

Patient reported outcomes for patients who returned to sport compared with those who did not after hip arthroscopy: minimum 2-year follow-up

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ABSTRACT

Previous studies assessed elite athletes' return to sport (RTS) after hip arthroscopy, but few investigated a cohort including athletes from all levels of sport. This study compared athletes who returned to sport to those who did not, based on four patient-reported outcome (PRO) scores, including the Hip Outcome Score—Sports Specific Subscale (HOS-SSS). Between September 2008 and April 2012, hip arthroscopies were performed on 157 patients (168 hips) who reported playing a sport preoperatively and indicated their level of sports activity post-operatively. Two-year follow-up was available for 148 (94%) amateur and professional athletes with a total of 158 hips. Of these 60 cases (65 hips) did not return to sports (NRTS) and were in the NRTS group. The remaining 88 cases (93 hips) constituted the RTS group. The modified Harris Hip Score, Non-Arthric Hip Score, Hip Outcome-Activities of Daily Living (HOS-ADL), and HOS-SSS were used to assess outcomes. The HOS-SSS was used to assess specific sport-related movement. Both groups demonstrated significant improvement at 2 years post-operatively in visual analog score and four PRO scores ($P < 0.001$). There was no significant preoperative differences in HOS-SSS scores between groups; however, the RTS group had significantly higher HOS-SSS scores at 1 and 2 years post-surgery. Post-operatively, the RTS group had significantly better ability to jump, land from a jump, stop quickly and perform cutting/lateral movements ($P < 0.05$). In summary, patients who indicated RTSs demonstrated significantly higher PRO scores and abilities to perform several sport-related movements, compared with patients who did not.

INTRODUCTION

Hip pain and injuries commonly occur during sporting activities that involve physical contact, strain, and pressure placed on the hip joint [1]. Hip arthroscopy is a minimally invasive surgery frequently performed in athletes to restore function of the joint and help return athletes to sport [2]. Many studies have demonstrated that arthroscopic management of femoroacetabular impingement (FAI) leads to high patient satisfaction and high rate of RTS in elite athletes [1–7]. Nho *et al.* [8] determined that arthroscopic

treatment of hip injuries in elite athletes might result in improved hip outcomes at minimum 1-year follow-up. Malviya *et al.* compared athletes versus non-athletes diagnosed with FAI, showing significantly higher outcomes for athletes at 6-week follow-up [4]. However, there are few descriptive studies that outline the RTS of a cohort of athletes at minimum 2-year follow-up.

The purpose was to compare athletes who returned to sport to those who did not in terms of patient reported outcome (PRO) scores and sports related movements,

using the Hip Outcome Score-Sports Specific Subscale (HOS-SSS) as the primary outcome measurement. We hypothesize patients who returned to their sport will demonstrate higher HOS-SSS scores and increased abilities to perform sport-specific movements such as jumping or making cutting/lateral movements.

METHODS

PRO scores were collected pre- and post-operatively at 3 months, 1 year and minimum 2-year follow-up. We collected PRO scores at clinic visits, through encrypted emails, or by telephone calls. PRO scores used included the modified Harris Hip Score (mHHS), the Non-Arthritic Hip Score (NAHS), the Hip Outcome Score—Activities of Daily Living (HOS-ADL) and the HOS-SSS. The HOS-SSS represents a patient's self-reported ability to perform specific-related sports movements such as cutting/lateral movements. All four questionnaires were used, as it has been reported that there is no conclusive evidence for the use of a single PRO questionnaire for patients undergoing hip arthroscopy [9, 10]. Additional PRO scores were used in addition to the HOS-SSS to assess baseline and post-operative abilities to perform activities of daily living and to see if differences between patients who did and did not return to sport were based on more sports specific movements of if differences were present in more general scores. The questionnaire also included: sport played before hip pain, primary sport and sport ability level after surgery. Visual analog scale (VAS) pain scores were collected. As an *a priori* power analysis, we calculated that we would need at least 51 patients in each group to rule out Type II error when comparing PRO scores, assuming a 10-point difference between groups and a standard deviation of 20 points in both groups.

Between September 2008 and April 2012, 1100 hip arthroscopies were performed. Of these 1100 hip arthroscopies, there were 475 procedures for which the patient did not report whether he or she played a sport prior to surgery and 304 procedures for which the patient reported no involvement in sports prior to surgery. We excluded these cases from the current study. Of the remaining 321 procedures, for which patients did report playing a sport prior to surgery, the HOS-SSS and whether the patient returned to sport after surgery were recorded for 52% (168/321) hips. We obtained 2-year follow-up for 49% (158/321) hips in 148 patients which constituted our study cohort.

Descriptive statistics were used to report frequencies and means for the cohort and subgroups. A two-tailed Student's *t*-test was performed to compare pre- and post-operative PRO data for the cohort. Changes from pre- to

post-operative PRO scores and VAS were calculated (delta), and a *t*-test was used to compare changes between groups. A χ^2 test was used to compare categorical data such as abilities to perform sports-specific movements. All statistics were done using Microsoft Excel (Redmond, WA). A *P*-value < 0.05 was considered statistically significant.

RESULTS

In the overall cohort of 148 amateur and professional athletes (158 hips) who underwent hip arthroscopies 60 patients (65 hips) comprised the non-return-to-sports (NRTS) group. Twenty five patients (17%) did not RTSs due to hip-related issues. Thirty two patients (22%) did not RTSs due to non-hip-related issues such as lifestyle transitions, advancing from high school to college, a desire to avoid further injury, and co-morbid conditions. Three patients did not return sports but did not provide a reason. The remaining 88 patients (93 hips) who reported returning to sports constituted the RTS group.

The average ages were 30.7 (range, 13.2–61.4) years for the RTS group and 30.4 (range, 14.8–59) years for the NRTS group. The RTS group contained 29 male patients (30 hips, 32%) and 59 female patients (63 hips, 68%), while the NRTS group contained 32 female patients (35 hips, 54%) and 28 male patients (30 hips, 46%). There were no statistically significant differences between groups in terms of gender, age or body mass index (BMI) (Table I). In the overall cohort, 20 patients played sports at a professional level preoperatively. The remainder of the cohort was split evenly between patients who played at a high school or college level and patients who played recreationally.

Table I. Demographic information for each group, by number of hips

	RTS	NRTS	<i>P</i> -value
Total count	93	65	
Male	30	30	0.08
Female	63	35	0.08
Age	30.7	31.1	0.86
Height (inches)	67.5	67.9	0.61
Weight (pounds)	157.5	161.0	0.60
BMI	30.7	24.0	0.90
Time to 2-year follow-up (months)	2.1	2.1	0.27

Table II. Sports played by patients in each group, by number of patients

	RTS	NRTS	P-value
Running	32	18	0.37
Soccer	10	11	0.26
Volleyball	11	3	0.12
Softball	7	5	0.79
Tennis	9	5	0.67
Basketball	7	6	0.70
Football	3	8	0.06
Baseball	5	6	0.54
Hockey	5	3	0.88
Swimming	6	2	0.56
Other	33	23	0.30

We recorded the patients' level of play in four approximate levels: recreation, high school, college and professional. Of patients in the NRTS group, 38.5% were recreational athletes, 33.8% were high school-level athletes, 15.4% were college-level athletes and 12.3% were professional athletes prior to surgery. Of patients in the RTS group, 36.3% were recreational athletes, 27.5% were high school-level athletes, 23.8% were college-level athletes, and 12.5% were professional athletes prior to surgery. A χ^2 test did not show a significant difference between groups in terms of the preoperative level of play. At the time of latest follow-up, 33.8% of patients in the RTS group reported a decreased level of play, while 66.2% patients reported an equivalent or increased level of play, compared with their level prior to surgery.

Sports played prior to surgery were compared between groups. The 10 most commonly played sports were established as distinct categories, while one additional category represented all other activities reported. This classification showed no significant differences between groups (Table II).

There were no statistically significant differences between groups related to type of arthroscopic procedures performed (Table III). Each group reported one conversion to total hip replacement and no revisions were noted.

There were no significant preoperative differences between groups for VAS, or any of the four PRO measures, including HOS-SSS. Both groups demonstrated statistically significant improvements from preoperative to 3-month, 1- and minimum 2-year follow-up scores based

Table III. Procedures for each group, by number of hips

	RTS	NRTS	P-value
Femoral osteoplasty	58	41	0.928
Acetabuloplasty	63	45	0.843
Ligamentum teres debridement	38	27	0.932
Synovectomy	14	10	0.955
Femoral chondroplasty	0	0	
Acetabular chondroplasty	0	0	
Removal of loose body	13	15	0.141
Iliopsoas release	41	34	0.308
Trochanteric bursectomy	4	0	0.238
Labral			
Repair	57	39	0.870
Base refixation	23	10	0.155
Combined	2	3	0.682
Simple stitch	32	26	0.473
Debridement	31	18	0.451
Excision	1	0	0.857
Resection	1	0	0.857
Reconstruction	2	4	0.383
None	1	4	0.183
Capsular			
Repair/Plication	54	28	0.0635
Release	39	36	0.096
Partial capsulotomy	0	1	0.857
None	0	0	

on VAS and the four PRO measures, including HOS-SSS ($P < 0.001$) (Fig. 1 and Table IV). However, all four PRO scores were significantly higher in the RTS group at minimum 2-year follow-up compared with the NRTS group ($P < 0.01$). The VAS score was also significantly lower in the RTS group than the NRTS group at minimum 2-year follow-up ($P < 0.01$). Furthermore, 1-year scores were significantly better in the RTS group for all four PRO measures ($P < 0.05$) but not VAS.

Delta values calculated between the preoperative and minimum 2-year scores were significantly different between the RTS and NRTS groups for mHHS, HOS-ADL and HOS-SSS, but not for NAHS ($P = 0.14$). Pre- and

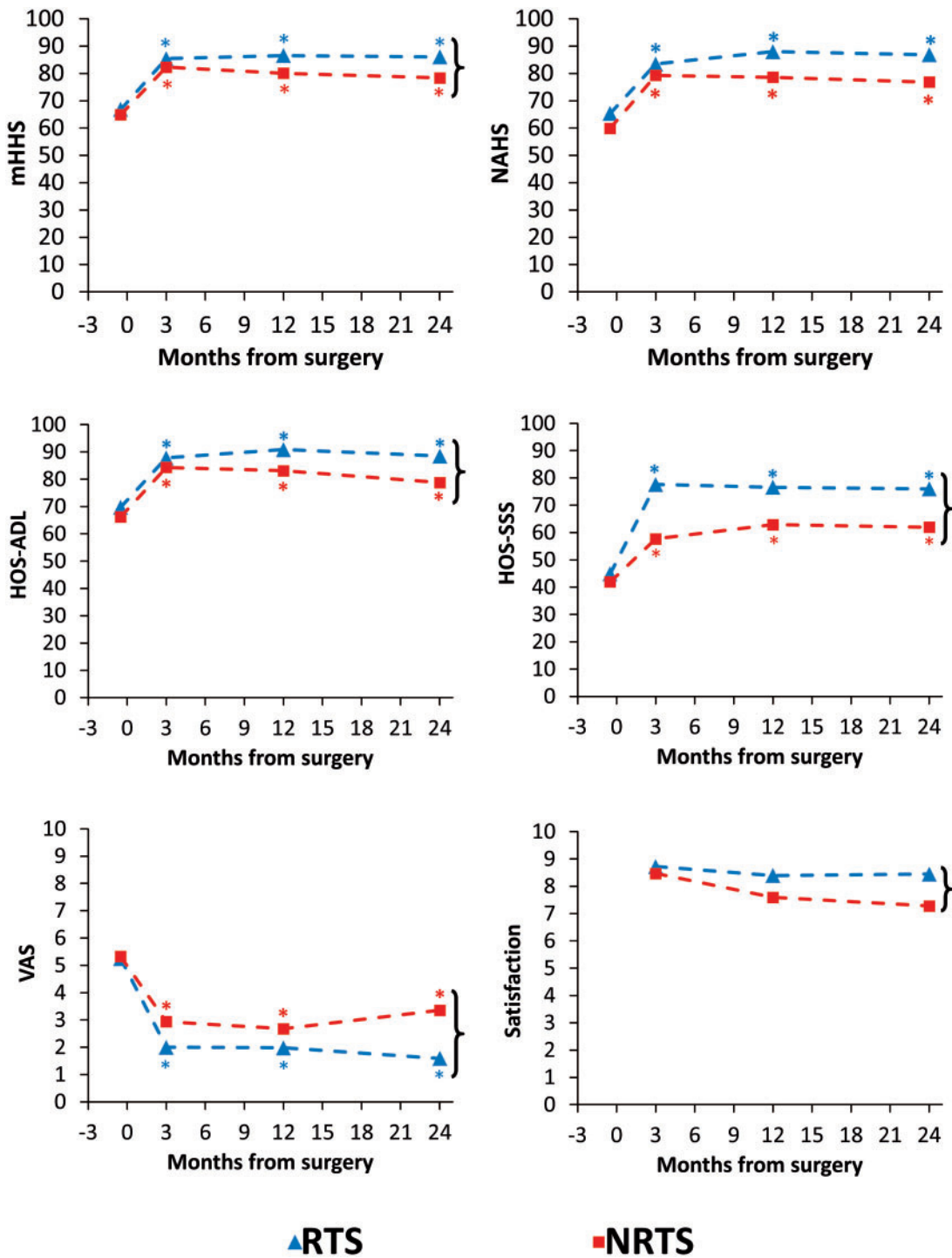


Fig. 1. Changes in four PRO scores, VAS, and patient satisfaction over 2 years. Average scores for the RTS and NRTS groups are shown in dark grey and light grey, respectively. Star markers indicate statistically significant differences between pre- and post-operative measurements. Braces indicate statistically significant differences in delta value, calculated from preoperative to 2-year time points, (between the RTS and NRTS groups).

Table IV. Preoperative and minimum 2-year outcome scores for each group, by number of hips

		RTS	NRTS	P-value RTS versus NRTS	P-value pre to 2-years (RTS)	P-value pre to 2 years (NRTS)
mHHS	Pre	66.8	64.9	0.41		
	2 years	86.1	78.4	0.0026	3.0×10^{-17}	5.3×10^{-6}
NAHS	Pre	65.4	59.9	0.053		
	2 years	86.9	76.8	0.00023	7.5×10^{-17}	4.4×10^{-7}
HOS-ADL	Pre	69.7	66.2	0.21		
	2 years	88.5	78.8	0.00038	1.5×10^{-13}	0.00015
HOS-SSS	Pre	44.9	41.9	0.44		
	2 years	76.0	62.0	0.0019	6.8×10^{-15}	3.9×10^{-5}
VAS	Pre	5.25	5.32	0.85		
	2 years	1.59	3.35	2.2×10^{-7}	2.0×10^{-25}	4.3×10^{-6}
Satisfaction	2 years	8.45	7.28	2.2×10^{-7}		

P-values are provided for the differences between groups, as well as for the differences between preoperative and minimum 2-year scores, for each group.

post-operative baseline and 2-year follow-up averages are reported in Table IV. The VAS delta values between the two groups were also significantly different ($P < 0.001$). In the RTS group, the mean VAS improved from 5.4 preoperatively to 1.8 at 2-year follow up, while in the NRTS group, the mean VAS improved from 5.4 preoperatively to 3.4 at 2-year follow up.

Ability to perform sports-related movements was assessed by analyzing data from questions within the HOS-SSS. These sport-specific movements were graded at 2-year follow-up from 0 to 4. A grade of 0 showcased the ability to perform the action with no difficulty, whereas a grade of 4 demonstrated the inability to perform said action with varying degrees of difficulty in between. For the RTS group, 91 (98%) completed surveys compared with 65 (100%) from the NRTS group. We found that, at minimum 2-year follow-up, patients in the RTS group were significantly better able to perform the following sport-specific movements ($P < 0.05$): running one mile, jumping, landing from a jump, stopping quickly and cutting/lateral movements (Fig. 2). No difference seen between groups for: swinging or low impact activity.

DISCUSSION

We illustrate our findings of hip arthroscopy evaluating RTS capabilities in a general hip arthroscopy cohort. We found that arthroscopic hip surgery was associated with significant improvements in all PRO scores. The RTS group

demonstrated significantly higher PRO scores than the NRTS group at 1- and minimum 2-year follow-up. Similarly, VAS pain scores were significantly more improved in RTS patients than in NRTS patients, at minimum 2-year follow-up. Additionally, RTS patients had higher self-reported abilities to perform several sport-specific actions such as cutting/lateral movements and running 1 mile.

FAI is a common cause for pain and discomfort in patients, whether athletes or not [1, 2, 6, 8, 11, 12]. Abnormal axial, torsional and rotational forces placed on the hip joint result from these pathologies [1–3]. Recently implicated as a possible factor in early onset osteoarthritis, FAI causes abnormal and distressing motions of the lower extremities [4]. Many studies have hypothesized that early treatment of FAI using arthroscopic modes of surgery may prevent further hip damage as well as aid in an early return to activities [2–4, 8]. Although this study includes a diverse group of athletes undergoing hip arthroscopy primarily for labral tears, the majority of this patients have a component of FAI. The data contained here can be used to counsel FAI patients on the potential to RTSs following hip arthroscopy. It is clear that not all patients are able to RTS, or chose not to, following hip arthroscopy, and of those who do approximately one-third return at a decreased level of play.

Previous studies on RTS have included different designs and measures [13, 14]. They are difficult to compare

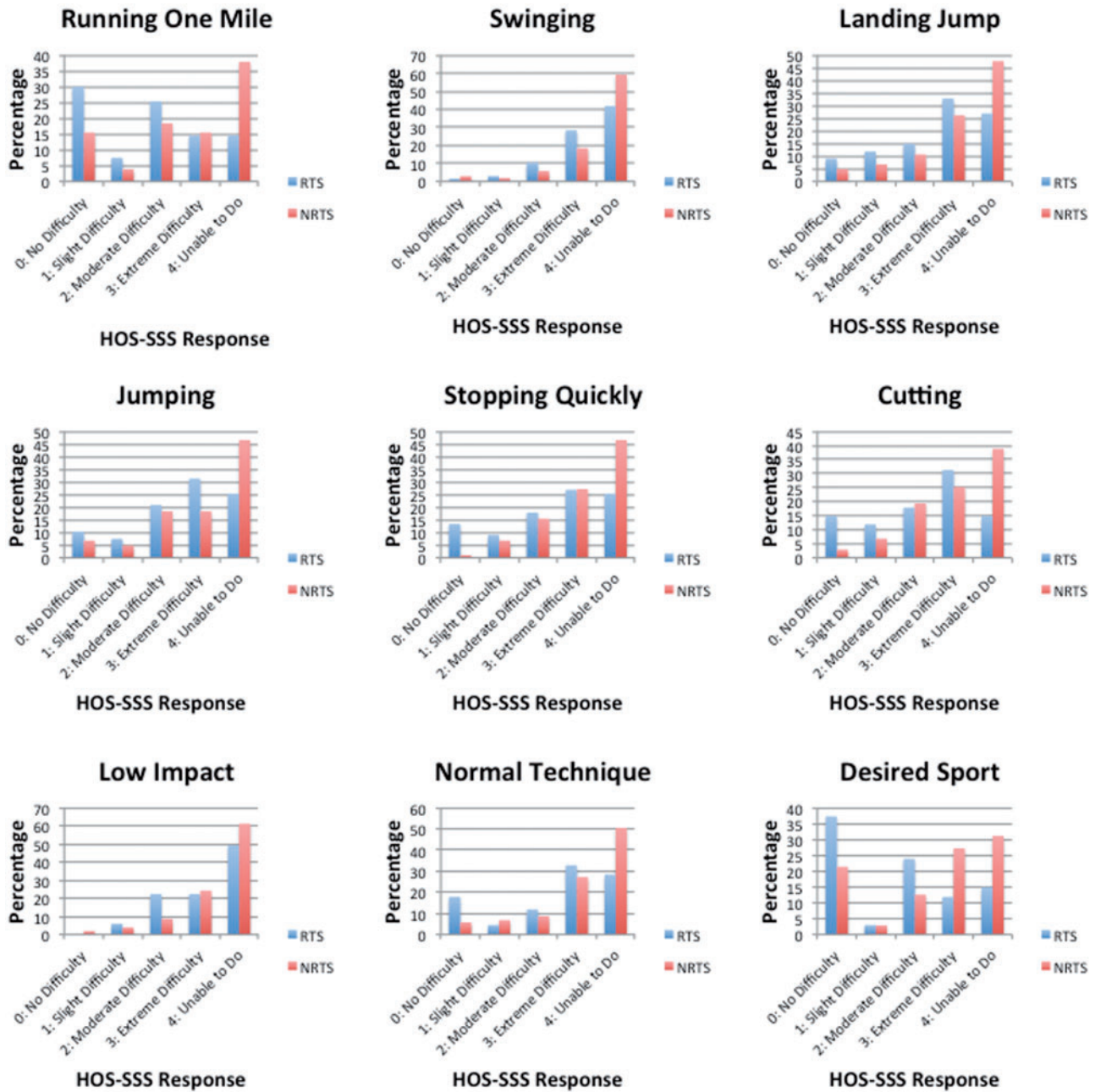


Fig. 2. Ability of patients in RTS and NRTS groups to perform sports-related activities, as reported via HOS-SSS. Subplots indicate frequency of HOS-SSS responses within each group, ranging from 0 (no difficulty to perform sports-related activity) to 4 (unable to perform activity).

directly to this study. Malviya *et al.* [4] compared hip arthroscopy outcomes between 80 athletes and 42 non-athletes diagnosed with FAI at minimum 1-year follow-up. No differences between athletes and non athletes were noted at 1-year follow up, and mHHS increased from a mean of 61–80, NAHS increased from a mean of 67–85. They concluded athletes and non athletes may benefit from hip

arthroscopy for FAI. This study differs in that we only included athletes in the study, and compared patients who continued in their sport to patients who did not. We observed very similar changes in mHHS and NAHS scores at 2-year follow up (Table IV). Interestingly, there did not seem to be a significant change in mean PRO scores from 3 months to 2 years. Naal *et al.* [12] investigated RTSs in a

general cohort of 153 patients that underwent open surgical hip dislocation for FAI. Within their cohort 126 patients acknowledged sports participation prior to surgery, and 107 (85%) acknowledged sports participation after surgery. However, eight patients started participating in sports after surgery that did not participate prior to surgery, and 19 (12.4%) stopped participating in sports. At a mean 5-year follow-up they found an HOS-SSS score of 75, and a HOS-ADL score of 89. In this study, we found 25 of 148 patients (17%) did not RTSs for hip-related issues. The studies utilized different methods of collecting sports participation data and clearly the surgical procedures differ; however, the percentage of patients that discontinued sports secondary to persistent hip disability was similar between studies.

One might expect those patients who participate in high level sports, are female, are older, have a higher BMI or have a more complex surgical procedure to be at risk for not returning to sports. However, this study found no difference in preoperative level of competition, gender, age, BMI, types of sports and surgical procedures and whether the patient returned to sports or not. We did note football, a high impact and high-level sport, showed a near statistically significant difference in patients not returning to sport. However, we don't believe the study is powered to detect such differences, and this should be the topic of further investigation.

Capsular closure at the time of hip arthroscopy has recently gained attention as a potential variable that may impact long term outcomes. Frank *et al.* recently demonstrated improved HOS-SSS scores in patients undergoing capsular closure at 6 months, 1 and 2.5 years compared with a group of patients not undergoing complete closure (Frank and Nho *AJSM* 2014) [15]. Interestingly in this study, the RTS group had 54 (58%) patients treated with capsular repair and/or plication compared with 28 (44%) from the NRTS group. With the number of patient available the difference trended towards statistical significance ($P=0.06$). Our results demonstrate a similar observation to that by Frank *et al.* Those that receive capsular repair/plication may have a better outcome than those who do not.

There are numerous studies in the literature, such as those discussed above, assessing RTSs in professional athletes. Professional athletes may be more inclined to RTS due to their limited window of opportunity to maintain their livelihood and may be influenced by monetary considerations as opposed to recreational athletes who may decide not to RTS for the sake of prolonging hip longevity [3, 16, 17]. Yet, even among professional athletes, confounding variables such financial incentives, age and talent, which differ among them, often play a role in RTSs as well

[3]. Our study addresses a wide continuum of athletic activity, from recreational to professional, that represents the majority of patients who are candidates for arthroscopic intervention of the hip. We believe the results of this study are applicable to the general athletic population that a hip arthroscopist may encounter in practice.

In our study, we defined two cohorts, one consisting of patients that reported involvement in athletic activities post-surgery and the other consisting of patients that did not. Although there is no accepted gold standard in quantifying RTSs, we believe that using pre- and post-operative comparisons of both PROs and sports-specific activity provides valuable information in comprehensively assessing successful RTSs.

LIMITATIONS

Our study addressed a mixed cohort of patients who provided sports-related information and other outcomes at minimum 2-year follow-up. The cohort is limited to patients who chose to indicate participation in sports, which may represent selection bias. The study was a retrospective review of prospectively collected data, and we had complete sport related information on 158 of 321 (49%) hips. Additionally, our cohort was not broken down into categories indicating level of play, such as recreational versus professional, as this information was not consistently available. Responses indicating sports-related abilities were also self-reported, and therefore have the potential for reporting bias. A common limitation not unique to our study is the incomplete ability to assess the many confounding factors that influence and affect an individual's decision to RTSs.

CONCLUSION

In a general cohort of hip arthroscopy patients, patients who indicated RTSs demonstrated significantly higher PRO scores and abilities to perform several sport-related movements, compared with patients who did not.

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CONFLICT OF INTEREST STATEMENT

Dr. Domb reports: consulting fees from Arthrex Inc., Stryker MAKO Surgical Corp., Amplitude, and Pacira;

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REFERENCES

1. Feeley BT, Powell JW, Muller MS *et al.* Hip injuries and labral tears in the national football league. *Am J Sports Med* 2008; **36**: 2187–95.
2. Byrd JWT. Hip arthroscopy in the athlete. *Oper Tech Sports Med* 2012; **30**: 310–9.
3. Philippon MJ, Weiss DR, Kuppersmith DA *et al.* Arthroscopic labral repair and treatment of femoroacetabular impingement in professional hockey players. *Am J Sports Med* 2010; **38**: 99–104.
4. Malviya A, Stafford GH, Villar RN. Is hip arthroscopy for femoroacetabular impingement only for athletes? *Br J Sports Med* 2012; **46**: 1016–8.
5. Shah VM, Andrews JR, Fleisig GS *et al.* Return to play after anterior cruciate ligament reconstruction in National Football League athletes. *Am J Sports Med* 2010; **38**: 2233–9.
6. Johnson AC, Shaman MA, Ryan TG. Femoroacetabular impingement in former high-level youth soccer players. *Am J Sports Med* 2012; **40**: 1342–6.
7. Anderson K, Strickland SM, Warren R. Hip and groin injuries in athletes. *Am J Sports Med* 2001; **29**: 521–33.
8. Nho SJ, Magennis EM, Singh CK *et al.* Outcomes after the arthroscopic treatment of femoroacetabular impingement in a mixed group of high-level athletes. *Am J Sports Med* 2011; **39**(Suppl): 14S–9.
9. Lodhia P, Slobogean GP, Noonan VK *et al.* Patient-reported outcome instruments for femoroacetabular impingement and hip labral pathology: a systematic review of the clinimetric evidence. *Arthroscopy* 2011; **27**: 279–86.
10. Tjissen M, van Cingel R van Melick, N *et al.* Patient-Reported Outcome questionnaires for hip arthroscopy: a systematic review of the psychometric evidence. *BMC Musculoskelet Disord* 2011; **12**: 117.
11. McDonald JE, Herzog MM, Philippon MJ. Return to play after hip arthroscopy with microfracture in elite athletes. *Arthroscopy* 2013; **29**: 330–5.
12. Naal FD, Fischer M, Preuss A *et al.* Return to sports and recreational activity after unicompartmental knee arthroplasty. *Am J Sports Med* 2007; **35**: 1688–95.
13. Feller J, Webster KE. Return to sport following anterior cruciate ligament reconstruction. *Int Orthop* 2013; **37**: 285–90.
14. Mascarenhas R, Tranovich MJ, Kropf EJ *et al.* Bone-patellar tendon-bone autograft versus hamstring autograft anterior cruciate ligament reconstruction in the young athlete: a retrospective matched analysis with 2–10 year follow-up. *Knee Surg Sports Traumatol Arthrosc* 2012; **20**: 1520–7.
15. Frank Rachel M, Lee Simon, Bush-Joseph Charles A, Kelly Bryan T, Salata Michael J, Nho Shane J. *Am J Sports Med.* published online September 11, 2014 DOI: 10.1177/0363546514548017.
16. Byrd JW, Jones KS. Hip arthroscopy in athletes: 10-year follow-up. *Am J Sports Med* 2009; **37**: 2140–3.
17. Guanche CA, Sikka RS. Acetabular labral tears with underlying chondromalacia: a possible association with high-level running. *Arthroscopy* 2005; **21**: 580–5.