Technical Note

Low-Profile Cartilage Repair With Knotless All-Suture Anchors: Surgical Technique

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Abstract: Osteochondral and pure chondral lesions of the knee are common after patellar dislocations. There are multiple described techniques for the fixation of these lesions, including metallic screws, bioabsorbable screws, bioabsorbable implants, and suture devices. The purpose of this article is to describe a surgical technique for surgical fixation of a lateral condyle chondral lesion using knotless all-suture anchors, with second-look knee arthroscopy illustrating healing of the cartilage repair.

Patellar dislocations are common in young patients, with a reported incidence of 108/100,000 in patients aged 10 to 17 years of age and 42/100,000 in the general population.[1] Concurrent pathology after patellar dislocations is also common, with reports of osteochondral and chondral lesions of the knee occurring in 39% to 95% of patients, 30% of which involve the lateral condyle.[2,3]

Patients with osteochondral and chondral lesions of the knee typically present with pain, swelling, and potentially mechanical symptoms, especially in the setting of unstable lesions. Initial imaging consists of knee radiographs and magnetic resonance imaging. Although various treatment options exist, surgical management is typically recommended for larger (>1 cm^2) lesions after patellar dislocation.[4] Options for fixation include metallic screws, bioabsorbable screws, bioabsorbable implants, and suture-based techniques.[5] Although screws provide compression and rotational stability, they leave a relatively large footprint in normal/healthy articular cartilage, occasionally cause cartilage damage, and may necessitate a second surgery for removal (particularly for metal screws).[5,6] Bioabsorbable implants offer similar compression without the obligate need for hardware removal, but potential risks include implant breakage, osteolysis, and synovitis.[7] Suture techniques, including all suture devices, have also been used in various configurations, but their ability to routinely provide adequate compression across osteochondral lesions is not entirely clear.[8-11] The purpose of this article is to describe a technique for surgical fixation of a lateral condyle osteochondral lesion using knotless suture anchors, with subsequent second-look knee arthroscopy illustrating healing of the cartilage repair.

Surgical Technique

Patient Evaluation, Imaging, and Indications

Each patient undergoing cartilage repair or restoration of the knee requires preoperative evaluation. A complete history, physical examination, and imaging workup are used to identify osteochondral pathology. The history should establish the age and activity level of the patient, because these are essential factors that influence treatment options. In addition to anteroposterior, lateral, and merchant (or sunrise) view radiographs, a weightbearing long-leg alignment film is

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used to identify malalignment, which may impact the surgical decision-making.[12] Magnetic resonance imaging specifies the size and location of the defect and determines whether there is meniscus pathology or subchondral edema and identifies any other concomitant knee pathologies. An option to further evaluate the bony extent of an osteochondral lesion is through computed tomography, which can be helpful in surgical fixation planning.[13]

In some cases, chondral and osteochondral defects are managed without surgery. However, many patients will require cartilage repair (or restoration) in the setting of failed nonoperative management, particularly those with mechanical symptoms. Surgical management is often preferred in young, active patients with a full-thickness chondral defect[12] and can be performed arthroscopically or with an open approach.[13] The location, size, and containment of the lesion will often dictate the method of fixation. For instance, arthroscopic fixation of a far posterior lateral condyle lesion may be inappropriate because of the inability to get perpendicular to the distal lateral condyle lesion via an arthroscopic portal. Thus an open approach may be more practical.

Surgical Positioning and Diagnostic Arthroscopy

We perform this procedure in the supine position under general anesthesia. The patient is positioned on the operating room table, a tourniquet is placed, and an examination with the patient under anesthesia is performed. Standard diagnostic knee arthroscopy is performed to identify the pathology, perform debridement, and remove any loose bodies (Fig 1A, B, D). If there is an opportunity to get perfectly perpendicular to the defect site via an arthroscopic portal, this technique for cartilage repair can be attempted arthroscopically.[8] If the procedure cannot be executed perfectly because of the inability to get perpendicular to the defect for fixation, an open approach should be used.

Open Approach and Defect Preparation

The arthroscopic instrumentation is removed, the leg is elevated and exsanguinated, and the tourniquet is inflated. The anterolateral arthroscopy portal is extended to approximately 2 cm proximal to the superior pole of the patella. A small lateral parapatellar arthrotomy is created, and the patella is subluxated to expose the distal lateral condyle defect in roughly 100° of flexion. The loose body is carefully removed and

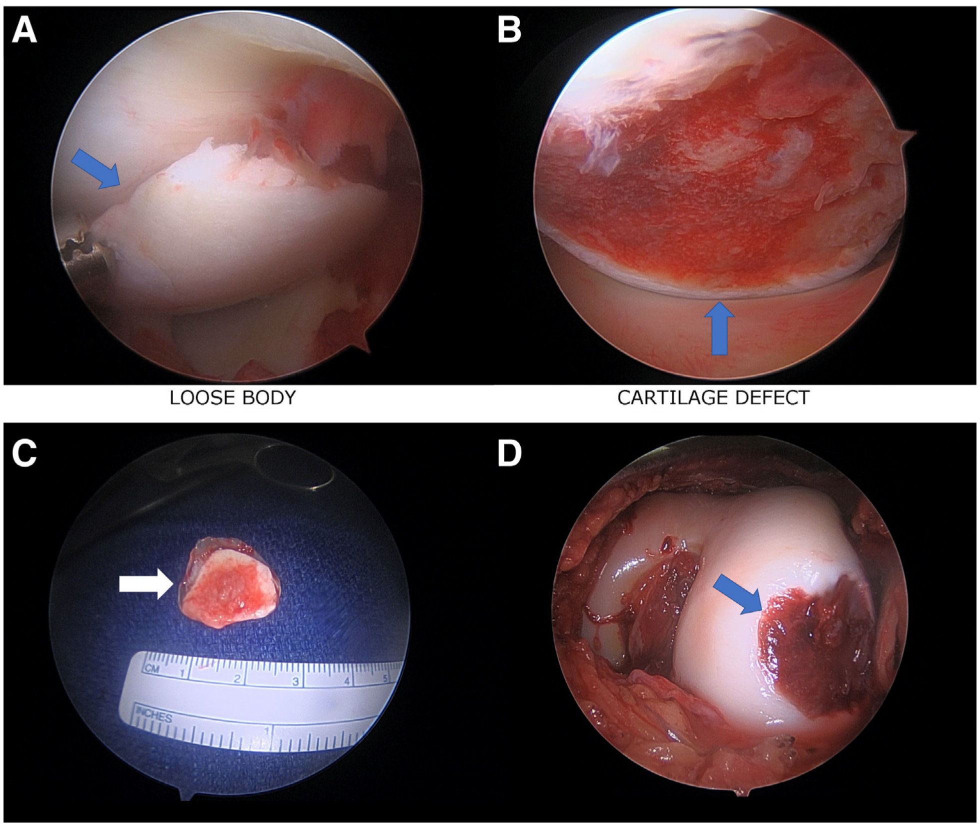

Fig 1. (A) Arthroscopic intraoperative image in a left knee viewing from the anterolateral portal demonstrating a loose chondral fragment (blue arrow) in the intercondylar notch adjacent to the medial femoral condyle and (B) the corresponding osteochondral defect located on the lateral aspect of the lateral femoral condyle (blue arrow). (C) Intraoperative image demonstrating the chondral fragment (white arrow) from the knee viewed on the operating room table. (D) Intraoperative image of the corresponding cartilage defect (blue arrow) viewed through an open medial parapatellar arthrotomy.

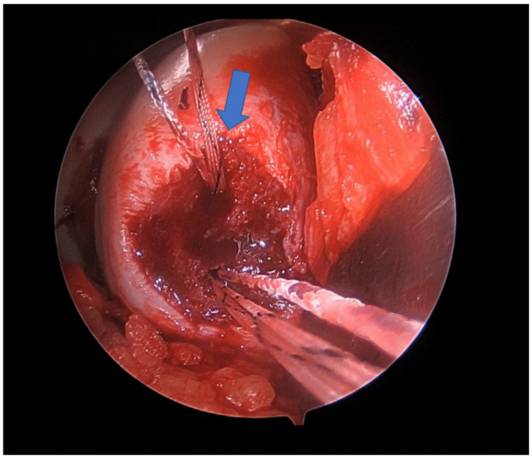

Fig 2. Intraoperative image of the defect viewed through an open medial parapatellar arthrotomy following anchor placement 8 mm apart (blue arrow).

assessed for bone on the undersurface of the fragment (Fig 1C). The defect bed is minimally debrided with a curette.

Cartilage Repair and Fixation

Two 1.8 mm FiberTak (Arthrex Inc., Naples, FL) suture anchors are placed in the defect bed, approximately 8 mm apart (Fig 2). Tension is pulled on both anchors to ensure they are well secured in the defect site. Next, on the back table, 2 small holes are drilled into the loose body with a Kirschner wire. A passing suture (FiberLink with 1.3 mm SutureTape; Arthrex Inc.) is placed through each drill hole. Holding the chondral defect anatomically in line with the defect base, from deep to superficial, each FiberLink is used to shuttle all 3 limbs of each knotless suture anchor through the chondral defect. It is important to ensure that the sutures from the more superior anchor (in the defect base) are passed through the more superior hole (in the defect) to maintain proper suture orientation. Next, the black-white shuttle sutures from each suture anchor are used to shuttle the blue repair suture from the opposite anchor, interlinking the 2 anchors. A firm tug technique, pulling in line with the placement of the anchors, is used to shuttle the sutures smoothly. If done correctly, the blue repair suture from the superior anchor will be shuttled through the inferior anchor, and vice versa, to create a linked knotless construct. Next, these blue repair sutures are cinched down to pull the defect to the defect base. Care is taken to avoid the sutures rubbing on the cartilage. A probe held between the sutures and the cartilage can be helpful here to prevent the sutures from causing friction on the otherwise healthy cartilage between the 2 points where the sutures are exiting the fragment. The fragment is anatomically reduced to the defect bed (Fig 3A; Video 1). The suture tails are then cut flush (Fig 3B).

Rehabilitation Protocol

After cartilage repair, patients are made toe-touch weightbearing for 6 weeks if performed in a weightbearing zone (i.e., femoral condyles). If performed in the patellofemoral joint, weightbearing as tolerated, is permitted with a knee brace locked in extension. Continuous passive motion is started within 48 hours after surgery for 4 to 6 hours per day for the first 6 weeks. The continuous passive motion protocol includes one cycle per minute beginning at 0° to 30°, with advancement of 5° to 10° per day. After 6 weeks, weightbearing is advanced 25% every 3 to 5 days until full weightbearing is achieved at 8 weeks. Full return to

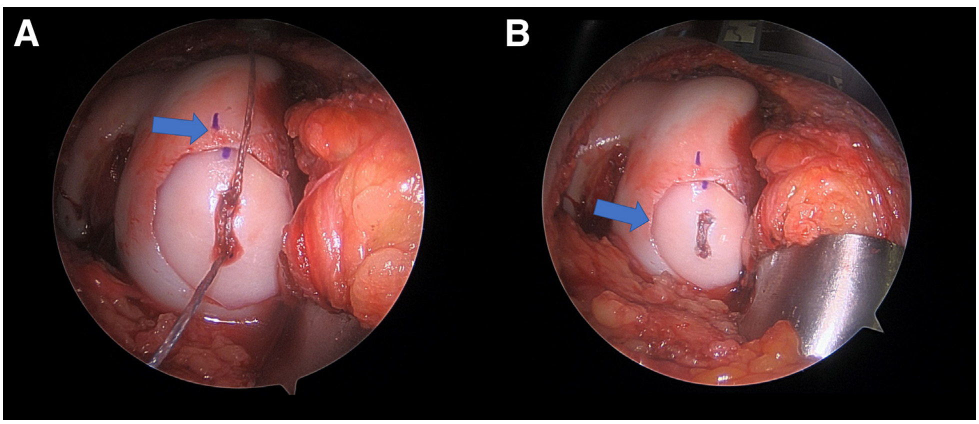

Fig 3. (A) Intraoperative image viewed through an open medial parapatellar arthrotomy demonstrating anatomic reduction of the chondral fragment of the lateral femoral condyle with a marking at the 12:00 position demonstrating maintenance of proper fragment orientation (blue arrow). (B) Intraoperative image viewed through an open medial parapatellar arthrotomy demonstrating anatomic reduction of the chondral fragment of the lateral femoral condyle achieved using knotless suture anchors after final tensioning and cutting of the repair stitch (blue arrow).

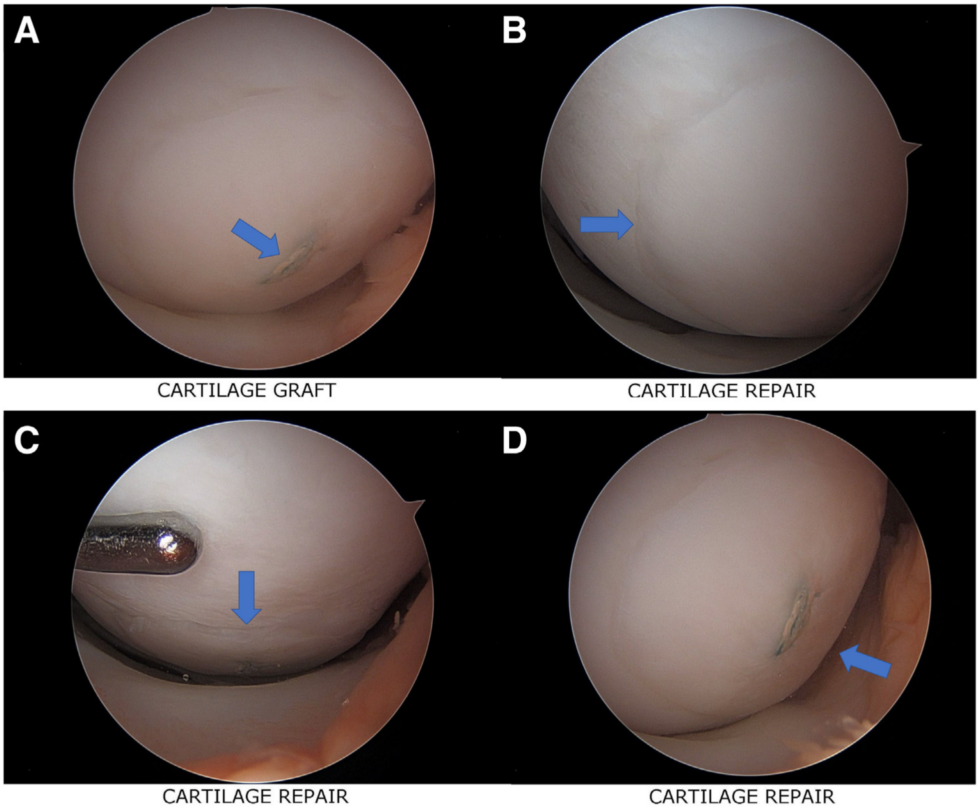

Fig 4. (A) Arthroscopic image of the lateral femoral condyle of the left knee at second-look arthroscopy at 20 weeks after surgery, viewed through the anteromedial portal, including suture from the knotless suture anchors demonstrating a completely intact, stable, and well-healed cartilage repair with synovialized suture material (blue arrow). (B) Arthroscopic image of the lateral femoral condyle viewed through the anterolateral portal demonstrating the medial border of the healed chondral fragment (blue arrow), including (C) engagement with the lateral meniscus and lateral tibial plateau through range of motion (blue arrow) and (D) when viewed through the anteromedial portal (blue arrow).

sport is permitted at 6 months, pending any additional procedures that are performed (i.e., osteotomy, ligament reconstruction, etc.) (Fig 4; Video 1).

Discussion

Various techniques have been described for treating chondral and osteochondral lesions of the knee after patellar dislocation, including metallic screws, bioabsorbable implants, and all-suture devices.[5] Metallic screws have the benefit of providing compression and rotational stability but have the potential to cause iatrogenic cartilage damage and, potentially, a need for additional surgery to remove hardware.[5] For example, in their review of 22 skeletally mature knees treated with headless metal compression screws for unstable cartilage lesions, Barrett et al.[6] noted additional surgical procedures in 95% of their patients. These procedures included loose fragment excision, hardware removal, screw advancement, and additional cartilage procedures such as chondroplasty or osteochondral autologous transplantation.

Bioabsorbable implants also provide compression and rotational stability but have been associated with risks such as implant breakage, osteolysis, and synovitis.[7] Millington et al.[14] reported an 18% rate of reoperation for implant breakage and back-out in their retrospective review of patients with unstable lesions treated with various bioabsorbable implants. Additional issues related to implant back-out, breakage, loose bodies, synovitis, effusions, cartilage damage, and osteolysis have also been reported with bioabsorbable implants.[15-17]

To avoid complications associated with metallic and bioabsorbable implants, fragment-preserving all-suture techniques using various configurations have been described.[9-11] Importantly, the ability of all-suture techniques to provide adequate compression across osteochondral lesions remains less understood,

Table 1. Pearls and Pitfalls of Low-Profile Cartilage Repair With Knotless All-Suture Anchors

Pearls
Place arthroscopic portal perpendicular to the defect site for arthroscopic repair
Ensure the sutures from the more-superior anchor are passed through the more-superior aspect of the defect to maintain proper suture orientation
Use a probe to create a barrier between the sutures and the cartilage while shuttling the sutures to prevent friction against the cartilage itself
Pitfalls
Failure to match the defect contour to the fragment will prevent compression across the fragment
Lack of attention to the two suture exit points within the fragment can result in damage to the surrounding cartilage
Failure to provide counter-tension on the pulley construct during graft placement can prevent adequate fixation

Table 2. Advantages and Disadvantages of Low-Profile Cartilage Repair with Knotless All-Suture Anchors

Advantages
High-strength sutures provide stable fixation of the osteochondral lesion with uniform compression across the fragment
Low-profile construct maintains stability
Smaller implant size minimizes morbidity to the surrounding cartilage and bone
Does not require subsequent for hardware removal
Versatility for fragment fixation in various anatomic locations accomplished by arthroscopic and open methods
Disadvantages
Requires proper orientation of the osteochondral fragment in relation to the anchors
Potential for abrasion or inflammatory response to the suture material
Cost of implants

particularly compared to metal screws.[8] Prior descriptions of techniques using knotless all-suture anchors have not used open techniques in addition to arthroscopy and have not shown follow-up arthroscopy to assess healing of the cartilage repair.[8]

We describe a technique for surgical fixation of a lateral condyle cartilage lesion using knotless all-suture anchors, with subsequent second-look knee arthroscopy illustrating healing of the cartilage repair. Advantages of this technique include the use of a high-strength suture to provide stable fixation of the lesion, with uniform compression across the fragment. This stability is achieved while maintaining a low-profile construct that does not require hardware removal that may be required with metallic or bioabsorbable implants. Additionally, this technique minimizes morbidity to the surrounding cartilage and bone because of smaller implant sizes. Finally, knotless suture anchors offer versatility for fragment fixation in various anatomic locations with a reproducible technique that can be accomplished by both arthroscopic and open methods. The potential disadvantages of this technique include the cost of the implants, the possibility of abrasion or inflammatory response to the suture material, and the need to ensure proper orientation of the osteochondral fragment in relation to the anchors (Tables 1 and 2). However, despite these possible disadvantages, using knotless all-suture anchors provides a stable, low-profile, and reproducible construct for osteochondral fragment fixation that minimizes the risk of secondary surgery.

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