

Concurrent Needle and Standard Arthroscopy for Posterior Cruciate Ligament Reconstruction



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Abstract: Arthroscopic posterior cruciate ligament (PCL) reconstruction is a technically demanding procedure, particularly with respect to tibial footprint debridement and tibial tunnel placement, where iatrogenic damage to anatomic structures is a well reported complication and incorrect tunnel placement can have functional implications. Preparation of the tibial component often involves switching between 30° and 70° arthroscopes and frequent portal swapping and reorientation, which can be inefficient and time-consuming. As the technology and picture resolution of needle arthroscopy has improved, its clinical application has widened. This manuscript describes the use of needle arthroscopy-assisted arthroscopic PCL reconstruction for optimal visualization of the PCL tibial footprint using an accessory posterolateral portal, while obviating the need of both 30° and 70° arthroscopes.

The posterior cruciate ligament (PCL) is an extrasynovial, intracapsular structure that inserts within the intercondylar notch on the medial femoral condyle and originates on the PCL facet on the posterior tibia, 1.0 to 1.5 cm distal to the articular surface of the tibial plateau.¹⁻³ The primary function of the PCL is to restrain posterior translation of the tibia relative to the femur, with lesser roles identified in resisting internal and external rotation and varus/valgus stress.^{1,4} Acute PCL injury in the setting of acute knee injury has a wide range of reported incidence in the existing literature.

Described mechanisms of injury include a sudden, posteriorly directed force to the proximal tibia in a flexed knee, a fall onto a flexed knee, and sudden knee hyperflexion or hyperextension.⁵

Currently, there exists no widely agreed upon consensus on the treatment of PCL injuries. In general, nonsurgical management is favored for isolated, grade I PCL injuries, or mildly symptomatic higher-grade injuries in lower-demand patients. Surgical management is advocated for acute symptomatic grade III injuries and in chronic injuries that have failed nonsurgical management. Both single- and double-bundle reconstruction, as well as transtibial and tibial inlay techniques, are well described, although no outcome studies clearly identify a single technique as superior.⁶ Regardless of technique, one major challenge of the procedure is adequate visualization of the tibial PCL footprint in the posterior aspect of the joint, as well as protection of the posterior neurovascular structures.

Needle arthroscopy has been shown to be a safe, useful instrument in the visualization and treatment of a wide array of pathologies.⁷⁻⁹ It incorporates a 1.9-mm arthroscope, which is smaller and less rigid than a standard arthroscope (4 mm), allowing it to be used with smaller incisions and in areas where minimal soft tissue disruption is desired. For most standard PCL reconstructions, accessory portals, moving the arthroscope back and forth the between portals, and the use of a 70° arthroscope are necessary to appropriately visualize the tibial insertion on the posterior tibial facet. The use of adjunct needle arthroscopy affords excellent visualization of the tibial footprint while working with

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standard arthroscopic instruments from routine portals without the need to move back and forth between multiple portals.

The purpose of this Technical Note is to describe the benefits and use of ancillary needle arthroscopy through an accessory posterolateral portal during arthroscopic PCL reconstruction.

Surgical Technique (With Video Illustration)

Preoperatively, dual arthroscopy towers and monitors are arranged on the nonoperative side of the patient (Fig 1). The patient is positioned with a small hip bump under the operative side, a sequential compression device on the nonoperative calf, and a nonsterile tourniquet is placed high on the upper thigh, but not inflated. A lateral post is placed at the level of the tourniquet and a footrest is positioned distally such that the knee can be maintained in 90° of flexion. The limb is then prepped and draped in the usual sterile fashion.

Following surgical timeout, a standard anterolateral portal is established, and a diagnostic arthroscopy is conducted using a standard 30° arthroscope. A standard anteromedial portal is created to aid in diagnostic arthroscopy, and debridement.



Fig 1. Adjacent standard and needle arthroscopy towers arranged on the nonoperative (right) side of the patient.

Table 1. Pearls and Pitfalls

Pearls	
Familiarity with 0° arthroscope before surgery facilitates ease of use	
Optimal placement of accessory posterolateral portal is critical to tibial PCL footprint visualization	
No separate incision is needed for the accessory posterolateral needle arthroscopy portal, as the needle arthroscopy obturator has a sharp tip	
Staying anterior to and above the level of the posterior iliotibial band helps avoid iatrogenic injury the peroneal nerve when making accessory posterolateral portal	
Having consistent visualization of the PCL tibial footprint can enhance tibial tunnel placement and lessen surgical time	
Pitfalls	
0° arthroscope requires a learning curve	
The needle arthroscope is more malleable than a standard arthroscope, and excessive forceful movement can damage components	
Staying anterior to and above the level of the posterior iliotibial band helps avoid iatrogenic injury the peroneal nerve when making accessory posterolateral portal	
The sharp tip of the needle arthroscope obturator carries with it the risk of damage/injury to anatomic structures if placed incorrectly	

PCL, posterior cruciate ligament.

After completion of the diagnostic arthroscopy, accessory portals are established for PCL reconstruction. The posteromedial portal is established first by placing the knee in 90° of flexion and palpating the soft spot between the medial head of the gastrocnemius and the semimembranosus. An 18-gauge spinal needle is introduced through the posteromedial capsule under direct visualization from the anterolateral portal and a large cannula is inserted over a switching stick to allow easy access to the posterior aspect of the joint. The insertion point and trajectory for the needle arthroscope (NanoScope; Arthrex, Naples, FL) are similarly evaluated by placing a spinal needle from the lateral side of the knee, proximal to the lateral femoral condyle. Care is taken to stay anterior to and above the level of the posterior iliotibial band to avoid potential iatrogenic injury the peroneal nerve. No incision with a scalpel is necessary, as the initial obturator for the needle arthroscopy trocar has a sharp tip on the end to pierce through the skin and joint capsule. After appropriate placement of the small trocar, the obturator is removed and the needle arthroscope is placed through the trocar sheath into the posterolateral aspect of the knee and aimed directly towards the posterior tibia (Table 1). The needle arthroscope may then be left in place for the remainder of the case to provide direct visualization of the posterior tibial footprint throughout the procedure. The 2 separate points of visualization allow for use of standard 30° or 70° arthroscopes through any of the anterolateral, anteromedial, and posteromedial portals as needed, as well as the use of

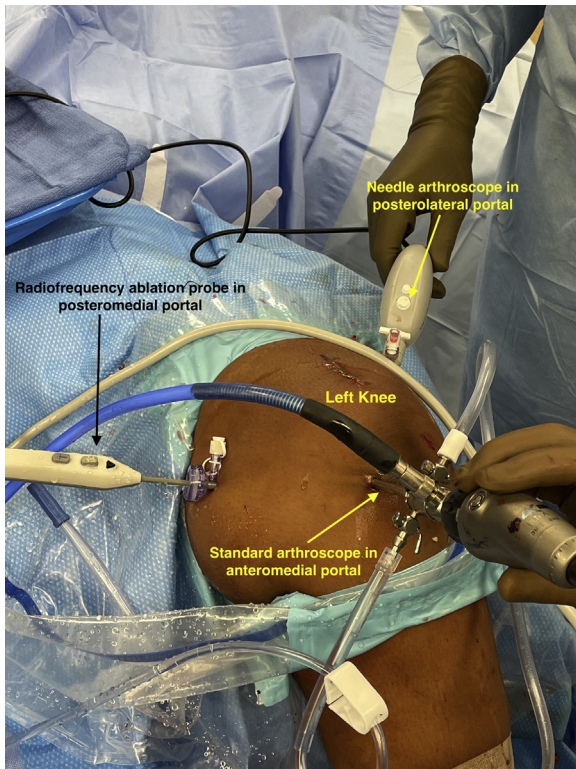


Fig 2. Portal setup for needle arthroscopy assisted arthroscopic posterior cruciate ligament reconstruction. Top right is the needle arthroscope in the accessory posterolateral portal on the patient's operative left knee. The radiofrequency ablation probe can be seen in the accessory posteromedial portal at the left side of the image, and the standard 30° arthroscope is seen bottom right in the anteromedial portal.

the needle 0° arthroscope through the posterolateral viewing portal (Fig 2).

In this patient, an Achilles tendon allograft was selected for PCL reconstruction. The graft was thawed on the back table and fashioned to a diameter of 10.5 mm and a length of 85 mm. One end is often fanned out and is tubularized with cerclage 0-Vicryl sutures. For graft fixation, we used an all-inside cortical suspensory fixation technique with the QuadLink FiberTag and Tightropes (Arthrex). The QuadLink (Arthrex) graft prep card and suture were used to prepare either end of the allograft, using FiberTag (Arthrex) circumferential sutures and sutures running back-and-forth through the graft. A looped FiberTag suture over a TightRope RT (Arthrex) is used for the femoral side and a TightRope Attachable Button System (Arthrex) is used for the tibial side. The graft is marked at 20 mm from either end which corresponds with the end of the suture materials.

With graft preparation complete, attention can be turned to preparation of the tibial and femoral PCL footprints. Debridement is carried out in anterior to

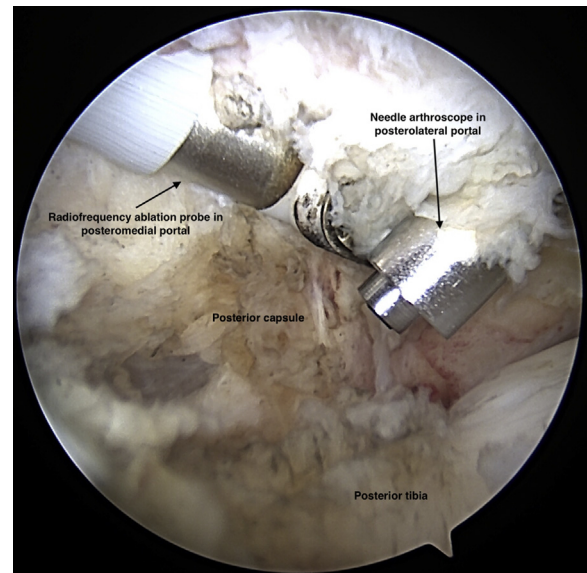


Fig 3. Image captured from the standard 30° arthroscope from the anteromedial portal of the operative left knee, showing tensioning of the posterior capsule with the radiofrequency ablation probe via the accessory posteromedial portal. The needle arthroscope in the accessory posterolateral portal is seen next to the ablation probe.

posterior and proximal to distal directions with radiofrequency ablation and a mechanical shaver, beginning at the posterior tibial plateau and continuing down along the posterior tibial facet in between the mamillary bodies on the posterior proximal tibia. Care is taken to stay intracapsular and avoid straying posteriorly into the popliteal neurovascular bundle. Either instrument can be used as a probe to intermittently

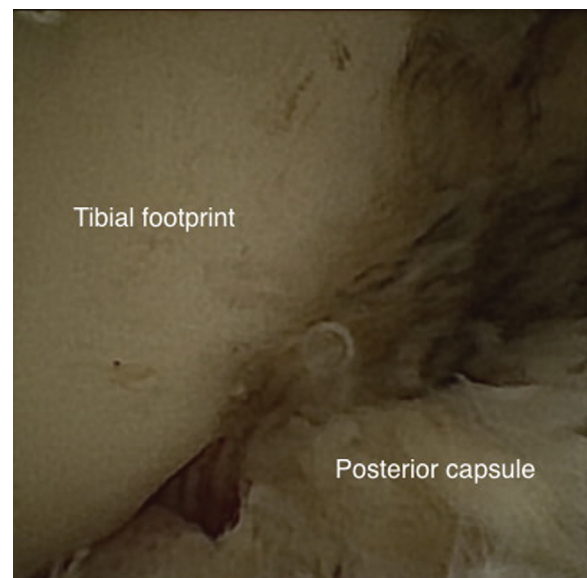


Fig 4. Image showing the posterior cruciate ligament tibial footprint in the operative left knee, captured from the needle arthroscope from the accessory posterolateral portal.

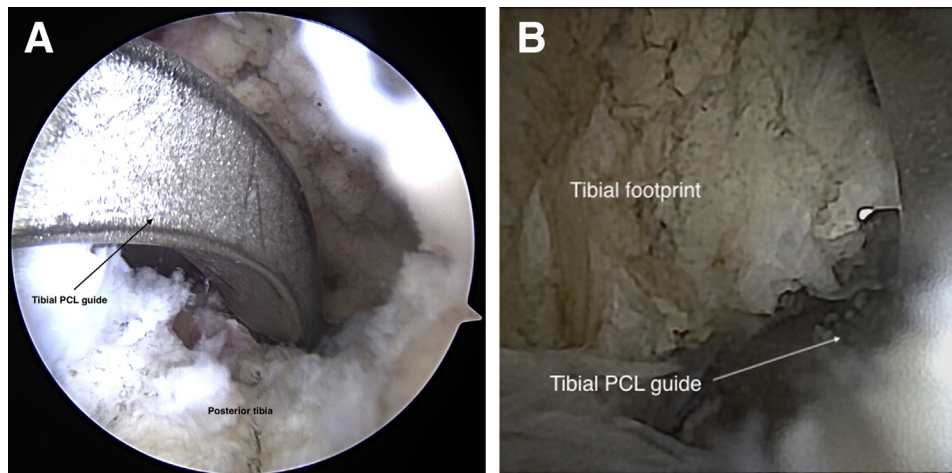


Fig 5. View of the tibial posterior cruciate ligament guide as seen from the standard arthroscope in the accessory posteromedial portal of the operative left knee (A) and from the needle arthroscope in the accessory posterolateral portal (B).

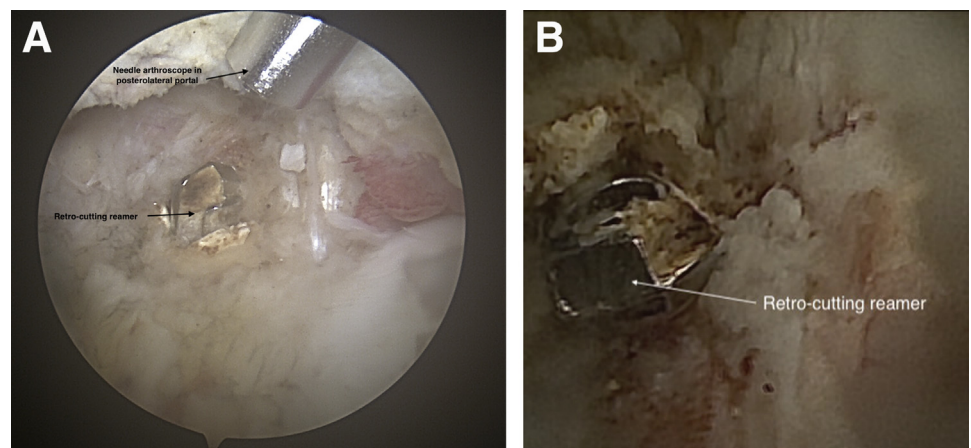
tension the posterior capsule and confirm continued safe debridement (Fig 3). The needle arthroscope is maintained in the posterolateral portal throughout this process, providing a continuous second vantage point (Fig 4). The tibial footprint is considered appropriately prepared when bone is visible between the mammillary bodies 1 to 1.5 cm distal to the posterior articular margin of the tibia. A curved tibial PCL guide is then introduced through the anteromedial portal and seated over the debrided footprint. Optimal guide placement down the posterior aspect of the tibia is confirmed via the needle arthroscopic view (Fig 5A and B). A small stab incision is made anteromedially over the tibia and the guide sleeve is advanced directly down to bone. Confirming that the tibial guide remains centered on the tibial footprint on both the standard and needle arthroscopes, a retro-cutting reamer is drilled up through the guide and out the posterior tibial cortex (Fig 6A and B). A socket is then retro-reamed to a depth of 40 mm with a 10.5 mm diameter, and a self-passing nonabsorbable suture is

passed through the tunnel into the knee and retrieved out the anterolateral portal (Fig 7).

To prepare the femoral footprint, a flat, circular PCL guide is introduced through the anteromedial portal and seated at the footprint of the anterolateral bundle of the PCL on the femur, posterior to the articular cartilage of the medial femoral condyle (Fig 8). A small stab incision is made over the medial aspect of the distal femur, and the guide sleeve is advanced down to bone. The retro-cutting reamer is then advanced through the guide until it emerges intra-articularly under direct visualization (Fig 9). The cutter is flipped, sized to 10.5 mm and a 25-mm socket is retro-reamed. A second self-passing suture is introduced through the femoral tunnel and brought out the anteromedial portal (Fig 10).

The TightRope and tibial side of the graft are then brought into the knee via the anterolateral portal and passed through the notch by pulling the passing suture out the anteromedial tibia. The femoral side of the graft is similarly seated using the femoral passing suture,

Fig 6. View of the retro-cutting reamer emerging from the posterior tibia in the operative left knee as seen from the standard 30° arthroscope in the accessory posteromedial portal (A) and the needle arthroscope in the accessory posterolateral portal (B).



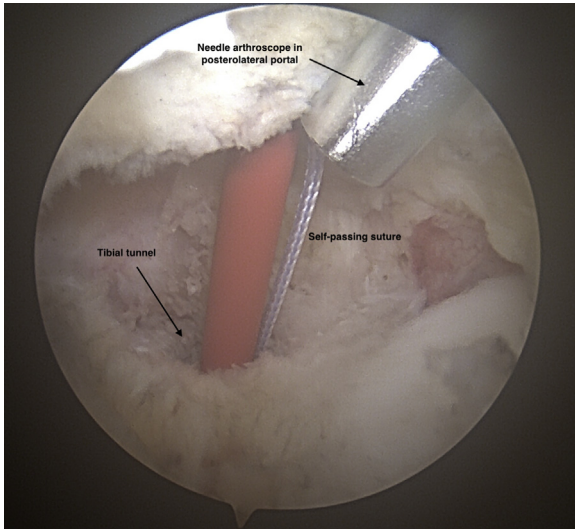


Fig 7. View of the self-passing nonabsorbable suture being passed through the tibial tunnel in the operative left knee, as seen from the standard 30° arthroscope in the anteromedial portal. The needle arthroscope is seen adjacent to the suture.

which is shuttled through the medial femoral tunnel proximally. The cortical button is flipped on the medial distal femur and the ABS button is attached to the tibial side and seated on the anterior tibia. The suspensory fixation constructs are then sequentially tightened, first on the tibia, then the femur, until 20 mm of the graft is firmly seated in each. The knee is maintained in 70-90° of flexion throughout. The knee is then cycled and both the femoral and tibial sides of the graft are re-tensioned

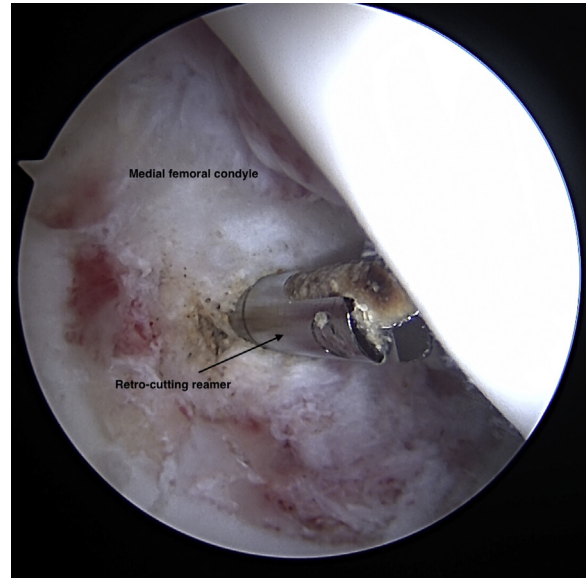


Fig 9. Image from the standard 30° arthroscope from the anterolateral portal of the operative left knee, showing the retro-cutting reamer emerging in the footprint of the anterolateral posterior cruciate ligament bundle on the medial femoral condyle.

a final time. An example of the surgical technique is shown in [Video 1](#).

Discussion

PCL reconstruction can be technically challenging, particularly with regards to work on and around the posterior tibial footprint, where visualization, even when employing a 70° arthroscope, can be difficult. Optimal visualization often requires the inefficient process of

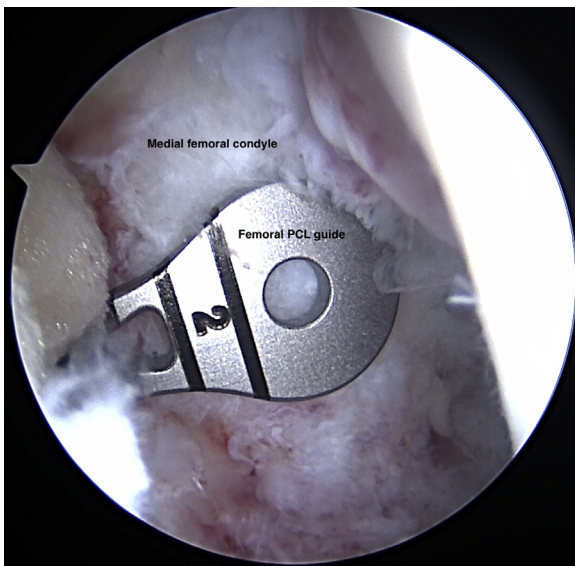


Fig 8. Standard 30° arthroscope image from the anterolateral portal in the operative left knee, showing the femoral posterior cruciate ligament guide placed over the footprint of the anterolateral bundle on the medial femoral condyle, just posterior to the articular cartilage margin. (PCL, posterior cruciate ligament.)

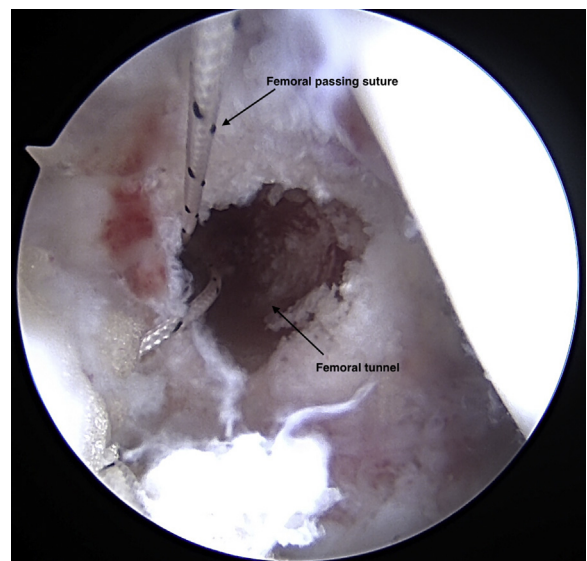


Fig 10. Femoral passing suture in the operative left knee, as seen from the standard 30° arthroscope from the anterolateral portal.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Can eliminate need to switch between 30° and 70° arthroscopes	Surgeon unfamiliarity with equipment
Equipment set up is quick and straightforward	Use of needle arthroscope incurs additional cost
Consistent dual point visualization	Instrumentation is comparatively fragile

switching between 30° and 70° arthroscopes and multiple anterior and posterior portals, with frequent reorientation and recalibration of the arthroscopes. In addition, accurate identification of the tibial footprint is paramount to avoid damage to nearby structures, such as the posterior root of the medial meniscus and popliteal neurovascular bundle.¹⁰ Optimal visualization is necessary for avoiding unwanted complications and for ideal placement of the tibial component of the PCL graft, which has functional implications. Use of ancillary needle arthroscopy throughout the procedure can aid in visualizing and confirming safe debridement of the tibial footprint, assuring accurate tunnel placement, and obviating the need to switch between different arthroscopes and portals.

Needle arthroscopy equipment requires minimal set up, without large towers or pumps. The battery-powered imaging console may be placed on a mayo stand next to the arthroscopy tower. The camera and sheath are disposable, eliminating the need for instrumentation processing/sterilization and making it easy to use as an accessory in arthroscopic procedures. In addition, the small 1.9 mm diameter, results in minimal skin incisions and potentially lowers risk of soft tissue or neurovascular injury as it is placed into the joint.

Multiple studies have demonstrated the utility of needle arthroscopy for numerous pathologies, both as an adjunct to standard arthroscopy and as the primary visualization instrument.^{7-9,11} Peters et al.⁸ demonstrated safe use for elbow arthroscopy, while Dankert et al.¹² detailed its use for loose body removal from the ankle joint. Others have demonstrated its use for more complicated procedures, such as meniscal repair or as an adjunct to anterior cruciate ligament repair.^{13,14} Having consistently good visualization of the tibial footprint can potentially decrease technical difficulty and lessen surgical time.

There are some limitations to the use of needle arthroscopy (Table 2). The camera is smaller and more malleable than a standard arthroscope and over-manipulation can result in damage. Care should be taken to avoid excessive blunt force when moving the needle arthroscope about the knee joint. Limited manipulation means the surgeon should ensure placement at the entry point into the joint is optimal for direct viewing. If this does not occur, optimal

visualization can be challenging. In addition, the camera tip is set at 0°, requiring a small learning curve to adjust to this type of visualization. Despite these limitations, use of needle arthroscopy is technically straightforward and can be a helpful tool as an adjunct to standard arthroscopy in the completion of an arthroscopic PCL reconstruction.

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