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Neck-Shaft Angle and the Angle of Anteversion of Femur in Central India Population

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ABSTRACT

Background & Objectives: Femur carries the body weight, supports movements of body and provides attachment for regional muscles in order to carry out myriad of biomechanical functions. It's pertinent to know the morphometric characteristics of the proximal femur, with the intent of minimizing the risk of complications related to surgical procedures executed in the area. This study was planned to measure the Neck-Shaft Angle (NSA) and Angle of Anteversion (AOA) of Femurs in central India population.

Materials and Methods: This study was carried out on intact, dried, non-pathological dried Femurs of both gender (n=100). NSA and AOA were measured using Osteometric Board, Goniometer, Vernier Caliper (least count of 0.01 mm) and coloured threads.

Results: The AOA was found to be higher in female Femurs and on the left sided Femurs. There was no statistically significant difference in NSA gender or side wise.

Conclusion: It is important for medical practitioners to know the normal morphometric values as well as regional variations of Femur in order to understand and treat different disorders of the Femur and hip joint. Findings of our study can be useful in designing femoral implants for central India population for various hip joint surgeries.

Key words Hip joint, Femur, Anatomy, India

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INTRODUCTION

Anatomical knowledge of different dimensions of femur in general, and head neck region in particular is essential in anthropological and medico-legal practice, to radiologists, rheumatologists and orthopaedic surgeons for diagnosis and planning of treatment [1].

The primary loading forces on bone are tension, compression, bending, and torsion [2]. The proximal end of femur is subjected to considerable bending stress, because of the positions of its articulations and major muscle attachments [3-5].

Maximum stress during bodily movements occurs at the neck of Femur (Collum Femoris). The neck is cylindrical in shape and connects head to the body. It forms a wide angle with the body that opens medial wards. It is flattened anteroposterior, constricted in the middle, and wider laterally than medially. It is pierced by several vascular foramina on the anterior surface. The posterior surface of neck broader, smoother and more concave compared to the anterior surface. Approximately a centimetre above the intertrochanteric line, the posterior part of the capsule of the hip- joint is attached to it. The superior border of neck is pierced by large vascular foramina and ends at greater trochanter laterally. The inferior border of neck is long and slender, and curves slightly backwards to end at lesser trochanter.

Proximal femur fractures have become quite rampant in today's hectic lifestyle and these numbers probably will continue to rise particularly affecting the elderly people [6]. Apart from decreasing bone mass with aging [7], several other factors are implicated in these fractures, like reduced muscle mass [8], postural unsteadiness, quality of bone [9], genetic factors such as type 2 collagen synthesizing gene polymorphism [10] and the geometry of the proximal femur [11].

Present study was planned to measure the Neck-Shaft Angle (NSA) and Angle of Ante version (AOA) of Femurs in central India population.

MATERIALS AND METHODS

A total of 100 dried adult Femurs of both gender and sides were included in the study. Segmented, mal-united, deformed Femurs and the ones with unclear bony landmarks were excluded. Osteometric Board, Goniometer,

Vernier Caliper (least count of 0.01 mm) and coloured threads were used for measurement of NSA and AOA of Femurs.

The femoral NSA was measured on the anterior surface of femur as an obtuse angle between the neck axis and the proximal femoral diaphysis [12,13]. The AOA was determined using the Kingsley Olmsted method [13-15].

This descriptive research study was conducted in department of Anatomy over a period of two years. The study was approved by the Institutional Ethics Committee of L N Medical College and Research Centre, Bhopal, Madhya Pradesh, India beforehand.

Statistical analysis was done with the help of MS Excel and Graph Pad software. Unpaired student's t-test was used to compare the means and p value of less than 0.05 was considered as statistically significant.

RESULTS

Results are show in Tables 1 to Table 5. The AOA was found to be higher in female Femurs and on the left side (Tables 2 and 3). On gender and sidewise comparison, AOA was higher in female Femurs on right side (Table 4) and in male Femurs on the left side (Table 5). There was no statistically significant difference in NSA gender or side wise.

Table 1: Gender and side wise number of femurs included in the study.

Gender	Right Side	Left Side	Total
Male	32	29	61
Female	18	21	39

Table 2: Comparison between male and female Femurs (Unpaired student's t test).

	Male (n =61)	Female (n =39)	p Value
NSA	128 ± 5	128 ± 5	1
AOA	11.2 ± 4	13.5 ± 5	0.0126

Table 3: Comparison between right and left side femurs (unpaired student's t test).

	Right side (n =50)	Left side (n =50)	p Value
NSA	128 ± 6	130 ± 5	0.0732
AOA	11 ± 5	13 ± 5	0.0483

Table 4: Gender wise comparison of right and left side femurs (unpaired student's t test).

	Right side (n =50)			Left side (n =50)		
	Male (n=32)	Female (n=18)	p Value	Male (n=29)	Female (n=21)	p Value
NSA	128 ± 6	127 ± 6	0.5742	129 ± 5	130 ± 5	0.4885
AOA	10 ± 5	13 ± 5	0.0472	13 ± 4	14 ± 6	0.4827

Table 5: Side wise comparison of male and female femurs (unpaired student's t test).

	Male (n =61)			Female (n =39)		
	Right Side (n=32)	Left Side (n=29)	p Value	Right Side (n=18)	Left Side (n=21)	p Value
NSA	128 ± 6	129 ± 5	0.4848	127 ± 6	130 ± 5	0.0968
AOA	10 ± 5	13 ± 4	0.0127	13 ± 5	14 ± 6	0.5791

DISCUSSION

The NSA of Femur is an imperative parameter in the Morphometry of upper Femur which is used for design and placement of femoral implant during THR (Total Hip Replacement) and other surgeries. In the present study, NSA was more on left side in both males and females,

however it was not significant statistically. A study by Ravi et al. [16] reported no significant difference in NSA between right and left femur bone. Studies have reported different values for the NSA such as 128.4 degrees [17], 123.5 degrees [18], 127.5 degrees [19], 129.23 degrees [13], 136.80 degrees [16], and 126.28 degrees [20]. We found the NSA to be 128 degrees in central India population. As far as the difference between both sides is concerned, De Sousa et al. [21] did not find any difference, showing a natural tendency to laterality. In our study we observed that NSA was higher on left side.

We found that the AOA of Femur exceeded on the left side in both gender. Kate et al. [22] suggested that the smaller AOA in Indians could be associated with the squatting habit. It can also be ascribed to the prolonged low floor activities and nutritional factors. Many researchers noted the AOA to be more on left side, while others found it to be more on right side.

Debnath, et al. [23] found that mean femoral ante version was 20.05 degrees. The value was higher on the left side than the right. There was no significant difference between the male and female type bones though greater values were obtained in females. Average ante version angle of Femurs in Bengali population was higher than that of several previous studies. Dwivedi et al. [24] found out that the mean ante version was 11.23 and 13.39 degrees on the left and right side respectively in male bones, and 13.23 and 16.21 degrees in female bones on the left and right side respectively. Rajni et al. [25] opined that identifying and comparing the femoral angle of ante version of various populations is essential in proximal femoral geometry in addition to the other femoral head & neck diameters for designing the implants.

Morphometric values of the Femur vary in different groups of populations, basis of which could be attributed to racial and ethnic differences.

CONCLUSION

Femur being most important bone of thigh, it is important that medical care practitioners should be well aware of normal morphometric values as well as regional variations of Femur in order to understand and treat different disorders of the Femur and hip joint. Findings of our study can be useful in designing femoral implants for central India population for various hip joint surgeries.

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CONFLICT OF INTEREST

None.

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