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

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Background: Femoroacetabular impingement syndrome (FAIS) is most commonly diagnosed in athletes who sustain repetitive flexion and rotational loading to their hip. The purpose of this study was to evaluate a patient's ability to return to cycling after hip arthroscopy for FAIS.

Hypothesis: There is a high rate of return to cycling after hip arthroscopy.

Study Design: Retrospective analysis.

Level of Evidence: Level 4.

Methods: Consecutive patients who had identified themselves as cyclists and had undergone hip arthroscopy for the treatment of FAIS were reviewed. Pre- and postoperative physical examinations, imaging, and patient-reported outcomes (PROs) 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 for pain, as well as a cycling-specific questionnaire, were assessed for all patients.

Results: A total of 58 patients (62% female; mean age, 30.0 ± 7.1 years; mean body mass index, 23.2 ± 2.7 kg/m^2) were included. Prior to surgery, patients averaged 30 ± 42 miles per week (range, 2-300 miles). Fifty-five patients (95%) were forced to discontinue cycling at an average of 7.5 ± 6.2 months prior to surgery due to hip pain. Fifty-six patients (97%) returned to cycling at an average of 4.5 ± 2.5 months after surgery, with 33 (59%) returning to a better level of cycling and 23 (41%) to the same cycling level. Postoperatively, there was no difference in the average number of miles patients completed per week compared with preoperative values ($P = 0.08$). At a mean follow-up of 31.14 ± 0.71 months (range, 24-48 months), all patients experienced significant improvements in mHHS, HOS-ADL, and HOS-SS PROs (all $P < 0.0001$), with an overall satisfaction rate of 91% ± 13%.

Conclusion: Recreational and competitive cyclists return to cycling 97% of the time after hip arthroscopy for FAIS, with most of these patients returning at an average of 4.5 months after surgery. This information is helpful in counseling patients on their expectations with regard to returning to cycling after hip arthroscopy for FAIS.

Clinical Relevance: Cyclists return to sport 97% of the time at an average of 4.5 months after hip arthroscopy for FAIS.

Keywords: FAI; femoroacetabular impingement; hip arthroscopy; cycling; female athlete

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Over the past decade, femoroacetabular impingement syndrome (FAIS) has become an increasingly recognized source of hip pain in the young, athletic patient population. Impingement is most often symptomatic when the hip is in the provocative position of flexion, adduction, and internal rotation, and thus is commonly diagnosed in athletes who participate in sports that require repetitive flexion and rotational movements of the hip. Recently, there has been a substantial increase in the number of publications regarding hip impingement in general, and in particular, FAIS in athletes. Cycling is an activity growing in popularity that involves these motions, particularly with regard to repetitive hip flexion movements. In a study comparing hip flexion angles achieved while cycling with those at which impingement occurs, Lajam et al[15] found that the mean maximum hip flexion angle in the forward flexed position during cycling is 133.7° ± 9.7°, while the mean flexion angle at which impingement occurs (intraoperatively) is 52.8° ± 11.4°.[15] These findings led the authors to conclude that engagement of FAIS lesions occurs at substantially lower hip flexion angles compared with the degrees of hip flexion often experienced by cyclists, suggesting that athletes predisposed to developing FAIS can become symptomatic with repetitive cycling.

When appropriately indicated, hip arthroscopy incorporating acetabular rim trimming, labral debridement/repair/reconstruction, and femoral osteochondroplasty is a reliable surgical solution for patients with FAIS, resulting in good to excellent outcomes with low complication rates.[4,7,11,12,27,30,31] For the athletic patient population; however, one of the more critical clinical outcomes is the ability of athletes to return to sport (RTS) after hip arthroscopy.[1-6,8-10,14,16-30,32,33,35,36] This type of data are important for individual patients to understand their expected outcomes after hip arthroscopy, particularly for athletes participating in potentially high-risk activities such as cycling.

Unfortunately, no studies to date have evaluated patients' abilities to return to cycling after hip arthroscopy for FAIS. Given the rising popularity of cycling as a recreational and competitive activity, both as a stand-alone sport as well as through its role in triathlon, 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 cycling after hip arthroscopy for FAIS. The authors hypothesized that there would be a high rate of return to cycling 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

Our university's institutional review board (Rush University Medical Center) approved this study. A retrospective review of prospectively collected clinical data from an institutional surgical registry for patients undergoing hip arthroscopy for FAIS was performed. Patients who had identified themselves as recreational or competitive cyclists on intake forms and had undergone hip arthroscopy for FAIS between 2012 and 2014, with a minimum clinical follow-up of 2 years, were included. Indications for surgery were based on patient history, physical examination findings, and imaging findings consistent with FAIS (α angle >50°, lateral center-edge angle of Wiberg [LCEA] >25°). Exclusion criteria included patients undergoing revision arthroscopy as well as patients with a history of rheumatologic disease, Tönnis grade > 1, hip dysplasia (LCEA <20°), prior history of congenital hip dislocation, Perthes disease, slipped capital femoral epiphysis, neurological disorders, and/or concomitant orthopaedic conditions (ipsilateral limb injuries, scoliosis, sacroiliac joint dysfunction).

Rehabilitation

All patients underwent a 4-phase rehabilitation protocol (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. By 6 weeks, patients were permitted to use the elliptical machine. By 12 weeks, running on an antigravity treadmill was allowed, with progression to sport-specific activities (in addition to cycling) at week 16.

Patients progressed to return to cycling when they were able to perform the exercises from the earlier phases of the rehabilitation protocol with no pain. Patients started on a stationary bike and progressed to road cycling (if desired) when they were able to cycle continuously on the stationary bike for at least 30 minutes without pain. Resistance training, including sit/stand drills, was gradually introduced at 10 weeks, and positioning in aerobars or drops was added at 12 weeks. Subsequently, patients then advanced to single-leg pedal and standing upper body freeze drills. Patients were cleared to return to cycling at the recommendations of the senior author, typically between 4 and 5 months after surgery.

Clinical Outcomes

Clinical outcomes were assessed for all patients preoperatively and at a minimum 2 years after surgery. Data collected included physical examination findings with range of motion as well as various patient-reported outcomes (PROs), 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 for pain. In addition, data on pain and patient satisfaction were recorded. Complications, failures, and reoperations were analyzed for all patients. A customized return-to-cycling questionnaire was sent to patients to complete via email at a minimum 2 years after surgery (Appendix 1, available in the online version of this article).

Imaging Outcomes

Anterior-posterior and Dunn lateral radiographs were obtained for all patients both preoperatively and postoperatively. For all patients, the alpha angle was measured on Dunn lateral radiographs, and the LCEA was measured on anterior-posterior

Table 1. Rehabilitation regimen for returning to cycling after hip arthroscopy

Phase	Goal	Restrictions	Techniques
1	Protect the hip joint	20-lb foot-flat weightbearing at 3 weeks No external rotation at 3 weeks Limit flexion, abduction, extension at 3 weeks No active sitting >30 minutes at 3 weeks	Soft tissue mobilization Isometrics Nonresistant stationary bicycle Active range of motion
2	Noncompensatory gait progression	Work to avoid compensatory or Trendelenburg gait Avoid aggressive stretching Avoid treadmill use	Gait training Aquatic pool program Core stability Joint mobilization Elliptical at week 6
3	Return to preinjury function	Avoid agility drills until week 10 Avoid hip rotational activities until week 10 No contact or high-impact activities Avoid treadmill	Single-leg squat and strengthening Soft tissue and joint mobilization for prolonged stiffness Cardiovascular fitness
4	Return to sport	Ensure adequate functional strength and proximal control prior to advancing	Plyometrics and performance training Sport training and conditioning Gradual increase in continuous biking on elliptical machine After 30 minutes is achieved, resistance is gradually introduced Timed sit to stands on the pedals Aero bars or drops, introduced after 12 weeks Single-leg pedal drills Standing upper body freeze drill

radiographs. 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 standard deviations or percentages. Continuous variables were compared using bivariate regression, while categorical data were compared using Pearson χ^2. One-way analysis of variance was used to compare continuous variables against categorical variables. Pre- and postoperative scores were compared using Student *t* tests. Return-to-cycling variables were reported as continuous data for miles spent weekly cycling before and after surgery, length of time patients discontinued or decreased cycling preoperatively, and time to return to cycling postoperatively. An alpha value of $P < 0.05$ denoted statistical significance.

RESULTS

The query of the surgical repository identified 68 patients who indicated that they were cyclists prior to hip arthroscopy. Six patients were excluded for having arthroscopy performed for indications other than FAIS (trochanteric bursitis, n = 2; gluteus medius repair, n = 4). Sixty-two patients met the inclusion criteria, and 58 (60 hips) of these patients completed the return-to-cycling surveys and PROs at a minimum 2 years after surgery, for an overall follow-up of 93.5%.

The study cohort of 58 patients (60 hips) included 36 women (62%) and 22 men (38%), with a mean age of 30.0 ± 7.1 years and a mean body mass index (BMI) of 23.2 ± 2.7 kg/m^2 (Table 2). All patients reported biking or cycling as a recreational activity. Two patients (3%) underwent bilateral hip arthroscopy; their PROs are reflective of their most recent surgery, with a mean 4.5 months between surgeries.

Intraoperative Data

All patients underwent primary hip arthroscopy for the correction of FAIS (Table 3). Specific procedures performed at the time of arthroscopy included labral repair in 60 hips (100%), acetabular rim trimming in 55 (91%), capsular plication in 60 (100%), synovectomy in 59 (98%), heterotopic ossification excision in 1 (2%), and acetabular microfracture in 1 patient (2%). Intraoperative evidence of cartilaginous delamination was observed in 26 hips (43%).

Table 2. Demographics[a]

Sex	36 women, 22 men
Age, y, mean ± SD	30.0 ± 7.1
Body mass index, kg/m^2, mean ± SD	23.2 ± 2.7
Surgical side	32 left, 28 right
Bilateral surgery, n (%)	2 (3)
Competition level, n (%)	
Recreational	58 (100)
Competitive	0 (0)
Cycling mode, n (%)	
Stationary	18 (31)
Mobile	40 (69)
Biking as means of transportation, n (%)	14 (24)

[a]*N* = 60 hips in 58 patients.

Table 3. Intraoperative findings[a]

	No. of Hips	%
Cam deformity	60	100
Pincer deformity	52	87
Mixed femoroacetabular impingement	52	87
Labral tear	60	100
Cartilage delamination	26	43
Surgical procedures performed		
Labral repair	60	100
Acetabular rim trimming	55	91
Femoral osteochondroplasty	60	100
Capsular closure	60	100
Microfracture	1	2
Heterotopic ossification excision	1	2

[a]*N* = 60 hips in 58 patients.

Clinical Outcomes

At a mean 31.14 ± 0.71 months after surgery, all patients had significant improvements in all PROs (all $P < 0.0001$), with a satisfaction rate of 91% ± 13% (Table 4). Postoperatively, there was significant improvement in forward flexion (110.3 ± 11.4 to 118.1 ± 8.44 degrees, $P < 0.01$) and internal rotation (12.58 ± 9.91 to 20.97 ± 9.62 degrees, $P < 0.001$).

Return-to-Cycling Results

All patients (100%) were considered recreational cyclists (Table 5). Forty patients (69%) participated primarily in outside cycling while the other 18 patients (31%) rode stationary bikes (ie, in a health club). Fourteen patients (24%) reported using a bicycle as means of transportation. Preoperatively, patients averaged 30.3 ± 42.4 miles (range, 2-300 miles) of cycling per week. Because of pain and discomfort, 55 patients (95%) were forced to discontinue cycling at an average of 7.5 ± 6.2 months prior to undergoing surgery for FAI. Postoperatively, 56 patients (97%) returned to cycling at an average of 4.5 ± 2.5 months after arthroscopy, with 33 patients (59%) returning to a better level of cycling and 23 patients (41%) to the same cycling level. At the time of latest follow-up, patients who returned to cycling averaged 23.8 ± 22.9 miles per week, which was not significantly different from their average preoperative mileage ($P = 0.08$). On bivariate analysis, patients using the stationary bike had a lower return to cycling time after surgery (3.5 ± 2.6 months) compared with patients primarily using a mobile bike (4.9 ± 2.4 months, $P = 0.06$). The number of miles cycled preoperatively was positively correlated with a shorter time to return to cycling postoperatively ($r^2 = 0.6$, $P = 0.07$). There was no association between when preoperative cycling was stopped due to hip symptoms and when patients were able to return to cycling ($P = 0.18$). The 2 patients who returned at a lower level were found to have persistent pain postoperatively. The 2 patients who did not return to cycling at all did not return because of loss of interest (n = 1) and persistent postoperative hip pain (n = 1).

Imaging Outcomes

The mean alpha angle, as measured on Dunn lateral radiographs, was 61.7° ± 10.3°, with all hips ($N = 60$) in the 58 patients (100%) having a radiographic cam deformity. The mean preoperative LCEA was 31.39° ± 5.6°. No patient demonstrated joint space width measures less than 2.5 mm on any radiographic measurement. Radiographs obtained after arthroscopy showed significant reduction in both alpha angle and LCEA when compared with preoperative values (Table 6).

DISCUSSION

The principle findings of this study demonstrate that (1) there is a high rate of return to cycling (97%) after hip arthroscopy for FAIS at a mean 4.5 months after surgery, (2) there is no association between when preoperative cycling was stopped due to hip symptoms and when patients are able to return to cycling, and (3) patients are able to return to the same volume of cycling after surgery.

Table 4. Clinical outcomes

Outcomes	Preoperative	Postoperative	*P*
HOS-ADL	70.3 ± 16.3	92.9 ± 9	<0.0001
HOS-SS	41.5 ± 23.2	85.2 ± 16	<0.0001
mHHS	61.7 ± 11.2	92.1 ± 9.9	<0.0001
VAS pain	71.9 ± 17.3	8.5 ± 12.7	<0.0001
VAS satisfaction		90.7 ± 12	

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

Similar to the findings in the present study, the ability of athletes to return to both high- and low-impact sports after hip arthroscopy for FAIS is quite good among both recreational and professional athletes, as demonstrated by multiple prior authors.[6,18,19,23,36] Rates of RTS after arthroscopy for FAIS approach 82% to 100% in professional hockey players,[20,29] 87% in professional football players,[21] 96% in Australian football players,[33] 100% in professional soccer players and golf athletes,[1,24] 88% in competitive baseball players,[8] and 94% in runners.[17] Interestingly, rowers appear have a substantially lower rate of RTS, with Boykin et al[3] reporting an RTS rate of 56% at a mean 8 months after surgery. It is unclear why rowing, a nonimpact activity requiring high hip flexion movements, would be associated with relatively low RTS rates compared with cycling, a similarly nonimpact activity that requires high hip flexion movements.

Athletes participating in cycling are at particular risk for pain attributable to hip impingement because of the repetitive hip flexion movements at high flexion angles. In the single available study published on cyclists and FAIS, Stone et al[34] compared the intraoperative findings of 16 cyclists undergoing hip arthroscopy for FAIS with 167 noncyclists. Patients in the cyclist group had significantly greater femoral head chondromalacia grade (2.0 vs 1.4, $P = 0.043$), femoral head chondromalacia area (242 vs 128 mm^2, $P < 0.001$), and femoral head chondromalacia index (486 vs 247, $P = 0.001$) compared with noncyclists. Hip pain in cyclists correlated positively with increased acetabular CEAs, increased Tönnis grade, and the presence of a coxalgic gait. They concluded cyclists with hip pain have more femoral head chondral pathology than noncyclists. Unfortunately, clinical outcomes after surgery were not available in their article, and thus no comparisons with the present study can be made.

In 2016, Girard et al[13] assessed the rate of RTS in 48 long-distance triathletes after hip resurfacing. Prior to surgery, in addition to time spent running and swimming, athletes cycled an average of 5 hours and 50 minutes per week. Interestingly, after surgery, there was a significant increase in the patients' mean cycling volume by 1 hour and 5 minutes ($P < 0.05$), with associated significant decreases in running volume and increases in swimming volume. The RTS rate for cycling was 85%, compared with 69% for running and 79% for swimming. While it is certainly difficult to compare RTS rates after hip resurfacing with RTS rates after hip arthroscopy, it follows that low-impact sports such as cycling, despite the high flexion angles required, are well tolerated by patients undergoing hip surgery, leading to a high rate in activity resumption after surgery.

Table 5. Summary of return-to-cycling outcomes[a]

Returned to cycling, n (%)	56 (97)
Preoperative miles per week	30.3 ± 42.4
Postoperative miles per week	23.8 ± 22.9
Length of time cycling was discontinued, mo	7.5 ± 6.2
Length of time to return to cycling with minimal pain, mo	4.5 ± 2.5

[a]Data presented as mean ± SD unless otherwise indicated.

In the present study, return to cycling activities occurred at a mean 4.5 ± 2.5 months after hip arthroscopy, with 97% of patients able to return the same (41%) or higher (59%) level of cycling compared with preoperative levels. Two of 58 patients were unable to RTS, with only 1 of those stopping due to persistent hip pain. Because of the overall low occurrence of inability to RTS, no statistical association between preoperative cessation from cycling and rate of RTS was able to be determined. Notably, patient age, sex, and BMI were not independently associated with PROs or RTS rates.

Limitations

This study has several limitations, including its retrospective nature and relatively short-term follow-up. Because of the methodology of administering the cycling questionnaire retrospectively, there is a potential for recall bias. There was no control group of patients participating in cycling undergoing a similar rehabilitation protocol (but without surgery), which would strengthen the study.

Table 6. Radiographic measures for recreational cyclists with symptomatic FAI

	Preoperative	Postoperative	*P*
Alpha angle, deg	61.7 ± 10.3	39.05 ± 4.31	<0.0001
LCEA, deg	31.39 ± 5.6	26.89 ± 4.32	<0.0001
Superolateral JSW, mm	4.1 ± 0.8	4.0 ± 0.7	0.47
Apical JSW, mm	3.97 ± 0.8	4.0 ± 0.8	0.83
Superomedial JSW, mm	4.3 ± 0.8	4.1 ± 0.8	0.18
Mean JSW, mm	4.2 ± 0.7	4.1 ± 0.7	0.48

FAI, femoroacetabular impingement; JSW, hip joint space width; LCEA, lateral center-edge angle.

CONCLUSION

Recreational and competitive cyclists return to cycling 97% of the time after hip arthroscopy for FAIS, with most of these patients returning at a mean of 4.5 months after surgery. This information is critical in counseling patients on their expectations with respect to returning to cycling after hip arthroscopy for FAIS.

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