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Return to sport after shoulder arthroplasty: a systematic review

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- The main goal of this study was to determine the rate of return to sport (RTS) after shoulder arthroplasty.
- A systematic review of the literature was performed using the PRISMA guidelines. All clinical studies written in English, French or German, with a level of evidence of 1 to 4, and evaluating return to sport after shoulder arthroplasty, were included.
- A total of 23 studies were included with 2199 patients who underwent hemiarthroplasty (HA), anatomic total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (RSA). Mean age was 68 years (range 18 to 92.6), sex ratio (male:female) was 1:1.5. The surgery was performed on the non-dominant/dominant shoulder in 1:1.8 cases. The mean follow-up was 4.2 years. The rate of RTS was 75.5% with a mean time of 7 months. It was 77.4% for TSA, 75% for RSA and 71.2% for HA (P = non-significant).
- RTS after shoulder arthroplasty is high, regardless the type of arthroplasty, with a trend for a higher rate after TSA. Patients who were able to maintain a sport activity preoperatively had a greater chance of RTS after arthroplasty. Failure to RTS seems to be mostly linked to the severity of the underlying condition and length of preoperative disability.

Keywords: arthroplasty; return to sport; shoulder

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Introduction

Shoulder arthroplasty has significantly increased worldwide in recent decades, amongst both young[1,2] and elderly populations.[3] For example, in the United States the rate of shoulder arthroplasty has increased by 200% between 2003 and 2015.[4,5] In addition, one-third of shoulder replacements are performed in patients under 65 years of age.[4] In Scandinavia, the average incidence of shoulder replacements is 13.3/100,000 per year in Denmark, 7.1/100,000 per year in Norway and 9.1/100,000 per year in Sweden.[5] The aim of this procedure is to alleviate pain, improve shoulder motion and strength and thus enhance quality of life. Especially since the advent of reverse shoulder arthroplasty, the surgical indications have broadened to situations such as advanced post-traumatic or degenerative arthritis with or without damage to the rotator cuff, rotator cuff arthropathy, rheumatic diseases (e.g. rheumatoid arthritis), avascular necrosis of the humeral head, complex proximal fracture of the humerus, tumour, etc.

There are mainly three types of shoulder prosthesis: anatomic total shoulder arthroplasty (TSA), reverse shoulder arthroplasty (RSA) and humeral hemiarthroplasty (HA). The choice of implant depends on multiple factors. TSA is mainly indicated for arthritis with a preserved rotator cuff and adequate glenoid bone stock. However, when the rotator cuff is deficient due to irreparable massive tear, post-septic, rheumatic disease, or fracture with comminuted and osteoporotic tuberosities (bony rotator cuff tears), RSA or more rarely HA is indicated. The main indications for the latter are avascular necrosis of the humeral head with minimal glenoid involvement, arthritis in the younger population, fracture with a non-salvageable humeral head, or revision of failed previous arthroplasty. Nevertheless, some centres also use HA for glenoid component failure, deltoid fatigue and other deleterious factors over time for RSA.

Advances in technologies, younger patients who undergo shoulder replacement, and improvement in health and life quality of the elderly population have conversely led to increased demands and expectations in terms of functional recovery and return to daily life and sports activities. Several studies, including meta-analyses, have investigated the return to sport (RTS) after shoulder replacement.[6–28] However, the latest meta-analyses include

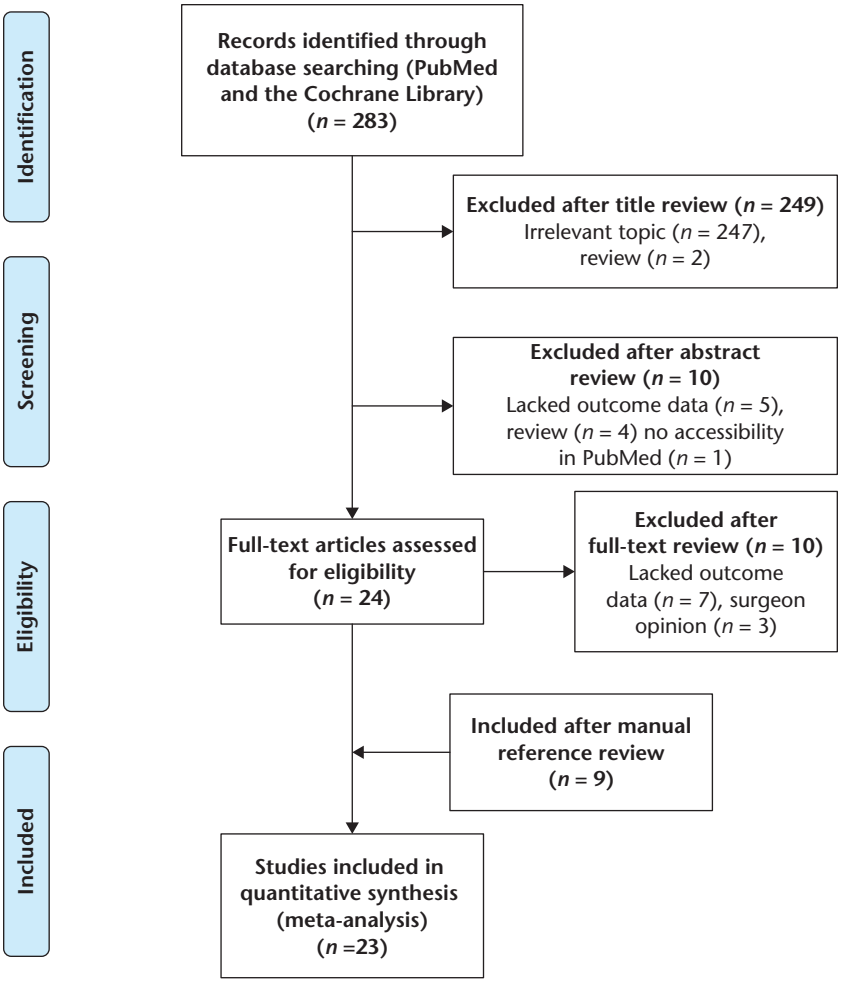

Fig. 1 PRISMA flow diagram presenting the systemic review process.

articles published before 2017 and do not carry out distinctive analyses between the three groups (TSA, RSA and HA). In addition, they include limited numbers of studies (seven and 13).[29,30] Several studies have been published between 2017 and 2020, with many of them including over 100 patients.[24,26–28] Moreover, no distinction has yet been made between the general population and athletes, which could theoretically underestimate the rate of RTS. The purpose of this systematic review is thus to summarize the current literature and to synthesize the information based on RTS after implantation of a shoulder arthroplasty, in order to guide practitioners in advising their patients about strategies and timing before taking up sports activities, according to the type of procedure performed, the underlying diagnosis, and the level of sport practice.

Methods

This systematic review was performed in MEDLINE via PubMed and the Cochrane Library according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[31] by two authors (JK and GC) (Fig. 1) using various combinations of keywords e.g. “shoulder arthroplasty”, “shoulder prosthesis”, “shoulder replacement”, “return to sport”, “return to play”, “athletes”, “sports”. The final article search ended on 31 March 2020.

All clinical studies written in English, French or German, and evaluating return to sport after shoulder replacement, were included. There were no study design, geographical or publication restrictions. Excluded studies included expert opinions, reviews, non-clinical studies, and studies that did not evaluate return to sport after shoulder arthroplasty. Outcome of interest were type of sports, delay before returning to sports according to the type of procedure performed, side, age, and other demographic factors.

A preliminary database search identified 283 results. Of these, 249 studies were excluded after title review and 10 after abstract review. Twenty-four full-text articles were assessed for eligibility and 10 more were excluded after

full-text review. The reference lists of each of the 24 articles were manually checked to assess whether they could be included, adding nine more studies. Twenty-three studies were included for final analysis.

Basic statistics are reported in means and ranges, two-tailed z-tests were used to compare proportions between groups using StatPlus version 7 (AnalystSoft, Walnut Grove, CA, USA). Statistical significance was set at $P \leq 0.05$.

Results

A total of 23 studies were included. All were retrospective, with 21 case series, and two cohort studies. Seven comparative studies included different types of arthroplasty. When grouping the studies according to type of arthroplasty, we found nine studies concerning HA, 12 concerning TSA, and 10 concerning RSA (Table 1 and Supplemental Table S1).

Patient characteristics

We refer to as 'athletes' in this sturdy any individual who practiced sport before surgery, but not necessarily to a professional or competitive level. Out of the 23 studies, 2199 patients were included. Mean age was 68 years (range 18 to 92.6 years, as reported in 22 studies) (Table 2), sex ratio (male/female) was 763/1164 (as reported in 19 studies). The surgery was performed on the dominant/non-dominant shoulder in 913/505 cases (as reported in 16 studies).

Demographic characteristics according to type of arthroplasty are further reported in Table 2. The overall proportion of 'athletes' was 38.5%. The proportion of 'athletes' was the highest in patients with TSA (56.3% out of 814 patients reported in 12 studies, mean age 64.2 years, range 18 to 88 years); it was 47.5% in patients with HA (out of 457 patients reported in 9 studies, mean age 62.7 years, range 21 to 91 years), and the lowest in patients with RSA with 18.6% of 928 patients (reported in nine studies, mean age 74.2 years, range 47 to 92.6 years). Differences in proportions of 'athletes' between groups were significant (P value range < 0.001 to 0.002).

Diagnosis and treatment

Preoperative diagnosis was reported in 20 studies, and included the following: primary osteoarthritis, post-traumatic arthritis, dislocation arthropathy, rheumatoid arthritis, cuff tear arthropathy, massive rotator cuff tear with or without pseudo-paralysis, proximal humerus fracture, fracture nonunion/malunion, avascular necrosis and tumour.

Concerning the length of follow-up, we recorded an overall mean of 4.2 years (range 0.5 to 12.8 years) with the following distribution: 5.7 years for HA (range 0.5 to 12 years), 4.5 years for TSA (range 1 to 12.8 years) and 3.2 years for RSA (range of 1 to 10 years) (Table 3).

Return to sport

The definition of RTS is variable in the literature. In this systematic review, RTS is defined as the ability to go back to sport (and sometimes a new sport), but not necessarily at the same level as before. Many sports were identified, with (Table 4a) or without load (Table 4b) on the shoulder, and with or without contact. For example: swimming, golf, tennis, hiking, bowling, skiing, jogging, cycling, gym (Table 4a and Table 4b).

In the overall studied population, the mean rate of RTS was only 65.4% (range 23.5–97.3%) (Table 3). On the other hand, in the 'athletes' population, the mean rate of RTS was significantly higher at 75.5% ($P < 0.001$; range 40–97.3%). According to arthroplasty type, it was 69.7% (range 65.5–76%) for HA, 65.1% (range 23.5–93%) for RSA, and 63.3% (range 29.5–97.3%) for TSA in the overall population (Table 3). According to arthroplasty type, it was 71.2% (range 65.5–95.8%) for HA, 77.4% (range 57.1–97.3%) for TSA, and 75% (range 40–93%) for RSA in the 'athletes' population (Table 3).

The only significant difference between arthroplasty type was found between TSA and HA in the overall population ($P = 0.02$). 'Athletes' with TSA and RSA had a significantly higher rate of RTS than the overall population ($P < 0.001$ and 0.015, respectively), whereas the difference was not significant for patients with HA.

The overall mean time before RTS after surgery was 7 months (range 1 to 36 months) (reported in 13 studies). The mean time of RTS according to arthroplasty type was 6.2 months (range 1 to 24 months) for HA, 7.9 months (range 1.5 to 36 months) for TSA, and 6.2 months (range 1 to 36 months) for RSA. RTS time in athletes was shorter overall and for every arthroplasty type except for HA (Table 3).

According to the most frequently practiced sports (Table 4a and Table 4b), RTS after HA was 72.9% for swimming, 66.7% for golf and 60.9% for weightlifting. After TSA, RTS was 86.9% for golf, 84.8% for gym and 82.8% for swimming. After RSA, RTS was 78.4% for swimming, 94.2% for weightlifting and 78.7% for cycling.

The mean RTS at the same level of sport after surgery or better for the 'athletes' was 90% for TSA. We did not have enough data to analyse HA and RSA (Table 5). The mean RTS at a better level was 44.9% for HA (only the results of two studies included) and 40% for RSA. The mean RTS at the same level is 77% for HA (two studies included), 40% for TSA (two studies included), and 54.9% for RSA. The mean RTS at a worse level of sport was 9.6% for TSA and 10.6% for RSA (Table 5). These results show that most of the 'athletes' regained either their previous level or an improved level when they returned to sport.

Table 1. Description of the studies

Study	Level of evidence	Patients, *n*	'Athletes', *n*	Mean age (range), years	Types of shoulder arthroplasty, *n*	Rate of RTS, %	Level of sport after surgery
Jensen and Rockwood (1998)[6]	4	23	23	52.4 (26.4–71.9)	TSA: *n* = 20; HA: *n* = 6 (3 with massive rotator cuff tear, no repair attempted)	95.8	No change or improved: 75%
Skutek et al (1998)[7]	4	13	13	62 (47–82)	HA	69.2	No change: weekend (≤ 2x/week): 6/9 (66.7%); recreational (≥ 3x/week): 4/4 (100%)
Schmidt-Wiethoff et al (2002)[8]	4	171	118	56.5 (21–84)	TSA: *n* = 63, HA: *n* = 118	84	No change: 16%; low restriction: 42%; restriction: 26%; no sport: 16%
McCarty et al (2008)[9]	4	75	75	65.5 (24–88)	TSA: *n* = 61 (54 patients); HA: *n* = 25 (21 patients)	Total: 81.3; HA 81; TSA 81.5	Continue to play: 75 (64%); improved: 71%
Labriola and Edwards (2008)[10]	4	4	4	NR	RSA	75	Low restriction: 100%
Schumann et al (2010)[11]	4	100	55	66.2 (22.6–87.4)	TSA	Athletes: 89.1	Competitive: 4, recreational: 45 (1 switch from competitive to recreational); No change: 40.8%
Lefevre et al (2013)[12]	4	3	3	74.2±8.7	TSA	66.7	Recreational (before: competitive)
Bülhoff et al (2015)[13]	4	154	105	72 (33–88)	TSA	Total: 39; athletes: 57.1	Worsened: 9%; changed their sports after surgery: 13%
Papaliodis et al (2015)[14]	4	35	35	67.2 (57.2–80.4)	TSA	88.6	Improved: 15 (48.4%), worsened: 4 (12.9%), no change: 12 (38.7%)
Simovitch et al (2015)[15]	4	67	67	Athletes: 73 (61–88)	RSA	60	Improved: 12 (30%); worsened: 2 (5%); no change: 26 (65%)
Fink Barnes et al (2015)[16]	4	78	NR	75.3±7.5	RSA	79.2	No change: 57.7%
Garcia et al (2015)[17]	4	102	76	Athletes: 74.8 (49.9–92.6)	RSA	Athletes: 85.5	Improved: 47.6%; no change: 43.1%; worsened: 10.9%
Garcia et al (2016)[18]	3	80	80	TSA: 66.2 (47.7–87.6); HA: 65.7 (42.7–87.7)	TSA: *n* = 40; HA: *n* = 40	TSA: 97.3; HA 65.5	No change or improved: TSA: 34 (85%); HA: 27 (67.5%)
Garcia et al (2016)[19]	4	79	58	63.8 (21.6–91)	HA	Athletes: 67.2%	Improved for those who returned to upper extremity sports: 12/22 (54.5%)
Liu et al (2016)[20]	3	173	RSA: 76; HA: 51	RSA: 72.3; HA: 65.6	RSA: *n* = 102; HA: *n* = 71	RSA: 85.9, HA: 66.7	Physical fitness improvement: RSA: 41.1%; HA: 40.8%
Bülhoff et al (2016)[21]	4	38	21	Total: 78.4 (68–92); athletes: 76.2 (65–85)	RSA	Athletes: 93	Less frequency: 24%; Worsened: 10%
Wang et al (2016)[22]	4	51	NR	74.1	RSA	78	NR
Bülhoff et al (2017)[23]	4	42	29	Total: 66.9 (29–80); athletes: 56.3 (21–75)	HA	Athletes: 67	NR
Garcia et al (2017)[25]	4	59	57 (50 recreational athletes, 4 competitive sports, 3 professional level)	48.9 (25–55)	TSA	96.4	No change or improved: 82.4%
Kolling et al (2018)[24]	4	271	166	77.1 (47–92)	RSA	77	NR
Flurin (2018)[26]	4	377	99	TSA: 62.8±6.3; RSA: 71.8±5.2	TSA: *n* = 169; RSA: *n* = 208	TSA: 29.5; RSA: 23.5	NR
Mannava et al (2018)[27]	4	95	95	64 (18–82)	TSA: *n* = 112	Lower extremity sports: 69.4, upper extremity sports: 67.2	Recreational sporting: no change or better: 69.7%; No more compete: 6.3%
Wang et al (2018)[28]	4	109	TSA: 19; RSA: 5; HA: 46	TSA: 69.5 (54.7–83.3); RSA: 74.6 (62.5–86.9); HA: 64.7 (42.8–83)	TSA: 27; RSA: 7; HA: 75	Total: TSA: 70.4, RSA: 28.6, HA: 49.3; Athletes: TSA: 95, RSA: 40, HA: 76	NR

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty; NR, not reported.

Table 2. Patient demographics

	Patients, *n*	Arthroplasty, *n*	'Athletes', *n*	Mean ages (range), years	Sex ratio (M/F), *n*	Dominant/non-dominant, *n*
Overall	2199	2240	848	68 (18.0–92.6)	763/1164	913/505
HA	457	469	217	62.7 (21–91)	245/318	240/165
TSA	814	843	458	64.2 (18–88)	279/379	282/149
RSA	928	928	173	74.2 (47.0–92.6)	239/467	391/191

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty.

Table 3. Follow-up, rate and time to return to sport

	Patient	Mean follow-up (range), years	Rate of RTS, %	Mean time to RTS after surgery, months
Overall	All	4.2 (0.5–12.8)	65.4 (23.5–97.3)	7 (1–36)
	'Athletes'		75.5 (40.0–97.3)	6.5
HA	All	5.7 (0.5–12.0)	69.7 (65.5–76.0)	6.2 (1–24)
	'Athletes'		71.2 (65.5–95.8)	6.2
TSA	All	4.5 (1.0–12.8)	63.3 (29.5–97.3)	7.9 (1.5–36.0)
	'Athletes'		77.4 (57.1–97.3)	7.3
RSA	All	3.2 (1–10)	65.1 (23.5–93.0)	6.2 (1–36)
	'Athletes'		75 (40–93)	5.3

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty.

a statistically non-significant trend (Table 3) for higher results after TSA (77.4%), followed by 75% after RSA and 71.2% after HA. This is in accordance with the meta-analysis by Liu et al,[30] and the literature reviews by Johnson et al[32] and Christensen et al,[33] who also found a higher level of RTS after TSA.

RTS after HA

Three retrospective studies by Garcia et al,[19] Bülhoff et al[23] and Liu et al[20] report a rate of RTS after HA between 66.7 and 67.2% in 29 to 58 'athletes'. Liu et al[20] further reported that RTS is safer after HA than after TSA or RSA

Table 4a. Return to sport according to sport for sports with load on the shoulder

Sports	Overall players, *n*	Overall RTS, %	Players, *n*	RTS for HA, %	Players, *n*	RTS for TSA, %	Players, *n*	RTS for RSA, %
Swimming	285	77.5	96	72.9	64	82.8	125	78.4
Golf	241	74.3	76	66.7	111	86.9	54	59.3
Gym/ weightlifting	198	83.3	46	60.9	66	84.8	86	94.2
Tennis	77	64.9	28	75.0	28	75.0	21	38.1
Singles tennis	53	52.8	16	62.5	13	84.6	24	29.2
Doubles tennis	41	58.5	16	68.7	9	88.9	16	31.3
Softball/baseball	39	41.1	19	42.2	18	38.9	2	50.0
Fishing	36	75.6	15	93.1	13	92.0	8	25.0
Bowling	27	33.3	15	33.3	10	40.0	2	0.0
Basketball	17	70.6	6	50.0	9	77.8	2	100.0
Rowing/kayaking	15	66.7	8	62.5	5	60.0	2	100
Judo	3	66.7	NR	NR	3	66.7	NR	NR
Hockey	2	50.0	NR	NR	2	50.0	NR	NR

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty; NR, not reported.

Table 4b. Return to sport according to sport for sports without, or with very little, load on the shoulder

Sports	Overall Players, *n*	Overall RTS, %	Players, *n*	RTS for HA, %	Players, *n*	RTS for TSA, %	Players, *n*	RTS for RSA, %
Cycling	109	79.8	21	71.6	13	100	75	78.7
Hiking	75	89.3	NR	NR	NR	NR	75	89.3
Running	74	78.4	28	68.0	32	93.7	14	64.3
Downhill skiing	61	62.2	27	66.5	20	79.8	14	28.6
Cross-country skiing	21	76.4	11	72.9	10	80.2	NR	NR
Riding	6	33.3	2	0.0	NR	NR	4	50.0
Football	4	75.0	NR	NR	4	75.0	NR	NR

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty; NR, not reported.

Discussion

In this systematic review, we found a high level of RTS in the 'athletes' population after shoulder arthroplasty. It was similarly high regardless the type of arthroplasty, with because of the lower risk of complications (component failure or loosening). However, long-term results show low satisfaction after HA for primary arthritis (25% at 17 years of follow-up).[34]

Table 5. Return to sport according to level of sport after surgery

	No change or improved, %	Improved, %	No change, %	Worsened, %
HA	NR	44.9	77.0	NR
TSA	90.0	NR	40.0	9.6
RSA	NR	40.0	54.9	10.6

Note. HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty; NR, not reported.

RTS after TSA

Schumann et al,[11] Bülhoff et al,[13] Papliodis et al,[14] Garcia et al[25] and Mannava et al[27] evaluated patients who underwent a TSA with a main diagnosis of primary arthritis (> 60%). The rate of RTS for the 'athletes' was > 85% for all studies except for Bülhoff et al with a rate of 57.1%, and Mannava et al with rates of 69.4% for lower extremity sports and 67.2% for upper extremity sports.

In summary, all studies mentioned above show that patients who were able to maintain a sports activity preoperatively had a greater chance of returning to sport postoperatively. This suggests that failure to RTS was not necessarily linked to the surgery itself but to the severity and length of the preoperative disability. Most patients achieved a full RTS within 6 months of the surgery. A few patients even noticed an improvement in their sports level. However, a small proportion of patients also described persistent restrictions in their sports activity even after their operation.

RTS after RSA

The rate of RTS after RSA is reported at 60–78% in the general population. The main diagnosis in all studies was irreparable rotator cuff tear with or without arthropathy (55.2–76%). The study by Fink Barnes et al[16] including a significant number of revisions (31% of 78 patients) still found a high level RTS of 79.2%, with 57.7% at the same level in sports mainly consisting of golf, tennis, swimming, skiing and hiking. According to diagnosis, RTS was the highest for primary arthritis (100%), and the lowest for fracture (76.9%). According to sport type, it was the highest for gym (81.5%) and the lowest in tennis (25%).[17]

Overall, there only were few studies looking specifically at RTS in younger patients after RSA. RTS seems to be higher in patients aged less than 70 years compared to patients aged 70 years or over. However, the results of these studies also suggest that care should be taken when returning to moderate and high-demand sporting activities following RSA in the younger population, such as tennis and golf, and that low-impact sports should be privileged (for example: swimming, biking, jogging).

Comparative RTS between HA and TSA

Schmidt-Wiethoff et al[8] and McCarty et al[9] reported equivalent rates of RTS after HA and TSA between 81% and 84%, whereas Garcia et al[18] found a higher rate after TSA than for HA (97.3% versus 65.5%, respectively). This discrepancy could be due to the different underlying conditions. The latter study only included patients with primary glenohumeral arthritis, whereas the first two also included various conditions such as avascular necrosis, fracture, and fracture sequelae. Therefore, glenoid involvement may impede RTS after HA.

Level of RTS was higher in sports such as fishing (92%), swimming (75–86%) and downhill skiing (81%), cross-country skiing (78%), golf (77–83.3%), tennis (75–100%), and cycling (100%).[9,18]

Comparative RTS between HA and RSA

Only one retrospective study, that by Liu et al,[20] directly comparted RTS between HA and RSA. They reported a significantly higher rate of RTS after RSA at 85.9% versus 66.7% after HA. According to sport, rate of RTS was 69.2% (HA) and 100% (RSA) for gym, 70% (HA) and 71.4% (RSA) for running, and 60% (HA) and 69.7% (RSA) for swimming (Table 2).

Comparative RTS between TSA and RSA

In a study published in 2018 by Flurin,[26] 377 patients (99 'athletes') underwent a shoulder arthroplasty (169 TSA and 208 RSA). RTS was 29.5% for TSA and 23.5% for RSA. The mean time before RTS after surgery was similar in both groups. The main sports engaged in in this study were swimming, cycling, gymnastics, walking, aqua fitness, Nordic walking, gym, and skiing.

Comparative RTS between HA, TSA and RSA

Only one retrospective study by Wang et al[28] directly compared HA, TSA and RSA, in 109 patients (70 'athletes'). The overall rate of RTS for all patients was 49.3% for HA, 70.4% for TSA, and 28.6% for RSA; and for 'athletes': 76% for HA, 95% for TSA, 40% for RSA.

We identified two meta-analyses comparing RTS after shoulder arthroplasty. Aim et al[29] looked at nine studies in which subgroup analysis showed a lower rate of RTS after RSA: 76.5% versus HA and TSA combined 80.7%. Unfortunately, they did not carry out any subgroup analyses for HA and TSA because the included studies used mixed data. Liu et al[30] analysed 13 studies and found that the patients with a TSA had a statistically significantly higher rate of RTS than those with HA or RSA (92.6% versus 71.1% and 74.9%, respectively). We found a similar trend in our analysis including 21 studies, although there was no significant difference between arthroplasty types.

The lower rate of RTS after RSA may be due to patients being older, the diagnosis of rotator cuff tear arthropathy

Table 6. Comparative RTS between athletes and the general population

	Overall			Athletes			P (z-test)
	n	*n* RTS	% RTS	*n*	*n* RTS	% RTS	
Overall	2199	1438.15	65.4	848	640.24	75.5	**< 0.001**
TSA	814	515.26	63.3	458	354.49	77.4	**< 0.001**
RSA	928	604.13	65.1	173	129.75	75.0	**0.015**
HA	457	318.53	69.7	217	154.50	71.2	0.7

Note. RTS, return to sport; HA, hemiarthroplasty; TSA, anatomic total shoulder arthroplasty; RSA, reverse total shoulder arthroplasty.

leading to lower preoperative function, and the altered natural biomechanics inherent to the configuration of RSA. As stated above, Garcia et al[18] revealed that age over 70 years was a significant predictor of decreased RTS. Aim et al[29] could not carry out subgroup analyses for HA and TSA because the included studies used mixed data about HA and TSA. However, most studies[18,30,32,33] conclude that TSA leads to a higher level of RTS than HA, although the latter should be privileged in younger patients with high sports activity demands because of the risk of early glenoid component failure.

In our study, we found a mean rate of RTS in 'athletes' that was highest after TSA (77.4%) followed by RSA (75%) and lowest after HA (71.2%) (Table 3 and Table 6). However, time before RTS was longer for TSA (7.9 months), than HA (6.2 months) and RSA (6.2 months).

Our findings confirm that sports placing low demand on the shoulder had a better rate of RTS. For example, swimming had a mean rate of RTS of 72.9% for HA, 82.8% for TSA and 78.4% for RSA. Cycling had a mean rate of RTS of 71.6% for HA, 100% for TSA and 78.7% for RSA (Table 4). However, sports with high demand on the shoulder may also have a good rate of RTS, such as tennis (75% for HA and for TSA, but only 38.1% for RSA). The low rate found for RSA in this specific activity could be explained by the fact that it does not restore as much range of motion as TSA, specifically external rotation,[35] which is important for tennis.

The main strength of this systematic review is that it includes a higher number of articles (23) than previously published similar studies, including recent ones with large numbers of patients, but also articles in foreign languages (French, German). This allowed us to compare TSA, HA, and RSA separately, which was previously not achievable. Also, isolating 'athletes' from the general population allowed a more realistic evaluation of RTS, as including patients who practiced little if any sports before surgery would be to underestimate the actual RTS after surgery. Moreover, we have separated the rate of RTS according to different sports, which provides guidance for surgeons when advising patients about time for return to a specific sport.

There were also some limitations. The most important is the heterogenicity of the included studies (age, indication for arthroplasty, type of sport and intensity), their limited level of evidence (all studies are level 3 or 4), and relatively limited number of patients (often fewer than 100, sometimes fewer than 10), introducing a risk of bias. We could therefore not conduct significant in-depth subgroup analyses. For instance, we cannot report on the rate of RTS according to the underlying pathology. Furthermore, although we can affirm that RTS after shoulder arthroplasty is high, there were insufficient data reported on the level of RTS and whether it is sustainable over time. Long-term longitudinal studies are necessary to answer this last question.

Conclusion

RTS after shoulder arthroplasty is high, regardless the type of arthroplasty, with a trend for a higher rate after TSA. Patients who were able to maintain a sport activity preoperatively had a greater chance of RTS after arthroplasty. Failure to RTS seems to be mostly linked to the severity of the underlying condition, the length of preoperative disability and an older age.

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