Current Concepts in Labral Repair and Refixation: Anatomical Approach to Labral Management

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Abstract

Arthroscopic labral repair and refixation have garnered much attention over the past several years. Restoration of suction seal and native labral function has been an evolving focus for achieving excellent results in hip preservation surgery. Authors have reported using several labral management techniques: débridement, labralization, looped suture fixation, base stitch fixation, inversion-eversion, and reconstruction. The optimal technique is yet to be determined. Absolute indications for labral repair are symptomatic intra-articular pain, joint space >2 mm, and failed conservative management. Extreme attention is given to identifying and addressing the cause, whether it be acute or repetitive trauma, instability, or femoroacetabular impingement. In this article, we discuss indications for labral repair; describe Dr. Mather's preoperative planning, labral repair technique, and postoperative care; and review published outcomes and future trends in labral repair.

Arthroscopic labral repair and refixation have garnered much attention over the past several years. Restoration of suction seal and native labral function has been an evolving focus for achieving excellent results in hip preservation surgery.[1-6] Given the superior results of labral repair, including level I evidence, repair or refixation should be pursued whenever possible.[7] Authors have reported using several labral management techniques: débridement, labralization, looped suture fixation, base stitch fixation, inversion-eversion, and reconstruction.[7-13] The optimal technique is yet to be determined. When possible, steps should be taken to repair the labrum to an anatomical position. Absolute indications for labral repair are a confirmed intra-articular diagnosis with symptomatic pain, joint space >2 mm with or without femoroacetabular impingement (FAI), labral tear or instability, and failed conservative management.[9,11,12,14,15] More important, the surgeon must have a clear etiology of the pathologic cause of the tear and be aware of the limitations of the procedure. Labral repair is relatively contraindicated in end-stage arthritis and has failed when used alone in undiagnosed dysplasia or hip instability.[16] In this article, we discuss indications for labral repair; describe Dr. Mather's preoperative planning, labral repair technique, and postoperative care; and review published outcomes and future trends in labral repair.

Indications

At our institution, anatomical labral repair is the preferred procedure for most primary and revision hip arthroscopy procedures. We aim to restore the suction seal, re-create the contact of the labrum and the femoral head to facilitate proprioception, and restore normal stability of the labrum. Indications for primary repair are labrum width >3 mm, no more than 2 repairs, and ability to hold a suture. Our indications for reconstruction or débridement are stage 3 irreparable labral tear, calcified/cystic labrum, and multiple failed labral repairs or reconstructions. The decision to perform labral débridement or reconstruction is made on a case-by-case basis but is primarily influenced by the stability of the hip joint and the activity goals of the

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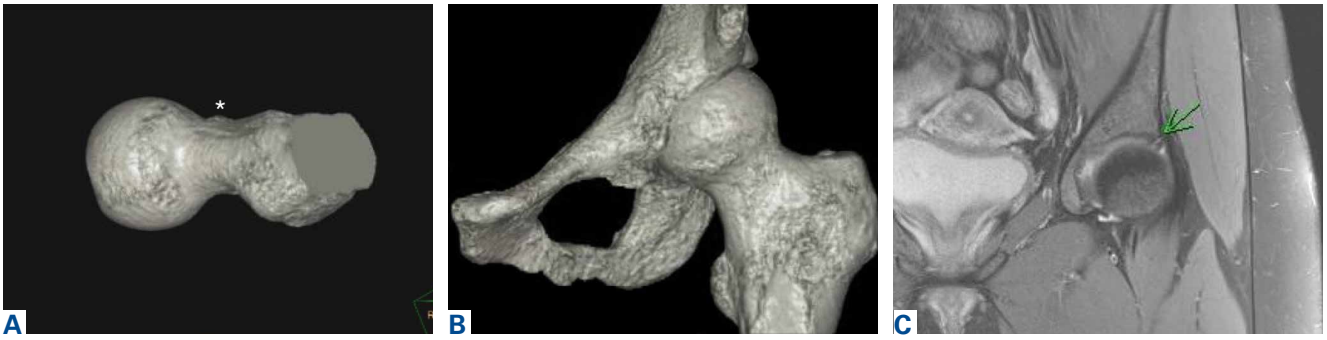

Figure 1. Volumetric interpolated breath-hold examination (VIBE) 3.0 Tesla magnetic resonance imaging (MRI) sequence with 3-dimensional rendering. (A) Femoral isolation. Asterisk indicates cam lesion on femoral neck. (B) Acetabular rim. (C) Noncontrast MRI with labral tear. Green arrow shows labral tear.

patient. If preoperative presentation and intraoperative examination suggest labral instability as a major component of the pathology, or if the patient wants to return to high-demand activity, we more strongly favor reconstruction over débridement. In our experience, with the technique described in this article, more than 95% of all primary labral tears can be addressed with repair.

Preoperative Planning

The goals in hip preservation surgery are to identify and address the underlying cause of the labral tear, whether it be FAI syndrome, trauma, labral instability, or all 3, and to re-create the anatomy and biomechanics of the acetabular labrum. For repair, we prefer an inversion-eversion technique with independent control of the labrum. Our initial work-up includes a thorough history and physical examination with baseline patient-reported outcome scores. Standard erect anteroposterior pelvis, Dunn lateral, and false-profile radiographs are obtained. Standard measurements of lateral center edge angle, anterior center edge angle, Tönnis angle, Tönnis grade, lateral joint space, and head extrusion indices are evaluated. Selective in-office ultrasound-guided injections are used to confirm an intra-articular source of pain. At our institution, noncontrast 3.0 Tesla magnetic resonance imaging (MRI) with volumetric interpolated breath-hold examination (VIBE) sequencing and 3-dimensional rendering is obtained for evaluation of labral and FAI morphology.[17] All advanced imaging is performed without arthrogram or radiation exposure (**Figures 1A-1C**). Although the advanced MRI used is of benefit in preoperative planning, it is limited in detecting labral pathology. Although its results are valuable, they do not predict the operative treatment algorithm of débridement, repair, or reconstruction.[18]

With use of the radiographs and the MRI scans, we engage the patient in an informed discussion about the labral tear, FAI, and concomitant pathology. We discuss expected outcomes of conservative or operative management given the patient's expected functional activities, and inform the patient that primary repair is indicated for many others in similar situations. The potential for possible labral reconstruction is discussed if the patient had prior intra-articular hip surgery, has a large calcified labrum or a cystic labrum, is an athlete with failed prior surgery, or is younger than 40 years.

Labral Repair Technique

The patient is taken to the surgical suite, and a general anesthetic is administered. A peripheral nerve block is not routinely used. The patient's feet are padded, and boots for the traction table are applied. The patient is carefully placed on a Hana table in modified supine position. Balanced traction is used to achieve proper joint distraction. The C-arm is used to verify proper distraction, assess hip stability, and achieve standard anterolateral (AL) portal placement. A midanterior portal (MAP) is created and an interportal capsulotomy is performed. Capsular suspension is performed with the InJector II Capsule Restoration System (Stryker Sports Medicine) and typically 4 or 5 high-strength No. 2 sutures (Zipline; Stryker Sports Medicine).[19] Diagnostic arthroscopy is performed to identify the tear type, measure the labral width, determine the impingement

Take-Home Points

- Labral preservation is recommended when possible to ensure restoration of suction seal, stability, and contact pressure of the hip joint.
- Over 95% of labral tears can be addressed with primary repair.
- Consider using an accessory portal (ie, DALA) to allow for more anatomic placement of suture anchor.
- Mattress stitch when labrum >3 mm and looped stitch when labrum <3 mm.
- Control labral repair to avoid excessive inversion or eversion.

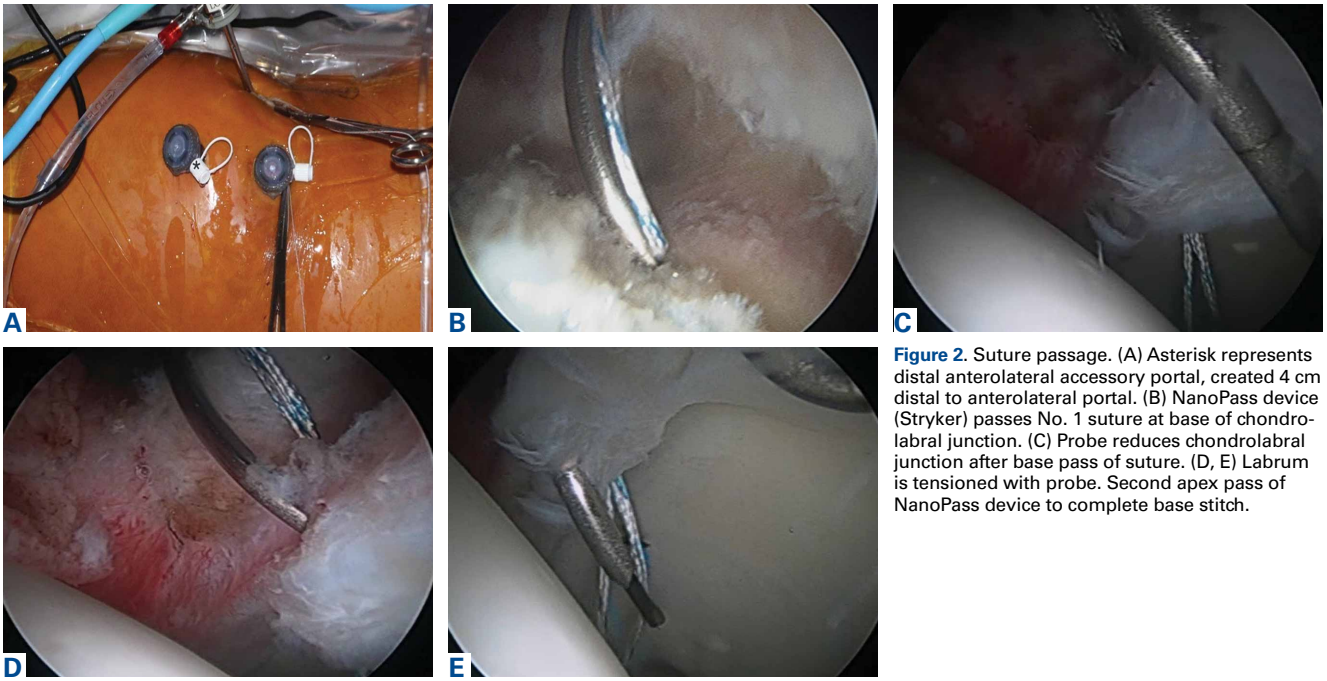

Figure 2. Suture passage. (A) Asterisk represents distal anterolateral accessory portal, created 4 cm distal to anterolateral portal. (B) NanoPass device (Stryker) passes No. 1 suture at base of chondrolabral junction. (C) Probe reduces chondrolabral junction after base pass of suture. (D, E) Labrum is tensioned with probe. Second apex pass of NanoPass device to complete base stitch.

area, and identify the intra-articular pathology. After the intra-articular pathology is addressed, a radiofrequency Ambient HIPVAC 50 Coblation Wand (Smith & Nephew) is used to expose the acetabular rim and subspine as indicated. Acetabuloplasty or subspine decompression is performed, and then a primary repair or refixation of the labrum is performed. We do not routinely detach the labrum for acetabular rim trimming. A crucial step here is to expose a bleeding surface to which the labrum can be repaired. If the rim is sclerotic, or the rim cannot be removed because of underlying low acetabular coverage, we prefer to obtain the bleeding surface with a microdrilling device (Stryker) that is routinely used for acetabular microfracture.

Labrum quality is used to determine which repair method to use. A hypertrophic labrum is debulked. The acetabular rim is seldom resected >3 mm, but, when it is, the newly exposed cartilage is removed. We have found that >3 mm of residual cartilage prevents refixation of the labrum directly to the bone and may interfere with anatomical positioning. When a labrum is <3 mm in width or will not hold a base technique, repair stability is the priority, and a looped method is used. A knotless anchor with No. 1 permanent suture designed for hip labral repair (CinchLock; Stryker) is our first-line anchor choice. A distal anterolateral accessory (DALA) portal is created with an outside-in technique, and anchors are drilled through this portal into zones 2 to 4 (**Figures 2A-2E**). For far medial anchor placement, the anchor drill guide is offset in an attempt to avoid iatrogenic psoas irritation or medial wall penetration. The socket is visually inspected before anchor insertion to confirm complete bony insertion. In the rare case in which a small part of the medial aspect of the anchor is exposed toward the psoas, this part of the anchor is carefully resected with a burr without disrupting anchor fixation or the suture in the anchor. For posterior anchor placement, the AL portal is cannulated and used for far lateral drilling. The MAP and the DALA portal traditionally are cannulated for repairs in zones 2 to 4. With visualization through the AL portal, the probe is used to apply tension on the labral segment being repaired for reduction. A suture-passing device (NanoPass; Stryker) is used to pass (with base stitch technique) the No. 1 suture for the anchor, and the acetabular (base) side of the No. 1 suture is marked with a methylene blue marker. The key is to make the first pass of suture at the base of the chondrolabral junction. The probe is then used to apply tension on the labrum and to reduce the labrum to the chondrolabral junction through the MAP. The second pass of the suture-passing device is through the labrum apex, and the suture is retrieved. Care is taken to make sure the suture is on equal sides of the labral apex to avoid labrum distortion (Figures 2A-2E).

A 2.4-mm drill guide is advanced through the

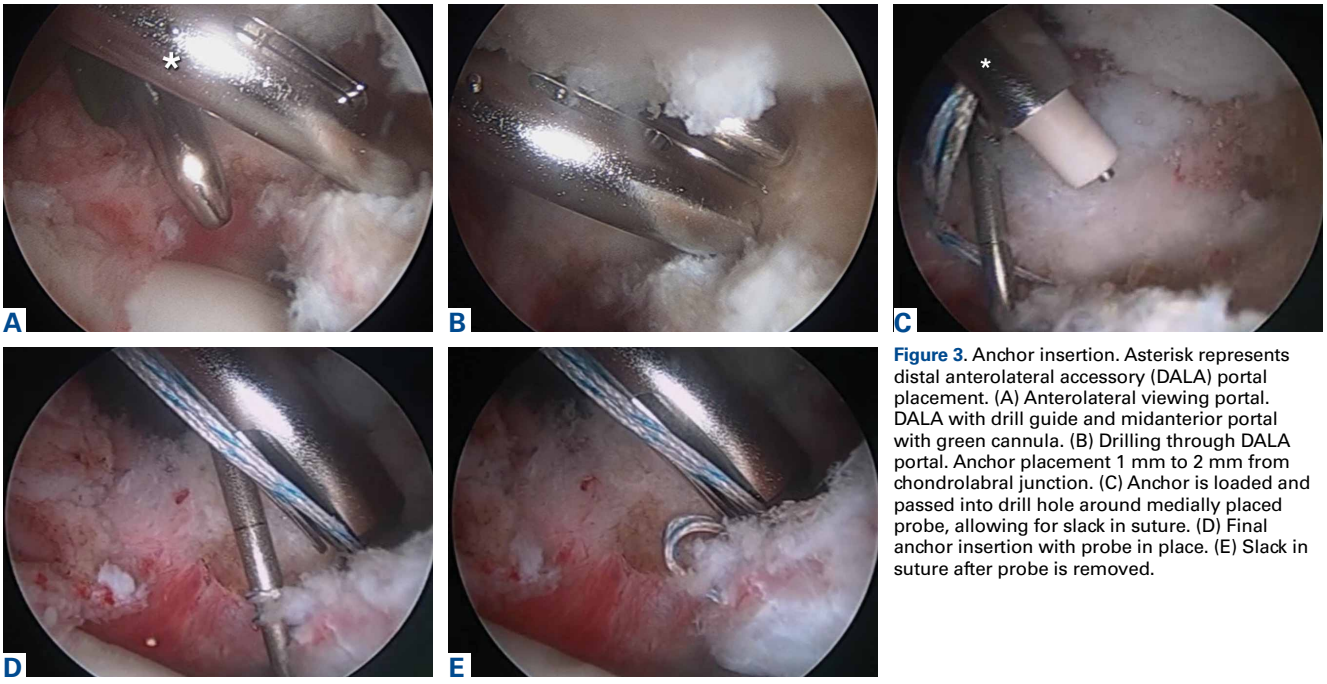

Figure 3. Anchor insertion. Asterisk represents distal anterolateral accessory (DALA) portal placement. (A) Anterolateral viewing portal. DALA with drill guide and midanterior portal with green cannula. (B) Drilling through DALA portal. Anchor placement 1 mm to 2 mm from chondrolabral junction. (C) Anchor is loaded and passed into drill hole around medially placed probe, allowing for slack in suture. (D) Final anchor insertion with probe in place. (E) Slack in suture after probe is removed.

DALA portal and placed in the appropriate position for drilling. We aim for 1 mm to 2 mm from the chondrolabral junction. Next, the probe is placed intra-articular and medial to the anchor insertion site, and the anchor is loaded and then inserted around the probe (**Figures 3A-3E**). The probe allows the suture to remain free for independent tensioning. We then remove the probe and independently tension the suture ends. Gentle pulling on the marked suture end and then on the unmarked side allows for proper labrum inversion-eversion as needed, and the device is deployed. If the capsular side of the labrum does not lie flat against the bone, the nonmarked end is tightened to position the labrum so that, when the base stitch is tightened, the tissue is compressed against the bone to maximize healing. For a standard 3-cm repair, it is routine to use 3 or 4 anchors placed 6 mm to 8 mm apart (**Figures 4A-4D**).

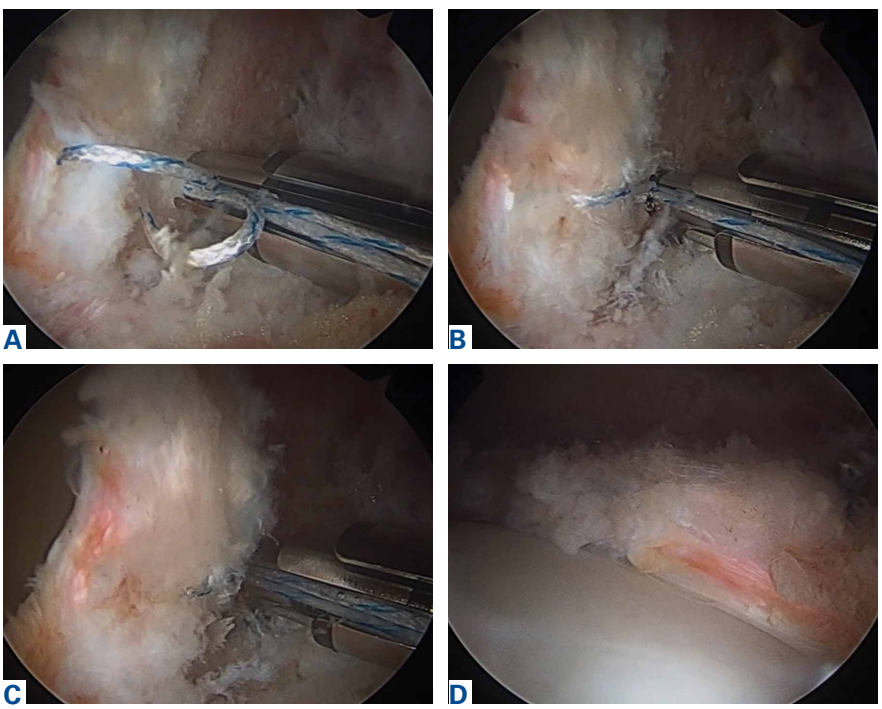

Figure 4. Anatomical reduction. (A) Suture slack in probe after insertion. (B) Marked base side of suture is initially tensioned. (C) Apex pass. Unmarked end of suture is tensioned secondarily. Final anatomical reduction. (D) Suction seal restored.

The hip is then reduced. If indicated, a T-capsulotomy is performed for femoral osteochondroplasty. Routinely, the capsule is anatomically repaired with the Injector II Capsule Restoration System and No. 2 permanent suture. The **Table** presents our technical pearls.

Postoperative Care

Patients are placed in a postoperative hip brace and use a continuous passive motion machine 6 hours a day for 2 weeks, and an ice machine. They

Table. **Technical Pearls for Labral Repair**

Technical Pearl	Rationale
Perform proper preoperative work-up: physical examination, intra-articular injection response, volumetric interpolated breath-hold examination (VIBE) rendering on 3.0 Tesla magnetic resonance imaging	Confirms intra-articular source of pain and identifies cause of labral tear
Use No. 1 suture for labral fixation	Increases precision and management of small labra
Place base suture against rim	Sets up spacing for second suture pass Allows for control of base reduction Allows for suture to cross and secure chondrolabral junction
Use probe to reduce labrum	Assists in ideal suture placement Facilitates recognition of labral apex
Pass mattress suture on equal sides of labral apex	Keeps labrum from becoming distorted during tensioning Avoids twisting of labrum with multiple anchors (suture through different planes of labrum)
Create distal anterolateral accessory portal	Facilitates optimal positioning for anchor placement Allows anchor to be placed closer to edge of rim
Keep slack in suture when inserting anchor	Keeps suture loop loose for proper tensioning Prevents excessive eversion
Preferentially pull base suture	Reduces chondrolabral junction Prevents excessive eversion

maintain 30 lb of foot-flat weight-bearing for 3 weeks, and begin a standard labral repair protocol on postoperative days 3 to 7.

Discussion

Hip labral preservation has evolved over the past 10 years, and current options for labral management include excision, débridement, labralization, repair, and reconstruction.[1-13] Labral excision was studied by Miozzari and colleagues,[8] who postulated on the basis of animal models that the labrum may regenerate. In their series of 9 patients treated with surgical hip dislocation and labral excision at average 4-year follow-up, repeat magnetic resonance angiography revealed no regeneration of tissue—modified Harris Hip Score was 83. The hip scores were less than those of patients treated with the same procedure with repair, and the authors concluded that defining labral débridement versus excision in the literature, and treating patients with primary repair or reconstruction techniques, may lead to better results. Their study used a small sample and was limited to an open procedure. Arthroscopic labral débridement in isolation was also a poor option for treatment of a labral tear. In a 2-year follow-up of 59 isolated labral débridement procedures, Krych and colleagues[9] found 47% combined poor results.

There is level I evidence of the importance of labral repair. In 2013, Krych and colleagues[7] conducted a randomized control trial of 38 female patients who underwent hip arthroscopy for FAI. At time of surgery, patients were randomly assigned to either débridement or repair. At 1-year follow-up, activities of daily living and Sports specific Hip Outcome Scores were statistically significantly superior in the repair group. On a subjective scale, 94% vs 78% of patients reported normal or near normal hips in the repair versus débridement groups respectively. Ayeni and colleagues[20] performed a systematic review of 6 studies in an attempt to develop labral management recommendations. Five of the studies (N = 490 patients total) had improved results with labral repair over reconstruction. Although the studies had a low level of evidence, they found a trend toward improved results with labral repair. These studies highlight the importance of labral preservation and proper FAI management.

Techniques for labrum repair have advanced as well—from a looped suture technique to a base stitch and knotless independent tensioning.[11-13] Restoration of the hip labrum function as a suction

seal, fluid circulator and anatomic capsular repair is paramount to excellent results and stresses the importance of performing an anatomic labral repair.[1-6] Knotless anchor repair is not novel and has been previously described. Fry and Domb[12] reported on a knotless labral repair technique that uses push-lock devices (Arthrex) that do not allow for independent tensioning. Inversion-eversion was introduced to the literature by Moreira and colleagues,[13] who described an independent tensioning technique that uses speed-lock anchors (Smith & Nephew). Our technique differs in that it involves a DALA portal; labral reduction and tensioning with a probe assist to ensure the second pass of the base stitch is at the apex of the labrum; and use of No. 1 instead of No. 2 suture. Although seemingly subtle, these differences allow for proper anchor placement nearer the rim, additional support in achieving precise suture placement, and less disruption of small labra. These differences are particularly relevant for smaller labra.

Evaluating repair techniques on the basis of high-evidence literature is challenging. In a matched-cohort study of 220 patients, Jackson and colleagues[21] compared 2 techniques: looped and base stitch. At 2-year follow-up, patients in both groups showed improvement, and there was no statistically significant difference in patient-reported outcome measures between the groups. Sawyer and colleagues[22] studied the outcomes of 326 consecutive patients who underwent looped, pierced, or combined labral repair at an average 32-month follow-up. The groups' revision rates were comparable, each group improved in postoperative patient-reported outcomes, and the pierced group had significantly higher preoperative scores on the Western Ontario and McMaster Universities Osteoarthritis Index. These studies described a base or pierce repair that did not differ from a looped repair, though the techniques did not allow for independent tensioning to re-create an anatomical inversion-eversion repair and may have altered the reported outcomes.

Our current technique uses independent tensioning of the repair to allow control of labrum inversion-eversion to give an anatomical repair with restoration of the suction seal. Preoperative planning, addressing the FAI appropriately, proper suture-passing technique, controlling the labrum in inversion-eversion fashion, and anatomical labral repair are the elements of Dr. Mather's preferred method for preserving the native labrum and allowing it to assume its native function.

Future Directions

As our understanding of FAI and labral function evolves, labral preservation surgery continues to advance. With surgeons continually developing new techniques and following up on previous techniques, the ability to preserve the native hip with lasting procedures evolves as well. Proper identification of the underlying cause of the labral tear and proper anatomical repair are paramount to the success of FAI surgery.

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