

Content available at: <https://www.ipinnovative.com/open-access-journals>

Indian Journal of Clinical Anatomy and Physiology

Journal homepage: <https://www.ijcap.org/>

Original Research Article

Morpho-metrical analysis of upper humerus- A study from Central Maharashtra

Shaikh Shamama Farheen^{1,*}, G Ajit Shroff¹, Sadaf Tanveer Khan²¹Dept. of Anatomy, MGM Medical College, Aurangabad, Maharashtra, India²Dept. of Anatomy, Government Medical College, Aurangabad, Maharashtra, India

ARTICLE INFO

Article history:

Received 03-05-2023

Accepted 08-06-2023

Available online 08-07-2023

Keywords:

Cadaveric

Humerus

Morpho-Metric

Osteometer

Replacement

ABSTRACT

Introduction: The humerus is largest bone of the upper limb and also defines the human brachium. The shoulder joint is ball and socket joint formed by articulation of hemispherical head of humerus and shallow glenoid cavity of scapula. The sizes of Humeri & Glenoid can impact decision making during surgery for shoulder replacement and shoulder instability. Study of humerus is helpful for providing data and correlation factors which has enormous importance while making prosthesis for replacement surgery.

Materials and Methods: A retrospective study was conducted on 61 cadaveric humeri - 31 from left side and 30 from right side. Length, AP diameter, MLD and head size was calculated using vernier calliper, scale, no elastic thread and osteometer.

Results: The combined length of humerus was 309.84±17.91 mm. Left and right sided length was 308.42±17.859 mm and 311.30±17.91 mm respectively. AP diameter on left and right side was 39.10±2.791mm and 39.54±2.544 mm respectively. MLD combined was 42.959±3.264 mm and head height was 30.92±2.53 respectively.

Conclusion: The morpho-metric dimensions of right side of humerus was more than that of left side. Proper measurements are required when surgical procedures are to be done. More studies should be conducted measuring head height.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

In upper body largest bone is humerus. The upper end of humerus comprises of rounded head with proximal and medial part of upper end of the bone. It forms articulation with glenoid cavity of scapula.¹ The head is joined to shaft by constricted neck and two eminences, with both tubercles.² The head of the humerus forms less than half a spheroid. Its smooth articular surface which is thicker centrally is covered with hyaline cartilages. When arm is at rest by the side it is directed upwards, medially and backwards to articulate with glenoid cavity of scapula. Proximal fractures of humerus are common injuries. They

occur along with epiphyseal lines of proximal humerus and within humeral segments.³

The shoulder joint is ball and socket type of joint formed by articulation of humerus (hemispherical head) and shallow glenoid cavity of scapula. The sizes of Humeri & Glenoid cavity can impact decision-making during surgery for shoulder replacement and also shoulder instability. The authors have emphasized importance of Glenoid sizes in Asian population and its impact on decision of Bankart Vs Latarjet procedure. Though shoulder joint is highly movable but few disease conditions like rheumatoid arthritis avascular necrosis of humeral head and rotator cuff tear hampers its movements and requires arthroplasty for better movements.

* Corresponding author.

E-mail address: sadafsajjad1990@gmail.com (S. S. Farheen).

There is limited literature on the shoulder bony morphological parameters in the Indian population, also the surgical correction of humerus requires measurements of humeral upper end which differ with reference to race and geographical area. Reconstruction of proximal humeral defect with custom made acrylic prosthesis is less expensive and effective, which can be used in developing countries.⁴

Most of the prosthesis designs are based on western measurements. Shoulder prosthesis should accurately mimic proximal shoulder with glenoid anatomy to recreate the shoulder biomechanics. The bony morphology of Indians may be different from that of the western countries. Also, dimensions of proximal end of humerus vary.⁵ Usually length of Indian population is smaller as compared to western population.⁶

Estimating the stature of the individual from bones and as well as reconstructions of life from the human skeletal still remains a challenge for many anthropologists, researchers and forensic experts. Statures estimated from the human skeletal remains overall is an important step in assessing health as well as general body size trends among the given populations.

Morphometrical analysis of bone is very important not only for the reconstruction surgery but also for determining the gender of dead bodies. The examination of the upper and lower limb asymmetries can be useful to medical anthropologists, archeologists, forensic experts and for medico legal studies. The humerus confers important advantages over other long bones of human body in that its entire outline can readily be traced on total body X-ray absorptiometry images, and its shape can be modelled as a cylinder with excellent accuracy.⁷ This study was done to determine-

1. The length of humerus.
2. The size of head of humerus.
3. The Antero-posterior(AP) diameter of humerus.
4. Medio-lateral diameter(MLD) of humerus.

This is done mainly to compare the variations in size of humerus in Indian population.

2. Materials and Methods

Our study was a retrospective study conducted for 20 months from 20-5-21 to 5-1-23 in the dept. of anatomy MGM medical college, Aurangabad. The study was approved by the ethical committee of MGM medical college on 21-5-21. The sample size taken was 61 because only that much bones are available in our departmental bone bank. All the intact/non damaged humeri were included in the study whereas damaged and Pathological humeri were excluded.

The Materials required for study included Sliding Vernier caliper, Scale, Non elastic thread and Osteometer.

Statistical analysis was done with the help of SPSS 25. Descriptive and analytical statistical analysis was

done. Analysis was done by Pearsons correlation. Linear multivariant regression equation was calculated.

2.1. Procedure

The present study was performed on 61 cadaveric humeri (31 left sided and 30 right sided). All were of unknown age and gender. Length of humerus, Head of Humerus, AP diameter and Medio-Lateral diameter of humerus head was calculated as follows-

2.1.1. Total length (L)

Functional length of humerus which is distance between upper and lower end in anatomical position is recorded in mms with the help of osteometer.¹



Fig. 1: Total length

2.1.2. Antero posterior dimeter of head(AP)

Distance between middle point of anatomical neck anteriorly to middle point of neck posteriorly.¹



Fig. 2: Antero posterior diameter of head (AP)

2.1.3. Medio lateral diameter of head (MLD)

Distance between middle point of upper margin of greater tubercle till middle point of medial margin of surgical neck.⁴



Fig. 3: Medio lateral diameter of head(MLD)

2.1.4. Head height (H)

Distance between highest point of anterior margin of anatomical neck to lowest point of posterior margin of anatomical neck.⁴



Fig. 4: Head height(H)

3. Results

Out of 61 cadaveric humeri that were collected, 31 were left sided and 30 were right sided. The result of length of humerus, Head of humerus, AP diameter of humerus and MLD of humerus is as follows-

The length of humerus of right side is more as compare to left side. AP diameter of head is almost equal of both side. Medioloateral diameter of head is more of left side whereas head height is more of left humerus.

4. Discussion

One of the longest bone in the human body is humerus. In forensic study and anthropological practice it plays an important role helps to identify the length from the segmental measurements. This method is an essential step in assessing health, sexual dimorphism and the general body size that trends among the past populations.² For morphometric analyses use of well-preserved bones of the human body is of utmost importance. Besides the bone structure of the pelvis and cranium, other bones like humerus, tibia, femur, sternum, ulna, talus, calcaneus, radius bones are also used in anthropological studies. Because of the bone deformities formed due to chemical factors and mechanical factors, humerus is the common bone used for the sex determination. Therefore, humerus has been frequently used by researchers in forensic and anthropological studies.³

This study was conducted on 61 human cadaveric humeri. Of these, based on side we found that 31 were left sided and 30 were right sided. We have measured length, head size, AP and MLD of these humeri. Mean and standard deviation was calculated using vernier caliper, osteometer, scale and thread.

According to our study, the mean±SD for length of humerus was 308.42±17.85mm for left sided and 311.30±18.15mm for right sided humerus. The total mean±SD was 309.84±17.91mm.

In the study conducted by S. Desai et al which was conducted in Bijapur, Karnataka, maximum length of humerus was 292.3±22.9mm on right and left was 289.45±21.8mm. Their values were quite lower as compared to our study.⁸ The other comparable studies are mentioned in Table 4.

The combined total length of humeri in our study was, 309.84 ±2.53mm. In the study conducted by Akman et al, the combined length was 305.95mm ± 1.6mm.¹² This was a Turkish study. In the study conducted by Papaloucas et al, which is Athenian study, the combined length was 330.67mm ± 3.5mm.¹³ In one study conducted in Istanbul, the combined length was 324.16mm ± 32.21mm.¹⁴ So, our combined length of humerus was much smaller as compared to Athenian and Istanbul study. .

The next parameter taken by us was AP diameter of head. In present study it was 39.106±2.791 mm on left side and 39.54±2.544 mm on right side. The combined AP diameter was 39.32 ±2.61 mm. In the study conducted by Moumita Chatterjee et al it was 39.06± 3.26 mm on right side and 38.82±2.71 mm on left side respectively. This is quite comparable to our study.¹⁵ In the study conducted by Sinchal Dutta et al, it was 38.946+ 3.383 on right side and 38.208+ 3.684mm and left side respectively.¹⁶ While in study conducted by Ayadin et al, the transverse diameter on right and left side was 38.29±3.04mm and 38.66±3.92mm respectively.¹⁷ In the study conducted by Azari Ashutsh et

Table 1: Length, AP head, MLD and head height on left side of shoulder with respect to mean±SD

Parameter	Mean	Standard Deviation	Standard error	Minimum	Maximum
Length	308.425806	17.8589094	3.2075548	265.0000	314.976507
AP Head	39.106129	2.7915882	0.5013840	30.8500	43.9400
MLD	42.730000	3.7436177	0.6723736	26.8000	47.2700
Head Height	31.019355	2.7398576	0.4920929	25.4600	37.3700

Table 2: Length, AP head, MLD and head height on right side of shoulder with respect to mean±SD

Parameter	Mean	Standard Deviation	Standard error	Minimum	Maximum
Length	311.306667	18.1512977	3.3139584	304.528861	318.084473
AP Head	39.549333	2.4547588	0.4481756	33.8000	44.3000
MLD	43.196667	2.7277657	0.4980196	36.2400	44.215231
Head Height	30.823000	2.3576920	.4304537	23.7000	36.3500

Table 3: Length, AP head, MLD and head height combined) of shoulder with respect to mean±SD

Parameter	Mean	Standard Deviation	Standard error	Minimum	Maximum
Length	309.842623	17.9115276	2.2933361	265.0000	370.0000
AP Head	39.324098	2.6189472	0.3353218	30.8500	44.3000
MLD	42.959508	3.2648147	0.4180167	26.8000	48.1500
Head Height	30.922787	2.5396687	0.3251713	23.7000	37.3700

Table 4: The other comparable studies

Study names	Left sided humerus length	Right sided humerus length
Somesh et al ⁹	299.6 mm ± 22.5mm	309.6 mm ± 20.6mm
Salles et al ¹⁰	300.85mm ± 18.35mm	313mm ± 17.71mm
Niraj et al ¹¹	307.2mm ± 16.13mm	308.5mm ± 19.16mm
Present study	308.42±17.85mm	311.30±18.15mm

al, the transverse combined diameter was 39.65±2.97mm respectively which is relatable to our study.¹⁸ Quite higher AP diameter of head was found in the study of Dipti Sahu et al and it was 40.1 ± 2.8mm.¹⁹

In present study, the medio-lateral diameter of Humerus head was 42.73±3.743mm on left side while 43.196±2.727mm on right-hand side. The total MLD was 42.959±3.264mm. In the study conducted by Moumita Chatterjee et al, the maximum vertical diameter of head was 35.56±3.26 on right side and 35.19±3.38 on left side.¹⁵ This is quite higher as compared to our study. In the study conducted by Lokanadham et al the vertical diameter of head was 32.66±.31 in males and 29.6±.41 in females.²⁰ The difference in values in both the above studies could be due to, our study was conducted on cadaveric humeri while their study was conducted on human beings. In the study conducted by Aydin et Al, the vertical diameter was 42.41±3.25mm and 42.94±4.01mm respectively for right and left side.¹⁷

In our study, the head height with respect to mean±SD was 31.019±2.739mm on left side and 30.82±2.35mm on right side. The combined head height was 30.92±2.53mm. The head height was calculated from distance between highest points of anterior margin

of anatomical neck to lowest point of posterior margin of anatomical neck. We could not find many studies mentioning the head height. The head is important part of humerus as it helps in formation of ball and socket joint and it serves as the insertion point for muscles which make up the shoulder girdle.

Anthropometry measurements are extremely useful to estimate stature and bone length from the skeletal remains of body. It's a very important step in assessing health as well as general body size trends away the given populations is stature estimated from the human skeletal remains. It also has an unmeasurable role in the identification of persons that are missing into medical legal investigations, finding the mean values of different humerus segment which helps in forensic and anthropometric practice. For the assessment of the living stature of the individual, assessment of long bones of the individual is very important in anthropological practice for morphometric analysis in case of pelvis, cranium and long bones such as tibia and femur of the lower limb collectively remains the best. 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 like humerus, radius and ulna.

There is limited literature on the shoulder bony morphological parameters in the Indian population, also the surgical correction of humerus requires measurements of humeral upper end which differ with reference to race and geographical area. Reconstruction of proximal humeral defect with custom made acrylic prosthesis is less expensive and effective, which can be used in developing countries.⁴

5. Conclusion

The morpho-metric dimensions of right side of humerus was more than that of left side. There was variability in dimensions which was found in different studies. The length of humerus is shorter as compared to Athenian and Istanbul study. Proper measurements are required when surgical procedures are to be done. More studies should be conducted measuring head heights.

6. Source of Funding

None.


7. Conflict of Interest

None.

References

- Jahan S, Srivastava R. Morphometric Study of Proximal End of Humerus in North Indian Population. *J Med Sci Clin Res.* 2020;8(8):102–6.
- Strandring S, Borley NR, Collins P, Crossman AR, Gatzoulis MA, Healy JC. The Anatomical Basis of Clinical practice. In: and others, editor. *Gray's Anatomy*. London: Churchill Livingstone Elsevier; 2008.
- Kantha BML, Kulkarni R. Estimation of total length of humerus from its fragments in south indian population. *Int J Anat Res.* 2014;2(1):213–20.
- Jagiasi JD, Valavi AS, Ubale TV, Sahu D. Humeral head and glenoid dimensions in the Indian population: a cadaveric study. *Int J Anat Res.* 2018;6(4):5760–64.
- Adijat AO, Roche S, Sivarasu S. An interpopulation comparison of 3-dimensional morphometric measurements of the proximal humerus. *JSES Int.* 2020;4(3):453–63.
- Singh KA, Shankar V, Mohanty SP. Reconstruction of Proximal Humerus Using Custom Made Acrylic Prosthesis in Malignant Bone Tumors. *J Orthop Case Rep.* 2016;6(5):65–8.
- White TD, Folkens PA. *The Human Bone Manual*. 1st ed. New York (NY): Elsevier Academic Press; 2005. p. 52–4.
- Desai SD, Shaikh HS. A Morphometric Study of Humerus Segments. *J Pharm Sci Res.* 2012;4(10):1943–5.
- Somesh MS, Prabhu LV, Shilpa K, Pai MM, Krishnamurthy A, Murlimanju BV. Morphometric study of the humerus segments in Indian population. *Int J Morphol.* 2011;29(4):1174–80.
- Salles AD, Carvalho CRF, Silva DM, Santana LA. Reconstruction of humeral length from measurements of its proximal and distal fragments. *Braz J Morphol Sci.* 2009;26(2):55–61.
- Niraj P, Dangol P, Ranjit N. Measurement of length and weight on non-articulated adult humerus in Nepalese corpses. *J Kathmandu Med Coll.* 2014;2(1):25–7.
- Akman SD, Karakas P, Bozkir MG. The Morphometric Measurements of Humerus Segments. *Turk J Med Sci.* 2006;36:81–5.
- Papaloucas M, Papaloucas C, Tripolitsioti A, Stergioulas A. The asymmetry in length between right and left humerus in humans. *Pak J Biol Sci.* 2008;11(21):2509–12.
- Atamtürk D, Akçal MA, Duyar I, Mas N. Sex estimation from the radiographic measurements of the Humerus. *Eurasian J Anthropol.* 2010;1(2):99–108.
- Chatterjee M, Sinha I, Poddar R, Ghosal AK. Humeral morphometrics: A study in eastern Indian population. *Int J Anat Res.* 2017;5(4):4454–9.
- Dutta S. A Morphometric Study to Find Correlations among Various Dimensions of Proximal End of Humerus of Telugu Population. *Indian J Forensic Med.* 2020;14(4):531–7.
- Kabakci ADA, Buyukmumcu M, Yilmaz MT, Cicekcibasi AE, Akın D, Cihan E. Estudio osteométrico del húmero. *Int J Morphol.* 2017;35(1):219–26.
- Ashutosh A, Kate DR, Chandanwale A, Bahetee BH, Babhulkar A. Morphometric analysis and surgical anatomy of proximal humerus. *Int J Anat Res.* 2017;5(3):4056–62.
- Sahu D, Joshi M, Rathod V, Nathani P, Valavi AS, Jagiasi JD. Geometric analysis of the humeral head and glenoid in the Indian population and its clinical significance. *JSES Int.* 2020;4(4):992–1001.
- Lokanadham S, Khaleel N, Raj PA. Morphometric analysis of humerus bone in Indian population. *Sch J App Med Sci.* 2013;1(4):288–90.

Author biography

Shaikh Shamama Farheen, Assistant Professor  <https://orcid.org/0009-0009-0707-7282>

G Ajit Shroff, Professor

Sadaf Tanveer Khan, Assistant Professor

Cite this article: Farheen SS, Shroff GA, Khan ST. Morpho-metrical analysis of upper humerus- A study from Central Maharashtra. *Indian J Clin Anat Physiol* 2023;10(2):119-123.