

Ultrasound of the Ankle and Foot

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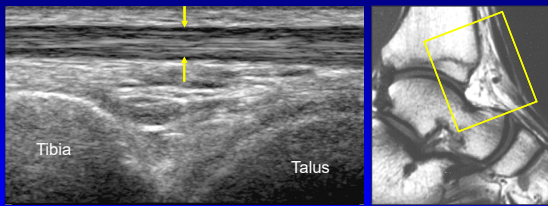
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Disclosures

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

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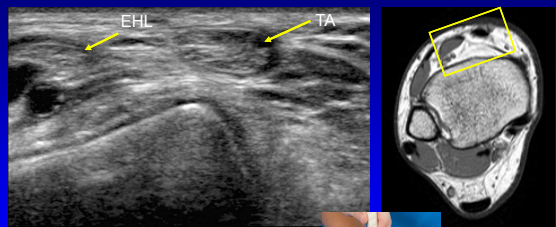
Tibialis Anterior Tendon



Long Axis

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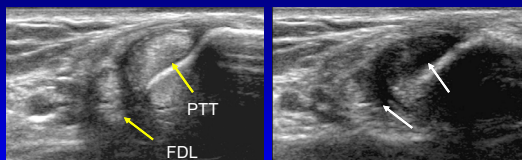
Tibialis Anterior & Extensor Hallucis Longus



Short Axis

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Medial Tendons: short axis

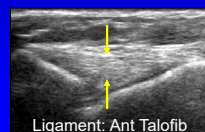


Anisotropy

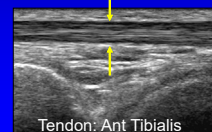
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Technique: ligaments

- Hyperechoic
- Fibrillar echotexture
 - More compact than tendon echotexture
- Anisotropy



Ligament: Ant Talofib



Tendon: Ant Tibialis

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Outline

- Tendon Pathology
- Ligament Pathology
- Inflammation
- Masses
- Miscellaneous

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Tenosynovitis

- Fluid distending tendon sheath
 - Anechoic or hypoechoic
 - May be heterogeneous, complex
- Synovial hypertrophy:
 - Hypoechoic
 - May be isoechoic to tendon
 - Variable flow on color Doppler imaging

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Tenosynovitis: peroneal tendons

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Paratenonitis: Achilles

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Tendon Sheath Injection

- Short axis to tendon
- Anterior or posterior
- Deep to tendon:
 - Decreased risk of depigmentation, fat atrophy
- 100% accurate

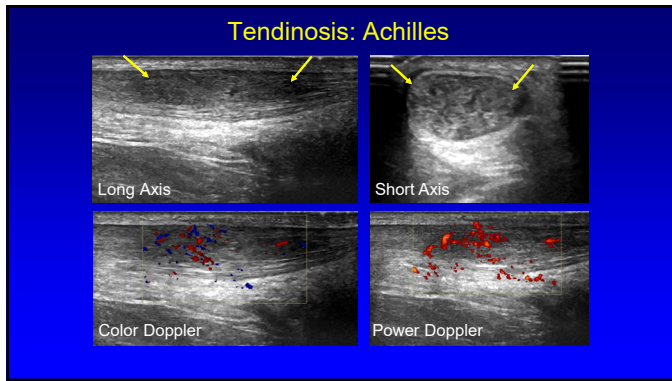
Muir JJ et al. Am J Phys Med Rehab 2011; 90:564

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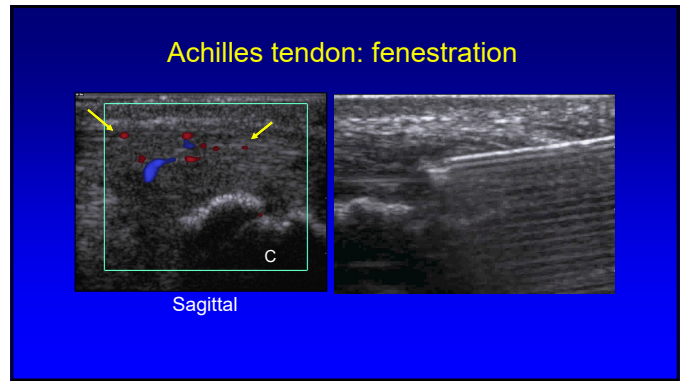
Tendinosis

- Tendon degeneration
- Not tendinitis: no acute inflammation
- Swollen, hypoechoic tendon
- Unlike tear:
 - Tendon fibers still continuous
 - No defined clefts

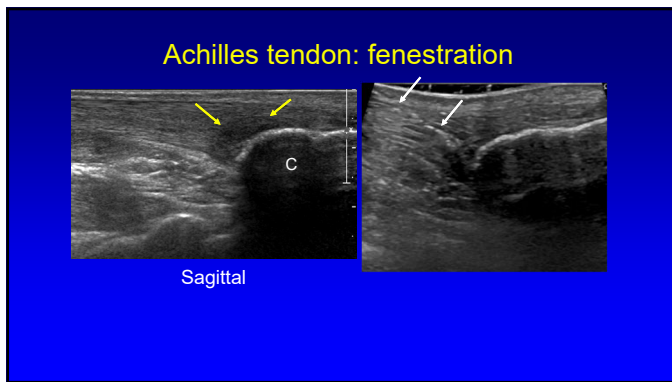
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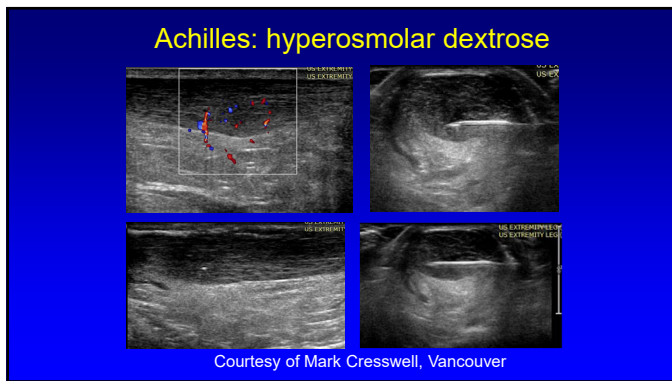
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Prolotherapy

- Injection of an irritant
- Hyperosmolar dextrose or morrhuate sodium
- Unknown mechanism
 - Irritant attracts inflammatory mediators
 - Stimulate release of growth factors
 - Vascular sclerosant

Distel et al. PMR 2011; 3:S78

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Prolotherapy

- Achilles
 - 36 patients with chronic tendinosis
 - Hyperosmolar dextrose every 6 weeks
 - Significant reduction in pain
 - Decreased vascularity in 55%

Maxwell et al. Am J Roentgenol 2007; 189:W215

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Achilles Tendon

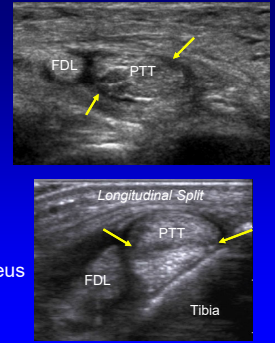
- Randomized controlled: 54 patients
- PRP versus saline injection
- No significant difference in outcomes
 - At 24 weeks¹
 - At 1 year²
 - *Both groups: eccentric physical therapy

¹de Vos RJ et al. JAMA 2010; 303:145
²de Jonge S. Am J Sports Med 2011; 39:1623

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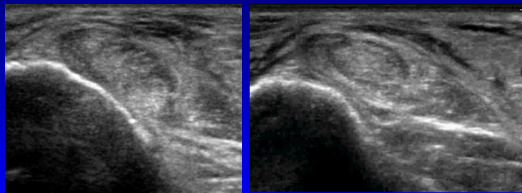
Partial Tear

- Anechoic / hypoechoic clefts
- Surface irregularity
- Longitudinal split
- Possible tenosynovitis
- Specific locations:
 - Where tendons curve around bone
 - Achilles: 2 - 6 cm proximal to calcaneus



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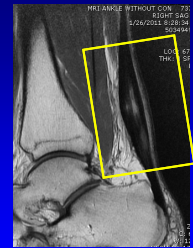
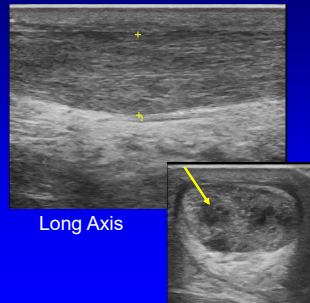
Peroneus Brevis Split Tear



Short Axis

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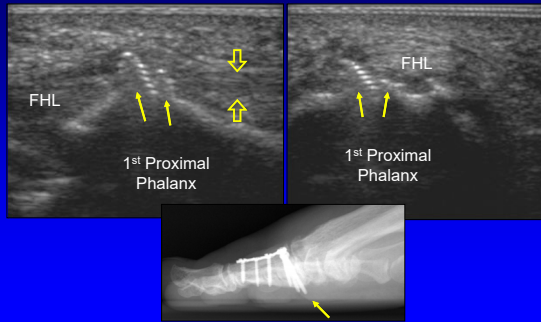
Achilles Tendon: partial-thickness tear



Courtesy of Jon Halperin, San Diego

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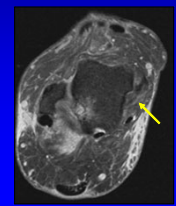
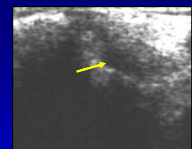
Flexor Hallucis: screws



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Full-thickness Tear

- Complete disruption of tendon fibers
- Hypoechoic or anechoic
- Transverse:
 - Absent tendon fibers
- Long axis imaging:
 - Tendon retraction (dynamic imaging)



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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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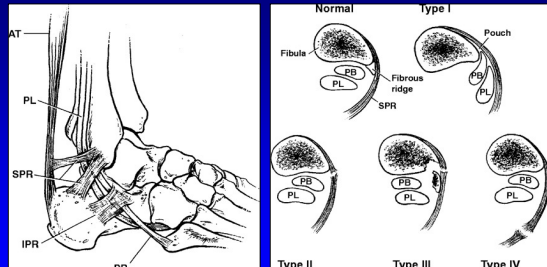
Peroneal Tendon Tears: US

- 54 tendons (5 peroneal): surgery
 - US: 100% sensitivity, 93% accuracy¹
- 60 peroneal tendons: surgery
 - US: 100% sensitivity, 90% accuracy²

¹Waitches et al. JUM 1998; 17:249
²Grant et al. 2005; 87:1788

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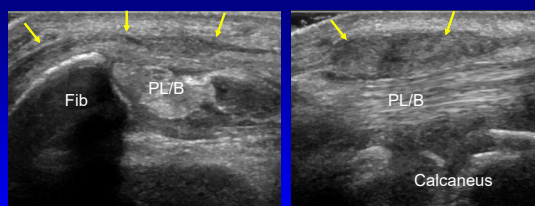
Peroneal Retinaculum



Rosenberg et al. AJR 2003; 181:1551

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Superior Peroneal Retinaculum Injury



Short Axis to Peroneal Tendons

Long Axis

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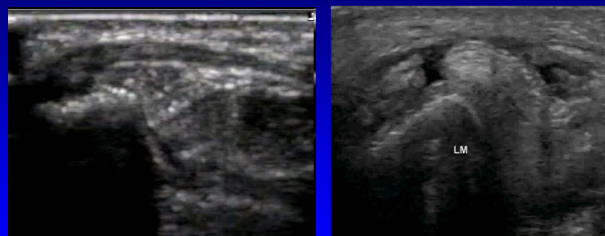
Peroneal Tendon Subluxation

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

Neustadter et al. AJR 2004; 183:985

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Peroneal Tendon: *dynamic imaging*



Subluxation: Type 1 pouch

Dislocation and tendon tear

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Intrasheath Peroneal Subluxation

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

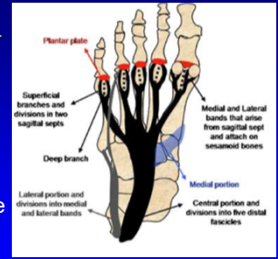


J Bone Joint Surg Am 2008; 90:992
J Foot Ankle Surg 2009; 48:323

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Plantar Fascia

- Fasciopathy
 - Central cord, proximal
 - Degenerative, tendinosis-like
- US:
 - Hypoechoic, thickened > 4 mm
 - Painful with transducer pressure

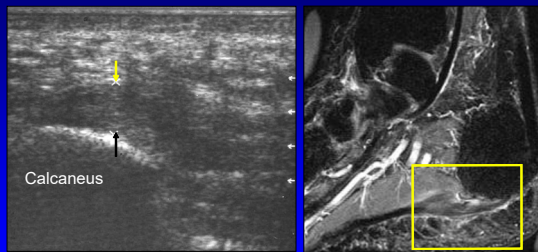


Cardinal, E. et al. Radiology 1996; 201:257

From: Moraes do Carmo, Skeletal Radiol 2008; 37:929

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Plantar Fasciopathy



Long Axis

Sagittal T2w

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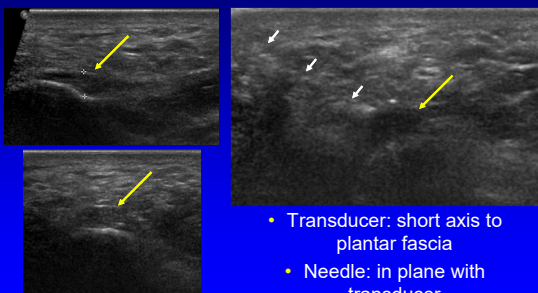
Steroid Injection: plantar fascia

- Into fascia:
 - 2% risk of plantar fascia rupture¹
 - Temporary pain relief: 4 weeks
 - No difference at 8, 12 weeks compared to saline²
- Deep to fascia: 1st branch of the lateral planter nerve (Baxter's nerve)
- Superficial to fascia:
 - Risk of fat atrophy theoretical using US guidance

¹Kim C et al. Foot Ank Spec 2010; 3:335
²McMillan AM et al. BMJ 2012; 344:e3260

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Steroid Injection: plantar fascia



- Transducer: short axis to plantar fascia
- Needle: in plane with transducer

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Outline

- Tendon Pathology
- Ligament Pathology
- Inflammation
- Masses
- Miscellaneous

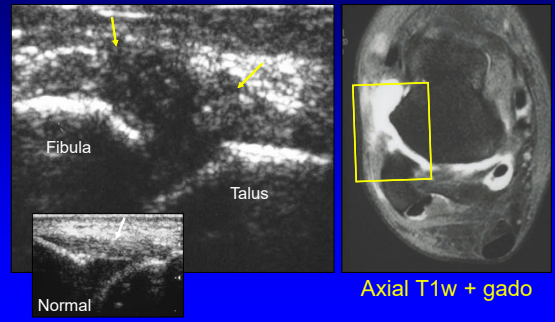
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Ligament Tear:

- Hypoechoic & thickened
- Acute: anechoic fluid tracking through defect indicates full-thickness tear
- Cortical avulsion: hyperechoic

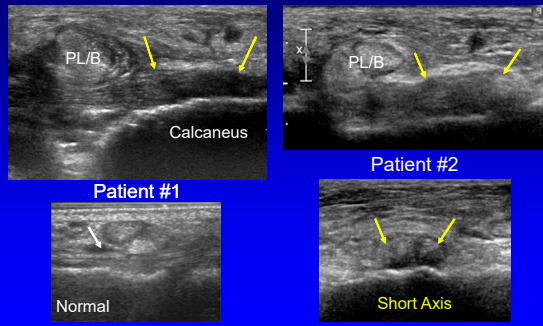
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Anterior Talofibular Ligament Tear



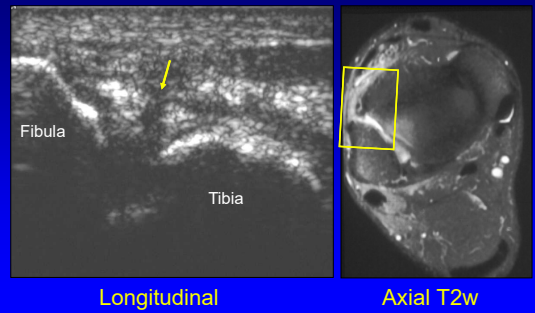
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Calcaneofibular Ligament Tear



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Anterior Inferior Tibiofibular Ligament Tear



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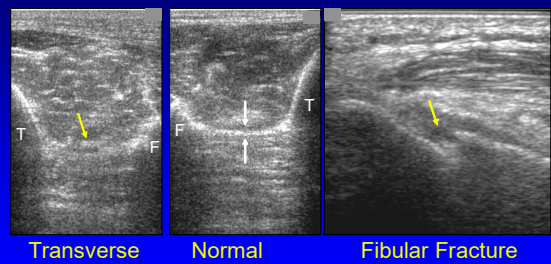
Ligament Tear:

- Anterior inferior tibiofibular ligament:
 - Look for interosseous membrane tear if absent lower fibular fracture
 - Maisonneuve fracture



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Maisonneuve Fracture

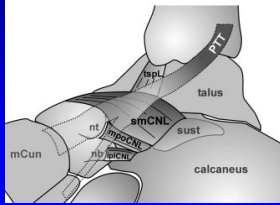


Durkee, J Ultrasound Med 2003; 22:1369

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Spring Ligament Complex

- Calcaneonavicular ligament
 - Superomedial
 - Perpendicular to distal PTT
 - Mediolateral oblique
 - Inferoplantar longitudinal

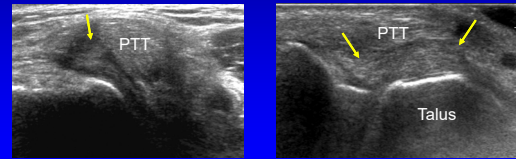


From: Radiology 2005; 237:242

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Superomedial Calcaneonavicular Ligament

- Associated with PTT dysfunction
- Abnormal: hypoechoic, thick > 4 mm, thinned or disrupted



Harish, J Ultrasound Med 2008; 27:1145

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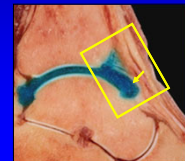
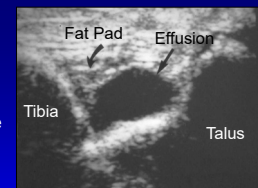
Outline

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Tibiotalar Joint: *effusion*

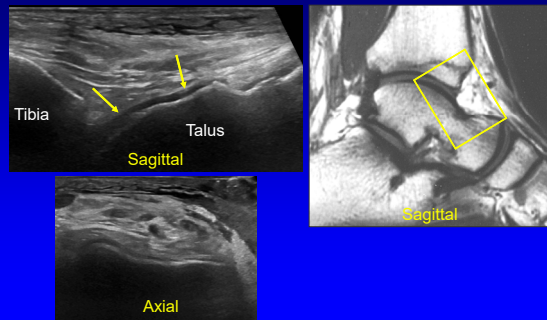
- Anterior evaluation most sensitive
- Plantar flexion
- Hyperechoic fat pad displaced by anechoic or hypoechoic fluid
- Sensitivity: MRI > US > PF



Jacobson, JA et al. AJR 1998; 170:1231

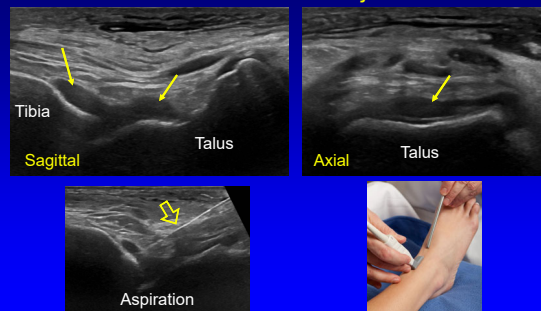
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Pitfall: normal hyaline cartilage



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Effusion: tibiotalar joint



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Septic Joint

- Anechoic or hypoechoic distention of joint recesses
- May be hyperechoic if complicated
 - Possible synovitis
- US or color Doppler cannot distinguish between septic and aseptic effusion*

*Strouse et al. Radiology 1998; 206:731

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5th Metatarsal Phalangeal Joint: septic

Sagittal Coronal

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Posterior Subtalar Joint

- Lateral joint recess
- **Out of plane**
- Transducer: coronal
- Place roll: varus
- Avoid: peroneal tendons

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MTP Joints

- Dorsal recesses
- **In plane**
- Parasagittal or transverse
- Sterile gel stand off

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Synovitis: color flow

Tibia Talus RA Ankle No flow RA ankle Positive flow

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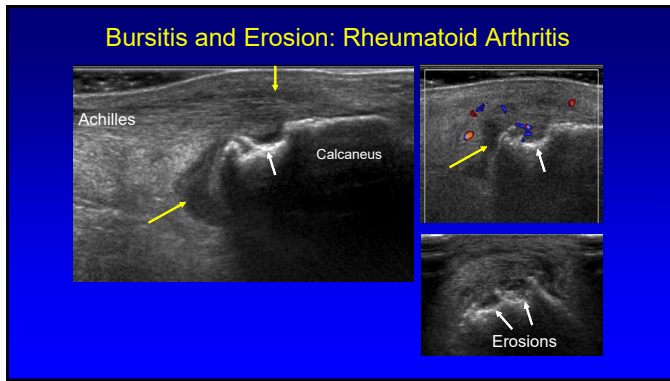
Rheumatoid Arthritis

5th MT Sagittal: dorsal Sagittal: plantar lateral Transverse

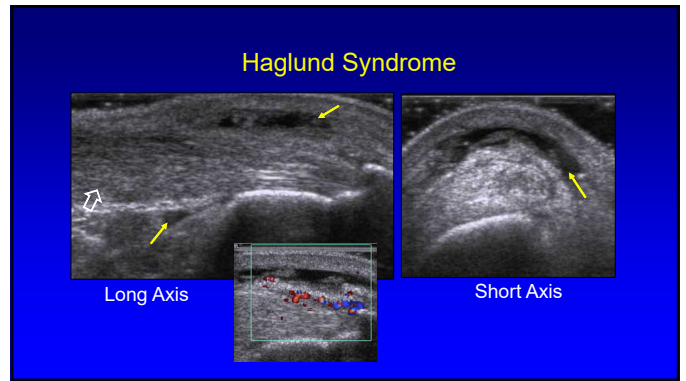
- 5th metatarsal head
 - Most common site for involvement
- Supplement dorsal evaluation with lateral and plantar view

Inanc N et al. US Bio Med 2016; 42:865

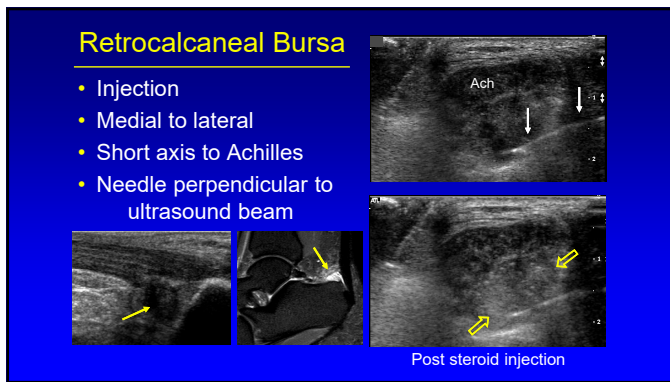
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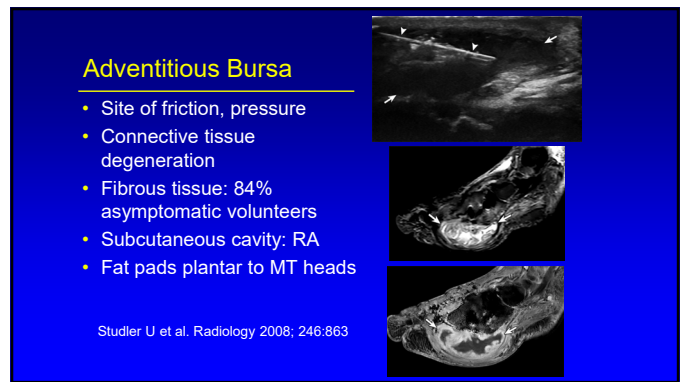
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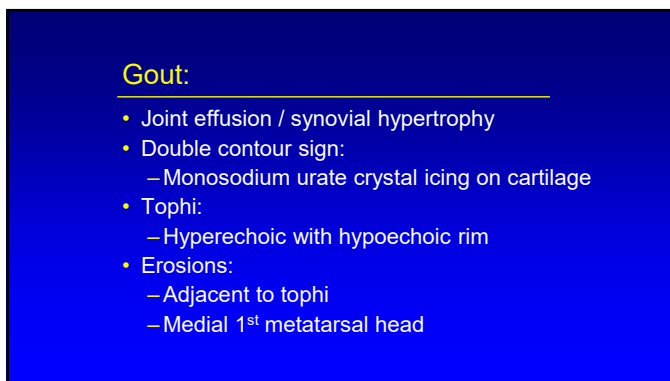
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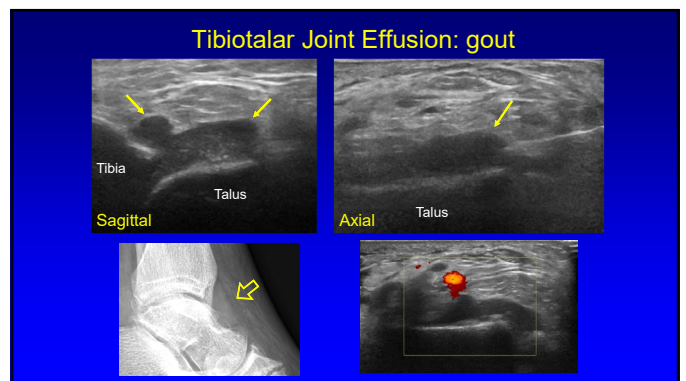
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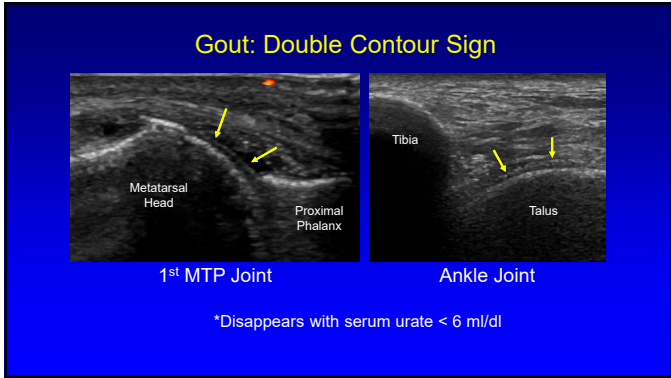
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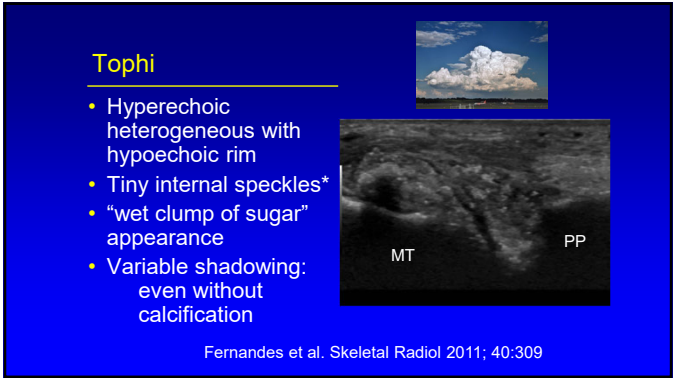
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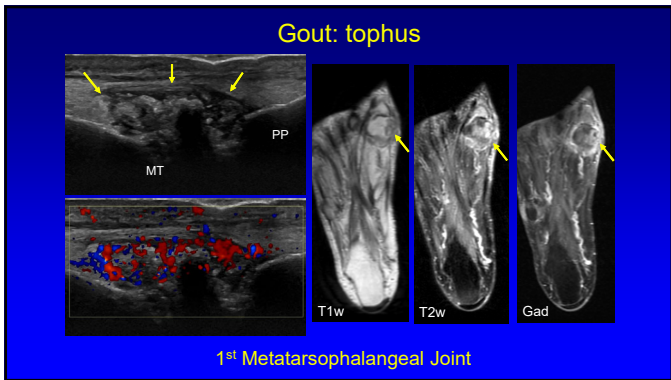
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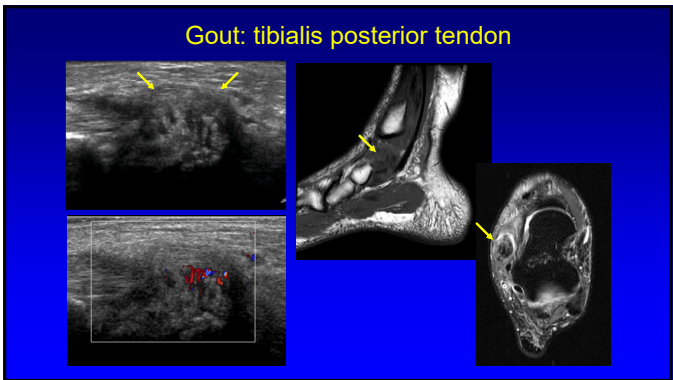
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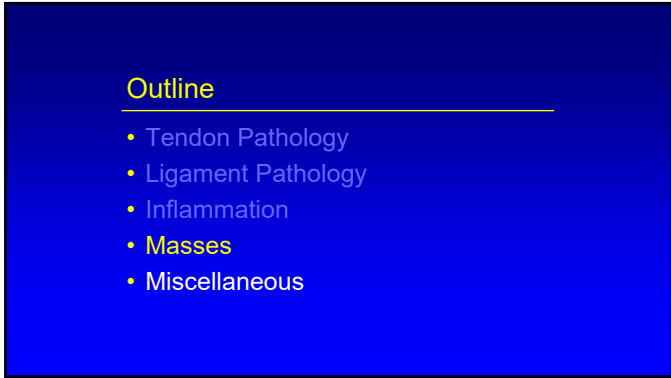
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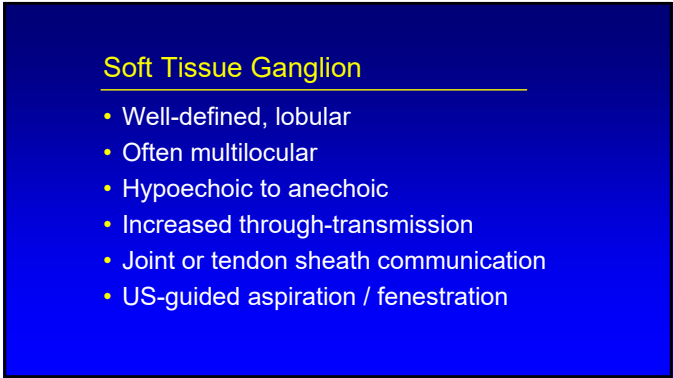
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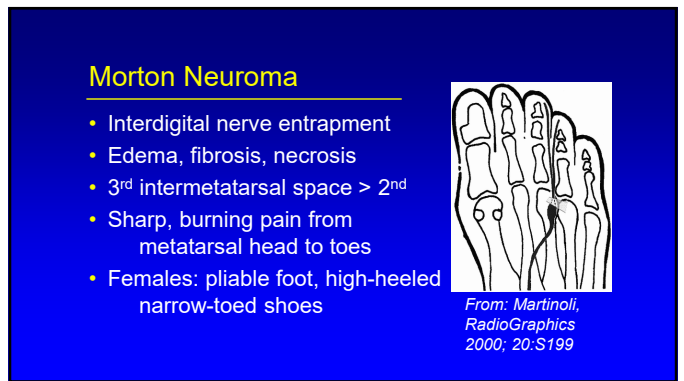
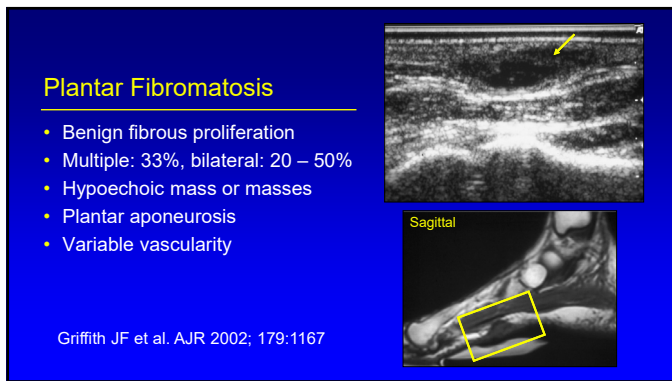
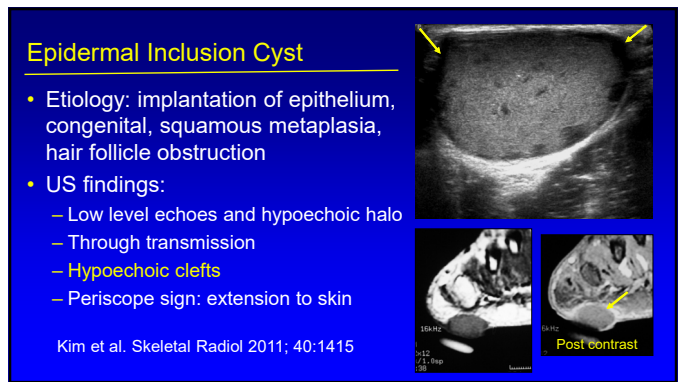
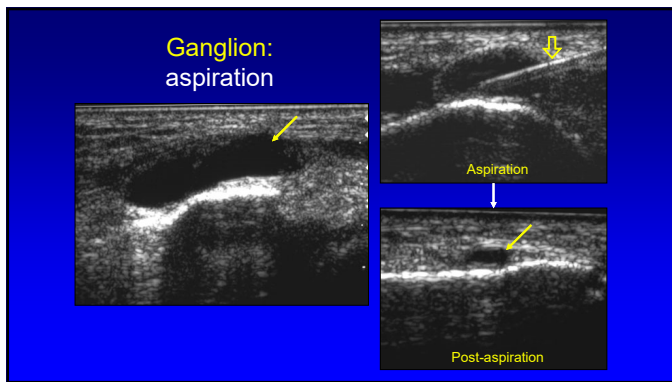
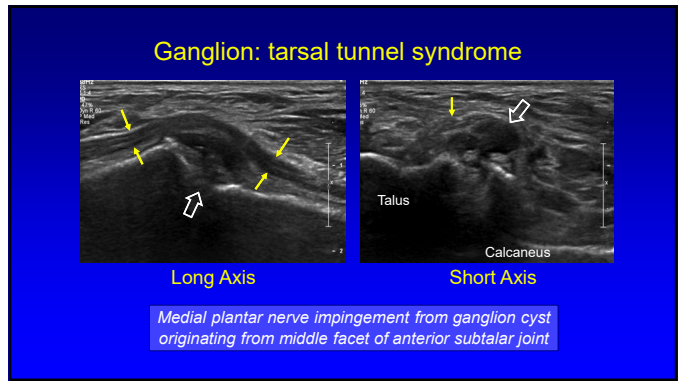
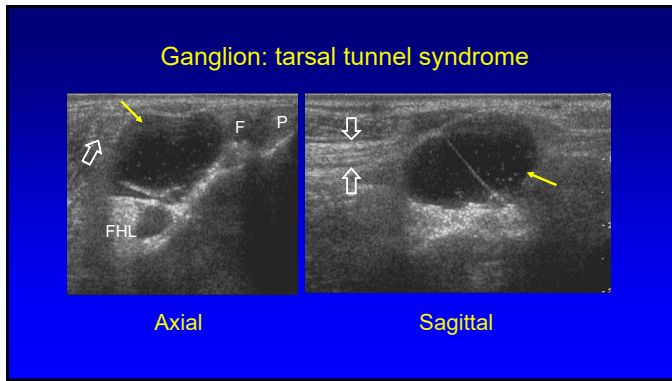
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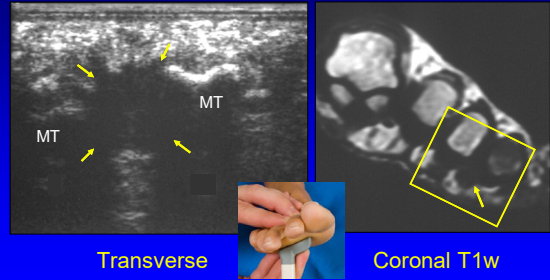
Morton Neuroma

- Hypoechoic 5 mm mass
 - Sensitivity: 100% ; Specificity: 83%
- Digital nerve continuity*
 - Excludes other causes for mass
- Compression:
 - Produces symptoms
 - Bursa (compressible) vs. neuroma (not compressible)

Redd et al. Radiology 1989; 171:415
Quinn et al. AJR 2000; 174:1723

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Morton Neuroma

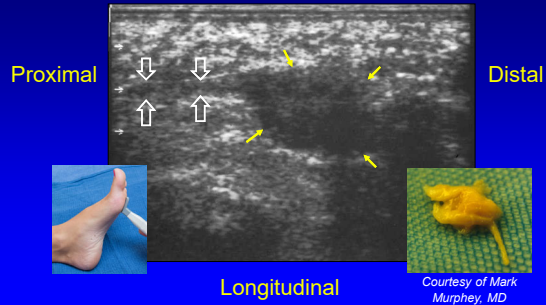


Transverse

Coronal T1w

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Morton Neuroma: nerve continuity



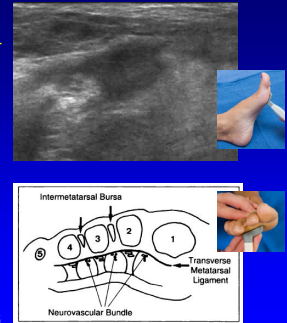
Longitudinal

Courtesy of Mark Murphey, MD

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Dynamic Evaluation

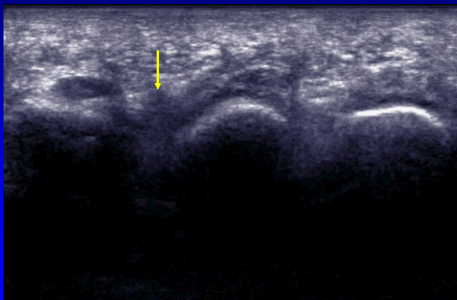
- Compression
 - Between transducer and palpation
 - Bursae (dorsal) compress, neuromas (plantar) do not
- Sonographic Mulder Sign
 - Scan plantar: coronal plane
 - Neuroma displaces: plantar
 - Palpable click



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

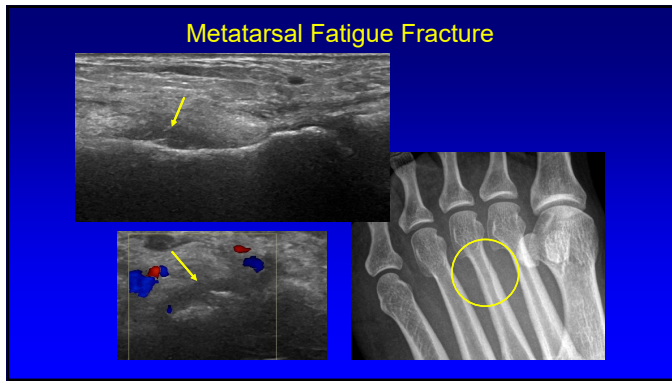


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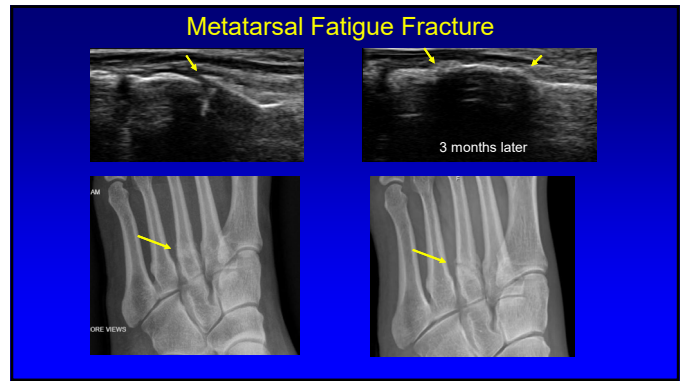
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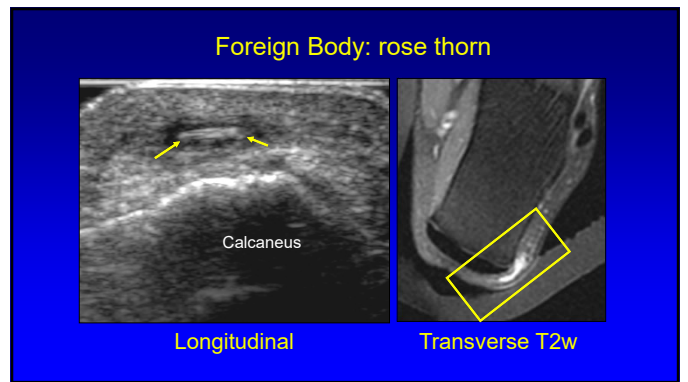
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Soft Tissue Foreign Bodies:

- All are initially hyperechoic by US
- Surrounding hypoechoic foreign body response improves conspicuity
- Flat & smooth: **reverberation**
- Irregular & small radius: **shadowing**

Jacobson, JA et al. Radiology 1998; 206:45

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Take Home Points

- Tendon, ligament, joint assessment
- Gout: specific findings
- **Dynamic imaging**
 - Peroneal subluxation
 - Achilles tear
 - Morton neuroma

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

Twitter handle: @jjacobsn

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