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Morphometric Study of Humerus Segments in Karnataka Region

[1]Pramod Rangasubhe, [2]Pavan P. Havaldar [3]Samita Rani and [4]Pratik Khona

[1,3,4]Deptartment of Anatomy Gadag Institute of Medical Sciences Gadag, Karnataka, India

[3]Department of Anatomy, Teerthankar Mahaveer medical college and Research Centre, Moradabad, UP, India

ABSTRACT

Humerus is skeleton of arm. The proximal and medial portions of the upper end of the bone make up the rounded head of the humerus. It creates an articulation with the scapula's glenoid cavity. Two tubercle-adorned eminences and a constricted neck connect the head to the shaft. Less than half of a spheroid is formed by the humerus head. Hyaline cartilages cover its smooth, centrally thicker articular surface. When the arm is at rest by the side, it points upward, medially and posteriorly to articulate with the scapular glenoid cavity. Humeral proximal fractures are frequent injuries. They appear inside humeral segments and beside the proximal humerus's epiphyseal lines. The goal of the current study is to analyse humerus segments morphometrically. For the current investigation, 100 humerus were used, each was meticulously inspected, with damaged ones being excluded. For the study, 100 humerus were chosen, of which 79 were male and 21 were female. For the purpose of humeral segment morphometric analysis, each was examined. Every parameter was noted and represented in a table. The parameters in the current study, including its maximum length, total length, proximal and distal epiphysis widths the middle's maximum diameter, The middle's minimum diameter, least shaft girth, Girth at the shaft's centre, Maximum head diameter measured in both transverse and vertical directions circumference of the head are studied. Studies on the breadth of the trochlea the breadth of the capitulum and the depth of the trochlea revealed statistically significant differences ($p<0.05$) between males and females. The current study comes to the conclusion that there are few studies on the shoulder bone morphological characteristics in the Indian population and that different racial and regional measures of the humeral upper end are needed for surgical humerus correction. In underdeveloped nations the adoption of custom-made acrylic prosthesis for reconstruction of proximal humeral defects provides a cost-effective and efficient option. Understanding humeral morphometry may be useful in the fields of orthopaedics, forensic medicine and surgery.

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Key Words

Humerus, surgical neck of humerus, trochlea, head of humerus

Corresponding Author

Pratik Khona,
Department of Anatomy Gadag Institute of Medical Sciences Gadag, Karnataka, India
office.iasrinternational@gmail.com

Author Designation

[1,2]Associate Professors
[3,4]Assistant Professor

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INTRODUCTION

Forensic professionals and seasoned anthropologists both find it difficult to reconstruct a person's life from their skeleton and to estimate an individual's height from their bones in the current day. Estimating statistics from human skeletal remains is a crucial first step in evaluating general body size trends and health among the targeted populations. It also plays a significant role in identifying individuals who go missing during medical-legal investigations. The femur and tibia of the lower limb together remain the best for the assessment of the individual's living stature. In anthropology and forensic science investigations, morphometric analysis is frequently performed on the remains of the long bones of the individual in the absence of the pelvis and cranium. The humerus can be used individually or in combination with other upper limb bones to estimate an individual's stature and determine their sex. Additionally, in many circumstances when the entire set of long bones becomes unavailable. The dimensions of the various humeral segments, based on their articular surfaces and muscle attachments, can be used to calculate the total length of the humerus[1-6].

The articulation of the humerus and the shallow glenoid cavity of the scapula form the ball and socket type of joint that is the shoulder joint. Shoulder instability and decision-making after shoulder replacement surgery can be influenced by the diameters of the Humeri and Glenoid cavities. Very little research has been done on the morphological features of the shoulder bones. Measurements of the humeral upper end are also necessary for surgical humerus repair. Forensic specialists, anthropologists, and scholars continue to find it difficult to recreate an individual's life story from their skeletal remains and to estimate an individual's stature from their bones. An essential first step in evaluating general body size changes and health within the populations under consideration is to determine overall statistics from the human skeletal remains. Bone morphometric analysis is crucial for both reconstructive surgery and identifying the gender of deceased individuals. Examining the asymmetries of the upper and lower limbs might be helpful for medicolegal research, medical anthropologists, archaeologists, and forensic specialists. Compared to other long bones in the human body the humerus has two significant advantages its whole contour can be easily traced on pictures obtained by total body X-ray absorptiometry, and its shape can be accurately represented as a cylinder[7-11].

The average values of long bone segments, such as the humerus, aid in the identification of a skeleton and provide proof of the traits that distinguish a population of archaeological materials[12-14]. Distal humeral fractures are frequently caused by falls onto outstretched hands. We looked at the averages of the various morphometric measurements taken from the humerus in our investigation. Our study's criteria, which can also be used to create different implants for the reconstruction of humerus fractures, show the distinctive morphological characteristics of humerus segments. The goal of the current study was to find the mean humerus values, which could be useful in forensic and archaeological investigations.

MATERIALS AND METHODS

The current morphometric analysis used 100 dry adult human humeruses. The Humeruses work at various medical colleges in the Karantaka region of India, specifically in the departments of anatomy and forensics. For the humerus segmental morphometric study, each was examined. The following measurements were observed for this study, all results were expressed in Mean±SEM, T-test is conducted and $p<0.05$ was set as statistical significant. Maximum length:

- Total length
- Breadth of proximal epiphysis
- Breadth of distal epiphysis
- Maximum diameter in the middle
- Minimum diameter in the middle
- Least girth of shaft
- Girth in the middle of the shaft
- Maximum transverse diameter of head
- Maximum vertical diameter of head
- Girth of head
- Breadth of trochlea
- Breadth of capitulum
- Depth of trochlea

RESULTS

Fourteen parameters, which were previously explained in the materials and methods, were measured for each humerus. Out of a hundred humeri, 71 male and 29 female humeri were obtained based on parameter differences. We are talking about all 71 male and 29 female humeri in the current study. The mean maximum length in male was 32.72±0.35 cm, female it was 30.15±0.22 cm. The mean total length in male was 32.34±0.31 cm. In female it was 29.95±0.34 cm. The mean breadth of proximal epiphysis in male was 4.96±0.06 cm and in female was 4.62±0.06 cm. The mean breadth of distal epiphysis in male was 6.24±0.07 cm, in female was 5.95±0.46 cm. The mean maximum diameter in middle in male was 2.15±0.05 cm, in female was: 1.94±0.06 cm. The mean minimum diameter in middle in male was 1.88±0.03 cm, in female was 1.62±0.04 cm. The mean least girth of the shaft in male was 6.14±0.04, in female was 5.84±0.12.

Table 1: Showing morphometric values of adult humerus

Parameters (males) Mean±SEM	Mean±SEM (males) (Cm) n = 79	Mean±SEM (females) (cm) n = 21	p-value
Maximum length	32.72±0.35	30.15±0.22	All parameters values between male and female humerus showing statistically significant p<0.05
Total length	32.34±0.31	29.95±0.34	
Breadth of proximal epiphysis	4.96±0.06	4.62±0.06	
Breadth of distal epiphysis	6.24±0.07	5.95±0.46	
Maximum diameter in the middle	2.15±0.05	1.94±0.06	
Minimum diameter in the middle	1.88±0.03	1.62±0.04	
Least girth of shaft	6.14±0.04	5.84±0.12	
Girth in the middle of the shaft	6.64±0.09	5.98±0.24	
Maximum transverse diameter of head	4.76±0.9	3.88±0.09	
Maximum vertical diameter of head	3.78±0.06	3.36±0.06	
Girth of head	13.16±0.12	12.72±0.36	
Breadth of trochlea	2.68±0.08	2.26±0.04	
Breadth of capitulum	1.98±0.02	1.82±0.03	
Depth of trochlea	2.76±0.04	2.38±0.04	

cm. The mean girth in the middle of the shaft in male was 6.64±0.09 cm, in female was 5.98±0.24 cm. The mean maximum transverse diameter of head in male was 4.76±0.9cm, in female was 3.88±0.09cm. The mean maximum vertical diameter of head in male was 3.78±0.06 cm, in female was 3.36±0.06cm. The mean girth of head in male was 13.16±0.12 cm, in female was 12.72±0.36 cm. The mean breadth of trochlea in male was 2.68±0.08 cm, in female was 2.26±0.04 cm. The mean breadth of capitulum in male was 1.98±0.02 cm, in female was 1.82±0.03 cm. The mean depth of trochlea in male was 2.76±0.04 cm, in female was 2.38±0.04 cm. All parameters between male and female were statistically significant (p<0.05).

DISCUSSIONS

The current morphometric analysis used 100 dry adult human humeruses. We have measured the following maximum length, total length, breadth of the proximal epiphysis, minimum and maximum diameters in the centre, least and maximum shaft girths, maximum vertical diameter of the head, head girth, trochlea breadth and trochlea depth. The findings of our study are consistent with the research of Lokanathanam *et al*.[12] who found statistical significance in all parameters pertaining to the humeral segments of males and females. Maximum humeral length, or the distance between the most distal point of the trochlea and the most proximal points of the humerus head, was the subject of a study by Zarana *et al*.[15]. The distance measured horizontally between the lateral and medial epicondyles. horizontal length between the capitulum and the medial border of the trochlea. Trochlea maximum transverse diameter. Horizontal distance between the capitulum and the medial epicondyle. Anteroposterior diameter of the trochlea Their investigation found that the mean values of the total humerus length on the left and right sided humerus were 30.32±1.58 cm and 30.39±1.66 cm, respectively. These results are consistent with our research. According to Sales *et al*.[16] the mean value of the proximal and distal segments of the humerus as well as the overall humerus length of the Brazilian population have been measured. The mean values of the whole humerus length are 31.3±2.3 cm on the right side and 30.5±1.6 cm on the left side, respectively. In the Turkish population, Akman *et al*.[17] measured the average length of five humerus segments and its maximum length. They then compared their findings to those of other populations, finding that the highest humerus length was 30.71±2.08 cm and 30.48±1.89 cm on average.

A study by Akpinar[18] used a variety of techniques and measures to ascertain the dimensions, length, curvature and shape of the humeral medullary canal in 57 human dry cadaver bones. Anterior angulation was discovered at 1/3 of the distal portion, with an average distance of 21 cm between the larger tubercle. Nine was the mean degree of angulation. The medullary canal of humerus bones with supratrochlear foramen at the fossa coronoidea was found to be extremely small. An area along the line extending from larger tubercle anteromedially to caput humeri was determined to be the optimal location for nail insertion. According to their research, accurately choosing a nail with the right length and diameter, as well as carefully assessing the shape of the humeral medullary canal and other congenital features like the septal hole, are crucial for successful nailing. According to Tanner and Hughes[19] research, male humeri are wider than female humeri from the age of three years old until the point at which female pubertal growth

acceleration occurs. Numerous studies that show prepubertal boys to have wider humeri in comparison to girls support the idea that gender variations in humeral shape are established before to puberty. According to a study by Kranito *et al*.[20] using data from the Cretan population the proximal epiphysis is the most dimorphic part, with a classification accuracy of 89.9%, while the distal epiphysis ranks third with a length of 85.1%. The same study also demonstrated that men's humerus shafts are shorter than women's. Iscan my and Shihai[21] state that the morphology of the humerus's distal segments is crucial due to the bone's sexual dimorphism and increased functional load. The relationship between the highest point on the articular segment of the head of the humerus and the most proximal point on the greater tuberosity is significant because it dictates the amount of subacromial clearance required for treating isolated greater tuberosity fractures and for raising the arm. This information was reported in a study by Green and Izzi. This distance was determined to be 5.95±1.18 mm on the right side and 5.83±1.57 mm on the left side in a study by Somesh[1]. When proximal humeral fractures occur the measuring of these proximal humeral segments becomes crucial because they cause the displacement of the proximal humerus and its segments along their epiphysial lines.

The goal of Somesh[1] work was to calculate the humerus's length using measurements of its segments, which would be useful for forensic or archaeological research. Even though the specimens in their investigation were unmatched that is, they did not belong to the same individuals the results found on the right side differed from those observed on the left. The proximal and distal ends of select fragments from both sides showed a substantial positive connection with humeral length in the Salles *et al*.[16] investigation. From these fragments the humeral length could be estimated and the findings were obtained in the right side. Only the longitudinal measures and related proximal and distal humeral segments are taken into account in the Somesh[1]. investigation. Only the longitudinal measures and related proximal and distal humeral segments are taken into account in the Somes[1] investigation. The study suggests that the morphometry of humerus segments provides insights into both forensic investigations and archaeological data, since the estimate may be applied to both live and deceased individual's heights based on similar proportions seen in long bone fragments.

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