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John Hayden Sonnier

Gregory Connors

Michael P. Campbell

Matthew Sabitsky

Ryan W. Paul

See next page for additional authors

Authors

John Hayden Sonnier, Gregory Connors, Michael P. Campbell, Matthew Sabitsky, Ryan W. Paul, Hayden E. Sando, William D. Emper, Steven B. Cohen, Michael G. Ciccotti, Fotios P. Tjoumakaris, and Kevin B. Freedman

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Return to recreational sports participation following rotator cuff repair in adults over 40 Years of age: outcomes and return to play analysis

John Hayden Sonnier, MS[a], Gregory Connors, BS[b], Michael P. Campbell, MD[a], Matthew Sabitsky, BS[c], Ryan W. Paul, BS[a], Hayden E. Sando, BS[b], William D. Emper, MD[a], Steven B. Cohen, MD[a], Michael G. Ciccotti, MD[a], Fotios P. Tjoumakaris, MD[d], Kevin B. Freedman, MD[a,*]

[a]*Division of Sports Medicine, Rothman Orthopaedic Institute, Philadelphia, PA, USA*
[b]*Drexel University College of Medicine, Philadelphia, PA, USA*
[c]*Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, PA, USA*
[d]*Rothman Orthopaedic Institute, Egg Harbor Township, NJ, USA*

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Background: Despite the high prevalence of rotator cuff (RTC) tears in older adults, there is limited literature evaluating the return to recreational sport after repair. The purpose of this study was (1) to assess the patient-reported outcomes and return to sport rates following rotator cuff repair in patients aged more than 40 years with minimum 2-year follow-up; (2) to compare baseline, preoperative and postoperative outcomes, and level of play following repair of self-reported athletes with nonathletes; and (3) to compare return to sport rates in overhead athletes compared to nonoverhead athletes.

Methods: Patients undergoing arthroscopic rotator cuff repair between January 2016 and January 2019 were screened for inclusion. Inclusion criteria included (1) age more than 40 years at the time of surgery, (2) arthroscopic repair of a full thickness RTC tear, and (3) preoperative American Shoulder and Elbow Surgeons score (ASES) available. Eligible patients were contacted and invited to fill out a custom return to sport and patient-reported outcome survey.

Results: Overall, 375 of the 1141 eligible patients completed the survey instrument. There were 210 self-reported athletes (mean age 59.2 ± 9.55 years) and 165 nonathletes (mean age 62.0 ± 8.27 years) ($P = .003$). Of the athletes, 193 (91.9%) returned to sport. The average age of athletes was 59.4 ± 9.33 years for those who returned to sport and 57.9 ± 12.0 years for those who did not ($P = .631$). Athletes reported higher ASES scores than nonathletes both preoperatively (49.8 ± 20.3 vs. 44.8 ± 18.9, $P = .015$) and postoperatively (87.6 ± 16.7 vs. 84.9 ± 17.5, $P = .036$), but there was no difference in mean ASES improvement between groups (37.7 ± 23.0 vs. 40.3 ± 24.5, $P = .307$). There was no difference in postoperative Single Assessment Numeric Evaluation scores when comparing self-reported athletes to nonathletes (85.4 ± 17.5 vs. 85.0 ± 18.7, $P = .836$). After controlling for age, sex, body mass index, and smoking status using a multivariate analysis, there was no difference in mean ASES improvement when comparing athletes to nonathletes.

Conclusion: There is a high rate of return to sport activities (> 90%) in older adult recreational athletes following arthroscopic repair of full thickness RTC tears and rates of return to sport did not significantly differ for overhead and nonoverhead athletes. Self-reported athletes were noted to have higher baseline, preoperative, and postoperative ASES scores than nonathletes, but the mean ASES improvement following repair did not significantly differ between groups.

Full-thickness rotator cuff (RTC) tears are common in older adults, present in 25% of individuals aged more than 60 years and in more than 50% aged more than 70 years.[12] Age, smoking, hypercholesterolemia, and family history have been identified as independent risk factors, but the cause is multifactorial with degeneration over time.[12] When present, full-thickness RTC tears

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*Corresponding author: Kevin B. Freedman, MD, Rothman Orthopaedics at Thomas Jefferson University, 825 Old Lancaster Road, Suite 200, Bryn Mawr, PA 19010, USA.

E-mail address: Kevin.Freedman@rothmanortho.com (K.B. Freedman).

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can cause significant pain and disability in the upper extremity. Although surgical management of RTC tears in older adults often comes with age-related challenges such as larger tear size, decreased tendon vascularity, and inferior bone quality, arthroscopic repair has been shown to significantly improve pain and shoulder function.[3,8,13] Arthroscopic rotator cuff repair (RCR) leads to significant improvements in overall health status as measured by the Short Form-36 General Health Survey.[7]

Despite the frequency at which adults aged more than 40 years participate in recreational sports, the size and number of case series evaluating return to sport after RCR in this population is relatively small. Antoni et al surveyed a cohort of 76 patients aged less than 70 years and reported an 88.2% return to sport rate.[1] Bhatia et al studied 38 patients aged more than 70 years and reported a 77% return to same level of play.[2] Shimada et al isolated 31 swimming athletes aged more than 45 years and reported a 97% return to swimming and Liem et al studied 21 throwing athletes with a mean age of 58.9 years and reported a 100% return to sport.[9,11] Given that many adults are eager to return to physical activity after RCR, understanding postoperative return to sport rates is an important discussion preoperatively.

The primary aims of this study were (1) to assess the patient-reported outcomes and return to sport rates following RCR in patients aged more than 40 years with minimum 2-year follow-up; (2) to compare baseline, preoperative and postoperative outcomes, and level of play following repair of self-reported athletes with nonathletes; and (3) to compare return to sports rates in overhead athletes compared to nonoverhead athletes. We hypothesized that there would be (1) a high rate of return to sport activities in older adult recreational athletes following arthroscopic repair of full thickness RTC tears, (2) no difference in patient-reported outcomes or return to sport between self-reported athletes and nonathletes, and (3) no difference in outcomes between overhead and nonoverhead athletes.

Methods

Patient selection

Patients who underwent arthroscopic RCR between the January 2016 and January 2019 at a single, multicenter institution were identified by Current Procedural Terminology (CPT) code (29827). Inclusion criteria included (1) age more than 40 years at the time of surgery, (2) arthroscopic repair of a full thickness RTC tear, and (3) preoperative American Shoulder and Elbow Surgeons (ASES) score on file. At our institution, preoperative ASES scores are routinely collected in patients scheduled for arthroscopic RTC repair using the Outcomes Based Electronic Research Database database (Universal Research Solution, LLC; Columbia, MO, USA), an electronic system used to collect patient-reported outcome measurements.[6] Exclusion criteria included (1) surgical repair of partial-thickness RTC tears, (2) subjects not responding to the survey invitation, and (3) subjects undergoing revision RCR. Following patient screening, there were 1141 patients eligible for inclusion in the study. Demographic variables such as age, sex, body mass index (BMI), and smoking status were recorded for included patients. Surgical records were reviewed to document CPT codes for all concomitant procedures.

Survey administration

Using the RedCap (Vanderbilt University, Nashville, TN, USA) electronic data capture tool, outcome data were collected via a survey that contained both validated and custom survey instruments. The validated surveys used included the ASES score and the Single Assessment Numeric Evaluation (SANE) score.[10,14] The ASES survey was used so that postoperative outcomes could be compared to the preoperative ASES scores on record. The custom survey (Supplementary Appendix S1) was based on the telephone survey reported by Antoni et al.[1] In this survey, all subjects were asked to rate the current function of their affected shoulder and to list any additional surgeries performed on the affected shoulder (if applicable). Preoperative participation in recreational sporting activity was assessed by asking the question "Were you participating in a recreational sport such as golf, tennis, swimming (or other) BEFORE your surgery? Select yes if you participated in this sport with some level of regularity at any point during the two years leading up to your surgery." Subjects who answered "yes" to this question were given the full return to sport survey instrument where they were asked to select their primary sport from the list provided. The option to write in a sport was also provided. Additional questions asked about highest level of competition, length of participation, and hours per week of sport participation. Subjects who did not identify as athletes were not given the return to sport survey.

Statistical analysis

All data were analyzed using Mann-Whitney tests for nonparametric data and Chi-squared or Fisher's exact tests for categorical data. Linear regression analysis was performed using ASES improvement as the dependent outcome of interest and participation in sport as the primary independent outcome. Demographic, preoperative, and postoperative outcome data were compared between self-reported athletes and nonathletes. Return to sport data was analyzed within the athlete cohort and subgroup analysis was performed to compare overhead athletes to nonoverhead athletes. As is standard in the orthopedic literature, sports requiring repetitive overhead motion were considered to be overhead sports. All statistical analyses were done using R Core Team (Version 3.6.3; R Foundation for Statistical Computing, Vienna, Austria) and P values less than .05 were deemed significant.

Results

Patient characteristics

Overall, 375 of the 1141 eligible patients completed the survey instrument. Of these, 210 self-identified as an athlete and 165 identified as nonathletes. Regarding highest level of competition achieved within their selected sport, there were 182 (86.7%) previous and current recreational athletes, 10 (4.8%) previous high school athletes, 15 (7.1%) previous college athletes, and 3 (1.4%) previous professional athletes. All athletes were current recreational athletes. There were 116 participants in overhead sport and 94 participants in a nonoverhead sport. Table I displays all included sports and their grouping.

Self-reported athlete versus nonathlete

There was no difference in race, smoking status, or laterality (right vs. left) of RTC repair between the self-reported athlete group and the nonathlete group. However, the athlete group was statistically younger (59.2 ± 9.6 years vs. 62.0 ± 8.3 years, $P = .003$), had a statistically lower mean BMI (28.3 ± 5.1 vs. 30.5 ± 6.11, $P < .001$), and contained a statistically higher proportion of male subjects (69.5% vs. 46.7%, $P < .001$) compared to the nonathlete group (Table II). There was no significant difference in concomitant procedures between the self-reported athlete and nonathlete group, and the most common concomitant procedure was biceps

Table I
All included sports

Overhead (n = 116)	Nonoverhead (n = 94)
Weightlifting (n = 58)	Golf (n = 42)
Swimming (n = 16)	Running (n = 12)
Tennis (n = 9)	Biking (n = 7)
Baseball (n = 7)	Yoga (n = 4)
Basketball (n = 5)	Bowling (n = 3)
CrossFit (n = 4)	Rowing (n = 3)
Football / Flag football (n = 3)	Skiing (n = 3)
Pickleball (n = 3)	Boxing (n = 2)
Volleyball (n = 3)	Dance (n = 2)
Triathlon (n = 2)	Fishing (n = 2)
Boomerang (n = 1)	Wrestling (n = 2)
Handball (n = 1)	Archery (n = 1)
Racquetball (n = 1)	Dragonboat (n = 1)
Softball (n = 1)	Horseshoe (n = 1)
Squash (n = 1)	Horseback riding (n = 1)
Ultimate Frisbee (n = 1)	Motorcycle racing (n = 1)
	Obstacle course racing (n = 1)
	Paddleboard (n = 1)
	Pilates (n = 1)
	Soccer (n = 1)
	Diving (n = 1)
	Surfing (n = 1)
	Kayaking (n = 1)

Table II
Comparison of baseline patient characteristics between self-reported athletes and nonathletes

Characteristic	Non-athlete	Athlete	*P* value
No. (% of total)	165 (44.0%)	210 (56.0%)	
Age	62.0 (8.4)	59.2 (9.6)	**.003**
Sex			**<.001**
Male	77 (46.7%)	146 (69.5%)	
Female	88 (53.3%)	64 (30.5%)	
BMI	30.5 (6.1)	28.3 (5.1)	**<.001**
Smoking			.153
No	87 (59.6%)	120 (62.8%)	
Former	41 (28.1%)	59 (30.9%)	
Yes	18 (12.3%)	12 (6.3%)	
Race			.144
White	114 (69.1%)	158 (75.2%)	
Asian	4 (2.4%)	3 (1.4%)	
Black	21 (12.7%)	13 (6.2%)	
Other	26 (15.8%)	36 (17.1%)	
Laterality			.386
Left	51 (30.9%)	75 (35.7%)	
Right	114 (69.1%)	135 (64.3%)	

Statistically significant differences are in bold.
BMI, body mass index.

tenodesis (Table III). In addition, there was no difference in subsequent surgery between groups (5.71% vs. 6.67%, $P = .869$).

Overhead athletes versus nonoverhead athletes

There was no difference in baseline demographics (age, sex, BMI, race, smoking, laterality), years of participating in sports ($P = .365$), or highest level of competition ($P = .131$) between overhead athletes and nonoverhead athletes. Although overhead athletes underwent mini-open biceps tenodesis significantly more frequently (CPT 23430) than nonoverhead athletes (31.0% vs. 14.9%, respectively, $P = .01$), there was no difference in subsequent surgery (6.03% vs. 5.32%, $P = 1.00$) between these groups.

Return to sport

Of the surveyed self-reported athletes, 193 (91.9%) returned to playing any sport and 187 (89%) returned to their selected sport

Table III
Comparison of concomitant procedures between self-reported athletes and nonathletes

Concomitant procedure	Nonathlete (n = 165)	Athlete (n = 210)	*P* value
Biceps Tenodesis	65 (24.3%)	84 (24.4%)	.983
Limited/Extensive Débridement	185 (69.3%)	248 (72.1%)	.449
Lysis of Adhesions	2 (0.7%)	1 (0.3%)	.421
Distal Clavicle Excision	12 (4.5%)	8 (2.3%)	.135
Loose body removal	1 (0.4%)	0 (0.0%)	.256
SLAP repair	1 (0.4%)	1 (0.3%)	.857
Capsulorrhaphy	1 (0.4%)	2 (0.6%)	.717

Arth, arthroscopic; *SLAP*, superior labral tear anterior to posterior.

Table IV
Characteristics of subjects who returned to sport versus those who did not

	No RTP (N = 17)	RTP (N = 193)	*P* value
Age	57.9 (12.0)	59.4 (9.33)	.631
Sex:			.356
Male	14 (82.4%)	132 (68.4%)	
Female	3 (17.6%)	61 (31.6%)	
BMI	28.0 ± 4.61	28.3 ± 5.11	.76
Net ASES	33.3 ± 27.5	38.1 ± 22.6	.512

RTP, return to play; *BMI*, body mass index; *ASES*, American Shoulder and Elbow Surgeons.

(Table IV). The respective rates of return to any sport between overhead and nonoverhead athletes were 89.7% and 94.7% ($P = .283$). Of those self-reported athletes who returned, 97.1% of overhead athletes and 96.6% of nonoverhead athletes returned to their selected sport ($P = 1.00$). A large majority (81.3%) of the patients returned to sport between 3 and 12 months with 6-9 months being the most commonly reported (25.10%) timeline (Fig. 1). The average age of athletes who returned to sport was 59.4 ± 9.33 years. The average age of athletes who did not return to sport was 57.9 ± 12.0 years. Age at procedure did not affect return to sport rate ($P = .631$). Of the patients who did not return to sport, 8 (3.8%) stated the reason was because their shoulder pain was too significant, 4 (1.9%) were no longer interested in sports, and 2 (0.9%) no longer had the time to participate in sports.

There was no difference in current time (hours per week) spent playing sport ($P = .579$) or current level of play (Table V, $P = .446$) between overhead and nonoverhead athletes. However, the distribution of time spent playing sport before surgery differed significantly between the overhead and nonoverhead groups ($P = .009$). Of the 86 nonoverhead athletes who returned to their selected sport, 29.1% reported a decrease in time spent playing sport, 62.8% reported no change, and 8.1% reported an increase. Of the 101 overhead athletes who returned to their selected sport, 35.6% reported a decrease in time spent playing sport, 58.4% reported no change, and 5.9% reported an increase. When comparing the overhead group to the nonoverhead group, there was no difference in the change in time participating in sport ($P = .581$), even after controlling for age, sex, BMI, and smoking status. Overall, 77.6% of all self-reported athletes stated that their current level of play was the same or better than it was before surgery.

Patient-reported outcomes

Overall, 210 (56%) subjects rated their function as “excellent,” 124 (33%) rated it as “good,” 31 (8.3%) rated it as “fair,” and 10 (2.7%) rated it as “poor.” There was no difference in subjective function when comparing self-reported athletes to nonathletes ($P = .156$) or when comparing overhead athletes to athletes participating in nonoverhead sports ($P = .122$).

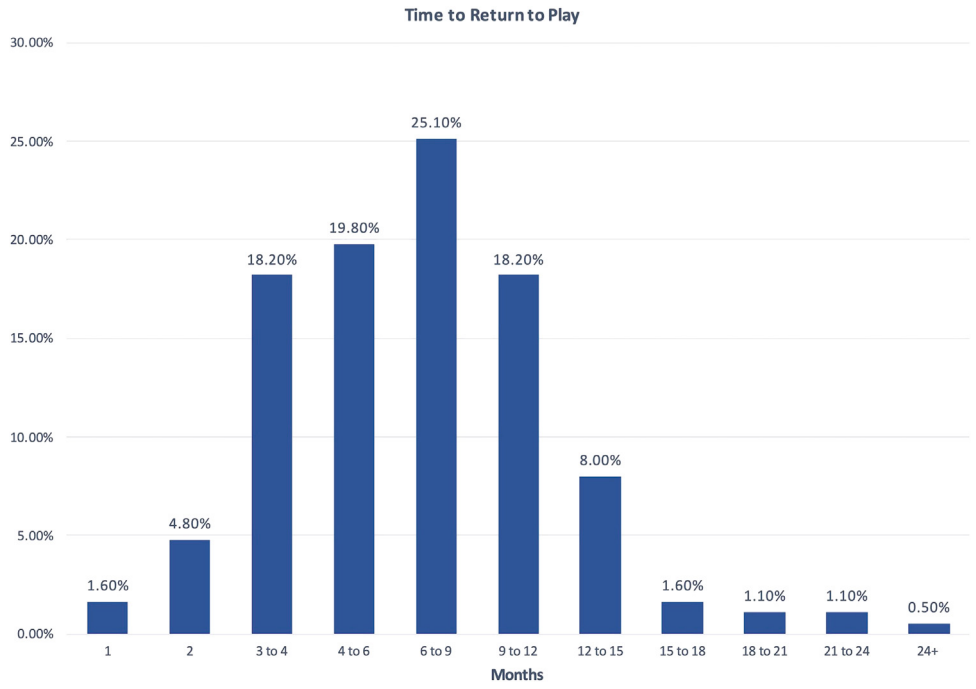

Figure 1 Time until return to sport for the 193 included athletes that successfully returned to sport.

Table V
Comparison of the current level of play between overhead and nonoverhead athletes

	Nonoverhead	Overhead	*P* value
Current Level of Play:			.446
Same	50 (58.1%)	52 (51.5%)	
Better	24 (27.9%)	37 (36.6%)	
Worse	12 (14.0%)	12 (11.9%)	

With regards to ASES scores, self-reported athletes had higher preoperative (49.8 ± 20.3 vs. 44.8 ± 18.9, $P = .015$) and postoperative (87.6 ± 16.7 vs. 84.9 ± 17.5, $P = .036$) scores than nonathletes, but there was no difference in ASES improvement (37.7 ± 23.0 vs. 40.3 ± 24.5, $P = .307$) (Table VI). After controlling for age, sex, BMI, and smoking status, regression analysis found that sport participation did not significantly affect ASES score improvement. There was no difference in SANE scores when comparing self-reported athletes to nonathletes (85.4 ± 17.5 vs. 85.0 ± 18.7, $P = .836$).

When comparing overhead vs. nonoverhead athletes, there was no difference in preoperative ($P = .828$), postoperative ($P = .446$), or ASES score improvement ($P = .363$) (Table VII).

Logistic regression analysis controlling for age, sex, BMI, and smoking status found that there was no difference in ASES improvement at long-term (4.2 years) follow-up when comparing self-reported nonathletes (40.3 ± 24.5) to nonoverhead athletes (36.1 ± 21.2) ($P = .654$, 95% confidence interval −8.05 to 5.05) or to overhead athletes (39.0 ± 24.4) ($P = .936$, 95% confidence interval −6.07 to 6.60). There was no difference in SANE scores when comparing overhead athletes to nonoverhead athletes (85.4 ± 18.7 vs. 85.4 ± 16.0, $P = .976$).

Discussion

The primary finding of this study was that adults aged more than 40 years returned to recreational sport at a high rate (91.9% returned to any sport, 89.0% returned to their selected sport).

Table VI
Comparison of preoperative and postoperative ASES scores and overall improvement in ASES scores, between self-reported athletes and nonathletes

Outcome	Nonathlete	Athlete	*P* value
Preoperative	44.8 (18.9)	49.8 (20.3)	**.015**
Postoperative	84.9 (17.5)	87.6 (16.7)	**.036**
Difference	40.3 (24.5)	37.7 (23.0)	.307

Statistically significant differences are in bold.
ASES, American Shoulder and Elbow Surgeons.

Table VII
Comparison of preoperative and postoperative ASES scores and overall improvement in ASES scores, between overhead and nonoverhead athletes.

Outcome	Nonoverhead	Overhead	*P* value
Preoperative	50.1 (20.0)	49.5 (20.6)	.828
Postoperative	86.6 (14.8)	88.4 (18.2)	.446
Difference	36.1 ± 21.2	39.0 ± 24.4	.363

ASES, American Shoulder and Elbow Surgeons.

Interestingly, there was no difference in ASES improvement between overhead and nonoverhead athletes, even after controlling for age, sex, BMI, and smoking status. Secondarily, self-reported athletes reported higher preoperative (49.8 ± 20.3 vs. 44.8 ± 18.9, $P = .015$) and postoperative (87.6 ± 16.7 vs. 84.9 ± 17.5, $P = .036$) scores than nonathletes, but there was no difference in ASES improvement (37.7 ± 23.0 vs. 40.3 ± 24.5, $P = .307$).

There is currently a paucity of literature comparing return to sport after RCR in overhead versus nonoverhead athletes aged more than 40 years. This highlights the importance of our finding that both groups returned to sport at similar rates and reported statistically similar preoperative ASES scores, postoperative ASES scores, ASES score improvement, and current level of play ratings. Due to the stress imposed upon the repaired supraspinatus during overhead movements, there is concern that overhead athletes would have a more challenging time returning to sport.[5] However, our

findings suggest that these patient populations benefit similarly from RCR despite the inherent biomechanical differences between overhead and nonoverhead sports. This shows that older adults involved in overhead sports are likely to benefit from RCR and return to an active lifestyle.

Regarding overall return to sport rate, our findings expand upon a 2016 study by Antoni et al that reported an 88.2% return to sporting activity in adult recreational athletes.[1] However, only 68.4% returned to their selected sport. Although our overall rate of return to sporting activity was similar, we recorded a notably higher rate of return to selected sport.[1]

Several other studies have looked at return to sport in narrower subsets of middle-aged and elderly athletes. Bhatia et al studied 38 self-described recreational athletes aged more than 70 years who underwent arthroscopic repair of a full-thickness supraspinatus tear. Mean subjective outcome scores were significantly improved at minimum 2-year follow-up and 77% of respondents were able to return to sport at a similar level of intensity.[2] Similarly, Shimada et al studied a cohort of 31 swimmers aged more than 45 years and reported a 97% return to swimming with a mean return to sport time of 8 months. ASES and The University of California, Los Angeles (UCLA) scores significantly improved after surgery.[11] Finally, Liem et al studied a cohort of 21 throwing athletes with a mean age of 58.9 years. Constant Scores significantly improved after RTC repair, 100% of patients returned to sport at a mean 6.3 months after surgery, and time spent per week participating in overhead throwing sports was not significantly lower after surgery than it was before surgery.[12]

Our findings support findings from previous literature which demonstrated that patient-reported outcome scores significantly improved after surgery in athletes.[2,9,11] There were differences between the self-reported athlete and nonathlete groups: the self-reported athlete group was found to be younger, had a higher proportion of males, a lower mean BMI, and reported higher absolute preoperative and postoperative ASES scores. Despite this, however, there was no difference in ASES score improvement even after controlling for age, sex, BMI, and smoking status. Given that the ASES score improvements in both groups exceeded the minimal clinically important difference defined by Cvetanovich et al, this suggests that although self-reported athletes tend to report superior ASES scores, all patients tend to improve by a similar amount after surgery.[4] It is unclear if participation in recreational sporting activity was the cause of or a result of superior baseline ASES scores. Further research can help to clarify this distinction.

Looking at the self-reported athletes specifically, the return to sport rates and timelines reported in this study are comparable to previous studies in that patients tended to return to sport at high rates between 6 and 9 months postoperatively.[2,9,11] Interestingly, our finding that 77.6% of self-reported athletes rated their current level of play as similar to or better than before surgery mirrors the finding by Bhatia et al that 77% of patients returned to sporting levels at or near their preinjury level.[2]

The present study is not without limitations. For one, the overall survey response rate was relatively low (32.9%). Despite the fact that we included a large sample size and that preoperative ASES scores are routinely collected at our institution, there is still the potential for nonresponse bias. In addition, the study was retrospective in nature and patients were asked to recall the time that was required to return to sport. This creates the potential for recall bias. Finally, although regression analysis did not identify any sex-related differences in ASES score improvement, the athlete cohort consisted of approximately 70% men, indicating that female athletes are under-represented.

Following RCR, recreational athletes can expect to return to both overhead and nonoverhead sports at a rate of > 90%. The timeline for return can vary from 3 to 12 months, with a majority of patients returning between 6 and 9 months. Patients can expect their level of play postoperatively to mirror their preoperative status, with about 30% of patients reporting improved performance.

Conclusion

There is a high rate of return to sport activities (> 90%) in adult recreational athletes aged more than 40 years following arthroscopic repair of full thickness RTC tear. Self-reported athletes were noted to have higher baseline, preoperative, and postoperative ASES scores than nonathletes, but the mean ASES improvement following repair did not significantly differ between groups. Rates of return to sport did not significantly differ for overhead and nonoverhead athletes.

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Fotios P. Tjoumakaris is a board or committee member of AAOS, American Board of Orthopaedic Surgery, Inc., and American Orthopaedic Society for Sports Medicine and holds stock options at Trice Medical, Inc.
Kevin B. Freedman is a board or committee member of the American Orthopaedic Society for Sports Medicine and is a paid consultant at DePuy, A Johnson & Johnson Company, and Vericel.
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Supplementary data

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References

1. Antoni M, Klouche S, Mas V, Ferrand M, Bauer T, Hardy P. Return to recreational sport and clinical outcomes with at least 2 years follow-up after arthroscopic repair of rotator cuff tears. Orthop Traumatol Surg Res 2016;102:563-7. https://doi.org/10.1016/j.otsr.2016.02.015.
2. Bhatia S, Greenspoon JA, Horan MP, Warth RJ, Millett PJ. Two-year outcomes after arthroscopic rotator cuff repair in recreational athletes older than 70 Years. Am J Sports Med 2015;43:1737-42. https://doi.org/10.1177/0363546515577623.
3. Brewer BJ. Aging of the rotator cuff. Am J Sports Med 1979;7:102-10.
4. Cvetanovich GL, Gowd AK, Liu JN, Nwachukwu BU, Cabarcas BC, Cole BJ, et al. Establishing clinically significant outcome after arthroscopic rotator cuff repair. J Shoulder Elbow Surg 2019;28:939-48. https://doi.org/10.1016/j.jse.2018.10.013.
5. Drakos MC, Rudzki JR, Allen AA, Potter HG, Altchek DW. Internal Impingement of the shoulder in the overhead athlete. J Bone Jt Surg 2009;91:2719-28. https://doi.org/10.2106/JBJS.I.00409.

6. Farr J, Verma N, Cole B. Validation study of an electronic method of condensed outcomes tools reporting in orthopaedics. J Knee Surg 2013;26:445-52. https://doi.org/10.1055/s-0033-1347361.
7. Gartsman GM, Brinker MR, Khan M. Early effectiveness of arthroscopic repair for full-thickness tears of the rotator cuff: an outcome analysis. J Bone Joint Surg Am 1998;80:33-40.
8. Hattrup SJ, Ariz S. Rotator cuff repair: relevance of patient age. J Shoulder Elbow Surg 1995;4:95-100.
9. Liem D, Lichtenberg S, Magosch P, Habermeyer P. Arthroscopic rotator cuff repair in overhead-throwing athletes. Am J Sports Med 2008;36:1317-22. https://doi.org/10.1177/0363546508314794.
10. Richards RR, An K-N, Bigliani LU, Friedman RJ, Gartsman GM, Gristina AG, et al. A standardized method for the assessment of shoulder function. J Shoulder Elbow Surg 1994;3:347-52.
11. Shimada Y, Sugaya H, Takahashi N, Matsuki K, Tokai M, Morioka T, et al. Return to sport after arthroscopic rotator cuff repair in middle-aged and elderly swimmers. Orthop J Sports Med 2020;8:232596712092220. https://doi.org/10.1177/2325967120922203.
12. Tashjian RZ. Epidemiology, natural history, and Indications for treatment of rotator cuff tears. Clin Sports Med 2012;31:589-604. https://doi.org/10.1016/j.csm.2012.07.001.
13. Verma NN, Bhatia S, Baker CL, Cole BJ, Boniquit N, Nicholson GP, et al. Outcomes of arthroscopic rotator cuff repair in patients aged 70 Years or older. Arthrosc J Arthrosc Relat Surg 2010;26:1273-80. https://doi.org/10.1016/j.arthro.2010.01.031.
14. Williams GN, Gangel TJ, Arciero RA, Uhorchak JM, Taylor DC. Comparison of the single assessment numeric evaluation method and two shoulder rating Scales. Am J Sports Med 1999;27:214-21.