Ultrasound-Guided Hip Injections: A Comparative Study With Fluoroscopy-Guided Injections

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Purpose: The purpose was to assess ultrasound-guided injections through patient satisfaction in a comparative internally controlled study of fluoroscopic versus ultrasound technique and to quantitate the reliability of the ultrasound method. In addition, the reliability of the ultrasound method was quantitated. **Methods:** This study consisted of the first 50 consecutive patients to undergo ultrasound-guided intra-articular injection of the hip (by a nurse practitioner) and who had previously undergone fluoroscopy-guided intra-articular injections by our center's fellowship-trained musculoskeletal radiologists. The patients rated the ultrasound and fluoroscopic experiences on a scale from 1 to 10 for convenience and pain; in addition, they indicated their preference between the 2 techniques. Success of the injection was documented among a total of 206 consecutive patients who underwent ultrasound-guided injections during the period of the controlled study. **Results:** For convenience, ultrasound injection had a mean rating of 9.8 whereas fluoroscopic injection had a mean rating of 3.1. For pain, ultrasound had a mean rating of 3 and fluoroscopy had a mean rating of 5.6. These differences were statistically significant ($P < .01$) in favor of ultrasound. For preference, 49 of 50 patients in the control study (98%) stated that they would prefer the ultrasound injection, whereas 1 was uncertain. The injection was successful in 202 of the first 206 patients (98%) to undergo ultrasound injection, whereas 4 patients required a second pass for successful injection. **Conclusions:** In this study in-office ultrasound-guided injections of the hip were more convenient and less painful than fluoroscopy-guided hospital-based injections and were preferred by patients who have undergone both. Furthermore, the ultrasound-guided injections were performed by a recently trained physician extender in contrast to the fluoroscopic method, which was performed by experienced fellowship-trained musculoskeletal radiologists. The procedure is highly successful in the hands of a properly trained clinician. **Level of Evidence:** Level II, prospective comparative study.

Fluoroscopic guidance has been the standard for intra-articular hip injections.[1] Confirmation is provided by intra-articular positioning of radiopaque contrast material. However, there can be significant variations in the skill level of clinicians who are technically qualified to perform the injection. Disadvantages to the patient are that the injection process can sometimes be painful, even in the hands of a capable clinician, and it cannot routinely be performed in an office setting, thus necessitating the patient's referral to a hospital radiology department or other imaging facility.

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More recently, ultrasound guidance has been proposed as a routine method for intra-articular injections.[2,3] The process is relatively simple and can be performed in an office setting, so the patient does not have to be referred to another facility.

The purpose of this study was to assess ultrasound-guided injections through patient satisfaction in a comparative internally controlled study of fluoroscopic versus ultrasound technique, in addition to quantitating the reliability of the ultrasound method. We postulated that ultrasound-guided injection of the hip joint would be an acceptable alternative for patients compared with fluoroscopic methods and that this technology can be readily adapted to an office setting.

Methods

This study consisted of the first 50 consecutive patients to undergo ultrasound-guided intra-articular injection of the hip by a single nurse practitioner and who had previously undergone fluoroscopy-guided intra-articular injections by our center's fellowship-trained musculoskeletal radiologists. This group included all patients

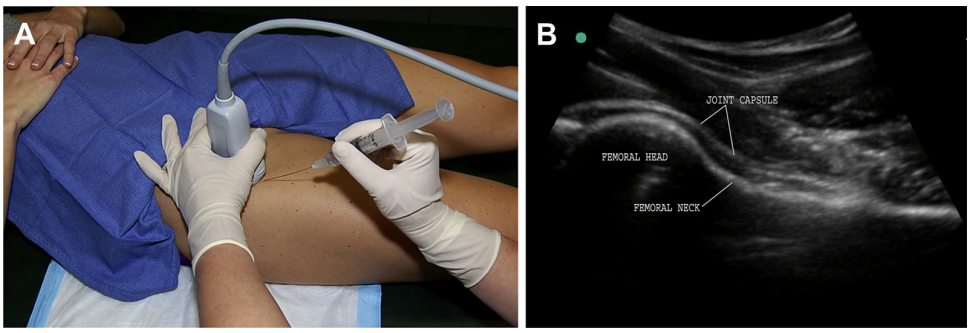

Fig 1. (A) Visualization of the hip is performed by placing the transducer firmly over the area of the femoral head-neck junction in the long axis and slightly oblique. A slightly oblique angle to the transducer allows a more lateral entry site for the needle into the joint and increases the distance 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 hip joint with probe positioned over femoral head-neck junction as described earlier. © 2014 J. W. Thomas Byrd.

deemed appropriate candidates for an intra-articular injection. None were deferred because of size or other perceived technical challenges. The diagnoses in this cohort included femoroacetabular impingement in 12 cases, osteoarthritis in 13, unexplained hip pain in 8, and postoperative hip pain in 17.

In addition, during the period of the controlled study, a total of 206 consecutive patients underwent ultrasound-guided intra-articular injections. By use of a previously validated method, the success of the injection was determined by confirmation of the instilled material distending the space underneath the capsule and was documented in all patients.[4] This study received exemption status from the institutional review board.

The nurse practitioner had no previous experience with hip injections or the use of ultrasound. She participated in 2 general musculoskeletal lecture and laboratory courses accredited by the Society of Diagnostic Medical Sonography and visited an experienced hip ultrasonographer for 2 days before performing her first hip injection, which was the initiating point of this study. The hospital-based musculoskeletal radiologists, located across the street from the orthopaedic office, consisted of a nucleus of 4 physicians experienced in hip joint injections.

Each patient completed a questionnaire delivered by a separate observer. The patients were asked to rate the ultrasound experience and the fluoroscopic experience on a scale from 1 to 10 for convenience (1, not convenient; 10, very convenient) and pain (1, no pain; 10, very painful); in addition, they indicated their preference between the 2 techniques. Patient ratings were analyzed with the Mann-Whitney *U* test.

Ultrasound-Guided Injection Technique

The ultrasound-guided injection is performed with the patient in the supine position.[5] By use of a curvilinear probe placed on the skin anterior to the hip, the femoral neck is located and visualized in the long axis (Fig 1A). This also allows visualization of the joint capsule (Fig 1B). After the femoral neck is located, the femoral artery and vein are located with color Doppler. Once the major vessels are visualized, the joint capsule is again located, as far lateral as possible, with the intent of distancing the needle as far from the major vessels as possible. The skin is then prepared with a chlorhexidine swab, and sterile ultrasound gel is applied. Povidone-iodine is not used because it can stain the ultrasound probe. A 22-gauge spinal needle is then advanced into the joint capsule at the femoral head-neck junction with continuous visualization of the needle (Fig 2). If the patient has a joint effusion, this can be visualized and aspirated if necessary. The medication is then administered and can be visualized filling the joint capsule (Fig 3). The needle is removed and a small bandage applied. The instilled material consisted of a standard volume of 7 mL: either 4 mL of 0.25% bupivacaine and 3 mL of 1% lidocaine or 4 mL of 0.25% bupivacaine, 2 mL of 1% lidocaine, and 1 mL of 40 mg/1 mL methylprednisolone acetate when a steroid was used. No complications were encountered.

Fluoroscopy-Guided Injection Technique

For fluoroscopy-guided injections, an anterior approach (Fig 4) centered over the lateral aspect of the femoral neck is used.[1] Informed written consent is obtained from all patients. With the patient supine on the fluoroscopic table, an ink mark is placed on the skin directly over the lateral aspect of the femoral neck near the head-neck junction (Fig 4). The overlying skin is then prepared with povidone-iodine solution, and the skin and subcutaneous tissues are anesthetized with buffered 1% lidocaine hydrochloride. A 22-gauge spinal needle is advanced to the cortex of

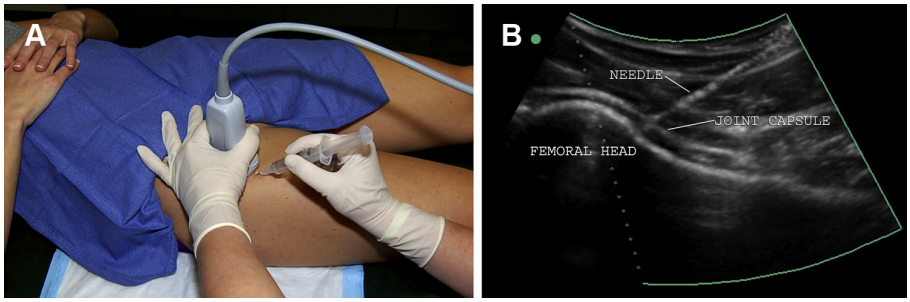

Fig 2. (A) The needle is inserted in plane with the transducer, which allows visualization of the needle throughout the course of its advancement to the capsule. (B) The needle can be seen entering the joint capsule at the base of the femoral head. © 2014 J. W. Thomas Byrd.

the lateral femoral head-neck junction with the bevel of the needle oriented medially. Medial orientation of the bevel allows the needle to course laterally along the cortical surface of the femoral neck rather than to penetrate the cortex. Aspiration is then performed and allows gross evaluation for infection as well as decompression of a joint effusion, if present, to allow space for mixtures used in injections. Approximately 1 mL of iodinated contrast is administered to confirm an intra-articular position of the needle (Fig 5).

Results

For the convenience score, ultrasound injection had a mean rating of 9.8 whereas fluoroscopic injection had a mean rating of 3.1. For pain, ultrasound had a mean rating of 3 and fluoroscopy had a mean rating of 5.6. These differences were statistically significant ($P < .01$) in favor of ultrasound. For preference, 49 of 50 patients in the control study (98%) stated that they would prefer the ultrasound injection, whereas 1 was uncertain. The injection was successful in 202 of the first 206 patients (98%) to undergo ultrasound injection, whereas 4 patients required a second pass for a successful injection.

Discussion

Our data clearly show that ultrasound-guided office-based intra-articular injection of the hip is an effective alternative to traditional fluoroscopy-guided techniques. Ultrasound-guided hip injection offers numerous potential advantages.

The option of performing the injection in the office in the same setting of a normal office visit is highly convenient for the patient. It avoids the necessity for transfer to another facility with a separate registration process and necessities of robing and disrobing.

The injections in our study were performed for diagnostic and/or therapeutic purposes. In-office assessment allows real-time evaluation of the response to the injection. For some individuals, such as athletes participating in high-intensity activities, the force and pain generated on the hip far exceed those that can be generated simply by examining the joint. Thus, for some individuals, it is helpful to have them provoke symptoms with vigorous activities in the therapy department before injection so that these activities can be repeated after injection for a more reliable assessment of pain relief.

Historically, we relied more on the response to an intra-articular injection than the findings on conventional magnetic resonance imaging (MRI) when these studies were less reliable and patterns of hip pathology were less well understood. With the advent of gadolinium arthrography, we simply began combining the diagnostic test of anesthetic injection along with concomitant contrast for gadolinium studies.[6] There are 2 caveats about gadolinium arthrography that can render it less sensitive than conventional MRI.[7] Historically, we placed significance on the presence of a joint effusion as an indirect sign of hip pathology. Contrast negates the ability to assess for an effusion. In addition, imaging sequences performed with contrast can obscure the presence of subchondral and soft-tissue edema that may be more evident on sequencing performed with conventional MRI. Thus, historically, we have used screening conventional MRI followed by post-contrast imaging as described by Byrd and Jones.[6] Another caveat of gadolinium MRI encountered as an anecdotal

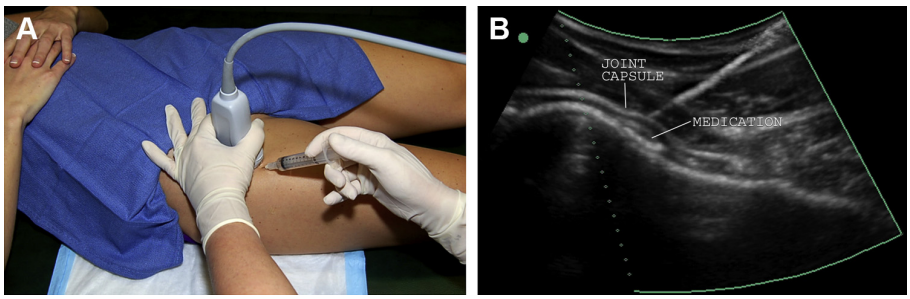

Fig 3. (A) The transducer remains in the same plane throughout the injection. (B) The medication can be visualized entering the joint capsule. © 2014 J. W. Thomas Byrd.

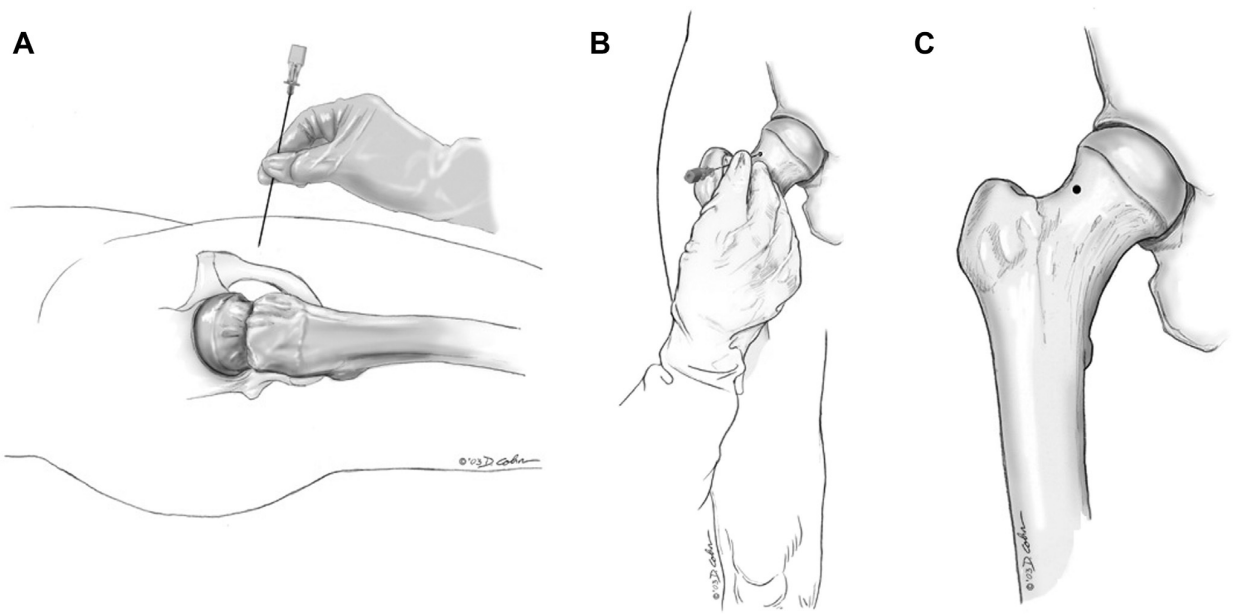

Fig 4. (A-C) Technique for fluoroscopic hip injection. One should note the anterior approach targeting the lateral aspect of the femoral neck. © 2014 J. W. Thomas Byrd.

observation among experienced hip surgeons has been that the gadolinium may negate the expected response to the anesthetic, resulting in a false-negative interpretation. The exact chemistry of this has not been elucidated, but this is an observation independently cited by a number of experts. Thus, with the improved resolution of conventional MRI and downsides to gadolinium and fluoroscopic methods, we have currently abandoned gadolinium studies as a routine investigative method in favor of high-resolution conventional MRI and ultrasound-guided injections as necessary for diagnostic and therapeutic purposes.

Occasionally, patients express their sentiments on the painful nature of the fluoroscopy-guided injection process. Therefore, in our center, we have limited these injections to fellowship-trained musculoskeletal radiologists. Thus, if patients indicated that they had a painful experience, at least we were confident that the procedure was performed with expertise.

Limitations

This study used an historical internal control of patients undergoing ultrasound-guided intra-articular injections who had previously undergone fluoroscopy-guided injections. The rating of the fluoroscopy-guided injections was not performed at the time of the injection process. The 2 injections did not include the same material, and this could have had some influence. In addition, they were performed in separate settings. The ultrasound-guided injections were performed by a single person in a single office, and thus the generalizability of the procedure is uncertain. Lastly, there was no independent confirmation of the success of the injection.

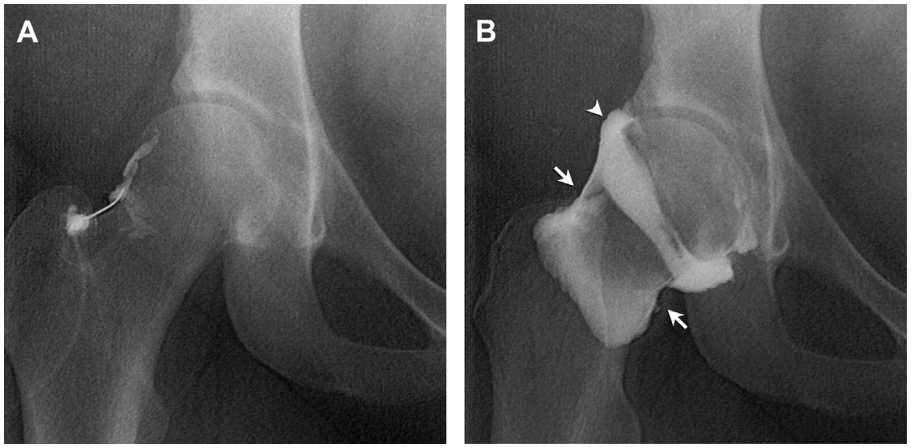

Fig 5. Intra-articular contrast injection and arthrogram. (A) Spinal needle coursing along lateral femoral neck with early contrast filling lateral joint, confirming intra-articular needle position. (B) Completed arthrogram showing perilabral sulcus (arrowhead) and zona orbicularis (arrows). © 2014 J. W. Thomas Byrd.

Conclusions

In this study, in-office ultrasound-guided injections of the hip were more convenient and less painful than fluoroscopy-guided hospital-based injections and were preferred by patients who have undergone both. Furthermore, the ultrasound-guided injections were performed by a recently trained physician extender in contrast to the fluoroscopic method, which was performed by experienced fellowship-trained musculoskeletal radiologists. The procedure is highly successful in the hands of a properly trained clinician.

References

1. Erb RE. Adult hip imaging for the arthroscopist. In: Byrd JWT, ed. *Operative hip arthroscopy*. Ed 3. New York: Springer, 2012;33-54.
2. Sofka CM, Saboeiro G, Adler RS. Ultrasound-guided adult hip injections. *J Vasc Interv Radiol* 2005;16:1121-1123.
3. Smith J, Hurdle MF. Office based ultrasound guided intra-articular hip injection: Technique for physiatric practice. *Arch Phys Med Rehabil* 2006;87:296-298.
4. Smith J, Hurdle MF, Weingarten TN. Accuracy of sonographically guided intra-articular injection in the native hip. *J Ultrasound Med* 2009;28:329-335.
5. Jones KS, Potts EA, Byrd JWT. Perioperative care. In: Byrd JWT, ed. *Operative hip arthroscopy*. Ed 3. New York: Springer, 2012;441-455.
6. Byrd JWT, Jones KS. Diagnostic accuracy of clinical assessment, MRI, gadolinium MRI, and intra-articular injection in hip arthroscopy patients. *Am J Sports Med* 2004;32:1668-1674.
7. Byrd JWT. Patient selection and physical examination. In: Byrd JWT, ed. *Operative hip arthroscopy*. Ed 3. New York: Springer, 2012;7-32.