

Patient Activity Levels After Reverse Total Shoulder Arthroplasty

What Are Patients Doing?

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Background: The indications for reverse total shoulder arthroplasty (RTSA) continue to expand, which has resulted in younger patients who want to remain active after RTSA. Little information is available to manage expectations of both physicians and patients for return to sporting activities.

Purpose: To determine the rate of return to sporting activities and assess average time to return to sports after RTSA.

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

Methods: This was a retrospective review of consecutive RTSA patients collected from our institution's shoulder arthroplasty registry. All patients who played sports preoperatively and had a minimum of 1-year follow-up were included. Final follow-up consisted of an additional patient-reported questionnaire with questions regarding physical fitness and sporting activities. Each patient also completed an assessment with the American Shoulder and Elbow Society (ASES) Shoulder Score and a visual analog scale (VAS) for pain.

Results: Seventy-six patients played a sport preoperatively and met inclusion and exclusion criteria. The average follow-up was 31.6 months (range, 12-65 months), and average age was 74.8 years (range, 49.9-92.6 years). Average VAS pain scores improved from 6.57 to 0.63 ($P < .001$). Average ASES scores improved from 34.30 to 81.45 ($P < .001$). Subjectively, 11.8% of patients complained of stiffness and 10.5% complained of chronic pain. After RTSA, 85.5% of patients returned to at least 1 sport. Average time to return to full sports was 5.3 months. Fitness sports had the highest direct rate of return (81.5%), followed by swimming (66.7%), running (57.1%), cycling (50.0%), and golf (50%). Postoperatively, 41.1% of patients reported improved physical fitness; 88.2% felt that their sports outcome was good to excellent, and 93.4% felt that their surgical outcome was good to excellent.

Conclusion: Patients undergoing RTSA had an 85% rate of return to 1 or more sporting activities at an average of 5.3 months after surgery. Age greater than 70 years was a significant predictor of decreased return to activities. The present study offers valuable information to help manage patient and surgeon expectations.

Keywords: reverse total shoulder arthroplasty; sports; shoulder replacement; physical fitness

Technical innovations in total joint arthroplasty have raised patients' expectations for functional recovery and return to activities including sports. In fact, patient satisfaction is closely correlated with resumption of regular activities.^{30,32} The total hip and knee replacement literature on sport participation^{8,9,21,28,31} confirms that these patients often return to their presurgical recreational activities^{11,21} and in some cases exceed their preoperative fitness levels.^{17,22,23} Despite this, many surgeons remain conservative in their recommendations of postoperative activity levels due to concerns over premature prosthesis loosening and reduced prosthesis longevity.^{24,26}

Over the past decade, total shoulder replacement surgeries, including reverse total shoulder arthroplasty (RTSA), have more than doubled.¹³ Surgical indications for RTSA continue to evolve and now include massive rotator cuff tears, proximal humerus fractures, and revision total shoulder arthroplasty (TSA).^{2,5,7,20,29} This contrasts with historical indications, which were limited to elderly patients. This is largely in response to concerns over component longevity and the dearth of available revision procedure options.^{3,7-9} More recent studies, however, indicate that appropriately selected, younger patients can also achieve satisfactory results.^{1,20} It is likely that this growing population of relatively young RTSA patients are more active than their elderly counterparts, and thus postoperative activity levels weigh more heavily in their presurgical considerations.

While there is abundant literature documenting activity levels after hip and knee replacements, few have reported

on TSA, with only 2 studies considering RTSA. With regard to anatomic TSA, 75% to 96% of patients returned to regular sporting activities such as golf, tennis, swimming, and cycling and were satisfied with their recreational status after surgery.^{12,18,25}

Both of the RTSA studies demonstrated low activity participation after surgery,^{14,15} but neither study reported rates of return to sporting activities. Furthermore, in a recent investigation by Golant et al.,⁶ only 45% of shoulder surgeons surveyed allowed any type of sporting activity after RTSA.

Additional information regarding rate of return to sports would help both patient and surgeon more accurately manage expectations. The purpose of this study was to (1) determine the rate of return of sports activities and (2) assess average time to return to sports for RTSA patients.

METHODS

The institutional review board approved this study. A prospectively collected shoulder arthroplasty registry was queried for consecutive patients who underwent RTSA from 2007 to 2013. Patients with a primary diagnosis of rheumatoid arthritis, proximal humerus fracture, osteoarthritis, and rotator cuff tear arthropathy were included. All patients in the cohort received a Biomet Comprehensive RTSA. Patients who underwent revision procedures and bilateral procedures were included. Patients were excluded for follow-up less than 1 year. Patients who were unreachable after 5 phone attempts and 1 mailing were considered lost to follow-up. Social Security records were used to determine a deceased status. Finally, during interviews, patients were excluded if they had not participated in a sport within 3 years preoperatively.

After applying inclusion and exclusion criteria, we identified 132 consecutive patients who had undergone Biomet RTSA at a single institution. Of these, 21 patients were lost to follow-up, 5 patients declined, and 4 were deceased. Consequently, 102 RTSA patients remained available for interviews.

The charts and operative records of eligible patients were reviewed for preoperative diagnosis, body mass index (BMI), age, medical comorbidities, and operative complications. Additionally, we obtained prospectively collected preoperative American Shoulder and Elbow Society (ASES) Shoulder Scores and preoperative visual analog scale (VAS) pain scores from the patient registry data.

The outcome questionnaire (see the Appendix, available online at <http://ajsm.sagepub.com/supplemental>) was

based on the work by MCarty et al.¹⁸ and other postoperative arthroplasty sport studies.^{6,31} The questionnaire investigated demographic data, preoperative activity assessment, postoperative activity assessment, and subjective fitness level. The preoperative activity assessment considered sports participation.^{6,8} The fitness sports category was based on a similar categorization by Wylde et al.³¹ and Naal et al.²¹ Fitness sports were defined as lightweight training or resistance bands (not used for physical therapy) and gym attendance more than 2 hours per week. No patient participated in heavy weight lifting, so this category was eliminated. If sports were discontinued, the reason for stoppage was noted. Direct rates of return were calculated for each sport (return rates were calculated only if the patients participated in the sport preoperatively). Additional sports information was recorded if patients started a new sport postoperatively. Finally, ASES and VAS questionnaires were administered.¹⁹

Postoperative Sports Protocol

All surgeons followed a similar postoperative restriction protocol. Patients were encouraged to return to previous recreational activities and work if they wished. The only limitation imposed was to avoid contact sports.

Statistics

Descriptive analysis of the study population included reporting means and standard deviations for continuous variables, while frequencies and percentages were reported for discrete variables. Comparative differences between the study groups were analyzed via independent samples *t* tests for continuous variables and chi-square or Fisher exact tests for categorical variables. Correlation between comorbidities and subjective postoperative complaints (2 categorical variables) was evaluated with Fisher exact test. Changes in patient-reported outcome measures were assessed by use of paired samples *t* tests. All tests were conducted using 2-sided hypothesis testing with statistical significance set at $P \leq .05$. All data analyses were performed by use of IBM SPSS Statistics for Windows, version 21.0 (IBM Corp).

RESULTS

Demographics

A total of 102 patients were interviewed. Only 76 patients (74.5%) participated in sports within 3 years before surgery.

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TABLE 1
Pre- and Postoperative Outcomes^a

Variable	Preoperative	Postoperative	P Value
VAS pain, average \pm SD	6.57 \pm 2.4	0.63 \pm 1.7	<.001
ASES for affected arm, average \pm SD	34.3 \pm 17.2	81.45 \pm 17.1	<.001
Satisfaction with sports	NA	88.2% good to excellent	NA
Satisfaction with surgery	NA	93.4% good to excellent	NA

^aThere was a statistically significant improvement in visual analog scale (VAS) pain scores and American Shoulder and Elbow Society (ASES) Shoulder Scores for all patients. Satisfaction scores were high in this patient population. NA, not applicable.

The average age at follow-up was 74.8 years (range, 49.9-92.6 years) and average follow-up was 31.6 months (range, 12-65 months). There was a female predominance (65.7%; $n = 50$). Average BMI was 28.4 (range, 14.8-46.3). The most common primary preoperative diagnosis was cuff tear arthropathy (55.2%), followed by osteoarthritis (22.3%), proximal humerus fracture (17.1%), and rheumatoid arthritis (5.2%). A total of 73.7% of patients had undergone prior ipsilateral shoulder surgery. The dominant extremity was involved 60.5% of the time. Revision from a non-RTSA prosthesis or RTSA prosthesis to a new RTSA occurred in 15.7% and 3.9% of the population, respectively.

For the 26 patients who did not participate in sports, average age was 75.0 years (range, 47.3-102.5 years) with no significant difference in age from the preoperatively active patients ($P = .919$); 65.4% of these non-sports participants ($n = 17$) were over 70 years old, compared with 76.3% of patients who participated in preoperative sports ($n = 58$).

Validated Outcomes

The average \pm SD preoperative VAS pain score improved from 6.57 \pm 2.4 to 0.63 \pm 1.7 postoperatively ($P < .001$). The average preoperative ASES score improved from 34.30 \pm 17.2 to 81.45 \pm 17.1 postoperatively ($P < .001$) (Table 1). Complications necessitating further surgery occurred in none ($n = 0$) of the patients, and 71.1% had no complaints during follow-up. The remaining 28.9% of patients had subjective complaints including stiffness (11.8% of all patients) and chronic pain (10.5% of all patients). Patient-reported preoperative history of depression was highly correlated with the presence of subjective postoperative complaints ($P < .001$).

Return to Sports After Surgery

Postoperatively, 85.5% of the cohort restarted at least 1 sport; 60.5% reported discontinuation of 1 or more sports due to their RTSA. The average time to return to sport was 5.3 months (range, 1-36 months). Fitness sports had the highest rate of return (81.5%, 22/27), followed by swimming (66.7%, 22/33), running (57.1%, 4/7), cycling (50.0%, 6/12), and golf (50%, 10/20). Lower rates of return were seen in higher demand sports such as downhill skiing (28.6%, 2/7), doubles tennis (25.0%, 2/8), and singles tennis (25.0%, 3/12) (Figure 1). After surgery, 47.6% of patients returned to higher

intensity and longer duration of sports, 43.1% returned to previous duration and intensity, and 10.9% had to lower their duration and intensity. Of note, these active patients started some sports for the first time after surgery, which included fitness sports ($n = 5$), cycling ($n = 2$), singles tennis ($n = 1$), doubles tennis ($n = 1$), squash ($n = 1$), and swimming ($n = 1$) (these were not included in the rates of return). There was no difference between patients who returned to sports and those who did not with respect to BMI ($P = .737$), revision status ($P = .446$), sex ($P = .99$), preoperative pathologic abnormalities ($P = .169$), or dominant extremity ($P = .193$). Younger age (<70 years old) demonstrated an improved rate of return to sports ($P < .02$) (Table 2). Revision surgery patients reported a lower degree of satisfaction with their ability to return to sports postoperatively ($P < .005$). The most common reasons for discontinuation of sport among all patients were pain (13.1%), problems due to the RTSA (11.8%), and lack of interest (9.2%).

Of the 76 patients who played sports preoperatively, rates of return to at least 1 sport differed by diagnosis. For osteoarthritis patients there was a rate of return of 100% (17/17), for rheumatoid arthritis 100% (4/4), for cuff tear arthropathy 80.9% (34/42), and for proximal humerus fractures 76.9% (10/13).

Preoperative Fitness Levels and Postoperative Satisfaction

Preoperatively, 67.1% of patients participated in 2 or more hours of physical fitness weekly. After surgery, 40.7% of patients felt that their physical fitness had improved, 88.2% felt that their sports outcome was good to excellent, and 93.4% felt that their surgical outcome was good to excellent (Table 1). Accordingly, patients who returned to sports were more satisfied with their surgery ($P < .001$), their ability to play sports ($P < .001$), and their improvements in physical fitness ($P < .003$).

Postoperative Activity Recommendations

The majority of patients (96.0%) stated that they obeyed all postoperative activity restrictions. Only 3 patients reportedly engaged in activities that were prohibited by their surgeon. One patient went cycling and 2 patients went downhill skiing very early in their postoperative course. None of these patients, however, required revision surgery.

TABLE 2
Sporting Activities Before and After
Reverse Total Shoulder Arthroplasty (N = 76)^a

Subgroup and Sport	Preoperative Participation ^b		Postoperative Participation ^b	
	n	% ^c	n	% ^c
Women (n = 50)				
Swimming	25	50.0	19	38.0
Fitness sports	17	34.0	16	32.0
Golf	10	20.0	5	10.0
Cycling	10	20.0	6	12.0
Men (n = 26)				
Golf	10	38.5	6	23.1
Fitness sports	10	38.5	4	15.4
Swimming	8	30.8	4	15.4
Fishing	4	15.4	1	3.8
Older patients (≥70 y) (n = 58)^d				
Swimming	24	41.4	16	27.6
Fitness sports	22	37.9	18	31.0
Golf	16	27.6	9	15.5
Cycling	8	13.8	5	8.6
Singles tennis	8	13.8	5	8.6
Younger patients (<70 y) (n = 18)^d				
Swimming	9	50.0	7	38.9
Fitness sports	5	27.8	7	38.9
Singles tennis	4	22.2	3	16.7
Cycling	4	22.2	3	16.7
Golf	4	22.2	2	11.1
Revision patients (n = 15)^e				
Swimming	7	46.7	6	40.0
Fitness sports	7	46.7	5	33.3
Singles tennis	4	26.7	1	6.7
Cycling	3	20.0	1	6.7
Doubles tennis	3	20.0	1	6.7
Primary patients (n = 61)				
Swimming	26	42.6	17	27.9
Fitness sports	20	32.8	20	32.8
Golf	18	29.5	10	16.4
Cycling	9	14.8	7	11.5

^aSports breakdown of patients by age, sex, and revision status. The top 4 or 5 sports for each group are listed. As noted, the rates of return were significantly higher for patients younger than 70 years than for the older patient population.

^bIncluding patients who did not continue the individual sport postoperatively.

^cPercentage of total in the given category.

^dRate of return was significantly better for younger patients ($P < .02$).

^eRevision defined as any previous arthroplasty on affected shoulder (hemiarthroplasty, total arthroplasty, and/or reverse total arthroplasty).

DISCUSSION

This is the largest study evaluating return to activity after RTSA,^{14,15} the only one to consider preoperative activity, and the first to report sport-specific rates and timing to full return.

Return to sports and physical activities is increasingly evaluated as a factor in judging orthopaedic surgical outcomes. While numerous studies exist with regard to resumption of sports after hip and knee arthroplasty,^{4,8-11,21,22} fewer have evaluated anatomic TSA and hemiarthroplasty,^{12,18,28,31,33} and only 2 series looked at activity levels after RTSA.^{14,15} The general paucity of literature on activity after RTSA may be due, in part, to the perceived need for surgeons to restrict these patients' activity⁶ or the relatively advanced age of RTSA patients compared with other joint arthroplasty cohorts.

In this investigation, the overall resumption of sporting activities was 85.5%, which falls within the reported rates (75%-96%) for return to sport after anatomic TSA.^{12,18,25} This is the first study to report specific sport-related rates of return for the RTSA population. The rates of return for the most commonly reported sports—swimming (66.7%), cycling (50.0%), golf (50.0%), downhill skiing (28.6%), doubles tennis (25.0%), and singles tennis (25.0%)—were lower, on average, than reported values after TSA.^{18,25}

Age less than 70 years was a significant predictor of higher rate of return to sports. Somewhat surprisingly, involvement of the contralateral extremity and high BMI were not significant predictors. This stands in contrast to findings by Li et al,¹⁶ who demonstrated worse physical function in obese and overweight patients after anatomic TSA. We found an average return time to full sports of 5.3 months, similar to TSA literature with return times ranging from 4.5 to 11.2 months.^{12,18,25} No studies have examined time until return to sport in RTSA patients. These findings will help guide surgeons during counseling about postoperative activity expectations.

An additional finding that should not be understated is that 28.9% of patients had postoperative complaints, with 11.8% of patients complaining of stiffness and 10.5% of chronic pain. While this cohort had significant increases in average ASES scores, patients should understand these potential limitations of RTSA and the possibility of these symptomatic outcomes.

As previously noted, limited data are available on sports after RTSA. The first study published was a small case series (n = 4) in which 75% of patients returned to presurgical sports.¹⁴ Lawrence et al¹⁵ surveyed 78 RTSA patients and found that they maintained a high level of activity after RTSA. That study did not document preoperative sport participation or include validated outcomes such as ASES or VAS pain scores. As such, few conclusions may be drawn, particularly with regard to rates of return and overall clinical outcome.

While postoperative activity restrictions after RTSA have traditionally been the most stringent among shoulder arthroplasty procedures, this study's findings suggest that patients can safely return to sports and activities. Healy et al⁸ surveyed 35 members of the ASES with regard to sport allowance after shoulder arthroplasty and found a wide range of recommendations. The investigators concluded that low-impact sports should be permitted, but sports of medium and high demand (aerobics, weight training, tennis, and racquet sports) lacked definitive recommendations. In another study, Golant et al⁶ polled 310 shoulder

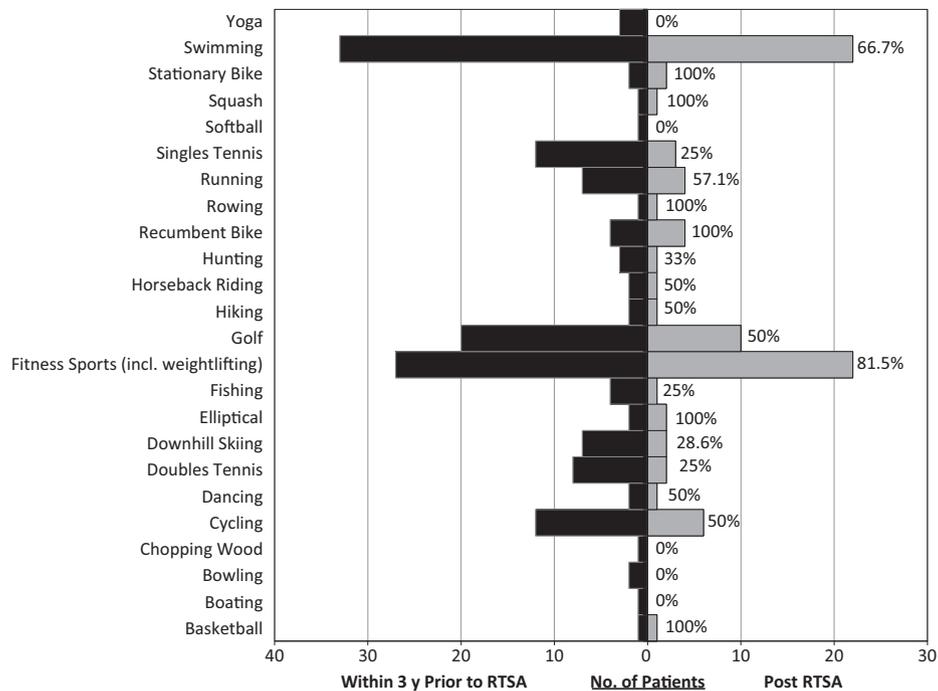


Figure 1. All sports in which the patients participated pre- and postoperatively. Direct rates of return are listed in the postoperative column on the right. Swimming, golf, and fitness sports were the most common activities.

experts about postoperative restrictions after all types of shoulder replacements. These investigators reported that RTSA restrictions were most stringent, with 72% of surgeons allowing low-impact sports and only 51% allowing noncontact, high-load sports such as tennis.

While a large number of patients successfully returned to noncontact, high-load sports without resultant complications, one should use caution when generalizing the safety of such activity into the mid- and long-term. For example, the current study investigated activities and patient-reported complications at an average of less than 3 years of follow-up and without radiographic follow-up. The mid- and long-term impact of increased activity and load-bearing remains to be realized. The study's retrospective design carries inherent biases, including spurious patient recall. In an effort to mitigate this bias, we cross-referenced patient records whenever possible. Additionally, our survey was conducted by telephone, with the possible introduction of investigator bias. Despite this, telephone surveys have been shown to yield a greater rate of patient responses compared with postal mail, and therefore our study may have included a more diverse response group.²⁷ Finally, as noted above, this study did not include any physical examination or radiographic review, procedures that are included in most studies regarding return to sport for shoulder arthroplasty.^{3,15,18,33} Radiographic review may have demonstrated increased wear or other deleterious effects; because such a review was not conducted, no recommendation on return to higher intensity sports and effects on radiographic findings can be made from this

study. This alone may limit recommendations of return to sports for some orthopaedic surgeons. Despite these limitations, we have established the most comprehensive data set to date of RTSA patients that involves both preoperative and postoperative reporting of activities and fitness.

It is important to realize that none of the patients in this cohort underwent surgery for the sole purpose of improving their recreational activities. All patients had pain and dysfunction of their shoulders and underwent the procedure to eliminate pain and improve their ability to perform activities of daily living. This is evidenced by an average preoperative ASES score of 34.8. However, patients are often interested in resuming their recreational activities once the primary goals of the surgery have been realized, and this work will help provide surgeons with data to manage patients' expectations.

CONCLUSION

Patients undergoing RTSA had an 85% rate of return to 1 or more sporting activities at an average of 5.3 months after surgery. Noncontact, high-demand activities (swimming, skiing, golf, and tennis) had lower return rates than lower demand activities. Age greater than 70 years old was a significant predictor of decreased return to activities. This is the first study to document both preoperative and postoperative sports after RTSA. The present investigation offers valuable information to help manage patient and surgeon expectations.

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