

**A Comparative Study on the Outcome of Closed Suction Drain versus No Drain in Patients Undergoing Total Knee Arthroplasty**Modi Amul Kaushikkumar<sup>1</sup>, Nirav Rathi<sup>2</sup>, Saurabh Patel<sup>3</sup>, Dishant Mehta<sup>4</sup><sup>1</sup>Senior Resident, Department of Orthopaedics, GMERS Medical College, Sola, Ahmedabad, Gujarat, India<sup>2,3</sup>Assistant Professor, Department of Orthopaedics, GMERS Medical College, Sola, Ahmedabad, Gujarat, India<sup>4</sup>Orthopaedic Surgeon, Department of Orthopaedics, GMERS Medical College, Sola, Ahmedabad, Gujarat, India

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**Abstract****Background and Aim:** There is on-going debate surrounding the use of suction drains in total knee arthroplasty (TKA). In this study, we aimed to evaluate the impact of using a closed suction drain versus not using a drain on factors such as the rate of allogeneic blood transfusion, haemoglobin levels, and length of hospital stay.**Material and Methods:** At the Department of Orthopaedic GMERS Medical College and Hospital Sola, Ahmedabad, Gujarat, a series of 40 primary total knee arthroplasty procedures were carried out over the course of one year. The study involved a total of 40 patients who had undergone unilateral non-traumatic primary TKA and were above the age of 18. There were 20 patients in the 'no drain' group and 20 patients in the 'closed suction' group.**Results:** Men generally had fewer comorbidities and lower BMI values. However, a significant majority of the study populations were overweight, with a BMI over 25 kg/m<sup>2</sup>. The group that received a drain experienced a notably extended hospital stay, a 30% increase in tourniquet time, a more significant decrease in haemoglobin and haematocrit levels, and a higher average count of transfused packed RBC units. The mean preoperative haemoglobin levels for the closed suction drain group and the no drain group were 12.50 ± 1.71 g/dL and 13.22 ± 1.28 g/dL, respectively. There was no statistical difference between the two groups.**Conclusion:** This study revealed that the utilisation of suction drains during primary total knee arthroplasty (TKA) was linked to extended hospital stays, elevated blood loss, and greater transfusion needs. In addition, the use of TXA during surgery has been linked to improved outcomes. These include shorter hospital stays, reduced blood loss, improved levels of haemoglobin and haematocrit, and fewer postoperative complications overall.**Keywords:** Blood Transfusion, Haemoglobin, Suction Drains, Total Knee Arthroplasty.

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**Introduction**

Many individuals have found relief from the disability and pain caused by osteoarthritis of the knee through total knee arthroplasty, a widely performed orthopaedic reconstructive procedure. Although the outcomes are encouraging, it is important to acknowledge that managing haemorrhage can be challenging but not impossible.

Various methods have been tried to manage the bleeding, such as femoral intramedullary plugs, fibrin usage, antifibrinolytics, epinephrine, and closed suction drain. Nevertheless, there is still on-going discussion regarding the use of a closed suction drain. Closed suction drainage, while aiming to prevent hematoma formation, can

inadvertently increase the chances of requiring a blood transfusion and prolonging the hospital stay. [1-4]. Numerous studies have supported the use of drain after total knee arthroplasty (TKA) because it has been suggested to reduce the collection of blood clots and the resulting complications, such as serous leakage from the wound.

Additionally, it may lead to decreased swelling in the limb after surgery, lower the risk of infection, and improve the range of motion. [5-7] On the flip side, the use of drains has been linked to higher rates of postoperative infection, blood loss, the need for blood transfusion, and longer hospital stays. [8,9] Numerous studies have examined the efficacy of drains in comparison to not using drains

following total knee arthroplasty (TKA). According to a study, the use of a drain after TKA was found to be linked to decrease postoperative blood loss and enhanced range of motion. On the other hand, a separate study that followed strict scientific protocols discovered that there were no discernible variations in the medical results of patients who were equipped with a drain compared to those who were not [10,11] This study aimed to evaluate the impact of using a closed suction drain versus not using a drain on factors such as allogeneic blood transfusion rates, haemoglobin levels, and length of hospital stay.

### Material and Methods

At the Department of Orthopaedic GMERS Medical College and Hospital Sola, Ahmedabad, Gujarat, a series of 40 consecutive primary total knee arthroplasty procedures were carried out over the course of one year. Patients included in this study were 18 years and older and had undergone primary total knee arthroplasty (TKA) for osteoarthritis. Patients who were excluded from the study had conditions such as coagulopathy, traumatic total knee replacements, inflammatory arthritis, simultaneous bilateral total knee arthroplasty, malignancy, and revision TKA. The data was collected by reviewing records of procedures performed by two experienced surgeons.

One surgeon chose to use a closed suction drain, while the other surgeon did not use any drainage system. The study analysed various factors including case notes, age, sex, BMI, type of anaesthesia, tourniquet time, comorbidities, preoperative hematocrit and haemoglobin levels, postoperative hematocrit and haemoglobin levels (at 24-hour, 72-hour, and discharge), the amount of allogeneic packed red cells transfused, and the duration of hospital stay.

All the patients provided written informed consent, as required by the surgeons. This report does not contain any data that could potentially reveal the identity of the patient. A group of 20 patients did not have drains, while another group of 20 patients had closed suction drains.

Multiple knee surgeons performed total knee replacement surgeries. Tranexamic Acid (TXA) has been observed to be linked to the personal preferences of the surgeons performing the procedures.

Some surgeons followed a particular procedure that included giving 10-15 mg/kg of TXA during the start of the surgery and an extra 1 mg when the tourniquet was released. In contrast, some surgeons

regularly opt not to use TXA during surgical procedures.

### Statistical analysis

The data was compiled and entered into a spreadsheet computer programme (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). The quantitative variables were reported using either means and standard deviations or median and interquartile range, depending on their distribution. Qualitative variables were presented as count and percentages. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

### Results

During the study period, a total of 40 cases underwent Total Knee arthroplasty. Most of the participants were women, making up 75% of the group, and their ages ranged from 45 to 86 years old. Out of the cases that underwent surgery, a significant majority (75%) had multiple comorbidities. The most common comorbidity observed was hypertension, which was present in 65% of cases, followed by type 2 diabetes mellitus. Both genders exhibited similar baseline characteristics when it comes to gender variations. On the other hand, it was observed that males generally had fewer comorbidities and lower BMI values. However, a significant majority of the study populations were classified as overweight, with a BMI over 25 kg/m<sup>2</sup>.

A surgical drain was used in 20 patients. The patients in both groups had similar baseline characteristics, including age, BMI, and comorbidities. There were no significant differences between the two groups (P-value>0.05). In comparison, the group that received a drain experienced several notable differences. They had a significantly longer hospital stay, a 30% longer tourniquet time, a greater drop in haemoglobin and haematocrit, and a higher average count of transfused packed RBC units.

The study found that both the closed suction drain group and the no drain group had similar results in terms of preoperative and postoperative haemoglobin levels. The mean preoperative haemoglobin was 12.60 ± 1.49 g/dL, the mean postoperative haemoglobin at 72 hours was 9.40 ± 1.84 g/dL, and the mean haemoglobin at discharge was 10.01 ± 1.02 g/dL. There was no statistical difference in the mean preoperative haemoglobin levels between the closed suction drain group (12.50 ± 1.71 g/dL) and the no drain group (13.22 ± 1.28 g/dL) (p = 0.07).

**Table 1: Baseline characteristics of the study population**

Variables	Males	Females	P value
Number	10 (25 %)	30 (75%)	
Age in years	67.6	65.9	0.35
BMI	31.5 (5.3)	36.42 (6.5)	0.01*
Count of comorbidities	2.2 (1.4)	2.5 (1.3)	0.02*
HTN	6 (60%)	21 (70%)	
DM	5 (50%)	15 (50%)	
Hospital Stay (Days)	8.7 (5.2)	8.1 (5.1)	
Received TXA	4 (40%)	12 (40%)	0.1

Statistically significance at  $p \leq 0.05$

**Table 2: Comparison of outcome variables in terms of drain use**

Variables	Drain used (n=20)	No drain (n=20)	P value
Hospital Stay (Days)	10.3 (4.9)	5.5 (4.5)	0.01*
Tourniquet time (mins)	112.1 (18.7)	81.1 (28.5)	0.02*
Hb (pre- & post-op) g/dl	1.7 (1.1)	1.3 (0.8)	0.003*
Hct (pre- & post-op) %	5.5 (2.9)	3.4 (2.5)	0.001*
Transfused packed RBC units (L)	0.16 (0.5)	0.03 (0.3)	0.05*

\* indicate statistically significance at  $p \leq 0.05$

## Discussion

TKR is a widely used surgical procedure for individuals suffering from severe knee osteoarthritis. Research has shown that it effectively alleviates pain, enhances patients' quality of life, and improves their overall functionality. [12-14] Efforts have been made to minimise post-operative blood loss, which can be quite significant, including hidden blood loss and bleeding during surgery.

Additionally, steps are taken to avoid the need for blood transfusion and to prevent surgical and deep wound infections after total knee replacement. [15-17] In 1961, Waugh and Stinchfield recommended the use of a closed suction drain after orthopaedic procedures to prevent hematoma production and wound problems. [18] However, numerous surgeons questioned its effectiveness until a study conducted by Beer, et al. in 1991 found that postoperative wound drainage had no significant impact on total knee arthroplasty. [19] The closed suction drain is designed to minimize hematoma formation by removing the collected blood. [20] However, there is a downside to this practice, as highlighted in a meta-analysis conducted by Markar, et al.

A recent study found that the use of closed suction drain after total knee arthroplasty was linked to higher rates of homologous (allogeneic) blood transfusion and longer hospital stays. [21] In addition, homologous blood transfusions can pose a risk of blood-borne infections and cardiopulmonary complications. [22] Three previous studies have been identified that compare closed suction drains with no drains [23-25]. Mengal et al discovered that there was no significant variation in post-operative Hb levels between the two groups. However, they did observe that the no drain group

had a higher incidence of blood transfusion. [23] In the studies conducted by Kumar et al [24] and Sundaram and Parkinson [25], no significant difference was found between the two groups when looking at post-operative Hb levels and autologous transfusion rates as outcomes.

The patients included in our study had been diagnosed with bilateral, end stage, advanced osteoarthritis. The surgeons, with expertise in the field, employed a shared approach and a minimally restrictive prosthesis during the total knee arthroplasty procedure. A closed suction drain was inserted during the closure of the skin incision and later removed on the postoperative day. The levels of haemoglobin and hematocrit were monitored before and after the operation, specifically at 24 hours, 72 hours, and upon discharge. The closed suction drain group showed significantly lower haemoglobin and hematocrit levels compared to the no suction drain group, particularly after 72 hours of operation.

According to a comprehensive study conducted across the country, TKR is among the procedures that most commonly necessitate blood transfusion in the United States. Unfortunately, this procedure is linked to a range of serious complications, including wound infection, prolonged hospitalization, and increased risk of mortality during the hospital stay, adverse reactions to donated blood, and the development of deep venous thromboembolism. Reducing the need for blood transfusion is crucial in order to prevent these complications. Past research has indicated that closed suction drainage (CSD) may lead to higher levels of total blood loss in TKR. [23-26] According to a study, closed suction drainage was found to increase the need for transfusions after knee arthroplasty without providing significant

benefits. [27] Another study also did not support the use of closed suction drains in primary elective TKR. Furthermore, Bjerke-Kroll et al [28] found that CSD had a potential impact on the number of allogeneic blood transfusions in unilateral primary TKR, potentially attributed to blood loss in the drain group. It is possible that the observed decrease in the need for post-operative blood transfusion can be attributed to the BMI and "pre-operative Haemoglobin" levels, which are measured and taken into account before the surgery. In contrast, the drain output is only identified and measured after the surgery.

A study comparing retransfusion drains with no drains was found. There was no significant difference observed by Jones et al in the post-operative Hb levels or autologous blood transfusion rates between the two groups. [29] In line with previous research by Adalberth et al [30], our study's findings also indicate that there was no significant difference in postoperative Hb levels among the three groups. Additionally, the need for allogeneic blood transfusion was similar across all groups.

There can be variations in blood transfusion protocols across different institutions. We have taken into account various factors such as age, clinical condition, and underlying comorbidities to determine the appropriate blood transfusion criterion, even though some research studies suggest a threshold of 8-10 g/dl. Patients in the closed suction group experienced a slightly longer hospital stay of one day compared to those in the no drain group. It is important to note the necessity of blood transfusion and the subsequent need for careful monitoring.

Researchers and surgeons are actively seeking alternative methods to manage the problems posed by blood loss in total knee arthroplasty and the risks associated with allogeneic blood transfusion. Several methods currently under investigation include autologous transfusion, the utilisation of an interval draining clamp, and the administration of tranexamic acid. These techniques have significantly decreased blood loss, length of hospital stay, and the need for blood transfusions after total knee replacement surgery. [31,32].

Our study has some weaknesses, including the retrospective analysis and non-randomized study design. Given the limited number of patients, it is important to consider the potential for a type II error that could obscure any true differences between the groups.

### Conclusion

This study demonstrated that the use of suction drains in primary TKA was associated with longer hospital stays, increased blood loss, and higher

transfusion requirements. Moreover, the use of TXA during surgery was found to be associated with better outcomes, including shorter hospital stays, decreased blood loss, improved haemoglobin and haematocrit levels, and less overall postoperative complications. The reason behind the lower rate of allogeneic blood transfusion and higher hemoglobin levels in the group without drains may be attributed to the tamponade effect of the knee's soft tissue encasing the joint cavity.

### References

1. Høvik LH, Winther SB, Foss OA, Gjeilo: KH. Preoperative pain catastrophizing and postoperative pain after total knee arthroplasty: a prospective cohort study with one year follow-up. *BMC*. 2016; 17:1.
2. Madadi F, Mehrvarz AS, Madadi F, Boreiri M, Abachizadeh K, Ershadi A: Comparison of drain clamp after bilateral total knee arthroplasty. *J Knee Surg*. 2010; 23:215–21.
3. Esler CN, Blakeway C, Fiddian NJ: The use of a closed-suction drain in total knee arthroplasty. A prospective, randomised study. *J Bone Joint Surg Br*. 2003; 85:215–17.
4. Walmsley PJ, Kelly MB, Hill RM, Brenkel I: A prospective, randomised, controlled trial of the use of drains in total hip arthroplasty. *J Bone Joint Surg Br*. 2005; 87:1397-401.
5. Chen J, Chiu YL, Chen LH, Lin SJ, Lo WH, Hsu YC. Continuous wound infusion system in TKA reduces pain and improves early knee function: a randomized controlled study. *ClinOrthopRelat Res*. 2014; 472(5):1502–1507.
6. Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE. Prevention of VTE in orthopedic surgery patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012; 141(2 Suppl):e278Se325S.
7. Kurtz SM, Ong KL, Lau E, Bozic KJ, Berry D. Prosthetic joint infection risk after TKA in the Medicare population. *ClinOrthopRelat Res*. 2007; 461:49–53.
8. Iseki T, Nakamura H, Kato T. Comparison of closed suction drainage and nondrainage in total knee arthroplasty. *Orthopedics*. 2005; 28(12):1445–1448
9. Parvizi J, Ghanem E, Joshi A, Sharkey PF, Hozack WJ, Rothman RH. Does "excessive" anticoagulation predispose to periprosthetic infection? *J Arthroplasty*. 2012; 27(9):1475–1480
10. Smith TO, Sexton D, Mann C, Donell S. Suction drainage versus no drainage for postoperative management of knee arthroplasty. *Cochrane Database Syst Rev*. 2005; (4):CD005972.

11. Yang JH, Yoon JR, Oh CH, Kim JH. Theocracy of closed-suction drainage in total knee arthroplasty: a prospective, randomized study. *J Arthroplasty*. 2007; 22(8):1126–1130.
12. Mahomed NN, Barrett J, Katz JN, Baron JA, Wright J, Losina E. Epidemiology of total knee replacement in the United States Medicare population. *JBJS*. 2005; 87(6): 1222–1228
13. Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, Judge A, Beard DJ. Knee replacement. *Lancet*. 2012; 379(9823):1331–1340
14. Woolhead GM, Donovan JL, Dieppe PA. Outcomes of total knee replacement: a qualitative study. *Rheumatology*. 2005; 44(8):1032–1037.
15. Banerjee S, Kapadia BH, Issa K, McElroy MJ, Khanuja HS, Harwin SF, Mont MA. Postoperative blood loss prevention in total knee arthroplasty. *J Knee Surg*. 2013; 26(06):395–400.
16. Parker MJ, Roberts CP, Hay D. Closed suction drainage for hip and knee arthroplasty. A meta-analysis. *J Bone Joint Surg Am*. 2004; 86-A(6):1146–52.
17. Demirkale I, Tecimel O, Sesen H, Kilicarslan K, Altay M, Dogan M. Nondrainage decreases blood transfusion need and infection rate in bilateral total knee arthroplasty. *J Arthroplasty*. 2014; 29(5):993–997.
18. Waugh TR, Stinchfield FE: Suction drainage of orthopaedic wounds. *J Bone Joint Surg Am*. 1961, 43-A:939-46.
19. Beer KJ, Lombardi AV Jr, Mallory TH, Vaughn BK: The efficacy of suction drains after routine total joint arthroplasty. *J Bone Joint Surg Am*. 1991, 73:584-87.
20. Cheung G, Carmont MR, Bing AJ, Kuiper JH, Alcock RJ, Graham NM: No drain, autologous transfusion drain or suction drain? A randomised prospective study in total hip replacement surgery of 168 patients. *ActaOrthop Belg*. 2010; 76:619-27.
21. Markar SR, Jones GG, Karthikesalingam A, Segaren N, Patel RV: Transfusion drains versus suction drains in total knee replacement: meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2012; 20:1766-72.
22. Levine BR, Haughom B, Strong B, Hellman M, Frank RM: Blood management strategies for total knee arthroplasty. *J Am AcadOrthop Surg*. 2014; 22:361-71.
23. Mengal B, Aebi J, Rodriguez A, Lemaire R. A prospective randomized study of wound drainage versus non-drainage in primary total hip or knee arthroplasty. *Rev Chir Orthop Reparatrice Appar Mot* 2001; 87: 29–39.
24. Kumar S, Penematsa S, Parekh S. Are drains required following a routine primary total joint arthroplasty? *IntOrthop* 2007; 31: 593–596.
25. Sundaram RO, Parkinson RW. Closed suction drains do not increase the blood transfusion rates in patients undergoing total knee arthroplasty. *IntOrthop*. 2007; 31: 613–616.
26. Xu H, Xie J, Lei Y, Huang Q, Huang Z, Pei F. Closed suction drainage following routine primary total joint arthroplasty is associated with a higher transfusion rate and longer postoperative length of stay: a retrospective cohort study. *J OrthopSurg Res*. 2019;14(1):1–8.
27. Al-Zahid S, Davies AP. Closed suction drains, reinfusion drains or no drains in primary total knee replacement? *Ann R CollSurgEngl*. 2012;94(5):347–350.
28. Bjerke-Kroll BT, Sculco PK, McLawhorn AS, Christ AB, Gladnick BP, Mayman DJ (2014) The increased total cost associated with post-operative drains in total hip and knee arthroplasty. *J Arthroplasty* 29(5):895–899.
29. Jones AP, Harrison M, Hui A. Comparison of autologous transfusion drains versus no drain in total knee arthroplasty. *ActaOrthopBelg* 2007; 73: 377–385.
30. Adalberth G, Byström S, Kolstad K et al. Postoperative drainage of knee arthroplasty is not necessary: a randomized study of 90 patients. *ActaOrthopScand* 1998; 69: 475–478.
31. Singh VK, Singh PK, Javed S, Kumar K, Tomar J: Autologous transfusion of drain contents in elective primary knee arthroplasty: its value and relevance. *Blood Transfus*. 2011; 9:281-85. 32.
32. Chareancholvanich K, Siri wattanasakul P, Narkbunnam R, Pornrattanamanee Wong C: Temporary clamping of drain combined with tranexamic acid reduces blood loss after total knee arthroplasty: a prospective randomized controlled trial. *BMC MusculoskeletDisord*. 2012; 13:124.