Sex-Based Differences in Athletes Undergoing Primary Hip Arthroscopy With Labral Reconstruction

A Propensity-Matched Analysis With Minimum 2-Year Follow-up

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Background: There is a paucity of literature comparing sex-based outcome differences in athletes after primary hip arthroscopy with labral reconstruction for femoroacetabular impingement syndrome (FAIS) and irreparable labral tears.

Purpose: To report sex-based differences in clinical characteristics, patient-reported outcome (PRO) scores, and return-to-sports (RTS) rates in athlete who underwent primary hip arthroscopy with labral reconstruction.

Study Design: Cohort study; Level of evidence, 3.

Methods: Data were reviewed for recreational, organized amateur, high school, collegiate, and professional athletes who underwent primary hip arthroscopy with labral reconstruction for FAIS and irreparable labral tears between July 2014 and May 2019. Inclusion criteria included preoperative and minimum 2-year postoperative PRO scores (modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, International Hip Outcome Tool [iHOT-12], and visual analog scale [VAS] for pain). Exclusion criteria were Tönnis grade >1, hip dysplasia (lateral center-edge angle, $<18^\circ$), or prior ipsilateral hip surgery/conditions. Patients were divided into groups by sex and were propensity-matched in a 1:1 ratio by age, body mass index, graft type, labral tear size, and sports level.

Results: A total of 101 hips were eligible, and 94 hips (93.1%) had a minimum 2-year follow-up. Twenty-nine female athlete hips were propensity-matched to 29 male athlete hips. Female athletes underwent higher rates of capsular repair (79.3% vs 24.1% for men; $P < .001$) and lower rates of acetabular microfracture (0.0% vs 20.7% for men; $P = .024$). Both female and male athletes experienced significant improvement on all PRO scores ($P < .001$ for all), high RTS rates (women, 84% vs men, 80.8%), and high rates of achieving the minimal clinically important difference for the iHOT-12 and VAS pain (women, 88.5% vs men, 71.4% for both) and achieving the patient acceptable symptom state for the iHOT-12 (women, 88.5% vs men, 71.4%), with no significant difference between the sexes.

Conclusion: Despite different clinical characteristics and surgical procedures, both female and male athletes undergoing primary hip arthroscopy with labral reconstruction had significant improvements in all PROs at the minimum 2-year follow-up, high RTS rates, and similar rates of achieving the minimal clinically important difference and patient acceptable symptom state.

Keywords: hip arthroscopy; labral reconstruction; sports; athletes

Hip arthroscopy for femoroacetabular impingement (FAI) syndrome (FAIS) has been increasingly performed in the athletic population and has demonstrated favorable results in both the general and athletic populations.[3,10,20,22,33,56] A key factor in the surgical management of FAIS is the restoration of labral function in the setting of labral tears. Labral tear management can be performed arthroscopically using methods such as labral debridement and labral repair or more technically demanding procedures, namely, labral reconstruction and labral augmentation.[19]

Increased attention is being paid in the literature toward hip arthroscopy and outcomes in specific patient populations. More specifically, sex-based differences are increasingly recognized, as female and male patients have unique

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pathologies that may require different treatments.[53] Male patients often demonstrate a higher prevalence of cam-type FAI, while female patients are more susceptible to microinstability. Given these differences, it is critical to study outcomes of hip arthroscopy with labral reconstruction in sex-based populations. Recent studies have established favorable outcomes in athletes undergoing labral reconstruction, but no studies have evaluated sex-based differences in presentation and outcomes of these athletes.[21,28]

The purpose of this study was to report sex-based differences in clinical characteristics, patient-reported outcomes (PROs), and return-to-sports (RTS) rates in patients undergoing primary hip arthroscopy with labral reconstruction. We hypothesized that male and female patients undergoing primary hip arthroscopy with labral reconstruction (1) would have different clinical conditions and require different surgical procedures and (2) would both experience favorable outcomes after hip arthroscopy.

METHODS

Participation in the American Hip Institute Hip Preservation Registry

All patients included in this study participated in the American Hip Institute Hip Preservation Registry and provided informed consent. Although this present study represents a unique analysis, data on some patients in this study may have been reported in other studies.[28] This study was performed in accordance with the ethical standards in the 1964 Declaration of Helsinki and with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA). Institutional review board approval was received for the study protocol.

Patient Selection

Data were prospectively collected and retrospectively reviewed for all patients who underwent hip arthroscopy by the senior surgeon (B.G.D.) between July 2014 and May 2019. Patients were considered eligible if they were an athlete and underwent hip arthroscopy with labral reconstruction for FAIS and irreparable labral tears within the study period. Athletes were defined as patients participating in sports at the professional, collegiate, high-school, amateur, or recreational level within a year before their first surgery.[24] Patients were included in the present analysis if they had preoperative and minimum 2-year follow-up PRO scores for the modified Harris Hip Score (mHHS),[5] Non-Arthritic Hip Score (NAHS),[14] Hip Outcome Score–Sports Specific Subscale (HOS-SSS),[44] visual analog scale (VAS) for pain,[13] and International Hip Outcome Tool (iHOT-12)[43] and completed an RTS survey. Patients were excluded if they had Tönnis osteoarthritis grade >1, hip dysplasia (lateral center-edge angle [LCEA], <18°),[40] prior ipsilateral hip surgery, or prior hip conditions (ie, avascular necrosis, ankylosing spondylitis, Ehlers-Danlos syndrome, Legg-Calvè-Perthes disease, pigmented villonodular synovitis, or slipped capital femoral epiphysis) or were unwilling to participate.

Preoperative Evaluation and Surgical Indications

A detailed patient history, physical examination, and radiographic analysis were collectively utilized preoperatively by the senior author (B.G.D.) to evaluate surgical candidates. Descriptive variables, including age at surgery, body mass index (BMI), sex, operative side, and follow-up time, were collected. Gait, range of motion, strength, points of tenderness, and signs of FAIS or mechanical symptoms (snapping, catching, locking) were noted during physical examination. Radiographs were obtained and evaluated by a board-certified orthopaedic surgeon (B.G.D.) specialized in hip preservation for signs of cam-type and pincer-type morphologies, acetabular dysplasia, and osteoarthritis in all patients using the anteroposterior pelvis, Dunn 45°, and false-profile views.[15] Radiographic measurements included the LCEA,[47] anterior center-edge angle (ACEA),[36] alpha angle,[8] Tönnis angle of acetabular inclination,[27] and femoral head-neck offset.[23] Osteoarthritis was graded according to the Tönnis classification.[17] Cam morphology was defined as an alpha angle >55°[16,42] or femoral head-neck offset <0.8 cm.[23] Evaluations of these images were performed using a picture archiving and communication system (General Electric Healthcare). Radiographic measurements have demonstrated good interobserver reliability in previously published studies.[18,38]

Magnetic resonance imaging or magnetic resonance arthrography was obtained in all patients before surgical indication and was used to identify intra-articular pathology, such as labral tears or chondral damage. Before being recommended for surgery by the senior author, all patients had pain that interfered with activities of daily living for ≥3 months and did not improve with activity modification,

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Ethical approval for this study was obtained from Advocate Health Care (study No. 5276).

nonsteroidal anti-inflammatory drugs, physical therapy, intra-articular ultrasound-guided injections, and rest.

Surgical Technique

All arthroscopic surgeries were performed by the senior author (B.G.D.). Under general anesthesia, patients were placed in the modified supine position, and traction was applied to a hip.[35] After the anterolateral and midanterior portal were created,[41] a systematic diagnostic arthroscopy was performed to assess the labrum, intra-articular cartilage, and ligamentum teres (LT). Labral damage was reported using the Seldes classification,[54] and articular cartilage damage and cartilage lesions were reported using the acetabular labrum articular disruption (ALAD) and Outerbridge classifications, respectively.[25] LT damage was graded using the Domb and Villar classifications.[39]

Under fluoroscopic guidance, acetabuloplasty and femoral osteoplasty were performed to address pincer-type and cam-type morphologies, respectively, when needed.[34] The senior surgeon decided the proper labral restoration technique based on the extent of labral damage found intraoperatively. The decision to reconstruct the labrum was made if nonviable, calcified, and/or irreparable labral tissue was found during diagnostic arthroscopy. Labral reconstruction was performed using anterior/posterior tibialis or hamstring tendon allograft and the previously published knotless pull-through technique.[52] During the labral reconstruction, nonviable, calcified, and irreparable labral tissue was debrided. Patients underwent acetabular bone trimming to modify the LCEA and ACEA to avoid iatrogenic instability before the graft was inserted into the joint. The decision to conduct a segmental or circumferential reconstruction was determined based on the amount of irreparable labrum present. Suction seal was restored between the labrum and femoral head by releasing traction. Capsular repair was performed in patients without adhesive capsulitis, insufficient capsular tissue, or excessive stiffness. Additionally, preoperative characteristics such as age, sex, BMI, hip microinstability, and generalized ligamentous laxity also went into this multifactorial decision algorithm.

Rehabilitation Protocol

All patients were provided individualized rehabilitation programs by the senior surgeon. Patients used a brace (DJO Global) to restrict range of motion and limit hip flexion to between 0° and 90°. Patients were instructed to use crutches and follow weightbearing limitations of $\leq$ 20 pounds (9.1 kg) for 6 to 8 weeks. Patients were also recommended to follow an 8-week physical therapy exercise routine and daily stationary bicycle programming. Additionally, patients were recommended to take nonsteroidal anti-inflammatory drugs twice daily for 6 weeks to minimize the chance of heterotopic ossification.

Surgical Outcomes

Preoperative and minimum 2-year follow-up outcome questionnaires for the mHHS, NAHS, HOS-SSS, iHOT-12, and VAS pain were collected during clinic visits. Patients unable to complete clinic questionnaires were contacted via encrypted email or telephone interview.

Unique minimal clinically important differences (MCIDs) were calculated for the mHHS, NAHS, HOS-SSS, iHOT-12, and VAS pain using the method described by Norman et al.[46] Patient acceptable symptom state (PASS) values for the mHHS, NAHS, and iHOT-12 were used based on previously established values in the literature.[12,49,50] RTS was determined based on athlete ability to resume play at any time. Postoperative patient satisfaction was calculated by having patients answer a series of questions determining if the surgery had exceeded their initial goals.

Propensity Score Matching

Propensity score matching was utilized to minimize the potential effect of confounding factors. Matching was completed using RStudio (Version 1.3.959; RStudio). Greedy matching without replacement was used to match female and male athletes in a 1:1 ratio; for this process of matching, female hips can only be matched to a male hip once. Previous studies have shown that the optimal method for group comparison is greedy matching without replacement.[2,6,7] A caliper of 0.3 times the standard deviation of the logit propensity scores was used. Patients who were outside the caliper ("propensity range") were excluded from analysis. Groups were matched in a 1:1 ratio according to age at the time of surgery, BMI, graft type, labral tear size, and preoperative sports level.

Statistical Analysis

A 2-tailed t test or its nonparametric equivalent were used to analyze continuous data, and the chi-square test or Fisher exact test was used to assess categorical data. The F test and Shapiro-Wilk test were used to assess variance equality and normality. All statistical analyses were conducted using Microsoft Excel with the Real Statistics Add-In package (Microsoft Corporation). A P value of .05 was determined as the statistical significance threshold before the study.

A 1:1 power analysis used to detect 80% power was conducted before the study to minimize the risk of type 2 errors. Power analysis was calculated using the expected mean difference in the mHHS of 8 points and standard deviation of 10 points. The calculation concluded that 26 hips in the male and female athlete groups were needed to minimize the probability of type 2 errors.

RESULTS

Patient Selection

Ninety-four of the 101 athlete hips (93.1%) undergoing labral reconstruction had a minimum 2-year follow-up. Propensity score matching into 2 sex-based groups created a cohort of 58 hips, with 29 male and 29 female hips included. The patient selection process is shown in Figure 1.

Patient Characteristics

Labral tear size was comparable between the male and female athlete groups (3.9 ± 1.4 vs 4.0 ± 1.2 mm, respectively; $P = .765$). Additionally, male and female groups had a majority of segmental labral tears (82.8% and 93.1%, respectively; $P = .423$). The majority of male and female athletes participated at the recreational level (62.1% and 69.0%). Preoperative sports played by male and female athletes are shown in Figure 2. All patient characteristics were comparable between sexes and are shown in Table 1.

Radiographic Measurements

Male athletes had a significantly higher preoperative alpha angle compared with female athletes (71.3° ± 11.7° vs 60.1° ± 13.3°, respectively; $P = .002$). All other radiographic measurements were comparable and are summarized in Table 2.

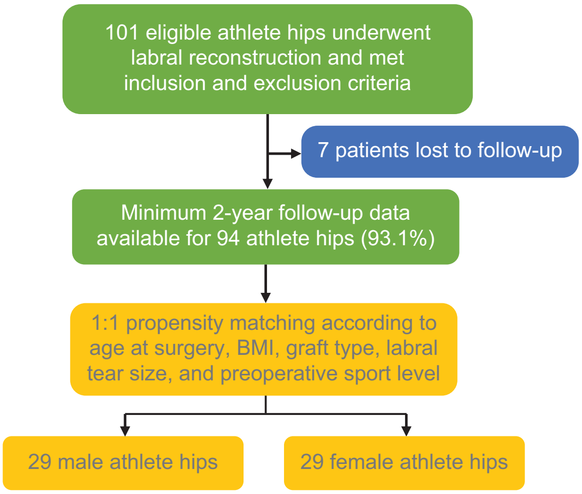

Figure 1. Patient selection criteria. BMI, body mass index.

Intraoperative Findings and Surgical Procedures

Male and female athletes had comparable labral tears according to the Seldes guidelines ($P = .354$). Female athletes had a significantly higher rate of capsular repair than did male athletes: 79.3% versus 24.1%, respectively ($P < .001$). Additionally, male athletes had a higher rate of acetabular microfracture than did female athletes: 20.7% versus 0.0%, respectively ($P = .024$). All other intraoperative findings and surgical procedures were comparable between groups and are found in Tables 3 and 4, respectively. Figure 3 depicts the final construct of a labral reconstruction in the left hip.

Outcomes

Male and female athletes experienced significant rates of improvement after surgery in the mHHS, iHOT-12, NAHS, HOS-SSS, and VAS pain ($P < .001$ for all). Additionally, male and female athletes experienced high rates of achieving MCID and PASS for the iHOT-12 (71.4% vs 88.5%, respectively, for both) and MCID for VAS pain (71.4% vs 88.5%, respectively). All other PRO scores were comparable between male and female athletes (Table 5). All clinical psychometric evaluations were comparable between groups (Table 6).

Secondary Surgeries

Male and female athletes experienced low rates of revision hip arthroscopy: 1 revision arthroscopy (3.4%) and 2 revision arthroscopies (6.9%), respectively ($P > .999$). No male

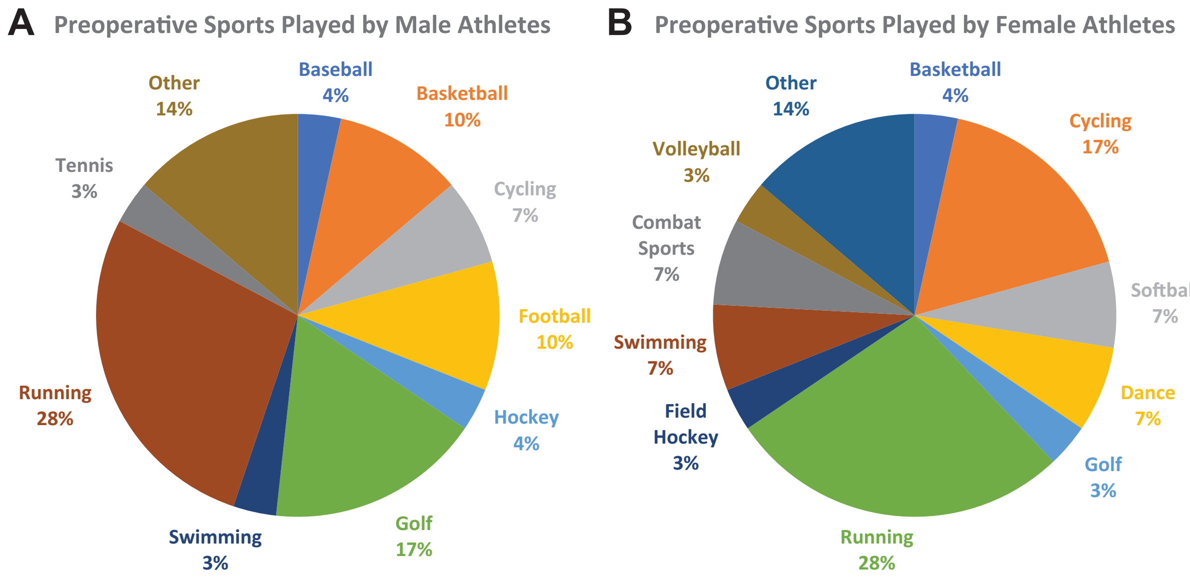

Figure 2. Preoperative sports played by (A) male and (B) female athletes.

TABLE 1
Patient Characteristics by Sex[a]

	Male Athletes	Female Athletes	*P*
Age at surgery, y	40.3 ± 12.3 (15.7-57.2)	40.5 ± 11.7 (19.9-65.4)	.948
Body mass index	27.8 ± 5.4 (20.1-49.5)	27.1 ± 5.1 (19.6-40.3)	.468
Follow-up time, mo	30.2 ± 7.5 (24.0-59.8)	27.6 ± 3.9 (24.0-39.7)	.118
Tear size, mm	3.9 ± 1.4 (0.5-7.0)	4.0 ± 1.2 (1.5-7.0)	.765
Tear type			.423
Circumferential	5 (17.2)	2 (6.9)	
Segmental	24 (82.8)	27 (93.1)	
Athletic level			.782
Collegiate	5 (17.2)	3 (10.3)	
High school	2 (6.9)	1 (3.4)	
Organized amateur	4 (13.8)	5 (17.2)	
Recreational	18 (62.1)	20 (69.0)	

[a]Values are presented as mean ± SD (range) or No. of hips (%).

TABLE 2
Radiographic Measurements by Sex[a]

	Male Athletes	Female Athletes	*P*
LCEA, deg	31.2 ± 6.8 (18.0 to 47.0)	33.8 ± 8.4 (19.0 to 51.0)	.222
Acetabular inclination, deg	4.7 ± 6.0 (–8.0 to 17.0)	2.7 ± 5.9 (–16.0 to 12.0)	.300
ACEA, deg	31.2 ± 8.4 (16.1 to 48.0)	33.8 ± 8.2 (20.0 to 51.0)	.276
Alpha angle, deg	71.3 ± 11.7 (48.0 to 92.0)	60.1 ± 13.3 (41.0 to 88.0)	**.002**
Tönnis grade			.790
0	16 (55.2)	18 (62.1)	
1	13 (44.8)	11 (37.9)	

[a]Values are presented as mean ± SD (range) or No. of hips (%). Boldface *P* value indicates a statistically significant difference between groups ($P < .05$). ACEA, anterior center-edge angle; LCEA, lateral center-edge angle.

athletes underwent conversion to THA, while 1 female athlete (3.4%) converted to total hip arthroplasty (THA) ($P >$ .999).

Return to Sports

Male and female athletes experienced high RTS rates (80.8% vs 84%, respectively; $P > .999$). Three male athletes and 4 female athletes underwent lifestyle transitions and were not included in the RTS analysis. Additionally, the male and female RTS rate was comparable across preoperative sports level ($P = .676$). RTS outcomes are located in Figure 4. There were no sex-based differences in the athletes who did or did not RTS (Table 7).

DISCUSSION

The main findings of this study are that female and male athletes undergoing primary hip arthroscopy with labral reconstruction have unique clinical characteristics and may require specialized treatment options. When compared with a propensity-matched control group of female athletes, male athletes demonstrated higher preoperative alpha angles, higher rates of undergoing acetabular microfracture, and lower rates of undergoing capsular repair. Despite these dissimilarities, female and male athletes achieved significant improvement in all measured PROs at the minimum 2-year follow-up and achieved high rates of RTS (84% and 80.8%, respectively). They also achieved the MCID and PASS for the iHOT-12 at high rates and demonstrated low rates of undergoing revision surgery.

There has been increasing sports participation in recent decades, and as a result, an emphasis should be placed on understanding sex-based differences related to arthroscopic treatment of FAI and labral tears. Shibata et al[55] performed a nonmatched comparison of elite-level male and female athletes and demonstrated excellent RTS rates in both male and female athletes. Similarly, Glein et al[21] also demonstrated favorable outcomes at a minimum 2-year follow-up in a cohort of elite female athletes undergoing primary hip arthroscopy; however, in their study, female athletes demonstrated statistically significantly greater improvement in PROs compared with male patients. The outcomes in the present study provide further evidence to support similar outcomes in male and female athletes undergoing hip arthroscopy with labral reconstruction despite the preoperative differences present in bony morphology.

TABLE 3
Intraoperative Findings by Sex[a]

	Male Athletes	Female Athletes	*P*
Seldes classification			.354
0	0 (0.0)	0 (0.0)	
1	2 (6.9)	2 (6.9)	
2	3 (10.3)	7 (24.1)	
1 and 2	24 (82.8)	20 (69.0)	
ALAD			.063
0	1 (3.4)	0 (0.0)	
1	4 (13.8)	8 (27.6)	
2	7 (24.1)	13 (44.8)	
3	16 (55.2)	8 (27.6)	
4	1 (3.4)	0 (0.0)	
Outerbridge: acetabulum			.159
0	1 (3.4)	1 (3.4)	
1	4 (13.8)	8 (27.6)	
2	7 (24.1)	11 (37.9)	
3	11 (37.9)	8 (27.6)	
4	6 (20.7)	1 (3.4)	
Outerbridge: femoral head			.811
0	25 (86.2)	24 (82.8)	
1	0 (0.0)	0 (0.0)	
2	1 (3.4)	0 (0.0)	
3	2 (6.9)	3 (10.3)	
4	1 (3.4)	2 (6.9)	
LT percentile (Domb) classification			.891
0 (0%)	14 (48.3)	13 (44.8)	
1 (>0% to <50%)	8 (27.6)	7 (24.1)	
2 (50% to <100%)	5 (17.2)	6 (20.7)	
3 (100%)	2 (6.9)	3 (10.3)	
LT Villar classification			.976
0 (no tear)	14 (48.3)	14 (48.3)	
1 (complete tear)	1 (3.4)	2 (6.9)	
2 (partial tear)	6 (20.7)	5 (17.2)	
3 (degenerative tear)	8 (27.6)	8 (27.6)	

[a]Values are presented as No. (%). ALAD, acetabular labrum articular disruption; LT, ligamentum teres.

TABLE 4
Surgical Procedures by Sex[a]

	Male Athletes	Female Athletes	*P*
Capsular repair	7 (24.1)	23 (79.3)	**<.001**
Acetabuloplasty	29 (100)	28 (96.6)	>.999
Femoroplasty	29 (100)	29 (100)	>.999
Acetabular microfracture	6 (20.7)	0 (0.0)	**.024**
Femoral head microfracture	0 (0.0)	0 (0.0)	>.999

[a]Values are presented as No. of hips (%). Boldface *P* values indicate a statistically significant difference between groups ($P < .05$).

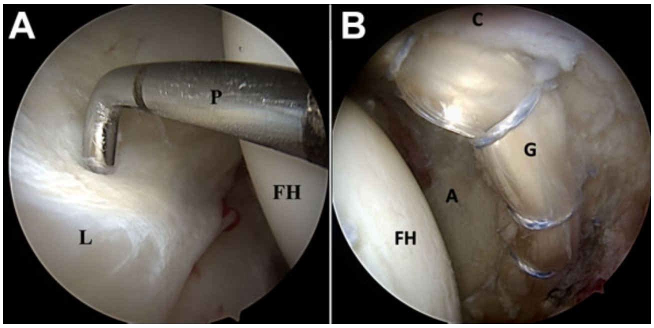

Figure 3. (A) Intraoperative images depicting a calcified labrum (L) in the left hip; labral reconstruction is indicated in this setting. (B) Labral reconstruction using posterior tibialis tendon allograft and the pull-through technique visualized using a 70° arthroscope from the anterolateral portal in the left hip, with the patient placed in the modified supine position under traction. A, acetabulum; C, capsule; FH, femoral head; G, posterior tibialis allograft; P, probe.

The finding of higher preoperative alpha angles observed in male athletes compared with female athletes is in line with prior literature evaluating male and female patients with FAI.[26,31,37] Similarly, cam deformity and higher alpha angles have been correlated with worse acetabular

TABLE 5
Patient-Reported Outcome Scores by Sex[a]

	Male Athletes	Female Athletes	*P*
mHHS			
Preoperative	67.0 ± 14.6 (40.0 to 96.0)	60.3 ± 16.0 (26.0 to 92.0)	.100
Latest	86.9 ± 16.5 (45.0 to 100)	84.6 ± 16.7 (42.0 to 100)	.806
Improvement	20.0 ± 20.4 (–22.0 to 58.0)	19.0 ± 28.4 (–62.0 to 57.0)	.887
P	**<.001**	**<.001**	
iHOT-12			
Preoperative	38.1 ± 19.0 (0.0 to 77.9)	37.4 ± 22.7 (0.1 to 86.8)	.901
Latest	76.6 ± 21.1 (32.6 to 100)	84.4 ± 20.5 (22.2 to 100)	.094
Improvement	39.0 ± 31.5 (–26.7 to 85.9)	45.1 ± 28.7 (–24.6 to 95.7)	.468
P	**<.001**	**<.001**	
NAHS			
Preoperative	66.3 ± 11.1 (45.0 to 87.5)	63.1 ± 17.2 (26.3 to 88.8)	.418
Latest	81.8 ± 17.1 (47.5 to 100)	88.8 ± 13.0 (56.3 to 100)	.154
Improvement	15.8 ± 20.1 (–25.0 to 55.0)	23.8 ± 17.4 (–16.3 to 56.3)	.124
P	**<.001**	**<.001**	
HOS-SSS			
Preoperative	40.2 ± 20.7 (5.6 to 86.1)	44.3 ± 22.8 (0.0 to 83.3)	.478
Latest	71.0 ± 28.5 (19.4 to 100)	79.8 ± 23.6 (38.9 to 100)	.399
Improvement	32.3 ± 31.5 (–22.2 to 88.9)	33.8 ± 29.3 (–33.3 to 97.2)	.873
P	**<.001**	**<.001**	
VAS pain			
Preoperative	5.1 ± 2.2 (1.7 to 10.0)	5.22 ± 1.8 (1.0 to 8.0)	.822
Latest	2.2 ± 2.3 (0.0 to 7.6)	2.0 ± 2.3 (0.0 to 7.0)	.699
Improvement	2.9 ± 3.2 (–3.4 to 10.0)	3.1 ± 2.1 (–2.0 to 6.3)	.807
P	**<.001**	**<.001**	
Patient satisfaction	7.5 ± 2.9 (1.0 to 10.0)	8.8 ± 1.7 (5.0 to 10.0)	.064

[a]Values are presented as mean ± SD (range). Boldface *P* values indicate a statistically significant improvement from preoperatively to latest follow-up ($P < .05$). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; VAS, visual analog scale.

TABLE 6
Clinical Psychometric Evaluations by Sex[a]

	Male Athletes (n = 28)	Female Athletes (n = 26)	*P*
mHHS			
MCID	20 (71.4)	17 (65.4)	.854
PASS	22 (78.6)	18 (69.2)	.637
iHOT-12			
MCID	20 (71.4)	23 (88.5)	.179
PASS	20 (71.4)	23 (88.5)	.179
HOS-SSS			
MCID	19 (67.9)	17 (65.4)	>.999
NAHS			
MCID	19 (67.9)	22 (84.6)	.207
PASS	14 (50.0)	18 (69.2)	.246
VAS pain			
MCID	20 (71.4)	23 (88.5)	.179

[a]Values are presented as No. of hips (%). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; PASS, patient acceptable symptom state; VAS, visual analog scale.

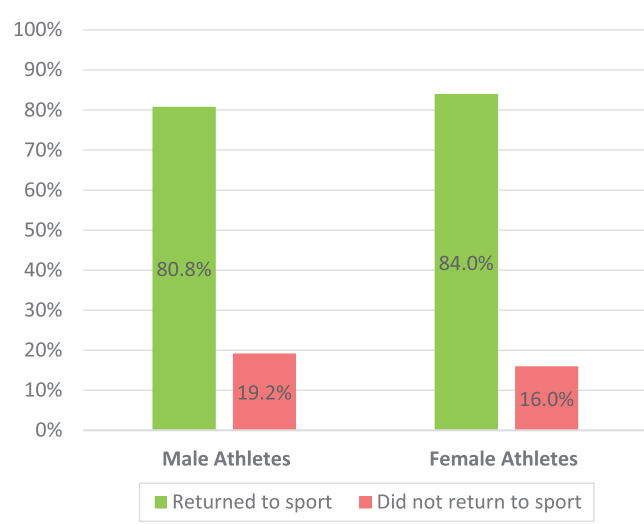

Figure 4. Return-to-sports rates by sex.

cartilage lesions, but similar rates of high-grade acetabular cartilage injury were observed in this study.[1,9,30,32] Prior literature by Saks et al[53] evaluated intraoperative findings and postoperative outcomes comparing male and female patients with borderline dysplasia undergoing primary hip arthroscopy for FAIS. In their study, similar outcomes were found at a minimum 2-year follow-up, but male patients demonstrated higher preoperative alpha angles and underwent acetabular microfracture at higher rates.[53]

TABLE 7
Breakdown by Sex and Level of Athletes Who Returned and Did Not Return to Sports[a]

	Returned to Sports			Did Not Return to Sports		
	Male Athletes	Female Athletes	*P*	Male Athletes	Female Athletes	*P*
Level			.676			.722
Collegiate	3 (14.3)	1 (4.8)		1 (20.0)	1 (25.0)	
High school	2 (9.5)	1 (4.8)		0 (0.0)	0 (0.0)	
Organized amateur	4 (19.0)	4 (19.0)		0 (0.0)	0 (0.0)	
Recreational	12 (57.1)	15 (71.4)		4 (80.0)	3 (75.0)	

[a]Values are presented as No. of hips (%).

Male sex and higher alpha angles have been previously associated with predictors of acetabular cartilage damage in patients with FAIS undergoing hip arthroscopy.[45] In the present cohort, men and women had similar incidence rates of high-grade acetabular cartilage injury; however, significantly more male athletes in this study underwent acetabular microfracture compared with female athletes. Although it did not reach the level of significance, male athletes had a greater prevalence of Outerbridge grade 4 acetabular cartilage damage (6 men [20.1%] vs 1 woman [3.4%]), in line with the higher rate of acetabular microfracture. Despite the higher rate of acetabular microfracture in male athletes, they demonstrated similar outcomes compared to the female athlete control group. These outcomes are similar to those presented by Shibata et al,[55] who also found that male athletes underwent higher rates of acetabular microfracture but still experienced high rates of RTS. These findings are further supported with results from Byrd and Jones[11] and Amenabar and O'Donnell,[4] who demonstrated high rates of RTS in male athletes receiving acetabular microfracture.

The present study found that capsular repair was more commonly performed in the female athlete cohort to address concerns for microinstability, especially in those with generalized ligamentous laxity. Generalized ligamentous laxity has been commonly reported in women undergoing primary hip arthroscopy.[51,53] In a study by Saadat et al,[51] women were reported to have a higher risk of generalized ligamentous laxity, defined as a Beighton score ≥4. In their patient population, 84.2% of patients with Beighton scores ≥1 were women, and 92.7% of those with Beighton scores ≥4 were women. The present study's finding of higher rates of capsular repair in female athletes may be explained by sex-based pathology differences that consequently require different treatment modalities.[51,53]

Strengths of the Study

This study has several notable strengths. First, there are no previously published studies that have compared and reported outcomes and RTS rates for male and female athletes receiving labral reconstruction. Second, the use of multiple validated hip outcome scores that are specific to nonarthritic hips, athletes, quality of life, and pain increases the generalizability and validity of the reported findings. Third, the authors contextualize patient postoperative improvement via the use of clinical psychometric evaluations. Fourth, the study employs propensity matching to ensure that the treatment and control groups are similar across a range of patient characteristics to increase external validity. Fifth, the power analysis used reduces the chance of committing type 2 errors and increases the external validity of the findings.

Limitations

The limitations of this study must also be acknowledged. First, the retrospective design may introduce responder and selection bias and limit the validity. Second, the randomization is not double-blind, and measures such as propensity matching are unable to fully eliminate the bias of creating a control group. Third, the paper uses patient data for athletes with borderline dysplasia. Recent literature has demonstrated that these patients demonstrate favorable and comparable outcomes to patients without borderline dysplasia, but more prospective studies with longer follow-up are needed.[39] Fourth, all hip arthroscopies with labral reconstructions were performed by a single surgeon at a high-volume practice, which may limit the generalizability of the results. Fifth, the sample size is relatively small, which limits its generalizability, and further studies may look into increasing sample size and following the cohort over a longer period. Sixth, the propensity-matched analysis does not include professional athletes, which may limit its validity. Seventh, RTS data, an ambiguous term, and lack of data prevent observations on whether athletes returned to preinjury participation levels. Additionally, relevant data such as microinstability, generalized ligamentous laxity, time to RTS, and postoperative ability level were not available for all patients; thus, these variables were not examined in the present analysis. Finally, surgical technique has evolved and improved substantially over the study period, which may introduce potential bias to the results. As a result, some patients in the present study cohorts who underwent capsulotomy without repair would currently be treated with capsular repair/plication.[29,48]

CONCLUSION

Despite different clinical characteristics and surgical procedures, female and male athletes undergoing primary hip arthroscopy with labral reconstruction demonstrated significant improvements in all PROs at a minimum 2-year follow-up and returned to sports at high rates (84% vs 80.8%). Female and male athletes had comparable PROs, RTS, and rates of achieving MCID and PASS.

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