Interventional Musculoskeletal Ultrasound

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Outline:
• Technique
• Joint
• Tendon sheath
• Bursa
• Cyst
• Miscellaneous

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

Technique:
• In plane approach
  – Long axis of needle along long axis of transducer
  – See entire needle including tip
  – Most accurate
In Plane Approach

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

Out of Plane Approach

Superficial joints:
- AC, SI, CMC, MCP, PIP, DIP
Technique: guidance

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

Technique: curved surface

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

Technique: transducer

• Most applications:
  – > 10 MHz
  – Linear transducer

• In versus out of plane approach
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**Technique: transducer**

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

  ![Image of linear transducer]

  15 - 7 MHz Compact linear

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

  ![Image of curvilinear transducer]

  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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**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
  - More echogenic
  - Pierces fascia

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**Technique:**

- **Beam is focused**
  - Narrower than transducer width
  - 2 mm

- **Sweep transducer slowly**
  - Only millimeters at a time
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:
- Direct:
  - “X” marks puncture site
  - “--” marks plane for transducer and needle
- Indirect:
  - Paperclip technique

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

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

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

Technique: in versus out of plane approach
- Planning needle course
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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

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

Technique: in plane
- Needle and transducer not parallel
Needle Visualization
- Large needle
- Coated needle
- "Jiggle" the needle
- Rotate needle: bevel
- Needle perpendicular to sound beam

Needle Anisotropy: 20-gauge
Oblique  Perpendicular

Needle Orientation

Beam Steering  Normal  With Beam Steering
**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

**Aligning Needle and Target**
- Needle 1 cm into soft tissues
- Needle visualized in plane
- However, target not seen
  - Pivot transducer fixed at needle entrance site
  - Visualize target
  - Look down at patient
  - Move needle into plane

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**Joint Aspiration and Injection**
- Aspiration:
  - Infection, crystal disease
- Injection:
  - Anesthetic: Lidocaine, Ropivacaine
  - Steroids
  - Therapeutic or diagnostic

**Steroids: flush or no flush?**
- Steroids in subcutaneous fat:
  - Depigmentation, atrophy
- Flush needle: lidocaine/saline to avoid complication
- Needed with diluted steroid injection?
- Needed for deep injection?

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

**Acromioclavicular Joint**
- In plane
- Transducer: coronal
- Lateral to medial

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

**Wrist Joints**
- Dorsal recesses
- In plane
- Transducer: axial
- Medial or lateral

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

**Hip Joint**
- Anterior recess
- In plane
- Transducer:
  - Parallel to femoral neck
  - Consider curvilinear
- Needle: distal to proximal
- 97% accuracy†

*Hg
**IST
G
H
**Eur Radiol 2011; 21:1858

†Smith J. J Ultrasound Med 2009; 28:329
Joint Injection

- Transducer: in plane
  - Lateral to medial
  - Horizontal and parallel to sound beam


Knee Joint: effusion

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

Tibiotalar Joint: effusion

Sagittal

Fat Pad
Effusion
Tibia
Talus

Transverse

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

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

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

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

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Tendon Sheath
- Aspiration:
  - Infection, crystal disease
- Injection:
  - Anesthetic: Lidocaine, Ropivacaine
  - Steroids
  - Therapeutic or diagnostic
**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

**Biceps Brachii: sheath injection**

- Ultrasound-guided: highest accuracy
  - Statistically significant difference in pain relief compared with blind injection at 33 weeks
- In plane, lateral to medial:
  - Deep to tendon: avoid SA-SD bursa
  - Avoid anterior circumflex humeral artery
- Glenohumeral joint extension: if 5 ml injected

1Hashiuchi et al. J Sho Elb Surg 2011; 20:1069
3Nwawka et al. AJR 2016; 206:337

**Biceps Tendon Sheath Injection**

- Injection should surround tendon
- Confirm post-injection in short and long axis

**De Quervain’s Tenosynovitis**

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

**A1 Pulley Injection**

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

**Tendon Sheath: injection**

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

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

1Hashiuchi et al. J Sho Elb Surg 2011; 20:1069
3Nwawka et al. AJR 2016; 206:337
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Bursa
- Aspiration:
  - Infection, crystal disease
- Injection:
  - Steroids
  - Therapeutic

Bursa: normal appearance
- Thin hypoechoic layer: fluid / synovium
- Hyperechoic layers: bursa walls / fat

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

Subacromial-subdeltoid: injection

Olecranon Bursa
- Arm extended
- Axial plane
- Lateral to medial
- Avoid cubital tunnel
Iliopsoas Bursa

- Oblique-axial plane:
  - Superior to femoral head
  - Lateral to medial
  - Inject between tendon, ilium
- Pain relief = successful iliopsoas surgical release

1Dauffenbach J et al. J Ultrasound Med 2014; 33:405
2Blankenbaker DG. Skeletal Radiol 2006; 35: 565

Greater Trochanter

Trochanteric Region Bursae

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

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


Prepatellar Bursa

- Leg extended
- Axial plane
- Sagittal plane

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
### Outline:
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### “Cyst” Algorithm

#### Multilocular
- Non-compressible

#### Bursa: anatomic or adventitious
- Hematoma
- Bone

#### Direct Trauma
- Myxoid liposarcoma
- Synovial sarcoma

#### Other
- Ganglion cyst
- Paralabral cyst
- Parameniscal cyst
- Inflammatory
- Rheumatoid
- Tuberculosis
- Fungal
- PVNS
- Synovial osteochondromatosis
- Hematoma
- Benign

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

### Ganglion Cyst: dorsal + aspiration

#### Ganglion Cyst (elbow): aspiration
- 18-gauge needle
- Post-aspiration

#### Medial Meniscus: tear and parameniscal cyst
- Femur
- Tibia
- Aspiration and Steroid injection
Outline:

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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
\(^2\)Gurdez S Foot Ankle Int 2013; 34:1064
\(^3\)Chuter GSJ Skeletal Radiol 2013; 42:107

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.

Meralgia Paresthetica

- Sensory: anterolateral thigh
- Hypoechoic enlargement
- Ultrasound-guided steroid injection

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

Syllabus on line and other educational material:
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