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Acetabular Labral Tears Are Common in Asymptomatic Contralateral Hips With Femoroacetabular Impingement

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Abstract

Background The number of patients undergoing hip arthroscopy for labral tears has increased, but labral tears are sometimes seen in asymptomatic patients with femoroacetabular impingement (FAI). The frequency of this finding, however, has not been well characterized nor is the proportion of patients with previously asymptomatic labral tears who may later become symptomatic.

Questions/purposes The purpose of this study was to determine (1) the prevalence of labral tears and other intra-articular pathology in the asymptomatic contralateral hip of patients undergoing surgery for symptomatic FAI; (2) the likelihood that the asymptomatic hip had become symptomatic at latest followup; and (3) any association between MRI findings and age, sex, and body mass index (BMI) in both symptomatic and asymptomatic sides.

Methods This study included patients who were diagnosed with unilateral symptomatic FAI between 2013 and 2015 and who had an available MRI of both hips. The study included 100 patients (47 females, 53 males) with a mean age of 33 years (range, 17-57 years). Patients with a symptomatic contralateral hip (n = 56) or an unsuitable MRI for review based on both reviewers' consensus (n = 344) were excluded. The MRI of both hips was independently evaluated by two orthopaedic surgeons and interobserver reliability tested. The interobserver reliability for the two surgeons' MRI ratings was almost perfect ($\kappa \geq 0.85$). The presence of a labral tear, an acetabular chondral

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lesion, subchondral acetabular cysts, and fibrocystic changes in the femoral head-neck junction was documented for both hips. At latest followup, asymptomatic hips were investigated for any symptomatic labral tears or surgical procedures resulting from FAI.

Results A labral tear was recorded in 97 (97%) and 96 (96%) of symptomatic hips, respectively, for each surgeon's evaluation. A labral tear was also detected in 41 (41%) and 43 (43%) of asymptomatic hips. In addition, an acetabular chondral lesion was detected in 32 (32%) and 35 (35%) of the symptomatic hips and 15 (15%) and 17 (17%) of the asymptomatic hips. At latest followup, nine of the patients were diagnosed with symptomatic labral tears in the contralateral asymptomatic hip and were treated. None of the radiologic parameters examined demonstrated an association with patient age, sex, or BMI in either symptomatic or asymptomatic hips.

Conclusions Labral tears and acetabular chondral lesions are common in the asymptomatic contralateral hip of patients undergoing surgery for FAI. The incidence of a symptomatic labral tear in these asymptomatic hips was 9% during 2 years of followup. We suggest that the decision to perform chondral or labral surgery in patients with FAI should be made with caution considering the relatively high prevalence of labral tears in asymptomatic hips and the low chance of development of symptoms.

Level of Evidence Level IV, case-series study.

Introduction

Femoroacetabular impingement (FAI) and associated intraarticular lesions have been recognized as predisposing factors for hip degenerative joint disease [1, 5, 8, 15]. A complete physical examination followed by radiographic and MRI evaluation usually is needed to diagnose FAI. Patients with symptomatic FAI may be successfully treated with femoroacetabular osteoplasty (FAO) [2, 4, 10]. However, patients with FAI may present with symptoms in one hip and report that the contralateral hip is asymptomatic.

A high prevalence of labral tears in an asymptomatic population has been reported in previous studies [7, 11, 12, 14]. Development of modern diagnostic imaging (MRI) and its high sensitivity (95%) to detect acetabular labral tears [9] have been very helpful in the management of patients with FAI. We recognized that labral tears appeared common on MRI in the asymptomatic contralateral hip of patients undergoing FAI procedures in our institution. However, the likelihood that these asymptomatic hips later become symptomatic has not been previously investigated. Answering this question will help hip preservation surgeons have a more informed discussion with their patients about the chance of the contralateral hip becoming symptomatic in the future.

We therefore sought to determine (1) the prevalence of labral tears and other intraarticular pathology in the asymptomatic contralateral hip of patients undergoing surgery for symptomatic FAI; (2) the likelihood that the asymptomatic hip had become symptomatic at latest followup; and (3) the association between MRI findings and age, sex, and body mass index (BMI) in both symptomatic and asymptomatic hips.

Materials and Methods

After institutional review board approval, we evaluated MRIs and MR arthrograms of 500 patients who had undergone surgical treatment of symptomatic FAI at our institution between January 2013 and December 2015 and had received this advanced imaging of the symptomatic hip. We excluded 56 patients with bilateral symptomatic hips based on a review of the longitudinally maintained institutional database of patients undergoing hip preservation surgery at our institution. Although both hips were almost always imaged on the MRI or MR arthrogram, we limited our study to the evaluation of patients who had good-quality images of both hips (based on the consensus of both reviewers) captured on the cross-sectional studies. Three hundred forty-four hips were deemed by both reviewers as unsuitable for evaluation of hip pathology as a result of lack of appropriate MRI cuts. MR arthrograms of the asymptomatic contralateral hips were not performed. Of those 500 patients initially screened, we included 100 patients with symptomatic FAI in one hip after the previously mentioned exclusions. The cohort consisted of 53 males with a mean age of 33 years (range, 17-57 years) (Fig. 1).

All patients had good-quality MRIs of both hips, defined as having all sagittal, coronal, and oblique axial views of each hip. At our institution, different locations perform hip MRI with similar technique by using 1.5-T or 3-T scanners, obtaining full panoramic coronal T1 and T2 images with a slice thickness of 5 mm. Also, hip-concentrated 4-mm T2 sequences with and without fat saturation including sagittal, coronal, and axial oblique views are taken to ensure adequate imaging of hip pathology. Two fellowship-trained orthopaedic surgeons (HV, IA) who were unaware of the patients' details regarding the side of the symptomatic hip independently reviewed the MRIs of these patients. The presence of an acetabular labral tear, an acetabular chondral lesion, subchondral acetabular cysts, and fibrocystic changes in the femoral head-neck junction in both hips was determined as simple presence or absence of the lesion in question. Acetabular labral tears were described as high-signal linear

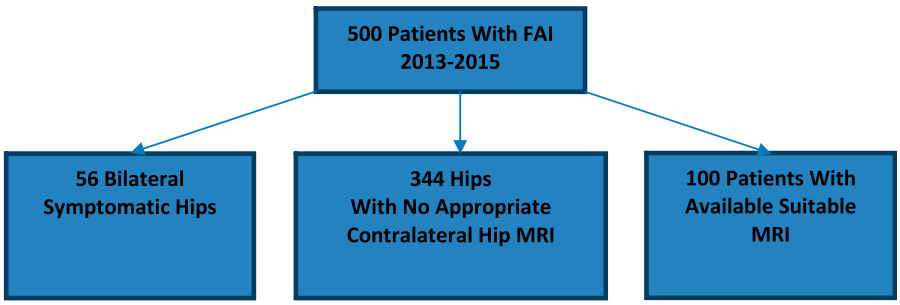

Fig. 1 Flowchart showing patients with FAI.

intensity starting from the articular side to the base of the labrum. All triangular, low-intensity labrums with a base-sitting flush with the acetabulum were considered normal.

All patients were followed for a minimum of 2 years in routine post-FAO visits (6 weeks, 3 months, and 1 and 2 years) to monitor the progress of the operative hip, the natural history of the asymptomatic hip, and to determine whether the latter had become symptomatic. Eighty-six patients were evaluated in the clinic at least one time after 2 years and 14 patients were contacted by phone to determine whether they had any symptoms in the contralateral hip or had undergone any surgical or nonsurgical treatment of that hip.

Statistical Analysis

Interobserver reliability for the two surgeons was determined with Cohen's (1960) κ statistic for dichotomous ratings with two judges [3]. Interobserver reliability for MRI evaluation by the two observers was almost perfect ($\kappa \geq 0.85$) according to the guidelines of Landis and Koch [6]. General estimating equations (GEEs) were conducted for each imaging parameter to test if the presence of each parameter was greater in the symptomatic than the asymptomatic hip. Each GEE model specified a binomial distribution and logit link function and repeated measurements on each hip (symptomatic than asymptomatic). Finally, logistic regression was used to determine whether the presence of each MRI parameter varied by demographic variables including age, BMI, and sex (note that these models would not run for labral tears in symptomatic hips given there were only three individuals without tears). All analyses were performed using SPSS Version 23 (IBM Corp, Armonk, NY, USA).

Results

Of 100 patient MRI scans, one orthopaedic surgeon reviewer detected labral tears in 97 (97%) symptomatic hips and the other reviewer detected 96 (96%) labral tears (Table 1). Additionally, 41 (41%) and 43 (43%) of the asymptomatic hips were judged to have a labral tear by each observer, respectively. No significant difference was detected between males and females for the presence of labral tear in asymptomatic hips ($p = 0.766$; odds ratio [OR], 0.886; confidence interval [CI], 0.399-1.968). Acetabular chondral lesions were detected in 32 (32%) and 35 (35%) of symptomatic hips by the two observers, respectively, compared with 15 (15%) and 17 (17%) of the asymptomatic hips. All hips with acetabular chondral

Table 1. Prevalence of acetabular labral tears, acetabular chondral lesions, subchondral acetabular cysts, and head-neck junction fibrocystic lesions in symptomatic and asymptomatic hips evaluated by each observer (linear comparison of each variable in symptomatic and asymptomatic hips)

Radiographic findings	Symptomatic hips (n = 100)			Asymptomatic hips (n = 100)			
	Observer 1	Observer 2	Average of observers	Observer 1	Observer 2	Average of observers	p value
Labral tears	97	96	96.5	41	43	42	< 0.001
Acetabular chondral lesions	32	35	33.5	15	17	16	< 0.001
Subchondral acetabular cysts	13	12	12.5	5	5	5	0.005
Femoral head-neck junction fibrocystic lesions	17	17	17	9	9	9	0.004

lesions had concomitant labral tears, whereas none of the hips without a labral tear appeared to have an acetabular chondral lesion. One reviewer detected a subchondral acetabular cyst in 13% (n = 13) of symptomatic hips, whereas the other observed it in 12% (n = 12) of symptomatic hips; both surgeons detected a subchondral acetabular cyst in 5% (n = 5) of asymptomatic hips. Both observers identified a fibrocystic lesion in the head-neck junction of the femoral head in 17% (n = 17) and 9% (n = 9) of the symptomatic and asymptomatic hips, respectively (p = 0.004). All hips with a subchondral acetabular cyst had a concomitant acetabular chondral lesion. Interestingly, none of these concomitant lesions were identified in the hips without a labral tear.

After a minimum 2 years of followup, nine patients/hips in the asymptomatic group became symptomatic and underwent hip arthroscopy (n = 5), miniopen femoroacetabular osteoplasty (n = 3), or intraarticular injection (n = 1). Three of nine patients had been noted to have a labral tear when the index MRI was reviewed and they were asymptomatic. No labral tear was detected in the other six patients' initially asymptomatic hips when the index MRI was reviewed.

After adjusting for covariates of BMI and sex, increasing age was associated with a greater likelihood of labral tears (p = 0.022; OR, 1.249; 95% CI, 1.033-1.511), chondral lesions (p = 0.001; OR, 1.116; 95% CI, 1.043-1.195), subchondral cysts (p = 0.003; OR, 1.118; 95% CI, 1.039-1.203), and femoral cysts (p = 0.006; OR, 1.094; 95% CI, 1.026-1.166) being found in both symptomatic and asymptomatic hips (n = 200). Logistic regression for a labral tear in symptomatic hips could not be performed because there were only three hips in the latter group without a labral tear. None of the radiologic parameters examined demonstrated an association with patient age, sex, or BMI in either symptomatic or asymptomatic hips (Table 2).

Discussion

The prevalence of contralateral asymptomatic labral tears in patients with symptomatic FAI has not been investigated before, and the likelihood of becoming symptomatic during their followup is not clearly defined. The current study was designed to determine (1) the prevalence of labral tears and other intraarticular pathologies in the asymptomatic contralateral hip of patients undergoing surgery for symptomatic FAI; (2) the likelihood that the asymptomatic hip had become symptomatic at latest followup; and (3) the association between MRI findings and age, sex, and BMI in both symptomatic and asymptomatic hips. Our study showed a high percentage of labral tears and chondral lesions in asymptomatic hips of the same patients at the time of undergoing surgery for symptomatic FAI and labral tear in the contralateral hip. At a minimum 2 years of followup, 9% of patients developed a symptomatic labral tear in the contralateral hip. Increasing age was associated with a greater likelihood of labral tears, chondral lesions, subchondral cysts, and femoral cysts being found in both symptomatic and asymptomatic hips. None of the radiographic parameters demonstrated an association with patient age, sex, or BMI in either symptomatic or asymptomatic hips.

This study has some limitations. The study's retrospective design did not allow us to determine our target population based on patient age, sex, and activity level and the development of hip symptoms in the asymptomatic hip. Also, we had to exclude a significant number of cases because the reviewers were not able to evaluate the MRI as a result of the lack of high-quality contralateral hip imaging. As a result, selection bias may affect our results, because the 100 patients analyzed here may not be completely representative of the entire group. None of the asymptomatic hips had an MR arthrogram examination, for obvious reasons, which most likely resulted in an underestimation of the labral tear incidence. Also, because the study was retrospective, we did not repeat the MRIs obtained at outside centers and the quality of some of these studies was lower than what we would have seen had we obtained the MRIs at our center. However, patients were included if they had enough high-quality cross-sectional cuts for evaluation. Having these MRIs included in our series may over- or underestimate the prevalence of the hip pathologies.

We found that > 40% of the asymptomatic contralateral hips of patients undergoing procedures for symptomatic FAI had labral pathology. A few prior studies have demonstrated that a relatively large percentage of patients with asymptomatic hips may have evidence of a labral tear and other pathologies associated with FAI. In a recent study by Lee et al. [7], labral tears were detected in 27 (38.6%) of 70 asymptomatic volunteers, and intraarticular pathology was present in 15.7% of the cohort. In another study, labral tears were seen in 57% and acetabular chondral lesions were seen in 14% of 63 asymptomatic individuals compared with labral tears in 80% and chondral defects in 47% of symptomatic patients with FAI [14]. Other studies showed a higher prevalence of labral tears and other related hip pathologies in asymptomatic military personnel and collegiate and professional hockey players [12, 13]. The unique aspect of this study is the inclusion of patients with a symptomatic hip and evaluation of the contralateral, asymptomatic hip, which helps limit between-patient confounding differences. The results of the logistic regression analyses indicated that increasing age was associated with a greater likelihood of labral tears and other hip pathologies in both symptomatic and asymptomatic hips.

Table 2. Association between demographic parameters (age, BMI, sex) and radiologic parameters (labral tears, chondral lesions, subchondral cysts, femoral neck junction cysts (adjusted)

Demographics/radiologic findings	Symptomatic hips (n = 100)		
	Mean ± SD	Odds ratio (95% CI)	p value
Age			
Labral tears	26.3± 6.65		
Chondral lesions	29.9 ± 7.16	NA	NA
Subchondral cysts	31.5 ± 9.13		
Femoral fibrocystic lesions	31.8 ± 8.66	1.51 (1.06-1.25)	0.001
		1.11 (1.03-1.2)	0.007
		1.14 (1.05-1.23)	0.001
BMI			
Labral tears	23.94 ± 3.92	NA	NA
Chondral lesions	24.89 ± 4.23	1.08 (0.98-1.2)	0.13
Subchondral cysts	24.44 ± 4.12	1.03 (0.90-1.19)	0.67
Femoral fibrocystic lesions	24.45 ± 3.74	1.03 (0.91-1.17)	0.62
Sex (male)			
	Within group (%)	NA	NA
Labral tears (n = 97)	50 (51.5%)	0.84 (0.36-1.94)	0.68
Chondral lesions (n = 32)	16 (50%)	1.49 (0.45-4.93)	0.51
Subchondral cysts (n = 13)	8 (61.54%)	0.99 (0.35-2.83)	1.00
Femoral fibrocystic lesions (n = 17)	9 (52.9%)		
Demographic/radiologic	**Asymptomatic hips (n = 100)**		
	Mean ± SD	**Odds ratio (95% CI)**	**p value**
Age			
Labral tears	29.90 ± 7.11	1.25 (1.11-1.4)	< 0.001
Chondral lesions	31.40 ± 8.51		
Subchondral cysts	34.00 ± 13.17	1.11 (1.03-1.20)	0.005
Femoral fibrocystic lesions	31.33 ± 10.54		
		1.12 (1.01-1.22)	0.022
		1.09 (1.01-1.18)	0.29
BMI			
Labral tears	24.44 ± 4.01	1.05 (0.95-1.16)	0.37
Chondral lesions		1.04 (0.91-1.19)	0.54
Subchondral cysts	24.58 ± 3.90	1.01 (0.81-1.26)	0.91
Femoral fibrocystic lesions		0.92 (0.74-1.13)	0.42
	24.20 ± 2.28		
	22.97 ± 2.39		
Sex (male)	Within group (%)		
Labral tears (n = 41)	21 (51.2%)	0.89 (0.40-1.97)	0.77
Chondral lesions (n = 15)	8 (53.3%)	1.01 (034-3.05)	0.98
Subchondral cysts (n = 5)	3 (60%)	1.35 (0.21-8.45)	0.74
Femoral fibrocystic lesions (n = 9)	4 (44.4%)	0.68 (0.17-2.72)	0.60

BMI = body mass index; CI = confidence interval; NA = not applicable.

Theoretically, existence of the hip anatomic abnormality along with increasing age would increase the chance of development of the FAI-correlated findings including cystic changes and chondral lesions in affected hips. Also, none of the radiologic parameters examined demonstrated an association with patient age, sex, or BMI in either symptomatic or asymptomatic hips. This finding may need a more robust prospective study with a larger number

of patients to better examine the association between demographics and the radiographic findings.

Only 9% of our asymptomatic hips became symptomatic during their followup period of minimum 2 years. This finding highlights the fact that prudence is required when approaching these patients for treatment of the contralateral hip. However, it may be expected that a greater percentage of the asymptomatic hips would become painful in longer term followup, especially if the abnormal radiographic parameters related to FAI existed in the contralateral hip. However, this necessitates another study to investigate the fate of asymptomatic hips with abnormal FAI findings on radiographs and MRIs.

The high proportion of labral tears in the asymptomatic hips of the same patients undergoing FAI surgery raises two questions. First, are the imaging findings alone of any clinical importance? The findings from our study and those mentioned previously suggest that clinicians must ensure that there is a clear correlation between clinical presentation and imaging findings. Other diagnostic interventions such as intraarticular injection can be implemented in borderline situations to confirm the diagnosis. Second, do the imaging findings in the asymptomatic hip invariably lead to a symptomatic clinical presentation? This is the subject of another ongoing study at our institution. Based on preliminary findings, it appears that some of these asymptomatic hips in patients with bilateral FAI eventually become symptomatic. The practical issue that must be addressed in future studies is whether the natural history of patients without symptoms but convincing radiologic findings of FAI means that earlier surgical intervention should play a role. This cannot be answered with the present study.

In conclusion, we believe this study highlights an important issue. It demonstrates that labral tears and other hip pathologies related to FAI are common findings on MRI of the contralateral asymptomatic hips and that a relatively low percentage of these patients become symptomatic during 2 years of followup. Any decisions regarding surgical intervention in these patients must consider that fact. Patients with FAI and clinical symptoms must be carefully evaluated and the correlation between the clinical presentation and imaging findings strictly analyzed before embarking on surgical intervention.

References

1. Allen D, Beaulé PE, Ramadan O, Doucette S. Prevalence of associated deformities and hip pain in patients with cam-type femoroacetabular impingement. *Bone Joint J*. 2009;91:589-594.
2. Byrd JWT, Jones KS, Gwathmey FW. Femoroacetabular impingement in adolescent athletes: outcomes of arthroscopic management. *Am J Sports Med*. 2016;44:2106-2111.
3. Cohen J. A coefficient of agreement for nominal scales. *Educ Psychol Meas*. 1960;20:37-46.
4. Cohen SB, Huang R, Ciccotti MG, Dodson CC, Parvizi J. Treatment of femoroacetabular impingement in athletes using a mini-direct anterior approach. *Am J Sports Med*. 2012;40:1620-1627.
5. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res*. 2003;417:112-120.
6. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159-174.
7. Lee AJJ, Armour P, Thind D, Coates MH, Kang ACL. The prevalence of acetabular labral tears and associated pathology in a young asymptomatic population. *Bone Joint J*. 2015;97:623-627.
8. McCarthy J, Noble P, Aluisio FV, Schuck M, Wright J, Lee J. Anatomy, pathologic features, and treatment of acetabular labral tears. *Clin Orthop Relat Res*. 2003;406:38-47.
9. Mintz DN, Hooper T, Connell D, Buly R, Padgett DE, Potter HG. Magnetic resonance imaging of the hip: detection of labral and chondral abnormalities using noncontrast imaging. *Arthroscopy*. 2005;21:385-393.
10. Parvizi J, Huang R, Diaz-Ledezma C, Og B. Mini-open femoroacetabular osteoplasty: how do these patients do? *J Arthroplasty*. 2012;27(Suppl):122-125.e1.
11. Register B, Pennock AT, Ho CP, Strickland CD, Lawand A, Philippon MJ. Prevalence of abnormal hip findings in asymptomatic participants: a prospective, blinded study. *Am J Sports Med*. 2012;40:2720-2724.
12. Schmitz MR, Campbell SE, Fajardo RS, Kadrmas WR. Identification of acetabular labral pathological changes in asymptomatic volunteers using optimized, noncontrast 1.5-T magnetic resonance imaging. *Am J Sports Med*. 2012;40:1337-1341.
13. Silvis ML, Mosher TJ, Smetana BS, Chinchilli VM, Flemming DJ, Walker EA, Black KP. High prevalence of pelvic and hip magnetic resonance imaging findings in asymptomatic collegiate and professional hockey players. *Am J Sports Med*. 2011;39:715-721.
14. 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.
15. Wagner S, Hofstetter W, Chiquet M, Mainil-Varlet P, Stauffer E, Ganz R, Siebenrock KA. Early osteoarthritic changes of human femoral head cartilage subsequent to femoro-acetabular impingement. *Osteoarthritis Cartilage*. 2003;11:508-518.