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Original Research Article

A STUDY ON THE NUTRIENT FORAMEN OF HUMERUS

Asharani S K *[1], Ajay Ningaiah [2].

*[1,2] Assistant Professor, Department of Anatomy, Adichunchanagiri Institute of Medical Sciences, B G Nagar, Mandya (district), Karnataka, India.

ABSTRACT

Background: Lack of an adequate vascular supply can significantly delay or prevent fracture healing. Nutrient artery is the major source of blood supply to the long bone and hence plays an important role in fracture healing.

Aim: To determine the number, direction and location of nutrient foramen of humerus.

Materials and Methods: The study was conducted on 120 adult humerii collected from the Department of Anatomy, Adichunchanagiri Institute of medical sciences. Bones were observed for the number, direction and location of nutrient foramen.

Results: In the present study 87% bones have one and 11% have two nutrient foramina respectively. In Majority of the bones studied, the nutrient foramen is located either on the medial border (57%) or on the anteromedial surface (43%). In the rest nutrient foramen is located on lateral border(3%), posterior surface(3%) or anterior border(2%). 87% have the nutrient foramen located in Zone II , 22% at the junction between Zone II and Zone III and 2% in Zone III. The direction of foramen is towards the elbow joint i.e. away from the growing end.

Conclusion: Nutrient artery is the principal source of blood supply to long bones which enters through the nutrient foramen. The anatomical knowledge of nutrient foramen is important for orthopaedic surgeons during surgical procedures on the humerus viz, bone grafting and microsurgical bone transplantation.

KEY WORDS: Nutrient foramen, Nutrient artery, Humerus, Fractures.

Address for Correspondence: Dr. Asharani S K, Assistant Professor, Department of Anatomy, Adichunchanagiri Institute of Medical Sciences, B G Nagar, Nagamangala (taluk), Mandya (district) – 571448, Karnataka, India. Mobile no.: +919480304208 **E-Mail:** ashakshetty@gmail.com

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INTRODUCTION

All bones possess large or small foramina for the entrance of the nourishing blood-vessels; these are known as the nutrient foramina, and are particularly large in the shafts of the larger long bones. These foramina lead to nutrient canals through which vessels entering the bone supply the medullary cavity. Their sites of entry and direction are almost constant and characteristically directed away from the dominant growing ends [1]. In long bones the nutrient foramen is found in the shaft, and in irregular bones it is found in other locations. Long bones are supplied by four sets arterial system – nutrient artery, epiphyseal, metaphyseal and periosteal arteries. Nutrient vessels enter the bone through these foramina and divide into ascending and descending branches in the medullary cavity and supply bone marrow and inner two-thirds of the compact bone [2]. Some bones such as femur and humerus have several nutrient foramina. Before entering the nutrient foramen the nutrient vessels become tortuous so that they will not affect the bone movement [3]. Nutrient arteries

play an important role during active growth period as well as uniting callus in fractured bone [1].

The fractures of long bones are increasing in number due to an increase in road traffic accidents, industrial accidents, sports injuries and pathological fractures in osteoporotic patients. Nonunion of a fractured long bone can be a complication of closed or an open reduction [4]. Nonunion of a fracture of long bone is a state in which all healing processes have come to a halt as diagnosed by clinical and radiological evidence beyond the stipulated time due to various reasons usually requiring a change in the treatment. One of the very important reasons for nonunion is loss of blood supply to the fractured bone. Damage to nutrient vessels, excessive stripping or injury to periosteum and muscle are few causes for loss of blood supply to the fracture site [5].

Humerus is the largest and longest bone of the upper limb. It is supplied by nutrient artery which is a branch of brachial artery. The nutrient artery enters the bone through nutrient foramen located on anteromedial surface a little below its midpoint which is directed downwards, opens close to the medial border [1]. Nutrient artery is the major source of blood supply to the bone and hence plays an important role in fracture healing. Orthopaedic surgical procedures like vascularized bone microsurgery requires the detailed knowledge of the blood supply. In free vascular bone grafting, the blood supply by nutrient artery is extremely important and must be preserved in order to promote fracture healing [6]. The present study was carried out to determine the number, direction and location of nutrient foramen of humerus.

Objective of the present study is to determine the number, direction and location of nutrient foramen of humerus.

MATERIALS AND METHODS

The study was conducted on 120 adult humerii collected from Department of Anatomy, Adichunchanagiri Institute of medical sciences. Damaged bones and pathologically deformed bones were excluded from the study. Length of each humerus bone was measured with the help of osteometric board. Bones were divided into three zones; Zone I – upper 1/3rd, Zone II – Middle 1/3rd and Zone III – lower 1/3rd. With the help of hand lens bones were observed for the number, direction and location of nutrient foramen with respect to the surface and borders.

RESULTS

Among 120 bones studied, 64 were left sided and 56 were right sided.

Table 1: Number of nutrient foramen on humerus.

No. of nutrient foramen	Right		Left		Both (%)
	Number	Percentage	Number	Percentage	Percentage
1	50	89	54	84	87
2	4	7	10	16	11
Absent	2	4	--	--	2

The percentage of the bones having one nutrient foramen is 87% and two foramina are 11%. Among the bones studied there was no dominant foramen in two bones.

Table 2: Location of nutrient foramen on humerus.

Location of nutrient foramen	Right		Left		Both (%)	
	Number	Percentage	Number	Percentage	Number	Percentage
Medial border	32	57	36	56	68	57
Anteromedial surface	18	32	34	53	52	43
Lateral border	4	3	--		4	3
Anterior border	--		2	3	2	2
Posterior surface	--		4	6	4	3

About 57% of the bones have nutrient foramen located on the medial border. Next in the order are Anteromedial surface (43%), Lateral border (3%), Posterior surface (3%) and anterior border (2%).

Table 3: Location of nutrient foramen with respect to the zones of humerus

Zones	Right	Left	Both
Middle 1/3rd (Zone II)	42	62	104
Junction between middle1/3rd and lower 1/3rd	8	18	26
Lower 1/3rd (Zone III)	2	--	2

Majority of the bones i.e. 87% have the nutrient foramen located in the middle 1/3rd, 22% at the junction between middle 1/3rd and lower 1/3rd and 2% in the lower 1/3rd.

Direction of nutrient foramen: It was observed that all the nutrient foramina were directed to

wards the elbow joint i.e. away from the growing end.

DISCUSSION

The blood supply to bones is a very important factor in fracture healing [7]. In spite of optimal treatment, some fractures heal slowly or fail to heal. This indolent fracture healing may be related to the severity of the injury, poor blood supply, age and nutritional status of the patient or other factors [8].

Humerus receives highest vascularity among all the bones of upper limb. It is mainly supplied by a branch of brachial artery and also by the branches of axillary, radial and ulnar artreis [6]. The constancy of the main nutrient artery to humeral diaphysis is remarkable. The danger of damaging this artery is greatest in open reduction of the fracture involving the mid-shaft region of the bone [9].

A study done by Khan AS et al on 75 humerus, 90% of humerii had single nutrient foramen. Among them, 96% were located on the middle 1/3rd of anteromedial surface, 2.67% on the posterior surface and 1.33% on the anterolateral surface [10]. Ukoha UU et al studied 150 humerii and found that 66% of them had a single foramen, 18% had double foramina and 26% had no foramen. In their study all foramina except one were directed away from the growing end [11].

Roul B et al in their study observed that nutrient foramen was found in middle 1/3rd in most of the cases and in lower 1/3rd in few cases [12]. This finding was supported by another study done by Chandrasekaran S and Shanthi K C. The result of the present study also correlates with this. In addition to that the percentage of location of nutrient foramen on the anteromedial surface was 89.92%, on the posterior surface was 8.53% and on the anterolateral surface was 1.55% [7].

According to the study of Yaseen S et al on 100 dry humerii, 79% had 1 foramen, 19% had 2 foramina and only 2% had 3 foramina. In their study 88.5% of foramina were present on the anteromedial surface, 3.5% on anterolateral surface and 11% on the posterior surface. With respect to the zones 89% were located in Zone II and 11% in Zone III. None of them were located in Zone I [6]. In a study of 200 humerii by Joshi H et al 63% had a single nutrient foramen which implies that the major blood supply to humeral shaft will enter at one particular point [13].

In the present study, 87% bones have one nutrient foramen and 11% have two foramina. Majority of the bones have nutrient foramen located mainly on the medial border(57%), then on the anteromedial surface(43%), lateral border(3%), posterior surface(3%) and anterior border(2%). 87% have the nutrient foramen located in the Zone II , 22% in the junction between Zone II and Zone III and 2% in the Zone III.

The anatomical knowledge of nutrient foramen is important for orthopaedic surgeons during operations on the humerus like bone grafting and microsurgical bone transplantation [4]. Precise location of nutrient artery before elective surgery also plays an important role in arterial anastomoses for vascularized grafts [14].

CONCLUSION

It is evident from the study that majority of the humerus bones have single nutrient foramen and they are mainly located on the anteromedial surface specially in the middle 1/3rd. The direction of these foramina is always constant i.e. away from the growing ends. Orthopaedic surgical procedures like vascularized bone microsurgery requires the detailed knowledge about the blood supply of the operating bone. Therefore the anatomical knowledge of nutrient foramen is important for orthopaedic surgeons during operations on the humerus like bone grafting and microsurgical bone transplantation [4].

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Conflicts of Interests: **None**

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