

Original Research Article

OUTCOMES OF SINGLE-STAGED BILATERAL TOTAL KNEE REPLACEMENT

Ahmad Zeb¹, Awal Hakeem², Farmanullah Khan³, Qaiser Azeem⁴, Imdad Ullah⁵, Israr Khan⁶

¹Experiential Registrar, Department of Orthopedics, Khyber Teaching Hospital Peshawar, Pakistan

²Associate Professor, Department of Orthopedics, Khyber Teaching Hospital Peshawar, Pakistan

³Senior Registrar, Department of Orthopedics, Pak International Medical Collage Peshawar, Pakistan

⁴Assistant Professor, Department of Orthopedics, Khyber Teaching Hospital Peshawar, Pakistan

⁵Medical Officer, Khyber Teaching Hospital Peshawar, Pakistan

⁶Trainee Medical Officer, Khyber Teaching Hospital Peshawar, Pakistan

Received : 18/07/2026
Received in revised form : 22/09/2026
Accepted : 03/10/2026

Corresponding Author:

Dr. Farmanullah Khan,
Senior Registrar, Department of
Orthopedics, Pak International Medical
Collage Peshawar, Pakistan
Email: drfarmanullahkhan@gmail.com

DOI: 10.70034/ijmedph.2026.4.65

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (4); 446-451

ABSTRACT

Background: Bilateral knee osteoarthritis can produce substantial pain, restricted mobility, and functional disability. In some patients, the two knees can be replaced at the same time, in a single anesthetic and single hospital stay, called single-stage bilateral total knee replacement. This could reduce the total rehabilitation time, but the potential for perioperative blood loss, transfusion needs and post-operative complications are still a concern. The objective is to evaluate the clinical, functional, and perioperative outcomes of patients undergoing single-stage bilateral total knee replacement.

Materials and Methods: This descriptive prospective study was conducted in the Department of Orthopaedics, Khyber Teaching Hospital, Peshawar, from January 2024 to June 2026. There were 40 patients undergoing single-stage bilateral total knee replacement included. Demographic data, history of morbidity, duration of surgery, estimated blood loss, hemoglobin, need for transfusion, hospital stay and complications were noted. Functional outcome measures were the Visual Analogue Scale (VAS) for pain, knee range of motion and Knee Society Score (KSS). Preoperative and postoperative results were compared and a p-value of less than 0.05 was deemed statistically significant.

Results: The mean age of the patients was 63.7 ± 7.4 years, and 26 (65.0%) were female. The mean operative duration was 168.4 ± 21.6 minutes, while mean estimated blood loss was 615.3 ± 142.8 mL. Blood transfusion was required in 13 (32.5%) patients. Mean VAS pain score decreased significantly from 8.1 ± 1.0 preoperatively to 2.4 ± 1.1 postoperatively ($p < 0.001$). Mean knee range of motion improved from $87.6 \pm 12.5^\circ$ to $112.9 \pm 10.8^\circ$ ($p < 0.001$), while mean KSS increased from 42.8 ± 9.6 to 83.5 ± 8.7 ($p < 0.001$). Superficial surgical-site infection occurred in 3 (7.5%) patients and deep-vein thrombosis in 2 (5.0%). No pulmonary embolism, myocardial infarction, prosthetic joint infection, revision surgery, or mortality was observed.

Conclusion: Single-stage bilateral total knee replacement produced substantial improvement in pain, knee mobility, and functional status in appropriately selected patients. Although perioperative blood loss and transfusion requirements were notable, major complications were uncommon. Careful patient selection, perioperative optimization, thromboprophylaxis, and early rehabilitation remain important for achieving favorable outcomes.

Keywords: Bilateral knee osteoarthritis; bilateral total knee replacement; total knee arthroplasty; functional outcome; Knee Society Score; postoperative complications.

INTRODUCTION

Total knee arthroplasty (TKA) is an established surgical treatment for patients with advanced knee arthritis who continue to experience severe pain, progressive deformity, restricted movement, and functional impairment despite appropriate conservative management. Many patients that need arthroplasty have clinically significant disease in both knees. In these patients, it is possible to replace both joints either at the same time or as two staged procedures with a known time between operations. Single-stage bilateral TKA (SSBT) has gained growing popularity since it can treat bilateral disability during a single hospital stay and could possibly reduce the entire recovery period compared to staged surgery.^[1,2]

Single-stage bilateral TKA offers several potential practical and functional advantages. Both knees are treated in the same admission, eliminating the need to be exposed to anaesthetic for the second knee and to have a second stay in hospital and a second period of rehabilitation. There has also been some observational evidence of decreased cumulative hospital utilization and overall treatment burden. The functional recovery following simultaneous bilateral TKA can be remarkable, with significant improvement seen in the Knee Society Score, Oxford Knee Score, pain, walking ability, and postoperative range of motion.^[3,4] Recent analyses of the current perioperative pathways have also shown that good functional results can be obtained if the patient population is well selected and treated with a standardized surgical procedure and rehabilitation.^[5,6]

In spite of the possible advantages, performing bilateral TKA in a single session remains a topic of debate. Simultaneous surgery has more immediate physiological and surgical burden than unilateral/surgaged surgery. The issues of concern are increased blood loss in the perioperative period, postoperative anemia, need for allogeneic blood transfusion, venous thromboembolism, cardiopulmonary complications, and longer physiological stress in the postoperative period.^[3,7] The use of modern methods of blood conservation, such as tranexamic acid, reduction in transfusion thresholds, careful hemostasis, and not using any surgical drains, has significantly reduced transfusion needs in current bilateral arthroplasty practice.^[7,8]

Patient selection appears to be one of the most important determinants of safety. Adverse postoperative events may be more likely to occur in patients with cardiovascular disease and renal impairment, and in patients with multiple comorbidities and in higher American Society of Anesthesiologists classification. Modern research therefore focuses on thorough evaluation and optimization of the preoperative medical status prior to bilateral surgery at the same time.^[5,9] The introduction of enhanced recovery programs aimed at

reducing postoperative complications and optimizing early functional recovery through multimodal analgesia, mobilization, venous thromboembolism prophylaxis, structured physiotherapy and close postoperative monitoring has also led to a lower hospital stay and quicker functional recovery in selected patients with bilateral TKA.^[9,10]

There is recent comparative evidence that suggests the choice of simultaneous or staged bilateral TKA is a compromise between efficiency and peri-operative risk. The total operative exposure, cumulative hospital stay and requirement for two sequential episodes of rehabilitation may be reduced with simultaneous procedures, and a few large studies and meta-analyses have shown higher rates of transfusion and selected medical complications when compared to staged surgery.^[3,11] Meanwhile, long-term functional results seem to be fairly similar in the two approaches, provided that suitable candidates are chosen.^[4,11] Thus, assessment of local outcomes is essential as there is significant inter-institutional variability in patient characteristics, perioperative practices, rehabilitation facilities and the available healthcare resources. This study aimed to assess the clinical, peri-operative, functional and postoperative results of those undergoing single bilateral total knee replacement at Khyber Teaching Hospital, Peshawar.

MATERIALS AND METHODS

This descriptive prospective study was conducted in the Department of Orthopaedics, Khyber Teaching Hospital, Peshawar, from January 2024 to June 2026. A total of 40 patients undergoing single-staged bilateral total knee replacement were included in the study. Patients were enrolled after fulfillment of the predefined eligibility criteria. Ethical approval was obtained from the institutional ethical review committee before initiation of the study, and written informed consent was taken from all participants after explaining the nature, purpose, potential benefits, and possible risks of the procedure. Patient confidentiality was maintained throughout the study. Patients who were either adults or suffered from symptomatic bilateral knee arthritis and were scheduled for bilateral total knee replacements in the same operative session were eligible. Patients were included who had OA of both knees at a late stage or other knee condition that caused persistent pain, limited mobility and functional disability despite appropriate conservative treatment. Exclusion criteria were as follows: patients with active local or systemic infection, severe uncontrolled medical illness, advanced cardiopulmonary disease that was deemed unsuitable for prolonged anesthesia, severe renal or hepatic dysfunction, active deep-vein thrombosis, or contraindication to major orthopedic surgery. Pre-anesthetic assessment, detailed history, physical exam and radiological evaluation were done prior to surgery.

The baseline demographic and clinical data were collected on a structured data collection instrument. The variables analysed included age, gender, BMI, primary diagnosis, duration of knee symptoms, comorbidities, ASA classification, preoperative haemoglobin level, Visual Analogue Scale (VAS) pain score, knee range of motion, and Knee Society Score (KSS). Preoperative investigations were carried out routinely, these included complete blood count, renal function tests, liver function tests, coagulation profile, blood grouping and cross matching, electrocardiography and other investigations as per clinical condition of the patient. Both knee joints were radiographed to determine the extent of joint damage and for surgery planning.

Operative procedures for the single-stage bilateral total knee replacement were performed with the usual principles of surgery, and all patients were put to sleep at the same time. Prophylactic antibiotics were used before the incision of the skin was made. Generally, the more symptomatic knee was operated on first, with the contralateral knee operated on during the same time frame. The surgical exposure, bone preparation, positioning of components, trial, implantation of the components, hemostasis and wound closure were done. The duration of the operation and estimated blood loss during the operation were documented. Standardized analgesia and thromboprophylaxis, antibiotic prophylaxis, physiotherapy, and early mobilization were provided to patients after surgery, following the institutional protocol. Hemoglobin levels were followed and blood transfusion was given as per clinical indications.

During the postoperative period, patients were evaluated for the achievement of adequate pain and mobility, hospital stay, blood transfusion and early postoperative complications. Complications assessed included: surgical-site infection, surgical-site issues, pulmonary embolus, deep-vein thrombosis, hypotension following surgery, myocardial infarction, acute kidney injury, urinary tract infection, intensive care admission, reoperation, and

death. Functional outcome measures included VAS pain score, knee range of motion and Knee Society Score, which were compared to their preoperative values. Further, patient satisfaction, ambulatory status and need for walking assistance were recorded at follow-up.

IBM SPSS Statistics was used to enter and analyze data. The results for the continuous variables (age, BMI, operative time, blood loss, hemoglobin level, pain score, range of motion, Knee Society Score) were summarized as means $\pm$ SDs and for the categorical variables as frequencies and percentages. The paired-samples t-test or an appropriate non-parametric test was used to compare the preoperative and postoperative continuous outcome measures. The chi-square test or Fisher's exact test was used to compare categorical variables to postoperative complications. A p value < 0.05 was set as a cut-off for statistical significance.

RESULTS

A total of 40 patients underwent single-stage bilateral total knee replacement. The mean age of the participants was 63.7 ± 7.4 years, with an age range of 50–76 years. Females constituted the majority of the study population, accounting for 26 (65.0%) patients, while 14 (35.0%) were males. The mean body mass index (BMI) was 29.1 ± 3.8 kg/m². Osteoarthritis was the predominant indication for surgery, observed in 37 (92.5%) patients, whereas inflammatory arthritis was present in 3 (7.5%). Hypertension was the most common comorbidity, affecting 19 (47.5%) patients, followed by diabetes mellitus in 11 (27.5%) and ischemic heart disease in 4 (10.0%). Regarding preoperative anesthetic risk, 25 (62.5%) patients were classified as ASA class II, 10 (25.0%) as ASA class III, and 5 (12.5%) as ASA class I. The baseline demographic and clinical characteristics of the study participants are presented in [Table 1].

Table 1: Baseline demographic and clinical characteristics of patients (n=40)

Variable	Value
Age, years, mean $\pm$ SD	63.7 $\pm$ 7.4
Male	14 (35.0%)
Female	26 (65.0%)
BMI, kg/m ² , mean $\pm$ SD	29.1 $\pm$ 3.8
Osteoarthritis	37 (92.5%)
Inflammatory arthritis	3 (7.5%)
Hypertension	19 (47.5%)
Diabetes mellitus	11 (27.5%)
Ischemic heart disease	4 (10.0%)
ASA class I	5 (12.5%)
ASA class II	25 (62.5%)
ASA class III	10 (25.0%)

The mean duration of bilateral knee symptoms before surgery was 7.2 ± 3.1 years. The mean total operative time for bilateral knee replacement was 168.4 ± 21.6 minutes, while the estimated intraoperative blood

loss was 615.3 ± 142.8 mL. Mean hemoglobin decreased from 12.5 ± 1.3 g/dL preoperatively to 10.1 ± 1.2 g/dL postoperatively. Thirteen patients (32.5%) required perioperative blood transfusion. Early

mobilization was achieved in most patients, with 29 (72.5%) mobilized within the first 24 hours and the remaining 11 (27.5%) within 48 hours. The mean

duration of hospital stay was 5.8 ± 1.7 days. The operative and perioperative characteristics are summarized in [Table 2].

Table 2: Operative and perioperative characteristics

Variable	Value
Operative time, minutes, mean $\pm$ SD	168.4 $\pm$ 21.6
Estimated blood loss, mL, mean $\pm$ SD	615.3 $\pm$ 142.8
Preoperative hemoglobin, g/dL, mean $\pm$ SD	12.5 $\pm$ 1.3
Postoperative hemoglobin, g/dL, mean $\pm$ SD	10.1 $\pm$ 1.2
Patients requiring blood transfusion	13 (32.5%)
Mobilized within 24 hours	29 (72.5%)
Mobilized within 48 hours	11 (27.5%)
Hospital stay, days, mean $\pm$ SD	5.8 $\pm$ 1.7

Marked improvements were observed in pain, knee mobility, and functional status following surgery. The mean VAS pain score decreased from 8.1 ± 1.0 preoperatively to 2.4 ± 1.1 postoperatively, representing a statistically significant reduction ($p < 0.001$). Knee range of motion increased significantly from $87.6 \pm 12.5^\circ$ before surgery to $112.9 \pm 10.8^\circ$ at final follow-up ($p < 0.001$). Similarly, the mean Knee Society Score increased from $42.8 \pm$

9.6 preoperatively to 83.5 ± 8.7 postoperatively ($p < 0.001$), indicating substantial improvement in functional outcome. A statistically significant reduction in hemoglobin was also observed after surgery, from 12.5 ± 1.3 g/dL to 10.1 ± 1.2 g/dL ($p < 0.001$). The comparison of preoperative and postoperative clinical outcomes is shown in [Table 3].

Table 3: Comparison of preoperative and postoperative outcomes

Outcome	Preoperative	Postoperative	p-value
VAS pain score	8.1 ± 1.0	2.4 ± 1.1	<0.001
Knee range of motion, degrees	87.6 ± 12.5	112.9 ± 10.8	<0.001
Knee Society Score	42.8 ± 9.6	83.5 ± 8.7	<0.001
Hemoglobin, g/dL	12.5 ± 1.3	10.1 ± 1.2	<0.001

Table 4: Postoperative complications among study participants

Complication	n (%)
Superficial surgical-site infection	3 (7.5%)
Deep-vein thrombosis	2 (5.0%)
Acute kidney injury	1 (2.5%)
Postoperative hypotension	3 (7.5%)
Urinary tract infection	1 (2.5%)
Pulmonary embolism	0 (0.0%)
Myocardial infarction	0 (0.0%)
Prosthetic joint infection	0 (0.0%)
Reoperation	0 (0.0%)
Mortality	0 (0.0%)

Postoperative complications were relatively infrequent. Superficial surgical-site infection occurred in 3 (7.5%) patients and was managed with local wound care and antibiotics. Deep-vein thrombosis developed in 2 (5.0%) patients, while acute kidney injury occurred in 1 (2.5%). Postoperative hypotension was recorded in 3 (7.5%) patients, and urinary tract infection occurred in 1 (2.5%). Importantly, no cases of pulmonary embolism, myocardial infarction, prosthetic joint infection, reoperation, or in-hospital mortality were recorded. The distribution of postoperative complications is presented in [Table 4].

At the final follow-up, 34 (85.0%) patients were able to walk independently or with minimal assistance, whereas 6 (15.0%) continued to require a regular walking aid. Patient-reported satisfaction was favorable, with 32 (80.0%) patients reporting high satisfaction, 6 (15.0%) reporting moderate satisfaction, and 2 (5.0%) reporting limited satisfaction. No patient required revision surgery

during the follow-up period. The functional outcomes and patient satisfaction at final follow-up are summarized in [Table 5].

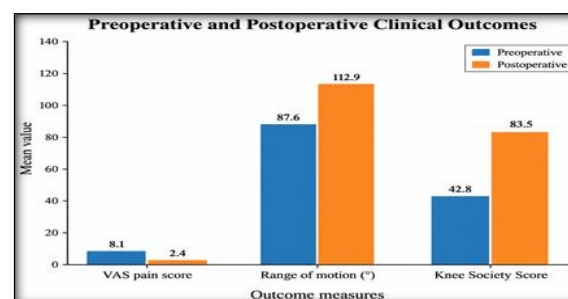


Figure 1: Comparison of preoperative and postoperative clinical outcomes in patients undergoing single-staged bilateral total knee replacement (n = 40). The graph shows a marked reduction in mean VAS pain score after surgery, along with improvement in mean knee range of motion and Knee Society Score, indicating better postoperative pain control and functional outcome.

Table 5: Functional outcomes at final follow-up

Outcome	n (%)
Independent/minimally assisted walking	34 (85.0%)
Regular walking aid required	6 (15.0%)
High patient	

DISCUSSION

The present study demonstrated substantial clinical and functional improvement following single-stage bilateral total knee replacement. Mean VAS pain score decreased from 8.1 ± 1.0 before surgery to 2.4 ± 1.1 postoperatively, while mean knee range of motion improved from $87.6 \pm 12.5^\circ$ to $112.9 \pm 10.8^\circ$. Similarly, the Knee Society Score increased markedly from 42.8 ± 9.6 to 83.5 ± 8.7 . These findings indicate that simultaneous bilateral knee replacement can provide considerable relief from pain together with meaningful restoration of joint mobility and functional capacity. Qadir et al. reported that both simultaneous and staged bilateral TKA produced substantial improvements in Knee Society Score, range of motion, Oxford Knee Score, and other functional measures, without an important difference in overall functional recovery between the two approaches.^[11] Makaram et al. also observed favorable functional outcomes following simultaneous bilateral TKA, although they emphasized that perioperative safety must be considered when selecting patients for this procedure.^[12]

Perioperative blood loss is still an important concern in the case of single-stage bilateral TKA. The mean estimated blood loss was 615.3 ± 142.8 mL and the mean hemoglobin was 12.5 ± 1.3 g/dL preoperatively and 10.1 ± 1.2 g/dL postoperatively. 13 patients (32.5%) needed transfusion. These results are in line with the previous studies indicating that transfusion remains a significant issue in the context of bilateral arthroplasty even after the development of blood-conservation measures. Chalmers et al. found that despite the use of tranexamic acid and restrictive transfusion guidelines, approximately 20% of patients receiving bilateral simultaneous TKAs were still transfused.^[13] D'Souza et al. concluded that there was a decrease in transfusion requirements and hospital stay with the use of tranexamic acid in simultaneous bilateral TKA.^[14] Similarly, Agarwala and Menon stressed on patient optimization with care and said that they had to adopt modern perioperative management to minimize blood loss and transfusion-related morbidity.^[15]

Postoperative complications in the present series were relatively uncommon. The superficial surgical-site infection rate was 7.5%, deep-vein thrombosis 5.0%, transient acute kidney injury 2.5%, and postoperative hypotension 7.5%. Significantly, there was no pulmonary embolism, myocardial infarction, prosthetic joint infection, reoperation, or mortality observed. In reviewing patients for simultaneous bilateral TKA, an appropriate selection criteria is important due to the potential for increased blood loss

and medical complications during the procedure compared to unilateral TKA, as emphasized in a Pakistan comparative study by Obaid-ur-Rahman et al.,^[16] Similarly, Bawazir et al. reported favourable clinical outcomes for simultaneous bilateral TKA in those undergoing surgery in an appropriate patient population, while medical comorbidities were found to be a significant factor in their experience.^[17] However, more recent, prospective, evidence has indicated that simultaneous bilateral replacement can be performed in carefully selected patients with advanced bilateral knee osteoarthritis with acceptable safety and functional results.^[18]

These results are in keeping with the functional advantages to treating both diseased knees during one surgical procedure. Of the patients mobilized in this study, 72.5% did so within 24 hours, and the mean hospital stay was 5.8 ± 1.7 days; at final follow-up, 85.0% were independent or required minimal assistance in walking. Moreover, 80.0% of the patients were very satisfied with the procedure. Modern systematic reviews show that ST-BTKA could shorten the global surgical times, hospital length of stay, and burden of the treatment when compared to a two-stage surgery. These benefits must be weighed against the risks of more transfusion and thromboembolic events and selected systemic complications, however. Bensa et al. reported decreased hospital and operative times with one-stage bilateral TKA, but also noted increased risks for DVT, PE, and mortality at specific follow-up time points compared with the two-stage procedure.^[19] A large recent meta-analysis also showed reduced overall costs and fewer reoperations for combined surgery, and increased transfusion requirements and some postoperative risks.^[20] These results strongly support the use of individual decision-making and not simultaneous bilateral surgery for all patients with bilateral knee disease.

There are certain limitations in the present study. It was performed at one tertiary care centre and only 40 patients were included, making it difficult to make statistical inferences and generalise the results. No staged bilateral TKA control group was available and, thus, direct comparisons of safety, hospitalization, cost, transfusion and long-term function were not available. Postoperative follow up was also short, and there was no evaluation for late complications including implant loosening, polyethylene wear, periprosthetic fracture or for long term revision. The study, however, gives local evidence of the perioperative and functional results of a bilateral knee replacement. Future prospective studies with larger numbers of patients, multi-center, with longer follow-up and direct comparison with staged bilateral TKA in a single prospective study

will be needed to determine which patients benefit most with an acceptable safety profile.

CONCLUSION

Single-stage bilateral total knee replacement resulted in marked reduction in pain and substantial improvement in knee range of motion and functional status among appropriately selected patients. Although postoperative reduction in hemoglobin and the requirement for blood transfusion were notable, major cardiopulmonary complications, prosthetic joint infection, revision surgery, and mortality were not observed in this cohort. Careful preoperative patient selection, correction of modifiable risk factors, effective blood-conservation measures, thromboprophylaxis, early mobilization, and structured rehabilitation are essential for achieving favorable outcomes. Larger comparative studies with longer follow-up are required to further define the long-term safety and effectiveness of this surgical approach.

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