Technical Note

Circumferential and Segmental Arthroscopic Labral Reconstruction of the Hip Utilizing the Knotless Pull-Through Technique with All-Suture Anchors

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Abstract: Appropriate labral tear management is one of the principal priorities of hip-preservation surgery. The labrum's role in the stability and biomechanics of the hip and preservation of the suction seal has been thoroughly demonstrated. Favorable patient-reported outcomes with labral reconstruction and, more recently, labral augmentation have shown that these are viable reconstructive procedures in the setting of irreparable labra. A wide variety of grafts have been used for these advanced labral restoration techniques. The present Technical Note will describe a detailed arthroscopic circumferential labral reconstruction using the pull-through technique with knotless all-suture anchors. The benefits of such can be applied to both segmental and circumferential labral reconstruction procedures, as well as labral augmentation, based on the intraoperative findings and preference of the surgeon.

The importance of the acetabular labrum in maintaining the suction seal effect in the hip joint has been thoroughly studied.[1,2] Restoration of labral function has been shown to lead to significantly improved outcomes and decreased likelihood of conversion to total hip arthroplasty.[3-5] To address irreparable or nonviable labral tears in the context of femoroacetabular impingement syndrome, labral reconstruction has been shown to

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Table 1. Advantages of Arthroscopic Labral Reconstruction Using the Knotless All-Suture Anchor Pull-Through Technique

- Measurement of labral defect/graft is unnecessary
- Eliminates length mismatch
- Decreased surgical time
- Small anchor size allows placement closer to subchondral bone (more anatomical reconstruction)

provide superior outcomes compared with selective labral debridement.[6,7]

The present Technical Note presents an innovative technique using a low-profile Knotless 1.8 FiberTak all-suture anchor (Arthrex, Naples, FL). Some of the benefits of using the Knotless FiberTak all-suture anchors include that the anchor can be placed closer to the inferior border of the acetabular rim, with a lower risk of acetabular cartilage penetration; this placement allows for an anatomical labral reconstruction and the restoration of the suction seal; and also, its design allows for acetabular bone preservation. The use of the pull-through maneuver allows for reconstruction regardless of the size of the labral defect or the available graft, thereby avoiding potential graft length mismatch.[8] The advantages of using this method are presented in Table 1. Furthermore, this technique advocates for the use of a fresh-frozen posterior tibialis allograft, the benefits of which are described in Table 2.

Finally, this versatile technique proves to be beneficial when used in any labral restoration setting, from required segmental or circumferential labral reconstruction procedures, and also may be used for labral augmentation.

Surgical Technique (With Video Illustration)

This study was performed in accordance with the ethical standards in the 1964 Declaration of Helsinki. This study was carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA). Details that might disclose the identity of the subjects under study have been omitted. This study was approved by the institutional research board (ID: 5276).

Patient Preparation and Positioning

Under general anesthesia, the patient is placed in the supine position on a post-less traction table (Fig 1A). The feet are protected with extra padding, and the patient is adequately positioned and secured. The operative leg is positioned in neutral rotation and adduction, while the contralateral leg is placed at 30° of abduction. The operative table is then fixed at 10 to 15° of Trendelenburg inclination.

Portal Placement

The anterolateral portal is created using fluoroscopic guidance as previously described at the 12-o'clock position.[9] The remaining 3 portals, mid-anterior, distal anterolateral accessory, and posterolateral, are created under direct visualization.[8] Routine portal placement is shown in Figure 1B.

Diagnostic Arthroscopy

Systematic assessment of the hip joint is performed (Fig 2). The extent and severity of labral pathology are assessed, and the appropriate labral restoration procedure is determined. The senior author's decision-making algorithm for labral restoration is presented in Fig 3.

Chondrolabral Preparation

The chondrolabral junction is critical for the decision-making process of the surgeon. If the arthroscopic assessment demonstrates a macroscopically irreparable labrum, the next step is to assess the condition of the chondrolabral junction. If compromised, the surgeon would likely decide on a segmental reconstruction; if not, an augmentation may be performed. Lastly, if a complete defect of the labrum with compromise of the chondrolabral junction is evidenced, a circumferential reconstruction is the procedure of choice. In the setting of labral reconstruction, preparation of the chondrolabral junction includes decortication and complete labral tissue debridement. A shaver, radiofrequency device, and 5.5-mm burr are used for this purpose. Preparation of the graft bed in the setting of labral reconstruction and is shown in Video 1.

Graft Preparation

A 6- to 7-mm tibialis posterior allograft is prepared in a single-stranded fashion. Three to four Krackow stitches are placed at both ends of the graft with 2.0 FiberLoop sutures (Arthrex). One end of the graft will serve as the furthest anterior point of fixation, whereas the other end remains free to control graft tension and placement (Fig 4).

Anchor Placement

After rim preparation, Knotless 1.8 FiberTak all-suture anchor (Arthrex) placement is performed from an anterior to posterior direction for the desired length of labral restoration. All anchors are typically placed through the distal anterolateral accessory portal (Fig 5) and secured to the sterile drape in an organized manner to simplify identification and usage.

Pull-Through Technique

The graft pull-through technique has been previously described.[10] When performing a labral reconstruction,

Table 2. Benefits of Arthroscopic Labral Reconstruction With Tibialis Posterior Tendon Allograft

- Reduces donor-site morbidity
- Length allows it to be used for any labral restoration procedure
- Cylindrical shape eliminates the need for tubularization, making preparation quick, efficient, and reproducible

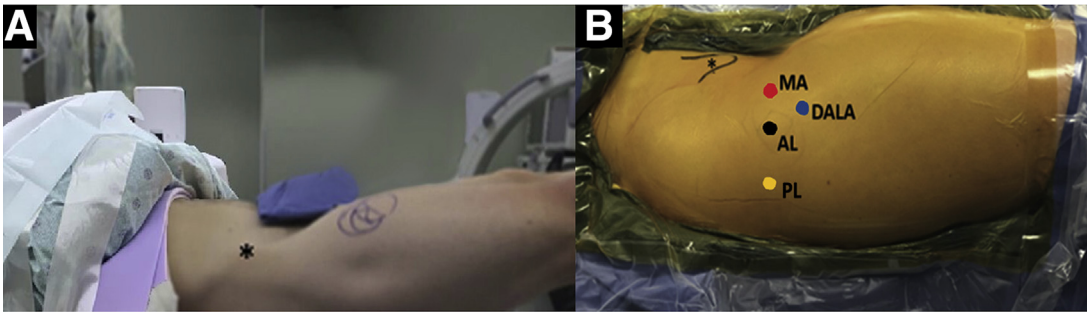

Fig 1. (A) The patient is placed in the modified supine position, and the anterior inferior iliac spine is marked (*). (B) The right hip is shown, with patient's head to the left and feet to the right. The 4 portals used are identified: anterolateral (AL), mid-anterior (MA), distal anterolateral accessory (DALA), and posterolateral (PL). Anterior inferior iliac spine (*) is also identified.

and after all Knotless 1.8 FiberTak all-suture anchors are placed and secured, a needle is threaded with the "repair" limb suture of the furthest anterior Knotless FiberTak anchor. The suture is passed just proximal to the most distal Krackow suture within the graft, providing a ripstop configuration. The posterior end of the graft is then pulled through the hip joint from the mid-anterior (MA) portal to posterolateral portal (Fig 6). This maneuver can be seen in Video 1.

Graft Fixation

Graft fixation is performed from anterior to posterior, following the order in which the all-suture anchors were placed. Visualization is obtained through the anterolateral portal, while the graft end is introduced through the MA portal and inserted in the anterior position. Tension is applied through the FiberLoop suture until the graft is inserted into the hip joint and brought adjacent to the anchor.

The front end of the graft is brought into position with slight tension applied to the "repair" suture of the most anterior anchor, which was previously passed through the graft, aided by a push with knot "pusher" through the MA portal. Once in position, the loop end of "shuttle" suture is retrieved from the MA portal and assembled with the "repair" suture. The surgeon then pulls the contralateral limb of the "shuttle" suture until desired tension is achieved to the "repair" suture, securing the graft to first anchor. Next, moving in a sequential fashion from anterior to posterior, the repair limb of each knotless suture is passed around opposite end of graft from the looped end of the "shuttle" stitch. The contralateral end of shuttle suture is again tensioned until graft is fixated to acetabular rim. The

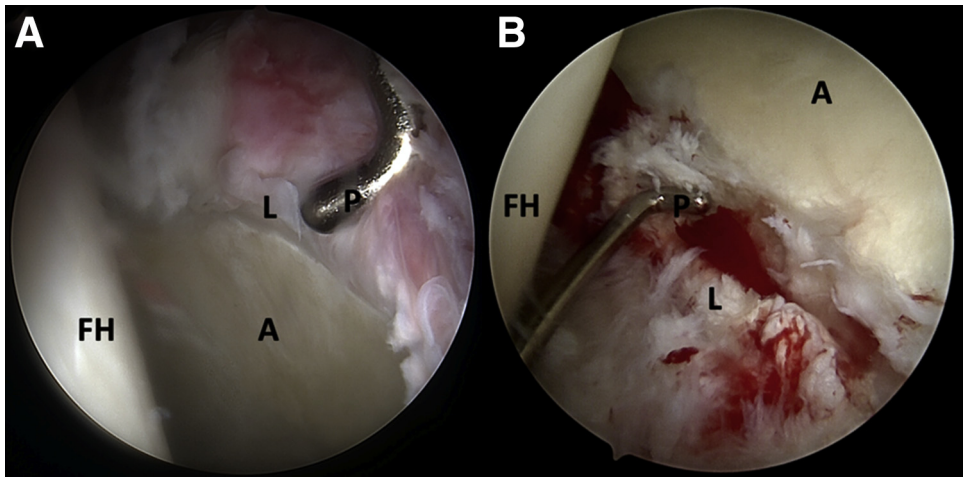

Fig 2. Intraoperative images during diagnostic arthroscopy and labral assessment depicting settings that indicate labral reconstruction (A-B). The patient is placed in the modified supine position. The labrum (L) is visualized with a 70° arthroscope from the anterolateral portal. Probe (P) is coming from the mid-anterior portal, and the femoral head (FH) and acetabulum (A) are identified. (A) Labral tear evidenced in a left hip with a complex circumferential labral defect and nonviable tissue. In this setting, labral reconstruction is indicated. (B) Posterior view of circumferential intrasubstance labral tear in a left hip, indicating labral reconstruction.

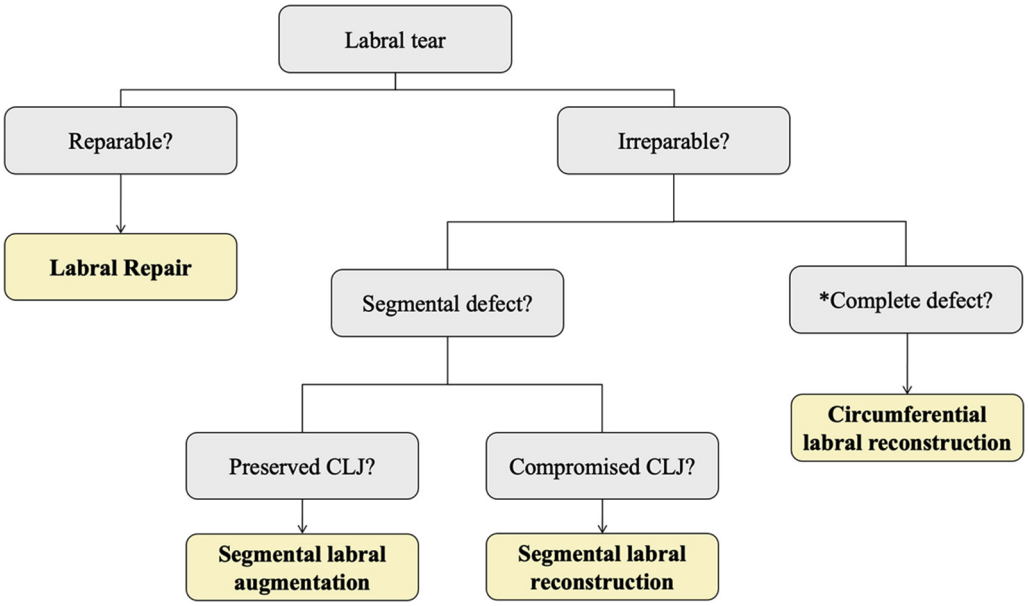

Fig 3. Flowchart depicting the decision-making algorithm for the arthroscopic management of labral tears. *Circumferential intrasubstance tearing, and/or calcification, and/or prior circumferential debridement. (CLJ, chondrolabral junction.)

same steps are repeated for all remaining anchors. Finally, the excess graft is amputated using a radiofrequency device (Fig 7 and Video 1).

Postoperative Protocol

The patient is placed in a hip brace (DonJoy X-Act ROM Hip Brace; DJO Global, Carlsbad, CA) to limit movement. In addition, weight-bearing restrictions (up to 20 pounds) are set, with the patient instructed to use crutches for a period of 6 weeks. The surgical wound is assessed weekly and suture removal is performed after 2 weeks. Dedicated physical therapy begins within 2 days following surgery, including passive motion and stationary bicycle exercises. At the 6-week mark, therapy protocol is begun to obtain the full range of motion, weight-bearing, strength, and stability. A biomechanical motion analysis is performed at 6 months and a 9-week home training program is tailored to the patient's needs, to complete the process of rehabilitation and allow return to athletic activity.

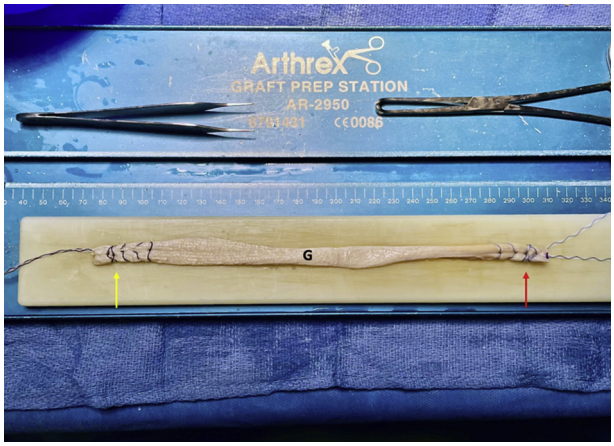

Fig 4. Preparation of an assembled posterior tibialis tendon allograft (G) is shown. The yellow and red arrows identify the free FiberLoop (Arthrex, Naples, FL) limbs after preparation with Krackow stitches.

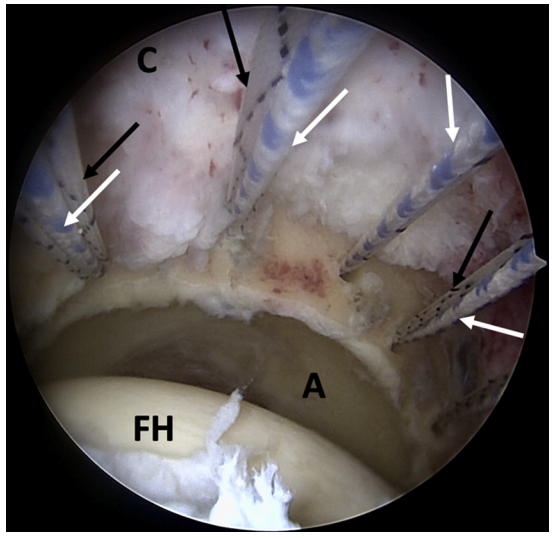

Fig 5. Intraoperative image during labral reconstruction visualized with a 70° arthroscope from the anterolateral portal. The patient is placed in the modified supine position, and the left hip is visualized after chondrolabral preparation and anchor placement. Knotless FiberTak anchors have been placed using the distal anterolateral accessory portal. Both the "repair" (white arrow) and "shuttle" limb (black arrows) sutures are visible from multiple anchors placed. (A, acetabulum; C, capsule; FH, femoral head.)

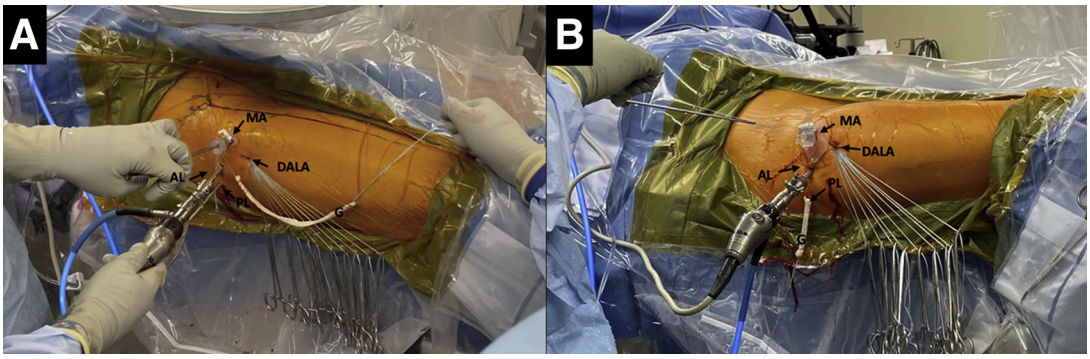

Fig 6. The right hip is shown in the modified supine position, patient's head is to the left, and feet to the right. Portals are identified by black arrows: anterolateral (AL), mid-anterior (MA), distal anterolateral accessory (DALA), and posterolateral (PL). After all Knotless FiberTak anchors are placed, the posterior tibialis allograft (G) must be introduced and pulled through the MA portal (A) and out the PL portal (B). In this image, sutures from the Knotless FiberTak anchors are seen attached to the external drape, inferior to superior.

Discussion

The all-suture knotless pull-through is developed to obtain a more reproducible technique with consistent outcomes after primary and revision arthroscopic procedures to restore labral anatomy and function.[11,12] The versatility of this technique allows for its use in circumferential and segmental labral defect reconstructions (Fig 8), in multiple scenarios: in the setting of irreparable tears with partial or completely preserved native circumferential fibers, a hypoplastic

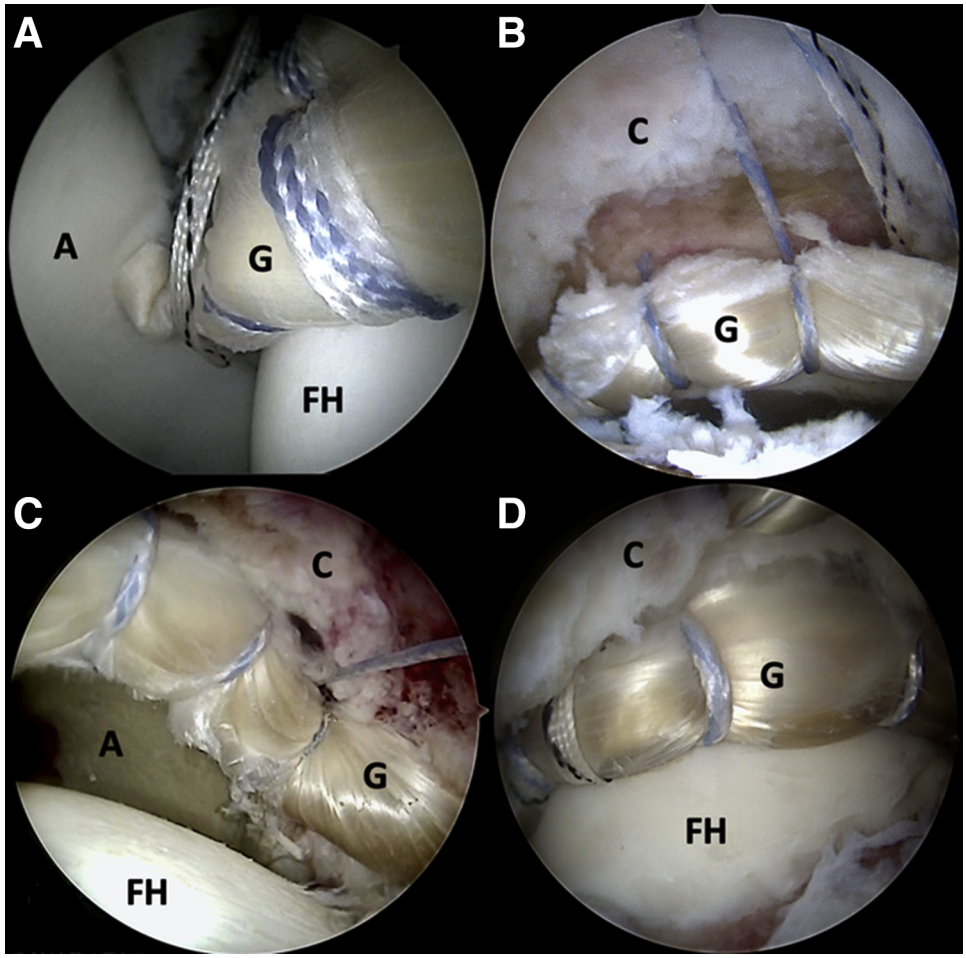

Fig 7. Intraoperative images of labral reconstruction using posterior tibialis tendon allograft and the pull-through technique visualized with a 70° arthroscope from the anterolateral portal in the right hip, with the patient placed in the modified supine position under traction. (A) The graft (G) is positioned anteriorly to be secured to the first anchor, and the loop end of "shuttle" and the free end of the "repair" sutures are assembled. Tension is given to the "repair" suture, securing the graft to the first anchor. (B-C) This is repeated from anterior to posterior, securing the graft to each anchor. The acetabulum (A) and femoral head (FH) are identified. (D) The remaining excess of the graft (G) is amputated with a radiofrequency device. Traction is released to restore the suction seal. (C, capsule.)

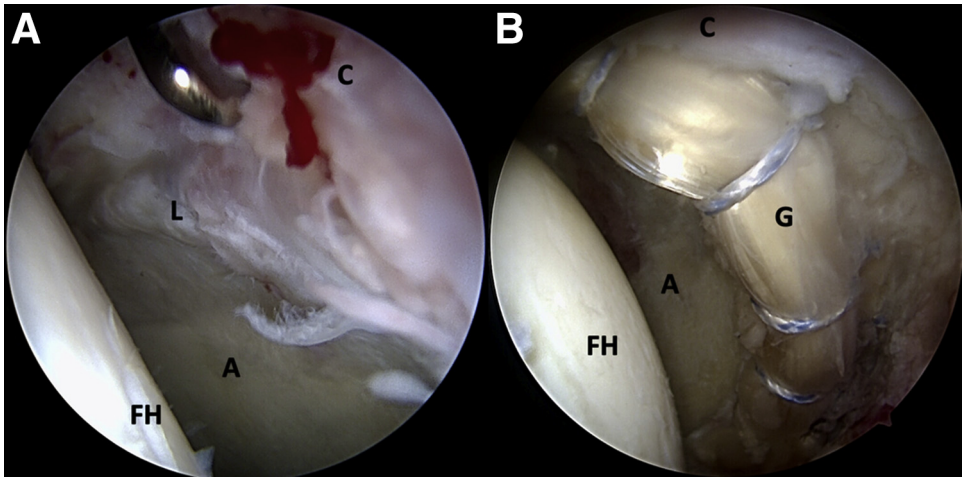

Fig 8. The patient is placed in the modified supine position. (A) Before and (B) after intraoperative images are shown of the labral reconstruction using posterior tibialis tendon allograft and the pull-through technique, visualized with a 70° arthroscope from the anterolateral portal in a left hip. (A, acetabulum; C, capsule; FH, femoral head; G, posterior tibialis allograft; L, irreparable labral tear with circumferential intrasubstance defect.)

labrum, a completely calcified labrum, other labral lesions that result in a complete or partial labral defect, and in revision procedures. This procedure also may be used when performing a labral augmentation. The knotless all-suture anchors technology provides the surgeon with a reproducible and efficient procedure that reduces operative time and the potential for related complications.

Previous studies have demonstrated that labral reconstruction leads to superior outcomes over labral debridement in the setting of femoroacetabular impingement syndrome and irreparable labral tears.[6,13] This has led to the development of different anatomic grafts to reconstruct the labral seal. While there has not been a graft choice proven to be superior with regard to outcomes, the tibialis posterior allograft tendon has, in the authors' experience, been technically beneficial in its shape and size (Table 2); because of its shape, it does not need to be tubularized during its preparation, and its length allows for its use in every scenario of labral reconstruction, whether complete or partial.

Limitations of this technique include the need for an experienced surgeon/surgical team, the lack of which may lead to difficulty in obtaining a reproducible technique. The size of the reconstruction may require a large number of sutures and anchors, the order of which may be lost if not carefully organized. Also, this technique may be limited by the availability of grafts needed to perform the procedure. Lastly, if the graft is not properly tensed during the fixation, it can result in a bulky reconstructed labrum, with loss of the labral seal. Risks and pitfalls of this procedure are standard in performing hip arthroscopy and include abdominal extravasation, abdominal compartmental syndrome, tight compartmental syndrome, and increased risk of neurologic damage (Table 3).

Hip labral reconstruction surgery has been described in the past and has had great short-, mid-term, and long-term success.[7,12,14,15] Continued innovation in the field has helped to develop this once highly-demanding surgery into a reproducible and more consistent technique. In addition, this technique may be applied in the future for labral augmentation, broadening the scope of its benefits.

Table 3. Pitfalls and Risks of Arthroscopic Labral Reconstruction Using the Knotless All-Suture Anchor Pull-Through Technique

Pitfalls	Risks
• Minimal experience in advanced arthroscopy techniques may result in a non-reproducible procedure • Losing track of the order of sutures and anchors • Forgetting to apply gentle tension in the graft during the fixation can result in bulky reconstruction and loss of "suction seal"	• Abdominal extravasation • Abdominal compartmental syndrome • Tight compartmental syndrome • Increased risk of neurologic lesion

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