Original Article

A Morphometric Analysis of the Right-sided Human Humerus's Shaft and Nutrient Foramen

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Abstract

Background: *The term 'morphometry' describes the quantitative analysis of form, which includes size and shape. Additionally, it is employed in describing the shapes of various objects and in precisely locating specific locations of organs. Forensic experts and anatomists both appreciate knowing the average values of humerus segments since it aids the investigator in determining the identity of the skeleton. The nutrient foramen (NF) is important to bone formation and nutrition.* ***Materials and Methods:*** *This descriptive type of study was conducted in the Department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet from January to December 2021 with ethical clearance from respective IERB. Two hundred (200) normal adult right humerus were collected for the study purpose. Samples were collected according to the inclusion and exclusion criteria. Study variables were maximum humeral length (cm), the circumference of the middle shaft of the humerus (mm) and the number and location of the nutrient foramen. To explore the morphometry of the humerus, measurement was evaluated by using sliding vernier calipers, measuring tape, graph paper, cardboard and measuring scales.* ***Results:*** *Maximum humeral length was 30.33±2.11 cm and circumference of the middle shaft of the humerus was 0.72±0.05 mm. In this study 86% of humerus had single nutrient foramen and 14% had double nutrient foramen. Among them 88% of nutrient foramen belonged to Zone II, 7% to Zone I and 5% to Zone III.* ***Conclusion:*** *The study provides morphometric data of Right-sided Human Humerus's Shaft and Nutrient Foramen, which will be helpful to place the various implants in the reconstructive surgery of humerus fractures and helps the anthropologists & forensic experts in identifying unknown body parts of bodies.*

Keywords: Morphometry, Shaft of human femur, Nutrient foramen.
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Introduction

To determine bone length from skeletal remains and unidentified body parts, anthropometric techniques have been widely applied for more than a century[1]. It plays a significant role in the identification of missing people in medical and legal investigations[2]. According to Celbis, upper limb bones like the humerus, radius and ulna can be used to estimate living stature in the lack of lower limb bones to determine the height[3]. The complete length of long bones may not always be available; instead, just segments of the bones may, as per Wright's investigations in the case of humerus segments[4].

Mullar was the first to recognize the bone length from incomplete long bones. She used the edges of the articular surfaces and significant places of muscle attachment to establish five segments for the humerus[2]. Knowing these stated segment dimensions is essential for calculating the humerus assessment[5]. One of the body's strongest long bones, the humerus, is likely to be observed in a forensic investigation even in a fragmented state[6]. Knowing the blood supply of the humerus plays an important role in the healing of fractures and many surgical procedures. The nutritive, periosteal, metaphyseal and epiphyseal arteries deliver blood to long bones[7]. The nutritious foramen is an entrance in the nutrient canal that leads the nutrient artery and the peripheral nerves to the bones. The nutrient artery's entry point is almost always constant and faces away from the growth end. This foramen is situated in the middle third of the humerus shaft at the anteromedial surface[8]. The nutrient artery, a branch of the brachial artery, serves as the point of entry for the nutrient artery[9]. Knowledge of the nutrient foramen aids in protecting them during any operative procedure on the humeral shaft.

It's necessary to have a thorough grasp of the long bones' morphometry and blood supply. The aim of

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this present study was to determine the morphometric study of the shaft of the humerus and determine the number as well as the location of nutrient foramen in the cadaveric body.

Materials and Methods

It was a descriptive study conducted over a period of one (01) year from January to December 2021. Dry fully ossified two hundred (200) human right humeri were collected from the department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet, fulfilling the inclusion criteria of the study. Ethical permission for the protocol of the study was obtained from the Ethical Committee of Sylhet MAG Osmani Medical College, Sylhet (Ref: SOMC/2021/64). For this purpose, the normal adult right humerus was collected. Fragmented or distorted humerus was excluded from the study. Congenital malformations, pathological alterations and damaged bones with repaired fractures were also eliminated from this study. An osteometric board, digital slide caliper and flexible ribbon tape were used for measuring the humerus. A purposive sampling technique was used for data collection and a pre-designed data sheet was used to document the data. Maximum humeral length (cm), the circumference of the middle shaft of the humerus (mm), number and location of nutrient foramen were measured and documented. The maximum length of the humerus was measured from the most distal point of the trochlea to the most proximal point of the caput humeri by using the osteometric board. The circumferential length at the middle of the shaft was measured by flexible ribbon tape. The existence of a clearly visible groove leading to the foramen was identified as the nutritional foramina. Their number and location were documented. When the foramen was present in the upper one third of the bone it was considered Zone I. When the foramen was present in the middle one third of the bone it was considered as Zone II and when the foramen was present in the lower one third of the bone it was considered as Zone III.

Photographs were taken during the measurement of the specimens. Data were processed manually and analyzed with the help of SPSS V-22. The data were presented as the mean and standard deviation. Tables and figures were used for data presentation.

Results

In this study, maximum humeral length was 30.33±2.11 cm and circumference of middle shaft of the humerus was 0.72±0.05 mm in 200 humerus (Table-I). Figure-3 shows the number of the nutrient foramen. In this study 86% humerus had single foramen, whereas 14% had double nutrient foramen. Among them 88% nutrient foramen are in Zone II. 7% and 5% were located in Zone I and Zone III respectively (Table-II).

Figure-1: The maximum length of the humerus was measured using an osteometric board.

Figure-2: Measurement of the circumference of middle of the shaft of femur

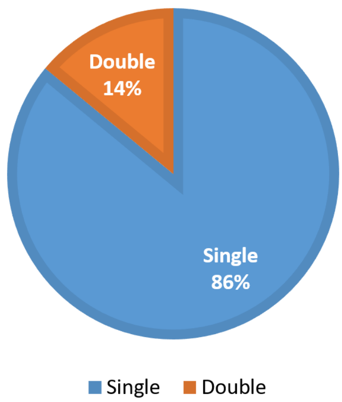

Figure-3: Pie chart shows the number of nutrients foramen.

Table-I: The measurements of maximum humeral length and circumference of middle shaft of the humerus (n=200)

Different segments of humerus	Number	Mean±SD	Range
Maximum humeral length (cm)	200	30.33±2.11	25.70-35
Circumference of middle shaft of the humerus (mm)	200	0.72±0.05	0.60-0.86

Table-II: Position of the nutrient foramen (n=200)

Position of nutrient foramen	Frequency (n)	Percentage (%)
Zone I	14	7.0
Zone II	176	88.0
Zone III	10	5.0

Discussion

Forensic and anatomical research depends heavily on knowing the mean values of humerus segments since it aids the investigator in determining the skeleton's identity. Additionally, these data provide evidence for a population defining characteristics for archaeological materials[1].

The mean value of the maximum humerus length (MHL) was 30.33±2.11 cm in the present study. Similar findings were reported in the studies conducted on the Indian population, the Brazilian population and the Turkish population[10-12]. The maximum humerus length, from an Indian study, was 29.2±22.9 cm[13]. Other studies demonstrated that the mean value of the maximum humerus length was 30.9±20.6 cm and 37.4±2.44 cm[14,15]. According to Kumari, et al.[7] the maximum length of the humerus on the right side was measured to be 29.0.17±18.67 cm.

The mean value of circumference of middle shaft of the humerus was 0.72±0.05 mm in our study. The findings of the study are in well agreement with the findings of the other research works[7,10,16]. Chaudhary, et al.[16] reported the mean value of the circumference of the middle shaft of the humerus was 0.58±0.07 mm. It serves as the humerus' primary blood supply and is crucial for the fetus's rapid growth as well as the early stages of ossification. Understanding the location of the nutrient foramen is crucial during surgical procedures to maintain proper blood circulation[8]. A fracture of the humeral shaft or surgical treatment for a fracture may injure the nutritive artery, resulting in a nonunion or delayed union of the humerus. In the present study, we found single nutrient foramen in 86% of the dry right humerus. Similar finding was observed in Southern Brazil population (88.5%) and Uttar Pradesh of India (90%)[17]. Chaudhary, et al.[16] reported 83.3% single nutrient foramen in their study. Rajeeb, et al.[18] reported 83.5% of single nutrient foramen in the Nepalese population. A study conducted by Pankaj, et al.[19] on North Indian population and observed almost similar findings (80.86%).

The Majority (88%) of nutrient foramina were found in the middle one-third (zone II) of the humerus. Our results align with those of other studies. A study in Bihar, India obtained 85.36% nutrient foramen in right middle 1/3rd and 87.80% in the left middle 1/3rd of the humerus[7]. Chaudhary, et al. (88.13%), Rajeev, et al. (86.66%), Mansur, et al. (94.84%) in the Nepalese population and Khan, et al. (96.2%) in the Pakistani population reported similar results regarding nutrient foramina[16,18,20,21].

Conclusion

The study provides morphometric data of Right-sided Human Humerus's Shaft and Nutrient Foramen, which will be helpful to place the various implants in the reconstructive surgery of humerus fractures. Most of the nutrient foramen were in zone II (88%) followed by 7% were in zone I and 5% were in zone III in this study population. Knowledge about the location of the nutrient foramina is important because of the increased chances of rupture to the nutrient artery during open or closed procedures.

Conflict of interest

The authors declared that they have no conflict of interest.

References

1. Akman ŞD, Karakaş P, Bozkir MG. The morphometric measurements of humerus segments. Turk J Med Sci. 2006; 36 (2): 81-5.
2. Wright LE, Vásquez MA. Estimating the length of incomplete long bones: forensic standards from Guatemala. Am J Phys Anthropol. 2003; 120 (3): 233-51. doi: 10.1002/ajpa.10119.
3. Celbis O, Agritmis H. Estimation of stature and determination of sex from radial and ulnar bone lengths in a Turkish corpse sample. Forensic Sci Int. 2006; 158 (2-3): 135-9. doi: 10.1016/ j. forsciint.2005.05.016.
4. Nath S, Badkur P. Reconstruction of stature from long bone lengths. Anthropologist. 2002; 4: 109-14. doi: 10.1080/09720073.2002.1189 0736.
5. Muñoz JI, Liñares-Iglesias M, Suárez-Peñaranda JM, Mayo M, Miguéns X, Rodríguez-Calvo MS, et al. Stature estimation from radiographically determined long bone length in a Spanish population sample. J Forensic Sci. 2001; 46 (2): 363-6.

6. Albanese J, Cardoso HFV, Saunders SR. Universal methodology for developing univariate sample-specific sex determination methods: an example using the epicondylar breadth of the humerus. J Archaeol Sci. 2005; 32: 143-52. doi: https://doi.org/10.1016/j.jas.2004.08.003.
7. Kumari N, Subhash A, Sinha RR. Morphometric analysis and clinical significance of humeral condyles in dry bone. Eur J Mol Clin Med. 2020; 7 (10): 3471-3476.
8. Kumar S, Sinha SK, Akhtar MJ, Kumar B, Sinha RR, Kumar A. Morphometric Study of the Nutrient Foramen of the Humerus in the Population of Bihar. Cureus. 2022; 14 (12): e32856.
9. Kizilkanat E, Boyan N, Ozsahin ET, Soames R, Oguz O. Location, number and clinical significance of nutrient foramina in human long bones. Ann Anat. 2007; 189 (1): 87-95. doi: 10.1016/j.aanat.2006.07.004.
10. Salles AD, Carvalho CR, 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.
11. Ashiyani ZA, Solanki S, Mehta CD. The morphometric measurement of segments of humerus. J Res Med Den Sc. 2016; 4 (1): 38-40. doi: 10.5455/jrmds.2016418.
12. Pires LAS, Leite TFO, Fonseca Junior A, Babinski MA, Chagas CAA. The olecranon aperture of the humerus: a meta-analysis with anthropological and clinical discussion. Homo. 2019; 70 (1): 75-84. doi: 10.1127/homo/2019/1025.
13. Desai SD, Shaik HS. A morphometric study of humerus segments. J Pharm Sci Res. 2012; 4 (10): 1943-5.
14. 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.
15. Udhaya K, Sarala Devi KV, Sridhar J. Regression equation for estimation of length of humerus from its segments: A South Indian population study. J Clin Diagn Res. 2011; 5 (4): 783-6.
16. Chaudhary RK, Dhakal A, Sah SK, Parajuli SB, Pokhrel S, Deo SK. Morphometric evaluation of dry humerus bone in a Medical College of Eastern Nepal. Birat J Health Sci. 2019; 4 (2): 729-33. doi: 10.3126/bjhs.v4i2.25455.
17. Pereira GAM, Lopes PTC, Santos AMPV, Silveira FHS. Nutrient foramina in the upper and lower limb long bones: morphometric study in bones of Southern Brazilian adults. Int J Morphol. 2011; 29 (2): 514-20.
18. Rajeev M, Powar BP. A Study of Humerus Bone of Nepalese Origin. J Human Anat. 2018; 3 (2): 1-4. doi: 10.23880/ jhua16000133.
19. Pankaj AK, Verma RK, Rani A, Rani A, Kumar N. Morphometric study of nutrient foramina of humerus in North Indian population. Indian J Clin Anat Physiol. 2017; 4: 169-72.
20. Mansur DI, Manandhar P, Haque MK, Mehta DK, Duwal S, Timalsina B. A Study on Variations of Nutrient Foramen of Humerus with its Clinical Implications. Kathmandu Univ Med J. 2016; 14 (53): 78-83.
21. Khan AS, Shah Z, Inayat Q. Anatomical variations in diaphyseal nutrient foramina of humerus in cadavers from Khyber Pakhtunkhwa, Pakistan. Khyber Med Univ J. 2014; 6 (1): 18-21.

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