Original Research Article

A study of the topographic anatomy and morphology of the nutrient foramina in human adult upper limb long bones from East Indian populations

Md. Zahid Hussain[1], Sigraf Tarannum[2], Soni Kumari[3*], Rashmi Prasad[4]

[1]Tutor, Anatomy, Nalanda Medical college & Hospital(NMCH), Patna, Bihar, India
[2]Tutor, Anatomy, Nalanda Medical college & Hospital(NMCH), Patna, Bihar, India
[3]Tutor, Anatomy, Patna Medical college & Hospital(PMCH), Patna, Bihar, India
[4]Professor & Head of department, Anatomy, Nalanda Medical college & Hospital(NMCH), Patna, Bihar, India

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Abstract

Background: The nutrient artery is a long bone's primary source of blood supply, and it is particularly necessary during the embryonic and foetal stages of development, as well as during the early stages of ossification.**Aim:** The aim of the present study was to study the topographic anatomy and morphology of the nutrient foramina in human adult upper limb long bones. **Materials and Method:** This prospective observational study was conducted in the department of Anatomy, Nalanda Medical College and Hospital (NMCH) and Patna Medical College and Hospital (PMCH) Patna, Bihar, India. The study was conducted over a period of 3 years and 6 months from January 2018 to June 2021. The scientific and ethics committee of the institution gave its approval to the project. The study was performed on 120 upper limb long bones which include 40 humeri, 40 radii, 40 ulnae. **Results**: The number and location of nutrient foramen in distinct upper limb bones were discovered to differ. Double and triple foramina were found in the humerus. At the maximum, double foramina were seen in the radius and ulna. Radius was found to be absent of nutrient foramen.**Conclusion:** Most studies agree that the incidence and distribution of nutrient foramina in upper limb long bones are similar. The knowledge about these foramina is useful in the surgical procedure to preserve the circulation. The findings are important for the clinicians who are involved in bone graft surgical procedures and are enlightening to the clinical anatomists and morphologists.

Keywords: Nutrient foramina, Humerus, Radius, Ulna.

Introduction

Nutrient foramina in human limb long bones are said to be directed towards the elbow and away from the knee. This is due to, one end of limb bone growing faster than other[1]. In the radius, there is one nutrient diaphysial foramen located on the anterior surface of the bone, which is directed proximally towards the elbow. In the ulna, the nutrient foramen admits a branch of the anterior interosseous artery.A rough, variable prominence descending from the interosseous to the anterior border crosses it obliquely on the distal side. In the humerus, the nutrient foramen is directed from a little below the midpoint of the shaft and opens close to the medial border, usually transmitting the median nerve and brachial artery, but sometimes enclosing only the nerve plus the ulnar artery (in the case of high division of the brachial artery)[2]. The nutrient artery enters individual bones obliquely through a nutrient foramen [3] reported that the position of the nutrient foramina in mammalian bones are variable and may alter during the growth. The knowledge of nutrient foramina in bone is helpful in surgical procedures like microvascular bone transfer to maintain the blood circulating. In children, males have a longer average tibial length than females[3]. The nutrient foramen is located in the middle of the anteromedial surface, and the nutrient canal is directed opposite to the growing end of the humerus. In both the radius and ulna, the nutrient foramen is located in the upper part of the bone and leads into the nutrient canal, which is directed upwards.The nutrient artery is a branch of the anteriosseous artery[4]. It is also useful in various clinical implications such as bone grafting or radiologic evaluation for the fracture line[5]. The purpose of this study was to examine the topographic anatomy and morphology of the nutrient foramina in human adult upper limb long bones from East Indian populations

**Correspondence*
Dr. Soni Kumari
Tutor, Anatomy, Patna Medical college & Hospital(PMCH), Patna, Bihar, India.
E-mail: dr.soniya1980@gmail.com

Material and Methods

This prospective observational study was conducted in the department of Anatomy, Nalanda Medical College and Hospital (NMCH) and Patna Medical College and Hospital (PMCH), Patna, Bihar, India. The study was conducted over a period of 3 years and 6 months from January 2018 to June 2021. The scientific and ethics committee of the institution gave its approval to the project. The study included 120 upper limb cadaveric long bones which include 40 humeri (20 Right side and 20 left side), 40 radii (20 right side and 20 left side), 40 ulnae (20 right side and 20 left side). The bones were obtained from osteology section of department of anatomy. The number, location, and direction of nutrient foramina in all of the bones were examined macroscopically. The foramina were examined using a magnifying lens.

Results

In this study, 70% of the humeri (28 out of 40) had a single nutrient foramen. The double foramen was observed in 25% (10 out of 40) of the cases and triple foramen was found in 5 % cases (2 out of 40). Table 1 shows the morphological and topographical distribution of the humeral foramina.

Table 1: Morphological and topographical distribution of the nutrient foramina in the humerus (n= 40)

No. of foramina	Right side	Left side	Total	%	MB	MS	LB	PS
1	16	12	28	70	26			2
2	4	6	10	25	4	8	4	4
3	-	2	2	5	6			
Total	20	20	40	100	36	8	4	6

MB-medial border; MS-medial surface; LB-lateral border; PS-posterior surface

In case of radius 80% (32 out of 40) had single foramen, 15% (6 out of 40) had double foramen and in 5% (2 out of 40) cases the foramen was absent. The morphological and topographical distribution of the radius foramina is depicted in table 2.

Table 2: Morphological and topographical distribution of the nutrient foramina in the radius (n= 40)

No. of foramina	Right Side	Left Side	Total	%	AB	AS	IB
1	18	14	32	80%	8	14	10
2	2	4	6	15%	7		5
Absent		2	2	5%			
Total	20	20	40	100%	15	14	15

AB-Anterior Border; AS-Anterior Surface; IB-interosseous border

In case of ulna 95% (38 out of 40) had single foramen, 5% (2 out of 40) had double foramen. Table 3 shows the morphological and topographical distribution of the foramina of the ulna.

Table 3: Morphological and topographical distribution of the nutrient foramina in the ulna (n=40)

No. of foramina	Right side	Left side	Total	%	AB	AS	IB
Single	20	18	38	95%	16	20	2
Double		2	2	5%	2	2	
Total	20	20	40	100%	18	22	2

AB-Anterior border; AS-Anterior surface ; IB-Interosseous border

Discussion

The morphological knowledge of nutrient foramina is important for orthopaedic surgeons doing an open reduction of a fracture to avoid injuring the nutrient artery and reducing the likelihood of the fracture not healing properly[6]. It is well known fact that one of the causes of delayed union or non-union of fracture is lack of arterial supply.

In the present study, a single nutrient foramen of the humeri has a higher percentage 70% compared to that of double (25%) and triple foramina (5%) respectively. Many studies reported a percentage approximately similar to that of present result[7-9]. The other studies reported the higher percentage of a single nutrient foramen (80-88%)[10-12]. The range of occurrence of double foramina varied from 13% to 42%[9]. [1] According to kizilkanat, [12] the percentage of occurrence of triple foramina in the humeri did not exceed 1-7%. The latter observations were in accordance to those reported in the present study. Kizilkanat.[11] on the other hand, found four nutrient foramina in 1% of the humeri examined. Such number was not observed in the present study. Furthermore, some authors [7,13, 10,12]. documented the absence of nutrient foramina in some humeri, stating that in such cases, the periosteal vessels were entirely responsible for the bone's blood supply.The nutrient foramina were seen along the whole middle third of the humerus in 95% of the cases (38 out of 40). Previous studies have indicated the position of the nutrition foramina within the middle part of the bone, which is consistent with the current findings[8-12].In the present study, 80% (32 out of 40) radii had single foramen. In most of the previous studies 100% radii have single foramen observed by Longia et al,[10] In more than 90% of cases, Kizilkanat et al [12] and Shulman, [14] found a single foramen. In the present study 15% (6 out of 40) had double foramen. Longia et al, [10] Shulman, [14] also reported the same findings. Forriol campos et al [9] and kizilkanat et al [12] has reported the double foramen in 0.63% cases. In the present study in 5% (2 out of 40) cases the foramen was absent.In the present study 95% ulnae (38 out of 40) had single foramen. Double nutrient foramen were observed in rest of the ulnae examined. Other authors observed a single nutrient foramen in more than 91% of ulnae, with the exception of Nagel (1993), who found a single nutrient foramen in all specimens studied[9,10,12,14]. Furthermore, Longia et al [10] observed three nutrient foramina in 1% of ulnae examined while Shulman [14] and reported the absence of nutrient foramina in 0.6% and 1.1% of ulnae respectively. Such findings were not found in present study. Such findings were not found in present study.

Conclusion

Most studies agree that the incidence and distribution of nutrient foramina in upper limb long bones are similar. The knowledge about these foramina is useful in the surgical procedure to preserve the circulation. The findings are important for the clinicians who are involved in bone graft surgical procedures and are enlightening to the clinical anatomists and morphologists.

References

1. Keith L Moore, Arthur F, Dalley et al. Moore Clinical oriented anatomy, seventh edition, 2014, 146-147p.
2. Standring S. Gray's anatomy, The Anatomical basis of clinical practice, 41th Ed, 2016, 806- 842p.
3. Snell's clinical anatomy by regions, south asian edition by Vandana Mehta, R K Suri, 2018; 1:1405
4. Nafis Ahmad Faruqi – Human osteology, A Clinical orientation, 3thedition, 2017, 17-35p
5. Prashanth KU, Murlimanju BV, Prabhu LV, Kumar CG, Pai MM. Morphological and topographical anatomy of nutrient foramina in the lower limb long bones and its clinical importance. Australasian medical journal. 2011; 4(10):530-537.
6. Joshi H, Doshi B, Malukar O. A study of the nutrient foramina of the humeral diaphysis. NJIRM. 2011; 2:14-17.
7. Lutken.Investigation into the position of the nutrient foramina and the direction of the vessel canals in the shafts of the humerus and femur in Man. Acta znat . 1950; 9(1-2):57- 68.
8. Carroll SE. A study of the nutrient foramina of the humeral diaphysis. J Bone Jt Surg B. 1963; 45:176-181.
9. Forriol Campos F, Gomez Pellico l, Gianonatti Alias M, Fernandez-Valencia R. A study of the nutrient foramina in human long bones. Surg Radiol Anat. 1987; 9(3):251-255.
10. Longia GS, Ajmani ML, Saxena SK, Thomas RJ. Study of diaphysial nutrient foramen in human long bone. Acta anat (basel). 1980; 107(4):399-406.
11. Nagel A. The clinical significance of the nutrient artery. Orthop. 1993; 22(5):557-61.
12. 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.
13. Patake SM. Diaphysial nutrient foramina in human metacarpals and metatarsals. J anat. 1977;124(pt 2):299-304.
14. Shulman SS. Observation of the nutrient foramina of the human radius and ulna. Anat Rec. 1959; 134:685-97.

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