Technical Note

All-arthroscopic Knee Patellofemoral Ligament Repair

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Abstract: Patellar dislocations are common injuries in the pediatric and adolescent population, with an estimated mean incidence of 42/100,000 person-years. The medial patellofemoral ligament is the most important structure preventing lateral patellar translation, whereas its patellar attachment is frequently damaged after patellar dislocations. This technical note presents an all-arthroscopic medial patellofemoral ligament repair technique suggested after a first episode of patellar dislocation.

Patellar dislocations are common injuries in the pediatric and adolescent population, with an estimated mean incidence of 42/100,000 person-years.[1] Especially, female patients have a high risk of recurrent patellar instability, with an incidence reaching 36.8% in some epidemiologic studies.[1] The medial patellofemoral ligament (MPFL) represents the major medial static restraint, reducing lateral patellar translation from 0° to 30° of flexion.[2] This ligament is frequently injured in the skeletally immature patient after the first episode of patellar dislocation, mostly with an avulsion from its patellar attachment.[3] This technical note presents an all-arthroscopic MPFL repair technique suggested after the first episode of patellar dislocation (Video 1).

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Indications

The indications for the described technique are acute first-time patellar dislocations in children and adolescents with magnetic resonance imaging findings of avulsion of the MPFL from the patella.

Surgical Technique

The patient is positioned supine on the operating table with a high-thigh tourniquet. Standard preoperative prophylactic antibiotics are administered intravenously. General or locoregional anesthesia may be used according to the local standard of care and the patient's age and risk factors.

By use of a skin marker, the following anatomic structures are identified and marked: patella, anatomic course of the MPFL from its patellar insertion to the medial femoral condyle, patellar tendon, and quadriceps tendon. The following arthroscopic portals are used (Fig 1): lateral portal (portal A), a standard lateral parapatellar portal used as a viewing portal; medial portal (portal B), a standard medial parapatellar portal used for suture management; central-medial portal (portal C), situated 1 cm medial to the medial border of the patella at the junction of its upper and lower halves, used for anchor placement and knot tying; and superior-medial portal (portal D), situated 4 cm proximal to and in line with the medial border of the patella. We defined 4 different steps for this surgical procedure: diagnostic arthroscopy, anchor placement, suture passage, and suture retrieval with knot tying.

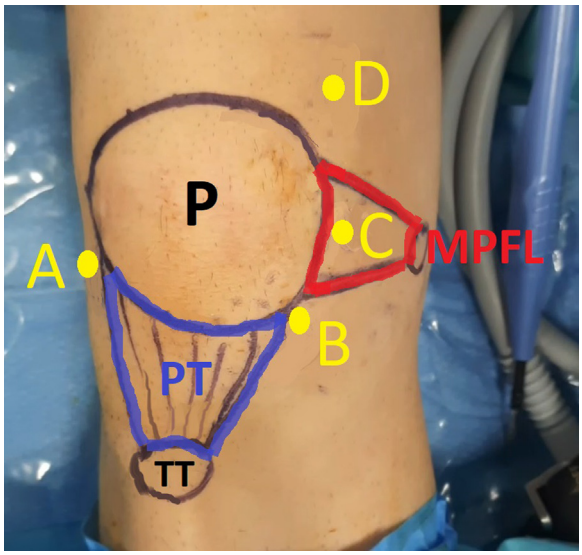

Fig 1. Identification of the anatomic structures before surgery is essential. Surgery is performed using 4 working portals: lateral portal (portal A) for viewing, medial portal (portal B) for suture management, central-medial portal (portal C) for anchor placement and knot tying, and superior-medial portal (portal D) for suture management. A right knee is shown. (MPFL, medial patellofemoral ligament; P, patella; PT, patellar tendon; TT, tibial tubercle.)

Diagnostic Arthroscopy: Identification of MPFL and Debridement of MPFL Tear

After drainage of the hematoma, the surgeon performs a diagnostic arthroscopy through portal A with a 30° arthroscope to explore all the knee compartments, searching for cartilage damage and meniscal or ligament tears. The arthroscope is then positioned to visualize the medial facet of the patella and medial pouch of the knee joint. Two spinal needles are placed: the first on the superior side and the second on the inferior side of the MPFL previously outlined on the skin. Because the MPFL is an extracapsular structure and is therefore not visible from an intra-articular view, the tips of the needles visible inside the joint are used as anatomic landmarks for the proximal and distal borders of the MPFL (Fig 2).

In patients with acute lesions, a locally structured hematoma at the capsuloligamentous avulsion site is common. The surgeon introduces an arthroscopic shaver through portals B and D to accurately remove this hematoma and identify the capsuloligamentous tear and patellar avulsion site of the MPFL (Fig 3).

Anchor Placement

The surgeon creates a portal between the medial border of the patella at its center and the torn MPFL (portal C) for anchor placement. Two anchors will be placed on the patella on the most proximal and distal parts of the MPFL footprint. The anchor drill guide is placed on the proximal-medial portion of the patella through portal C. After drilling of the pilot hole under direct visualization, a double-loaded all-suture anchor (Iconix 2.3-mm anchor with 2 strands of No. 2 Force Fiber; Stryker, Kalamazoo, MI) is implanted. A second anchor is placed through portal C on the distal-medial part of the patella (Fig 4). The surgeon will retrieve the sutures of the proximal anchor out of portal D and the sutures of the distal anchor out of portal B.

Suture Passage

The surgeon will pass the sutures of the proximal anchor through the proximal half and the sutures of the distal anchor through the distal half of the MPFL (Fig

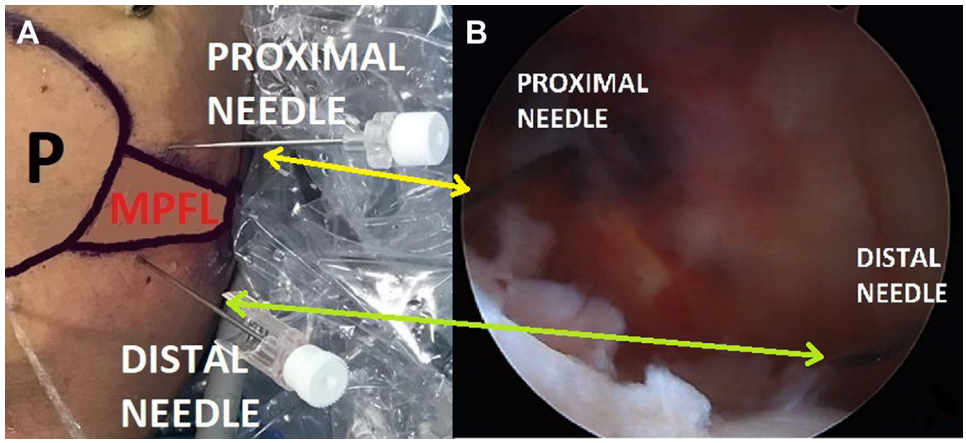

Fig 2. (A) Right knee. (B) Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. Placement of spinal needles on the proximal border (yellow arrow) and distal border (green arrow) of the medial patellofemoral ligament (MPFL) previously outlined on the skin (A) helps in understanding the course of the ligament from the intra-articular side (B). (P, patella.)

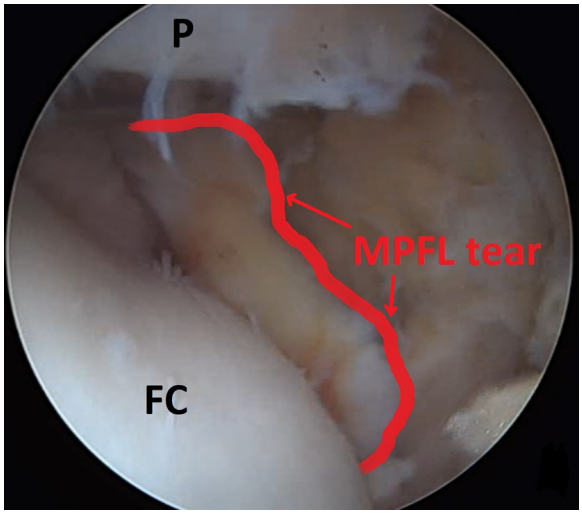

Fig 3. Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. After debridement with an arthroscopic shaver through portals B (medial portal) and D (superior-medial portal), the medial patellofemoral ligament (MPFL) tear (red arrows) is exposed. (FC, femoral condyle; P, patella.)

5). The passage of the anchor sutures through the torn and more medially situated MPFL tissue is performed with the aid of an 18-gauge spinal needle loaded with a No. 1 polydioxanone suture acting as a suture loop (Fig 6). The spinal needle with the suture loop is inserted percutaneously into the MPFL tissue between the borders outlined by the skin drawing and is visualized

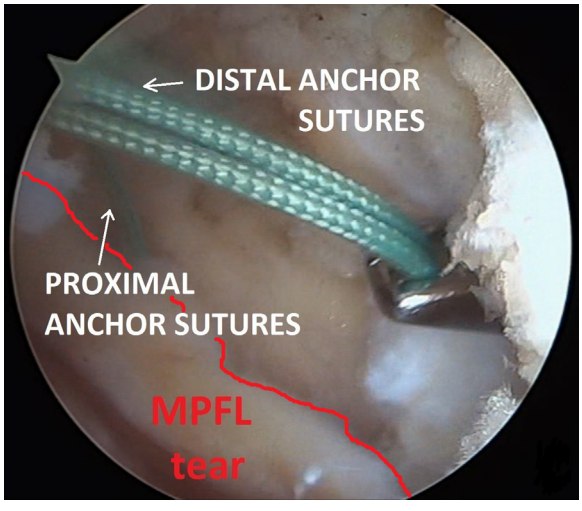

Fig 4. Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. After placement of 1 proximally and 1 distally placed Iconix 2.3-mm all-suture anchor implanted through portal C (central portal), the proximal anchor sutures are retrieved through portal D and the distal anchor sutures are retrieved through portal B (white arrows). (MPFL, medial patellofemoral ligament.)

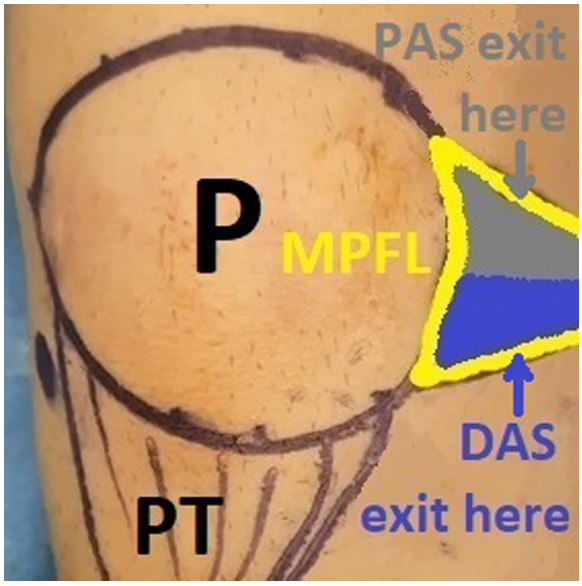

Fig 5. The goal of the surgical procedure is to shuttle the proximal anchor sutures (PAS) through the proximal half of the medial patellofemoral ligament (MPFL) (gray arrow) and the distal anchor sutures (DAS) through the distal half of the MPFL (blue arrow). A right knee is shown. (P, patella; PT, patellar tendon.)

intra-articularly. The green suture of the proximal anchor is retrieved through the loop with a suture retriever introduced through portal B (Fig 6). In the next step, the surgeon retrieves the spinal needle with the suture loop, shuttling the green suture through the MPFL tissue out of the skin. This step is repeated for the tiger suture of the proximal anchor and, finally, for both the remaining green and tiger sutures of the proximal anchor, which are retrieved simultaneously to speed up suture passage. All sutures of the proximal anchor should pass through the proximal half of the MPFL tissue.

Suture passage of the distal anchor starts by retrieving all sutures from portal B out of portal D. Suture passage through the MPFL tissue is performed as previously described, with the only difference being that distal anchor sutures are passed in the area of the distal half of the MPFL tissue (Fig 7).

Suture Retrieval and Knot Tying

To complete the repair by tying the knots of the anchor sutures passed through the MPFL tissue, the surgeon must retrieve the sutures from the space between the capsuloligamentous layer and the skin. A Pean forceps is introduced through portal C in the direction of the medial femoral condyle to bluntly divide the subcutaneous plane (Fig 8). The next step is the retrieval of all anchor sutures with the aid of a suture retriever introduced in the subcutaneous tissue through portal C and directed toward the sutures exiting the

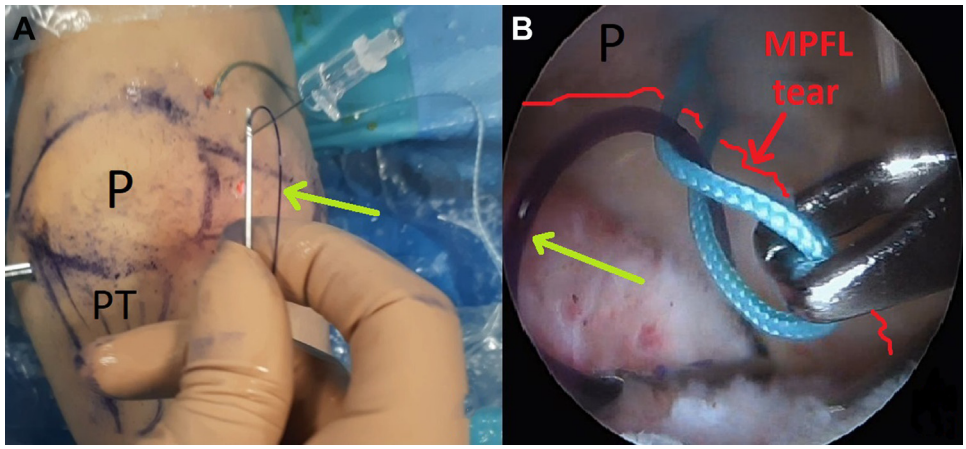

Fig 6. (A) Right knee. (B) Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. An 18-gauge spinal needle is loaded with a No. 1 polydioxanone suture acting as a loop (A) (yellow arrow) and introduced percutaneously piercing the medial patellofemoral ligament (MPFL) tissue at the desired location starting from the proximal half of the MPFL tissue (B) (yellow arrow). The green suture of the proximal anchor is retrieved through the loop, followed by retrieval of the spinal needle, thus shuttling the green suture through the MPFL tissue. (DAS, distal anchor sutures; FC, femoral condyle; P, patella; PAS, proximal anchor sutures; PT, patellar tendon; TT, tibial tubercle.)

skin. All anchor sutures are now passing through portal C, and the proximal and distal anchor sutures are divided (Fig 9). Knot tying is performed using standard arthroscopic sliding knots (Fig 10), beginning with the proximal anchor sutures first, followed by the distal anchor sutures, under direct arthroscopic visualization to control adequate tension of the repair (Fig 11).

Postoperative Care

A range-of-motion brace limited to 90° of flexion and the use of crutches are recommended for 4 weeks. Weight bearing as tolerated and quadriceps strengthening exercises are encouraged from the first day after surgery. Passive range of motion is started 1 week after surgery, with the target of reaching 90° of flexion at 3 weeks postoperatively. Active flexion and extension are encouraged after 3 weeks. Return to sports is permitted 3 to 4 months after surgery. Advantages and disadvantages of our technique are presented in Table 1, and pearls and pitfalls are listed in Table 2.

Discussion

Patellar dislocation is a common injury in the pediatric and adolescent population. The ideal treatment strategy, whether surgical or conservative, especially in the case of a first-time dislocation associated with an MPFL tear, is

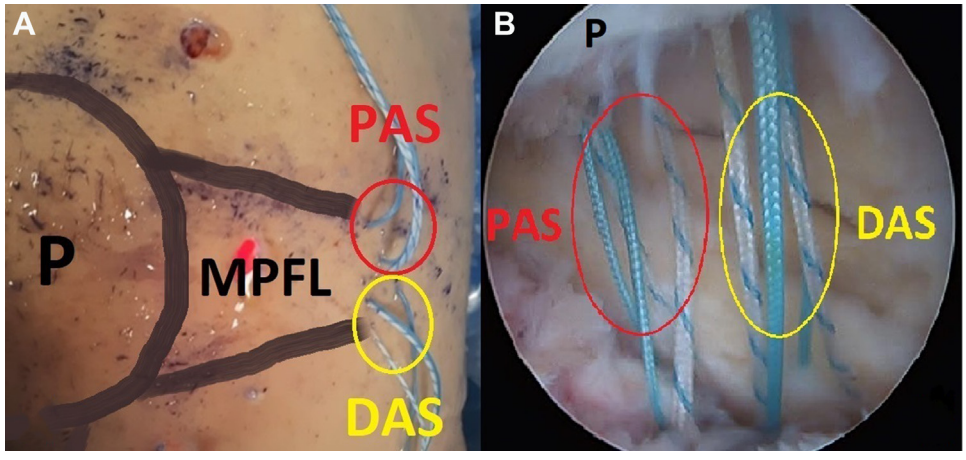

Fig 7. (A) Right knee. (B) Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. The proximal anchor sutures (PAS) (red ovals) and distal anchor sutures (DAS) (yellow ovals) have been shuttled through the medial patellofemoral ligament (MPFL) tissue. (P, patella.)

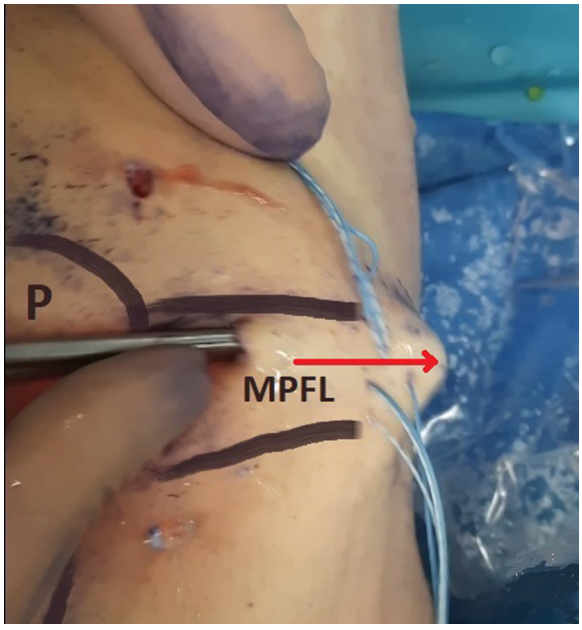

Fig 8. A Pean forceps is introduced through portal C (central-medial portal) and bluntly divides the subcutaneous plane, moving toward the direction of the medial femoral condyle (red arrow). A right knee is shown. (MPFL, medial patellofemoral ligament; P, patella.)

still a matter of debate.[4] Regarding the redislocation rate, it seems that MPFL reconstruction is the most effective procedure when compared with MPFL repair and

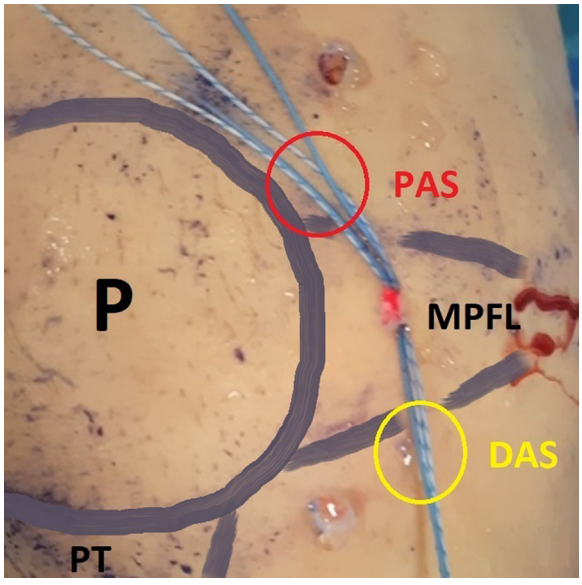

Fig 9. The anchor sutures have been retrieved through portal C (central-medial portal) using a suture retriever introduced in the subcutaneous plane. Subsequently, the proximal anchor sutures (PAS) (red oval) and distal anchor sutures (DAS) (yellow oval) are divided. A right knee is shown. (MPFL, medial patellofemoral ligament; P, patella; PT, patellar tendon.)

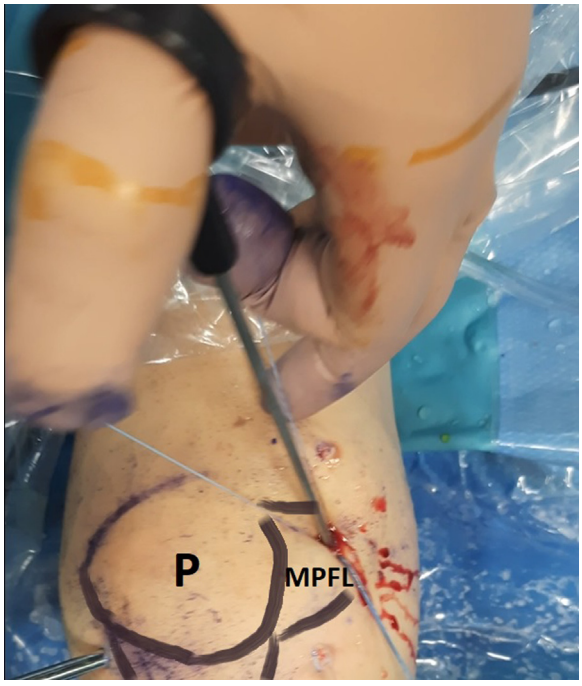

Fig 10. Anchor sutures are sequentially tied in a proximal-to-distal direction using standard arthroscopic sliding knots. A right knee is shown. (MPFL, medial patellofemoral ligament; P, patella.)

conservative treatment[5,6] while it bears the highest risk of clinically significant complications such as femoral tunnel widening or MPFL over-tightening[7,8] and thus may be considered an over-treatment after a first-time patellar dislocation. In such cases, MPFL repair may represent a valid alternative because it shows a lower redislocation rate when compared with conservative

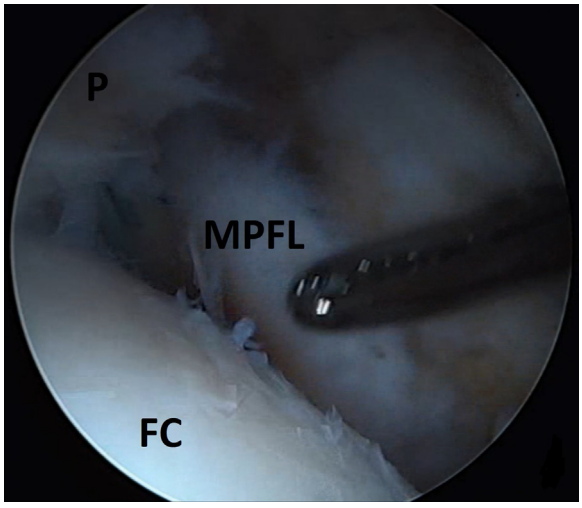

Fig 11. Intra-articular arthroscopic visualization of right knee from portal A (lateral portal) with knee kept in full extension. The medial patellofemoral ligament (MPFL) has been reinserted on the patella (P) and is probed for adequate tension. (FC, femoral condyle.)

Table 1. Advantages and Disadvantages of All-arthroscopic MPFL Repair

Advantages
Quick procedure
Surgical procedure performed through 4 arthroscopic portals with reduced morbidity compared with open procedures
Anatomic repair of MPFL
Allows for adequate control of tension of repair
No special equipment needed
Disadvantages
Cost of implants (suture anchors)
Advanced arthroscopic skills required (especially regarding suture management)

MPFL, medial patellofemoral ligament.

Table 2. Pearls and Pitfalls of All-arthroscopic MPFL Repair

Pearls
Meticulous outlining of anatomic structures (patella and MPFL) with a skin marker is essential for adequate placement of spinal needles to help distinguish the proximal and distal MPFL borders while viewing intra-articularly.
To distinguish the sutures of the proximal and distal anchors before knot tying, it is helpful to color the extremities of the sutures of one anchor with a skin marker before suture passage.
To correctly place the arthroscopic knots, the surgeon should always direct the tip of the knot pusher toward the medial femoral condyle.
Pitfalls
Clear exposure of bone prior to anchor hole drilling and anchor insertion on the patella is crucial to avoid incomplete insertion of the all-suture anchor resulting in potential anchor pullout.
The surgeon should avoid forceful tapping during all-suture anchor implantation as the drill guide may penetrate and weaken the patellar cortex and thus compromise the pullout strength of the anchor.
Failure to perform the sequence of suture passages through the MPFL tissue systematically, starting from proximal to distal, may lead to suture entanglement and, consequently, limit correct sliding of the knots.

MPFL, medial patellofemoral ligament.

treatment and the rate of procedure-related complications is low.[5,9]

The technique described in this technical note may be a helpful option after a first-time dislocation of the patella with femoral avulsion of the MPFL, especially in the young patient. In terms of advantages, a minimally invasive arthroscopic technique with modern small-diameter all-suture anchors helps preserve the patella's bone stock and minimize potential complications after MPFL repair while permitting future revisions in case of failure without significant limitations.

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