Review Article

Current Concepts in Management of Femoroacetabular Impingement

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Abstract

Femoroacetabular impingement (FAI) is a progressive pathology of hip joint affecting young adults causing hip pain and osteoarthritis. FAI results from contact secondary to abnormal morphology of proximal femur, femoral head-neck junction and acetabular rim. Two types of femoroacetabular impingement have been described: Pincer ve Cam impingement. Pincer impingement is caused by the overcoverage of the acetabulum. On the other hand, Cam impingement develops as the result of abnormal spherity of femoral head-neck junction which usually occurs at the anterosuperior part of femoral neck. This review will provide the framework for diagnosis and treatment of FAI from the perspectives of the practicing orthopedic surgeon. Strategies for safe and successful diagnosis and treatment of FAI are presented.

INTRODUCTION

Femoroacetabular impingement (FAI) is a progressive pathology of hip joint affecting young adults causing hip pain and osteoarthritis. FAI results from contact secondary to abnormal morphology of proximal femur, femoral head-neck junction and acetabular rim. The incidence of FAI is reported to be 10-15% in literature. Impingement was first described by Smith Peterson in 1936 [1]. Ganz et al. [2] described the FAI as the most common cause of premature major osteoarthritis. This hip pathology, with repetitive microtraumas, results with acetabular degeneration, labral tear and joint damage. Three types of femoroacetabular impingement have been described: Pincer lesions, Cam lesions and mixed tip lesions impingement. Pincer impingement is caused by the overcoverage of the acetabulum. On the other hand, Cam impingement develops as the result of abnormal spherity of femoral head-neck junction which usually occurs at the anterosuperior part of femoral neck [2,3]. In Cam impingement, the recurrent irritation of the anterosuperior part of acetabulum by the abnormal femoral head leads to acetabular cartilage damage with forced hip motions, especially flexion of the hip. In Pincer impingement, the labrum degenerates through pinching between acetabular rim and femoral neck during flexion of the hip. This degenerating labrum may be ossified [4]. A combination of both forms (mixed pattern) can be detected in the same hip joint. Combination of Cam and pincer lesions can also occur which actually is the most common presentation [3-7].

Pathology of FAI

FAI is essentially a dynamic problem. Normally, hip joint has a space between the femoral head neck junction and the acetabular rim provides unhindered hip movement. This is achieved with an offset. The normal head neck offset is 9 mm. If this offset is distorted, a mechanical blockage occurs in the hip joint. In addition, overexposure or retroversion of the acetabulum may cause mechanical blockage of the hip. Many diseases can lead to FAI due to these two pathological causes.

The Etiology of FAI

Various morphologic abnormalities of acetabulum and femoral neck may predispose to FAI. The most common predisposing factor of Cam impingement is delayed separation of femoral head physis and trochanteric physis or abnormal physisal scar in femur neck after eccentric closure of femoral head epiphysis [5]. Other than these, subclinical SCFE, Perthes disease, coxa vara and posttraumatic deformity of femoral head might contribute to Cam impingement [6]. The acetabular retroversion, coxa profunda, and acetabular protrusion have been found to be predisposing factors for Pincer impingement [6]. Genetic factors may also play a role, the frequency of Pincer or Cam impingement is much more higher in the siblings of the impingement patients with respect to normal population [7].

The Clinical Findings of FAI

FAI is a disease of young and physically active patients. Clinical findings vary in symptomatic FAI; the most frequent
complaint is groin pain. Patients with posterior impingement may experience gluteus medius and trochanteric bursitis pain [4]. Impingement type could be different according to sex. Posterior impingement is more common in middle-aged women whereas anterior impingement is more common in younger men [8,9]. It is also thought that genetic factors may be risk factors in the development of FAI [10] but in our knowledge there is no clear evidence of genetic transit. In the Pincer type impingment, the posterior impingement test the hip is flexed to 90 degrees, abducted and externally rotated (FABER) [6,11,12]. The patient experiences hip pain with femoral neck jamming against posterior acetabular margin. In patients with acetabulum labral lesion, painful hip clicking and locking may be detected. These complaints are aggregated by ascending stairs, prolonged periods of sitting on chair, sports straining the hip flexion [13].

Anterior impingement occurs when the femur head sphericity is distorted and the diameter of the femur neck is increased pathologically, causing damage to the labrum of the acetabulum anterior wall during flexion and internal rotation of the hip joint. Anterior impingement test (FADIR) is performed by internally rotating and adducting the maximum flexed hip. This results in contact between femoral neck and anterosuperior acetabulum.

There are some physical examination procedures that are superior to others in differentiating FAI from other pathologies of the hip and lombar spine. Anterior impingiment test are the most specific test for this disease. FADIR sensitivity is %94-98 specificity %10-25 Posterior Impingement test sensitivity (FABER)% 42-81, specificity %25-75. In some lomber spine pathology (sacroiliac joint disease and LS-S1 facet joint degeneration) FABER test can be seen as positive.

The Radiology of FAI

Radiological evaluation of FAI anteroposterior pelvis radiography, cross-table lateral radiography to visualize the proximal femur and an alternative Dunn view (45° flexion) to visualize the femoral neck [3]. Plain films give the chance to evaluate morphological abnormalities of femoral neck and acetabulum, to identify the lesions of cartilage and the labrum and to exclude the possible differential diagnoses such as avascular necrosis, acetabular dysplasia and stress fracture. Abnormal morphology may give rise to bilateral FAI imaging in the plain radiographs, however, majority of patients experience unilateral symptoms [3].

Acetabular overcoverage is measured by the lateral center edge (LCE) angle. LCE angle is formed by a vertical line and a line connecting the femoral head center with the lateral edge of the acetabulum (Figure 1). The LCE angle makes the diagnosis of acetabular dysplasia and acetabular overcoverage if it is less than 25 degrees and above than 39 degrees, respectively. In Pincer impingement LCE angle is above normal [12,14]. The retroversion of Pincer type impingement can be diagnosed with the “crossover sign” in anteroposterior plain radiography (Figure 1). The “crossover sign” is the result of misplacement of the anterior part of the acetabular margin more laterally with respect to the posterior part. Furthermore, the ischial prominences can be much more clearly defined on plain films. In coxa profunda and acetabular protrusion the surface of acetabular fossa extends beyond the medial of ilioischial line and leads to the Cam impingement [14]. The alpha angle is used to measure the aspheric femoral head. It is between two lines from the centre of the femoral head through the middle of the femoral neck and through the point where the sphericity of the anterior femoral head is broken down to the center of femoral head (Figure 1) [11,15,16]. The normal level of alpha angle is 40°, it increases with Cam impingement, and with increasing degrees, the cartilage and labral damages also increase. The alpha angle is not related to the age.

The conventional radiography may reveal pistol grip deformity and synovial pitting in Cam impingement. (Figure 1). The pistol grip deformity is considered to be diagnostic [15].

Magnetic Resonance Imaging

MR arthrography is the gold standard method to evaluate the acetabular labrum and articular cartilage. The acetabular configuration, femoral neck contour and labral lesions can be well defined with the axial MRI sections. Femoral torsion can be assessed with CT or MRI images [12,14,17]. Femoral anteversion is much more pronounced in Pincer impingement with respect to Cam impingement.

The coronal MRI sections may reveal the alpha angle in Cam impingement. The anterosuperior labral tears are the most widely seen labral tears detected in Cam impingement. It can easily be diagnosed with MR arthrography.

The other MRI findings detected both in Cam and Pincer impingement are: paralabral cysts, subchondral edema, fibrocystic changes, labrum ossification, marginal osteophytes and subchondral sclerosis.

The Conservative Treatment of FAI

The conservative treatment options of FAI are limited. In addition, to our knowledge there is no high evidence-level study comparing conservative and surgical outcomes. The preservation of the muscle power, modification of activities and nonsteroidal antiinflammatory drugs are the treatment of choice [1]. The physiotherapy concentrating on hip abductor and perarticular muscles should be conducted [18]. Increase in pelvic tilt results with postural deformities with advancing FAI. In advanced stages, the gait and posture should be analyzed, and the rehabilitation programme should be designed accordingly [18,19]. Although the rehabilitation programmes may help to preserve the functional level of the patient, it can not prevent the progression of the joint damage and the symptoms of FAI [2]. In the study conducted by Peter Wall et al. [13] analyzing 18 trials investigating conservative treatment of FAI, strengthening the hip musculature and the abdominal muscles has been proven to be effective in preservation of the patients’ functional activity and decrease the symptoms. These studies revealed that increase in passive range of motion could lead to labral tears and thus be harmful for the patient. The prevalence of FAI, which is asymptomatic in the community, is high. In the systematic review of Frank et al.37% of patients had CAM deformities and 67% had pincer deformities with 2114 aseptomatic FAI patient. In the follow-up of 96 asymptomatic FAI hips monitored by Hartofilakidis et al.79 hips (82.3%) remained free of osteoarthritis for a mean of 18.5 years. In contrast, 17 hips (17.7%) developed osteoarthritis at a mean
The Surgical Treatment of FAI

Surgical treatment of symptomatic FAI should aim to ameliorate primarily the mechanical factors causative of impingement and to repair the pathologies secondary to impingement [1,2,19]. The method and approach of choice depends on the type and magnitude of the impingement. The goal of the surgery should be relief of the pain, regain of functional activity and prevention of joint arthrosis [1,20].

The clinical studies about FAI treatment are level 3 and 4 in the literature [21]. Randomised controlled or prospective clinical trials comparing the conservative treatment with surgery or the arthroscopic surgery with open surgery have not been conducted yet [21, 22].

The patients without signs of osteoarthritis or with minimal symptoms get the best results with surgical treatment with relief of pain and increase in functional activities. However, there is limited evidence suggesting the conservative surgery applied to asymptomatic patients with FAI can decrease the development of osteoarthritis in the future [21,23]. In open procedure, safe surgical dislocation of the hip joint as described by Ganz et al is performed [2]. The patient is placed in lateral decubitus position, an incision of approximately 10 cm is made to the anterolateral hip and the greater trochanter is explored. The hip is internal rotated and an osteotomy of 15 mm of is performed with preservation the adhesions of vastus lateralis and medialis. A Z-shaped capsulotomy is created and the joint is dislocated. Safe dislocation can be applied both to Cam and Pincer impingement. In the case of Pincer impingement, labrum is separated from the acetabular rim, focal bony protuberence is
removed and then anchors with sutures are attached to secure the labrum. In Cam impingement, the extra bone is removed from the femoral head and it is washed out. It is crucial to not to leave any fragments in the joint. After the surgical procedure, the trochanter major is fixed with two cannulated screws [24]. Naal et al. [25], demonstrated that of 22 athletes with the symptoms of FAI treated with open surgery and safe dislocation, 21 got back to normal healthy sport life (19 of them in the professional league, 2 of them in the amateur league). 18 of these patients were satisfied with the surgical procedure. Kockara et al. [24], showed the increase in Harris Hip Score from preoperative 54.3 levels to 70.6 in 22 patients safe dislocation performed in a follow up period of 27.5 months. One of those patient needed total hip replacement because of avascular necrosis. This method carries the disadvantages of the need for a larger incision, the risk of nonunion and irritation of the implant. The open surgery did not eventuate promising results in the patients with Tönnis grade 3 or 4 [25-27]. Sampson et al. [26] reported that the surgery created worser results than expected in patients with chondromalasia grades greater than 3 when detected during surgery. McCarthy et al. [27], showed 3 of 4 patients with grade 3 needed hip joint arthroplasty in 2 years of open surgery.

The other surgical treatment option of FAI is mini-open surgery, developed first by Ribas et al. [28]. Mini open surgery, while debridement of cam impingement is performed, also enables to explore the labrum and acetabular rim with arthroscopy. Ribas et al. [29] applied mini open surgery to treat the FAI in 35 hips of 32 patients. During the follow up period of 2.4 years, a statistical difference in internal rotation and flexion of the hip was found and an improvement of Merle d'Aubign clinical hip scores from 13.8 to 16.9 points in one year was achieved. Laude et al. [29], demonstrated the improvement of non arthritic hip scores (NAHS) from preoperative 54.8 to 83.9 points in 5 years follow up period of 94 patients treated with mini open surgery. Total hip replacement was performed to 11 of these patients, whereas 13 of them needed to undergo additional surgical procedures. Only isolated acetabulum decompression and labrum repair can be performed due to the risks of femoral osteochondroplasty in combined type FAI patients. The clinical outcomes of isolated acetabulum decompression in patients with combined type FAI are similar to those in patients undergoing combined de compression techniques. However, there are few studies on this subject in the literature. Mini open surgery has played a role of bridge between open surgery and arthroscopy in the treatment of FAI [30]. This procedure has the advantages of usage of mini incision, no need of traction for arthroscopy, however, carries the disadvantages of longer and more difficult surgery and 10-15 percentage of total hip replacement ratio after surgery [19]. Furthermore, injury to the posterior branch of lateral femoral cutaneous nerve is reported to be 17.1% after mini open surgery [19,29]. Therefore, arthroscopic treatment is favored against mini open surgery today. Arthroscopic hip surgery is one of the most widely used techniques to correct FAI. In order to perform the arthroscopic hip surgery, the patient is placed in supine position on the traction table and hip joint is tracted to expand the joint space 15-20 mm. Since excessive traction may result with pudendal nerve neuropraxis, the genital region should be suspend with pads and sponges and excessive traction longer than 2 hours should be avoided [31,32]. The portals should be placed when the leg is maximally internal rotated. Anterior, anterolateral and posterolateral portals are frequently used as described by Byrd et al. [33,34]. After surgery is completed, the traction is relieved, the hip is internally rotated and flexed to 90°. In the case of any signs of impingement, open debridement of the remnant in the femoral neck can be performed [34]. Postoperative physiotherapy may include tolerable weight bearing by the axillary crutches for the first 2 weeks. After 4-6 weeks forced hip flexion exercises (e.g. bicycling) can be started.

Arthroscopic FAI surgery enables to visualize the the central and peripheral chondral damage of the joint, to repair the labrum and treat both two types of impingement. The chondral damage on the joint surface can be observed and properly treated (Figure 2A, 2B) [35].

The studies that focused on hip arthroscopy for the treatment of FAI have been published since 2006. In the study conducted by Philippou et al. [33] 112 patients who had undergone hip arthroscopy with a mean follow up period of 2.3 years, the mean Harris Hip Scores of patients improved from the preoperative 58 to postoperative 84. Total hip replacement was indicated in 10 patients in the postoperative period. They have shown the scores of patients administered labral repair were much more higher than those of labral excision applied [33]. Fabricant et al. [35] treated 21 athletes with FAI below 19 years of age with hip arthroscopy. The mean follow-up period was 1.5 years. They showed that the Harris Hip Scores improved significantly after operation with a mean of 21 points. The mean alpha angle decreased from 64+/− 16 to 40+/− 5 degrees [35].

The results of hip arthroscopy in the treatment of FAI depends largely on the experience of the surgeon, with increasing experience the results are promising. Büchler et al. [36] evaluated the patients operated for FAI between 2006-2010 years according to the years. In patients operated in first 2 years, there was no statistical difference between preoperative and postoperative alpha angles. However, the postoperative alpha angles of the patients operated in the third and fourth years decreased more significantly than those operated in first two years [36]. This study also demonstrated the alpha angles of patients to whom safe dislocation applied were statistically less than those treated with arthroscopy.

Hip arthroscopy is a difficult treatment method that requires experience. The minor risks and complications are: Traction – related injuries, iatrogenic chondral and labrum damage, painful skar, instrument breakage, fluid extravasation. Major risks and complications are; femur head avascular necrosis, femur neck fracture, infection Possibility of norovascular injuries when entering portals [37-41].

R. Seijas et al. Showed 14% [37]) total complications in 258 patients in the literature review. 3 patients show traumatic pudendal neuropathy and were resolved within 6 weeks, In 6 patients, Lateral femoral Cutaneous nerve injury due to portal entrance were observed. 4 patients had improvement within 8 weeks and 2 patients had sequelae. In 2 patients had painful skar at the portal entrance and treated with scar excision under local anesthesia. 5 patients had instrumental breakage and were
removed without any problems during operation. In 9 patients ilibitial band syndrome developed on the same side after a mean 6 weeks after surgery. Physical therapy was started for all patients and Z-plasties were applied to 3 patients who did not pass the pain. In 4 patients developed heterotopic ossification but they were followed up for not having any complaints. Stress fracture occurred in one patient with a Cam Type lesion. Although fracture was non-displaced the patient was treated conservatively. One patient had debridement due to infection. Capsular adhesions developed in 3 patients. Arthroscopic capsular release was applied to this patient again. AVN developed in 1 patient. This patient was fully recovered after 6 months. The total number of patients remaining sequential was %0.7 (2/258) [38-43].

CONCLUSION

The arthroscopic treatment of FAI is more advantageous compared to open surgery, due to no need of osteotomy, no risk of nonunion, being less invasive and easier postoperative physio rehabilitation. Longer learning curves and neuropsy after traction constitute the disadvantages [6,19]. The success rates of arthroscopic FAI treatment increase with the learning curve and give rise to promising results as much as safe dislocation. Still, we believe that further randomized controled trials are required as studies proving that arthroscopic treatment is better than conservative methods are lacking.

REFERENCES

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