

Knotless Suture Anchor Fixation of a Traumatic Osteochondral Lesion of the Lateral Femoral Condyle



Neal B. Goldenberg, M.D., and Clayton W. Nuelle, M.D.

Abstract: Osteochondral injuries commonly occur after lateral patellar instability events. Recognition and early intervention of displaced fragments is key to maintaining the viability of the fragment and congruency of the articular surface. Multiple fixation techniques exist for achieving stable fixation of displaced osteochondral lesions, including metal or bioabsorbable screws and all suture techniques. In this Technical Note, we describe a technique for internal fixation of a displaced osteochondral fragment of the lateral femoral condyle using knotless suture anchors. This technique affords minimally invasive restoration of the native anatomy with excellent stability of the fracture fragment, allowing early range of motion and ambulation.

Lateral patellar dislocations commonly occur in adolescent and young adult populations at an estimated incidence of 42 per 100,000 person-years, with females representing the highest risk group.¹ First-time patellar instability events often occur after a noncontact twisting injury or, less commonly, a direct blow to the side of the knee. Concomitant injuries are common and include medial patellofemoral ligament injury, bone contusions, and chondral and osteochondral injuries.² Osteochondral injuries after a patellar instability event are reported to occur in 38% to 95% of individuals with first-time patellar dislocations.³⁻⁷ In the absence of osteochondral injury or loose body, many first-time patellar dislocations are treated conservatively. The presence of osteochondral fracture or loose body, however, is a primary indication for surgery. Early recognition of these injuries is important, as stable fixation is desirable for maintaining osteochondral viability and articular congruity.

From the Department of Orthopedic Surgery, Baylor College of Medicine, Houston, Texas, U.S.A. (N.B.G.) and The San Antonio Orthopedic Group (TSAOG) and Burkhart Research Institute for Orthopedics, San Antonio, Texas, U.S.A. (C.W.N.).

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Address correspondence to Neal B. Goldenberg, M.D., Department of Orthopedic Surgery, Cheshire Medical Center/ Dartmouth-Hitchcock Keene, 580 Court Street, Keene, NH 03431, U.S.A. E-mail: neal.b.goldenberg@gmail.com

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While fragment removal and debridement may be appropriate for small chondral or osteochondral fragments (<5 mm), surgical fixation is recommended for management of larger osteochondral lesions.^{4,8} Stable internal fixation promotes osteochondral fracture healing, early joint mobilization, and prevention of further chondral damage. Multiple options for achieving stable internal fixation of osteochondral lesions have been described, including metal screws, bioabsorbable screws and pins, and suture-only bridging techniques.⁹⁻¹³ Metal screw fixation affords excellent compression and stability across the fracture site but risks fragmentation of the fracture, has the potential for hardware prominence, and may necessitate subsequent hardware removal.^{9,14} Bioabsorbable fixation and suture-only techniques are alternative fixation options that do not necessitate hardware removal. Bioabsorbable fixation, however, has been associated with foreign body reactions, specifically, transient synovitis and delayed inflammatory reactions.^{15,16} In contrast, suture-only bridging techniques alone may not afford the same stability and fixation strength provided by metal screw fixation or full anchors. In this Technical Note, we describe a knotless all-suture anchor technique for internal fixation of a traumatic osteochondral fragment, which provides minimally invasive, stable internal fixation without the need for subsequent hardware removal.

Surgical Technique

The patient is positioned supine on the operating table using a basic knee arthroscopy setup as per surgeon preference. Standard arthroscopic portals are made and

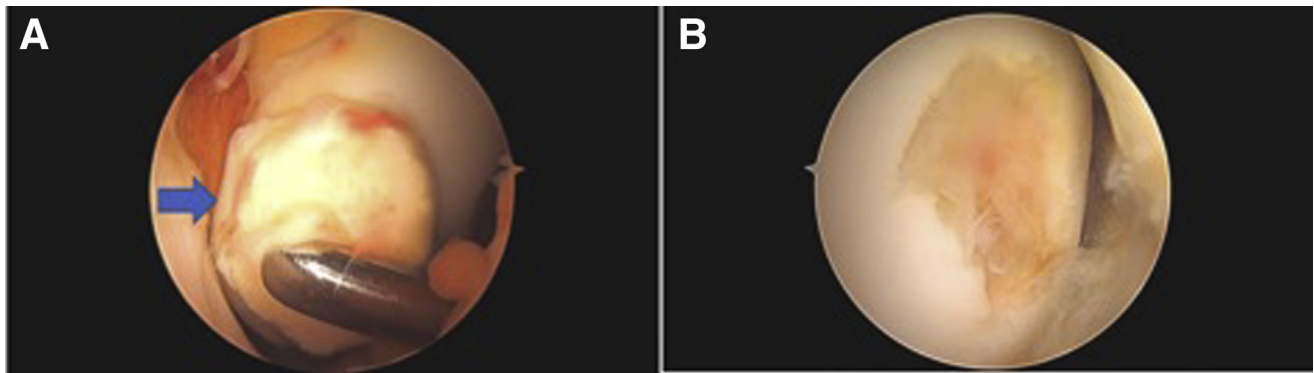


Fig 1. (A) Arthroscopic intraoperative image in a left knee viewing from the anteromedial portal demonstrating a loose osteochondral fragment (blue arrow) in the intercondylar notch adjacent to the lateral femoral condyle. (B) Arthroscopic image viewing from the anteromedial portal demonstrating the corresponding osteochondral defect located on the mid-weightbearing portion of the lateral femoral condyle.

a thorough diagnostic arthroscopy is performed to evaluate and address any concomitant pathology. Particular attention must be paid to the articular cartilage. In this case, there was a large osteochondral defect along the mid-weightbearing portion of the lateral femoral condyle with the associated loose osteochondral fragment located in the posterolateral recess of the knee (Fig 1 A and B). The loose fragment is removed and evaluated on the back table to ensure suitability for internal fixation. The osteochondral fragment is then debrided of any fibrous tissue, with care taken to preserve the osseous posterior portion (Table 1). The fragment is then measured and proper orientation determined (Fig 2). Attention is returned to the knee. The base of the osteochondral defect is debrided (Fig 3A). Marrow stimulation of the fracture bed is carried out using a small (1.2-mm) K-wire to drill microfracture tunnels (Figure 3B). Two separate socket tunnels are then prepared using the drill guide and 1.8-mm drill bit for the knotless all-suture FiberTak (Arthrex, Naples, FL) anchor. Socket tunnels are prepared with one at the superior aspect of the prepared bone bed and the other, in line with the first, placed inferiorly (Fig 3 C and D). The anchors are then placed and tension is pulled to ensure appropriate seating of the anchors. The distance between the anchors is measured with an arthroscopic probe, and the suture limbs are retrieved

out the lateral portal. On the back table, the measured distance between socket tunnels is marked out on the fragment. Using a 1.8-mm drill bit, 2 holes are drilled through the osteochondral fragment for later suture passage (Fig 4). It is paramount to ensure that these holes are drilled an equal distance apart, mirroring the socket tunnels in the fracture bed. The fixation limb from the superior anchor is then passed through the superior bone tunnel of the osteochondral fragment and back through the inferior bone tunnel so that the suture gently wraps around the central aspect of the articular surface of the osteochondral fragment. The remaining suture from the superior anchor is then unloaded and discarded. The fixation limb is then fed through the looped end of the pull suture from the inferior anchor. The pull suture is tensioned, feeding the fixation limb through the loading mechanism of the inferior anchor to create the knotless interconnection. The pull limb is then fed back through the inferior hole in the osteochondral fragment to ensure there is not a suture stack between the fragment and the base of the defect. The lateral portal is extended, creating a small, mini-open arthrotomy to allow for smooth passage of the osteochondral fragment. Gentle pressure is applied to the osteochondral fragment, and the pull suture is tensioned slowly, delivering the fragment into the joint and reducing it back to its prepared bone bed. Anatomic

Table 1. Pearls and Pitfalls of Knotless All-Suture Anchor Fixation of an Osteochondral Fracture Fragment

Pearls	Pitfalls
Debride the osteochondral fragment of any fibrous tissue, with care taken to preserve the osseous portion, leaving only a smooth healing surface for bony healing.	Failure to adequately prepare the donor site or the osteochondral fragment may prevent proper reduction and eventual fragment healing.
Confirm proper orientation of osteochondral fragment prior to drilling of the fragment.	Failure to feed the pull limb back through a tunnel in the osteochondral fragment may also prevent proper reduction of the fragment.
Measure the distance between the suture anchors with an arthroscopic probe and ensure when drilling holes in the osteochondral fragment they are placed at the same distance apart.	Ensure the incision over the defect is large enough (mini-open) to easily accommodate fragment reduction, as making a small arthroscopic incision alone makes reduction of the fragment difficult.

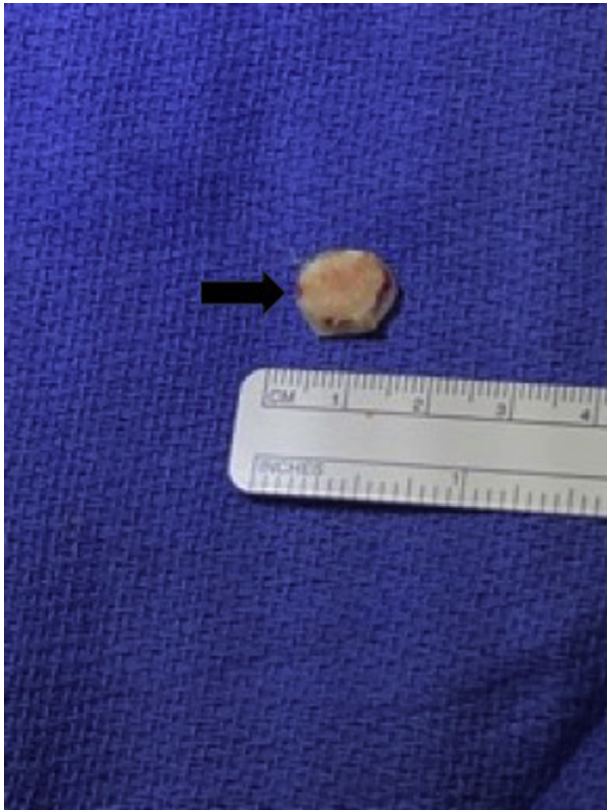


Fig 2. Intraoperative image demonstrating an osteochondral fragment (black arrow) from the knee on the operating room table, where it is sized using a ruler and evaluated for appropriateness of internal fixation. Once deemed suitable for fixation, proper fragment orientation is determined and the fragment is debrided of any fibrous tissue.

reduction is confirmed arthroscopically, and the knee is taken through range of motion to ensure osteochondral fragment stability (Fig 5). The wound is closed in layers and a standard dressing is applied. The technique is demonstrated in Video 1.

Rehabilitation

The patient is placed in a hinged knee brace locked in extension immediately postoperatively and during ambulation. The brace is unlocked for therapy and range of motion from 0 to 60 for the first 2 weeks. The patient is touchdown weightbearing during this time. From weeks 2 to 4, a partial, progressive weightbearing protocol is instituted, and range of motion is advanced to 0 to 90. Range of motion advances as tolerated thereafter.

Discussion

Osteochondral injuries after a patellar instability event have been reported to occur in 38% to 95% of individuals with first-time patellar dislocation.³⁻⁷ Treatment options include fragment excision, which

can lead to early degenerative arthritis, and osteochondral fragment fixation.^{17,18} There are a number of successful techniques for fixation of osteochondral fractures, including metal screws, bioabsorbable pins and screws, and suture-only techniques.^{9-13,15,16} Metal screws provide excellent fixation strength and compression across the fracture fragment, but they often require a second surgery for screw removal. Metal screws also present the additional risk of screw migration and fracture.¹⁴ Bioabsorbable fixation is another option. Benefits of bioabsorbable fixation devices include their ability to compress across the fracture site, decreased need for hardware removal, and ease of use. Despite these benefits, there are reports of foreign body reactions with associated synovitis, joint abrasion from prominent hardware, and cartilage damage.^{10,15,16,19,20} Suture-only techniques have been shown to have adequate fixation strength, can be used for smaller osteochondral fragments, and do not necessitate subsequent hardware removal.^{12,21} However, they provide minimal compression across the fracture fragment and are biomechanically inferior to screws and anchors. Therefore, suture-only techniques often necessitate minimal early range of motion and prolonged nonweightbearing postoperatively. Knotless suture anchor fixation is a technique for osteochondral fracture fragment fixation that mitigates the disadvantages of all suture fixation techniques while capitalizing on the benefits of anchor fixation.

There are several advantages of this technique (Table 2). First, implantation of the all-suture anchor requires minimal disruption of the underlying cancellous bone and is relatively sparing to the articular cartilage. Second, suture anchor placement directly beneath the fragment provides an improved vector for compression across the fracture site compared to all suture techniques. Third, capturing the fragment with the suture theoretically allows for enhanced stability of the fragment and decreases the risk of fragmentation of the osteochondral fracture fragment. Finally, this technique is very low profile, with no suture knots and no retained hardware that might require subsequent hardware removal.

This technique has some disadvantages (Table 2). First, it is technically challenging, requiring placement of suture anchors prior to fracture fragment reduction. Second, there is potential for abrasion of the articular cartilage by the overlying suture material. Finally, with multiple sutures and the need to interconnect the anchors, suture management is paramount. Despite these potential drawbacks, suture anchor fixation of traumatic osteochondral lesions is a reproducible, reliable procedure that enables stable fixation of fracture fragments, allowing early range of motion while minimizing the need for subsequent surgery. Knotless suture anchor fixation is therefore the authors'

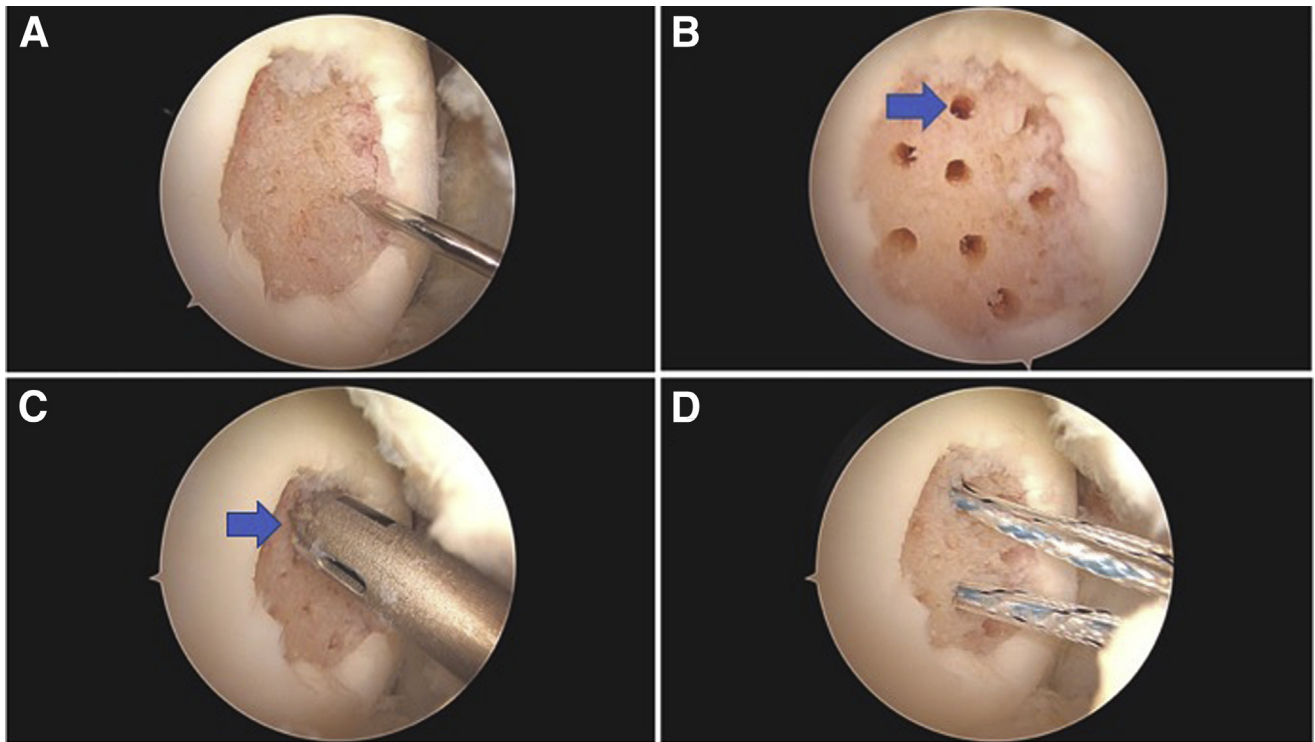


Fig 3. Arthroscopic intraoperative image of a left knee viewing from the anteromedial portal demonstrating an osteochondral defect after preparation of bone bed with a curette (A). Marrow stimulation is then carried out using a 1.2-mm K-wire to create small microfracture tunnels in the defect site (blue arrow). Tunnels are oriented perpendicular to bone and placed 2 to 3 mm apart (B). Socket tunnels are then prepared for suture anchors (blue arrow), with one placed in the superior aspect of the prepared bone bed and a second, in line with the first, inferiorly (C). The FiberTak all-suture anchors are then placed and tensioned to ensure appropriate seating of the anchors (D).

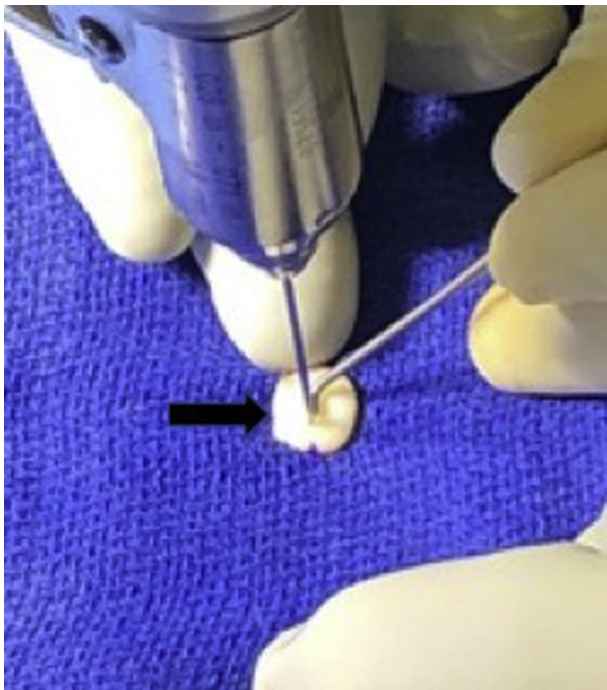


Fig 4. Intraoperative image demonstrating usage of a 1.8-mm drill bit to drill two drill holes in a knee lateral femoral condyle osteochondral fragment (black arrow) such that they will line up exactly with the suture anchors of the prepared bone bed defect. This allows for later anatomic reduction of the fragment within the knee.



Fig 5. Arthroscopic intraoperative image of a left knee viewing from the anterolateral portal demonstrating anatomic reduction of an osteochondral fragment of the lateral femoral condyle with stable fixation achieved using knotless suture anchors. Note the marking at the 12-o'clock position of the osteochondral fragment demonstrating maintenance of proper fragment orientation (blue arrow).

Table 2. Advantages and Disadvantages of Knotless All-Suture Anchor Fixation of a Traumatic Osteochondral Fracture Fragment

Advantages	Disadvantages
No staged surgery necessary for hardware removal	Requires placement of suture anchors prior to reduction of osteochondral fracture fragment
Articular cartilage sparing with minimal disruption of underlying cancellous bone	Potential for abrasion of articular cartilage by suture material
Provides in-line compression of fragment while spreading out compressive forces over larger surface area	Requires meticulous suture management
Suture anchor fixation allows for load sharing between anchors	Potentially more expensive implant costs than suture alone

preferred technique for the treatment of small osteochondral fracture fragments in this setting.

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