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Research Article

Femoral Acetabular Impingement in the Athletes: Surgical Treatment with AMIC Versus Microfractures

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Abstract

Femoro-acetabular impingement (FAI) is an anatomo-functional syndrome of the hip, characterized by an abnormal contact between the femoral neck and the acetabulum, predisposing to Osteoarthritis, especially in condition of functional overload, related or not to sport.

Cam impingement refers to an abnormal loss of sphericity of the femoral neck-head junction and a pincer impingement related to anterior hypercover of the acetabulum. Early diagnosis allows to plan arthroscopic surgery to optimize joint congruence and repair chondro-labral lesion, associated to a high percentage of cases. From the initial open surgical therapy, we have now moved on to arthroscopic surgery with several techniques for repairing chondrolabral lesions. The available procedure ranges from Microfracture to cartilage scaffold. Microfractures and AMIC procedure let to mark clinical short term improvement in chondral defect from FAI syndrome in the short term. This study values and compares the clinical outcomes of the arthroscopic surgery with Microfractures and AMIC techniques for the treatment of acetabular chondral defects in the femoro-acetabular impingement. Both arthroscopic surgery are valid procedure to repair medium sized chondral defects on the acetabulum side of the hip during FAI. AMIC technique gives statistically better results for chondral lesions in the presence of the acetabular lip. For minimal invasiveness for the single procedure, surgical time and morbidity are reduced to the minimum. The medium-term results are good either for the immediate resolution of coxalgia and functional limitation, or for the secondary prevention of coxarthrosis. This has implications for the rehabilitation of these patients after surgery too.

Keywords: *Hip; FAI Syndrome; Cartilage Damage; AMIC; Micro-Fractures*

Introduction

The cause of symptomatic hip pain in the young population is, in most cases, due to the labral tears [1], often secondary to impingement disorders [2]. Sport today is widespread in all social groups, with an ever younger age and greater sport longevity. Therefore, osteoarticular problems are increasing, either traumatic or not. The hip in particular has undergone an increase in the incidence of degenerative diseases also in young age, secondary to dysplastic, osteochondrosis and traumatic conditions [3]. Genetic influence has been noted in impingement disorders of the hip. Functional overload diseases in sport, especially in adolescence and males, have more insidious etiopathogenetic definition [4]. The femoro-acetabular impingement (FAI) described by Ganz., *et al.* [2] is considered today an anatomo-functional condition predisposing to coxarthrosis especially in conditions of functional overload, related or not to sport. Cam

impingement is referred to an abnormal loss of sphericity of the femoral neck-head junction and a pincer impingement if it is related to an anterior overlapping of the acetabulum.; there are mixed cases. In both cases it creates an abnormal contact during movement. The early clinical-instrumental diagnosis of FAI syndrome and the early surgical approach to chondral lesions of the hip today represent a qualifying moment of primary or secondary prevention of hip Osteoarthrosis [5]. In fact, acetabular or labral cartilage damage has a very high incidence, up to over 80% [6]. This work analyzes the results of arthroscopic treatment of chondral hip injuries in sports patients with FAI syndrome with two distinct surgical procedures, of the restorative type (Microfractures) [7] and of the regenerative type with Autologous Membrane Chondrogenesis Method (AMIC) [8].

Materials and Methods

60 patients, 44 males (73%) and 16 females (27%), with an average age of 40 years (minimum 22 and maximum 45), all amateur sportsmen, suffering from mixed type femoro-acetabular impingement (FAI) coxalgia, have undergone arthroscopic surgery.

The patients were divided into two groups: Group A included 28 cases (47%) with an average age of 38 years (minimum 35, maximum 45), Group B included 32 cases (53%) with an average age of 38 years (minimum 22, maximum 44) (Table 1).

	Cases	Age	Sampson score	Lesion extension	HH Score
	44 M (73%) 60 16 F (27%)	22ys-45ys (average 40y)	AC2: 28 (46,6%) AC3: 20 (33,4%) AC4: 12 (20%)		Pre-op 45,3 60 Post-op 81.2
Group A (AMIC)	28 6 F (21%) 22 M (79%)	35-45 ys (average 38ys)	AC2: 13 c AC3: 10 c AC4: 6 c	Average 2,0 cm	Preop average 63 Postop average 88
Group B (Microfracture)	32 10 F (31%) 22 M (69%)	22-44 ys (average 38ys)	AC2: 15 c AC3: 10 c AC4: 6 c	Average 2,5 cm	Preop average 60 Postop average 80

Table 1: *Cases material.*

The inclusion criteria were coxalgia with functional limitation and minimal persistent lameness from 30 days, resistant to medical therapy; hip radiography with congruent articulation; artroRM with FAI presence and signs of chondro-labral suffering.

The exclusion criteria were concomitans presence of femoral head chondral lesion, systemic rheumatoid diseases, dysplasia, femoral neck axial deviations coxa profunda and/or protrusio acetabuli.

Cam correction, acetabular rim trimmer and re-insertion were performed in all patients of the acetabular rim. For chondral lesions, in a subsequent randomized series, it was used in Group A Autologous Membrane Chondrogenesis Method (AMIC) and in Group B the repair method of Microfractures [8].

The single-step regenerative AMIC technique uses the growth factors, platelet rich plasma, (PRP) conveyed from a scaffold of hyaluronic acid (Chondrotissue). Find elective indication in chondral lesions acetabular not more than 3 cm^2 in extension. Growth factors, previously prepared by peripheral blood by centrifugation (PRP), are placed on an acid membrane hyaluronic [9].

Microfractures are the oldest technique for cartilage restoration in weight-bearing regions of the joint. It is slow in complexity with a low risk of associated patient morbidity. The perforations are normally 2 mm deep. The deeper holes show no significant effect on cartilage production, but may reduce integrity of the subchondral bone. Not the original cartilage, but is formed fibrocartilage less flexible [7].

All patients were assessed preoperatively and a follow-up after 3, 6, 12 months, 2 and 4 years using the modified Harris Hip Score (mHHS) [10]. This score assesses hip function with a maximum score of 91. Our results were rated as follows: excellent (81 - 91), good (71 - 80), fair (61 - 70) and poor (less than 60).

The instrumental evaluation was done with the radiography and the hip arthrography. After preliminary debridement and joint washing, the acetabular lesion was typed according to Sampson's intraoperative classification [11] which distinguishes following grading, summarized briefly:

- AC0, no damage;
- AC1, softening no wave sign, split up levels depending on intact labro-cartilage junction, with delamination, or torn labrocartilage junction with delamination;
- AC2, fibrillation with or without torn labrocartilage junction;
- AC3, exposed bone small area < 1 cm^2;
- AC4, exposed bone large area > 1 cm^2 (Table 2).

Acetabular Cartilage Injury
AC 0 = No damage
AC 1 = Softening no wave sign
AC 1w = Softening with wave sign intact labrocartilage junction
AC 1wTj = Softening with wave sign and torn labrocartilage junction
AC1wD = Softening with wave sign and intact labrocartilage junction with delamination
AC1wTjD = Softening with wave sign and torn labrocartilage junction with delamination
AC2 = Fibrillation
AC2Tj = Fibrillation with torn labrocartilage junction
AC3 = Exposed bone small area < $1cm^2$
AC4 = Exposed bone large area > $1cm^2$

Table 2: *Intraoperative classification of chondral lesions [11].*

Of the 60 cases operated, 28 were of AC2 (46.6%), 20 of AC3 (33.4%) and 12 of AC4 (20%).

In group A 13 cases of AC2, 10 cases of AC3 and 6 cases of AC4.

In group B 15 cases of AC2, 10 cases of AC3 and 6 cases of AC4 (Table 2).

In group A the AMIC procedure was performed arthroscopically in a single surgical stage. The ChondroGide matrix, a bilayer collagen I/III membrane (ChondroGide, Geistlich Pharma AG, Wolhsen, Switzerland) was cut to fit the size and the shape of the lesion and placed on the chondral defect with the porous layer towards the bone surface through an arthroscopic cannula. The chondral defect was measured with an arthroscopic probe. The scaffold is stabilized thanks to the femoral head pressure, after removing limb traction. The two layers, compact and porous, allow cell proliferation and engraftment [12].

In group B we proceeded with the restorative treatment of Microfractures, electively indicated in chondral lesions not exceeding 2.5 cm^2. After an accurate chondroabrasion of the cartilage defect, performed with appropriate instruments at various angles (chondralpick) microfractures perpendicular to the surface, with a depth of 3 mm and one 3 - 4 mm distance from each other.

The post-operative course involved the use of anti-thromboembolic therapy for 4 weeks and for 2 weeks therapy with indomethacin for analgesic purposes and for the prevention of particular heterotopic ossifications. The post-operative rehabilitation program started on the first post-op day, with isotonic and isometric quadriceps contractions. Walking was allowed with two crutches with partial weight bearing (25-30% of body weight) for three weeks; cycling exercises started from post-operative day two, swimming after two weeks. After 5 weeks the loading with a crutch and then free. Impact sport activity was granted at three months post-op and complete return to sport activities six months after surgery.

Results

All patients were monitored with a maximum follow-up of 4 years and a minimum of 2.

Preoperative HHS evaluation had a mean score of 45.3 (+ 4.9).

Only partial remission had occurred one month after the surgery, which became almost total after 2 months.

For 23 cases of Group A (Ac2, Ac3 lesions) and for 26 cases of Group B (Ac2, Ac3 lesions), there was a total functional recovery after 2 months. In the 5 cases of AC4 in Group A and in the 6 cases of AC4 in Group B load pain persisted until the 3rd month with a progressive and subsequent remission. Significant improvement (81.2 + 7.9) ($p < 0.001$) was observed at 6 months in comparison to preoperative levels; the mHHS was significant higher at 12 months. At the 4 years follow-up the mean HHS improvement recorded compared with preoperative scores was 88 for Group A and 80 for Group B. No patient had a poor postoperative HHS (Table 1).

There was a faster recovery in all patients of the Group A. The clinical-functional improvement correlated with the anatomical-pathological picture of the lesion, resulting in the longest path of remission in Ac4 lesions. In detail, at the last follow-up, the 28 patients of the two Groups (46,7%) with an initial AC2 lesion they had healed without recurrence; the 20 patients (33.3%) with AC3 lesions (10 in Group A and 10 in Group B) had reported occasional episodes of coxalgia, treated with symptomatic drugs, with subsequent remission. Of the 6 patients (10%) with AC4 lesion (2 of Group A and 4 of Group B), with an extension of just over 2.5 cm^2, they had undergone arthroplasty. The remaining 6 (10.0%) (4 of Group A and 2 of Group B) had occasional coxalgia, controlled by NSAIDs.

Furthermore, a fibroscopic second look (Innervue II-Biomet) was performed at a minimum distance of 2 years after surgery in 20 patients (33%), with evidence of fibrous cartilage restarting.

Discussion

The chondral lesions of the hip are a consequence of different pathologies such as trauma, dysplasia, osteonecrosis labral tears loose bodies, dislocation, slipped capital femoral epiphysis and femoro-acetabular impingement (FAI). FAI in particular has been indicated as a cause of Osteoarthritis of the hip due to an abnormal contact against the joint, for the altered morphology if the femur and/or he acetabulum, with degeneration of the labrum and cartilage [13]. The FAI is due to degenerative changes in the non-dysplastic hip, of the young adult, often engaged in intense motor or sport activity [14]. Siebenrock has experienced a percentage increase of Cam type deformity in a small group di playing ice hockey athletes [15]. Microfractures is the first choice treatment for both acetabular and femoral head small chondral defects (= < 2 cm); it is not invasive and very rarely has it been associated with post operative complications and good clinical results after micro fractures have been reported [16,17] including athletes [18,19]. The technique AMIC helps the cartilage regeneration

in a single surgical operation without the harvesting cells from a second site. Furthermore, the presence of collagen I/III used in AMIC from al regeneration site cell adhesion and differentiation capacity. The collagen matrix indeed has been shown to promote chondrogenetic differentiation of mesenchymal cells [20]. Large chondral lesions had significant improvements at 12 and 24 months of follow up [21]. Secondary prevention of FAI syndrome in athletes requires early diagnosis and a possible surgical treatment in the pre-arthrosis phase, since the subtle onset of the disorders clinical findings and/or misinterpretation of the radiography often lead to delayed diagnosis.

Alterations X-ray typical of FAI syndrome do not in themselves constitute disease (especially in cases minor). Sometimes minimal radiographic signs of osteoarthritis correspond intra operatively to significant chondral damage, with limited recovery of motor and sport activity. The limitation of ROM in hip rotation-flexion is an important screening test, then associated with radiographic and MRI study of the hip [6]; Information is paramount capillary about this pathology extended not only to specialists, but also to general practitioners and to the sportsmen themselves. Early arthroscopic surgery thus becomes decisive.

Case studies analyzed show a correspondence of clinical results between two groups. The pre- and post- operative comparison clinical score for the two groups was almost the same (vs 80 points for Group A and B respectively), without statistically significant differences. In the two Groups the 6 cases of AC4 chondropathy hesitated in arthroplasty (10% of the total).

The AMIC technique gave better results than microfractures with the same lesion (Ac2 in the presence of the acetabular lip). This study suggests that AMIC is a valid procedure to repair medium-sizes chondral defects on the acetabular side of the hip a leads to long term outcomes.

Conclusion

Furthermore, it reduces total therapy time and overall costs, compared to two-stages procedures such as MACI. AMIC may be considered today a first treatment for minimal invasiveness, single stage surgery and safety, especially when the acetabular lip is present. However, it is necessary to have long-term outcome data for the treatment of chondral defects of the hip using the AMIC treatment.

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