Ultrasound-Guided Knee Procedures

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KEYWORDS

• Injection • Knee • Musculoskeletal • Sonography • Sports Ultrasound • Ultrasound • Ultrasound-guided injection

KEY POINTS

- The anatomy of the knee is particularly amenable to ultrasound imaging, and therefore most knee structures can be accurately targeted using ultrasound guidance.
- Studies of ultrasound-guided knee procedures have consistently shown high accuracy.
- Using ultrasound guidance for knee procedures is particularly useful for obese patients, diagnostic injection specificity, safety around neurovascular structures, and precise targeting of pathology.
- More studies are needed to assess the clinical efficacy and cost-effectiveness of various ultrasound-guided knee procedures.

INTRODUCTION

The anatomy of the knee is particularly amenable to ultrasound (US) imaging, and therefore most knee structures can be accurately targeted using US guidance. In most individuals, these structures are superficial, and the overlying soft tissues are mobile and compressible, facilitating excellent visualization with a high-frequency linear array transducer. The circumferential accessibility to the knee affords flexibility and often multiple procedural approach options. In most cases, an in-plane approach (ie, parallel to the transducer) can be easily achieved, improving needle visualization and injection safety.

ULTRASOUND-GUIDED KNEE JOINT INJECTIONS

Indications

General indications for US-guided (USG) knee joint injections include failure of a prior landmark-guided (LG) knee joint injection, complex postoperative or

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posttraumatic anatomy, obese body habitus, need for diagnostic specificity, and orthobiologic injections (eg, hyaluronic acid, platelet-rich plasma, bone marrow aspirate concentrate), in which intra-articular placement is essential for the treatment mechanism.[1–4]

Cost-Effectiveness

- Although studies have generally shown superior accuracy of USG knee joint[2,3] injections, there remains some debate regarding cost-effectiveness.
- Sibbitt and colleagues[5] showed that, relative to LG knee joint corticosteroid injections, USG injections led to 13% reduction ($17) in cost per patient per year and 58% ($224) reduction in cost per responder per year.
- Because injection accuracy is likely more critical for orthobiologic versus corticosteroid injection efficacy, USG may be more cost-effective when delivering orthobiologic injections, although this has not been specifically investigated.

KNEE JOINT INJECTION: SUPRAPATELLAR APPROACH

Indications

- Easy access to the joint via the suprapatellar recess.[1,2,4,5]
- Avoid contact with cartilage and other intra-articular structures.
- Preferred approach for visualizing and aspirating effusion.

Accuracy

- Bum and colleagues[4] showed greater accuracy with the suprapatellar USG approach (96.0%) than LG injections (83.7%).
- Curtiss and colleagues[2] showed 100% accuracy with the suprapatellar USG approach across experience levels, whereas LG injections showed less accuracy and more variability (55%–100%).

Safety

There are no published complications with this approach.

Clinical Efficacy

Relative to LG injections, the suprapatellar USG approach resulted in 48% reduction in procedural pain, 42% reduction in pain at outcome, and 36% increase in therapeutic duration.[5]

Positioning

- Patient supine with knee partially flexed (**Fig. 1**A).
- Transducer in anatomic transverse plane over suprapatellar recess.

Preprocedural Scan

- Visualize suprapatellar recess deep to the quadriceps fat pad/tendon and superficial to the prefemoral fat pad.
- If effusion present, this makes for an effective target (**Fig. 1**B). Small effusions can be enhanced with knee flexion. Check dependent portions of joint recess.
- Note depth of target for planning skin entry point.

Needle Approach

- In plane relative to transducer (**Fig. 1**C, D).
- Advance lateral to medial or medial to lateral.

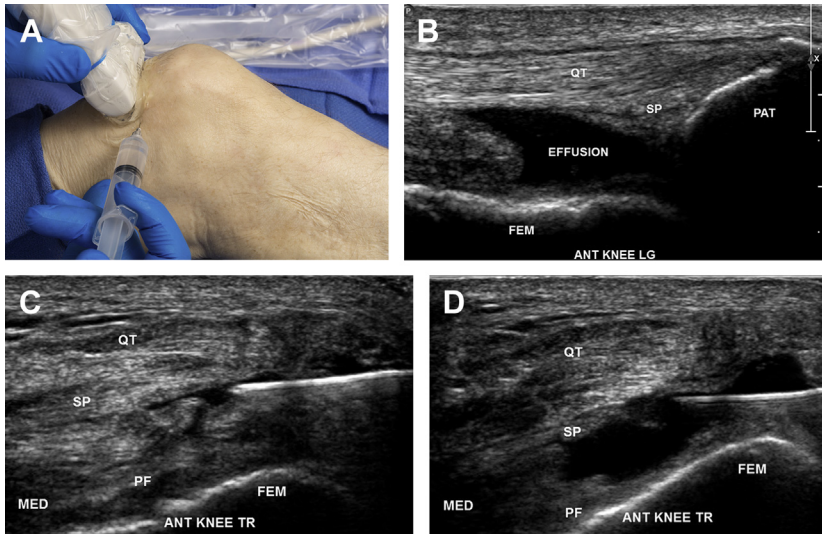

Fig. 1. (*A*) Setup for a right knee sonographically guided, lateral-to-medial, suprapatellar joint recess injection. Proximal is left. (*B*) Sonographic longitudinal view of an effusion in the suprapatellar joint recess between the suprapatellar fat pad and quadriceps tendon. Note that this is a different orientation from that depicted in Fig. 1A. (*C*) Sonographic transverse view of a lateral-to-medial injection, in plane with the transducer into the suprapatellar joint recess between the suprapatellar fat pad and prefemoral fat pad. Medial is left. (*D*) Injectate distending the suprapatellar joint recess. Medial is left. ANT, anterior, FEM, femur, LG, longitudinal; MED, medial; PAT, patella; PF, prefemoral fat pad, QT, quadriceps tendon, SP, suprapatellar fat pad, TR, transverse.

Pearls

- To confirm plane of suprapatellar recess, use external pressure to mobilize prefemoral fat pad and visualize differential motion relative to quadriceps tendon.
- Do not confuse hypoechoic fat pad or synovitis with an effusion; the latter is typically compressible and displaceable.
- During injection, confirm injectate flow distally into patellofemoral joint by visualizing suprapatellar recess in anatomic sagittal plane.

KNEE JOINT INJECTION: PATELLOFEMORAL APPROACH

Indications

No effusion present and/or suprapatellar recess is difficult to visualize.[1,3]

Accuracy

Ninety-five percent using lateral patellofemoral approach (out of plane, or perpendicular, relative to transducer), but there have been no direct comparisons with other USG approaches or LG injections.[3]

Safety

No published complications with this approach.

Clinical Efficacy

No published studies have evaluated the clinical efficacy of this approach.

Positioning

- Patient supine with knee extended (Fig. 2A).
- Transducer in anatomic axial plane over the anterolateral knee with visualization of the lateral patella and lateral femoral epicondyle.
- Positioning is similar on the medial side for a medial patellofemoral approach.

Preprocedural Scan

- Lateral (or medial) patellofemoral recess adjacent to patellofemoral joint.
- Check dependent regions of recess for small effusion.

Needle Approach

- Out of plane: advance proximal to distal or distal to proximal (Fig. 2B).
  - Use walk-down technique until needle descends into patellofemoral joint.
- In plane: advance lateral to medial or medial to lateral (Fig. 2C).
  - Can inject into patellofemoral recess or directly into patellofemoral joint.

Pearls

- If no effusion to target in joint recess, it is essential to visualize needle tip pass deep to patellofemoral retinaculum and periretinacular tissue before injecting.
- During injection, confirm intra-articular flow by visualizing injectate flow into suprapatellar recess.

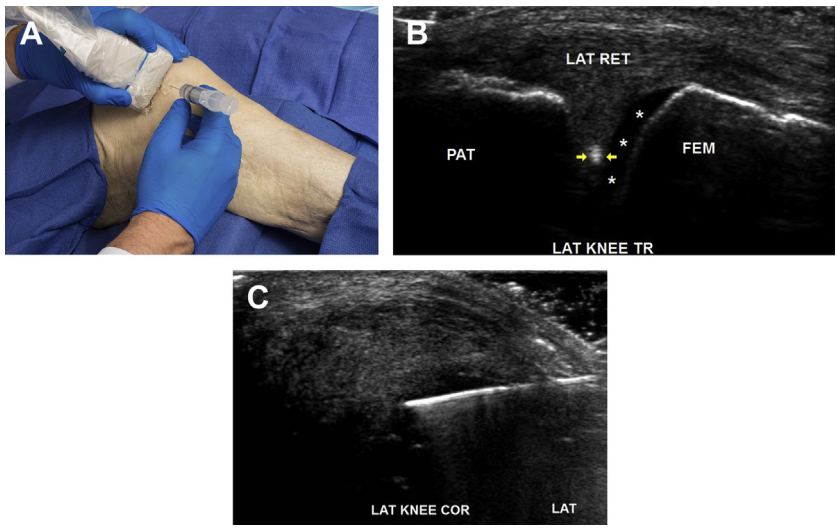

Fig. 2. (*A*) Setup for a right knee sonographically guided lateral patellofemoral joint injection, out of plane with the transducer. Proximal is left. (*B*) Sonographic oblique transverse view of the lateral patellofemoral joint space deep to the lateral patellofemoral retinaculum between the patella and femur showing an injection out of plane with the transducer. Arrows identify the needle tip in short axis adjacent to the femoral articular cartilage (asterisks). (*C*) Sonographic coronal view of lateral patellofemoral joint space injection in plane with the transducer. Right is lateral/distal. Note this is a different orientation than that depicted in Fig. 2A. COR, coronal; LAT, lateral; LAT RET, lateral patellofemoral retinaculum.

KNEE JOINT INJECTION: POSTEROMEDIAL APPROACH

Indications

- No effusion present and/or suprapatellar recess is difficult to visualize.[1,6]
- Patellofemoral osteoarthritis limits patellofemoral approach.
- Performing Baker cyst aspiration in conjunction with knee joint injection (allows for single sterile preparation without changing patient position).

Accuracy

- One study showed 100% accuracy of this approach, but made no direct comparisons with other USG approaches or LG injections.[6]

Safety

No complications with this approach in the series mentioned earlier (n = 67).[6]

Clinical Efficacy

No published studies have evaluated the clinical efficacy of this approach.

Positioning

- Patient prone with knee extended (Fig. 3A).
- Transducer in anatomic axial plane over the posteromedial femoral condyle.

Preprocedural Scan

- Identify chondral surface of posteromedial femoral condyle.
- Identify and avoid popliteal neurovascular bundle and saphenous nerve.

Needle Approach

In plane: advance medial to lateral between semimembranosus (SM) and gracilis just superficial to articular surface of medial femoral condyle (Fig. 3B).

Pearls

During injection, confirm intra-articular flow along superficial surface of hypoechoic medial femoral condyle cartilage.

BAKER CYST ASPIRATION/FENESTRATION

Indications

- Complete aspiration of cyst, including multilocular cysts.[1,7,8]

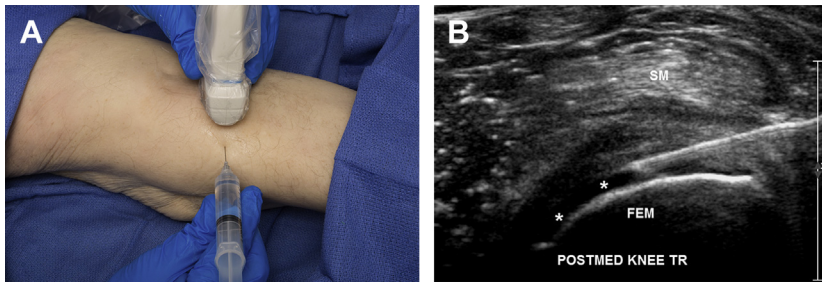

Fig. 3. (*A*) Setup for a right knee sonographically guided posteromedial knee joint injection, in plane with the transducer. Proximal is left, posterior is top. (*B*) Sonographic transverse view of a posteromedial-to-lateral knee joint injection, in plane with the transducer, and deep to semimembranosus (SM) and gently contacting the posterior medial femoral condyle articular cartilage (*asterisk*). POSTMED, posteromedial.

- Avoid injury to popliteal neurovascular bundle.
- Targeting walls and/or stalk of cyst with fenestration.

Accuracy

No published studies have evaluated USG relative to LG popliteal cyst aspirations.

Safety

Smith and colleagues[8] reported no complications in a series of 47 USG Baker cyst aspiration, fenestration, and cortisone injection procedures.

Clinical Efficacy

Smith and colleagues[8] reported significant clinical improvement at a mean 90.2 weeks of follow-up after USG Baker cyst aspiration, fenestration, and cortisone injection procedures.

Positioning

- Patient prone with knee extended.
- Transducer in anatomic transverse (Fig. 4A) or sagittal (Fig. 4B) plane over dependent part of cyst.

Preprocedural Scan

- Identify and avoid popliteal neurovascular bundle.
- Confirm Baker cyst (vs tumor, aneurysm, or ganglion cyst) (Fig. 4C).
  - Anechoic, compressible cyst with stalk emanating from posteromedial knee joint between medial gastrocnemius and SM.
  - Do not mistake anisotropic tendon for cyst/fluid. Toggle the transducer to confirm, particularly for the SM tendon, which may appear round and hypoechoic in this region because of anisotropy.
  - Cyst may be simple, multiloculated, or ruptured. May have hyperechoic synovial debris.
  - Assess with Doppler. May see cyst wall hyperemia, but be wary of extensive hyperemia or flow within cyst, which may suggest a soft tissue mass.
  - If cyst is in atypical location or has atypical soft tissue features, further investigation (eg, MRI with and without intravenous contrast) may be warranted to evaluate for the presence of a soft tissue tumor before consideration of a procedure.

Needle Approach

In plane: advance medial to lateral (or lateral to medial) (Fig. 4D) or distal to proximal (Fig. 4E), depending on shape and orientation of cyst.

Pearls

- Fenestration more accurately performed if done before aspiration.
- Aspirate with needle tip in most dependent portion of cyst (in prone position).
- Consider addressing source of cyst fluid with intra-articular injection (eg, corticosteroid).[7]

ILIOTIBIAL BAND PERITENDINOUS INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to iliotibial band (ITB) syndrome.[1,9]
- Avoid injury to the common fibular nerve.

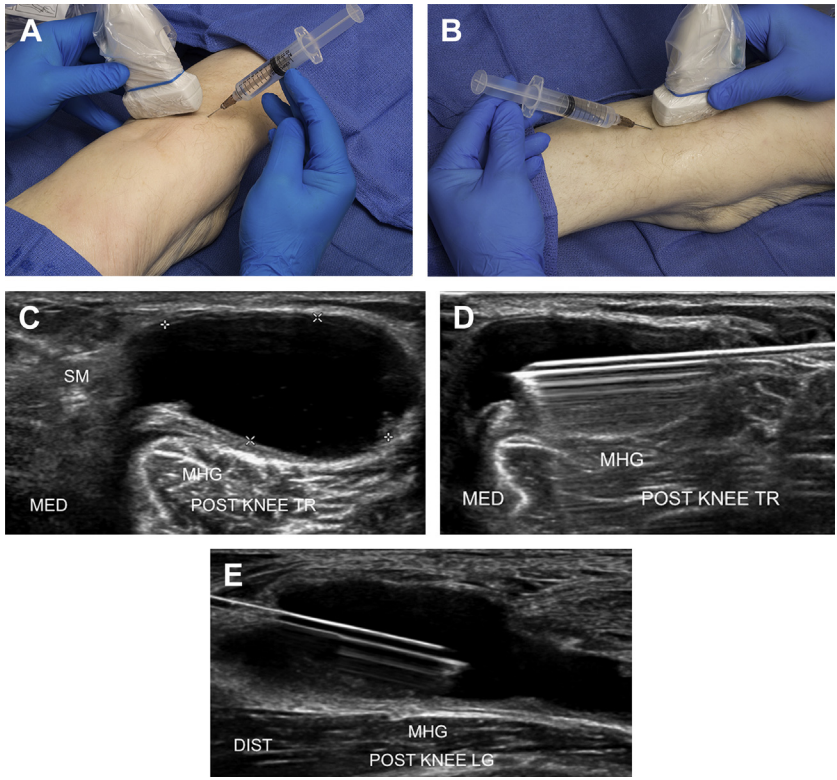

Fig. 4. (*A*) Setup for a right knee sonographically guided Baker cyst aspiration, in plane with the transducer and transverse to the leg. Proximal is bottom left, posterior is top. (*B*) Setup for a left knee sonographically guided Baker cyst injection, in plane with the transducer and longitudinal to the leg. Distal is left, posterior is top. (*C*) Sonographic transverse view of a Baker cyst (outlined by + and ×) between the SM tendon and medial head of gastrocnemius (MHG). (*D*) Sonographic transverse view of a lateral-to-medial Baker cyst aspiration, in plane with the transducer, between the SM tendon (SM) and MHG. (*E*) Sonographic longitudinal view of a distal-to-proximal Baker cyst aspiration, in plane with the transducer and superficial to the MHG. DIST, distal; MED, medial; POST, posterior.

Accuracy

No published studies have evaluated USG relative to LG ITB peritendinous injections.

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient is placed in lateral recumbent position with side to be injected facing up (Fig. 5A).
- Transducer in anatomic transverse plane over the ITB at the lateral femoral epicondyle.

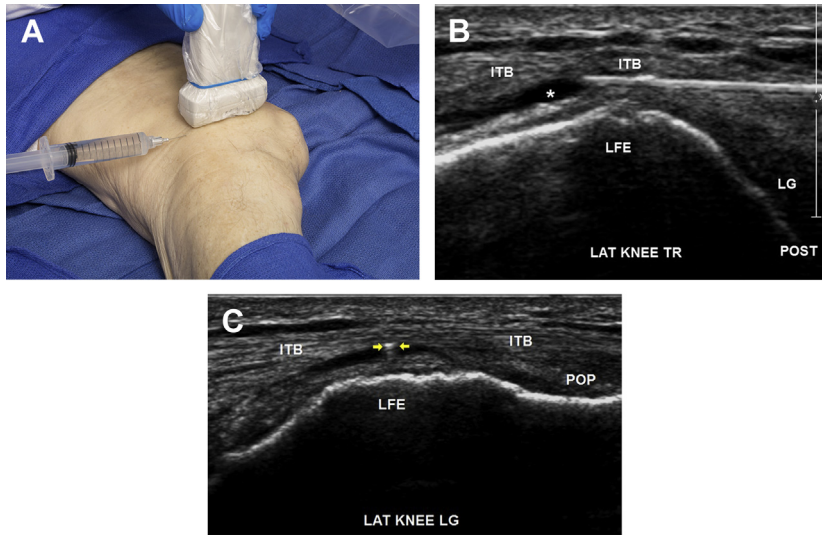

Fig. 5. (*A*) Setup for a right knee sonographically guided ITB injection, in plane with the transducer and in short axis to the ITB. Proximal is upper left, anterior is right. (*B*) Sonographic transverse view of a posterior-to-anterior injection, in plane with the transducer, between the ITB and the lateral femoral epicondyle (LFE). Note fluid (*asterisk*) deep to ITB. (C) Sonographic coronal/longitudinal view of a posterior-to-anterior injection, out of plane with the transducer, between the ITB and LFE (*arrows* denote needle tip). Popliteus is visualized on the distal, posterolateral femur. LG, lateral gastrocnemius; POP, popliteus.

Preprocedural Scan

- Confirm tendinopathic or tender region of distal ITB, most commonly at level of lateral femoral epicondyle.
- Identify and avoid common fibular nerve.

Needle Approach

In plane/Out of plane: advance posterior to anterior at the deep surface of the ITB (Fig. 5B, C).

Pearls

Float transducer to identify occult fluid deep to ITB. Be aware that what looks like fluid in the ITB bursa may be a knee effusion in the lateral joint recess.[9]

PES ANSERINE BURSA INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to pes anserine tendinopathy/bursopathy.[1,10]
- Avoid injury to the inferior medial geniculate artery and saphenous nerve.

Accuracy

Finnoff and colleagues[10] showed accuracy rate of 92% using USG injections compared with 17% for LG injections.

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient supine with the hip externally rotated and knee slightly flexed (Fig. 6A)
- Transducer
  - Oblique coronal plane, long axis (LAX) to pes anserine tendons.
  - Coronal plane, oblique short axis (SAX) to tendons.

Preprocedural Scan

- Identify semitendinosus tendon in SAX in distal posteromedial thigh.
- Trace semitendinosus tendon distally/anteriorly as it converges with gracilis and sartorius tendons.
- As tendons are traced to anteromedial tibia, identify medial collateral ligament (MCL) passing deep to tendons.
- Pes anserine bursa is in plane deep to tendons and superficial to MCL.
- Identify and avoid inferior medial geniculate artery deep to MCL.
- Note saphenous nerve emerging superficial to gracilis and avoid during procedure.
- Identify and avoid great saphenous vein posterior to pes anserine tendons.

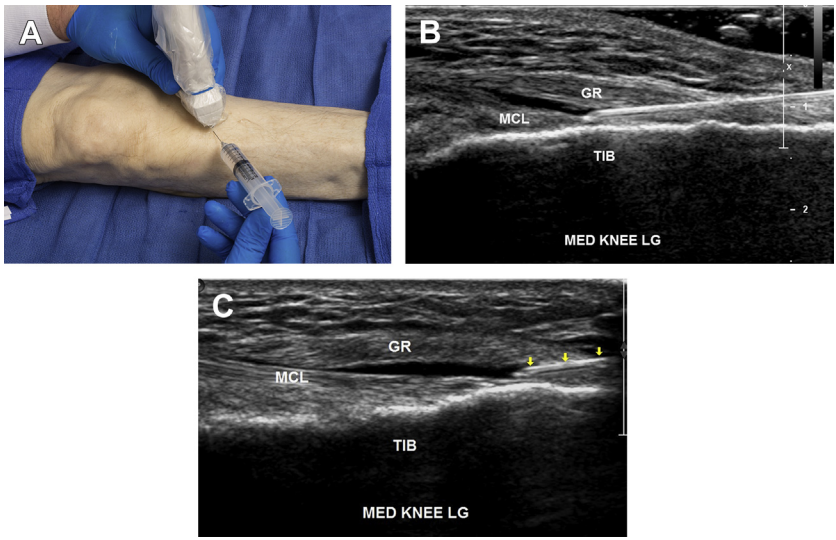

Fig. 6. (*A*) Setup for a right knee sonographically guided pes anserine bursa injection, long axis to the pes anserine tendons and in plane with the transducer. Proximal is left, medial is top. (*B*) Sonographic oblique longitudinal view of a distal/anterior to proximal/posterior pes anserine bursa injection, in plane with the transducer and long axis to the pes anserine tendons. The needle passes through the gracilis (GR) tendon, into the pes anserine bursa, which is superficial to the obliquely inserting medial collateral ligament (MCL) into the tibia. (*C*) Sonographic coronal/longitudinal view of a distal-to-proximal pes anserine bursa injection, in plane with the transducer, oblique short axis to the traversing gracilis (GR) tendon, and superficial to the MCL. The needle is denoted by arrows. Note this is a different orientation than that depicted in Fig. 6A. TIB, tibia.

Needle Approach

- In plane relative to transducer.
- LAX to tendons: advance distal/anterior to proximal/posterior (Fig. 6B).
- Oblique SAX to tendons: advance distal to proximal (Fig. 6C).

Pearls

Tilting the transducer can cause the tendons to appear anisotropic and facilitate differentiation from the underlying MCL.

SUPERFICIAL/DEEP INFRAPATELLAR BURSAE INJECTIONS

Indications

- Diagnostic and/or therapeutic injection for pain attributed to infrapatellar bursopathy.[1]
- Avoid intratendinous corticosteroid injection.

Accuracy

No published studies have evaluated or compared USG versus LG injections.

Safety

No published complications with these injections.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG for these injections.

Positioning

- Patient supine with the knee slightly flexed (Fig. 7A).
- Transducer in anatomic transverse plane over distal patellar tendon.

Preprocedural Scan

- Identify fluid superficial/deep to distal patellar tendon (Fig. 7B).
- Minimal fluid in deep infrapatellar bursa is physiologic.
- Excess fluid, presence of color or power Doppler flow, and sonopalpatory tenderness suggest bursitis.

Needle Approach

In plane/Out of plane: advance lateral to medial either deep (Fig. 7C, D) or superficial (Fig. 7E) to distal patellar tendon.

Pearls

- Float transducer to identify occult superficial infrapatellar bursal fluid.
- Sliding lateral/medial to midline patellar tendon can reveal dependent deep infrapatellar bursal fluid.

POPLITEUS TENDON SHEATH INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to popliteus tendinopathy or snapping popliteus tendon.[1,11]
- Avoid common fibular nerve injury or intratendinous corticosteroid injection.

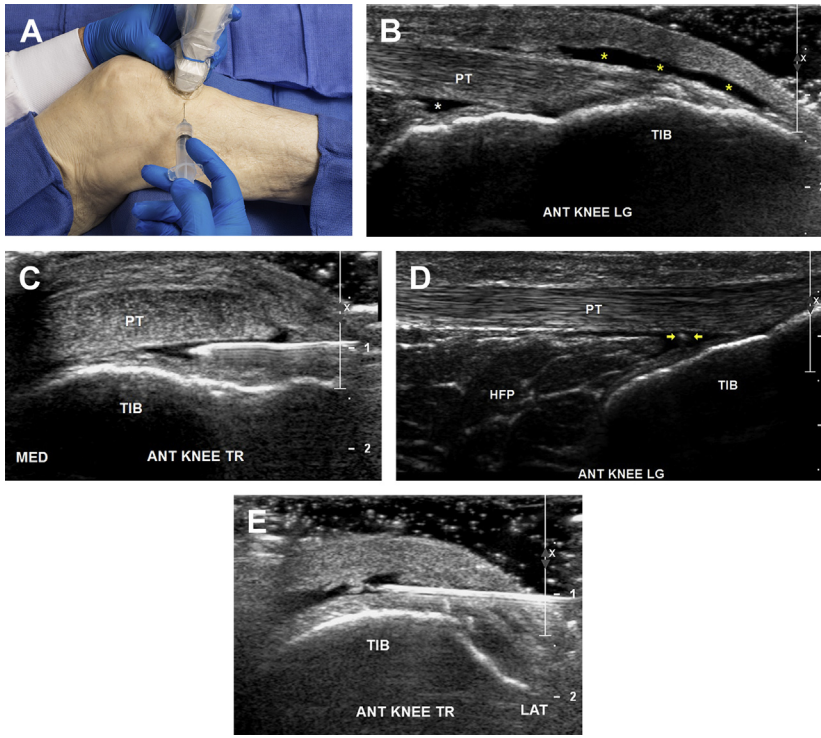

Fig. 7. (*A*) Setup for a right knee sonographically guided, lateral-to-medial, deep infrapatellar bursa injection, in plane with the transducer. A similar approach can be used to target the superficial infrapatellar bursa. Proximal is left. (*B*) Sonographic longitudinal view showing fluid (*asterisk*) within the superficial and deep infrapatellar bursae, superficial and deep to the patellar tendon near its insertion into tibia. (*C*) Sonographic transverse view of a lateral-to-medial injection, in plane with the transducer into the deep infrapatellar bursa, between the tibia and patellar tendon. (*D*) Sonographic longitudinal view of a lateral-to-medial injection, out of plane with the transducer, into the deep infrapatellar bursa. The needle tip is identified between the arrows. (*E*) Sonographic transverse view of a lateral-to-medial superficial infrapatellar bursa injection, in plane with the transducer. Needle tip is superficial to the patellar tendon near its insertion into the tibia. HFP, Hoffa fat pad; PT, patellar tendon.

Accuracy

- Smith and colleagues[11] showed 100% accuracy with LAX approach and 83% accuracy with SAX approach.
- No published studies have compared USG with LG injections.

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient lateral recumbent with the top/symptomatic knee slightly flexed and leg internally rotated.
- Transducer:
  - Anatomic oblique coronal plane (proximal end anterior) over posterior aspect of the lateral femoral epicondyle, LAX to popliteus tendon (Fig. 8A).
  - Anatomic oblique coronal plane (proximal end posterior) over lateral knee, SAX to the popliteus tendon (Fig. 8B).

Preprocedural Scan

- Place proximal end of transducer on lateral femoral epicondyle and visualize fibular collateral ligament (FCL) and popliteus sulcus with popliteus in oblique transverse view.
- Approach LAX to tendon:
  - Keeping popliteus tendon fibers in view, rotate distal end of transducer posteriorly until popliteus tendon is visualized in LAX.
- Approach SAX to tendon:
  - Keeping popliteus tendon fibers in view, rotate proximal end of transducer posteriorly until popliteus tendon is visualized in SAX.
- Identify and avoid common fibular nerve.

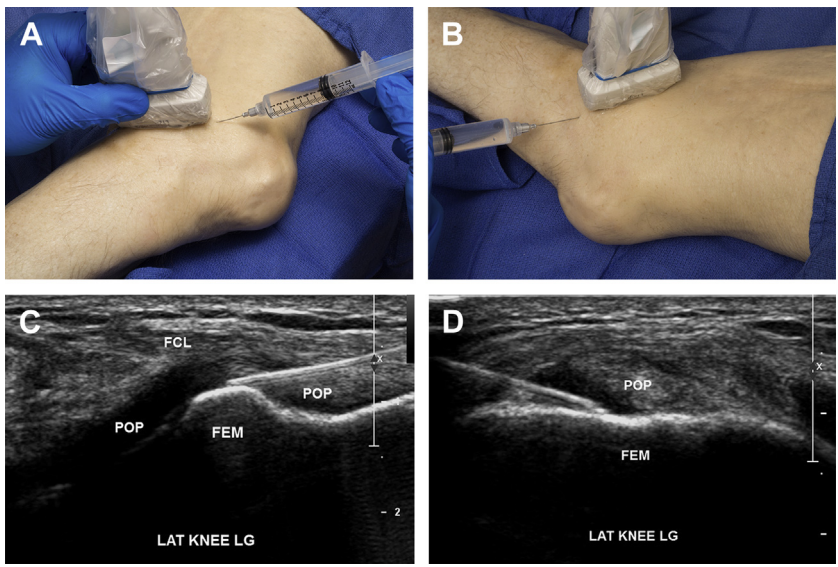

Fig. 8. (*A*) Setup for a right knee sonographically guided popliteus tendon sheath injection, LAX to the popliteus, and in plane with the transducer. Distal is left, lateral is top. (*B*) Setup for a right knee sonographically guided popliteus tendon sheath injection, SAX to the popliteus and in plane with the transducer. Distal is left, lateral is top. (*C*) Sonographic coronal oblique view of proximal/anterior-to-distal/posterior, popliteus tendon sheath injection, LAX to the tendon and in plane with the transducer. Note that the needle passes through the tendon to the deep side of the tendon sheath. Fibular collateral ligament (FCL) crosses obliquely superficial to the popliteus. (*D*) Sonographic coronal oblique view of distal/anterior-to-proximal/posterior popliteus tendon sheath injection, SAX to the tendon and in plane with the transducer. Note that the SAX approach allows for injection into the deep aspect of the tendon sheath without passing through the tendon.

Needle Approach

- LAX to tendon, in plane: advance proximal/anterior to distal/posterior, entering superficial side of tendon sheath just anterior and deep to FCL (Fig. 8C).
- SAX to tendon, in plane: advance distal/anterior to proximal/posterior, to either superficial or deep side of tendon sheath (Fig. 8D).

Pearls

- SAX to tendon approach allows injection to deep side of tendon sheath without passing through tendon.
- Given the frequency of asymptomatic popliteus tendinopathy, diagnostic injection can be helpful in evaluation of posterolateral knee pain, although injectate overflow into joint is possible via popliteus hiatus.

PROXIMAL TIBIOFIBULAR JOINT INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to proximal tibiofibular joint (PTFJ).[1,12]
  - Other diagnostic tests frequently lack specificity to make this diagnosis.
- Avoid injury to the common, superficial, and deep fibular nerves.

Accuracy

One study showed 100% accuracy for USG injection compared with 58% accuracy for LG injection.[12]

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient in oblique side-lying position with the knee slightly flexed (Fig. 9A).
- Transducer in anatomic transverse oblique plane (medial side pivoted proximally) with its LAX perpendicular to the PTFJ.

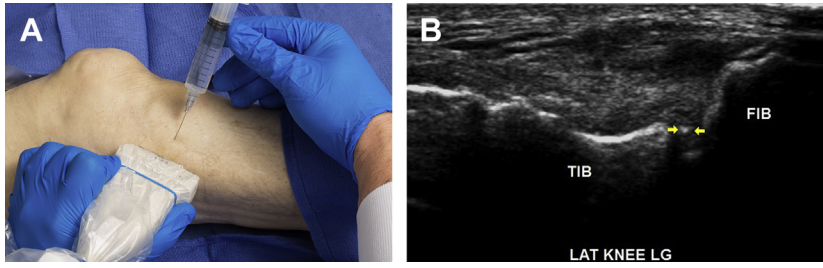

Fig. 9. (*A*) Setup for a right knee sonographically guided PTFJ injection, out of plane with the transducer. Proximal is left, anterior is top. (*B*) Sonographic oblique transverse view of a distal/anterior-to-proximal/posterior injection, out of plane with the transducer, into the PTFJ. Arrows denote needle tip.

Preprocedural scan

- Anchor lateral end of transducer on fibular head with medial end oriented toward inferior patellar pole and rotated to optimize visualization of the PTFJ.[12]
- Anterior superior tibiofibular ligament serves as landmark for the joint space.[12]
- Identify and avoid the common, superficial, and deep fibular nerves.

Needle Approach

Out of plane: distal-to-proximal approach, using a walk-down technique into PTFJ (Fig. 9B).

Pearls

Optimal transducer angulation highly variable given interindividual variation in PTFJ orientation.[12]

MEDIAL (TIBIAL) COLLATERAL LIGAMENT BURSA INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to MCL bursopathy.[13]
- Avoid inadvertent injection into adjacent soft tissues or knee joint.

Accuracy

No published studies have evaluated or compared USG versus LG injections.

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient supine with the hip externally rotated and knee slightly flexed (Fig. 10A).
- Transducer in anatomic coronal plane over the medial joint line.

Preprocedural Scan

Transducer translated anteriorly and posteriorly to optimally visualize the bursal space lying between the superficial and deep MCL fibers.

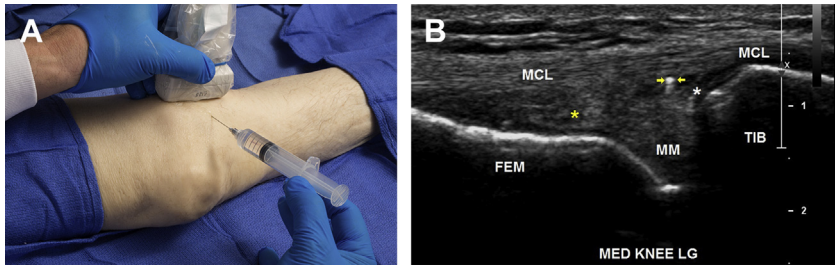

Fig. 10. (*A*) Setup for a right knee sonographically guided MCL bursa injection, out of plane with the transducer. Proximal is left, medial is top. (*B*) Sonographic coronal/longitudinal view of an anterior-to-posterior MCL bursa injection, out of plane with the transducer. The needle tip (*arrows*) is visualized deep to the traversing superficial MCL and superficial to the deep MCL (asterisks) and the medial meniscus (MM) in its SAX, between the distal femur and proximal tibia.

Needle Approach

Out of plane: advance anterior to posterior deep to superficial MCL fibers and into bursa (Fig. 10B).

Pearls

Initial lidocaine injection can be used to confirm flow within bursal plane.

SEMIMEMBRANOSUS BURSA INJECTION

Indications

- Diagnostic and/or therapeutic injection for pain attributed to SM tendinopathy/bursopathy.[14]
- Identification and avoidance of the saphenous nerve and its branches.

Accuracy

- Onishi and colleagues[14] showed 100% accuracy of USG SM bursa injections.
- No published studies have compared USG with LG injections.

Safety

No published complications with this injection.

Clinical Efficacy

No published studies have evaluated or compared the clinical efficacy of USG versus LG injections.

Positioning

- Patient lateral recumbent with bottom knee partially flexed to optimize imaging of the distal SM tendon (Fig. 11A).
- Transducer transverse to SM tendon at level of posteromedial tibial plateau, parallel to the popliteal crease.

Preprocedural Scan

- Trace SM tendon in SAX just proximal to division of anterior and direct arms.
- Identify and avoid saphenous nerve and its branches.

Needle Approach

In plane/Out of plane: advance anterior/proximal to posterior/distal to interval between SM tendon and posteromedial tibia (Fig. 11B, C).

Pearls

Placing towel under lateral midfoot internally rotates tibia and relaxes SM, facilitating injectate flow throughout bursa (Fig. 11D).

ANTERIOR CRUCIATE LIGAMENT INJECTION

Indications

Direct delivery of medication or regenerative agent into the anterior cruciate ligament (ACL) for therapeutic purposes (eg, partial tear).[15,16]

Accuracy

Smith and colleagues[15] showed 100% accuracy of USG ACL injections. Although fluoroscopically guided (FG) ACL injections are performed in practice, there are no published studies of LG ACL injection accuracy.

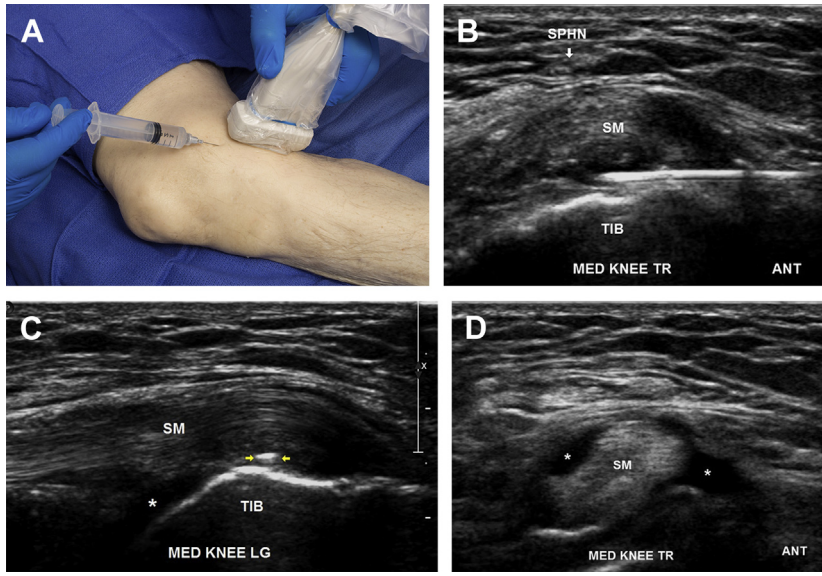

Fig. 11. (*A*) Setup for a right knee sonographically guided SM bursa injection, SAX to the SM tendon, and in plane with the transducer. Proximal is upper left, medial is top. (*B*) Sonographic transverse view of a proximal/anterior-to-distal/posterior injection, in plane with the transducer, and into the SM bursa, which is deep to the SM tendon in its SAX. Note the proximity of the saphenous nerve (SPHN). (*C*) Sonographic longitudinal view of a proximal/anterior-to-distal/posterior injection, out of plane with the transducer, and into the SM bursa (*asterisk*). Needle tip (*arrows*) is deep to the SM tendon, which is in its LAX as it inserts into the tibia. (*D*) Sonographic transverse view of injectate distending the SM bursa (*asterisk*).

Safety

No published complications with this injection.

Clinical Efficacy

Small case series (7 out of 10 patients) showed improvements in pain, function, and ACL MRI appearance after FG bone marrow concentrate injections for ACL sprains and partial tears. No published studies have evaluated the clinical efficacy of USG ACL injections.[16]

Positioning

- Patient supine with the knee flexed to at least 90° and the tibia in slight internal rotation to increase tension on the ACL (**Fig. 12**A).
- Transducer initially placed in anatomic coronal plane over medial joint line near MCL. Final position is in oblique sagittal orientation inferomedial to patella.

Preprocedural Scan

- Beginning in anatomic coronal plane over medial joint line, transducer is translated anteriorly toward patellar tendon.
- As the sagittal plane and patellar tendon are approached, the distal ACL can be identified in oblique orientation ~1 cm deep to anterior tibial cortex.
- ACL will appear hypoechoic because of anisotropy.

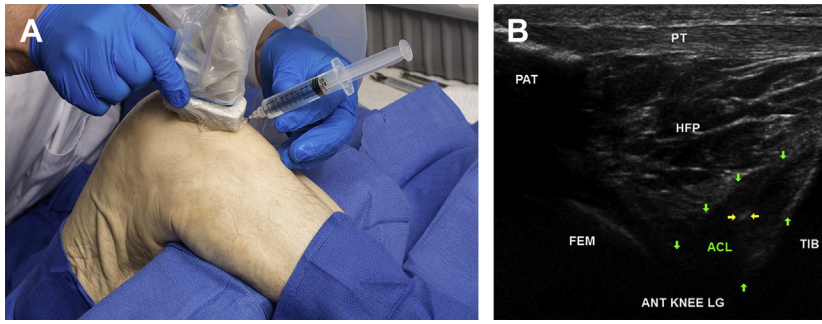

Fig. 12. (*A*) Setup for a right knee sonographically guided ACL injection, LAX to the ligament, and in plane with the transducer. Proximal is left, anterior is top. (*B*) Sonographic sagittal oblique view of an anterior cruciate ligament injection (*yellow arrows* indicate needle tip), in plane with the transducer, with the ACL (*green arrows*) in LAX. Femur, tibia, HFP, patella, and patellar tendon are all visible.

- Proximal end of transducer rotated laterally ~30° (toward inferior pole of patella) to align with orientation of ACL.

Needle Approach

In plane: distal/anterior to proximal/posterior approach, LAX to the ACL, passing medial to patellar tendon, above tibial plateau, and into distal ACL (**Fig. 12**B).

Pearls

- Proximal heel-toe maneuver may improve ACL conspicuity.
- Rotating transducer SAX to ACL/needle tip may facilitate targeting of specific ACL bundle.

SUMMARY

Most structures about the knee region can be accurately targeted for diagnostic or therapeutic injections using USG. The literature consistently reports excellent accuracy using USG to target knee structures, and the use of USG carries many benefits compared with LG injections, such as increased utility with obese patients, diagnostic injection specificity, safety around neurovascular structures, and precise targeting of disorders. However, the clinical efficacy and cost-effectiveness of USG knee procedures have not been well defined and further research in this area is warranted.

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