

## After Total Knee Arthroplasty Different Knee Position Bring Distinct Effects-A Prospective Study of One Hundred Patients

Ke Zheng, Wen-xiang Liu and Jie-bin Zhang\*

Department of Orthopedic, Anhui Number 2 Provincial Peoples Hospital, 1868 Dangshan Road, Yaohai District, HeFei, AnHui Province, China

### \*Corresponding author

Jie-bin Zhang, Department of Orthopedic, Anhui Number 2 Provincial Peoples Hospital, 1868 Dangshan Road, Yaohai District, HeFei, AnHui Province, China

Submitted: 21 April 2022; Accepted: 20 May 2022; Published: 05 Jun 2022

**Citation:** Ke Zheng, Wen-xiang Liu and Jie-bin Zhang. (2022). After Total Knee Arthroplasty Different Knee Position Bring Distinct Effects-A Prospective Study of One Hundred Patients. *Int J Ortho Res*, 5(2), 97-101.

### Abstract

**Background:** Following total knee arthroplasty (TKA) blood loss is a major factor influencing functional recovery and quality of life in patients. The aim of this study was to determine the effect of postoperative leg position on blood loss and functional recovery after TKA.

**Methods:** One hundred consecutive patients were enrolled in this prospective randomized study, which with degenerative osteoarthritis of the knee. An equal number of patients were randomly allocated to either flexion or extension groups. In the flexion group, the affected leg was elevated 45° at the hip and with 45° of flexion at the knee, while patients in the extension group had the knee extended fully. Primary outcomes were calculated total blood loss (CBL), hidden blood loss (HBL), intraoperative blood loss (IBL), haemoglobin (HB) level and haematocrit (HCT).

**Results:** CBL, HBL, postoperative levels of HB and HCT, drop level of HB and HCT between the two groups after 72 hours were significantly different, with patients in the flexion group experiencing lower blood loss than those in the extension group ( $P < 0.05$ ). However, there no difference between groups in the postoperative levels of HB and HCT, drop level of HB and HCT at 24 hours. Even though after 1 week range of motion (ROM) was statistical difference in groups, but after 6-week rehabilitation, patients from both groups attained a similar ROM in the knee.

**Conclusions:** The results of this study definite that after TKA execute the protocol, maintaining a position with the hip 45° flexion and the knee flexed at 45° prolong 48 hours, is an effective method for reducing blood loss and increasing functional ROM.

**Keywords:** Total knee arthroplasty, Knee position, Blood loss, Range of motion

### Background

With the growth of the elderly, more people suffering the pain of knee osteoarthritis, and total knee arthroplasty as an effective choice to solve the problem. During procedure include capsule resection, soft tissue release and bone incisions, all the operation led to significant blood loss.

Blood loss after total knee arthroplasty may reach up to 1500ml in average result to an important health issue and also economical concern [1]. With the blood loss, many factors about the success of TKA will be change, such as range of motion, infection, DVT and knee swelling. Therefore, search for better blood management minimizing blood loss has long been a major question. Intraoper-

ative several aspects can reduce blood loss; the use of tourniquet, minimally invasive surgery, injection tranexamic acid (TXA) computer assisted TKA and drain placement protocols [2-7]. Methods of postoperative include utilize elastic bandage, cryotherapy, continuous passive motion (CPM) and postoperative knee position regimens [8-10].

Many research reported positing the knee in flexion postoperative is a simple and cost-effective way to reduce blood loss and improve patient outcomes while decreasing the hospitalization day and medical cost. However, nearly studies reported the effects of different position have contradictory results. A recently systematic review study concluded that the flexion protocol has significantly

decreased in hemoglobin level after surgery during 48h to 6days, while no significant difference at 24 h after surgery [11].

With the state of no specific consensus, even though systematic review study has a conclusion, but there have not illustrated exact limb position or duration of flexion which can bring the most benefits [8]. So, we choose the protocol of 48h after total knee arthroplasty in different knee position to examine the effect of blood loss and related parameters.

## Materials and Methods

### Study Design

From July 2019 to June2020, one hundred consecutive patients who diagnosed degenerative osteoarthritis was randomized divide into two groups have been taken primary TKA. The study was approved by our hospital, and after declaring the risks and benefits

of study, we obtained all patients informed consent. Patients were exclusion included the following: rheumatoid arthritis, revision TKA, diabetes, haemostasis defects (eg.Hemophilia arthritis),neuromuscular diseases, preoperative haemoglobin level less than 10g/dl, history of knee trauma or surgery, disorders of the hips, metabolic bone disease and other serious medical conditions.

One hundred patients are allocated to equal number of two groups, either flexion or extension, using a random number list produced after the TKA surgery. Patients in the flexion group which leg position with the hip 45°flexion and the knee flexed at 45°using a continuous passive motion machine. Other group had the knee extended fully, also with 45°hip flexion. All the patients maintain the position until 48 hours after surgery. Two group patients were matched for age, gender, body mass index (BMI), preoperative haemoglobin and haematocrit, preoperative ROM (Table 1).

**Table 1: Demographics and baseline measurements**

	Extension group	Flexion group	P value
Age(years)	66.11±8.26	65.91±7.10	0.91
Gender(F/M)	35(24/11)	35(28/7)	0.41
BMI (kg/m2)	26.55±3.98	27.48±4.66	0.37
Preoperative HB(g/dl)	12.4±1.29	12.6±1.38	0.43
Preoperative HCT (%)	38.48±3.52	38.21±3.26	0.73
Preoperative ROM	94.2±17.6	92.9±23.1	0.59

F: female, M: male, BMI: Body mass index, HB: hemoglobin, ROM: range of motion, HCT: haematocrit

### Surgical Procedure

All patients performed operations under general anesthesia by the same group of surgeons skilled in TKA. Throughout the operation blood pressure was evaluated, tourniquet start use after osteotomy accomplish. Everyone received two endovenous doses of Tranexamic acid (500mg\*2) and Cefuroxime sodium (1.5g) about 30 minutes before skin incision. All operation was performed via a midline skin incision and medial parapatellar approach. The implant type which used for surgery is posterior-stabilized, total knee prosthetic component (GEMINI PS, LINK, Hamburg, GER). A bone graft obtained from previous bone cuts was inserted into the femoral canal to reduce blood loss. After reshaped of the patella to match better moving faces to the femoral component trochlea. At the end of operation, all patients positioned a drainage and keep in for the first 24h. A compressive bandage was applied to at the end of surgery. During the surgery none patient were transfused blood. All the affected knee injected a cocktail mixed drug (NS 60ml, ropivacaine100mg, adrenaline 0.3mg, tranexamic acid 1g) into cavum articulate for analgesia and sustain close the channel in the first 4 hours.

### Postoperative management

At the first 24hours, ice bag was placed around the operation knee, and then removed the drainage after measured blood loss. Every patient received strict procedure for thromboprophylaxis in the form of low molecular weight heparin natrium (3200iu) daily before leave hospital. For control postoperative pain, NSAID drug was used. Even some patients were given a self-controlled analge-

sia system machine until 48 h after surgery. The bandage changed during remove drainage, and removed on 3 days after surgery. It will be started at 48h postoperative, active isometric quadriceps. Initiative straight leg raises and extension-flexion motion. When the level of hemoglobin below 8g/d, and also accompany dizziness and tachycardia, transfusion blood be performed.

### Outcome Assessment

We obtained calculated total blood loss, hidden blood loss, intraoperative blood loss, haemoglobin level and haematocrit measured after 24 and 72 hours, ROM at 7days and 1 month postoperatively, pain score of preoperative and postoperative. CBL, as the sum of HBL and IBL, which calculated from the change of haematocrit using the formula reported by Gross and Nadler. Before the surgery, all the patients have been recording ROM of operative knee. Using American knee society knee score (ASS) as the standard for evaluation two times, first is before operation, next is 1 month postoperative. All assessment had been accomplished by two surgeons independent and if have different score, they discussion result in one score. With surgery have some complications such as incision infection and deep vein thrombosis (DVT) had been recorded, diagnose each DVT by doppler ultrasound. All the result of parameters except pain scores for analyzing assessed by a surgeon who blinded to the groups.

### Statistical analysis

Choose SPSS for Windows17.0 software as for Statistical analysis, Continuous data with normal distribution were expressed as means

(±SD). Use the two-tailed Student t-test for compression, at the same time the chi-square test was used for nominal data. Define the different level of  $P < 0.05$  was statistically significant.

## Results

The outcomes of this study are summarized in the Table(2). CBL in the extension group was  $1150 \pm 391$  ml and flexion group was  $880 \pm 310$  ml, between two groups is have different significant ( $P = 0.03$ ), IBL was  $258 \pm 61$  ml and  $263 \pm 310$  ml respectively, no different significant ( $P = 0.75$ ); HBL in the extension was  $596 \pm 83$  ml and in the flexion was  $462 \pm 78$  ml, ( $p = 0.00$ ). Drop of HB and HCT levels also been calculate ,after 24h after operation ,  $1.57 \pm 1.10$  in the flexion and  $1.49 \pm 0.98$  in the extension with HB, ( $P = 0.74$ ); HCT was  $4.45 \pm 2.65$  and  $4.20 \pm 2.09$  in flexion and extension respectively, they have no different ( $p = 0.67$ ). But postoperative 72h, the

drop levels of HB in group flexion are  $3.0 \pm 1.24$ , and have different significant ( $p = 0.00$ ) with group flexion,  $2.48 \pm 0.97$ . Drop levels of HCT in two groups are  $8.6 \pm 3.2$  and  $6.4 \pm 2.4$ , ( $p = 0.00$ ).

The functional results of the surgery knee, after the operation 7days, ROM was  $98 \pm 8.3^\circ$  in the flexion group and  $103 \pm 10.5^\circ$  in another group, there was statistical difference,  $p = 0.03$ ; however, undergone 4 weeks rehabilitation, ROM of two group is  $118 \pm 11.5^\circ$  and  $116 \pm 9.7^\circ$ , they had no statistical difference,  $p = 0.96$ .

There some common postoperative complications occurred in the patients. In the flexion group 3 incision infections and 1 in the extension group; all the cases have been observed DVT in the hospital.

**Table 2: Clinical outcome and complications**

	Extension group	Flexion group	P value
CBL (ml) (72h)	$1150 \pm 391$ ml	$880 \pm 310$	0.03
IBL (ml)	$258 \pm 61$ ml	$263 \pm 57$ ml	0.75
HBL (ml) (72h)	$596 \pm 83$ m	$462 \pm 78$ ml	0.00
Postoperative HB(g/dl)-24h	$11.3 \pm 1.74$	$11.0 \pm 1.34$	0.94
Postoperative HCT (%) -24h	$33.9 \pm 3.49$	$34.1 \pm 4.52$	0.83
Drop of HB level-24h	$1.57 \pm 1.10$	$1.49 \pm 0.98$	0.74
Drop of HCT level-24h	$4.45 \pm 2.65$	$4.20 \pm 2.09$	0.67
Postoperative HB(g/dl)-72h	$9.68 \pm 1.43$	$10.09 \pm 1.11$	0.00
Postoperative HCT (%) -72h	$29.8 \pm 4.13$	$32.4 \pm 3.92$	0.01
Drop of HB level-72h	$3.0 \pm 1.24$	$2.48 \pm 0.97$	0.00
Drop of HCT level-72h	$8.6 \pm 3.2$	$6.4 \pm 2.4$	0.00
ROM-1week (°)	$98 \pm 8.3$	$103 \pm 10.5$	0.03
ROM-4weeks	$118 \pm 11.5$	$116 \pm 9.7$	0.96
Infection	3	1	
DVT	0	0	

ROM: Range of Motion

DVT: Deep Vein Thrombosis

## Discussion

After TKA the blood loss and functional recovery can be influenced by many factors. How to reduce blood loss be interested in orthopaedic doctors, many techniques be used in such as Intravenous tranexamic acid during pre-operative; use tourniquet; administration of erythropoietin and so on.

Intra-operative pharmacological treatment, TXA have been used frequently. AS an inhibitor of fibrinolysis, tranexamic acid acts by blocking the lysine-binding site of plasminogen to fibrin. It has been reported to reduce intraoperative and post-operative blood loss after TKA [12, 13]. Not only can reduce blood loss, but also which can inhibit plasmin and lower inflammation. Therefore, in this study every patient administered intravenously TXA [14, 15].

To minimize blood loss, surgeons are often using a tourniquet in operation, which could reduce the intraoperative blood loss and

decrease surgery time. But there some argument about the effect of use tourniquet, Tetro et al reported that during TKA using tourniquet can reduce the total blood loss, however in the other research showing the contrary viewpoint [21]. Whatever the effect of tourniquet, we agree that using it in the operation can take the view of incision clear and the surgery time more shortly. Tourniquet use also significantly decreases the risk of complications [17, 18]. Tourniquets were used during the procedure and not one patient occur adverse reaction.

There numerous studies reported postoperative flexion TKA reducing blood loss and transfusion rate and improving ROM. On the contrary also a lot of research showed between leg extension and flexion they have no significant difference on blood loss and others. On the study from Ong et al, which compare three different postoperative positioning on blood loss, groups of knee flexion at  $70^\circ$  and  $35^\circ$  less than about 25% of CBL in the full extension group,

Li et al. performed a study with flexion patients' knee to 30° and extension prolong 72h postoperative, the result of compare two groups that knee flexion significantly less blood loss, which include CBL and HBL [19, 20].

On the other side, Ma et al. reported the blood loss between knee flexion of 70° and extension for the first 24h is no significant difference [21]. Madarevic et al reported similar results comparing four methods which contain knee position to reduce blood loss. No difference in the two groups [22].

There some factors influence the results. Firstly, different surgical technique by the surgeon may bring different outcome, such as surgery time, intraoperative blood loss and so on. Secondly, the angle of flexion and prolong time affect postoperative blood loss. Prolong high angle of knee will compress the popliteal vessels lead to local perfusion reduction and increase incision oxygen tension result in wound complications, such as infection of the incision. Not just the angle, but the maintenance time also important for the affection. Many researches have shown results which maintain time from 6hours to 72 hours, but there no clear standard for the time. Faldini et al. make a meta-analysis include 7 studies found the project lasting 48-72h postoperatively can be effective and way to improve ROM and reduce blood loss [13, 23]. On the other hand, Charalambides C et al. report that patients treated for 48 hours compression with high-elasticity bandages have shown faster postoperative recovery, shortly hospital days [14]. Based on these, in our study all patients execute the program which maintains 48 hours and 45° of flexion for the study group. With the drop of blood loss the function ROM also restore more quickly. On the on hand, which took less time to regain an adequate level of health; on the other hand, lower degree of swelling and effusion reduce the burden on the quadriceps, bring leg straight for exercises easier.

From the result of this study, mild flexion position with 48 hours could be an effective protocol to reduce blood loss after TKA. Not only the prolong time is easier to be accepted, but also the angle of leg is not deep bringing some positive impact, which include lower blood loss, high ROM in the initial postoperative section and shorter time to recovery. So, this program is worthy to be done popularized.

There is must be some limitations kept in our results. First, the number of included patients was relatively small; this limitation the degree of reliability. Second, all the medical history of people was not deeply investigated. Therefore, there some morbidities could influence the results. Whereas, the protocol to be done easily repeatable and the results are inspiring.

## Conclusion

The results of this study definite that after TKA execute the protocol, maintaining a position with the hip 45° flexion and the knee flexed at 45° prolong 48 hours, is an effective method for reducing blood loss and increasing functional ROM, which can reduce length of hospitalization and social cost for TKA procedures.

## Abbreviations

TKA: Total knee arthroplasty  
CBL: Calculated Total Blood Loss  
HBL: Hidden Blood Loss  
IBL: Intraoperative Blood Loss  
HB: Haemoglobin  
HCT: Haematocrit  
ROM: Range of Motion  
TXA: Tranexamic Acid  
DVT: Deep Vein Thrombosis

**Funding:** Funding: Natural Science Research Project of Universities in Anhui Province (2020ZR12925B009)

## References

1. Chen, L. L., Wang, W. C., Mao, X. Z., Yu, M., & Zhu, Q. (2007). Evaluation and treatment of hemorrhage after hip and knee arthroplasty in the aged. *Zhong nan da xue xue bao. Yi xue ban= Journal of Central South University. Medical Sciences*, 32(2), 316-319.
2. Antinolfi, P., Innocenti, B., Caraffa, A., Peretti, G., & Cerulli, G. (2014). Post-operative blood loss in total knee arthroplasty: knee flexion versus pharmacological techniques. *Knee surgery, sports traumatology, arthroscopy*, 22(11), 2756-2762.
3. Lee, D. H., Choi, J., Nha, K. W., Kim, H. J., & Han, S. B. (2011). No difference in early functional outcomes for mini-midvastus and limited medial parapatellar approaches in navigation-assisted total knee arthroplasty: a prospective randomized clinical trial. *Knee Surgery, Sports Traumatology, Arthroscopy*, 19(1), 66-73.
4. Li, B., Wen, Y., Wu, H., Qian, Q., Lin, X., & Zhao, H. (2009). The effect of tourniquet uses on hidden blood loss in total knee arthroplasty. *International orthopaedics*, 33(5), 1263-1268.
5. Plaweski, S., Tchouda, S. D., Dumas, J., Rossi, J., Gaudry, A. M., Cinquin, P., ... & STIC NAV Per Op group. (2012). Evaluation of a computer-assisted navigation system for anterior cruciate ligament reconstruction: prospective non-randomized cohort study versus conventional surgery. *Orthopaedics & Traumatology: Surgery & Research*, 98(6), S91-S97.
6. Stucinskas, J., Tarasevicius, S., Cebatorius, A., Robertsson, O., Smailys, A., & Wingstrand, H. (2009). Conventional drainage versus four hour clamping drainage after total knee arthroplasty in severe osteoarthritis: a prospective, randomised trial. *International Orthopaedics*, 33(5), 1275-1278.
7. Zeng, Y., Si, H., Li, C., Wu, Y., & Shen, B. (2018). Effect of knee flexion position and combined application of tranexamic acid on blood loss following primary total knee arthroplasty: a prospective randomized controlled trial. *International Orthopaedics*, 42(3), 529-535.
8. Charalambides, C., Beer, M., Melhuish, J., Williams, R. J., & Cobb, A. G. (2005). Bandaging technique after knee replacement. *Acta orthopaedica*, 76(1), 89-94.
9. Kullenberg, B., Ylipää, S., Söderlund, K., & Resch, S. (2006). Postoperative cryotherapy after total knee arthroplasty: a prospective study of 86 patients. *The Journal of arthroplasty*,

- 21(8), 1175-1179.
10. Panni, A. S., Vasso, M., Cerciello, S., & Salgarello, M. (2011). Wound complications in total knee arthroplasty. Which flap is to be used? With or without retention of prosthesis?. *Knee Surgery, Sports Traumatology, Arthroscopy*, 19(7), 1060-1068.
  11. Wu, Y., Yang, T., Zeng, Y., Si, H., Li, C., & Shen, B. (2017). Effect of different postoperative limb positions on blood loss and range of motion in total knee arthroplasty: an updated meta-analysis of randomized controlled trials. *International Journal of Surgery*, 37, 15-23.
  12. Wu, Y., Yang, T., Zeng, Y., Si, H., Li, C., & Shen, B. (2017). Effect of different postoperative limb positions on blood loss and range of motion in total knee arthroplasty: an updated meta-analysis of randomized controlled trials. *International Journal of Surgery*, 37, 15-23.
  13. Charoencholvanich, K., & Siri wattanasakul, P. (2011). Tranexamic acid reduces blood loss and blood transfusion after TKA: a prospective randomized controlled trial. *Clinical Orthopaedics and Related Research*, 469(10), 2874-2880.
  14. Cid, J., & Lozano, M. (2005). Tranexamic acid reduces allogeneic red cell transfusions in patients undergoing total knee arthroplasty: results of a meta-analysis of randomized controlled trials. *Transfusion*, 45(8), 1302-1307.
  15. Mao, Z., Yue, B., Wang, Y., Yan, M., & Dai, K. (2016). A comparative, retrospective study of peri-articular and intra-articular injection of tranexamic acid for the management of postoperative blood loss after total knee arthroplasty. *BMC Musculoskeletal Disorders*, 17(1), 1-8.
  16. Tetro, A. M., & Rudan, J. F. (2001). The effects of a pneumatic tourniquet on blood loss in total knee arthroplasty. *Canadian Journal of Surgery*, 44(1), 33.
  17. Abbas, K., Raza, H., Umer, M., & Hafeez, K. (2013). Effect of early release of tourniquet in total knee arthroplasty. *Journal of the College of Physicians and Surgeons Pakistan*, 23(8), 562.
  18. Rathod, P., Deshmukh, A., Robinson, J., Greiz, M., Ranawat, A., & Rodriguez, J. (2015). Does tourniquet time in primary total knee arthroplasty influence clinical recovery?. *The Journal of Knee Surgery*, 28(04), 335-342.
  19. Chen, L. L., Wang, W. C., Mao, X. Z., Yu, M., & Zhu, Q. (2007). Evaluation and treatment of hemorrhage after hip and knee arthroplasty in the aged. *Zhong nan da xue xue bao. Yi xue ban= Journal of Central South University. Medical Sciences*, 32(2), 316-319.
  20. Li, B., Wen, Y., Liu, D., & Tian, L. (2012). The effect of knee position on blood loss and range of motion following total knee arthroplasty. *Knee Surgery, Sports Traumatology, Arthroscopy*, 20(3), 594-599.
  21. Ma, T., Khan, R. J. K., Smith, R. C., Nivbrant, B., & Wood, D. J. (2008). Effect of flexion/extension splintage post total knee arthroplasty on blood loss and range of motion—a randomised controlled trial. *The Knee*, 15(1), 15-19.
  22. Madarevic, T., Tudor, A., Sestan, B., Santic, V., Gulan, G., Prpic, T., & Ruzic, L. (2011). Postoperative blood loss management in total knee arthroplasty: a comparison of four different methods. *Knee Surgery, Sports Traumatology, Arthroscopy*, 19(6), 955-959.
  23. Faldini, C., Traina, F., De Fine, M., Pedrini, M., & Sambri, A. (2015). Post-operative limb position can influence blood loss and range of motion after total knee arthroplasty: a systematic review. *Knee Surgery, Sports Traumatology, Arthroscopy*, 23(3), 852-859.

**Copyright:** ©2022 Jie-bin Zhang. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.