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Morphometric Analysis of the Proximal Femur of males in the Bangladeshi Population: A Cadaveric Study

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Abstract
Background: *The femur is the longest, heaviest, and most powerful bone in the body. Osteoporosis and fractures are widespread in this area, and surgical procedures such as hip arthroplasty and internal fastening with implants need understanding the anatomy of the proximal femur for optimal treatment.*
Aim of the study: *The current study's purpose is to observe the proximal end of the femur and describe changes in the proximal end of the femurs of males in the Bangladeshi population, as well as other correlates.*
Methods: *This study was conducted in Department of Anatomy, Anwer Khan Modern Medical College, Dhanmondi, Dhaka, Bangladesh, from January 2022 to January 2023. A prospective morphometric investigation used 100 dry femurs from male Bangladeshi cadavers. The study examined six morphometric characteristics of the proximal femur, including head diameter, transverse diameter of fovea, longitudinal diameter of fovea, neck diameter, intertrochanteric line length, neck shaft angle, and their associations. All data was collected, documented in a Microsoft Excel work sheet, and analyzed using descriptive statistics in SPSS 17.0.*
Results: *The head diameter of the femur was 37.14 ± 3.00 mm. The fovea measured 10.94 ± 2.20 mm transversely and 9.44 ± 2.22 mm longitudinally. The neck diameter was 28.62 ± 3.33 mm. Intertrochanteric length measured 54.14 ± 5.91 mm. The angle between the neck and shaft was found to be 132.89° ± 5.95°. A favorable association between head diameter and longitudinal diameter of fovea. A substantial positive association between head and neck diameters.*
Conclusion: *Morphometric study of the proximal femur reveals anatomical and structural changes in the bone. This study's findings will contribute to a database for designing hip implants, plates, and prosthesis for male patients in Bangladesh.*
Keywords: *Morphometric, proximal femur, femoral head, hip joint.*

I. INTRODUCTION

The femur is the longest, heaviest, and most powerful bone in the body. The pyramid-shaped neck connects the spherical head at the apex to the cylindrical shaft at the base [1]. The greater and lesser trochanters are prominent bony protrusions that link to muscles controlling hip and knee mobility [2]. In the USA, an average of 5,44,000 hip arthroplasties are performed year, whereas in Bangladesh, the number is expected to increase significantly by 2026. By 2050, the total number of hip fractures is expected to increase from 2018 [3]. With an increase in the frequency of hip joint surgeries, a complete examination of the proximal femur and measurements of its components will aid in the creation of finer adjusted and better fitted prostheses and implants, ultimately enhancing treatment outcomes. Several research undertaken in recent years have demonstrated that these femur parameters are influenced by a person's ethnicity, gender, lifestyle, and environmental variables [4, 5]. As a result, the current study's goal is to observe the proximal end of the femur and describe changes in it in males in the Bangladeshi community, as well as other correlates.

II. METHODOLOGY

The Department of Anatomy at Anwer Khan Modern Medical College in Dhanmondi, Dhaka, Bangladesh, conducted this study from January 2022 to January 2023. A prospective morphometric study included 100 dry femurs from male Bangladeshi cadavers. The parameters measured include the diameter of the head of femur (the distance between the upper and lower ends of a femoral head in the cranio-caudal axis), transverse diameter of fovea (full extent of fovea capitis along the transverse axis), longitudinal diameter of fovea (full extent of fovea capitis along the vertical axis), and diameter of neck (the distance between the upper and lower ends of the anatomical neck in the cranio-caudal axis). The mean and standard deviation will be determined

after rounding up the data to two decimals. Data was tabulated and statistically analyzed using SPSS 17.0 software.

III. RESULT

The head diameter of the femur was 37.14 ± 3.00 mm. The fovea measured 10.94 ± 2.20 mm transversely and 9.44 ± 2.22 mm longitudinally. The neck diameter was 28.62 ± 3.33 mm. Intertrochanteric length measured 54.14 ± 5.91 mm. The angle between the neck and shaft was found to be 132.89° ± 5.95° [Table-1]. Table-2 shows a favorable association between head diameter and longitudinal diameter of fovea. Table- 3 shows a substantial positive association between head and neck diameters.

Table-1: Statistical summary of the proximal femur's morphometry

Parameter	N	Mean	SD	Minimum	Maximum
Head Diameter	100	37.14	3	30	43
Transverse Diameter of Fovea	100	10.94	2.2	4	21
Longitudinal Diameter of Fovea	100	9.44	2.22	4	16
Diameter of Neck	100	28.42	3.33	21	36
Intertrochanteric Length	100	54.14	5.91	39	70
Neck-Shaft Angle	100	132.9	5.95	122	153

Table -2: Correlation between head diameter of a femur and longitudinal diameter of Fovea

		Head Diameter	Longitudinal Diameter of Fovea
Head Diameter	Pearson Correlation	1	0.510
	Sig. (2-tailed)		0
	N	100	100
Longitudinal Diameter of Fovea	Pearson Correlation	0.510	1
	Sig. (2-tailed)	0	
	N	100	100

Table -3: Correlation between head diameter and neck diameter of proximal femur

		Head Diameter	Neck Diameter
Head Diameter	Pearson Correlation	1	0.730
	Sig. (2-tailed)		0
	N	100	100
Neck Diameter	Pearson Correlation	0.730	1
	Sig. (2-tailed)	0	
	N	100	100

IV. DISCUSSION

Several approaches have been used to quantify the characteristics of the bony proximal femur, including cadaveric morphometry, computed tomography, ultrasonography, and magnetic resonance imaging. This study's findings are consistent with previous research [3, 4, 5]. Research has found significant variability in these indicators among populations, highlighting the necessity for personalized prosthetic designs [4]. The fovea capitis is a vital anatomical feature in the proximal femur that transmits arteries to the femoral head. This ligament contributes to avascular necrosis of the head of the femur, a common consequence of hip fractures and dislocations. Our investigation found that the fovea had a mean transverse diameter of 10.94±2.20 mm. This number is comparable to Gupta et al.'s 11.38±2.35 mm. Ceynowa et al. [6] conducted a computed tomography investigation in Poland and discovered that the transverse diameter was 12.94±2.61 mm and the longitudinal diameter was 10.83±2.32 mm. The values were higher in men than in women. The intertrochanteric length was 54.14±5.91 mm, shorter than the dry bone investigation by Resmi George and Nithin K Raju, which measured 60.31±7.33 mm. [7]. This study found a higher mean neck shaft angle than Isaac B. et al. [8], Late SV & Keche H [9], but similar to Kamath SU et al. [10] and Haddad B et al. [11]. The data reported in this investigation demonstrate substantial positive associations between the longitudinal diameter of the fovea and the head diameter. The neck and vertical head diameters showed the strongest positive connection.

Limitation of the study:

The study featured a single focus point and minimal sample sizes. As a result, the study's conclusions may not completely reflect the entire situation.

V. CONCLUSION & RECOMMENDATION

Morphometric study of the proximal femur reveals anatomical and structural changes in the bone. Proximal femoral morphometry varies among populations, requiring careful attention when developing prostheses and surgical procedures. This study's findings will contribute to a database for designing hip implants, plates, and prosthesis for male patients in Bangladesh.

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