Return to sport after reverse total shoulder arthroplasty is highly frequent: a systematic review

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ABSTRACT

Importance One of the most frequent concerns of the increasing number of patients undergoing shoulder arthroplasty is the possibility to resume sport after surgery.

Objective The aim of this systematic review was to determine the rate of return to sport after reverse total shoulder arthroplasty (RSA) and the subjective level of performance.

Evidence review The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were followed to perform this systematic review. A systematic electronic search was performed using the PubMed (MEDLINE), Embase and Cochrane Library databases. All the studies analysing the rates were pooled; data were extracted and statistically analysed. The eligibility criteria were studies with at least 20 adult patients recruited. All studies had to relate return to sports after RSA.

Findings A total of six studies were included for a total of 457 patients. Mean age and average follow-up were, respectively, 74.7 years (range 33–88 years) and 3.6 years (range 1–9.4 years). The mean rate of return to sport ranged from 60% to 93%. The mean time for resuming sports was 5.3 months. The overall rate of return to sport after reverse shoulder arthroplasty was 79%. The mean level of sports at the time of the survey was worsened in 7.9%, improved in 39.6% and had no change in 55.2% of the cases.

Conclusions and relevance Based on the current available data, return to sports after reverse shoulder arthroplasty is possible and highly frequent. The subjective level of practice undergoes no change or improves in most of the cases. More studies and better-designed trials are needed in order to enrich the evidence on specific sports recovery after the procedure.

Level of evidence IV.

INTRODUCTION

Reverse total shoulder arthroplasty (RSA) is a well-established treatment for patients with glenohumeral osteoarthritis and rotator cuff dysfunction or cuff tear arthropathy. Over the last decade, indications for this type of surgery have been expanded, resulting in an important increase of procedures performed every year.1 Even if pain and limited function of the shoulder remain the main reasons why patients decide to undergo these procedures, the expanded indications have led to a larger young and active population who place an increasing interest on the ability to resume activities that were difficult to accomplish.2

The abilities of resuming sports after both total hip or knee replacement3 4 and anatomical total shoulder replacement are well documented in the literature. RSA are limited7 8 and do not appear to clarify the doubts of patients desiring to have a reliable prediction on the probability of resuming their activities after surgery. Also, the prospective could be extremely divergent worldwide due to different physical activities undertaken in the USA in relation to European countries.9 The aim of this systematic review was to determine the rate of return to any level of sport after RSA with the purpose of providing surgeons reliable information to make aware patients about the probability of resuming sport following the procedure. The Hypothesis based on our experience is that resuming sport with a complete regain of the predisease subjective level of practice is possible.

MATERIALS AND METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines have been used to carry out this systematic review.10 The PRISMA statement is composed of a 27-item checklist relating to review contents and a four-phase flow chart of the study selection process.

Eligibility criteria

Studies written in English, Italian, French, Spanish and German were eligible for inclusion. Only peer-reviewed journals were considered, and randomised controlled trials (RCTs), prospective and retrospective comparative studies and case series (CS) were included. Exclusion criteria were reviews of the literature, expert opinions and studies that did not evaluate return to play. The eligibility criteria were studies with...
at least 20 adult subjects recruited. All studies had to relate to return to sports after RSA.

**Information sources and search**

An electronic systematic search of CINAHL, Embase, PubMed and the Cochrane Central Registry of Controlled Trials was carried out by two reviewers (PG and EF), in order to identify eligible studies. Inter-rater reliability for study eligibility was measured using the kappa (κ) statistic. A κ of 0–0.2 represents slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement and 0.61–0.80 substantial agreement. A value greater than 0.80 is considered almost perfect agreement, according to the guidelines of Landis and Koch. The search was executed on 22 September 2020. The used search strings were: ((Return to sports [MeSH Terms]) AND RSA[MeSH Terms]); (((RSA [MeSH Terms]) AND Sports [MeSH Terms]) AND surgery) AND outcomes.

**Study selection**

Once the duplicates had been removed, relevant articles from the electronic search were retrieved in full text and evaluated. A manual search of the bibliography of each published study was performed in order to find relevant articles that could potentially have been missed. Reviews, systematic reviews and meta-analyses were also retrieved and read in order to broaden the search to include studies that might have been missed. The remaining articles were analysed by two reviewers (PG and EF) to exclude studies not fulfilling the eligibility criteria. The reviewers were not blinded to the authors, year and journal of publication. Studies eligible for inclusion were categorised by study type, according to the Oxford Centre for Evidence-Based Medicine (www.cebm.net). The following categories were used: case report, RCT and CS. Studies reporting data of fewer than 20 patients were excluded because of low significance.

**Data collection process**

Two assessors independently extracted data from eligible studies using a data extraction form that was predefined according to the protocol. For each study, we extracted the criteria concerning the epidemiological characteristics of participants (age, sport and level) and assessment of results (return to sport, mean follow-up, type of sport, time to return to sport and level after surgery). Data were analysed using R software (2020; R Core Team). The primary endpoint was the rate for resuming sport after shoulder reverse replacement surgery. The I² index was used to measure the heterogeneity of results within the included studies. Substantial heterogeneity was defined as I² >75%. The mean rate for resuming sport was calculated with a 95% CI. We realised a forest plot of the results (figure 1).

**Quality of the studies**

The quality of included studies was evaluated using the Methodological Index for Nonrandomized Studies (MINORS) score. The following domains were assessed: a clearly stated aim, inclusion of consecutive patients, prospective data collection, endpoints appropriate to the aim of the study, unbiased assessment of the study endpoints, follow-up period appropriate to the aim of the study, loss to follow-up of less than 5%, prospective calculation of the study size, adequate control group, contemporary group, baseline group equivalence and adequate statistical analysis (table 1). Two authors (PG and EF) performed this evaluation, which included a discussion to reach a consensus in case of disagreement. We also analysed the quality of the studies over the years through a graphic representation (figure 2).

**RESULTS**

A total of 68 studies were found in the electronic search; of these, five were eligible for inclusion in this systematic review. One more study was identified as relevant through the manual search and was included. A total of six studies were thus included; all were retrospective CS (inter-rater agreement K value=0.81). The study selection process is shown in figure 3. Study details are summarised in table 1. The main indication for arthroplasty was primary shoulder osteoarthritis. Other indications included chondrolysis after arthroscopy, rheumatoid arthritis, avascular necrosis, post-traumatic arthritis and postinstability arthritis. The most common reported sports were swimming (five studies), golf (five studies) and tennis (four studies). None of these studies included professional athletes.

A total of 457 patients were included in the six studies, mean age 74.7 years (range 33–88 years), treated for average follow-up of 3.6 years (range 1–9.4 years) (table 2).

**Methodological quality**

In order to evaluate methodological quality of the included studies, MINORS scores have been assessed. Average value was 8.6, although one comparative study was evaluated on a 24-point scale and not on a 16-point scale. This study had a MINORS score of 17. Also, an analysis of the literature has shown a progressive improvement in the quality of studies, evaluated through a graphic point of view in the trend line from 2008 to 2018 (figure 2).

**Return to sport**

The mean rate of return to sport ranged from 60% to 93%. The mean time for resuming sports was 5.3 months. All the included studies concluded that a return to sport after RSA is possible. The overall rate of return to sport after RSA, according to a random effect model, was 79% (95% CI 72% to 79%). I² index was 85% (figure 1).

Two studies collected patients referring a ‘worsened’ level of sport with a mean of 7.9%, three studies collected patients referring an ‘improved’ level of sports with a mean of 39.6% and three studies collected patients referring ‘no change’ of level with a mean of 55.2%.

**Functional outcome and patient satisfaction**

The rate of patient satisfaction with surgery was reported in four studies12–15 with a mean of 88.3% (±3.2%). None of the studies reported sports-specific satisfaction. Visual analogue scale or other investigations evaluating pain after surgery was reported in four studies12–15 showing statistically significant improvement in all reported cases. American Shoulder and Elbow Surgeons (ASES) Score was collected and reported by three studies81114 studies with a mean of 78.8% (±7.7%).

**DISCUSSION**

Over time, in addition to reducing pain, the aim of this procedure is to restore shoulder function and increase patient’s quality of life,
including daily living and sporting activities. Commonly, during preoperative and postoperative visits, the surgeon is asked by patients whether they will be allowed to participate in the activities they enjoyed prior to the beginning of shoulder pathology and/or surgery. Unlike for other replacement procedures, there is a lack of consensus concerning the recommendations to give patients about resuming sport activities after RSA. This systematic review aimed to evaluate the rate of return to sport after RSA. The overall return rate (independently from the type of sport) averaged 79% based on all the included studies, which suggests resuming sports after surgery is a realistic and frequent result. However, in a long term, revision rate may increase, and sport activities may not be recommended after RSA. This factor should be better analysed in future studies. Activity level was investigated through questionnaire in different steps of follow-up; the ones reporting a worsening of the subjective sports performance had a mean of 7.9%, while the ones analysing an improvement or full recovery of the same sports level prior the disease reported respectively a mean of 39.6% and 55.2%. The three percentage should be considered separately because most of the studies did not report all three variables (‘worsened’, ‘improved’ or ‘no change’). Even if evidence is low to draw precise conclusions about the level of return to sport, our study individuates a positive return to practice in almost the totality of patients. Our results are in accordance with Liu et al., who conducted a systematic review and meta-analysis evaluating return to sport after shoulder replacement. The overall return in the RSA group was 74.9%. Also Aim et al., in 2017, showed that patients undergoing RSA were still able to return to sport with a rate of 76.5%, underlying that a lower rate of return to sport in relation to anatomic total shoulder replacement or haemiarthroplasty could be explained by the presence, in the RSA procedures, of elderly patients, eccentric shoulder arthritis involving rotator cuff tears and worse shoulder function with modified natural biomechanics after surgery. Furthermore, the reported scores in all the included studies increased after surgery, which further underlines the benefits of the surgical procedure. When comparing hemiarthroplasty (HA) with RSA in working populations, Liu et al. individuated that the two groups returned to work at similar rates, 65% and 71%, respectively. Conversely, when comparing those two groups in relation to returning to sports, they found a significantly higher percentage in patients treated with RSA than in patients with HA. Even if patients were slightly but significantly younger than the HA group (72.3 vs 65.6 years), patients with RSA had a return rate of 86% versus 67% compared with patients treated with HA. In addition, patients with RSA had improved pain scores and fewer postoperative complaints. This results may suggest a better benefit of the reverse implant in patients likely to resume sports after surgery. A subgroup analysis on the return rate for specific sports could not be conducted due to the limited data in the literature, even if studies on anatomical shoulder replacements report higher return rates in association with specific sports. McCarty et al. in 2008 reported a return-to-sport rate for fishing and downhill skiing of 92%, 86% and 81%, respectively. Also Garcia et al. found a return-to-sport rate for fishing and double tennis exceeding 80%. In another study comparing hemiarthroplasty versus total shoulder arthroplasty, Garcia et al. found complete (100%) return to cycling, double tennis, softball, basketball, baseball and nature sports for both TSA an HA patients. Additionally, running, single tennis and golf had return rates higher than 80%. No study assessed competitive sports, but in our opinion, patients

Table 1 Study details

<table>
<thead>
<tr>
<th>Study</th>
<th>Level of evidence</th>
<th>Study type</th>
<th>Year of publication</th>
<th>Mean follow-up, (range)</th>
<th>MINORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fink Barnes et al</td>
<td>IV</td>
<td>CS</td>
<td>2015</td>
<td>4.8 (2–9)</td>
<td>7/16</td>
</tr>
<tr>
<td>Simovitch et al</td>
<td>IV</td>
<td>CS</td>
<td>2015</td>
<td>3.6 (2.9–5.3)</td>
<td>8/16</td>
</tr>
<tr>
<td>Garcia et al</td>
<td>IV</td>
<td>CS</td>
<td>2015</td>
<td>2.6 (1–5.4)</td>
<td>10/16</td>
</tr>
<tr>
<td>Bülhoff et al</td>
<td>IV</td>
<td>CS</td>
<td>2016</td>
<td>4.8 (2.4–9.4)</td>
<td>8/16</td>
</tr>
<tr>
<td>Liu et al</td>
<td>III</td>
<td>CS</td>
<td>2016</td>
<td>2.6 (1.0–5.4)</td>
<td>17/24</td>
</tr>
<tr>
<td>Kolling et al</td>
<td>IV</td>
<td>CS</td>
<td>2017</td>
<td>2.9 (1–5)</td>
<td>10/16</td>
</tr>
</tbody>
</table>

MINORS, Methodological Index for Nonrandomized Studies.

Figure 2 Diagram representing the quality of the study in relation to the year of publication. A positive trend, with increasing quality over the years, is shown.

Figure 3 PRISMA flow chart of the study selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.
with an indication for reverse shoulder replacement surgery occur to be a more elderly population participating in recreational activities, underlying that real aim would be to determine the possibility of resuming sports at all and not so much the level at which they can resume them for competition. Mean time of return was reported only by two of the analysed studies,13 14 which suggests that further investigations should be carried out to better define this parameter. The analysis of the quality of the studies revealed an increased reliability over the years, encouraging further research to better define the topic. In addition, it would be interesting to evaluate during follow-up if returning to sport after RSA modify the degree of radiographic wear or increase the rates of loosening. Our study had several limitations. The most relevant limitation of the present investigation is the low evidence level of the included studies (mostly level IV studies) and the low number of studies available on this topic. Moreover, indications and patients for arthroplasty were heterogeneous as well as the sport assessed. Finally, a lack of a subgroup analysis for the specific sport could contain a high risk of bias.

CONCLUSION
This study underlies a high rate of return to sport after reverse shoulder arthroplasty surgery. Our hypothesis was confirmed as in the vast majority of the cases sports can be resumed with a complete regain of the predisease or an improvement of the subjective level of practice. Further research and better well-designed studies should be carried out to better define specific sports recovery level and mean time.

Contributors EF, PG, GDG and FF reviewed articles. EGDS and AP wrote the paper. MP wrote the chapter.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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REFERENCES

Table 2 Main outcome rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients, n</th>
<th>Mean age (range), years</th>
<th>Sports played</th>
<th>Rate of return to sport (%)</th>
<th>Level of sport after surgery</th>
<th>Mean time to return to sport after surgery (month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fink Barnes et al11</td>
<td>78</td>
<td>75.3 (67.8–82.8)</td>
<td>Swimming, golf and fishing.</td>
<td>79.2</td>
<td>No change: 57.7</td>
<td>NR</td>
</tr>
<tr>
<td>Simovitch et al15</td>
<td>40</td>
<td>73 (61–88)</td>
<td>Golf, swimming, fishing, aerobics and tennis.</td>
<td>60</td>
<td>Improved: 30%; worsened: 5%; no change: 65%</td>
<td>NR</td>
</tr>
<tr>
<td>Garcia et al14</td>
<td>76</td>
<td>74.8 (49.9–92.6)</td>
<td>Fitness, skiing, golf, swimming, running, cycling and tennis.</td>
<td>85.5</td>
<td>Improved: 47.6%; no change: 43.1%; worsened: 10.9%</td>
<td>5.3</td>
</tr>
<tr>
<td>Büllhoff et al16</td>
<td>21</td>
<td>76.2 (65–85)</td>
<td>Swimming, leg sport, gardening, skiing, bowling, tennis, athletics, handball, volleyball and golfing.</td>
<td>93</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Liu et al13</td>
<td>76</td>
<td>72.3 (NR)</td>
<td>Tennis, softball/baseball, swimming, fitness sports, golf, cycling, fishing, rowing, running, dancing, horseshoe-riding and basketball.</td>
<td>88.1</td>
<td>Improved: 41.1%</td>
<td>5.3</td>
</tr>
<tr>
<td>Kolling et al7</td>
<td>166</td>
<td>76.5 (NR)</td>
<td>Hiking, swimming, cycling, callisthenics, weight training, alpine skiing, nording walking, tennis, aquafit and golf.</td>
<td>82</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

NR, not reported.