Technical Note

Capsular Management in Hip Arthroscopy: Interportal and T-Capsulotomy, Suspension, and Closure

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Abstract: Capsular management in hip arthroscopy has recently become a popular topic in the literature. Various approaches have been developed around the critical balance between safe and satisfactory exposure while maintaining hip joint stability and the restoration of capsular integrity at the conclusion of the case. Advocates for capsular closure recognize the role of the capsule in providing hip joint stability and aim to reestablish normal hip biomechanics through capsule preservation. Several recent studies have also shown capsular management strategies to influence both clinical outcomes and risk of revision surgery. We present an effective method for capsular management in hip arthroscopy that consistently allows excellent exposure and working space while allowing for facile, anatomic closure.

Hip arthroscopy has become an established, minimally invasive approach to address both osseous and soft-tissue pathologies about the hip. As in open surgery, obtaining safe and satisfactory exposure is a cornerstone of arthroscopic hip surgery.

Capsulotomies are employed to visualize and instrument intra-articular and periarticular pathology, and several capsular management techniques exist in the hip, with the aim of maximizing exposure and working space, while minimizing operative time and disruption of native tissue restraints. An interportal capsulotomy is created between typical anterolateral and modified anterior portals, while a T-capsulotomy entails creation of a longitudinal capsular incision extending down the femoral neck from the center of the interportal capsulotomy. Previous studies have suggested that a T-capsulotomy allows for the creation of potentially smaller interportal capsulotomy, while permitting complete visualization between the medial and lateral retinacular perfusing branches and access to the head-neck junction as distal as the intertrochanteric line.[1] Access can be further optimized through the use of suspension sutures, which is clinically relevant given that failed hip arthroscopic surgery is often the result of inadequate soft tissue and osseous correction, usually due to suboptimal access and visualization.[2,3] At the conclusion of arthroscopy, T-capsulotomies can be repaired with side to side sutures and offer the opportunity for advancement of the capsular edges, providing plication when indicated.

Hip capsular anatomy has been well described, and biomechanical studies have demonstrated its significance in maintaining hip joint stability.[4] Conversely, iatrogenic hip instability following hip arthroscopy has been attributed to capsular insufficiency.[5] Given this, capsular management is not just important for access but also for closure, given that several studies have shown capsular repair to restore hip biomechanics and optimize outcomes.[6]

In the following surgical technique and video (Video 1), we present an effective method for capsular management in hip arthroscopy that consistently allows excellent exposure and working space, while allowing for facile, anatomic closure at the conclusion of the case.

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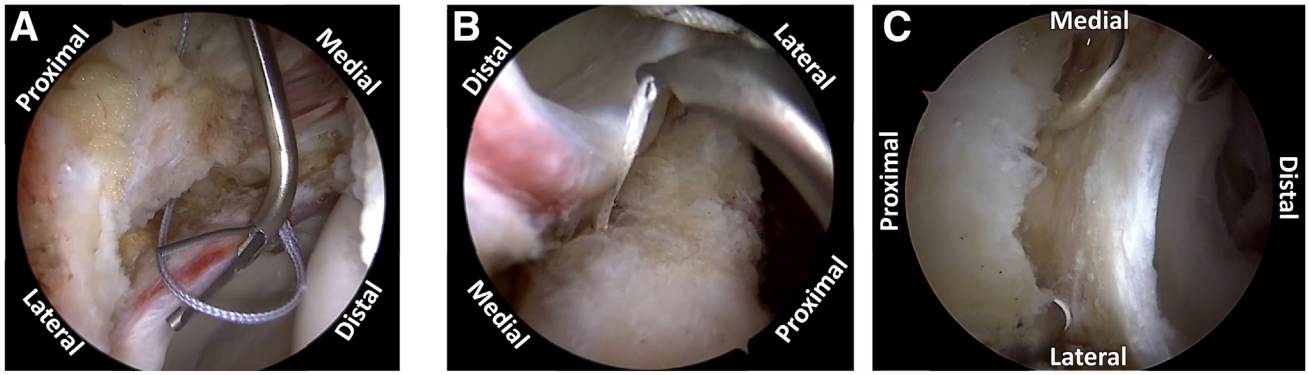

Fig 1. Central compartment suspension. 70° suture passer retrieving medial (mid-anterior portal) (A) lateral (anterolateral portal) (B) suspension sutures. (C) Central compartment exposure following tensioning of suspension sutures.

Surgical Technique

Accessing Hip Joint

The patient is positioned supine on a lower extremity suspension table with a perineal post and the feet placed into padded boots. Traction is applied and a standard scalpel handle is utilized to confirm 10-12 mm distraction.

Successful preparation for capsular closure at the completion of the case starts at the time of initial access and interportal capsulotomy. Under fluoroscopic visualization, a standard anterolateral (AL) portal is created, penetrating the capsule at the 12 o-clock position. Care is taken to stay outside the labrum and be distal in the capsule (~1 cm from the acetabular rim) to allow for future repair of the proximal and distal leaflets. While viewing from the AL portal, needle localization is used to establish a modified mid-anterior portal (MAP) with an outside-in technique, penetrating the capsule at the 2 o-clock position. Again, special attention is taken to ensure that the MAP is established distal in the capsule, near but not in contact with the femoral head, as to leave a satisfactory proximal acetabular cuff of capsular tissue for future repair. The inner stylet of the needle is exchanged for a 1.2-mm nitinol wire and then exchanged for a 5-mm arthroscopic cannula (Flowport II, Stryker Sports Medicine, Greenwood Village, CO). Viewing is switched to the MAP portal, thus ensuring that initial AL access was distal to the labrum, with a satisfactory acetabular cuff for subsequent repair.

Interportal Capsulotomy & Central Compartment Suspension

An arthroscopic scalpel (Stryker Sports Medicine, Greenwood Village, CO) is introduced through the AL portal, ensuring the avoidance of any iatrogenic chondral damage. The capsulotomy is extended by ~5 mm posteriorly beyond the 12:00 position. Viewing is switched to the AL portal, and the arthroscopic scalpel is used to complete the capsulotomy between the two portals, resulting in a 15–20 mm capsulotomy and leaving a cuff of capsular tissue on the acetabular side to aid in complete capsular closure at the conclusion of the case.

Using a combination of a 4.2-mm straight shaver (CoolCut, Arthrex, Naples, FL) and radio frequency ablator (50-S Sweep, Stryker Sports Medicine, Greenwood Village, CO), the edges of the capsulotomy can be

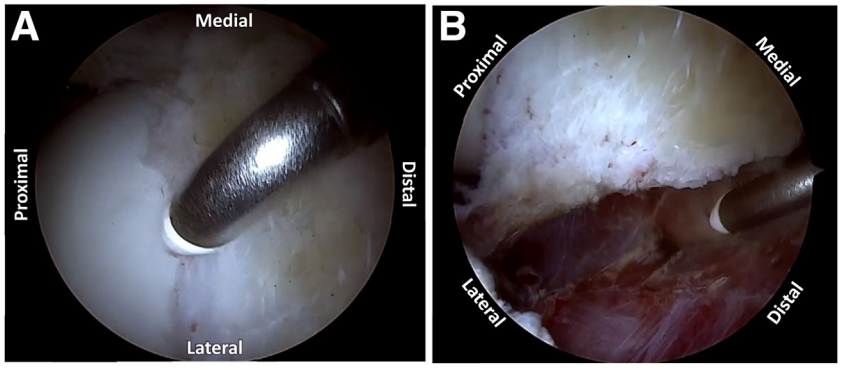

Fig 2. (A) Peripheral compartment exposure viewing from the anterolateral portal. (B) Working from the distal anterolateral accessory portal with a radiofrequency ablator, the anterior capsular surface is cleared of the overlying indirect insertions of the gluteus minimus, which are mobilized from the anterolateral capsule.

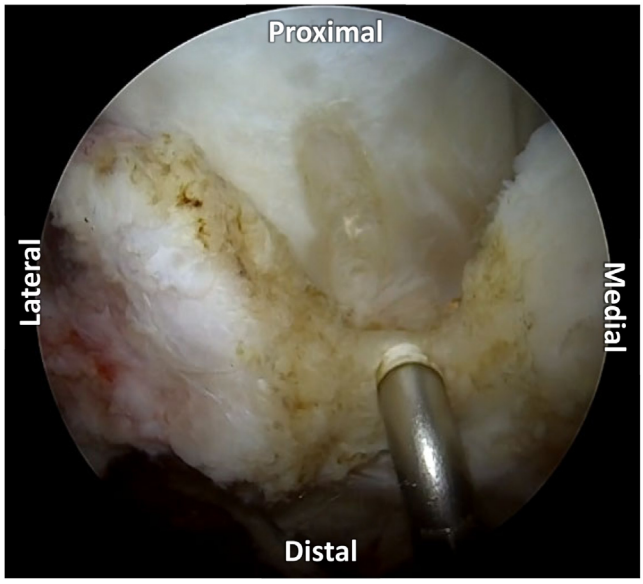

Fig 3. T-capsulotomy viewing from the mid-anterior portal. The vertical limb of the T-capsulotomy is created with a radio frequency ablator through the distal anterolateral accessory portal.

cleaned of any frayed edges, taking care not to resect or ablate away capsular tissue.

Working percutaneously from the MAP, a #2 high molecular-weight polyethylene suture is passed using a 70° suture passer and then subsequently retrieved and tensioned outside the body with a hemostat. This is then repeated posterolaterally, working percutaneously from the AL portal to pass, and then retrieve and suspend a second suture. Suspension in this manner provides excellent visualization of the acetabular rim for subsequent central compartment work, including labral repair, which is completed at this stage (Fig 1).

Peripheral Compartment Exposure

Following completion of central compartment procedures, we are ready to begin peripheral compartment exposure (Fig 2). The anterior capsular surface is cleared of overlying tissue with a combination of the radio frequency ablator and 4.2-mm shaver, again taking special care to preserve capsular tissue and only remove overlying adipose and connective tissue. We employ the radio frequency ablator to mobilize the native indirect insertions of the gluteus minimus to the capsule anterolaterally, working from a distal anterolateral accessory (DALA) portal and viewing from the AL portal. Traction is let down, and the hip is flexed to 30°.

T-Capsulotomy & Peripheral Compartment Suspension

Once capsular exposure is complete, we are ready to proceed with our T-capsulotomy. A Wissinger rod is used to place a 5.0-mm cannula into the MAP portal, as this is our preferred viewing portal for creation of the vertical limb of the T-capsulotomy, allowing a view down and along the femoral neck. A radio frequency ablator instrumented through the DALA portal is employed to palpate the medial and lateral aspects of the femoral neck and then mark our capsulotomy superficially on the capsular tissue, ensuring we do not harm the underlying proximally based articular surface. Subsequently, the capsulotomy is performed in line with the femoral neck and the iliofemoral ligament fibers with the radiofrequency ablator, extending to just proximal to the zona orbicularis (Fig 3).

Maintaining our view from the MAP, a 70° suture passer is used percutaneously through the DALA portal to first pass and then retrieve a #1 Vicryl suture through the medial leaflet of the T-capsulotomy. This is held under tension externally with a hemostat. Suture passage is then repeated, passing, and then retrieving a suture this time through the lateral leaflet of the T-capsulotomy and working percutaneously through the AL portal (Fig 4). We find that we can optimize the line of pull of the lateral leaflet by localizing a proximal anterolateral accessory (PALA) portal with a needle and then percutaneously retrieving the previously passed lateral T-capsulotomy

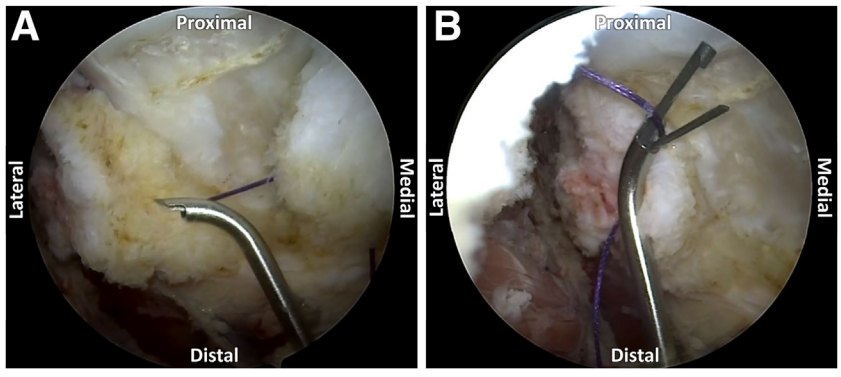

Fig 4. Peripheral compartment capsular suspension viewing from the mid-anterior portal. 70° suture passer retrieving #1 Vicryl from the medial leaflet through the distal anterolateral accessory portal (A) and from the lateral leaflet through AL portal (B).

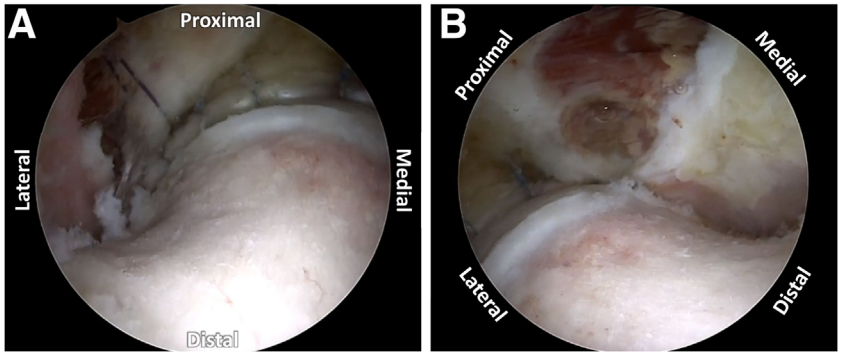

Fig 5. Peripheral compartment exposure. Peripheral compartment exposure following T-capsulotomy and subsequent femoral osteochondroplasty, with suspension sutures viewing laterally (A) and medially (B).

sutures with a 10° up-suture passer and tensioning these with a hemostat.

Subsequently, an excellent view of the femoral neck is obtained, allowing for peripheral compartment work, including femoral osteochondroplasty to proceed under direct visualization.

Capsulotomy Closure

After completion of femoral osteochondroplasty through the visualization provided by our T-capsulotomy and suspension sutures (Fig 5), we are ready to proceed with capsular closure. Viewing from the MAP, a Wissinger rod is placed in the axilla of the vertical limb of the T-capsulotomy from the DALA portal, and an 8.5 × 110 mm cannula (CLEAR-TRAC, Smith & Nephew, Watford, UK) is introduced over it. A #2 high molecular-weight polyethylene suture is passed across the medial and lateral leaflets of the capsulotomy distally, tied, and then cut (Fig 6). This is then repeated, progressing proximally until the vertical limb of the T-capsulotomy has been completely repaired, usually employing 3-4 sutures in total.

We now view the lateral extent of the interportal capsulotomy from the MAP and place our Wissinger rod and then the 8.5-mm cannula through the AL portal. A suture is passed through the acetabular cuff of the interportal capsulotomy with a 70° suture passer and then retrieved through the distal cuff, tied, and cut (Fig 7).

We now view from the AL portal and introduce a Wissinger rod, followed by the 8.5-mm cannula into the MAP. We first place a suture far medially across the acetabular cuff, then retrieve it through the distal cuff, using the 70° suture passer. Generally, we place a second, more lateral suture across the acetabular and distal cuffs in the same fashion. Subsequently, the sutures are sequentially tied and cut from the MAP cannula, progressing from medial to lateral (Fig 8). Capsular closure is considered complete when the femoral articular cartilage is no longer visible. Suspension sutures are removed and discarded.

Closure and Postoperative Rehabilitation

Incisions are closed with 3-0 Nylon sutures in horizontal mattress fashion, and a sterile dressing is applied. The primary determinant for postoperative restrictions is based on the central compartment procedure performed, with most patients restricted to 25% weight bearing with crutches for 4–6 weeks postoperatively following standard labral repair. Unless contraindicated, aspirin is used for deep venous thrombosis prophylaxis and meloxicam 15 mg daily is prescribed for heterotopic

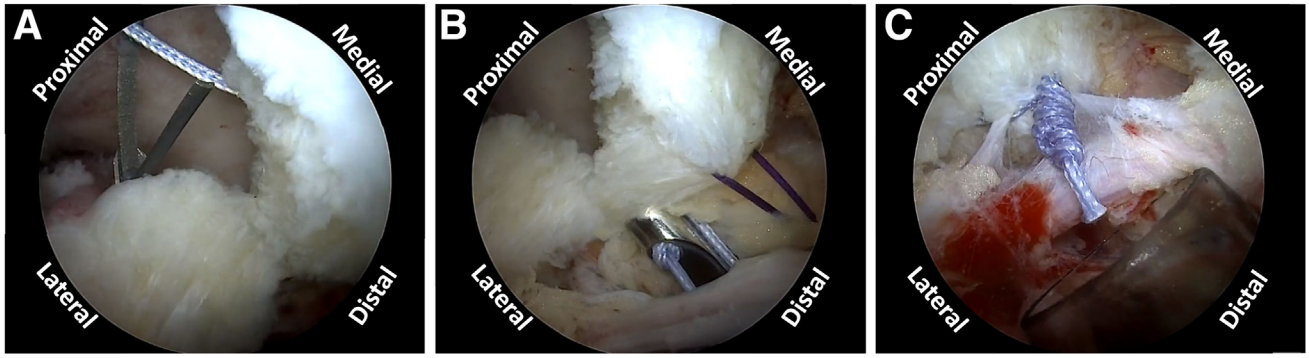

Fig 6. T-capsulotomy closure viewing from the mid-anterior portal. Beginning distally from the distal anterolateral accessory portal, suture is passed across the medial then lateral leaflets (A) with subsequent tying and cutting (B). The process is repeated proximally until the vertical limb (B) has been completely repaired.

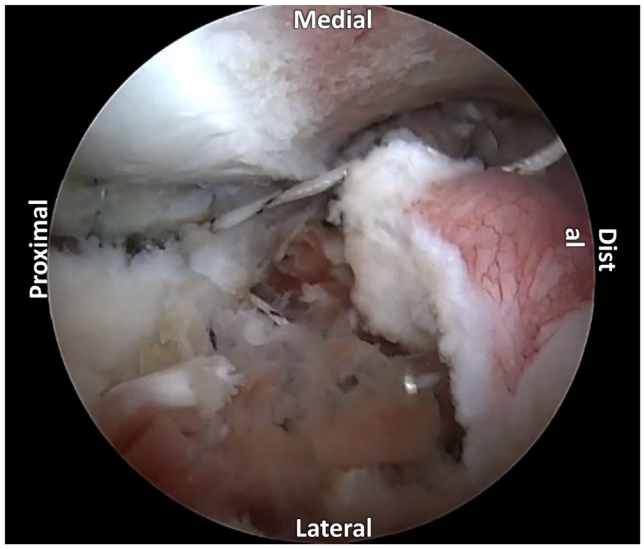

Fig 7. Lateral interportal capsulotomy closure viewing from the mid-anterior portal. Working through the anterolateral portal, a suture is retrieved through the distal cuff after passage through the acetabular cuff.

ossification prophylaxis. Patients transition from home therapy to formal physical therapy following their 2-week suture removal appointment.

Discussion

Although no clear consensus has been established on the optimal capsular management strategy in hip arthroscopy, there has been a recent growth of literature regarding the role of the capsule, capsulotomy, and capsular closure on stability and outcome measures following hip arthroscopy.[7] Common capsular entry techniques include periportal incisions, interportal capsulotomy, and T-capsulotomy. Each technique offers varying levels of visualization and working space to the central and peripheral compartments. Knowledge of the most common etiology for failed arthroscopic surgery, resulting from residual FAI secondary to inadequate osteochondral resection[3] has made T-capsulotomy an appealing technique, as it permits excellent exposure and facilitates comprehensive management of soft tissue and osseous pathology about the hip. In fact, Bedi et al.[8] compared the efficacy of arthroscopic osteoplasty, using a T-capsulotomy approach versus open surgical dislocation in the treatment of FAI in a consecutive series of 60 patients and reported equivalent resection efficacy between the two approaches for focal rim impingement lesions and for both anterior and anterosuperior femoral deformities.

Interestingly, recent evidence has identified postsurgical hip instability secondary to capsular insufficiency as an underrecognized cause of hip arthroscopy failure.[2] Although capsulotomy does disrupt the integrity of the iliofemoral ligament, a significant body of biomechanical evidence in both cadaveric and in vivo models has demonstrated that complete capsular closure restores the biomechanical profile of the hip back to the native, intact state.[6] Several recent studies have demonstrated enhanced patient-reported outcomes, less pain, lower complication rates, and decreased progression to THA following routine capsular closure after capsulotomy.[4]

Our arthroscopic capsular management technique with T-capsulotomy and capsular closure offers a pragmatic and versatile method that can be executed safely and efficiently when key principles are followed (Table 1). The technique offers several advantages and requires minimal equipment (Tables 2 and 3). A distinct advantage of the T-capsulotomy is the ability to use a smaller interportal capsulotomy with an extensile vertical limb permitting complete exposure of the medial-lateral margins of the femoral deformity as far distal as the intertrochanteric line, if necessary. The tensionable traction sutures assist with closure by aiding in preservation of the capsular tissue throughout the procedure. Depending on the surgeon's discretion,

Table 1. Pearls and Pitfalls of T-Capsulotomy, Suspension, and Closure for Hip Arthroscopy

Pearls	Pitfalls
Capsular closure begins at capsulotomy—maintain proximal and distal leaflets to allow suture passage on both sides of the capsulotomy.	Too proximal a capsulotomy leaves no acetabular cuff for subsequent repair.
Avoid excessive shaving or ablation of capsular tissue at the time of capsulotomy and throughout the case in order to preserve capsular tissue in anticipation of repair.	Overzealous trimming of capsular edges following capsulotomy may lead to a defect no longer amenable to repair.
Repair the lateral extent of the interportal capsulotomy viewing from the MAP and instrumenting from the AL portal. Repair the medial extent of the interportal capsulotomy viewing from the AL and instrumenting from the MAP portals.	Reversing viewing portals and trying to instrument from the MAP for lateral closure and from the AL for medial closure makes suture passage trajectory challenging and leads to crossing the arthroscope and suture passer.
At the time of interportal capsulotomy closure, pass through the acetabular leaflet first, and then retrieve from the distal leaflet with the 70° suture passer.	Passing the distal leaflet first provides less working space for passing through the acetabular leaflet and may increase the risk of iatrogenic cartilage damage.

AL, anterolateral portal; MAP, modified mid-anterior portal.

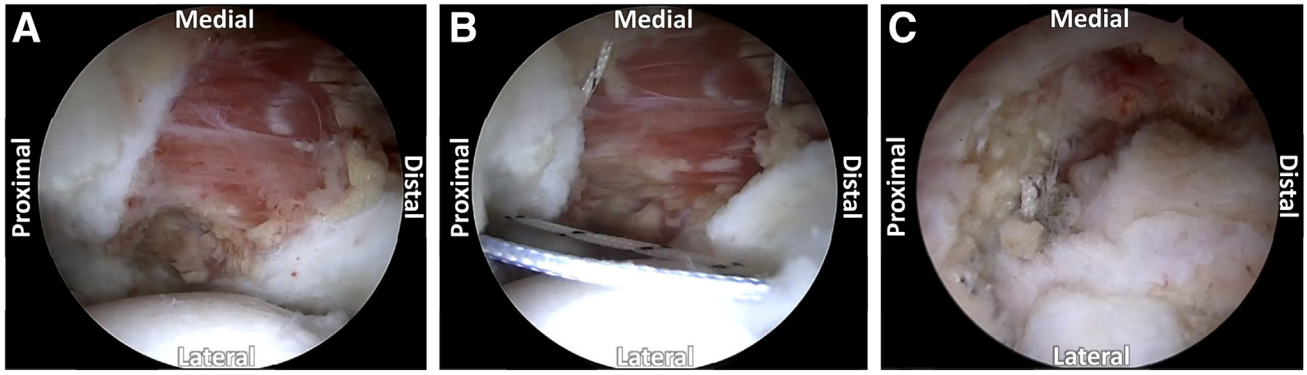

Fig 8. Capsular closure. Viewing from the anterolateral portal (A), two sutures are placed via the mid-anterior portal (B), and then sequentially tied and cut progressing from medial to lateral (C).

Table 2. Advantages and Limitations (Disadvantages) of T-Capsulotomy, Suspension, and Closure for Hip Arthroscopy

Advantages	Limitations
Increased visualization and working space are provided by suspension of capsular leaflets, while allowing for small capsulotomies.	Initial time/learning curve associated with percutaneous passage of suspension sutures, potential for iatrogenic cartilage damage.
Minimal additional equipment is necessary, consisting of a single 70° suture passer to achieve capsular suspension, as well as closure.	Surgeons may be more comfortable with self-retrieving suture devices, which certainly can be used but are associated with their own limitations in terms of angle of approach and familiarity.
The presented technique allows for facile capsular repair with countertraction provided from suspension sutures at the time of capsular repair and suture passage.	Ease of repair remains limited by initial capsular access and exposure, namely, providing a satisfactorily distal interportal capsulotomy with an intact acetabular cuff and avoiding capsular excision and ablation.

Table 3. Equipment Required

- Standard hip arthroscopy equipment including 70° arthroscopy and 5.0-mm cannulas (Flowport II, Stryker Sports Medicine, Greenwood Village, CO)
- Pivot Samurai Blade (Stryker Sports Medicine, Greenwood Village, CO)
- 70° suture passer (Slingshot, Stryker Sports Medicine, Greenwood Village, CO)
- Permanent #2 high molecular-weight polyethylene suture and #1 Vicryl suture

either permanent or absorbable suture can be used to either anatomically repair the capsular flaps or perform capsular plication when indicated. A single suture passer is used, mitigating the need for additional tissue penetrators, graspers, or shuttles.

There are potential limitations to this technique. Primarily, T-capsulotomy with closure carries a learning curve and may initially prolong operative times; however, surgeons can expect either negligible changes or improved operative times once procedural efficiency is established, given the associated enhancements in visualization and instrumentation of the central and peripheral compartments.

Disclosures

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