



High Rate of Return to Yoga for Athletes After Hip Arthroscopy for Femoroacetabular Impingement Syndrome

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Background: Femoroacetabular impingement syndrome (FAIS) is most commonly diagnosed in patients who perform activities that require repetitive hip flexion and rotational loading. Yoga is an activity growing in popularity that involves these motions. The purpose of this study was to evaluate patients' ability to return to yoga after hip arthroscopy for FAIS.

Hypothesis: There would be a high rate of return to yoga after hip arthroscopy.

Study Design: Retrospective analysis.

Level of Evidence: Level 4.

Methods: Consecutive patients with FAIS who had identified themselves as participating in yoga and had undergone hip arthroscopy for the treatment of FAIS between 2012 and 2015 were reviewed. Demographic data were collected and assessed for all patients, as well as preoperative physical examination, imaging, and patient-reported outcome (PRO) scores, including the modified Harris Hip Score (mHHS), Hip Outcome Score Activities of Daily Living (HOS-ADL) and Sports-Specific (HOS-SS) subscales, and visual analog scale (VAS) for pain. Postoperatively, examination and PRO data were collected at a minimum 1 year after surgery, including a yoga-specific questionnaire.

Results: A total of 42 patients (90% female; mean age, 35 ± 9 years; mean body mass index, 23.1 ± 3.2 kg/m²) were included. Thirty patients (71%) had to discontinue their yoga routine preoperatively because of hip-related symptoms at a mean 9.5 ± 8.2 months before surgery. After surgery, 39 patients (93%) were able to return to yoga at a mean 5.3 ± 2.2 months after surgery. Two of the 3 patients who did not return to yoga noted loss of interest as their reason for stopping, while 1 patient was unable to return because of persistent hip pain. Nineteen patients (45%) returned to a higher level of yoga practice, 17 patients (40%) returned to the same level, and 3 patients (7%) returned to a lower level. There was no difference in the number of hours spent practicing yoga per week pre- and postoperatively (2.7 ± 1.9 vs 2.5 ± 1.3 hours; $P = 0.44$). All patients demonstrated significant improvement in all PROs as well as pain scores after surgery (HOS-ADL, 67.4 ± 18.3 to 93.1 ± 6.9 [$P < 0.001$]; HOS-SS, 45.6 ± 24.7 to 81.5 ± 18.8 [$P < 0.001$]; mHHS, 62.3 ± 11.3 to 86.8 ± 12.3 [$P < 0.0001$]; VAS pain, 6.3 ± 2.2 to 0.90 ± 1.1 [$P < 0.001$]).

Conclusion: Patients participating in yoga return to yoga 93% of the time and at a mean 5.3 ± 2.2 months after hip arthroscopy for FAIS.

Clinical Relevance: Information regarding surgical outcomes is critical in counseling patients, particularly female athletes, on their expectations with respect to returning to yoga after hip arthroscopy for FAIS.

Keywords: FAIS; femoroacetabular impingement syndrome; hip arthroscopy; yoga; female athlete

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The following author declared potential conflicts of interest: Shane J. Nho, MD, MS, is a paid consultant for Stryker and Ossur and receives royalties from Ossur and Springer.

DOI: 10.1177/1941738118757406

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Femoroacetabular impingement syndrome (FAIS) is most commonly diagnosed in athletes who sustain repetitive flexion and rotational loading to their hip. Over the past decade, there has been a substantial increase in the number of publications regarding hip impingement in general, and in particular, FAIS in the young, athletic patient population. When nonoperative treatment fails, hip arthroscopy is a reliable surgical procedure for appropriately indicated patients, with excellent outcomes and low complication rates.^{5,9,13,14,30,32,33} Given the increasing volume of hip arthroscopy procedures being performed in athletes, data on the ability of athletes to return to sport (RTS) after hip arthroscopy have become more readily available.^{1,3-7,10-12,16-26,28-32,34-37} This information is critical, particularly for counseling patients, parents, and coaches on the expected outcomes after hip arthroscopy. While many of the available studies have focused on running and other high-impact and/or contact sports, there remains a paucity of data on the ability of patients to return to lower impact sports that require extremes of hip motion, including flexion and rotational loading.

Yoga is an activity growing in popularity that involves these motions. Recent epidemiologic data suggest that the majority of yoga participants are female, with a mean age of 30 to 40 years.^{2,8} While female patients benefit from hip arthroscopy, their overall outcomes and magnitudes of improvement are inferior compared with male patients, particularly in women older than 45 years.¹⁴ Unfortunately, no studies to date have evaluated patients' abilities to return to yoga after hip arthroscopy for FAIS. Given the rising popularity of yoga as a recreational activity, especially in women, as well as the seemingly increasing prevalence of hip-related complaints resulting from the extreme motions of flexion and/or rotation, a better understanding of expected outcomes after hip arthroscopy in this patient population is warranted. Therefore, the purpose of this study was to evaluate patients' abilities to return to yoga after hip arthroscopy for FAIS. The authors hypothesized that there would be a high rate of return to activity after hip arthroscopy, with the majority of patients returning to the same or better level of activity, with no differences based on age or sex.

METHODS

The Rush University Medical Center Institutional Review Board approved this study. Clinical data were retrospectively retrieved from a prospectively maintained institutional surgical registry for consecutive patients with FAIS who had identified themselves on intake forms as participating in yoga and who had undergone hip arthroscopy for the treatment of FAIS by a single fellowship-trained surgeon between 2012 and 2015. Indications for hip arthroscopy were based on clinical history, physical examination, and radiographic findings of FAIS (alpha angle, $>50^\circ$; lateral center-edge angle [LCEA], $>25^\circ$). Inclusion criteria included patients with a diagnosis of FAIS who self-reported themselves as participating in yoga with a minimum clinical

follow-up duration of 1 year. One year was chosen because of the primary aim of this study to describe return-to-yoga rates after hip arthroscopy, as this information is helpful in counseling athletes on appropriate expectations for returning to sport/activity after surgery. Exclusion criteria included patients with a history of rheumatologic disease, Tönnis grade >1 , hip dysplasia (LCEA, $<20^\circ$), prior history of congenital hip dislocation, Perthes disease, slipped capital femoral epiphysis, revision surgery, neurological disorders, and/or concomitant orthopaedic conditions (ipsilateral limb injuries, scoliosis, sacroiliac joint dysfunction).

Operative Technique

All arthroscopic procedures were performed under general anesthesia with the patient in the supine position on a standard traction table. Anterolateral and midanterior portals provided visualization of the central and peripheral compartments. Procedures performed included labral refixation or partial debridement, acetabular rim trimming, femoral osteochondroplasty, limited synovectomy, subspine decompression, and heterotopic excision, among others. T-capsulotomy was performed in all patients through the distal anterolateral accessory portal to assist with arthroscopic visualization in the peripheral compartment. Thorough femoral osteochondroplasty was performed in the peripheral compartment to address cam pathology. Dynamic examination confirmed no further evidence of impingement. The capsule was plicated at the end of the procedure; high-strength sutures were passed to ensure full-thickness bites through the vertical limb of the capsulotomy and were used to plicate the iliofemoral ligament, then the interportal capsulotomy was closed using 2 or 3 sutures, completing the procedure.

Rehabilitation

All patients underwent a 4-phase rehabilitation protocol lasting an average of 32 weeks (Table 1). Initially, the surgical leg was restricted to 20-pound foot-flat weightbearing. At week 3, patients were weaned off of crutches if they were able to tolerate ambulation without significant pain or compensatory gait movements. At week 6, patients were allowed to use the elliptical machine. Running on an antigravity treadmill was permitted at week 12. Patients progressed to sport-specific activities at week 16.

Within the first week, patients were instructed on how to perform a child's pose in a pain-free hip flexion motion. This creates a pelvic-on-femoral arthrokinematic glide, which reduces pain by limiting superior migration of the femur in the acetabulum and subsequent compression of the anterior superior labrum. The pose can be progressed to include slight, progressive hip internal and external rotation positioning as the hip flexion improves in a pain-free range. Patients were restricted from returning to yoga classes within the first 6 weeks because of the extreme ranges of motion required and to

Table 1. Rehabilitation regimen for returning to activity/yoga after hip arthroscopy

Phase	Goal	Restrictions	Techniques
1	Protect the joint	20-lb foot-flat weightbearing at 3 weeks Limit flexion, abduction, extension at 3 weeks No active sitting greater than 30 minutes at 3 weeks	Soft tissue mobilization Isometrics and pelvic stabilization Child's pose
2	Noncompensatory gait progression	Work to avoid compensatory or Trendelenburg gait Avoid sitting poses with twists Avoid deep flexion such as low lunges and/or hip rotation in forward folds Avoid long holds with surgical hip held actively in flexion such as tree poses	Aquatic therapy Soft tissue and joint mobilization Elliptical at week 6 Can begin standing poses such as warrior, modified triangle Child's pose with hip internal/external rotation
3	Return to preinjury function	Avoid agility drills until week 10 Avoid hip rotational activities until week 10 Avoid sitting poses with twists Avoid long holds with surgical hip held actively in flexion such as hip opening poses	Soft tissue and joint mobilization for prolonged stiffness Modified sitting poses without twists and modified tree pose Slowly work into forward and back bends with rotation
4	Return to yoga	Avoid any pose in deep flexion and rotation that cause groin or anterior hip pain Muscle strength and full range of motion goals at week 12	Soft tissue and joint mobilizations Slow progression to return to presurgery-level classes and poses Can begin hip flexor holds and sitting poses with bends and twists

protect the capsule and labrum. Weightbearing yoga poses, including warrior and single-leg poses such as tree formations, were allowed as early as week 6, with hip rotation and flexion maintained in pain-free positions (see Figures A1-A6 in Appendix 1, available in the online version of this article). Patients were advised to avoid deep flexion or extreme extension poses, including backbends and forward stretches, in weightbearing stances until after 6 weeks. As hip stability and strength improved, dynamic movements were incorporated into triangle poses that involved rotation in various positions. Patients were instructed to avoid sitting poses with extreme external rotation and flexion such as butterfly and cow face poses for up to 12 weeks.

Clinical Outcomes

Clinical outcomes were assessed at baseline and at a minimum of 1 year after surgery. For all patients, pre- and postoperative physical examination findings, including range of motion, as well as patient-reported outcome (PRO) measures, including the modified Harris Hip Score (mHHS), Hip Outcome Scores with Activities of Daily Living (HOS-ADL) and Sports-Specific (HOS-SS) subscales, and visual analog scale (VAS) for pain,

were assessed. The mHHS, HOS-ADL, HOS-SS, and VAS outcomes were assessed preoperatively and at the 6-month, 1-year, and 2-year follow-up periods. Data on pain and patient satisfaction were also recorded. A customized return-to-yoga questionnaire was sent to patients to complete by email (see Appendix 2, available online). Complications and reoperations were analyzed for all patients.

Imaging Outcomes

Anterior-posterior and Dunn lateral radiographs were obtained for all patients both pre- and postoperatively. The LCEA of Wiberg was measured on pre- and postoperative anterior-posterior radiographs to assess acetabular coverage. Pre- and postoperative alpha angles were measured on Dunn lateral radiographs according to the method previously defined by Notzli et al.²⁷ Additional characterization of hip arthritis was performed by measuring hip joint space width at the superolateral, apical, and superomedial positions.

Statistical Analysis

Patient data were analyzed using SPSS statistical software (IBM Corp). Patient demographics were presented as means and

Table 2. Patient demographics (N = 45 hips in 42 patients)

Sex	38 females, 4 males
Age, y	35 ± 9
Body mass index, kg/m ²	23.1 ± 3.2
Surgical side	19 left, 26 right
Bilateral surgery, n (%)	3 (7)

standard deviations or percentages. Categorical variables were presented as frequencies and percentages and were compared using Pearson χ^2 analysis. Continuous variables were expressed as means ± standard deviations and compared using the Student *t* test. To determine the predictors of early RTS, a logistic regression model was used for multivariate analysis. Return-to-yoga variables were reported as continuous data for hours spent weekly practicing yoga before and after surgery, length of time patients discontinued or decreased yoga preoperatively, and time to return to yoga postoperatively. Statistical significance was indicated by a *P* value <0.05.

RESULTS

Demographics

The query of the surgical repository identified 48 patients who self-indicated practicing yoga prior to hip arthroscopy. Four patients were excluded due to ipsilateral lower limb injuries (3 with knee injuries and 1 with recent ankle surgery). Forty-four patients met the inclusion criteria, and 42 of these patients (45 hips) completed the return-to-yoga surveys and PROs at a minimum 1 year after surgery, for an overall follow-up of 95%.

The study cohort included 38 females (90%) and 4 males (10%), with a mean age of 35 ± 9 years (range, 17-57 years) and mean body mass index (BMI) of 23.1 ± 3.2 kg/m² (Table 2). Patients participated in an average 2.5 ± 1.3 hours of yoga per week prior to surgery (range, 1-5 hours). Thirty patients (71%) had to discontinue or decrease their yoga participation because of hip-related pain at a mean 9.1 ± 6.8 months prior to surgery. Three patients (7%) underwent bilateral hip arthroscopy; their PROs are reflective of their most recent surgery, with a mean 4.5 months between hip surgeries.

Intraoperative Data

Hip arthroscopic procedures performed consisted of acetabular labral repair, femoral osteochondroplasty, acetabular rim trimming, and capsular closure (Table 3 and Figure A7 in Appendix 1). No surgical complications were recorded.

Clinical Outcomes

All patients demonstrated significant improvements in all PROs (*P* < 0.05) as well as in pain scores at a mean 30.5 ± 12.0

Table 3. Intraoperative findings and procedures performed

	N (hips)	%
Intraoperative findings		
Cam deformity	43	96
Pincer deformity	40	89
Mixed FAIS (cam and pincer)	38	84
Labral tear	45	100
Cartilage delamination	11	24
Surgical procedures performed		
Labral repair	45	100
Acetabular rim trimming	45	100
Femoral osteochondroplasty	43	96
Capsule closure	45	100
Trochanteric bursectomy	7	16
Excision of PVNS	1	2

FAIS, femoroacetabular impingement syndrome; PVNS, pigmented villonodular synovitis.

months (range, 12-44 months) after surgery (Tables 4 and 5, Figure A7 in Appendix 1). Within the follow-up period, none of the patients required revision hip arthroscopy or conversion to hip arthroplasty. After surgery, there were significant improvements in postoperative hip flexion (*P* = 0.0025) and internal rotation (*P* = 0.001); there was no difference in hip external rotation (*P* = 0.608) (Tables 4 and 5).

On linear regression analysis, lower BMI (*P* = 0.013; *R*² = -0.245) was a significant predictor of higher postoperative PROs, including mHHS, HOS-ADL, and HOS-SS outcomes. Age and sex did not correlate with PROs (*P* = 0.775 and 0.898, respectively).

Return-to-Yoga Results

A total of 39 patients (93%, 41 hips) were able to return to yoga at a mean 5.3 ± 2.2 months after hip arthroscopy for FAIS (Table 5). Two of the 3 patients who did not return to yoga noted loss of interest as their reason for discontinuing yoga. One patient did not return to yoga because of hip pain with activities. Nineteen patients (45%) were able to return to a higher level of yoga compared with their preoperative level, 17 patients (40%) returned to the same level, and 3 patients (7%) returned to a lower level. There was no significant difference between hours spent practicing yoga per week pre- and postoperatively (2.7 ± 1.9 vs 2.5 ± 1.3, *P* = 0.44). There was no association between when preoperative yoga was stopped due to hip symptoms and when patients were able to return to yoga (*R* = 0.0219).

Table 4. Clinical outcomes, including patient-reported outcome scores and range of motion

Outcome Measure	Preoperative Score	Postoperative Score	P
HOS-ADL	69.98 ± 18.71	93.84 ± 6.06	<0.0001
HOS-SS	48.03 ± 23.69	85.88 ± 12.87	<0.0001
mHHS	61.75 ± 12.93	89.65 ± 10.89	<0.0001
VAS pain	6.27 ± 2.15	1.40 ± 1.81	<0.0001
VAS satisfaction	—	87.1 ± 22.3	
Hip flexion, deg	111.81 ± 10.83	119.23 ± 8.15	0.0025
Hip external rotation, deg	39.2 ± 8.5	40.5 ± 11.1	0.608
Hip internal rotation, deg	19.17 ± 7.32	23.46 ± 5.64	0.001

HOS-ADL, Hip Outcome Score Activities of Daily Living subscale; HOS-SS, Hip Outcome Score Sports-Specific subscale; mHHS, modified Harris Hip Score; VAS, visual analog scale.

Table 5. Summary of return-to-yoga outcomes

No. of patients able to return to yoga, n (%)	39 (93)
Preoperative hours per week	2.7 ± 1.9
Postoperative hours per week	2.5 ± 1.3
Length of time yoga was discontinued prior to surgery, months	9.1 ± 6.8
Length of time to return to yoga after surgery, months	5.3 ± 2.2
Return ability level, n (%)	
Higher level	19 (45)
Same level	17 (40)
Worse level	3 (7)
Reasons for lower level return to yoga, n (%)	
Fear of reinjury	2 (5)
Other physical limitations	1 (2)

Imaging Outcomes

Alpha angles were measured on standard anterior-posterior and Dunn lateral radiographs (Table 6). Forty patients (95%) had evidence of cam deformity, as defined by alpha angle $>50^\circ$. Anterior-posterior pelvis radiographs revealed that 40 (95%) patients demonstrated pincer-type deformity of the femur, which was defined by an LCEA $>40^\circ$ or the presence of a

crossover sign. No patient demonstrated joint space width measures less than 2.0 mm on any radiographic measurement. Postoperative assessment of radiographs obtained after surgery showed significant reduction in both alpha angle and LCEA when compared with preoperative values (Table 6).

DISCUSSION

The principle findings of this study demonstrated that (1) there was a high rate of return to yoga after hip arthroscopy for FAIS at a mean 5.3 months after surgery, (2) there was no association between when preoperative yoga was stopped due to hip symptoms and when patients were able to return to yoga, and (3) most patients were able to return to the same or better level of yoga after surgery. This information is critical in counseling patients, particularly female athletes, on their expectations with respect to returning to yoga after hip arthroscopy for FAIS.

In general, the rate of RTS in athletes after hip arthroscopy for FAI is high. In 2017, Weber et al³⁷ reported on 66 patients (61% female) who underwent hip arthroscopy for FAI after failure of nonoperative treatment. Their cohort consisted of 49 recreational and 17 high-level amateur athletes participating in a variety of athletic activities and found an overall high rate of RTS in both groups: 94% for recreational athletes and 88% for high-level athletes. Notably, athletes who had stopped sports participation for greater than 8 months prior to arthroscopy returned to activities significantly more slowly compared with athletes who had been able to continue sports participation within 8 months of their surgery.³⁷ Mohan et al²⁴ reported even higher rates of RTS in their analysis of 50 amateur athletes undergoing hip arthroscopy for FAI, with an overall RTS of 96% at a mean 34 months after surgery. The authors noted that

Table 6. Radiographic outcomes

Outcome	Preoperative	Postoperative	P
Preoperative alpha angle, deg	59.20 ± 15.26	38.79 ± 9.9	<0.0001
Preoperative LCEA, deg	32.87 ± 9.17	27.74 ± 7.9	0.0030
Superolateral JSW, mm	3.57 ± 1.02	3.54 ± 1.3	0.5625
Apical JSW, mm	3.68 ± 0.9	4.2 ± 1.0	0.1782
Superomedial JSW, mm	4.1 ± 0.9	4.22 ± 1.0	0.3636
Mean JSW, mm	3.78 ± 0.9	3.9 ± 1.0	0.6619

JSW, joint space width; LCEA, lateral center-edge angle.

chondrolabral preservation, as opposed to labral takedown and reattachment, was associated with improved overall outcomes.²⁴ Similar high rates of RTS have been recently reported in professional football players,²² professional soccer players,¹ professional golfers,²⁵ and runners.¹⁸ These findings are supported by the data described in 2 previously published systematic reviews assessing RTS in both amateur and high-level athletes.^{7,19} In the present study, the return-to-yoga rate was 93%, with only 3 of 42 patients unable to RTS, and 2 of those patients stopping due to “loss of interest,” as noted on their postoperative yoga questionnaire; only a single patient did not return to yoga due to hip pain with activities. Because of the overall low occurrence of inability to RTS, no statistical association between preoperative cessation from yoga and rate of RTS was able to be determined.

The time to return to yoga in this series was, on average, 5.3 ± 2.2 months after hip arthroscopy, with 85% of patients able to return the same level (40%) or higher level (45%) compared with their preoperative level. While these data are encouraging, it is important to note that there was no clinically relevant difference between the patients’ preoperative and postoperative number of hours of participation in yoga per week. Notably, when assessing age, sex, and BMI as potential variables associated with PROs, only BMI was a significant predictor of postoperative PROs, while age and sex were not independent predictors of better or worse outcomes. Given that the study’s cohort was 90% female, this study was underpowered to detect any difference in any outcome on the basis of patient sex. In addition, given the narrow range of ages among the patients included in this study, we were unable to statistically determine any negative influence of older age on PROs, which has been shown in other studies.^{14,15}

Although there are some concerns about overconstraining the hip joint with capsular plication, the present study actually shows improvement in hip flexion and internal rotation. With the increased joint motion coupled with an activity that exceeds the physiologic joint tolerance, capsular plication may be critical to enhance kinematics while maintaining stability.

Limitations

This study has several limitations, including its retrospective nature and short follow-up of 1 year.^{13,18,37} Because of the methodology of administering the yoga questionnaire retrospectively, there is potential for recall bias. There was also no control group of patients participating in yoga undergoing a similar rehabilitation protocol (but without surgery), which would have strengthened the study.

CONCLUSION

Patients participating in yoga with the indications for surgery outlined here return to yoga 93% of the time at a mean 5.3 ± 2.2 months after hip arthroscopy for FAIS. There was no association between when preoperative yoga was stopped due to hip symptoms and when patients were able to return to yoga.

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