Ankle and Foot Ultrasound: Common Pathology

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Disclosures

- Book Royalties: Elsevier
- Consultant: Bioclinica
- Advisory Board: POCUSPRO
- Not relevant to this talk

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

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Outline

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

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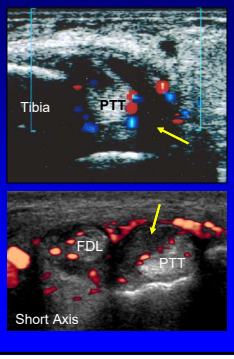
Tenosynovitis

- 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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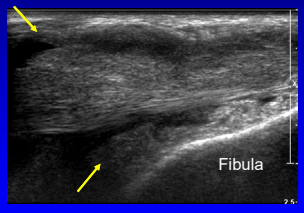
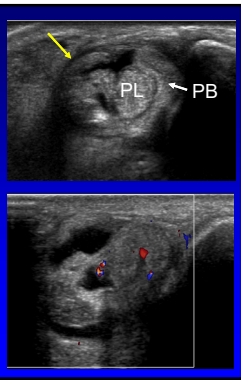
Tenosynovitis: peroneal tendons





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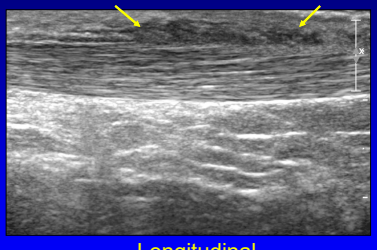
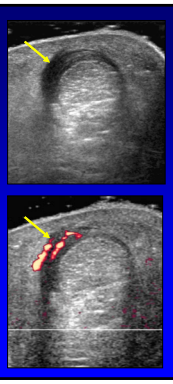
Paratenonitis: Achilles



Longitudinal



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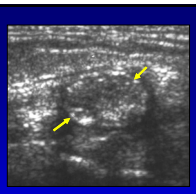
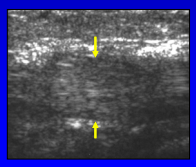
Tendinosis

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





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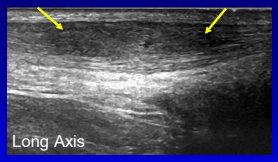
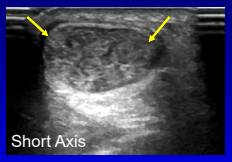
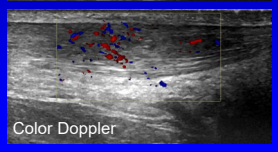
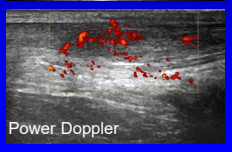
Tendinosis: Achilles









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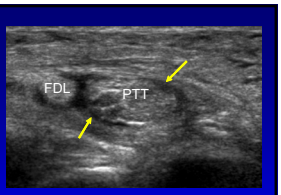
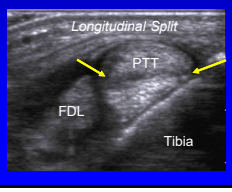
Partial Tear

- 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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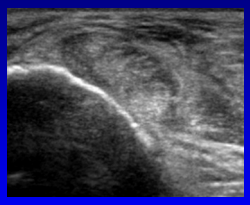
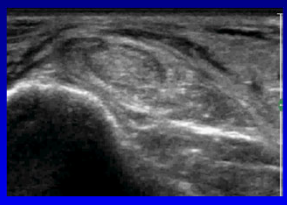
Peroneus Brevis Split Tear





Short Axis

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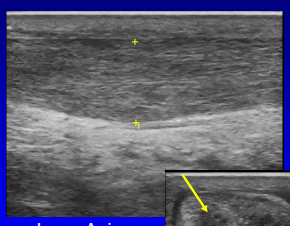
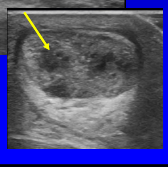
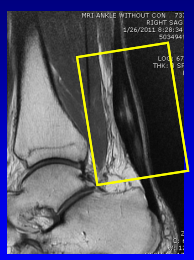
Achilles Tendon: partial-thickness tear



Long Axis





Courtesy of Jon Halperin, San Diego

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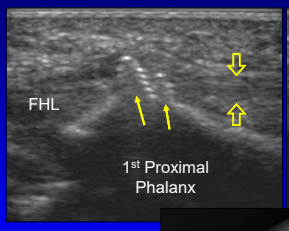
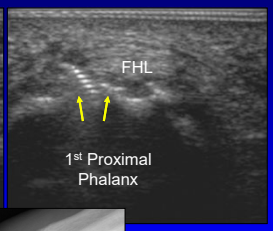
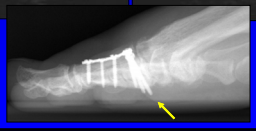
Flexor Hallucis: screws







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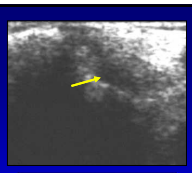
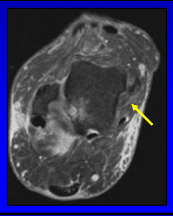
Full-thickness Tear

- 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% accuracy[1]
- 60 peroneal tendons: surgery
  - US: 100% sensitivity, 90% accuracy[2]

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

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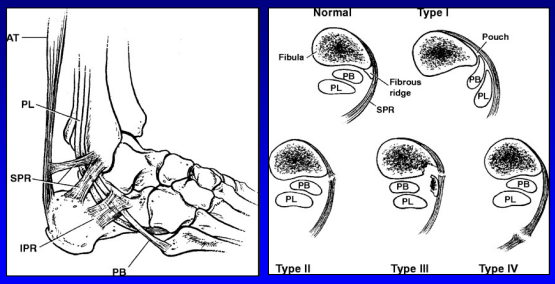
Peroneal Retinaculum



Rosenberg et al. AJR 2003; 181:1551

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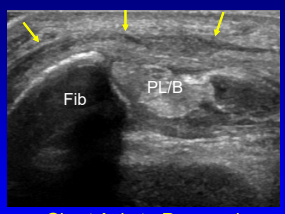
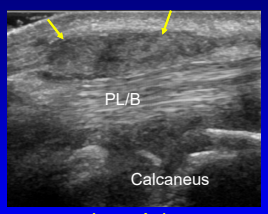
Superior Peroneal Retinaculum Injury



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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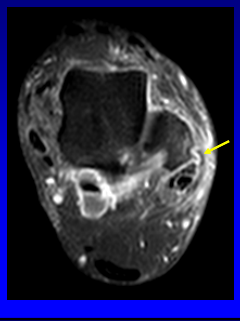
Superior Retinaculum Avulsion (+ PB split)



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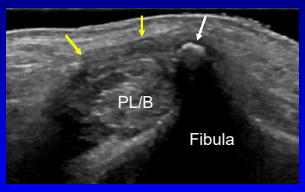
Superior Peroneal Retinaculum Avulsion



Short Axis to
Peroneal Tendons

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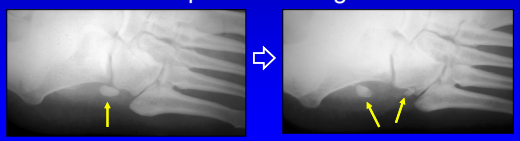
Os Peroneum Fracture:

- Interval fragmentation or fracture
- Contraction + compression on cuboid
- Separation: > 6 mm (unlike bipartite)
- Associated: peroneus longus tear



Kalume-Brigido et al. 2007; Radiology 2005; 237:235.

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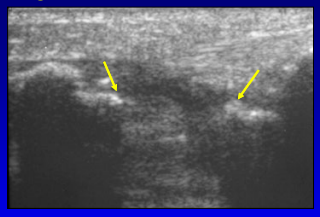
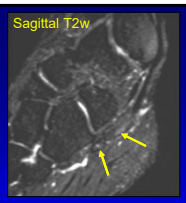
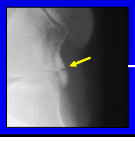
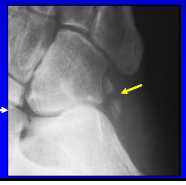
Os Peroneum Fracture









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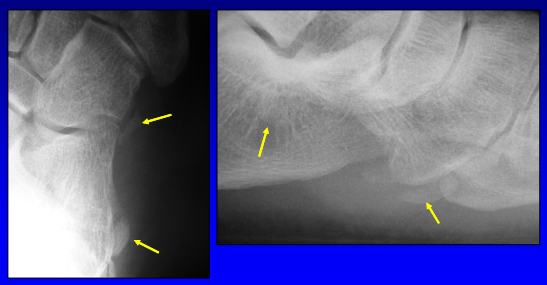
Os Peroneum Fracture



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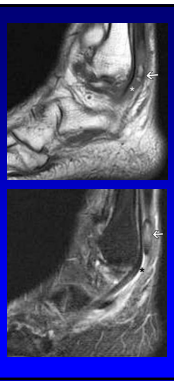
Os Peroneum Fracture



From: Kalume-Brigido et al. 2007; Radiology 2005; 237:235

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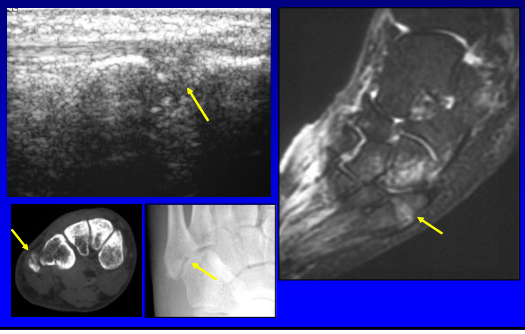
Avulsion: peroneus brevis / aponeurosis



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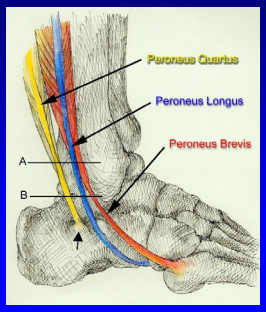
Peroneus Quartus

- Accessory tendon: in 22%
- Origin: peroneus brevis muscle
- Insertion: retrotrochlear eminence of calcaneus
- Can simulate peroneus brevis split tear
- Can cause tear

*Radiology 2001; 218:415



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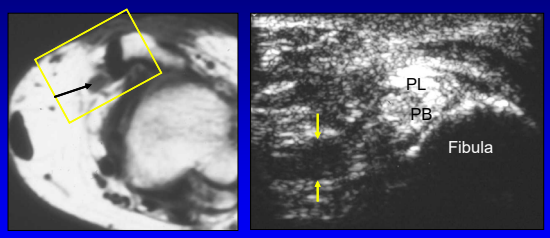
Peroneus Quartus



Transverse

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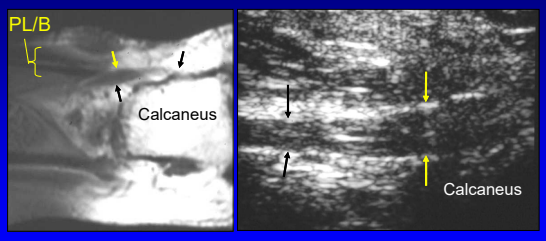
Peroneus Quartus



Longitudinal

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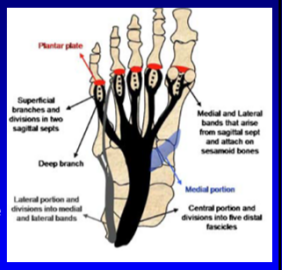
Plantar Fascia

- 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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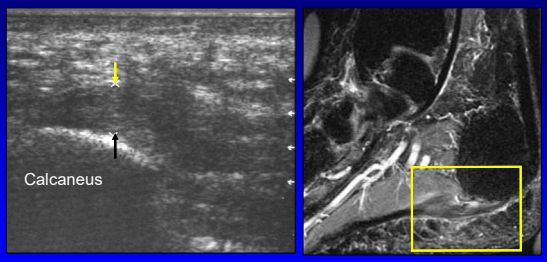
Plantar Fasciopathy



Long Axis Sagittal T2w

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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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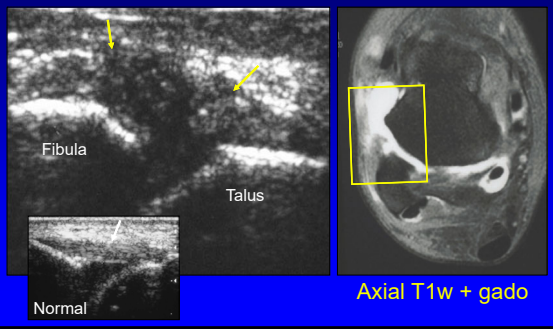
Anterior Talofibular Ligament Tear



Axial T1w + gado

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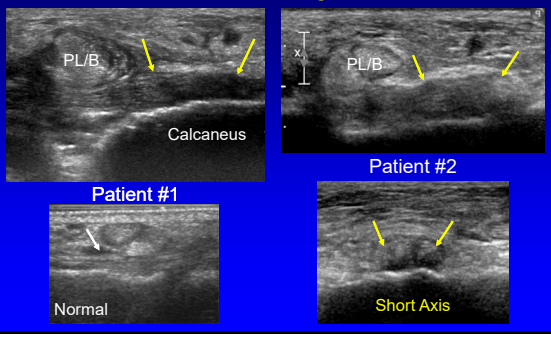
Calcaneofibular Ligament Tear



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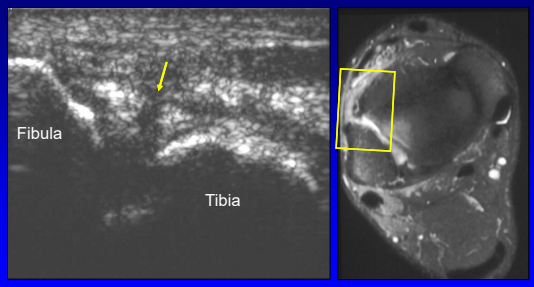
Anterior Inferior Tibiofibular Ligament Tear



Longitudinal | Axial T2w

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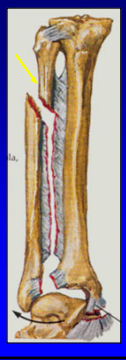
Ligament Tear:

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



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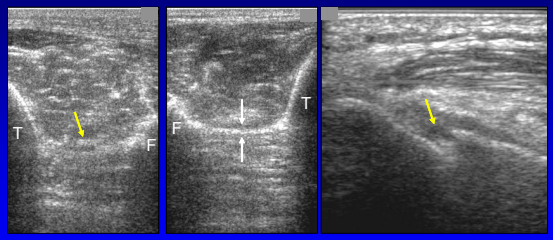
Maisonneuve Fracture



Transverse | Normal | Fibular Fracture

Durkee, J Ultrasound Med 2003; 22:1369

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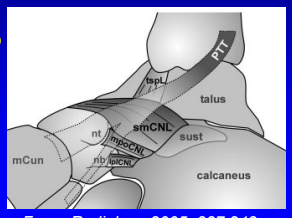
Spring Ligament Complex

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



From: Radiology 2005; 237:242

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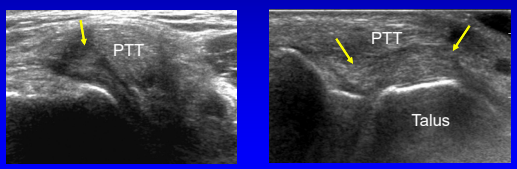
Superomedial Calcaneonavicular Ligament

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



Harish, J Ultrasound Med 2008; 27:1145

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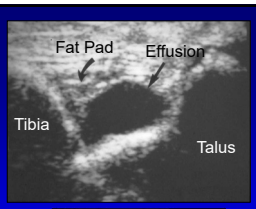
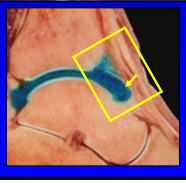
Tibiotalar Joint: *effusion*

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

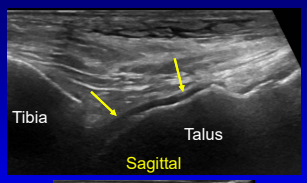
Jacobson, JA et al. AJR 1998; 170:1231

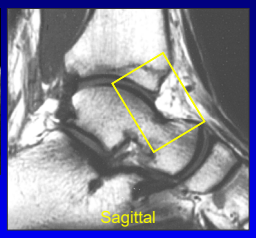


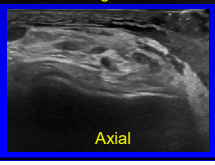


43

Pitfall: normal hyaline cartilage







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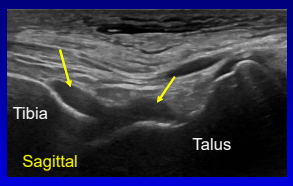
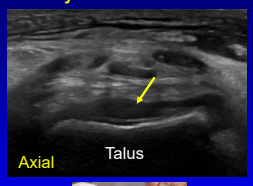
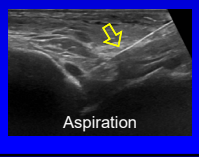
Effusion: tibiotalar joint





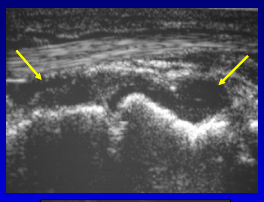


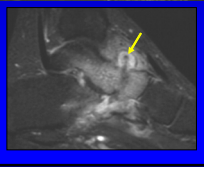
45

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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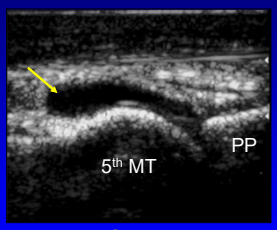
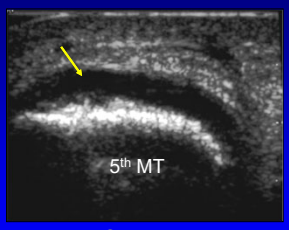
5th Metatarsal Phalangeal Joint: septic



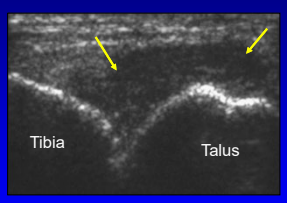
Sagittal



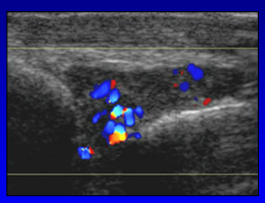
Coronal

47

Synovitis: color flow



RA Ankle
No flow



RA ankle
Positive flow

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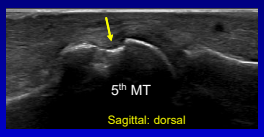
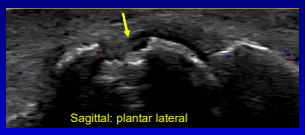
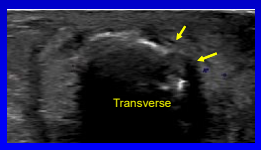
Rheumatoid Arthritis







- 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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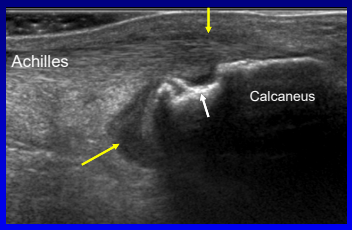
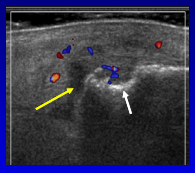
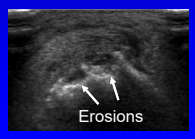
Bursitis and Erosion: Rheumatoid Arthritis







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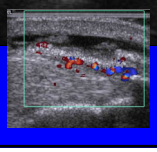
Haglund Syndrome



Long Axis

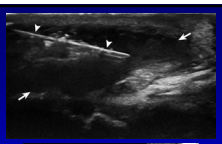
Short Axis

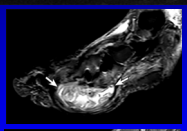
51

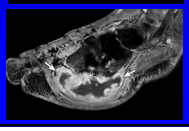
Adventitious Bursa

- Site of friction, pressure
- Connective tissue degeneration
- Fibrous tissue: 84% asymptomatic volunteers
- Subcutaneous cavity: RA
- Fat pads plantar to MT heads

Studler U et al. Radiology 2008; 246:863







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Gout:

- Joint effusion / synovial hypertrophy
- Double contour sign:
  - Monosodium urate crystal icing on cartilage
- Tophi:
  - Hyperechoic with hypoechoic rim
- Erosions:
  - Adjacent to tophi
  - Medial 1st metatarsal head

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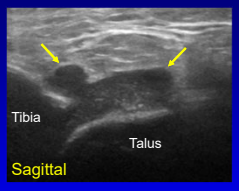
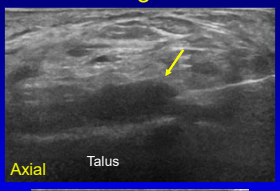
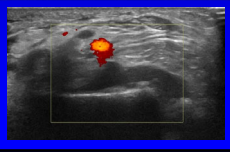
Tibiotalar Joint Effusion: gout







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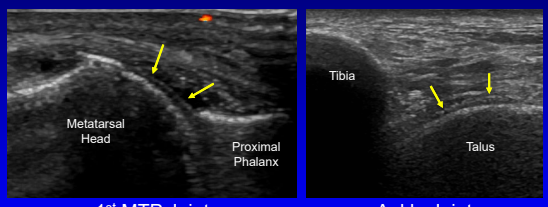
Gout: Double Contour Sign



1st MTP Joint Ankle Joint

*Disappears with serum urate < 6 ml/dl

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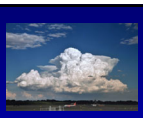
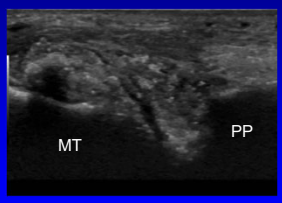
Tophi

- Hyperechoic heterogeneous with hypoechoic rim
- Tiny internal speckles*
- "wet clump of sugar" appearance
- Variable shadowing: even without calcification





Fernandes et al. Skeletal Radiol 2011; 40:309

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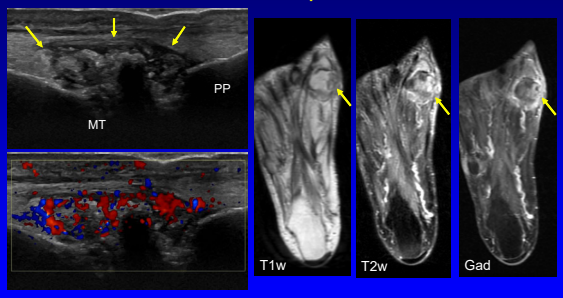
Gout: tophus



1st Metatarsophalangeal Joint

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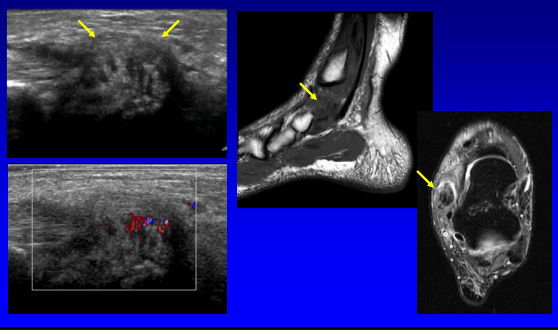
Gout: tibialis posterior tendon



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Outline

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

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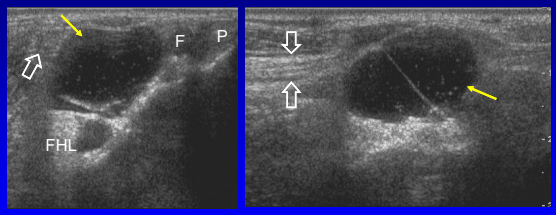
Soft Tissue Ganglion

- Well-defined, lobular
- Often multilocular
- Hypoechoic to anechoic
- Increased through-transmission
- Joint or tendon sheath communication
- US-guided aspiration / fenestration

60

Ganglion: tarsal tunnel syndrome



Axial Sagittal

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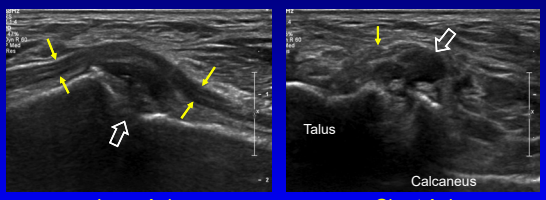
Ganglion: tarsal tunnel syndrome



Long Axis Short Axis

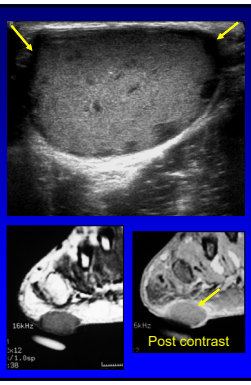
Medial plantar nerve impingement from ganglion cyst originating from middle facet of anterior subtalar joint

62

Epidermal Inclusion Cyst

- Etiology: implantation of epithelium, congenital, squamous metaplasia, hair follicle obstruction
- US findings:
  - Low level echoes and hypoechoic halo
  - Through transmission
  - Hypoechoic clefts
  - Periscope sign: extension to skin

Kim et al. Skeletal Radiol 2011; 40:1415



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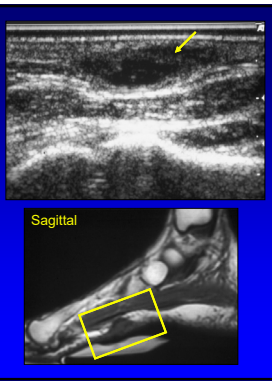
Plantar Fibromatosis

- Benign fibrous proliferation
- Multiple: 33%, bilateral: 20 – 50%
- Hypoechoic mass or masses
- Plantar aponeurosis
- Variable vascularity

Griffith JF et al. AJR 2002; 179:1167



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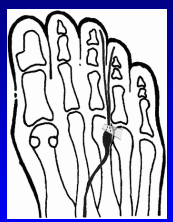
Morton Neuroma

- Interdigital 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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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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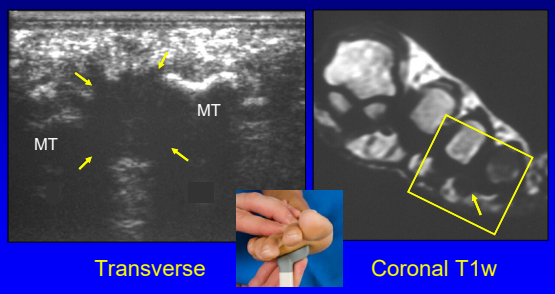
Morton Neuroma



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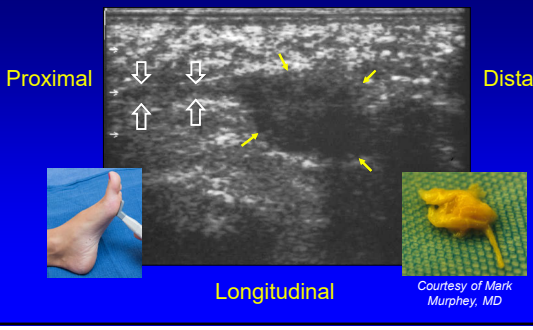
Morton Neuroma: nerve continuity



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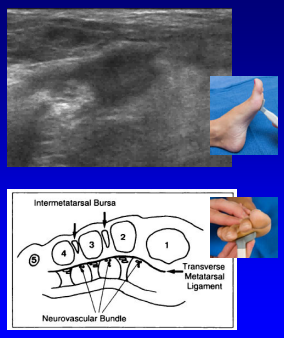
Dynamic Evaluation

- 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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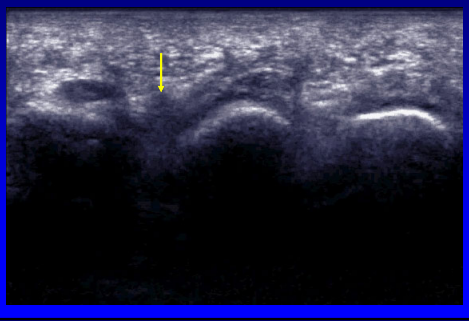
Dynamic imaging: Mulder's Maneuver



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Outline

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

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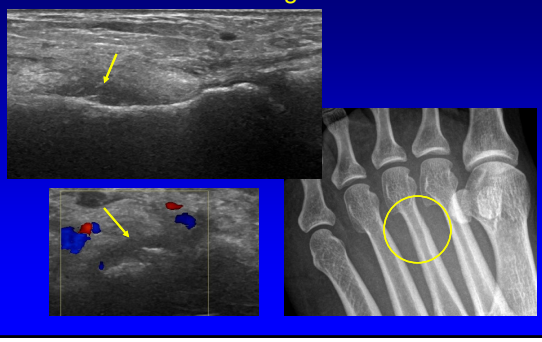
Metatarsal Fatigue Fracture



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Metatarsal Fatigue Fracture

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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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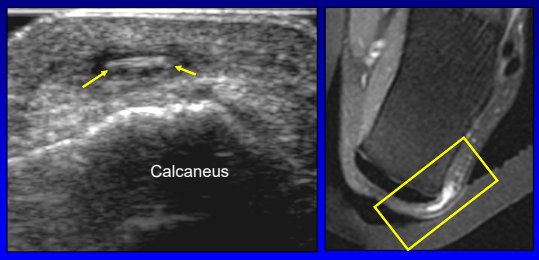
Foreign Body: rose thorn



Longitudinal Transverse T2w

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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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Thank you!

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

Twitter handle: @jjacobsn

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