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Morphometric Study of Upper End of Humerus and Its Nutrient Foramen: An Osteological Study

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ABSTRACT

Background: The humerus is longest bone of the upper limb. The upper end of the humerus consists of head, anatomical neck, greater and lesser tubercles. Nutrient artery of humerus is a branch of brachial artery. Thus, morphometry of the upper end of humerus will help in reconstruction of bone and a proper surgical planning. Nutrient foramen is an opening into shaft of humerus which gives passage to the blood vessels of medullary cavity. The knowledge of nutrient foramen is important in surgical procedures like bone grafting and more recently in microsurgical vascularized bone transplantation.

Justification: Morphometric study of upper end of humerus will help in identification of unknown bodies and in determining stature of individuals from our population. The study is indispensible for an orthopaedic surgeon, where it helps in reconstruction of bone and a proper planning.

Methods: This present cross sectional, observational study was done from July 2023 to September 2023, in the Postgraduate Department of Anatomy, Govt. Medical College, Srinagar by using 50 dry human humeri taken from bone bank. Inch tape and vernier calipers were used for taking measurements.

Results: In our study average humeral length (HL) was observed to be 30.8±1.78, transverse diameter of humeral head (TDHH) was 3.84±0.35, Vertical diameter of humeral head (VDHH) was 4.0±0.34 and Highest Point of Humeral Head and Greater Tubercle (HHGT) was 4.5±0.33. Single nutrient foramen was present in 88% of humeri. 88% of foramina were situated on the anteromedial surface.

Conclusion: The measurements play an important role in prosthesis manufacturing units, in designing the prosthesis on basis of racial and ethnic variations. This study will help surgeons planning the surgical intervention of the shaft of the humerus, which will possibly reduce the chances of non union or delayed union.

Keywords: Morphometric, Humeral length, Transverse diameter of humeral head, Highest Point of Humeral Head and Greater Tubercle, anteromedial surface.

INTRODUCTION

Nutrient foramen is an opening in the shaft of humerus. It leads to oblique nutrient canal passing through

cortex and ultimately opens into the medullary cavity. The nutrient artery enters into the medullary cavity through nutrient foramen and the canal which is a rich source of blood supply to the medullary cavity and inner two-third of cortex of the humerus[1]. The nutrient blood supply is crucial for any long bones and it should be preserved in order to promote the fracture healing[2]. Moreover, the presence of preserved nutrient blood supply is essential for the survival of the osteocytes in cases of tumor resection, trauma, and congenital pseudoarthrosis[3].

The nutrient artery enters through the nutrient foramen, which is a branch of the brachial artery[4]. It is the main source of blood supply to the humerus and is also important during the active growth period of the fetus and during the early phase of ossification[5]. The nutrient foramen of the humerus is directed toward the elbow. The knowledge of the location of the nutrient foramen is important in operative procedures to preserve circulation[6-8]. The vascular system of bone is closely related to fracture healing and hematogenic osteomyelitis[9]. Detailed knowledge about the blood supply of long bones is important in the development of new transplantation and resection techniques in orthopedics.

AIMS AND OBJECTIVES

- To find out the number and location of the nutrient foramen in relation to different surfaces, and the site of the nutrient foramen in relation to different segments and directions of the nutrient foramen of the humerus.
- To determine the number, location, site, and direction of the nutrient foramen.

MATERIAL AND METHODS

The present observational study was conducted on 50 (25 right and 25 left) dry humeri of unknown sexes obtained from the Bone Bank of Government Medical College, Srinagar. Bones that were damaged and had healed fractures, congenital anomalies, and significant pathological changes were excluded from this study. Based on the above criteria, 10 bones were excluded. Side determination was done for all humeri. The nutrient foramina were distinguished by the presence of a well-marked groove leading to the foramen. All humeri were studied for the number, location, site, and direction of the nutrient foramen. Nutrient foramen was observed with the help of magnifying glass. In case of humeri with multiple nutrient foramina, the foramen that is larger in size is called the dominant foramen, and the other is called the secondary foramen.

1. **Humerus length (HL):** The distance between the highest point of the humeral head and the lowest point of the trochlea.
2. **Transverse diameter of humeral head (TDHH):** The diameter of the humerus head in the antero-posterior direction.
3. **Vertical diameter of humeral head (VDHH):** The diameter of the bone in the lateral-medial direction.
4. **Highest Point of Humeral Head and Greater Tubercle (HHGT):** The distance between the highest point of the humeral head and the highest point of the greater tubercle.
5. Position of nutrient foramen.

The total length of humeri was measured by an osteometric board in centimeters. The distance of nutrient foramen from the most proximal point of the humerus was measured by a vernier caliper in centimeters. All observations were tabulated and statistically analyzed using a Microsoft Excel Spreadsheet (2010) and Statistical Package for Social Sciences (SPSS Ver. 20).

RESULTS

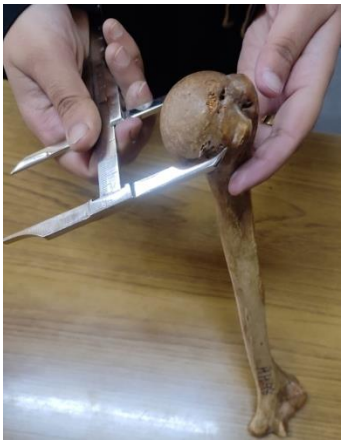
Table 1: Incidence, location, site of nutrient foramen in relation with surface of humerus

		Right Humerus (n=25)		Left Humerus (n=25)		Total (n=50)	
		No.	%	No.	%	No.	%
Incidence of nutrient foramen	Single nutrient foramina	22	88.0	22	88.0	44	88.0
	Double nutrient foramina	2	8.0	1	4.0	3	6.00
	Triple nutrient foramina	0	0.0	0	0.0	0	0.0
	No nutrient foramina	1	4.0	2	8.0	3	6.0
	Total	25	100.0	25	100.0	50	100.0
Location	Anteromedial	21	84.0	23	92.0	44	88.0
	Posterior	1	4.0	1	4.0	2	4.0
	Anterolateral	3	12.0	1	4.0	4	8.0
	Total	25	100.0	25	100.0	50	100.0
Site	Proximal 1/3	0	0.0	1	4.0	1	2.0
	Middle 1/3	22	88.0	23	92.0	43	86
	Distal 1/3	3	12.0	1	4.0	6	12.0
	Total	25	100.0	25	100.0	50	100.0

Single nutrient foramen was observed in 44 (88%) of the total humerus including 22 (88%) each on right and left humerus. Double nutrient foramen were observed in 2 (8%) of the right humerus, 1 (4%) of the left humerus, and three (6%) of the total humerus. Three nutrient foramen were not observed in our study while nutrient foramen was absent in 3 (6%) of the total humerus including 2 (8%) and 1 (4%) on left and right humerus respectively. It has been observed that a total of 50 nutrient foramina were observed and they were present on anteromedial, anterolateral, and posterior surfaces. Out of 50 nutrient foramina, 44 (88%) were present on the anteromedial surface, 21 on the right side, and 23% on the left side. Of the nutrient foramen, 4 (8%) were found on the anterolateral surface, out of which 3 (12%) were on the right and 1 (4%) on the left side. The posterior surface had 2 (4%) of the nutrient foramen, out of which 1 (4%) each were on the right and left side. Out of a total of 50 nutrient foramen, the maximum number was observed in the middle one-third of the shaft 43 (86%), followed by the distal third 6 (12%). Only 1 (2%) nutrient foramen was found on the proximal one-third of the shaft.

Table 2:

Parameter	Average (in cm)
HL	30.8 ±1.78
TDHH	3.84±0.35
VDHH	4.0±0.34
HHGT	4.5±0.33



TDHH **VDHH** **HHGT**

DISCUSSION

In our study average humerus length was observed to be 30.8±1.78, Transverse diameter of humeral head was 3.84±0.35, Vertical diameter of humeral head was 4.0±0.34 and Highest Point of Humeral Head and Greater Tubercle was 4.5±0.33. The similar results were observed by Kabakei A et al.

The present study showed that single nutrient foramen was present in 44 (88%) of humeri. A similar finding was seen in studies by Laing PG (93%)[10] and Bhatnagar S et al. (90%)[11]. Joshi DH et al.[12] and Arfan NK et al.[13] reported single nutrient foramen only in 63% and 60.40% of humerus, respectively. The present study showed that the prevalence of double nutrient foramen was found in (6% (n=3) of humeri, which was very similar to the study done by Laing PG (7%)[10] and Bhatnagar S et al. (7.14%)[11]. Joshi et al.[12] found a higher incidence of a double nutrient foramen in 33% of humeri. Almost all authors observed the presence of triple nutrient foramina in humeri[12,14,15]. The present study observed that triple nutrient foramen was found in none of humeri, which was very close to studies done by Halagatti MS, Rangasubhe P (2%)[15] and Bhatnagar S et al. (1.43%)[11]. In this study, it has been observed that 6% (n=3) of humeri did not have nutrient foramen, which was very similar to the study done by Ramya Sree et al.[16], who reported that in such cases, 3.67% of humeri are supplied by periosteal arteries[17].

In the present study, 88% of foramina were situated on the anteromedial surface, which was in accordance with the findings of Chandrasekaran S et al. (89.92%)[18] and Mansur DI et al. (88.86%)[19]. In contrast to this, a study done in Pakistan by Khan AS et al.[20] reported a higher incidence (96%) of nutrient foramina situated on the anteromedial surface. In our study, 86% of nutrient foramina were located in the middle one-third of humeri followed by distal one-third in 12%. Only 1 nutrient foramina was found on the proximal one-third of the humerus.

CONCLUSION

The measurements play an important role in prosthesis manufacturing units, in designing the prosthesis on basis of racial and ethnic variations. This study will also help surgeons planning the surgical intervention of the shaft of the humerus, which will possibly reduce the chances of non-union or delayed union.

REFERENCE

1. Krishna Garg. BD Chaurasia's Hand Book of General Anatomy. Blood supply of bones. 4th ed. 2011. CBS Publishers and Distributors Pvt. Ltd:43-44.

2. Longia GS, Ajmani ML, Saxena SK, Thomas RJ. Study of diaphyseal nutrient foramina in human long bones. Acta Anat. 1980;107:399-406.
3. Sendemir E, Cimen A. Nutrient foramina in the shafts of lower limb long bones: situation and number. Surg Radiol Anat. 1991; 13:105-8.
4. 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;189:87-95. 10.1016/j.aanat.2006.07.004
5. Henderson RG. The position of the nutrient foramen in the growing tibia and femur of the rat. J Anat. 1978, 125: 593-9.
6. Mysorekar VR. Diaphysial nutrient foramina in human long bones. J Anat. 1967, 101:813-22.
7. Bharathi A, Janaki V, Gouri TLS, Archana. Morphometric variations of nutrient foramen in adult human humerus in Telangana region. IOSR J Dent Med Sci. 2016;15:43-6.
8. Taylor GI. Fibular transplantation. Microsurgical Composite Tissue Transplantation. Serafin D, Bunke HJ (ed): Mosby, London, UK; 1979;418-23.
9. Yaseen S, Nitya W. Morphological and topographical study of nutrient foramina in adult humerii. Int J Innov Res Dev. 2014;3:7-10.
10. Laing PG. The arterial supply of the adult humerus. J Bone Joint Surg Am. 1956 Oct; 38-A(5): 1105-16.
11. Bhatnagar S, Deshwal AK, Tripathi A. Nutrient foramina in the upper and lower limb long bones: a morphometric study in bones of western Uttar Pardesh. Int J Sci Res. 2014;3:301–303.
12. Joshi DH, Doshi DB, Malukar DO. A study of the nutrient foramina of the humeral diaphysis. Natl J Integr Res Med. 2011;2:14–17.
13. Arfan NK, Suresh NM, Suma MP. A morphometric study on variations of nutrient foramen of humerus with its clinical implication. Indian J Clin Anat Physiol. 2022;9:29–34.
14. Carroll SE. A study of the nutrient foramina of the humeral diaphysis. J Bone Joint Surg Br. 1963;45-B:176–181.
15. Halagatti MS, Rangasubhe P. A study of nutrient foramina in dry adult humeri of South Indian subjects. Natl J Clin Anat. 2012;1:76–80.
16. Ramya Sree A, Udaya Kumar P, Kalpana T, Vinayaka Naik I. Morphometric and morphological study of the nutrient foramina in dry human humerus bones of Telangana region. Int J Anat Res. 2019, 7:6302-6.
17. Xinaris C, Benedetti V, Rizzo P, et al. In vivo maturation of functional renal organoids formed from embryonic cell suspensions. J Am Soc Nephrol. 2012, 23:1857-68.
18. Chandrasekaran S, Shanthi KC. A study on the nutrient foramina of adult humerii. J Clin Diagn Res. 2013;7:975–77.
19. Mansur DI, Manadhar 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, 53:78-83.
20. Khan AS, Shah Z, Qaiser I: Anatomical variations in diaphyseal nutrient foramina of humerus in cadavers from Khyber Pakhtunkhwa, Pakistan. Khyber Med Univ J. 2014, 6:18-21.