Ultrasound Guided Injection Techniques

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

Needle Guidance:
• Needle guide:
  – Attached to ultrasound transducer
• Free hand:
  – Indirect (only mark skin)
  – Direct (visualize needle)
    • In plane of transducer: best
    • Out of plane: superficial targets

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

Technical:
• 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:
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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
Technique: transducer

• Most applications:
  – > 10 MHz
  – Linear transducer

12 - 5 MHz Linear

Technique: transducer

• Superficial:
  – > 10 MHz
  – Linear transducer
  – Small footprint

15 - 7 MHz Compact linear

Technique: transducer

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

9 - 4 MHz Curvilinear

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Scanning: basics

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

Scanning: basics

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

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

Technique:
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Technique:
• Direct:
  “X” marks puncture site
  “--” marks plane for transducer and needle

Free hand technique

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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

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:
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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

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- Cyst

**Joint Aspiration and Injection**
- Aspiration:
  - Infection, gout, crystal disease
- Injection:
  - Anesthetic: Lidocaine, Ropivicaine
  - 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: anterior recess
- Anterior and posterior layers
  - Fibrous tissue + minute layer of synovium
  - Hyperechoic
  - Each 2 - 4 mm thick

Hip Joint: septic effusion
- Radiology 1999; 210:499

Invest Radiol 1998;33:117
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

Joint Injection

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


Knee Joint: effusion

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

Joint Effusion: transverse plane

Knee Joint: effusion

Tibiotalar Joint: effusion
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

Tibiotalar Joint Effusion: gout

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

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- Injection:
  - Anesthetic: Lidocaine, Ropivicaine
  - Steroids
  - Therapeutic or diagnostic

Biceps Tendon Long Head:
Sheath Injection

- In plane with transducer
- Lateral to medial:
  - Avoid branch of anterior circumflex humeral artery

De Quervain's Tenosynovitis

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

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, gout, crystal disease
• Injection:
  – Steroids
  – Therapeutic

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

Olecranon Bursa: injection

Iliopsoas Bursa
• Oblique-axial plane:
  – Superior to femoral head
  – Lateral to medial
  – Inject between tendon and ilium
• Pain relief = successful iliopsoas surgical release

1Dauffenbach J et al. J Ultrasound Med 2014; 33:695
2Blankenbaker DG et al. 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 injection1

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

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

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Radiology 1995; 194:525

Inferior to superior
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: aspiration

Post-aspiration

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- Miscellaneous

Paralabral cyst

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

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

Carpal Tunnel Injection

- Axial plane
- Ulnar to radial
- Begin over ulnar nerve and stay superficial
- Inject adjacent to median nerve
- Cross-sectional area may decrease within 1 week after steroid injection\(^4\)


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

See www.jacobsonmkus.com for syllabus and other educational material