Early outcome of hip arthroscopy for the treatment of pincer femoroacetabular impingement

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Background
Femoroacetabular impingement (FAI) is recognized as a cause of hip pain in young adults and as a precursor to osteoarthritis. Labral tears have been described in association with FAI. It is not clear as to whether arthroscopic labral debridement can improve patient symptoms.
Patients and methods
Eleven patients with FAI pincer-type lesion were treated with arthroscopic labral debridement. The presence of FAI was confirmed preoperatively on plain radiograph and MRI. The clinical (Merle d'Aubigné) score was used preoperatively and at 1 year postoperatively.
Results
The mean Merle d'Aubigné score improved from 10 points (range = 7–11 points) preoperatively to 17 points (range = 14–18 points) at 1 year postoperatively.
Conclusion
Arthroscopic labral debridement for pincer type of FAI significantly improves patient symptoms and gives rapid functional recovery.

Keywords:
femoroacetabular impingement, hip arthroscopy, labral tear

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Introduction

Femoroacetabular impingement (FAI) is a well-described pathologic condition that can lead to osteoarthritis of the hip [1]. The first category of FAI is the cam type lesion, which is caused by shear forces of the nonspherical portion of the femoral head against the acetabulum. These stresses of a normal femoral neck against an abnormal anterior acetabular rim as a result of so-called overcoverage result in degeneration, ossification, and tears of the anterosuperior portion of the labrum, as well as the characteristic posteroinferior 'contre-coup' pattern of cartilage loss from the femoral head and the corresponding acetabulum [2]. In this setting, the acetabular labrum fails first, which leads to degeneration and eventual ossification, which worsens the overcoverage. The second category of FAI is the 'pincer impingement', which is due to overcoverage of the anterior acetabulum or acetabular retroversion. Several conditions may predispose to pincer-type impingement, including acetabular protrusion, acetabular retroversion, malunion of an acetabular fracture, or overcoverage secondary to previous surgery, such as can occur with a periacetabular osteotomy [3]. Overall, the pincer-type lesion has limited chondral damage compared with the deep chondral injury that is associated with cam-type impingement. Although isolated femoral-side or acetabular-side impingement can occur, the majority of cases of FAI involve a combination of lesions. Beck *et al.* [4,5] analyzed 302 hips and found that only 9% had isolated cam impingement and 5% had isolated pincer impingement; the majority of cases (86%) had a combination of femoral and acetabular lesions. FAI usually presents in active young adults who experience a slow onset of groin pain because of repetitive impingement between the femoral head and neck and the acetabular rim [6]. During the initial stages, pain is intermittent and may be exacerbated by high demands on the hip during activities such as sports. Often, the individual experiences pain after sitting for a prolonged period [7]. Initially, arthroscopic surgery of the hip was mainly diagnostic, but better understanding of the pathology, better examination techniques, and better imaging have led to increasing numbers of therapeutic procedures being performed and also led to recognition of new pathologies. These conditions were difficult to diagnose with traditional modalities and required direct visualization of the joint. The most common indication for arthroscopic hip surgery remains pathology of the acetabular labrum, although these lesions are notoriously hard to diagnose [8].

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Patients and methods

Between June 2008 and July 2010, 11 consecutive patients underwent arthroscopy of the hip to treat FAI. Inclusion criteria in the present study were the availability of complete preoperative and postoperative clinical (Merle d'Aubigné) scores and radiographic documentation (anteroposterior pelvic and lateral hip radiographs). Exclusion criteria included having open growth plates, age greater than 40 years, and previous hip surgery. All of the patients had a moderate or low-work-load occupation. All patients had not responded to conservative treatment of the FAI, which included activity modification, restriction of athletic pursuits, and avoidance of symptomatic motion for a minimum of 6 months. The indications for surgery were persistent pain, mechanical symptoms, and radiographically confirmed structural abnormalities of the hip. Each patient was treated with the arthroscopic labral resection and resection of the overgrown portion of the acetabular rim. Clinical evaluations were performed preoperatively and at 1 year postoperatively with the use of the classification system of Merle d'Aubigné and Postel [9,10]. This score assigns a minimum of 0 points and a maximum of 6 points for pain, range of motion, and walking ability. A higher score indicates less pain and better function (Appendix 1). The impingement test was performed with the patient lying supine. The hip was internally rotated and adducted as it was passively flexed to 90°; the combination of flexion and adduction leads to the approximation of the femoral neck and the acetabular rim; the additional forceful internal rotation induces shearing forces at the labrum, creating a sharp pain [11,12]. This study approved by the Ethical committee of Suez Canal University, Cairo, Egypt.

Imaging studies

Standardized conventional anteroposterior pelvic radiographs were taken with the patient lying supine, with a tube-to-film distance of 120 cm and the tube oriented perpendicular to the table. Both lower limbs were positioned in 15° of internal rotation to present the anteverted femoral neck in its maximum length. The central beam was directed to the midpoint between the superior border of the pubic symphysis and a horizontal line connecting both anterior superior iliac spines. Neutral pelvic rotation was achieved when the tip of the coccyx was aligned with the middle of the pubic symphysis and the radiographic teardrops, the obturator foramina, and the iliac wings were symmetrical [13]. The radiographic findings that were considered to be positive for pincer FAI included an abnormally sloping acetabular roof, acetabular overcoverage (with an anterior or lateral center-edge angle of >40), posterior acetabular deficiency (with the posterior wall medial to the center of the femoral head), and acetabular retroversion demonstrated by the crossover sign (with the anterior acetabular rim projecting lateral to the posterior margin) [14] (Fig. 1). All patients underwent preoperative MRI to define the type of FAI and to assess the extent of labral and cartilaginous damage and to better delineate alterations of intra-articular structures within the hip that were not readily detectable on conventional radiographs.

Operative technique

The patient was placed in the supine position with traction to help distract the joint. Prerequisites for this traction include a broad, well-padded perineal post and a well-padded boot. Once the patient was positioned, and before portal placement, the anterior superior iliac spine and greater trochanter were marked using a surgical marking pen. A line was then drawn from the anterior superior iliac spine down the anterior thigh, to mark the course of the lateral femoral cutaneous nerve of the thigh. Placement of portals lateral to this line will minimize injury to the lateral femoral cutaneous nerve The joint was then distracted under fluoroscopic guidance and distension of the joint was maintained by means of traction and fluid instillation under pressure using a fluid management system. Adequate distraction was demonstrated by the 'halo' sign on the image intensifier, which represents the formation of a vacuum within the joint. The joint was then penetrated with a long 17-G needle and distended with 30–40 ml of saline. A guide wire was then passed into the joint through the needle and the needle was withdrawn and the arthroscope then passed over the guide wire into the joint. A 70° arthroscope was used for viewing the hip joint. Two portals were

Figure 1

Anteroposterior radiograph of the pelvis, demonstrating the crossover sign that is indicative of a retroverted acetabulum. The anterior acetabular rim (solid line) crosses over the posterior acetabular rim (dashed line).

used, posterolateral and anterolateral, which provide excellent visualization of the joint in its entirety. Saline was infused under a pressure of 50–60 mmHg to assist with capsular distension. A probe was used to assess the labral injury, the extent of the bony impingement lesion, and calcifications within the substance of the labrum. Following visualization and treatment of any pathology in the central compartment, the traction was released and the peripheral compartment dealt with in turn. Access to the peripheral compartment was achieved using the same standard portals. To visualize the lateral compartment, the anterior portal was usually redirected between the bursa of the greater trochanter and the iliotibial band. The following principles were followed:

(a) A generous capsular cut using a beaver blade to allow adequate visualization,
(b) Finding of the exact location of the impingement lesion,
(c) Adequate clearing of the soft tissue off the lesion,
(d) Protection of the uninjured labral tissue,
(e) Adequate resection of the bony impingement lesion using a 5.5-mm burr,
(f) Partial labral debridement using an arthroscopic shaver at the exact location of the bony impingement lesion, as confirmed by means of intraoperative probing and by means of fluoroscopic assessment.

Radiofrequency ablation was used for removing any unstable tissue adjacent to the healthy labral tissue (Figs 2 and 3).

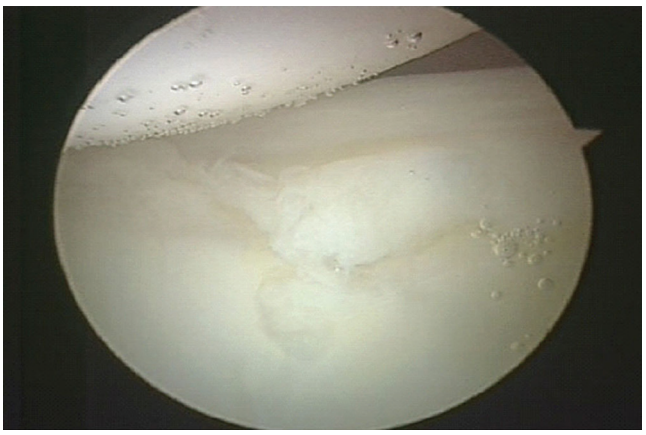
Statistical methods

Comparisons were made using the Wilcoxon Mann–Whitney test for ordered categorical variables and using the independent-samples *t*-test for continuous variables. The level of significance was set at *P* value less than 0.05. The nonparametric Wilcoxon signed-rank test was used to evaluate the significance of changes in each measured variable from the preoperative to the postoperative state.

Results

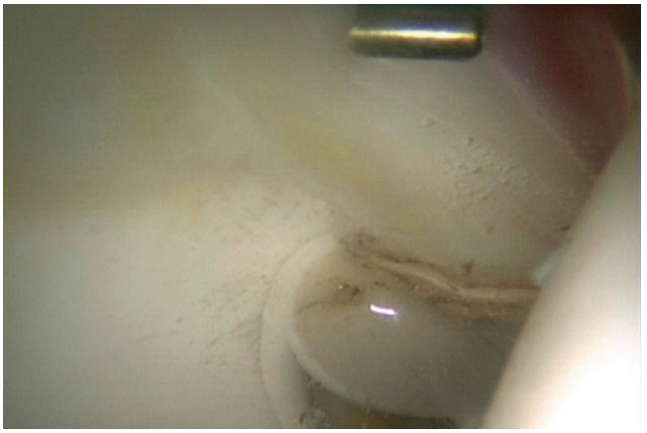
The mean operative time was 91 min (range = 80–130 min). There were no intraoperative complications. One patient had postoperative leg numbness, which improved after 1 week. No postoperative hip subluxation or dislocation occurred. One patient had superficial wound infection, which improved after a short course of antibiotics. Of the 11 labral lesions identified at arthroscopy, six lesions were anterior–superior and five lesions were posterior–superior. There was no significant difference between the type of lesion and preoperative pain, range of motion, and walking ability. Seven of the 11 hips were found to have delamination. Cartilage delamination was considered to be present when two criteria were met [15,16]: (a) at least two consecutive slices in the same plane or in the same location in two different planes showed focal discontinuity of cartilage and fluid was located between the articular cartilage and subchondral bone plate in MRI of the hip (Figs. 4), and (b) the area of abnormal cartilage was not completely detached from the adjacent cartilage. There were significant differences preoperatively and postoperatively between patients who had preoperative cartilage delamination and patients who had no cartilage delamination in terms of Merle d'Aubigné score. Although there was no significant difference between the two groups with regard to the prevalence of labral lesions (P = 0.63), whenever labral and

Figure 2



Arthroscopic view of the hip joint showing a tear of the acetabular labrum.

Figure 3



Appearance of the labrum after arthroscopic labral debridement.

delamination lesions were found at the time of surgery in the same hip, they were always found directly adjacent to one another.

Clinical outcome

The mean Merle d'Aubigné score improved from 10 points (range = 7–11 points) preoperatively to 17 points (range = 14–18 points) at 1 year. Six patients had excellent clinical result at 1 year, four patients had good results, and one patient had moderate result. This patient had a high preoperative pain level. There was no significant difference between the type of labral lesion and clinical end results (Table 1). There were no surgical complications. The Wilcoxon test revealed a statistically significant improvement in preoperative to postoperative pain (P = 0.0003), range of motion (P < 0.001), and walking ability (P < 0.001).

Discussion

The hip joint is a ball and socket joint consisting of the femoral head articulating with the acetabulum of the pelvis. This highly congruent joint has three planes of movement, sagittal, transverse, and frontal. The bony acetabulum is deepened by a triangular fibrocartilaginous structure called the acetabular labrum. This originates at the transverse acetabular ligament and attaches to the rim of the bony acetabulum. It increases the acetabular volume by a third and creates a negative intra-articular pressure to increase the inherent stability of the joint. Its second major function is to help the even distribution of forces within the joint [17]. Any dysplasia of the hip disrupts this and increases the load through the labrum [18], which may explain the higher incidence of labral tears in these conditions. The labrum, much like the meniscus, derives most of its blood supply from the bony rim and is only vascularized in its peripheral third [19]. Nociceptors are present in all regions of the labrum, particularly anterosuperiorly [20]. Thus, damage to the labrum causes pain, and tearing it from the rim may cause segments to be devascularized [21]. The acetabular labrum can be placed under an undue amount of stress in conditions where the morphology of the hip is abnormal — that is, dysplasia and FAI [22,23]. FAI is a recently described condition wherein there is a painful contact between the femoral neck and the acetabular rim, occurring within the physiologic range of motion of the hip joint. There are essentially two morphological classifications that may lead to FAI. Cam impingement occurs because of a nonspherical femoral head abutting against the anterior aspect of the acetabulum [24]. During flexion, the nonspherical femoral head shears off the anterosuperior acetabular articular cartilage and there is chondrolabral separation. The second type of FAI, 'pincer impingement', is due to overcoverage of the anterior acetabulum or acetabular retroversion. This causes only limited cartilage damage in a narrow strip circumferentially, but the repeated abutment crushes the labrum between the acetabular rim and the femoral neck, causing degeneration and ossification [25]. FAI has shown no influence on kinematics during walking, but does reduce the range of movement of the hip, particularly abduction and flexion [26,27]. This is most apparent during deep squatting [28] and may be associated with repetitive trauma of the peripheral articular cartilage [29,30]. The acetabular labrum functions as a shock absorber and effects proper joint lubrication and pressure distribution. Biomechanical studies performed by Ferguson *et al.* [31,32] revealed that hydrostatic fluid pressurization within the joint space is greater in the presence of an intact labrum, which may enhance joint lubrication. Hydrostatic pressurization was impaired in hips without an acetabular labrum. Absence of this fluid seal resulted in higher joint loads on force transmission and poorer joint lubrication. Thus, the labrum acts as a seal that prevents fluid loss from the joint and protects articular cartilage. In addition, the labrum functions as a 'sensible shock absorber' of the hip. In this study, patients treated with labral debridement recovered earlier and had superior clinical and radiographic results. Improvements in hip scores were mostly attributable to improvements in pain

Figure 4

Cartilage delamination demonstrated in MRI.

Table 1 Relation between type of labral lesion and end results

End results	Lesion			
	Excellent	Good	Fair	Total
Tear	3	3	0	6
Detachment	3	1	1	5
Total	6	4	1	11

Table 1A Scores of pain, hip range of motion, and walking ability [10]

Score	Pain	Hip range of motion	Walking
0	Disabling pain at rest	Ankylosis in poor position	No walking possible
1	Pain interfering with sleep	No movement, slight deformity	Only with 2 crutches or frame
2	Pain that prevents walking	Flexion ≤40°	Minimal walking with 1 cane
3	Pain tolerable with limited activity	Flexion 40–60°	Walking for <1 h with 1 cane
4	Pain that disappears with rest	Flexion 60–80°	Short walk without cane but marked limp
5	Mild pain with normal activity	Flexion 80-90° + 15° abduction	Walks without cane but noticeable limp
6	No pain	Flexion >90 + 30° abduction	Normal
Score sum	Classified as …		
0–8 points	Poor		
9–12 points	Moderate		
13–16 points	Good		
17–18 points	17–18 points		

scores. Labral tears have been described in association with FAI. FAI may be an important factor in the pathogenesis of osteoarthritis of the hip, particularly in hips currently considered to have an 'idiopathic' etiology [33]. In light of reports of encouraging results after the treatment of FAI, these new data on the effect of labral debridement may be important for pain relief postoperatively. Long-term follow-up will be necessary to assess whether the use of this technique results in improved functional outcomes and a reduction in the prevalence of symptomatic osteoarthritis in affected patients. In this study population, seven of the 11 hips that underwent hip arthroscopy had acetabular cartilage delamination at the time of surgery. Beck *et al.* [4] previously addressed risk factors for acetabular cartilage injury by comparing 26 patients who had isolated pistol-grip deformities (cam FAI) with 16 patients who had isolated coxa profunda (pincer FAI). They noted a rate of delamination of 38% (10 of 26) among hips with an isolated pistol grip, compared with 12.5% (two of 16) among those with isolated coxa profunda. Acetabular hyaline cartilage lesions are often associated with abnormalities of the labrum. James *et al.* [34] reported that the labral–chondral transition zone abnormalities (including the separation of cartilage from the underlying bone) on MRI corresponded well with arthroscopic lesions predominantly in the anterosuperior quadrant of the rim. Given the proven contribution of pincer impingement in the creation of chondral damage, it is noticed in the present study that patients after arthroscopic debridement did better after 1 year. In terms of relief of symptoms, the procedure is worthwhile. In this study, there was no difference between delamination and the site of labral lesions; delamination lesions were found at the anterosuperior acetabular rim and adjacent to the labral lesions when the two were found in the same hip; these findings are similar to those by Beck *et al.* [5].

Arthroscopic surgery of the hip was mainly diagnostic, but better understanding of the pathology, better examination techniques, and better imaging have led to increasing numbers of therapeutic procedures being performed and also led to recognition of new pathologies. These conditions were difficult to diagnose with traditional modalities and required direct visualization of the joint. Noninvasive radiological investigations typically have high false-negative rates in these conditions. MRI has a false-negative rate of up to 42% in the diagnosis of intra-articular hip pathology [35], which can be improved using intra-articular contrast. Thus, for a lot of pathologies, arthroscopic evaluation is vital in the diagnosis, and arthroscopic intervention may be the mainstay of treatment. Robertson *et al.* [36] in a recent systemic review of outcome study of hip arthroscopy for labral tears found that 67% of patients were satisfied after the procedure. Other studies were also found where patient satisfaction reached up to 91% [37]. However, none discussed the issue of the underlying cause of the labral tears. In this study, there was a significant improvement in pain score after arthroscopic labral debridement among patients with FAI.

Appendix

Table 1A.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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