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# An Anthropometric Study of the Humerus in Adults.

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Research Article

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## ABSTRACT

The long bones are most commonly used for identification of unknown bodies and parts of bodies. Seventy two adult dried humeri (36 right and 36 left) were obtained from the Anatomy Department of University College of Medical College and GTB Hospital. Somatometry was done by means of an osteometric board, a vernier caliper and a tapeline. The maximum height was found to be 306.41± 25.8mm on the right bone and 304.43 ± 23.4mm on the left bone. In the upper third the mean circumference of the shaft was 60.6 ± 6.6mm and 58.85 ± 6.0mm whereas the mean transverse diameter was 18.6 ± 2.1mm and 18.2 ± 2 mm on right and left sides respectively. The mean sagittal diameter of upper third of the shaft was measured to be 19.63 ± 2.1mm and 19.52 ±2.3mm on right and left sides respectively. In the middle third of the shaft the mean circumference was measured to be 56.79 ± 4.8mm and 55.51 ± 4.4mm on the right and left humerus. The mean transverse diameter was 17.37 ± 2.4mm and 16.55 ± 2.2mm whereas the mean sagittal diameter was 18.67 ± 2.7 mm and 18.32 ± 2.6mm in right and left sided bones respectively. In the lower third the mean circumference of the shaft was measured to be 55.57 ± 5.3mm and 54.47 ± 4.8mm and the mean transverse diameter was 18.31± 1.8mm and 18.21 ± 2.0mm on the right and left humerus respectively. However, the mean sagittal diameter was 16.84 ± 1.5mm and 16.7 ± 1.5mm for the lower third of the shaft in right and left humerus respectively. Obtained data was statistically analyzed.

## INTRODUCTION

An understanding of normal humeral morphology is important, since recreation of normal anatomy is the goal in prosthetic replacement of the upper end of the humerus. This knowledge can affect prosthetic sizing, positioning and design [1].

Estimation of stature from bones plays an important role in identifying unknown bodies, parts of bodies or skeletal remains. Anthropometric techniques have been commonly used to estimate stature and bone length from the skeletal remains and unknown body parts by anthropologists, medical scientists and anatomists for over a hundred years [2-4].

The estimation of bone length from incomplete long bones was firstly identified by Muller. She defined 5 segments for the humerus using the margins of articular surfaces and key points of muscle attachment [5]. Knowing these segment measurements which are defined, is very helpful for determining

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the humerus length [6]. Finding the mean values of different humeral segments helps in forensic and anthropometric practice. These findings are very useful to determining the humerus segment [5].

Celbis [7] stated that in case of absence of lower limb bones the estimation of living stature can be done by the help of remains of upper limb bones such as humerus, radius and ulna. In many situations the full length of long bones may not be available but only segments of bones may available in that case some methods can be used, as per as studies of Wright [5] in case of humerus segments and Mysorekar`s [8] two studies in case of radius, ulna, femur and tibia.

Depending on Munoz et al study [9] we can find out the total humerus length by a remains of humerus segment, for estimating of sex from whole skeletal or remains.

Many studies were confirmed the humerus by using classical osteometric techniques, the humerus is one of the strongest long bones of the skeleton which even in a fragmented state is likely to be recorded in a forensic case [10].

The present study is conducted for morphometric analysis of humerus segments.

## MATERIAL AND METHODS

Seventy two dried humeri were studied from the collection of bones from the Anatomy department of University College of Medical Sciences and Guru Teg Bahadur Hospital.

The tools used for various measurements were:

An osteo-metric board (precision = 0.1 cm).
A vernier calipers (precision = 0.1 mm)
A tapeline

To reduce the inter-observer and intra-observer rate of error, all measurements were taken twice by the same author.

Each humerus was positioned with the help of plastercin so that its shaft axis was aligned with the horizontal plane of the osteometric board.

**Total length of humerus (AB)**: The distance between the most proximal point of the caput humeri to the most distal point of the trochlea humeri [11].

**Humeral Shaft Length (CD)**: Proximal end of shaft was marked at the surgical neck of humerus and the distal end of the shaft was marked at the upper end of the olecranon fossa. (fig. 1)

- The shaft was divided into three parts named:
  Upper third (US)
  Middle third (MS)
  Lower third (LS)
- The center of each third was marked for the other measurements.

**Circumference of the shaft:** Measured with the help of a thread which followed the contour of the shaft at the mid-point of three divisions of the shaft and then measured on a tapeline, namely:

- Upper shaft circumference (USC)
- Middle shaft circumference (MSC)
- Lower shaft circumference (LSC)

**Transverse or coronal diameter:** Measured with the Vernier Calipers at the marked center of each third, namely:

- Transverse diameter upper shaft (TDUS),
- Transverse diameter Middle shaft (TDMS)
- Transverse diameter Lower shaft (TDLS)

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**Sagittal or antero-posterior diameter:** Measured with the Vernier Calipers at the marked center of each third, namely:

- Sagittal diameter upper shaft (SDUS)
- Sagittal diameter middle shaft (SDMS)
- Sagittal diameter lower shaft (SDLS)

Obtained data of the right and left femurs was tabulated and statistically analyzed by students-t test.

## RESULTS

Comparative statistics with the means and the standard deviations for each dimension of the contemporary individual humerus are presented in table 1.

The mean length of right humerus was found to be greater than left but it was statistically insignificant.

The mean value for the circumference of humerus in all the segments (upper, middle and lower) of the shaft was found to be greater on the right side as compared to the left but the difference was not significant.

The statistical difference was not significant as the mean value for the sagittal (anteroposterior) diameter was found to be only slightly greater on the right side in all the three segments of the shaft of humerus. (Table 1)

**Table 1: Measurements of the femoral anthropometrics - Bilateral comparative results of the contemporary individuals femora. (mm, Mean ± SD).**

| S.NO. | MEASUREMENTS | RIGHT HUMERUS "mm" | LEFT HUMERUS "mm" |
|---|---|---|---|
| 1. | MAXIMUM LENGTH | 306.41±25.8 | 304.4389±23.4 |
| 2. | CIRCUMFERENCE | | |
| | USC | 60.6±6.6 | 58.85±6.03 |
| | MSC | 56.79±4.8 | 55.51±4.4 |
| | LSC | 55.57±5.3 | 54.47±4.8 |
| 3. | SAGGITAL DIAMETER | | |
| | SDUS | 19.63±2.1 | 19.52±2.3 |
| | SDMS | 18.67±2.7 | 18.32±2.6 |
| | SDLS | 16.84±1.5 | 16.70±1.5 |
| 4. | TRANSVERSE DIAMETER | | |
| | TDUS | 18.6±2.1 | 18.2±2 |
| | TDMS | 17.37±2.4 | 16.55±2.2 |
| | TDLS | 18.31±1.8 | 18.21±2 |

**Table 2: Humeral length measurements in different populations compared with the present study. (mm, Mean ± SD)**

| Author | Population | Maximum length (mean ±SD) mm |
|---|---|---|
| Akman et al | Turkish | 305.95±1.6 |
| M Papalaucos et al | Athenian | 330.67±3.5 |
| Salles et al | Rio de Janeiro | 309.00±5.6 |
| Derya Atamtürk1 et al | Istanbul | 324.16±32.21 |
| Mall G | Munich and Cologne | 320.50±19.09 |
| Our study | North Indian | 305.42±1.4 |

**Table 3: Humeral transverse diameter measurements in different populations compared with the present study. (mm, Mean ± SD)**

| Author | Population | Mid Shaft Transverse Diameter (Mean) mm |
|---|---|---|
| Derya Atamtürk et al | Istanbul | 23.29 ± 2.37 |
| Our Study | North Indian | 16.90± 0.56 |

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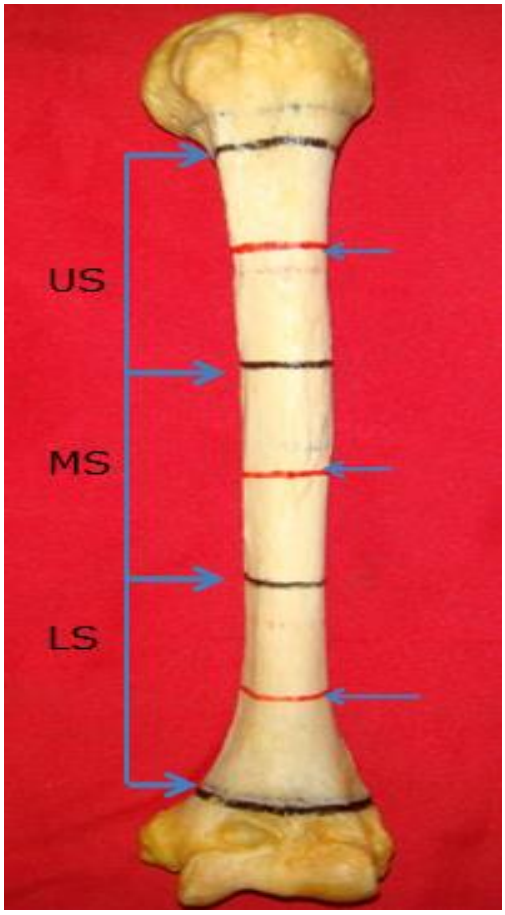


**Figure 1: Humerus shaft variables measured. US- upper shaft, MS-middle shaft, LS- lower shaft. Red lines show the middle point of each one third of the shaft.**

The mean value for the transverse (coronal) diameter in upper and lower segments of the shaft were slightly greater for the right side humerus as compared to left though in the middle third of the shaft the difference was more towards the right side but the differences were statistically non-significant. (Table 1)

On Comparison, the Athenian and Istanbul populations have a greater humeral length than the north Indians. The Athenian and Istanbul population humeral length are quite greater than those of the South Americans, Turks and the population of Munich. (Table 2) The difference can be attributed to the diet and genetic differences between the different populations.

The difference between north Indian population with that of South American and Munich populations could be attributed to the genetics and the environmental factors influencing the two populations. (Table 1) The humeral length in the Turkish population is found to be almost similar to the north Indian population. (Table 1)

The transverse diameter in the mid shaft of the humerus is greater in an Istanbul population as compared with North Indians which probably may be due to the fact that they measured the bones in radiographs and /or the racial difference. (Table 3)

## CONCLUSION

Humeral length shows a great variation in different populations which are likely to be due to factors such as nature of work, mode of life, continuous modifications that may affect the characteristics of man as well as the effects of civilization on the composition of the human body.

The length of the humerus was found to be greater on the right side as compared to the left this is in accordance with Akman et al [11] and Papalaucas et al [12].

The values for the transverse and antero-posterior diameter of the three sections of the shaft were found to be slightly greater on the right side but the difference is insignificant. The mean circumferences of the three sections of the shaft were found to be slightly greater on the right side but the difference is insignificant.

The existence of the phenomenon of asymmetry of bones of upper limb has been reported by Hiramoto1993 [13]. This exists with slight differences in all races of man and is present not only in man but also in other primates. Earlier studies have reported right-bias in the upper limb bone dimensions, which, combined with the contralateral asymmetry in lower limbs, has been termed ''crossed symmetry''[14,15]. The phenomenon of right and left asymmetry in the upper limb is an inherited one [16,17]. It can also be explained due to the contralateral control of the cerebral hemisphere, the left hemisphere is larger than the right and being functionally superior it exhibits its dominant influence on the right limb [18].

On Comparison, the humeral length shows great variation in different populations as the Athenian and Istanbul populations have a greater humeral length than that of North Indians. The length in the South American and Munich populations is also more as compared to population in our study which could be attributed to the genetics and the environmental factors influencing the two populations. The length in the Turkish population is found to be almost similar to the north Indian population.

The transverse diameter in the mid shaft of the humerus is greater in an Istanbul population as compared with North Indians which may probably be due to the fact that they measured the bones in radiographs and /or the racial difference.

The literature was not available on other parameters in different populations for comparison.

This study for the specific population group creates perspectives not only to forensic and anthropological investigations, but the estimate could also be extended to living height of individuals and also to archaeological studies. The detailed morphometry will also help in the planning of surgical intervention by clinicians.

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