

# Sealing of Femoral Tunnel with Autologous Bone Graft Decreases Blood Loss

Utěsnění femorálního kanálu autologním kostním štěpem snižuje krevní ztrátu

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## ABSTRACT

### PURPOSE OF THE STUDY

Total knee arthroplasty is commonly used procedure with advanced stage arthritis which causes extensive blood loss intraoperatively and postoperatively. Purpose of this study is to show the effectiveness of sealing of femoral tunnel with bone grafting in preventing blood loss.

### MATERIAL AND METHODS

288 patients with primary bicompartamental knee arthroplasty who were operated in between April 2012 and June 2015 are retrospectively studied. Two groups are formed according to sealing of femoral tunnel with autologous bone graft or not. Group 1 was the plugged group with 192 patients and group 2 was the unplugged group with 96 patients. Operation time, arthrotomy method, anticoagulant therapy, postoperative care were similar in between two groups. 'Independent sample t-test' is used to compare two groups as statistical method.

### RESULTS

Postoperative lowest hemoglobin levels are higher in plugged group ( $p < 0.001$ ). Drain outputs are much less than unplugged group ( $p < 0.001$ ). There is no statistically significant difference between amount of given erythrocyte suspensions.

### DISCUSSION

In the literature there are many attempts to reduce blood loss and allogenic blood transfusion. Some systemic or local usage of medical therapies, mechanical interventions such as cold application or intraoperative fibrin sealers are some of them. There are a few studies favoring usage of plugs and a few do not. Our findings showed less blood loss with usage of autologous bone grafting but did not significantly affect the blood transfusion amount.

### CONCLUSION

Autologous bone grafting is a free to use, non-time consuming and an effective method to reduce blood loss.

**Key words:** knee arthroplasty, plug, sealing of femoral tunnel, blood loss.

## INTRODUCTION

Total knee arthroplasty is a routinely used procedure for treatment of advanced stage osteoarthritis. During this procedure average blood loss is up to 1,500 ml. In a study it is shown that 39% of patients require blood transfusion due to blood loss. It is ideal that plugging the blood leaking areas and effective hemostasis for maintenance of hemoglobin levels. There are some reports favoring fibrin seal usage. There are many studies about tourniquet use, medical therapy such as tranexamic acid and preoperative and postoperative cold compression to reduce blood loss. But there are only a few studies showing the effect of bone plug usage for femoral tunnel to reduce blood loss. In one of the studies it is observed that postoperative blood drainage decreases with use of femoral bony plug but hemoglobin levels do not differ from unplugged group.

In our study we retrospectively studied the hemoglobin levels and amount of drain output of plugged and unplugged groups.

## MATERIAL AND METHODS

We retrospectively studied the patients with primary bicompartamental knee arthroplasty who were operated in between April 2012 and June 2015. There were 288 patients who had gone through unilateral knee arthroplasty surgery. We categorized these patients in two groups according to usage of bone plug sealed in femoral tunnel. The choice of using femoral bony plug is due to senior surgeons' preference. 4,000 U/day of enoxaparin sodium prophylaxis has been done to all patients. During surgery all patients were operated under tourniquet with 300 mm Hg pressure. Surgical technique was standardized; midline skin incision and medial parapatellar arthrotomy were done and posterior stabilized prosthesis were used for all patients. For femoral side we used intramedullary guide whereas extramedullary guide for tibial side.

All patients received 1g cefazoline prophylaxis for 24 hours postoperatively. An intravenous paracetamol 1 gram/6 hours was ordered for analgesic purpose during hospitalization. In both groups, 1 milligram/kilogram/hour

of morphine subcutaneously administered and divided into four doses was scheduled as rescue analgesia.

In both groups 4,000 U/day enoxaparine sodium was started 8 hours after surgery and continued for 3 weeks postoperatively.

The first hemoglobin control was done at 2 hours after the surgery. The second and third hemoglobin controls were performed at 24 and 72 hours after the surgery. If erythrocyte suspension was given to the patient control hemoglobin levels were checked 2 hours after transfusion. The nursing staff recorded the postoperative drainage at each 8 hour-shifts.

Transfusion criteria in our department were defined as follows; hemoglobin level is less than 8 g/dl or if the patient is symptomatic like dyspnea, palpitation, dizziness or tachycardia even if the hemoglobin was 8–10 g/dl.

Cold application with ice bags were routinely used to all patients. Drainage has been put in negative pressure unless more than 1,000 cc were present. If more than 1,000 cc drain was present at one shift we let the suction of the drain by only with gravity force. In group 1; patients were operated without plugging the femoral tunnel by one senior surgeon. In group 2 patients were operated by another senior surgeon and femoral tunnel was sealed with bony plug which was reshaped from anterior chamfer cut (Fig. 1, 2).

In group 1 there were 192 unilateral knee arthroplasty patients and in group 2 there were 96. We excluded patients with history of thromboembolic event, acetyl salicylic acid usage, different dosage of anticoagulant therapy due to pulmonary conditions or suspicion of venous thrombosis or bleeding diastasis. Patients with missing data were also excluded. Data included age, gender, preoperative hemoglobin values, lowest postoperative Hb values and amount of transfused erythrocyte suspension during hospitalization and last Hb values before discharge. Implants used were same for all patients. There were 192 patients who met these criteria; 132 in group 1 and 60 in group 2.

'Independent sample t-test' is used to compare two groups as statistical method.

## RESULTS

Neither inter- nor intra-group variables were different according to; operation time, type of prosthesis, tourniquet use and timing, preoperative and postoperative antibiotic usage and postoperative anticoagulant therapy usage.

There were 132 patients in group 1; age ranging from 43 to 82 and 60 patients in group 2 age ranging from 55 to 78. In group 1 there were 65 female, 57 male patients and in group 2; 35 of the patients were male. Radiologically all the patients were grade 4 osteoarthritis according to Kelgren- Lawrence classification. While the tourniquet time was 63 minutes in group 1; 58 minutes in group 2 which is not statistically significant.

Comparison of two groups by means of mean preoperative and postoperative hemoglobin levels are given in table 1. Also hemoglobin levels at time of discharge, drain output levels during hospitalization and mean ery-



Fig. 1. Bone plug from anterior chamfer cut.



Fig. 2. Sealing the femoral tunnel.

throcyte suspension given in units are also stated in table 1. Neither drainage nor amount of erythrocyte transfusion was affected from the age or gender.

In plugged group; lowest postoperative hemoglobin levels are higher than unplugged group which is statistically significant ( $p < 0.001$ ). Postoperative drain outputs are also lower in unplugged group ( $p < 0.001$ ) and amount of erythrocyte suspension are lower than unplugged group but there is no statistical difference.

## DISCUSSION

Total knee arthroplasty is one of the most widely used operations in daily practice of orthopedists. During this procedure average blood loss is up to 1,500 cc which may require transfusion and increasing susceptibility to transfusion complications (2, 3, 8, 12). There are many attempts to reduce blood loss. Some of them includes medical interventions such as systematic or local usage of tranexamic acid. There are some studies favoring usage of tranexamic acid in control of hemostasis (1, 7, 13). We do not use any systemic or local hemostatic agents.

Table 1. Comparison of the groups by means of hemoglobin levels, drain output and given erythrocyte suspension

	Group 1	Group 2	P value
Preoperative Hb levels	12.7 ± 1.42	12.5 ± 1.54	0.36
Lowest postoperative Hb levels	9.02 ± 1.14	10.01 ± 1.72	< 0.001
Hb levels during discharge	9.6 ± 1.09	9.93 ± 1.18	0.18
Total drain output (cc)	979.7 ± 285.1	729.84 ± 293.2	< 0.001
Erythrocyte suspension (U)	0.66 ± 0.75	0.61 ± 0.79	0.17

Usage of cryotherapy is controversial in reducing the blood loss. It has effect on rehabilitation and pain relief but maintaining of hemostasis is not proved in the literature. In both groups we use periodic cold application with ice bags postoperatively.

Clamping of drainage is also not proved to be effective against blood loss (10). In our study we did not clamp the drainage. We routinely put in negative pressure postoperatively unless the amount of drain is over 1,000 cc.

According to our senior surgeons' preference we use autologous bone plug during the surgery. In the literature there are some studies conforming the reduction in blood loss via autologous bone plug (5, 6). On the other hand there are also some studies showing no benefit of sealing femoral intramedullary canal. For example; Torres-Claramunt et al. showed no effect on blood loss, nor blood transfusion requirement by sealing the femoral tunnel with bony plug either bone cement in their prospective randomized study (11).

In group 1; 60 of 132 (45%) patients have given blood transfusion whereas in group 2; 29 of 66 (43%) patients required blood transfusion Ko et al. showed decrease need for allogenic blood transfusion in sealed group in their study (4). On the other hand Kumar et al. showed no significant change in transfusion need (5). In our study we observed no statistical difference in amount of erythrocyte transfusion. The only difference was the postoperative hemoglobin levels and drain outputs. Postoperative hemoglobin levels are much higher and drain output is much less than unplugged group. However this difference did not statistically effect the amount of given erythrocyte transfusion. Theoretically; lower drain output, higher postoperative hemoglobin levels are favorable in means of shorter duration of hospitalization and decreased need for transfusion although our results showed no statistically significant difference.

Skovgaard et al. studied the effect of fibrin sealers to provide effective hemostasis but showed no significant effect (9). Even sealing the femoral tunnel with bone plug did not effect the erythrocyte transfusion rate it is free to use.

## CONCLUSION

In conclusion; knee arthroplasty may cause bleeding which may lead to hematoma, necessity to blood transfusion. Sealing of femoral tunnel is a easy method and free to use which may decrease blood loss and transfusion necessity.

## References

1. Alvarez JC, Santiveri FX, Ramos I, Vela E, Puig L, Escolano F. Tranexamic acid reduces blood transfusion in total knee arthroplasty even when a blood conservation program is applied. *Transfusion*. 2008;48:519–525.
2. Berman AT, Geissele AE, Bosacco SJ. Blood loss with total knee arthroplasty. *Clin Orthop Relat Res*. 1988;234:137–138.
3. Bierbaum BE, Callaghan JJ, Galante JO, Rubash HE, Tooms RE, Welch RB. An analysis of blood management in patients having a total hip or knee arthroplasty. *J Bone Joint Surg Am*. 1999;81:2–10.
4. Ko PS, Tio MK, Tang YK, Tsang WL, Lam JJ. Sealing the intramedullary femoral canal with autologous bone plug in total knee arthroplasty. *J Arthroplasty*. 2003;18:6–9.
5. Kumar N, Saleh J, Gardiner E, Devadoss VG, Howell FR. Plugging the intramedullary canal of the femur in total knee arthroplasty. *J Arthroplasty*. 2000;15:947–949.
6. Raut VV, Stone MH, Wroblewski BM. Reduction of postoperative blood loss after press fit condylar knee arthroplasty with the use of a femoral intramedullary plug. *J Bone Joint Surg Am*. 1993;75:1356–1357.
7. Roy SP, Tanki UF, Dutta A, Jain SK, Nagi ON. Efficacy of intra-articular tranexamic acid in blood loss reduction following primary unilateral total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc*. 2012;20:2494–2501.
8. Sehat KR, Evans RL, Newman JH. Hidden blood loss following hip and knee arthroplasty Correct management of blood loss should take hidden loss into account. *J Bone Joint Surg Br*. 2006;86:561–565.
9. Skovgaard C, Holm B, Troelsen A, Lunn TH, Gaarn-Larsen L, Kehlet H, Husted H. No effect of fibrin sealant on drain output or functional recovery following simultaneous bilateral total knee arthroplasty. *Acta Orthop*. 2013;84:153–158.
10. Tai TW, Yang CY, Jou IM, Lai KA, Chen CH. Temporary drainage clamping after total knee arthroplasty: a meta-analysis of randomized controlled trials. *J Arthroplasty*. 2010;25:1240–1245.
11. Torres-Claramunt R, Hinarejos P, Pérez-Prieto D, Gil-González S, Pelfort X, Leal J, Puig L. Sealing of the intramedullar femoral canal in a TKA does not reduce postoperative blood loss. *Knee*. 2014;21:853–857.
12. White KL, Goodnough LT, Merkel K, Davis MH, Monk TG. A comparison of autologous blood procurement techniques for total hip replacement surgery. *Anesth Analg*. 1977;84(Suppl):S58.
13. Zhu M, Chen JY, Yew AK, Chia SL, Lo NN, Yeo SJ. Intra-articular tranexamic acid wash during bilateral total knee arthroplasty. *J Orthop Surg*. 2015;23:290–293.

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