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## Original Article

## Who Is Not a Candidate for a 1-Day Hospital-Based Total Knee Arthroplasty?

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## ABSTRACT

**Background:** Short-stay total knee arthroplasty (TKA), defined as a 1-day length of stay (LOS), is feasible in many patients, yet variables identifying who are candidates for a short stay are not well described in literature. With an emphasis on cost-efficiency, we examined preoperative patient characteristics and perioperative hospital factors that correlated with a longer LOS.

**Methods:** A retrospective review of 381 primary TKAs was performed. Clinical measures differentiating a 1-day LOS group from that of a  $\geq 2$ -day LOS group were identified.

**Results:** Multiple logistic regression demonstrated older age (odds ratio [OR], 1.92; 95% confidence interval [CI], 1.34-2.77;  $P < .001$ ), female gender (OR, 4.22; 95% CI, 2.35-7.57;  $P < .001$ ), American Society of Anesthesiologists score 3 or 4 (OR, 2.00; 95% CI, 1.01-3.95;  $P = .046$ ), atrial fibrillation (OR, 8.87; 95% CI, 1.81-43.47;  $P = .007$ ), and prior TKA on the contralateral side (OR, 3.57; 95% CI, 1.27-10.05;  $P = .016$ ) as significant preoperative characteristics correlating with the  $\geq 2$ -day LOS group. The most significant hospital perioperative factor associated with longer stays was patients not ambulating on the day of surgery (OR, 4.09; 95% CI, 1.77-9.48;  $P = .001$ ). Walking 150 ft (93% sensitive, 35% specific) on the day of surgery was predictive of patients in the 1-day LOS group. Hospital costs were US\$1873 ( $P < .001$ ) lower for patients in the 1-day group.

**Conclusion:** Shorter stays decrease costs associated with TKA, and more refined predictive models are needed to optimize discharge protocols. Preoperative data help allocate limited healthcare resources toward patients more likely to leave in 1 day, while perioperative data facilitate learning to create a more efficient hospital process.

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Total knee arthroplasty (TKA) is a safe and cost-effective treatment for end-stage knee arthritis [1]. In 2012, more than 670,000 TKA procedures were performed in the United States, at a cost of US\$11.1 billion [2]. Patients aged 65 years or older were the largest recipients of these procedures, making TKAs a substantial procedural cost in the Medicare budget [3]. By 2020, the demand for TKAs is projected to increase by 673%, resulting in the Centers for Medicare and Medicaid Services increasingly focusing on improving the cost-efficiency of care for TKA patients [4].

Length of stay (LOS) continues to be a major predictor of cost for TKA. Costs associated with inpatient services directly correlate with length of hospitalization [5,6]. Efforts to safely decrease LOS have led to the increased popularity of enhanced recovery after surgery (ERAS) protocols for TKA, which expedite postoperative recovery, support an early discharge, and decrease postoperative complications [7]. Advancements in ERAS protocols have made outpatient (same-day discharge) and short-stay (1-day LOS) TKA feasible in select patients. With the anticipated growth in demand for TKA procedures and the increasing focus on cost-efficiency, utilization of outpatient and short-stay TKAs in appropriate patients is likely to increase in the future.

As hospitals currently performing TKA procedures using 1-day LOS protocols, such as ours, look to expand services to include outpatient TKA, there is a void in literature identifying which patients are appropriate candidates for outpatient surgery. Although previous studies have investigated preoperative predictors of LOS, they have done so using standard modes of care that do not use fast-track protocols [8-10], or used fast-track protocols but were

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limited to examining only preoperative predictors of LOS [11,12]. Our study differs from the current body of literature in that we evaluate preoperative patient characteristics and perioperative surgical factors associated with 1-day LOS patients and differentiate them from those discharging on or after postoperative day 2 (POD #2). Studying the association of clinical factors with 1-day LOS patients is needed to counsel patients and optimize discharge planning.

## Methods

Institutional review board approval was obtained. A retrospective chart review was performed for a consecutive series of unilateral primary elective TKAs, from April 2014 to March 2015. A total of 381 TKAs were included in this study. No patients were excluded. All surgeries were performed by 1 of 2 experienced surgeons, performing >200 TKAs per year. The standard medial parapatellar approach was used. The patella was routinely resurfaced. All procedures, regardless of LOS, were performed using our ERAS protocols.

### Enhanced Recovery After Surgery Protocol

Preoperative processes included patient education, including a class with nurse navigators, physical therapy, and medical evaluations. The 2 full-time nurse navigators (available Monday through Friday 8 am to 4 pm) are a resource for patients in their preoperative, intraoperative, and postoperative phases of care. They assist patients with discharge dispositions and appointments and answer any postoperative questions. Nurse navigators are also a liaison between floor nursing staff and surgeons and collaborate closely with all members of the joint replacement team. Patient education involved educational programs overviewing daily activities after surgery, identifying a specific care companion “Coach” at home, and discussing expectations. Perioperative protocols included increased use of regional anesthesia, multimodal pain management, aggressive intraoperative fluid management, tranexamic acid utilization, anticoagulation prophylaxis, and day of surgery ambulation. No femoral nerve blocks were used. Standard Surgical Care Improvement Guidelines for perioperative antibiotics was followed. Pharmacologic (aspirin 325 mg bid or Coumadin international normalized ratio, 1.8–2.4) and mechanical postoperative deep vein thrombosis prophylaxis were maintained in all patients. Oxycodone (5-mg increments as needed) was prescribed only for pain unresponsive to nonopioid analgesics. Patient controlled analgesia was not utilized.

### Study Outcomes

The primary goal of our study was to identify preoperative patient characteristics and perioperative surgical factors associated with patients in the 1-day LOS group and differentiate them from patients discharging on or after POD #2. Secondary outcomes were examining hospital costs for patients in the 1-day LOS and  $\geq 2$ -day LOS groups. An institutional cost accounting system was used to quantify direct medical costs to the hospital for medical services rendered during index admission.

### Statistical Analysis

We analyze LOS as both a categorical (1-day LOS vs  $\geq 2$ -day LOS groups) and continuous variable (in hours). Multiple logistic regression models were employed to examine the association between LOS (as a categorical variable) and patient demographics and clinical characteristics. Odds ratios, their 95% confidence intervals,

and *P* values are presented. The automated algorithm, backward stepwise model selection based on Akaike information criterion, was used to help construct the final multiple logistic regression model. To identify a clinically meaningful cutoff point for distance walked on the day of surgery, which separated patients in the 1-day LOS group from those in the  $\geq 2$ -day LOS group, sensitivities and specificities corresponding to the distance walked were calculated in the sample.

We then performed the Student *t* test to examine the association between comorbidity and LOS (as a continuous variable). This was done to identify any significant differences in LOS for comorbidities with a low prevalence in our study population (ie, liver cirrhosis, implanted pacemakers). We calculated the average LOS in hours for patients presenting with a disease and compared it to the average LOS in hours for patients without the disease. All analyses were performed using STATA version 14.0 (Stata Statistical Software, College Station, TX). A *P* value  $\leq .05$  was treated as statistically significant.

## Results

Two surgeons performed 381 TKAs. Mean LOS was 2.3 days. Patients were categorized into 2 groups based on hospital LOS (1-day vs  $\geq 2$ -day LOS). Patients in the  $\geq 2$ -day LOS group were more likely to be older, be female, present with an American Society of Anesthesiologists (ASA) score of 3 or 4, have hypertension, be diabetic, and have atrial fibrillation (Table 1). Patients in the  $\geq 2$ -day LOS group were also more likely to undergo surgery after noon, not ambulate on the day of surgery, and be discharged to a skilled nursing facility (Table 2).

Two set of variables were examined: one set of variables could be identified and/or controlled preoperatively in the clinic while the second set of perioperative variables became evident during the hospital stay. Multiple logistic regression models identified older age, female gender, ASA score 3 or 4, atrial fibrillation, prior TKA in the contralateral side, and patients not ambulating on the day of surgery to be associated with patients in the  $\geq 2$ -day LOS group (Table 3).

In addition to evaluating the relationship between comorbidity and LOS as a categorical variable (1-day LOS vs  $\geq 2$ -day LOS groups),

**Table 1**  
Comparison of Patient Demographics Between the 2 Groups.

Patient Characteristics	1-d LOS	$\geq 2$ -d LOS	<i>P</i> Value
N (%)	85 (22)	296 (78)	
Age (y)	62.7	67.5	<.001
Body mass index (kg/m <sup>2</sup> )	31.4	32.0	.420
Gender			<.001
Male (%)	60.0	33.8	
Female (%)	40.0	66.2	
ASA score 3 or 4 (%)	20.0	41.5	<.001
Osteoarthritis of the knee (%)	95.3	92.2	.332
Hypertension (%)	56.5	74.0	.002
Hyperlipidemia (%)	47.1	58.1	.071
Diabetes (%)	7.1	18.2	.013
Atrial fibrillation (%)	2.4	13.9	.003
Coronary artery disease (%)	8.2	10.8	.490
Chronic obstructive pulmonary disease (%)	3.5	7.8	.172
Congestive heart failure (%)	1.2	2.7	.414
Implanted pacemaker (%)	—	0.7	.447
History of TKA (%)	21.2	21.6	.930
History of THA (%)	10.6	5.1	.065
History of stroke/CVA (%)	4.7	7.1	.433
History of MI (%)	2.4	4.1	.462
History of DVT/PE (%)	2.4	4.4	.394

LOS, length of stay; ASA, American Society of Anesthesiologists; CVA, cerebrovascular accident; MI, myocardial infarct; DVT, deep vein thrombosis; PE, pulmonary embolism; THA, total hip arthroplasty; TKA, total knee arthroplasty.

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