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Complication rates comparing primary with revision reverse total shoulder arthroplasty

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Background: Complication rates after reverse total shoulder arthroplasty (RTSA) have, in previous series, been reported to be high. The purpose of this study was to describe the complication rates, types, timing, and risk factors after revision RTSA, as compared with primary RTSA.

Methods: We performed a retrospective review of patients who underwent primary or revision RTSA to determine early (within 90 days) complication rates. Complications were subdivided into medical versus surgical and minor versus major.

Results: One hundred thirty-seven patients met the inclusion criteria. Of these, 111 underwent primary RTSA and 26 underwent RTSA as a revision from a previous arthroplasty. The overall complication rates were 25% after primary RTSA and 69% after revision RTSA. Minor complications accounted for 80% of the complications after primary RTSA and 94% after revision RTSA. Surgical complications were more frequent than medical complications in revision patients, occurring in 18% of primary cases and 62% of revisions. Revision patients more frequently required transfusions, with rates of 5% and 31% for primary cases and revisions, respectively. Overall, minor, surgical, intraoperative, perioperative, and postoperative complications were all significantly more frequent after revision RTSA. Multivariate logistic regression showed that revision status was the most significant predictor of overall ($P < .001$), minor ($P < .001$), surgical ($P < .001$), intraoperative ($P = .002$), and postoperative ($P < .001$) complication rates. Medical complications were predicted by body mass index ($P < .001$).

Conclusion: Revision RTSA has a significantly higher rate of complications than primary RTSA. These patients are significantly more likely to require transfusions. Patients should be aware that minor complications are frequent after revision RTSA and should be counseled accordingly.

Level of evidence: Level III, Retrospective Cohort Study, Treatment Study.

Keywords: Complications; revision; reverse total shoulder arthroplasty; medical; surgical; transfusion

This study was approved for exemption from institutional review board (IRB) review by the Rush University Medical Center Research and Clinical Trials Administration Office because it was deemed that ''this research involves the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are either publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.'' The IRB exemption was approved and obtained for this study under protocol 11102407-IRB01.

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Although reverse total shoulder arthroplasty (RTSA) was initially designed for rotator cuff tear arthropathy, indications have expanded to include massive rotator cuff tears without glenohumeral arthritis, proximal humeral fractures, glenohumeral osteoarthritis in the setting of irreparable rotator cuff tears, and revision arthroplasty.[8,14] Although RTSA has been associated with significant improvements in patient satisfaction, symptoms, and function,[1,12,20,23,28] complication rates have ranged from 19% to 68%.[27,35] Surgical complications include but are not limited to periprosthetic fracture, hematoma, periprosthetic sepsis, instability, acromial fracture, glenoid baseplate failure, scapular notching, damage to the axillary nerve, heterotopic ossification, glenoid component dissociation, scapular fracture, and blood-loss anemia requiring transfusion.[5,8,9,13,33,36] Previously identified risks factors for complications after RTSA include a body mass index (BMI) greater than 35 kg/m^2 or less than 25 kg/m^2.[2,17,19]

RTSA used to revise a previous failed primary arthroplasty provides significant improvements in patient pain and range of motion,[18,21,24,25,31,34] with rates of patient satisfaction as high as 89%.[3] Isolated outcome studies of revision RTSA have shown high surgical complication rates comparable with or higher than primary RTSA.[3,14,15,21,24,26,31,34] However, there is a paucity of studies directly comparing complication rates in primary and revision RTSA, as well as determining whether these rates are because of the revision nature of the surgical procedure or underlying patient characteristics.

The primary specific aim of this study was to compare the complication rates in patients who underwent either primary or revision RTSA by a single surgeon in a consecutive series of patients. The secondary aim was to determine whether revision versus primary status was a more or less important driver of complication rates than patient characteristics. We hypothesized that revision RTSAs would have significantly higher complication rates and that revision status would be the most important predictor of complication rates.

Materials and methods

This is a comparative retrospective cohort study. Patients who underwent either primary or revision RTSA by the senior author (G.P.N.) between October 2007 and April 2011 with a minimum of 90 days' postoperative follow-up were included for analysis. The preoperative indications for primary RTSA included a massive irreparable rotator cuff tear with pseudoparalysis, rotator cuff tear arthropathy, inflammatory arthropathy in the setting of a rotator cuff tear, glenohumeral osteoarthritis in the setting of an irreparable rotator cuff tear, and proximal humeral fracture sequelae. The preoperative indications for revision RTSA included failed hemiarthroplasty due to glenoid arthritis and/or rotator cuff deficiency and failed total shoulder arthroplasty due to glenoid loosening and/or rotator cuff deficiency. Patients were excluded if the RTSA had been performed as a revision of a failed open reduction–internal fixation procedure or as a revision of an antibiotic-laden polymethyl methacrylate spacer placement because these were not revisions from arthroplasty components. Patients with incomplete records were also excluded.

Preoperative consultation notes, operative reports, perioperative inpatient records, and postoperative clinic notes were reviewed, and the following data were recorded: age, sex, BMI, laterality of the dominant extremity, laterality of the RTSA, whether the procedure was a revision or primary arthroplasty, indication for the RTSA, medical comorbidities, length of surgery in minutes, estimated intraoperative blood loss in milliliters, implants, concurrent procedures, whether intraoperative or postoperative transfusion was necessary, postoperative length of inpatient hospital stay in days, need for admission to the intensive care unit (ICU), and any complications. The decision to perform transfusion with packed red blood cells was made by the attending orthopaedic surgeon on a case-by-case basis. Our institution does not have binding policies regarding when a postoperative transfusion can or must be given.

The Charlson Comorbidity Index (CCI) was calculated for all patients included in this study. This is a validated tool used in surgical patients to predict their long-term mortality risk based on their medical comorbidities. The CCI assigns medical conditions such as diabetes mellitus, heart disease, renal dysfunction, and cancer history scores ranging from 1 to 6 based on a rising quantitative contribution to mortality risk.[6,7,10]

Complication classification

Complications were categorized using a previously validated classification system.[4,11,17] Any malevolent event deviating from the normal intraoperative, perioperative, or postoperative course was deemed a complication. These events were then subdivided into minor versus major and medical versus surgical. In general, minor complications are non–life threatening and require only pharmacotherapy, whereas major complications are life or limb threatening and require prolonged pharmacologic treatment, surgical intervention, or repeat hospitalization. Medical complications are systemic, whereas surgical complications occur locally at the surgical site. Examples of each subdivided classification are as follows: minor medical complications include ileus and clinical/radiographic atelectasis; minor surgical complications include local cellulitis, wound drainage, and acute blood-loss anemia requiring transfusion; major medical complications include myocardial infection, deep vein thrombosis, and pulmonary embolus; major surgical complications include periprosthetic fracture requiring additional fixation, deep infection requiring debridement, and instability requiring reduction or revision.

Statistical analysis

All analyses were performed using Excel X software (Microsoft, Redmond, WA, USA) and SPSS software, version 18 (IBM, Armonk, NY, USA). Descriptive statistics were calculated first. Kolmogorov-Smirnov analysis was performed on continuous variables, and Mann-Whitney U tests or Student t tests were performed as appropriate based on data normality. Statistical comparison of categorical variables was performed with the Pearson χ^2 test. Multivariate binary logistic regression was

performed to determine which variables served as the most important determinants of complication rates.

Results

One hundred fifty consecutive patients underwent RTSA by the senior author (G.P.N.) between October 2007 and April 2011. We excluded 13 revision patients, 8 of whom had undergone prior antibiotic spacer placement for infection and 5 of whom had undergone prior failed open reduction–internal fixation. These patients were excluded because they were not revisions from a prior arthroplasty. One hundred thirty-seven patients remained for analysis. Of these patients, 111 underwent primary RTSA and 26 underwent revision RTSA, having undergone a prior shoulder arthroplasty, with total shoulder arthroplasty in 4 and hemiarthroplasty in 22.

Revision RTSA patients were significantly younger (Table I) ($P = .001$) and had higher BMIs ($P = .022$), but there were no significant differences in sex ($P = .673$) or whether the arthroplasty involved the dominant extremity ($P = .489$). There were significant differences in the distribution of the etiology of degeneration leading to the RTSA, with rotator cuff tear arthropathy and glenohumeral arthritis with a concomitant rotator cuff tear accounting for the majority of primary RTSAs (Table I) ($P < .001$). Operative time was significantly longer for revision RTSAs than for primary RTSAs ($P < .001$), and blood loss was significantly higher for revision RTSAs ($P = .021$).

Among the total population, the overall complication rate was 34%, with a 25% rate in primary RTSAs and a 69% rate in revision RTSAs. Minor complications accounted for most complications, occurring in 28%, 20%, and 65% of total, primary, and revision RTSA patients, respectively. In comparison, major complications occurred in 10% of total patients and occurred in 9% and 15% of primary and revision RTSA patients, respectively. Surgical complications occurred in 26% of all patients. Surgical complications were more frequent than medical complications in both primary and revision patients, occurring in 18% and 62%, respectively, whereas medical complications occurred in 14.6% of all patients, with 12% of primary and 23% of revision patients having a medical complication. The overall transfusion rate was 9%, with primary RTSAs receiving transfusions 5% of the time and revision RTSAs receiving transfusions 31% of the time (Table II). Overall complications, minor complications, surgical complications, intraoperative complications, perioperative complications, and postoperative complications were all significantly more frequent after revision RTSA than after primary RTSA ($P < .001$, $P < .001$, $P < .001$, $P < .001$, $P = .034$, and $P < .001$, respectively) (Fig. 1, Table III). There were no significant differences between primary and revision RTSAs in rates of major complications and rates of medical complications ($P = .334$ and $P = .174$ respectively) (Fig. 1, Table III). Length of stay did not significantly differ between groups (2.32 ± 0.86 days in primary RTSA group vs 2.35 ± 1.09 days in revision RTSA group, $P = .363$). Postoperatively, 5 of the 111 patients who underwent primary RTSA required a brief stay in the ICU as compared with 1 of the 25 patients who underwent revision RTSA ($P = .681$). Dislocation occurred in 1 patient after revision RTSA (3.8% of revision RTSA cohort) compared with 5 of the 111 patients who underwent primary RTSA (4.5% of primary RTSA cohort). Neither cohort incurred deep periprosthetic infection during the follow-up period.

Intraoperative surgical complications occurred significantly more frequently with revision RTSA (23%) than primary RTSA (3.8%). Among revision RTSA patients, these complications included a humeral shaft fracture, 2

Table I Demographic and intraoperative characteristics of total cohort and primary and revision RTSA patients

Variable	Total	Primary RTSA	Revision RTSA	*P* value
No. of patients	137	111	26	NA
Age (mean ± SD) (y)	72.5 ± 10.4	73.9 ± 9.7	66.6 ± 11.4	.001*
Female patients [% (n)]	90 (66)	72 (65)	18 (69)	.673
CCI (mean ± SD)	0.33 ± 0.60	0.32 ± 0.56	0.35 ± 0.75	.715
BMI (mean ± SD) (kg/m^2)	30.4 ± 6.1	29.7 ± 5.7	32.8 ± 6.9	.022
Indications (n)				<.001*
Cuff tear arthropathy	45	45	0	
GHOA with irreparable cuff tear	35	35	0	
Massive/irreparable cuff tear	17	17	0	
Revision from prior arthroplasty	26	0	26	
Sequelae of proximal humeral fracture	8	8	0	
Inflammatory arthropathy	4	4	0	
Operative time (mean ± SD) (min)	115 ± 32	108 ± 26	139 ± 40	<001*
Estimated blood loss (mean ± SD) (mL)	354 ± 236	322 ± 163	470 ± 389	.021*
Transfusion required [% (n)]	9.5 (13)	4.5 (5)	31 (8)	< .001*

GHOA, Glenohumeral osteoarthritis; *NA*, not applicable.
* Statistically significant.

Table II Prevalence of intraoperative, perioperative, or postoperative complications; minor or major complications; medical or surgical complications; and overall complications

Complication	% of cohort (n)			Comparison *P* value
	Total	Primary RTSA	Revision RTSA	
Any complication	33.6 (46)	25.2 (28)	69.2 (18)	<.001*
Major complication	10.2 (14)	9.0 (10)	15.4 (4)	.334
Minor complication	28.5 (39)	19.8 (22)	65.4 (17)	<.001*
Medical complication	14.6 (20)	12.6 (14)	23.1 (6)	.174
Surgical complication	26.3 (36)	18.0 (20)	61.5 (16)	<.001*
Intraoperative complication	6.6 (9)	2.7 (3)	23.1 (6)	<.001*
Perioperative complication	16.8 (23)	13.5 (15)	30.8 (8)	.034*
Postoperative complication	19.7 (27)	12.6 (14)	50.0 (13)	<.001*

* Statistically significant.

perforated humeral canals, and multiple blood transfusions. Among primary RTSA patients, intraoperative surgical complications included a glenoid fracture, a perforated humeral canal, and a scapular fracture. A similar trend applied to postoperative surgical complications: 34.6% of patients in the revision RTSA cohort had a postoperative complication, whereas only 11.7% of primary RTSA patients had a postoperative surgical complication. Among revision RTSA patients, these complications included a case of axillary nerve mononeuropathy, a case of cubital tunnel syndrome, 2 hematomas, a periprosthetic distal humeral fracture, 2 superficial wound infections, and several blood transfusions. Among the primary RTSA patients, these included a case of ulnar nerve reflex sympathetic dystrophy, 2 superficial wound infections, 4 acromial stress fractures, 4 dislocations, and 2 blood transfusions (Table II).

Multivariate logistic regression using age, CCI, BMI, sex, preoperative diagnosis, and revision versus primary status showed revision status to be the only significant predictor of overall complication rates (Table IV) ($P < .001$), minor complication rates ($P < .001$), surgical complication rates ($P < .001$), intraoperative complication rates ($P = .002$), and postoperative complication rates ($P < .001$). Medical complications were only predicted by BMI ($P < .001$). BMI was directly correlated with the risk of a medical complication developing, with a coefficient of 0.135 ± 0.4879, indicating that for each 7.4 ± 2.05–kg/m^2 increase in BMI, patients will have 1 additional medical complication. Perioperative complications were predicted by both revision status ($P = .047$) and CCI ($P = .022$). No variables predicted major complication rates.

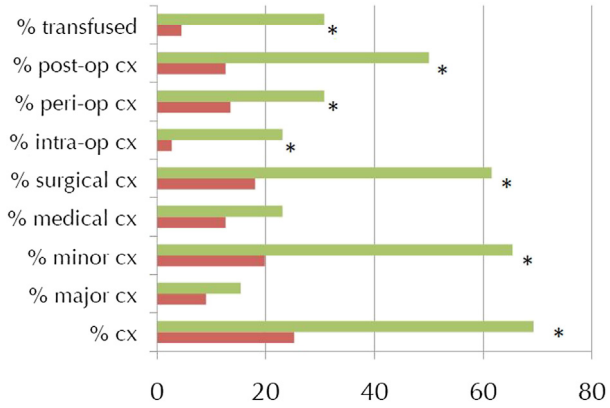

Figure 1 Overall, major, minor, medical, surgical, intraoperative (*intra-op*), perioperative (*peri-op*), postoperative (*post-op*) complication (*cx*) rates and transfusion rates in primary RTSAs (*red*) and revision RTSAs (*green*). Statistically significant differences are denoted by *asterisks*.

Discussion

RTSA performed as a revision of a prior arthroplasty presents significant challenges, including loss of both glenoid and humeral bone stock, compromise of the soft-tissue envelope, loss of the periarticular static and dynamic stabilizers, loss of anatomic soft-tissue planes, altered neurovascular anatomy, and damage to the deltoid and pectoralis major. The primary aim of this study was to compare the complication rates in patients who underwent primary versus revision RTSA. The secondary aim was to determine whether revision versus primary status was a more or less important driver of complication rates than patient characteristics. In our study, postoperative complications were significantly more frequent after revision (69%) than after primary (25%) RTSA. Surgical complications occurred with a higher frequency than medical complications, and revision patients required blood transfusions at a significantly greater rate. Revision status was the most important predictor of complication rates for most complication types and timing. BMI was predictive of medical complications, as shown previously.[17] CCI was the most significant predictor of perioperative complications, similar to previously published analyses: Chalmers et al[4] and Singh et al[29,30] reported similar findings in primary total shoulder arthroplasty. There were no cases of deep periprosthetic infection in either primary or revision RTSA patients, which is fortunate given the morbidity associated with periprosthetic sepsis. There were also no cases of instability in the revision cohort, as compared with 4 patients in the primary

Table III Complications found in total cohort and primary and revision RTSA patients

Complication	Total No. of patients (%)	Primary RTSA [n (%)]	Revision RTSA [n (%)]	Minor/ major	Medical/ surgical
Intraoperative	9 (6.6)	3 (2.7)	6 (23.1)		
Humeral shaft fx	1 (0.7)	—	1 (3.8)	Major	Surgical
Glenoid fx	1 (0.7)	1 (0.9)	—	Major	Surgical
Perforated humeral canal	3 (2.2)	1 (0.9)	2 (7.7)	Minor	Surgical
Scapular fx	1 (0.7)	1 (0.9)	—	Minor	Surgical
Transfusion	3 (2.2)	—	3 (11.5)	Minor	Surgical
Perioperative	29 (21.2)	21 (18.9)	8 (30.8)		
Prolonged intubation	1 (0.7)	—	1 (3.8)	Major	Medical
Atelectasis	3 (2.2)	2 (1.8)	1 (3.8)	Minor	Medical
Urinary retention	1 (0.7)	—	1 (3.8)	Minor	Medical
Altered mental status	1 (0.7)	1 (0.9)	—	Minor	Medical
Asystole, with pacemaker	1 (0.7)	1 (0.9)	—	Major	Medical
Anemia, requiring erythropoietin	1 (0.7)	1 (0.9)	—	Minor	Surgical
Hypoxia	1 (0.7)	1 (0.9)	—	Minor	Medical
Dehydration	1 (0.7)	1 (0.9)	—	Minor	Medical
Pulmonary embolus	2 (1.5)	2 (1.8)	—	Major	Medical
Acute respiratory failure/insufficiency	2 (1.5)	2 (1.8)	—	Major	Medical
Hypotension	2 (1.5)	2 (1.8)	—	Minor	Medical
Chronic nerve paresis (related to anesthesia)	1 (0.7)	1 (0.9)	—	Minor	Medical
Acute renal insufficiency	1 (0.7)	1 (0.9)	—	Minor	Medical
Persistent tachycardia	1 (0.7)	1 (0.9)	—	Minor	Medical
Transfusion	10 (7.3)	5 (4.5)	5 (19.2)	Minor	Surgical
Postoperative	33 (24.3)	17 (15.3)	16 (61.5)		
Axillary nerve mononeuropathy	1 (0.7)	—	1 (3.8)	Minor	Surgical
Cubital tunnel syndrome	1 (0.7)	—	1 (3.8)	Minor	Surgical
Ulnar nerve RSD	1 (0.7)	1 (0.9)	—	Minor	Surgical
Hematoma	2 (1.5)	—	2 (7.7)	Minor	Surgical
Periprosthetic distal humeral fx	1 (0.7)	—	1 (3.8)	Minor	Surgical
Pulmonary embolus	1 (0.7)	—	1 (3.8)	Major	Medical
Atelectasis	3 (2.2)	1 (0.9)	2 (7.7)	Minor	Medical
Acute upper GI bleed	1 (0.7)	—	1 (3.8)	Minor	Medical
Pulmonary effusion/edema	2 (1.5)	—	2 (7.7)	Minor	Medical
Superficial wound infection	4 (2.9)	2 (1.8)	2 (7.7)	Minor	Surgical
Acromial stress fx	4 (2.9)	4 (3.6)	—	Minor	Surgical
Dislocation	6 (4.4)	5 (4.5)	1 (3.8)	Major	Surgical
Acute renal insufficiency	1 (0.7)	1 (0.9)	—	Minor	Medical
Acute respiratory insufficiency	1 (0.7)	1 (0.9)	—	Minor	Medical
Transfusion	4 (2.9)	2 (1.8)	2 (7.7)	Minor	Surgical

fx, Fracture; *GI*, gastrointestinal; *RSD*, reflex sympathetic dystrophy.

cohort.[3,18,25] There was no significant difference in postoperative length of hospital stay or ICU stay despite the higher morbidity of the revision RTSA procedure.

Multiple studies have shown that revision RTSA improves patient outcomes but with often high complication rates, producing a weighted total overall complication rate of 26.0% among 8 referenced studies (Table V).[3,14,18,21,24,25,31,34] As a point of comparative reference, complication rates have been appreciably lower in recent studies of primary RTSA, with a weighted total overall complication rate of only 20.1% among 5 referenced studies (Table V).[12,22,23,28,32] Few previous studies have directly compared complication rates between primary and revision RTSA. Groh and Groh[16] evaluated 114 RTSAs, comprising 93 primary and 21 revision cases, with a total-cohort complication rate of 7% and complication rates of 4.3% in the primary cases and 19% in the revision cases. Similarly, Wall et al[35] reviewed 191 RTSAs and found a significantly higher complication rate among revision cases than among primary cases (36.7% vs 13.3%, $P < .001$). However, these studies did not compare cohorts using multivariate analysis techniques. The complication rates reported in our study are higher than those previously reported because of the rigorous systematic definitions used in this study. Our methodology led to the reporting of relatively minor complications, such as atelectasis, acute renal failure, and acute blood-loss anemia requiring transfusion, that have gone unreported elsewhere and thus

Table IV Significance of multivariate logistic regression analyses

	P value							
	All complications	Major complications	Minor complications	Surgical complications	Medical complications	Intraoperative complications	Perioperative complications	Postoperative complications
Age	.955	.140	.706	.934	.646	.071	.296	.182
BMI	.707	.210	.917	.691	.001*	.670	.715	.512
CCI	.178	.495	.244	.566	.055	.601	.022*	.617
Sex	.456	.208	.580	.304	.776	.950	.996	.095
Diagnosis	.213	.774	.369	.066	.506	.429	.888	.067
Revision status	<.001*	.351	<.001*	<.001*	.558	.002*	.047*	<.001*

Multivariate logistic regression analyses were performed to determine whether age, BMI, CCI, sex, diagnosis leading to RTSA, or revision status (ie, primary vs revision RTSA) served as significant covariates when comparing all complications and major, minor, medical, surgical, intraoperative, perioperative, and postoperative complications.

* Statistically significant.

provides a more accurate and comprehensive picture of the postoperative course.

The significant difference in transfusion rates between primary and revision patients, both intraoperatively and postoperatively, reflects both the significantly longer operative times needed for revision and the significantly greater intraoperative blood loss rate. Intraoperative glenoid and humeral fractures, including canal perforation, were also encountered more frequently, which is consistent with previous reports.[14] These fractures reflect the technical difficulty of removing a well-fixed stem in the setting of poor bone quality. These types of complications reflect the operative complexity of these cases and further suggest that future studies should consider these patients separately. From a public health perspective, comparisons of complication rates among surgeons and among institutions must consider revision volume, and reimbursement should be adjusted accordingly because these complications can be costly and time-consuming. Given the significant patient benefits with respect to pain, range of motion, and function with revision arthroplasty and the minor nature of the majority of the complications encountered in this series,[3,18,21,24,25,31,34] in our opinion, the benefits of revision RTSA outweigh the risks, but the surgeon must be prepared for complications and the patient must be

Table V Published studies reporting complication rates of revision RTSA

Author	Year	N	Mean length of FU (mo)	Complications (%)	Common complications
Revision RTSA					
Valenti et al[31]	2013	30	36.4	26.6	Humeral diaphysis fx, material disassembly, dislocations, infection
Walker et al[34]	2012	24	39.6	22.7	Scapular spine fx, dislocation, septic loosening
Ortmaier et al[24]	2013	50	51	24	Hematoma, instability, axillary nerve injury, periprosthetic infection
Flury et al[14]	2011	21	46	43 (intraoperative) 38 (postoperative)	Humeral fx, shaft perforation, hematoma, radial nerve palsy, periprosthetic infection
Melis et al[21]	2012	37	47	30	Glenoid loosening, instability, fx, infection, hematoma
Patel et al[25]	2012	28	40.7	10.7	Humeral fx, instability
Boileau et al[3]	2013	37	34	30	Instability, infection, aseptic prosthetic loosening
Holcomb et al[18]	2009	14	33.6	21	Dislocation, instability, hematoma
Weighted total				26	
Primary RTSA					
Sershon et al[28]	2014	36	33.6	16.7	Dislocation, periprosthetic fx, acromion fx
Muh et al[23]	2013	66	36.5	15	Dislocation, deep infection, humeral fx, radial/ulnar nerve palsy
Virani et al[32]	2013	55	48	20 (minor) 11 (major)	Deep infection, acromial fx, hyponatremia, hypokalemia, UTI
Ek et al[12]	2013	35	93	37.5	Dislocation, periprosthetic infection, scapular fx, nerve palsy
Mizuno et al[22]	2013	27	54	15	Early glenoid loosening, neurologic compromise
Weighted total				20	

FU, Follow-up; *fx*, fracture; *UTI*, urinary tract infection.

counseled accordingly. There were no significant differences in major complications between cohorts, and thus the revision nature of the procedure may not substantially alter the cost-benefit ratio for RTSA.

Several limitations exist with this study. First, it was a retrospective study; if patients presented to outside hospitals for postoperative complaints and did not mention these issues to the senior surgeon (G.P.N.) during their postoperative follow-up visits, complications may have gone unrecorded in the medical records and thus been missed in this study's analysis. The relatively small sample size of revision RTSAs in comparison with the larger cohort of primary RTSA patients may have limited statistical significance among variables that could otherwise have significance with a larger study. The relatively short follow-up period allows this report to focus on the relatively immediate perioperative and postoperative complications incurred in this patient population but does not account for complications that may arise in the longer postoperative period, such as periprosthetic sepsis, glenoid loosening, and component wear. In addition, the data may not be generalizable to the population as a whole given that all operations were performed at a single institution by a single surgeon. Several of the complications that we describe in this report—including transfusion, prolonged intubation, anemia, and hypotension—may be regarded by some surgeons as of low significance to the overall morbidity of the procedure. However, we believe that this method of reporting provides a more complete picture of the perioperative and postoperative course and that even minor medical complications are not entirely benign. Finally, longer follow-up may uncover further medical or surgical complications in either cohort of patients that had not yet occurred in the shorter postoperative period that was evaluated through chart review. In particular, the relative long-term survival of the glenoid component in revision RTSA as compared with primary RTSA remains unknown.

Conclusion

Revision RTSA has a significantly higher rate of complications than primary RTSA. Revision RTSA patients are significantly more likely to require transfusion. Patients should be aware that minor complications are frequent after revision RTSA and should be counseled accordingly.

Disclaimer

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