Ultrasound-guided MSK Procedures: Fundamentals

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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

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

Technique:
• In versus out of plane approach
• Planning needle course
• Transducer selection
• Needle selection
• Marking skin
• Sterile technique
• Needle visualization
**Technique: plan ahead**
- Needle path
  - Shortest distance
  - Avoid neurovascular structures

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

**Technique:**
- In versus out of plane approach
- Planning needle course
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- Needle visualization

**Technique: transducer**
- Most applications:
  - > 10 MHz
  - Linear transducer

**Technique: transducer**
- Superficial:
  - > 10 MHz
  - Linear transducer
  - Small footprint
**Technique: transducer**
- Deep structures:
  - < 10 MHz
  - Curvilinear transducer
  - Hip, piriformis, posterior shoulder

**Scanning: basics**
- Holding transducer:
  - Anchor hand/transducer
  - 5th finger or hand on patient
- Holding needle:
  - Your “good” hand

**Scanning: basics**
- Beam is focused
  - Narrower than transducer width
  - 2 mm
- Sweep transducer slowly
  - Only millimeters at a time

**Technique:**
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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

- Trocar or Stylet
Technique:
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Technique:
- Direct:
  - "X" marks puncture site
  - "--" marks plane for transducer and needle
- Indirect:
  - Paperclip technique

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:
- Cleanse: ChloraPrep
  - 70% alcohol, 2% Chlorhexidine
- Sterile drapes
- Sterile ultrasound cover
- Local anesthetic
  - 1% Lidocaine
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
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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 Visualization
• Large needle
• Coated needle
• “Jiggle” the needle
• Rotate needle: bevel
• Needle perpendicular to sound beam
Needle Anisotropy: 20-gauge

Oblique Perpendicular

OR

Needle Orientation

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

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

Knee Joint: effusion


Joint Effusion: transverse plane

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

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

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

Nwawka et al. AJR 2016; 206:337

A1 Pulley Injection
- Out of plane
- 10 mg triamcinolone, 2% lidocaine
- 90% success rate: 1 year

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

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


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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

- 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

Retrocalcaneal Bursa

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

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“Cyst” Algorithm

Multilocular Non-compressible

- Ganglion cyst or
- Paralabral cyst, parameniscal cyst

Bursa anatomic or adventitious

- Inflammatory
  - Rheumatoid
  - TB, fungal
- Proliferative
  - Pigmented villonodular synovitis

Direct Trauma

- Hematoma
- Sarcoma

Other

- Solid Neoplasm
  - Myxoid liposarcoma
  - Synovial sarcoma

Cyst Aspiration

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

18-gauge needle

Ganglion Cyst (elbow): aspiration

Post-aspiration

Medial Meniscus: tear and parameniscal cyst

Femur

Tibia

Aspiration and Steroid injection
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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

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; 44:26

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

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