

Morphometric study of head and neck of diameter of the human left and right femur

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Abstract

Background: The knowledge about different diameter of the head and neck of the femur is essential in orthopedic surgery and for radiological practice in identifying pathology of bone. The femoral normative values are also essential to plastic and reconstructive surgeons and medical rehabilitation. **Aim:** To evaluate the morphological features of head and neck of diameter of the human left and right femur. **Material and Methods:** In this prospective study 353 dried, intact human femora were classified into Right side and Left side. Variables studied were vertical diameter of head and neck of the femur and Neck-shaft angle of the femur. Digital slide caliper and goniometer were used for the measurements. **Results:** The circumference of the neck and Neck-shaft angle were found to be significantly different on both the sides. Whereas, the vertical diameter of the head and neck did not show significant difference on comparison of both the sides. **Conclusion:** This study was an attempt to construct morphological data on head and neck diameter of femur. The data allow safe instrumentation and fixation and also help in formulating parameters for manufacturing implants using data derived from a studied population.

Key Words: Femur, Neck circumference, Head diameter, Neck-Shaft angle.

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Received Date: 26/05/2018 Revised Date: 30/06/2018 Accepted Date: 26/07/2018

DOI: <https://doi.org/10.26611/1021719>

Access this article online

Quick Response Code:



Website:

www.medpulse.in

Accessed Date:
30 July 2018

INTRODUCTION

The femur is the longest and strongest bone of the human body. Morphologically it is a typical long bone. It forms the skeleton of the thigh, bears body weight in erect posture, supports movement of legs, provides attachment to muscles, form blood cells and acts as store house for calcium and phosphate.¹ The proximal end of femur that constitutes the hip joint is crucial for the purpose of locomotion and is important from the clinical point of

view. To understand the epidemiology and modalities of treatment of fractures in this region, it becomes imperative to understand the morphological, functional and kinesiological aspects of the neck of femur, neck shaft angle, head of femur etc. In clinical practice, dislocation of the hip joint and fracture neck femur is very common. The knowledge about different diameter of the head and neck of the femur is essential in orthopedic surgery in prosthesis and nail application and for radiological practice in identifying pathology of bone and also for determining age. The femoral normative values are also essential to plastic and reconstructive surgeons in their reconstruction and medical rehabilitation. This study was undertaken to evaluate the morphological features of head and neck of diameter of the human left and right femur which will provide important data to radiologists, rheumatologists and orthopedic surgeons for diagnosis and planning of treatment.

MATERIAL AND METHODS

In this prospective study 353 dried, intact human femora were selected for the study. All the femora were classified into Right side and Left side. The femora were not sexed for measurements in the present study. The following variables were studied:

- Vertical diameter of head of the femur
- Vertical diameter of neck of the femur
- Neck-shaft angle of the femur

All the measurements were recorded in metric unit – centimeters (cm).

Methodology: Morphometric study was carried out on all 353 dried, intact human femora by direct physical methods. Each parameter was measured thrice and then the mean was calculated. All parameters were measured by same observer.

- Procedure for measurement of vertical diameter of head of the femur²:** The fixed jaw of the digital slide caliper was placed on the superior surface and the sliding jaw was placed on the inferior surface of the head of the femur and three readings were taken between different points. The maximum reading was recorded as vertical diameter of head of the femur.
- Procedure for measurement of vertical diameter of neck of the femur²:** The fixed jaw of the digital slide caliper was placed on the superior surface and the sliding jaw was placed on the inferior surface of the neck of the femur and several readings were taken between different points. The minimum reading was recorded as vertical diameter of neck of the femur
- Procedure for measurement of femoral neck shaft angle²:** For measurement of the neck shaft angle the respective bone was first held in its anatomical position, then the two limbs of the goniometer were made to align along the axis of neck and shaft. The angle between the two limbs of goniometer gives the value of the corresponding neck-shaft angle of femur. Circumference of femoral neck was measured at midpoint between base of femoral head and inter-trochanteric line with the help of metric tape. For denoting the mid-point of the neck the neck length was first measured and then divided by two. The distance thus obtained is measured either from the inter-trochanteric line or from base of head. The point is demarcated with the help of pencil. Neck shaft angle was measured as the angle between major axis of shaft and major axis of neck (measured at posterior surface of neck).

Statistical Analysis: The findings were tabulated, statistically analyzed and discussed, comparing them with similar studies done earlier. Each parameter was statistically studied by calculating Mean, Standard deviation (S.D.), 'Z' value, 'P' value. Mean of the two groups were compared by applying Z test.

RESULTS

The study was carried out on right and left femora. In total 353 cases are studied and observation on the morphometric data of head and neck circumference and diameter, neck-shaft angle etc. were recorded. After completing the measurements of all 353 femora, data was divided into two groups: Right side (n=175) and Left side (n=178).

Table 1: Circumference of neck (cm)

	Right side	Left side
Observations	175	178
Mean± SD	9.50±.78	9.33±0.78
Known Variance	0.6099	0.6146
z	2.065389	
z Critical two-tail	1.959964	
p-Value	0.038886 (Significant)	

The mean values of circumference of the neck of femur on the right side was 9.50±0.78 cm and on the left side was 9.33±0.78 cm. There was significant difference between mean circumference of neck of right side and left side.

Table 2: Vertical diameter of head

	Right side	Left side
Observations	175	178
Mean± SD	3.98±0.34	3.92±0.33
Known Variance	0.121	0.1116
z	1.681185	
z-critical two-tail	1.959964	
P-Value	0.092727	

The mean value of the vertical diameter of the head of femur on the right side was 3.98±0.34 and on the left side was 3.92±0.33. There was no significant difference between mean diameter head of Right side and left side.

Table 3: Vertical diameter of neck

	Right side	Left side
Observations	175	178
Mean± SD	2.94±0.81	2.83±0.31
Known Variance	0.6723	0.0986
z Critical two-tail	1.959964	
Z	1.655647	
P-Value	0.097793	

The mean value of the vertical diameter of the neck of femur on the right side was 2.94±0.81 cm and on the left side was 2.83±0.31. There was no significant difference between mean diameter head of Right side and left side.

Table 4: Neck-shaft angle of femur

	Right side (deg)	Left side (deg)
Observations	175	178
Mean± SD	134.49±7.70	132.63±8.71
Known Variance	59.4432	75.9945
z Critical two-tail	1.959964	
Z	2.125715	
P(Z<=z) two-tail	0.033527	

In the present study mean values of neck-shaft angle of femur on the right side was 134.49±7.70 and on the left side was 132.63±8.71. There was significant difference between neck shaft angle of right side and left side.

DISCUSSION

The mortality and morbidity associated with fracture neck femur imposes immense physical, mental, social and economic trauma to both the patient and the family. It has been documented in various literature that neck-shaft angle of femur, neck-circumference, neck length is well associated with risk of fracture neck femur.³ Lower values of neck-circumference is associated with low bone-mineral density and hence higher risk of fracture.^{4,5} In the present study there was significant difference between mean circumference of neck of right side and left side. Valter José da Silva *et al*⁶ did not find statistically significant difference in circumference of the femur neck, when the right and left femurs were compared. In the present study, there was no significant difference between mean diameter head of right side and left side. Züylan T *et al*,⁷ found that the vertical diameter of the head of the right femur was significantly greater than the corresponding left femur ($p<0.05$). Chauhan R *et al*⁸ noticed that in both sexes the vertical diameter was more on the left side than the right side though the difference was statistically non significant (male $p=0.71$; female $p=0.28$). Asala SA *et al*⁹ noted that the mean diameter of the head of the Nigerian male femur was significantly greater than that of the female ($p<0.001$). Asala SA *et al*⁹ found that the mean head diameter of the male femur was significantly greater than the mean head diameter of the female femur in both the south African white and black population groups (significant at $P<0.001$). Afroze A *et al*¹⁰ observed that the mean vertical and transverse diameters of the head of the male femur were significantly greater than that of female ($p<0.001$). Chauhan R *et al*⁸ noticed that the vertical diameter of femoral head was greater in males than in females, both on right and left sides, but was statistically insignificant (right $p=0.42$, left $p=0.42$). It was also noticed that in both the sexes the vertical diameter was more on the left side than the right side, though the difference was statistically non significant (male $p=0.71$, female $p=0.28$). Mishra *et al*¹¹ found that the mean vertical diameter of head was

4.29 cm. There was no significant difference between mean diameter head of Right side and left side. Mishra *et al*¹¹ have found femoral neck diameter (superoinferior) to be 3.05cm. Züylan T *et al*,⁷ did not notice any statistically significant difference in the two sides. There was significant difference between neck shaft angle of right side and left side. Otsianyi WK *et al*¹² have found no statistical difference between right and left sided femora, as well as between male and female sexes. Ali L¹³ has found higher values in right side as compared to left side. Saikia *et al*¹⁴ have found significantly higher values in left side as compared to right side.

CONCLUSION

The present study was an attempt to construct morphological data on head and neck diameter of femur. The data allow safe instrumentation and fixation. The study will also help in formulating parameters for manufacturing implants using data derived from a studied population.

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Source of Support: None Declared
Conflict of Interest: None Declared

