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Trends in outpatient shoulder arthroplasty during the COVID-19 (coronavirus disease 2019) era: increased proportion of outpatient cases with decrease in 90-day readmissions

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Background: The COVID-19 (coronavirus disease 2019) pandemic has placed an increased burden on health care resources, with hospitals around the globe canceling or reducing most elective surgical cases during the initial period of the pandemic. Simultaneously, there has been an increased interest in performing outpatient total joint arthroplasty in an efficient manner while maintaining patient safety. The purpose of this study was to investigate trends in total shoulder arthroplasty (TSA) during the COVID-19 era with respect to outpatient surgery and postoperative complications.

Methods: We conducted a retrospective chart review of all primary anatomic and reverse TSAs performed at our health institution over a 3-year period (January 2018 to January 2021). All cases performed prior to March 2020 were considered the “pre-COVID-19 era” cohort. All cases performed in March 2020 or later comprised the “COVID-19 era” cohort. Patient demographic characteristics and medical comorbidities were also collected to appropriately match patients from the 2 cohorts. Outcomes measured included type of patient encounter (outpatient vs. inpatient), total length of stay, and 90-day complications.

Results: A total of 567 TSAs met the inclusion criteria, consisting of 270 shoulder arthroplasty cases performed during the COVID-19 era and 297 cases performed during the pre-COVID-19 era. There were no significant differences in body mass index, American Society of Anesthesiologists score, smoking status, or distribution of pertinent medical comorbidities between the 2 examined cohorts. During the COVID-19 era, 31.8% of shoulder arthroplasties were performed in an outpatient setting. This was significantly higher than the percentage in the pre-COVID-19 era, with only 4.5% of cases performed in an outpatient setting ($P < .0001$). The average length of stay was significantly reduced in the COVID-19 era cohort (0.81 days vs. 1.45 days, $P < .0001$). There was a significant decrease in 90-day readmissions during the COVID-19 era. No significant difference in 90-day emergency department visits, 90-day venous thromboembolism events, or 90-day postoperative infections was observed between the 2 cohorts.

Conclusion: We found a significant increase in the number of outpatient shoulder arthroplasty cases being performed at our health institution during the COVID-19 era, likely owing to a multitude of factors including improved perioperative patient management and increased hospital burden from the COVID-19 pandemic. This increase in outpatient cases was associated with a significant reduction in average hospital length of stay and a significant decrease in 90-day readmissions compared with the pre-COVID-19 era. The study data suggest that outpatient TSA can be performed in a safe and efficient manner in the appropriate patient cohort.

Approval for this study was received from the Indiana University Institutional Review Board (no. 10421).

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Total shoulder arthroplasty (TSA) is an effective treatment strategy for patients with glenohumeral osteoarthritis and rotator cuff arthropathy that has been shown to improve functional outcomes and decrease pain.^{8,15,21,24,25} Over the past 2 decades, the number of TSA surgical procedures being performed in the United States has continued to increase, with some projections that the growth rate may exceed the numbers of hip and knee arthroplasty procedures.^{10,16,22} There has also been an increased interest in the safety and efficacy of outpatient joint arthroplasty. Improvements in preoperative medical optimization, perioperative analgesia, and surgical techniques have reduced the average length of stay (LOS), blood loss, and overall complication rates after total joint arthroplasty.^{1,9,11,23,26} Furthermore, through improvements in regional anesthesia, pain control has been greatly improved, leading to the overall increase in migration of TSA to an outpatient setting.

Several recent publications regarding outpatient TSA have demonstrated significant improvements in clinical outcomes with no differences in complications when compared with inpatient TSA.^{2,11,18} Additionally, outpatient surgery may be more economical, especially in an era of increasing health care costs in the United States.^{4,7,12} Despite these favorable trends, future research and scrutiny of patient outcomes are important to ensure that patient safety ultimately remains the top priority.

The recent COVID-19 (coronavirus disease 2019) pandemic has placed an unprecedented burden on hospital systems across the globe. The initial response by many governments was to pause all elective surgical procedures. When elective operations were resumed, many hospitals were at or near full capacity because of admissions of patients with COVID-19.^{27,28} The purpose of this study was to investigate trends in TSA before and during the COVID-19 pandemic. With an increased inpatient burden, we hypothesized that there would be an increase in outpatient TSA during the COVID-19 era. Additionally, we sought to compare complication rates between the 2 periods to determine whether increased outpatient TSA was associated with significant changes in postoperative complications such as emergency department (ED) visits, readmissions, repeated operations, and venous thromboembolism (VTE) events.

Methods

The study design was a retrospective cohort study design. A retrospective chart review was performed. We identified all

patients who underwent shoulder arthroplasty from January 1, 2018, to January 1, 2021, in our institutional electronic medical record. The inclusion criteria were patients undergoing elective primary TSA for osteoarthritis or rotator cuff arthropathy. Patients undergoing revision arthroplasty, hemiarthroplasty, or arthroplasty to treat fractures were excluded from the study. The final patient cohort included shoulder arthroplasties performed by 17 surgeons in 8 hospitals or surgery centers.

Patients who met the inclusion criteria were separated into 2 groups based on the date of surgery. Patients who underwent surgery in March 2020 or later were included in the “COVID-19 era” group, and patients who underwent surgery before March 2020 were considered the “pre-COVID-19 era” group. Patients in both groups were then matched based on age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, type of arthroplasty (anatomic vs. reverse), use of regional anesthesia, and smoking status, as well as other key medical comorbidities (Table 1). Outcomes measured included the type of surgical encounter (outpatient vs. inpatient), LOS, 90-day surgery-related readmissions, 90-day surgery-related ED visits, 90-day VTE events, and 90-day infections, as well as any other postoperative complications. Any readmissions or ED visits for issues unrelated to a patient’s surgical encounter were not counted as complications in this study.

Statistics

Statistical analysis was conducted using GraphPad Prism software (version 8.4.3; GraphPad Software, San Diego, CA, USA). Continuous data were described by means and standard deviations. A 2-tailed, unpaired *t* test was performed to analyze differences in demographic characteristics and LOS between the 2 cohorts. The proportions of patients undergoing outpatient or inpatient surgical procedures and postoperative complications were compared via the Fisher exact test. $P < .05$ was considered statistically significant.

Results

After initial screening, we identified 736 patients over the 3-year period who met the inclusion criteria. The exclusion criteria highlighted in the “Methods” section were met by 169 of these patients, resulting in 567 patients who were included for final analysis. Of these patients, 270 were in the COVID-19 era cohort and 297 patients were in the pre-COVID-19 cohort. There were no significant differences in average patient age, sex proportion, BMI, patients with an ASA score ≥ 3 , diabetes, smoking status, and other key medical comorbidities between the 2 groups (Table 1). We observed a significant increase in the proportion of

Table I Patient demographic characteristics

	Pre-COVID-19 era	COVID-19 era	<i>P</i> value
Patients, n	297	270	
Mean age, yr	68.6 ± 8.8	68.3 ± 8.9	.73
Sex, n (%)			.24
Male	123 (41.4)	126 (46.7)	
Female	174 (58.6)	144 (53.3)	
Average BMI	32.3 ± 7.2	31.7 ± 7.3	.44
ASA score ≥ 3, n (%)	165 (55.6)	140 (51.9)	.45
Diabetes, n (%)	74 (26.7)	67 (24.8)	.63
Smoking status, n			
Never	180	154	
Former	100	92	
Current	15	20	
CAD, n (%)	47 (15.8)	52 (19.3)	.32
CHF, n (%)	17 (5.7)	8 (3.0)	.15
Cognitive disorder, n (%)	6 (2.0)	6 (2.2)	>.99
COPD, n (%)	23 (7.9)	26 (9.6)	.55
OSA, n (%)	59 (19.9)	62 (22.9)	.42
CKD, n (%)	25 (8.4)	32 (11.8)	.21

COVID, coronavirus disease; BMI, body mass index; ASA, American Society of Anesthesiologists; CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; OSA, obstructive sleep apnea; CKD, chronic kidney disease.

outpatient TSA cases performed during the COVID-19 era compared with the pre-COVID-19 era (31.9% vs. 6.1%). There was no significant difference in the type of arthroplasty performed between the 2 groups. As hypothesized, significantly more inpatient cases were performed in the pre-COVID-19 era than in the COVID-19 era. There was no significant difference in the type of anesthesia administered between the patient cohorts (Table II). The minimum 90-day follow-up rate for this study was 93% (526 of 567 patients).

Regarding the outcomes examined, there was a statistically significant reduction in average LOS in the COVID-19 era cohort (0.8 days vs. 1.4 days, $P < .0001$). There was a significant decrease in the number of surgery-related 90-day readmissions during the COVID-19 era. Decreases in ED visits, 90-day VTE events, and 90-day postoperative infections were also observed between the 2 cohorts, although these differences were not statistically significant (Table III).

A subgroup analysis of the COVID-19 era cohort was performed to better understand demographic characteristics and complication rates within this cohort. Age was statistically significantly increased in patients undergoing inpatient surgery (70.6 years vs. 64.1 years, $P < .001$), but no differences were observed in other variables including BMI, ASA score, diabetes, and smoking. With respect to complications, there was no significant difference in the rate of studied complications between the inpatient and outpatient groups within the COVID-19 era cohort (Table IV).

Discussion

The COVID-19 pandemic has placed an increased burden on hospital inpatient capacity, from the lack of hospital beds to the overall reduction in elective surgical procedures. Once guidelines were relaxed and elective operations were allowed to be resumed, many surgeons and systems began to transition to fewer admissions and more surgical procedures performed on an outpatient basis. The pandemic essentially coincided with a growing trend to perform shoulder replacement as an outpatient procedure, especially with increasing evidence of its safety and efficacy. The objective of our study was, therefore, to investigate trends in outpatient shoulder arthroplasty before and during the COVID-19 pandemic and subsequent short-term adverse postoperative events at our institution. Our hypotheses were confirmed as we found a significant increase in the proportion of outpatient TSA cases performed during the COVID-19 era with fewer 90-day complications when compared with TSA cases performed prior to the COVID-19 pandemic. We also found a significant reduction in average hospital LOS between the 2 periods examined that correlated with an increased proportion of outpatient shoulder arthroplasty cases.

Kramer et al¹⁷ studied 6503 elective primary shoulder arthroplasties between 2005 and 2016 and found no difference in 90-day readmissions between same-day discharge and longer in-hospital stay when adjusting for age, sex, and other medical comorbidities. Similarly, Erickson et al¹¹ found no significant difference in outcome

Table II Surgical encounter data

	Pre-COVID-19 era	COVID-19 era	P value
Patients, n	297	270	
Outpatient cases, n (%)	18 (6.1)	86 (31.9)	<.0001*
Inpatient cases, n (%)	279 (93.9)	184 (68.1)	<.0001*
Anatomic TSA, n (%)	120 (40.4)	91 (33.7)	.32
Reverse TSA, n (%)	177 (59.6)	179 (66.3)	.22
Anesthesia			
General and regional	293 (98.7)	261 (96.7)	.16
General only	4 (1.4)	9 (3.3)	

COVID, coronavirus disease; TSA, total shoulder arthroplasty.

* Statistically significant ($P < .05$).

Table III Outcomes

	Pre-COVID-19 era	COVID-19 era	P value
Average LOS, d	1.37	0.81	<.0001*
90-d readmissions, n (%)	20 (6.8)	3 (1.1)	.0005*
90-d ED visits, n (%)	33 (11.1)	11 (4.1)	.26
90-d infections, n (%)	3 (1.0)	2 (0.7)	.99
90-d VTE events, n (%)	5 (1.7)	2 (0.7)	.45

COVID, coronavirus disease; LOS, length of stay; ED, emergency department; VTE, venous thromboembolism.

* Statistically significant ($P < .05$).

scores or complications between outpatient and inpatient TSA cases between 2 matched cohorts. Two multicenter studies comparing outpatient and inpatient TSA outcomes found an increased rate of complications such as VTE and deep infection among inpatient cases, although these patients did have higher rates of diabetes and smoking, as well as other medical comorbidities.^{2,18} A study by Brolin et al⁵ compared 90-day complications and readmissions after TSA in an outpatient cohort vs. a matched inpatient cohort, finding no difference in complication rates between the 2 groups. Between our 2 patient cohorts, there was no significant difference in age, sex, BMI, or other comorbidities, and we found a decrease in 90-day readmissions during the COVID-19 era and no differences in other examined postoperative complications despite a significantly higher proportion of outpatient cases performed in the COVID-19 era cohort.

Although our data show fewer readmissions and ED visits for patients during the COVID-19 era, it is important to note that the COVID-19 pandemic likely had some impact on those numbers. Several recently published studies have shown fewer ED visits for matters unrelated to COVID-19 since the pandemic began, likely owing to initial mobility restrictions and fear of contagion.^{3,13} However, the greatest reduction in ED visits was seen during the early portion of the pandemic,¹⁴ when most elective surgical procedures were also paused by government mandate, making it unclear how large a confounding

factor this would be for our particular study. Therefore, our results showing fewer ED visits and readmissions could be attributable to the initial fear of going to the hospital.

There are sufficient data in the literature to suggest that outpatient TSA is safe, cost-effective, and efficient for both surgeons and patients.^{6,19} However, appropriate patient selection is still important to ensure a low perioperative complication risk. Prior research has shown that perioperative factors are key predictors of LOS after shoulder arthroplasty. Matsen et al²⁰ found a 73% increase in LOS in patients with a Charlson Comorbidity Index > 1. Our 2 patient cohorts were separated based on the date of surgery but were matched to have no differences in age, sex, BMI, and other comorbidities. However, when our patient cohort was separated based solely on outpatient vs. inpatient TSA regardless of period, patients who underwent outpatient TSA, on average, were younger, had a lower BMI, and had a lower ASA score. These differences, however, were not statistically significant. The rates of smoking, diabetes, and other comorbidities were similar between the outpatient and inpatient cohorts. When performing further analysis of the COVID-19 era subgroup, we did note a statistically significantly younger age in patients undergoing outpatient arthroplasty. However, there was still no difference noted in other demographic and comorbidity data collected. There were also no significant differences in measured complication rates between the outpatient and inpatient groups in our subgroup analysis. Although the results of our study

Table IV COVID-era subgroup analysis

	Inpatient	Outpatient	<i>P</i> value
Patients, n	184	86	
Mean age, yr	70.6 ± 8.1	64.1 ± 7.6	<.001*
Sex, n (%)			.23
Male	86 (53.2)	47 (54.7)	
Female	98 (46.7)	39 (45.3)	
BMI	32.1 ± 7.4	31.1 ± 7.7	.18
ASA score ≥ 3, n (%)	76 (54.2)	64 (45.7)	.13
Diabetes, n (%)	37 (55.2)	30 (44.8)	.23
Smoking status, n			
Never	80	74	
Former	53	39	
Current	12	8	
CAD, n (%)	34 (18.5)	18 (20.9)	.63
CHF, n (%)	5 (2.7)	3 (3.5)	.73
Cognitive disorder, n (%)	4 (2.2)	2 (2.3)	.94
COPD, n (%)	16 (8.7)	10 (11.6)	.44
OSA, n (%)	38 (20.6)	24 (27.9)	.18
CKD, n (%)	20 (10.8)	12 (14.0)	.46
90-d readmissions, n (%)	2 (1.1)	1 (1.2)	.96
90-d ED visits, n (%)	8 (4.3)	4 (3.5)	.91
90-d VTE events, n (%)	1 (0.5)	1 (1.2)	.58
90-d infections, n (%)	2 (1.1)	0 (0)	

COVID, coronavirus disease; BMI, body mass index; ASA, American Society of Anesthesiologists; CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; OSA, obstructive sleep apnea; CKD, chronic kidney disease; ED, emergency department; VTE, venous thromboembolism.

* Statistically significant ($P < .05$).

suggest that increased outpatient TSA did not lead to increased 90-day complications, it is still important to evaluate each patient independently to determine the appropriateness of outpatient surgery.

This study has limitations that are important to note. First, this was a retrospective cohort study and therefore has limitations that are common to all retrospective studies. As an observational study, no inference about causation can be made and the findings should be interpreted accordingly. Additionally, we were able to measure short-term postoperative complications, but because of the nature of our institutional health system, we did not have consistent prospective patient outcomes to report, which may have enhanced the conclusions drawn from this study. Similarly, we were unable to study functional outcomes, to study patient satisfaction, or to compare costs between our 2 cohorts. Our primary outcomes of interest were the proportion of outpatient surgical procedures and LOS. However, our secondary outcomes, including readmissions and ED visits, may be under-reported because patients may have sought care at EDs or hospitals outside our health institution. Patients who presented to the clinic with 90-day complications that required repeated operations were included in our complication outcomes. Overall, the patients in this cohort had a 93% minimum 90-day follow-up rate, suggesting that this limitation may be more minimal.

It also should be noted that this study compares 2 patient cohorts from different periods, and improvements in perioperative management and outpatient surgery may have positively influenced the results seen in our more recent (COVID-19 era) cohort. Although it would be logical to assume that patients with more recent surgery dates received better perioperative management, the majority of patients in our earlier (pre-COVID-19 era) cohort were treated in 2020 or late 2019, which is not significantly different when comparing perioperative and postoperative management techniques. Further studies looking at patient-reported outcomes and costs would help draw additional conclusions about the effectiveness of outpatient shoulder arthroplasty.

Conclusion

Outpatient TSA has become increasingly more popular in recent years. This increasing interest combined with a heavy inpatient burden from the COVID-19 pandemic led to a significant increase in the proportion of outpatient shoulder arthroplasty cases being performed at our health institution. Despite an increase in outpatient surgical procedures, 90-day readmissions were actually decreased, and other 90-day complications (ED visits,

VTE events, and infections) were no different than prior to the COVID-19 pandemic, when the majority of shoulder arthroplasty cases were performed as inpatient procedures. This finding suggests that outpatient shoulder arthroplasty can be performed safely and effectively in the appropriate patient population. Further investigation is warranted to evaluate changes in patient-reported outcome measures and long-term complications from an increase in outpatient TSA.

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