Technical Note

Arthroscopic Hip Labral Reconstruction and Augmentation Using Knotless Anchors

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Abstract: Biomechanical stability is the primary function of the acetabular labrum. It provides a hip suction seal and optimal joint function. Labral tears are a common reason for hip arthroscopy, to improve patient function and to prevent long-term degenerative arthropathy. Arthroscopic labral repair has shown significantly better outcomes in return to premorbid activity levels when compared with labral debridement. Injury to the acetabular labrum is a challenge and can lead to long-term complications. In this scenario, arthroscopic labral reconstruction has shown good results regarding patient subjective and objective outcomes. We describe a technique for complete arthroscopic labral reconstruction using tensor fascia lata allograft.

Techniques for the surgical treatment of femoroacetabular impingement have been advancing rapidly. The osseous abnormality within the hip leads to repetitive contact of the femoral neck with the acetabulum and causes cartilage delamination and labral damage.[1] The labrum performs an important biomechanical function in the hip by improving stability, extending femoral head coverage, and ensuring adequate lubrication.[2,3] Failure of the labrum leads to increased contact stress between the acetabulum and the femoral head.[4] Arthroscopic labral repair has resulted in excellent outcomes in several recent series.[5,6]

There are situations in which labral repair is not possible because of extensive damage, diminutive size, or previous labral debridement. Arthroscopic labral reconstruction techniques have been developed, with encouraging early results showing good patient satisfaction and quality-of-life outcomes.[6,7] In this article we describe an all-arthroscopic technique used to reconstruct the labrum using tensor fascia lata allograft.

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Technique

After thorough clinical, radiographic, or arthroscopic evaluation suggests labral insufficiency as a cause for symptoms, a decision is made to reconstruct the labrum. Our hip arthroscopy setup has been described previously.[8,9] The supine position is used on a traction table. Traction is gradually applied on the operative side, and a spinal needle is inserted to break the suction seal of the hip. Once adequate traction is applied, the mid-trochanteric and anterior portals are established to allow access to the central compartment.

Acetabular Preparation

Once it has been established that labral reconstruction will be required, the poor-quality labral tissue remaining over the recipient site is debrided. Occasionally, when the labral tissue remains but is nonfunctional (because of small size or tissue characteristics), it is left in place and a supplemental reconstruction is performed to act as an augmentation (Fig 1). In these cases no side-to-side anastomosis is needed because the circumferential fibers of the native labrum are left intact. This augmentation technique is also used in patients with borderline dysplasia, as well as other patients with instability, when there is a need for a larger labrum to assist in keeping the femoral head in place. In these cases, anchor drilling and labral graft implantation will follow segmental reconstruction in the absence of continuous circumferential native labrum tissue.

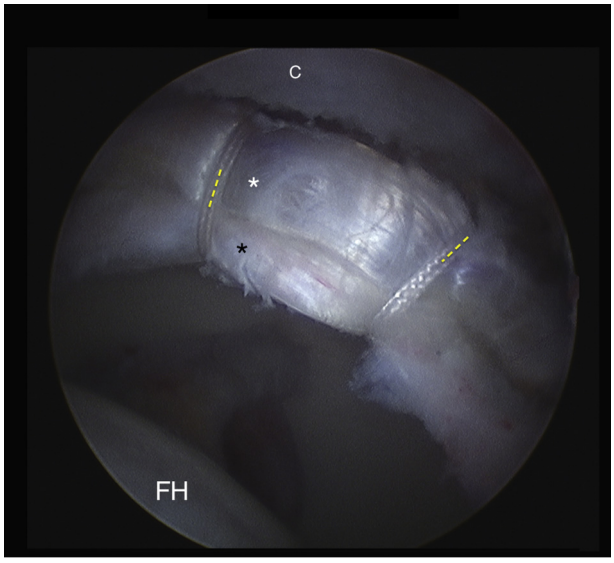

Fig 1. A labral "augmentation" allograft is shown in a left hip from the mid-trochanteric portal. The tensor fascia lata (white asterisk) graft has been augmented to the remnant, deficient labrum seen inferior to the graft (black asterisk) with 2 anchors and ultrahigh-strength sutures (yellow dashed lines). This preserves the longitudinal circumferential fibers of the native labrum to obtain better contact with the femoral head and improve the suction-seal effect, while generating a more robust labral construct. This technique is very useful in patients with borderline dysplasia when reinforcing the labrum and improving the femoral head coverage, which improves joint stability. This technique is also useful in native labral tissue that rests away (with a visible gap) from the femoral head when traction is off, lacking a suction-seal effect. The graft in these cases would push the labrum downward to restore contact between the femoral head and labrum. (C, capsule; FH, femoral head.)

The remaining labral tissue at the ends of the recipient site should have healthy edges to allow for a robust anastomosis of the graft either end to end or front to end. The acetabular rim is trimmed down to a flat, smooth bleeding bed of bone, and any pincer lesion is trimmed in accordance with the preoperative plan. The length of the defect is measured and recorded using a probe or burr of known size (4-mm unhooded burr; Stryker, Kalamazoo, MI) from both portals at least twice (Video 1).

Drill holes are made in the acetabular rim starting from medial to lateral (far to near). Drilling is performed from the anterior portal with the camera in the mid-trochanteric portal. A typical labral reconstruction will span from the 3-o'clock position to the 11-o'clock position and require 4 to 5 anchors. The most medial anchor is drilled just past, and proximal to, the most medial extent of the native labrum, and further drill holes are placed 6 to 8 mm apart moving laterally (Video 1). The most lateral anchor drill hole is usually drilled after switching portals to achieve a better drill trajectory. If the most medial anchor hole cannot be drilled safely from the anterior portal, a third portal is used to achieve a better drilling trajectory. To avoid slippage on the thin anterior acetabular rim into the iliopsoas region when drilling the most medial anchor hole past the 4-o'clock position, an angled leading anchor (Nantotack, 1.4 mm; Stryker) may be used.

Any cam impingement osteoplasty is performed before completion of the labral reconstruction, usually while the surgical assistant is preparing the graft for implantation. Fine-tuning of the cam work can be performed after the new labrum is in place.

Graft Preparation

An iliotibial band or tensor fascia lata allograft is used because in our experience tendon grafts have swollen in the joint quite quickly, obscuring arthroscopic visualization. An additional advantage is the ability to decide on the graft diameter (or width) by increasing or decreasing the number of folds made with the allograft tissue.

The graft is prepared with the help of an anterior cruciate ligament graft preparation system (Acufex Graftmaster; Smith & Nephew Endoscopy, Andover, MA). The arthroscopic measurement of the defect size is recalled, and a graft is prepared to a length of 110% of the length of this measurement, enabling a few millimeters of overlap between the native labrum and the graft at both ends. As mentioned earlier, the width of the graft can be adjusted according to the requirements of each patient as well. For example, patients with borderline dysplasia require a wider labrum because it serves as a shelf or bumper. On the contrary, patients with pincer impingement have relatively deep acetabuli, even after resection, and can be sufficiently treated with a narrower graft without compromising the function of the reconstructed labrum.

The allograft is attached to the graft preparation system and, at this point, should be twice the length of the required graft. This ensures that adequate tissue on each side is secured to the graft preparation system for ease of work. The final graft length is marked with a pen in the mid portion of the graft. No. 1 Vicryl (Ethicon, Somerville, NJ) is used to tubularize and stiffen the graft tissue so that it maintains its shape and size once in the joint and swells as little as possible. A well-tensioned graft will be less affected by the tension applied from the anchor sutures and will result in more streamlined morphologic characteristics, without a swollen protuberance between the suture anchors. The Vicryl suture should terminate 1 to 2 mm medial to the marked end point of the graft so that it is not cut during excess graft tissue removal (Fig 2A). A locking whipstitch is passed through each end of the graft using two No. 2 ultrahigh-strength sutures (MagnumWire; ArthroCare, Austin, TX), each in a separate color (Fig 2B). The graft is now cut to length

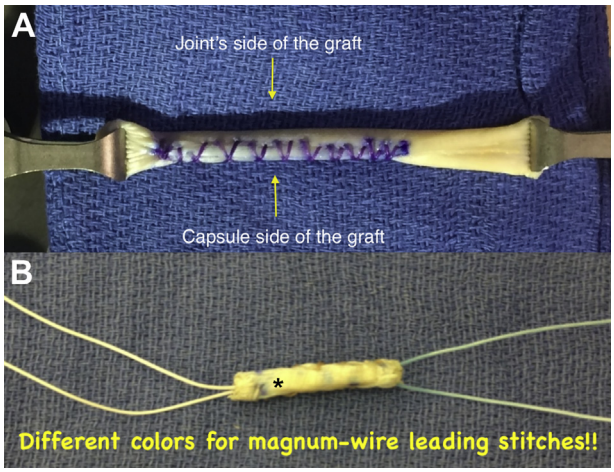

Fig 2. Graft preparation is performed on the back table. (A) The graft is prepared to a length of 110% of the required length. The graft is whipstitched with No. 2 Vicryl suture (purple stitch) to reduce its tendency to absorb fluids and prevent excess swelling once in the joint. The Vicryl is stitched through 1 side of the graft only (the capsular side), leaving 1 side free of suture material (joint side). (B) The graft has been trimmed to the appropriate length, and ultrahigh-strength sutures have been placed on each end in 2 separate colors. This enables easier suture management once inside the joint. The Vicryl-free side of the graft is seen (asterisk).

at the previously made marks, and a dry cloth is placed over the top of the graft. We avoid the use of a wet cloth to prevent graft swelling.

Graft Placement

Once the graft has been prepared, the camera is placed in the anterior portal and a free stitch that has been folded in half is pushed into the joint through the mid-trochanteric portal by use of a looped grasper. The camera is then placed in the mid-trochanteric portal, and the MagnumWire is retrieved from the anterior portal. The 2 ends of the suture are snapped together outside the joint. This suture is later used to shuttle the posterior (lateral) graft by way of the lead stitch to the mid-trochanteric portal. This allows the surgeon control over both ends of the graft, through the 2 portals, as the leading end goes through the anterior portal (to be placed in the most anterior drilled anchor tunnel) and the posterior end through the mid-trochanteric portal. A slotted cannula is now placed in the anterior portal. The stitches of the medial end of the graft are loaded onto the SpeedLock Hip system (ArthroCare), and the graft is shuttled into the joint, led by the anchor, with 5 to 10 mm of slack between the anchor and the graft (Video 1). The anchor is tapped into the far medial hole, and the sutures are sequentially tensioned to ensure appropriate tension and inversion/eversion of the graft. The sutures are cut after the anchor is locked. Alternatively, the stitches can be used to perform an anastomosis to the native labrum, after the anchor is locked, and can be cut thereafter. The sutures attached to the lateral aspect of the graft are now shuttled from the anterior portal to the mid-trochanteric portal using the pre-passed free suture, so the graft can be controlled better from the mid-trochanteric portal. At this stage, to avoid the graft obscuring our visualization and for ease of graft handling, we push the graft deep into the joint, toward the acetabular fossa, using a tissue grasper.

The SpeedStitch device (ArthroCare) is now used to place a suture through the base of the labral graft adjacent to the second most medial drill hole. The point of penetration for the SpeedStitch device will match the distance between the first and second drilled holes to maintain graft tension. The stitch is then loaded onto a second SpeedLock Hip system, and the anchor is tapped into place in the same manner as the first. Inversion/eversion is controlled again by pulling sequentially on the appropriate suture end in the device as the graft is seated (Video 1).

The camera is now placed in the anterior portal, and the lateral whipstitch is shuttled into the joint, through the mid-trochanteric portal, on a SpeedLock Hip anchor and secured in the lateral-most drill hole as described earlier for the first most medial anchor. This creates a bucket handle—type labrum, which is easier to handle inside the joint and enables more accurate positioning and distribution of tension along the graft. After correct lateral drill hole placement, there should be a small amount of overlap between the graft and native labrum to allow an end-to-front anastomosis (end allograft behind native labrum).

The camera is moved back to the mid-trochanteric portal, and the SpeedStitch device is used to pass a suture through the base of the graft adjacent to the remaining anchor drill hole(s) (Fig 3A). If the graft tissue is very large or thick, the suture can travel around the graft rather than through its base. Tension is applied once again to the sutures that have been passed through the anchor to ensure that the labrum sits anatomically before locking the implant. Supplementary anchors can be placed if further security is needed for final graft positioning (Fig 3B). A side-to-side or side-to-front anastomosis of the native labrum to the graft can be performed with Vicryl suture or with the leading anchor's stitches, after they have been locked, as necessary.

Traction is released once the graft is secure and the labral graft is assessed for its position to ensure that it forms a seal on the femoral head. Adjustments can be performed thereafter if deemed necessary.

Discussion

In this article we describe and demonstrate a technique used for reconstruction of the labrum of the hip. Preservation of the hip labrum has been recognized as

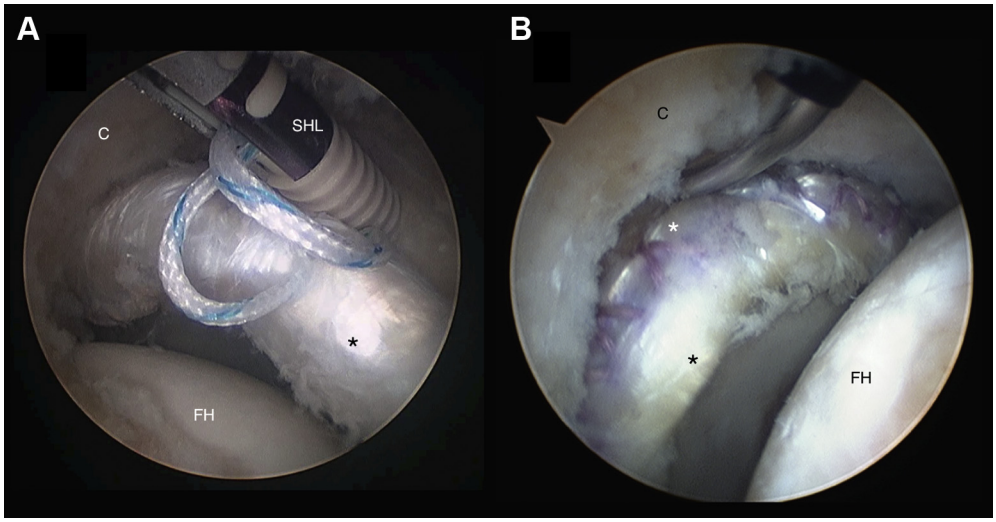

Fig 3. (A) With the camera in the mid-trochanteric portal in a left hip, a SpeedLock Hip anchor (SHL) is being placed after sutures have been passed through the labral graft (asterisk) in a "labral base" stitch fashion in its mid portion. Before this, the labrum has been secured at both ends, turning it into a bucket handle—type construct. (B) A graft that has been fully secured, before releasing traction applied on the femur. The Vicryl-free side of the labrum is seen facing the joint/femoral head (black asterisk), whereas the Vicryl-stitched side is facing the capsule (white asterisk). (C, capsule; FH, femoral head.)

an important aspect of hip preservation, with excellent results reported when labral tears are repaired.[10] One study compared arthroscopic labral repair versus debridement at a mean of 3.5 years' follow-up.[10] Those patients who underwent repair achieved significantly better results in terms of pain and outcome scores compared with those who underwent debridement. Good to excellent results were noted in 68% of the debridement group compared with 92% of the repair group.

Research into the potential clinical benefits of labral reconstruction remains limited in this early stage, but basic-science literature supports the theory that a functional hip labrum is important for long-term hip health.[2-4] There are several recent midterm reports that have supported labral reconstruction in appropriately selected patients. Geyer et al.[11] recently reported minimum 3-year outcomes of labral reconstruction using iliotibial band autograft. They showed excellent patient satisfaction and a modified Harris Hip Score improvement from 58.9 preoperatively to 83 postoperatively. Importantly, they found that a preoperative joint space of less the 2 mm was a poor prognostic factor for the survival of the hip. Several other recent studies have added to the literature supporting the ability of labral reconstruction in appropriately selected patients to improve symptoms and quality of life.[12-14]

One of the advantages of our technique is the ease of manipulation of the graft using the SpeedLock Hip anchor. It is a knotless anchor but allows rotation of the graft either away from or toward the femoral head by selective tensioning of the 2 sutures that are passed through the base of the graft and then into the anchor. This allows the surgeon to control the location of the graft, which should improve the ability to form a suction seal against the femoral head. We prefer the use of a tubularized fascia lata because it tends not to swell as much as a tendon autograft or allograft in our experience. The diameter of the graft is easily adjusted by trimming appropriate amounts of the graft before tubularizing it. Finally, unlike many of the previous techniques published on labral reconstruction, our

Table 1. Pearls and Pitfalls

During labral debridement, the surgeon should ensure that good edges of the native labrum remain at the ends of the defect for graft-labrum anastomosis.
The prepared graft should be 110% to 115% of the measured defect length.
The holes for the knotless anchors are predrilled before graft shuttling into the joint.
A looped passing stitch, shuttled from the mid-trochanteric portal to the anterior portal, is key for controlling the posterior/superior graft end as it is being secured.
With the suture ends passed through the graft and into the SpeedLock Hip system, variable tension on each of the suture ends allows the surgeon to control the rotation of the graft to seat it on the femoral head and reconstitute the suction seal.
After the graft is secured anteriorly with 2 SpeedLock devices, the camera is switched to the anterior portal, and the posterior aspect of the graft is secured using a SpeedLock Hip system, forming a bucket handle—type labrum and allowing easier control of the graft.
The SpeedStitch device allows for timely and accurate passing of the sutures through the base of the graft, before it is secured with the SpeedLock Hip system.
Side-to-side anastomosis of the graft to the native labrum improves the stability of the graft at each end.
Patients with dysplasia may benefit from a wider labral graft to serve as a shelf or bumper.
We recommend a final graft width of 130% to 150% of the (expected) native labrum and length of 110% to 115% of the measured defect.
Ultrahigh-strength suture is used at each end of the graft, which is tubularized using Vicryl.

Table 2. Advantages

The SpeedLock Hip system allows individual tensioning of suture ends, which controls the version of the graft and allows it to seat against the femoral head.
Knotless anchors decrease the complexity of the case and speed up graft fixation.
A 2-portal technique decreases tissue damage.
Use of fascia lata graft allows the surgeon to adjust the length and width with ease and, in our experience, is less apt to swell when compared with tendon grafts.
The SpeedStitch device allows quick and easy labral base fixation, decreasing the surgical time and likelihood of suture tangling.

technique allows the operation to be performed entirely through the standard 2 portals used in impingement surgery or labral repair.

This article describes a new technique for labral reconstruction using tensor fascia lata or iliotibial band allograft and knotless suture anchors, allowing easy tension adjustment and labral manipulation (Tables 1 and 2). Advances in technology and technique should allow surgeons to improve surgical outcomes with more anatomic reconstruction. Further clinical studies are necessary on this and other described reconstruction techniques.

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