# AMSER Radiology Case of the Month April 2021

## Wrist Pain

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# Patient Presentation

Chief complaint: Persistent left wrist pain

History of present illness: Patient is a 48-year-old female with no significant PMH who presented to her PCP with daily intermittent pain in her left wrist. She reports a recent history of multiple traumas to her left wrist. Inciting injuries to the wrist were characterized as hyperextension.

# Patient Presentation

Past medical history: GERD, depression, anxiety, fibromyalgia

Review of systems: Joint pain, swelling, and restricted motion in left wrist; Numbness, tingling, and burning sensation in left wrist

Physical exam: Swelling of left thumb carpometacarpal joint, as well as dorsally on radial aspect of the wrist, with significant tenderness; decreased left wrist range of motion, with palmar flexion of 50 degrees and dorsiflexion of 60 degrees compared to 70 degrees on right; decrease in radial and ulnar deviations on left wrist compared to right

Labs: None

Imaging: Previous imaging attained on 09/2020

# Previous Imaging

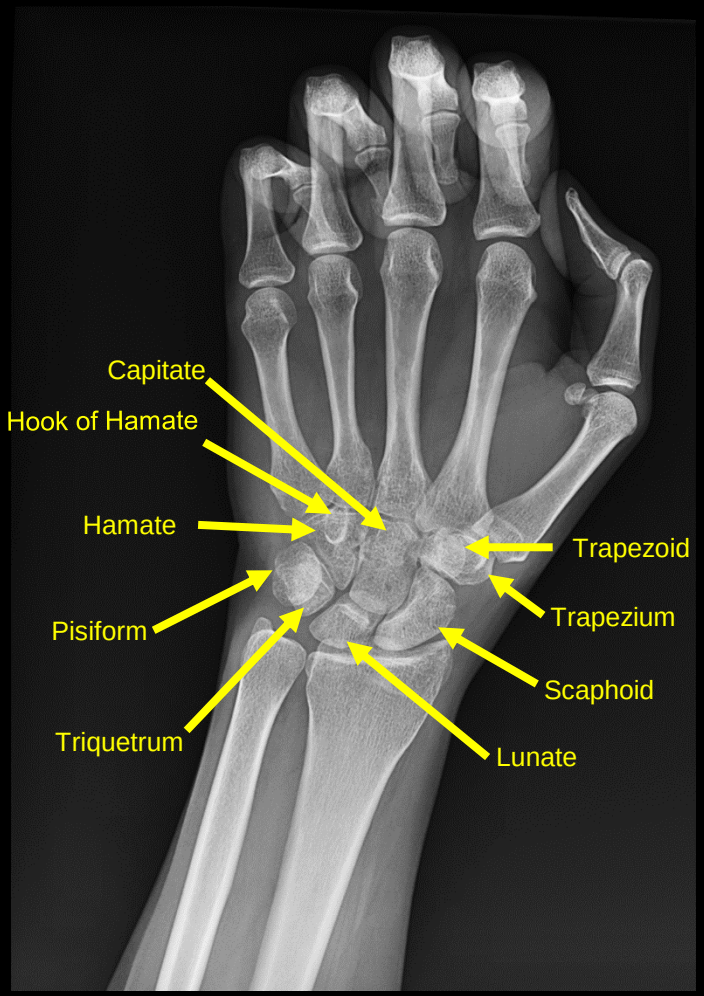
Posterior-Anterior Radiograph

Lateral Radiograph

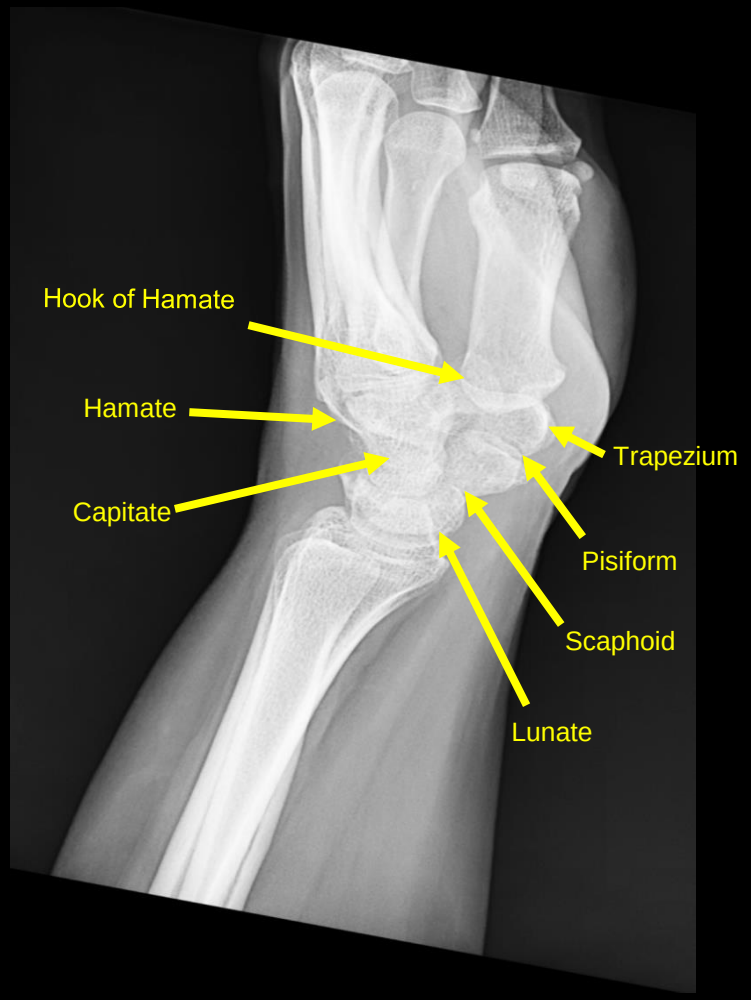
Oblique Radiograph

# Previous Imaging

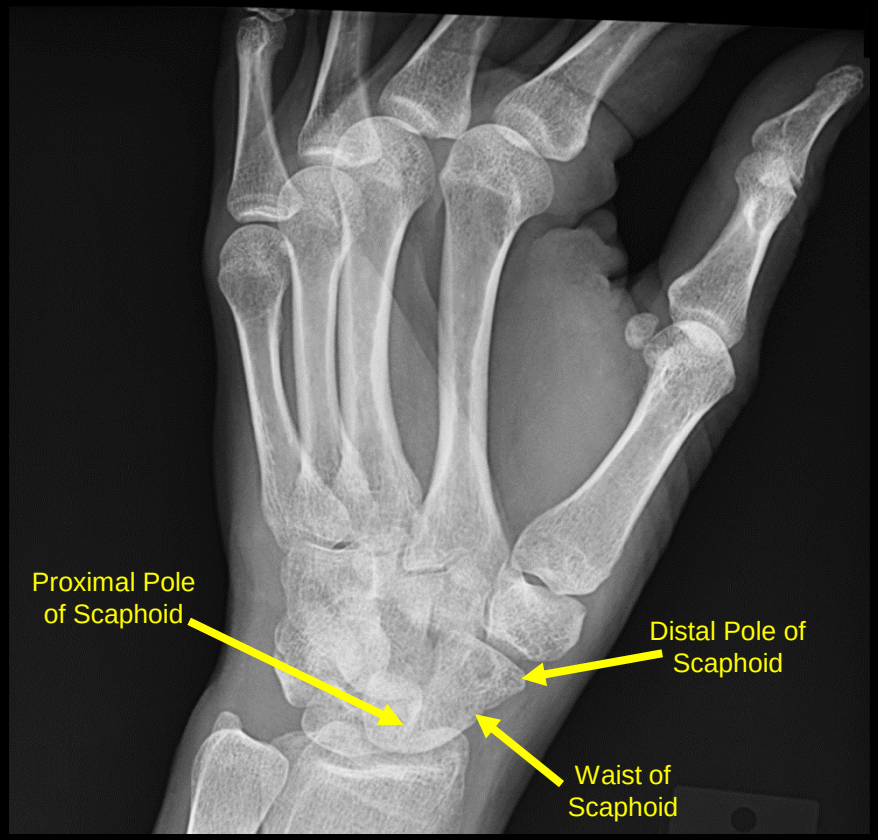
Posterior-Anterior Radiograph




Lateral Radiograph




Oblique Radiograph



# Previous Imaging

X-ray wrist 3+ views left (09/2020): No fracture, dislocation, nor joint space abnormality. No bony defects nor soft tissue abnormalities are seen.

What imaging should we order *next*?

# ACR Appropriateness Criteria®

Ordered on 09/2020 →

**Variant 1:** **Chronic wrist pain. With or without prior injury. Best initial study.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| X-ray wrist | Usually Appropriate | ☢ |
| MRI wrist without IV contrast | Usually Not Appropriate | O |
| MRI wrist without and with IV contrast | Usually Not Appropriate | O |
| MR arthrography wrist | Usually Not Appropriate | O |
| US wrist | Usually Not Appropriate | O |
| CT wrist without IV contrast | Usually Not Appropriate | ☢ |
| CT wrist with IV contrast | Usually Not Appropriate | ☢ |
| CT wrist without and with IV contrast | Usually Not Appropriate | ☢ |
| CT arthrography wrist | Usually Not Appropriate | ☢ |
| X-ray arthrography wrist | Usually Not Appropriate | ☢ |
| Bone scan wrist | Usually Not Appropriate | ☢☢☢ |

Order next →

**Variant 2:** **Chronic wrist pain. Routine radiographs normal or nonspecific. Persistent symptoms. Next study.**

| Procedure | Appropriateness Category | Relative Radiation Level |
|---|---|---|
| MRI wrist without IV contrast | Usually Appropriate | O |
| MR arthrography wrist | May Be Appropriate | O |
| MRI wrist without and with IV contrast | Usually Not Appropriate | O |
| US wrist | Usually Not Appropriate | O |
| CT wrist without IV contrast | Usually Not Appropriate | ☢ |
| CT wrist with IV contrast | Usually Not Appropriate | ☢ |
| CT wrist without and with IV contrast | Usually Not Appropriate | ☢ |
| CT arthrography wrist | Usually Not Appropriate | ☢ |
| X-ray arthrography wrist | Usually Not Appropriate | ☢ |
| Bone scan wrist | Usually Not Appropriate | ☢☢☢ |

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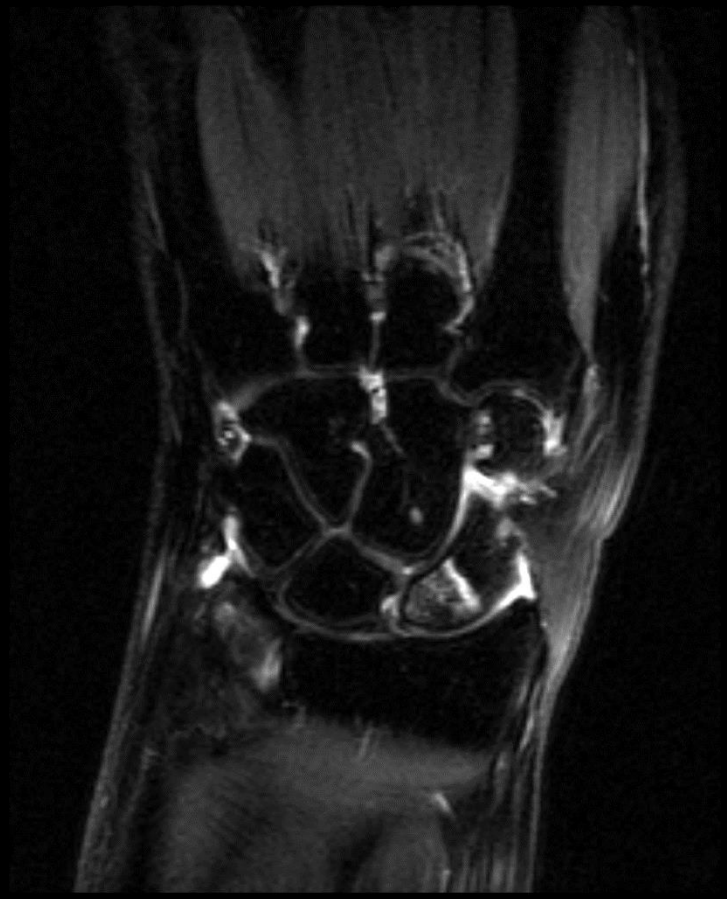
# MRI Images Not Labeled

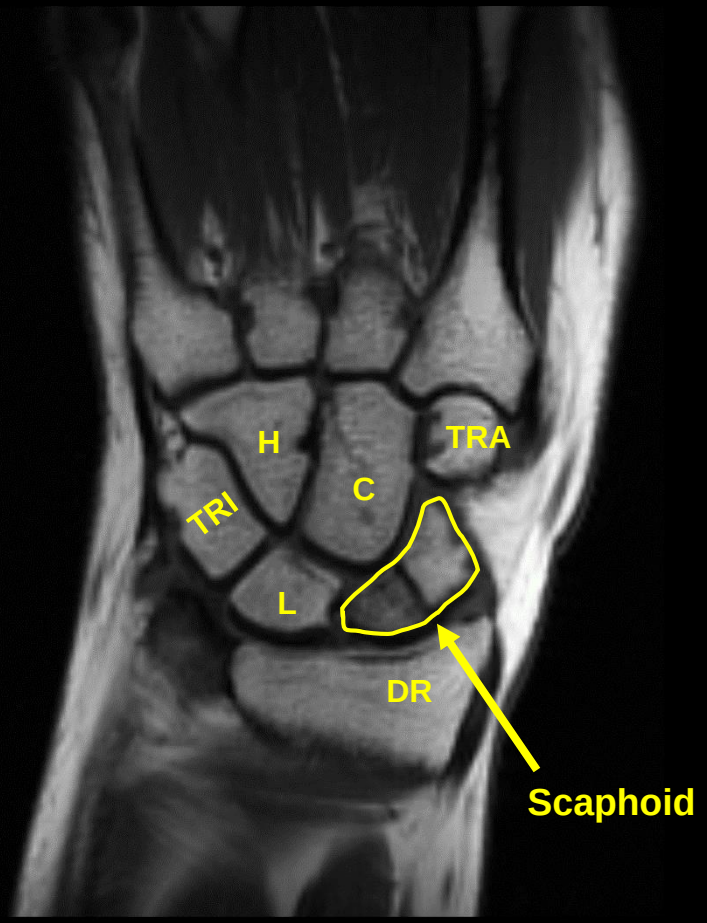
T1-Weighted Coronal Sequence

T2-Weighted Fat-Saturated Coronal Sequence

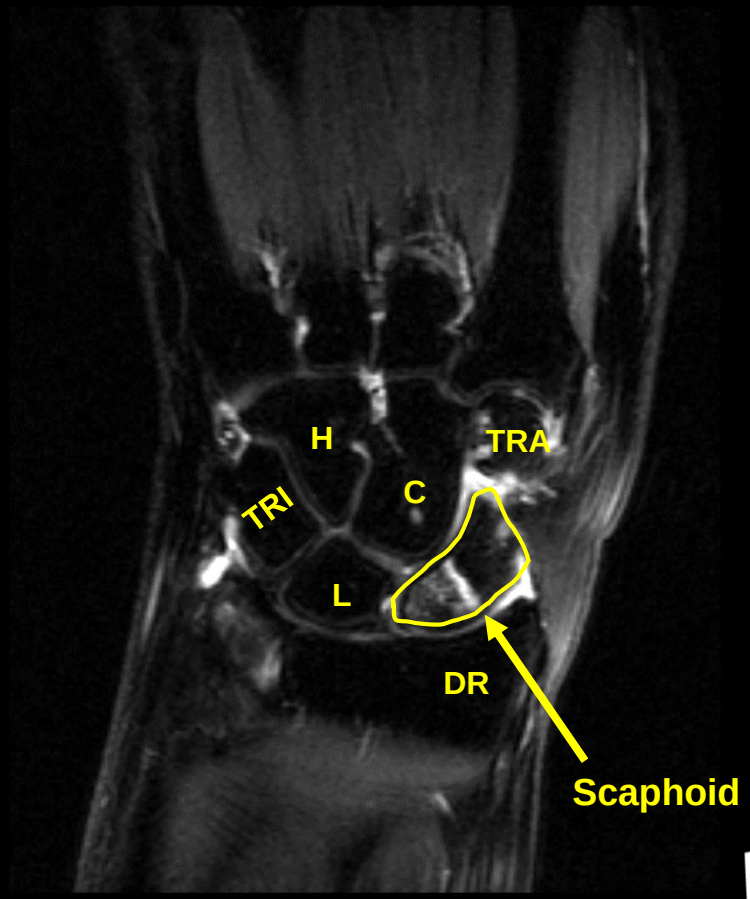


# MRI Images Labeled

T1-Weighted Coronal Sequence




T2-Weighted Fat-Saturated Coronal Sequence




DR: Distal radius
L: Lunate
TRI: Triquetrum
H: Hamate
C: Capitate
TRA: Trapezoid

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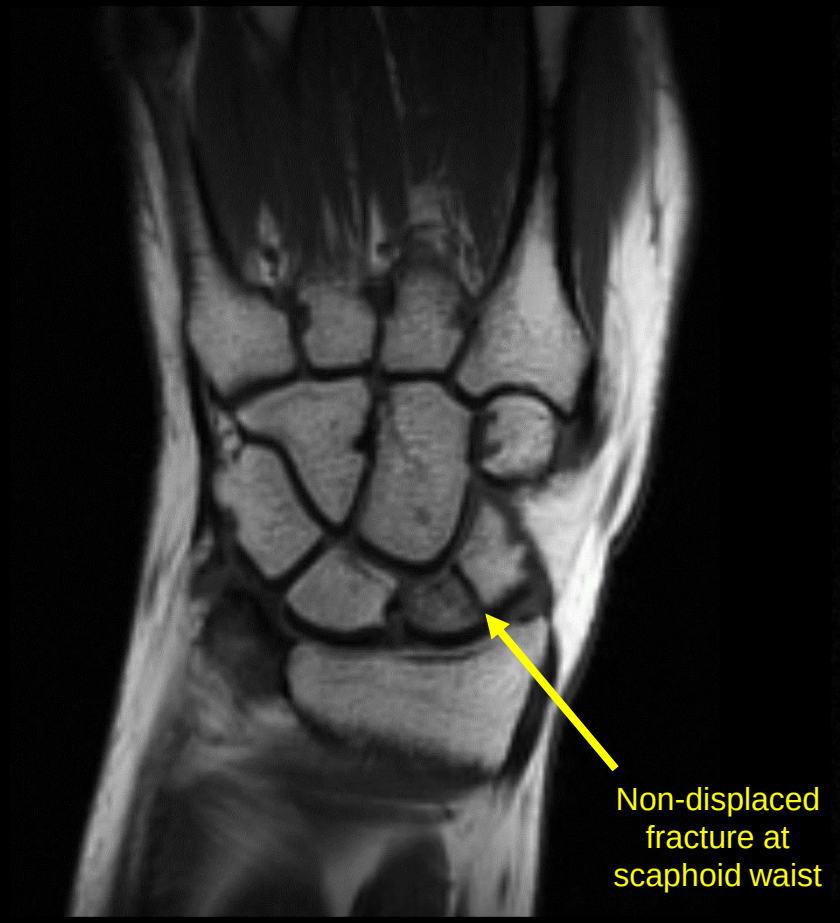
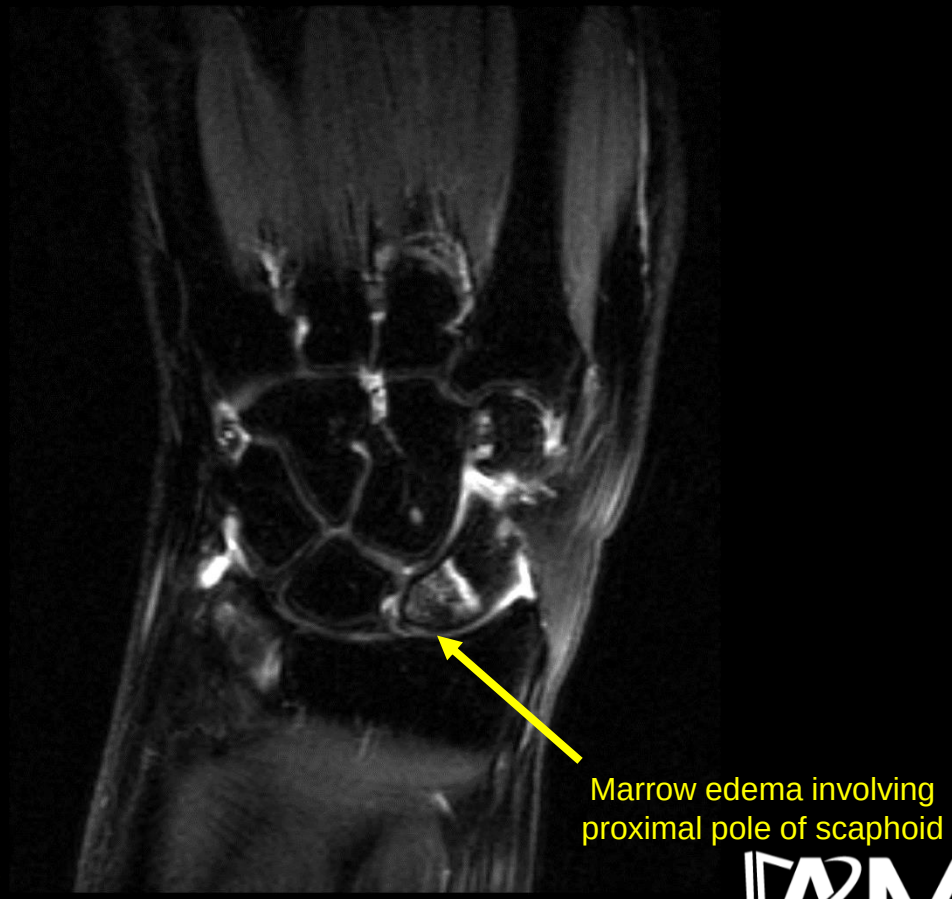
# MRI Images Labeled

T1-Weighted Coronal Sequence



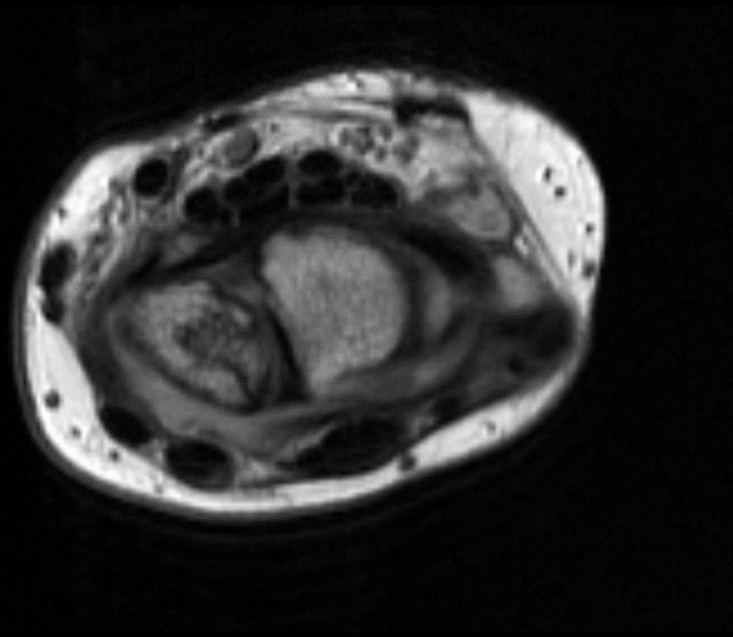

T2-Weighted Fat-Saturated Coronal Sequence



# MRI Images Not Labeled

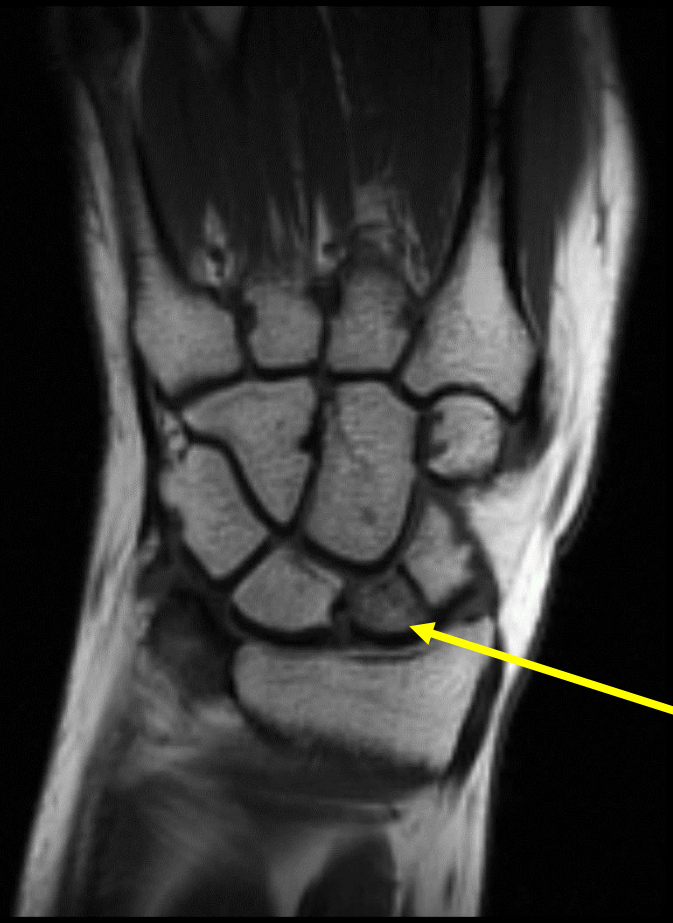
T1-Weighted Coronal Sequence

Proton-Density Axial Sequence through Scaphoid

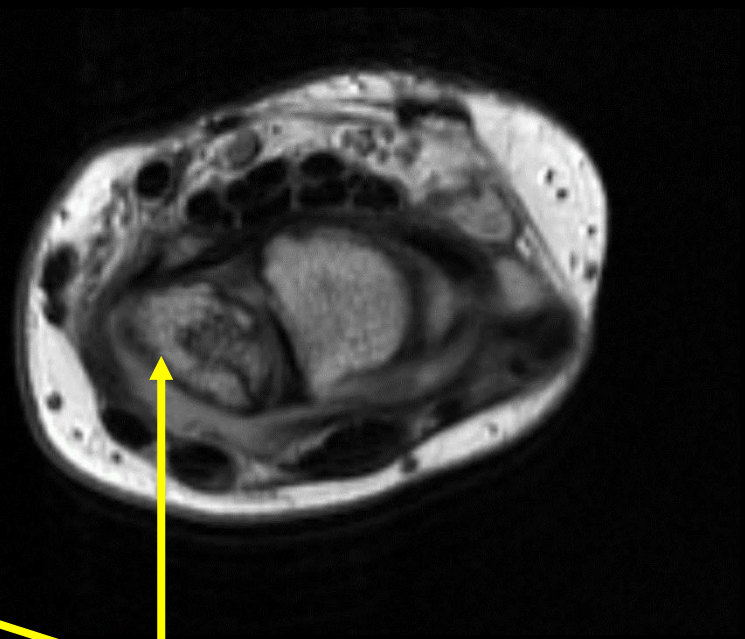


# MRI Images Labeled

T1-Weighted Coronal Sequence



Proton-Density Axial Sequence through Scaphoid



Serpiginous T1 marrow replacement of proximal pole of scaphoid

# Differential Diagnosis

1. Scaphoid fracture with avascular necrosis
2. Scaphoid fracture
3. Bone contusions
4. Focal red marrow

# Final Diagnosis

Imaging: MRI wrist without contrast left

Indication: Persistent left wrist pain *with normal X-rays three months prior*

Technique: Multiplanar, multisequence MRI of left wrist performed without use of intra-articular contrast; T1 and fluid sensitive sequences were acquired in axial, coronal, and sagittal planes

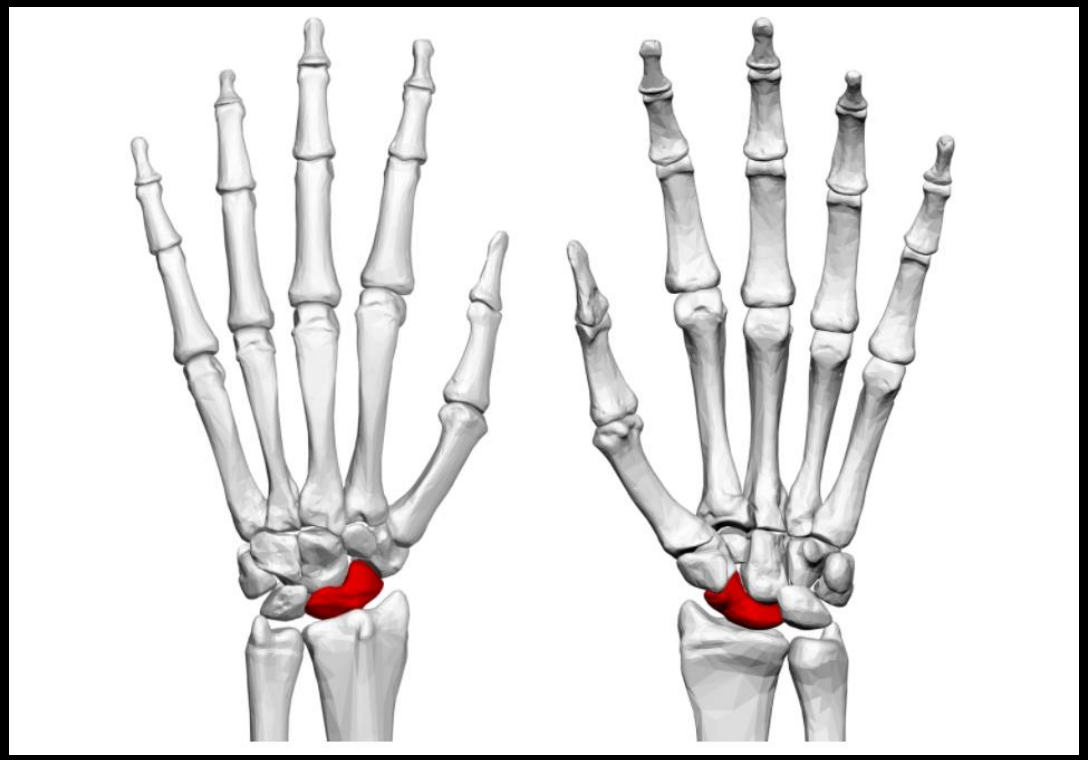
Finding/impression: Nondisplaced scaphoid waist fracture with proximal pole osteonecrosis

**Patient was referred to orthopedic hand specialist*

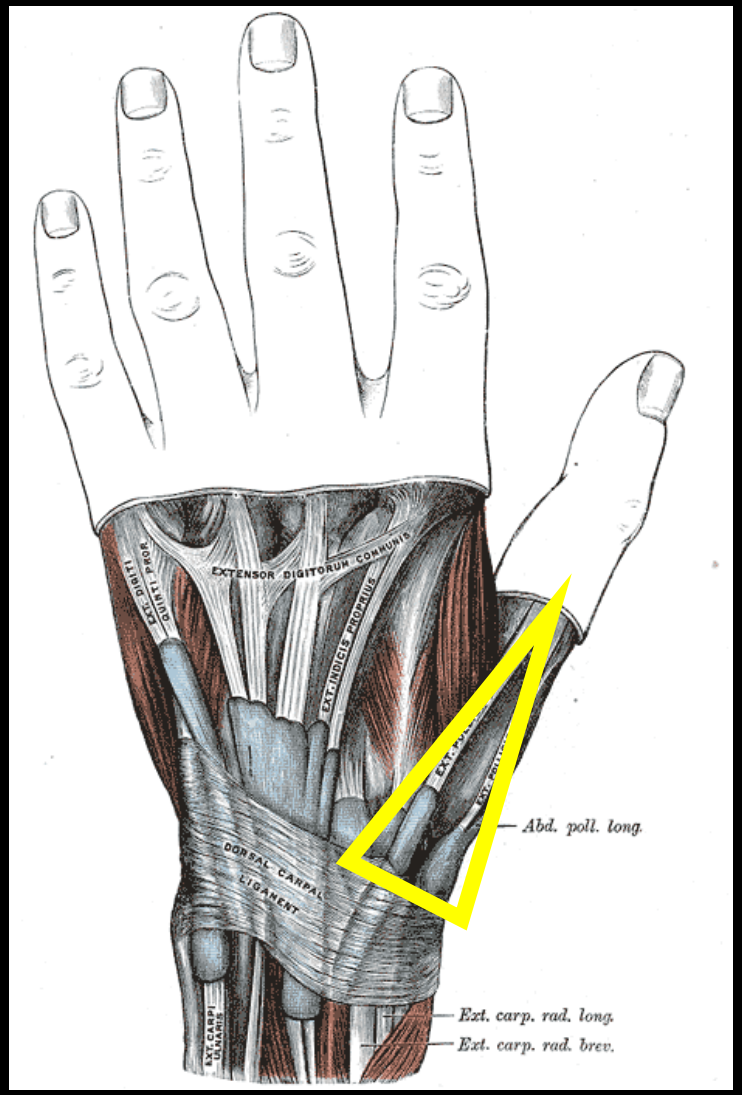
# Case Discussion

- Introduction
  - Scaphoid fracture “break of scaphoid bone in wrist”
  - Commonly caused by Fall On OutStretched Hand (FOOSH injury)
  - Most common wrist bone fracture, accounts for 60% of all carpal fractures
- Epidemiology and risk factors
  - Males are affected more often than females, most common in 2nd to 3rd decades of life
  - Less common in children and older adults as distal radius is weaker contributor to wrist and more likely to fracture
  - Nondisplaced fractures may be occult on initial radiographs, leading to delayed diagnosis and risk for avascular necrosis
- Mechanism of injury
  - Direct axial compression or wrist hyperextension
  - Proximal pole fracture (10-20%), waist fracture (60-80%), and distal pole fracture (10%)

# Anatomy



# Anatomy: Anatomic “Snuffbox”




Medial border (ulnar side): tendon of extensor pollicus longus

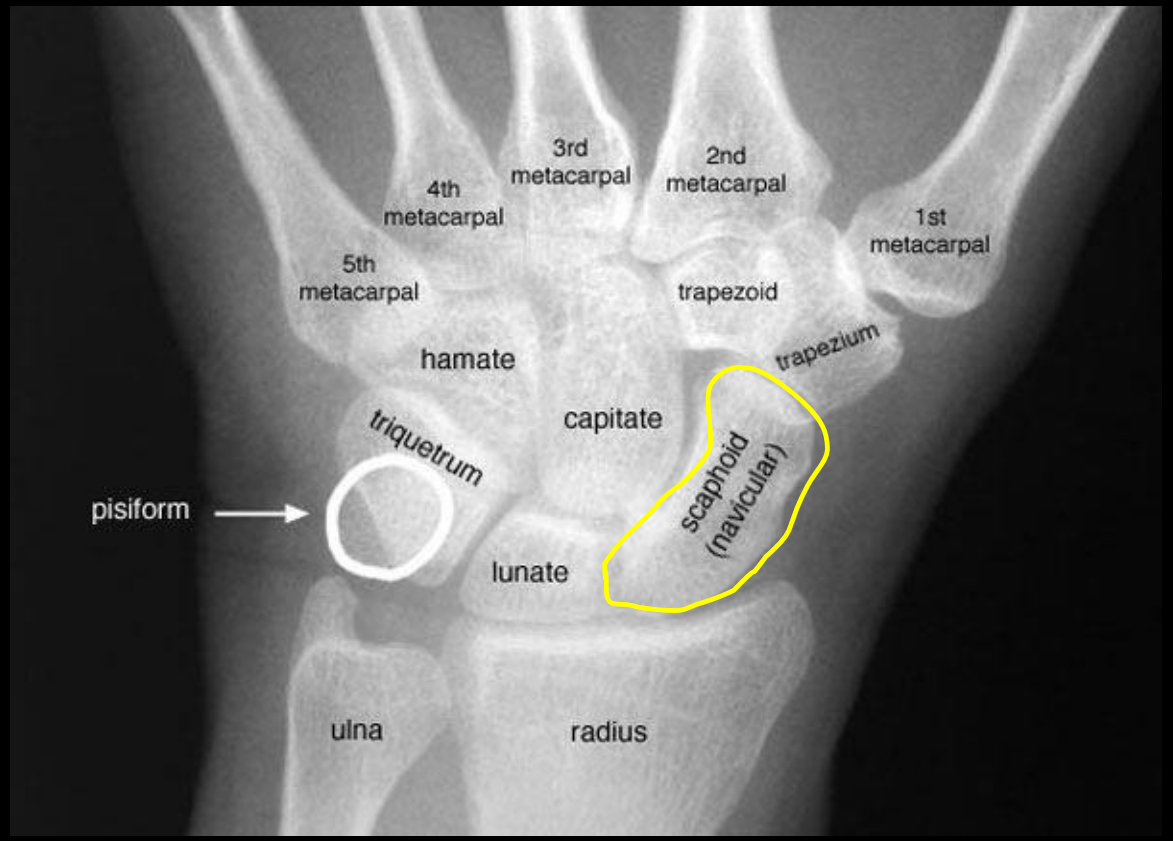
Lateral border (radial side): tendon of extensor pollicus brevis and tendon of abductor pollicus longus

Proximal border: styloid process of radius

Distal border: schematic “snuffbox” isosceles triangle

Floor: trapezium and scaphoid bone

# Anatomy




Largest bone in proximal carpal row

80% of scaphoid bone is covered by articular cartilage

Articulates with radius, lunate, trapezium, trapezoid, and capitate

Link between proximal and distal carpal row

# Case Discussion

- Clinical presentation
  - Focal tenderness at volar prominence at distal wrist for distal pole fractures, anatomic snuffbox for waist or midbody fractures, or distal to Lister's tubercle for proximal pole fractures
  - Provocative tests: anatomic snuffbox tenderness dorsally, scaphoid tubercle tenderness volarly, and/or scaphoid compression test

- Diagnosis
  - Often diagnosed by posterior-anterior and lateral radiographs of wrist; however, fractures may be radiographically occult
  - Individuals with tenderness in anatomic “snuffbox” are generally splinted in a thumb spica for 7-10 days
    - Repeat radiographs can demonstrate fracture healing to indicate presence of a fracture
    - Consider MRI without contrast in the setting of chronic wrist pain *plus* normal or nonspecific radiographs *plus* persistent symptoms

# Case Discussion

Radiographs

- Recommended views
  - Neutral rotation posterior-anterior and lateral, semi-pronated 45º oblique view
- Scaphoid view
  - 30º wrist extension, 20º ulnar deviation
- If radiographs are negative (approximately 30% of cases) and there is a high clinical suspicion, repeat radiographs can be obtained in 10-14 days

Bone scan

- Indications: occult fractures in acute setting
- Sensitivity/specificity: sensitivity (100%), specificity (98%)

MRI

- Indications: most sensitive for diagnosing occult fractures < 24 hours, assessment of vascular status of bone
- Sensitivity/specificity: approach 100% for occult fractures

CT scan

- Indications: evaluate fracture location, angulation, displacement, size, collapse, and progression of nonunion
- Sensitivity/specificity: sensitivity (62%), specificity (87%)
- High negative predictive value

# Case Discussion

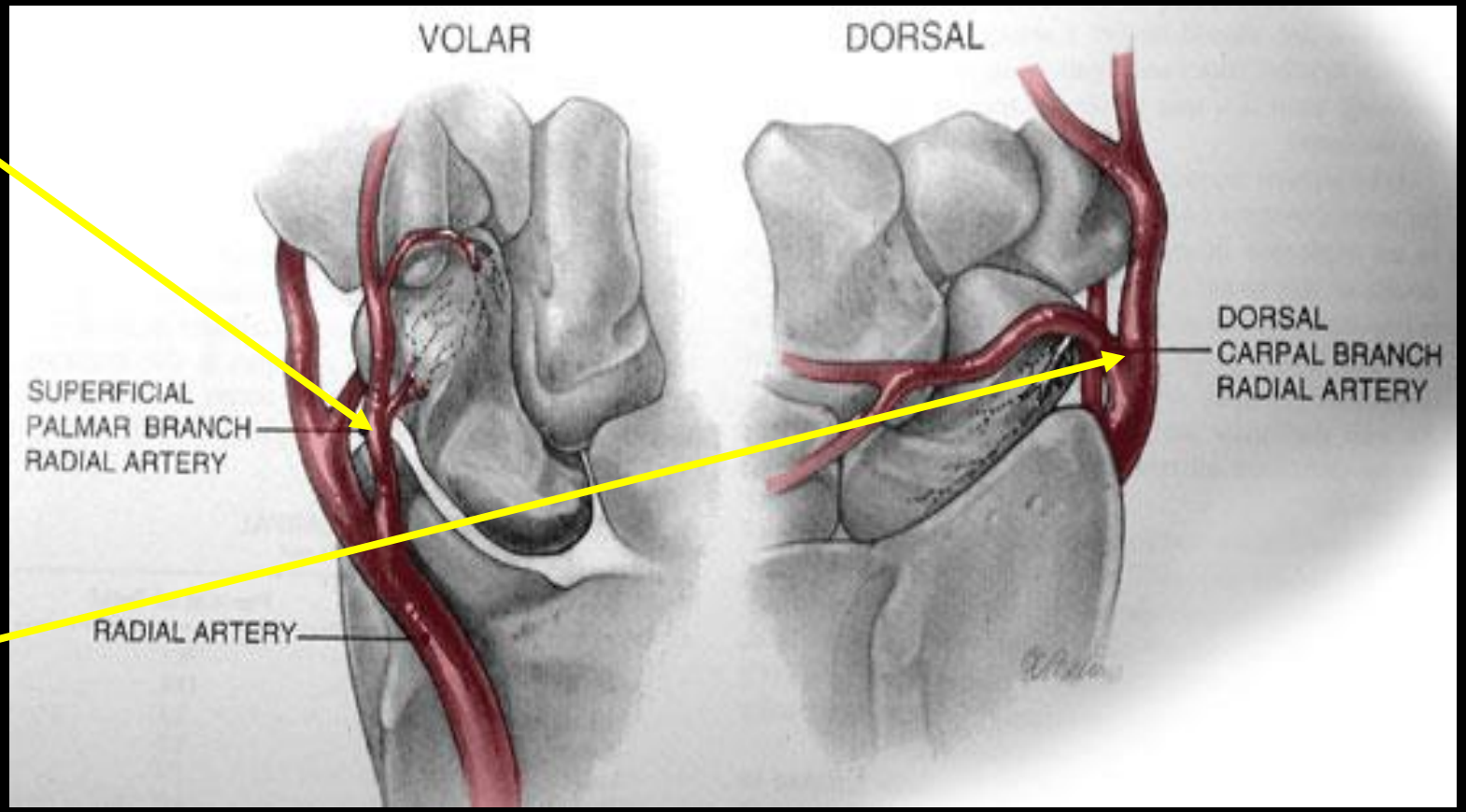
- Complications
  - Bony avascular osteonecrosis is a common complication because of scaphoid's tenuous blood supply
    - Risk correlates to location: proximal 1/3rd fracture (high risk), waist middle 1/3rd fracture (moderate risk), and distal 1/3rd fracture (low risk)
    - Incidence of avascular osteonecrosis directly correlated with proximity of fracture to proximal pole
  - Bony scaphoid non-union can also occur from undiagnosed or undertreated scaphoid fractures, may lead to wrist osteoarthritis
  - Other complications: malunion, subchondral bone penetration with arthrosis, scaphoid non-union advanced collapse wrist (SNAC wrist), and osteoarthritis

- Treatment
  - Based on location in bone of fracture (proximal, waist, distal), displacement (instability) of fracture, and tolerance for cast immobilization
    - Options: closed cast management, percutaneous screw fixation, or open reduction internal fixation
    - Fractures disrupting blood flow from distal end of bone may not heal which may require surgery

# Avascular Osteonecrosis

20-30% of blood supply comes from superficial palmar branch of radial artery and enters bone at tubercle

70-80% of blood supply comes from dorsal carpal branch of radial artery and travels towards proximal pole unidirectionally creating a “vascular watershed”



# References


- DeWebber, K. Scaphoid Fractures. UpToDate. https://www.uptodate.com/contents/scaphoid-fractures.
- Duckworth, A. D., Jenkins, P. J., Aitken, S. A., Clement, N. D., & McQueen, M. M. (2012). Scaphoid fracture epidemiology. Journal of Trauma and Acute Care Surgery, 72(2), E41-E45.
- Kaewlai, R., Avery, L. L., Asrani, A. V., Abujudeh, H. H., Sacknoff, R., & Novelline, R. A. (2008). Multidetector CT of carpal injuries: anatomy, fractures, and fracture-dislocations. Radiographics, 28(6), 1771-1784.
- Rubin, D. A., Roberts, C. C., Bencardino, J. T., Bell, A. M., Cassidy, R. C., Chang, E. Y., ... & Kransdorf, M. J. (2018). ACR appropriateness criteria® chronic wrist pain. Journal of the American College of Radiology, 15(5), S39-S55.
- Steffes, M.J. Scaphoid Fracture. OrthoBullets. https://www.orthobullets.com/hand/6034/scaphoid-fracture.
- Ten Berg, P. W., Drijkoningen, T., Strackee, S. D., & Buijze, G. A. (2016). Classifications of acute scaphoid fractures: a systematic literature review. Journal of wrist surgery, 5(2), 152.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