A Morphometric Study of Femur and Its Clinical Importance

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ABSTRACT

Background: The femur is the largest and strongest bone in the body and the structure of its proximal portion allows the leg to move in three dimensions relative to the torso, thus serving as a linchpin of human mobility. Moreover, age related and pediatric disorders at this skeletal site are common and confer strong risk factors for current and future disability. In Orthopaedic practice, operations on femur are the most common. Variations in hip morphology are also of critical interest to surgical planning where the ability to take hip morphology into account on a patient specific basis is crucial for success in choosing designs of implants and other structures used for hip replacements and augmentations of hip stability. The present study is focused on morphometric measurement of adult dry femur.

Objectives: The objectives of present study to find out the measurements of Neck shaft angle, Femoral Length and Neck Length of femur.

Materials and Methods: In present study have used 592 femurs from different colleges in south India. The following measurements were conducted Neck shaft angle, Femoral Length and Neck Length of femur.

Results: The results of present study are the length of femur was 447.1+28.94mm, right femur was 447.9+28.72mm and left femur was 446.2+29.12mm, the Neck Length femur was 36.3+5.4mm, right femur was 36.4+5.2mm and left femur was 36.1+5.6mm. the neck shaft angle of femur was 136.8°, right femur was 136.7° and left femur was 136.9°.

Conclusion: There is no significance difference between right and left femur measurements. The present study results are may helpful for orthopaedic, radiology and anthropological practice.

KEY WORDS: Femoral Length, Neck Length, Neck Shaft angle and Femur.
of the individual. The objective is to enable the law enforcement agencies to achieve the ultimate goal of personal identification. Long bones that make up greatest proportion of stature, femur and tibia are more accurate than humerus and ulna. Intact long bones of upper and lower extremities have been used in derivation of regression equations for estimation of stature in different population groups. These bodies are sometimes presented to forensic anthropologists in different states of fragmentation, thereby making derived equations unstable. This has necessitated the need to assess the usefulness of measurement of fragments of long bones in estimation of stature [2]. It is also helpful for the clinicians in the treatment of proximal and distal femur fractures. Femoral neck fractures involve the narrow neck between the round head of the femur and the shaft [3].

The angle of the femur formed by the longitudinal axis of the neck and the longitudinal axis of the shaft of femur bone is termed as neck shaft or collodiaphysial angle. This angle varies with age, sex, race, dominant and non-dominant leg or development of femur. The neck shaft generally ranges from the angle of 115° to 140° at an average of 126° in adults. The proximal femur acts as a brace, and its biomechanical properties depend on the width and length of the femoral neck. It also helps the limbs to swing clear of pelvis. Different aspects of clinical disease conditions and fracture, congenital anomalies and changes in osteoporosis as well as medico-legal cases can be understood by the study of femur bone. Femur bone has almost cylindrical shaft and a proximal rounded articular head projecting medially from its neck. The femoral neck is about 5 cm long and connects the head to shaft at an angle of 135°. The mobility of hip joints is facilitated by the angle and it allows the obliquity of the femur within the thigh, which helps the knees to be adjacent and inferior to trunk. It enables to swing clear of the pelvis [4-6]. Numerous people are affected from fractures of the bone, especially in an elderly age. The lifetime risk of osteoporosis related fractures in the hip, spine and wrist is considered to be 30-40% in women and 13-20% in men[7].

As humans grow from childhood to adulthood, the neck shaft angle decreases significantly because of the changes in body portion and adaptation of hip joint to vertical posture[8]. Hip axis length, femoral neck axis length, neck shaft angle and femoral neck width collectively influence the risk of fracture especially in women apart from bone mineral density[9,10]. The present study is focused on find out the measurements of neck shaft angle, femoral Length and neck Length of femur, which is help in orthopaedic practice.

**MATERIALS AND METHODS**

In present study have used 250 femurs from different colleges in south India. The following measurements were measured Neck shaft angle, Femoral Length and Neck Length of femur. Instruments Used for this study are Sliding Calliper, Osteometric Board and measurements measured according to standard anthropometrical method[6,7].

**RESULTS**

The present study is conducted in different institutions in south India. The results of present study are the length of femur was 447.1±28.94 mm, right femur was 447.9±28.72 mm and left femur was 446.2±29.12 mm, the Neck Length femur was 36.3±5.4 mm, right femur was 36.4±5.2 mm and left femur was 36.1±5.6 mm, the neck shaft angle of femur was 136.8°, right femur was 136.7° and left femur was 136.9°.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number</th>
<th>Mean±SD (mm)</th>
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<tbody>
<tr>
<td><strong>Femoral Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>592</td>
<td>447.1±28.94 mm</td>
</tr>
<tr>
<td>Right</td>
<td>281</td>
<td>447.9±28.72 mm</td>
</tr>
<tr>
<td>Left</td>
<td>311</td>
<td>446.2±29.12 mm</td>
</tr>
<tr>
<td><strong>Neck length</strong></td>
<td></td>
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</tr>
<tr>
<td>Total</td>
<td>592</td>
<td>36.3±5.4 mm</td>
</tr>
<tr>
<td>Right</td>
<td>281</td>
<td>36.4±5.2 mm</td>
</tr>
<tr>
<td>Left</td>
<td>311</td>
<td>36.1±5.6 mm</td>
</tr>
<tr>
<td><strong>Neck shaft angle</strong></td>
<td>592</td>
<td>136.8±4.45°</td>
</tr>
<tr>
<td>Right</td>
<td>281</td>
<td>136.9±4.41°</td>
</tr>
<tr>
<td>Left</td>
<td>311</td>
<td>136.7±4.49°</td>
</tr>
</tbody>
</table>

**DISCUSSION**

In present study, the mean neck-shaft angle of dry femur was observed 136.8°±4.45°, the right femur was 136.9°±4.41° and left was 136.7°±4.49°, these readings which falls under
the range 115° to 140° given by Moore et al [11]. The studies of Ali L et al [12], Ravichandran D [13] and Khan SM [14] are coherent with our findings. Present study shows no significant difference of neck shaft angle between right and left femur bone (P>0.05). The right and left femur bones are measured with mean angles 136.9°+4.41° and 136.7°+4.49° respectively. These results are in correlation with study of Gujar et al[15]which has presented the mean value of 136.6° of right and 136° of left respectively. Another study reported the values lower than our study as the angle of 122.5° to the right and 125.6° to the left femur[16].

According to Reddy et al[17] a strong correlation has been established between the occurrence of thigh pain and inadequate fit and fixation of the implant. It has been noted that there is an increase in the clinical outcome score, which was directly proportional to the degree of implant bone fit. In using implants which have been designed for western counties, the chance of implant mismatch is much greater. This in turn may lead to increase in the rate of aseptic loosening, greater implant subsidence, and increased incidence of anterior thigh pain, more number of intraoperative complications and shorter lifespan of the implant[18].

The implant device and prosthesis designed for western skeleton are large in size, there angles, orientations and thread length also mismatch the femora. Implants that are designed by taking in to account anthropometric and bio mechanic data will help in designing patient specific implants thereby minimizing the complications [21]. Numerous studies have also shown that there is increase in the rate of intraoperative complication in the event of using mismatched implants especially over size implants[19].

In present study, the mean length of femur was 447.1±28.94 mm, right femur was 447.9±28.72 mm and left femur was 446.2±29.12 mm. Our results are in agreement with Bhosale and Zambare[20]. In their study the mean length of left male femur was 45.23 cm that of left female was 42.04, the mean length of right male femur was 45.08 cm that of right female was 41.64 cm[21]. Our measurements are similar to the study of Zuylan and Murshid in their study left femur length as 42.84 cm, right femur length was 41.68 cm. in study of S Dhiyva[22] average length of femur was 41.66cm, right femur was 41.29cm and left femur was 41.88cm. The difference in mean femoral length in between populations may possibly be a result of factors affecting bone morphology such as genetic constitution, diet, nutrition status, environment, and physical activity.

Our results in agreement with Pandya A M et al study[23], in this study mean value of maximum length was higher in male as compared to female. For right male bone calculated range was 379.99-523.63 and for right female bone it was 358.26-476.70, in same study right femur with maximum length more than >476.70 mm can be correctly classified as a male and right femur with maximum length less than <379.99 mm can be correctly classified as a female, according to Pandya if the length is between 379.99 mm and 476.70 mm, sexing was not possible[23]. The present study femur length is correlated with study of Rajeshwari S B[24] in this study the calculated range for right male was 379.88-523.33 mm and that for right female it was 358.16-476.80 mm.

The mean femur neck length of present study was 36.3±5.4mm, the right femur neck length was 36.4±5.2mm and the left femur neck length was 36.1±5.6mm., our results are in agreement with Ravichandran et al study, in their study the mean femur neck length was 31.88mm[25]. Our results also in correlation with Siwach RC[26] study in his study the mean femur neck length was 37.2 mm and minimum effective neck length was 22.6 mm. In study of S Dhiyva[22] the mean femur neck length was 3.09 cm, right femur neck length was 2.98 cm and left femur neck length was 3.16 cm. Our study is similar to that of De Sousa et al[27] in their study right femur neck length was 3.01 cm, left femur neck length was 3.05 cm.

The knowledge of the morphometric values of femoral segments is important in forensic, anatomic and archaeological cases in order to identify unknown bodies and stature[28,29]. It is also helpful for the clinician in the treatment of proximal and distal femoral fractures [30,31,32]. Therefore, the present study supplies the mean values of different morphometric measurements from the femur. As a result, these
measurements may help to indicate the characteristic morphological features of femoral segments in south Indian population and also help the orthopaedic surgeon to place various implants in the reconstruction of femoral fragments.

REFERENCES