



CONVENTIONAL DRAINAGE VERSUS THREE HOUR CLAMPING DRAINAGE AFTER TOTAL KNEE ARTHROPLASTY IN SEVERE OSTEOARTHRITIS: A PROSPECTIVE, RANDOMISED TRIAL

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ABSTRACT

Background: Postoperative haemorrhage is a significant problem following total knee arthroplasty, especially in patients with advanced osteoarthritis necessitating considerable osseous resection and soft-tissue release. Closed suction drainage is frequently employed; nevertheless, continuous draining may exacerbate observable blood loss. Temporary drain clamping has been suggested as an uncomplicated technique to mitigate early postoperative haemorrhage by creating a localised tamponade effect. **Objective:** To evaluate standard continuous drainage versus three-hour clamping drainage following total knee arthroplasty in individuals with advanced osteoarthritis. **Materials and Methods:** This prospective randomized comparative study included 50 patients undergoing primary unilateral total knee arthroplasty for severe osteoarthritis. Patients were randomly assigned to two equal groups of 25 individuals each. In the usual drainage group, the drain remained continuously open post-surgery, but in the three-hour clamping group, the drain was clamped immediately after wound closure and released after three hours. The postoperative drain output, decrease in haemoglobin, need for transfusion, pain ratings, knee range of motion, mobilisation, wound problems, and duration of hospital stay were compared across the groups. **Results:** The baseline demographic data were similar across the groups. The three-hour clamping cohort had markedly reduced drain production over the initial six hours and a considerably lower total drain output in comparison to the traditional drainage cohort. The average decrease in haemoglobin was considerably reduced in the clamping group. The transfusion demand was reduced in the clamping group, although the change lacked statistical significance. Pain ratings, early knee flexion, mobilisation day, wound problems, and duration of hospital stay were similar among the groups. **Conclusion:** The three-hour drain clamping method is a straightforward, secure, and efficient approach to minimising postoperative haemorrhage following total knee arthroplasty, without negatively impacting early recovery.

KEYWORDS :

INTRODUCTION

Total knee arthroplasty is a highly successful surgical intervention for advanced knee osteoarthritis, especially in patients with significant pain, deformity, stiffness, and functional limitations who do not sufficiently respond to conservative therapy. In advanced osteoarthritis, the treatment may necessitate extensive osteotomies, synovial debridement, and soft-tissue releases, which can lead to considerable postoperative haemorrhage, decreased haemoglobin levels, elevated drain output, and the requirement for blood transfusions. Consequently, managing blood loss during the perioperative period is a crucial element of early recovery following total knee arthroplasty.^{–[13]}

Closed suction drainage has conventionally been employed during total knee arthroplasty to mitigate wound haematoma, oedema, and ongoing wound exudate. Nonetheless, its habitual application is contentious, since ongoing draining may elevate observable blood loss without demonstrably enhancing functional recovery or diminishing wound problems. The temporary closing of the drain during the initial postoperative hours has been suggested as a straightforward method to establish a local tamponade effect, therefore minimising early postoperative haemorrhage while permitting subsequent drainage of accumulated blood.^{–[46]}

A comparison is necessary between traditional continuous drainage and three-hour clamping drainage in patients having total knee arthroplasty for severe osteoarthritis, since this cohort is predisposed to increased intraoperative soft-tissue release and postoperative haemorrhage. A prospective randomised research will evaluate whether three-hour clamping may decrease drain output, haemoglobin reduction, and transfusion need without elevating consequences such as wound collection, infection, discomfort,

delayed mobilisation, or diminished knee range of motion. The results may facilitate the development of a straightforward, economical, and effective postoperative drainage regimen for blood conservation and prompt rehabilitation following total knee arthroplasty.

OBJECTIVES

The primary objective of the study was to compare the total postoperative drain output between conventional continuous drainage and three-hour clamping drainage after total knee arthroplasty in patients with severe osteoarthritis of the knee. The secondary objectives were to compare the postoperative fall in haemoglobin, requirement for blood transfusion, wound-related complications, postoperative pain, early knee range of motion, day of mobilization and duration of hospital stay between the two groups.

The study also aimed to assess whether three-hour clamping of the drain was a safe and effective method for reducing postoperative blood loss without adversely affecting early functional recovery after total knee arthroplasty.

MATERIALS AND METHODS

This prospective randomised comparative study was performed at Vydehi Institute of Medical Sciences and Research Centre from January 2026 to June 2026. Fifty patients diagnosed with severe knee osteoarthritis and scheduled for primary unilateral total knee arthroplasty were enrolled following the acquisition of written informed permission. Patients were randomly assigned to two groups of 25 individuals each.

Patients in the control group had traditional drainage, wherein the drain remained unobstructed and unclamped post-surgery. Patients in the research group had a three-hour

clamping of the drainage, during which the drain was occluded immediately upon wound closure and subsequently released after three hours. Patients receiving revision or bilateral total knee arthroplasty, as well as those with bleeding problems, coagulation abnormalities, active infections, inflammatory arthritis, or those on anticoagulant treatment that could not be suspended, were excluded.

All patients received complete knee arthroplasty with a conventional surgical method under suitable anaesthesia. A closed suction drain was inserted prior to wound closure in all instances. The outflow from the surgical drain was documented at specified intervals, and haemoglobin levels were evaluated both preoperatively and postoperatively. Documentation included the necessity for blood transfusion, problems linked to wounds, postoperative discomfort, knee range of motion, day of mobilisation, and length of hospital stay.

Data were recorded in a predetermined proforma and evaluated with suitable statistical tools. Continuous variables were represented as mean and standard deviation, whilst categorical variables were represented as frequency and percentage. Intergroup comparisons were conducted utilising the independent t-test or Mann-Whitney U test for continuous variables, and the Chi-square test or Fisher's exact test for categorical data. A p-value below 0.05 was deemed statistically significant.

RESULTS

The research comprised 50 patients with severe knee osteoarthritis receiving primary total knee arthroplasty. Participants were randomly assigned to two groups: 25 patients in the traditional drainage group and 25 patients in the three-hour clamping group.

Table 1: Distribution of Study Subjects Based on Demographic Variables

Variable	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
Mean age, years	67.84 ± 6.92	66.76 ± 7.14	0.590
Male	5 (20.0%)	6 (24.0%)	0.733
Female	20 (80.0%)	19 (76.0%)	0.733
Mean BMI, kg/m ²	31.64 ± 4.86	32.12 ± 5.08	0.735
Right knee operated	14 (56.0%)	13 (52.0%)	0.777
Left knee operated	11 (44.0%)	12 (48.0%)	0.777

Inference: Both groups were equivalent in terms of age, sex distribution, BMI, and surgical side. No statistically significant difference existed between the groups, suggesting an equitable distribution of baseline demographic traits.

Table 2: Comparison of Preoperative and Postoperative Haemoglobin

Haemoglobin Parameter	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
Preoperative Hb, g/dL	13.18 ± 1.21	13.32 ± 1.28	0.694
Postoperative day 1 Hb, g/dL	9.82 ± 1.36	10.54 ± 1.18	0.050
Mean fall in Hb, g/dL	3.36 ± 0.82	2.78 ± 0.74	0.012

Inference: Preoperative haemoglobin levels were similar across the two groups. The average postoperative decrease in haemoglobin was considerably less in the three-hour clamping group than in the traditional drainage group, indicating reduced postoperative blood loss associated with

temporary drain clamping.

Table 3: Comparison of Postoperative Drain Output

Drain Output	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
0-6 hours, mL	252.40 ± 76.82	132.60 ± 58.44	<0.001
6-24 hours, mL	184.80 ± 72.36	154.20 ± 61.75	0.114
24-48 hours, mL	128.60 ± 63.72	108.40 ± 54.26	0.234
Total drain output, mL	565.80 ± 148.64	395.20 ± 129.48	<0.001

Inference: The three-hour clamping group exhibited markedly reduced drain production during the initial 6 hours and considerably lower overall drain output throughout 48 hours in comparison to the traditional drainage group. This demonstrates that early drain clamping significantly decreased observable postoperative blood loss.

Table 4: Comparison of Blood Transfusion Requirement

Variable	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
Patients requiring transfusion	9 (36.0%)	4 (16.0%)	0.105
Patients not requiring transfusion	16 (64.0%)	21 (84.0%)	0.105
Total blood units transfused	18	7	—
Mean blood units transfused per patient	0.72 ± 1.02	0.28 ± 0.61	0.071

Inference: The necessity for blood transfusion was reduced in the three-hour clamping group compared to the traditional drainage group. Despite the lack of statistical significance, the decrease in both the number of patients necessitating transfusion and the total units transfused was clinically pertinent.

Table 5: Comparison of Postoperative Pain, Mobilization and Knee Range of Motion

Parameter	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
VAS pain score on postoperative day 1	5.72 ± 1.04	5.36 ± 0.95	0.207
VAS pain score on postoperative day 3	3.64 ± 0.86	3.44 ± 0.82	0.405
Knee flexion on day 3, degrees	81.20 ± 12.34	82.80 ± 11.76	0.641
Knee flexion on day 6, degrees	89.40 ± 10.62	91.20 ± 9.84	0.537
Day of mobilization	1.92 ± 0.57	1.76 ± 0.52	0.305

Inference: No statistically significant difference was seen between the groups for postoperative pain scores, early knee flexion, or the day of mobilisation. This indicates that three-hour drain clamping decreased blood loss without negatively impacting early functional recovery.

Table 6: Comparison of Postoperative Complications and Hospital Stay

Variable	Conventional Drainage Group (n=25)	3-Hour Clamping Group (n=25)	p-value
Wound swelling	4 (16.0%)	3 (12.0%)	0.684
Haematoma	2 (8.0%)	1 (4.0%)	0.552
Persistent wound discharge	3 (12.0%)	1 (4.0%)	0.297
Superficial infection	1 (4.0%)	0 (0.0%)	0.312
Deep infection	0 (0.0%)	0 (0.0%)	—
Mean hospital stay, days	7.24 ± 1.20	7.04 ± 1.09	0.541

Inference: Postoperative problems linked to wounds were similar across the two groups. The three-hour clamping group exhibited no elevated incidence of wound oedema, haematoma, infection, or extended hospital stay, suggesting that the procedure was safe during the early postoperative phase.

Overall Interpretation

The current study found that three-hour clamping drainage following total knee arthroplasty in patients with severe osteoarthritis resulted in markedly reduced early drain output and overall postoperative drain output compared to traditional continuous drainage methods. The decrease in haemoglobin was also markedly less in the clamping group. Despite the lack of statistical significance in the lowering of transfusion requirements, a smaller number of patients in the three-hour clamping group needed transfusion. Significantly, there was no escalation in wound complications, discomfort, delayed mobilisation, or limitation of early knee range of motion. The data indicate that three-hour drain clamping is a straightforward, safe, and effective approach for minimising postoperative blood loss following total knee arthroplasty.

DISCUSSION

In our investigation, both groups were equivalent for age, sex distribution, BMI, and surgical side, suggesting that the disparities in postoperative outcomes were largely attributable to the draining technique rather than baseline demographic discrepancies. The primary discovery was that three-hour clamping drainage markedly decreased early drain production and overall postoperative drain output in comparison to traditional continuous draining. The decrease was most pronounced within the initial six postoperative hours, reinforcing the notion that the majority of observable haemorrhaging following total knee arthroplasty transpires in the early postoperative phase, and that brief clamping may offer a localised tamponade effect.

Our results align with those of Stucinskas et al., who evaluated conventional drainage versus four-hour clamping drainage following total knee arthroplasty for severe osteoarthritis, and found considerably reduced blood loss in the clamping cohort. Pornrattanamaneewong et al. demonstrated that a three-hour interval clamping procedure decreased postoperative bleeding and mitigated the decrease in haemoglobin without elevating the risk of wound or thromboembolic consequences. The findings align with our study, indicating that the mean decrease in haemoglobin was much less in the three-hour clamping group, demonstrating that temporary clamping effectively reduced visible drain output and preserved postoperative haemoglobin levels. [1,7]

The transfusion necessity in our study was diminished in the three-hour clamping group, with a reduced number of patients necessitating transfusion and a lower quantity of blood units transfused. Nonetheless, this disparity did not attain statistical significance. This conclusion aligns with Stucinskas et al., who also saw less transfusions in the clamping group, but with varying degrees of statistical significance. The absence of statistical significance in our study may be attributed to the limited sample size of 50 individuals. Nonetheless, the decrease from a 36% transfusion need in the typical drainage cohort to 16% in the three-hour clamping cohort is clinically significant and substantiates the blood-conservation advantage of temporary drain clamping.[1]

Jeon et al. proposed that a three-hour clamping duration may serve as the best release time following total knee arthroplasty, as it successfully mitigates bleeding while preventing the increased acute discomfort and delayed range-of-motion recovery linked to prolonged clamping. Our

findings corroborate this view, since there was no significant disparity in postoperative pain levels, early knee flexion, or the day of mobilisation between the two groups. This demonstrates that three-hour clamping decreased blood loss without impairing early functional recovery. Raleigh et al. and Prasad et al. observed that intermittent or temporary clamping decreased external blood loss without elevating morbidity, hence reinforcing the safety of our technique. [8,10]

Nonetheless, not all research has demonstrated consistent advantages. Kiely et al. saw no notable benefit from two-hour clamping in standard knee arthroplasty, but Park et al. indicated that three-hour clamping decreased drainage volume but did not decrease total blood loss, since concealed blood loss was greater in the clamping cohort. These divergent findings underscore that apparent drain output alone may not comprehensively reflect total perioperative blood loss. Our study demonstrates a markedly reduced decline in haemoglobin, reinforcing the evidence for a genuine blood-conservation benefit; nevertheless, concealed blood loss was not assessed independently and warrants consideration in future investigations.[11,12]

Postoperative complications due to wounds were similar amongst the groups in our research. The three-hour clamping group exhibited no significant increase in wound oedema, haematoma, persistent discharge, superficial infection, deep infection, extended hospital stay, discomfort, or delayed mobilisation. This aligns with the findings of Pornrattanamaneewong et al., Raleigh et al., and Prasad et al., who indicated that temporary clamping decreased blood loss without elevating wound complications. These findings have clinical significance due to the primary worry associated with drain clamping, which includes the potential for retained blood, haematoma development, wound discharge, or infection. Our findings indicate that a three-hour clamping duration is safe during the early postoperative phase.

Our study endorses three-hour drain clamping as a straightforward, cost-effective, and efficacious method for minimising postoperative blood loss following total knee arthroplasty in cases of severe osteoarthritis. The approach markedly decreased early and total drain output and resulted in a lesser decline in haemoglobin, while preserving similar pain ratings, mobilisation, knee range of motion, wound complication rates, and duration of hospital stay. Despite the lack of statistical significance in the lowering of transfusion requirements, it held clinical relevance. It is advisable to do larger randomised trials that evaluate estimated total blood loss, concealed blood loss, and extended follow-up to further substantiate the efficacy of three-hour clamping drainage in standard total knee arthroplasty procedures.

Strengths:

Our study was a prospective randomised comparison trial with equal patient allocation to traditional drainage and three-hour clamping drainage groups, hence enhancing the internal validity of the findings. Both groups were equivalent for age, sex, BMI, and surgical side, hence minimising the potential for baseline bias. The research evaluated many clinically significant outcomes, including drain output, haemoglobin reduction, transfusion need, pain levels, knee range of motion, mobilisation, wound problems, and duration of hospital stay.

LIMITATIONS:

The primary drawback of our study was the modest sample size of 50 patients, which may have constrained the capacity to identify statistically significant differences in outcomes such as transfusion requirements and wound problems. The follow-up was restricted to the first postoperative phase, thereby precluding the evaluation of long-term functional outcomes, late infections, stiffness, and thromboembolic

events. Hidden blood loss was not assessed independently, hence total perioperative blood loss may not have been entirely captured by drain output and haemoglobin reduction alone.

Overall interpretation:

Our study indicates that three-hour drain clamping following total knee arthroplasty is a straightforward, safe, and efficacious approach for minimising postoperative blood loss in patients with severe osteoarthritis. The clamping group exhibited markedly reduced early drain production, diminished overall drain output, and a lesser decline in haemoglobin, without an escalation in pain, postponed mobilisation, decreased knee flexibility, wound problems, or length of hospital stay. Despite the lack of statistical significance in the decrease of transfusion requirements, the observed trend was clinically relevant and endorses the use of three-hour clamping as an effective blood-conservation technique following total knee arthroplasty.

CONCLUSION:

Our study indicated that three-hour drain clamping following total knee arthroplasty in patients with severe osteoarthritis significantly decreased early postoperative drain output, total drain output, and mean decrease in haemoglobin compared to standard continuous drainage. Despite the lack of statistical significance in the decrease of blood transfusion requirements, a lower number of patients in the clamping group need transfusions, indicating a clinically beneficial blood-conservation effect.

Three-hour clamping did not elevate postoperative pain, wound oedema, haematoma, persistent wound discharge, infection, delayed mobilisation, diminished knee flexibility, or length of hospital stay. Consequently, three-hour drain clamping seems to be a straightforward, secure, economical, and pragmatic method for minimising postoperative blood loss without hindering early recovery following total knee arthroplasty. It is advisable to do larger studies that evaluate concealed blood loss and include extended follow-up to further corroborate these findings.

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