Arthroscopic Reduction and Internal Fixation of a Rim Fracture

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Abstract: Femoroacetabular impingement is uncommonly associated to a rim fracture. Complete resection of the fragment might result in iatrogenic instability or poor femoral head coverage. In this report, we describe the step-by-step surgical technique of arthroscopic partial resection of a rim fracture, reduction and internal fixation of the remaining fragment to correct the impingement, and preserve the adequate acetabular coverage.

The true prevalence of rim fracture associated with femoroacetabular impingement (FAI) in nondysplastic hips is unknown. Complete excision of these bone fragments as part of an FAI surgical correction procedure is the recommended treatment. However, when a bone fragment is involved, the treatment should be different. Bone resection should be planned to avoid poor femoral coverage postoperatively, which increases the risk of iatrogenic subluxation or even dislocation, or rapid development of osteoarthritis.

To address the FAI and the acetabular retroversion, a periacetabular osteotomy could be an alternative. In this case, this technique may be associated to substantial morbidity, likely prolonged recovery period, and difficulty in recovering the preoperative level of sport activity.

Physical examination in these patients shows positive impingement test and limitation of internal rotation. Plain radiographs show well-maintained joint space and pincer or combined-type FAI with a rim fracture (Fig 1). Cam deformity can be well defined and measured in axial Dunn radiographic (Fig 2), computed tomographic (CT), or magnetic resonance images (MRIs). CT scan describes the presence of a rim fracture at the superolateral acetabular rim with an intact anteroinferior iliac spine (Fig 3). MRI shows the relation of the labrum and the fragment (Fig 4).

If the fragment is displaced and there is evidence of nonunion, and the bone fragment resection produces center-edge angles of less than 20° to 25° on anteroposterior (AP) pelvis and less than 20° on a false-profile view, internal fixation may be needed. Few reports have been published concerning internal fixation of an unstable rim fracture associated with FAI.

The purpose of this article is to describe step-by-step the arthroscopic technique of partial resection and internal fixation with cannulated screws as part of an arthroscopic joint preservation procedure.

Indications
The technique is indicated for patients with pincer or combined-type FAI associated with rim fractures, if rim resection to correct the impingement produces center-edge angles of less than 20° to 25° on AP pelvis and less than 20° on a false-profile view.

Surgical Technique
The diagnosis can be made on load AP pelvic radiographs, and Dunn axial projections, CT, and MRI.

Preoperative Setup
The patient is placed in the supine position on a hip traction table with padded perineal post and foot protection. The affected limb is placed in neutral adduction, slight flexion, and 15° internal rotation. Traction is
applied under fluoroscopic guidance to confirm that enough joint space has been achieved for safe instrument insertion.

**Portal Placement**

In this technique, anterolateral, midanterior or ancillary, and distal anterior portals are used (hip arthroscopy disposable kit with banana blade; Arthrex, Naples, FL). An anterolateral portal is created under fluoroscopic guidance. Once the anterolateral portal has been established, a 70° arthroscope (Arthrex) is inserted and a complete diagnostic evaluation of the hip joint is performed without irrigation fluid. Distal midanterior and distal anterior portals are created under arthroscopic control. Irrigation fluid is then introduced into the joint using an arthroscopy dual wave pump setting pressure at 40 mmHg (Arthrex).

**Surgical Correction of Subspine Impingement**

Once a stable environment has been achieved and bone fragment identified, it is time for rim resection (Fig 5). It may include part of the rim fracture. Area between fragment and acetabular bone must be clearly defined to decide whether partial (Fig 6) or total resection or fixation should be performed. Bone

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**Fig 1.** Radiographic anteroposterior pelvis view of the bilateral hips demonstrating the presence of a rim fracture on a left hip (white arrow).

**Fig 2.** In the left hip, the center-edge angle (CEA) has been measured incorporating the fragment (52°) and taking into consideration complete removal of the fragment (24°).

**Fig 3.** Radiographic Dunn view on a left hip revealed a rim fracture (white arrow) and cam lesion (gray arrow).
fragment is prepared with a motorized 4.5-mm burr (Arthrex), with an aim to leave a smooth surface adjacent to the intact acetabular rim.

In case fixation is needed, the distal anterior portal is the working portal used for pass all the instruments. A 1.6-mm Kirschner wire (DePuy Synthes, West Chester, PA) is guided into the central portion of the rim fracture to reduce the fragment and secure it to the acetabular rim (Fig. 7). This wire should be the longest length possible. Through the wire and using a 3.2-mm drill bit (DePuy Synthes), a hole is drilled (Fig. 8). Screw sizing is performed with a second Kirschner wire (Fig. 9). Bone fragment is fixed with a 4.5-mm unicortical cannulated screw (DePuy Synthes) (Fig. 10). A long screwdriver is necessary. The screw head can be prevented from sinking into the bone fragment using a washer (DePuy Synthes)
Synthes). Fluoroscopic guidance allows assessing the appropriate location of the screw.

Labral fixation is then performed using a bio-absorbable 2.4-mm Suture Tak anchor (Arthrex). Traction is released and the hip is flexed to access the peripheral compartment.

**Cam Resection**

Cam deformity is now performed (if necessary) in which the initial capsulotomy may be extended into a “T” to gain better access to the distal part of the cam deformity. Femoral osteoplasty is carried out with a motorized 4.5-mm burr. Dynamic examination of the hip is performed to assess the range of motion and to ensure that all impinging areas have been adequately addressed.

**Capsular Closure**

Capsule is repaired using 2 or 3 side-to-side sutures.

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**Complications**

Although we do not have any complications with this procedure, we consider that the same complications may be found as in other hip arthroscopy procedures. The more frequent complications related to hip arthroscopies are iatrogenic, traction-related, and temporary nerve injury related to portal placement.

A step-by-step summary of this technique is provided in **Table 1**. Pearls and pitfalls and advantages/

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**Table 1. Step-by-Step Summary of Arthroscopic Reduction and Internal Fixation of Rim Fracture**

| Step | Description |
|------|-------------|
| 1.   | Position the patient in supine position on a traction table with a well-padded perineal post and boots. |
| 2.   | Apply traction under fluoroscopic guidance. |
| 3.   | Establish anterolateral, midanterior, and distal-anterior portals. |
| 4.   | Use a 70° arthroscope and hip arthroscopy set as instrumentation. |
| 5.   | Use an irrigation pump set at 40 mmHg pressure. |
| 6.   | Perform joint evaluation: labrum, cartilage, and ligamentum teres. |
| 7.   | Proceed to rim resection. |
| 8.   | Identify bone fragment. |
| 9.   | Define area between bone fragment and acetabular bone. |
| 10.  | Debride fibrous tissue. |
| 11.  | Reduce bone fragment. |
| 12.  | Fix it with a 4.5-mm unicortical cannulated screw under arthroscopic and fluoroscopic guidance. |
| 13.  | Perform labral fixation. |
| 14.  | Release traction. |
| 15.  | Perform a T-capsulotomy to access cam deformity. |
| 16.  | Perform cam osteoplasty under fluoroscopic and arthroscopic visualization. |
| 17.  | Suture capsulotomy |
disadvantages are presented in Tables 2 and 3, respectively. Key steps of the procedure are shown in Video 1.

Postoperative Rehabilitation Protocol

Patient is discharged on the following day and restricted to full weight bearing for 6 weeks assisted by crutches. A program to achieve full range of motion in the affected hip starts on the third postoperative day. Exercise to gain strength is delayed until the seventh postoperative week, and the patient is advised to avoid exercises involving the rectus femoris and quadriceps muscles. It is recommended not to progress back into contact sports at least until the sixth postoperative month. Figure 11 shows a radiographic anteroposterior pelvis view of the healed rim fracture and internal fixation with a cannulated screw with a washer. The rim fracture had healed. The joint remained congruent without joint space narrowing.

Discussion

The origins of ossicles at the acetabular rim are widely reported as unfused secondary ossification centers of the acetabulum. The joint side of the os acetabuli is covered with hyaline cartilage and the labrum attached to the periphery. In dysplastic hips, the acetabular rim is exposed to forces more frequently, and acetabular fragments are reported. The difference from an ossicle or ossicles depends on the fibrous tissue filling the joint side.

True prevalence of rim fractures associated with FAI in nondysplastic hips is unknown. Martinez et al. reported a 3.6% incidence in his retrospective study of 495 surgically treated radiographs. They showed that highly active patients, cam-type FAI, and acetabular retroversion are risk factors for the development of a rim fracture.

Removal of these rim fractures has been common in the treatment of FAI. Martinez et al. reported 18 hips

| Table 2. Pearls and Pitfalls |
|-------------------------------|
| Pearls                       | Pitfalls                                       |
| Measure center-edge angles with and without associated rim fractures | No identification of structural impingement or instability preoperatively and intraoperatively |
| Achieve a stable environment Identify bone fragment | Incorrect portal placement No identification of the bone fragment |
| Avoid excessive bone resection Use a long K-wire | Excessive bone resection K-wire will not be long enough to reach the bone fragment |
| Screw sizing with a second Kirschner wire Use a long screwdriver | K-wire not long enough to size the screw Screwdriver will not be long enough to get to the screw |
| Use a washer to prevent screw sinking | The screw will sink into the fragment |
| Treat associated lesions: labral injuries and femoral asphericity | No correction of impingement |
| Perform dynamic examination | No clinical results improvement |

| Table 3. Advantages and Disadvantages |
|----------------------------------------|
| Advantages                             | Disadvantages                                           |
| This procedure allows complete visualization of the fragment This is a minimally invasive procedure | It is a challenging technique Intrapelvic migration of the K-wire |
| This procedure allows to maintain appropriate acetabular coverage | No indication if after fragment resection center edge angle less than 20°-25° on anteroposterior pelvis view |
| Quicker and shorter recovery time | Longer operative time |

Fig 11. Radiographic anteroposterior pelvis view of the bilateral hips at 1-year follow-up showed partial resection of the rim fracture and internal fixation with a cannulated screw with a washer. The rim fracture had healed. The joint remained congruent without joint space narrowing.

Fig 12. In the left hip, the center-edge angle (CEA) had decreased from 52° to 34° postoperatively.
with large osseous fragments at the anterolateral acetabular rim. The mean center-edge angle of Wiberg was 32° (range 27°–45°). They performed surgical dislocation of the hip with excision of the fragment when it was macroscopically mobile and trimming of the overcovering acetabular rim, combined with osteochondroplasty of the femoral head-neck (12 hips)—or direct trimming of the overcovering acetabular rim and osteochondroplasty of the femoral head (6 hips). They did not report any postoperative complications.10

On the other hand, other authors reported iatrogenic dislocation and subluxation after arthroscopic rim resections. Benali and Katthagen5 reported the case of a 49-year-old woman who underwent hip arthroscopy for a long ventrolateral labral tear and exostosis of the lateral acetabular rim. The labrum was resected from its ventral to its lateral aspect, and an exostosis was removed from the lateral edge of the acetabulum. Three weeks after hip arthroscopy, the patient allocated most of the pain to the groin, and radiographs showed a subluxation of the hip. Cuéllar et al.6 published a case of a 42-year-old woman with FAI and os acetabuli. The center-edge angle was 15° preoperation. They performed complete resection of the os acetabuli. At 10 months after surgery, radiographs showed Tönnis grade III degenerative changes.

These reports emphasize the importance of maintaining appropriate acetabular coverage when performing these procedures. Larson and Stone8 published the results of 2 cases where partial resection of a rim fracture and internal fixation of the remaining fragment were performed to correct the impingement. In one case, the lateral center-edge angle without the rim fracture was 15° and 18° in the other. The authors performed partial rim resection, and the remaining fragment was secured with a arthroscopy-assisted 3.5-mm cannulated screw. There were improved outcome scoring and healing of the fragment at 2-year follow-up. Rafols et al.1 presented one case with bilateral FAI and large superior rim fracture. The lateral center-edge angle without the rim fracture was 18° in both hips. They proceed to partial resection and fixation of the fragment with arthroscopy-assisted 3.0-mm cannulated screw in both sides. Clinical results improved and radiographs showed that rim fracture healed at 6 months.

We agree with Larson and Stone that if removal of the bone fragment results in a center-edge angle less than 20° to 25° on the AP pelvis view, partial resection and internal fixation of the remaining fragment should be contemplated.9 Hence, preoperative planning is mandatory to assess adequate acetabular coverage after corrected impingement in an arthroscopically performed joint preservation procedure. In this sense, we describe an arthroscopic technique to perform a partial resection with internal fixation of a rim fracture.

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