Rate of Return to Sport and Functional Outcomes After Bilateral Hip Arthroscopy in High-Level Athletes

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Background: Bilateral hip symptoms are common in athletes, and athletes may require treatment with bilateral hip arthroscopy. Return-to-sport (RTS) rates in competitive athletes after unilateral procedures have been reported at 74% to 93%; however, RTS rates after bilateral hip arthroscopy are still unknown.

Purpose/Hypothesis: The purpose was to determine rate of RTS in competitive athletes undergoing bilateral hip arthroscopy and report minimum 1-year patient-reported outcomes (PROs) for this cohort. We hypothesized that after bilateral hip arthroscopy, the RTS rate would be similar to the square of the probability of returning after unilateral hip arthroscopy.

Study Design: Case series; Level of evidence, 4.

Methods: Data were prospectively collected on patients undergoing hip arthroscopy at our institution from November 2011 to July 2018. Patients were included if they underwent bilateral hip arthroscopy and were a high school, collegiate, or professional athlete before their first surgery. A patient's RTS was defined as return to competitive participation in one's sport at a level the same as or higher than the preoperative level. Additionally, minimum 1-year PROs, including modified Harris Hip Score (mHHS), nonarthritic hip score, and Hip Outcome Score–Sports Specific Subscale (HOS-SSS), as well as complication rates and future surgery were compared for all patients. Rates of reaching the minimal clinically importance difference (MCID) and patient acceptable symptomatic state (PASS) for the mHHS (8 and 74, respectively) and HOS-SSS (6 and 75, respectively) were also recorded.

Results: A total of 87 patients met inclusion criteria, for which follow-up was available for 82 (94.3%). At latest follow-up, 100% of professional athletes had returned to their sport, while 53.7% of the entire cohort returned to their sport, with 75.8% of male patients returning versus 38.8% of female patients ($P < .001$). Of patients returning, 56% did so at the same ability or higher. The most common reason for not returning was graduation or lifestyle change (47.4%). Patients returning to sport had significantly higher PROs at latest follow-up relative to those who did not return, including mHHS (93.7 vs 87.5), nonarthritic hip score (94.4 vs 88.2), and HOS-SSS (90.9 vs 78.2) ($P < .05$). Rates of achieving the PASS and MCID for the mHHS were not significantly different. However, for the HOS-SSS, patients who returned had significantly higher rates of achieving the MCID and PASS thresholds.

Conclusion: The rate of RTS among competitive athletes after bilateral hip arthroscopy was similar to the square of published RTS rates after unilateral hip arthroscopy. Both those who returned to play and those who did not showed significant improvement in PROs after surgery. However, those who returned to sports achieved significantly higher scores in all outcome measures. Additionally, patients returning to sports showed a significantly higher rate of attaining the MCID and PASS scores for the HOS-SSS.

Keywords: bilateral surgery; return to sports; hip arthroscopy; femoroacetabular impingement

Hip injuries are common in athletes and can lead to significant impairment in performance and, in some cases, even early retirement.[6] Different athletic activities have been shown to be associated with specific hip pathologies. Cam lesions causing femoroacetabular impingement (FAI) are often more common and prominent in soccer, hockey, and American football athletes.[22] Conversely, in dancers, a combination of hyperlaxity and extreme ranges of motion can cause subluxations and FAI, even in the absence of morphological features such as cam and pincer lesions.[16,44] Regardless of pathoetiology, labral tears and chondral damage may develop in both cases, which may lead to pain and loss of function in these patients.

Bilateral FAI has been extensively discussed in the literature, and it has been shown that although radiographic evidence of FAI does not equate to symptomatic FAI, the prevalence of contralateral symptomatic FAI is relatively high, ranging from 15% to 40% in patients undergoing surgical treatment for unilateral hip pain.[21,23,25,33] Additionally, risk factors for undergoing bilateral FAI surgery include male sex, younger age, and lack of medical

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comorbidities. Nawabi et al[33] found that among high-level athletes undergoing hip arthroscopy, 28.4% underwent bilateral surgical procedures, which was significantly higher than in recreational athletes. Possibly, these patients undergo a contralateral surgical procedure at a higher rate owing to a desire to return to a high level of activity.[21,24]

Several studies have reported on return to sport (RTS) after hip arthroscopy, at the recreational level as well as in high-level athletes. Reiman et al[39] performed a systematic review demonstrating RTS at the same level or higher in 74% of athletes. A number of systematic reviews have been conducted showing higher rates of return to play, although with variable reporting on level of play.[8,31,32,34] Studies have also demonstrated that RTS rates are dependent on factors such as preinjury competition level[8] and duration of symptoms.[41,43] Although a number of studies have reported on sport-specific outcome scores after bilateral hip arthroscopy,[1,30] no studies to date have examined the RTS rate after bilateral hip arthroscopy in high-level athletes. Importantly, any bilateral surgery should have a mathematically lower probability of returning to sport, equal to the unilateral probability squared. For example, if the rate of RTS is 74%, as in the systematic review by Reiman et al, then the expected rate of RTS after bilateral arthroscopy would be 55% based on the following calculation: $0.74 \times 0.74 = 0.55$.

The purpose of this study was to determine the rate of return to play in competitive athletes undergoing staged bilateral hip arthroscopy and to report on minimum 1-year functional scores in this cohort. We hypothesized that, at minimum 1-year follow-up, rate of RTS and sport-specific functional scores will be similar to the square of RTS rates reported in the literature for unilateral hip arthroscopy.

METHODS

Patient Selection

Data were prospectively collected on all patients who underwent hip arthroscopy at our institution from November 2011 to July 2018. Patients were excluded if they had a preoperative Tönnis grade >1, a prior hip condition (ie, avascular necrosis of the femoral head, slipped capital femoral epiphysis, hip fracture, or Legg-Calve-Perthes disease), or prior hip surgery. Patients were included if they underwent staged bilateral hip arthroscopies within the study period and were a high school, collegiate, or professional athlete before their first surgery. None of the bilateral operations were same-day procedures, and the interval between procedures was recorded in months. All patients participated in the American Hip Institute Hip Preservation Registry. While the present study represents a unique analysis, data on some patients in this study may have been reported in other studies.[11,36,37] All data collection received institutional review board approval.

Surgical Indications and Procedures

Patient history, radiographic analysis, and magnetic resonance arthrography were collectively used to diagnose labral tears and/or FAI in all patients. Additionally, all patients underwent a physical examination by the senior author (B.G.D.). Before surgical intervention, all patients had persistent hip pain that interfered with their daily activities for >3 months, and all had failed nonoperative measures, such as rest, nonsteroidal anti-inflammatory drugs, intra-articular injections, and physical therapy.

Arthroscopic surgery was performed with the patient under general anesthesia and placed on a traction table in the modified supine position. The anterolateral, midanterior, and distal lateral accessory portals were used to access the hip joint. Before any procedures were performed, diagnostic arthroscopy was performed, and hip joint pathologies were noted with the following classification systems: acetabular labrum articular disruption,[7] acetabular and femoral head articular cartilage lesions (Outerbridge),[35] and Seldes for labral tears.[42] The ligamentum teres was assessed with the Villar and Domb classification systems.[5,18]

If possible, labral tears were repaired. In the case of an irreparable labrum, treatment options included reconstruction or selective debridement.[15] All bony lesions were corrected with an arthroscopic burr under fluoroscopic guidance. Femoral and acetabular osteoplasty was performed in cases of cam- and pincer-type impingement, respectively.[28] Microfracture was used to treat full-thickness chondral defects. Iliopsoas fractional lengthening was used to treat patients who noted painful internal snapping.[10] Capsular repair was performed in patients who had ligamentous laxity or tendency for microinstability,

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characterized by a lateral central-edge angle between 18° and 25° (borderline dysplasia) and elevated Beighton score.[40] However, a capsular release was performed in patients with hip stiffness or a limited range of motion.

Rehabilitation

For the first 2 weeks after surgery, all patients were instructed to use crutches with partial weightbearing (20 lb [9 kg]) and to wear a DonJoy hip brace (DJO Global), which limited flexion and extension to 90° and 0°, respectively. Patients received a structured rehabilitation protocol, with a predetermined goal of RTS 6 months from the second surgery. Patients underwent the rehabilitation process with a physical therapist or trainer of their choice. Patients then progressed to 3 months of physical therapy to improve strength and range of motion. If a patient underwent labral reconstruction or microfracture, the rehabilitation protocol was modified so that the patient was partial weightbearing for 6 to 8 weeks.

RTS and Outcome Scores

Before their first surgery, all patients completed a questionnaire reporting their level of participation in sports within 1 year of the surgical date. After their contralateral hip surgery, RTS was determined with either a follow-up questionnaire or a clinician office note. RTS was defined as a patient's return to competitive participation in his or her sport at the same level as or higher than that of presurgery, regardless of time elapsed after surgery.

Patient-reported outcomes (PROs) collected for this study included minimum 1-year follow-up for modified Harris Hip Score (mHHS), nonarthritic hip score (NAHS), Hip Outcome Score–Sports Specific Subscale (HOS-SSS), visual analog scale (VAS) for pain, International Hip Outcome Tool (iHOT-12), Veterans RAND 12-Item Health Survey–Physical and Mental scores (VR-12 P and VR-12 M), and 12-Item Short Form Health Survey–Physical and Mental scores (SF-12 P and SF-12 M), as well as patient satisfaction (0-10). Complication rates and future surgery were also documented for all patients. Questionnaires were sent to patients through encrypted email at the 3-month and annual time points postoperatively. If questionnaires were not completed online, patients completed them at the time of their follow-up visit or through a phone interview.

The rates of patients achieving the minimal clinically importance difference (MCID) for the mHHS and HOS-SSS were recorded (8 and 6 points, respectively).[20,29] Additionally, the number of patients who met the patient acceptable symptomatic state (PASS) for the mHHS and HOS-SSS was documented (74 and 75 points, respectively).[9]

Statistical Analysis

All statistical analyses for this study were performed with Microsoft Excel and the Real Statistics add-on package. All continuous data were first assessed for normalcy and equal variance with a Shapiro-Wilk test and F test, respectively. Data were then compared with a Student t test or its nonparametric equivalent. Categorical data were compared with the Fisher exact and chi-square test. A P value $<.05$ was considered statistically significant.

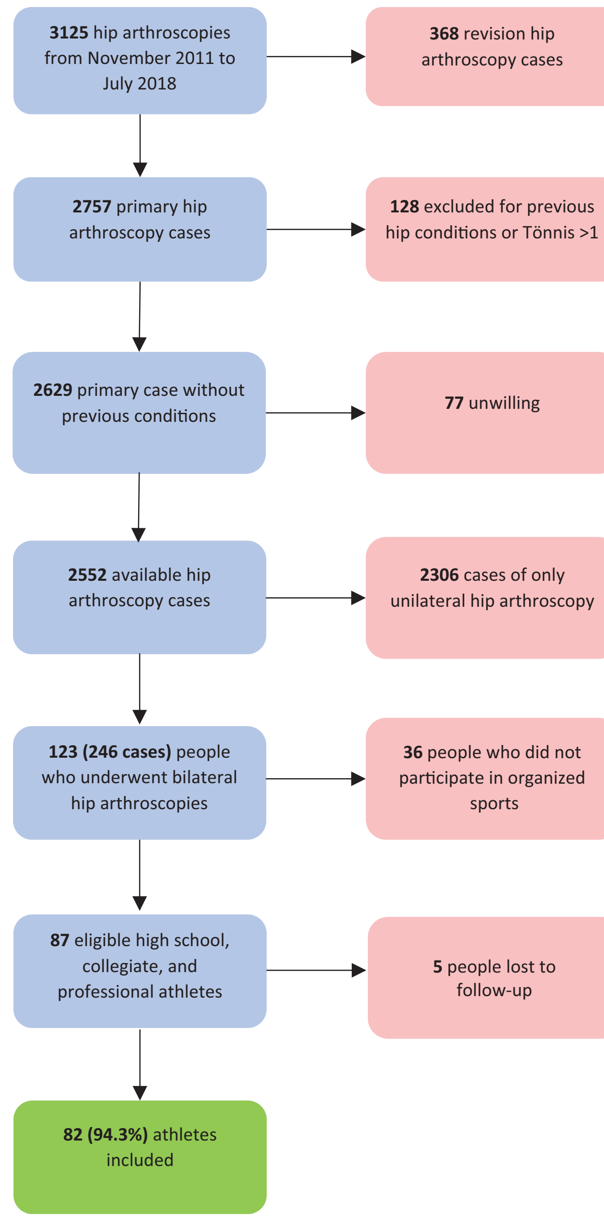

Figure 1. Flowchart summarizing the patient selection process.

RESULTS

Patient Demographics

A total of 87 patients met the inclusion criteria. Of those patients, 82 (94.3%) had follow-up information regarding RTS. Of the 82 patients, 69 (84.1%) had minimum 1-year PROs and were included in the analysis of PROs. The overall patient selection process is detailed in Figure 1.

TABLE 1
Patient Characteristics[a]

	First Side	Second Side	*P* Value
Hips included in study			.2115
Left	45 (54.9)	37 (45.1)	
Right	37 (45.1)	45 (54.9)	
Sex			
Male	33 (40.2)		
Female	49 (59.8)		
Age at surgery, y	17.3 ± 2.9 (13.2-32.8)	18.4 ± 3.3 (14.1-33.0)	.0782
BMI, kg/m^2	23.3 ± 4.2 (17.06-37.9)	23.7 ± 4.5 (16.75-42.9)	.5648
Time between procedures, mo		9.3 ± 14.3 (1.0-69.7)	

[a]Values are presented as n (%) or mean ± SD (range). BMI, body mass index.

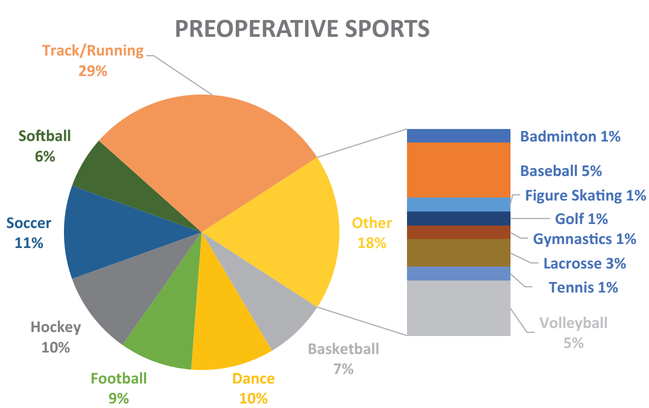

Figure 2. Full summary of the sports played by the included athletes.

Thirty-three (40.2%) patients were male, and 49 (59.8%) were female (Table 1). Mean age at the time of first surgery was 17.3 years (range, 13.2-32.8 years), and mean age at the time of second surgery was 18.4 years (range, 14.1-33.0 years). Mean follow-up time from second surgery was 35.0 months (range, 2.7-94.9 months). Overall, there were 58 (70.7%) high school athletes, 18 (22.0%) college athletes, and 6 (7.3%) professional athletes. The most common sport reported, at 29%, was "Track/Running" (Figure 2).

Intraoperative Findings

The most common intraoperative finding was labral tears, which were found in 97.6% of the first-side cases and 98.8% of the second-side cases. Regarding rates of cartilage defects, patients had an acetabular labrum articular disruption cartilage grade ≥2 in 32.9% and 37.8% of the first and second surgery cases, respectively. There were no significant differences between the intraoperative findings of the patients' first and second operations. Table 2 presents a full summary of the intraoperative findings.

Arthroscopic Procedures

The most common procedure performed for patients' first and second surgery was labral treatment (97.6% and 98.2%, respectively). Other common procedures performed for patients' first and second surgery were capsular repair (84.1% and 89.0%), femoroplasty (85.4% and 87.8%), and acetabuloplasty (76.8% and 81.7%). There were no significant differences in the frequency of the procedures performed between the operative sides (Table 3). Rates of iliopsoas snapping requiring iliopsoas fractional lengthening were highest among track athletes (62.5%) and dancers (100%).

RTS and PROs

At latest follow-up, 44 (53.7%) of the 82 included patients returned to sport, with male patients returning at 75.8% and female patients at 38.8% ($P < .001$). Reasons for not returning to sport included lifestyle change (18 patients), continued hip symptoms (17 patients), doctor recommendation of activity modification (2 patients), and a nonhip injury (1 patient) (Figure 3). Table 4 summarizes ability after returning to sport, and rates of return based on competition level are summarized in Figure 4.

Before surgery, there were no significant differences regarding radiographic measurements between patients who returned to sport and those who did not (Table 5). However, the group that did RTS had a larger lateral center-edge angle postoperatively (mean ± SD, 29.7 ± 4.9 vs 27.4 ± 5.0; $P = .0085$).

For their first and second surgery, patients experienced significant improvements between preoperative and latest follow-up scores for the mHHS, NAHS, HOS-SSS, and VAS. Patients had significantly different preoperative scores for the mHHS and VAS between their first and second surgery ($P = .0174$ and $P = .0053$, respectively). However, there were no significant differences in the mean improvement in mHHS or VAS between the operative sides. Mean satisfaction scores for patients' first and second surgical sides were 8.5 and 8.6, respectively, and were not statistically different at latest follow-up. Additionally, no significant differences were found regarding the iHOT-12, SF-12 P, SF-12 M, VR-12 P, and VR-12 M at latest follow-up. Mean pre- and postoperative PROs regarding patients' first and second surgery are summarized in Table 6.

TABLE 2
Intraoperative Findings of Patients' First- and Second-Side Surgery[a]

	First Side	Second Side	*P* Value
Seldes			.7408
No tear	2 (2.4)	1 (1.2)	
I	37 (45.1)	40 (48.8)	
II	24 (29.3)	19 (23.2)	
Combined I and II	19 (23.2)	22 (26.8)	
ALAD			.8766
0	16 (19.5)	17 (20.7)	
1	39 (47.6)	34 (41.5)	
2	15 (18.3)	18 (22.0)	
3	12 (14.6)	13 (15.9)	
Outerbridge (acetabulum)			.7910
0	14 (17.1)	18 (22.0)	
1	41 (50.0)	33 (40.2)	
2	14 (17.1)	17 (20.7)	
3	11 (13.4)	12 (14.6)	
4	2 (2.4)	2 (2.4)	
Outerbridge (femoral head)			.3432
0	75 (91.5)	80 (97.6)	
1	1 (1.2)	1 (1.2)	
2	2 (2.4)	1 (1.2)	
3	3 (3.7)	0 (0.0)	
4	1 (1.2)	0 (0.0)	
LT percentile class (Domb)			.1659
0: 0%	58 (70.7)	58 (70.7)	
1: 0% to <50%	12 (14.6)	18 (22.0)	
2: 50% to <100%	12 (14.6)	5 (6.1)	
3: 100%	0 (7.1)	1 (1.2)	
LT Villar class			.7781
0: No tear	57 (69.5)	58 (70.7)	
1: Complete tear	1 (1.2)	1 (1.2)	
2: Partial tear	24 (29.3)	1 (1.2)	
3: Degenerative tear	0 (0.0)	0 (0.0)	

[a]Values are presented as n (%). ALAD, acetabular labrum articular disruption; LT, ligamentum teres.

TABLE 3
Surgical Procedures for Patients' First- and Second-Side Surgery[a]

	First Side	Second Side	*P* Value
Labral treatment			.8245
None	2 (2.4)	1 (1.2)	
Debridement	6 (7.3)	4 (4.9)	
Repair	71 (86.6)	73 (89.0)	
Reconstruction	3 (3.7)	4 (4.9)	
Capsular treatment			.3594
Repair	69 (84.1)	73 (89.0)	
Release	13 (15.9)	9 (11.0)	
Acetabuloplasty	63 (76.8)	67 (81.7)	.4410
Femoroplasty	70 (85.4)	72 (87.8)	.6468
Acetabular microfracture	1 (1.2)	2 (2.4)	.5601
Femoral head microfracture	1 (2.4)	0 (0)	.3158
Ligamentum teres debridement	13 (15.9)	13 (15.9)	>.999
Iliopsoas fractional lengthening	48 (58.5)	51 (62.2)	.6320
Trochanteric bursectomy	0 (0.0)	1 (1.2)	.3158

[a]Values are presented as n (%).

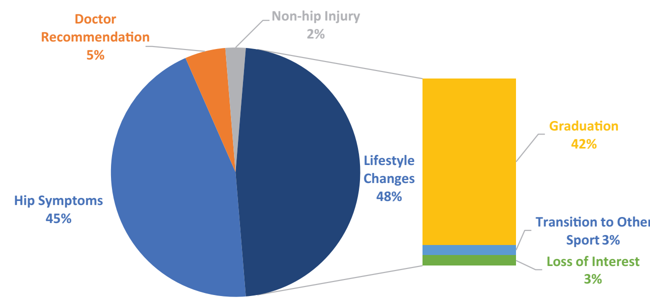

Figure 3. Reasons for not returning to sport.

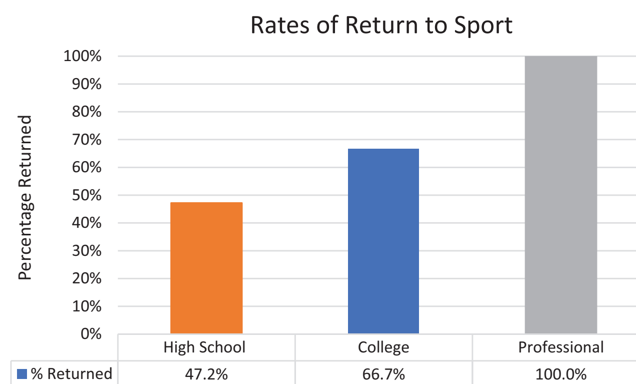

Figure 4. Rates of return to sport based on competition level.

TABLE 4
Rate of Returning to Sport by Gender and Level of Performance If Returned

	n (%)
Returned to sports	44 (53.7)
Male	25 (75.8)
Female	19 (38.8)
Ability after returning[a]	
Higher	6 (24.0)
Same	8 (32.0)
Lower	11 (44.0)

[a]Data regarding ability after returning were not available for all patients who returned. Percentage reported of those with data available.

For the entire cohort, mean outcome scores for the mHHS and HOS-SSS demonstrated that patients met the PASS and MCID for both sides at latest follow-up, and there were no significant differences between rates of reaching the PASS or MCID between first and second surgery (Table 7).

Between patients who returned to sport and those who did not, patients who returned had significantly higher PROs for the majority of outcome measures at latest follow-up. Outcome measures that showed a statistically

TABLE 5
Pre- and Postoperative Radiographic Measurements for Patients Who Did and Did Not Return to Sport[a]

	RTS	Non-RTS	*P* Value
LCEA			
Preoperative	30.8 ± 5.2 (20 to 43)	29.2 ± 6.3 (19 to 47)	.1312
Latest	29.7 ± 4.9 (19 to 41)	27.4 ± 5.0 (18 to 43)	.0085
ACEA			
Preoperative	31.7 ± 5.5 (18 to 43)	30.9 ± 7.7 (17 to 51)	.2437
Latest	31.3 ± 5.9 (18 to 42)	29.9 ± 6.8 (17 to 48)	.2034
Alpha angle			
Preoperative	61.1 ± 13.8 (37 to 99)	57.0 ± 11.7 (39 to 93)	.0710
Latest	43.1 ± 5.4 (32 to 58)	43.1 ± 5.8 (33 to 64)	.7720
Tönnis angle			
Preoperative	4.0 ± 5.9 (–15 to 15)	4.3 ± 4.9 (–1 to 14)	.9694
Latest	4.0 ± 5.2 (–13 to 14)	4.2 ± 4.1 (–1 to 15)	.8030
Offset			
Preoperative	0.4 ± 0.3 (0 to 1.1)	0.4 ± 0.2 (0 to 1)	.3824
Latest	0.8 ± 0.1 (0.3 to 1.2)	0.8 ± 0.1 (0.3 to 1.4)	.8548

[a]Values are presented as mean ± SD (range). ACEA, anterior center-edge angle; LCEA lateral central-edge angle; RTS, return to sport.

TABLE 6
Patient-Reported Outcome Scores for Patients' First- and Second-Side Surgery[a]

	First Side	Second Side	*P* Value
mHHS			
Preoperative	66.1 ± 14.6 (25.0 to 96.0)	71.8 ± 15.7 (19.0 to 97.0)	.0174
Latest	90.2 ± 12.3 (54.0 to 100.0)	90.7 ± 10.9 (63.0 to 100.0)	.8071
P value	<.0001	<.0001	
Delta	22.3 ± 21.2 (–65.0 to 71.0)	21.7 ± 14.9 (–7.0 to 55.0)	.8671
NAHS			
Preoperative	66.0 ± 17.3 (26.0 to 94.0)	70.9 ± 18.6 (23.0 to 96.3)	.0687
Latest	90.9 ± 11.2 (56.3 to 100)	91.0 ± 9.5 (65.0 to 100.0)	.9811
P value	<.0001	<.0001	
Delta	24.2 ± 18.6 (–7.5 to 64.0)	20.4 ± 18.4 (–8.8 to 73.8)	.2125
HOS-SSS			
Preoperative	48.5 ± 20.6 (0 to 94)	45.8 ± 25.1 (0 to 94.0)	.4866
Latest	86.3 ± 19.4 (16.7 to 100)	82.4 ± 19.6 (16.7 to 100)	.1607
P value	.0011	<.0001	
Delta	36.9 ± 28.5 (–50.0 to 94.0)	37.6 ± 30.5 (–36.3 to 97.2)	.9060
VAS			
Preoperative	5.4 ± 2.4 (0 to 9)	4.1 ± 2.7 (0 to 9)	.0053
Latest	1.6 ± 2.0 (0 to 7.0)	1.6 ± 1.8 (0 to 7)	.3732
P value	.0001	<.0001	
Delta	–3.9 ± 3.1 (–9.0 to 3.0)	–2.8 ± 3.1 (–8.2 to 4.4)	.0616
iHOT-12	84.4 ± 17.4 (35.1 to 100)	81.7 ± 17.4 (40.2 to 100)	.3526
SF-12 M	57.9 ± 4.9 (33.5 to 65.7)	57.5 ± 6.0 (30.1 to 67.2)	.9544
SF-12 P	52.4 ± 6.9 (30.0 to 61.9)	51.7 ± 7.0 (31.8 to 59.5)	.5114
VR-12 M	63.0 ± 4.7 (48.1 to 40.9)	62.6 ± 5.7 (40.9 to 67.9)	.8852
VR-12 P	53.9 ± 5.7 (35.1 to 59.4)	53.3 ± 5.9 (36.2 to 60.2)	.4214
Patient satisfaction	8.5 ± 1.7 (4 to 10)	8.6 ± 1.7 (3 to 10)	.7864

[a]Values are presented as mean ± SD (range) unless noted otherwise. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; NAHS, Non-arthritic Hip Score; SF-12 M, 12-Item Short Form Health Survey–Mental; SF-12 P, 12-Item Short Form Health Survey–Physical; VAS, visual analog scale; VR-12 M, Veterans RAND 12-Item Health Survey–Mental; VR-12 P, Veterans RAND 12-Item Health Survey–Physical.

significant difference ($P < .05$) at latest follow-up for patients who returned versus those who did not return were the mHHS (93.3 vs 87.5), NAHS (94.1 vs 88.2), HOS-SSS (90.4 vs 78.2), VAS (0.9 vs 2.3), iHOT-12 (90.2 vs 76.5), SF-12 P (54.9 vs 49.0), VR-12 P (55.9 vs 51.2), and satisfaction (9.1 vs 8.0) (Table 8). However, there were no significant differences in the mean improvement of PROs between the groups (Figure 5). Additionally,

TABLE 7
Rates of MCID and PASS for Patients' First- and Second-Side Surgery[a]

	First Side	Second Side	*P* Value
mHHS			
MCID: 8	44 (75.9)	41 (83.7)	.3192
PASS: 74	56 (86.2)	50 (87.7)	.7983
HOS-SSS			
MCID: 6	47 (88.7)	40 (87.0)	.7934
PASS: 75	54 (84.4)	41 (74.5)	.1828

[a]Values are presented as n (%). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; MCID, minimal clinically importance difference; mHHS, modified Harris Hip Score; PASS patient acceptable symptomatic state.

when groups were divided according to returning or not returning owing to lifestyle changes or hip symptoms, there were still higher PRO scores for the RTS group (Table 9).

Regarding rates of achieving the MCID and PASS for the mHHS, there were no significant differences between the groups. However, for the HOS-SSS, patients returning to sport had significantly higher rates of reaching the MCID and PASS than those who did not return (Table 10).

Complications and Secondary Operations

There were no complications after patients' first surgery, but 2 (2.4%) patients had minor complications after their second surgery that resolved over time. One of the complications was a superficial infection, and the other was leg swelling around a hamstring autograft harvest site. These minor complications occurred in 2 patients who ultimately returned to sport.

Regarding revision arthroscopies, 5 (6.1%) patients underwent a secondary arthroscopy on the first side, and 3 (3.7%) underwent revision arthroscopy on the second operative side (P = .4684). There was no significant difference in revision rate between those returning to sport and those who did not return. Additionally, by latest follow-up, no patients underwent conversion to total hip arthroplasty (Table 11).

DISCUSSION

The results of this study show that in high-level athletes undergoing bilateral hip arthroscopy, the RTS rate is 53.7%, with male athletes returning at higher rates than female athletes (75.8% vs 38.8%). Professional athletes had the highest rate of RTS (100%), followed by

TABLE 8
Patient-Reported Outcome Scores for Patients Who Returned to Sport and Those Who Did Not Return[a]

	Returned to Sport	Did Not Return	*P* Value
mHHS			
Preoperative	70.1 ± 16.1 (19.0 to 97.0)	68.1 ± 14.2 (33.0 to 96.0)	.1684
Latest	93.3 ± 9.8 (66.0 to 100)	87.5 ± 12.8 (54.0 to 100.0)	.0038
P value	<.0001	<.0001	
Delta	23.4 ± 17.5 (–4.0 to 77.0)	21.8 ± 17.3 (–19 to 55.0)	.8705
NAHS			
Preoperative	70.6 ± 18.4 (23.0 to 96.2)	66.6 ± 17.4 (26 to 94)	.1698
Latest	94.1 ± 8.3 (65.0 to 100)	88.2 ± 11.4 (56.3 to 100.0)	.0009
P value	<.0001	<.0001	
Delta	23.7 ± 18.5 (–8.75 to 67.0)	21.3 ± 19.2 (–7.5 to 73.75)	.4714
HOS-SSS			
Preoperative	48.5 ± 23.7 (0 to 94)	47.1 ± 21.5 (2.8 to 94.0)	.4465
Latest	90.4 ± 14.1 (44.4 to 100)	78.2 ± 22.7 (16.7 to 100)	.0005
P value	<.0001	<.0001	
Delta	42.1 ± 24.2 (–5.6 to 94.0)	30.9 ± 34.2 (–50.0 to 97.2)	.0757
VAS			
Preoperative	4.6 ± 2.5 (0 to 9)	4.8 ± 2.6 (0 to 9)	.7537
Latest	0.9 ± 1.4 (0 to 5)	2.3 ± 2.1 (0 to 7)	<.0001
P value	<.0001	<.0001	
Delta	–3.7 ± 3.1 (–9.0 to 2.6)	–2.8 ± 3.1 (–9.0 to 4.4)	.1543
iHOT-12	90.2 ± 13.3 (40.1 to 100)	76.5 ± 18.6 (35.1 to 100)	<.0001
SF-12 M	57.8 ± 5.6 (30.1 to 63)	57.9 ± 4.8 (45.1 to 67.2)	.6780
SF-12 P	54.9 ± 3.6 (37.3 to 61.8)	49.0 ± 8.2 (30.0 to 58.1)	<.0001
VR-12 M	63.4 ± 4.7 (40.8 to 67.4)	62.4 ± 5.1 (48.7 to 68.6)	.2141
VR-12 P	55.9 ± 3.1 (43.3 to 60.1)	51.2 ± 6.9 (35.1 to 59.6)	<.0001
Patient satisfaction	9.1 ± 1.1 (5 to 10)	8.0 ± 2.0 (3 to 10)	.0001

[a]Values are presented as mean ± SD (range) unless noted otherwise. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; NAHS, Non-arthritic Hip Score; SF-12 M, 12-Item Short Form Health Survey–Mental; SF-12 P, 12-Item Short Form Health Survey–Physical; VAS, visual analog scale; VR-12 M, Veterans RAND 12-Item Health Survey–Mental; VR-12 P, Veterans RAND 12-Item Health Survey–Physical.

TABLE 9
Patient-Reported Outcomes Between Those Who Returned to Sport and Those Who Did Not (for Lifestyle Changes or Hip Symptoms)[a]

		Non-RTS	
	RTS	Lifestyle Changes	Hip Symptoms
mHHS			
Preoperative	70.1 ± 16.1 (19-97)	67.8 ± 14.1 (45-96)	67.6 ± 13.4 (45-96)
Latest	93.3 ± 9.8 (66-100)	88.6 ± 12.4 (58-100)	87.5 ± 12.2 (54-100)
NAHS			
Preoperative	70.6 ± 18.4 (23-96.2)	66.8 ± 17.2 (26-94)	64.6 ± 17.6 (26.2-93.7)
Latest	94.1 ± 8.3 (65-100)	89.2 ± 10.6 (60-98.7)	86.4 ± 12.5 (56.2-100)
HOS-SSS			
Preoperative	48.5 ± 23.7 (0-94)	46.4 ± 22.9 (8.3-94)	45.6 ± 21 (2.7-86.1)
Latest	90.4 ± 14.1 (44.4-100)	79.6 ± 22.1 (16.6-100)	77.8 ± 23.5 (16.6-100)
VAS			
Preoperative	4.6 ± 2.5 (0-9)	4.8 ± 2.5 (0-9)	4.9 ± 2.8 (0-9)
Latest	0.9 ± 1.4 (0-5)	2 ± 2 (0-7)	2.2 ± 2.1 (0-7)
iHOT-12, latest	90.2 ± 13.3 (40.1-100)	78.7 ± 17.9 (35.1-97.9)	73.8 ± 18.1 (38.3-100)
Patient satisfaction	9.1 ± 1.1 (5-10)	8.6 ± 1.4 (5-10)	7.3 ± 2.4 (3-10)

[a]Values are presented as mean ± SD (range). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; NAHS, Non-arthritic Hip Score; RTS, return to sport; VAS, visual analog scale.

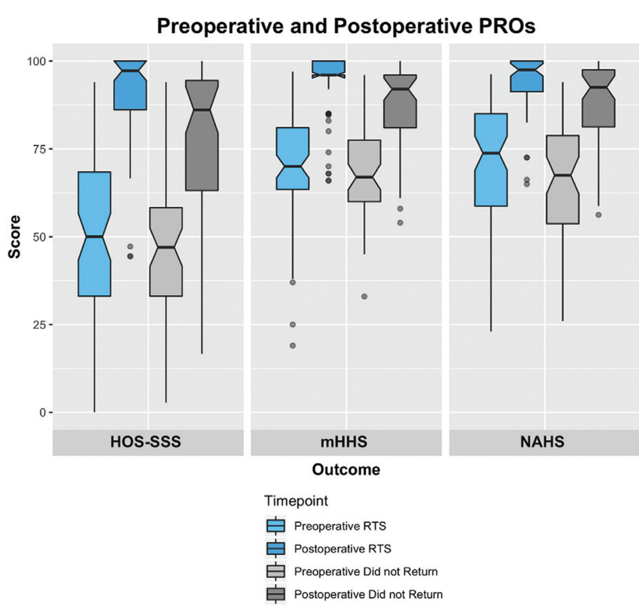

Figure 5. Notched boxplot comparing the pre- and postoperative increases in PROs between patients who returned to sport and those who did not. Values are presented as median (thick horizontal line), 95% CI of median (notch), interquartile range (thin horizontal lines), 95% CI (vertical lines), and outliers (circles). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; mHHS, modified Harris Hip Score; NAHS, nonarthritic hip score; PRO, patient-reported outcome; RTS, return to sport.

collegiate-level athletes (66.7%) and high school–level athletes (47.2%). Additionally, results show that athletes who returned and those who did not return achieved significant improvements in all PROs. However, the athletes who returned achieved significantly higher mHHS, NAHS, and HOS-SSS scores and lower VAS scores for pain. Complication rates and revision rates were low in both groups, and no conversion to total hip arthroplasty was found in either group.

TABLE 10
Rates of MCID and PASS for Patients Who Returned to Sport and Those Who Did Not[a]

	Returned to Sport	Did Not Return	*P* Value
mHHS			
MCID: 8	45 (80.4)	39 (79.6)	.9221
PASS: 74	56 (91.8)	48 (81.4)	.0924
HOS-SSS			
MCID: 6	51 (96.2)	34 (79.1)	.0087
PASS: 75	56 (91.8)	39 (69.6)	.0022

[a]Values are presented as n (%). HOS-SSS, Hip Outcome Score–Sports Specific Subscale; MCID, minimal clinically importance difference; mHHS, modified Harris Hip Score; PASS patient acceptable symptomatic state.

Within high-level athletes, studies on return to play have shown a significant distinction between professional athletes and less competitive athletes. Memon et al[31] performed a systematic review and reported an RTS rate of 93% in all athletes after unilateral hip arthroscopy, although only 82% returned to their preoperative activity level. In that study, professional athletes were shown to have higher rates of RTS than nonprofessional athletes. Similar findings have been shown in several systematic reviews and meta-analyses.[8,26,34] In professional athletes across the National Football League, Major League Baseball, National Basketball Association, and National Hockey League, return to play is high, although performance in hockey players was the lowest among all other sports.[4,12]

TABLE 11
Rates of Secondary Surgery[a]

	First Side	Second Side	*P* Value
Secondary arthroscopies	5 (6.1)	3 (3.7)	.4684
Time to secondary arthroscopy, mo	16.7 ± 11.4 (1.8-30.7)	20.6 ± 6.6 (13.2-25.7)	.6109
	Returned to Sport	Did Not Return	
Secondary arthroscopies	5 (6.3)	3 (4.3)	.6426
Time to secondary arthroscopy, mo	22.9 ± 6.4 (13.2-30.7)	10.2 ± 9.1 (1.8-19.8)	.0573

[a]Values are presented as n (%) and mean ± SD (range).

In contrast to the high rates of RTS in the literature, doubts have been cast regarding the reporting of athletic performance after surgery. Reiman et al[39] performed a systematic review and found that only 74% of athletes undergoing surgery for FAI returned to preinjury level of competition. Additionally, the authors noted that only 14% of studies reported on measures of athletic performance, such as number of starts in football players or running mileage in runners, and no studies reported actual postoperative ability. Ishøi et al[19] reported on 189 athletes included in the Danish National Hip Registry after hip arthroscopy for FAI and demonstrated that only 57% of patients returned to their preinjury level and only 17% reported an optimal sport performance.

Currently, confusion exists in the literature regarding the terms "level" and "ability" or "performance." In our study, level was defined as the competition level at which the athlete participated, while ability was defined as the subjective perception of the athlete regarding his or her performance after returning to play. In the present study, although we do not have complete data on ability after surgery, we found that 56% of patients thought that they were able to perform at the same level or higher, which is comparable with the study by Ishøi et al[19] despite our population's undergoing a bilateral procedure.

There is a paucity of studies reporting on attaining the MCID and PASS for the HOS-SSS. A study by Kuhns et al[23] compared patients undergoing unilateral and bilateral hip arthroscopy without focusing on athletes. In their study, fewer patients undergoing bilateral arthroscopy achieved the MCID and PASS for the mHHS. However, no difference was noted between the groups for the HOS-SSS. Cvetanovich et al[14] found that 78.7% of patients achieved the MCID for the HOS-SSS and 60.4% of patients achieved the PASS. However, athletic status was not noted in this study. In adolescents and young adults, Cvetanovich et al[13] found that the MCID for the HOS-SSS was achieved in 97% of patients and the PASS was achieved in 79%. Frank et al[17] reported on RTS in female athletes after surgery for FAI and found that 97% attained the HOS-SSS PASS. In their study, only 49% of a matched cohort of nonathletes attained the PASS for the HOS-SSS.

In our study, the outcome scores recorded for each hip demonstrate that patients attained the MCID and PASS for the mHHS and HOS-SSS at higher rates than the RTS rate. Specifically, 84.4% and 74.5% of patients reported attaining the PASS for the HOS-SSS after their first and second surgery, respectively. This would indicate that approximately 75% of patients achieved a satisfactory state for both hips regarding their athletic ability, although not all of these patients would return to active competition. While PROs such as the mHHS and HOS-SSS as well as their thresholds are valuable tools for measuring postoperative outcomes, they must be understood within the context of the more complex postoperative evaluation and cannot serve alone as indicators for RTS. Additionally, although patients may achieve high scores that suggest the ability to RTS, lifestyle changes or other conditions unrelated to the hip may contribute to the individual patient's decision to RTS or not.

Of note, this study included a relatively higher proportion of patients with iliopsoas snapping than that of our overall patient population. One explanation for the high rates of iliopsoas pathology in this cohort may be the predominance of young female athletes (60%), who have been shown to have a higher risk for iliopsoas pathology.[27,38] Additionally, this study comprised a large number of running and track athletes (29%). Since iliopsoas pathology has been shown to commonly occur in long-distance runners,[2] this may further explain the high rate of painful internal snapping in this cohort. Previous studies have shown favorable results in athletes undergoing iliopsoas fractional lengthening.[3,37] We previously suggested that in the unstable hip, the iliopsoas may become inappropriately hyperactive in an attempt to stabilize the hip. After surgical restoration of the static stabilizers, such as labral restoration and capsular plication, the iliopsoas can be safely lengthened to address the painful snapping.[27]

In accordance with our hypothesis, the rate of RTS in our study was lower than rates commonly published for unilateral hip arthroscopy. The mean time between surgical procedures was 9.3 months, and nearly 50% of those who did not return stated "graduation/lifestyle change" as the primary reason for not returning. One possible explanation for this finding is that, given the prolonged rehabilitation after a bilateral procedure, a significant proportion of high school–level athletes reached graduation before completing rehabilitation after their second surgery and did not continue on to participate in college-level athletics.

Strengths

Our study has multiple strengths. First, this is the first study, to our knowledge, that reports on RTS in competitive athletes after bilateral hip arthroscopy. Second, we collected data on a range of validated functional hip outcome measures, preoperatively as well as postoperatively, in addition to RTS rates. Additionally, by using PASS and MCID, this study was able to demonstrate clinical significance regarding patient outcomes. Last, our included patients represent athletes from multiple competition levels.

Limitations

This study has a number of limitations. First, this study has inherent limitations based on its retrospective nature. Although data collection was performed prospectively to reduce recall and selection bias, patients were included in this study by self-reported athletic level on questionnaires and by patient chart review. Second, the determination of RTS was based on these methods, which may introduce reporting bias. Additionally, data regarding ability of play after surgery was not available for all patients and was subjective per patient self-report. Fourth, all surgery was performed by a single surgeon, which may limit the generalizability of the study. Finally, our minimum follow-up of 1 year for PROs may be too short to completely elucidate longer-term outcomes.

CONCLUSION

The rate of RTS among competitive athletes after bilateral hip arthroscopy was similar to the square of published RTS rates after unilateral hip arthroscopy. Those who returned to play, as well as those who did not, showed significant improvement in PROs after surgery. However, those who returned to sports achieved significantly better scores in all outcome measures. Additionally, patients returning to sports showed a significantly higher rate of attaining the MCID and PASS scores for the HOS-SSS.

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