Musculoskeletal Pathology: An Algorithmic Approach to Image Interpretation

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Syllabus PDF

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Disclosures

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

See www.jacobsonmskus.com for syllabus other educational material

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Outline

- Meniscal tear
- Osteomyelitis
- Arthritis
- "Cyst" on MRI or US

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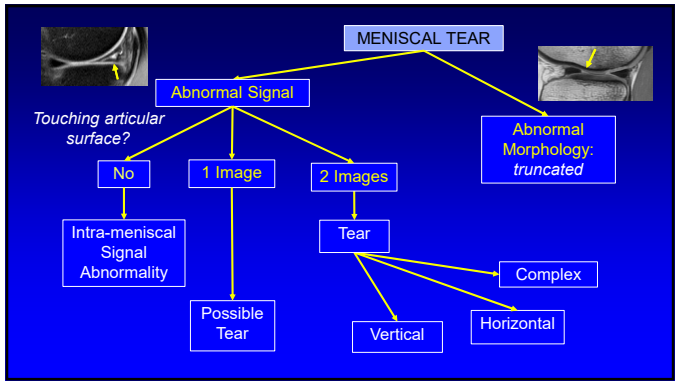

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Meniscus Tear: MRI criteria

- Abnormal morphology
  - Truncation, absence
- Abnormal signal
  - Extends to articular surface (unequivocally)
  - Two consecutive or orthogonal images
  - "Two-slice-touch rule"

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Meniscus Tear: MRI criteria

- Positive predictive value for meniscus tear: One slice versus two slice touch

	1 Slice	2 Slice
Medial Meniscus	43%	94%
Lateral Meniscus	18%	96%
Reporting	*"Possible Tear"*	*"Tear"*

Nguyen JC et al. Radiographics 2014; 34;981

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Meniscus: internal signal

- Not in contact with articular surface
- Vascularity (periphery): children
- Radial tie fibers (periphery)[1]
- Contusion: globular, ill-defined[2]
- Degenerative signal
  - If linear in medial meniscus: progress to tear
  - If middle aged without osteoarthritis[3]

[1]Hauger O et al. Radiology 2000; 217:340
[2]Cothran RJ et al. AJR 2001; 177:1189
[3]Kumm J et al. Radiology 2015; 278:164

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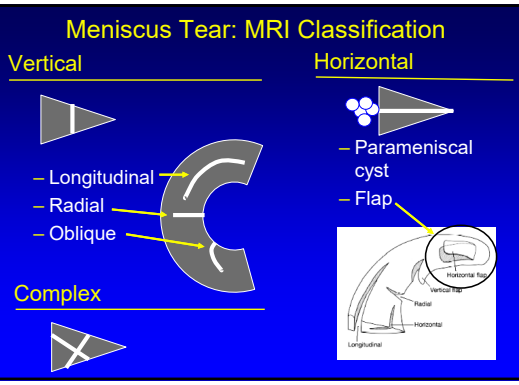
Meniscus Tear: MRI Classification



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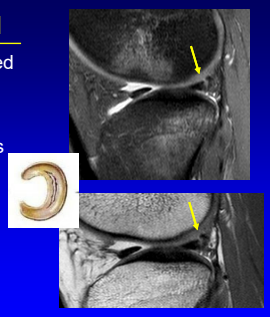
Meniscal Tear: vertical

- Longitudinal: non-displaced
- Usually peripheral
- Often traumatic
- Associated with ACL tears
  - 90% of medial tears
  - 83% of lateral tears
- >1 cm in length: unstable
- *Pitfall:* meniscofemoral ligament of Wrisberg



Nguyen JC et al. Radiographics 2014; 34;981

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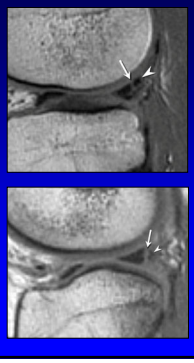
PHLM Rip Tear

- Longitudinal tear PHLM
- Associated with ACL tears
- Pitfall: continuous with meniscofemoral ligament
- Cleft >3 images lateral to PCL (>10 mm) = tear



Park et al. Skeletal Radiol 2007; 36:399

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Meniscal Tear: vertical

- Longitudinal: displaced
  - Bucket-handle
    - Medial > lateral
    - Double-PCL (medial)
    - Intact meniscal ring
- *Pitfall:* oblique meniscomeniscal ligament

Nguyen JC et al. Radiographics 2014; 34;981

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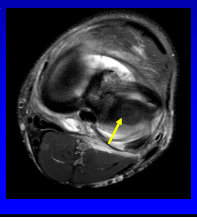
Meniscal Tear: vertical

- Longitudinal: displaced
  - Flipped fragment
    - Connected at one end
  - Free fragment



Lance V et al. Skeletal Radiol 2015; 44:375

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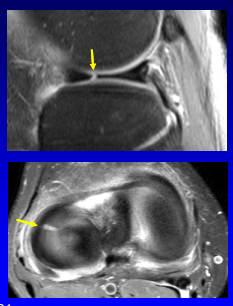
Meniscal Tear: vertical

- Radial
- Incomplete or complete
- Free edge tear
- Disrupted bow tie appearance of meniscus



Nguyen JC et al. Radiographics 2014; 34;981

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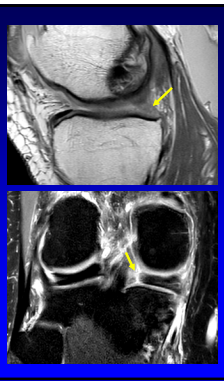
Meniscal Tear: vertical

- Radial
- Root tear
  - Meniscotibial root ligament
- "Ghost meniscus"
  - Absent on one slice
- Possible meniscal extrusion (relative to tibia)



Choi JY et al. AJR 2014; 203:1286

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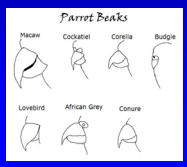
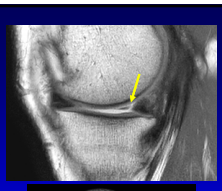
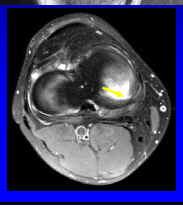
Meniscal Tear: vertical

- Oblique vertical
  - Parrot beak
  - Vertical flap tear







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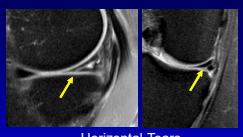
Meniscal Tear: horizontal

- Often to or near apex
- Parameniscal cyst
  - Multilocular
  - Axial plane around meniscus
  - Medial: away from meniscus
- Pitfall: AHLM ganglion cyst

Nguyen JC et al. Radiographics 2014; 34;981



Horizontal Tears

Parameniscal Cysts

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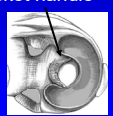
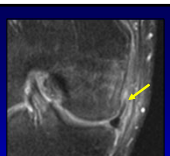
Meniscal Tear: horizontal

- Horizontal flap tear
- Flap: deep to MCL
  - May not be low signal
- Superior 6x > inferior
- Key: truncated meniscus
- Also: hemi-bucket handle



Lecas LK et al. AJR 2000; 174:161
Engstrom SK et al Skeletal Radiol 2012; 41:933



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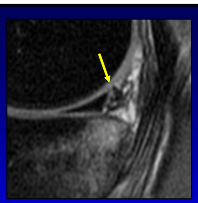
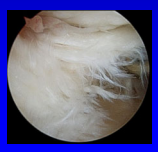
Meniscal Tear: complex

- Does not fit into one specific tear pattern
- Often degenerative and macerated





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Outline

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- Osteomyelitis
- Arthritis
- “Cyst” on MRI or US

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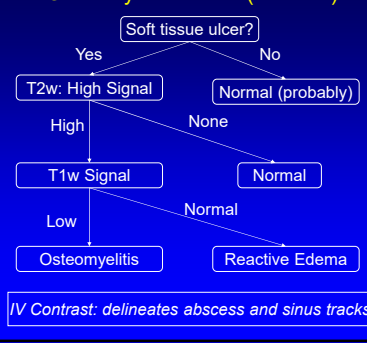
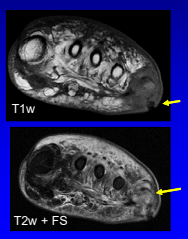
Osteomyelitis: adult (diabetic)



*In the absence of ulcer, surgery, or penetrating injury, osteomyelitis of foot is rare



IV Contrast: delineates abscess and sinus tracks

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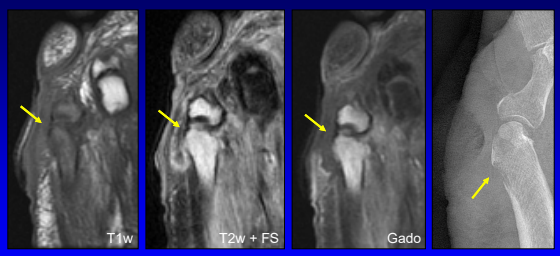
Osteomyelitis: 5th metatarsal



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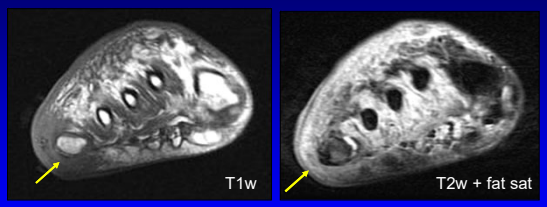
Reactive Edema



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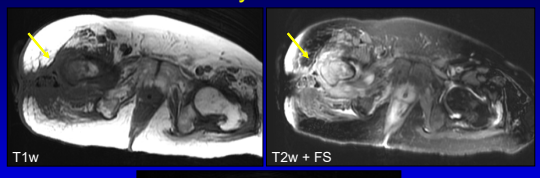
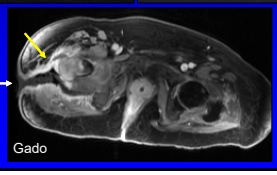
Osteomyelitis: femur





Sinus track

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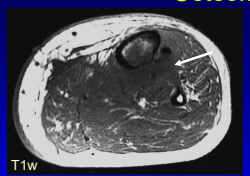
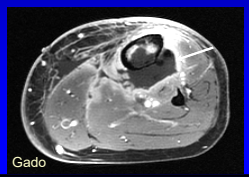
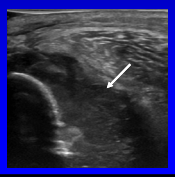
Osteomyelitis







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Neuropathic Foot

- Bone marrow edema:
  - High T2w
  - T1w: variable, often normal
- No adjacent ulcer
- Multiple joints: esp. midfoot
  - Osteomyelitis: 5th MT > 1st MT > calcaneus
- Subluxation

Radiology 2002; 224:649

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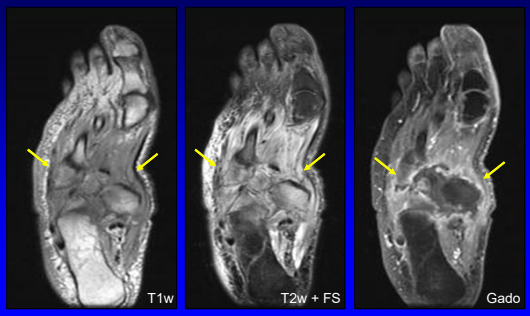
Neuropathic Foot



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Neuropathic Foot

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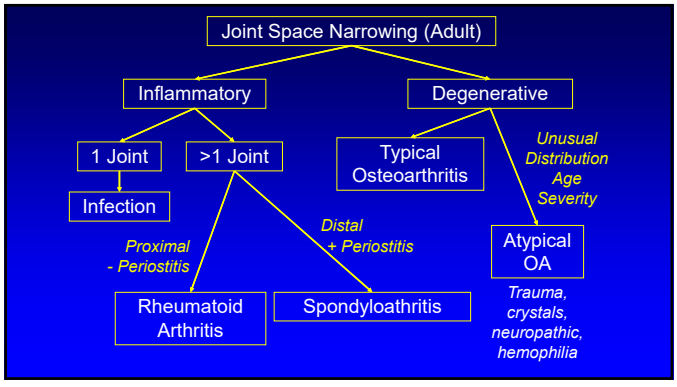

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Radiographic Algorithm: *adult*

- Starting point: joint space narrowing
- Inflammatory versus degenerative arthritis

*Evaluation of Arthritis: Inflammatory Conditions. Radiology 2008; 248:378-389

*Evaluation of Arthritis: Degenerative Joint Disease and Variations. Radiology 2008; 248:737-747

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Inflammatory Arthritis

- Periarticular osteopenia
- Soft tissue swelling
- Erosions:
  - Initially marginal
  - Cortex discontinuous
- Joint space narrowing: uniform

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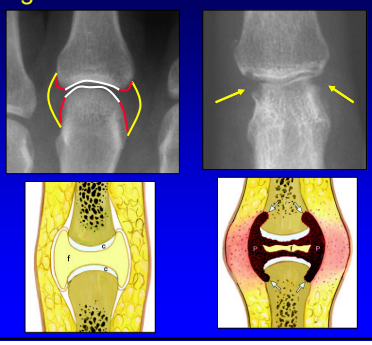
Marginal Erosions: rheumatoid arthritis



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Degenerative Arthritis:

- Joint space narrowing: not uniform
- Normal mineralization
- Osteophytes
- Sclerosis and eburnation

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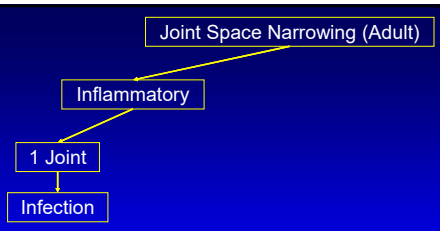

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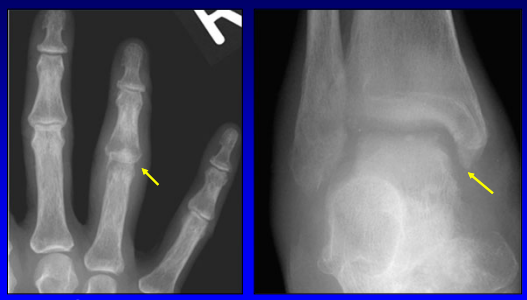
Inflammatory: septic joint



Staph. Aureus | Tuberculosis

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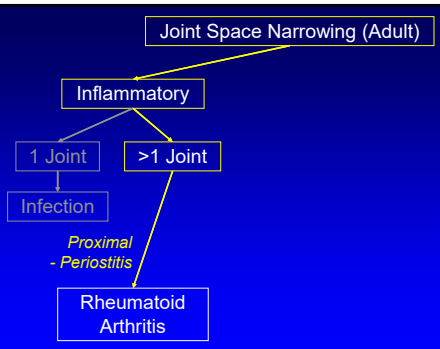

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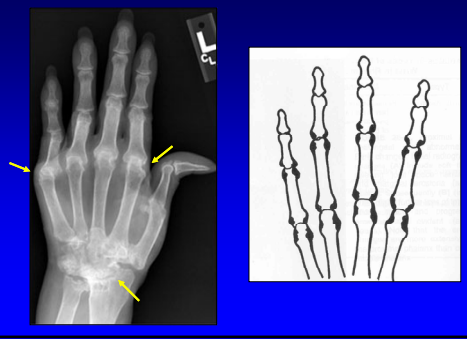
Rheumatoid Arthritis



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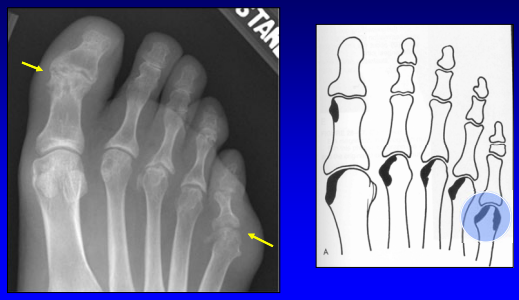
Rheumatoid Arthritis



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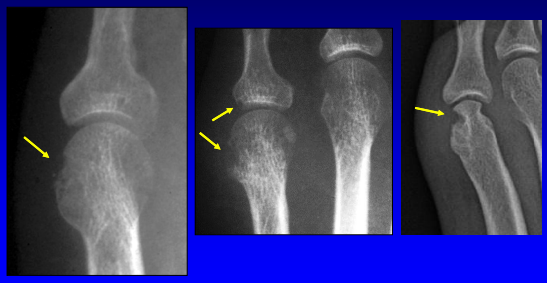
Rheumatoid Arthritis



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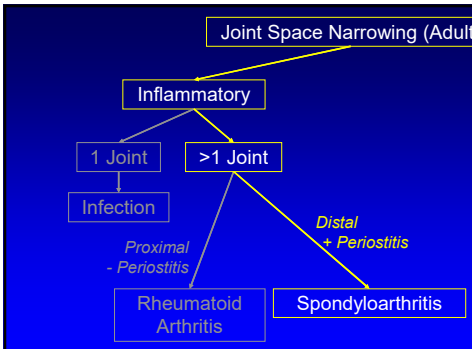

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Spondyloarthritis:

- Synovial joints:
  - Erosions, uniform joint space narrowing
  - Periostitis
- Cartilaginous joints: erosions
- Entheses:
  - Tendon and ligament attachment
  - Fluffy enthesophytes, erosions

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Seronegative Spondyloarthropathy:

- Key to diagnosis: distribution
- Psoriasis: hands, feet, spine, SI joints
- Reactive arthritis: feet, SI joints
- Ankylosing spondylitis: axial skeleton, glenohumeral joints

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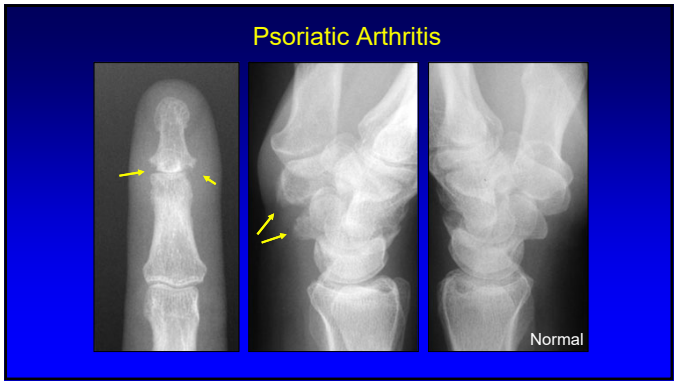

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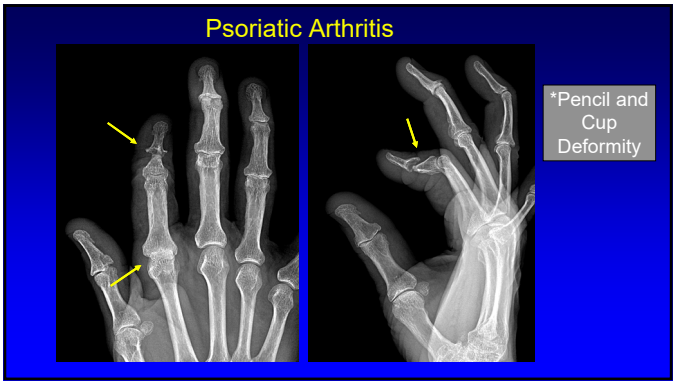

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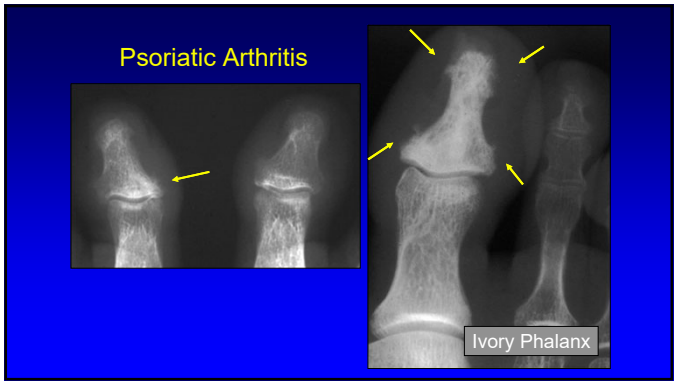

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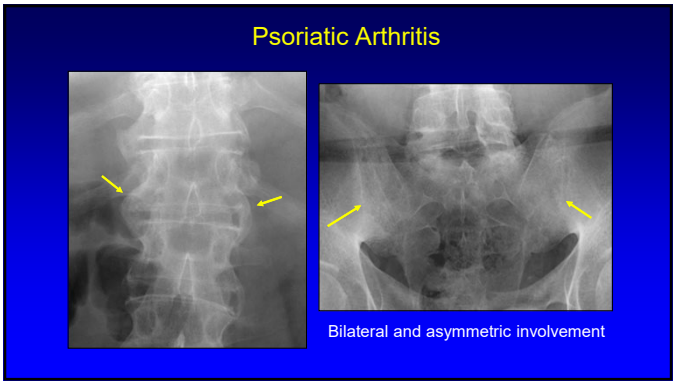

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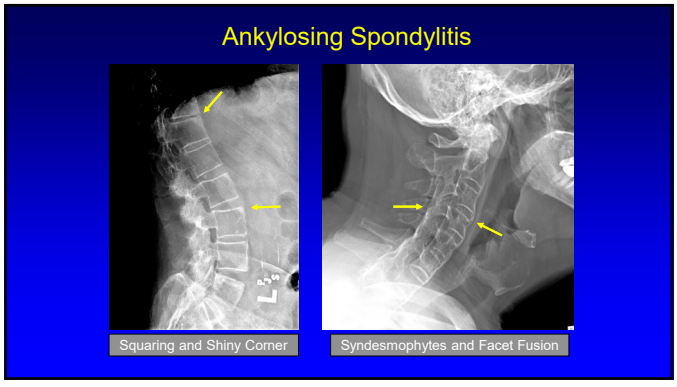

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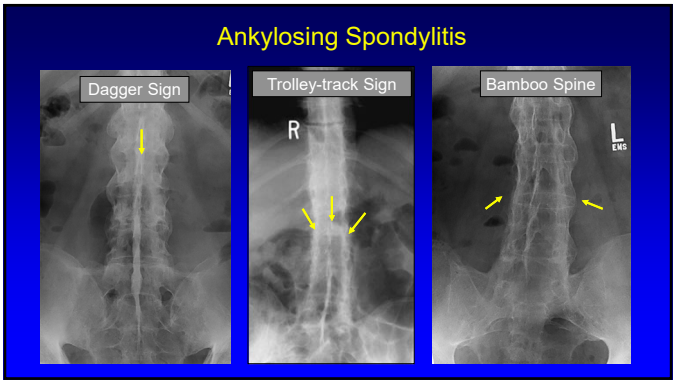

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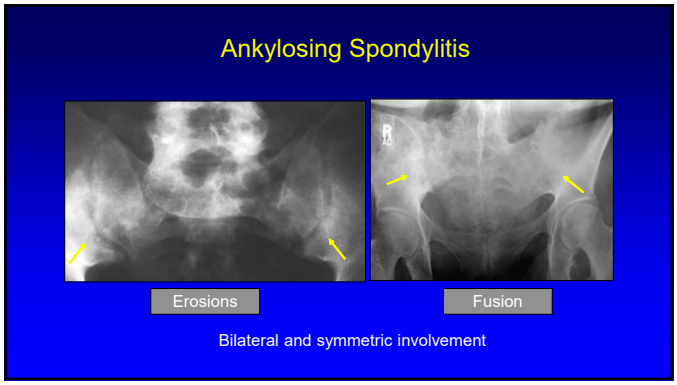

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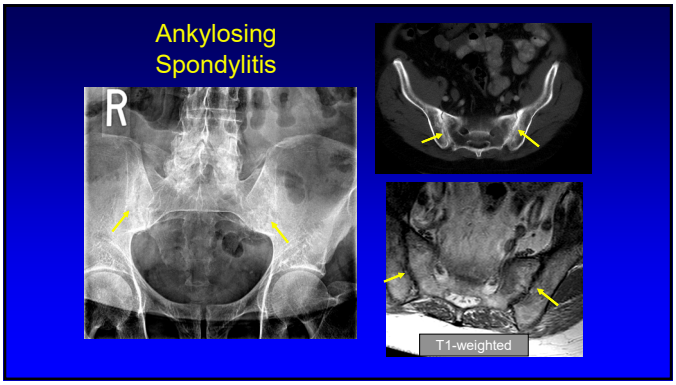

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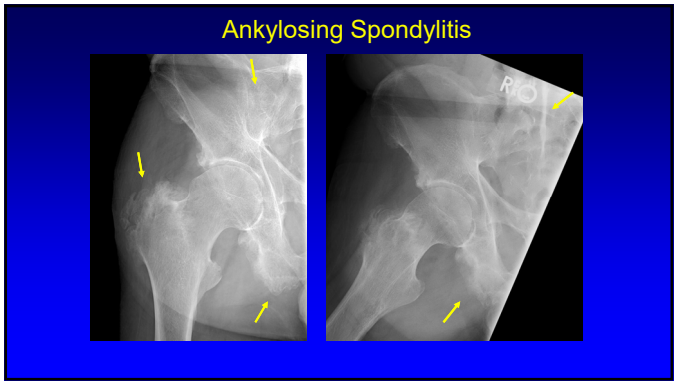

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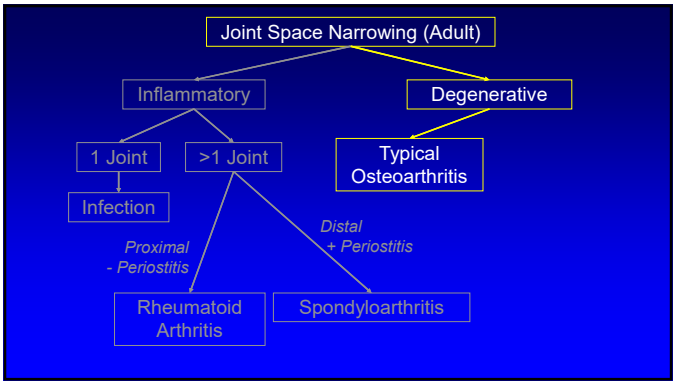

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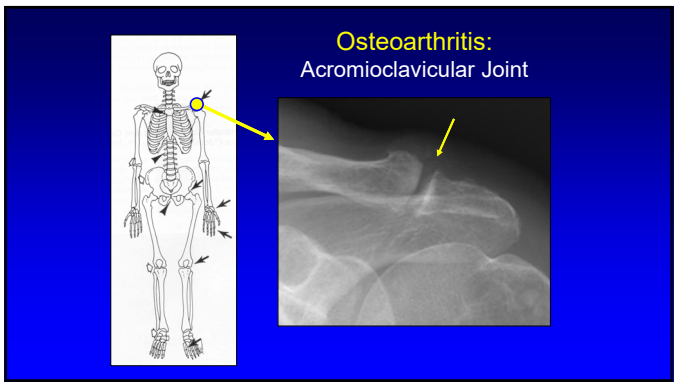

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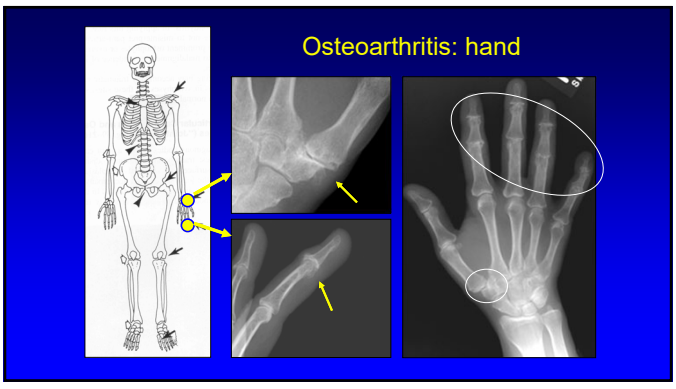

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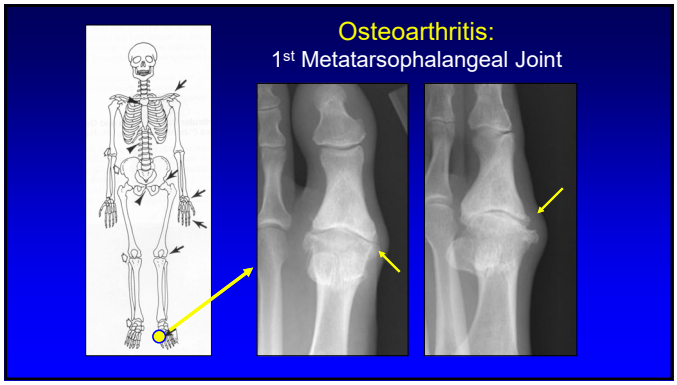

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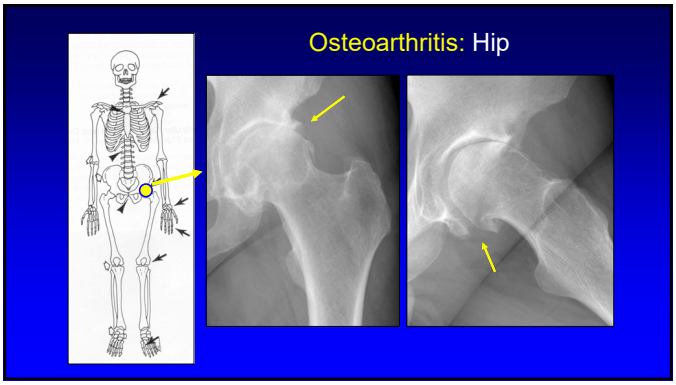

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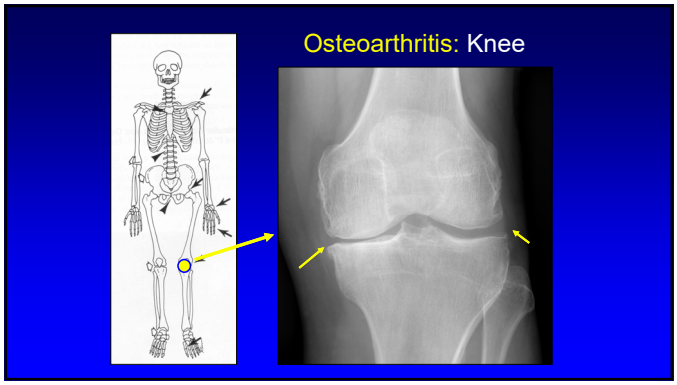

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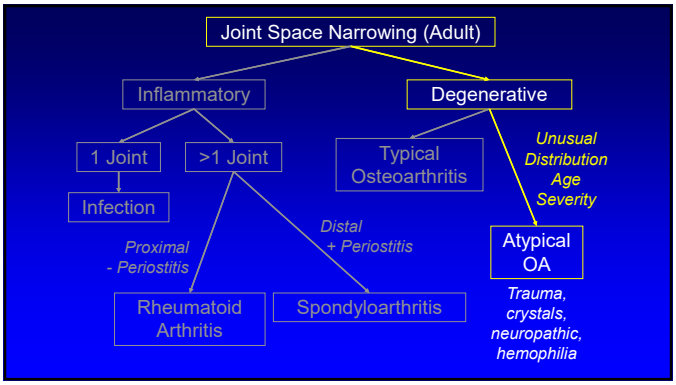

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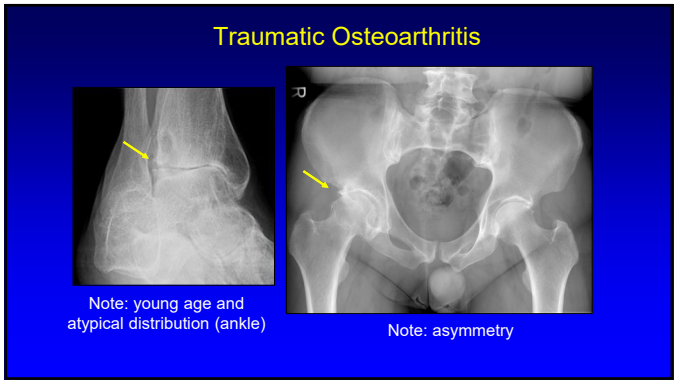

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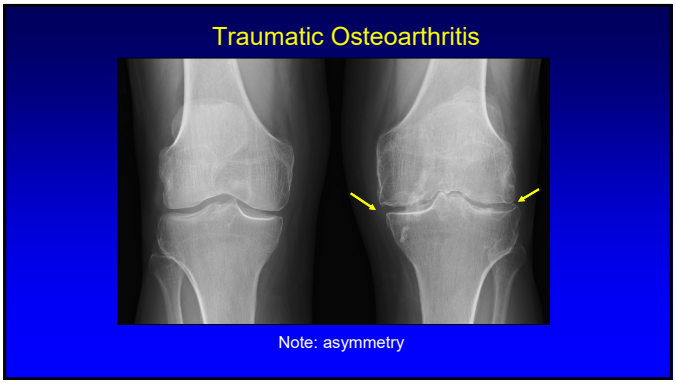

60

Calcium Pyrophosphate Dihydrate Crystal Deposition Disease

Note: chondrocalcinosis and atypical distribution (MCP 2 and 3)

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Neuropathic Joint

Note: distribution (midfoot)

62

Hemophilia

Note: young age and atypical distribution (ankle)

63

Outline

- Meniscal tear
- Osteomyelitis
- Arthritis
- "Cyst" on MRI or US

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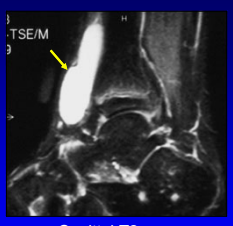
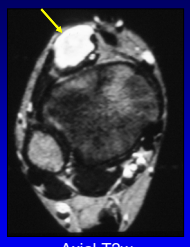
Synovial Sarcoma

Sagittal T1w



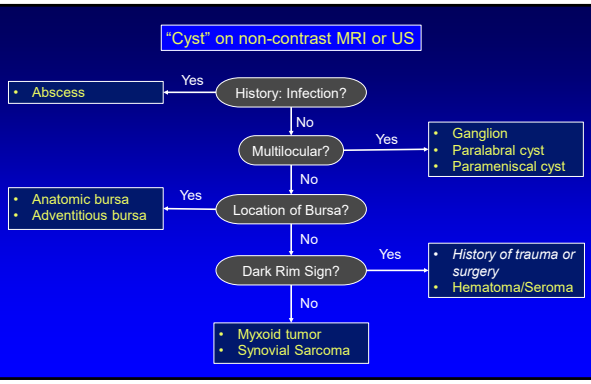
Sagittal T2w



Axial T2w

Teaching Point:
All that is bright on T2w is not a cyst

65



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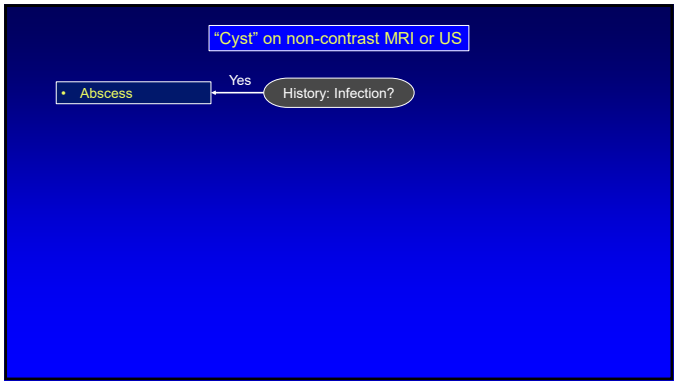

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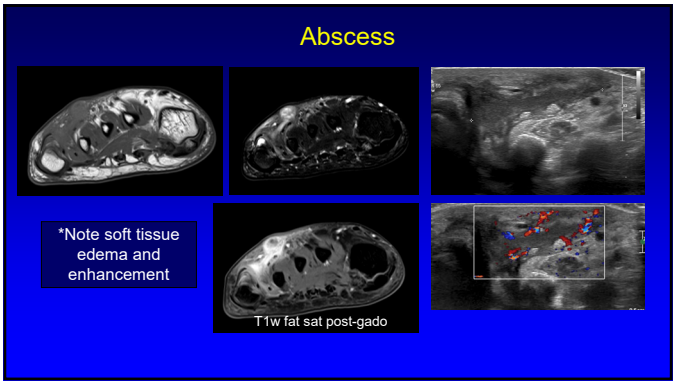

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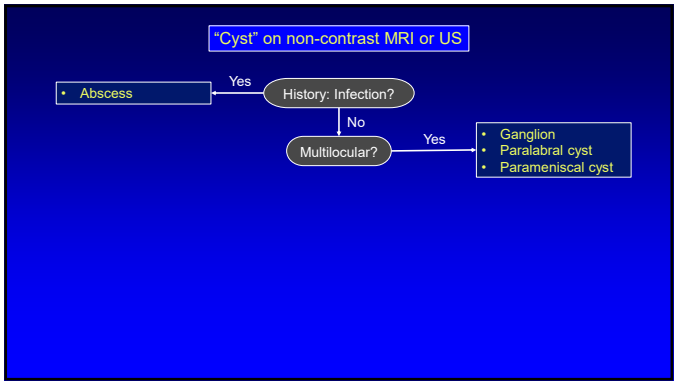

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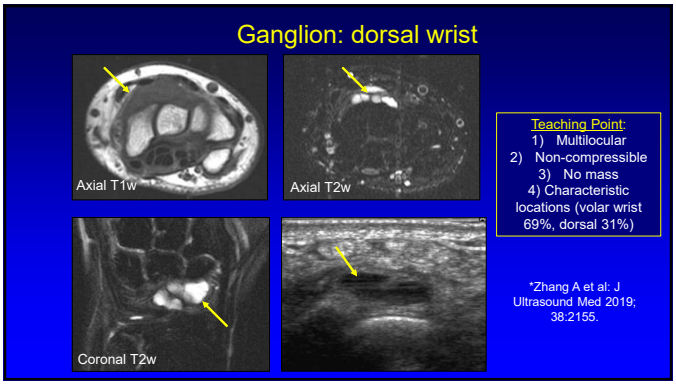

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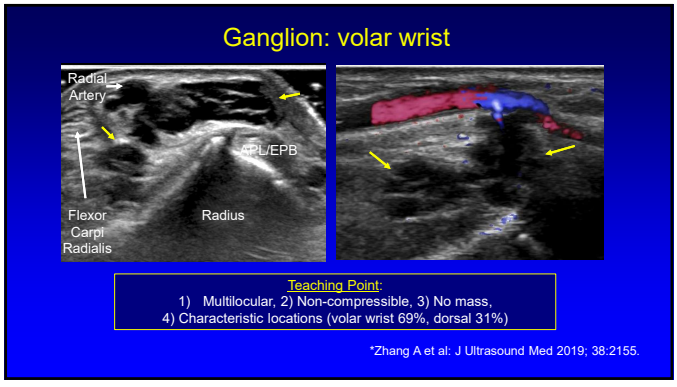

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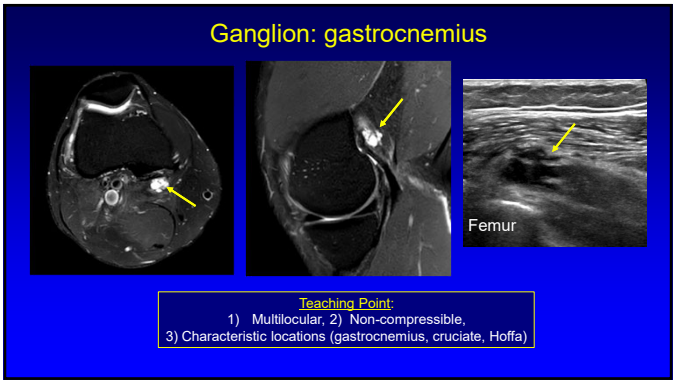

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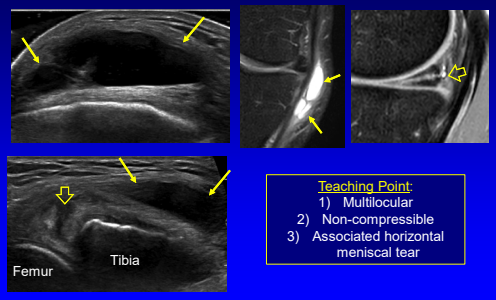
Medial Meniscus: tear and parameniscal cyst



Teaching Point:
1) Multilocular
2) Non-compressible
3) Associated horizontal meniscal tear

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"Cyst" on non-contrast MRI or US

- Abscess ← Yes ← History: Infection?
- No → Multilocular? → Yes → Ganglion, Paralabral cyst, Parameniscal cyst
- No → Location of Bursa? → Yes → Anatomic bursa, Adventitious bursa
- Differential Diagnosis
  - Inflammatory
    - ✓ Trauma
    - ✓ Rheumatoid
    - ✓ TB, fungal
  - Proliferative
    - ✓ PVNS
    - ✓ Synovial chondromatosis
    - ✓ Amyloid

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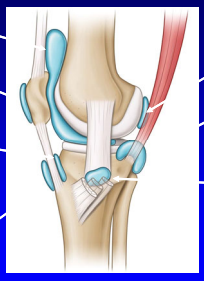
Knee Bursae



*Suprapatellar Recess
Prepatellar Bursa
Deep Infrapatellar Bursa
Superficial Infrapatellar Bursa
Baker Cyst
Semimembranosus -Tibial Collateral Ligament Bursa
Pes Anserinus Bursa

Ruangchaijatuporn T et al: Skeletal Radiol 2017;46:445.

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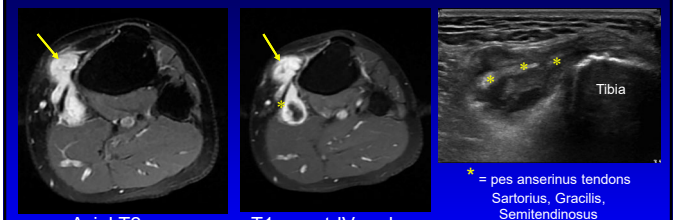
Bursitis: pes anserinus



Axial T2w
T1w post-IV gado

* = pes anserinus tendons
Sartorius, Gracilis, Semitendinosus

Teaching Point:
1) Characteristic location deep to pes anserinus
2) Often complex with synovial hypertrophy

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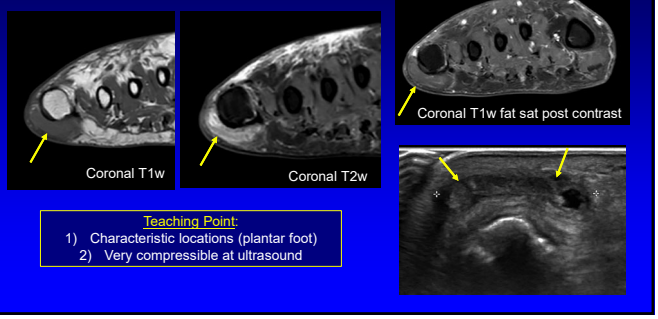
Adventitious Bursitis



Teaching Point:
1) Characteristic locations (plantar foot)
2) Very compressible at ultrasound

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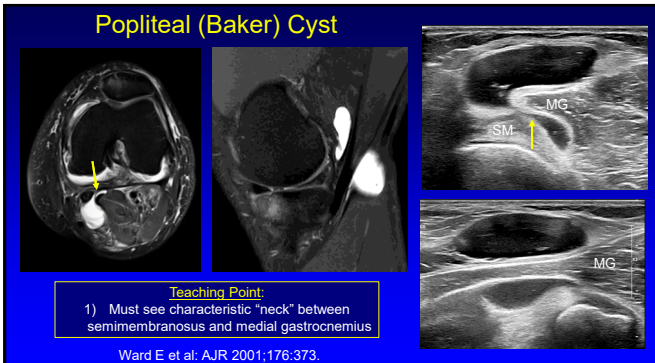
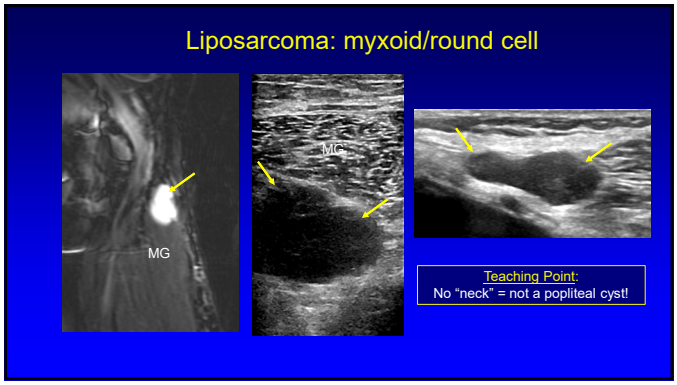
Popliteal (Baker) Cyst



Teaching Point:
1) Must see characteristic "neck" between semimembranosus and medial gastrocnemius

Ward E et al: AJR 2001;176:373.

78



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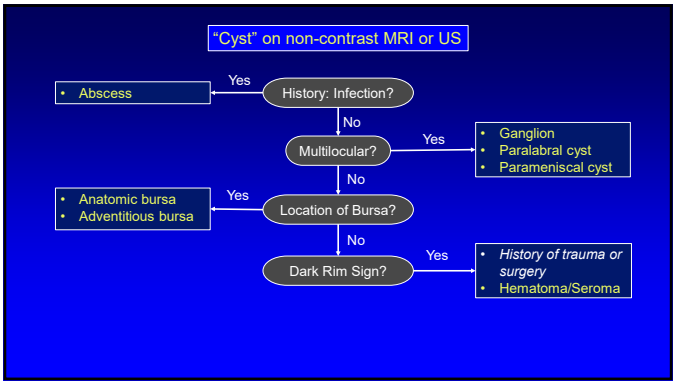

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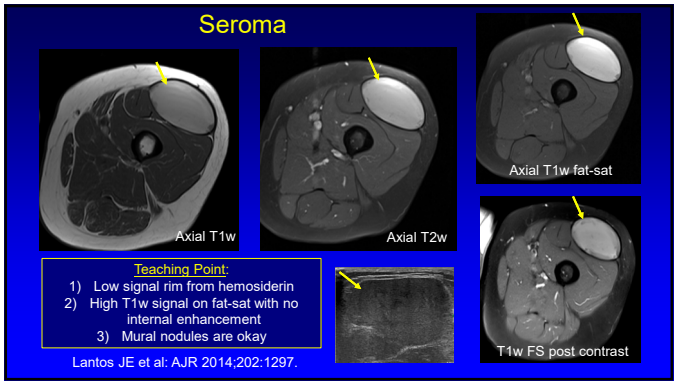

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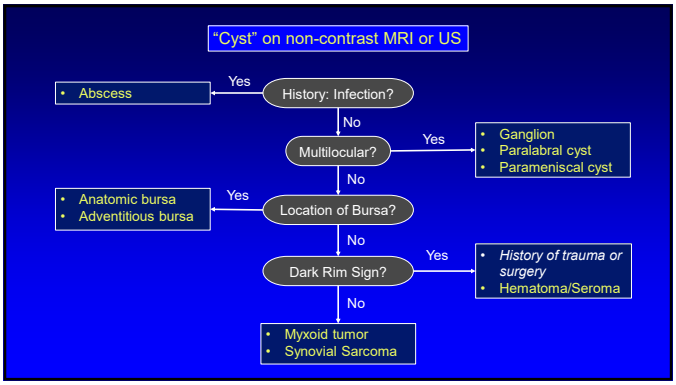

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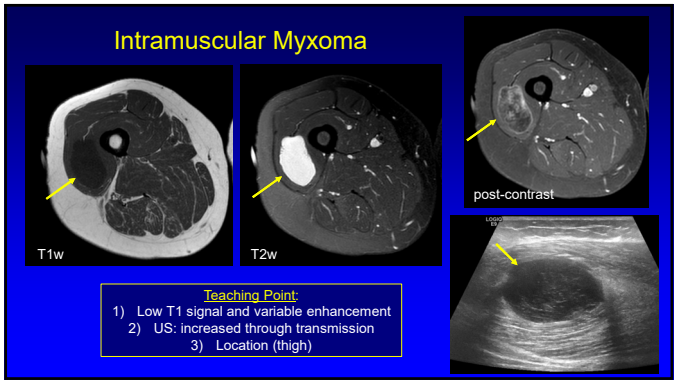

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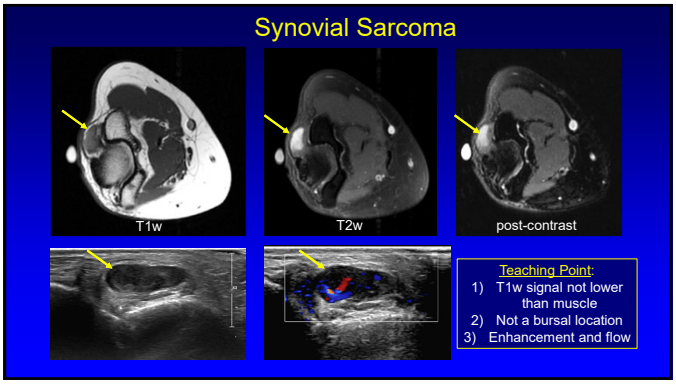

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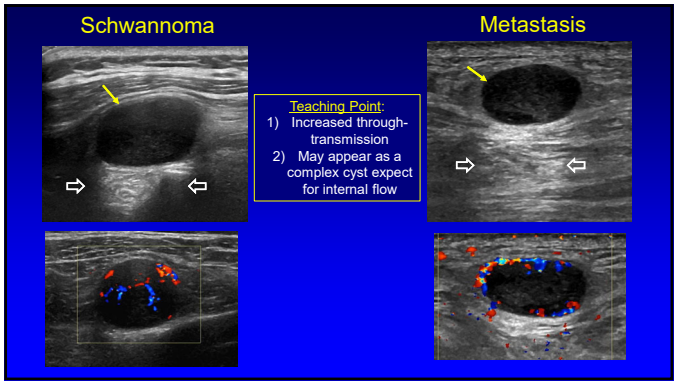

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Take home points

- Meniscal tear:
  - 2 slice touch rule
- Osteomyelitis:
  - High T2, low T1
  - Neuropathic: no ulcer
- Arthritis
  - Inflammatory: uniform narrowing, erosion
  - Degenerative: non-uniform, osteophyte
- "Cyst" on MRI
  - "Cyst" should never be a final diagnosis

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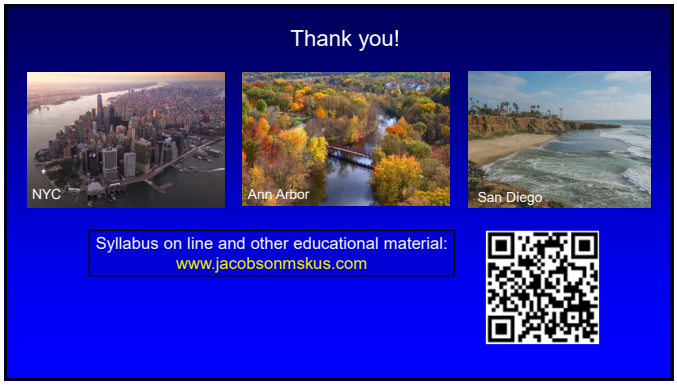

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