

Ultrasound Evaluation of Wrist and Hand Pathology

Jon A. Jacobson, MD FACR
FSRU, FAIUM, RMSK

Professor of Radiology
Lenox Hill Radiology, NYC
University of California, San Diego

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Disclosures

- Consultant: Bioclinica
- Advisor: Philips
- Book Royalties: Elsevier
- Not relevant to this lecture

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Fundamentals of Musculoskeletal Ultrasound are
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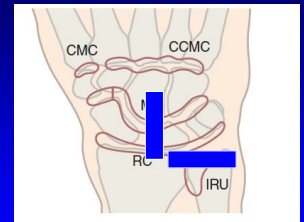
Pathology:

- Joint effusion and synovitis
- Tendon abnormalities
- Nerve entrapment
- Ligament injury
- Cysts and masses

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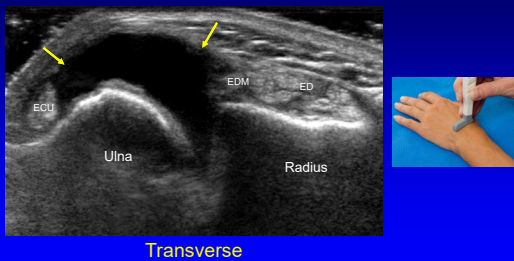
Joint Assessment: dorsal

- Wrist:
 - Radiocarpal joint (RC)
 - Midcarpal joint (MC)
 - Distal or inferior radioulnar joint (IRU)
- Hand:
 - MCP and PIP joints
 - 1st CMC (if symptomatic)



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Joint Effusion: distal radioulnar joint

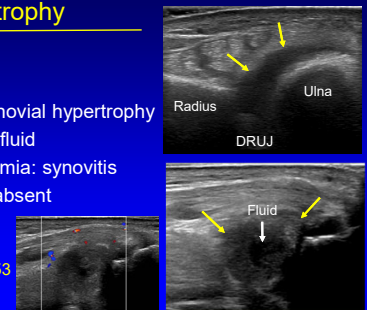


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Joint Effusion vs Synovial Hypertrophy

- Anechoic: fluid
 - Hypoechoic:
 - Effusion vs. synovial hypertrophy
 - Compressible: fluid
 - Internal hyperemia: synovitis
- *flow may be absent

AJR 2000; 174: 1353



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Inflammatory Arthritis: role

- Identify synovitis and erosions
 - Prior to initiating treatment
- Determine activity: hyperemia
- Aspirate or inject
- Follow-up after therapy
 - Decreased hyperemia
 - Decreased synovial thickness

Radius
Lunate
Capitate

Rheumatoid Arthritis

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Arthritis: synovitis

- Synovial locations:
 - Joint recess, bursa, tendon sheath
- Hypoechoic compared to adjacent subcutaneous fat
 - May be isoechoic or hyperechoic
- Hyperemia: variable
 - Represents activity of inflammation
 - Decreased: treatment (even NSAIDS)

5th PIP

Backhaus M, Arthritis and Rheum 1999; 42:1232

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Synovitis: MCP joint

MC2
PP

Sagittal Plane: 2nd MCP Joint

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Pitfall Alert! Normal Joint Capsule Appearance

- Dorsal capsule thickness:
 - MCP 1: 6 mm
 - MCP 2: 4 mm
 - MCP 3-5: 3 mm
 - RC joint: 4 mm
 - MC joint: 3 mm
- Do not interpret as abnormal synovial hypertrophy

MCP2
PP

Radius
Lunate
Capitate

*Note normal echogenic triangular fibrocartilage (white arrow)

*Falkowski A et al. Eur J Radiology 2020; 124

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Erosions

- Disrupted cortex in 2 planes
- Ultrasound not very good for erosions:
 - Better than radiographs
 - 40% sensitivity¹, 29% false positives²: wrist/hand compared with CT
 - Very non-specific, time consuming
- Adjacent synovitis adds specificity
- Correlate with radiographs, labs, distribution

2nd PIP

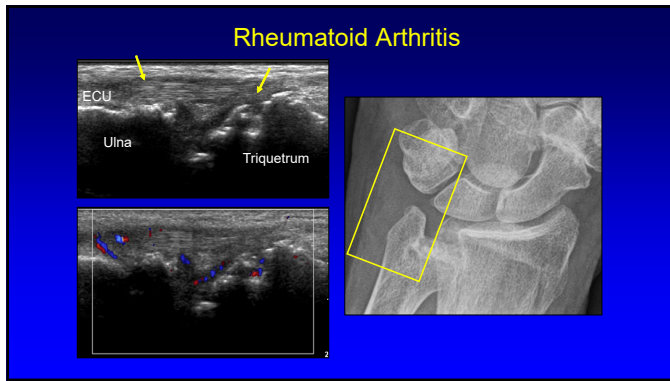
¹Dohn UF M, Arthritis Res Ther 2006; 8:1
²Finzel S. et al. Arth Rheumatism 2011; 63:1231

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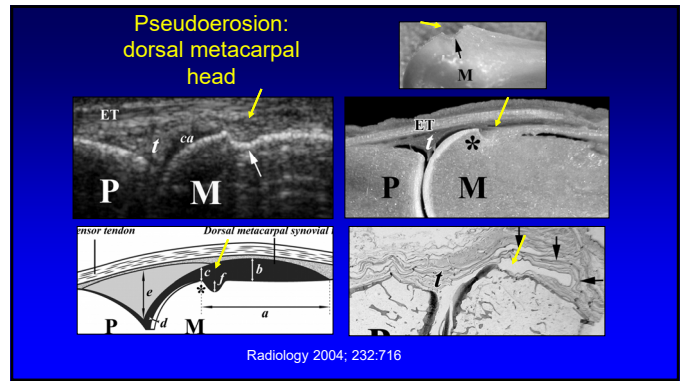
Rheumatoid Arthritis

2nd MCP

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Pitfall Alert! Pseudoerosions Are Everywhere!

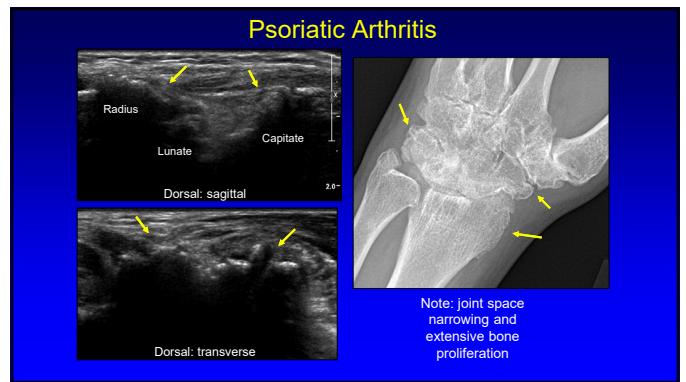
- Pseudoerosions: 100%
- Metacarpal heads: all
 - 2nd: 92%
 - 3rd: 86%
- Carpal bones:
 - Lunate: 82%
 - Triquetrum: 84%
 - Distal ulna: 22%

*Falkowski A et al. Eur J Radiology 2020; 124

3rd MCP: sagittal
Lunate
3rd MCP: transverse
ECU
Ulna

*Note lack of adjacent synovitis

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Osteoarthritis: ultrasound

- Osteophytes
- Joint effusion
- Minimal synovial hypertrophy
- Variable hyperemia
- Possible intra-articular bodies

First CMC Joint: Thumb

First Metacarpal
Proximal Phalanx

Sagittal Plane: dorsal
Note: osteophytes (arrow) and intra-articular body (open arrow)

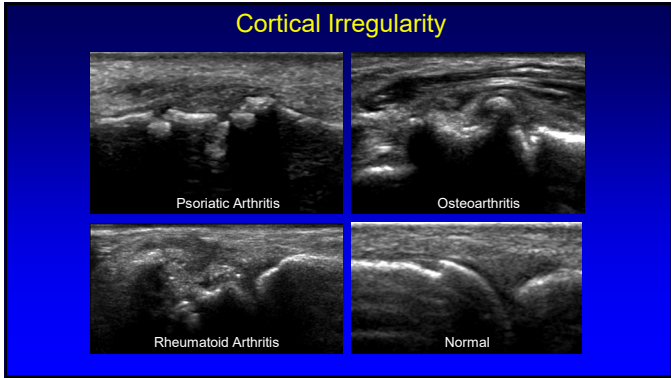
Keen HI et al. Radiol Clin N Am 2009; 47:581

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Erosions: specificity

- To add specificity to bone irregularity:
 - Correlate with history
 - Correlate with lab values
 - Review radiographs!
 - Look at distribution
 - Evaluate for adjacent synovitis (if acute)

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Synovitis: screening (<10 minutes)

- Hand and wrist: (6 joints – actually 10)
 - Radiocarpal, midcarpal, distal radioulnar (dorsal)
 - MCP2 and 3 (dorsal): transverse and sagittal
 - Any symptomatic site
 - Cine: flexor and extensor tendons (short axis)
- Ankle and Foot:
 - Ankle joint
 - MTP5 (dorsal and plantar)
 - Any symptomatic site

Rosa J et al. J Clin Rheumatol 2016; 22: 179

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Pathology:

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- Ligament injury
- Cysts and masses

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Tenosynovitis (paratenonitis):

- Simple fluid: anechoic
- Complex fluid: mixed echogenicity
- Synovitis:
 - Hypoechoic
 - Echogenic if gout

The image shows two panels of ultrasound scans of the wrist. The top panel is labeled 'Rheumatoid Arthritis' and 'Short Axis', showing a hypoechoic fluid collection around a tendon (T) with yellow arrows pointing to the inflamed paratenon. The bottom panel is labeled 'Long Axis', showing a similar fluid collection around the tendon.

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Tenosynovitis: lupus

The image shows two panels of ultrasound scans of the wrist. The left panel is labeled 'Short Axis', showing a hypoechoic fluid collection around a tendon (T) with a yellow arrow pointing to the inflamed paratenon. The right panel is labeled 'color Doppler', showing increased vascularity (red and blue areas) around the tendon, indicating active inflammation.

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Tenosynovitis: rheumatoid arthritis

The image shows two panels of ultrasound scans of the wrist. The left panel is labeled 'Short Axis', showing a hypoechoic fluid collection around the extensor carpi ulnaris (ECU) tendon. The right panel is labeled 'Long Axis: color Doppler', showing increased vascularity (red and blue areas) around the ECU tendon, indicating active inflammation.

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de Quervain Tenosynovitis

- Stenosing tenosynovitis
 - Overuse, primary care givers
- 1st dorsal wrist compartment:
 - Extensor pollicis brevis + abductor pollicis longus
- Ultrasound findings:
 - Thick synovial sheath
 - Tendinosis
 - Cortical irregularity, hyperemia

J Ultrasound Med 1997; 16:685

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Pitfall Alert! Pseudo-tenosynovitis

- Extensor retinaculum
- Hypoechoic due to anisotropy
- Characteristic location
- Up to 1.7 mm thick and 23 mm in width

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Pitfall Alert! Pseudo-tenosynovitis

- Hypoechoic muscle
- Musculotendinous junction
- Confirmed in long axis
- Normal tapering of muscle

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Flexor Carpi Radialis

- Courses volar to triscaphe joint (scapho-trapezium-trapezoid compartment)
- FCR tendinosis and tear
- Associated triscaphe osteoarthritis

Parellada et al. Skeletal Radiol 2006; 35:572

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Extensor Pollicis Longus: tear

Long Axis Short Axis

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Pitfall Alert! Pseudo-tendon Tear

- Multiple tendon fascicles
- Abductor pollicis longus
 - Incidence: 80%
 - Up to 4 fascicles
- Extensor pollicis brevis
 - Incidence: 7%
 - Up to 2 fascicles
 - May be absent
- "Lotus Root Sign"
 - Seen best distal to radius

Rousset et al. Radiology 2010; 257:427
Choi et al. Radiology 2011; 260:480

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Pitfall Alert!

Pseud-tendon tear

- Extensor carpi ulnaris
- 6th extensor compartment
- Short axis: hypochoic cleft
- Due to fibrovascular tissue in between two heads of extensor carpi ulnaris

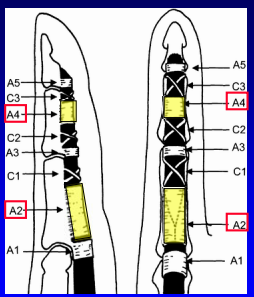


Short Axis

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Pulley Tear

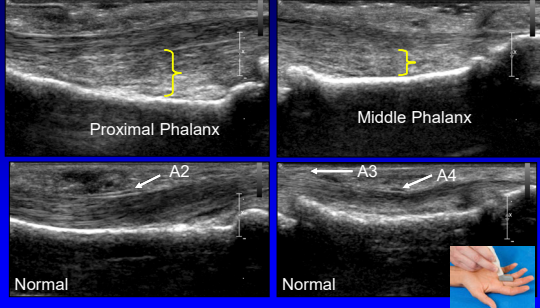
- A2 and A4 pulleys: most important
- Sagittal image
 - Bowstringing
 - Hypochoic edema / hemorrhage
- Dynamic evaluation*



*Radiology 2002; 222:755
Radiology 1998; 206:339

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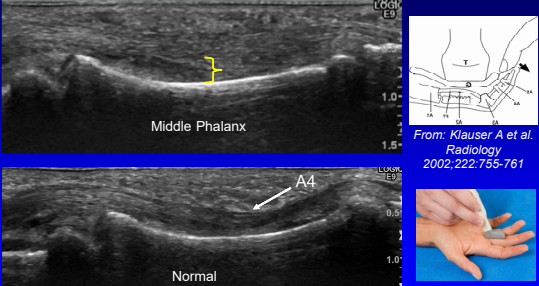
A2 – 4 Pulley Injury



Proximal Phalanx
Middle Phalanx
Normal
Normal

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A4 Pulley Injury: bowstringing



Middle Phalanx
Normal

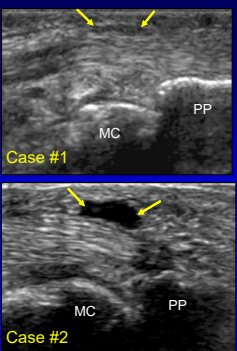
From: Klausner A et al.
Radiology
2002;222:755-761

Normal: < 1 mm; incomplete rupture: 1 – 3 mm; complete: 3 mm

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Trigger Finger

- Stenosing tenosynovitis: A1 pulley
- Thick and hypochoic pulley
- Hyperemia: 91%
- Tendinosis: 48%
- Tenosynovitis: 55%



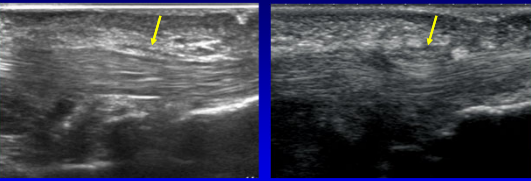
Case #1
Case #2

MC PP

Guerini et al. J Ultrasound Med 2008; 27:1407

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Trigger Finger: thumb

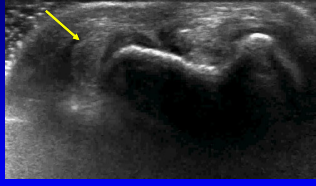


Case #1
Case #2

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Extensor Carpi Ulnaris

- 6th extensor wrist compartment
- Dislocation:
 - Dynamic
 - Supination/pronation
 - Subsheat tear or dysfunction
- Predisposes to tendon tear and tenosynovitis

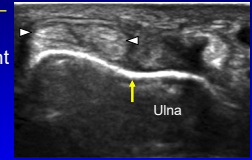


Campbell D et al. Br J Sports Med 2013; 47:1105

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Pitfall Alert! Pseudo-subluxation

- Extensor carpi ulnaris
- 6th extensor wrist compartment
- Asymptomatic subluxation
 - Supination
 - Up to 50% out of groove
 - No tear or tenosynovitis



Lee KS et al. AJR 2009; 193:651

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Pathology:

- Joint effusion and synovitis
- Tendon abnormalities
- **Nerve entrapment**
- Ligament injury
- Cysts and masses

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Carpal Tunnel Syndrome:

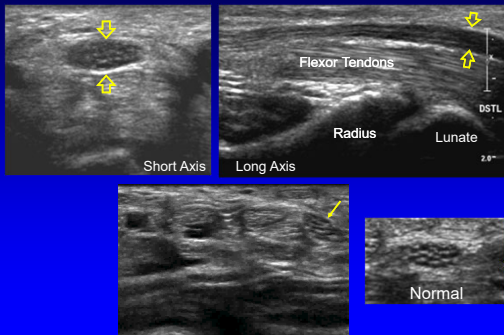
- Proximal median nerve swelling
 - Area: circumferential trace
 - Normal: <9 mm²
 - Borderline: 9 – 12 mm²
 - Abnormal: > 12 mm²
 - 12.8 mm² = moderate (83% sens, 95% spec)
 - 14.0 mm² = severe (77% sens, 100% spec)



Klauser AS et al. Sem Musculoskel Rad 2010; 14:487
Ooi et al. Skeletal Radiol 2014; 43:1387

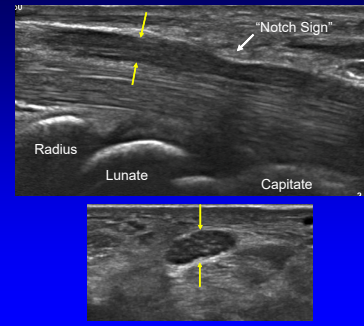
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Carpal Tunnel Syndrome



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Carpal Tunnel Syndrome

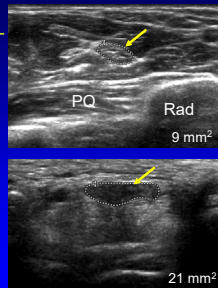


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Carpal Tunnel Syndrome

- Compare areas:
 - Proximal: pronator quadratus
 - Distal: carpal tunnel
- = or $>2 \text{ mm}^2$ = carpal tunnel syndrome
- 99% sensitivity
- 100% specificity

Klauser AS. Radiology 2009; 250:171



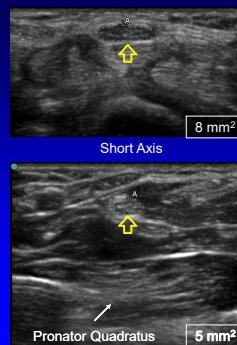
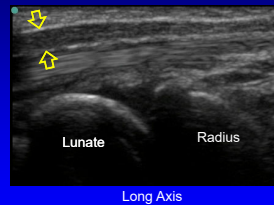
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Median Nerve: how to measure

- Short axis
- Toggle transducer: defined borders
- Site of maximal enlargement
- Circumferential trace
- Inner border of hyperechoic epineurium

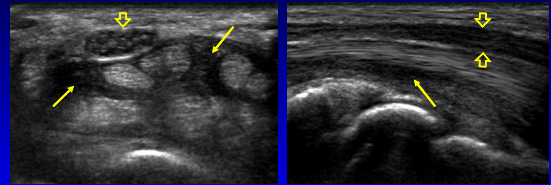
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Carpal Tunnel Syndrome



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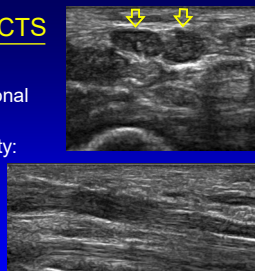
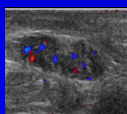
Carpal Tunnel Syndrome: ulnar bursa distention



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Bifid Median Nerve + CTS

- Carpal tunnel syndrome¹
 - Increase in cross-sectional area of $\geq 4 \text{ mm}^2$
- Intraneural hypervascularity: 95% accuracy in diagnosis of CTS²

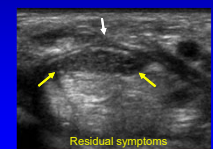
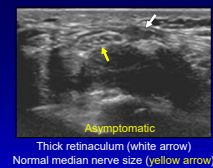


¹Klauser et al. Radiology 2011; 259; 808
²Mallouhi et al. AJR 2006; 186:1240

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Postoperative Carpal Tunnel

- Discontinuous or thickened transverse carpal ligament
- Anterior displacement of transverse carpal ligament¹
- Median nerve size:
 - May decrease²
 - Does not correlate with success³



¹Lee CH et al. Ann Plast Surg 2005; 54:143
²Abicalaf CA et al. Clin Radiol 2007; 62:891
³Naranjo A et al. Scand J Rheum 2010; 39:49

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Pathology:

- Joint effusion and synovitis
- Tendon abnormalities
- Nerve entrapment
- **Ligament injury**
- Cysts and masses

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Scapholunate Ligament

From: Linkous MD, et al. Radiology 2000; 216:846

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Dorsal Wrist: scapholunate ligament

Axial T1w Transverse

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Scapholunate Ligament Tear

At Rest Clench Fist Normal

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Gamekeeper's or Skier's Thumb

- Injury: ulnar collateral ligament of first MCP joint
- Chronic (gamekeeper's thumb): historically in Scottish gamekeepers
- Acute (skier's thumb): acute hyperabduction

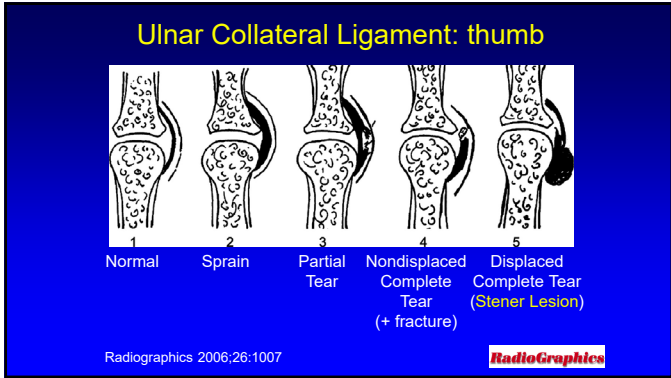
Acute Mechanism Chronic Mechanism

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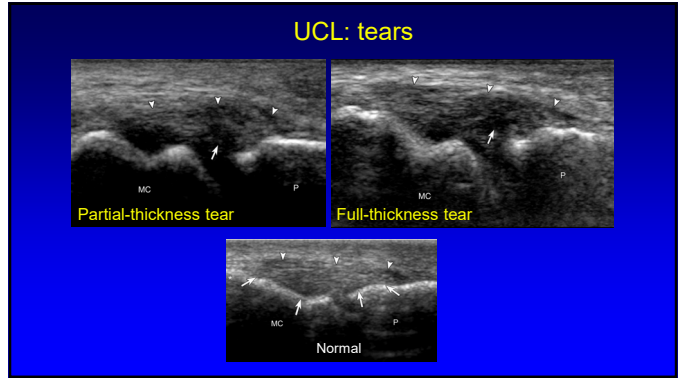
Ulnar Collateral Ligament: thumb

Note: sliding of adductor aponeurosis with isolated interphalangeal joint flexion

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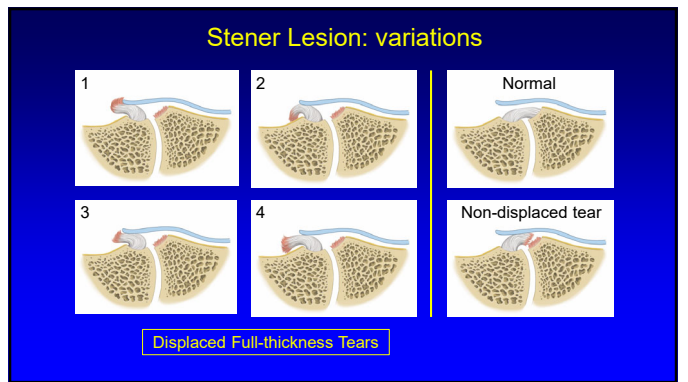
Stener Lesion

- Displaced proximal stump of UCL
 - Hypochoic & round
 - Proximal to MCP joint
 - At proximal edge of adductor pollicis aponeurosis
- No tissue spanning MCP joint
- “Yo-yo on a string” sign
- Ultrasound: 100% accuracy

Yellow arrows: Stener
 White arrows: aponeurosis

*Melville D. et al. Skeletal Radiology 2013; 42:667

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Stener Lesion: dynamic

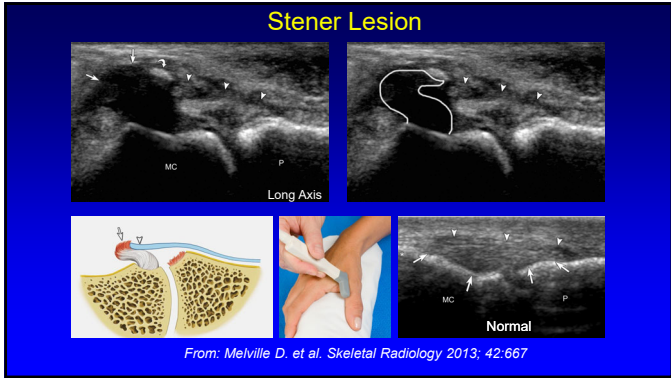
1st Metacarpal Proximal Phalanx
 White arrows = adductor aponeurosis
 Yellow arrows = Stener lesion
 Normal

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Stener Lesion

MC P Long Axis
 Normal
 From: Melville D. et al. Skeletal Radiology 2013; 42:667

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Pathology:

- Joint effusion and synovitis
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Soft Tissue Mass: wrist ganglia

- Most wrist masses are ganglion cysts
- Volar (69%): radial artery & flexor carpi radialis
 - Proximal from radioscapoid joint capsule
- Dorsal: scapholunate ligament
 - Not compressible (unlike joint recess)

*Skeletal Radiol 1994; 23:201

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Ganglion: wrist

- Anechoic or hypoechoic
- Multilocular (except digits)
- Non-compressible
- Joint or tendon sheath communication
- <10 mm: hypoechoic without posterior acoustic enhancement

*Wang et al. J Ultrasound Med 2007; 26:1323

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Ganglion Cyst vs Dorsal Recess

Ganglion: not compressible Recess: compressible
Sagittal with Wrist Flexion

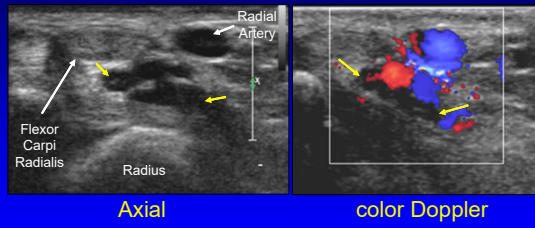
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Ganglion: volar

Axial color Doppler

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Ganglion Cyst: volar



Axial

color Doppler

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Take Home Points:

- Arthritis: emphasize synovitis
- Nerve: swelling at entrapment site
- Stener:
 - Proximal to MCP joint and aponeurosis
 - Dynamic imaging
- Ganglion cysts:
 - Volar at FCR and radial artery
 - Dorsal over SL ligament

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Thank you!



NYC



Ann Arbor



San Diego

Syllabus on line and other educational material:
www.jacobsonmskus.com



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