Hip Arthroscopy for Femoroacetabular Impingement Syndrome Shows Good Outcomes and Low Revision Rates, With Young Age and Low Postoperative Pain Score Predicting Excellent 5-Year Outcomes

Hong-Jie Huang, M.D., Han-Han Dang, M.D., Mahmut Mamtimin, M.D., Gang Yang, M.D., Xin Zhang, M.D., and Jian-Quan Wang, M.D.

Purpose: To evaluate the clinical outcomes of hip arthroscopy for femoroacetabular impingement syndrome (FAIS) and their predictors at a minimum 5 years' follow-up. **Methods:** We retrospectively analyzed patients with FAIS after first-time unilateral hip arthroscopy between January 2010 and July 2016. Patient-reported outcomes (PROs) included the validated modified Harries Hip Score (mHHS) and Visual Analog Scale for Pain (Pain VAS). We included patients with Tönnis grade 0 or 1 and reported PROs, and excluded patients with previous hip diseases or bilateral symptoms. Bivariate and multivariate analyses were used for data analysis. **Results:** We included 159 patients with a mean follow-up of 6.4 years, aged 36.18 ± 8.61 years, 41.5% female, and a mean body mass index of 23.61 ± 3.45. The mean postoperative mHHS was 88.82 ± 11.60, and the mean Pain VAS was 1.93 ± 1.89, significantly better than before surgery ($P < .001$). Postoperative alpha angle ($P = .003$) and lateral center edge angle ($P < .001$) were significantly decreased. Most patients (83.7%) achieved clinically important improvement based on patient-acceptable symptom state and minimal clinically important difference (MCID). The overall revision surgery rate was 2.5%. There were no conversions to total hip arthroplasty. Bivariate analysis indicated that age ($P < .001$), preoperative mHHS ($P = .002$), and postoperative Pain VAS ($P < .001$) correlated with postoperative mHHS at a minimum 5 years' follow-up. Multivariate regression analysis of MCID showed that age ($P < .001$), preoperative PROs ($P < .01$ for both), and postoperative Pain VAS ($P < .001$) were significant outcome predictors. **Conclusion:** Patients with FAIS after first-time unilateral hip arthroscopy showed significant improvement in PROs at mid-term follow-up, with a low revision surgery rate. Young patients and those with low postoperative Pain VAS showed excellent outcomes at a minimum 5 years' follow-up. **Level of Evidence:** Level IV, retrospective case series.

From the Department of Sports Medicine, Peking University Third Hospital, Institute of Sports Medicine of Peking University, Beijing Key Laboratory of Sports Injuries (H-J.H., M.M., G.Y., X.Z., J-Q.W.), and the Peking University Health Science Center (H-H.D.), Beijing, China.

X.Z. and J-Q.W. contributed equally to this article.

The authors report the following potential conflicts of interest or sources of funding: Supported by the Natural Science Foundation of China (Grant Nos. 82072403, 81871761, 81902205), Beijing Municipal Natural Science Foundation (Grant No.7192221). Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received November 4, 2021; accepted March 18, 2022.

Address correspondence to Xin Zhang, M.D., 49 North Garden Rd, Haidian District Beijing 100191, P.R. China. E-mail: tozhangxin@sina.com; Jian-Quan Wang, M.D., 49 North Garden Rd, Haidian District Beijing 100191, P.R. China. E-mail: wjqsportsmed@163.com

© 2022 by the Arthroscopy Association of North America

0749-8063/211539/$36.00

https://doi.org/10.1016/j.arthro.2022.03.024

The impingement phenomenon between the femur head and acetabulum was first described by Ganz et al.[1] in 1991. Femoroacetabular impingement syndrome (FAIS) is a clinical disease of the hip joint with morphological abnormalities of the proximal femur and/or acetabular edge. Hip joint impingement during movement causes damage to the cartilage and acetabulum and can be accompanied by pain, reduced function, and osteoarthritis.[2-5] Kopec et al.[6] reported based on 500 participants a FAIS incidence of approximately 3% in Caucasians aged 20 to 49 years. However, Frank et al.[7] found a cam deformity rate of 37% and a pincer deformity rate of 67% in a systematic review of 2114 asymptomatic hips. A study in Japan found in older adults cam and pincer deformity incidences of 4.2%

and 20.3%, respectively.[8] Hale et al.[9] used a geographic database to identify FAIS incidence in 14- to 50-year-old people between 2000 and 2016. They found an overall incidence rate of 54.4 cases per 100,000 person-years. With the improving understanding of the disease, an increasing number of patients with FAIS is found.

Hip arthroscopy has become a more common and effective surgery for FAIS in recent years.[10-12] There has been a huge improvement in FAIS arthroscopic surgery, with high satisfaction and low revision surgery rates when performed in patients with appropriate indications.[13-17] Nevertheless, some patients had mild residual pain or limited function after the surgery.[14] In large-group studies with a 2-year follow-up, authors have demonstrated a higher functioning state than preoperative baseline.[18,19] Other studies have shown short-term trends of apparent improvement during medium- and long-term 5- or 10-year follow-up.[18,20] The study by Domb et al.[21] with a minimum 5-year follow-up showed that secondary arthroscopic surgery and conversion to total hip arthroplasty (THA) might be needed 2 years after surgery. Therefore data on long-term follow-up outcomes of hip arthroscopy for FAIS are still limited.[22] A literature review showed that many studies were based on a short-term follow-up,[17] whereas research on the clinical outcomes of patients with FAIS based on long-term follow-up was scarce.

This study aimed to evaluate the clinical outcomes of hip arthroscopy for FAIS and their predictors at a minimum 5-year follow-up. We hypothesized that the patients in this study would have favorable postoperative outcomes, and potential predictors of postoperative outcomes at mid-term follow-up could be found.

Methods

Patient Selection

Based on the inclusion and exclusion criteria, this study included 159 of the 194 patients who underwent unilateral hip arthroscopy for the first time from January 2010 to July 2016. The remaining 35 patients were lost to follow-up (Fig 1). The Ethics Committee at our institution approved the study. FAIS was confirmed based on (1) symptoms, clinical signs, radiographic findings (alpha angle > 55° for cam deformity and lateral center edge angle [LCEA] > 39° for pincer deformity)[23]; (2) positive response to intra-articular diprospan and lidocaine injection (i.e., significant relief of pain); (3) conservative treatment failure (physical therapy, activity modifications, oral anti-inflammatory drugs, and intra-articular cortisone injection). The inclusion criteria were (1) patients with FAIS following the above criteria who underwent unilateral hip arthroscopy for the first time; (2) Tönnis grade 0 or 1.[24] Patients were excluded if they had (1) bilateral symptoms, (2) acetabular or femoral fractures, (3) Legg-Calve-Perthes disease, (4) Ehlers-Danlos syndrome, or (5) neoplastic disease (pigmented villonodular synovitis).

Surgical Technique

Three senior surgeons performed all operations. After anesthesia was established, patients were placed on the hip traction bed. The affected hip was placed in traction to widen the hip joint space to about 1 cm. A guide needle puncture in the anterolateral approach was made under C-arm radiography. Mid-anterior portal and proximal mid-anterior portal were accessed with the arthroscope monitoring system. Most pathologies in the central compartment, including pincer deformity, labral injury, and chondral injury, could be treated. The labrum reconstruction, including repair, suture, and debridement, was recorded during surgery. After addressing the central compartment pathology, decompression of the cam deformity was performed using a 4.5-mm bur and confirmed by intraoperative fluoroscopy and dynamic examination. The capsule was routinely repaired at the end of the procedure.

Postoperative Rehabilitation

On the first day after the operation, the patients were required to rest in bed with the affected limb raised and walk without weightbearing. Passive activities were performed from the third day to the third week after surgery in all movement directions of the hip joint within the painless range (including flexion, adduction, abduction, extension, and external and internal rotations). The hip joint was passively flexed by no more than 90°. Quadriceps strength training was allowed from the second week, with a gradual increase in the angle of the passive activities. At postoperative week 4, the patients were allowed to walk with full weightbearing on the affected limb but with crutches. Patients could then gradually perform tolerable positive activities, assisted by other appropriate functional exercises, within the painless range (e.g., riding stationary bikes, planking) until normal function levels of the lower limb were recovered.

Data Collection

We collected data on basic variables, including age, sex, body mass index (BMI), and duration of symptoms (from appearance to operation). Lateral and anteroposterior radiographs and computed tomography scans were obtained on the affected hip of all patients before and after surgery. The Tönnis grade, LCEA, alpha angle, and joint space were measured. The alpha angle was assessed on frog-leg lateral radiographs, whereas the LCEA and joint space were assessed on the anteroposterior radiographs. All measurements were

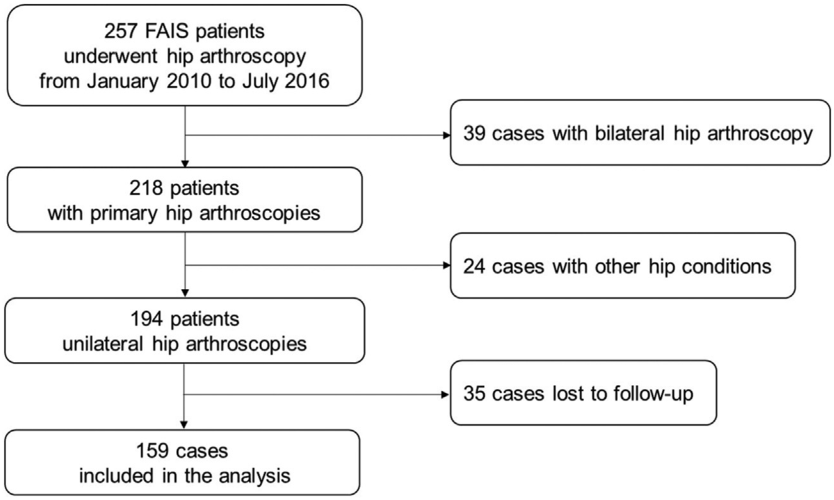

Fig 1. Patient Selection. The study analysis included 159 patients who met the inclusion criteria and complete data of at least five years of follow-up were available.

performed by a senior imaging technician and a hip arthroscopic surgeon. Patient-reported outcomes (PROs), including modified Harries Hip Score (mHHS) and Visual Analog Scale for Pain (Pain VAS), were collected by contacting the patients by messaging and telephone. These PROs were previously proved valid.[25,26] Pain VAS and mHHS were recorded on the day before the surgery and at the last follow-up assessment.

Statistical Analysis

We analyzed 13 factors potentially affecting the postoperative mHHS at a minimum 5 years' follow-up. The 2-tailed paired samples *t*-test compared preoperative to postoperative variables (LCEA, alpha angle, mHHS, Pain VAS). We used bivariate analysis and multivariate regression to identify predictors of clinical improvement. In the bivariate analysis, we assessed the relationship between each variable and postoperative mHHS. Categorical variables were compared by a 2-tailed independent samples *t*-test. The Spearman correlation coefficient was calculated for continuous variables. Stepwise multivariate regression was used. Statistical significance was set at $P < .05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY).

Results

Patient Characteristics

The study included 159 patients, of which 66 (41.5%) were female. The average follow-up time was 77.22 ± 14.5 (range, 60-123) months, and the duration of symptoms was 21.33 ± 24.9 (range, 1-204) months. Seventy-four patients (46.5%) underwent left hip surgery. The average age was 36.18 ± 8.61 (range, 15-60) years, and the average BMI was 23.61 ± 3.45 (range, 16.04-33.83). The patient characteristics are summarized in Table 1.

Radiographic Analysis

As shown in Table 1, the mean preoperative alpha angle was 61.13° ± 7.9° (range, 40.6°-89.7°), corrected after surgery to 41.6° ± 4.52° (range, 30.1°-55.5°; P =.003). Moreover, the mean LCEA was 32.28° ± 6.36° (range, 15.3°-48.5°) before surgery and 30.39° ± 5.82° (range, 13.2°-46.1°) after surgery (P <.001).

Table 1. Patient Characteristics

Variable	Data*
Age, y	36.18 ± 8.61 (15-60)
BMI	23.61 ± 3.45 (16.04-33.83)
Sex	
Female	66 (41.5%)
Male	93 (58.5%)
Side	
Left	74 (46.5%)
Right	85 (53.5%)
Tönnis grade	
Grade 0	61 (38.4%)
Grade 1	98 (61.6%)
FAIS type	
Cam	158 (99.4%)
Pincer	78 (49.1%)
Follow-up time, mo	77.22 ± 14.45 (60-123)
Duration of symptoms, mo	21.33 ± 24.9 (1-204)
Joint space, mm	4.7 ± 0.85 (2.46-7.41)
Preoperative	
Alpha angle	61.13° ± 7.90° (40.6°-89.7°)
Lateral center-edge angle	32.28° ± 6.36° (15.3°-48.5°)
Postoperative	
Alpha angle	41.6° ± 4.52° (30.1°-55.5°)
Lateral center-edge angle	30.39° ± 5.82° (13.2°-46.1°)

BMI, body mass index; FAIS, femoroacetabular impingement syndrome.

*Values are presented as mean ± standard deviation (range) or n (%).

Table 2a. Comparison of Preoperative and Postoperative Patient-Reported Outcomes for All Patients

PRO*	Preoperative	Postoperative	*P*-value†
mHHS	62.55 ± 11.00	88.82 ± 11.60	<0.001
Pain VAS	6.21 ± 1.82	1.93 ± 1.89	<0.001

mHHS, modified Harries Hip Score; Pain VAS, Visual Analog Scale for Pain.

*Values are expressed as mean ± standard deviation.

†Paired-samples *t*-test. The *P*-values are for comparisons between the preoperative scores and those at a minimum of 5 years after surgery.

Patient-Reported Outcomes

The mHHS and Pain VAS were the only PROs used in early cases at our institution. Both showed significant differences between the preoperative and postoperative scores (Table 2a). The mHHS improved from 62.55 (range, 32-92) before surgery to 88.82 (range, 52-100) after surgery ($P < .001$). The Pain VAS decreased from 6.21 (range, 2-10) before surgery to 1.93 (range, 0-8) after surgery ($P < .001$; Fig 2). Furthermore, we assessed the postoperative mHHS based on clinically important improvements using the patient-acceptable symptom state (PASS)[27,28] and minimal clinically important difference (MCID).[27,29] It was shown that the PASS value for mHHS in arthroscopic surgery was 74.[29] The proportion of patients in our study who achieved the PASS and MCID thresholds are presented in Table 2b. At a minimum 5 years' follow-up, 83.7% of the patients achieved both thresholds.

Bivariate and Multivariate Analyses

The bivariate analysis results for categorical and continuous variables are shown in Tables 3a and 3b. Sex and labrum treatment were not associated with postoperative mHHS. Among the 11 continuous variables, 3 were associated with superior postoperative mHHS. These included young age at the time of surgery, high preoperative mHHS, and low postoperative Pain VAS. We used the MCID of mHHS as a dependent variable for the multivariate regression analysis, the outcomes of which are shown in Tables 4a and 4b. Age and VAS Pain ($P < 0.001$ for both) were negatively correlated with postoperative mHHS and MCID of mHHS.

Revision and THA

Four patients underwent a second operation during the minimum 5-year follow-up, representing an overall revision surgery rate of 2.5%. There were no conversions to THA.

Discussion

This study has demonstrated promising clinical outcomes in patients with FAIS after hip arthroscopy at a minimum 5 years' follow-up. Young age and low postoperative Pain VAS were the most important predictors of good clinical outcomes in this cohort.

At a minimum 5-year follow-up, paired-samples *t*-testing indicated significant decreases in alpha angle and LCEA on postoperative imaging and improvements in both mHHS and Pain VAS. The rates of overall revision surgery and conversion to THA in our study were 2.5% and 0%, respectively, acceptable rates based on previous studies.[30,31] A meta-analysis involving 6134 patients found rates of 6.3% and 2.9% for revision surgery and conversion to THA, respectively.[30] The systematic review by Kyin et al.[31] found considerable variability in the rates of overall revision surgery and conversion to THA at the 5-year time points, ranging between 0.0%-17.4% and 3.0%-17.9%, respectively.

We used bivariate analysis and multivariate regression to identify predictors of clinical improvement after hip arthroscopy in patients with FAIS at a minimum 5 years' follow-up. As mentioned above, bivariate correlation analysis was performed to determine the relationship between individual variables and the postoperative mHHS scores, whereas multivariate analysis identified significant predictors of clinically meaningful outcomes at a minimum of five years after the surgery. Older adults (>45), higher BMI (>32.0), longer duration of symptoms, lower joint space (<2 mm), and lower preoperative mHHS had all been correlated with poor prognosis and outcomes in previous studies.[17,32] We intended to investigate whether

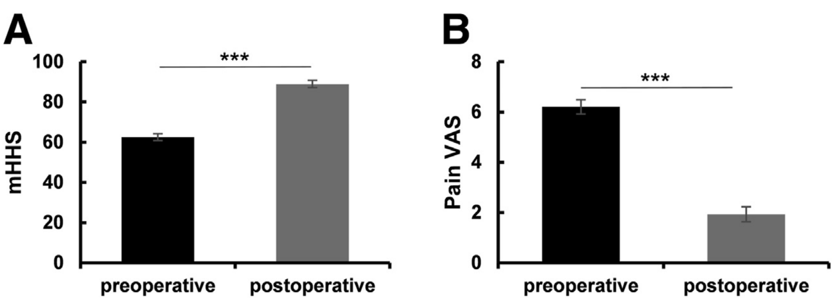

Fig 2. Preoperative and postoperative PROs (**A**, mHHS; **B**, Pain VAS) for patients with FAIS who underwent hip arthroscopic surgery. The *error bars* represent 95% confidence intervals. ***$P < 0.001$.

Table 2b. Proportion of Patients Achieving the PASS and MCID Thresholds Based on mHHS ($n = 159$)

	Postoperative mHHS*	Threshold	Patients Achieved, n (%)
PASS	88.82 ± 11.60	74	139 (87.4%)
MCID	26.27 ± 13.87	8.2	144 (90.6%)
Both			133 (83.7%)

MCID, minimal clinically important difference; mHHS, modified Harries Hip Score; PASS, patient-acceptable symptom state.

*Values are expressed as mean ± standard deviation.

these factors could predict the clinical outcomes at a minimum 5 years' follow-up. The bivariate analysis showed that age and postoperative Pain VAS were negatively associated and preoperative mHHS was positively associated with postoperative mHHS (Table 3b). Multivariate analysis showed that age and postoperative Pain VAS were significant predictors of mHHS and MCID of mHHS at a minimum 5 years' follow-up, whereas BMI, duration of symptoms, and joint space were not (Tables 4a and 4b). The multivariate regression results indicated higher sensitivity for MCID than mHHS. This suggested that MCID might have greater clinical relevance. We found that age might be particularly important in predicting hip arthroscopic prognosis at a minimum 5 years' follow-up. Age as a predictor is consistent with many previous studies.[13,17] Furthermore, our study indicated that postoperative clinical outcomes for patients older than 30 years could be worse than for younger patients. Similarly, Frank et al.[33] concluded that patients older than 45 years performed worse than younger patients.

Our analysis found that BMI was not associated with postoperative outcomes, inconsistent with previous studies. Domb et al.[17] showed that the postoperative mHHS scores of patients with a BMI > 32.0 were inferior to those with lower BMI. In a matched-pair study, both obese (BMI > 30.0) and nonobese patients showed overall improvement in PROs, but obese patients had significantly lower scores 2 years after surgery.[34] Furthermore, the study indicated that obese patients faced a higher risk of revision surgery and conversion to THA. Only 7 of our patients were with BMI > 30.0, and the postoperative mHHS scores of all exceeded the PASS threshold. Parvaresh et al.[35] performed matched-pair analysis of 4 BMI groups, noting that, except the morbidly obese patients (BMI > 35.0) who only showed improvement in pain, patients in the higher BMI groups (BMI = 25.0-34.9) showed significant improvements in pain and function at the 5-year follow-up. Therefore BMI might not be a suitable predictor but requires further research.

The duration of symptoms and joint space were insignificant predictors in our study. Previous studies have shown that a narrow joint space (≤2 mm) predicted inferior outcomes at a minimum 5 years' follow-up.[17,36] The joint space in our cohort ranged between 2.46 and 7.41 mm, resulting in good outcomes. Aprato et al.[37] investigated the duration of symptoms, showing that it could be an important outcome predictor. Dierckman et al.[38] found a significantly negative association between the duration of symptoms and mHHS 2 years after surgery. However, a 5-year analysis by Domb et al.[17] found that the duration of symptoms was an insignificant predictor. We think that our results are valuable for guiding our patients because most tended to endure the disease to continue with their lives rather than immediately seek active treatment. Although this predictive factor may not be applicable in long-term follow-up, it may be appropriate as a predictor of short-term postoperative outcomes.

Our study included 17 patients with LCEA of under 25°, of which in one it was as low as 15°. Such patients with FAIS were infrequently treated by arthroscopy in many series. We found for this group of patients an average postoperative mHHS of 91.41 ± 11.20 (range, 64-100), with 15 of them (88.24%) having reached the PASS threshold and all having reached the MCID threshold. Most studies defined borderline developmental dysplasia of the hip (BDDH) as an LCEA of 18°-25° or 20°-25°.[39,40] Wyatt et al.[40] thought that this category was outdated. Defining BDDH based on static radiographs is difficult because it is partially a dynamic process. One study found no difference in mHHS at least 1 year after hip arthroscopy between patients with BDDH (n = 77) and those with developmental dysplasia of the hip (LCEA <20°; n = 83).[41] Many studies described a significant increase in the PROs 2 years after arthroscopic hip surgery for FAIS in patients with BDDH.[42-44] Therefore more high-level, long-term evidence is needed to prove that arthroscopic surgery is

Table 3a. Bivariate Analysis of the Association of Categorical Variables with mHHS at Least 5 Years After Surgery

Variable	Category	Sample Size	Mean Postoperative mHHS	*P* Value
Sex				.198
	Male	93	89.82	
	Female	66	87.41	
Treatment of labrum				
	Repaired and sutured	124	88.36	.354
	Debridement	35	90.43	

Table 3b. Bivariate Analysis of the Association of Continuous Variables with mHHS at Least 5 Years After Surgery

Variable	Spearman Correlation	*P* Value
Age at surgery	−0.265	**.001**
BMI	0.053	.508
Joint space	−0.052	.513
Duration of symptoms	−0.068	.401
Preoperative		
mHHS	0.247	**.002**
Pain VAS	0.048	.547
Alpha angle	0.009	.905
LCEA	−0.035	.660
Postoperative		
Pain VAS	−0.752	**<.001**
Alpha angle	0.034	.673
LCEA	0.016	.841

BMI, body mass index; mHHS, modified Harries Hip Score; LCEA, lateral center edge angle; Pain VAS, Visual Analog Scale for Pain.

favorable for patients with BDDH. It is believed that these patients will achieve optimal outcomes when correctly diagnosed and receiving comprehensive individualized treatment.[45]

Limitations

Our study had several limitations. First, we only used mHHS and Pain VAS as PROs during our early hip arthroscopy development stage. These PROs could not evaluate the patients' motor function. The patients' motor function should be further studied during long-term follow-up, using Hip Outcome Score (HOS)-Activities of Daily Living (HOS-ADL), HOS-Sports Scale (HOS-SS), and the short version of the International Hip Outcome Tool (iHOT-12) currently used at our institution to assess the prognosis. Second, low-volume surgeons could be a limitation; therefore the results should be viewed with caution. It is worth noting that Domb et al.[17] reported favorable outcomes in a larger series with a minimum 5-year follow-up. We plan to conduct further studies with larger sample size. Third, we did not perform reconstructions, an effective procedure for older patients.[46] In the early days, we treated relatively young patients with repair or debridement. As the technology matures, we will explore reconstruction procedures further. Fourth, many patients were excluded from the study because of loss to follow-up. This may have affected the applicability of the results. Fifth, we had no radiographic follow-up data. We hope that more studies on this aspect will be done in the future.

Table 4a. Multivariate Logistic Regression Results for Predicting mHHS At Least 5 Years After Surgery

Variable	Rate	*P* Value
Age at surgery	−0.217	**<.001**
BMI	0.020	.698
Joint space	−0.027	.618
Duration of symptoms	0.026	.608
Preoperative mHHS	0.080	.133
Preoperative Pain VAS	0.086	.091
Postoperative Pain VAS	−0.737	**<.001**

BMI, body mass index; mHHS, modified Harries Hip Score; Pain VAS, Visual Analog Scale for Pain.

Table 4b. Multivariate Regression Results for Predicting MCID for mHHS at Least 5 Years After Surgery

Variable	Rate	*P* Value
Age at surgery	−0.208	**<.001**
BMI	0.005	.902
Joint space	−0.037	.402
Duration of symptoms	0.034	.423
Preoperative mHHS	−0.662	**<.001**
Preoperative Pain VAS	0.132	**.006**
Postoperative Pain VAS	−0.596	**<.001**

BMI, body mass index; mHHS, modified Harries Hip Score; Pain VAS, Visual Analog Scale for Pain.

Conclusion

Patients with FAIS following first-time unilateral hip arthroscopy showed significant improvement in PROs at a mid-term follow-up, with a low revision surgery rate. Young patients and those with low postoperative Pain VAS showed excellent outcomes at a minimum 5 years' follow-up.

Acknowledgments

Thanks to all the participating authors. They all have contributed a lot to this article. We thank Zhao Qiang, a senior imaging technician, for help with the imaging data.

References

1. Ganz R, Bamert P, Hausner P, Isler B, Vrevc F. Cervico-acetabular impingement after femoral neck fracture [in German]. *Unfallchirurg* 1991;94:172-175.
2. Beck M, Kalhor M, Leunig M, Ganz R. Hip morphology influences the pattern of damage to the acetabular cartilage: Femoroacetabular impingement as a cause of early osteoarthritis of the hip. *J Bone Joint Surg Br* 2005;87: 1012-1018.
3. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H, Siebenrock KA. Femoroacetabular impingement: A cause for osteoarthritis of the hip. *Clin Orthop Relat Res* 2003;417: 112-120.
4. Reynolds D, Lucas J, Klaue K. Retroversion of the acetabulum. A cause of hip pain. *J Bone Joint Surg Br* 1999;81: 281-288.
5. Lieberman EG, Pascual-Garrido C, Abu-Amer W, Nepple JJ, Shoenecker PL, Clohisy JC. Patients with symptomatic sequelae of slipped capital femoral epiphysis have advanced cartilage wear at the time of surgical intervention. *J Pediatr Orthop* 2021;41:e398-e403.

6. Kopec JA, Hong Q, Wong H, et al. Prevalence of femoroacetabular impingement syndrome among young and middle-aged white adults. *J Rheumatol* 2020;47:1440-1445.
7. Frank JM, Harris JD, Erickson BJ, et al. Prevalence of femoroacetabular impingement imaging findings in asymptomatic volunteers: A systematic review. *Arthroscopy* 2015;31:1199-1204.
8. Hasegawa M, Morikawa M, Seaman M, Cheng VK, Sudo A. Population-based prevalence of femoroacetabular impingement in Japan. *Mod Rheumatol* 2021;31:899-903.
9. Hale RF, Melugin HP, Zhou J, et al. Incidence of femoroacetabular impingement and surgical management trends over time. *Am J Sports Med* 2021;49:35-41.
10. Colvin AC, Harrast J, Harner C. Trends in hip arthroscopy. *J Bone Joint Surg Am* 2012;94:e23.
11. Kremers HM, Schilz SR, Van Houten HK, et al. Trends in utilization and outcomes of hip arthroscopy in the United States between 2005 and 2013. *J Arthroplasty* 2017;32:750-755.
12. Zhang D, Chen L, Wang G. Hip arthroscopy versus open surgical dislocation for femoroacetabular impingement: A systematic review and meta-analysis. *Medicine (Baltimore)* 2016;95:e5122.
13. Domb BG, Martin TJ, Gui C, Chandrasekaran S, Suarez-Ahedo C, Lodhia P. Predictors of clinical outcomes after hip arthroscopy: A prospective analysis of 1038 patients with 2-year follow-up. *Am J Sports Med* 2018;46:1324-1330.
14. Kierkegaard S, Langeskov-Christensen M, Lund B, et al. Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: A systematic review with meta-analysis. *Brit J Sport Med* 2017;51:572-579.
15. Hartwell MJ, Morgan AM, Nelson PA, et al. Isolated acetabuloplasty for femoroacetabular impingement: Favorable patient-reported outcomes and sustained survivorship at minimum 5-year follow-up. *Arthroscopy* 2021;37:3288-3294.
16. U NB, C BE, N KK, Jorge C, Jonathan R, J NS. Defining the clinically meaningful outcomes for arthroscopic treatment of femoroacetabular impingement syndrome at minimum 5-year follow-up. *Am J Sports Med* 2020;48:901-907.
17. Domb BG, Chen SL, Go CC, et al. Predictors of clinical outcomes after hip arthroscopy: 5-year follow-up analysis of 1038 patients. *Am J Sports Med* 2021;49:112-120.
18. Akpinar B, Lin LJ, Bloom DA, Youm T. Hip arthroscopy for femoroacetabular impingement: 1-Year outcomes predict 5-year outcomes. *Am J Sports Med* 2021;49:104-111.
19. Stone AV, Beck EC, Malloy P, et al. Preoperative predictors of achieving clinically significant athletic functional status after hip arthroscopy for femoroacetabular impingement at minimum 2-year follow-up. *Arthroscopy* 2019;35:3049-3056.
20. Domb BG, Chaharbakhshi EO, Rybalko D, Close MR, Litrenta J, Perets I. Outcomes of hip arthroscopic surgery in patients with Tönnis grade 1 osteoarthritis at a minimum 5-year follow-up: A matched-pair comparison with a Tönnis grade 0 control group. *Am J Sports Med* 2017;45:2294-2302.
21. Domb BG, Yuen LC, Ortiz-Declet V, Litrenta J, Perets I, Chen AW. Arthroscopic labral base repair in the hip: 5-year minimum clinical outcomes. *Am J Sports Med* 2017;45:2882-2890.
22. Chambers CC, Zhang AL. Outcomes for surgical treatment of femoroacetabular impingement in adults. *Curr Rev Musculoskelet Med* 2019;12:271-280.
23. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): An international consensus statement. *Br J Sports Med* 2016;50:1169-1176.
24. Tonnis D. Normal values of the hip joint for the evaluation of X-rays in children and adults. *Clin Orthop Relat Res* 1976:39-47.
25. Nguyen TQ, Friedman JM, Flores SE, Zhang AL. Fast starters and slow starters after hip arthroscopy for femoroacetabular impingement: Correlation of early postoperative pain and 2-year outcomes. *Am J Sports Med* 2020;48:2903-2909.
26. Chahla J, Beck EC, Nwachukwu BU, Alter T, Harris JD, Nho SJ. Is there an association between preoperative expectations and patient-reported outcome after hip arthroscopy for femoroacetabular impingement syndrome? *Arthroscopy* 2019;35:3250-3258.
27. Shanxing Z, Chenhui D, Zhongli L, et al. Endoscopic iliotibial band release during hip arthroscopy for femoroacetabular impingement syndrome and external snapping hip had better patient-reported outcomes: A retrospective comparative study. *Arthroscopy* 2021;37:1845-1852.
28. Jaskarndip C, S VTG, C MR, et al. The patient acceptable symptomatic state for the modified Harris Hip Score and Hip Outcome Score among patients undergoing surgical treatment for femoroacetabular impingement. *Am J Sports Med* 2015;43:1844-1849.
29. Harris JD, Brand JC, Cote MP, Faucett SC, Dhawan A. Research pearls: The significance of statistics and perils of pooling. Part 1: Clinical versus statistical significance. *Arthroscopy* 2017;33:1102-1112.
30. Harris JD, McCormick FM, Abrams GD, et al. Complications and reoperations during and after hip arthroscopy: A systematic review of 92 studies and more than 6,000 patients. *Arthroscopy* 2013;29:589-595.
31. Kyin C, Maldonado DR, Go CC, Shapira J, Lall AC, Domb BG. Mid- to long-term outcomes of hip arthroscopy: A systematic review. *Arthroscopy* 2021;37:1011-1025.
32. Sogbein OA, Shah A, Kay J, et al. Predictors of outcomes after hip arthroscopic surgery for femoroacetabular impingement: A systematic review. *Orthop J Sports Med* 2019;7:2325967119848982.
33. Frank RM, Lee S, Bush-Joseph CA, Salata MJ, Mather RC 3rd, Nho SJ. Outcomes for hip arthroscopy according to sex and age: A comparative matched-group analysis. *J Bone Joint Surg Am* 2016;98:797-804.
34. Asheesh G, M RJ, E HJ, E SC, G DB. Does obesity affect outcomes in hip arthroscopy? A matched-pair controlled study with minimum 2-year follow-up. *Am J Sports Med* 2015;43:965-971.
35. Parvaresh K, Rasio JP, Wichman D, Chahla J, Nho SJ. The influence of body mass index on outcomes after hip

arthroscopy for femoroacetabular impingement syndrome: Five-year results in 140 patients. *Am J Sports Med* 2021;49:90-96.
36. Skendzel JG, Philippon MJ, Briggs KK, Goljan P. The effect of joint space on midterm outcomes after arthroscopic hip surgery for femoroacetabular impingement. *Am J Sports Med* 2014;42:1127-1133.
37. Aprato A, Jayasekera N, Villar R. Timing in hip arthroscopy: Does surgical timing change clinical results? *International Orthopaedics* 2012;36:2231-2234.
38. Dierckman BD, Ni J, Hohn EA, Domb BG. Does duration of symptoms affect clinical outcome after hip arthroscopy for labral tears? Analysis of prospectively collected outcomes with minimum 2-year follow-up. *J Hip Preserv Surg* 2017;4:308-317.
39. Kuroda Y, Saito M, Kumar KHS, Malviya A, Khanduja V. Hip arthroscopy and borderline developmental dysplasia of the hip: A systematic review. *Arthroscopy* 2020;36:2550-2567.
40. Wyatt M, Weidner J, Pfluger D, Beck M. The femoro-epiphyseal acetabular roof (FEAR) index: A new measurement associated with instability in borderline hip dysplasia? *Clin Orthop Relat Res* 2017;475:861-869.
41. Byrd JW, Jones KS. Hip arthroscopy in the presence of dysplasia. *Arthroscopy* 2003;19:1055-1060.
42. Beck EC, Nwachukwu BU, Chahla J, et al. Patients with borderline hip dysplasia achieve clinically significant outcome after arthroscopic femoroacetabular impingement surgery: A case-control study with minimum 2-year follow-up. *Am J Sports Med* 2019;47:2636-2645.
43. Cvetanovich GL, Levy DM, Weber AE, et al. Do patients with borderline dysplasia have inferior outcomes after hip arthroscopic surgery for femoroacetabular impingement compared with patients with normal acetabular coverage? *Am J Sports Med* 2017;45:2116-2124.
44. Evans PT, Redmond JM, Hammarstedt JE, Liu Y, Chaharbakhshi EO, Domb BG. Arthroscopic treatment of hip pain in adolescent patients with borderline dysplasia of the hip: Minimum 2-year follow-up. *Arthroscopy* 2017;33:1530-1536.
45. Ding Z, Chen J. Editorial commentary: arthroscopy for borderline developmental dysplasia of the hip: Selection determines the outcomes. *Arthroscopy* 2020;36:2568-2571.
46. White BJ, Patterson J, Scoles AM, Lilo AT, Herzog MM. Hip arthroscopy in patients aged 40 years and older: Greater success with labral reconstruction compared with labral repair. *Arthroscopy* 2020;36:2137-2144.