Intramedullary Versus Extramedullary Tibial Alignment Guides in Total Knee Arthroplasty: A Radiographic Analysis

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Purpose: *to evaluate the postoperative radiographic position of the TKA components and compare the difference in the accuracy of positioning of tibial components between Intramedullary guides tibia and extramedullary guides tibia.*
Methods: *An intramedullary guide was used in 50 cases and extramedullary guide was used in another 50 cases. A radiographic study was performed after 3 month of follow up to evaluate postoperative component position and compare the difference in the tibiofemoral angle and the tibial component angle between 2 groups.*
Results: *Radiographic analysis showed that satisfactory position was achieved using both types of instrumentation. No statistically significant difference was observed in the tibiofemoral angle. However the coronal plane positioning of the tibial component revealed a statistically significant difference ($p < 0.01$), with intramedullary guides being superior to extramedullary guides. Both groups were within the percentage of outlier (< 3 degree varus). The mean surgery time and the drainage blood loss in intramedullary guides was more than extramedullary guides with statistically significant difference ($p < 0.01$).*
Conclusion: *Both techniques allowed satisfactory alignment. It is important for the surgeon to appreciate the benefits and deficiencies of each guide and to use whichever is suited most properly in each particular case.*

Keywords: *Intramedullary versus extramedullary tibial alignment guides*

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Introduction

Fundamental objectives of total knee arthroplasty (TKA) include relieve of pain, correction of deformity and restoration range of motion and function near normal of activity daily living. The prosthetic placement and overall limb alignment correlate with long-term clinical success. Positioning of the implant is felt to be the most important factor and significant increase in loosening when the tibial implant was placed more than 3 degree of varus[1-8,11-14]. The purpose of this study was to evaluate the postoperative radiographic position of the TKA components and compare the difference in the accuracy of positioning of tibial components between Intramedullary guides tibia and extramedullary guides tibia.

Materials and Methods

At the King Narai Hospital in Lopburi, Thailand, 100 cemented posterior stabilized design (PFC sigma Depuy Synthes) TKA were implanted in 61 left knees and 39 right knees by a single surgeon. A block randomization technique was applied. A computer randomization system was used to allocate each patient to either the extramedullary guides tibia or intramedullary guides tibia. Prior to each surgery, the surgeon opened an opaque sealed envelope to determine the allocation. The femoral component was positioned using intramedullary guides in both groups.

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Radiographic Analysis

After surgery, each patient was evaluated using a standing long-leg alignment radiographs. All radiograph were performed at the distance of 190 cm. Angular measurements include

1. The tibiofemoral angle is the angle between the anatomic axis of the tibia and the anatomic axis of the femur. (optimal value = 7 +/- 5 degree)[6]
2. The tibial component angle is the angle between a line drawn from the exact middle of the talus to the exact middle of the proximal tibial cut. A second line was drawn along the underface of the tibial component. The angle formed by the intersection of these lines was named the tibial component angle. (optimal value = 90 +/- 4 degree)[9]

To measure these angles, the mechanical and anatomic axis must be identified.

The anatomic axis of the femur was drawn from the midpoint of the femoral shaft center (bisecting the proximal-to-distal length of the femur) to the midpoint 10 cm proximal to the joint line. The anatomic axis of the tibia was drawn from the center of the prosthesis at the joint to the center of the ankle. The mechanical axis of the tibia was defined to coincide with its anatomic axis[10].

Two independent radiographic reviewer, blinded to the surgical technique, independently measured all radiographic measurements 2 times and the results were assessed for inter-observer reliability.

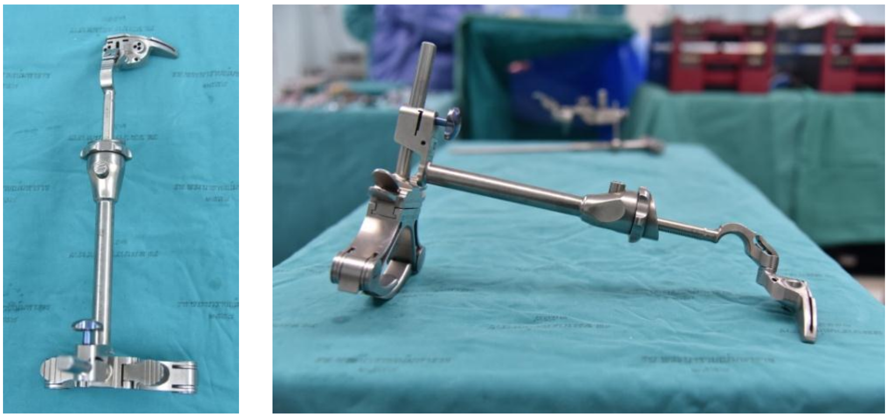

Fig.1 Extramedullary guides tibia tool

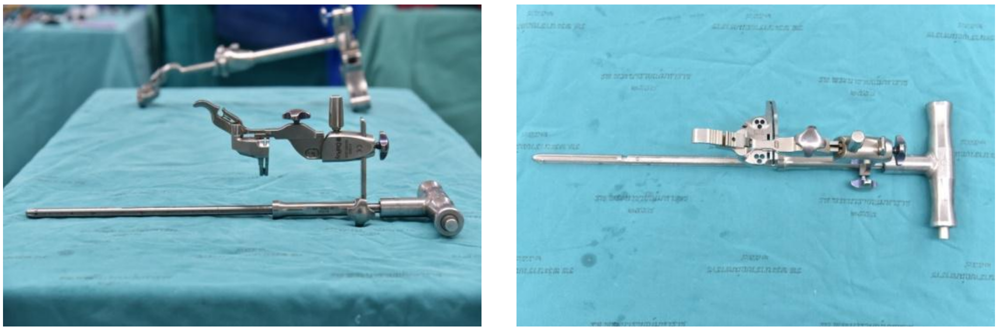

Fig.2 Intramedullary guides tibia tool

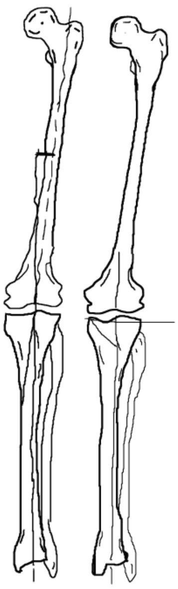

Fig.3 A: The tibiofemoral angle, B: The tibial component angle

Statistical analysis was carried out using the chi-square method and Student's t test with the Yates and Fisher correction.

Surgical Technique

Similar surgical techniques were used in both groups. For the femoral cut, a 10-mm pilot hole was created in the distal femur just above the insertion of the posterior cruciate ligament. The femoral canal was decompressed and an 8-mm intramedullary rod combined with a distal femoral cutting block was inserted. A femoral valgus angle was 5 degree.

For the tibial cut, in the intramedullary guides, a pilot hole was created in the articular surface approximately in the midmedial and lateral positions, near the base of the anterior tibial spine. This usually was located in the anterior one-third of the tibial articular surface. Pilot hole placement was adjusted and passage of the 8-mm intramedullary rod. Rotational alignment was referenced to both the tibial tubercle and the transmalleolar axis. Target alignment on the tibia was 90 degree to the longitudinal axis in the coronal plane, with a 3 degree posterior slope in the sagittal plane.

For the tibial cut, in extramedullary guides, the alignment instrument was positioned in the center of the tibia just anterior to the tibial spine, with rotation also being set referencing the tibial tubercle and transmalleolar axis.

Results

The preoperative diagnosis was primary osteoarthritis. The demorgraphic data include a mean age, a mean weight, a mean height, the body mass index (BMI), the degree of the preoperative tibiofemoral angle, the degree of the preoperative proximal tibial angle showed no statistically significant differences.

Results of postoperative showed the mean values for the postoperative tibiofemoral angle in intramedullary group was 4.98 +/- 1.91 degree. This compared to 4.58 +/- 1.51 degree in extramedullary group. This difference was not statistically significant. The tibial component angle in coronal plane showed a mean value of 88.48 +/- 1.32 in intramedullary group. The extramedullary group showed a mean value of 87.72 +/- 1.40. This difference was statistically significant ($p < .01$). Both groups were within the percentage of outlier (< 3 degree varus).

The mean surgery time and the drainage blood loss in intramedullary group was more than extramedullary group. The mean surgery time was 97.04 +/- 1.70 min in the intramedullary group and 94.66 +/- 1.74 min in extramedullary group. The drainage blood loss as measured by suction drainage, was 440.80 +/- 17.12 ml in the intramedullary group and 419.80 +/- 13.62 ml in the extramedullary group. Both these difference were statistically significant.

Table1 Demorgraphic data

	Intramedullary Mean (SD)	**Extramedullary Mean (SD)**	***p*-value**
Age (year)	63.76 (4.59)	62.26 (4.36)	0.09
Weight (kg)	65.95 (13.71)	66.28 (12.95)	0.90
Height (cm)	153.62 (6.50)	152.38 (6.03)	0.36
BMI	27.90 (4.56)	28.25 (5.76)	0.39
Pre-op Tibiofemoral angle	8.54 (5.15)	6.92 (5.10)	0.11
Pre-op proximal tibial angle	78.32 (5.14)	78.28 (4.50)	0.70

Table 2 Result

	Intramedullary Mean (SD)	**Extramedullary Mean (SD)**	***p*-value**
Post op Tibiofemoral angle	4.98 (1.91)	4.58 (1.51)	0.24
Post op Tibial component angle	88.48 (1.32)	87.72 (1.40)	<0.01*
The mean surgery time (min)	97.04 (1.70)	94.66 (1.74)	<0.01*
The drainage blood loss (ml)	440.80 (17.12)	419.80 (13.62)	<0.01*

* significant

Discussion

Since alignment and positioning of the prosthetic components of TKA critically influence its longevity and surviviorship, it is possible to obtain optimal postoperative position[1-8,11-14]. In this study, intramedullary group gave a slightly more valgus postoperative tibiofemoral angle alignment (4.98 +/- 1.91 versus 4.58 +/- 1.51) the difference was not statistically significant. However, several studies of TKA longevity have pointed out that a wide margin of tibiofemoral alignment and limb angulation can be tolerated, varying between 0 and 12 degree of overall valgus alignment and not accept varus alignment. Regarding tibial component positioning in the coronal plane, we did find a statistically significant improvement of position using intramedullary instrumentation (88.48 +/- 1.32 versus 87.72 +/- 1.40), several investigators have shown that a more varus alignment of the tibial component leads to poor results due to loosening, and therefore improvement in this positioning would seem desirable[1-8,11-14].

Review of the suboptimal results using intramedullary guides found that the medullary canals appeared rather wide in general with thin cortices and a poorly defined isthmus. It could be postulated that entry hole placed in the proximal tibia for intramedullary rod was poorly placed, allowing for lateral drift of the intramedullary rod, thereby resulting in a more varus cut.

Review of the suboptimal results using extramedullary guides found that same wide intramedullary canal and distal jig positioning at the ankle is less precise in the obese due to the loss of accuracy in palpating and sitting the bony landmarks. We would favor intramedullary guides in general for all knees if possible, difficulties may be encountered in localizing the exact point of entry in the tibial articular surface. In case of extreme deformity such as with prior fracture, prior osteosynthesis, prior osteotomy, marked bowing, and extraarticular deformity, extramedullary instrumentation be well appropriate. In this study not found complication from use intramedullary guides such as embolization of medullary contents.

Conclusion

Both techniques allowed satisfactory alignment. It is important for the surgeon to appreciate the benefits and deficiencies of each guide and to use whichever is suited most properly in each particular case.

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การประเมินผลภาพถ่ายทางรังสีของตำแหน่งข้อเข่าเทียม เปรียบเทียบระหว่างวิธีการผ่าตัดข้อเข่าเทียม2วิธี คือ Intramedullary guides tibia กับ Extramedullary guides tibia

นิติพล นวลสาลี, พบ, ชาลี สุเมธวานิชย์, พบ

วัตถุประสงค์: *ศึกษาประเมินภาพถ่ายทางรังสีของตำแหน่งข้อเข่าเทียม เปรียบเทียบระหว่างการผ่าตัด 2 วิธี คือ Intramedullary guides tibia กับ Extramedullary guides tibia*

วิธีการศึกษา: *ผ่าตัดข้อเข่าเทียมที่โรงพยาบาลพระนารายณ์มหาราชจำนวน 100 เข่า แบ่งผู้ป่วยเป็นกลุ่มละ 50 คน ด้วยวิธีแบบ Randomized หลังการผ่าตัดประเมินภาพถ่ายทางรังสีได้แก่ tibiofemoral angle กับ tibial component alignment*

ผลการศึกษา: *ค่าเฉลี่ยหลังการผ่าตัดของมุม tibiofemoral angle ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ แต่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของมุมข้อเข่าเทียมส่วนกระดูก tibia ในแนว coronal ส่วนค่าเฉลี่ยเวลาการผ่าตัดและปริมาณการสูญเสียเลือดหลังการผ่าตัดพบว่ากลุ่ม Intrmedullary guides ใช้เวลาการผ่าตัดนานกว่า และเสียเลือดหลังการผ่าตัดมากกว่า*

สรุป: *ทั้ง 2 เทคนิคการผ่าตัด ทำให้ได้มุมหลังการผ่าตัดเป็นอยู่ในเกณฑ์ที่น่าพอใจทั้งมุม tibiofemoral และมุม tibial component สำคัญที่แพทย์ผู้ผ่าตัดที่จะต้องทราบข้อดี ข้อเสีย ของแต่ละวิธี และเลือกใช้ให้เหมาะสมกับผู้ป่วยในแต่ละราย*