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Original Research Article

THE PROXIMAL SEGMENT OF HUMERUS IN NORTH INDIAN POPULATION: A MORPHOMETRIC STUDY

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ABSTRACT

Background: The present study was conducted on the morphometry of proximal segment of the humeri in order to provide critical data which would help in the estimation of the stature and identification of remains in forensic studies and for better shoulder prosthetic designs in this population.

Material and methods: The present study was conducted on 100 dry humeri of unknown age and sex.The measurements of the proximal segment included the circumference of the head, the vertical and transverse diameters of the superior articular surface and the upper epiphyseal breadth were made.

Result: The mean circumference of head of humerus was found to be 13.66±1.13cm.The mean vertical diameter of superior articular surface of humerus was 4.28±0.38 cm .The mean transverse diameter of superior articular surface of humerus was found to be 3.88±0.33 cm.The mean upper epiphyseal breadth of humerus was found to be 4.55±0.36 cm.

Conclusion: The present study adds critical information to the data already available on anthropometry of the proximal humerus.The study data is useful for anthropologists, archaeologists and forensic investigators as well as for prosthetic designing.

KEYWORDS: Proximal Humerus, Morphometry, Anthropologists.

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INTRODUCTION

The humerus is longest and largest bone in the upper limb [1]. It has become apparent that normal anatomy of the proximal end of humerus is highly variable from individual to individual and from one population to another. Knowledge of the mean values of humerus segments is very important for anatomic and forensic science and helps the investigator to define the identity of askeleton [2-5]. The variations of the anatomy of the proximal segment of humerus among various populations, has major implications in prosthetic designing.Clinical studies of total shoulder arthroplasty have shown that restoration of the normal anatomy of the proximal humerus is desirable. This affects the lever arms of the deltoid and rotator cuff in the vertical plane and soft-tissue balance in the horizontal plane[6-8].Changes in this anatomy may produce abnormal kinematics by malpositioning the joint line

and by moving the instant centres of rotation [9-11]. Despite this, few studies have examined the detailed anatomy of the proximal humerus[12-18].

The purpose of this study was to add critical information to the data already available on anthropometry of the proximal humerus.

MATERIALS AND METHODS

The present study was conducted on 100 dry humeri of unknown age and sex, which were obtained from Department of Anatomy, Government Medical College, Jammu. Prior permission was sought from Head of Department, Anatomy. These humeri were labelled from 1-100.Of the 100 humeri, 47 were of the left side and 53 were of the right side. Humerus bones used for the study fulfilled were dry and macerated, complete in all respects so that they could give the correct morphometry and they were thoroughly cleaned.Each bone was examined for important morphometric features and finally analysed to a detailed meticulous study as given below. All the measurements were recorded in centimeters.

The following parameters were recorded:

Circumference of head of humerus: It was measured by winding the flexible tape around the circumference of head of the humerus along its articular surface **(**Fig. 1**)**.

Fig. 1: Circumference of the head of humerus.

The vertical diameter of superior articular surface: It was measured as the distance between the highest and the lowest point on the articular margin of the head taken at right angle to the transverse diameter. The measuring instrument was Vernier Calliper (Fig. 2).

The transverse diameter of superior articular surface: It was measured by Vernier Calliper, as the horizontal distance between the lateral most points on the articular margin of head (Fig. 3).

Fig. 2: Vertical diameter of head of humerus.

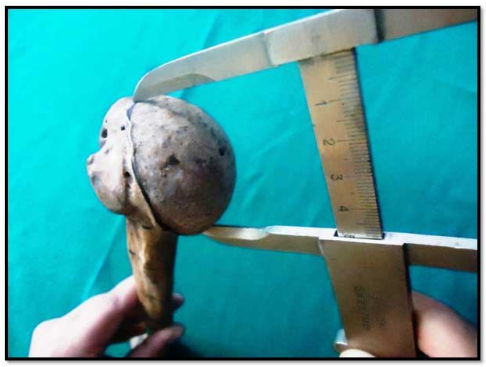
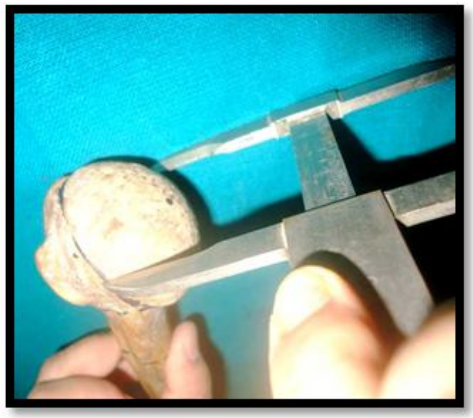


Fig. 3: Transverse diameter of head of humerus.



d). Upper epiphyseal breadth: It was calculated with the help of Vernier Calliper as a distance between the medial most point on the articular surface of head and the lateral most point on the greater tubercle (Fig. 4).

Fig. 4: showing upper epiphyseal breadth.

RESULTS

The observations were made in reference to the circumference of head of humerus, vertical diameter of superior articular surface, transverse diameter of superior articular surface and upper epiphyseal breadth of humerus. Tables 1-4 give a summary of our results.

Table 1: Statistical measurements of circumference of head of humerus (in cms).

S.No.	Parameters	Right	Left	Total average
1	Mean	13.76	13.54	13.66
2	Range	11.2-15.6	10.4-16.1	10.4-16.1
3	Standard deviation	1.05	1.22	1.13

Table 2: Statistical measurements of vertical diameter of superior articular surface (in cms).

S.No.	Parameters	Right	Left	Total average
1	Mean	4.33	4.23	4.28
2	Range	3.4-5.1	3.3-5	3.3-5.1
3	Standard deviation	0.38	0.37	0.38

Table 3: Statistical measurements of transverse diameter of superior articular surface (in cms).

S.No.	Parameters	Right	Left	Total average
1	Mean	3.92	3.84	3.88
2	Range	3.1-4.5	2.9-4.5	2.9-4.5
3	Standard deviation	0.31	0.35	0.33

Table 4: Statistical measurement of upper epiphyseal breadth of humerus (in cms).

S. No.	Parameters	Right	Left	Total average
1	Mean	4.6	4.5	4.55
2	Range	3.7-5.1	3.5-5.3	3.5-5.3
3	Standard deviation	0.33	0.39	0.36

DISCUSSION

Table 5: Showing comparison of circumference of head of humerus.

Author	Race	Right		Left	
		Mean(cm)	SD	Mean(cm)	SD
Devi et al [19]	North Indians	13.03	0.86	13.02	0.78
Present study	North Indians	13.76	1.05	13.54	1.22

Proximal end of humerus is important because the articular head is present along this end which forms part of shoulder joint.

Circumference of head of humerus or Anatomical neck circumference: The circumference of the head of humerus or anatomical neck is of importance to Anatomists, Forensic experts and Anthropologists. In the absence of intact long bones, which are most commonly used for estimating stature and the fact that mass disasters often leave only bone fragments and commingled remains, anatomical neck circumference provides forensic anthropologists means of estimating stature through regression formulae.

The mean circumference of head of humerus was found to be 13.66±1.13cm with mean of 13.76±1.05 cm on right side and 13.54±1.22 cm as mean on the left side. Devi et al., (2014) worked on the same parameter i.e. the circumference of head of humerus and reported mean on the right side as 13.03±0.86 cm and 13.02±0.78 cm on the left side. Values on the right side are slightly higher than the left side in the present study as well as in study of Devi et al [19]. Results of the present study are in concinnity with the study of Devi et al.

The vertical diameter of superior articular surface of humerus: The knowledge of the geometry of superior articular surface or head of the humerus along with its diameters is important for the design of prosthesis for treatment of its various fractures [20].A structural analysis of proximal humerus provides a method to facilitate precise placement of humeral stem in shoulder arthroplasty [21].

Table 6: Showing comparison of vertical diameter of superior articular surface of humerus

Author	Race	Total			Right			Left		
		Mean (cm)	SD	Range (cm)	Mean (cm)	SD	Range (cm)	Mean (cm)	SD	Range (cm)
Udhaya et al [22]	South Indians	4.07	0.37	3.2-5	4.03	0.4	3.2-5	4.1	0.33	3.4-4.8
Devi et al [19]	North Indians	-	-	-	4.26	0.33	-	4.25	0.29	-
Gayatri et al [23]	South Indians	3.32	0.51	1.9-4	3.43	0.5	2.2-4	3.22	0.51	1.9-3.8
Present study	North Indians	4.28	0.38	3.3-5.1	4.33	0.38	3.4-5.1	4.23	0.37	3.3-5

The mean vertical diameter of superior articular surface of humerus was 4.28±0.38 cm (range=3.3-5.1 cm), with mean on right side as 4.33±0.38 cm (range=3.4-5.1 cm) and on left side, it was 4.23±0.37cm (range=3.3-5 cm). Studies were done on same parameter by Udhaya et al[22], Devi et al[19] and Gayatri et al[23]. Results of present study correspond with that of Udhaya et al. Moreover, mean on right and left side is in consonance with mean on right and left side in the study of Devi et al. Result of Gayatri et al. is slightly lower than present study.

The transverse diameter of superior articular surface: Diameters of superior articular surface i.e. the humeral head is of prime importance to orthopaedicians since there is influence of humeral head size on glenohumeral kinematics.

The mean transverse diameter of superior articular surface of humerus was found to be 3.88±0.33 cm (range=2.9-4.5 cm) with mean of 3.92±0.31 cm (range=3.1-4.5 cm) on right side; and 3.84±0.35 cm (range=2.9-4.5 cm) on left side.

Table 7: Showing comparison of transverse diameter of superior articular surface of humerus.

Author	Race	Total			Right			Left		
		Mean (cm)	SD	Range (cm)	Mean (cm)	SD	Range (cm)	Mean (cm)	SD	Range (cm)
Udhaya et al [22]	South Indians	3.76	0.33	3.1-4.7	3.75	0.34	3.1-4.7	3.77	0.32	3.1-4.6
Devi et al [19]	North Indians	-	-	-	3.96	0.26	-	3.97	0.24	-
Gayatri et al [23]	South Indians	2.68	0.28	2.2-3.2	2.78	0.28	2.2-3.2	2.59	0.26	2.2-3.2
Present study	North Indians	3.88	0.33	2.9-4.5	3.92	0.31	3.1-4.5	3.84	0.35	2.9-4.5

Earlier, Udhaya et al, [22] Devi et al, [19] and Gayatri et al [23] also measured transverse diameter of superior articular surface of humerus. Results of present study are in agreement with those of Udhaya et al. Moreover, in the present study, the mean on right and left side are in consonance with that of Devi et al. Results of study conducted by Gayatri et al are inconsistent with present study.

Upper epiphyseal breadth of humerus: The mean upper epiphyseal breadth of humerus was found to be 4.55±0.36 cm, (range=3.5-5.3 cm), with mean of 4.60±0.33 cm (range=3.7-5.1 cm) on right side; and 4.50±0.39 cm (range=3.5-5.3 cm) on left side.

Table 8: Showing comparison of upper epiphyseal breadth of humerus.

Author	Race	Right		Left	
		Mean(cm)	SD	Mean(cm)	SD
Salles et al[24]	Brazilians	3.8	0.4	3.7	0.3
Chavda et al[25]	West Indians	3.82	0.42	3.86	0.58
Devi et al[19]	North Indians	4.63	0.29	4.61	0.27
Present Study	North Indians	4.6	0.33	4.5	0.39

Measurements of the study conducted by Devi et al [19] regarding the mean upper epiphyseal breadth, on the right and left side was 4.63±0.29 cm and 4.61±0.27 cm respectively which is in concinnity with the present study, having values as 4.60±0.33 cm and 4.50±0.39 cm on right and left side respectively with a slightly higher values on the right side. Results of studies conducted by Salles et al [24] and Chavda et al [25] are not coinciding with the results of the present study.

CONCLUSION

The present study adds critical information to the data already available on anthropometry of the proximal humerus.In the absence of intact long bones, anatomical neck circumference provides forensic anthropologists means of estimating stature. These data include many significant parameters used in prosthesis design and the prostheses design based on North Indian population data would minimize the possible complication during the operation or post-operation.

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Conflicts of Interests: None

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