# Bilateral Shoulder Arthroplasty for Rotator Cuff Intact Glenohumeral Osteoarthritis: Anatomic vs Reverse Shoulder Arthroplasty

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INTRODUCTION:

The primary purpose is to analyze patients with rotator cuff intact glenohumeral osteoarthritis (RCI GHOA) who have undergone primary anatomic total shoulder arthroplasty (aTSA) and contralateral primary reverse total shoulder arthroplasty (rTSA), or vice versa, and determine differences in clinical outcomes and rate of revision surgery. The secondary purpose is to determine if patients with bilateral RCI GHOA have similar patterns of pathology between shoulders. The tertiary purpose is to radiographically evaluate the quality of reconstruction and to gauge how changes in the center-of-rotation (COR) for aTSA and anatomic reverse center (ARC) for rTSA impact patient-reported outcomes.

METHODS:

This was a retrospective review of prospectively collected data of a single surgeon, single institution database. The inclusion criteria were patients with bilateral RCI GHOA who underwent primary aTSA and subsequently contralateral primary rTSA, or vice versa, between January 2004 and January 2023. Glenoid morphology including retroversion, inclination, and posterior humeral head subluxation were calculated using a surgical planning software. Postoperatively, patient-reported outcomes (PROs) and range of motion (ROM) were measured at various time points (3-6 months, 12 months, 24 months, and final follow-up) as well as revision surgery.

aTSA and rTSA reconstructions were also evaluated using the following methods: For aTSA reconstructions, the best-fit method, which was previously published and validated, was used to compare differences between the anatomic COR and prosthetic COR. For rTSA reconstructions, a novel technique was used to compare differences between the anatomic COR and prosthetic point of maximal inlay (PPMI) within the humeral component to evaluate differences in the anatomic reverse center. The PPMI within the humeral component was calculated by first drawing a best-fit circle around the glenosphere. Then, two additional lines were made: the first along the humeral tray from the two farthest points and the second line perpendicular to the humeral tray through the glenosphere. The intersection point between the best-fit circle and the perpendicular line represented the ARC. A subgroup analysis was performed to further divide aTSA and rTSA shoulders based on the postoperative changes in COR and ARC, respectively.

RESULTS:

The entire cohort featured 24 (48%) females and 26 (52%) males. Six (12%) aTSA shoulders underwent revision during the follow-up period compared to 1 (2.00%) rTSA shoulder ($p = 0.02$). The mean follow-up times for aTSA and rTSA shoulders were 7.16 years and 4.72 years, respectively ($p < 0.001$). Both aTSA and rTSA shoulders demonstrated similar patterns of preoperative glenoid pathology: glenoid retroversion (aTSA: 19.8° v rTSA: 17.5°, $p = 0.323$), glenoid inclination (aTSA: 5.6° v rTSA: 5.9°, $p = 0.718$), and posterior humeral head subluxation (aTSA: 71.7% v rTSA 68.5%, $p = 0.262$). There were no significant differences for ASES score between aTSA and rTSA shoulders at any time point. (**Table 1**) Similarly, there were no significant differences for VAS and SST scores between aTSA and rTSA at all follow-up time points apart from lower VAS pain for rTSA than aTSA (1.46 v 2.65, $p = 0.041$) at final follow-up. For ROM, rTSA had increased forward elevation (rTSA: 163.1° v aTSA: 147.0°, $p = 0.023$) at final follow-up, whereas aTSA had increased internal rotation (aTSA: 5.72 vertebral levels v rTSA: 4.37 vertebral levels, $p = 0.023$).

For changes in COR for aTSA, the mean prosthetic COR was shifted 1.87 mm medial and 1.22 mm proximal, which accounted for a total ΔCOR of 3.71 mm. For changes in ARC for rTSA, the PPMI was shifted 3.44 mm medial and 1.52 mm proximal, which accounted for a total ΔARC of 4.84 mm. aTSA shoulders with ΔCOR ≤3 mm experienced significantly greater increases in ΔASES score than those with ΔCOR >3 mm at the 3-6 month (≤3 mm: 53.6 v >3 mm: 40.3, $p = 0.023$) and at final follow-up (≤3 mm: 57.8 v >3 mm: 27.1, $p < 0.001$). When comparing rTSA shoulders with ΔARC ≤3 mm and >3 mm, there were no statistically significant differences in ASES score at any follow-up time point. One (4.5%) aTSA with ΔCOR ≤3 mm underwent revision shoulder arthroplasty, whereas 5 (17.8%) aTSA with ΔCOR >3 mm underwent revision shoulder arthroplasty. For rTSA, there were no revisions in the ΔARC ≤3 mm group and just 1 (2.7%) revision in the ΔARC >3 mm subgroup. There was no significant difference for survivorship among the four stratified groups ($p = 0.389$). (**Figure 1**)

DISCUSSION AND CONCLUSION: In patients who underwent bilateral primary shoulder arthroplasty (aTSA then contralateral rTSA, or vice versa) for RCI GHOA, aTSA and rTSA shoulders experienced no difference in functional outcomes or range of motion. aTSA shoulders experienced a slightly higher, non-significant, rate of revision surgery. Shoulders undergoing aTSA or rTSA also had similar patterns of glenoid pathology. Lastly, aTSA reconstructions with a ΔCOR >3 mm had worse functional outcomes and higher rates of revision than those with ΔCOR ≤3 mm, whereas there was no difference in functional outcomes or rate of revisions for rTSA reconstructions with a ΔARC ≤3 mm or >3 mm.

**Figure 1**

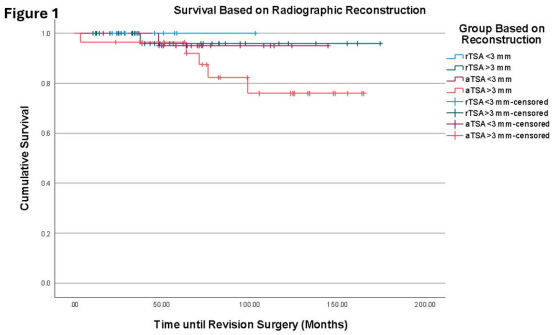


**Table 1**

| | aTSA | rTSA | p-value |
|---|---|---|---|
| Preoperative | 32.2 | 30.8 | 0.699 |
| 3-6 Months | 79.0 | 76.1 | 0.451 |
| 12 Months | 77.7 | 86.7 | 0.530 |
| 24 Months | 87.0 | 84.6 | 0.615 |
| Final Follow-Up | 72.8 | 81.2 | 0.063 |