Association of Post-Operative Lateral Skin Numbness after Total Knee Arthroplasty and Length of Skin Incision

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Objectives: *This study aimed to identify factors associated with lateral skin numbness after total knee arthroplasty (TKA), in particular, the length of the skin incision from the inferior margin of the patella and from the tibial tubercle to the inferior end of the skin incision including identification of common locations of numbness. The study also investigated the relationship between the diabetes status of the patient and the occurrence of numbness.*

Materials and Methods: *A prospective analytic observational study was conducted with a total of 45 TKAs from 33 patients (12 bilateral, 21 unilateral) who had undergone primary TKA for primary osteoarthritis. All TKAs were performed by conventional surgical techniques. The length of the skin incision was determined based on the skin tension of each patient. The location of skin numbness was identified with the knee in 90 degrees of flexion using a blunt pin to elicit a pin-prick sensation. We performed pin-prick sensation tests at 4 areas: the upper and lateral border of the patella, the upper lateral half of the patella, the lower border of the patella inferiorly to the end of the incision and expanding laterally, and the lower half of the patella. Two skin incision lengths were measured. The length of the incision from the patella was defined as a the distance from the inferior border of the patella inferiorly to the end of the skin incision. The length of the incision from the tibial tubercle was measured from the tibial tubercle inferiorly to the end of the skin incision. Both incision lengths were measured intraoperatively and then were measured again during the first follow up visit at between 2 weeks and 1 month.*

Results: *Among the 45 TKAs, 26 (57.78%) developed objective numbness. In the group of TKAs with numbness, the length of the incision from the lower patella was 7.13 cm. which was significantly longer than the 6.00 cm. in the group with no numbness. The mean length of the incision from the tibial tubercle in the numbness group was 2.88 cm. compared with 2.04 cm. in the no numbness group, a statistically significant difference. Of the 5 knees from 4 patients with well controlled DM, all had skin numbness. Of the TKAs with numbness, 100% had numbness on the lower border of the patella inferior to the incision, 57.69% had numbness in the lower half of the patella and 15.38% had numbness in the upper lateral half of the patella.*

Conclusions: *A longer incision length is associated with a higher incidence of postoperative numbness. The incision lengths suggested in this study may potentially help reduce the incidence of short-term skin numbness complications after TKA.*

Keywords: *skin numbness, lateral skin numbness, total knee replacement, length of skin incision*

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Introduction

Primary total knee arthroplasty (TKA) is a reliable and cost-effective treatment of osteoarthritis of the knee which can alleviate pain and restore physical function. The 10- to 15-year survivorship of primary TKA is more than 90%[1,2]. There are several complications which can occur after TKA, e.g.,aseptic loosening, periprosthetic fracture, and infection. In addition, lateral skin numbness is a common symptom which often occurs after conventional TKA. Previous studies have reported that the incidence of lateral skin numbness was about 58%-68%[3,10]. However, numbness has received only limited attention. Infrapatellar branches of the greater saphenous nerve (IPBSN) extend medially and laterally along the patella from the superior pole to the tibial tubercle[4]. There are 3 or more variations of this nerve. The IPBSN can be injured after TKA which can result in lateral skin numbness. The purpose of this study was to determine the association between the length of the skin distally from 2 anatomical landmarks and the incidence of numbness after surgery and to investigate whether an appropriate incision length can decrease the risk of lateral skin numbness.

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Materials and Methods

A prospective cohort study was conducted from August 2016 to July 2019. Patients with primary osteoarthritis of the knee who underwent primary TKA during the study period were enrolled. Exclusion criteria were having had previous knee surgery or having a knee scar, having previously had impaired sensation of the knee from any cause, e.g., spinal stenosis, recent spine surgery, DM neuropathy, other neuropathy, and having a valgus deformity or secondary osteoarthritis of the knee. All surgeries were performed by one surgeon using conventional surgical techniques including a midline skin incision and the medial parapatellar approach. The length of the skin incision increased with the amount of skin tension. All TKAs used the same implant from MicroPort's Evolution® Medial-Pivot Total Knee Arthroplasty (Microport Orthopedics Inc., Arlington, TN, USA). An anesthesiologist used the same technique of regional anesthesia, followed by analgesic and pain control drugs in all cases.

The length of the first incision was measured from the inferior border of the patella to the inferior end of the skin incision (the distance from the patellar tubercle) (Fig. 1). The length of the second incision was measured from the tibial tubercle to the inferior end of the skin incision (the distance from the tibial tubercle) (Fig. 2). Both incision lengths were measured intraoperatively and again post-operatively at the first follow up, between 2 weeks and 1 month (Fig. 3).

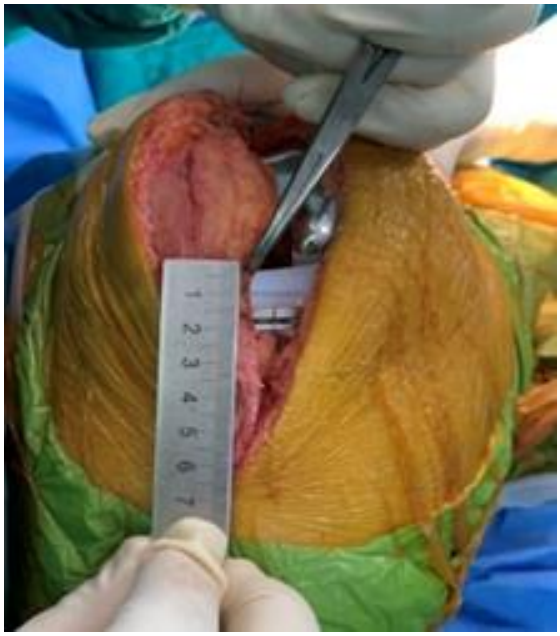

Fig.1 Incision length from the Inferior margin of the patella.

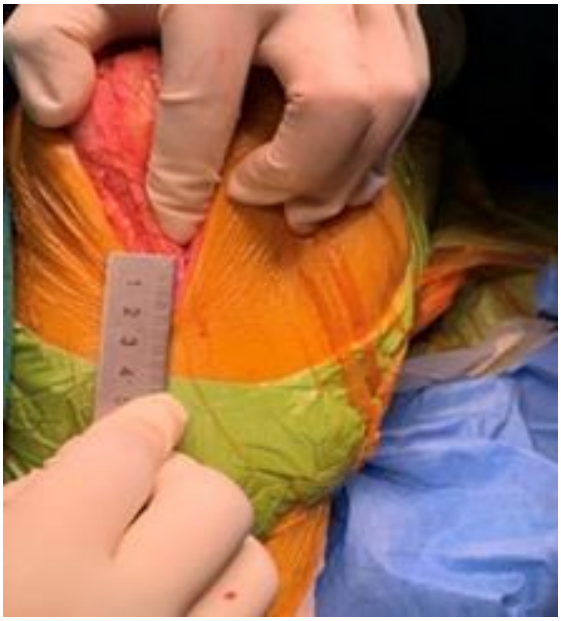

Fig.2 Incision length from the tibial tubercle.

Fig.3 Measurement of length of skin incision.

Skin numbness was assessed using the blunt pin-prick sensation test which is a simple and reliable method to assess numbness from an IPBSN injury[4]. A Semmes-Weinstein monofilament size 5.07 was applied to the skin with the knee in 90 degrees of flexion. A blunt pin-prick was then performed every 1 cm vertically and horizontally from the lateral to the mid patella lateral to the scar. Based on the distribution of the IPBSN[5,6] and from cadaveric studies, the locations of numbness

were grouped into 4 areas: Area 1 was above and lateral to the border of the patella; Area 2 was the upper lateral half of the patella; Area 3 was the lower border of the patella inferior to the end of the incision and expanding laterally; and Area 4 was the lower half of the patella (Fig. 4). Margins and locations of skin numbness were recorded. An area of skin numbness was defined as an area of at least 1 cm^2.

Fig.4 Areas of skin numbness.

Statistical Analysis

The sample size in this study was calculated using a formula for comparing two independent means. Parameters, including the mean and SD of the incision length between the numbness and non-numbness groups, were determined based on a pilot study. According to our pilot study, the mean (SD) incision length of patients with numbness and without numbness were 7.68 (1.09) and 5.88 (0.65) cm, respectively. With the alpha error at 0.05 and power at 80%, a sample size of 6 was required for each group. However, to increase precision, the study recruited all eligible patients during the 3-year study period.

Patient demographic data are presented as either frequency or mean (SD). The TKAs were classified into two groups: numbness and no-numbness. For patients with bilateral TKAs, each knee was analyzed independently as the IPBSN generally functions independently in each knee[11]. The Chi-square test or Fisher's exact test was performed for comparison of categorical data between the two groups. The independent t-test was used to compare means between the two groups. *P*-values < 0.05 were considered statistically significant. In addition, the Receiver Operating Characteristics Curve (ROC) was calculated to determine an optimal incision length to minimize reduce the risk of lateral skin numbness. Sensitivity and specificity to determine skin numbness were also calculated using the cut-off point suggested by the ROC.

Results

A total of 33 patients representing 45 TKAs were enrolled in the study. Twelve patients underwent bilateral TKAs and 21 patients had unilateral TKAs. Most of the patients were female with a male:female ratio of 1:4.5. The mean age of the patients was 66.59 years. There were 4 patients with diabetes, all of whom had well-controlled DM with FBS < 150 mg/dl. All TKAs were performed to correct a varus deformity; in three patients with 3 knees the varus deformity was excessive (>15 degrees). (Table 1)

Lateral skin numbness was observed in 26 TKAs (57.7%) from 24 patients. There was no significant difference in sex, age, or side of TKAs between the numbness and no-numbness groups. There were 19 TKAs (43.3%) from 14 patients in the no-numbness group (Table 2). Twelve patients had bilateral TKAs of whom 5 had numbness on one side only. All 4 diabetic patients (5 TKAs) had lateral skin numbness after surgery, although DM was not significantly associated with numbness. The 3 TKAs with severe varus deformity were all in the numbness group, but the difference between the severe and not severe deformity groups was not statistically significant. (Table 2)

The mean length of skin incision from the patella was 7.13 cm. among patients with skin numbness, significantly longer than the 6.00 cm. in the no-numbness group. The appropriate cut-off point for the length of the incision from the patella to minimize the risk of numbness as determined by the ROC Curve was 6.8 cm. (Sensitivity = 69.23%, Specificity = 78.95%) (Table 2 and Chart 1).

The mean incision length from the tibial tubercle in the lateral skin numbness group was 2.88 cm. and 2.04 cm. in the no-numbness group, a statistically significant difference. The optimal cut-off point for the incision length from the tibial tubercle suggested by the ROC curve was 2.5 cm. (Sensitivity = 76.92%, Specificity = 94.74%) (Table 2 and Chart 2).

Numbness at the lower border of the patella and inferior to the end of the incision expanding laterally (Area 3) was observed in all cases with numbness (100%). Numbness at the area on the lower half of the patella (Area 4) and the area on the upper lateral half of the patella (Area 2) were observed in 57.69% and 15.38 % of cases with numbness, respectively. (Chart 3)

Table 1 Patient Demographic Data.

	Total patients: n=33 (45 TKAs)
Male/Female	6/27
Age	66.59±5.49(57-79)
DM/Non DM	4/29
TKA Lt/Rt	22/23
Bilateral/Unilateral TKAs	12/21
Severe Varus Deformity (>15 degrees)/Not Severe	3/30

Table 2 Length of skin incision and incidence of numbness.

	Numbness n=26 TKAs	**No Numbness n=19 TKAs**	***P*-value**
Male/Female	5/21	2/17	*0.681†*
Age	65.96±5.12 (58-75)	66.00±5.79 (57-79)	*0.981‡*
DM/Non DM	5/21	0/19	*0.063†*
TKA Lt/Rt	13/13	9/10	*0.862**
Bilateral TKA/Unilateral TKA	9/17	15/4	*0.003**
Severe varus (>15 Degrees)/Non severe	3/23	0/19	*0.252†*
Length from lower margin of patella	7.13±0.91	6.00±0.76	*<0.001‡*
Length from tibial tubercle	2.88±0.47	2.04±0.31	*<0.001‡*

*Chi-square test, †Fisher's exact test, ‡Independent t-test, statistically significant p<0.05

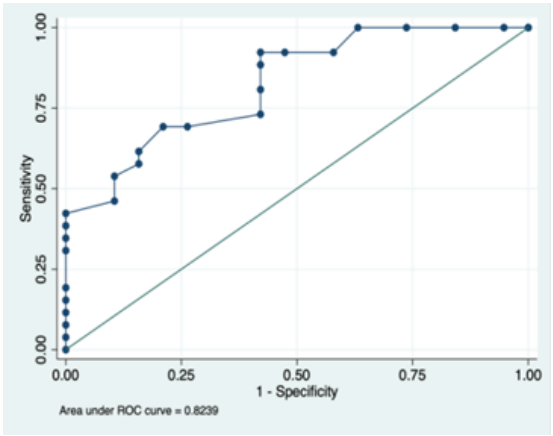

Chart 1 ROC curve of incision length from lower tubercle.

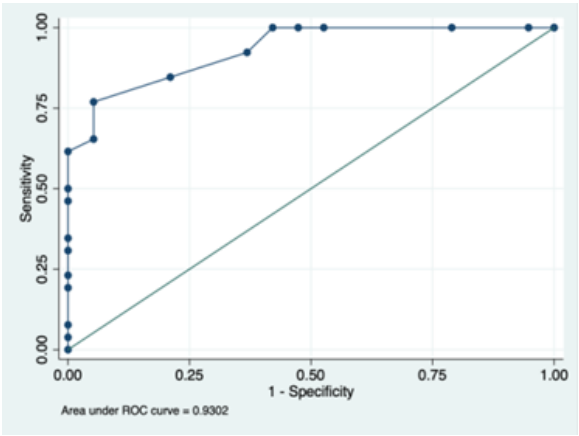

Chart 2 ROC curve of incision length from tibial patella.

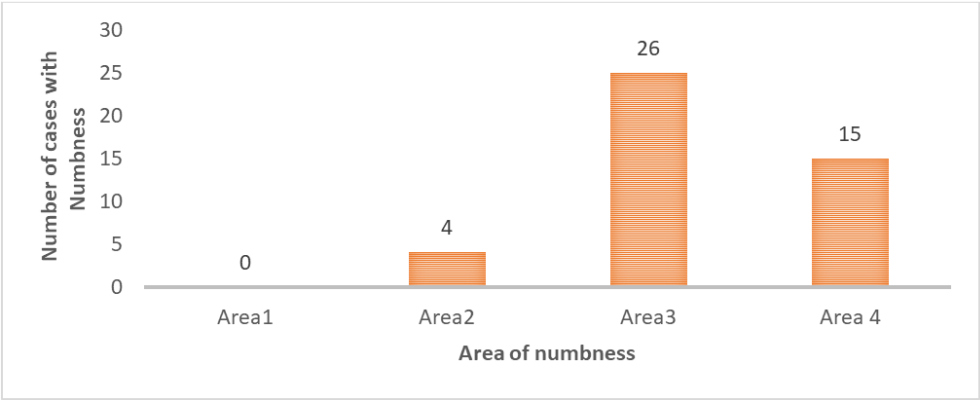

Chart 3 Comparison of incidence of lateral skin numbness after TKA by area group.

Discussion

Lateral skin numbness is a common post-operative complaint after knee arthroplasty. However, this symptom has not been a major focus in most studies. Additionally, there is lack of evidence regarding the appropriate incision length to decrease the risk of skin numbness. In this study, post-operative lateral skin numbness was observed in 57.7% of 45 TKAs. Most previous studies have also reported an area of numbness at 1-2 years after the surgery. For example, Arak et al.[4] reported on the area of skin numbness in 25 consecutive minimally invasive surgeries (MIS) TKAs. In that study, median numbness areas of 9.6 and 11.83cm^2 were still observed at the 1 year follow up in the group with a skin incision < 10 cm and the group with a skin incision ≥10 cm, respectively. Johnson et al.[7] conducted a study of 26 TKAs which used a medial parapatellar skin incision. The mean residual area of skin numbness was 33 cm^2 at 2 years postoperatively. However, previous studies have reported only the total area of numbness. No definitive length of incision that might increase the risk of lateral skin numbness has been reported. For example, Hopton et al.[8] reported that patients with a TKA scar over 22 cm long had a mean numbness area of 82.0 cm^2, as compared with 31.7 cm^2 in patients with a scar less than 18 cm in length. Another study looked at the effect of the side of incision. Berg et al.[9] demonstrated that a lateral incision produced less dysesthesia than a medial incision. Our study, looking specifically a the length of the incision, demonstrated that patients with numbness had a longer skin incision than those without numbness and that the total area of skin numbness after a TKA increased with the length of the skin incision. In this study, skin sensation was found to improve with time. Regarding the location of numbness and the side of the knee, Thomas el al.[11] reported that numbness is independent of whether the left or right knee is involved. In our study, of the 12 patients who had undergone a TKA in both knees at different times, 7 patients had the same results in both knees: 2 patients had numbness in both knees and 5 patients had no numbness in either knee. Five patients had different numbness results in each knee.

Diabetes can lead to neuropathy. In our study, all 4 DM patients, all of whom had well-controlled DM, had numbness after their TKA. The DM status was not a significant factor in predicting numbness which could be due to the small number of DM patients in our study. Further study is ongoing.

Strengths of this study include that it was a prospective study with all data measured and recorded using a standard protocol. Patients were recruited following the inclusion/exclusion criteria to avoid potential confounders. In addition, all TKAs were performed by one surgeon which helped reduce the likelihood of variation in operative outcomes due to the performance of the attending physician. This study also has some limitations. Although the number of TKAs included was higher than the calculated required sample size, due to the small number of DM patients in the study we were not able to determine whether DM is associated with skin numbness. In addition, skin numbness outcomes in this study were assessed at 2 weeks to 1 month post-operation, providing only relatively short-term information. Previous studies have reported inconsistent results regarding whether skin numbness can recover 1-2 years after surgery[5,9]. Our research is ongoing to determine the long-term impact of incision length on the skin numbness.

Findings of this study provide evidence-based information regarding factors associated with skin numbness after TKA. Adhering to the optimum incision lengths suggested in this study could potentially help surgeons reduce the incidence of this complication and properly plan for providing advice to patients.

Conclusions

The length of the skin incision from the inferior margin of the patella and tibial tubercle is associated with the incidence of lateral skin numbness after TKA surgery. Longer incision length is associated with a higher incidence of postoperative numbness. The most common area of skin numbness is the lower border of the patella inferior to the end of the incision and expanding laterally. The proper incision lengths from the patella and from the tibial tubercle, 6.8 cm. and 2.5 cm, respectively, can potentially reduce the incidence of short-term skin numbness.

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ภาวะชาหัวเข่าด้านข้าง ภายหลังการผ่าตัดเปลี่ยนข้อเข่า ความสัมพันธ์กับขนาดความยาวของแผล

เศกสิทธิ์ เสงี่ยมศักดิ์,พบ

วัตถุประสงค์: การศึกษานี้มีวัตถุประสงค์เพื่อหาความสัมพันธ์ ระหว่าง ขนาดความยาวของแผลที่ผิวหนังคนไข้หลังผ่าตัดเปลี่ยนข้อเข่าเทียม ว่ามีความสัมพันธ์ กับภาวะชาเข่าด้านข้างหรือไม่ โดยวัดจากจุดล่างสุดของลูกสะบ้าและ ตุ่มกระดูกหน้าแข้ง (tibial tubercle) ไปยังขอบล่างสุดของแผล เราต้องการทราบความยาวที่เหมาะสมที่สุดที่สามารถ ลดความเสี่ยง การเกิดภาวะชาหัวเข่าได้ นอกจากนี้ ยังได้ศึกษาเรื่องเบาหวานว่ามีผลต่อกลุ่มตัวอย่างหรือไม่ และโดยศึกษาผลของการชาครั้งแรกตั้งแต่หลังผ่าตัด ตำแหน่งที่ชา ณ วันนัดตรวจอาการที่ 2 สัปดาห์ ถึง 1 เดือน ว่าตำแหน่งใดพบมีอาการชามากที่สุด

วัสดุและวิธีการ: เป็นการศึกษาแบบ Prospective Analytic Observational Study โดยศึกษาในเคสผ่าตัดข้อเข่าเทียม จำนวน 45 เข่าจากคนไข้ 33 คน (12 Bilateral, 21 Unilateral) โดยทุกเคสเป็นจากภาวะเข่าเสื่อมแบบปฐมภูมิ ทุกเคสได้รับการผ่าตัดแบบดั้งเดิม การขยายขนาดของบาดแผลขึ้นกับว่าสามารถยืดผิวหนังได้มากน้อย เราแบ่งคนไข้เป็น 2 กลุ่ม กลุ่มแรกคือมีภาวะชาหัวเข่าภายหลังผ่าตัด จำนวน 26 เข่า (57.78%) และกลุ่มที่ 2 ไม่มีภาวะชาหัวเข่า จำนวน 19 เข่า (42.22%) โดยได้ตรวจตำแหน่งที่ชา ขณะที่หัวเข่างอ 90 องศา ด้วยการใช้ pin-prick ใน 4 ตำแหน่ง คือ Area 1) ด้านบนและขอบนอกต่อลูกสะบ้า, Area 2) ครึ่งลูกสะบ้าด้านบน ฝั่งด้านนอก, Area 3) จากขอบล่างของลูกสะบ้าจนถึงล่างสุดของแผลและขยายไปทางด้านนอกและ Area 4) ครึ่งลูกสะบ้าด้านล่างฝั่งด้านนอก กล่าวถึงการวัดความยาวของแผล ทำการวัด 2 ครั้งคือ ณ ขณะผ่าตัดหลังใส่ ข้อเข่าเทียมแล้วก่อนเย็บปิด และ ณ วันที่นัดตรวจติดตามครั้งแรกที่ 2 สัปดาห์ ถึง 1 เดือน

ผลการศึกษา: ในกลุ่มที่มีอาการชา ค่าเฉลี่ยความยาวแผล จากขอบล่างของลูกสะบ้าคือ 7.13 เซนติเมตร ยาวกว่าในกลุ่มที่ไม่ชา ซึ่งมีค่าเฉลี่ยความยาวแผล จากขอบล่างของลูกสะบ้าคือ 6.00 เซนติเมตร ค่าเฉลี่ยความยาวแผลจากตุ่มกระดูกหน้าแข้งของกลุ่มที่ชาเข่าคือ 2.88 เซนติเมตร ซึ่งยาวกว่าในกลุ่มที่ไม่ชาที่มีค่าเฉลี่ยความยาวแผล จากตุ่มกระดูกหน้าแข้งคือ 2.04 เซนติเมตร ซึ่งเราพบว่ามีความแตกต่างอย่างมีนัยยะสำคัญทางสถิติ เราพบ 5 เข่า (11.1%) จาก คนไข้ 4 คน ที่เป็นเบาหวาน ทุกคนมีอาการชาเข่าแต่ไม่พบความแตกต่างทางสถิติระหว่าง 2 กลุ่ม และเรายังพบว่า ตำแหน่งที่ชาบริเวณจากขอบล่างของลูกสะบ้าจนถึงล่างสุดของแผลและขยายไปทางด้านนอก (Area3) พบถึง 100%, ครึ่งลูกสะบ้าด้านล่าง (Area4) พบ 57.69% และครึ่งลูกสะบ้าด้านบน ฝั่งด้านนอก (Area2) พบเพียง 15.38% ตามลำดับ

สรุป: จากการศึกษา เราพบว่า ความยาวของบาดแผล มีผลทำให้อุบัติการณ์การเกิดภาวะชาเข่าภายหลังผ่าตัดสูงขึ้น จากการค้นพบความสัมพันธ์จากการศึกษานี้ จะสามารถนำไปใช้ประโยชน์ในการให้ข้อมูลผลข้างเคียงระยะสั้น ภายหลังการผ่าตัดเปลี่ยนข้อเข่าได้