

# Radiofrequency Ablation for Muroid Degeneration of the Anterior Cruciate Ligament



Andrew J. Hotchen, M.R.C.S., and Joel T. K. Melton, F.R.C.S.(Tr & Orth)

**Abstract:** Muroid degeneration of the anterior cruciate ligament (MD-ACL) is an underdiagnosed ACL pathology. When recognized, one potential management strategy involves arthroscopic debridement to “debulk” the ACL. Here, with the addition of video footage, we describe our arthroscopic technique for MD-ACL debridement using radiofrequency ablation. We show the engorged, stranded MD-ACL during arthroscopy and how this engorgement causes impingement in the femoral notch, resulting in the symptoms described by the patient. After radiofrequency ablation, we show a reduction in impingement and assess the stability of the cruciate ligaments. This Technical Note aims to raise awareness of this pathology and show the technique of arthroscopic radiofrequency ablation to reduce impingement of the ACL within the femoral notch.

**M**uroid degeneration of the anterior cruciate ligament (MD-ACL) was first described in the literature in 1999.<sup>1</sup> Since then, MD-ACL has been recognized as a pathology present on between 0.7% and 5.3% of magnetic resonance images performed for knee pain.<sup>2</sup> MD-ACL is thought to be part of a spectrum of ACL disease that can range from ganglion cysts to MD.<sup>3</sup> MD-ACL can either be primary (idiopathic in nature) or secondary to other joint pathology such as meniscal tears, chondral damage, or osteoarthritis.<sup>4-7</sup>

Arthroscopic surgery for MD-ACL has been attempted with good results from procedures such as reduction plasty<sup>8</sup> and either complete or partial ACL debridement.<sup>3,9-11</sup> However, the specifics of these techniques have not been described well within the literature.

Here, we show our technique of debridement of the ACL, impingement of the ACL within the

femoral notch, and the assessment of stability after debridement.

## Surgical Technique

### Patient Preparation

Informed consent for the procedure should include an explanation of both the general risks of arthroscopy and the specific risks of radiofrequency ablation that are shown in [Table 1](#). These risks are bleeding that could lead to hemarthrosis, knee instability that may require ACL reconstruction, and ongoing pain after the operation (which could be due to inadequate debridement or from concomitant joint pathology). After the consenting process, the patient is brought to the operating room and the World Health Organization checklist is performed.<sup>12</sup> The patient is positioned on the table with the knee flexed at 90° with side supports and foot rest (sandbag). A tourniquet is applied and placed as proximally as possible on the thigh. The knee is prepared and draped as for standard diagnostic arthroscopy (see [Fig 1](#)). Stability of the ACL is assessed using the Lachman, Drawer, and pivot shift test before arthroscopy is commenced. Standard anteromedial and anterolateral portals are created using a number 11 blade in the standard positions, medial and lateral to the patella tendon ([Figs 2 and 3](#)).

### Diagnostic Arthroscopy

The knee is assessed for signs of chondral damage or meniscal pathology. Any associated non-ACL pathology is addressed. The ACL is inspected and is seen to be thickened and engorged within the femoral notch

*From the Division of Trauma and Orthopaedic Surgery, University of Cambridge, Addenbrooke's Hospital (A.J.H.); and Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust (A.J.H., J.T.K.M.), Cambridge, England.*

*The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).*

*Received October 16, 2017; accepted November 21, 2017.*

*Address correspondence to Andrew J. Hotchen, M.R.C.S., Division of Trauma and Orthopaedic Surgery, University of Cambridge, Hills Road, Cambridge CB2 2QQ, England. E-mail: [ah874@cam.ac.uk](mailto:ah874@cam.ac.uk)*

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2212-6287/171285

<https://doi.org/10.1016/j.eats.2017.11.006>

**Table 1.** Key Points and Pearls for Radiofrequency Ablation of the ACL

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Recognition	<ul style="list-style-type: none"> <li>• Consider the diagnosis in patients who present with dull posterior pain and limitation of terminal flexion</li> <li>• Diagnosis can be made on sagittal MRI with the ACL being greater than 10 mm in diameter<sup>3,7</sup></li> </ul>
Consenting process	<ul style="list-style-type: none"> <li>• Discuss the risk of ACL instability/need for reconstruction after radiofrequency ablation (approximately 20%)<sup>8</sup></li> <li>• Discuss how surgery can improve flexion and therefore knee function</li> <li>• Discuss that there could be associated pathology that may be addressed on arthroscopy that could be a cause for residual knee pain</li> <li>• Discuss the risk of bleeding that could result in hemarthrosis</li> </ul>
Arthroscopic setup	<ul style="list-style-type: none"> <li>• Setup as normal for diagnostic arthroscopy with foot bolster and side support (Figs 1 and 2)</li> <li>• Prepare and drape as standard and place anteriomedial and anteriolateral ports (Fig 3)</li> </ul>
Diagnostic arthroscopy	<ul style="list-style-type: none"> <li>• Make the diagnosis arthroscopically of MD-ACL observing an engorged, thickened ACL (Fig 4)</li> </ul>
Radiofrequency ablation via the anteriomedial port (Fig 5)	<ul style="list-style-type: none"> <li>• Start peripherally and move centrally (Fig 6)</li> <li>• Use the radiofrequency ablation for hemostasis if bleeding from the ACL (Fig 7)</li> <li>• Ensure that any peripheral fibers are debrided to prevent impingement in the femoral notch</li> </ul>
Postdebridement assessment	<ul style="list-style-type: none"> <li>• Assess for impingement of the ACL within the femoral notch (Fig 8)</li> <li>• Assess for impingement of the ACL on the PCL</li> <li>• Assess for stability of the ACL using Lachman's and Drawer's tests</li> </ul>
Follow-up	<ul style="list-style-type: none"> <li>• Mobilize full weight bearing, with analgesia as required, commencing with an ACL rehabilitation program</li> <li>• Seen in the outpatient clinic at 6-8 wk by the operating surgeon</li> </ul>

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ACL, anterior cruciate ligament; MD, mucoid degeneration; MRI, magnetic resonance imaging.

(see [Video 1](#), Part 1). The ACL can be seen to be intact but with an increased cross-sectional diameter filling the femoral notch. Mucinous deposits within the ACL fibers cause the individual fibers of the ACL to be separated with a characteristic “stranding” of the ACL fibers ([Fig 4](#)). This stranding is easily visualized because of atrophy of synovium covering of the ACL, and the ACL bundles can be separated longitudinally with an arthroscopic probe (see [Video 1](#), Part 1).<sup>3</sup> In flexion, the engorged fibers of the ACL can be seen to prolapse into the medial and lateral compartments. The diagnosis of MD-ACL can therefore be confirmed on diagnostic arthroscopy.

### Debridement of the ACL

First, the ACL is probed to ensure that it is intact. In full extension, the ACL can be seen to impinge on the roof of the femoral notch and in full flexion, on the posterior cruciate ligament (PCL). The radiofrequency ablation probe (ArthroCare, Smith & Nephew, London, UK) is inserted into the joint using the medial port (see [Fig 5](#)). Radiofrequency ablation commences with removal of synovial coverings overlying the ACL and in the intercruciate space between the ACL and PCL (see [Fig 6](#)). This should continue by further ablation at the peripheries of the ACL commencing on the lateral wall and also debriding peripheral fibers if impinging on the PCL and femoral notch medially. The concept should be to reduce the diameter of the engorged ACL, removing as much tissue as necessary to avoid impingement (see [Video 1](#), Part 2). An arthroscopic shaver can be used for

this task but does not offer the coagulation benefits of radiofrequency ablation (see [Video 1](#), Part 3; and [Fig 7](#)). Flexion and extension testing should be carried out periodically throughout the debridement to assess adequacy of ACL “debulking” until there is no longer impingement within the femoral notch against the PCL (see [Video 1](#), Part 4).

### Postdebridement Assessment

After debridement, the knee is tested for stability using the Lachman and both the anterior and posterior Drawer tests. This is shown in Part 5 of [Video 1](#). If the ACL is deemed to be unstable, then a reconstruction can be performed at the time of this surgery. The debrided ACL is now assessed for impingement on the PCL and within the femoral notch (see [Video 1](#), Part 5; and [Fig 8](#)). After debridement, any persistent bleeding can be controlled using radiofrequency ablation.

### Closure

After assessment of the ACL, the arthroscopic port sites are closed in the standard manner. Chirocaine (10 mL 0.5%) is infiltrated into each of the port sites to control postoperative pain. The wounds are covered with an occlusive dressing, with wool and crepe bandages.

### Postoperative Recovery

Full neurovascular observations should be performed of the operated limb as per the usual arthroscopy protocol with regular assessment of the pedal pulses and



**Fig 1.** Setup as for standard arthroscopy using a side support and foot bolster. Tourniquet should be applied and inflated to 250 mm Hg.

sensation. If neurovascular observations are satisfactory and pain is well controlled, then the patient can be discharged home the same day. The patient can mobilize fully weight bearing as tolerated using crutches with analgesia as required. The patient should have the wounds checked at 12 to 14 days by a practice nurse and then follow-up should be in 6 to 8 weeks with the operating surgeon who should assess relief of symptoms, degree of knee flexion, and clinical integrity of the ACL. The patient should then commence an ACL rehabilitation program.

### Discussion

MD-ACL is characterized by a chronic buildup of mucinous fluid within the fibers of the ACL that can arise either primarily or secondary to underlying joint pathology. Here, we have shown the engorged ACL with separation of the fibers that gives the characteristic “celery-stalk” appearance and how it can impinge on



**Fig 2.** The port placement. This should be a standard anteriomedial and anteriolateral port either side of the patella tendon.



**Fig 3.** Prepare and drape the patient as for standard arthroscopy.

both the femoral notch and the PCL preventing full flexion of the knee. We have shown how radiofrequency ablation can be performed arthroscopically to reduce the bulk of the ACL and subsequently reduce the impingement of the ACL within the femoral notch.

Arthroscopic procedures that aim to reduce the size of the ACL within the femoral notch have shown good outcomes using a variety of patient-reported outcome measures. These have been the International Knee Documentation Committee (IKDC) score, the Knee Injury and Osteoarthritis Outcome score, and the visual analog pain score at short-to-medium-term follow-up.<sup>3,9</sup> In a series of 27 patients (29 knees) presenting with symptomatic MD-ACL, who all underwent complete or partial ACL debridement, Lintz et al.<sup>3</sup> showed

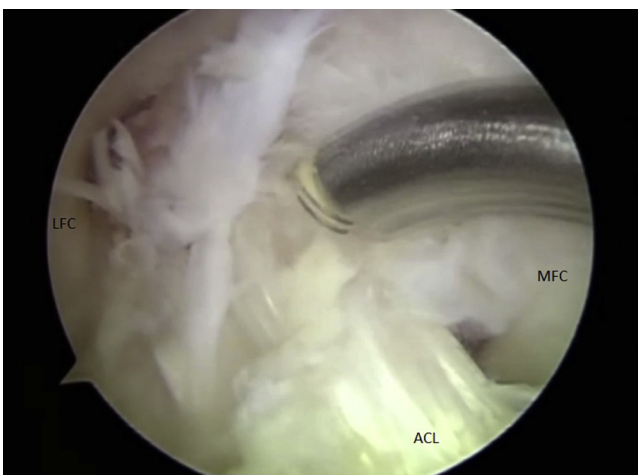


**Fig 4.** Arthroscopy still as viewed by the anterolateral portal showing mucinous deposits and characteristic “stranding” of the mucoid degenerate ACL fibers, which confirms the diagnosis of MD-ACL. (ACL, anterior cruciate ligament; LFC, lateral femoral condyle; MD, mucoid degeneration; MFC, medial femoral condyle.)

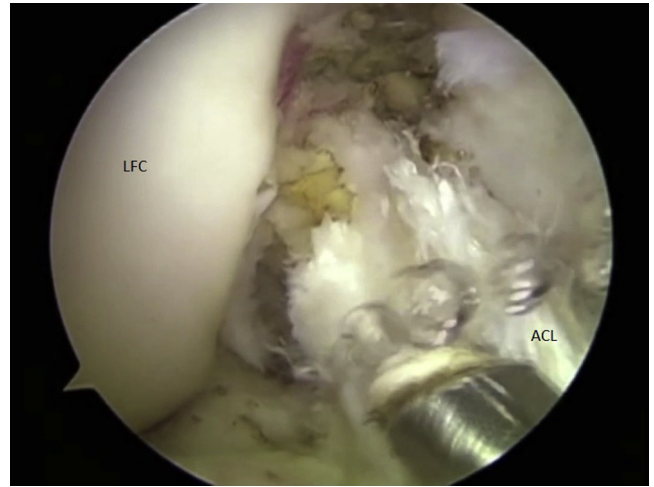


**Fig 5.** The radiofrequency probe should be inserted via the anteromedial port. The camera should be inserted through the anterolateral port.

good postoperative outcome measures at an average of 6 years' follow-up with IKDC score an average of 71 points and the Knee Injury and Osteoarthritis Outcome an average of 78 points. In this study, factors that predicted a poor prognosis were the presence of a preoperative meniscal lesion, cartilaginous lesion, and age over 50 years. However, preoperative scores for comparison were not reported within this study. A similar study was presented in 2016 by Khanna et al.<sup>9</sup> using similar techniques with a mean follow-up of 8.4 months that did compare preoperative scores with postoperative scores. In 12 of the 13 knees presented within this series, there was an improvement in the visual analog pain score by 4 grades and improvement



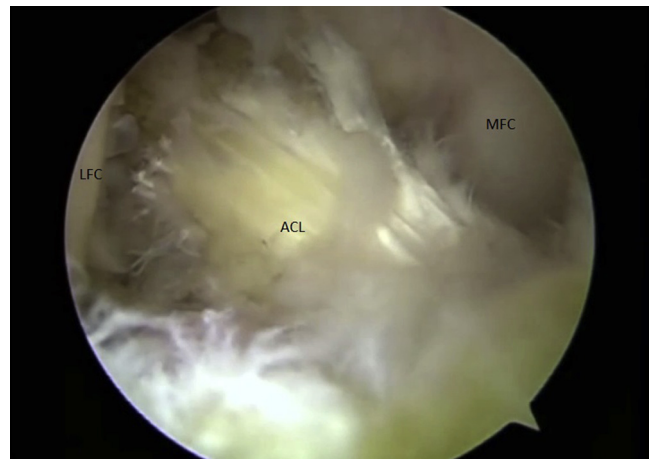
**Fig 6.** Arthroscopy still as viewed by the anterolateral portal showing the debridement of the medial wall of the ACL using a radiofrequency probe. This should continue to the peripheries until all ACL tissue that causes impingement has been debrided. (ACL, anterior cruciate ligament; LFC, lateral femoral condyle; MFC, medial femoral condyle.)



**Fig 7.** Arthroscopy still as viewed by the anterolateral portal showing the hemostasis that can be achieved using the radiofrequency probe. Hemostasis of any bleeding synovial vessels covering the ACL should be stopped by using the radiofrequency probe. There can be significant bleeding from the synovial vessels. (ACL, anterior cruciate ligament; LFC, lateral femoral condyle.)

in the IKDC from an average of 36.4 to 73.2 postoperatively.

As previously discussed, MD-ACL can be caused by other pathology within the joint. The most common associated pathologies are the presence of meniscal tears and chondral damage that have been reported as 41% to 69% and 66% to 70% of cases, respectively.<sup>3,13</sup> Therefore, during diagnostic arthroscopy, it is likely that



**Fig 8.** Arthroscopy still as viewed by the anterolateral portal showing that the debrided ACL can now freely move within the femoral notch without impingement. The ACL has reduced in bulk compared with the start of the operation and now does not impinge on either the PCL or within the notch. (ACL, anterior cruciate ligament; LFC, lateral femoral condyle; MFC, medial femoral condyle; PCL, posterior cruciate ligament.)

these pathologies may be encountered. This should be addressed because it is found after diagnostic arthroscopy, and the patient should be informed of this during the consenting process. The other pathology that may be present as part of the spectrum of ACL disease is that of ACL ganglia. Along with MD-ACL, ACL ganglia may represent an inflammatory response to mucinous fluid within the ACL caused by chronic inflammatory processes that are present within the joint.<sup>14-16</sup> This multitude of etiology (either primary or secondary) and range of ACL pathology gives a varied picture between patients, making comparisons between studies and patients difficult to achieve.

As described in the technique, the importance of performing both Lachman's and Drawer's tests for the stability of the cruciate ligaments is important intraoperatively. The decision to perform ACL reconstruction should be based on stability intraoperatively combined with patient activity levels and sporting demand after rehabilitation. In a 23-patient series, all of whom had arthroscopic debridement, 20% of cases resulted in an unstable knee and needed subsequent ACL reconstruction.<sup>8</sup> Therefore, it is paramount to inform the patient of this potential complication before surgery.

Despite the benefits that have been shown in performing arthroscopic debridement of the ACL, there is yet to be a comparison of arthroscopic debridement versus conservative management. Therefore, the natural history of MD-ACL is not known. Furthermore, because of the amount of associated pathology that can lead to the presentation of MD-ACL, it is difficult to establish whether knee pain is originating from the presence of MD-ACL or from other sources. The limitation of terminal flexion, supported by radiological evidence of MD, is likely to be caused by MD-ACL. The clinical presentation and therefore assessment on follow-up after arthroscopy can be difficult due to this heterogeneous patient population.

In summary, we have presented an arthroscopic technique of radiofrequency ablation for the treatment of MD-ACL. It is vital to assess the ACL for stability after debridement. The procedure can be performed as a day case and has been shown to offer patients benefits at short-to-medium-term follow-up.

### Acknowledgment

We would like to thank Vanessa Shepherd and the Addenbrooke's Media Studio for assistance with the photography contained within this article.

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