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The transition of total elbow arthroplasty into the outpatient theater

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Background: Outpatient total joint arthroplasty is increasing in frequency as reimbursement models change. Potential benefits include same-day surgery for patients and decreased exposure to nosocomial pathogens. This study aims to determine if total elbow arthroplasty (TEA) is also trending toward an outpatient setting, and if there is any impact on complication rates as a result.

Methods: A retrospective chart review of the American College of Surgeons National Surgical Quality Improvement Program was performed. Specifically, the database was queried for all patients with CPT code 24363 from 2010-2017. The percentage of TEAs performed each year as an outpatient was trended from 2010-2017. Additionally, the complication rate between the inpatient and outpatient cohorts was compared.

Results: A total of 524 TEAs were analyzed. Of these, 111 procedures (21.2%) were performed as an outpatient. There was a statistically significant increase in the percentage of outpatient TEAs from 2010-2017 ($P = .0016$). In 2010, 2.4% of TEAs were outpatient, compared with 34.5% in 2017. The total complication rate trended toward being lower in the outpatient group, but this difference was not statistically significant ($P = .08$).

Conclusions: There is a significant trend toward TEA being performed as an outpatient procedure, with more than one-third currently being performed in this manner. In our study, there was no difference in the complication rate between inpatient and outpatient TEAs; in fact, outpatient TEAs trended toward having a lower complication rate than inpatient TEAs. Taken together, the outpatient setting comprises an ever-increasing segment of TEA without an increase in morbidity to patients.

Outpatient total joint arthroplasty is increasing in frequency as hospitals and health systems labor to deliver health care efficiently. Benefits include same-day surgery for patients as well as decreased exposure to nosocomial pathogens. Outpatient arthroplasty is also accompanied with substantial monetary savings for the health care system.[5,23] The complication rate for total shoulder arthroplasty has been shown to be the same for inpatient and outpatient procedures.[7,18] Likewise, outpatient total hip arthroplasty has been shown to be safe, without an increased risk of complications relative to inpatient total hip arthroplasty.[10,17] With respect to total knee arthroplasty, there is no consensus regarding complication rate and care setting.[4,14]

Total elbow arthroplasty (TEA) is increasing in prevalence as outcomes for patients with rheumatoid and post-traumatic arthritis have improved. The number of primary TEAs performed have increased by 248% from 1993 to 2007.[9] From 2007 to 2011, the number of TEAs performed in the United States increased steadily, at a rate of about 600-700 additional procedures per year.[24] The potential for financial savings is profound; one study found that average length of stay for TEA was 4.23 days and, on average, each procedure cost the hospital $16,300.[24] Literature regarding outpatient TEA, however, is sparse. One case report described the use of a continuous infraclavicular nerve block as a method for performing outpatient TEA.[12] The prevalence and safety of outpatient TEA, however, is not something that has been thoroughly explored in the literature. In light of the recent boom in outpatient total joint arthroplasty, the purpose of this study is to characterize outpatient TEA. Specifically, we will determine the prevalence of outpatient TEA and compare complication rates between outpatient and inpatient TEA.

Methods

A retrospective chart review of the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)

No institutional review board approval was required for this study, as it was conducted using data from a publicly available, deidentified database.

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was performed. The ACS NSQIP database is a prospectively collected clinical registry with more than 700 participating hospitals from around the United States with a mix of private and academic institutions that enroll patients 18 years of age and older. Each of the hospitals that submits data to the ACS NSQIP employs a surgical clinical reviewer who collects patient data for the 30-day postoperative period. This is done via an in-depth patient chart review during the inpatient and outpatient perioperative period. There are 150 variables collected in the registry. A full description of the methodology is available from the ACS.[3]

The ACS NSQIP database was queried for all patients with CPT code 24363 from 2010-2017. Patients with other major primary procedures coded, such as proximal humerus or humeral shaft open reduction internal fixation, were excluded. This was done because the focus of this study is primarily elective TEA, and the presence of other major procedures would not make the outpatient setting feasible as an option. The percentage of TEAs performed each year as an outpatient was trended from 2010-2017. Additionally, the complication rate between the inpatient and outpatient cohorts was compared. Complications reviewed were superficial surgical site infection, deep surgical site infection, wound disruption, pneumonia, pulmonary embolism, renal insufficiency, acute renal failure, urinary tract infection, stoke, cardiac arrest, myocardial infarction, deep venous thrombosis, sepsis, septic shock, and return to operating room.

Statistical analysis

Continuous variables were tested with a 2-tailed *t* test assuming unequal variance for comparison of 2 groups, and an analysis of variance for comparison of more than 2 groups. Trending the percentage of outpatient TEA was done using regression analysis. Sex was compared between the years studied and between inpatient and outpatient cohorts using a χ^2 goodness-of-fit test. American Society of Anesthesiologists classification distributions and complications were compared between inpatient and outpatient cohorts using χ^2 contingency tests. A *P* value of .05 was used as the cutoff for significance for all analyses.

Results

Outpatient trends

A total of 524 TEAs were analyzed. Demographic information is shown in Table I. Mean and standard deviation of age was 64.3 ± 13.3 years, and 118 of patients (22.5%) were male. Age and sex did not differ from year to year for the time period analyzed (Table II). A total of 111 TEAs (21.2%) were performed as an outpatient. A statistically significant trend toward increasing outpatient surgery was noted for the years analyzed ($P = .0016$; Fig. 1). The least squares regression trend line had a slope of 0.0471, indicating that, on average, there was a 4.7% increase in the percentage of outpatient TEA per year. The lowest percentage of outpatient TEA was observed in 2010, when 2.4% of TEAs were performed in the outpatient setting (Table II). The highest percentage of outpatient TEA was observed in 2017, when 34.5% of TEAs were performed in the outpatient setting.

Complication rate

Of the 524 TEAs analyzed, 413 (78.8%) were performed in the inpatient setting and comprised the inpatient cohort. The other 111 (21.2%) TEAs were performed in the outpatient setting, and comprised the outpatient cohort. Means and standard deviations of age for the inpatient and outpatient cohorts were 64.1 ± 13.6 years and 65.4 ± 12.3 years, respectively (Table I). With respect to sex, 23.7% (n = 98) and 18.0% (n = 20) of the inpatient and outpatient cohorts were male, respectively. Neither age ($P = .3561$) nor sex ($P = .2603$) was different between cohorts. Operative characteristics for the inpatient and outpatient cohorts are shown in Table III. There was no difference in American Society of Anesthesiologists classification distribution between the inpatient and outpatient cohorts ($P = .1073$). Mean and standard deviation of operative time was 159.8 ± 66.0 minutes and 160.0 ± 67.6 minutes in the inpatient and outpatient cohorts, respectively ($P = .9778$). There were no statistically significant differences in any of the complications reviewed between the inpatient and outpatient groups (Table IV). Thirty patients (7.3%) in the inpatient cohort experienced a complication, and 3 patients (2.7%) in the outpatient cohort experienced a complication. In the inpatient cohort, 10 patients experienced 2 complications and 1 patient experienced 3 complications. Total complication rate (percentage of patients experiencing a complication) trended toward being lower in the outpatient group, but this difference was not statistically significant ($P = .0790$).

Discussion

There is a significant trend toward TEA being performed as an outpatient procedure, with more than one-third currently being performed in this manner. In the time period reviewed, there was an average increase of 4.7% of TEAs being performed in the outpatient setting per year. There was also no difference in the complication rate between inpatient and outpatient TEAs; in fact, outpatient TEAs trended toward having a lower complication rate than inpatient TEAs.

Patients undergoing outpatient TEA are typically discharged from the recovery room once they are cleared by the anesthesia team. They are often placed into either a bulky dressing or anterior splint postoperatively.[1,22] A closed wound suction drain may be used as well, depending on surgeon preference. These are removed within 1 week during the first postoperative visit. Oral antibiotics such as trimethoprim-sulfamethoxazole may be prescribed for up to 10 days postoperatively. Options for perioperative pain control include oral narcotic and non-narcotic medications (such as acetaminophen, celecoxib, and oxycodone), home patient-controlled analgesia, and infraclavicular nerve catheter. Patient-controlled analgesia is continued for 24-48 hours postoperatively and is supervised by a home health nurse. The infraclavicular nerve catheter is infused with 0.20% or 0.25% ropivacaine at 6-7 mL per hour and is removed 3-6 days postoperatively.[12,22] Early range of motion is initiated, and no weightlifting is permitted for 3 months postoperatively. A weight limit restriction of 5 pounds is imposed indefinitely.

Table I
Demographic data of TEA patients, separated by setting of surgery

Characteristic	All (N = 524)	Inpatient (n = 413)	Outpatient (n = 111)	*P* value
Age, yr, mean ± SD	64.3 ± 13.3	64.1 ± 13.6	65.4 ± 12.3	.3561
Sex, male, n (%)	118 (22.5)	98 (23.7)	20 (18.0)	.2603

TEA, total elbow arthroplasty; *SD*, standard deviation.
Age between cohorts was analyzed with a 2-tailed *t* test assuming unequal variance. Sex was analyzed using a χ^2 goodness-of-fit test.

Table II
Demographic data of TEA patients by year

Year	No. of patients	Age, yr, mean ± SD	Sex, male, n (%)	Outpatient, n (%)
2010	42	59.9 ± 14.0	13 (31)	1 (2.4)
2011	48	67.2 ± 10.9	10 (20.1)	3 (6.3)
2012	50	62.7 ± 12.5	14 (28.0)	5 (10)
2013	45	66.5 ± 12.7	13 (28.9)	3 (6.7)
2014	86	64.6 ± 14.8	20 (23.3)	26 (30.2)
2015	73	64.3 ± 13.1	13 (17.8)	18 (24.7)
2016	93	62.6 ± 13.5	23 (24.7)	25 (26.9)
2017	87	67.2 ± 13.0	12 (13.8)	30 (34.5)
P value		.0600	.4555	.0016

TEA, total elbow arthroplasty; *SD*, standard deviation.
Age was analyzed using analysis of variance. Sex was analyzed using a χ^2 goodness-of-fit test. Outpatient percentage for each year was trended as a regression analysis.

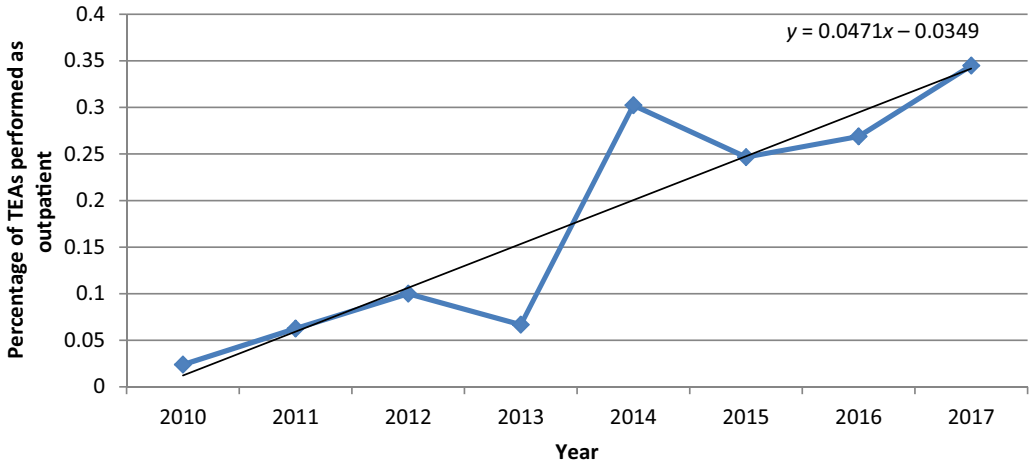

Figure 1 Percentage of TEAs performed as an outpatient per year. Regression analysis was used to test the trend ($P = .0016$). Linear trendline and its equation are displayed. *TEAs*, total elbow arthroplasties.

Table III
Operative characteristics of TEA patients, separated by setting of surgery

Operative characteristic	Inpatient (n = 413)	Outpatient (n = 111)	*P* value
ASA class, median	3	3	.1073
Operative time, min, mean ± SD	159.8 ± 66.0	160.0 ± 67.6	.9778

TEA, total elbow arthroplasty; *ASA*, American Society of Anesthesiologists; *SD*, standard deviation.
ASA classification distributions were compared using a χ^2 contingency test. Operative time between cohorts was analyzed with a 2-tailed *t* test assuming unequal variance.

Table IV
Comparison of complication rate between inpatient and outpatient cohorts

Complication	Inpatient (n = 413)	Outpatient (n = 111)	*P* value
Superficial SSI	5	0	.2441
Deep SSI	3	0	.3678
Wound disruption	2	1	.6055
Pneumonia	5	0	.2441
Pulmonary embolism	3	0	.3678
Renal insufficiency	0	0	—
Acute renal failure	0	0	—
Urinary tract infection	1	0	.6038
Stroke/CVA	2	0	.4626
Cardiac arrest	0	0	—
Myocardial infarction	1	0	.6038
Deep venous thrombosis	3	0	.3678
Sepsis	4	0	.2980
Septic shock	2	0	.4626
Return to OR	11	2	.6044
Patients experiencing a complication	30	3	.0790

SSI, surgical site infection; *CVA*, cerebrovascular accident; *OR*, operating room.
Each complication was compared between the 2 cohorts using a χ^2 contingency test. Total patients experiencing a complication is less than the total number of complications for the inpatient cohort because 10 patients had 2 complications and 1 patient had 3 complications.

Safety of outpatient total joint arthroplasty has been studied by a multitude of authors. Outpatient total hip arthroplasty and total shoulder arthroplasty have been shown to have the same complication rate as respective inpatient procedures.[7,10,17,18] There is no consensus in the literature, however, regarding the complication rate of outpatient relative to inpatient total knee arthroplasty.[4,6,14,21] In an analysis of a single surgeon's cases, Albert et al[1] showed that there was no difference in the complication rate between inpatient and outpatient TEA. The infection rate was higher in the inpatient group, however. This study is the only other study, to our knowledge, to compare complication rates of inpatient and outpatient TEA.

The most common complications following TEA are delayed healing, wound drainage, hematoma formation, infection, nerve injury, and implant failure.[2,8,11,13,16,19,20] The present study reports a 30-day complication rate of 7.3% for inpatient TEA, compared with 2.7% for the outpatient setting. This inpatient complication rate is comparable to what has been reported in the literature, albeit for 90 days. Krenek et al[15] reported a 90-day complication rate of 10.5%, and a 90-day reoperation rate of 8.1%. Stone et al[22] reported a 7.1% rate of major complications and a 39.2% rate of minor wound complications in 90 days. Meanwhile, Zhou et al[24] reported a 30-day complication rate of 3.1% for inpatient TEA, which is comparable to the outpatient complication rate found presently.

The present study is not without limitations. It is a retrospective database study and is thus accompanied by all of the shortcomings associated with database studies. The cases reviewed here were performed by a wide variety of surgeons at a wide variety of institutions. Operative and perioperative protocols were therefore not standardized. Additionally, the ACS NSQIP database only follows patients for 30 days postoperatively. Complications occurring more than 30 days after surgery would thus not be accounted for in this study. It is possible these data, therefore, do not capture the segment of patients in both cohorts who experienced hardware failure or delayed healing. Longer-term follow-up would likely increase the complication rate reported. Although TEA is increasing in frequency, it is still a relatively uncommon procedure. We reviewed a total of 524 cases over the course of 8 years. Analysis of our data reviewed a nonsignificant trend toward a lower complication rate in outpatient TEA. It is possible that this trend could reach significance in a future study if a greater number of cases were reviewed. Additionally, it is possible that patients with an increased number of medical comorbidities would be more likely to be operated on in the inpatient setting, confounding the increased complication rate in the inpatient cohort. American Society of Anesthesiologists classification distributions were not significantly different between the inpatient and outpatient cohorts, but that does not eliminate the possibility that this type of bias was present.

This study found that the outpatient setting is comprising an ever-increasing segment of TEA procedures, without an increase in short-term morbidity to patients. To our knowledge, this is the largest study comparing complication rates between outpatient and inpatient TEA. Further study is warranted to determine the effects of TEA surgery setting on long-term complication rates.

Conclusions

This study analyzed the trend in TEA setting from 2010-2017 and compared the complication rates between inpatient and outpatient TEA. There was a significant trend toward TEA being performed as an outpatient procedure. There was no difference in complication rate between inpatient and outpatient TEAs, though there was a nonsignificant trend toward a lower complication rate in the outpatient cohort. Taken together, the outpatient setting comprises an ever-increasing segment of TEA without an increase in morbidity to patients.

Disclaimer

Jack Choueka is part-owner and board member of Brooklyn Surgery Center in Brooklyn, NY. All the other authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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