



Ultrasound-Guided Intra-Articular Injection of the Hip: The Nashville Sound

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Abstract: Ultrasound-guided intra-articular injection has become a mainstay in the diagnosis and treatment of a variety of hip disorders. It is the single greatest adjunct to history and examination in the clinical assessment of hip problems and has substantial therapeutic value in the conservative management of symptomatic disorders, especially when used in conjunction with supervised physical therapy.

Reliability of the diagnostic response to an intra-articular injection and its efficacy as a therapeutic tool depends on reliable injection methodology. We describe a technique validated by successful execution among thousands of consecutive cases.

Intra-articular hip joint injections are commonly performed for diagnostic and therapeutic purposes. It is important to have a reliable technique for validity of the diagnostic information, efficacy of the therapeutic effect, and safety of the procedure while minimizing patient inconvenience.

In 2004, Byrd and Jones¹ first reported on the diagnostic value of an intra-articular injection of anesthetic for patients undergoing arthroscopy. Such injections were performed in conjunction with contrast magnetic resonance imaging. Subsequently, Byrd et al.² published their experience with in-office ultrasound-guided injections, demonstrating superiority over fluoroscopically guided injections based on patient satisfaction and convenience with excellent reliability and a minimal learning curve in development of the technique.

Intra-articular corticosteroid injections have been a mainstay of conservative treatment of hip osteoarthritis.^{3,4} Intra-articular injections also have a role in the treatment of nonarthritic disorders, including femoroacetabular impingement.⁵⁻⁷ Other therapeutic intra-articular modalities include viscosupplementation and an expanding role for orthobiologics such as platelet-rich plasma.^{4,8}

The purpose of this report is to describe a technique of ultrasound-guided intra-articular injection of the hip (the Nashville Sound), which was developed with a minimal learning curve and has proven to be safe and effective based on the outcomes of thousands of procedures (Tables 1 and 2).

Procedural Technique

The goal of the intra-articular hip injection is to enter the joint capsule at the anterolateral surface of the femoral neck at the femoral head–neck junction (Video 1). Injection is performed so that the needle enters the joint capsule as far lateral as possible while maintaining visualization of the femoral neck and joint capsule to avoid needle contact with the femoral vessels. A slightly oblique angle can also be used to further distance needle entry from the femoral vessels.

During the procedure, the patient is in the supine position with the lower extremity in neutral rotation. The ultrasound machine is placed on the side of the patient's symptomatic hip and positioned in front of the provider. In our center we use the SonoSite M-Turbo ultrasound system (SonoSite, Bothell, WA). The ultrasound transducer used for the injection is based on the patient's body habitus, but a low-frequency curvilinear transducer is typically used because of the depth of the hip joint. We use the Sonosite C60x transducer with a 5-2 MHz bandwidth for the majority of intra-articular

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The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received September 7, 2018; accepted November 21, 2018.

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2212-6287/181105

<https://doi.org/10.1016/j.eats.2018.11.016>

Table 1. Advantages and Disadvantages of Ultrasound-Guided Intra-Articular Injection

Advantages	Disadvantages
> Convenient/cost-effective for patient > Less painful than fluoroscopic guided > Can avoid contrast in patients with allergies > Allows for immediate postinjection reassessment/real-time information > Can visualize effusion and aspirate if needed > No radiation exposure > More accurate than landmark injections	> User dependent > Limited by body habitus > Upfront cost of ultrasound equipment and supplies > Requires time of provider in clinic to perform procedure

hip joint injections. Before the injection, a survey scan of the hip joint anatomy is performed, allowing visualization of the anterior rim of the acetabulum, femoral head, and femoral neck, as well as the joint capsule. It is helpful to do this before setting up the injection so that if an effusion is present, the provider can plan for an aspiration if needed. During this preprocedure scan, Doppler imaging should be used to locate the femoral vessels and smaller vessels that will need to be avoided, such as the lateral circumflex femoral artery.⁹ The anatomic location of these smaller vessels can differ from patient to patient so it is worthwhile to complete Doppler assessment during every procedure, especially for patients who are taking blood-thinning medication. If it is difficult to immediately find the femoral neck in long axis view, the femur can be visualized in short axis view and followed up to the femoral neck, which can then be viewed in long axis. Typically, preprocedure images are recorded and then the patient can be prepped for the procedure. While this is being done, the procedure assistant can set up the supplies and sterile tray (Figs 1 and 2).

Before the injection, the patient is draped with aseptic towels or a medical pad. Sterile technique is used: the patient's anterior hip and groin area is sterilized by cleansing with a chlorhexidine swab, and sterile ultrasound gel is applied over the sterilized area just above the targeted injection site. Betadine should be avoided because it can stain the ultrasound transducer. After the medication has been drawn up (Fig 3), the procedure assistant can clean the ultrasound transducer with a germicidal cloth wipe, while handing the transducer to the provider so that the ultrasound cord is also wiped down. The provider pulls the transducer cord through the wipe as the assistant holds the wipe in his or her hand. The provider should check with the

manufacturer of the ultrasound system to determine whether the cloth wipes are safe to use for the machine and transducer being used. The hip joint is then, once again, visualized in long axis view by moving the ultrasound transducer toward the most lateral portion of the femoral neck in which the joint capsule can still be visualized (Fig 4). At this point, any excess gel is wiped away with a sterile 4 × 4 gauze pad. Once the correct position has been located so that the femoral head–neck junction is well visualized, ethyl chloride can be sprayed on the skin for anesthetic purposes. The ethyl chloride must not come in direct contact with the transducer because it can damage the transducer. Contact with the needle should also be avoided. Subcutaneous anesthetic is not used in our facility because, often, the primary goal of the injection is to differentiate soft tissue pain from joint pain. If the subcutaneous tissue or muscle tissue down to the joint capsule is anesthetized, the patient could have improvement that was not related to the joint, obscuring the diagnostic value of the procedure. This also prevents the need to stick the patient with a needle twice. At that point, a 3.5-inch 22-gauge sterile spinal needle is inserted, bevel up, approximately 1 cm from the distal portion of the ultrasound transducer. Visualization of the needle is maintained so the needle can then be inserted in plane with the transducer until it pierces the joint capsule at the femoral head–neck junction (Fig 5). The needle trajectory can be adjusted as the needle is inserted to reach the desired location. When the needle is in the correct position within the capsule, the medication can be injected and visualized entering the joint capsule (Fig 6). Once the injection is complete, the needle can be removed while maintaining visualization. After the needle is removed, a small bandage can be applied, and the patient can be mobilized.

Table 2. Pearls and Pitfalls of Ultrasound-Guided Intra-Articular Injection

> When in doubt, use more ultrasound gel. Too much gel may make a mess, but too little can limit image quality. > Know your limits. If you are not 100% confident in your ability to reach the joint because of patient's body habitus, do not proceed. > The transducer should not be pressed into the soft tissues with force. It should sit securely on top of the skin. Downward force can cause compression of the soft tissues and vascular structures, obscuring visibility. > The transducer should be held firmly with the fingers around the probe and on the patient's skin. This will prevent the transducer from moving during the procedure, causing loss of visibility. > Always check for vascular structures before moving forward with an injection to prevent damage to the vessels and bleeding. > Optimize the ultrasound image before moving forward with an injection, using appropriate depth, focal zone, and gain.
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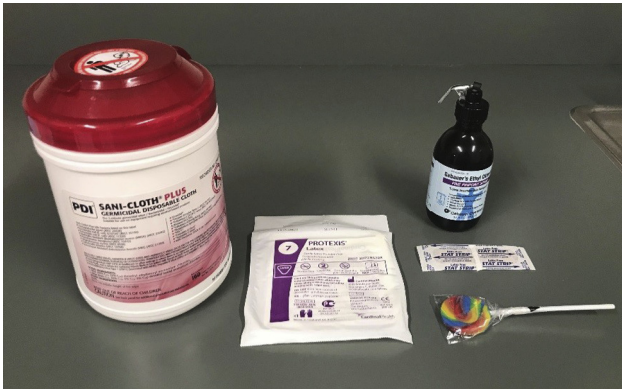


Fig 1. Injection procedure supplies (germicidal disposable cloth wipe, sterile gloves, ethyl chloride spray, bandage, lollipop [optional]).

Although not necessarily a medical technique, speaking to the patient casually during the procedure can be beneficial for the patient by increasing comfort and decreasing anxiety. We find that having the patient discuss vacation plans or upcoming family or social functions works very well. We try to make the patient as comfortable as possible, and creating a relaxed, friendly environment goes a long way. We also try to reward everyone with a lollipop after the procedure is complete. Who doesn't love a lollipop?

After the injection, the patient can be reassessed to determine how much of his or her overall discomfort was related to an intra-articular source. This may be done through physical examination or by having the patient perform activities that created symptoms before the injection. Strength can also be tested to differentiate between muscle weakness and guarding. This ultrasound-guided injection technique can be used for both diagnostic injections of anesthetic and



Fig 2. Sterile tray containing procedure supplies (1.5-inch, 18-gauge needle; sterile 10-cc syringe; 3.5-inch, 22-gauge beveled spinal needle; chlorhexidine swab; sterile ultrasound gel packet; sterile 4 × 4 gauze pad).

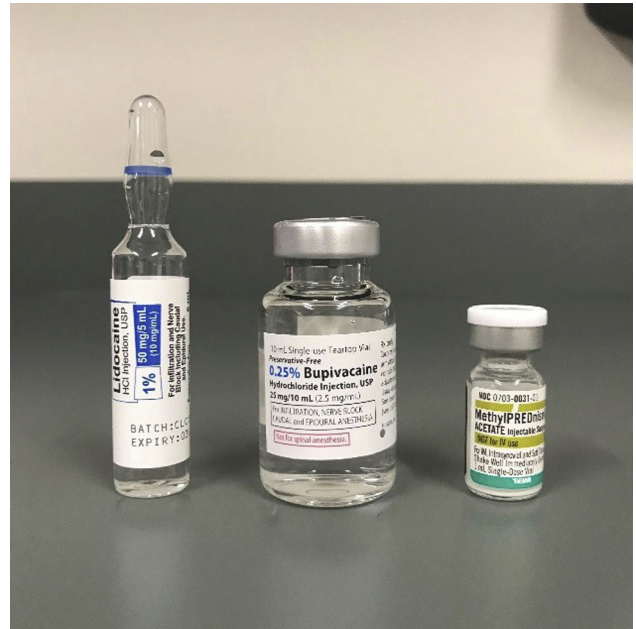


Fig 3. Typical medication used for diagnostic and therapeutic injections (1% lidocaine hydrochloride; 0.25% bupivacaine hydrochloride; methylprednisone acetate, 40 mg). For a diagnostic injection, 3 cc of 1% lidocaine and 4 cc of 0.25% bupivacaine are injected. For a therapeutic injection, 2 cc of 1% lidocaine, 4 cc of 0.25% bupivacaine, and 1 cc (40 mg) of methylprednisone are injected.

injections of corticosteroid, viscosupplements, amniotic allograft, platelet-rich plasma, or stem cells. Depending on what is being injected, the gauge of the needle may need to be adjusted. In addition to injection, this image guidance technique for needle placement can be used for joint aspiration. This allows for immediate hip joint fluid visualization and collection for laboratory assessment when infection is suspected.

After an intra-articular injection is performed and functional testing is carried out in the office for diagnostic purposes, the patient is asked to refrain from physical exercise for a specific amount of time, depending on the type of injection. If only anesthetic is injected, the patient may return to baseline activity immediately. If a corticosteroid is injected, the patient is asked to rest the hip for 1 week. When physical therapy is recommended, the program can be initiated after the 1 week of rest. The patient may immediately return to activities of daily living outside of exercise with the understanding that there may be some soreness in the joint and musculature for a couple of days.

Discussion

In our center, after history and physical examination, ultrasonography has proven to be the most important diagnostic tool and greatest adjunct to patient care. Before in-office ultrasonography was available, intra-

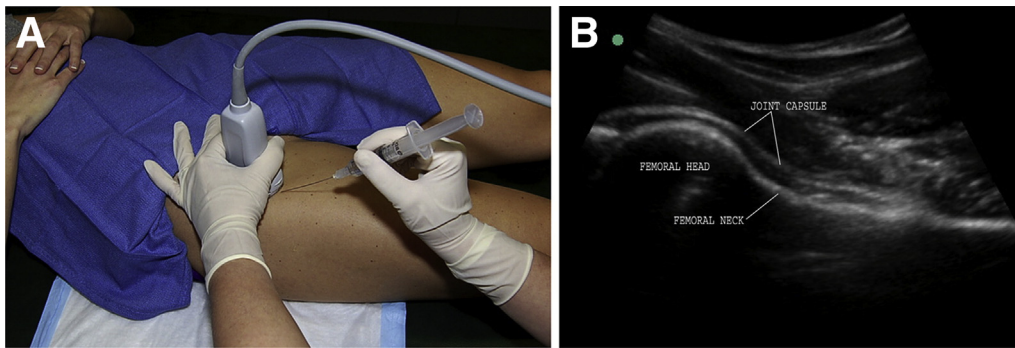


Fig 4. (A) Visualization of this right hip is performed by placing the curvilinear transducer firmly over the area of the femoral head–neck junction in the long axis view and slightly oblique. A slightly oblique angle to the transducer allows a more lateral entry site for the needle into the joint capsule and increases the distance between the needle and the femoral neurovascular structures anterior to the hip. The skin has been sterilely prepared, and sterile gel is used. Before the injection, a scan should be performed to visualize the location of the neurovascular bundle. (B) Ultrasound image of anterior right hip joint with transducer positioned over femoral head/neck junction as described earlier.

articular injections were performed under fluoroscopy, requiring a referral to the radiology department. Patients had to check in at the hospital, disrobe, and receive an injection in an unfamiliar environment from a person they had never met. For each case, the value of the injection had to be weighed against the burden of exposing the patient to the process.

In our experience, the diagnostic value of an intra-articular injection is often immeasurable. Patients with joint pathology frequently have other concomitant extra-articular problems. An injection helps to determine the degree to which the joint is a contributing to the patient's pain. For example, imaging evidence of joint pathology may be present but may not be a source of a patient's problems. An injection can help to establish the clinical relevance of imaging findings of joint damage.

Results of numerous studies support the worthiness of diagnostic hip joint injections.¹⁰⁻¹³ In 2 studies investigators have questioned the value of these injections because they were poor prognostic indicators of a patient's response to arthroscopic surgery.^{14,15} However, an injection can only help

determine whether a joint is a source of pain; it does not establish the cause of the pain. For example, advanced osteoarthritis may respond well to an intra-articular injection of anesthetic, but the patient would still be a poor candidate for arthroscopy.

At our center a combination of short-acting and long-acting anesthetics is used. The short-acting anesthetic allows an immediate postinjection reassessment to highlight any change from the preinjection symptoms. Because some patients require resumption of specific activities to provoke symptoms, the long-acting anesthetic provides a longer period in which the patient's response to the injection can be thoroughly assessed. Because of the potential cytotoxic effect of bupivacaine, a dilute solution is administered, although no clinically relevant untoward effects have been reported outside of the laboratory.^{16,17}

The potential therapeutic benefits of hip joint injection have been described in detail in the literature. Corticosteroid is most commonly the treatment of choice.³⁻⁷ Results of injections of viscosupplements and orthobiologics, especially platelet-rich plasma, have been published as well.^{4,8} The scientific data behind

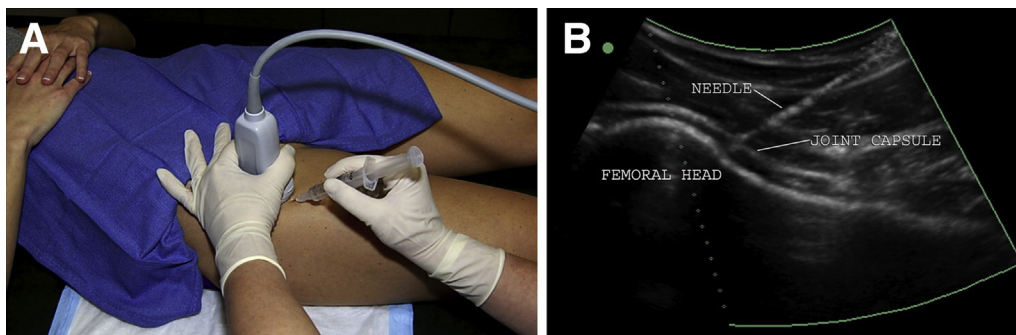
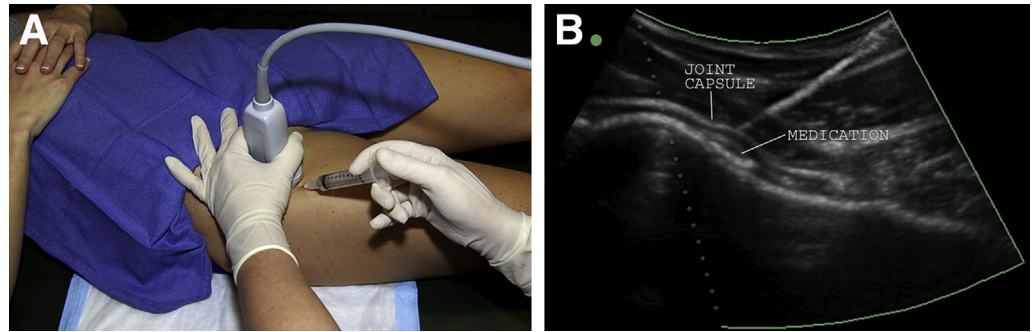


Fig 5. (A) The needle is inserted in plane with the transducer, which allows visualization of the needle throughout the course of its advancement to the capsule. (B) The needle can be seen entering the right hip joint capsule at the femoral head–neck junction.

Fig 6. (A) The transducer remains in the same plane throughout the injection. (B) The medication can be visualized entering the right hip joint capsule.



these alternative injections are mixed and sometimes inconsistent. The reported problems associated with these products are minimal. For some patients, the response in terms of relief of symptoms has been sufficient to at least consider it as an option for modulating symptoms, especially in the face of degenerative disease for which the only predictable surgical option is an arthroplasty.

For patients being evaluated for arthroscopy, there is no time limit between a diagnostic injection and surgery, but when corticosteroids are injected, a waiting period of 4 to 6 weeks is usually implemented. The waiting period has 2 purposes. The first purpose is to minimize any inhibitory effect the corticosteroid may have on healing and recovery from the surgery. The second is to determine the beneficial effects of the corticosteroid injection for the patient, which can take at least a month to become apparent. Thus, injecting the joint and proceeding directly with surgery does not seem like a very logical treatment algorithm. When this strategy is used, no adverse postoperative effects are encountered as a result of a preoperative injection.

There are no reports in the literature of complications associated with ultrasound-guided intra-articular hip injections, but most of the published series are relatively small. Potential concerns include iatrogenic injury, infection, and reaction to medication. Our method has been validated by successful execution among thousands of consecutive cases. The practicality of using this technique is dependent on having a provider proficient in ultrasound-guided procedures. It can also be limited by a patient's body habitus.

This ultrasound-guided technique of intra-articular hip injection has demonstrated a minimal learning curve in the hands of a previously inexperienced mid-level provider.² It has subsequently proven to be effective, with an appropriate safety record, and has been well tolerated by patients. It allows real-time assessment of the patient's response to the injection and provides a convenient therapeutic option.

Acknowledgment

The authors thank Michael Voight, P.T., D.H.Sc., O.C.S., S.C.S., A.T.C., F.A.P.T.A., and Ashley Campbell, P.T., D.P.T., S.C.S., C.S.C.S., for assistance with video production; Ashley Civils, L.P.N., for technical assistance; and Sharon Parker for assistance with manuscript preparation.

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