

Title: Trends in Revision Shoulder Arthroplasty: Changing Rates, Indications, and Treatments

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Background: Primary shoulder arthroplasty is now one of the most common surgeries performed in orthopaedics; subsequently, revision shoulder arthroplasty is becoming more prevalent. It is unclear what challenges await surgeons with this evolving burden. This study aims to describe the rate at which revision shoulder arthroplasty is increasing as well as trend changing indications and treatment strategies.

Methods: This is a retrospective review of prospectively collected single surgeon database from 2002-2022. Patients undergoing revision shoulder arthroplasty were identified using CPT codes 23472 and 23332 (before 2014) and 23474 (2014 and later). Any surgery that exposed deep components was included. Patients were excluded if the original surgery was ORIF/IMN, the revision was a superficial debridement or an arthroscopic procedure, or if there was insufficient data to determine surgery type or indication. The primary outcome was the change in the rate of revision surgery year-over-year. Secondary outcomes include trends in the type of revision performed, revision indication, and re-revision rate. Infection status was determined by either a patient having an infection listed as their primary indication in the operative note or post-operative intravenous antibiotics for 6-week duration. For two stage revisions, the first and second stage surgeries were counted as independent surgeries. Simple statistics were calculated.

Results: During the 20-year period, 859 patients underwent 1030 revision surgeries, or 52 revisions per year (52 \pm 12 range 14-66). This reflects 20% of the surgeon's overall shoulder arthroplasty volume (20 \pm 2.5 range 8-24). The average time to revision was 41 months (41 \pm 47.5 range 0-229). Figure 1 depicts the failed implants that required revision. This represents 358 failed hemiarthroplasties (HA), 312 failed anatomic total shoulder arthroplasties (TSA), 358 failed reverse shoulder arthroplasties (RSA) and 2 failed resection arthroplasties. Revisions of failed HA decreased, while revisions of failed TSA and RSA continue to rise. Figure 2 depicts what patients were revised to, or the type of revision performed, demonstrating that RSA was used in most cases (85%). The indications for revision are listed in Table 1. The following are the most common by implant type: HA failed because of rotator cuff failure (45%) and glenoid wear (34%); TSA failed because of glenoid loosening (40%) and rotator cuff failure (33%); RSA failed because of instability (30%), baseplate failure (28%), and infection (26%). One hundred thirty patients required multiple revisions, an overall 15% rate of re-revision. The re-revision rate by implant was 15% HA, 12% TSA, 20% RSA. Humeral loosening, infection, and instability had the highest rates of re-revision. All indications for re-revision are listed in Table 1.

Conclusions: There is an increasing burden of revision shoulder arthroplasty. The rate of revision shoulder arthroplasty increased 12% over 20 years, now comprising 20% of shoulder arthroplasty volume. TSA and RSA failures are rising as more primary shoulder arthroplasty is performed. Revisions performed for humeral loosening, infection, and instability had the highest rate of multiple revisions. These failures pose unique challenges for surgeons and are opportunities for innovation.

Figure 1. Trends of failed implants (revised from). Failed TSA and RSA are rising; failed HA are declining.

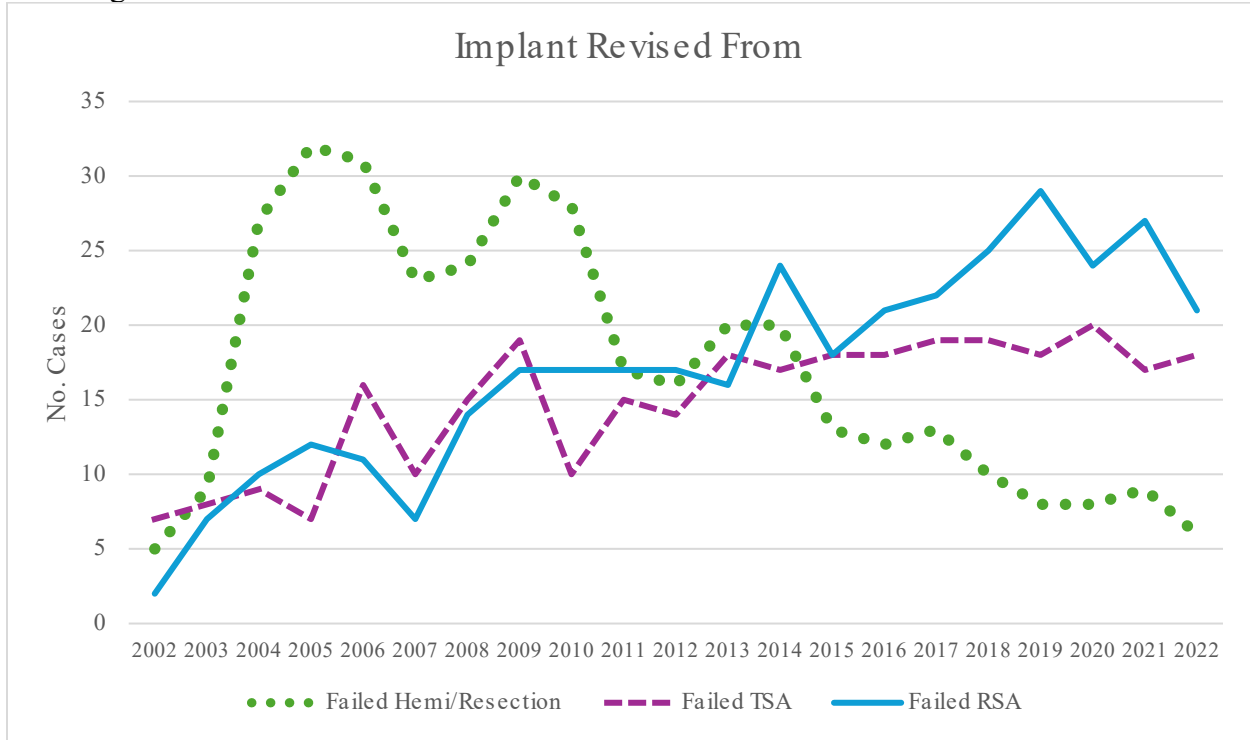


Figure 2. Trends of revisions preformed (revised to). RSA is the dominant implant used for revision through the study period.

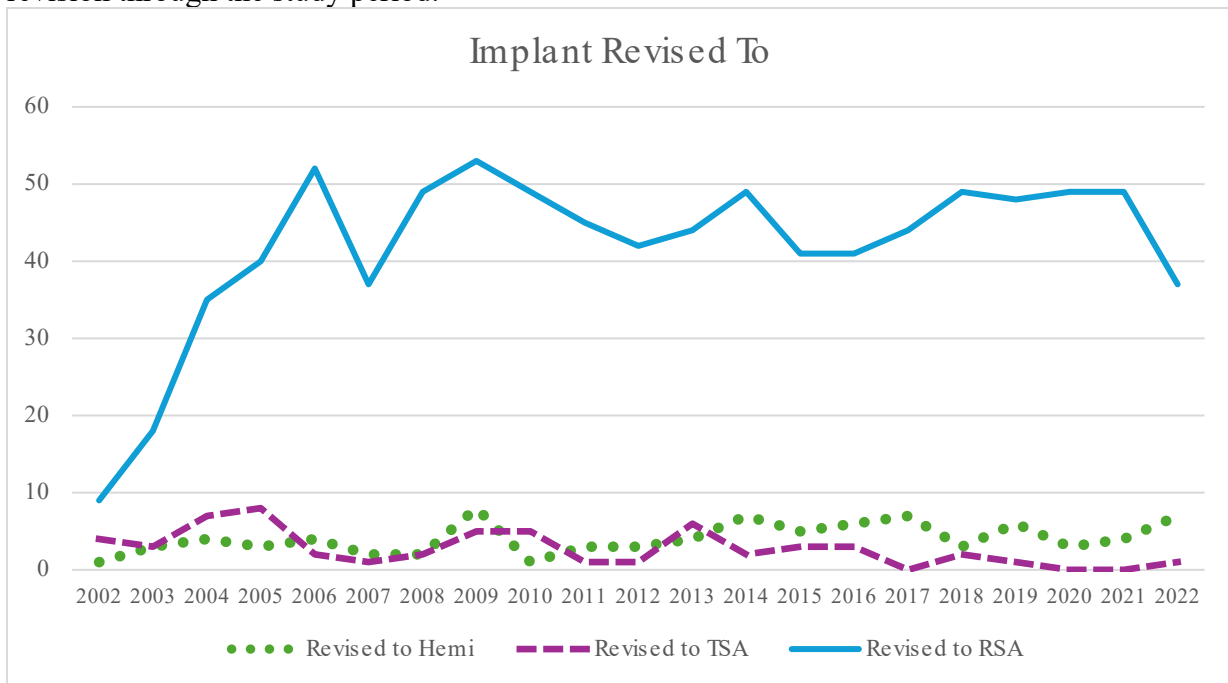


Table 1. Indications for revision and re-revision. The three highest values in each column are bolded.

Indication	No. Patients	Percentage Revision Volume	Percentage Requiring Re-Revision
Rotator cuff failure (TSA, HA)	249	29%	12%
Infection (HA, TSA, RSA)	139	16%	26%
Glenoid loosening (TSA)	120	14%	13%
OA progression (HA)	112	13%	8%
Instability (HA, TSA, RSA)	90	10%	17%
Baseplate failure (RSA)	62	7%	13%
Humeral loosening (HA, TSA, RSA)	43	5%	33%
Periprosthetic fracture (HA, TSA, RSA)	25	3%	0%
Glenoid loosening and rotator cuff failure (TSA)	19	3%	11%