International Journal of Research in Orthopaedics
Shamseer KV et al. Int J Res Orthop. 2025 Jul;11(4):733-740
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20251792

Original Research Article

Comparison of the patients undergoing total knee arthroplasty with and without drain in terms of functional outcome, hemoglobin drop and infection rate

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Received: 11 March 2025
Revised: 21 May 2025
Accepted: 28 May 2025

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ABSTRACT

Background: There is still no consensus about use of post-op drain in TKA. We compared postoperative outcomes of TKA with drain and without drain in terms of hemoglobin drop, functional outcome and infection.
Methods: An observational cohort study was conducted at a tertiary hospital between March 2023, and March 2024. Men and women with primary OA knee and age more than 40 years were included. Patients on antiplatelets, with acute and active infection, revision TKA, malignancy were excluded.
Results: 90 patients were included age range 50-80 years. Males to female ratio was 74.4:25.6. Of 90 patients, 45 (50%) received a drain. The drain group had greater hemoglobin drops. There was no statistically significant difference in functional outcome by KOOS score and WOMAC score in both groups. There was no significant difference in occurrence of infection in both groups.
Conclusions: This comparative study aimed to assess the outcomes of total knee arthroplasty (TKA) with and without drain insertion, focusing on hemoglobin drop, functional outcomes measured by (KOOS) and (WOMAC) scores, and infection rates. In conclusion, my study supports reconsidering routine drain use in TKA procedures, as omitting drains was associated with a notable reduction in hemoglobin drop without compromising functional outcomes or increasing infection risks. Surgeons should carefully weigh the potential benefits of reduced blood loss against the need for drainage and associated risks, considering individual patient factors and surgical circumstances.

Keywords: Closed suction drainage, KOOS, Total knee arthroplasty, WOMAC

INTRODUCTION

Knee osteoarthritis (OA) is one of the most common degenerative joint disorders affecting the adult population. It is characterized by gradual deterioration of articular cartilage, subchondral bone, and synovial inflammation, which together contribute to pain, stiffness, muscle weakness, reduced mobility, and limitations in performing daily activities.

Total knee arthroplasty (TKA) remains a well-established and reliable surgical intervention for alleviating pain and restoring joint function in individuals with moderate to severe OA. The procedure has demonstrated consistent success in improving quality of life for patients with end-stage joint degeneration.

In orthopedic surgeries, including TKA, postoperative accumulation of fluids such as blood near the surgical wound is a common concern. These collections may hinder wound healing, serve as a medium for bacterial growth, and contribute to increased pain and joint stiffness, ultimately delaying the recovery process. To mitigate these risks, closed suction drains are frequently employed in surgical practice to evacuate excess fluids.

However, the use of surgical drains remains a topic of ongoing debate. While drains can help prevent hematoma formation and reduce localized swelling, they may also promote blood loss by counteracting the natural tamponade effect, increase the risk of infection through retrograde contamination, and hinder early mobilization due to the physical presence of the drainage apparatus.[1-6]

Given the conflicting perspectives, the clinical decision to use postoperative drainage should be based on clear evidence. This study sought to contribute to that evidence by systematically evaluating and comparing postoperative outcomes in patients undergoing TKA with and without the use of surgical drains. Specifically, we aimed to assess differences in hemoglobin levels, functional outcomes (via KOOS and WOMAC scores), and infection rates between the two groups

Review of literature

Wan et al, between January 2015 and September 2015, 80 consecutive patients were prospectively randomized into two groups: a CSD group (40 cases; average age, 66.9±8.6 years; male, 8; female, 32) and a non-CSD group (40 cases; average age, 66.8±10.1 years; male, 9; female, 31). Local inflammation outcomes [assessed by a visual analog scale (VAS), swelling and skin temperature], calculated total blood loss (CBL), hidden blood loss (HBL), blood transfusion requirements and hemoglobin concentrations were recorded. Hospital for special surgery (HSS) knee scores, range of motion (ROM), limb swelling, tension vesicles, ecchymosis, time to regaining straight leg raising and duration of hospital stay were documented. All surgeries were performed by the same surgeon and followed up for 3 months. Results showed the peri-wound skin temperature and knee VAS pain scores were lower in the non-CSD group. Patients in the non-CSD group had significantly better knee ROM (p=0.028). The time to regaining active straight leg raising was significantly shorter in the non-CSD group N than in the CSD group (p=0.014). In addition, patients in the non-CSD group had a shorter length of hospital stay (p=0.004) than those in the CSD group, indicating earlier recovery of knee function. HBL was significantly less in the CSD group than the non-CSD group (p=0.006) on postoperative day (POD) 5. However, CBL did not differ significantly between the two groups on POD5. There were no significant differences between two groups in all other assessed variables.[7]

In 2019 Xu et al conducted a study in 6325 total knee arthroplasties (TKA).[8] Patients were divided into two groups according to whether they received a drain postoperatively following TKA. Results showed the transfusion rate and PLOS were 15.07% and 7.75±3.61 days, respectively, in the drain group and 6.72% and 6.54±3.32 days, respectively, in the no-drain group following TKA. After adjusting for the following variables: age, gender, body mass index, orthopedic diagnoses, hypertension, type 2 diabetes, coronary heart disease, chronic obstructive pulmonary disease, preoperative hemoglobin, albumin, analgesic use, anesthesia, American Society of Anesthesiologists class, tranexamic acid use, intraoperative bleeding, operative time, and tourniquet use (for TKA), drain use correlated significantly with a higher transfusion rate [risk ratio =2.812, 95% confidence interval (CI) 2.224-3.554, p<0.001 for TKA and risk ratio =1.872, 95% CI 1.588-2.207, p<0.001 for THA] and a longer PLOS [partial regression coefficient (B)=1.099, 95% CI 0.879-1.318, p<0.001, standard regression coefficient (B') =0.139 for TKA; B=0.973, 95% CI 0.695-1.051, p<0.001, and B'=0.115 for THA]. Two groups showed no significant difference in wound complications.[8]

In 2015 Watanabe et al conducted a study in 63 patients (126 knees) who underwent simultaneous bilateral TKA using a cemented posterior stabilized prosthesis, classified into 3 groups: 20 patients with a closed suction drain on both sides (bilateral group), 22 patients with a closed suction drain on one side and no drain on the other side (unilateral group), and 21 patients with no drain (no-drainage group). Short- and long-term clinical outcomes were evaluated. Results showed Mean hemoglobin drop on the day after surgery was significantly greater in the bilateral group (2.2 gm/dl, p=0.038) and unilateral group (2.2 gm/dl, p=0.045) compared with the no-drainage group (1.5 gm/dl). The incidence of short-term and long-term complications was not significantly different between knees with drainage and those without drainage. In side-to-side comparisons, no significant differences were found in knee extension, flexion, or circumference in the unilateral group. In group comparisons, he found no significant differences in clinical outcomes between the bilateral group and no-drainage group, either.[9]

METHODS

Study area

This was a prospective study done on patients undergoing total knee arthroplasty (TKA) at Aster MIMS Hospital, Calicut, Kerala, India.

Inclusion criteria

Men and women with primary OA knee. Age more than 40 years. Patients with inflammatory joint diseases leading to secondary OA knee like rheumatoid arthritis.

Exclusion criteria

Acute and active infection, local or systemic. Revision TKA. Malignancy. Patients on antiplatelets (clopidogrel).

Sample size

Sample size was calculated by the formula $n=Z^2_{1-\alpha}/2SD^2/d^2$ in a study done by Wan et al, closed suction drainage is not associated with faster recovery after total knee arthroplasty, decrease in Hb was 29.3±9.3 gm/l. Taking the precision at 2% the sample size was n = 4×9.3×9.3 2×2 =86.5. So, the minimum sample size was rounded of to 90.

Study tools

After obtaining informed consent, face to face interview with pretested semi structured questionnaire was conducted for the subjects. i) Pre-operatively patients were assessed using Hemoglobin, infection, WOMAC and KOOS scores. ii) Immediate post operative assessment of hemoglobin on day 1 and day 2. iii) Post-operative assessment was done at 1,3,6,12 months post op with WOMAC and KOOS.

Study design

It was an observational study

Study duration

This study took place from March 2023 to March 2024.

Data collection methods

After obtaining approval from SRC, Aster MIMS Calicut, the data was collected only after obtaining informed consent from the study subjects.

Statistical methods

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 26.0) and graphs were depicted using Microsoft excel. Normality of distribution of all data was assessed using histograms and Shapiro Wilk test. Continuous variables were summarized as mean±standard deviation. Comparison of Hb, KOOS and WOMAC scores in different time periods between groups were tested using Mann Whitney U test. Categorical variable between groups were summarized in terms of frequency with % and testes using chi square test. Sub group analysis was performed with Kruskal Wallis test. Post hoc analysis with Bonferroni adjustment was used to find the inter differences in Hb and KOOS and WOMAC on follow up within groups. For all test p values; 0.05 was considered as statistically significant.

Ethical concerns

The study protocol was submitted to IEC, Aster MIMS Hospital Calicut for approval and ethical approval was obtained.

Written informed consent from the study subjects was obtained. Details of the study was explained to the participants in local language. The information collected was used only for the purpose of study and strict confidentiality was maintained throughout the study. Participants were informed that they have the full freedom to withdraw their consent from any point of study.

RESULTS

There was no significant difference in age between groups, but gender was significantly different between groups (Table 1).

There was no significant difference in comorbidities and TKR status between groups (Table 2).

There was no significant difference in pre-operative Hb, KOOS and WOMAC scores between groups (Table 3).

Table 1: Comparison of basic demographic characteristics between groups.

Variables	Groups		P value
	With drain (n=45)	Without drain (n=45)	
Age	64.9±6.8	67.5±7.9	0.097
Gender			
Male	6 (13.3%)	17 (37.8%)	0.008
Female	39 (86.7%)	28 (62.2%)	

Table 2: Comparison of various clinical characteristics between groups.

Variables	Groups		P value
	With drain (n=45) (%)	Without drain (n=45) (%)	
Comorbidities			
Yes	36 (80.0)	35 (77.8)	0.796
No	9 (20.0)	10 (22.2)	
TKR			
Left	24 (53.3)	23 (51.1)	0.833
Right	21 (46.7)	22 (48.9)	

Table 3: Comparison of pre-operative characteristics between groups.

Variables	Groups		P value
	With drain (n=45)	Without drain (n=45)	
Hb	12.8 (12.5-13.2)	13 (12.6-13.7)	0.110
KOOS	45 (44-47)	45 (43-47)	0.958
WOMAC	34 (32-35)	34 (32-36)	0.486

Table 4: Comparison of post-operative characteristics between groups.

Hb day 1 and 2	Group		P value
	With drain (n=45)	Without drain (n=45)	
Day 01	10.2 (9.8-10.8)	11.6 (11.2-12.4)	0.001
Day 02	8.6 (8.2-9.2)	10.8 (9.9-11.2)	0.001
KOOS and WOMAC			
1 Month	66 (64-68)	64 (62-68)	0.158
3 Month	76 (74-78)	76 (74-77.5)	0.288
6 Month	85 (82-86)	84 (82-86)	0.967
12 Month	88 (86-89)	88 (86-89.5)	0.486
WOMAC			
1 Month	22 (19.5-23.5)	23 (20-24.5)	0.054
3 Month	14 (13-16)	15 (12.5-16)	0.277
6 Month	10 (7-11)	10 (8-12)	0.488
12 Month	6 (5-7)	6 (5-7)	0.993

Table 5: Comparison of HB within drain group.

Variables	Pre op	Day 01	Day 02	P value
Hb	12.8 (12.5-13.2)	10.2 (9.8-10.8)	8.6 (8.2-9.2)	0.001
Post hoc analysis				
Pre op	-	0.001	0.001	
Day 01	-	-	0.001	
Day 02	-	-	-	

Table 6: Comparison of KOOS and WOMAC within drain group.

Variable	Pre OP	1 Month	3 Months	6 Months	12 Months	P value
KOOS	45 (44-47)	66 (64-68)	76 (74-78)	85 (82-86)	88 (86-89)	0.001
Post hoc analysis						
KOOS						
Pre OP	-	0.001	0.001	0.001	0.001	
1 Month	-	-	0.001	0.001	0.001	
3 Months	-	-	-	0.001	0.001	
6 Months	-	-	-	-	0.001	
12 Months	-	-	-	-	-	
WOMAC	34 (32-35)	22 (19.5-23.5)	14 (13-16)	10 (7-11)	6 (5-7)	0.001
Post hoc analysis						
WOMAC						
Pre OP	-	0.001	0.001	0.001	0.001	
1 Month	-	-	0.001	0.001	0.001	
3 Months	-	-	-	0.001	0.001	
6 Months	-	-	-	-	0.001	
12 Months	-	-	-	-	-	

Table 7: Comparison of HB within non drain group.

Variable	Pre op	Day 01	Day 02	P value
Hb	13 (12.6-13.7)	11.6 (11.2-12.4)	10.8 (9.9-11.2)	0.001
Post hoc analysis				
Pre op	-	0.001	0.001	
Day 01	-	-	0.001	
Day 02	-	-	-	

Table 8: Comparison of KOOS and WOMAC within non drain group.

Variable	Pre OP	1 Month	3 Months	6 Months	12 Months	P value
KOOS	45 (43-47)	64 (62-68)	76 (74-77.5)	84 (82-86)	88 (86-89.5)	0.001
Post hoc analysis						
KOOS						
Pre OP	-	0.001	0.001	0.001	0.001	
1 Month	-	-	0.001	0.001	0.001	
3 Month	-	-	-	0.001	0.001	
6 Month	-	-	-	-	0.001	
12 Month	-	-	-	-	-	
WOMAC	34 (32-36)	23 (20-24.5)	15 (12.5-16)	10 (8-12)	6 (5-7)	0.001
Post hoc analysis						
WOMAC						
Pre OP	-	0.001	0.001	0.001	0.001	
1 Month	-	-	0.001	0.001	0.001	
3 Month	-	-	-	0.001	0.001	
6 Month	-	-	-	-	0.001	
12 Month	-	-	-	-	-	

There was a significant difference in Hb between groups after first and second day of surgery (Table 4).

There was no significant difference in KOOS and WOMAC scores between groups (Table 5).

There was a significant reduction of Hb in drain group, and the reduction was statistically significant (Table 6).

Post hoc analysis with Bonferroni correction reveals that there was a statistically significant difference in Hb at pre-operative period compared to post-operative 1st day ($p<0.001$), from pre op to post op 2nd day ($p<0.001$) in drain group (Table 6).

There was a significant increase of KOOS in drain group, and the increase was statistically significant (Table 7).

Post hoc analysis with Bonferroni correction reveals that there was a statistically significant difference in KOOS at pre-operative period compared to post-operative 1 month ($p<0.001$), from pre-op to post op 3 month ($p<0.001$) , pre-op to post-op 6 month ($p<0.001$), from pre-op to post-op 12 months ($p<0.001$), from post op 1 month to post op 3 month ($p<0.001$), from post op 1 month to post-op 6 month ($p<0.001$), post-op 1 month to 12 month ($p<0.001$), post-op 3 month to post-op 6 month ($p<0.001$), post-op 3 month to post op 12 month ($p<0.001$) and post op 6 month to post op 6 month in drain group.

There was a significant reduction of WOMAC in drain group, and the reduction was statistically significant

Post hoc analysis with Bonferroni correction reveals that there was a statistically significant difference in WOMAC at pre-operative period compared to post-operative 1 month ($p<0.001$), from pre-op to post op 3 month ($p<0.001$) , pre-op to post-op 6 month ($p<0.001$), from pre-op to post-op 12 months ($p<0.001$), from post op 1month to post op 3 months ($p<0.001$), from post op 1 month to post-op 6 months ($p<0.001$), post-op 1 month to 12 months ($p<0.001$), post-op 3 months to post-op 6 months ($p<0.001$), post-op 3 months to post op 12 months ($p<0.001$) and post op 6 months to post op 6 months in drain group (Table 7).

There was a significant reduction of Hb in non-drain group, and the reduction was statistically significant.

Post hoc analysis with Bonferroni correction revealed that there was a statistically significant difference in Hb at pre-operative period compared to post-operative 1st day ($p<0.001$), from pre op to post op 2nd day ($p<0.001$) in non-drain group.

There was a significant increase of KOOS in non-drain group, and the increase was statistically significant.

Post hoc analysis with Bonferroni correction reveals that there was a statistically significant difference in KOOS at pre-operative period compared to post-operative 1 month ($p<0.001$), from pre-op to post op 3 month ($p<0.001$) , pre-op to post-op 6 month ($p<0.001$), from pre-op to post-op 12 months ($p<0.001$), from post op 1 month to post op 3 month ($p<0.001$), from post op 1 month to post-op 6 months ($p<0.001$), post-op 1 month to 12 months ($p<0.001$), post-op 3 months to post-op 6 months ($p<0.001$), post-op 3 months to post op 12 months ($p<0.001$) and post op 6 months to post op 6 months in non-drain group.

There was a significant reduction of WOMAC in non-drain group, and the reduction was statistically significant.

Post hoc analysis with Bonferroni correction reveals that there was a statistically significant difference in WOMAC at pre-operative period compared to post-operative 1 month ($p<0.001$), from pre-op to post op 3 months ($p<0.001$), pre-op to post-op 6 months ($p<0.001$), from pre-op to post-op 12 months ($p<0.001$), from post op 1 month to post op 3 months ($p<0.001$), from post op 1 month to post-op 6 months ($p<0.001$), post-op 1 month to 12 months ($p<0.001$), post-op 3 months to post-op 6 months ($p<0.001$), post-op 3 months to post op 12 months ($p<0.001$) and post op 6 months to post op 6 months in non-drain group.

Table 9: Comparison of infection between groups.

Infection	Group		P value
	With drain (n=45) (%)	Without drain (n=45) (%)	
Yes	0 (0.0)	0 (0.0)	-
No	45 (100.0)	45 (100.0)	

There were no infections reported in both groups (Table 9).

DISCUSSION

The comparison of patients with and without a drain after primary unilateral total knee arthroplasty (TKA) can provide valuable insights into several important outcomes.

Patients who have a drain inserted postoperatively might experience reduced swelling and hematoma formation, potentially leading to improved early mobilization and functional recovery. Conversely, patients without a drain might have less discomfort related to the drain itself, potentially allowing for more natural movement and quicker adaptation to weight-bearing activities.

The presence of a drain could theoretically reduce the risk of hematoma formation and subsequent infection by draining excess blood and fluid from the surgical site. However, the absence of a drain might reduce the risk of introducing pathogens into the surgical wound through the drain site itself, potentially lowering the overall infection risk.

Patients with a drain might experience a more significant initial drop in hemoglobin due to blood loss into the collection reservoir of the drain. In contrast, patients without a drain might experience less immediate blood loss into a reservoir, potentially resulting in a smaller drop in hemoglobin levels postoperatively.

Potential complications associated with drains include infection at the drain site, blockage of the drain leading to retained fluid, or discomfort for the patient. Patients without drains may have fewer complications related directly to drain usage, such as drain site infections or discomfort.

When we look at the current clinical guidelines and practices regarding the use of drains in TKA, many institutions have moved towards minimizing drain usage or adopting alternative strategies to manage postoperative drainage and hematoma formation.[10-12]

Our study found a statistically significant difference in haemoglobin drop between patients undergoing TKA with and without a drain. This suggests that patients with a drain experienced a greater drop in hemoglobin levels compared to those without a drain.[13-16] The higher hemoglobin drop in the drain group is likely due to blood loss into the drain reservoir post-surgery

According to the study, there was no statistically significant difference in functional outcome as assessed by KOOS (knee injury and osteoarthritis outcome score) and WOMAC (Western Ontario and McMaster Universities osteoarthritis index) scores between patients with and without a drain.[17-20] This indicates that both groups achieved similar functional recovery post-TKA, despite the difference in hemoglobin drop.

The study found no signs of infection in either group. This suggests that the presence or absence of a drain did not significantly impact the incidence of postoperative infections in this cohort.[21-23]

Between January and September 2015, Wang et al randomized 80 patients into two groups: CSD (n=40) and non-CSD (n=40). Both groups had similar demographics and underwent surgery by the same surgeon. Key outcomes included pain (VAS), swelling, skin temperature, blood loss, hemoglobin levels, HSS knee scores, ROM, recovery markers, and hospital stay. Results showed the non-CSD group had lower peri-wound skin temperature and VAS scores, better knee ROM ($p=0.028$), faster straight leg raise recovery ($p=0.014$), and shorter hospital stay ($p=0.004$). The CSD group had lower hidden blood loss on POD5 ($p=0.006$), but total blood loss was similar between groups. Other outcomes showed no significant differences.

Xu et al studied 6,325 total knee arthroplasty (TKA) cases, comparing outcomes between patients with and without postoperative drains. The drain group had higher transfusion rates (15.07% versus 6.72%) and longer postoperative length of stay (7.75±3.61 versus 6.54±3.32 days). After adjusting for multiple variables, drain use was significantly associated with increased transfusion risk and longer hospital stays (p<0.001). No significant differences in wound complications were observed between groups.[8]

Watanabe et al studied 63 patients (126 knees) undergoing simultaneous bilateral TKA, divided into three groups: bilateral drainage, unilateral drainage, and no drainage. The mean hemoglobin drop was significantly greater in the bilateral (2.2 gm/dl) and unilateral (2.2 gm/dl) groups compared to the no-drainage group (1.5 gm/dl). However, there were no significant differences in short- or long-term complications, knee motion, or clinical outcomes among the groups.[9]

Migliorini et al conducted a study and found no evidence of a statistically significant evidence between the two groups in occurrence of postoperative infections, mean total postoperative hemoglobin or length of hospital stay. The no-drainage group showed a lower rate of blood transfusion.[24]

Si et al conducted a study and found no significant differences in infection rate or blood loss between the closed drainage and nondrainage TKAs, and there was also no significant difference in haematoma formation, deep venous thrombosis, postoperative VAS score or range of motion between the two groups.[25]

Tao et al conducted a study and found that the total blood loss was significantly greater in those with a drain although those without lost more blood into the dressings. There was no statistical difference in the postoperative swelling or pain score, ecchymosis, deep vein thromboses (DVT), time at which flexion was regained or the incidence of infection at a minimum of two years after surgery in the two groups.[26]

Crevoisier et al conducted a study in patients undergoing TKA with and without suction drain. Statistical analysis of the results showed no difference in wound healing, severity of wound haematoma, postoperative blood transfusion requirement, range of motion and duration of the hospitalization between the two groups.[27]

Erne et al conducted a randomized trial with 36 patients undergoing primary TKA. The CSD group had a significantly greater hemoglobin drop (~1 gm/dl, p=0.012), but no significant differences in knee circumference, wound healing, or ROM. Both groups met discharge criteria by day 9. Patients without CSD reported more pain during hospitalization and at 6 weeks (p=0.012), but this difference disappeared by later follow-ups. Overall, CSD use increased blood loss without offering clear clinical benefits.[28]

Quinn et al conducted randomized controlled trials comparing drainage versus no drainage after total knee arthroplasty. Results showed no significant differences in knee flexion, swelling, hospital stay, or hemoglobin levels (p>0.05). Specifically, there was no significant difference in ROM (mean difference 0.03°, p=0.64) or knee circumference (mean difference 1.63 cm, p=0.34).[29]

CONCLUSION

This study compared outcomes of total knee arthroplasty (TKA) with and without drain use, focusing on hemoglobin drop, KOOS and WOMAC scores, and infection rates. Patients without drains had a significantly lower hemoglobin drop, suggesting reduced blood loss and possibly fewer transfusions. Functional outcomes and infection rates showed no significant differences between groups. These findings support reconsidering routine drain use in TKA, as omitting drains may reduce blood loss without affecting recovery or increasing infection risk. Surgeons should weigh the benefits and risks based on individual patient needs.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Shamseer KV, Kumar PT, Shameem GM, Khan PS. Comparison of the patients undergoing total knee arthroplasty with and without drain in terms of functional outcome, hemoglobin drop and infection rate. Int J Res Orthop 2025;11:733-40.