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Thirty-day readmissions and reoperations after total elbow arthroplasty: a national database study

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Background: The purpose of this study was to determine the rate of short-term complications after total elbow arthroplasty (TEA) and identify predictors of readmission and reoperation. We hypothesized that TEA performed for acute elbow trauma would have higher rates of 30-day readmission and reoperation than TEA performed for osteoarthritis (OA).

Methods: Using the National Surgical Quality Improvement Program for the years 2011-2017, we identified patients undergoing TEA for fracture, OA, or inflammatory arthritis. Patient demographic characteristics, comorbidities, reoperations, and readmissions within 30 days of surgery were analyzed. Potential predictors of reoperation and readmission in the model included age, sex, race, body mass index (BMI), diabetes, hypertension, chronic obstructive pulmonary disease, congestive heart failure, smoking, bleeding disorders, American Society of Anesthesiologists classification, wound classification, operative time, and indication for surgery.

Results: A total of 414 patients underwent TEA from 2011-2017. Of these patients, 40.6% underwent TEA for fracture; 37.0%, for OA; and 22.7%, for inflammatory arthritis. The overall rate of unplanned readmissions was 5.1% (21 patients). The rate of unplanned reoperations was 2.4% (10 patients). Infection was the most common reason for both unplanned readmissions and reoperations. The rates of reoperations and readmissions were not significantly associated with any of the 3 operative indications: fracture, OA, or inflammatory arthritis. Multiple logistic regression analysis found increased BMI to be associated with lower odds of an unplanned readmission (odds ratio [OR], 0.883; 95% confidence interval [CI], 0.798-0.963; $P = .0035$) and found wound classification ≥ 3 to be associated with increased odds of an unplanned reoperation (OR, 16.531; 95% CI, 1.300-167.960; $P = .0144$) and total local complications (OR, 17.587; 95% CI, 2.207-132.019; $P = .0057$). Patients who were not functionally independent were more likely to experience local complications (OR, 4.181; 95% CI, 0.983-15.664; $P = .0309$) than were functionally independent patients.

Conclusions: The 30-day unplanned reoperation rate after TEA was 2.4%, and the unplanned readmission rate was 5.1%. Low BMI was predictive of readmission. Wounds classified as contaminated or dirty were predictive of reoperation. Dependent functional status and contaminated wounds were predictive of local complications. The indication for TEA (fracture vs. OA vs. inflammatory arthritis) was not found to be a risk factor for reoperation or readmission after TEA.

Institutional review board approval was not required for this retrospective study.

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Total elbow arthroplasty (TEA) has become a more popular treatment option for debilitating elbow pathologies over the years. The main indications for TEA include rheumatoid arthritis, degenerative joint disease, joint instability, and acute fracture.[10] Despite the increasing popularity of TEA, it is still a relatively uncommon procedure, especially in comparison to total hip, knee, and shoulder arthroplasty procedures.[3] One national database review reported that 3146 TEAs were performed over a 5-year period in comparison to 700,000 total knee arthroplasties performed annually.[7]

Complication rates following TEA between 3.1% and 38% have been reported.[6,17,19] Common complications include aseptic loosening, infection, periprosthetic fracture, triceps rupture, and neuropathy.[1,6,14] DeBernardis et al[4] reported that the most common reasons for primary TEA failure requiring revision were infection (43.5%) and aseptic loosening (37%). Early outcome data for TEA have been limited because most studies have been completed at a single institution with a limited number of patients. Prior database studies have reported a 30-day readmission rate of 4.4%[19] and 90-day reoperation rate of 6.4%.[5]

The current literature demonstrates trends to incorporate TEA for fracture management in addition to the classic indication for inflammatory arthritis.[2,5] Studies with longer follow-up intervals have shown a trend toward worse implant survival rates in patients with post-traumatic arthritis compared with those with other indications for TEA.[11,18] The objective of this study was to determine whether the surgical indication for TEA, comparing osteoarthritis (OA), inflammatory arthritis, or fracture, is predictive of 30-day unplanned reoperations, unplanned readmissions, systemic complications, or local complications after TEA.

Materials and methods

Study design and population

This retrospective cohort study was performed using data from the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database (Chicago, IL, USA). The ACS-NSQIP database is a validated and risk-adjusted database of 30-day perioperative outcomes from a national sample of >600 participating hospitals in the United States. Patients in the ACS-NSQIP database who underwent total elbow replacement between 2011 and 2017 were identified using Current Procedural Terminology (CPT) code 24363 for TEA. *International Classification of Diseases, Ninth Revision* (ICD-9) and *International Classification of Diseases, Tenth Revision* (ICD-10) codes were reviewed to determine the underlying surgical diagnosis. Patients were included if they underwent TEA for fracture, OA, or inflammatory arthritis. Patients were excluded for diagnoses of malignancy, infection, or revision arthroplasty.

The primary outcomes of interest were unplanned reoperation, unplanned readmission, total systemic complications, and total local complications within the 30-day postoperative period. Unplanned reoperation and unplanned readmission are variables directly reported in the NSQIP database. The reason for readmission and reoperation and related ICD-9 codes were also reviewed. Cases that underwent reoperation and readmission are identified as either related or unrelated to the index surgical procedure in the NSQIP database. ''Total systemic complications'' is an aggregate variable designed for this study, combining NSQIP variables of death, pulmonary embolism, sepsis, septic shock, cerebrovascular accident, renal failure, cardiac arrest, urinary tract infection, deep vein thrombosis, pneumonia, renal insufficiency, and blood transfusion. A patient experiencing >1 of these complications is counted only once as a patient experiencing a systemic complication. ''Total local complications,'' similarly, is an aggregate variable designed for this study, combining deep wound infection, superficial wound infection, and wound dehiscence.

The ACS-NSQIP database reports patients' postoperative outcomes up to 30 days after the initial surgical procedure. Unplanned reoperations are captured whether they are performed at the same hospital or at an outside hospital that participates in ACS-NSQIP. Fifteen characteristic variables were selected for analysis as potential predictors of unplanned reoperation, unplanned readmission, total systemic complications, and total local complications: patient age, sex, race (white vs. non-white), smoking status, body mass index (BMI), insulin-dependent diabetes mellitus, congestive heart failure, hypertension, chronic obstructive pulmonary disease, bleeding disorder, wound classification (≥3), American Society of Anesthesiologists (ASA) classification (≥3), functional status (independent vs. dependent or partially dependent), length of operation, and operative indication (fracture, inflammatory arthritis, or OA). Wound classification was assigned according to the US Centers for Disease Control and Prevention surgical wound classification scheme: clean, 1; clean-contaminated, 2; contaminated, 3; and dirty or infected, 4. A positive smoking history was noted if the patient was a current smoker and had smoked in the year before admission for surgery.

Statistical analysis

The demographic and clinical characteristics of the patient sample were described using the mean and standard deviation for continuous variables and frequency and percentage for categorical

variables. Continuous variables were compared using the Kruskal-Wallis test. Categorical variables were compared using the χ^2 or Fisher test. Within-group comparisons were analyzed between the fracture, OA, and inflammatory arthritis groups using the Mann-Whitney *U* test and 2 × 2 χ^2 or Fisher test. A separate multiple logistic regression analysis with penalized maximum likelihood estimation and Firth bias correction was performed to identify independent risk factors for unplanned reoperation, unplanned readmission, total systemic complications, and total local complications. Adjusted odds ratios (ORs) along with 95% confidence intervals (CIs) were reported. An estimated OR >1 indicated greater odds of an unplanned reoperation and/or readmission and total complications. Statistical analyses were carried out using SAS software, version 9.4 (SAS Institute, Cary, NC, USA). The level of significance was set at $\alpha = .05$ (2-tailed).

Results

A total of 414 patients who underwent TEA surgery for fracture, OA, or inflammatory arthritis (rheumatoid arthritis) were identified for inclusion in the study. The average patient age at the time of surgery was 65.7 ± 13.9 years, 79.9% of patients were female patients, and 74.4% of patients were non-Hispanic white. The mean BMI was 29.1 ± 7.2 kg/m^2. The mean operative time was 158.0 ± 62.8 minutes. Of the included patients, 40.6% underwent TEA for fracture; 37.0%, for OA; and 22.7%, for inflammatory arthritis. Demographic and clinical characteristics are shown in Table I. Fracture patients were significantly older and significantly more likely to have diabetes, hypertension, and a history of a bleeding disorder. Fracture patients had a significantly shorter operative time. OA patients had a significantly higher incidence of smokers and a significantly lower ASA score than the fracture group but had a significantly higher ASA score than the inflammatory arthritis group. The inflammatory arthritis cohort had a significantly lower BMI than the fracture or OA cohort ($P < .001$).

The overall rate of unplanned readmissions was 5.1% (21 patients), occurring at an average of 14.2 ± 8.6 days after surgery. Among these, 71.5% were identified as related to the index surgical procedure in the NSQIP database. The indications for readmission included infection (7), hematoma (2), seroma (1), fracture (1), other indication related to the index surgical procedure (4), and unrelated causes (6). Of the 6 unplanned readmissions for unrelated causes, 1 readmission was for orthostatic hypotension (ICD-10 code I95.1) and the other was for hypotension not otherwise specified (ICD-9 code 458.9). The other 4 readmissions did not have associated ICD-9 or ICD-10 codes listed in the database. The rate of unplanned reoperations was 2.4% (10 patients), occurring at an average of 20.2 ± 4.7 days postoperatively. Of these, 80.0% were related to the index surgical procedure. The indications for reoperation included infection (4), hematoma (2), other related causes (2), and unrelated causes (2). Of the 2 reoperations for unrelated causes, 1 reoperation was for a vein ligation procedure (CPT 37609); the reason for the other reoperation is unknown because it had no associated CPT code or listed procedure in the database. The rate of total systemic complications was 6.5%, and the rate of total local complications was 3.1%.

Adverse events compared among fracture, OA, and inflammatory arthritis patients showed significantly more blood transfusions and total systemic complications in fracture patients. The rates of reoperations and readmissions were not significantly associated with any of the 3 operative indications in the univariate analysis—fracture, OA, or inflammatory arthritis (Table II).

The multiple logistic regression results for unplanned readmission and reoperation, as well as total systemic and local complications, are shown in Tables III-VI. Increased BMI was associated with lower predicted odds of an unplanned readmission (OR, 0.883; 95% CI, 0.798-0.963; $P = .0035$). Wound classification ≥3 was associated with increased odds of an unplanned reoperation (OR, 16.531; 95% CI, 1.300-167.960; $P = .0144$) and total local complications (OR, 17.587; 95% CI, 2.207-132.019; $P = .0057$). Patients who were not functionally independent were more likely to experience local complications (OR, 4.181; 95% CI, 0.983-15.664; $P = .0309$) than were functionally independent patients. No other significant predictors of unplanned readmission, unplanned reoperation, and total complications emerged from the multiple logistic regression analysis (Tables III-VI).

Discussion

This study of 30-day outcomes among 414 patients who underwent TEA for fracture, OA, and inflammatory arthritis provides important prognostic information regarding the relative complication profiles for these unique surgical indications. The overall 30-day unplanned reoperation rate was 2.4%, and the overall unplanned readmission rate was 5.1%. TEA has grown dramatically over the past decade because of improvements in implant designs and expanded surgical indications.[13] Several small cohort studies have described and quantified long-term complications,[1,8,10,12,15,18] yet the incidence of short-term reoperations, readmissions, and complications after TEA remains undefined.

Our study identified a trend toward increased total systemic complications among patients undergoing TEA for fracture, which did not reach the threshold for significance in the multivariate analysis. Lower BMI was significantly associated with increased odds of readmission. Functional dependence was significantly associated with increased local complications. Increased local complications and reoperations were seen with wounds classified preoperatively as contaminated or dirty.

Table I Demographic and clinical characteristics (N = 414)

Characteristic	Acute fracture (n = 168)	OA (n = 153)	RA (n = 94)	*P* value	Pair-wise comparison		
					Fracture vs. OA	Fracture vs. RA	OA vs. RA
Demographic characteristics							
Age	73 (64-81)	64.5 (54-71)	63 (56-70)	<.001*	<.001*	<.001*	.92
Female	142 (84.5)	111 (73)	77 (82)	.078	.051	.709	.224
Race				<.001*			
White	137 (81.5)	121 (79.6)	50 (53.2)		<.001*	.115	.01*
Black	1 (0.6)	11 (7.2)	8 (8.5)		.003*	<.001*	.445
Asian	3 (1.8)	1 (0.7)	6 (6.4)		.623	.031*	.006*
Other	2 (1.2)	1 (0.7)	3 (3.2)		.999	.33	.109
BMI, kg/m^2	28.3 (24.8-33.2)	28.9 (25-35)	26.3 (22.2-31)	<.001*	.422	.005*	<.001*
Comorbidities							
Functional status (dependent)	13 (7.7)	6 (3.9)	1 (1.1)	.104	.254	.063	.254
Diabetes	18 (10.7)	10 (6.6)	1 (1.1)	.015*	.17	.002*	.054
Hypertension	113 (67.3)	75 (49.3)	37 (39.4)	<.001*	<.001*	.002*	.162
COPD	12 (7.1)	11 (7.2)	3 (3.2)	.487	.999	.297	.295
CHF	5 (3)	2 (1.3)	0 (0)	.379	.452	.163	.525
Smoking	17 (10.1)	31 (20.4)	9 (9.6)	.031*	.016*	.999	.04*
Bleeding disorder	20 (11.9)	4 (2.6)	3 (3.2)	.005*	.002*	.021*	.996
ASA class ≥3	115 (68.5)	81 (53.3)	66 (70.2)	.016*	.008*	.876	.013*
Wound class ≥3	4 (2.4)	2 (1.3)	0 (0)	.488	.687	.3	.526
Operative time, min	136 (100-183)	158 (122-199)	169 (121-201)	.014*	.005*	.005*	.737

OA, osteoarthritis; *RA,* rheumatoid arthritis; *BMI,* body mass index; *COPD,* chronic obstructive pulmonary disease; *CHF,* congestive heart failure; *ASA,* American Society of Anesthesiologists.
* Statistically significant.

Table II Complications and adverse events

Characteristic	Acute fracture (n = 168)	OA (n = 153)	RA (n = 94)	*P* value	Pair-wise comparison		
					Fracture vs. OA	Fracture vs. RA	OA vs. RA
Unplanned reoperation	2 (1.2)	5 (3.3)	3 (3.2)	.487	.263	.353	.999
Unplanned readmission	7 (4.2)	10 (6.6)	4 (4.3)	.696	.455	.999	.576
Systemic complications							
Death	1 (0.6)	0 (0)	0 (0)	.999	—	—	—
Pulmonary embolism	0 (0)	2 (1.3)	0 (0)	.379	—	—	—
Sepsis	0 (0)	0 (0)	1 (1.1)	.387	—	—	—
Septic shock	0 (0)	0 (0)	1 (1.1)	.387	—	—	—
CVA	2 (1.2)	0 (0)	0 (0)	.592	—	—	—
Acute renal failure	0 (0)	0 (0)	0 (0)	NA	—	—	—
Cardiac arrest	0 (0)	0 (0)	0 (0)	NA	—	—	—
UTI	0 (0)	0 (0)	0 (0)	NA	—	—	—
DVT	1 (0.6)	0 (0)	0 (0)	.999	—	—	—
Pneumonia	1 (0.6)	2 (1.3)	1 (1.1)	.93	.606	.999	.999
Renal insufficiency	0 (0)	0 (0)	0 (0)	NA			
Blood transfusion	17 (10.1)	3 (2)	0 (0)	<.001*	.002*	<.001*	.289
Total systemic complications	20 (11.9)	5 (3.3)	2 (2.1)	.005*	.006*	.005*	.711
Local complications							
Deep wound infection or organ space infection	4 (2.4)	4 (2.6)	0 (0)	.487	.999	.3	.301
Superficial wound infection	0 (0)	2 (1.3)	1 (1.1)	.482	.225	.359	.999
Wound dehiscence	1 (0.6)	1 (0.7)	0 (0)	.999	.999	.999	.999
Total local complications	5 (3)	7 (4.6)	1 (1.1)	.478	.56	.425	.159

OA, osteoarthritis; *RA*, rheumatoid arthritis; *CVA*, cerebrovascular accident; *UTI*, urinary tract infection; *DVT*, deep vein thrombosis.
* Statistically significant.

The underlying drivers of these associations cannot be directly identified in the NSQIP data set. However, one could expect that functional dependence may make postoperative wound care difficult, leading to local wound complications. Our study showed a significantly increased odds of local complications and reoperations among patients with wound classification $\geq$3. It is unclear why low BMI is associated with increased short-term readmissions. We hypothesize that this finding may be a result of malnutrition of these patients, but unfortunately, the albumin data set was incomplete; therefore, we were unable to analyze this correlation. Additionally, owing to the body habitus that can occur in elderly, malnourished patients, there is a less robust soft tissue envelope surrounding the elbow, which puts them at increased risk of wound complications postoperatively. This is an area for future investigation. Finally, increased blood transfusions among fracture patients vs. OA patients and inflammatory arthritis patients were the primary contributor to the increase in total systemic complications in this group. In the trauma patient, it stands to reason that TEA for acute fracture could lead to increased transfusion rates as preoperative patient optimization may be limited.

It is interesting to note that in contrast to our finding of low BMI being a risk factor for short-term readmission, Morrey and Hevesi[8] showed that BMI > 40 kg/m^2 in TEA patients is a risk factor for long-term complications and revision arthroplasty. Specifically, they reported an increased risk of implant loosening, intraoperative and postoperative fracture, stiffness, heterotopic ossification, and extensor mechanism failure in their retrospective review of 548 patients treated at their institution over a 15-year period.

The NSQIP database was used by Noureldin et al[9] to evaluate unplanned readmissions after all elective hand and elbow surgical procedures. They found a 1.2% overall 30-day unplanned readmission rate among 14,106 surgical cases. Postoperative infection accounted for nearly 20% of the causes of readmission. Risk factors for readmission were age, smoking, dialysis, low preoperative hematocrit level, and importantly, elbow procedure. Their findings underscore the need for special consideration of patients undergoing TEA as they are at high risk of readmission. Our result demonstrating a higher overall rate of unplanned readmissions (5.1%) is likely based on the fact that we only analyzed patients who underwent TEA whereas the previous study looked at all elective hand and elbow surgical procedures. The weakness of this data set is that elective hand and elbow surgical procedures were combined with no specifics related to procedures.

Table III ORs from multiple logistic regression for predictors of unplanned readmission

Characteristic	Adjusted OR	95% CI for adjusted OR	*P* value
Patient demographic characteristics			
Age	1.024	0.988-1.066	.1842
Sex (male vs. female)	1.234	0.393-3.377	.6829
Race (white vs. non-white)	1.620	0.539-6.407	.3861
Patient factors			
Current smoker (yes vs. no)	0.956	0.006-14.462	.9773
BMI	0.883	0.798-0.963	.0035*
Functional status (partially dependent vs. independent)	1.215	0.200-4.916	.7969
ASA classification (3 or 4 vs. <3)	2.517	0.989-6.402	.1245
Wound classification (3 or 4 vs. <3)	6.310	0.561-41.456	.0896
Length of operation (minutes)	1.001	0.992-1.008	.8833
Operative indication			
Osteoarthritis (reference group)	—	—	—
Fracture	0.427	0.140-1.222	.0968
Inflammatory arthritis	0.503	0.132-1.655	.2497
Patient comorbidities (yes vs. no)			
High blood pressure	0.913	0.330-2.543	.8489
Diabetes	1.210	0.127-5.621	.8219
Lung disease	0.994	0.096-4.639	.9945
Bleeding disorder	0.263	0.002-2.048	.3035
Heart disease	3.773	0.341-25.379	.2206

OR, odds ratio; *CI*, confidence interval; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists.
Multiple logistic regression with penalized maximum likelihood estimation, along with Firth bias correction, was implemented to estimate the odds of an unplanned readmission from the set of predictors. The model area under the curve equaled 0.778, with N = 414.
* Statistically significant.

Table IV ORs from multiple logistic regression for predictors of unplanned reoperation

Characteristic	Adjusted OR	95% CI for adjusted OR	*P* value
Patient demographic characteristics			
Age	1.032	0.982-1.091	.1681
Sex (male vs. female)	2.179	0.544-7.899	.1895
Race (white vs. non-white)	1.174	0.303-6.597	.8007
Patient factors			
Current smoker (yes vs. no)	0.976	0.005-28.110	.9893
BMI	0.902	0.772-1.017	.0548
Functional status (partially dependent vs. independent)	1.372	0.122-7.389	.7256
ASA classification (3 or 4 vs. <3)	1.367	0.349-6.491	.6230
Wound classification (3 or 4 vs. <3)	16.531	1.300-167.960	.0144*
Length of operation	1.005	0.995-1.013	.2318
Operative indication			
Osteoarthritis (reference group)	—	—	—
Fracture	0.253	0.033-1.309	.0651
Inflammatory arthritis	0.859	0.171-3.738	.8226
Patient comorbidities (yes vs. no)			
High blood pressure	1.199	0.293-4.952	.7643
Diabetes	0.813	0.006-7.516	.9692
Lung disease	2.442	0.189-13.527	.3125
Bleeding disorder	0.955	0.008-8.182	.9692
Heart disease	2.783	0.020-35.673	.5120

OR, odds ratio; *CI*, confidence interval; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists.
Multiple logistic regression with penalized maximum likelihood estimation, along with Firth bias correction, was implemented to estimate the odds of an unplanned reoperation from the set of predictors. The model area under the curve equaled 0.799, with N = 414.
* Statistically significant.

Table V ORs from multiple logistic regression for predictors of total systemic complications

Characteristic	Adjusted OR	95% CI for adjusted OR	*P* value
Patient demographic characteristics			
Age	1.025	0.989-1.066	.1627
Sex (male vs. female)	1.505	0.514-3.937	.4043
Race (white vs. non-white)	0.757	0.306-2.044	.5447
Patient factors			
Current smoker (yes vs. no)	0.335	0.002-4.205	.5012
BMI	0.958	0.892-1.021	.1807
Functional status (partially dependent vs. independent)	1.316	0.344-4.132	.6581
ASA classification (3 or 4 vs. <3)	2.211	0.765-7.704	.1425
Wound classification (3 or 4 vs. <3)	0.666	0.005-6.944	.8042
Length of operation	1.005	1.000-1.011	.0463
Operative indication			
Osteoarthritis (reference group)	—	—	—
Fracture	2.523	0.926-7.895	.0681
Inflammatory arthritis	0.570	0.096-2.560	.4544
Patient comorbidities (yes vs. no)			
High blood pressure	1.198	0.449-3.428	.7074
Diabetes	1.287	0.328-4.149	.6881
Lung disease	1.630	0.339-5.846	.4834
Bleeding disorder	2.020	0.617-5.892	.2129
Heart disease	0.238	0.002-2.695	.4001

OR, odds ratio; *CI*, confidence interval; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists.
Multiple logistic regression with penalized maximum likelihood estimation, along with Firth bias correction, was implemented to estimate the odds of total systemic complications from the set of predictors. The model area under the curve equaled 0.774, with N = 414.

Table VI ORs from multiple logistic regression for predictors of total local complications

Characteristic	Adjusted OR	95% CI for adjusted OR	*P* value
Patient demographic characteristics			
Age	1.033	0.987-1.089	.1370
Sex (male vs. female)	1.225	0.288-4.275	.7397
Race (white vs. non-white)	0.524	0.161-1.892	.2413
Patient factors			
Current smoker (yes vs. no)	1.643	0.011-23.845	.7406
BMI	0.945	0.841-1.040	.2121
Functional status (partially dependent vs. independent)	4.181	0.983-15.664	.0309*
ASA classification (3 or 4 vs. <3)	1.088	0.290-4.581	.8908
Wound classification (3 or 4 vs. <3)	17.587	2.207-132.019	.0057*
Length of operation	1.004	0.996-1.012	.2261
Operative indication			
Osteoarthritis (reference group)	—	—	—
Fracture	0.368	0.084-1.393	.1089
Inflammatory arthritis	0.259	0.026-1.348	.1122
Patient comorbidities (yes vs. no)			
High blood pressure	0.921	0.259-3.346	.8873
Diabetes	0.389	0.003-3.815	.4692
Lung disease	2.110	0.202-10.952	.3858
Bleeding disorder	1.634	0.150-9.129	.5863
Heart disease	1.583	0.010-19.226	.7795

OR, odds ratio; *CI*, confidence interval; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists.
Multiple logistic regression with penalized maximum likelihood estimation, along with Firth bias correction, was implemented to estimate the odds of total local complications from the set of predictors. The model area under the curve equaled 0.841, with N = 414.
* Statistically significant.

Gay et al[5] reviewed reoperation rates after TEA in New York State using the Statewide Planning and Research Cooperative System (SPARCS) database from 1997-2006. The 90-day readmission rate among 1155 TEA cases was 12%, with nearly half of these complications being implant related. Risk factors for readmission included age >65 years, Charlson Comorbidity Index >2, and oncologic indication for surgery. No difference was seen between the trauma, OA, and inflammatory arthritis groups. The study also looked at long-term revision arthroplasty rates, showing a higher rate of revision surgical procedures among patients with OA and a lower rate among those who underwent TEA for trauma. The overall average revision rate was 6.4% at an average of 2.3 years. The revision rate within 90 days of surgery was 0.7%. Although our reoperation rate was much lower (2.4%), these findings may be the result of shorter follow-up as we were only able to report events occurring within the first 30 days after surgery. The previous study was able to provide longer postoperative follow-up. It is unknown what the results of our investigation would be at longer-term postoperative follow-up. Additionally, the previous study included patients undergoing TEA for tumor, and these patients inherently are at increased risk of postoperative complications owing to immunosuppression. Oncology-related TEA was an exclusion criterion for our investigation.

There is disagreement in the TEA literature about whether TEA for trauma is associated with lower subsequent revision rates. In contrast to Gay et al,[5] Perretta et al[11] found that patients who underwent TEA for trauma were more likely to undergo reoperations and revision arthroplasty. They reported the results of 102 TEA patients treated at 2 institutions for 6 years postoperatively, showing a 41% rate of reoperation at an average of 1.8 years postoperatively and a 30% rate of revision arthroplasty at 6 years' follow-up. It is important to note that both of the aforementioned studies combined acute trauma and post-traumatic arthritis under the diagnosis category "trauma."[5,11] This method differs from our study, in which fracture is compared with OA and inflammatory arthritis. Many OA cases are likely sequelae of remote elbow trauma (ie, post-traumatic arthritis).

Somerson et al[16] used the Statewide Planning and Research Cooperative System (SPARCS) database of surgical procedures performed in New York State to evaluate the outcomes of TEA. They evaluated risk factors for infection among 1452 TEA patients. The overall rate of readmission for periprosthetic joint infection was 3.7%; of these readmissions, 50% occurred <3 months after the index procedure vs. 31% at 3-24 months and 13% at >24 months. Our finding of a 2.7% rate of deep or superficial infection at 30 days is comparable to these findings. Somerson et al additionally found that rheumatoid arthritis, hypothyroidism, and tobacco use were associated with the development of periprosthetic joint infection.

Our study is not without limitations. The NSQIP database lacks orthopedic-specific variables, such as hardware failure or component loosening. These variables would give valuable insight into the reasons for readmission and reoperation that are specific to the elbow implants. However, a majority of the readmissions and reoperations were linked to local infections and wound complications, suggesting that orthopedic-specific variables may be a lesser contributor to short-term complications. This study is also limited to only 30-day follow-up. Extending this period to 90 days to coincide with the 90-day postoperative global period may be beneficial for the purposes of anticipating the associated costs of early complications after TEA. Finally, our sample size of 414 patients is small for a statistical analysis of events that occur at a rate of 2%-5%. A power analysis was not performed for this study. However, among studies of TEA, which are primarily case series of <100 patients, our sample is one of the largest series reported. The findings of this study may be useful as prognostic information for patients, families, and hospitals managing the expense associated with adverse events after TEA.

Conclusion

The 30-day unplanned reoperation rate after TEA was 2.4%, and the unplanned readmission rate was 5.1%. Low BMI was predictive of readmission. Wounds classified as contaminated or dirty were predictive of reoperation. Dependent functional status and contaminated wounds were predictive of local complications. The indication for TEA (fracture vs. OA vs. inflammatory arthritis) was not found to be a risk factor for reoperation or readmission after TEA.

Disclaimer

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