

Arthroscopic Posterior Capsulotomy for Knee Flexion Contracture Using a Spinal Needle



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Abstract: Knee flexion contractures can arise from posterior capsule arthrofibrosis secondary to trauma, surgery, or chronic degenerative disease. This leads to limited knee extension and increased mechanical stress on the contralateral joint. Depending on the severity of the contracture, a treatment option may include surgical release of the posterior capsule. Arthroscopic posterior capsular release has been reported previously to have excellent resolution of extension deficits with minimal risk of postoperative complications. These techniques typically use an array of instruments, including shavers, biters, or scissors to perform arthrolysis of the posteromedial and posterolateral capsules. Our primary objective is to present a modified arthroscopic surgical technique for percutaneous treatment of knee flexion contracture using a spinal needle to perform a posterior capsule release.

Knee flexion contractures represent a significant source of morbidity and disability, leading to limited range of motion, quadriceps weakness, gait disturbances, diminished functional capacity, persistent anterior knee pain, and reduced quality of life.¹⁻³ Extension deficit can arise from arthrofibrosis secondary to trauma, iatrogenically following operative procedures, or chronic degenerative diseases.¹ Management of this condition can be challenging, given variable severity of symptoms and etiologies.

Treatment of knee flexion contractures include both conservative and operative measures. Conservative management is the first-line treatment and includes physical therapy, passive stretching, joint mobilization, and serial casting or bracing.^{4,5} However, these methods may fail to improve moderate-to-severe knee flexion contracture, necessitating more invasive measures including manipulation under anesthesia (MUA) and

posterior capsule release.⁶ Surgically, extension deficit can be treated with anterior arthrolysis, although this approach may not adequately correct extension deficit due to adhesions in posterior compartments.^{7,8} In cases of inadequate correction, a posteromedial capsular release can be performed. If sufficient extension motion is still not achieved, a posterolateral and central posterior capsular release also can be performed.⁵

Although functional outcomes and mobility gains are generally excellent following posterior capsular release, this procedure is not without risk and can involve injury to the popliteal neurovascular structures.⁸⁻¹¹ Moreover, this procedure also may lead to posterior instability and subsequent knee recurvatum.¹⁰ A variety of open and arthroscopic posterior capsulotomy techniques have been described.^{3,5,12-14} The purpose of this Technical Note is to present a safe and effective percutaneous technique for arthroscopic posteromedial and posterolateral capsular release using a spinal needle for the treatment of knee flexion contracture.

Surgical Technique (With Video Illustration)

Indications

All studies have been carried out in accordance with relevant regulations of the U.S. Health Insurance Portability and Accountability Act (HIPAA). Posterior capsulotomy, performed either open or arthroscopically,¹⁵ is indicated in patients with persistent flexion contractures $>10^\circ$ not responsive to nonsurgical treatment.^{5,15} Quadriceps strengthening and knee stretching with bracing and physical therapy as well as MUA should be attempted before undergoing posterior capsular release.

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Contraindications include patients with osteoarthritis or gastrocnemius shortening, as capsular release in these conditions will not result in improvements in range of motion.³

Patient Positioning

The patient is placed supine, the surgeon's preferred arthroscopic position, and is given general or regional anesthesia. The extension deficit can be compared with the contralateral side. The operative knee will be maintained at 90° of flexion throughout the duration of the capsular release to minimize risk of injury to popliteal neurovascular structures.

General Arthroscopic Portal Overview

Standard anterolateral and anteromedial portals are used to visualize both posteromedial and posterolateral capsular releases via the modified Gillquist interval (Fig 1).¹⁶ This interval allows for adequate visualization of the posterior compartment. In our technique, we use a 30° arthroscope for the posterior compartment (Arthrex, Inc., Naples, FL).

Initial Approach to the Posteromedial Capsule

An anterolateral viewing portal is created 1 cm above the tibiofemoral joint line adjacent to the patellar tendon. The arthroscope is inserted and subsequently advanced in the space between the posterior cruciate ligament and the anterolateral border of medial femoral condyle to allow for visualization of the posteromedial compartment (Fig 2). We recommend using a blunt obturator to create the desired trajectory through this

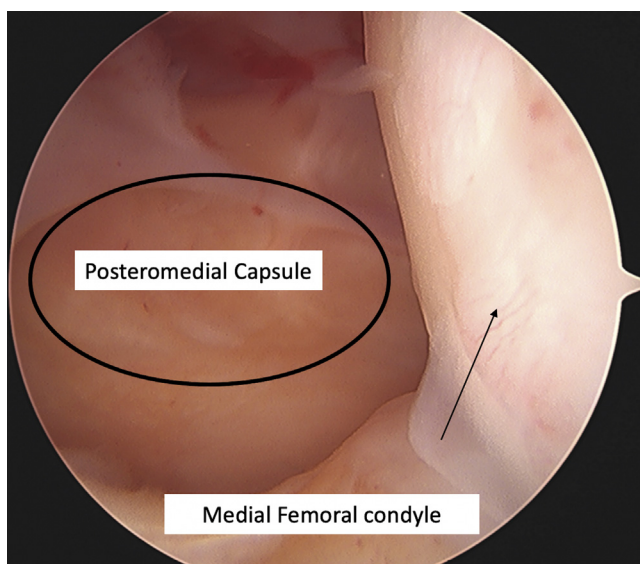


Fig 1. The Gillquist interval: The posteromedial compartment (labeled with an oval) is visualized using the Gillquist interval through the anterolateral compartment. The medial femoral condyle is labeled. The Gillquist interval is used to complete both posteromedial and posterolateral capsular releases.

interval before placing the arthroscopic camera through this interval.

Posteromedial Capsulotomy

An 18-gauge spinal needle is introduced through the anteromedial arthroscopic portal with visualization from the anterolateral portal (Fig 3A). The needle is used to release posteromedial capsule by using the beveled edge to repeatedly section the capsule in layers. Initial sectioning can be performed safely under direct visualization, with the needle positioned just anterior to the capsule. Sectioning also can be done safely, with the needle just posterior to the capsule, once insufflation has separated the capsular from the more posterior structures (Fig 3B, Video 1). This is performed until the entire length of the posteromedial capsule is cut to the medial border of posterior septum (Fig 3C).

Posterolateral Capsulotomy

An anteromedial viewing portal is created 1 cm above the tibiofemoral joint line adjacent to the patellar tendon. The arthroscope is then inserted into the anteromedial viewing portal and positioned between the medial border of lateral femoral condyle and posterolateral bundle of the anterior cruciate ligament (Fig 2). A spinal needle is inserted into the posterolateral portal and used to perform the capsulotomy (Fig 4A). Applying varus force on the knee joint in 30° flexion during arthroscope placement may facilitate easier access as the interval between the anterior cruciate ligament and medial femoral condyle increases. After placement of the arthroscope, knee position should return to 90° flexion.

Similar to the posteromedial capsule, the posterolateral capsule is released by using the bevel of the needle to section the capsule in layers (Fig 4B, Video 1). Fig 4C demonstrates the completed posterolateral release. After posterolateral release, knee extension is re-examined and compared with the contralateral side to confirm contracture improvement.

Postoperative Rehabilitation

The patient is placed in a hinged knee brace locked in 10° of hyperextension to passively stretch the posterior structures but encouraged to unlock it for maintaining or regaining flexion. They are weaned off of crutches as tolerated. The knee is hyperextended by elevating the heel for 30 minutes, 3 times/day for the first 6 weeks, but more is encouraged. Graded physical therapy is prescribed postoperatively, focusing on achieving full range of motion, and pushing through mild discomfort. Patients should be told to gradually increase their activity level back to the presurgical level. At 6 weeks, they are re-examined in the office and are typically cleared to resume all activities, or if arthrofibrosis is postsurgical, to resume their previous rehabilitation protocol.

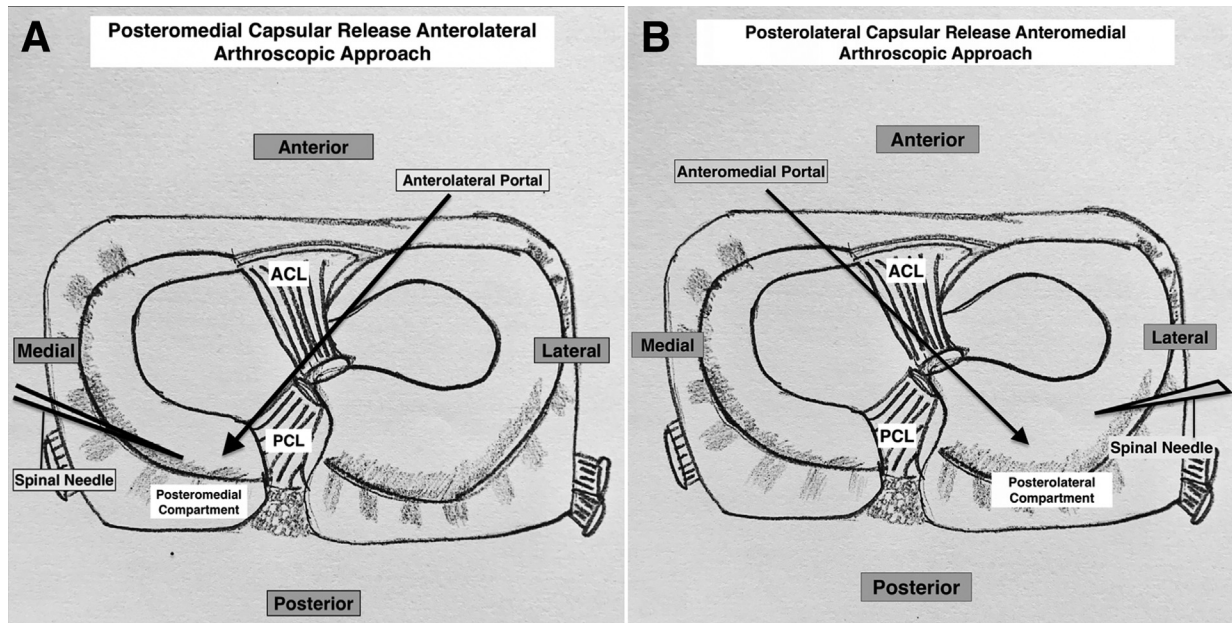


Fig 2. Arthroscopic approaches used in posterior capsular release. Schematic drawings of anterolateral (A) and anteromedial (B) arthroscopic approaches with the Gillquist interval.

Discussion

Arthrofibrosis of the posterior knee capsule can result in significantly diminished knee extension and can cause quadriceps weakness, anterior knee pain, and gait abnormalities leading to increased mechanical stress on the contralateral joint. Persistent extension deficit refractory to conservative therapy, MUA, or anterior arthrolysis may require posterior capsular release. Although arthroscopic approaches to posterolateral and posteromedial capsular releases have been previously described, we present an alternative method of arthroscopic posterior release performed with a percutaneous spinal needle for treatment of flexion contractures of the knee.

Posterior capsular release can be performed with an open or arthroscopic technique. Gomes et al.³ described an open posteromedial approach using a 4-cm incision posterior to the medial femoral condyle edge, with an oblique incision through the medial retinaculum. However, due to increased risk of damage to the posterior neurovascular structures, arthroscopic techniques may be preferred, as they allow direct visualization of the structures.^{3,12}

Arthroscopic techniques have been previously used to perform isolated posteromedial release, posteromedial and posterolateral release, and total transeptal capsulotomy.^{5,12,13} Our arthroscopic approach is similar to those used previously for posteromedial

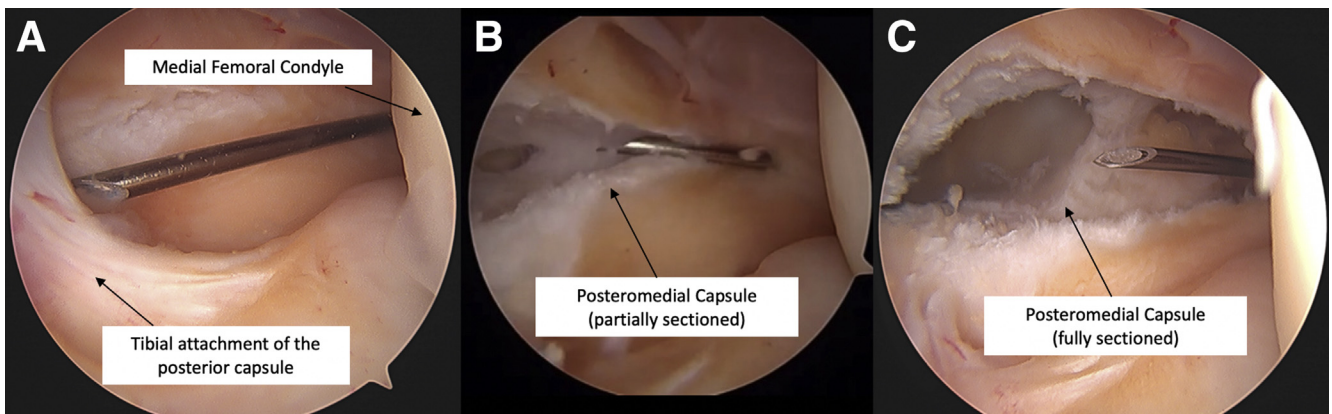


Fig 3. Posteromedial capsular release: Posteromedial capsular release with an 18-gauge needle viewed from the anterolateral portal through the Gillquist interval. (A) The needle enters the posteromedial compartment. The posterior cruciate ligament and medial femoral condyle are labeled. (B) Capsular resection begins. The partially sectioned posteromedial capsule (labeled) is visualized. (C) With repeated sawing motion of the needle tip, the posteromedial capsule (labeled) is completely released.

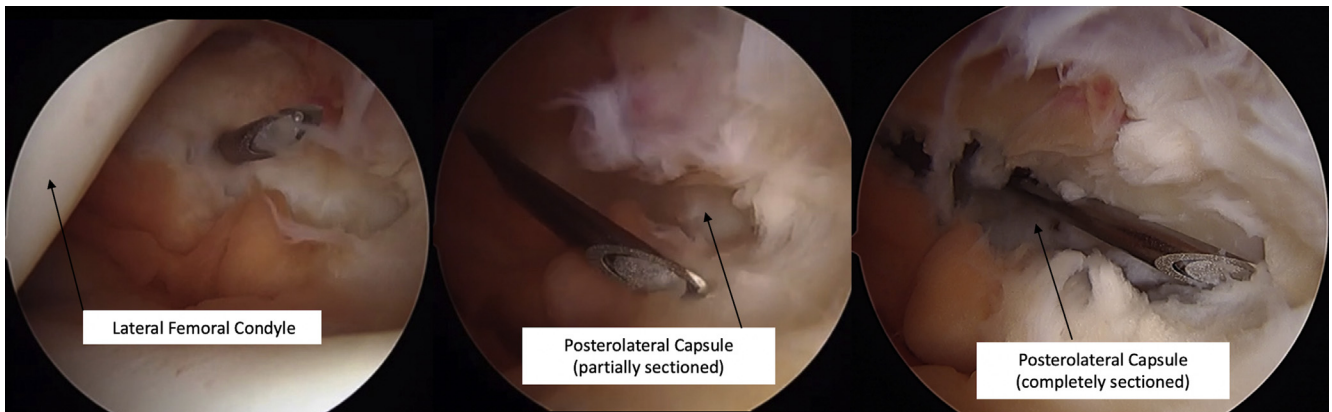


Fig 4. Posterolateral capsular release: Posterolateral capsular release with an 18-gauge needle viewed from the anteromedial portal through the Gillquist interval (A) The needle enters the posterolateral compartment. The lateral femoral condyle is labeled. (B) Capsular resection begins. The partially sectioned posterolateral capsule (labeled) is visualized. (C) With repeated sawing motion of the needle tip, the posterolateral capsule (labeled) is completely released.

and posterolateral release, although we used 2 portals with the modified Gillquist interval.^{13,17} Using this method, successful competition of posteromedial and posterolateral capsular releases were performed. In contrast to our technique involving capsular sectioning using spinal needle, previous techniques use a combination of shavers, scissors, or biters to perform capsular release.^{5,12,13,18,19} Similar to these arthroscopic techniques, capsular release performed with a spinal needle resulted in significant clinical improvement of preoperative extension deficit. Previous studies report an improvement of approximately 15-20° in extension with complete posteromedial and posterolateral capsulotomy, similar to the degree of correction seen in our patient.^{10,20}

Our technique has several advantages compared with other techniques (Table 1). Our approach yields lower surgical morbidity compared with alternate arthroscopic or open approaches; specifically, regarding the lack of a posterior incision. In addition, the absence of cauterization avoids local tissue distortion offering the surgeon a clearer anatomical landscape and improved visualization of neurovascular structures. A spinal needle may offer greater maneuverability in the joint capsule and around the condyles due to its narrow frame. This improved maneuverability may allow for

more consistent anterior orientation of the needle, potentially decreasing risk of posterior popliteal artery injury. It also may offer increased precision in resection compared with a shaver that bites and tears tissue. This increased visualization, maneuverability, and precision may offer an improved postoperative outcome by limiting excess tissue injury.

There are limitations to this technique (Table 1). Given the minimally invasive approach, there is limited ability to retract the central neurovascular bundle posteriorly. Protection of the structures hinges on methodic sectioning of capsule adjacent to the central bundle. Due to sequential sectioning of the capsule with a fine-point needle, time to perform capsular release may be greater. However, time is saved by the avoidance of portal creation and closure, in addition to the need to introduce and exchange multiple instruments. Extensive capsular fibrosis with a thick, soft-tissue envelope may make capsular releases more time-consuming, with the smaller cutting surface of the spinal needle. An incomplete capsular release may result in recalcitrant flexion contracture and persistent extension deficit, but assessments can be performed intraoperatively to avoid this.³ Conversion to a posterior arthroscopic or open approach may be necessary if persistent bleeding is encountered.

Table 1. Advantages vs Disadvantages of Posterior Capsulotomy Using a Spinal Needle

Advantages	Disadvantages
Lack of incision yields less morbidity compared with arthroscopic or open approaches	Requires anterior arthroscopic portals for visualization
Absence of cauterization offers improved visualization and less morbidity	Limited ability to retract neurovascular bundle
Narrow frame of spinal needle offers improved maneuverability	Sequential sectioning with fine tip requires additional time
Fine needle tip offers improved precision compared with shaver or biter	Capsular release may not be as efficient in the setting of extensive fibrosis
	Conversion to posterior arthroscopic or open approach may be necessary in the case of persistent bleeding

Overall, we present a technical modification using a spinal needle to perform an arthroscopic posterior capsular release for knee flexion contractures secondary to arthrofibrosis of the posterior compartments.

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