Systematic Review

Low complication rate following reverse total shoulder arthroplasty at 90-days follow-up – A systematic review

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ABSTRACT

Importance: As reverse total shoulder arthroplasty (RTSA) has become an increasingly common procedure, rates of post-operative complications leading to potential hospital readmission are of greater importance. No previous systematic reviews have focused exclusively on post-operative complications and mortality rates at 90 days post RTSA.

Objectives: The purpose of this study was to review complication, readmission, and mortality rates within 90 days post RTSA.

Evidence review: Two independent reviewers performed a literature search using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines using PubMed, Embase, and Web of Science databases. Only studies reporting on outcomes of RTSA at 90-days follow-up specifically were considered for inclusion.

Findings: Our search included 79,037 shoulders (62.1 % female) from a total of 15 studies with an average age of 72.4 ± 5.8 years. The overall 90-day re-admission rates were reported in nine studies as 6.1 % (4205/69,127) following RTSA. Additionally, a total of five studies reported the overall 90-day mortality rate as 1.1 % (19/1733).

The overall pooled rate of medical complications was 3.9 % (2998/77,826) as reported in 13 studies, at 90-days post-RTSA, with the occurrence of anaemia being the most commonly reported outcomes as 2.9 % (1013/34,385) in six studies. The overall rate of surgical complications was 1.1 % reported in 13 studies (1327/77,826), with the pooled rate of surgical revisions of 1.5 % (607/40,563) at 90-days follow-up. A total of 8, 5, and 3 studies reported rates of dislocation, requirement for closed reduction and glenoid loosening as 0.9 % (344/37,995), 0.6 % (7/1180), and 0.3 % (30/9115) respectively at 90-days following RTSA.

Conclusions and relevance: This study established that the overall rates of mortality and medical and surgical complications are low in the short-term following RTSA, with only 6 % of patients requiring re-admission in the first 90 days.

Level of evidence: IV - Systematic Review of all levels of evidence.

What is already known:

- Zumstein et al. reported complication rates as high as 24 % following reverse total shoulder arthroplasty with a minimum of 2 year follow-up, with most common reported complications being scapular notching and haematomas.
- Although the literature reporting outcomes of reverse total shoulder arthroplasty is ever-growing, few previous systematic reviews have investigated short-term complication and re-admission rates in isolation, with scant prior literature focussing exclusively on rates of hospital readmission, post-operative complications, and mortality rates at 90-days follow-up.

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INTRODUCTION

Reverse total shoulder arthroplasty (RTSA) has become an increasingly common procedure, reported to now be performed more commonly than anatomic total shoulder arthroplasty in the United States, with excellent outcomes reported for a variety of clinical indications such as rotator cuff arthropathy, glenohumeral joint arthritis, and proximal humerus fractures [1,2]. As the usage of RTSA continues to grow, analysis of the total numbers and rates of post-operative complications leading to potential hospital readmission rates is warranted [3]. Although low rates of peri-operative morbidity and mortality are often quoted when patients are consented for procedures such as RTSA, evaluation of relevant quality and cost parameters such as readmissions rates are important for institutions offering such procedures, with 90-day readmission rates in particular being previously demonstrated to be an important indicator of quality care [4,5].

In their previous systematic review, Zumstein et al. reported complication rates as high as 24% following RTSA with a minimum of 2 years follow-up, with most common reported complications being scapular notching and haematomas [6]. However, more recent studies suggest that these findings are outdated, and are now reporting complication rates of less than 10% at medium-term follow-up [3,7]. Although the literature reporting outcomes of RTSA is ever-growing, few previous systematic reviews have investigated short-term complication and re-admission rates in isolation, with scant prior literature focussing exclusively on rates of hospital readmission, post-operative complications and mortality rates at 90-days follow-up [8,9].

Given such conflicting results in relation to complication rates following RTSA reported in the literature, the authors of this study believe an updated systematic review evaluating the short-term complication and re-admission rates post-RTSA is warranted. Therefore, the purpose of this study was to review complication, readmission and mortality rates within 90 days post-RTSA. Our hypothesis was that the overall readmission rates would be less than 10% at 90-days follow-up.

METHODS

Search strategy

A literature search was performed by two independent reviewers (L.K. and M.S.D.) based on the preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines [10]. The following search terms were used in Embase, Scopus, and PubMed in February 2021 as the search algorithm:(90-day or 90 day or short term or short-term) and (reverse total shoulder arthroplasty or RTSA or reverse shoulder arthroplasty or RSA or reverse total shoulder replacement or reverse shoulder replacement)). It was pre-determined by all authors that no time limit would be applied to the search. Following the removal of duplicated studies, the title and abstracts were reviewed with the application of pre-determined exclusion criteria, followed by the inclusion criteria, with all search results and potentially eligible studies receiving a full text review. Both reviewers performed each stage of the search independently, with the results of each stage reviewed with the senior author (H.M.). The senior author then arbitrated in the instance of discrepancies in opinion. Finally, the reference lists of the included studies and literature reviews found in the initial search were manually screened for additional articles meeting the inclusion criteria.

Inclusion and exclusion criteria

Prior to commencement of the search, both the two independent reviewers and senior author decided on both the pre-determined inclusion and exclusion criteria for this review. The inclusion criteria for this study included the following parameters: (1) any clinical study reporting outcomes of RTSA at 90-days follow-up, (2) at least five patients included in the study (3) published in the English language, and (4) manuscript published in a peer-reviewed journal. The exclusion criteria included the following parameters: (1) studies focussing on RTSA in absence of outcomes reported at 90-day follow-up, (2) studies evaluating revision procedures, (3) biomechanical studies, (4) cadaveric studies, (5) abstract only studies, and (6) case reports.

Data extraction/analysis

Prior to study commencement, the relevant information regarding the study characteristics was decided by the authors. Such outcomes of interest included the following parameters: (1) patient demographic data including; (a) age at surgery in years, (b) gender, and (c) follow-up in months, (2) pre-operative individual patient factors including; (a) Charlson Co-morbidity Index (CCI) score, (b) body mass index (BMI), (c) smoking, (d) hypertension (HTN), (e) diabetes mellitus (DM), and (f) peripheral vascular disease (PVD), (3) operative time in minutes, (4) readmission rates within 90-days of RTSA procedure, (6) post-operative complications categorised into either (a) medical or (b) surgical complications, and (7) mortality rates. All data were collected by the two independent reviewers using a pre-determined data sheet which was designed prior to study commencement, with the results compared and the senior authors acting as an arbitrator in the instance of discrepancies in opinion.

It was pre-determined that complications would be classified into medical and surgical causes. Post-operative medical complications included the following parameters: (1) lower respiratory tract infections (LRTI), (2) urinary tract infections (UTI), (3) venous thromboembolisms (VTE) such as (a) deep vein thrombosis (DVT), (b) pulmonary embolism (PE) or (c) cerebrovascular accident (CVA), (4) myocardial infarction (MI), (5) anaemia, (6) blood transfusion rates, (7) respiratory failure including atelectasis, and (8) acute kidney injury (AKI). Post-operative surgical complications included the following parameters: (1) infection, sub-classified into (a) superficial, and (b) deep, (2) residual pain, (3) glenoid loosening, (4) glenohumeral dislocation or instability, (5) haematoma or seroma formation, (6) intraoperative fractures, (7) acromial and scapular fractures, (8) peri-prosthetic fractures, (9) neural injuries, and (10) closed reduction. The overall pooled rate of surgical revisions was also tabulated. Guidelines created by the Oxford Centre for Evidence-Based Medicine were used in the evaluation of the level of evidence, while the modified Coleman methodology score was used to evaluate the Methodological quality of evidence (MQOE) [11]. In line with these guidelines, studies were considered excellent quality if they scored 85 to 100; good quality, 70 to 84; fair quality, 55 to 69; and poor quality, less than 55. A bias analysis was performed on studies included for data extraction. The
methodology index for non-randomised studies (MINORS) score was utilised [12].

Statistics

Quantitative statistical analysis was performed using SPSS version 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.)

RESULTS

The initial literature search of the three aforementioned databases resulted in a total of 1,521 studies. After the removal of 353 duplicates, the remaining 1,168 studies were screened using our exclusion criteria. Thereafter, our inclusion criteria were applied to the full texts of the remaining 98 studies to screen for eligibility. Overall, 15 clinical studies including 79,037 shoulders who underwent RTSA were included in this study (Fig. 1).

Study characteristics and patient demographics

This review included 79,037 shoulders from a total of 15 studies; all of which were carried out in the USA. All included studies were level III evidence, with a mean MQOE of 44 (21–54). Bias analysis was performed using the MINORS criteria on all studies (range 10–20). Results of the bias analysis are presented in Table 1. Overall, the majority of patients were female (62.1 %) with an average age of 72.4 years ± 5.8 (18–97). The mean operation duration and follow-up were reported in six and nine studies, respectively as 127.9 ± 33.3 min (85–168) and 5.6 months ± 12.8 (3–31). The mean BMI of included patients was reported as 30.2 ± 1.8 in seven studies (n = 1315). A summary of the study characteristics and patient demographics is further illustrated in Table 1.

Patient co-morbidities

Overall, HTN was the most common co-morbidity reported amongst patients undergoing RTSA; a total of 76.3 % included patients (27,053/35,410) in five studies had been diagnosed with HTN at the time of RTSA. Additionally, the mean CCI was reported as 1.3 ± 1.2 (0.3–3.1) in a total of five studies (n = 34,498). A total of 10.5 % of patients (7794/73,593) reported being active smokers at the time of RTSA. Overall, a total of 25.1 % (18,521/73,869) and 8.2 % (23/280) reported having being diagnosed with DM and PVD in seven and two studies, respectively when undergoing RTSA. In four studies (n = 1514), the rates of patients who were ASA grade I, II, III and IV were 0.6 %, 34.4 %, 60.1 % and 5.2 %, respectively.

90 Day re-admission and mortality rates

The overall 90-day re-admission rates were reported in nine studies as 6.1 % (4205/69,127) following RTSA. Additionally, a total of five studies reported the overall 90-day mortality rate as 1.1 % (19/1733). A
The overall pooled rate of medical complications was 3.9 % (2998/77,826) reported in 13 studies. The overall rate of VTE at 90-days post-RTSA was reported as 0.9 % in eight studies, with rates of DVT, PE, and CVA reported as 0.7 % (231/35,607), 0.3 % (115/34,385) and 3.5 % (360/10,214), respectively. A total of five and three studies reported rates of LRTI and UTI as 0.8 % (311/37,095) and 0.1 % (33/26,333), respectively at 90-days following RTSA. Additionally, AKI and respiratory failure (including atelectasis) were reported as 1.1 % (389/35,462) and 2.6 % (276/10,053) in both five studies, respectively. Sepsis was reported in 0.07 % (21/29,079) of patients in three studies. Finally, 2.9 % (1013/34,785) patients were reported to have post-operative anaemia at 90-days post-RTSA, with 9.4 % (175/1099) having received a blood transfusion in six and five studies respectively.

Medical complications

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Surgical complications

The overall rate of surgical complications was 1.1 % reported in 13 studies (1327/77,826). The overall rate of revision was 1.5 % (607/40,563) at 90-days follow-up as reported in a total of eight studies, with rates of infection and haematoma formation at 90-days post-RTSA were reported as 0.3 % in nine studies (110/38,890) and 0.1 % (5/3407) in three studies, respectively. A total of 8, 3 and 5 studies reported rates of dislocation, glenoid loosening and requirement for closed reduction as 0.9 % (344/37,995), 0.3 % (30/9115), and 0.6 % (7/1180), respectively at 90-days following RTSA. Additionally, the rates of acromial fractures, peri-prosthetic fractures, and neural injuries at 90-days following RTSA were reported as 0.8 % (74/9331), 1.9 % (642/34,346), and 1.2 % (111/9331) in four studies, respectively.

DISCUSSION

The most important finding in this study was that the overall re-admission rate was approximately 6 % at 90-days following RTSA. Additionally, although generally performed in a more elderly cohort of patients who may have numerous medical co-morbidities, this study found that the overall pooled rates of medical and surgical complications following RTSA are low, with approximately 5 % of patients admitted for RTSA suffering a complication, with a mortality rate of approximately 1 % at 90-days follow-up. The emergence of RTSA in select patient cohorts for a variety of indications including acute trauma, osteoarthritis, inflammatory arthropathy, and massive rotator cuff tears amongst others has enabled significant improvements in patient pain levels, reported satisfaction and range of motion leading to improvements in their quality of life [13,14]. However, orthopaedic surgeons should remain wary of the potentially high complication rates reported in the literature. Previous systematic reviews have reported complication rates varying from 6 % to 24 % at medium-term follow-up [3,7,15], with many studies focussing on survivorship of RTSA implants at long-term follow-up rather than short-term outcomes [8,16].
CONCLUSIONS

This study established that the overall rates of mortality, medical, and surgical complications are low in the short-term following RTSA, with about 6% of patients requiring re-admission in the first 90 days.

References


[15] Bohsali KI, Bois AJ, Wark JD. Selection bias in registry studies. This is a limitation in itself given the possibility of error at an institutional level. Finally, it was not possible to stratify the techniques or implant models used for each RTSA in all studies included.


