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Research Article

To determine morphometric analysis, vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter of the proximal femur in individuals from Central India

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Abstract:

Background: The proximal femur, vital for human skeletal system, plays a vital role in hip joint biomechanical functions and is essential for medical and anthropological applications due to its anatomical dimensions. **Aim:** To determine the regional differences in this anatomical location by doing a thorough morphometric investigation of the vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter of the proximal femur. **Materials & methods:** The study examined the morphometric characteristics of the proximal femur in individuals from Central India, specifically in the Indore region. Participants aged 20-80 visited prestigious clinics or hospitals in Indore for non-femoral or hip pathology-related causes. Eligible adults had to have spent at least two generations in Central India to account for geographical variances. Radiographic imaging and dry bone measurements were used to measure shape and size. Orthopedic specialists examined participants for mobility problems or unusual gait patterns that might alter the femur's form. **Results:** The study analyzed femur measurements, including vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter. The vertical head diameter was 40.60 ±3.36 mm, and the mean foveal depth was 2.86 ± 0.86 mm. The fovea's transverse and longitudinal diameters were 12.49 ± 2.46 mm and 16.05 ± 4.48 mm respectively. No significant differences were found between age and gender. **Conclusion:** Morphometric data including presents study is crucial for hip interventions and prosthetic designs, revealing regional variations in anatomy, improving patient outcomes and reducing complications.

Key words: Morphometric analysis, vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter.

Introduction:

The proximal femur is a crucial part of the human skeletal system, responsible for locomotion and weight-bearing. Its morphology and morphometry are crucial for understanding the biomechanical functions of the hip joint, including force distribution and stability [1-4]. Understanding the anatomical dimensions of the proximal femur, such as the vertical head diameter, foveal diameter, transverse diameter, and

longitudinal diameter of the fovea capitis, is essential for medical and anthropological applications [1,2.4].

The morphology of the proximal femur significantly influences procedures like total hip arthroplasty, fracture fixation, and treatment of developmental or degenerative hip disorders [5-8]. Variations in these parameters can significantly impact range of motion, joint congruency, and the likelihood of conditions like femoro-acetabular impingement or hip dysplasia [7,8]. Population-specific morphometric data are essential due to the variability in skeletal dimensions observed among different ethnic and geographic groups, which are influenced by genetics, nutrition, lifestyle, and environmental factors [9-11]. Central India, with unique demographic and anthropological characteristics, is a distinct population group with scarce region-specific morphometric data [12,13]. The design and implantation of prosthetic femoral components depend on the vertical head diameter of the femur, which serves as an indicator of the femoral head's size. The foveal diameter, transverse diameter, and longitudinal diameter of the fovea capitis are noteworthy for understanding its anatomical variations and their potential clinical implications [14-16].

This research aims to perform a comprehensive morphometric analysis of the proximal femur in Central Indian individuals, focusing on the dimensions of the fovea capitis and the vertical head diameter. The results will be incorporated into a more comprehensive database of anthropometric data, enabling the development of orthopedic and prosthetic solutions specific to specific regions and facilitating comparative studies across populations. To determine the regional differences in this anatomical location by doing a thorough morphometric investigation of the vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter of the proximal femur.

Materials & methods:

This cross-sectional observational research aimed to examine the morphometric characteristics of the proximal femur in individuals from Central India, particularly those residing in the Indore region. The study involved anthropometric measurements and x-ray techniques to provide data on the femur. Participants were people aged 20-80 who visited prestigious clinics or hospitals in Indore for non-femoral or hip pathology-related causes. Eligible adults included those between the ages of 20 and 80 who have never experienced osteoarthritis, a femur or hip break, or any other musculoskeletal issue that could cause the femur to alter in form. Participants must have spent at least two generations in Central India to account for geographical variances. The study used radiographic imaging of living people and dry bone measurements from deceased corpses to measure shape and size. Radiological tests for living people included CT scans and X-rays, which were then analyzed using image analysis tools. Participants' age, gender, height, weight, and medical history were recorded using a structured questionnaire. Orthopedic specialists examined participants to determine any mobility problems or unusual gait patterns that might alter the femur's form.

Statistical analysis:

The data was analyzed using SPSS, calculating descriptive statistics for parameters like mean and standard deviation, and comparing cohorts by age and gender using appropriate methods, with a p-value of less than 0.05.

Results:

Table 1: Descriptive statistical data of femur measurements including vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter.

Variable	Mean ± S.D	Minimum	Maximum
Head diameter (mm)	40.60 ± 3.36	33.16	46.43
Foveal depth (mm)	2.86 ± 0.86	1.40	6.74
Foveal transverse diameter (mm)	12.49 ± 2.46	7.54	18.23
Foveal longitudinal diameter (mm)	16.05 ± 4.48	7.84	25.60

Table 1 shows the descriptive statistical summaries of all femur measurements including vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter. In our study, the vertical head diameter was observed to be 40.60 ±3.36 mm. The mean foveal depth in the present study was 2.86 ± 0.86 mm. The mean transverse and longitudinal diameters of the fovea were 12.49 ± 2.46 mm and 16.05 ± 4.48 mm, respectively, according to the same study. We did not observe significant differences in mean and standard deviation between the age and gender in terms with vertical head diameter, foveal diameter, fovea transverse diameter, and foveal longitudinal diameter.

Discussion:

The present study aimed to ascertain the regional variations in this anatomical location by conducting a comprehensive morphometric examination of the proximal femur in the central India region. The morphometric analysis of the proximal femur is crucial for understanding the intricacies of femoral anatomy, which has significant implications for the disciplines of orthopedics, forensic anthropology, and prosthetic design. Critical factors such as the femoral head diameter, foveal depth, foveal transverse diameter, and foveal longitudinal diameter significantly influence the planning of operations and the manufacturing of orthopedic implants. This discussion synthesizes global research findings, with a particular emphasis on regional variations and their clinical implications.

The femoral head diameter is a critical parameter that affects the mechanics of the hip joint and the design of prostheses. Our investigation measured the vertical head diameter to be between 40.60- and 3.36-mm. Research suggests that there are variations among different populations. An investigation conducted in Eastern Uttar Pradesh reported an average femoral head diameter of 41.59 ± 3.25 mm [16]. The investigation demonstrated that the mean diameter of the femoral head was 42.11 mm on the left and 42.51 mm on the right [17]. According to an additional investigation [18], the transverse diameter was 37.96 ± 4.20 mm, and the mean vertical head diameter was 40.89 ± 4.26 mm. These variations underscore the importance of population-specific data in orthopedic practice.

The fovea capitis femoris is responsible for the stability of the hip joint and serves as the

attachment site for the ligamentum teres. Morphometric parameters of the fovea, including depth, transverse diameter, and longitudinal diameter, are subject to change. The mean foveal depth in the present study was 2.86 ± 0.86 mm [19]. The mean transverse and longitudinal diameters of the fovea were 12.49 ± 2.46 mm and 16.05 ± 4.48 mm, respectively, according to the same study. The mean foveal depth in Eastern Uttar Pradesh was 2.95 ± 0.75 mm [16]. The fovea's mean transverse and longitudinal diameters were 7.14 ± 1.25 mm and 8.95 ± 1.35 mm, respectively, as reported in the same study [16]. The turkey fovea had a mean longitudinal length of 15.01 ± 2.13 mm and a mean transverse length of 10.23 ± 1.52 mm, with a mean depth of 2.71 ± 1.09 mm [17].

Conclusion:

Such morphometric data including the present study is crucial in hip interventions and prosthetic designs, as it helps design implants suitable for a wide range of individuals. Understanding regional variations in anatomy is essential for improving patient outcomes and reducing complications. Morphometric analysis on the proximal femur reveals significant differences between populations, emphasizing the importance of region-specific data in clinical practice.

Conflict of interest:

There is no conflict of interest among the present study authors.

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