

Wrist MR I: Ligaments and TFC

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Disclosures:

- Financial
 - None
- Off Label Use
 - Intraarticular Gadolinium

Outline:

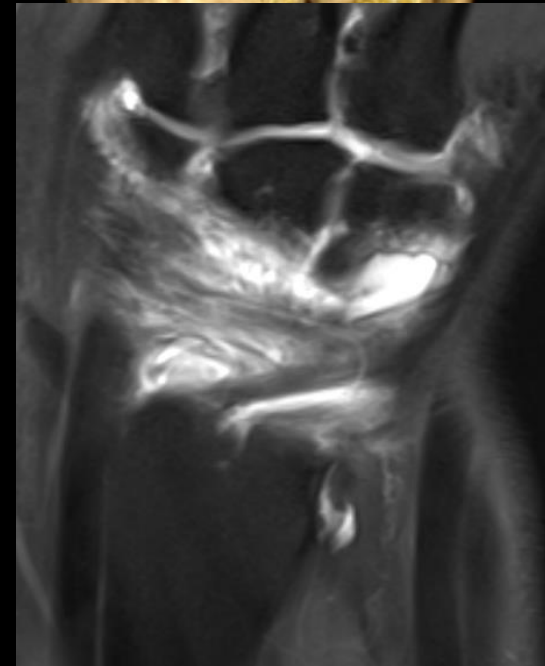
- “Extrinsic” Ligaments
- TFCC
 - Ulnocarpal abutment
- Scapholunate instability
- Lunotriquetral instability

Wrist Ligaments

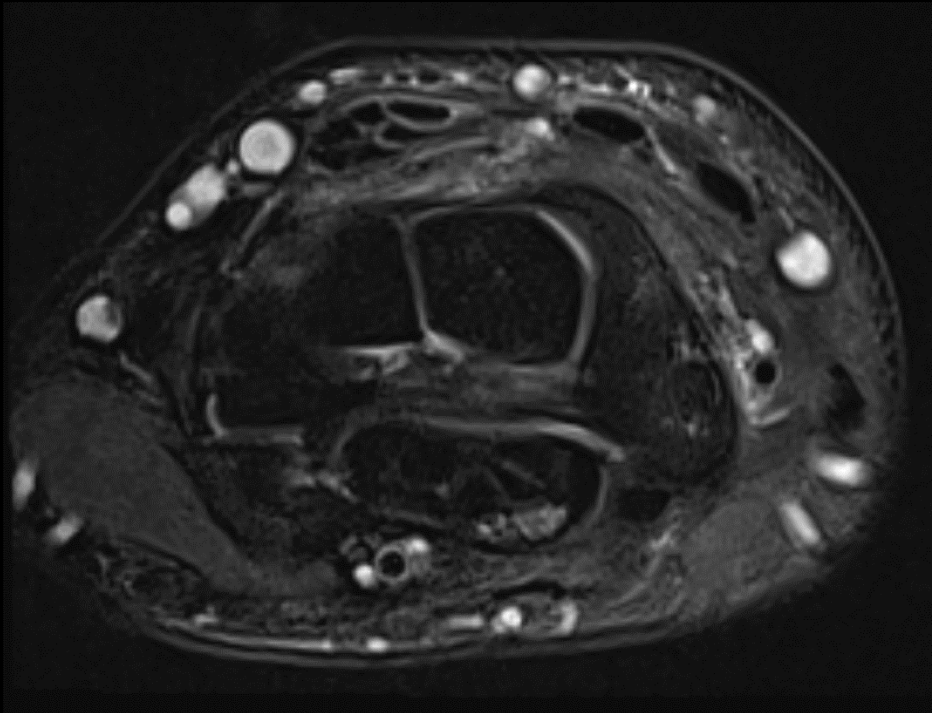
- Interosseous ligaments
 - Origin and insertion carpal bones
- Intrinsic ligaments
 - Origin and insertion carpal bones
 - Have a capsular component
- Extrinsic ligaments
 - Originate distal radius or ulna
 - Insert onto carpal bones

Dorsal Ligaments

- Dorsal Intercarpal ligament
 - Scaphotriquetral ligament —
 - Intrinsic ligament (capsular component)
- Dorsal radiocarpal
 - Dorsal radiolunotriquetral —
 - Lister tubercle to triquetrum
- Injured in “wrist sprain”



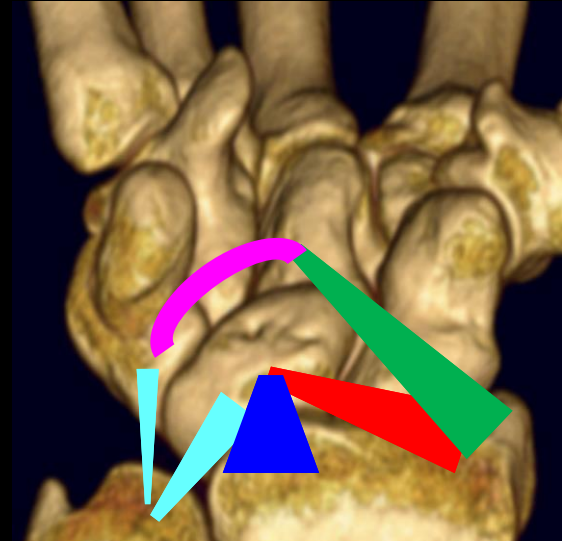
Capsular Ligamentous Injuries



Dorsal Extrinsic Ligament Tear
- Scaphotriquetral ligament

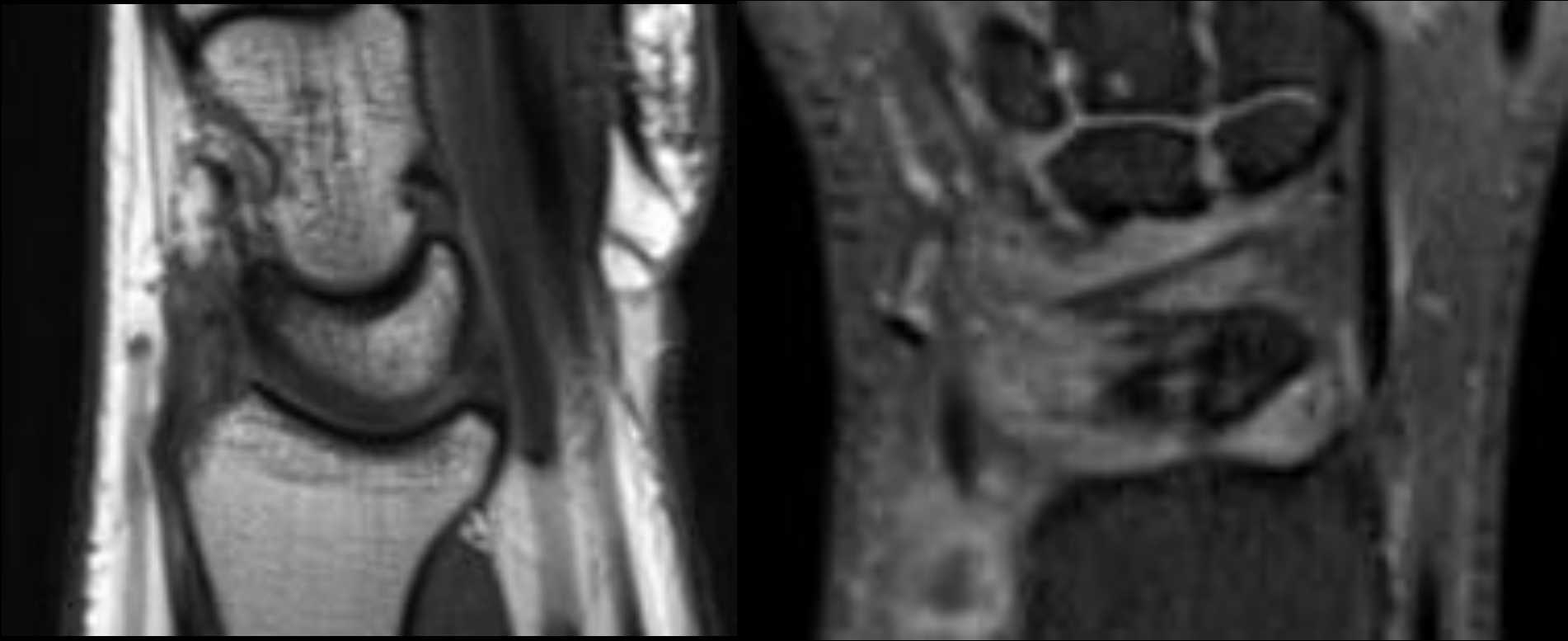
Volar Ligaments

- Radioscaphocapitate (RSC) —
 - Provides scaphoid stability
- Long radiolunate (LRL) —
 - Radiolunotriquetral
 - Interdigitate with RSC
- Short radiolunate (SRL) —
- Ulnocapitate (UC) —
- Arcuate ligament
 - SC + THC — + —

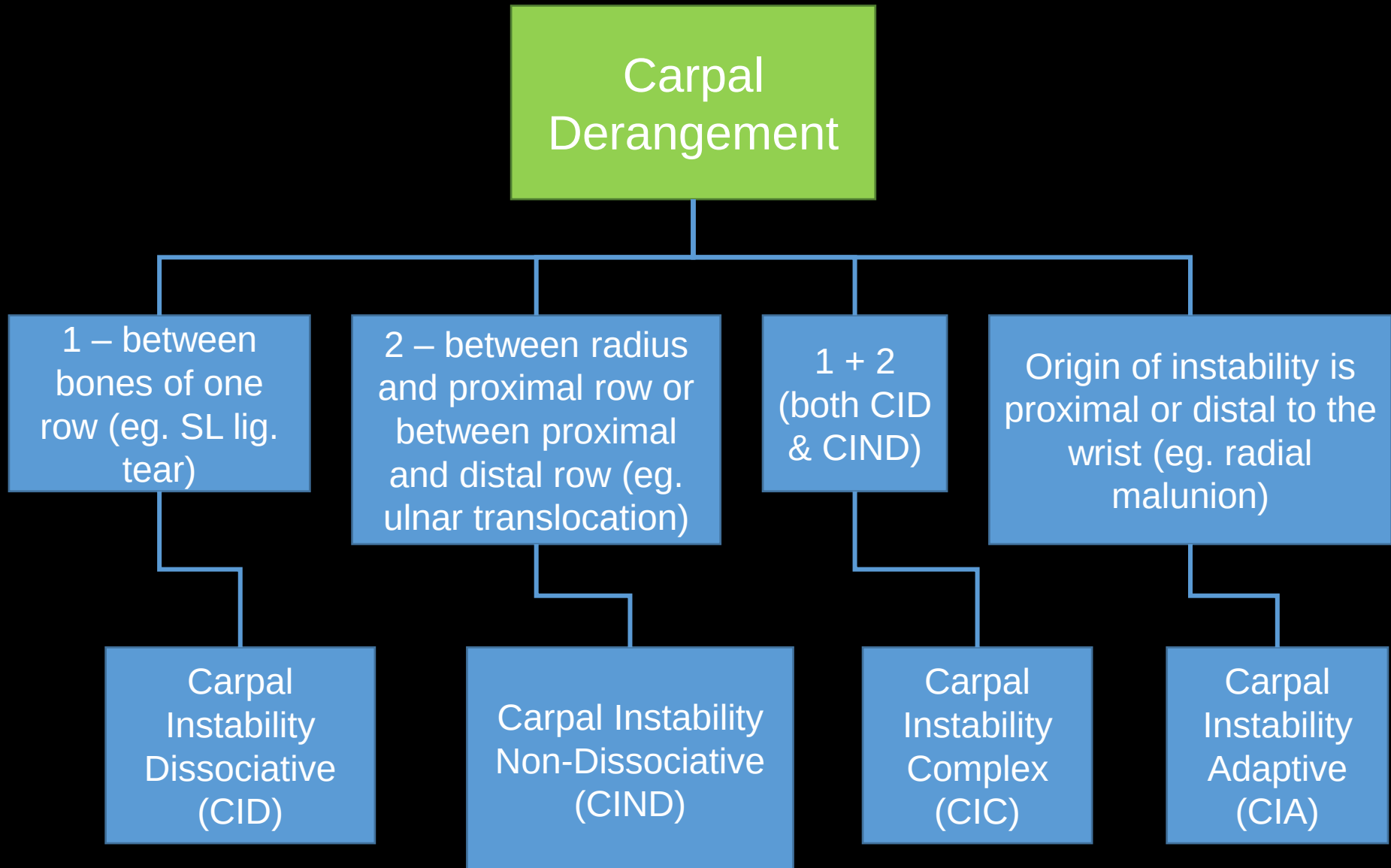


Capsular Ligamentous Injuries

- May be seen with later stages of scapholunate and lunotriquetral instability
- Seen in ulnar translocation (**RSC and LRL tear**)



Capsular Ligamentous Injuries



Ulnar-sided Wrist Pain

- Ulnar-sided
 - diagnostic dilemma
 - mainly
 - the **small size and complexity** of the anatomical structures
 - compounded
 - occurrence of **positive imaging findings** that are clinically **asymptomatic**

Classification of Ulnar-sided Wrist Pain

Cartilage	Bone	Joint	Ligament	Tendon	Nerve
<i>TFCC pathology</i>	<i>Ulnar styloid #</i>	<i>Ulnocarpal impaction</i>	<i>Lunotriquetral ligament tear</i>	<i>ECU tendinopathy & subluxation</i>	<i>Ulnar nerve compression</i>
	<i>Hook of hamate #</i>	<i>Ulnar styloid impaction</i>		<i>FCU tendinopathy</i>	
	<i>Kienböck disease</i>	<i>Hamatolunate impaction</i>			
	<i>Ulnar impingment</i>	<i>Pisotriquetral arthropathy</i>			
		<i>Lunotriquetreal coalition</i>			
		<i>DRUJ instability</i>			

Triangular Fibrocartilage Complex (TFCC)

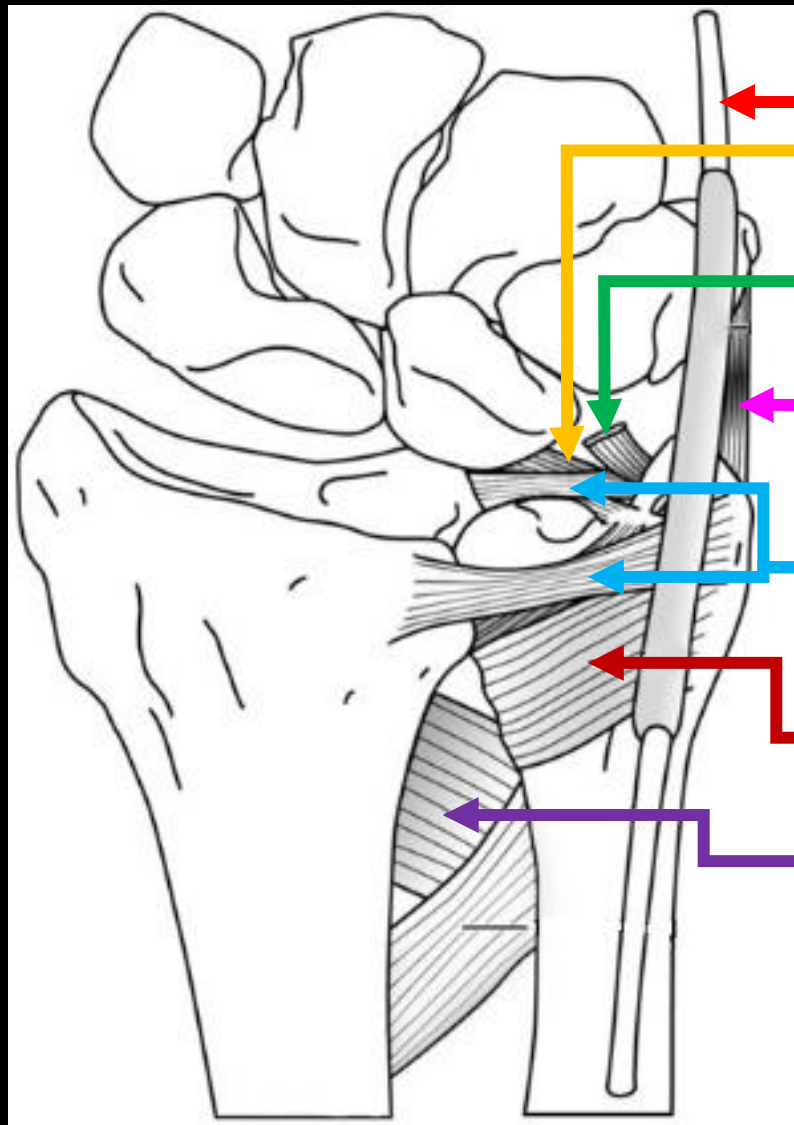
- Function
 - Cushioning effect
 - Carries axial load
 - Extends radial surface
 - Stabilize DRUJ
 - Stabilize ulnar carpus
- Components
 - Radial attachment
 - Articular disc
 - Ulnar attachment

TFCC

- Ulnar components
 - Ulnar fovea
 - Ulnar styloid
 - Ulnotriquetral
 - Ulnolunate
 - Dorsal and volar radioulnar ligaments
 - ECU subsheath
 - Meniscal homologue



TFCC –Dorsal View



Extensor carpi ulnaris

Ulnolunate ligament

Ulnotriquetral ligament

Ulnar collateral ligament

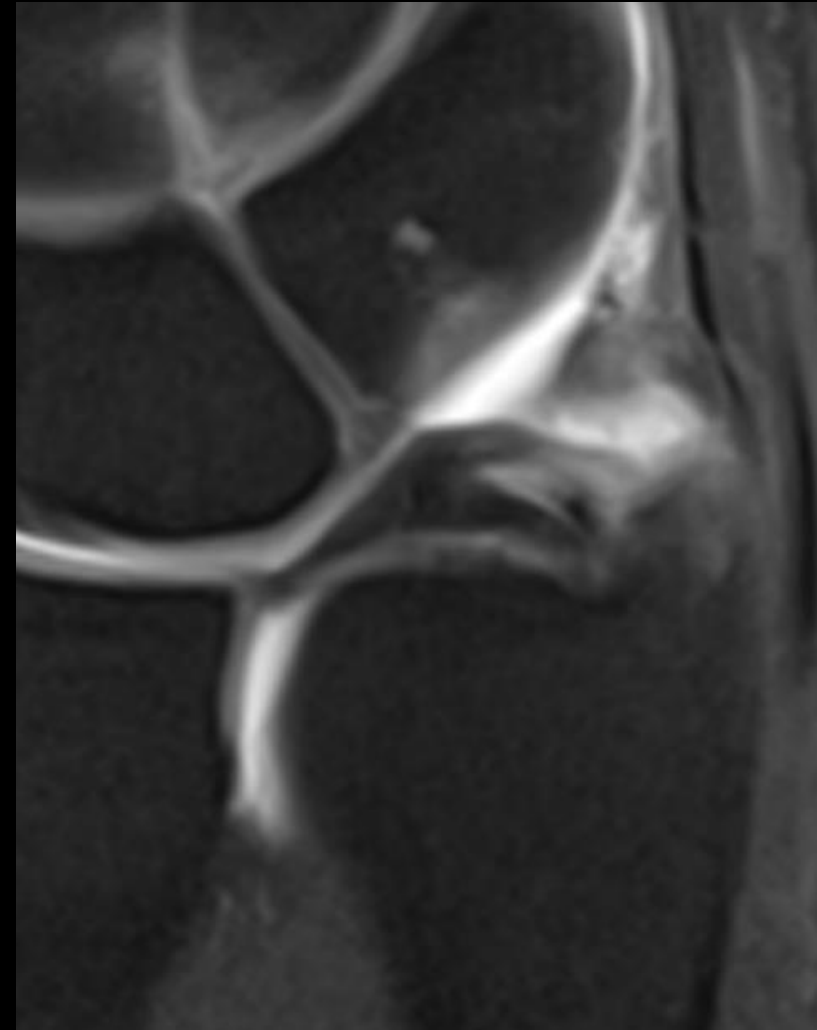
Dorsal and volar
radioulnar ligaments

Dorsal radioulnar capsule

Pronator quadratus muscle

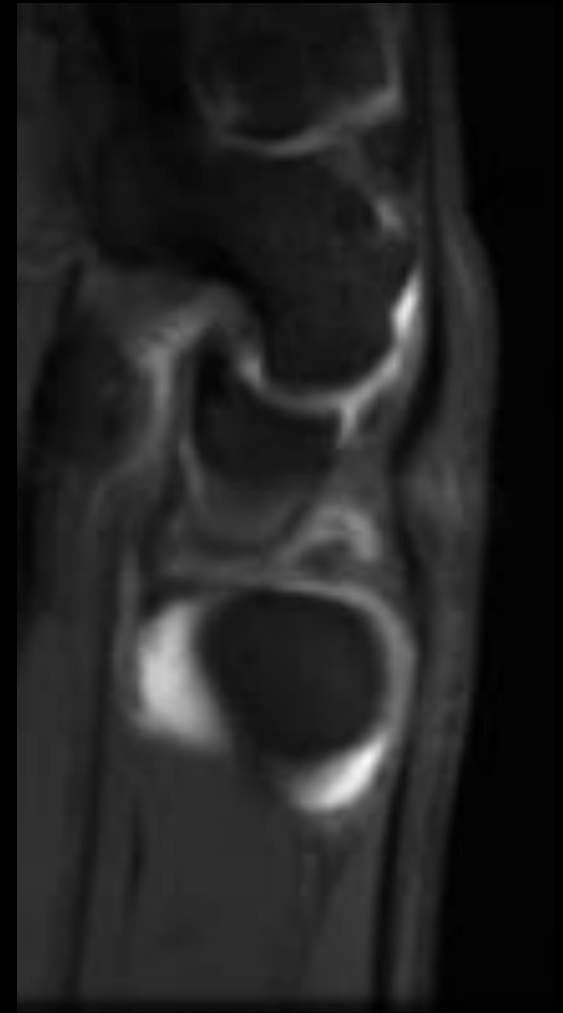
TFCC – Ulnar Attachment

- Ulnar fovea and styloid
 - Disk → fovea + styloid
- **Ulnocarpal ligaments**
 - Ulnolunate/ulnotriquetral
 - Originate from TFC
 - Volar
 - Sagittal images
- **Radioulnar ligaments**
 - Dorsal and volar



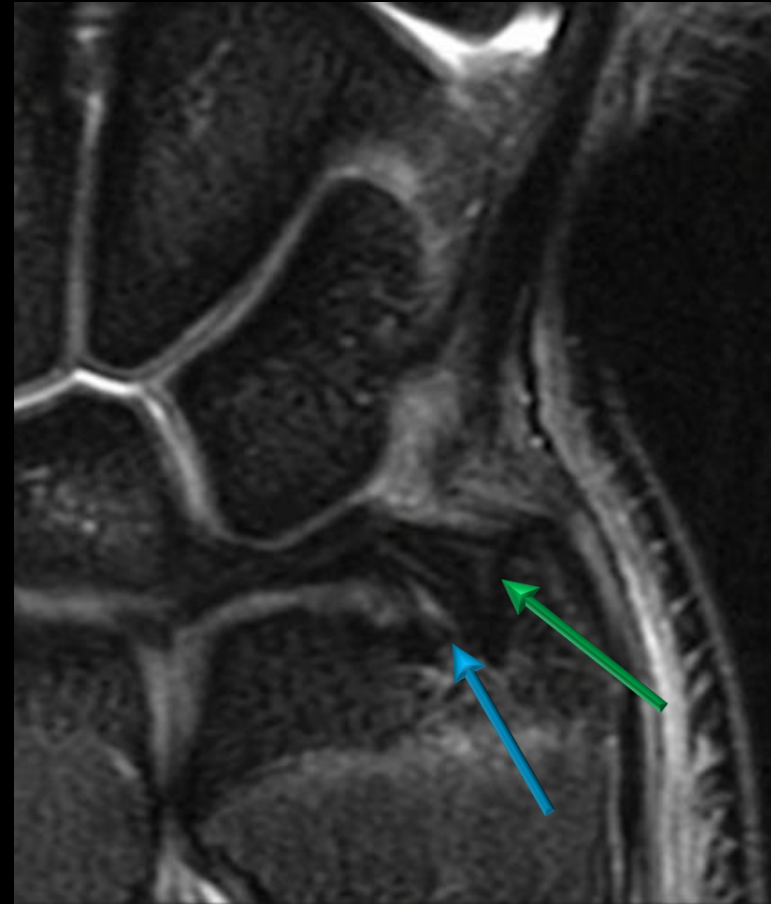
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 - Volar
 - Sagittal images
- **Radioulnar ligaments**
 - Dorsal and volar



TFCC – Ulnar Attachment

- Ulnar fovea and styloid
 - Disk → fovea (proximal lamina) + styloid (distal lamina)
- Normal striated appearance = Pitfall
 - Not a tear
- Fibrovascular connective tissue between the 2 lamina (ligamentum subcruentum)
 - Not a tear



TFCC Morphology

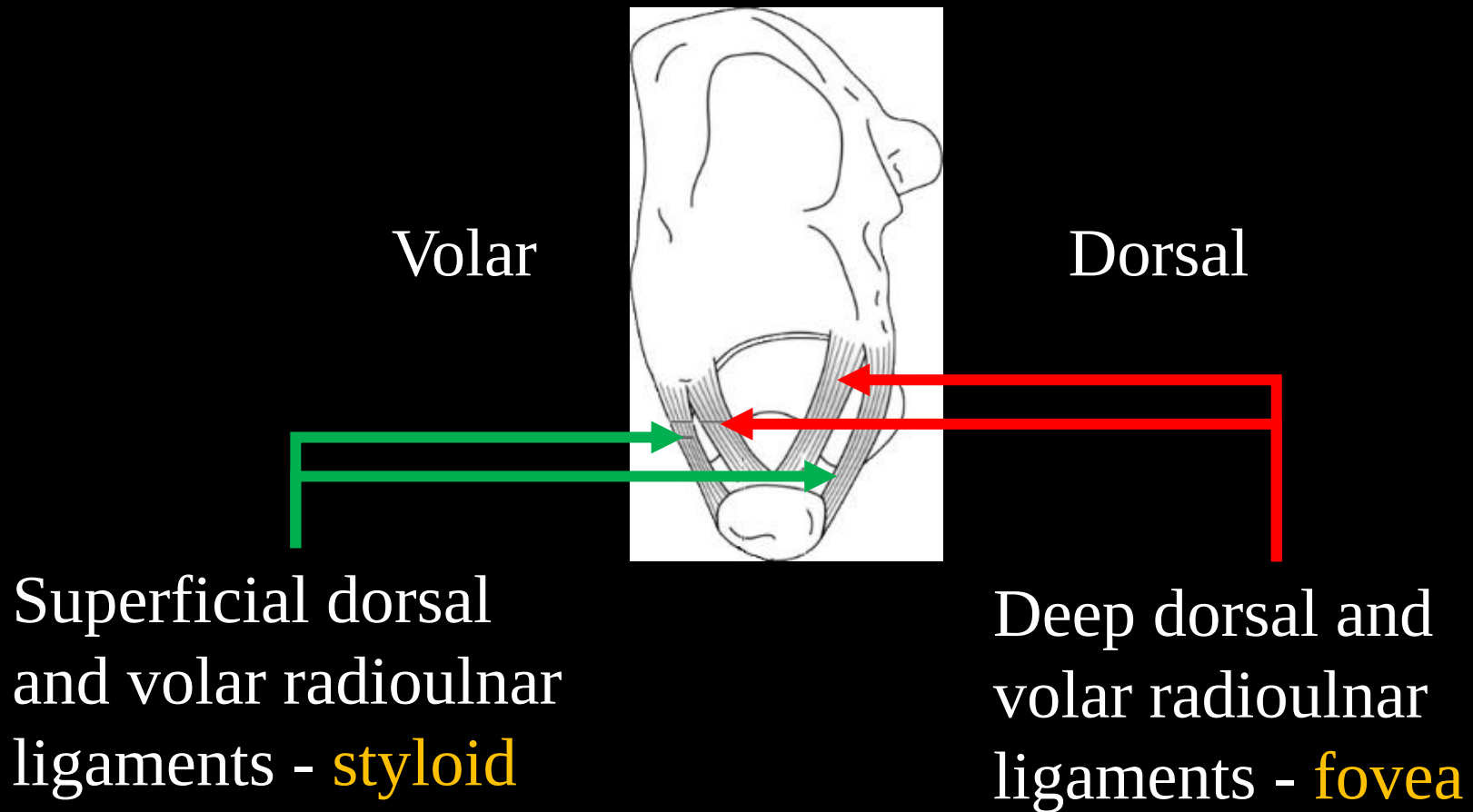


Neutral Variance



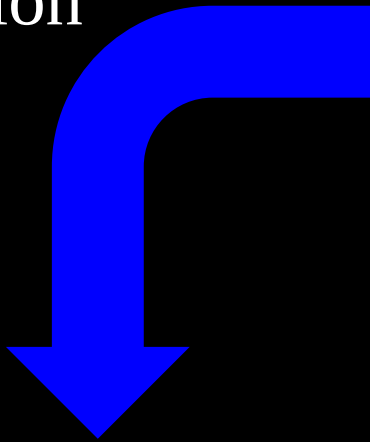
Negative Variance

TFCC – Ulnar Attachment

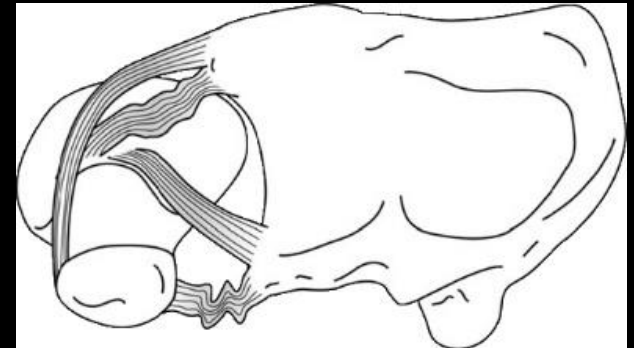
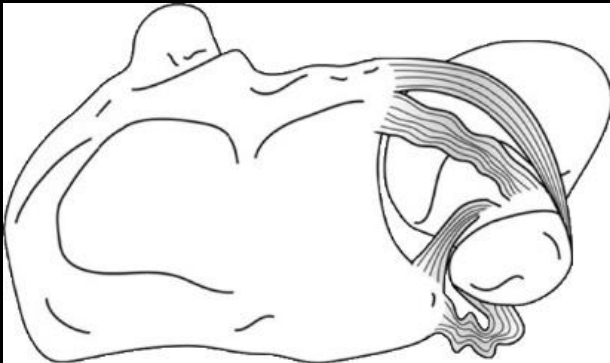
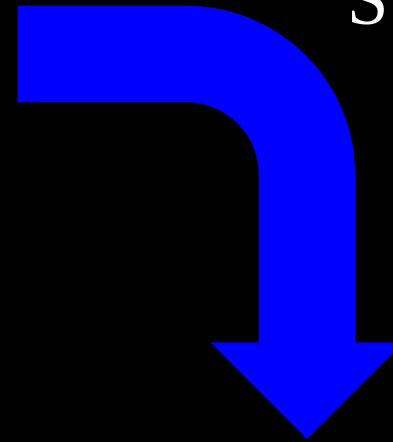


TFCC – Ulnar Attachment

Pronation



Supination



Athletes Stress of TFCC

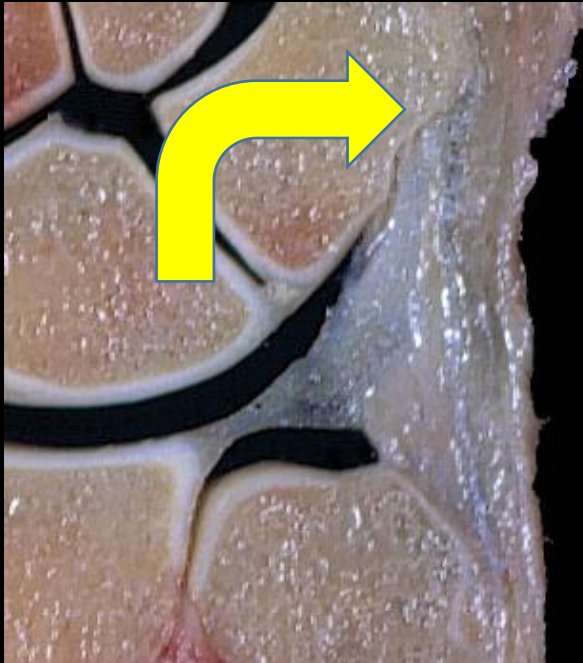


Axial Load

- Falling
 - football, rugby, basketball, etc.
- Weight bearing
 - Gymnastics, weight lifting, boxing
- Sliding into base
- Hitting boards in hockey



Athletes Stress of TFCC



Ulnar Deviation

- Swinging
 - Racquet
 - Bat
- Golf
 - Hitting the ground
 - Scooping



Athletes Stress of TFCC

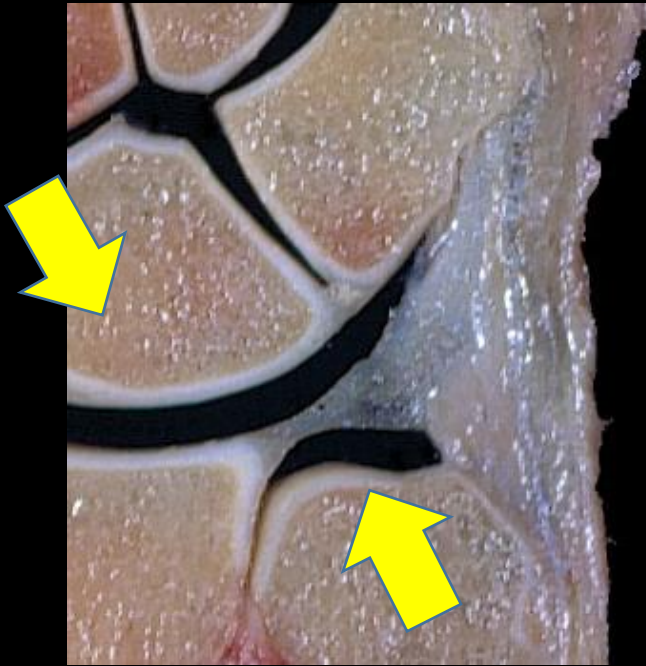


Forearm Pronation

- Swinging
 - Racquet
 - Bat
- Throwing a ball



Athletes Stress of TFCC

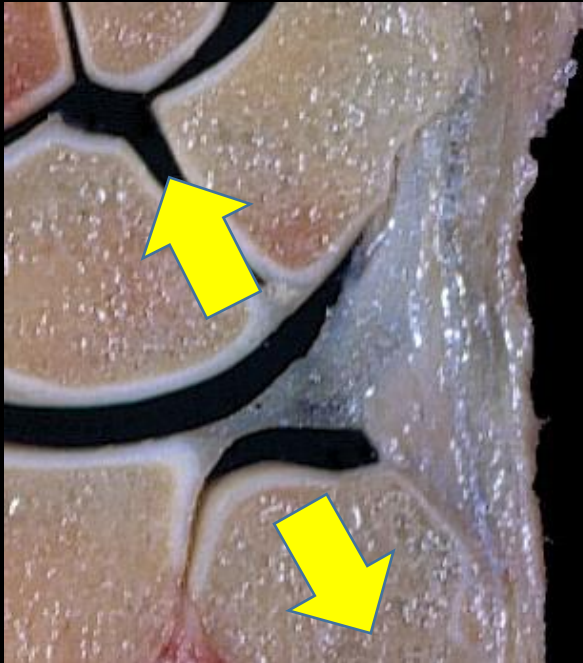


Forceful Grip

- Swinging
 - Racquet
 - Bat
- Throwing a ball



Athletes Stress of TFCC



Traction

- Waterskiing
- Rowing
- Weight-lifting
 - Rowing
 - Deadlift



TFCC Tears

- Mechanism
 - Repetitive microtrauma
 - Fall onto pronated wrist
 - Rotational injury
- Symptoms
 - Ulnar sided wrist pain
 - Clicking on pronation/supination

TFCC Classification

- Palmer I: Traumatic
 - IA: Avascular disk
 - IB: Base of styloid
 - IC: Carpal detachment
 - UTL or ULL
 - ID: Radial detachment
- Palmer II: Degenerative
 - Additive
 - IIA: Thinning of disk
 - IIB: + chondromalacia
 - IIC: + central perforation
 - IID: Lunotriquetral tear
 - IIE: Ulnocarpal arthritis
- Spectrum of ulnar impaction



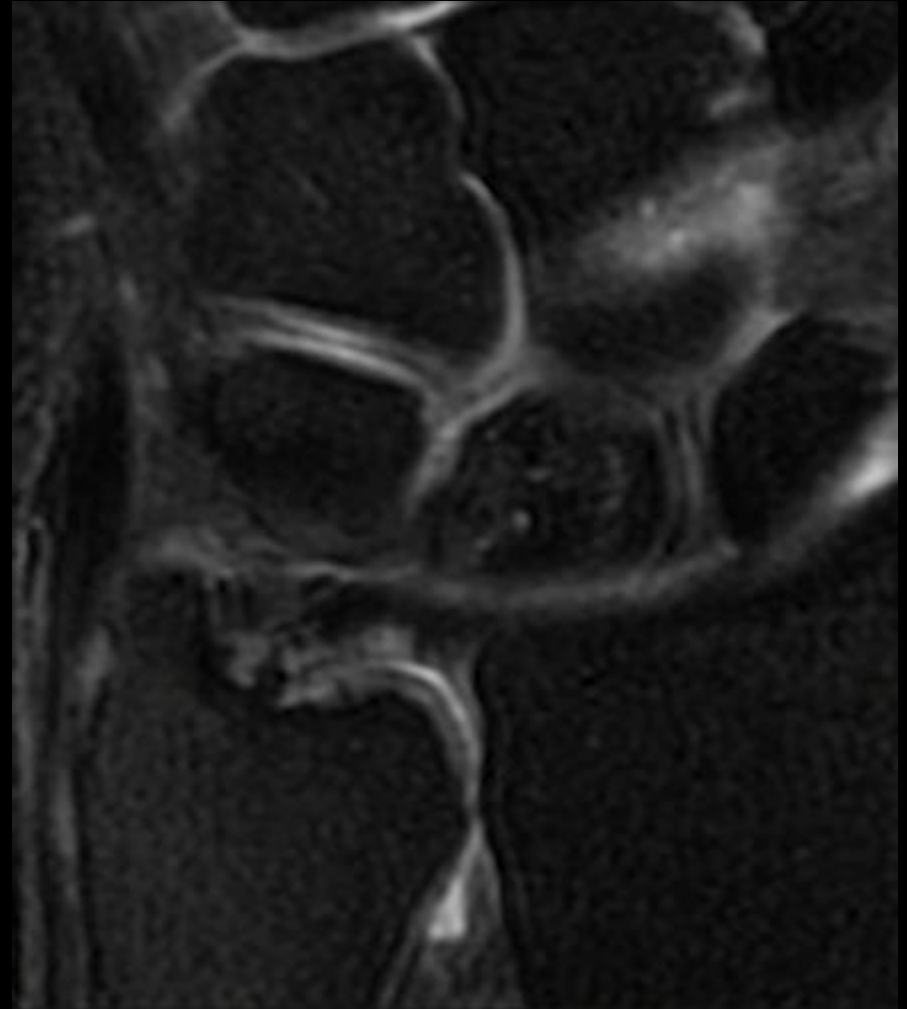
TFCC Tears – Articular Disc

- Perforation
 - Common
 - Often asymptomatic
 - Age dependent
 - Unusual < 25 years
 - > 50% by 70 years
 - Correlate clinically
- Tears
 - Non-healing
 - Debridement



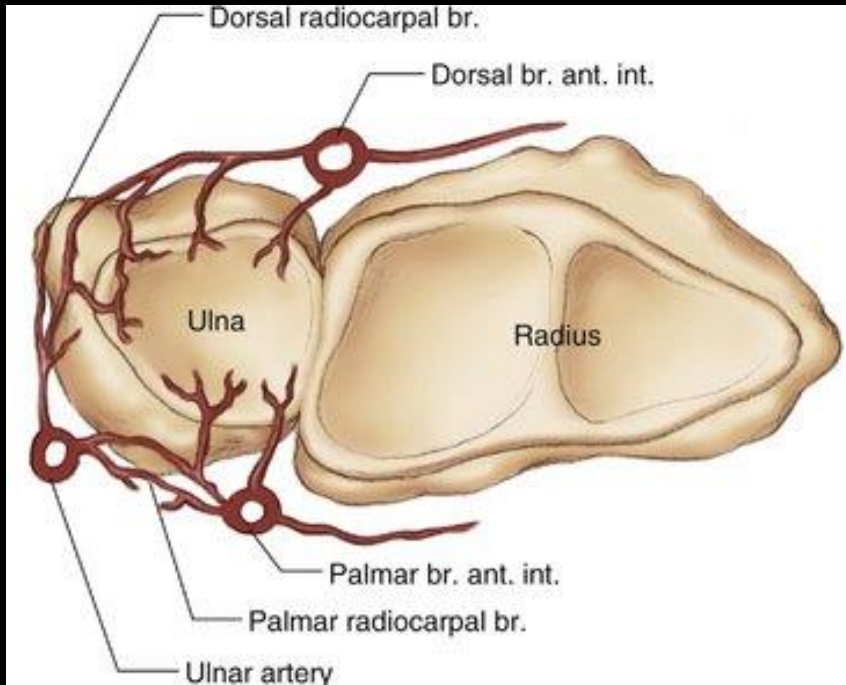
TFCC Tears – Articular Disc

- History: ulnar sided wrist pain
- Dx: Partial Tear of the proximal aspect of the TFC



PD Fat Sat

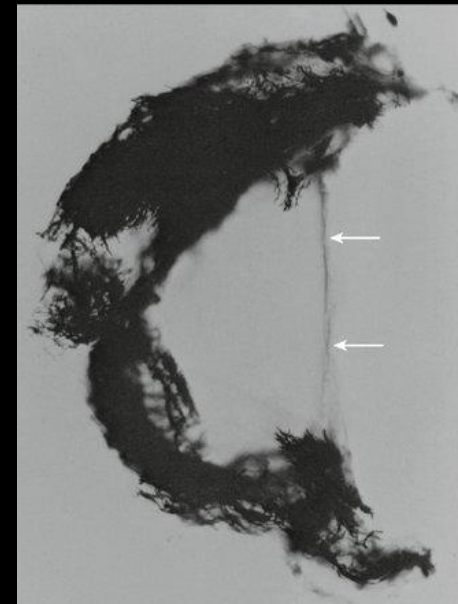
TFCC Blood Supply



Thiru-Pathi RG, et al.: J Hand Surg. 1986; 11A:261.

TFCC – Cadaveric angiogram

- vascular supply
 - periphery
 - avascular radial attachment (arrows)



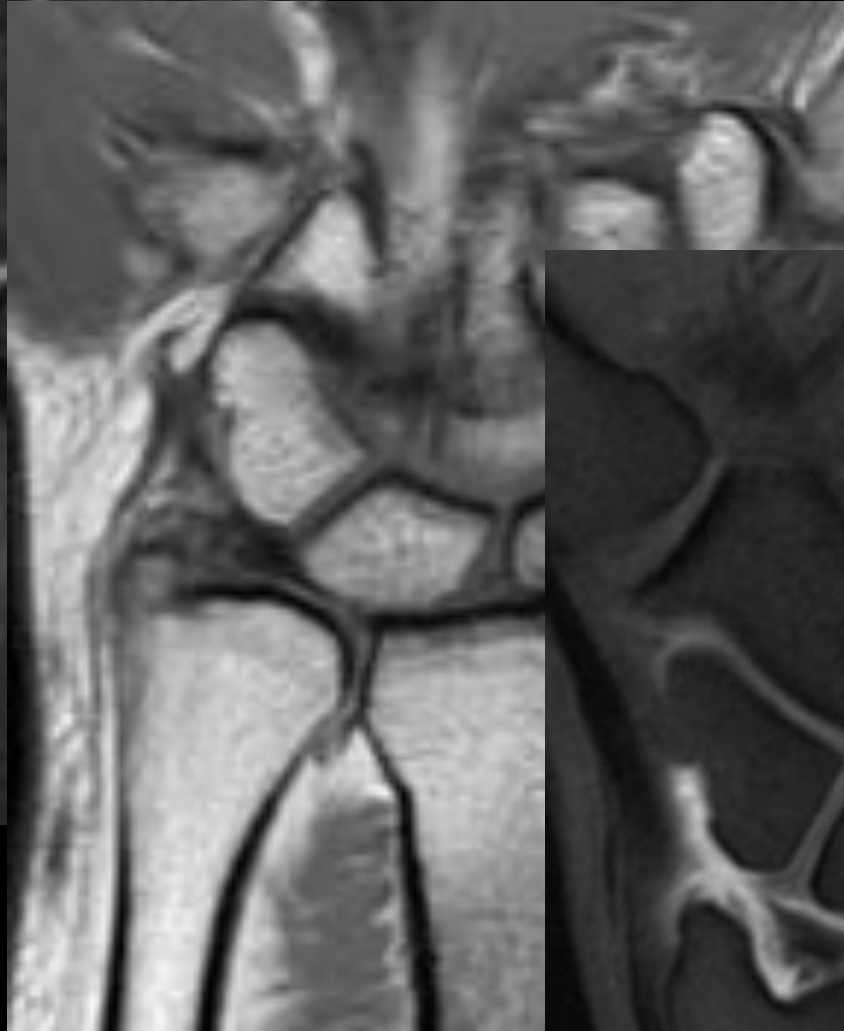
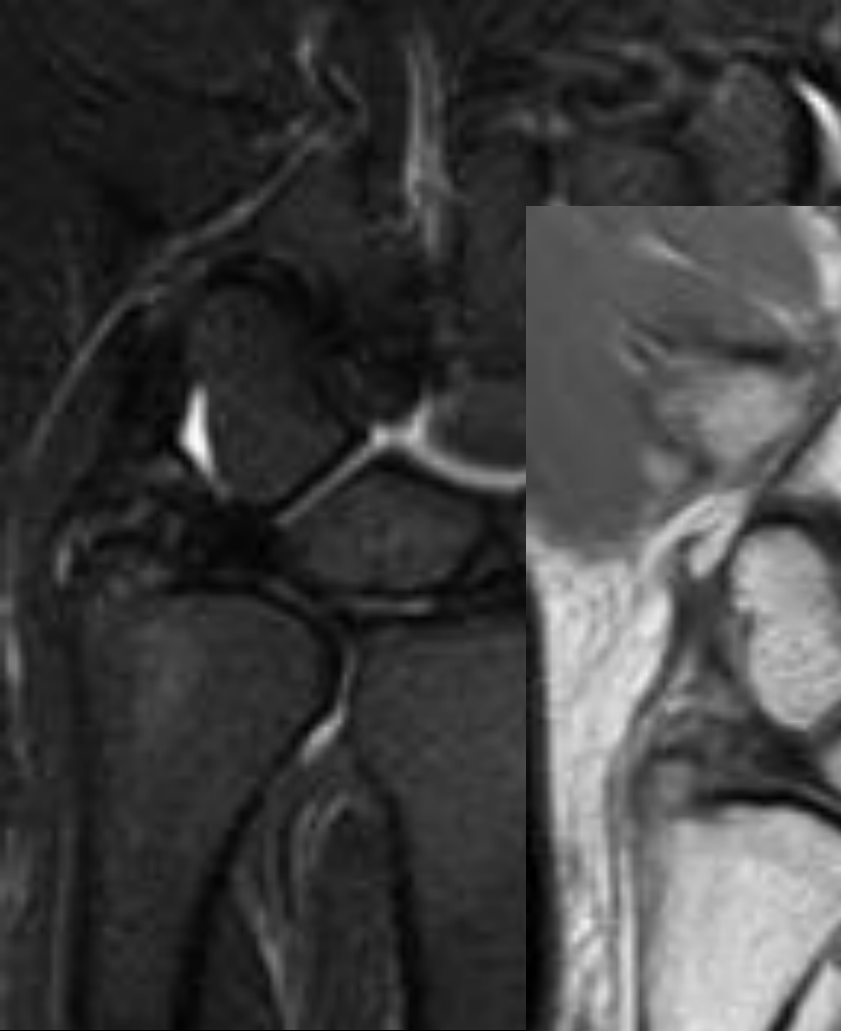
Bednar MS, Arnoczky SP, Weiland AJ: J Hand Surg. 1991; 16A:1103.

TFCC Tears – Ulnar-Sided Tears

- Foveal / styloid tears
 - Higher correlation with symptoms
 - Non-communicating tears
 - Arthroscopic blind spots
 - Loss of trampoline effect
- Vascular → repair



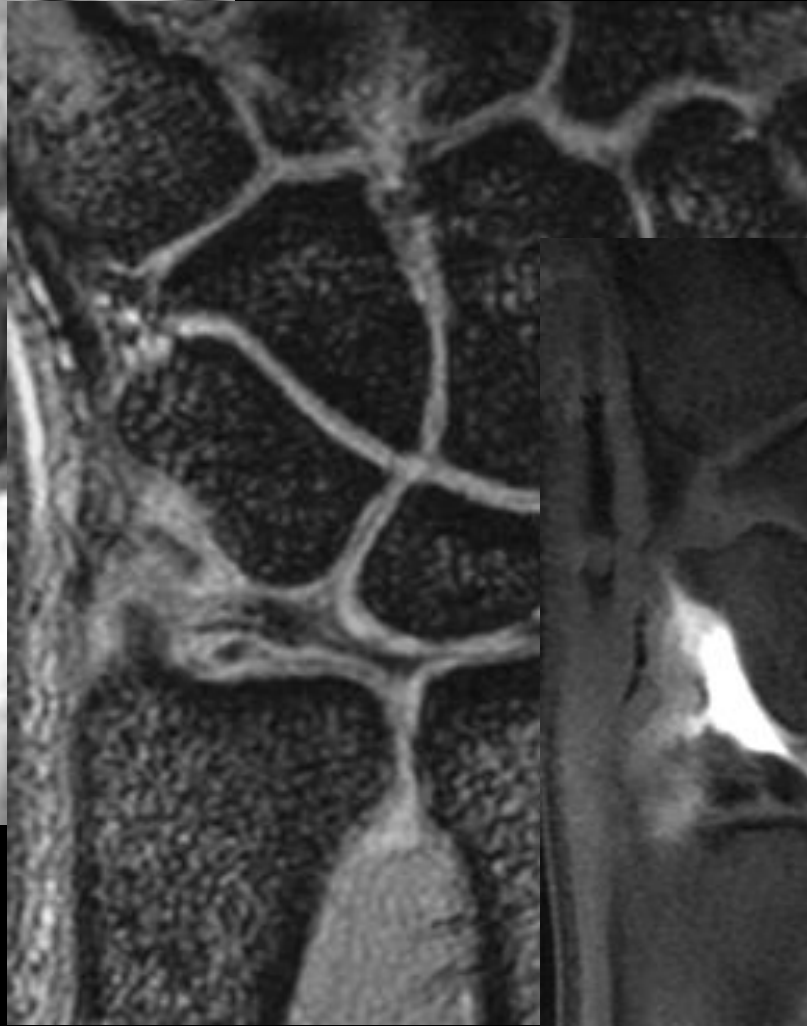
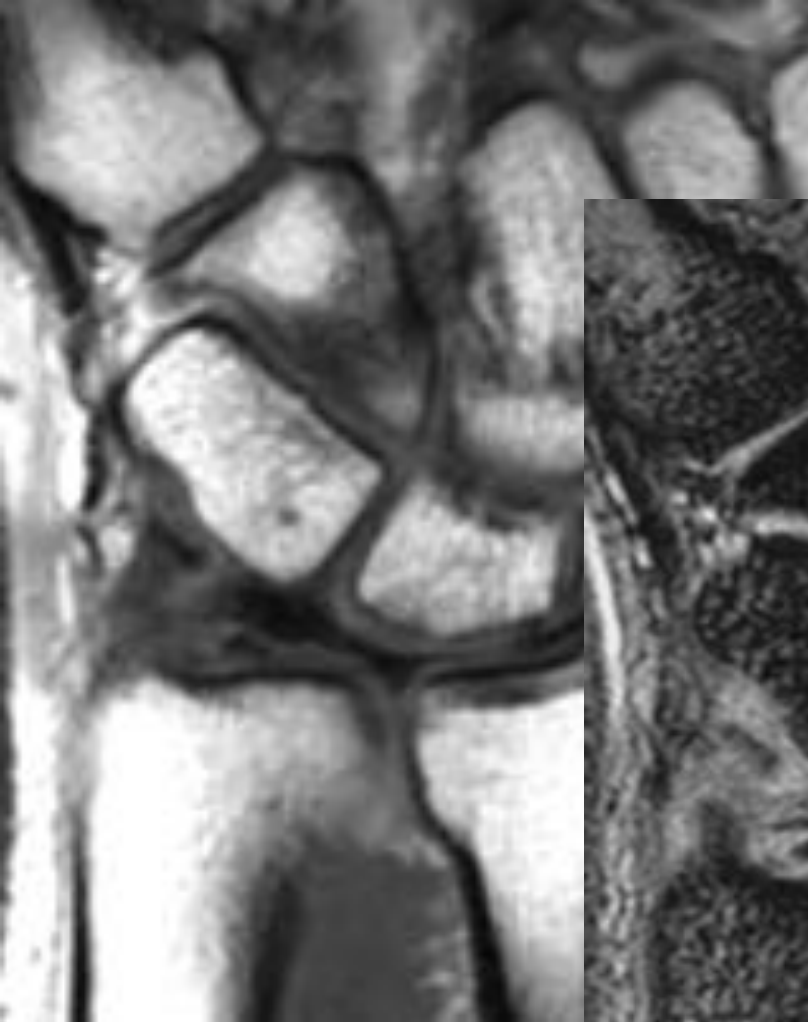
Case 1 Hx. Ulnar Sided Wrist Pain



Case 2 Hx. Ulnar Sided Wrist Pain



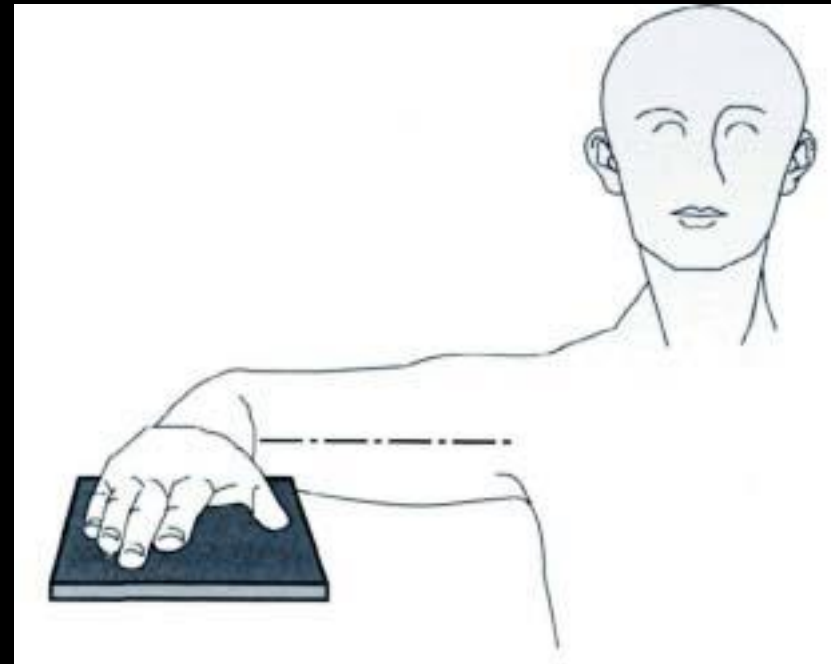
Case 3 Hx. Ulnar Sided Wrist Pain



More likely to be symptomatic than
central perforation

Ulnar Variance

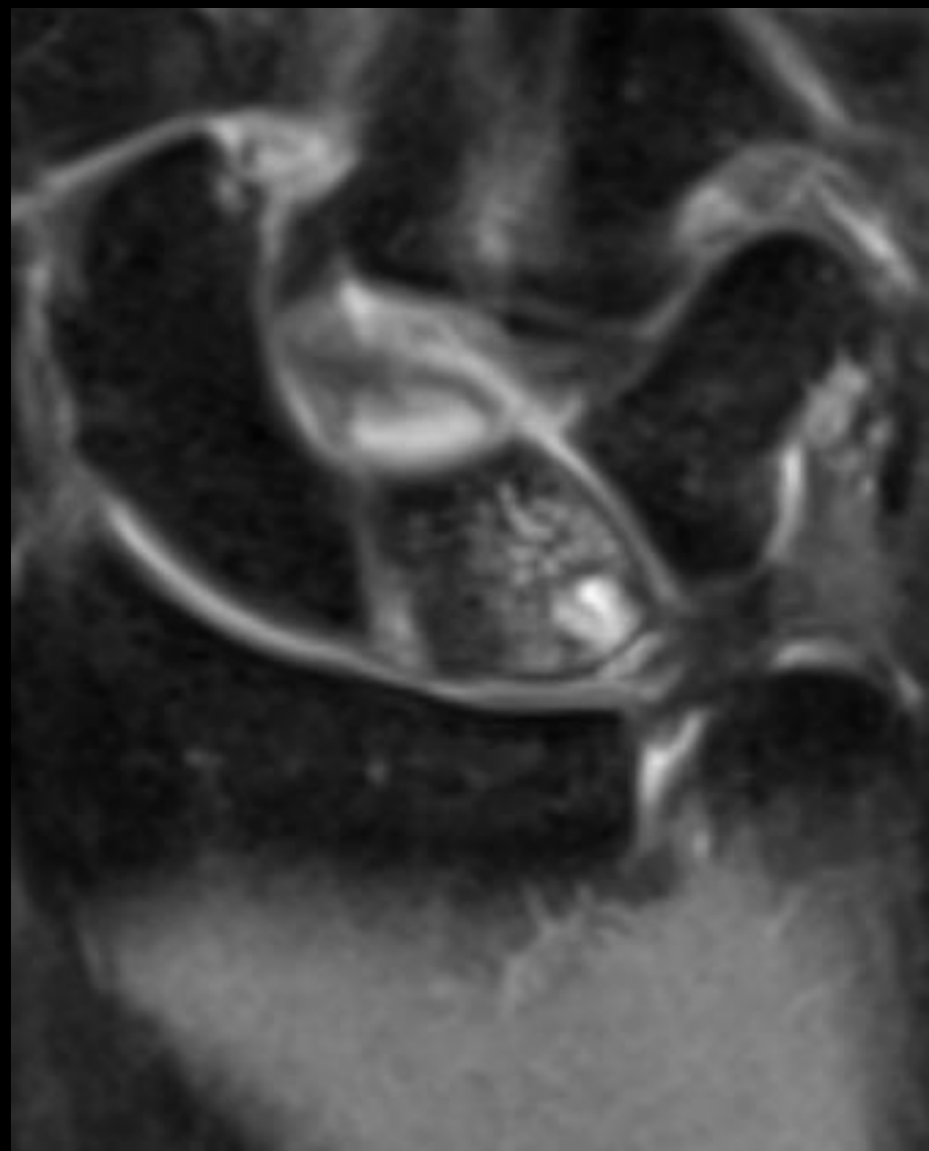
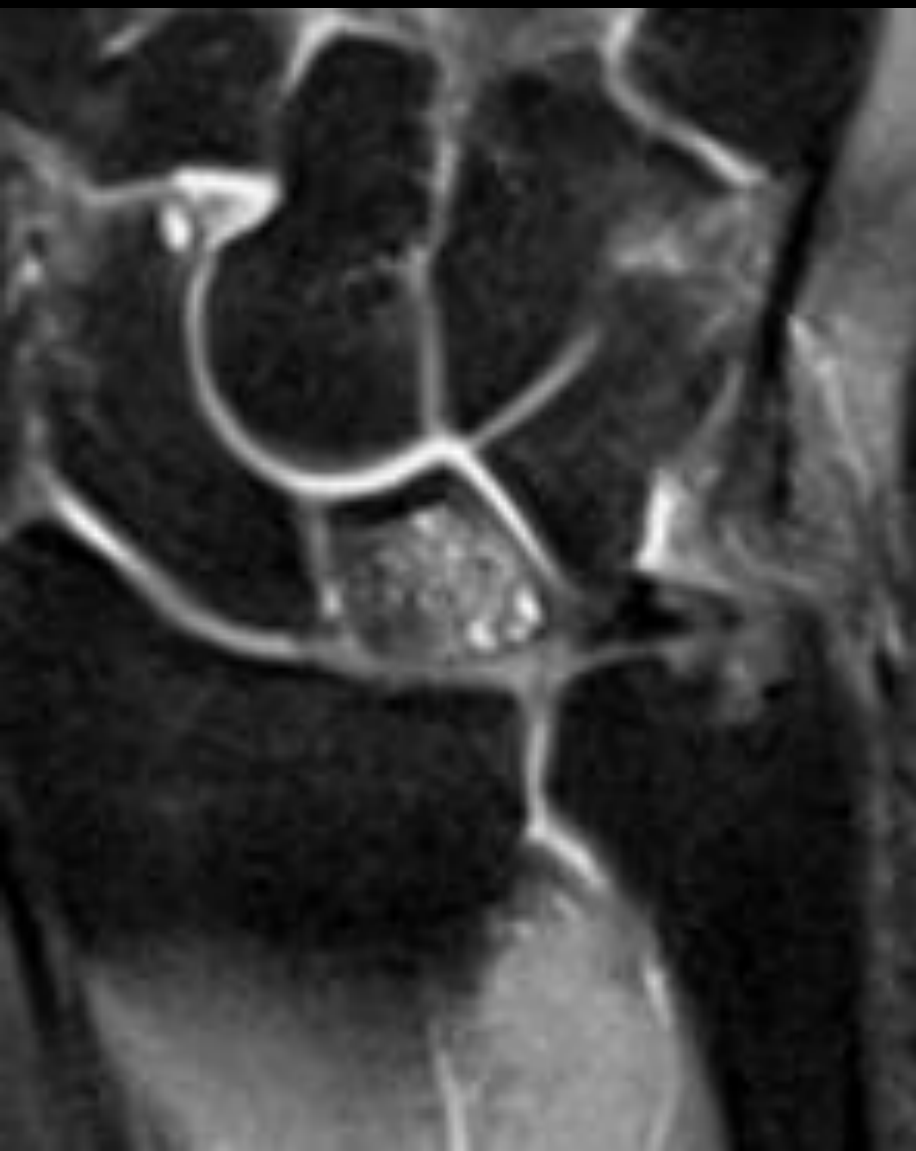
- Radiographic technique
 - Shoulder 90 degrees
 - Elbow 90 degrees
 - Wrist neutral
- Increase in ulnar variance
 - Pronation: 1mm
 - Grip: up to 4mm





Ulnocarpal Impaction

- Subacute/chronic pain:
 - Pronation
 - Power grip
 - Ulnar deviation
- Radiographic changes
 - Positive variance
 - Sclerosis
 - Cystic change
- MRI: early cases
 - Chondral changes
 - TFCC
 - LT ligament





Lunate Chondrosis

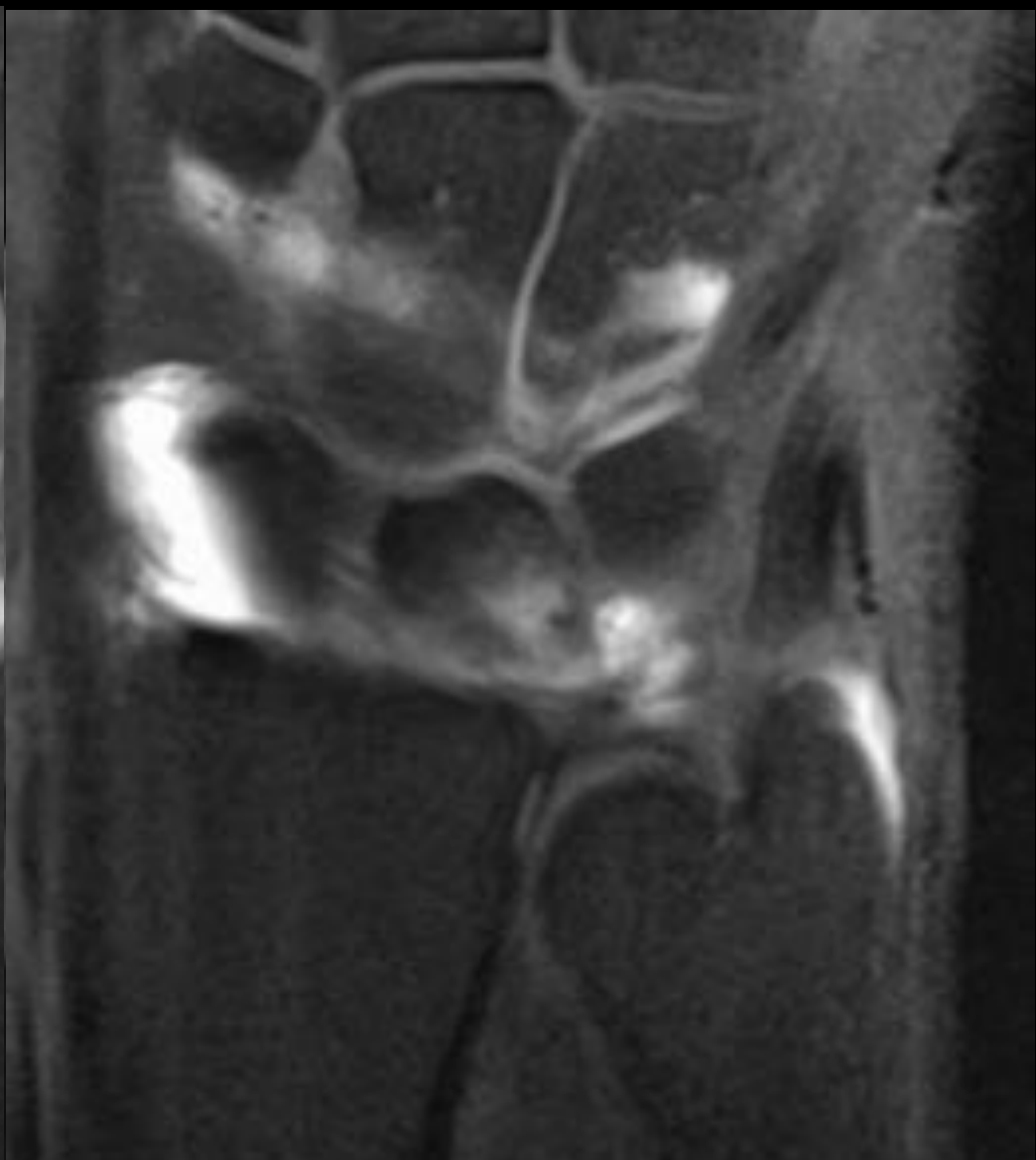
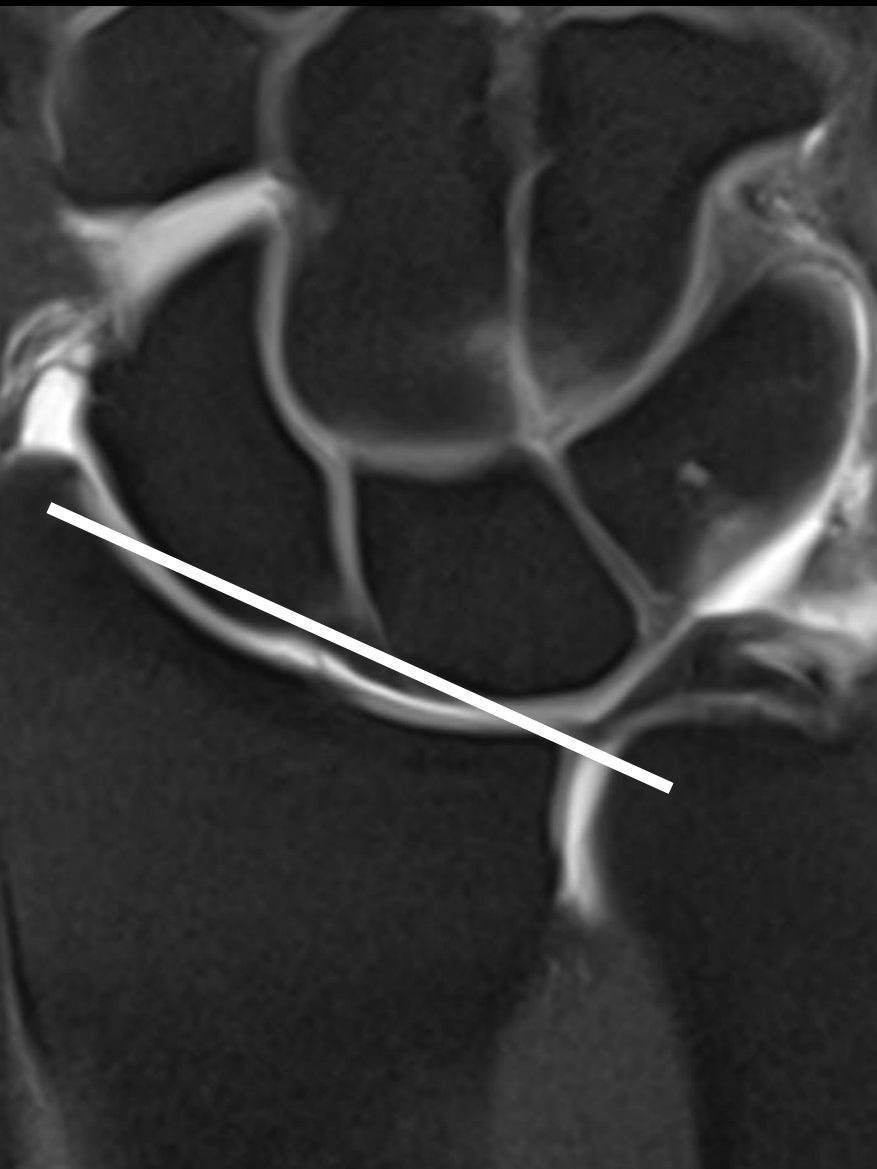
	Sensitivity	Specificity	Accuracy
Conventional MRI	100	90	97
Conventional MRI (Ulnar tears)	17	50	64
3T MRI	Confirmation of tear Exclude other injuries		
MR Arthrography	97	97	96
MR Arthrography DRUJ Injection (Ulnar tears)	85	76	80

Evaluation of TFCC Injury on MRI

- Partial vs. Full Thickness (perforation)
- Describe the location
- Report cartilage abnormalities, osseous cystic changes and arthritis
- Evaluate the lunotriquetral ligament

Scapholunate Ligament

- U-Shaped
- 3 components
 - Dorsal: **Most important, thickest**
 - True ligament
 - Membranous:
 - Triangular on coronal, thinnest, fibrocartilage
 - May have perforations without instability
 - Volar: thin
 - True ligament
- Torn in scapholunate instability



Scapholunate Ligament

- Optimal Detection of Scapholunate Ligament Tears with MRI
 - Retrospective study
 - Wrist MR and OR
 - Most cases had partial thickness volar/membranous tears

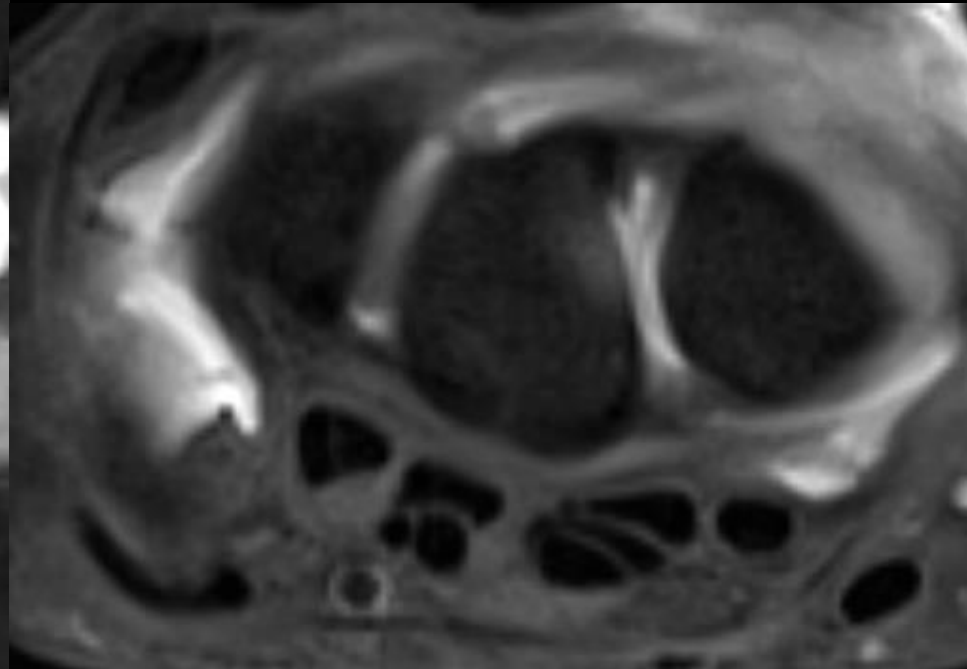
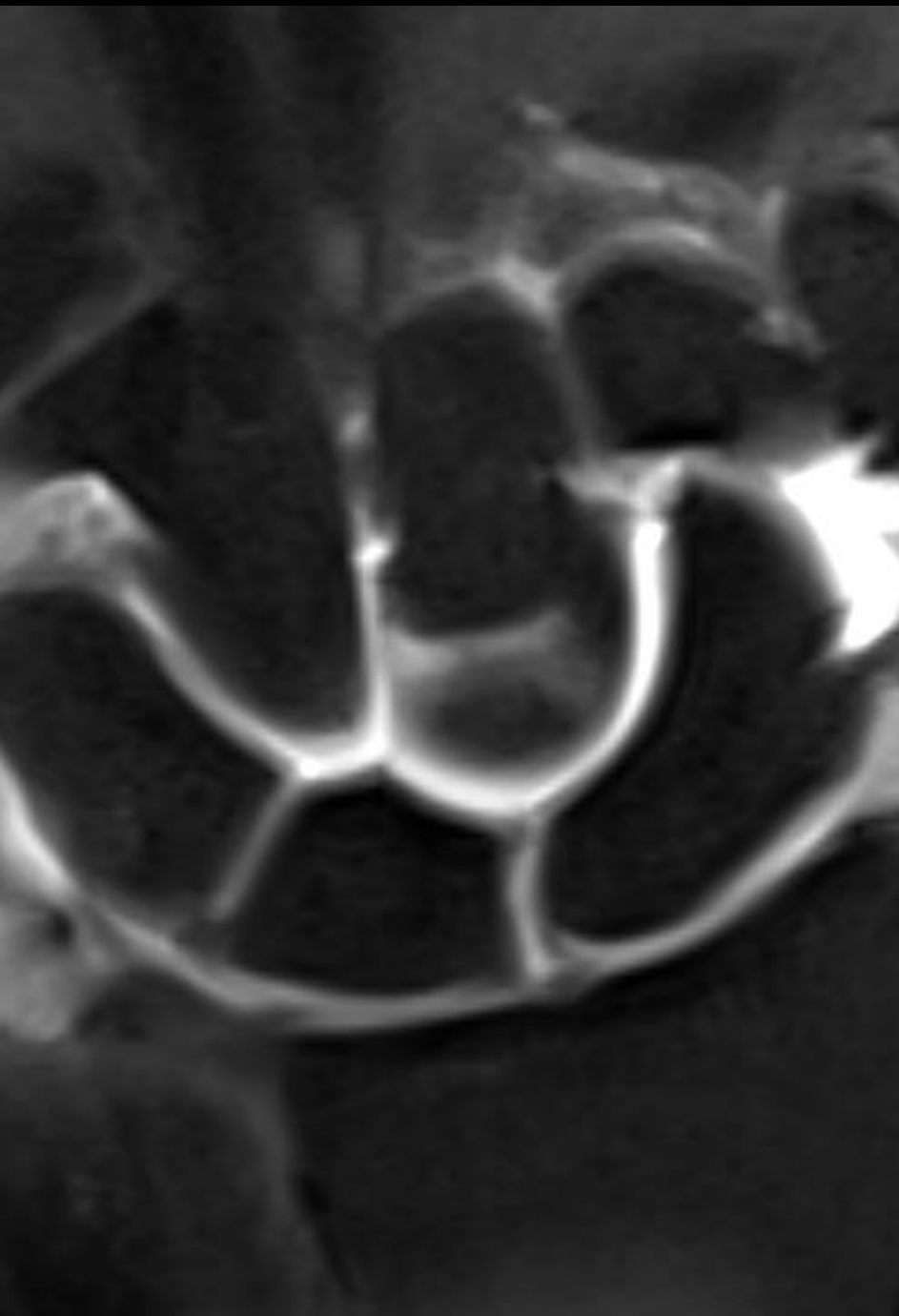
Table 1. Scapholunate interosseous ligament positive cases at arthroscopy and surgery.

Patients	Type of tear	SLIL location of tear
Case 1	Partial thickness	Volar
Case 2	Partial thickness	Volar and membranous
Case 3	Partial thickness	Volar
Case 4	Partial thickness	Volar and membranous
Case 5	Focal full-thickness	Dorsal
Case 6	Complete	Dorsal, membranous, and volar
Case 7	Partial thickness	Volar
Case 8	Partial thickness	Volar and membranous
Case 9	Partial thickness	Volar and membranous
Case 10	Partial thickness	Volar and membranous
Case 11	Focal full-thickness	Volar and membranous

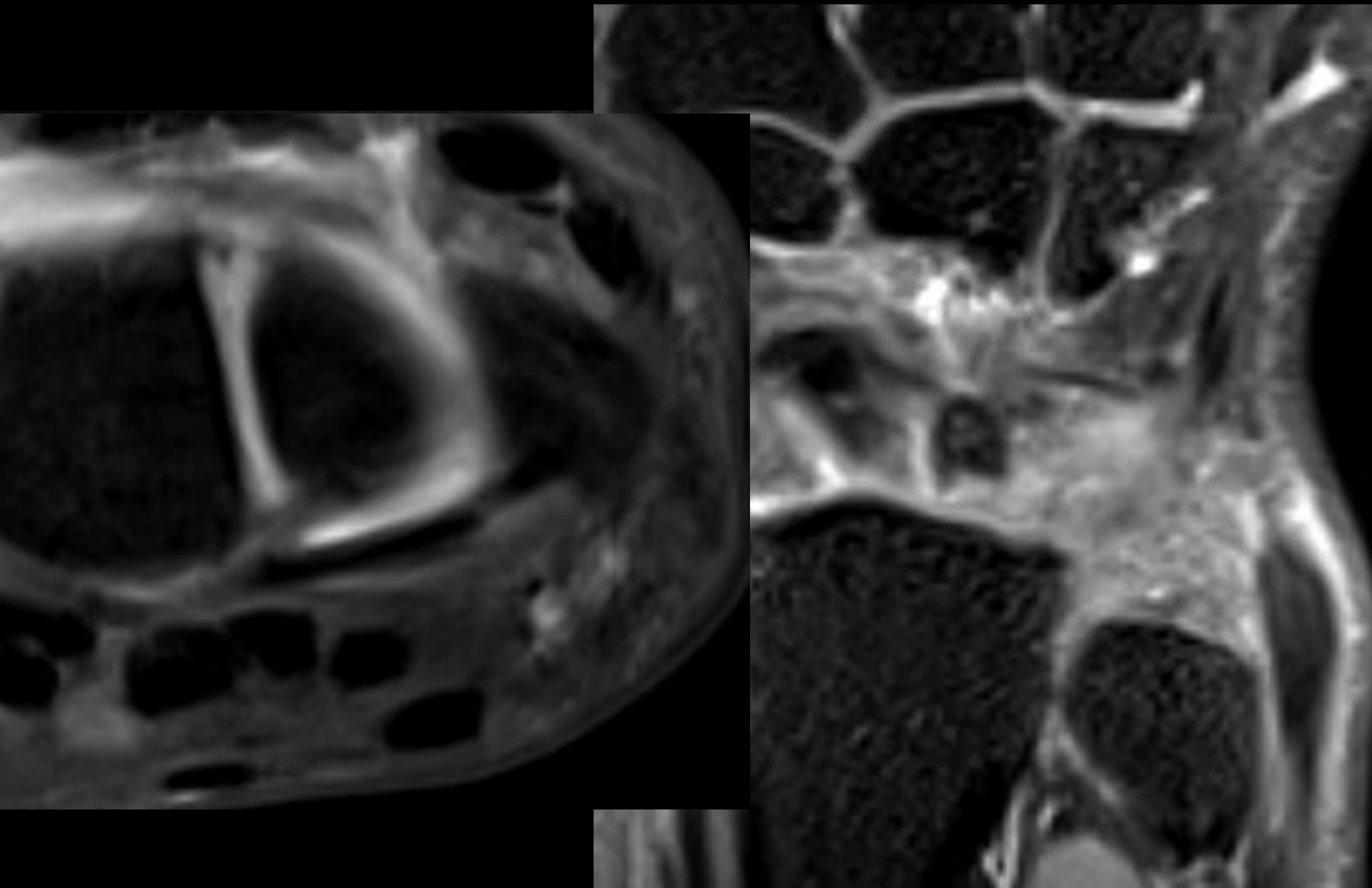
Scapholunate Ligament

- Optimal Detection of Scapholunate Ligament Tears with MRI
 - 26 participants – 11 patients and 15 “normals”

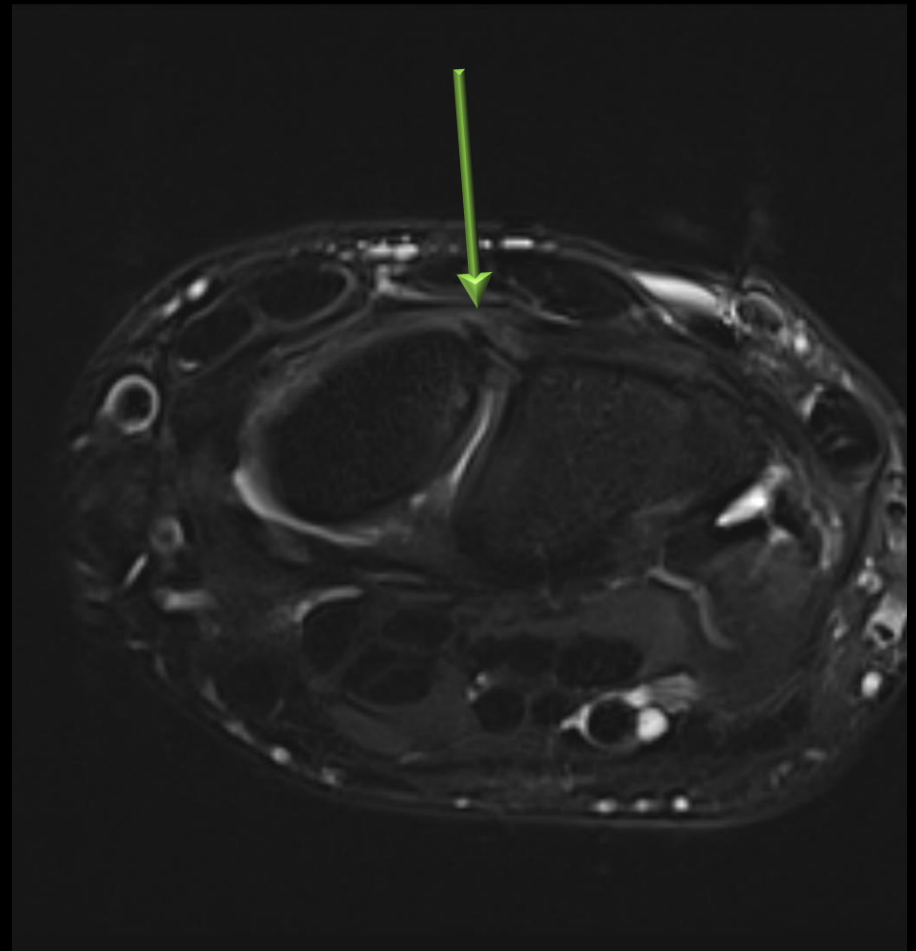
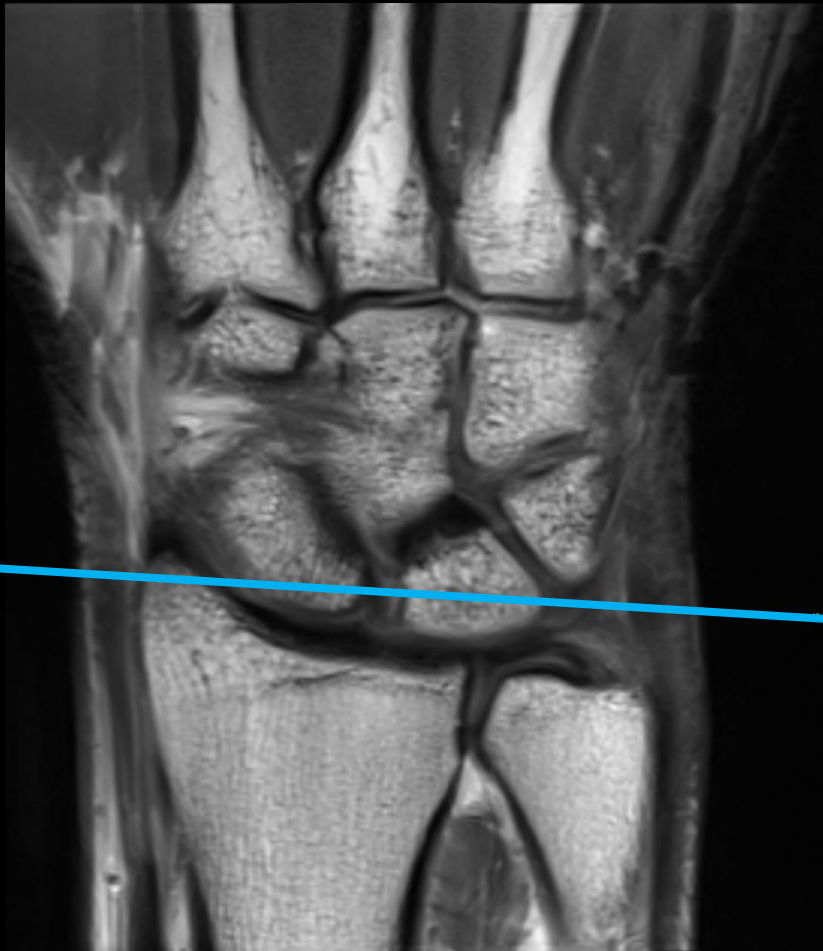
Plane	Sensitivity	Specificity	Accuracy
Coronal	65	69	67
Axial	79	82	80



Membranous Tear



Dorsal & Membranous Tear



Dorsal Tear

Scapholunate Instability

- Most common form of carpal instability
- Isolated tear or with fractures
- Stages
 - Scapholunate dissociation
 - Rotary subluxation
 - Dorsal intercalated segmental instability (DISI)
 - Scapholunate advanced collapse (SLAC)
- +/- tears RSC ligament

Diastasis: $>4\text{mm}$

Ulnar
translocation of
the lunate

Usually need
extrinsic ligament
injury as well



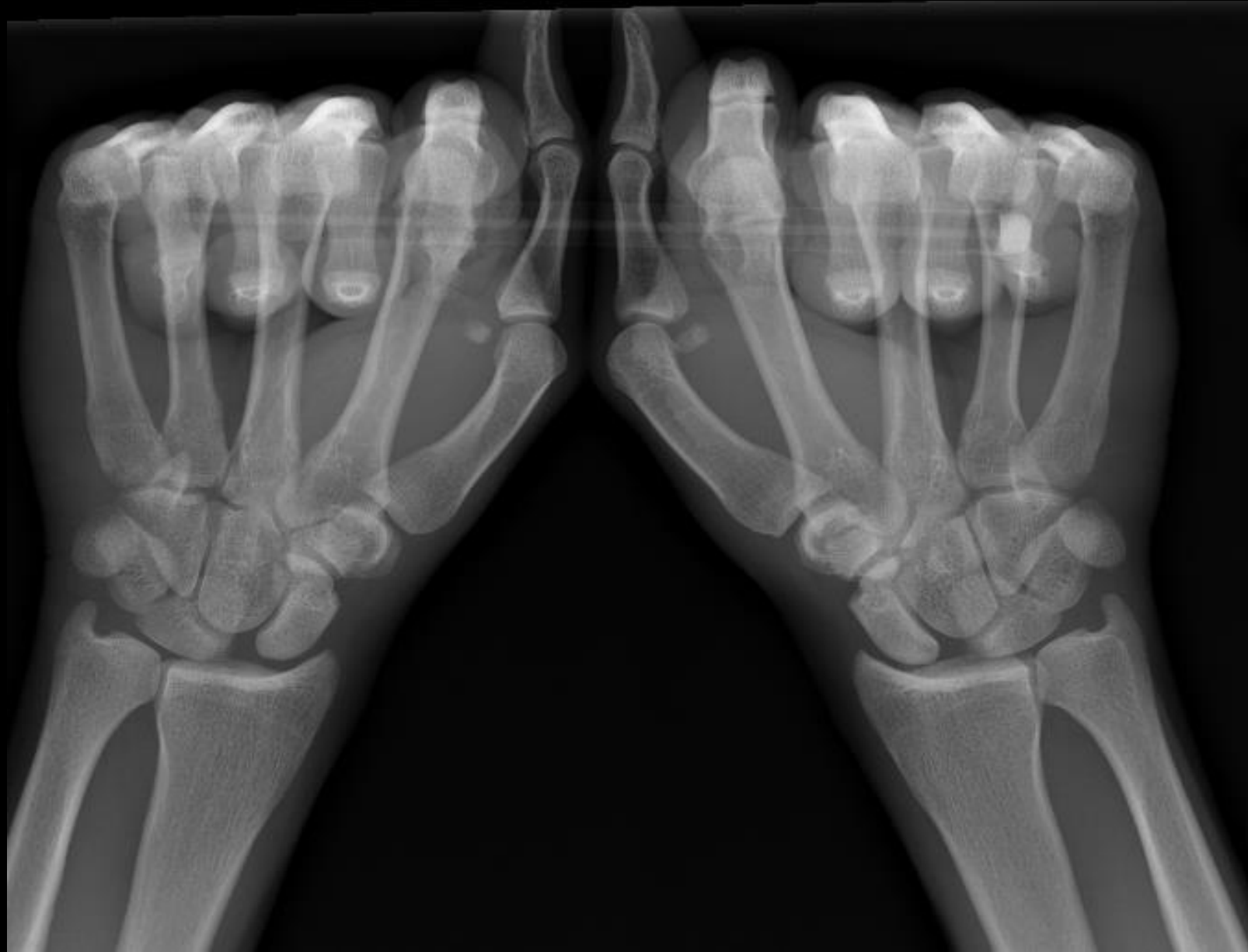
Scapholunate dissociation



normal



SL widening



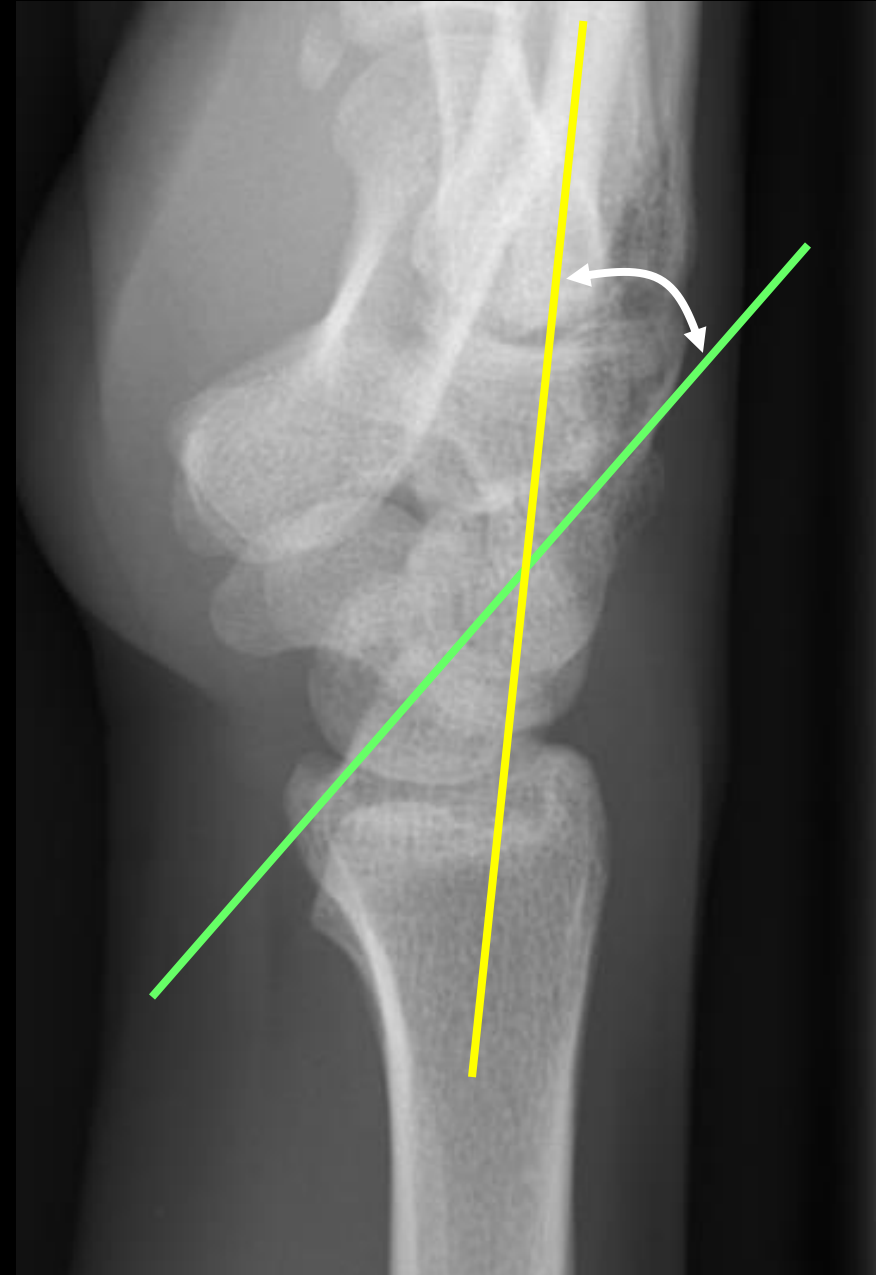
DISI

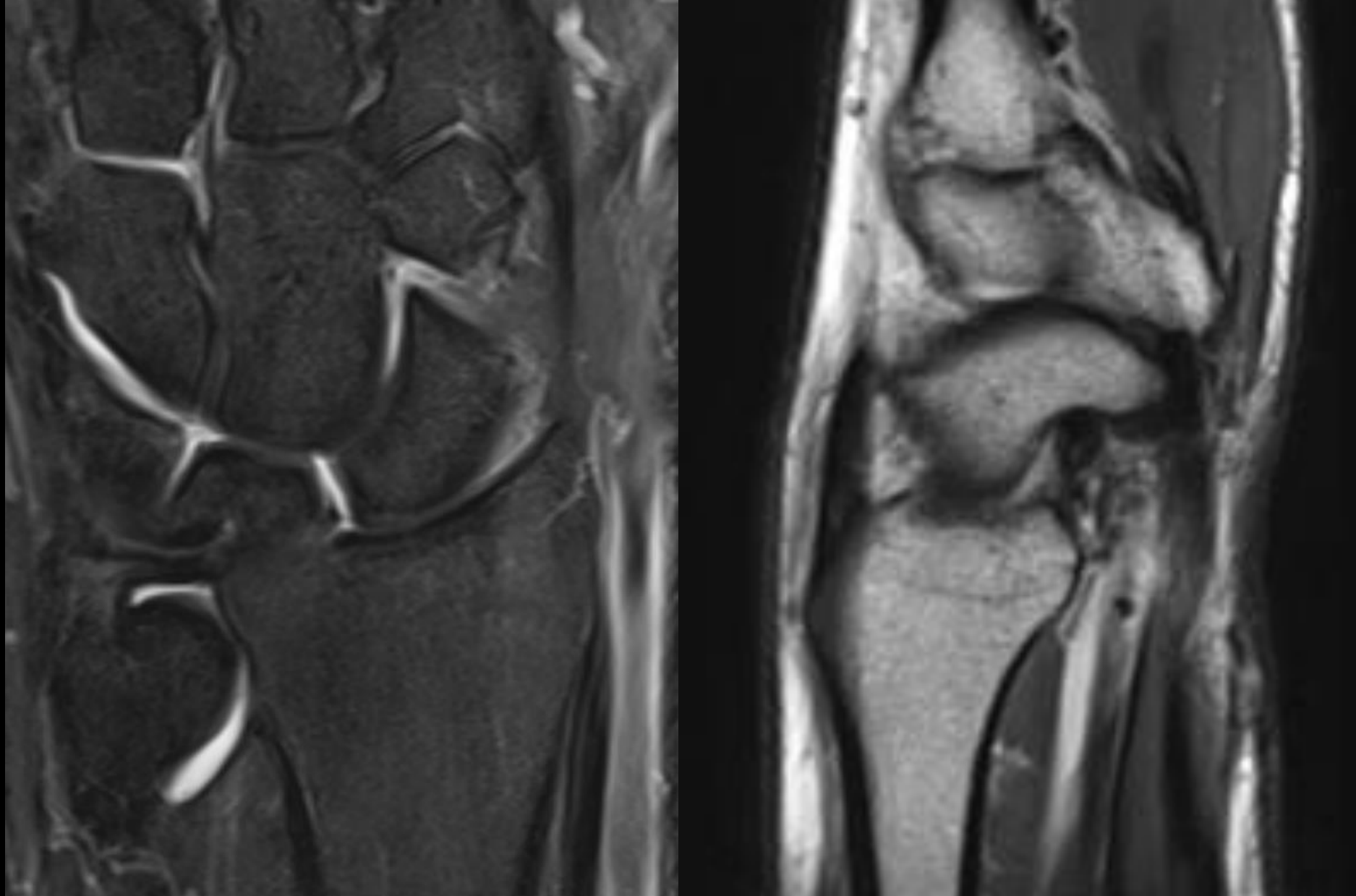
- Dorsal intercalated segment instability
- Lunate is tilted dorsally
- Scapholunate angle $> 80^\circ$
- Questionable between $60-80^\circ$



DISI

- Dorsal intercalated segment instability
- Lunate is tilted dorsally
- Scapholunate angle $> 80^\circ$
- Questionable between $60-80^\circ$
- Capitollunate angle $> 30^\circ$





Note: Lunate tilts dorsally in ulnar deviation

SLAC Wrist

- Progressive degenerative change secondary to SL tear
- Severe radioscaphoid joint space loss
- Proximal migration of capitate



Scapholunate Ligament Injury

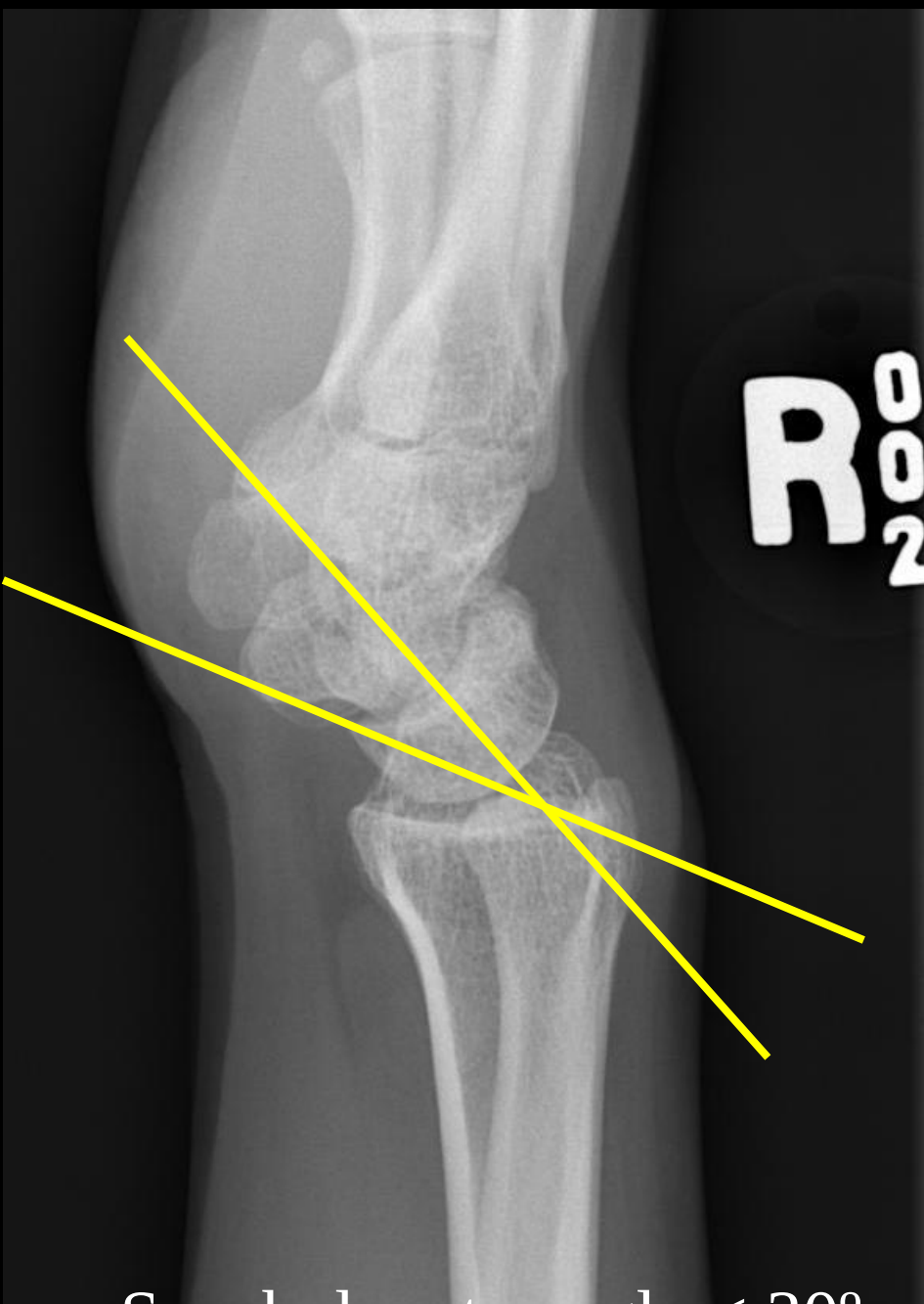
- Diagnosis of tears on MRI
 - Fluid signal traversing the ligament
 - Morphologic distortion or absence
- Include in report
 - Partial vs. complete
 - Location
 - Dorsal, membranous, or volar
 - Chondral, osseous, (alignment) abnormalities



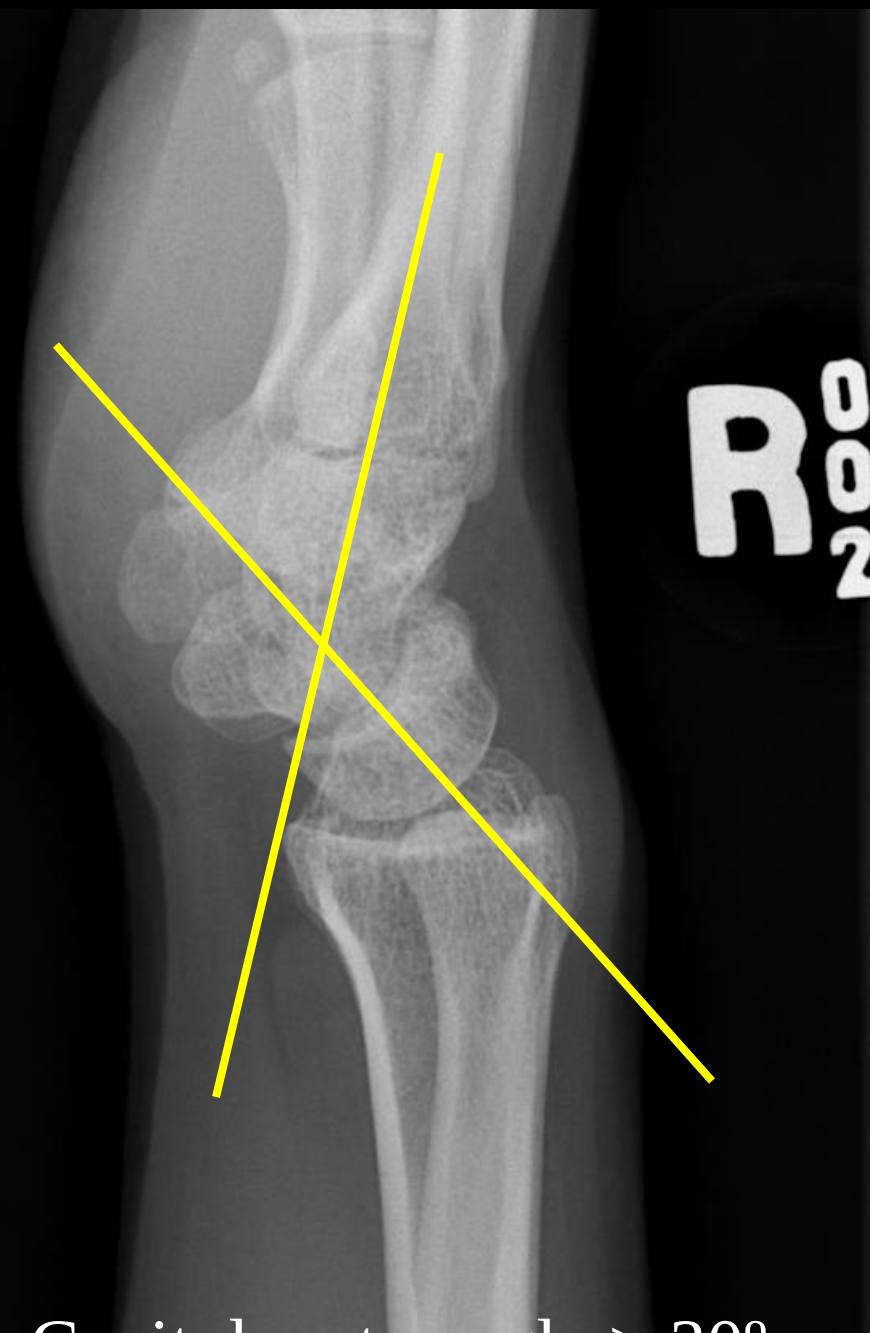
Lunotriquetral Instability

- U-shaped
- Components
 - **Dorsal:** thin collagen fibers
 - restraint to rotation
 - Membranous
 - fibrocartilage
 - **Volar:** thick collagen fibers
 - restraint to translation
- Fibers from ulnotriquetral lig.





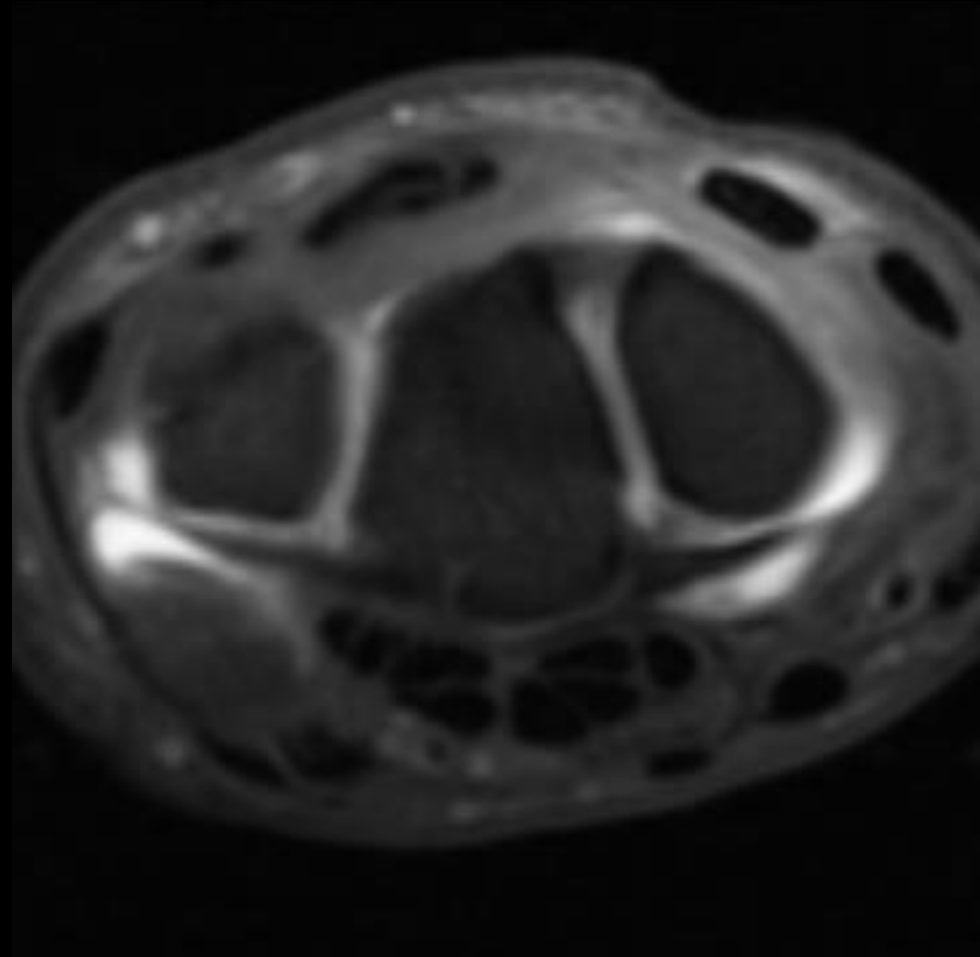
Scapholunate angle $< 30^\circ$



Capitulum angle $> 30^\circ$

Lunotriquetral Instability

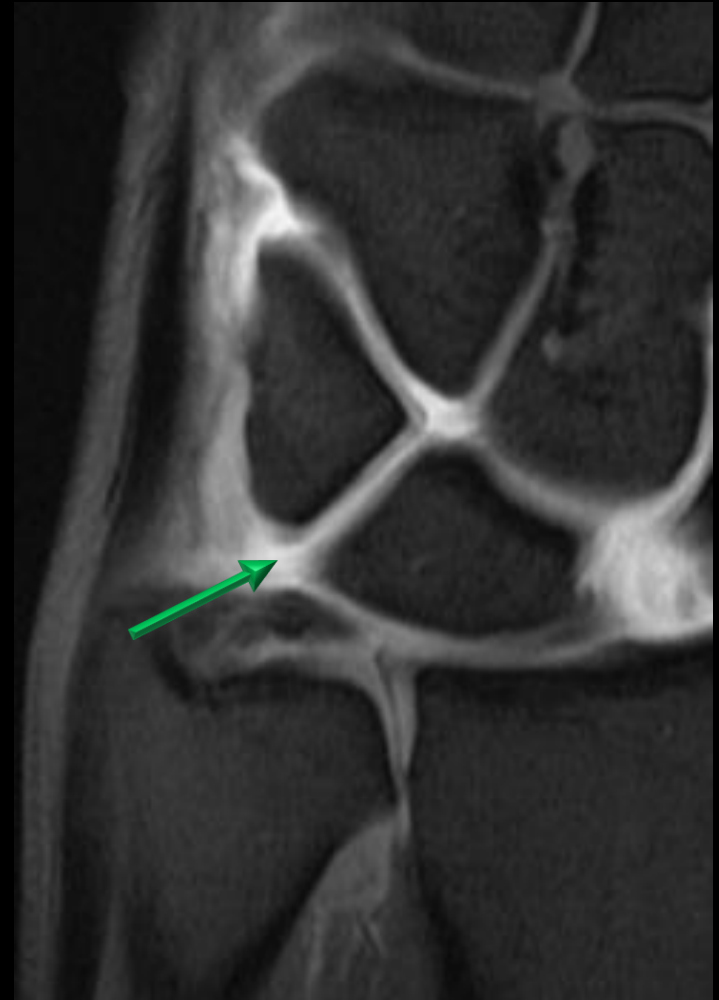
- MRI
 - MR arthrography > conventional MRI
 - Communicating tear
 - ?non-visualization of ligament
 - Accuracy ~50%





Lunotriquetral Ligament Injury

- Diagnosis of tears on MRI
 - Difficult
 - Fluid signal traversing the ligament
 - Morphologic distortion or absence
- Include in report
 - Presence of tear
 - Location
 - Chondral, osseous, TFCC abnormalities



Conclusion

- Capsular ligaments – difficult to assess on MR
 - Dorsal: Dorsal intercarpal and dorsal radiocarpal
 - Volar: RSC, long RL
- TFCC
 - Variable accuracy of standard MRI
 - Exclude other causes of ulnar sided pain
 - Perforations common in older patients
 - Consider MR arthrography
 - Degenerative / ulnar impaction more common

Conclusion

- SL instability
 - Continuum of changes
 - Dorsal band – most important
- LT instability
 - LT ligament not as well visualized
 - MR arthrography
- Most obvious component often least important clinically
- Don't forget the axials for SL and LT