Technical Note With Video Illustration

Arthroscopic Femoral Osteochondroplasty With Capsular Plication for Osteochondroma of the Femoral Neck

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Abstract: Osteochondromas of the femoral neck are a rare but challenging problem because of their distal location, which is difficult to access arthroscopically. Traditional methods of osteochondroma resection used invasive open approaches to manage these lesions. More recently, advances in hip arthroscopy have allowed expanded treatment of extra-articular hip conditions with a minimally invasive approach. Reports have described the use of hip arthroscopy for osteochondroma removal; however, surgical techniques for the procedure have yet to be described. We describe a technique for arthroscopic resection of a femoral neck osteochondroma using an extended capsulotomy and osteochondroplasty with subsequent capsular plication. This technique uses contemporary hip arthroscopic techniques and constitutes a safe and effective approach to addressing this rare intra-articular pathology of the hip.

Osteochondromas of the femoral neck are a rare occurrence but can be a significant source of pain and discomfort for the patient when impingement occurs. These lesions can present a challenge to treating surgeons, particularly when the lesion is located posteriorly.[1,2] Traditionally, resection of femoral neck osteochondromas has been performed through invasive techniques.[1,3-5] In a case series of 4 patients, Siebenrock and Ganz[1] described the use of femoral head dislocation and subsequent resection for femoral neck osteochondromas through the use of a straight lateral incision over the greater trochanter. More recently, advances in hip arthroscopy have conferred a more minimally invasive approach to addressing such intra-articular pathology, avoiding the associated morbidity of previous approaches.

Arthroscopic osteochondroma removal has been documented by a few authors in the literature. In 2001, Bonnomet et al.[6] described the first use of hip arthroscopy for the treatment of multiple exostoses in 2 patients who had symptoms of hip subluxation and impingement. Subsequently, others have also reported the use of hip arthroscopy for the management of these lesions.[2,7,8] Despite the existence of earlier reports of arthroscopic management of osteochondromas of the proximal femur, prior studies have not described techniques for arthroscopic osteochondroma removal. Furthermore, trends in hip arthroscopy have evolved over recent years, with more efficient and effective techniques continuously being developed.[9] As such, a detailed description of the use of hip arthroscopy with modern techniques to address extra-articular hip osteochondromas may be of benefit.

We describe a technique for arthroscopic resection of a femoral neck osteochondroma using an extended capsulotomy, osteochondroplasty, and subsequent capsular plication. This technique uses contemporary hip arthroscopic techniques and constitutes a safe and effective approach to addressing this rare extra-articular pathology of the hip.

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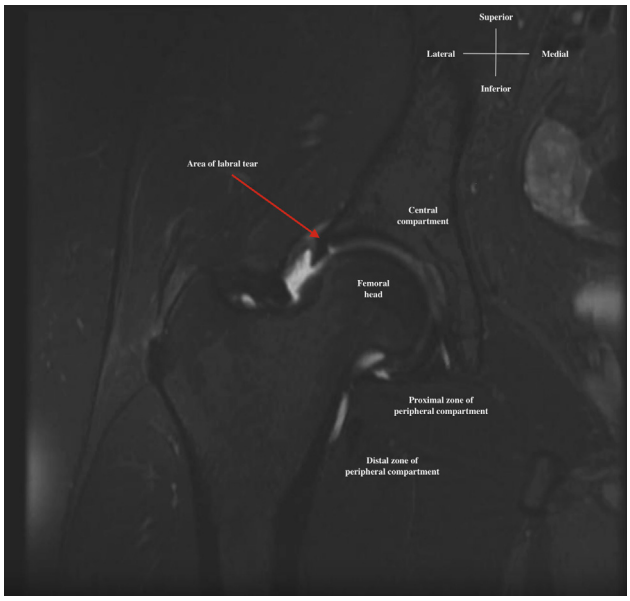

Fig 1. View from mid-anterior portal, patient in supine position. Magnetic resonance arthrogram of the right hip in the coronal plane indicating a tear at the superior aspect of the acetabular labrum (red arrow).

Objective Diagnosis

Standard preoperative diagnostic imaging should be obtained including anteroposterior, false profile, and Dunn lateral radiographs of the hips (Fig 1). Additionally, diagnostic magnetic resonance imaging (MRI) should be obtained to confirm the presence or absence of labral tears and soft tissue pathology. MRI may also be useful to identify associated lesions of the hip joint. If present, computed tomography with 3D reconstruction may be pursued to better characterize the lesion. In the case of a femoral neck osteochondroma, computed tomography imaging will show a pedunculated osseous lesion on the femoral neck, which may be contiguous with the medullary canal (Fig 2).

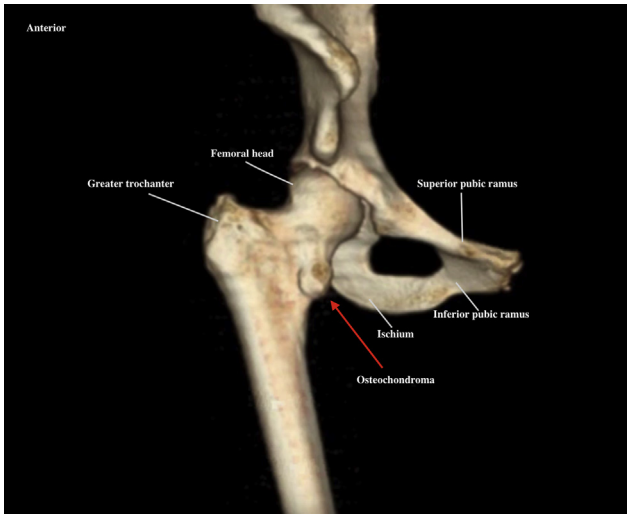

Fig 2. Anterior view of a 3-dimensional computed tomography reconstruction of the right hip in the coronal plane. A 2.2-cm pedunculated osseous lesion is apparent on the anteromedial aspect of the femoral neck (red arrow), which is continuous with the medullary canal.

Surgical Technique

Patient Positioning and Anesthesia

The patient is positioned supine on a standard traction table, after which both general anesthesia and muscle relaxation are applied (Video 1). The lower extremities are placed in well-padded boots, and a perineal post is applied. At this point, gentle traction is applied to the contralateral limb, while axial traction is applied to the surgical limb with the hip abducted and slightly flexed. The operative limb is then adducted and neutrally extended, while the foot is internally rotated. This particular orientation of the operative limb provides the optimal positioning for establishment of arthroscopic portals to access the central compartment.

Approach

With fluoroscopic guidance, the anterolateral (AL) portal is established 1 cm proximal and 1 cm anterior to the tip of the greater trochanter. Needle localization is used to establish a modified anterior portal (MAP). The arthroscope is then placed through the MAP to confirm safe entry into the central compartment without jeopardizing the labrum.

Acetabuloplasty and Labral Repair

A 2- to 4-cm transverse interportal capsulotomy using an arthroscopic scalpel (Samurai Blade; Stryker Sports Medicine) is created 8 to 10 mm from the labrum. Adjacent capsule is exposed from the anterior inferior iliac spine at approximately the 2 o'clock position anteromedially to the direct head of the rectus femoris

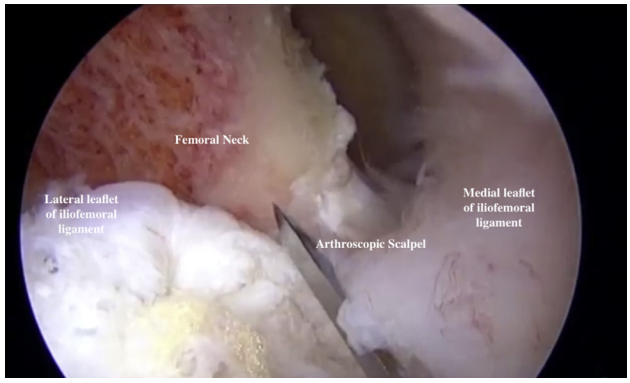

Fig 3. Right hip, patient in supine position. Creation and extension of the T-capsulotomy using an arthroscopic scalpel within the distal anterolateral portal viewed from the perspective of an arthroscope in the mid-anterior portal. The T-capsulotomy is extended distally from the interportal capsulotomy until appropriate exposure of the femoral neck is achieved for the femoral osteochondroplasty.

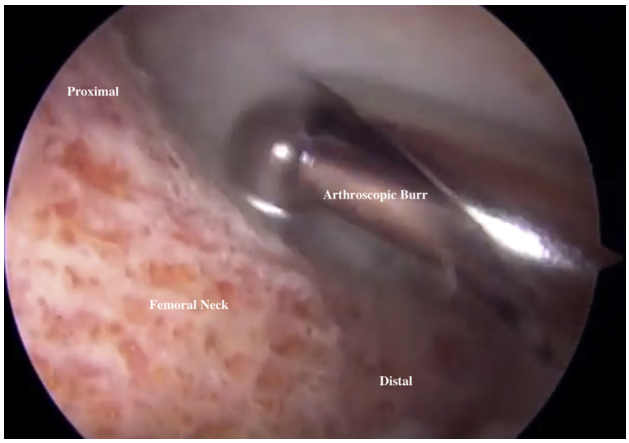

Fig 4. Right hip, patient in supine position. Perspective from the mid-anterior portal of the femoral osteochondroplasty. The arthroscopic burr is placed within the distal anterolateral portal to begin resection of the abnormal cam morphology. This arthroscopic burr is used to resect bone in a semi-circumferential fashion, moving anterolaterally to posteromedially and proximally to distally about the femoral neck.

origin posterolaterally. After creation of an interportal capsulotomy, a 5.0-mm arthroscopic burr is used to perform acetabuloplasty. Next, the distal AL (DALA) portal is created 4 to 6 cm distal to and slightly anterior to the AL portal, allowing for suture/anchor-based labral repair, after which traction is released and the hip is flexed between 20° and 30° for access to the peripheral compartment.

T-Capsulotomy

A T-capsulotomy is created for optimal visualization of cam morphology. Pericapsular adipose tissue is debrided until the interval between the gluteus minimus and the iliocapsularis muscle is well visualized. Through a 5.0-mm cannula in the DALA portal, an arthroscopic scalpel is used to extend the capsulotomy longitudinally and perpendicular to the previously established interportal capsulotomy along the length of the femoral neck (Fig 3).

Femoral Osteochondroplasty

A 5.0-mm arthroscopic burr is used to perform femoral osteochondroplasty (Fig 4). Correction of the cam morphology is confirmed intra-operatively with fluoroscopic imaging (Fig 5). The osteochondroplasty is performed until the femoral head-neck junction is symmetrically resected circumferentially, and absence of impingement is confirmed with a dynamic examination. If the dynamic examination reveals impingement, further osteochondroplasty is performed.

Resection of Osteochondroma

To identify the femoral neck lesion, the T-capsulotomy is extended inferiorly. To accomplish this, 2 capsular retraction stitches are placed in the medial and lateral leaflets of the extended T-capsulotomy to enhance exposure (Fig 6). C-arm radiography is then used to confirm the location of the lesion (Fig 7). A biopsy of the lesion is obtained at this point with an arthroscopic biter and sent to pathology for further evaluation (Fig 8). The surgeon should then proceed with completing the initial femoral osteochondroplasty by extending it inferomedially to completely excise the lesion. After correction of the residual deformity, a dynamic examination in conjunction with C-arm radiography is performed to confirm appropriate resection of cam morphology and complete excision of the lesion (Fig 9).

Capsular Closure

Capsular closure is performed by plicating the capsule as previously described. Briefly, capsular closure begins with the vertical limb of the T-capsulotomy at its base. A crescent tissue-penetrating device (Slingshot; Stryker

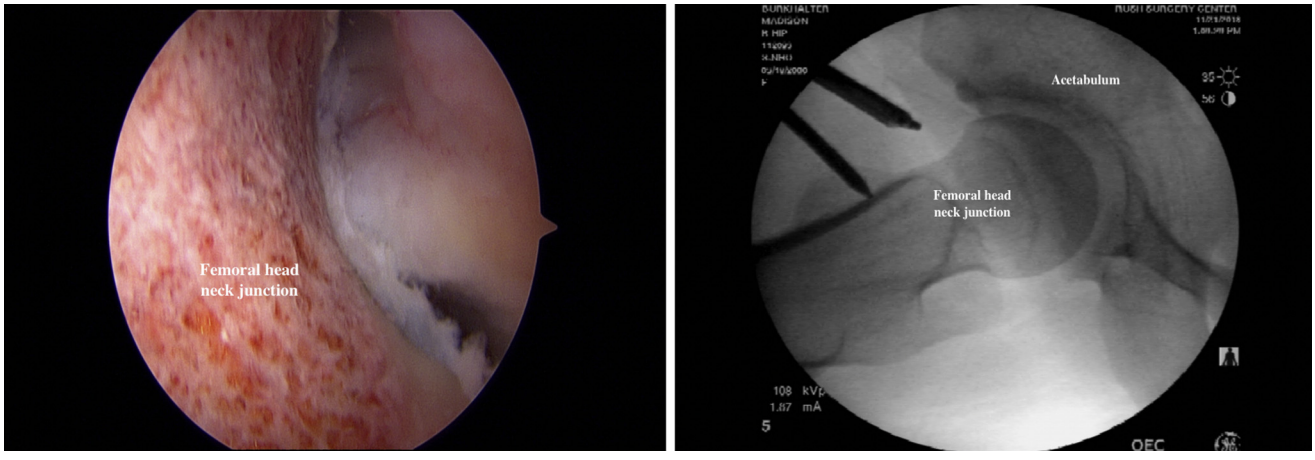

Fig 5. View from mid-anterior portal. With the patient in the supine position on a standard traction table, full correction of the femoral cam lesion is confirmed by dynamic examination of the right hip through both direct arthroscopic visualization (left) and fluoroscopic imaging (right).

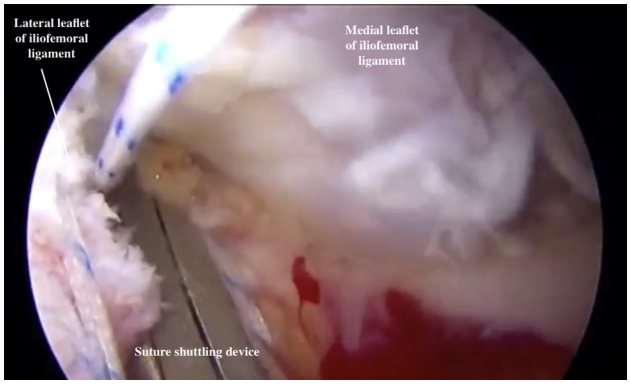

Fig 6. Right hip, patient in supine position. View of capsular retraction before osteochondroma resection from the mid-anterior portal. After distal extension of the T-capsulotomy, the medial and lateral leaflets of the iliofemoral ligament are retracted for increased exposure.

Sports Medicine) is loaded with no. 2 suture (Zipline; Stryker Sports Medicine) and placed through the AL portal to sharply pierce the lateral leaflet of the iliofemoral ligament (Fig 10). The suture is then shuttled intra-articularly and passed back through the medial leaflet of the iliofemoral ligament and retrieved through the DALA portal. The sutures are tied after each pass, with each subsequent suture being passed ~1 cm proximal to the previous.

Attention is then turned to closure of the interportal capsulotomy. The arthroscope is placed in the AL portal while a 8.5 × 110-mm cannula is placed in the DALA portal and a 8.5 × 90-mm cannula is placed in the MAP. Closure begins with the medial portal of the capsulotomy, again using a suture shuttling device loaded with no. 2 suture. This is first passed through the MAP to pierce the proximal leaflet, then passed intra-articularly, and back through the distal leaflet.

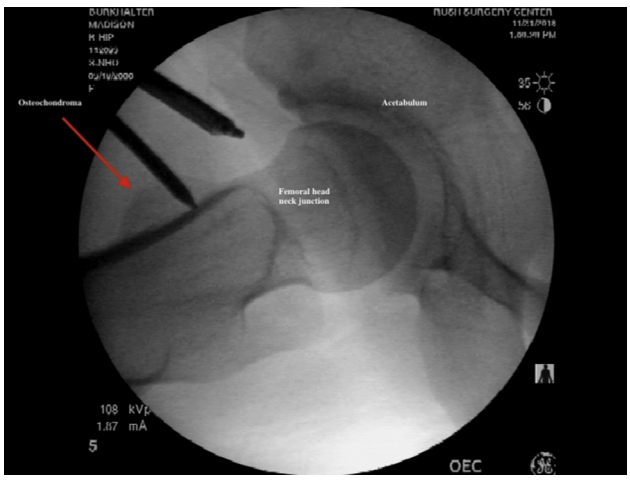

Fig 7. View from mid-anterior portal. Intraoperative fluoroscopic image of the right hip with the patient in the supine position on a standard traction table indicates the location of the osteochondroma lesion on the anteromedial aspect of the femoral neck (red arrow).

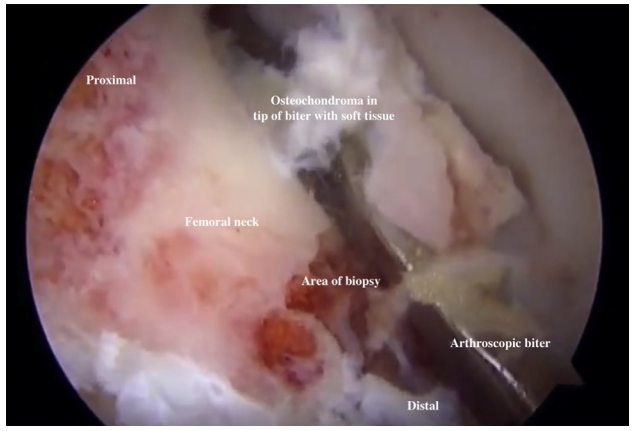

Fig 8. Right hip, patient in supine position. View of arthroscopic resection of the osteochondroma from the mid-anterior portal. An arthroscopic biter device is used in the distal anterolateral portal to biopsy the majority of the osteochondroma, and the rest is resected using an arthroscopic burr.

Attention is turned to the lateral aspect of the leaflet, and sutures are retrieved through the DALA portal and tensioned using arthroscopic tying techniques. The degree of plication should be adjusted appropriately for the patient depending on degree of capsular laxity. Complete closure of the capsule is confirmed when the femoral head and neck can no longer be visualized under the capsule and by probing the anterior aspect of the capsule to ensure appropriate tension has been created. Pearls and pitfalls of the technique are listed in Table 1.

Postoperative Rehabilitation

The patient is initially restricted to 20-pound flat-foot weightbearing with the use of crutches and uses a derotational boot for the first 3 postoperative weeks. In

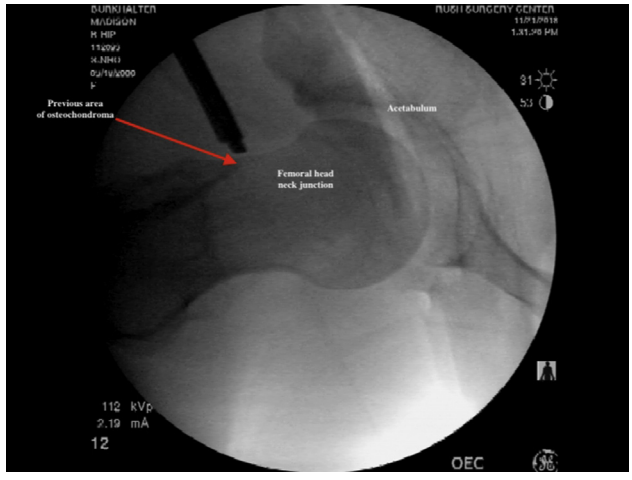

Fig 9. View from mid-anterior portal. Intraoperative fluoroscopic image of the right hip with the patient in the supine position on a standard traction table indicates confirmed complete excision of the osteochondroma.

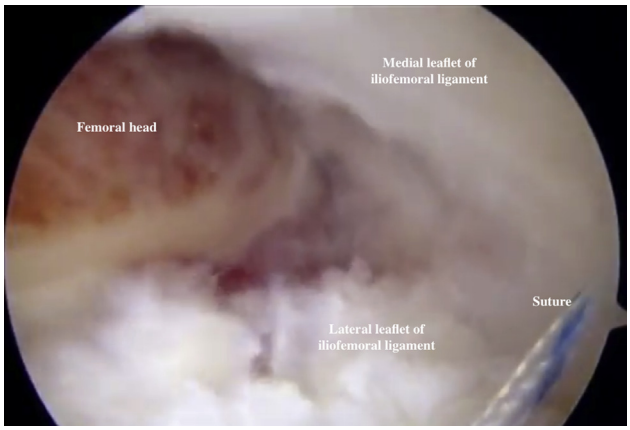

Fig 10. Right hip, patient in supine position. Arthroscopic view from the mid-anterior portal of closure of the vertical limb of the T-capsulotomy. A suture shuttling device is inserted simultaneously through the distal anteriolateral portal, and a suture is passed through the medial leaflet of the iliofemoral ligament, passed intra-articularly, and then through the lateral leaflet of the iliofemoral ligament. This process is continued proximally in 1-cm increments until complete closure of the vertical limb is achieved.

the immediate postoperative period, physical therapy focuses on passive and low-intensity active range of motion with circumduction. At postoperative week 3, the patient should be weaned from crutches and should advance weightbearing. At this time, focus is to restore normal gait. At postoperative week 6, open- and closed-chain exercises are begun. Range of motion should also be advanced at this point. Activities focusing on return to sport are begun at postoperative week 12.

Discussion

Osteochondromas of the femoral neck are rare entities that may cause significant pain and dysfunction to patients. Common symptoms included decreased range of motion, hip or groin pain, and limitations with activities of daily living. Although they are traditionally treated through open methods, the development of hip arthroscopy has provided a minimally invasive treatment that avoids the associated morbidity of surgical dislocation. Our article presents a description of modern arthroscopic osteochondroma resection through an extended T-capsulotomy with concomitant capsular plication.

To date, few studies have described the use of hip arthroscopy for resection of proximal femoral osteochondromas.[2,6-8,10] Wang et al.[2] described the use of hip arthroscopy for the treatment of a osteochondroma of the posteroinferior femoral neck with secondary synovial osteochondromatosis. At 2 years postoperatively, they noted full hip range of motion without evidence of necrosis or limping; however, their methods of resection and capsular management, if any, were not described. Feeley and Kelly[7] provided a brief description of their surgical approach for addressing a symptomatic labral tear secondary to a proximal femur osteochondroma distal to the head-neck transition. They first performed labral debridement for an anterosuperior labral tear, followed by acetabuloplasty with a 4.0-mm burr. Subsequently, they accessed the peripheral compartment and used a 5.5-mm burr to resect the osteochondroma. The authors did not provide any description of capsular repair, if any, and it is unknown whether these patients developed instability at longer follow-up. Another recent case report of a patient with 2 intra-articular osteochondromas and an AL labral tear was described in which the authors used hip arthroscopy to resect the lesions.[10] Interestingly, these authors first addressed the lesions in the peripheral compartment without traction, as opposed to first entering the central compartment, which is not routine. The authors stated that they feared the large osteochondroma in the AL femoral neck would interfere with their first AL portal, the size of which was not reported. This technique may complicate portal

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Care should be taken to properly identify landmarks for portal placement for optimal access to central and peripheral compartments	Improper portal placement can significantly limit the amount of exposure to the central and peripheral compartments, result in longer operative times, and require the surgeon to create an additional portal, causing unnecessary damage to soft tissues
Generous use of fluoroscopic guidance should be performed to confirm the degree of osteochondroma and cam resection to avoid removal of excess bone	Overresection of the acetabulum or femoral head/neck may result in loss of the seal of the hip joint and result in instability or abnormal joint biomechanics
Confirmation of appropriate capsular tensioning should be performed through probing the anterior aspect of the capsule for degree of tension and by the inability to arthroscopically visualize the femoral head and neck	Capsular laxity has been shown to result in poor postoperative outcomes and may result in the necessity for revision surgery for capsular insufficiency
Before skin closure, a dynamic examination of the operative hip using both direct arthroscopic and fluoroscopic visualization should be performed to confirm appropriate cam morphology resection and absence of residual impingement	Failure to confirm appropriate resection of osseous morphology may result in residual impingement and recurrent labral tears

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Use of T-capsulotomy allows excellent exposure to lesions in challenging locations	Technically challenging
Capsular closure avoids iatrogenic instability of the hip joint	Potential to damage articular surfaces with suture shuttling
Edge loading is prevented by appropriate labral repair and osseous lesion resection	Learning curve may increase operative times
Full range of motion and resolution of impingement are confirmed intraoperatively through arthroscopic and fluoroscopic visualization in conjunction with dynamic examination	Potential to overresect osseous morphology with excessive use of burr

placement, be more technically challenging, and does not allow for the creation of a T-capsulotomy. Furthermore, the outcome of hip arthroscopy using this sequence of surgical steps is unknown.

In the current technical note, we performed an osteochondroma resection through an extended T-capsulotomy. We believe that the use of a T-capsulotomy can help augment the efficacy of these procedures, particularly those with posterior lesions, as the capsulotomy can provide larger access within the peripheral compartment (Table 2). Through the use of the capsulotomy, we were able to perform a comprehensive osteochondroplasty with imaging-confirmed excision of the large osteochondroma. Other advantages of this technique include that it does not create iatrogenic hip joint laxity, it prevents edge loading of the repaired labrum, and it fully restores range of motion. The benefits of routine capsular closure can be shown by both recent trends in its use among published hip arthroscopic literature[9] and the superior clinical and functional outcomes observed in patients who receive capsular closure.[11-15]

This technique does have limitations. Performing complete capsular closure imposes the risk of damaging articular surfaces while passing the sutures through the leaflets of the hip capsule. Furthermore, capsular closure is technically demanding and may increase operative times, as there is a learning curve in performing this method of capsular management. This is particularly true in the case of osteochondroma resection, which requires greater extension of the T-capsulotomy. With regard to osteochondroma cam morphology resection, the surgeon must avoid overresection to best restore biomechanics and an appropriate seal between the acetabulum and femoral head.

Conclusions

The current article describes the use of contemporary arthroscopic hip surgery with extended capsulotomy to treat an intra-articular hip osteochondroma. This method allows not only for resection of the osteochondroma, but also for the evaluation and treatment of any associated intra-articular hip pathology. By performing routine capsular closure after osteochondroma resection, the risk of iatrogenic instability is minimized.

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