Original Article

DOI: 10.4274/haseki.galenos.2025.10088
Med Bull Haseki 2025;63:24-32

Comprehensive Survival Analysis of Reverse Shoulder Arthroplasty: Do Gender, Age, and Surgical Indication Influence Prosthesis Survivorship?

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Abstract

Aim: The parameters such as age, gender, and indication for surgery would have a significant influence on the survival of reverse shoulder arthroplasty (RSA). In this context, we aimed to determine how long patients survive after primary and revision RSA procedures and how factors like sex, age, and different reasons for surgery affect survival in a similar group of patients treated by the same surgeon.

Methods: This study presents a retrospective analysis of prospectively collected data from 376 patients who underwent RSA surgery between April 2014 and February 2023 in a tertiary university hospital that serves as a referral center for shoulder disorders. Complication and revision rates were assessed, and survivorship analysis was performed using Kaplan-Meier survival plots in different groups according to gender, age, and indication.

Results: Forty-six complications were observed in the study population, and 35 (76.1%) of them needed revision surgery. Ten-year revision-free survival was significantly lower in revision RSA compared to primary RSA cases (75.0% vs. 88.7%). Gender did not have a significant influence on complication rates, and survival probabilities were comparable between male and female patients. Younger patients (<60 years) had a higher complication rate and the lowest revision-free survival at 10 years (75.6%). According to the indication, revision RSA for failed arthroplasty and RSA for infection sequelae led to the worst 10-year revision-free survival rates (75.0% and 62.2%, respectively).

Conclusion: RSA showed satisfactory survivorship at 10 years, reaching up to almost 90% in the overall population. Age and indication showed significant influence on the survival of RSA, with lower survival probability and a higher complication rate in younger patients.

Keywords: Arthroplasty, replacement, shoulder, prosthesis failure, treatment outcome, survivorship, survival rate, shoulder joint/surgery

Introduction

Reverse shoulder arthroplasty (RSA) was first designed by Grammont et al. (1) with an effort to establish an effective treatment for cuff tear arthropathy (CTA). Due to promising early reports (2), it has become a popular treatment option with a significant increase in its usage over the years. In the following decades, indications for RSA have expanded, including proximal humeral fracture (PHF), fracture sequelae, glenohumeral osteoarthritis (OA), avascular necrosis of the humeral head, the revision of failed shoulder arthroplasty, and the development of other pathologies (3).

Despite favorable clinical outcomes, RSA is not devoid of complications, and instability, infection, and loosening have been reported to be among the most common complications associated with RSA (4,5). Some of these complications may lead to a revision surgery that yields variable and unpredictable results (6), which can be markedly debilitating. Therefore, determination of factors related to failure and prosthesis survival is of great

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Received: 09.25.2024 **Accepted:** 04.02.2025 **Publication Date:** 29.04.2025

Cite this article as: Sahin K, Kaya HB, Kapicioglu M, Bilsel K. Comprehensive survival analysis of reverse shoulder arthroplasty: do gender, age, and surgical indication influence prosthesis survivorship? Med Bull Haseki. 2025;63:24-32

importance to make proper risk assessments and patient counseling.

Previous studies indicated an overall survival rate around 90% for RSA in the short- to mid-term (6-10), but these data mostly rely on multicenter retrospective studies and registry studies combining a large number of different prosthesis designs, surgical techniques, surgeons, or follow-up protocols. This heterogeneity may reduce the accuracy of the study, especially if the cohort size is not large enough or the aforementioned parameters are not confined to overcome possible biases. We hypothesized that parameters such as age, gender, and indication for surgery would have a significant influence on the survival of RSA. In this study, we aimed to determine how long patients survive after primary and revision RSA procedures and how factors like sex, age, and different reasons for surgery affect survival in a similar group of patients treated by the same surgeon.

Methods

Study Design

This is a retrospective analysis of prospectively collected data from patients who underwent RSA surgery between April 2014 and February 2023 in a tertiary university hospital that serves as a referral center for shoulder disorders. Institutional Review Board approval was obtained from the relevant Bezmialem Vakif University board before the initiation of the study (approval no.: 6, date: 04.03.2024). Written informed consent regarding the use of their medical records data with the purpose of publication has been obtained from all patients before surgical interventions.

All patients were operated on by a single surgeon who is a fellowship-trained, experienced shoulder surgeon, and they were clinically and radiologically followed up on a regular basis. Clinical follow-up visits were performed by two authors at the 2nd, 4th, and 8th weeks postoperatively, the 3rd and 6th months, and each consecutive year with additional visits if required. Medical records of all patients were obtained from an institutional shoulder arthroplasty database. The dataset included information on patient demographics, date, diagnosis, and indication for RSA surgery complications, reoperations, and revisions (including date and cause for reoperation/revision). Reoperation was defined as any kind of surgical intervention, including revision surgery, following the index procedure, and overall survivorship was evaluated using patients' reoperation-free survival time. A revision surgery was defined as any surgical intervention following the index procedure, including the change, addition, or removal of any part of the prosthesis. The date of revision was used to assess revision-free survival of patients.

Patient Selection and Study Groups

Patients who underwent RSA surgery due to oncologic indications and patients who did not have complete follow-up data were excluded. Included patients were categorized into 8 groups according to indication as follows: cuff deficient shoulder (CDS), acute PHF, fracture sequelae (malunion or nonunion) of previous proximal humeral fracture, glenohumeral OA, avascular necrosis of humeral head, failed previous arthroscopic rotator cuff repair (FARCR), infection sequelae (previous history of osteomyelitis or septic arthritis), and the revision of failed shoulder arthroplasty (previous hemiarthroplasty, RSA, or total anatomical shoulder arthroplasty). The CDS group included patients with massive irreparable rotator cuff tears without imminent CTA [Hamada et al. (11) grade I-II and III] and patients with CTA (Hamada et al. (11) grade IV and V). The FARCR group consisted of patients who had a history of previous arthroscopic intervention (rotator cuff repair, latissimus dorsi tendon transfer, or superior capsular reconstruction) for rotator cuff tear and who underwent RSA surgery due to clinical and radiological failure of the index procedure.

Surgical Procedure and Rehabilitation

Surgical setup and skin preparation were standard, and the same protocol was applied for all patients. All patients were operated on under general anesthesia in the beach-chair position. Povidone-iodine paint solution combined with isopropyl alcohol was used for skin preparation, and the operative area was fully covered with Ioban 2 surgical drapes (3M, St. Paul, MN, USA). A standard deltopectoral approach was preferred in all procedures. Uncemented humeral stems were used for all primary cases, but cemented stems were occasionally preferred in revision surgeries, considering the bone stock and tissue quality of the humerus. Comprehensive Reverse Shoulder System (Zimmer Biomet, Warsaw, Indiana, USA), SMR Reverse (LimaCorporate, Udine, Italy), Delta Xtend (Depuy, Warsaw, Indiana, USA), and Next Shoulder Solutions (Next, Ankara, Turkey) were the implants used during the study period. Suction drains or medical prophylaxis for deep venous thrombosis was not routinely used.

All patients in the infection sequelae group underwent two-stage surgery. The first surgery included resection of the humeral head, debridement of avascular bone and soft tissue, and implantation of a spacer with antibiotic-loaded cement. Following an antibiotics regimen for a minimum of 6 weeks, second-stage surgeries (removal of spacer and implantation of prosthesis) were performed.

Depending on the indication and surgical status, patients were immobilized using an abduction sling, putting the shoulder in 30° of abduction and neutral rotation, for 4 weeks. Active elbow, wrist, and hand motions were

encouraged immediately after surgery. A physiotherapist visited all patients on the first postoperative day and gave instructions about immobilization and home exercises. At the 4th postoperative week, passive range of motion (ROM) exercises were initiated by a physiotherapist until full ROM was achieved. At the 6th to 8th postoperative weeks, active-assisted and active ROM exercises were gradually initiated, followed by deltoid strengthening exercises. Individually, considering the recovery level of each patient, return to full physical activity was allowed between the 3rd and 6th postoperative months.

Statistical Analysis

Descriptive statistical methods, including mean, standard deviation, range, percentage, and frequency, were used to analyze the data. During the follow-up period, patients were censored on the date of the event (reoperation or revision surgery) or on the date of the last follow-up visit or death if the event did not occur. Reoperation and revision rates were stratified by age, sex, and indication for RSA surgery and compared between strata using Fisher's exact test or chi-square test. Estimated survival probabilities and their pointwise 95% confidence intervals were then calculated and plotted using the Kaplan-Meier method. The log-rank (Mantel-Cox) test was then used to compare the survivorship distributions. The significance level was set at p=0.05, and all analyses were performed using GraphPad Prism software for Windows (version 9.3.0, San Diego, California, USA).

Results

During the study period, 394 primary and revision RSA procedures were performed for 379 patients (15 patients underwent a sequentially bilateral surgery). According to defined inclusion and exclusion criteria, 376 patients (356 primary and 20 revision RSA procedures) were included in the final analysis, which consisted of 82 (22.7%) male and 279 (77.3%) female patients (Figure 1). The mean age of patients was 69.7±10.6 (range: 29.0-95.0) years, and the mean follow-up duration was 61.4±25.3 (17.7-125.6) months. The most common indication for RSA was CDS, which constituted 40.7% of the study population. The distribution of the study population according to indication was summarized in Table 1.

46 complications were noted, of which some caused reoperation or revision surgery. The most common complications were infection (n=21, 45.7%), followed by instability (n=13, 28.3%). Among these 46 complications, 35 shoulders (76.1%) needed revision surgery. The mean delay for a complication to occur was 20.6±19.9 months. In one patient, evident neurological impairment was observed (musculocutaneous nerve dysfunction) immediately after surgery. The diagnosis was neuropraxia of the nerve due to overtensioning, and an exchange to a smaller-diameter glenosphere was performed the following day. Full recovery was observed immediately after the revision surgery. Data regarding complications were detailed in Table 2.

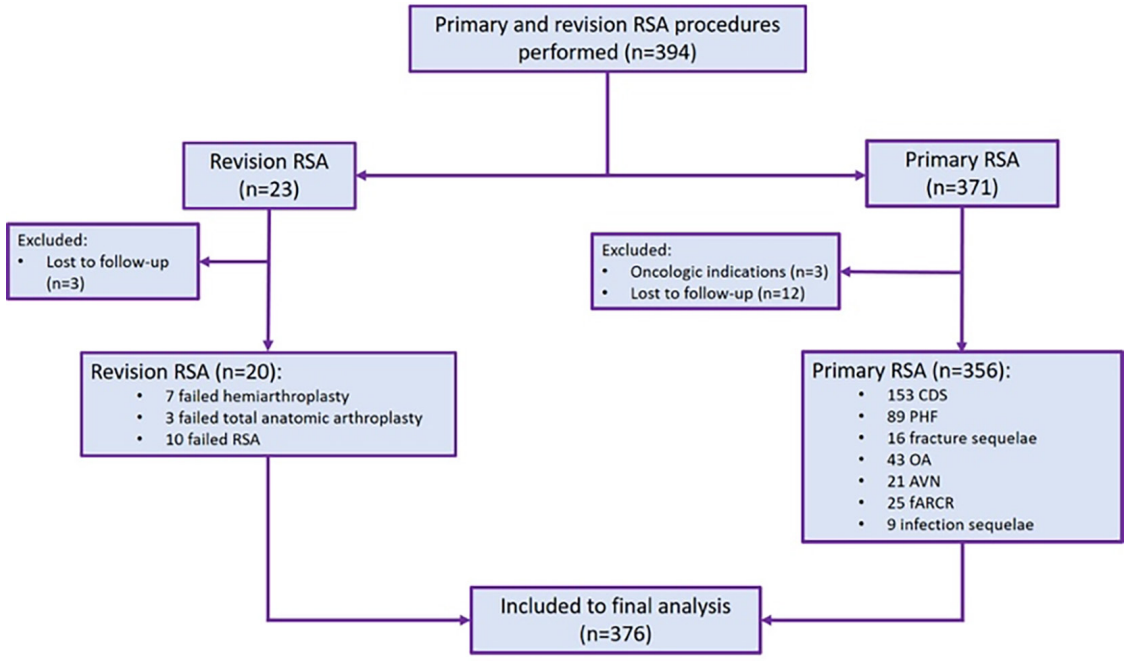

Figure 1. Patient selection flowchart
RSA: Reverse shoulder arthroplasty, CDS: Cuff deficient shoulder, PHF: Proximal humeral fracture, OA: Osteoarthritis, AVN: Avascular necrosis, FARCR: Failed arthroscopic rotator cuff repair

The estimated overall and revision-free survival probabilities of the study population, including both primary and revision RSAs, were 85.5% and 88.5%, respectively, at the 10th postoperative year (Figure 2). When stratified between primary and revision RSAs, both overall and revision-free survival rates were significantly inferior in the revision RSA group (p=0.0005 and 0.01, respectively). Assessment of survival curves showed that in the revision RSA group, almost all complications occurred within the first 24 months, with a mean delay of 8.6±7.8 months (Table 3, Figure 3).

Complication and revision rates were comparable for female and male patients (p>0.05) (Table 4). Even though the survival rates were similar at 10 years between sexes, survival curves showed that for male patients, an earlier complication/revision was more likely in the short term. Two-year overall survival rates were 94.5% for female patients and 88.5% for male patients. Distribution of survivorship for both overall and revision-free survival rates during the follow-up period did not show a significant difference by gender (p>0.05) (Table 5, Figure 4).

Younger patients had significantly higher complication and revision rates. Patients younger than 60 years of age at the time of surgery had the highest complication and revision rates (23.4% and 21.3%, respectively) (Table 6). Accordingly, at 10 years, younger patients (<60 years) had the lowest overall and revision-free survival rates, 73.4% and 75.6%, respectively, and the survival differences between age groups were statistically significant. (p=0.018 for overall survival and p=0.014 for revision-free survival) (Table 7, Figure 5).

Complication and revision rates varied significantly between indication groups (p=0.012 for complication rate and p=0.008 for revision rate), with the highest complication rates observed in the revision RSA group for failed arthroplasty (35.0%) and in the infection sequelae group (33.3%). Infection sequelae (33.3%) and failed arthroplasty (25.0%) groups were associated with the highest rates of revision (Table 8). All complications in the infection sequelae group were due to recurrence of infection, which needed two-stage revision surgery. Assessment of survival curves showed that the distribution of overall and revision-free survivorship varied significantly among indication groups (p=0.008 and p=0.01, respectively) (Figure 6) and that infection sequelae and

Table 1. Distribution of study population according to indication for RSA surgery

Indication	Frequency (%) (n=376)
CDS	153 (40.7)
• Massive irreparable rotator cuff tear (Hamada grade I-II-III)	• 58 (15.4)
• CTA (Hamada grade IV and V)	• 95 (25.3)
PHF	89 (23.7)
Fracture sequelae	16 (4.3)
Glenohumeral OA	43 (11.4)
AVN	21 (5.6)
fARCR	25 (6.6)
• Previous arthroscopic repair	• 18 (4.8)
• Previous latissimus dorsi transfer	• 4 (1.1)
• Previous superior capsular reconstruction	• 3 (0.8)
Infection sequelae	9 (2.4)
Revision for failed previous shoulder arthroplasty	20 (5.3)
• Revision of previous hemiarthroplasty	• 7 (1.9)
• Revision of previous total anatomic shoulder arthroplasty	• 3 (0.8)
• Revision of previous RSA	• 10 (2.7)

RSA: Reverse shoulder arthroplasty, CDS: Cuff deficient shoulder, CTA: Cuff tear arthropathy, PHF: Proximal humeral fracture, OA: Osteoarthritis, AVN: Avascular necrosis, FARCR: Failed arthroscopic rotator cuff repair

Table 2. Observed complications during follow-up period that needed a surgical treatment

Complication	Frequency (%) (n=46)	Mean delay (months)	Treatment
Infection	21 (45.7)	19.4±21.4	DAIR (n=4) One-stage revision (n=2) Two-stage revision (n=15)
Instability	13 (28.3)	15.6±13.8	Open reduction (n=3) Humeral component and insert revision (n=2) Glenosphere and insert revision (n=6) One-stage RSA revision (n=2)
Periprosthetic fracture	4 (8.7)	14.2±12.6	Osteosynthesis with plate fixation (n=4)
Humeral component loosening	3 (6.5)	43.0±14.2	Humeral component revision (n=2) One-stage RSA revision (n=1)
Glenoid component loosening	4 (8.7)	38.2±23.8	Glenoid component revision (n=3) Revision to BIO-RSA using femoral head allograft (n=1)
Neurological injury	1 (2.2)	0.03	Glenosphere revision

DAIR: Debridement, antibiotics and implant retention, RSA: Reverse shoulder arthroplasty, BIO-RSA: Bony increased-offset reverse shoulder arthroplasty

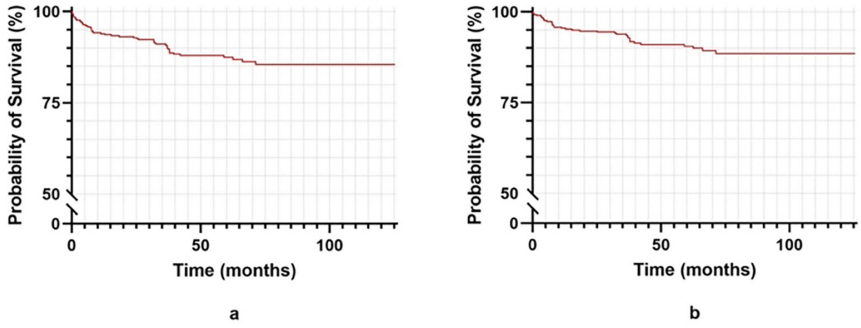

Figure 2. Kaplan-Meier curves of overall (a) and revision-free (b) survivals of RSA in study population
RSA: Reverse shoulder arthroplasty

Table 3. Overall and revision-free survival rates of primary and revision RSA			
	Primary RSA (n=356) (95% CI)	**Revision RSA (n=20) (95% CI)**	**p-value[a] (comparison of survivorship distribution)**
	Overall survival		
2-year	94.4% (91.4-96.4%)	70.0% (45.1-85.3%)	**0.0005**
10-year	86.7% (81.9-90.3)	65.0% (40.3-81.5%)	
	Revision-free survival		
2-year	95.8% (93.1-97.5%)	75.0% (50.0-88.7%)	**0.01**
10-year	89.3% (84.7-92.6%)	75.0% (50.0-88.7%)	
a: Log-rank test, bolded p-values indicate statistical significance RSA: Reverse shoulder arthroplasty, CI: Confidence interval			

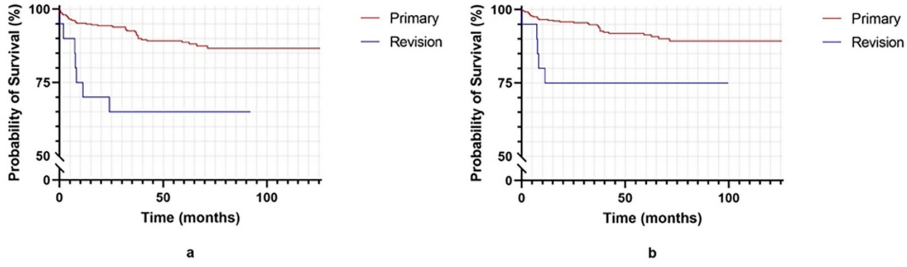

Figure 3. Kaplan-Meier curves of overall (a) and revision-free (b) survivals of primary and revision RSA
RSA: Reverse shoulder arthroplasty

Table 4. Complication and revision rates according to gender		
	Complication, frequency (%)	**Revision, frequency (%)**
Female (n=289)	34 (11.8)	25 (8.7)
Male (n=87)	12 (13.8)	10 (11.5)
p-value[a]	0.58	0.4
[a]: Fisher's Exact test		

revision RSA groups had the lowest survival rates. At 10 years, estimated revision-free survival rates were 62.2% in the infection sequelae group and 75.0% in the revision RSA group.

Discussion

This study has several important findings. First, primary RSA had a satisfactory survival rate in the long term, reaching up to almost 90% at 10 years. Secondly, revision RSA led to significantly lower survival rates compared to primary RSA, with all failures occurring within the first 24 months. Thirdly, in our series, gender did not have a significant impact on complication and revision rates. Even though survival rates were comparable in the long term, male patients had earlier complications, and survival rates were lower in the short term compared to female patients. This finding implies that failures tend to occur earlier in male patients; however, further evidence is required to

Table 5. Overall and revision-free survival rates of RSA according to gender			
	Female (n=289) (95% CI)	**Male (n=87) (95% CI)**	**p-value[a] (comparison of survivorship distribution)**
	Overall survival		
2-year	94.5% (91.2-96.6%)	88.5% (79.7-93.6%)	0.55
10-year	85.3% (79.6-89.5%)	86.1% (76.8-91.9%)	
	Revision-free survival		
2-year	95.8% (92.8-97.6%)	90.8% (82.4-95.3%)	0.39
10-year	88.6% (83.2-92.4%)	88.4% (79.5-93.6%)	
[a]: Log-rank test RSA: Reverse shoulder arthroplasty, CI: Confidence interval			

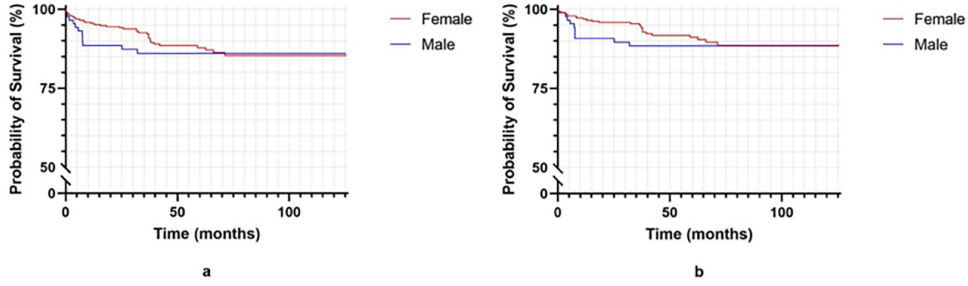

Figure 4. Kaplan-Meier curves of overall (a) and revision-free (b) survivals according to gender

Table 6. Complication and revision rates according to age at time of surgery		
	Complication, frequency (%)	**Revision, frequency (%)**
<60 years (n=47)	11 (23.4)	10 (21.3)
60-70 years (n=124)	13 (10.5)	11 (8.9)
70-80 years (n=150)	12 (8.0)	10 (6.7)
>80 years (n=55)	10 (18.2)	4 (7.3)
p-value[a]	**0.017**	**0.023**
[a]: Chi-square test, bolded p-values indicate statistical significance		

draw such a conclusion. Another finding that needs to be mentioned is that younger age at the time of surgery was associated with higher complication and revision rates and lower prosthesis survival.

In our series, 76.1% of complications required revision surgery, and the most common complications were infection and instability, which is consistent with previous literature (6,7,12,13). The mean delay time for a complication to occur was 20.6±19.9 months. Aseptic loosening (humeral or glenoid) tended to occur in the mid-term, with a mean delay time of 43.0±14.2 months for humeral loosening and 38.2±23.8 months for glenoid loosening. Other complications, such as infection, instability, or periprosthetic fracture, which constituted the majority of all complications, were most likely to occur in the short term. Especially in revision RSA cases, almost all failures occurred within the first two years, with a mean delay of 8.6±7.8 months. Similar findings have been reported in previous studies. In their registry-based observational study, Di Martino et al. (8) reported that 67% of all revisions occurred within the first year following index surgery. Another registry study evaluating 3828 RSA procedures indicated that the majority of revisions were performed in the short term, with 51% within the first 6 months (6).

In accordance with previous reports (7,14-16), revision RSA showed significantly inferior survival rates compared to primary RSA at every time point (70.0% vs. 94.4% at 2 years and 65.0% vs. 86.7% at 10 years) in our series. Zumstein et al. (12) reported that revision RSA had more than twice the complication rate compared to primary RSA (33% vs. 13%). The revision status (primary pathology and indication for revision) has been reported to be the most important predictor for intraoperative and postoperative complications (16). These findings imply that revision RSA is a challenging surgery with high rates of complication and low survival rates and that surgeons should make proper risk assessments for each patient requiring revision surgery.

Sex has been reported to have a significant impact on complication/revision rates, and male sex has been related to lower survival rates in previous reports. In their study, Chelli et al. (7) reported a higher complication rate (23.1% vs. 14.2%) and a lower 10-year revision-free survival rate (83.2% vs. 91.5%) in male patients. Similar findings have been reported in the Nordic registry, with higher revision

Table 7. Overall and revision-free survival rates of RSA according to age				
	Overall survival (95% CI)		**Revision-free survival (95% CI)**	
	2-year	**10-year**	**2-year**	**10-year**
<60 years (n=47)	87.2% (73.7-94.0%)	73.4% (56.6-84.5%)	87.2% (73.7-94.0%)	75.6% (58.9-86.2)
60-70 years (n=124)	92.7% (86.5-94.1%)	87.2% (78.0-92.7%)	94.4% (88.6-97.3%)	88.9% (79.9-94.0%)
70-80 years (n=150)	96.7% (92.2-98.6%)	91.0% (84.6-94.8%)	96.7% (92.2-98.6%)	92.4% (86.3-95.9)
>80 years (n=55)	89.1% (77.3-95.0%)	78.9% (63.5-88.4)	96.4 (86.3-99.1%)	90.0% (74.5-96.3%)
p-value[a]	**0.018**		**0.014**	
[a]: Log-rank test, bolded p-values indicate statistical significance RSA: Reverse shoulder arthroplasty, CI: Confidence interval				

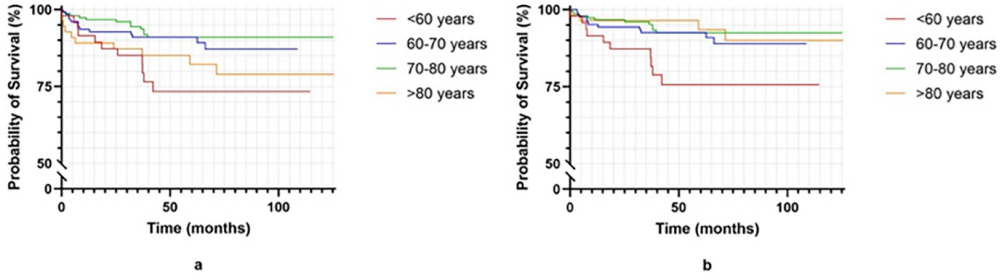

Figure 5. Kaplan-Meier curves of overall (a) and revision-free (b) survivals according to age

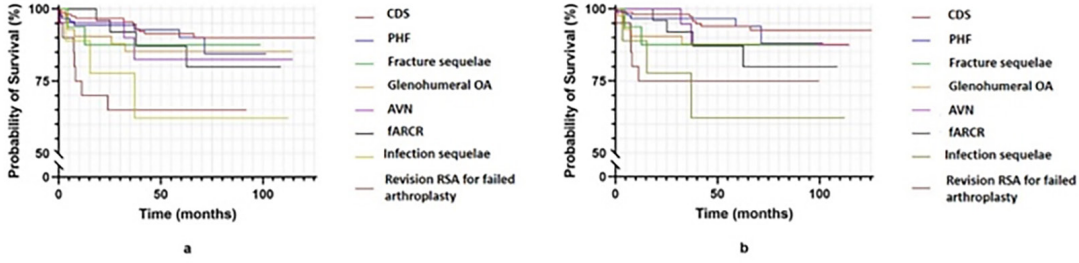

Figure 6. Kaplan-Meier curves of overall (a) and revision-free (b) survivals according to indication
RSA: Reverse shoulder arthroplasty, CDS: Cuff deficient shoulder, PHF: Proximal humeral fracture, OA: Osteoarthritis, AVN: Avascular necrosis, FARCR: Failed arthroscopic rotator cuff repair

Table 8. Complication and revision rates according to indication for RSA		
	Complication, frequency (%)	**Revision, frequency (%)**
CDS (n=153)	12 (7.8)	8 (5.2)
PHF (n=89)	8 (9.0)	5 (5.6)
Fracture sequelae (n=16)	2 (12.5)	2 (12.5)
Glenohumeral OA (n=43)	7 (16.3)	6 (14.0)
AVN (n=21)	3 (14.3)	2 (9.5)
FARCR (n=25)	4 (16.0)	4 (16.0)
Infection sequelae (n=9)	3 (33.3)	3 (33.3)
Revision RSA for failed arthroplasty (n=20)	7 (35.0)	5 (25.0)
p-value[a]	**0.012**	**0.008**
[a]: Chi-square test, bolded p-values indicate statistical significance RSA: Reverse shoulder arthroplasty, CDS: Cuff deficient shoulder, PHF: Proximal humeral fracture, OA: Osteoarthritis, AVN: Avascular necrosis, FARCR: Failed arthroscopic rotator cuff repair		

rates in male patients (6). Authors stated that this might be due to more prevalent Cutibacterium acnes colonization in male skin (17) or due to a higher level of activity in male patients, which might cause a higher stress level placed on the prosthesis. This finding was supported by the Norwegian registry showing higher revision rates in male patients due to infection (18). However, some reports suggested that male sex increases the risk of revision only in the short term and does not have a significant influence on survival rates in the long term. The Australian registry indicated a higher risk of revision for male patients only in the short term (first three months postoperatively) (19). In accordance with this finding, our results showed that complication and revision rates, as well as 10-year survival rates, were comparable between male and female patients. However, male patients had lower overall and revision-free survival at 2 years (88.5% vs. 94.5% and

90.8% vs. 95.8%).

Previous data has related younger age at the time of surgery to higher complication rates and lower survival rates. Chelli et al. (7) reported that patients younger than 60 years had a higher revision rate and a lower survival rate of 75.7% at 10 years compared to other age intervals. A registry-based study by Di Martino et al. (8) also suggested that the revision rate was higher in young patients undergoing RSA. This might be due to a higher level of activity in young patients and less favorable indications for RSA, which are possibly related to higher morbidity. Accordingly, our study showed that patients younger than 60 years had the highest complication and revision rates (23.4% and 21.3%, respectively). In our series, younger (<60 years) and older (>80 years) patients had lower overall survival rates at 10 years (73.4% and 78.9%, respectively) compared to other age intervals. However, 10-year revision-free survival was lower in younger patients (75.6%) compared to older patients (90.0%). This might be because a revision surgery could have been avoided in older patients due to the high risk of complications and morbidity, and those complications could have been managed conservatively. Despite these findings, recent data showed that there was a trend towards a younger population with the advancements in prosthetic designs and management of postoperative complications (20).

Indication for RSA, apart from age at the time of surgery, was another factor that had a significant influence on complication/revision rates and prosthesis survival. In our series, revision RSA for failed previous arthroplasty had the highest complication rate (35.0%), followed by the infection sequelae (33.3%). Among primary RSA procedures, CDS and PHF had the lowest rates of complications (7.8% and 9.0%, respectively) and revision (5.2% and 5.6%, respectively). In accordance with our results, Chelli et al. (7) stated that diagnosis of primary RSA was one of the main predictive factors for complications and revisions. The authors reported high survival rates of RSA in massive cuff tears at 10 years. In their series, RSA for tumors, fracture sequelae, and revision RSA were associated with inferior survival rates and with major complications. The authors related this to the high frequency of missing bone stock in these patients and possible impaired stability of the prosthesis (21).

Our findings provide clinical recommendations by highlighting the necessity for personalized decision-making in RSA. Surgeons must take into account patient age, indications, and surgical history while planning RSA, as these elements significantly influence outcomes. In younger patients or those receiving revision for previous unsuccessful arthroplasty, collaborative decision-making must consider the increased risk of early failure and the possibility of reoperation.

A further practical consideration is the time of follow-up. Considering that the majority of complications and failures occurred within the initial two years, particularly in revision cases or younger patients, more rigorous and frequent early postoperative monitoring may be warranted in these subgroups. Adjusting rehabilitation intensity or imposing activity modifications may be necessary for these higher-risk populations. Consequently, this study supplements the existing knowledge regarding RSA outcomes and survival and offers insights into patient and procedural characteristics that may inform prognosis and treatment approaches. This also emphasizes that a nuanced approach, rather than a uniform method, is crucial in RSA.

Study Limitations

We acknowledge that there are several limitations related to our study. The retrospective nature of the study is the first limitation that needs to be mentioned. Complication, revision, and survival rates are the only reported data. Clinical baseline and outcome data were not evaluated, which might be considered another drawback of this study. Another limitation is the relatively small patient population compared to registry studies. However, this study has one of the largest series in the literature from a single center, which constitutes its main strength. Most of the available data regarding the survival of RSA are derived from registry studies or multicenter studies with numerous surgeons, surgical techniques, implants, or follow-up protocols. This heterogeneity might cause some possible biases if these parameters are not controlled in these studies. Therefore, more accurate inferences can be made from our findings. Despite the use of a standardized surgical technique and an established follow-up protocol, four different prosthetic systems were used throughout the study period. Potential variations in prosthesis design, instrumentation, or component characteristics among prosthesis types may have introduced confounding effects on survivorship results and should be acknowledged as a limitation.

Conclusion

RSA showed a satisfactory mid- to long-term survival probability, reaching almost 90% in the overall population. Younger age at surgery led to a higher complication rate and worse survival probability. Even though male patients showed a tendency to fail in the short-term, survival probabilities were comparable between male and female patients in the long-term and gender did not have a significant impact on complications and revision rates. Revision RSA had a significantly lower survival probability and higher complication rates than primary RSA. Among

primary RSA indications, CDS showed the most successful results with the lowest complication and revision rates and the highest survival probabilities. These findings would make a valuable contribution to decision-making and risk assessment in clinical practice. However, further research is needed to make more precise conclusions.

Ethics

Ethics Committee Approval: Institutional Review Board approval was obtained from the relevant Bezmialem Vakif University board before the initiation of the study (approval no.: 6, date: 04.03.2024).

Informed Consent: Written informed consent regarding the use of their medical records data with the purpose of publication has been obtained from all patients before surgical interventions.

Footnotes

Authorship Contributions

Surgical and Medical Practices: K.Ş., M.K., K.B., Concept: K.Ş., H.B.K., M.K., K.B., Design: K.Ş., H.B.K., M.K., K.B., Data Collection or Processing: K.Ş., H.B.K., Analysis or Interpretation: K.Ş., H.B.K., Literature Search: K.Ş., H.B.K., Writing: K.Ş.

Conflict of Interest: No conflicts of interest were declared by the authors.

Financial Disclosure: This study received no financial support.

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