



ORIGINAL RESEARCH PAPER

Anatomy

MORPHOMETRIC STUDY OF NECK AND NECK SHAFT ANGLE OF DRY FEMUR

KEY WORDS: Femoral shaft; Neck shaft angle; Neck vertical diameter; Neck transverse diameter.

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ABSTRACT

Background: Mostly femoral fracture of upper end involving the neck and trochanters are common. The neck shaft angle, neck transverse and neck vertical diameter influence the fractures of proximal femur. Internal fixation and reduction of fracture of upper end of femur with implants to restore normal anatomy and functional activity of femur is necessary for early recovery of patients. The study was performed to enlighten the orthopedic surgeons and implant manufacturer about the geometry of upper end of femur. **Objectives:** The objectives of present study to measure the neck shaft angle, neck transverse and vertical diameter. **Material and Methods:** The present study was performed on 310 dry femora in the department of anatomy RKDF Medical College Hospital & Research Centre, Bhopal, Madhya Pradesh. The measurements were taken of neck shaft angle, neck transverse and vertical diameter of femur by using goniometer and vernier calipers. The mean value and range were calculated by using SPSS software. **Results:** The mean neck shaft angle of right and left femora was $126.04 \pm 4.9^\circ$ and $127.43 \pm 5.2^\circ$ respectively and maximum range of right and left femora was 135° and 136° respectively. Neck transverse diameter of right and left femora was $24.10 \pm 2.4\text{mm}$ and $24.58 \pm 3.1\text{mm}$, respectively. Neck vertical diameter of right and left femora was $28.96 \pm 3.18\text{mm}$ and $28.0 \pm 3.7\text{mm}$ respectively. **Conclusion:** Right and left femoral measurements show no significant difference. The use of normal means and range of femoral dimensions helps to decide the plan and management of surgeries and manufacturer to develop appropriate implants suitable for the Indian population.

INTRODUCTION:

The femur is the longest and strongest bone and provide skeletal support to the thigh. The proximal part of femur included a head, a neck, upper part of the shaft and trochanters. The neck of femur connect the head to the shaft at an angle known as neck shaft angle (NSA) or collodiaphyseal angle (CDA)¹. Mostly femoral fracture of upper end involving the neck and trochanters are common. The neck shaft angle, neck transverse and neck vertical diameter influence the fractures of proximal femur. Internal fixation and reduction of fracture of upper end of femur with implants to restore normal anatomy and functional activity of femur is necessary for early recovery of patients². Depending upon the dimensions, implants are designed. On the basis of measurements performed in western population, the implants are used for the treatment of fractures³. In India, very few studies have done on femoral morphometry and these studies reveal that in Indian population the results of Western studies are not applicable⁴. The study was performed to enlighten the orthopedic surgeons and implant manufacturer about the geometry of upper end of femur.

OBJECTIVE: The objectives of present study to measure the neck shaft angle, neck transverse and neck vertical diameter.

MATERIALS AND METHODS: The present study was performed on 310 dry femora (160 right femora and 150 left femora) in the department of anatomy, RKDF Medical College Hospital & Research Centre, Bhopal, Madhya Pradesh. The measurements were taken of neck shaft angle (NSA), neck transverse diameter (NTD) and neck vertical diameter (NVD) of femur by using Goniometer and Digital Vernier Calipers. Any femora having gross deformities or damage were excluded from this study.

Neck shaft angle: By using the thread, axis of the neck was determined. The thread divides the anterior surface of the neck into two equal halves. In the mid sagittal plane over the anterior surface, the axis of the shaft was marked using the same thread. Then the angle between the neck and shaft is measured by using the Goniometer (Figure-1).

Transverse diameter of neck: Transverse diameter of neck is measured, minimum diameter of the neck of the femur in antero-posterior direction is measured using a digital vernier calipers (figure-2).

Neck vertical diameter: The vertical diameter of the neck is the minimum diameter of the neck of the femur at supero-inferior direction and it is measured by using a digital vernier calipers (figure-3).



Statistical analysis was done by using SPSS (version 20.0). The results were presented as Mean, standard deviation and range values. To compare right and left femora, t-test was used.

RESULTS:

		Right Side	Left Side	Total Femur (n=310)	p-value
Neck shaft angle (NSA) in degree	Mean±SD	126.04 ±4.93	127.43 ±5.23	126.71 ±5.12	P>0.05
	Range	113-135	119-136	113-136	
Neck transverse diameter in mm	Mean±SD	24.10±2.45	24.58±3.19	24.33±2.84	P>0.05
	Range	19-30	18-35	18-35	

Neck vertical diameter in mm	Mean±SD	28.96±3.18	28±3.73	28.49±3.49	P>0.05
	Range	23-35	23-46	23-46	

The mean and standard deviation of NSA of total femur 126.71±5.12°, right and left side are 126.04±4.9° and 127.43±5.23° respectively. The maximum NSA is 136° on left femur and minimum is 113° in right femur. The mean and standard deviation of neck transverse diameter of total femur 24.33±2.84 mm, right and left side are 24.10±2.45 mm and 24.58.43±3.19 mm respectively. The maximum neck transverse diameter is 35 mm and minimum is 18 mm found in left femur. The mean and standard deviation of neck vertical diameter of total femur 28.49±3.49 mm, right and left side are 28.96±3.18 mm and 28±3.73 mm respectively. The maximum neck vertical diameter is 46 mm on left femur and minimum is 23 mm in both sides. No significant difference between right and left femora.

DISCUSSION:

The mean NSA in the present study is 126.71°. The study was done in western part of India, the mean NSA is comparable with most of other Indian studies. Where as Saikia KC⁷ (139°), Shakil M khan¹¹ (137.1°), & Subhash gurjar¹⁰ (136.3°) reported higher value. Kaur P⁸ while working in punjab region reported lower value of 121°. Isaac B⁵ (126.7°), and Ravichandran D² (126.55°) reported similar result with our study and Siwach RC⁶ (123°) showed slightly less compare to our result. Western authors Hoaglund FT¹² reported NSA (136°), Yoshioka¹³ (131°), Bulandra AM¹⁴ (140.48°), and Toogood PA¹⁵ (129.2°) which are comparatively higher than our study.

Siwach RC⁶ found anteroposterior neck width (NTD) 24.9 mm which is similar to our study (24.10 mm) and superoinferior width (NVD) 31.8 mm slightly higher from our value (28.96). Murlimanju BV⁹ reported neck transverse diameter was 23.9 mm and neck vertical diameter was 30.2 mm which is almost similar to our findings.

CONCLUSION:

Right and left femoral measurements show no significant difference. The use of normal means and range of femoral dimensions helps to decide the plan and management of surgeries. And also biomechanical engineer to develop appropriate implants suitable for the Indian population.

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