Evaluating the Impact of Surgeon Experience on Cost Efficiency and Operating Room Time in Shoulder Arthroplasty: A Multicenter Retrospective Study

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Introduction:
Shoulder arthroplasty is increasingly performed, with rising utilization of both total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA). While the impact of surgeon experience on clinical outcomes is well established, its relationship to procedural cost and operative efficiency has not been well defined, and healthcare systems are placing greater emphasis on understanding the drivers of procedural cost and operating room efficiency.[1] This study primarily evaluates whether surgeon case volume is independently associated with cost and OR time. As a secondary objective, we compare resource utilization between TSA and RTSA.

Materials and Methods:
We conducted a retrospective cross-sectional study of 4,143 primary elective TSA and RTSA procedures performed between 2018 and 2023 across 21 medical centers by 48 orthopedic surgeons. All patients were adults (≥18 years). Primary outcomes included total cost, implant cost, supply cost, and OR time (incision to close), derived from an internal cost accounting system. Cost outcomes are reported as percentage differences from the median.
The primary predictor was surgeon annual case volume, categorized as <30 vs ≥30 cases/year. Multivariable mixed-effects gamma models were used to evaluate associations with cost and operative time, with surgeon included as a random effect to account for clustering. Both outcomes were modeled using gamma distributions due to their positive, right-skewed nature. Models were adjusted for age, sex, race/ethnicity, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, smoking status, osteoporosis diagnosis, diabetes, and procedure type (TSA vs RTSA), and surgery year.

Results:
High-volume surgeons (≥30 cases/year) were associated with 11% lower supply costs and 5% shorter OR times. Compared to TSA, RTSA was associated with 29% higher total cost**,** 37% higher implant cost**,** 8% lower supply cost, and 7% shorter OR time**.**

Discussion:
Surgeon experience, measured by annual case volume, was independently associated with operative efficiency and supply cost in shoulder arthroplasty. High-volume surgeons had lower supply costs and shorter operative times, reinforcing the role of experience in optimizing intraoperative resource use.
RTSA was associated with higher total and implant costs but lower supply costs and shorter OR times compared to TSA. These differences likely reflect greater standardization and repetition as RTSA becomes more commonly performed.[2] The procedure's reduced need for soft tissue balancing may also contribute to more streamlined workflows and reduced operative time.
These findings highlight modifiable drivers of cost and efficiency that may inform OR scheduling, surgeon benchmarking, and mentorship strategies in integrated healthcare systems. Incorporating cost-efficiency data into quality initiatives may further support value-based care. Future work should also evaluate whether differences in cost and operative time are associated with patient outcomes, to ensure that gains in efficiency align with maintaining or improving clinical quality.

References:
1. Yian, E. H., et al. (2022). "Procedure Cost Comparison of Outpatient and Inpatient Shoulder Arthroplasty and Lower-Extremity Arthroplasty Within a Managed-Care Organization." Perm J 26(4): 6-13.
2. Farley, K. X., et al. (2021). "Prevalence of Shoulder Arthroplasty in the United States and the Increasing Burden of Revision Shoulder Arthroplasty." JB JS Open Access 6(3).

Table 1. Cohort Demographics & Provider Experience.

	Characteristic	Metric	Value
Patient Demographics	Age	Mean (SD)	71 (29.0–95.0)
	Gender	N (%)	Female: 2160 (52.1%)
			Male: 1983 (47.9%)
	Race/ethnicity	N (%)	White: 2,905 (70.1%)
			Asian: 149 (3.6%),
			Black: 256 (6.2%),
			Hispanic: 804 (19.4%),
			Other: 29 (0.7%)
	Smoking Status	N (%)	Never/Passive: 2280 (55.1%) Former/Current: 1859 (44.9%)
	ASA ≥ 3	N (%)	1666 (40.3%)
	BMI ≥ 30	N (%)	1052 (25.4%)
	Osteoporosis	N (%)	718 (17.3%)
	Diabetes	N (%)	1124 (27.1%)
	Surgery Type	N (%)	TSA: 1577 (38.1%)
			RTSA: 2566 (61.9%)
Surgeon Experience	Avg Yearly Volume	Median (Range)	30 (<1 – 105)

Figure 1. Adjusted Associated with Surgical Resource Use. Dots represent cost ratios (exp[B]); error bars show 95% confidence intervals. Red line denotes null value (cost ratio = 1.0).