Technical Note

Arthroscopic Hip Labral Repair Using Needle Arthroscopic Visualization

Sean McMillan, D.O., Elizabeth Ford, D.O., and Vincent Lau, D.O.

Abstract: Hip arthroscopy has become increasingly popular in recent years and continues to grow as techniques and understanding of hip arthroscopy evolve. Needle hip arthroscopy is emerging as a technique that can offer potential advantages compared with a traditional arthroscope. These benefits include a higher degree field of view, lower profile design for easier maneuverability, decreased arthroscopic fluid, and potentially decreased postoperative pain and swelling. We herein present and describe a technique of needle hip arthroscopy as a viable option in the treatment of hip pathology.

Over the past decade, hip arthroscopy cases have grown more than 600%.[1] This exponential growth has occurred for a variety of reasons. Some of these reasons include dedicated hip preservation fellowships, an increase in hip arthroscopies in sports fellowships, a growing body of literature identifying pathology and treatment, and dedicated hip arthroscopy surgical tools that allow for a more efficient procedure.[2] Nevertheless, the procedure remains technically demanding, and challenges still exist.

Go et al. performed a systematic review of the literature and reported hip arthroscopy proficiency began at approximately 30 cases, however the range was significant (20 to >500).[3] As the surgeon case numbers increased, patient-reported outcomes improved. Similarly, major (traction neuropraxias, fluid extravasation) and minor complications (iatrogenic cartilage injuries, heterotrophic ossification) decreased. Complications and failures in hip arthroscopy can be multifactorial. Iatrogenic cartilage and labral damage has been noted to occur in up to 68% of cases, although it is widely under-reported.[4] Most commonly, the anterior-superior labrum and femoral head cartilage are injured during initial joint access or accessory portal placement.[5] Furthermore, traditional 70° arthroscopes used for hip arthroscopy require 4.5 mm to 6.5 mm inflow cannulas for access. Challenges exist with central compartment access, particularly in the face of pincer lesions that may increase the risk of iatrogenic damage. Typically, 10 mm of joint distraction is required for hip arthroscopy at 50 to 100 pounds of traction.[4] Excessive traction time, limb distraction force against a post, and improper positioning can result in perineal compression injuries, traction neuropraxia, fluid extravasation, as well as operative foot and ankle injury.[4]

Needle arthroscopy (NA) is a rapidly growing field that provides an alternative solution for the surgeon with options for both diagnosis and treatment.[6] Traditionally used for a diagnostic role in the office setting, advances in visualization optics allows for its use in the operative theater in lieu of a traditional arthroscope during surgical repair.[7] With a 120° field, the disposable 14-gauge arthroscope provides visualization not attainable with a traditional arthroscope. Furthermore it can percutaneously be repositioned within the surgical field for optimal visualization. The decrease in diameter over a traditional arthroscope has benefits pertinent to hip arthroscopy including mitigation of iatrogenic cartilage and labral injuries, decreased traction force, decreased arthroscopic fluid, and potentially decreased postoperative pain and swelling.[8,9]

From Virtua Orthopedics (S.M.), Burlington; Inspira Health (E.F.), Vineland; and Jefferson Health, New Jersey (V.L.), Stratford, New Jersey, U.S.A.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: E.F. reports other from Trice Medical. S.M. reports other from Trice Medical. The other author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received June 25, 2023; accepted August 27, 2023.

Address correspondence to Vincent Lau, D.O., Jefferson Health New Jersey, 18 E Laurel Rd, Stratford, NJ 08084, U.S.A. E-mail: vwl003@jefferson.edu

2212-6287/23892
https://doi.org/10.1016/j.eats.2023.08.024

Surgical Technique

Patient Set-Up

The lead author's preferred technique for hip arthroscopy is a post-less traction system (Stryker Guardian; Stryker, Kalamazoo, MI) in the lateral decubitus position. Alternatively, this technique follows the same steps with the patient in the supine position. The patient is maintained in the lateral position with a standard beanbag. An axillary roll is placed and all down bony prominences are well padded. The operative foot is inserted into a well-padded boot and attached to the distraction tower. A small triangle pillow is placed between the knees to create an abduction angle of 20° to 25°. The table is subsequently positioned into 15° of Trendelenburg, and then 25 pounds of longitudinal traction is placed on the operative limb. The patient is then prepped and draped in a sterile manner (Fig 1). Before incision, the patient is given 1 gm of intravenous tranexemic acid if there are no contraindications to aid in visualization during the procedure. The pump pressure is routinely run at 50 mm Hg.

Needle Scope Insertion and Portal Placement

Traditionally, the lead author performs hip arthroscopy utilizing an anterior-lateral (AL) viewing portal and a mid-anterior (MA) portal for bony resections and anchor placement. Similarly, these portals are used for NA hip cases, with the added advantage of percutaneously placing the camera throughout the working field as needed (Fig 2). Furthermore, distal anterolateral accessory, anterior (A), and posterior (P) portals can be used as needed for anchor placement.

The AL portal is localized using a cannulated system consisting of an 18-gauge hip length spinal needle under fluoroscopic assistance. Before the spinal needle is inserted fully into the acetabulum, the lead author will withdraw the inner stylet of the needle after the tip pierces the hip capsule. This allows for a release of the hip "suction seal," creating more potential space for access while minimizing the risk of the needle

Fig 1. Patient is set up in lateral decubitus (in this case left lateral decubitus) position with beanbag and a post-less traction system. The operative extremity (right-side in the image) is placed in a boot and abducted to a 20° to 25° angle. The table is positioned in 150° of Trendelenburg with 25 pounds of traction to the limb. The C-arm is positioned under the table to take an anteroposterior image of the operative hip.

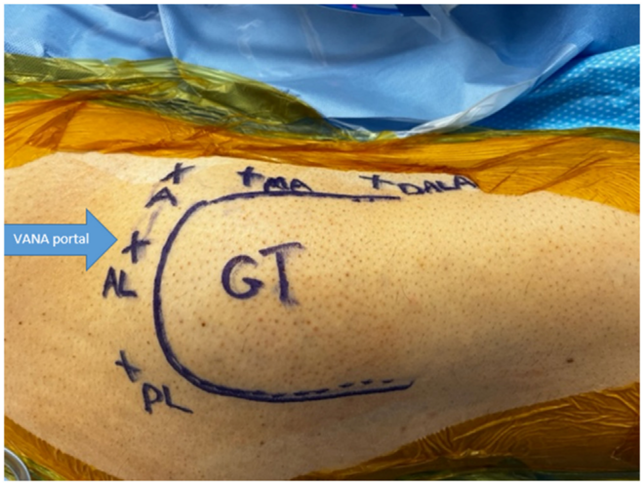

Fig 2. The hip has been marked out with traditional portals. Hip access for viewing is carried out through the anterolateral (AL) portal initially; however, the needle arthroscope can be percutaneously placed between the AL and anterior (A) portal as needed. Viewing of the labrum for anchor placement is carried out through the viewing anterior needle arthroscope (VANA) portal. Extremity: right-side; position: left lateral decubitus.

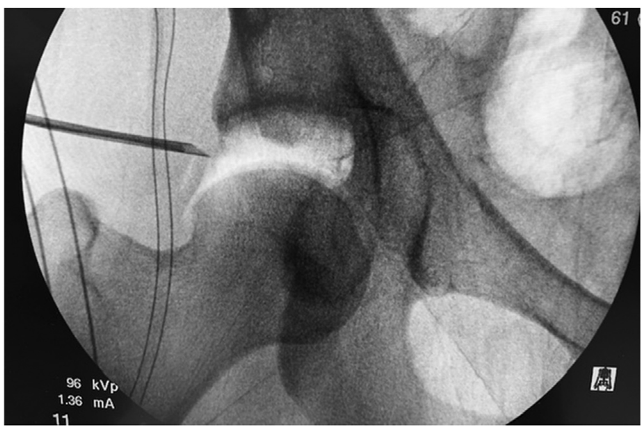

Fig 3. Spinal needle is introduced into the hip joint to release the "suction seal" with fluoroscopy. It is subsequently redirected to the appropriate trajectory and positioned so the needle arthroscope can follow the same path into the joint. Extremity: right-side; position: left lateral decubitus.

Fig 4. Under direct visualization and fluoroscopy, the mid-anterior (MA) working portal is developed using the spinal needle and Nitinol wire. Extremity: right-side; position: left lateral decubitus.

damaging the cartilage or labrum. After reinserting the inner stylet, the needle can be redirected if needed to enter the joint safely.

Once appropriate positioning and trajectory are confirmed with fluoroscopy, the spinal needle is withdrawn, and the needle arthroscope is inserted through the same needle mark. Before penetrating the capsule with the needle arthroscope, fluoroscopy is used to confirm the trajectory (Fig 3).

Typically, a 160 mm length 0° arthroscope is used. However, in thinly built patients, a 95 mm 0° arthroscope (Mi-Eye 3; Trice Medical, Malvern, PA) can be implemented. An advantage of the 95 mm-length arthroscope is that it can be used in combination with a needle-scope cannula system. This cannula for the needle scope can be inserted over a Nitinol guidewire after initial access is obtained with the spinal needle if desired.

Fluid inflow is connected directly to the needle arthroscope hand piece via a 1-way stopcock. The lead author typically runs the pump pressure at 50 to 60 mm Hg, with the first 3L of fluid infused with epinephrine. Under direct visualization, with fluoroscopic assistance, the above steps are repeated to create a MA portal (Fig 4). A cannulated switching stick is placed over the Nitinol wire, and then a skid is placed down to the capsule (Fig 5). The switching stick and Nitinol wire are removed, and a hip capsular blade is inserted. Penetration through the capsule with the blade is achieved under direct arthroscopic visualization. A transverse capsulotomy is then created, allowing for access within the central compartment (Fig 6). A traction suture is placed into the acetabular side of the capsule using a self-capturing suture passer. The limbs are then percutaneously pulled out of the A portal location, and a clamp is placed at the level of the skin to allow for capsular retraction and visualization. Finally, a 7 mm cannula is used through the MA portal to allow for instrumentation. The needle arthroscope is next repositioned approximately 1 cm anterior to the original AL viewing portal to optimize viewing. We label this portal the viewing anterior needle

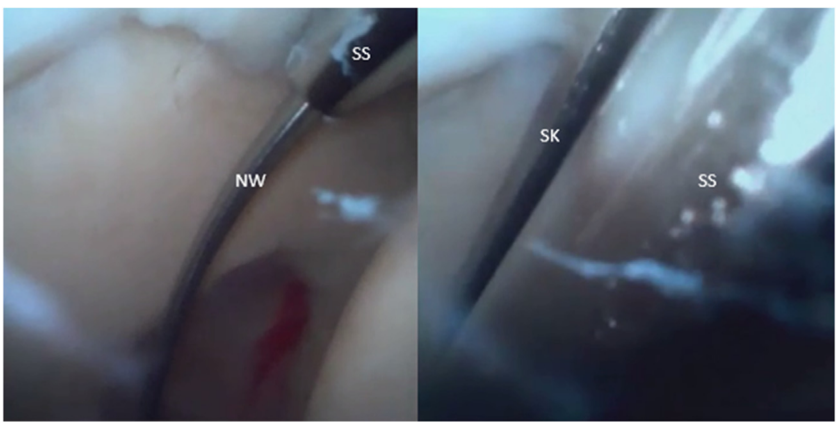

Fig 5. Through the mid-anterior (MA) portal, the cannulated switching stick (SS) is inserted over the Nitinol wire (NW). Subsequently, a skid (SK) is placed, and the wire and switching stick are removed. Extremity: right-side; position: left lateral decubitus.

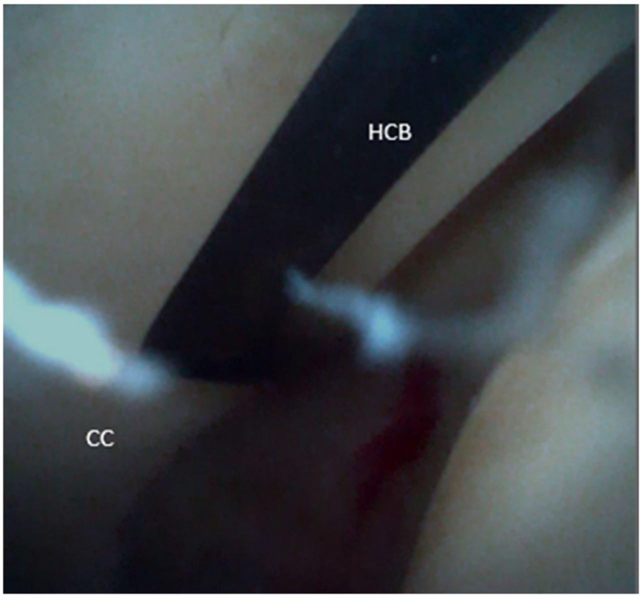

Fig 6. A hip capsular blade (HCB) is inserted over the skid. Then, a transverse capsulotomy is performed to gain access to the central compartment (CC). Portal: mid-anterior; extremity: right-side; position: left lateral decubitus.

arthroscope portal (VANA) (Fig 2). The entire central compartment can then be inspected, including the fovea and labrum (Fig 7).

Acetabuloplasty

Acetabuloplasty is performed while viewing through the A portal with the needle scope, and the burr placed through the MA portal. Direct visualization of acetabulum is seen from "10 o'clock" up to the "2 o'clock" position. Once visualization of the anterior section of the acetabulum is achieved, the burr can be inserted through the MA portal cannula for completion of the procedure (Fig 8). Fluoroscopy is used, in conjunction with direct arthroscopic visualization, to confirm adequate resection.

Anchor Placement

Viewing is percutaneously returned to the VANA portal and labral repair is undertaken using a knotless approach through the MA portal. A 1.5mm suture passer is used to deliver a 2-0 looped suture tape (SutureTape; Arthrex, Naples, FL) through the acetabular-labral interface from top-down. After the suture is passed, the needle scope is able to follow the suture into the joint for direct visualization during suture retrieval. The suture is then retrieved back out the same MA portal, and the tail is placed into the loop to create a "cinch" stitch around the labral tissue (Fig 9). Next, the drill guide is positioned at the acetabular rim and placement is confirmed with the needle arthroscope and fluoroscopy. After drilling the socket, the anchor is inserted, and the labrum is appropriately tensioned (Fig 10). The needle arthroscope is able to view down into the socket before, during, and after anchor placement to optimize ease of placement and avoid penetration into the articular cartilage. The above steps are repeated as needed to repair the labrum (Fig 10). For far anterior anchors ("2 o'clock" and "3 o'clock"), the needle scope can be percutaneously placed in either the A portal or anywhere within the safe zone of working for optimal visualization. Once the repair is complete, traction is taken down and a final survey is performed (Fig 11).

Femoral Osteoplasty

Femoral osteoplasty, if required, can be performed while viewing through the AL portal. Alternatively, the viewing portal can be moved percutaneously to the P portal and directed toward the femoral neck. A traction suture can be placed into the femoral side of the capsule through the MA cannula to facilitate the osteoplasty

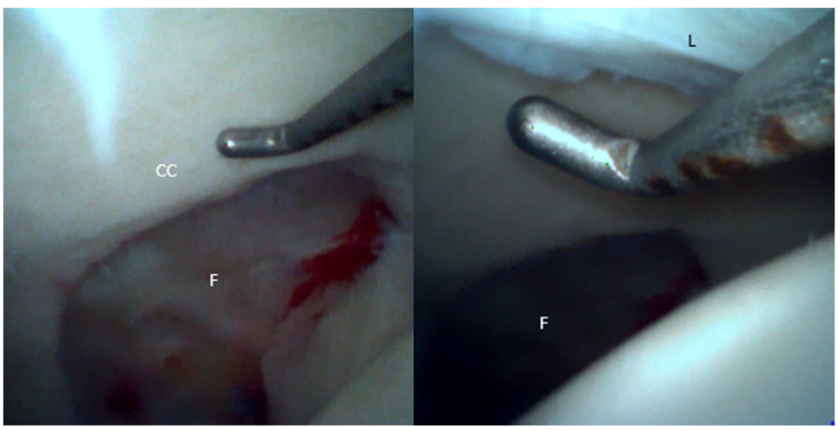

Fig 7. Viewing with the needle arthroscope through the viewing anterior needle arthroscope (VANA) portal, the central compartment (CC), fovea (F), and labrum (L) are inspected with a probe through the mid-anterior (MA) portal. Extremity: right-side; position: left lateral decubitus.

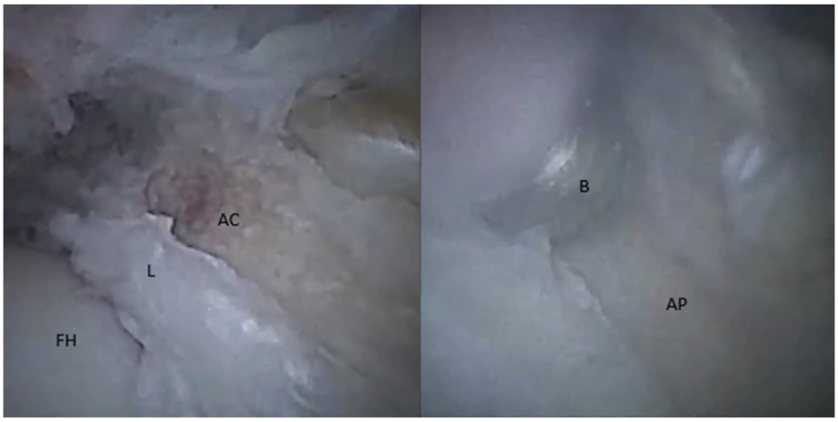

Fig 8. Needle scope is now placed at the anterior (A) portal for viewing the antero-lateral acetabulum (AC). A burr (B) through the mid-anterior (MA) portal is used to perform the acetabuloplasty (AP). L, labrum; FH, femoral head. Extremity: right-side; position: left lateral decubitus.

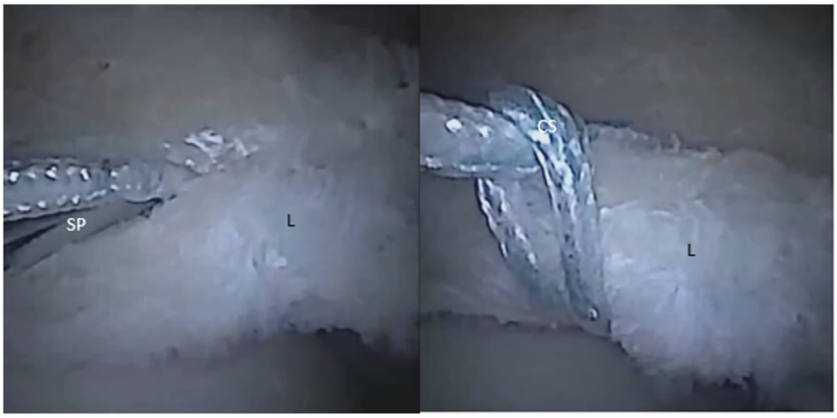

Fig 9. Viewing is now through the viewing anterior needle arthroscope (VANA) portal. A suture passer (SP) delivers suture tape through the acetabular-labral interface from the top down. Suture is retrieved through the mid-anterior (MA) portal with the tail then put into the loop to create a "cinch" stitch. L, labrum. Extremity: right-side; position: left lateral decubitus.

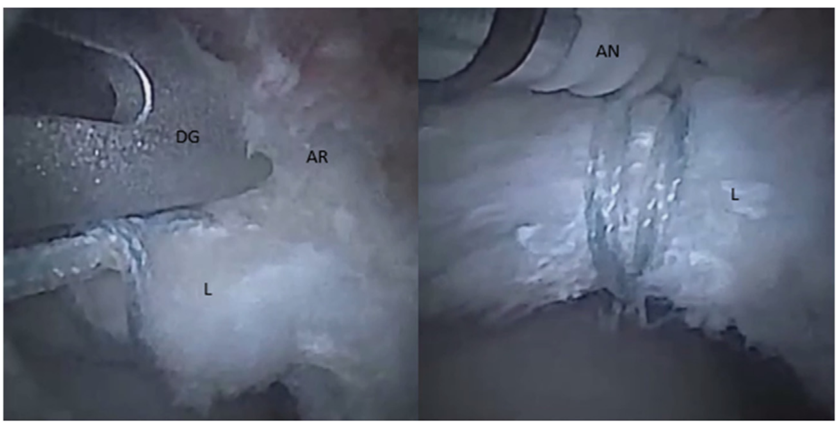

Fig 10. Viewing through the viewing anterior needle arthroscope (VANA) portal, drill guide (DG) is positioned at the acetabular rim (AR). After drilling, an anchor (AN) is inserted while the labrum (L) is appropriately tensioned. Steps are repeated for the desired repair. Extremity: right-side; position: left lateral decubitus.

Fig 11. After repair, the operative limb is taken off traction to allow for final assessment. L, labrum; FH, femoral head. Portal: viewing anterior needle arthroscope (VANA); extremity: right-side; position: left lateral decubitus.

without the need to resect more capsule. The hip is flexed to 45° and externally rotated to help in the identification of the cam lesion. Through the MA or A portal the burr can be used to complete the bony resection. If visualization of the lesion becomes obscured by soft tissue or a far anterior cam lesion is present, the needle arthroscope can be placed through the A portal percutaneous cannula for the completion of the case.

Discussion

NA has evolved from an in-office diagnostic tool to an effective alternative for surgical procedures in the operating room setting. This technique has many advantages (Table 1). The 14 gauge small-bore needle arthroscope (approximately 2.26 mm) and cannula (Mi-Eye 3) allows for a percutaneous, low-profile visualization tool that can minimize iatrogenic cartilage and labral damage on central compartment entry. The percutaneous utility of the needle arthroscope allows for optimal visualization across the central and peripheral compartment during acetabuloplasty, femoral osteoplasty, and anchor placement. With a 120° field of view, the 0° arthroscope offers a ready-to-go, disposable, visualization option suitable for hip arthroscopy. In many institutions, 70° arthroscopes are of limited availability compared to traditional 30°, leading to delays because of turnover or if the camera is damaged. The disposable, sterile-packed needle arthroscope can help in eliminating these delays

Table 1. Advantages and Disadvantages to Hip Arthroscopy Performed Using a Percutaneous 0° Arthroscope

Advantages	
	Decreased soft tissue swelling
	Potentially decreased postoperative pain
	Ability to rapidly move arthroscope to improve visualization
	120° field of view
	Readily available disposable, sterile arthroscope
	Less risk of iatrogenic cartilage and labrum damage
Disadvantages	
	Learning curve to adoption
	Difficulty maneuvering arthroscope in more muscular/heavy patients
	Lack of cannulated system in "hip length" arthroscopes
	Potential image degradation when projecting image to standard arthroscopic towers

As advances in surgical technique continue to evolve, minimally invasive surgical options offer potential benefits, including decreased swelling, decreased post-operative pain and faster post-operative recovery.[10,11] Compared to a traditional arthroscope, NA uses significantly less arthroscopic fluid per case. Across the lead author's first 10 hip arthroscopic procedures using the needle scope, the average volume of surgical fluid used between 1,200 and 1,600 mL total. Traditional hip arthroscopy for the same surgeon typically utilizes between 12,000 and 15,000 mL of total fluid. Percutaneous placement of a 14-gauge arthroscope compared to a 5.5 or 6.5 mm arthroscopic cannula can also theoretically lead to less soft tissue trauma and subsequent muscle shut down. This may, in turn, lead to a faster recovery after surgery.[10,11]

As with any emerging technology, there are limitations with NA when performing hip arthroscopy (Table 1). The current generation of needle arthroscopes are not all designed to be "hip length," with the popular iterations ranging between 95 and 110 mm in length. Nevertheless, these cameras can adequately view most patients' hip joints, and in 1 current system a 160 mm length arthroscope (Mi-Eye 3) is available. Currently, viewing of the procedure can be projected from the bedside tablet to most standard arthroscopic towers via HDMI cables. However, some image degradation may occur when attempting to project the video image from the tablet to a traditional arthroscopy tower. Additionally, difficulty can arise with manipulation of the needle scope in the working field on very muscular or heavier patients.

As with the adoption of any new procedure, comfort and reproducibility will occur with repetition and fundamental surgical technique. Meticulous portal localization with the spinal needle, combined with fluoroscopic assistance, will allow for optimal viewing and, ultimately, a successful completion of the surgical procedure. Utilization of the VANA portal will take advantage of the 120° field of view when addressing the labrum. Advancements in the quality of the images provided by needle arthroscopy are driving various arthroscopic procedures currently with the goal being improved patient outcomes with less trauma to the soft tissues. We believe NA has a role in the hip and have moved to this technique as our primary viewing option in the surgical theater. NA offers advantages including an increased field of view, nimble maneuverability within the central compartment, less soft tissue swelling, and potentially decreased risk of iatrogenic cartilage and labrum damage. Further data collecting is imperative; however, the authors believe this technique is an effective alternative to traditional arthroscopic evaluation of femoral acetabular impingement and labral tears.

References

1. Bozic KJ, Chan V, Valone FH, Feeley BT, Vail TP. Trends in hip arthroscopy utilization in the United States. *J Arthroplasty* 2013;28:140-143.
2. Gordon AM, Flanigan DC, Malik AT, Vasileff W. Orthopaedic surgery sports medicine fellows see substantial increase in hip arthroscopy procedural volume with high variability from 2011 to 2016. *Arthroscopy* 2021;37:521-527.
3. Go CC, Kyin C, Maldonado DR, Domb BG. Surgeon experience in hip arthroscopy affects surgical time, complication rate, and reoperation rate: a systematic review on the learning curve. *Arthroscopy* 2020;36:3092-3105.
4. Papavasiliou AV, Bardakos NV. Complications of arthroscopic surgery of the hip. *Bone Joint Res* 2012;1:131-144.
5. Nakano N, Khanduja V. Complications in Hip Arthroscopy. *Muscle Ligaments Tendons J* 2019;6:402.
6. DeClouette B, Birnbaum A, Campbell H, Bi AS, Lin CC, Struhl S. Needle arthroscopy demonstrates high sensitivity and specificity for diagnosing intra-articular shoulder and knee pathology. *Cureus* 2022;14:e33189.
7. Zhang K, Crum RJ, Samuelsson K, Cadet E, Ayeni OR, De Sa D. In-office needle arthroscopy: A systematic review of indications and clinical utility. *Arthroscopy* 2019;35:2709-2721.
8. Quinn R, Lang SD, Gilmer BB. Diagnostic needle arthroscopy and partial medial meniscectomy using small bore needle arthroscopy. *Arthrosc Tech* 2020;9:e645-e650.
9. McMillan S, Chhabra A, Hassebrock JD, Ford E, Amin NH. Risks and complications associated with intra-articular arthroscopy of the knee and shoulder in an office setting. *Orthop J Sports Med* 2019;7:232596711986984.
10. Peters M, Gilmer B, Kassam HF. Diagnostic and therapeutic elbow arthroscopy using small-bore needle arthroscopy. *Arthrosc Tech* 2020;9:e1703-e1708.
11. Daggett MC, Busch K, Ferretti A, Monaco E, Bruni G, Saithna A. Percutaneous anterior cruciate ligament repair with needle arthroscopy and biological augmentation. *Arthrosc Tech* 2021;10:e289-e295.