Technical Note

Hip Labral Reconstruction: The "Kite Technique" for Improved Efficiency and Graft Control

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Abstract: Although the merits of labral reconstruction have been well established, the technical difficulty of presently used reconstruction techniques—particularly with graft passage and fixation—limit its efficacy and potentiates the risk of iatrogenic damage within the hip joint. The unwieldy nature of a floating labral graft anchored on one end may impede accurate fixation of the other end, which is critical for restoration of the fluid hip seal and preservation of graft integrity. In this technique narrative, we present a "kite technique" for introduction, control, and efficient fixation of a labral reconstruction graft. The principles of this method are founded on the belief that a soft-tissue graft in an arthroscopic environment is much easier to guide into position with 2 control sutures using a pulley system similar to flying a kite with 2 fly lines. Although we herein detail the technique as it applies to labral reconstruction in the hip, the concept of the kite technique may also be employed in arthroscopic-assisted soft-tissue reconstructions of other joints.

Preserving labral integrity has become a guiding principle in hip preservation surgery given the recent understanding of the importance of the acetabular labral hydraulic seal.[1-4] Clinical studies on patients who have previously undergone partial labral resections have shown a faster progression of hip arthritis.[5] In patients with deficient labral tissue—often due to ossification from chronic impingement, a hypotrophic or degenerative native labrum, iatrogenic causes, or revision situations—labral reconstruction has emerged as a viable solution for symptoms of microinstability, pain, and discomfort.[6,7] In cadaveric investigations involving partial labral resection and subsequent labral reconstruction using an iliotibial band graft, Philippon et al.[2] and Nepple et al.[3] reported that labral reconstruction significantly improved hip intra-articular fluid pressurization—potentially reducing hip contact pressures[4]—and dramatically improved distractive stability.

Although the merits of labral reconstruction have been established in the literature,[2,3,6] the technical difficulty of previously described reconstruction techniques[6-8]—particularly with graft passage and fixation—limits its efficacy, increases traction time, and potentiates the risk of iatrogenic damage within the hip joint. In addition, the unwieldy nature of a floating labral graft anchored on one end may impede accurate fixation of the other end, which is critical for restoration of the fluid hip seal and preservation of graft integrity.[2]

In this report, we present the "kite technique" for introduction, control, and efficient fixation of a labral reconstruction graft. Similar 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 much easier to guide into position with 2 control sutures using a pulley system. Although we herein detail the technique as it applies to labral reconstruction in the hip, the principles of the kite technique may also be employed in arthroscopic-assisted soft-tissue reconstructions of other joints.

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Surgical Technique

Patient Positioning and Anesthesia

After general anesthesia is induced, the patient is positioned supine on a traction table (Smith & Nephew,

Fig 1. Patient positioning. The patient is placed supine and the operative leg (left) is put in traction, adducted, and internally rotated. The perineum and all bony prominences are appropriately padded.

Andover, MA) with all bony prominences and the perineum appropriately padded. The operative leg is internally rotated and adducted (Fig 1).

Diagnostic Arthroscopy

The operative leg is placed under traction and fluoroscopy is used to guide entry into the hip joint via the proximal anterolateral portal (PAL). Three standard arthroscopic portals are used for this procedure: the PAL, a mid-anterior portal (MAP), and a distal anterolateral accessory (DALA) portal created 3 to 4 cm distal and 1 to 2 cm anterior to the PAL portal (Fig 2, Video 1). An interportal capsulotomy is performed between the MAP and PAL portals, with care to preserve at least 1 cm of acetabular capsular remnant tissue for closure at the conclusion of the case.

A standard diagnostic arthroscopy is performed, 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.[2] However, if the labral tissue is inadequate for repair (i.e., <2 to 3 mm in width, segmental defect, or ossified labrum), a decision for reconstruction is made.

Acetabuloplasty

With the hip in or out of traction, the interval between the proximal capsule and labrum is developed using a mechanical shaver (ConMed Linvatec, Largo, FL) and radiofrequency probe (Smith & Nephew, Andover, MA). The authors prefer to perform this step with the hip flexed to 45°, off traction, and with suspension sutures placed on the proximal capsular leaflet to better preserve this tissue for later repair. In cases of labral ossification, fluoroscopy is used to resect the ossified labrum and pincer lesion. A standard acetabuloplasty is performed with a 5.5-mm burr (ConMed Linvatec) to reshape the acetabular rim and eliminate the pincer lesion, thereby providing an excellent bleeding environment amenable for graft incorporation.

Femoral Osteochondroplasty

A femoral osteochondroplasty is performed to correct head-neck offset and eliminate cam impingement. During this step, 2 tractions 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 Reconstruction

The damaged labral tissue is excised from the affected portion of the acetabulum. In most cases, this leaves a "segment" of exposed acetabular rim devoid of soft tissue. This defect is measured using a probe, and the graft is prepared 10 mm longer than the measured length to account for the convexity of the acetabular rim.

Graft Preparation

The authors prefer a tibialis anterior allograft (AlloSource, Centennial, CO) for labral reconstructions, but various autograft and allograft tissues have been described as acceptable alternatives.[7,8] After thawing and measuring to the appropriate length, the graft is tubularized to 5 to 6 mm in diameter and whipstitched with several 2-0 Vicryl sutures (Ethicon, Edinburgh, UK), as previously described.[8] The sutures are then tied and cut in preparation for graft insertion.

Kite Technique

A large adjustable cannula (Pivot TransPort 789 cannula, 110 to 140 mm, Pivot Stryker, Kalamazoo, MI) is inserted through the DALA portal into the joint via the interportal capsulotomy. Via this cannula, 2 suture anchors are placed into the acetabular rim without

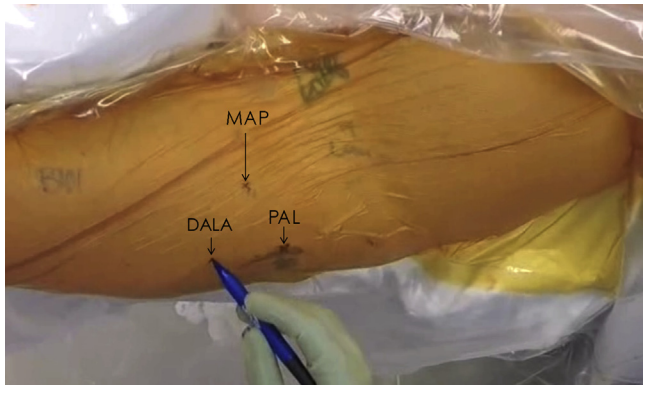

Fig 2. Intraoperative photograph of a left hip showing the location of the portals and their relation to the greater trochanter. (DALA, distal anterolateral accessory portal; MAP, mid-anterior portal; PAL, proximal anterolateral portal.)

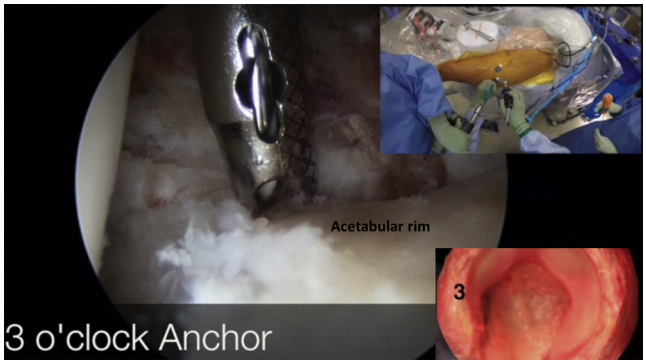

Fig 3. A suture anchor is placed at the anterior most aspect of the defect (3 o'clock position is this patient) using the distal anterolateral accessory portal as shown here in an arthroscopic image of a left hip as viewed through the proximal anterolateral portal.

breeching the joint, 1 at the most anterior aspect of the defect adjacent to the native labrum (Fig 3) (1.4-mm NanoTack anchor; Pivot Stryker), and 1 at the most posterior aspect of the defect adjacent to the native labrum (Fig 4) (2.3-mm OsteoRaptor anchor; Smith & Nephew, London, UK). Anchors should be placed adjacent to native, healthy labral tissue and 2 to 3 mm off the acetabular rim to prevent infolding of the graft after insertion. These anchors will be used to secure each end of the graft in place. With the arthroscope (Smith & Nephew, Andover, MA) in the MAP, a suture retriever instrument (Smith & Nephew, London, UK) is used to pull 1 strand of suture from each anchor out the PAL portal, and the arthroscope is then switched to the PAL portal (i.e., same portal as the 2 suture strands) for the remainder of the procedure. These 2 suture strands are the "post" sutures, whereas their opposite ends out the DALA portal are the "non-post" sutures. Bringing the post sutures out the PAL portal effectively removes them from the arthroscopic field and decreases the risk of suture entanglement. A second adjustable cannula (Pivot TransPort cannula; Pivot Stryker) is then inserted into the MAP to aid with suture passage and knot tying.

The graft is brought from the back table and positioned outside the DALA cannula. Using a free needle, the non-post suture strand out the DALA portal from the most anterior anchor is pierced through one end of the graft, and simple half hitches are used to create a knot to itself at the end of the suture (Fig 5). If added security around the graft is desired for graft passage, this non-post suture can alternatively be passed through and around the graft before being tied to itself (Fig 6). The same procedure is performed for the posterior anchor non-post suture, as it is pierced through the opposite end of the graft with a free needle and tied to itself in a simple fashion. Finally, 2 to 3 additional, mid-body, free No. 1 nonabsorbable sutures (Stryker #1 force fiber suture) are placed through the graft using a free needle, with each suture separated by approximately 8 to 10 mm. The number of additional sutures is dependent on the length of the graft. These sutures will be used for knotless fixation of the mid-body of the graft after the ends of the graft are secured in the joint.

At this time, the graft is inserted into the joint using the kite technique. The 2 sutures out the PAL portal (post sutures) adjacent to the arthroscope are alternatingly tensioned back and forth, similar to fly lines on a kite, and the knots on the ends of the anterior and posterior non-post sutures effectively pull each end of the graft into position along the rim (Figs 7 and 8). A knot pusher or blunt trochar is helpful to plunge the graft through the cannula and into the joint. An arthroscopic grasper (Smith & Nephew, Andover, MA) 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, the anterior most sutures are retrieved and tied via the MAP using standard knot tying techniques, securing the anterior end of the graft (Fig 9). The posterior end is then secured in a similar fashion via the PAL portal. The kite technique allows for technically easy and efficient entry of the graft into the joint, and provides an expeditious way to secure both ends of the graft to the acetabular rim without suture entanglement, often the most difficult part of previously described techniques for labral reconstruction.[6-8]

Mid-body Sutures

Once the ends of the graft are secured in place, these sutures are cut and attention is turned to the mid-body sutures. Each respective set of sutures are retrieved out the DALA portal and secured to the rim using a knotless

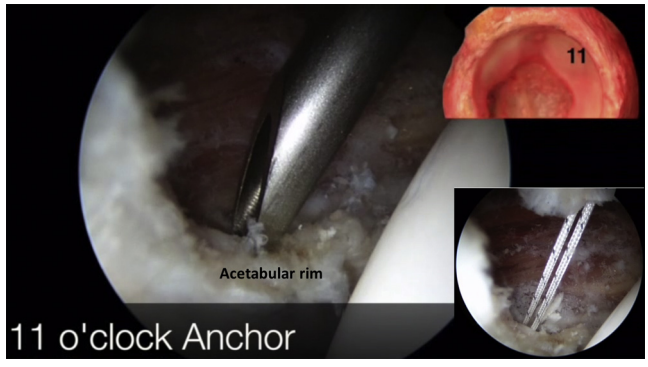

Fig 4. A suture anchor is placed at the posterior most aspect of the defect (11 o'clock position is this patient) using the distal anterolateral accessory portal as shown here in an arthroscopic image of a left hip as viewed through the proximal anterolateral portal.

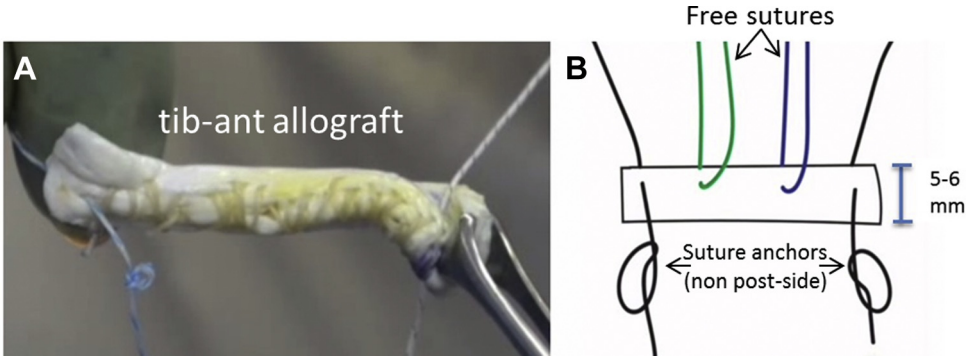

Fig 5. The prepared graft shown with (A) an intraoperative photograph and (B) an illustrated image showing the post, non-post, and free sutures. The width should be approximately 5-6 mm.

suture anchor (2.4 mm knotless Cinchlock SS anchors with #1 force fiber suture; Pivot Stryker, Kalamazoo, MI) (Fig 10). Prepassing these mid-body sutures avoids excess time required to pass and tie additional sutures, and allows for secure placement of all anchors for labral reconstruction in a safe and efficient manner. After fixation of the graft (Fig 11), traction is released and a dynamic examination is performed to verify that the reconstruction 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 standard technique. Pearls for the kite technique for labral reconstruction are summarized in Table 1.

Discussion

The kite technique offers safe and efficient graft passage and enhanced control of the soft-tissue graft within the joint, allowing immediate, anatomic fixation of the graft ends and simple knotless fixation of the remaining prepassed mid-body sutures. Using this technique, the total traction time typically is less than 60 minutes. All sutures employed in this technique pierce through the graft, rather than loop it, potentially fostering enhanced biomechanical stability and improvement in the suction seal.[3]

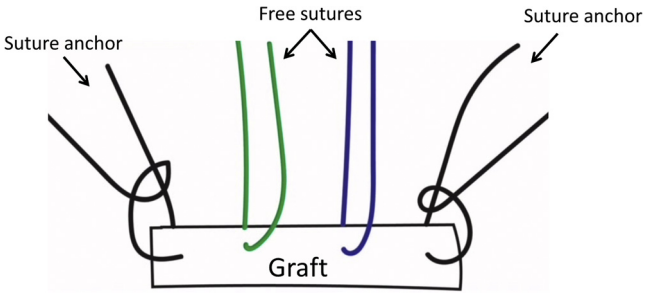

Fig 6. Illustrated image of an alternate option of graft preparation. If added security around the graft is desired for graft passage, the non-post suture can be passed through and around the graft before being tied to itself.

Recently, Carreira and Philippon were the first to describe a "shuttle technique" for labral reconstruction using 2 sutures to shuttle the graft in place.[7] Although the shuttle and kite techniques are conceptually similar, the kite technique may offer several advantages. First, in the kite technique, the post sutures are brought out a different portal, effectively removing them from the arthroscopic field and reducing the risk of suture entanglement.[7] These sutures are then alternatively tensioned to pass the graft into the joint, resulting in easy, safe, and efficient graft end fixation along the acetabular rim. Second, the kite technique provides an option for tying the non-post sutures either to itself after piercing the graft, or through and around the graft if additional security is desired by the surgeon. Finally, the kite technique is the first to describe a method to

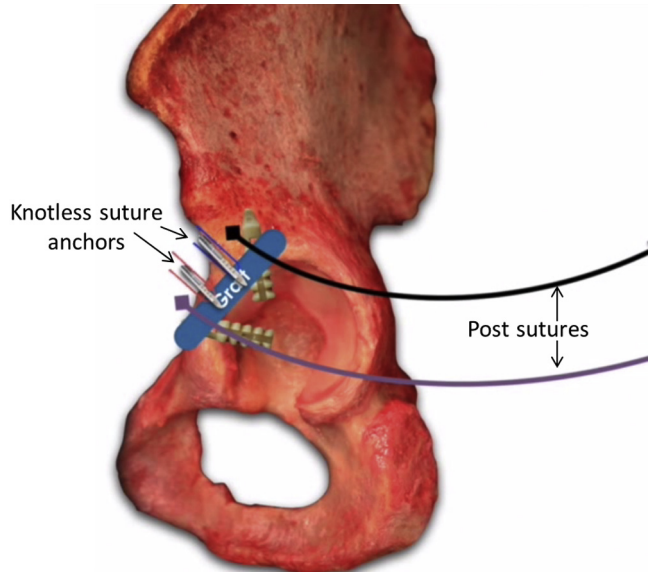

Fig 7. Illustrated diagram of how the graft will be placed to reconstruct the labral defect. The post and non-post sutures are depicted in black and purple, with the square shape indicating the non-post side. In between these sutures are the knotless suture anchors.

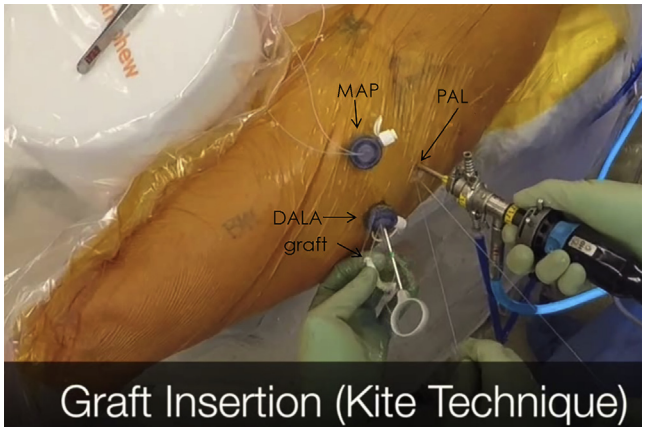

Fig 8. Intraoperative image of the graft being inserted through the DALA portal, whereas the arthroscope is in the PAL portal. The graft is inserted into the joint using the "kite technique." The 2 sutures out of the PAL portal (post sutures) adjacent to the arthroscope are alternatingly tensioned back and forth, similar to fly lines on a kite, and the knots on the ends of the anterior and posterior non-post sutures effectively pull each end of the graft into position along the rim. (DALA, distal anterolateral accessory portal; MAP, mid-anterior portal; PAL, proximal anterolateral portal.)

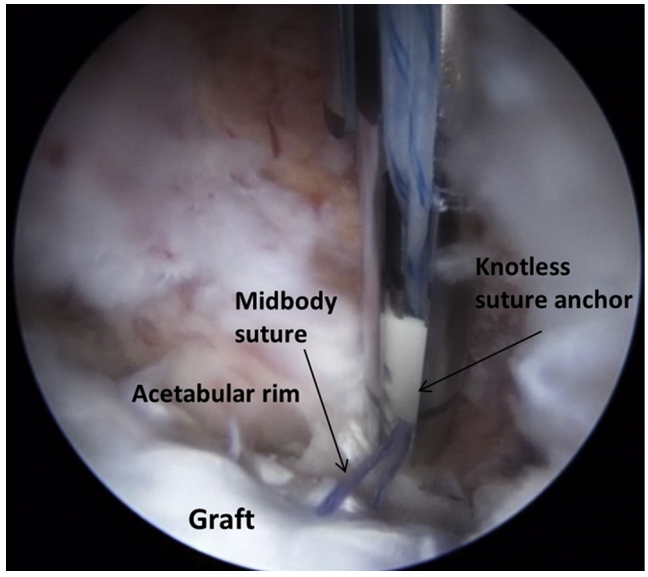

Fig 10. Knotless mid-body sutures are viewed through the proximal anterolateral portal and retrieved and secured to the acetabular rim through the distal anterolateral accessory portal.

increase efficiency of mid-body graft fixation with the use of prepassed No. 1 sutures for knotless fixation. This avoids the need to pass additional sutures once the graft is provisionally fixed, which can be technically difficult if the graft inverts into the joint after provisional end fixation. This pearl reliably reduces traction time and decreases the risk of iatrogenic damage to articular cartilage.

The kite technique is not without limitations. First, this technique requires accurate measurement of defect size to completely reconstitute segmental soft-tissue loss. Second, this technique is intended for use during segmental labral reconstructions only. For patients with a completely deficient labrum requiring a 270° labral reconstruction, a technique has been previously described that allows for

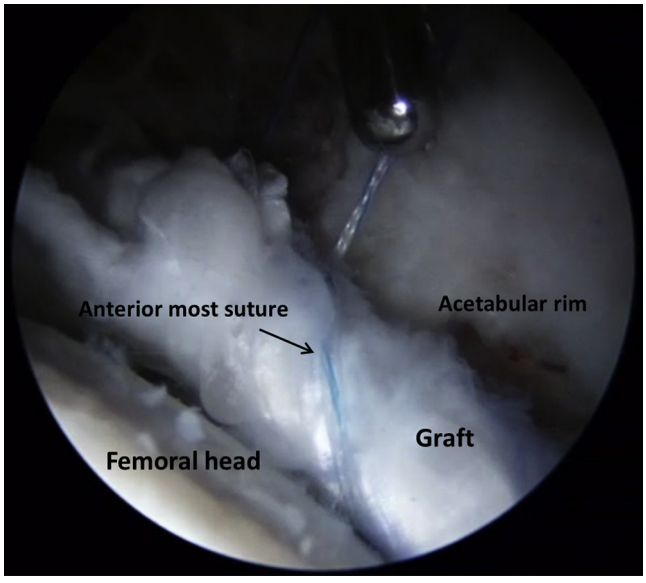

Fig 9. The anterior most suture is retrieved and tied via the mid-anterior portal.

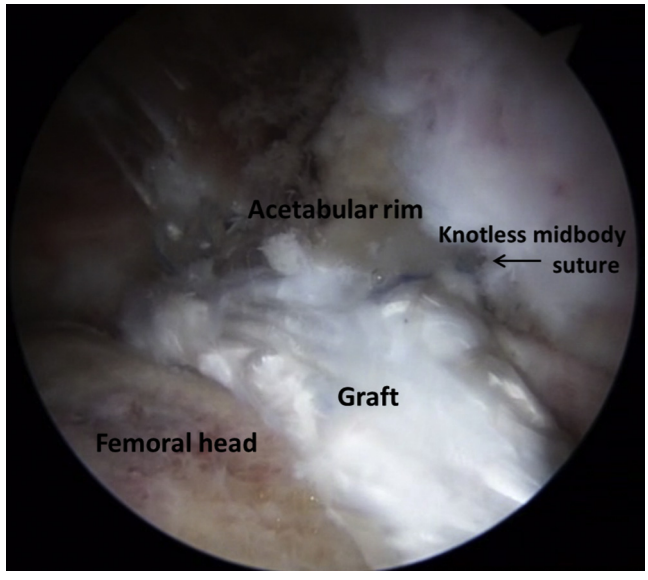

Fig 11. Intraoperative photograph of the finished labral reconstruction viewed through the proximal anterolateral portal.

Table 1. Pearls for Kite Technique Labral Reconstruction

Graft preparation:
• Run sutures tight to avoid graft "blowing up" in the joint.
Graft passage:
• Bring 1 strand of each suture (post sutures) out the proximal anterolateral portal, same as arthroscope, to remove these strands from arthroscopic field and prevent suture tangling.
• Using different colored sutures for "end anchors."
• Before placing sutures into graft ensure that non-post suture strands are not crossed in cannula.
• If added security around the graft is desired for graft passage, the non-post suture should alternatively be passed through and around the graft before being tied to itself.
Graft Fixation
• Use prepassed sutures of differing color in the central part of the graft with subsequent knotless fixation for improved efficiency.
• Either a sliding locking knot or half hitches can be employed successfully with the kite technique sutures.

reconstitution of labral hoop stresses with an entirely new labrum.[8] In most cases, however, most of the native labrum is intact with a "segment" that is irreparable, and segmental reconstructions are favorable in this situation to avoid damaging healthy, native labral tissue. Advantages and limitations to the kite technique for labral reconstruction can be found in Table 2.

In conclusion, the principles of the kite technique, namely using post and non-post sutures for accurate positioning and immediate multiple point fixation of soft-tissue grafts, can be applied successfully to soft-tissue reconstructions of the hip and shoulder, or any arthroscopic procedure in which control of soft-tissue grafts is desired. To date, long-term outcomes on this technique are not yet available and currently in process, but the technical pearls presented here may help to improve efficiency, reduce operative time, and provide excellent and secure fixation of segmental labral reconstruction grafts.

Table 2. Advantages and Limitations for Kite Technique Labral Reconstruction

Advantages	Limitations
Enhanced control of the soft-tissue graft within the joint.	Requires accurate measurement of defect size to completely reconstitute segmental soft-tissue loss.
Reduced traction time.	Only intended for segmental labral reconstructions.
Theoretical enhanced biomechanical stability and improvement in the suction seal.	
Simple knotless fixation of the prepassed, mid-body sutures decreases risk of iatrogenic injury to articular cartilage.	
Reduced risk of suture entanglement.	

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