Creating and Closing the T-Capsulotomy for Improved Visualization During Arthroscopic Treatment of Femoroacetabular Impingement

Christopher L. Camp, M.D., Patrick J. Reardon, M.S., Bruce A. Levy, M.D., and Aaron J. Krych, M.D.

Abstract: Treatment of femoroacetabular impingement through an arthroscopic approach has gained widespread popularity in recent years. Although outcomes are generally favorable, one of the most common reasons for failure is incomplete resection of cam lesions of the femoral neck. As a result, the T-capsulotomy has been introduced as a method for improving access to the femoral head-neck junction, which is not always visible through a standard interportal capsulotomy. The T-capsulotomy has the benefits of improving arthroscopic visualization of the femoral neck, reducing overall fluoroscopy exposure for the patient and surgeon, and facilitating capsular plication. We present a reliable and efficient method for creating and repairing the T-capsulotomy. We routinely perform this technique in patients with cam lesions that are too large or too distal to safely visualize and decompress through an interportal capsulotomy.

The use of arthroscopic techniques to treat femoroacetabular impingement and other hip pathologies has been growing rapidly in recent years. As our understanding of these conditions advances, the procedures used to treat them are being improved and refined. Although favorable outcomes can be expected after hip arthroscopy in appropriately selected patients, one of the most common reasons for persistent symptoms is inadequate bony decompression. Insufficient resection can occur for many reasons, but one of the most common is lack of visualization or access to the pathologic region. This is particularly true on the femoral side. The hip is unique from other large joints in that arthroscopic treatment of intra-articular pathology typically requires a capsulotomy. The central compartment is generally accessible through an interportal capsulotomy, and small cam lesions near the femoral head can often be addressed through this approach. However, larger or more distal lesions may require additional exposure. To fully access these peripheral compartment lesions, a T-capsulotomy (also known as the T-cut) in line with the femoral neck may be necessary.

The vertical limb of the T-capsulotomy begins at the mid portion of the interportal capsulotomy and travels along the femoral neck as far distal as the vastus intermedius. It is centered between the iliocapsularis and gluteus minimus musculature, and when appropriately positioned, these muscles tend to retract the medial (iliocapsularis) and lateral (gluteus minimus) limbs of the capsule away from the femoral neck. In addition to improving access, the T-capsulotomy allows for increased capsular advancement or plication during repair when needed. Because of the significant contribution of the anterior capsule (iliofemoral ligament) to hip stability, it is recommended that the T-capsulotomy be repaired or plicated to reduce the risk of postoperative hip instability. This is also supported by multiple biomechanical studies that have shown increased laxity in the unrepaired hip capsule. The purpose of this report and Video 1 is to present a simple, reliable, and reproducible technique for creating and closing the T-capsulotomy in an efficient manner (Table 1) with minimal equipment required (Table 2). This technique allows increased peripheral compartment visualization, reduces reliance on fluoroscopy, and provides robust closure (Video 1).
Technique

Portal Placement

Our technique uses an anterolateral portal (ALP), midanterior portal (MAP), and distal anterolateral accessory portal (DALAP) (Fig 1). To begin, the ALP is created under fluoroscopic guidance. Once the hip joint is accessed, our preferred technique is to create the MAP and penetrate the capsule under direct arthroscopic visualization with a 70° arthroscope (Stryker Sports Medicine, Greenwood Village, CO). Once these portals are established, an interportal capsulotomy is created in the standard fashion (Fig 2A). With traction applied to the hip, adequate access to the central compartment is obtained for treatment of acetabular chondral injuries, labral deficiencies, and pincer lesions of the acetabulum. Very proximal or small cam deformities can typically be addressed through this interportal capsulotomy (Fig 2A); however, if the cam lesion is large, distal, or inadequately visualized, a T-capsulotomy is recommended.

T-Capsulotomy

To create the T-capsulotomy, the hip is gently flexed to 40° to relax the anterior capsule and iliofemoral ligament. This portion of the capsule is visualized from the MAP with the camera looking down the femoral neck. The iliocapsularis muscle should be identified along the medial surface of the capsule, and the gluteus minimus must be identified laterally. It is critical that this interval be clearly delineated. Once this interval is visualized, a DALAP is established under arthroscopic visualization, and an 8.0-mm cannula (hip length) (Arthrex, Naples, FL) is placed. A switching stick can be inserted in the DALAP and used to further define the intermuscular plane between the iliocapsularis and the gluteus minimus by gently sweeping the muscles from the central neck. This is then exchanged for a Samurai Blade (Pivot Medical [Stryker Sports Medicine]). Beginning proximally, the vertical limb of the capsulotomy is created, starting at the mid portion of the interportal capsulotomy. It travels distally and is centered along the femoral neck. It is acceptable to cut against the femoral neck because this region is not weight bearing and will be recontoured later. The T-capsulotomy is extended to allow adequate peripheral compartment visualization (Fig 2B). The medial and lateral limbs of the capsulotomy generally do not require retraction, but a switching stick can be used as a retractor through the accessory portal if needed.

Resection of Cam Lesion

Now that the femoral neck is exposed, attention is turned to resecting the cam lesion. To address the anteromedial region of the femoral neck, the hip is maintained in the flexed position. For lesions extending to the posterolateral region of the neck, the hip can be placed in slight abduction to relax the lateral capsule. With the hip in full extension and internal rotation, this region comes into view. After resection and contouring of the deformity with a high-speed, 5.5-mm round burr (Stryker Sports Medicine), the quality of the osteoplasty can be examined arthroscopically, fluoroscopically, and dynamically by taking the hip through a gentle range of motion (Fig 2C). Residual impingement can be addressed accordingly.

T-Capsulotomy Closure

Once the resection is completed, attention is turned to closure of the T-capsulotomy. The camera remains

Table 1. Key Points for T-Capsulotomy

| Point                                                                 |
|----------------------------------------------------------------------|
| Clearly develop and visualize the interval between the iliocapsularis and gluteus minimus before placing the cannula. |
| Extend the capsulotomy distally to the vastus intermedius to create 2 long capsular flaps with minimal tension for retraction. |
| Use a switching stick as a retractor if needed.                      |
| Reduce pump pressure to minimize fluid extravasation.               |
| Be certain to obtain secure capsular repair to minimize the risk of postoperative hip instability.                         |
| Consider routine use of heterotopic ossification prophylaxis with anti-inflammatory medications.                          |

Table 2. Equipment Required

| Equipment                                      |
|------------------------------------------------|
| Standard arthroscopy equipment including cannulas |
| Pivot Samurai Blade                            |
| 90° penetrating SutureLasso                    |
| Sharp tissue-penetrating suture grasper (BirdBeak) |
| No. 2 permanent or absorbable suture           |

Fig 1. The anterolateral portal (ALP) is just anterior and proximal to the greater trochanter and is created under fluoroscopic guidance. The midanterior portal (MAP) is created under arthroscopic guidance when viewing from the ALP. The distal anterolateral accessory portal (DALAP) is placed just anterior to the femur and creates a nearly equilateral triangle with the MAP and ALP. The anterior superior iliac spine (ASIS) has been labeled for reference.
Fig 2. (A) When viewing the left hip from the anterolateral portal, the femoral head (FH) can be visualized after the interportal capsulotomy is complete, but the distal extent of the cam lesion is difficult to identify because of the overlying capsule (C). (B, C) Once the T-capsulotomy has been created, the cam lesion is easily identified between the medial limb (ML) and lateral limb (LL) of the capsule (B) before and (C) after osteoplasty.

Fig 3. (A) While viewing from the midanterior portal, the SutureLasso (SL) can be seen penetrating the distal aspect of the lateral limb (LL) of the capsule. The lasso is then advanced toward the medial limb (ML) of the capsule. (B) A sharp tissue-penetrating BirdBeak (BB) suture passer is advanced through the ML and grabs the SutureLasso. This is subsequently retrieved through both capsular limbs and out the distal anterolateral accessory portal. (C) A suture is then shuttled back through both limbs using the SutureLasso. (D) Finally, the knots are tied arthroscopically.
in the MAP, and standard arthroscopy cannulas of at least 8 mm in diameter are inserted into the ALP and DALAP. Closure proceeds from distally to proximally. The 90° SutureLasso (Arthrex) is inserted through the ALP and passed through the distal portion of the lateral limb. The lasso is advanced into the articular space and left in place (Fig 3A). A sharp tissue-penetrating suture grasper (BirdBeak; Arthrex) is inserted into the DALAP and used to penetrate the distal aspect of the medial capsular limb. If simple repair is being performed, the suture grasper is passed directly across from the SutureLasso. If plication of the capsule is desired, the point of penetration can be advanced as needed. Once through the medial limb, the grasper is used to grab the free SutureLasso (Fig 3B). The lasso is then retrieved through the medial capsular limb and out the DALAP. A No. 2 suture (absorbable or permanent per the surgeon’s discretion) is then shuttled into the lasso and pulled out through the ALP (Fig 3C). Both free suture ends can be retrieved through the DALAP for suture management. A second suture is then passed in the same fashion approximately 1 cm proximal, followed by a third. Three sutures are typically sufficient to provide robust closure, but additional sutures can be used when needed. Knots are then tied arthroscopically in a distal-to-proximal fashion (same order in which they were placed) (Fig 3D). Generally, these knots are all tied at the end, but they can be tied after passing each suture. Sequential knot tying may speed up the repair, but it runs the risk of closing down the capsule distally, making the proximal repair difficult. Once the T portion of the capsulotomy is closed, the interportal portion can be repaired as necessary.

Postoperative Rehabilitation

Activity after surgery is determined primarily by the portion of the procedure performed within the central compartment (cartilage treatment, labral repair, and so on). In patients undergoing T-capsulotomy, capsular repair is performed routinely. For these patients, we recommend restricting hip extension and external rotation for 4 weeks postoperatively to prevent unnecessary stress on the repair.7 Some authors have noted an increased risk of heterotopic ossification (HO) in cases where a T-capsulotomy had been performed, but the incidence of HO can be reduced by adding prophylaxis.8 We prefer to administer long-acting indomethacin for 4 days after surgery.

Discussion

With the increased use of hip arthroscopy to treat femoroacetabular impingement, techniques that improve access, exposure, and outcomes continue to evolve. As our understanding of this entity advances, the contribution of the capsule to hip stability is also becoming better elucidated. It is now evident that the capsule is a key stabilizer of the hip joint, and as a result, many surgeons are now repairing the capsulotomy routinely.1,2,4-9 Use of the T-capsulotomy has the benefits of increasing arthroscopic visualization of the femoral neck, reducing radiation exposure from fluoroscopy, and facilitating plication when needed. It has the potential downsides of creating iatrogenic instability if not repaired properly, permitting fluid extravasation into the thigh, and possibly increasing the risk of HO. Generally, it is thought that the risk of HO formation may be reduced with repair of the capsule, but this notion has recently been called into question.10

Ultimately, an effective and reliable method of accessing the femoral neck during hip arthroscopy is desirable for surgeons treating patients with femoroacetabular impingement. When precise steps are followed, the described technique can be performed in a safe and efficient manner (Table 1). It allows for robust closure, which should be performed routinely. We use this technique for T-capsulotomy in patients with large or distal cam lesions that are difficult to visualize solely through the interportal capsulotomy. Although repair is performed routinely after the T-capsulotomy, plication or capsular advancement may be considered in patients at risk of instability.

References

1. Frank RM, Lee S, Bush-Joseph CA, Kelly BT, Salata MJ, Nho SJ. Improved outcomes after hip arthroscopic surgery in patients undergoing T-capsulotomy with complete repair versus partial repair for femoroacetabular impingement: A comparative matched-pair analysis. Am J Sports Med 2014;42:2634-2642.
2. Bedi A, Galano G, Walsh C, Kelly BT. Capsular management during hip arthroscopy: From femoroacetabular impingement to instability. Arthroscopy 2011;27:1720-1731.
3. Chow RM, Engasser WM, Krych AJ, Levy BA. Arthroscopic capsular repair in the treatment of femoroacetabular impingement. Arthrosc Tech 2014;3:e27-e30.
4. Domb BG, Philippon MJ, Giordano BD. Arthroscopic capsulotomy, capsular repair, and capsular plication of the hip: Relation to atraumatic instability. Arthroscopy 2013;29:162-173.
5. Martin HD, Savage A, Braly BA, Palmer JJ, Beall DP, Kelly B. The function of the hip capsular ligaments: A quantitative report. Arthroscopy 2008;24:188-195.
6. Myers CA, Register BC, Lertwanich P, et al. Role of the acetabular labrum and the iliofemoral ligament in hip stability: An in vitro biplane fluoroscopy study. Am J Sports Med 2011;39:855-918 (suppl).
7. Spencer-Gardner L, Eisichen JJ, Levy BA, Sierra RJ, Engasser WM, Krych AJ. A comprehensive five-phase
rehabilitation programme after hip arthroscopy for femoroacetabular impingement. Knee Surg Sports Traumatol Arthrosc 2014;22:848-859.

8. Bedi A, Zbeda RM, Bueno VF, Downie B, Dolan M, Kelly BT. The incidence of heterotopic ossification after hip arthroscopy. Am J Sports Med 2012;40:854-863.

9. Harris JD, Slikker W III, Gupta AK, McCormick FM, Nho SJ. Routine complete capsular closure during hip arthroscopy. Arthrosc Tech 2013;2:e89-e94.

10. Amar E, Warschawski Y, Sampson TG, Atoun E, Steinberg EL, Rath E. Capsular closure does not affect development of heterotopic ossification after hip arthroscopy. Arthroscopy 2015;31:225-230.