

Return to sports after shoulder arthroplasty

Christine C Johnson, Daniel J Johnson, Joseph N Liu, Joshua S Dines, David M Dines, Lawrence V Gulotta, Grant H Garcia

Christine C Johnson, Joseph N Liu, Joshua S Dines, David M Dines, Lawrence V Gulotta, Grant H Garcia, Department of Sports Medicine and Shoulder Surgery, Hospital for Special Surgery, New York, NY 10021, United States

Daniel J Johnson, the School of Medicine, Vanderbilt University School of Medicine, Nashville, TN 37232, United States

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Correspondence to: Christine C Johnson, MD, Department of Sports Medicine and Shoulder Surgery, Hospital for Special Surgery, 535 E 70th St, New York, NY 10021, United States. johnsonc@hss.edu
 Telephone: +1-212-6061466
 Fax: +1-212-6061477

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Abstract

Many patients prioritize the ability to return to sports

following shoulder replacement surgeries, including total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RTSA), and hemiarthroplasty (HA). While activity levels after hip and knee replacements have been well-established in the literature, studies on this topic in the field of shoulder arthroplasty are relatively limited. A review of the literature regarding athletic activity after shoulder arthroplasty was performed using the PubMed database. All studies relevant to shoulder arthroplasty and return to sport were included. The majority of patients returned to their prior level of activity within six months following TSA, RTSA, and shoulder HA. Noncontact, low demand activities are permitted by most surgeons postoperatively and generally have higher return rates than contact sports or high-demand activities. In some series, patients reported an improvement in their ability to participate in sports following the arthroplasty procedure. The rates of return to sports following TSA (75%-100%) are slightly higher than those reported for HA (67%-76%) and RTSA (75%-85%). Patients undergoing TSA, RTSA, and shoulder HA should be counseled that there is a high probability that they will be able to return to their preoperative activity level within six months postoperatively. TSA has been associated with higher rates of return to sports than RTSA and HA, although this may reflect differences in patient population or surgical indication.

Key words: Total shoulder arthroplasty; Reverse total shoulder arthroplasty; Shoulder replacement; Return to sport; Hemiarthroplasty

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Core tip: Many patients prioritize the ability to return to sports following shoulder replacement surgeries, including total shoulder arthroplasty, reverse total shoulder arthroplasty and hemiarthroplasty. While activity levels after hip and knee replacements have been well-established in the literature, studies on this topic in the field of shoulder arthroplasty are relatively limited. Information about activity levels and the rate of return

to sports following shoulder arthroplasty would help both patients and surgeons more accurately manage expectations. This clinical review examines how return to sport following shoulder arthroplasty has been studied and reported in the literature.

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INTRODUCTION

Over the past decade, shoulder replacement surgeries, including total shoulder arthroplasty (TSA), reverse total shoulder arthroplasty (RTSA), and hemiarthroplasty (HA), have become increasingly more common^[1,2]. Technical innovations in shoulder arthroplasty have led to good implant survival and satisfactory long-term outcomes^[3-6]. Although most commonly performed in elderly patients for degenerative shoulder conditions^[3-5,7], shoulder replacement surgery is also routinely performed in young and active patients^[8-11].

As the indications for these procedures expand and life expectancy increases, the goals of shoulder replacement are changing, and many patients are now prioritizing the ability to resume sports postoperatively^[12-15]. Frequently during both preoperative and follow-up visits, patients inquire about sports after shoulder arthroplasty^[12]. While activity levels after hip and knee replacements have been extensively reported in the literature^[16-23], the number of studies on this topic in the field of shoulder arthroplasty are relatively limited^[13,14].

Information about activity levels and the rate of return to sports following shoulder arthroplasty would help both patients and surgeons more accurately manage expectations^[24]. This clinical review examines how return to sport following shoulder arthroplasty has been studied and reported in the literature^[12].

RETURN TO SPORT AFTER TSA

TSA has been shown to be a highly effective treatment for degenerative shoulder disease, and has been shown to have good medium- and long-term outcomes^[7,25,26]. The number of total shoulder arthroplasties performed in the United States has risen exponentially over the last decade: Since 2004, TSA has increased by approximately 3000 cases each year in the United States compared with an annual increase of fewer than 400 cases each year prior^[27]. This trend is only expected to continue^[27], and patients have come to have higher expectations of their functions postoperatively. While return to activity has been studied extensively in the lower extremity arthroplasty literature, it is only relatively recently that the same focus has been

placed on TSA^[12-14].

The largest study by Bühlhoff *et al.*^[28] examined return to sports in 154 TSA patients at an average follow-up of 6.2 years. Their cohort included 105 TSA patients who had participated in sports preoperatively (group 1) and 49 TSA patients who had never participated in sports (group 2). At the time of final follow-up, 60 patients (39%) were participating in sports, and all 60 patients were from the first group (those that had participated in sports preoperatively). The authors concluded that patients who had not recently participated in sports are unlikely to do so after surgery. Among patients who had participated in sports preoperatively, however, the rate to return to sports was 57% in their cohort. Furthermore, of the 45 patients who participated in sports preoperatively and did not resume the activity postoperatively, only 18% cited shoulder problems as the reason^[28].

McCarty *et al.*^[13] reported on 75 patients (86 shoulders) with a minimum follow-up of two years. In their series, 54 patients (61 shoulders) underwent TSA and the other 21 patients (25 shoulders) received a HA. Sixty-four percent of the patients stated that one of the reasons that they were having the surgery was to participate in sports. Overall, 81% of patients resumed at least one sport following the arthroplasty procedure, and 71% of these patients demonstrated an improvement in their ability to play the sport. In their study, fishing (92%), swimming (86%), and golf (77%) were associated with the highest rates of return postoperatively; bowling (40%) and softball (20%) showed the least favorable rates of return. Patients participated in their sport more frequently after surgery (1.7 d/wk compared to 0.7 d/wk previously), and most made a full return to sports by 5.8 mo postoperatively.

Zarkadas *et al.*^[1] used a mailed questionnaire to assess patient-reported activity after either TSA or HA. With respect to the TSA group, 27 of the 52 respondents (60%) reported having high demand use of their shoulder. The most commonly reported sports that patients were unable to perform due to the arthroplasty procedure were canoeing, biking, and golf^[1].

Schmidt-Wiethoff *et al.*^[29] reported that 62 of 74 patients (84%) were able to return to sport after TSA, but 30% (19 patients) played with limitations. The remaining 12 patients (16%) did not return to sports, but it is not known whether this was due to shoulder problems or comorbid medical conditions^[12,29,30].

Schumann *et al.*^[15] reported on 100 patients who underwent TSA and were followed for a minimum of one year. Eighty-nine percent of patients who participated in sports preoperatively (49 of 55) were able to resume participating in that sport at an average follow-up of 2.8 years; over a third of these patients (36.7%), however, reported persistent restrictions on sports activities due to shoulder issues. Regarding time to return to sports, 67% of the patients that resumed sports were able to do so within 6 mo. Golf was one of the most commonly reported sporting activity in their series (16.3%), and many of the golfers reported an improvement in performance

postoperatively: The golfers in their series increased their maximum drive distance from an average of 110 ± 91.5 m preoperatively to an average of 173.1 ± 51.2 m following the arthroplasty procedure.

Jensen *et al.*^[14] studied 24 patients (26 shoulders) who played golf prior to TSA (20 shoulders) or HA (6 shoulders). They found that all but 1 patient (96%) had returned to golf by a mean of 4.5 mo postoperatively. Performance improved in most patients, and 18 patients were able to decrease their handicap by an average of five strokes postoperatively. When compared to 76 non-golf playing controls, golfers did not have an increased risk of implant loosening at an average follow-up of 52.4 mo^[14].

In summary, these studies demonstrate that patients who participate in sports preoperatively have a high likelihood of returning to sports after TSA. Most are able to return to full activity within six months, and some patients will experience an improvement in their performance. Patients should be cautioned that a small proportion of patients report persistent restrictions on sports activities following TSA.

RETURN TO SPORT AFTER REVERSE TSA

In 2003, the reverse prosthesis, or RTSA, was approved by the Food and Drug Administration for patients with cuff tear arthropathy^[31]. Despite the technical challenges it initially presented to surgeons^[32], the results of RTSA have been encouraging^[31,33], and the indications for RTSA have expanded to include proximal humerus fractures and TSA revisions^[24]. The success of the reverse total shoulder prosthesis has been shown to contribute to the large increase in the number of shoulder replacement procedures performed in the United States over the past decade^[2,34,35]. Reverse prostheses accounted for nearly half of all total shoulder arthroplasties performed in 2011^[36]. Patient satisfaction has been shown to correlate with the resumption of recreational activities^[37,38], but only a handful of studies have assessed return to sport and activity following RTSA.

Edwards *et al.*^[39] reported on postoperative activity levels in a small number ($n = 4$) of RTSA patients. The authors found that 75% of the patients in this series returned to preoperative sports.

Lawrence *et al.*^[40] surveyed 78 RTSA patients (81 shoulders) at an average follow-up of 3.6 years, and found that they maintained a high level of activity following RTSA. The most commonly reported low-demand sporting activities were stationary biking (31%) and treadmill (23%), and the most popular medium-demand sports were fishing (23%), dancing (16%), and swimming (16%). The authors concluded that the activities patients participate in after RTSA are similar to those reported after other types of shoulder arthroplasty, including TSA and HA.

In an evaluation of RTSA in a senior athletic popu-

lation, Simovitch *et al.*^[41] reported that 60% (40 of 67) patients who participated in a sport preoperatively returned to sports after surgery. Of the patients that resumed sports postoperatively, 12 patients (30%) indicated that they were able to perform their activities at a higher level, and 26 patients (65%) reported no change in performance. The three most popular sports in their series were golf, swimming, and water aerobics. The authors also examined radiographic outcomes in the patients who returned to sports for a minimum of 35 mo (mean 43 mo). At final follow-up, a single zone of lucency was present in 17% of humeral stems and there was one case of early subsidence, but no cases with loosening. The glenoid notching rate was 7% in their cohort, but there were no cases of glenoid subsidence, lucency, or loosening.

Garcia *et al.*^[24] reported on 76 RTSA patients at an average follow-up of 31.6 mo. All of the patients included in their series participated in sports preoperatively, and the authors found that 85.5% of patients returned to at least one sport following RTSA. The average time to return to full sport was 5.3 mo. The sports with the highest rates of return included fitness sports (81.5%), swimming (66.7%), running (57.1%), cycling (50%), and golf (50%). Nearly half (47.6%) of the patients reported that the duration and intensity of their sporting activities had increased. The most common reasons for not returning to sports in their series were pain (13.1%), shoulder issues related to surgery (11.8%), and loss of interest (9.2%).

Despite no clear consensus in the literature regarding the acceptable activity level after RTSA, the available data demonstrates that most patients are able to return to low-impact sports, such as swimming, biking, jogging, and golf. Further studies are required to determine the mid- and long-term impact of increased activity and load-bearing following RTSA.

RETURN TO SPORT AFTER HA

Despite exponential rises in TSA and RTSA, the rate of HA procedures continues to grow^[2]. Glenohumeral HA is well established as a method to treat glenohumeral arthritis and complex three- and four-part proximal humerus fractures^[42]. With its low failure rate, HA has traditionally been considered a safer option than total or reverse total shoulder replacements for patients who wish to remain active^[41]. Other advantages of HA over these other prostheses include a less technically demanding procedure and shorter operative time^[43]. However, others caution against its use in young, active patients, as long-term data shows deteriorating outcomes and worsening glenoid erosion for shoulders that undergo HA for osteoarthritis^[44]. Despite a relative indication for HA in patients who wish to resume sporting activities^[45], there is limited data on rates of return to sports after HA.

Skutek *et al.*^[46] evaluated a small series ($n = 13$) of HA patients and reported a 76% rate of return to

preoperative sport. Swimming ($n = 6$) and cycling ($n = 3$) were the most common sports resumed postoperatively, and the average time to return to sport was 33 wk in their series.

Garcia *et al.*^[45] reported on activity levels following HA in 79 patients at a mean follow-up of 63.1 mo. Of the 58 patients who played a sport preoperatively, the authors found that 67.2% resumed at least one of their previous sports following HA. The average time to return to full sports was 6.5 mo. Among the patients with preoperative sports participation, the sports with the highest rates of return were fitness sports (69%), swimming (65%), running (64%), cycling (63%), and doubles tennis (57%). Of the patients who returned to sports postoperatively, 87% felt that their sports outcome was good or excellent.

Return to sports after HA is considered "safer" than total or reverse shoulder arthroplasty due to its a low risk of component failure or loosening^[47]. However, the rates of return to sports following HA (67% to 76%)^[45,46] reported in the literature appears slightly lower than those reported for TSA (75%-100%)^[13-15] and RTSA (75%-85%)^[24,39]. In addition, many studies have shown poor results in long-term follow-up of HA, with one finding that only 25% of HA patients were satisfied with their outcome seventeen years after the operation^[44]. Despite these results, HA continues to be a common procedure performed by recent orthopaedic residency graduates, where it is commonly performed on younger, active patients^[48].

COMPARISON BETWEEN RETURN TO SPORT IN HA AND TSA

Patients with primary glenohumeral osteoarthritis may be treated with either TSA or HA. The choice is guided primarily by the presence or absence of glenoid arthrosis, but also in part by the patient's age and intended level of activity. TSA has been shown to provide superior pain relief, function, range of motion, and patient satisfaction as compared to HA^[49-51]. However, proponents of shoulder HA argue that it provides reliable pain relief in a shorter, less technically demanding, and less costly procedure. Furthermore, many shoulder surgeons permit patients to return to sports with less restrictions following HA as compared to TSA^[52,53]. Opposition to TSA in young active patients stems from concerns regarding implant longevity and glenoid loosening^[49]. To date, only three studies have compared return to activity following the two procedures^[1,13,49].

McCarty *et al.*^[13] reported on 75 patients who underwent either TSA ($n = 54$) or HA ($n = 21$). The authors found an 81% rate of return to sports in both the TSA group (44 of 54 patients) and the HA group (17 of 21 patients) at a minimum follow-up of two years. The authors concluded that there was no difference between TSA and HA in patients' ability to return to sports.

Zarkadas *et al.*^[1] used a mailed questionnaire to assess patient-reported activity after either TSA or HA.

Activities were classified as low-demand (*e.g.*, stationary biking and treadmill use); medium-demand (*e.g.*, fishing, dancing, and swimming); or high-demand (*e.g.*, free weights and hunting). Responses were received from 52 TSA patients and 47 HA patients. The TSA group reported better range of motion and strength than the HA group ($P < 0.05$). Sixty percent of TSA patients (27 of 52) reported having high demand use of their shoulder as compared to 46% of HA patients (11 of 47); however, this difference was not statistically significant.

Garcia *et al.*^[49] compared rates of return to sports in a matched cohort of HA and TSA patients. All arthroplasty procedures were performed for glenohumeral arthritis, and patients were followed for a minimum of two years (average 62.0 and 61.1 mo for the HA and TSA groups, respectively). The investigators found significantly higher rates of return to sport in the TSA group as compared to the HA group: Ninety-seven percent of TSA patients (36 of 37) resumed at least one sport postoperatively as compared to 65% of HA patients (19 of 29). The average time to return to full sports was similar in both groups (5.5 mo and 5.4 mo for HA and TSA patients, respectively).

To date, three studies have compared rates of return to athletic activities following HA or TSA^[1,13,49].

Only one demonstrated a difference in return to sports between the procedures, concluding that TSA was associated with more favorable rates of return to any sport as compared to HA^[49]. All of the studies are limited by their sample sizes, retrospective nature, and follow-up. The mixed results may also reflect differences in patient populations, indication for surgery, and surgeons' postoperative restrictions.

COMPARISON BETWEEN RETURN TO SPORT IN HA AND RTSA

In patients who are not candidates for anatomic TSA due to rotator cuff dysfunction, rheumatoid arthritis, or proximal humerus fracture, the choice between RTSA and HA remains controversial. As compared to HA, RTSA has been associated with improved functional and range of motion outcomes^[54-58]. However, HA is generally perceived as the "safer" option in patients who wish to remain active because there is less risk of failure^[47]. Consistent with this notion, surveys of surgeons demonstrate that they place fewer postoperative sports restrictions on HA patients than on those undergoing RTSA^[52,53]. However, limited literature exists on return to sports following RTSA and HA, and only one study to date has compared rates of return to sport following the two procedures^[47].

Liu *et al.*^[47] reported on 102 RTSA and 71 HA patients with a minimum follow-up of 1 year. All patients participated in sports preoperatively, and had a contraindication for an anatomic TSA, including rotator cuff dysfunction, inflammatory arthritis, or proximal humerus fracture. The authors found significantly higher rates of return

to sport in the RTSA group (85.9%) as compared to the HA (66.7%) group. The RTSA patients also had subjectively higher satisfaction scores regarding their surgery and their ability to return to sports. Female sex, age under 70 years, surgery on the dominant extremity, and a preoperative diagnosis of arthritis with rotator cuff dysfunction predicted a higher likelihood of return to sports for patients undergoing RTSA compared with HA. There were no significant differences in the time to return to full sports between HA (6.2 mo) and RTSA (5.3 mo). No sports-related complications occurred.

Surgeons have been shown to impose much more stringent restrictions on activities following RTSA as compared to HA^[52,53], but recent data demonstrates higher rates of return to sports following RTSA than HA^[47]. RTSA may be particularly beneficial in certain patient populations, including females, patients under 70 years old, patients with dominant shoulder pathology, and patients with a preoperative diagnosis of arthritis and rotator cuff dysfunction. The conclusions of this study should be interpreted in light of its length of follow-up (31 mo for the RTSA group and 62 mo for the HA group), lack of radiographic outcomes, and differences in the two patient populations.

SURGEONS' PREFERENCES REGARDING RETURN TO SPORTS FOLLOWING SHOULDER ARTHROPLASTY

Several studies have reported on the recommendations of experienced shoulder surgeons regarding return to sport following shoulder arthroplasty^[14,52,53,59]. Long-term outcome studies are needed to assess whether these surgeon preferences are clinically supported by patient outcomes or implant survival in patients who participate in sports after shoulder arthroplasty.

Jensen *et al.*^[14] surveyed 50 surgeons from the American Shoulder and Elbow Society (ASES) on return to golf following TSA; responses were received from 44 (88%) of the surgeons queried. Ninety-one percent of the responding surgeons allowed their patients to resume playing golf at an average of 4.3 mo. However, 29.5% of surgeons surveyed believed that participation in sports following TSA may accelerate component wear^[59].

Healy *et al.*^[60] surveyed 35 surgeons in the ASES regarding participation in 42 different athletic activities following TSA. Surgeons were instructed to rate each activity as one of the following: Recommended/allowed, allowed with experience, not recommended, and no opinion. Not surprisingly, low impact sports such as swimming, dancing, bowling, doubles tennis, and bicycling were recommended and allowed. Activities that were allowed with experience included golf, ice skating, and downhill skiing. The authors determined that only four activities of the list of forty-two were not recommended, including hockey, rock climbing, gymnastics, and football. Activities for which a consensus could not be reached

included: Baseball/softball, lacrosse, rowing, soccer, weight lifting, and singles tennis.

Magnussen *et al.*^[53] queried the members of ASES as well as the European Society for Surgery of the Shoulder and Elbow about return to sports after TSA, RTSA, or HA. The survey contained 37 activities and participants were instructed to classify their postoperative recommendations for each activity as one of the following: Allowed, allowed with experience, not allowed, or undecided. Looking specifically at TSA, almost all of the 94 responding surgeons indicated that they would allow their patients to participate in noncontact activities, such as jogging/running (86%), stationary cycling (91%), and dancing (87%). Although the majority of surgeons would also permit low impact activities following RTSA, other activity restrictions were more conservative than those following TSA or HA. For example, swimming was permitted by the majority surgeons following TSA (82%) and HA (87%), but less than half (45%) would permit participation following RTSA. Similarly, golf was allowed by most surgeons after TSA (75%) or HA (77%), but only 45% of surgeons would permit golf following RTSA; doubles tennis was allowed by about half of surgeons following TSA (48%) or HA (55%), but only permitted by 15% after RTSA. Time to return to sport following RTSA was comparable to that of TSA, with most (56%) of the responding surgeons allowing patients to resume their maximum level of activity 5-7 mo after RTSA. Twenty percent of surgeons, however, required patients to wait at least 8 mo after RTSA to return to this level of activity.

Magnussen *et al.*^[53] found that recommendations on return to sport following HA were the most lenient. For example, weight-lifting was not recommended following RTSA (82%) or TSA (57%), but permitted or allowed with experience following HA according to 52% of the surgeons surveyed.

Nearly half of surgeons (47%) would allow patients to resume their maximum level of activity earlier following HA, at 2-4 mo postoperatively. Patients were also allowed to return to sports faster following HA, with 48% of surgeons allowing return to maximum level of activity 5-7 mo postoperatively and 47% allowing return to this level earlier, at 2-4 mo postoperatively.

More recently, Golant *et al.*^[52] surveyed 310 members of the ASES regarding what types of activities they allow their patients to participate in after five different types of shoulder arthroplasty. Responses were received from 94 surgeons (30.3%). Regarding activities after TSA, 59.1% of the surgeons surveyed indicated that they allow their patients to participate in low-impact sports (including golf, bowling, rowing, and swimming) without limitations. About 20% of the surgeons surveyed would permit participation in high-impact sports (including tennis, squash, volleyball, and baseball) without limitations, and 8.2% of the surgeons reported that they would allow participation in contact sports (including football, lacrosse, hockey, and basketball) without limitations.

Consistent with the findings of Magnussen *et al.*^[53]

restrictions following RTSA were found to be the most stringent of the arthroplasty procedures evaluated. For example, 25.7% of surgeons polled by Golant *et al.*^[52] would allow their patients to participate in low-impact sports, such as golf and swimming, without restrictions, as compared to 59.1% and 80% of surgeons allowing participation following TSA and HA, respectively. Similar trends were observed with high-impact and contact sports: High-impact sports were allowed with limitations by a greater proportion of surgeons following HA (31.9%) or TSA (39.7%) than RTSA (19.4%); contact sports were allowed with limitations by about one in five surgeons following HA (21.6%) or TSA (18.5%), but only 5.2% of surgeons following RTSA.

In the available literature, there is extensive variation in surgeon recommendations on activity restrictions after joint arthroplasty. The majority of surgeons allow return to noncontact, low-load activities after all types of shoulder arthroplasty. Restrictions on high-impact sports, sports with fall risk, and contact sports were more liberal following HA or TSA as compared to RTSA.

CONCLUSION

The majority of patients are able to return to their pre-operative level of activity following TSA, RTSA, and shoulder HA. The rates of return to sports following TSA (75%-100%)^[45-46] are slightly higher than those reported for HA (67% to 76%)^[45-46] and RTSA (75%-85%)^[24,39], although this may reflect differences in patient population or surgical indication. Noncontact, low demand activities are permitted by most surgeons postoperatively and generally have higher return rates than contact sports or high-demand activities. Most patients can expect to return to sports within six months postoperatively, and many will experience an improvement in their ability to participate in sports following the arthroplasty procedure.

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