



**AMERICAN COLLEGE  
of **SPORTS** MEDICINE®**  
**www.acsm.org**  
**Team Physician Course - Part 1**  
**Essentials of Sports Medicine:**  
**From Sideline to the Clinic**  
**Jacksonville, FL**  
**February 3-7, 2016**



# **Hand and Wrist Diagnosis and Imaging Mary Lloyd Ireland, MD FACSM**



[www.MaryLloydIreland.com](http://www.MaryLloydIreland.com)  
[www.youtube.com/ukyortho](http://www.youtube.com/ukyortho)

# Disclosure

- Neither I, **Mary Lloyd Ireland, MD**, nor any family member(s), have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation.

**Menu**

**DDX**

**Plain Radiographs**

**SL Dissociation**

**Imaging**


**Scaphoid FX**

**Hamate FX**

**Hand**

# Introduction

Most  
Important  
and  
Key to  
Correct  
Diagnosis



- HISTORY
- PHYSICAL EXAM
- GOOD PLAIN RADIOGRAPHS





***IS IT A WRIST SPRAIN OR NOT?***



**Make the Diagnosis!**

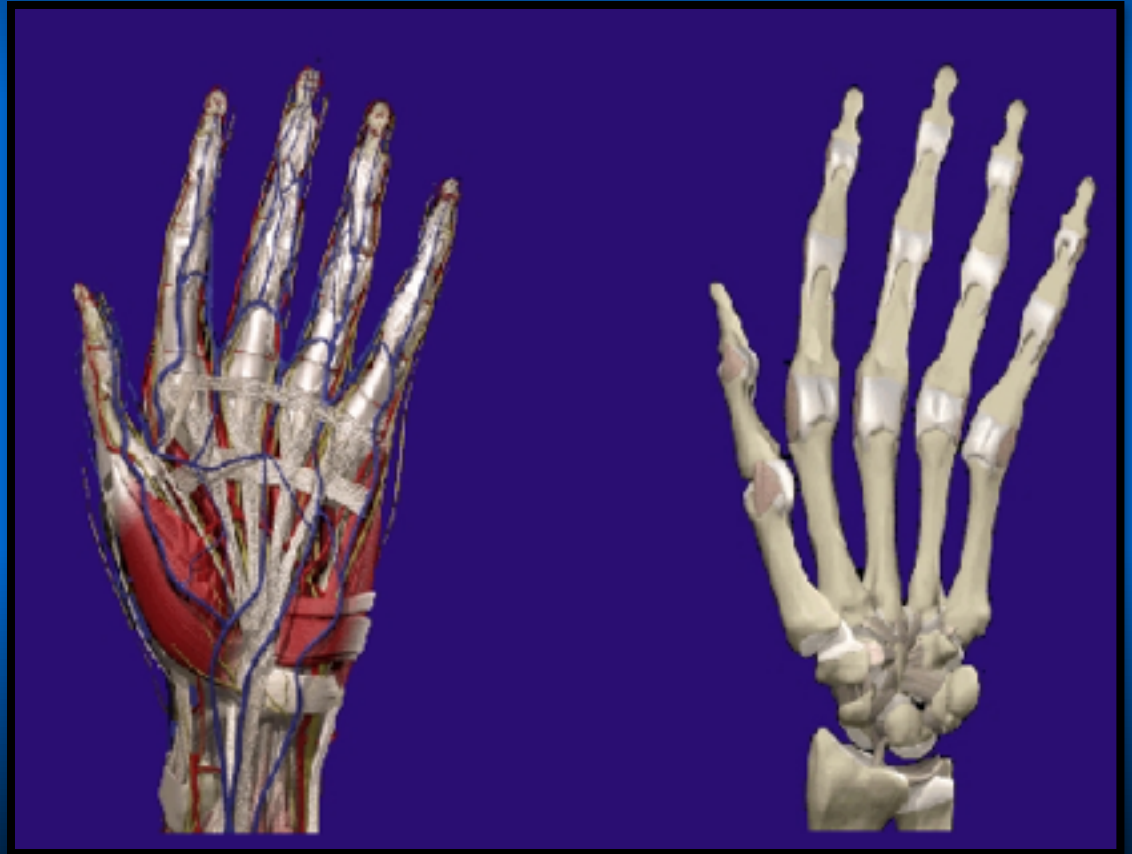
# Wrist Sprains Do Exist, but . . .

- You must make a diagnosis
- Don't miss:
  - Scaphoid fractures
  - Carpal instability
  - Hook of hamate fracture
  - Tendinopathies
- If missed, athlete will develop chronic wrist problems and disability



# Physical Exam by Zones

- Anatomic: 5 zones of the wrist
  - Radial dorsal
  - Central dorsal
  - Ulnar dorsal
  - Radial volar
  - Ulnar volar



# Radial Dorsal Zone

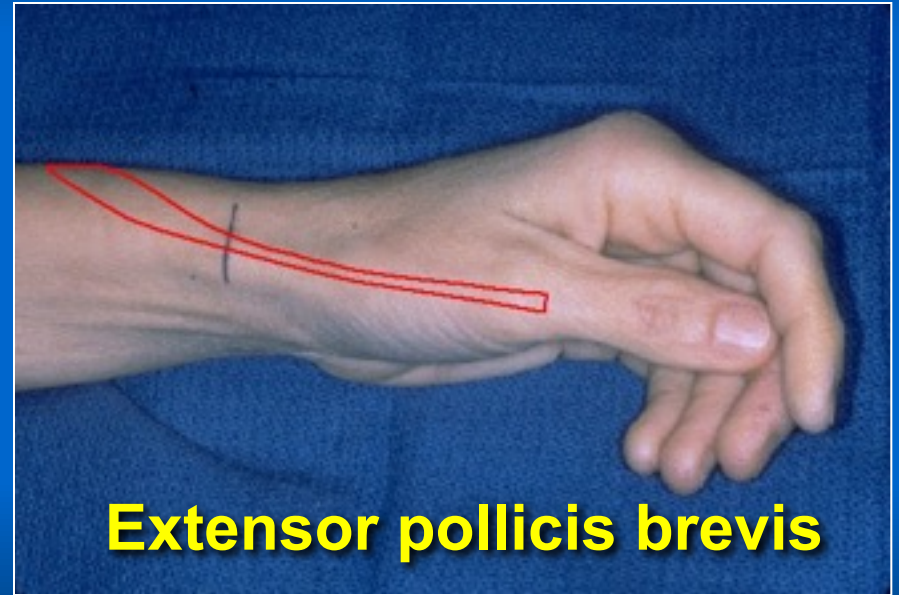
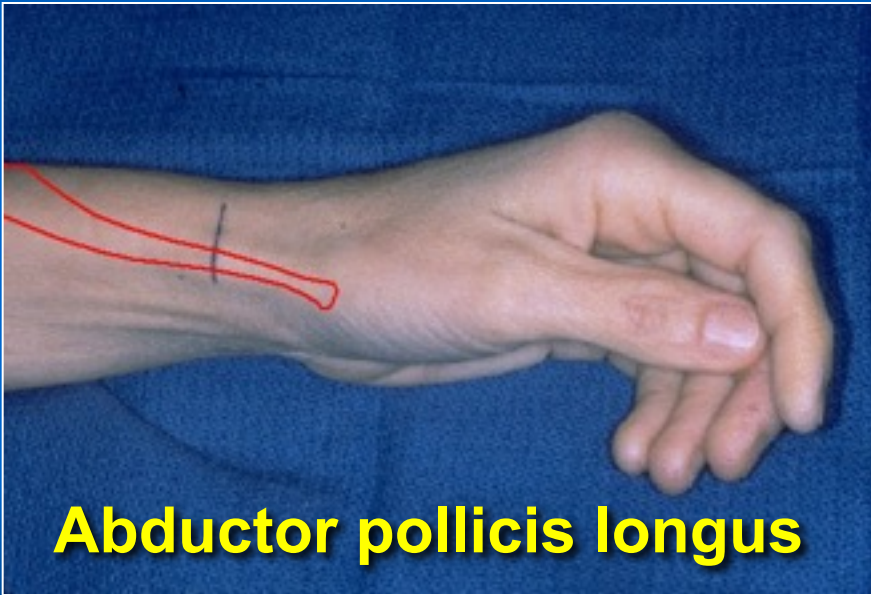
- Ganglion cyst
- Sensory branch radial nerve irritation
- Intersection syndrome
  - Friction between extensor pollicis brevis and abductor pollicis longus

# Radial Dorsal Zone

- Fracture
  - Scaphoid
  - Radial styloid
- Arthritis
  - 1<sup>st</sup> CMC
  - Basilar joint
- Tenosynovitis
  - De Quervain's



## De Quervain's Tenosynovitis





# DeQuervain's tenosynovitis



## Central Dorsal Zone

- Kienbock's Disease
- Ganglion cyst
- Scapholunate ligamentous injury
- Capitate pain

## Radial Volar Zone

- Scaphoid tuberosity pain palpation
- Flexor carpi radialis tendinitis
- Median nerve – carpal tunnel syndrome
- Vascular
  - Allen's test



## Ulnar Dorsal Zone

- DRUJ
  - Instability
- TFCC Tear
- Ulnar impaction
- Fracture
  - Hook of hamate
  - Pisiform

## Ulnar Dorsal Zone

- Lunotriquetral instability
- Extensor carpi ulnaris
  - Instability
  - Strain
  - Tendinitis



# Ulnar Volar Zone

- Arthrosis
  - Pisotriquetral
- Fracture
- Ulnar nerve compression



# Volar Wrist Ganglion

- **Diagnosis**
  - Location over STT joint (adjacent to FCR tendon) or over radiocarpal joint
- **DDx**
  - Radiocarpal arthritis
  - FCR tendinitis
  - CMC/STT arthritis



# DIAGNOSIS MADE EASY

- Cysts / Masses
  - Dorsal Wrist Ganglion
  - Volar Wrist Ganglion
  - Volar Retinacular Ganglion Cyst
  - Giant Cell Tumour of the tendon sheath
  - Mucous cyst of DIP joint



# Dorsal Wrist Ganglion

- **Diagnosis**
  - Mass over dorsal radial carpus
  - Fluctuates in size
  - Pain often associated with increases in size, but may also be present if mass disappears
  - Sometimes a history of indirect injury



# DIAGNOSIS MADE EASY

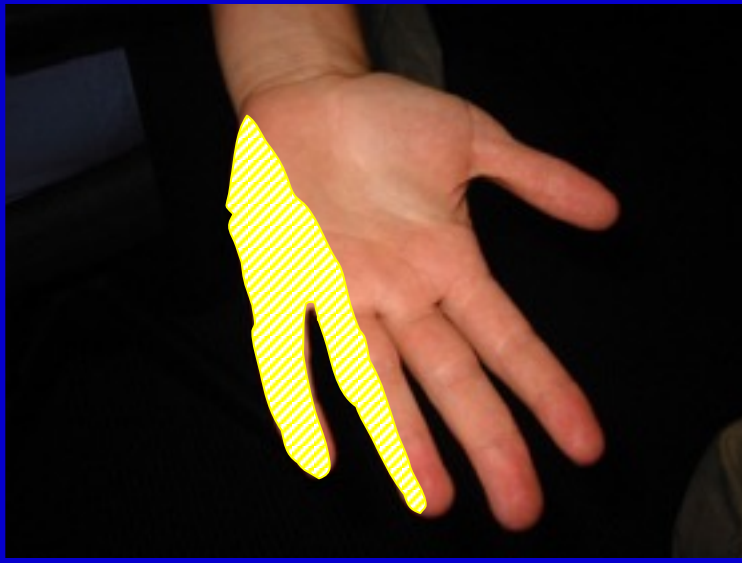
- **Compression: Nerve or tendon**
  - Carpal tunnel syndrome
  - Cubital tunnel syndrome
  - Radial tunnel syndrome
  - DeQuervaine's
  - Trigger finger



# Carpal tunnel syndrome

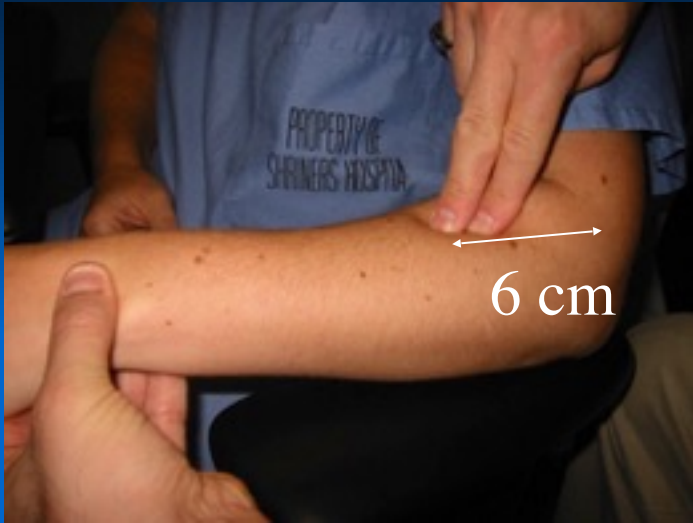


# Cubital tunnel syndrome

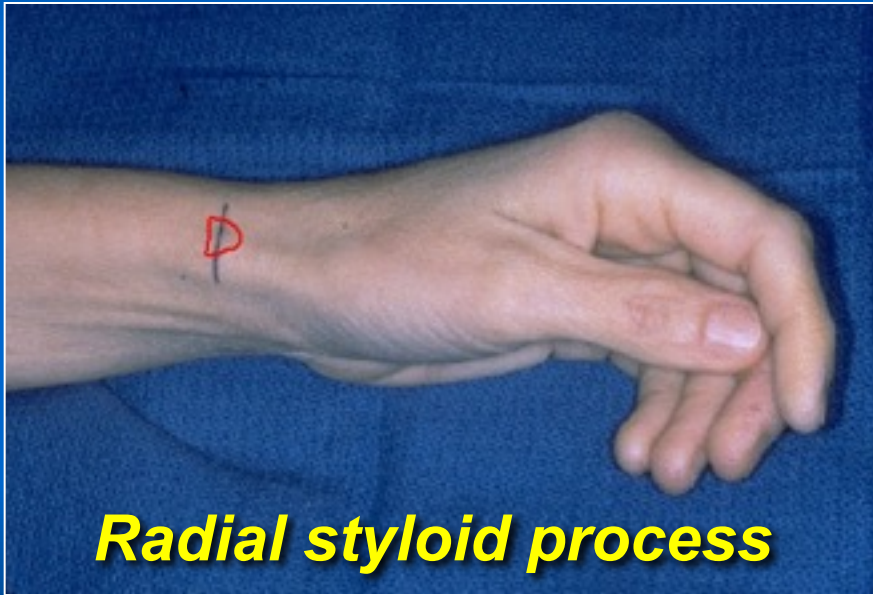




# Radial tunnel syndrome



**Physical Exam:**  
Know the surface anatomy  
and location of structures



## Hematoma, no fracture



***Infection, MRSA***



# Plain Radiographs

- Three views: AP, Lateral, Oblique
- Marked cone views
- Bilateral views
  - Navicular
  - Stress
- Carpal tunnel views



# GENERAL PRINCIPLES

Two plain orthogonal xray views that incorporate 'the joint above and the joint below' may be (and often are) insufficient to diagnose fractures and dislocations of the hand and wrist





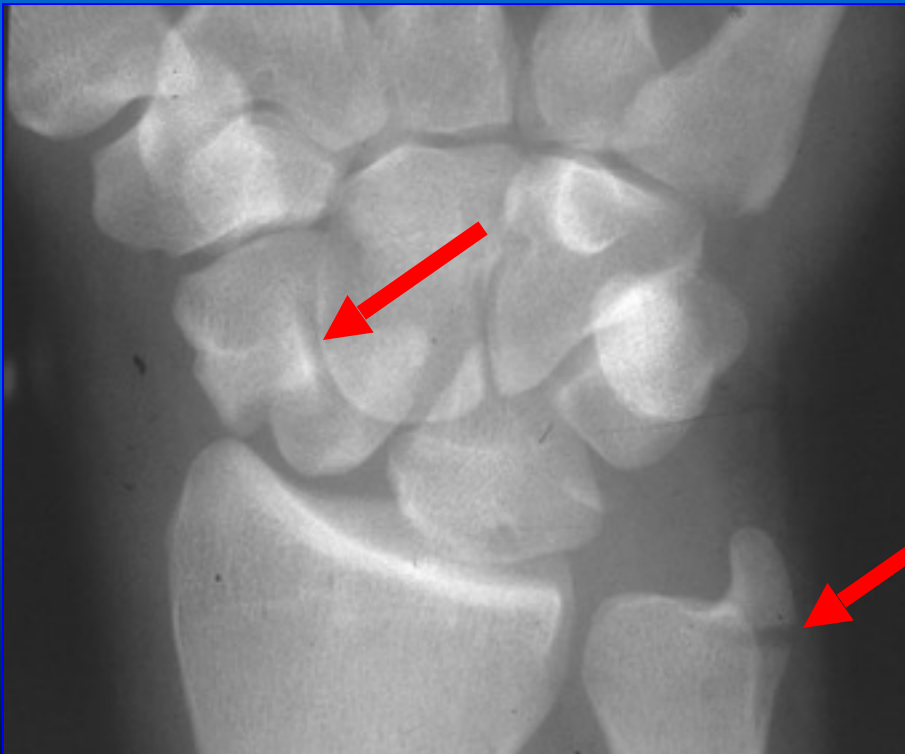
# GENERAL PRINCIPLES

A physical examination precedes every plain radiograph so that appropriate orthogonal views to the expected plane of the pathology/fracture can be requested



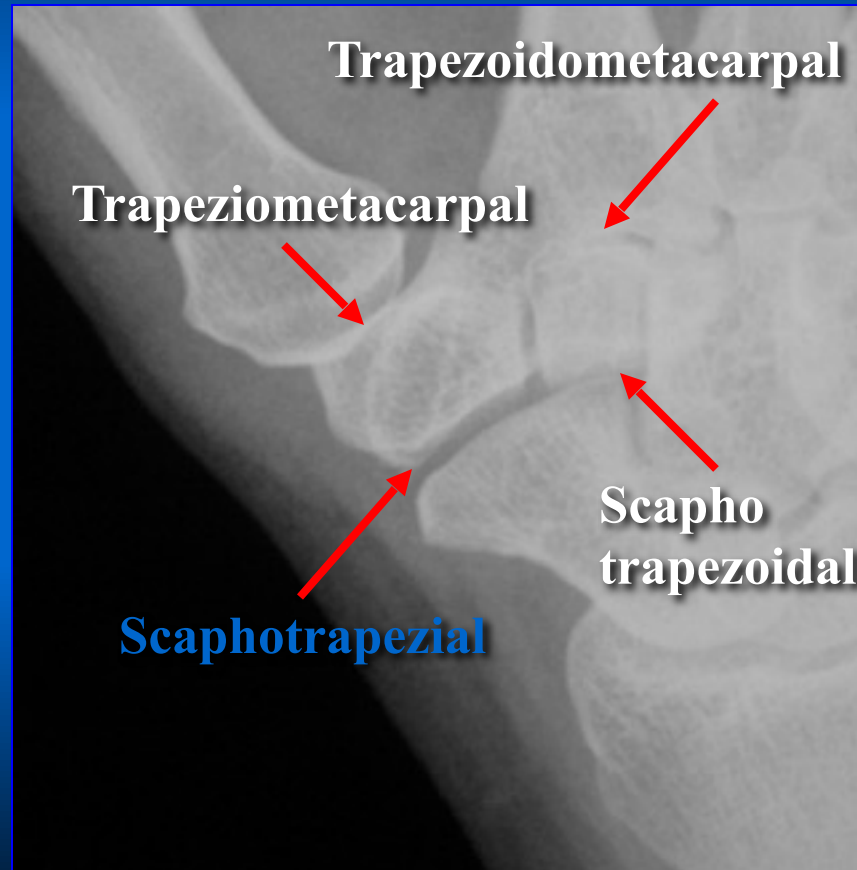
# GENERAL PRINCIPLES

Remember to request 'stress' views for the evaluation of suspected ligamentous disruption of the hand and wrist (such as SLIOL tears, LTIOOL tears, collateral ligament tears of the MCP and IP joints)



# ANGLED RADIOGRAPHS

- Carpometacarpal joints





# PLAIN RADIOGRAPHS

- Carpus
  - Scaphoid



← Pisiform  
uncovered on  
pronated view



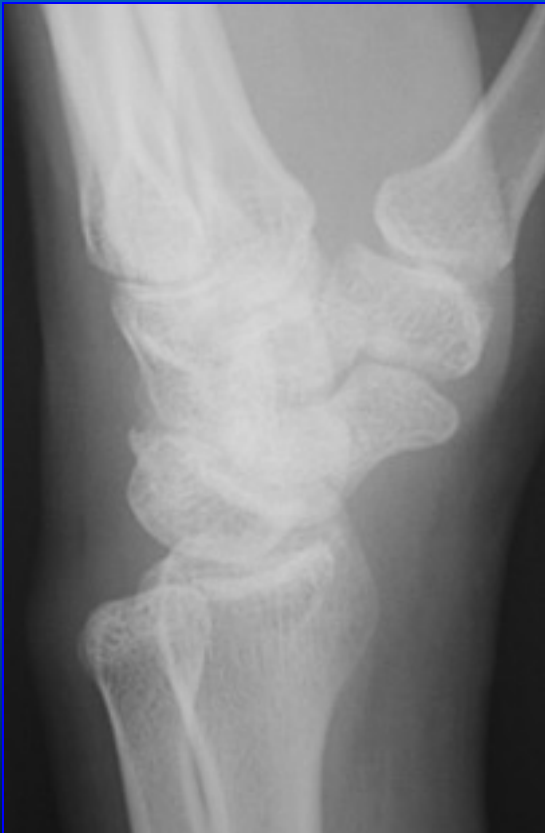
# PLAIN RADIOGRAPHS

- Carpus
  - Lunate



# PLAIN RADIOGRAPHS

- Carpus
  - LT ligament, triquetrum



# PLAIN RADIOGRAPHS

- Carpus
  - Trapezoid : Hyperpronated view



# PLAIN RADIOGRAPHS

- Carpus
  - Capitate



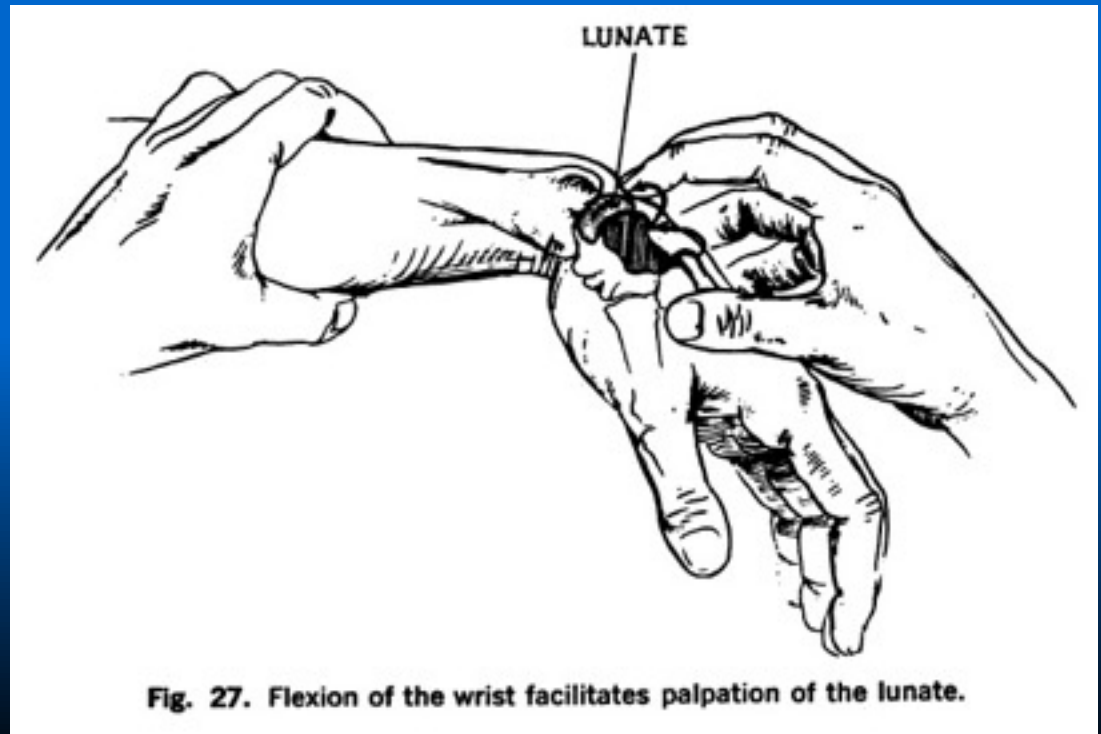
# Scapholunate Dissociation

- Wrist injuries very common in sports
- Some injuries difficult to diagnose
- Scapholunate ligament injuries typically occur from a fall on an outstretched hand or forced extension and radial deviation



# Physical examination

- Tender to palpation directly over the lunate and the scapholunate interval
- “Snuffbox” non-tender
- Pain with wrist extension
- Watson’s test negative



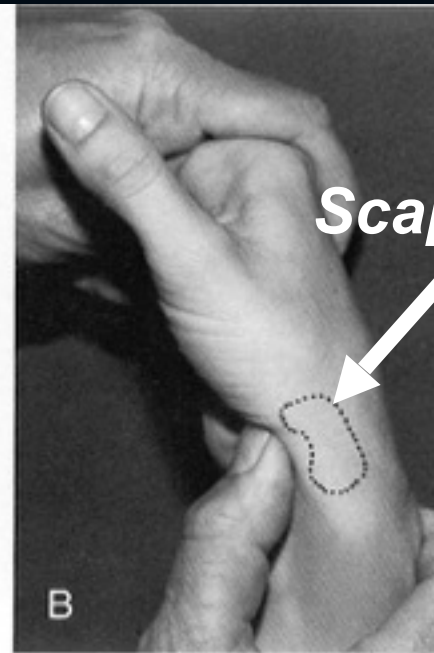
# Scapholunate Dissociation

- Typical findings
  - Positive Watson's test
  - Increased scapholunate angle on lateral view - DISI deformity
  - Widened scapholunate interval on ulnar deviation and clinched fist views





# Watson's Test



**Forceful resistance against  
pronation and radial deviation**

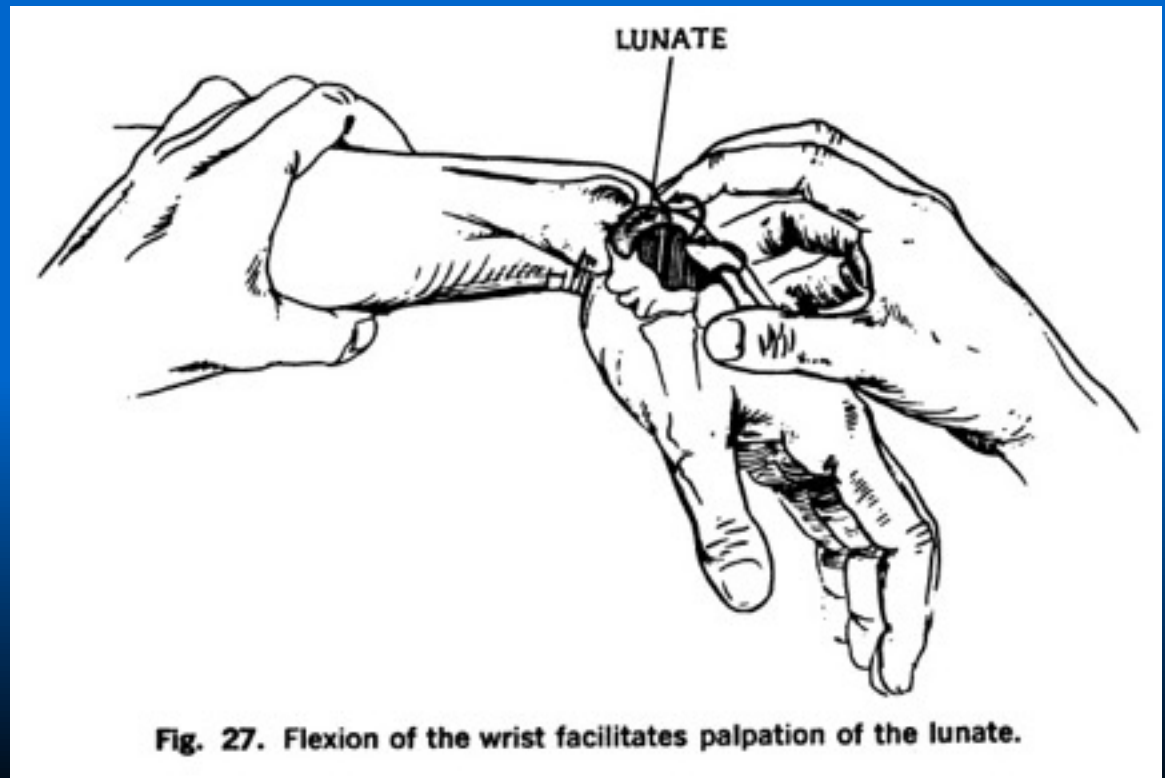


**Patient able to voluntarily reproduce  
“popping” maneuver in wrist**



# Physical examination

- Tender to palpation directly over the lunate and the scapholunate interval
- “Snuffbox” non-tender
- Pain with wrist extension
- Watson’s test negative



# Scapholunate Dissociation

- Typical findings
  - Positive Watson's test
  - Increased scapholunate angle on lateral view - DISI deformity
  - Widened scapholunate interval on ulnar deviation and clinched fist views



# Clenched Fist PA View

## Scapholunate Ligament Disruption

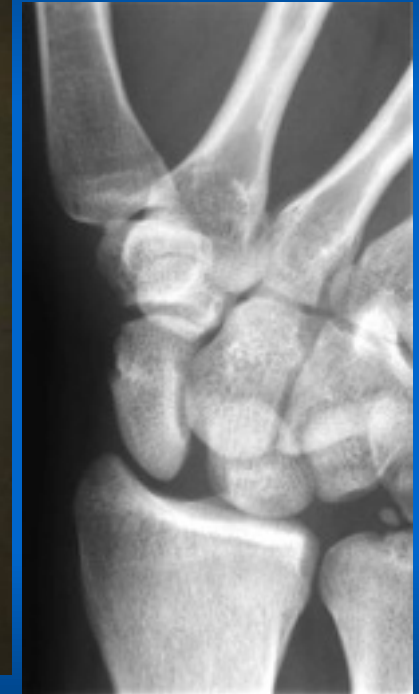
The Capitate migrates proximally in the distal row forcing the proximal row scaphoid and lunate to move apart







# Ulnar deviation views



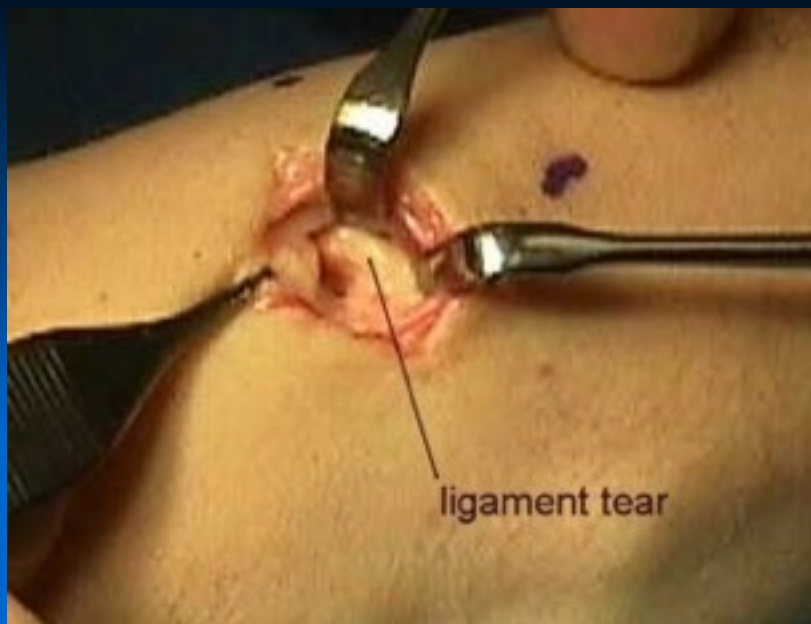
**Normal**

**Scapholunate  
dissociation**



# Terry Thomas sign

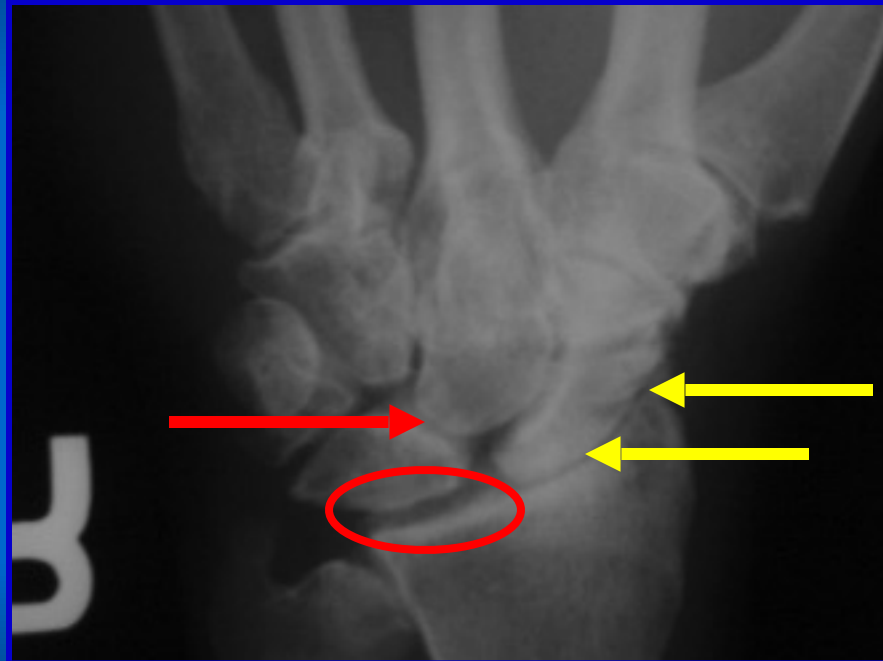






# Wrist arthritis

- Sequel of untreated SL dissociation or scaphoid waist fracture



## **Plain Xrays**

- Soft tissue swelling / fat pad

## **MRI Scan**

- Soft tissue masses
- Fixed / Mobile

## **CT Scan**

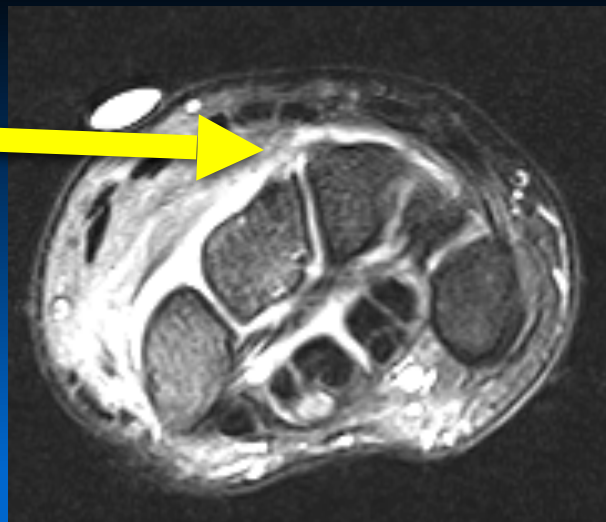
- Bone fracture healing

## **Ultrasound**

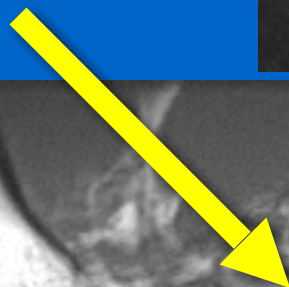
- Solid vs. cystic lesions



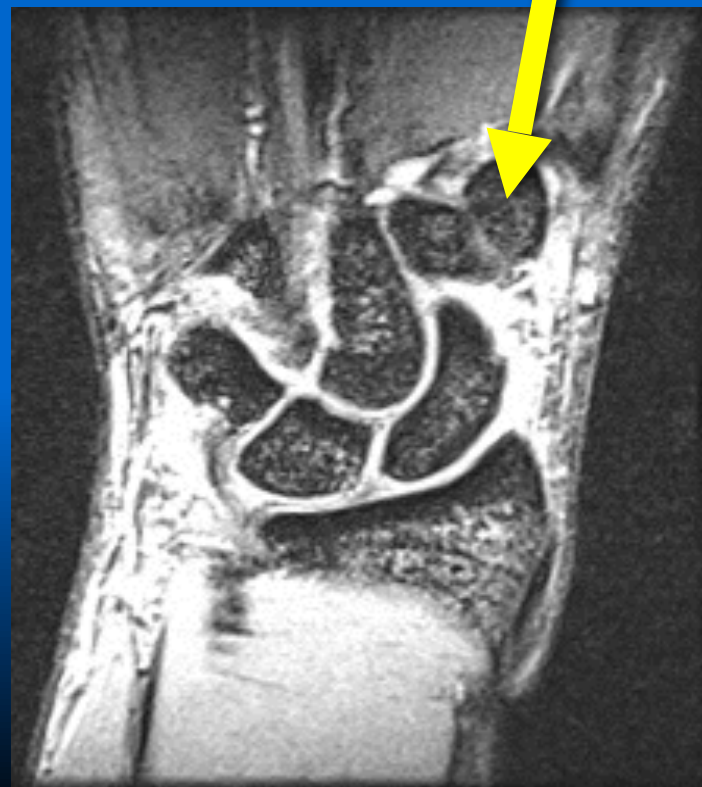
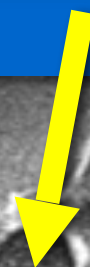
**Acute scapholunate  
ligament tear**



**Chronic  
triquetrum  
fracture**



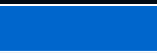
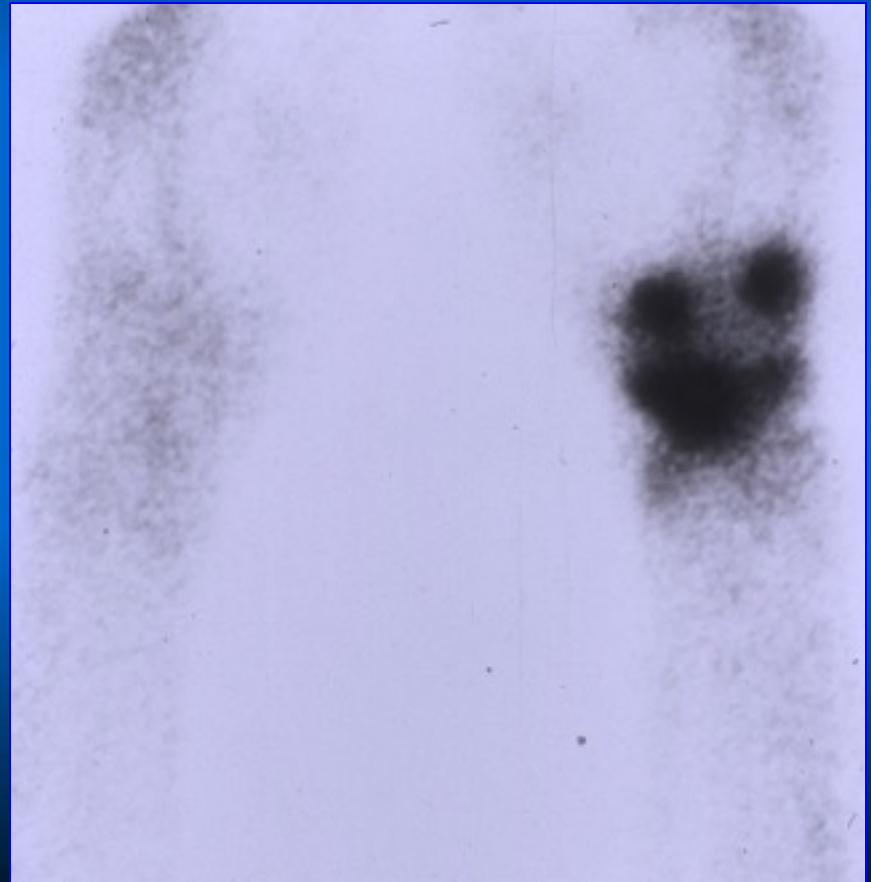
**Chronic  
triquetrum  
fracture**





# UNCLEAR MEDICINE

- Limited usefulness
  - Gilula says:  
It's only hot if it's  
**REALLY** hot



# CT SCAN

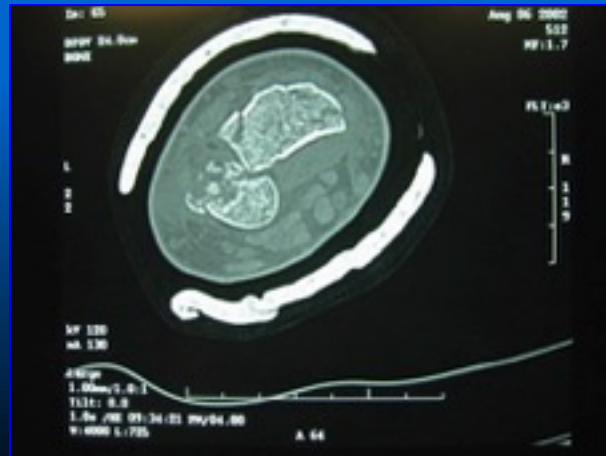
- Principle:

The plane of the imaging should be determined before the scan is done, so that 2-D (transverse, sagittal or frontal) or 3-D recons are not counted upon to make up for information that was unobtained at the time of scan



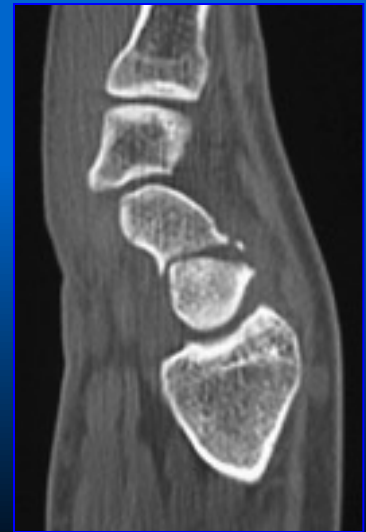
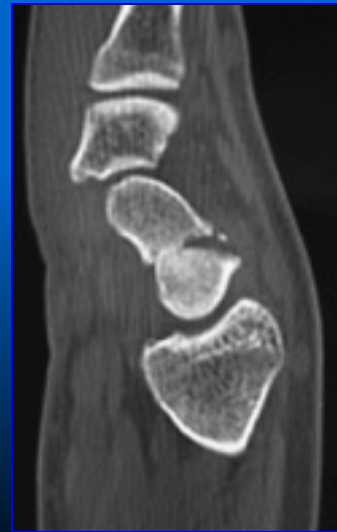
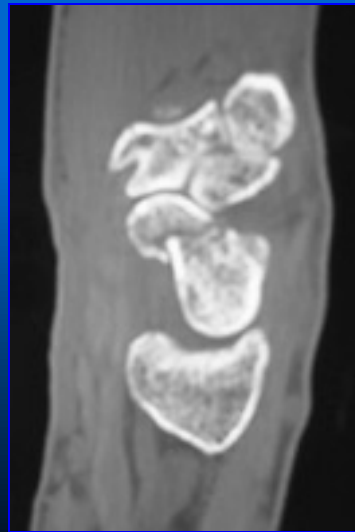
# CT SCAN

- Coronal, sagittal, frontal



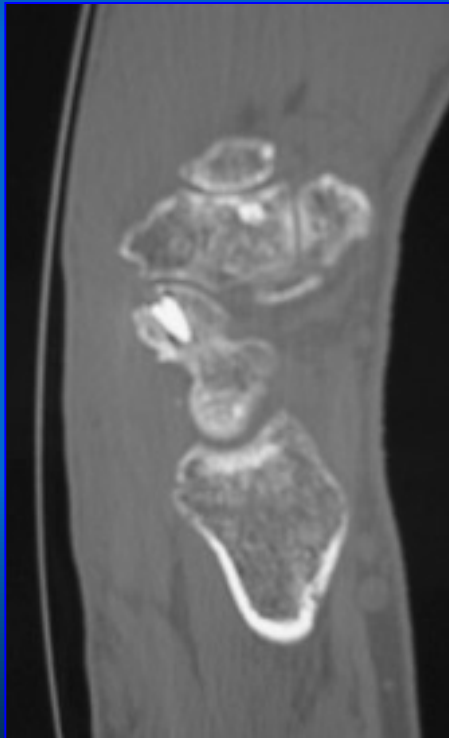
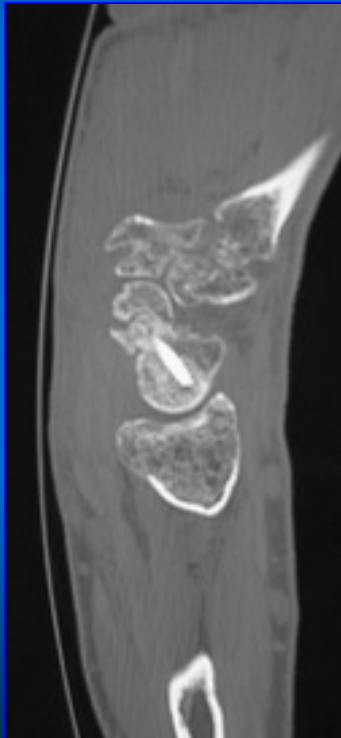
# CT SCAN

- Scaphoid



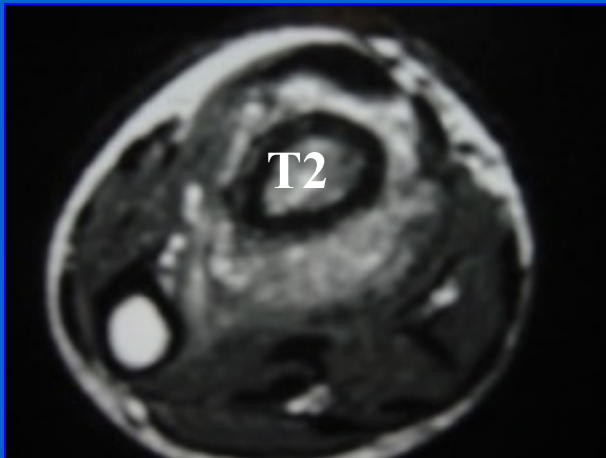
# CT SCAN

- **Scaphoid:** A fracture is not healed until it is healed radiographically (usually by CT scan)



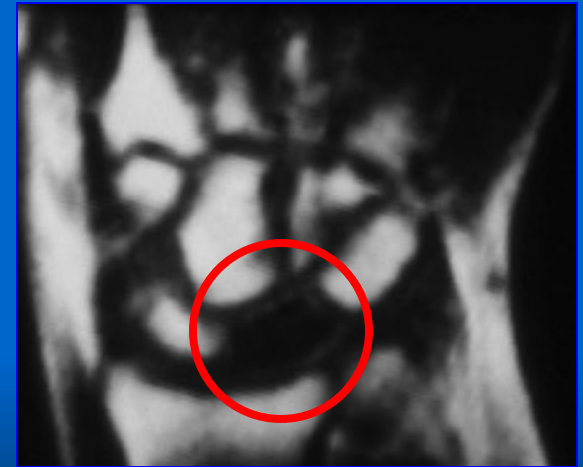
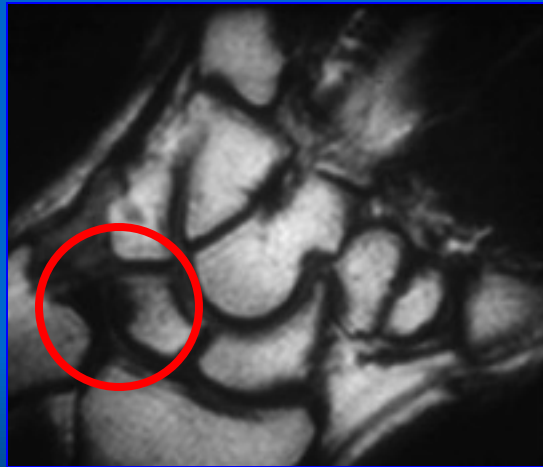
# MRI

- T1, T2, fat suppression T2



# MRI

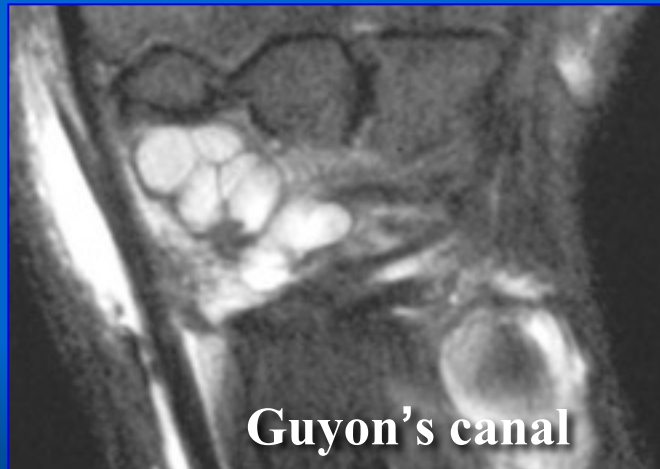
- Radiolunate OA vs. ulnocarpal impaction vs. Kienbock's





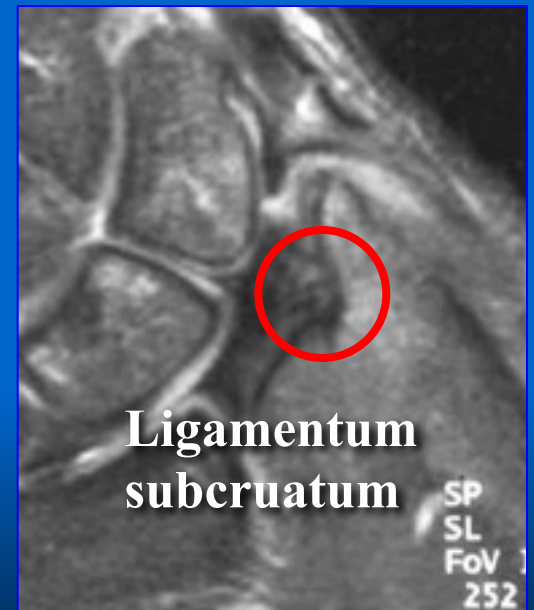
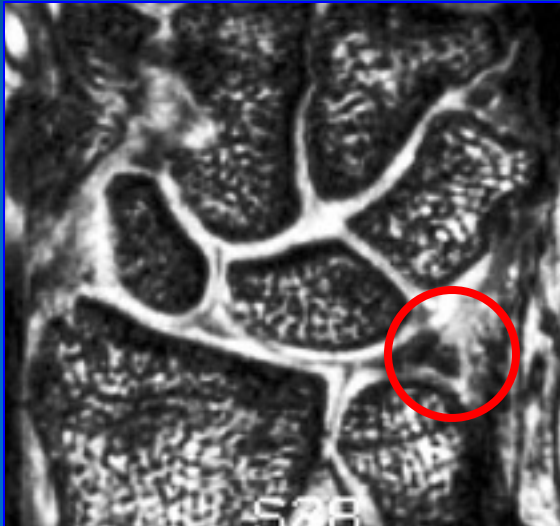
# MRI

- Ganglion



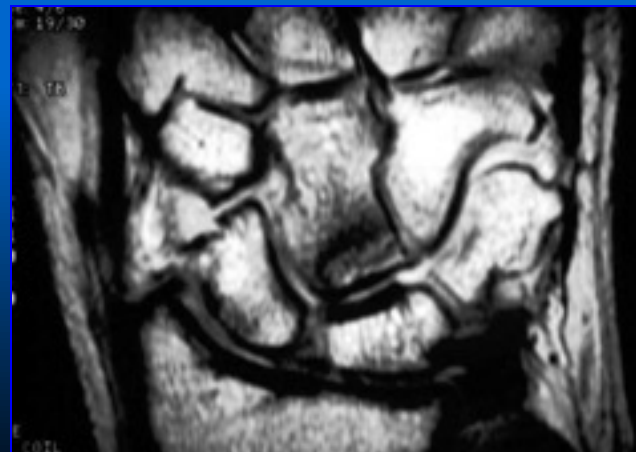
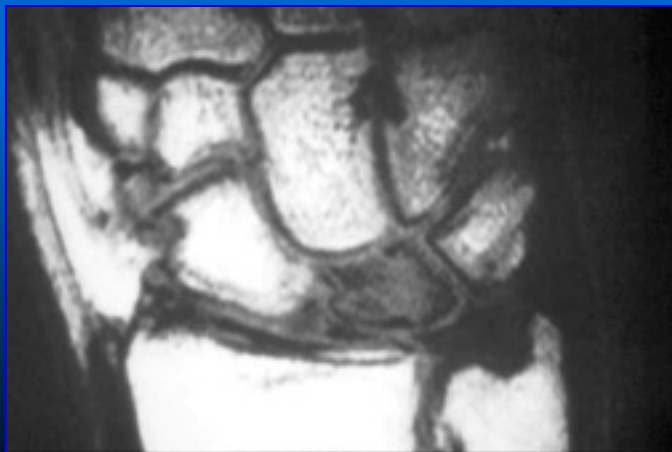
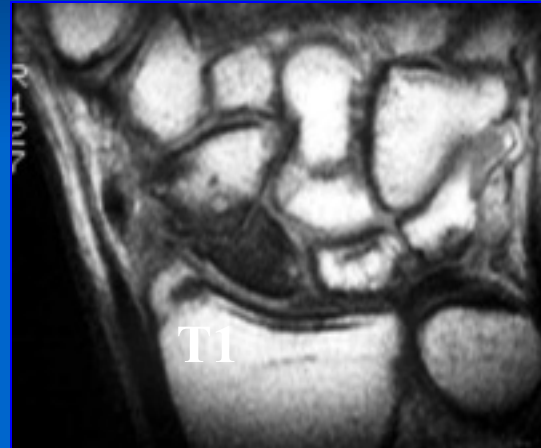
# MRI

- TFCC



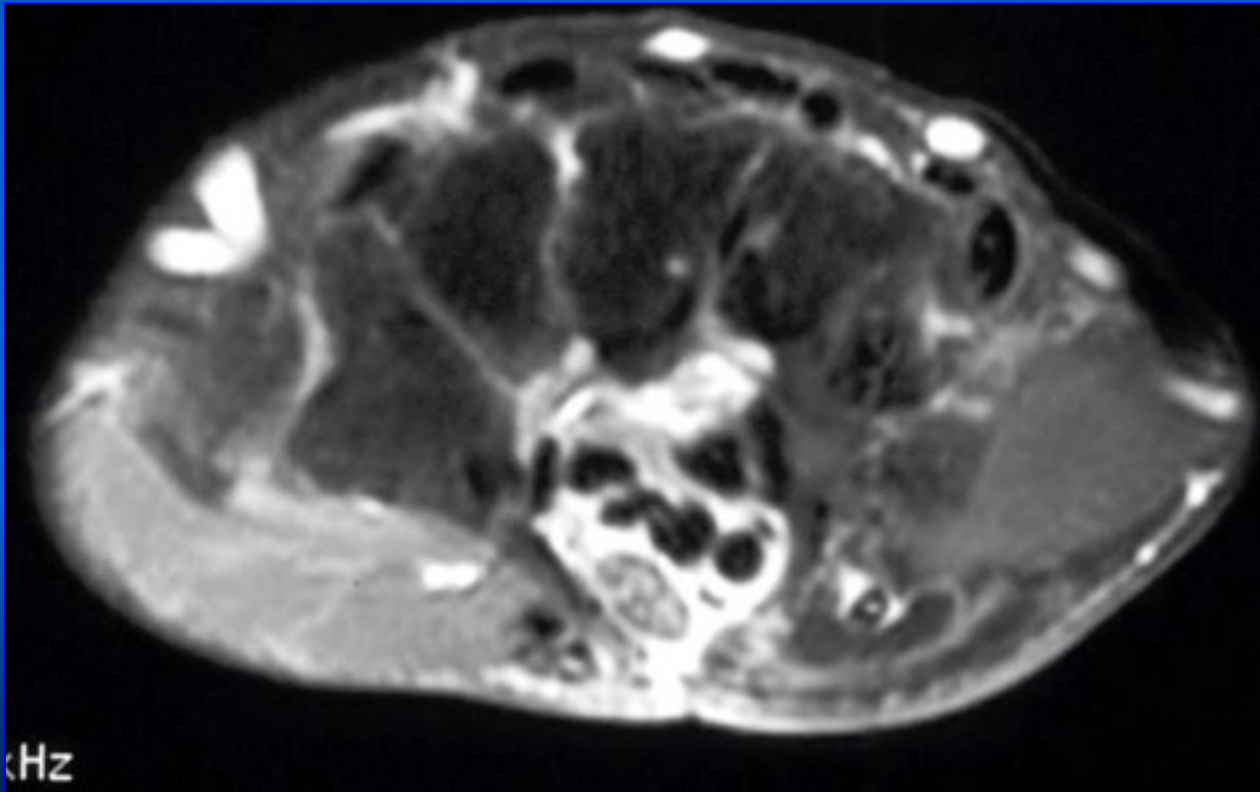
# MRI

- AVN



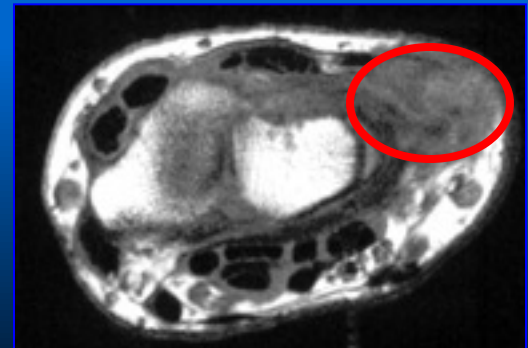
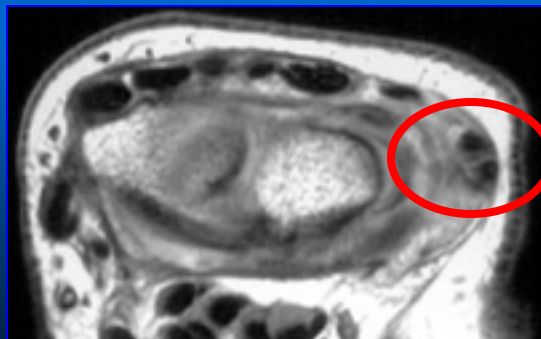
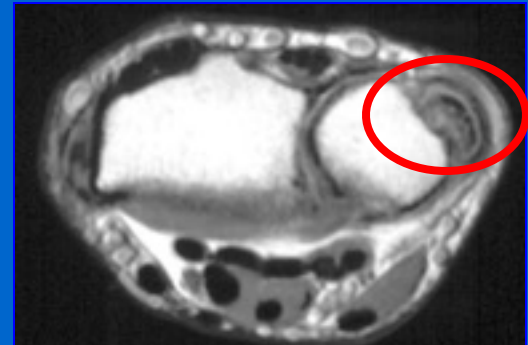
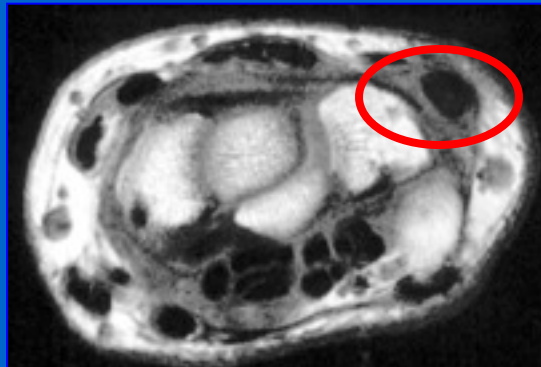
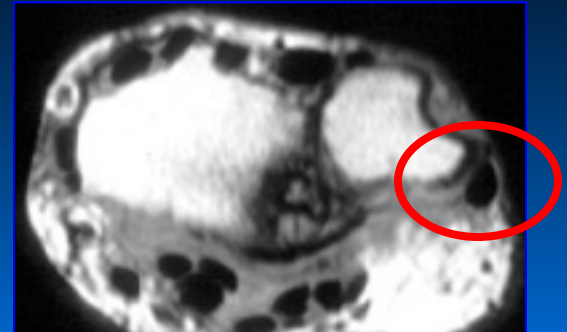
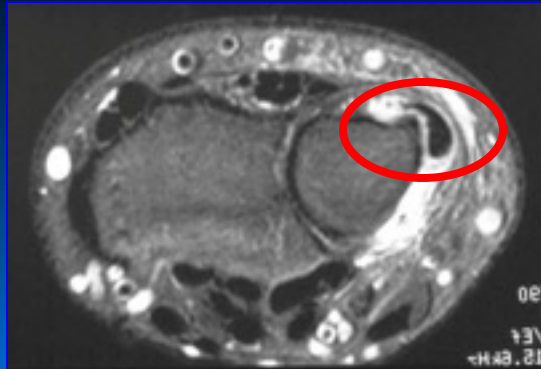
# MRI

- s/p CTR: Palmar subluxation of median nerve



# MRI

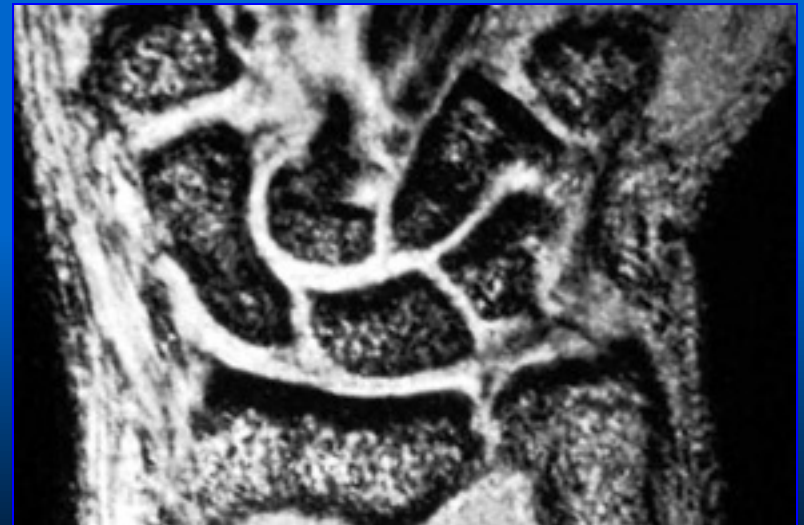
- ECU disease





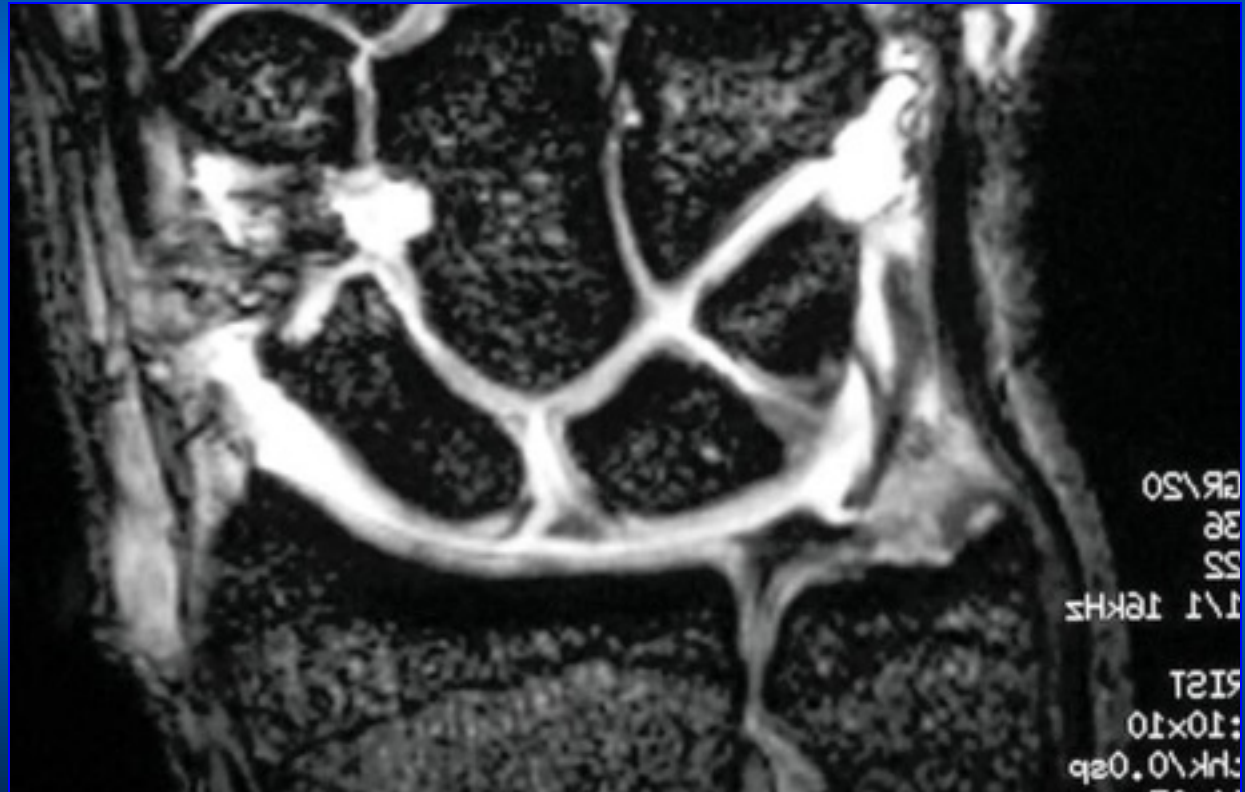
# MRI

- Occult fracture - scaphoid



# MRI

- Arthrography: Added value c/w plain MRI
  - SLIOL
  - TFCC





# Difficult Wrist Injuries in Athletes

- Radial Sided Wrist Injury
- Fall on Hyperextended wrist in Radial deviation
- Easy to Diagnose
- Difficult management decisions
- Potential long term severe disability
- Non union common

= Scaphoid



*Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa*

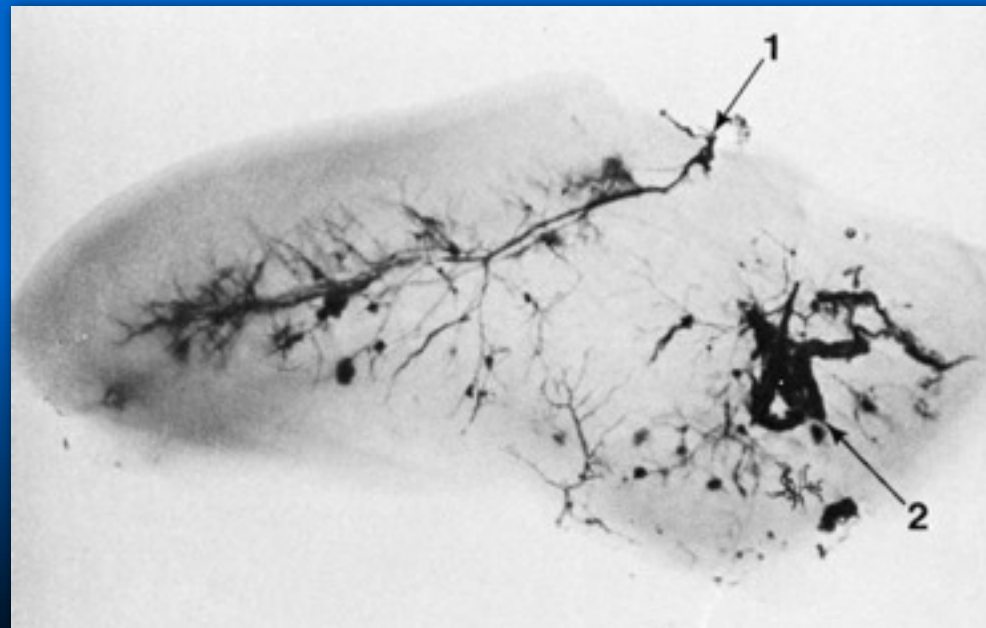
# Symptoms

- Weakness of grip
- Tenderness  
(specifically anatomic snuff box)
- Limited ROM
- NOT specific to scaphoid fractures

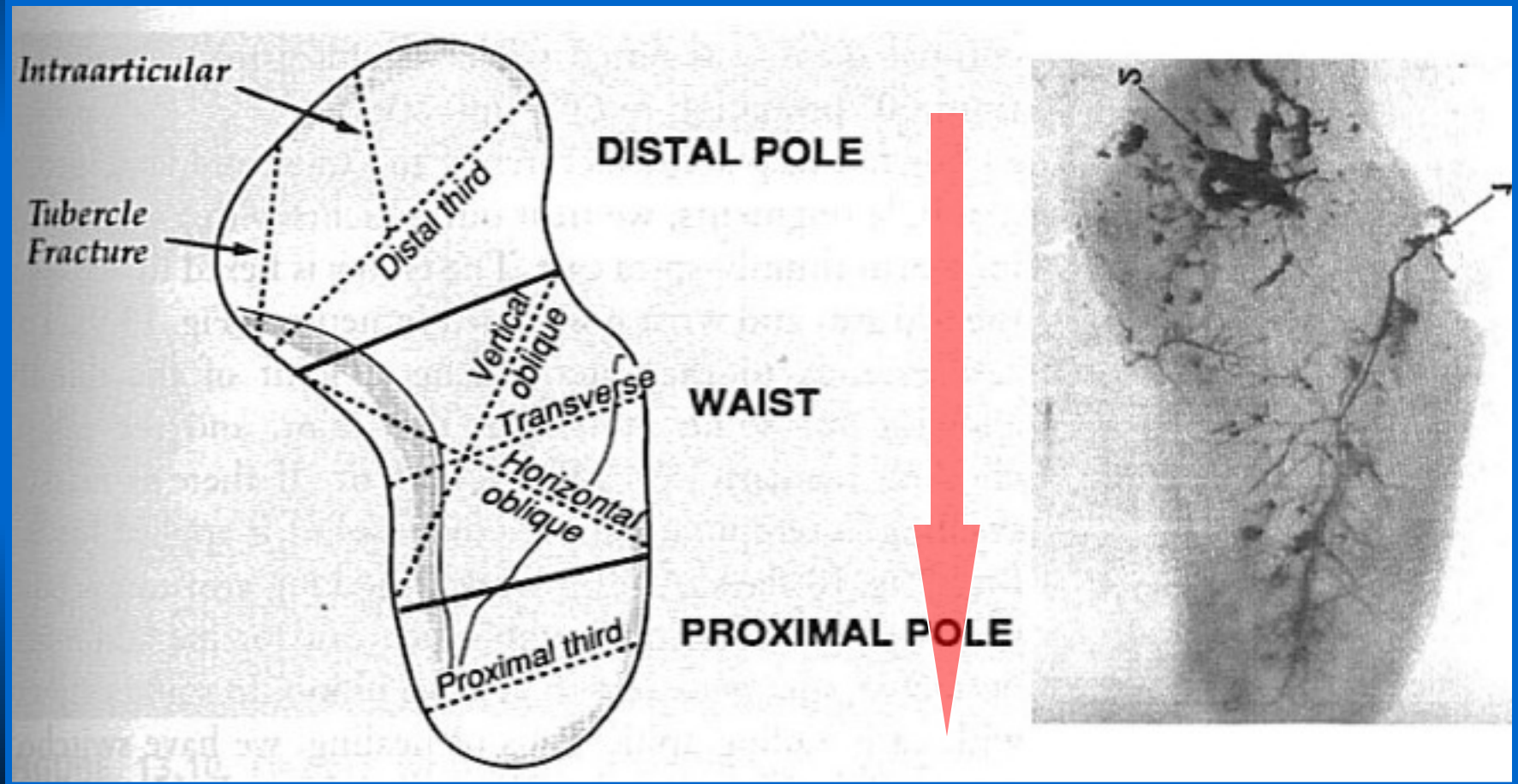


# Vascularity

- Increased incidence of delayed healing/ nonunion with isolation of proximal pole by the fracture
- No interosseus anastomosis
- 1. Dorsal branch of radial artery
- 2. Volar scaphoid branch



# Fracture type comparison



# Proximal Pole Scaphoid Fracture Ulnar Styloid Fracture



**Initial View**



**Immobilized 4 Months  
Osteopenia except proximal pole**



# Scaphoid Fracture



**ORIF**



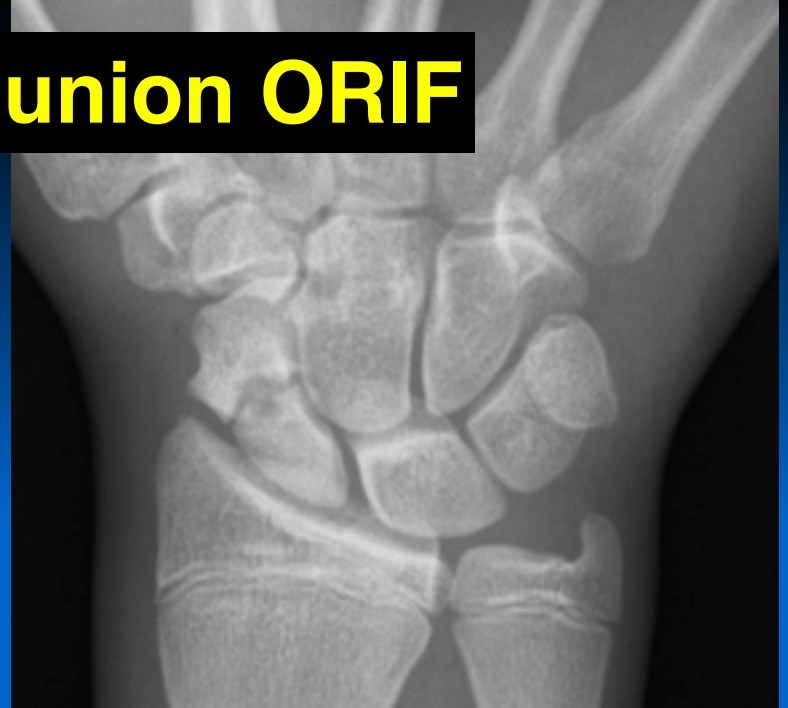
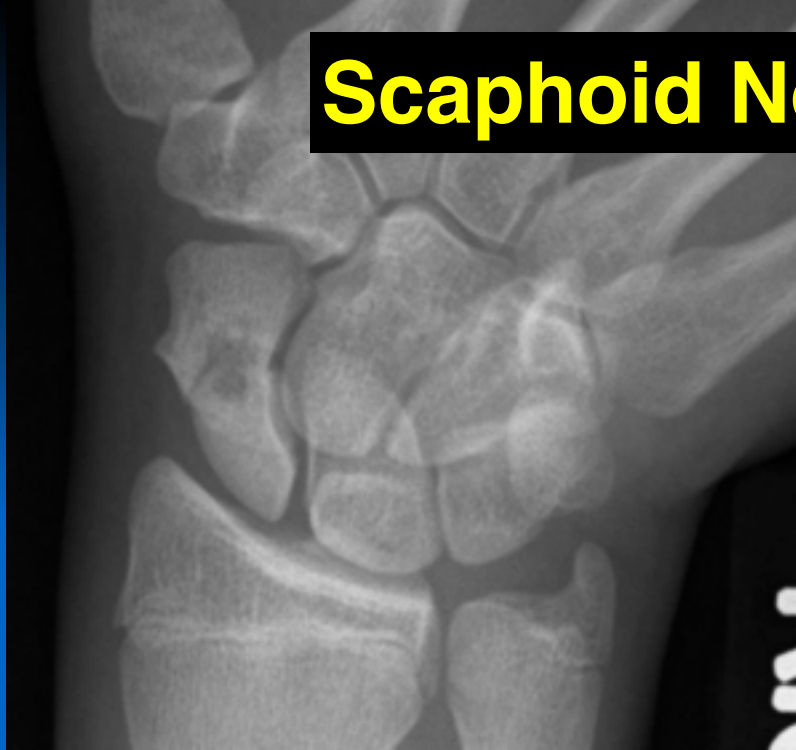


# Scaphoid Nonunion ORIF





# Scaphoid Nonunion ORIF





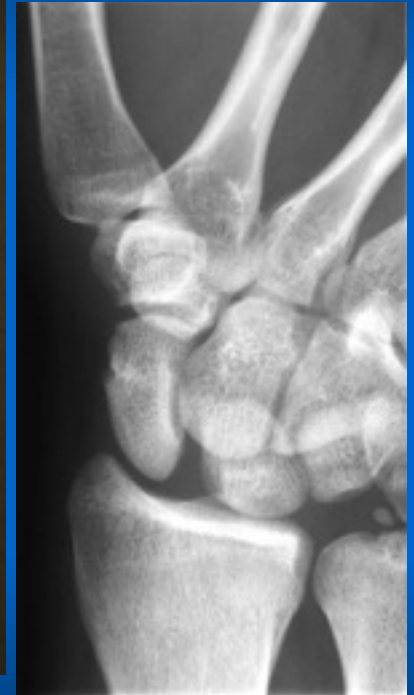
# Ulnar deviation views



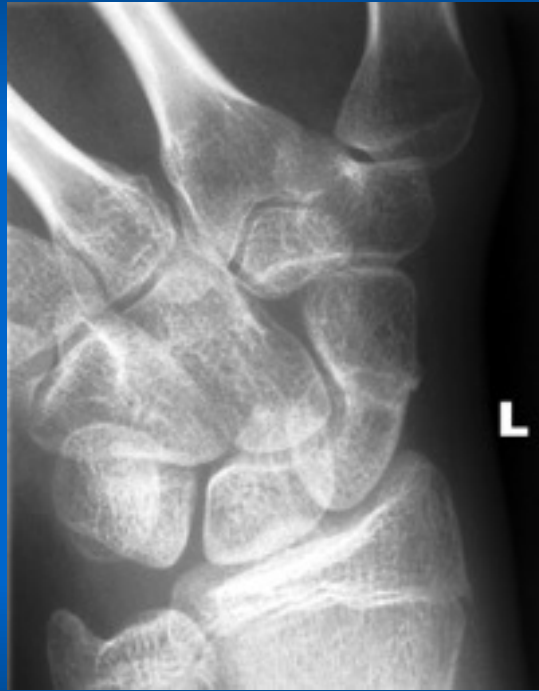
**Normal**



**Scapholunate  
dissociation**



# Scaphoid fracture, left wrist



# Basketball Injury, 10 YO, Left Wrist: Initial



# Basketball Injury, Left Wrist: 2 weeks



***Scaphoid Fracture Can you see it?***





# Basketball Injury, Left Wrist: 5 weeks Now you can..





**Basketball Injury, Left Wrist: 8 weeks Casted SATS 6 weeks then brace-wore at all times! HEALED!**



# Making the diagnosis with a negative x-ray

- MRI

Accurate

(Fowler, Sullivan Skeletal Radiol 1998 Dec;27(12))

Cost effective

(Brooks, Br J. Sports Med 2005 Feb;39(2))

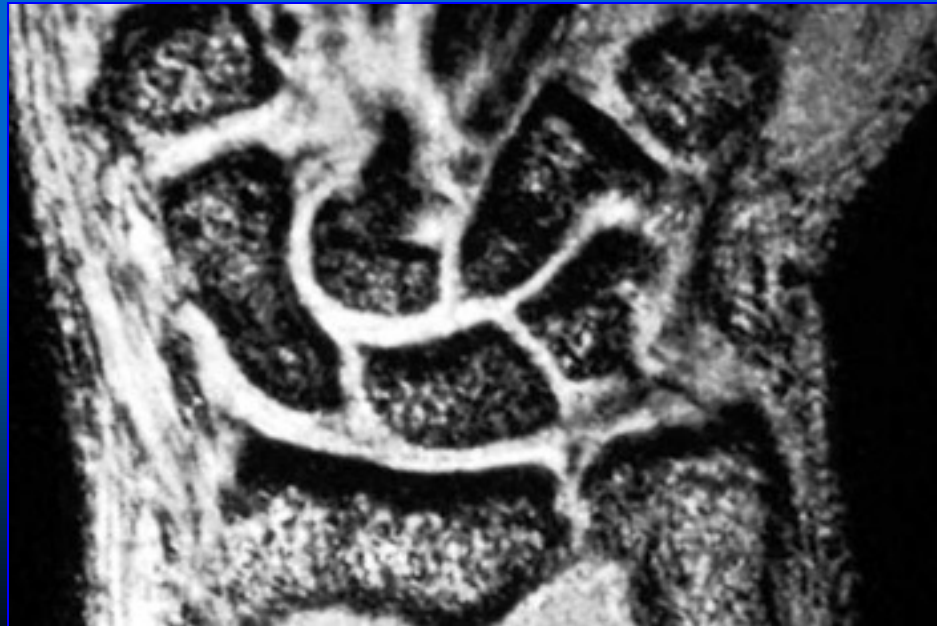
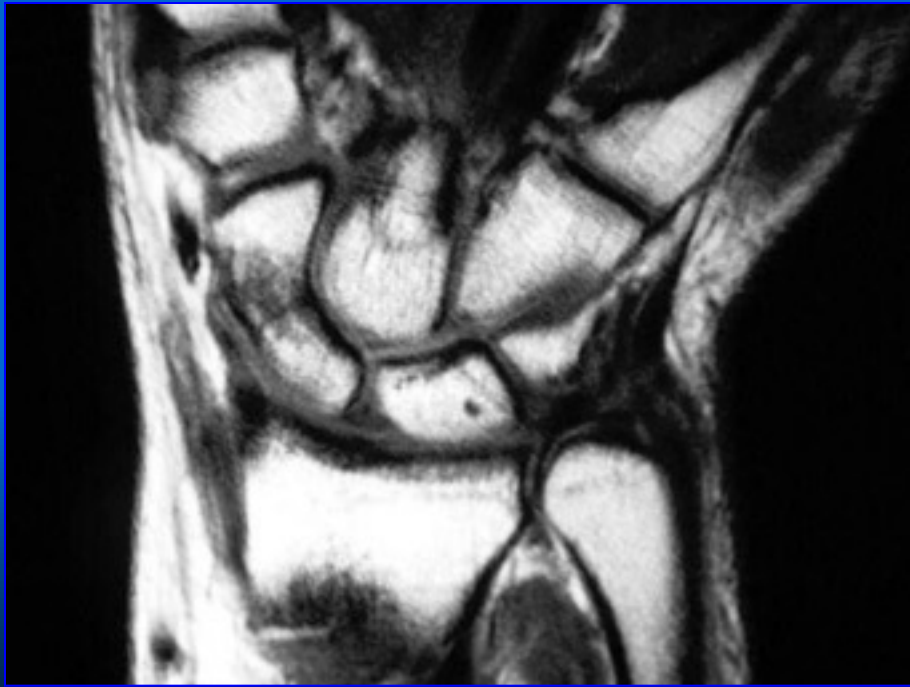
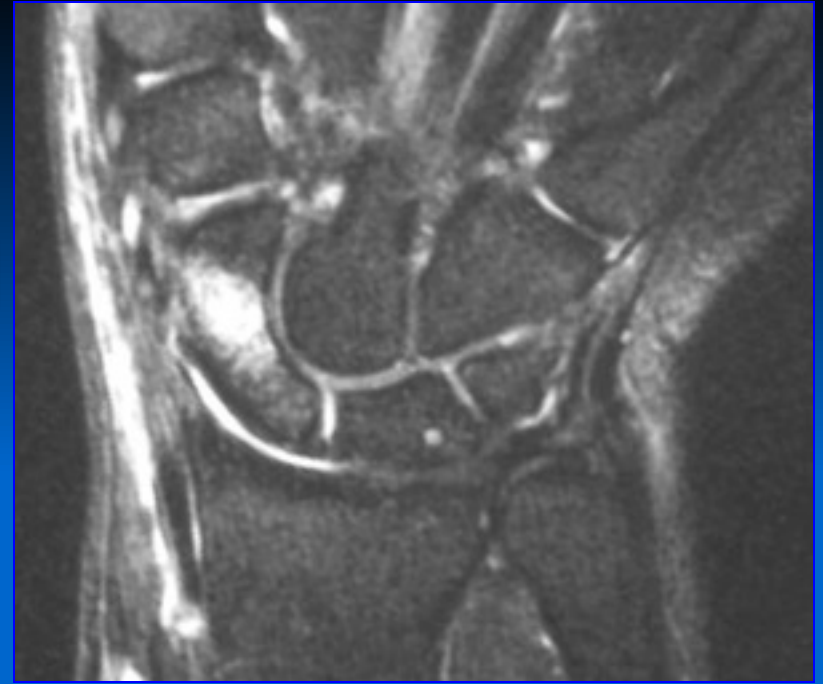
Gooding N Z Med J. 2004 Sept 10;117

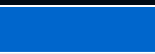
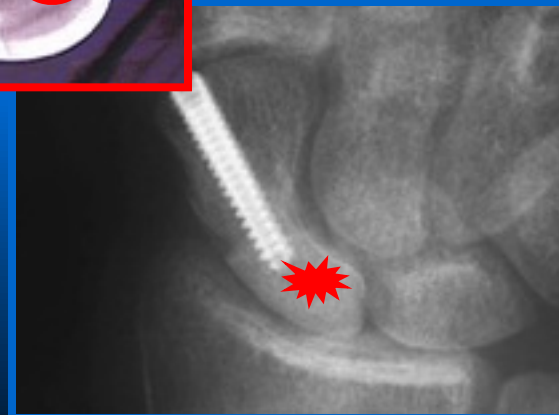
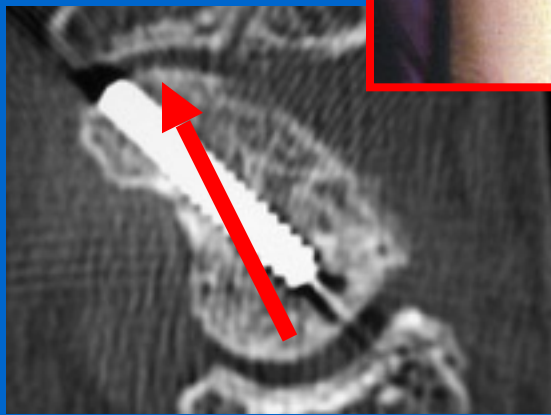
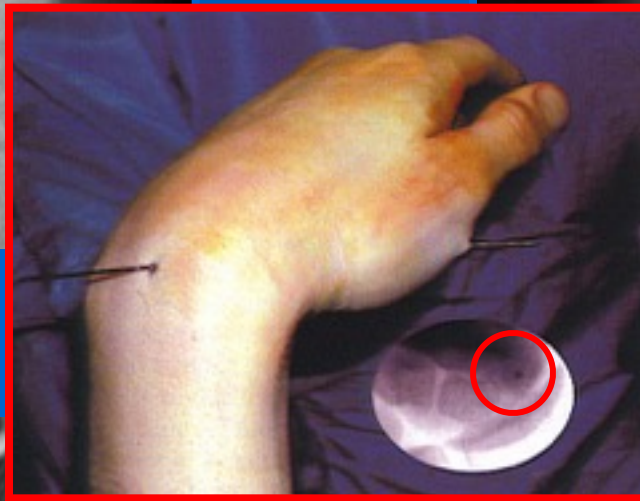
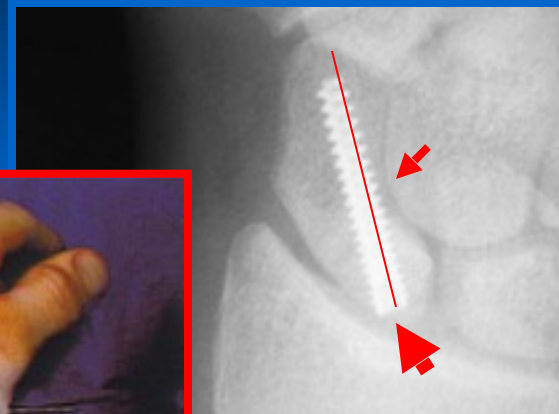
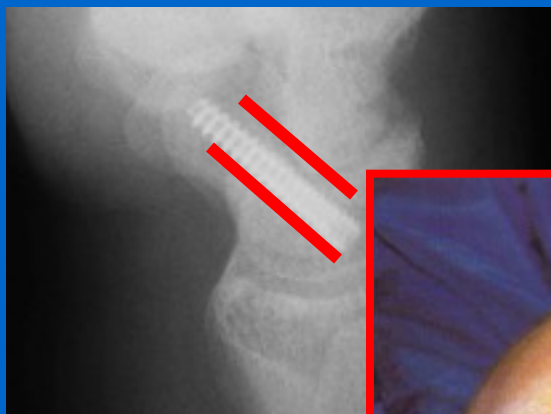
Dorsay, Am J Roentgenol 2001 Dec 177(6)



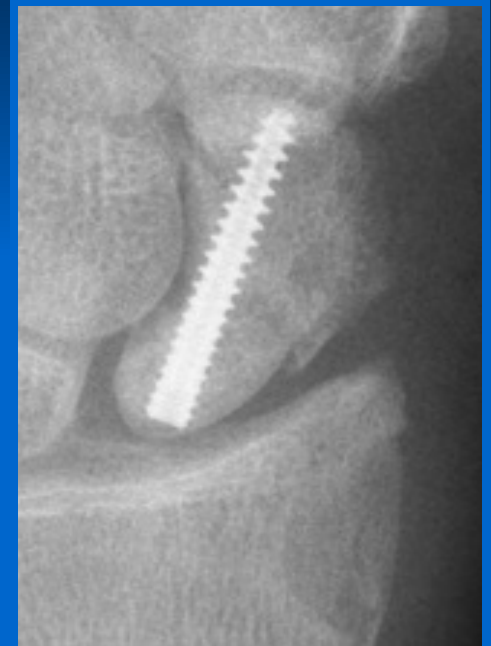
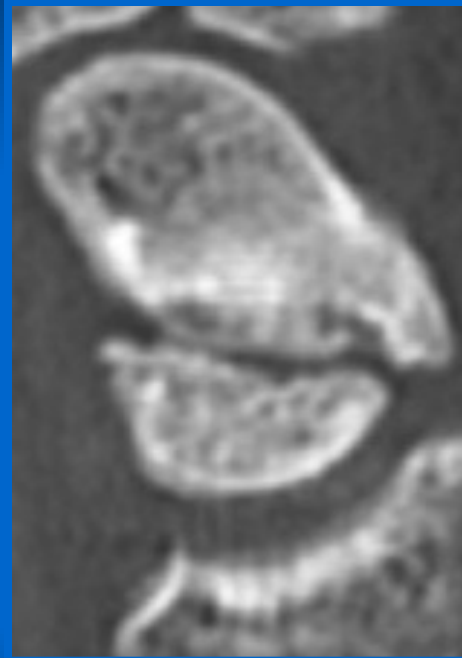
# MRI

- Occult fracture - scaphoid





# Scaphoid Fracture Nonunion



# Difficult Wrist Injuries in Athletes

- Ulna sided wrist injury
- Fall on hyperextended wrist in Ulna deviation
- Difficult to diagnose
- Difficult to Image Controversy as to Imaging techniques
- Easy management decision
- Very few long term problems
- Non union common

= Hook of Hamate



*Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa*



# Keys to Diagnosis...

## Targeted clinical examination:

- Volar tenderness over hamate hook
- Resisted Flexion of ring and little fingers with wrist in ulnar deviation



***Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa***



# Radially deviated wrist

- Almost linear flexor tendon excursion
- Small resultant ulnar vector
- Minimal pain with resisted flexion of ring and little fingers



***Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa***

# Ulnar deviated wrist

- Hook acts as pulley for RF and LF excursion
- Large resultant ulnar vector
- Shearing force against hook causes pain

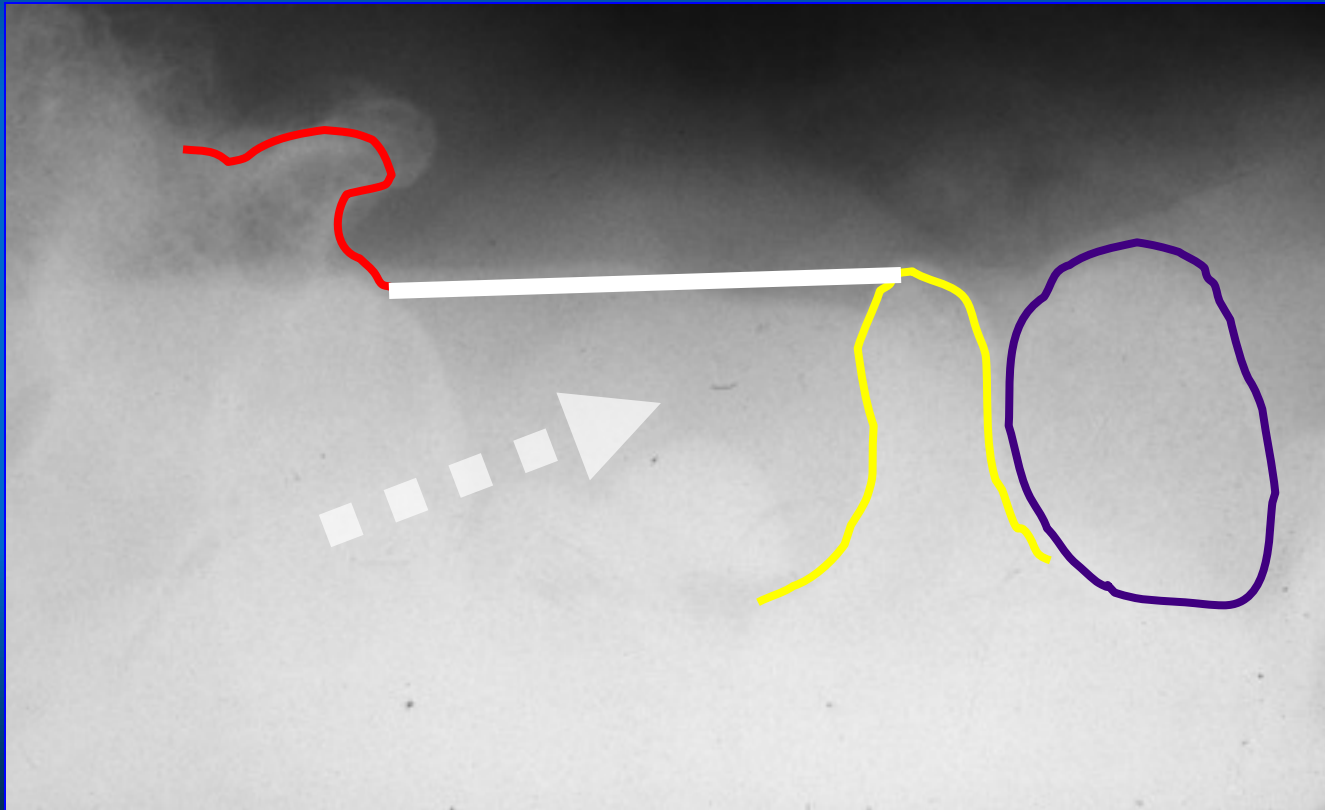


***Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa***



# ANGLED RADIOGRAPHS

- Carpus



# Hamate Fracture



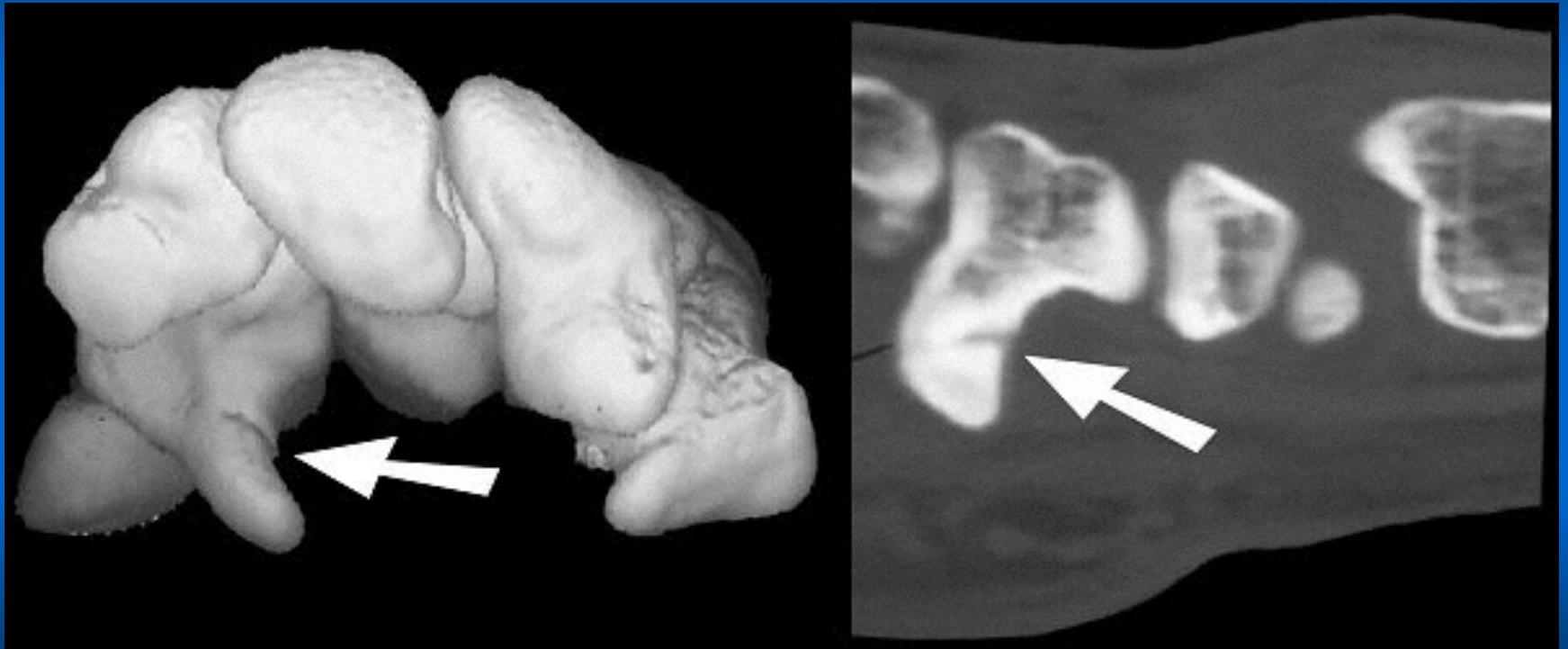
# PLAIN RADIOGRAPHS

- Carpus
  - Hamate





# CT SCAN TO DIAGNOSE Hook of Hamate fracture





# Summary

- **A hook of hamate fracture should not be missed!**
- **Have a high index of suspicion based on suggestive history.**
- **Include resisted finger flexion in the ulnar deviated wrist and palpation over the hamate hook as part of your examination**
- **Request a CT scan rather than MRI or XR to confirm clinical diagnosis**

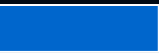
***Dr. Steve Carter • Consultant Hand Surgeon  
Sports Science Institute • Capetown, South Africa***



# Wrist

- Triangular fibrocartilage disorders
  - Assessment
  - Repair vs. debridement
- Intra-articular fractures
- Acute instability

***WRIST PAIN = LOW BACK PAIN***



# History

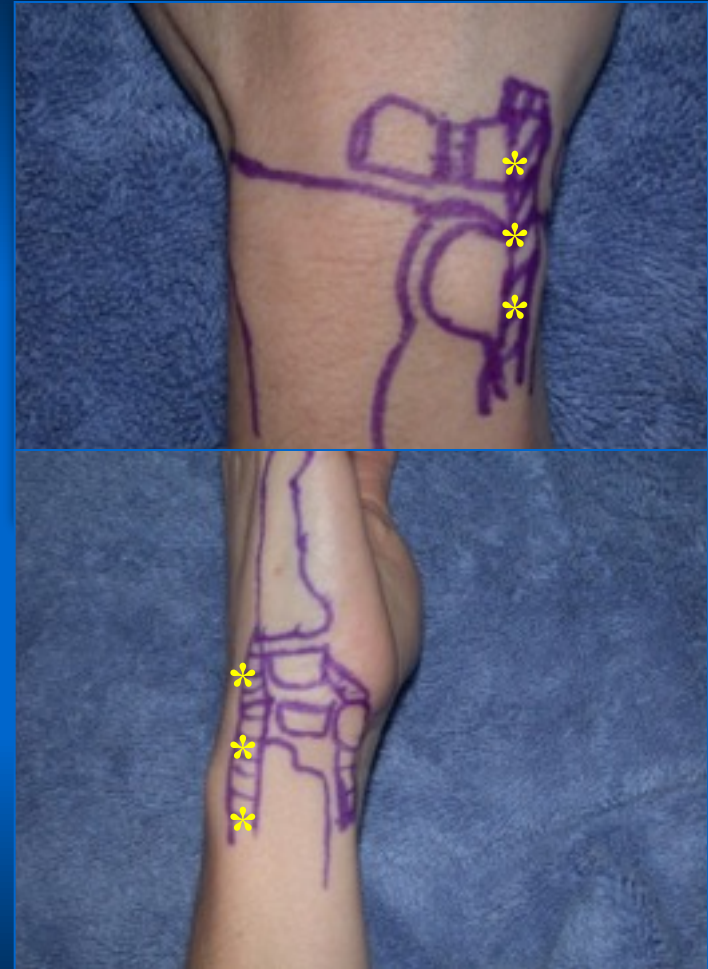


- **Single Episode or Chronic Overuse**
- **Grip Style**
  - 'loose grip'
- **Swing Style**
  - Spin
  - Double or single handed
- **Dominant Hand?**

# Physical Examination

- *Swelling*
- *Point of Maximal Tenderness*
- *Provocative testing*

*ECU tendinitis (primary)*  
*ECU subluxation*



# Physical Examination

*ECU tendinitis (primary)*

*ECU subluxation*

*Ulna-carpal impaction*

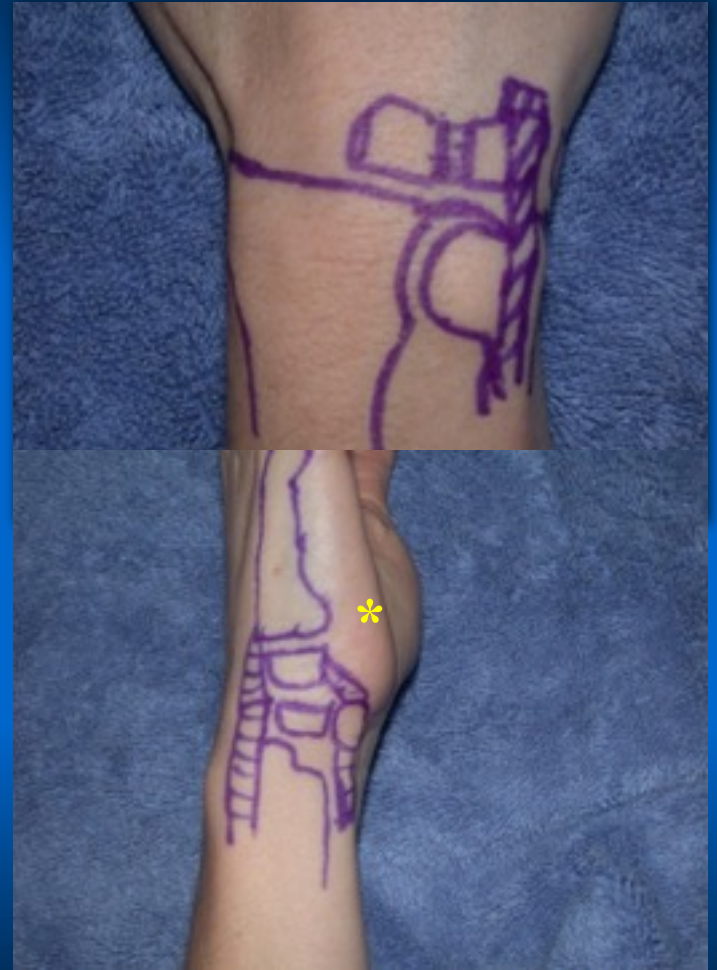
*TFCC injury*

*FCU tendinitis*

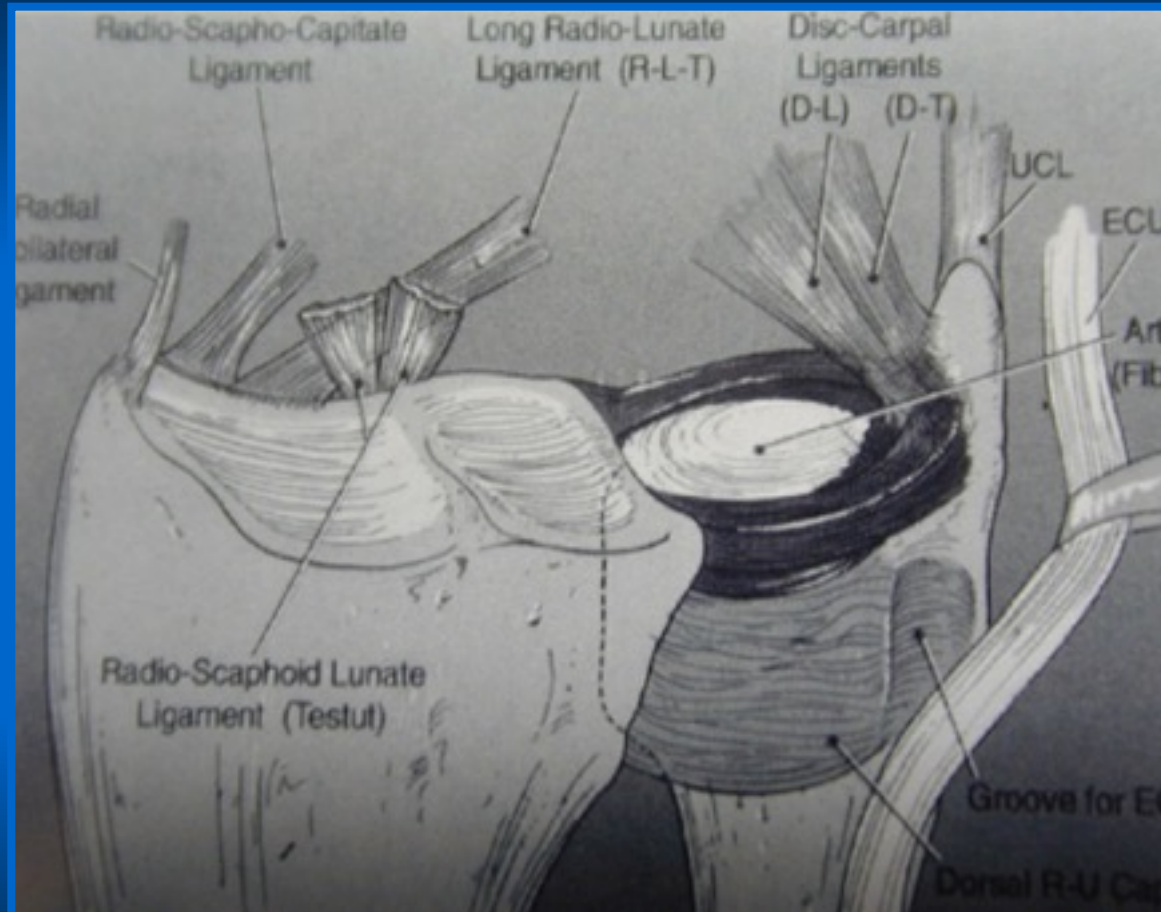
*Lunotriquetral ligament tear*

*Triquetral hamate impaction*

*Hook of the hamate fracture*



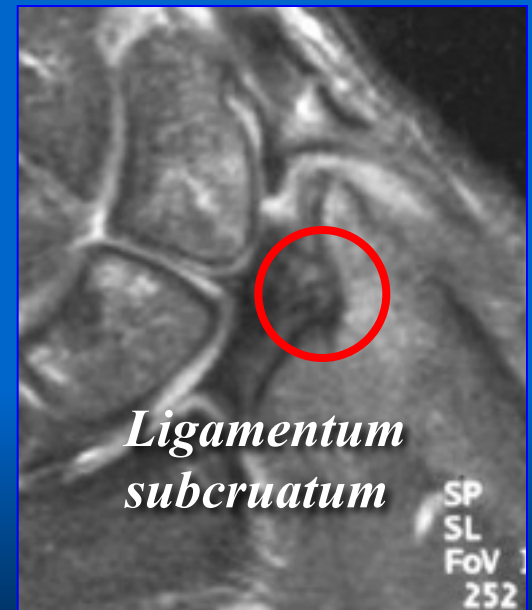
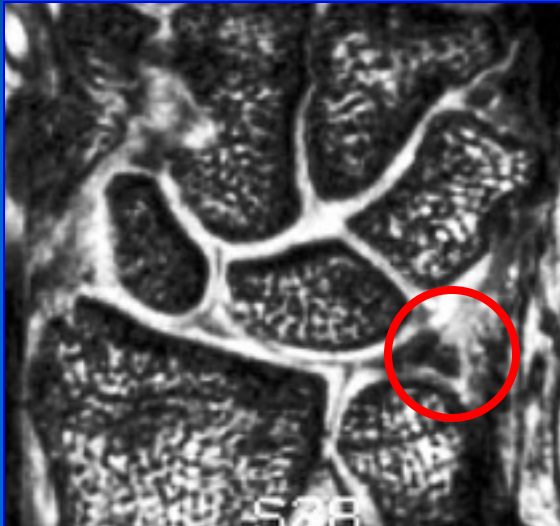
# Triangular fibrocartilage complex





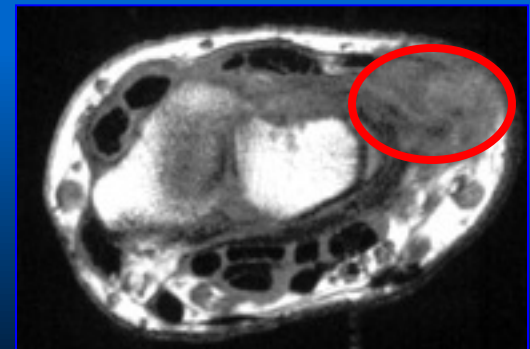
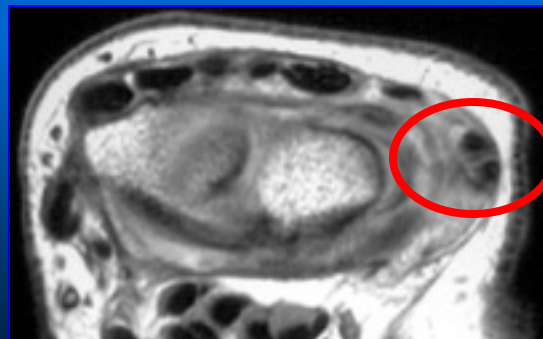
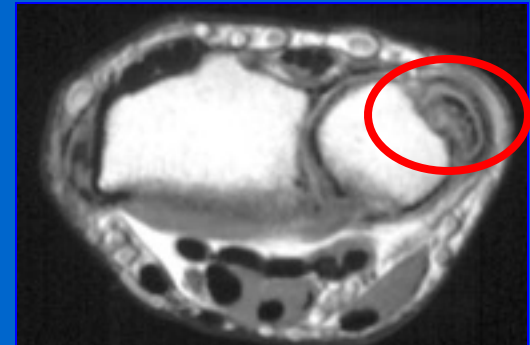
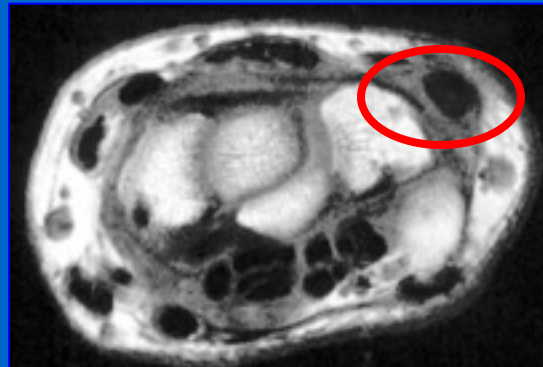
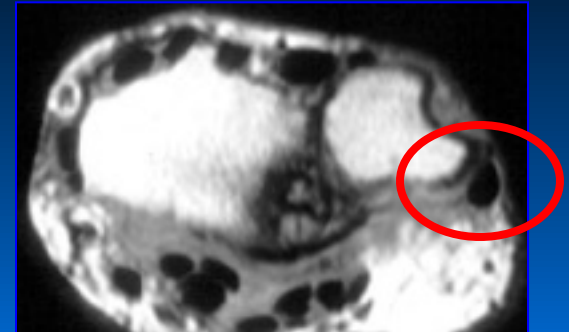
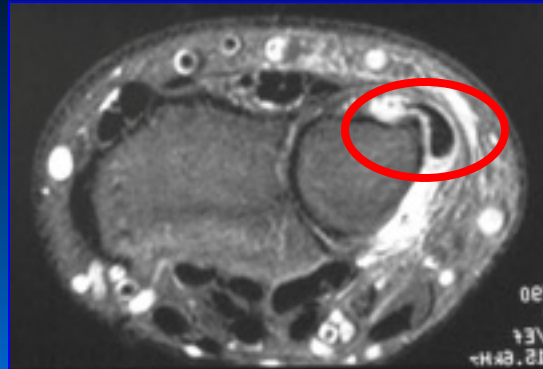
# MRI

- TFCC



# MRI

- ECU disease

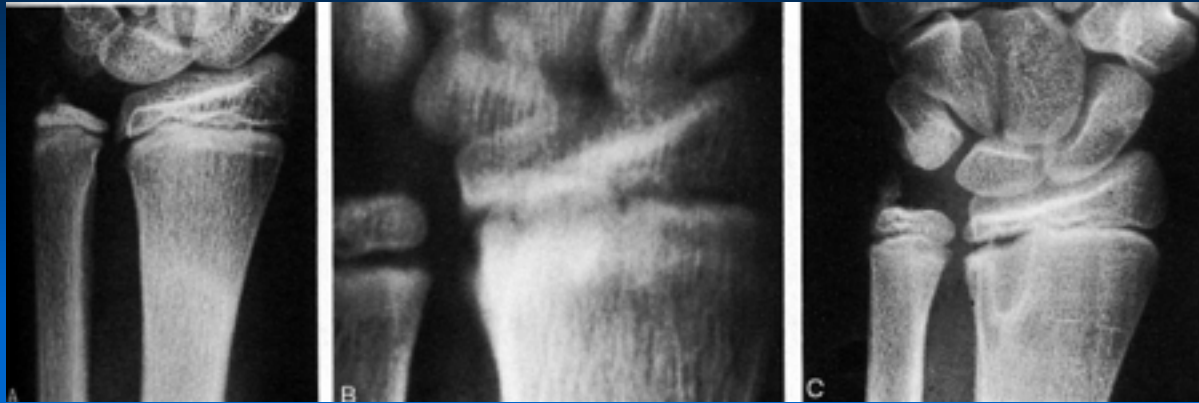


# Ulnar sided wrist pain

- “DRUJ-ery” – Richard A Berger, MD, Mayo Clinic
- “I have spent over 25 years studying an area of the wrist that measures one square centimeter” – William B. Kleinman, MD, Indiana Hand Center



# Distal radial growth arrest



## *Little Leaguer's Shoulder*



# Wrist

- Distal radius epiphyseal fractures
  - Gymnast's wrist
    - Symptoms: wrist pain
    - Xrays widened distal radius
    - Trend toward negative ulnar variance
    - Then higher than normal 80% load on radial epiphyseal plate

*DiFiori JP, Puffer JC, Aish B, Dorey F, "Wrist Pain, distal Radial Physeal Injury, and Ulnar Variance in Young Gymnasts: Does a Relationship Exist?" Am J Sports Med 2002;30(6):879-885.*

# Wrist

- More ⊕ ulnar variance
- Ulnar variance not associated with wrist pain
- 59 Gymnasts (28 girls / 31 boys)
  - Average age 9.3 years
    - 10-14 years of age: 83% had wrist pain
    - Outside that age range: 44% had wrist pain

*DiFiori JP, Puffer JC, Aish B, Dorey F, “Wrist Pain, distal Radial Physeal Injury, and Ulnar Variance in Young Gymnasts: Does a Relationship Exist?” Am J Sports Med 2002;30(6):879-885.*



# Wrist

- Radiographic survey
  - 60 gymnasts (39 females / 21 males)
  - Delay in maturation for females
  - 5 abnormal wrist xrays (4 females / 1 male)
  - Look for widening and irregularity, distal radius
  - Look for arrested growth
  - Positive ulnar variance in Salter I or II fractures
  - Need larger scale studies

*Caine D, Roy S, Singer KM, Broekhoff J, "Stress changes of the distal radial growth plate: A radiographic survey and review of the literature," Am J Sports Med 1992;20(3):290-298.*



## Congenital laxity party trick



**PIPJ dorsal dislocation  
deformity at joint**



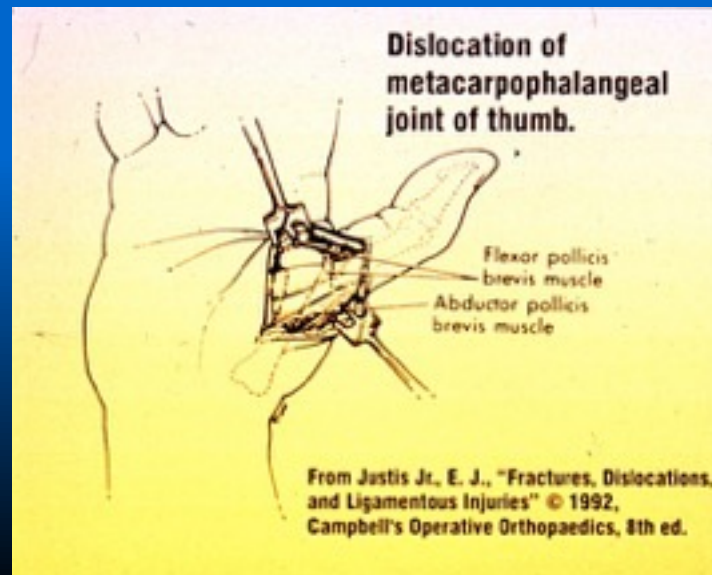
**Proximal phalanx  
fracture deformity  
proximal to joint  
with rotation**



# MCP, Volar dislocation, reducible



Some are not





# PLAIN RADIOGRAPHS

## Digits

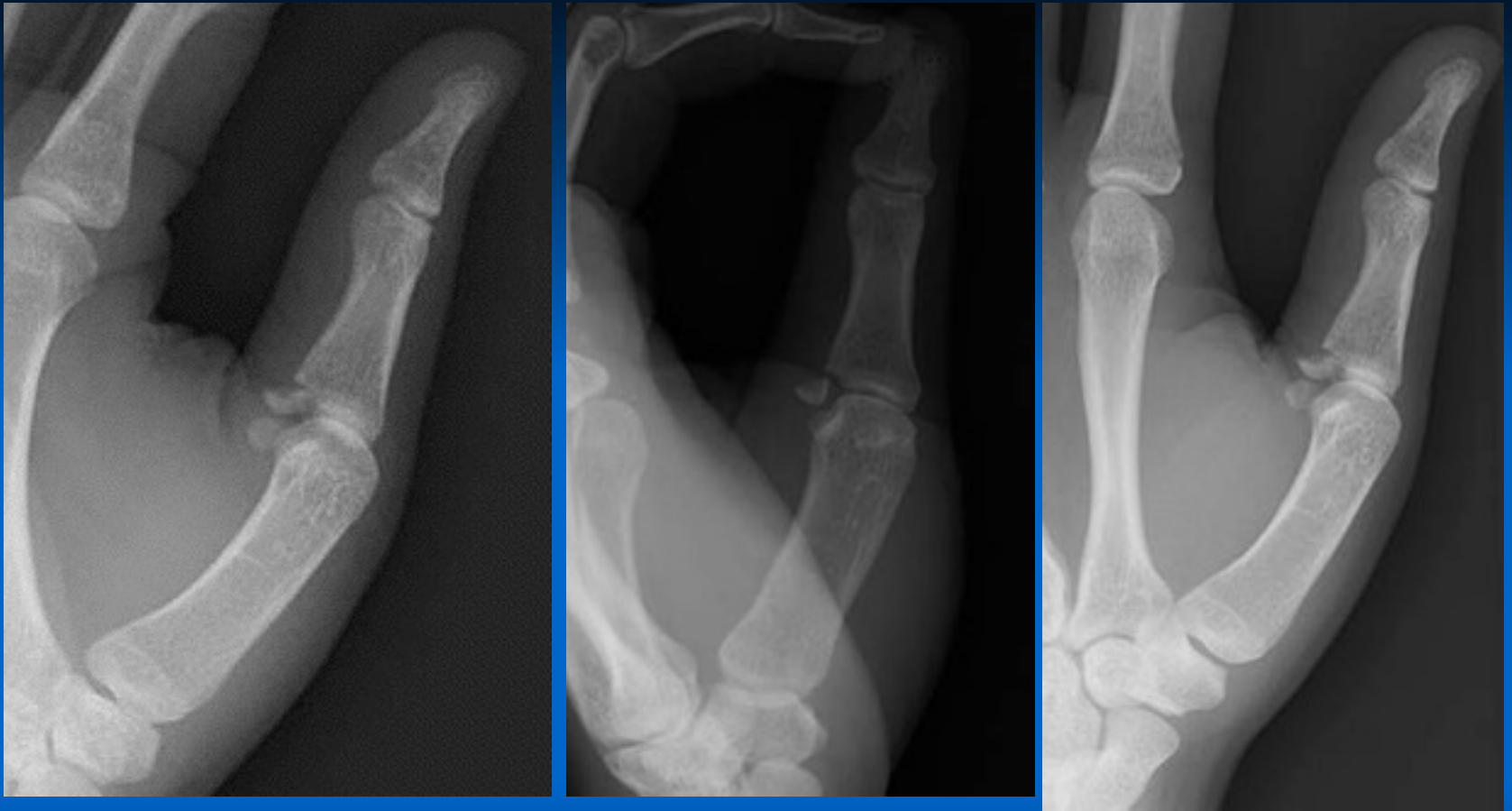


# PLAIN RADIOGRAPHS

## Digits







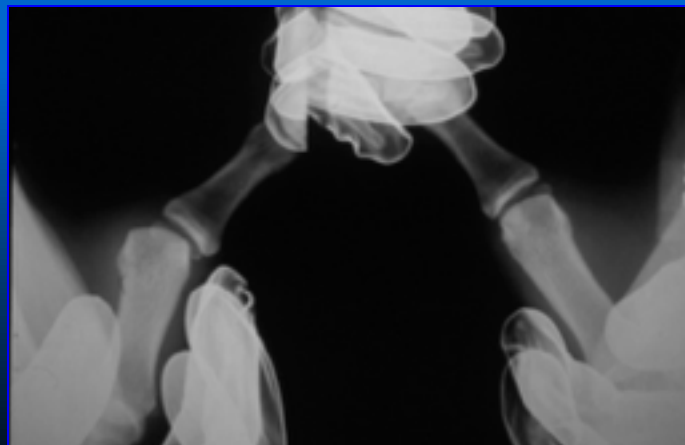
## Gamekeepers Thumb

Stener's lesion complete UCL tear adductor aponeurosis attached to fragment



# PLAIN RADIOGRAPHS

- MCPs



# PLAIN RADIOGRAPHS

- PIPs





**Mallet Finger**



# PLAIN RADIOGRAPHS

- XR evaluation of 'jersey finger'



# Trigger finger

- **Diagnosis**
  - **THE GREAT PRETENDER**
    - Clicking, locking
    - Pain over A1 pulley
    - Mass at MCP flexion crease
    - Flexion deformity of PIP joint
    - “Weakness” of power grip
  - **Associated diagnoses**
    - Diabetes mellitus
    - Hypothyroidism





# Trigger finger

- Diagnosis
  - Tenderness over A1 pulley is the SINE QUA NON of diagnosis



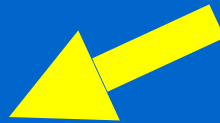
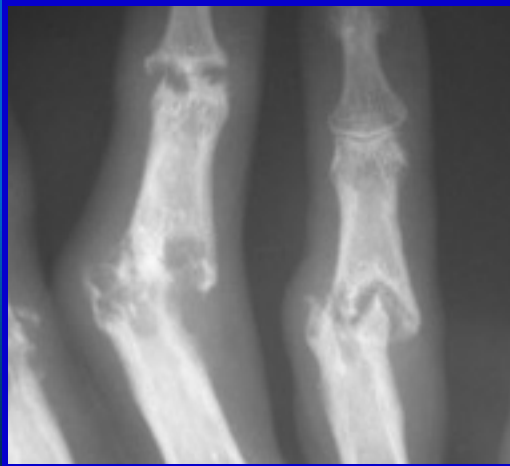
# PIP & DIP joint arthritis

- **Diagnosis**
  - PIP nodes: Bouchard
  - DIP nodes: Heberden
  - AM pain, stiffness
  - Systemic diathesis



# PIP & DIP joint arthritis

- Diagnosis
  - Radiographic findings



# PLAIN RADIOGRAPHS

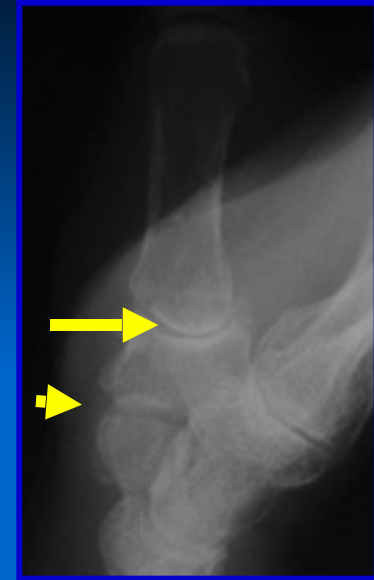
- Metacarpals



# Thumb CMC Arthritis

- **Diagnosis**
  - Pain at thumb base or thenar eminence upon attempted key pinch, attempted 'wide grip' (opening tight jar), attempted 'narrow grip' (turning doorknob)
  - Perceived decrease in function due to poor thumb anteposition
    - Thumb MC adducted into web space

# Thumb CMC Arthritis





# Conclusions

- Do history and physical before imaging studies
- Imaging studies may overdiagnose hand disorders
- Must correlate your exam with imaging studies
- History and physical overrides imaging



# **Splints –Many Companies Many Braces**

- **Wrist and Hand Supports**
- **One company 29 different braces for forearm, wrist, hand, and thumb**
- **Waterproof reformable removable braces**
- **heat, fit, mold, fit to patient**
- **Wrist sprains require compression and splinting until painless range of motion is possible, then functional exercise and sport specific activities.**
- **Kinesiotaping: For axial load or bat/racquet sports**



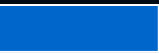
# Treatment of Wrist Sprains

- Cold -- not directly on skin
- Putty and other materials for padding and restoration of active motion and intrinsic muscle activation
- Immerse the Hand in Warm Sand or Wax
- Local Modalities
  - Ultrasound, Iontophoresis, many others . . .
- Creams
- Early On Get OT, ATC and Patient on an Intense Reduction of Swelling & Restoration of Function Program. Splint appropriately



# Conclusions

- Make sure your diagnosis is correct
- Many wrist sprain diagnoses are not!
- Don't miss:
  - Scaphoid Fracture
  - Carpal Instability
  - TFCC Injuries
  - Hamate Fractures in Athletes . . .



# IMAGING OF THE HAND AND WRIST

THANKS TO:

William W. Dexter, MD

Maine Medical Center

Portland, ME

And

Martin I. Boyer, MD

Department of Orthopaedic Surgery

Washington University School of Medicine

with

David A Rubin, Louis Gilula, Bill Middleton, Sharlene Teefey

Mallinkrodt Institute of Radiology



