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RESEARCH ARTICLE

CERVICO-DIAPHYSEAL ANGLE OF FEMUR-A COMPARATIVE STUDY IN SOUTH INDIAN POPULATION

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ABSTRACT

Background: Cervico- diaphyseal angle or neck-shaft angle is the angle made by the neck of the femur with the femoral shaft. This angle had grabbed much attention of researchers and different studies with variable results were obtained.
Aim: The aim of the study is to measure the neck-shaft angles on both gender types and on both sides and correlate it clinically.
Materials and Methods: This study was done in Department of Anatomy, Yenepoya Medical College, Mangalore.100 dry human femora of both sexes belonging to either sides were measured mechanically using osteometric board, threads and glass protractor .The results obtained were statistically analyzed.
Results: The neck-shaft angle of femur is measured in100 dry bones and the mean value is calculated as 134.56 degrees. The mean values for males were 134.29 and females were 134.82 degrees respectively. The mean values for left side were 135.22 and that of right side were 133.86 degrees. Even though the value is higher in females and in left side, no statistical difference was found.
Conclusion: Any increase or decrease in femoral neck-shaft angle is associated with various clinical conditions.It had a significant role in maintaining hip stability and normal gait pattern. Knowledge about this is essential in hip arthroplasties and corrective osteotomies. The data established in this study will be useful for various orthopedic diagnosis and procedures and also in the field of general human osteology and anthropology.

INTRODUCTION

Hip joint is a synovial josint of ball and socket (multi-axial, spheroidal) type of joint with a close-packed position of full extension, with slight abduction and medial rotation. The femoral neck is approximately 5cm long connecting the head to the shaft of the femur at an average angle of 135 degrees. This is known as the angle of inclination or neck-shaft angle or collo-diaphyseal angle or cervico-diaphyseal angle. It is this angle which enables the limb to swing clear of pelvis facilitating a normal gait. The neck shaft angle is widest at birth and diminishes through age reaching the adult range of 120-140 degrees. When the angle decreases, it results in a condition known as coxa vara and when the angle increases, it results in coxa valga. The knowledge about this angle is of paramount importance in the management of proximal femur fractures and gait abnormalities [2]. The angle was extensively studied by many workers and conclusions were drawn. It was found to be different in different races and in different ages. However, the findings pertaining to sex were inconsistent. It was said to be higher in males or in females or nosex difference at all. The present study focuses on the sexual variation in relation to the neck-shaft angle of femur. An attempt is also made to compare the angle between the sides to which the bone belongs.

MATERIALS AND METHODS

The study was conducted on 100 dry human femora from the Department of Anatomy, Yenepoya Medical College, Mangalore. The femora selected were free of any gross deformities or pathologies.Of these, 48 were male and52 were female.49 belong to right side and 51 belong to left side. The gender of the femora was determined by the following criteria:

1. Caput-condylar length using osteometric board
2. Prominence of muscular markings.
3. Weight of the bone

The bones were cleaned and observed under day light.The femur was fixed over the osteometric board .Midpoint of neck is determined by measuring the width of the narrowest part of the neck using vernier calipers and dividing it by 2. The point is marked with a marker on the surface of the bone. The axis is defined by means of a thread fixed on either ends of the bone along the neck axis. The diaphyseal axis is defined by another thread mounted through the center of the shaft of bone. The angle at the meeting point of the two threads is determined using a transparent protractor and the value is recorded. This angle between the neck axis and diaphyseal axis defines the neck-shaft angle of the femur [1].

Figure 1. (Method of axis determination)

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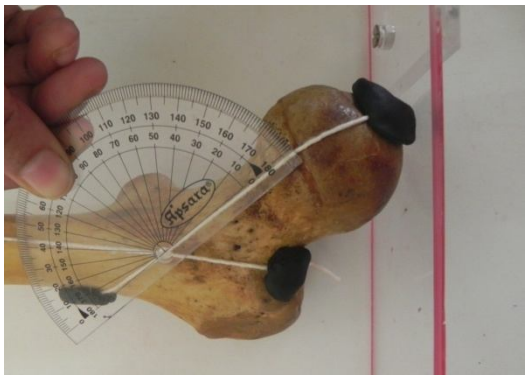

Figure 2. (Method of measurement of neck shaft angle)

Observations

The results obtained after measuring the neck-shaft angle of dry femora were tabulated and statisticallyanalyzed. The mean value obtained for neck-shaft angle was 134.56. In females, the mean angle was 134.8 degrees and in males, 134.2 degrees with standard deviation of 6.06 and 5.97 respectively. Independent t-test was usedand p- value came to be .658 which was insignificant statisticaly. In left side, the mean value was 135.2 and on right side 133.8 with standard deviation of 5.55 and 6.39 respectively. The p-value turned out to be .259 which shows statistical insignificance.

Table 1. Descriptive statistics for femur side and gender type

Study group	Number of bones	Mean	Standard deviation	t- value	Degrees of freedom	p value
Male	48	134.2917	5.97498	0.444	98	0.658
Female	52	134.8269	6.06087			P > 0.05 Not significant
Right	49	133.86	6.397	1.136	98	0.260
Left	51	135.21	5.547			P > 0.05 Not significant

DISCUSSION

Femoral neck shaft angle had grabbed much attention of researchers and different studies with variable results had come forth owing to the different methods of study and population variations. Parsons in1914 studied neck shaft angle of femora and came out with male right femora measuring113-140 with an averageof 127 degreesand male left femora measuring 112-138 with an average of126 degrees, female right femora measured114-133 with an average of126 and female left femora measured118-133 with an average of 125 degrees. He concluded that neck-shaft angle had no sex difference [21]. Average neck-shaft angle found in Hong Kong Chinese femora was135 in males and 134 in females and in Caucasian femora was, in males 136 and in females 133 degrees. The study showed that the neck shaft angle is increased in males than in females in both groups [13]. A study conducted on117 male and 33 female femora and 15 x-ray films showed the angle is larger in males than in females with an average of 125.7 and 125.5 degrees respectively [20].

Table 2. Comparison of present study with previous studies (Mean neck-shaft angle of human femora)

Year	Region	Author	Mean (Degree)
1928	Japan	Hirai &Tabata	130.50
1941	China	Weidenreich	131.20
1961	Belgium	wiesselmann	133.10
1986	India	Singh	131.10
1987	Canada	Yoshioka	131.00
1997	South India	Issac	126.70
2010	South India	Nagarathnamma	132.45
2012	South India	Present study	134.56

The femoral neck angles were measured in 48 pairs of normal specimens from cadavers of Norwegians. In this study, the neck-shaft angle in females were 127+/- 7.2 degrees and in males, 128.3 +/-7.9. There was no significant differences between sexes [8].The neck-shaft angle was measured in 100 male and 100 females and came out with females having more valgus neck-shaft angle than males in radiographic assessment [15]. In a study of neck shaft angle between 50 white and 50 black subjects using dual x-ray absorptiometry scan print out, there was no significant difference between sexes in neck-shaft angle [19]. In the present study, 100 dry femora of South Indian population were measured and the mean angle in females were 134.82 and in males were 134.29 degrees respectively showing no significant statistical difference. A comparative analysis was done over neck shaft angle of 33 right and 33left adult Brazilian human femora using metallic ruler and goniometer.On right side the angle was122.55+/-4.9 degrees and on left were 125.61+/-6.6 degrees [20]. In the present study, 100 femora of which 49 belonged to right side and 51 belonged to left side was studied and the mean neck-shaft angle was 133.86 on right side and 133.21 on left side which show no statistical significance. The neck shaft angle allows greater mobility at hip joint. Variation from a normal neck-shaft angle may reflect anatomical variation or disease of natural or acquired origin. A decreased angle is termed coxa vara. In a varus position the femoral head tends to seat more deeply into the acetabulum and the hip remains very stable. An increased neck-shaft angle is termed coxa valga. A valgus hip tends to allow poor contact with the dorsal acetabulum and subluxation or luxation may result. One of the main diagnostic rules that doctors use to detect femur fracture is by assessing the distortion of neck-shaft angle. A large discrepancy from the healthy neck-shaft angle would indicate a possibility of fracture.It is one of the important parameters in designing the prosthesis for hip replacement.It is also helpful in forensic identification of individuals.

Conclusion

Considering the above mentioned importance of neck shaft angle of femur, this study was conducted to analyze the angle and its variations with respect to side and sex using anatomical methods.In the present study, the mean neck-shaft angle value for females were slightly higher than that of males but there was no statistical difference. The mean neck-shaft angle of left femora was higher than that of right femora but the values were not statistically significant. Therefore, this study will be of use in the field of orthopedic surgery and general osteology and anthropometry.

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