

Musculoskeletal Ultrasound: Dynamic Evaluation

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Disclosures

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

*Note: all images from the textbook
Fundamentals of Musculoskeletal Ultrasound are
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See www.jacobsonmskus.com for syllabus other educational material

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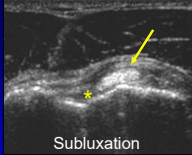
Objectives:

- To demonstrate musculoskeletal pathologies requiring:
 - Joint movement or positioning
 - Muscle contraction

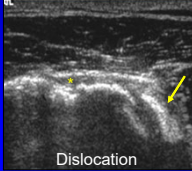
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Shoulder: biceps tendon

- Subluxation
 - Partial medial displacement
- Dislocation
 - Complete out of groove
 - Possibly located within subscapularis or glenohumeral joint
- Evaluate dynamically



Subluxation

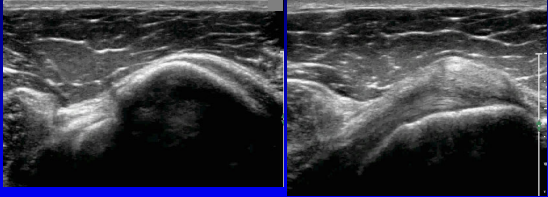


Dislocation

*Farin et al. Radiology 1995; 195:845

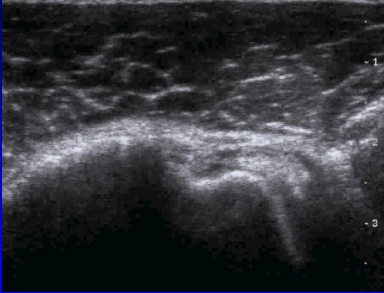
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Biceps Tendon Dislocation



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Biceps Tendon Dislocation

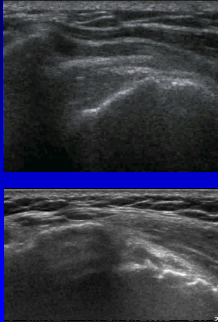


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Subacromial Impingement

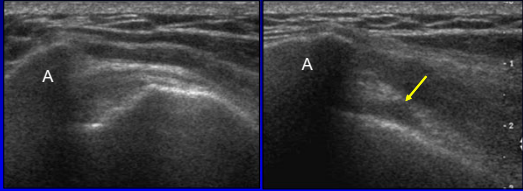
- Thickened tendon or bursa
 - Possible snapping of thickened bursa
 - "Gathering" of bursa: may be asymptomatic¹
- Superior movement of humeral head
 - Possible contact between humerus and acromion²

¹Daghir A et al. Skeletal Radiol 2012; 41:1047
²Bureau N et al. AJR 2006; 187:216



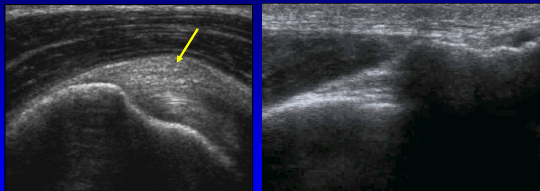
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Impingement Syndrome



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Impingement: supraspinatus

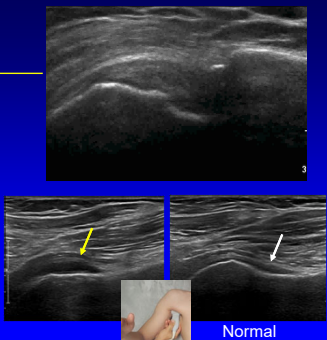


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Adhesive Capsulitis

- Supraspinatus tendon does not slide beneath acromion with lateral elevation of arm
- Sensitivity 91%, specificity 100%, accuracy 92%
- Axillary recess capsule thickness >3 mm

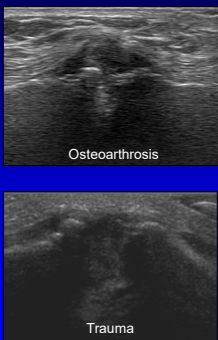
Ryu et al. J Ultrasound Med 1993; 12:445
 Kim DH et al. Skeletal Radiol 2018; 47:1491



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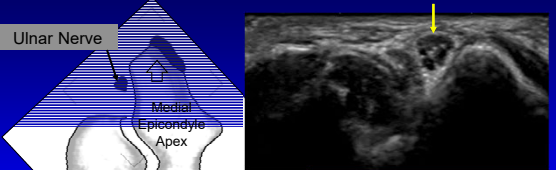
Acromioclavicular Joint

- Dynamic evaluation: clinical sign "cross-arm"
 - Ipsilateral hand to opposite shoulder: pain
- Normal:
 - Maneuver: ACJ narrows, <1 mm, no pain
 - Rest: widens back to normal (up to 5 mm)
- Abnormal:
 - Maneuver: ACJ narrows, > 1 mm, extruded capsule and disc: **osteoarthritis**
 - Rest: ACJ widens > 5 mm: **trauma**



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Isolated Ulnar Nerve Dislocation



Ulnar Nerve
 Medial Epicondyle
 Apex

Okamoto, J Hand Surg 2000; 25B:85

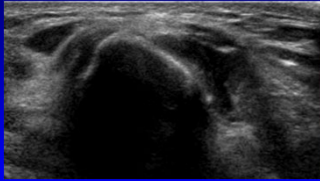
*Asymptomatic finding in 20%



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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

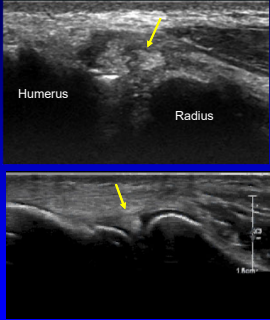


Jacobson JA et al. Radiology 2001; 220:601

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Synovial Fold Syndrome

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

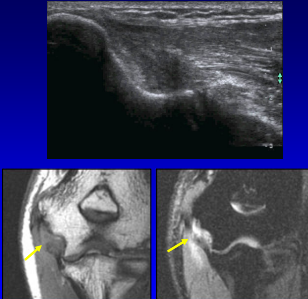


Cerezal et al. AJR 2013; 201:W88

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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



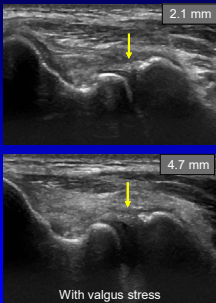
Ulnar Collateral Ligament: partial tear

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

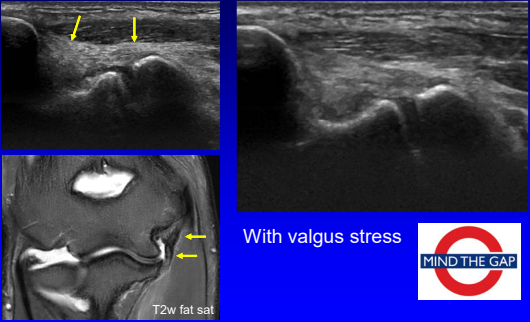


With valgus stress

Roedl JB et al. Radiology 2016

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Ulnar Collateral Ligament: laxity



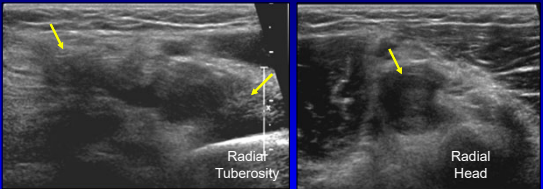
With valgus stress

T2w fat sat

MIND THE GAP

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Biceps Brachii Tendon: complete tear



Longitudinal


Transverse

Radial Tuberosity

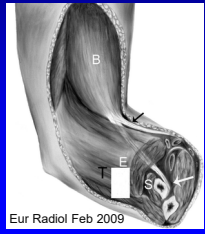
Radial Head

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Biceps Brachii Tendon: normal




Longitudinal: dynamic imaging



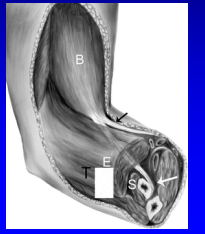
Eur Radiol Feb 2009

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Biceps Brachii Tendon: complete tear non-retracted



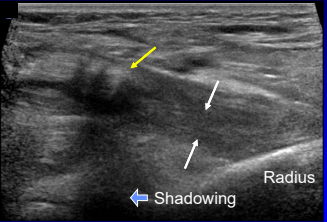
Longitudinal: dynamic imaging



Kalume Brigido M. Eur Radiol 2009 ; 19:1817

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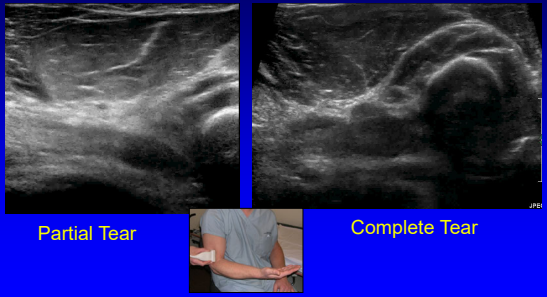
Biceps Brachii Tendon: partial tear (short head)



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

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Biceps Tendon Tears: dynamic imaging

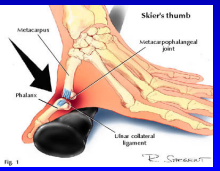


Partial Tear Complete Tear


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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



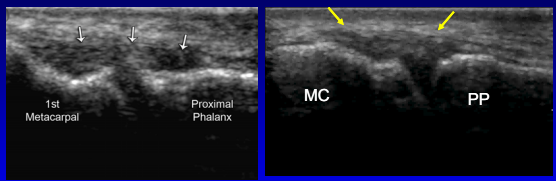
Chronic Mechanism



Rabbit
Mandals

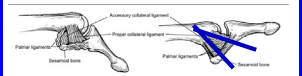
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Ulnar Collateral Ligament: thumb

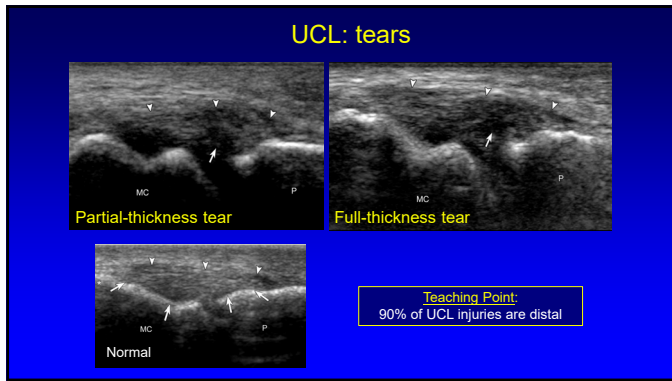


1st Metacarpal Proximal Phalanx MC PP

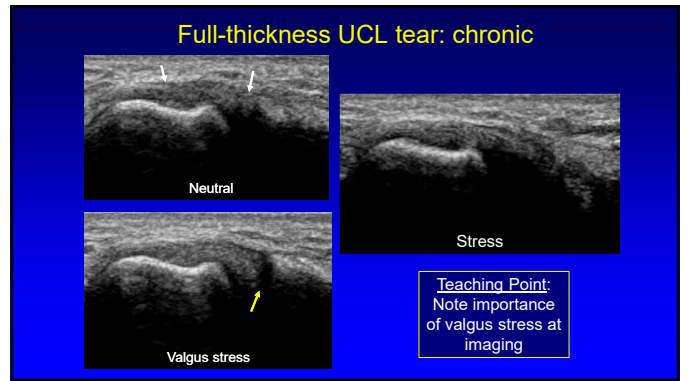
Note: sliding of adductor aponeurosis with isolated interphalangeal joint flexion



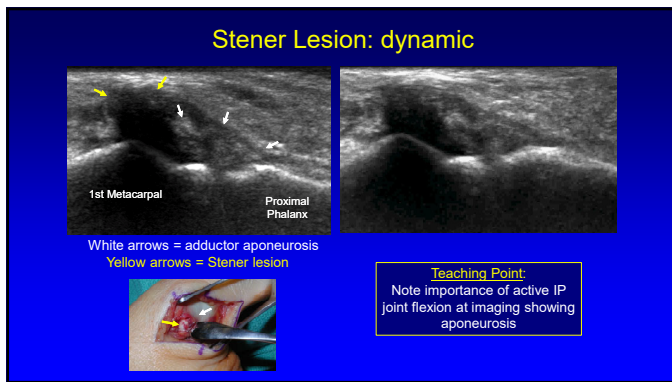
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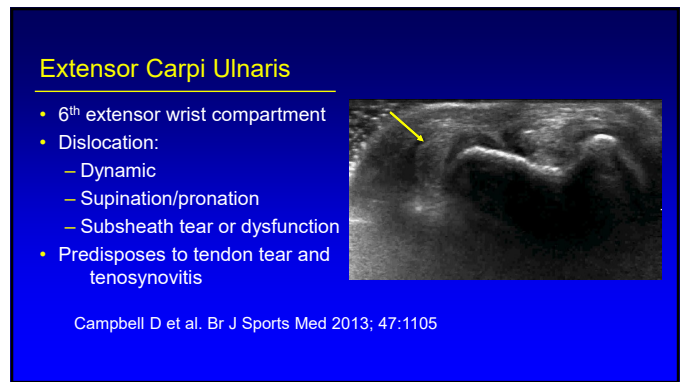
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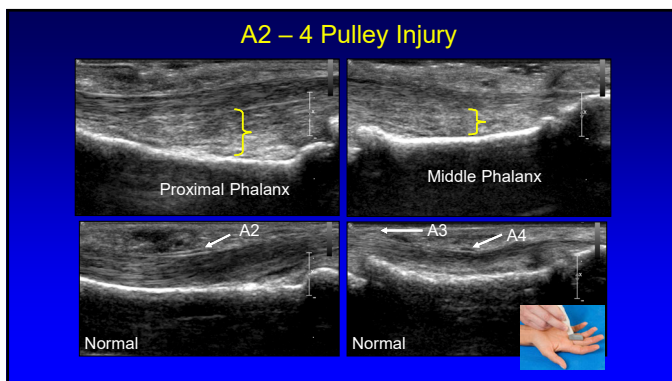
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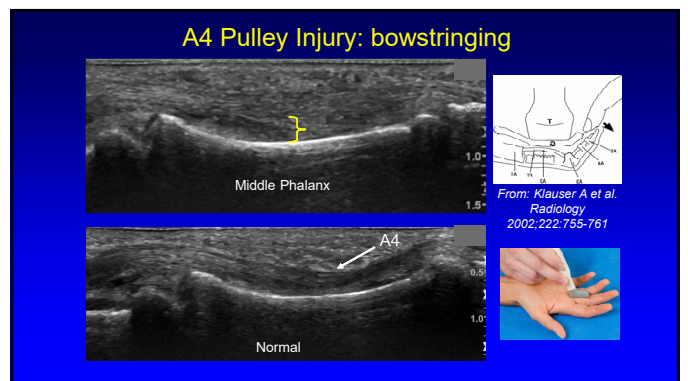
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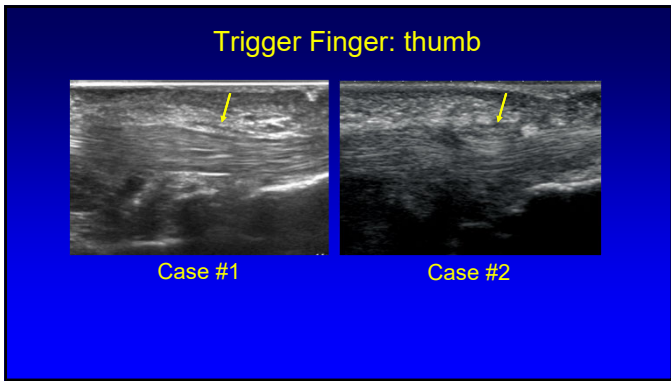
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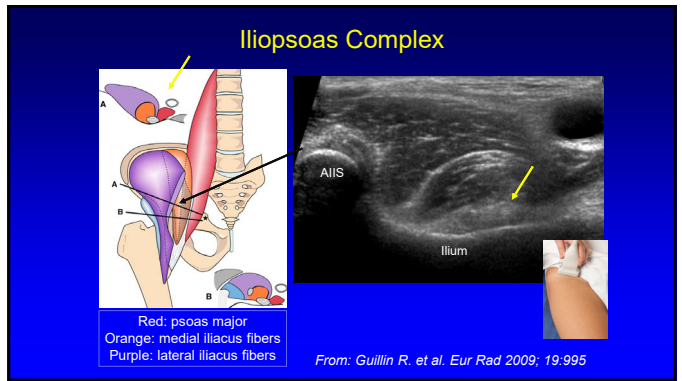
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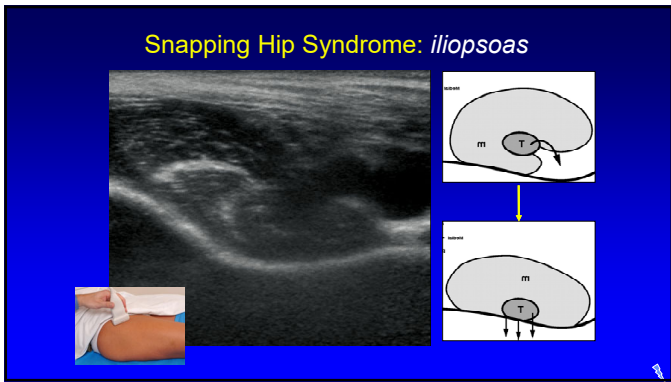
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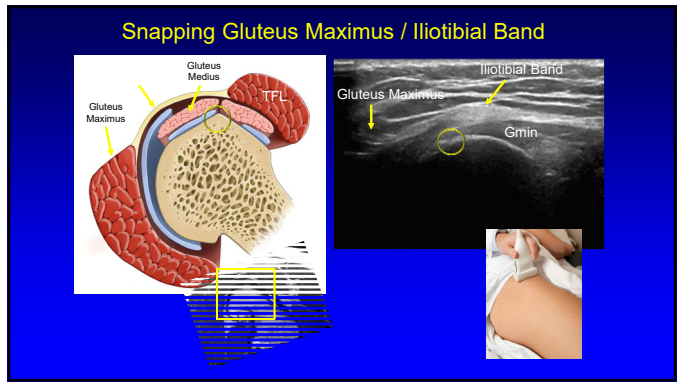
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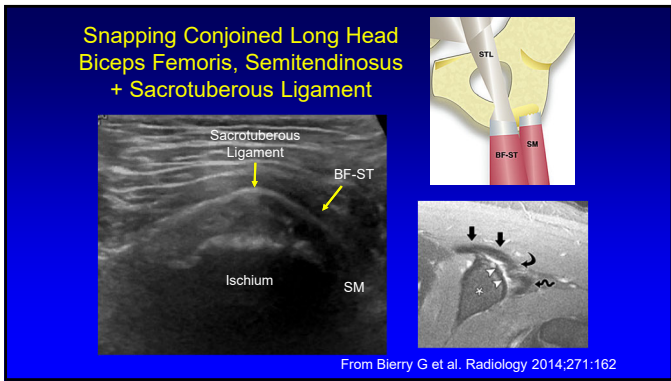
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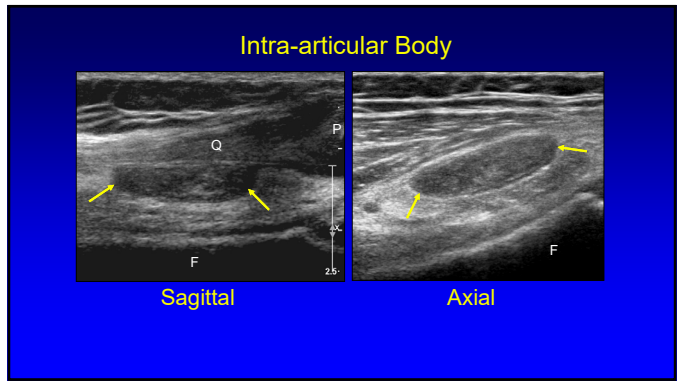
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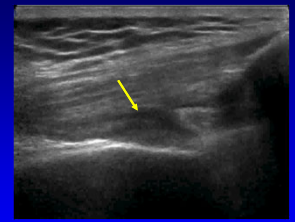
Intra-articular Body



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Patellar Clunk Syndrome

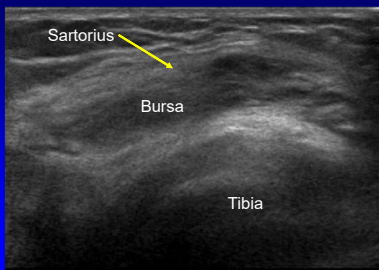
- After total knee arthroplasty
- 1% to 7.5% incidence
- Fibrous nodule: intercondylar notch
- Pain with flexion - extension



Okamoto T. et al. J Orthop Sci 2002; 7:590

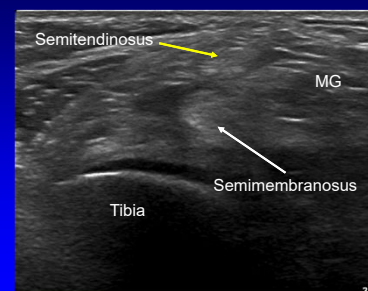
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Sartorius Snapping over Pes Anserinus Bursa



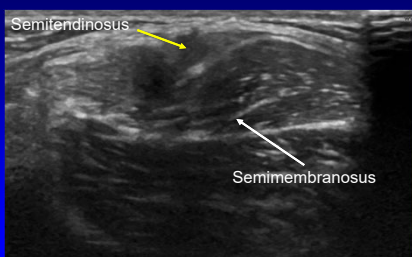
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Semitendinosus Snapping over Semimembranosus



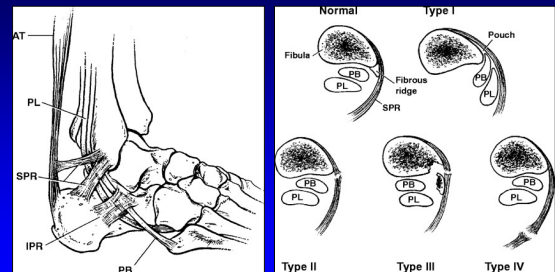
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Semitendinosus Snapping over Semimembranosus



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Peroneal Retinaculum





Rosenberg et al. AJR 2003; 181:1551

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Peroneal Tendon Subluxation

- Abnormal movement may only occur dynamically
- Predisposes to peroneal tendon tears
 - Longitudinal split of peroneus brevis
- US: examine with dorsiflexion / eversion
 - 100% accurate US diagnosis





Neustadter et al. AJR 2004; 183:985

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Intrasheath Subluxation

- Abnormal snapping of peroneal tendons
- No lateral displacement, intact retinaculum
- Associations:
 - Convex posterior fibula: 92%
 - Tendon tear in 86%
 - Low lying peroneus brevis muscle: 71%

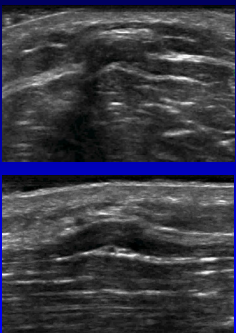


J Bone Joint Surg Am 2008; 90:992
J Foot Ankle Surg 2009; 48:323

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Muscle Hernia

- Cause: trauma, activities, weak fascia
- Lower leg: especially anterior tibialis
- Swelling with muscle contraction
- US: muscle bulge, possible fascial defect
 - Site of perforating vessel



Beggs, AJR 2003; 180:395

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Achilles Tendon: complete tear

- Pitfall: misinterpretation of intact plantaris as Achilles fibers
- Dynamic imaging: look for
 - Widening of gap with passive dorsiflexion
 - Lack of tendon movement across tear
 - Determine if ends approximate



Long Axis

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Achilles Tendon: healing tear



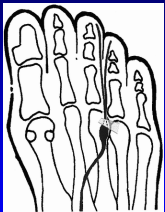
Longitudinal



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Interdigital Neuroma:

- Common plantar digital nerve entrapment
- Edema, fibrosis, necrosis
- 3rd intermetatarsal space > 2nd
- Sharp, burning pain from metatarsal head to toes
- Females: pliable foot, high-heeled narrow-toed shoes



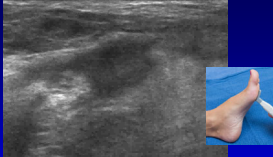
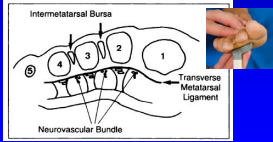
From: Martinoli, RadioGraphics 2000; 20:S199

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Dynamic Evaluation

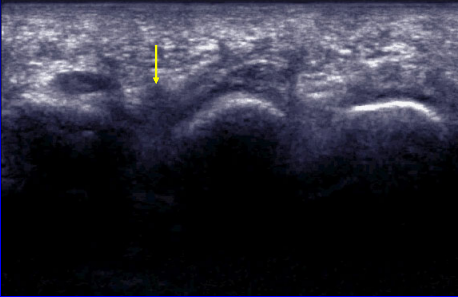
- Compression
 - Between transducer and palpation
 - Bursae (dorsal) compress, neuromas (plantar) do not
- Sonographic Mulder Sign
 - Scan plantar: coronal plane
 - Neuroma displaces: plantar
 - Palpable click

Torriani M et al. AJR 2003; 180:1121
Zanetti M et al. Radiology 1997; 203:516

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Dynamic imaging: Mulder's Maneuver

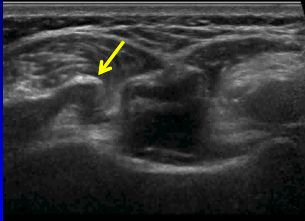


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Slipping Rib Syndrome

- Abnormal mobility of cartilaginous rib
- Slips over adjacent rib with muscle contraction or activity
- Visible with dynamic ultrasound

J Ultrasound Med 2002; 21:339



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Dynamic Imaging: summary

- Dynamic pathologic conditions
 - Limited number
 - Involve specific structures
- Consider ultrasound for any snapping or painful dynamic situation

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Thank you!



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



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