e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(6); 811-815

**Original Research Article**

# Determining the Variations of Nutrient Foramen of Humerus with its Clinical Implication: A Morphometric Analysis

**Neha Singh**

**Tutor, Department of Anatomy, Nalanda Medical College, Patna, Bihar, India**

**Received: 05-03-2022 / Revised: 05-04-2022 / Accepted: 11-04-2022**
**Corresponding author: Dr. Neha Singh**
**Conflict of interest: Nil**

**Abstract**

**Aim:** To determine variations of nutrient foramen of humerus with its clinical implication.

**Material & Methods:** The present study consisted of 92 (40 right and 52 left side) dried and cleaned humerus from the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India.

**Results:** It has been observed that total of 122 number of nutrient foramina was found to be present on all humerii in relation to the surfaces.

**Conclusion:** Our study provides details about the nutrient foramina that will benefit clinicians in surgical procedures, orthopedic procedures like bone grafting and in plastic and reconstructive surgery.

**Keywords:** morphometric study, nutrient foramen, humerus



## Introduction

The long bones have four sets arterial system – nutrient artery, epiphyseal, metaphyseal and periosteal arteries. Out of them nutrient artery play an important role during active growth period as well as in healing of fractured bones. [1]

All bones possess foramina for the passes of the nourishing blood-vessels; these are known as the nutrient foramina. In long bones it is present on the shaft and in irregular bones it is found in other locations. These foramina lead to nutrient canals through which nutrient vessels entering the medullary cavity and supply bone marrow & inner 2/3rd of cortex. Their sites of entry and direction are almost constant and away from the dominant growing ends. [2]

Now a days fracture of long bones is increasing in number due to an increase in road traffic accidents, industrial accidents, sports injuries, construction of multistory building and pathological fractures in osteoporotic patients. There are many complications of fracture, nonunion is one of them. [3]

The complications like delayed union or a non-union of the fracture may result when the blood supply is not established well. The medullary arterial system plays an important role in revascularization of the necrosing cortex and the uniting callus of the fracture site. [4] These complications can be minimized by having knowledge on the location of nutrient foramen and the relevant anatomy. With this knowledge the surgeon can prevent damage to the nutrient artery and minimize the complication of a delayed union or a non-union of the fracture. [5]

Our study aims at analyzing the nutrient foramen in dry adult humeri, with regards to the number, location of the nutrient foramen with respect to the surfaces and zones and its distance from the mid-point of the humerus.

## Material & Methods

The present study consisted of 92 (40 right and 52 left side) dried and cleaned humerus from the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India.The bones which were damaged and those which had any pathological abnormalities were excluded.

## Methodology

The side determination was done for every humerus. Each humerus was numbered to avoid confusion and nutrient foramen was observed and studied carefully under proper illumination. The following parameters were noted; a) number of nutrient foramen b) location of the nutrient foramen with respect to the surfaces and the zones, c) direction of entry d) the size of the nutrient foramen e) the length of the humerus and f) the distance of the nutrient foramen from distal ends and from the mid-point of the humerus were analyzed. Determination of the total length of the individual humerus was taken as the distance between the superior aspect of the head and the most distal aspect of the trochlea of each humerii in millimeter.

Further, the humerus bone was divided into three equal zones as Zone 1(upper 1/3rd), Zone 2 (middle 1/3rd) and Zone 3 (lower 1/3rd) which was calculated by using an osteometric board (Figure 1).

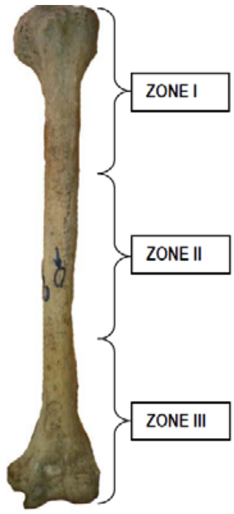


**Figure 1**

The mid-point of the humerus was also calculated by the same instrument. The nutrient foramina were distinguished by the presence of a well-marked groove leading to the foramen and by a well-marked often slightly raised edge of the foramen at the commencement of the canals.

This was reconfirmed using a biconvex lens under proper illumination. In ambiguous cases, we passed a fine needle through the foramen to confirm that it indeed enters the medullary cavity. Measurements of all the found nutrient foramina on each limb were noted and calculated. The nutrient foramen with the largest diameter was considered the dominant foramen and was considered in further statistical data. The diameters of the nutrient foramina were measured using a digital sliding caliper that was accurate to 0.01 mm.

Each bone was divided into 6 possible locations in relation to surfaces of the humerus. They are anteromedial surface (AMS), anterolateral surface (ALS), posterior surface (PS), medial border (MB), lateral border (LB) and anterior border (AB).

We calculated two indices, I1 and I2 to have a more comparative and comprehensive study. I1 {Foramina index} was calculated based on Hughes methodology and formula I1= (DF/TL)*100, where DF is the distance from the distal most end of the bone to the nutrient foramen, and TL is the total length of humerus. Whereas I2 {Landmark index} was calculated based on Due Z's methodology and formula, I2= (DNF/TL)*100, where DNF is the distance nutrient foramen.

Variation in distance of the nutrient foramen from the mid-point of the humerus was also noted. All calculation was performed on WD-220MS-BU model Casio calculator twice, 1) while data recording and 2) while reviewing to eliminate possibilities of errors.

**Results:**

The following observations were found in our study. The mean total length was 305.173 ±20.61 mm (range 255 - 359mm).

Table 2 shows distribution of nutrient foramen in respect to zone of humerii. 90.16% foramina were in zone 2 with the dominant foramina being 92.84.

**Table 1: Shows highest number of humerii (59.78%) in foramina 1.**

| Number of Foramina (n) | Number of Humerii (n) | % |
|---|---|---|
| 1 | 55 | 59.78 |
| 2 | 28 | 30.43 |
| 3 | 5 | 5.43 |
| 0 | 4 | 4.34 |

**Table 2: Showing distribution of nutrient foramen in respect to zone of humerii**

| Zone on the bone | Number of Humerii (n) | % | The Number of dominant foramina (n) | % |
|---|---|---|---|---|
| 1 | 9 | 7.37 | 6 | 5.61 |
| 2 | 110 | 90.16 | 81 | 92.84 |
| 3 | 56 | 4.92 | 4 | 1.55 |

**Discussion:**

From this study it is observed that 59.78% of humeri have single nutrient foramen. A similar finding 60.87% was observed by Mansur DI et al. in Nepalese subjects. [6] Almost similar finding (60%) was observed by Shaheen in Saudi Arabia. [7] Mysorekar et al. (58%) in Indian population and Joshi et al. (63%) among Gujarati population. [8-9]

Halagatti et al. noticed lower (84 %) incidence of nutrient foramina in the middle one-third of the shaft of humeri. The direction of the nutrient foramina was directed horizontally before birth but as the growth proceeds the direction of nutrient foramina were directed away from the growing end of the humeri.' The present study showed that the direction of all the nutrient foramina of humeri was directed towards the lower end of humeri which was supported by many other studies, [10] which revealed that the direction of nutrient foramina was constant and obeys the law of ossification.

Similarly, Kumar et al. reported that the direction of all nutrient foramina present in the humeri were directed away [11] from the growing end of humeri except one which was directed towards the upper end. [12-13]

A study conducted by Ukoha et al. in humerus of Nigerian population found that 100% of the nutrient foramina were located on the middle one-third of the humerus and a similar trend also reported by Kumar et al. (100%) in Indian population which were higher than the present result [14-15].

The 'Span-fold' procedure was derived from cumulative knowledge observed, recorded and assessed during this study. The distribution of location of the nutrient foramina on the surfaces of the humerus bone where it was found most of the dominant foramina were on the anterior median surfaces and medial border and posterior surface, all of which covered by the 3 digits and very small fraction of it lied on the anterolateral surface and none on the lateral border. This method is also based of the mean indexes (I1 and I2) that was calculated during this study, I1 was 56.835±7.802% (range 29.71% - 72.64%) while the I2 had a mean value of 56.299±7.750% (range 29.51% 72.03%). The average hand span is 17.5-21.5 cms. The area between the points of PIP joints of first and third digit as kept in the 'Span-fold' position would give the equivalent to the indexes being in the range of 25% to 65% which is the most probable point of Landmark Index. [16,17]

## Conclusion:

Our study provides details about the nutrient foramina that will benefit clinicians in surgical procedures, orthopedic procedures like bone grafting and in plastic and reconstructive surgery. A majority of the humeri had a single nutrient foramen, though some humeri had more than one nutrient foramen. Both the Foramina Index and the Landmark Index can help clinicians locate the nutrient artery. The 'Span-fold' procedure would make this index useable in the practical field. Fractures passing through the foraminal area may lead to poor prognosis.

## References:

1. Datta A K. The sclerous tissue. In: Principles of General Anatomy. 6th edition. Kolkata: K.P.Basu Publishing Co;2007.75-6.
2. Standring S. Functional anatomy of the musculoskeletal system. Gray's Anatomy. The Anatomical basis of clinical practice. 40th edition. London: Churchill Livingstone Elsevier, 2008;91.
3. Bharathi A, Janaki V, Gouri TLS, Archana. Morphometric variations of nutrient foramen inadult human humerus in Telangana region. Journal of Dental and Medical sciences 2016; 15(4):43-6.
4. Rhinelander FW. The normal microcirculation of diaphyseal cortex and its response to fracture. J Bone Joint Surg Am. 1968;50(4):784 – 800.
5. Carroll SE. A Study of Nutrient Foramina of the Humeral Diaphysis. J Bone Joint Surg Br. 1963; 45:176–81.
6. Hughes H. The factors determining the direction of canal for the nutrient artery in the long bones of mammals and birds. Acta Anatomica. 1952; 15(3): 261-280.
7. Mansur DI, Manandhar P et al. A Study on Variations of Nutrient Foramen of Humerus with its Clinical Implications. Kathmandu University Medical Journal 2016; 79-82.
8. Shaheen SY. Diaphyseal nutrient foramina in human upper and lower limb long bones. A thesis submitted for the partial fulfillment of the requirement for the master degree in anatomy. 2009:20-21.
9. Mysorekar VR. Diaphysial nutrient foramina in human long bones. J Anat. 1967;101(4):813–22.

10. Joshi H, Doshi B, Malukar O. A study of the nutrient foramina of the humeral diaphysis. NJIRM 2011; 2:14-17.
11. Bharathi A, Janaki V, Gouri TLS, et al. Morphometric variations of nutrient foramen in adult human humerus in Telangana region. Journal of Dental and Medical Sciences 2016;15(4):43-6.
12. Hughes H. The factors determining the direction of canal for the nutrient artery in the long bones of mammals and birds. ActaAnat (Basel) 1952;15(3):261-80.
13. Datta AK. The sclerous tissue. In: Principles of General Anatomy. 6th edn. Kolkata: K.P. Basu Publishing Co 2007:75-6.
14. Ukoha UU, Umeasalugo KE, Nzeako HC, Ezejindu DN, Ejimofor OC, Obazie IF. A study of nutrient foramina in long bones of Nigerians. Natl J Med 2013;3(4):304-8.
15. Kumar S, Kathiresan K, Gowda MST, Nagalaxmi. Study of diaphyseal nutrient foramina in human long bones. Anat Karnataka.2012;6(2): 66-70.
16. Xue Z, Ding H, Hu C, Xu H, An Z. An Anatomical Study of the Nutrient Foramina of the Human Humeral Diaphysis. Med Sci Monit. 2016;22: 1637–45
17. Córdoba Guzmán, A. C., & castro Daza E. M. Heyde syndrome as a presentation of acquired Von Willebrand syndrome: what the gastroenterologist should know. Journal of Medical Research and Health Sciences, 2022:5(7), 2072–2082.