Temporal Trends in Demographic, Comorbidity, and Episode-of-Care in Total Shoulder Arthroplasty From 2012 to 2020

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INTRODUCTION: The purpose of this study was to characterize trends in the demographic characteristics, comorbidities, and episode-of-care outcomes for patients who underwent primary elective total shoulder arthroplasty (TSA) between 2012-2020.

METHODS: The American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database was queried to identify patient demographic characteristics, comorbidities, and episode-of-care outcomes for patients who underwent primary elective anatomic and reverse TSA between 2012-2020 (n=32,112). Trends in continuous and categorical variables were evaluated using linear regression and the Cochran-Armitage trend test, respectively.

RESULTS: Over the study period, the proportion of patients ages 60-80 years undergoing elective TSA increased, while patients ≤60 and >80 years decreased (*P*<.001). There was a trend towards increasing obesity in patients undergoing elective TSA (*P*=.008). There was a reduction in the proportion of white patients undergoing elective TSA with a concomitant increase in minority patients during the study period (*P*<.001). There was an overall increase in the proportion of patients with an American Society of Anesthesia physical status score ≥ 3 (*P*<.001) and a history of heart failure (*P*=.014). Conversely, there was a decrease in the proportion of patients with hypertension requiring medication and patients who received dialysis (*P*=.038 and *P*=.006, respectively). The rate of 3-day medical complications decreased from 8.5% to 4.5% during the study period (*P*<.001).

DISCUSSION AND CONCLUSION: Despite increasing medical complexity and increasing diversity of patients undergoing elective TSA during the study period (2012 to 2020), the rate of 30-day postoperative medical complication rates decreased. These findings demonstrate an improvement in the delivery of care in patients undergoing elective TSA. Reimbursement adjustments should reflect rising patient medical complexity, requiring a reevaluation of frameworks to align with evolving healthcare models and resource demands.

Table III. 30-day postoperative medical complication rates from 2012 to 2020 for patients who underwent elective TSA

Characteristic	2012-2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	P
Unplanned Readmission	2.82%	3.05%	2.29%	2.85%	2.79%	3.09%	3.00%	2.46%	2.79%	3.01%	.850
Any complication	4.62%	8.47%	7.18%	5.53%	4.82%	4.57%	4.08%	3.89%	3.82%	4.47%	<.001
Death	0.15%	0.25%	0.13%	0.12%	0.16%	0.13%	0.11%	0.14%	0.18%	0.14%	.944
Superficial Incisional SSI	0.25%	0.17%	0.32%	0.12%	0.16%	0.18%	0.19%	0.18%	0.42%	0.16%	.015
Deep Incisional SSI	0.08%	0.25%	0.19%	0.12%	0.03%	0.05%	0.09%	0.08%	0.02%	0.09%	.055
Organ/Space SSI	0.21%	0.08%	0.19%	0.17%	0.13%	0.23%	0.24%	0.16%	0.17%	0.38%	.076
Wound Disruption	0.06%	0.08%	0.06%	0.04%	0.09%	0.03%	0.02%	0.08%	0.04%	0.14%	.460
Pneumonia	0.47%	0.51%	0.44%	0.45%	0.56%	0.38%	0.54%	0.48%	0.37%	0.54%	.910
Unplanned Intubation	0.18%	0.17%	0.13%	0.25%	0.22%	0.10%	0.26%	0.26%	0.04%	0.20%	.599
Pulmonary Embolism	0.29%	0.51%	0.38%	0.37%	0.28%	0.30%	0.30%	0.28%	0.15%	0.34%	.113
On Ventilator greater than 48 Hours	0.10%	0.17%	0.13%	0.04%	0.13%	0.10%	0.11%	0.16%	0.06%	0.07%	.459
Progressive Renal Insufficiency	0.09%	0.08%	0.13%	0.17%	0.09%	0.08%	0.06%	0.08%	0.07%	0.14%	.780
Acute Renal Failure	0.05%	0.00%	0.06%	0.08%	0.06%	0.03%	0.06%	0.08%	0.04%	0.00%	.439
Urinary Tract Infection	0.67%	0.76%	0.70%	0.62%	0.50%	0.68%	0.73%	0.50%	0.86%	0.70%	.479
Stroke/CVA	0.08%	0.00%	0.13%	0.12%	0.06%	0.10%	0.09%	0.06%	0.07%	0.11%	.896
Cardiac Arrest Requiring CPR	0.06%	0.08%	0.06%	0.04%	0.06%	0.08%	0.09%	0.04%	0.06%	0.05%	.635
Myocardial Infarction	0.24%	0.42%	0.13%	0.04%	0.25%	0.25%	0.28%	0.30%	0.22%	0.25%	.558
Transfusion/Intraop/Postop	2.12%	5.67%	4.45%	3.51%	2.76%	2.24%	1.44%	1.15%	1.25%	1.65%	<.001
DVT Requiring Therapy	0.31%	0.42%	0.38%	0.17%	0.38%	0.35%	0.32%	0.48%	0.26%	0.14%	.564
Sepsis	0.14%	0.25%	0.19%	0.17%	0.09%	0.20%	0.17%	0.10%	0.06%	0.20%	.353
Septic Shock	0.05%	0.08%	0.06%	0.04%	0.09%	0.05%	0.02%	0.02%	0.06%	0.07%	.680

SSI, surgical site infection; CVA, cerebrovascular accident; CPR, cardiopulmonary resuscitation; DVT, deep vein thrombosis; TSA, total shoulder arthroplasty.
P values calculated using the Cochran-Armitage trend test.

Table II. Comorbidities of patients who underwent elective TSA (n = 32,112).

Characteristic	2012-2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	P
ASA ≥ 3	56.6%	50.5%	51.8%	53.7%	54.3%	56.3%	58.0%	57.9%	58.3%	58.6%	<.001
Diabetes											.322
None	82.1%	83.1%	82.3%	83.5%	81.9%	82.2%	81.9%	82.6%	82.1%	81.3%	-
Insulin-dependent	5.2%	5.1%	5.3%	5.0%	5.2%	5.2%	4.9%	5.6%	4.8%	5.3%	-
Not insulin-dependent	12.7%	11.8%	12.3%	11.5%	12.9%	12.6%	13.2%	11.8%	13.1%	13.4%	-
Current smoker within the past year	10.4%	8.8%	10.2%	11.1%	11.2%	10.9%	11.6%	10.3%	9.7%	8.9%	.017
Dyspnea											.838
None	93.3%	93.4%	94.0%	93.2%	93.8%	93.5%	93.2%	93.0%	93.3%	93.0%	-
Moderate exertion	6.4%	6.4%	5.3%	6.6%	6.0%	6.1%	6.5%	6.6%	6.4%	6.8%	-
At rest	0.3%	0.3%	0.7%	0.2%	0.2%	0.4%	0.3%	0.4%	0.3%	0.2%	-
Hypertension requiring medication	66.5%	68.2%	67.7%	65.8%	66.7%	66.5%	67.9%	66.3%	66.2%	64.9%	.038
History of CHF	0.6%	0.3%	0.4%	0.5%	0.4%	0.6%	0.5%	0.8%	0.9%	0.6%	.014
History of COPD	6.6%	6.2%	6.7%	6.8%	6.2%	7.0%	6.9%	6.8%	6.6%	6.3%	.834
Dialysis within 2 weeks of surgery	0.3%	0.4%	0.6%	0.5%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%	.006
Preoperative functional status											.627
Independent	97.0%	96.4%	96.2%	95.8%	97.1%	97.7%	97.5%	97.0%	96.5%	97.1%	-
Partially Dependent	2.0%	3.3%	1.8%	2.8%	2.5%	2.1%	1.9%	1.8%	1.4%	2.1%	-
Unknown	0.9%	0.3%	1.9%	1.2%	0.4%	0.2%	0.5%	1.1%	2.0%	0.6%	-
Totally Dependent	0.1%	0.0%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	-
Recent weight loss	0.2%	0.0%	0.2%	0.3%	0.2%	0.3%	0.1%	0.2%	0.2%	0.3%	.397
Bleeding disorder	2.6%	3.8%	3.1%	3.0%	2.4%	2.4%	2.5%	2.5%	2.1%	3.1%	.129
Sepsis within 48 hours of surgery											.240
None	99.5%	99.7%	99.6%	99.6%	99.6%	99.4%	99.6%	99.6%	99.5%	99.2%	-
SIRS	0.5%	0.3%	0.3%	0.4%	0.4%	0.6%	0.4%	0.4%	0.5%	0.7%	-
Septic Shock	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	-
Septic Shock	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-
Steroid/immunosuppressant use for a chronic condition	0.3%	0.3%	0.4%	0.6%	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	.493

ASA, American Society of Anesthesia physical status classification system; CHF, chronic heart failure; COPD, chronic obstructive pulmonary disease; TSA, total shoulder arthroplasty.
P values calculated using the Cochran-Armitage trend test.

Table I. Demographics of patients who underwent elective TSA (n = 32,112).

Characteristic	2012-2020	2012	2013	2014	2015	2016	2017	2018	2019	2020	P
N	31910	1181	1574	2424	3193	4638	5044	5450	4425		
Age											<.001
≤ 60	16.5%	14.1%	16.0%	18.5%	18.2%	17.8%	17.6%	16.4%	14.7%	14.6%	
61-70	36.3%	33.9%	34.0%	37.4%	36.3%	37.1%	35.9%	37.0%	36.6%	36.2%	
71-80	36.7%	36.3%	36.5%	33.6%	35.0%	34.9%	36.0%	37.3%	38.6%	39.1%	
>80	10.5%	15.7%	13.5%	10.6%	10.8%	10.1%	10.5%	9.4%	10.1%	10.1%	
Sex											.426
Male	44.5%	43.7%	43.5%	44.5%	43.8%	44.7%	44.5%	45.0%	45.0%	44.0%	
Female	55.5%	56.3%	56.5%	55.5%	56.2%	55.3%	55.5%	55.0%	55.0%	56.0%	
BMI categories											.008
Underweight	0.7%	0.8%	0.6%	0.5%	0.7%	0.6%	0.7%	0.6%	0.7%	0.8%	
Normal weight	15.9%	16.8%	17.4%	17.2%	15.3%	15.5%	16.7%	15.4%	15.5%	15.9%	
Overweight	31.8%	34.1%	32.5%	31.0%	32.3%	32.3%	31.9%	31.6%	31.0%	31.9%	
Class I obesity	26.8%	27.2%	25.7%	25.9%	26.9%	26.1%	26.4%	26.3%	27.7%	26.8%	
Class II obesity	14.3%	12.6%	13.6%	14.7%	13.6%	15.0%	13.6%	15.0%	14.4%	14.4%	
Class III obesity	10.6%	8.7%	10.4%	10.7%	11.2%	10.4%	10.7%	11.0%	10.7%	10.2%	
Race											<.001
White	83.7%	88.1%	84.7%	85.2%	84.9%	85.1%	84.2%	85.0%	81.3%	80.1%	
Black	4.7%	3.1%	4.3%	4.5%	4.6%	5.2%	5.4%	4.6%	4.3%	4.6%	
Asian	0.7%	0.5%	0.8%	0.5%	0.5%	0.5%	0.8%	0.6%	0.9%	0.9%	
Unknown/Not Reported	10.3%	7.7%	9.1%	9.1%	9.5%	8.7%	9.0%	9.5%	12.7%	13.5%	
Other	0.6%	0.5%	1.0%	0.6%	0.5%	0.5%	0.5%	0.4%	0.9%	0.9%	

BMI, body mass index; TSA, total shoulder arthroplasty.
BMI categories were based on the CDC categories, defined as underweight (BMI<18.5 kg/m2), normal weight (BMI ≥18.5 and <25 kg/m2), overweight (BMI ≥25 and <30 kg/m2), class I obesity (BMI ≥30 and <35 kg/m2), class II obesity (BMI ≥35 and <40 kg/m2), and class III obesity (BMI≥40 kg/m2).
White and Black here refer to non-Hispanic White and non-Hispanic Black.
P values calculated using the Cochran-Armitage trend test.