CLINICAL ARTICLE

Outcomes in Patients with Global Pincer Versus Focal Pincer Femoroacetabular Impingement Treated with Hip Arthroscopy: A Retrospective Study with a Minimum 2-Year Follow-Up

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Objective: Global pincer is a relatively rare form of pincer deformity and is typically associated with technical challenges during surgery. So far, controversy remains whether patients with global pincer have equivalent surgical outcomes compared to patients with focal pincer. This study compares the clinical outcomes of arthroscopic treatment between patients with global pincer femoroacetabular impingement (FAI) and focal pincer FAI in the Chinese population.

Methods: Data were retrospectively collected from patients with global and focal pincer FAI who underwent hip arthroscopy with a minimum two-year follow-up between April 2016 and December 2018. Radiographic measurements, arthroscopic procedures, preoperative and postoperative patient-reported outcomes (PROs) including modified Harris hip score (mHHS), hip outcome score-activities of daily living (HOS-ADL), international hip outcome tool–12 (iHOT-12), and visual analogue scale (VAS) scores, rates of revision surgery and conversion to total hip arthroplasty (THA) were recorded. Achievement of minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) was compared for the VAS, mHHS, HOS-ADL, and iHOT-12 scores between groups.

Results: The total of 33 and 167 patients were included in the global and focal group, respectively. There were no intergroup differences in age, gender, body mass index or follow-up times. Lateral center-edge angle (LCEA) was reduced in both groups postoperatively. Both groups demonstrated significant improvements in PROs compared with preoperative levels at the final follow-up. The preoperative scores showed significant differences in terms of mHHS (60.34 *vs* 62.90, $P = 0.031$) and HOS-ADL (61.45 *vs* 64.74, $P = 0.022$) scores between two groups, and the improvement of HOS-ADL score was significantly higher in global group ($P = 0.027$). However, the postoperative scores, including VAS, mHHS, HOS-ADL, and iHOT-12 scores, showed no significant differences between two groups. And there were no significant differences in the rate of meeting the PASS and MCID between groups. One (3.0%) in the global group and six (3.6%) patients in the focal group underwent revision arthroscopy respectively, with no significant difference ($P = 0.876$). There were no conversions to THA in both groups.

Conclusions: Arthroscopic management of global pincer FAI can achieve excellent functional scores at minimum 2-year follow-up. The outcomes were similar to focal pincer FAI patients with a low rate of secondary procedure.

Key words: Femoroacetabular impingement; Focal pincer; Global pincer; Hip arthroscopy

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Introduction

Femoroacetabular impingement (FAI) has been recognized as a potential cause for hip pain and functional limitation in young active adults in recent years. The osseous deformities would cause abnormal contact between the proximal femur and acetabulum during terminal motion of the hip[1] and thus damage acetabular labrum and adjacent articular cartilage of the hip with early development of hip osteoarthritis.[2] Three types of FAI have been identified: cam deformity, pincer deformity, and combined.[3,4] Pincer-type FAI can be further categorized into global pincer and focal pincer type. Global pincer type has more generalized and extreme acetabular overcoverage compared with the focal pincer type.[5] Typically, the radiography reveals an acetabulum with a lateral center edge angle (LCEA) greater than 40° with a concomitant acetabular protrusion or coxa profunda.[6,7] Focal type is much more common than the global type, and radiography often shows a LCEA between 25° and 40°, with the presence of crossover sign or ischial spine sign.[8,9]

While focal pincer FAI can be treated with arthroscopic techniques effectively, global pincer FAI once required open surgery due to the technical difficulties of joint distraction, decreased access to the central compartment, and insufficient access to the posterior acetabulum.[10] Nevertheless, with the development of arthroscopic instrumentation and techniques, studies in recent years have shown that patients with global pincer FAI can be treated arthroscopically with satisfactory outcomes.[11] However, controversy remains whether the patients with global pincer have equivalent outcomes compared with patients with focal pincer.[12,13] Also, there was no study in the current English literature that compared the clinical outcomes between global and focal pincer FAI in the Chinese population. Therefore, the purpose of this study is to: (i) compare the patient-reported outcomes (PROs) between the global and focal pincer FAI: and (ii) compare the rates of revision hip surgery and conversion to total hip arthroplasty (THA) between the global and focal pincer FAI in the Chinese population. Our hypothesis was that global pincer FAI patients would gain similar clinical outcomes compared with focal pincer FAI patients after arthroscopic surgery at a minimum of two-year follow-ups.

Methods

Patient Selection

This study was approved by the Peking University Third Hospital institutional review board (M2019193). Data were retrospectively collected from April 2016 to December 2018. Inclusion criteria in the study were: (i) diagnosed with FAI and underwent unilateral hip arthroscopy without other hip conditions; (ii) had a LCEA of ≥40° for global cohort (Fig. 1A) or had an LCEA of 25°–40° with crossover sign or ischial spine sign for focal cohort (Fig. 1B) on anteroposterior radiography; and (iii) had minimum two-year follow-up of outcome scores. Patients were excluded if they had: (i) previous hip conditions or rheumatoid conditions; (ii) pervious surgery in the operated hip; and (iii) moderate-to-advanced osteoarthritis (Tönnis grade ≥2). (Fig. 2).

The diagnosis of FAI syndrome was made based on symptom, physical examination, and radiology. The symptoms included pain in groin, greater trochanter and buttock that was exacerbated with activity, painful clicking or locking during hip movement. Physical examination typically presented positive anterior impingement test or positive flexion abduction external rotation (FABER) provocation test. If FAI syndrome was suspected, the patients would undergo anteroposterior pelvis view, 45° Dunn view and false profile view radiography, three-dimensional CT and unilateral hip MRI to confirm the pathology.

Surgical Technique

All hip arthroscopies were performed by three senior authors (Xiao-Dong Ju, Yan Xu, and Yan Xu). After anesthesia, the patient was placed in modified supine position with a standard hip traction (Smith & Nephew, Memphis, TN, USA). Three standard portals were used: anterolateral (AL) portal, mid-anterior portal (MAP), and proximal mid-anterior portal (PMAP). Most pathologies in the central compartment, including pincer deformity, labral injury, and cartilage injury, could be treated with AL portal and MAP. Superolateral and anterior acetabuloplasty was performed in both groups, and a more extensive acetabuloplasty was performed in the global group (Fig. 3A, B). The aim for the global group was to reduce the LCEA to its normal range (approximately 35°), whereas the goal for the focal group was the eradication of crossover sign which was confirmed by intraoperative fluoroscopy. The labrum lesions were treated with debridement, repair, or reconstruction with autograft, depending on the size and available labral tissue for repair. Cartilage injury was treated with chondroplasty or microfracture. After addressing pathology in the central compartment, the arthroscope was then introduced into the peripheral compartment for osteochondroplasty of cam deformity by a high-speed burr (Smith & Nephew, Memphis, TN, USA) (Fig. 3C). The aim of the osteochondroplasty procedure was to restore the alpha angle to less than 50°. Finally, the incised joint capsule was repaired routinely before closure.

Postoperative Rehabilitation

All patients followed a standardized rehabilitation protocol postoperatively, which began with isometric contraction exercises and passive hip joint activities without weight-bearing for 4 weeks. Partial weight-bearing was conducted 4–6 weeks after the operation, and active hip joint activities within the tolerable range were carried out, as well as exercises for strengthening of hip abduction, flexion, and extension, while continuing passive hip joint activities. After 6 weeks, the patients could walk with a full load and recovered normal functional activities of the lower limbs. From the third to the sixth month after the operation, the patients gradually returned to normal activity levels and sports.

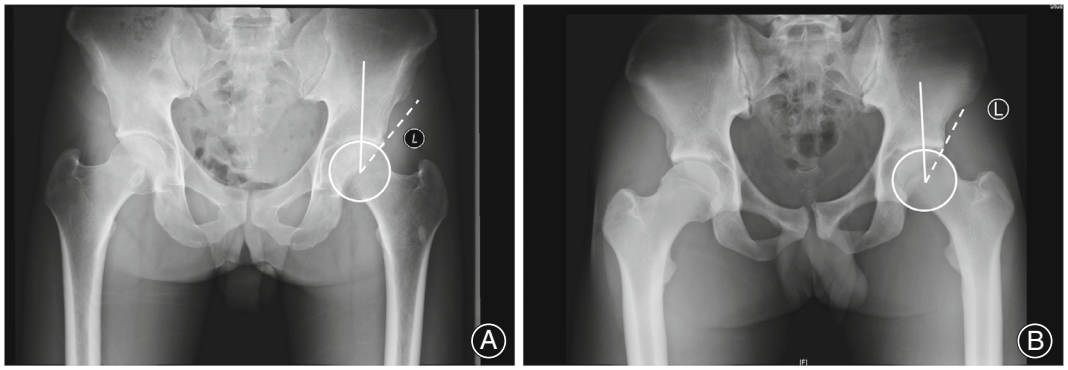

Fig. 1 Radiograph of two patients with pincer deformity. (A) Radiograph of a patient with global deformity (LCEA: 45.7°). (B) Radiograph of a patient with normal LCEA (30.7°) and crossover sign. LCEA was measured by the angle formed from a line from the center of the femoral head to the lateral bone-edge of the acetabulum and a vertical reference line from the center of the femoral head. Abbreviation: LCEA, lateral center edge angle

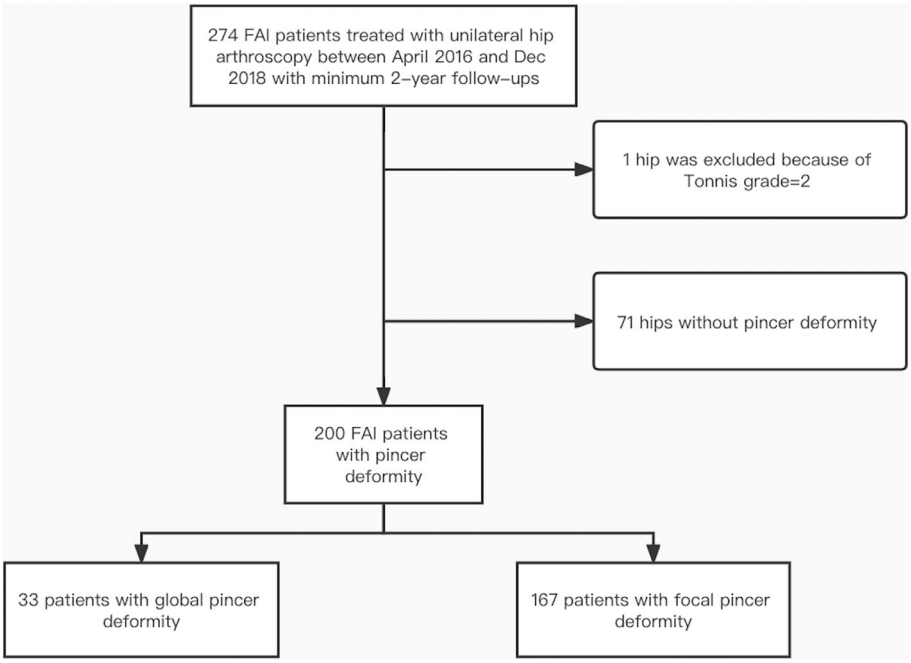

Fig. 2 Patient selection flowchart indicating the total patient population that met inclusion and exclusion criteria.Abbreviation: FAI, femoroacetabular impingement

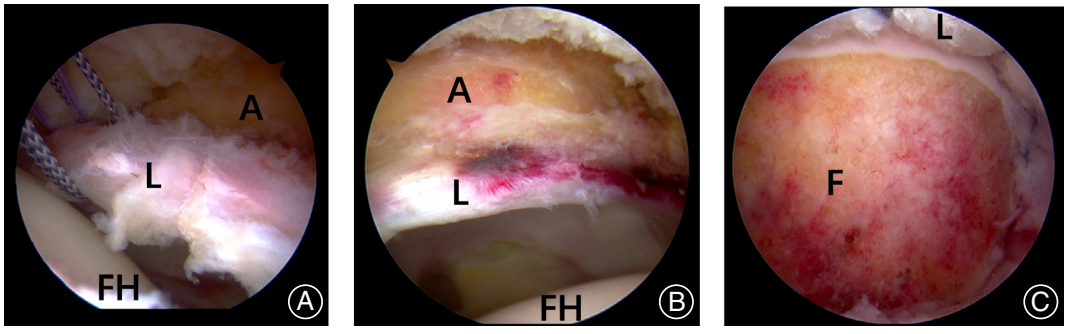

Fig. 3 Intraoperative arthroscopic view. (A) Arthroscopic image of a left hip with global overcoverage after extensive acetabuloplasty. (B) Arthroscopic image of a right hip with focal pincer deformity after acetabuloplasty. (C) Arthroscopic view of a left hip after femoral osteochondroplasty. Abbreviations: A, acetabulum; L, labrum; FH, femoral head; F, femoral head–neck junction

Patient-reported Outcomes (PROs)

PROs including the modified Harris hip score (mHHS), hip outcome score-activities of daily living (HOS-ADL), international hip outcome tool–12 (iHOT-12)- scores before and after surgery were used to evaluate the clinical outcomes of arthroscopic treatment. Visual analogue scale (VAS) scores was also used for pain assessment. The minimal clinically important difference (MCID) and patient acceptable symptomatic state (PASS) of mHHS, VAS, HOS-ADL, and iHOT-12 were determined and compared between groups. The MCID was defined as a change of 8, 1.5, 9, and 13 points in the mHHS and VAS, HOS-ADL, and iHOT-12 scores, respectively.[14–16] The PASS was defined as the achievement of 74, 1.91, 87, and 72.2 points for mHHS, VAS, HOS-ADL, and iHOT-12, respectively.[17,18]

Statistical Analysis

A priori power analysis was performed with an error probability of 0.05 and power of 0.80 using the G*power software (v3.1.9.4, Franz Faul, Christian-Albrechts-Universität Kiel, Kiel, Germany). Based on the previous literature, a difference of 8 points in the mHHS was considered statistically significant. Therefore, with an estimate SD of 15 points, it was determined that the study required a minimum of 30 patients in each group to achieve statistically significance. All data were first assessed for normal distribution and homogeneity of variance by using the Shapiro–Wilk and Fisher tests. We used a 2-tailed unpaired Student's *t*-test to compare the demographic data and PROs between different cohorts. Non-parametric testing was used for analysis in cases where parametric statistical assumptions were violated. The 2-tailed paired Student's *t*-test was used to compare pre- and post-operative PROs. The chi-square test or Fisher exact test was used to compare categorical variables between the two groups. All data were statistically analyzed using the SPSS 19.0 (IBM, Armonk, NY, USA) software. The *P* values <0.05 were considered statistically significant.

Results

Characteristics of the Patients

Overall, 200 FAI patients with pincer deformities were included in this study. The global group had 33 patients and the focal group had 167 patients. There were no significant intergroup differences in age, gender, body mass index (BMI), side involved or follow-up time. The demographic and radiographic data of the two groups are presented in Table 1.

TABLE 1 Characteristics of the patients

	Global group	Focal group	Chi-square or *t* value	*P* value
Age, years	39.30 ± 10.73	37.40 ± 9.36	1.047	0.296
BMI	24.32 ± 3.27	23.28 ± 3.08	1.743	0.083
Sex, male/female	18/15	85/82	0.147	0.702
Side L/R	19/14	80/87	1.031	0.310
Preoperative alpha	65.12 ± 6.50	66.01 ± 8.30	0.580	0.562
Postoperative alpha	42.87 ± 6.08	44.33 ± 4.88	1.504	0.134
Preoperative LCEA	44.32 ± 3.42	31.74 ± 3.85	17.440	**<0.001**
Postoperative LCEA	38.49 ± 5.19	30.36 ± 4.31	9.556	**<0.001**
Changes in LCEA	5.82 ± 4.76	1.38 ± 3.74	5.947	**<0.001**
Follow-up time, m	39.09 ± 9.76	38.63 ± 8.11	0.285	0.776

Notes: Values are shown as mean ± SD. Bold value indicates statistical significance.; Abbreviations: BMI, body mass index; LCEA, lateral center-edge angle.

TABLE 2 Procedures performed on patients

	Global group	Focal group	Chi-square value	*P* value
Labral				
Repair	32(97.0)	161(96.4)	0.026	0.872
Debridement	0(0)	4(2.4)	0.807	0.369
Reconstruction	1(3.0)	2(1.2)	0.626	0.429
Acetabuloplasty	33(100)	167(100)	<0.001	≥0.999
Acetabular chondroplasty	14(42.4)	44(26.3)	3.459	0.063
Femoroplasty	33(100)	167(100)	<0.001	≥0.999
Femoral head chondroplasty	2(6.1)	16(9.6)	0.417	0.518

Note: Data are reported as *n* (%).

The Performed Procedures

The arthroscopic procedures of both groups are summarized in Table 2. All patients in both groups were combined-type FAI and underwent acetabuloplasty and femoroplasty. The majority of the patients in two groups underwent labral repair (97.0 *vs* 96.4%). There were no significant differences in any intraoperative variables between the two groups.

Patient-reported Outcomes

Both groups demonstrated significant improvements in PROs compared with preoperative levels at the final follow-up ($P < 0.001$) (Table 3). The preoperative scores showed significant differences in terms of mHHS (60.34 *vs* 62.90, $P = 0.031$) and HOS-ADL (61.45 *vs* 64.74, $P = 0.022$) scores between two groups. Also, the improvement of HOS-ADL score was significantly higher in global group ($P = 0.027$). However, postoperative scores showed no significant differences between two groups.

The rate of MCID and PASS for each PROs were presented in Table 4. There were no significant differences in the rate of meeting the PASS and MCID between groups.

Complications and Secondary Procedures

There was no case of surgical wound site infection or neurologic deficit in both cohorts at final follow-ups. One (3.0%) in the global group and six (3.6%) patients in the focal group

TABLE 3 Patient-reported outcomes of the global and focal groups

	Global group	Focal group	*t* value	*P* value
VAS				
Preoperative	6.12 ± 1.54	6.00 ± 1.37	0.151	0.880
Postoperative	1.67 ± 1.47	1.74 ± 1.44	0.235	0.814
Statistic value	$t = 12.497$, **$P < 0.001$**	$t = 27.920$, **$P < 0.001$**		
Improvement	4.45 ± 2.05	4.26 ± 1.97	0.523	0.601
mHHS				
Preoperative	60.34 ± 8.97	62.90 ± 6.92	2.162	**0.031**
Postoperative	89.47 ± 11.13	88.97 ± 8.59	1.045	0.296
Statistic value	$t = 14.359$, **$P < 0.001$**	$t = 34.285$, **$P < 0.001$**		
Improvement	29.13 ± 11.65	26.07 ± 9.83	1.942	0.052
HOS-ADL				
Preoperative	61.45 ± 9.37	64.74 ± 8.49	2.290	**0.022**
Postoperative	90.32 ± 9.71	89.01 ± 8.61	1.374	0.169
Statistic value	$t = 14.911$, **$P<0.001$**	$t = 30.695$, **$P < 0.001$**		
Improvement	28.88 ± 11.13	24.29 ± 10.23	2.212	**0.027**
iHOT-12				
Preoperative	41.57 ± 5.30	40.88 ± 7.15	0.917	0.359
Postoperative	74.97 ± 12.09	72.80 ± 10.21	1.512	0.130
Statistic value	$t = 15.278$, **$P<0.001$**	$t = 37.386$, **$P<0.001$**		
Improvement	33.40 ± 12.56	31.93 ± 11.03	1.317	0.188

Note: Data are reported as mean ± SD. Bold value indicates statistical significance.; Abbreviations: HOS-ADL, Hip Outcome Score-Activities of Daily Living; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; VAS, visual analogue scale.

TABLE 4 Rates of achieving the MCID and PASS in the global and focal group

	Global group	Focal group	Chi-square value	*P* value
MCID				
VAS	93.90	92.20	0.118	0.731
mHHS	97.00	94.60	0.323	0.570
HOS-ADL	93.90	91.00	0.302	0.582
iHOT-12	93.90	93.40	0.013	0.911
PASS				
VAS	48.50	53.90	0.323	0.570
mHHS	93.90	94.00	<0.001	0.987
HOS-ADL	72.70	72.50	0.001	0.974
iHOT-12	60.60	55.10	0.340	0.560

Notes: Data are shown as percentages.
Abbreviations: HOS-ADL, Hip Outcome Score-Activities of Daily Living; iHOT-12, International Hip Outcome Tool–12; MCID, meeting minimal clinically important difference; mHHS, modified Harris Hip Score; PASS, Patient Acceptable Symptomatic State; VAS, visual analogue scale.

underwent revision arthroscopy, respectively, with no significant difference ($P = 0.876$). One patient in global group required revision surgery due to heterotopic ossification. In focal pincer group, three patients (50%) underwent revision surgery due to subspine impingement (SSI), two patients (33%) due to capsulolabral adhesions and one patient (17%) due to residual cam deformity. There was no conversion to THA in both groups.

Discussion

The most important findings of this study were that the majority of the patients with either global or focal pincer could get significant improvement after arthroscopic surgery at a minimum of 2-year follow-ups. Also, patients with global pincer deformity had equivalent clinical outcomes following arthroscopic treatment compared to those with focal pincer deformity.

Surgical outcomes between global and focal pincer group were comparable

Global acetabular overcoverage (global pincer) is a relatively rare form of pincer deformity and is typically associated with technical challenges in hip distractibility, hip joint access, and central compartment access.[10] The initial treatment for global pincer was circumferential rim trimming via open surgical hip dislocation,[19,20] and acetabular protrusion has once been considered as a relative contraindication of hip arthroscopy.[5] However, with the advancement of arthroscopic instruments and techniques, global pincer deformity has been treated via arthroscopic surgery in recent years.[5]

Several studies have investigated the clinical outcomes of patients with global pincer following hip arthroscopy. So far, there are still controversies about the surgical improvement of global pincer *via* open or arthroscopic surgery and whether the surgical outcomes of global pincer are comparable to those of focal pincer. Three studies have shown favorable clinical outcomes of global pincer patients after arthroscopic surgery. In a cohort study, Matsuda *et al.*[9] reported that similar PROs and THA conversion rate were obtained between patients with global pincer and focal pincer deformities at 2-year follow-ups, suggesting that arthroscopic treatment for global pincer is a safe procedure and as effective as that for focal pincer. Brick *et al.*[12] conducted a prospective study with a larger sample size, and the results showed that arthroscopic management of acetabular overcoverage was able to achieve excellent clinical results, and was equivalent to arthroscopy for FAI with a LCEA between 25° and 40°. Maldonado *et al.*[10] reported that 45 global pincer FAI patients had significant improvement in PROs which were comparable with the control group without acetabular overcoverage in a minimum of 5-year follow-ups. However, results from two other studies conducted by Chandrasekaran *et al.* were not that satisfactory. In a case series of 35 patients with global pincer FAI, Chandrasekaran*et al.*[21] reported that arthroscopic management for global pincer was able to make improvement in PROs, but these improvements did not reach the MCID. In another matched cohort study with 36 patients for each group, Chandrasekaran *et al.*[13] found that although significant improvements were achieved in patients with global pincer, they showed lower improvements in all PROs compared with a matched cohort with normal coverage.

Our results from the current study were in accordance with the reports of Matsuda *et al.*, Brick *et al.* and Maldonado *et al.* We found that PROs and the rate of achieving the MCID and PASS between the global and focal pincer group were not statistically different from each other at minimum 2-year follow-ups. These results suggested that patients in the global pincer group who undergoing hip arthroscopy could have equivalent clinical outcomes compared to those in the focal pincer group. Interestingly, the preoperative scores of mHHS and HOS-ADL and the improvement of HOS-ADL score after arthroscopy were found to be significantly different between two groups. However, as these differences was relatively small, we do not think this is of clinical significance.

We also found that the changes of LCEA in global group were significantly larger than that in focal group, suggesting that global pincer required more extensive resections of the lesion, especially the anterosuperior and superolateral part of the acetabulum.[22] The literature has shown the necessity of acetabuloplasty in patients with pincer deformity,[23] but have also risen concerns that excessive amount of rim resection could lead to poorer outcomes, as it could lead to significant increase of contact pressures of the hip joint.[12,24] Our study found that a 5.8° reduction in LCEA in the global pincer FAI by acetabuloplasty was appropriate and no patients experienced adverse effects. This finding was consistent with the results from Brick *et al.*[12]

Incidence for Revision Hip Arthroscopy in Both Groups Was Low

In our study, the incidence for revision hip arthroscopy in the global and focal groups was 1 (3.3%) and 6 (3.6%), respectively. The reason for revision surgery in the global group was heterotopic ossification. In the focal pincer group, three patients (50%) underwent revision surgery due to subspine impingement (SSI), two patients (33%) due to capsulolabral adhesions and one patient (17%) due to residual cam deformity. Also, there was no conversion to THA in both groups. The rate for hip revision arthroscopy in patients with global pincer reported by Matsuda *et al.*, Chandrasekaran *et al.*, Brick *et al.* and Maldonado *et al.* was 1.5%, 5.6%, 8.8%, and 13.3%, respectively. And the rate for THA ranged from 0 to 11.1%.[9,10,12,21] While the rates for revision surgery or conversion to THA increase over time, our study combined with others studies showed that the need for a secondary procedure after primary arthroscopic treatment in global pincer patients was low.

Strengths and Limitations

This is the first study comparing the clinical outcomes of arthroscopic treatment between patients with global pincer

FAI and focal pincer FAI in the Chinese population. The current study had a relatively large cohort of global pincer patients, with reliable and complete data. Our results showed that patients with global pincer FAI can be treated arthroscopically with satisfactory outcomes, despite the technical challenges.

This study has several limitations. First, it was a retrospective study, there was an inherent bias. Second, although there was no difference in the age, gender, BMI or follow-up times between groups, patients in the global group were not propensity-matched to the focal group, and thus the effect of confounding factors exist. Finally, this study involved a minimum 2-year follow-up. It is unknown whether the improvements will persist over time. Mid- and long-term follow-ups are mandatory to investigate the strengths and drawbacks of hip arthroscopy in treating patients with global pincer.

Conclusion

To our best knowledge, this study was the first to report the clinical outcomes between patients with global pincer and focal pincer deformities in the Chinese population, and the results showed that patients with global pincer FAI who underwent hip arthroscopy reported significant improvements in all PROs at minimum 2-year follow-up. The outcomes were similar to focal pincer FAI patients with a low rate of secondary procedure.

Author's contribution

Jia-Yi Shao performed the data analyses and drafted the manuscript; Zi-Yi He and Ling-Hui Dai collected the original data. Yan Xu, Jian-quan Wang, and Xiao-Dong Ju performed all the surgeries of this study. Jian-quan Wang and Xiao-Dong Ju contributed to the conception of the study.

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