

Ultrasound Evaluation of Ankle and Foot Pathology

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Disclosures

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

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Fundamentals of Musculoskeletal Ultrasound are
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Outline:

- Tendon Pathology
- Ligament Pathology
- Inflammation
- Masses

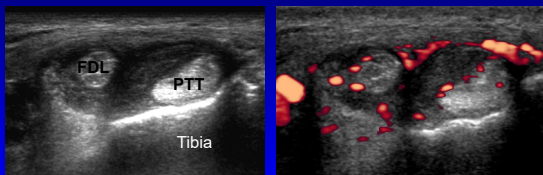
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Tenosynovitis: US

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

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Tenosynovitis: ankylosing spondylitis



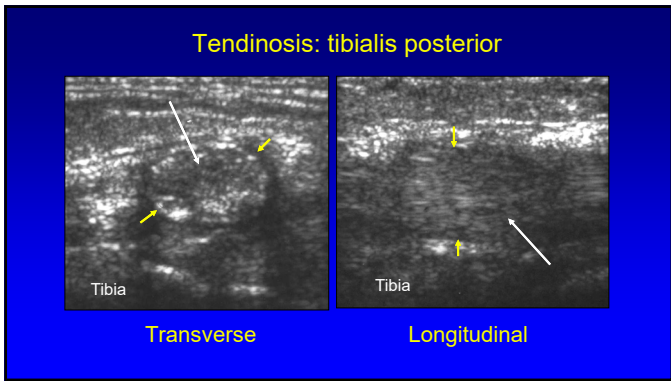
Short Axis

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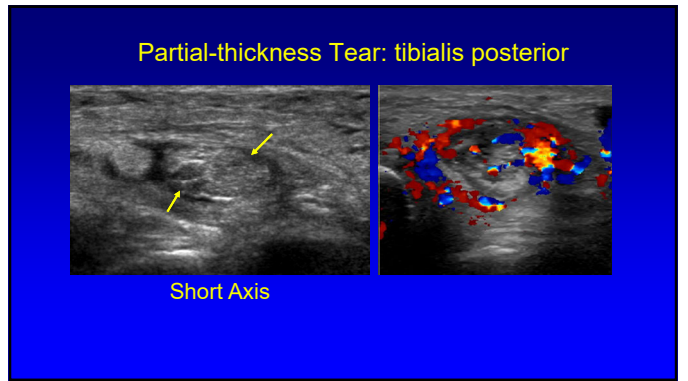
Tendinosis

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

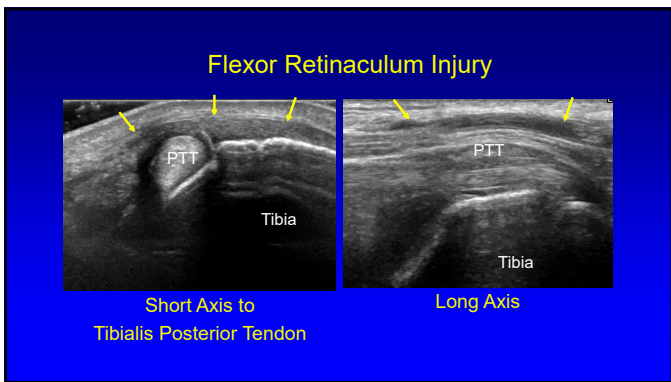
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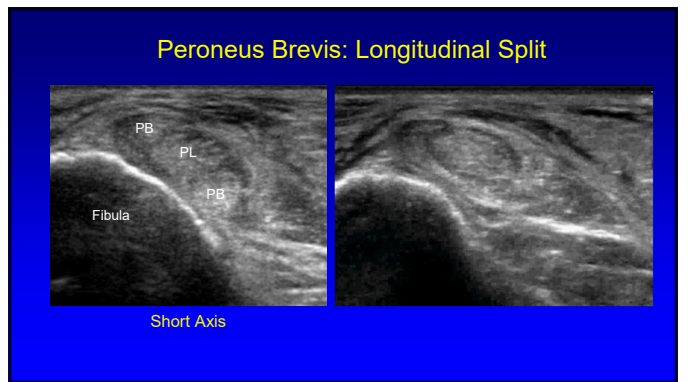
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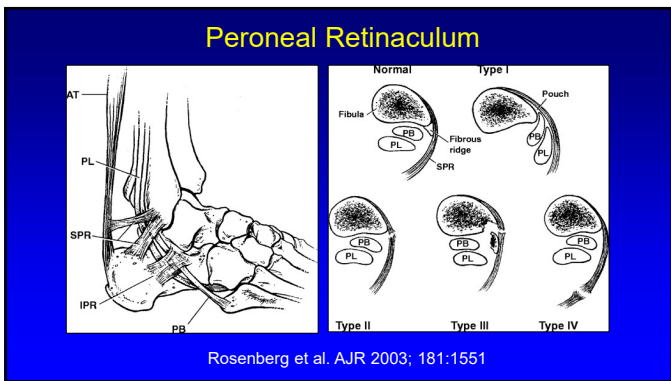
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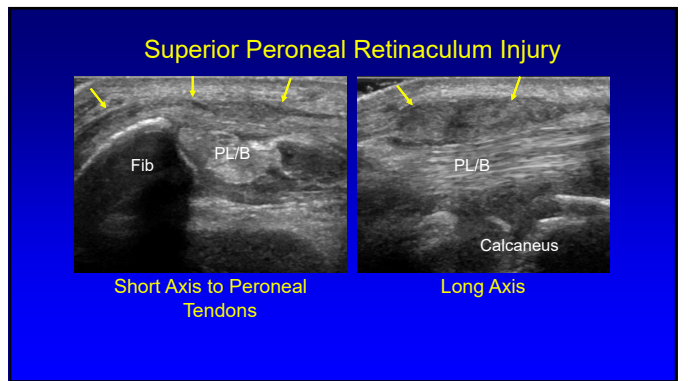
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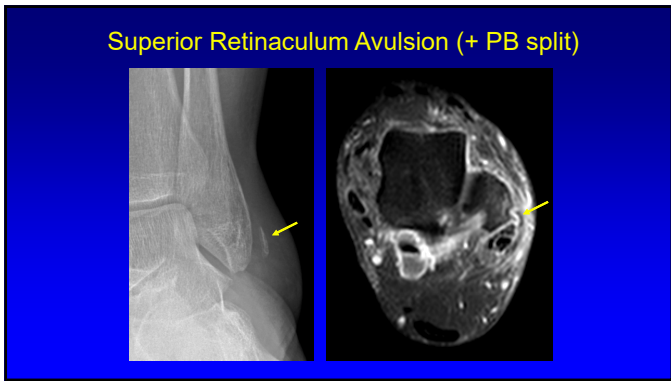
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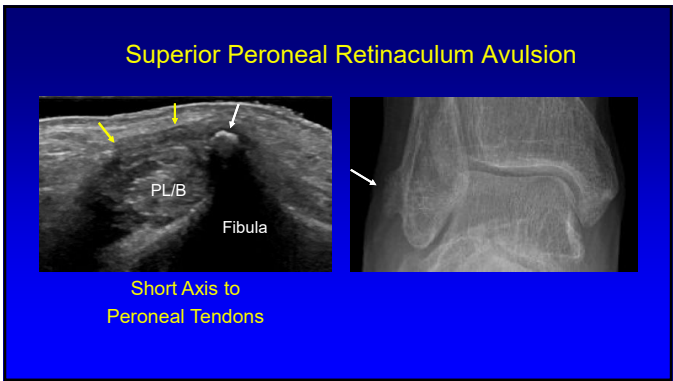
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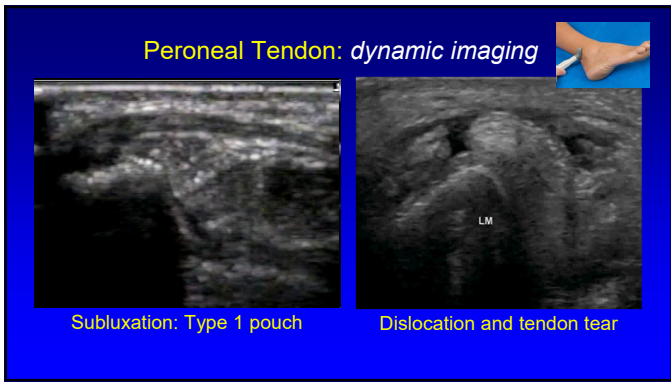
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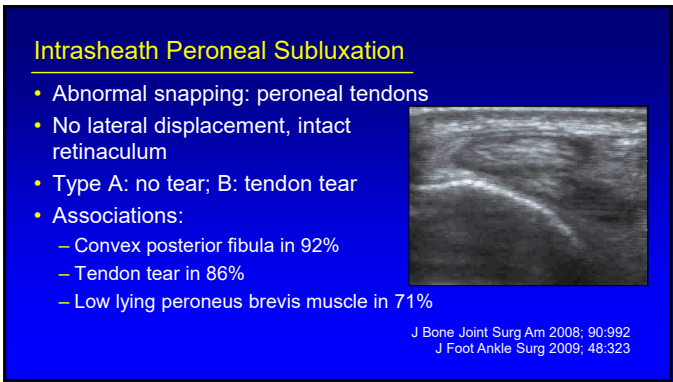
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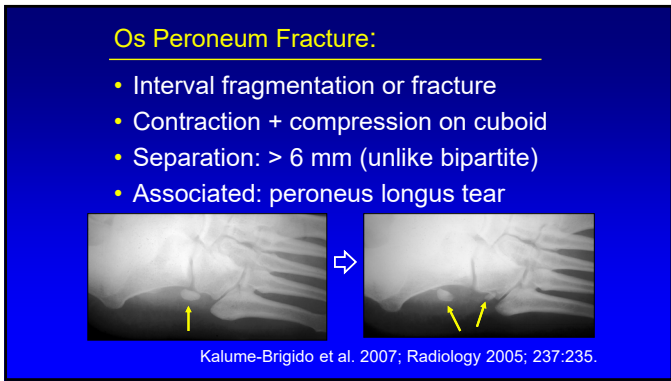
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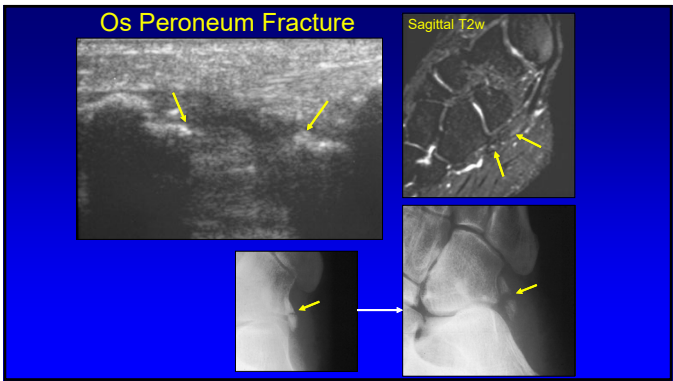
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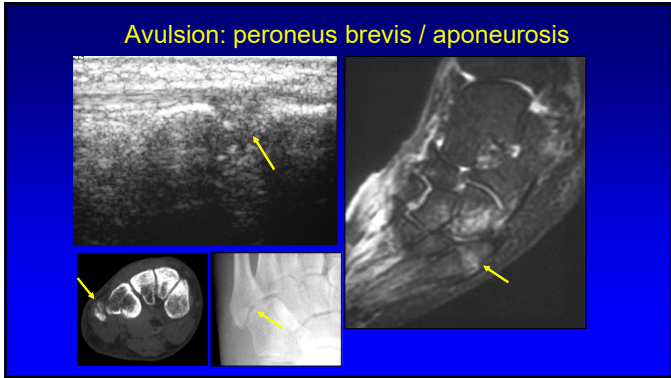
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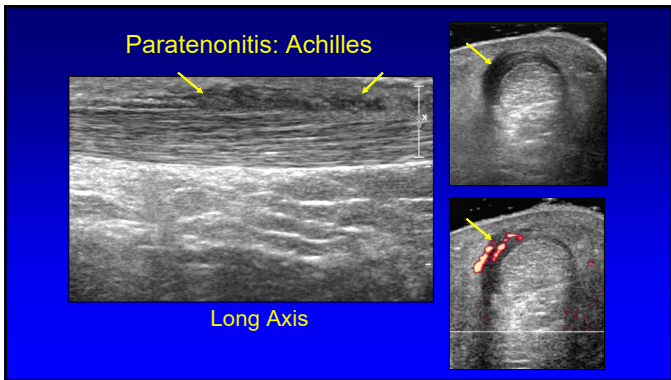
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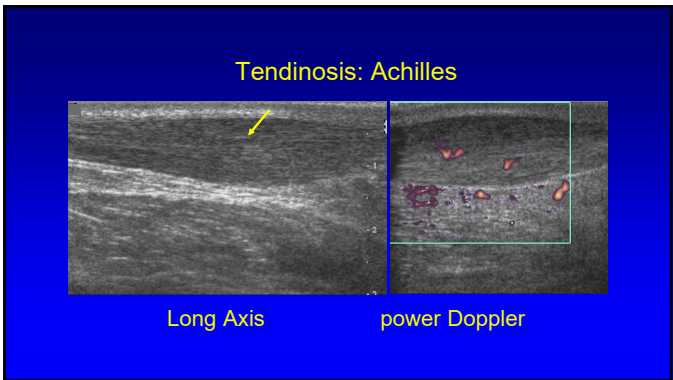
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- Achilles Tendon:**
- 2 – 6 cm proximal to insertion
 - Tendinosis
 - Full-thickness tear
 - Calcaneal attachment
 - Tendinosis, tear
 - Haglund Syndrome

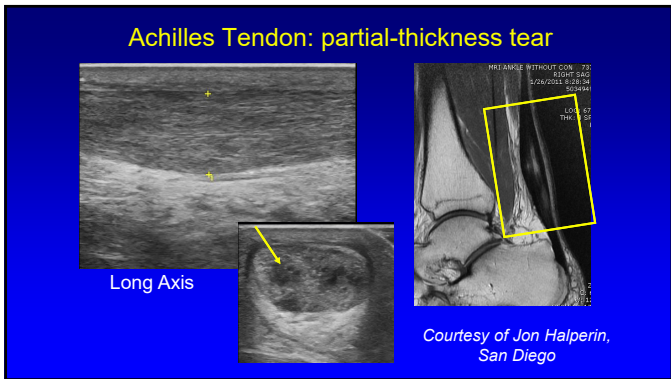
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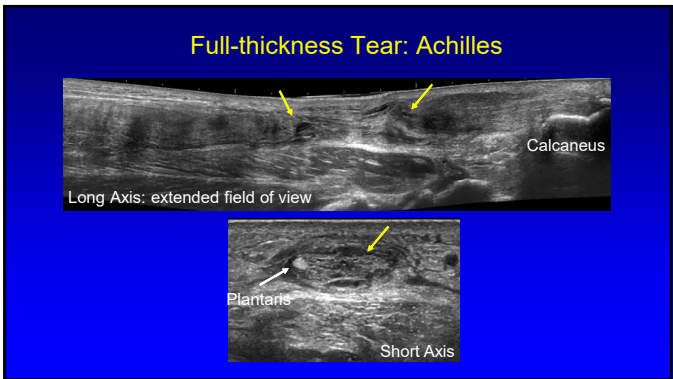
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Achilles Tendon: *complete tear*

- 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

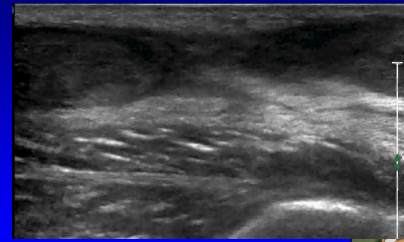


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Achilles Tendon: *healing tear*

Prox

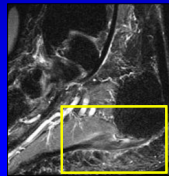
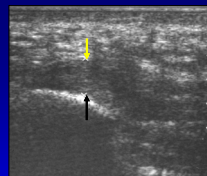
Distal



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Plantar Fascia

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



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

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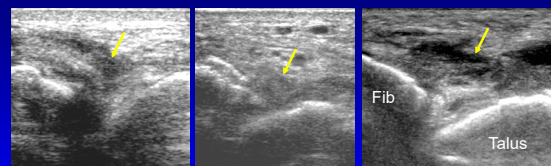
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Ligament Tear:

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

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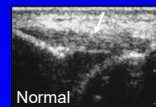
Anterior Talofibular Ligament Tear



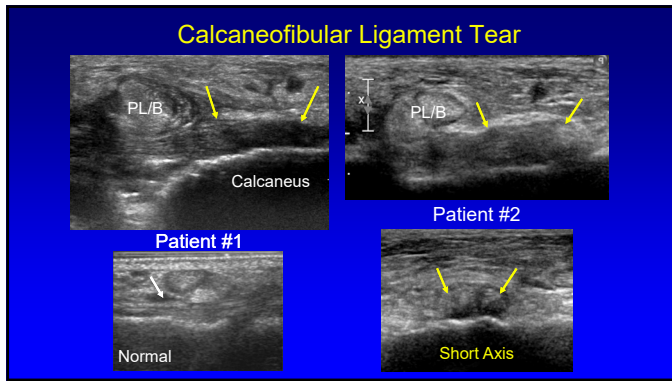
Patient #1

Patient #2

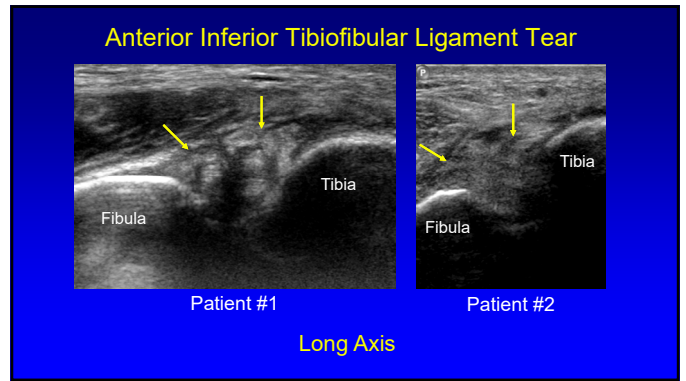
Patient #3



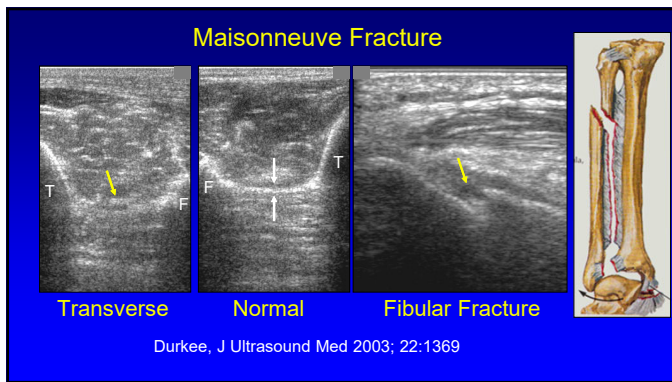
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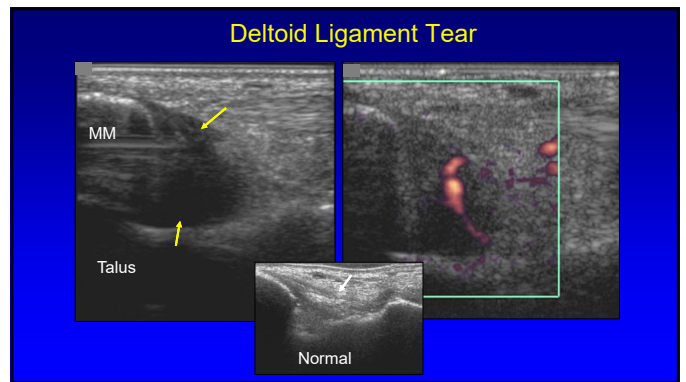
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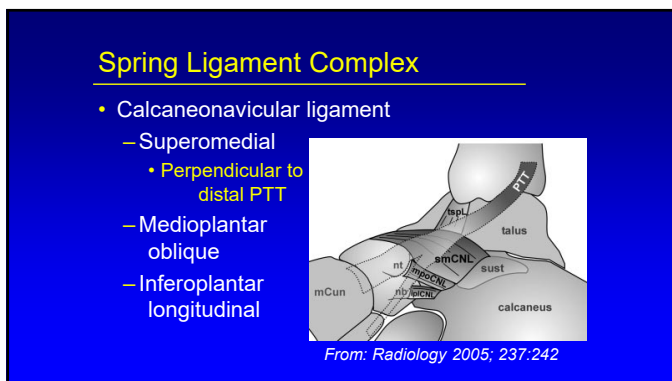
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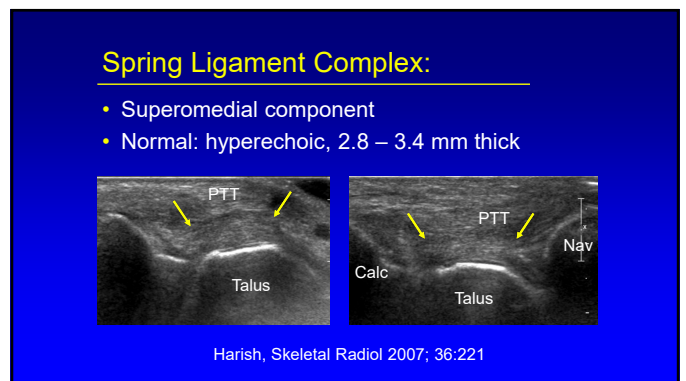
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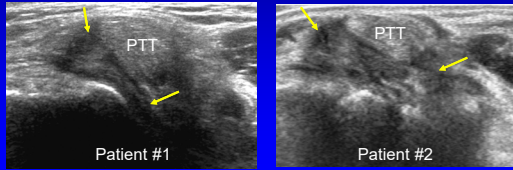
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Superomedial Calcaneonavicular Ligament

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



Harish, J Ultrasound Med 2008; 27:1145

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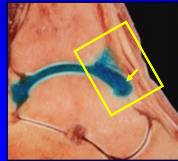
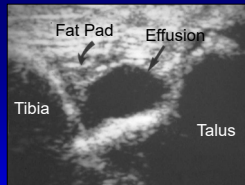
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Tibiotalar Joint: *effusion*

- 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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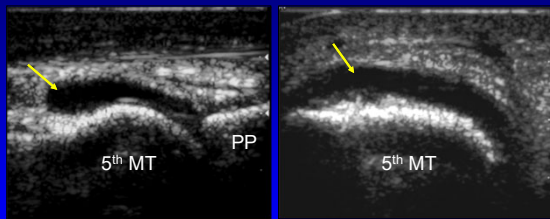
Septic Joint:

- 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

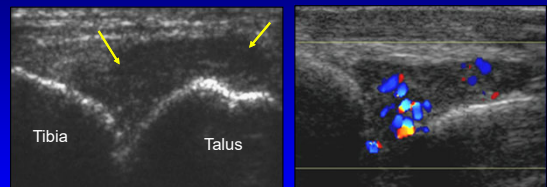


Sagittal

Coronal

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Synovitis: color flow



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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Bursitis and Erosion: Rheumatoid Arthritis

Achilles
Calcaneus
Erosions

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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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Tophi

MT PP

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

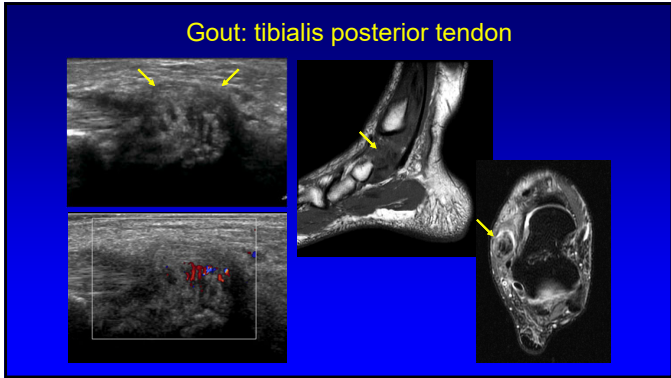
Fernandes et al. Skeletal Radiol 2011; 40:309

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Gout: Double Contour Sign

Metatarsal Head
Proximal Phalanx
1st MTP Joint
Tibia
Talus
Ankle Joint

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Outline:

- Tendon Pathology
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- Inflammation
- **Masses**

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Soft Tissue Ganglion

- Hypoechoic or anechoic
- Multilocular
- Non-compressible
- Possible increased through-transmission
- Joint or tendon sheath communication

Ortega et al. AJR 2002; 178:1445

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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

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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

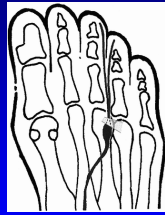
Griffith JF et al. AJR 2002; 179:1167

Sagittal

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Intermetatarsal 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

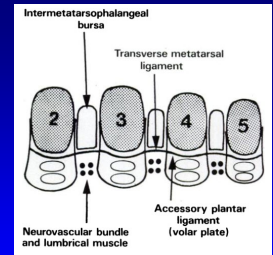


From: Martinoli, RadioGraphics 2000; 20:S199

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Anatomy

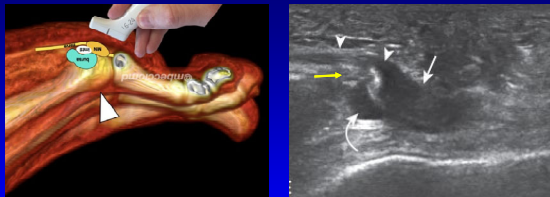
- At level of metatarsal heads:
 - Transverse metatarsal ligament
 - Attaches to plantar plates
 - Intermetatarsal bursa: dorsal
 - Neurovascular bundle: plantar



Zanetti M et al. Radiology 2014; 203:516

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Intermetatarsal Neuroma



Note: neuroma is at distal edge of intermetatarsal ligament
 White arrow: neuroma
 Arrowheads: interdigital nerve
 Curved arrow: intermetatarsal bursa
 Yellow arrow: intermetatarsal ligament

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Intermetatarsal Neuroma

- Hypoechoic 5 mm mass
 - Sensitivity: 100% ; Specificity: 83%
 - Accuracy equal to MRI
 - <5 mm: asymptomatic
- Intermetatarsal bursa
 - Associated with neuroma
 - “Neuroma-bursal complex”

Quinn T et al. AJR 2000; 174:1723
 Bignotti B et al. Eur Radiol 2015; 25:2254
 Cohen SL et al. J Ultrasound Med 2016; 25:3191

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Ultrasound Evaluation

- #1: plantar, short axis
 - With dorsal compression
- #2: plantar, long axis
 - With dorsal compression
- #3: Mulder maneuver
 - With side-to-side compression



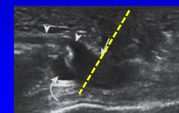
*Neuroma of 5 mm or larger: 100% sensitivity, 83% specificity

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

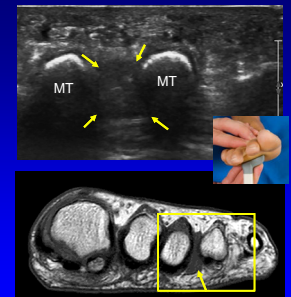
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Step #1

- Plantar, short axis
- Dorsal compression
- Neuroma: more plantar
- Bursa: dorsal, anechoic, compressible



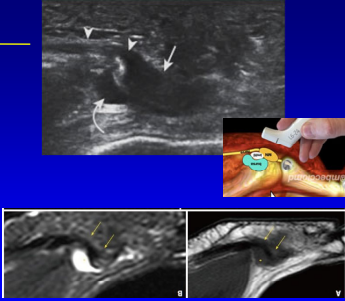
Note: coronal-oblique plane moving distal to metatarsal heads



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Step #2

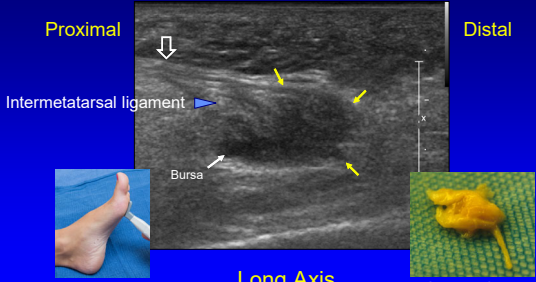
- Plantar, long axis
 - Follow MT head curvature
- Dorsal compression
 - Move finger distal, proximal
 - See neuroma sliding over intermetatarsal ligament
- Neuroma: plantar, distal
- Bursa: curved arrow
 - Dorsal, proximal
 - Anechoic, compressible



MRI flipped upside down to simulate US

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Neuroma: nerve continuity (white open arrow)



Proximal Distal

Intermetatarsal ligament

Bursa


Long Axis

Courtesy of Mark Murphey, MD

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Step #3: Mulder's maneuver

- Transducer: plantar, short axis
- Squeeze foot side-to-side
- Neuroma moves plantar
 - Palpable click, elicits symptoms
 - Important to document
 - Improved accuracy, measurements
- Make sure to perform distal to intermetatarsal ligament
- Bursa: remains dorsal

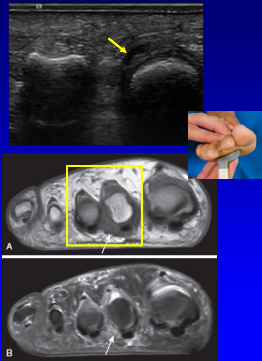


Torriani M et al. AJR 2003; 180:1121

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Differential Diagnosis

- Pericapsular fibrosis
- Associated with capsule injury
- Hypoechoic
- Eccentric
- Not truly intermetatarsal
- Negative Mulder's maneuver



Umans H et al. Skeletal Radiol 2014

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Take Home Points

- Tendons:
 - Tenosynovitis, tendinosis, partial tear, longitudinal split, complete tear
- If concern for infection: aspirate
- Gout: specific findings
- Dynamic imaging
 - Peroneal subluxation
 - Achilles tear
 - Interdigital neuroma

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Thank you!



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



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