

## SAFETY AND EFFECTIVENESS OF OUTPATIENT SIMULTANEOUS BILATERAL TOTAL KNEE ARTHROPLASTY: AN INDIAN EXPERIENCE

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### Abstract

**Background:** Outpatient total knee arthroplasty (OP TKA) is found to be beneficial to patients as well as the health care system. Studies on OP TKA have been limited to unilateral TKA. The aim of this study was to find out if simultaneous bilateral total knee arthroplasty (SBTKA) can also be safely and effectively performed in the outpatient setting in an Indian population. **Materials and Methods:** In this retrospective study, two propensity-matched cohorts of patients who underwent simultaneous bilateral TKA in the outpatient setting (OP SBTKA, n=50) and in the inpatient setting (IP SBTKA, n=50) between July 2021 to December 2022 were created. The complication rate, readmission, and ER visit rate were compared at 1-month and 3-month follow-ups. Functional outcomes using the Knee society score (KSS), and pain scores using the Visual analog scale (VAS) were compared at 1 month and 3 months. **Result:** We found a comparable complication rate (10% in the OP group versus 8% in the IP group), a comparable readmission rate (4% in OP versus 6% in IP), and a comparable ER visit without admission rate (6% in OP versus 2% in IP). All patients had comparable, excellent outcomes at 1-month and 3-month follow-ups ( $P<0.05$ ). None of the patients required reoperation or revision surgery. **Conclusion:** Outpatient SBTKA demonstrated similar functional outcome scores, complications, and readmission rates compared to inpatient SBTKA. Simultaneous bilateral OP TKA had comparable results to previous studies on unilateral OP TKA. The results from similar future studies can alleviate surgeon and patient concerns about outpatient TKA.

## INTRODUCTION

Total knee arthroplasty (TKA) has proven to be a successful, safe, and cost-effective treatment in the management of advanced osteoarthritis. The incidence of TKA is expected to increase by 143% between 2012 and 2050.<sup>[1]</sup> Thus, there is a need to manage resources in the most efficient way possible. Simultaneous bilateral TKA (SBTKA) and outpatient TKA (OP TKA) are two methods that have been increasingly popular in recent years, reported to come with no increased risk to safety in appropriately selected patients. OP TKA is defined as same calendar day discharge.<sup>[2]</sup> SBTKA is defined as bilateral TKA done on the same day under the same anesthesia.

Though the first case series of OP TKA was published in 2005,<sup>[3]</sup> surgeons were skeptical about the safety and outcomes. The last few years have seen a substantial increase in OP TKA in the Western world related to - the removal of TKA from the inpatient-only list in the Medicare and Medicaid

services in 2018, the pooling up of elective surgeries post-COVID-19 pandemic, and the rapidly evolving improvement in perioperative protocols.<sup>[4-6]</sup> In various studies, OP TKA when done in a well-selected group of patients has proved to be beneficial to both patients and health care systems in terms of fewer expenses and similar safety and functionality as compared to conventional arthroplasty.<sup>[7-16]</sup> With a population of 1.4 billion and a recent huge expansion in the private sector, there is an immense opportunity for the expansion of OP surgeries in India.<sup>[17]</sup> No data is available regarding the incidence, success, and safety of OP TKA in India.

Several studies have demonstrated SBTKA to be more cost-effective and with similar functional outcomes, and safety profile compared to unilateral arthroplasty.<sup>[18-20]</sup>

Combining SBTKA in the outpatient setting may be technically feasible, but we are not aware of any published literature regarding the safety and outcomes associated with outpatient simultaneous bilateral total knee arthroplasty (OP SBTKA). Given

the increased surgical time and prolonged recovery associated with SBTKA, it seems that this procedure would be challenging to perform in the outpatient setting.

Thus, the aim of this study was to compare the complications and early functional outcomes at 1 month and 3 months between SBTKA performed in the outpatient setting versus the inpatient setting in an Indian tertiary care hospital. Our hypothesis was that OP SBTKA would have similar complication rates and outcome scores compared to IP SBTKA.

## MATERIALS AND METHODS

After approval from the Institutional Review Board, we performed a retrospective cohort study of patients who had undergone SBTKA from 1 July 2021 to 31 December 2022 at our tertiary care center. We categorized discharge on the same calendar day (day 0) as outpatient TKA (OP TKA) and discharge on or after day 1 as inpatient TKA (IP TKA). Inclusion criteria for OP TKA were similar to that described by Gogineni et al i.e surgical factors (primary knee arthroplasty, first or second case of the day), medical factors (age <75 years, and body mass index (BMI) <35, American Society of Anesthesiologists (ASA) grade I/II, hemoglobin > 11 g/dl, exclusion of patients with uncontrolled diabetes, chronic obstructive pulmonary disease, congestive heart failure, cirrhosis, venous thromboembolism, spinal stenosis, benign prostate hyperplasia, coagulopathy, and chronic corticosteroid usage), and social factors (proximity to hospital, availability of a willing caregiver at home).<sup>[12]</sup>

For detecting a significant difference in Knee society score (KSS) with a 5% significance level and a power of 80%, a sample size of 40 cases was needed in each group. We included 50 patients who underwent bilateral TKA via the outpatient approach in the OP SBTKA group. OP SBTKA implied same calendar day discharge. One-to-one matching was done with a cohort of 50 bilateral TKA cases operated via conventional inpatient (IP SBTKA) approach according to age (within 5 years), body mass index (BMI), sex, Kellgren Lawrence (KL) grade of knee osteoarthritis, ASA score, and preoperative KSS. IP SBTKA included the patients who were discharged after 24 hours. The demographic data of each group after propensity matching is summarized in [Table 1]. The two groups were similar concerning medical comorbidities.

**Outpatient protocol:** We developed an enhanced recovery after surgery (ERAS) protocol in June 2020 through a consensus meeting involving the orthopedic surgeons, anesthesiologists, physiotherapists, and nursing staff. We evaluated our protocol on 200 inpatients for a period of 6 months gradually reducing the length of hospital stay before starting the outpatient program in January 2021. The outpatient protocol began with a pre-visit when patients were counseled regarding each phase of the procedure, the

potential risks, and the possible discomforts of going home on the same day. Preemptive analgesia included the use of gabapentin and cyclooxygenase-2 (COX- 2) inhibitors. The patient was kept nil by mouth from 12 midnight.

On the day of surgery, all patients got admitted early in the morning. Urinary catheterization was not done. All surgeries were performed by the same team of arthroplasty surgeons under a low dose of spinal anesthesia. All TKA were performed using a minimal invasive sub vastus approach. The same type of posterior-stabilized primary fixed-bearing prosthesis (PFC Sigma, Depuy Orthopedics, Warsaw, USA) was implanted with cement in each patient without patellar resurfacing. Each knee was injected with 50 ml of a cocktail containing 0.2% ropivacaine, 7.5 mg of morphine, and 40 mg of triamcinolone. Tourniquet usage was minimized by inflating just before cementing and deflating before closure. Standard layered wound closure was done after meticulous hemostasis was achieved. The second knee surgery was commenced while one surgeon closes the capsule of the first knee. Tranexamic acid 1g was given intravenously at induction and a further 1g was given as an intra-articular injection after the closure of the knee capsule. The suction drain was not used. Peripheral nerve blocks in the form of adductor canal block and the IPACK (infiltration between the popliteal artery and the capsule of the knee) block were given. Antibiotic prophylaxis included two doses of intravenous Cefuroxime.

Postoperative analgesia was modified as per the requirement of the patient which includes paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), and COX- 2 inhibitors. Postoperatively, all patients were shifted to the recovery room initially and were started on oral fluids 2 hours after the surgery, followed by a soft diet depending on the return of bowel motility. All patients were mobilized in the recovery room with the help of a walker.

Patients were discharged from the hospital on the same night before 8 pm if the following criteria were met - intraoperative blood loss < 500 ml, returned to the ward before 3 pm, mobilized safely with minimal pain, spontaneously urinated, had no clinical symptoms of anemia, tolerating oral intake, and had postoperative radiograph approved. In addition, standard discharge criteria of being able to get dressed independently, ability to get in and out of bed, ability to sit and rise from a chair/toilet seat, and independence in personal care were monitored. At the time of discharge, the patient's vital signs and condition were rechecked and confirmed to be stable. One nursing staff was provided to the patient at home for the next 48 hours. Physiotherapists monitored the rehabilitation program at home. Anticoagulation was maintained with Aspirin for 4 weeks. Patients were advised a hospital visit at 2 weeks for suture removal. Early follow-up and readmission were considered in case of any systemic ailment, pain out of proportion, induration, redness, or soakage. Outcome scores, and

complications if any were noted during the follow-up visits at 2 weeks, 1 month, and 3 months.

**Inpatient Protocol:** The patients were admitted one day prior and discharged around 3-5 days after surgery. Routine urinary catheterization was done. Tourniquet was used from the incision till the completion of cementing. The surgical procedure was similar to that in the OP protocol. Patients were shifted to the ward the next day morning and mobilized.

**Outcome Measures:** All major and minor complications were recorded by reviewing the medical files. Hospital readmissions, emergency room (ER) visits without admission, and reoperations within 3 months were recorded. The visual analog scale (VAS) score for pain, and Knee Society Score (KSS) were assessed at different follow-up points.

**Data Analyses:** Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 21 (IBM Corp., Armonk, New York, USA). Shapiro-Wilk tests confirmed the normal distribution of the data. The continuous variables were expressed in means  $\pm$  standard deviation (SD). The average values of both knees in bilateral TKA were used for evaluation. Differences in the continuous variables (age, body mass index, VAS, time to SLR, and KSS score) were compared by Student t-tests. The Chi-squared tests were used to compare non-parametric variables. The significance threshold was set at  $P < 0.05$ .

## RESULTS

### Complications, readmissions, and ER visits:

Overall, 4/50 (8%) of patients who underwent IP SBTKA had any complication in the postoperative period, compared to 5/50 (10%) of patients who underwent OP SBTKA. The 1-month readmission rate was 4% (2/50) in the OP group and 6% (3/50) in

the IP group. The reasons for readmission in the OP group were chest pain on day 3 in one patient that required a workup for myocardial infarction, which was negative, and a febrile episode unrelated to the surgery on day 15 in the other. In the IP group, one patient was admitted with a suspicion of deep vein thrombosis on day 6 which was ruled out by scans, one patient had knee swelling and pain on day 9, and the third one had a febrile episode on day 13. The number of patients who visited the ER but did not require admission during the first month was 6% (3/50) in the OP group (1 case of hematoma, and 2 cases of excess knee pain) and 2% (1/50) in the IP group (1 case of excess knee pain). There were no readmissions or ER visits after the first month. No patient in either group required revision surgery within the first 1, 3 months. There was no statistically significant difference between the groups in terms of complication rate, readmissions, and ER visits without admission ( $P > 0.05$ ). Only 1 patient in the IP group required a blood transfusion while none required a transfusion in the OP group. The incidence of specific complications, readmissions, and ER visits are detailed in [Table 4].

**Functional Outcomes:** There was no statistically significant difference between the two cohorts regarding pain scores (VAS) on the day of surgery or at other follow-up times. The IP and OP groups showed similar improvement in the pain score over time. The comparison of VAS scores was detailed in [Table 2].

The mean KSS significantly improved postoperatively in both groups, and all patients had excellent outcomes at 1 month and 3 months postoperative. The KSS at 2 weeks, 1 month, and 3 months showed no significant difference between the groups ( $P > 0.05$ ). Radiographic component alignment in all the cases at 3-month follow-up was acceptable. Table III gives details about the comparison of KSS between the groups.

**Table 1: Comparison of demographics of the two groups**

| Demographics        | OP SBTKA group (n=50)  | IP SBTKA group (n=50)  | P value |
|---------------------|------------------------|------------------------|---------|
| Mean age (range)    | 66.9 $\pm$ 7.1 (55-74) | 67.5 $\pm$ 8.3 (56-75) | 0.7     |
| Number of women (%) | 84                     | 86                     | 0.8     |
| Mean BMI (range)    | 28.7 $\pm$ 2.3 (24-35) | 29.1 $\pm$ 2.8 (24-35) | 0.5     |
| Mean ASA score      | 1.6 $\pm$ 0.2 (1-2)    | 1.7 $\pm$ 0.4 (1-2)    | 0.2     |
| Varus : Valgus (%)  | 90 : 10                | 88 : 12                | 0.7     |

OP SBTKA= Outpatient simultaneous bilateral total knee arthroplasty, IP SBTKA= Inpatient simultaneous bilateral total knee arthroplasty, ASA= American Society of Anesthesiologists, BMI= Body mass index

**Table 2: Comparison of the visual analog score (VAS) in the two groups**

| Parameter        | OP SBTKA group      | IP SBTKA group      | P value |
|------------------|---------------------|---------------------|---------|
| Mean VAS (range) |                     |                     |         |
| Pre-operative    | 6.5 $\pm$ 0.7 (6-8) | 6.7 $\pm$ 0.8 (6-9) | 0.2     |
| Postop day 1     | 4.3 $\pm$ 1.1 (2-6) | 4.6 $\pm$ 1.3 (2-6) | 0.2     |
| Postop day 2     | 3.8 $\pm$ 1.3 (2-6) | 4.0 $\pm$ 1.5 (2-6) | 0.5     |
| Postop day 7     | 3.4 $\pm$ 0.9 (1-5) | 3.3 $\pm$ 1.1 (1-5) | 0.6     |
| Postop 1 month   | 1.9 $\pm$ 0.7 (1-4) | 1.8 $\pm$ 1.1 (1-4) | 0.6     |
| Postop 3 months  | 1.2 $\pm$ 0.8 (0-3) | 1.3 $\pm$ 0.9 (0-3) | 0.5     |

OP SBTKA= Outpatient simultaneous bilateral total knee arthroplasty, IP SBTKA= Inpatient simultaneous bilateral total knee arthroplasty, VAS= Visual analog scale

**Table 3: Comparison of Knee Society Score (KSS) in the two groups**

| Parameter                         | OP SBTKA group | IP SBTKA group | P value |
|-----------------------------------|----------------|----------------|---------|
| Mean KSS Knee score (range)       |                |                |         |
| Pre-operative                     | 37±6 (30-45)   | 38±5 (30-45)   | 0.4     |
| Postop day 7                      | 65±4 (55-70)   | 63±7 (50-70)   | 0.1     |
| Postop day 14                     | 76±5 (60-85)   | 75±5 (60-80)   | 0.3     |
| Postop 1 month                    | 86±5 (75-90)   | 85±6 (70-90)   | 0.4     |
| Postop 3 months                   | 94±10 (80-98)  | 93±12 (80-99)  | 0.7     |
| Mean KSS Functional score (range) |                |                |         |
| Pre-operative                     | 45±4 (35-50)   | 44±5 (35-50)   | 0.3     |
| Postop day 7                      | 62±6 (55-70)   | 60±6 (50-70)   | 0.1     |
| Postop day 14                     | 73±7 (60-80)   | 72±6 (60-80)   | 0.5     |
| Postop 1 month                    | 81±9 (75-90)   | 80±10 (70-90)  | 0.6     |
| Postop 3 months                   | 89±12 (80-95)  | 88±13 (80-95)  | 0.7     |

OP SBTKA= Outpatient simultaneous bilateral total knee arthroplasty, IP SBTKA= Inpatient simultaneous bilateral total knee arthroplasty, KSS= Knee society score

**Table 4: Comparison of complications between the groups**

| Parameter                             | OP SBTKA group | IP SBTKA group | P value |
|---------------------------------------|----------------|----------------|---------|
| Total complications (%)               | 5 (10%)        | 4 (8%)         | 0.7     |
| Major complications (%)               | 0              | 1 (2%)         | 0.5     |
| Venous thromboembolism                | 0              | 1              |         |
| Minor complications (%)               | 5 (10%)        | 3 (6%)         | 0.5     |
| Chest pain                            | 1              | 0              |         |
| Excess pain in the surgical site      | 2              | 1              |         |
| Fever                                 | 1              | 1              |         |
| Hematoma in surgical site             | 1              | 0              |         |
| Knee swelling                         | 0              | 1              |         |
| Blood transfusion requirement (%)     | 0              | 1 (2%)         | 0.5     |
| 30-day readmissions (%)               | 2 (4%)         | 3 (6%)         | 0.6     |
| 30-day ER visit without admission (%) | 3 (6%)         | 1 (2%)         | 0.3     |

OP SBTKA= Outpatient simultaneous bilateral total knee arthroplasty, IP SBTKA= Inpatient simultaneous bilateral total knee arthroplasty, ER= Emergency room

## DISCUSSION

The results of the study confirm our hypothesis that the complication rates and functional outcomes would be similar between the OP and IP SBTKA groups in properly selected patients. There are no studies in the literature comparing OP SBTKA versus IP SBTKA procedures. Thus, we compared our results with OP unilateral TKA studies.

To avoid the increase in perioperative medical burden, patients at low risk for complications and readmissions should be selected based on validated criteria. We used the criteria described by Gogineni et al for the inclusion and exclusion of patients into the OP TKA group.<sup>[12]</sup> We followed the criteria used by Gromov et al to ascertain which patients can be discharged on the same day.<sup>[13]</sup> Courtney et al and Gromov et al suggested a broader inclusion of patients in outpatient surgery after reporting the feasibility and safety of OP TKA even in unselected patient cohorts with appropriate education and preparation.<sup>[9,13]</sup>

We utilized the ERAS protocol which is a multimodal perioperative approach that improves patient outcomes and recovery.<sup>[21]</sup> Short-acting neuraxial anesthesia, quadriceps-sparing minimally invasive subvastus approach, opioid-sparing pain control measures, the absence of urinary catheters, and surgical drains made mobilization easier and more independent.<sup>[22]</sup> Using a tourniquet sparingly

and at appropriate pressures is associated with decreased post-operative pain.<sup>[23]</sup> Patients who received nerve blocks and periarticular cocktail injections had lower pain scores, lower opioid intakes, higher ranges of movement at 24 hours, and a shorter length of stay (LOS) in many studies.<sup>[24]</sup> Hypotensive anesthesia, clean surgical technique, reduced tourniquet time, thermocautery of all bleeders before closure, refraining from drain usage, and the perioperative use of tranexamic acid minimized blood loss and the need for postoperative transfusion.<sup>[25]</sup>

Published studies have presented conflicting results regarding postoperative complications. Pollock et al, Gauthier-Kwan et al, Hoffmann et al, Gogineni et al, Jaibaji et al, and Springer et al have reported comparable complication rates in OP versus IP TKA.<sup>[8,10-12,26,33]</sup> Courtney et al. found a significantly lower overall complication rate for outpatient vs inpatient procedures (8% vs 16%).<sup>[9]</sup> However, some studies have found increased complication rates when comparing OP with IP TKA. Liu et al. found higher pulmonary and cardiac complications in the OP group.<sup>[27]</sup> Arshi et al. found a higher risk of component failure, surgical site infection, knee stiffness, acute renal failure, and deep vein thrombosis.<sup>[28]</sup> A systematic review by Bordoni et al. reported a complication rate of 16% for OP TKA compared to 11% for IP TKA.<sup>[29]</sup> Lovecchio et al also reported a higher complication rate of 6% in the OP

group versus 1% in the IP group.<sup>[30]</sup> Our study had an 8% complication rate in the OP SBTKA group, all being minor complications.

Reported readmission and ER visit rates at 1 month and 3 months also vary across studies. Studies by Hoffmann et al, Gromov et al, Lovecchio et al, and Lan et al reported comparable low readmissions between OP and IP TKA groups.<sup>[11,30-32]</sup> Springer et al reported an increased readmission rate (12%) among the OP group.<sup>[33]</sup> Our study had a 4% readmission rate and a 6% ER visit rate for the OP group. Courtney et al, Husted et al, Huang et al, and Lovald et al found OP TKA to have reduced the cost significantly, saving between \$4000 to \$8000 per case because of fewer hospital stays, low complications, and readmissions.<sup>[9,14,16]</sup>

In our study, pain scores in the first 7 days after surgery, where the pain is maximum pronounced, did not differ significantly between the groups. The VAS scores at 1 month and 3 months also were comparable between the groups. These findings are consistent with the studies by Gauthier-Kwan et al, Hoffmann et al, and Husted et al.<sup>[10,11,34]</sup> Multimodal pain management at different time points, targeting different pathways for a synergistic effect has led to low pain scores postoperatively.<sup>[24,35,36]</sup>

Patient-reported outcomes measured using Knee Society Score (KSS) were similar between the groups at 1-month and 3-month follow-up periods, suggesting that the outcome scores are not affected by discharging on the same day. Patient education and a well-coordinated physiotherapy program at home resulted in good outcomes. Studies by Gauthier-Kwan et al, Crawford et al, and Husted et al reported good outcomes and satisfaction scores following OP TKA comparable to that of IP TKA.<sup>[10,15,34]</sup>

All the results in our present study on simultaneous bilateral OP TKA were comparable to the results of studies in unilateral OP TKA. This is consistent with the studies proving bilateral TKA to be as safe and effective as unilateral TKA in properly selected patients.<sup>[18-20]</sup>

With the demand for primary total knee arthroplasties estimated to grow exponentially, the demand for OP SBTKA will have a similarly increased growth potential, provided the safety of these surgeries is well-studied. Currently, 5-10% of all TKAs worldwide are performed on an outpatient basis.<sup>[37]</sup> In India, outpatient knee arthroplasty is still in relative infancy, the results of our study should continue to be used as a comparison in the context of future studies that may be performed on this topic.

One of the major limitations of this study is its retrospective design. However, accurately matching the two cohorts reduced the effects of potential confounding variables. The generalizability of this study may be limited by the strict inclusion criteria and all surgeries being performed at a single center. The sample size is small and future studies with large cohorts are needed. Formal quadriceps strength testing was not performed to compare the cohorts.

One possible explanation for our observation of reduced complications in OP TKA patients is the lower monitoring of vitals and laboratory testing postoperatively while the inpatients undergo more monitoring and elaborate treatments. The follow-up period studied is limited to 3 months. Long-term follow-up studies are needed for tracking late complications and assessing outcomes between the groups.

## CONCLUSION

Outpatient SBTKA demonstrated similar functional outcome scores, complications, and readmission rates compared to inpatient SBTKA in properly selected patients. Our study on simultaneous bilateral OP TKA had comparable results to previous studies on unilateral OP TKA. The results from similar future studies can alleviate surgeon and patient concerns about outpatient TKA.

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