Technical Note

Outside-In Capsulotomy of the Hip for Arthroscopic Pincer Resection

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Abstract: Hip surgical techniques have evolved significantly, transitioning from open techniques to arthroscopic techniques. Hip arthroscopy has many advantages over open techniques, including reduced trauma to surrounding tissues, reduced risk of infection, and improved patient-reported outcome measures. Hip arthroscopic techniques are now commonly used for pathologies such as femoroacetabular impingement (FAI). FAI can include cam, pincer, or mixed impingement. Through hip arthroscopy, FAI may be treated with a femoroplasty and acetabuloplasty along with addressing any labral pathology that may exist. Owing to the capsule playing an integral role in hip stability, surgeons are now mindful of the initial approach and closure on completion of the intra-articular procedure. The most common approach for capsulotomy is the inside-out approach. However, this approach can be difficult in patients with a large pincer deformity. The authors describe an outside-in approach to arthroscopic hip capsulotomy. This capsular approach helps protect the labrum and articular cartilage while preserving capsular tissue.

Surgical techniques have evolved over the last 50 years with arthroscopy becoming the prevalent technique to address various musculoskeletal and osseous pathologies.[1,2] Compared with open techniques, arthroscopy seems to improve patient-reported outcomes, with lower rates of postoperative complications.[3,4] Hip arthroscopy is commonly used to treat femoroacetabular impingement (FAI), which can present as cam, pincer, or mixed (both cam and pincer) impingement.[5] Cam impingement is a loss of sphericity of the femoral head present at the femoral head-neck junction, owing to an osseous bump.[6] Having cam impingement predisposes an individual to early onset osteoarthritis.[7] Pincer impingement arises from a focal or global overcoverage of the femoral head by the acetabulum.[6] Having pincer impingement is a risk factor for developing labral and chondral lesions.[8]

The hip joint during arthroscopy is typically accessed through portals while the hip joint is distracted and making a capsulotomy using an inside-out technique.[9] However, this technique can be difficult and the procedure demanding owing to anatomic and mechanical constraints caused by the pincer deformity.[10] In the setting of a large pincer lesion, the senior author (M.B.) prefers to enter the hip joint using an outside-in approach and to perform the capsulotomy from the extracapsular space. This outside-in approach allows for an appropriate interportal capsulotomy while limiting degradation of capsule tissue, as well as preventing iatrogenic injury to the labrum and articular cartilage.[11]

Surgical Technique (With Video Illustration)

Preoperative Planning

Preoperative planning consists of a thorough history, physical examination, and imaging (Video 1). Physical examination should include hip range of motion, hip strength testing, and special tests such as FADIR (flexion, adduction, and internal rotation), FABER (flexion, abduction, and external rotation), and the log roll. FADIR is one of the most sensitive physical examination maneuvers with a sensitivity for the diagnosis of FAI as high as 99%.[10] Imaging is particularly

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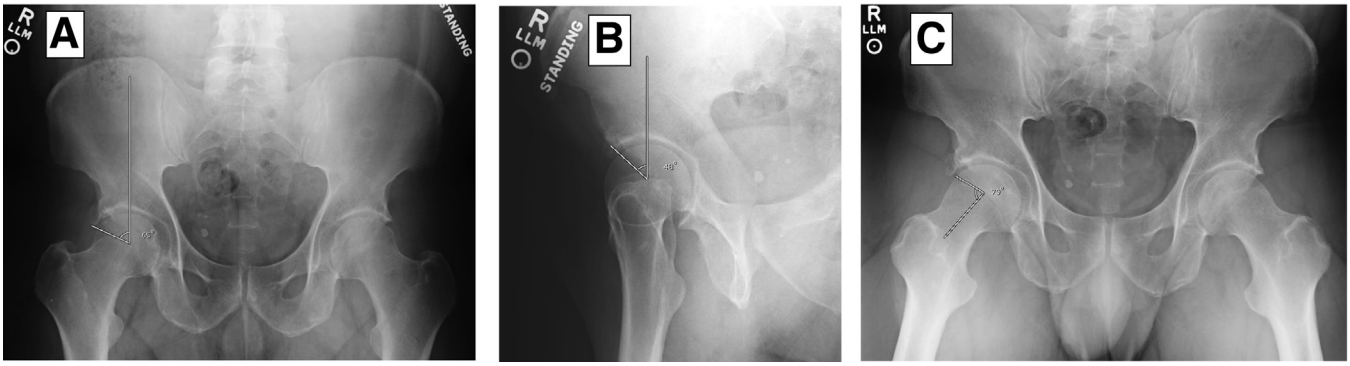

Fig 1. (A) Anteroposterior pelvis radiograph demonstrating an os acetabuli with elevated lateral center edge angle (65°) of the right hip, and (B) false profile right hip radiograph demonstrating elevated anterior center edge angle (48°) consistent with pincer femoroacetabular impingement pathology. (C) Modified Dunn lateral view of the right hip demonstrating abnormal alpha angle (79°) consistent with concomitant cam femoroacetabular impingement pathology.

important for the evaluation of FAI and is a crucial step for surgical planning in the setting of pincer impingement. Plain radiographs with anteroposterior pelvis, false profile, and modified Dunn views are obtained to assess for features of cam and pincer impingement (Fig 1). Radiographic evaluation specific to pincer impingement has been described, which includes measuring the anterior and lateral center edge angles and assessing for crossover sign, posterior wall sign, and ischial spine sign.[12]

Patient Positioning

The procedure can be performed in both the supine and lateral positions. This surgeon author (M.B.) uses a post-less table with the patient supine and placed in 10° of Trendelenburg to avoid injury to the pudendal nerve (Fig 2A).

The patient is then induced under general anesthesia. The patient's feet are placed in well-padded boots and the legs are secured in slight internal rotation to accommodate for the patient's femoral version. Linear traction is then applied to provide distraction to the hip joint.

Fluoroscopy is used to obtain an anteroposterior view of the hip. An 18-gauge spinal needle is used to create an air arthrogram, and traction is applied to distract the hip. In cases with a large pincer deformity, it may be difficult to place a needle intra-articularly preventing application of adequate traction prior to the capsulotomy.

The operative extremity is then prepped and draped in the usual sterile fashion. Bony landmarks and planned arthroscopic portals are marked on the patient's skin (Fig 2B).

Portal Placement and Capsulotomy

An anterolateral portal is established with a spinal needle and extra-articular placement is confirmed on

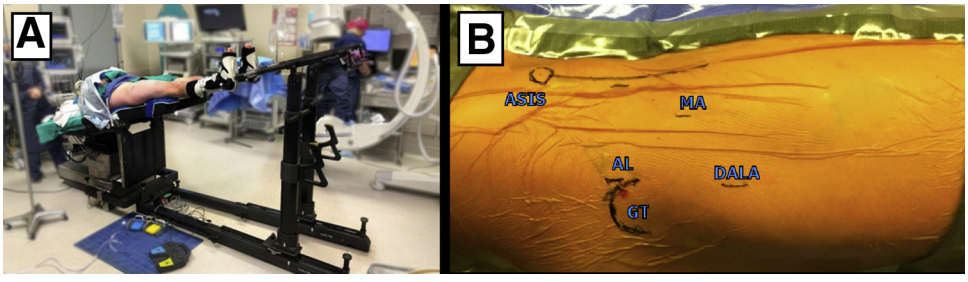

Fig 2. (A) Operating room right hip arthroscopy setup with patient in supine position on a post-less traction table in approximately 10°-15° of Trendelenburg. (B) Standard arthroscopy portals for the right hip with anterolateral (AL), mid-anterior (MA), and distal anterolateral (DALA) portals marked relative to pertinent anatomic landmarks. (ASIS, anterior superior iliac spine; GT, greater trochanter.) For this outside-in capsulotomy technique, only the AL and MA portals are used.

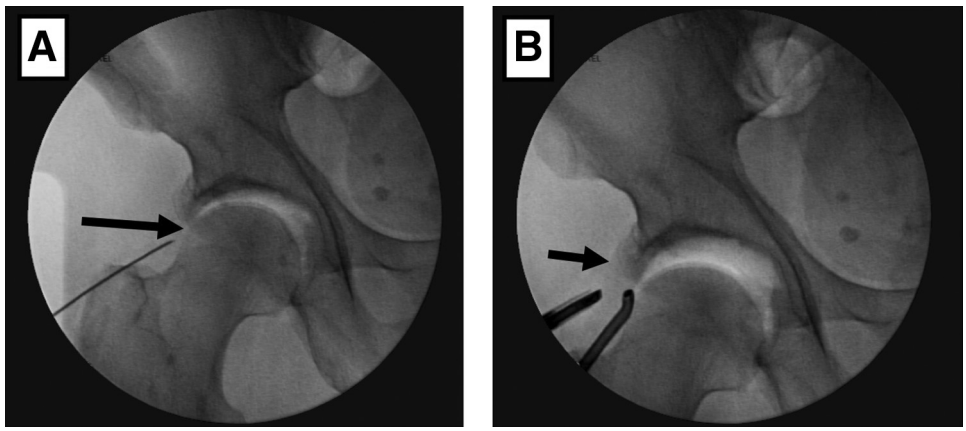

Fig 3. (A) Anteroposterior intraoperative fluoroscopic image of the right hip showing an 18-gauge spinal needle placed from the anterolateral portal into the extracapsular compartment to establish the primary viewing portal. Note the lack of space between the pincer deformity and femoral head restricting access into the central compartment (arrow). (B) Fluoroscopic image of the right hip showing arthroscopic instruments within the external compartment from the anterolateral and mid-anterior portals. Additional traction was applied after the outside-in capsulotomy that was performed under direct visualization to facilitate entry into the central compartment. However, owing to the presence of the large os acetabuli (arrow), entry into the central compartment with arthroscopic instruments was not possible until removal.

fluoroscopy (Fig 3A). A nitinol guidewire is then threaded until an endpoint is felt against the joint capsule. A trocar is then placed to create the primary viewing portal of the external compartment. A 70° arthroscope is inserted, and saline solution is introduced into the external compartment. A spinal needle is

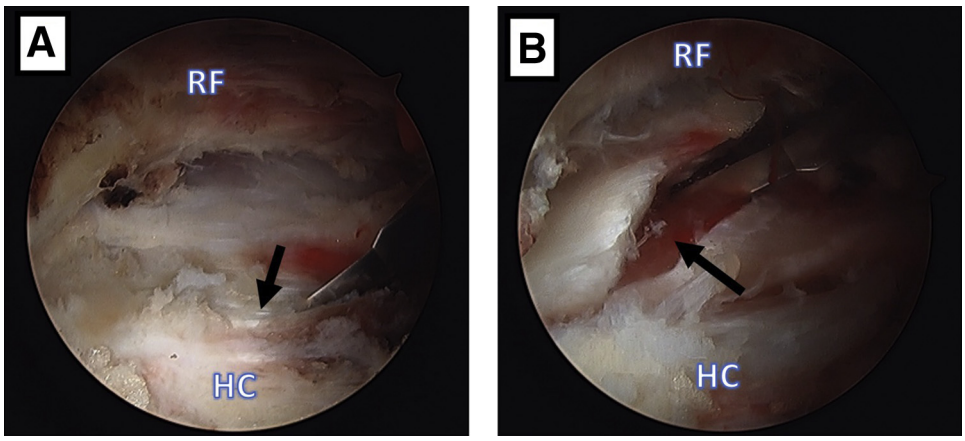

Fig 4. (A) Arthroscopic view of the right hip using a 70° arthroscope from the anterolateral portal within the external compartment. The pericapsular tissue has been cleared off of the hip capsule (HC) and the T-capsulotomy limb (arrow) is performed approximately 1 cm lateral and parallel to the reflected head of the rectus femoris (RF) using a fixed blade device. (B) Arthroscopic view of the right hip using a 70° arthroscope within the external compartment. The interportal portion of the capsulotomy is performed perpendicular to the RF under direct visualization (arrow). This allows for access into the intra-articular space. Traction stitches may then be applied within the acetabular and femoral capsular leaflets to improve visualization.

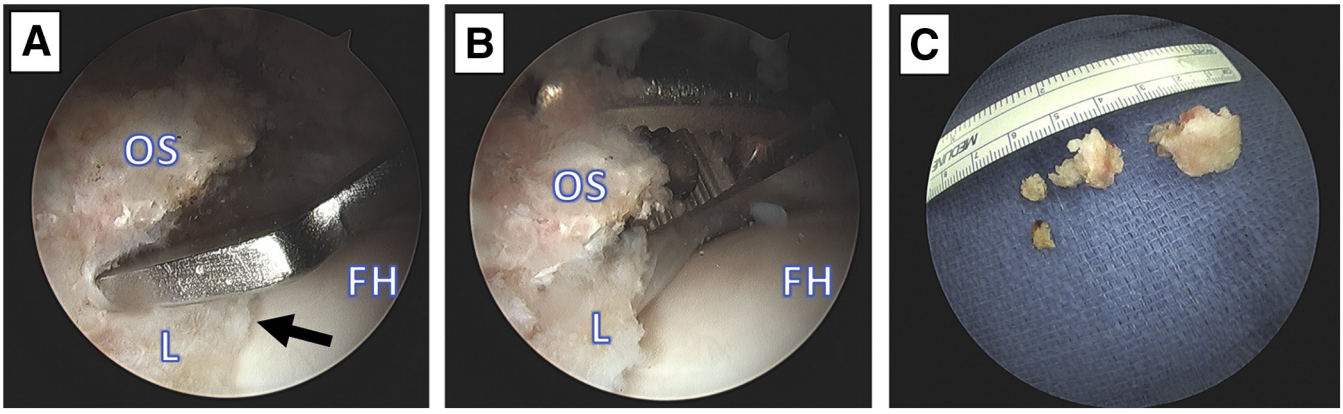

Fig 5. (A) Arthroscopic view of the right hip using a 70° arthroscope from the anterolateral portal after capsulotomy shows mobilization of the os acetabuli (OS) using an elevator. Prior to this, development of the capsulolabral interval and removal of periosteal tissue was performed using a radiofrequency wand. Note the lack of space (arrow) between the labrum (L) and femoral head (FH) owing to the presence of the OS. (B) Arthroscopic view of the right hip using a 70° arthroscope from the anterolateral portal shows a grasper removing the OS in its entirety. (C) An arthroscopic picture taken outside of the hip joint demonstrating the volume of the entire OS after removal.

then introduced from the mid-anterior portal and triangulated into the extracapsular space under direct visualization. In similar fashion, a nitinol wire is advanced onto the joint capsule, and a trocar is placed to establish the working portal (Fig 3B).

A shaver is then used to clear muscle and soft tissue off of the hip capsule in the pericapsular space. The reflected head of the rectus femoris is identified and an interportal capsulotomy is performed approximately 1 cm lateral and perpendicular to the reflected head of the rectus femoris. If a T-capsulotomy is required for additional exposure, this limb is made parallel to the rectus femoris tendon. A fixed blade device (Pivot Medical Inc., Stryker) is used to make the capsulotomy using an outside-in technique under direct visualization from the extracapsular space (Fig 4). At this point, additional in-line traction may be applied to the extremity, which facilitates entrance into the central compartment. Traction sutures are placed using a self-capturing suturing device (Pivot Medical Inc., Stryker) in the acetabular and femoral capsular leaflets to allow for better visualization.

The pincer deformity is addressed with acetabuloplasty or treatment of any os acetabuli (Fig 5). Large, unstable os acetabuli can be treated with anatomic reduction and internal fixation, whereas small os acetabuli can be treated with removal. Additional intra-articular procedures, including chondral and labral work, and femoroplasty may then be performed as indicated. At the completion of the procedure, standard

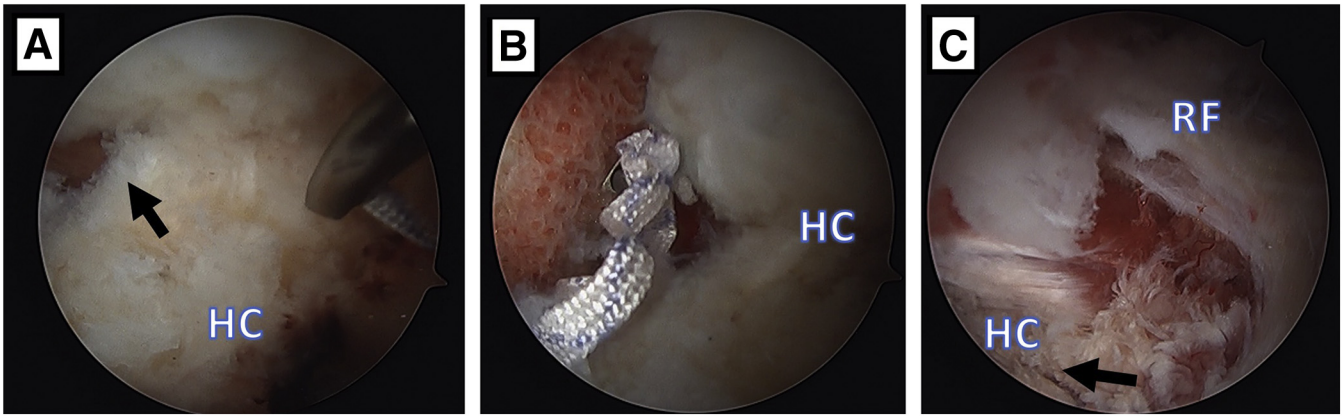

Fig 6. (A) Arthroscopic view of the right hip using a 70° arthroscope from the anterolateral portal within the pericapsular space. A standard hip capsule (HC) closure of the capsulotomy is performed using a suture passing device (arrow) in simple or figure-of-eight pattern. (B) Passage of the nonabsorbable, high-tensile strength suture within the HC leaflets. (C) Watertight seal after HC closure (arrow). The rectus femoris (RF) is shown for orientation within the external compartment.

Table 1. Advantages and Disadvantages

Advantages	Disadvantages
Allows for entrance into the central compartment in the presence of a large pincer deformity	May be difficult to visualize structures within extracapsular space
Minimizes iatrogenic injury to cartilage and labrum owing to direct visualization	Entry into the hip joint may be difficult until capsulotomy and/or acetabuloplasty is performed
Maintains viable capsular tissue for repair at the completion of the procedure	

capsular closure is performed using nonabsorbable, high-tensile strength sutures in a simple or figure-of-eight pattern (Fig 6).

Postoperative Course and Rehabilitation

Patients are encouraged to weight-bear as tolerated with crutches for the first 2 weeks postoperatively. Patients also use foam boots at night for the first 7 days to avoid external rotation while sleeping to protect the repaired capsule. Range of motion is performed with a continuous passive motion machine, or stationary bike with no resistance, limiting hip flexion to below 90°. Rehabilitation exercises are initiated day 1 post-operatively. Lower extremity resistance exercises are used to begin restoring neuromuscular control and isometric strengthening of the surrounding hip musculature, such as the gluteals, quadriceps, and hip abductors. At 2 weeks postoperatively, patients progress to full weight-bearing. Patients are prescribed naproxen sodium 500 mg twice daily for the first 30 days for both pain and heterotopic ossification prophylaxis.

Discussion

In the setting of a large focal or global pincer deformity, it may be difficult to access the central and peripheral compartments to address hip FAI and associated pathology.[13] The technique described in this article provides a safe and effective way to perform an interportal capsulotomy when joint access is limited caused by pincer deformity. Advantages to this technique include providing access to the hip joint and allowing better visualization of the intra-articular cartilage and labrum within the central compartment in the setting of a large pincer deformity (Table 1). Secondarily this approach maintains viable capsular tissue, which facilitates an anatomic capsule repair to prevent postoperative instability. Recent studies have demonstrated that patients who undergo capsular repair have superior mid-term outcomes when compared with nonrepair.[14,15]

However, this outside-in technique is not without risks and requires a complete understanding of the anatomy within the extracapsular space (Table 2). Without clear identification of the rectus femoris tendon for orientation, using an outside-in capsulotomy may minimize the amount of capsular tissue available for closure while putting the intra-articular structures at risk of iatrogenic injury. Future studies would be useful to evaluate clinical outcomes with this described technique of accessing the hip joint from outside-in in the setting of large pincer deformities.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
Establish orientation by identifying the rectus femoris tendon within extracapsular space	Capsulotomy performed too medial may make capsular repair difficult
Interportal capsulotomy is performed 1 cm lateral and perpendicular to the rectus femoris tendon	Hip capsule should be repaired to prevent postoperative instability
T-capsulotomy (if required) is performed parallel to the rectus femoris tendon	

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