

Functional Outcomes of the Second Surgery Are Similar to the First in Asians Undergoing Staged-Bilateral Total Knee Arthroplasty

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Abstract

Introduction: Patients suffering from bilateral knee osteoarthritis often require bilateral total knee arthroplasty (TKA) to alleviate symptoms. There is controversy surrounding the approach to the surgical treatment of such patients. We asked if Asian patients undergoing staged-bilateral TKA had any difference in their short-term functional outcomes, comparing the first TKA to the second one and if the interval between the 2 surgeries had any impact of functional outcomes. **Materials and Methods:** We identified 100 patients from a single surgeon from 2006 to 2010 who had staged-bilateral TKA and had at least 2 years of follow-up for each TKA. The time interval between the first and second TKA ranged from 6 months to 1 year. Range of motion, Oxford knee questionnaire scores, knee scores and function scores at 6 months and 2 years of follow-up were then compared between the first and second TKA using the Student's T-test. **Results:** Although length of stay was reduced and time to ambulation was shorter for the second TKA, there were no significant differences in functional outcomes at 2 years. There was also no difference in outcome when patients were stratified according to time interval between TKAs. **Conclusion:** Staged-bilateral TKA continues to be a good option for patients presenting with severe bilateral knee osteoarthritis. The second arthroplasty has similar functional outcomes as the first arthroplasty. Our results can be used in preoperative counselling of patients undergoing staged-bilateral TKA.

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Introduction

Total knee arthroplasty (TKA) is one of the most common elective surgical procedures performed to alleviate pain and disability associated with knee osteoarthritis.¹ Patients suffering from bilateral knee osteoarthritis intuitively would require bilateral TKA. In such patients, the surgeries can be performed either simultaneously or in a staged manner. A simultaneous-bilateral TKA offers an advantage of a single hospital stay and shorter rehabilitation period thereby making it more cost effective.^{2,3} However, there are concerns with the safety of simultaneous-bilateral TKA. A higher risk of serious cardiac complications, pulmonary complications, and mortality was reported with simultaneous-bilateral knee arthroplasty as compared with staged-bilateral or unilateral TKA.³

The literature is still divided on the method of approach of surgery for patients with bilateral knee osteoarthritis. Furthermore, there are no studies done on an Asian population with regards to simultaneous- or staged-bilateral TKA. We asked if Asian patients undergoing staged-bilateral TKA had any difference in their short-term functional outcomes, comparing the first TKA to the second one.

Materials and Methods

This study is a retrospective review of prospectively collected data. From January 2006 to May 2009, 118 patients who underwent elective staged-bilateral TKA in an Asian tertiary teaching hospital were reviewed. Patients from a single surgeon, the senior author of the paper, were selected

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for consistency of surgical technique and postoperative care. All patients underwent the staged-bilateral TKA between 6 months and a year from the first TKA. Our Institutional Review Board approved the study.

Exclusion criteria were: 1) other lower extremity orthopaedic conditions or neurological impairment that limited function, and 2) patients who underwent the second TKA more than a year after the first. A total of 18 patients were excluded from this study based on the above exclusion criteria, leaving a total of 100 patients for the study.

All patients underwent a staged-bilateral posterior-stabilised TKA by a single surgeon. The second surgery was performed at least after 6 months and within a year from the first TKA for all patients. The time interval between the surgery was decided based on patient preference as well as surgeon availability. All patients had tourniquet applied to the operated limb throughout the course of the surgery. The medial parapatellar approach was used for patients with varus knees and the lateral parapatellar approach for those with valgus knees. No patellar resurfacing was performed. Postsurgical drains were inserted for all patients and removed on either postoperative day 2 or when the drainage was less than 70 millilitres, whichever occurred earlier.

All patients received standardised postoperative care, which included appropriate analgesia, pneumatic calf pumps and continuous passive motion from first postoperative day and

daily physiotherapy assessment. None of the patients received oral chemoprophylaxis against venous thromboembolism (VTE) as our institution-based study by Bin Abd Razak et al shows a very low incidence of VTE in low-risk Asian patients undergoing TKA without chemoprophylaxis.⁴

Height and weight on admission were extracted from the standardised medical case notes. Health services utilisation data over the 6 months after discharge were extracted from the local health databases. This data included length of stay (LOS) and readmission to hospitals within the country. Complications were also extracted from the standardised medical case notes. They were categorised as major and minor complications as well as mortality. Adverse cardiovascular or respiratory events, venous thromboembolic phenomenon, blood loss requiring more than 1 litre of transfusion and any complication requiring re-operation within the same admission, a readmission or requiring an extended admission of more than 7 days than the mean LOS was classified as a major complication. All others were considered as minor complications and included superficial wound infection, uncomplicated urinary tract infection, chest infection and thrombophlebitis.

Measured outcomes include the range of motion of the operated knee which was documented daily by the physiotherapist using a goniometer, the Knee Society Score,⁵ SF-36 questionnaire⁶ and the Oxford Knee Score⁷ at 6 months

Table 1. Patient Characteristics

Characteristics	First TKA (n = 100)	Staged Second TKA (n = 100)	P Value
Demographics			
Mean age (range) (years)	66 (43 – 82)	66 (44 – 83)	1.00
Gender: female (%)	72 (72)	72 (72)	1.00
Mean body mass index (range) (kg/m ²)	29.5 (20.8 – 44.6)	29.8 (19.5 – 46.4)	0.889
Medical status			
Primary diagnosis osteoarthritis (%)	94 (94)	94 (94)	1.00
Primary diagnosis inflammatory arthritis (%)	6 (6)	6 (6)	1.00
Cardiovascular disease (%)	35 (35)	35 (35)	1.00
Diabetes mellitus (%)	38 (38)	38 (38)	1.00
Mean number of comorbidities (and SD)	2.2 (± 1.7)	2.6 (± 2.2)	0.152
Health services utilisation			
Hospital LOS (and SD) (days)	5.2 (± 2.7)	4.2 (± 1.8)	0.002
Discharge directly home (%)	82 (82)	93 (93)	0.177
Surgical			
Duration of surgery (and SD) (mins)	72 (± 15.4)	61 (± 12.2)	<0.001
Time to ambulation (and SD) (days)	2.4 (± 1.6)	1.6 (± 1.2)	<0.001
Complications			
Major complications (%)	2 (2)	3 (3)	0.655
Minor complications (%)	7 (7)	10 (10)	0.467
Mortality (%)	0 (0)	0 (0)	-

LOS: Length of stay; SD: Standard deviation; TKA: Total knee arthroplasty

Table 2. Preoperative Range of Motion and Outcome Scores

	First TKA (n = 100)	Staged Second TKA (n = 100)	P Value
Mean range of motion (range) (degrees)	114 (96 – 132)	115 (97 – 133)	0.828
Mean Knee Score (range)	32 (14 – 50)	35 (17 – 53)	0.230
Mean Function Score (range)	47 (27 – 67)	44 (25 – 63)	0.381
Mean Oxford Knee Questionnaire Score (range)	38 (30 – 46)	39 (32 – 46)	0.718
Mean SF-36 Physical Component Score (range)	32 (11 – 53)	30 (9 – 51)	0.502
Mean SF-36 Mental Component Score (range)	50 (19 – 71)	50 (23 – 72)	0.814

TKA: Total knee arthroplasty

and 2-year intervals. The patients were then stratified based on the chronology of the operated knee into 2 groups, the 'First TKA' group and the 'Staged second TKA' group. Differences in the range of motion and outcome scores were then compared between the 2 groups at 6 months and 2 years of follow-up for the respective knee. All statistical analyses were performed using Statistical Package for the Social Sciences Version 17. The Students' T-test was used to compare the means between the 2 groups.

Results

Table 1 shows the patient characteristics. There were 72 female and 28 male patients. The mean age of the patients

was 66 years. The primary diagnosis was osteoarthritis in 94 patients whereas 6 patients were suffering from inflammatory arthritis. Duration of surgery was significantly shorter for the second TKA. Patients undergoing the second TKA also started ambulating earlier as compared to their first TKA and were hospitalised for a significantly shorter period of time. Of note, there were no significant differences in the complication rates as well as mortality. The mean time interval between the first TKA and second TKA was 7.4 months. There was no significant difference in the preoperative range of motion and outcome scores between the 2 knees (Table 2). Similarly, the postoperative range of motion and outcome scores at both 6 months and 2 years showed no significant difference (Table 3).

Table 3. Postoperative Range of Motion and Outcome Scores*

	First TKA (n = 100)	Staged Second TKA (n = 100)	P Value
Mean range of motion (range) (degrees)			
6 months	112 (98 – 126)	112 (97 – 125)	1.00
2 years	116 (103 – 129)	116 (101 – 131)	0.868
Mean Knee Score (range)			
6 months	80 (66 – 94)	79 (6 – 93)	0.614
2 years	84 (75 – 93)	84 (75 – 93)	0.973
Mean Function Score (range)			
6 months	57 (37 – 77)	58 (38 – 78)	0.724
2 years	68 (47 – 89)	67 (46 – 88)	0.946
Mean Oxford Knee Questionnaire Score (range)			
6 months	22 (15 – 29)	23 (15 – 31)	0.348
2 years	20 (13 – 27)	20 (13 – 27)	1.00
Mean SF-36 Physical Component Score (range)			
6 months	52 (28 – 76)	50 (26 – 74)	0.556
2 years	60 (36 – 84)	61 (38 – 84)	0.764
Mean SF-36 Mental Component Score (range)			
6 months	80 (61 – 99)	78 (60 – 96)	0.446
2 years	79 (61 – 97)	81 (64 – 98)	0.420

*All scores are recorded with respect to the operated knee only. For example, the Mean Knee Score of 80 for the 'First TKA' group refers to the Mean Knee Score of the operated knees of patients undergoing the first TKA. The Mean Knee Score of 79 for the 'Staged Second TKA' group refers to the Mean Knee Score of the operated knees of patients undergoing the staged second TKA.

Discussion

Patients suffering from advanced osteoarthritis of the knees often require TKA for both knees for alleviation of symptoms. The options of surgery are simultaneous-bilateral and staged-bilateral TKA. Although a simultaneous-bilateral TKA is equally successful as a staged-bilateral TKA in terms of outcome scores and implant survival,^{8,9} it has been shown by various authors that a staged TKA is safer than a bilateral knee replacement done at the same sitting.¹⁰⁻¹⁵ However, Kim et al reported that the operative risk of staged-bilateral knee arthroplasty is underestimated in retrospective studies.¹⁶ Regardless of the controversy, patients who have been counselled for staged-bilateral TKA will wonder if the second TKA would fare as well as the first and may enquire on the ideal interval between the 2 surgeries.

There has been no study done in the Asian population comparing the outcome of the second TKA to the first in a staged-bilateral TKA setting. We asked if Asian patients undergoing staged-bilateral TKA had any difference in their short-term functional outcomes, comparing the first TKA to the second one. An accurate answer to this question would be important during preoperative counselling for patients undergoing staged-bilateral TKA.

Interestingly, the length of stay was significantly less for the second TKA as compared to the first. This could possibly be explained by the fact that the patients undergoing the second surgery already have the “experience” and know the postoperative protocol as well as the rehabilitation regimen. Another observation was that the time to ambulation was also less for the second knee compared to the first knee. In patients undergoing staged-bilateral TKA, the intuitive practice would be to operate on the more symptomatic knee first followed by the other knee. We postulate that at the time of the second TKA, patients were relatively asymptomatic on the contralateral knee. This would have an added benefit on postoperative rehabilitation. These patients are also more likely to be familiar with the postoperative rehabilitation protocols. Gabr et al also reported a better walking ability and reduced LOS following the second knee arthroplasty.¹⁷ Further to this, our study shows that the duration of surgery was significantly shorter for the second TKA. This is presumably due to the fact that the surgeon is already aware of the implant size used for the previously operated knee, which may have decreased the instrumentation time. We also found that there was no significant difference in the complication rates and mortality rates between the first and second TKA. Mangaleshkar et al also reported zero mortality in the staged-bilateral TKA group as compared to the simultaneous-bilateral TKA group.¹⁸ In their study, they compared 54 patients who had simultaneous-bilateral TKA with 34 patients who had staged-bilateral TKA. Four patients

who had simultaneous-bilateral TKA died in the immediate postoperative period while no deaths were observed in the staged-bilateral group. Hence, they concluded that a staged operation appears to be safer than simultaneous-bilateral TKA. Similarly, Meehan et al reported a higher incidence of cardiovascular complications in patients undergoing simultaneous-bilateral TKA.¹¹ In their comparative study of 11,445 simultaneous-bilateral TKA to 23,715 staged-bilateral TKA, patients who underwent simultaneous-bilateral TKA had a significantly higher adjusted odds ratio (OR) of myocardial infarction (OR = 1.6, 95% confidence interval [CI], 1.2 to 2.2) and of pulmonary embolism (OR = 1.4, 95% CI, 1.1 to 1.8) compared to patients who planned to undergo staged-bilateral TKA. The unadjusted 30-day incidence of death or a coronary event was 3.2 events per thousand patients higher after simultaneous-bilateral TKA than after staged-bilateral TKA. We could not find any current literature comparing complication and mortality rates between the first and second TKA in patients undergoing staged-bilateral TKA.

In answering our primary question, our findings lead us to conclude that there are no differences in the short-term outcomes between the first and second surgeries in Asian patients undergoing staged-bilateral TKA. This is supported by the findings of Vulcano et al in a recent study.¹⁹ Ritter et al however, found that patients undergoing staged-bilateral TKA had significantly lower Knee Society scores than the simultaneous bilateral group across all postoperative time-intervals.¹⁰ However, this could be due to lower preoperative Knee Society scores of the patients who underwent staged-bilateral TKA as it has been well established in current literature that preoperative scores are a strong determinant of postoperative outcomes.^{20,21} Controversy will continue to exist with regards to comparison of outcomes, as each centre would have its own set of criteria for risk stratification and patient selection. This makes comparison of studies difficult. From our study, it can be said that one should not recommend staged-bilateral over simultaneous-bilateral (or vice versa) based on short-term outcomes.

Although our study did not analyse the impact of time interval between the 2 surgeries on outcomes due to the relatively small numbers, we have to acknowledge that much controversy still exists with regards to the ideal interval between the 2 TKAs in patients undergoing staged-bilateral TKA. There is also a lack of literature surrounding this topic. Some authors have suggested an interval of as short as 5 to 7 days to be safe.^{22,23} There are very few studies to date that have evaluated the time interval between surgeries with regards to outcomes and this is a potential area of further study.

There were several limitations to this study. This study is retrospective in nature, which limits the number of outcome

variables being studied. The sample size is also small with only 100 patients. Furthermore, there is a gender bias, with 72 patients being female. However, this could also be indicative of the disease epidemiology in the country of origin. Another significant limitation is that no comparison was made with patients undergoing simultaneous-bilateral TKA. As mentioned above, we also did not evaluate the impact of the time interval between the surgeries on the outcomes. This could potentially be a confounder in our study. Notwithstanding the above limitations, the strength of the study lies in the fact that every patient underwent the same operative procedure and received a standard protocol of postoperative care and rehabilitation. The outcomes scores were all prospectively collected. This makes for a meaningful comparison of the functional outcomes.

Currently, there are no clear guidelines or international consensus on the management of patients presenting with severe bilateral osteoarthritis of the knee. A prospective randomised study comparing simultaneous-bilateral and staged-bilateral TKA with regards to outcomes and the ideal interval would be needed for a conclusive answer. However, the results of our study can be used to inform and assure the patients that in the hands of an experienced surgeon, the functional outcomes of the second TKA would be similar to the first one and that they would be able to go home as well as ambulate earlier as compared to the first TKA.

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