e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(10); 476-481

Original Research Article

The Study of Neck Shaft Angle of Dry Femur Bones in a Tertiary Care Teaching Institute

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Received: 25-08-2022 / Revised: 25-09-2022 / Accepted: 15-10-2022
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Conflict of interest: Nil

Abstract:

Background: Understanding the clinical significance of the biomechanics of the hip joint is made easier with the aid of femur neck shaft angle evaluation. It aids in the development of prosthetics as well as the improved treatment of various pathological hip and femur problems. The femoral neck-shaft angle is also crucial for communicating the subject's racial identity. Therefore, the goal of the current study was to establish the neck shaft angle of the femur in humans.

Methods: Adult dry femur bones totaling n=100 (n=50 left and n=50 right) were examined and analyzed. By drawing outlines of all of the femora's contours, the neck-shaft angle of each femur was calculated. additional characteristics using a vernier caliper, osteometric board, and scale.

Results: The neck shaft angle was measured and recorded in n=100 femur bones. Among n=100 femurs, n=70 bones were classified as male, and n=30 bones were female. The minimum angle measured was 118 degrees and maximum angle was 137 degrees and the mean angle was 128.92 degrees in male femur bones. In female femur bones, the minimum angle was 119 degrees and maximum angle was 139 degrees and the mean angle was 129.41 degrees.

Conclusion: The Mean neck-shaft angles in the sample of the study was 129.16 degrees. Minor differences between the NSA of males and females were found although the differences remain insignificant. Similarly, the differences between the right and left femora were also found to be insignificant. These kinds of studies help us to determine the biomechanics of hip joints and the knowledge that could be utilized for hip replacement surgeries.

Keywords: Neck Shaft Angle (NSA), dry femur bones, anthropometry

Introduction

The understanding of clinical relevance in the biomechanics of the hip joint is made easier by evaluating the Neck-Shaft Angle (NSA) of the femur. It aids in the more effective treatment of certain pathological hip and femur problems. The angle must be determined when designing osteotomies for congenital dislocations. hip osteoporosis and to have a healthy, typical gait pattern. The angle between the femoral neck axis and the femoral shaft axis is known as the neck-shaft angle. [1] Axis is an imaginary line passing through the center of an object, around which the object revolves. Between 120° and 140° is the normal neck-shaft angle. Coxa vara is a reduction in the typical neck-shaft angle. Nevertheless, if the angle exceeds 140° is named coxa valga. [2] The upper end of the femur becomes weak due to the neck shaft angulation. However, angulation is a significant adaptive trait that aids in the development of bipeds' upright posture. Numerous workers began the angulation in great detail, and conclusions were made. It was discovered that its valuations varied among races and at various ages in terms of sex, age, and race. [3] The results on sex were contradictory. However, it was noted that there was either no gender difference or that it was more prevalent in men than in women. [3] Understanding the mechanics of the hip joint completely requires knowledge of the anatomy of the proximal end of the femur, which also forms the basis for treating pathological diseases of the hip and femur. a design substitute for restoring the neck shaft's normal angle. [4] It may help to prevent the comparatively greater occurrence of dislocations in female patients by being aware of the anatomic differences between genders for the acetabular anteversion angle and neck-shaft angle. It may also result in different implant designs for male and female patients. For optimal implant placement and to avoid dislocation in total arthroplasty, it is critical to understand the usual acetabular and femoral anteversion angles. Aiming to better understand the proximal end of the femur, the current study was conducted to quantify the neck-shaft angle of the femur in adult human cadaveric bones.

Material and Methods

This study was conducted in the Department of Anatomy, Prathima Institute of Medical Sciences, Nagunoor, Karimnagar. Dry Femora were obtained for the evaluation. N=100 femora (n=50 right side and n=50 left side) were used in the current study. The bone side was identified by using classical anatomical landmarks. Similarly, the sex was determined by measurement of the femur's oblique length, Trochanteric oblique length, bicondylar width, and vertical diameter of the head. The following five measurements, which are necessary for determining the femur's sex, were collected using calipers, an osteometric board, and a scale. Vertical diameter of the head: This is the distance from the top of the femur's head on the superior side to the bottom or deepest part of the head on the inferior side. Due to the presence of cartilage, this measurement will be 3 mm larger in a living situation. Bicondylar width: This measurement is made perpendicular to the infracondylar plane. The greater trochanter's height above the infracondylar plane is measured by the trochanteric oblique length, which is the vertical distance. The oblique length of the femur: This refers to the distance between the infracondylar plane and the highest point on the skull. The angle was measured using tools like a simple protractor, a simple measuring tape, and a linear metallic scale. Both anterior and posterior images were used to estimate the neck shaft angles of all the bones. Two locations, one at the center of the head and the other at the upper end of the midway of the narrowest region of the neck, were used to draw the long axis of the neck. The long axis of the shaft was drawn by joining the two midpoints, one at the higher end of the shaft and the other at the lower end, and extending the same line at the upper end to cut the long axis of the neck. A transparent protractor is used to measure and record the angle at the point where the two threads converge.

Results

In this study out of n=100 dry femur bones taken the mean oblique length was calculated to be 441.02 ± 31.59 millimeters. The trochanteric length was 423.74 ± 30.41 millimeters. The vertical diameter of the head was 43.01 ± 3.83 millimeters. The bicondylar width was 80.19 ± 6.01 millimeters and the mean neck shaft angle was 129.16 ± 5.92 degrees details depicted in table 1.

Table 1: The value of mean parameters of measurement of the femur bone

Parameter	*Number of bones*	*Range*	*Mean*	*± SD*
Oblique length (mm)	100	365 – 525	441.02	31.59
Trochanteric length (mm)	100	351 – 496	423.74	30.41
Vertical Diameter of the head (mm)	100	33 – 52	43.01	3.83
Bicondylar width (mm)	100	59 – 92	80.19	6.01
Neck Shaft angle	100	118 – 139	129.16	5.92

The range of distribution of the neck shaft angle was ranging from 118 degrees to 139 degrees. The distribution of neck shaft angle found a maximum of 65% of bones between angles 126-130 degrees followed by 17% of bones having angles ranging from 121 – 125 degrees. The mean angle of all the bones was calculated as 129.16 degrees the details of distribution based on the angles are depicted in figure 1.

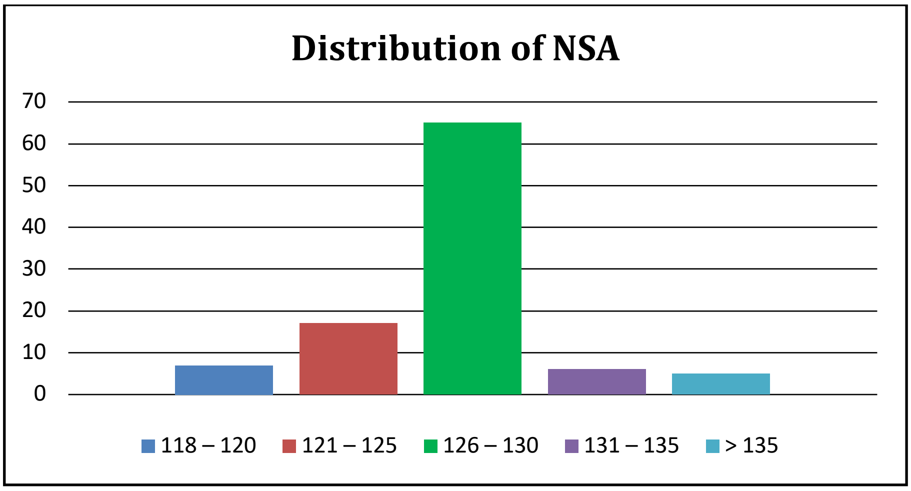

Figure 1: Distribution of neck shaft angle in the femur bones

In this study, neck shaft angle was measured and recorded in n=100 femur bones. Among 100 femurs, 70 were classified as male, and 30 were female. The minimum angle measured was 118 degrees and maximum angle was 137 degrees and the mean angle was 128.92 degrees in male femur bones. In female femur bones, the minimum angle was 119 degrees and maximum angle was 139 degrees and the mean angle was 129.41 degrees details depicted in table 3.

Table 3: Distribution of Neck shaft angles between male and female femoral bones

Neck Shaft angle (Degrees)	*N*	*Range*	*Mean*	*± SD*
Males	70	118 – 137	128.92	5.92
Females	30	119 – 139	129.41	5.17

The measurement of neck shaft angles between the right femur bones and left femur bones was done in the cases of the study. It was found that the mean neck shaft angle of right femur bones was 130.63 ± 5.64 and the mean left femur bones were 131.91 ± 5.91 degrees the details has been depicted in table 4.

Table 4: Distribution of neck shaft angles between right and left femoral bones

Neck Shaft angle (Degrees)	N	Range	Mean	± SD
Right femur	50	119 – 138	130.63	5.64
Left femur	50	118 – 139	131.91	5.91

Discussion

Studies have revealed variations in neck shaft angle, which can be ascribed to differing levels of activity, heredity, race, diet, and lifestyle. [5, 6] Despite extensive research on the anatomical and biomechanical elements that affect the methods used to treat orthopedic disorders, the neck-shaft angle is crucial in determining hip biomechanics and in preoperative planning and template development for hip procedures. Early in fetal life, the femur's neck-shaft angle is the highest, and very early in the growth process, the head and neck diverge from the shaft. The angle is largest at birth and gradually narrows until the adult ranging from up to 160.0 degrees in a kid to 125.0 degrees in an adult. [7] A high neck-shaft angle is related to a long-necked femur, whereas a low angle is associated with a short-necked femur. Each side of the neck that is longer than normal or shorter than average has a wider angle of 2 degrees. The inclination increases approximately by 0.04 degrees for every mm increase in the total length of the shaft. Several studies have recorded a number of measurements and neck-shaft angle of the femur, the angle varied from 104 -147 degrees with a mean of 126.4 degrees at random. [8-10] In this study, the mean neck-shaft angle of femur bones was observed at 130.38 which falls under the range given by most of the studies (117.0 to 140.0 degrees). The value of neck shaft angle in males was 128.92 versus females 129.41 hence no significant differences in the neck shaft angle were noted in the current study. CS Fischer et al., [11] The mean NSA was 127 ± 7.0 degrees, while men had a lower NSA than women the reference range was 114°–140°. According to Lofgren L [12], The average femoral neck angle for men was 125.2° and for women, it was 125.1°, practically the same for both sexes. Reikerås O et al., [13] measured the femoral neck angle; there was no discernible variation in the angle between the sexes. The mean neck angles for men and women were 128.3° and 127°, respectively. Martin R et al., [14] researched female participants from the Japanese, French, Negroes, Egyptians, and Bantu, and noted that women had a larger angle than men did (127.1° to 128° compared to 124.3° to 128°). Several Indian studies have also found similar neck-shaft angles. Pathak SK et al., [15] found a mean NSA of 129.26 degrees in males and 126.62 degrees in females. Similarly, Rani N et al., [16] in South India found the mean NSA of males at 132.3 degrees and females at 132.8 degrees. Roy S et al., [17] found a mean NSA of 131.0 degrees in males and 130.37 degrees in males. In this study, there was a slight difference between male and female angles although it was not significant. The reason could be because of the lesser number of female bones examined as compared to males. The present study also revealed no significant differences between right and left NSA angles (table 4). Gujar S et al., [18] in their study found a mean angle of 136.6 degrees, and SM Khan et al., [19] found a mean angle of 137.0 degrees which was slightly higher compared to the current study. Agarwal et al., [20] and Choudhary et al., [21] found angles similar to our study.

Conclusion

Within the limitations of the current study, it can be concluded that the mean neck-shaft angles in our sample of study were 129.16 degrees. Minor differences between the NSA of males and females were found although the differences remain insignificant. Similarly, the differences between the right and left femoral neck-shaft angles were also found to be insignificant. These kinds of studies help us to determine the biomechanics of hip joints and the knowledge that could be utilized for hip replacement surgeries.

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