Technical Note

Technical Pearls for Arthroscopic Labral Augmentation of the Hip

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Abstract: Our recent understanding of the importance of the acetabular labral suction seal has placed preserving labral integrity as a guiding principle in hip preservation surgery. In cases with a hypoplastic labrum and intact chondrolabral junction, labral augmentation presents as a viable alternative and an often preferred treatment option over labral reconstruction. At this time, there are few studies that have described the technical pearls of performing labral augmentation of the hip. In this technique guide, we describe, in detail, the kite technique for the introduction, control, and acetabular fixation of a hip labral augmentation graft. Comparable to flying a kite with 2 fly lines and to the previously described kite technique for hip labral reconstruction, the kite technique for labral augmentation is based on the principle that the use of 2 control sutures in a pulley system creates an efficient method to accurately and reproducibly facilitate graft passage and fixation during arthroscopic labral augmentation procedures.

Our recent understanding of the importance of the acetabular labral suction seal has placed preserving labral integrity as a guiding principle in hip preservation surgery.[1-4] Clinical studies have shown a faster progression of hip arthritis in patients who have previously undergone partial labral resection.[5] In patients with deficient labral tissue—commonly the result of chronic impingement causing ossification, a degenerative or hypoplastic native labrum, iatrogenic causes, or revision cases—labral augmentation and reconstruction have emerged as viable alternative solutions to labral repair for symptoms of microinstability, pain, and discomfort in both primary and revision settings.[6-8]

Since its introduction by Philippon et al.,[8] arthroscopic labral reconstruction has proved to be an essential tool for preserving native hip function and integrity. Although this procedure was originally described using fascia lata autograft, several techniques for segmental and circumferential reconstruction have been described, with a multitude of allografts and autografts, with good to excellent outcomes.[9-15] In contrast, cadaveric biomechanical studies have shown improved restoration of the hip joint fluid suction seal with labral preservation versus labral reconstruction.[16]

In cases with a hypoplastic labrum and intact chondrolabral junction, labral augmentation presents as a viable alternative and an often preferred treatment option over labral reconstruction.[7] Labral augmentation involves placement and fixation of either autograft or allograft tissue proximal and adjacent to the native labrum, essentially creating a larger, thicker labrum allowing for a more robust suction seal. The advantages of labral augmentation over reconstruction include (1) maintenance of the chondrolabral junction, decreasing

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Fig 1. Patient positioning. The patient is placed supine on a post-free distraction table, and the operative leg (left leg in photograph) is put into traction in a neutral position. The perineum and all bony prominences are appropriately padded.

the risk of damage to the acetabular cartilage; (2) maintenance of the native proprioceptive fibers of the native labrum; and (3) avoidance of disruption of labral hoop stresses if a segment of the labrum is excised in a reconstruction.

Despite the growing interest in labral augmentation, many of the technical considerations of this procedure have yet to be elucidated in the literature. Previously, the "kite technique" was developed for the introduction, control, and efficient fixation of a segmental labral reconstruction graft.[15,17] Similarly to flying a kite with 2 fly lines, the principles of this method are founded on the belief that a soft-tissue graft in an arthroscopic environment is safe, efficient, and easy to guide into position with 2 control sutures using a pulley system. This technique may be reproduced with labral augmentation procedures with some important differences, as we introduce the kite technique for arthroscopic fixation of a labral augmentation graft.

Indications

The indications for labral augmentation include (1) a hypoplastic labrum (<3 mm wide) with symptoms of instability and a poor native suction seal; (2) an intact chondrolabral junction; and (3) a young, active patient. Augmentation procedures are typically reserved for revision procedures but may be indicated in rare primary cases if an adequate seal is unable to be achieved with a primary repair using labral advancement techniques.

Surgical Technique

Patient Positioning and Anesthesia

After general anesthesia is induced, the patient is positioned supine on a post-free distraction table (Pivot Guardian Distraction System; Stryker, Kalamazoo, MI) with all bony prominences appropriately padded. The operative leg is placed in a neutral position (Fig 1). Post-free distraction affords the benefit of excellent distraction by using Trendelenburg positioning of the bed while negating the risk of iatrogenic pudendal nerve palsy or perineal soft-tissue compression.

Diagnostic Arthroscopy

The operative leg is placed under traction, and fluoroscopy is used to guide entry into the hip joint via the anterolateral portal (ALP). Four standard arthroscopic portals are used: the ALP, a midanterior portal (MAP), a proximal midanterior portal (PMAP) located 3 cm proximal to the MAP to allow for suture storage, and a distal anterolateral accessory (DALA) portal created 3 to 4 cm distal and 1 to 2 cm anterior to the ALP (Fig 2). An interportal capsulotomy is performed between the MAP and ALP, with care to preserve at least 1 cm of acetabular capsular remnant tissue for closure or plication at the conclusion of the case.

The surgeon performs a standard diagnostic arthroscopy, noting the size and quality of the native labrum and labral tear, status of the articular cartilage, and presence or absence of an adequate suction seal. If the labrum is of adequate quality, a labral repair is performed using previously described techniques.[4] However, if the labral tissue is inadequate for repair but amenable for augmentation based on our specified indications described earlier, a decision for augmentation is made.

Acetabuloplasty

The interval between the proximal capsule and labrum is first developed using a mechanical shaver and radiofrequency probe. We prefer to perform this step

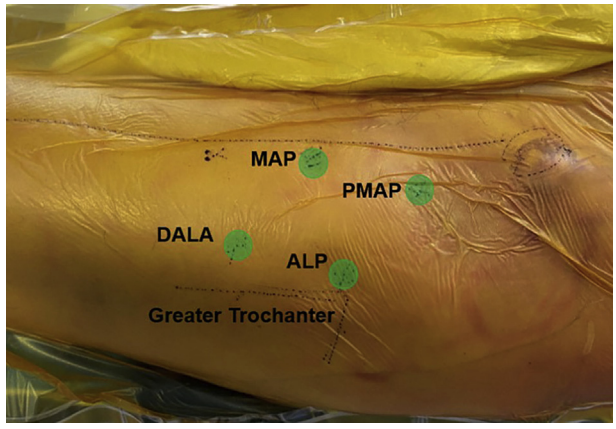

Fig 2. Intraoperative photograph of a left hip, in the supine position, showing the location of the portals and their relation to the greater trochanter. (ALP, anterolateral portal; DALA, distal anterolateral accessory portal; MAP, midanterior portal; PMAP, proximal midanterior portal.)

with the patient's hip flexed to 25°, off traction, with suspension sutures placed within the proximal capsular leaflet to better preserve this tissue for later repair. A standard acetabuloplasty is performed to reshape the acetabular rim and eliminate the pincer lesion as necessary, thereby providing a bleeding environment amenable for graft incorporation.

Femoroplasty

A femoral osteochondroplasty is performed to correct the head-neck offset and eliminate cam impingement. During this step, 2 traction sutures are placed in the distal leaflet of the capsule to ensure adequate visualization of the anterior, superior, and distal femoral head-neck junction.

Labral Augmentation

The hip is placed into traction to allow for access to the central compartment. As previously noted, when we elect to perform an augmentation, the labrum is typically hypoplastic (2 to 4 mm) with a poor native suction seal and intact chondrolabral junction. Therefore, as opposed to a labral reconstruction in which the damaged labrum is completely excised, care is taken in this case to avoid damage to the native labral tissue. The region of labral hypoplasia is often segmental and rarely involves the entirety of the labrum, and therefore, a segmental augmentation is performed using the kite technique.

The area of hypoplasia requiring augmentation is evaluated and spanned with suture anchors. Multiple anchors (1.4-mm NanoTack anchors; Stryker) are sequentially placed around the acetabular rim using a curved guide via the DALA portal without breaching the joint (Fig 3), just proximal to the labrum. The anchors are spaced approximately 8 mm apart along the rim, spanning the segment of labral hypoplasia. In most cases, the drill guide should push directly against the capsular side of the native labrum during anchor placement to ensure proper graft placement and restoration of a robust suction seal. In some cases in which the native labrum requires advancement to achieve a suction seal, the anchors are placed via an intra-articular, inside-out approach, with the drill guide placed at the chondrolabral junction within the joint on the articular side of the native labrum.

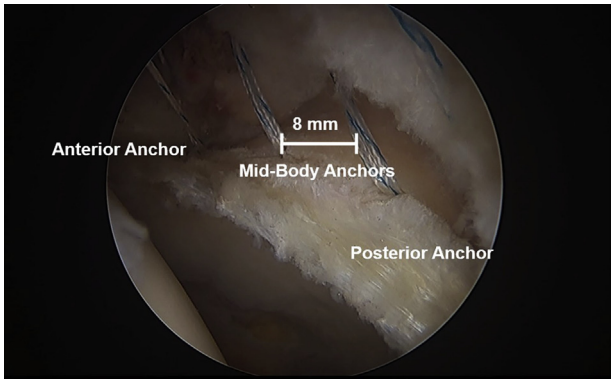

Fig 3. Intraoperative photograph showing the placement of the anterior, midbody, and posterior anchors along the acetabular rim in a left hip, in the supine position, with the arthroscope in the anterolateral portal. The anchors are sequentially placed approximately 8 mm apart along the acetabular rim, just proximal to the hypoplastic labrum.

Suture Management

The anterior-segment anchor suture limbs are retrieved from the MAP and stored. The midbody sutures are retrieved from the proximal midanterior portal (PMAP) for suture storage until final graft fixation later in the case. The posterior-segment anchor suture limbs are retrieved from the ALP (adjacent to the arthroscope). This facilitates measurement, graft passage, and graft fixation while minimizing the risk of suture entanglement (Fig 4).

Measurement Technique

Similarly to a labral reconstruction, we prefer to use the previously described kite measurement technique[17] to measure graft length in augmentation procedures. This technique allows for easy measurement of a segmental defect using 2 tied sutures, 1 from each end anchor, via a pulley system, to create a suture "bridge," allowing for an accurate and reproducible measurement for graft preparation (Fig 5).[17] The steps for the kite measurement technique are shown in Video 1.

Graft Preparation

We prefer a tibialis anterior allograft (AlloSource, Centennial, CO) for labral augmentations, but various autograft and allograft tissues have been described as acceptable alternatives.[7,18,19] After thawing and measurement to the appropriate length, as noted earlier, the graft is tubularized to 4 to 5 mm in diameter and whipstitched with several No. 2-0 Vicryl sutures (Ethicon, Somerville, NJ), as previously described (Fig 6).[20]

Graft Insertion

The graft is inserted and fixed using similar principles to the kite technique for labral reconstruction, as previously described.[15] A second cannula is inserted into the MAP to aid with suture passage and knot tying. One suture limb from the anterior anchor and one from the posterior anchor are retrieved from the DALA cannula. The graft is positioned outside the DALA cannula. With a free needle, the anterior anchor suture strand out of the DALA portal is pierced through one end of the graft, and multiple half-hitches are thrown to create a knot to itself at the end of the suture, leaving a tail of approximately 1 cm. The same procedure is performed for the posterior anchor suture, as it is pierced through the

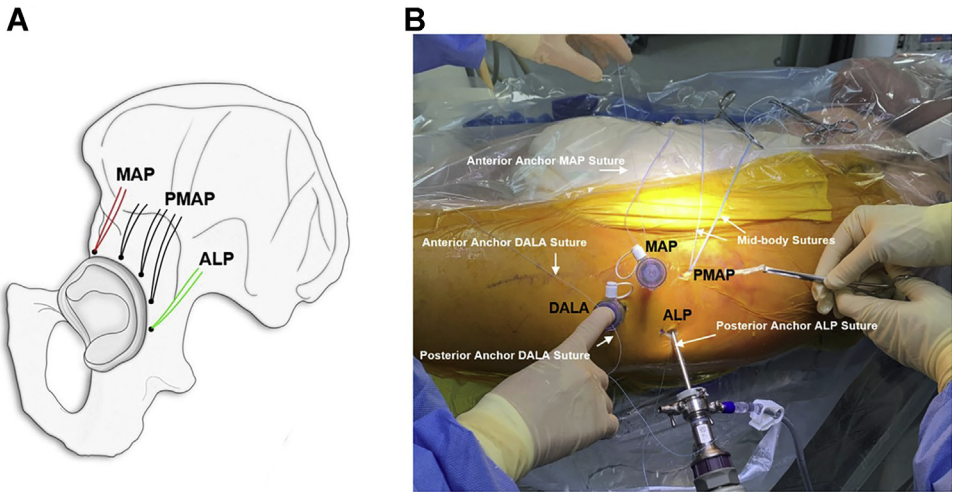

Fig 4. Illustrated diagram (A) and intraoperative photograph (B) showing intraoperative suture organization in a left hip in the supine position. The anchor sutures are organized with the anterior anchor sutures (red) stored in the midanterior portal (MAP), midbody sutures (black) within the proximal midanterior portal (PMAP), and posterior anchor sutures (green) within the anterolateral portal (ALP), adjacent to the arthroscope. One suture strand from the anterior and posterior anchors is then retrieved via the distal anterolateral accessory portal (DALA) cannula for the kite measurement technique.

opposite end of the graft with a free needle and tied to itself (Fig 7).

At this time, the graft is inserted into the joint using the kite technique. The 2 corresponding suture strands from the anterior and posterior anchors, 1 out of the MAP and 1 out of the ALP, are alternatingly tensioned, similarly to fly lines on a kite, and the knots on the ends of the anterior and posterior sutures effectively pull each end of the graft into position along the rim. An arthroscopic grasper and probe may be used to aid in positioning the graft, but typically, this is not necessary. Once the graft is provisionally placed along the rim proximal to the native labrum, the anterior anchor sutures are retrieved. The sutures that are pierced through the graft are now termed the post sutures. The non-post, free suture is then looped around both the native labrum and graft by piercing through the chondrolabral junction, similarly to a labral repair, and tied using standard knot-tying techniques, securing the

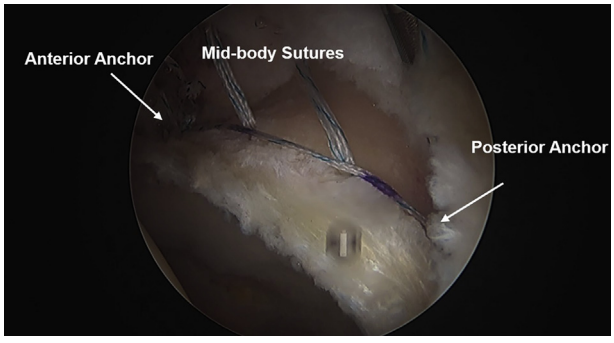

Fig 5. Intraoperative photograph showing the suture bridge formed between the anterior and posterior suture anchors during the kite measurement technique viewed through the anterolateral portal in a left hip in the supine position. The hash marks in 5-mm increments placed along the posterior strand are counted for accurate and reproducible measurement for graft preparation.

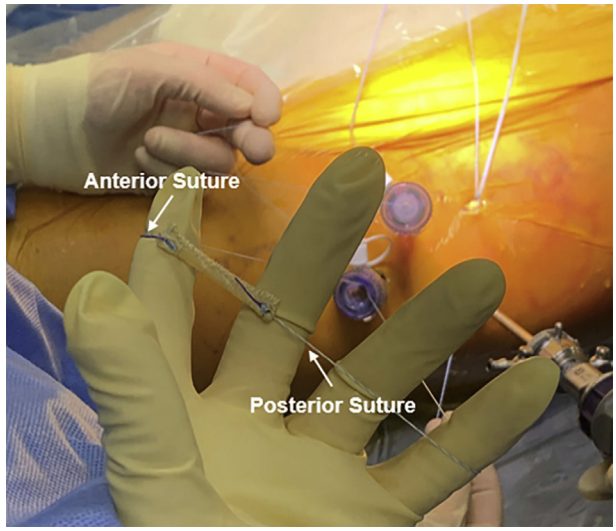

Fig 6. Intraoperative image showing the prepared tibialis anterior allograft. After thawing and measurement to the appropriate length, as noted from the kite measurement technique, the tibialis anterior allograft is tubularized to 4 to 5 mm in diameter and whipstitched with several No. 2-0 Vicryl sutures. A free needle is used to pierce 1 suture strand from both the anterior and posterior suture anchors into their respective ends of the graft. Multiple half-hitches are thrown to create a knot onto each respective suture strand, leaving a tail of approximately 1 cm. The tails of each suture strand are colored to allow for easy identification once the graft is placed into the joint.

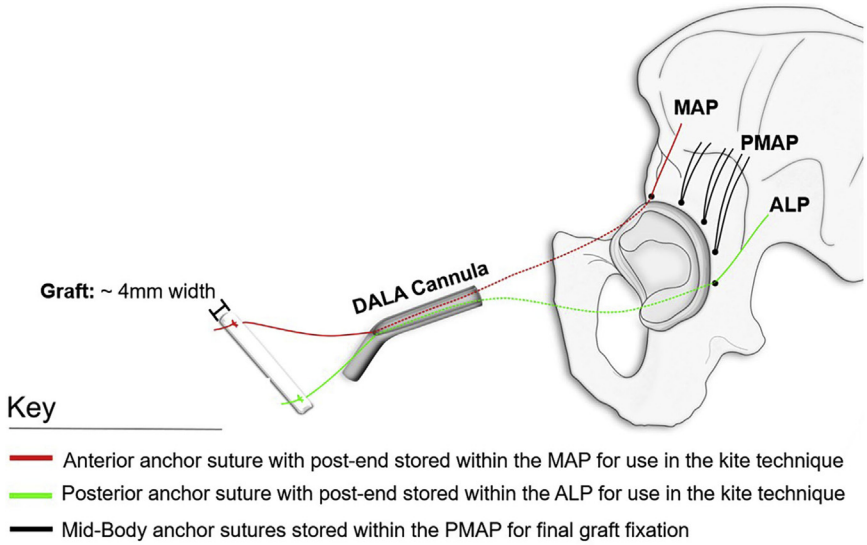

Fig 7. Illustrated diagram depicting the kite technique for labral augmentation graft passage in a left hip in the supine position. The red and green sutures represent the sutures from the anterior and posterior anchors, respectively. These sutures are tied onto themselves with multiple half-hitches on their respective ends of the graft. The post ends of these sutures, with the anterior ones stored in the midanterior portal (MAP) and the posterior ones stored in the anterolateral portal (ALP), are alternatingly tensioned during the kite technique for graft passage to effectively pull each end of the graft through the distal anterolateral accessory portal (DALA) cannula into position along the rim. The black sutures represent the midbody anchor sutures, which are stored within the proximal midanterior portal (PMAP) for final graft fixation.

anterior end of the graft. The posterior end is secured in similar fashion via the DALA portal. This is a key difference from labral reconstruction procedures because augmentation requires an additional step of passing the suture under the labrum and/or graft prior to tying, with a vertical mattress configuration through the graft and labrum together and the knot aligned against the graft. Once the ends of the graft are secured to both bone and the native labrum, the midbody sutures are retrieved sequentially, looped around both the labrum and graft, and tied using a standard technique to secure the augmented labral graft into place (Fig 8).

After fixation of the graft, traction is released, and a dynamic examination is performed to verify that the augmentation is stable, the impingement is adequately decompressed, and the suction seal is restored. To complete the procedure, the anterior portion of the capsule is closed per a standard technique. Pearls for the kite technique for labral augmentation are summarized in Table 1.

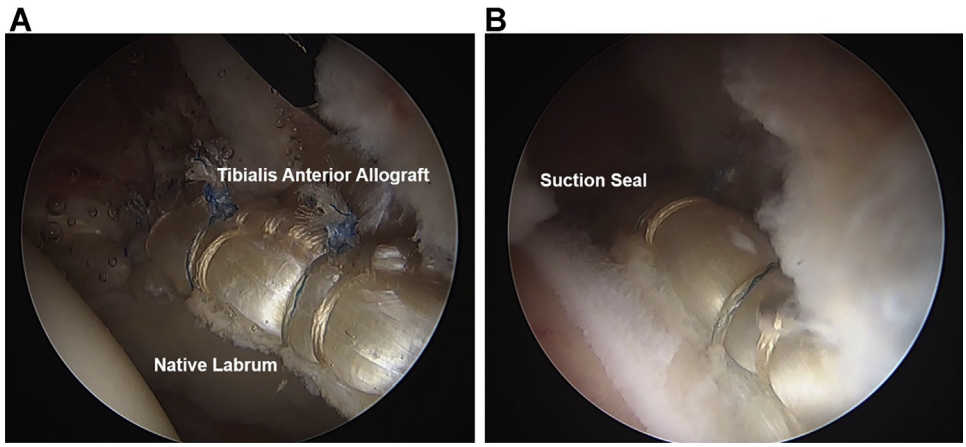

Fig 8. Intraoperative photograph showing final graft fixation (A) and restoration of the suction seal viewed through the anterolateral portal in a left hip in the supine position.

Table 1. Pearls for Kite Technique in Labral Augmentation of Hip

Preparation
Traction sutures are placed in the proximal capsular leaflet to preserve capsular integrity for later repair, as well as improve exposure and visualization.
Anchor insertion and the kite measurement technique are performed with the hip in traction.
Suture management
The anterior anchor sutures are stored within the MAP.
The midbody sutures are stored within the PMAP.
The posterior anchor sutures are stored within the ALP adjacent to the arthroscope.
Graft passage and fixation
The dam should be cut out of the DALA cannula to facilitate graft passage.
Retrieval of 1 strand of anterior anchor suture, followed by 1 strand of posterior anchor suture, should be performed via the DALA cannula.
Prior to placing sutures into the graft with a free needle, the surgeon should ensure that the suture strands are not crossed within cannula.
Each end of the graft should be pierced outside of the joint with the respective suture because attempting to pierce the graft after graft passage into the joint may induce iatrogenic damage to the native labrum, graft, or capsule.
Knots should be tied at the end of each suture after the graft is pierced because these knots will be used to "pulley" the graft into the joint via the kite technique.
The graft should be inserted with the hip in 20° of flexion to relax the proximal capsular remnant and allow for excellent visualization.
The suture piercing the graft will be the post suture for tying, while the opposite strand should be passed around the graft and labrum through the chondrolabral junction to secure the graft and labrum to bone.
The remaining midbody sutures should be placed around the graft and/or labrum similarly to standard labral repair.

ALP, anterolateral portal; DALA, distal anterolateral accessory portal; MAP, midanterior portal; PMAP, proximal midanterior portal.

Postoperative Rehabilitation

Postoperatively, the patient is restricted to 20 lb of partial weight bearing for 6 weeks with standard hip arthroscopy precautions, as previously described for labral reconstruction of the hip.[15]

Discussion

This Technical Note outlines our preferred method for labral augmentation, using the kite technique for safe and efficient graft passage and enhanced control of the soft-tissue graft within the joint. The kite technique for labral augmentation allows for immediate, anatomic fixation of the graft ends and ease of graft fixation with pre-placed midbody anchors. The end result is restoration of the labral suction seal, maintenance of the chondrolabral junction, and conservation of the native labrum's circumferential fibers while increasing the efficiency of this technically demanding procedure.

In cases with a hypoplastic labrum and intact chondrolabral junction, labral augmentation presents as a viable alternative and an often preferred treatment option over labral reconstruction.[7] In particular, a recent study by Philippon et al.[21] showed a significantly higher Hip Outcome Score—Activities of Daily Living and Hip Outcome Score—Sports in patients undergoing labral augmentation compared with labral reconstruction. However, no statistically significant differences in revision or conversion to total hip arthroplasty were reported for either group.

The proposed benefits of labral augmentation over reconstruction include (1) maintenance of the chondrolabral junction, decreasing the risk of damage to the acetabular cartilage; (2) maintenance of the proprioceptive fibers of the native labrum; (3) maintenance of labral hoop stresses by not severing the circumferential fibers as is commonly done in reconstruction; and (4) maintenance of the native labrum's vascular supply, which may aid in graft incorporation.

To date, there are 2 commonly described techniques for hip labral augmentation in the literature.[7,19] In contrast to the technique described by Locks et al.,[7] our technique uses tibialis anterior allograft as opposed to iliotibial band allograft or autograft. This simplifies graft preparation, and tibialis anterior allograft has been shown to be equivalent biomechanically to iliotibial band grafts and the native labrum.[22] Furthermore, relative to the techniques of Locks et al. and Maldonado et al.,[19] graft passage into the joint is simplified by use of the kite technique. Rather than securing the free graft end after graft passage into the joint, our technique allows for immediate, anatomic fixation of both graft ends prior to shuttling the graft into the joint. This increases the ease with which labral augmentation is performed by increasing control of the graft inside the joint. Thus, when the allograft is shuttled into the joint, the allograft is immediately placed in the desired position to more easily complete the remaining fixation.

The kite technique for labral augmentation is not without limitations. First, this technique is intended for use during labral augmentation only. For patients with a completely deficient labrum or a segmental labral defect, labral reconstruction remains the gold standard. The kite technique for labral augmentation relies on accurate measurements of the labral segment to be augmented. Although making accurate measurements can be technically challenging, we have provided our reproducible technique for accurately measuring the desired segment. Additionally, labral augmentation entails an increased cost compared with labral repair because of allograft use. Finally, there is a learning curve with this technique to prevent suture entanglement and to minimize trauma or disruption of the allograft tissue. This learning curve is estimated at approximately 5 to 10 cases, which is a relatively high number for a rare procedure. Advantages and limitations of the kite technique for labral augmentation can be found in Table 2.

Table 2. Advantages and Limitations of Kite Technique in Labral Augmentation of Hip

Advantages
Enhanced control of soft-tissue graft within joint
Precise measurement using kite measurement technique decreases risk of graft-defect mismatch
Anterior and posterior anchor suture passed into graft outside of joint to avoid iatrogenic injury to graft, labrum, and capsule
Reproducible, simple kite entry technique with immediate graft end fixation—easing technical difficulty
Limitations
Requirement for accurate measurement of defect size to avoid graft-defect mismatch
Only intended for cases with segmental (not global) labral hypoplasia
Increased cost compared with labral repair because of allograft use
Learning curve estimated at 5-10 cases

In conclusion, the kite technique offers an efficient, safe, and reproducible method for labral augmentation. Using the described technique, we have noted improved consistency and efficiency in performing this technically demanding procedure. To date, mid- and long-term outcomes of this technique are not yet available, but the technical pearls presented in this study may help to improve efficiency, reduce operative time, and provide excellent and secure fixation of labral augmentation grafts.

References

1. Bedi A, Kelly BT, Khanduja V. Arthroscopic hip preservation surgery: Current concepts and perspective. *Bone Joint J* 2013;95-B:10-19.
2. Ferguson SJ, Bryant JT, Ganz R, Ito K. An in vitro investigation of the acetabular labral seal in hip joint mechanics. *J Biomech* 2003;36:171-178.
3. Nepple JJ, Philippon MJ, Campbell KJ, et al. The hip fluid seal—Part II: The effect of an acetabular labral tear, repair, resection, and reconstruction on hip stability to distraction. *Knee Surg Sports Traumatol Arthrosc* 2014;22:730-736.
4. Philippon MJ, Nepple JJ, Campbell KJ, et al. The hip fluid seal—Part I: The effect of an acetabular labral tear, repair, resection, and reconstruction on hip fluid pressurization. *Knee Surg Sports Traumatol Arthrosc* 2014;22:722-729.
5. Espinosa N, Rothenfluh DA, Beck M, Ganz R, Leunig M. Treatment of femoro-acetabular impingement: Preliminary results of labral refixation. *J Bone Joint Surg Am* 2006;88:925-935.
6. Philippon MJ, Carreira D. Surgical technique: Arthroscopic labral reconstruction using iliotibial band autograft or allograft. In: Nho SJ, Leunig M, Larson CM, Bedi A, Kelly BT, eds. *Hip arthroscopy and hip joint preservation surgery*. New York, NY: Springer, 2015;1157-1163.
7. Locks R, Chahla J, Frank JM, Anavian J, Godin JA, Philippon MJ. Arthroscopic hip labral augmentation technique with iliotibial band graft. *Arthrosc Tech* 2017;6:e351-e356.
8. Philippon MJ, Briggs KK, Hay CJ, Kuppersmith DA, Dewing CB, Huang MJ. Arthroscopic labral reconstruction in the hip using iliotibial band autograft: Technique and early outcomes. *Arthroscopy* 2010;26:750-756.
9. Rathi R, Mazek J. Arthroscopic acetabular labral reconstruction with rectus femoris tendon autograft: Our experiences and early results. *J Orthop* 2018;15:783-786.
10. Matsuda DK, Burchette RJ. Arthroscopic hip labral reconstruction with a gracilis autograft versus labral refixation: 2-Year minimum outcomes. *Am J Sports Med* 2013;41:980-987.
11. Redmond JM, Cregar WM, Martin TJ, Vemula SP, Gupta A, Domb BG. Arthroscopic labral reconstruction of the hip using semitendinosus allograft. *Arthrosc Tech* 2015;4:323.
12. Chandrasekaran S, Darwish N, Close MR, Lodhia P, Suarez-Ahedo C, Domb BG. Arthroscopic reconstruction of segmental defects of the hip labrum: Results in 22 patients with mean 2-year follow-up. *Arthroscopy* 2017;33:1685-1693.
13. Scanaliato JP, Christensen DL, Salfiti C, Herzog MM, Wolff AB. Primary circumferential acetabular labral reconstruction: Achieving outcomes similar to primary labral repair despite more challenging patient characteristics. *Am J Sports Med* 2018;46:2079-2088.
14. White BJ, Stapleford AB, Hawkes TK, Finger MJ, Herzog MM. Allograft use in arthroscopic labral reconstruction of the hip with front-to-back fixation technique: Minimum 2-year follow-up. *Arthroscopy* 2016;32:26-32.
15. Bhatia S, Chahla J, Dean CS, Ellman MB. Hip labral reconstruction: The "kite technique" for improved efficiency and graft control. *Arthrosc Tech* 2016;5:337.
16. Cadet ER, Chan AK, Vorys GC, Gardner T, Yin B. Investigation of the preservation of the fluid seal effect in the repaired, partially resected, and reconstructed acetabular labrum in a cadaveric hip model. *Am J Sports Med* 2012;40:2218-2223.
17. Ellman MB, Hulse J, Chahla J, Bhatia S. Kite measurement technique for enhanced accuracy and technical proficiency of graft preparation in segmental labral reconstruction of the hip. *Arthrosc Tech* 2019;8:e1043-e1049.
18. McConkey MO, Moreira B, Mei-Dan O. Arthroscopic hip labral reconstruction and augmentation using knotless anchors. *Arthrosc Tech* 2015;4:701.
19. Maldonado DR, Chen JW, Lall AC, et al. Hip labral augmentation with tibialis anterior tendon allograft using the knotless pull-through technique. *Arthrosc Tech* 2019;8:e1209-e1216.
20. White BJ, Herzog MM. Labral reconstruction: When to perform and how. *Front Surg* 2015;2:27.
21. Philippon MJ, Bolia IK, Locks R, Briggs KK. Labral preservation: Outcomes following labrum augmentation versus labrum reconstruction. *Arthroscopy* 2018;34:2604-2611.
22. Ferro FP, Philippon MJ, Rasmussen MT, Smith SD, LaPrade RF, Wijdicks CA. Tensile properties of the human acetabular labrum and hip labral reconstruction grafts. *Am J Sports Med* 2015;43:1222-1227.