Original Article

Clin Shoulder Elbow 2024;27(3):353-360
https://doi.org/10.5397/cise.2024.00374

CiSE
Clinics in Shoulder and Elbow

eISSN 2288-8721

# Rheumatoid arthritis is associated with higher 90-day systemic complications compared to osteoarthritis after total shoulder arthroplasty: a cohort study

**Peter Boufadel[1], Jad Lawand[1], Ryan Lopez[1], Mohamad Y. Fares[1], Mohammad Daher[1], Adam Z. Khan[2], Brian W. Hill[3], Joseph A. Abboud[1]**

[1]*Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, Philadelphia, PA, USA*
[2]*Department of Orthopaedic Surgery, Southern California Permanente Medical Group, Panorama City, CA, USA*
[3]*Palm Beach Orthopaedic Institute, Palm Beach Gardens, FL, USA*

**Background:** Total shoulder arthroplasty (TSA) in patients with rheumatoid arthritis (RA) can present unique challenges. The aim of this study was to compare both systemic and joint-related postoperative complications in patients undergoing primary TSA with RA versus those with primary osteoarthritis (OA).
**Methods:** Using the TriNetX database, Current Procedural Terminology and International Classification of Diseases, 10th edition codes were used to identify patients who underwent primary TSA. Patients were categorized into two cohorts: RA and OA. After 1:1 propensity score matching, postoperative systemic complications within 90 days following primary TSA and joint-related complications within 5 years following anatomic TSA (aTSA) and reverse shoulder arthroplasty (RSA) were compared.
**Results:** After propensity score matching, the RA and OA cohorts each consisted of 8,523 patients. Within 90 days postoperation, RA patients had a significantly higher risk of total complications, deep surgical site infection, wound dehiscence, pneumonia, myocardial infarction, acute renal failure, urinary tract infection, mortality, and readmission compared to the OA cohort. RA patients had a significantly greater risk of periprosthetic joint infection and prosthetic dislocation within 5 years following aTSA and RSA, and a greater risk of scapular fractures following RSA. Among RA patients, RSA had a significantly higher risk of prosthetic dislocation, scapular fractures, and revision compared to aTSA.
**Conclusions:** Following TSA, RA patients should be considered at higher risk of systemic and joint-related complications compared to patients with primary OA. Knowledge of the risk profile of RA patients undergoing TSA is essential for appropriate patient counseling and education.
**Level of evidence:** III.

**Keywords:** Shoulder arthroplasty; Shoulder replacement; Rheumatoid arthritis, Osteoarthritis; Complications

## INTRODUCTION

Rheumatoid arthritis (RA) is a systemic autoimmune condition characterized by widespread joint inflammation, synovitis, and other systemic symptoms [1,2]. While medical management of RA has improved recently with the development of disease-modifying anti-rheumatic drugs (DMARDs), uncontrolled RA remains relevant to shoulder surgeons due to its potential to lead to

Received: May 7, 2024 Revised: June 24, 2024 Accepted: July 7, 2024
Correspondence to: Peter Boufadel
Division of Shoulder and Elbow Surgery, Rothman Orthopaedic Institute, 925 Chestnut St, Philadelphia, PA 19107, USA
Tel: +1-2676664716, E-mail: paboufadel@gmail.com, ORCID: https://orcid.org/0000-0001-7078-9148

erosive arthritis of the glenohumeral joint [3]. In addition, the use of corticosteroids in the treatment of RA may lead to avascular necrosis of the humeral head, necessitating treatment [3]. The treatment options for RA patients experiencing RA-related glenohumeral arthritis are largely limited to either anatomic total shoulder arthroplasty (aTSA) or reverse shoulder arthroplasty (RSA). However, performing TSA in patients with RA entails a greater complication profile, such as a heightened risk for infection from immunosuppressive medications [4,5], compromised rotator cuff integrity [1,6], and impaired bone quality from the systemic inflammation and corticosteroid use, making these patients more susceptible to acromial stress fractures [7,8], intraoperative fractures [7], and the sequelae of poor implant fixation [1].

Despite these challenges, a multicenter study by Lévigne et al. [9] demonstrated that RSA is a durable and effective treatment option for RA-related destruction of the glenohumeral joint, with a survivorship of 96% at 7-year follow-up. Conversely, in a systematic review of 279 shoulders, Haleem et al. [1] showed an expectedly lower revision-free survivorship of aTSA in RA patients, 87% at less than 7 years of follow-up. While numerous studies have reported on the outcomes of shoulder arthroplasty in patients with RA, there is a paucity of large-cohort studies that assess the risks of RA in comparison to primary osteoarthritis (OA). Understanding the comprehensive risk profile of RA patients is important for informed decision-making when considering surgical intervention. As such, the aim of this study was to compare both systemic and joint-related postoperative complications in patients undergoing primary TSA with RA versus those with primary OA.

## METHODS

### Study Design and Data Source

The TriNetX research database was retrospectively queried on January 20, 2024, for patients who underwent primary TSA from 2008 to 2024. TriNetX is a global health collaborative research platform that includes deidentified electronic health record data from 81 healthcare organizations and more than 170 million patients within the research network [10]. Data available include patient demographics, medications, lab values, diagnoses, and procedures. This study was exempt from institutional review board approval due to the use of solely deidentified patient information. TriNetX is a HIPAA-compliant national database that does not collect patient-identifying information. We did not interact directly with any of the patients included in this study, and thus informed consent could not be obtained.

### Cohort Selection and Outcomes

Patients who underwent primary TSA, including both aTSA and RSA, were identified using Current Procedural Terminology code 23472 and International Classification of Diseases, 10th edition (ICD-10) codes Z96.611 and Z96.612. The initial pool of patients was divided into two cohorts using ICD-10 codes: RA and OA. The RA cohort consisted of patients who underwent primary TSA with a prior diagnosis of RA (M05 and M06). The OA cohort consisted of patients who underwent primary TSA with a diagnosis of primary OA of the shoulder (M19.012, M19.011), excluding RA (M05 and M06). The primary outcomes assessed were major systemic complications within 90 days following primary TSA, including total complications, wound dehiscence, superficial surgical site infection (SSI), deep SSI, deep vein thrombosis, pulmonary embolism, myocardial infarction (MI), pneumonia, acute renal failure, urinary tract infection, readmission, stroke, death, and blood transfusions within 72 hours postoperatively.

A secondary analysis was performed to assess postoperative joint complications between RA and OA patients within 5 years following aTSA and RSA, respectively. Patients who underwent RSA were identified using ICD-10 codes specific to reverse prosthetic total arthroplasty: 0RRK00Z and 0RRJ00Z and SNOMED codes 733591007 and 733592000. RSA patients were divided into two cohorts, RA-RSA and OA-RSA, and outcomes assessed were scapular fracture, periprosthetic fracture, prosthetic dislocation, periprosthetic joint infection (PJI), and revision shoulder arthroplasty. Patients who underwent aTSA were identified using ICD-10 codes Z96.61 and Z96.612 and excluding ICD-10 codes K00Z and 0RRJ00Z and SNOMED codes 733591007 and 733592000. aTSA patients were divided into two cohorts, RA-aTSA and OA-aTSA, and outcomes assessed were periprosthetic fracture, prosthetic dislocation, PJI, and revision shoulder arthroplasty. Additionally, postoperative joint complications of aTSA and RSA in RA patients were compared.

Patients were excluded during the analysis if a studied outcome was present prior to surgery. Propensity (1:1) matching was employed to account for age, sex, race, essential (primary) hypertension, diabetes mellitus, obesity, heart failure, chronic obstructive pulmonary disease (COPD), cerebrovascular disease, chronic kidney disease (CKD), liver disease, and tobacco use for all analyses assessing outcomes between RA and OA patients.

### Statistical Analysis

The TriNetX platform incorporates analytical software that enables cohort selection, propensity score matching, and advanced data exploration and analysis. All statistical analyses were con-


https://doi.org/10.5397/cise.2024.00374

ducted through the TriNetX platform. Univariate analysis was performed using two-tailed Student t-tests for continuous variables and chi-square tests for categorical variables. Continuous variables were expressed as mean and standard deviation, and categorical variables were expressed as percentage. Statistical significance was determined at $P < 0.05$.

## RESULTS

### Demographics

Prior to propensity score matching, the RA cohort consisted of 8,588 patients, and the OA cohort consisted of 54,976 patients. Significant differences between the two cohorts were noted for age, sex, race, essential hypertension, diabetes mellitus, overweight and obesity, heart failure, COPD, cerebrovascular disease, CKD, liver disease, and tobacco use ($P < 0.05$).

Following 1:1 propensity score matching, our analysis included 8,523 patients in each cohort. After matching, there were no significant differences in patient demographics or comorbid characteristics ($P > 0.05$), except for American Indian or Alaska Native race ($P = 0.032$). In the RA cohort, the mean age was 68.9 ± 10.3 years, and 70.9% were female. In the OA cohort, the mean age was 69.2 ± 9.9 years, and 71.5% were female. In both cohorts, most patients, 70.9% and 71.5%, respectively, self-identified as white (Table 1). Of the 8,523 RA patients, 5,308 (62.3%) were rheumatoid factor- and/or anti-CCP antibody-positive. In the secondary analysis, postoperative joint complications were compared between RA and OA patients who underwent aTSA and RSA, respectively. Following 1 to 1 propensity score matching, the analysis included 5,720 patients in each of the RA-aTSA and OA-aTSA cohorts and 2,332 patients in each of the RA-RSA and OA-RSA cohorts.

### Postoperative Systemic Complications

Within 90 days following TSA, patients with RA had a significantly increased risk of total complications ($P < 0.001$; odds ratio [OR], 1.50; 95% confidence interval [CI], 1.21–1.85), wound dehiscence ($P = 0.001$; OR, 2.92; 95% CI, 1.47–5.79), deep SSI ($P = 0.024$; OR, 2.30; 95% CI, 1.10–4.84), MI ($P = 0.005$; OR, 1.82; 95% CI, 1.19–2.17), pneumonia ($P = 0.004$; OR, 1.60; 95% CI, 1.16–2.20), acute renal failure ($P < 0.001$; OR, 1.63; 95% CI, 1.24–2.15), urinary tract infection (UTI; $P = 0.003$; OR, 1.61; 95% CI, 1.17–2.23), readmission ($P = 0.012$; OR, 1.37; 95% CI, 1.07–1.76), and mortality ($P < 0.001$; OR, 2.00; 95% CI, 1.45–2.75) compared with OA patients. Patients in the RA cohort also had a significantly increased risk of a blood transfusion within 72 hours fol-

**Table 1.** Patient demographics and comorbid characteristics of non-matched and matched RA-TSA and OA-TSA patients

| Characteristic | Non-matched patient | | | Matched patient | | |
|---|---|---|---|---|---|---|
| | RA | OA | P-value | RA | OA | P-value |
| Total | 8,588 | 54,976 | | 8,523 | 8,523 | |
| Patient demographics | | | | | | |
| Age (mean ± SD, yr) | 68.9 ± 10.3 | 68.5 ± 10.0 | < 0.001 | 68.9 ± 10.3 | 69.2 ± 9.9 | 0.058 |
| Female sex (%) | 70.9 | 49.5 | < 0.001 | 70.9 | 71.5 | 0.379 |
| Race (%) | | | | | | |
| White | 78.0 | 79.9 | < 0.001 | 78.0 | 79.1 | 0.090 |
| Black or African American | 8.8 | 6.8 | < 0.001 | 8.8 | 8.4 | 0.543 |
| Hispanic or Latino | 4.3 | 3.0 | < 0.001 | 4.3 | 3.8 | 0.094 |
| American Indian or Alaska Native | 0.4 | 0.3 | 0.327 | 0.4 | 0.2 | 0.032* |
| Other race | 1.4 | 1.6 | 0.346 | 1.4 | 1.1 | 0.056 |
| Unknown race | 10.3 | 10.5 | 0.734 | 10.3 | 9.6 | 0.119 |
| Comorbidity (%) | | | | | | |
| Essential hypertension | 68.5 | 59.1 | < 0.001 | 68.5 | 69.4 | 0.196 |
| Diabetes mellitus | 26.0 | 21.5 | < 0.001 | 26.0 | 26.1 | 0.889 |
| Overweight and obesity | 34.0 | 28.4 | < 0.001 | 33.9 | 33.7 | 0.734 |
| Heart failure | 15.0 | 8.4 | < 0.001 | 15.0 | 14.6 | 0.463 |
| Chronic obstructive pulmonary disease | 17.4 | 9.7 | < 0.001 | 17.4 | 17.1 | 0.656 |
| Cerebrovascular disease | 16.4 | 11.0 | < 0.001 | 16.4 | 16.0 | 0.467 |
| Chronic kidney disease | 17.8 | 10.5 | < 0.001 | 17.8 | 17.8 | 0.984 |
| Liver disease | 13.0 | 9.1 | < 0.001 | 13.0 | 12.8 | 0.648 |
| Tobacco use | 4.1 | 3.8 | 0.176 | 4.1 | 3.8 | 0.307 |

RA: rheumatoid arthritis, TSA: total shoulder arthroplasty, OA: primary osteoarthritis, SD: standard deviation.
*Significant P-value < 0.05.

lowing TSA (P = 0.048; OR, 1.52; 95% CI, 1.00–2.30) compared to patients in the OA cohort (Table 2).

### Postoperative Joint Complications

Within 5 years following aTSA, patients with RA had a significantly higher risk of prosthetic dislocation (P = 0.001; OR, 1.58; 95% CI, 1.22–2.05) and PJI (P = 0.004; OR, 1.69; 95% CI, 1.18–2.44) compared with OA patients (Table 3). Within 5 years following RSA, RA patients had a significantly higher risk of scapular fracture (P < 0.001; OR, 2.15; 95% CI, 1.54–2.99), prosthetic dislocation (P < 0.001; OR, 1.78; 95% CI, 1.32–2.45), and PJI (P = 0.003; OR, 1.89; 95% CI, 1.23–2.92) compared with OA patients (Table 4). There were no significant differences in the risks of periprosthetic fracture and revision TSA between RA and OA patients following aTSA or RSA.

When comparing RSA and aTSA outcomes in RA patients,

**Table 2.** Ninety-day postoperative systemic complications for matched RA and OA patients

| Outcome | Incidence (%) | | OR | 95% CI | P-value |
|---|---|---|---|---|---|
| | RA | OA | | | |
| Total complications | 3.61 | 2.45 | 1.50 | 1.21–1.85 | 0.000* |
| Wound dehiscence | 0.38 | 0.13 | 2.92 | 1.47–5.79 | 0.001* |
| Superficial SSI | 0.33 | 0.23 | 1.40 | 0.79–2.45 | 0.248 |
| Deep SSI | 0.27 | 0.12 | 2.30 | 1.10–4.84 | 0.024* |
| Deep vein thrombosis | 0.63 | 0.41 | 1.54 | 0.99–2.40 | 0.052 |
| Pulmonary embolism | 0.50 | 0.56 | 0.90 | 0.59–1.38 | 0.632 |
| Myocardial infarction | 0.74 | 0.41 | 1.82 | 1.19–2.79 | 0.005 |
| Pneumonia | 1.30 | 0.82 | 1.60 | 1.16–2.20 | 0.004* |
| Acute renal failure | 1.81 | 1.11 | 1.63 | 1.24–2.15 | 0.000* |
| Urinary tract infection | 1.46 | 0.91 | 1.61 | 1.17–2.23 | 0.003* |
| Readmission | 1.76 | 1.29 | 1.37 | 1.07–1.76 | 0.012 |
| Stroke | 0.38 | 0.31 | 1.21 | 0.71–2.06 | 0.485 |
| Mortality | 1.32 | 0.67 | 2.00 | 1.45–2.75 | 0.000* |
| Blood transfusion < 72 hours | 0.66 | 0.43 | 1.52 | 1.00–2.30 | 0.048* |

RA: rheumatoid arthritis, OA: primary osteoarthritis, OR: odds ratio, CI: confidence interval, SSI: surgical site infection.
*Significant P-value < 0.05.

**Table 3.** Five-year postoperative joint complications for matched RA-aTSA and OA-aTSA

| Outcome | Incidence (%) | | OR | 95% CI | P-value |
|---|---|---|---|---|---|
| | RA-aTSA | OA-aTSA | | | |
| Periprosthetic fracture | 1.09 | 0.86 | 1.27 | 0.87–1.85 | 0.212 |
| Prosthetic dislocation | 2.65 | 1.69 | 1.58 | 1.22–2.05 | 0.001* |
| Periprosthetic joint infection | 1.39 | 0.83 | 1.69 | 1.18–2.44 | 0.004* |
| Revision TSA | 2.16 | 2.25 | 0.96 | 0.75–1.23 | 0.749 |

TSA: total shoulder arthroplasty, RA-aTSA: anatomic TSA patients with rheumatoid arthritis, OA-aTSA: anatomic TSA patients with primary osteoarthritis, OR: odds ratio, CI: confidence interval.
*Significant P-value < 0.05.

**Table 4.** Five-year postoperative joint complications for matched RA-RSA and OA-RSA

| Outcome | Incidence (%) | | OR | 95% CI | P-value |
|---|---|---|---|---|---|
| | RA-RSA | OA-RSA | | | |
| Periprosthetic fracture | 1.86 | 2.20 | 0.84 | 0.56–1.27 | 0.409 |
| Prosthetic dislocation | 5.13 | 2.92 | 1.78 | 1.32–2.45 | 0.000* |
| Periprosthetic joint infection | 2.61 | 1.39 | 1.89 | 1.23–2.92 | 0.003* |
| Revision TSA | 4.06 | 3.12 | 1.32 | 0.96–1.81 | 0.093 |
| Scapular fracture | 4.92 | 2.35 | 2.15 | 1.54–2.99 | 0.000* |

RSA: reverse shoulder arthroplasty, RA-RSA: RSA patients with rheumatoid arthritis, OA-RSA: RSA patients with primary osteoarthritis, OR: odds ratio, CI: confidence interval, TSA: total shoulder arthroplasty.
*Significant P-value < 0.05.


https://doi.org/10.5397/cise.2024.00374

those who underwent RSA had a significantly higher risk of prosthetic dislocation (P < 0.001; OR, 2.15; 95% CI, 1.55–2.97), PJI (P < 0.001; OR, 2.56; 95% CI, 1.59–4.12), scapular fracture (P < 0.001; OR, 2.52; 95% CI, 1.73–3.66), and revision (P < 0.001; OR, 2.24; 95% CI, 1.60–3.12) compared to those who underwent aTSA (Table 5).

## DISCUSSION

Although several studies have reported on the outcomes of shoulder arthroplasty in patients with RA, there is a paucity of large-cohort studies evaluating the risks relative to patients with primary OA. In this study, we compared both systemic and joint-related complications following TSA in 1 to 1 matched cohorts of patients with RA and OA using a large, up-to-date national database. Within 90 days following TSA, RA patients had significantly higher risk of total complications, wound dehiscence, deep SSI, MI, pneumonia, acute renal failure, UTI, readmission, and mortality. Additionally, RA patients exhibited an increased likelihood of a blood transfusion within 72 hours following surgery. Furthermore, within 5 years following aTSA or RSA, RA patients showed a significantly higher risk of prosthetic dislocation and PJI, and a significantly higher risk of scapular fractures was observed in patients treated with RSA.

Our study found a greater incidence of systemic complications in RA patients compared to OA patients in the first 90 days following TSA. As a systemic autoimmune disease, RA causes damage not only to joints, but also to other tissues and organs [11]. The incidence of cardiovascular disease in RA patients ranges from 30% to 60%, and such disease is the most common cause of death in this population [11,12]. Our study found RA patients to have a two-fold greater incidence of MI and mortality within 90 days after surgery compared to OA patients. This contrasts reported outcomes in the total hip/total knee arthroplasty (THA/TKA) literature, in which no significant difference in MI and mortality rates was found between RA and OA patients [13,14]. In addition, a significantly higher incidence of pneumonia was found in the RA cohort. Respiratory complications can occur in 30%–40% of RA patients and is the second leading cause of death [11,12].

Significantly greater postoperative rates of wound complications including dehiscence, deep SSIs, and readmissions were found in RA patients, which coincides with outcomes reported in the THA/TKA literature [13-17]. The greater rate of aseptic wound complications exhibited in the RA cohort may be attributed to the abundant presence of tumor necrosis factor-alpha, which can inhibit granulation tissue formation and disrupt wound healing [18]. Patients with RA were more likely to receive a blood transfusion within 72 hours postoperatively. Anemia is a common comorbidity in patients with RA, prevalent in 33%–60% of patients, and may explain the greater incidence of blood transfusions in RA patients [19]. Though some cases may result from iron deficiency caused by gastrointestinal bleeding secondary to non-steroidal anti-inflammatory drugs use, the anemia observed in RA patients is more likely a consequence of chronic inflammation and increased production of proinflammatory cytokines [19].

Furthermore, RA patients had a significantly higher risk of PJI and prosthetic dislocation within 5 years following surgery for aTSA or RSA. While superficial SSIs were similar in the two cohorts, RA patients had significantly higher rates of deep SSIs and PJIs postoperatively. Nezwek et al. [20] conducted a retrospective review of 902 RSA patients to explore risk factors for infection within 3 months postoperatively. In their study, patients with RA had a 3.5 times greater risk of developing a PJI compared to non-RA patients [20]. Patients with RA may be susceptible to infections due to immunosuppressive drugs, such as steroids and DMARDs. Therefore, physicians should maintain a heightened index of suspicion of postoperative infection in RA patients who present with persistent unexplained shoulder pain postoperatively [20]. The chronic inflammatory effects of RA may compromise the soft tissue around the shoulder as well, which may pre-

**Table 5.** Five-year postoperative joint complications for matched RA-RSA and RA-aTSA

| Outcome | Incidence (%) | | OR | 95% CI | P-value |
|---|---|---|---|---|---|
| | RA-RSA | RA-aTSA | | | |
| Periprosthetic fracture | 1.95 | 1.27 | 1.55 | 0.97–2.46 | 0.063 |
| Prosthetic dislocation | 5.14 | 2.46 | 2.15 | 1.55–2.97 | < 0.001* |
| Periprosthetic joint infection | 2.61 | 1.04 | 2.56 | 1.59–4.12 | < 0.001* |
| Revision | 4.18 | 1.70 | 2.52 | 1.73–3.66 | < 0.001* |
| Scapular fracture | 4.88 | 2.24 | 2.24 | 1.60–3.12 | < 0.001* |

RA-RSA: reverse shoulder arthroplasty patients with rheumatoid arthritis, RA-aTSA: anatomic total shoulder arthroplasty patients with rheumatoid arthritis, OR: odds ratio, CI: confidence interval.
*Significant P-value < 0.05.

dispose patients to higher rates of prosthetic dislocation. Within 5 years following RSA, RA patients demonstrated a more than two-fold greater incidence of scapular fractures. This outcome aligns with previous studies that have demonstrated RA to be a strong predictor of postoperative acromial and scapular spine stress fractures [8,21-25]. RA can cause significant bone loss and reduced bone strength, resulting in a higher risk of fracture [26]. However, no significant difference in the incidence of periprosthetic fractures was found. With increased postoperative joint complications in RA patients, the revision rate was slightly increased compared to OA patients following RSA, but this did not reach statistical significance (4.06% vs. 3.12%, P = 0.093).

Reverse and anatomic TSA are both indicated in the setting of end-stage glenohumeral joint arthritis secondary to RA. While RSA has become increasingly favored over aTSA in the treatment of RA patients due to concerns over the integrity of the rotator cuff and managing glenoid bone loss, in our study, the RA-aTSA cohort (5,720 patients) was larger than the RA-RSA cohort size (2,332 patients). Nevertheless, both surgical options are effective in restoring function and reducing pain [1,25,27]. Garcia et al. [27] performed a retrospective study comparing clinical outcomes and complications of aTSA and RSA in 86 patients with inflammatory arthritis, with a mean follow-up of 51.6 months. The authors showed that both aTSA and RSA significantly improved patient-reported outcome measures and range of motion; although, aTSA exhibited significantly greater improvement and final postoperative outcome scores than RSA [27]. While the authors demonstrated no significant difference in complication rates between aTSA and RSA in RA patients [27], our study found that patients who underwent RSA had significantly higher risk of prosthetic dislocation, PJI, and scapular fracture. Additionally, we found that patients who underwent RSA had a higher revision rate compared to those who underwent aTSA. However, this contrasts with findings of a systematic review of 279 shoulders by Lévigne et al. [9] showing RSA to be a durable and effective option with a revision-free survivorship of 96% at a 7-year follow-up, which was greater than the 87% revision-free survivorship reported for aTSA [1].

Our study had several limitations. First, the data were sourced from electronic medical record databases of healthcare organizations, originally intended for clinical practice rather than research. Additionally, the dataset was limited to electronic medical records and lacked chart review data. Hence, certain essential health information may have been underreported, and inaccurate diagnoses and coding of clinical events may have occurred. The use of ICD codes may not consistently classify all relevant diagnoses, procedures, or adverse events, which may have affected the cohorts created and the outcome variables studied. In particular, we were unable to control for rotator cuff health in patients undergoing TSA for primary OA. Despite these limitations, this study is the first to assess and compare postoperative complications after TSA in patients with RA to those in patients with OA.

## CONCLUSIONS

Following TSA, RA patients should be considered at a higher risk compared to patients with primary OA. RA is associated with significantly higher systemic complication rates within 90 days, including wound dehiscence, deep SSI, MI, pneumonia, acute renal failure, urinary tract infection, blood transfusion, readmission, and mortality. Patients with RA also have an elevated 5-year risk of PJIs and prosthetic dislocations following aTSA and RSA, as well as scapula fractures following RSA in comparison to patients with OA. Knowledge of the comprehensive risk profile of RA patients undergoing TSA is essential for appropriate patient counseling and education. Further studies are necessary to enhance our understanding of the increased risks associated with RA and to explore postoperative management following shoulder arthroplasty in this higher-risk patient population.

## NOTES

### ORCID

Peter Boufadel https://orcid.org/0000-0001-7078-9148
Ryan Lopez https://orcid.org/0000-0002-5757-1782
Mohamad Y. Fares https://orcid.org/0000-0001-8228-3953
Mohammad Daher https://orcid.org/0000-0002-9256-9952
Joseph A. Abboud https://orcid.org/0000-0002-3845-7220

### Author contributions

Conceptualization: PB, MYF. Data curation: PB, JL, RL, MD. Formal analysis: PB, JL. Investigation: PB, JL, RL, MYF, AZK, BWH, JAA. Methodology: PB, RL, MYF, MD, AZK, BWH, JAA. Resources: JL. Software: JL. Supervision: AZK, BWH, JAA. Validation: PB, MYF. Writing – original draft: PB, RL. Writing – review & editing: PB, MYF, MD, AZK, BWH, JAA.

### Conflict of interest

AZK would like to disclose to receive support for education from Arthrex, Medical Device Business Services, and Elite Orthopedics and hospitality payments from Stryker and Exactech. JAA would like to disclose royalties from: DJO Global, Zimmer-Biomet, Smith and Nephew, Stryker, Globus Medical Inc. Research sup-


https://doi.org/10.5397/cise.2024.00374

port from: Lima Corporation - Italy, Orthofix, Arthrex, OREF. Royalties, financial or material support from: Wolters Kluwer. Board member/committee appointments for: American Shoulder and Elbow Society, Pacira.

**Funding**
None.

**Data availability**
Contact the corresponding author for data availability.

**Acknowledgments**
None.

## REFERENCES

1. Haleem A, Shanmugaraj A, Horner NS, Leroux T, Khan M, Alolabi B. Anatomic total shoulder arthroplasty in rheumatoid arthritis: a systematic review. Shoulder Elbow 2022;14:142–9.
2. Scott DL, Wolfe F, Huizinga TW. Rheumatoid arthritis. Lancet 2010;376:1094–108.
3. Lehtinen JT, Kaarela K, Belt EA, Kautiainen HJ, Kauppi MJ, Lehto MU. Incidence of glenohumeral joint involvement in seropositive rheumatoid arthritis: a 15 year endpoint study. J Rheumatol 2000;27:347–50.
4. Zumstein MA, Pinedo M, Old J, Boileau P. Problems, complications, reoperations, and revisions in reverse total shoulder arthroplasty: a systematic review. J Shoulder Elbow Surg 2011;20:146–57.
5. Morris BJ, O'Connor DP, Torres D, Elkousy HA, Gartsman GM, Edwards TB. Risk factors for periprosthetic infection after reverse shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:161–6.
6. Lehtinen JT, Belt EA, Lybäck CO, et al. Subacromial space in the rheumatoid shoulder: a radiographic 15-year follow-up study of 148 shoulders. J Shoulder Elbow Surg 2000;9:183–7.
7. Young AA, Smith MM, Bacle G, Moraga C, Walch G. Early results of reverse shoulder arthroplasty in patients with rheumatoid arthritis. J Bone Joint Surg Am 2011;93:1915–23.
8. ASES Complications of RSA Research Group; Lohre R, Swanson DP, et al. Risk factors of acromial and scapular spine stress fractures differ by indication: a study by the ASES Complications of Reverse Shoulder Arthroplasty Multicenter Research Group. J Shoulder Elbow Surg 2023;32:2483–92.
9. Lévigne C, Chelli M, Johnston TR, et al. Reverse shoulder arthroplasty in rheumatoid arthritis: survival and outcomes. J Shoulder Elbow Surg 2021;30:2312–24.
10. TriNetX. Real-world data for the life sciences and healthcare [Internet]. TriNetX; 2024 [cited 2024 Jun 20]. Available from: https://trinetx.com/
11. Wu D, Luo Y, Li T, et al. Systemic complications of rheumatoid arthritis: focus on pathogenesis and treatment. Front Immunol 2022;13:1051082.
12. Figus FA, Piga M, Azzolin I, McConnell R, Iagnocco A. Rheumatoid arthritis: extra-articular manifestations and comorbidities. Autoimmun Rev 2021;20:102776.
13. Qiao Y, Li F, Zhang L, et al. A systematic review and meta-analysis comparing outcomes following total knee arthroplasty for rheumatoid arthritis versus for osteoarthritis. BMC Musculoskelet Disord 2023;24:484.
14. Zhang Y, Chu SS, Liu K, Huang Q, Wang Y. Outcomes in patients with rheumatoid versus osteoarthritis for total hip arthroplasty: a meta-analysis and systematic review. Semin Arthritis Rheum 2022;56:152061.
15. Jiang W, Xu H, Wang X, et al. More complications and higher transfusion rate in patients with rheumatoid arthritis than osteoarthritis undergoing total hip arthroplasty. Int Orthop 2023;47:1189–96.
16. Singh JA, Inacio MC, Namba RS, Paxton EW. Rheumatoid arthritis is associated with higher ninety-day hospital readmission rates compared to osteoarthritis after hip or knee arthroplasty: a cohort study. Arthritis Care Res (Hoboken) 2015;67:718–24.
17. Jauregui JJ, Kapadia BH, Dixit A, et al. Thirty-day complications in rheumatoid patients following total knee arthroplasty. Clin Rheumatol 2016;35:595–600.
18. Moelants EA, Mortier A, Van Damme J, Proost P. Regulation of TNF-α with a focus on rheumatoid arthritis. Immunol Cell Biol 2013;91:393–401.
19. Wilson A, Yu HT, Goodnough LT, Nissenson AR. Prevalence and outcomes of anemia in rheumatoid arthritis: a systematic review of the literature. Am J Med 2004;116 Suppl 7A:50S–57S.
20. Nezwek TA, Dutcher L, Mascarenhas L, et al. Prior shoulder surgery and rheumatoid arthritis increase early risk of infection after primary reverse total shoulder arthroplasty. JSES Int 2021;5:1062–6.
21. ASES Complications of RSA Research Group; Mahendraraj KA, Abboud J, et al. Predictors of acromial and scapular stress fracture after reverse shoulder arthroplasty: a study by the ASES Complications of RSA Multicenter Research Group. J Shoulder Elbow Surg 2021;30:2296–305.
22. Routman HD, Simovitch RW, Wright TW, Flurin PH, Zuckerman JD, Roche CP. Acromial and scapular fractures after reverse total shoulder arthroplasty with a medialized glenoid and lateralized humeral implant: an analysis of outcomes and risk

factors. J Bone Joint Surg Am 2020;102:1724–33.
23. King JJ, Dalton SS, Gulotta LV, Wright TW, Schoch BS. How common are acromial and scapular spine fractures after reverse shoulder arthroplasty?: a systematic review. Bone Joint J 2019; 101:627–34.
24. Miller M, Chalmers PN, Nyfeler J, et al. Rheumatoid arthritis is associated with increased symptomatic acromial and scapular spine stress fracture after reverse total shoulder arthroplasty. JSES Int 2020;5:261–5.
25. Cho CH, Kim DH, Song KS. Reverse shoulder arthroplasty in patients with rheumatoid arthritis: a systematic review. Clin Orthop Surg 2017;9:325–31.
26. Fardellone P, Salawati E, Le Monnier L, Goëb V. Bone loss, osteoporosis, and fractures in patients with rheumatoid arthritis: a review. J Clin Med 2020;9:3361.
27. Garcia JR, Cannon D, Rodriguez HC, et al. Comparison of reverse shoulder arthroplasty and total shoulder arthroplasty for patients with inflammatory arthritis. J Shoulder Elbow Surg 2023;32:573–80.


https://doi.org/10.5397/cise.2024.00374