

An Osteometric Analysis Of Femoral Neck And Its Clinical Importance

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Abstract

Background: Fracture Of The Neck Of Femur And Inter-Trochanteric Fractures Of Femur Are Very Common. Treatment Of These Fractures By Internal Fixation Using Implants Plays A Crucial Role In Rehabilitation And Early Mobilisation Of The Patients. Hip Prosthesis Are Designed Based On The Measurements Of Proximal End Of Femur. Femoral Neck Fractures Are Usually Intracapsular And Can Interrupt The Blood Supply To Head Of Femur Causing Avascular Necrosis Of Femoral Head.

Materials And Methods: This Study Was Carried Out In The Department Of Anatomy, Goa Medical College On 80 Unpaired Dry Adult Human Femurs After Acquiring Ethical Clearance From The Institutional Ethics Committee.

Results: The Data Collected Was Analysed Using SPSS Version 24 And Was Tabulated Using Microsoft Office Excel. In The Study Of 80 Femurs Even Though We Found A Difference Of 1.6 Mm Between Inter-Trochanteric Crest Length Of Right And Left Sides, It Was Not Statistically Significant.

Conclusion: In-Depth Understanding Of Measurements Of Proximal End Of Femur Will Aid In The Day To Day Practice Of Orthopedicians, Radiologist, Forensic Experts And Anthropologists.

Keywords: Osteometric Analysis, Femoral Neck, Inter-Trochanteric Crest Length

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I. INTRODUCTION

Humans are unique among primates since they adopted an upright posture and a bipedal mode of locomotion. The upright posture brought out several changes especially in skeleton, muscle and joints of the lower limb. Most of these important modifications were on the femoral neck of femur. The femoral neck, on average 5 cm long, connects the head to the shaft.^{1,2}

Fracture of the neck and trochanteric fractures of femur are very common. Treatment of these fractures plays a crucial role in rehabilitation and early mobilisation of the patients.³

Hence, the aim of the study was to compare the femoral neck measurements of right and left sides as they will be helpful to orthopedicians in diagnosis and treatment of diseases related to hip joint.

II. MATERIALS AND METHODS

This descriptive observational study was carried out in the Department of Anatomy, Goa Medical College from January 2021 to December 2022 on dry adult human femurs after acquiring Ethical Clearance from the Institutional Ethics Committee. A total of 87 unpaired human femurs were obtained from the Department of Anatomy, Goa Medical College.

After applying the exclusion criteria, 7 femurs were found to be unsuitable in achieving the objectives of our study.

Following were the exclusion criteria:

- (a) Femurs with evident deformity
- (b) Femurs that have loss of bony features
- (c) Damaged (e.g. fractured) femurs

Hence the total sample size of this study is 80 out of which 40 belonged to the right side and 40 to the left.

The following parameters were measured:

1. Femoral neck vertical diameter (FNVD) - It is the minimum diameter of the neck of the femur in the supero-inferior direction measured anteriorly. (Figure 1)
2. Femoral neck transverse diameter (FNTD) - It is the minimum diameter of the neck of the femur in antero-posterior direction. (Figure 2)

3. Femoral neck circumference (FNC) - The circumference of neck was measure at the same points as diameter with the help of a coloured thread and then measuring the coloured thread by sliding digital Vernier caliper. (Figure 3)
 4. Intertrochanteric crest length (ITCL) - It is the distance from most superior point on the intertrochanteric crest to the most prominent point on the lesser trochanter measured on the posterior aspect of femur. (Figure 4)
- All measurements were measured using digital Vernier calliper with a least count of 0.01mm. The measurements were tabulated and analysed using Microsoft Office Excel. p value of significance was calculated to find any significant difference in measurements on right and left side femurs.

III. RESULTS

A descriptive study was carried out on 80 dry femora from the Department of Anatomy, at Goa Medical College, Bambolim. The morphometric difference between right and the left femoral neck were assessed. The data was collected from January 2020 to December 2022

Though there is a difference of 1.63mm difference between Right and left side ITCL, there is no statistical difference between right and left side FNVD, FNTD, FNC and ITCL.

Table 1:Femoral neck measurements

Measurements	Right (mm)		Left (mm)		p value
	Mean	S.D	Mean	S.D	
FNVD	29.84	3.49	30.38	3.44	0.48
FNTD	24.69	3.42	25.21	3.08	0.47
FNC	88.94	8.36	88.74	9.45	0.92
ITCL	62.25	5.33	60.62	4.68	0.15

(FNVD- Femoral Neck Vertical Diameter, FNTD- Femoral Neck Transverse Diameter, FNC- Femoral Neck Circumference, ITCL-Intertrochanteric Crest Length)

IV. DISCUSSION

The neck of femur plays a crucial role in the structural and functional aspect of human's erect posture. Intertrochanteric fracture which needs dynamic hip screw fixation needs reaming which removes the available cancellous bone. Screws with larger thread diameter occupy a larger area in the neck and head of femur. Use of such large thread diameter screws remove a large cancellous stock cylinder from the neck and occupy most of the available spaces in the neck and this could cause tamponade effect resulting in non-union or malunion and avascular necrosis.

The knowledge of proximal femur morphometry is of great importance in diagnosis, treatment and follow-up of fracture of proximal end of femur, slipped upper femoral epiphysis, developmental dysplasia of hip and other neuromuscular disorders involving lower extremities.

In a study conducted by Ravichandran et al⁴ on 578 unpaired femurs in Tamil Nadu, they reported femoral neck vertical diameter of 30.99 mm. This is similar to the values in our study at 30.11 + 3.45mm, while Verma et al⁵ observed 91 femurs in Delhi population and found the mean femoral neck vertical diameter to be 33.02 ± 4.22mm which is higher than the value in our study

150 dry adult human femurs in Haryana were studied by Siwach⁶ who came to a conclusion that the mean femoral neck vertical diameter 31.87 ± 2.91mm which is almost similar to our study while Dwivedi et al⁷ in their study on 280 dry adult human femur in Maharashtra found the mean human femoral neck vertical diameter to be 27.82 ± 2.82mm which is less than the values obtained in our study.

Our study found similar results as those conducted by Mukhia et al⁸ on 75 dry adult human femurs in Nepal where the mean femoral neck vertical diameter was 29.4 ± 3mm and by Mishra et al⁹ who studied 50 human femurs in Nepal and found the femoral neck vertical diameter to be 30.52 ± 3.48mm.

Ziylan et al¹⁰ in their study on 72 dry adult human femurs in Turkey found that the mean femoral neck vertical diameter of 30.6 ± 3mm on left side and 30.7 ± 3.6mm on right side which is similar to our study.

The result in our study differed from Sendhoorani et al¹¹ who studied 200 dry adult human femur in Tamil Nadu and concluded that the mean femoral neck vertical diameter to be 28.66 ± 0.4mm.

Durga et al¹² in their study on 100 dry adult human femur in Karnataka found the femoral neck transverse diameter on right side to be $25.13 \pm 2.9\text{mm}$ and $26.15 \pm 3.9\text{mm}$ on the left side. This is similar to our study at $24.69 \pm 3.42\text{ mm}$ on right and $25.21 \pm 3.08\text{mm}$ on left side.

The values obtained in the current study coincide with those obtained in a study on 91 dry adult human femurs by Verma et al⁵ in Delhi who came to a conclusion that mean femoral neck transverse diameter on right side is $24.15 \pm 3.04\text{mm}$ on right side and $23.86 \pm 3.09\text{mm}$ on left side.

Our findings are also similar with those of Siwach⁶ who studied 150 dry adult human femurs in Haryana and found that mean femoral neck transverse diameter to be $24.9 \pm 2.94\text{mm}$ and Dwivedi et al⁷ who in their study on 280 dry adult human femur in Maharashtra found that the mean femoral neck transverse diameter was $23.21 \pm 2.84\text{mm}$.

Similar values as ours were obtained by Ziylan et al¹⁰ who studied 72 dry adult human femurs in the Turkish population and concluded that the mean femoral neck transverse diameter on right side is $26.3 \pm 3.1\text{mm}$ and on left side it is $25.5 \pm 2.7\text{mm}$.

In a study conducted by Mukhia et al⁸ in Nepal region on 75 dry adult human femur they found that the mean femoral neck transverse diameter on right side to be $21.9 \pm 4.6\text{mm}$ and on left side to be $25.3 \pm 3.8\text{mm}$. In this the right sided values are much lower than the values of our study and on left side it is similar to our study.

The mean intertrochanteric crest length was calculated to be 63.1mm in a study conducted by Singh et al¹³ on 200 dry adult human femurs in Madhya Pradesh. This is higher than the value obtained in our study at $61.35 \pm 5.01\text{mm}$.

In our pioneer study on dry adult femoral neck circumference, the values on right side were $88.94 \pm 8.36\text{ mm}$ and on left side $88.74 \pm 9.45\text{ mm}$ and the mean femoral neck circumference of all the femurs in our study was $88.84 \pm 8.87\text{ mm}$

V. CONCLUSION

Our study has comprehensively highlighted the measurements of femoral neck in Goan as well as in Indian population and will aid in the day to day practice of orthopedicians, radiologist, forensic experts and anthropologists.

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Figure 1: Measurement of femoral neck vertical diameter



Figure 2: Measurement of femoral neck transverse diameter



Figure 3: Measurement of femoral neck circumference



Figure 4: Measurement of Intertrochanteric crest length