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Research article

Multicenter outcomes of arthroscopic surgery for femoroacetabular impingement in the community hospital setting

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ABSTRACT

The purpose of this study is to determine multi-center outcomes from arthroscopic surgery for femoroacetabular impingement in the community hospital setting. A prospective design with 2-year minimum follow-up using the nonarthritic hip score (NAHS), a 100-point scale of perceived post-operative change for pain, activities of daily living, sports activities, and patient satisfaction was implemented at three community hospitals. Of 150 enrolled patients (159 hips) with mean age of 40 years (range, 12–73), there was 81% participation. Mean NAHS at preoperative was 54.9, 3 months: 66.6, 12 months: 74.9 and 24 months: 75.4. This represents a 20.5-point improvement in NAHS ($P < 0.001$). On the 100-point scale, pain was rated +73.5, ADL's: +76.2 and sports: +68.6. 64% of patients were satisfied with their surgical outcome. Conversion arthroplasty rate was 8.8% and complication rate was 2.5%. In conclusion, arthroscopic surgery for symptomatic femoroacetabular impingement in the community setting provides safe and successful outcomes.

INTRODUCTION

Femoroacetabular impingement (FAI) is a leading cause of hip pain and dysfunction and a risk factor for osteoarthrosis. Cam, pincer and combined subtypes cause chondrolabral damage. Surgery attempts to address both the chondrolabral pathology and the inciting skeletal morphology by restoring more normal non-impinging anatomy while preserving labral function. Surgical treatment using open or arthroscopic methods appear to yield symptomatic improvement and functional restoration in the majority of those patients [1]. Hip arthroscopy in general and arthroscopic surgery for FAI in particular may have a very long learning curve [2]. Recent evidence demonstrates the arthroscopic method as having equal or better outcomes and fewer major complications than the open and/or mini-open approaches in studies; however, those studies were outcomes by high-volume single surgeons often at specialty or tertiary referral centers [3, 4]. As the utilization of hip arthroscopy expands, a larger prevalence of arthroscopic surgery for FAI is being performed in the community hospital or ambulatory surgery center setting. The purpose of this study is to determine multi-center outcomes from arthroscopic surgery for femoroacetabular impingement in this setting. Our hypothesis is that arthroscopic FAI surgery in the community setting provides safe and efficacious outcomes.

METHODS

An Institutional Review Board-approved non-randomized prospective design with 2-year minimum follow-up was

performed at three community hospitals (Kaiser West Los Angeles, Kaiser Baldwin Park, and Kaiser San Rafael medical centers) with three separate surgeons(DKM, MK, FA). The study enrollment period was March 2008 to June 2009. At the onset of this study, one surgeon (MK) had been recently trained in formal hip arthroplasty/arthroscopy fellowship with <50 prior cases as primary surgeon, one experienced knee arthroscopic surgeon (DKM) had moderate arthroscopic FAI experience with <200 prior cases (<70 cases per annum), and one surgeon (FA) had approximately 300 cumulative hip arthroscopy cases of which <50 were arthroscopic FAI surgeries. Inclusion criteria were patients with symptomatic FAI who underwent arthroscopic treatment and agreed to participate in this prospective study. Cam deformity was radiographically assessed via digital measurement of alpha angle on modified Dunn lateral view on picture archiving and communication system >55° and pincer deformity was measured via positive crossover sign and/or lateral center-edge angle on AP pelvis radiograph ≥40°. Exclusion criteria included prior hip surgery, advanced coxarthrosis, and athletic pubalgia. Pre-operative demographic (age, gender, and BMI) clinical (e.g. length of painful symptoms and mechanical symptoms) and radiographic findings (cam, pincer, or mixed FAI, Tonnis grade, joint narrowing), intra-operative findings (Beck labral grade, Outerbridge and Beck cartilage grade, loose body, dysplasia, capsular laxity), and surgical procedures (acetabular side procedures, femoral side procedures, chondrolabral and other procedures (Tables I and II). Surgical outcomes were assessed with pre- and post-operative NAHS at 3-, 12-, and 24-post-operative months, a 100-point scale of perceived post-operative change for pain, activities of daily living (ADLs), and sports activities, and patient satisfaction at 3, 12, and 24 months using a five-point Likert scale with one being highly dissatisfied and five being highly satisfied. Complications, revision surgeries, and conversion hip arthroplasties were recorded. A multivariable model was created for analysis with statistical significance set at $P < 0.05$.

Table I. Patient demographics and surgical findings

	Mean	*SD*	n	*Min*	*Max*
Age	40.3	13.4	150	13.01	73.57
BMI	26.9	5.02	150	17.3	45.6
Gender	*n*	%			
Female	78	52.0			
Male	72	45.3			
Tonnis (on hips, $n = 159$)	*n*	%			
0	120	75.5			
1	31	19.5			
2	8	5.0			
FAI type (on hips, $n = 159$)	*n*	%			
Not reported	2	1.3			
Cam only	7	4.4			
Pincer only	8	5.0			
Cam-Pincer	142	89.3			
Outerbridge Class (on hips, $n = 159$)	*n*	%			
0	11	6.9			
1	33	20.8			
2	22	13.8			
3	67	42.1			
4	26	16.4			
Labral tears (on hips, $n = 159$)	*n*	%			
No labral tear	10	6.3			
Labral tear	149	93.7			

Min = minimum, Max = maximum.

RESULTS

A total of 150 patients (159 hips), mean age 40 years (range, 12–73) were enrolled. Outcomes are shown in Table III. Predicted NAHS means at preoperative timepoint was 54.9, 3 months: 66.6, 12 months: 74.9, and 24 months: 75.4. This represents a 20.5-point improvement in NAHS ($P < 0.001$; Fig. 1) On the 100-point scale, pain was rated +73.5, ADL's: +76.2, and sports: +68.6 (Fig. 2) There were no statistically significant predictors of change in NAHS (Table IV). Predictors analyzed age, gender, BMI, duration of symptoms, diagnosis, Tonnis score, surgeon, labral refixation, labral debridement, Outerbridge score, bilateral procedure, and microfracture chondroplasty.

64% of patients were either satisfied or highly satisfied with their surgical outcome (Fig. 3). Patients (8.8% of hips) with persistent pain underwent conversion to total hip (12) or resurfacing (2) arthroplasties and 3.1% required revision arthroscopy of which two patients (1.2%) specifically underwent revision of residual FAI. Complication rate from primary surgery was 2.5% (one

Table II. Surgical procedures

Procedure (on hips, n = *159)*	n	%
Acetabuloplasty only	12	7.5
Femoroplasty only	6	3.8
Both acetabuloplasty and femoroplasty	141	88.7
Labral procedures (on hips, *n* = 159)	*n*	%
No labral procedure	13	8.2
Labral debridement only	45	28.3
Labral repair only	94	59.1
Labral reconstruction only	7	4.4
Other procedures (on hips, *n* = 159)	*n*	%
Chondroplasty	40	25.2
Microfracture (acetabular)	10	6.3
Microfracture (femoral)	1	0.6

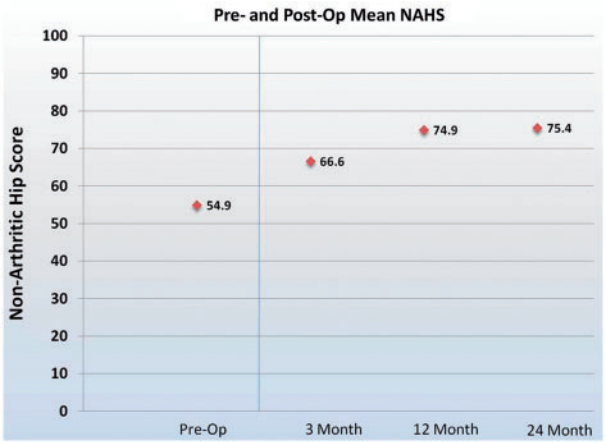

Fig. 1. Graphic display of pre- and postoperative mean nonarthritic hip scores at 3, 12, and ≥24 postoperative months. The latter represents a 20.5-point improvement in NAHS ($P < 0.001$).

pudendal neuropraxia, one sciatic neuropraxia, and two heterotopic ossification of Brooker grade 2 that did not require revision surgery) and there was one case of osteonecrosis following revision surgery.

DISCUSSION

The main finding of this study is that arthroscopic surgery for FAI in the community setting produced patient-assessed incremental improvements in pain and function and a low

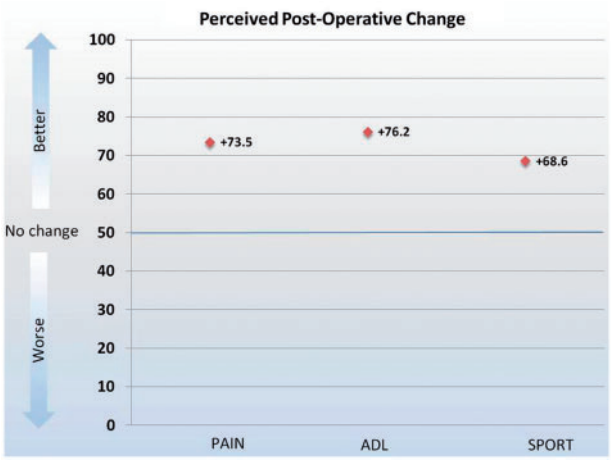

Fig. 2. Graphic display of patient-perceived post-operative change in pain, ADL, and sport. + = perceived improvement, − = perceived worsening.

complication rate. These outcomes are comparable to those from specialty referral centers [5, 6] but with somewhat lower satisfaction. Mean NAHS improved 20.5 points at minimum 2-year follow-up. The methodology used in this study retained patients who underwent conversion arthroplasty from post-operative analysis of all scores including the NAHS. Hence, these outcomes are at least as good as those reported in studies which excluded these "treatment failure" patients. The increase in mean NAHS was greater at 1 year than at 3 months and did not deteriorate (slightly increased) at ≥2 years. This trend in symptomatic improvement and functional restoration appears consistent with other studies with gradual continued improvement over a relatively long post-operative period. A recent study [5] showed sustained post-operative improvement after arthroscopic FAI surgery with minimum 4-year follow-up, suggesting that the clinical outcomes may be durable [7].

This study found no significant predictors of poorer outcomes including surgeon volume. As a large prospective study on arthroscopic surgical outcomes for FAI, the number of patients may still be insufficient to detect possibly significant factors. The least experienced surgeon was not a surgeon new to hip arthroscopy, being fellowship-trained in joint arthroplasty where a high volume of hip arthroscopy was performed. It is conceivable that surgeons with less experience in arthroscopic hip surgery may have inferior outcomes.

The current literature suggests that higher grade chondral lesions (Outerbridge grades 3–4) and osteoarthritis are predictors of poorer outcomes. Multivariate analysis did not detect worse outcomes from higher grade chondral lesions; however, these lesions, typically at the

Table III. Study outcomes

	Mean	*SD*	n	*Min*	*Max*
Nonarthritic hip score					
Baseline NAHS	54.58	17.8	127	9	94
3-month NAHS	67.71	18.15	89	18	99
12-month NAHS	74.78	18.99	102	14	100
24-month NAHS	75.82	18.79	116	25	100
Satisfaction response (average)					
3-month satisfaction	3.5	1.39	119	1	5
12-month satisfaction	3.47	1.54	116	1	5
24-month satisfaction	3.57	1.56	129	1	5
Satisfaction responses	1	2	3	4	5
3-month satisfaction	15	15	23	27	39
12-month satisfaction	21	16	6	27	43
24-month satisfaction	23	16	8	28	54
Arthroplasty conversions	*n*	%			
Total hip arthroplasty	12	7.5			
Birmingham hip resurface	2	1.3			
Revision arthroscopies					
ITB release + trochanteric bursectomy	3	1.9			
FAI revision	1	0.6			
FAI revision + ITB release	1	0.6			

Min = minimum, Max = maximum, ITB = iliotibital band, n = number.

anterosuperior acetabular rim, were often eradicated during acetabuloplasty. It is currently unknown whether acetabuloplasty with removal of these areas of chondrosis improves outcomes. Moreover, although we did not detect osteoarthritis as a predictor of poor outcomes, this study included mostly nonarthritic patients with only a minority with Tonnis 1 (mild) and Tonnis 2 (moderate) radiographic osteoarthritis.

The complication rate of 2.5% was comparable to that of other studies. There were no major complications (e.g. femoral neck fracture, hip dislocation, deep venous thrombosis/pulmonary embolism) although there was one patient who had femoral head osteonecrosis following revision surgery who underwent successful total hip arthroplasty. Pudendal neuropraxia occurred in one patient and sciatic neuropraxia in another with eventual spontaneous resolution. Two patients had Brooker stage 2 heterotopic ossification requiring no further surgery.

The arthroplasty conversion rate of 8.8% is almost identical to that of a large study of a single high-volume surgeon from a tertiary referral center [6]. Although direct comparisons are not made between patient populations and recognizing that longer term follow-up would likely produce more eventual arthroplasty conversions, we counsel patients that 5–10% of patients may undergo hip replacement within 2–3 years after surgery.

Patients (64%) in this study were either highly or moderately satisfied with their surgical outcome. A large systematic review reported patient satisfaction of 80% [3]. A number of studies have examined patient expectations in relation to hip arthroplasty [8–18]. Collectively, these have shown that patients' expectations are often overly

Table IV. Bivariate associations with change in nonarthritic hip score from baseline to 24 months

	Spearman correlation	*Spearman P values*	*Wilcoxon/Kruskal–Wallis P values*
Discrete variables			
Surgeon			0.80
Male	0.02	0.82	0.81
Osteoarthritis	0.13	0.22	0.22
Tonnis	0.12	0.26	0.50
Outerbridge class	0.08	0.45	0.87
Bilateral procedure	−0.14	0.17	0.17
Acetabuloplasty	−0.06	0.54	0.54
Femoroplasty	−0.02	0.87	0.86
Labral debridement	−0.14	0.17	0.17
Labral repair	0.05	0.61	0.61
Labral reconstruction	−0.19	0.06	0.06
Chondroplasty	−0.10	0.32	0.32
Acetabular microfracture chondroplasty	−0.03	0.77	0.76
Femoral microfracture chondroplasty	0.14	0.17	0.17
Continuous variables			
Age	−0.06	0.55	
BMI	−0.10	0.34	

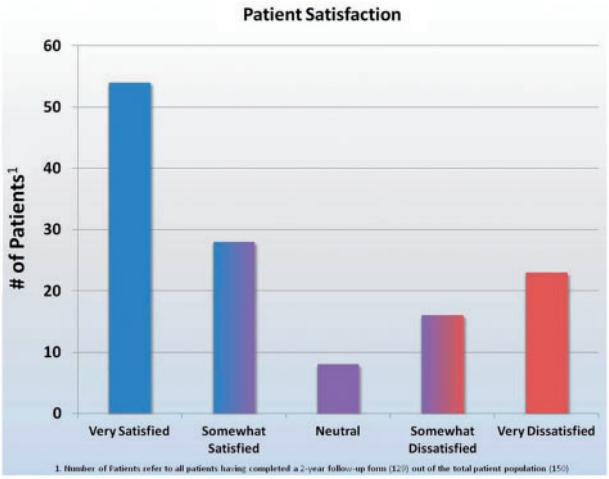

Fig. 3. Graphic display of patient satisfaction based on five-point Likert scale. Patients (64%) reported satisfaction with their surgical outcome.

optimistic, that 40% expectations go unfulfilled, and that pre-operative expectations or perceived fulfillment of such adversely impact satisfaction [19]. A single study investigating satisfaction following FAI surgery identified significant domains of pain relief and athletic function in this generally young adult patient population [19]. This study demonstrated self-perceived improvements in pain, ADL, and athletic function with the greatest improvement in ADL. During the study period, patients were told that they could return to their sport at 3 months. A level of short-term dissatisfaction would be reasonable based on current understanding of 4- to 6-month return to sports, but this dissatisfaction would not necessarily persist with longer follow-up. Professional athletes and high-level/motivated individuals seen at tertiary referral centers were not typically seen at our facilities and may differentially influence outcomes and satisfaction. Patient perception may also influence satisfaction via a Caruba effect [20]. Community hospitals and/or their surgeons and staff may not have the perceived expertise of those at specialty hip centers.

Although the incremental improvement in NAHS was similar to other published studies from tertiary single-surgeon referral centers, the absolute pre-operative and post-operative values were commensurately lower. This may be partially attributable to the stringent study methodology (potentially lowering mean post-operative scores), reflect a somewhat different patient population (e.g. no professional athletes), or relatively poor patient selection. Less post-operative improvement may occur in patients with more severe pre-operative symptoms and/or lower pre-operative PROMs [21, 22]. A recent study suggests a minimum threshold (patient-acceptable symptomatic state, PASS) at or above which patients deem their outcome acceptable or satisfactory following arthroscopic FAI surgery [23]. Although that study did not investigate the NAHS, a modified Harris Hip Score (mHHS) of 74 out of a possible 100 was determined to be the PASS. The mean NAHS at ≥2-year follow-up in this study was 75.4. Moreover, patients with higher baseline (pre-operative) mHHS were found to have higher odds (odds ratio, 3.36) of meeting the PASS. The lower relative baseline NAHS may have contributed to the lower patient-assessed satisfaction observed in this study.

As one of few multicenter, multi-surgeon community hospital-based study of outcomes following arthroscopic

surgery for FAI, these findings and derived conclusions may be generalizable to the growing number of surgeons performing these surgeries in non-tertiary referral centers. As such, this study supports the provision of arthroscopic FAI surgery in the community hospital setting.

LIMITATIONS

This prospective study used the NAHS as the primary PROM. As such, comparison with other studies using other PROMs (e.g. mHHS or iHOT) is limited. However, the NAHS is a validated PROM and has been used as the primary measure of outcome in several studies. Another limitation is the use of a five-point Likert scale to measure satisfaction. Comparison with surgical FAI outcome studies using other PROMs (e.g. 10-point satisfaction scale) is limited. The lack of post-operative physical examination data and radiographic measures documenting post-operative change is a limitation.

The surgeries for this study were performed in 2008–9. Interval advancements in the arthroscopic treatment of FAI (e.g. arthroscopic cam decompression of the anteromedial critical corner [24], capsular repair, extra-articular subspine decompression [25]) have since been implemented which might improve outcomes and affect comparison with more recent studies.

This study did not attempt to define a learning curve or minimal number of cases required to gain proficiency in hip arthroscopy in general and arthroscopic FAI surgery in particular. Nor was this study designed to determine the contribution of clinical factors to patient-assessed post-operative satisfaction.

CONCLUSION

Arthroscopic surgery for symptomatic femoroacetabular impingement in the community setting provides safe and successful outcomes.

CONFLICT OF INTEREST STATEMENT

D. K. Matsuda reports no relevant disclosures to this study, however does receive royalties for intellectual property from Smith and Nephew and Zimmer Biomet. The remaining authors have no relevant disclosures.

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