Short-Term Outcomes of Anatomic Total Shoulder Arthroplasty with a Posteriorly Augmented Glenoid vs. Reverse Total Shoulder Arthroplasty for Posterior Glenoid Bone Loss in Glenohumeral Osteoarthritis

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INTRODUCTION: Posterior glenoid bone loss is challenging to address in the setting of end-stage glenohumeral osteoarthritis (GHOA). A variety of treatments, including anatomic total shoulder arthroplasty (TSA) with or without a posteriorly augmented glenoid (PAG) and reverse TSA (RTSA), have been described with success in this setting. However, comparative studies of patients with similar preoperative morphologies and different treatment options are lacking. This study compares TSA with PAG and RTSA in patients with posterior glenoid bone loss with GHOA at minimum 2 year follow up. We hypothesize that patients will have similar patient-reported outcome scores (PROMs), but RTSA will have a higher rate of reoperation.

METHODS:

We retrospectively identified a cohort of 74 patients from 103 consecutive patients with GHOA and B2 or B3 glenoids who underwent primary TSA with PAG with minimum 2-year follow up or earlier reoperation and preoperative 3D CT scan from Jan 2010-Apr 2015 (PAG group). The 29 exclusions were for <2 year outcome scores (22), and phone follow up only (7). All patients with a PAG had a goal of placing the glenoid component to recreate the premorbid joint line and version. We identified a comparative cohort of 40 patients from 59 consecutive patients with GHOA and B2 or B3 glenoids who underwent primary RTSA with or without bone graft with minimum 2-year follow up or earlier reoperation and preoperative 3D CT scan from Jan 2010-Feb 2016 (RTSA group). The 19 exclusions were for <2 year outcome scores due to being deceased (8), declined (7), or no 2-year outcome scores with clinical visits (4). All patients were classified as Walch B2 or B3 glenoids by consensus reads from fellowship trained shoulder surgeons based on the preoperative 3D CT scans. Patients were indicated for RTSA based on glenoid bone loss and not for a rotator cuff tear. All RTSA patients had a goal of achieving solid baseplate seating with recreation of the premorbid joint line and version with or without bone graft. Humeral head autograft was used as bone graft in 38/40 patients, including 19/21 patients with a lateralized glenosphere design and 19/19 with a medialized Grammont-style design.

Demographic, intraoperative, and clinical exam variables were collected from the electronic medical record, and postoperative radiographic data and PROMs were collected at most recent follow up. Our primary outcome of interest was the Penn Shoulder Score (PSS) at minimum 2 years. Secondary outcome was revision surgery. Parametric and non-parametric tests were used depending on normality of distribution of data, and paired-tests were used to analyze pre and postoperative data. Fisher's exact test was used when appropriate when comparing proportions. A one-tailed test was used when comparing reoperations, and two-tailed for other comparisons.

RESULTS:

Overall patient demographics are presented in Table 1. Median follow up for the 105 patients who did not undergo reoperation was 2.5 years (range 1.8-5.7). All patients improved from before to after surgery for range of motion (ROM) and PSS ($p<0.0001$).

More reoperations occurred in RTSA patients (6/40, 15%) than PAG patients (3/74, 4%) ($p=0.047$). The PAG group had 3 patients undergo reoperation in the study period (early revision subscapularis repair, arthroscopic biopsy for painful arthroplasty, revision to RTSA for rotator cuff failure), compared to 6 RTSA patients with reoperations (4 glenoid revisions for baseplate failure, 1 ORIF for periprosthetic fracture, 1 glenosphere and poly exchange for infection). One RTSA patient had a second surgery for periprosthetic fracture after baseplate revision. There was no difference in time to reoperation between groups (PAG median 23 months, range 4-103 months, RTSA median 28 months, range 8-38 months, $p=1.00$). In the RTSA group, 2 revisions were in lateralized implants with bone graft, and 4 were in Grammont-style implants with bone graft, which was not statistically significant ($p=0.76$). There were also no significant differences in age at surgery, sex, or Walch classification when comparing all patients with ($n=9$) and without ($n=105$) a reoperation, although there was a trend ($p=0.09$) toward higher frequency of B3 glenoids in reoperation cases (7/9, 78%) compared to patients without reoperation (48/105, 46%).

When excluding reoperations, 71 PAG and 34 RTSA patients were available for comparison at minimum 2 years (Table 1). RTSA patients were older and more likely to have a B3 glenoid. While there were no differences in final PSS, change in PSS, or PSS<80 between groups, a significant difference in internal rotation (IR) was found. RTSA patients had slightly better IR, but there was ~50% missing IR data in the PAG group. Linear regression models for PSS and PSS Change were run with age, sex, Walch type, groups (PAG vs. RTSA), and PSS follow-up time, and neither model was found to be significant ($p=0.27$ and $p=0.65$ respectively).

DISCUSSION AND CONCLUSION:

This study suggests both TSA with PAG and RTSA are good options for addressing posterior glenoid bone loss in GHOA. Both implant types show significant improvement in ROM and PSS. Patients who underwent RTSA were more likely to have a B3 glenoid, be older at time of surgery, and had higher rates of reoperation. Further investigation into the risk factors for implant failure and reoperation for TSA and RTSA at longer follow up are necessary to optimize patient-specific treatment options for posterior glenoid bone loss.

TABLE 1

	All Patients n=114	No Reoperations		
		aTSA with PAG (n=71)	RTSA (n=34)	p-value
Age at Surgery (yrs)	66 ± 7 (51-80)	64 ± 7 (51-80)	69 ± 6 (52-80)	0.001*
Male Female	85 (75) 29 (25)	55 (77) 16 (23)	23 (68) 11 (32)	0.28
Walch B2 B3	 59 (52) 55 (48)	 46 (65) 25 (35)	 11 (32) 23 (68)	 0.002*
aTSA with PAG RTSA	74 (65) 40 (35)			
Preop ROM FF (°) (n=67, 34) ER (°) (n=66, 34} IR (°) (n=36, 33)	 108 [90-140] (50-170) 20 [10-35] (-30-60) L3 [L3-S1] (T6-GT)	 110 [90-140] (60-170) 20 [10-30] (0-60) L5 [L3-Buttock] (T6-GT]	 98 [90-136] (50-160) 20 (10-36) [-30-60] L3 [T12-L4] (T6-GT)	 0.25 0.90 0.0002*
Preop PSS (n=49, 33)	30 [17-43] (0-71)	30 [16-43] (5-66)	33 [23-44] (6-71)	0.33
Radiographic Follow-Up Time (yrs) (n=71, 34)	2.4 [2.1-3.3] (1.8-5.7)	2.4 [2.1-3.2] (1.9-5.7)	2.3 [2.0-4.2] (1.8-5.4)	0.39
Clinical Follow-up Time (yrs) (n=64, 33)	2.4 [2.1-3.2] (1.8-5.7)	2.4 [2.1-3.2] (1.9-5.7)	2.2 [2.0-3.9] (1.8-5.4)	0.58
Postop ROM n=105 FF (°) (n=63, 33) ER (°) (n=60, 33) IR (°) (n=33, 33)	 160 [145-165] (90-180) 50 [45-60] (10-80) T12 [T6-T12] (T6-Buttock)	 160 [150-170] (90-180) 50 [40-60] (10-80) T12 [T7-L3] (T6-Buttock)	 160 [145-165] (100-170) 50 [45-55] (20-60) T12 [T6-T12] (T6-Sacrum)	 0.30 0.58 0.03*
PSS Follow-up Time (yrs) (n=71, 34)	2.5 [2.1-3.5] (1.8-5.7)	2.5 [2.1-3.3] (1.9-5.7)	2.4 [2.0-4.2] (1.8-5.3)	0.65
Postop PSS (n=71, 34)	95 [88-98] (37-100)	94 [88-98] (51-100)	96 [90-99] (37-100)	0.29
PSS Change (n=71, 34)	61 [46-71] (19-92)	61 [46-73] (19-88)	61 [46-68] (25-92)	0.66
PSS< 80? (n=71, 34)	9 (9)	7 (10%)	2 (6%)	0.72
Reoperation?	9 (8)			
Time to Reoperation (months)	23 [8-36] (4-103)			

Mean ± Standard Deviation (Range), N (%), Median [Interquartile Range] (Range), Anatomic Total Shoulder Arthroplasty (aTSA), Reverse Total Shoulder Arthroplasty (RTSA), Posteriorly Augmented Glenoid (PAG), Range of Motion (ROM), Forward Flexion (FF), External Rotation (ER), Internal Rotation (IR), Penn Shoulder Score (PSS)