Pincer-type femoroacetabular impingement is an acetabular/pelvic-sided disorder. Although acetabular overcoverage is a common theme for this disorder, there are distinct pincer subtypes with variable pathomorphologies that must be considered when contemplating the ideal approach and treatment for these disorders. In addition, emerging evidence suggests that extra-articular pelvic structures, such as the anterior inferior iliac spine, may also result in hip impingement. The current chapter will describe the various pincer subtypes, their clinical presentation, and typical imaging findings. Arthroscopic indications, contraindications, specific arthroscopic surgical techniques, postoperative rehabilitation, and femoroacetabular impingement surgical outcomes will be discussed as well.

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Femoroacetabular impingement (FAI) is a disorder that can result in hip pain and disability and may be a precursor for hip osteoarthritis. This disorder is traditionally described as femoral head–neck asphericity or decreased femoral head–neck offset (cam-type FAI), acetabular overcoverage (pincer-type FAI), or mixed cam- and pincer-type FAI. There has been much written with regard to this topic, and our understanding of FAI is rapidly evolving. The current article will focus on acetabular-sided impingement or pincer-type FAI. Anatomy and biomechanical considerations, epidemiology, patient presentation, imaging evaluation, indications and technique for arthroscopic treatment, and outcomes after arthroscopic management of pincer-type FAI will all be discussed.

Anatomy/Pathogenesis

Pincer-type FAI is secondary to acetabular overcoverage, and although this is typically anteriorly based, overcoverage can be present superiorly and posteriorly as well. This acetabular overcoverage results in impingement of the acetabular rim against the femoral neck during range of motion. The acetabular labrum is subsequently crushed between the acetabulum and femoral neck, which results in the typical labral ecchymosis, degeneration, and eventual ossification in the chronic setting. In addition, posterior acetabular damage can occur secondary to a contrecoup injury. There are 3 primary types of pincer-type FAI: true retroversion, focal anterior overcoverage, and global overcoverage. Global overcoverage can be further divided into coxa profunda and protrusio acetabuli. In some cases, rim fractures/os aceta-buli may be present and are typically seen in the presence of combined cam- and pincer-type FAI. In addition, impingement secondary to a prominent anterior or distal anterior inferior iliac spine (AIIS) has received recent attention. AIIS or subspine impingement can be secondary to previous apophyseal or rectus femoris avulsions or previous periacetabular osteotomy, or can be developmental, and is typically seen in the setting of acetabular retroversion.

Clinical Presentation and Physical Examination

Patients with pincer-type impingement and associated labral pathology will typically complain of anterior/groin pain with torsional activities, getting in and out of a car, and prolonged sitting. Superior- and posterior-based impingement may result in anterior and deep lateral pain with abduction/lateral-based movements and posterior pain with extension/external rotation, respectively. With advancing degenerative changes, aching pain may predominate. Patients with AIIS/subspine impingement will typically complain of pain with prolonged sitting and flexion-based activities.

Physical examination is critical when intra-articular pincer-type and extra-articular AIIS/subspine pathology is sus-
pected. The anterior impingement test (flexion/adduction/internal rotation) is positive when anterior and deep lateral pain is reproduced and may indicate anterior-based overcoverage. The posterior impingement test (extension, external rotation) is positive when deep lateral and posterolateral pain is reproduced and may indicate posteriorly based pathology. Patients with superior overcoverage may have pain reproduced and motion limitations with abduction and flexion/abduction/internal rotation testing. The posterior impingement test (extension, external rotation) is positive when deep lateral and posterolateral pain is reproduced and may indicate posteriorly based pathology. Patients with superior overcoverage may have pain reproduced and motion limitations with abduction and flexion/abduction/internal rotation testing. Pincer-type FAI can coexist with cam-type FAI (combined-type FAI), and these patients may have greater motion limitations, in particular for forward flexion and internal rotation. Patients with AIIS/subspine impingement will typically have pain and motion limitations with straight forward flexion and tenderness to palpation over the AIIS, which recreates their typical discomfort. Temporary relief of pain with an intra-articular or a subspine injection can be confirmatory for intra-articular hip joint pathology or AIIS/subspine impingement, respectively.

**Imaging**

Plain radiographs are first evaluated, and the current author obtains a well-centered anteroposterior (AP) pelvis radiograph of both hips, a 45° modified Dunn view, and a false-profile view for all patients presenting with hip-related pain. It is critical to have an appropriately aligned AP radiograph, with the coccyx centered over the pubic symphysis and 0 to 3 cm between the tip of the coccyx and symphysis to evaluate for pincer-type morphology. For example, increased anterior pelvic tilt and rotation of the hip toward the affected hip will result in an overestimation of acetabular retroversion and AIIS prominence. Acetabular retroversion is present when radiographs demonstrate a positive crossover sign, a positive posterior wall sign, and an ischial spine sign. Focal anterior overcoverage is the presence of a positive crossover sign and a negative posterior wall sign. Coxa profunda is present when the teardrop is medial to the ilioischial line, with a lateral center edge angle (LCE) of >35°. Protrusio is present when the femoral head extends medial to the ilioischial line. Findings consistent with AIIS/subspine impingement include previous AIIS avulsion or ossification of the proximal rectus femoris and extension of the AIIS well below the acetabular sourcil on a well-centered AP pelvis. A crossover sign with a thick sclerotic anterosuperior cortex indicates distal extension of the AIIS beyond the acetabular rim. The false-profile view provides clear view of the AIIS and associated anterior or distal deformities.

Magnetic resonance imaging (MRI) can be helpful to identify associated labral and chondral pathology, and the current author prefers a 3-T MRI or MRI arthrogram, which have been shown to be more accurate for defining labral and chondral pathology. In the presence of pincer-type FAI, labral degeneration, intra-labral calcific and cystic changes, and labral/rim ossification may be appreciated. For isolated pincer-type FAI, chondral pathology may be minimal early on with the development of posterior chondral pathology later in the disease process. More significant posterior, medial, and inferior chondral pathology can be seen in the setting of protrusio.

Three-dimensional computerized tomography can be invaluable when performing arthroscopic hip procedures (Fig. 1). The current author obtains a three-dimensional computerized tomography for all patients undergoing arthroscopic hip procedures. This allows the surgeon to appreciate an image similar to that achieved through open surgical approaches. Acetabular version, subtle variability in rim morphology, femoral head coverage, location and size of rim fractures/os acetabuli, AIIS morphology, and subtle joint space narrowing are assessed. In addition, the magnitude and extent of cam-type morphology, neck shaft angle, as well as an assessment of femoral neck version when additional cuts are taken through the knee allow for a more global assessment of the hip.

**Indications and Contraindications**

The indications for arthroscopic management of pincer-type FAI continue to evolve. The goal of arthroscopic treatment is to resect the areas of acetabular overcoverage, preserve the acetabular labrum whenever possible, and manage associated acetabular chondral pathology. The procedure should ultimately result in an acetabulum with adequate global coverage, impingement-free range of motion, and an intact labral seal, with resultant improved hip biomechanics.

The current author’s indications for arthroscopic rim resection include mild-to-moderate acetabular retroversion (Fig. 2A and B), focal anterior overcoverage, coxa profunda (LCE: >35°), an LCE of >40° (in the absence of protrusio), and...
labral/rim ossification and acetabular overcoverage, acetabular overcoverage with associated os acetabuli/rim fractures, and AIIS deformities with subspine impingement. If the AIIS extends excessively anterior and/or distal to the acetabular rim, then a subspine decompression might be considered as part of an arthroscopic FAI corrective procedure.

The current author’s contraindications for arthroscopic rim resection include >50% joint space narrowing or joint space narrowing with MRI evidence of bipolar grade 4 changes, protrusio acetabuli with a large notch and relatively deficient articular cartilage volume, severe acetabular retroversion, a low volumetric acetabulum, and dysplasia. Significant degenerative changes are best treated with injections and eventual hip arthroplasty. Protrusio presents a difficult treatment dilemma and may be best treated with surgical dislocation, pelvic osteotomy, or hip arthroplasty, depending on multiple patient factors. Recent finite element models suggest that some cases of protrusio have a large acetabular notch with overall deficient acetabular surface area. The abnormal forces in this situation are localized to the medial aspect of the joint rather than the rim. Simulated rim resections and finite element models have shown increased medial joint stress after global rim resections in this situation. Severe acetabular retroversion may be best treated with a reverse or an antever sion periacetabular osteotomy. Finally, rim resections in the setting of a low volumetric acetabulum or borderline dysplastic acetabulum should be avoided, and corrective pelvic osteotomies should be considered when dysplastic features predominate.

**Arthroscopic Technique**

Preoperative imaging is critical when planning rim resec tions. It is important to avoid rim resections that might com-
promise stability. The current author carefully evaluates acetabular morphology and coverage on preoperative three-dimensional imaging. On an AP pelvis radiograph, a point where the LCE is 30° or 35° is marked and the center of the femoral head is marked. The posterior wall should then extend from this point superiorly and just medial to the center of the femoral head. The anterior wall extends from this superior point and running toward the inferior aspect of the teardrop and medial to the posterior wall. Extension of the superior and anterior rim lateral to this marks the area that might be safely resected if intraoperative assessment confirms a pincer mechanism. If the acetabulum is medial to this line, then rim resection should be avoided and any retroversion noted may be secondary to superoposterior acetabular undercoverage.

Arthroscopy is performed, as previously described, primarily using the anterolateral and midanterior portals. A spinal needle is introduced through the posterolateral portal for outflow and is occasionally formally established if posterior rim or labral pathology requires treatment. A capsulotomy from the mid anterior portal to the posterolateral portal is performed by the current author in essentially every case (Fig. 3) and is repaired at the conclusion of the procedure. A less-extensive capsulotomy has been advocated by others and can be performed if femoral resection is not required.

Pincer-type FAI is confirmed when significant labral bruising and degeneration (Fig. 4), rim fractures/os acetabuli, and rim ossification or extension of the acetabular rim well beyond the labrochondral junction are visualized. A prominent rim anteriorly with focal labral bruising and synovitis should raise the suspicion for AIIS/subspine impingement. Focal labral bruising further inferiorly at the level of the psoas U (3:00 R hip) may be consistent with psoas impingement. This may, however, be seen in the setting of excessive femoral neck or acetabular anteversion and anterior instability, and indiscriminate psoas release may lead to anterior instability.34

The periphery of the labrum is then exposed with a motorized shaver and/or thermal device. The current author performs a rim resection without formal takedown in most cases (Fig. 5A-C). If a more extensive rim resection is required (ie, profunda), the labrum is then formally taken down with an arthroscopic knife to resect the transition zone acetabular cartilage and better approximate the labrum to the acetabular margin. Intraoperative fluoroscopy can be helpful to help evaluate the amount of rim resection if the pelvis is well aligned and images reproduce a well-centered AP pelvis radiograph as previously described.35 If posterior rim resection is required, additional traction can be helpful to better access this region (Fig. 6A-C). After rim resection, if the labrum is not stable, suture anchors are placed and 1 limb of the suture is passed through the labrochondral junction (Fig. 7A) and the other limb is passed through (Fig. 7B) or around the labrum, depending on the status and morphology of the labrum. Loop-around sutures may be used for a more degen-
erative labrum or hypoplastic labrum. The current author favors a mattress suture to potentially better recreate the labral seal (Fig. 7C). Traction can be released during suture tensioning to verify the labrum is not everted or pulled too far proximally to maintain the labral seal. During drilling, intraoperative fluoroscopy and direct visualization of the acetabular articular surface are used to prevent iatrogenic intra-articular drill or anchor penetration.

There are unique pincer-type variants that can be encountered and deserve special mention. If there is a rim fracture that contributes to pincer-type morphology and the acetabular coverage is appropriate without the fragment, the fragment can be excised with a burr or dissected out and removed with a grasper. The current author prefers to remove the fragment with the burr without a formal labral takedown. If acetabular volume is deficient or dysplastic without the fragment (ie, LCE: <20° to 25°; anterior center edge angle (ACE): <15° to 20°), a portion of the rim fracture is removed and the remaining fragment is stabilized with 1 or 2 cannulated screws (3.5 or 4 mm) (Fig. 8).14 The screws are typically 24 to 26 mm in length. A K-wire is used to drill across the fibrocartilaginous junction if the articular cartilage junction between the rim fracture and native acetabulum is intact. The labrum is then stabilized as previously described. In some cases, the AIIS can contribute to pincer-type impingement due to a previous apophyseal or rectus femoris avulsion, due to previous pelvic osteotomy, or in the case of acetabular retroversion, as previously described.15,16 If AIIS impingement is present, a thermal device can be used to define the AIIS anteriorly. A burr is then introduced through the mid-anterior portal and the AIIS is decompressed to a point above the acetabular sourcil, typically 1 to 1.5 cm (Fig. 9A and B). Occasionally a more proximal decompression is required, and a separate window can be made through the rectus tendon with an arthroscopic knife to better preserve the anterior capsule and rectus origin. The rectus tendon can be visualized and/or palpated with the burr during the decompression, and early hip flexor weakness has not been noted after this procedure.

At the conclusion of the procedure, all bony debris are removed and areas of bleeding are coagulated within the exposed musculature to minimize the potential for hetero-

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**Figure 7** (A) An arthroscopic image of the left hip with the arthroscope in the midanterior portal demonstrates passage of 1 limb of the suture anchor passed through the labro-chondral junction. (B) The suture is then retrieved with a penetrating device passed through the base of the labrum. (C) Standard knot tying is then performed, and release of traction demonstrates maintenance of the labral seal (arrows) (L = labrum, F = femoral head).

**Figure 8** (A) A preoperative AP radiograph of the left hip demonstrates a large superior rim fracture and superior cam-type morphology (arrow). (B) A postoperative AP radiograph of the left hip demonstrates excision of a portion of the rim fracture to eliminate the acetabular-sided impingement, arthroscopic fixation of a portion of the fracture with a cannulated screw to maintain stability, and femoral resection osteoplasty to eliminate the femoral-sided impingement (arrow).
topic bone formation. In addition, the current author closes a portion of the capsulotomy in nearly every case (Fig. 10A). The arthroscope is placed in the midanterior portal, a cannula in the anterolateral portal, and the hip is flexed to approximately 20° with some external rotation. This hip position will help to avoid the potential for capsular overtightening if excessive capsule has been excised during the procedure. A monofilament looped suture is passed through the distal (femoral neck) limb of the capsulotomy and retrieved through the proximal (acetabular side) limb with a penetrating device (Fig. 10B). A #2 Vicryl suture is then shuttled across the capsulotomy, and the suture is secured on the superficial side of the capsule with standard knot tying (Fig. 10C). Typically 2 to 4 sutures are used to close the capsulotomy, which closes approximately 50% to 90% of the capsulotomy, respectively.

**Postoperative Rehabilitation**

Early range of motion is initiated on postoperative days 0 or 1. This consists of circumduction of the leg and well leg cycling. A continuous passive motion machine is only used by the current author for patients with a history of postoperative adhesions/arthrofibrosis with past surgeries and for revision cases. Active range of motion to pain tolerance is allowed immediately, and passive external rotation and hip hyperextension are limited for 3 to 4 weeks to protect the capsular repair anteriorly. The current author does not use hip braces or straps to limit external rotation postoperatively. Weight bearing is limited until core muscle strength is adequate to allow walking relatively pain free and with a nonantalgic gait. Crutches are typically used for 2 to 3 weeks. Limited weight bearing (Foot Flat) is recommended for 4 to 6 weeks after microfracture and for patients with relatively soft bone encountered during osteoplasties, and for 6 weeks after internal fixation of rim fractures. Skating and running are typically introduced at 6 to 10 weeks, depending on progress, and progressive cutting and pivoting activities are begun after 3 months if relatively pain free. Most athletes progress into functional drills, practice, and game situations between 4 and 6 months postoperatively, but this can be quite variable.
Outcomes

There is an increasing body of evidence reporting improved outcomes after arthroscopic management of FAI. Recent meta-analysis and systematic reviews have shown improvements after arthroscopic FAI correction comparable with surgical dislocation, and neither approach has been shown to be clearly superior. 36-40 Labral refixation/preservation has been associated with better outcomes compared with labral debridement/excision, but these studies either consist of retrospective analysis of consecutive patient groups or nonrandomized labral repair vs debridement cohorts, which introduces some significant bias with respect to evolving techniques and different pathologies present, respectively. 2,9,11,34,41

Conclusions

Arthroscopic management of pincer-type FAI has evolved in recent years with respect to our technical ability to treat these disorders and our understanding of the pathomechanics. There are certain pincer subtypes that may be best addressed arthroscopically and others that might be best approached with surgical dislocation and/or pelvic osteotomies. The goal of surgery for pincer-type FAI is to remove the areas of impingement, preserve the labrum and the labrum’s function when possible, and avoid iatrogenic instability regardless of the surgical approach. Further studies are necessary to define the optimal surgical approach for various FAI pathomorphologies.

References


