

## Research Article

# Is there a difference in distal femur rotational axis between right and left knee in Indian population?

Karthik Jayachandran\*, Ganesan Ganesan Ram, Karthik Anand Parachuru

Department of Orthopedics, Sri Ramachandra Medical College and Research Institute, Chennai, Tamil Nadu, India

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### \*Correspondence:

Dr. Karthik Jayachandran,

E-mail: [drjkarthik@gmail.com](mailto:drjkarthik@gmail.com)

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## ABSTRACT

**Background:** Errors in positioning the femoral component in the axial plane are the cause of patellofemoral complications, ligamentous instability and disturbed joint kinematics.

**Methods:** Prospective study done in Sri Ramachandra Medical Center in the month of March and April 2015. The study group consists of 50 voluntaries who underwent MRI for their knee bilaterally.

**Results:** The mean femorotibial alignment for the left side was 171.79 (SD 2.70 and range 167.10 -175.80) while the mean femorotibial alignment for the right side was 170.32 (SD 2.49 and range 165.20 -174.50).

**Conclusions:** There are differences in distal femur rotational axes among Indian and Japanese population. There is no significant difference in distal femur rotational axis between right and left knee in an individual.

**Keywords:** Distal femur, Transepicondylar axis, Posterior condylar axis, Whiteside line

## INTRODUCTION

Total knee arthroplasty has an excellent track record for improving quality of life, allowing greater independence and reducing pain in both primary and secondary osteoarthritis knee. Its efficacy depends mainly upon proper alignment of femoral and tibial component. The alignment should be proper in all the three planes frontal, sagittal and axial. The rotational axis refers to the axial plane. Errors in positioning the femoral component in the axial plane are the cause of patellofemoral complications, ligamentous instability and disturbed joint kinematics.<sup>1,2</sup> There are many CT scan studies measuring distal femur rotational axis, while our study was done using MRI measuring distal femur rotational axis between right and left knee of an individual.

## METHODS

Prospective study done in Sri Ramachandra Medical Center during the month of March and April 2015. The

study group consists of 50 voluntaries with equal number of males and females. Inclusion criteria were 50 voluntaries with age between 20 to 40 years. Exclusion criteria were patients with clinical or radiographic features of arthritic knees, those with knee pain, previous fracture around the knee, and any surgery in and around the knee. Each subject gave the informed consent, and our hospital ethics committee approved the study.

Standing radiographs of the whole lower limb were taken using a standard protocol. All subjects were asked to stand, wearing their usual footwear, with both knees fully extended and both patellae facing forward.<sup>3,4</sup>

A weight bearing AP radiograph of the entire lower limb then was made with the X-ray beam centered at the knees at a distance of 2.5 m. A cassette holding long radiographs (300 × 900 mm) was placed immediately behind the subject. A setting of 60 mA seconds and a kilovoltage of 65 to 80 were required to provide the necessary exposure. Substantial malrotation of the long

films was assumed to be present if the patella was not centrally located. In all cases, all anatomic landmarks were defined on MRI scan. The MRI scans were performed with a 1.5-Tesla MRI system using a knee coil. Six sequences, including T1 and T2, coronal, sagittal, and axial planes were performed. The other parameters for all six sequences included matrix,  $256 \times 256$ ; field of view, 16 cm; thickness, 4 mm; and space, 0.5 mm. The scanning of the axial scan of the distal femur was performed along the anatomical axis of the distal femur.<sup>5</sup> The posterior condylar axis was a tangent joining the most posterior point of the medial and lateral femoral condyles.<sup>6</sup> The transepicondylar axis was

a line joining the most prominent point of the medial and lateral 12

## RESULTS

The mean femorotibial alignment for the left side was 171.79 (SD 2.70 and range 167.10-175.80 while the mean femorotibial alignment for the right side was 170.32 (SD 2.49 and range 165.20-174.50). The results of both left and right side posterior condylar angle, white side line-epicondylar angle and white side line-posterior condylar angle were tabulated as per Table 1.

**Table 1: Results of distal femur rotational axis measurements.**

Parameter	Minimum	Maximum	Mean $\pm$ SD
Left femorotibial alignment	167.10	175.80	171.7938 $\pm$ 2.70443
Left posterior condylar angle	1.70	7.90	5.1313 $\pm$ 2.03788
Left white side- epicondylar angle	85.00	95.20	90.0063 $\pm$ 2.99232
Left white side- posterior condylar angle	85.30	95.80	89.8587 $\pm$ 3.20764
Right femorotibial alignment	165.20	174.50	170.3214 $\pm$ 2.49004
Right posterior condylar angle	2.60	7.40	5.0429 $\pm$ 1.67870
Right white side- epicondylar angle	84.80	95.40	89.5786 $\pm$ 3.60559
Right white side- posterior condylar angle	85.50	95.80	90.7429 $\pm$ 3.19223

## DISCUSSION

Total knee replacement has proven its efficacy in treating osteoarthritis and other disabling disorders of the knee. Prosthesis designs are now more suited to the patient anatomy. Moreover the instrumentation available today allows a more precise and more customized prosthetic positioning. In spite of that the rotational alignment of femur should be properly evaluated in order to prevent the complications.

Excessive external rotation of the femoral component also affects total knee arthroplasty function. Olcott et al. described symptomatic flexion instability as a consequence of increased medial compartment flexion gap caused by excessive external rotation of the femoral component.<sup>10</sup> Hanada et al. showed that excessive external rotation of the femoral component induced varus alignment in flexion, thus leading to mechanical overload on the medial side of the joint.<sup>11</sup>

Our study is MRI measurement of different rotational axis of distal femur. There are no similar MRI studies in different races or ethnicity. However there is Japanese the study<sup>12</sup> measuring distal femur rotational axis using computer tomogram. The differences between the distal femur rotational parameters of our studies are compared in Table 2. The mean posterior condylar angles in Indian population are lesser than that of Japanese population.

**Table 2: Comparison of distal femur rotational axis to other studies.**

Studies	Mean posterior condylar angle	Mean whiteside-posterior condylar angle	Mean whiteside-epicondylar angle
Our study (MRI)	5.1	90.3	89.7
Takai et al. (CT) <sup>12</sup>	6.3	93.5	87.7

When we compare the femorotibial angle, posterior condylar angle, Whiteside-posterior condylar angle, Whiteside-epicondylar angle between the right and left knee there is no statistical significance. Hence data's obtained while doing total knee replacement on one knee of an individual can be taken as reference while operating on the other side of the same individual.

## CONCLUSION

Our data can be used to evaluate changes in rotational axes in Indian patient as there are no authenticated studies done using MRI in Indian populations. There is no single method showing its superiority while aligning distal femur rotations in total knee arthroplasty. Combining different techniques and averaging their results might be the best way to reproduce the flexion

extension axis of the knee. There are differences in distal femoral rotational axes among Indian and Japanese population. There is no significant difference in distal femoral rotational axis between right and left knee in an individual.

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