Ultrasound Guided Injection Techniques

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Disclosures

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

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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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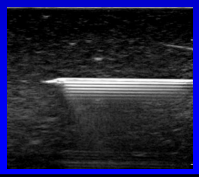
Technique:

- In plane approach
  - Long axis of needle along long axis of transducer
  - See entire needle including tip
  - Most accurate



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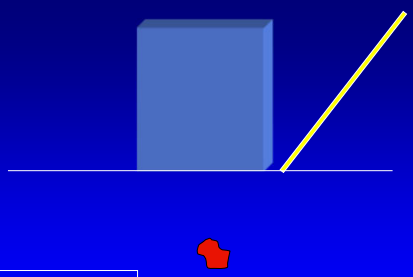

In Plane Approach

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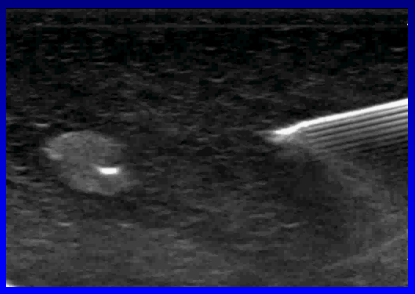
In Plane Approach



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Technique:

- Out of Plane Strategy
- Short axis of needle crosses ultrasound beam
- Less accurate
- US: could represent needle shaft or tip

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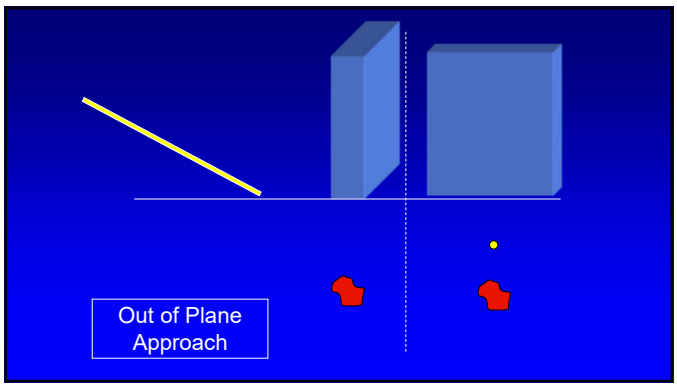

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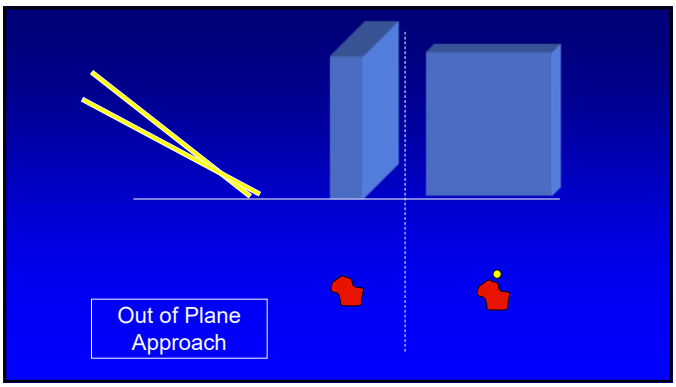

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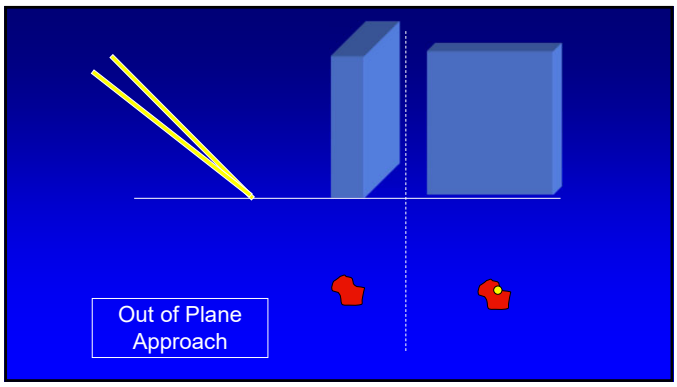

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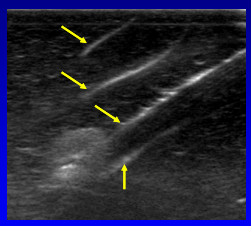
Out of Plane Approach



Superficial joints:
•AC, SI, CMC, MCP, PIP, DIP

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Technique: guidance

- Always confirm in the orthogonal plane (90 degrees)
- Ensure needle tip in target
- Especially important:
  - Small targets
  - Out of plane approach

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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Technique: plan ahead

- Needle path
  - Shortest distance
  - Avoid neurovascular structures

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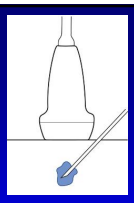
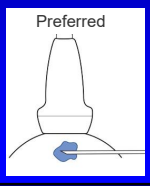
Technique: curved surface

- More room to work
- Puncture site away from transducer
- Access tendon sheath in short axis
- Needle perpendicular to sound beam





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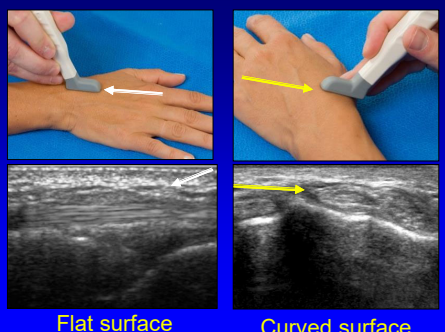

Flat surface

Curved surface

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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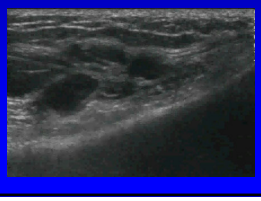
Technique: transducer

- Most applications:
  - > 10 MHz
  - Linear transducer



12 - 5 MHz Linear

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Technique: transducer

- Superficial:
  - > 10 MHz
  - Linear transducer
  - Small footprint

15 - 7 MHz
Compact linear

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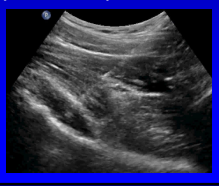
Technique: transducer

- Deep structures:
  - < 10 MHz
  - Curvilinear transducer
  - Hip, piriformis, posterior shoulder



9 - 4 MHz
Curvilinear

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Scanning: basics

- Holding transducer:
  - Anchor hand/transducer
  - 5th finger or hand on patient
- Holding needle:
  - Your "good" hand

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Scanning: basics

- Beam is focused
  - Narrower than transducer width
  - < 2 mm
- Sweep transducer slowly
  - Only millimeters at a time

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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Technique:

- Needle selection
  - Do not want needle to bend
    - Stay in plane w/ sound beam
  - 20 or 22 gauge
  - With stylet or trocar
    - More echogenic
    - Pierces fascia

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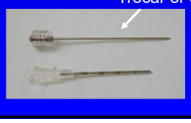
Needle: trocar or no trocar?

- May help puncture through fascial planes, bursal wall, joint capsule
- Avoids taking cores of tissue
- Avoids plugging needle with tissue
- Disadvantage: must set transducer down to remove trocar, connect syringe



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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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Step #1: mark skin

(these are not my kids)

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Technique:

- Direct:
  - "X" marks puncture site
  - "--" marks plane for transducer and needle

Free hand technique

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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Sterile Technique

- Best practice: entire area cleaned, sterile probe cover and sterile gel
- Sterile puncture site, semi-sterile probe site: pitfalls
  - Contamination can be expected
  - Regardless of sterile gel
  - Must cleanse entire area

Sherman T. et al. Clin Orthop Rel Res 2015; 473:351

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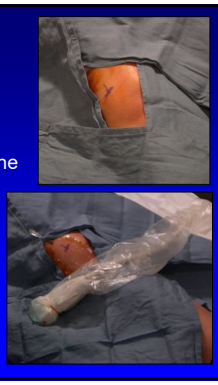
Technique:

- Cleanse: ChloraPrep
  - 70% alcohol, 2% Chlorhexidine
- Sterile drapes
- Sterile ultrasound cover
- Local anesthetic
  1% Lidocaine



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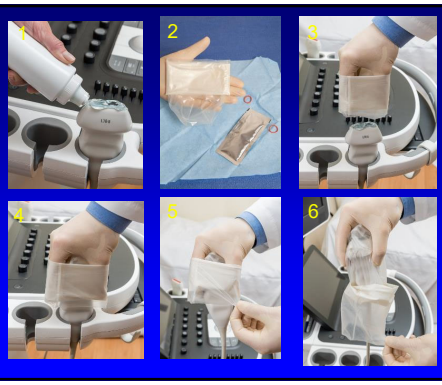

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Technique:

- Ergonomics
  - Patient laying in front
  - Monitor beyond
    - Left hand seen at left side of monitor
  - Secondary monitor
  - Chair

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Technique:

- In versus out of plane approach
- Planning needle course
- Transducer selection
- Needle selection
- Marking skin
- Sterile technique
- Needle visualization

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Technique: free hand

- Insert needle 1 cm into soft tissues
- Find needle by moving transducer
- Elongate needle in long axis to see entirety to tip
- Advance needle under visualization

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Technique: guidance

- DO NOT advance needle unless completely seen longitudinally to tip
- DO NOT move transducer and needle at same time

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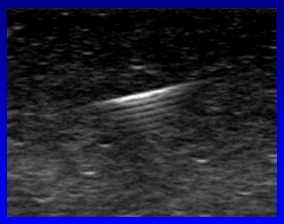
Technique: in plane



Needle and transducer not parallel

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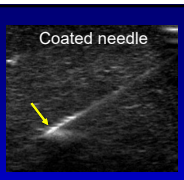
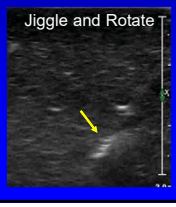
Needle Visualization

- Large needle
- Coated needle
- "Jiggle" the needle
- Rotate needle: bevel
- Needle perpendicular to sound beam





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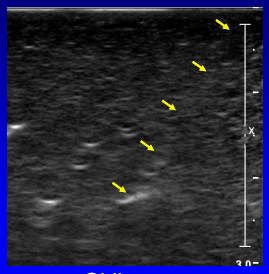
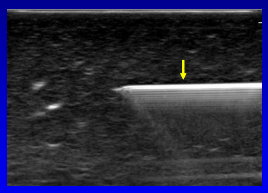
Needle Anisotropy: 20-gauge



Oblique



Perpendicular

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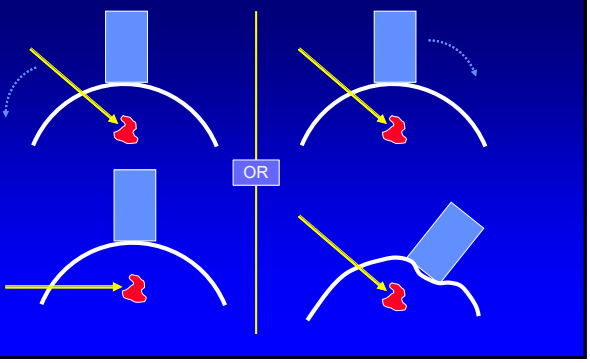

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Needle Orientation

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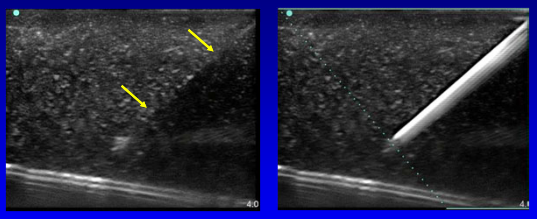
Beam Steering



Normal | With Beam Steering

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Sterile Gel Standoff

- Lift distal transducer off skin
- Thick layer of sterile gel between transducer and probe
- Superficial targets
- See needle prior to entering skin and target

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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst

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Joint Aspiration and Injection

- Aspiration:
  - Infection, gout, crystal disease
- Injection:
  - Anesthetic: Lidocaine, Ropivicaine
  - Steroids
  - Therapeutic or diagnostic

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Considerations

- Aspiration:
  - Consider trocar (or stylet)
  - Prevent needle blockage
  - Especially calcific tendinitis
- Steroid injection:
  - Flush needle after injection
  - Reduces skin depigmentation and subcutaneous fat atrophy

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Joint Aspiration and Injection

- Know which joint recesses become distended and which are accessible
- For joint access:
  - Aim for joint fluid seen at ultrasound
  - Aim for specific joint recess
  - If no recess, aim for joint space

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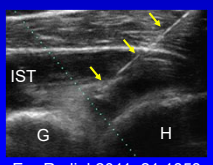
Glenohumeral Joint

- Posterior joint recess
  - In plane
  - Transducer: axial
  - Lateral to medial
  - Most reliable site*



Eur Radiol 2011; 21:1858

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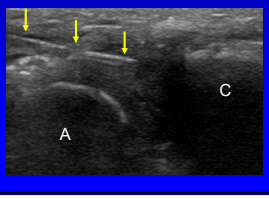
Acromioclavicular Joint

- In plane
- Transducer: coronal
- Lateral to medial



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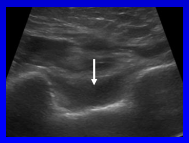
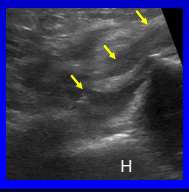
Elbow Joint

- Olecranon recess
- Elbow flexed
- In plane
- Lateral to medial





Invest Radiol 1998;33:117

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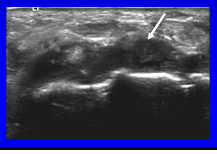
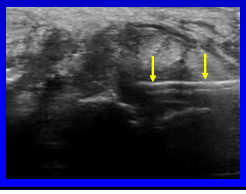
Wrist Joints

- Dorsal recesses
- In plane
- Transducer: axial
- Medial or lateral





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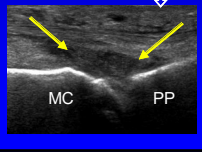
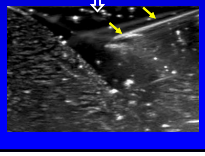
MCP Joints

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





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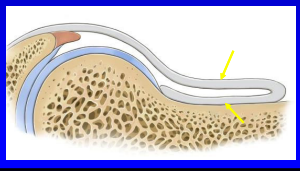
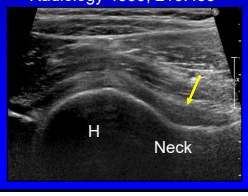
Hip: anterior recess

- Anterior and posterior layers
  - Fibrous tissue + minute layer of synovium
  - Hyperechoic
  - Each 2 - 4 mm thick



Radiology 1999; 210:499



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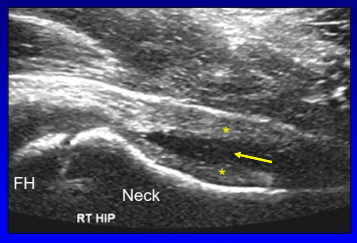
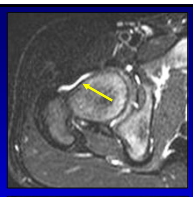
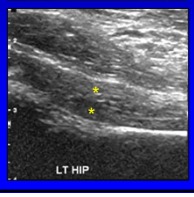
Hip Joint: septic effusion



Long Axis





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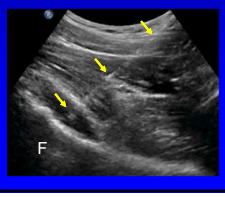
Joint injection

- Anterior recess
- In plane
- Transducer:
  - Parallel to femoral neck
  - Consider curvilinear
- Needle: distal to proximal
- 97% accuracy[1]

[1]Smith J. J Ultrasound Med 2009; 28:329



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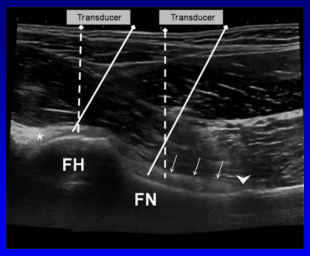
Joint Injection

- Femoral neck target
- Preferred over head
- High volumes
- Less extra-articular contrast



From Kantarci F et al. Skeletal Radiol 2013; 42:37.

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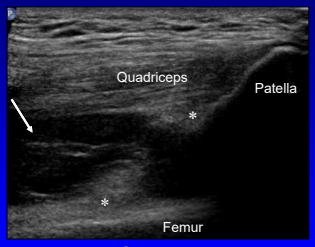
Knee Joint: effusion



Sagittal

T2w

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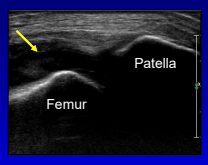
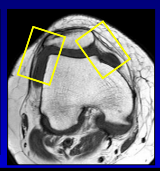
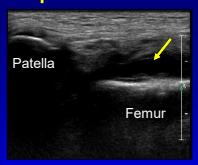
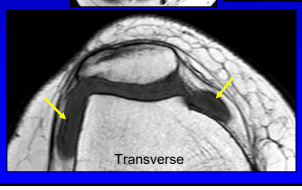
Joint Effusion: transverse plane









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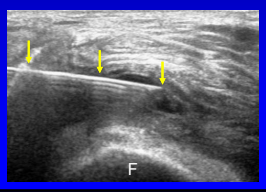
Knee Joint

- Suprapatellar recess or medial/lateral recesses
- In plane
- Transducer: axial
- Needle: lateral to medial



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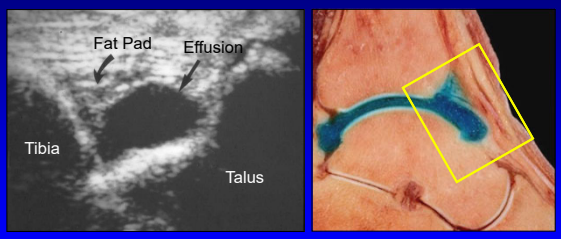
Tibiotalar Joint: effusion



Sagittal

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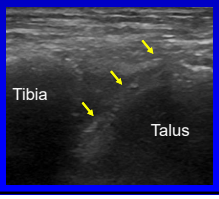
Ankle Joint

- Anterior joint recess
- In plane
- Transducer: sagittal
- Needle: inferior to superior



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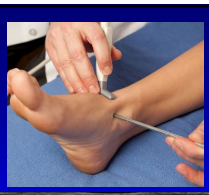
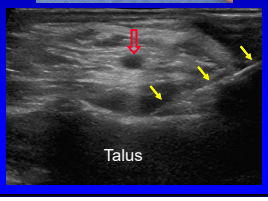
Ankle Joint

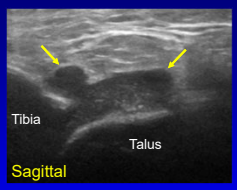
- Anterior joint recess
- Out of plane
- Transducer: axial
- Needle: medial to lateral
- Deep to dorsalis pedis

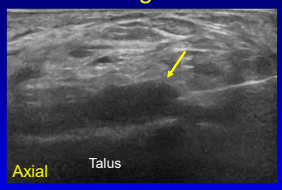


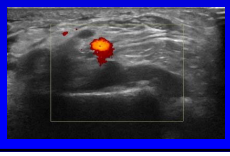


63

Tibiotalar Joint Effusion: gout



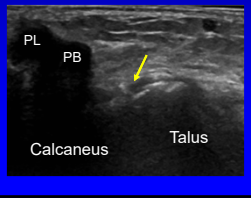




64

Posterior Subtalar Joint

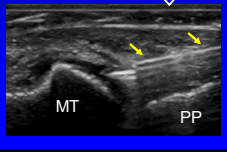
- Lateral joint recess
- Out of plane
- Transducer: coronal
- Place roll: varus
- Avoid: peroneal tendons

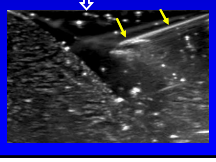


65

MTP Joints

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





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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst

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Tendon Sheath

- Aspiration:
  - Infection, gout, crystal disease
- Injection:
  - Anesthetic: Lidocaine, Ropivicaine
  - Steroids
  - Therapeutic or diagnostic

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Tendon Sheath

- Axial versus longitudinal
- Aspiration: look for fluid collection
- Injection with steroids:
  - Do not inject steroids into tendon
  - Risk of tendon rupture
  - Test needle location with Lidocaine first

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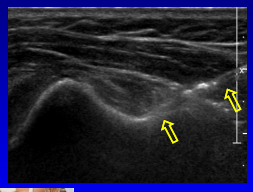
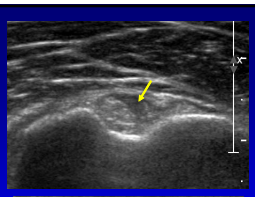
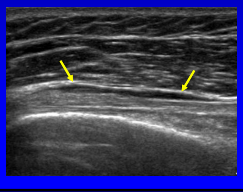
Biceps Tendon Sheath Injection



*Injection should surround tendon

*Confirm post-injection in short and long axis





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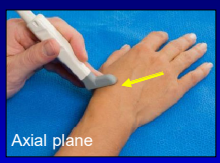
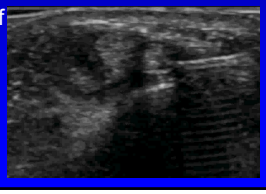
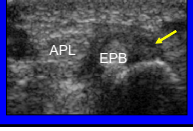
De Quervain Tenosynovitis

- Inject short axis: dorsal
- Between EPB & radius
- Possible septation
- Inject around both tendons
- Avoid superficial branch of radial nerve







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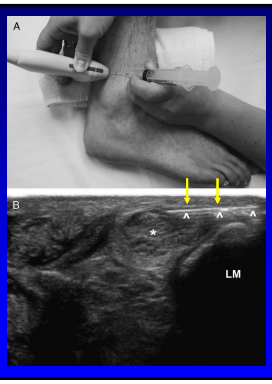
Tendon Sheath: injection

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

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



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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst

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Bursa

- Aspiration:
  - Infection, gout, crystal disease
- Injection:
  - Steroids
  - Therapeutic

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Subacromial-subdeltoid Bursa

- In plane
- Posterior to anterior or lateral to medial
- Patient supine
- Test inject
- Avoid rotator cuff

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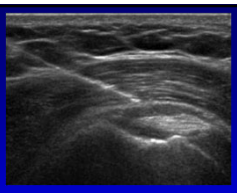
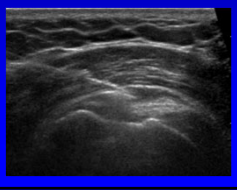
Subacromial-subdeltoid: injection





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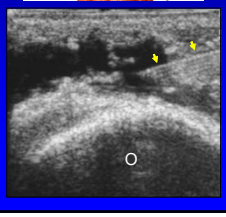
Olecranon Bursa

- Arm extended
- Axial plane
- Lateral to medial
- Avoid cubital tunnel



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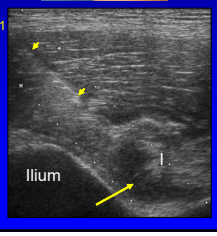
Iliopsoas Bursa

- Oblique-axial plane:
  - Superior to femoral head
  - Lateral to medial
  - Inject between tendon and ilium[1]
- Pain relief = successful iliopsoas surgical release[2]

[1]Dauffenbach J et al. J Ultrasound Med 2014; 33:405

[2]Blankenbaker DG et al. Skeletal Radiol 2006; 35: 565



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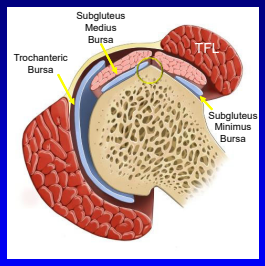
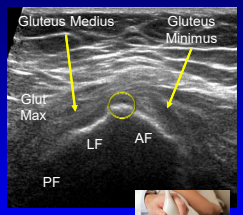
Greater Trochanter





AF: anterior facet
LF: lateral facet
PF: posterior facet

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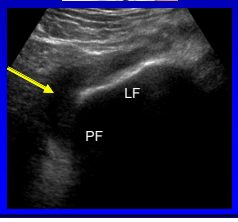
Trochanteric Region Bursae

- Trochanteric: deep to gluteus maximus
- Subgluteus medius
- Subgluteus minimus
- Axial or coronal plane



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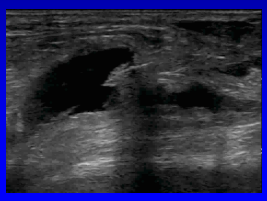
Baker Cyst

- Aspiration
  - Inferior to superior
  - Medial to lateral
- Aspirate joint effusion first if present
- Steroid injection
  - Baker cyst injection works better than intra-articular injection[1]

[1]Banidelli F. et al. Clin Rheum 2012; 31:727



Inferior to superior

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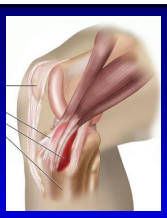
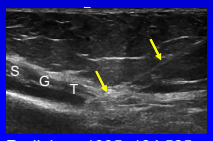
Pes Anserinus

- Pes anserinus: "goose foot"
  - Sartorius
  - Gracilis
  - Semitendinosus
- Bursa:
  - Deep to tendons
  - Adjacent to proximal tibia





Radiology 1995; 194:525

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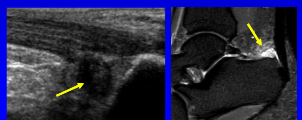
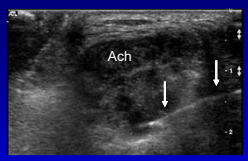
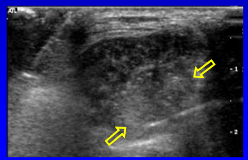
Retrocalcaneal Bursa

- Injection
- Medial to lateral
- Short axis to Achilles
- Needle perpendicular to ultrasound beam



Courtesy of C. Yablon, MD Ann Arbor, Michigan





Post steroid injection

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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst

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Cyst Aspiration

- Ganglion:
  - Large bore needle
  - Wrist, knee: lobular, anechoic or hypoechoic
- Other cysts:
  - Paralabral cysts: shoulder and hip labrum
  - Parameniscal cysts

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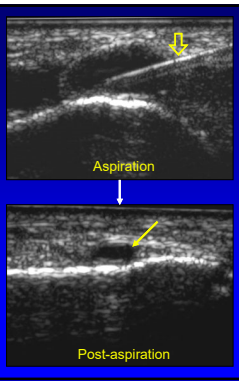
Ganglion: aspiration



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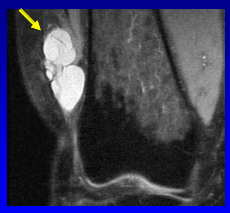
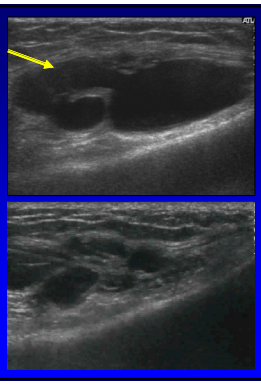
Ganglion: aspiration





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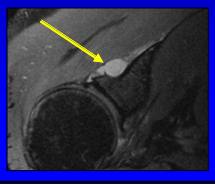
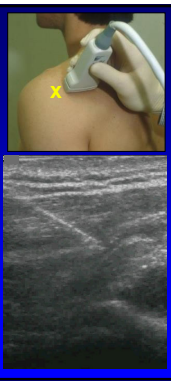
Paralabral cyst

- Usually with labral tear
- Aspiration
  - Axial plane
  - Lateral to medial





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"Cyst" Algorithm

Multilocular Non-compressible	Bursa: anatomic or adventitious	Direct Trauma	Other
• Ganglion or • Paralabral cyst, paramensical cyst	• Trauma • Inflammatory • Rheumatoid • TB, fungal • Proliferative • PVNS • Synovial chondromatosis	• Hematoma • Seroma	• Solid Neoplasm • Myxoid liposarcoma • Synovial Sarcoma

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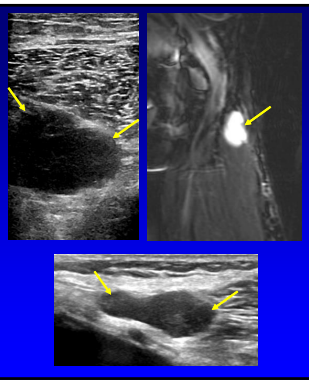
Myxoid Liposarcoma:

- Hypoechoic
- May look like a cyst
- Not a ganglion:
  - Not multilocular
  - Not a good location
- Not a Baker cyst:
  - No neck



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Outline:

- Technique
- Joint
- Tendon sheath
- Bursa
- Cyst
- Miscellaneous

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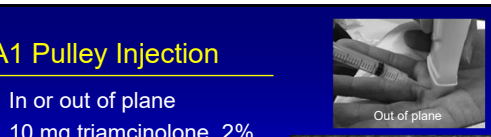
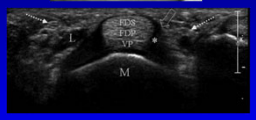
A1 Pulley Injection

- In or out of plane
- 10 mg triamcinolone, 2% lidocaine
- 90% success rate: 1 year





From: Bodor M. et al. JUM 2009; 28:737

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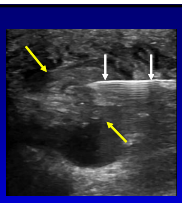
Morton Neuroma

- Steroid injection[1]
  - 3 month: pain relief
- Alcohol injection[2]
  - Symptoms return at 5 yrs
- Radiofrequency ablation[3]
  - 85% effective at 6 months

[1]Thomson CE JBJS 2014; 96A:334
[2]Gurdezi S Foot Ank Int 2013; 34:1064
[3]Chuter GSJ Skeletal Radiol 2013; 42:107



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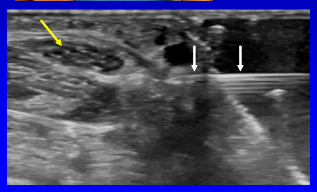
Carpal Tunnel Injection

- Axial plane: ulnar to radial
- Sterile gel stand-off
- Begin over ulnar nerve and stay superficial
- Inject adjacent to median nerve
- Cross-sectional area may decrease within 1 week after steroid injection[1]

[1]Cartwright MS et al. Muscle Nerve 2011; 44:25.

From: Smith J. et al. JUM 2008; 27:1485



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Summary

- Technique:
  - Image long axis to needle
  - Must see entire needle to tip
- Joint:
  - Aim for recess
- Bursa:
  - Know anatomic locations
- Cyst:
  - Large bore needle

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Thank you!

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

Twitter handle: @jjacobsn

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