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Complications - Other

Bilateral Simultaneous vs Staged Total Knee Arthroplasty: A Comparison of Complications and Mortality

Dhiren S. Sheth, MD [a,*], Guy Cafri, PhD [b], Elizabeth W. Paxton, MA [b], Robert S. Namba, MD [a]

[a] Department of Orthopaedic Surgery, Southern California Permanente Medical Group, Irvine, California
[b] Surgical Outcomes and Analysis, Kaiser Permanente, San Diego, California

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ABSTRACT

Background: The purpose of this study was to compare the complications and mortality between bilateral simultaneous total knee arthroplasty (BTKA-Simultaneous) and bilateral staged TKA (BTK-Staged) while adjusting for differences in patient, surgeon, and hospital characteristics.
Methods: An integrated health care system total joint registry was used to compare patients undergoing BTKA-Simultaneous to BTKA-Staged. For outcomes related to revision and infection, the sample included 11,118 patients, and for outcomes of death, acute myocardial infarction, stroke, and venous thromboembolism, a subsample of 7991 patients with comorbidity data was selected.
Results: Overall death and complications in both groups were rare. The complication rates for BTKA-Simultaneous and BTKA-Staged were comparable: aseptic revision (1.17% vs 0.9%), septic revision/deep infection (0.8% vs 0.7%), death (0.28% vs 0.1%), and adverse events (2.49% vs 1.97%). In the adjusted models, there were no significant differences in any of the outcomes between the 2 groups.
Conclusion: There is a lack of evidence to support superiority of either BTKA-Simultaneous or BTKA-Staged.

Several studies support the concept of bilateral simultaneous knee arthroplasty (BTKA-Simultaneous) in patients with moderate-to-severe symptoms of both knees for treatment of arthritis [1,2]. In addition to economic benefits [3,4], there is evidence of improved functional outcomes [5-7] in patients undergoing BTK-Simultaneous as compared to bilateral staged total knee arthroplasties (BTKA-Staged). These advantages would not be justified if the risk of major complications, and mortality, for BTKA-Simultaneous were greater than BTKA-Staged [8].

Numerous studies have indicated that BTKA-Simultaneous increases the risk of major complications (cardiac, pulmonary, and neurologic) and perioperative mortality [4,9-17]. Comparison of complications between BTKA-Simultaneous and BTKA-Staged in Medicare beneficieries, revealed significantly higher 90-day risk of death, venous thrombotic events (VTE), and acute myocardial infarction (acute MI) in the simultaneous group [11]. In a study analyzing pooled data of all retrospective studies comparing BTKA-Simultaneous and BTKA-Staged, there was significantly higher mortality in the BTKA-Simultaneous group [12]. In a meta-analysis, the risk of overall mortality and 30-day postoperative mortality was higher in BTKA-Simultaneous than that in BTKA-Staged [14]. However, other studies have found no evidence of increased risk of complications with BTKA-Simultaneous over unilateral TKA [18-21].

Prior comparisons of complications and mortality between BTKA-Simultaneous and BTKA-Staged may have been hampered by differences in the baseline characteristics of the patients, surgeon preference, and hospital characteristics. The purpose of this study was to compare the complications and mortality between BTKA-Simultaneous and BTKA-Staged while adjusting for these differences.

Methods

An integrated health care system total joint arthroplasty registry (Kaiser Permanente Total Joint Registry) was used to identify a cohort of patients with primary elective bilateral TKA. For outcomes

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* Reprint requests: Dhiren S. Sheth, MD, Department of Orthopaedic Surgery, Southern California Permanente Medical Group, 6670 Alton Pkwy, Irvine, CA 92618.

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related to revision and infection, patients with operative dates from 17 April, 2001, to 28 December, 2012, were included. The sample included 11,118 individuals (22,236 implants) from 43 medical centers, 322 surgeons in 4 US geographical regions Southern California, Northern California, Hawaii, and Northwest (Oregon, Washington). For outcomes related to death and other complications, a subsample of patients with operative dates from 16 November, 2004, to 28 December, 2012, were included because availability of extensive comorbidity information was only available during this period. The sample included 7991 individuals from 42 medical centers, 271 surgeons in the 4 aforementioned US geographical regions.

The Registry consists of standardized data collection forms (paper and electronic) including preoperative form, operative form, and status report [22]. These forms are completed by the surgeons and staff in the clinic and operating room. The forms capture information on patient demographics, surgical technique, implant characteristics, and patient outcome. Registry data are validated using hospital utilization database and independent chart review. Several outcomes were considered: aseptic revisions, septic revisions/deep surgical site infections (DSSIs), death, acute MI, stroke, and VTE, the latter 4 considered within 90 days of the index procedure. The first 2 outcomes made use of the entire sample, whereas the latter outcomes made use of the subsample described previously. The rationale for not exclusively using the subsample that had all the comorbidity information available to model all outcomes is that the additional comorbidities (ie, Elixhauser comorbidities) are unlikely related to joint survival and therefore would not be regarded as potential confounders, consequently this strategy would simply reduce the size of the sample thereby decreasing efficiency and power.

Acute MI and stroke were based exclusively on *International Classification of Diseases, 9th revision, Clinical Modification* codes, with VTEs and DSSI screening based on *International Classification of Diseases, 9th revision, Clinical Modification* codes and positive screens validated through chart review. The only exposure variable of interest was based on whether 2 joints were replaced on the same day (simultaneous) or on different days but after 90 days and less than 1 year (staged). The variables considered as confounders are listed in Tables 1 and 2. With respect to measurement of the outcomes, we note that for aseptic revisions and septic revisions and/or DSSIs, the outcome is time to event separately for each joint. For individual complications (ie, stroke only, Acute MI only, VTE only), these were considered as patient-level outcomes. Although it

Table 1
Comparison of Same Day and Staged Bilateral Groups on Covariates in the Sample Used to Evaluate Revision and Infection Outcomes.

Variable	Same Day, Mean (SD)	Staged, Mean (SD)	Original Data (Std. Diff)	ATE Weights (Std. Diff)
American Society of Anaesthesiologist (ASA) class	2.32 (0.52)	2.40 (0.53)	0.154	0.005
BMI	31.58 (6.11)	32.70 (6.54)	0.176	0.010
Surgeon experience (running total)	351.19 (291.55)	272.68 (268.28)	0.280	0.025
Age, y	64.94 (8.86)	66.84 (8.93)	0.213	0.013
	Same Day (%)	Staged (%)		
Osteoarthritis (yes)	93.71	92.96	0.030	0.000
Diabetes (yes)	24.74	30.63	0.132	0.008
Gender (female)	57.28	63.40	0.125	0.004
Race				
White	72.81	70.14	0.059	0.001
Black	7.29	7.52	0.009	0.003
Asian/Pacific Islander	6.06	6.75	0.028	0.002
Hispanic	13.13	14.56	0.042	0.003
Other	0.71	1.03	0.034	0.011
Mobility (fixed)	89.99	90.72	0.025	0.000
Stability (Posterior-stabilized)	58.19	65.40	0.149	0.007
Gender-specific (yes)	1.42	1.50	0.006	0.001
High flex (yes)	23.53	27.86	0.099	0.027
Bearing surface				
Cobalt-Chromium on highly cross-linked	12.03	15.88	0.111	0.018
Cobalt-Chromium on conventional	83.11	82.01	0.029	0.007
Oxinium on conventional	4.86	2.11	0.150	0.022
Fixation				
Uncemented	3.82	3.26	0.030	0.008
Hybrid	7.24	4.20	0.131	0.006
Cemented	88.94	92.54	0.124	0.001
Exposure				
Mini	2.87	3.02	0.009	0.001
Midvastus	14.97	15.58	0.017	0.001
Parapatellar	78.57	77.75	0.014	0.002
Subvastus	3.79	4.00	0.011	0.002
Trivector	1.89	1.61	0.022	0.004
Other (includes quadriceps release and tubercle osteotomy)	0.94	1.22	0.027	0.027
Infection prohpylaxis				
Antibiotic irrigation	25.94	25.45	0.011	0.004
Antibiotics in cement	20.99	21.37	0.010	0.001
Clean air	28.51	28.42	0.003	0.002
IV antibiotics	96.26	95.95	0.016	0.005
Laminar flow	23.91	22.95	0.023	0.001
Space suits	77.12	78.77	0.040	0.007
Other	2.77	2.97	0.012	0.001

The values presented in this table are averaged over the 20 imputed data sets.
ATE, average treatment effect; BMI, body mass index; IV, intravenous; SD, standard deviation.