

Ultrasound Evaluation of Wrist and Hand Pathology

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Disclosures

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

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Fundamentals of Musculoskeletal Ultrasound are
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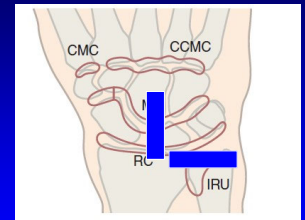
Pathology:

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

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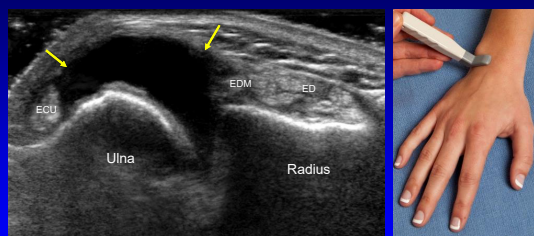
Joint Assessment: dorsal

- 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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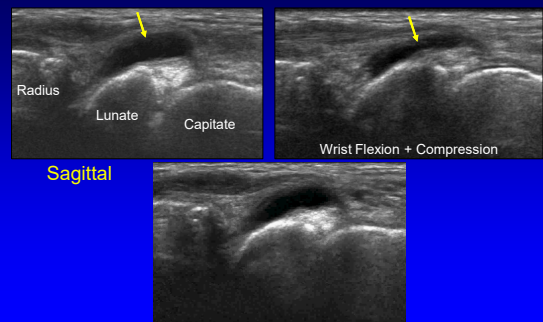
Joint Effusion: distal radioulnar joint



Transverse

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Effusion: radiocarpal joint dorsal recess



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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

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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)

Backhaus M, Arthritis and Rheum 1999; 42:1232

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Synovitis (Rheumatoid Arthritis): dorsal wrist

Sagittal Plane: Radiocarpal and Mid-carpal Joints

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Rheumatoid Arthritis

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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

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

*Note normal echogenic triangular fibrocartilage (white arrow)

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Erosions

- US criteria:
 - Disrupted cortex, two planes
 - Adjacent synovitis increases specificity
- US better than radiographs¹
- 29% false-positive rate compared to CT²
- 40% sensitivity³

¹Lopez-Ben, et al. Skeletal Radiol 2004; 33: 80
²Finzel S, et al. Arth Rheumatism 2011; 63:1231
³Dohn UF M, Arthritis Res Ther 2006; 8:1

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Rheumatoid Arthritis

The image shows two views of the 2nd MCP joint. On the left, two ultrasound images show cortical disruptions (erosions) indicated by yellow arrows. On the right, a radiograph of the same joint shows a corresponding erosion, also indicated by a yellow arrow. The label '2nd MCP' is visible at the bottom right of the radiograph.

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Rheumatoid Arthritis

The image displays the wrist joint. On the left, two ultrasound images show erosions at the ECU, Ulna, and Triquetrum, marked with yellow arrows. On the right, a radiograph of the wrist shows a yellow box highlighting the area of interest, corresponding to the ultrasound findings.

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Pitfall Alert!

Pseudoerosion

- Metacarpal head: dorsal
- Up to 37% of metacarpal heads: 2nd most common
- Bare area: no hyaline cartilage
- Unlike erosion:
 - Smooth
 - Maximum depth: 2 mm
 - No adjacent synovitis

Boutry N. et al. Radiology 2004; 232:716

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Pseudoerosion: dorsal metacarpal head

The image illustrates pseudoerosion at the dorsal metacarpal head. It includes two ultrasound images (top left and middle left) and two radiographs (top right and bottom right). The ultrasound images show a smooth, shallow defect in the cortex, marked with yellow arrows. The radiographs show a similar appearance, with an asterisk (*) marking the pseudoerosion. A diagram at the bottom left shows the anatomy of the dorsal metacarpal head with labels 'P' (proximal), 'M' (metacarpal), 'ET' (extensor tendon), and 'ca' (cortex). The diagram also labels 'Dorsal metacarpal synovial' and 'a', 'b', 'c', 'd', 'e', 'f'.

Radiology 2004; 232:716

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Pitfall Alert! Pseudoerosions Are Everywhere!

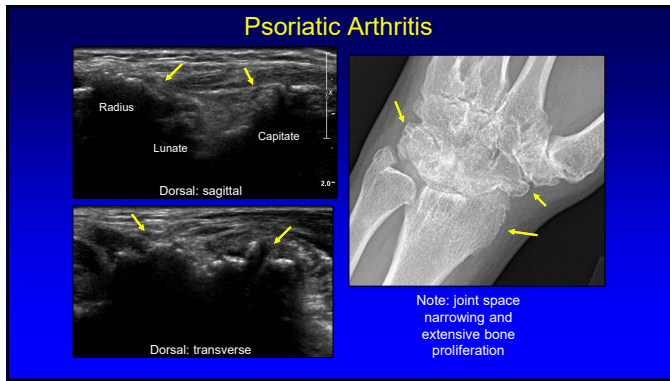
- Pseudoerosions: 100%
- Metacarpal heads: all
 - 2nd: 92%
 - 3rd: 86%
- Carpal bones:
 - Lunate: 82%
 - Triquetrum: 84%
 - Distal ulna: 22%

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

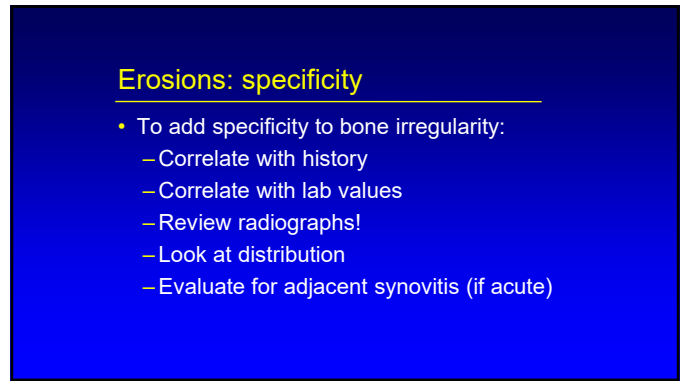
The image shows four ultrasound images. The top row shows the 3rd MCP in sagittal view and the Lunate. The bottom row shows the 3rd MCP in transverse view and the Ulna. Yellow arrows in all images point to pseudoerosions. The label 'ECU' is visible in the bottom right image.

*Note lack of adjacent synovitis

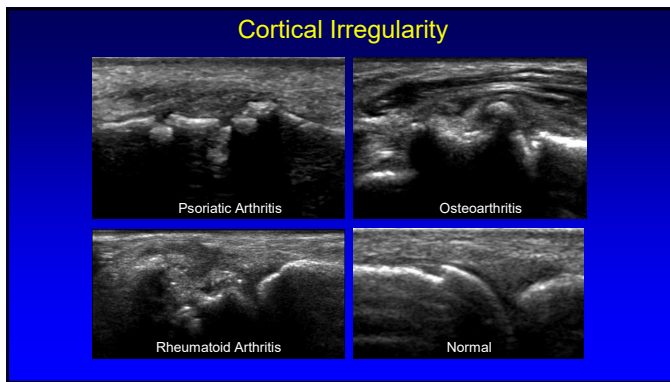
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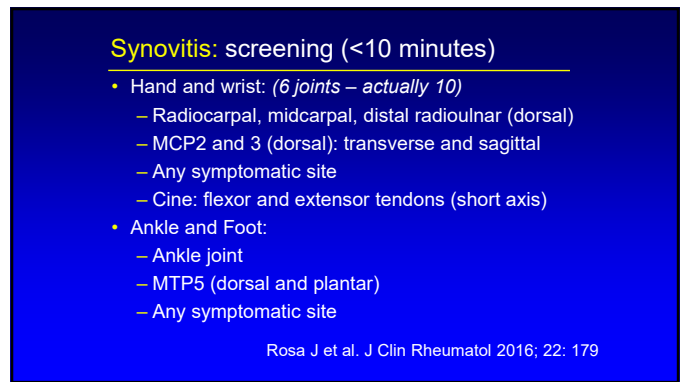
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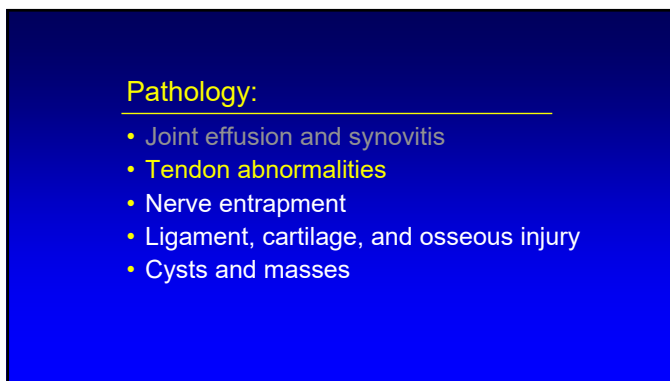
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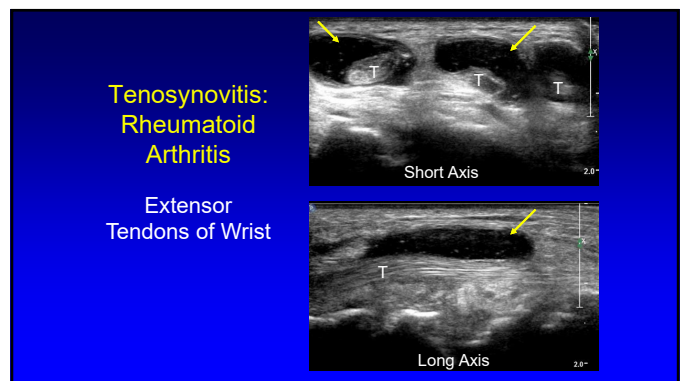
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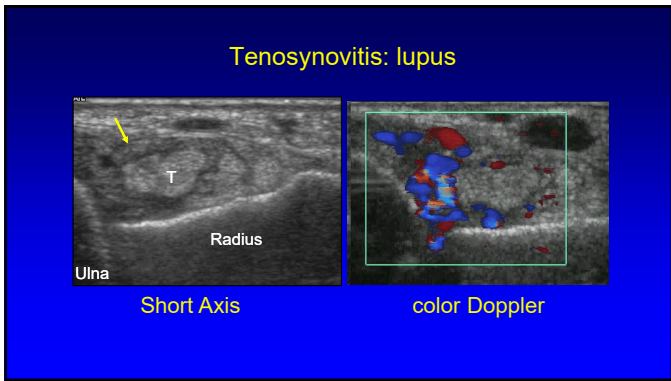
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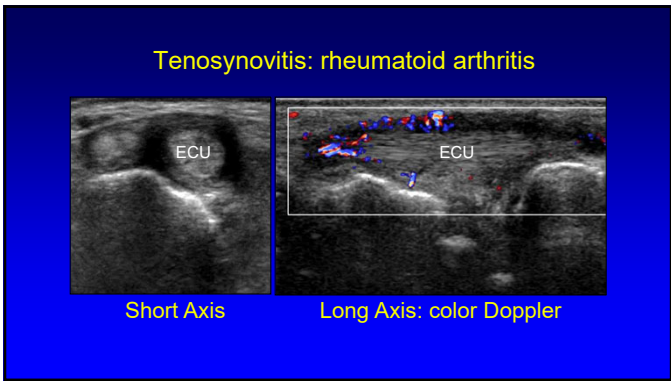
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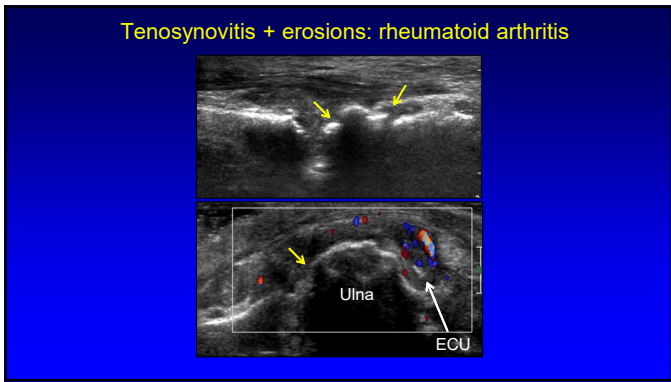
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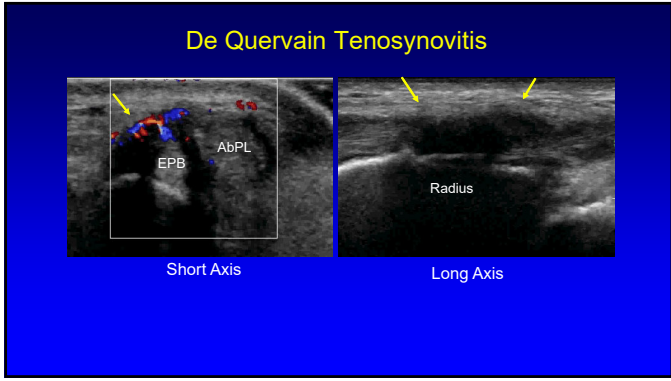
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de Quervain Tenosynovitis:

- 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

Anisotropy

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Pitfall Alert!
Pseudo-tenosynovitis

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

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Tendon Tear

- Hypoechoic or anechoic
- Disruption of tendon fibers
- Retraction: full-thickness
– Dynamic imaging

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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: hypoechoic cleft
- Due to ground substance in between two heads of extensor carpi ulnaris

Ali S et al. Skelet Radiol 2015; 44:1735
Chiavaras MM et al. AJR 2014; 203:531

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Pulley Tear

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

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

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A2 – 4 Pulley Injury

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A4 Pulley Injury: bowstringing

From: Klauser 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 hypoechoic pulley
- Hyperemia: 91%
- Tendinosis: 48%
- Tenosynovitis: 55%

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

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Trigger Finger: A1 pulley

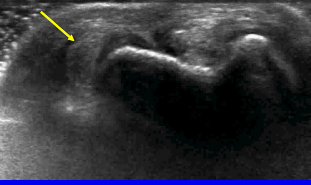
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Trigger Finger: thumb

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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

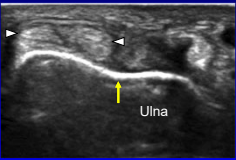


Campbell D et al. Br J Sports Med 2013; 47:1105

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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, cartilage, and osseous injury
- Cysts and masses

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Carpal Tunnel Syndrome:

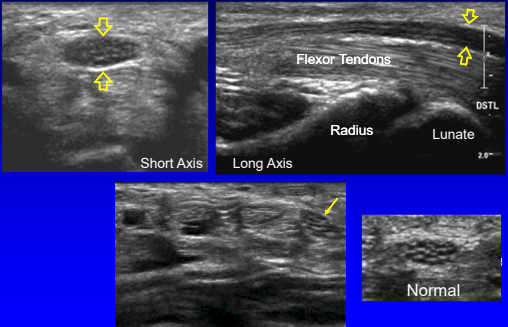
- Proximal median nerve swelling
 - Area: circumferential trace
 - Normal: <9 mm²
 - Borderline: 9 – 12 mm²
 - Abnormal: > 12 mm²
 - 12.8 mm² = moderate (83% sens, 95% spec)
 - 14.0 mm² = severe (77% sens, 100% spec)



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

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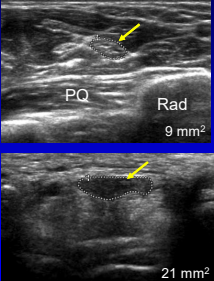
Carpal Tunnel Syndrome



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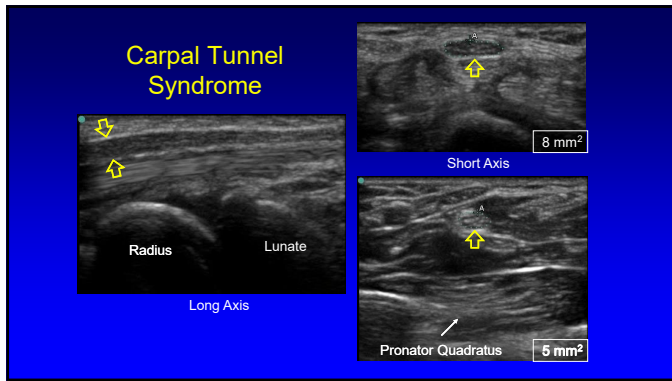
Carpal Tunnel Syndrome

- Compare areas:
 - Proximal: pronator quadratus
 - Distal: carpal tunnel
- = or >2 mm² = carpal tunnel syndrome
- 99% sensitivity
- 100% specificity

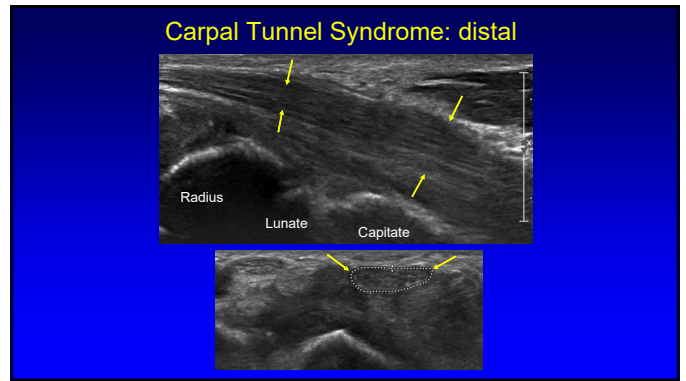


Klauser AS. Radiology 2009; 250:171

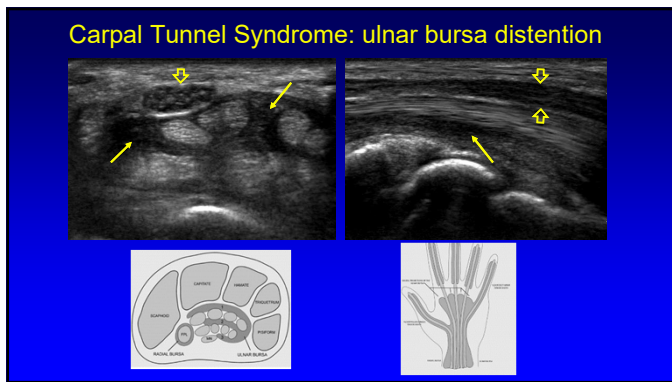
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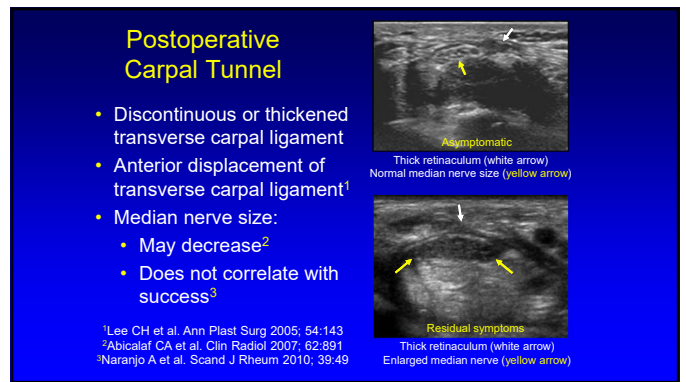
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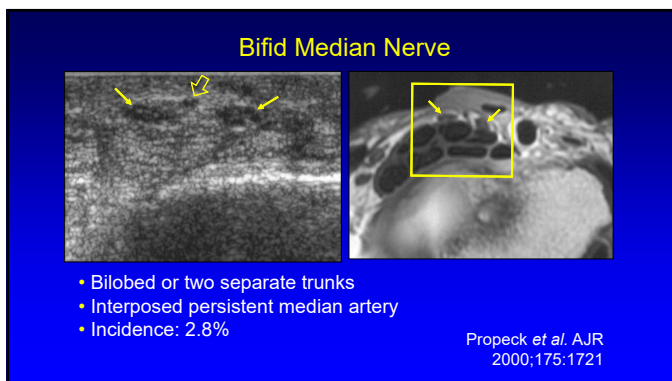
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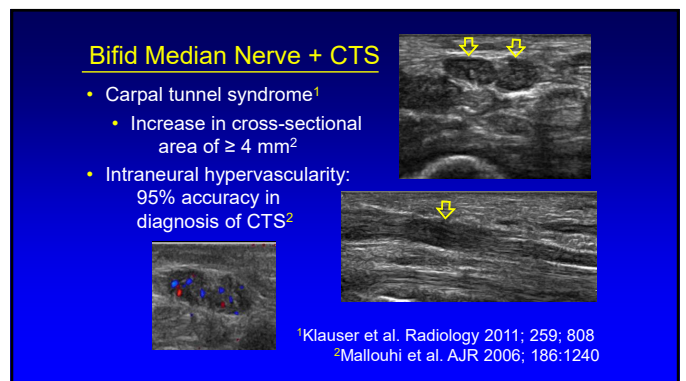
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Pathology:

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

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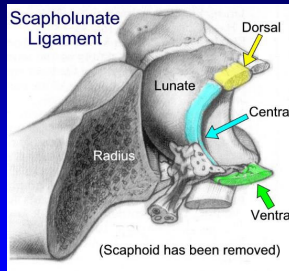
Scapholunate Ligament Tear

- Normal hyperechoic ligament not seen
- Abnormal hypoechogenicity
- Wide scapholunate space
- Dynamic imaging: fist clench

AJR 2002; 179:523

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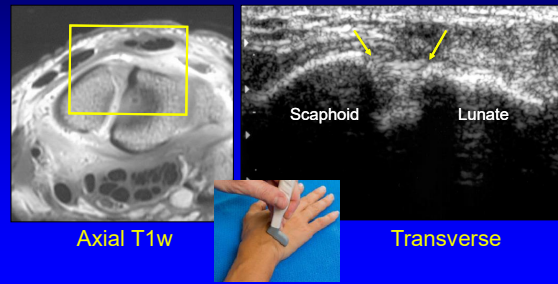
Scapholunate Ligament



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

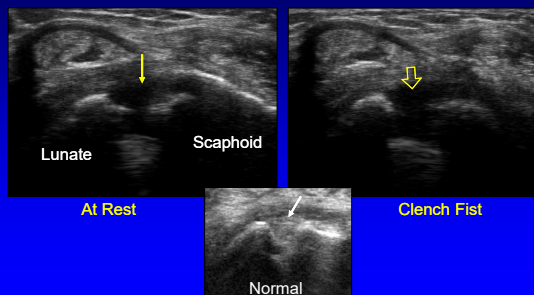
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Dorsal Wrist: scapholunate ligament



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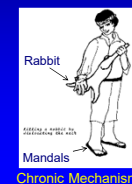
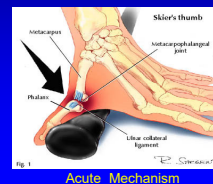
Scapholunate Ligament Tear



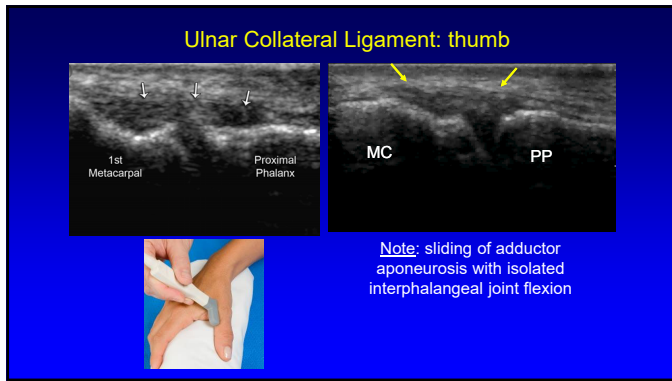
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Gamekeeper's Thumb

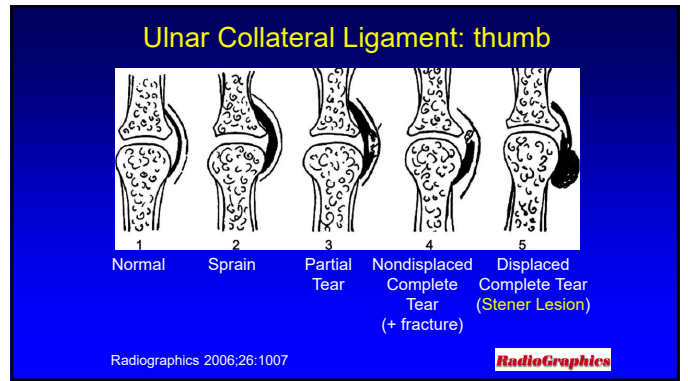
- Injury of the ulnar collateral ligament (UCL) of the thumb
 - Historically, chronic injury in Scottish gamekeepers
 - Frequently, due to acute MCP joint hyperabduction
 - **Skier's thumb**: up to 86% of thumb base injuries



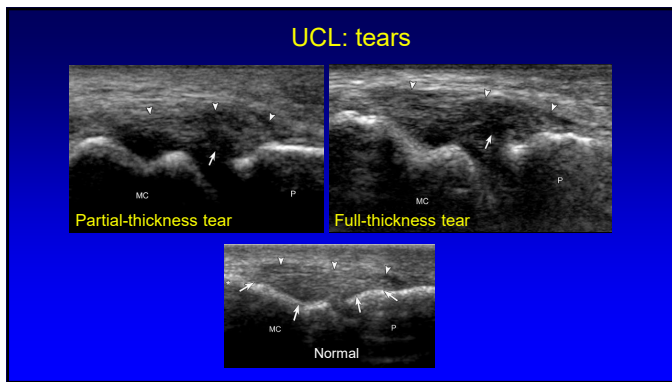
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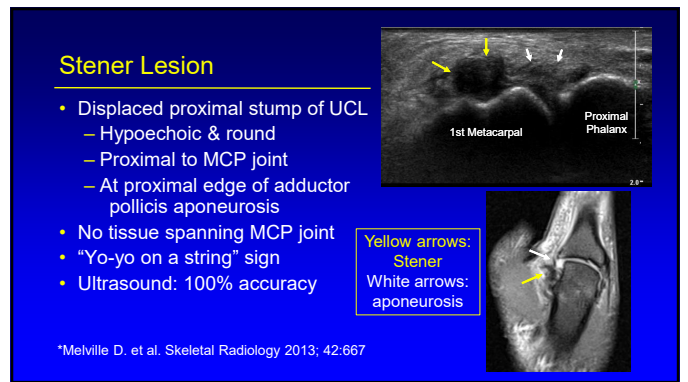
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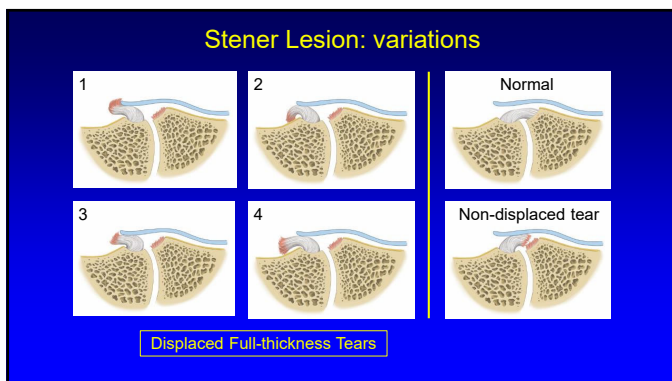
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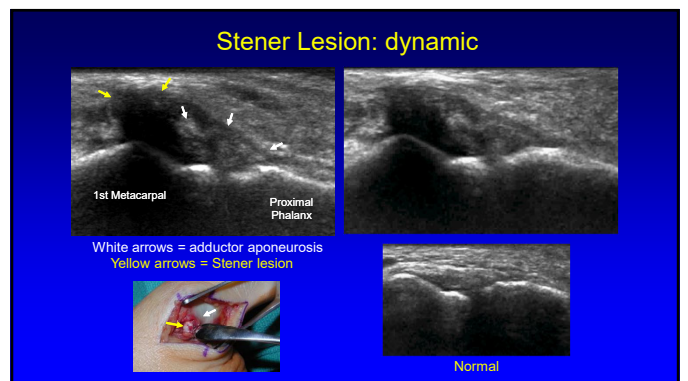
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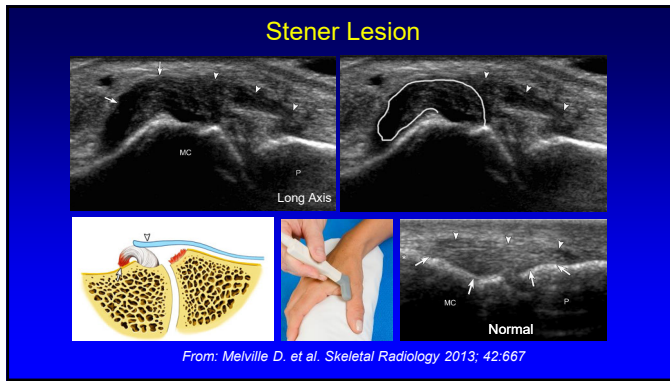
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- ### Pathology:
- Joint effusion and synovitis
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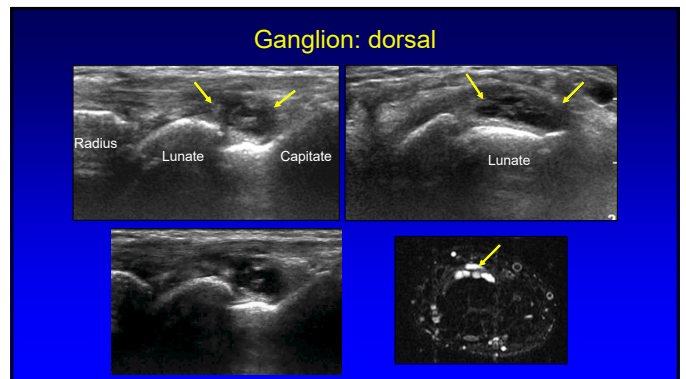
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- ### Soft Tissue Mass: wrist ganglia
- Most wrist masses are ganglia
 - Volar (69%):
 - Radial artery & flexor carpi radialis
 - Proximal from radioscaphoid joint capsule
 - Dorsal: scapholunate ligament
 - Not compressible (unlike joint recess)

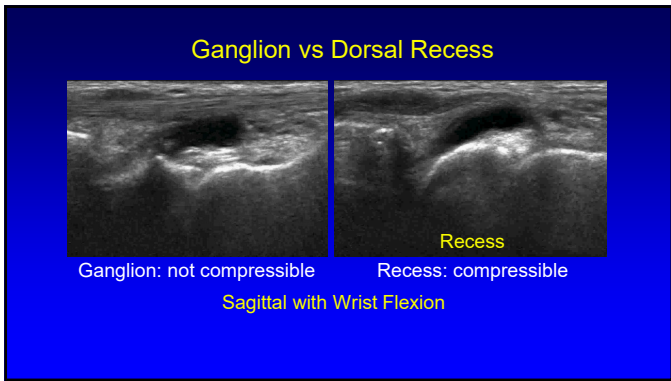
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- ### Soft Tissue Mass: wrist ganglia
- Anechoic or hypoechoic
 - Well-defined, lobular
 - Joint or tendon sheath communication
 - <10 mm: hypoechoic without posterior acoustic enhancement
- *Wang et al. J Ultrasound Med 2007; 26:1323

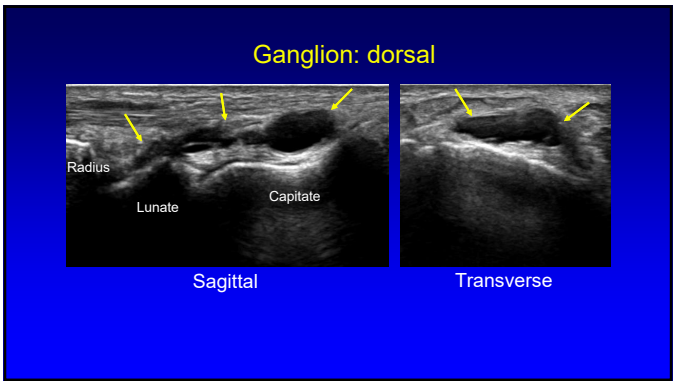
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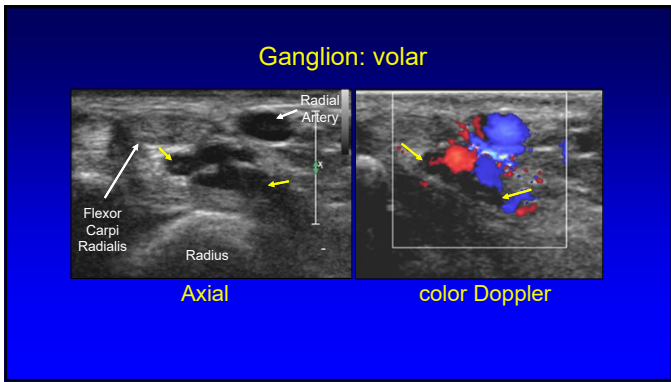
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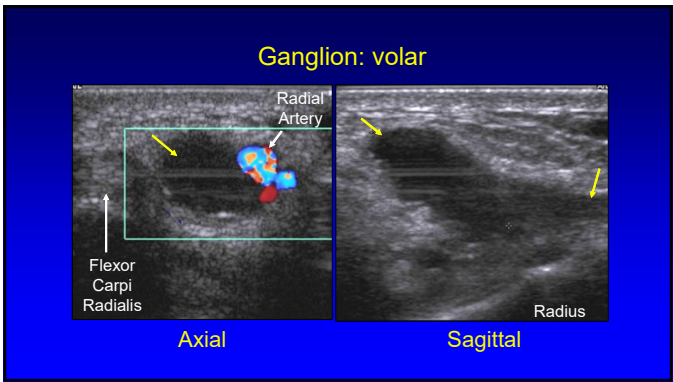
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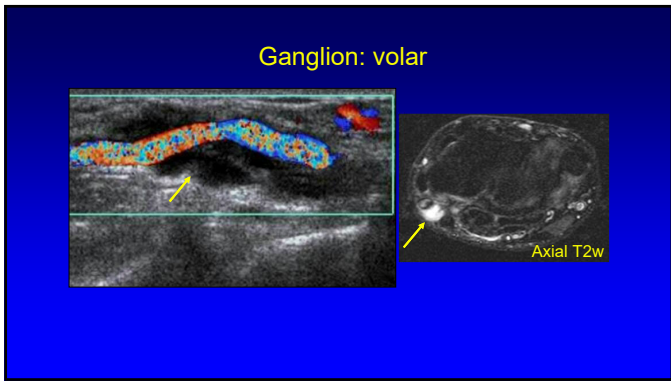
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Mucous Cyst

- Arises from DIP joint
 - Osteoarthritis
 - Pedicle
- Often extends to nail bed
- Subungual mass
- Middle-age or older women
- Recur

Baek HJ et al. Radiographics 2010; 30:1621

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Soft Tissue Foreign Bodies

- Wood and plastic: not radiopaque on radiographs
- All soft tissue foreign bodies are initially **hyperechoic**

Radiology 1998; 206:45

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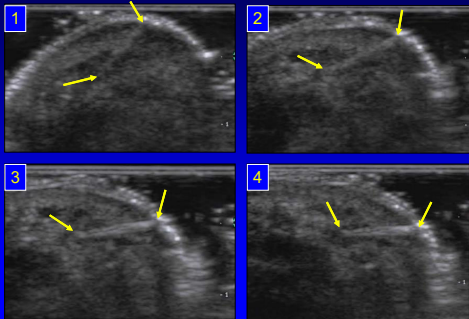
Sonography:

- All foreign bodies: initially hyperechoic
 - Organic matter: less echogenic over time
- Most echogenic if ultrasound beam perpendicular to surface of foreign body

Radiology 1998; 206:45

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US: foreign body echogenicity



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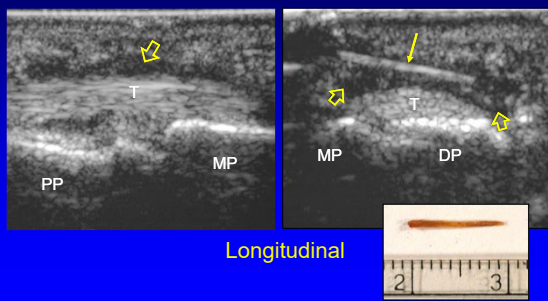
Soft Tissue Foreign Bodies

- Hypoechoic halo: foreign body response
- Smooth and flat: **reverberation**
- Irregular and small radius of curvature: **shadowing**

Radiology 1991; 181:231

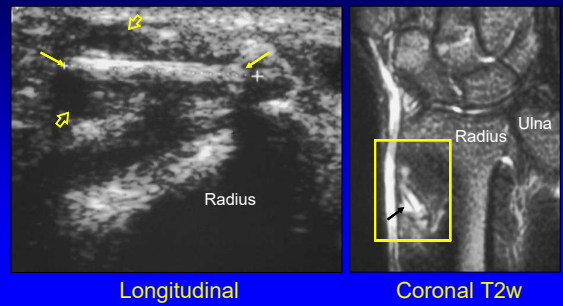
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Wooden Foreign Body: finger

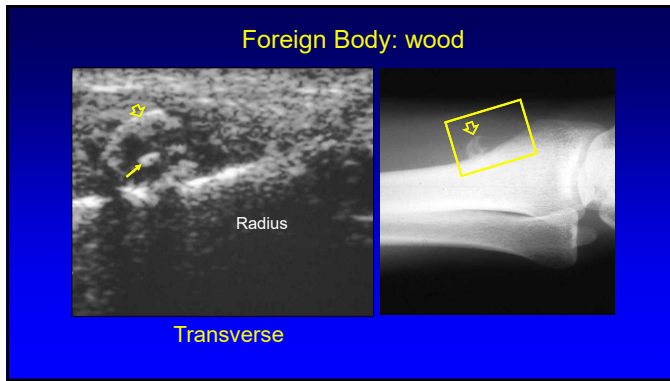


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Foreign Body: wood



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Tenosynovial Giant Cell Tumor

- Localized:
 - Giant cell tumor (GCT) tendon sheath
 - Hand, volar digits #1 - 3
 - Localized pigmented villonodular synovitis (PVNS)
- Diffuse:
 - Conventional PVNS
 - Diffuse-type GCT

Jelinek. AJR 1994; 162:919

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Glomus Tumor

- Hamartoma:
 - Neuromyoarterial glomus body
- 75% in hand: subungual
- Pain, tenderness, temperature sensitivity
- US:
 - Hypochoic to isoechoic mass
 - Increased flow

Drape. Radiology 1995;195:507

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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: multilocular
 - Volar at FCR and radial artery
 - Dorsal over SL ligament

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Thank you!

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

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