Surgical Technique: Open Acetabular Rim Trimming, Labral Refixation, Open Femoral Osteochondroplasty

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Abstract

Femoroacetabular impingement (FAI) of the hip is an osseous abnormality of the proximal femur and/or acetabulum as described by Ganz. Although no longer the most commonly used approach for the treatment of cam FAI, open surgical dislocation is the most established technique for hip preservation surgery and is a more powerful tool than arthroscopy as it allows the surgeon to address any atypical or complex intra- and extra-articular pathology and can be combined to a concomitant femoral or pelvic osteotomy. This surgery is performed through a Gibson approach, the femoral head is dislocated after a trochanteric osteotomy (trochanteric slide), and the whole head-neck junction is perfectly visualized as well as the acetabulum. This chapter describes the surgical setup, the dissection, the location of the neurovascular structure at risk, and how to avoid complications.

Introduction

Femoroacetabular impingement (FAI) of the hip is an osseous abnormality of the proximal femur and/or acetabulum as described by Ganz et al. [1–3]. The process of motion leads to a forceful contact between the femoral head and neck with the acetabulum that may cause hip pain, labral tears, cartilage delamination, and potentially osteoarthritis later in life [4–8]. The prevalence has

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been shown to be 10–15 % in young active patients and up to 94 % of young patients with hip pain [9]. Although the pathomechanism leading to the onset of symptoms is still being studied, it is clear that the severity of the cam lesion is a significant risk factor for the development of hip pain as well as cartilage damage.

In a follow-up study, 170 of 200 returned the questionnaire in regard to a new onset of hip pain, and those with internal rotation of less than 20° had an odds ratio of 3.1 ($p = 0.006$) of developing hip pain [10]. These findings are also consistent with the recent paper by Kapron et al. [11] in collegiate football athletes. There is a consistent biological gradient associated with the alpha angle severity and risk of articular pathology. In several studies, the severity of the alpha angle was predictive of intraoperative severity of acetabular cartilage damage (as well as the risk of developing hip pain in individuals with a previously asymptomatic cam deformity [12–16]). Alpha angle values greater than 60° represented the greatest risk of developing hip pain as well as leading to more severe acetabular cartilage damage.

Although no longer the most commonly used approach for the treatment of cam FAI, the surgical dislocation approach described by Ganz [31] was pivotal in our understanding of the pathomechanism of FAI as well as establishing its principals of treatment. And even though hip arthroscopy is now being hailed as the preferred technique to treat cam-type FAI as well as minor forms of pincer, one should not underestimate the technical demands of this surgical technique [2, 3, 17, 18].

Philippon et al. [19] and Heyworth et al. [20] reported that the most common reason for revision surgery is the failure to completely address the bony impingement lesions of the hip. Open surgical dislocation is the most established technique for hip preservation surgery and is a more powerful tool than arthroscopy as it allows the surgeon to address any atypical or complex intra- and extra-articular pathology and can be combined to a concomitant femoral or pelvic osteotomy [21]. Favorable good to excellent midterm clinical outcomes of 70–80 % have been reported in the literature [22–30].

Surgical Technique

The patient is placed in a lateral decubitus position as described by Ganz et al. [31]. A Gibson approach is performed so the anterior muscle fibers of the gluteus maximus are not split and the neurovascular supply is not at risk [32, 33]. The skin incision should be centered over the tip of the greater trochanter (GT) and runs through the anterior one-third of the GT (approximately 20 cm). The subcutaneous tissue is then cut until the iliotibial band and the fascia over the gluteus maximus muscle are reached. Branches from the inferior gluteal artery that run within the fascia between the tensor and the gluteus maximus can help us identifying the anterior border of the gluteus maximus. This fascia is kept with the gluteus maximus in order to protect branches of the inferior gluteal nerve that accompany the vessels. The tissue over the GT is exposed and incised at its posterior border, then reflected anteriorly, away from the trochanteric crest, allowing visualization of the vastus lateralis ridge. After exposure the trochanteric branch of the medial femoral circumflex artery can be seen and coagulated before performing the trochanteric flip. The hip is prepared for the trochanteric osteotomy by internal rotation of the joint (20–30°) and identification of the posterior borders of the gluteus medius and GT; it is sized at a thickness of approximately 15 mm to allow stable reattachment to the trochanteric base. To facilitate the reduction of the trochanteric fragment, one can predrill one of the screw holes. Two 4.5 mm screws are typically used. The goal is to keep the insertions of the gluteus medius, gluteus minimus, and vastus lateralis on the trochanteric fragment. The major part of the piriformis insertion as well as the other external rotators remains on the femoral side of the osteotomized trochanter (stable trochanter). It is important to keep in mind that the deep branch of the medial femoral circumflex artery reaches the trochanter just proximal to the quadratus femoris [34]. The osteotomy follows a line that starts at the posterosuperior edge of the GT and is extended distally toward the posterior border of the vastus lateralis muscle, with a plane

parallel to the lower limb. Proximally, the osteotomy starts about 5 mm anterior to the most posterior insertion of the gluteus medius muscle onto the tip of the trochanter. A thin oscillating saw is used to perform the osteotomy, but it should stop at the anterior cortex, and then an osteotome is used to complete the osteotomy [31, 35]. To enhance stability and facilitate anatomic reduction of the trochanteric fragment, Notzli introduced a stepped osteotomy. This osteotomy allows a more anatomic fixation and a more aggressive postoperative mobilization [28, 36]. A small Hohmann retractor is then placed over the anterior edge of the stable trochanter, and the trochanteric fragment is flipped anteriorly with the attached medius proximally and vastus lateralis distally. Eventually, fibers of the piriformis tendon that remain attached to the trochanteric fragment must be cut to allow for its further mobilization. The lower limb is now flexed and externally rotated, allowing more anterior retraction of the mobile trochanter. The vastus lateralis and the vastus intermedius are lifted off the lateral and anterior aspects of the proximal part of the femur. The gluteus medius muscle is gently retracted in an anterosuperior direction. The capsule is approached within the interval between the piriformis and the gluteus minimus. The gluteus minimus tendon is detached from the capsule. Now, the posterior, superior, and anterior aspects of the joint capsule are exposed. The insertions of the short external rotator muscles and the piriformis muscle are left intact, protecting the deep branch of the medial femoral circumflex artery. A z-shaped capsulotomy is performed with the leg flexed and externally rotated, with an inside-out technique to avoid injury to the labrum or cartilage. The incision starts at the posterior acetabular rim and then along the anterolateral femoral neck to the anteromedial femoral neck; extreme care should be taken to avoid injury to the medial femoral circumflex artery, which runs posterosuperior to the lesser trochanter. Injury to the small branches of the lateral femoral circumflex artery can result from incision of the inferomedial aspect of the capsule, but they do not contribute to the perfusion of the femoral head. Additionally, care must be taken not to damage the underlying labrum. The hip should be taken through a full range of passive motion to most precisely locate the area of impingement. This step should always be performed prior to dislocation so that the surgeon may better visualize the area where osteochondroplasty must be performed. To assess the acetabulum, the femoral head is subluxated anteriorly by flexion and external rotation with the use of a bone hook that is placed around the calcar. A curved pair of scissors is used to cut the ligamentum teres allowing a complete anterior dislocation. External rotation aids in opening up the anterior joint space and tensioning the ligament for easier transection. Now, it is possible to fully evaluate the femoral head-neck junction as well as to probe the labrum and adjacent acetabular cartilage. Lowering the knee lets the femoral head rise automatically out of the surgical site, permitting its full inspection (Fig. 1). For visualization of the acetabulum, the knee is brought higher than the pelvis, and a gentle axial push allows the head to go posteriorly, creating enough space to view the acetabulum in its entirety. Three retractors are inserted. One double-angled Hohmann retractor is placed over the anterior rim of the acetabulum, a second straight Hohmann on the anterosuperior rim, and a cobra retractor into the teardrop to retract the femoral neck posteroinferiorly. With a blunt probe, the integrity of the labrum and the articular cartilage is determined. The labrum can be released temporarily and preserved for later refixation and the osseous overcoverage can be resected [37, 38]. If the labrum appears significantly diseased, it should be resected and reconstructed using IT band or the ligamentum teres; otherwise, attempts to mobilize and preserve the labrum should be attempted in order to preserve normal function of the hip joint [39–41].

The amount of acetabular rim resection is determined on the basis of the magnitude of the damage to the acetabular cartilage and/or the degree of overcoverage, but resection should be less rather than more in order to avoid any instability of the hip joint. Currently, the senior author will perform rim resection for exposed subchondral bone secondary to acetabular cartilage delamination if associated with acetabular

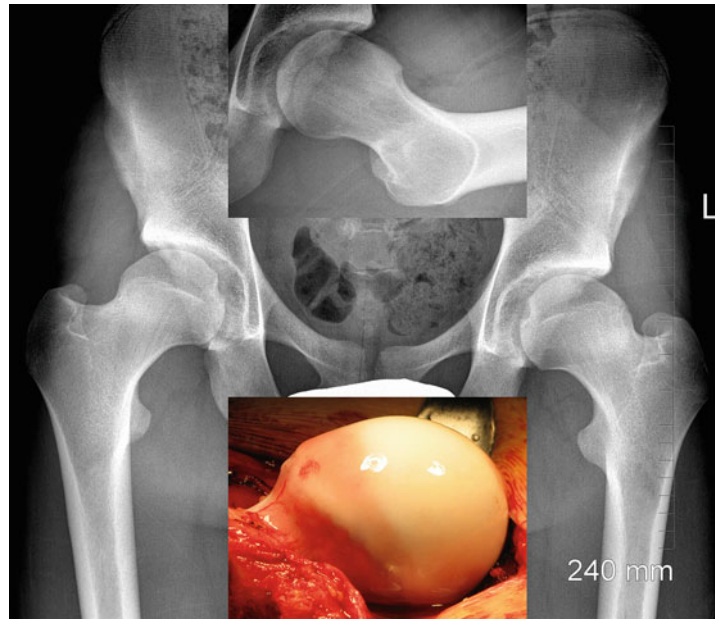

Fig. 1 Surgically dislocated hip demonstrating CAM lesion (*inset-bottom*) with preoperative anteroposterior radiograph with Dunn view (*inset-top*) and of a 24-year-old male

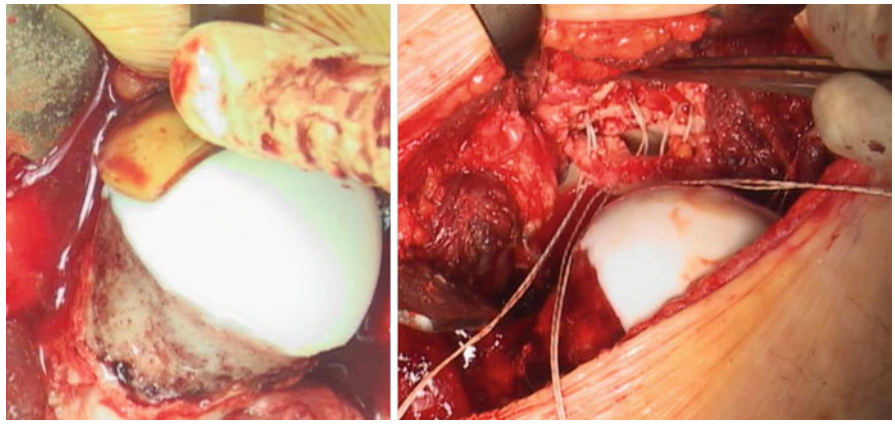

Fig. 2 Surgically corrected CAM lesion with suture anchors has been placed after acetabular rim trimming

retroversion and >3 mm in depth. In the absence of cartilage delamination, acetabular rim trimming with labral refixation will be performed if the crossover sign extends more than 5 mm from acetabular roof. The labrum is taken down using an 11 blade and then retracted using a blunt probe.

The resection is performed with use of a curved 10-mm osteotome or high-speed burr, normally with exposure of the well-bleeding cancellous bone of the acetabular rim. If an area of acetabular cartilage damage persists, microfracture can be performed. Most acetabular rim lesions are located anterosuperiorly and require two to four bone anchors to reattach the labrum. It is important to note that the refixation of the tip of the labrum (not labral repair) requires a base of bleeding cancellous bone. Positioning of the anchors is performed under direct vision, about 2 mm away from the bone-cartilage interface. Knots are tied on the outer surface, with the suture being passed through the base of the labrum (Fig. 2). After acetabular rim trimming and labral refixation, the acetabulum is carefully irrigated to remove all osseous and fibrous debris. The nonspherical

portion of the femoral head is assessed with the use of transparent spherical templates and usually is located anterosuperiorly and with a reddish appearance of the cartilage. Gentle removal of excess bone and recreation of a smooth femoral neck are performed with small curved chisels and repetitive assessment with templates. Excessive bone removal during the offset procedure should be avoided, although a resection of <30 % of the neck diameter has been reported to not weaken the femoral neck [42]. Furthermore, excessive resection may compromise the sealing function of the labrum. To address cam lesions extending superiorly or posterosuperiorly, the penetrating retinacular vessels were elevated and protected under direct visualization during the resection. Perfusion of the femoral head is checked by observation of the bleeding coming from the foveolar artery or the resection surface, and laser Doppler flowmetry is also possible [43]. Although in the initial experience of surgical dislocation a thin layer of bone wax was placed over the bleeding cancellous bone to avoid adhesions to the capsule, a recent report on allergic reaction has led to the abandonment of this technique [44].

Following reduction, the hip should once again be taken through a full range of motion paying special attention to those positions that were noted to cause impingement prior to dislocation [45]. If adequate resection of the offending lesions has been performed, the hip should be able to be taken through a full range of motion with no further impingement. The capsule is closed avoiding any tension because this may stretch the retinaculum and adversely influence the perfusion of the femoral head. The trochanteric fragment is anatomically reduced and fixed with two or three 4.5-mm cortical screws; the screws are best aimed toward the lesser trochanter. An intraoperative radiograph is used to confirm proper screw length/position and trochanteric reduction. Thereafter, the various soft tissue layers are closed with running or single sutures. Potential complications include trochanteric nonunion, heterotopic ossification, trochanteric bursitis, sciatic nerve palsy, osteonecrosis of the femoral head, femoral neck fractures, as well as intra-articular adhesions [22, 46, 47].

Postoperatively the patient should be restricted to toe-touch weight bearing on the operative extremity for 6–8 weeks until there is solid union of the trochanteric osteotomy site. During the same period, the patient receives deep vein thrombosis prophylaxis. Nonsteroidal anti-inflammatory drugs were given for 2 weeks postoperatively as heterotopic ossification prophylaxis. Physical therapy may be started immediately using passive range of motion for the first and second weeks postoperatively. At 10–14 days active motion may begin; however, flexion should be limited 70° for the first 6–8 weeks. Early range of motion will help prevent the formation of adhesions. Return to competitive sports depended on recovery of muscle function and strength, especially of the abductors. Typically, patients returned to competitive sports after 4–6 months [26, 48].

Summary

Surgical dislocation is a safe and powerful tool that allows open acetabular rim trimming, labral refixation, and femoral osteochondroplasty. One should not underestimate the technical demands of this surgical technique. Favorable good to excellent midterm clinical outcomes of 70–80% have been reported in the literature.

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