

RESEARCH ARTICLE

Clinical Outcome Comparison between Staged –Bilateral Versus Simultaneous Bilateral Total Knee Replacements

Mohammad Mahdi Sarzaeem, MD¹ ; Farzad Amoozadeh Omrani, MD²; Mohammad Mahdi Omidian, MD³; Mohammad Ali Sahebalzamani, PhD⁴; Ehsan Maniei, BSc⁵

Research performed at Department of Orthopedic Surgery in Imam Hossein Hospital affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran

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Abstract

Background: This retrospective study aimed to compare the clinical outcomes of patients with staged and simultaneous bilateral total knee arthroplasty (TKA).

Methods: The present study included 100 patients with a mean age of 62 ± 3.72 years from 2014 to 2017. Among them, 51 and 49 patients underwent simultaneous and staged bilateral TKA, respectively. The two groups were compared regarding the range of motion (ROM), Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) improvement, and Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) scores. The mean follow-up duration was 24 months (range: 12-36 months).

Results: According to the results obtained from the SF-36 questionnaire (possessing eight different factors of quality of life), there was no significant difference between the two groups. Furthermore, the OKSs were 39.98 ± 1.52 and 38.68 ± 2.55 in the simultaneous and staged groups, respectively. Moreover, the WOMAC improvement scores were obtained at 84.15 ± 2.2 and 83.26 ± 2.6 in the simultaneous and staged groups, respectively. The final knee ROM was acceptable without a significant difference between the two groups.

Conclusion: Substantial controversy about the complications, functional, and clinical outcomes has negatively affected the decision of the surgeons on conducting bilateral sequential TKA. This clinical assessment revealed that all determinants, including OKS, WOMAC, SF-36, ROM, postoperative bleeding, and hospitalization duration exhibited almost the same improvement in both groups. According to this study, no statistically significant difference exists in both procedures.

Level of evidence: III

Keywords: Arthroplasty, Knee, Knee Prosthesis, Replacement

Introduction

Knee osteoarthritis incidence is about 12% in the United States; however, it is increasing due to improving life expectancy and increasing obesity prevalence in the world population (1). Health-Related Quality of Life (HRQOL) is one of the crucial factors for modern medicine decision-making. QOL is generally defined as a weak performance in necessary daily activities capable of affecting older adults' health (2). Ko et al. reported a significant improvement in QOL of the patients undergoing joint replacement, particularly in the knee joint; accordingly, the total knee replacement is a gold standard treatment

in end-stage knee osteoarthritis (3, 4).

Generally, bilateral knee osteoarthritis is observed in 5% of the patients; however, in some patients, especially those with rheumatoid arthritis (RA) and hemophilia may reach 19% (5). There are two operative approaches in bilateral total knee arthroplasty (TKA), namely simultaneous and stage surgeries.

When both knee replacements are performed upon one hospital admission and one anesthesia, it is called simultaneous bilateral total knee replacement. However, when the knee replacements are performed in two separate anesthesia, it is called staged bilateral surgery.

Corresponding Author: Mohammad Ali Sahebalzamani, Department of Biomaterials, Faculty of Biomedical Engineering, Science and Research, Branch, Islamic Azad University, Tehran, Iran.

Email: ali_bme@yahoo.com, sahebalzamani.ali@gmail.com



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The interval between two operations is commonly from one week to one year (6, 7). Simultaneous bilateral knee replacements include nearly 6% of all knee replacements in the United States (8). However, there is controversy among knee surgeons about indications in simultaneous knee arthroplasty in patients with bilateral osteoarthritis (9). There are also concerns about suboptimal technical performance in the second knee replacement in simultaneous operations (10). Simultaneous operations are usually preferred in younger patients with low comorbidities (11). Some complications, such as deep vein thrombosis, cardiac, respiratory, neurologic, deep infection, and mortality were reported in simultaneous bilateral replacement (12). On the other hand, the recently conducted studies have not shown increasing complications during and after simultaneous bilateral knee arthroplasty (6, 13, 14). Simultaneous operations are associated with patients' satisfaction, low charge, and rapid recovery (6, 7). This study aimed to compare the outcomes in patients who underwent simultaneous bilateral knee replacement and staged bilateral knee arthroplasty based on Oxford Knee Score (OKS), Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) score, and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Materials and Methods

This retrospective study included 100 patients who were referred to the Department of Orthopedic Surgery in Imam Hossein Hospital affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran, from 2014 to 2017. In total, 51 and 49 patients were undergoing simultaneous and staged bilateral TKA operations between two to six months after the first surgery, respectively. The patients were classified based on age and comorbidities; therefore, younger patients with low comorbidity were enrolled in the simultaneous operation group. This was a non-randomized study; however, the participants in each group were matched in terms of age, gender, body mass index, and the same knee prosthesis. On the other hand, the patients with a history of RA and septic arthritis were excluded from the study. All patients received 40 mg of Enoxaparin daily for two weeks. Physical therapy was started on day one after the surgery. A single surgeon conducted operations in both groups with high thigh tourniquet and subvastus arthrotomy. All data were collected from medical records at the hospital and interpreted by an author independently. The outcome scores were evaluated for two years after the last operation. The WOMAC and OKS were validated concerning the Persian patients (15, 16). The obtained data were analyzed and any differences between the two mentioned groups were investigated in SPSS software (version 16.0) through descriptive statistics that were reported as mean±standard deviation (x±SD) or percentage (%).

Furthermore, the data were entered a spreadsheet (Microsoft Excel for Mac 2011, version 14.2.3), and summary statistics were calculated. Baseline comparison of the two treatment groups was conducted after a descriptive analysis of the variables (means and

SD) in order to determine their equivalence to the measured variables. The next step involved within-group comparisons of pre-and post-intervention scores and between-group comparisons of change scores on all outcome measures. A p-value less than 0.05 was considered statistically significant.

Results

Totally, 100 patients (51 and 49 cases in simultaneous bilateral TKA and two-staged bilateral TKA, respectively) participated in this study. There was no significant difference between the two groups regarding the mean age (62.04±4.51 in the first group and 61.70±5.62 in the second group). Table 1 tabulates the gender distribution of patients, and the overall summary of systemic complications in both groups was analyzed in [Table 2].

The WOMAC improvement and OKS were presented in. The results of the SF-36 questionnaire show no significant changes in any of the eight items between the two groups [Table 3, 4].

Table 1. Demographic characteristics of the patients

Characteristics	Simultaneous	Staged	P-value
Patients (n)	51	49	0.001
Mean age (y, range)	62.4±4.51	61.70±5.62	0.503
Female (n, %)	42%	39%	0.001
Male (n, %)	9%	10%	0.001
Osteoarthritis (n, %)	49%	48%	0.664
Rheumatoid arthritis (n)	2	1	0.001
Body mass index (kg/m ²)	25.8±2.48	26.1±7.59	0.879
Hypertension (n)	18	16	0.001
Coronary artery disease (n)	9	11	0.001
Diabetes (n)	7	8	0.001
Range of motion pre-operatively	111.05°±0.463° (80°-140°)	114.12°±0.432° (90°-140°)	0.437

Table 2. Overall summary of systemic complications in simultaneous and staged bilateral total knee arthroplasty

Complications	Simultaneous	Staged	P-value
Hypovolemic shock	0	0	0.001
Pneumonia	1	0	0.001
Confusion	1	1	0.001
Intensive care unit admission	2	1	0.001
Thromboembolic disease	0	0	0.001
Mortality	0	0	0.001

Scoring Systems	Pre-operation	Simultaneous group	Staged group
		2-3-year-follow-up	2-3-year-follow-up
OKS	21±1.70	45.98±1.52	44.68±2.55
WOMAC Improvement	---	58%	49%
KOOS (QOL)	8±0.9	13±0.4	12±0.27

OKS: Oxford Knee Score

WOMAC: The Western Ontario and McMaster

Universities Osteoarthritis Index

KOOS: Knee Injury and Osteoarthritis Outcome Score

QOL: Quality of Life

Scoring systems-SF-36	Simultaneous	Staged	Maximum excellent score	P-value
General health	4±0.9	4±1.10	2	0.001
Activities on a typical day	21±1.50	23±0.70	30	0.001
Physical health	5±1.25	6±1.65	8	0.001
Emotional problems	20±1.70	19±1.85	22	0.001
Statements	45±0.60	41±1.18	58	0.001
Feeling	16±1.40	17±1.30	20	0.001

The range of motion (ROM) was also assessed by digital goniometry. Active ROM was also applied in the comparison between the two groups. Series 1 and series 2 depict post-operative ROM of simultaneous and staged groups, respectively. Figure 1 illustrates the ROM data [Figure 2]. Comparison of ROM and functional status of the patients over two years of follow-up showed no statistically significant difference at any assessment point. In terms of post-operative bleeding, no significant difference was detected between the simultaneous bilateral (the sum of blood loss from the two knees) and staged bilateral groups (the sum of blood loss through the two procedures).

The average decrease rates of hemoglobin level were 3.5-4 g/dl and 2-2.5 g/dl in the simultaneous bilateral and staged bilateral groups, respectively. Furthermore, the mean length of hospitalization for the staged bilateral group was equal to that of the simultaneous group. It must be mentioned that the mean follow-up period of the staged bilateral group started after a second surgery.

Discussion

Similar outcome scores and complication rates in patients with simultaneous and staged bilateral TKA were the main findings

of this study. The most common disease in the musculoskeletal system is osteoarthritis, and about 20% of patients with a primary knee replacement have significant pain in another knee so that 10% of them will agree on second knee arthroplasty within one year after the first

operation (17, 18). Despite multiple studies about simultaneous versus staged bilateral TKA, there is no consensus about indications and complications about them (9). Simultaneous bilateral TKA can eliminate knee problems upon one hospital admission and anesthesia with lower respiratory complications, cost, and deep infection; meanwhile, deep vein thrombosis, pulmonary embolism, and mortality rates are lower in staged replacement strategy (19). There are varying results about mortality between two protocols, and some studies reported high mortality in the simultaneous approach; however, other studies found no significant difference (14, 20). The mortality rate was similar between the two groups in this study that may be due to patient selection, improved postsurgical care, or a small number of patients. Some previous studies reported a high rate of deep vein thrombosis and pulmonary emboli in simultaneous strategy.

On the other hand, other studies showed no difference between them. One study found higher rates of the above complications in the staged approach (6, 7, 19, 21-23). The probability of thromboembolic complications was zero in this study between simultaneous and staged groups that may be attributed to the use of chemoprophylaxis and early mobilization of patients. Respiratory complications, including pneumonia, were reported higher in staged bilateral knee replacement patients (19). One patient in the staged group was complicated with pneumonia in this study that recovered completely by medical management. The neurologic complications were higher in the simultaneous bilateral group; however, in one systemic review and meta-analysis report, neurologic complications were the same in staged and simultaneous groups (19, 24, 25). One patient in each group showed confusion during intensive care unit admission in this study that recovered without future problems. Many studies reported an increasing blood transfusion in simultaneous bilateral knee replacement. The rate of blood transfusion was the same between the two groups in this study that may be due to appropriate hemoglobin levels in both groups and the use of tranexamic acid.

Patient-Reported Outcome Measures (PROMs) were reported to increase interest for the evaluation of postoperative outcomes after TKA recently. The OKS is a kind of PROMs that was developed in 1998 (7, 21, 22, 26-28), and the scores between 30 and 38 suggest the threshold of satisfaction after TKA during six months to three years follow-up (26, 29, 30). The WOMAC outcome study that was used mostly in elderly patients assesses stiffness, daily living function, and pain. It is the most commonly recommended tool for disease-specific outcome studies (31, 32). There was no significant difference between simultaneous and staged bilateral replacement groups in terms of OKS assessment (33-35). Based on WOMAC outcome studies, some papers reported no post-operative difference in simultaneous and staged groups (29, 36, 37). The postoperative improvement in WOMAC and OKS was significant in both simultaneous and staged bilateral knee replacement groups in this study; however, there was no significant difference between the two groups. The OKS in both simultaneous and staged groups were in an acceptable range of satisfaction. The SF-36 is acceptable for QOL assessment in orthopedic surgery.

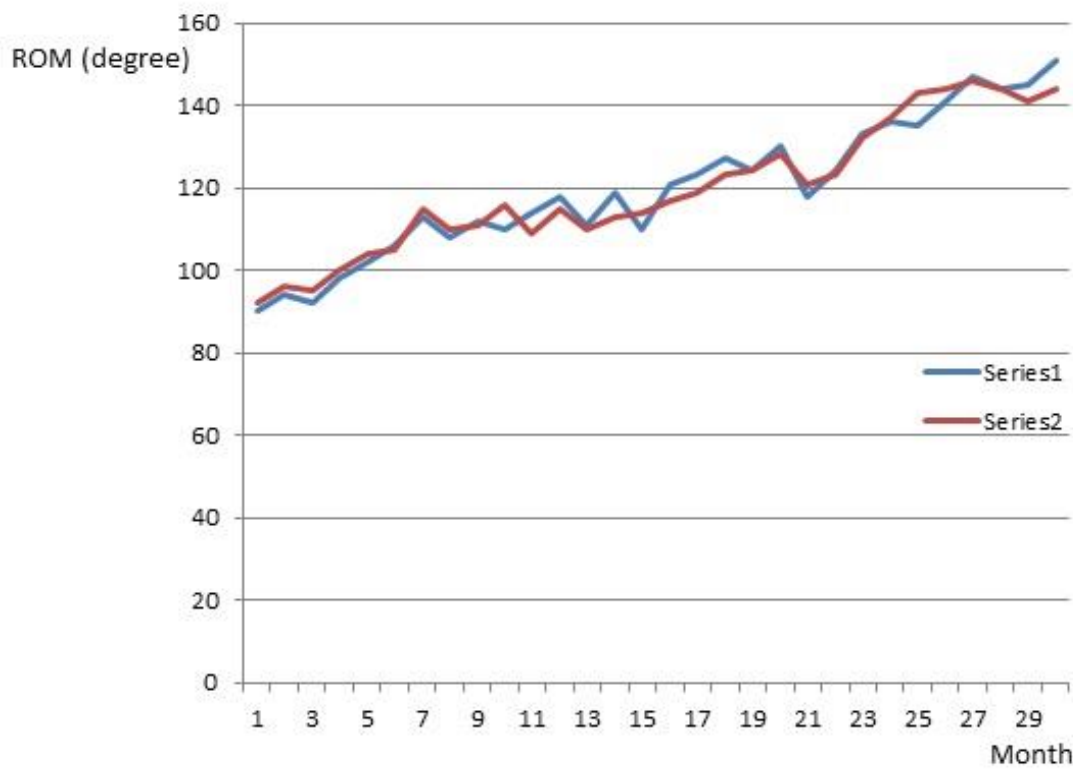


Figure 1. Post-operation mean range of motion of patients under assessment, (Series 1: simultaneous bilateral group; Series 2: staged bilateral group)

It is generic so that it is used to compare different operative interventions (30, 38, 39). SF-36 is an appropriate and practical method for outcome study after total knee replacement (30). All aspects of health outcome scores of SF-36 improved postoperatively in simultaneous and staged groups in this study. The comparison of this score between the two groups showed no significant difference in this regard.

Final knee ROM in this study was the same in both simultaneous and staged strategies that was consistent with the results of previous reports (35, 36). The improving functional outcome and decreasing complication rates in simultaneous bilateral knee replacement in recent years may be due to improvement in surgical technique, patient selection, optimization of patients, and preoperative care. The indications for simultaneous bilateral total knee replacement are not clear cut; however, it may be an acceptable plane in younger patients with low comorbidities. Teamwork cooperation may be necessary for decreasing preoperative complications. The non-randomized retrospective assessment and a small number of patients are the main limitations of this study; therefore, a randomized prospective study with a large number of cases will be the answer to many questions in the future.

According to the results of this study, all outcome determinants in OKS, WOMAC, SF-36, and ROM, as well as postoperative bleeding, and hospitalization duration,

exhibited the same results in both groups. Accordingly, the statistical results showed no significant difference in both procedures.

Mohammad Mahdi Sarzaeem, MD¹

Farzad Amoozadeh Omrani, MD²

Mohammad Mahdi Omidian, MD³

Mohammad Ali Sahebalzamani, PhD⁴

Ehsan Maniei, BSc⁵

1 Department of Orthopedic Surgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences (SBUMS), Tehran, Iran.

2 Department of Orthopedic Surgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences (SBUMS), Tehran, Iran.

3 Department of Orthopedic Surgery, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences (SBUMS), Tehran, Iran.

4 Department of Biomaterials, Faculty of Biomedical Engineering, Science and Research, Branch, Islamic Azad University, Tehran, Iran.

5 Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran.

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