



Beth Israel Deaconess
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CAN'T MISS: RADIOLOGICAL DIAGNOSIS OF SUBTLE SCAPHOID FRACTURES

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Our Patient #1: History and Physical Exam

- 36 yo with FOOSH 3 months ago
- Persistent pain in radial side of left wrist, worse with movement
- Anatomic snuffbox tenderness



<http://www.picturesof.net/pages/110102-144849-942053.html>



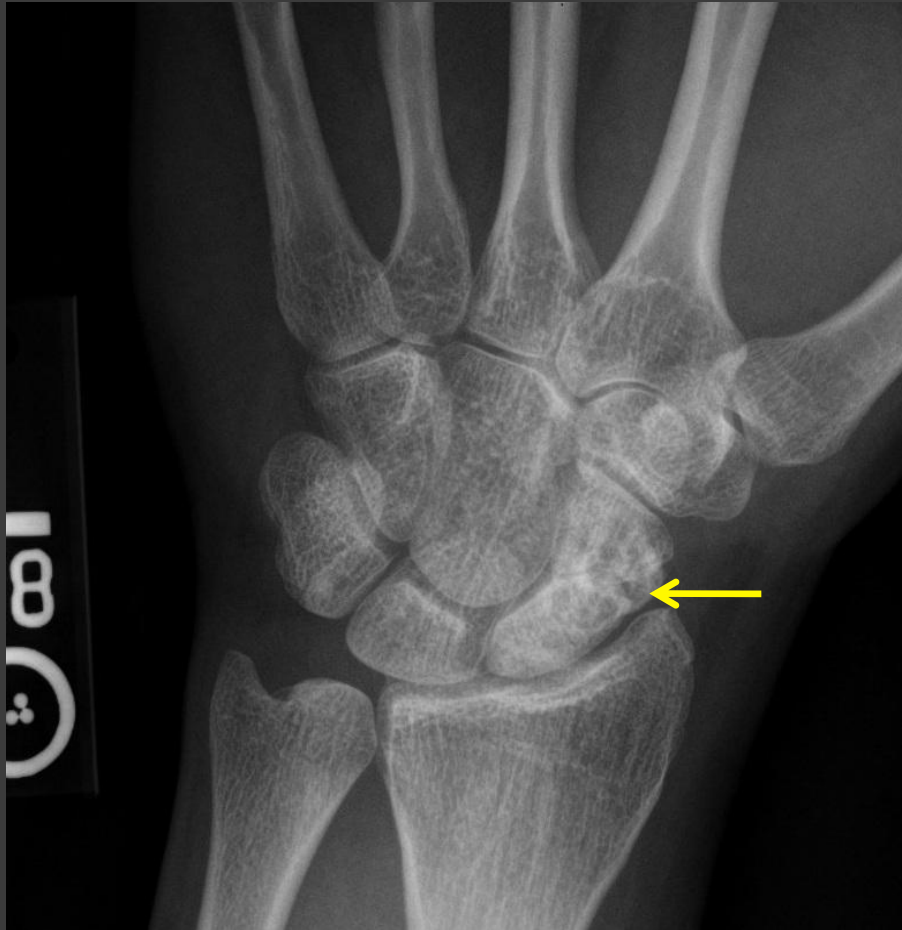
Our Patient #1: Differential Diagnosis

- Fracture (scaphoid, triquetrum, lunate, distal radius)
- Ligament or Tendon Injury
- Dislocation
- Osteoarthritis
- Infection
- Nerve impingement



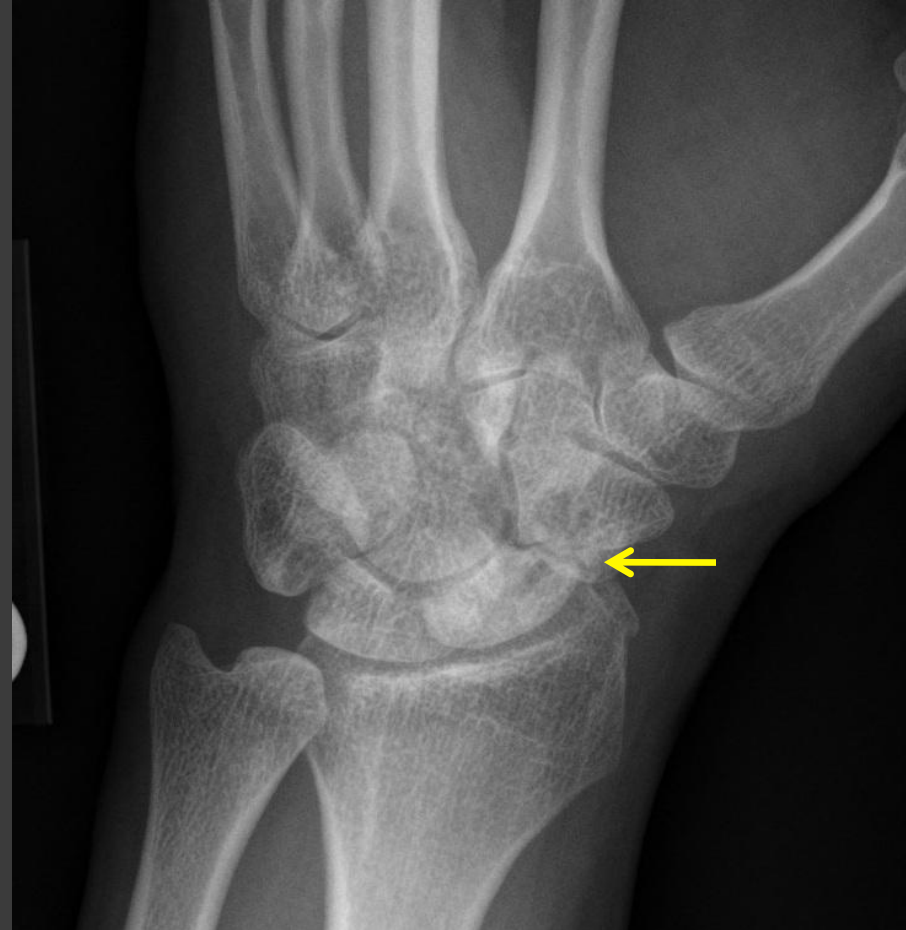
Our Patient #1: Plain Films

PA View



PACS, BIDMC

Oblique View



PACS, BIDMC

Findings: Linear lucency in scaphoid waist with surrounding sclerosis

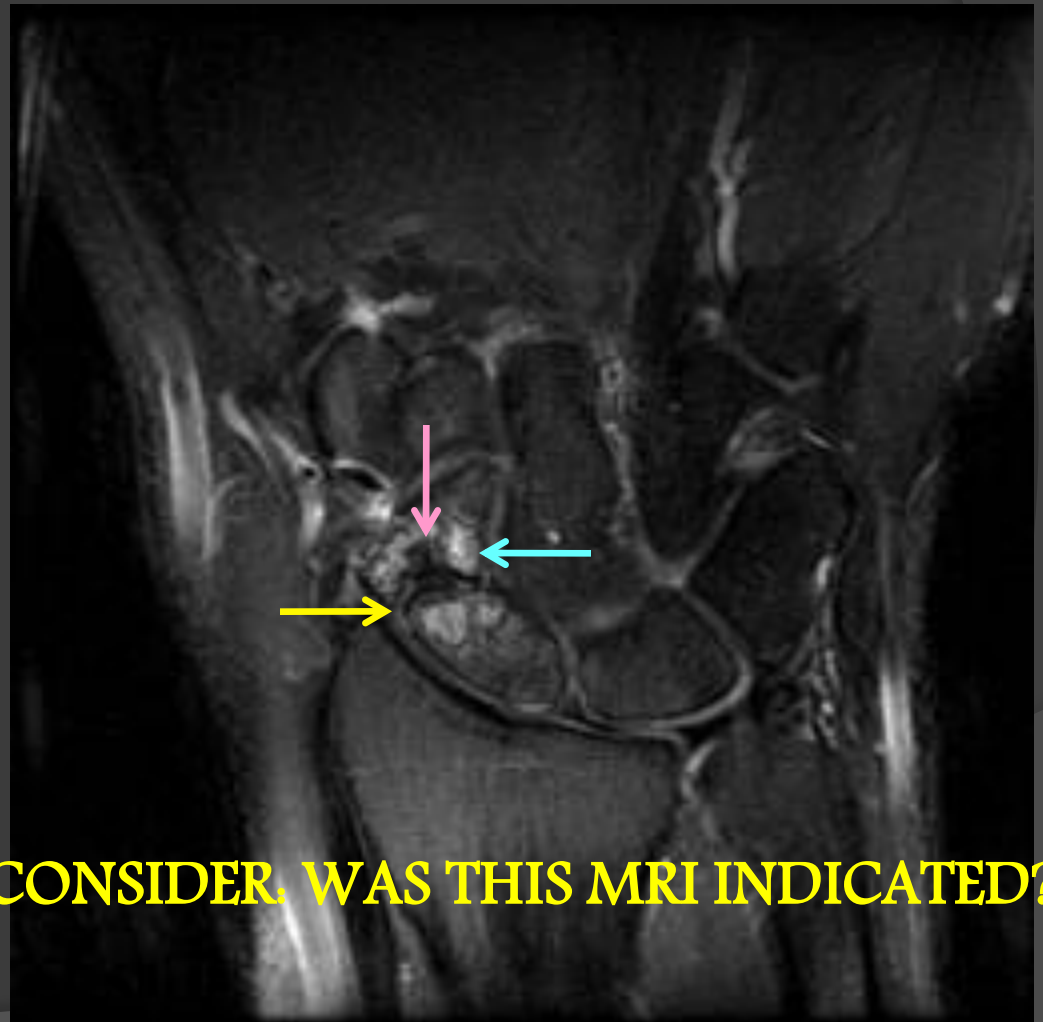


Our Patient #1: MRI

T2-weighted MRI

Findings:

- Fracture line through scaphoid waist
- Bone marrow edema
- Cystic areas in the bones



CONSIDER. WAS THIS MRI INDICATED?



Our Patient #2: History and Physical Exam

- 27 yo, falls horizontally on right wrist and forearm
- Persistent pain in radial side, swelling
- Anatomic snuffbox tenderness



<http://singlemindedwomen.com/blog/sex-the-single-woman-falling-for-you/attachment/tripping/>



Our Patient #2: Plain Films

PA View



PACS, BIDMC

Scaphoid View



PACS, BIDMC

Findings: Soft tissue/bone artifact, no evidence of fracture



Our Patient #2: Interval History

- Wrist immobilization with cast
- Scheduled for repeat radiographs 2 weeks later
- Pain persisted, still worse with movement
- Continued anatomic snuffbox tenderness



Our Patient #2: Plain Films, 1 Month Later

Oblique View

Findings:

- Linear lucency reflecting scaphoid fracture or soft tissue density



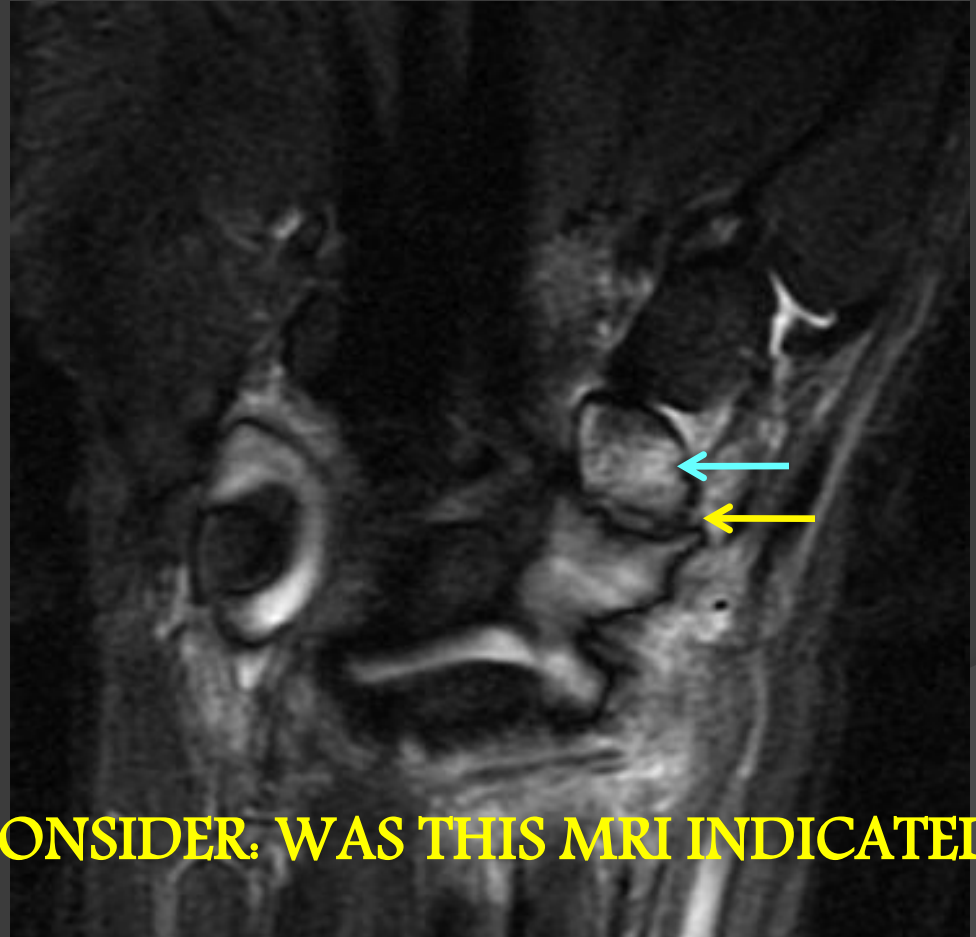


Our Patient #2: MRI

T2-weighted MRI

Findings:

- Fracture line through scaphoid waist/distal pole boundary
- Bone marrow edema in distal pole



CONSIDER: WAS THIS MRI INDICATED?



Objectives

- **Regional Anatomy of the Wrist**
- **Menu of Radiological Tests**
- **When to Order Certain Radiological Tests**



Scaphoid Fractures: The Basics

- Accounts for 79% of carpal fractures
- Mechanism of injury: dorsiflexion and radial deviation
- Young and healthy population
- 70% in waist, 20% in proximal pole, 10% in distal pole
- Prognosis improves with more distal fractures



Regional Anatomy: Carpal Bones



Proximal Row

- A-Scaphoid
- B-Lunate
- C-Triquetrum
- D-Pisiform

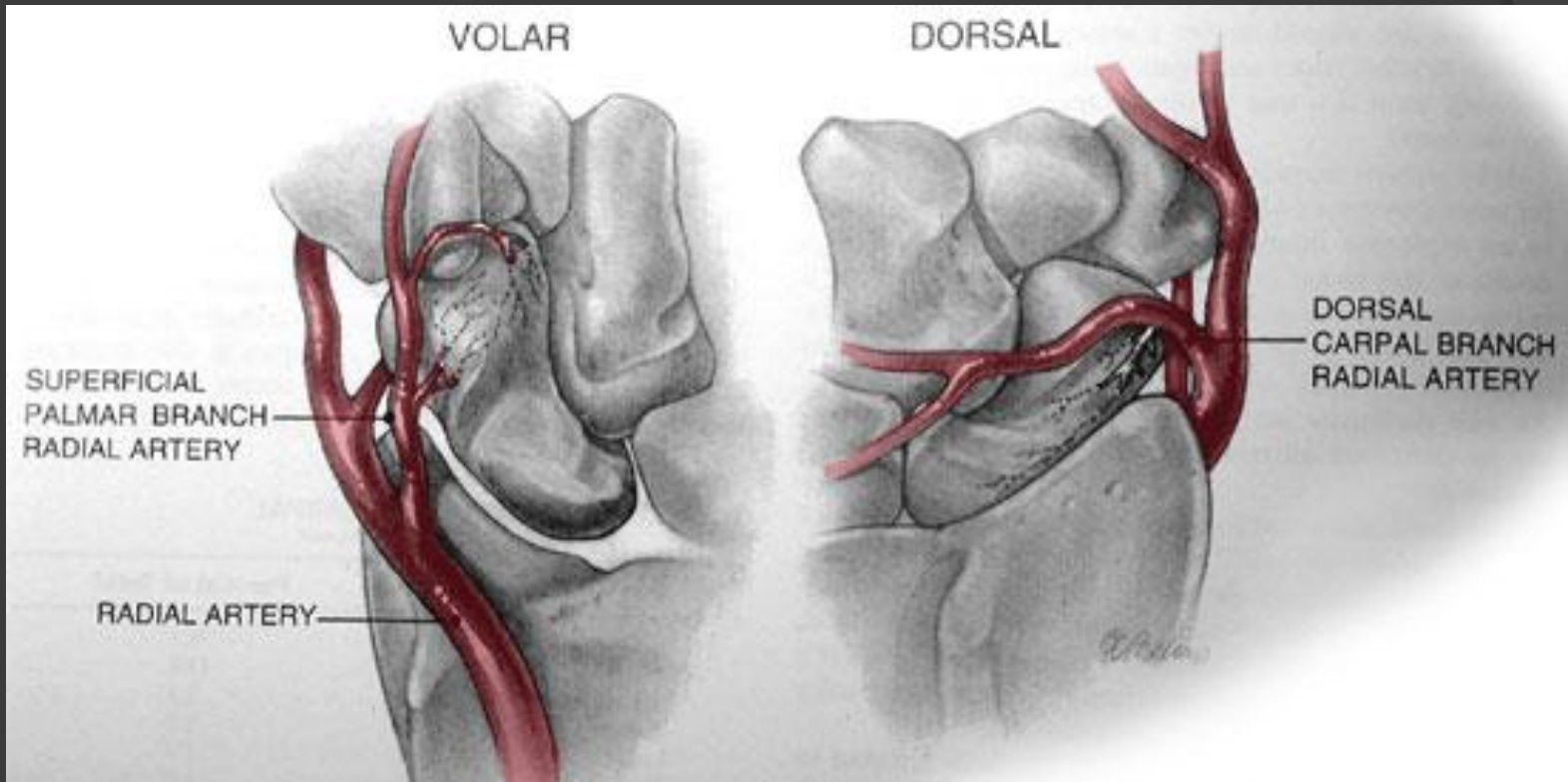
Distal Row

- E-Trapezium
- F-Trapezoid
- G-Capitate
- H-Hamate

Temple, CL, et al., *J Hand Surg*, 2005 May; 30(3):
534-542.



Regional Anatomy: Blood Supply to the Scaphoid



Amadio PC, et al. Green's operative hand surgery, 5th edition. 2005. pp. 711–768

Blood is supplied from the distal to proximal pole, making the proximal pole susceptible to AVN in scaphoid fractures



Menu of Radiological Tests

- Plain films
- Ultrasound
- Bone scan
- CT
- MRI



Menu of Radiological Tests: Plain Films

- 1st diagnostic step
- Use specialized views to visualize scaphoid
- Misses up to 20% of scaphoid fractures
- Low inter- and intra-observer reliability in multiple studies
- Bone and soft tissue artifacts possible





Menu of Radiological Tests: Scaphoid Views

Neutral PA



PACS, BIDMC

30 degrees



PACS, BIDMC

45 degrees



PACS, BIDMC

60 degrees

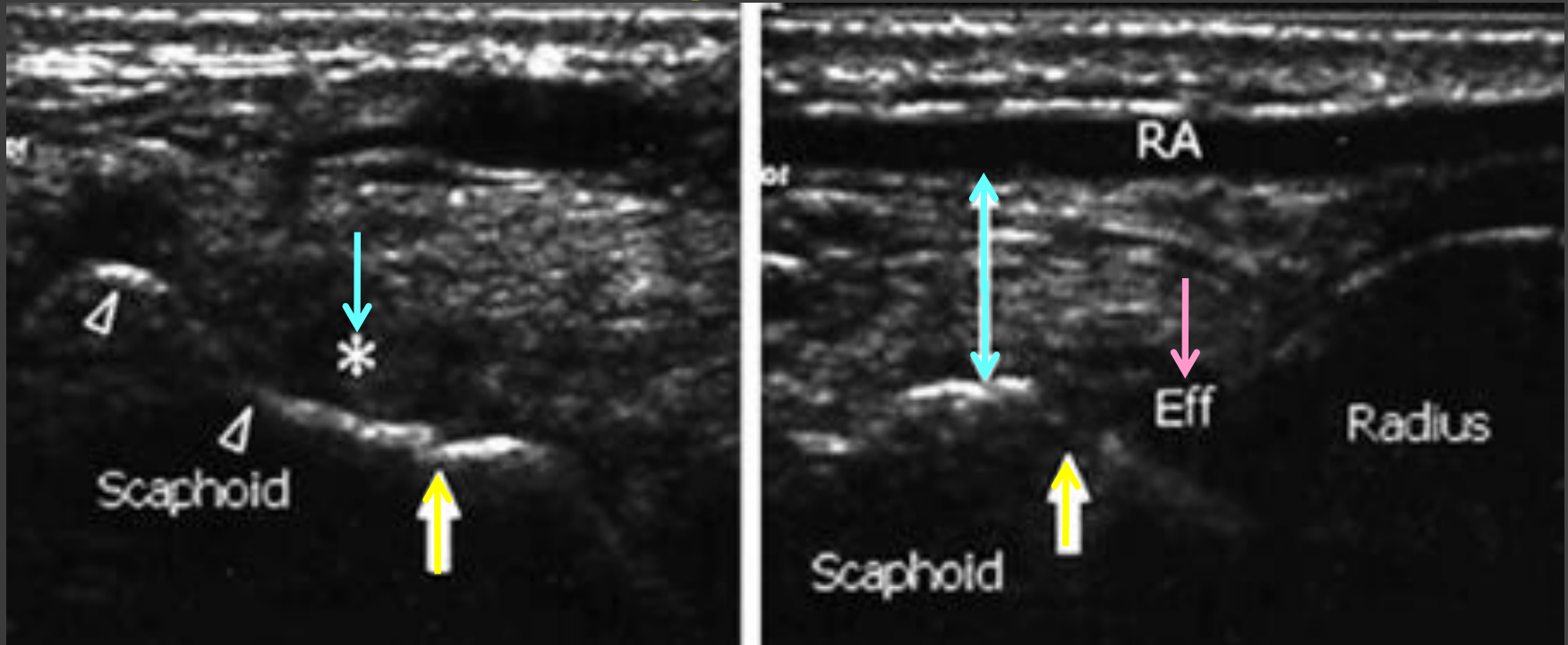


PACS, BIDMC

Beam is angulated toward the elbow; useful for detecting waist fractures



Menu of Radiological Tests: Ultrasound



Smith M, et al., ANZ J. Surg, 2010 Jan;80(1-2): 82-90.

Findings: Cortical disruption, hematoma

Findings: Cortical disruption, soft tissue swelling, joint effusion

- High-spatial resolution sonography (5-15 MHz)
- Specific, but not sensitive; rarely used in United States



Menu of Radiological Tests: Radionuclide Bone Scan



- High sensitivity, low specificity

- Age affects rate of osteoblastic activity

- Quantification bone scan has higher specificity but rarely used

Findings: Increased uptake in the right scaphoid



Menu of Radiological Tests: CT Scan

- High sensitivity and specificity
- Best spatial resolution allows for detection of displacement, angulation, and non-union
- Longitudinal axis slices preferred; risk of missing oblique non-unions
- Useful for operative planning



Companion Patients #1 and #2: CT Scan



PACS, BIDMC

Findings: Scaphoid waist fracture



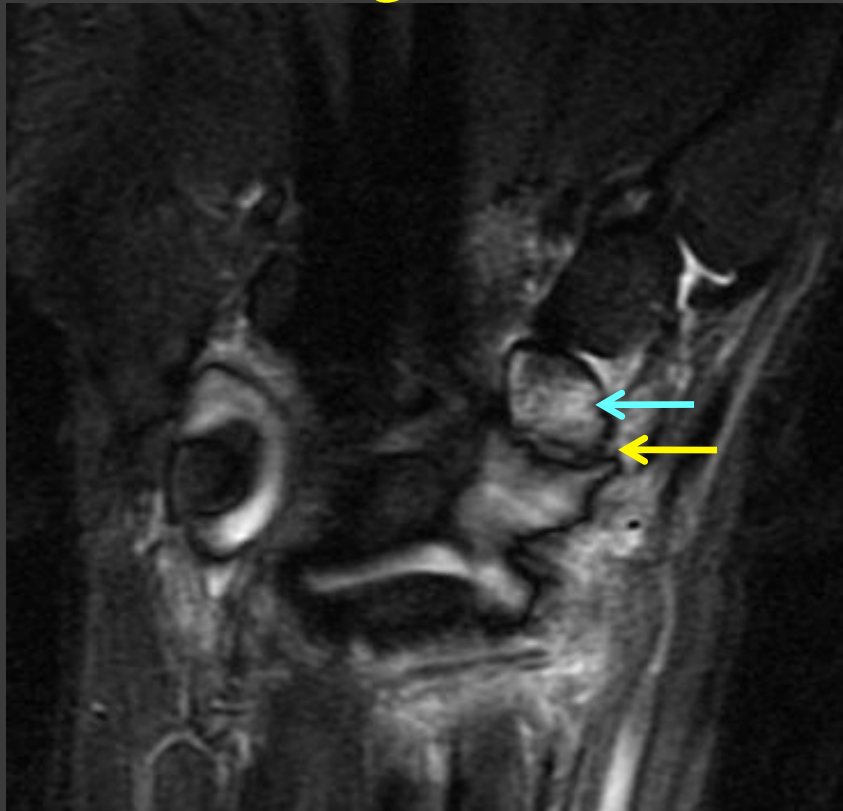
Smith M, et al., ANZ J. Surg, 2010
Jan;80(1-2): 82-90

Findings: Displaced scaphoid
waist fracture



Menu of Radiological Tests: MRI

T2-weighted MRI



PACS, BIDMC

- Most sensitive and specific imaging test
- Useful for evaluating soft tissue injuries and avascular necrosis
- Is it cost-effective?

Findings: Fracture line, bone marrow edema

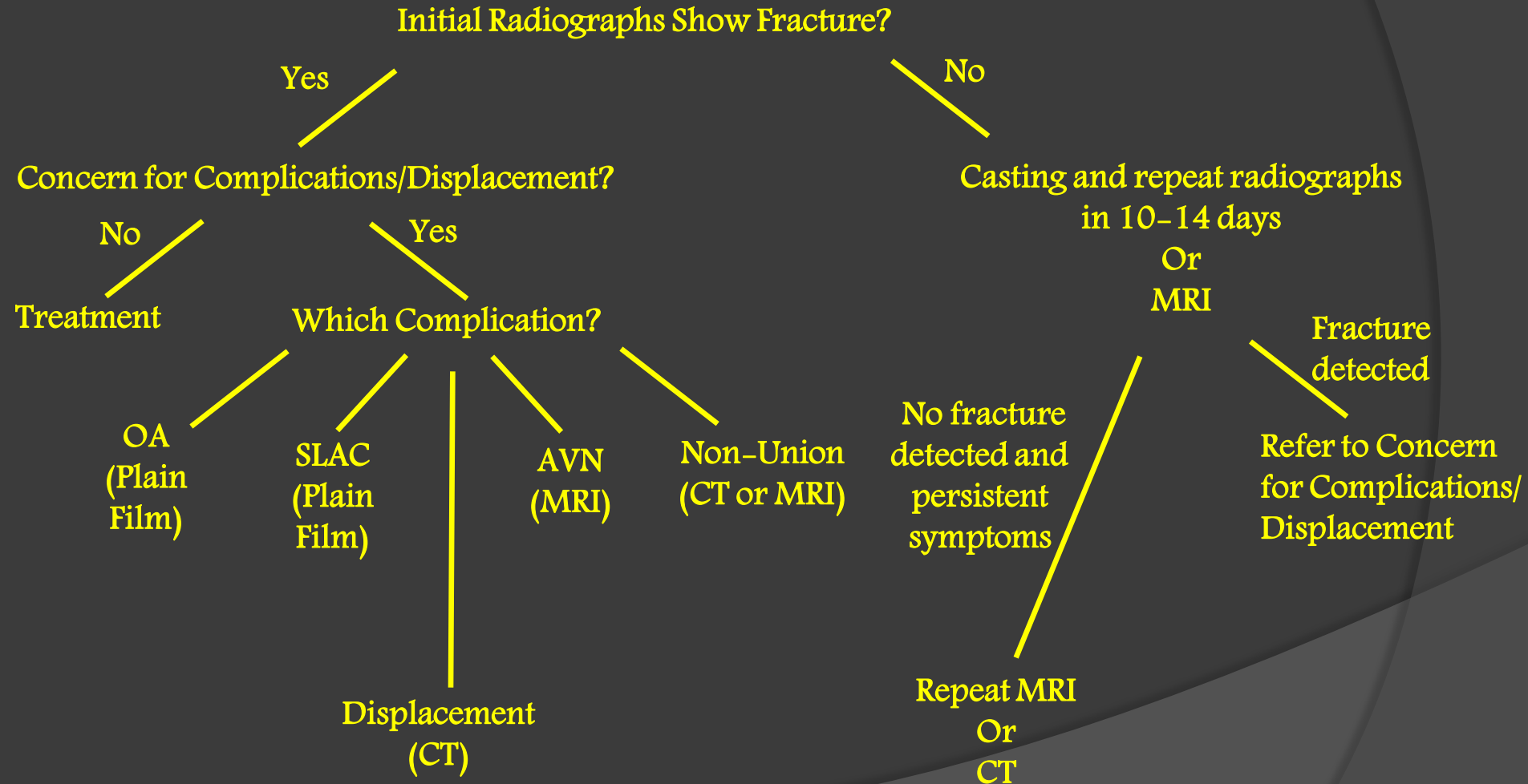


When to Order Certain Radiological Tests

- Studies showed that imaging protocol varies significantly. In study of 105 hospitals across 6 continents, only 7% of hospitals shared same protocol
- Four-view plain radiograph may miss scaphoid fractures; patients may present months to years after initial injury
- Balance diagnostic use, cost-effectiveness, patient compliance
- ACR recommends use of repeat radiographs or MRI for initially undetected fractures
- In prospective study, use of early MRI, before repeat radiographs, resulted in therapeutic consequence in 66% of cases
- Cost-effectiveness studies have been equivocal



When to Order Certain Radiological Tests: Algorithm





Back to Our Patients #1 and #2

Patient #1: Injury 3 months prior, evidence of non-union on plain films

MRI indicated?

YES

Patient #2: Initial plain radiographs normal, follow-up radiographs were inconclusive

MRI indicated?

YES



Summary

- Scaphoid fractures are most common carpal fracture
- Menu of radiological tests include plain films, ultrasound, bone scan, CT, and MRI
- Four-view plain films, including scaphoid view, is initial radiological test
- MRI has highest sensitivity and specificity for detecting scaphoid fractures
- CT useful for assessing displacement and for operative planning



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