Shoulder Arthroplasty Evolution: Comparing Reverse, Anatomic, and Hemiarthroplasty Trends and Outcomes in Key Demographics at a High-Volume Institution

James Fuchs Gannon, Mitchell Thomas Pfennig, Anthony Arveschoug, Betina Bremer Hinckel, J Michael Wiater[1], Leonardo M Cavinatto
[1]Beaumont Health

INTRODUCTION:

The field of shoulder arthroplasty has changed markedly since the inception of the reverse total shoulder arthroplasty (RTSA) in 2004. With yearly gains of 32%, the RTSA now encompasses the largest portion of shoulder arthroplasty procedures. In contrast, the anatomic total shoulder arthroplasty (ATSA) and hemiarthroplasty (HA) have steadied or decreased in usage. Some have offered several explanations for these trends, such as expanding indications for the RTSA, in particular for pathologies traditionally treated with ATSA such as glenohumeral arthritis with an intact rotator cuff and no major bone loss/deformity. Others have cited superior postoperative outcomes of the RTSA over the ATSA and HA; however, the literature is mixed in areas such as complication and readmission rates, duration of surgery, length of hospital stay, and risk of revision. This study sought to first analyze and plot trends in shoulder arthroplasty usage over 5 years at a high-volume center in the United States and compare those to trends reported elsewhere. Further analyzing surgical outcomes in both our total population as well as in key subgroups may help better characterize the trends in shoulder arthroplasty usage, add to this growing body of literature, and help inform surgeon choice.

METHODS:

Permission to access patient data was granted by our institution's Ethical Review Board. A cohort of 2,296 patients were retrospectively collected for having undergone primary shoulder arthroplasty with one of eight fellowship-trained orthopaedic surgeons between January 1, 2016 to October 31, 2020. Participants were organized into three separate groups based on the procedure they received: RTSA, ATSA, or HA. Patients were identified from our institution's electronic medical record using ICD-10 procedure codes for RTSA, ATSA, and HA. Data on each participant was collected through October 31, 2021, allowing each a minimum 12 months of follow up. Outcomes information on duration of surgery (DOS), length of hospital stay (LOS), charges for episode of care, and risk of revision in 12 months were queried from each patient's medical record. Two further analyses were conducted after subdividing the cohort based on age greater vs. less than 65 years as well as a chief diagnosis of primary glenohumeral osteoarthritis (OA). Trends of procedure volume by year were plotted for the total population as well as for subgroups based on age above vs. below 65 years as well as diagnosis of primary glenohumeral OA.

RESULTS:

A total of 2,296 patients were recruited. In total, 1,588 (69.2%) underwent RTSA, 673 (29.3%) ATSA, and 35 (1.5%) HA. Patients older than 65 comprised 65% of the overall group, but comprised 74.3% of all RTSA patients. OA was the second largest indication for RTSA at 27.52% of the total population, second only to arthropathy with 40.37%.

Overall volume changed significantly over the study timeline with RTSA increasing 11.70% to comprise 78.7% of total volume by 2020 ($p<0.0004$). For patients with a diagnosis of glenohumeral OA without a combined diagnosis of rotator cuff tear, which in theory could be surgically treated with either ATSA or RTSA, RTSA usage increased from 43.41% to 56.12% from 2016 to 2020. For patients under the age of 65, there was a significant increase in RTSA usage (57.3% to 76.14%). LOS, DOS, and charges differed significantly between the three procedures ($p<0.0001$) for the overall population. Similar findings were shown when comparing RTSA to ATSA in patients with primary OA. In both groups, RTSA carried a longer LOS, shorter DOS, and higher charges compared to the ATSA. No significant difference existed in risk of revision within 12 months for these groups.

DISCUSSION AND CONCLUSION:

Trends and outcomes in shoulder arthroplasty usage at our institution mirror those reported elsewhere. RTSA usage has increased significantly over the study timeline while ATSA and HA have not. While not significant, our data also did show that RTSA increased among the patients with a diagnosis of glenohumeral OA, which traditionally had been treated with ATSA. Interestingly, key outcomes variables do not demonstrate a clear superiority of the RTSA, with results being mixed. Our analysis goes further than others by highlighting key demographic groups such as patients under 65 years of age as well as those with primary glenohumeral OA.

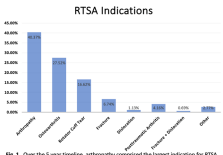

Fig. 1. Over the 5 year timeline, arthropathy comprised the largest indication for RTSA at 40.37%. The second largest indication was primary glenohumeral osteoarthritis with 27.52% followed by rotator cuff tear in third at 16.62%. The remaining patients had various trauma pathologies or did not have a shoulder-related primary diagnosis available.

Fig. 2. The RTSA grew to comprise a larger proportion of total arthroplasty volume in 2020 compared to 2016. Both the ATSA and HA fell in use over the same time period, ***p<0.001.***

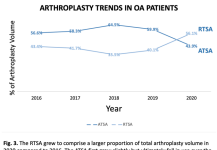

Fig. 3. The RTSA grew to comprise a larger proportion of total arthroplasty volume in 2020 compared to 2016. The ATSA first grew slightly but ultimately fell in use over the same time period. Chi square testing revealed significance of ***p=0.0001***, however Cochran-Armitage trend testing did not reveal significance, **p=0.2029**.

Table 1 – Key Surgical Outcomes

	ATSA N=673	RTSA N=1588	HA N=35	Total N=2296	P-Value
LOS (days)	**2.0 (1.2, 2.4)**	2.2 (1.3, 3.2)	2.2 (1.3, 3.4)	2.1 (1.3, 3.1)	<0.0001
DOS (hrs)	**1.9 (1.7, 2.1)**	1.6 (1.4, 1.9)	1.7 (1.4, 2.0)	1.7 (1.5, 2.0)	<0.0001
Charges*	1.63 (1.40, 2.01)	**1.84 (1.63, 2.37)**	1.3 (1.0, 2.04)	1.76 (1.56, 2.31)	<0.0001
Revis.					0.1278
(No)	658 (97.8%)	1563 (98.4%)	33 (94.3%)	2254 (98.2%)	
(Yes)	15 (2.2%)	25 (1.6%)	2 (5.7%)	42 (1.8%)	

Table. 1. In the overall population, the ATSA is associated with significantly longer DOS but shorter postoperative LOS compared to RTSA and HA, ***p<0.0001***. The RTSA was associated with higher patient charges, **p=0.0001**. No difference in risk of revision surgery within 12 months between procedures, ***p=0.1278***.
*Charges represented as multiples of lowest charge (1.0).

Table 2 – Key Surgical Outcomes (Osteoarthritis Patients)

	ATSA N=638	RTSA N=466	Total N=2204	P-Value
LOS (days)	**2.0 (1.2, 2.3)**	2.2 (1.3, 3.2)	2.1 (1.3, 3.0)	<0.0001
DOS (hrs)	**1.9 (1.7, 2.1)**	1.7 (1.5, 2.0)	1.8 (1.6, 2.1)	<0.0001
Charges*	1.17 (1.0, 1.42)	**1.34 (1.16, 1.70)**	1.23 (1.07, 1.60)	<0.0001
Revis.				0.7625
(No)	624 (97.8%)	457 (98.1%)	1081 (97.9%)	
(Yes)	14 (2.2%)	9 (1.9%)	23 (2.1%)	

Table. 2. In the osteoarthritis population, the ATSA is associated with significantly longer DOS but shorter postoperative LOS compared to RTSA, ***p<0.0001***. The RTSA was associated with higher patient charges, ***p<0.0001***. No difference in risk of revision surgery within 12 months between procedures, ***p=0.7625***.
*Charges represented as multiples of lowest charge (1.0).