Clinical Outcomes of Hip Arthroscopic Surgery in Patients With Femoral Retroversion

A Matched Study to Patients With Normal Femoral Anteversion

David E. Hartigan,*† MD, Itay Perets,* MD, John P. Walsh,*‡ BS, Edwin O. Chaharbakhshi,*§ BS, Leslie C. Yuen,* BA, and Benjamin G. Domb,*‖¶ MD

Investigation performed at the American Hip Institute, Westmont, Illinois, USA

Background: Femoral retroversion has been noted as a possible risk factor for poor clinical results after hip arthroscopic surgery.

Purpose: To compare the outcomes of the arthroscopic treatment of hip abnormalities in patients with femoral retroversion to patients with femoral anteversion between 10° and 20°.

Study Design: Cohort study; Level of evidence, 3.

Methods: Between November 2011 and September 2013, 790 hip arthroscopic procedures were performed at a single institution. Of these, 59 hips (7.5%) were located in patients with femoral version ≤0°, calculated using preoperative magnetic resonance imaging. These patients were pair matched, based on body mass index ±5 kg/m^2, age ±5 years, and Tönnis grade, with 59 patients with femoral anteversion between 10° and 20°. Exclusion criteria included Perthes disease, inflammatory arthritis, slipped capital femoral epiphysis, previous hip surgery, abductor repair, lateral center-edge angle <20°, Tönnis grade >1, and acetabular profunda or protrusio. Patient-reported outcomes (PROs) were recorded preoperatively, at 3 months postoperatively, and annually thereafter. The PROs utilized were the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), and Hip Outcome Score–Sports-Specific Subscale (HOS-SSS). The visual analog scale (VAS) was collected to assess the patients' pain; patient satisfaction scores (0-10) were also collected. Radiographs were collected at the above time intervals as well.

Results: Two patients from the control group and 1 patient from the retroverted group required total hip arthroplasty at a mean 19.5 and 26.3 months, respectively. Both groups demonstrated significant improvement from their preoperative state in all PRO and VAS scores ($P < .001$). No differences in preoperative, postoperative, or change in PRO and VAS scores between the groups were noted.

Conclusion: Patients with femoral retroversion reported similar outcomes compared to patients with normal femoral version when undergoing hip arthroscopic surgery. Both groups had similar improvements from the preoperative state.

Keywords: hip arthroscopic surgery; femoral retroversion; hip retroversion; hip impingement

Hip arthroscopic surgery is a successful procedure in young patients who have maintained joint spaces and known abnormalities, as demonstrated on physical examination and magnetic resonance imaging (MRI).[2,5,19-21] Not all hip arthroscopic procedures have excellent outcomes, and it is important that we study cases with unsuccessful results so as to avoid surgery that may not provide adequate relief and find a treatment that is better suited for their hip condition.

Many factors have been shown to contribute to poor outcomes in hip arthroscopic surgery. Increased age, diminished joint space, dysplasia, high body mass index, and cartilage damage are just a few factors that have been shown to negatively affect results.[1,6,7,17,18,24] A recent study noted that patients with femoral retroversion, as defined by femoral version <5°, had inferior outcomes with hip arthroscopic surgery compared to patients with normal version.[3] This difference in outcomes is thought to be caused by the patient requiring less internal rotation of the hip before impingement, as surgical intervention in the form of cam decompression would not significantly alter this problem. Consequently, many surgeons approach hip arthroscopic

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surgery in this patient population with caution and more pessimism. There are currently no recommendations on when rotational osteotomy of the femur should be performed to improve abnormal femoral version, making treatment difficult for patients with relative femoral retroversion.

The purpose of this study was to compare the outcomes of hip arthroscopic surgery in patients with femoral version $\leq 0^\circ$ to those with version between 10° and 20° to determine if the outcomes from hip arthroscopic surgery were significantly different. Our hypothesis was that the results would be similar because of increased impingement-free range of motion in the hip in both groups with surgical treatment of offending abnormalities, regardless of the underlying femoral version.

METHODS

Our institution's database was searched for patients who underwent arthroscopic hip surgery between November 2011 and September 2013, during which femoral version was calculated using preoperative MRI. Inclusion criteria were MRI-confirmed version calculated at $\leq 0^\circ$ and follow-up greater than 2 years. Previous authors have defined femoral retroversion as $<5^\circ$ of anteversion.[5] We arbitrarily utilized $\leq 0^\circ$ to constitute the retroverted group because it was felt that more extreme retroversion would allow for a difference to be elucidated if a difference truly existed. Exclusion criteria included Perthes disease, inflammatory arthritis, slipped capital femoral epiphysis, previous hip surgery, abductor repair, lateral center-edge angle (LCEA) $<20^\circ$, Tönnis grade >1, and acetabular profunda (acetabulum medial to the ilioischial line) or protrusio (femoral head medial to the ilioischial line).

These patients were then pair matched to patients with femoral version between 10° and 20° of femoral anteversion, as measured on preoperative MRI. Anteversion of 10° to 20° was utilized based on previous work by Ito et al[8] defining normal version as 5° to 20°. We utilized 10° to 20° to have a significant difference between the 2 version groups so that if retroversion truly determined results, we would detect this difference. The matching criteria were body mass index ±5 kg/m^2, age ±5 years, and Tönnis grade.

All patients were evaluated in the clinic by the senior author (B.G.D.) both preoperatively and at follow-up for range of motion and signs of labral tears and impingement. Range of motion was assessed with the patient in the supine position. Internal and external ranges of motion were assessed with the hip flexed to 90°. Labral tears were specifically evaluated in the impingement population with the flexion, adduction, and internal rotation impingement test; flexion impingement test; flexion, abduction, and external rotation impingement test; and abduction impingement test. If there were clinical signs or symptoms of a labral tear, the patient was treated conservatively with physical therapy, activity modification, and nonsteroidal anti-inflammatory drugs for at least 3 months. If the patient was still having significant pain and dysfunction in the hip, then operative intervention was offered.

Outcomes were measured with patient-reported outcomes (PROs), a visual analog scale (VAS), and patient satisfaction. The VAS is a measure of patient pain from 0 to 10, with 0 being no pain at all and 10 being the worst pain imaginable. Patient satisfaction was measured on a scale of 0 to 10 with 0 being completely dissatisfied with surgery and 10 being completely satisfied with surgical intervention. The PROs utilized were the modified Harris Hip Score (mHHS), Non-Arthritic Hip Score (NAHS), and Hip Outcome Score–Sports-Specific Subscale (HOS-SSS). All of the PROs have been shown to have good clinimetric support in the hip impingement population.[4,11,13-16,20,23] Patients were surveyed preoperatively for all measures except satisfaction, as well as at 3 months postoperatively and annually thereafter.

Radiographs were obtained preoperatively on every patient and consisted of an anteroposterior view of the pelvis, a false-profile view, and a 45° Dunn view. These radiographs were utilized to calculate the LCEA, anterior center-edge angle, alpha angle, and Tönnis grade of osteoarthritis. The same radiographic views were obtained again at 2-week follow-up and annually thereafter if patients were able to return. MRI or magnetic resonance arthrography (MRA) was performed on every patient before operative intervention. The purpose of MRI/MRA was to evaluate the labrum and chondral surfaces. MRI/MRA was also utilized for the calculation of femoral neck version. This was calculated by referencing the posterior femoral condyles and a line through the center of the femoral neck in the axial-oblique plane, as described previously in the literature.[22]

Operative Technique

Patients were all placed in a supine position on an operative table with traction boot extensions. All operative procedures were performed by the senior author. The anterolateral and midanterior portals were utilized in every patient.

¶Address correspondence to Benjamin G. Domb, MD, American Hip Institute, 1010 Executive Court, Suite 250, Westmont, IL 60559, USA (email: DrDomb@americanhipinstitute.org).

*American Hip Institute, Westmont, Illinois, USA.

†Mayo Clinic, Rochester, Minnesota, USA.

‡College of Osteopathic Medicine, Des Moines University, Des Moines, Iowa, USA.

§Stritch School of Medicine, Loyola University Chicago, Chicago, Illinois, USA.

‖Hinsdale Orthopaedics, Hinsdale, Illinois, USA.

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If suture anchors were required, a distal lateral accessory portal was created. Diagnostic arthroscopic surgery consisted of an examination of the ligamentum teres, labrum, and cartilage of the femoral head and acetabulum. Labral tears were repaired if possible; if not possible, they were either debrided to a stable rim or reconstructed using a semitendinosus allograft. Preoperative radiographs and intraoperative fluoroscopy were utilized for decisions regarding whether bone needed to be resected for cam and/or pincer lesions. When resection was warranted, fluoroscopy was utilized to ensure that adequate resection was performed.

Rehabilitation

All patients were placed in a hip brace and instructed to be 20-lb flat-foot weightbearing on the operative extremity for 2 weeks postoperatively. If patients underwent microfracture, then they were required to be 20-lb flat-foot weightbearing for 8 weeks. Thereafter, they were gradually allowed to return to weightbearing as tolerated. All patients started physical therapy on the first postoperative day to initiate range of motion. This was accomplished by using a continuous passive motion machine for 4 hours per day or using a stationary bicycle for 2 hours per day.

Statistical Analysis

An a priori power analysis was conducted for this study to ensure adequate power. Previously published research estimated that a clinically significant difference between the groups for the mHHS would be 6, with an SD of 8 for the preoperative cohort. To obtain a power greater than 0.80 for matched pairs, a total sample size greater than 17 in each group was needed. The Shapiro-Wilk test was used to determine whether the data were normally distributed. For nonnormally distributed data, a 2-tailed Wilcoxon signed-rank test for paired samples was used; for normally distributed data, a 2-tailed Student *t* test was used. These tests were used to determine whether there were significant differences with regard to preoperative and postoperative PRO scores within and between the retroverted and control groups. Statistical significance was set at $P < .05$.

RESULTS

Between November 2011 and September 2013, there were 790 hip arthroscopic procedures performed at our institution. Of these, 59 hips (7.5%) were located in 59 patients with preoperative MRI/MRA that showed the patient's femoral version as $\leq 0^\circ$; these constituted the retroverted group. These patients were matched with 59 patients with femoral version between 10° and 20° from a pool of 183 patients. The 59 patients were chosen from the pool at random, selecting every third patient on a randomly generated spreadsheet to comprise the control group. They were selected based on similar timing of the operative procedure to ensure similar surgical techniques, as these can evolve

TABLE 1
Demographics of Retroverted and Control Groups[a]

	Retroverted	Control	*P* Value
Sex, n			.45
Male	23	19	
Female	36	40	
Body mass index, kg/m^2	25.3 ± 4.0	24.9 ± 3.9	.43
Age, y	36.1 ± 12.6	36.3 ± 13.0	.91
Laterality, n			.27
Right	28	35	
Left	31	24	
Follow-up time, mo	37.6 ± 14.9	37.9 ± 14.1	.58
Conversion to THA, n	3	2	>.99
Time to THA, mo	26.3 ± 4.1	19.5 ± 18.9	

[a]Values are shown as mean ± SD unless otherwise specified. THA, total hip arthroplasty.

TABLE 2
Procedures Conducted in Retroverted and Control Groups[a]

	Retroverted	Control	*P* Value
Labral treatment			.4923
Repair	39	35	
Reconstruction	2	1	
Debridement	17	23	
Capsular treatment			**.0399**
Repair	31	19	
No repair	28	40	
Acetabuloplasty	50	45	.3529
Microfracture	4	8	.3617
Femoroplasty	52	45	.1476
Iliopsoas release	19	24	.1138
Ligamentum teres treatment	20	27	.2591
Notchplasty	2	7	.1626

[a]Values are shown as No. unless otherwise specified. Bolded value indicates statistically significant difference between groups ($P < .05$).

TABLE 3
Radiographic Findings in Retroverted and Control Groups[a]

	Retroverted	Control	*P* Value
LCEA, deg			
Preoperative	30.9 ± 4.9	30.3 ± 5.3	.649
Postoperative	29.0 ± 4.7	28.3 ± 4.9	.466
P value	.0604	.0504	
ACEA, deg			
Preoperative	28.5 ± 10.4	30.8 ± 6.2	.530
Postoperative	30.8 ± 6.6	30.5 ± 7.3	.824
P value	.560	.847	
Tönnis angle, deg			
Preoperative	3.6 ± 3.8	3.9 ± 4.1	.945
Postoperative	3.6 ± 3.6	3.9 ± 3.9	.675
P value	.978003203	.960175041	
Alpha angle, deg			
Preoperative	60.5 ± 11.5	59.3 ± 13.3	.465
Postoperative	44.7 ± 8.7	43.0 ± 6.8	.529
P value	<.001	<.001	

[a]Values are shown as mean ± SD unless otherwise specified. ACEA, anterior center-edge angle; LCEA, lateral center-edge angle.

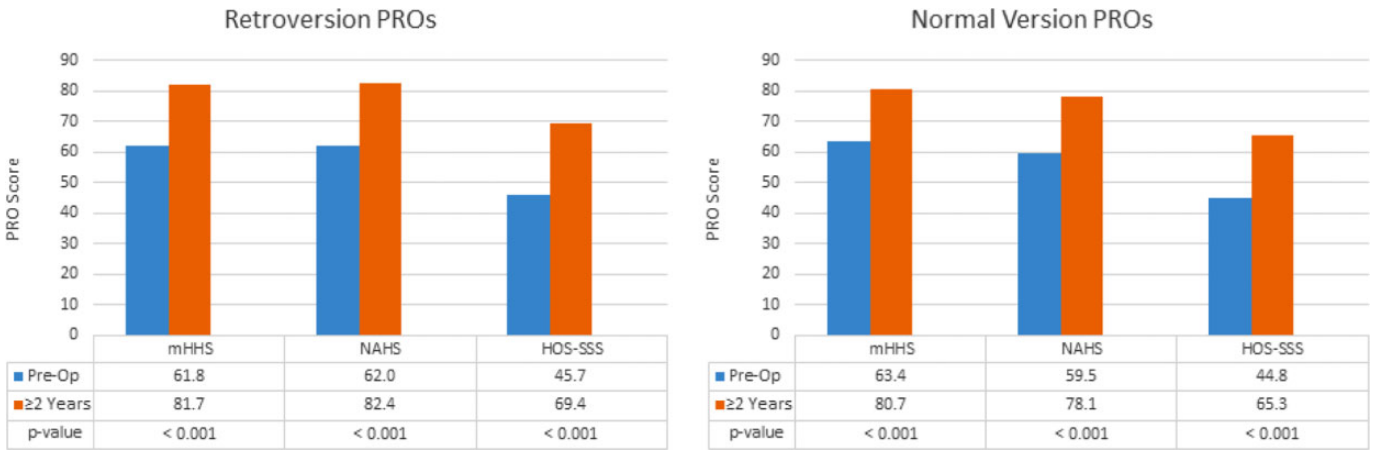

Figure 1. Preoperative (pre-op) and postoperative patient-reported outcome (PRO) scores for the retroverted and control groups. HOS-SSS, Hip Outcome Score–Sports-Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score.

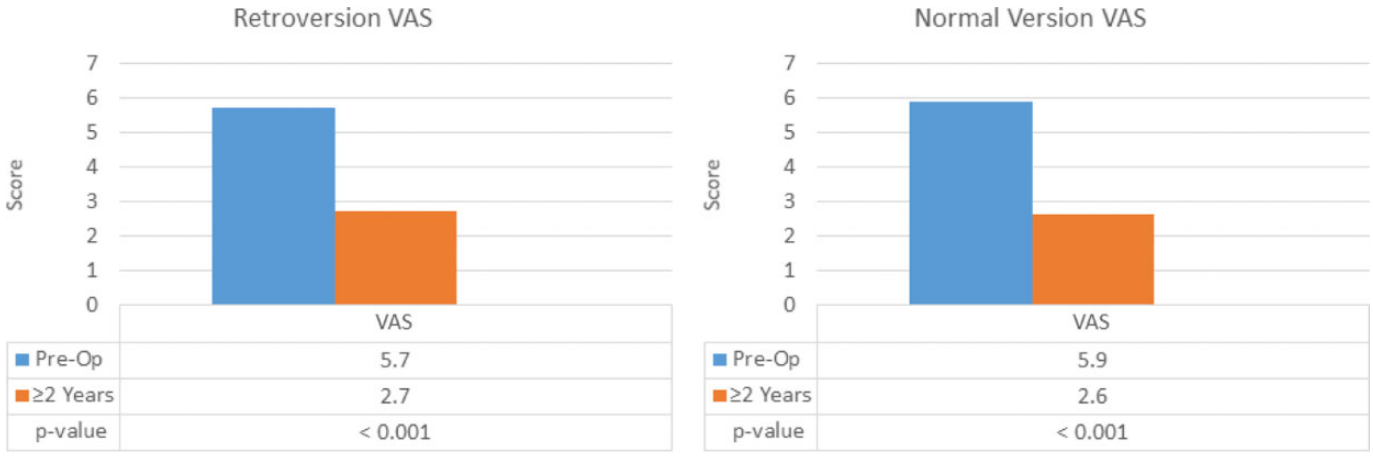

Figure 2. Visual analog scale (VAS) scores preoperatively (pre-op) and at >2-year follow-up in the retroverted and control groups.

with time. The mean femoral version in the retroverted group was –4.9° ± 4.9°, and the mean femoral version in the control group was 13.6° ± 2.8°. The demographics of both groups can be found in Table 1. The procedures performed at the time of surgery can be found in Table 2. The radiographic parameters measured preoperatively and postoperatively are demonstrated in Table 3.

The retroverted and control groups both demonstrated significant improvement in mHHS, NAHS, HOS-SSS, and VAS scores ($P < .001$) (Figures 1 and 2). The scores in the control group improved from 63.4 to 80.7, 59.5 to 78.1, 44.8 to 65.3, and 5.9 to 2.6, respectively ($P < .001$). The retroverted group also showed significant improvement in mHHS, NAHS, HOS-SSS, and VAS scores, from 61.8 to 81.7, 62.0 to 82.4, 45.7 to 69.4, and 5.7 to 2.7, respectively ($P < .001$). There was no statistically significant difference between the retroverted and control groups when comparing the changes in the different PRO and VAS scores from preoperatively to latest follow-up ($P > .4$) (Figure 3 and Table 4). The mean patient satisfaction score was 6.7 and 6.8 in the retroverted and control groups, respectively ($P = .89$). There were 2 patients in the control group who required total hip arthroplasty at a mean of 19.5 months, compared to 1 patient in the retroverted group at 26.3 months.

DISCUSSION

This study demonstrated that both the retroverted and control femurs progressed to significant improvement in all metrics from their preoperative state to the postoperative state. When comparing the retroverted group to the control group, there was no difference between changes in PRO, VAS, or patient satisfaction scores.

There are currently 3 studies in the literature that have examined PROs with hip arthroscopic surgery when considering proximal femoral version. Kelly et al[10] demonstrated that patients with relative femoral retroversion, defined as femoral version <5°, had equal improvement in their internal rotation postoperatively compared to those with normal or increased version. It was noted that the retroverted patients started and ended with lower values,

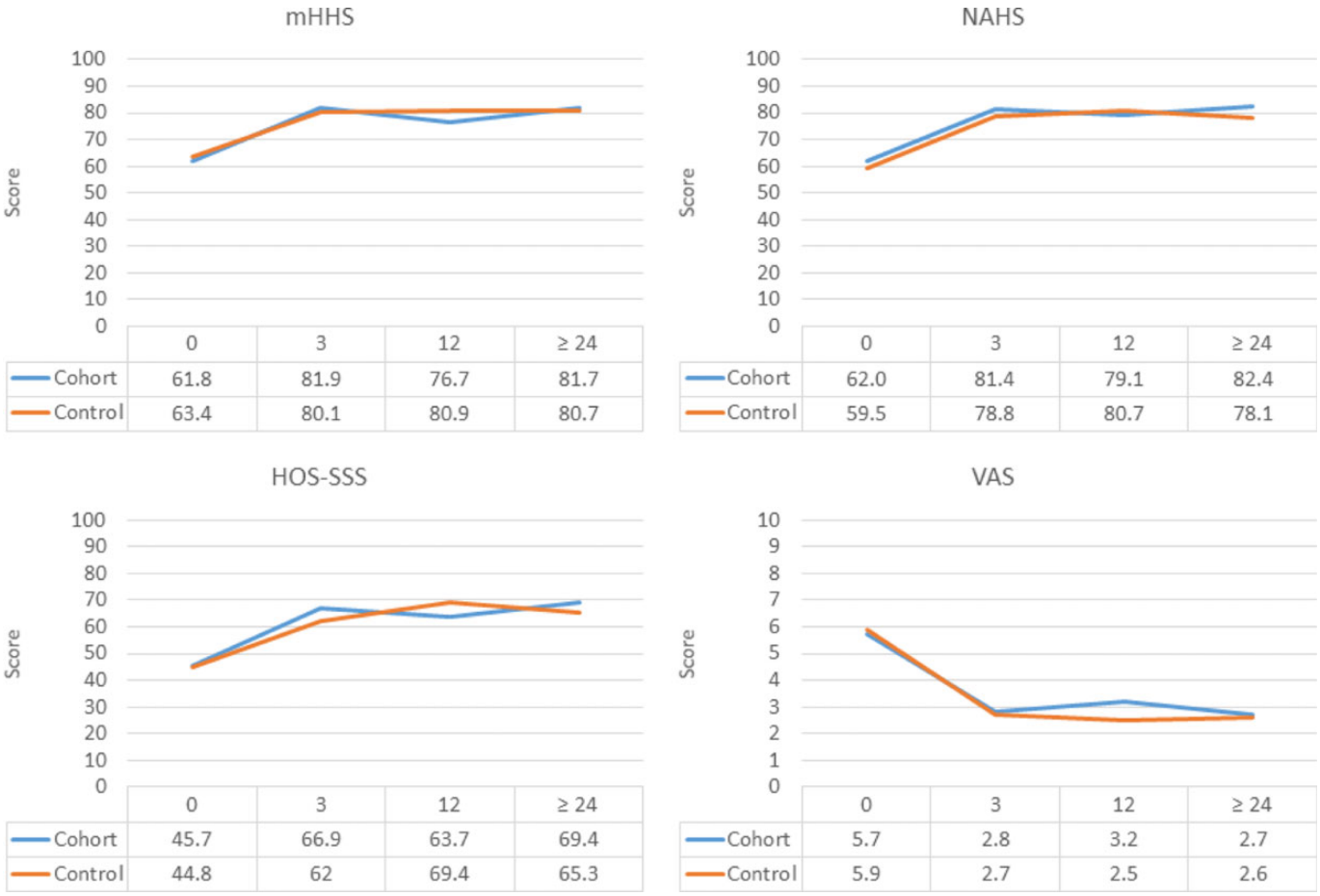

Figure 3. Patient-reported outcome and visual analog scale (VAS) scores between the retroverted and control groups over time in months. HOS-SSS, Hip Outcome Score–Sports-Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score.

TABLE 4
Patient-Reported Outcome and VAS Scores Between Retroverted and Control Groups[a]

	Preoperative			Postoperative			Change		
	Retroverted	Control	*P* Value	Retroverted	Control	*P* Value	Retroverted	Control	*P* Value
mHHS	61.8 ± 14.6	63.4 ± 15.9	.481	81.7 ± 14.8	80.7 ± 19.3	.883	15.4 ± 21.2	14.1 ± 20.6	.596
HOS-SSS	45.7 ± 25.5	44.8 ± 23.8	.89	69.4 ± 28.0	65.3 ± 33.1	.723	24.1 ± 31.6	20.7 ± 30.2	.874
NAHS	62.0 ± 17.3	59.5 ± 18.9	.569	82.4 ± 13.7	78.1 ± 21.8	.51	20.6 ± 22.1	18.3 ± 19.4	.489
VAS	5.7 ± 2.1	5.9 ± 2.3	.889	2.7 ± 2.3	2.6 ± 2.5	.658	–3.0 ± 3.0	–3.2 ± 3.1	.993

[a]Values are shown as mean ± SD unless otherwise specified. HOS-SSS, Hip Outcome Score–Sports-Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale.

but the improvement was the same as those with greater femoral version.[10] Fabricant et al[3] demonstrated that patients treated with hip arthroscopic surgery with femoral version <5°, although having significant improvement from their preoperative state, did not improve as much as patients with normal version (5°-20°) on the mHHS and International Hip Outcome Tool–33 (iHOT-33). Two recent studies noted no difference in clinical outcomes in patients with femoral neck retroversion compared to those with normal or increased anteversion.[4,10]

Femoral retroversion leads to decreased femoral internal rotation before contact of the femoral neck on the acetabular rim compared to patients with more anteverted femoral necks.[9] Many of these patients have obligate external rotation with hip flexion. Femoral version is a variable that cannot be significantly altered with hip arthroscopic surgery. To

significantly alter femoral version, rotational osteotomy must be performed, but this is a larger surgical undertaking, and results have not been reported on this procedure. This is why understanding the results of hip arthroscopic surgery in this population is important. Another variable that has yet to be considered is the tilt of the femoral head on the neck, which is not considered in calculating femoral neck version. With the head-neck junction being the primary source of impingement, the logical conclusion drawn would be that the more posterior the head tilted on the neck, the sooner impingement would occur with internal rotation secondary to the relatively anteriorized neck.

Kelly et al[10] noted that patients with femoral retroversion had an equal increase in internal rotation compared to those without retroversion. They demonstrated that in the immediate postoperative period, the motion was significantly less than it was at the 3-month postoperative visit, suggesting that the soft tissues were able to accommodate more motion as they were stretched with therapy over time.[10] When the impingement lesions were decompressed with arthroscopic surgery, more motion to bony impingement was possible.[12,19] The authors concluded that the soft tissues surrounding the hip joint were accustomed to the limited internal rotation of the hip that it had for many years and thus may not have allowed the motion that was now required to cause impingement. Our study suggests that with decompression of bony impingement, the soft tissues will allow some extra motion but may prohibit the requisite motion for impingement to occur in either patients with normal or retroverted femurs.

This is the first study to directly compare the results of hip arthroscopic surgery in patients with femoral retroversion to those of patients with normal femoral version in a matched-cohort format. The clinical follow-up rate was 100% in both groups, with a greater than 2-year radiographic follow-up rate of more than 70% in each group. This study used 3 PROs of high clinimetric value to attempt to demonstrate differences between the 2 groups. There were no significant differences noted in the procedures carried out between the 2 groups.

A limitation of this study is that it was retrospective in nature. Additionally, as with most hip arthroscopic studies, multiple procedures were conducted on each patient, so it is difficult to attribute successful outcomes to just resection of impingement lesions; however, there were no significant differences between the groups in the procedures performed. We also did not calculate or account for acetabular retroversion; however, this has not been shown to significantly affect the results of hip arthroscopic surgery in previous studies.[3] Finally, because of inconsistent and missing measurements, preoperative and postoperative ranges of motion were not reported.

CONCLUSION

Patients with femoral retroversion reported similar outcomes compared to patients with normal femoral version when undergoing hip arthroscopic surgery. Both groups had similar improvements from the preoperative state.

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