



Are patients more satisfied and have better functional outcome after bilateral total knee arthroplasty as compared to total hip arthroplasty and unilateral total knee arthroplasty surgery ? A two-year follow-up study

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This study aims to review the quality of life and physical improvement achieved by total joint arthroplasty surgery, namely unilateral TKA, bilateral TKA and THA. We hypothesize that patients who undergo bilateral TKA should have greater improvement in patient-reported outcome measures, as compared to patients who had unilateral TKA, and their outcomes may be comparable to that of THA. We analyzed prospectively collected data of all patients who underwent unilateral TKA, bilateral TKA and THA (5291, 187 and 529 patients respectively) for end-stage osteoarthritis at a tertiary hospital during the 5-year period. Patients who underwent bilateral TKA had a greater degree of improvement in SF-36 and Knee Society Scores as compared to unilateral TKA at 6 months and 2 years follow-up. Bilateral TKA had the highest proportion of patients who were satisfied and had expectations met by surgery.

Keywords :

INTRODUCTION

The prevalence of osteoarthritis worldwide is stated to rise with an increasingly aging and overweight population (9). Osteoarthritis primarily affects quality of life and causes physical inactivity (8). Arthroplasty surgery has proven to be an extremely successful procedure in improving the

quality of life and providing functional improvement for patients who experience debilitating pain from degenerative joint disease (6,27,31). Degenerative changes most commonly affect the hips and knees and may occur in both knees concurrently, warranting bilateral knee arthroplasty (TKA) (24).

Simultaneous bilateral TKA is typically indicated for American Society of Anesthesiology (ASA)

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1 or 2 patients with few or no associated co-morbidities (21). In contrast to patients who undergo unilateral TKA, patients who undergo bilateral knee arthroplasty potentially benefit from shorter rehabilitation times, comparable patient satisfaction scores and comparable or better functional outcome (19, 26). Moreover, as one of the principal determinants of patient-reported functional outcome after a unilateral TKA is pain in the contralateral, un-replaced knee, patients may have better long-term functional outcome after a simultaneous bilateral TKA (20). However, there is currently no clear consensus on the benefits of performing simultaneous bilateral TKA.

In general, patients whose expectations have been met are more satisfied with their outcomes following total arthroplasty surgery (3,16,17,22). In comparison to patients who underwent unilateral TKA, patients who underwent THA have been shown to have better joint-specific, general health and satisfaction scores, as well as better fulfillment of expectations (5,7,28,29). However, there are no published studies comparing the post-operative outcomes of bilateral TKA and THA.

Hence, this study aims to review the quality of life and physical improvement achieved by total joint arthroplasty surgeries, namely unilateral TKA, bilateral TKA and THA. We hypothesize that, despite their low levels of physical activity prior to total joint arthroplasty, patients experience significant improvement in physical activity and pain scores post-operatively, which correlate to improvement in both the objective measures and patient-reported outcome measures. Furthermore, patients who undergo bilateral TKA should have greater improvement in patient-reported outcome measures at 2 years follow-up, as compared to patients who had unilateral TKA, and their outcomes may be comparable to that of THA.

MATERIALS AND METHODS

Study design

We analyzed prospectively collected data of all patients who underwent unilateral TKA, bilateral TKA and THA for end-stage osteoarthritis at a tertiary hospital

during the 5-year study period (January 2007 to December 2011). Centralized Institutional Review Board approval was obtained for this study (CIRB 2014/465/D). Patients who underwent revision surgery were excluded from the study to limit the number of intra- and post-operative variables. All patients were part of a standardized post-operative clinical pathway for arthroplasty surgery and received supervised physical therapy post-operatively by trained physiotherapists.

Patient metrics

Clinical parameters were assessed pre-operatively and post-operatively at 6 months and 2 years. Patient-reported outcome measures were assessed using a self-administered patient questionnaire containing the SF-36 Health Survey, Oxford Knee Score (OKS), Oxford Hip Scores (OHS), and Knee Society Score (KSS) to evaluate the impact of arthroplasty surgeries at 6 months and 2 years follow-up. The Knee Society Score was further stratified into the functional component (KSS – Functional Score), which includes ability to walk distances and climb stairs, and the objective component (KSS – Objective Score), which includes clinician assessment of patient's pain, range of motion, stability and alignment. The SF-36 Health Survey was further stratified into the physical component score (PCS) and the mental component score (MCS). The PCS comprises of the physical functioning, bodily pain and general health component of SF-36, while the MCS comprises of the vitality, social functioning and mental health component of SF-36.

We also evaluated patients' opinions as to whether the surgery met their expectations and whether they were satisfied with the results of their surgery, using two questions adopted from the validated North American Spine Society (NASS) Questionnaire. They are (1) "Has the surgery met your expectations so far?" and (2) "How would you rate the overall results of surgery?". For Question 1, patients had the choice of selecting from the following answers: (1) Yes, totally; (2) Yes, almost totally; (3) Yes, quite a bit; or (4) More or less; (5) No, not quite; (6) No, far from it or (7) No, not at all. For Question 2, patients had the choice of selecting from the following answers: (1) Excellent; (2) Very good; or (3) Good; (4) Fair; (5) Poor or (6) Terrible. Patients were defined as either having their expectations met by their surgeries (Responses to Question 1 = 1-4) or not having their expectations met by their surgeries (Responses to Question 1 = 5-7). Patients were defined as either satisfied (Responses to Question 2 = 1-3) or dissatisfied (Responses to Question 2 = 4-6).

Statistical analysis

A paired t-test was used to compare pre-operative and post-operative scores for each arthroplasty surgery. For all patients undergoing knee arthroplasty, the correlation between the improvement of an objective outcome measure (KSS – Objective Score) and the improvement of an subjective outcome measures (KSS – Functional Score and SF-36 component scores) was calculated using the Pearson's correlation coefficient. In addition, a stepwise logistic regression was conducted specifically for knee arthroplasty patients to identify which pre-operative metrics were associated with bilateral surgery. For all analyses, statistical significance was defined as *p*-value of 0.05 or less. All statistical analysis was performed using SPSS version 21 (SPSS, Inc., Chicago, Illinois) with consultation from biostatisticians.

RESULTS

Patient demographics

A total of 5291, 187 and 529 patients who underwent unilateral TKA, bilateral TKA and THA respectively were included for analysis in this study. Age, gender distribution, pre-operative BMI and clinical parameters are shown in Table I.

Post-operative improvement

The clinical outcomes of the patients for the 3 different surgeries at 6 months and 2 years follow-

up are shown in Table II. The differences between pre-operative and post-operative clinical outcomes and their respective statistical significances are shown in Table III. All patients who underwent TKA and THA surgery experienced significant improvement in PCS and MCS scores at 2 years follow-up ($p < 0.001$). Patients undergoing unilateral and bilateral TKA were shown to have significant improvement in KSS – Functional Score, KSS – Objective Score, and OKS at both 6 months and 2 years ($p < 0.001$), while patients undergoing THA were shown to have significant improvements in OHS at both 6 months and 2 years ($p < 0.001$). At 2 years follow-up, 90.7% of unilateral TKA, 93.7% of bilateral TKA and 91.9% of THA patients felt that they were satisfied with the results of their surgery. 95.4% of unilateral TKA, 97% of bilateral TKA and 95.1% of THA patients felt that their expectations were met by surgery.

Correlation between KSS – objective score and KSS – functional scores

The difference in pre-operative and 2-year post-operative KSS – Objective scores was found to correlate significantly with the difference in pre-operative and 2-year post-operative subjective outcome measures, which included KSS – Functional score, OKS and SF-36 (PCS and MCS). The improvement of KSS – Objective scores were found to correlate with the improvement in KSS – Functional score,

Table I. — Patient demographics for each group of arthroplasty patients pre-operatively

	Unilateral TKA	Bilateral TKA	THA
Number of patients	5291	187	529
Age	66.97 ± 7.7 (30.54-90.76)	64.94 ± 7.51 (47.7-83.35)	61.41 ± 5.28 (21.67-91.28)
Gender (Male: Female)	1053 (19.9%): 4238 (80.1%)	30 (16%): 157 (84%)	150 (28.4%): 379 (71.6%)
BMI	27.85 ± 4.61 (14.79-50.80)	27.32 ± 4.0 (18.55-40.48)	25.84 ± 5.28 (24.74-54.63)
KSS-Functional Score	52.28 ± 18.33 (0-100)	48.08 ± 21.14 (0-90)	–
KSS-Objective Score	37.39 ± 19.15 (0-95)	37.20 ± 19.35 (0-93)	–
Oxford Knee Score	35.44 ± 8.19 (12-60)	36.45 ± 8.32 (18-60)	–
Oxford Hip Score	–	–	40.27 ± 9.41 (14-60)
SF-36 (PCS)	32.44 ± 10.63 (5.04-62.28)	30.50 ± 9.87 (10.70-55.05)	32.10 ± 15.50 (0-85.5)
SF-36 (MCS)	50.81 ± 10.72 (3.63-74.88)	52.39 ± 9.91 (3.64-69.22)	60.84 ± 22.84 (0-100)

Table II. — Clinical outcomes for unilateral TKA, bilateral TKA and THA at 6 months and 2 years post-operatively

	Unilateral TKA	Bilateral TKA	THA
6 months post-operatively			
KSS-Functional Score	67.32 ± 18.86 (0-100)	71.78 ± 20.72 (0-100)	–
KSS-Objective Score	82.50 ± 12.01 (13-100)	84.89 ± 11.61 (20-100)	–
Oxford Knee Score	20.34 ± 6.11 (12-55)	19.8 ± 6.82 (12-59)	–
Oxford Hip Score	–	–	18.81 ± 7.35 (12-55)
SF-36 (PCS)	45.82 ± 10.63 (5.05-62.28)	47.96 ± 10.12 (13.74-64.49)	60.63 ± 26.67 (0-100)
SF-36 (MCS)	54.42 ± 10.72 (3.63-74.88)	55.51 ± 11.93 (3.64-74.92)	77.84 ± 23.97 (0-100)
Percentage of patients satisfied with results of surgery	87.1	91.8	90.7
Percentage of patients who felt that surgery met their expectations	94.2	97.2	95.8
2 years post-operatively			
KSS-Functional Score	71.90 ± 19.2 (0-100)	80.08 ± 18.46 (0-100)	–
KSS-Objective Score	85.54 ± 11.33 (0-100)	86.60 ± 11.49 (0-100)	–
Oxford Knee Score	18.72 ± 5.60 (12-60)	17.31 ± 5.31 (12-56)	–
Oxford Hip Score	–	–	16.87 ± 7.35 (12-57)
SF-36 (PCS)	47.98 ± 9.87 (5.2-68.16)	51.42 ± 8.19 (7.57-62.07)	68.68 ± 23.78 (0-100)
SF-36 (MCS)	55.02 ± 10.42 (7.58-76.41)	57.87 ± 8.76 (32.09-71.34)	83.21 ± 17.43 (0-100)
Percentage of patients satisfied with results of surgery	90.7	93.7	91.9
Percentage of patients who felt that surgery met their expectations	95.4	97.0	95.1

PCS, MCS and OKS. The correlation coefficients are shown in full in Table IV.

Logistic regression

Of the pre-operative variables analyzed, BMI, KSS, and OKS were identified as significant predictors for bilateral TKA. An increase in BMI of 1.0 kg/m² was shown to predict for increased likelihood of bilateral TKA by 9.35 times. An increase of 1 point on either the KSS or OKS predicted for increased likelihood of bilateral TKA by 1.23 and 1.40 times respectively. The results of the logistic regression are shown in Table V.

DISCUSSION

Total hip and total knee arthroplasty surgeries are effective in terms of improving symptoms and health-related quality of life post-operatively. In our

study, we evaluated the outcomes of unilateral, bilateral TKA and THA in terms of patient-reported outcomes measures, satisfaction scores as well as objective outcomes (KSS – Objective Score). From the literature, both THA and TKA conferred substantial improvement in patients' report of pain and ability to perform physical tasks, as well as very high levels of patient satisfaction (5,7). Patients who reported poorer pre-operative symptoms were more likely to experience a greater improvement post-operatively. It is intuitive to associate greater improvement in pain and function with high levels of satisfaction. However, it has been reported that patient satisfaction cannot be predicted from pre-operative Oxford Scores (29). It is important to understand an individual patient's expectations of surgery and fulfillment of patients' expectations of total joint arthroplasty is an important predictor for patient satisfaction (3,16,17,22,28). It is interesting to note that from comparative studies (5,7), patients

Table III. — Degree of improvement of clinical outcomes for unilateral TKA, bilateral TKA and THA at 6 months and 2 years post-operatively

	Unilateral TKA	P- value	Bilateral TKA	P- value	THA	P- value
Comparison between pre-operative and 6 months post-operatively						
KSS – Functional Score	13.2 ± 21.67	< 0.001	22.94 ± 23.71	< 0.001	–	–
KSS – Objective Score	40.76 ± 29.01	< 0.001	43.75 ± 31.10	< 0.001	–	–
Oxford Knee Score	15.65 ± 9.19	< 0.001	16.86 ± 9.16	< 0.001	–	–
Oxford Hip Score	–	–	–	–	22.19 ± 11.68	< 0.001
SF-36 (PCS)	12.12 ± 14.63	< 0.001	17.46 ± 11.95	< 0.001	28.53 ± 26.15	< 0.001
SF-36 (MCS)	2.13 ± 14.48	0.003	3.12 ± 13.34	< 0.001	17.00 ± 28.04	< 0.001
Comparison between pre-operative and 2 years post-operatively						
KSS – Functional Score	19.6 ± 20.46	< 0.001	32.01 ± 21.72	< 0.001	–	–
KSS – Objective Score	46.54 ± 25.04	< 0.001	49.54 ± 22.23	< 0.001	–	–
Oxford Knee Score	16.71 ± 8.48	< 0.001	19.14 ± 8.46	< 0.001	–	–
Oxford Hip Score	–	–	–	–	23.35 ± 10.82	< 0.001
SF-36 (PCS)	15.54 ± 12.79	< 0.001	20.92 ± 11.03	< 0.001	36.59 ± 23.08	< 0.001
SF-36 (MCS)	4.23 ± 11.65	< 0.001	5.58 ± 11.15	< 0.001	22.38 ± 23.13	< 0.001

Table IV. — Correlations between changes in KSS – Objective Knee Score and patient-reported outcome scores post-operatively at 2 years using Pearson's correlation coefficient

Difference between the clinical scores measured		KSS – Functional Score	Oxford Knee Score	SF-36 (PCS)	SF-36 (MCS)
KSS – Objective Score	Pearson Correlation	0.189	0.392	0.21	0.103
	P – value	< 0.001	< 0.001	< 0.001	< 0.001

who underwent THA as compared to TKA were more likely to report a greater improvement in both health-related quality of life and patient satisfaction. One of the explanations is that THA is able to fulfill patients' expectations of surgery to a greater extent.

All TKA and THA performed in our institution provided significant post-operative improvement in terms of patient-reported outcome measures with high levels of satisfaction and expectations being met by surgery. For TKA surgery, the improvement in patient-reported outcome measures correlates to the objective scoring of KSS. Similar to the literature, THA was more successful than TKA in terms of greater degree of improvement in SF-36 (both PCS and MCS) as well as Oxford scores. Of note, in our study, we found that a greater proportion of patients who underwent bilateral TKA were satisfied with surgery and had expectations met by surgery as compared to those who underwent THA.

The use of single-staged simultaneous bilateral TKA has been highly debated among the orthopedic surgical community. Benefits of simultaneous bilateral TKA include potential cost-saving, single anesthesia administration, single hospital stay, and significantly shorter length of stay in hospital as well as two-fold need for physical therapy in unilateral TKA (11,13). Disadvantages of simultaneous bilateral TKA include increased risk of intensive care unit stay, deep venous thrombosis (DVT) and pulmonary embolism following bilateral TKA (4,11,25). However, there have been conflicting results reported with regards to higher incidence of post-operative DVT and pulmonary embolism (2,30). Also, the post-operative mortality from bilateral TKA in all studies has been extremely low (10,18,23). Another potential downside of bilateral TKA was increased intra-operative blood loss, which may require homologous blood transfusion (10). However, there

Table V. — Odds ratio for predictors of bilateral total knee arthroplasty through logistic regression analysis. (Odds ratios for variables that were non-significant ($p > 0.05$) in each regression model are not reported)

Variable	P-value	OR	95% Confidence Interval for Odds Ratio (OR)	
			Lower	Upper
BMI	0013	9.35	1.60	54.58
KSS	< 0.001	1.23	1.10	1.36
Oxford Knee Score	0.007	1.40	1.10	1.77

have also been conflicting results to refute increased blood loss during bilateral TKA as bilateral surgery presents shorter total anesthesia and operative times compared with the unilateral surgery (23).

In our study, patients who presented for bilateral TKA were more symptomatic as compared to those who presented for unilateral TKA, with higher OKS, and lower KSS and SF-36 (PCS) scores. Post-operatively, the patients who underwent bilateral TKA made a greater degree of improvement in clinical outcomes for OKS, KSS – Functional and Objective scores and SF-36 (PCS and MCS) as compared to unilateral TKA. Bagsby and Pierson (2015) concluded from their study that simultaneous bilateral TKA is an effective option, which may be worth the possible added risks. This is because simultaneous bilateral TKA not only provides equivalent results as measured by KSS, but also better outcomes in terms of post-operative range of motion and function score than unilateral TKA (1). Nevertheless, with the inconsistent results and uncertain risks of bilateral TKA, the health status of patients must be assessed carefully pre-operatively and patients should be properly counseled regarding the possible risks and complications of bilateral TKA. From our study, we agree with performing simultaneous bilateral TKA in appropriate patients, as they tend to be more symptomatic and have been shown to achieve a greater degree of improvement in post-operative patient-reported outcomes and objective measures, as compared to unilateral TKA.

To identify predicting factors for bilateral TKA, we evaluated the possible predicting factors using a logistic regression analysis. In our study, a higher BMI is one of the major predicting factors for bilateral TKA. We report that an increase in BMI of 1.0 kg/m² was shown to predict for increased likelihood

of bilateral TKA by 9.35 times. This is similar to the literature, which had reported associations between higher BMI and risk of developing osteoarthritis in the hip and knees (1,12,14). Other predicting factors include poorer OKS and KSS, which meant that bilateral TKA patients were generally more symptomatic pre-operatively as compared to unilateral TKA patients.

Some of the limitations of our study include, firstly, that this is a retrospective study. However, this study consisted of a large group of patients, who were non-selective patients who underwent arthroplasty surgery at the tertiary institution during the study period. Secondly, the Charlson co-morbidity index or post-operative complication rates for the patients were not included, which could potentially be one of the reasons for different outcomes among the patients. One of the strengths of our study include that this is one of the first studies comparing the post-operative outcomes of arthroplasty surgeries to include bilateral TKA. Also, all patients were on standardized post-operative clinical pathway and supervised physical therapy post-operatively.

In summary, total joint arthroplasty of the hip and knee are effective treatments, which provide significant functional improvement, high level of post-operative patient satisfaction and meet patients' expectations for surgery. In our study, more than 90% of patients were satisfied with their overall results of surgery after undergoing total joint arthroplasty surgery. Patients who underwent bilateral TKA had a greater degree of improvement in both patient-reported outcome measures (SF-36 and KSS – Functional score) as well as KSS – Objective score as compared to unilateral TKA. Patients with total hip arthroplasty had the greatest degree of improve-

ment in post-operative clinical outcomes, such as Oxford Score and SF-36 (PCS and MCS). However, bilateral TKA had the highest proportion of patients who were satisfied and had their expectations met by surgery. This study further justifies the use of bilateral TKA for appropriate patients who have end-stage arthritis of bilateral knees to improve their function and quality of life.

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