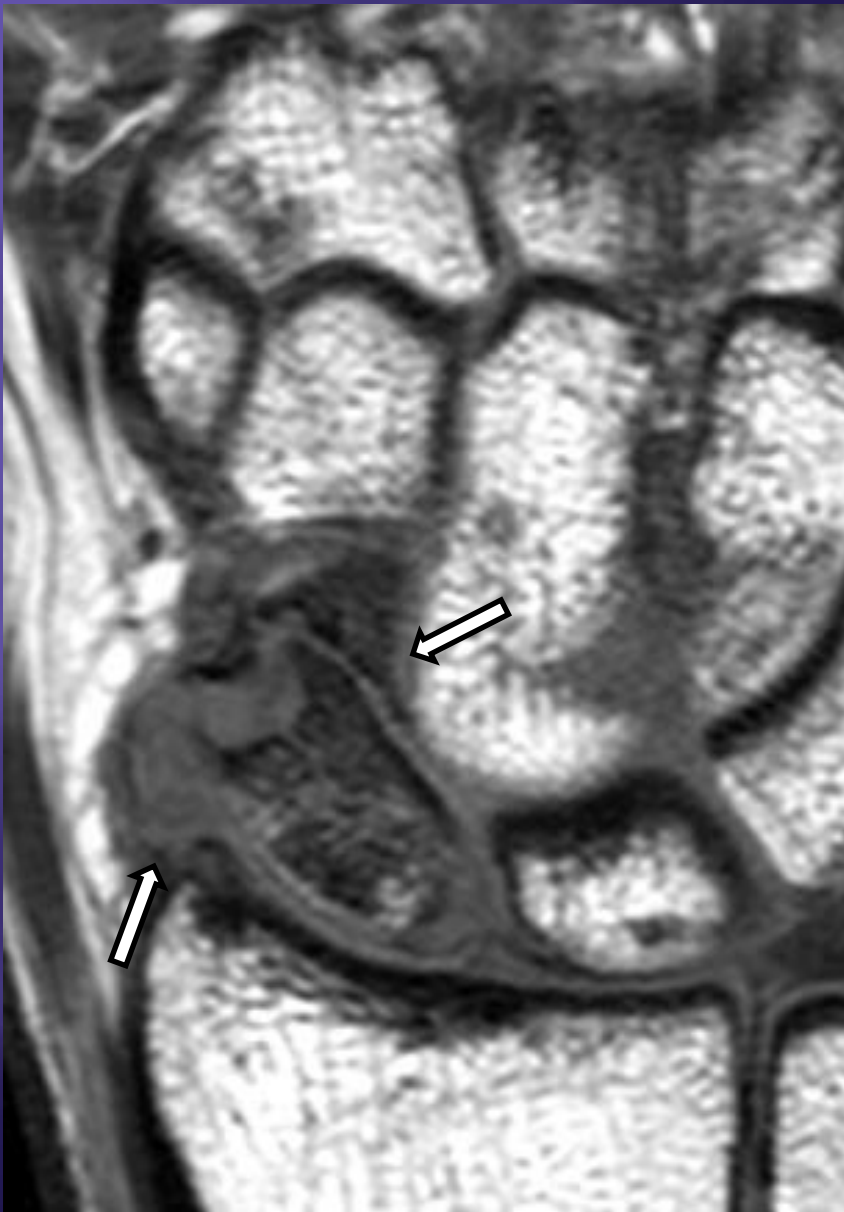
## SNAC



SNAC stages:

- 1: OA between distal pole of scaphoid and radial styloid process
- 2: scaphoid and capitate
- 3: Lunate and capitate

## SNAC III



SNAC II/III



# AVN

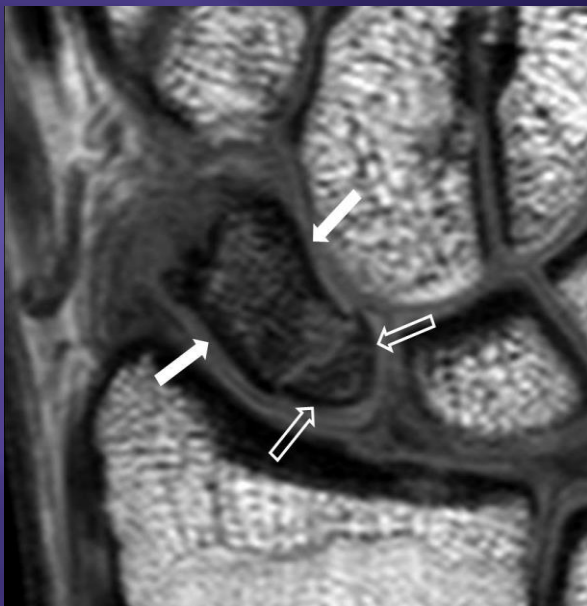


Sclerosis of proximal pole (Marrow signal is replaced by low T1W and T2W signal) → Highly suspicious of AVN

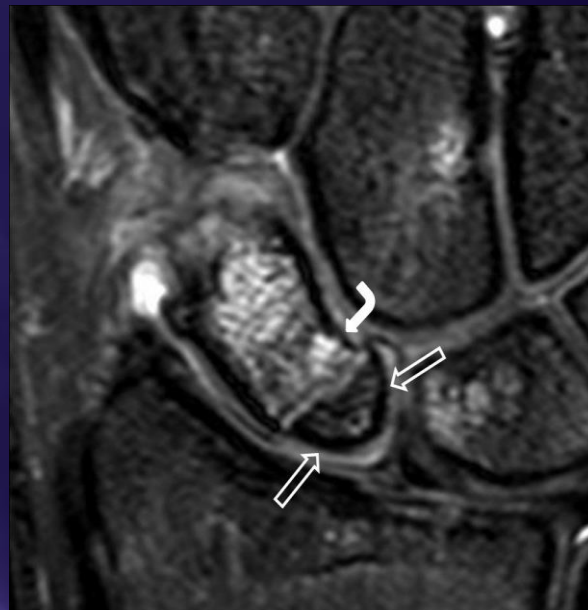


Proximal pole collapse, fragmentation and resorption  
→ compatible with AVN

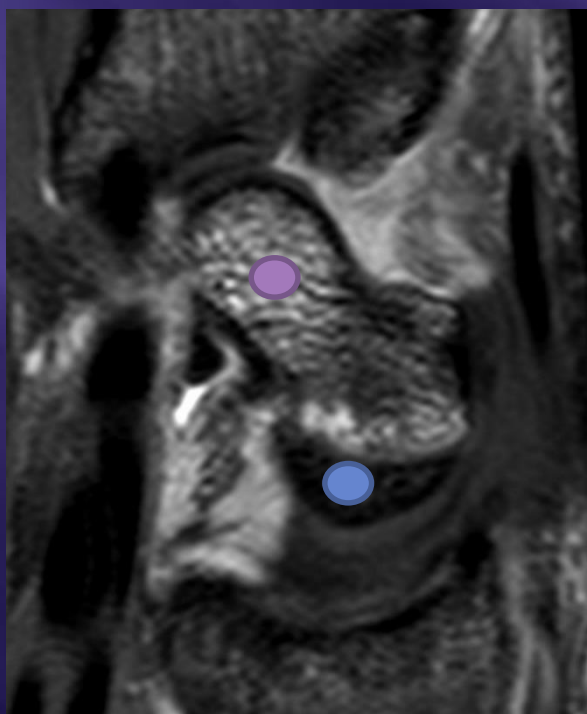
T1W:  
homogeneous  
low signal in  
the proximal  
and distal  
fragments  
without  
collapse.



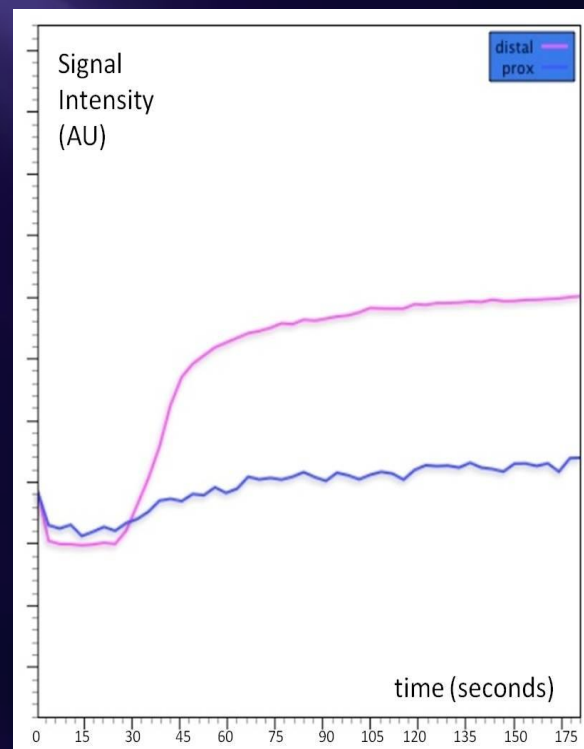
T2W FS:  
homogeneous  
low signal in  
the proximal  
fragment →  
Poor  
vascularity



T1W FS+Gd:  
No contrast  
enhancement  
→ poor  
vascularity.

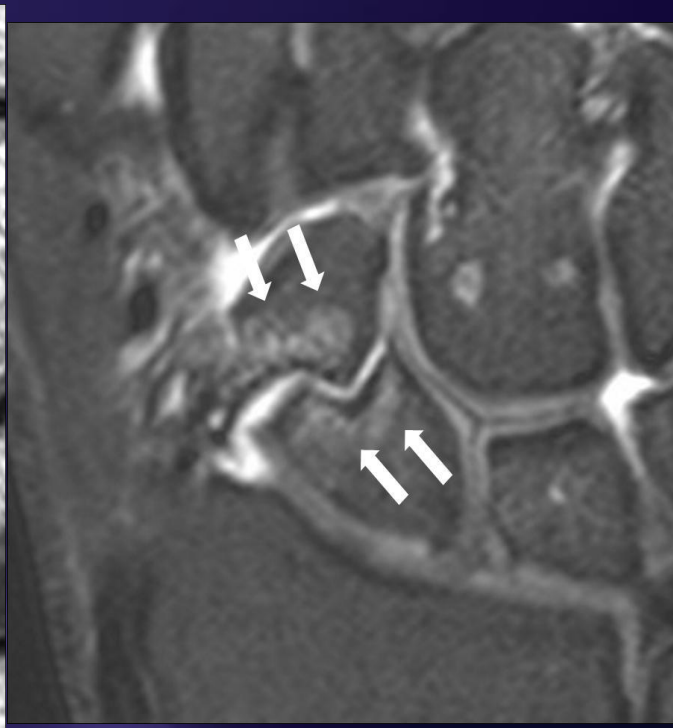
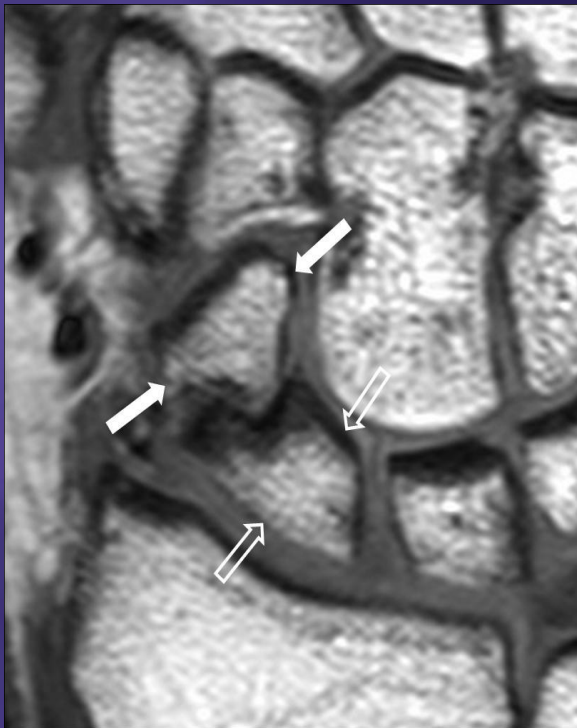


DCE :flat  
perfusion  
curve → poor  
vascularity



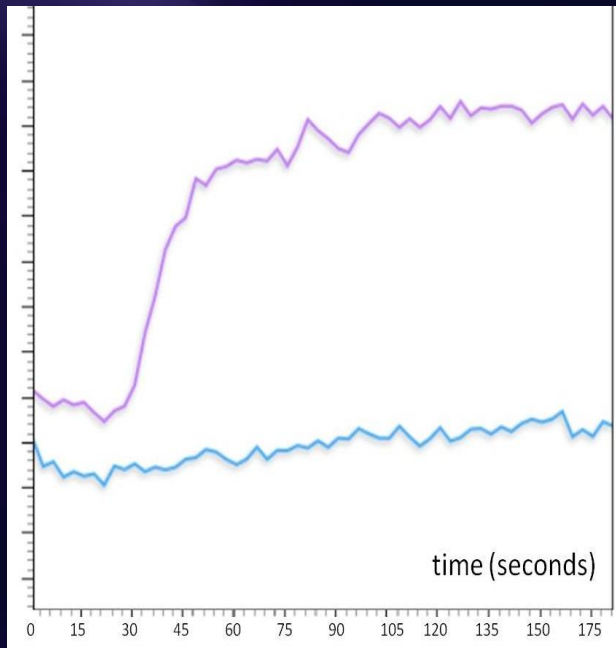
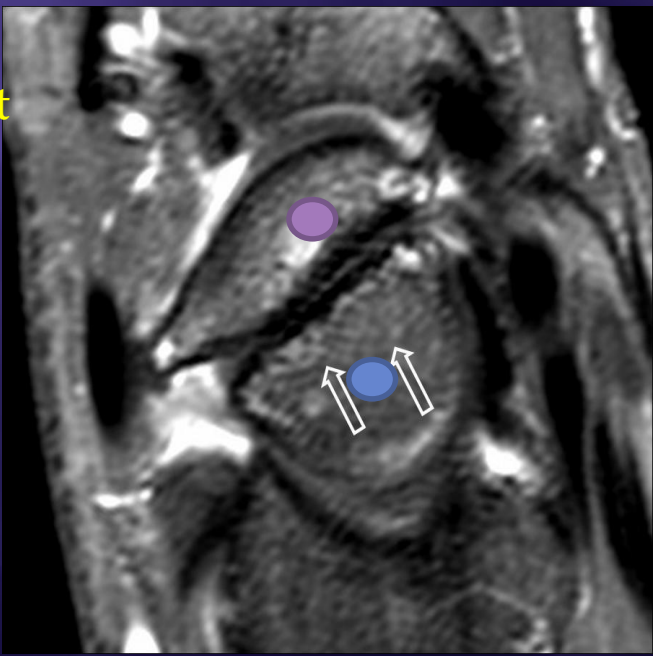
Surgery confirmed

T1W:  
Preserved  
normal bone  
marrow fat  
signal → good  
vascularity



T2W FS:  
Mild  
increased  
signal  
intensity  
adjacent to  
the fracture  
site

Post-Gd:  
No significant  
contrast  
enhancement  
near the  
fracture  
margin →  
poor  
vascularity



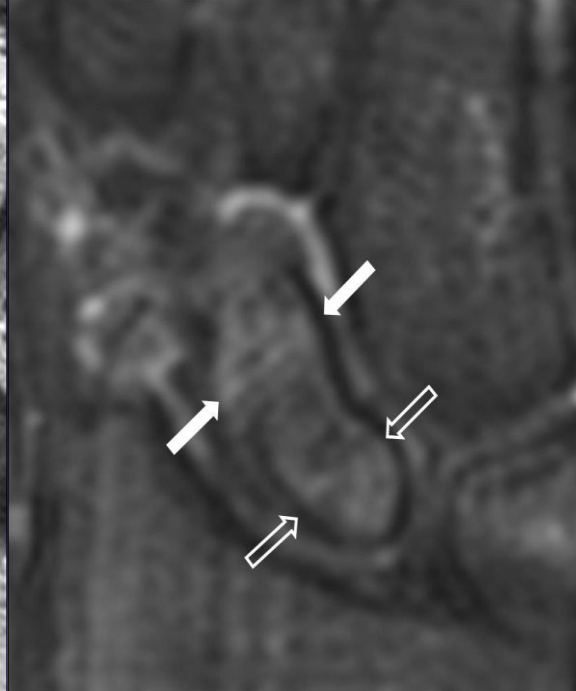
DCE showed  
poor  
vascularity

Surgery confirmed

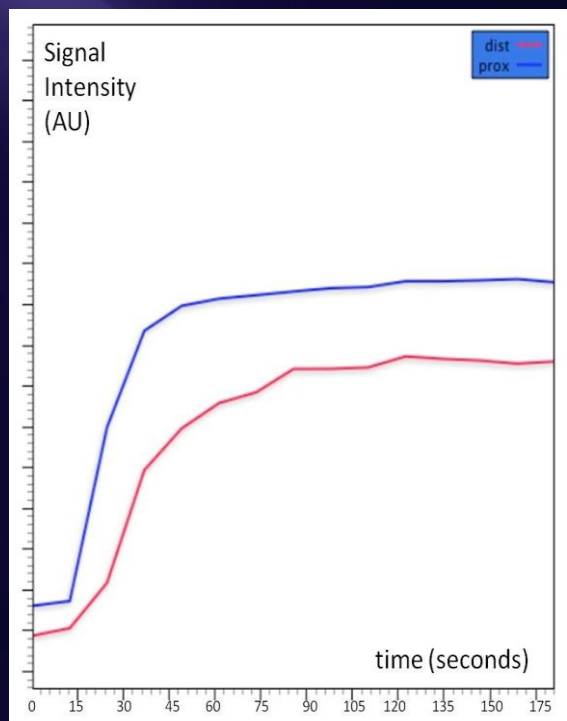
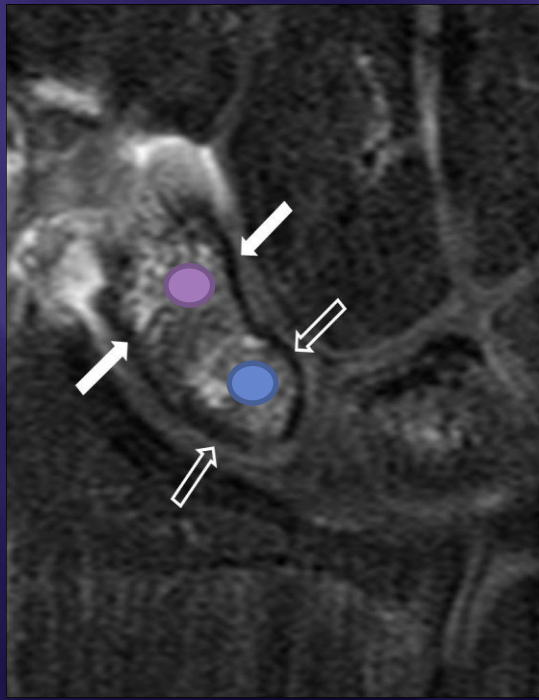
T1W:  
homogeneous  
diffuse low  
signal



T2W FS:  
homogeneous  
isointense signal  
intensity → Poor  
vascularity.



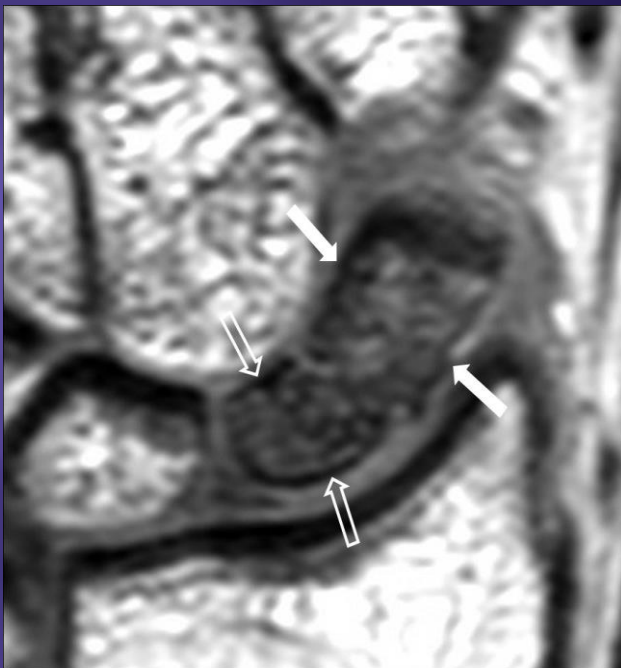
Post-Gd: Good  
enhancement →  
good vascularity



DCE: steep  
enhancement  
slope with  
enhancement  
similar to the  
distal pole  
→ good  
vascularity

Surgery confirmed

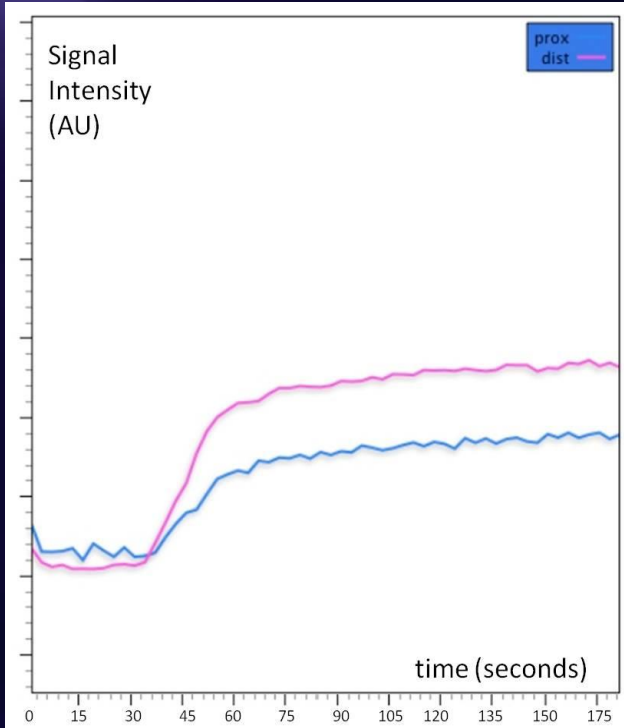
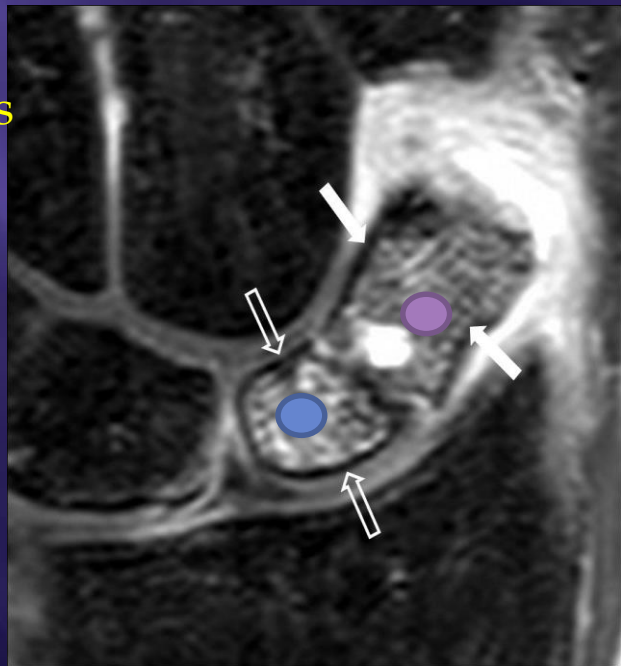
T1W:  
homogeneous low  
signal in the  
proximal  
scaphoid  
fragment



T2W FS:  
homogeneous  
increased signal  
intensity at the  
with peri-  
fracture cyst  
formation →  
Poor vascularity



Post-Gd:  
homogeneous  
enhancement  
→ good  
vascularity.



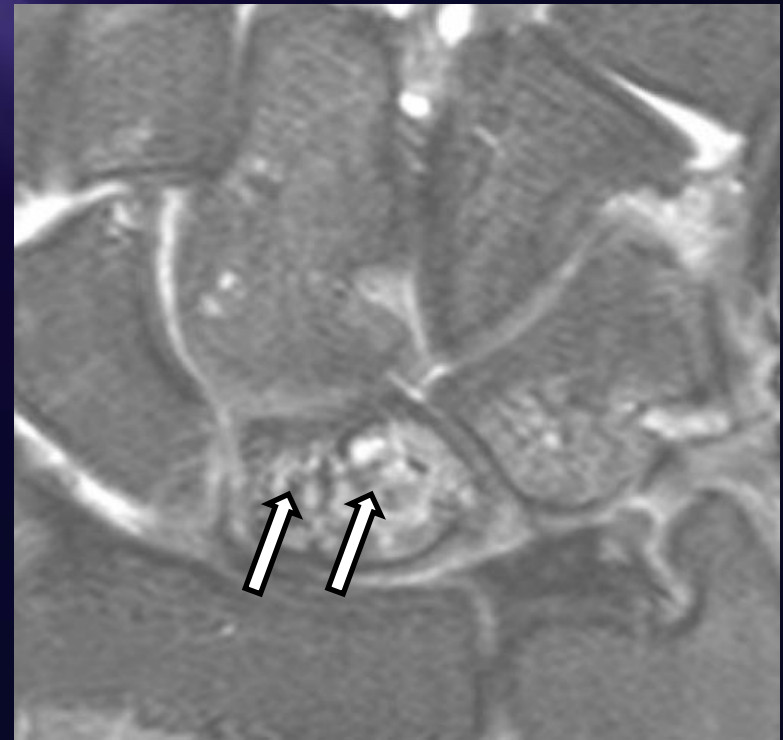
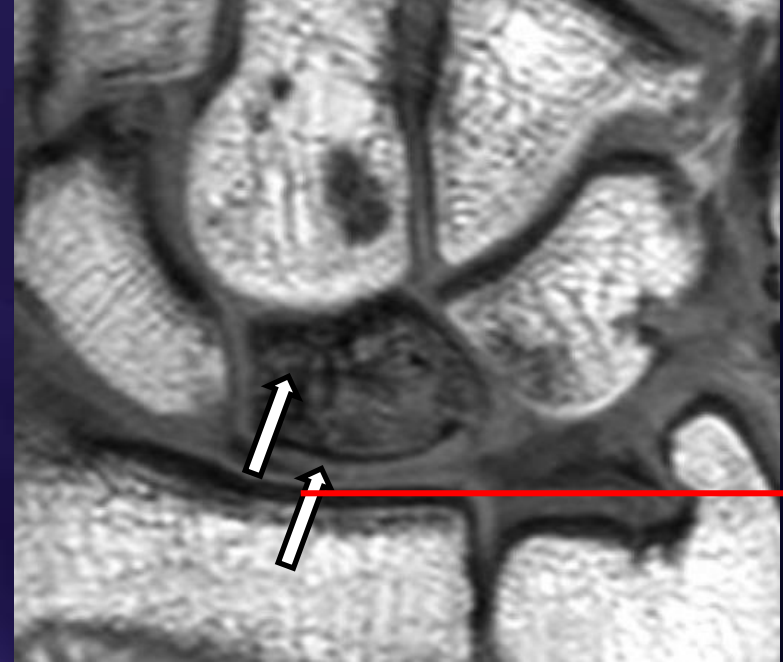
DCE : Flat  
slope → fair  
vascularity

Surgery confirmed

# Lunate

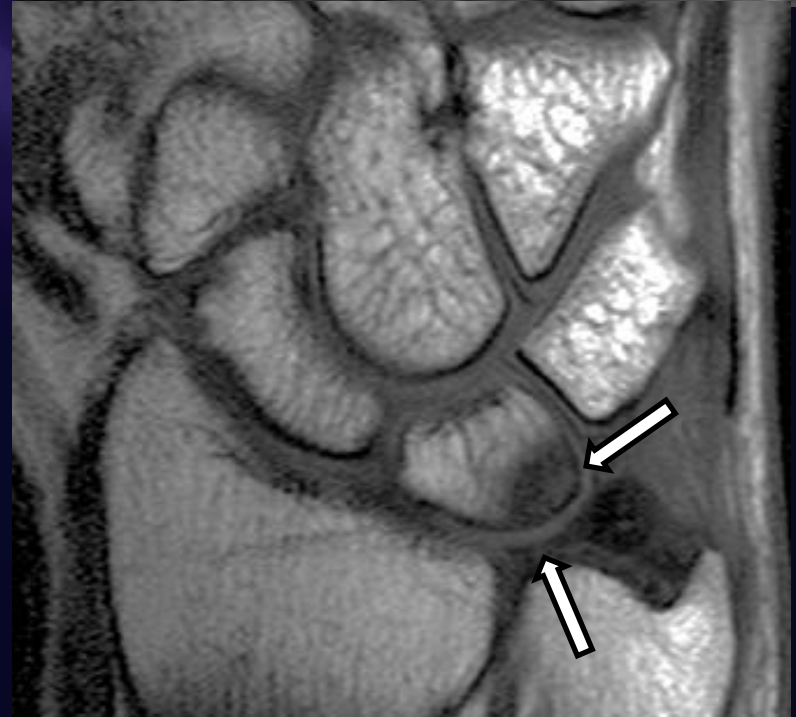
## Kienbock disease

- Ulna negative (78%)
- Uniform hypointense T1W signal
  - Oedema or sclerosis
- Cystic changes on T2W
- Fracture line
- Fragmentation/Collapse of lunate
- Proximal migration of capitate + scaphoid hyperflexion (degeneration of mid carpal and RCJ)



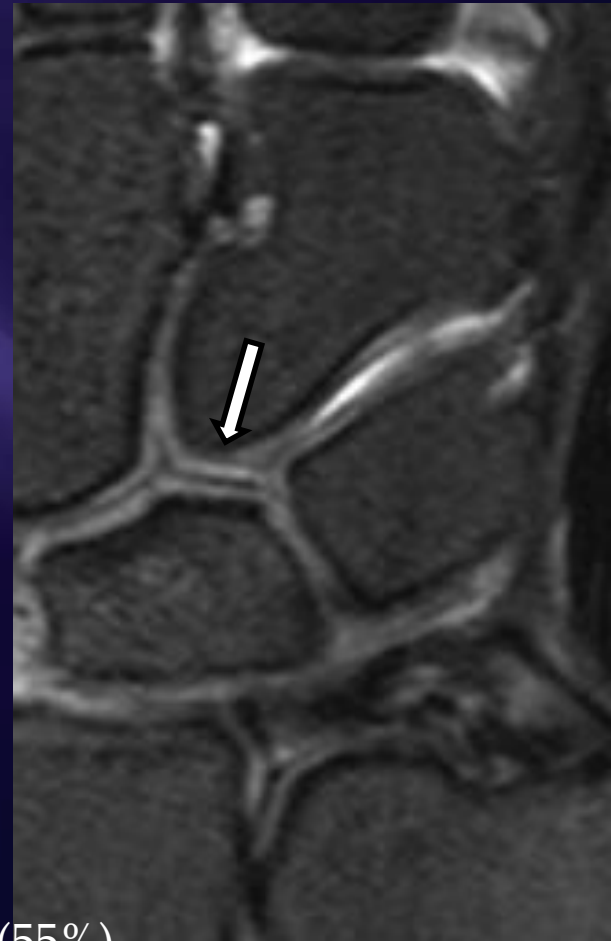
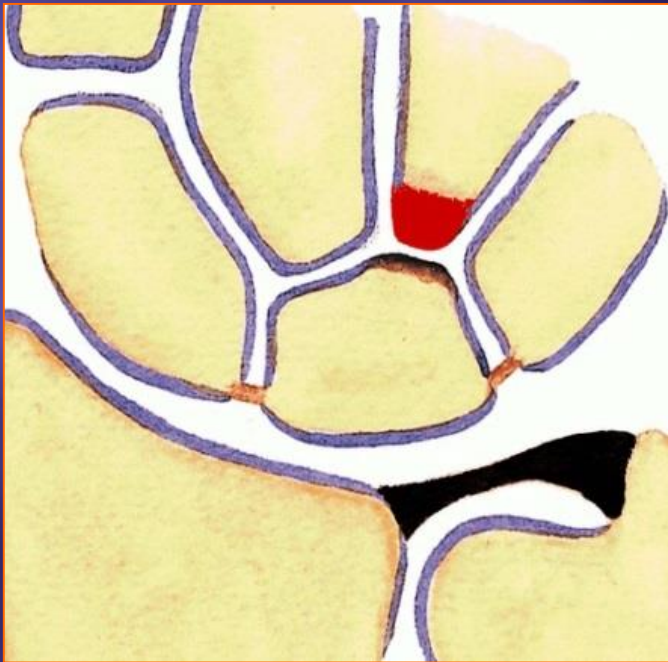
# Ulnocarpal impaction

- ▣ Impingement of lateral ulna against TFCC and proximal carpal row
- ▣ Features:
  - Ulna positive variance (rarely can be neutral or negative)
  - TFCC tear/degeneration
  - Eccentric bone oedema, subchondral cyst, sclerosis
  - Cartilage loss
  - LT tear

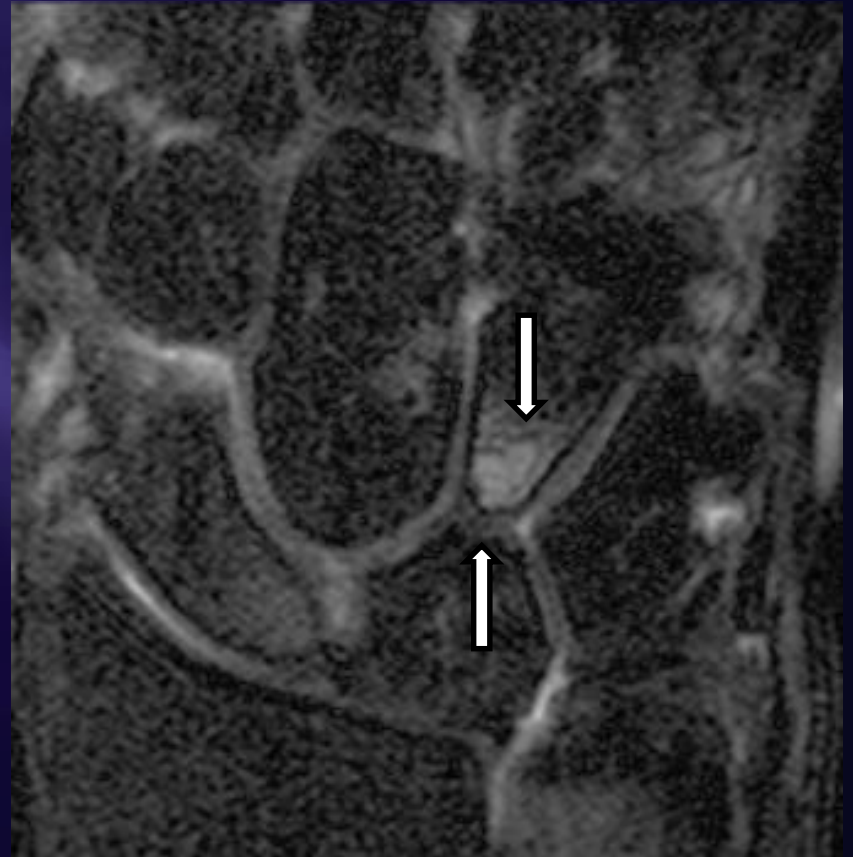




# Hamatolunate impaction



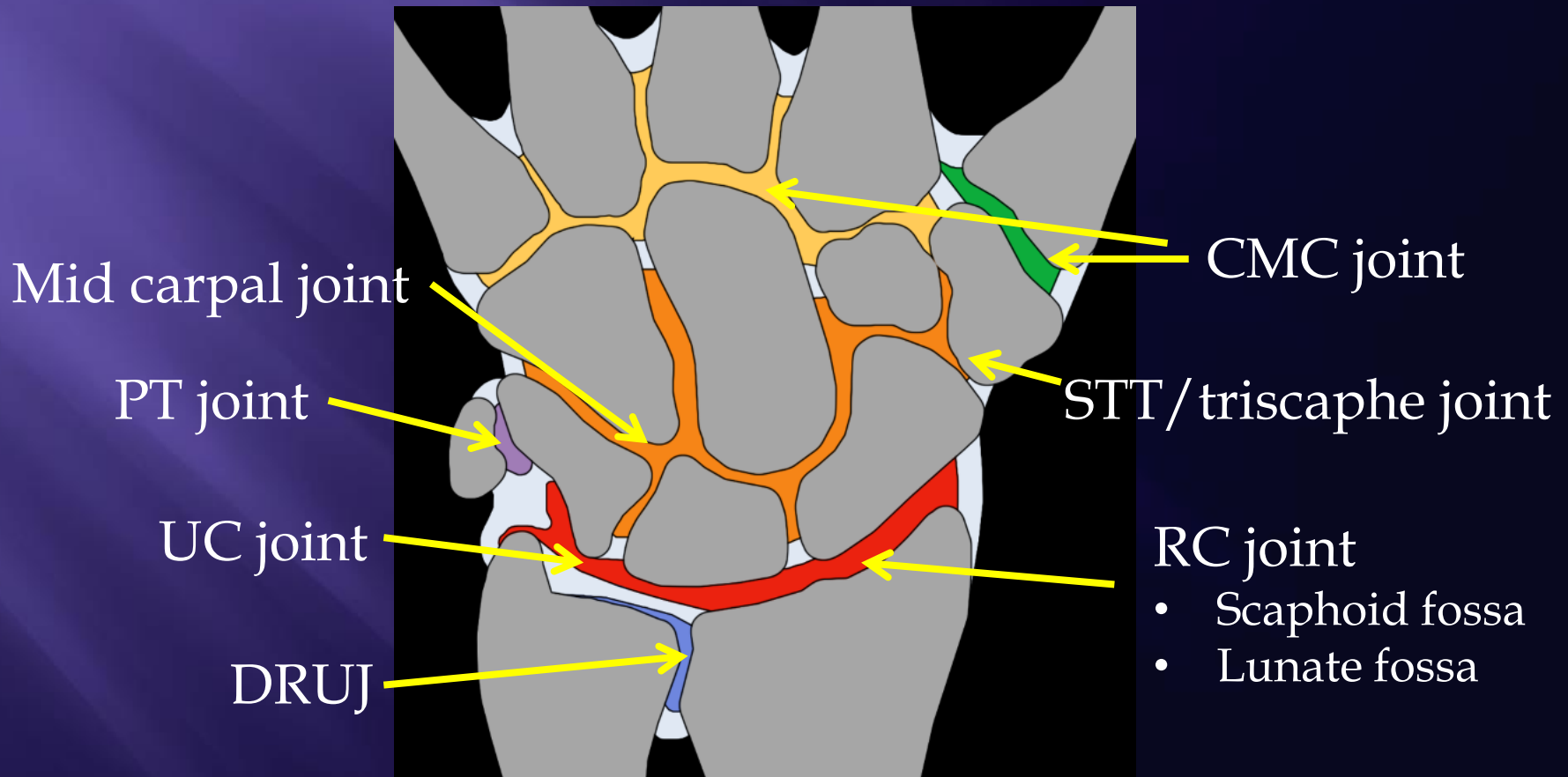
Type 2 lunate: additional facet with hamate (55%)



- Chondral injury
- Oedema tip of hamate (subchondral oedema)
- Sclerosis

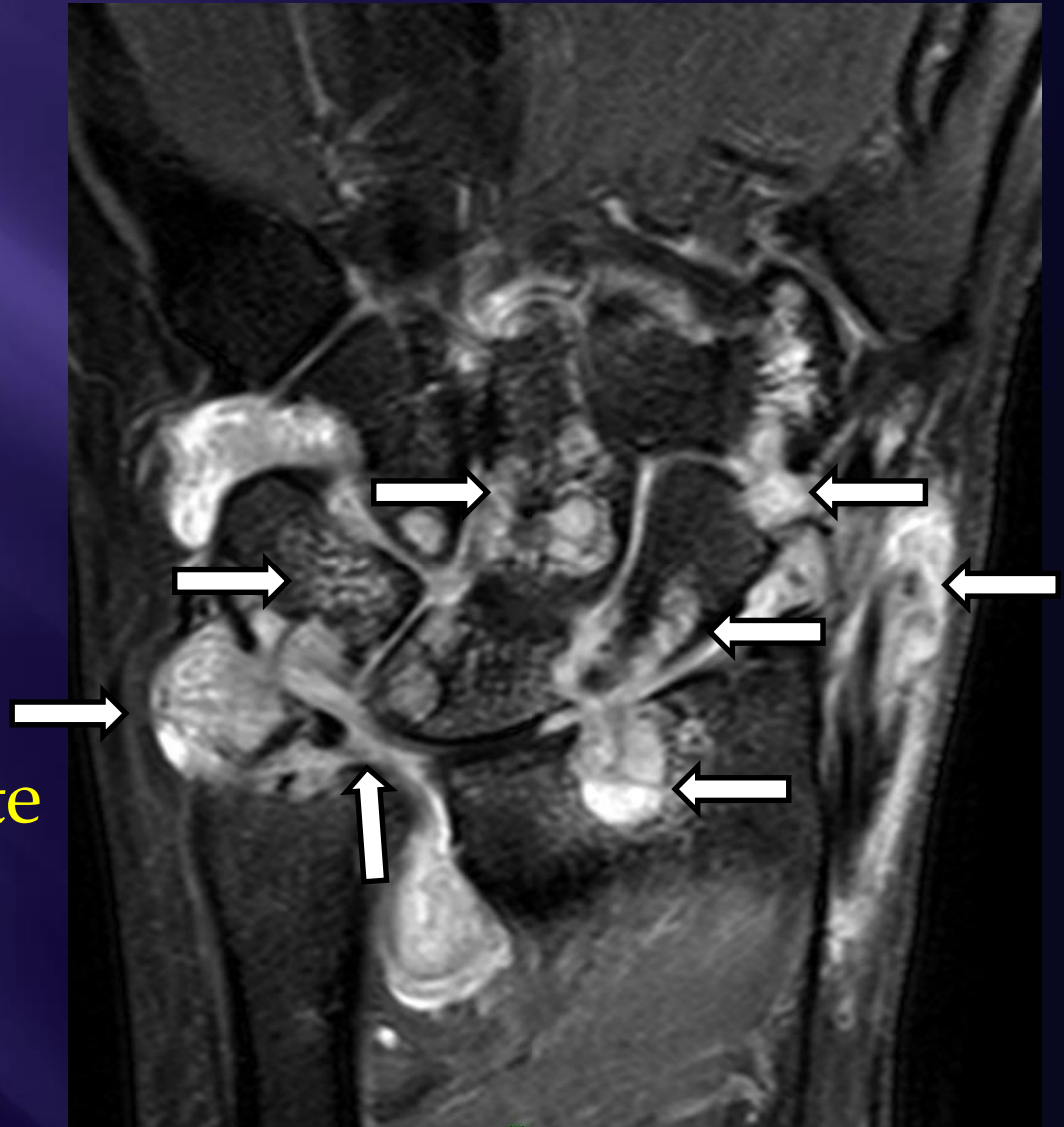
# JOINT AND CARTILAGE

## Anatomy

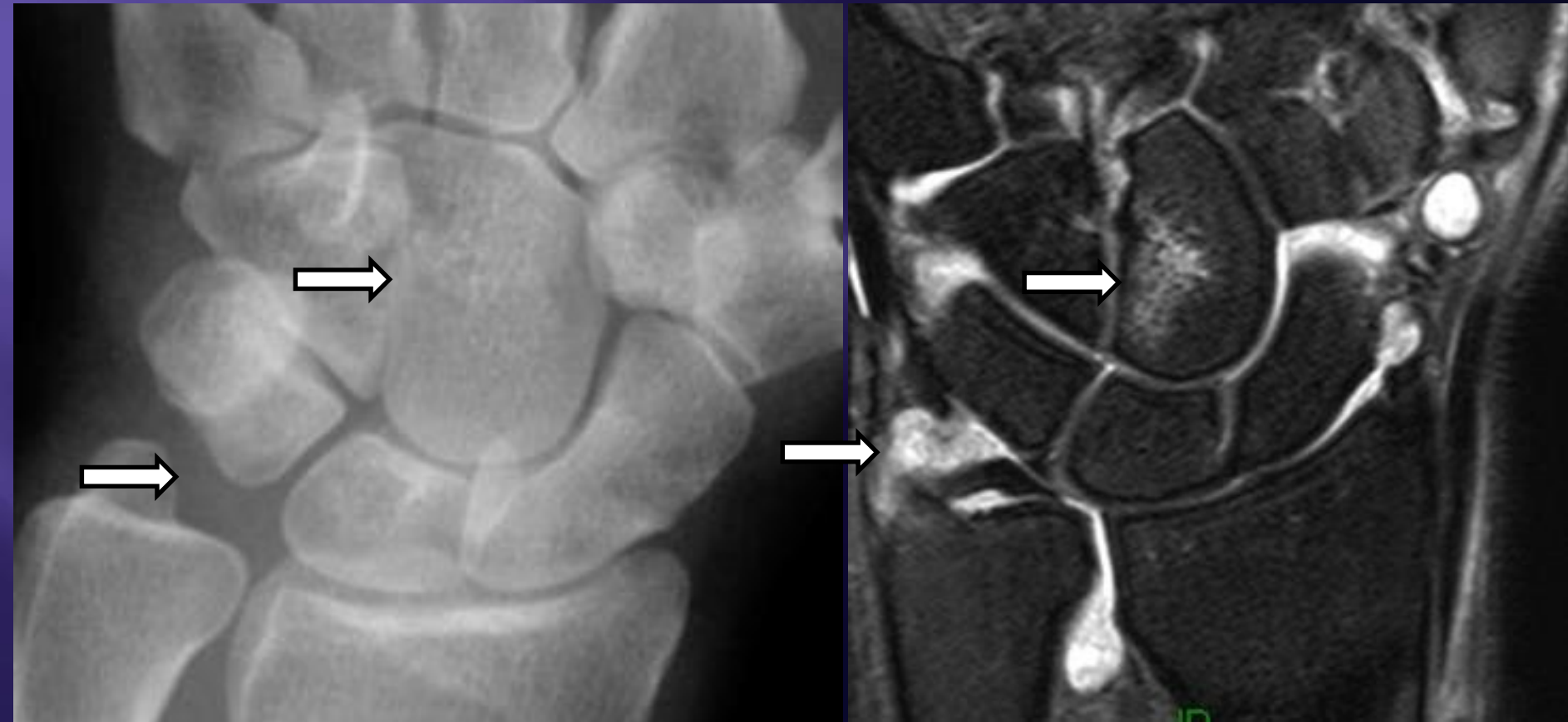


# Rheumatoid arthritis

- Bone erosions
- Bone oedema
- Synovitis
- Pannus: synovial mass causing erosions
- Tenosynovitis
- TFCC/ligament/te  
ndon tear



# MRI is much much better for detection of Synovitis & Bone oedema



Before Treatment



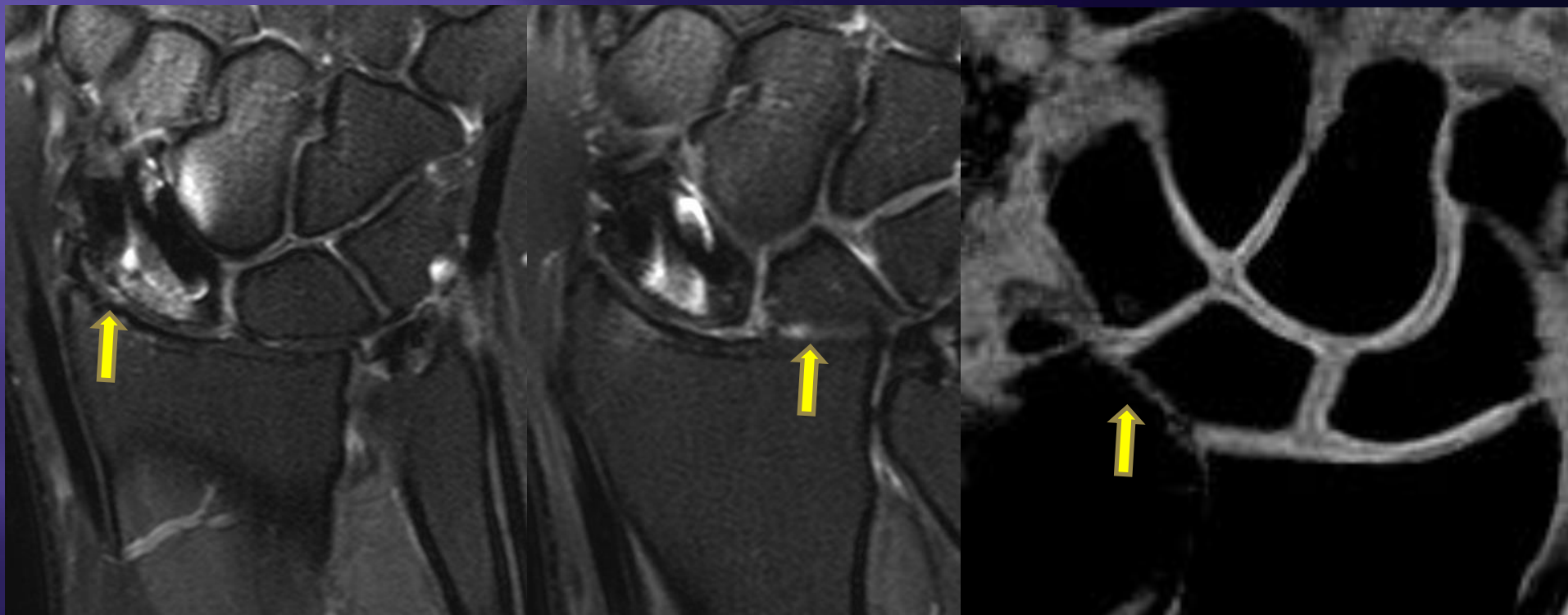
After Treatment



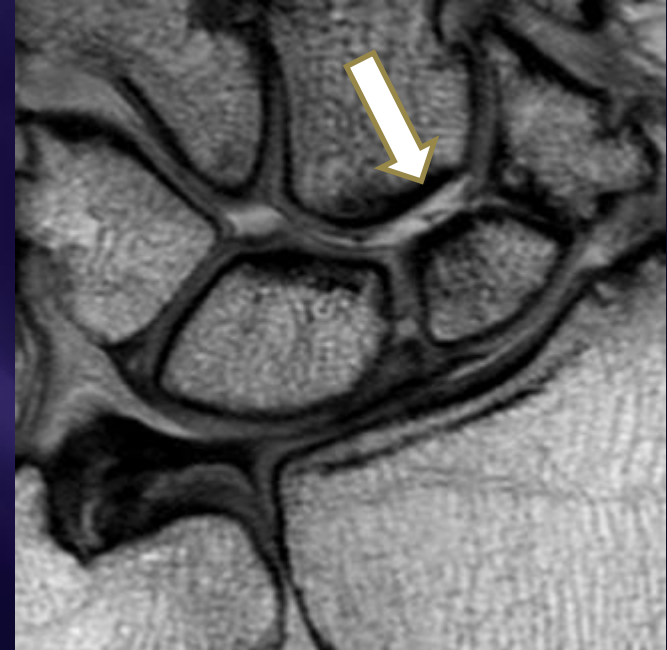
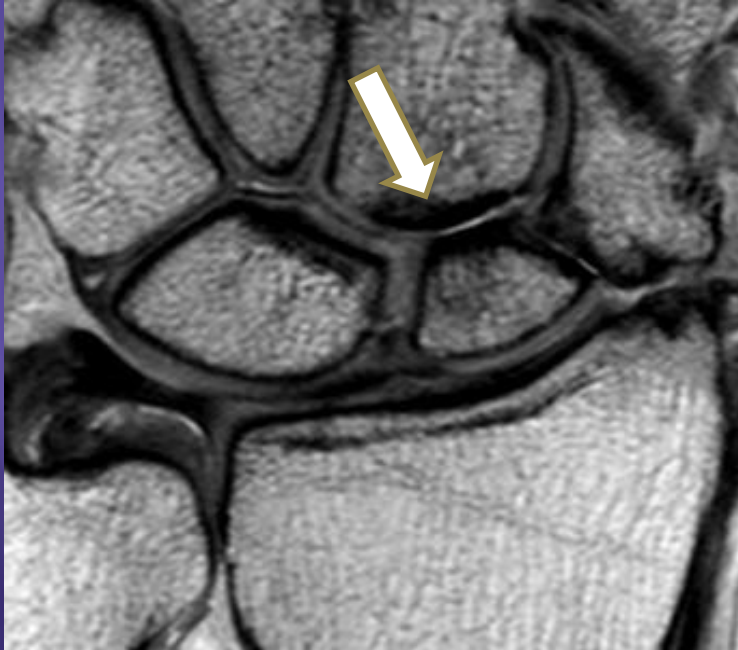
**Monitor the progression**

- Pain decreased after medications
  - less oedema
  - less synovitis/joint effusion

# Degenerative arthritis – cartilage loss



# Cartilage loss – MRI Limitation



Better depiction

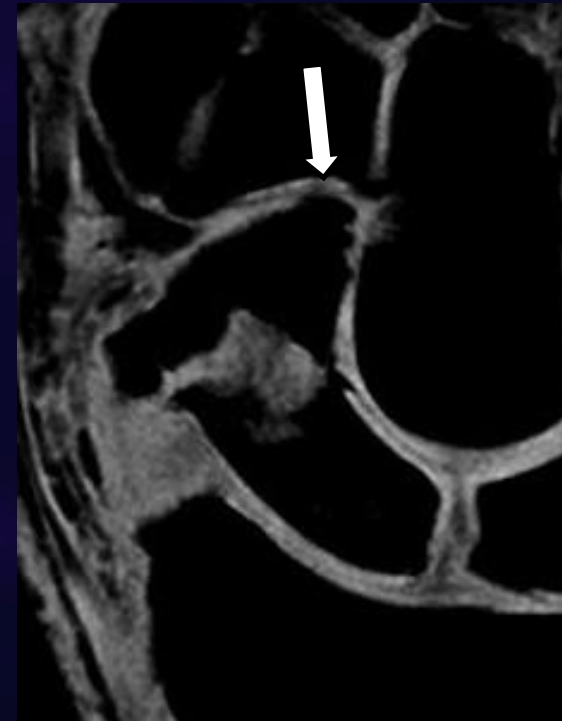
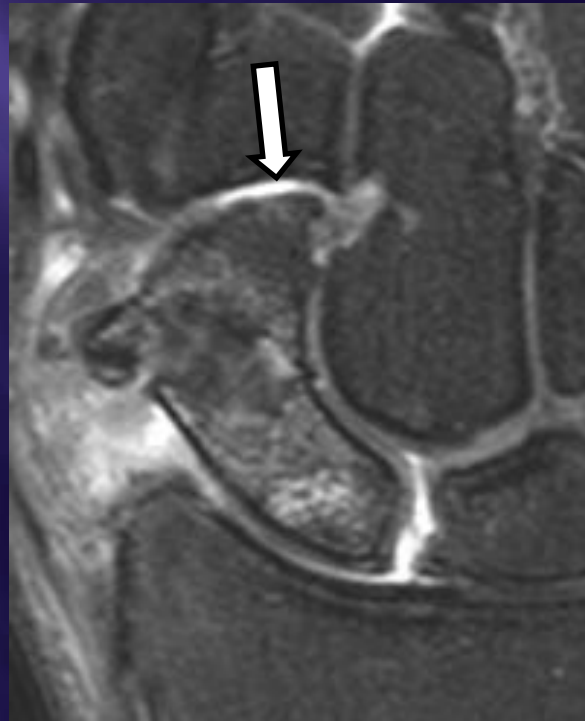
Arthrogram or  
traction



# Loose body-MRI Limitation



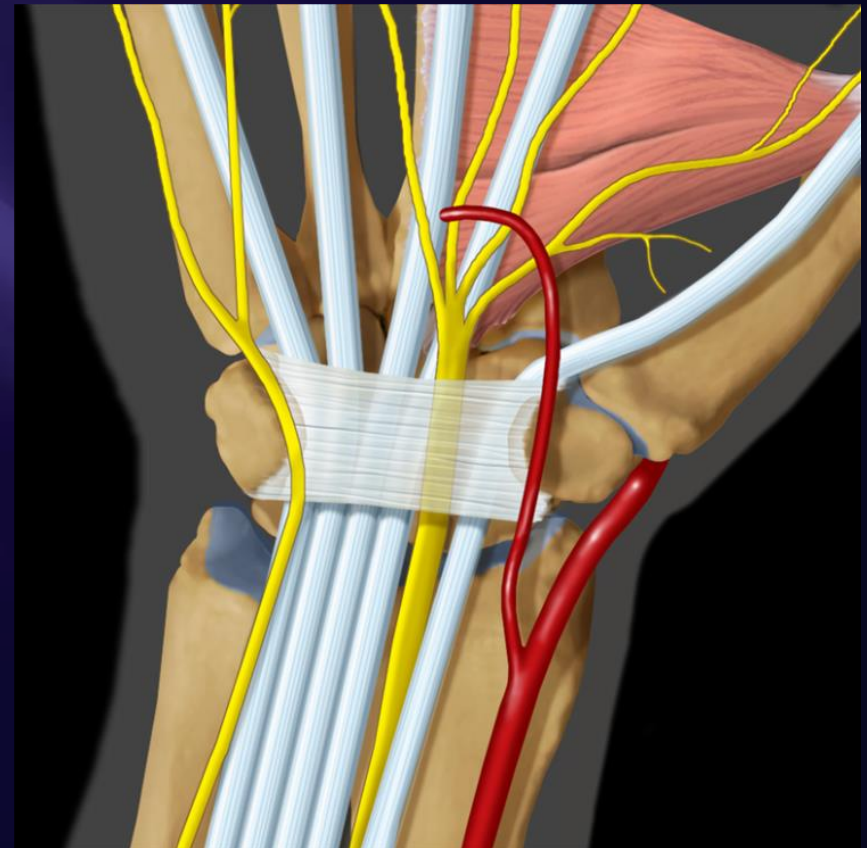
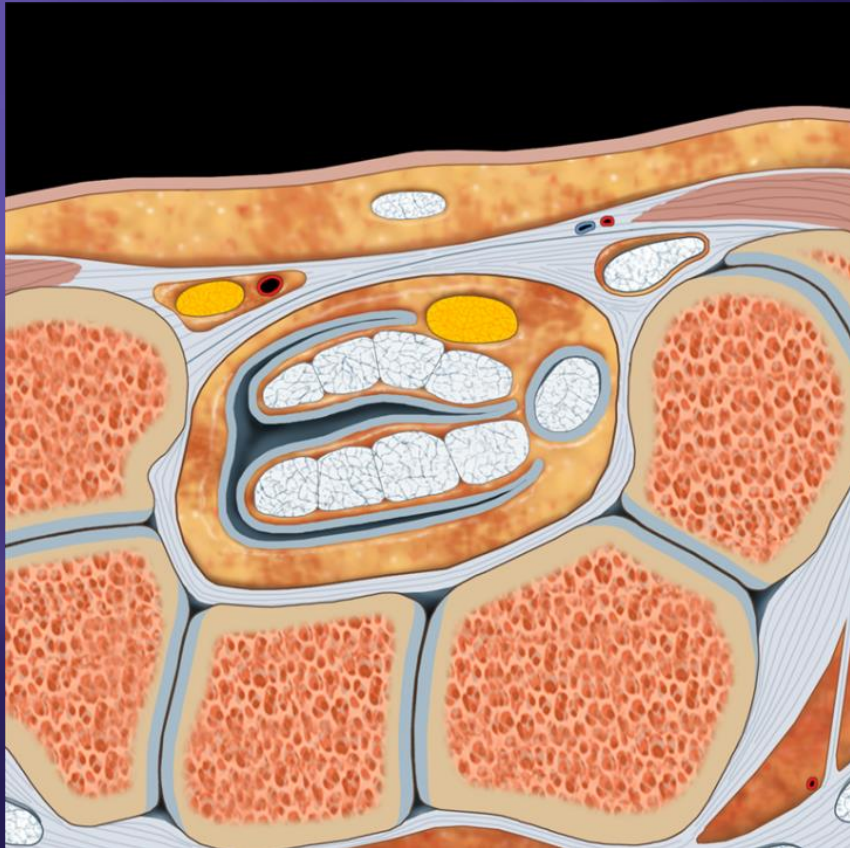
# Triscaphe arthritis



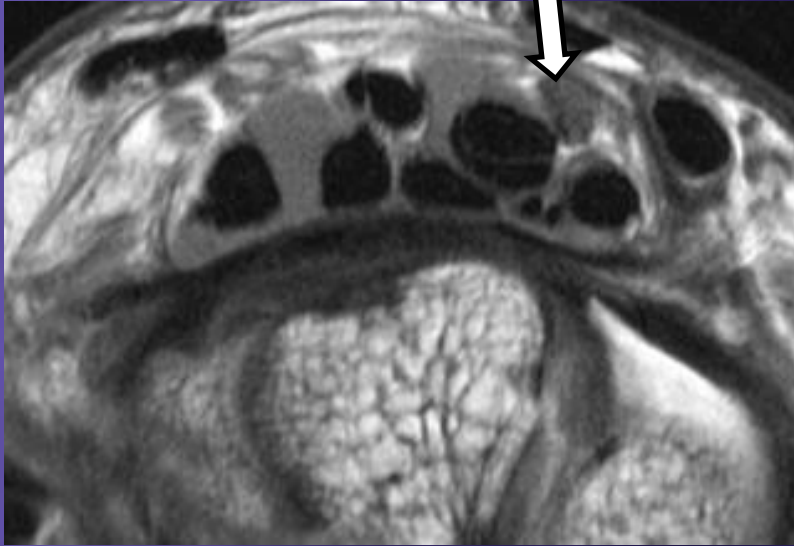
- Scaphoid-trapezoid (most common)
- Scaphoid-trapezium
- Trapezium-Trapezoid

# Nerve entrapment

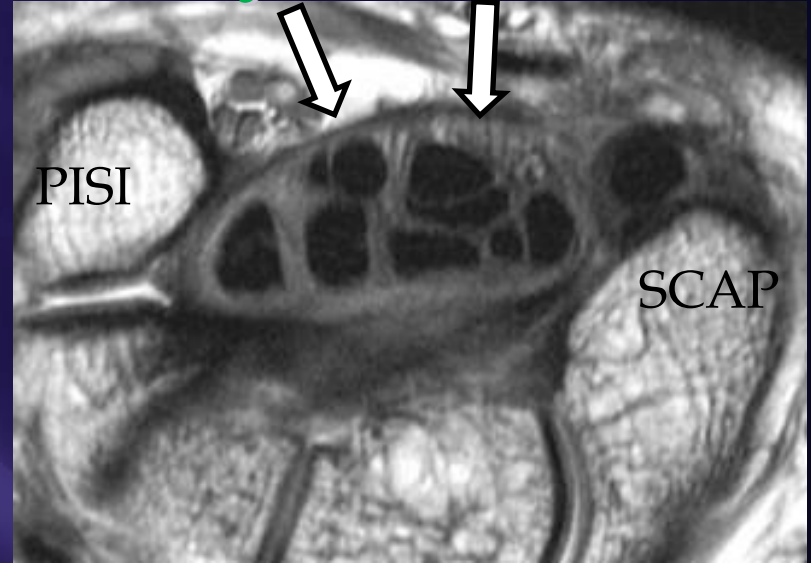
## Carpal tunnel syndrome



# MRI Anatomy



Proximal to tunnel



At tunnel inlet

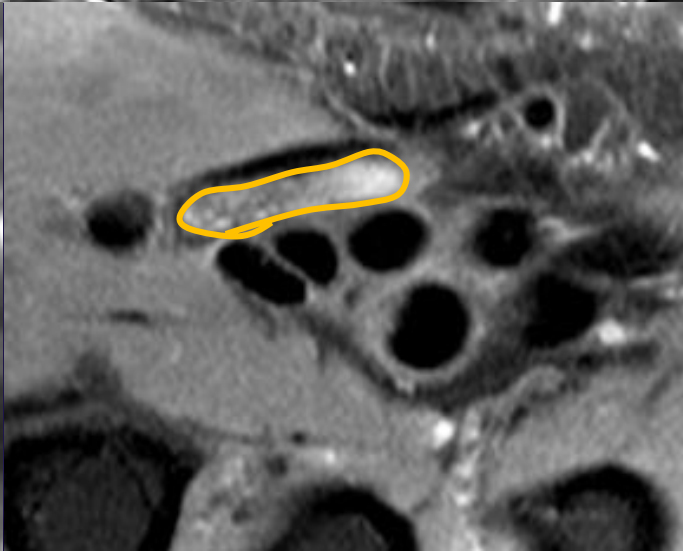
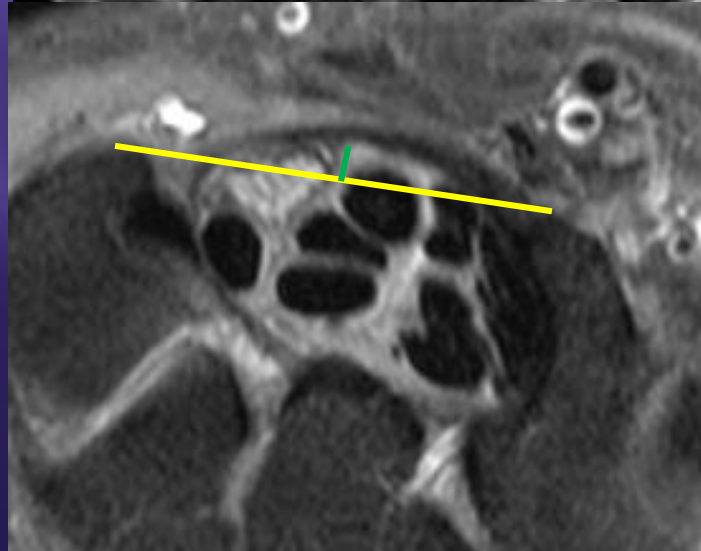
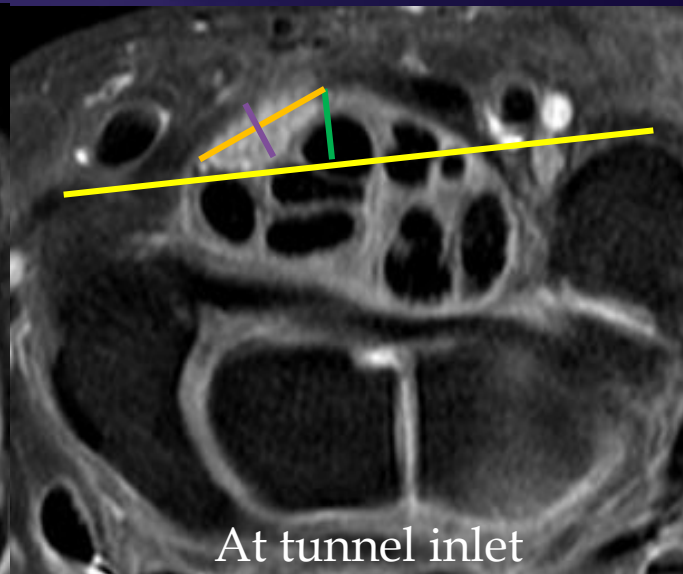
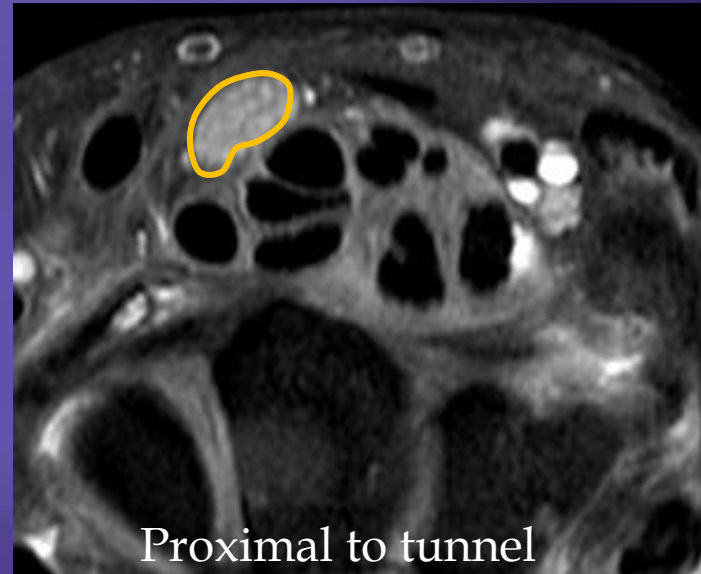


At tunnel outlet



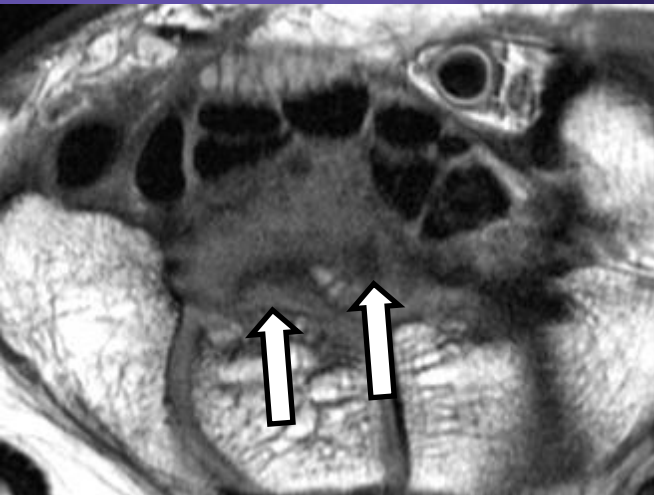
Distal to tunnel

# CTS: MRI No established role??

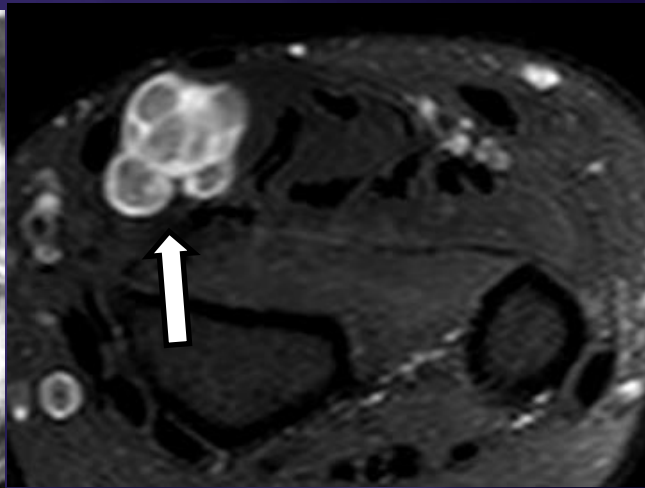


|                        |                        |
|------------------------|------------------------|
|                        | CTS<br>(controversial) |
| CSAp                   | >15mm <sup>2</sup>     |
| CSAnormal              | <12mm <sup>2</sup>     |
| FR                     | >3??                   |
| BRi                    | >4mm                   |
| BRo                    | >3mm                   |
| CSAd                   | >15mm <sup>2</sup>     |
| CSAd normal            | <13mm <sup>2</sup>     |
| Hyperintense           | yes                    |
| Thickened tenosynovium | yes                    |

# Secondary cause



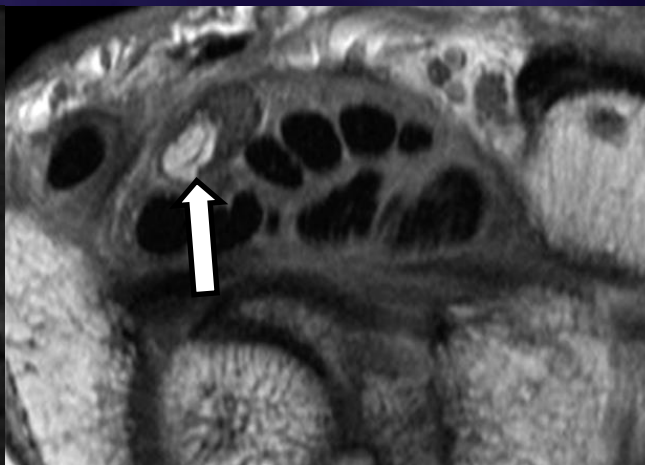
Gouty tophus



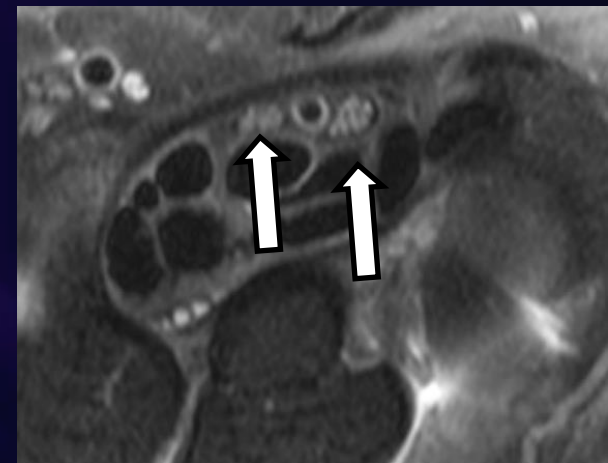
Neurogenic tumour



Ganglion cyst

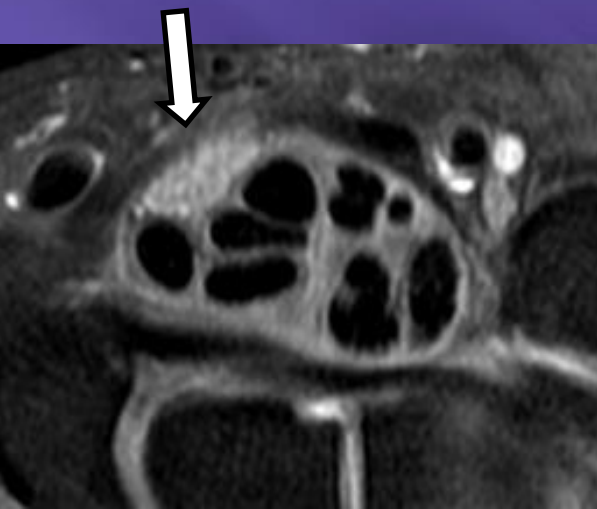


Lipoma



Persistent median artery

# Post carpal tunnel release

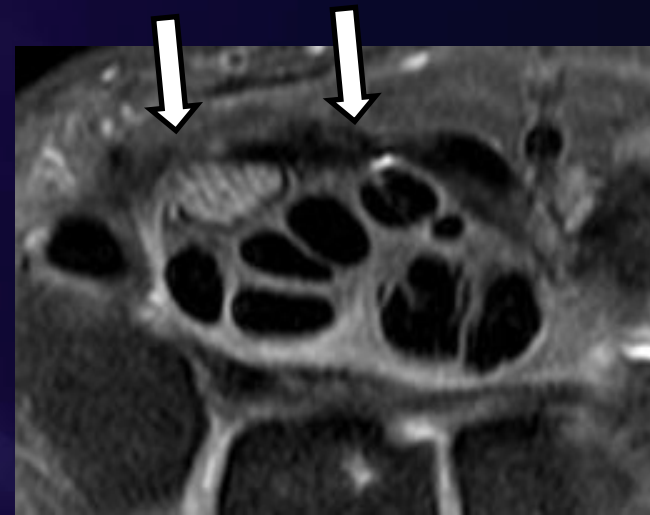


Preop



Three months

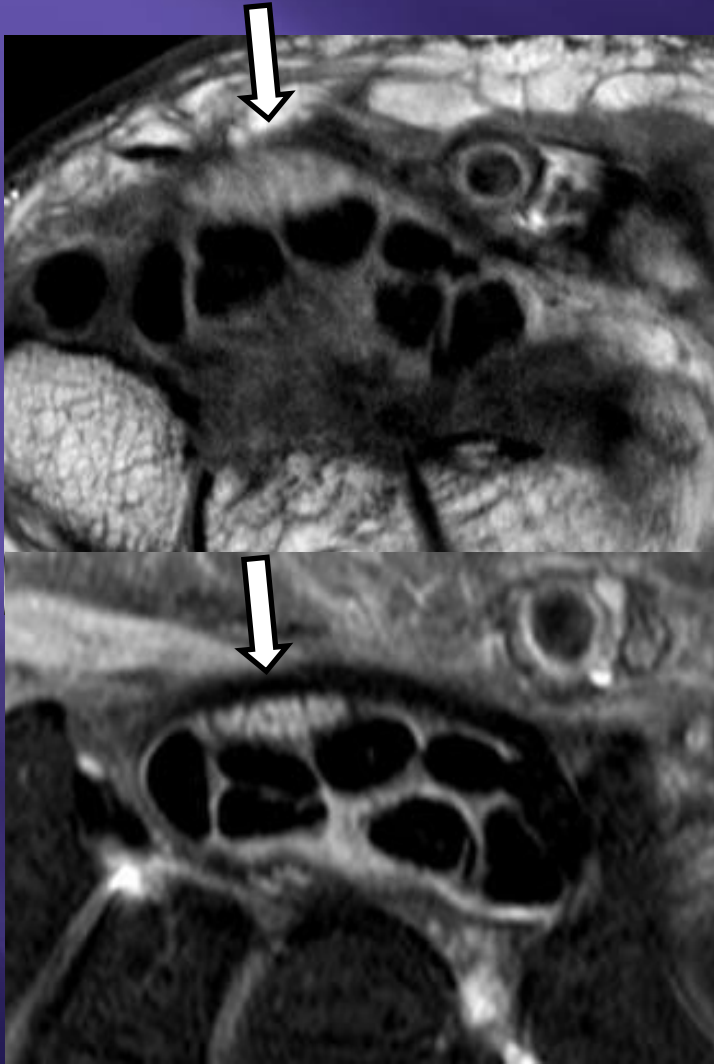
More bowing  
Less oedema



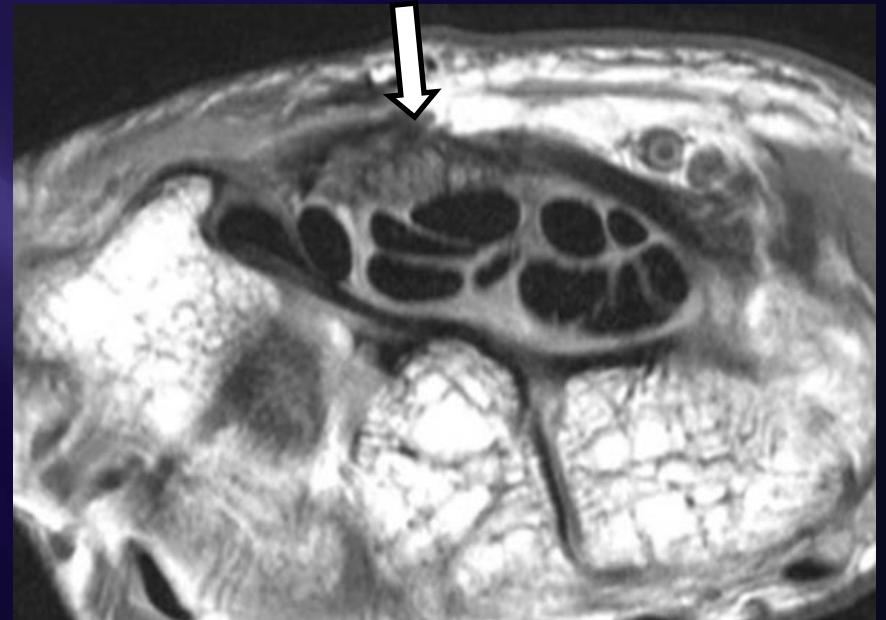
One year

Less bowing  
Reformed TCL

# CTS recurrence



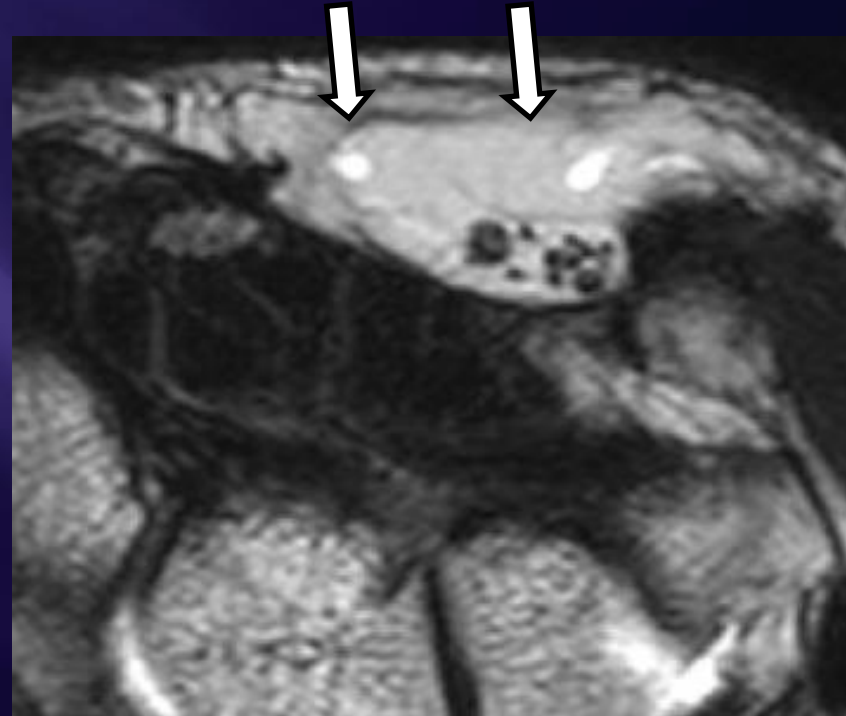
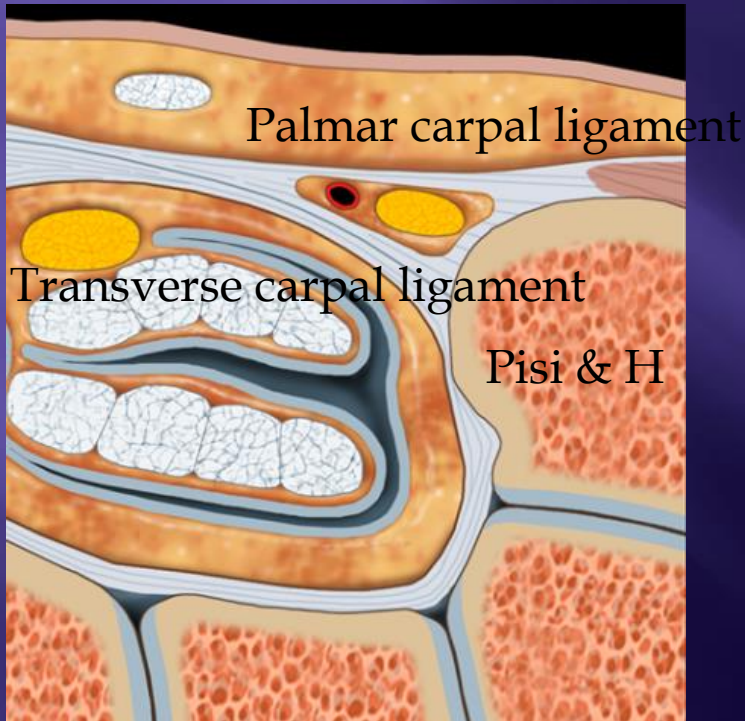
Incomplete release



Perineural scarring with tethering



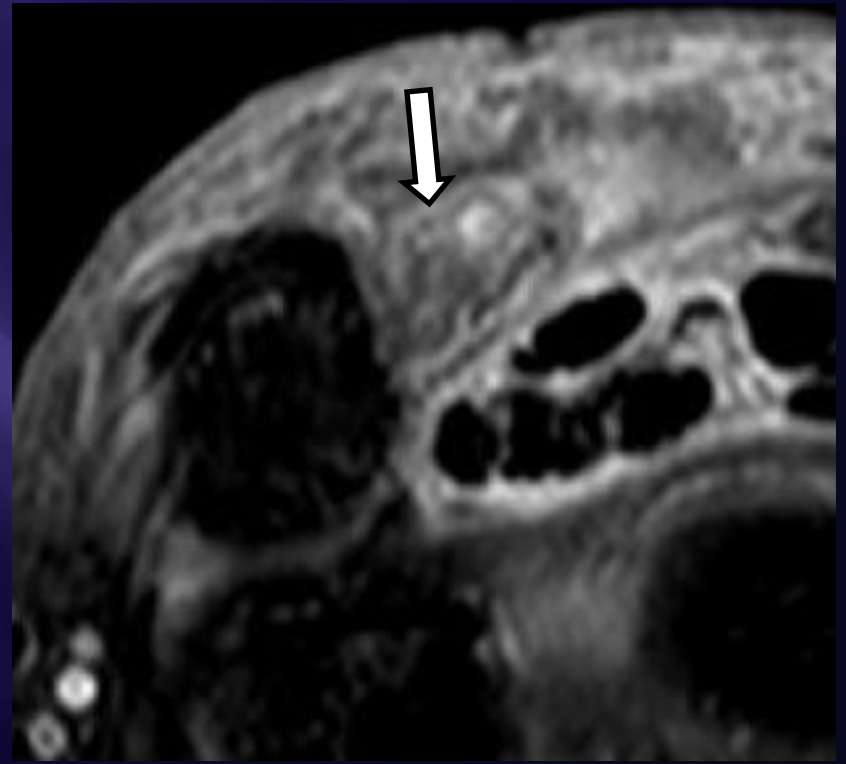
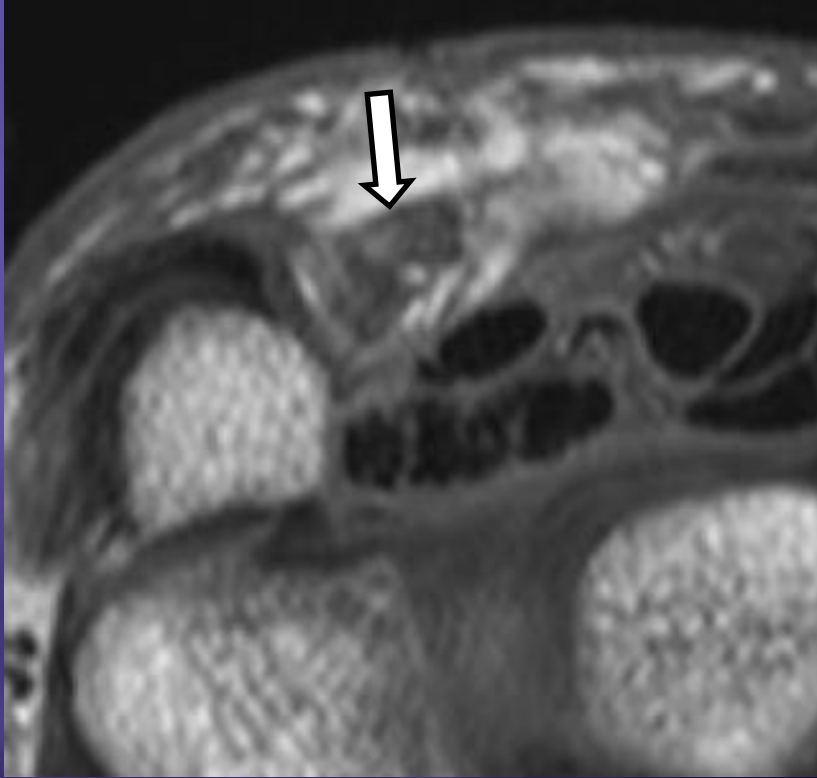
# Guyon's tunnel syndrome



Causes:

- Carpal tunnel fracture
- OA
- Ganglion
- Anomalous muscle
- Ulnar artery aneurysm

**Guyon's tunnel lipoma**



Guyon's tunnel fibrosis

# TAKE HOME MESSAGE

- ▣ Answer the clinical questions
  - Good communication with clinicians
- ▣ Familiar with the anatomy
- ▣ Describe the abnormalities
  - Using a checklist
  - Correlate all the planes