

Postoperative Clinical and Economic Outcomes of Patients with Reverse or Anatomic Total Shoulder Arthroplasty at One Year: A Retrospective, United States Hospital Billing Database Analysis

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OBJECTIVES

- There is little evidence available on hospital costs and hospital-related revisits, revisions, and complications of Anatomic TSA (ATSA) and Reverse TSA (RTSA).
- A better understanding of the real-world contemporary postoperative hospital burden of RTSA/ATSA procedures may assist providers and payors in identifying additional opportunities for improving patient quality of care while simultaneously reducing healthcare costs.
- Thus, the study objective was to evaluate the one-year postoperative revision, complication and economic hospital outcomes after RTSA and ATSA.

METHODS

Study Design: Retrospective, noncomparative cohort study of ATSA RTSA patients.

Data Source: Premier Healthcare Database, a US-based hospital database, October 1, 2015 to December 31, 2021.

Study Population:

- Inclusion:** Adult (18+ years) primary, elective ATSA or RTSA cases, with primary diagnosis of shoulder osteoarthritis or rotator cuff tear
- Exclusion:** Fracture/trauma, infection or cancer of the upper arm/shoulder at index; OR evidence of shoulder revision one-year prior or at index; OR contralateral TSA, both RTSA/ATSA concurrently or bilateral surgery at index/follow-up

Outcomes:

- Occurrence and cost of one-year post-operative:
 - hospital all-cause revisits,
 - shoulder/non-shoulder complications,
 - revision-related events with and without infection.

Statistical Analysis:

- RTSA and ATSA cohorts were analyzed separately.
- Costs were inflation adjusted to 2022.
- Generalized linear models (GLM) with appropriate link and distribution, depending on the outcome for factor analysis.
- Marginal standardization with GLM for adjusted incidence and incremental cost.

RESULTS

Table 1 presents patient characteristics of the ATSA and RTSA cohorts.

Table 1. Baseline characteristics of patients undergoing TSA

Patient Characteristic	Overall	RTSA	ATSA
N	86,101 (100.0%)	51,478 (100.0%)	34,623 (100.0%)
Age, n (%)			
Age 18 to 54	4,265 (5.0%)	1,237 (2.4%)	3,026 (8.8%)
Age 55 plus	18,093 (21.0%)	8,271 (16.1%)	9,822 (28.4%)
Age 65 to 74	37,933 (44.0%)	22,899 (44.5%)	14,977 (43.2%)
Age 75 Plus	25,869 (30.0%)	19,071 (37.0%)	6,789 (19.6%)
Female	46,293 (53.8%)	29,385 (57.1%)	16,908 (48.8%)
Race, n (%)			
Asian	374 (0.4%)	234 (0.5%)	140 (0.4%)
Black	4,559 (5.3%)	2,895 (5.6%)	1,664 (4.8%)
Other	3,441 (4.0%)	1,967 (3.8%)	1,474 (4.3%)
Unable to Determine	912 (1.1%)	533 (1.0%)	379 (1.1%)
White	76,815 (89.2%)	45,849 (89.1%)	30,966 (89.4%)
Payor n (%)			
Medicare	62,944 (73.1%)	40,986 (79.6%)	21,958 (63.4%)
Commercial	16,290 (18.9%)	6,606 (12.8%)	9,684 (28.0%)
Medicaid	2,554 (3.0%)	1,288 (2.5%)	1,266 (3.7%)
Other	4,313 (5.0%)	2,596 (5.0%)	1,715 (5.0%)
Hypertension	62,388 (72.5%)	38,848 (75.5%)	23,540 (68.0%)
Diabetes	20,153 (23.4%)	13,060 (25.4%)	7,093 (20.5%)
Rheumatoid Arthritis	5,762 (6.7%)	4,011 (7.8%)	1,751 (5.1%)
Tobacco Use Indication, n (%)			
Osteoarthritis	34,568 (40.1%)	21,240 (41.3%)	13,328 (38.5%)
Rotator Cuff Tear	72,914 (84.7%)	38,455 (74.4%)	34,459 (99.5%)
	13,187 (15.3%)	13,023 (25.3%)	164 (0.5%)

- 45.0% of RTSA and 42.3% of ATSA returned for a hospital visit after surgery.
- The twelve-month total hospital costs of RTSA and ATSA were mean (SD) \$25,225 (\$15,911) and \$21,520 (\$13,531), respectively.
- The most expensive cost per visit was for revision procedures and device removals, \$22,920 (\$18,652), RTSA and \$26,911 (\$18,619), ATSA.
- Patients with infection complications requiring revision had the highest one-year hospital costs (~\$60,000).
- Tables 2a to 2c** present the incidence and costs of the study outcomes.
- Significant factors associated with a high risk of revision-related events and complications included chronic comorbidities and noncommercial insurance (**Figures 1 to 4**).
- Significant factors associated with higher costs of revision events and complications included age, race, chronic comorbidities, and noncommercial insurance (**Table 3**).

Table 2a. RTSA and ATSA, index and total postoperative hospital costs

	RTSA		ATSA	
	N (%) of patients	Mean (SD) Cost per patient ¹	N (%) of patients	Mean (SD) Cost per patient ¹
Index procedure, from admission to discharge	51,478 (100%)	\$20,988 (\$8,600)	34,623 (100%)	\$18,218 (\$8,128)
12-month hospital all-cause revisit (total post-index)	23,778 (45.0%)	\$4,237 (\$12,954)	14,066 (42.3%)	\$3,302 (\$10,422)
12-month total (revisit + index)	51,478 (100%)	\$25,225 (\$15,911)	34,623 (100%)	\$21,520 (\$13,531)

¹Cost across entire cohort

Table 2b. RTSA and ATSA, breakdown of occurrence, hospital utilization and hospital cost per visit of revision-related events and complication

	RTSA			ATSA		
	Incidence (%) n=51,478	Mean (SD) count of visits ¹	Mean (SD) postop cost per visit	Incidence (%) n=34,623	Mean (SD) count of visits ¹	Mean (SD) postop cost per visit
Irrigation and debridement visits ²	0.1%	2.1 (1.7)	\$5,843 (\$4,327)	0.2%	1.8 (1.4)	\$5,957 (\$4,743)
Revision procedure and device removals ²	2.1%	1.8 (1.4)	\$22,920 (\$18,652)	1.9%	1.7 (1.4)	\$26,911 (\$18,619)
Shoulder /non-shoulder complications no revision ²	17.8%	1.9 (1.5)	\$5,718 (\$11,842)	14.4%	1.9 (1.4)	\$5,193 (\$11,711)
Shoulder complications no revision ²	12.4%	1.9 (1.4)	\$4,085 (\$14,115)	9.9%	2.1 (1.6)	\$3,666 (\$11,245)

¹Only patients with the outcome;

²Includes other postoperative complication-related visits in addition to the visit where revision occurred

³All visits over 12 months

Table 2c. RTSA and ATSA, Total hospital cost associated with revision-related events and infection. Revision-related events includes revision procedures, device removals, and irrigation and debridement.

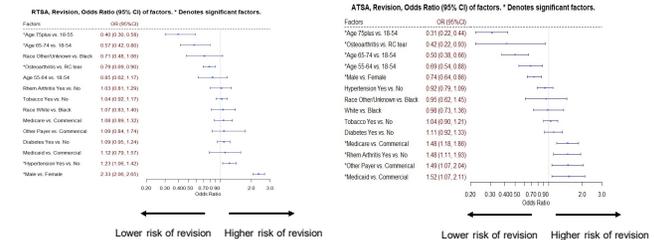
	RTSA			ATSA		
	Incidence (%) of patients n=51,478	Mean (95% CI) total hospital cost (index + all-cause)	Mean (95% CI) difference in cost ¹	Incidence (%) of patients n=34,623	Mean (95% CI) total hospital cost	Mean (95% CI) difference in cost
Revision with infection	0.6%	\$60,887 (\$56,951, \$64,823)	\$36,148 (\$32,210, \$40,086)	0.2%	\$59,478 (\$52,312, \$66,644)	\$38,426 (\$31,258, \$45,593)
Revision without infection	1.7%	\$41,985 (\$40,384, \$43,585)	\$17,246 (\$15,641, \$18,851)	1.9%	\$40,112 (\$38,335, \$41,888)	\$19,060 (\$17,278, \$20,841)
Infection without revision	0.5%	\$44,772 (\$41,740, \$47,804)	\$19,659 (\$16,624, \$22,694)	0.4%	\$41,184 (\$37,292, \$45,077)	\$19,754 (\$15,859, \$23,650)

¹Estimates represent the difference in cost compared to patients without the outcome.

CONCLUSIONS

- Postoperative healthcare burden within the hospital setting persists for patients who undergo RTSA or ATSA procedures.
- This study highlights the need for technologies and surgical techniques that may help reduce TSA healthcare utilization and economic burden.

Figures 1 and 2. Factors associated with revision among patients undergoing RTSA/ATSA*



Figures 3 and 4. Factors associated with complications among patients undergoing RTSA/ATSA*

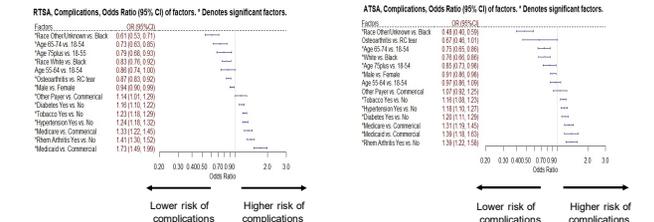


Table 3. Generalized linear model output indicating associations between patient variables and outcome costs expressed as cost ratio with 95% Confidence Intervals. Statistically significant cost ratios are bolded.

Characteristic*	Revision		Complications	
	ATSA	RTSA	ATSA	RTSA
Age 55-64 vs. 18-54	1.12 (0.95, 1.32)	1.17 (0.92, 1.48)	1.22 (0.98, 1.51)	0.82 (0.62, 1.08)
Age 65-74 vs. 18-54	1.06 (0.88, 1.26)	1.04 (0.80, 1.32)	1.28 (1.00, 1.62)	0.80 (0.61, 1.06)
Age 75 Plus vs. 18-54	1.01 (0.81, 1.26)	1.01 (0.77, 1.29)	1.60 (1.23, 2.07)	0.98 (0.74, 1.29)
Male vs. Female	1.00 (0.90, 1.10)	0.96 (0.87, 1.06)	1.00 (0.89, 1.12)	1.01 (0.93, 1.11)
White vs. Black	1.03 (0.83, 1.26)	1.17 (0.95, 1.43)	0.84 (0.66, 1.05)	1.20 (1.01, 1.42)
Race Other/Unknown vs. Black	0.98 (0.74, 1.31)	1.10 (0.81, 1.51)	1.10 (0.77, 1.58)	1.10 (0.85, 1.45)
Medicaid vs. Commercial	1.41 (1.13, 1.79)	1.10 (0.84, 1.44)	0.97 (0.74, 1.29)	1.07 (0.82, 1.41)
Medicare vs. Commercial	1.22 (1.05, 1.41)	1.08 (0.93, 1.24)	1.20 (1.01, 1.43)	1.16 (0.97, 1.36)
Other vs. Commercial	1.14 (0.92, 1.42)	1.15 (0.94, 1.41)	1.16 (0.88, 1.57)	1.09 (0.85, 1.39)
Diabetes Yes vs. No	1.04 (0.92, 1.18)	1.03 (0.93, 1.14)	1.17 (1.02, 1.34)	1.33 (1.21, 1.47)
Hypertension Yes vs. No	1.06 (0.95, 1.19)	1.02 (0.90, 1.14)	1.27 (1.10, 1.44)	1.30 (1.16, 1.45)
Rhem Arthritis Yes vs. No	1.08 (0.90, 1.30)	0.87 (0.73, 1.05)	1.18 (0.94, 1.48)	1.29 (1.10, 1.47)
Tobacco use Yes vs. No	0.94 (0.85, 1.04)	1.00 (0.91, 1.10)	1.11 (0.99, 1.25)	1.13 (1.04, 1.24)
Osteoarthritis vs. Rotator Cuff Tear	0.95 (0.57, 1.48)	1.02 (0.92, 1.13)	1.36 (0.64, 2.50)	1.00 (0.91, 1.10)

*Reference categories for Figures 1 to 4 and Table 3 are 18-54 years; Female, Black, Commercial, No and Rotator cuff tear.