

Is Simultaneous Bilateral Knee Replacement a Safe Approach for Patients with Bilateral Knee Osteoarthritis? A Prospective Case-control Study

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SUMMARY

Background. Total knee arthroplasty (TKA) is the standard treatment for terminal knee osteoarthritis. Simultaneous bilateral total knee arthroplasty (STKA) can be a cost-effective and practical option for patients with degenerative joint disease affecting both knees. The purpose of this study was to assess complication rates and functional outcomes following simultaneous versus staged bilateral total knee replacement.

Material and methods. Approximately 60 individuals who experienced debilitating knee osteoarthritis were enrolled in a prospective study with a randomized comparative design. Out of these, 30 patients underwent simultaneous total knee arthroplasty (STKA), while the remaining 30 individuals underwent two separate surgeries with a gap of 3-6 months between each procedure for both knees. After excluding 7 patients from both groups, a total of 53 patients were included in the study and followed up for at least 12 months.

Results. Pre-operative demographic parameters were equated between both groups. The overall number of systemic complications was higher in the simultaneous group compared with the staged one. Systemic complications were correlated with the elderly and high-risk populations. However, simultaneous procedures were safe in a low-risk group with shorter hospitalization and operative times.

Conclusions. 1. Simultaneous bilateral total knee arthroplasty (TKA) is considered safe and feasible mainly for younger individuals with ASA 1 or 2 health status. 2. Patients undergoing simultaneous bilateral TKA experience significantly reduced hospital stays. 3. The procedure may not be advisable for elderly patients at a higher risk of systemic complications.

Key words: arthroplasty, bilateral replacement, knee joint, outcomes

BACKGROUND

Total knee arthroplasty (TKA) stands as the gold standard in addressing advanced knee osteoarthritis. In cases where degenerative joint disease impacts both knees, patients and surgeons may consider the viability of simultaneous bilateral total knee arthroplasty (STKA). This approach, known for its cost-effectiveness and practicality, obviates the need for two distinct TKA procedures, thereby mitigating rehabilitation duration and associated expenses [1-3].

Furthermore, this technique may reduce the overall use of pain medication and recovery time. Despite these advantages, the safety of STKA remains controversial, as many recent publications have found that, when compared to staged and unilateral operations, STKA surgery is linked to an increase in morbidity and mortality [4-6].

Our study aimed to scrutinize perioperative risks, postoperative blood loss, and hospitalization duration in simultaneous bilateral and staged bilateral TKA, both utilizing the same prosthesis. The aim was to determine whether simultaneous bilateral TKA is safe and beneficial or not.

MATERIAL AND METHODS

This is a prospective study of 53 patients, or of 106 knees. Of all patients with advanced knee osteoarthritis, 27 were simultaneous bilateral, and 26 staged bilateral, for a total knee arthroplasty. These patients were 16 males (30.9%) and 37 females (69.1%). The procedures were performed in the period between June 2013 and March 2016, with a minimum one-year follow-up.

Approval for the study was granted by the ethical committee at Cairo University (No. 10/2012). All patients were fully informed about the trial and the possible benefits and drawbacks of one-stage vs two-stage treatments. Preoperative randomization was done to ensure the demographic distribution of age, gender and BMI (Tab. 1, 2) as well as ASA grades and risk factors like DM and heart diseases.

Accordingly, patients were included in one of the two groups to undergo either simultaneous bilateral knee replacement or staged bilateral knee replacement. One of three experienced knee arthroplasty surgeons conducted the procedures using the same surgical technique from a medial parapatellar approach.

Patients eligible for inclusion in the study had bilateral debilitating knee arthritis graded as 3 or 4 according to the Kellgren & Lawrence classification. These individuals were also listed for total knee arthroplasty (TKA) and had demonstrated lack of response to all conservative treatments.

There were exclusion criteria applying to both groups, including conditions such as complex knee replacement situations (e.g., post-traumatic knee arthritis, severe deformity, or instability), inflammatory joint illnesses like rheumatoid arthritis, psoriatic arthritis, and ankylosing spondylitis, as well as advanced patellofemoral arthritis necessitating resurfacing.

Group 1: Bilateral Simultaneous Total Knee Arthroplasty (STKA). This group initially included 30 patients. After the exclusion of one patient who died after nine months (acute MI) and two patients who were missed during follow-up, the number declined to 27 patients.

Group 2: Bilateral Staged Total Knee Arthroplasty (StTKA). Bilateral Total Knee Arthroplasty had been done in two sessions, and 28 patients were initially included. Then, two patients were excluded as they suffered from a cerebral infarction (after 6 months) and lung cancer after the first stage. The second TKA was cancelled. Thus, the group ultimately numbered 26 patients.

The second surgery in the staged bilateral TKA was scheduled after a consultation with the patient. In general, a full recovery should take between 3 and 9 months following the initial procedure. For the staged bilateral group, the average duration between the first and second surgeries was 6.3 months.

The anaesthesiologists calculated the ASA grade before surgery using the American Society of Anaesthesiologists (ASA) categorization system. These groups were further classified depending on their ASA grade. Patients in the low-risk category (ASA 1 and 2) were either healthy or had a mild condition that did not interfere with daily functioning at the time of operation. In general, regarding ASA and preoperative medical risk factors, there was no statistically significant difference between the two groups.

The Knee Society Score (KSS) and Functional Knee Score (FKS) were frequently used in both groups to assess pain and impairment before surgery. A complete local examination of the affected knee joint was also performed, with a focus on deformity, instability, and range of motion.

The Zimmer cemented posteriorly stabilized (Nexgen PS) Fixed Bearing, Standard notch, without resurfacing the patella, was the implant utilized in all instances of the study.

Under tourniquet control, all cases were performed via the medial parapatellar route. Typically, in simultaneous bilateral TKA, the primary surgeon worked on each knee sequentially, beginning with the more symptomatic side and progressing to the second TKA after implant placement and before wound closure.

and tourniquet deflation of the first TKA. A drain was not used in any of our patients.

All patients were given an anticoagulant (Fragmin 5000 IU once daily) for two weeks, and the dose was changed postoperatively based on BMI. Serum haemoglobin levels were determined by blood tests. Total blood loss was calculated as intraoperative blood loss plus a reduction in Hb before surgery.

The minimum period of follow-up was 12 months, with a mean of 16.5 months, ranging from 12 to 30 months. KSS and KFS were performed on all patients before surgery and for one year thereafter. The occurrence of postoperative complications was investigated. The two TKA groups' serological parameters and clinical outcomes were compared.

The orthopaedic team documented all data as part of the normal postoperative patient assessment. The data were compared using the Student test between the two groups in terms of perioperative complications, knee score, and functional result. Fisher's exact test was used to compare categorical data between the two groups. The statistical significance level was set at $p < 0.05$.

RESULTS

27 participants diagnosed with advanced knee arthritis constituted the experimental group. In this group, 54 knees underwent bilateral knee arthroplasty at the same time. The comparison group, consisting of 26 patients, had a total of 52 knees treated with staged bilateral knee arthroplasty.

Systemic Complications

The incidence of systemic complications was notably higher in the simultaneous TKA group, particularly within the high-risk subset (ASA 3) and among individuals aged 65 and above. A total of ten systemic complications were observed in nine patients (33.0%) who underwent simultaneous bilateral TKA, in contrast to three systemic complications occurring in two patients (7.7%) who underwent staged bilateral TKA. This discrepancy in systemic complications between the two groups was statistically significant (p value = 0.021).

The majority of systemic complications manifested during the immediate postoperative phase. Specifically, complications arose within a span of less than 72 hours after surgery in 7 out of 9 patients within the simultaneous bilateral group, and in all patients within the staged bilateral group.

In the first group, two patients encountered urinary retention (which defined as a sudden painful inability to void despite having a full bladder) was resolved through Foley catheterization. Another pa-

tient had an episode of acute angina necessitating intensive postoperative care and monitoring. On the third day following the surgery, two patients developed dyspnoea, attributed to a pulmonary embolic event confirmed by pulmonary CT angiography. This condition was successfully treated with medication.

Three patients in the same group developed postoperative pneumonia. They received a five-day course of intravenous Tazocin antibiotics and exhibited complete clinical and radiological improvement in their chest condition. Additionally, two patients experienced postoperative disorientation within the first 24 hours. A brain MRI was conducted, revealing normal results, and their disorientation was fully resolved by the second day after the surgery.

In contrast, within the staged group, a single patient with cardiac issues was admitted to the critical care unit for close monitoring and medication due to postoperative atrial fibrillation. Furthermore, another patient experienced postoperative disorientation due to an electrolyte imbalance, but this individual completely recuperated after the electrolyte levels were normalized.

Within the simultaneous group, notable disparities were observed in the occurrence of complications between patients categorized as low risk and those identified as high risk based on ASA grading ($p < 0.05$). However, in the staged group, there were no statistically significant differences ($p > 0.05$).

Regarding age distribution, among the participants in the simultaneous bilateral group, 13 patients (48.17 percent) were aged 65 or below, while 14 patients (51.8 percent) were above the age of 65. In the context of simultaneous bilateral surgery, systemic issues were experienced by 8 individuals (29.6 percent). In contrast, within the staged TKA group, only one patient encountered a systemic complication.

Local Complications

Two individuals (3.7 percent) in the simultaneous group encountered a superficial wound infection affecting both knees. To compare, one knee (1.9 percent) in the staged group experienced the same issue. However, this difference was not deemed statistically significant ($p = 0.6527$). Within the initial three weeks post-surgery, all patients had controlled wound management through dressing, and no further intervention was required. Notably, no instances of deep infections or revision surgeries were observed throughout the course of this trial.

A single patient (1.9 percent) within the simultaneous group developed temporary weakness in right ankle dorsiflexion following the operation, which resolved within the six-week follow-up period. Addi-

Tab. 1. Demographic data

	Simultaneous (n=27)		Staged (n=26)		Test of Sig.	p
	No.	%	No.	%		
Sex						
Male	7	25.9	9	34.6		
Female	20	74.1	17	65.4	$\chi^2= 0.475$	0.491
Age (years)						
Min. – Max	50.0 – 84.0		56.0 – 82.0			
Mean \pm SD.	65.22 \pm 8.77		67.81 \pm 6.86		t=1.198	0.237

Tab. 2. Comparison between the two groups according to BMI

BMI	Simultaneous (n=27)	Staged (n=26)	T	p
Min. – Max.	26.80 – 36.60	27.70 – 37.0		
Mean \pm SD.	31.24 \pm 1.60	32.0 \pm 1.25	0.618	0.539

T and p values for Student t-test for the two groups

tionally, in both groups, one knee each developed cellulitis around four to five days after the surgical procedure (both patients had diabetes). Successful treatment was achieved through intravenous Flucloxacillin antibiotics, followed by six weeks of oral antibiotics.

Two patients (1.9 percent) within the simultaneous TKA group experienced deep vein thrombosis (DVT), which was confirmed via Doppler ultrasound. Both cases were managed with therapeutic anticoagulation. While one of these patients exhibited prolonged wound bruising after an increase in low molecular weight heparin (LMWH), there was no significant wound seepage or bleeding.

Regarding local complications, there was no statistically significant disparity between the two groups (p = 0.142).

Postoperative Bleeding and Length of Hospital Stay

There was no statistically significant difference in postoperative blood loss between the simultaneous bilateral (the quantity of blood loss from both knees) and staged bilateral groups (the sum of blood loss from both procedures). However, there was a statistically significant difference in the number of blood units transfused between the simultaneous and staged TKA groups. Only three patients in the staged group had a four-unit transfusion, but 21 patients in the simultaneous group received 38 units (p < 0.001).

The mean length of hospital stay in the staged bilateral group was defined as the sum of two hospitalizations and was 11.7 days. This was 4.2 days longer than the 7.5 days mean by the simultaneous bilateral group. The length of hospitality varied substantially. (p < 0.008*).

Operative time

There was a statistically significant difference in operating time between the two groups; it was less in the simultaneous group (mean 175.8 \pm 26.21). operative time in the staged group (206.2 \pm 21.73) was estimated by adding the operative times of the two distinct operations. Patients who had TKA in the staged group had a longer operational time.

Knee Society scoring

The pre-and post-operative knee rating scores were compared between both groups as a supplementary end-point of the comparison. The results demonstrate no statistically significant difference in post-operative KSS across groups, and both groups exhibited considerable improvement in KSS following surgery.

Functional knee score (FKS)

The mean functional knee score in the simultaneous group was 38.64 in the pre-operative stage and 85.35 in the post-operative stage, whereas the mean functional knee score in the staged group was 37.145 in the pre-operative stage and 83.255 in the post-operative stage. Both groups had no statistically significant differences. The P value was more than 0.5.

DISCUSSION

For patients with bilateral knee osteoarthritis who opt for total knee arthroplasty (TKA), a decision must be made regarding whether to undergo the procedure in a single hospitalization and surgery or to split it into two separate admissions. This decision takes into consideration both the patient’s preferences and expectations, as well as the recommendations of their surgeons, considering any coexisting health conditions [5].

Hence, the surgeon must be well-informed about the potential risks associated with simultaneous bilateral knee replacement. Over the last two decades, the perioperative morbidity and mortality rates for patients undergoing simultaneous bilateral TKA have been a subject of debate [7].

Complications – Systemic complications

1. Pulmonary embolism :

Barrett et al. reported an 80% increased risk of PE within three months of concomitant surgery [1]. Conversely, certain studies indicated a higher incidence of deep vein thrombosis (DVT) and PE in patients undergoing one-sided TKA, contrasting with the simultaneous group [8].

However, a subsequent meta-analysis by Restrepo et al. produced contrasting outcomes [9]. Their investigation suggested a heightened risk of cardiac complications with simultaneous bilateral TKA, while DVT and PE risk did not exhibit significant disparities between groups [9].

Our study's findings align with those of Restrepo et al. While two cases of PE post-DVT occurred in the simultaneous TKA group (7.4%), statistical analysis revealed no substantial inter-group differences concerning DVT or PE. Notably, a potential reduction in DVT and PE rates was observed in patients receiving regional anaesthesia and epidural analgesia. Additionally, the advantageous role of low molecular weight heparin (LMWH) in venous thromboembolism prevention is recognized [10,11].

2. Pneumonia

Among our analyses, there were three cases of pneumonia (11%) in ASA 3 simultaneous bilateral patients. Because these patients had a history of chronic obstructive lung illness, they were at significant risk of pulmonary consequences.

3. Cardiac Complications

Yasuo et al.'s meta-analysis identified an increased risk of cardiac problems (odds ratio = 2.49) and death (odds ratio = 2.2) after simultaneous bilateral total knee arthroplasty (TKA) [4,12].

In our study, only one case of cardiac issues (3.7 percent) was found in the simultaneous group, and there were no reported deaths in either the simultaneous or staged groups.

4. Neurological Complications:

In our ongoing research, postoperative disorientation occurred more frequently in the simultaneous bilateral TKA group, with two cases compared to one

in the staged group. Factors contributing to the elevated risk (7.4 percent) in the simultaneous group include increased postoperative blood loss, greater analgesic requirements, heightened rates of hypoxaemia and anaemia, increased fluid transfusions, and potential electrolyte abnormalities.

Lane et al. indicated that intramedullary canal instrumentation during simultaneous TKA can lead to postoperative confusion due to the embolic load generated. Strategies to address this include over-drilling the femoral entry point and utilizing specialized rods [13].

Additionally, the insertion of alignment rods might amplify the fat embolic burden, particularly affecting simultaneous TKA cases, potentially explaining the heightened disorientation risk in this group [14-16].

Relationship Between Systemic Complications and ASA Score

ASA scores were employed to assess the link between systemic complications and overall health. Patient categorization into low-risk (ASA 1 and 2) and high-risk (ASA 3) groups revealed no significant difference in percentages between the simultaneous and staged bilateral TKA groups. Notably, high-risk patients undergoing simultaneous TKA experienced more complications than low-risk patients. The simultaneous group also exhibited a higher occurrence of systemic issues in high-risk patients compared to the staged group, while no notable disparity was found among low-risk patients.

According to Luscombe et al, co-morbidities were prevalent among ASA 3 patients in the simultaneous group, guiding anaesthetists in preoperative strategies [17,18].

Age-Related Relationship of Systemic Complications

Age's impact on total knee replacement outcomes was highlighted due to age-related comorbidities influencing surgical risk [19,20].

Notably, systemic complications were more prevalent in patients over 65 undergoing simultaneous bilateral TKA, with significant contrasts observed compared to those under 65. This underscores the role of patient age in surgical outcomes.

Studies by Lynch et al. and Bullock et al. emphasized diverse outcomes in elderly patients undergoing bilateral procedures. Age-related factors were linked to hypoxaemia and confusion related to fat emboli in findings by Urban et al. [21, 22].

Local Complications

Infections in skin and soft tissue showed no variations between STKA and StTKA. Concerns about

infection risks in simultaneous bilateral TKA due to extended operation times and shared instruments have been raised.

In this study, meticulous measures taken by the operating room staff, including separate instrument sets, contributed to the absence of increased infection risks in both bilateral groups.

Postoperative Bleeding

Postoperative blood loss showed no significant difference between the simultaneous and staged bilateral TKA groups, with averages of 1286 mL and 1302 mL respectively. Adequate intervention for simultaneous blood loss was stressed, including blood product availability and fluid replacement.

Notably, Gradillas and Volz reported varying total blood loss figures in different groups, while Stubbs et al. highlighted higher bleeding in simultaneous bilateral groups [23, 24].

Length of Hospital Stay

Simultaneous bilateral TKA offers a shorter hospital stay, reducing overall costs. While Gradillas and Volz found a 20% longer hospital stay in the simultaneous bilateral group, our study recorded an average stay of 7.5 days for simultaneous and 11.7 days for staged bilateral procedures [25].

Clinical Outcome

Early clinical outcomes over a 12-month follow-up showed no significant differences between simultaneous and staged groups. Postoperative Knee Society Scores (KSS) and Knee Functional Scores (KFS) showed minimal variation. Postoperative KSS was 80-95 (mean 86.80) in the simultaneous groups vs 82-94 (mean 85.79) in the staged groups.

Study limitations

Study limitations include the use of observational data, involvement of multiple surgeons, and a relatively small sample size. The analysis focused on patients with bilateral osteoarthritis who chose either simultaneous or staged TKA.

CONCLUSIONS

1. Simultaneous bilateral total knee arthroplasty (TKA) is considered safe and feasible mainly for younger individuals with ASA 1 or 2 health status.
2. Patients undergoing simultaneous bilateral TKA experience significantly reduced hospital stays.
3. The procedure may not be advisable for elderly patients at a higher risk of systemic complications.

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