Technical Note

Arthroscopic Triple Reconstruction in the Hip Joint: Restoration of Soft-Tissue Stabilizers in Revision Surgery for Gross Instability

Hari K. Ankem, M.D., Samantha C. Diulus, B.S., Mitchell B. Meghpara, M.D., Philip J. Rosinsky, M.D., Jacob Shapiro, M.D., David R. Maldonado, M.D., Ajay C. Lall, M.D., M.S., and Benjamin G. Domb, M.D.

Abstract: Gross hip instability in an active adult with previous normal hip anatomy is usually due to disruption of the static stabilizers of the hip joint. Although such a disruption can result from a high-grade injury, it can be iatrogenic after previous hip arthroscopy. The patient may present with a painful limp and recurrent subluxation sensation in the affected hip joint. Revision hip arthroscopy in this scenario is generally complicated, and it is not uncommon for all the soft-tissue stabilizers to be compromised. The labrum, ligamentum teres (LT), and capsule of the hip joint are often so damaged that reparation is not an option. Reconstruction of the torn LT is an established method to add secondary stability while addressing the labral pathology in the hip joint with microinstability. Concomitant reconstruction of all the static restraints has yet to be described addressing triple instability. This Technical Note presents a stepwise approach, including tips and pearls, for arthroscopic triple reconstruction of the labrum, LT, and capsule. We believe this method is a safe and reproducible way to effectively treat gross hip instability in young patients.
Gross hip instability in an active adult with previous normal hip anatomy is usually due to disruption of the primary and secondary stabilizers of the hip joint.\textsuperscript{1-3} Although such a disruption can result from a high-grade injury, it can be iatrogenic after previous hip arthroscopy.\textsuperscript{4-11} The patient usually presents with a painful limp and recurrent subluxation of the affected hip that may result in frequent falls. Furthermore, the patient may give a history of spontaneous dislocation of the hip during sleep, requiring emergency reduction. Repetitive injury from either the patient’s recreational activities or prior arthroscopic exploration of the hip joint is sometimes forthcoming in the narrative.\textsuperscript{4-11} Alternatively, the patient might sustain a secondary traumatic incident that could then trigger the train of events that followed primary hip arthroscopy.

Recent advances in arthroscopic hip preservation have led us to better understand the roles of various static stabilizers in maintaining the hip’s suction seal.\textsuperscript{12-14} A diagnostic workup with advanced imaging studies delineates the extent of soft-tissue injury and helps plan definitive surgical management. Soft-tissue deficiencies such as segmental labral defects, torn nonfunctional labra,\textsuperscript{15,16} complete ligamentum teres (LT) tears,\textsuperscript{17-19} and capsular defects after previous arthroscopic interventions\textsuperscript{20-23} are often noticed, in addition to secondary avulsion injuries. Generalized ligamentous laxity further increases the instability risk in these individuals.\textsuperscript{11,24,25}

Revision hip arthroscopy in this scenario is generally complicated, and it is not uncommon for all the soft-tissue stabilizers to be compromised.\textsuperscript{4-11} The labrum, LT, and capsule of the hip joint are often so damaged that reparation is not an option. Reconstruction of the torn LT has recently gained traction to add secondary stability while addressing the capsulolabral defects in the grossly unstable hip joint.\textsuperscript{17-19} Concomitant reconstruction of all the static restraints in the setting of complex instability (i.e., triple reconstruction) has yet to be described. This Technical Note presents a stepwise approach, including tips and pearls, for arthroscopic triple reconstruction of the labrum, LT, and capsule. We believe this method is a safe and reproducible way to effectively treat gross hip instability in young patients.

**Indications, Patient Evaluation, and Imaging**

The patient history could include prior hip arthroscopy after which a trivial trauma causes instability symptoms with repetitive subluxations and sometimes even an anterior hip dislocation. There could be significant hip pain limiting the patient’s activities of daily living that will be unresponsive to conservative management. Clinical examination findings are positive for hip impingement and anterior apprehension, suggesting hip instability. Radiographically, there may be a large cam morphology with a loose bony fragment representing capsular avulsion (Fig 1 A-C). Magnetic resonance arthrogram of the affected hip will show a labral tear with a capsular defect anterosuperiorly and a tear of the LT (Fig 1 D-G).

**Surgical Technique**

**Patient Preparation and Positioning**

After induction of general anesthesia, the patient is placed in the modified supine position on the traction extension table with a well-padded peroneal post, the genitalia protected, and the feet well secured.\textsuperscript{26} The operative hip and the contralateral iliac crest are prepared and draped in usual sterile fashion. Traction is applied to the hip under fluoroscopy.

**Fluoroscopic Technique**

The C-arm is positioned on the nonoperative side and draped in sterile fashion. A true anteroposterior radiograph of the pelvis is obtained by tilting the C-arm to compensate for the Trendelenburg inclination.\textsuperscript{26} A spinal needle is then introduced into the joint under fluoroscopy, and the joint is vented, achieving further distention.

**Portal Placement**

The anterolateral portal is created with a No. 11 blade. The spinal needle is reinserted to ensure avoidance of the labrum and femoral head. An over-the-guide wire technique is used to place a 70° arthroscope through a 4.5-mm cannula. This same technique is repeated to place a 5-mm cannula through the midanterior portal. A Beaver blade (BVI Medical, Waltham, MA) is used to perform an interportal capsulotomy, incising the intact part of the capsule parallel to the acetabular rim to connect the 2 portals. In addition, a distal anterolateral accessory portal is made to provide a better angle for capsular elevation and capsular closure.

**Diagnostic Arthroscopy**

Diagnostic arthroscopy of the hip, when performed, may show the presence of a labral tear (Seldes type I or II)\textsuperscript{27} (Fig 2A) that might not be reparable. Varying grades of acetabular labrum articular disruption (ALAD) and/or Outerbridge acetabular cartilage lesions of significant dimensions (grade 2 or above)\textsuperscript{28} can be identified in the 1-to 3-o’clock zone. Additionally, there may be a femoral head cartilage lesion of varying dimensions (Outerbridge grade 2 or above)\textsuperscript{28} in the 9- to 11-o’clock zone consistent with anterior instability (Fig 2 B and C). An anterior capsular defect may be present that will enable us to see the iliopsoas tendon easily in the foreground, along with
a full-thickness tear of the LT that may coexist (Fig 2). Occasionally, a loose body may be identified, which could have resulted from an acetabular rim fracture. In the peripheral compartment, there may be a residual cam morphology that can be visualized.

Loose Body Removal
The loose body, if identified, is removed using an arthroscopic grasper. Remnant suture material from the suture anchors of the previous labral repair, if found, is also removed.
Arthroscopic Rim Trimming and Femoroplasty

After the capsule is elevated using an ablator radiofrequency wand, acetabular rim trimming is performed with a 5.5-mm burr under fluoroscopic guidance to create a bleeding edge of bone and encourage healing. Next, the arthroscope and a curved shaver are moved into the peripheral compartment as the traction is released, and the hip is flexed to 45°. Femoroplasty is then performed using a 5.5-mm burr with extensive fluoroscopic visualization.29

Arthroscopic Labral Reconstruction With Allograft

Traction is reapplied. The irreparable labrum is removed, and the rim is prepared. An allograft (tibialis posterior tendon) is taken to the back table and prepared in a single-stranded fashion. The anterior end of the graft is anchored first at the 5-o’clock zone, near the anterior end of the transverse acetabular ligament. The graft is then secured with anchors placed sequentially from anterior to posterior, using a total of 6 anchors (1.8-mm knotless FiberTak; Arthrex, Naples, FL). The excess graft is cut off with the Beaver blade and pulled out through the posterolateral portal. Excellent restoration of the continuous labrum is achieved in this fashion (Fig 3, Video 1).15,16

Arthroscopic LT Reconstruction With Allograft

The torn LT stump is debrided using an ablation device. A distal inferolateral incision is made, and a trans-trochanteric bone tunnel is drilled over a guidewire exiting through the foveal footprint of the LT under biplanar fluoroscopic guidance. The soft tissue is removed from the cotyloid fossa with the shaver and ablation device, and the LT footprint is decorticated with the burr to create a bleeding bed of bone for healing. A double-stranded tibialis posterior tendon allograft is prepared. The fixation on the acetabular side is kept ready by passing two 1.8-mm knotless FiberTak anchors in a posteroinferior direction at the inferior end of the cotyloid fossa in the footprint of the LT attachment. A passing suture is placed through the anterior portal and retrieved through the femoral tunnel. The graft is then introduced through the anterior portal. The graft is cinched

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Fig 2. Revision arthroscopic images of right hip. (A, B) Dry view showing labral tear with large capsular-labral separation and segmental defect (arrow) in 12- to 3-o’clock zone (A) and 8- to 12-o’clock zone (B). (C) Large capsular-labral separation (double-line arrow) and segmental defect (single-line arrow) (1- to 4-o’clock zone). (D) Arthroscopic view of right hip showing completely torn ligamentum teres with remnants (arrows). (E) Deficient anterosuperior joint capsule (black arrows). The iliopsoas tendon (Ip, white arrow) is easily seen in the foreground at the bottom of the image. Orientations are marked for reference. (Ac, acetabulum; Ant, anterior; Caps Def, capsular defect; FH, femoral head; Inf, inferior; L, labrum; Lab Def, labral defect; LT Rem, ligamentum teres remnants; P, probe; Post, posterior; Sup, superior; TAL, transverse acetabular ligament.)
and secured to the footprint on the cotyloid fossa. The femoral side of the graft is then pulled into the femoral tunnel with the passing suture and fixed with a PEEK (polyether ether ketone) interference screw while the tension on the graft is maintained with the hip in 60° of external rotation. The graft is well positioned in this manner and verified to have appropriate tension when examined through internal and external rotation (Fig 4, Video 1).

**Arthroscopic Capsular Reconstruction**

The incompetent remnants of the capsule, including the involved parts of the iliofemoral ligament, are excised. The capsular defect is then...
measured using a measuring probe. A dermal allograft patch (Arthroflex; Arthrex) is sutured to the free edges of the native capsule using No. 2 SutureTape (Arthrex) to complete the capsular reconstruction. Excellent fill of the capsular defect is achieved in this fashion (Fig 5, Video 1).31

Fig 4. Revision arthroscopic images of acetabular floor in right hip. (A) Completely torn ligamentum teres with remnants (arrows) (Fig 2D repeated for orientation). (B, C) Ligamentum teres reconstruction with hip in neutral rotation (B) and hip in full external rotation (C), showing ligamentum teres fibers’ differential tensioning. The arrows indicate the acetabular fossa. (Ac, acetabulum; FH, femoral head; Inf, inferior; LT Rem, ligamentum teres remnants; LT Recon, ligamentum teres reconstruction; Post, posterior; TAL, transverse acetabular ligament.)

Fig 5. Revision arthroscopic images of right hip. (A) Complete anterosuperior capsular defect area in center and top of image (Fig 2E repeated for orientation). (B-D) Initial steps of capsular reconstruction using dermal allograft (with femoral head at bottom of images). (E) Final step of capsular reconstruction. (F) Triple reconstruction of soft-tissue stabilizers of hip (labral reconstruction, ligamentum teres reconstruction [LT Recon], and capsular reconstruction) (artistic rendering). (Ac, acetabulum; Ant, anterior; Caps def, capsular defect; Caps Rem, capsular remnant; Caps Recon, capsular reconstruction; FH, femoral head; Ip, iliopsoas; L, labrum; Lab Recon, labral reconstruction; P, probe; Post, posterior; Sup Med, supramedial.)
often, iatrogenic from prior arthroscopy with non-dysplastic hip is either post-traumatic or, more strongly believe that to effectively manage this type of patient, it is important to recognize complex instability in the setting of revision hip arthroscopy.

A painful limp and a feeling of recurrent subluxation in the affected hip joint are the usual mode of presentation owing to disruption of all the static stabilizers. The primary stabilizers of the hip joint are the capsuloligamentous structures, whereas the labrum and the LT act as secondary stabilizers. The hip joint labrum has proprioceptive and nociceptive functions and aids in load distribution. The aim of the different hip labral restoration techniques—repair, augmentation, or reconstruction—is to help maintain intra-articular fluid pressurization. Torn labra with viable tissue quality and good volume can be repaired to restore the transition zone and suction seal. However, it is not too uncommon for most of the

**Discussion**

This Technical Note describes our preferred method of treatment for triple hip instability if a patient presents with a defective hip joint capsule, labrum, and LT that require reconstruction (Video 1). Gross instability in a non-dysplastic hip is either post-traumatic or, more often, iatrogenic from prior arthroscopy with disruption of the soft-tissue stabilizers. While commenting on iatrogenic instability, Byrd identified 6 contributing factors. The patient may have all of these factors, placing him or her at increased risk of complex hip instability. First, there may be a loose fragment resulting from the capsular avulsion, putting the hip at risk of becoming under-covered. Second, the labrum may be diminutive, from either repeated injury or aggressive labral debridement during previous hip arthroscopy. Third, the LT could be completely torn. Fourth, there may be a capsular defect that might have resulted from either failed repair or excessive resection during prior arthroscopy in addition to violation from avulsion, resulting in a capsular breach. Fifth, the patient could have been preconditioned to be at risk owing to previous hip arthroscopy. Finally, a new traumatic injury could occur in the patient and could trigger the aforementioned cascade of events. We strongly believe that to effectively manage this type of patient, it is important to recognize complex instability in the setting of revision hip arthroscopy.

**Table 1. Indications and Contraindications for Arthroscopic Triple Reconstruction of Soft-Tissue Stabilizers in Hip Joint**

| Indications          | Contraindications                                      |
|----------------------|--------------------------------------------------------|
| Iatrogenic and complex triple hip instability with all 3 major static stabilizers compromised | Lack of experience with each reconstruction procedure |
|                      | Inadequate acetabular bony coverage                    |
|                      | Arthritis or significant chondral damage                |

**Closure**

The joint is lavaged and sucked dry of fluid. All instruments are withdrawn from the joint. The portals are closed using No. 3-0 nylon sutures. Steri-Strips (3M, St. Paul, MN) and sterile dressings are applied, and the hip is placed in a hip brace locked in 0° to 90° of flexion. The patient is safely awakened and extubated and is taken to the recovery room in stable condition.

**Postoperative Rehabilitation**

The patient is advised to remain partially weight bearing (20 lb) on the operated extremity using crutches for 6 weeks while continuing to wear the hip brace for postoperative stability for 6 weeks. Physical therapy begins the day after surgery, following all 4 phases as per our previously published protocol.

**Table 2. Advantages and Disadvantages of Arthroscopic Triple Reconstruction of Soft-Tissue Stabilizers in Hip Joint**

| Advantages                                                                 | Disadvantages                                           |
|---------------------------------------------------------------------------|----------------------------------------------------------|
| Addresses complex triple hip instability by restoring all static stabilizers | Technically demanding procedure with steep learning curve |
| Follows principles of restoration of anatomy                              | Potential for major complications with individual and combined procedures |
| Single-stage procedure                                                    | - Labral reconstruction: sciatic neurapraxia from traction (early) and/or iatrogenic dysplasia from over-resection |
|                                                                          | - Labral reconstruction: pelvic floor neurovascular injury (early) and/or stress injury to femoral neck |
|                                                                          | - Capsular reconstruction: abdominal compartment syndrome (early) and/or postoperative instability |

LT, ligamentum teres.

**Table 3. Pearls and Pitfalls for Arthroscopic Triple Reconstruction of Soft-Tissue Stabilizers in Hip Joint**

| Pearls                                                                 | Pitfalls                                      |
|-----------------------------------------------------------------------|----------------------------------------------|
| Femoroplasty before reconstruction                                      | Risk of prolonged surgery and anesthesia time |
| Multiple allografts simultaneously kept readily available in operating room | Complex nature of procedure with 3 major reconstructions |
| LT reconstruction first, followed by labral reconstruction and, finally, capsular reconstruction | Multiple allografts needed |
| Intermittent release of traction during and between the 3 reconstruction procedures | Steep learning curve |

LT, ligamentum teres.

**Table 4. Risk and Limitations of Arthroscopic Triple Reconstruction of Soft-Tissue Stabilizers in Hip Joint**

| Risks                                                                 | Limitations                                      |
|----------------------------------------------------------------------|--------------------------------------------------|
| Risk of sciatic nerve injury if traction time is prolonged            | Cost and availability of various graft sources   |
| Abdominal compartment syndrome if intra-abdominal fluid extravasation occurs | Inability to compensate for deficient acetabular bony coverage |

LT, ligamentum teres.
soft-tissue stabilizers to be grossly damaged and irreparable in the revision setting.

Reconstruction may be indicated for a degenerative labrum with a calcified or ossified labral segment or a labrum that is irreparably torn with nonviable tissue. Likewise, a hypertrophic labrum, a previously debrided labrum that is reduced in effective depth and volume, or a segmental defect that disrupts the labral seal may be addressed with labral reconstruction. Segmental labral reconstruction is an option when there is a missing section of labral tissue or a segment with no viable fibers. Circumferential labral reconstruction is a technically reproducible and reliable method that not only maintains continuous hoop stress circumferentially but also replaces potentially pain-generating damaged native labral tissue. However, it has a steep learning curve and is technically demanding.

In addition to the labrum, the capsuloligamentous structures are primary stabilizers that deter any dislocating force on the hip joint. After breakage of the suction seal, the capsule may be the most important structure resisting distraction. Various capsular management strategies concerning repair of the iliofemoral ligament and avoidance of zona orbicularis injury were described earlier in the literature and remain valid options in the primary hip arthroscopy setting. However, reports of iatrogenic hip dislocation or recurrent subluxation after hip arthroscopy may relate to underlying damage to the hip joint capsule from aggressive resection or inefficient capsular management strategies. The resulting capsular defect thus precludes definitive repair. Capsular reconstruction is a valid option in this setting, and different graft choices are available, each with its advantages and disadvantages. Finally, the role of the LT in adding to hip joint stability has been well recognized. Several studies have reported the efficacy of LT debridement, making it an accepted standard of care in earlier published reports. However, LT reconstruction has gained popularity recently. Reconstruction of the torn LT has become an established method to add secondary stability while addressing labral defects in hip microinstability.

Hip joint capsular defects, a completely torn LT, and an irreparable labrum together may present as a grossly unstable hip. We believe that our method is a safe and effective method that is reproducible when performed using the proper, stepwise technique for arthroscopic triple reconstruction of the labrum, LT, and capsule described in this article. There are some contraindications for this technique, as well as a few disadvantages, pitfalls, risks, and limitations, as addressed in Tables 1 through 4.

In conclusion, complex instability of the hip from combined damage to primary (capsuloligamentous structures) and secondary (labrum and LT) stabilizers can present as hip pain with recurrent subluxation. The cause of this type of presentation can be post-traumatic or, more often, iatrogenic after previous hip arthroscopy. Concomitant reconstruction of the damaged labrum, LT, and capsule is the definitive treatment for this type of triple instability. This approach not only ensures joint stability by restoring the anatomy but also prevents further damage to the articular cartilage.

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