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Arthroscopic management of femoroacetabular impingement: evaluation of a two-year follow-up

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Objective Review outcomes of arthroscopic management of femoroacetabular impingement (FAI) at two years. **Material and methods** This is a retrospective, uncontrollable, unicenter level IV evidence study (case series) that included 29 patients (19 females and 10 males) with clinical and radiological signs of FAI treated arthroscopically. Exclusion criteria included Kellgren-Lawrence grade 3 osteoarthritis, avascular necrosis of the femoral head and Wiberg's center edge angle < 20° and > 40°. All patients underwent a preoperative complete set of radiographic views including the plain, 45° and 90° Dunn's views to identify impingement mechanisms and quantify alpha and Wiberg's angles. The Kellgren-Lawrence scale was used to grade hip osteoarthritis. The Outerbridge classification system was intraoperatively applied for grading cartilage lesions. The Hip Disability and Osteoarthritis Outcome Score (HOOS) was used to evaluate physical function of the hip and the International Hip Outcome Tool (iHOT-12) and the Oxford Hip Score were employed to measure health-related quality of life. The mean follow-up period was 29.3 ± 3.1 months. **Results** Combined hip impingement was observed in 82.8 % of the cases, 10.3 % had Pincer and 6.9 % Cam types. The mean alpha and Wiberg's angles measured preoperatively 67.7 ± 12.1º and 31.8 ± 8.3º, respectively. Patients reported improved pain and function of the hip at a 3-month follow-up. Patient reported outcome measures rated 65.8 % results as excellent, 6.8 % good, 13.7 % fair and 13.7 % as poor at 12- and 24-month follow-ups. The mean alpha angle measured postoperatively 48.7 ± 3.9º. Patients with poor outcomes underwent consersion to total hip replacement within a year following arthroscopic procedure. No complications were recorded in the patients. Overall two-year survival was 86.3 %. **Conclusion** Hip arthroscopy now has an established place in the treatment of FAI. Poor outcomes seen in 13.7 % of the cases were associated with acetabular cartilage lesions undetected preoperatively and seen as intraoperative arthroscopic findings.

Keywords: femoroacetabular impingement, hip arthoscopy, cartilage lesion

INTRODUCTION

Femoroacetabular impingement (FAI) is a pathomechanical process of chronic injury to the acetabular cartilage and the labrum with the femoral head or neck [1]. FAI is a common cause of hip pain and limited range of motion [2, 3]. Over time abnormal contact between the femoral head and acetabulum rim, the repetitive mechanical insult to the articular tissues leads to hip degeneration [4]. FAI has been found to cause premature osteoarthritis of the hip, especially in young and active adults, and appropriate and timely surgical care is important for the patients [5]. Three types of morphologic abnormalities can occur in FAI: Cam, Pincer, and Mixed. Cam impingement presents with femoral head asphericity, seen as an osseous bump at the anterolateral region of the femoral head neck junction and can be identified as a "pistol grip" deformity on radiographs [6, 7]. Pincer-type impingement results from focal overgrowth of the anterior acetabular rim with acetabular retroversion in dysplastic hips [5]. A typical radiographic sign of an acetabular retroversion is a cross-over sign with the anterior rim crossing the posterior wall [8, 9]. The third type of FAI, mixed, is a combination of cam and pincer impingement characteristics [4].

Although there is a wide discrepancy in reported prevalence rates for cam, pincer, and mixed FAI, the most common types seen, are the cam and mixed types. J. Clohisy et al. evaluated the epidemiology of FAI in a study of 1076 subjects and reported that 47.6 % had cam type impingement, 44.5 % had combined cam/pincer, and 7.9 % had pincer deformity [10]. Performing a systematic review of existing literature V. Mascarenhas et al. identified 60 studies to include 3472 patients (4169 femurs) with either cam, pincer or mixed morphology FAI. The authors reported symptomatic 49.0 ± 21.2 % cam, 40.2 ± 18.0 % mixed and 28.5 ± 19.2 % pincer types [11].

The goals of treatment are to dealy the onset of osteoarthritis or slow its progression, alleviate

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symptoms of the disorder, improve function and allow a return to activity [12]. Surgical options for FAI include 3 surgical approaches: open surgical dislocation, mini-direct anterior approaches or hip arthroscopy [13]. Each one of the different surgical approaches for FAI has its own disadvantages. Hip arthroscopy is a technically demanding and difficult procedure with nerve injuries being most likely due to traction. The open dislocation approach is a major operation which necessitates the use of a trochanteric osteotomy and hip joint dislocation with a risk of complications associated with fixation of the greater trochanteric osteotomy sites with metal hardware. The mini-open approach can be associated with a damage to the lateral femoral cutaneous nerve and under-resection of the lateral aspect of femoral head neck junction [14, 15]. Hip arthroscopy has seen increasing utilization over the last decade providing less invasive approach to the hip as compared to the open procedure. Our literature search has indicated to a little experience in hip arthroscopy in the Russian Federation and we report findings regarding the matter from our University hospital study.

The purpose of the study was to review outcomes of arthroscopic management of femoroacetabular impingement (FAI) at two years.

MATERIAL AND METHODS

This is a retrospective, uncontrollable, unicenter level IV evidence study (case series). Informed consent was given prior to inclusion in this study by all patients. The study included 29 patients with clinical and radiological signs of FAI and positive FADDIR (Flexion, Adduction, Internal Rotation) and FABER (Flexion, Abduction and External Rotation) tests. Of 29 participants, 19 were females and 10 were males, their age averaged to 48.4 ± 12.8 years (range, 23 to 75 years). Exclusion criteria included Kellgren-Lawrence grade 3 osteoarthritis, avascular necrosis of the femoral head and Wiberg's center edge angle < 20° and > 40°. Patients underwent hip arthroscopy using standard arthroscopic portals with the hip placed in traction at suturing the labrum. Operative interventions were performed between 2016 and 2017 at the University hospital of the Privolzhsky Federal Medical Research Center. The mean follow-up period was 29.3 ± 3.1 months.

All patients underwent a preoperative complete set of radiographic views including the plain, 45° and 90° Dunn's views. Radiographs were used to identify impingement mechanisms, quantify alpha angle formed by the axis of the femoral neck and a line drawn from the femoral head center to the point where the head extends beyond the margin of the best-fit circle, Wiberg's angle formed by a verticle line drawn through the center of the femoral head and the line that connects the centre of the femoral head with the lateral margin of the acetabular rim. The Kellgren-Lawrence scale was used for clinical and radiological grading of hip osteoarthritis (OA). The Outerbridge classification system was intraoperatively applied for grading cartilage lesions. The Hip Disability and Osteoarthritis Outcome Score (HOOS) was used to evaluate physical function of the hip and the International Hip Outcome Tool (iHOT-12) and the Oxford Hip Score (OHS) were employed to measure health-related quality of life. Outcome measures were rated as excellent, good, fair or poor [16] and employed preoperatively, at 3, 6, 12 and 24 months during follow-up visits. All patients underwent plain pelvic radiography for alpha angle measurement.

Statistical analysis was performed using the tools of Microsoft Office Excel and Statistica 12.0 software. The data obtained were summarized as means (M) ± standard deviations (SD). Comparisons between findings obtained at the last follow-up visit were performed with analysis of non-parametric test, specifically, Wilcoxon rank-sum test. For calculations, a significance level of p being equal to 0.05 was adopted.

RESULTS

Combined hip impingement was observed in 82.8 % of the cases, 10.3 % had Pincer and 6.9 % Cam types. No clinical and radiological signs of hip OA were observed in 17.2 % of the cases. Grade 1 hip OA was diagnosed in 62.1 %, and grade 2 hip OA was detected in 20.7 %. The mean alpha and Wiberg's angles measured preoperatively 67.7 ± 12.1° and 31.8 ± 8.3°, respectively.

All surgeries were performed by a single surgical team with the operating time averaged to 82.6 ± 29.6 minutes. Acetabular labral refixation with either knot-tying or knotless suture anchor was utilized in 93.2 % of the cases. Outerbridge grade III and IV chondral lesions of the acetabulum were detected in 24.1 % of the cases.

The majority of the patients had low HOOS, OHS and iHOT12 scores preoperatively. Patients reported improved pain and increased range of motion in the hip at a 3-month follow-up and showed more improvements during the next follow-up visits (Table 1). No hip pain during activities of daily living, vigorous-intensity physical activity,

sports was reported by 65.8 % of the patients whose results were rated as excellent with 80–100 HOOS, 40–48 OHS and 80–100 iHOT-12 scores. Some discomfort, slight pain during intense physical activity that completely arrested after rest was reported by 6.8 % of the patients whose results were rated as good with 70–79 HOOS, 30-39 OHS and 70–79 iHOT-12 scores. Hip pain during moderate physical activity that arrested after rest was reported by 13.7 % of the patients whose results were rated as fair with 60–69 HOOS, 20-29 OHS and 60–69 iHOT-12 scores. Hip pain at rest that aggravated with a slight physical activity and activities of daily living that arrested with use of NSAIDs was reported by 13.7 % of the patients whose results were rated as poor with 0–59 HOOS, 0–19 OHS and 0–59 iHOT-12 scores. Four patients with poor outcomes underwent total hip replacement within a year following arthroscopic procedure. Overall two-year survival was 86.3 %. The mean alpha angle measured 48.7 ± 3.9º postoperatively. No complications were recorded in the patients.

Table 1

Outcome measures reported by patients preoperatively and at different periods following surgical treatment of FAI

Questionnaires completed	Scores (M±SD)		
	HOOS	iHOT12	OHS
Preoperatively	41.9 ± 17.1	47.9 ± 14.7	22.3 ± 7.3
at 3-month follow-up	65.3 ± 18.02*	67.7 ± 15.5^	35.5 ± 8.4#
at 6-month follow-up	73.9 ± 17.2*	83.5 ± 18.3^	39.5 ± 7.9#
at 12-month follow-up	78.2 ± 17.9*	93.9 ± 19.7^	41.4 ± 7.9#
at 24-month follow-up	78.4 ± 18.1*	94.3 ± 20.1^	42.4 ± 8.2#

* – statistically significant differences compared to preoperative HOOS scores, $p < 0.05$; ^ – statistically significant differences compared to preoperative iHOT12 scores, $p < 0.001$; # – statistically significant differences compared to preoperative OHS scores, $p < 0.001$.

DISCUSSION

Hip arthroscopy is an effective approach to treat FAI. Hip arthroscopy as a treatment for FAI results in significant improvements in patient pain and function, with high satisfaction and relatively low revision surgery rates in appropriately indicated patients [1, 8, 17, 18]. Hip arthroscopy has been shown to be a relatively safe procedure with a lower risk of infection and a lower rate of complications in comparison with open surgery of the hip joint [5]. The majority of symptomatic and functional improvements occur within 1 to 2 years of hip arthroscopy.[1]. In our series, statistically significant pain relief and functional improvement occurred within 3 months of hip arthroscopy, and the majority of patients (72.6 %) showed high satisfaction scores.

M.Sansone et al. reported outcomes of 289 patients (359 hips) 2 years after the arthroscopic treatment of FAI [17]. The patients showed statistically and clinically significant improvements at the follow-up period compared with preoperative characteristics. Re-operations were performed in 17 (5 %) cases and 14 (4 %) converted to total hip arthroplasty. Completing questionnaires online 82 % of the patients who underwent hip arthroscopy reported they were satisfied with the outcome of surgery, 13 % were not satisfied and 5 % gave no answer. The authors detected correlation between the length of symptom duration and poor outcomes of FAI treatment. No correlation was found between age, level of cartilage damage and outcomes [17]. In our series, poor outcomes were observed in patients older than 50 years with radiological signs of grade II hip OA, chondromalacia at the anteriolateral aspect of the acetabulum classified as Outerbridge grade III and IV chondral lesions. Deep chondral lesions were detected intraoperatively but were not addressed with acute chonrdoplasty and bone drilling due to a large lesion area (more than 2 cm^2). These patients underwent conversion to total hip replacement within a year following arthroscopic procedure. Age and level of subchondral damage are thought to be important prognostic factors for planning hip arthroscopy.

A. Öhlin et al. reviewed outcomes of arthroscopic treatment for FAI syndrome 5 years post-surgery [19]. The study included 184 patients. Mixed morphology FAI was detected in 104 (57.8 %) cases, Cam, in 74 (41.1 %) and Pincer in 2 (1.1 %) patients. Acetabular chondral lesions were identified in 87 hips (65.4 %) with Konan type 2 being most common. A comparison of preoperative iHOT12, HAGOS, EQ-5D, VAS, HSAS scores and those obtained at the 5-year follow-up revealed statistically significant improvements for all outcome scores, except for the HSAS scores, which were unchanged. Four (2.2 %) re-operations were performed during the follow-up period. At the 5-year follow-up, 154 patients reported that they were satisfied with surgery (84.6 %). Survivorship at the 5-year follow-up was

86.4 % [19]. Overall two-year survival in our series was 86.3 % that is on par with the rate reported by A. Öhlin et al. The follow-up period in our series was shorter, however, a poor outcome would come out at one year following hip arthroscopy so that comparable survival rates can be anticipated at five years with a slight decrease.

A group of experienced hip arthroscopists of North America developed the first national consensus-based Best Practice Guidelines (BPG) for the surgical and nonsurgical management of FAI. Arthroscopic treatment for FAI syndrome is contraindicated with the following criteria: Tonnis angle > 13–15°, Wiberg's angle < 20°, hypermobility and dysplastic manifestations, Outerbridge grade III and IV chondromalacia, joint space narrowing < 2 mm and absent hip pain [20]. We totally agree with the above contraindications to surgical treatment of FAI. Radiological and physical examinations allow quantification of the above parameters with exception of the cartilage thinning. With more experience gained we have concluded that preoperative MRI is very important for patients with FAI and now MRI scanning is an intergral part of preoperative workup. Absence of MRI findings in several patients of our series resulted in missing grade III and IV chondromalacia during preoperative planning and, finally, in a poor outcome.

O.A. Sogbein et al. performed a systematic review to identify demographic, radiographic, and other operative predictors of positive and negative predictors of outcomes after hip arthroscopic surgery for patients with FAI [21]. Body mass index < 24.5 kg/m^2 and younger age were found to predict positive outcomes. There was a correlation between sex and outcomes of surgery detected: males older than 45 years showed significantly higher scores on the Hip Outcome Score-Sports Specific Subscale (HOS-SSS) and the modified Harris hip score (mHHS) scales than females of matching age. Body mass index is an essential parameter enabling approach to the joint. The presence of severe cartilage injury at the time of arthroscopic FAI surgery is unlikely to result in good subjective outcome and hip function in patients of advanced age.

The authors revealed radiological signs predicting negative outcome after surgical treatment of FAI being on par with the above contraindications identified by surgeons of North America. Femoral retroversion and Kellgren-Lawrence grade III hip OA can be also considered as signs predicting a poor outcome [21]. We do not perform a hip arthroscopic procedure with one of the signs diagnosed in the patient. The authors considered microfracture of the acetabular articular cartilage as a surgical factor predicting negative outcome after hip arthroscopy for FAI. Patients showed less favorable results with labral debridement performed without use of suture anchors [21]. We normally used suture anchors after labral debridement in our series.

B. Capogna et al. examined clinical outcomes in 42 patients aged 60 years or older who underwent hip arthroscopy for management of hip pain and reported 2-year survival rate of 88.9 % and 11.9 % (n = 5) of the cases with failed criteria that appeared to be lower than that in similar studies. The authors concluded and strict patient selection criteria is needed for advanced age group [22]. We strongly support the conclusions. Our findings indicated to correlation between age and outcome of hip arthroscopy with no statistically available evidence.

We want to emphasize on the role of MRI scanning in preoperative planning of surgical treatment for FAI determining appropriate treatment strategy. MRI allows visualization of degenerative articular cartilage, deformity of the proximal femur and the acetabulum to rule out avascular necrosis of the femoral head. MRI can reveal location of chondrolabral lesions [23].

Preoperative detection of articular cartilage deformity allows us to prepare the patient to two-stage chondroplasty for descrete chondral defects. Scanners of at least 1500 T can be recommended for the examination using specific imaging methods. Compared to MRI magnetic resonance arthrography allows more accurate diagnosis and measurement of articular cartilage lesions [24].

Literature data show failures of hip arthroscopic procedures as one of treatment options for FAI ranging between 2.9 to 13.2 % [21]. Potential complications of hip arthroscopy may include persistent postoperative pain, weakness, stiffness, decreased range of motion, traction injury to the lateral femoral cutaneous nerve, ischial, femoral, common peroneal, pudental nerves and superior gluteal neurovascular bundle [8]. Neuropathy is one of the most common complications following hip arthroscopy. Neuropraxia related to traction can be prevented by releasing traction. The foot is to be well padded inside the boot using cotton or gel. Some authors suggest keeping traction for 60 minutes. Traction release is deemed to improve nerve perfusion [8]. None of the patients developed neuropraxia in our series since traction was applied for labral suturing and that took 15 minutes on average. We also used a smooth banana-shaped knife to make checked incisions perpendicular to the capsule fibers for sustainable release of the

anterolateral aspect of the capsule and better intra-articular visualization [25]. Failed hip arthroscopy would require a re-operation including either a revision hip arthroscopy, or open surgical dislocation or conversion to THA [21]. Neither revision hip arthroscopy nor open surgical dislocation were produced for our patients. With full clinical and radiological evidence of failure in primary hip arthroscopy revision arthroscopy was not considered as a method of choice and the patients went on hip arthroplasty.

Arthroscopic intervention in the hip joint has evolved as a successful therapeutic procedure for treating FAI leading to pain relief and improvement of hip function. Further studies are required to outline algorithms for methods of preoperative evaluation, indications and contraindications to hip arthroscopy, assessment of patient-reported outcome measures in the surgical treatment of FAI. Limitations of this study include the small number of participants and a relatively short-term follow-up.

CONCLUSION

Hip arthroscopy now has an established place in the treatment of FAI. Poor outcomes seen in 13.7 % of the cases were associated with acetabular cartilage lesions undetected preoperatively and seen as intraoperative arthroscopic findings.

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