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Results of Arthroscopic Treatment of Patients With Femoroacetabular Impingement Depending on the Type of Hip Deformity

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Abstract

Background. Femoroacetabular impingement (FAI) is one of the most common causes of pain syndrome and limited mobility in the hip joint among young and middle-aged individuals.

***The aims of this study*:** 1) To evaluate the impact of the type of hip joint deformity in patients with FAI on treatment outcomes; 2) To identify the type of hip joint deformity that is optimal for correction using arthroscopy; 3) To determine the impact of the acetabular structure in conditions of borderline dysplasia on the treatment outcome.

Methods. A retrospective uncontrolled single-center study was conducted, including 121 patients (135 hip joints), among them 49 (40.5%) women and 72 (59.5%) men. Patients were divided into four groups based on the type of deformity. The first group included 33 (24.4%) joints with cam-type FAI, the second group — 72 (53.4%) joints with mixed-type, the third group — 17 (12.6%) joints with dysplasia (LCEA-O<25°) and cam-type deformity of the femoral head-neck junction, and the fourth group — 13 (9.6%) joints with a combination of dysplasia, cam-type deformity, and retroversion of the acetabulum. All patients underwent physical examination and radiographic diagnostics. In patients with borderline dysplasia, the version of the acetabulum was additionally assessed. The iHOT-33 and HOS scales were used to evaluate the preoperative status and postoperative results.

Results. The best treatment outcome was achieved in the first group of patients, which was statistically significantly different from the results in the third group. The treatment outcomes in the second group of patients did not show statistically significant differences from the first group according to the HOS questionnaire, but differed according to the iHOT-33 scale. The treatment outcomes in the fourth group of patients were almost indistinguishable on the iHOT-33 scale from the first group and on the HOS scale from the second group. In the third group, a statistically significant result on the HOS-Sport subscale was achieved in only 30% of patients, while in other groups it was not less than 58%. Other scales showed a slight superiority of treatment results in the first and fourth groups compared to the second and third groups. In the first years after surgery, all groups of patients showed a significant improvement in sports activity, but after 2 years, there was a tendency for a decrease in patients in the second and third groups.

Conclusions. The highest results of arthroscopic treatment were shown by patients in the first group with isolated cam-type deformity, slightly worse were results by patients in the second group (with mixed-type). In patients with borderline dysplasia, the effectiveness of arthroscopy depended on the structure of the anterior wall of the acetabulum. The worst result was observed in patients with borderline dysplasia and insufficiently developed anterior wall of the acetabulum — in that group of patients, it is worth preferring isolated periacetabular osteotomy or in combination with arthroscopy.

Keywords: femoroacetabular impingement, hip arthroscopy, acetabular dysplasia, acetabular retroversion.

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Результаты артроскопического лечения пациентов с фемороацетабулярным импинджментом в зависимости от типа деформации тазобедренного сустава

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Реферат

Актуальность. Фемороацетабулярный импинджмент (ФАИ) является одной из наиболее частых причин болевого синдрома и ограничения подвижности в тазобедренном суставе (ТБС) у лиц молодого и среднего возраста.

***Цели исследования*:** 1) оценить влияние типа деформации тазобедренного сустава у пациентов с фемороацетабулярным импинджментом на результат лечения; 2) выявить тип деформации тазобедренного сустава, который является оптимальным для коррекции с использованием артроскопии; 3) определить влияние строения вертлужной впадины в условиях пограничной дисплазии на результат лечения.

Материал и методы. Выполнено ретроспективное неконтролируемое одноцентровое исследование, в которое вошел 121 пациент (135 тазобедренных суставов), в том числе 49 (40,5%) женщин и 72 (59,5%) мужчины. Пациенты были разделены на 4 группы по типу деформации. В группу 1 включено 33 (24,4%) сустава с cam-типом ФАИ, в группу 2 — 72 (53,4%) сустава с mixed-типом, в группу 3 — 17 (12,6%) суставов с дисплазией (LCEA-O<25°) и cam-типом деформации головки, в группу 4 — 13 (9,6%) суставов с сочетанием дисплазии, cam-типа деформации и ретроверсии вертлужной впадины. Всем пациентам выполняли физикальное обследование и лучевую диагностику. У пациентов с пограничной дисплазией дополнительно оценивали версию вертлужной впадины. Для оценки предоперационного статуса и послеоперационных результатов использовали шкалы iHOT-33 и HOS.

Результаты. Лучший результат лечения достигнут в группе 1 пациентов, что статистически значимо отличалось от результата в группе 3. Результаты лечения пациентов в группе 2 не имели статистически значимых отличий от группы 1 по опроснику HOS, однако отличались по шкале iHOT-33. Результаты лечения пациентов в группе 4 почти не отличались по шкале iHOT-33 от группы 1 и по шкале HOS от группы 2. В группе 3 по подшкале HOS-Sport статистически значимый результат был достигнут только у 30% пациентов, в то время как в остальных группах он был не ниже 58%. Остальные шкалы показали незначительное превосходство результатов лечения в группах 1 и 4 по сравнению с группами 2 и 3. В первые годы после операции все группы пациентов показывали существенное улучшение спортивной активности, однако спустя 2 года у пациентов групп 2 и 3 наблюдалась тенденция к снижению.

Заключение. Лучшие результаты артроскопического лечения показали пациенты группы 1 с изолированным cam-типом деформации. Несколько хуже пациенты группы 2 (с mixed-типом). У пациентов с пограничной дисплазией эффективность артроскопии зависит от строения передней стенки вертлужной впадины. Наихудший результат наблюдается у пациентов с пограничной дисплазией и недостаточно развитой передней стенкой вертлужной впадины — при их лечении стоит отдать предпочтение изолированной периацетабулярной остеотомии или в комбинации с артроскопией.

Ключевые слова: фемороацетабулярный импинджмент, артроскопия, дисплазия вертлужной впадины, ретроверсия вертлужной впадины.

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BACKGROUND

Femoroacetabular impingement (FAI) is often the cause of pain syndrome and limited mobility in the hip joint in young and middle-aged patients [1, 2, 3]. FAI biomechanics comprises the repeated pathological contact of the edge of the acetabulum and articular labrum with the head and neck of the femur, which leads to the injury of the hip structures, pain syndrome, reduced range of motion, and, eventually, to the deterioration of patients' quality of life. Morphological classification of FAI includes three main types: cam-type, in which the sphericity of the femoral head is compromised and the offset of the femoral head and neck is reduced [4]; pincer-type - excessive coverage of the femoral head in a certain area, including local pincer deformation or total pincer deformation (coxa profunda) around the entire circumference; mixed type – a combination of both types of deformity [5].

Hip arthroscopy is a modern method of treating patients with FAI [6]. The outcome of surgical treatment of FAI depends on a number of factors [7], including the type of deformity. According to the literature, there is a decrease in treatment efficacy from cam-type to mixed-type and pincer-type [8]. However, the results of arthroscopic treatment of patients with cam-type FAI combined with borderline acetabular dysplasia are contradictory. Some authors note the high efficiency of this technique [9, 10], while others report a low degree of satisfaction and worse functional results of arthroscopic correction of FAI in these patients [11, 12].

Aims of the study: 1) to evaluate the influence of the type of hip deformity in patients with femoroacetabular impingement on the treatment outcome; 2) to identify the type of hip deformity that is optimal for arthroscopic correction; 3) to determine the influence of acetabular anatomy in borderline dysplasia on the treatment outcome.

METHODS

Study design

Type of the study: retrospective uncontrolled single-centered.

The study included patients with FAI confirmed by clinical and X-ray examinations who underwent hip arthroscopy between September 2014 and March 2022.

Exclusion criteria: patients with grade 2-3 osteoarthritis according to the classification of N.S. Kosinskaya, with osteonecrosis of the femoral head, Legg-Calvé-Perthes disease, primary chondromatosis, and aged over 50 years.

During physical examination of patients, provocation tests confirming the clinical manifestation of FAI were used: flexion, adduction, internal rotation (FADIR), flexion, abduction, external rotation (FABER), Thomas test. All patients had at least two positive tests out of three. The study took into account the age, body mass index (BMI), duration of symptoms before surgical treatment and follow-up period after surgery.

Plain pelvic X-ray in the standing position and pelvic X-ray in a modified Dunn 45° view with 40° external rotation of the femur were used as a radiological method of examination. In the plain pelvic X-ray, we measured the lateral center-edge angle in the Ogata modification (LCEA-O), the Tönnis angle, the angle α of the outer part of the femoral head, the height of the articular gap in the lateral (LS) and medial (MS) sides of the sclerosed part of the acetabulum. In patients with borderline dysplasia (LCEA-O<25°), the acetabular version was additionally evaluated. Using the modified Dunn 45° view, the angle α of the antero-superior aspect of the femoral head was measured. If the angle α did not exceed 42°, the femoral head/neck offset was additionally calculated. A decrease in offset of less than 0.17 confirmed the presence of a cam-deformity. Calculations and assessment of radiological parameters were carried out according to our method described earlier [13].

The study enrolled 121 patients: 49 (40.5%) women and 72 (59.5%) men. A total of 135 surgeries on hip joints were performed: 7 women and 7 men had both joints operated on.

Patients were divided into 4 groups according to the type of deformity. Group 1 included 33 (24.4%) joints with cam-type FAI, group 2 included 72 (53.4%) joints with mixed-type, group 3 included 17 (12.6%) joints with dysplasia (LCEA-O<25°) and cam-type head deformity, and group 4 included 13 (9.6%) joints with a combination of dysplasia, cam-type deformity, and acetabular retroversion.

Surgical technique

Arthroscopic correction of intra-articular deformities and injuries was performed by a single surgeon via standard approaches. Arthroscopic correction of cam-deformities was performed

without distraction of the joint. After distraction of the joint, if acetabular labrum damage was detected, the acetabular rim was refixed using anchor fixators after its modeling resection, the extent of which depended on the pattern of deformity. Minimal resection of the acetabular rim was performed in patients with borderline dysplasia when suturing the acetabular labrum. If the acetabular labrum and cartilage were superficially damaged, smoothing of the damaged areas with a shaver and arthroscopic coagulator was performed. Unstable areas of the acetabular rim cartilage were resected.

Localization, pattern, and extent of the acetabular labrum and cartilage damage were assessed during the surgery. The Outerbridge classification [14] was used to evaluate cartilage damage of the femoral head. Damage to the cartilage of the acetabulum was evaluated according to the classification of M. Beck et al. [15].

Postoperative management

All patients were ambulated the next day after the surgery with restriction of the axial load on the operated joint. It was recommended to use crutches with the load on the operated limb of 15-20% of body weight in the first 3 weeks after surgery, followed by a gradual increase and bringing the load to full within 2 weeks.

Outcomes assessment

The minimum follow-up period after surgery was 1 year. All patients completed the International Hip Outcome Tool-33 (iHOT-33) and Hip Outcome Score (HOS) scales before the surgery and then, starting from the first year after surgery, annually online in the Google forms. Data from the latest survey were used for analysis. Results range from 0 to 100, where higher scores correspond to better outcomes.

Statistical analysis

Database was created in the form of Excel tables. Statistical analysis was performed in Statistica 12 (StatSoft) X86 software for Windows.

The Shapiro-Wilk test was used to assess the normality of distribution. Analysis of variance (ANOVA) followed by post-hoc analysis was used to compare normally distributed variables between groups. The distribution of numerical variables of the iHOT-33 and HOS questionnaire scales differed from the normal distribution, so the Kruskal-Wallis test was used to evaluate quantitative parameters in four independent groups, followed by pairwise analysis using the Mann-Whitney U test. Considering the effect of multiple comparisons, the critical level of statistical significance p for these comparisons was assumed to be 0.0085 (1-0.951/6 = 0.0085 - taking into account six pairwise comparisons). The Wilcoxon's W-test was applied to compare the results of the questionnaire scales before and after treatment.

The level of statistical significance p in the study was assumed to be 0.05.

RESULTS

There was no statistically significant difference between the patient groups in terms of age, BMI, duration of symptoms, angle α, joint gap size before surgery and follow-up period after surgery (p>0.05) (Table 1).

Table 1

Characteristics of patients of all groups (M; SD)

Parameter	Group 1 (cam-type) (33 joints)	Group 2 (mixed-type) (72 joints)	Group 3 (dysplasia + cam-type) (17 joints)	Group 4 (dysplasia + retroversion + cam-type) (13 joints)
Age, years	32.3; 7.7	30.3; 7.4	39.9; 7.9	28.7; 4.9
BMI, kg/m^2	23.3; 4.4	23.7; 2.9	23.4; 3.6	23.0; 2.3
Duration of symptoms, months	33.3; 29	31.4; 29.6	33.9; 36.5	39.2; 39.9
Angle α AP*, deg.	58.2; 19.1	60.7; 19.1	55.5; 24.4	61.6; 20.5
Angle α Dunn, deg.	62.4; 12.1	63.1; 11.2	62.0; 15.4	62.4; 15.6
LS, mm	4.9; 0.7	4.8; 0.8	4.9; 1.0	4.7; 0.7
MS, mm	4.1; 0.9	4.3; 0.7	4.3; 0.8	4.8; 0.8
Follow-up duration, months	52.3; 22.1	44.7; 22.2	53.7; 25.8	58.1; 26.5

*AP — anterior-posterior setup.

Comparison of α LCEA-O angle and Tönnis angle showed a statistically significant difference between patients in groups 1 and 2 compared to groups 3 and 4 ($p<0.01$). No statistically significant difference was obtained when comparing groups 1 and 2 ($p=0.18$ for LCEA-O and $p=1.0$ for Tönnis angle), as well as between groups 3 and 4 ($p=1.0$ for LCEA-O and $p=0.34$ for Tönnis angle) (Table 2).

Table 3 shows the characteristics of the acetabular labrum and cartilage injuries detected during surgical treatment.

The incidence of articular labrum ($p = 0.81$), acetabular cartilage ($p = 0.33$), and femoral head ($p = 0.14$) injuries was similar in all groups. However, despite the lack of statistical difference, cartilage injuries were more common in patients with dysplasia than in the other groups.

Damage to the acetabular labrum and acetabular cartilage was more often detected in the anterosuperior regions (Figs. 1, 2). The incidence of lesions' distribution by the section of acetabulum in all groups had comparable values.

Table 2

Values of LCEA-O and Tönnis angle in groups, deg. (M; SD)

Parameter	Group 1 (cam-type) (33 joints)	Group 2 (mixed-type) (72 joints)	Group 3 (dysplasia + cam-type) (17 joints)	Group 4 (dysplasia + retroversion + cam-type) (13 joints)
LCEA-O	29.1; 3.5	30.7; 3.9	2.0; 1.9	21.8; 2.1
Tönnis angle	3.9; 2.7	4.0; 2.5	8.6; 4.1	10.6; 2.7

Table 3

Quantity of lesions, discovered intraoperatively, and procedures to acetabular labrum, n (%)

Parameter	Group 1 (cam-type) (33 joints)	Group 2 (mixed-type) (72 joints)	Group 3 (dysplasia + cam-type) (17 joints)	Group 4 (dysplasia + retroversion + cam-type) (13 joints)
Acetabular labrum lesion	29 (87.9)	67 (93.1)	15 (88.2)	12 (92.3)
Fixation of damaged parts of acetabular labrum	20 (60.6)	62 (86.1)	14 (82.3)	12 (92.3)
Resection of damaged parts of acetabular labrum	0	1 (1.4)	0	0
Resection of superficial lesions of acetabular labrum	9 (27.3)	4 (5.6)	1 (5.9)	0
Acetabular cartilage lesion	21 (63.6)	41 (56.9)	13 (76.5)	6 (46.2)
Superficial lesion (Beck grade 1)	4 (12.1)	11 (15.3)	3 (17.6)	0
Deep cartilage lesion (Beck grade 2 and 3)	14 (42.4)	25 (34.7)	9 (53)	4 (30.8)
Flap lesion and cartilage desquamation (Beck grade 4 and 5)	3 (9.1)	5 (6.9)	1 (5.9)	2 (15.4)
Femoral head cartilage lesion	5 (15.2)	4 (5.6)	3 (17.6)	3 (23.1)
Superficial lesion (Outerbridge grade 1 and 2)	4 (12.2)	4 (5.6)	3 (17.6)	2 (15.4)
Deep lesion (Outerbridge grade 3 and 4)	1 (3)	0	0	1 (7.7)

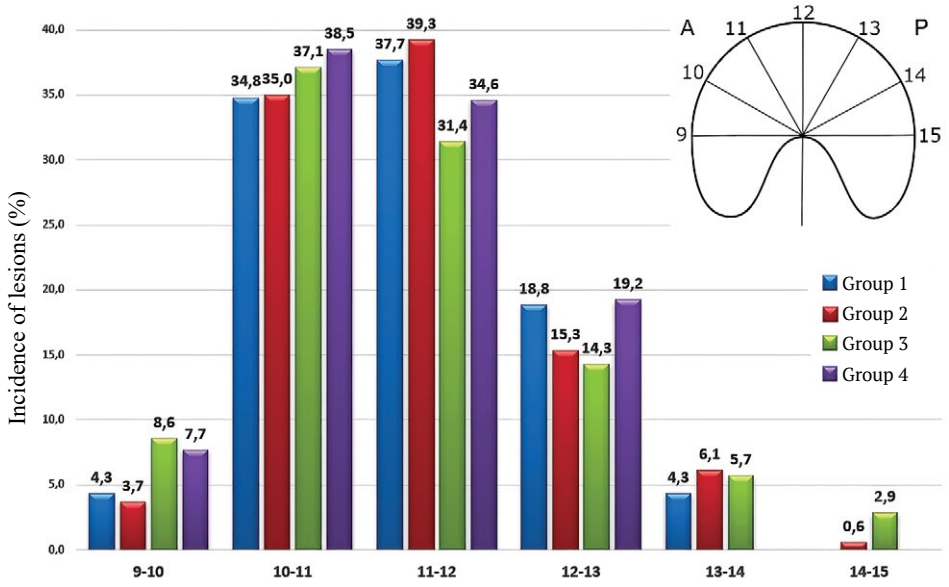

Fig. 1. Localization and incidence of acetabular labrum lesions determined by dividing the acetabulum according to the conventional dial, left-sided mark

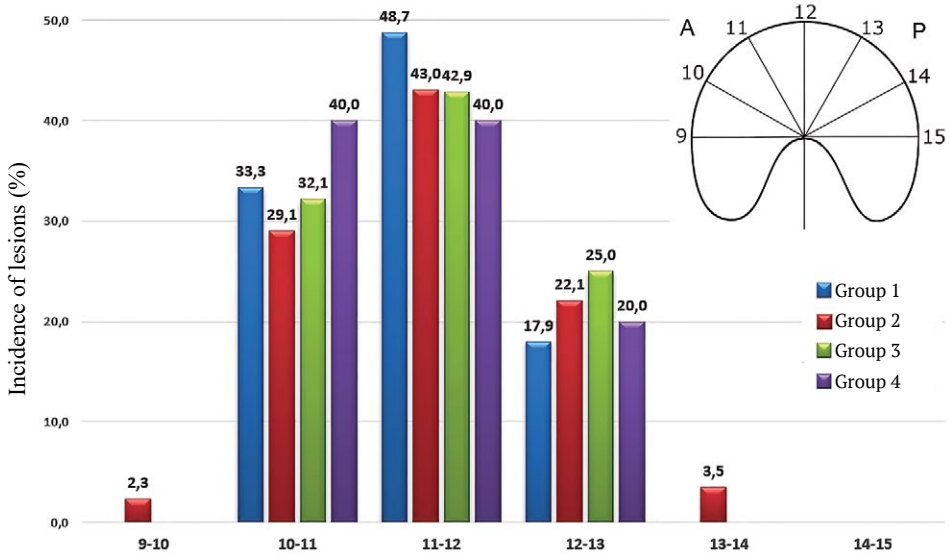

Fig. 2. Localization and incidence of acetabular cartilage lesions determined by dividing the acetabulum according to the conventional dial, left-sided mark

Neuropathy of the external cutaneous nerve was found in 18.5% (23 patients, 25 joints) of cases and of the pudendal nerve in 6.7% (9 patients) of cases. All these complications resolved spontaneously. There was no statistically significant difference in the incidence of complications between the groups ($p>0.05$). No infectious complications were observed in the operated patients.

The data of iHOT-33 and HOS questionnaires before surgery were not statistically different between groups ($p>0.05$). In the postoperative period, statistically significant improvement was achieved in all groups based on the scales used ($p<0.05$), except for the "Sport" section of the HOS questionnaire in group 3, where no statistically significant difference was found ($p=0.55$) (Table 4).

However, comparing treatment results between groups according to the scales used, considering the correction for multiple comparisons of the four groups, the best result was obtained in group 1, which was statistically significantly different from group 3 according to both questionnaires (Table 5). Treatment results of group 2 patients

did not differ statistically significantly from group 1 according to the HOS questionnaire, but differed according to the iHOT-33. Treatment results of group 4 were comparable with group 1 according to the iHOT-33 scale and with group 2 according to the HOS scale.

In group 3 patients, the HOS-Sport subscale showed a substantial clinical benefit (SCB) [16] in only 30%, while in the other groups it was at least in 58%. Other scales showed insignificant superiority of treatment results in groups 1 and 4 over groups 2 and 3 (Table 6).

All the patient groups showed a significant improvement in sports activity in the first years after surgery, but after 2 years, there was a tendency for its decrease in the patients of groups 2 and 3. The dynamics of changes in the results of treatment of patients with FAI based on the data of the HOS-Sport subscale in the average time from 1 to 7 years is presented in Figure 3.

Table 4

Pre- and postoperative iHOT-33 и HOS scores in groups (Me [Q25; Q75])

Parameter	Group 1 (cam-type) (33 joints)	Group 2 (mixed-type) (72 joints)	Group 3 (dysplasia + cam-type) (17 joints)	Group 4 (dysplasia + retroversion + cam-type) (13 joints)
iHOT-33 preop.	52.1 [36.7; 63.5]	55.8 [43.6; 70.6]	46 [41.5; 51.2]	54.4 [48.2; 59.1]
p-value	p<0.01	p<0.01	p<0.01	p<0.01
iHOT-33 postop.	91.8 [85.8; 98.5]	87 [72.5; 94.2]	75.5 [68.2; 86.9]	95.2 [86.3; 96]
HOS-ADL preop.	79.4 [67.6; 88.2]	79.4 [66.9; 86.8]	73.5 [69.1; 82.4]	75 [66.2; 82.4]
p-value	p<0.01	p<0.01	p<0.01	p<0.01
HOS-ADL postop.	98.5 [94.1; 100]	94.1 [89; 98.5]	89.7 [82.4; 95.6]	95.6 [86.8; 97.1]
HOS-Sport preop.	66.7 [50; 75]	55.6 [36.1; 72.2]	58.3 [44.4; 66.7]	52.8 [22.2; 66.7]
p-value	p<0.01	p<0.01	p = 0.55	p<0.01
HOS-Sport postop.	94.4 [83.3; 100]	80.6 [72.5; 94.2]	61.1 [38.9; 86.1]	86.1 [75; 88.9]

iHOT-33 — international Hip Outcome Tool-33; HOS-ADL — Hip Outcome Score-Activities of Daily Living; HOS-Sport — Hip Outcome Score-Sports-Specific Subscale.

Table 5

Comparison of results between groups (Me [Q25; Q75])

Parameter	Group 1 (cam-type) (33 joints)	Group 2 (mixed-type) (72 joints)	Group 3 (dysplasia + cam-type) (17 joints)	Group 4 (dysplasia + retroversion + cam-type) (13 joints)	p*-value		
					group 1 vs group 3	group 1 vs group 4	group 2 vs group 4
iHOT-33	52.1 [36.7; 63.5]	55.8 [43.6; 70.6]	46 [41.5; 51.2]	54.4 [48.2; 59.1]	p = 0.0004	p = 0.9029	p = 0.0737
p*-value	p = 0.0073	p = 0.0413	p = 0.0044				
HOS-ADL	79.4 [67.6; 88.2]	79.4 [66.9; 86.8]	73.5 [69.1; 82.4]	75 [66.2; 82.4]	p = 0.0057	p = 0.057	p = 0.927
p*-value	p = 0.0302	p = 0.0702	p = 0.3358				
HOS-Sport	66.7 [50; 75]	55.6 [36.1; 72.2]	58.3 [44.4; 66.7]	52.8 [22.2; 66.7]	p = 0.001	p = 0.0947	p = 0.8118
p*-value	p = 0.0247	p = 0.0115	p = 0.0364				

* Level of statistical significance p-value <0.0085.

Table 6

Frequency of minimal clinically important difference (MCID) and SCB achievement in groups, %

Scale	Group 1			Group 2			Group 3			Group 4		
	NCI	MCID	SCB	NCI	MCID	SCB	NCI	MCID	SCB	NCI	MCID	SCB
HOS-ADL	7.69	3.85	88.46	16.95	5.08	77.97	31.25	0.00	68.75	9.09	0.00	90.91
HOS -Sport	27.27	9.09	63.64	19.61	21.57	58.82	53.85	15.38	30.77	18.18	18.18	63.64
iHOT-33	0.00	10.34	89.66	16.67	23.33	60.00	25.00	12.50	62.50	0.00	16.67	83.33

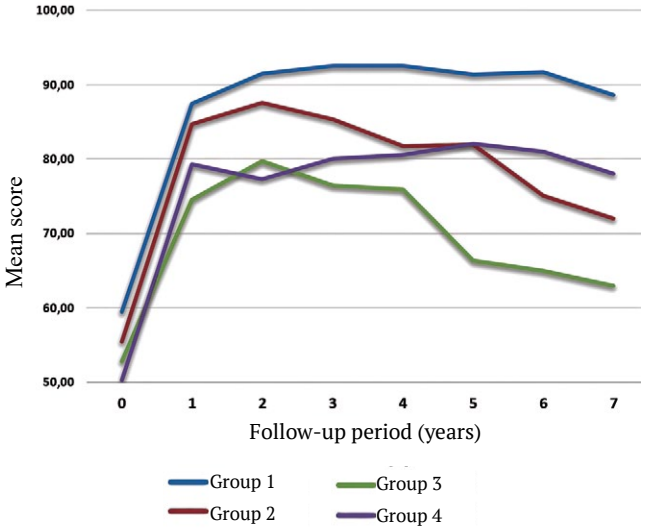

Fig. 3. Changes in treatment results of patients with FAI according to the HOS-Sport subscale

DISCUSSION

At the present moment of arthroscopic hip surgery development, the scientific community does not only actively search for the expansion of the possibilities of this method, but also thoroughly analyzes unsatisfactory results of treatment. Most authors mention as predictors of failure such factors as osteoarthritis preceding surgical treatment, decreased joint gap size in general or in the external region, discongruence of the articular surfaces, true acetabular dysplasia, and a significant increase in the angle α [17, 18, 19]. C. Kyin et al. pointed out an increase in age as one of the important predictors of FAI surgical treatment failure. Their statement was based on the analysis of 13 articles evaluating the results of arthroscopic treatment of 1571 joints [20]. Considering this fact, we excluded patients older than 50 years from our study.

The type of hip deformity also affects the treatment outcome. It is known that arthroscopic correction of cam-type FAI shows the best results, while mixed-type FAI is slightly behind in the treatment results. H.G. Said et al. analyzed the dependence of the results of arthroscopic treatment of FAI on its type based on the treatment of 90 hip joints and concluded that cam-type is more favorable compared to mixed-type [21]. We obtained similar results comparing the treatment efficacy of groups 1 and 2, which showed statistically significant improvement in group 1 according to the iHOT-33 questionnaire and marked, but not statistically significant, differences according to both HOS subscales compared to group 2.

Patients with a combination of FAI and borderline hip dysplasia are of particular interest, and the use of arthroscopy alone in these patients yields inconsistent results according to the literature [22]. Acetabular dysplasia has its own specific mechanism of biomechanics disturbance, which consists in the appearance of microinstability and decrease in the contact surface area, which increases the concentration of mechanical load on the anterosuperior part of the acetabulum [23]. These changes in load distribution lead to differences in the pattern of intra-articular injuries in patients with and without dysplasia. There was no statistically significant difference between all groups in the incidence of articular labrum, acetabular cartilage, and femoral head injuries, but acetabular cartilage injuries were more common in group 3. Similar data were obtained by I.K. Bolia et al. in 2018. Based on the analysis of arthroscopic treatment of 2429 patients, of which 305 were with borderline dysplasia, they found that with approximately the same frequency of

detection of deep acetabular cartilage lesions, the size of these lesions was larger in patients with borderline dysplasia than in patients with normal femoral head coverage [24].

The difference in results between patients in groups 3 and 4, with borderline dysplasia present in both groups, is particularly noteworthy. A statistically significant difference ($p = 0.0044$) between the groups was obtained according to the iHOT-33 questionnaire. Differences according to the HOS-Sport subscale ($p = 0.0364$) were statistically insignificant, but considering the data of the post-hoc analysis, it is possible to conclude that there were significant differences between the groups. No significant difference between the groups ($p = 0.335$) on the HOS-ADL subscale against the background of statistically significant improvement in the postoperative period in group 3 seems to indicate a satisfactory clinical outcome for everyday life. Overall, the treatment outcome of patients in group 4 was comparable to that of groups 1 and 2.

Presumably, the outcome of group 4 patients was favorably affected by better femoral head coverage of the anterior wall of the acetabulum due to retroversion. S. Chen et al. studied the correlation between the distribution of the contact mechanical load on the acetabulum and the anterior central edge angle (ACEA), which reflects the development of the anterior column. Authors have found, based on computer modeling of the acetabular structure of 9 patients with true and borderline dysplasia, that for the same value of the Wiberg angle (LCEA), with decreasing ACEA, there is a significant concentration of mechanical load in the anterosuperior region of the acetabulum [25]. Another group of authors led by J.C. Christensen, based on the analysis of 173 patient outcomes, found that older patients with borderline dysplasia and anterior wall deficiency have significantly worse iHOT-12 arthroscopic outcomes compared to other patient groups [11]. Due to the limitation of our study, we could not evaluate the significance of the femoral neck anteversion, but its value above 25° also shifts the mechanical load to the anterior acetabulum. E.O. Chaharbakhshi et al. analyzed the results of arthroscopic treatment of 12 hips with borderline dysplasia and excessive femoral neck anteversion. Authors concluded that these patients showed significantly worse scores on the mHHS, NAHS, and HOS-SSS scales and lower satisfaction with surgery compared to the control group, which included study subjects with normal head coverage and anteversion [26].

Despite the good two-year treatment outcome of patients with borderline dysplasia and weak anterior acetabular wall, we believe that in order to achieve a more stable result, we should consider periacetabular osteotomy rather than arthroscopy as a method of surgical treatment for these patients. Another option is simultaneous performance of periacetabular osteotomy and hip arthroscopy, which can be quite effective according to M.S. Lee et al. [27].

Limitations

Measurements and comparison of values of femoral neck anteversion and anterior center-edge angle (ACEA) were not performed due to the absence of X-ray in false profile and pelvis and knee computed tomography in preoperative examination protocol prior to conducting current study. Patients with pincer-type FAI were excluded from the study due to their small numbers.

CONCLUSIONS

The result of arthroscopic correction of FAI depends on many factors, including the type of deformity. The best results are achieved when correcting cam- and mixed-type FAI. The effectiveness of arthroscopy in patients with cam deformity and borderline dysplasia depends on the structure of the anterior acetabular wall. The worst outcome is observed in patients with borderline dysplasia without retroversion of the acetabulum. When treating this group of patients, isolated periacetabular osteotomy or in combination with arthroscopy may be preferable.

DISCLAIMERS

Author contribution

Bogopolskiy O.E. — data collection and processing, data analysis and interpretation, statistical analysis of results, writing the article.

Filonov P.V. — data collection and processing, data analysis and interpretation, drafting the article.

Tikhilov R.M. — study concept and design, drafting the article.

All authors have read and approved the final version of the manuscript of the article. All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the correctness and reliability of any part of the work.

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