Technical Note

# In-Office Needle Arthroscopy With Cartilage Allograft Extracellular Matrix Application for Cartilage Lesions of the Knee

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**Abstract:** Chondral and osteochondral lesions of the knee are a common cause of pain, mechanical symptoms, and swelling for patients. The benefits of in-office needle arthroscopy (IONA) include the ability to diagnose and treat chondral or osteochondral lesions in the office, quicker patient recovery, reduced cost, and improved patient satisfaction. The purpose of this technical note is to describe the technique for performing in-office needle arthroscopy for chondral or osteochondral contained lesions of the knee, with special consideration of the technique for obtaining adequate local anesthesia, proper indications, adequate visualization, and the advantages of performing these procedures in the office rather than the operating room.

## Introduction

Cartilage lesions of the femoral condyles are a common cause of pain, swelling, and mechanical symptoms and present a challenging problem to treat for orthopedic surgeons.[1,2] There is currently no consensus on a gold standard treatment, and the ideal treatment depends on a variety of patient factors: lesion size, lesion location, and associated pathologies, as well as a multitude of cost considerations.[3,4] Treatments for cartilage lesions of the femoral condyles range from arthroscopic techniques, such as chondroplasty or microfracture to open techniques, such as matrix-induced autologous chondrocyte implantation, osteochondral autograft, or allograft transplantation procedures. Additional augmentation with a cartilage allograft extracellular matrix (BioCartilage; Arthrex, Naples, FL) has been shown to improve outcomes, particularly in conjunction with microfracture.[5,6]

Prior in-office needle arthroscopy (IONA) designs involved arthroscopes greater than 2 mm in diameter, with a detachable lens requiring a separate lens and light source. The current needle arthroscopic system (NanoScope; Arthrex) developed uses a 1.9-mm diameter malleable sheath, equivalent to a 15-gauge needle, providing a minimally invasive option for diagnostic and therapeutic treatments in either the office or operating room setting. The camera is positioned at the tip of the needle arthroscope with a built-in light, eliminating the need for a separate lens and fiberoptic light cord, providing image quality similar to conventional arthroscopy. Although it provides only a 0° orientation of the lens, the semi-flexible material allows for manual bending of the arthroscope up to 15° without disruption of visual quality. Various nano-arthroscopic instruments accompany the needle arthroscope, such as 2.0-mm shavers, burrs, smaller probes, graspers, and scissors, to permit minimally

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**Table 1.** Advantages and Disadvantages of Proposed Technique

| Advantages | Disadvantages |
|---|---|
| Real-time assessment of cartilaginous or osteochondral lesions | Potential for patient pain or discomfort |
| Reduced operating room utilization, avoidance of anesthesia complications | Learning curve |
| Potential for true patient-physician education and shared decision making | Difficulty accessing posterior lesions |
| Improved ability to exactly measure size, location, and depth of lesions | |
| Ability to obtain cartilage biopsy without utilization of a two-stage procedure requiring two trips to the operating room | |
| Faster recovery | |

**Table 2.** Pearls and Pitfalls of the Proposed Technique

| Pearls | Pitfalls |
|---|---|
| Having a dedicated procedure room and blocked time for a 30-minute office visit | Not having all available assistants, instruments, and implants ready at beginning of procedure |
| Familiarity of office staff with room setup, instrument turnover, and workflow | Poor indications of patients with excessive expectations |
| Thorough preprocedure discussion with patient in regard to mental readiness and expectations for wide-awake procedures | Inadequate time between local anesthetic and procedure |
| At least 10 minutes between portal and intra-articular local anesthetic injection and procedure | Poor portal placement given 0° needle scope |
| Viewing portal opposite the lesion is ideal for instrumentation/delivery, i.e., needle arthroscope in anterolateral portal for medial femoral condyle lesions | Attempting to treat posterior lesions without the ability to provide varus or valgus stress |
| Epinephrine in saline for hemostasis and visualization | Inadequate visualization during the dry arthroscopy when attempting to place the cartilage allograft extracellular matrix |
| Thorough synovectomy around the lesion, so after suctioning and transitioning to dry needle arthroscopy adequate visualization is achieved | |

invasive procedures on identified in-office pathology. Indications and contraindications for needle arthroscopy can be found in Table 1.

The purpose of this technical note is to describe in-office needle arthroscopy with chondroplasty and cartilage allograft extracellular matrix (BioCartilage, Arthrex) for the treatment of focal cartilage lesions of the knee, particularly anterior femoral condyle lesions, with special consideration for obtaining adequate anesthesia, proper indications, visualization tips, and the advantages of performing these procedures in the office rather than in the operating room. In order to demonstrate the procedure in a reproducible method, we have provided the in-office positioning and equipment set-up, a step-by-step technical guide to performing the procedure, as well as an associated cadaveric video (Video 1) for teaching purposes (Tables 2 and 3).

## Surgical Technique

### Preoperative Planning/Positioning

To allow gravity to best open the joint space, the patient is positioned supine on an examination table with the operative leg over the edge of the bed (Fig 1). A tourniquet-less approach is used given the discomfort in a wide-awake patient, with hemostasis achieved with high-flow fluid and epinephrine. Standard arthroscopic landmarks are marked per surgeon preference, with the senior author using the same landmarks in-office as in the operating room (OR) (Fig 2, Video 1). Prior to the procedure, the planned anterolateral and anteromedial arthroscopy portals are injected with 10 cc of 1% lidocaine in each. After 10 minutes, another 20 cc of a 1:1 mixture of 1% lidocaine and 0.5% bupivacaine is injected into the knee joint through the anterolateral portal, which accomplishes two goals; anesthetic pain control, as well as confirmation of portal positioning. Allowing adequate time following local anesthetic administration and using appropriate volumes is the key portion of IONA. The surgeon and any assistants, using sterile technique, then prep (solution of chlorhexidine gluconate mixed with isopropyl alcohol) and drape the extremity and a preprocedure timeout is performed while visualizing the surgeon's initials on the affected extremity. A minimum of 10 minutes following injection prior to any invasive procedure is necessary in the senior author's experience, and given the variability of surgeon office workflow, adding IONA to each surgeon's office setting should be adjusted, as necessary.

### Portal Placement

It is the senior author's preference to view from the anteromedial portal to begin. A standard anteromedial arthroscopic portal is made using a number 11-blade. Using just the width of the blade, a 2-mm stab incision is made toward the intercondylar notch to accommodate the 1.9-mm 0° viewing needle arthroscope

**Table 3.** Step-by-step Guide to Performing the Proposed Technique

| |
|---|
| Step 1: Position the patient comfortably in the supine position with the operative knee flexed over the table (Fig 1). Mark out relevant surface anatomy and anticipated portals (Fig 2). |
| Step 2: Deliver anteromedial and anterolateral portal local anesthesia and through these portals, the intra-articular block to minimize patient discomfort. Wait 10 minutes. |
| Step 3: Establish anterolateral portal, about 0.5 cm lateral to standard arthroscopic portal. |
| Step 4: Perform diagnostic scope of the knee, as needed, per patient-physician discussion. Visualize lesion (Fig 3). |
| Step 5: Make anteromedial portal under direct visualization with standard arthroscopic technique, except with a single stab through skin and capsule without cutting superiorly. |
| Step 6: Ensure visualization portal and working portal to allow adequate access to the lesion being treated, and switch portals, as necessary. |
| Step 7: Use a minimally invasive 2.0-mm shaver to remove infrapatellar fat pad, hypertrophic synovium, and any loose cartilaginous flaps as necessary for wide visualization |
| Step 8: Use a curette to debride damaged cartilage to vertical stable borders. Measure depth and size of lesion for possible future interventions (Fig 4). |
| Step 9: Utilize a combination of a 2.0-mm shaver a 3.0-mm burr for bone marrow stimulation, taking care not to violate the subchondral plate (Fig 5). |
| Step 10: Suction out the joint fully. Swab lesion bed to ensure dry recipient surface (Fig 6). |
| Step 11: Apply cartilage allograft extracellular matrix to debrided chondral/osteochondral lesion (Fig 7A). Smooth to the stable borders with the inserter or a freer (Fig 7B). |
| Step 12: Apply wound closure (steri-strips) and soft dressing. |

(NanoScope, Arthrex, Naples, FL). In our experience, it is helpful to make the anteromedial portal 0.5 cm more medial and superior to the standard portal placement adjacent to the medial edge of the patellar tendon, to aid in subsequent direct visualization of anterolateral portal placement and to facilitate the passage of the camera and instruments over the tibial spines. Undercutting the capsule or spreading with a blunt clamp should be avoided, both to prevent discomfort to the patient, as well as to prevent extravasation of fluid through the portal around the needle arthroscope instruments.

## Operative Technique

A blunt trocar is then used to enter the lateral compartment, sweeping the infrapatellar fat pad and synovium anteriorly to optimize visualization. The camera is exchanged over the trocar and connected to the integrated inflow and outflow fluid management system at a pressure of 35 mmHg (DualWave; Arthrex). Fluid inflow consisting of 1 liter of 0.9% normal saline mixed with 5 cc of epinephrine establishes the optimal combination of fluid flow and hemostasis in the senior author's experience. Given the in-office nature of the procedure, rather than performing a complete diagnostic arthroscopy at this time, often the senior author moves directly into anterolateral portal creation and instrumentation (Fig 3). While directly visualizing the entry point for the anterolateral portal, a spinal needle followed by an 11-blade is used to make the anterolateral portal. Again, a single stab to make a 2-mm incision is used, without undercutting capsule or bluntly spreading. The needle arthroscope and a probe

**Fig 1.** In-office needle arthroscopy standard knee setup. The patient is supine and seated comfortably on an examination table, with the ipsilateral knee prepped and draped in sterile fashion. The knee hangs off the table to allow gravity to open the joint space.

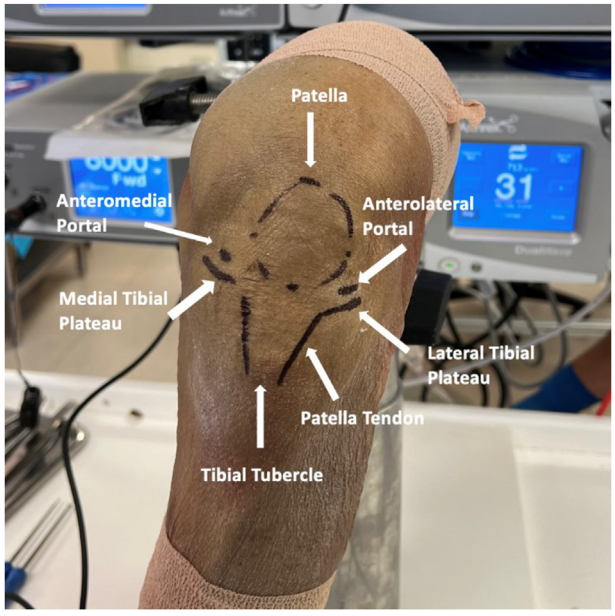


**Fig 2.** In office arthroscopic approach to the knee via the anterolateral and anteromedial portals. Relevant surface anatomy markings, including the anterior joint line and portal locations, are shown. We find a slightly more lateral position of the anterolateral portal to be helpful with the 0° scope to be able to view the medial portal under direct visualization. Surface anatomy landmarks are labeled.

are alternately placed in each portal and switched as required to achieve optimal visualization and instrumentation of the chondral lesion, which in this case is found on the medial femoral condyle, which in this case, optimal instrumentation would involve viewing from the anterolateral portal and instrumentation from the anteromedial portal. A 2.0-mm shaver or nano-grasper can be used to remove synovial hyperplasia or loose bodies, respectively, to optimize visualization of the anterior aspect of the joint.

Next, a chondroplasty is performed, debriding the lesion with a combination of nano-grasper, curettes, and 2.0-mm shaver to debride the injured cartilage to stable, vertical borders (Fig 4). Using a probe, the surgeon measures the lesion for operative report records and possible future interventions. At this time, a cartilage biopsy can also be performed if a decision is made with the patient in real-time to move forward with future matrix-induced autologous chondrocyte implantation. Taking care not to violate the subchondral plate, a 3.0-mm burr is used for bone stimulation to allow for mesenchymal signaling cells to extravasate from the underlying bone marrow (Fig 5). We do not recommend microfracture, as recent literature has suggested that violation of the subchondral plate may lead to poorer cartilage ingrowth. In the senior surgeon's experience, this bony portion of the procedure does not cause patients pain, but rather a sensation of vibration in their knee following adequate local anesthetic application.

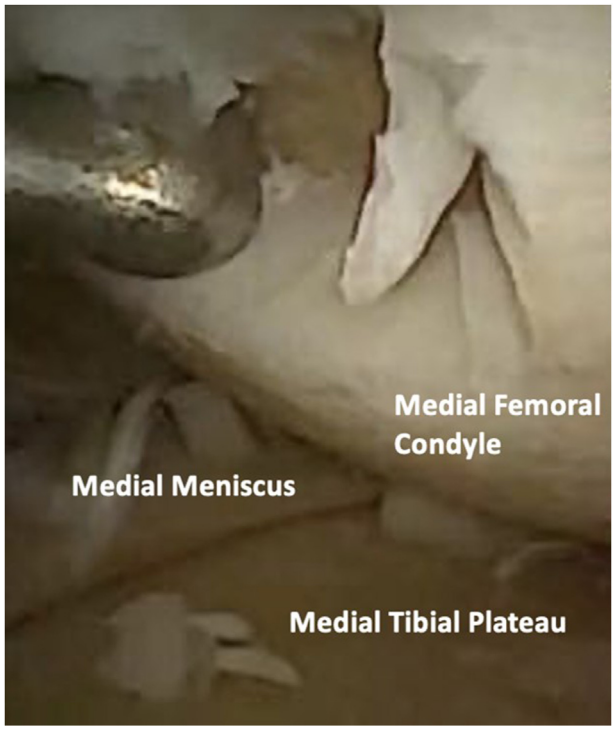


**Fig 4.** A needle arthroscopic view of the left knee medial femoral condyle chondral lesion from the anterolateral viewing portal. Nano-arthroscopic curettes are used to debride the chondral lesion back to stable, vertical borders.

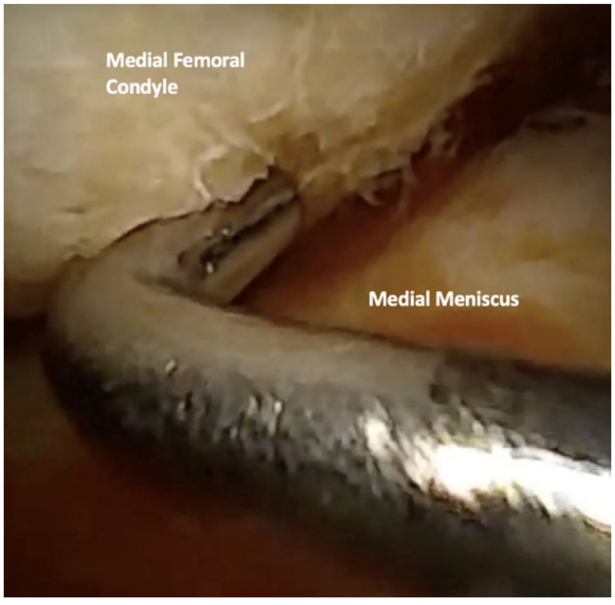


**Fig 3.** A needle arthroscopic view of the left knee from the anterolateral viewing portal. Demonstrated is an anterior medial femoral condyle chondral lesion. The key to the procedure is ensuring adequate visualization not only during the arthroscopic portion of the case but following suctioning of the joint to allow for cartilage allograft extracellular matrix placement. An aggressive synovectomy with the nano-arthroscopic 2.0-mm shaver is, thus, required around the lesion.

The knee joint is then suctioned out using a Fraser tip suction (8 French ~2.7-mm size). If adequate visualization of the lesion remains during the dry scope, then multiple swabs are inserted to ensure a dry recipient surface of the chondral lesion bed (Fig 6). If suctioning causes synovial tissue to compress against the femoral condyle, the joint is reinsufflated, further synovial debridement is performed, and the suctioning step is repeated. Once optimal visualization and a dry recipient bed is achieved, the cartilage allograft extracellular matrix is implanted into the chondral lesion using the inserter and smoothed until flush with the intact cartilage walls with a freer elevator (Fig 7). An optional addition is to add platelet-rich-plasma (PRP) or concentrated bone marrow aspirate (CBMA) to the cartilage allograft extracellular matrix to provide additional cellular biology and growth factors to the bone marrow stimulation procedure. Fibrin glue (Tisseel, Baxter International, Deerfield, IL) is then applied over the matrix.

Portals can be sealed primarily using adhesive wound closure strips (Steri-Strip, 3M, Saint Paul, MN) or with simple nylon sutures if the surgeon feels they are necessary. A dry, sterile dressing is applied that facilitates early knee range of motion.

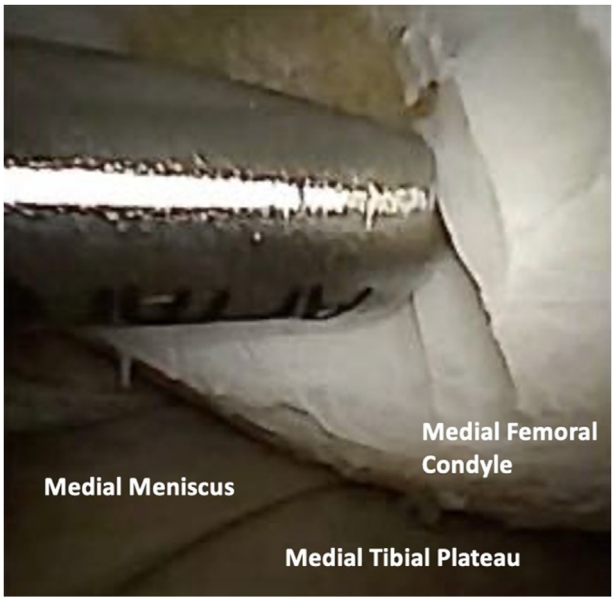


**Fig 5.** A needle arthroscopic view of the left knee medial femoral condyle chondral lesion from the anterolateral viewing portal. Using combination of a 2.0-mm shaver and a 3.0-mm burr, bone stimulation is performed without violation of the subchondral plate.

### Postoperative Protocol

Postoperatively, the patient is allowed to mobilize with full weight-bearing, as tolerated. The patient is encouraged to perform straight leg raises, knee extension, and flexion exercises every hour for 5 minutes for the first 24 hours. The patient is encouraged to apply ice and elevate the leg when not ambulating for the first 24 to 72 hours. No deep vein thrombosis prophylaxis or antibiotics are required. Acetaminophen and anti-inflammatories are sufficient for postoperative pain control. The patient returns on postprocedure day 5, and formal physical therapy is begun.

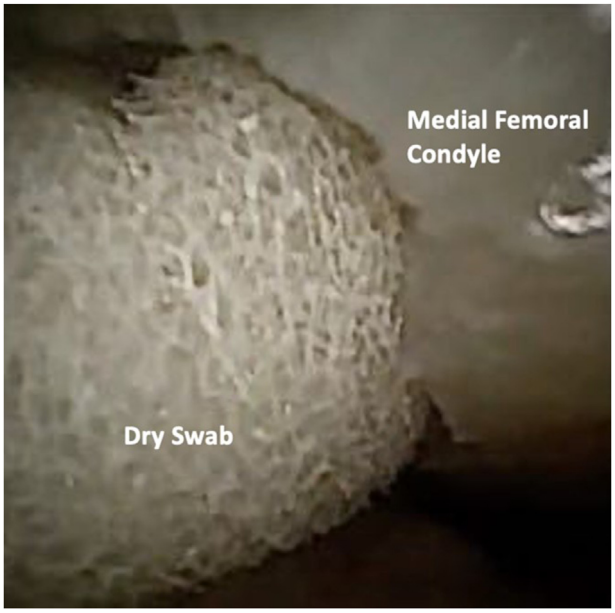


**Fig 6.** A needle arthroscopic view of the left knee medial femoral condyle chondral lesion from the anterolateral viewing portal. Swabs are used to ensure a dry recipient bed of the debrided chondral lesion to allow for "sticky" contact of the cartilage allograft extracellular matrix.

## Discussion

The ability to perform in office procedures using needle arthroscopy provides orthopedic surgeons with another versatile tool in the treatment of sports pathologies, allowing for decreased morbidity, increased patient ownership and satisfaction, and a faster recovery when indicated properly. In this technical note, we describe the use of IONA to perform wide-awake marrow stimulation and cartilage allograft extracellular matrix application of a medial femoral condyle chondral lesion. With the advent of needle arthroscopy and improving technology, a multitude of new techniques have been reported. Lavender et al. has described several techniques, including single incision rotator cuff repair, as well as medial meniscal repairs using needle arthroscopy.[7,8] These procedures were performed in the operating room using either regional or general anesthesia and tourniquets, whereas Bradsell et al. recently published their technique on IONA for diagnostic knee arthroscopy using similar instrumentation as our technique.[9] DeClouette et al. and Wagner et al. independently demonstrated diagnostic accuracy of needle arthroscopy in the shoulder and knee when compared to MRI and formal surgical arthroscopy.[10,11] Several techniques for IONA have been described in foot and ankle surgery literature using wide-awake local anesthesia no tourniquet (WALANT), ranging from posterior hindfoot debridement to peroneal tendoscopy and debridement.[12-14]

IONA using WALANT provides a unique experience for the patient-physician relationship. Rather than a preoperative discussion without true insight, or perhaps with the use of simple figures or models, the surgeon can demonstrate in real time to the patient his or her pathology, correlate it to the symptoms and imaging findings, and treat the causal problem in the office setting. IONA has been associated with increased patient satisfaction scores. Colasanti et al. reported on 31 patients who underwent IONA treatment for anterior ankle impingement with a mean follow-up time of 15.5 months. 29 out of 31 patients (94%) expressed a willingness to undergo the same procedure again.[15] Patient satisfaction following in office wide-awake procedures using local anesthesia has been extensively studied in the hand literature. Pina et al. found that 97% of patients would undergo a WALANT-style surgery again, and Moscato et al.

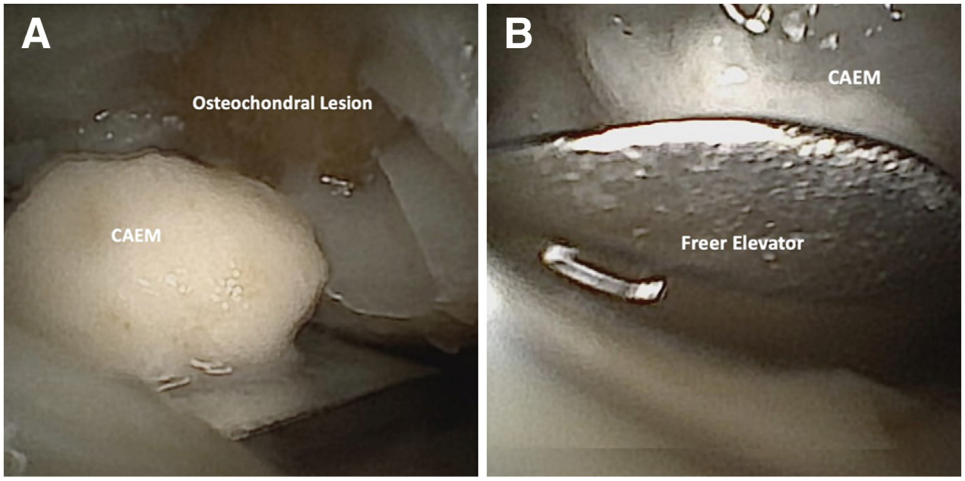


**Fig 7.** A needle arthroscopic view of the left knee medial femoral condyle chondral lesion from the anterolateral viewing portal. (A) The cartilage allograft extracellular matrix (CAEM) is applied using a dedicated applicator. (B) A freer elevator can be used to smooth the CAEM over the stable walls of the lesion. Fibrin glue is applied over the matrix.

demonstrated that procedures performed in an office-based setting showed higher rates of patient satisfaction when compared to ambulatory surgery centers.[16,17] Townsend et al. demonstrated in a randomized control trial that even in the high-anxiety patient population, the use of noise-cancelling headphones and music decreased intraoperative anxiety during wide-awake hand surgery.[18]

Functional and patient-reported outcomes following IONA have been promising in recent literature. In the aforementioned study by Colasanti et al., minimal clinically important difference (MCID) was achieved by 84% of patients, according to the Foot and Ankle Outcome Score (FAOS) for pain, 77% for symptoms, 75% for quality of life, 74% for sports, 65% for Patient-Reported Outcome Measurement Information System Pain Interference, and 61% for FAOS ADL.[15] Mercer et al. demonstrated significant improvements in FAOS symptoms, pain, ADLs, sports activities, and quality of life in 10 patients who underwent IONA for posterior ankle impingement syndrome at a mean follow-up of 13.3 months.[19] In addition, they found all patients returned to sport at a median time of 4.1 weeks and work at a median of 3.4 days.

The cost of IONA compared to other diagnostic modalities has been investigated as well. A study by McMillan et al. performed a retrospective review of 200 patients with a cost-analysis of IONA versus non-contrast MRI for diagnosis and found minimum savings of $418/patient for knees and $554.62/patient for shoulders when using independent imaging centers, which doubled when performed at hospital-based facilities.[20] Munn et al. demonstrated needle arthroscopy to be cost-effective, even in a United Kingdom national healthcare center, with the cost of the needle arthroscopy pathway to be nearly 800 pounds less per patient compared to conventional arthroscopy pathway, as well as over 3 times less recyclable waste.[21]

## Conclusion

IONA allows patients to undergo a diagnostic and therapeutic procedure in the office setting and actively participate in the understanding of their condition. We have found that our patients are extremely interested during the procedure and the experience of watching the arthroscopic feed with the surgeon provides rapport and high satisfaction. Furthermore, IONA has the theoretical potential to limit hospital costs by reducing OR utilization and expenses, while simultaneously allowing surgeons to perform increased procedures in a high turnover office setting and saving larger procedures for the OR. The ability to treat a chondral lesion in real time with chondroplasty and cartilage allograft extracellular matrix application, or alternatively performing a cartilage biopsy, provides a unique tool for the orthopedic surgeon.

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