International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 3, March 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.3.2025.151

ORIGINAL RESEARCH

To determine morphometric analysis of neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum length of thefemur in individuals from Central India

Dr. Asha Changil[1], Dr. Anjali Patil[2], Dr. Rajendra Singh[3]

[1]Ph.D Research scholar, [2]Associate Professor, [3]Tutor, Department of Anatomy, IMCH& RC, Indore, India

Corresponding author
Dr. Rajendra Singh
Tutor, Department of Anatomy, IMCH& RC, Indore, India
Email: rajendrasingh211@gmail.com

Received: 10 February, 2025 Accepted: 22 February, 2025 Published: 21 March, 2025

ABSTRACT

Background: Morphometric analysis of the proximal femur is crucial for understanding its anatomy and biomechanical characteristics, which are essential for designing implants, prostheses, forensic investigations, and orthopedic surgery. **Aim:** To determine morphometric analysis of neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum length of the femur in individuals from Central India. **Materials & methods:** We studied the morphometric features of the proximal femur in people from Central India, particularly in the Indore region. For reasons unrelated to femoral or hip disease, participants (ranging in age from 20 to 80) sought treatment at prominent Indore clinics or hospitals. For geographical variants to be considered, persons had to have spent a minimum of two generations in Central India. We measured the size and shape of the bones using radiographs and dry-bone measurements. Orthopedists checked each participant for mobility issues and abnormal gait patterns that could change the shape of the femur. **Results:** The study analyzed femur measurements, including neck diameter, length, thickness, shaft angle, intertrochanteric line length, and maximum femur length. The mean values were 0.56 ± 4.44, 37.17 ± 5.05, 28.72 ± 2.82, 120.19 ± 6.29, 42.13 ± 4.11, and 43.22 ± 3.02. No significant difference was observed between age and gender in these measurements. **Conclusion:** The study on femur morphometry in Central India highlights regional anatomical variances, emphasizing the need for population-specific data for clinical and orthopedic applications, suggesting better adaptation of surgical procedures and forensic studies.

Key words: Morphometric analysis, neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum length of the femur.

INTRODUCTION

Morphometric analysis of the proximal femur is crucial for understanding its anatomy and biomechanical characteristics, which are essential for designing implants, prostheses, forensic investigations, and orthopedic surgery. The femoral neck, particularly in the elderly population, is susceptible to fractures, and its stability and strength are evaluated using parameters such as neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximal femur length[1-3]. These dimensions are crucial for understanding variations in skeletal morphology and ensuring optimal outcomes in fracture fixation and hip arthroplasty[4].

The femoral neck is also affected by the unique lifestyle and nutritional patterns of the diverse population in Central India. Morphometric analysis can identify variations attributed to cultural, dietary, and genetic factors, contributing to the development of orthopedic solutions specific to specific populations[5,6]. These findings have significant implications for diagnosing and treating conditions common in the elderly population, such as osteoporosis, hip dysplasia, and femoral fractures[7,8]. The development of imaging technologies, such as computed tomography (CT) and three-dimensional

DOI: 10.69605/ijlbpr_14.3.2025.151

(3D) reconstructions has transformed the discipline of morphometric analysis[9]. These technologies enable precise and non-invasive measurements, enabling researchers to produce high-quality data that informs clinical practices and serves as a reference for future anthropological and biomechanical studies[10,11]. Morphometric analysis of the proximal femur in the Central Indian population is a field of significant clinical and anthropological importance. This study aims to provide valuable insights into regional anatomical characteristics and their implications for healthcare and research. Hence the aim of the present study was to determine morphometric analysis of neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum length of the femur in individuals from Central India.

MATERIALS & METHODS

The morphometric features of the proximal femur in people from Central India, namely those living in the Indore region, were the focus of this cross-sectional observational study. The study derived data on the femur using anthropometric measures and x-ray procedures. The study included individuals from 20 to 80 years old who sought treatment at renowned Indore hospitals or clinics for conditions unrelated to hip or femoral pathology. Anyone between the ages of 20 and 80 who has never had osteoarthritis, a femur or hip fracture, or any other musculoskeletal condition that could affect the femur's shape was considered an eligible adult. In order to take geographical differences into consideration, participants must have spent a minimum of two generations in Central India. The research measured size and shape using radiographic imaging of living subjects and dry bone measurements of dead bodies. We used image analysis technologies to sift through CT scans and X-rays taken from live subjects as part of our radiological testing. We used a standardized questionnaire to record the participants' ages, genders, heights, weights, and medical histories. Orthopedists checked each participant for mobility issues and abnormal gait patterns that could change the shape of the femur.

Statistical analysis

We ran the data via SPSS for statistical analysis, calculating descriptive statistics for parameters like standard deviation and mean. We used appropriate procedures to compare cohorts by age and gender, ensuring the p-value remained below 0.05.

RESULTS

Table 1: Descriptive statistical data of femur measurements including neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum femur length.

Variable	Mean ± S.D	Minimum	Maximum
Neck diameter (mm)	30.56 ± 4.44	24.11	36.91
Neck length (mm)	37.17 ± 5.05	26.70	47.18
Neck thickness (mm)	28.72 ± 2.82	23.22	34.49
Neck shaft angle (mm)	120.19 ± 6.29	110.11	139.11
Intertrochanteric line length (mm)	42.13 ± 4.11	35.19	52.64
Maximum femur length (cm)	43.22 ± 3.02	36.51	55.31

Table 1 shows descriptive statistical data of femur measurements including neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum femur length. The mean neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum femur length were 0.56 ± 4.44, 37.17 ± 5.05, 28.72 ± 2.82, 120.19 ± 6.29, 42.13 ± 4.11, and 43.22 ± 3.02. We did not observe significant difference in mean and standard deviation between the age and gender in terms of neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum femur length.

DISCUSSION

The objective of the present study was to determine morphometric analysis of neck diameter, neck length, neck thickness, neck shaft angle, intertrochanteric line length, and maximum length of the femur in individuals from Central India.

The femur, the longest and strongest bone in the body, supports an individual's ability to walk and bear their own weight. Forensic science, anthropology, orthopedics, and other related fields rely on accurate measurements of the neck, including its diameter, length, thickness, intertrochanteric line length, and maximum length, as well as the neck-shaft angle. New research on these factors across populations has shed light on both global trends and regional differences.Important for hip joint mechanics is the size of the femoral neck, which connects the femoral head to the shaft. The mean neck diameter observed in the present study was 0.56 ± 4.44. In an Indian population, Verma et al. [12] found that the average neck diameter was 29.45 ± 3.33 mm, the average neck length was 36.06 ± 4.94 mm, and the average neck thickness was 27.61 ± 2.71 mm.

There appears to be some regional homogeneity in the size of the femoral neck, since these measurements agree with those of other areas. However, there are slight variations due to factors such as genetics and environmental factors. To illustrate the importance of area-specific data in orthopedic procedures and prosthesis design, consider a study that found comparable measures in Eastern Uttar Pradesh [13].

DOI: 10.69605/ijlbpr_14.3.2025.151

The neck-shaft angle (NSA) influences hip biomechanics, including load distribution and mobility. Some people are more likely to develop osteoarthritis or hip fractures because of variations in NSA. The mean neck shaft angle observed in the present study was 120.19 ± 6.29, 42.13 ± 4.11, and 43.22 ± 3.02. According to Chaudhary et al. [14], adults had an average NSA of 126°, ranging from 115° to 140°[14]. Although there have been some small regional variations, these results are in line with worldwide data. For instance, NSAs averaging around 136.8° were found in studies of South Indian populations, suggesting that lifestyle and ethnicity may have a role.

The iliofemoral ligament attaches anterior to the femur, on the intertrochanteric line. When operating on the proximal femur, its length is an important consideration. Despite its anatomical significance, the precise measurement of the intertrochanteric line length rarely receives publication. Thorough familiarity with this parameter enhances both implant placement precision and postoperative problem avoidance. Establishing normative statistics across varied groups requires further research.Forensic identification and stature estimation both rely on femur length. The mean femur length observed in the present study was 43.22 ± 3.02. The average length of a femur was found to be 446.1 ± 30.4 mm in a 2017 morphometric study, with the average length of a right femur being 448.8 ± 31.4 mm and a left femur being 444.4 ± 28.6 mm[15]. With variances caused by genetics, nutrition, and the environment, these readings are in line with worldwide averages. The development of forensic and anthropological models that are specific to populations relies on precise measurements of femur length.

CONCLUSION

The study on femur morphometry in Central India reveals regional anatomical variances, emphasizing the importance of population-specific data for clinical and orthopedic applications. Key measurements reveal how genetic and environmental factors affect structural changes, such as neck-shaft angle, longest femur, intertrochanteric line length, neck diameter, and thickness. This suggests better adaptation of surgical procedures, prosthetics, and implants to meet Central Indian needs, and underscores the significance of regional morphometric databases for forensic and anthropological studies.

Conflict of interest

None declared.

REFERENCES

1. Singh R. Variations of cords of brachial plexus and branching pattern of nerves emanating from them. Journal of Craniofacial Surgery. 2017 Mar 1;28(2):543-7.DOI: 10.1097/SCS.0000000000003341
2. Sinha S, Khani M, Mansoori N, Midha R. Adult brachial plexus injuries: Surgical strategies and approaches. Neurology India. 2016 Mar 1;64(2):289-96. DOI: 10.4103/0028-3886.177597
3. Jung IJ, Choi EJ, Lee BG, Kim JW. Population-based, three-dimensional analysis of age-and sex-related femur shaft geometry differences. Osteoporosis International. 2021 Aug 1:1-8. https://doi.org/10.1007/s00198-021-05841-6
4. Mopin C, Chaumoître K, Signoli M, Adalian P. Developmental stability and environmental stress: A geometric morphometrics analysis of asymmetry in the human femur. American Journal of Physical Anthropology. 2018 Sep;167(1):144-60.**https://doi.org/10.1002/ajpa.23613**
5. Al Anouti F, Taha Z, Shamim S, Khalaf K, Al Kaabi L, Alsafar H. An insight into the paradigms of osteoporosis: From genetics to biomechanics. Bone reports. 2019 Dec 1;11:100216. https://doi.org/10.1016/j.bonr.2019.100216
6. Zaghloul A, Mohamed EM. Hip joint: embryology, anatomy and biomechanics. Biomedical Journal of Scientific & Technical Research. 2018;12(3). DOI: 0.26717/BJSTR.2018.12.002267
7. Bozkurt M, Gursoy S, Shohat N, Simsek ME, Akkaya M, Parvizi J. Definition of a novel proximal femur classification in the sagittal plane according to the femur morphometric analysis. The Journal of Arthroplasty. 2019 Jul 1;34(7):1502-8. https://doi.org/10.1016/j.arth.2019.03.005
8. Iyidobi EC, Obande BO, Eyichukwu GO, Nwadinigwe CU, Ekwunife RT, Ede O, Lasebikan OA. Assessment of the femoral neck-shaft angles of adults in Nigeria: Establishing an age and gender stratified reference values. Asian J Orthopaed Res. 2020;3:80-6. https://urn.fi/URN:ISBN:978-952-15-4118-6
9. Kamath SU, Agarwal S, Austine J. Morphology of proximal femur in South-West Coast of India. Malaysian Orthopaedic Journal. 2020 Nov;14(3):143. doi: 10.5704/MOJ.2011.022
10. Haider IT, Schneider PS, Edwards WB. The role of lower-limb geometry in the pathophysiology of atypical femoral fracture. Current osteoporosis reports. 2019 Oct;17:281-90. https://doi.org/10.1007/s11914-019-00525-x
11. Su YB, Wang L, Wu XB, Yi C, Yang MH, Yan D, Cheng KB, Cheng XG. The spatial differences in bone mineral density and hip structure between low-energy femoral neck and trochanteric fractures in elderly Chinese using quantitative computed tomography. Bone. 2019 Jul 1;124:62-8. https://doi.org/10.1016/j.bone.2019.04.007
12. Verma M, Joshi S, Tuli A, Raheja S, Jain P, Srivastava P. Morphometry of proximal femur in Indian population. Journal of clinical and diagnostic research: JCDR. 2017 Feb;11(2):AC01.doi: 10.7860/JCDR/2017/23955.9210
13. Gupta M, Devadas D, Sahni C, Nayak A, Tiwari PK, Mishra A. Morphometric analysis of the proximal femur with its clinical correlation in Eastern Uttar Pradesh Region. Cureus. 2022 Sep;14(9). https://doi.org/10.17826/cutf.82812
14. Chaudhary PN, Shirol VS, Virupaxi RD. A morphometric study of femoral length, anterior neck length, and neck-shaft angle in dry femora: A cross-sectional study. Indian Journal of Health Sciences and Biomedical Research kleu. 2017 Sep 1;10(3):331-4. DOI: 10.4103/kleuhsj.kleuhsj_72_17

DOI: 10.69605/ijlbpr_14.3.2025.151

15. Manjunath TH, Santhosh CS. MORPHOMETRIC STUDY OF ADULT DRY FEMUR AND ITS FORENSIC IMPORTANCE. Int J Acad Med Pharm. 2023;5(5):1241-4. DOI: 10.47009/jamp.2023.5.5.245