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Fixed distal femoral valgus cutting angle is still justifiable in total knee replacement

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ABSTRACT

Purpose: We undertook this study to determine whether it is justifiable to use a fixed femoral valgus angle in patients undergoing TKR.
Method: 134 knees (59 females and 19 males) were studied by measuring their femoral valgus angle (FVA) on CT scan and the data was assessed statistically.
Result: The average FVA was 5.83° ± 0.64 (range – 4–7.5°). There was no statistically significant difference ($p > 0.05$) between the FVA between males and females and as per age.
Conclusion: We conclude that it is justifiable to use a fixed femoral valgus cutting angle in the patients undergoing total knee replacement.

1. Introduction

The restoration of the mechanical alignment of the limb in total knee replacement (TKR) has been shown to significantly reduce the incidence of loosening and improve the long term survival of the prosthesis.[1–4] During surgery the alignment of the limb is restored by appropriately placed bone cuts augmented by soft tissue release. The neutral alignment of the limb can be achieved by perpendicular cuts made to the tibia and femoral mechanical axis. The resection of the tibia is done perpendicular to its anatomical axis which corresponds to the mechanical axis. On the femoral side, however, because the anatomical axis does not correspond to the mechanical axis and hence the cut has to be made at an angle which varies from patient to patient. The goal is to restore the mechanical axis of the limb within 3° of normal.[5,6]

To achieve a cut perpendicular to the mechanical axis of the femur, one of the three options is available to surgeons. These include computer navigation, patient specific instrumentation and utilization of a fixed valgus angle in all patients. The gold standard for accurate femoral valgus angle is considered to be computer navigation but the cost and increased time duration associated with its use is a major deterrent.[7] The use of patient specific jigs is further associated with a marginal increased cost and delay in surgery for manufacturing of the custom jigs.[8]

The aim of this study is to determine the normal variability of the distal femoral valgus angle in the Indian population and to see whether it is justified to use a fixed femoral valgus angle. We also tried to find out the affect of age and sex on the femoral valgus angle in the Indian population.

2. Materials and methods

All patients of osteoarthritis presenting to our institution undergoing CT scans for pre-operative evaluation for patient specific instrumentation were included in the study between December 2015 to September 2016 and the data was assessed retrospectively. CT scanning was done using the PrePlan (Stryker ™, USA) protocol. One hundred and thirty four knees in 59 females and 19 males were included in the study. The knees were bilateral in 59 cases and unilateral in 16 cases. The average age of the patients was 63.84 years (range: 43–86 years).

3. Technique for angle calculation

All CT images included the hip, the knee and the ankle and the three dimensional reconstruction of each scan was done and key landmarks identified.

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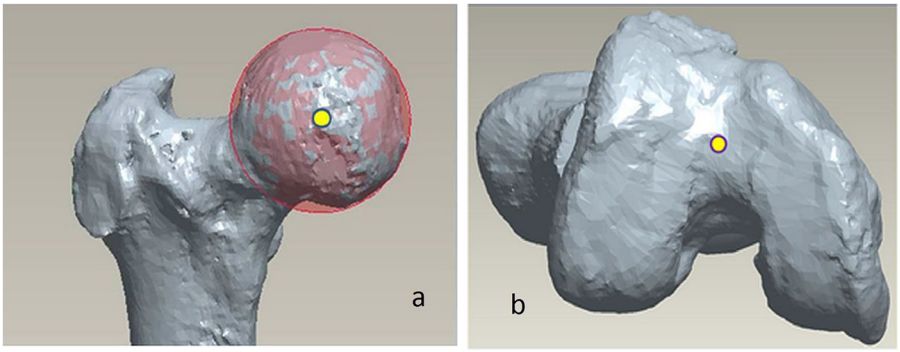

Fig. 1. a Determination of Hip centre – Center of geometrical sphere which replicates the hip centre of femoral head. b Determination of femur centre at knee – Center of trochlear sulcus which is 5–10 mm anterior to Intercondylar notch roof.

3.1. Centre of femoral head

The centre of the femoral head is determined using the centre of the geometrical sphere which replicates the femoral head (Fig. 1a).

3.2. Centre of the knee

The centre of the knee on the other hand, corresponds to the trochlear sulcus which is 5–10 mm anterior to the roof of the intercondylar notch (Fig. 1b).

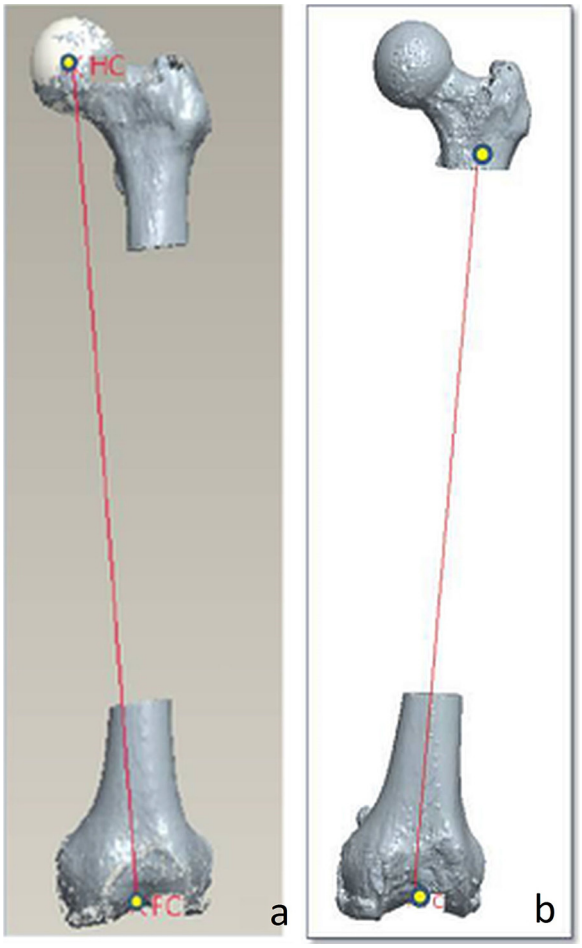

Fig. 2. a Determining the Femoral mechanical axis – Line joining to femur centre and hip centre called as femoral mechanical axis. b Determining Anatomical axis – Line joining through Femur centre and centre of femoral shaft.

3.3. Mechanical and anatomical axes

The mechanical axis is defined as the line joining the centre of the femoral head and the centre of the knee joint (Fig. 2a) and the anatomical axis is the line joining the centre of the knee and the centre of the femoral shaft (Fig. 2b). The femur is then oriented in the coronal plane and angle between the mechanical and anatomical axes measured. (Fig. 3).

3.4. Femoral valgus angle

The distal femoral valgus angle (FVA) was defined as the angle between the anatomical and mechanical axes of the femur in the coronal plane.

4. Statistical analysis

The values of the FVA obtained were analyzed statistically using the SPSS software (version 12.0: SPSS, Chicago,IL). The data was subjected to Student's *t*-test and Pearson correlation coefficient to evaluate the statistical correlation between the genders, between the ages, and between the sides. P values <0.05 were considered statistically significant.

5. Results

The average FVA for the whole study population was 5.83°, with a range of 4° to 7.5° (Table 1). The average angle was 5.86° for the left side and 5.8° for the right side. The FVA for males was 5.81° and for females and 5.84° in males. There was no statistically significant difference ($p > 0.05$) between the FVA on the left and right side or between the males and females on either side (Table 2). There was positive correlation between the FVA on the left and right side for each patient ($R^2 = 0.752$; $P < 0.01$; Fig. 4) but no significant relationship between the FVA with the age of the patient (Fig. 5a, b).

The average femoral valgus angle in the present study was 5.83°. There was no statistically significant difference between the individuals with regard to sex. Moreover, there was no difference as far as other parameters like age and side was concerned.

6. Discussion

Total knee replacement aims at restoration of the mechanical axis of the patients. The first option is to use a fixed valgus angle of 5° or 6° as provided by commercially available cutting jigs.[9,10] There may however be wide variations in the femoral anatomy that can significantly alter the FVA outside the acceptable margin.[11,12] The variations include femoral bowing and changes in the neck

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