



Short Term Outcomes of Revision Total Knee Arthroplasty

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ABSTRACT

Few studies have assessed postoperative complications in revision total knee arthroplasty (rTKA). The aim of this study was to assess which preoperative factors are associated with postoperative complications in rTKA. Using the National Surgical Quality Improvement (NSQIP) database, we identified patients undergoing rTKA from 2010 to 2012. Patient demographics, comorbidities, and complications within thirty days of surgery were analyzed. A total of 3421 patients underwent rTKA. After adjusted analysis, dialysis ($P = 0.016$) was associated with minor complications. Male gender ($P = 0.03$), older age ($P = 0.029$), ASA class >2 ($P = 0.017$), wound class >2 ($P < 0.0001$), emergency operation ($P = 0.038$), and pulmonary comorbidity ($P = 0.047$) were associated with major complications.

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Total knee arthroplasty (TKA) has been one of the most important and successful practices of modern day orthopedics in alleviating joint pain, restoring function, and improving quality of life of those with osteoarthritis [1,2]. In the United States, there were approximately 660,000 total knee arthroplasties in 2009 [3]. Some estimates expect that number to grow exponentially to 3.5 million procedures by 2030 [4]. TKA is generally well-tolerated and about 95% of implants last at least fifteen years [5,6]. However, about 6% and 12% of TKA require revision at 5 and 10 years, respectively and these numbers will increase with more patients undergoing primary TKA [4,7]. It is therefore important to understand the postoperative outcomes of patients requiring revisions.

There have been numerous studies examining the causes of TKA requiring revision [8–15]. The most common indications for revision are infection (25%), mechanical loosening (16%) and implant failure or breakage (10%) [8]. Although there have been studies examining the preoperative comorbidities that are associated with worse outcomes in primary TKA [16], this has yet to be done for revision total knee arthroplasty (rTKA). There have been some studies examining outcomes of rTKA but many of these investigations focus on specific revision techniques or infection rates rather than medical complications [17–19].

The American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) database was used to identify patients who underwent rTKA. The aim of the present study was to determine the thirty-day morbidity and mortality of patients

undergoing rTKA and to assess which preoperative factors were associated with postoperative complications.

Methods

The ACS NSQIP Participant Use Data Files from 2010 to 2012 were used to carry out this investigation. The NSQIP database has been used in previous orthopedic surgery studies [20–22]. Multicenter prospective data were collected from 258 (2010), 315 (2011), and 374 (2012) academic and private participating United States hospitals [23]. Patient data are compliant with the Health Insurance Portability and Accountability Act (HIPA) with institution and protected health information removed.

A surgical clinical reviewer (SCR) at each participating hospital is responsible for collecting the data for the NSQIP database [23]. ACS defines collection criteria and trains the SCR. The ACS audits NSQIP data to ensure high interrater reliability. Training and audit procedures involving the NSQIP database have been validated and the reliability of data has increased each year [24].

The Current Procedural Terminology codes 27486 and 27487 were used to identify patients who underwent rTKA. We collected patient data that included demographics, comorbidities, and postoperative outcomes. Specifically, postoperative outcomes included mortality, need for reoperation, length of stay, and complications occurring within thirty days of surgery. Wound class is designated on a four-point scale and is defined by NSQIP as: 1 (clean), 2 (clean/contaminated defined as showing no infection signs but associated with an unsterile body cavity/tract), 3 (contaminated, defined as having major breaks of sterile technique or gross GI spillage), and 4 (dirty/infected cases such as old traumatic wounds with devitalized tissue or existing infection). ASA (American Society of Anesthesiologists) physical status classification system is used as a scale of patient fitness

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before surgery. More specifically, NSQIP defines ASA as 1 = normal healthy patient, 2 = patient with mild systemic disease, 3 = patient with severe systemic disease, 4 = patient with severe systemic disease that is a constant threat to life, 5 = moribund patient who is not expected to survive without the operation. Previous publications have provided definitions for other NSQIP variables [23].

The primary outcomes in this study were major morbidity and minor morbidity. Postoperative complications that comprise major morbidity included mortality, respiratory complications (pneumonia, reintubation, and failure to wean from ventilator within 48 h), renal complications (acute renal failure and renal insufficiency), neurological complications (coma > 24 h and stroke), cardiac complications (cardiac arrest requiring CPR and myocardial infarction), organ space infection, sepsis/septic shock, venous thromboembolism (deep vein thrombosis and pulmonary embolism), deep wound infection, wound dehiscence, and return to operating room. Postoperative complications that comprise minor morbidity included urinary tract infection and superficial wound infection.

Statistical Analysis

Univariate analysis was performed using the Pearson chi-square test or Fisher's exact test for categorical variables and an independent t-test for continuous variables. Multivariate logistic regression was employed to determine independent risk factors for major and minor morbidity. Risk factors with $P < 0.2$ in the initial univariate exploratory analysis were included in the multivariate model. $P < 0.05$ was considered significant for all tests. Odds ratios (ORs) and 95% confidence intervals (CIs) are reported. All statistical analyses were conducted using SPSS software version 20.0 (SPSS Inc., Chicago, IL).

Results

There were a total of 3421 patients who underwent rTKA included in the analysis. The patient demographics and clinical characteristics are outlined in Table 1. The mean patient age was 65.88 years (± 11.47 years), mean BMI was 32.72 kg/m^2 ($\pm 7.53 \text{ kg/m}^2$), and 59.9% of the patients were female. The most common comorbidities were diabetes (20.6%), hypertension (67.7%), and dyspnea (9.1%). The mean operative

Table 1
Demographics Total Knee Arthroplasty Revisions.

Demographic	Total (N = 3421)
Age, y	65.88 ± 11.47
Female gender	2050 (59.9%)
BMI, kg/m^2	32.72 ± 7.53
Race	
White	2692 (78.7%)
Black	346 (10.1%)
Asian	36 (1.1%)
Clinical characteristics	
ASA 1 or 2	1473 (43.1%)
Wound class 1 or 2	3090 (90.3%)
Functional status (dependent)	185 (5.4%)
Outpatient	32 (0.9%)
Smoker within 1 year	389 (11.4%)
Steroid use	149 (4.4%)
Comorbidities	
Diabetes	705 (20.6%)
Dyspnea	312 (9.1%)
Hypertension	2315 (67.7%)
COPD	180 (5.3%)
Mean operative time, min	133.69 ± 66.70
Anesthesia type (general)	2107 (61.6%)
Emergency	78 (2.3%)
Length of stay	3.74 ± 3.17

Continuous variables given as mean \pm SD.

BMI, body mass index; ASA, American Society of Anesthesia; COPD, chronic obstructive pulmonary disease.

time was 133.69 min (± 66.70 min) and the mean length of stay was 3.74 days (± 3.17 days).

There were a total of 364 major complications recorded during the thirty-day postoperative surveillance period affecting 189 patients (5.5% of total group) (Table 2). There were a total of 76 minor complications affecting 76 patients (2.2% of total group). There were 12 deaths during the thirty-day postoperative study period (0.4% of total group). Due to the low mortality, there was no separate analysis for this end point.

Table 2 summarizes the thirty-day postoperative major and minor complications experienced by the patient cohort. The most common major complications were venous thromboembolism (1.1% of total cohort), organ space infection (1.1% of total cohort), and return to operating room (3.9% of total cohort). The most common minor complication was urinary tract infection (1.3% of total cohort).

Multivariate logistic regression analysis assessing the relationship between preoperative comorbidities, intraoperative variables, and postoperative major and minor complications was carried out. Factors that were independently associated with major postoperative complications were male gender (OR = 1.44; 95% CI = 1.05 to 1.98; $P = 0.03$), older age (OR = 1.02; 95% CI = 1.00 to 1.03; $P = 0.029$), ASA score (OR = 1.60; 1.09 to 2.36; $P = 0.017$), wound class (OR = 5.39; 95% CI = 3.70 to 7.80; $P < 0.0001$), emergency case (OR = 1.94; 95% CI = 1.04 to 3.61; $P = 0.038$), and pulmonary comorbidity (OR = 1.51; 95% CI = 1.01 to 2.3; $P = 0.047$) (Table 3). Factors independently associated with minor complications were dialysis (OR = 7.82; 95% CI = 1.46 to 49.17; $P = 0.016$).

Discussion

Despite the high success and efficacy of TKA, revisions of these procedures remain a burden on surgeons and patients. Up to 6% of TKA procedures require a revision within 5 years [7]. Even given continued improvements in surgical technique and implants, revision rates are not going down [25]. In fact, it is anticipated that as primary TKA rates increase in the future, so will the rates of rTKA [4]. Revision total joint arthroplasty tends to be more technically challenging, involves more blood loss, and requires longer operation time than primary procedures [26]. Superimposed patient medical comorbidities may also contribute to increased complications in patients undergoing rTKA. The purpose of this study was to examine postoperative complications in patients undergoing rTKA and to understand preoperative patient characteristics that predict postoperative complications.

Table 2
Thirty-Day Post Operative Complications in Total Knee Arthroplasty Revision.

Factor	Total (N = 3421)
Number of patients with major complications	189 (5.5%)
Deaths	12 (0.4%)
Respiratory	27 (0.8%)
Neuro	10 (0.3%)
Cardiac	13 (0.4%)
VTE	39 (1.1%)
Renal	15 (0.4%)
Organ space infection	37 (1.1%)
Deep SSI	22 (0.6%)
Wound dehiscence	15 (0.4%)
Sepsis/septic shock	41 (1.2%)
Return to OR	133 (3.9%)
Total number of major complications	364
Number of patients with minor complications	76 (2.2%)
UTI	46 (1.3%)
Superficial SSI	30 (0.9%)
Total number of minor complications	76

Variables given as number and percentage.

SSI, surgical site infection; UTI urinary tract infection; VTE, venous thromboembolism; OR, operating room; Neuro, neurological.

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