



Same-Day Versus Staged Bilateral Total Knee Arthroplasty Poses No Increase in Complications in 6672 Primary Procedures

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ABSTRACT

We examined the assumption that patients undergoing same-day bilateral total knee arthroplasty (TKA) have a higher incidence of major peri-operative complications than patients who stage their procedures over the course of a year. Between April 2001 and March 2007, prospective data were collected using a total joint registry. Patients undergoing primary, bilateral, same-day, TKAs were compared to patients undergoing primary, staged, bilateral TKAs within 12 months of the index operation. A total of 2441 TKAs were performed on the same day, while 4231 were staged. There were no significant differences in 90-day mortality, thrombotic events and infections between the two groups. Performing same-day bilateral TKA does not predispose patients to increased cumulative incidence of major complications over staged arthroplasty.

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The relative safety of performing bilateral simultaneous total knee arthroplasty (TKA) compared to an unilateral procedure has been the subject of numerous studies [1–13]. The consensus that has emerged is that there is a higher risk of complications following bilateral knee replacements than there is following unilateral surgery. In several studies, an increase in 90-day mortality was associated with same-day bilateral procedures in patients with known cardiac disease [4,6,11,12,14]. A higher rate of procedure-related complications following simultaneous bilateral TKAs was also noted in a study of over 4 million admissions when compared to unilateral procedures [15].

However, these findings do not help the orthopedic surgeon with patients who present with symptomatic bilateral disease. These patients are frequently obliged to have both knees operated in short succession. Few studies have specifically considered whether the cumulative, per-person complication rate following staged unilateral procedures exceeds that of bilateral simultaneous surgery. The largest series we are aware of that specifically compared staged with simultaneous TKAs was published by Barrett et al and reported on 4957 Medicare patients with staged TKAs and 8324 Medicare patients

with simultaneous TKAs [3]. These authors concluded that “the sum of the risks associated with the two operations of a staged procedure may equal or exceed the risk of simultaneous total knee replacement.” When specifically looking at differences in cardiac morbidity between staged and same-day bilateral knee replacement in a cohort of 359 patients, Syed et al found no statistical difference in the per-person risk [13]. Another study, an exhaustive meta-analysis of the literature, concluded that “simultaneous bilateral total knee replacement carries a higher risk of serious cardiac complications, pulmonary complications, and mortality than staged bilateral or unilateral knee arthroplasties” [9]. However, this study included data from older literature.

In this paper, we review clinical outcomes following bilateral TKA in a large population managed using modern perioperative protocols in a community-based health care system. We compare the rate of major complications following bilateral, same-day total knee arthroplasty to the cumulative complication rate in patients who undergo staged bilateral procedures within 1 year of their index operation. We hypothesize that patients who undergo staged bilateral knee replacement are at an equal cumulative risk of complications with patients who undergo same-day bilateral knee arthroplasty.

Materials and Methods

This study is a retrospective analysis of a prospectively collected cohort data using the Kaiser Permanente (KP) Total Joint Replacement Registry (TJRR) [16]. The KP TJRR comprises clinical data entered by

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the clinician at the point of care in conjunction with data abstracted from administrative databases and electronic health records in an integrated health care delivery system. The TJRR data collection forms include a pre-operative, intra-operative, and status (post-operative) data sheets that are collected by surgeons and providers evaluating the patient. After electronic screening of the data collected from these sources, a chart review is performed by trained research assistants to verify any complications and confirm these events using standardized definitions and reporting guidelines [17].

Kaiser Permanente is an integrated health care organization and patients receive their care almost entirely within our hospital system. When care is delivered at an outside hospital, the patient is repatriated and treatment and diagnostic codes are captured. Further, year-to-year membership is stable, particularly in the older patient populations, such that few patients are lost to follow-up. This community-based integrated health care system contributes to the KP TJRR through over 50 hospitals and 350 arthroplasty surgeons. Patient selection for bilateral knee replacement is at the discretion of the individual surgeon.

All patients who had undergone a primary, bilateral TKA between March 2001 and March 2007 were identified. Bilateral TKAs performed on the same day were compared to staged bilateral TKAs where the patient's second TKA was performed within 12 months of the index operation. If a patient was identified by the surgeon as a bilateral procedure but information on only one knee was available in the registry, the patient was entered in the study as a bilateral knee patient using the information recorded in the registry form. Age, weight, diabetic status, American Society of Anesthesiologists (ASA) scores and implant information were collected at the time of surgery. The indication for surgery (diagnosis) and yearly surgeon volume was also analyzed; however, data regarding pre-operative selection criteria for bilateral procedures were not readily available. The complication rates used as outcomes measures were revision (re-operation for any reason at any time during the study period), mortality, thrombotic events both pulmonary embolism [PE] and deep vein thrombosis [DVT]), and infection. Revision and infection rates are reported per procedure while PE, deep vein thrombosis (DVT), and mortality are reported per patient. According to the Centers for Disease Control and Prevention (CDC) guidelines [18], deep surgical site infection rates are reported for at least 1 year and superficial surgical site infections for at least 30 days after surgery. PE, DVT, and mortality rates are reported for 90 days post-operatively. The cumulative complication rate for bilateral staged procedures was obtained by adding the complications associated with each procedure.

Chi-square and Fisher's exact test were used to compare categorical variables. All reported *P* values were two-sided with statistical significance considered at *P* values less than 0.05. Statistical analyses were performed using the SPSS program (SPSS for Windows Release 14.0.0, SPSS Inc., Chicago, IL, USA).

Results

During the study period, 6672 bilateral primary TKAs were performed in 3353 patients, representing 22.4% of the primary TKA cases in the registry (*N* = 29,840). Of these, 2441 (37%) were bilateral procedures performed on the same day while 4231 (63%) were staged within 1 year. Forty-four percent (1076) of bilateral same-day, and 38% (1603) of bilateral staged TKAs were done in patients under 65 years of age.

Patient characteristics: The distribution of the underlying diagnoses for surgery (osteoarthritis, post-traumatic arthritis, inflammatory arthritis, osteonecrosis, and rheumatoid arthritis) was not statistically significantly different between the groups (all *P* > 0.05). A higher percentage of males had bilateral same-day surgery (41.6%) than within 1 year (34.2%, *P* < 0.001). Patients with same-day surgeries also

had lower ASA scores (ASA 1 or 2, 66.2%) than patients with surgeries staged within 1 year (ASA 1 or 2, 62.9%), *P* = 0.009. Patients with surgeries on the same day (median age = 66, range 26–91) tended to be younger than patients with staged surgeries (median = 67, range 32–91), *P* < 0.001 though only by 1 year. Diabetes rates were lower in patients with surgery on the same day (7.6% vs. 10.3%), *P* < 0.001. Furthermore, surgeons with high volume (≥ 30 TKAs per year) were more likely to do surgeries on the same day (82.3% vs. 74.6%), *P* < 0.001. See Table 1 for details on study sample.

Complications: Mortality data were available on 93.3% of the 3353 patients in the cohort. Validated data on DVT and PE rates were available from January 2005 onward, and were therefore reported in a subset of 1974 patients (58.9% of 3353 patients). None of the measured outcomes of death, revision, DVT, PE, infection, deep infection, superficial infection were found to be statistically significantly different between the same-day bilateral TKA group and the staged procedure group (Table 2).

Discussion

In this analysis comparing patients who underwent simultaneous bilateral TKAs and those who had staged procedures over 1 year in a large community-based clinical practice, we found that the demographic characteristics of our simultaneous bilateral population are similar to that reported elsewhere [13].

Twenty-two percent of our patients who have a knee replacement had the procedure performed bilaterally, whether simultaneously or within a 1-year time frame. This mirrors almost exactly the Medicare data [3]. Further, like the Medicare population, patients who have same-day surgery tend to be male, slightly younger and have fewer comorbidities [3]. Interestingly, the underlying pathology leading to knee replacement is evenly distributed between both groups, a finding not yet noted elsewhere. This suggests that surgeons and

Table 1

Comparison of Demographics, Procedure Diagnosis, and Surgeon Volume Categories Between Bilateral TKAs Performed on the Same-day vs. Bilateral TKAs Performed Within 1 Year.

		Bilaterals: Same Day		Bilaterals: Staged Within 1 Year		<i>P</i> -Value
		<i>N</i>	%	<i>N</i>	%	
Gender	Male	996	41.6	1416	34.2	<0.001***
	Female	1397	58.4	2721	65.8	
ASA category	1 or 2	1524	66.2	2517	62.9	0.009**
	≥ 3	778	33.8	1483	37.1	
Age category	<65 years	1076	45.1	1603	38.5	<0.001***
	≥ 65 years	1311	54.9	2563	61.5	
BMI category (kg/m ²)	<30	613	46.1	919	38.2	<0.001***
	≥ 30 and <35	376	28.3	699	29.1	
	≥ 35	341	25.6	785	32.7	
Diabetes		185	7.6	437	10.3	<0.001***
	Diagnosis					
	Osteoarthritis	2266	92.8	3926	92.8	0.952 (ns)
	Rheumatoid arthritis	62	2.5	105	2.5	0.883 (ns)
	Inflammatory arthritis	12	0.5	15	0.4	0.396 (ns)
	Post-traumatic arthritis	9	0.4	12	0.3	0.550 (ns)
	Osteonecrosis	8	0.3	10	0.2	0.488 (ns)
	Other	19	0.8	36	0.9	0.752 (ns)
Surgeon median volume category	Low (<6)	50	2	69	1.6	<0.001***
	Medium (<30)	383	15.7	1005	23.8	
	High (≥ 30)	2008	82.3	3157	74.6	

ASA = American Society of Anesthesiologists; BMI = body mass index.

Missing information: 2.1% gender, 5.5% ASA, 1.8% age, 44% BMI.

Asterisks indicate the level of significance for each variable in the model (*P* values): *0.01 < *P* < 0.05; **0.001 < *P* < 0.01; ****P* < 0.001; ns: *P* > 0.05.

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