Technical Note

Anterior Cruciate Ligament Ganglion and Decompression of Mucoid Degeneration Using a "Figure-of-4 Position"

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Abstract: Anterior cruciate ligament (ACL) ganglion cysts and mucoid degeneration of the ACL are 2 distinct non-traumatic lesions of the ACL that occur discretely but can coexist. The exact etiopathogenesis still needs to be clarified. Mucoid degeneration presents as pain mainly on the posterior or posterolateral aspect of the knee and loss of terminal flexion and extension range of motion of the knee. There are several methods of treatment, including ultrasound-guided decompressions and arthroscopic decompression procedures. Arthroscopic decompressions include resecting the most affected posterolateral bundle and complete takedown of the ACL, with or without notchplasty. The reason for flexion deficit is the femoral-sided thickened ACL tissue (mucoid degeneration of the ACL) or the presence of a ganglion cyst. The impinging tibial insertion ganglion, the anvil osteophyte, or the thickened tibial stump of the ACL cause the extension deficit. Hence, addressing both anterior and posterior compartments is necessary for complete decompression. This Technical Note gives a stepwise approach to bicompartmental decompression using only anterior portals with the figure-of-4 positions.

Mucoid degeneration of the anterior cruciate ligament (ACL), also known as MDACL or ACL ganglion cyst, was first described by Kumar et al.[1] in 1999. Insidious-onset chronic knee pain behind the patella is the most common complaint[2] associated with discomfort in the popliteal fossa or posterolateral aspect of the knee on prolonged standing. There is usually no antecedent history of significant trauma, and when present, it is usually trivial. Pain and limitation in range of motion have been attributed to increased volume and tension within the ligament and mechanical impingement, with the unique function of the ACL providing nociceptive sensory signals.[3] This pathology is seen in middle-aged people with painful restriction of the terminal knee range of motion without compromising the stability.[4] With the disease progression, the ACL thickens, which is attributed to the accumulation of a mucoid substance containing mucoproteins and glycoproteins in the fibers of the ACL.[5]

The exact ethology of MDACL is not clear. Several theories are put forth about which 3 are more likely to cause MDACL. Synovial fluid seepage is theorized to be caused by excessive synovial fluid production, which herniates into the ligament. Post-trauma, the glycosaminoglycan deposition occurs in the ACL after the injury, or a repetitive microtrauma can lead to MDACL. According to the theory of degeneration, MDACL results from age-related degeneration.[6,7]

The cause of clinical symptoms is mainly mechanical obstruction due to thickened ACL, anvil osteophyte, and ganglion cyst at the tibial attachment of the ACL into the roof of the intercondylar notch anteriorly. The posterior symptoms are attributed to a large mucoid or a femoral side ganglion cyst compressing the posterior structures during knee flexion.[3]

Clinical Diagnosis

The most striking clinical feature is pain at the posterolateral aspect of the knee with a restricted range of motion in flexion and extension without instability.

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Fig 1. X-ray of the knee showing spike of the bone at tibial insertion of the anterior cruciate ligament (anvil osteophyte).

Usually, there is pain on deep flexion, and special tests for instability are negative.[4]

Investigation

On x-ray, the presence of an anvil osteophyte suggests MDACL (Fig 1). The clinical suspicion of MDACL needs to be confirmed on magnetic resonance imaging, which typically gives a "celery stalk" appearance. The hypertrophy of the ACL is seen impinging on the lateral femoral condyle (LFC) and in the posterior aspect of the femoral ACL footprint (Fig 2).[5]

Operative Steps

Patient Positioning

The patient is placed in a supine position under spinal anesthesia. Arthroscopy is performed using a 30° arthroscope through standard anterolateral (AL) and anteromedial portals. The absence of ligamentum mucosum is a consistent arthroscopic finding in MDACL (Fig 3, Video 1). The ACL looks hypertrophied, and the posterolateral (PL) bundle impinges on the LFC (Fig 4).

Step 1: The debulking starts with probing and creating a plane between the 2 bundles. The probe teases the ACL tissue to find yellow-looking degenerative fibers. Some amount of serosanguinous fluid may be seen extruding from this area (Fig 5). The PL bundle is shaved with the help of a 3.5-mm shaver tip (Dyonic; Smith & Nephew) or a radiofrequency device (Fig 6). The scope is then shifted to the anteromedial portal, and a biopsy punch is used to debulk the PL bundle (Fig 7). Working from the AL port gives good access to the PL bundle. The scope is switched back to the AL port to complete the excision of the PL bundle.

Step 2: The femoral side ganglion and the mucoid tissue are best addressed by entering between the ACL and posterior cruciate ligament through the septum, which gives excellent access to the posteromedial compartment of the knee (Fig 8). This also allows inspection of the

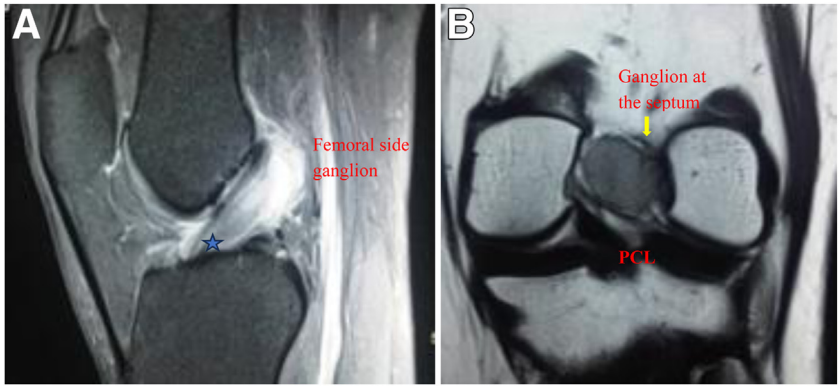


Fig 2. (A) Magnetic resonance imaging (MRI) of the knee T2-weighted image of the sagittal section of the anterior cruciate ligament (ACL) showing the femoral side ganglion compressing the posterior capsule. Blue star shows intact macrostructure of ACL fibers. (B) MRI of the knee T1-weighted image of the coronal section of the ACL showing the femoral side ganglion in the notch pressing on the posterior cruciate ligament. (PCL, posterior cruciate ligament.)

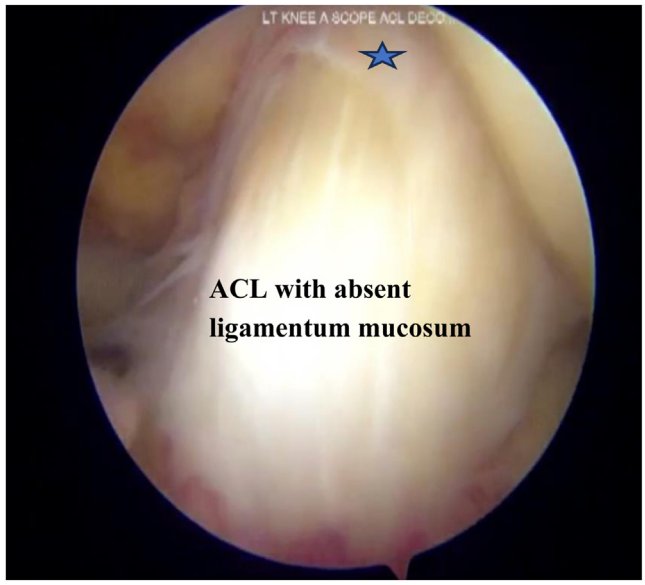


Fig 3. Left knee at 90° of knee flexion through the anterolateral portal showing the anterior cruciate ligament with absent ligamentum mucosum with hypertrophied, yellow-looking anterior cruciate ligament. Blue star shows disruption of the synovial lining of the anterior cruciate ligament. (ACL, anterior cruciate ligament.)

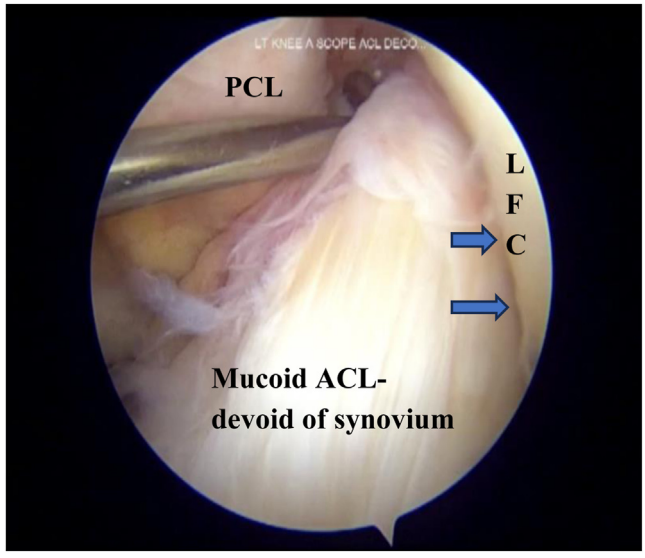


Fig 4. Left knee at 90° of knee flexion through the anterolateral portal showing mucoid anterior cruciate ligament with disrupted synovium. Blue arrows show impingement of the hypertrophied anterior cruciate ligament on the lateral femoral condyle. (ACL, anterior cruciate ligament; PCL, posterior cruciate ligament.)

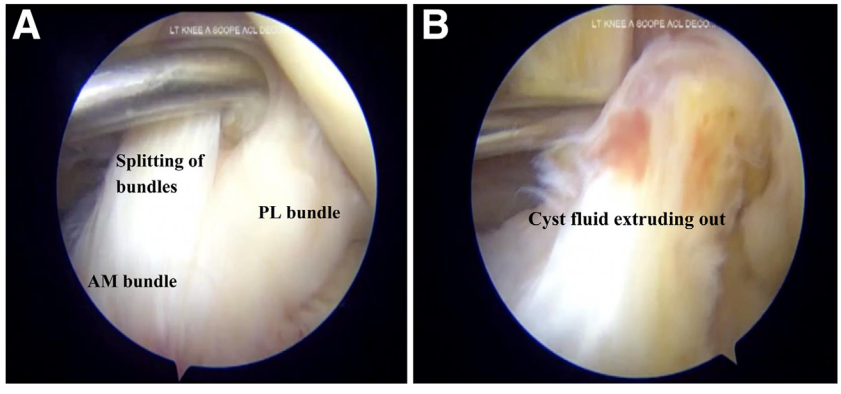


Fig 5. (A) Left knee at 90° of knee flexion through the anterolateral portal showing hypertrophied anterolateral and anteromedial bundle of the anterior cruciate ligament. The probe is splitting both the bundles. (B) Left knee at 90° of knee flexion through the anterolateral portal showing serosanguinous cyst fluid extruding out of the cyst after removal of the posterolateral bundle. (AM, anteromedial; PL, posterolateral.)

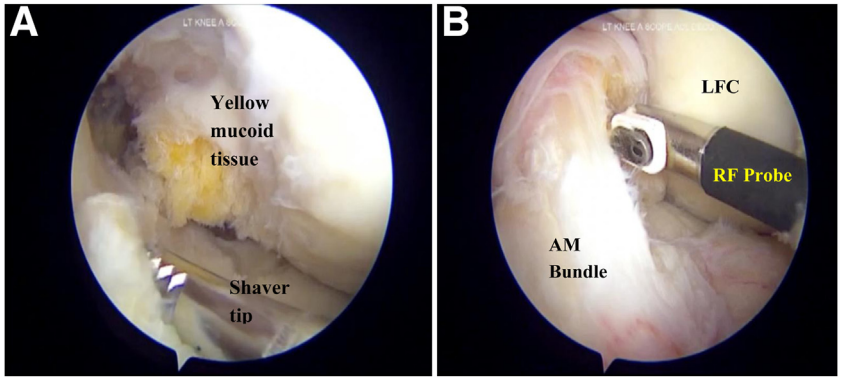


Fig 6. (A) Left knee at 90° of knee flexion through the anteromedial portal showing a 3.5-mm shaver tip from the anterolateral (AL) portal with complete removal of the anterior cruciate ligament (ACL). Yellow-looking degenerative fibers of the ACL are seen at the femoral footprint. (B) Left knee at 90° of knee flexion through the anteromedial portal showing a radiofrequency probe from the AL portal for removal of the posterolateral bundle of the ACL. The anteromedial bundle is seen intact. (AM, anteromedial; LFC, lateral femoral condyle; RF, radiofrequency.)

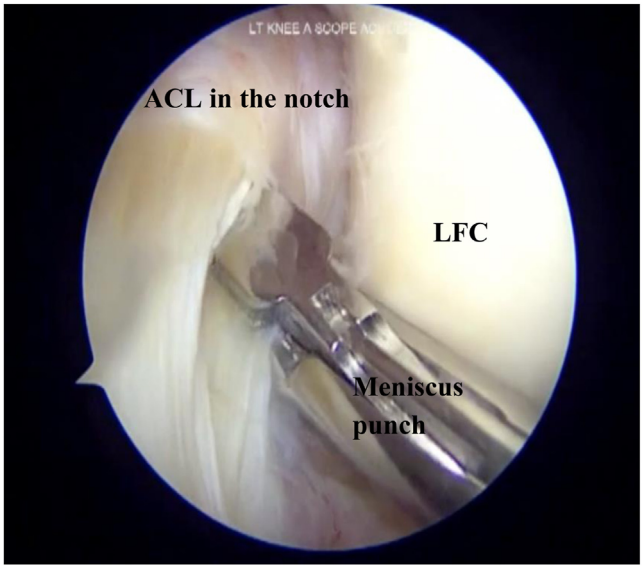
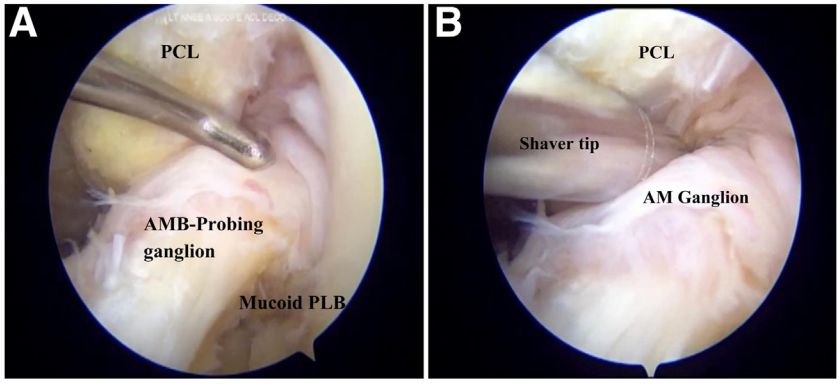


Fig 7. Left knee at 90° of knee flexion through the anteromedial portal showing a meniscus punch from anterolateral (AL) port taking down the poaterolateral bundle, ACL is seen in the notch. (LFC, lateral femoral condyle).

Fig 8. (A) Left knee at 90° of knee flexion through the anterolateral (AL) portal showing excised mucoid posterolateral bundle. Probe shows the ganglion cyst in the anteromedial bundle. (B) Left knee at 90° of knee flexion through AL portal showing a 3.5-mm shaver tip from the anteromedial portal entering the space between the anterior cruciate ligament and posterior cruciate ligament to access the posteromedial compartment. (AM, anteromedial; AMB, anteromedial bundle; PCL, posterior cruciate ligament; PLB, posterolateral bundle.)



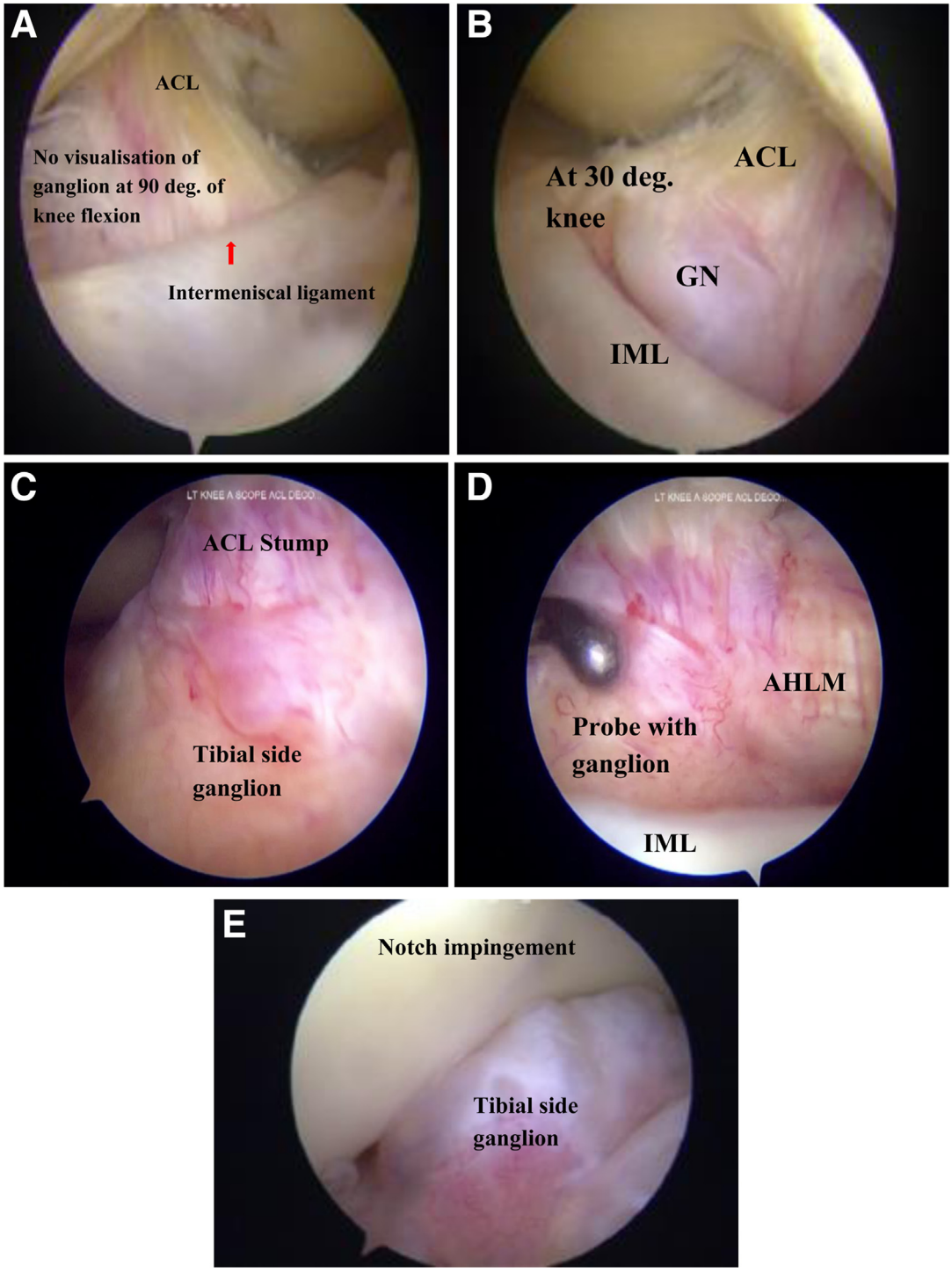


Fig 9. (A) Left knee at 90° of knee flexion through the anterolateral (AL) portal showing the intermeniscal ligament (red arrow). The tibial side ganglion is not seen at 90° of knee flexion as it moves below the intermeniscal ligament. (B) Left knee at 30° of knee flexion through the anteromedial (AM) portal showing the tibial side ganglion when the knee is moved from 90° to 30° of knee flexion. (C) Left knee at 90° of knee flexion through the AM portal showing the tibial side anterior cruciate ligament ganglion. (D) Left knee at 90° of knee flexion through the AL portal showing probing of the tibial side ganglion. (E) Left knee at full knee extension through the AL portal showing the notch impingement with a large tibial side ganglion causing extension deficit. (ACL, anterior cruciate ligament; AHLM, anterior horn of lateral meniscus; GN, ganglion cyst; IML, intermeniscal ligament.)

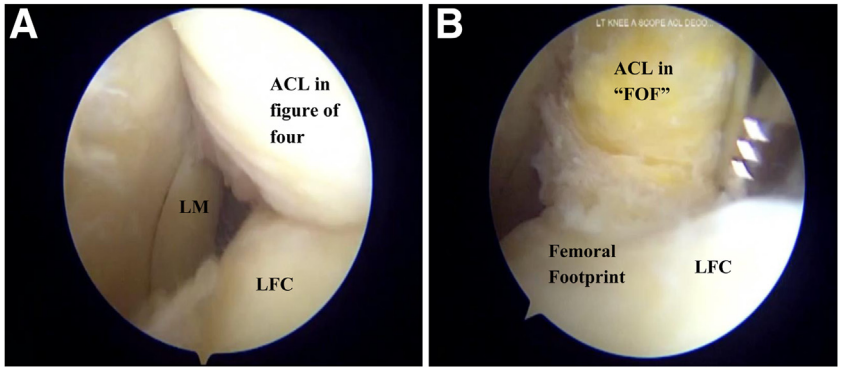


Fig 10. (A) Left knee in the figure-of-4 position through the anterolateral (AL) portal showing the hypertrophied anterior cruciate ligament (ACL) and its femoral footprint. This position helps entering the posterolateral compartment. (B) Left knee in a figure-of-4 position through the AL portal showing the hypertrophied ACL and its femoral footprint. A 3.5-mm shaver is used through the anteromedial portal and yellow-looking mucoid tissue. (FOF, figure-of-4 position; LFC, lateral femoral condyle; LM, lateral meniscus.)

posterolateral compartment for the presence of mucoid tissue. Excision of the mucoid tissue here ensures complete removal from the posteromedial side.

Step 3: The attention is now diverted to the tibial attachment of the ACL. By slowly extending the knee, careful inspection of the area below the intermeniscal ligament is performed for any presence of the ganglion (Fig 9). These tibial side ganglia tend to disappear below the intermeniscal ligament at 90° of knee flexion (the usual position for knee arthroscopy). This is resected with a shaver tip.

Step 4: The knee is now moved in the figure-of-4 position with the scope in the AL port (Fig 10). This gives an excellent view of the femoral ACL footprint and the posterolateral part of the lateral femoral condyle. As the PL bundle of the ACL is predominantly affected in MDACL, the ganglion cyst with mucoid tissue is found posterior to the LFC. This ensures the complete removal of the MDACL tissue (Fig 11).

Step 5: The knee is moved through the range of flexion to full extension, observing any residual impingement of the medial wall of the LFC and intercondylar notch. Usually, the removal of the complete PL bundle will take care of this impingement.

Copious debridement of mucoid hypertrophied lesions of the ACL is performed using basket forceps and a 3.5-mm motorized shaver and radiofrequency device.

Discussion

MDACL is a rare pathology affecting middle-aged individuals with a mean age of 42 years.[8] There are several procedures described to decompress the ACL. They range from decompressing the mucoid ACL of the mucinous material to partial resection to removal of the complete ACL. Kumar et al.[1] showed total removal of the ACL to be a safe procedure without causing instability. Most authors believe that partial debulking of the ACL, mainly the PL bundle, and removing the mucinous material to decompress the ACL is enough for symptomatic relief without causing instability.[9] In a recently published article, Malinowski et al.[10] described a technique of ACL decompression by anterior and

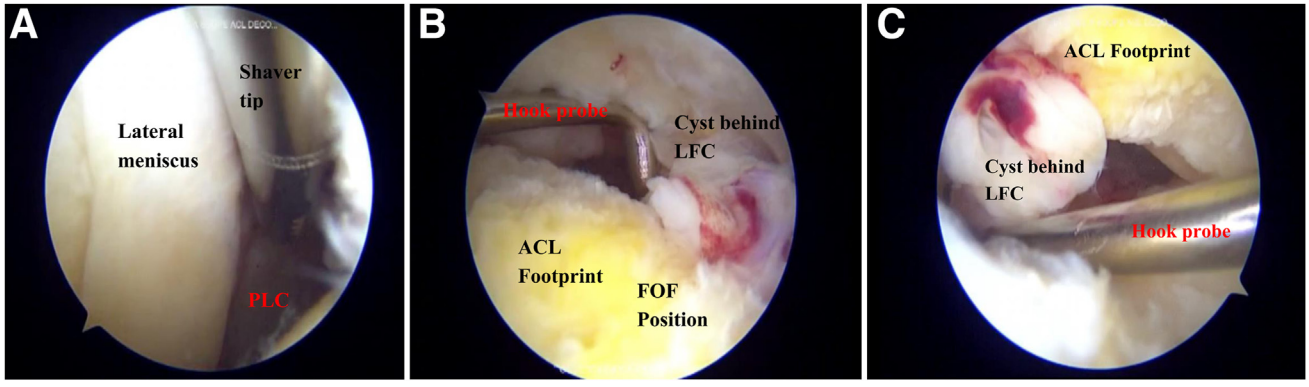


Fig 11. (A) Left knee in figure-of-4 position through the anterolateral (AL) portal shows a 3.5-mm shaver tip through the anteromedial (AM) portal and removal of mucoid tissue from the posterolateral compartment. (B) Left knee in the figure-of-4 position through the AL portal showing visualization and the excision of the ganglion behind the lateral femoral condyle. (C) Left knee at 90° of knee flexion through the AM portal showing the same cyst in 90° of knee flexion. (ACL, anterior cruciate ligament; FOF, figure-of-4 position; LFC, lateral femoral condyle; PLC, posterolateral compartment.)

Table 1. Advantages and Disadvantages of the Procedure

Advantages	Disadvantages
• It is a complete technique for all sites of mucoid degeneration. • It is performed only from anterior portals. • There is no need for an additional posteromedial portal. • The procedure can be tailored depending on the symptoms to either the anterior or the posterior compartment. • It does not require any specialized instruments.	• There may be a chance of postoperative instability needing secondary ACL reconstruction.

ACL, anterior cruciate ligament.

posterior portals, preserving the ACL tissue to address the post-debulking instability and ACL reconstruction. The true incidence of ACL reconstruction after debulking, partial resection, and total removal of the ACL is debatable. However, Pandey et al.[11] reported no incidence of instability post-debulking of the ACL. Lintz et al.[12] reported increased anterior translation of the tibia (mean, 8 mm). However, only 2 of 29 patients needed ACL reconstruction after debulking. In a review article, Sweed et al. concluded that arthroscopic debridement of ACL results in satisfactory pain relief and improves the outcome scores.[6] Postoperative ACL laxity is common after the complete removal of the ACL; however, it does not cause symptomatic instability.[13] However, the need for secondary ACL reconstruction should be discussed with the patient. Out of the 9 studies reviewed, only 1 study reported symptomatic instability of 5.8%.[10] The rest of the studies did not report any symptomatic instability.

The technique described here is a reproducible and stepwise surgical exercise that addresses the pathology at all 3 anatomic locations. 1) At tibial attachment of ACL, 2) Posterolateral bundle in anterior compartment, and 3) Posteromedial/Posterolateral compartment gaining access through a window between ACL and PCL. The septum is shaved off for posteromedial decompression, and the "figure-of-4" position is used to complete the posterolateral decompression. We believe in removing only the PL bundle to decompress the ACL, but all 3 anatomic locations mentioned above are decompressed. At times, when a PM bundle is also involved (which can be confirmed by yellow-looking fibers of the ACL), complete removal of the ACL is done. This technique has the advantage of using only anterior portals. The additional posteromedial portal is not required, which reduces the surgical time and ease of operation (Table 1).

We have never done primary ACL reconstruction alongside the ACL decompression as it is theorized to be a degenerative pathology, and the symptoms are purely attributed to mechanical impingement along with increased tension in the ACL. However, it is necessary to address anterior and posterior compartments for adequate decompression.

Disclosures

All authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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