

The Pull String Method: Optimizing Visualization for Arthroscopic Femoroplasty



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Abstract: Capsular management during hip arthroscopy represents an important component to access, visualization, and restoration of hip stability. In the setting of femoroacetabular impingement, the peripheral compartment represents access to the femoral neck where abnormal morphology is commonly addressed with arthroscopic femoroplasty. While various techniques have been described for peripheral compartment visualization, difficulty can arise in creating a wide display of the femoral neck while minimizing subsequent impairment of the capsule. In order to obtain an unobstructed view of the femoral neck, the hip capsule must be managed skillfully. The use of hip flexion to relax the capsule for visualization of the peripheral compartment is a nearly universal practice for hip surgeons. However, differences in management of the capsule have previously included traction sutures and further capsulotomies. In this technical note, we describe our Pull String method for peripheral compartment access using an interportal capsulotomy with strategic traction suture placement and choreography of suture tensioning. This enables full view of the femoral neck for successful femoroplasty, while still allowing for complete capsule repair to help restore stability.

Introduction

The role of hip arthroscopy in the management of femoroacetabular impingement (FAI) is widely adopted as a minimally invasive approach for treatment. Symptomatic FAI has been associated with early chondrolabral degeneration and poses significant risk for the patient to develop subsequent osteoarthritis.^{1,2} In being able to address the associated pathology of FAI, both central and peripheral compartment access is necessary. Adequate visualization within both compartments starts with initial access to the hip and

subsequent management of the hip capsule. The hip capsule has been found to play a major role in hip joint stability,³ although preferences for capsular management during hip arthroscopy vary between surgeons. Without proper management of the hip capsule, post-operative instability following hip arthroscopy may occur, leading to increased revision surgery.⁴ Therefore, capsular management throughout the entire surgery is crucial for success, from the initial capsulotomy to capsule closure.

Capsulotomy is performed during hip arthroscopy to allow for intraoperative visualization, with interportal capsulotomy being the most common approach used by surgeons.⁵ In the setting of FAI surgical management, the most common cause of failure is underresection of the cam deformity.⁶ This is often due to poor intraoperative visualization and access to the cam deformity. To avoid these scenarios, some surgeons have used a T-capsulotomy or limited capsulectomy to offer a better view of the affected cam lesion. However, further manipulation of the capsule can lend to impaired functional impact if incomplete repair occurs. These concerns may be heightened in patients with a diagnosis of hip instability or borderline dysplasia. In contrast, techniques that aim to minimize or even eliminate hip capsulotomy can be hindered by restricted view of larger cam deformities.

Similar to conventional open surgery, manual retraction and soft tissue tension must be anticipated to provide optimal view of the field. Using a similar

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mindset, capsular suspension and directional tension of the capsule should be considered to provide optimal views during arthroscopic femoroplasty. The purpose of the Pull String method is to detail the steps of capsular suspension and choreography of suture tensioning to optimize visualization during peripheral compartment access. This allows for improved visibility of the cam deformity with an interportal capsulotomy, while allowing for subsequent capsular repair.

Surgical Technique

A standard supine hip arthroscopy set-up is used for the procedure. A post-less traction table (Guardian; Stryker, Kalamazoo, IN) is routinely used and positioned at approximately 10-15° of Trendelenburg position to help facilitate adequate traction of the hip for central compartment access. During the procedure, three portals are created: standard anterolateral (AL) portal, mid-anterior portal (MAP), and distal anterolateral (DALA) portal (Fig 1, Video 1).

Central Compartment / Interportal Capsulotomy

Initial access is via the central compartment after traction of the hip is achieved. An interportal capsulotomy is then created between the AL and MAP, allowing for access and visualization throughout the case. The performed capsulotomy divides the hip capsule into acetabular side (superior) and femoral side (inferior) leaflets (Fig 2). All necessary procedures within the central compartment are performed first. Notably, labral repair or reconstruction is customarily performed in the central compartment and will involve an 8-mm cannula being placed through the DALA portal for anchor placement. This cannula will be left in place until traction sutures are placed during peripheral compartment procedures. Traction sutures are occasionally used in the acetabular side of the capsule while performing procedures within the central compartment, although it is not necessary for this described method within the peripheral compartment.

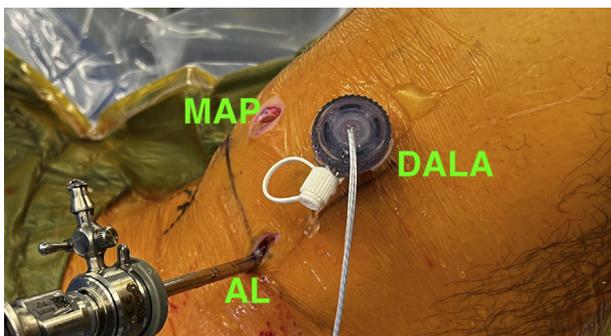


Fig 1. Standard supine hip arthroscopy set-up with the use of three portals; anterolateral (AL), mid-anterior (MAP), and distal anterolateral (DALA).

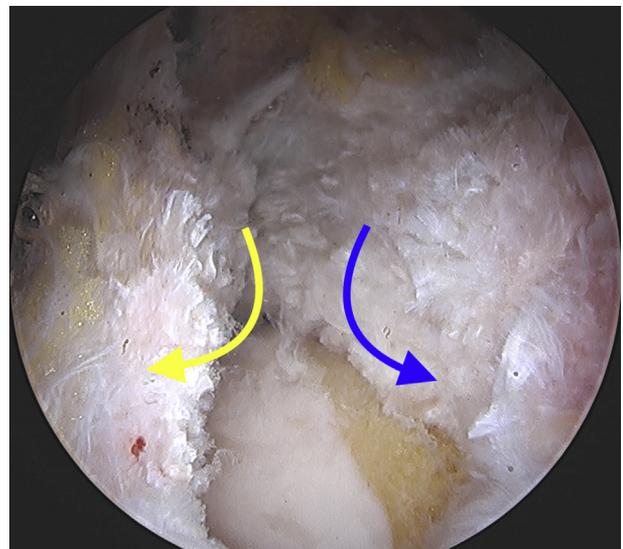


Fig 2. The interportal capsulotomy creates a superior acetabular leaflet (yellow arrow) and inferior femoral leaflet (blue arrow). This represents visualization of the capsule prior to retraction from the anterolateral portal.

Peripheral Compartment / Traction Suture Placement

Once all procedures within the central compartment are completed, traction of the hip is released. Boot straps are also loosened at this time to take undue pressure off the patient's feet. The hip is then flexed to ~30-40° of flexion in neutral rotation. This helps relax the femoral side of the capsule. If there is significant tissue adherence between the gluteus minimus and iliocapsularis overlying the femoral capsule, a shaver or electrocautery will be used to gently clear the anterior capsule to improve capsular mobility.

At this point, a 70° slingshot suture passer (Pivot Slingshot; Stryker) is used to pass a #2 nonabsorbable suture through the DALA portal cannula. The steep angle from the DALA portal allows for distal penetration of the femoral side capsule, followed by deployment of the suture within the capsulotomy window. This suture end is then retrieved out of the DALA portal. A total of 2-3 traction sutures are placed through the DALA portal, starting from the medial aspect of the capsulotomy and extending laterally/posteriorly. Once traction sutures have been placed, the cannula is removed, and the traction sutures are tensioned against the skin with a clamp (Fig 3).

Next a switching stick is placed in the AL portal, and the camera is moved to the MAP. A 5.5-mm slotted cannula is placed over the switching stick. The switching stick is removed, and the slingshot suture passer is placed on the slotted cannula through the AL portal. The slingshot is then used to penetrate the far posterior aspect of the femoral capsule and deploy a traction suture that is subsequently retrieved through the AL portal. The camera is switched back to the AL portal,



Fig 3. Traction sutures are tensioned from the distal anterolateral portal. This represents a view of the distal femoral neck for access during corrective femoroplasty.

and the traction suture from the AL portal is tensioned to the skin. In scenarios of a large posterior cam deformity, an additional far posterior traction suture can be placed through the AL portal.

Suture Tension Choreography for Visualization During Femoroplasty

While performing femoroplasty, exposure of the femoral neck can be optimized through strategic tensioning of the traction sutures. Distal access of the femoral neck is achieved by tensioning the DALA sutures, while leaving some slack in the AL traction suture. However, to access the lateral femoral neck, the leg is brought into extension with slight internal rotation. This can tension the posterior/lateral capsule; therefore, the DALA traction sutures are loosened and the AL portal traction suture is tightly tensioned to the skin to view the posterior extent of the cam deformity. In performing the femoroplasty, we will initially start with visualizing from the AL portal and use a 5.5-mm burr from the MAP. However, once the leg is extended, we will switch the camera to the MAP and the 5.5-mm burr to the AL portal for access to the posterior cam deformity and completion of the femoroplasty.

Interportal Capsular Repair

As we previously demonstrated,⁷ the interportal capsulotomy is consistently closed for each case using 4-5 nonabsorbable sutures in a simple or figure-of-8 configuration to provide adequate tensile strength to the repair (Fig 4).

Discussion

The incidence of hip arthroscopy has grown by 85% from 2011 to 2018 and signals the growing popularity

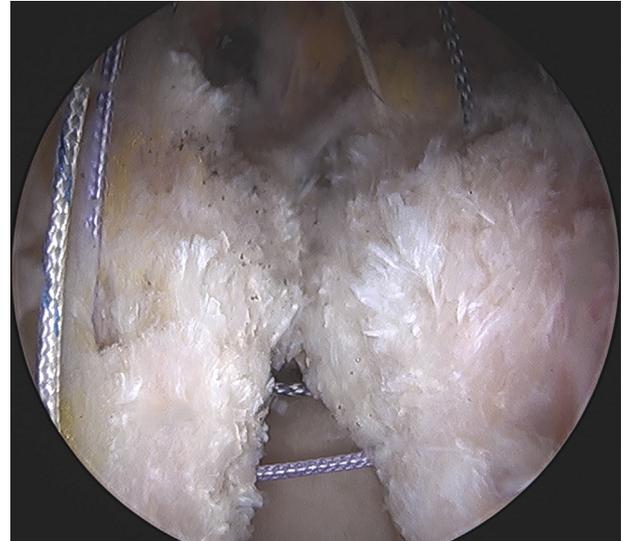


Fig 4. Sutures placed for closure of the interportal capsulotomy following femoroplasty. This ensures that stability can be restored with complete closure of the femoral capsule following traction suture manipulation.

for its successful management of patients.⁸ The treatment of FAI is the most common indication for hip arthroscopy, which often requires treatment for central compartment and peripheral compartment pathology. In the setting of failed hip arthroscopy, incomplete femoroplasty is the most common cause.⁶ This can be due to poor visualization in the peripheral compartment, given the proximity of the capsule overlying the femoral neck. Therefore, skillful management of the capsule is necessary to visualize and address the cam deformity present. The parallel concern is the preservation of the hip capsule throughout the procedure to allow for subsequent repair.

Access to the hip is most commonly achieved by interportal capsulotomy to allow for intraoperative visualization.⁵ While capsulotomy can impair subsequent hip stability, capsular closure is crucial in returning the hip to its native state.⁹ Furthermore, improved outcomes have been seen with complete capsule repair compared to partial capsule repair for patients undergoing T-capsulotomy for FAI.¹⁰ Patients who undergo repair of capsulotomy have reported improved Hip Outcome Daily Living (HOS-ADL) scores, as well as modified Harris hip scores (mHHS), when compared to patients where the capsule is not repaired.¹¹ Furthermore, a growing body of evidence suggests the importance of returning the hip capsule to its native state for stability.⁹⁻¹¹

This technique has the advantage of being able to effectively increase visibility of the cam deformity to allow for easier resection of the cam deformity present (Table 1). While traction sutures for capsular suspension have been described prior, this represents a novel technique to provide guidance on suture placement and

Table 1. Technique Pearls and Pitfalls

Pearls	Pitfalls
<ul style="list-style-type: none"> • Remove adhesions overlying the anterior femoral capsule to improve mobility during retraction. • A minimum of 2-3 traction sutures should be used through the DALA portal with at least one placed laterally through the AL portal. • Leave the DALA portal cannula in during suture placement to allow for easier retrieval. • Removing periosteum of the cam deformity with electrocautery prior to femoroplasty will also help release any undersurface adhesions. 	<ul style="list-style-type: none"> • Traction sutures placed close together will provide suspension in a limited vector. • Suture passers that do not allow for distal penetration of the capsule will provide limited capsular retraction. • Traction suture placement can transiently increase operative time until efficient placement can occur.

ensioning to optimize visualization through an interportal capsulotomy. While improved visibility can also be achieved with a T-capsulotomy, further insult to the iliofemoral ligament raises concerns for those with hip instability considerations.

There are potential limitations to this technique. Traction suture placement can increase operative time initially; however, once efficiency is achieved, this time is often negligible. While cam resection is performed with the use of a bur under direct visualization with the Pull String method, we still use intraoperative fluoroscopy to ensure appropriate resection is completed.

Conclusions

We have described our surgical technique for capsular suspension and traction suture tension choreography to optimize access for arthroscopic femoroplasty. The technique serves as an effective method to manage the hip capsule during femoroplasty, while preserving the integrity of the capsule for subsequent repair.

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