Arthroscopic management of large-size cam-type femoroacetabular impingement

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Background
Ganz and colleagues have popularized that femoroacetabular impingement (FAI) is a cause of hip pain in adolescents and young adults, and it can eventually lead to osteoarthritis of the hip. FAI is the result of abnormal contact between the proximal femur and the acetabulum. A size and shape mismatch within the hip joint causes collision events that lead to labral and cartilage degeneration. The principle of treatment is based on providing an adequate clearance during terminal range of movement of the hip, thereby avoiding abutment of the proximal femur on the acetabular rim.

Objective
The aim of our study was to report the results of arthroscopic femoroplasty in cases with large-size cam-type FAI.

Patients and methods
Twenty patients (11 male and nine female) with a mean age of 33 years (range: 22–48 years), with a large cam-type FAI underwent arthroscopic femoroplasty. The duration of symptoms before surgical intervention averaged 14 months. The patients were assessed preoperatively and 3 months and 1 year postoperatively using the modified Harris hip score (MHHS). The patients were excluded if the disease state was too advanced to reasonably benefit from arthroscopic intervention, with bone-on-bone contact an absolute contraindication.

Results
The mean MHHS increased more than 20 points from 52 preoperatively to 72 postoperatively after 3 months and to 75 after 1 year. The mean abduction improved from 22° preoperatively to 28° at 12 months postoperatively. The mean internal rotation improved from 16° preoperatively to 23° at 12 months postoperatively. The mean pain score in MHHS increased from 25.8 preoperatively to 41 at 12 months postoperatively. The mean duration of arthroscopic femoroplasty was 120 min (range: 90–180 min).

Conclusion
With the advancement in hip arthroscopy techniques, it is now possible to address large cam-type FAI arthroscopically with results comparable to open surgical dislocation and femoroplasty with the advantage of low morbidity and early rehabilitation.

Keywords:
cam-hip arthroscopy, femoroacetabular impingement

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Introduction

The concept of femoroacetabular impingement (FAI) is not entirely novel. In 1975, Stuberg and colleagues were credited with introducing the term pistol grip deformity, which described the abnormal morphologic features of the femoral head and neck in anteroposterior (AP) radiographs of patients with early osteoarthritis [1].

Ganz *et al.* [2] have popularized that FAI is a cause of hip pain in adolescents and young adults, and it can eventually lead to osteoarthritis of the hip. FAI is the result of abnormal contact between the proximal femur and the acetabulum. A size and shape mismatch within the hip joint causes collision events that lead to labral and cartilage degeneration [2–4].

There are two primary mechanisms of FAI: the cam-type and the pincer-type impingement. However, most patients are purported to have a mixed subtype involving a varying degree of both the cam and pincer subtypes [2,3,5].

The cam-type impingement is more common in young active men. It is caused by insufficient concavity of the femoral head–neck junction anterolaterally. As a consequence, this region of the femoral head has an increased radius of curvature that is too large for the

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tightly congruent acetabulum leading to its abutment against acetabular rim. This abutment is most evident in flexion and internal rotation. The repeated movement of the deformed femoral head in and out of the acetabulum produces shearing of the labrum and the adjacent acetabular cartilage. This can cause the labrum and articular cartilage to delaminate from the subchondral bone. This damage is consistently seen at the anterosuperior aspect of the acetabular rim [4,6,7]. Several predisposing conditions reduce the femoral head–neck offset resulting in cam impingement. These include slipped capital femoral epiphysis with posterior tilt of the femoral head, femoral head necrosis with subsequent flattening, previous fracture of the femoral neck with minor rotational malunion, or a femoral head with a nonspherical extension anterosuperiorly [8,9].

The pincer-type impingement is the result of abnormal contact between the acetabular rim and the femoral neck. The femoral head in this situation may be normal, and the abutment is mostly a result of overcoverage of the femoral head in conditions such as coxa profunda or acetabular retroversion. Continued abutment of the femoral neck against the acetabular rim results in degenerative changes in the labrum and ossification of the rim [6,10].

The principle of treatment is based on providing an adequate clearance during terminal range of movement of the hip, thereby avoiding abutment of the proximal femur on the acetabular rim [5].

There are several surgical techniques used for the treatment of FAI. Options for surgical management include open surgical hip dislocation, arthroscopic-assisted surgery, and completely arthroscopic surgical techniques. The arthroscopic technique has increasingly been used because it involves less surgical trauma and can be performed on an outpatient basis [2,4,7,11].

The aim of our study was to report the results of arthroscopic femoroplasty in cases with large-size cam-type FAI.

Patients and methods

Between the years 2010 and 2012, we performed arthroscopic femoroplasty for 20 patients with large cam-type FAI. The indication for hip arthroscopy was persistent hip pain, which the patient feels as he or she starts to walk after rising from a sitting position or dull groin ache when the hip is in a flexed position, and not responding to nonoperative management, consisting of activity modification, NSAIDs, and a range of movement exercises for 3 months. The duration of symptoms before surgical intervention averaged 14 months (range: 12–30 months).

The patients were excluded if the disease state was too advanced to reasonably benefit from arthroscopic intervention, with bone-on-bone contact an absolute contraindication.

The patients were assessed radiologically using plain AP pelvic radiograph, cross table lateral view and modified Dunn view (an AP radiograph of the hip in neutral rotation, 20° of abduction and 45° of flexion).

Cam-type impingement was suggested by the radiographic features of loss of sphericity of the femoral head. For cases in which this was suspected, three-dimensional computed tomography was performed to provide three-dimensional surface renderings of the impingement deformity and aid in determining the area of resection to correct femoral head asphericity (Fig. 1a–d).

The patients were assessed preoperatively, 3 months postoperatively, and 1 year postoperatively using the modified Harris hip score (MHHS). This excluded the points allocated by the full Harris hip score (HHS) for deformity and range of movement, giving a maximum of 44 points for absence of pain and 47 for full function. Preoperative scores were obtained on the day of surgery, and postoperative scores were obtained at 3 months and 1 year. As the MHHS can reach a maximum value of 91, we categorized the results as excellent (81–91), good (71–80), fair (61–70), and poor (≤60).

We started the hip arthroscopy with the patients in supine position on orthopedic table. The hip to be operated upon was put in slight flexion of 20 and 10° of abduction. Traction was applied and fluoroscopy was used to assess sufficient distraction of the hip joint. Thereafter, traction was released completely. We then established the proximal anterolateral portal to the peripheral compartment (at the soft spot one-third the distance of a line drawn from the anterior superior iliac spine to the tip of the greater trochanter). The cannula was introduced perpendicular to the femoral neck axis, aiming at the anterolateral head–neck junction to perforate the joint capsule; distension of the capsule was carried out with 20 ml of saline followed by insertion of the nitinol guide wire. Dilatation of the portal was performed using hip dilators (arthrex) followed by introduction of the 70° scope. Thereafter, the anterior portal was established (4–6 cm distal to the anterior superior iliac spine and lateral to the line joining the

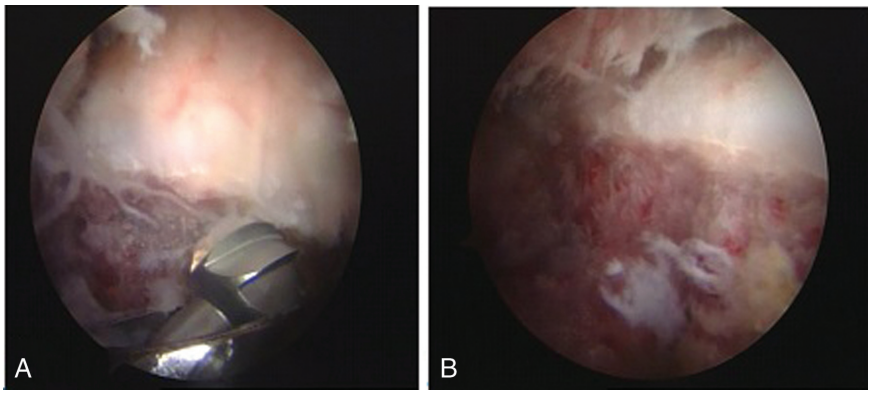
Figure 1

A. preoperative plain x-ray showing large cam lesion. **B.** postoperative plain x-ray after arthroscopic excision of the cam lesion. **C.** Three dimensions computed tomography of patient with old Perthes disease. **D.** Three dimensions computed tomography after femoral osteoplasty.

anterior superior iliac spine and the superior pole of the patella). Nitinol guide wire was introduced through a cannula in the anterior portal and the wire was advanced to the central compartment between the acetabular labrum and the femoral head cartilage while applying traction. The scope was transferred to the anterior portal to examine the central compartment, and the anterolateral portal to the central compartment was established. We examined the labrum and the articular cartilage of the acetabulum and femoral head. Any articular damage was addressed with chondroplasty (using mechanical shaver and radiofrequency energy probe), and labral pathology was debrided until reaching a stable edge. After finishing work in the central compartment, the traction was released and the cam lesion was addressed in the peripheral compartment. We started with synovectomy and release of the anterior capsule to expose the area of cam lesion; the hip was flexed from 35 to 45° with the help of an assistant. The line of demarcation between the healthy cartilage and the abnormal fibrocartilage that covered the cam lesion was identified arthroscopically and the site of the cam lesion was confirmed under fluoroscopy. The fibrocartilage covering the bone of the cam lesion was removed. Once the bone was exposed, osteoplasty and recontouring of the femoral head–neck junction were performed using burr (Fig. 2a and b). Switching between the three portals was important to completely address the cam lesion. Completion of femoral osteoplasty was confirmed with arthroscopic examination while performing the impingement test (moving the hip in flexion and internal rotation) to ensure adequate clearance and that the anterolateral rim of the acetabulum was no more impressed. The restoration of the head–neck offset was further confirmed under fluoroscopy.

Postoperatively, emphasis was placed on optimizing range of motion and restoring muscle power with the aid of supervised physical therapy program. Patients were allowed to bear weight as tolerated, but crutches were used for 4 weeks as a precautionary measure to protect the femoral osteoplasty site. The rehabilitation protocol was continued for 3 months.

Figure 2



A. Arthroscopic view of the burr excising the cam lesion in the peripheral compartment **B.** After excision of cam lesion.

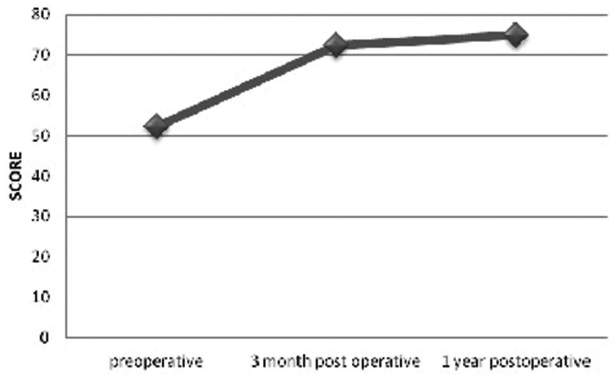
Results

Our study included 20 patients (11 male and nine female) with a mean age of 33 years (range: 22–48 years). The right side was involved in 50% of the patients.

The mean MHHS increased more than 20 points from 52 preoperatively to 72 postoperatively after 3 months and to 75 after 1 year (Fig. 3). Preoperatively, 17 (85%) patients had poor MHHS and three (15%) patients had fair score. At 1 year postoperatively, the MHHS was excellent in 11 (55%) patients, good in two (10%) patients, fair in four patients, and poor in three patients (Fig. 4).

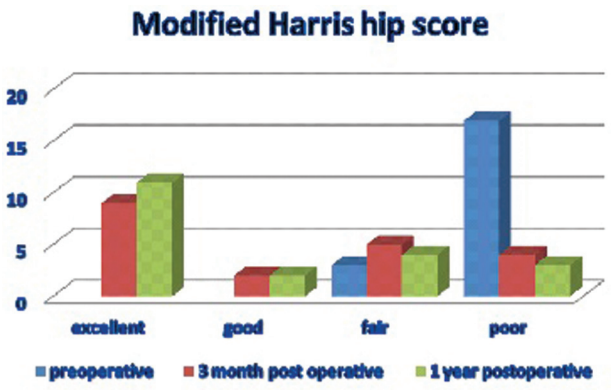
The mean abduction improved from 22° preoperatively to 28° at 1 year postoperatively. The mean internal rotation improved from 16° preoperatively to 23° at 1 year postoperatively. The mean pain score in MHHS increased from 25.8 preoperatively to 41 at 1 year postoperatively. Preoperatively, all patients had positive impingement test. Postoperatively, the impingement test became negative in 17 (85%) patients and remained positive in three (15%) patients. The mean duration of arthroscopic femoroplasty was 120 min (range: 90–180 min). Two patients developed neuropathy of the lateral cutaneous nerve of the thigh, which resolved within the first 2 months postoperatively; no other complications were encountered.

Figure 3



Change in modified Harris hip score over time. Continued improvement can be seen till the end of first year.

Figure 4



Change in MHHS.

Discussion

FAI is now considered to play a role in the development of hip osteoarthritis in young patients with structural proximal femoral head and neck abnormalities [6,10].

FAI has been historically treated with open techniques [12]. Compared with the generous exposure provided by open surgical dislocation of the hip, arthroscopic visualization and orientation of the cam lesion is more challenging. However, surgical advances have made it possible for FAI to be handled arthroscopically, with both soft tissue and osseous abnormalities treatable during the same procedure in a comparable manner that approaches that of open technique [1,13].

The recent literature on hip arthroscopy for intra-articular pathology has largely focused on femoral osteoplasty as a key factor for a successful outcome [14,15]. Although excision of the labrum may lead to resolution of mechanical symptoms, failure to address the impingement lesion is considered to lead to persistent pain and patient dissatisfaction [13].

Kim *et al.* [14], in their study on the effect of FAI on the results of hip arthroscopy of the central compartment only, with no excision of impingement lesion, for mild (Tönnis grades 0 and 1) arthritis, found that the clinical improvement was insufficient in patients with FAI. In 2008, Bardakos *et al.* [13] found that in the short term it is possible to improve patient's pain without removing an impingement lesion. However, they also reported that patients perform better with their impingement lesion removed rather than when ignored. Peter and Erickson [16]reported on 30 hips undergoing open reconstruction. The HHS improved from a mean of 70 preoperatively to 87 at most recent follow-up, and, in four hips, total hip arthroplasty was planned because of progressive osteoarthritis and pain.

Yun *et al.* [17] reported on 16 patients (17 hips) with FAI treated with surgical dislocation. The mean HHS improved from 76 points preoperatively to 93 points postoperatively at the last follow-up. The impingement test was negative in all cases at the last follow-up. There were three cases of nonunion at the trochanteric osteotomy site, which were treated with internal fixation using a trochanteric plate. Larson and Giveans [3] reported on 96 patients (100 hips). All hips had a positive impingement test preoperatively. The impingement test was negative or only mildly positive in 86% (86 hips) and remained unchanged in 14% (14 hips). Moreover, according to HHS at 1-year follow-up, 55.39% of hips were rated as excellent, 19.1% were rated as good, 10.6% were rated as fair, and 14.9% were rated as poor.

Our results results showed improvement in impingement test from being positive in all patients preoperatively to negative in 85% (17 patients) of patients postoperatively. Moreover, the mean MHHS improved by more than 20 points at 1 year postoperatively, with 55% of patients with excellent MHHS, 10% with good MHHS, 20% with fair MHHS, and 15% with poor MHHS. These results are consitent with the results in the literature for open femoral osteoplasty. In contrast to a study on conservative treatment of mild FAI, in which there was no improvement in the range of hip movement despite improvement in function and symptoms [18], our study showed improvement in mean adduction by 5.75° and the mean internal rotation by 6.5° at 1 year postoperatively.

There are some limitations to our study; the most obvious is the lack of a control group of nonsurgically treated patients or patients with open mangement of FAI. Nevertheless, the magnitude of improvement in our study is consistent with improvement seen in other studies for open management and is better than the improvement seen with conservative management. Moreover, the impingement test is somwhat subjective, and hence all patients were examined by the senior author both preoperatively and postoperatively.

In conclusion, with the advancement in hip arthroscopy techniques, it is now possible to address large-size cam-type FAI arthroscopically with results comparable to open surgical dislocation and femoroplasty with the advantage of low morbidity and early rehabilitation.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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