Arthroscopic Capsular Reconstruction of the Hip With Acellular Dermal Extracellular Matrix: Surgical Technique

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Abstract: Atraumatic instability of the hip has become an increasingly studied occurrence in recent years. There are several established surgical techniques that help restore stability of the native hip joint. In some cases, these procedures are not an option. As the phenomenon has become recognized more frequently, a greater number of revision surgeries are warranted in patients with ligamentous laxity. A durable solution for irreparable microinstability needs to be formulated to address this vulnerable patient demographic. We describe the surgical technique for capsular reconstruction with acellular dermal extracellular matrix.

The hip is a ball-and-socket joint enveloped with a thick capsule and 170° of coverage of the femoral head.1 As the result of the aforementioned characteristics, this joint exhibits strong gross stability. It is thought, however, that microinstability in the hip can lead to both pain and dysfunction.2 The hip capsule is one of the static stabilizers of the joint, and it consists of the iliofemoral, pubofemoral, and ischiofemoral ligaments and the zona orbicularis.3 Repetitive injury to the anterior part of the joint and its capsular stabilizers may lead to iliofemoral strain. Chronic iliofemoral strain may progress to plastic deformity and capsular redundancy.4 This mechanism of hip microinstability ultimately may lead to labral injury and subsequent arthritic changes.5-7

In hip arthroscopy, most surgeons perform interportal capsulotomy to enhance mobility for maneuvering instruments. The capsule is closed in some surgeries at the end of the procedure. Capsular plication is performed to help stabilize the joint if the hip is unstable, such as in cases of borderline dysplasia or generalized ligamentous laxity; however, a capsular release is performed in stiff hips, such as those found in cases of arthritic hips or elderly patients.8

It has been shown that treatment of instability leads to favorable outcomes.9-11 A capsular reconstruction may be indicated if the capsule is needed to help stabilize the joint but there is not sufficient tissue to perform a plication. Cases of ligamentous laxity of the native tissue may not suffice for a plication. In addition the growing place of arthroscopy, often involving partial capsulectomy, leads to growing number of cases of revision hip arthroscopy which require treatment of capsular insufficiency.

We describe our technique for arthroscopic capsular reconstruction with acellular dermal extracellular matrix, propose the following indications for capsular reconstruction, and present a case report.

Surgical Technique

The technique is demonstrated in Video 1.

Patient Preparation and Portal Placement (1-4)

1. The patient is placed in the modified supine position on a traction table, in slight Trendelenburg, with a well-padded perineal post.
2. The joint is vented with a spinal needle to allow distraction.
3. Traction is applied to the operative leg at an average of 25-50 lbs.
4. The hip joint is accessed through the anterolateral, the mid-anterior, and the distal lateral accessory portals.

Diagnostic Arthroscopy and Treatment to Address Pathology (5-6)

5. A diagnostic arthroscopy is performed to assess the ligamentum teres, labrum, chondral damage, and labral size.
6. Procedures to treat the pathologies are performed according to the findings in the diagnostic arthroscopy.

Capsular Reconstruction (7-25)

7. Preparing the capsular surface comprises 2 procedures: debridement of the scar tissue where the capsule once was and decortication of the acetabular and femoral beds for a better graft incorporation.
8. After the traction is released, the capsular defect is measured with an arthroscopic measuring tool (Arthrex, Naples, FL) on the acetabular rim and on the femoral neck, from proximal to distal and medial to lateral.
9. Four SutureTak anchors (Arthrex) are placed in the corners of the capsular defect; 2 are anchored in the acetabular rim and 2 in the femoral neck (Fig 1).
10. The loose ends of all 4 sutures are pulled out through the distal lateral accessory portals.
11. The distances between each of the 4 anchors are measured with the arthroscopic measuring tool (Arthrex) (Fig 2).
12. A 1.5-mm thick Arthroflex (Arthrex) is kept in saline until it is used.

Fig 1. The Suture Tak anchor (Arthrex) is implanted into the femoral neck using the distal lateral accessory portal while being visualized with the camera in the anterolateral portal. This anchor will be used for the attachment of the Arthroflex (Arthrex) graft to the capsular defect zone. (A, Knotless Suture Tak Anchor [Arthrex]; DC, distal capsule; FN, femoral neck.)

Fig 2. Distance between the anchors is measured by the use of an arthroscopic measuring tool (Arthrex) to plan for appropriate allograft dimensions. (AC, acetabulum; FH, femoral head; S, suture.)

Fig 3. The Arthroflex graft (Arthrex) is prepared according to the measurements taken arthroscopically. The graft is cut to be 1 cm beyond the distances between the anchors.
13. The Arthroflex is marked after adding 1 cm in each direction from the anchor measurement.
14. The graft is trimmed to the planned size (Fig 3).
15. A dot is marked in the place where the anchors should be.
16. All sutures are maintained in the correct order, with special attention given to prevent knotting among strands.
17. The proximal and the distal sutures are different colors.
18. The posterior sutures are marked with the use of a marking pen to help with orientation.

19. The sutures are passed in a mattress formation through the 4 corners of the Arthroflex graft with a free needle in the particular order.
20. A sliding knot (Tennessee slider) is tied on each of the 2 proximal anchors.
21. The posts of both proximal sliding knots are pulled simultaneously through the distal lateral accessory portal to slide the graft towards both acetabular anchors (Fig 4).
22. The knots are tied down over the acetabular and the femoral attachments and are secured to all 4 corners of the graft (Fig 5).
23. To perform a side-to-side repair, fiberwire sutures are passed by the use of a hip scorpion (Arthrex) through the anchored graft and the remnant of the native capsule at the medial and lateral borders.
24. Two sutures are tied on the medial side and 2 on the lateral side.
25. The reconstructed capsule is assessed on all sides and extraneous tissue is debrided (Fig 6).

Table 1. Pearls and Pitfalls

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<th>Pearls</th>
<th>Pitfalls</th>
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<tr>
<td>Use acellular dermal matrix graft</td>
<td>Not maintaining suture order can create knotting among strands</td>
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<tr>
<td>Prepare the remnant capsule appropriately to suture it to the graft at the end of the procedure</td>
<td>Incorrect measurement of the capsular defect</td>
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<tr>
<td>Cut the graft to dimensions 1 cm beyond each anchor distance and trim to the planned lengths</td>
<td>Passing sutures through the wrong anchors will leave the graft rotated in the incorrect orientation</td>
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<tr>
<td>Place a dot on the graft where the anchors should be</td>
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<tr>
<td>Use different colors for the proximal and distal sutures and mark the posterior sutures with a marking pen</td>
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Fig 4. The Arthroflex (Arthex) graft is shuttled through the DLAP into the left hip joint while pulling the posts of the proximal sliding knots. (AL, anterolateral portal into which the camera is inserted to visualize the procedure; DLAP, distal lateral accessory portal; LH, left hip.)

Fig 5. The graft is sutured to the anchors placed in each of the 4 corners of the capsular defect. (AG, Arthroflex graft [Arthrex]; CR, capsular remnant.)

Fig 6. The reconstructed capsule is then assessed on all facets. (AG, Arthroflex graft [Arthrex].)
ultimately arthritis. It is vital to treat the hip capsule, which may play a role in the development of labral tears and instability, capsular reconstruction remains a technically challenging procedure. The advantages, risks, and limitations of this technique are summarized in Table 2.

The current literature suggests that microinstability may play a role in the development of labral tears and ultimately arthritis. It is vital to treat the hip capsule appropriately because of its key role in hip stability. The anterolateral aspect of the capsule is the thickest and when left unclosed can lead to microinstability. It has been previously shown that capsular repair may reduce the risk of dislocations after hemiarthroplasty and total hip arthroplasty. Several other studies also have shown that the hip capsule influences biomechanical and clinical stability in patients after total hip arthroplasty. Cooper et al. found that the thickest parts of the capsule in the acetabular origin are posteroinferior and superolateral and anterior at the femoral insertion. Bayne et al. performed a rotation and translation test in 13 cadavers before and after transverse capsulotomy. They showed that capsulotomy permits more rotation than translation in a neutral position and more rotation than translation in flexion. According to these results, they concluded that specific capsular management is indicated in hip arthroscopy. Shindle et al. showed that the hip joint is stabilized when anterior capsule fibers and the fibers of the zona orbicularis tighten in a screw-home mechanism during extension and external rotation. Myers et al. showed that anteroposterior translation and external rotation increased after creating incisions in a native hip’s labrum and iliofemoral ligament. Anteroposterior translation and external rotation were restored to normal ranges after the authors repaired both the labrum and iliofemoral ligament. Recently, Trindade et al. published a surgical technique for arthroscopic capsular reconstruction of the hip that incorporates an iliotibial band allograft.

Because these are the only capsular reconstruction reports in current literature, follow-up data, patient-reported outcomes, and clinical results must be reported to assess the efficacy of this procedure. Research to better characterize hip microinstability continues to grow, along with the formulation of appropriate treatment options. In addition, as the field of arthroscopy has continued to expand, a greater quantity of revisions demonstrating intraoperative capsular defects will be observed. As such, continuing to devise novel treatment options such as capsular reconstruction will be critical to the efficient treatment of hip instability.

### Table 2. Advantages, Risks, and Limitations

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<tr>
<th>Advantages</th>
<th>Risks</th>
<th>Limitations</th>
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<tr>
<td>• Treating hip instability when there is a defect in the capsule</td>
<td>• The minor risk of infection using an allograft</td>
<td>• Technically demanding technique</td>
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<td>• Using an allograft and reducing donor-site complications</td>
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The pearls and pitfalls of this technique are summarized in Table 1.

### Discussion

The purpose of this technique is to help regain joint stability. The technique replaces the capsular defect with acellular dermal extracellular matrix and secures the tissue to acetabulum, femur, and the capsular remnants. Although this technique is advantageous because of its novel use of an allograft to treat hip instability, capsular reconstruction remains a technically challenging procedure. The advantages, risks, and limitations of this technique are summarized in Table 2.

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### References

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