

# A Systematic Approach to Arthroscopic Femoroplasty With Conservative Management of the Hip Capsule



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**Abstract:** As hip arthroscopy has become increasingly used to treat femoroacetabular impingement, the importance of a complete femoroplasty to properly address cam impingement has been demonstrated. In doing so, different capsulotomy techniques have been described for gaining access to the hip joint as well as the peripheral compartment for cam resection. The periportal capsulotomy technique allows joint access while preserving the structural integrity of the iliofemoral ligament, obviating the need for capsular closure. We present a systematic approach and surgical technique for performing a complete arthroscopic femoroplasty while maintaining conservative hip capsule management through a periportal capsulotomy.

**F**emoroacetabular impingement (FAI) describes the condition of pathologic contact between the femoral head–neck junction and acetabulum. Cam-type FAI is caused by aspherical femoral head anatomy due to a cam lesion. Cartilage delamination and labral separation results at the chondrolabral surface, particularly at the anterosuperior rim.<sup>1</sup>

Arthroscopic treatment has shown high satisfaction and positive outcomes.<sup>2,3</sup> Osteochondroplasty of the femoral head–neck junction to address the femoral-sided cam pathology is critical to achieving successful outcomes, as the most common reason for revision hip arthroscopy is due to residual cam deformity from under-resection.<sup>4,5</sup> In addition, both over-resection and cortical notching can increase the risk of femoral neck fracture.<sup>6,7</sup> Over-resection also leads to inferior clinical

outcomes and greater rates of conversion to total hip arthroplasty.<sup>8</sup>

Due to the anatomic constraints of the hip joint, distraction and capsulotomy are required for safe arthroscopic intervention. Capsulotomy allows access to the intra-articular pathology, as well as improved visualization in the peripheral compartment. The type of capsulotomy and capsular management strategies has been debated.<sup>9,10</sup> The iliofemoral ligament, the primary stabilizing structure for anterior translation and external rotation of the hip, is violated by the interportal and T-capsulotomy. Capsular closure is necessary in these settings but can be technically difficult, adds time to the procedure, and may potentially lead to a more constrained hip.<sup>9,11-13</sup>

The technique and outcomes of a periportal capsulotomy without capsular closure have been previously described.<sup>14,15</sup> This technique uses limited dilation of portals while preserving the structural integrity of the iliofemoral ligament, obviating the need for capsular closure. In a recent study,<sup>16</sup> periportal capsulotomy demonstrated similar clinical outcomes when compared with interportal capsulotomy with closure at 2-year follow-up.

The purpose of this study is to present the technique of for a systematic approach to arthroscopic femoroplasty in the setting of conservative capsule management using a periportal capsulotomy without capsular closure. Through an organized progression of hip flexion and rotation, it is possible to gain access to large cam lesions in the peripheral compartment through the windows provided by a periportal capsulotomy.

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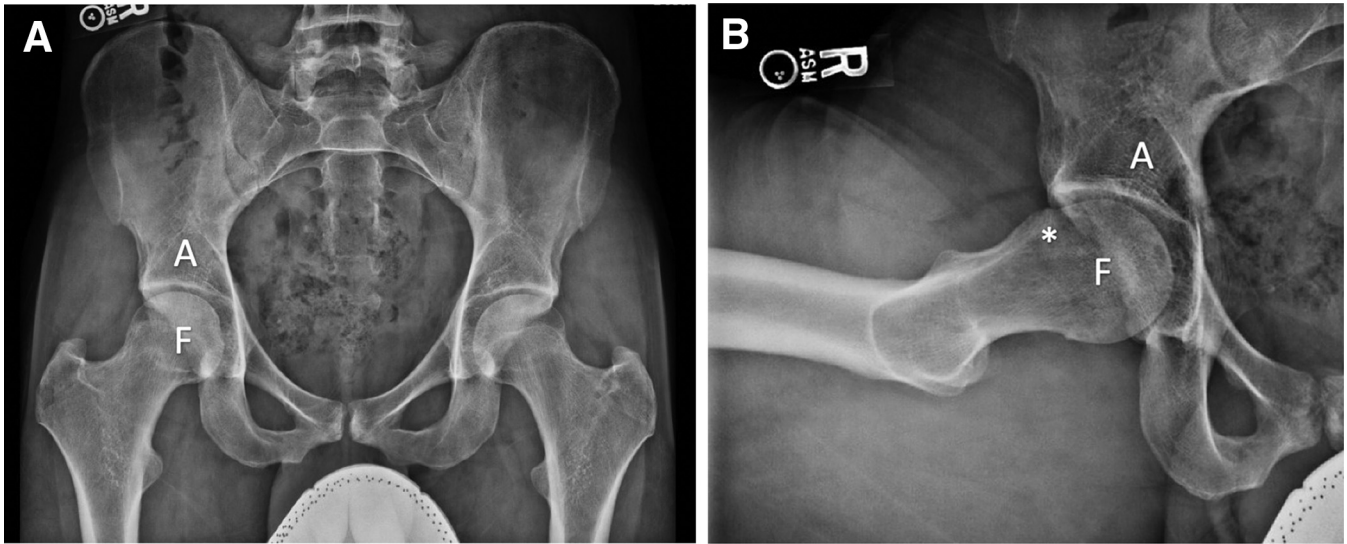
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**Fig 1.** Case example of right hip. Preoperative (A) anteroposterior pelvis and (B) frog-leg lateral radiographs. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.

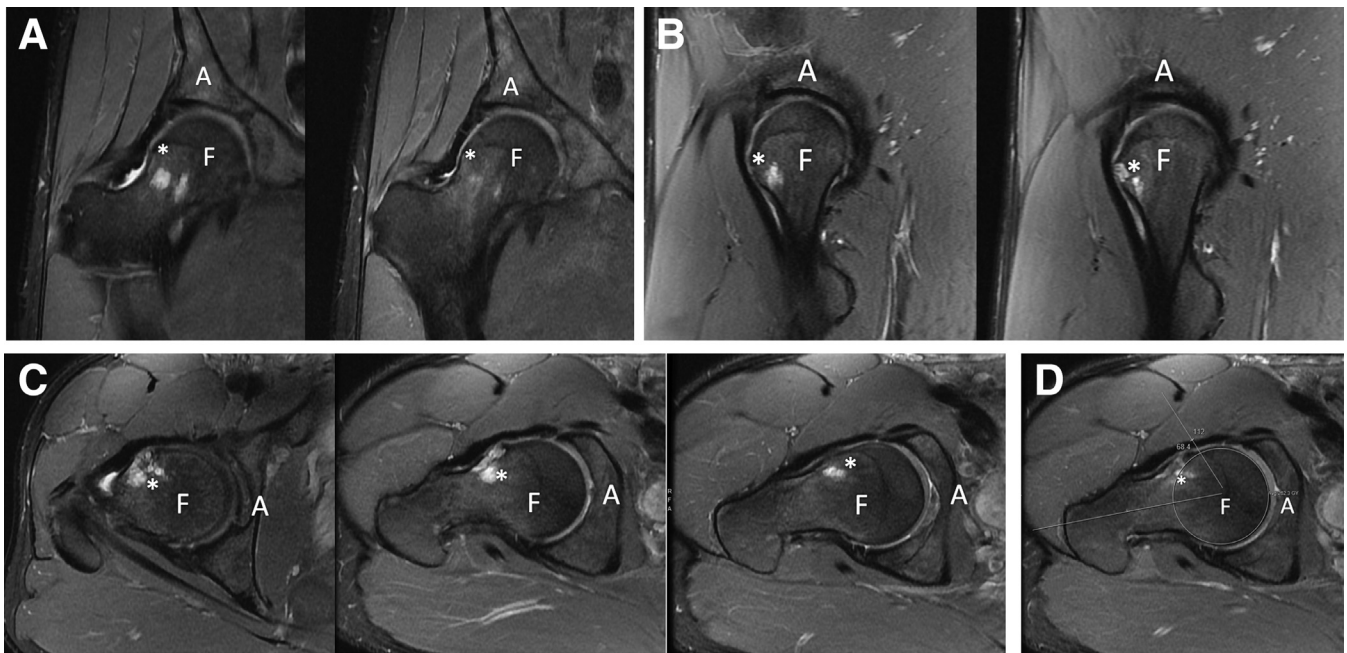
### Imaging

Shown in [Figure 1](#) A and B are the preoperative radiographs of a patient with right hip pain due to FAI with a large cam lesion. Select magnetic resonance imaging slices are shown in [Figure 2](#) A-D. Full-thickness anterosuperior labral tear and cartilage delamination of the superior acetabulum are seen, consistent with cam-type FAI.

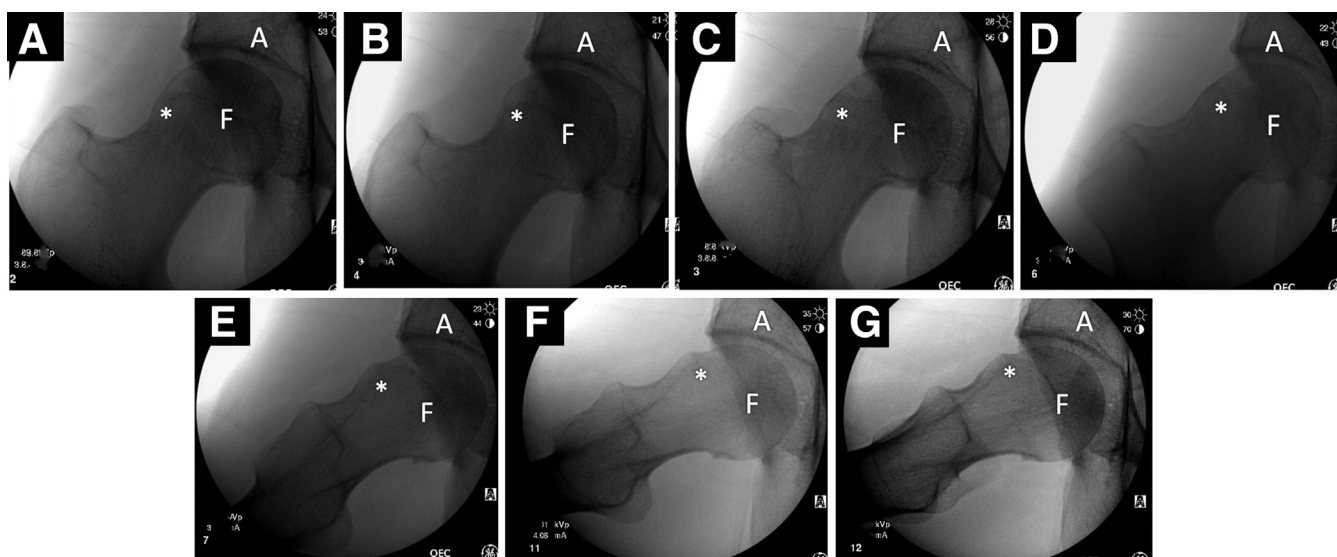
### Surgical Technique (With Video Illustration)

#### Preoperative Fluoroscopic Evaluation

The patient is positioned supine on a hip distractor table that allows dynamic leg positioning. Both post and post-free hip distractors can be used. The nonoperative leg is positioned in approximately 45° of abduction and 10° of flexion. The operative leg is placed in neutral

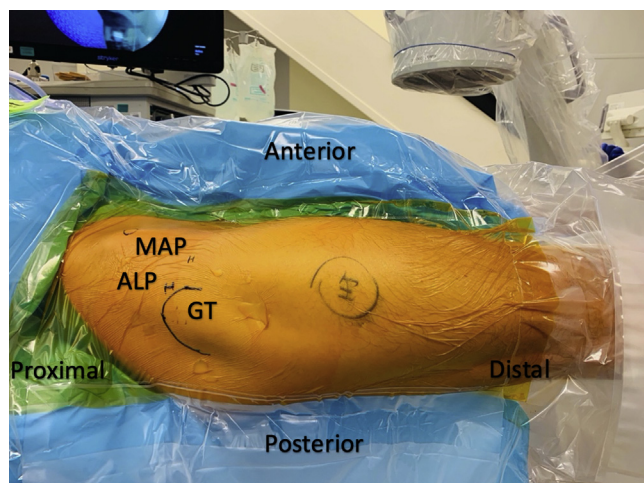


**Fig 2.** Preoperative right hip magnetic resonance imaging (A) coronal slices, (B) sagittal slices, and (C) axial slices with (D) alpha angle measurement of 68.4°. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.



**Fig 3.** Preoperative fluoroscopic examination of the operative (right) hip: (A) neutral flexion, neutral rotation, (B) neutral flexion, 30° IR, (C) neutral flexion, 30° ER, (D) Dunn 30, (E) Dunn 60, (F) Dunn 90, and (G) frog-leg lateral. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled. (IR, internal rotation.)

abduction, rotation, and flexion. The fluoroscopy x-ray generator with image intensifier (C-arm) enters from the nonoperative side. The cam deformity is then assessed with the leg in varying positions as described by Ross et al.<sup>17</sup> To evaluate the superolateral aspect of the femoral head–neck junction, anteroposterior images of the hip are obtained with the knee and hip in neutral flexion and the leg in neutral rotation, 30° internal rotation (IR), and 30° external rotation (ER). The hip is then progressively flexed to 30-, 60-, and 90° Dunn lateral views. Finally, a frog-leg lateral view in 90° of flexion and 60° of external rotation are obtained (Fig 3 A-G).



**Fig 4.** Patient in supine position on traction table with large padded post. The operative (right) hip is shown here. The greater trochanter (GT) is outlined. Anterolateral portal (ALP) and mid-anterior portal (MAP) portals are marked.

### Hip Entry and Central Compartment Procedures

Once imaging is complete, the operative extremity is placed in gentle gross traction. An air arthrogram is completed, using the technique previously described by our institution.<sup>18</sup> The anterolateral portal (ALP) is established first under fluoroscopic guidance. A modified mid-anterior portal (MAP) is then established approximately 3 cm anterior and just distal to the ALP under direct arthroscopic visualization (Fig 4). The ALP and MAP are used as the primary viewing and working portals, respectively.

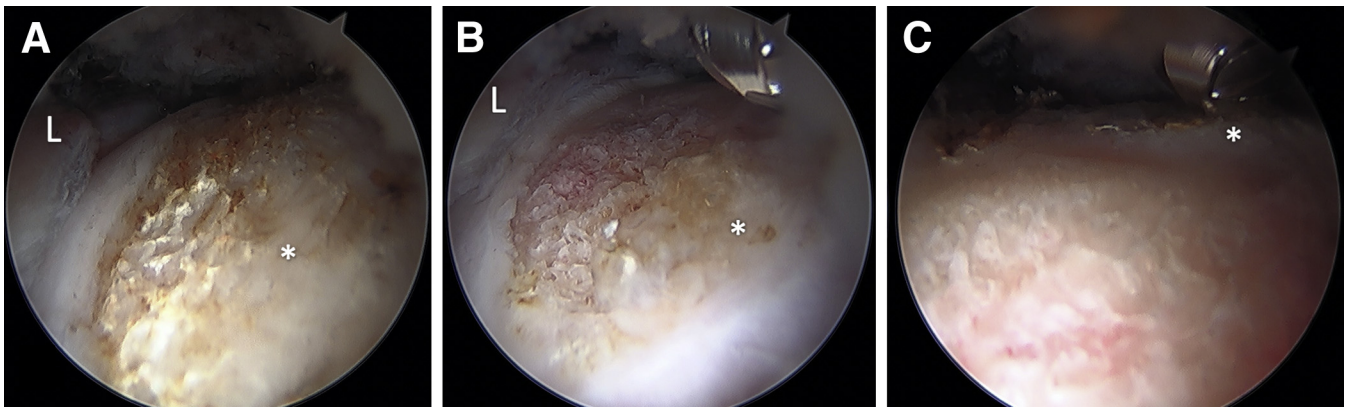
A radiofrequency ablation (RFA) (ArthroCare, Smith & Nephew, Andover, MA) device is used to perform a periportal capsulotomy as previously described with

**Table 1.** Positions of the Hip and Corresponding Anatomical Zones

Hip Position	Anatomical Zone of Head–Neck Junction (Clockface Value, Per Ross Et Al. <sup>17</sup> )
Neutral flexion, neutral rotation	Posterolateral (10:30-11:30)
Neutral flexion, 30° IR	Posterolateral/posterosuperior (9:30-10:30)
Neutral flexion, 30° ER	Anterolateral/anterosuperior (11:30-12:30)
Flexion 30°, 0-10° ER (dunn 30)	Anterolateral (12:30-1:30)
Flexion 60°, 0-10° ER (dunn 60)	Anteromedial (1:30-2:30)
Flexion 90°, 45-60° ER (frog-leg 90)	Anteromedial (2:30-3:30)

ER, external rotation; IR, internal rotation.





**Fig 5.** Arthroscopic images of the right femoral head–neck junction with hip in neutral flexion and (A) neutral rotation, (B) IR 30, (C) ER 30. For orientation, the labrum (L) and acetabulum are seen on the left. The femur and cam lesion (\*) are on the right. All arthroscopic images are seen through the ALP using a 70° arthroscope. The burr is placed through the MAP. (ALP, antero-lateral portal; ER, external rotation; IR, internal rotation; MAP, mid-anterior portal.)

dilation of the MAP to 8 to 10 mm.<sup>14,15</sup> This process allows movement of the instruments within the hip joint without creating a full interportal capsulotomy and compromising the iliofemoral ligament. A diagnostic arthroscopy of the central compartment is then performed followed by acetabuloplasty and labral repair, reconstruction, or debridement as indicated. Once work in the central compartment is completed, traction is released.

#### Femoroplasty Within the Peripheral Compartment

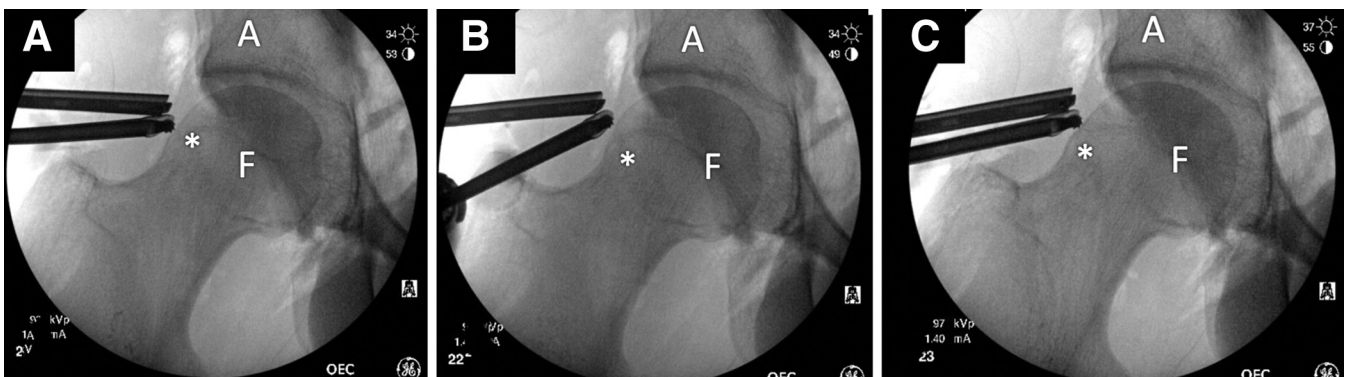
The arthroscope is used to view through the ALP and the burr is placed through the MAP as the working portal. The hip is progressively placed in 7 positions to bring the cam lesion into the window of the MAP for resection. [Table 1](#) summarizes the hip positions and corresponding zones on the femoral head/neck junction. [Video 1](#) serves as a brief overview of the technique.

#### Position 1: Neutral Flexion, Neutral Rotation

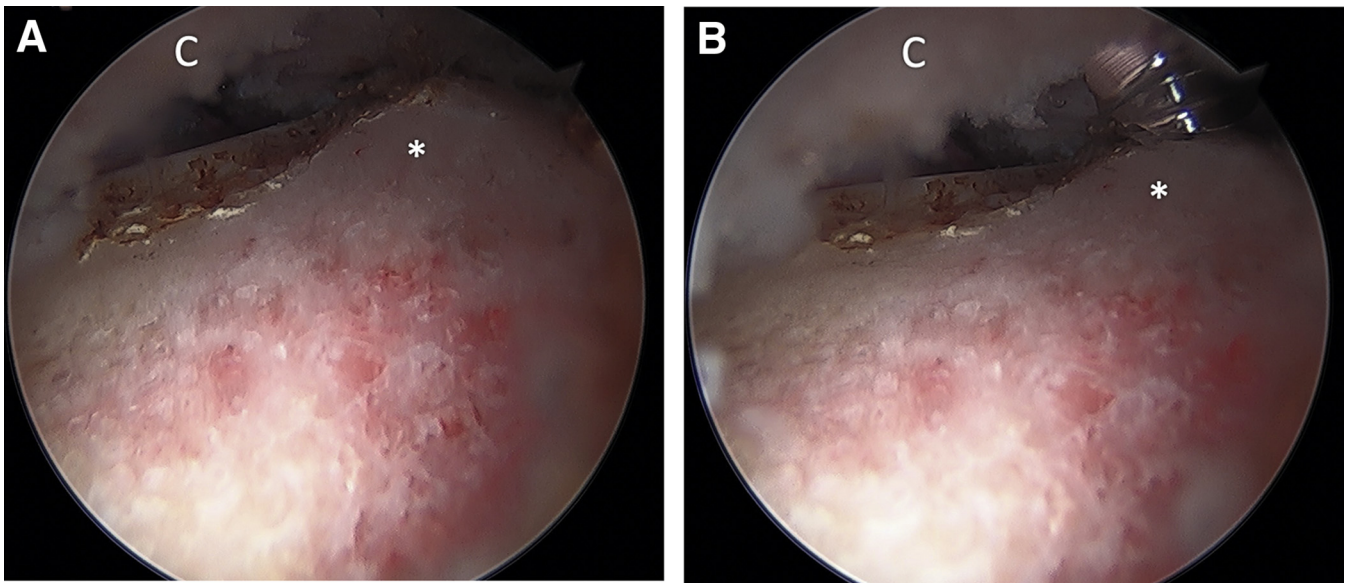
After the femoral head is reduced, the hip is brought into neutral flexion and rotation. This position allows access to the lateral aspect of the femoral head–neck junction. RFA is used to mark the most proximal extent of the osteoplasty, approximately 5 mm distal to the labrum. For more proximal lesions, it is safe to perform the femoroplasty up to the level of the labrum when the hip is off traction. Next, the cartilage overlying the cam lesion is removed by RFA. Once completed, a 5.5-mm round Burr (Stryker, Kalamzoo MI) is used to resect the cam lesion ([Figs 5A](#) and [6A](#)). The burr is used with reverse spin to protect from overly aggressive bone resection. This process is repeated for each position to follow.

#### Position 2: Neutral Flexion, 30° IR

Once debridement of the visualized cam lesion is complete in neutral rotation, rotate the hip into 30° IR



**Fig 6.** Intraoperative fluoroscopy views of hip in neutral flexion and (A) neutral rotation, (B) IR 30, and (C) ER 30. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled. (ER, external rotation; IR, internal rotation.)



**Fig 7.** (A and B) Arthroscopic images of the femoral head/neck junction with hip in 30° flexion and 0-10° external rotation (Dunn 30). Capsule (C) and cam lesion (\*) are labeled.

with the hip in neutral flexion to allow greater posterior access (Figs 5B and 6B).

#### **Position 3: Neutral Flexion, 30° ER**

Next, rotate the hip into 30° ER to allow greater anterior access (Figs 5C and 6C).

#### **Position 4: Flexion 30°, 0-10° ER (Dunn 30)**

Raise the hip to 30° of flexion by flexing the knee in order to obtain the Dunn 30 view. Hip flexion allows further visualization distally and anteriorly. Note that when using a large perineal post, the hip will be pushed into slight ER with greater flexion (Figs 7 A and B, 8 A-C).

#### **Position 5: Flexion 60°, 0-10° ER (Dunn 60)**

Further raise the hip to 60° of flexion to obtain the Dunn 60 view and reach the more anterior/distal extent of the cam (Figs 9 A and B, 10 A-C). As the hip is

progressively flexed, tension on the iliofemoral ligament will be decreased, which will increase the working space for the burr.

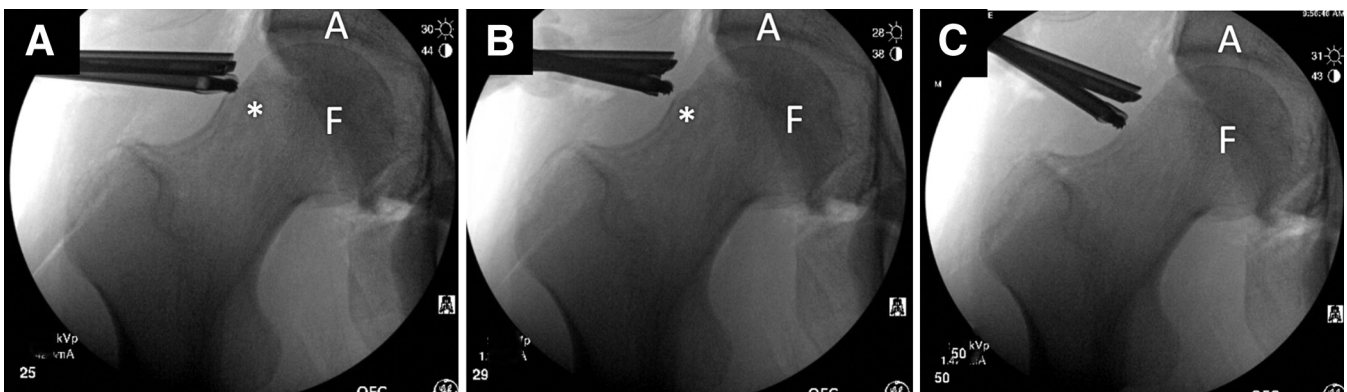
#### **Position 6: Flexion 90°, 0-10° ER (Dunn 90)**

Finally, raise the hip to 90° of flexion to obtain the Dunn 90 view and greater anteromedial access (Fig 11 A-D).

#### **Position 7: Flexion 90°, 45-60° ER (Frog-Leg 90)**

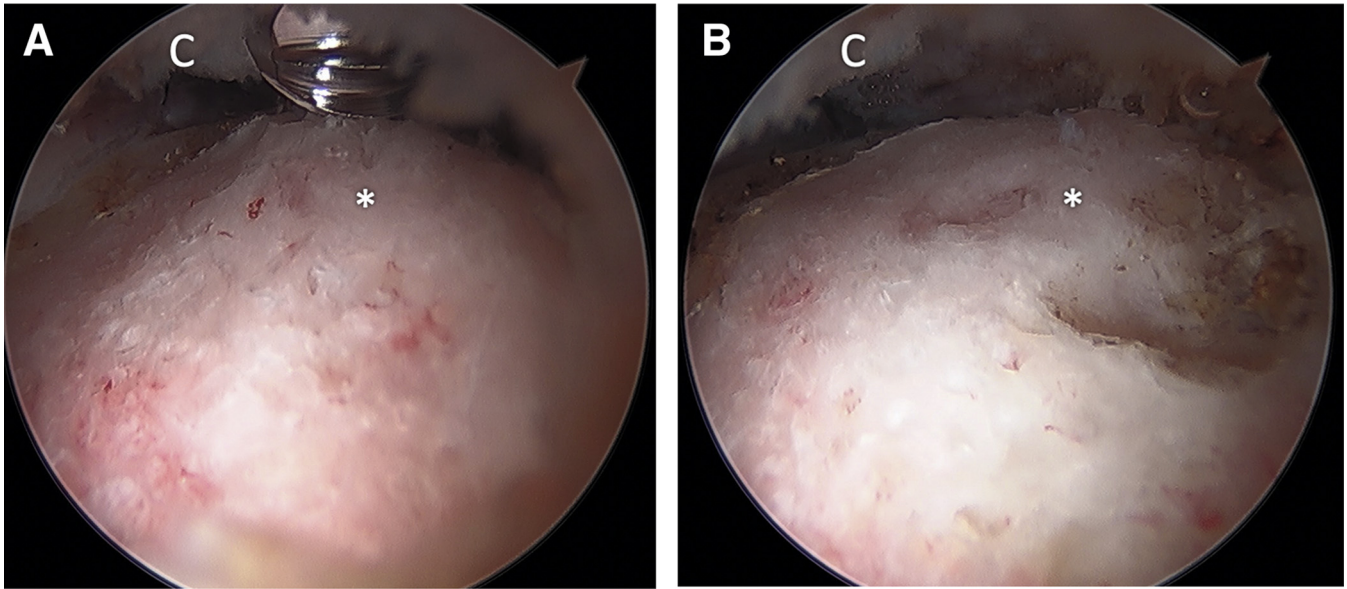
Allow the hip to ER 45 to 60° to gain access to the most anteromedial extent of the cam (Fig 12 A and B). As the hip is brought down from full flexion and ER and back to extension and neutral rotation, the proximal extent of the cam lesion is surveyed and resected.

Finally, to ensure complete proximal/posterior resection, the hip is brought back to neutral flexion and



**Fig 8.** (A, B, C) Intraoperative fluoroscopy views of hip in 30° flexion and 0-10° external rotation (Dunn 30), showing progression of cam resection. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.





**Fig 9.** (A and B) Arthroscopic images of the femoral head–neck junction with hip in 60° flexion and 0–10° external rotation (Dunn 60). Capsule (C) and cam lesion (\*) are labeled.

30° IR one more time to check that the posterior extent of the cam deformity has been reached. Now that the anterior cam lesion has been removed, greater IR should be achievable in this position and the posterior/superior gun stock deformity can be better accessed if needed. Frequent fluoroscopic checks at each position can prevent over- or under-resection of the cam lesion. Post-resection fluoroscopy views for all 7 positions are seen in [Figure 13 A-G](#). Finally, [Figure 14](#) demonstrates that after complete resection of the large cam lesion in this case, the iliofemoral ligament remained intact and capsule closure was not necessary.

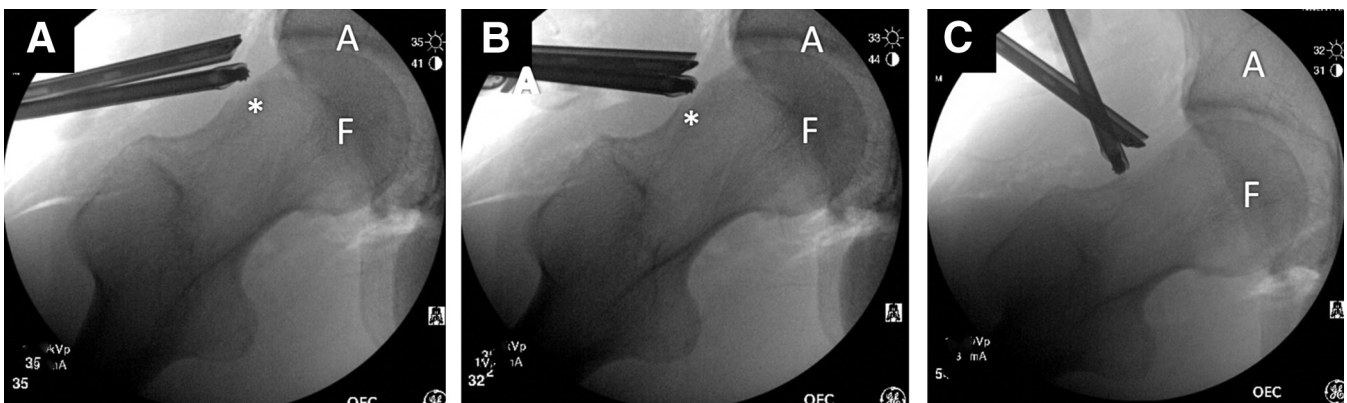
### Postoperative Rehabilitation

The patient is placed on foot-flat touchdown weight-bearing restrictions for 2 weeks after surgery with use

of crutches. Increased low-impact exercises are allowed after 6 weeks. No running or high impact activity is allowed until after 3 months with full sports at 5 to 6 months.

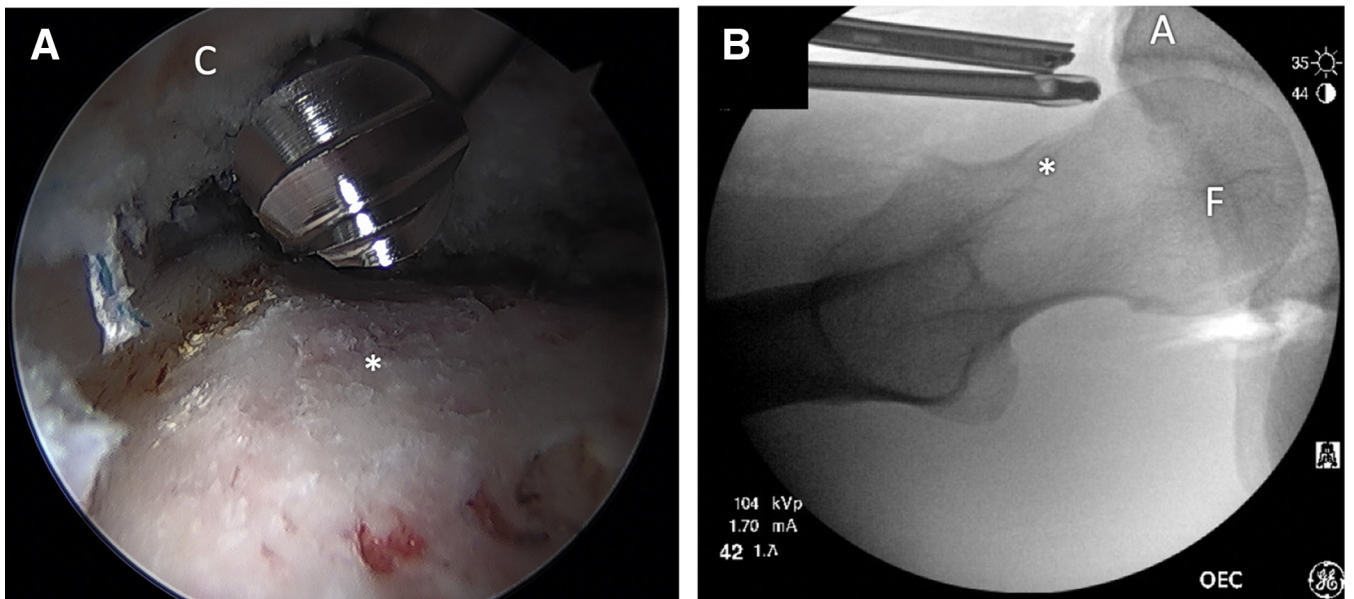
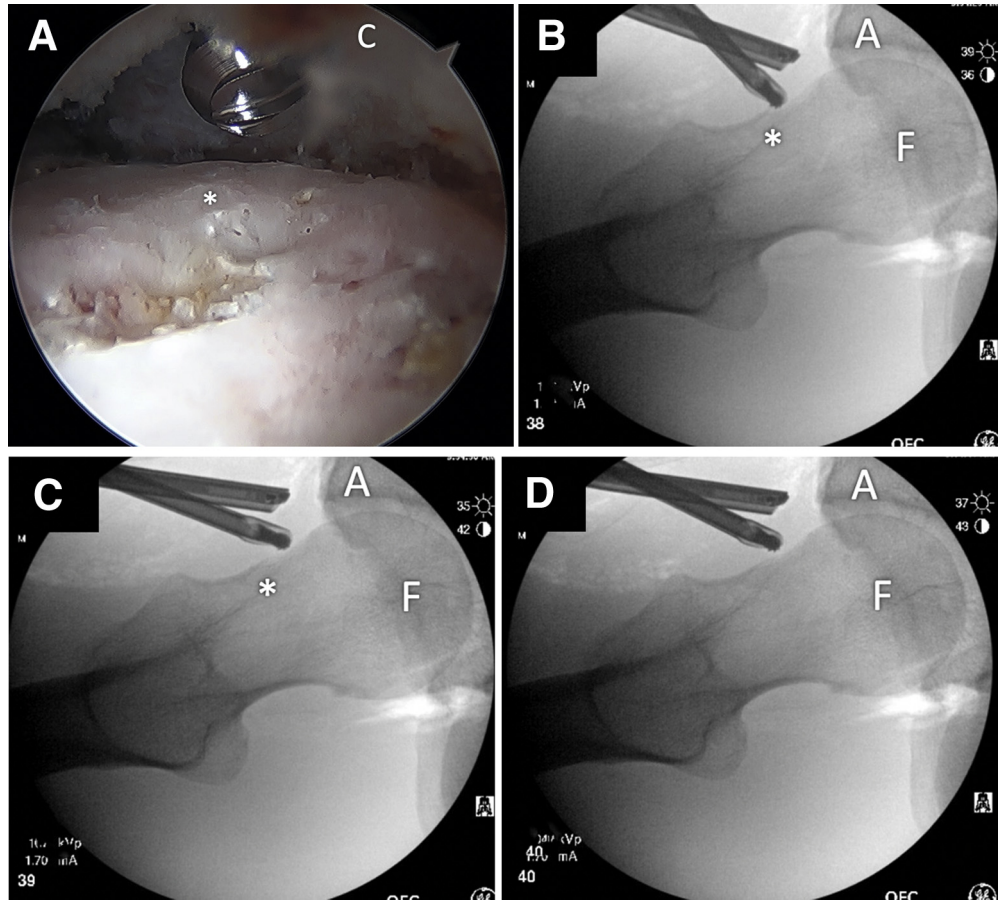
### Discussion

Although previous techniques have been published for arthroscopic femoroplasty to correct cam-type FAI,<sup>19–22</sup> our technique offers a systematic approach to femoroplasty with conservative management of the capsule using periportal capsulotomy. This technique provides valuable information for surgeons as a proper arthroscopic femoroplasty is critical to achieving good clinical outcomes with under-resection, over-resection, and cortical notching all



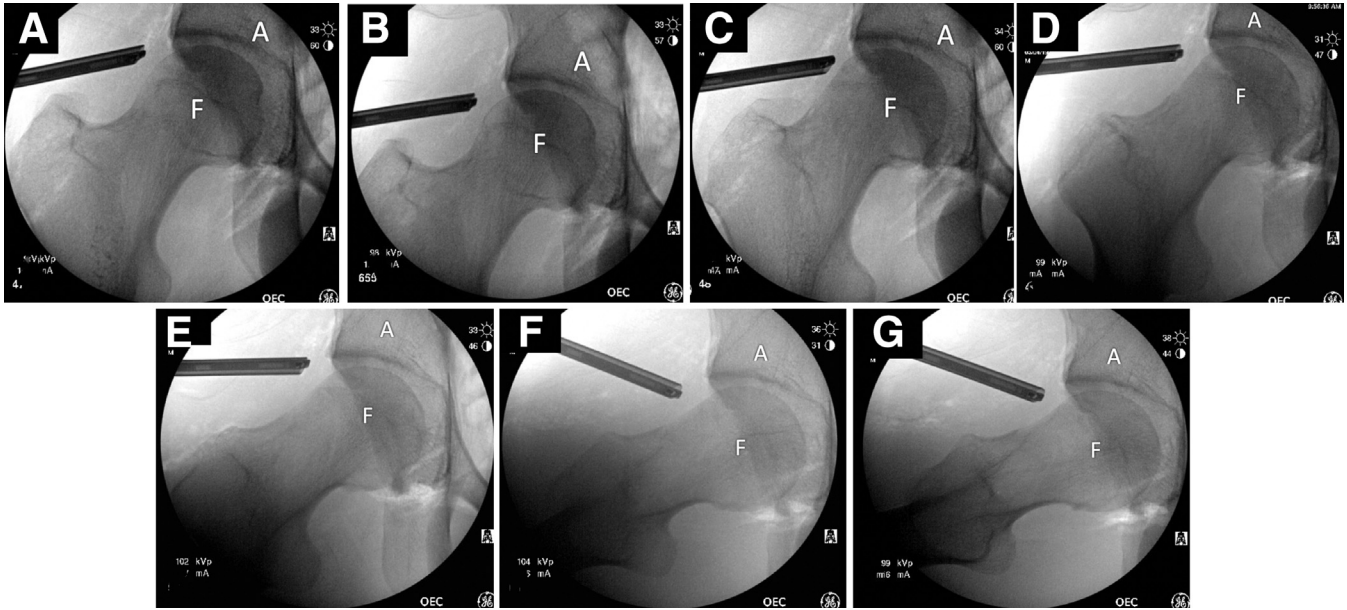
**Fig 10.** (A, B, C) Intraoperative fluoroscopy views of hip in 60° flexion and 0–10° external rotation (Dunn 60), showing progression of cam resection. Femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.

**Fig 11.** (A) Arthroscopic image and (B-D) intraoperative fluoroscopy views with hip in 90° flexion and 0-10° external rotation (Dunn 90), showing progression of cam resection. Capsule (C), femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.



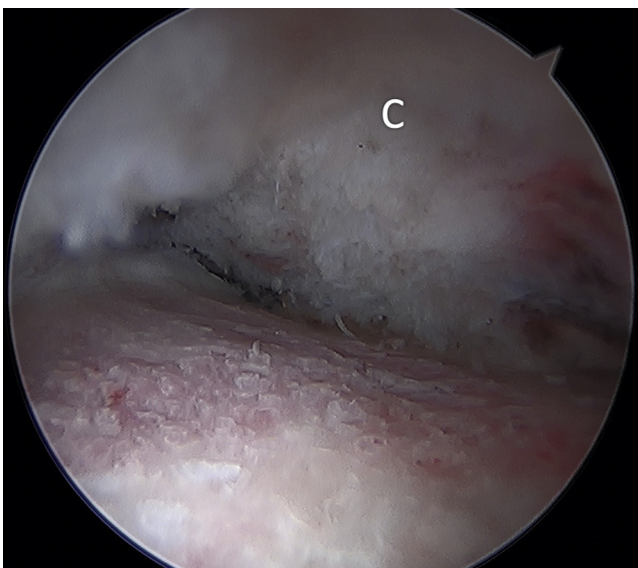
**Fig 12.** (A) Arthroscopic image and (B) intraoperative fluoroscopy view of hip in 90° flexion and 45-60° external rotation (frog-leg 90). In this position, the proximal extent of the cam lesion is resected. Capsule (C), femoral head (F), acetabulum (A), and cam lesion (\*) are labeled.





**Fig 13.** Final intraoperative fluoroscopic views following resection: hip in (A) neutral flexion and rotation, (B) neutral flexion and 30° internal rotation, (C) neutral flexion and 30° external rotation, (D) Dunn 30, (E) Dunn 60, (F) Dunn 90, and (G) frog-leg 90. Femoral head (F) and acetabulum (A) are labeled.

associated with poor results.<sup>4-8</sup> Furthermore, as increasing attention has been directed towards the relationship between capsule management and iatrogenic hip instability,<sup>23</sup> the periportal capsulotomy technique has gained traction as it allows sufficient and safe access to the peripheral compartment without



**Fig 14.** Arthroscopic image of intact capsule/iliofemoral ligament (C) following femoroplasty.

**Table 2.** Pearls and Pitfalls of Arthroscopic Femoroplasty with Periportal Capsulotomy

**Pearls**

- Use a dedicated hip distractor with or without post to allow for improved range of motion and rotation of the hip during femoroplasty. This will help bring the cam lesion into the window of the periportal capsulotomy.
- Use rfa to clear non-weight-bearing cartilage in the peripheral compartment.
- Use rfa to remove any synovitis and undermine the inner layer of the capsule to increase visualization.
- Use round burr (5.5 mm).
- Check neutral flexion and 30° ir as the last position to ensure that the most posterior extent of the cam lesion is accessed. Greater ir should be achievable after anterior cam resection.
- With movement between each position listed in Table 1, continue to look for deviations in the plane from the previous resection and level out in between each position. Do not leave gaps of under-resected cam deformity between each position.

**Pitfalls**

- For large cam lesions or tight anterior capsule, the periportal capsulotomy made need to be extended to a full interportal capsulotomy.
- The use of rfa results in capsular tissue loss. If capsular closure is subsequently required, there may be inadequate tissue.
- For severe gunstock deformities, it may be difficult to reach far superiorly and posteriorly when viewing through the al portal
- The arthroscope may need to be switched to the ma portal and the burr to the al portal to reach far posterior lesions which may make fluoroscopic evaluation of the cam lesion difficult.
- Increased manipulation and stretching may cause increased dilation of the periportal capsulotomy, which may necessitate repair.
- An assistant is typically required to help position the hip.

IR, internal rotation; RFA, radiofrequency ablation.



compromise of the iliofemoral ligament or need for capsular closure.<sup>14,15</sup>

The present case example demonstrates that through different hip flexion and rotation angles, it is possible to gain access to large cam lesions through a periportal capsulotomy. As seen in Figure 14, the capsule and iliofemoral ligament are minimally violated despite full resection of a large cam lesion.

Table 2 describes our pearls and pitfalls. Increased manipulation and stretching may cause increased dilation of the periportal capsulotomy, requiring repair. In the setting of a tight anterior capsule or extremely large cam lesion, it may be necessary to extend to a full interportal capsulotomy. Periportal dilation is performed in the same plane as an interportal capsulotomy to allow for this possible conversion. RFA use may result in capsular tissue loss and therefore if conversion to an interportal technique is needed, capsulotomy with a sharp blade should be considered. In addition, given the limited capsulotomy and working space, it may be necessary to switch the arthroscope to the MAP and burr to the ALP to reach far posterior lesions. Lastly, an assistant is usually needed to help position the hip as it is moved through a range of motion. This may increase the surgical time for femoroplasty.

In conclusion, hip arthroscopy using conservative capsule management with periportal capsulotomy can be effectively used in the setting of a large cam lesion through a systematic approach to arthroscopic femoroplasty.

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