**Posterior Slope of Tibial Plateau in Adult Nigerian Subjects**

Inclinación Posterior de la Meseta Tibial en Sujetos Nigerianos Adultos

*Blessing C. Didia & **Blessing N. R Jaja


**SUMMARY**: Normal values of the tibial slope are necessary for realignment of displaced fractures of the tibia crest, repair of cruciate ligaments and correction of knee deformities. True lateral radiographs of normal knees were obtained in 119 males and 93 female Nigerian subjects. The tibial slope was then measured according to the anterior tibial cortex method. Mean angle in sampled subjects was 12.3 ± 4.90 (range: 0-240). Sex differences were statistically insignificant (p>0.05). This study provides reference values of tibial slope among indigenous adult Nigerians. It also highlights on the clinical relevance of the angle and the need to establish normal ranges in other African populations.

**KEY WORDS**: Knee; Osteometry; Kinematics; Africans; Radiographs.

**INTRODUCTION**

The tibia is the large weight bearing medial long bone of the leg. Besides the femur, it is the longest and largest bone in the human body (Moore & Dalley, 1999). Its proximal end is widened and presents a plateau consisting of medial and lateral condyles and an intercondylar eminence, which articulates with the femoral condyles and intercondylar fossa respectively to form the knee joint (Moore & Dalley; Sinnatamby, 2000). The angle formed by the posterior inclination of the tibia plateau and a line perpendicular to the middiaphysis of the tibia is called the Tibial slope or Tibial plateau angle (Moore& Harvey, 1974; Giffin *et al.*, 2004). The tibial slope contributes to knee stability (Shoemaker *et al.*, 1982).

Fractures of the tibia plateau and injuries to its associated ligaments are common in athletes, but may also occur following road traffic injuries. The mechanism of injury has been related to axial compression with valgus and varus forces applied directly to the side of the knee (Solomon *et al.*, 2001).

Anatomic restitution of depressed fractures of tibia plateau and decisions on repair procedures of torn cruciate ligaments may require measurement of the posterior slope of the tibial plateau (Noyes *et al.*, 2005). This angle is also taken into consideration in planning for corrective osteotomies to restore normal alignment of the leg in certain knee deformities, for instance, some cases of abnormal knee hyperextension and standing varus recurvatum (Naudie *et al.*, 2004).

Normal values of the angle of the tibial plateau have been reported in Caucasian and in Asian populations. There is paucity of studies on knee kinematics in African subjects and standards of tibial plateau angle in our environment are based on studies carried out among Caucasians. The possibility of racial differences in this angle has not been adequately investigated. It is to provide reference values of tibial plateau angle in adult Nigerian subjects that this study was undertaken.

**MATERIAL AND METHOD**

We studied true lateral radiographs of the knee in 119 males and 93 female indigenous Nigerian subjects between the age ranges of 21-45 years. The films were selected from the records of the radiology department of six tertiary hospitals in Nigeria, namely; Lagos University Teaching Hospital...

1 Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Nigeria.
2 Department of Orthopaedic Surgery, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria.
The radiographs had been taken in the investigation of musculoskeletal problems in the limbs and only those that were adjudged normal in this respect were selected. Each radiograph was placed on an X-ray viewer and the posterior slope of the tibial plateau measured by drawing a straight line with a chinagraph pencil tangential to the tibia crest. A second line was drawn tangential to the proximal tibial articular surface and to intersect the first line. From the point of intersect, a third line was drawn perpendicular to the tibial crest line. The tibial slope was then measured with a protractor as the intersection between the second and third lines (Fig. 1). Our technique was according to the anterior tibial cortex method (Noyes et al.).

RESULTS

Table I show the mean values and ranges of the posterior slope of tibial plateau in the Nigerian subjects whose radiographs were sampled. Differences in angle values between the right and the left limbs and between the sexes were statistically insignificant (p>0.05).

Table II is a comparison of the tibial slope in some population groups, in whom this angle has been measured previously, using the anterior tibial cortex method. Mean angle in the sampled subjects were significantly lower than values in Chinese and American subjects (p<0.05); but statistically not different from the value obtained previously among French subjects (p>0.05).

DISCUSSION

The tibial slope is essential in knee biomechanics, both for ligament function and knee kinematics (Cullu et al., 2005). Comparative studies have shown that it is steepest in the sheep and dog and shallowest in humans, with the horse tibial slope being of intermediate value (Gupte et al., 2007). Among human fossil species, the angle varies very little and attempts to discriminate among locomotors modes in hominoids based on the curvature of the tibia condyle have been of limited success (Organ & Ward, 2006).

In humans, the obliquity of the tibial slope appears to be highly variable in the general population (Noyes et al.). This was also the finding in this study. Studies using similar methods in Americans, French and Chinese subjects have shown a narrower range of variation as compared to our Nigerian subjects (Table II); with the narrowest range being that of 50 to 100 reported by Bohler as early as 1958. Given the small sample size of most previous studies on the topic, the likelihood of regional variation could not be ascertained in this report. Nevertheless, the variability of the angle in the general population justifies the need for it to be widely measured to establish reference values in different African populations, more so considering its clinical significance in the operative management of orthopaedic conditions of the knee.
Table I. Mean values and range of tibial plateau angle for sex and limb of sampled Nigerian subjects.

<table>
<thead>
<tr>
<th></th>
<th>Right limb</th>
<th></th>
<th>Left limb</th>
<th></th>
<th>Both limbs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Range</td>
<td>Mean ±SD</td>
<td>n</td>
<td>Range</td>
<td>Mean ±SD</td>
</tr>
<tr>
<td>Males</td>
<td>45</td>
<td>0-23</td>
<td>11.4±6.2</td>
<td>74</td>
<td>2-21</td>
<td>12.2±4.8</td>
</tr>
<tr>
<td>Females</td>
<td>40</td>
<td>1-24</td>
<td>12.6±5.4</td>
<td>53</td>
<td>3-21</td>
<td>12.1±4.9</td>
</tr>
<tr>
<td>Both</td>
<td>85</td>
<td>0-24</td>
<td>12.1±5.7</td>
<td>127</td>
<td>2-21</td>
<td>12.2±4.8</td>
</tr>
</tbody>
</table>

Table II. A comparison of tibial plateau angle among French, Chinese, American and Nigerian subjects.

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Subject</th>
<th>n</th>
<th>Range</th>
<th>Mean ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moore</td>
<td>1974</td>
<td>Americans</td>
<td>50</td>
<td>7-22</td>
<td>14.0±3.7</td>
</tr>
<tr>
<td>Brazier et al.</td>
<td>1996</td>
<td>French</td>
<td>83</td>
<td>3.47-20.29</td>
<td>11.4±3.6</td>
</tr>
<tr>
<td>Chiu et al.</td>
<td>2000</td>
<td>Chinese</td>
<td>25</td>
<td>5-22</td>
<td>14.7±3.7</td>
</tr>
<tr>
<td>Present</td>
<td>2006</td>
<td>Nigerians</td>
<td>212</td>
<td>0-24</td>
<td>12.3±4.9</td>
</tr>
</tbody>
</table>

The tibial slope did not express sexual dimorphism among the sampled Nigerian subjects. In this regard, it is similar to the calcaneal angle (Didia & Dimkpa, 1999) but is unlike the subpubic angle (Nwoha, 1992), which has been shown to be sexually dimorphic in Nigerians. Osteometric parameters provide a verifiable means of sex differentiation in forensic anthropology. As a forensic tool therefore, the tibial slope most probably is of limited application in Nigerians.

ACKNOWLEDGEMENT. We would like to thank Ogbe Kehinde Deborah and Omo-okoro Arodovwe, who helped us in collating radiographs from the various Hospitals.

REFERENCES


Correspondence to:
Dr. Blessing N. R. Jaja
Department of Orthopaedic Surgery
University of Port Harcourt Teaching Hospital
Port Harcourt
NIGERIA

Email: jajabnr2000@yahoo.com

Received: 18-01-2008
Accepted: 26-08-2008