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Original Article

Morphometric Study of Femoral Neck in Dried Adult Human Femurs of Punjab Population with its Clinical Aspect

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Abstract

Introduction: Femoral neck (FN) shaft axis length and FN width collectively influence the risk of fracture especially in women apart from bone mineral density. The shape of the proximal femur is known to be an important risk factor for hip fracture of the FN, regardless of bone mass or bone strength. There are substantial variations in hip fracture incidence rates worldwide, which suggest the existence of important occurrence. This substantial variation may be related to genetic factors and environmental conditions bone mass index, bone mineral density, and the morphometry of the proximal femur.

Objectives: The present study aimed to record the FN parameters that were carried out which would be of help to the orthopedicians while carrying out surgical repairs around the hip joint especially in fracture of the neck of femur.

Materials and Methods: A total of 100 North Indian unpaired dry adult human femora (right-50, left-50) of unknown sex were studied. FN parameters of the femur were measured with the help of measuring thread and vernier caliper was recorded in millimeters. The raw data obtained were statistically analyzed. Range, mean, standard deviation, and standard error of mean were determined.

Results: The mean femoral length on anterior aspect of femur was found to be 29.58 mm (right 29.64 mm and left 29.52 mm), mean femoral length on posterior aspect was 39.45 mm (right-39.22 mm and left-39.68 mm), mean femoral neck width was 27.09 mm (right-27.54 mm and left-26.64 mm), and mean neck thickness was 21.66 mm (right-21.72 mm and left-21.60 mm). No significant difference in values of FN parameters was found in the right and left femur.

Conclusion: This study will enlighten the biomechanical engineers to take a revolutionary step towards altering the implant designs to suit our Indian needs and thus change the concept of orthopedic surgeries in our country.

Key words: Femora, Orthopedicians, Morphometry

INTRODUCTION

Femur is the longest and strongest bone of the human body. Its length is associated with a striding gait, its strength with weight and muscular forces. It comprises of an upper end, shaft, and lower end. Proximal part of femur includes head, neck, greater, and lesser trochanters.[1] The femoral neck (FN), which connects the head to the shaft, passes downward, backward, and laterally and make an angle of about 125° (slightly less in the females) with long axis of shaft. It is about 5 cm in length with two surfaces, anterior and posterior.[2]

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FN shaft axis length and FN width collectively influence the risk of fracture especially in women apart from bone mineral density.[3,4] The shape of the proximal femur is known to be an important risk factor for hip fracture of the FN, regardless of bone mass or bone strength.[5] There are substantial variations in hip fracture incidence rates worldwide, which suggest the existence of important occurrence. This substantial variation may be related to genetic factors and environmental conditions bone mass index, bone mineral density, and the morphometry of the

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proximal femur.[5,6] Undersized or overhanging femoral implants could lead to altered soft-tissue tensioning and altered patella femoral stresses.[7] Bony marking such as the head and neck of femur can be used in determination the femoral length when only one fragment of proximal femur is available and the required size of length of neck can be determined to design prosthesis for restoration of normal neck shaft angle.[8]

Figure 1: The measurement of femoral neck length on anterior aspect with the help of non-elastic cotton thread

Figure 2: The measurement of femoral neck length on posterior aspect with the help of non-elastic cotton thread

Figure 3: The measurement of femoral neck width with the help of venier caliper

Most of the Indian orthopedic surgeons have currently felt the need for the modification in implant sizes suitable for Indian population.[9] Thus, the present study to record the femoral length, FN was carried out which would be of help to the orthopedicians while carrying out surgical repairs around the hip joint especially in fracture of the neck of femur. In addition to the orthopedic surgeons, this study will be of great help to the anatomists, anthropologists, forensic experts, and radiologist also. Moreover, not much study has been done on femoral length, FN in North Indian population.

MATERIALS AND METHODS

A total of 100 North Indian unpaired right and left dry adult human femora of unknown sex were studied from teaching collection of the Anatomy department, Guru Gobind Singh Medical College, Faridkot. Out of the total of 100 femora, 50 were of the right side and 50 were of the left side. All the femora was complete and showed normal anatomical features. Bones with any gross abnormality or broken bones were excluded from the study.

FN Length on Anterior Aspect

It is the distance between the base of the head and intertrochanteric line [Figure 1]. It will be measured along the line that is perpendicular to intertrochantric line, which divides anterior part of neck into two equal halves. It will be measured with the help of non-elastic cotton thread and the readings will be taken using a measuring scale in millimeters (mm).

FN Length on Posterior Aspect

It is the distance between the base of head and intertrochantric crest [Figure 2]. It will be measured along the line that is perpendicular to intertrochantric crest which divide posterior

Figure 4: The measurement of femoral neck thickness with the help of venier caliper

part of neck into two equal halves. It will be measured with the help of non-elastic thread and the readings will be taken using a measuring scale in millimeters (mm).

FN Width

Width of the neck is measured at its narrowest part in superoinferior direction using vernier caliper [Figure 3]. It will be recorded in millimeters (mm).

FN Thickness

It is the thickness of femur from at midpoint of the line joining upper region of femoral head with the base of greater trochanter of femur [Figure 4]. It will be measured with the help of vernier caliper and recorded in millimeter (mm).

OBSERVATION AND RESULTS

A total of 100 femora (50 right and 50 left) were studied. Overall range, mean, standard deviation, and standard error of mean and distribution on the right and left side of parameters are given in Tables 1-4.

Table 1: Parameter of anterior femoral neck length of the right and left femur (mm)

Side	Range	Mean	SD	SEM
Right	21–43	29.64	5.58	0.78
Left	20–46	29.52	5.61	0.79
Total	20–46	29.58	5.56	0.78

SD: Standard deviation, SEM: Standard error of mean

Table 2: Parameter of posterior femoral neck length of the right and left femur (mm)

Side	Range	Mean	S.D	SEM
Right	26–55	39.22	5.94	0.84
Left	29–52	39.68	4.72	0.66
Total	26–55	39.45	5.34	0.75

SD: Standard deviation, SEM: Standard error of mean

Table 3: Parameter of femoral neck width of the right and left femur (mm)

Side	Range	Mean	S.D	SEM
Right	19–34	27.54	3.1	0.44
Left	19–33	26.64	3.5	0.58
Total	19–34	27.09	3.3	0.51

SD: Standard deviation, SEM: Standard error of mean

Table 4: Parameter of femoral neck thickness of the right and left femur (mm)

Side	Range	Mean	S.D	SEM
Right	16–29	21.72	2.81	0.39
Left	15–26	21.60	3.24	0.45
Total	15–29	21.66	3.02	0.42

SD: Standard deviation, SEM: Standard error of mean

DISCUSSION

The present study was conducted on 100 dried adult human femurs in the Department of Anatomy, Guru Gobind Singh Medical College, Faridkot. Different morphometric features were noted and measurements were taken. Data were compiled and the various parameters were compared with the studies available in the literature and any deviation was noted.

Reddy and Kumar[10] analyzed length of neck anteriorly 26.51 mm (standard deviation [SD] = 3.369), length of the neck posteriorly 30.846 mm (SD = 3.9 mm), width of the neck 30.68 mm anteroposteriorly (SD = 4.359 mm), and 29.94 mm superoinferiorly (SD = 3.599). Did study on 60 dried femora the mean values for the various parameters were as follows: Length of neck – 27.5 mm, width of neck – 48.33 mm.

In a study done by Sundar and Sangeetha[11] on 250 femurs in South Indian population showed that the anterior neck length of femur was 3.07 cm (right femur-2.88 cm and left femur-3.18 cm). Dhivya and Nandhini[12] did study on 158 dry femora and calculated the anterior neck length was from 2 cm to 4 cm with mean of 3.09 cm. Lakati *et al.*[13] reported that mean FN width was found to be 29.36 mm, with mean width of the left side being 28.67 mm and that of the right being 29.36 mm, respectively

Mukhia and Poudel[14] conducted a study on 75 femur of both sex showed that average FN length was 4.12 ± 0.32 cm, FN breadth was 2.94 ± 0.30 cm, and FN thickness was 2.36 ± 0.42 cm.

Muley and Bhuiyan[15] studied neck of 150 dry adult femora in West Indian population and noted that the mean width of neck of femur was 29.38 ± 2.50 mm on the right side and 28.86 ± 3.47 mm on the left side, mean length of neck of femur on anterior aspect was 34.96 ± 7.18 mm on the right side and 33.42 ± 4.12 mm on the left side and mean length of neck of femur on posterior aspect was 39.55 ± 5.81 mm on the right side and 40.00 ± 4.60 mm on the left side.

The values of present study are in consonance with the values of Sundar and Sangeetha[11] Mukhia *et al.*[14] and Muley and Bhuiyan[15] No significant difference was found between the values of the right and left side. The difference seen between the values of the present study and those recorded by other workers could be because of contribution to growth variation among different populations such as genetic factors, nutrition, environmental condition, social condition, and cultural conditions.

CONCULSION

The overall goal of this study was to generate information that would be useful for geometric modeling of femora and collecting data which could prove useful for development of prosthetic implants. In cases, where destruction of femora is extensive, due to trauma or some disease, this study will enlighten the biomechanical engineers to take a revolutionary step towards altering the implant designs to suit our Indian needs and thus change the concept of orthopedic surgeries in our country. However, it should be kept in mind, that the present study had a smaller number of femur bones, so it is worthwhile to perform similar study on more number of bones for its theoretical and practical importance in the coming years.

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