

Interdigital Neuroma and Forefoot: Ultrasound Evaluation

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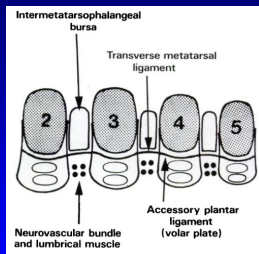
Outline

- Interdigital neuroma
- Plantar plate
- Fracture
- Infection and Inflammation
- Tumors and Tumor-like Abnormalities

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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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Interdigital Neuroma

- Common plantar digital nerve entrapment
- Edema, fibrosis, necrosis
- 3rd intermetatarsal space > 2nd
- Sharp, burning pain to toes
- Females: pliable foot, high-heeled, narrow-toed shoes
- Asymptomatic neuromas in up to 33%
- Neuromas < 5 mm mediolateral: **often asymptomatic**



Zanetti M et al. Radiology 1997; 203:516

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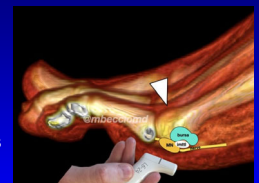
Neuromas: eponyms

- Medial to first metatarsal: Joplin
- 1st webspace: Heuter
- 2nd webspace: Hauser
- 3rd webspace: **Morton**
- 4th webspace: Iselin

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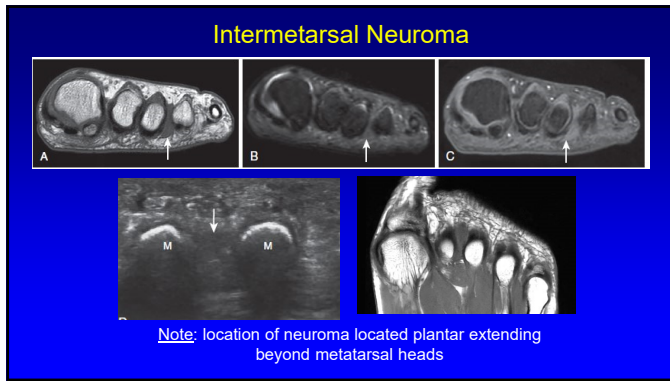
Interdigital Nerve

- Pathophysiology:
 - Neuroma forms where common plantar digital nerve passes distal around transverse metatarsal ligament at distal metatarsal heads
 - **Note:** intermetatarsal bursa is more dorsal and more proximal at level of intermetatarsal ligament

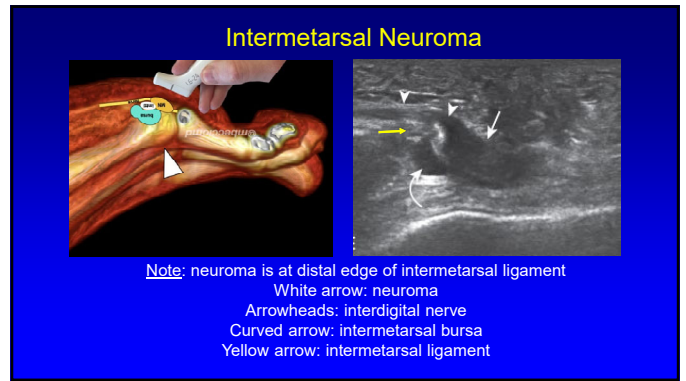


From: youtube @mbecciomd

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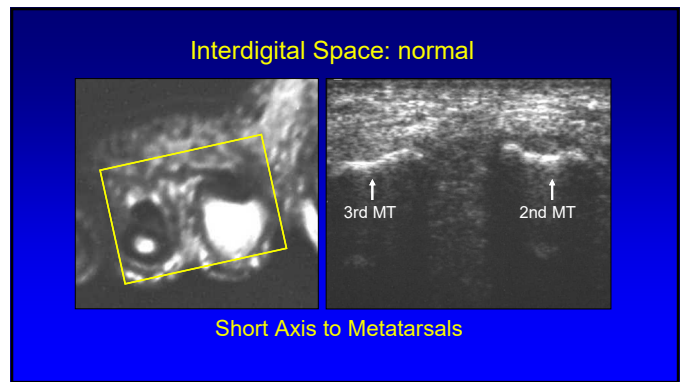
Ultrasound Evaluation

- #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

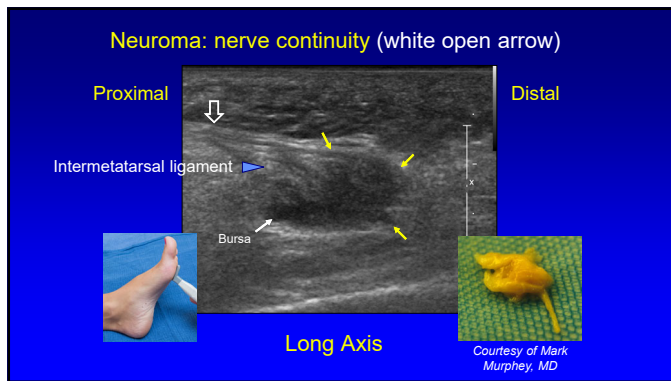
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Step #2

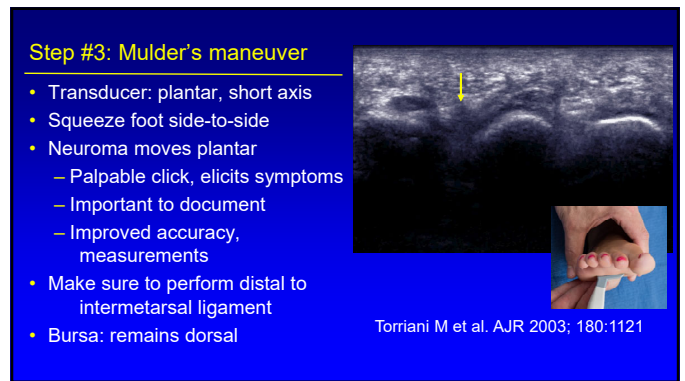
- Plantar, long axis
 - Follow MT head curvature
- Dorsal compression
 - Move finger distal, proximal
 - See neuroma sliding over intermetatarsal ligament
- Neuroma: plantar, distal
- Bursa: curved arrow
 - Dorsal, proximal
 - Anechoic, compressible

MRI flipped upside down to simulate US

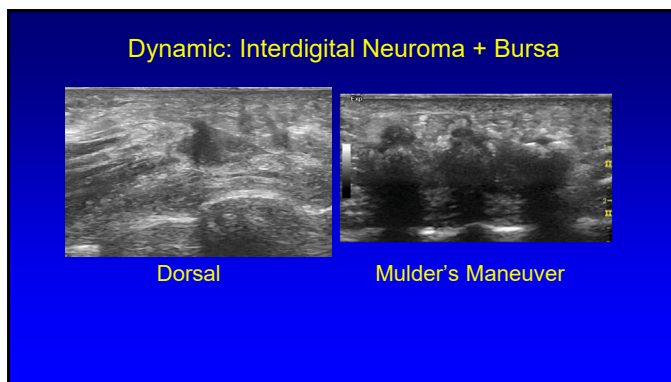
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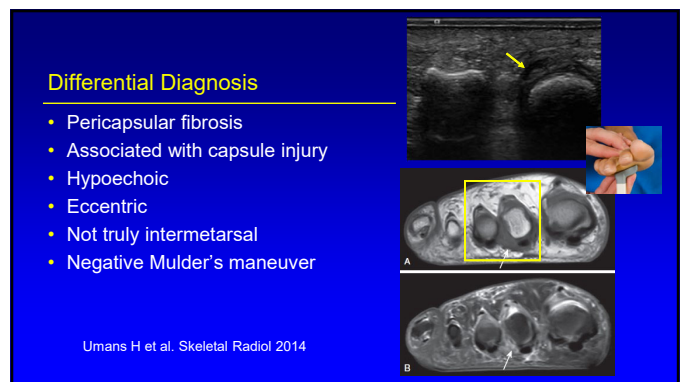
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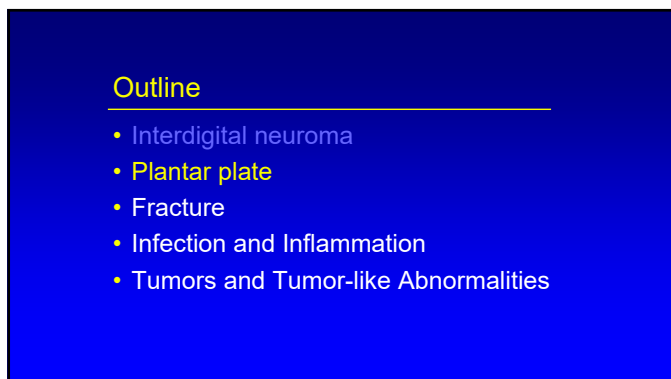
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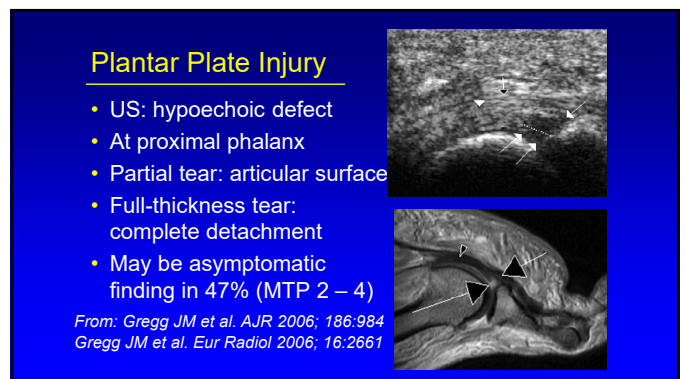
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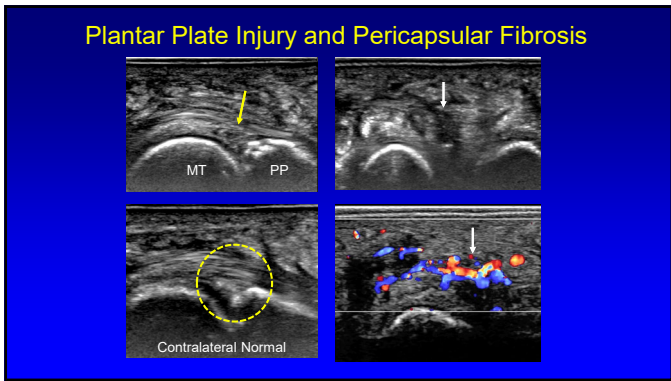
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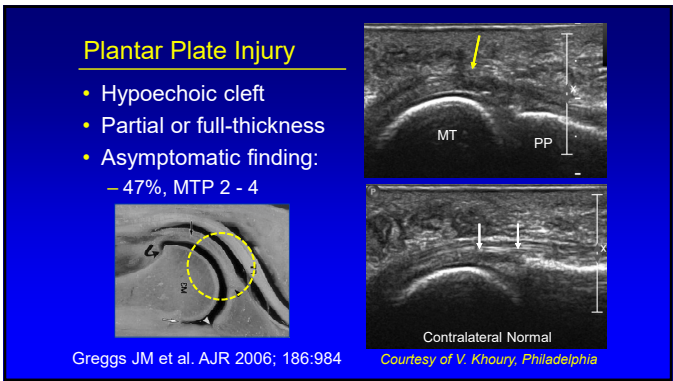
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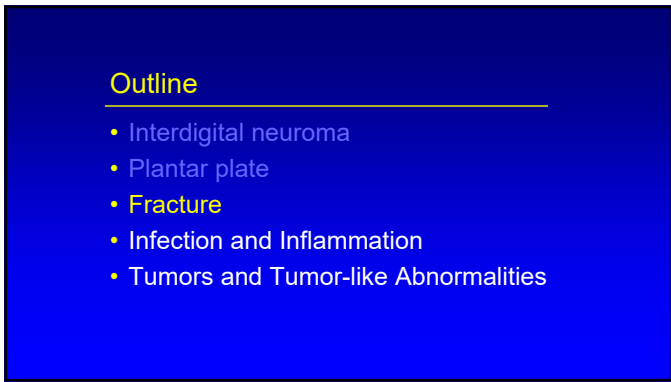
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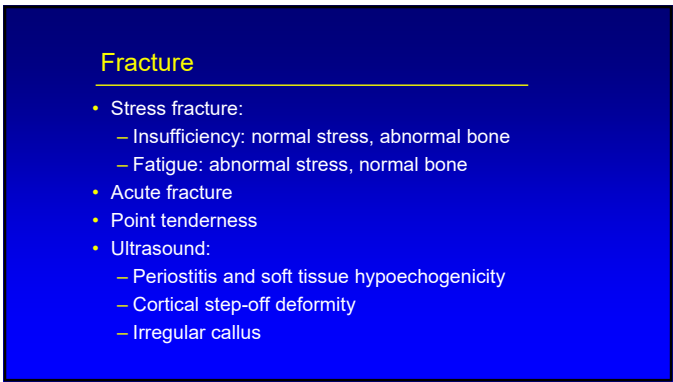
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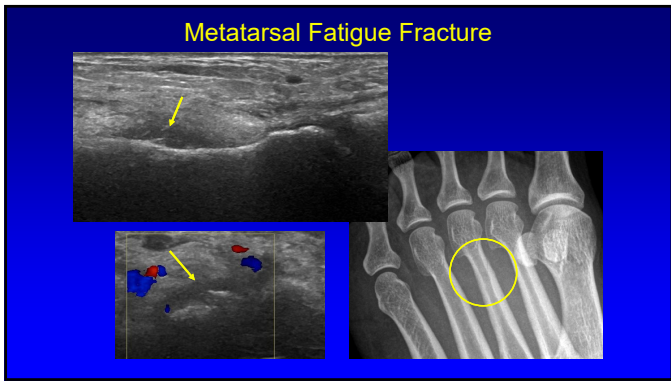
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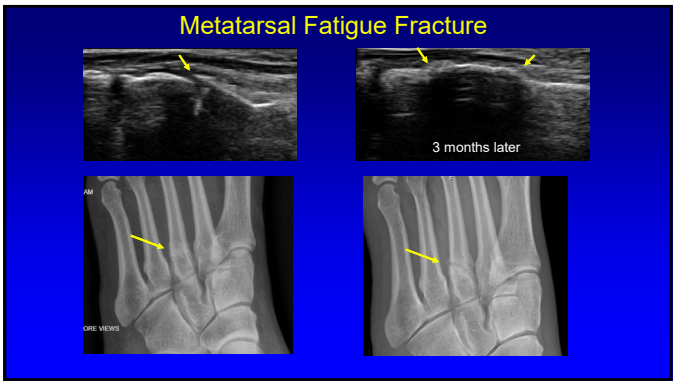
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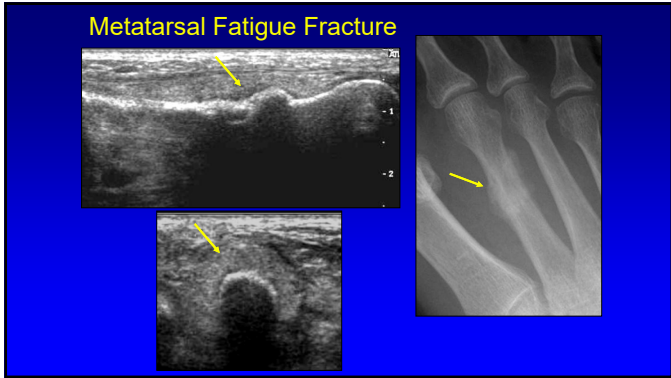
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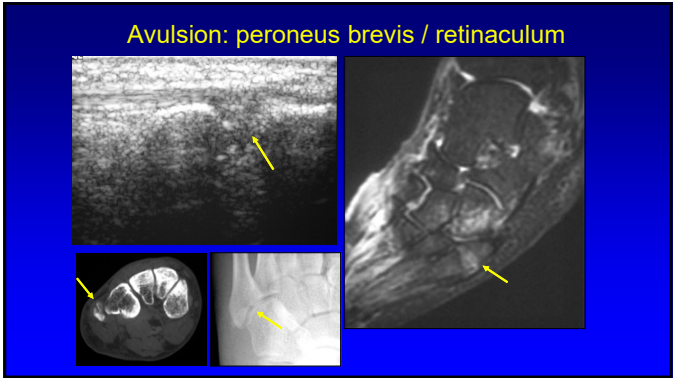
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- ### Outline
- Interdigital neuroma
 - Plantar plate
 - Fracture
 - **Infection and Inflammation**
 - Tumors and Tumor-like Abnormalities

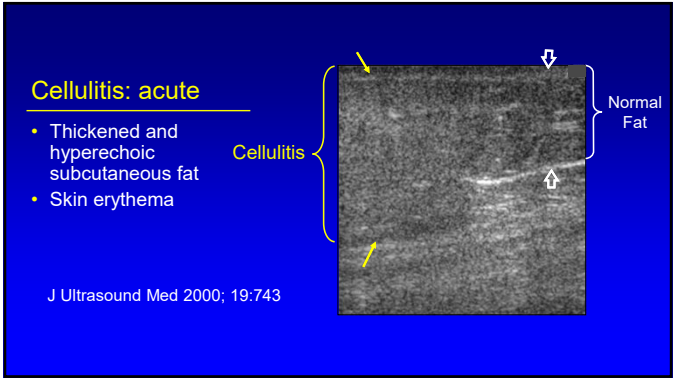
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- ### Infection and Inflammation:
- Infection:
 - Cellulitis, tenosynovitis, septic joint
 - Osteomyelitis
 - Inflammatory arthritis:
 - Rheumatoid arthritis
 - Spondyloarthritis
 - Gout

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- ### Infection: *predicted by route*
- Direct spread:
 - Ulceration (diabetic), penetrating injury
 - Osteomyelitis, tenosynovitis
 - Hematogenous spread:
 - Septic joint, osteomyelitis
 - Children, intravenous drug users

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Cellulitis: chronic

- Anechoic channels
- Distended lymphatics
- May appear similar to simple edema
- Not defined like an abscess
- Lower leg: look for popliteal cyst rupture

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Soft Tissue Abscess

- Anechoic or hypoechoic
 - less likely hyperechoic
- Posterior acoustic enhancement
- Swirling of contents with transducer pressure
- Hyperemia

AJR 1996; 166:149

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Abscess: forefoot

Sagittal T1w

Coronal post-gado

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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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Septic Joint: talonavicular

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5th Metatarsal Phalangeal Joint: septic

5th MT PP

5th MT

Sagittal Coronal

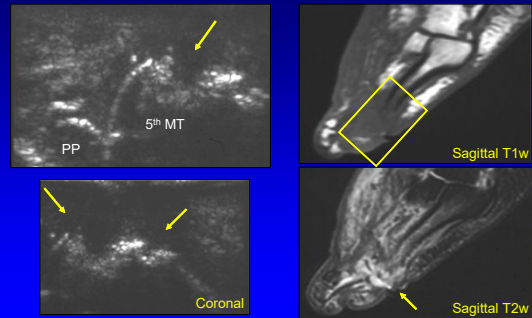
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Osteomyelitis:

- Direct spread:
 - Soft tissue cellulitis / abscess
 - Extension to bone
 - Cortical irregularity, destruction
- Hematogenous:
 - Periostitis: especially children
 - Bone destruction

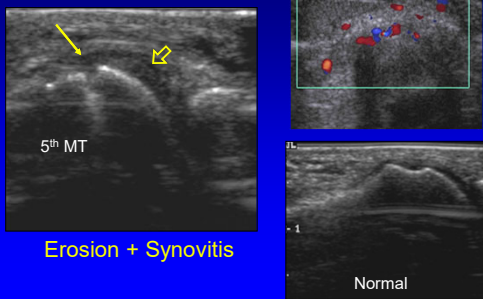
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Osteomyelitis: 5th metatarsal



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Rheumatoid Arthritis



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Gout:

- Monosodium urate crystals:
 - Negative birefringence
- Stages:
 - Asymptomatic hyperuricemia
 - Acute gouty arthritis
 - Interval asymptomatic phase
 - Chronic tophaceous gout

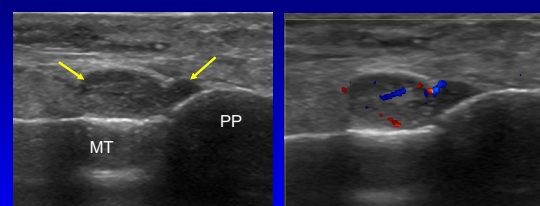
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Gout:

- 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

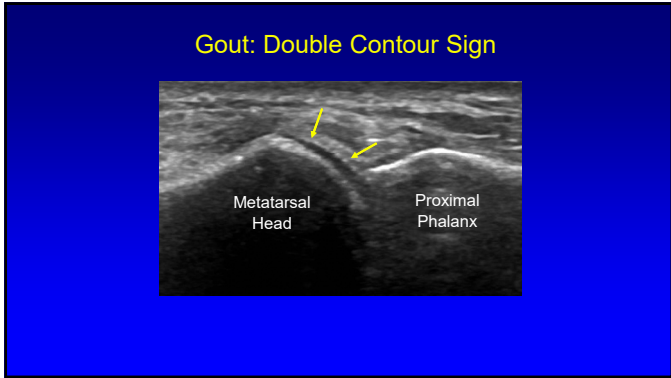
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Gout: synovitis



1st Metatarsophalangeal Joint

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Tophi

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

MT PP

Fernandes et al. Skeletal Radiol 2011; 40:309

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Gout: tophus

MT PP

T1w T2w Gad

1st Metatarsophalangeal Joint

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Soft Tissue Ganglion

- Multilocular, anechoic
- Non-compressible
- Posterior acoustic enhancement
- Joint or tendon sheath communication

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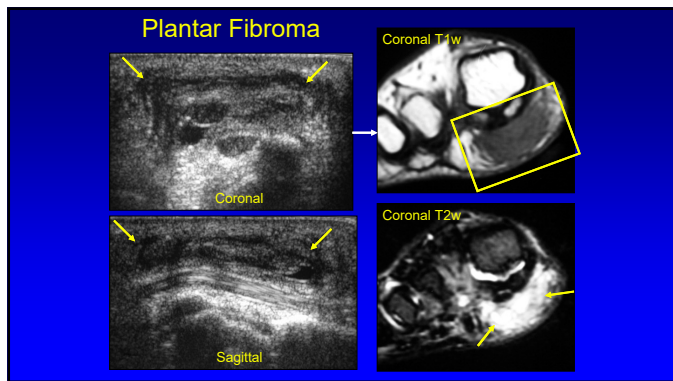
Plantar Fibromatosis

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

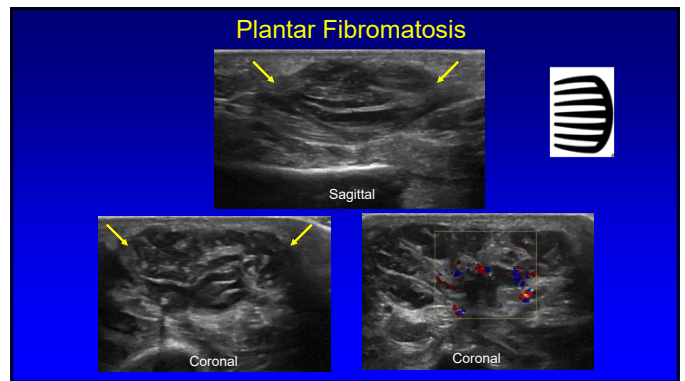
Sagittal

Cohen BE et al. J Ultrasound Med 2018; 2725
Griffith JF et al. AJR 2002; 179:1167

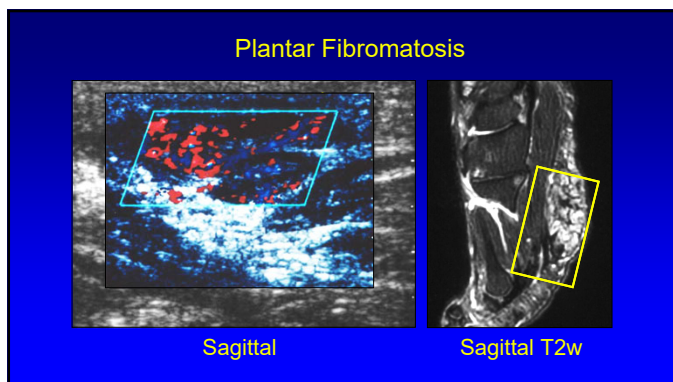
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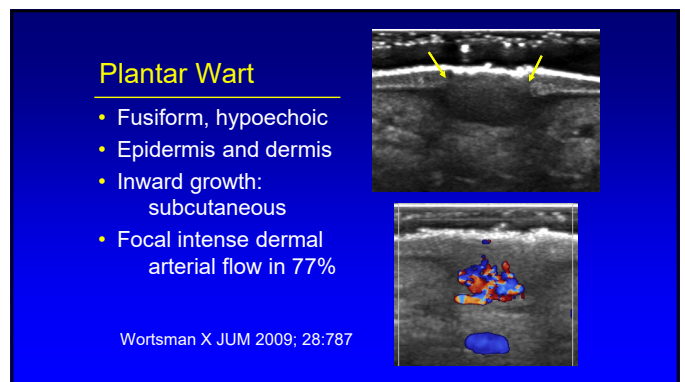
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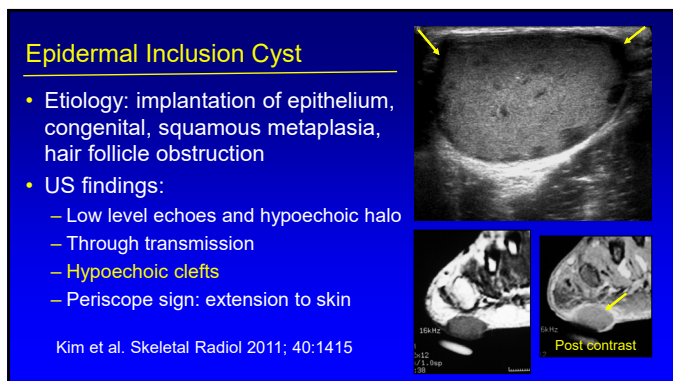
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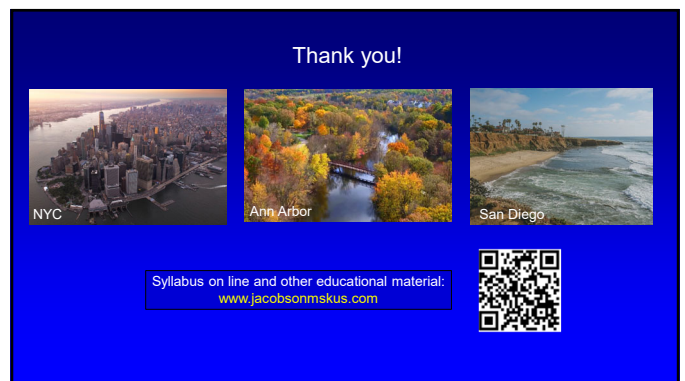
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