Original Article

Morphometric Measurement of Distance of Nutrient Foramen from Proximal, Distal Ends and Circumferential Diameter at the level of Nutrient Foramen in dry adult Humerii

Hafiz Moeen-Ud-Din,[1] Ayesha Afzal,[2] Asma Siddique,[3] Raafeya Rashid,[4] Muhammad Suhail,[5] Shahmurad Mastoi,[6] Uruj Zehra[7]

Abstract

Objective: To analyse the morphometric measurements of different parameters of adult dry humerii bones with reference to its clinical importance in different surgical conditions. Bones were available in the department of Anatomy, King Edward Medical University Lahore Pakistan.

Methods: A cross sectional morphometric study which was done from 1st March 2021 to 30th April 2021 in the department of anatomy by having 60 dry humerii. Bones which were not in good condition or damaged by any means were excluded from study. Different parameters like maximum length of humerus, distance of nutrient foramina from the different ends of humerus and the circumferential diameter of shaft at the level of nutrient foramen were also noted. The number, distance and site of nutrient foramina were noted macroscopically by using a vernier caliper, measuring scale and metallic wire. Ethical clearance was taken from Ethical review board of King Edward medical university.

Results: The number of right sided humerii were 31 and the number of left humerii were 29. The number of nutrient foramen varies in right and left side. On the right side the number of nutrient foramina were more as compared to the left side. Out of total right sided; 9 humerii were having double nutrient foramen and out of total left sided humerii ; the double nutrient foramen was found in only 1. When it compared to this study, the results for total length of humerus between right and left side it showed no significant difference as p-value was 0.311. But when it compared to the diameter between the two groups it showed the significant difference as p-value is < 0.05.

Conclusion: It is concluded that variations in the morphometry of humerus was present in current study. Such as humerus can have more than one nutrient foramen. Single nutrient foramen is mostly seen in both sides of humerii. Although there was no difference seen in the size and location of foramina and no statistical difference was found between maximum length of right and left humerii. But this study will add further knowledge of humerus into literature regarding variations in its morphology present in local population. This knowledge will also help clinicians during any type of reconstructive bone surgery.

Keywords: Maximum length of humerus (MLH), millimetres (mm), Mean deviation (MD) and standard deviation (SD) vascularized fibular graft (VFG).

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Introduction

Bones have profound forensic value.[1] In case of natural calamities where only bony remains are available,[2] their morphometric analysis could provide a lot of information of the person to which they belong; especially the bones of the limbs. If someone found only some parts of the long bones one can still use it for morphometric analysis.[3] If someone only found bones like femur, tibia and fibula, scientist can still understand the physical nature of human body very well.[4,5] But in cases, where there were no bones of the lower limb present and only bones of the upper limb like humerus, radius and ulna scientist can still understand about the physical nature of human body.[6,7]

Humerus is one of the important long bones of upper

1. Hafiz Moeen-Ud-Din
2. Ayesha Afzal
3. Asma Siddique
4. Raafeya Rashid
5. Muhammad Suhail
6. Shahmurad Mastoi
7. Uruj Zehra

1-7: Department of Anatomy, King Edward Medical University/ Mayo Hospital, Lahore.

Correspondence:
Dr. Hafiz Moeen-ud-Din, *Associate Professor of Anatomy King Edward Medical University. Email: moeendr81@yahoo.com*

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limb with a lot of surgical importance. It has a nutrient foramen in its shaft through which nutrient artery passes to supply it.[8] Nutrient artery gives diaphyseal and other branches in medullary cavity to supply haversian system and other parts of bone. There is usually a single nutrient foramen on the medial surface of shaft of humerus.[9] But with growth, number and site may change.[10] Morphometric differences in different parts of bones in individuals belonging to different geographical areas and races have been reported.[11,12]

In various surgeries involving bones, the surgeon prefers to secure the nutrient artery of respective bone[13,14] to avoid necrosis and death of bony tissue later[15,16]. Yet there is insufficient data available for local population regarding site and number of nutrient foramina, and morphometric measurements of humeral shaft. As the said information is of clinical significance in both corrective and reconstructive surgeries.[17,18] Hence the current study was planned to gather this base line information from dry adult humerii available in KEMU. So, that in the different aspects of medical sciences we can interpret the findings of this study in order to learn new things especially for anatomists, forensic sciences.

Materials & Methods

A cross sectional morphometric bone study. It was conducted from 1st March 2021 to 30th April 2021 on dry humerus bones of unknown sex (n= 60: 29 right and 31 left side) available in the dissection hall of Department of Anatomy of KEMU. Ethical clearance was taken from Ethical Review board of King Edward Medical University. The data was analyzed by using Statistical Package for the Social Sciences (SPSS) version 23. Vernier caliper, osteometric board, measuring tape and fine metallic wire were used for different measurements as under.

Figure 1: *Measuring total length of humerus, proximal and distal distance of nutrient foramen.*

The following segments of the humerus were studied for morphometric analysis. All the measurements were obtained in millimetres (mm). The measurement of the maximum length of humerus (MLH) was done by using an Otseometric board as shown in **(Figure-1)**, and the different segments of humerus were measured by using Vernier calliper (precision=0.1cm) were calcu-lated as shown in **(Figure-2)**. Mean deviation (MD) and standard deviation (SD). The following parameters were studied for the present study.

- Maximum length of humerus.
- The mean distance between most distal point of nutrient foramen and most distal point along the edge of medial flange of trochlea.
- The mean distance between the distal end of lesser tubercle and proximal point of nutrient foramen.
- Diameter of shaft at the level of nutrient foramen.

Figure 2: *Measuring cortical thickness of humerus at the level of nutrient foramen.*

Results

The results of the study showed that the number of nutrient foramen varies between right and left humerus. Total dry humerii were 60 in number. The number of right sided humerii were 31 and the number of left humerii were 29. On the right side the number of nutrient foramen were more as compared to the left side. Out of total right side, 9 humerii were having double nutrient foramen and out of total left side humerus the double nutrient foramen was only 1. This showed that on the right side mostly nutrient foramen was more than one and it is due to more nutrient foramina present in the right sided humerus, the nutrient arteries which supplied to the right sided humerus will be more and there will be increased blood supply to the humerus. Although when the results were compared between right and left side, there was no significant difference were present as p-value is 0.013 shows in **(Table-1)**

Comparison of total length of humerii were done between right and left side. It showed no significant difference as p-value was 0.311. But when the comparison

Table 1: *Distribution of humerus shaft evaluated for number and measurements of nutrient foramen*

Side of humerus	Number of nutrient foramen		Total
	Single	Double	
Left	28(46.7)	1(1.7)	29(48.3)
Right	22(36.7)	9(15.0)	31(51.7)
Total	50(83.3)	10(16.7)	60(100.0)

Fisher Exact p-value = 0.013

of the proximal and distal distance of nutrient foramina done in both right and left side. It also showed no significant difference between the two sides as p-value was > 0.05. But the comparison of the diameter between the two sides showed the characteristic difference as p-value is < 0.05 as showed in **(Table-2)**. It showed that the difference in diameter between the two sides at the level of nutrient foramina was significant and it may be due to increased cortical thickness of shaft of humerus at the level of nutrient foramen may be due to increased blood supply.

Table 2: *Comparison of measures for nutrient foramen between left and right humerus*

	Side		T-test	P-value
	Left	Right		
Total length(mm)	314.42±14.03	319.25±19.34	-1.02	0.311
Proximal	148.33±15.83	141.40±23.94	1.17	0.250
Distal	109.75±15.12	119.50±28.71	-1.44	0.159
Diameter	19.32±1.48	20.43±1.44	-2.65	0.011

Discussion

The present study was conducted on sixty adult humerus (31 right and 29 left). The maximum length of humerus in this study was 319.25±19.34mm on the right side and 314.42±14.03mm on the left side. A study conducted by Akman et al[19] observed the maximum length of humerus as 307.1±20.6 mm on right side and 304±18.9mm on left side in Turkish population and these values are comparable with this study. Many studies have been conducted focusing on morphometric measurements of humerus.[20] Then comparison of the proximal and distal distance of nutrient foramina was done in both right and left side. It also showed no significant difference between the two sides as p-value was > 0.05. The reference point was taken for proximal distance of nutrient foramen was lower limit of bicipital groove and distal distance was from lower limit of medial flange of trochlea. Although other parameters have been studied in other populations. One method based on specific landmarks has been applied by Carroll,[21] who measured the distance between the nutrient foramen and the medial epicondyle. However, he reported these in the form of an absolute distance, which could be easily affected by differences in the total length of the humerus.[21] If someone wants to study about transverse location of nutrient foramen, there will be difficulty because there are differences in definition and methodology present. So, keeping in view that there were no standard criteria for location of nutrient foramen is present. In this study nutrient foramen is also located near the medial border which is correlated with previous studies.[22-24] In this data, there is no significant correlation was found between the two sides as p-value was ≥ 0.05.

But when the comparison was done about the diameter of the shaft at the level of nutrient foramen between the two sides, it showed the characteristic difference as p-value is ≤ 0.05 as showed in **(Table-2)**. It showed that the difference in diameter between the two sides at the level of nutrient foramina was significant and it may be due to increased cortical thickness of shaft of humerus at the level of nutrient foramen and may be due to increased blood supply. But there is no literature present in which the diameter of the shaft of humerus at the level of nutrient foramen has been seen. So studies in this regard between different populations needs to be done in order to understand different racial morphometric relation-ship. The knowledge of anatomy of nutrient foramina is also crucial when surgeries are required in cases where the nutrient artery is not impacted or the dissection of the anteromedial humerus is necessary

Our present study showed that out of total humerii, 83.3% of humerii has single nutrient foramen. Then we saw that out of total humerii, 16.7% have double nutrient foramina. During any type of surgery the surgeon should take care in order to preserve the accessory nutrient arteries, which should be protected in case when the main nutrient artery gets damaged. In cases of burns the plastic surgeon should take special measures to identify the nutrient foramen during reconstructive surgeries.[25]

Conclusion

It has been studied that variation about the location and number of nutrient foramina of humerus is present in this study. Single nutrient foramen is most common in both sides of humerii. There is no association between the size and distribution of foramina. No statistical change was found between maximum length of right and left humerii. Therefore, it is recommended that

during any type of orthopedic or plastic surgeries, area of bone around the nutrient artery should be protected. Because if any fracture line passing around the nutrient foramen can lead to poor healing and it further leads to poor prognosis. The surgeries of this region should be done with care in order to avoid damage to main and accessory nutrient artery supplying the long bone.

Conflict of Interest

None

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Authors Contribution

KA: Conceptualization of Project
DUMH: Data Collection
RR: Literature Search
SM: Statistical Analysis
MS: Drafting, Revision
ZU: Writing of Manuscript