MORPHOMETRIC MEASUREMENTS OF SEGMENTS IN DRY HUMERUS

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ABSTRACT

BACKGROUND

The humerus which being the long bone in the arm presents with two expanded ends- upper end and lower end. The present study was conducted to study the different morphometric analysis of segments of humerus. Estimating the stature from long bones plays an important role for Anatomist, Anthropologist and Forensic expert to identify unknown body parts of bodies or skeletal remains. It is also important for surgeons to identify fractures of proximal and distal end of humerus for the reconstructive surgery of fracture of humerus.

The objective of this study was to study the morphometry of humerus and compare the findings with previous studies.

MATERIALS AND METHODS

A descriptive study was conducted on 49 human dry humerus, out of which 25 were of left side and 24 were of right side. Ten different parameters were measured to study the morphometry of humerus by using digital caliper, measuring tape, graph paper, cardboard and measuring scale.

RESULTS

In our study, we observed the mean value of the total humerus to be 283.36, ± 22.48 mm and 290.17, ± 18.67 mm on the left and right side respectively. Maximum transverse diameter of head 38.18, ± 4.78 mm on the left side and 35.85, ± 5.09 mm on the right side. The maximum vertical diameter was 40.01, ± 4.39 mm on left and right side respectively. The surface area of the head of the humerus was 22.23, ± 3.77 mm on the left side and 22.17, ± 4.09 mm on the right side.

CONCLUSION

The knowledge of morphometric measurement of segments of humerus is important for anatomist. Forensic experts and archaeologist to define the identity of a skeleton as well as the stature. It also helps the surgeons in various surgeries of humerus for implantation. In this study, there was no significant difference with other authors except for surface area of the head of the humerus.

KEYWORDS

Humerus, Anthropometry, Digital Caliper, Morphometry.

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BACKGROUND

The humerus or the arm bone being the longest and strongest bone of the upper limb and presents with two expanded ends- upper and lower ends and an intervening shaft which is cylindrical in shape. To know about the length, size and shape of the humerus is very important for anatomists and anthropologists. Estimation of stature from bones plays an important role in identifying unknown bodies, parts of bodies or skeletal remains in Forensic science. Knowing the mean length and weight of humerus segments is very important for anatomist and forensic experts and helps the investigator to define the identity of a skeleton. It is also important for the surgeons to identify the proximal and distal fracture of the humerus.

Mullar first measured five segments of the humerus by using the margins of articular surfaces and key points of muscle attachment. These findings are very useful to determining the humerus segment.⁽¹⁾ In many situations the full length of the long bone may not be available but only segment of bones may be available, in that case some methods can be used as per studies of Wright.⁽²⁾ These measurements indicate the characteristic morphological features of humerus segment in Indian population and provides data for various implants in reconstruction of various humerus fractures. The present study is conducted for morphometric analysis of segments of humerus.

MATERIALS AND METHODS

The study design is a descriptive study and in the present study 49 numbers of dry humeri were collected from the Department of Anatomy of Sikkim, Manipal Institute of Medical Sciences in Gangtok. Ten different parameters of humerus were measured to study the morphometry of the humerus by using digital caliper, measuring tape, graph paper, card board and measuring scale.

- a. Maximum length of humerus: It measures the distance between the highest point of the head of the humerus to the most distal point of the trochlea.

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- b. Maximum transverse diameter of the head: It measures the straight distance between the most lateral points on articular surface of the head.
- c. Maximum vertical diameter of the head: It measures the straight distance between the highest and lowest points on the articular surfaces, taken at right angle to the transverse diameter.
- d. Girth of the head: It measures the circumference of the head along its articular surface.
- e. Breadth of the trochlea: It measures the breadth between the midpoint of the lateral margin of the trochlea and midpoint of lateral margin of capitulum.

- f. Maximum diameter of the shaft.
- g. Minimum diameter of the shaft.
- h. Anterior-posterior diameter of trochlea.
- i. Distance between medial and lateral epicondyle.
- j. Surface area of the head of the humerus.

All the parameters were recorded and analysed statistically by using SPSS 16. The mean and standard deviation was calculated.

Side	Length	MTDH	MVDH	GOHead	BOTROCHLEA
Left Mean	283.36	38.18	40.93	124.84	25.82
N	25	25	25	25	25
STD DEV	±22.48	±4.786	±5.14	±11.75	±2.76
Right Mean	290.17	38.85	42.01	136.58	26.08
N	24	24	24	24	24
STD DEV	±18.67	±5.09	±4.39	±46.64	±2.61
Total Mean	286.69	38.51	41.46	130.59	25.95
N	49	49	49	49	49
STD DEV	±20.78	±4.90	±4.77	±33.86	±2.66
F-Value	1.323	0.225	0.619	1.488	0.112
P-Value	0.256	0.637	0.436	0.229	0.739
Table 1. Showing the Length, MTDH, MVDH, GoHead and Trochlea Mean, STD of Left and Right Humerus					

SIDE	MxDOS	MnDOS	APDOT	DBMAL	SURAH
Left Mean	31.73	26.17	27.43	56.11	22.23
N	25	25	25	25	25
STD DEV	±31.3	±1.87	±1.97	±5.41	±3.77
Right Mean	31.01	25.52	27.58	57.64	22.17
N	24	24	24	24	24
STD DEV	±3.42	±2.33	±1.73	±5.33	±4.09
Total Mean	31.38	25.85	27.51	56.86	22.20
N	49	49	49	49	49
STD DEV	±3.26	±2.11	±1.84	±5.37	±3.88
F-Value	0.585	1.137	0.082	0.999	0.003
P-Value	0.448	0.292	0.776	0.323	0.955
Table 2. Showing the MxDOS, MnDOS, APDOT, DBMAL and SURAH Mean, STD of Left and Right Humerus					

(MxDOS- Maximum Diameter of Shaft, MnDOS- Minimum Diameter of Shaft, APDOT- Anterior Posterior Diameter of

Trochlea, DBMAL- Distance Between Medial and Lateral Epicondyle, SURAH- Surface Area of Head of Humerus)±

Sl. No	Authors	Year	Length	MVDH	MTDH	GoHead	BoTrochlea	APDOT	MxDoS
1.	S.D A K Man	2005	L 304.8, ± 1.8 R 307.10, ± 2.1	40.9, ±3.9 41.0, ±5.1	-	-	40.6, ±3.3 39.7, ±3.4	-	-
2.	S.D Desai et al	2012	L 289.4, ±21.8 R 292.3, ± 22.9	-	-	-	-	-	-
3.	Niraj P et al	2013	L 307.27, ±16.13 R 308.58, ±19.17	-	-	-	-	-	-
4.	Lokanadham et al	2013	M 310.97, ±0.15 F 280.65, ±0.15	30.27, ±0.03 20.96, ±0.04	40.37, ±0.42 30.49, ±0.04	120.96, ±0.09 110.52, ±0.12	20.34, ±0.022 20.09, ±0.034	-	40.39, ±0.42 30.492, ±0.04
5.	Ashiyani et al	2016	L 300.32, ±1.58 R 300.39, ±1.66	-	-	-	-	10.45, ±0.15 10.15, ±0.14	-
6.	Pranoti et al	2017	L 283.36, ±22.48 R 290.17, ±18.67	40.93, ±5.14 42.01, ±4.39	38.18, ±4.79 38.85, ±5.09	124.84, ±11.75 136.58, ±46.64	25.82, ±1.97 26.08, ±2.61	27.43, ±1.97 27.58, ±1.73	31.73, ±31.3 31.01, ±3.42
Table 3. Comparative Studies carried out by different Authors on Humerus

RESULTS

The present study was conducted in 49 humerus (out of which 25 are of left side and 24 are of right side) to determine the different parameters of the humerus.

The maximum length of the humerus was 283.36 ± 22.48 mm on left side and 290.17 ± 18.67 mm on the right side. Maximum transverse diameter was 38.18 ± 4.78 mm on left side and 35.85 ± 5.09 mm on the right side. Maximum vertical diameter of head was 40.93 ± 5.14 mm on left side and 42.01 ± 4.39 mm on the right side. The maximum diameter of girth of head was 124.84 ± 11.75 mm on the left side and 136.58 ± 46.64 mm on the right side. The breadth of trochlear on the left side was 25.82 ± 2.76 mm and 26.08 ± 2.61 mm on the right side.

The maximum diameter of shaft of humerus was 31.73 ± 31.3 mm on left side and 31.01 ± 3.42 mm on the right side. The minimum diameter of shaft was 26.17 ± 1.87 on the left side and 25.52 ± 2.33 mm on the right side. Antero-posterior diameter of trochlea was 27.43 ± 1.97 mm on left side and 27.58 ± 1.73 mm on the right side. The distance between the medial and lateral condyle of humerus on the left side was 56.11 ± 5.41 mm and 57.64 ± 5.33 mm on the right side. The surface area of head of the humerus was 22.23 ± 3.77 mm on the left side and 22.17 ± 4.09 mm on the right side (Table 1).

DISCUSSION

The humerus being the longest and strongest bone of the upper limb and is very important to identify the humeral length by segmental measurements which is applicable for anatomist, anthropologist and forensic specialist in various studies. It is also essential for the surgeons in fractures of upper and distal end of the humerus. Thus knowing these segment measurements, which are defined is very helpful for determining the humerus length.⁽³⁾

In this study, the mean values of the total length of the humerus was identified as 283.36 ± 22.48 mm and 290.17 ± 18.67 mm on left and right humerus respectively. In comparison to the findings of this study, the total mean values of the total humerus length was 283.36 ± 22.48 mm and 290.17 ± 18.67 mm on the left and right respectively. The results were similar with the studies done by S D Desai et al^(4,5) (Table 3).

The maximum vertical diameter of head of the humerus was 40.39 ± 5.14 mm on the left side and 42.01 ± 4.39 mm which were similar with the measurements of S D Akmann et al⁽⁶⁾ (Table 3).

In a study done by Lokanadham et al, the maximum transverse diameter of head of humerus was 40.37 ± 0.420 mm in males and 30.492 ± 0.042 mm in females, whereas in this study the measurement was 38.18 ± 4.786 mm and 38.85 ± 5.09 on the left and right side respectively.

The girth of the head in this study was 124.84 ± 11.75 mm on the left side and 136.58 ± 46.64 mm on the right side which are similar with the study done by Lokandham et al.⁽⁷⁾

The breadth of the trochlea in this study was 25.82 ± 2.76 mm and 26.08 ± 26.10 mm on the left and the right side,

whereas study done by Lokandham et al were 20.34 ± 0.022 mm in males and 20.09 ± 0.034 mm in females⁽⁷⁾ (Table 1).

The antero-posterior diameter of the trochlea in this study was 27.43 ± 1.97 mm on the left side and 27.58 ± 1.73 on the right side which was different from the study done by Ashiyani et al which were 10.45 ± 0.15 mm on the right side and 10.45 ± 0.17 mm on the left side.⁸ The maximum diameter of the shaft of the humerus in this study was 31.73 ± 31.3 mm on the left side and 30.01 ± 3.42 mm on the right side, whereas study done by Lokanadham et al the measurements were 40.378 ± 0.420 mm in males and 30.492 ± 0.042 mm in females.⁽⁷⁾

The final measurement done in this study was surface area of the head of humerus. The readings were 22.23 ± 3.77 mm on the left side and 22.17 ± 4.09 mm on the right side. No previous data were found in relation with the surface area of the head (Table 2).

CONCLUSION

The knowledge of morphometric measurements of segments of humerus is important for Anatomist, Forensic Science and Archaeologist to identify the relationship between length of long bones and height of living as well as unknown bone fragments which may be influenced by different factors such as ethnicity, age, sex, race and culture. It is also helpful for the clinician to treat the proximal and distal fracture of humerus and also help the orthopaedic surgeon in various reconstructive surgery of humerus for implantation.

In this study, there was no significant difference with the other authors except for the surface area of the head of the humerus.

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