Minimum 2-Year Outcomes and Return to Sports of Competitive Athletes Who Undergo Subspine Decompression During Primary Hip Arthroscopy for Femoroacetabular Impingement Syndrome and Subspine Impingement: A Propensity-Matched Controlled Study

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Background: Patient-reported outcomes (PROs) and return to sports (RTS) have not been established in athletes undergoing primary hip arthroscopy and subspine decompression for femoroacetabular impingement syndrome (FAIS) and subspine impingement (SSI).

Purpose: (1) To report minimum 2-year PROs and RTS in competitive athletes undergoing primary hip arthroscopy for treatment of FAIS with subspine decompression for treatment of SSI and (2) to compare clinical results with a matched control group of athletes without SSI.

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

Methods: Data were reviewed for professional, collegiate, and high school athletes undergoing primary hip arthroscopy for FAIS with arthroscopic subspine decompression for SSI between February 2011 and October 2018. Inclusion criteria included preoperative and minimum 2-year follow-up scores for the modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score–Sport Specific Subscale, and visual analog scale for pain. Rates of achieving the minimal clinically important difference (MCID) were also calculated. For comparison, athletes in the SSI group were propensity matched according to age at the time of surgery, sex, body mass index, lateral center-edge angle, alpha angle, sport level, acetabular labrum articular disruption grade, and sport type to a control group of athletes without SSI.

Results: A total of 30 SSI athletes were included in the study, with a mean plus or minus standard deviation follow-up of 32.1 ± 7.1 months and age of 20.9 ± 5.7 years. The SSI cohort demonstrated significant improvement in all recorded PROs ($P < .001$), returned to sports at high rates (88.5%), and achieved the MCID for the Hip Outcome Score–Sport Specific Subscale at a high rate (80.0%). Furthermore, these patients had a low rate of undergoing revision surgery (6.7%). When compared with a propensity-matched control group of 59 athletes, the SSI group demonstrated similar rates of RTS, revision, and achieving the MCID for all PROs.

Conclusion: Competitive athletes with FAIS and SSI who underwent primary hip arthroscopy and subspine decompression had favorable outcomes and high RTS rates at minimum 2-year follow-up. These results were comparable with those of a control group of athletes without SSI undergoing primary hip arthroscopy.

Keywords: subspine impingement; femoroacetabular impingement; subspine decompression; athlete

Outcomes after primary hip arthroscopy have mainly been reported in the context of treating femoroacetabular impingement syndrome (FAIS); however, there are several extra-articular potential sites of impingement, such as the

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anterior inferior iliac spine (AIIS), ischial tuberosity, and greater trochanter.[1,6,12] Subspine impingement (SSI), caused by contact between the AIIS and femoral neck, may be present in addition to traditional intra-articular FAIS and is being increasingly recognized, studied, and treated when present.[32,38] SSI is reported to occur with intra-articular FAIS in 23% to 32% of patients.[1]

Previous literature has documented techniques to treat SSI with arthroscopic decompression of a prominent AIIS.[44] Recent studies have documented the safety and efficacy of treatment of SSI with subspine decompression, with promising results.[18,32,38] Indications for surgical management of SSI generally consist of persistent pain after intra-articular diagnostic injection, followed by deep flexion of the hip in neutral rotation, as well as imaging demonstrating a prominent AIIS.[32] Preliminary outcomes have been reported in the general population, but the outcomes of subspine decompression have been understudied in a high-demand athlete population. This cohort of competitive athletes creates an additional treatment challenge, as iatrogenic detachment of the rectus origin during subspine decompression could adversely affect their ability to return to sports (RTS).

The purposes of this study were as follows: (1) to report minimum 2-year patient-reported outcomes (PROs) and RTS in competitive athletes undergoing primary hip arthroscopy for treatment of FAIS with subspine decompression for treatment of SSI and (2) to compare clinical results with a matched control group of athletes without SSI. It was hypothesized that athletes undergoing primary hip arthroscopy for treatment of FAIS and subspine decompression for treatment of SSI would demonstrate favorable outcomes at minimum 2-year follow-up and that these outcomes would be similar to those of a matched control group of athletes undergoing primary hip arthroscopy for FAIS alone.

METHODS

Patient Selection Criteria

Data were prospectively collected and retrospectively analyzed on all patients who were professional, collegiate, and high school athletes and received a primary hip arthroscopy for FAIS and a subspine decompression for SSI during the study period between February 2011 and October 2018. Eligible study patients had preoperative data for the modified Harris Hip Score (mHHS),[2] Nonarthritic Hip Score (NAHS),[10] the Hip Outcome Score–Sport Specific Subscale (HOS-SSS),[29] and visual analog scale (VAS) for pain. Patients were excluded if they had previous hip surgery, were unwilling to consent to participate in the American Hip Institute Hip Preservation Registry, had a Tönnis osteoarthritis grade >1, or had a previous hip condition. Patients with dysplasia, defined as lateral center-edge angle (LCEA) <18°, were excluded from this analysis. Athletes with borderline dysplasia (LCEA, 18°-25°) were included, as reliable outcomes have been demonstrated in this patient population.[23]

Propensity Score–Matched Analysis

Eligible patients were propensity score matched in a 1:2 ratio of SSI to control using R (Version 4.1.0; R Foundation for Statistical Computing) to minimize the influence of possible confounding variables.[15] The SSI and control groups were greedy matched without replacement using a caliper of 0.3 according to the following variables: age at the time of surgery, body mass index (BMI), sex, preoperative LCEA, preoperative alpha angle, acetabular labrum articular disruption (ALAD), preoperative sports, and preoperative sport level. The SSI group was defined as patients having a clinical diagnosis of SSI and receiving a subspine decompression during the primary arthroscopy. The control group was defined as patients not diagnosed with SSI and not receiving a subspine decompression during the primary arthroscopy.

Participation in the American Hip Institute Hip Preservation Registry

All study patients consented to participate in the American Hip Institute Hip Preservation Registry, which contains patient data from February 2008. Although this study presents novel findings, patient data may have been used

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in previous publications. All data collection and reporting received institutional review board approval, and no external funding was received for this study.

Preoperative Evaluation and Radiographic Analysis

The senior author (B.G.D.) evaluated surgical candidates by conducting a detailed preoperative patient history, physical examination, and radiographic analysis. Patient variables were collected pre- and postoperatively, such as age at surgery, BMI, sex, operative laterality, and follow-up time. Patient mechanical variables were recorded during physical examination, including gait, range of motion, strength, points of tenderness, and signs of FAIS or mechanical symptoms (snapping, catching, and/or locking). Preoperative hip range of motion data were collected, and flexion, extension, adduction, abduction, and internal and external rotation were recorded.

Preoperative radiographs were ordered and reviewed by the senior author, using the anteroposterior pelvis, Dunn 45°, and false-profile views.[11] LCEA,[33] anterior center-edge angle,[26] alpha angle,[4] Tönnis angle of acetabular inclination,[22] and femoral head-neck offset[19] were collected during radiographic analysis. The Tönnis classification taken from the anteroposterior supine view was used to assess level of osteoarthritis.[14] The 45° Dunn view was used to measure alpha angle and femoral neck offset. Cam morphology was classified by an alpha angle >55° or femoral head-neck offset <0.8 cm.[13,19,28] The false-profile view was used to record anterior center-edge angle. All other extra- and intra-articular defects were viewed using magnetic resonance arthrography.

Surgical Indications

The senior author examined all patients. All patients were recommended nonoperative management before surgical intervention. Nonoperative treatments included activity modification, intra-articular injections, nonsteroidal anti-inflammatory drugs, and physical therapy. If nonoperative treatments failed, the senior author recommended patients for surgery. The false-profile and anteroposterior pelvis views were used to demonstrate SSI (Figure 1). The indication for addressing SSI was Hetsroni grade II and III AIIS accompanied by pain with hip flexion in neutral rotation.[21] Although not excluded from the present study, no patients with posttraumatic SSI were available to be included in the study group.

Surgical Technique

The senior author conducted all arthroscopic procedures. Patients were placed in the modified supine position on a traction table before surgery. Several portals were used during the diagnostic arthroscopy, including the anterolateral, distal anterolateral accessory, and modified midanterior portals. During surgery, labral tears and conditions of the cartilaginous surfaces of the acetabulum and femoral head were recorded. Intra-articular chondolabral and cartilage damage was recorded and graded using the ALAD and Outerbridge classifications.[34,40] Labral tears were noted

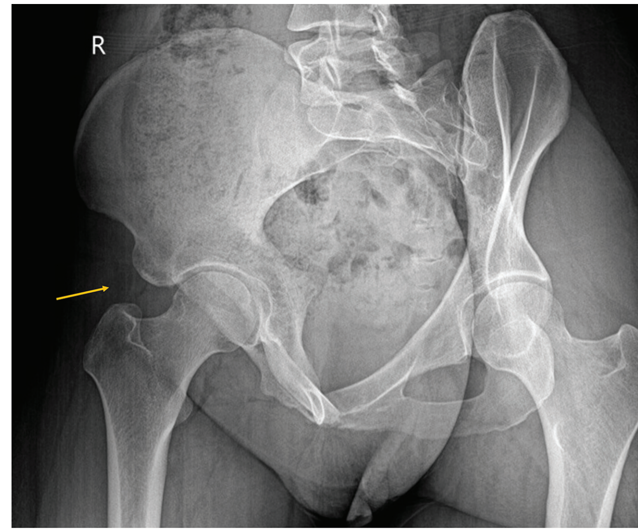

Figure 1. Preoperative false-profile radiographic view of the right hip demonstrating subspine impingement (arrow).

and reviewed using the Seldes classification.[30,37] The ligamentum teres was analyzed using the Domb and Villar classifications.[3,5] Management of the prominent AIIS included fluoroscopic localization of the protruding AIIS in the false-profile view. Careful release using an ablator radiofrequency wand was utilized for better accessibility to the prominent AIIS. When needed, an extracapsular approach was performed to allow for adequate decompression, which was considered reduction to a type I AIIS on the false-profile fluoroscopic view. Care was taken not to detach the rectus femoris from the AIIS. A 5-mm bur was used to achieve the bony subspine decompression. Fluoroscopic assessment throughout the procedure was performed to confirm the removal of bony prominence from the caudal level of the AIIS to the acetabular rim, indicating a satisfactory subspine decompression. The technique for capsular repair was performed with the hip flexed to 45° and using absorbable sutures (2.0 coated Vicryl polyglactin 910; Ethicon) and the 70° SlingShot Suture Manager (Pivot Medical, Inc). One by one, 4 to 6 sutures were passed from the midanterior portal through the acetabular-sided capsule and then retrieved inferomedially through the femoral-sided capsule from the distal anterolateral accessory portal. If indicated, plication was achieved by passing the suture more distally on the femoral-sided capsule as compared with the acetabular capsule in an oblique orientation, resulting in a 1- to 2-cm shift of the iliofemoral ligament. All sutures were passed medial to lateral and tied in the same order. Capsular repair was performed in all patients, without excessive stiffness, adhesive capsulitis, or insufficient capsular tissue.[9,16] Preoperative characteristics such as age, sex, and BMI also went into this multifactorial algorithm.

Rehabilitation Protocol

All patients were advised to use crutches and a brace (DJO Global) to restrict extension and flexion to 0° and 90°, respectively. Additionally, patients were instructed to abide by 2 weeks of postoperative weightbearing limitations of 20 pounds (9.1 kilograms) on the operative extremity and 8 weeks of stationary bike exercises after surgery. Patients were also recommended 3 months of physical therapy to help them regain strength and range of motion. Patients started physical therapy on postoperative day 1 and were recommended 2 or 3 sessions per week. Finally, a prescription of nonsteroidal anti-inflammatory drugs, twice daily for 6 weeks, was given for heterotopic ossification prophylaxis.

Patient-Reported Outcomes

Preoperative PROs were recorded in questionnaires at clinic appointments and included the mHHS, NAHS, HOS-SSS, VAS, and levels of sports activity. Postoperative scores and sports status were obtained at 3 months, 12 months, and annually thereafter. Questionnaires were primarily completed in clinic appointments. Patients unable to complete questionnaires during clinic visits were sent them through encrypted email or were called for phone interviews. For this study, PROs were analyzed preoperatively and at minimum 2-year follow-up.

The minimal clinically important difference (MCID) for the propensity-matched groups was calculated by dividing the standard deviation of the preoperative PRO score by 2.[31] The MCID described by Norman et al[31] has been used to estimate anchor-based methods.[36,39,42] MCIDs were calculated for the mHHS (subspine, 7.9; control, 7.7), NAHS (subspine, 8.8; control, 9.8), HOS-SSS (subspine, 11.0; control, 11.2), and VAS for pain (subspine, 1.2; control, 1.0). The Patient Acceptable Symptom State (PASS) was also used to assess postoperative patient improvement. The PASS has been accepted for the mHHS as ≥74; NAHS, ≥85.6; HOS-SSS, ≥75; and iHOT-12, ≥75.2.[7,8,25,35] Additionally, the maximum outcome improvement satisfaction threshold (MOIST) described by Maldonado et al[27] was used to help contextualize patient PRO improvement. The threshold was calculated for the mHHS (≥54.8%), NAHS (≥52.5%), and VAS for pain (≥55.5). The percentage of hips achieving the MCID and MOIST were reported for the mHHS, NAHS, and VAS for pain. RTS was distinguished by the patient returning to sports at any level up to 5 years postoperatively. Patients who went through lifestyle transitions or chose not to RTS for reasons other than hip pain on primary hip arthroscopy were excluded in the RTS calculations.

Statistical Analysis

All statistical analysis was performed using the Real Statistics Add-in package for Excel (Microsoft Corp). The F test and Shapiro-Wilk test were used to determine variance equality and normality. A 2-tailed t test or its nonparametric equivalent was used to determine significance in continuous variables. A chi-square test or Fisher exact test was used to establish significance in categorical variables. An a priori power analysis was conducted to determine the number of hips required in each group to establish 80% power in a 1:2 propensity score–matched ratio. The power analysis was based on the expected mean difference and standard deviation of the mHHS at 8 and 10 points, respectively.[24] The power analysis concluded that 20 hips in the SSI group and 39 hips in the control group were the minimum number of hips to minimize type II errors.

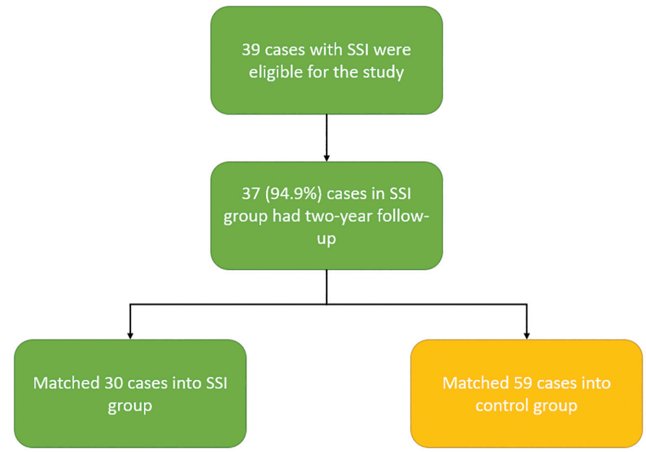

Figure 2. Flowchart depicting the patient selection process. SSI, subspine impingement.

TABLE 1
Patient Characteristics[a]

	SSI	Control	P Value
Age at surgery, y	20.9 ± 5.7 (15.7-36.7)	20.4 ± 6.5 (14.4-45.9)	.543
Sex			.936
Male	16 (53.3)	32 (54.2)	
Female	14 (46.7)	27 (45.8)	
Body mass index	24.4 ± 7.5 (17.6-30.0)	24.4 ± 5.0 (16.3-42.9)	.496
Follow-up time, mo	32.1 ± 7.1 (24.0-48.2)	34.7 ± 9.1 (24.0-59.9)	.993
Level			.345
Professional	1 (3.3)	0 (0.0)	
College	11 (36.7)	19 (32.2)	
High school	18 (60.0)	40 (67.8)	

[a]Values are presented as No. (%) or mean ± SD (range). SSI, subspine impingement.

RESULTS

Patient Characteristics

A total of 39 high-level athletes met inclusion criteria for the study cohort. After exclusion and inclusion criteria were applied, 37 patients (94.9%) had a minimum 2-year follow-up. Thirty high-level athletes with SSI were matched in a 1:2 ratio to 59 control high-level athletes. Figure 2 summarizes the patient selection process. Figures 3

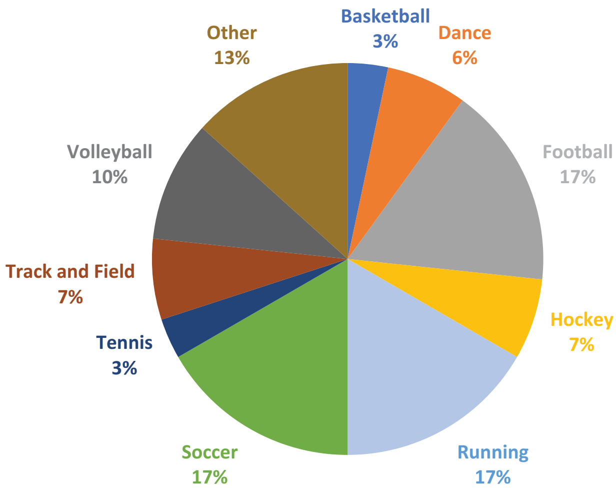

Figure 3. Preoperative sports played by high-level athletes with subspine impingement.

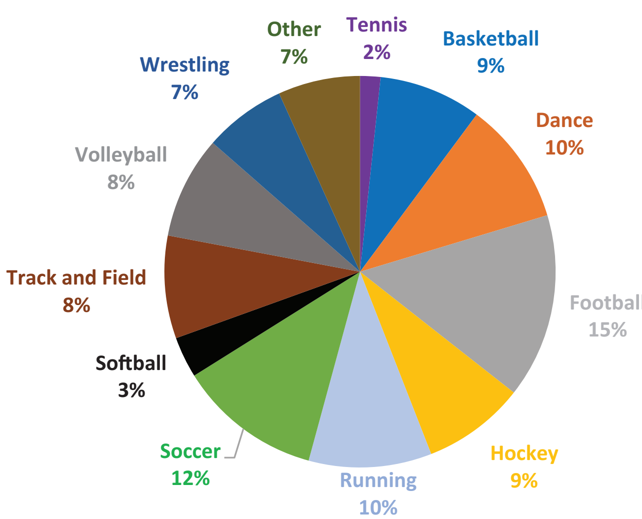

Figure 4. Preoperative sports played by high-level control athletes.

and 4 show all preoperative sports played by high-level athletes (SSI and control). All patient characteristics were comparable between the SSI and control groups (Table 1).

Radiographic Measurements

The majority of patients in the SSI and control groups had Tönnis grades of 0: 93.3% and 91.5%, respectively ($P >$ .999). All other radiographic measurements were similar between groups and are listed in Table 2.

Intraoperative Findings and Surgical Procedures

The majority of athletes in the SSI and control groups had labral tears with Seldes grade 1: 53.3% and 45.8%, respectively (P = .098). Additionally, the most common Outerbridge acetabulum classification was 1, at 50.0% and 28.8% (P = .098). All other intraoperative findings were similar and are recorded in Table 3.

TABLE 2
Radiographic Measurements[a]

	SSI	Control	*P* Value
Preoperative, deg			
LCEA	28.5 ± 5.0 (19.0-39.0)	29.1 ± 6.1 (18.0-47.0)	.682
ACEA	32.2 ± 7.7 (17.0-45.6)	30.9 ± 7.0 (13.0-48.0)	.414
Alpha angle	65.3 ± 9.3 (45.0-87.0)	65.9 ± 13.6 (39.0-93.0)	.792
Tönnis grade			>.999
0	28 (93.3)	54 (91.5)	
1	2 (6.7)	5 (8.5)	

[a]Values are presented as No. (%) or mean ± SD (range). ACEA, anterior center-edge angle; LCEA, lateral center-edge angle; SSI, subspine impingement.

TABLE 3
Intraoperative Findings[a]

	SSI	Control	*P* Value
Seldes			.098
0	0 (0.0)	0 (0.0)	
I	16 (53.3)	27 (45.8)	
II	5 (16.7)	14 (23.7)	
I and II	9 (30.0)	18 (30.5)	
ALAD			.163
0	2 (6.7)	11 (18.6)	
1	15 (50.0)	17 (28.8)	
2	9 (30.0)	15 (25.4)	
3	4 (13.3)	15 (25.4)	
4	0 (0.0)	1 (1.7)	
Outerbridge: acetabulum			.098
0	3 (10.0)	11 (18.6)	
1	15 (50.0)	17 (28.8)	
2	8 (26.7)	13 (22.0)	
3	2 (6.7)	15 (25.4)	
4	2 (6.7)	3 (5.1)	
Outerbridge: femoral head			.781
0	30 (100)	57 (96.6)	
1	0 (0.0)	0 (0.0)	
2	0 (0.0)	1 (1.7)	
3	0 (0.0)	0 (0.0)	
4	0 (0.0)	1 (1.7)	
LT percentile class: Domb			.274
0: 0	20 (66.7)	43 (72.9)	
1: 0 to <50	6 (20.0)	9 (15.3)	
2: 50 to <100	4 (13.3)	7 (11.9)	
3: 100	0 (0.0)	0 (0.0)	
LT Villar class			.275
0: No tear	20 (66.7)	43 (72.9)	
1: Complete tear	1 (3.3)	0 (0.0)	
2: Partial tear	7 (23.3)	15 (25.4)	
3: Degenerative tear	2 (6.7)	1 (1.7)	

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

TABLE 4
Surgical Procedures[a]

	SSI	Control	*P* Value
Labral treatment			.840
Repair	27 (90.0)	50 (84.7)	
Reconstruction	2 (6.7)	5 (8.5)	
Selective debridement	1 (3.3)	4 (6.8)	
Capsular treatment	25 (83.3)	48 (81.4)	>.999
Femoroplasty	30 (100)	55 (93.2)	.296

[a]Values are presented as No. (%). SSI, subspine impingement.

TABLE 5
Patient-Reported Outcomes[a]

	SSI	Control	*P* Value
mHHS			
Preoperative	66.6 ± 15.8 (42.0 to 96.0)	67.2 ± 15.5 (26.0 to 100)	.434
Latest	92.0 ± 10.3 (59.0 to 100)	87.8 ± 14.3 (40.0 to 100)	.147
P value	**<.001**	**<.001**	
Improvement	23.8 ± 16.9 (–11.0 to 55.0)	20.0 ± 20.0 (–25.0 to 70.0)	.403
NAHS			
Preoperative	65.6 ± 17.7 (26.3 to 96.3)	64.9 ± 19.7 (26.3 to 98.8)	.857
Latest	92.0 ± 11.3 (55.0 to 100)	88.5 ± 15.7 (22.5 to 100)	.266
P value	**<.001**	**<.001**	
Improvement	24.6 ± 18.0 (–11.0 to 73.8)	23.7 ± 23.9 (–45.5 to 65.0)	.863
HOS-SSS			
Preoperative	45.4 ± 22.0 (2.8 to 89.0)	47.4 ± 22.3 (0.0 to 100)	.688
Latest	85.2 ± 23.7 (0.0 to 100)	81.4 ± 22.0 (0.0 to 100)	.207
P value	**<.001**	**<.001**	
Improvement	38.9 ± 26.2 (–28.0 to 97.2)	35.2 ± 33.3 (–56.0 to 97.2)	.627
VAS for pain			
Preoperative	4.9 ± 2.4 (0.0 to 9.0)	5.3 ± 2.0 (1.1 to 9.0)	.414
Latest	1.4 ± 1.8 (0.0 to 5.0)	2.1 ± 2.3 (0.0 to 8.0)	.259
P value	**<.001**	**<.001**	
Improvement	3.5 ± 2.7 (–2.0 to 7.5)	3.1 ± 2.8 (–3.5 to 9.0)	.533
Patient satisfaction	9.0 ± 1.1 (7.0 to 10.0)	8.4 ± 1.8 (2.0 to 10.0)	.070

[a]Values are presented as mean ± SD (range). Bold indicates statistical significance ($P < .05$). HOS-SSS, Hip Outcome Score–Sport Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score; SSI, subspine impingement; VAS, visual analog scale.

The majority of athletes in the SSI and control groups received capsular treatment: 83.3% and 81.4%, respectively ($P > .999$). Additionally, the most common labral treatment was labral repair, at 90.0% and 84.7% ($P = .840$). All other surgical procedures were comparable between the groups and are located in Table 4.

TABLE 6
Clinical Psychometric Evaluations[a]

	SSI	Control	*P* Value
mHHS			
MCID	20 (66.7)	38 (64.4)	.833
PASS	25 (83.3)	43 (72.9)	.306
MOIST	18 (60.0)	33 (55.9)	.889
NAHS			
MCID	22 (73.3)	36 (61.0)	.359
PASS	20 (66.7)	39 (66.0)	.904
MOIST	20 (66.7)	37 (62.7)	.894
HOS-SSS			
MCID	24 (80.0)	35 (59.3)	.087
PASS	18 (60.0)	36 (61.0)	.926
VAS for pain			
MCID	19 (63.3)	40 (67.8)	.854
MOIST	15 (50.0)	32 (54.2)	.878

[a]Values are presented as No. (%). HOS-SSS, Hip Outcome Score–Sport Specific Subscale; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score; MOIST, maximum outcome improvement satisfaction threshold; NAHS, Nonarthritic Hip Score; PASS, Patient Acceptable Symptom State; SSI, subspine impingement; VAS, visual analog scale.

Surgical Outcome Tools

The SSI and control groups experienced significant improvement after surgery in the mHHS, NAHS, HOS-SSS, and VAS for pain ($P < .001$). The SSI and control groups had high rates of patient satisfaction at minimum 2-year follow-up: 9.0 and 8.4, respectively ($P = .070$). Additionally, the SSI and control groups experienced high PASS rates for the mHHS, at 83.3% and 72.9% ($P = .306$). Tables 5 and 6 summarize PROs and rates of achieving psychometric thresholds for both groups.

Secondary Surgery

The SSI and control groups each had 2 athletes undergo revision hip arthroscopy (6.7% vs 3.4%, $P = .601$). Both patients in the SSI group undergoing revision arthroscopy had labral retears. One patient undergoing revision arthroscopy in the subspine group went from labral repair to revision labral augmentation, and the other patient went from labral repair to revision labral reconstruction. Additionally, no SSI athletes and 1 control athlete underwent total hip arthroplasty ($P > .999$). All secondary surgery data were comparable between the groups and are outlined in Table 7.

RTS Outcomes

The majority of athletes in the SSI and control groups returned to sports: 88.5% and 72.9%, respectively ($P = .149$) (Figure 5). Additionally, groups had comparable percentages of female patients returning, at 43.5% and 48.6% ($P = .911$). All other RTS data were comparable between groups. RTS outcome data are listed in Table 8, and the characteristics of those who returned to sports are recorded in Table 9.

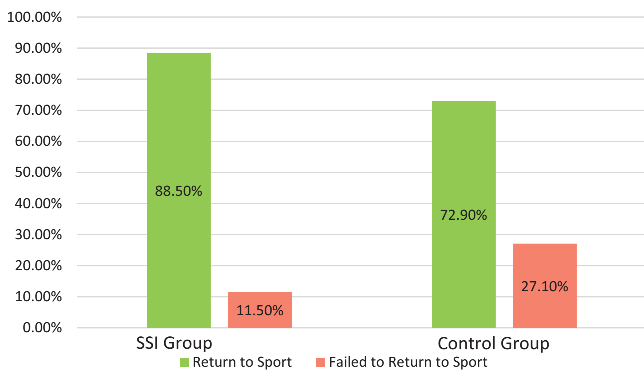

Figure 5. Return-to-sports outcomes. SSI, subspine impingement.

DISCUSSION

The main findings of the present study were that competitive athletes undergoing primary hip arthroscopy for FAIS and subspine decompression for SSI demonstrated favorable outcomes at minimum 2-year follow-up. These athletes had significant improvement in all recorded PROs, achieved psychometric thresholds at high rates, and had high rates of RTS. When compared with a propensity-matched control group of athletes undergoing primary hip arthroscopy for FAIS in isolation, the SSI group had similar PROs, rates of RTS, achievement of psychometric thresholds, and rates of revision surgery.

The present study suggests that primary hip arthroscopy and arthroscopic subspine decompression in competitive athletes with FAIS and SSI is a safe and effective treatment and that outcomes are comparable with those of a control group of athletes with FAIS but no SSI. The results of the present study in athletes echo those of previous studies in the general population. Feghhi et al[17] evaluated outcomes of arthroscopic subspine decompression in patients with symptomatic hip impingement and borderline dysplasia as compared with a matched cohort with nondysplastic FAIS. In their study, patients with borderline dysplasia and SSI demonstrated significantly more intra-articular damage and underwent more microfracture, capsular plication, and ligamentum teres debridement than the control group. Despite these differences, outcomes in the borderline dysplasia–SSI group were comparable with the control group at minimum 2-year follow-up.

Similarly, Flores et al[18] compared outcomes in patients undergoing hip arthroscopic surgery for global acetabular retroversion with a matched control group undergoing arthroscopic surgery for pincer-type FAIS. They also evaluated outcomes for patients with acetabular retroversion treated with additional subspine decompression. They found that patients who underwent treatment for acetabular retroversion and subspine decompression had greater improvement than patients who did not undergo subspine decompression in terms of Hip disability and Osteoarthritis Outcome Score (HOOS)–Pain (P = .046) and HOOS–Quality of Life (P = .030). The results of the present study build on this previous work and suggest that subspine decompression provides reliable results in the athlete population.

A notable finding of the current study is the high rate of RTS in the competitive athletes who underwent primary hip arthroscopy and subspine decompression, given the concern for iatrogenic detachment of the rectus origin in this high-functioning cohort. In the present study, 88.5% of the SSI group that attempted to RTS were successfully able to do so. We stress the importance of preserving the rectus femoris origin while performing the subspine decompression, especially in athletes. A similar rectus-sparing approach was utilized by Hetsroni et al[20] during subspine decompression for 10 high-level athletes with SSI; the authors noted that all patients were able to RTS at 6 months after surgery. Tateishi et al[41] assessed knee extensor and hip flexor strength and outcomes after FAIS correction with and without AIIS decompression at 6-month follow-up. They found that patients who underwent AIIS decompression had no significant difference in knee extension strength pre- versus postoperatively. Notably, hip flexion strength did improve pre- to postoperatively in the AIIS decompression group. The results of the present study support these findings, as evidenced by the high RTS rate in the SSI cohort; however,

TABLE 7
Future Surgery[a]

	SSI	Control	P Value
Arthroscopy	2 (6.7)	2 (3.4)	.601
THA	0 (0.0)	1 (1.7)	>.999

[a]Values are presented as No. (%). SSI, subspine impingement; THA, total hip arthroplasty.

TABLE 8
Return-to-Sports Outcomes[a]

	SSI	Control	P Value
Return-to-sports status			.149
Returned	23 (88.5)	35 (72.9)	
Attempted but did not return	3 (11.5)	13 (27.1)	
Did not attempt to return, n	4	11	

[a]Values are presented as No. (%), unless otherwise stated. SSI, subspine impingement.

TABLE 9
Characteristics of Those Who Did Return to Sports[a]

	SSI	Control	P Value
Sex			.911
Male	13 (56.5)	18 (51.4)	
Female	10 (43.5)	17 (48.6)	
Level			.490
Professional	0 (0.0)	0 (0.0)	
College	9 (39.1)	11 (31.4)	
High school	14 (60.9)	24 (68.6)	

[a]Values are presented as No. (%). SSI, subspine impingement.

further study is warranted with longer-term follow-up, particularly in athletes who rely on hip flexion strength.

Strengths

There are notable strengths of the present study. This is one of the few studies to report outcomes for competitive athletes undergoing revision hip arthroscopy and subspine decompression. Furthermore, a propensity-matched methodology was selected to isolate the potential confounding effects of age at the time of surgery, sex, BMI, LCEA, alpha angle, sport level, ALAD grade, and sport type. Next, the use of PROs designed for active patients with nonarthritic hips limits a potential ceiling effect.[43] The current study also had an adequate sample size based on a priori power analysis. Additionally, rates of achieving MCID, MOIST, and PASS were calculated to assess clinical significance.

Limitations

The present study has several limitations that should be noted. First, although data were prospectively collected, the current analysis is a retrospective review, which has inherent bias. Second, all patients with SSI were considered equal, and patients were not stratified by severity of impingement or by SSI classification according to Hetsroni et al.[21] Third, athletes from several levels of competition and many types of sports were included, which introduces significant heterogeneity. Furthermore, SSI was analyzed through radiographs and not evaluated or quantified with a computed tomography scan. Next, all surgical procedures were performed at a single high-volume center by 1 hip preservation–trained surgeon, which may limit the generalizability of the findings. Additionally, the study did not directly compare the effectiveness of subspine decompression by comparing the study group against a control group with SSI that did not undergo subspine decompression. Therefore, it is challenging to discern if the improved outcome scores in the SSI group can be attributed to the subspine decompression, the intra-articular decompression for FAIS, or both. RTS was also self-reported; as such, it is unknown whether patients actually returned to a game after surgery. Furthermore, the duration of their participation in preoperative sports was not reported. Next, postoperative ability was not reliably recorded, and as a result this study cannot quantify variables such as playing time and ability level after RTS. In addition, adequate decompression of SSI was determined by false-profile fluoroscopic views and not by a dynamic assessment of impingement. Last, the study had a minimum 2-year follow-up, and longer follow-up is necessary to determine the durability of the findings.

CONCLUSION

Competitive athletes with FAIS and SSI who underwent primary hip arthroscopy and subspine decompression demonstrated favorable outcomes and high RTS rates at minimum 2-year follow-up. These results were comparable with those of a control group of athletes without SSI undergoing primary hip arthroscopy.

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