



■ ARTHROPLASTY

Emergency department visits following total joint arthroplasty: do revisions present a higher burden?

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Aims

Although readmission has historically been of primary interest, emergency department (ED) visits are increasingly a point of focus and can serve as a potentially unnecessary gateway to readmission. This study aims to analyze the difference between primary and revision total joint arthroplasty (TJA) cases in terms of the rate and reasons associated with 90-day ED visits.

Methods

We retrospectively reviewed all patients who underwent TJA from 2011 to 2021 at a single, large, tertiary urban institution. Patients were separated into two cohorts based on whether they underwent primary or revision TJA (rTJA). Outcomes of interest included ED visit within 90-days of surgery, as well as reasons for ED visit and readmission rate. Multivariable logistic regressions were performed to compare the two groups while accounting for all statistically significant demographic variables.

Results

Overall, 28,033 patients were included, of whom 24,930 (89%) underwent primary and 3,103 (11%) underwent rTJA. The overall rate of 90-day ED visits was significantly lower for patients who underwent primary TJA in comparison to those who underwent rTJA (3.9% vs 7.0%; $p < 0.001$). Among those who presented to the ED, the readmission rate was statistically lower for patients who underwent primary TJA compared to rTJA (23.5% vs 32.1%; $p < 0.001$).

Conclusion

ED visits present a significant burden to the healthcare system. Patients who undergo rTJA are more likely to present to the ED within 90 days following surgery compared to primary TJA patients. However, among patients in both cohorts who visited the ED, three-quarters did not require readmission. Future efforts should aim to develop cost-effective and patient-centred interventions that can aid in reducing preventable ED visits following TJA.

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Introduction

The number of primary total joint arthroplasties (TJAs) is projected to continue growing rapidly over the next decade.¹ The mean hospital cost of primary hip and knee arthroplasty is estimated to be approximately \$18,621 and \$17,464, respectively, and, as such, this patient population represents a significant portion of healthcare spending.² As the volume of primary TJA increases, the expected volume of revision TJA (rTJA)

is also increasing.³ Furthermore, rTJA is not only a more technically challenging and riskier surgical procedure, but is also associated with about \$5,000 greater mean hospital costs than primary TJA per procedure.^{2,4} Traditionally, readmission rate has been the focus of cost-containment research and policy efforts,⁵⁻¹⁰ overshadowing the costs associated with emergency department (ED) visits. Aggregate spending on ED care is estimated to be as high as 10% of

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national health expenditures.¹¹ Previous studies evaluating ED visits following TJA have demonstrated that 10% of patients undergoing total knee arthroplasty (TKA) or total hip arthroplasty (THA) had a 30-day or 90-day ED visit following their procedure, and most visits occurred “after-hours” when costs are generally higher.^{12,13} Thus, in addition to the cost of readmissions, there may be significant hidden ED visit costs following TJA and rTJA.

Prior studies have focused on the reasons and risk factors behind ED visits and readmissions following TJA.^{10,14-16} The most common reasons for 30-day and 90-day ED visits are pain, swelling, medical, and wound concerns.^{12,13,16-18} Kelly et al¹⁶ determined the most common reasons for 90-day ED visits were pain and swelling after both THA and TKA, while the most common reasons for readmission were infection or unrelated procedures for THA and gastrointestinal or stiffness requiring manipulation under anesthesia for TKA. Risk factors for postoperative ED visits and readmissions have been previously studied. Older age, male sex, rural residence, and various comorbidities are associated with a higher risk of 30-day ED visits following TJA.¹⁵ There is also evidence individuals with lower income, no postoperative follow-up with a primary care physician, a longer length of stay (LOS), malnutrition (albumin levels ≤ 3.5 g/dl), and being of black or hispanic race is predictive of an increased likelihood of an ED visit within 90 days of TJA.¹⁹⁻²³

There is an extensive body of literature on reasons and risk factors for ED visits following TJA, as ED visits may have consequential financial implications. Despite the greater surgical costs and technical challenges of rTJA, little is known about whether or not rTJA is associated with higher ED visits relative to primary TJA. Thus, the purpose of this study is to elucidate the difference between primary TJA and rTJA cases in terms of rate and reasons associated with 90-day ED visits.

Methods

Study design. We retrospectively reviewed our institution's prospectively maintained TJA database in order to identify all patients who underwent TJA between June 2011 and May 2021. All patients included in the analysis underwent surgery at a single, urban institution (NYU Langone Orthopedic Hospital, USA), which comprises a large academic centre and a tertiary orthopaedic speciality hospital. We obtained institutional review board approval prior to conducting the present analysis. Cases performed due to oncologic-related reasons were excluded from this study. Patients were grouped into two cohorts based on whether they underwent primary or rTJA. All of our patients were managed with the same institutional protocol from the time when surgery was scheduled to discharge from the hospital after their procedure. This encompassed multimodal pain control, a physical rehabilitation programme, and medical co-management.

Outcomes of interest included ED visits within 90 days of the index arthroplasty, as well as specific reasons for the ED visit, which were grouped under pain, wound-related complications, limb swelling, gastrointestinal issues, cardiac issues, pulmonary issues, neurological issues, and all other non-orthopedic related causes. In addition, we also analyzed the readmission rate among patients who visited the ED. A sub-analysis was also performed, in which ED visits due to joint specific concerns (pain, wound-related complications, and limb swelling) and all other complaints grouped together were compared between primary TJA and rTJA cohorts.

Data collection. We collected baseline patient demographic data, which included age, sex, race, BMI (kg/m²), American Society of Anesthesiology (ASA) classification,²⁴ Charlson Comorbidity Index (CCI),²⁵ and smoking status. Clinical data such as whether the patient underwent THA or TKA, surgical time (minutes), hospital length of stay (LOS), 90-day ED visits, 90-day readmissions, and discharge disposition (home or all other facilities) was also collected. All data was extracted from our electronic patient medical record system, Epic (version 15; Epic Caboodle, USA) using SQL Server Management Studio 2017 (Microsoft, USA). LOS was evaluated in days spent in the hospital following surgery and surgical time was determined from calculating the time between skin incision and closure. All patients were either discharged home under self-care, home health services, or to an acute or subacute rehabilitation facility.

Statistical analysis. The data was organized using Excel (Microsoft). A binary variable was assigned to distinguish patients who underwent primary TJA or rTJA. Baseline demographic and clinical characteristics of the study participants were described as means with standard deviations (SDs) for continuous variables and frequencies with percentages for categorical variables. Statistical differences in continuous variables were detected using independent-samples *t*-test and for categorical variables using chi-squared test. Multivariate logistic regressions were performed to control for potential confounding variables. These regression models were used to compare all outcomes measures between the two cohorts. A *p*-value < 0.05 was considered to be significant. All statistical analyses were performed using SPSS v25 (IBM, USA).

Results

A total of 28,033 patients were included in this analysis, of which 24,930 (89%) underwent primary TJA and 3,103 (11%) underwent rTJA. The two cohorts did not statistically differ with regards to age ($p = 0.327$, independent-samples *t*-test), sex ($p = 0.075$, chi-squared test), and BMI ($p = 0.780$, independent-samples *t*-test). There were small but statistically significant differences in the racial distribution of the two groups (65.2% Caucasian

Table I. Patient demographics (n = 28,033).

Variable	Primary TJA (n = 24,930)	Revision TJA (n = 3,103)	p-value*
Age, yrs (SD)	64.46 (10.80)	64.66 (11.28)	0.327
Sex, n (%)			0.075
Female	15,405 (61.8)	1,866 (60.1)	
Male	9,525 (38.2)	1,237 (39.9)	
Race, n (%)			< 0.001
Caucasian	16,261 (65.2)	2,006 (64.6)	
African-American	3,875 (15.5)	579 (18.7)	
Asian	827 (3.3)	50 (1.6)	
Other	3,967 (15.9)	468 (15.1)	
ASA class, n (%)			< 0.001
I	1,109 (4.4)	76 (2.4)	
II	14,986 (60.1)	1,607 (51.8)	
III	8,423 (33.8)	1,317 (42.4)	
IV	412 (1.7)	103 (3.3)	
CCI (SD)	3.83 (2.02)	4.04 (2.22)	< 0.001
BMI, kg/m ² (SD)	30.63 (6.34)	30.67 (6.86)	0.780
Smoking status, n (%)			0.019
Never smoked	14,215 (57.0)	1,691 (54.5)	
Former smoker	8,739 (35.1)	1,138 (36.7)	
Current smoker	1,976 (7.9)	274 (8.8)	
Procedure details, n (%)			0.003
THA	11,985 (48.1)	1,581 (51.0)	
TKA	12,945 (51.9)	1,522 (49.0)	
Surgical time, mins (SD)	99.61 (39.75)	134.34 (60.79)	< 0.001
LOS, days (SD)	2.71 (1.82)	4.43 (8.14)	< 0.001
Discharge disposition, n (%)			< 0.001
Home	20,296 (81.4)	2,065 (66.5)	
Other facility	4,634 (18.6)	1,038 (33.5)	

*Continuous variables compared using independent-samples *t*-test, categorical variables compared using chi-squared test; p < 0.05 considered statistically significant.

ASA, American Society of Anesthesiology; CCI, Charlson Comorbidity Index; LOS, length of stay; SD, standard deviation; THA, total hip arthroplasty; TJA, total joint arthroplasty; TKA, total knee arthroplasty.

in primary TJA vs 64.6% in rTJA, 15.5% African American in primary TJA vs 18.7% in rTJA, 3.3% Asian in primary TJA vs 1.6% in rTJA; p < 0.001, chi-squared test). Patients undergoing primary TJA were more likely to be ASA I or II (4.4% and 60.1%, respectively) compared to those undergoing rTJA (2.4% and 51.8%), with the converse being true for ASA III or IV. Mean CCI in the rTJA group was higher compared to the primary TJA group and this was statistically significant (4.04 (SD 2.22) vs 3.83 (SD 2.02); p < 0.001, independent-samples *t*-test). Primary TJA patients were more likely to be never smokers compared to rTJA (57.0% vs 54.5%; p 0.019, chi-squared test). Demographic data for the two groups are presented in Table I.

Of the 24,930 cases included in the primary TJA cohort, 11,985 (48.1%) were primary THAs and 12,945 (51.9%) were primary TKAs in comparison to the 3,103 cases included in the rTJA cohort, composed of 1,581 (51.0%) revision THAs (rTHAs) and 1,522 (49.0%) revision TKAs (rTKAs); p = 0.003, chi-squared test). Surgical time (134.34 minutes (SD 60.79) vs 99.61

minutes (SD 39.75); p < 0.001, independent-samples *t*-test) and LOS (4.43 days (SD 8.14) vs 2.71 days (SD 1.82); p < 0.001, independent-samples *t*-test) were significantly greater for the rTJA group compared to primary TJAs. Patients who underwent rTJA were statistically more likely to be discharged to an acute or subacute rehabilitation facility (33.5% vs 18.6%; p < 0.001, chi-squared test) (Table I).

After controlling for demographic differences, the overall rate of 90-day ED visits was significantly lower for patients who underwent primary TJA compared to those who underwent rTJA (3.9% vs 7.0%; p < 0.001, multivariable logistic regression). Reasons for ED visits including pain (26.8% vs 23.9%; p = 0.116), wound issues (6.0% vs 4.6%; p = 0.923), limb swelling (6.1% vs 2.3%; p = 0.319), gastrointestinal reasons (9.1% vs 5.0%; p = 0.702), cardiac reasons (5.6% vs 4.1%; p = 0.618), pulmonary reasons (6.1% vs 9.6%; p = 0.014), neurological reasons (9.4% vs 2.8%; p = 0.117), and all other non-orthopedic related medical issues (30.8% vs 47.7%; p < 0.001, all multivariable logistic regression)

Table II. 90-day emergency department visit.

Variable	Primary TJA, n (%)	Revision TJA, n (%)	Odds ratio (95% CI)	p-value*
Overall 90-day ED visit rate	962 (3.9)	218 (7.0)	1.41 (1.19 to 1.67)	< 0.001
Reason for ED visit				
Pain	258 (26.8)	52 (23.9)	0.77 (0.55 to 1.07)	0.115
Wound issues	58 (6.0)	10 (4.6)	0.965 (0.47 to 1.99)	0.923
Limb swelling	59 (6.1)	5 (2.3)	1.63 (0.63 to 4.24)	0.319
Gastrointestinal issues	88 (9.1)	11 (5.0)	1.14 (0.59 to 2.21)	0.702
Cardiac issues	54 (5.6)	9 (4.1)	0.83 (0.39 to 1.75)	0.618
Pulmonary issues	59 (6.1)	21 (9.6)	0.50 (0.29 to 0.87)	0.014
Neurological issues	90 (9.4)	6 (2.8)	1.99 (0.84 to 4.71)	0.117
All others	296 (30.8)	104 (47.7)	0.49 (0.38 to 0.64)	< 0.001
ED visit requiring readmission	226 (23.5)	70 (32.1)	0.56 (0.42 to 0.76)	< 0.001

*Multivariable logistic regression.

CI, confidence interval; ED, emergency department; TJA, total joint arthroplasty.

Table III. Number of patients presenting to the emergency department requiring readmission.

Reason	Primary TJA (n = 962)		Revision TJA (n = 218)	
	ED visit, n	Readmission, n	ED visit, n	Readmission, n
Pain	258	74	52	21
Wound issues	58	20	10	8
Limb swelling	59	6	5	1
Gastrointestinal issues	88	26	11	3
Cardiac issues	54	12	9	1
Pulmonary issues	59	8	21	6
Neurological issues	90	19	6	2
All others	296	61	104	28

ED, emergency department ; TJA, total joint arthroplasty.

Table IV. Sub-analysis.

Reason for ED visit	Primary TJA, n (%)	Revision TJA, n (%)	Odds ratio (95% CI)	p-value*
Joint specific	375 (39.0)	67 (30.7)	0.89 (0.67 to 1.18)	0.433
All others	587 (61.0)	151 (69.3)	0.63 (0.52 to 0.77)	< 0.001

*Multivariable logistic regression.

CI, confidence interval; ED, emergency department; TJA, total joint arthroplasty.

between the primary TJA and rTJA cohorts, respectively. The diagnosis most commonly associated with readmission was uncontrolled pain. Among those patients who presented to the ED, the readmission rate was statistically lower for patients who primary TJA compared to rTJA (23.5% vs 32.1%; $p < 0.001$, multivariable logistic regression). The full comparison between the two study groups is shown in Tables II and III.

Sub-analysis. ED visits due to joint specific concerns (pain, wound-related complications, and limb swelling) did not statistically differ between primary TJA and rTJA cohorts (39.0% vs 30.7%; OR 0.89 (95% confidence interval (CI) 0.67 to 1.18); $p = 0.433$, multivariable logistic regression). However, ED visits due to all other complaints (non-joint specific) were significantly higher for the rTJA cohort compared to the primary TJA cohort

(69.3% vs 61.0%; OR 0.63 (95% CI 0.52 to 0.77); $p < 0.001$, multivariable logistic regression) (Table IV).

Discussion

Recently, a lot of attention has been focused on reducing readmission rates to contain costs of primary TJA and rTJA.⁵⁻¹⁰ ED visits are garnering recent attention of cost-reducing efforts, as reports suggest there may be an enormous and understudied economic burden of ED visits on healthcare systems.^{11,18,26} As a result of the Comprehensive Care for Joint Arthroplasty (CJR) model,²⁷ post-TJA ED visits represent a novel economic burden of cost associated with non-reimbursable encounters and require further scrutiny. However, there are no prior studies comparing ED visits following rTJA and primary TJA in the USA, which may serve as a proxy for assessing

relative financial impact. The present study demonstrated that rTJA is associated with a higher burden relative to TJA in terms of ED visits within 90 days.

We identified a significantly lower 90-day ED visit rate following primary TJA relative to rTJA (3.9% vs 7.0%). This aligns with a previous report by Ross et al,²¹ who reviewed over 205,000 TKAs performed in Canada from 2003 to 2016 and found revision surgery to be a predictor of increased odds of 30-day ED visits. Notably, our study also captures ED visits following rTHA and evaluates ED visits over the 90-day global period. We determined a higher percentage of the 90-day ED visits following rTJA also required readmission compared to ED visits proceeding primary TJA, although in both cases the majority of patients presenting to the ED did not require readmission. Additionally, the diagnosis most commonly associated with readmission in our study was uncontrolled pain. This coincides with a 2016 study reviewing over 500,000 cases of primary and rTJA in the USA, which demonstrated increased 90-day complications and costs following rTJA relative to primary TJA.²⁸

In the present study, the most common reason for 90-day ED visits related to the procedure was uncontrolled pain for both the primary TJA and rTJA cohorts (26.8% and 23.9%, respectively). This is supported by previous studies, which demonstrate uncontrolled pain is one of the most common reasons for ED visits following TJA.^{12,13,16,17} Comparing specific reasons for 90-day ED visits following both primary TJA and rTJA revealed no significant difference in pain, wound issues, swelling, gastrointestinal issues, cardiac concerns, or neurological reasons between the two cohorts. However, 90-day ED visits following rTJA were significantly more likely due to pulmonary causes and non-orthopedic reasons compared to visits following primary TJA. When reasons for ED visits were grouped as either joint-specific or non-joint-specific, the results remained similar as there were no statistical differences between primary TJA and rTJA cohorts; however, ED visits for non-joint-specific causes were statistically higher for the rTJA group compared to the primary TJA group. Given the underlying increased CCI and higher ASA classification in patients undergoing rTJA, the increased burden of non-orthopedic diagnoses requiring ED visits in the postoperative period is not surprising, but valuable to note. Prior studies have also noted respiratory related causes among the most common medical reasons patients are readmitted following TJA,^{16,29} which may place patients undergoing revision surgery at an even higher risk as our findings suggest.

Additionally, we found that a higher percentage of ED visits after rTJA resulted in readmissions. With greater surgical time, this may be due to surgical factors, such as disturbances in normal homeostatic mechanisms, resulting in increased pain, electrolyte,

and hemodynamic alterations. A larger surgical insult during revision surgery may also be less tolerated in patients with extensive medical comorbidities. In addition to the unique technical challenges and increased complexity of rTJA, more medical comorbidities suggest that patients undergoing rTJA may be at higher risk of 90-day ED visits.^{30,31} Whether or not some of these ED visits are preventable by way of increased accessibility of the surgical team and patient communication is a topic worth further investigation.

This study is not without some limitations. It is retrospective in nature, and consequently has inherent biases and limitations concerning data collection. Specifically, patient ED visits and readmissions outside of our institution may not have been included in this study, as we could only analyze patient data available to us through our electronic patient records database. Nevertheless, we believe the vast majority of ED visits were captured, as patients in our healthcare system tend to also follow-up at our institution perioperatively. The present study only evaluates ED visits following TJA or rTJA; other types of unscheduled visits, such as those at walk-in clinics, urgent care centres, and primary care physician offices were not considered. Additionally, revisions were not stratified by complexity (ie polyethylene liner exchange vs full component revision). With a larger soft-tissue insult during more complicated revisions, these patients may be at higher risk for postoperative pain and dysfunction. Some revision cases may be urgent (i.e infections) or traumatic in nature (i.e. periprosthetic fractures), which makes it difficult to maximally optimize the patients prior to surgery. Despite these limitations, the present study benefits from a large sample size, allowing sufficient statistical power to isolate small differences among factors and demonstrates that rTJA poses a higher burden relative to TJA with respect to 90-day ED visits. Moreover, 90-day ED visits following rTJA were more likely to result in readmission. Given the introduction of the CJR payment model, the characterization of rates and reasons for these potential non-reimbursable encounters is important.

In conclusion, ED visits present a significant burden to the healthcare system. Patients who undergo rTJA are more likely to present to the ED within 90 days following surgery compared to primary TJA patients. However, the significant majority of the patients in both cohorts that visited the ED did not require readmission. Patients after rTJA were more likely to present to the ED with non-orthopedic complaints and pulmonary-related diagnoses compared to those after primary TJA. Given these results and the potential for ED visits to impose substantial financial costs, our findings illustrate the importance of implementing initiatives to reduce post-TJA ED visits, with an increased focus on revision arthroplasty. Future efforts should aim to develop cost-effective and

patient-centred interventions that reduce preventable ED visits after TJA.



Take home message

- Patients undergoing revision total joint arthroplasty are more likely to present to the emergency department (ED) within 90 days compared to those undergoing primary total joint arthroplasty (TJA).
- Majority of patients in both the revision and primary cohort do not require readmission to the hospital.
- Patients after revision TJA are more likely to present to the ED with non-orthopedic complaints such as pulmonary complaints compared to patients after primary TJA.

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