



Arthroscopic Treatment of Femoroacetabular Impingement Using Labral Reconstruction with Capsular Autograft

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Abstract: The acetabular labrum is essential for stability during physiologic motion of the hip. Labral repairs frequently are attempted in cases of primary tears, although labral reconstruction is an important alternative in the revision setting or in the primary setting when the tissue is unsalvageable. Labral reconstruction has been shown to restore the hip's suction-seal and fluid pressurization to that of the pre-morbid state, and cohort studies have demonstrated significantly improved patient-reported outcomes at midterm follow-up. Notably, the cost is of consideration during any reconstruction, and techniques have been described using both allograft and autograft sources. Autograft sources include the iliotibial band, ligamentum teres, gracilis tendon, and hip capsule. A previously described technique using the capsule was noted to hinder routine capsular closure. We present an alternative method for labral reconstruction using hip capsular tissue that is easily performed and allows for routine capsular closure.

Many clinical and technical advances have been made in the subspecialty of hip arthroscopy in recent years.¹ Many of these have focused on the repair or reconstruction of the acetabular labrum. It has become apparent that the labrum is critical to both dynamic stability and maintenance of a fluid suctional seal during physiologic movement.^{2,3} In particular, loss of the suction seal, either by chronic degeneration or

iatrogenic means, can cause rapid degeneration and the development of osteoarthritis.²⁻⁴ Although labral repairs are commonly performed in the primary setting for patients with femoroacetabular impingement (FAI), labral reconstruction may be necessary for patients with severe injury or hypoplastic labra.⁵⁻⁸ Reconstruction may also be considered in the revision setting for patients with insufficient or inadequate tissue quality following debridement or attempted repair when FAI symptoms persist or recur.⁹

Multiple techniques have been described for labral reconstruction using both autograft and allograft sources.¹⁰⁻¹³ Although no randomized controlled trials have been performed comparing the effectiveness of one particular technique, mid-term outcomes appear promising for many.⁸ In particular, autograft sources appear ideal in consideration of the immunological advantage of native tissue as well as the potential cost savings. Matsuda¹³ and Philippon et al.¹⁴ previously described techniques using the iliotibial band and gracilis tendon, respectively. The potential use of hip capsular tissue is promising because it limits the need for a second surgical site. Domb et al.¹² have published a technique using capsular tissue, similar to the present technique but reported inadequate capsular closure as a specific limitation. Herein, we present an alternative method for labral reconstruction utilizing hip capsular

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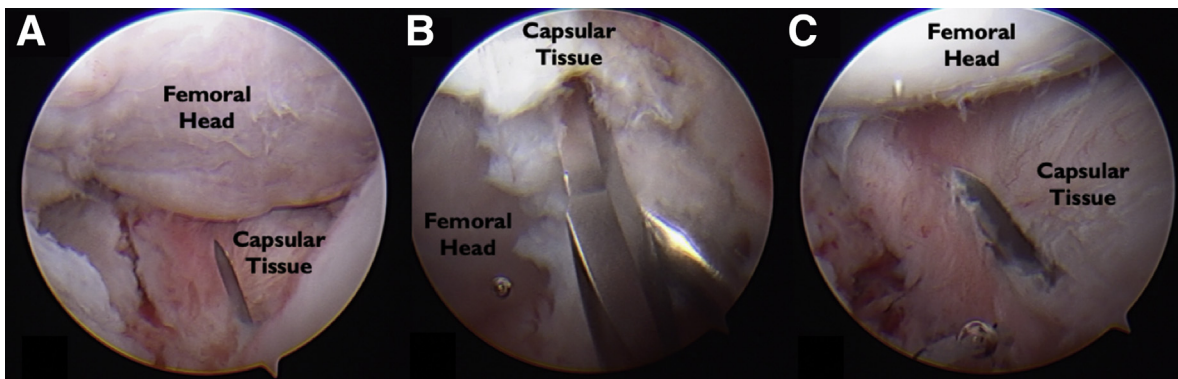


Fig 1. View from midanterior portal of patient undergoing right hip arthroscopy. (A-C) The arthroscopic scalpel being used through the anterolateral portal to longitudinally incise a portion of the capsule from the interportal capsulotomy for the autograft.

tissue that is easily performed and allows for routine capsular closure.

Surgical Technique (With Video Illustration)

Indications and Preoperative Imaging

While labral repair restores function of the native tissue and has been shown to produce favorable outcomes, there are settings in which labral reconstruction or augmentation is required.¹⁵ Reconstruction must be considered in the revision setting, as patients may have inadequate tissue as well as in patients with hypoplastic labra, ossified labra, or irreparable labra tears. Standard radiography can diagnose FAI, but magnetic resonance imaging is required to diagnose a labral tear and assess the status of the labrum and capsule.

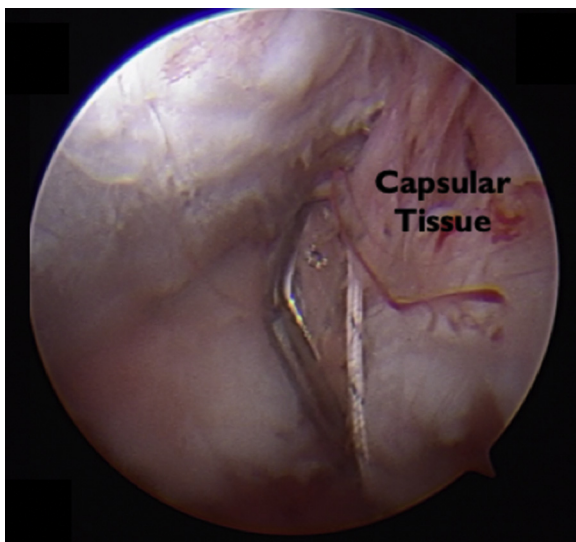


Fig 2. Arthroscopic image showing a traction stitch placed in the distal aspect of the interportal capsulotomy to maximize visualization the peripheral compartment in a right hip in the supine position.

Patient Positioning

The patient is positioned supine on a traction table (Smith & Nephew, Memphis, TN) with a well-padded perineal post. General anesthesia is administered, including muscle relaxation. The operative limb is placed in 20° of abduction and 20° flexion, manually distracted, and then adducted across the perineal post to neutral adduction and flexion. Adequate distraction of the femoroacetabular joint is confirmed radiographically, and the hip is internally rotated to 45° for maximal femoral length.

Arthroscopic Technique

Following sterile preparation of the lateral hip, the patient is draped. The anterior superior iliac spine is marked along with a line extending to the patella to demarcate a safe operating zone. The greater trochanter is outlined as well. A standard anterolateral (AL) portal is created under fluoroscopic guidance, entering the joint at the 12-o'clock position. Articular access is confirmed with a 70° arthroscopic, which is used to guide creating a modified mid-anterior portal at the 2-o'clock position. After appropriate portal placement is confirmed, an interportal capsulotomy is created with a Samurai arthroscopic scalpel (Pivot Medical, Sunnyvale, CA). A diagnostic arthroscopy is performed to evaluate the status of the labrum, femoral and acetabular cartilage. The capsulolabral recess is reflected to visualize and the labrum and bony pincer.

Acetabular Preparation

After confirmation of a nonsalvageable labrum, an arthroscopic shaver is used to debride remnant tissue. A healthy, viable labrum is left behind when possible, favoring existing tissue augmentation over complete reconstruction. A 5.5-mm arthroscopic burr is used to address the pincer morphology when necessary and create a bleeding bony bed along the acetabular rim to aid in graft incorporation.

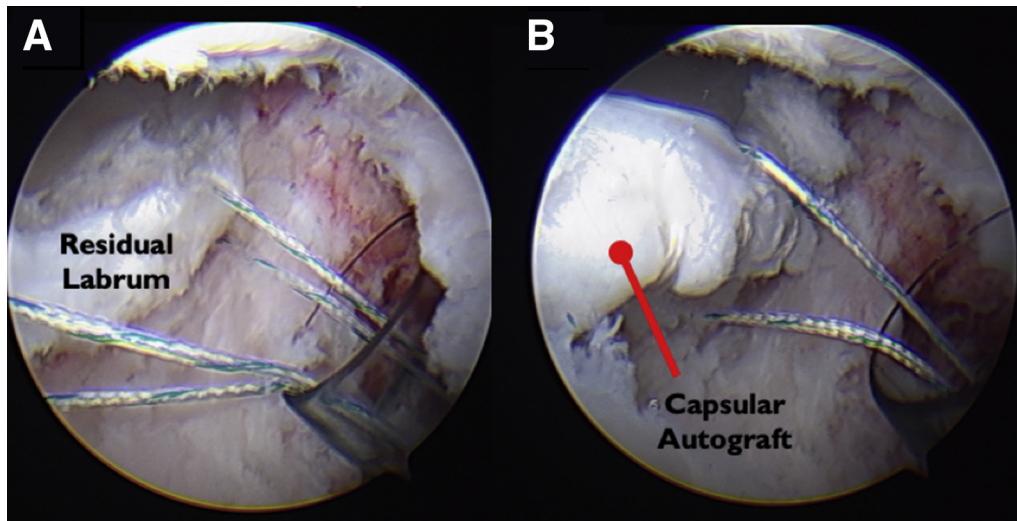


Fig 3. (A, B) Arthroscopic images of a total of 3 suture anchors are placed along the acetabular rim through the anterolateral portal in a right hip in the supine position.

Graft Harvest

A distal anterolateral accessory (DALA) portal is created percutaneously under direct visualization. When viewing from the mid-anterior portal, a layer of fat is debrided from the anterior capsule to aid in visualization. An interportal capsulotomy is created, and capsular laxity is assessed. In revision procedures

where it is felt that an excessively large interportal capsulotomy was created primarily, graft is harvested from the femoral leaflet of the capsulotomy. This preserves the acetabular-sided capsule for later closure. In a primary setting, or a revision in which a more routine interportal capsulotomy can be performed, a T-capsulotomy is then created from the center of the primary capsulotomy extending distally along the neck. The arthroscopic scalpel is then used to remove a crescent-shaped segment of capsule approximately 5 mm in width and long enough to span the labral defect from either T-limb of the capsulotomy (Video 1 and Fig 1).

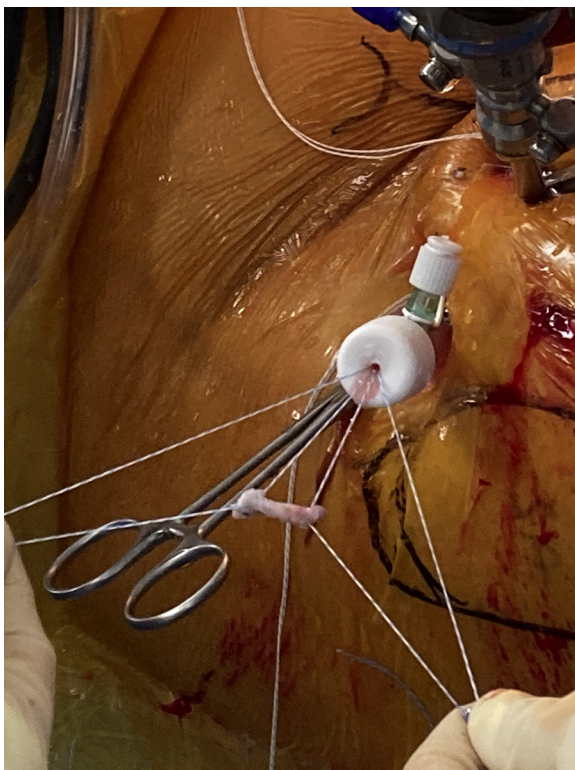


Fig 4. The capsular autograft is prepared, and using the “Kite” technique, is passed through the anterolateral portal in a right hip.

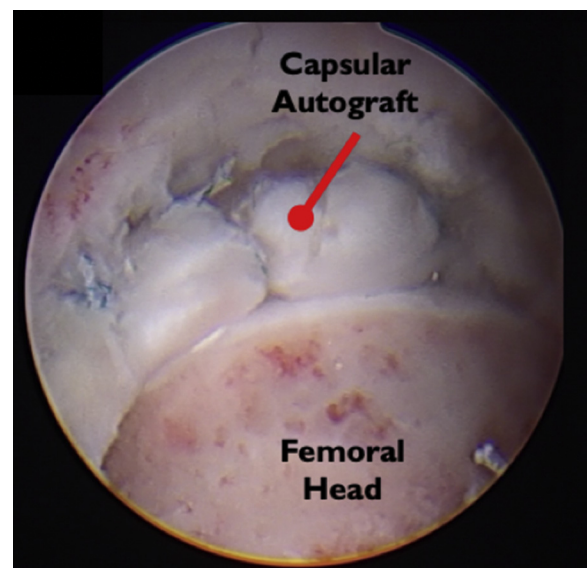


Fig 5. Arthroscopic image of the dynamic examination of the labral reconstruction in all planes to evaluate graft position and the fluid suction seal to ensure restoration of an adequate seal to the femoral head.

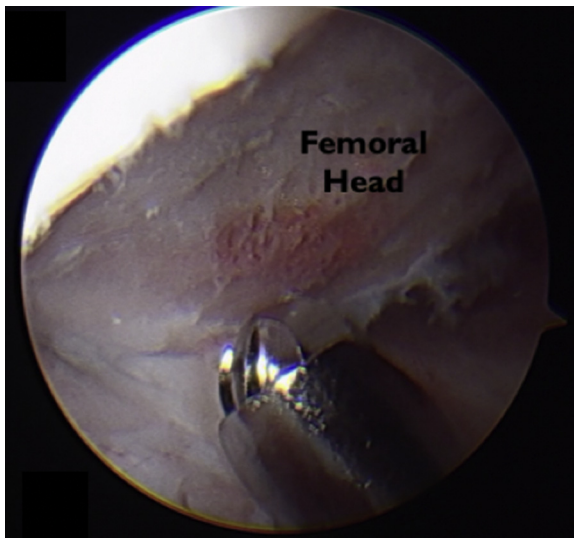


Fig 6. Arthroscopic image of a femoral osteochondroplasty performed in a patient with right hip femoroacetabular impingement syndrome.

The autograft is then prepared on the back table as previously described.¹⁰ Two traction sutures are placed along the length of the T-capsulotomy (Video 1 and Fig 2).

Anchor Placement and Graft Fixation

Our technique for labral reconstruction has previously been described.¹⁰ In short, an 8.5- × 90-mm cannula is placed in the AL portal, through which two 1.4-mm anchors are placed at the anterior and posterior aspects of the labral defect (Video 1 and Fig 3). Care is taken to ensure that the articular surface is not violated. Exact autograft length is confirmed using a specialized superior capsular reconstruction guide (Arthrex,

Naples, FL) walked along the acetabular rim from anterior to posterior. Additional anchors are then placed along the acetabular rim at 10-mm intervals for future graft fixation.

A free needle is used to pass one limb from each of the most anterior and posterior anchors through capsular autograft (Video 1 and Fig 4). These are placed such that, when positioned, the smooth surface of the autograft edge without suture material sits on the articular margin. Mulberry knots are placed to prevent graft slippage from the free sutures, the ends of which are used to shuttle the graft into place. The graft is then secured to the acetabulum at the anterior end with standard arthroscopic half-hitch knots. This step is then repeated at the posterior end of the graft. The remaining suture anchors are then passed around the graft and secured to the acetabular rim in a standard fashion. Traction is released, and the reconstruction is evaluated dynamically in all planes to evaluate graft position and fluid suction seal (Video 1 and Fig 5).

Osteoplasty and Capsular Plication

Following the traction release, the hip is flexed to 40°, and the peripheral compartment is examined. An arthroscopic injector device (Injector; Pivot Medical) is then used to reflect the capsule with the aid of 2 No. 2 high molecular-weight polyethylene sutures. At this point, an arthroscopic femoral osteochondroplasty is performed using a 5.5-mm, burr between the lateral and medial synovial folds (Video 1 and Fig 6). A combination of fluoroscopic guidance and dynamic hip examination confirms sphericity and the removal of bony pathology.

A capsular plication is performed along both the vertical and interportal arthrotomies. An 8.5- × 110-

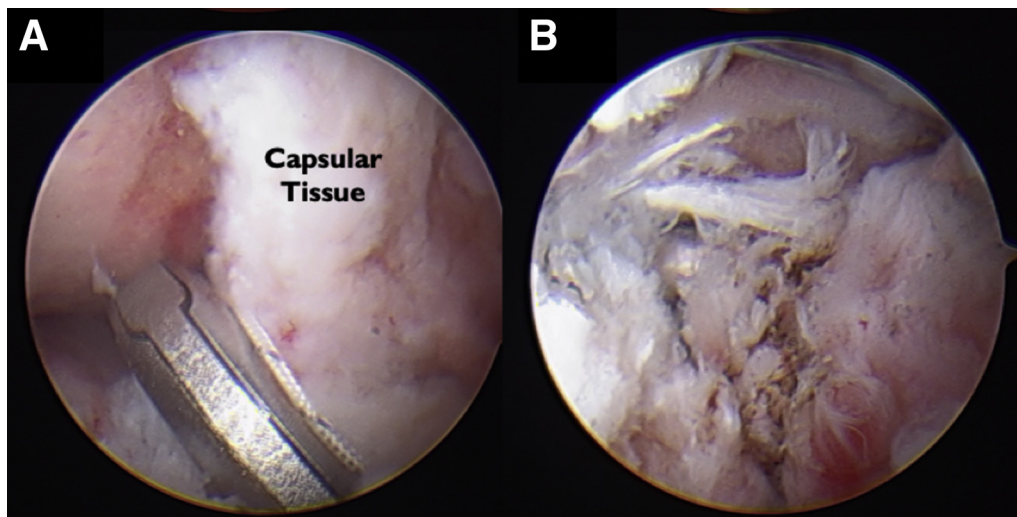


Fig 7. (A, B) Arthroscopic image of a capsular reconstruction performed until the femoral head is no longer visualized in a right hip in the supine position. An Injector through the anterolateral portal is used to close the lateral aspect of the interportal capsulotomy while the medial portion is closed using the distal anterolateral portal.

Table 1. A Guide for Labral Reconstruction Via Capsular Autograft

Preoperative planning	1. The possibility of labral reconstruction should be considered in cases of severe injury or hypoplastic labra as well as any revision hip arthroscopy.
Acetabular preparation	2. Confirm that the labrum is nonsalvageable and then debride down to viable labrum.
Capsular autograft harvesting	3. A burr should be used to prepare a bleeding bony bed to aid in graft incorporation.
Labral reconstruction	4. Afterward, an arthroscopic scalpel is used to remove a crescent-shaped segment of capsule from either the femoral leaflet of the horizontal capsulotomy or the "T" portion. 5. Experienced assistants can help prepare the graft after harvest.
Capsular plication	6. An anchor is placed at the anterior and posterior ends of the labral defect. 7. A specialized superior capsular reconstruction guide allows for accurate sizing of the autograft. 8. Additional anchors are placed at 10-mm intervals. 9. A large cannula is needed to pass the graft into the joint via the "Kite" method. 10. The autograft is secured to the acetabulum at the anterior end with standard arthroscopic half-hitch knots. 11. Capsular plication is performed along both the vertical and interportal capsulotomies with the vertical portion being closed first. 12. Dynamic examination should be performed to confirm that no femoral head articular cartilage is visible.

mm plastic cannula is placed in the DALA portal. The vertical portion of the T-capsulotomy is closed first, beginning at the iliofemoral ligament base using a Slingshot suture passer (Pivot Medical) loaded with a No 2 high molecular-weight polyethylene suture. Care is taken to ensure that full-thickness bites through each limb and the sutures are tied using standard arthroscopic tying techniques. The vertical portion of the T-capsulotomy is typically closed with 2 to 4 sutures. The interportal capsulotomy is repaired next. The Injector is placed through the AL portal to close the lateral aspect of the interportal capsulotomy by passing the suture through the capsule's acetabular limb and then through the lateral leaflet of the iliofemoral ligament (Video 1 and Fig 7). In the same fashion, the Injector is used to close the medial aspect of the interportal capsulotomy by passing a suture through the acetabular limb and then through the medial leaflet of the iliofemoral ligament using the DALA portal. With the capsule repaired, the femoral head articular cartilage should no longer be visible (Fig 7).

Postoperative Rehabilitation

Rehabilitation begins on postoperative day 1 and lasts approximately 16 to 18 weeks. The patient is restricted to 20-pound flat-foot weight-bearing with the assistance of crutches and uses a hip brace for the first 3

postoperative weeks. Patients are weaned off crutches at 3 weeks, and core-strengthening exercises are started. The focus from weeks 3 to week 6 is to restore normal gait. At 6 weeks, open- and closed-chain exercises are begun along with the advancement of range of motion. At 12 weeks, running on an antigravity treadmill was permitted with the focus on progressing to sport-specific activities at week 16.

Discussion

Hip labral reconstruction via capsular autograft is an effective technique when a labral deficiency is encountered, both in the primary and revision setting. The present technique describes our preferred method of capsular autograft harvest, preparation, and implantation (Table 1). Arthroscopic labral reconstruction, segmental reconstruction, and augmentation continue to be prevalent in hip arthroscopy, with excellent patient-reported outcomes.^{8,16} However, the graft source (allograft vs autograft) and location of the graft used (iliotibial band, gracilis, tibialis anterior) continue to vary based on surgeon preference.^{9,11-14} While it is thought that autograft tissue may be preferable for improved biologic healing, there can be considerable donor-site morbidity associated with graft harvest of the patients' ipsilateral hamstring or iliotibial band.¹⁷

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
A burr should be used to create a bleeding bony bed along the acetabular rim to enhance graft incorporation.	Technically challenging procedure.
A specialized superior capsular reconstruction guide should be walked along the acetabular rim from anterior to posterior to confirm exact autograft length and anchor placement.	The length of graft that can be harvested is limited by the size of the capsulotomy.
Harvesting the autograft from the femoral leaflet of the horizontal capsulotomy, or the "T" portion of the capsulotomy allows for normal capsular closure at the end of the case.	The capsule may be of inadequate quantity or quality for adequate harvest in cases in which capsular deficiency is present.

The present technique is advantageous because it does not require an additional incision or graft harvest to perform, and it uses the patients' capsular tissue for labral reconstruction or augmentation (Table 2). In our experience, an approximately 2- to 3-cm graft can easily be obtained. Domb et al.¹² also have proposed a technique in which autograft capsule is used for labral reconstruction for small segmental labral deficits. However, in this technique, there was concern regarding the ability to close the capsule. This technique varies from the present technique in that capsular tissue is left in situ and the acetabular leaflet from the horizontal capsulotomy is used to reconstruct or augment a deficient labrum.¹² While effective, this leaves the surgeon unable to close the capsule. Our technique relies on harvesting a strip of the capsule from the femoral-sided horizontal leaflet, or "T" portion of the capsulotomy rather than the acetabular aspect, allowing for normal capsular closure after the reconstruction and subsequent osteochondroplasty. Because most patients typically have excess capsule due to their underlying deformity, we have yet to encounter a situation in which the capsule could not be closed following this procedure.

In addition to using local autograft tissue, an additional advantage of our technique is the graft prep and passage are familiar to surgeons already performing reconstruction with other grafts. Following graft harvest, the graft is prepared similarly to other labral reconstruction grafts¹⁸; the graft is whip stitched and tubularized with absorbable suture. Shuttleing is also performed similar to existing techniques, with our preference to pass the graft into the joint via the "Kite" method, using 2 mulberry knots on the free end of sutures from the anterior and posterior-most anchor and transporting the graft into the joint by tensioning the reciprocal ends of the anchor sutures.¹⁹ Despite the relative ease and lack of modifications to what may already be a familiar procedure for the operating surgeon, this technique is not without limitation. Because we are harvesting autograft from the existing horizontal, or new T capsulotomy, the length of graft that can be harvested is limited by the size of the capsulotomy, leading us only to recommend this technique in the case of segmental defects less than approximately 3 cm in length.

In addition, in revision cases in which capsular deficiency is present, the capsule may be of inadequate quantity or quality for adequate harvest. This procedure also may be technically challenging to perform, particularly for inexperienced hip arthroscopists or those who are less adept at capsular management, and attempts at harvest could lead to large, irreparable capsular defects if done poorly. Lastly, surgeons may be reticent to use capsular autograft in patients with connective tissue disorders, as the tissue may be abnormal at baseline.

Despite some potential limitations, we believe that our labral reconstruction technique with capsular autograft is a viable option for patients with normal capsular tissue and a small or segmental area of labral deficiency or insufficiency.

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