Comparison of Blood Loss between Using Non Central Part Cutting Knee Prosthesis and Distal Central Part Cutting

Anan Malairungsakul MD*

** Phayao Hospital, Phayao, Thailand*

Background: *Patients who undergo knee replacement surgery may need to receive a blood transfusion due to blood loss during the operation. Therefore it was important to improve the design of knee implant operative procedures in an attempt to reduce the rate of blood loss.*

Objective: *The present study aimed to compare the blood loss between two types of knee replacement surgery.*

Material and Method: *This is a retrospective study in which 78 patients received cemented knee replacements in Phayao Hospital between October 2010 and March 2012. There were two types of surgical procedure: 1) using an implant position covering the end of the femoral bone without cutting into the central part of the distal femoral, 2) using an implant position covering the end of the femoral bone cutting the central part of the distal femoral. Blood loss, blood transfusion, hemoglobin and hematocrit were recorded preoperatively, immediately postsurgery and 48 hours after surgery.*

Results: *Findings revealed that the knee replacement surgery using the implant position covering the end of the femoral bone without cutting the central part of the distal femoral significantly lowered the rate of blood loss when compared to using the implant position covering the end of the femoral bone with central cutting of the distal femor. The average blood loss during the operation without cutting at the central part of distal femoral was 49.50±11.11 mL; whereas the operation cutting the central part of the distal femoral was 58.50±11.69 mL.*

Conclusion: *As regards blood loss, the knee replacement surgery using the implant position covering the end of the femoral bone without cutting the central part of distal femor was better than using the implant position covering the end of the femoral bone cutting at the central part of the distal femor.*

Keywords: *Blood loss, Knee replacement, Non central part cut*

J Med Assoc Thai 2014; 97 (12): 1302-7
Full text. e-Journal: *http://www.jmatonline.com*

While the exact cause of osteoarthritis (OA) is unknown, joint damage can be due to a repetitive movement or it can also begin as the result of an injury. The knee is particularly affected as it is a major weight-bearing joint. People with osteoarthritis usually suffer joint pain and some movement limitation and they refer themselves to physicians with symptoms of pain, strain and swelling in and around their joints. The initial treatments for osteoarthritis are providing patients with advice for reducing joint movement and providing medications such as NSAIDS, muscle relaxant. If the initial treatment cannot relieve the patients symptoms, knee replacement surgery standard guideline[1,2] is the next choice of treatment. Knee replacement is surgery to replace deteriorating knees and can reduce pain, prevent and fix disabilities as well as improve the quality of life among OA patients.

Total Knee Arthroplasty (TKA) was initiated in approximately 1860[3] and then the artificial knee joint with posterior stabilization[4] was designed. Much of TKA focused on its function in increasing the ability to bend and extend joints[5,6] and also to reduce the deterioration of artificial prosthesis[7,8]. However, the aurther found a difference in the cutting surface procedures may lead to a difference in the bleeding from knee replacement surgery. Medial pivot prosthesis can reduce blood loss during surgery, since it is designed for covering the total part of the femoral cut in an attempt to stop bleeding at the cancellous bone. However, there was no previous significant data to confirm the effectiveness of medial pivot total knee prosthesis. Therefore, this study aimed to determine the effect of using medial pivot total knee prosthesis, designed to cover the cancellous bone without cutting the central part of the distal femor, on reducing the blood loss during knee replacement surgery.

Correspondence to:
Malairungsakul A, Phayao Hospital, Bantom, Muang, Phayao 56000, Thailand.
Phone: 086-185-1719
E-mail: anan2an@hotmail.com

Objective

To compare blood loss between patients who underwent knee replacement using an implant position covering the cancellous bone without cutting the central part of the distal femor, and those who received artificial prosthesis with cutting the central part of the distal femor.

Research question

Did patients who underwent knee replacement using the implant position covering the cancellous bone without cutting the central part of the distal femor have less blood loss than those who received an implant with cutting the central part of the distal femor?

Material and Method

This was a retrospective study in which data from 78 patients was used who underwent knee replacement surgery at Phayao Hospital between October 2010 and March 2012. All of patients received knee replacement surgery according to the standard protocol using artificial joints. The surgery was carried out by one surgeon, but 2 different surgical techniques were used. The first group of 38 patients, received knee replacement surgery using implant positions covering the end of the femur without cutting the central part of the distal femor (Fig. 1-3). Whereas, the second group of 38 patients, received knee replacement surgery using implants involving cutting the central part of the distal femor (Fig. 4-6). All of them received local anesthesia via lumbar punctures, a haemostatic drug (tranxamine 10 mg/kg), and an antibiotic drug (cefazolin 2 gm) pre-operatively. Tourniquet pressure was set at 350 millimeters of mercury to monitor blood loss during surgery. Stop bleeding was done after finish operative procedure by released tourniquet pressure and used electrocauterization Blood loss was recorded during and at post-operative periods by measuring blood from the vacuum bottle and bloody gauzes which were measured by 1 gauze per 15 mL. Blood transfusion would be given to patients in cases where they had a hematocrit level lower than 30% or a hemoglobin level lower than 10 gram/dl. Patients who had history of medial illnesses such as blood disease, rheumatoid arthritis, gouty arthritis, post septic arthritis and traumatic arthritis were excluded from the present study.

Statistic

Descriptive statistics such as percentage, mean and standard deviation were used to describe the demographic data. An independent t-test was used to test the difference of hemoglobin and hematocrit levels between the two groups of patients.

Results

The mean age of type 1 surgery was 61.71±6.81 years and mean age of type 2 surgery was 63.18±5.92 years. There were no statistically significant differences in age and sex in both groups (Table 1).

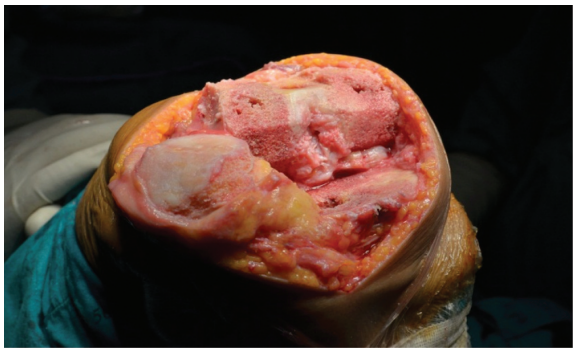

Fig. 1 Distal femoral cut of type 1 surgery without cutting the central part.

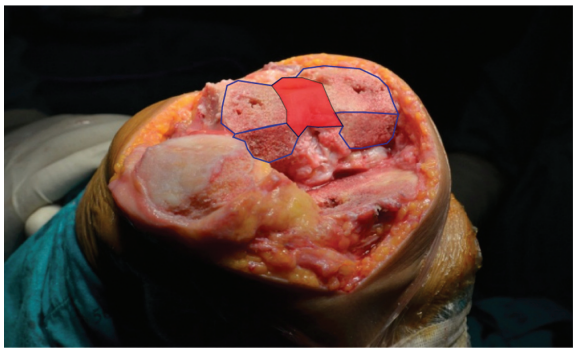

Fig. 2 Distal femoral cut of type 1 surgery without cutting the central part Identify area of bleeding.

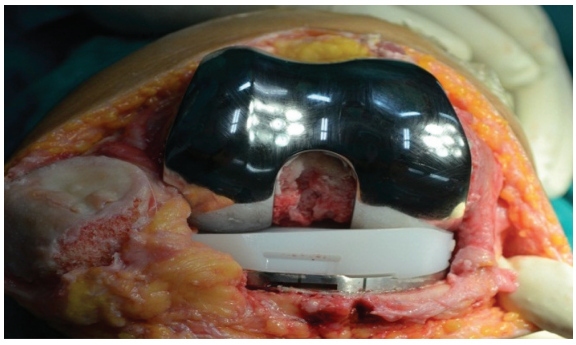

Fig. 3 After inserting the femoral prosthesis of type 1 surgery using the Medial pivot (posterior stabilize).

The mean blood loss during the operation of type 1 surgery was 49.50±11.1 mL; whereas type 2 surgery was 58.50±11.69 mL, patients undergoing type 1 surgery had significant lower of blood loss than those undergoing type 2 surgery (p<0.001) (Table 2).

The mean blood loss in post-operative 48 hours of type 1 surgery was 568.82±182.16 mL; whereas type 2 surgery was 591.75±201.33 mL, there was no significant difference in blood loss between type 1 and type 2 surgery (Table 3).

The mean of Hct and Hb before surgery post-operative 1 hours and post-operative 48 hours in both were no statistically significant differences groups.

The number of blood transfusion was equally 4 units in type 1 and 4 unit in type 2.

Fig. 4 Distal femoral cut of type 2 surgery with cutting the central hole part of distal femor.

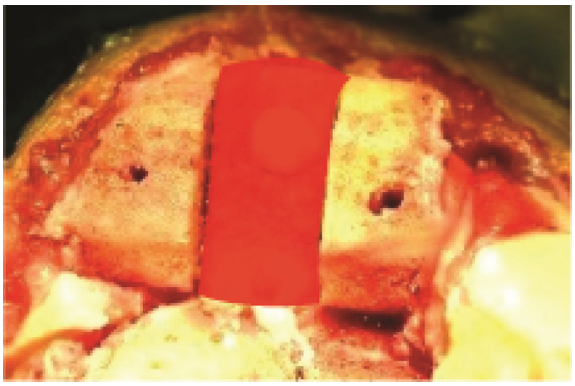

Fig. 5 Distal femoral cut of type 2 surgery with cutting the central hole Identify area of bleeding.

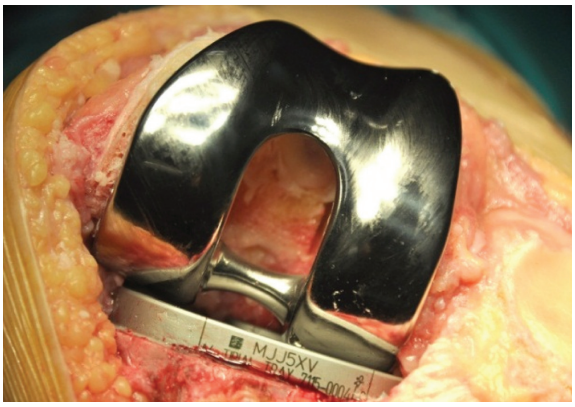

Fig. 6 After inserting the femoral prosthesis of type 2 surgery using the Styker scopioflex (posterior stabilize).

Discussion

There are two main operative techniques for cemented knee replacement. Type 1 surgery was designed to minimize the cutting of the central distal femoral part by using only a partial cut for inserting the femoral prosthesis and then the total part of the

Table 1. Demographic data of patients who received type 1 and type 2 surgery

Demographics	Type 1 surgery (n = 38)		Type 2 surgery (n = 40)		p-value
	n	%	n	%	
Gender					
Male	5	13.2	6	15.0	0.537
Female	33	86.8	34	85.0	
Age (years)					
Mean, SD	61.71±6.81		63.18±5.92		0.314
Range	56-80		56-81		

Indepenpent t-test and Chi-square test

Table 2. Comparison of the average blood loss during the operation between type 1 and type 2 surgery (n = 78)

Type of surgery	Mean	SD	df	t	p-value
Type 1 surgery	49.50	11.11	76	-3.48*	<0.0004
Type 2 surgery	58.50	11.69			

* p<0.05

Table 3. Comparison of the average blood loss immediately post-operative between type 1 and type 2 surgery (n = 78)

Type of surgery	Mean	SD	df	t	p-value
Type 1 surgery	568.82	182.16	76	-0.527	0.600
Type 2 surgery	591.75	201.33			

* p<0.05

Table 4. Comparison of the average lavel of hematrocrit and hemoglobin between type1 and type 2 surgery (n = 78)

	Type 1	Type 2	*p*-value
Hct (%)			
Before surgery	36.46	36.78	0.650
1 hour after surgery	33.29	33.11	0.523
48 hours after surgery	30.22	31.48	0.123
Hb (g/dL)			
Before surgery	12.11	12.17	0.803
1 hour after surgery	10.77	10.97	0.641
48 hours after surgery	10.59	10.49	0.185

ANOVA test

cancellous bone was closed. Whereas, the central part of distal femor was cut in type 2 surgery for inserting the femoral prosthesis; therefore, the 3 parts of cancellous bone was uncovered. During knee replacement surgery, blood loss mainly comes from the cancellous bone, soft tissue and blood vessels surrounding the knee joints. There are two main techniques used to reduce bleeding during knee replacement surgery. Firstly, the bone plug is used to stop bleeding from the femoral canal which is caused from inserting the guide in the first step of the operation into the distal femor. Secondly; an electrocauterization is used to stop bleeding from the cancellous bone and blood vessels surrounding the knee joints.

Since type 2 surgery was not designed for using prosthetic parts to cover the central part of both side bones (Fig. 4-6), the researcher expected that bleeding possibly came from cutting the central part of the cancellous bone. The uncovered part of the distal femoral cut was approximately 40% of the total distal femoral cut space located at the central and side bone areas. On the other hand, in the case of using the prothesis to cover the whole area of the distal femoral cut, then the bone cement would help to reduce some bleeding. Mean while, the prothesis attached at the central space would have bleeding coming from the cancellous bone and which would stop the coagulation process limiting the estimation of the actual volume of the blood loss. This was consistent with other studies into knee replacement surgery when it was agreed that patients always suffer a lot of bleeding[9,10]. A variety of surgical techniques were developed to reduce the amount of blood loss resulting in a decrease in the rate of blood transfusions, reducing the hospitalization rates and promoting the rehabilitation process. There were surgical techniques developed to stop bleeding such as using tourniquets[11]; MIS operative techniques[12] using small wound incisions in order to reduce soft tissue damage in the knee joints; arthroscopic surgery, sealing the intramedullary femoral canal with autologous bone plug[13]; knee positioning[14], and using coagulant drugs such as Tranexamic acid[15,16] known as an antifibrinolytic agent for reducing blood loss following major operations.

Patients who had hematocrit levels less than 30% or haemoglobin levels less than 10 gm/dl necessitated blood transfusions. Patients who received type 1 surgery had a higher level of haemoglobin immediately post operatively (Hb = 11.08 gm/dl) than those who received type 2 surgery (Hb = 10.79 gm/dl). Similarly, 48 hours after surgery, patients having undergone type 1 surgery had higher levels of haemoglobin immediately post operatively (Hb = 10.59 gm/dl) than those who underwent type 2 surgery (Hb = 10.49 gm/dl). But there were not significantly statistical difference in Type 1 and Type 2 Hb, Hct Preoperation post operation 1 hour post operation 24 hours.

Currently there are a lot of developments in prosthesis focused on promoting its function in bending and stretching. Research suggests that the design of prosthesis for reducing bleeding from operative procedures is a significant factor in knee replacement surgery.

Conclusion

Knee replacement surgery carried out using prosthetic design covering the femoral part without cutting the central part of the distal femor was more effective in reducing the amount of blood loss than using prosthesis with cutting at the central part of the distal femor.

What is already known on this topic?

According to the references of this study, the author has been reviewed the literatures from medical databases which found many articles mention about 2 type of surgical techniques. Both techniques for cutting the distal end of femur have been worldwide accepted. Then in this study, we also used both techniques which were standard surgical procedure. However, no comparison study about these 2 techniques.

What this study adds?

Aim of this study is find out the best one surgical technique for cut the distal end of femur by compare the intra-operative blood loss which is the

important point for surgery and also post-operative surgical outcome.

Acknowledgement

The author wishes to thank Sattaya Rojanasthien MD, for his support throughout the study, thanks to the participants for giving permission retrospectively for their data to be used in this study and thank to Sirichai Luevitoonvechkij MD, for his helpful suggestions and to G Lamar Robert PhD, for reviewing the manuscript.

Potential conflicts of interest

None.

References

1. Krackow KA. The technique of total knee arthroplasty. St. Louis: Mosby; 1990.
2. American Academy of Orthopaedic surgeons. AAOS clinical guideline on osteoarthritis of the knee (phase II) [Internet]. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2003 [cited 2014 Oct 10]. Available from: http://www.qualitymeasures.ahrq.gov/content.aspx?id=28039
3. Insall J, Ranawat CS, Scott WN, Walker P. Total condylar knee replacement: preliminary report. 1976. Clin Orthop Relat Res 2001; (388): 3-6.
4. Scuderi G, Insall J. Performance of posterior cruciate ligament substituting total knee arthroplasty. In: Insall J, Scott W, Scuderi G, editors. Current concepts in primary and revision total knee arthroplasty. Philadelphia: Lippincott-Raven; 1996: 41-5.
5. Dennis DA, Komistek RD, Stiehl JB, Walker SA, Dennis KN. Range of motion after total knee arthroplasty: the effect of implant design and weight-bearing conditions. J Arthroplasty 1998; 13: 748-52.
6. Ranawat CS, Luessenhop CP, Rodriguez JA. The press-fit condylar modular total knee system. Four-to-six-year results with a posterior-cruciate-substituting design. J Bone Joint Surg Am 1997; 79: 342-8.
7. Jacobs JJ, Roebuck KA, Archibeck M, Hallab NJ, Glant TT. Osteolysis: basic science. Clin Orthop Relat Res 2001; 71-7.
8. Hui FC, Fitzgerald RH Jr. Hinged total knee arthroplasty. J Bone Joint Surg Am 1980; 62: 513-9.
9. 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.
10. Lemos MJ, Healy WL. Blood transfusion in orthopaedic operations. J Bone Joint Surg Am 1996; 78: 1260-70.
11. Vandenbussche E, Duranthon LD, Couturier M, Pidhorz L, Augereau B. The effect of tourniquet use in total knee arthroplasty. Int Orthop 2002; 26: 306-9.
12. Tria AJ Jr, Coon TM. Minimal incision total knee arthroplasty: early experience. Clin Orthop Relat Res 2003; 185-90.
13. 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.
14. Ong SM, Taylor GJ. Can knee position save blood following total knee replacement? Knee 2003; 10: 81-5.
15. Samama CM. A direct antifibrinolytic agent in major orthopedic surgery. Orthopedics 2004; 27 (6 Suppl): s675-80.
16. Charoencholvanich K, Siriwattanasakul P. Tranexamic acid reduces blood loss and blood transfusion after TKA: a prospective randomized controlled trial. Clin Orthop Relat Res 2011; 469: 2874-80.

การศึกษาเปรียบเทียบการสูญเสียเลือดจากการผ่าตัดเปลี่ยนข้อเข่าเทียมสองชนิด

อนันต์ มาลัยรุ่งสกุล

ภูมิหลัง: *ผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมมีโอกาสได้รับเลือดเนื่องจากการสูญเสียเลือดระหว่างผ่าตัด ดังนั้นจึงจำเป็นที่จะปรับปรุงรูปแบบของข้อเข่าเทียม และวิธีการผ่าตัดเพื่อลดการสูญเสียเลือด*

วัตถุประสงค์: *เพื่อเปรียบเทียบการสูญเสียเลือดระหว่างการผ่าตัดข้อเข่าเทียมสองชนิด*

วัสดุและวิธีการ: *ศึกษาข้อมูลย้อนหลังในกลุ่มผู้ป่วยจำนวน 78 ราย ที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมแบบใช้ซีเมนต์ ในโรงพยาบาลพะเยา ระหว่างเดือนตุลาคม พ.ศ. 2553 ถึง เดือนมีนาคม พ.ศ. 2555 วิธีการผ่าตัดมีสองชนิด คือ 1) ผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยไม่เจาะเปิดส่วนกลาง 2) ผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยเจาะเปิดส่วนกลาง ผู้นิพนธ์บันทึกจำนวนเลือดที่สูญเสีย การได้รับเลือดของผู้ป่วย ฮีมาโตคริต และฮีโมโกลบิน ระหว่างก่อนผ่าตัด หลังผ่าตัดทันที และ 48 ชั่วโมง หลังผ่าตัด*

ผลการศึกษา: *พบว่าการผ่าตัดเปลี่ยนข้อเข่าโดยใช้การผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขา โดยไม่เจาะเปิดส่วนกลางมีการสูญเสียเลือดน้อยกว่า การผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยเจาะเปิดส่วนกลางอย่างมีนัยสำคัญทางสถิติ ค่าเฉลี่ยของการสูญเสียเลือดโดยวิธีการผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยไม่เจาะเปิดส่วนกลาง มีค่าเท่ากับ 49.50±11.11 มิลลิลิตร ในขณะที่การสูญเสียเลือดจากการผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยเจาะเปิดส่วนกลาง มีค่าเท่ากับ 58.50±11.69 มิลลิลิตร*

สรุป: *การผ่าตัดเปลี่ยนข้อเข่าเทียมแบบปิดส่วนปลายของกระดูกโคนขาโดยไม่เจาะเปิดส่วนกลางเป็นวิธีที่สูญเสียเลือดน้อยกว่าการผ่าตัดแบบปิดส่วนปลายของกระดูกโคนขาโดยเจาะเปิดส่วนกลาง*