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Primary Knee

Outpatient Simultaneous Bilateral Total Knee Arthroplasty: Is It Safe?



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ABSTRACT

Background: It is currently unknown if simultaneous bilateral total knee arthroplasty (si-BTKA) can also be safely performed in the outpatient setting. The primary aim of this study was to compare 30-day postoperative complication rates between outpatient and inpatient si-BTKA.

Methods: Adults undergoing simultaneous bilateral total knee arthroplasty (si-BTKA) from 2015–2019 were queried using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. Our primary analysis compared the rates of complications between outpatient si-BTKA and inpatient si-BTKA using bivariate comparisons and multivariable logistic regression of outpatient and inpatient cases controlling for differences in baseline demographics and comorbidities.

Results: From 2015 to 2019, the utilization of outpatient si-BTKA increased from 0.6% to 10.5%. Outpatient si-BTKA were found to have significantly lower odds of any complication (OR = 0.49), minor complication (OR = 0.50), and postoperative transfusion (OR = 0.66) compared to inpatient cases. Outpatient si-BTKA also had a significantly shorter operative time.

Conclusion: Compared to inpatient si-BTKA, patients who undergo outpatient si-BTKA do not demonstrate increased rates of any complication, severe complications, and minor complications within 30-days postoperatively. Further insight is needed on the effect of outpatient si-BTKA on long-term outcomes.

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After the first case series of patients undergoing outpatient total knee arthroplasty were published in the early 2000s [1,2], continued improvement in postoperative recovery protocols, anesthetic techniques and surgical technique have led to outpatient hip and knee arthroplasty becoming increasingly common [3,4]. Several level I studies have deemed TKA to be safe and effective when performed in the outpatient setting on appropriately selected patients [5,6] (although disagreement still exists regarding the optimal criteria for ‘appropriately selected’ patients) [6]. In the wake of this revolutionary advancement in lower extremity

arthroplasty, the Center for Medicaid and Medicare Services removed total knee arthroplasty (TKA), and thus also bilateral TKA, from an ‘inpatient only’ designation in 2018, which has led to increasing pressure on surgeons to perform TKA on an outpatient basis [7]. In a 2018 survey of members of the American Association of Hip and Knee Surgeons, 59.5% of respondents reported that their hospital expected all Medicare patients undergoing TKA to be scheduled as an outpatient [7]. In line with a recent emphasis on outpatient TKA, the rates of outpatient THA have also been increasing [8].

Although some studies suggest that complications may be increased with outpatient total joint arthroplasty [9,10], several studies have demonstrated bilateral lower extremity arthroplasty to be more cost-effective [11–14] and without significantly increased complication risk compared to unilateral arthroplasty [15,16]. Given the increased surgical time and prolonged recovery associated with bilateral lower extremity arthroplasty [17,18], it seems that this procedure would be challenging to perform in the outpatient setting. While the same advantages of cost-saving and

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efficiency that make outpatient unilateral hip and knee arthroplasty appealing also apply to bilateral outpatient arthroplasty, we are not aware of any published literature regarding the short-term safety and complications associated with outpatient simultaneous bilateral total knee arthroplasty (si-BTKA). Thus, the primary aim of this study was to compare 30-day complications between inpatient si-BTKA versus si-BTKA performed in the outpatient setting. Secondly, we sought to analyze the overall incidence of si-BTKA from 2015–2019 in a national sample of patients. Our hypothesis was that outpatient si-BTKA would have a similar 30-day complication rate compared to inpatient si-BTKA when accounting for differences in demographic variables and medical comorbidities between these two patient populations.

Materials and Methods

Dataset

Adults undergoing simultaneous bilateral total knee arthroplasty (si-BTKA) from 2015–2019 were queried using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) surgical registry. The database includes patients with prospectively collected data from 700 + hospitals throughout the continental United States and spans all surgical subspecialties [19]. NSQIP data is collected by trained personnel at each individual hospital, including demographic data, medical comorbidities, inpatient complications, 30-day complications and data regarding hospital readmission. The NSQIP database is utilized widely in the orthopedic literature, with frequent random audits being performed for data quality monitoring, often showing less than 2% inter-rater disagreement [20,21].

We defined outpatient surgery through two methods, such that only the cases classified as ‘outpatient’ within NSQIP based on the binary inpatient vs outpatient variable, and also having a length of stay of 0 days, were categorized as outpatient surgery. By using this definition, some patients may be admitted overnight but less than 24 hours overall. Of note, NSQIP includes data from hospitals and hospital outpatient departments, but ambulatory surgery centers that perform only outpatient surgery are not included. It should be mentioned that there are varying methodologies to define inpatient vs outpatient procedures using NSQIP [22], and the definition utilized in our study has been used and accepted in similar studies using this database [23,24].

In the NSQIP database, ‘concomitant’ CPT codes are used to define cases where multiple surgeries are performed in the same anesthetic setting. The si-BTKA cohort was thus defined as patients with a principal CPT code of 27,447 and an additional, concomitant CPT code of 27,447. It should also be noted that CPT modifiers are not present in NSQIP coding and that the aforementioned methodology has been previously used and validated for defining si-BTKA cases in NSQIP [25,26]. All patients had a primary surgical indication of osteoarthritis.

Primary Outcomes

The primary outcome measures were the rates of postoperative complications within 30 days of surgery. Complications examined included minor complications such as urinary tract infection (UTI), pneumonia, progressive renal insufficiency, and requiring a blood transfusion. Severe complications were also studied, including death, unplanned intubation, requiring a ventilator, stroke, venous thromboembolism, surgical site infection, cardiac arrest, myocardial infarction, and acute renal failure. We also examined unanticipated outcomes such as hospital readmission and unplanned reoperations within 30 days.

Table 1

Patient Demographics and Comorbidities of Patients Who Underwent Bilateral Total Knee Arthroplasty.

Patient Characteristic	Inpatient		Outpatient		P Value
	N	%	N	%	
	9552	-	297	-	-
Age					.859
18 to 54 y	2804	29.4	84	28.3	
55 to 64 y	2929	30.7	92	31.0	
65 to 74 y	2881	30.2	96	32.3	
75 to 84 y	850	8.9	22	7.4	
≥ 85 y	88	0.9	3	1.0	
Female Sex	5375	56.3	166	55.9	.897
ASA class ≥ 3	3960	41.5	91	30.6	<.001
Race					
White	7543	79.0	225	75.8	.41
Black	730	7.6	26	8.8	
Other	1279	13.4	46	15.5	
BMI					
<25 kg/m ²	1046	11.0	36	12.1	.009
25 to 29.9 kg/m ²	2555	26.7	99	33.3	
30 to 34.9 kg/m ²	2781	29.1	89	30.0	
≥35 kg/m ²	3170	33.2	73	24.6	
Hypertension	5574	58.4	158	53.2	.076
Smoking	730	7.6	20	6.7	.561
Congestive Heart Failure	19	0.2	1	0.3	.603
Diabetes	1415	14.8	28	9.4	.01
General Anesthesia	5058	53.0	109	36.7	<.001

Bolding indicates significance at $P < .10$.

Secondary Outcomes

Secondary outcomes that were examined included operative time associated with both inpatient and outpatient si-BTKA and the overall incidence of these procedures being performed each year from 2015 to 2019.

Statistical Analysis

Bivariate analyses were performed to detect differences in our outcomes measures between the outpatient and inpatient cohorts. The outcome measures found to be significant on bivariate analysis with $P < .05$ were further evaluated using multivariable logistic regression. The multivariable regression models controlled for all patient demographics and comorbidities were found to significantly differ between the inpatient and outpatient populations at $P < .20$. Significance for multivariable regression was set at $P < .05$.

Results

Descriptive Statistics of the Study Population

In total, 3% (297/9552) of si-BTKA procedures were performed in the outpatient setting. There were no significant differences between the ages of patients who underwent outpatient versus inpatient surgery. 56% of patients who had outpatient and si-BTKA were female. 91/297 (31%) of patients who underwent outpatient surgery were classified as American Society of Anesthesiologists classification ≥ 3 , compared to 3960/9552 (42%) of patients who underwent inpatient surgery, $P < .001$. There were also significant differences between BMI classifications as described in Table 1. Patients who underwent outpatient surgery also had significantly lower prevalence of diabetes (9.4% vs 14.8%, $P = .01$) and were less likely to have undergone general anesthesia (37% vs 53%, $P < .001$).

Table 2
Bivariate Comparison of Complications.

Patient Characteristic	Inpatient		Outpatient		P Value
	N	%	N	%	
Total	9552	-	297	-	-
Any Complication	1660	17.4	25	8.4	<.001
Severe Complication	342	3.6	5	1.7	.081
Death	11	0.1	0	0.0	.558
Ventilator > 48 h	10	0.1	0	0.0	.577
Unplanned Intubation	21	0.2	0	0.0	.419
Stroke or Cerebrovascular Accident	10	0.1	0	0.0	.577
Venous Thromboembolism	227	2.4	2	0.7	.055
Surgical Site Infection	74	0.8	2	0.7	.844
Cardiac Arrest requiring cardiopulmonary resuscitation	13	0.1	0	0.0	.525
Myocardial Infarction	26	0.3	1	0.3	.834
Acute renal failure	9	0.1	0	0.0	.597
Minor Complication	1412	14.8	21	7.1	<.001
Urinary tract infection	105	1.1	5	1.7	.345
Pneumonia	36	0.4	2	0.7	.417
Progressive renal insufficiency	19	0.2	0	0.0	.442
Blood transfusion	1292	13.5	15	5.1	<.001
Other Outcome Measures					
Readmissions	296	3.1	10	3.4	.793
Reoperation	138	1.4	3	1.0	.535
Return to the operating room	138	1.4	3	1.0	.535
Operative time (min)	147	-	147	-	.9191

Bolding indicates significance at $P < .05$.

Complications and Adverse Events

Bivariate Comparison

Overall, 1660/9552 (17%) of patients who underwent inpatient si-BTKA had any complication in the perioperative/postoperative period, compared to 15/297 (8.4%) of patients who underwent outpatient si-BTKA, $P < .001$. Patients who underwent si-BTKA did not have significantly lower rate of severe complications (1.7% vs 3.6%, $P = .081$), but had significantly lower rates of minor complications (7.1% vs 14.8%, $P < .001$), and lower rates of blood transfusion (5.1% vs 13.5%, $P < .001$). There were no significant differences in 30-day hospital readmissions for patients who underwent inpatient vs outpatient si-BTKA (3.1% vs 3.4%, $P = .793$) and return to the operating room (1.4% vs 1.0%, $P = .535$). The incidence of specific complications and their relative frequencies with bivariate analysis are detailed in [Table 2](#).

Multivariate Logistic Regression Analysis

Outpatient cases were found to have significantly lower odds of any complication (OR = 0.49), minor complication (OR = 0.50), and postoperative transfusion (OR = 0.39) compared to inpatient cases after controlling for differences in patient comorbidities, [Table 3](#).

Utilization of Outpatient si-BTKA

From 2015 to 2019, the utilization of outpatient si-BTKA increased from 0.6% to 10.5%.

Table 3
Multivariable Regression Analysis.

Patient Characteristic	Odds Ratio ^a	95% CI	P Value
Any Complications	0.49	0.33 0.75	.001
Minor Complications	0.50	0.32 0.79	.003
Transfusion	0.39	0.23 0.66	<.001

^a Outpatient Relative to Inpatient.

Operative Time

Interestingly, compared to inpatient cases, outpatient si-BTKA also had identical operative times. Both outpatient and inpatient si-BTKA procedures were performed in 147 minutes on average, $P = .9191$, [Table 2](#).

Discussion

As the evidence grows to support the safety and cost-effectiveness of outpatient arthroplasty, outpatient lower extremity arthroplasty, and specifically outpatient TKA, is becoming increasingly incentivized by payors and hospital systems. This shift is partly due to the demonstrated effectiveness of outpatient TKA and also to avoid lack of Medicare reimbursement for patients who are admitted to the hospital following TKA [7]. While outpatient si-BTKA may be technically feasible, the safety of these surgeries as an outpatient procedure has not been well studied. Overall, from 2015-2019, we found that only 3% of si-BTKA procedures were performed in the outpatient setting; however, among all si-BTKA, the prevalence of si-BTKA increased by more than 10-fold from 2015 to 2019. This larger-than-expected increase may be due to an increasing number of patients being classified as 'outpatient' per CMS after TKA was removed from inpatient-only designation.

Demographic and comorbidities between outpatient and inpatient groups were largely similar, although generally, patients who underwent outpatient total joint arthroplasty had a lower BMI, and a lower proportion of patients with ASA class ≥ 3 (31% vs 40%, $P < .001$), which may reflect preselection of patients by surgeons. There were also small, but statistically significant differences between the racial composition of outpatient vs inpatient groups. When controlling for patient demographics and comorbidities, outpatient si-BTKA was found to have lower odds of any complication, minor complications, and postoperative transfusion when compared to inpatient si-BTKA. This was contrary to our original hypothesis that outpatient si-BTKA would be associated with similar complication rates compared to inpatient si-BTKA.

While we found it counterintuitive to our hypothesis that outpatient si-BTKA had lower odds of complications when compared to inpatient si-BTKA, other studies in the literature have also reported lower and/or comparable complication rates in outpatient vs inpatient arthroplasty. In a study by Courtney et al., the NSQIP database was queried to investigate complication rates following outpatient vs inpatient total hip and knee arthroplasty, and the authors found significantly lower overall complication rate for outpatient vs inpatient procedures (8% vs 16%) [27]. In a 2017 study by Bovonratwet et al., the authors also examined complication rates following outpatient vs inpatient UKA using NSQIP data using propensity-matched cohorts. The authors found no differences in thirty-day perioperative complications and readmissions between the two cohorts and no significant difference in any perioperative complications [23]. In the context of the above-mentioned studies, it should also be noted that differences in complication rates between outpatient and inpatient arthroplasty are challenging to compare outside of a randomized trial, given that patients selected for outpatient arthroplasty tend to be younger, more active, and have less medical comorbidities [6]. This inherent difference in patient populations could potentially lead to the improved outcomes we found in the outpatient group.

As mentioned previously, at least two systematic reviews of the literature have demonstrated outpatient knee arthroplasty to be safe and without significantly higher complication rates compared to comparable inpatient procedures [5,6]. Still, it should be mentioned that several retrospective studies and at least one systematic review have found increased complication rates when

comparing outpatient to inpatient arthroplasty - contrary to the results of our study. For example, Liu et al. found that patients discharged on the same day of surgery after total knee and hip arthroplasty had higher odds of pulmonary/cardiac complications compared to patients who were admitted for at least one overnight stay [9]. Along the same lines, Arshi et al. examined patients who underwent total knee arthroplasty in a national insurance claims database and found a higher risk of component failure, surgical site infection, knee stiffness, and deep vein thrombosis in patients who underwent outpatient surgery versus inpatient surgery [10]. In addition, Bordoni et al. performed a systematic review of studies that compared complication rates and readmission rates between outpatient versus inpatient TKA. They found that the pooled complication rate for outpatient TKA was significantly higher at 16% for outpatient TKA vs 11% for inpatient TKA [28]. Given that outpatient hip and knee arthroplasty are still in their relative infancy, the results of our study should continue to be used as a comparison in the context of future studies that may be performed on this topic. It is important to realize that there may be similar discrepancies depending on the specific patient populations, methods of accounting for patient-related factors, and the retrospective/prospective nature of these studies. Additional studies on this topic should also focus on examining interventions to reduce the complication rate of bilateral, simultaneous arthroplasty. For example, two-surgeon simultaneous bilateral total knee arthroplasty has been described, with two surgeons having a lower rate of complications than one surgeon [14].

Given that outpatient arthroplasty has been shown to be safe, and that outpatient TKA was recently made reimbursable by Medicare as of 2018, it is not surprising that the prevalence of outpatient si-BTKA had increased from 0.6% to 10.5% in 2019 in our study. In a study of Medicare patients by Barnes et al., it was demonstrated that the prevalence of outpatient TKA was 0.2% prior to TKA being removed from inpatient only designation, with the prevalence catapulting to 25% in Q1 of 2018 (the first quarter after removal from inpatient only), to 36% in 2019 [29]. With the demand for primary total hip and knee arthroplasties estimated to grow by 174% and 673%, respectively, from 2007 to 2030 [30], the demand for outpatient si-BTKA will have a similarly increased growth potential, providing that the safety of these surgeries is well-studied.

Several important limitations of our study should be mentioned. First, the retrospective nature of our study limits our ability to control for inherent differences in patients who are selected for planned outpatient surgery versus those planned for inpatient surgery. Second, patients in NSQIP who were originally planned to have outpatient surgery may end up being admitted to the hospital, thus introducing selection bias into our sample that is not possible to rule out. One possible explanation for our finding of reduced complications in patients who underwent outpatient surgery may be that certain complications are much less likely to present in patients who are discharged on the same day of surgery, as patients do not have vital signs or laboratory monitoring at home. In addition, certain complications such as anemia requiring a transfusion are not possible in patients undergoing outpatient surgery as postoperative hemoglobin is not routinely drawn. In addition, a full assessment of the differences in outcomes between inpatient and outpatient si-BTKA would necessitate a prolonged follow-up period; however, we are again limited by the nature of the data available in NSQIP, which is limited to 30-day postoperative outcomes and complications. Our study is strengthened by the fact that we have nationally representative data, and a large amount of patients who have undergone si-BTKA, which is a relatively uncommon procedure at the present time.

In conclusion, when controlling for patient demographics and comorbidities, outpatient si-BTKA did not demonstrate increased

rates of any complication, minor complications, and postoperative transfusion when compared to inpatient si-BTKA. From 2015–2019, 3% of si-BTKA procedures were performed in the outpatient setting; however, among all si-BTKA, the prevalence of si-BTKA increased by more than 10-fold from 2015 to 2019. While our paper demonstrates that si-BTKA does not have drastically different complication rates in the outpatient versus inpatient setting, it should be noted that these patients were likely carefully selected by surgeons, and all procedures were performed in a setting where patients could be admitted to the hospital if needed. Additional studies are needed to fully demonstrate the safety of si-BTKA in all patients and the ambulatory surgery setting. Further insight is needed on the effect of outpatient si-BTKA on long-term outcomes.

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