



Arthroscopic Trans-septal Portal of the Knee With Direct Visualization and No Need for Posterolateral Portal Creation

Konrad Malinowski, M.D., Ph.D., Dong Woon Kim, M.S., Nicholas I. Kennedy, M.D., Przemysław A. Pękala, M.D., Ph.D., Robert F. LaPrade, M.D., Ph.D., and Marcin Mostowy, M.D.

Abstract: Arthroscopic visualization and access of the posterior knee are limited when using standard anterior and posterior portals. The creation of a trans-septal portal allows for complete access to the posterior compartment as arthroscopic instruments are able to be passed back and forth between the posteromedial and posterolateral compartments. Due to the close proximity of the popliteal artery and its branches, precise portal placement and safe orientation of arthroscopic instruments are critical to avoid iatrogenic injury. The conventional technique of trans-septal portal creation, involving a posterolateral portal, can be difficult in some cases. To overcome these obstacles, a posteromedial technique of trans-septal portal creation is presented. By using the medial parapatellar portal as the viewing portal, our technique allows for direct visualization of the posterior septum on each step of creation of the trans-septal portal, eliminating the need for “blind” maneuvers. What is more, no posterolateral portal is needed, decreasing the risk of potential complications. Using the posterior cruciate ligament fibers as a main landmark for trans-septal portal placement, preservation of the posterior part of the septum is achieved. This ensures optimal safe-margin distance away from the popliteal neurovascular bundle and making the technique safe and reproducible.

Arthroscopic visualization and access of the posterior compartment of the knee are limited when using traditional anterior portals.¹ Morin et al.² confirmed the presence of arthroscopic blind spots in the posterior compartments when viewed through the

anterolateral and anteromedial portals via transnotch maneuver, averaging 21.5% of the posteromedial meniscocapsular periphery. Although visualization and access to the posterior compartments can be vastly improved by using posteromedial and posterolateral portals in conjunction with standard anterior portals, many blind spots still persist. Tolin and Sapega³ reported that the combination of the anterolateral portal with transnotch view and the posteromedial portal still left a blind zone of 8.4%. Persistent blind zones may obstruct visualization and access to various structures, including the posterior and posterosuperior portions of femoral condyles, the periphery of the posterior menisci horns, the posterior and inferior portions of the posterior cruciate ligament (PCL), the posterior meniscofemoral ligament (ligament of Wrisberg), the posterior septum, and the posterior capsule.⁴⁻⁷

The creation of a trans-septal portal by perforating the posterior septum, as first described by Kim⁵ and later popularized by Ahn and Ha,⁶ eliminates the aforementioned posterior compartment blind spots associated with the traditional anterior-posterior arthroscopic approach. It allows for arthroscopic instruments to be passed back and forth between the posteromedial and posterolateral compartments.^{6,8} Better visualization of

From the Department of Anatomy, Jagiellonian University Medical College, International Evidence-Based Anatomy Working Group, Kraków, Poland (K.M., D.W.K., P.A.K.); Artromedical Orthopedic Clinic, Bełchatów, Poland (K.M., M.M.); Twin Cities Orthopedics, Edina, Minnesota, U.S.A. (N.I.K., R.F.L.); Faculty of Medicine and Health Sciences, Andrzej Frycz Modrzewski Kraków University, Kraków, Poland (P.A.P.); Lesser Poland Orthopedic and Rehabilitation Hospital, Kraków, Poland (P.A.P.); and Orthopedic and Trauma Department, Veterans Memorial Teaching Hospital in Lodz, Medical University of Lodz, Lodz, Poland (M.M.).

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Address correspondence to Konrad Malinowski, M.D., Ph.D., Artromedical Orthopedic Clinic, Antracytowa 1, 97-400 Bełchatów, Poland. E-mail: malwin8@wp.pl

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the posterior compartments and maneuverability of arthroscopic working instruments through the trans-septal portal facilitate technically difficult procedures in a safer, more reproducible manner. Among such procedures are removal of posterior pathologic findings (i.e., loose bodies, tumors, cysts), PCL reconstruction and repair, repair of the posterior meniscal horns, and posterior capsular release for extension contracture.^{1,4,6,8-13}

When creating the trans-septal portal, the surgeon must be attentive to the neurovascular structures that lie in close anatomic proximity to the posteromedial, posterolateral, and trans-septal portals.¹ The posterior septum consists of 2 fibrous membranes and adipose tissue between them and can be fairly thick and resistant to perforation in some cases. It could cause slippage of arthroscopic instruments and inadvertent injury to the popliteal neurovascular bundle that lies just behind the posterior capsule and the posterior part of the posterior septum.⁶ Furthermore, the middle geniculate artery courses along the superior border of the posterior septum; thus, safe placement of the trans-septal portal, as well as safe orientation of the arthroscopic instrument, is imperative to avoid serious iatrogenic complications.¹⁴

Conventional technique of trans-septal portal creation described by Kim⁵ and later popularized by Ahn and Ha⁶ is based on visualization of the impression of the instrument introduced in the contralateral posterior portal. Because of the distance between 2 membranes and incidental large amount of adipose tissue between them, it can be difficult to visualize the above-described switching stick impression. In such cases, this part of the procedure is done in a blind way. What is more, in cases when creation of the posterolateral portal is risky or impossible, conventional technique of the trans-septal portal is impossible to perform.¹⁵ In this Technical Note, we describe a posteromedial approach to trans-septal portal creation that allows for direct visualization on each step of the procedure. The technique eliminates the need for posterolateral portal creation and preserves the posterior part of the septum, ensuring optimal safe-margin distance away from the popliteal neurovascular bundle.

Surgical Technique

Indications

Indications include removal of posterior pathologic findings (i.e., loose bodies, tumors, cysts), PCL reconstruction and repair, repair of the posterior meniscal horns, and posterior capsular release for extension contracture.

Patient Positioning and Preparation

The technique is performed with the patient positioned supine in general or spinal anesthesia. After

tourniquet placement, the affected leg is prepared and draped in a sterile fashion. Routine diagnostic arthroscopy is performed using standard anterolateral and anteromedial portals. The anterolateral portal is placed high in the soft spot to avoid penetration of Hoffa's fat pad, while the anteromedial portal is created under direct visualization 2 to 3 mm above the medial meniscus, as peripherally as possible. What is more, a medial parapatellar portal is created under direct visualization, adjacent to the medial border of the patellar ligament. This placement of the anterior portals allows easy passage of the arthroscope into the posterior compartments via the intercondylar notch. After performing a full diagnostic arthroscopic examination, a trans-septal portal is created according to the following procedure.

Trans-septal Portal Creation

The technique requires 4 standard arthroscopic portals: anterolateral, anteromedial, medial parapatellar, and posteromedial. The first step is to establish a posteromedial portal by directly visualizing the posteromedial compartment through the anterolateral portal using a 30° arthroscope (ConMed). With the knee flexed at 90°, the arthroscope is passed through the intercondylar notch between the triangle formed by the PCL, medial femoral condyle, and the medial tibial spine. To confirm the correct placement of the posteromedial portal, a spinal needle is percutaneously inserted into the posteromedial compartment in the soft spot just anterior to the medial edge of the medial head of the gastrocnemius muscle under direct visualization (Fig 1, Video 1). The portal is then created using a No. 11 surgical knife.

The arthroscope is transferred to the newly created posteromedial portal. Under direct visualization of the posterior septum, a switching stick (ConMed) is introduced through the anterolateral portal and aligns parallel to the posterior horn of the medial meniscus (Fig 2A, Video 1). In contrast, when the switching stick is introduced through the medial parapatellar portal, it lies directly adjacent to the medial aspect of the septum (Fig 2B, Video 1) due to the different trajectory of the transnotch maneuver.

The creation of a trans-septal portal begins. The arthroscope is transferred to the medial parapatellar portal using the switching stick from the previous step. Therefore, proper visualization of the vertical fibers of the PCL (the most important landmark) and the aspect of the septum just posterior to the PCL is achieved. Under direct visualization, a radiofrequency probe (Smith & Nephew) is introduced through the posteromedial portal (Fig 3, Video 1).

The radiofrequency probe is positioned adjacent to the posterior PCL border, and the medial part of the septum is carefully transected. Afterward, the correct

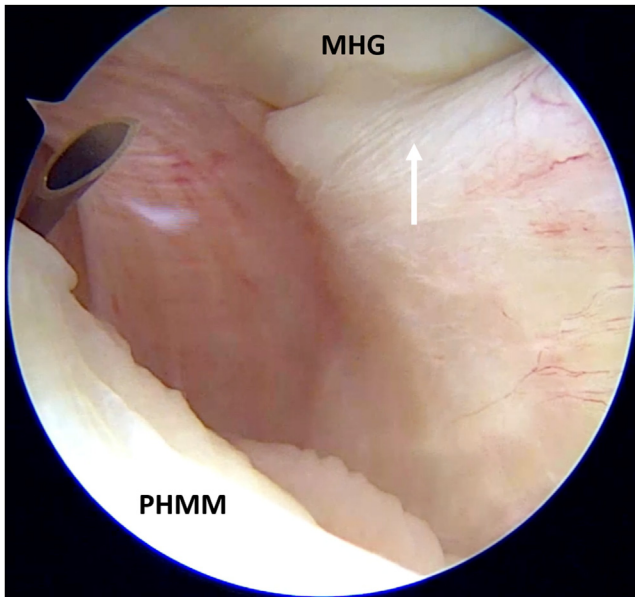


Fig 1. Arthroscopic view of the posteromedial compartment of the left knee from the anterolateral portal via the trans-notch maneuver. A spinal needle is used to visually confirm the placement of the posteromedial portal. Visible structures include the posterior horn of the medial meniscus (PHMM), medial head of gastrocnemius (MHG), and posteromedial synovial fold (white arrow).

trajectory of the further transection has to be confirmed. At this stage, adipose tissue lying between 2 fibrous membranes of the septum is visible, and it is possible to “palpate” the posterior part of the lateral

femoral condyle (LFC). The radiofrequency probe should strictly adhere to the PCL at all times and aim just posteriorly to the LFC. It is crucial to maintain visual contact with the radiofrequency probe at each step of the trans-septal portal creation. What is more, besides serving as a landmark for the radiofrequency probe, the PCL also serves as “a safety anchor” for the visualization. If the surgeon sees the PCL in the lateral part of their visualization field at all times, it is warranted that they did not advance too far posteriorly. The radiofrequency probe must also always be positioned horizontally to avoid any deviations from its course. The radiofrequency probe is cautiously slid posteriorly, as minimally as possible, over the palpable posterior part of the LFC, until the lateral part of the septum is transected, revealing the LFC and the posterolateral recess (Fig 4A, Video 1). It is essential to keep the radiofrequency probe facing superiorly or inferiorly, but never posteriorly, to ensure it is away from the popliteal neurovascular bundle. The radiofrequency probe is enlarged with the radiofrequency probe while ensuring clear visibility of the LFC and the posterolateral recess (Fig 4B).

The trans-septal portal has now been successfully created. Trans-septal visualization of both posterior compartments can now be achieved by switching the arthroscope to the posteromedial portal. Preservation of the posterior part of the septum is confirmed (Fig 5, Video 1). An overview of the basic steps of the surgical technique is summarized in Table 1.

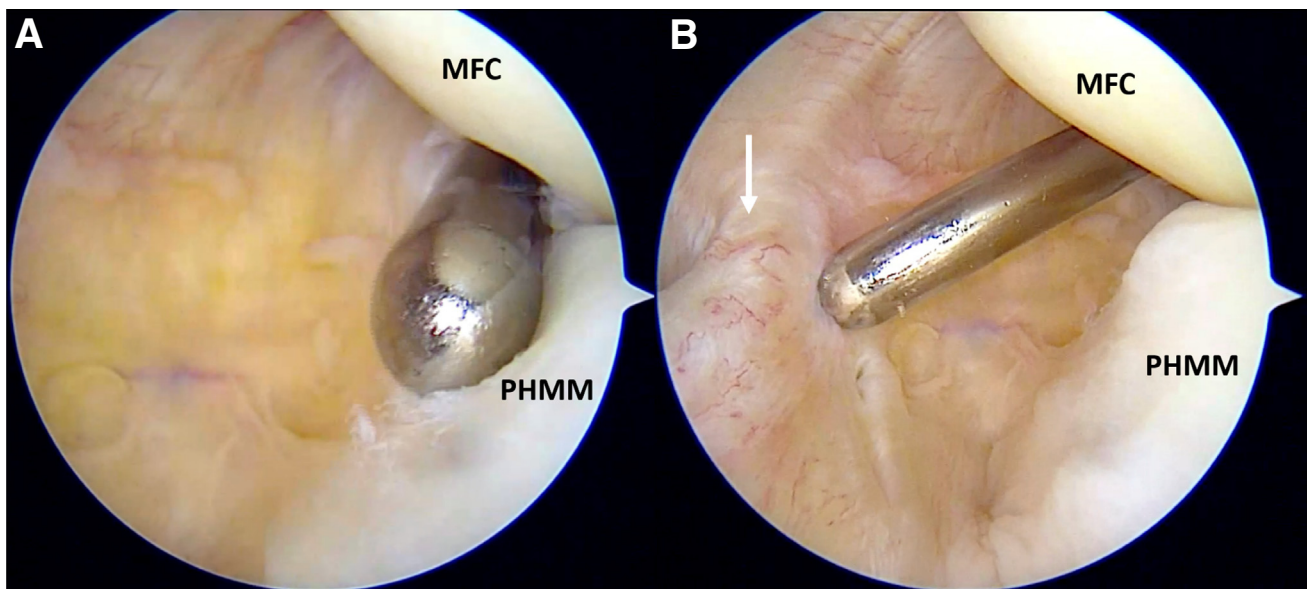


Fig 2. Arthroscopic view of the posteromedial compartment of the left knee from the posteromedial portal. (A) A switching stick, introduced into the posteromedial compartment through the anterolateral portal via the trans-notch maneuver, points in a direction that is parallel to the posterior horn of the medial meniscus (PHMM). (B) A switching stick, introduced into the posteromedial compartment through the medial parapatellar portal via the trans-notch maneuver, lies directly adjacent to the medial aspect of the posterior septum. White arrow indicates the posteromedial synovial fold. (MFC, medial femoral condyle.)

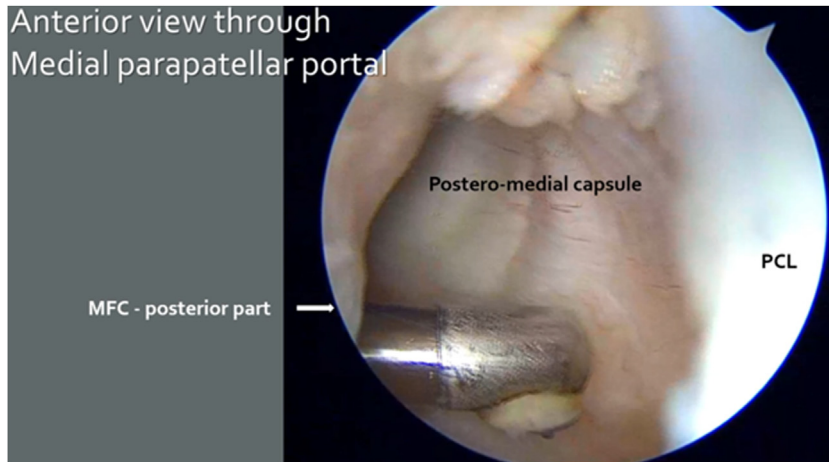


Fig 3. Arthroscopic view of the posteromedial compartment of the left knee from the medial parapatellar portal via the trans-notch maneuver. A radiofrequency probe is introduced through the the posteromedial portal. Visible structures include the posterior part of the medial femoral condyle (MFC), the postero-medial capsule, and the vertical fibers of the posterior cruciate ligament (PCL), which serves as the most important landmark during the creation of the trans-septal portal.

Discussion

The trans-septal portal creation technique described in this study offers several advantages. First, it overcomes the challenge of inadequate visualization that may arise in cases of well-developed adipose tissue within the posterior septum. The conventional technique of trans-septal portal creation involving posteromedial and posterolateral portals may result in difficulties in achieving a visible imprint of the arthroscopic tool introduced through the contralateral posterior portal. Ahn and Ha⁶ used the

posteromedial portal as the viewing portal and inserted a switching stick through the posterolateral portal to push the posterior septum medially before excising it in a piecemeal fashion with a motorized shaver introduced through the anteromedial portal. Several authors have published studies describing their own modifications to this technique, but the technique of trans-septal portal creation, as described in contemporary literature, remains in large the same; they all involve pushing an arthroscopic instrument against the posterior septum to indirectly

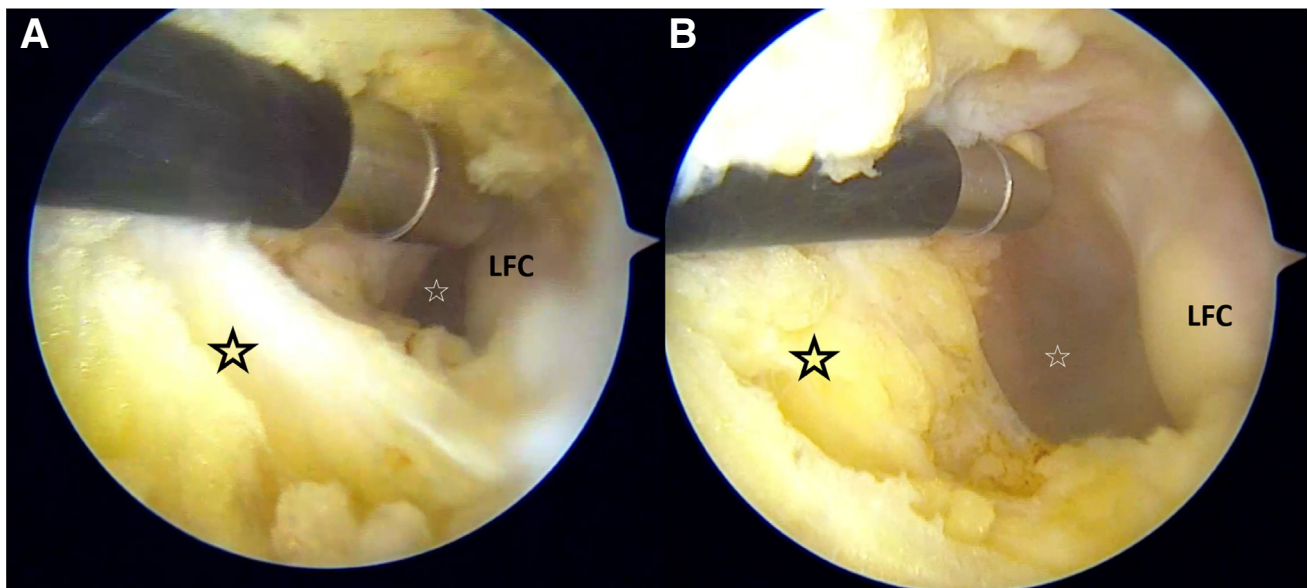


Fig 4. Arthroscopic view of the posterior septum of the left knee from the medial parapatellar portal via the trans-notch maneuver. (A) The adipose tissue within the posterior septum (dark asterisks) is divided using the radiofrequency probe introduced through the posteromedial portal. When the bony resistance of the lateral femoral condyle (LFC) can be felt over the tip of the radiofrequency probe, it is slid posteriorly over the bone just behind the LFC until the lateral part of the posterior septum is transected, revealing the LFC and the posterolateral recess (white asterisks). The probe is always facing superiorly or inferiorly but never posteriorly. (B) Afterward, the trans-septal portal is enlarged using the radiofrequency probe, with ongoing visualization of the LFC and the posterolateral recess (white asterisks).

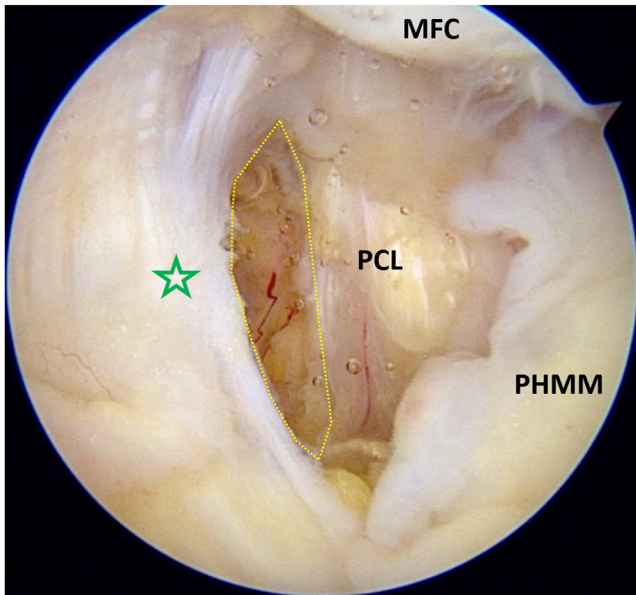


Fig 5. Arthroscopic view of the created trans-septal portal (yellow dashed line) of the left knee from the posteromedial portal. Preservation of the posterior part of the septum is confirmed (green asterisks). Other visible structures include the posterior cruciate ligament (PCL) with small bleeding vessels, the posterior part of the medial femoral condyle (MFC), and the posterior part of the medial meniscus (PHMM).

view its impression from the opposite posterior compartment—whether through a contralateral posterior portal or through an anterior portal.^{1,4,9} Because of the distance between 2 fibrous

Table 1. Summary of Surgical Technique

Trans-septal portal creation: basic steps	
1.	Creation of anterolateral and anteromedial portals for routine diagnostic arthroscopy
2.	Insertion of 30° arthroscope (Arthrex) into the anterolateral portal
3.	Creation of the medial parapatellar portal
4.	Transnotch visualization of the posteromedial compartment through the anterolateral portal
5.	Creation of the posteromedial portal using a spinal needle and No. 11 surgical blade under direct visualization of the posteromedial compartment from the anterolateral portal
6.	Insertion of the arthroscope into the posteromedial portal
7.	Insertion of a switching stick (ConMed) into the medial parapatellar portal
8.	Insertion of the arthroscope into the medial parapatellar portal
9.	Transnotch visualization of the posterior septum and fibers of the PCL (landmark) in the posteromedial compartment through the medial parapatellar portal
10.	Insertion of a radiofrequency probe (Smith & Nephew) into the posteromedial portal
11.	Creation of a trans-septal portal under direct visualization from the medial parapatellar portal
12.	Insertion of an arthroscope into the posteromedial portal to visualize the posterolateral compartment through the newly created trans-septal portal

PCL, posterior cruciate ligament.

Table 2. Advantages and Disadvantages of the Surgical Technique

Advantages	Disadvantages
Direct visualization at each step of trans-septal portal creation	Risk of iatrogenic PCL injury if visualization is insufficient or radiofrequency probe is used too extensively
No need to create a posterolateral portal	Need for creation of an accessory medial parapatellar portal
All steps can be performed with the use only of a standard 30° arthroscope	
Allows preservation of the posterior part of septum	
PCL as a “safety anchor”	
Able to create safe a trans-septal portal even in cases of distance between its fibrous membranes and incidental large amount of adipose tissue	

PCL, posterior cruciate ligament.

membranes forming a septum and the incidental large amount of adipose tissue between them, it can be difficult to visualize the above-described switching stick impression. In such cases, this part of the procedure is done in a blind way. In contrast, our technique allows for direct visualization of the posterior septum at each step of the procedure of the trans-septal portal creation.

The second advantage of this technique over the conventional technique for trans-septal portal creation is that the conventional technique requires the creation of the posterolateral portal. This is an unpopular technique for many surgeons given the increased risk of injury to the common peroneal nerve.¹⁶ Thus, the technique allowing the creation of the trans-septal portal without the need for a posterolateral portal has an added benefit in terms of safety.^{4,14,17} It also enables establishing the trans-septal portal in cases when creation of posterolateral portal is risky or impossible.

The third advantage of the presented technique is that the utilization of the PCL as the most important landmark enables the establishment of the trans-septal portal in the anterior part of the septum, thus preserving its posterior part. This allows the surgeon to maintain an optimal safe-margin distance from the popliteal neurovascular structures. It is especially important in light of study by Cancienne et al.,¹⁵ who reported in 2017 that the conventional trans-septal portal may be closer to the artery than previously reported in specimens with an intact posterior knee capsule.

The advantages and disadvantages of the surgical technique described in this Technical Note are summarized in Table 2. The most important tips and tricks of the surgical technique described in this Technical Note are summarized in Table 3.

Table 3. Tips and Tricks

Tips	Tricks
<p>The fibers of the PCL must be visualized at all times on the lateral aspect of the view during the creation of the trans-septal portal.</p> <p>The radiofrequency probe should be positioned horizontally and always facing superiorly or inferiorly but never posteriorly.</p> <p>After resection of the medial aspect of the septum, the bony resistance of the left femoral condyle can be felt over the tip of the radiofrequency probe. At this point, the radiofrequency probe is cautiously slid posteriorly (as minimally as possible), just enough to be able to enter the posterolateral recess.</p>	<ul style="list-style-type: none"> • If in doubt, withdraw the arthroscope slightly to reassess. • The arthroscope should not be rotated during this step of the procedure. • The tip of the radiofrequency probe must be visible at all time. • Visualization of the adipose tissue after resection of the medial membrane of the septum is a moment to start the “palpation” toward the LFC. • If the LFC is not palpated at this point, then further step-by-step resection should be done cautiously with reassessment by palpation before each step is conducted.

LFC, lateral femoral condyle; PCL, posterior cruciate ligament.

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