



# Title: A Study of the Assessment of Morphometric Analysis of Dry Adult Human Humeral Condyles Bone

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## Abstract

**Introduction** Morphometry of the long bones is important for the identification of unknown bodies, estimation of height, age, gender in forensic science. The present study aimed at morphometric analysis of dry adult human humeral condyles in dry bone. **Materials & Methods:** The current cross-sectional investigation, which involved 15 dry adults of both sexes from the human humeral species, was carried out at the Department of Anatomy, RPGMC in Tanda, Himachal Pradesh (India). **Results:** Most of the patients was  $\leq 40$  (46.67%) years aged group followed by 41-60 (33.33%) years and  $>60$  years (20%). 60% of patients were male and 40% of patients were female. The mean (mm) lengths of the right and left humeri were 284.8 and 287.3 respectively, while their transverse and vertical diameters were 34.4 and 37.6, their girth diameters were 131.8 and 125.9, their trochlear breadths were 24.3 and 23.4, their maximum and minimum shaft diameters were 29.5 and 30.4, their antero-posterior diameters were 24.9 and 27.6, and their respective surface areas were 21.6 and 25.5. Between all parameters in the right and left, there was no discernible difference ( $P > 0.05$ ). **Conclusion:** The morphometric measurements of segments of humerus are important for identifying the relationship between length of long bones and height of living as well as unknown bone fragments.

**Keyword:** Humerus, Long bones, Morphometry

## Introduction

The medial border of the humerus terminates in the medial epicondyle, a prominent, blunt projection on the medial side of the condyle. In most cases, especially when the elbow is passively flexed, it is subcutaneous and palpable. When jolted against the epicondyle, a distinctive tingling sensation is produced. The nerve is palpable and can be rolled on the bone in this location. The medial epicondyle's lower front surface is defined by the attachment of the superficial group of forearm flexors. The lateral epicondyle is situated in the lateral part of the condyle's non-particular region; however it only extends as far as the lateral supracondylar ridge.

The superficial extensor muscles of the international forearm originate from the lateral side of the lower humeral epiphysis and are evident on its sides and anterior. The anconeus originates in a tiny posterior region.<sup>1</sup> The medial epicondyle is prominent because the supracondylar section of the medial border is less prominent than the lateral one. The supracondylar process is the only difference.<sup>2</sup> The medial and lateral epicondyles on the lower humerus attach muscles and ligaments.<sup>3</sup> The humerus is the largest and strongest superior extremity bone. It has proximal, shaft, and distal ends. The distal arm bone has the capitulum, trochlea, medial epicondyle, and lateral epicondyle.

The medial and lateral epicondyles of the arm bone link forearm flexor and extensor muscles.<sup>4</sup> The elbow joint is formed by the trochlea at the distal end of the arm bone joining the ulna's trochlear indent and the capitulum joining the radial head. The pointed medial flange of the trochlea is lower than the capitulum. This affects elbow carrying angle.<sup>5</sup> In forensic science, long bone morphology helps identify unknown bodies and estimate height, age, and gender. Anatomists, health specialists, and anthropologists have employed anthropometric methods to estimate height and bone length from unknown skeletal remains.<sup>6</sup> The present study was aimed to evaluate the morphometric analysis of dry adult human humeral condyles bone.

## Materials & Methods

The current cross-sectional investigation, which involved 15 dry adults of both sexes from the human humeral species, was carried out at the Department of Anatomy, RPGMC in Tanda, Himachal Pradesh (India).

Maximum shaft diameter, minimum shaft diameter, anterior-posterior trochlea diameter, distance between medial and lateral epicondyle, surface area of the head of the humerus, maximum length of humerus that measures the distance between the highest point of the head to the most distal point of the trochlea, and maximum transverse diameter of the head that measures the straight distance between the most lateral points on Statistical analysis was performed on the data.

### *Statistical Analysis*

The data were recorded compiled using Microsoft® Excel worksheet (version 2019) and subjected to statistical analysis using SPSS (SPSS 21.0, IBM, Armonk, NY, USA). Categorical data were expressed as frequency, percentages, and compared using t-test. Quantitative data were expressed as mean, standard deviation.  $P < 0.05$  was statistically significant.

## **Results**

### *Baseline Characteristics*

Table 1 shows that most of the patients was  $\leq 40$  (46.67%) years aged group followed by 41-60 (33.33%) years and  $> 60$  years (20%). 60% of patients were male and 40% of patients were female.

### *Measurement of left and right humerus bone parameters*

Table 2, Figure 1 shows the mean (mm) lengths of the right and left humeri were 284.8 and 287.3 respectively, while their transverse and vertical diameters were 34.4 and 37.6, their girth diameters were 131.8 and 125.9, their trochlear breadths were 24.3 and 23.4, their maximum and minimum shaft diameters were 29.5 and 30.4, their antero-posterior diameters were 24.9 and 27.6, and their respective surface areas were 21.6 and 25.5. Between all parameters in the right and left, there was no discernible difference ( $P > 0.05$ ).

## **Discussion**

Younger individuals with osteomyelitis, rheumatoid arthritis, orthopaedic tumours with considerable bone loss, melanomas, and unreconstructed intraarticular distal humeral fractures may also benefit from distal humeral arthroplasty.<sup>9</sup> The humerus, which is located in the upper limb, is one of the longest bones in the human body. It is crucial to determine its length from the segmental measurements, which is why it is used so frequently in forensic and anthropological practise.<sup>10</sup> This method is an essential step in assessing health, sexual dimorphism, and the general body size that has trended among the past populations.<sup>11</sup>

In our study, most of the patients was  $\leq 40$  (46.67%) years aged group followed by 41-60 (33.33%) years and  $> 60$  years (20%). 60% of patients were male and 40% of patients were female. **Burkhart et al**,<sup>12</sup> reported that postoperative mobilization was immediate in elderly patients who underwent total elbow arthroplasty, and they could do routine activities.

The mean (mm) length of the right and left humerus was 284.8 and 287.3, the transverse diameter was 34.4 and 37.6, the vertical diameter was 41.7 and 39.9, the diameter of girth was 131.8 and 125.9, the breadth of trochlear was 24.3 and 23.4, the maximum shaft diameter was 29.5 and 30.4, the minimum shaft diameter was 28.6 and 29.2, the antero-posterior diameter of trochlea was 24.9 and 27.6, and the surface area of the head of

humerus was 21.6 and 25.5. There was no significant difference between all parameters in right and left ( $P > 0.05$ ).

**Guru et al**,<sup>13</sup> morphometry of the arm bone's distal end is provided for population comparison. In the current study, the right humerus' average maximal length was 306.3 ± 21.19 mm while the left humerus' average maximal length was 301.1 ± 22.4 mm. In the right and left humeri, the transverse distance between the medial and lateral epicondyles was 57.4 ± 4.8 mm and 56.0 ± 4.7 mm, respectively. In the right and left humeri, the average horizontal distance between the capitulum and medial end of the trochlea was 39.6 ± 3.4 mm and 39.5 ± 4.3 mm, respectively. In the right and left humeri, the average maximum transverse diameter of the trochlea was 24.4 ± 2.6 mm and 23.5 ± 2.6 mm, respectively. In the right and left humeri, the average anteroposterior diameter of the trochlea was 17.0 ± 3.9 mm and 16.3 ± 3.7 mm, respectively.

**Munoz et al** used remains of humerus segments to estimate the total length of humerus and Gender.<sup>14</sup> Orthopedic surgeons have a tough time treating complicated fractures affecting the distal end of the arm bone that include blood vessel and nerve damage. The accessibility of pre-contoured implants aids in the minimization of fractures. In reconstructive procedures using implants, knowledge of the morphometry of the distal end of the arm bone can be helpful.

**Kumari et al**,<sup>15</sup> ascertained the various humeral properties, 80 humeri were examined, of which 45 were on the left side and 35 on the right. The humerus's greatest length was 291.20 ± 19.70 mm on the right side, and 284.39 ± 23.51 mm on the left. The largest transverse diameter was 39.21 mm on the left and 36.91 mm on the right. The maximum vertical diameter of the head was 43.04 ± 5.42 mm on the right side and 41.96 ± 6.17 mm on the left. The maximum diameter of the head's girth was 137.61 ± 47.67 mm on the right side and 125.87 ± 12.78 mm on the left. The left side's trochlear width was 26.85 ± 3.79 mm, whereas the right side's was 27.11 ± 3.64 mm. On the left side of the humerus, the shaft's maximum diameter was 32.76 mm by 32.6 mm, and on the right, it was 32.04 mm by 4.45 mm. On the left side of the shaft, the minimum diameter was 27.20 ± 2.90 mm, and on the right, it was 26.55 ± 3.36 mm. The trochlea's anteroposterior diameter was 28.46 ± 2.81 mm on the left side, 28.61 ± 2.76 mm on the right side, and 28.61 ± 2.76 mm in the center.

## Conclusion

The morphometric measurements of segments of humerus is important for identifying the relationship between length of long bones and height of living as well as unknown bone fragments.

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**Table 1: Baseline Characteristics**

| Baseline Characteristics | Frequency (n=15) | Percentage (%) |
|--------------------------|------------------|----------------|
| <b>Age (Years)</b>       |                  |                |
| ≤40                      | 7                | 46.67%         |
| 41-60                    | 5                | 33.33%         |
| >60                      | 3                | 20%            |
| <b>Gender</b>            |                  |                |
| Male                     | 9                | 60%            |
| Female                   | 6                | 40%            |



Table 2: Measurement of left and right hummers bone parameters

| Parameter                                      | Right (mm) | Left (mm) | P value |
|--|------------|-----------|---------|
| Length   | 284.8      | 287.3     | 0.145   |
| Transverse diameter                            | 34.4       | 37.6      | 0.197   |
| Verticals diameter                             | 41.7       | 39.9      | 0.276   |
| Diameter of girth                              | 131.8      | 125.9     | 0.389   |
| Breadth of trochlear                           | 24.3       | 23.4      | 0.124   |
| Maximum shaft diameter                         | 29.5       | 30.4      | 0.367   |
| Minimum shaft diameter                         | 28.6       | 29.2      | 0.456   |
| Antero- posterior diameter of trochlea         | 24.9       | 27.6      | 0.423   |
| Distance between medial and lateral epicondyle | 55.4       | 58.7      | 0.225   |
| Surface area of head of humerus                | 21.6       | 25.5      | 0.535   |

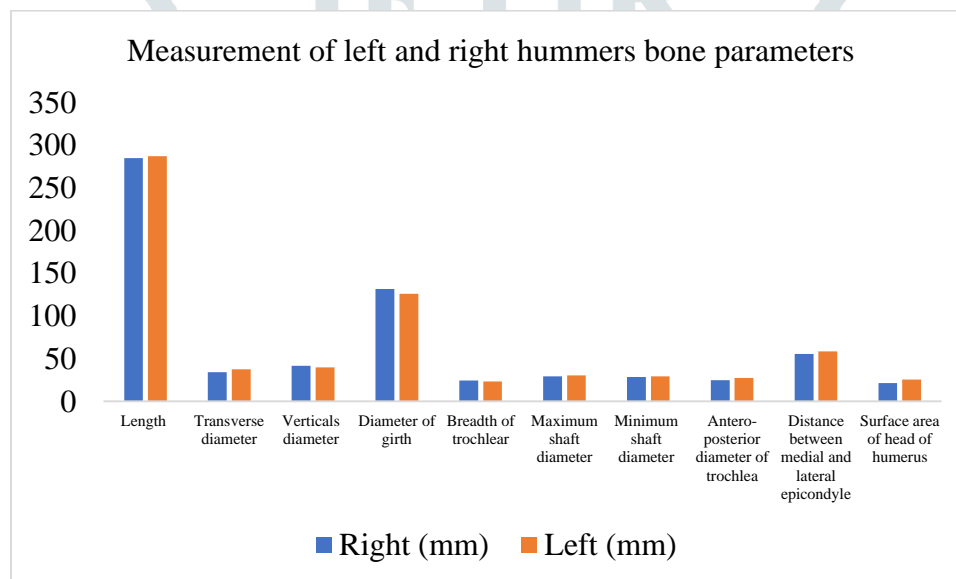


Figure 1: Measurement of left and right hummers bone parameters