

Elbow Ultrasound

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Disclosures

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

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Fundamentals of Musculoskeletal Ultrasound are
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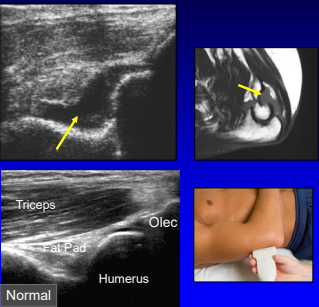
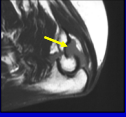
Pathology:

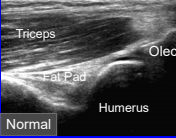

- Joint effusion and bursa
- Tendon abnormalities
- Ligament abnormalities
- Nerve abnormalities
- Soft tissue masses

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Joint Effusion

- Olecranon recess
- Displaced hyperechoic fat pad by anechoic / hypoechoic fluid
- Best place to look with US*
- More sensitive than radiographs*

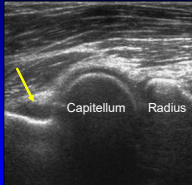



De Maeseneer, Invest Radiol
1998; 33:117

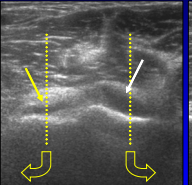
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Joint Effusion: anterior elbow

Radial Recess




Sagittal: lateral



Transverse

Coronoid Recess

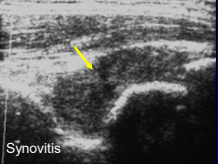
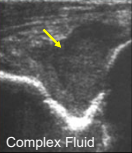


Sagittal: medial

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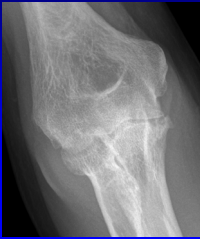
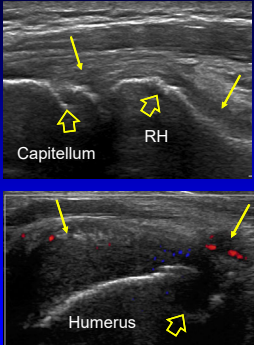
Complicated Fluid vs. Synovitis

- Both may appear hypo- or isoechoic
- *Findings that suggest effusion:*
- Displacement with transducer pressure
- Joint recess collapse w/ joint movement
- Negative flow on color Doppler imaging
- Swirling with transducer pressure

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Synovial Hypertrophy and Erosions

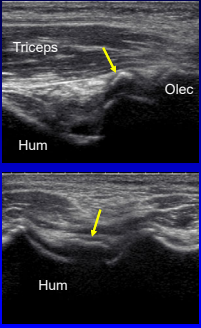



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Intra-articular body

- Olecranon, coronoid, annular recess
- Calcified & ossified bodies: hyperechoic with shadowing
- Surrounded by joint fluid: intra-articular


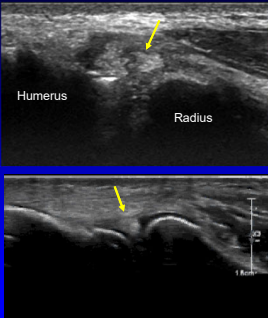
Frankel et al. Radiology 1998; 206:41



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Synovial Fold Syndrome

- Normal capsular tissue
 - Hyperechoic, triangular
- Abnormal:
 - Thickened > 3 mm
 - Heterogeneous
 - Adjacent synovitis

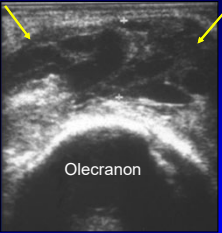



Cerezal et al. AJR 2013; 201:W88

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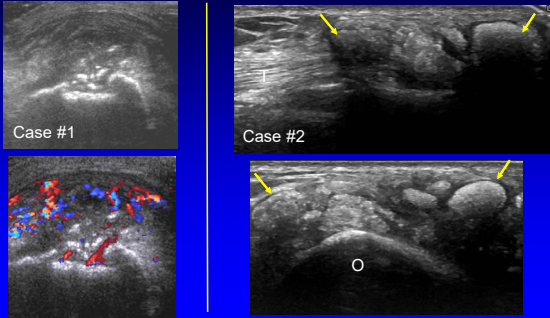
Olecranon Bursitis:

- Over olecranon
- Anechoic or hypoechoic
- Well-defined
- Heterogeneous: complicated fluid
- Trauma, infection, gout, rheumatoid arthritis



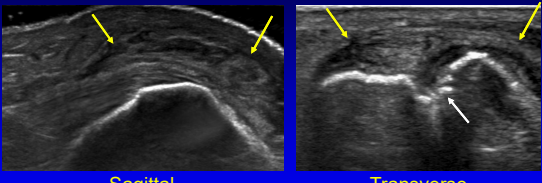
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Olecranon Bursitis: Gout



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Olecranon Bursitis: rheumatoid arthritis



Note erosion (white arrow)

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Olecranon Bursitis: dynamic imaging



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Pathology:

- Joint effusion and bursa
- Tendon abnormalities
- Ligament abnormalities
- Nerve abnormalities
- Soft tissue masses

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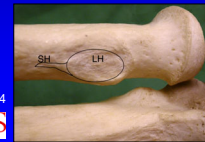
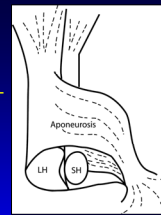
Tendon Abnormalities:

- Tendinosis: hypoechoic, swollen
- Partial-thickness tear: anechoic focus, no retraction
- Full-thickness tear: discontinuity
 - Dynamic imaging: retraction

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Biceps Brachii:

- Insertion: radial tuberosity
 - Short head: superficial, distal
 - Long head; deep, proximal
- No synovial sheath
- Bicipitoradial bursa

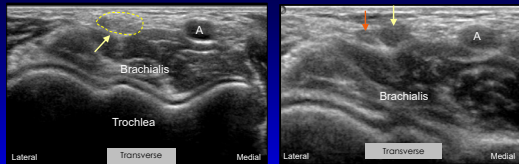


From: Eames M. et.al. J Bone Joint Surg 2007;89:1044



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Biceps Brachii: terminal bifurcation

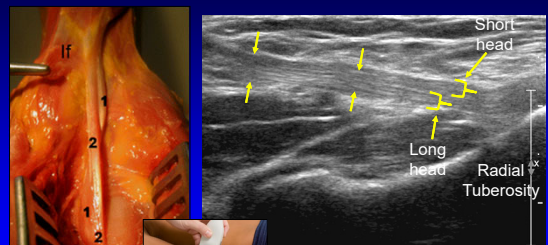


Note: toggling the transducer, which creates anisotropy allows visualization of two tendon heads



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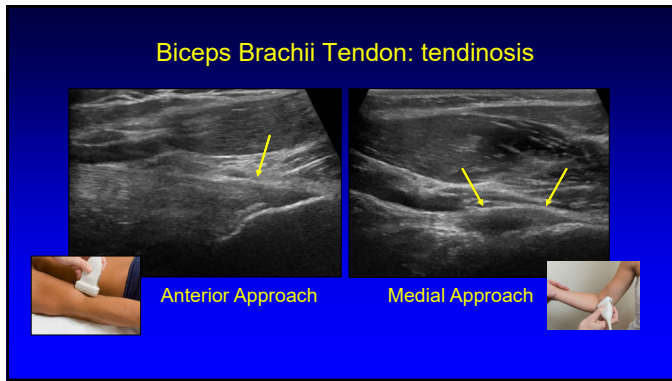
Biceps Brachii Tendon: distal



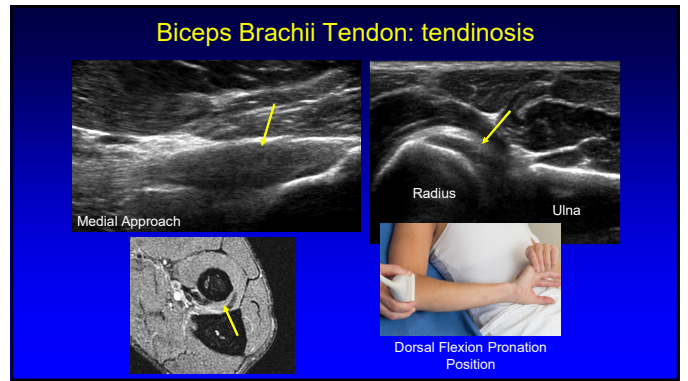
1 = long head
2 = short head

Tagliafico A., et.al. Eur Radiol 2010

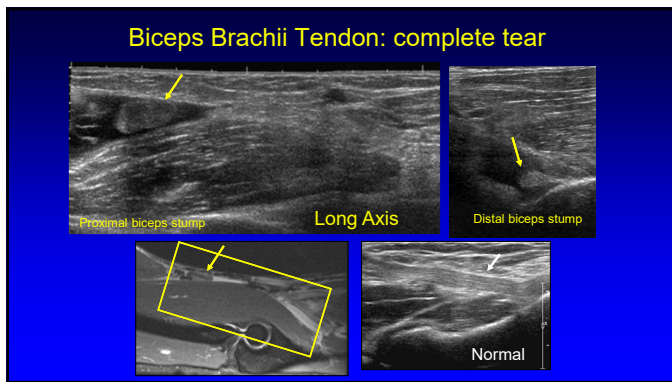
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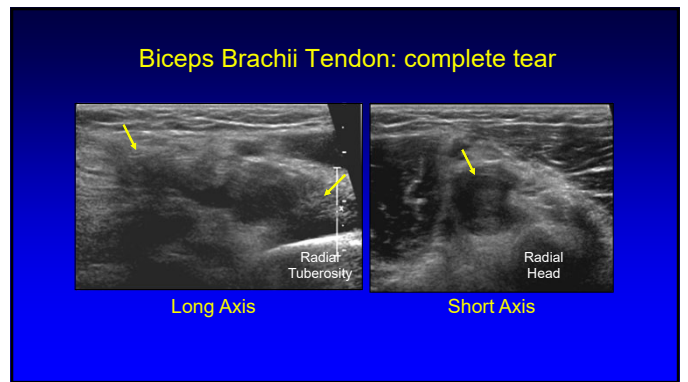
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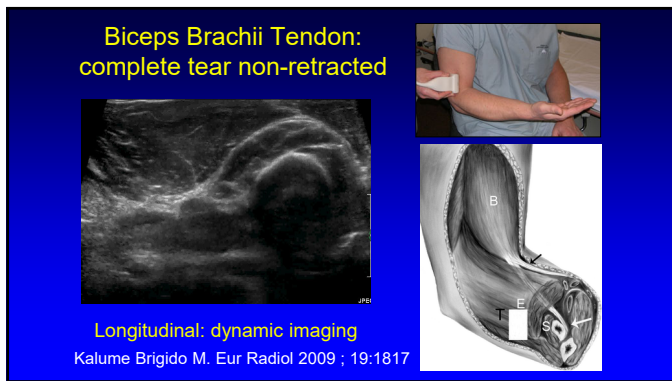
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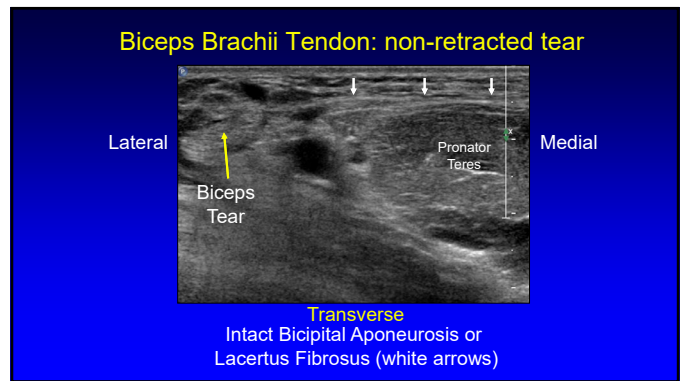
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Biceps Brachii Tears:

- Diagnosis of full-thickness tear versus partial-thickness tear:
 - 95% sensitivity
 - 71% specificity
 - 91% accuracy
- Shadowing: important indirect sign of tendon retraction

da Gama Lobo et al., Am J Roentgenol 2013; 200:158

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Biceps Brachii Tendon: partial tear (short head)

Retracted superficial short head (yellow arrows)
Hypoechoic but intact deep long head (white arrows)

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Biceps Brachii: short head tear

Yellow arrows = tear of short head
White arrows = intact long head

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Biceps Brachii Tendon: partial tear (long head)

Long head tear (yellow arrows)
Spared superficial short head (white arrows)

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Bicipitoradial Bursa

- Surrounds distal biceps
 - Does not communicate to elbow joint
 - No distal biceps tendon sheath
- If distended:
 - Mechanical, inflammatory
 - Characteristic "U" shape
 - Average: 1.8 – 2.5 cm in size
 - May displace deep branch of radial nerve

Skaf AY, Radiology 1999; 212:111

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Bicipitoradial Bursitis

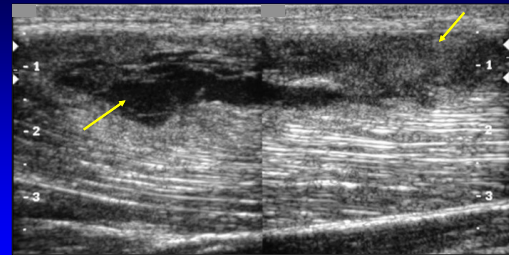
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Triceps Tear:

- Muscle injury: contusion
 - Mixed echogenicity hemorrhage
- Distal tendon injury
 - Usually partial-thickness tear
 - Superficial aspect of tendon
 - Avulsion fracture of olecranon

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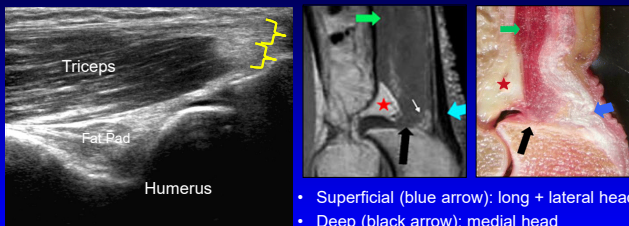
Hematoma: triceps



Longitudinal

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Triceps Brachii: insertion



- Superficial (blue arrow): long + lateral heads
- Deep (black arrow): medial head
 - Primarily muscular insertion

*From Resnick, Skeletal Radiol 2009, 38:171

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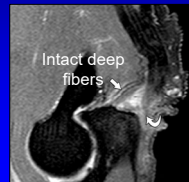
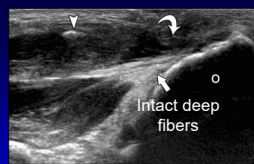
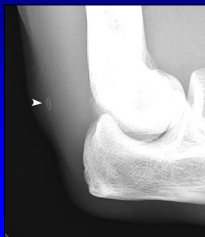
Triceps Tear: partial thickness tear

- Superficial layer torn
 - Long and lateral heads
- Intact deep layer (medial head)
- Associated enthesophyte bone fragment
 - 1 – 2 cm in size
 - 2.5 – 4 cm retraction
 - No donor site

J Ultrasound Med 2011; 30:1351

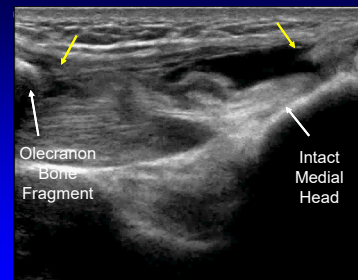
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Triceps Tendon: partial tear + avulsion



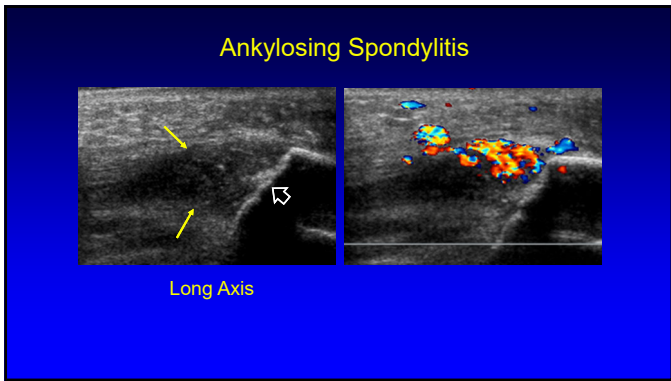
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Triceps Tendon: partial tear + avulsion



Long Axis (Sagittal Plane)

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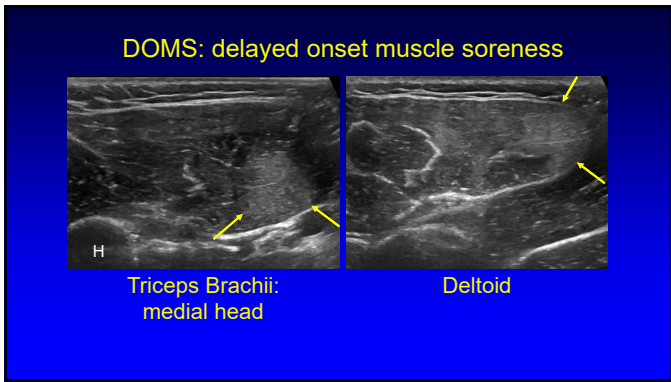
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Muscle Injury: DOMS

- Delayed onset muscle soreness
- Type 1 muscle strain
- Pain after intense physical activity:
 - Microtrauma: inflammation and edema
 - Onset: day 1, peak day 2-3, resolves day 7
 - Possible increased creatine kinase
- Upper extremity: triceps, biceps, brachialis
- Muscle enlargement with increased echogenicity

Longo V et al. J Ultrasound Med 2016; 35:2517

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“Epicondylitis”

- Common flexor and extensor tendons
- Abnormal hypoechogenicity
 - Mucoïd degeneration, tendinosis
- Anechoic: partial-thickness tear
- No inflammatory cells*

Potter, Radiology 1995; 196:43
Connell, AJR 2001; 176:777

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Common Extensor Tendon: elbow

- Often called “tennis elbow” or “lateral epicondylitis” or “epicondylosis” or
- All terms are misnomers
- Those inflicted usually do not play tennis (professionally or correctly)
- It is not inflammatory
- It is not a primary problem of the epicondyle

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Lateral Collateral Ligament Complex

- Radial collateral ligament (arrows)
- Common extensor tendon (E)
- Annular ligament (arrowhead)
- Lateral ulnar collateral ligament (curved arrow)

Jacobson J. et al. J Ultrasound Medicine 2013; 33:1041

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Lateral Collateral Ligament Complex

- Common extensor tendon (curved arrows)
- Radial collateral ligament (arrowheads)
- Annular ligament (a)

Jacobson J. et al.
J Ultrasound Medicine
2014; 33:1041

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Common Extensor Tendon: tendinosis

Note: normal radial collateral ligament (white arrow)

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Common Extensor Tendon

Patient #1
Tendinosis

Patient #2
Interstitial Tear

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Common Extensor Tendinosis + RCL Tear

Radial Head

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Pathology:

- Joint effusion and bursa
- Tendon abnormalities
- Ligament abnormalities
- Nerve abnormalities
- Soft tissue masses

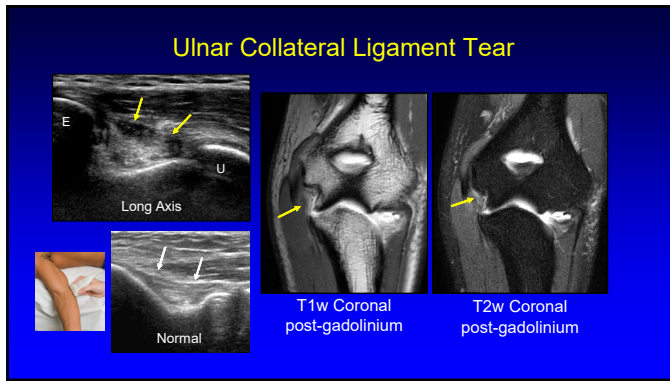
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Collateral Ligament Tear

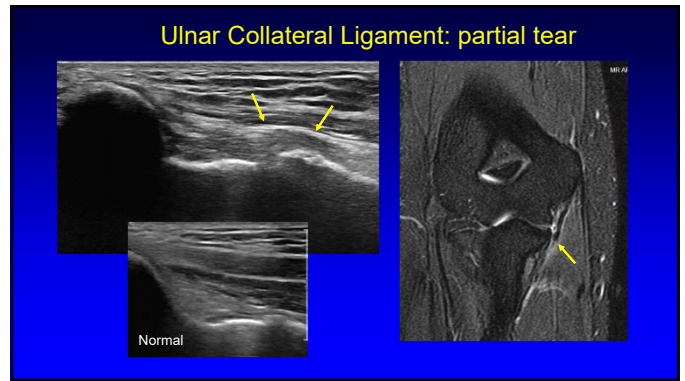
- Partial tear: hypoechoic, thickened
- Complete tear: anechoic fluid tracking through ligament defect
- Dynamic examination: stress

Miller et al. Skeletal Radiol 2004; 33:386

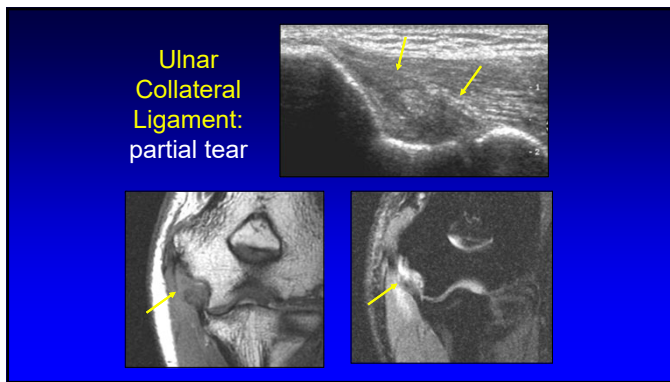
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Ulnar Collateral Ligament

- Valgus stress: 30 degrees elbow flexion
 - Unlock the olecranon
 - Stress: UCL anterior bundle
- Gravity stress is adequate, equal to Telos¹
- Ultrasound measurements:
 - Reliable and precise²

Ulnar Collateral Ligament: partial tear

¹Harada M et al. J Sho Elb Surg 2014; 23:561
²Bica D et al. J Ultrasound Med 2015; 34:371

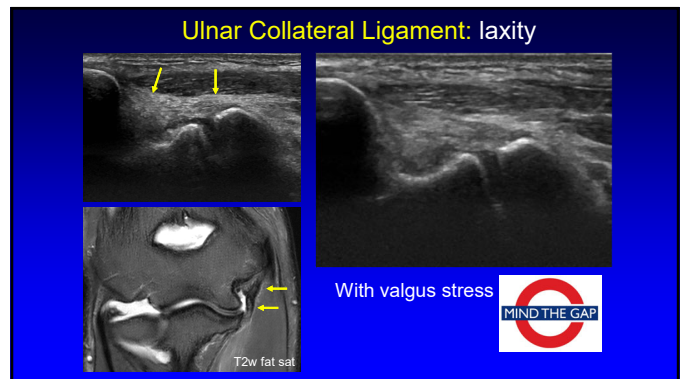
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Ulnar Collateral Ligament: valgus stress

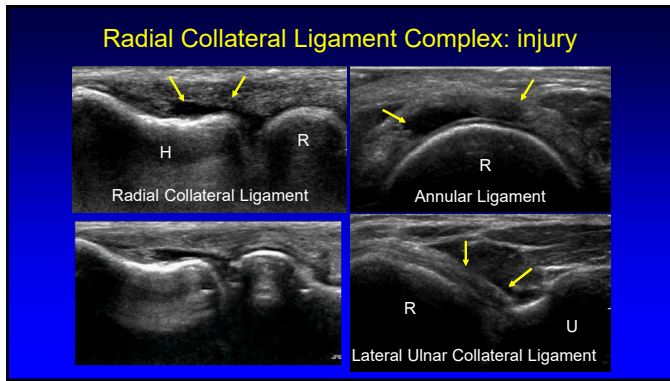
- >1 mm asymmetric gapping = 87% accuracy in diagnosis of UCL tear
 - MR arthrography accuracy = 88%
 - US + MR arthrography: accuracy = 98%
- Asymmetric joint space widening with stress:
 - Normal: 1.3 mm or less
 - Partial tear: 1.2 – 3.0 mm
 - Full thickness tear: 2.8 – 4.8 mm

Roedel JB et al. Radiology 2016

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- ### Pathology:
- Joint effusion and bursa
 - Tendon abnormalities
 - Ligament abnormalities
 - **Nerve abnormalities**
 - Soft tissue masses

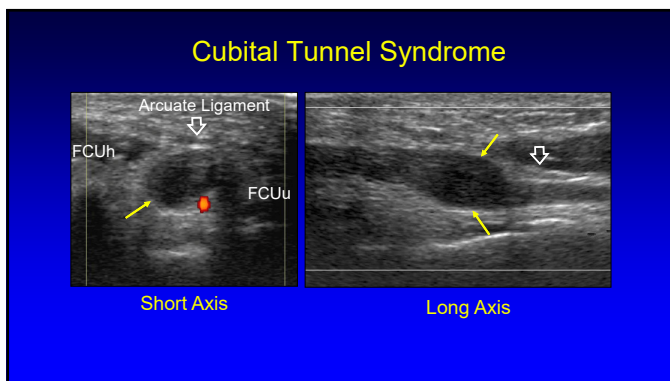
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- ### Ulnar Nerve: anatomy
- Behind medial epicondyle of humerus:
 - Cubital tunnel retinaculum or Osborne fascia
 - Distal to epicondyle:
 - True cubital tunnel
 - Between ulnar and humeral heads: flexor carpi ulnaris
 - Under arcuate ligament
-
- Martinoli, C. et al. Radiographics 2000;20:S199-S217

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- ### Ulnar Nerve: cubital tunnel syndrome
- Hypoechoic and enlarged
 - > 9 mm² area¹
 - Ratio greater than 2.8 compared to proximal²
 - Mild hypoechoogenicity alone: may be normal
 - Causes:
 - Idiopathic, overuse, joint process
 - Anconeus epitrochlearis: compression
 - Normal variant accessory muscle
- ¹Thoirs K et al. J Ultrasound Med 2008; 27:737
²Yoon JS et al. Muscle Nerve 2008; 38:1231

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- ### Anconeus Epitrochlearis
- Normal variant: 34% of population
 - Roof of cubital tunnel:
 - Residual muscle
 - In absence of normal attrition forming Osborn fascia
 - Secondary ulnar nerve entrapment
 - **Diagnose in elbow extension!**
-
- Sem Musculoskel Radiol 2000; 14:814:473

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Isolated Ulnar Nerve Dislocation

Ulnar Nerve
Medial Epicondyle Apex

Okamoto, J Hand Surg 2000; 25B:85

*Asymptomatic finding in 20%

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Snapping Triceps Syndrome

- Ulnar nerve and medial triceps dislocate over apex of medial epicondyle
- Ulnar nerve and medial triceps remain in contact with each other
- Palpable snap felt through transducer

Jacobson JA et al. Radiology 2001; 220:601

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Radial Nerve: deep branch

- Supinator syndrome:
 - Motor deficits (wrist, finger extension)
 - Abnormal electrodiagnostic studies
 - Nerve enlargement: entrapment
- Radial tunnel syndrome:
 - Pain, no motor deficits, normal EMG
 - Muscle denervation on MRI
 - No nerve enlargement

Ferdinand BD et al. Radiology 2006; 240:161

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Supinator Syndrome: deep br. radial nv.

Humerus Radius Supinator

Abnormal Normal

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Supinator Syndrome

Brachioradialis
Superficial Br. Deep Br.
Radial Head

Abnormal Normal

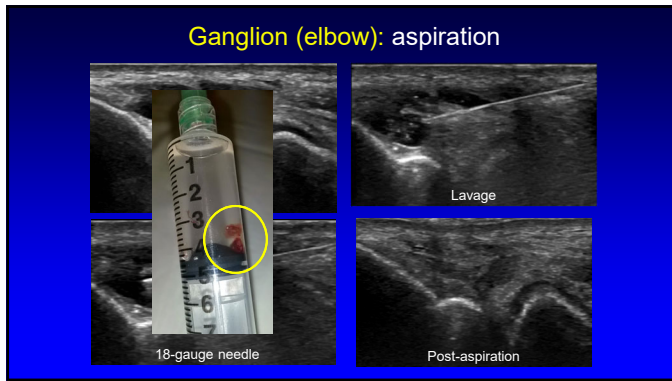
Transverse

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Pathology:

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- **Soft tissue masses**

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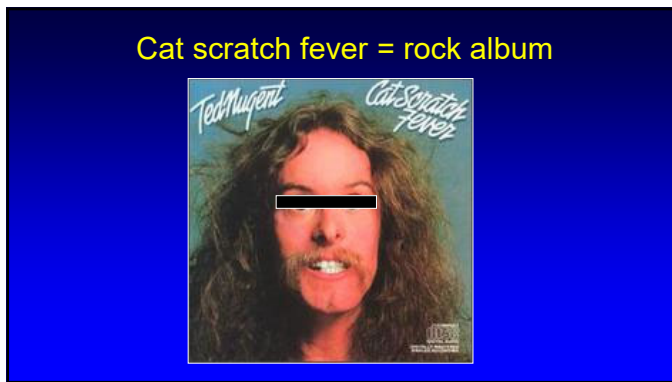


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Cat scratch disease

- Animal scratch: usually a cat
 - Bartonella henselae
- Child or adolescent:
 - Most common
- Elbow:
 - Lymphadenopathy
 - Epitrochlear lymph node (medial)

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Take-home Points:

- Joint: posterior recess
- Biceps and triceps:
 - Anatomy explains partial-thickness tears
- Nerves: don't forget to look
- Dynamic imaging
 - Ulnar nerve dislocation, snapping triceps
 - Ulnar collateral ligament evaluation

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Thank you!

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

Twitter handle: @jjacobsn

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