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Original Article

Radiographic analysis of the axial alignment of the lower extremity in Indian adult males

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ABSTRACT

Background: To evaluate data on the normal axial alignment of the lower extremity in Indian adults and its relevance in knee arthroplasty.
Methods: The axial alignment of the lower extremity in one hundred young male adults was measured on the weight bearing scanogram of the entire lower limb under standardized conditions. The angles measured were – neck shaft angle, lateral distal femoral angle, medial proximal tibial angle, tibiofemoral angle and valgus angle.
Results: Medial inclination of the tibial plateau in our subjects was 4°; this was greater than reported for American subjects but less than that for Chinese. It was significantly noted that valgus angle was 6.2° at an average with the range of 5–7°.
Conclusions: Axial alignment of lower extremity differs in various ethnic groups. Indian male subjects have more varus alignment of knee and significant higher medial inclination of tibia plateau than white male subjects (p value < 0.05). Four degrees of external rotation of the femoral component instead of commonly used 3° is necessary, while performing total knee arthroplasty in Indian male subjects.

1. Introduction

Does axial alignment of lower extremity differ in various ethnic groups? Recently published study of axial alignment of lower limb in Chinese subjects proposed so and advised more external rotation of femoral component than conventionally advised.[1] The incidence of osteoarthritis in various populations differs. The osteoarthritis of knee is more common in Asians compared with Americans.[1–3] The racial difference in

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axial alignment in lower extremity may be a reason for that, apart from difference in various living habits. The normal axial alignment of lower extremity has been described in various studies.[1,4,5] There have been no similar studies in Indian subjects. We performed a radiographic measurement of the lower limb alignment in Indian subjects and compared them with published data.

2. Materials and methods

Medical records of one hundred apparently normal males screened for recruitment to the city police force in the age group of nineteen to twenty five years with a mean age of twenty-one years were studied. Any lower limb deformity being a criterion for disqualification, a scanogram was a part of the screening. A scanogram was done with barefoot subject standing with patellae facing forwards under standardized conditions. Both lower extremities were included in one scanogram.

The axial alignment was measured as described by Hsu, Moreland and Tang[1,4,5] with some modifications. The centres of femoral head, the knee and ankle were identified as described by Moreland and Tang. The mechanical axes of femur and tibia were the line joining the centre of femoral head to centre of knee and centre of knee to the centre of ankle respectively. The femoral shaft anatomical axis was drawn from a point about 10 cm above the knee joint axis in the middle of the femoral canal to the another point in the middle of the medullary canal in the midpart of the femoral shaft similar to femoral anatomical axis II described by Moreland and Tang.[1,5] One line tangent to most distal points of femoral condyles was drawn. Another line tangent to proximal tibial condyles was drawn. These two lines according to us are more accurate while calculating the tibial and femoral inclination rather than one joint line passing through the distal femoral condyles, taken as transverse axis of the knee joint. The angles created by intersection of these lines, namely neck shaft angle (A), lateral distal femoral angle (B), medial proximal tibial angle (C) tibiofemoral angle (D) and valgus angles (E) were measured by finely calibrated protractor [Fig. 1]. All radiographs were measured twice, so as to remove the intra observer difference. The results were statistically analyzed and results compared with published series. Our subject population was of average age 21 years. This excludes the effect of various degenerative changes on the lower extremity, and bone growth is also complete. This according to us is representative of the most normal population subgroup with regards to axial alignment of the lower extremity [Fig. 2].

3. Results

Angle A represented the neck shaft angle. In our study neck shaft angle was a mean (and standard deviation) of $128.6 \pm 5.4^\circ$ (range 120–138°) on the right side and $126.8 \pm 4.5^\circ$ (range 120–137°) on the left side. Average neck shaft angle with both right and left sides included was 127.7 ± 5.

Angle B represents the lateral distal femoral angle. It was measured between the anatomical axis of femur and the line tangent to distal femoral condyles. The mean value was 82.1 ± 1.9 on the right side (range 79–87°) and $82.4 \pm 2^\circ$ (range 78–88°) on the left side. The average mean for both sides was 82.3 ± 2.

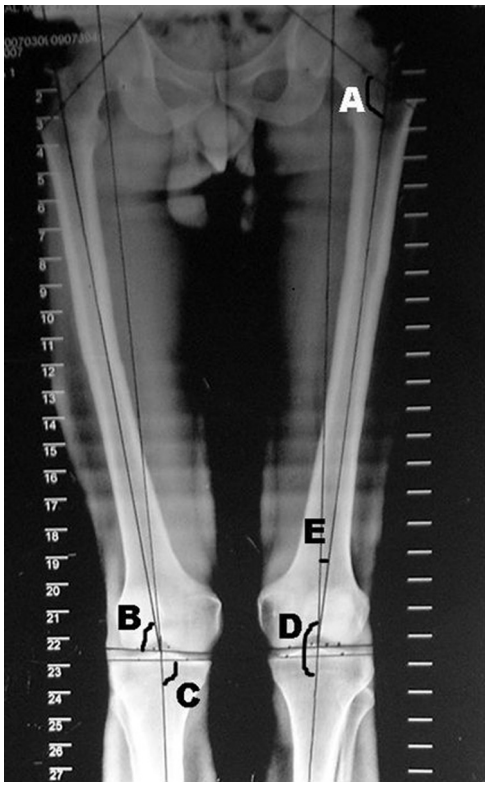

Fig. 1 – Scanogram showing the various angles measured.

Angle C is medial proximal tibial angle. It is measured between the tangent to proximal tibial condyle and mechanical axis of tibia. The knee joint surface is perpendicular to mechanical axis if this angle is 90°. This angle is index of obliquity of the knee joint. The angle C was $86.1 \pm 2.2^\circ$ (range 80–90°) on the right side and $85.8 \pm 2.7^\circ$ (range 80–90°) on the left side. The angle C was $86 \pm 2.4^\circ$ in on both right and left side in our subjects. The mean medial inclination of medial joint surface in our subjects was $4 \pm 2.4^\circ$. The other studies have taken angle C as the inferolateral angle between the knee joint transverse axis and mechanical axis of the tibia. We have measured inferomedial angle between the mechanical axis of tibia and line tangent to proximal tibial condyles. This in our view is more direct measurement of the obliquity of the tibial articular surface, which we try to reconstruct while doing total knee replacement or proximal tibial osteotomy.

Angle D represents the overall alignment of the lower extremity. The angle D was mean 177.2 ± 2.9 (range 172–188°) on right side and 176.2 ± 2.6 (range 170–180°) on the left side. The alignment for both right and left sides was $176.7 \pm 2.8^\circ$. The extremities in the Indian subjects had a mean of $3.3 \pm 2.8^\circ$ of varus alignment.

Valgus angle of femur, angle E in our subjects on right side was mean $6.1 \pm 0.7^\circ$ (range 5–7°), and it was $6.3 \pm 0.6^\circ$ (range 5–7°) on the left side. The alignment for both right and left sides was $6.2 \pm 0.7^\circ$.