

General

Total elbow and hip arthroplasties confer greater short-term risk of postoperative complications: a matched cohort analysis of the five major joint arthroplasties

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Background

Total joint arthroplasty (TJA) is a common orthopedic procedure.

Objective

The primary objective of this retrospective cohort study was to investigate 30-day postoperative complication rates following five major types of TJA (shoulder, elbow, hip, knee, ankle). Independent risk factors for adverse outcomes were also assessed.

Methods

The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database was filtered using current procedural terminology (CPT) codes to identify patients undergoing TJA from 2015 to 2020. Patients were divided into cohorts by joint replaced. Nearest neighbor matching and statistical analyses were performed to compare complication rates between cohorts.

Results

A total of 605,158 patients were identified, with 457 patients included per matched cohort. Mean age was youngest in the ankle cohort. Operative time and proportion of patients with dependent functional status were greatest in the elbow cohort. Length of stay (LOS) and risk of any adverse event (AAE) were greatest for elbow and hip arthroplasty. Risk of AAE was lowest with ankle arthroplasty. Wound dehiscence and return to the operating room (OR) were most common following elbow arthroplasty. Postoperative blood transfusion occurred most often after hip arthroplasty. Operative time, LOS, BMI, American Society of Anesthesiologists (ASA) class, and preoperative blood transfusion were independently associated with postoperative complications.

Conclusion

Elbow and hip arthroplasty appear to confer greater risk of short-term postoperative complications compared to other TJA types. This data can help inform clinical decision-making and may facilitate adoption of measures within orthopedic practice to optimize outcomes and minimize financial burden.

INTRODUCTION

Total joint arthroplasties (TJA) are among the most common orthopedic procedures performed in the United States, commonly treating affected shoulders, elbows, hips, knees, and ankles. Studies using data from the Healthcare Cost and Utilization Project (HCUP) and U.S. Census Bureau report increasing incidences of total knee arthroplasty (TKA) and total hip arthroplasty (THA) since the early 2000s, with

an estimated 7 million Americans living with a hip or knee replacement 2010.^{1,2} Additionally, data from the Centers for Medicare & Medicaid Services (CMS) estimate that the number of TKA and THA procedures in patients covered by Medicare both increased by more than 150% in the first two decades since 2000 and are expected to continue growing by more than 20% annually.³ Recent estimates of the prevalence of total shoulder arthroplasty (TSA) in the United States are nearly 200 in 100,000 people, with similar pro-

jections of increasing incidence each year.^{4,5} Total elbow arthroplasty (TEA) is becoming more common for treatment of traumatic conditions; however, its use in treating arthritis seems to be decreasing.⁶ Overall, however, TEA incidence also appears to be increasing over time.⁶ Lastly, annual volume of total ankle arthroplasty (TAA) has increased by more than 130% in recent years.⁷

Given the increasing incidence of TJA, postoperative complication risk is an important consideration for patients, surgeons, and surgical centers. Understanding how these adverse outcomes negatively impact patient health or increase medical costs and hospital resource utilization can enhance quality improvement efforts.⁸ Therefore, the current authors were interested in exploring differences in complication rates for different types of arthroplasty, as this knowledge would be helpful in approximating resource burden of TJA. A review by Grayson & Decker (2012) explores outcomes associated with joint arthroplasty used to treat osteoarthritis (OA).⁹ The authors concluded that, while long-term data for TAA was limited, TSA both had higher complication rates relative to TKA and THA.⁹ They also observed that TEA (albeit less common of a procedure) was associated with high complication rates and functional restrictions after surgery.⁹ Studies comparing risk factors and outcomes specifically between THA and TKA also exist. For example, Pugely et al. (2013) noted a greater rate of 30-day readmission and wound infection in their THA cohort.¹⁰ Other studies examine factors influencing complications following one specific TJA procedure. For example, readmission following TKA has been associated with dependent functional status and comorbid hypertension or COPD, and diabetes has been associated with readmission after TAA.^{11,12}

As discussed above, knowledge exists regarding complications after individual joint arthroplasties. However, there is a lack of original studies in the literature that contrast complication rates or overall safety of all five major TJAs. With each TJA becoming increasingly common, this study seeks to address this gap in existing knowledge by assessing short-term postoperative complications following each type of arthroplasty. We seek to compare rates of adverse events between the different types of TJA in order to elucidate any differences and trends in adverse event profiles for each surgery. We will also evaluate for any secondary independent risk factors associated with postoperative complications.

MATERIALS AND METHODS

The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) was used to conduct this analysis. NSQIP data was collected by the certified Surgical Clinical Reviewer at each participating site.¹³ Participant Use Data Files (PUF) from 2015 to 2020 were used in this analysis, which included patients who underwent surgery from January 2015 to December 2020. NSQIP uses a systematic sampling process to determine which cases are included in the PUF. All patients were followed for 30 days postoperatively.

The inclusion criteria for this analysis were patients that underwent primary TAA (27702), TEA (24363), TSA (23472), TKA (27447), or THA (27130) as identified by CPT code. NSQIP criteria for case exclusion included minors (patients less than 18 years of age), trauma cases, and cases that were returned to the operating room due to a complication from a prior procedure. The data was also cleaned for this analysis using R Studio version 2023.06.0 (Boston, MA) to exclude cases that had an operative time, length of hospital stay, or body mass index (BMI) less than zero. Cases were also excluded if functional status, days from hospital admission to operation, sex, or American Society of Anesthesiologists (ASA) class did not have a response. If the principal anesthesia technique was “none” or “other,” the case was excluded.

The independent variable for this analysis was the joint replaced: elbow, shoulder, hip, knee, or ankle. The dependent variables were adverse events following surgery. The outcomes of interest were death, wound dehiscence, sepsis, pulmonary embolism, renal complication, myocardial infarction, cardiac arrest, stroke, transfusion, deep vein thrombosis (DVT), urinary tract infection (UTI), pneumonia, intubation issues, surgical site infection (SSI), and return to the operating room. Any adverse event (AAE) included all the above complications.

STATISTICAL PLAN

Matched cohorts were created using the nearest neighbor method to match patients according to age, BMI, sex, race, diabetes, smoking status, ASA class, hypertension requiring medication, congestive heart failure, chronic obstructive pulmonary disease (COPD), bleeding disorders, and days from hospital admission to operation. SPSS version 28.0.1.1 (Armonk, NY) was used for statistical analyses. A one-way ANOVA was used to determine if there was a difference between the groups for continuous variables. A chi square test was used to determine if there was a difference between groups for categorical variables. A binary logistic regression was performed on all included patients to determine the odds ratio and 95% confidence intervals (CI) with any adverse event as the dependent variable and patient demographics and comorbidities as covariates. Results were statistically significant if $p \leq .05$.

ETHICAL CONSIDERATIONS

Ethical approval was not sought for the present study because data was obtained from a nationally used, de-identified database.

RESULTS

DEMOGRAPHICS

A total of 605,158 patients were identified as receiving any type of TJA. 26,650 patients underwent TSA (4.4%), 459 underwent TEA (0.1%), 221,697 underwent THA (36.6%), 354,842 underwent TKA (58.6%), and 1,510 underwent TAA (0.2%). Prior to matching, all baseline demographic charac-

teristics (age, BMI, sex, operative time, length of stay, outpatient status) and comorbidities were significantly different across all five groups ($p < 0.001$) (Table 1). The numbers of patients that were current smokers or qualified for dependent functional status were also significantly different across all cohorts.

After matching, 457 patients were included in each cohort. Mean age, operative time, length of stay (LOS), and number of patients with outpatient status remained significantly different across all five cohorts ($p \leq 0.001$). The THA cohort had the oldest average age (68.1 years), while the TAA cohort had the youngest average age (65.1 years). TEA conferred the longest mean operative time (162.8 ± 65.6 minutes), while THA conferred the shortest (91.2 ± 37.9 minutes). TEA and THA both conferred the longest average LOS of 2.6 days, and both TAA and TSA conferred the shortest mean LOS (1.8 days). The TEA cohort had the greatest proportion of patients with outpatient status (164 patients out of 457), and THA had the lowest (39 patients). Additionally, there was a statistically significant difference in mean ASA class when comparing the five groups ($p = 0.012$). The TKA cohort had a mean ASA class of 2.7, while all other cohorts had a mean class score of 2.6. The number of patients with dependent functional status (partial or total) significantly differed as well, with the greatest proportion seen in the TEA cohort (24 patients out of 457). Finally, preoperative steroid use was significantly different across the groups, with greatest use reported in the TEA cohort (84 patients, $p < 0.001$). No other comorbidities significantly differed in prevalence between matched groups. Complete demographic data for matched cohorts can be seen in Table 2.

OUTCOMES

Prior to matching, the rate of any adverse event (AAE) and all postoperative complications (except renal complication and stroke) were significantly different between the five cohorts (Table 3). After matching, wound dehiscence, postoperative blood transfusion, and return to OR were the only specific outcomes that significantly differed between cohorts. TEA had the highest rate of dehiscence (1.1%), while the TSA and TAA cohorts did not have any reported incidence ($p = 0.029$). The THA group had the highest incidence of transfusion (5.9%), while TAA had the lowest (0.2%) ($p < 0.001$). Return to OR was most commonly seen in the TEA cohort (3.5%) ($p = 0.01$). Finally, risk of AAE appeared greatest with THA (10.5%), followed by TEA (9.6%), TSA (7.4%), TKA (5.3%), and least in TAA (3.5%) ($p < 0.001$). All complication rates for matched cohorts are listed in Table 4.

To assess independent risk factors associated with postoperative complications following total joint arthroplasty, all demographic traits and comorbidities were analyzed using binary logistic regression. Lower BMI, longer operative time, longer length of stay, higher ASA class, and preoperative blood transfusion were all associated with increased risk of AAE following joint replacement. These statistically significant risk factors are reported in Table 5.

DISCUSSION

Operative time, total LOS, outpatient status, ASA class, proportion with dependent functional status, and proportion with preoperative steroid use were all demographic factors remaining significantly different between all five TJA types after matching. For specific complication types in the matched cohort, wound dehiscence, transfusion, and return to OR were significantly different, while overall rates of AAE were also significantly different between matched cohorts. Wound dehiscence and return to OR rates were highest following TEA, while transfusion and AAE rates were highest following THA. The TAA cohort had the lowest rates of AAE and transfusion, TKA had the lowest rate of return to OR, and neither TSA nor TKA had any cases of wound dehiscence. In summary, TEA and THA appear to confer greater risk for short-term postoperative complications compared to other types of joint arthroplasty.

Rates for return to OR for all surgeries were low as shown in Table 4, although significantly increased rates in TEA (3.5%) and THA and TSA (2.2%) within the matched cohorts are notable. Return to the OR within 30-days can happen for a variety of surgery-specific reasons which are not specified in the NSQIP database. However, this analysis found that TEA also had the highest rate of wound dehiscence alongside elevated counts of SSI in the matched cohort. Taken together, these findings corroborate the literature regarding a previously described association with posterior approach TEA and increased dehiscence/infection rates.¹⁴ It has been hypothesized that perfusion deficits or paucity of soft tissue coverage in the cubital region contribute to these findings through undescribed pathways.¹⁴ However, in an effort to troubleshoot these associations, cadaveric perfusion studies have highlighted the importance of preserving medial subdermal vascular structures to prevent complication.¹⁴ Regarding THA, return to OR can happen for dislocation, implant subsidence, periprosthetic fracture or other unforeseen complications.¹⁵ Additionally, while THA is a surgery with multiple possible techniques, there is conflicting data on whether surgical approach influences return to OR or other complication rates. It should be noted that details regarding surgical approach are beyond the scope of the present study, but this is a potential area for future research. Furthermore, all arthroplasty surgeries carry risks of revision surgeries that most frequently occur outside of a 30-day follow up due to prolonged processes like aseptic loosening or implant failure.¹⁶ Were it achievable, a large sample study with long-term follow up would authorize stronger comment on the differences between overall rates of 'return to the OR' or secondary surgery.

Insofar as we have been able to review the literature, this is the first study to report on the rates of any adverse events for all five arthroplasty surgeries using data included in the NSQIP database. It is interesting to note that, after matching, rates of adverse events increased in all groups. This is likely due to the pair-matching being limited to the smaller TEA sample size ($n=459$) in conjunction with the previously mentioned trend of TEA being performed as treatment for fracture around the joint, possibly selecting for patients

Table 1. Demographic information by arthroplasty type, prior to matching.

	TSA	TEA	THA	TKA	TAA	p-value
Patients, N (%)	26,650 (4.4)	459 (0.1)	221,697 (36.6)	354,842 (58.6)	1,510 (0.2)	
Age (mean $\pm$ SD, years)	69.2 $\pm$ 9.3	66.6 $\pm$ 13.1	65.3 $\pm$ 11.2	66.9 $\pm$ 9.2	64.1 $\pm$ 10.0	<0.001
BMI (mean $\pm$ SD, kg/m ²)	31.2 $\pm$ 6.9	29.6 $\pm$ 7.2	30.2 $\pm$ 6.3	33.0 $\pm$ 6.7	31.3 $\pm$ 5.9	<0.001
Male sex	11,796 (44.3)	96 (20.9)	100,313 (45.2)	138,012 (38.9)	831 (55.0)	<0.001
Operative Time (mins)	108.2 $\pm$ 43.9	162.8 $\pm$ 65.5	91.1 $\pm$ 38.1	90.6 $\pm$ 35.6	153.0 $\pm$ 58.9	<0.001
Length of Stay (days)	1.6 $\pm$ 3.5	2.1 $\pm$ 7.6	2.1 $\pm$ 3.5	2.2 $\pm$ 3.2	1.6 $\pm$ 1.1	<0.001
Outpatient status	3,031 (11.4)	164 (35.7)	17,598 (7.9)	51,987 (14.7)	252 (16.7)	<0.001
ASA Class	3.0 $\pm$ 0.4	3.0 $\pm$ 0.5	2.9 $\pm$ 0.6	3.0 $\pm$ 0.4	2.8 $\pm$ 0.6	<0.001
1 - no disturbance	385 (1.4)	9 (2.0)	7,616 (3.4)	6,114 (1.7)	67 (4.4)	-
2 - mild disturbance	10,915 (41.0)	180 (39.2)	113,822 (51.3)	168,801 (47.6)	823 (54.5)	-
3 - severe disturbance	14,531 (54.5)	245 (53.4)	95,527 (43.1)	173,961 (49.0)	603 (39.9)	-
4 - life-threatening disturbance	815 (3.1)	25 (5.4)	4,716 (2.1)	5,950 (1.7)	17 (1.1)	-
5 - moribund	4 (0.0)	0	16 (0.0)	16 (0.0)	0	-
Race						
White	22,213 (83.4)	342 (74.5)	158,060 (71.3)	250,750 (70.7)	1,183 (78.3)	
Black	1,267 (4.8)	24 (5.2)	17,894 (8.1)	28,653 (8.1)	40 (2.6)	-
Asian	189 (0.7)	10 (2.2)	3,368 (1.5)	7,365 (2.1)	22 (1.5)	-
American Indian or Alaska Native	123 (0.5)	6 (1.3)	920 (0.4)	1,827 (0.5)	1 (0.1)	
Native Hawaiian or Pacific Islander	37 (0.1)	0	554 (0.2)	1,232 (0.3)	3 (0.2)	
Other	7 (0.0)	0	32 (0.0)	59 (0.0)	0	-
Unknown	2814 (10.6)	77 (16.8)	40,869 (18.4)	64,956 (18.3)	261 (17.3)	
Dependent Functional Status (partial or total)	571 (2.1)	24 (5.2)	4,176 (1.8)	3,591 (1.0)	12 (0.8)	<0.001
Current smoker	2,750 (10.3)	58 (12.6)	27,272 (12.3)	28,023 (7.9)	117 (7.7)	<0.001
Comorbidities N(%)						
CHF	178 (0.7)	6 (1.3)	903 (0.4)	1,248 (0.4)	7 (0.5)	<0.001
Renal failure	13 (0.0)	0	148 (0.1)	94 (0.0)	0	<0.001
Dialysis	85 (0.3)	0	557 (0.3)	588 (0.2)	2 (0.1)	<0.001
Steroid use	1,291 (4.8)	85 (18.5)	8,286 (3.7)	12,465 (3.5)	70 (4.6)	<0.001
Weight loss	56	3	518	321	0	<0.001

	TSA	TEA	THA	TKA	TAA	p-value
	(0.2)	(0.7)	(0.2)	(0.1)		
Bleeding disorder	673 (2.5)	17 (3.7)	4,666 (2.1)	6,655 (1.9)	42 (2.8)	<0.001
Ascites	5 (0.0)	0	55 (0.0)	43 (0.0)	0	0.010
Pre-operative transfusion	58 (0.2)	3 (0.7)	353 (0.2)	123 (0.0)	0	<0.001
Diabetes	4,808 (18.0)	78 (17.0)	27,374 (12.3)	64,623 (18.2)	177 (11.7)	<0.001
IDDM	1,391 (5.2)	29 (6.3)	6,573 (3.0)	15,271 (4.3)	38 (2.5)	-
NIDDM	3,417 (12.8)	49 (10.7)	20,801 (9.4)	49,352 (13.9)	139 (9.2)	-
DOE	1,794 (6.7)	18 (3.9)	9,842 (4.4)	19,114 (5.4)	59 (3.9)	<0.001
COPD	1,170 (6.6)	34 (7.4)	8,634 (3.9)	11,842 (3.3)	41 (2.7)	<0.001

with greater deficits in baseline health.⁶ This is evidenced by the 3.6% and 3.2% increases in AAE rates after pair-matching for THA and TSA, respectively.

A future question the above finding may raise is how quickly the risk for AAE rises with increasing comorbidities or worse baseline health metrics. Future studies would be needed to map out the trajectory of these surgeries to elucidate how sharply the risk of adverse events rises with each additional comorbidity in patients undergoing TJA. Finally, while all cohorts' rates of AAE increased following matching, it should be noted that AAE persisted in being lowest in the TAA cohort both prior to and after matching. This result may reflect improvements in the procedure established over time to reduce complication risks.⁷

Within the matched groups, independent risk factors for developing any adverse event were BMI, operative time, LOS, ASA class, and preoperative transfusion. Increased BMI, ASA class, and transfusions are preoperative measures that are heavily associated with more complex patients with baseline health deficits and more comorbidities.¹⁷ Additionally, increased operative time and LOS can be considered either the cause or effect.⁸ However, there is still room for improvement with using these established risk factors to guide treatment. For example, a recent study suggested medication use as being a better predictor of LOS than ASA score in THA patients.¹⁸ Elucidating these independent risk factors is important for risk mitigation primarily for the patient's health, yet additional benefit is found in lowering the healthcare time and cost burden for the patients and hospitals alike. Another recent study by Culler et al. (2015) has described the monetary cost of complications that extend a patient's stay after undergoing TKA, finding that each adverse event cost patients greater than an additional \$5000 and increased LOS by more than two days when controlling for other patient factors.⁸ Such data highlights the importance of understanding patients' risks for complications and avoiding them where possible.⁸

Understanding differences in complication rates correlates to understanding differences in financial and resource burden associated with types of TJA. Culler et al. (2015) assessed the impact of TKA complications on resource burden in patients covered by Medicare.⁸ Most complications included in this study (infection, hemorrhage/shock requiring transfusion, acute renal failure, etc) extended a patient's LOS and increased their costs.⁸ Due to necessary treatments and consequently longer LOS, patients experiencing AAE consumed statistically significantly more resources compared to patients without complicated postoperative course.⁸ Certain complications like pneumonia or acute myocardial infarction more than doubled cost for a standard, uncomplicated TKA hospitalization, and adjusted hospital resource utilization was nearly \$3000 greater for patients with AAE compared to patients without complications.⁸ Applying this knowledge to our results, in which LOS was longest and complication rates were highest in the TEA and THA cohorts, we can reasonably assume that resource burden is greater in TEA and THA compared to other types of joint replacement.

Quality improvement efforts aiming to reduce complications have been evaluated in multiple studies. A meta-analysis by Zhang et al. (2023) assessed the use of Enhanced Recovery After Surgery (ERAS) strategies in THA and TKA. Such techniques (minimal catheter use, avoiding bowel preparation, early postoperative mobilization, etc) seek to minimize organ dysfunction and physiologic stress on the patient in order to make the recovery process faster.¹⁹ Zhang et al. found that ERAS implementation was significantly associated with shorter LOS, lower postoperative transfusion rate, and lower mortality.¹⁹ Additionally, robotic assistance has exhibited less adverse outcomes after TKA compared to conventional and computer-navigated surgery, making it a possible avenue for reducing complications after joint replacement.²⁰ Further research exploring the application of these techniques with other forms of TJA

Table 2. Demographic information by arthroplasty type, after matching.

	TSA	TEA	THA	TKA	TAA	p-value
Patients, N (%)	457 (20.0)	457 (20.0)	457 (20.0)	457 (20.0)	457 (20.0)	
Age (mean $\pm$ SD, years)	67.0 $\pm$ 10.4	67.2 $\pm$ 13.5	68.1 $\pm$ 11.5	67.4 $\pm$ 11.2	65.1 $\pm$ 10.8	0.001
BMI (mean $\pm$ SD, kg/m ²)	29.7 $\pm$ 7.4	29.6 $\pm$ 7.2	29.6 $\pm$ 6.6	29.5 $\pm$ 6.9	30.4 $\pm$ 5.9	0.337
Male sex	88 (19.3)	95 (20.8)	95 (20.8)	115 (25.2)	95 (20.8)	0.248
Operative Time (mins)	112.3 $\pm$ 52.6	162.8 $\pm$ 65.6	91.2 $\pm$ 37.9	92.2 $\pm$ 36.3	152.6 $\pm$ 65.7	<0.001
Length of Stay (days)	1.8 $\pm$ 2.1	2.6 $\pm$ 3.7	2.6 $\pm$ 3.4	2.3 $\pm$ 1.9	1.8 $\pm$ 1.3	<0.001
Outpatient status	52 (11.4)	164 (35.9)	39 (8.5)	83 (18.2)	72 (15.8)	<0.001
ASA Class	2.6 $\pm$ 0.6	2.6 $\pm$ 0.6	2.6 $\pm$ 0.6	2.7 $\pm$ 0.5	2.6 $\pm$ 0.6	0.012
1 - no disturbance	4 (0.9)	9 (2.0)	8 (1.8)	1 (0.2)	15 (3.3)	-
2 - mild disturbance	194 (42.3)	180 (39.2)	181 (39.6)	156 (34.1)	185 (40.5)	-
3 - severe disturbance	238 (52.1)	243 (53.2)	250 (54.7)	283 (61.9)	246 (53.8)	-
4 - life-threatening disturbance	21 (4.6)	25 (5.4)	18 (3.9)	17 (3.7)	11 (2.4)	-
5 - moribund	0	0	0	0	0	-
Race						0.485
White	352 (77.0)	349 (76.4)	340 (74.4)	340 (74.4)	349 (76.4)	-
Black	26 (5.7)	23 (5.0)	22 (4.8)	21 (4.6)	23 (5.0)	-
Asian	13 (2.8)	10 (2.2)	15 (3.3)	8 (1.8)	11 (2.4)	-
American Indian or Alaska Native	10 (2.2)	6 (1.3)	6 (1.3)	8 (1.8)	1 (0.2)	-
Native Hawaiian or Pacific Islander	0	0	0	0	0	-
Other	0	0	0	0	0	-
Unknown	56 (12.3)	73 (16.0)	74 (16.2)	80 (17.5)	73 (16.0)	-
Dependent Functional Status (partial or total)	15 (3.3)	24 (5.3)	10 (2.2)	6 (1.3)	5 (1.1)	0.001
Current smoker	47 (10.3)	57 (12.5)	55 (12.0)	52 (11.4)	49 (10.7)	0.831
Comorbidities N(%)						
CHF	4 (0.9)	5 (1.1)	5 (1.1)	3 (0.7)	6 (1.3)	0.888
Renal failure	0	0	1 (0.2)	0	0	0.406
Dialysis	3 (0.7)	0	1 (0.2)	0	2 (0.4)	0.224
Steroid use	24 (5.3)	84 (18.4)	20 (4.4)	24 (5.3)	41 (9.0)	<0.001

	TSA	TEA	THA	TKA	TAA	p-value
Weight loss	1 (0.2)	3 (0.7)	1 (0.2)	0	0	0.198
Bleeding disorder	13 (2.8)	17 (3.7)	17 (3.7)	21 (4.6)	9 (2.0)	0.232
Ascites	0	0	0	0	0	-
Pre-operative transfusion	1 (0.2)	3 (0.7)	2 (0.4)	1 (0.2)	0	0.444
Diabetes	81 (17.7)	78 (17.1)	77 (16.8)	77 (16.8)	70 (15.3)	0.815
IDDM	28 (6.1)	29 (6.3)	29 (6.3)	35 (7.7)	22 (4.8)	-
NIDDM	53 (11.6)	49 (10.7)	48 (10.5)	42 (9.2)	48 (10.5)	-
DOE	28 (6.1)	18 (3.9)	37 (8.1)	26 (5.7)	24 (5.3)	0.234
COPD	28 (6.1)	33 (7.2)	38 (8.3)	29 (6.3)	18 (3.9)	0.091

Table 3. Postoperative complication rates by arthroplasty type, prior to matching.

	TSA		TEA		THA		TKA		TAA		p-value
	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	
Any adverse event	1,129	4.2	35	7.6	15,266	6.9	16,228	4.6	35	2.3	<0.001
Death	48	0.2	3	0.7	451	0.2	363	0.1	1	0.1	<0.001
Wound dehiscence	17	0.1	5	1.1	311	0.1	778	0.2	6	0.4	<0.001
Sepsis	52	0.2	3	0.7	640	0.3	776	0.2	1	0.1	<0.001
Pulmonary Embolism	74	0.3	1	0.2	573	0.3	1,585	0.4	4	0.3	<0.001
Renal complication	34	0.1	0	0	309	0.1	482	0.1	0	0	0.559
MI	73	0.3	1	0.2	518	0.2	704	0.2	1	0.1	0.007
Cardiac arrest	15	0.1	2	0.4	186	0.1	248	0.1	0	-	0.007
Stroke	22	0.1	0	-	210	0.1	263	0.1	2	0.1	0.095
Transfusion	474	1.8	17	3.7	8,814	4.0	4,717	1.3	1	0.1	<0.001
DVT	148	0.6	3	0.7	1,244	0.6	3,730	1.1	8	0.5	<0.001
UTI	187	0.7	2	0.4	1,784	0.8	2,366	0.7	4	0.3	<0.001
Pneumonia	129	0.5	2	0.4	716	0.3	999	0.3	1	0.1	<0.001
Intubation issues	56	0.2	2	0.4	330	0.1	439	0.1	1	0.1	<0.001
SSI	144	2.2	9	2.0	2,637	1.2	3,743	1.1	20	1.3	<0.001
Return to OR	369	1.4	17	3.7	4,186	1.9	3,857	1.1	10	0.7	<0.001

should be done due to their potential in reducing patient and hospital resource burden.

LIMITATIONS

One potential limitation of this study is the extreme variation in sample sizes for unmatched cohorts that may have affected results in the matched cohorts. We observed an

Table 4. Postoperative complication rates by arthroplasty type, after matching.

	TSA		TEA		THA		TKA		TAA		p-value
	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	No.	Rate (%)	
Any adverse event	34	7.4	44	9.6	48	10.5	24	5.3	16	3.5	<0.001
Death	1	0.2	3	0.7	2	0.4	1	0.2	0	-	0.444
Wound dehiscence	0	-	5	1.1	1	0.2	0	-	2	0.4	0.029
Sepsis	0	-	2	0.4	1	0.2	1	0.2	0	-	0.477
Pulmonary Embolism	1	0.2	1	0.2	3	0.7	2	0.4	1	0.2	0.734
Renal complication	0	-	0	-	0	-	0	-	0	-	-
MI	1	0.2	1	0.2	0	-	0	-	0	-	0.557
Cardiac arrest	0	-	2	0.4	0	-	1	0.2	0	-	0.254
Stroke	0	-	0	-	1	0.2	1	0.2	0	-	0.557
Transfusion	19	4.2	17	3.7	27	5.9	11	2.4	1	0.2	<0.001
DVT	4	0.9	3	0.7	5	1.1	6	1.3	3	0.7	0.803
UTI	1	0.2	2	0.4	5	1.1	1	0.2	2	0.4	0.294
Pneumonia	1	0.2	1	0.2	2	0.4	0	-	0	-	0.477
Intubation issues	0	-	1	0.2	2	0.4	1	0.2	1	0.2	0.735
SSI	1	0.2	9	2.0	6	1.3	4	0.9	10	2.2	0.058
Return to OR	10	2.2	16	3.5	10	2.2	3	0.7	4	0.9	0.010

Table 5. Odds of developing any adverse event during surgery as related to patient demographics and comorbidities

	Matched Arthroplasty Groups (n=2,285)	
	Odds Ratio (95% CI)	p-value
BMI	0.968 (0.942-0.994)	0.016
Operative Time	1.005 (1.003-1.007)	<0.001
Length of Hospital Stay	1.197 (1.136-1.260)	<0.001
ASA Class	1.603 (1.161-2.212)	0.004
Pre-Operative Transfusion	13.900 (2.474-78.098)	0.003

increase in overall AAE rates for each cohort after matching, which may be due to some unknown factor(s) we could not ascertain using the information available to us in the NSQIP database. However, a benefit of the NSQIP database is that it does allow us to focus on immediate life-threatening complications following surgery, therefore providing us with a good understanding of safety of each TJA. We

excluded polytrauma cases in our cohorts, which may be another potential limitation and source of selection bias in the present study. However, this may have allowed for more accurate matching, as literature has shown that TEA is commonly performed for traumatic cases rather than arthritic/non-traumatic cases.⁶ A future avenue for research may be to compare complications following trau-

matic TJA, as the current study focused on non-traumatic operations.

CONCLUSION

The primary purpose of this study was to understand differences in complication risk following different types of TJA. We found that wound dehiscence and return to OR were most common in the TEA cohort, transfusion and AAE risks were highest following THA, and AAE incidence was lowest following TAA. Additionally, lower BMI, longer operative time and length of stay, more severe ASA class, and receiving preoperative blood transfusion were all associated with risk of AAE after joint arthroplasty. Our findings contribute to existing knowledge regarding the relative safety of arthroplasty, and this data may help inform clinical decisions regarding operative techniques and performing total replacement versus alternative procedures. Additionally, understanding such risks may facilitate adoption of new measures within practice in order to optimize outcomes and minimize financial burden. Future research may also be needed to further elucidate differences in postoperative complication risks for traumatic versus non-traumatic joint replacement.

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CONFLICT OF INTEREST

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