Research Article

OPEN

Risk Factors for Bilateral Femoroacetabular Impingement Syndrome Requiring Surgery

Natalie L. Leong, MD
William Neal, BS
Thomas Alter, BS
Edward Beck, MPH
Shane J. Nho, MD, MS

Abstract

Purpose: To identify the risk factors for contralateral surgery in patients undergoing hip arthroscopy for femoroacetabular impingement syndrome (FAIS).

Methods: Patients who underwent unilateral surgery were compared with those who underwent staged bilateral surgery to identify risk factors associated with bilateral surgery. Variables examined included demographics, comorbidities, and radiographic features. Binary logistic regression was used to identify predictors of bilateral FAIS.

Results: A total of 694 patients with an average age of 34.0 ± 13.1 years met were included in the analysis. Overall, 109 patients (15.3%) had staged bilateral hip arthroscopy for FAIS. Risk factors associated for bilateral FAIS requiring surgery were decreased age and lower Charlson Comorbidity Index (CCI). Compared with patients aged <25 years, those aged 25 to 34 years (odds ratio [OR], 0.5; $P = 0.031$), 35 to 44 years (OR, 0.5; $P = 0.034$), and ≥45 years (OR, 0.3; $P = 0.002$) had lower odds of bilateral labral tear. In addition, patients with a CCI <2 were three times more likely to require bilateral FAIS surgery (OR, 3.4; $P = 0.044$). None of the radiographic parameters predicted bilateral labral tears.

Conclusion: Patients younger than 25 years and those with a CCI <2 had markedly increased rates of bilateral FAIS necessitating surgery compared with older patients. This study may be of value in preoperative counseling.

From the Section of Young Adult Surgery, Division of Sports Medicine, Department of Orthopedic Surgery, Rush Medical College of Rush University, Rush University Medical Center, Chicago, IL.

Correspondence to Dr. Nho: Shane.nho@rushortho.com

IRB status: approved by local IRB (#12022108-IRB01-AM03).

JAAOS Glob Res Rev 2018;2:e070

DOI: 10.5435/JAAOSGlobal-D-18-00070

Acetabular labral tear is a common sequelae of femoroacetabular impingement syndrome (FAIS) in the active population.[1] The use of hip arthroscopy is rapidly growing in the treatment of pathologic hip conditions such as labral tear and FAIS.[2-4] Arthroscopic treatment of FAIS is generally successful,[5] with high rates of return to sport,[6] clinical outcomes similar to that of open surgical dislocation treatment,[6,7] and low complication and relatively rapid rehabilitation rates.[7,8]

Risk factors for labral tears have been studied, and several have been

identified. Labral tears can be secondary to abnormal pathomorphology due to FAIS, dysplasia,[1,9,10] traumatic hip dislocation,[11-13] or degeneration. Radiographically, early degenerative disease in FAIS is associated with labral lesions.[14] One MRI study found that 61% of symptomatic FAIS patients had labral tears compared with 44% of age-matched asymptomatic volunteers.[15]

Sometimes, patients have bilateral FAIS and require surgery on both hips.[16-18] This condition may be due to similar hip morphology bilaterally. Previously, it was reported that although both patients who underwent unilateral and bilateral hip arthroscopy had improved functional outcomes at 2-year follow-up, those who underwent bilateral surgery had less improvement in their modified Harris Hip Score and pain scores compared with sex-, body mass index (BMI)-, and age-matched patients who underwent unilateral surgery.[19] Thus, it would be of interest to be able to predict which patients would eventually require surgery on the contralateral hip, particularly for patient counseling and education. Yet despite a substantial number of patients with bilateral involvement, only one study has examined demographic risk factors leading to bilateral arthroscopic labral surgery.[20] Although this study was conducted well, it included a total of 81 patients undergoing bilateral hip arthroscopy. The present study would add to the literature by providing additional data points for a future systematic review or meta-analysis examining the various risk factors for bilateral surgery. Thus, the objective of this retrospective cohort study was to determine the risk factors for eventual bilateral FAIS requiring surgical intervention in patients undergoing labral surgery on a single hip. On the basis of the aforementioned study, we hypothesized that patients with more severe FAIS and higher activity levels would be more likely to require bilateral surgery.

Methods

A review of an institutional surgical registry was performed. Institutional review board approval for studies stemming from the surgical registry was received. Patients undergoing hip arthroscopy between January 1, 2012, and July 16, 2014, by a single surgeon were identified. A patient was considered to have bilateral procedures if they had a unilateral hip arthroscopy, followed by hip arthroscopy, on the contralateral side between the time of the first arthroscopy and November 2017. Patients who had hip arthroscopy on the contralateral side before the study period were excluded from the analysis of risk factors predicting contralateral FAIS requiring surgery. Data collected included demographics (eg, age, BMI, sex), self-reported physical activity level, comorbidities (eg, Charlson Comorbidity Index [CCI],[21] smoking status), and radiographic features (eg, alpha angle, lateral center edge angle, Tonnis grade) between patients with unilateral and bilateral surgery to identify risk factors associated with bilateral hip arthroscopy. The CCI is a tool that was originally developed to quantify the comorbidities on survival and assigns point values for comorbidities such as diabetes, heart disease, and liver disease.[22] The CCI has since been validated for a number of orthopaedic applications, including for prediction of the complication rate in patients undergoing revision total hip arthroplasty.[22] The alpha angle was measured off a Dunn lateral radiograph of the hip, whereas the lateral center edge angle was measured off an AP view. Imaging, and thus radiograph measurements, for the contralateral hip was not obtained unless the patient was symptomatic on the contralateral side.

Indications for surgery were pain affecting activities, failure of nonsurgical treatment, evidence of femoroacetabular impingement on physical examination, radiographic evidence of FAIS, and evidence of labral tear on MRI, all in the absence of arthritis higher than Tönnis grade 1. Patients undergoing only peritrochanteric procedures were not included in this study, and none of the contralateral surgeries captured during the study period were for peritrochanteric diagnoses. In general, patients were not booked for bilateral surgeries at one time. The more symptomatic hip was treated with hip arthroscopy, and after a recovery period of several weeks to months, if the other hip continued to meet indications for surgery, it was then scheduled.

Surgical Technique and Postoperative Rehabilitation

The senior author's preferred surgical technique has been previously described, which uses a combination of labral débridement or labral repair depending on the quality of labral tissue and extent of detachment, femoral osteochondroplasty,

Dr. Nho or an immediate family member has received IP royalties from Ossur; serves as a paid consultant to Ossur and Stryker; has received research or institutional support from Allosource, Arthrex, Athletico, DJ Orthopaedics, Linvatec, Miomed, Smith & Nephew, and Stryker; and serves as a board member, owner, officer, or committee member of the American Orthopaedic Society for Sports Medicine and the Arthroscopy Association of North America. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Leong, Mr. Neal, Mr. Alter, and Mr. Beck.

acetabular rim trimming, synovectomy, and capsular plication.[23-25] Rehabilitation started on postoperative day 1 for all patients regardless of athletic status as previously described.[23]

Statistical Analysis

Data are reported as mean ± SD unless otherwise noted. First, univariate testing in the form of *t*-tests was used to determine whether continuous variables (eg, BMI, alpha angle, lateral center edge angle, age) were associated with a significant risk of bilateral hip surgery. Similarly, logistic regression was performed to determine whether categoric variables (eg, sex, self-reported activity level, Tonnis grade, smoking status, CCI, psychiatric history, narcotic use) were predictors of bilateral labral tear requiring surgery, and odds ratios were reported. All data analysis was performed with SPSS Statistical Software (IBM SPSS Statistics for Windows, Version 23.0; IBM).

Table 1

Continuous Risk Factors for Contralateral Labral Tears, Presented as Mean ± SD, Along With *P* values

Risk Factor	Unilateral	Bilateral	*P* Value
Age	34.8 ± 12.6	28.8 ± 11.0	0.0001
BMI	25.1 ± 4.8	24.8 ± 5.6	0.584
Alpha angle	60.4 ± 10.7	62.4 ± 10.1	0.121
CEA	32.9 ± 7.4	32.2 ± 5.7	0.420

BMI = body mass index, CEA = center edge angle
Only younger age was a significant risk factor.

Table 2

Categoric Risk Factors for Contralateral Labral Tears

Risk Factor	Unilateral (%)	Bilateral (%)	OR	*P* Value
Female	64.6	63.1	0.936	0.786
Current smoking	4.0	7.4	1.46	0.144
Regular exercise	67.1	74.0	1.47	0.157
Tonnis = 1	9.2	7.3	0.782	0.583
Psychiatric history	18.6	18.6	0.998	0.995
Previous narcotic use	22.3	13.0	0.522	0.083
CCI >0	24.6	15.5	0.561	0.068
CCI >1	11.1	3.6	0.296	0.044

CCI = Charlson Comorbidity Index, OR = odds ratio
With significance at $P < 0.05$, only a CCI >1 was predictive of a lower likelihood of contralateral tear.

Results

A total of 694 unique consecutive patients who underwent hip arthroscopy for treatment of FAIS by a single surgeon were identified. Two-year follow-up was completed in 555 patients (80%). The average follow-up period was 2.2 ± 1.1 years in unilateral patients and 2.4 ± 0.6 years in bilateral patients. Of the 585 unilateral patients, 40 of the index surgeries were revision surgeries. Two of the unilateral patients underwent revision hip arthroscopy during the study period. Staged bilateral hip arthroscopy was performed in 109 patients (15.7%) during the study period. Of these patients, two index surgeries were revision surgeries, and one had a revision surgery on the index side during the course of the study for revision labral repair. Of these 109 patients, 25 (22.9%) had contralateral surgery before enrollment in the study, and 84 patients (77.1%) had contralateral surgery after the index surgery for which they were enrolled into the study, averaging 263 ± 192 days apart. The 25 patients who were excluded because only their second hip arthroscopy fell within the enrollment period were omitted from analysis because data regarding their preoperative status before the first surgery had not been collected and could be subject to recall bias. The average age was 33.9 ± 12.6 years, 65.1% of the patients were female, and average BMI was 25.1 ± 5.0. The only demographic factors associated with bilateral pathology requiring operation were age ($P < 0.001$) (Table 1) and a CCI greater than 1 ($P < 0.044$) (Table 2). Patients undergoing unilateral surgery were aged 34.8 ± 12.6 years compared with patients undergoing staged bilateral surgery who were aged 28.8 ± 11.0 years. Eighteen percent of patients younger than 25 years, 14% of patients aged 25 to 34 years, 10.4% of patients aged 35 to 44 years, and 5.2% of patients older than 45 years went on to have surgery on the contralateral side. Compared with patients aged <25 years, those aged 45 and older had less than one-third the rate of staged bilateral hip arthroscopy compared with those younger than 25 years (odds ratio, 0.3; $P = 0.002$). The CCI of unilateral patients was 0.46 ± 1.1 versus 0.19 ± 0.48 in bilateral patients. Of the unilateral patients, 441 had a CCI of zero, 79 had a CCI of 1, 37 had a CCI of 2, 11 had a CCI of 3, 11 had a CCI of 4, and 6 had a CCI of at least

5. Among the bilateral patients, 71, 10, and 3 patients had CCIs of zero, 1, and 2, respectively. In addition, 67.1% of unilateral patients reported participating in regular exercise compared with 75.0% of bilateral patients. However, regular exercise was not a statistically significant predictor of contralateral surgery.

All the patients in the study were either Tonnis grade 0 or grade 1; no significant difference in the incidence of FAIS treated with surgery was found in grade 1 patients. Furthermore, no differences in the incidence of contralateral surgery were found as a function of smoking status, preoperative narcotic use, psychiatric history, sex, BMI, alpha angle, or lateral center edge angle. Specifically, the unilateral patients had alpha angles of 60.4 ± 10.7 versus 62.4 ± 10.1 in the bilateral patients, and the lateral center edge angles were 32.8 ± 7.3 in the unilateral patients versus 32.2 ± 5.7° in the bilateral patients.

Discussion

Although data exist on differences in affected and unaffected hips in patients with bilateral cam-type deformities,[26] a relative paucity of literature exists regarding the risk factors leading to bilateral hip arthroscopy. In this cohort study of data from 694 hip arthroscopy patients, we sought to determine the specific risk factors that are predictive bilateral hip arthroscopy for FAIS. We found that 15.3% of patients undergoing unilateral surgery would require surgery on the contralateral side within 2 years. Furthermore, we found that younger, healthier patients (as measured by the lower CCI) were more likely to undergo bilateral surgeries. Specifically, we found that patients younger than 25 years were approximately twice as likely (20%) to eventually undergo surgery on the contralateral side. The mean age of bilateral patients undergoing surgery on the first side was 6 years younger than unilateral patients, suggesting that bilateral patients may develop symptoms requiring surgical treatment at a younger age than unilateral patients. However, CCI is not an independent risk factor from age. For every decade after age 50 years, one point is added to the CCI.

Only one previous study, performed by Klingenstein et al,[20] has investigated risk factors that lead to bilateral hip arthroscopy for FAIS, in which the prevalence of bilateral surgery was found to be 20.4%. This study found that younger patients, males, higher alpha angles, and reduced acetabular anteversion at initial presentation of the first hip were predictive of bilateral surgery for FAIS. Although we also found the increased likelihood of bilateral surgery in younger patients, we did not find alpha angles or patient sex to be predictive risk factor for bilateral surgery. One reason for this difference is that in our cohort, female patients comprised 65.1% of study subjects and 63.1% of bilateral surgery patients ($P = 0.786$) compared with 48% females in the unilateral group and 35% in the bilateral group ($P = 0.006$) in the Klingenstein study. These differences may be attributable to differences in patient populations seen by the individual surgeons in the respective studies.

Haviv and O'Donnell[27] also reported a case series of 82 patients who underwent staged hip arthroscopy to address bilateral FAIS, concluding that patients had improved modified Harris Hip Scores and Nonarthritic Hip Scores after these surgeries. In this series, the average time interval between the two surgeries was 5 months compared with 8.6 months in the present study.

It has been reported that among patients with bilateral hip abnormalities, considerable morphologic symmetry was noted.[23] In addition, a quantitative MRI study of 19 patients with bilateral cam deformities found a loss of the typical regional variation in T1ρ values among the four quadrants of the hips regardless of the presence of symptoms, suggesting that a cam deformity may predispose to hip arthritis in the future.[28] However, it has also been reported that bilateral FAIS does not necessarily result in bilateral symptoms.[29] Although we were unable to detect a predictive value of alpha angles with regard to eventual bilateral surgery, the P value was 0.12, suggesting that with the inclusion of additional patients, statistical significance might be achieved. Future work on this topic could also focus on attempting to correlate intra-articular findings in the index hip with the risk of contralateral surgery. In addition, many other factors exist that could be considered in light of risk of contralateral FAIS surgery such as preoperative length of symptoms, severity of symptoms, and patient-rated functional outcomes.

All the patients in this study who underwent bilateral surgery for labral tear due to FAIS have staged surgeries rather than having both hips treated simultaneously. Some studies showed no difference in patient-reported outcomes, pain, or satisfaction in patients undergoing simultaneous bilateral hip arthroscopy versus staged surgery.[16,17,30] However, other have described disadvantages of surgical repair of bilateral hips at the same time, including the increased risk of temporary wheelchair ambulation, difficulties initiating early postoperative rehabilitation, and increased anesthesia time, particularly with surgical teams inexperienced with hip arthroscopy.[31,32] The authors of these studies suggest that single-surgery bilateral treatment of FAIS should be reserved for young, motivated, and physically fit patients who have a window for returning to sport or activity.

Although this is a large study that examines risk factors associated with staged bilateral hip arthroscopy for FAIS, some limitations inherent to the design of this study exist. Given the large number of database entries, incomplete data were sometimes present. In addition, it would have been interesting to note how many patients had bilateral hip pain due to FAIS at the time of presentation but ultimately only required surgery on one side. Unfortunately, these data were not readily available for review. Next, all patients in the study underwent labral repair, femoroplasty, and acetabular rim trimming. Although many etiologies exist for labral tear, this study did not address those not associated with FAIS, such as trauma. Also, our ability to capture future surgery on the contralateral labrum is limited to the 2-year follow-up period of the study, thus likely underestimating the true rate of bilateral labral surgery. Additional unilateral patients would cross over into the bilateral group with time, and thus, a more accurate incidence of bilateral hip surgery would be determined with longer follow-up. Furthermore, activity was self-reported in this study, rather than using a validated tool. Last, our findings on the CCI may be correlated with the younger population of this study because an inverse relationship exists between the CCI and age. Although the CCI is often used for less healthy populations and has not been formally validated for hip arthroscopy, it has previously been used as an outcome measure in a large review of hip arthroscopies.[33] Nevertheless, because of the large cohort involved, the findings that can be gleaned from this study are important to appropriately counsel patients regarding expected results.

Conclusion

This study of 694 hip arthroscopy patients demonstrated that patients younger than 25 years had markedly increased rates of bilateral labral tears necessitating surgery compared with older patients. Patients with a CCI less than two had a higher risk of bilateral FAIS treated with surgery. This study may be of value in preoperative counseling of patients limit.

References

1. Tamura S, Nishii T, Takao M, Sakai T, Yoshikawa H, Sugano N: Differences in the locations and modes of labral tearing between dysplastic hips and those with femoroacetabular impingement. *Bone Joint J* 2013;95-B:1320-1325.
2. Harris JD, McCormick FM, Abrams GD, et al: Complications and reoperations during and after hip arthroscopy: A systematic review of 92 studies and more than 6,000 patients. *Arthroscopy* 2013;29: 589-595.
3. Montgomery SR, Ngo SS, Hobson T, et al: Trends and demographics in hip arthroscopy in the United States. *Arthroscopy* 2013;29:661-665.
4. Bozic KJ, Chan V, Valone FH, Feeley BT, Vail TP: Trends in hip arthroscopy utilization in the United States. *J Arthroplasty* 2013;28:140-143.
5. Clohisy JC, Baca G, Beaulé PE, et al: Descriptive epidemiology of femoroacetabular impingement: A North American cohort of patients undergoing surgery. *Am J Sports Med* 2013;41: 1348-1356.
6. Alradwan H, Philippon MJ, Farrokhyar F, et al: Return to preinjury activity levels after surgical management of femoroacetabular impingement in athletes. *Arthroscopy* 2012;28:1567-1576.
7. Matsuda DK, Carlisle JC, Arthurs SC, Wierks CH, Philippon MJ: Comparative systematic review of the open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. *Arthroscopy* 2011;27: 252-269.
8. Botser IB, Smith TW, Nasser R, Domb BG: Open surgical dislocation versus arthroscopy for femoroacetabular impingement: A comparison of clinical outcomes. *Arthroscopy* 2011;27:270-278.
9. Fujii M, Nakashima Y, Noguchi Y, et al: Factors associated with severity of intra-articular lesions in patients with severe hip dysplasia. *Arthroscopy* 2016;32: 1581-1589.
10. Sankar WN, Beaulé PE, Clohisy JC, et al: Labral morphologic characteristics in patients with symptomatic acetabular dysplasia. *Am J Sports Med* 2015;43: 2152-2156.
11. Dameron TB: Bucket-handle tear of acetabular labrum accompanying posterior dislocation of the hip. *J Bone Joint Surg Am* 1959;41-A:131-134.
12. Chivers T: The sick dentist trust. *Br Dent J* 1992;172:396.
13. Groh MM, Herrera J: A comprehensive review of hip labral tears. *Curr Rev Musculoskelet Med* 2009;2:105-117.
14. Kappe T, Kocak T, Bieger R, Reichel H, Fraitzl CR: Radiographic risk factors for labral lesions in femoroacetabular impingement. *Clin Orthop Relat Res* 2011; 469:3241-3247.
15. Tresch F, Dietrich TJ, Pfirrmann CWA, Sutter R: Hip MRI: Prevalence of articular cartilage defects and labral tears in asymptomatic volunteers: A comparison with a matched population of patients with femoroacetabular impingement. *J Magn Reson Imaging* 2017;46:440-451.
16. Mei-Dan O, McConkey MO, Knudsen JS, Brick MJ: Bilateral hip arthroscopy under the same anesthetic for patients with symptomatic bilateral femoroacetabular impingement: 1-year outcomes. *Arthroscopy* 2014;30:47-54.
17. Degen RM, Nawabi DH, Fields KG, Wentzel CS, Kelly BT, Coleman SH: Simultaneous versus staged bilateral hip arthroscopy in the treatment of femoroacetabular impingement. *Arthroscopy* 2016;32:1300-1307.
18. White BJ, Patterson J, Herzog MM: Bilateral hip arthroscopy: Direct comparison of primary acetabular labral repair and primary acetabular labral reconstruction. *Arthroscopy* 2018;34:433-440.
19. Kuhns BD, Hannon CP, Makhni EC, et al: A comparison of clinical outcomes after unilateral or bilateral hip arthroscopic surgery: Age- and sex-matched cohort study. *Am J Sports Med* 2017;45: 3044-3051.
20. Klingenstein GG, Zbeda RM, Bedi A, Magennis E, Kelly BT: Prevalence and preoperative demographic and radiographic predictors of bilateral femoroacetabular impingement. *Am J Sports Med* 2013;41:762-768.
21. Charlson ME, Pompei P, Ales KL, MacKenzie CR: A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis* 1987;40:373-383.
22. Schmolders J, Friedrich MJ, Michel R, et al: Validation of the Charlson comorbidity index in patients undergoing revision total hip arthroplasty. *Int Orthop* 2015;39: 1771-1777.
23. Frank RM, Lee S, Bush-Joseph CA, Kelly BT, Salata MJ, Nho SJ: Improved outcomes

after hip arthroscopic surgery in patients undergoing T-capsulotomy with complete repair versus partial repair for femoroacetabular impingement: A comparative matched-pair analysis. *Am J Sports Med* 2014;42:2634-2642.

24. Harris JD, Slikker W III, Gupta AK, McCormick FM, Nho SJ: Routine complete capsular closure during hip arthroscopy. *Arthrosc Tech* 2013;2:e89-e94.

25. Slikker W III, Van Thiel GS, Chahal J, Nho SJ: The use of double-loaded suture anchors for labral repair and capsular repair during hip arthroscopy. *Arthrosc Tech* 2012;1: e213-e217.

26. Ng KCG, Lamontagne M, Beaule PE: Differences in anatomical parameters between the affected and unaffected hip in patients with bilateral cam-type deformities. *Clin Biomech (Bristol, Avon)* 2016;33:13-19.

27. Haviv B, O'Donnell J: Arthroscopic treatment for symptomatic bilateral cam-type femoroacetabular impingement. *Orthopedics* 2010;33:874.

28. McGuffin WS, Melkus G, Rakhra KS, Beaulé PE: Is the contralateral hip at risk in patients with unilateral symptomatic cam femoroacetabular impingement? A quantitative T1ρ MRI study. *Osteoarthritis Cartilage* 2015;23: 1337-1342.

29. Allen D, Beaulé PE, Ramadan O, Doucette S: Prevalence of associated deformities and hip pain in patients with cam-type femoroacetabular impingement. *J Bone Joint Surg Br* 2009; 91:589-594.

30. McConkey MO, Chadayammuri V, Garabekyan T, Mayer SW, Kraeutler MJ, Mei-Dan O: Simultaneous Bilateral Hip Arthroscopy in Adolescent Athletes With Symptomatic Femoroacetabular Impingement. *J Pediatr Orthop* 2017. E pub. doi: 10.1097/BPO. 0000000000000987.

31. Matsuda DK, Ching K, Matsuda NA: Simultaneous bilateral hip arthroscopy. *Arthrosc Tech* 2017;6:e913-e919.

32. Konyves A: Editorial commentary: Shall we just get it all done with? Simultaneous versus staged bilateral hip arthroscopy. *Arthrosc The J Arthroscopic Relat Surg* 2016;32:1308.

33. Malviya A, Raza A, Jameson S, James P, Reed MR, Partington PF: Complications and survival analyses of hip arthroscopies performed in the national health service in England: A review of 6,395 cases. *Arthroscopy* 2015;31:836-842.