Technical Note

Diagnostic Evaluation of the Knee in the Office Setting Using Small-Bore Needle Arthroscopy

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Abstract: Arthroscopy is currently the gold standard for diagnosing intra-articular knee pathology. Magnetic resonance imaging (MRI) can be a clinical adjunct for diagnosis; however, it is not without its shortcomings. Although highly accurate, even advanced imaging misdiagnoses the condition in 1 in 14 patients with regard to anterior cruciate ligament pathology. Previous studies have indicated that MRI fails to identify meniscal pathology when one exists in 1 of every 10 cases, and diagnoses pathology when pathology truly does not exist in 1 of every 5 patients. In-office arthroscopy offers an alternative to formal diagnostic arthroscopy, with reduced cost and risk of complications. This is a technique article that discusses the use of small-bore needle arthroscopy in the office setting.

Arthroscopy is currently the gold standard for diagnosing intra-articular knee pathology. Magnetic resonance imaging (MRI), in addition to clinical evaluation, can be helpful in delineating pathology. However, even as technology advances and MRI continues to improve, inaccuracies do exist. Previous systematic reviews have demonstrated that MRI has a sensitivity of about 87%, specificity of 93%, and accuracy of 93% when diagnosing acute anterior cruciate ligament injuries.[1,2] Although highly accurate, even advanced imaging misdiagnoses the condition in 1 in 14 patients with regard to anterior cruciate ligament pathology. When evaluating for meniscal pathology, accuracy diminishes further (86% medial meniscus, 88% lateral meniscus).[1-4] Previous studies have indicated that MRI fails to identify meniscal pathology when one exists in 1 of every 10 cases, and diagnoses pathology when pathology truly does not exist in 1 of every 5 patients.[2] Evaluation of cartilage defects presents the biggest challenge for advanced imaging. Even with the development of 3-tesla MRI combined with cartilage-specific 3-dimensional double-echo steady-state sequences, the sensitivity for evaluation of cartilage lesions remains moderate at best (grade I Outerbridge: 9%; grade II: 68%; grade III: 74%; and grade IV: 83%).[5] This can simultaneously lead to unnecessary surgical intervention or lack of intervention when it is indicated at the expense of the patient and health care system.

Table 1. Preoperative Examination and Imaging

Preoperative Examination and Imaging	Purpose
Inspection	Obvious trauma, swelling, atrophy, asymmetry
Palpation	Joint line and soft tissue tenderness
Range of motion	Contractures, catching, locking
Neurovascular	Intact sensation and pulses
Lachman test	ACL pathology
Posterior drawer	PCL pathology
Varus/valgus stress examination	LCL and MCL pathology
McMurray test	Meniscal pathology
Dial test (if indicated)	Posterolateral corner pathology
Radiographs (weight-bearing, 45° PA flexion, Merchant/Sunrise)	Evaluation of joint space, patellofemoral space, tilt, alignment
Magnetic resonance imaging	Soft tissue pathology, evaluation of chondral surfaces

ACL, anterior cruciate ligament; LCL, lateral collateral ligament; MCL, medial collateral ligament; PA, posteroanterior; PCL, posterior cruciate ligament.

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Table 2. Equipment Needed for In-Office Arthroscopy

Equipment Needed
Mi-Eye 2
Topical antiseptic and local anesthetic of the surgeon's preference
Multiple 10- or 20-mL syringes filled with sterile saline
Dressing of surgeon's preference

Although diagnostic arthroscopy is the gold standard for diagnosing intra-articular knee pathology, it is not without risks. Previous studies have noted 30-day readmission rates of 0.64% and 30-day reoperating rates of 0.40%.[6] Although these percentages are small, if we consider the number of potential false negatives and positives obtained following advanced imaging every year, the burden for both the patient and the health care system is significant. Thus, in-office arthroscopy allows the provider to visualize the structures within the knee in the clinical setting, aiding the physician in diagnosing particularly difficult cases, without the need for anesthesia or a formal diagnostic arthroscopy (Mi-eye; Trice Medical, King of Prussia, PA).

This is a technique paper demonstrating the use of small-bore needle arthroscopy of the knee with the Mi-Eye 2 system.

Technique

Preoperative Workup and Patient Setup

Standard preoperative workup should be conducted based on the patient's presenting symptoms. See Table 1 for a brief list of preoperative workup and clinical exam. An MRI is not a prerequisite for this procedure, and in many instances, an in-office arthroscopy can be a substitute for advanced imaging. Nevertheless, we strongly recommend plain radiographs prior to any in-office arthroscopy.

Fig 1. Office setup for preparation of in-office arthroscopy for the right knee. Note that the patient is supine with her knee at 90°. Tablet and sterile stand can be set up per the surgeon's preference. The patient can also be positioned sitting upright with the affected knee flexed to 90°.

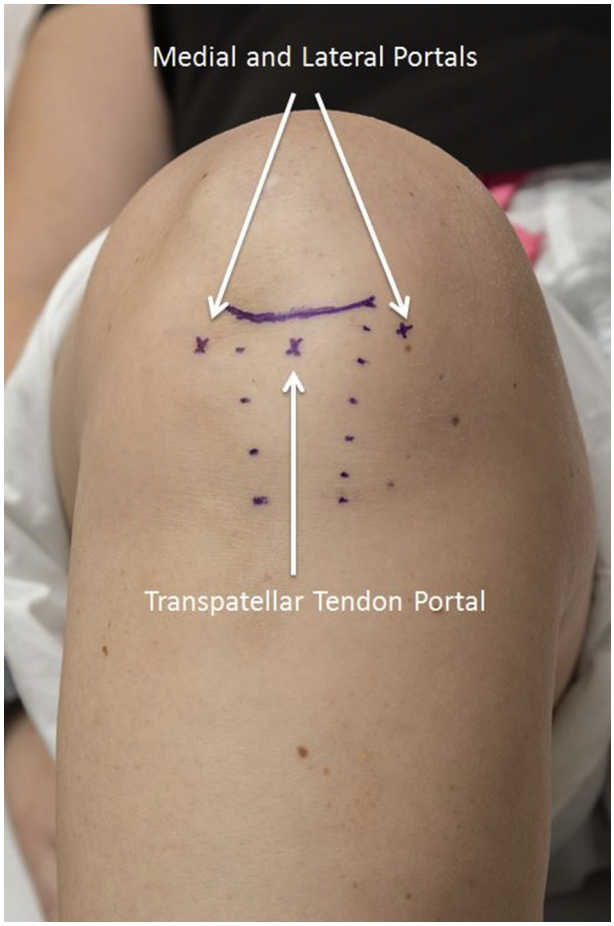

Fig 2. Right knee. The medial and lateral portals are drawn out just off the patella tendon medially, and laterally 0.5 cm inferior to the inferior pole of the patella. A transpatellar tendon portal 1 cm inferior to the inferior pole can be used if necessary. Also, accessory superior lateral or superior medial portals can be used.

The patient's knee should be marked and appropriate signed consent obtained. Time-out should be performed in the standard fashion. Because of the small size of the entry, no prophylactic antibiotics are suggested. See Table 2 for the equipment needed. No sedative medication is needed prior to beginning the procedure. Management of anticoagulation is per the surgeon's preference, and it is recommended to use the same protocol as that before an aspiration or injection, as the needle size is similar.

The patient should be positioned on the office table with the knee in 90° of flexion. This can be done with the patient seated or supine with a bump at the foot, per the surgeon's preference (Fig 1). Each position allows the surgeon the possibility of a dynamic examination if needed.

Portals

The lateral, medial, and inferior border of the patella should be palpated and drawn out along with the

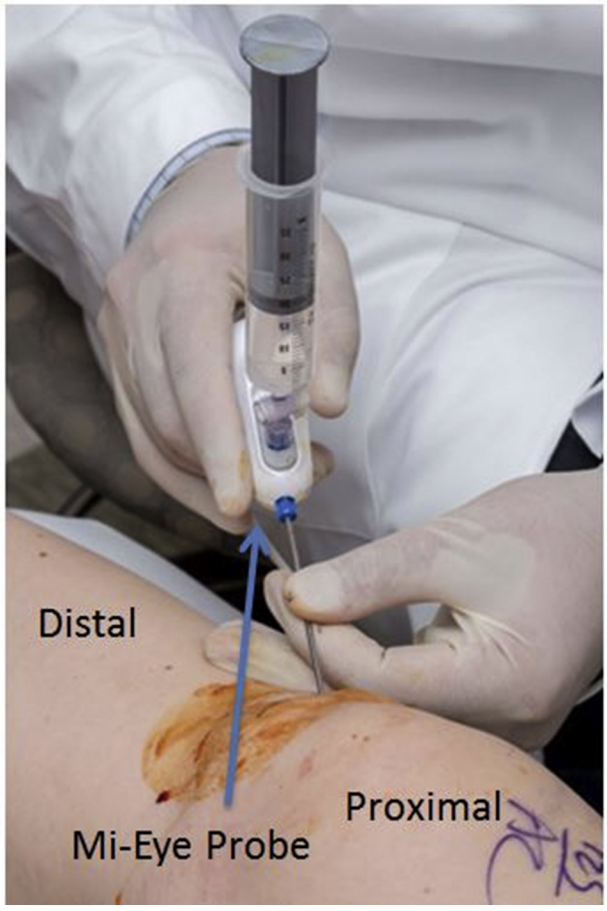

Fig 3. Insertion of a Mi-Eye probe into the lateral portal of the right knee. Note that the syringe connected to the probe and stopcock is in open position ready to distend the capsule. The patient is supine with the knee extended.

patellar tendon. The medial and lateral portals are drawn out just off the patellar tendon medially and laterally 0.5 cm inferior to the inferior pole of the patella. A transpatellar tendon portal 1 cm inferior to the inferior pole can be used if necessary (Fig 2). If further evaluation of the patellofemoral joint is necessary, standard superior lateral or superior medial portals can be used. Topical antiseptic of the surgeon's preference should be applied over the anticipated portal sites. We prefer sterile triple betadine preparation. Thirty milliliters of 2% lidocaine without epinephrine should be drawn up sterilely. One to 2 mL per portal and 20 mL into the joint can then be injected. Allow 3 to 5 minutes for the analgesic to take full effect, ensuring adequate analgesia using a pinch test. Reapplication of antiseptic to the area should be performed immediately before inserting the Mi-Eye 2 probe into the joint.

Diagnostic Arthroscopy

Remove the Mi-Eye 2 tray from its sterile packing. Prepare multiple syringes with sterile saline to account for the varying amounts of fluid needed per patient to distend the joint and obtain adequate visualization. We suggest using 10- or 20-mL syringes to better control the probe. Attach the first syringe to the stopcock. Remove the probe connector and hand to assistant to be plugged into the tablet. Insert the probe into the medial or lateral portal sites, making sure to aim at the notch to avoid injury to the cartilage and menisci (Fig 3). Again, keep in mind that this is a 0° scope. Once in the capsule, depress the retraction button and retract the needle, exposing the probe optics. The stopcock should be opened to allow for injection of saline. Slowly inject saline to distend the capsule and fill the joint to allow for adequate visualization. Bursts of 3 mL of fluid will be needed to push away soft tissue and allow for visualization at specific times. Perform diagnostic arthroscopy in surgeon's preferred order using knee manipulation as needed to visualize structures (Fig 4). Images and live video can be saved to the portal when desired. For an example of a case, please see Figure 5.

After completion of the arthroscopy, the fluid in the joint can be aspirated through the same stopcock using

Fig 4. Just as in standard arthroscopy, the knee can be manipulated using varus force or a figure-of-4 position to visualize the lateral and medial compartments, respectively.

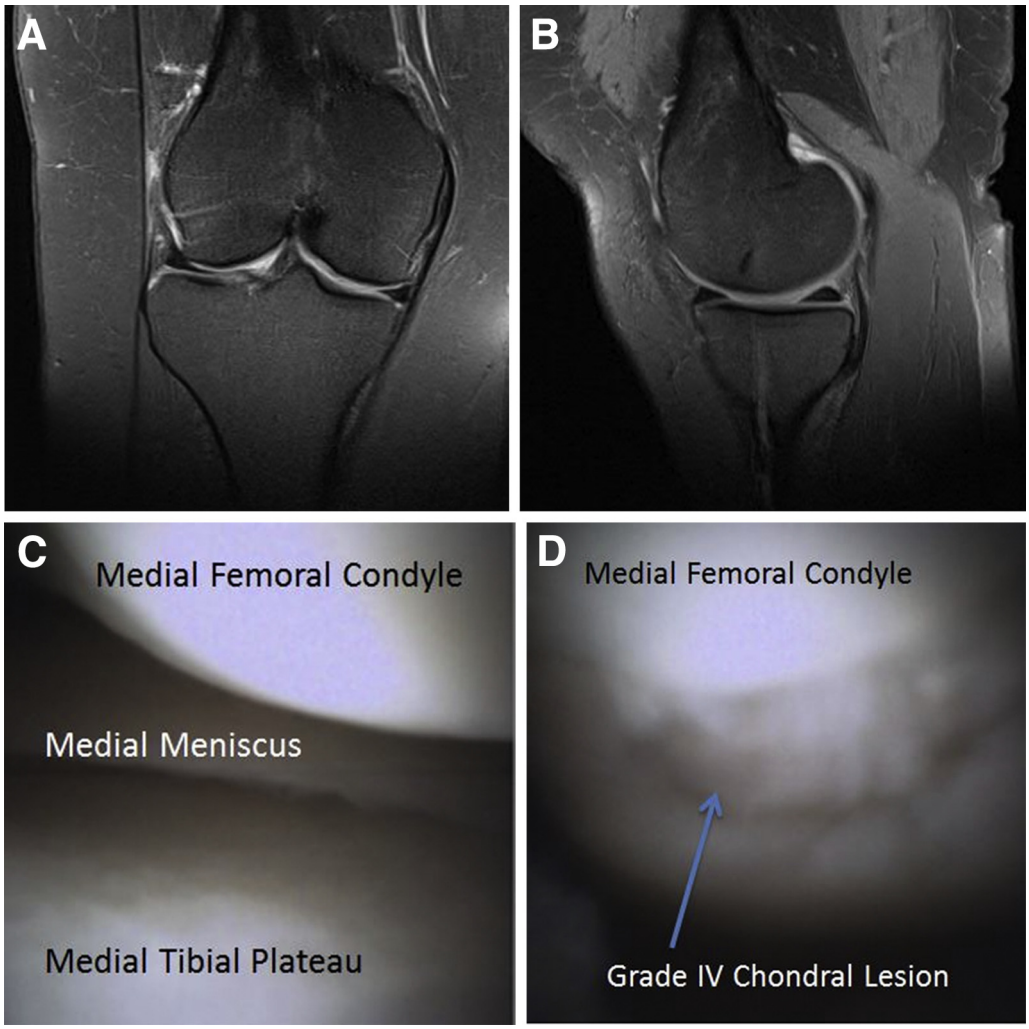

Fig 5. Three-tesla T2-weighted coronal (A) and sagittal (B) magnetic resonance image of a patient with chronic medial-sided right knee pain with minimal chondral damage on advanced imaging. In-office arthroscopy of the medial compartment (C) showed a grade IV chondral lesion on the medial femoral condyle after flexion of the knee to approximately 45° (D) viewed from the anterolateral portal.

50-mL syringes. On removal of the probe, a compressive dressing should be applied to the knee, such as an Ace Wrap. The images saved to the portal can then be reviewed with the patient immediately following the procedure. Please see attached video for a demonstration of in-office needle arthroscopy using the Mi-Eye 2 system (Video 1). The technical pearls for the procedure are presented in Table 3.

Discussion

In-office arthroscopy has been available for use since the early 1990s.[7,8] However, as technology continues to improve, the quality of images that are obtained from in-office diagnostic arthroscopy have improved. This allows the surgeon another tool to diagnose patients with intra-articular pathology that has been missed on previous advanced imaging. It can also be potentially beneficial for patients with intra-articular pathology who are unable to have an MRI for medical reasons or as a result of claustrophobia. Another potential use is in patients with continued knee pain following return to activity after a previous meniscal surgery, a situation

Table 3. Technical Pearls of In-Office Arthroscopy

Technical Pearls
Place patient's knee in 90° of flexion in seated position or supine with a bump
Each position allows the possibility of a dynamic examination
The medial and lateral portals are drawn out just off the patella tendon medially and laterally 0.5 cm inferior to the inferior pole of the patella. A transpatellar tendon portal 1 cm inferior to the inferior pole can be used if necessary. If further evaluation of the patellofemoral joint is necessary, standard superolateral or superomedial portals can be used.
Allow 3-5 minutes for portal analgesia to take full effect (2% lidocaine, 1-2 mL/portal, 20 mL in the joint)
Use a 10- or 20-mL syringe for better control of the probe
Use bursts (3 mL) of saline to push away soft tissue and allow for visualization at specific times during arthroscopy

Table 4. Advantages and Limitations of In-Office Arthroscopy

Advantages of In-Office Arthroscopy	Limitations of In-Office Arthroscopy
Minimal risk compared with diagnostic arthroscopy	Surgeon unfamiliarity in using a 0° scope
No risk of anesthesia	Visualization not as clear as operative arthroscopy
Can be used when MRI is contraindicated because of medical reasons or claustrophobia	Contraindicated with acute hemarthrosis because of the inability to flush knee out
Improved accuracy compared with MRI	Scar tissue from previous surgeries limits excursion of small-bore needle
Allows visualization of previous repair without diagnostic arthroscopy	
Cost-effectiveness and cost-savings	

MRI, magnetic resonance imaging.

that occurs commonly and one where advanced imaging is often nondiagnostic. This would allow the surgeon a less expensive, more readily available way to visualize the previous repair, without having to bring the patient back for a diagnostic arthroscopy. Additionally, in-office arthroscopy can be valuable to assess the knee joint prior to the use of an allograft, such as an osteochondral or meniscal allograft. In these cases, a diagnostic arthroscopy is often required before authorization of the procedure.

In-office arthroscopy is not without limitations. Because of the smaller size of the needle, the visualization is not as clear as a true operative diagnostic arthroscopy. Additionally, if the patient either has a hemarthrosis or one is created during the process of in-office arthroscopy, visualization can be severely limited as the surgeon is unable to run fluid through the knee to clear it out. Also, in patients with previous surgery, scar tissue can limit the excursion of the small-bore needle. These are all situations to keep in mind during patient selection for in-office arthroscopy. See Table 4 for the advantages and disadvantages of needle arthroscopy.

In-office arthroscopy presents minimal risk, especially when compared with diagnostic arthroscopy in the outpatient setting. The needle used is no larger than a similar arthrocentesis needle. Compared with the higher risks of a diagnostic arthroscopy and the associated anesthesia, in-office arthroscopy offers a cost-effective, safer alternative. Studies are ongoing on the effectiveness of current in-office arthroscopy technology relative to MRI, but preliminary data (Dines J., M.D., unpublished data) indicate better accuracy than MRI (91.5% vs 61.3% accuracy for all pathologies).

Previous studies have also demonstrated the potential cost savings for in-office arthroscopy. Cost analysis studies have shown more than $150 million per year in savings to the health care system with the use of in-office arthroscopy over MRI in patients with medial meniscus pathology.[9] Although in-office arthroscopy might not be needed in each case, its use in specific situations can greatly improve and expedite patient care, as well as save patients the cost and morbidity of an unnecessary procedure. In-office arthroscopy offers the surgeon another diagnostic tool that can be valuable in a multitude of clinical settings.

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