

Research Article

Prior Shoulder Arthroscopy is Associated with Inferior Clinical Outcomes Following Primary Reverse Shoulder Arthroplasty for Rotator Cuff Tear Arthropathy

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Background

Various patient-related and condition-related factors can influence the clinical benefits of reverse shoulder arthroplasty (RSA). With the emergence of new potential joint-preserving arthroscopic interventions, understanding the impact of shoulder arthroscopy prior to RSA is increasingly relevant. Therefore, the purpose of this study was to understand the impact of previous ipsilateral shoulder arthroscopy on outcomes and shoulder function following RSA for rotator cuff tear arthropathy.

Methods

Patients who underwent RSA for rotator cuff tear arthropathy from June 2016 to September 2020 by a single surgeon were retrospectively reviewed from a prospectively collected clinical database. Patients were separated into two groups: 1) patients who underwent RSA following prior ipsilateral shoulder arthroscopy (RSAPA) and 2) patients who underwent RSA without previous shoulder surgery (RSA). Patient-reported outcomes (PROs), including SST, ASES, UCLA score, SAS score, and active shoulder range of motion were measured preoperatively and at a minimum 2 years postoperative.

Results

A total of 103 patients (n=38 RSAPA and n=65 control RSA) were analyzed. The mean duration of follow-up for patients with prior ipsilateral shoulder arthroscopy was significantly shorter compared to the control patients (RSAPA=33 months and RSA=50 months, $p < 0.0001$). All PROs improved postoperatively ($p < 0.001$). Improvements in PROs for RSAPA were diminished relative to RSA control group patients, including SST (RSAPA=5.4 vs RSA=7.6, $p = 0.005$), ASES (RSAPA=40.8 vs RSA=54.7, $p = 0.021$), and UCLA (RSAPA=16 vs RSA=20.7, $p = 0.009$) scores. Improvements in forward flexion (RSAPA=69° vs RSA=95°, $p = 0.0003$) and abduction (RSAPA= 67° vs RSA=83°, $p = 0.003$) were decreased in the RSAPA group compared to the control group (RSA). One patient (1.5%) with prior shoulder arthroscopy required revision due to recurrent instability, whereas no patients in the control group required revision surgery ($p=0.25$).

Conclusion

Patients with rotator cuff tear arthropathy who underwent RSA following prior shoulder arthroscopy demonstrated significant improvements in function and patient-reported outcomes, but these outcomes are diminished compared to those patients with no history of surgery.

INTRODUCTION

In recent decades, reverse shoulder arthroplasty (RSA) has had the highest level of growth due to its expanded indications for the management of a myriad of complex shoulder conditions, including rotator cuff arthropathy, massive

irreparable rotator cuff tears, glenohumeral osteoarthritis, and proximal humerus fractures (Frankle et al. 2005; Sellers, Abdelfattah, and Frankle 2018). By altering native shoulder biomechanics to accommodate an injured and/or deficient rotator cuff, RSA has demonstrated reliable efficacy in alleviating pain and improving the quality of life for many patients (Chamberlain et al. 2023; Jo, Kim, and Lee

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2021; Sheth et al. 2022). Despite the clinical versatility of RSA to treat a broad array of end-stage shoulder pathologies, various patient-related and diagnosis-related factors can influence the clinical outcomes conferred by RSA. For instance, RSA performed for proximal humerus fracture or fracture-related sequelae has been associated with lower postoperative patient-reported outcomes when compared with RSA performed for chronic degenerative conditions, such as rotator cuff arthropathy (Doany et al. 2022; Paras et al. 2022).

Despite a dramatic increase in literature pertaining to RSA, there remains a paucity of studies examining the impact of revision surgery for patients undergoing RSA who have undergone prior surgery. Clearly this population is growing and our understanding of the impact of prior shoulder surgery is limited for patients undergoing RSA on the ipsilateral shoulder. Previous studies have compared RSA outcomes to other surgical interventions, such as total shoulder arthroplasty, or evaluated the outcomes of RSA in specific patient populations or for specific indications but little is known specifically for patients who underwent a previous arthroscopy followed by an RSA (Farshad and Gerber 2010; Muh et al. 2013; Wall et al. 2007). Patients with a history of prior surgery are commonly excluded from studies evaluating the efficacy of RSA (Friedman et al. 2022). An improved understanding of the impact of shoulder arthroscopy on subsequent RSA is increasingly relevant with the emergence of new technologies and salvage procedures that offer potential joint-preserving arthroscopic surgical interventions. Arthroscopic procedures, such as partial rotator cuff repair, superior capsular reconstruction (SCR) (Mihata et al. 2019), subacromial balloon spacer (Verma et al. 2022), biologic tuberopectoplasty (Mirzayan and Bouz 2021), and lower trapezius tendon transfer (Wagner and Elhassan 2020), espouse the benefits of a less invasive surgical solution that does not “burn a bridge” to a subsequent shoulder arthroplasty. However, the extent to which shoulder arthroscopy affects clinical outcomes in patients who proceed to subsequent RSA remains poorly understood.

The purpose of this study was to understand the impact of previous ipsilateral shoulder arthroscopy on outcomes and shoulder function following RSA for rotator cuff tear arthropathy. The authors hypothesized that patients who undergo RSA with a history of previous ipsilateral shoulder arthroscopy will have inferior clinical outcomes and shoulder range of motion when compared to patients who have not had prior shoulder surgery.

MATERIALS AND METHODS

STUDY DESIGN

This is an institutional review board approved retrospective study of collected data from a single institution's electronic medical record database of patients who had undergone RTSA between 2016 and 2020. Patients were separated into two groups: 1) patients that underwent RSA following prior ipsilateral shoulder arthroscopy (RSAPA group) and 2) patients who underwent RSA without previous shoulder surgery (RSA group). Inclusion criteria consisted of patients with documented primary RSA for rotator cuff tear arthropathy, and available clinical outcomes data at a minimum 2-year follow-up. Exclusion criteria consisted of: (1) prior ipsilateral open shoulder procedures, (2) patients lacking a minimum of 2-year follow-up data, (3) previous ipsilateral humerus fractures, (4) concomitant periarticular fractures, and (5) patients with a history of cancer and/or systemic inflammatory diseases.

PATIENT EVALUATION AND DATA ANALYSIS

Patient's medical records were retrospectively reviewed for demographic data by two independent investigators (initials blinded for peer review) and outcomes data was prospectively collected. Patient demographics data included age, gender, body mass index, ethnicity, comorbidities (diabetes, hypertension, cardiac disease, history of smoking), glenoid baseplate type (standard or augmented) and time to follow-up. Subjective patient-reported outcomes were collected preoperatively and at final follow-up and included: Simple Shoulder Test (SST), American Shoulder and Elbow Surgeons score (ASES), University of California-Los Angeles (UCLA) score, Shoulder Arthroplasty Smart (SAS) score, and active range of motion (forward flexion, external rotator, internal rotation). Internal rotation was scored using a numerical value that referenced the highest vertebral level reached by the patient (thigh = 0 pts, hip/greater trochanter = 1 pt, buttocks = 2 pts, sacrum = 3 pts, L4-L5 = 4 pts, L1-L3 = 5 pts, T8-T12 = 6 pts, $\geq$ T7 = 7 pts).

SURGICAL PROCEDURE

Reverse shoulder arthroplasty was performed in all patients by a single, fellowship-trained shoulder surgeon with extensive surgical experience via a standardized technique. A standard deltopectoral approach with a subscapularis tenotomy and implantation of the Equinox (Exactech, Inc., Gainesville, FL, USA) RSA system according to the manufacturer's recommendation was performed for all patients.

STATISTICAL ANALYSIS

Descriptive statistics were used for demographic characteristics of RSA patient cohorts. Categorical variables were reported as counts. Continuous variables were presented as mean $\pm$ standard deviation. Paired t-tests and chi-squared tests were used to assess differences between the cohorts for continuous and categorical variables, respectively. The

level of significance was established at a alpha level of $p < 0.05$. All statistical analyses were performed utilizing R (version 4.2.2; R Foundation for Statistical Computing).

RESULTS

PATIENT DEMOGRAPHICS

A total of 665 patients were initially included, of which 63 patients were excluded for having a previous ipsilateral proximal humerus fracture, 80 patients were excluded for having prior ipsilateral open shoulder procedures, 403 patients for lacking a minimum of 2-year follow-up data, and 16 patients with a history of cancer and/or systemic inflammatory diseases. A total of 103 patients ultimately met the inclusion/exclusion criteria and were included in the final analysis. Of the total 103 patients included, 38 patients underwent a RSA with prior arthroscopy (RSAPA) and 65 were included in the control RSA with no history of previous surgery. The control group had a greater number of females (47 vs. 19, $p=0.023$) and a significantly longer mean follow-up (49.8 months vs. 33.6 months, $p<0.0001$). Otherwise baseline patient demographics, including age, body mass index (BMI), comorbidities, and glenoid base-plate type were similar between the two groups (RSAPA vs RSA) (**Table 1**).

PATIENT-REPORTED OUTCOME SCORES

Overall, there was significant improvement in SST, ASES, UCLA, and SAS scores postoperatively in both groups (**Table 2**). Improvements in PROs for RSAPA were diminished relative to RSA control group patients for SST (RSAPA=5.4 vs RSA=7.6, $p = 0.005$), ASES (RSAPA=40.8 vs RSA=54.7, $p = 0.021$), UCLA (RSAPA=16 vs RSA=20.7, $p = 0.009$), and SAS scores (RSAPA=32.4 vs RSA=44.1, $p = 0.007$).

RANGE OF MOTION

All range of motion measurements, including forward flexion, abduction, external rotation, and internal rotation improved postoperatively in both groups (**Table 2**). Improvements in forward flexion (RSAPA=69° vs RSA=95°, $p = 0.0003$) and abduction (RSAPA= 67° vs RSA=83°, $p = 0.003$) were decreased in the RSAPA group compared to the control group. No difference in postoperative external rotation (RSAPA=26° vs RSA=32°, $p = 0.202$) or internal rotations scores (RSAPA=1.3 vs RSA=1.6 $p = 0.06$) were found between groups.

REVISION RATE

One patient (1.5%) with a prior arthroscopic rotator cuff repair required revision RSA at 37 months postoperatively due to recurrent dislocations, whereas no patients in the control group required revision surgery ($p=0.25$). Scapular notching was found in two patients (3.1%) with prior shoulder arthroscopy and one patient (2.6%) in the control group ($p=0.401$).

DISCUSSION

This study found that patients who underwent RSA following prior ipsilateral shoulder arthroscopy reported inferior clinical outcomes both in terms of patient function and satisfaction relative to patients without previous surgical history. While existing literature explores the impact of prior open procedures, our study provides novel insights into the distinctive challenges associated with prior arthroscopy in the context of RSA (Frank et al. 2018; Schiffman et al. 2020; Shields et al. 2017). Our findings are consistent with prior research by Frank et al (Frank et al. 2018). and Schiffman et al (Schiffman et al. 2020)., both reported that patients with a history of prior ipsilateral shoulder surgery in particular shoulder arthroscopy had significantly worse outcomes after shoulder arthroplasty. Similarly, Shields et al (Shields et al. 2017). showed that patients with a history of prior rotator cuff repair experienced worse clinical outcomes after RSA. These findings collectively suggest that the history of prior non-arthroplasty shoulder surgery may negatively impact the outcomes of shoulder arthroplasty which may be attributable to increased scarring, adhesions, or altered biomechanics that contribute to the substandard outcomes observed in patients with prior arthroscopy or other surgeries. The initial pathology leading to arthroscopy also may have progressed or impacted the surrounding soft tissue structures of the shoulder impacting the outcomes after RSA (Boileau, Ahrens, and Hatzidakis 2004; Galatz et al. 2004; Mall et al. 2014).

It is crucial to exercise caution when considering arthroscopic procedures before RSA, as our study highlights the potential for inferior outcomes. Historically, observational studies have identified the number of previous surgeries as a negative prognostic factor. However, this insight is often overlooked in randomized controlled trials, which typically do not stratify patients based on the number of prior surgeries. This oversight can lead to a gap in understanding the true impact of prior surgeries on RSA outcomes. Recognizing this issue is vital for surgeons in making informed clinical decisions and optimizing patient outcomes following RSA.

Surgeons should consider the possibility of future RSA in a patient who may have been selected for shoulder arthroscopy at the time due to their higher healing potential and greater activity demands. If there is uncertainty about whether a patient should undergo an arthroscopic procedure before RSA, or if the patient is expected to eventually require RSA, it may be warranted to avoid the arthroscopic procedure. This approach can help mitigate potential negative outcomes associated with prior surgeries.

Despite the negative impact seen in patients with prior arthroscopic procedures after RSA, these patients still demonstrated significant improvements postoperatively in pain, function and satisfaction compared to preoperatively following RSA. While there may be a relative reduction in the magnitude of improvement compared to individuals without prior arthroscopy, RSA remains an effective intervention for patients even with a history of arthroscopic shoulder surgery. This nuanced perspective is essential for

guiding informed discussions between healthcare providers and patients, reinforcing the potential benefits of RSA while acknowledging the importance of prior surgical history on the trajectory of postoperative recovery.

Not only negatively impacting function and satisfaction, but prior arthroscopic surgery may lead to increased revisions as our study found a trend toward higher revision rates due to recurrent dislocations, compared to the control group required. Although this finding was not significant given the low overall revision rates, further investigation with larger cohorts is necessary to substantiate this relationship and identify additional underlying factors possibly leading to this observation. Interestingly, our findings align with those observed in the context of knee arthroplasty, where prior arthroscopic procedures have been associated with poorer outcomes, including an increased risk of revision following total knee arthroplasty (TKA).²² This similarity underscores the need to carefully evaluate the potential long-term impact of arthroscopic procedures when arthroplasty may be required in the future.

The decreased function found in our study for the prior ipsilateral arthroscopy group is concerning. This may be due to the progression of underlying pathology or consequences from surgery itself, contributing to stiffness and limited improvements in function. Surgeons need to be aware of the impact of prior surgery, educate patients on realistic expectations, and potentially modify postoperative rehabilitation protocols to address and optimize patient function. Further investigation is warranted to dissect the precise mechanisms behind these range of motion differences and to determine whether implant selection or targeted rehabilitation strategies could help mitigate these effects.

Overall, patients with prior shoulder arthroscopy indicated for reverse shoulder arthroplasty for rotator cuff tear arthropathy should receive preoperative counseling to set realistic post-operative expectations. They can anticipate significant clinical improvement after RSA, although the magnitude of improvement at two years postoperatively may be less than a similar individual who had not previously undergone shoulder surgery. This insight underscores the importance of managing patient expectations and fostering open communication to ensure realistic postoperative goals.

LIMITATIONS

As a retrospective cohort analysis, our study is subject to inherent biases such as selection and recall bias and potential confounding variables. Additionally, our study population was relatively small to evaluate for revision rates and may limit the generalizability and statistical power of our findings. The study population size was affected due to the large number of patients (n=403 patients) that did not meet the minimum two-year follow-up which may have inherently introduced attrition bias. But given all procedures were performed by a single surgeon with extensive expertise in shoulder arthroplasty this may decrease variability and allowed for focused evaluation of the intervention in this study. A larger sample size for future studies may further validate our findings. While a multi-center study with multiple surgeons may increase the generalizability of study findings, discrepancies between individual surgeons and/or clinical practices may introduce additional confounding variables that impede a direct comparison between the patient populations of interest. Second, our study reports outcomes at a minimum of 2 years postoperatively which typically has been shown as an optimal timepoint to reach MCID or SCB after RSA. Although the 2-year outcomes may not be sufficient to encapsulate the long-term effects of prior shoulder arthroscopy on RSA outcomes. Typically, outcomes after RSA stabilize and have been shown to reach MCID and 2 year follow up is adequate to understand short term outcomes and patient recovery. Lastly, the control group had a significantly longer mean follow-up time compared to the RSAPA group, which may have confounded the findings of this study.

CONCLUSION

Patients with rotator cuff tear arthropathy who underwent RSA following prior shoulder arthroscopy demonstrated significant improvements in function and patient-reported outcomes, but these outcomes are diminished compared to those patients with no history of surgery.

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