

# Incidence of Deep Vein Thrombosis Following Staged Bilateral and Simultaneous Bilateral Total Knee Arthroplasty

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## Abstract

**Background:** The present study aimed at determining the incidence of deep venous thrombosis (DVT) in 2 groups of patients who underwent simultaneous bilateral total knee arthroplasty (BTKA) or staged bilateral TKA.

**Methods:** Patients with bilateral knee osteoarthritis, who were candidates for BTKA, were divided into 2 groups of patients undergoing either simultaneous bilateral or staged TKA. Incidence of DVT was measured during a 38-month follow-up period and compared between the 2 groups.

**Results:** Finally, 120 patients with a mean age of  $68.2 \pm 2.3$  years were enrolled (65% male). Baseline and demographic data of the 2 groups were not statistically significant ( $P > 0.05$ ). During the 38-month follow-up, DVT occurred in 2 patients (3.3%) in the staged BTKA group. The incidence of DVT in the 2 studied groups was significantly different ( $P = 0.12$ ).

**Conclusions:** It seems that performing same-day bilateral TKA does not have higher rates of DVT, when compared to those patients who underwent staged bilateral procedure. Simultaneous bilateral TKA can be a better choice for managing patients who need bilateral osteoarthritis surgery because of the significant reduction of hospital stay using this method.

**Keywords:** Total Knee Arthroplasty, Deep Vein Thrombosis, Osteoarthritis, Treatment Outcome, Orthopedic Surgery

## 1. Background

Total knee arthroplasty (TKA) is among the most common orthopedic surgeries (1). Indication for TKA is degenerative diseases like severe osteoarthritis (OA), which is commonly manifested with bilateral knee joint pain and deformity. It is well accepted that TKA can lead to excellent long-term outcomes in such patients (2, 3). Bilateral TKA (BTKA) may be needed occasionally, and its rate is about 4% to 7% of all TKA cases (4, 5). Surgical intervention in patients requiring BTKA can be done as a simultaneous bilateral procedure or in a staged bilateral fashion. Some have claimed that staged BTKA is associated with double pathophysiologic insults that increase the risks of mortality and morbidity (6-11). However, whether simultaneous BTKA or two-staged unilateral TKA carry higher risks, remains controversial, and a matter of debate. Most previous studies have focused on the outcome of unilateral TKA, and data regarding bilateral TKA are limited (12-14).

## 2. Objectives

The present study compared the incidence of deep venous thrombosis (DVT) in 2 groups of patients who under-

went simultaneous BTKA and staged BTKA, to determine which one carries a lower risk of DVT; one of the postoperative complications of TKA.

## 3. Methods

### 3.1. Study Design

This was a prospective cohort study conducted from 2013 and 2015 at Imam Hussein hospital, Tehran, Iran. The protocol of the study was approved by the institutional review board and the ethical committee of Shahid Beheshti University of Medical Sciences. All participants provided written informed consent. All investigators adhered to the Declaration of Helsinki principles.

### 3.2. Participants

The study population consisted of patients with bilateral knee OA candidates for TKA surgery. Patients were aged above 40 years, and had symptoms in both knees to warrant BTKA. The inclusion criterion was bilateral OA exceeding grade III based on the Kellgren and Lawrence classification (15) including primary OA and secondary OA, resulting from osteonecrosis.

Patients with a history of previous surgery including orthopedic surgery within 6 months, previous DVT or PTE, malignant neoplasm, hospitalization within 6 months, trauma, receiving anticoagulation therapy, bed-ridden, family history of thrombophilia, on hormone replacement therapy, pregnancy, lactation, and women taking oral contraceptives were excluded. Using the permuted block randomization method, we randomized 120 eligible patients into 2 equal groups of 60 to undergo simultaneous or staged BTKA. Both groups were carefully matched for baseline characteristics including age, gender, comorbidities, diagnosis, anesthetic method, and type of prosthesis.

### 3.3. Intervention

The simultaneous BTKA group included patients who underwent BTKA under a single anesthesia between July 2013 and December 2014. In another group, the first stage of the TKAs was performed between July 2013 and January 2014, while the second stage of the TKAs was done between October 2013 and September 2014. The mean interval between the 2 stages was  $3.1 \pm 0.4$  months (range: 2.5 - 4 months).

All patients underwent surgery under general anesthesia. All operations in both groups were performed by the same surgeon, who used minimally invasive techniques through a minisubvastus approach under tourniquet control. The implant used was a posterior-stabilized prosthesis. Conventional preoperative planning by alignment view was done for all patients and all bone cuts were performed according to the planning data. For simultaneous BTKA, the same surgeon operated on each knee in a sequential fashion, proceeding with the second TKA after wound closure and tourniquet deflation of the first TKA.

The protocol of DVT prophylaxis with LMWH (clexane) was administered for all patients. They received thromboprophylaxis with 40 mg of clexane (SC) once a day from the postoperative day for 2 weeks. Early postoperative exercises were considered as well, which were performed under the supervision of a physical therapist and consisted of physical exercises including isometric exercises, range of motion and muscle strengthening exercises, and early walking. No one used any type of brace, and Jones bandage was placed in the recovery room for all patients. To prevent the excess edema, ice pack was used intermittently. Isometric exercises including quadriceps sets and ankle pump were started at the day of the surgery, and range of motion exercises were added the day after the operation. Early walking was encouraged and facilitated with the use of crutches or walkers.

### 3.4. Outcome Assessment

Preoperative Doppler ultrasonography (DUS) was performed in all patients. To diagnose possible DVT, DUS was repeated between 14th and 21st postoperative day. Warfarin was administered orally to patients with DUS-confirmed DVT and continued for 3 months. The incidence of DVT was assessed at a mean of 38-month follow-up (range: 24 to 51 months).

### 3.5. Statistical Analysis

All statistical analyses were performed using Stat View-J Version 5.0 software (SAS Institute, Cary, NC, USA). Mann-Whitney test was used for continuous variables, and the  $\chi^2$  or Fisher's exact test was utilized for categorical findings. P value less than 0.05 was considered statistically significant.

## 4. Results

There were 120 patients with the mean age of  $68.2 \pm 2.3$  years enrolled (65% male). Demographic and baseline characteristics of the patients are presented in Table 1. No significant difference was found between the 2 groups in demographic features.

**Table 1.** Demographic and Baseline Characteristics of Studied Patients (N = 60)<sup>a</sup>

Variables	Staged BTKA	Simultaneous BTKA	P Value <sup>b</sup>
Age, y	$67.8 \pm 1.1$	$68.5 \pm 3.2$	0.74
Sex, male/female	40/20	38/22	0.68
Body mass index	$28 \pm 8.1$	$29 \pm 1.2$	0.54
Knee score	$49 \pm 2.1$	$48 \pm 8.2$	0.87
Function score	$50 \pm 2.3$	$51 \pm 3.4$	0.76
FIA, degrees	$181.2 \pm 5.2$	$180.1 \pm 7.7$	0.64

Abbreviations: BTKA, Bilateral Total Knee Arthroplasty; FIA, Femorotibial Angle.

<sup>a</sup>Values are given as mean  $\pm$  standard deviation (SD).

<sup>b</sup>P values are calculated using one-factor analysis of variance.

During the follow-up period, 2 patients (3.3%) from the staged BTKA group referred to the emergency department with complaint of acute pain in their right leg. In one patient, DVT diagnosis was confirmed by DUS; and in the other, DVT was diagnosed with history taking and clinical examination during the patient's management. After DVT diagnosis, patients were admitted to hospital and discharged after proper management.

Table 2 demonstrates the comparison of DVT occurrence in the 2 studied groups. There was a higher but not significant incidence of DVT in simultaneous BTKA group compared with staged BTKA group. Also, there was no mortality during the follow-up period.

**Table 2.** Comparison of DVT Occurrence in Two Studied Groups (N = 60)

Variable	Staged BTKA	Simultaneous BTKA	P Value <sup>a</sup>
DVT occurrence, No. (%)	2 (3)	0 (0)	0.12

Abbreviation: BTKA, Bilateral Total Knee Arthroplasty.

<sup>a</sup>P value was calculated using one-factor analysis of variance.

## 5. Discussion

Based on the findings of the current study, performing simultaneous BTKA did not lead to higher rates of DVT occurrence, when compared with staged BTKA with a 3 month interval.

It was reported that the rate of advanced degenerative disease, especially osteoarthritis, was increasing. Unfortunately, one third of such patients referred with bilateral symptoms, and most of them required BTKA that is now well accepted as a proper intervention for pain relief and functional restoration (16).

Whether simultaneous TKA or two-staged unilateral TKA carries higher risks, still remains controversial. However, the consensus that has emerged is that there is a higher risk of complications following bilateral knee replacements than unilateral surgery. Thus, the present study aimed at comparing the incidence of DVT as one of the TKA complications in patients with bilateral OA who underwent bilateral TKA and staged bilateral TKA. The relative safety of performing simultaneous BTKA, compared to unilateral procedure, has been the subject of numerous studies. In several studies, an increase in 90-day mortality was associated with same day bilateral procedures in patients with known cardiac disease (13, 17-19).

Our findings are in accordance with those of other studies that showed no difference in the occurrence of the thromboembolic events between the 2 groups (20, 21). Luscombe et al. conducted a study to compare the thromboembolic risk of bilateral same anesthetic simultaneous knee replacements (BSATKR) with unilateral knee replacements and found no significant difference (22). Moreover, Courtney et al. conducted a study to determine the occurrence of thromboembolic events in patients with bilateral knee osteoarthritis selected more staged unilateral TKA compared to those who had simultaneous bilateral surgery. They also found no difference between the groups in DVT occurrence (23). In a retrospective study, Liu et al. showed that DVT incidence was not significant in patients who underwent staged BTKA with staging 1 to 3 days apart during the same hospital admission with patients who underwent simultaneous BTKA (24).

Conversely, some studies reported that staged BTKA

has a greater propensity for occurrence of venous thrombotic events than the simultaneous BTKA (13, 17).

Low incidence of DVT in our study might have been due to type of anesthesia, use of LMWH, and early mobilization for all patients during and after surgery.

### 5.1. Limitations and Implications for Future Researches

According to published literatures and general medical knowledge, during 2 stage operation of knees, morbidity could be higher. However, it was found to be advantageous in the current study. Conducting similar studies with more patients and longer follow-up are needed.

### 5.2. Conclusion

The findings of the present study suggest that performing same-day bilateral TKA does not have higher rates of DVT when compared to the patients who had staged bilateral procedures within 3 months. We conclude that bilateral TKA can be favorable for bilateral osteoarthritis because of its advantages, and significant reduction in hospital stay expenses and less complications.

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## References

1. Memtsoudis SG, Gonzalez Della Valle A, Besculides MC, Gaber L, Sculco TP. In-hospital complications and mortality of unilateral, bilateral, and revision TKA: based on an estimate of 4,159,661 discharges. *Clin Orthop Relat Res.* 2008;466(11):2617-27. doi: [10.1007/s11999-008-0402-5](https://doi.org/10.1007/s11999-008-0402-5). [PubMed: 18704616].
2. Kelly MA, Clarke HD. Long-term results of posterior cruciate-substituting total knee arthroplasty. *Clin Orthop Relat Res.* 2002(404):51-7. doi: [10.1097/00003086-200211000-00009](https://doi.org/10.1097/00003086-200211000-00009). [PubMed: 12439237].
3. Worland RL, Johnson GV, Alemparte J, Jessup DE, Keenan J, Norambuena N. Ten to fourteen year survival and functional analysis of the AGC total knee replacement system. *Knee.* 2002;9(2):133-7. doi: [10.1016/S0968-0160\(01\)00146-6](https://doi.org/10.1016/S0968-0160(01)00146-6). [PubMed: 11950577].

4. Surgeons AAoO. Primary total hip and total knee arthroplasty projections to 2030. *American Academy of Orthopaedic Surgeons*. 2002.
5. Levit K, Wier L, Stranges E, Elixhauser A. 2009.
6. Restrepo C, Parvizi J, Dietrich T, Einhorn TA. Safety of simultaneous bilateral total knee arthroplasty. A meta-analysis. *J Bone Joint Surg Am*. 2007;**89**(6):1220-6. doi: [10.2106/JBJS.F.01353](https://doi.org/10.2106/JBJS.F.01353). [PubMed: [17545424](https://pubmed.ncbi.nlm.nih.gov/17545424/)].
7. Memtsoudis SG, Ma Y, Gonzalez Della Valle A, Mazumdar M, Gaber-Baylis LK, MacKenzie CR, et al. Perioperative outcomes after unilateral and bilateral total knee arthroplasty. *Anesthesiology*. 2009;**111**(6):1206-16. doi: [10.1097/ALN.0b013e3181bfab7d](https://doi.org/10.1097/ALN.0b013e3181bfab7d). [PubMed: [19934863](https://pubmed.ncbi.nlm.nih.gov/19934863/)].
8. Memtsoudis SG, Hargett M, Russell LA, Parvizi J, Cats-Baril WL, Stundner O, et al. Consensus statement from the consensus conference on bilateral total knee arthroplasty group. *Clin Orthop Relat Res*. 2013;**471**(8):2649-57. doi: [10.1007/s11999-013-2976-9](https://doi.org/10.1007/s11999-013-2976-9). [PubMed: [23564364](https://pubmed.ncbi.nlm.nih.gov/23564364/)].
9. Memtsoudis SG, Starcher B, Gonzalez Della Valle A, Ma Y, Jules-Elysee K, Sculco TP. Urine desmosine as a marker of lung injury following total knee arthroplasty. A pilot study. *HSS J*. 2009;**5**(2):154-8. doi: [10.1007/s11420-009-9116-9](https://doi.org/10.1007/s11420-009-9116-9). [PubMed: [19521737](https://pubmed.ncbi.nlm.nih.gov/19521737/)].
10. Memtsoudis SG, Salvati EA, Go G, Ma Y, Sharrock NE. Perioperative pulmonary circulatory changes during bilateral total hip arthroplasty under regional anesthesia. *Reg Anesth Pain Med*. 2010;**35**(5):417-21. doi: [10.1097/AAP.0b013e3181e85a07](https://doi.org/10.1097/AAP.0b013e3181e85a07). [PubMed: [20814281](https://pubmed.ncbi.nlm.nih.gov/20814281/)].
11. Gurunathan U. Perioperative considerations of bilateral total knee replacement: a review. *J Clin Anesth*. 2013;**25**(3):232-9. doi: [10.1016/j.jclinane.2013.01.001](https://doi.org/10.1016/j.jclinane.2013.01.001). [PubMed: [23558311](https://pubmed.ncbi.nlm.nih.gov/23558311/)].
12. Adili A, Bhandari M, Petrucci D, De Beer J. Sequential bilateral total knee arthroplasty under 1 anesthetic in patients > or = 75 years old: complications and functional outcomes. *J Arthroplasty*. 2001;**16**(3):271-8. doi: [10.1054/arth.2001.21495](https://doi.org/10.1054/arth.2001.21495). [PubMed: [11307122](https://pubmed.ncbi.nlm.nih.gov/11307122/)].
13. Bullock DP, Sporer SM, Shirreffs TJ. Comparison of simultaneous bilateral with unilateral total knee arthroplasty in terms of perioperative complications. *J Bone Joint Surg Am*. 2003;**85-A**(10):1981-6. doi: [10.2106/00004623-200310000-00018](https://doi.org/10.2106/00004623-200310000-00018). [PubMed: [14563808](https://pubmed.ncbi.nlm.nih.gov/14563808/)].
14. Bederman SS, Betsy M, Winiarsky R, Seldes RM, Sharrock NE, Sculco TP. Postoperative ileus in the lower extremity arthroplasty patient. *J Arthroplasty*. 2001;**16**(8):1066-70. doi: [10.1054/arth.2001.27675](https://doi.org/10.1054/arth.2001.27675). [PubMed: [11740765](https://pubmed.ncbi.nlm.nih.gov/11740765/)].
15. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthritis. *Ann Rheum Dis*. 1957;**16**(4):494-502. doi: [10.1136/ard.16.4.494](https://doi.org/10.1136/ard.16.4.494). [PubMed: [13498604](https://pubmed.ncbi.nlm.nih.gov/13498604/)].
16. Showery JE, Kusnezov NA, Dunn JC, Bader JO, Belmont PJ, Waterman BR. The Rising Incidence of Degenerative and Posttraumatic Osteoarthritis of the Knee in the United States Military. *J Arthroplasty*. 2016;**31**(10):2108-14. doi: [10.1016/j.arth.2016.03.026](https://doi.org/10.1016/j.arth.2016.03.026). [PubMed: [27181491](https://pubmed.ncbi.nlm.nih.gov/27181491/)].
17. Leonard L, Williamson DM, Ivory JP, Jennison C. An evaluation of the safety and efficacy of simultaneous bilateral total knee arthroplasty. *J Arthroplasty*. 2003;**18**(8):972-8. doi: [10.1016/S0883-5403\(03\)00282-1](https://doi.org/10.1016/S0883-5403(03)00282-1). [PubMed: [14658100](https://pubmed.ncbi.nlm.nih.gov/14658100/)].
18. Ritter MA, Harty LD, Davis KE, Meding JB, Berend M. Simultaneous bilateral, staged bilateral, and unilateral total knee arthroplasty. A survival analysis. *J Bone Joint Surg Am*. 2003;**85-A**(8):1532-7. doi: [10.2106/00004623-200308000-00015](https://doi.org/10.2106/00004623-200308000-00015). [PubMed: [12925634](https://pubmed.ncbi.nlm.nih.gov/12925634/)].
19. Parvizi J, Sullivan TA, Trousdale RT, Lewallen DG. Thirty-day mortality after total knee arthroplasty. *J Bone Joint Surg Am*. 2001;**83-A**(8):1157-61. doi: [10.2106/00004623-200108000-00004](https://doi.org/10.2106/00004623-200108000-00004). [PubMed: [11507123](https://pubmed.ncbi.nlm.nih.gov/11507123/)].
20. Yoon HS, Han CD, Yang IH. Comparison of simultaneous bilateral and staged bilateral total knee arthroplasty in terms of perioperative complications. *J Arthroplasty*. 2010;**25**(2):179-85. doi: [10.1016/j.arth.2008.11.103](https://doi.org/10.1016/j.arth.2008.11.103). [PubMed: [19195827](https://pubmed.ncbi.nlm.nih.gov/19195827/)].
21. Bini SA, Khatod M, Inacio MC, Paxton EW. Same-day versus staged bilateral total knee arthroplasty poses no increase in complications in 6672 primary procedures. *J Arthroplasty*. 2014;**29**(4):694-7. doi: [10.1016/j.arth.2012.09.009](https://doi.org/10.1016/j.arth.2012.09.009). [PubMed: [24360340](https://pubmed.ncbi.nlm.nih.gov/24360340/)].
22. Luscombe JC, Theivendran K, Abudu A, Carter SR. The relative safety of one-stage bilateral total knee arthroplasty. *Int Orthop*. 2009;**33**(1):101-4. doi: [10.1007/s00264-007-0447-1](https://doi.org/10.1007/s00264-007-0447-1). [PubMed: [17874240](https://pubmed.ncbi.nlm.nih.gov/17874240/)].
23. Courtney PM, Melnic CM, Alosch H, Shah RP, Nelson CL, Israelite CL. Is bilateral total knee arthroplasty staged at a one-week interval safe? A matched case control study. *J Arthroplasty*. 2014;**29**(10):1946-9. doi: [10.1016/j.arth.2014.05.004](https://doi.org/10.1016/j.arth.2014.05.004). [PubMed: [24953946](https://pubmed.ncbi.nlm.nih.gov/24953946/)].
24. Liu J, Elkassabany N, Poultsides L, Nelson CL, Memtsoudis SG. Staging Bilateral Total Knee Arthroplasty During the Same Hospitalization: The Impact of Timing. *J Arthroplasty*. 2015;**30**(7):1172-6. doi: [10.1016/j.arth.2015.02.006](https://doi.org/10.1016/j.arth.2015.02.006). [PubMed: [25724110](https://pubmed.ncbi.nlm.nih.gov/25724110/)].