

Surgical Technique for Release of Anterior Interval Scarring of the Knee After Anterior Cruciate Ligament Reconstruction



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Abstract: Postoperative scarring is a known complication after arthroscopic anterior ligament reconstruction of the knee. The anterior interval of the knee has been previously identified as a common location for anterior scar formation. The anterior interval is defined as the space between the infrapatellar fat pad and the anterior border of the tibia. Patients with anterior interval scarring often present with lack of terminal knee extension, anterior knee pain, decreased patellar mobility, and quadriceps atrophy. The goal of this paper is to describe the technique for anterior interval release of the knee.

Postoperative scarring is a known complication after arthroscopic anterior ligament reconstruction of the knee. The rate of symptomatic scarring requiring surgical lysis of adhesions after isolated anterior cruciate ligament (ACL) reconstruction is approximately 0.34%.¹ Specifically, scarring of the anterior knee can lead to knee pain and patellofemoral dysfunction.² The anterior interval of the knee has been previously identified as a common location for anterior scar formation.³ The anterior interval is defined as the space between the infrapatellar fat pad and the anterior border of the tibia.⁴ Patients with anterior interval scarring often present with lack of terminal extension, anterior knee pain, decreased patellar mobility, and quadriceps atrophy. A recent biomechanical analysis showed anterior interval scarring significantly increased

patellofemoral contact forces at all flexion angles tested.⁵ The goal of this paper is to describe the technique for anterior interval release (AIR) of the knee.



Fig 1. Measurement of heel height differences in a patient with lack of terminal extension of the right leg after anterior cruciate ligament reconstruction. Patient is placed prone on the examination table with the patella resting just on the edge of the table. A retractable tape measure and level (arrow) are used to compare the involved (right) extremity to the uninvolved leg. The surgical heel (star) sits higher than the uninvolved heel.

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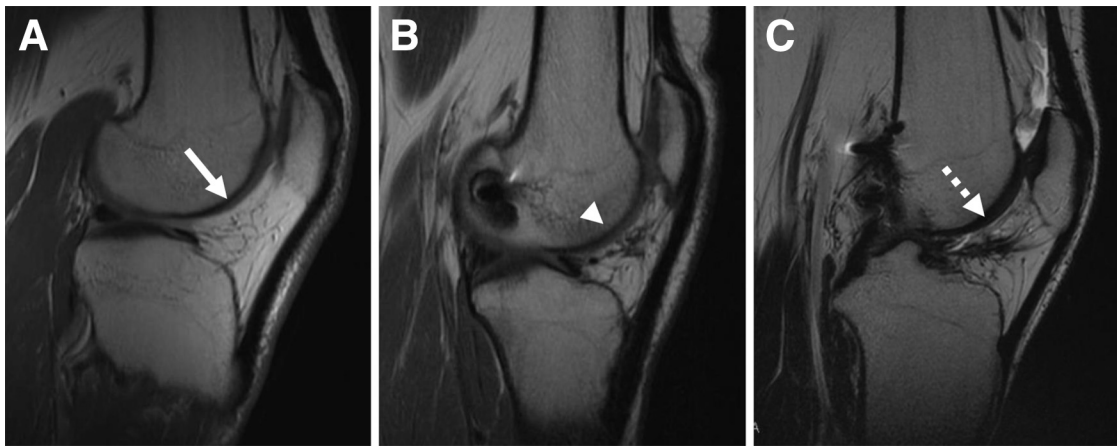


Fig 2. Sagittal T1 weighted magnetic resonance imaging and schematic of normal knee (A) and knee with anterior interval scarring after anterior cruciate ligament reconstruction (B). When anterior interval scar tissue is present, the normal intrapatellar fat pad (arrow) volume is decreased and the patellar tendon is retracted. The fibrotic bands (arrow head) indicating the anterior interval scar can be subtle, as in panel B, and require a high index of suspicion, or more obvious, as in panel C (dashed arrow).

Surgical Technique

Indications

Patients with anterior interval scarring after ACL reconstruction present with limited knee extension, anterior knee pain, decreased patellar mobility, and quadriceps weakness. If decreased knee extension is encountered in our clinic, heel height differences are routinely measured (Fig 1).⁶ Thigh circumference measured 5 and 15 cm proximal to the superior pole of the patellae can also be used to assess the degree of quadriceps atrophy. In patients with these constellation of findings, a postoperative magnetic resonance imaging (MRI) is ordered to assess the degree of anterior interval scarring. Often, the sagittal T1-weighted sequence provides the best view of the anterior

interval scar tissue (Fig 2). Patients with signs and symptoms of anterior interval scar who fail conservative management, including extensive physical therapy, are indicated for arthroscopic AIR.

Procedure

AIR procedures (Video 1) are performed under general anesthesia and can be supplemented with a single-shot adductor canal block to maximize pain control. Patients are placed supine on a standard operating table, and complete examination of the knee is performed, including passive range of motion, grading of

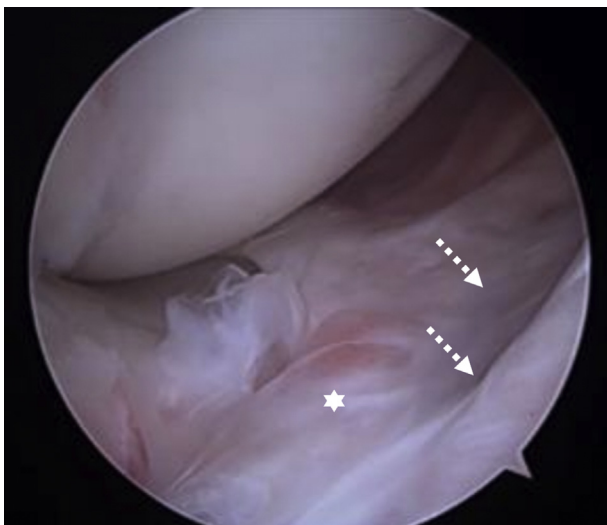


Fig 3. Arthroscopic view from the lateral portal of a left knee. Anterior interval scar tissue (dashed arrows) before surgical release. Star indicates anterior horn of the medial meniscus.

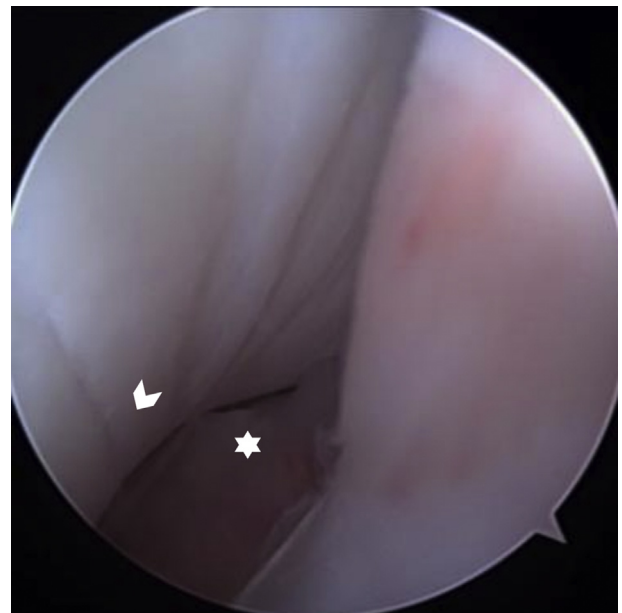


Fig 4. Arthroscopic view from the lateral portal of a left knee. Impingement of the pathologic anterior interval scar (star) with the femoral notch (arrowhead) can be seen as the knee is brought into terminal extension.

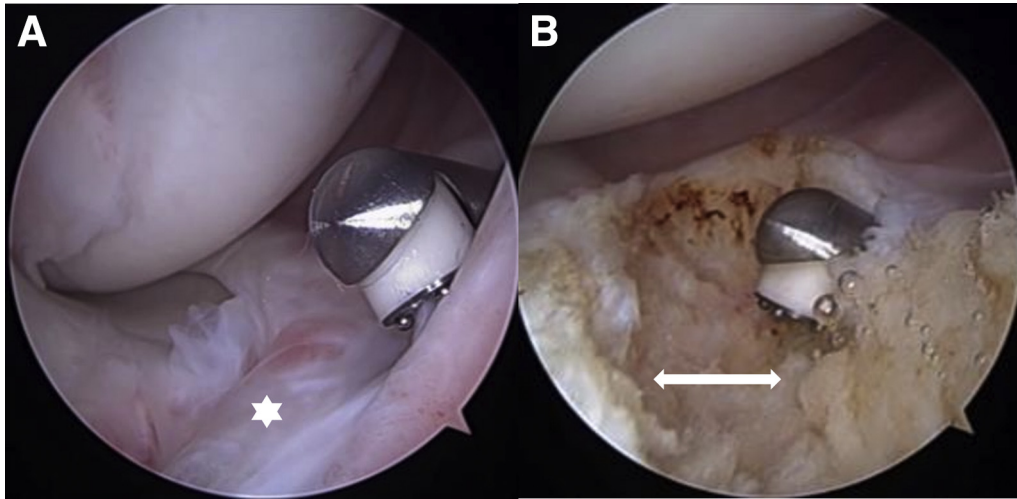


Fig 5. Arthroscopic view from the lateral portal of a left knee with the instrument in the medial portal. (A) Electrocautery is used to sharply divide the scar tissue. (B) Double arrow indicates space created by resecting pathologic scar tissue. Star indicates anterior horn of the medial meniscus.

the Lachman's and pivot shift, and testing of the collateral ligaments. A nonsterile tourniquet is placed high on the thigh, and the leg is prepped and draped in sterile fashion. Using a lateral suprapatellar approach, the knee is sequentially insufflated with normal saline until significant resistance and backflow are encountered (often 60-120 mg). This allows for distention of the compliant joint capsule, which can aid in visualization if significant arthrofibrosis is present. A lateral parapatellar portal is then made with an 11 blade even with the distal pole of the patella. The knee is entered in full extension. A medial working portal is then created with an 11 blade after localization with a spinal needle. Care is taken to establish the portal outside the area of scar formation if possible. If significant bleeding is encountered, the tourniquet can be inflated, but this should be avoided if possible. A probe is then placed into the knee, and the ACL is examined arthroscopically. Care is taken to remove any infrapatellar plica, and the tibial footprint is inspected for a cyclops lesion. A diagnostic evaluation of the medial and lateral compartments is then performed, and any concomitant meniscal or chondral pathology is addressed. The medial and lateral gutters are then inspected for loose bodies. Attention is then turned to the anterior interval. When significant scarring is present, a veil of tissue can be seen traveling from the inferior pole of the patella to the region just proximal to the intermeniscal ligament (Fig 3). This corresponds to the area of scarring seen on preoperative MRI (Fig 2). When the knee is brought into extension, the anterior interval scar can be seen impinging on the femur and preventing terminal extension (Fig 4). Using bipolar electrocautery (VAPR Suction Electrode, Depuy Mitek), the area of anterior interval scarring is sharply transected between the 2 arthroscopic portals. The direction of release is caudal

toward the anterior tibia. The release is continued until normal fat pad is encountered (Figs 5 and 6). The electrocautery tool can be bounced on the scar tissue to assess whether an adequate release has been achieved as pathologic scar is much stiffer than healthy fat pad. Care is taken to avoid the anterior horns of the menisci and the intermeniscal ligament. After release is completed, the inflow or pump pressure is reduced, and any ongoing bleeding can be cauterized. The knee is then once again brought into terminal extension, and

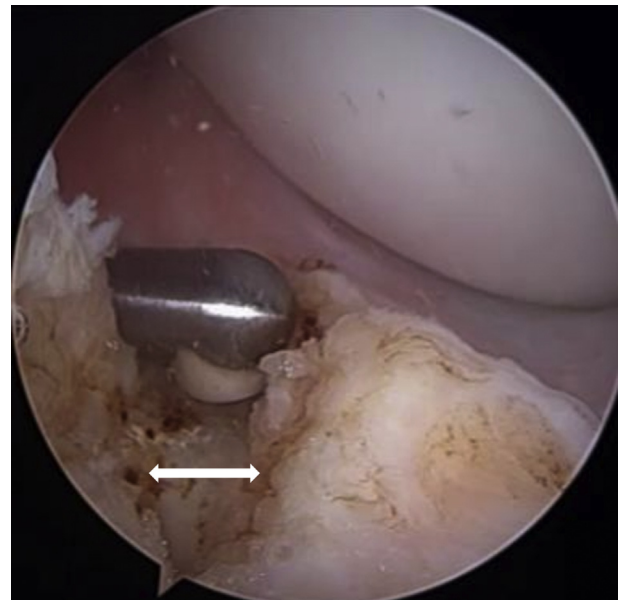


Fig 6. Arthroscopic view from the medial portal of a left knee with the instruments in the lateral portal. After releasing the remaining tissue, opening of the anterior interval can be seen (double arrow).

Table 1. Pearls and Pitfalls of Anterior Interval Release

	Pearls	Pitfalls
History	Any patient with anterior knee pain or limited ROM should be evaluated for anterior interval scarring.	Assuming patient has anterior knee pain due to other cause (bone patellar tendon bone harvest etc.).
Physical examination	In addition to supine ROM measurement with a goniometer, patients should be placed prone and heel heights should be measured.	Missing subtle lack of terminal extension in a patient with anterior knee pain after anterior cruciate ligament reconstruction.
Portal placement	Medial portal should be localized with spinal needle and placement should be outside of the pathologic scar tissue.	Failure to recognize prolonged quadriceps atrophy. Portal placement in anterior interval scar leading to decreased freedom of movement for the instruments as well as the potential for synovial fistula development.
Interval release	Use electrocautery device on cut to sharply transect the scar tissue until normal fat is encountered. This should be done from both the medial and lateral portals with the goal of dividing the tissue completely but not removing any tissue.	Mechanically shaving the tissue for scar removal, which can lead to bleeding and repeat scarring. Iatrogenic damage to the anterior horns of the menisci or intermeniscal ligament.
Hemostasis	Let the pump pressure down or modulate the inflow to ensure all bleeding is cauterized.	Incomplete resection of pathologic scar tissue. Not obtaining adequate hemostasis, which leads to postoperative swelling, potential scarring, and delayed recovery.
Postoperative protocol	Permit immediate and unrestricted ROM with aggressive physical therapy to work on patellar mobility and inferior patellar glide.	Inadequate physical therapy preventing the maintenance of extension achieved intraoperatively.

ROM, range of motion.

lack of impingement is seen. Often any flexion contracture that was present preoperatively is immediately gone. The arthroscopic fluid is evacuated, and the portals are sufficiently closed with 3-0 nylon suture to prevent synovial fistula formation. The wounds are dressed with sterile gauze, and an elastic bandage is applied. A postoperative brace is not prescribed, and patients are made partial weight bearing with crutches until they are able to ambulate without a limp. Physical therapy is started on postoperative day 1 without range of motion restrictions. Aggressive physical therapy is used until patellar mobility and motion return to normal and quadriceps circumference is equal to the contralateral extremity.

Discussion

Even in the absence of anterior interval scar, load in the patellofemoral joint is increased after ACL reconstruction.⁷ However, scarring of the anterior interval can cause patella baja and may lead to patellofemoral arthritis.⁵ The rate of patella baja after autogenous patellar tendon ACL reconstruction has been reported to be as high as 76% in 1 case series.⁸ Therefore, we

believe anterior interval scarring after ACL reconstruction is an under-recognized condition. We recommend obtaining an MRI to assess for anterior interval scarring for any patient who presents to the clinic with limited knee motion, anterior knee pain, and decreased patella mobility. Although limited prospective data exist, Steadman et al.³ published a case series on arthroscopic release of anterior interval scar in which 100% of subjects who lacked terminal extension greater than 5° had full return of motion postoperatively. Average Lysholm and International Knee Documentation Committee scores also improved significantly. Pearls and pitfalls of the procedure can be found in [Table 1](#). It is important to note this procedure is not without risks, and the advantages and limitations can be found in [Table 2](#). There are risks associated with an additional procedure, like infection, and there is a risk of iatrogenic damage to the meniscus. Additionally, the degree of clinical improvement has not been studied, which makes preoperative counseling difficult. Postoperatively, patients may continue to have anterior knee pain from another source like patellofemoral chondral changes. However, in appropriately indicated

Table 2. Potential Advantages and Limitations of Anterior Interval Release

Advantages	Limitations
<ul style="list-style-type: none"> Improved range of motion immediately postoperatively. Decreased patellofemoral joint forces. Easier quadriceps strengthening due to decreased anterior knee pain. Immediate weight bearing without brace and unrestricted range of motion, which allows for expedited recovery. 	<ul style="list-style-type: none"> Risk of iatrogenic damage to anterior horns of menisci and intermeniscal ligament. Degree of clinical improvement expected has not been studied. Patients may continue to have anterior knee pain from another source. Requires additional surgery (cost) and associated risks.

patients, AIR can improve terminal extension and allow for improved extensor mechanism function.

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