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### **Original Article** Morphometric Study of Nutrient Foramen of Tibia in Population of Bihar

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#### Abstract

**Introduction:** Nutrient foramen of tibia is located in the proximal third of shaft. In most of the cases nutrient foramen located away from the growing end. During growing period 80% of blood supply of bone occurs through nutrient artery. Through knowledge about the nutrient foramen and blood supply of long bone is one of the important features for success of new technique in bone transplantation and resection in orthopaedics.

**Material and Methods:** The present study was conducted on 60 dry tibia (35 right and 25 left sided) of unknown sex from department of Anatomy and department of Forensic Medicine of Indira Gandhi Institute of Medical Sciences, Patna, Bihar and also from Darbhanga Medical College, Laheriasarai, Bihar, India. Studied carefully for the number, position, distance of nutrient foramen from upper and lower end and the foraminal index of tibia.

**Results:** In this study single nutrient foramen was found in 95% of Tibia and double nutrient foramen on in 5%. All the tibia either right or left showed nutrient foramen on the upper one third. All the bones showed the nutrient foramen on the posterior surface. Among the right tibia nutrient foramen were found lateral to the vertical line in 92.29% and medial to vertical line in 5.71%. Foraminal index on the right tibia was 32.48 and on the left side was 32.36.

**Conclusion:** It is important to know clinically about the number, direction and position of nutrient foramen during vascularisd bone grafting to preserve the blood supply of graft. **Keywords:** Nutrient Foramina, Foraminal Index

#### Introduction

Tibia is also called the shin bone or shank bone. It

is largest and strongest bone of the leg present in the medial aspect. Tibia derived its blood supply

from three sources- medullary nutrient, epiphyseal – metaphyseal and periosteal. Functionally the three parts are interrelated systems that allow a reserve that can be called on if one of the divisions is adversely affected by injury or disease [1]. Tibia primarily receive about 80% of blood supply from nutrient arteries during growing period and their absent, vascularisation occurs through periosteal vessels [2]. The nutrient arteries enters the tibia through the nutrient foramen. In most of the cases, nutrient foramen located away from the growing end [3].

Tibia is the most commonly fractured long bone and significantly contributes to the total cost of fracture care worldwide [4]. Fracture of tibia through nutrient canal disrupt the blood flow in the nutrient artery, results in delayed union or non-union of bone. Through knowledge about the nutrient foramen and blood supply of long bone is one of the important features for success of new technique in bone transplant and resection in orthopaedics [5,6]. The statistical data related to the location of nutrient foramina is important for operating surgeons to select the osseous section levels and place the graft without damaging nutrient arteries thus preserving diphyseal vascularisation and also the transplantation consolidation [7]. There are many studied about nutrient foramina morphometry and vascularisation of long bones were reported in different population [8-13].

#### **Material And Methods**

The present study was conducted using 60 normal dry tibia (35 right sided and 25 left sided) of unknown sex and origin obtained from department of Anatomy, department of Forensic Medicine and also from first year medical student of Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, India and department of Anatomy, Darbhanga Medical College, Laheriasarai, Bihar, India. All bones were labelled from 1 to 60. Dry tibia bones were cleaned thoroughly and complete in all aspect were included in this study. Broken and deformed bone were excluded. Total length of tibia were observed. Nutrient foramina were observed in all bones. Nutrient foramina were identified by the presence of elevated margins and distinct groove proximal to them [14]. Only well defined diphyseal nutrient foramina were observed on all tibia. Foramina at the end of bones were ignored [15].

Following measurement were taken by using digital vernier calliper-

- 1. Length of tibia
- 2. Number of nutrient foramina
- 3. Size of nutrient foramina- Nutrient foramina larger than size of 24 hypodermic needle (0.56 mm in diameter) were considered as dominant nutrient foramina while smaller than those considered as secondary nutrient foramina [16]. Only dominant nutrient foramina were accepted.
- 4. Direction of nutrient foramen
- 5. Position of nutrient foramina- with respect of soleal line (medial/lateral/over), with respect of shaft of tibia (upper/middle/lower)

Position of nutrient foramina with respect of shaft is determined by calculating Foraminal Index (FI) by using formula-

#### FI=(DNF/TF) X100

DNF= distance of nutrient foramina from upper end, TF= total bone length (total length measured the distance between most upper end of intercondylar iminence and to the lower end of tip of medial malleolus of tibia)

#### **Observation And Results**

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Table 1: No. of nutrient foramina in tibia
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No of	No of tibia		Total no of	Percentage
foramina	Right	Left	foramina	
0	0	0	0	0
1	33	24	57	95%
2	2	1	6	5%
3	0	0	0	0
Total	35	25	63	100

Table 1 Shows, single nutrient foramen present in 95% of tibia and double nutrient foramina present in 5% of tibia. None of the tibia have 3 nutrient foramina.

Side	Number of tibia	Number of nutrient foramina	Lengthwise distribution	Number	Percentage
			Upper third	35	100
Right	35	37	Middle third	0	0
			Lower third	0	0
			Upper third	25	100
Left	25	26	Middle third	0	0
Lett	25		Lower third	0	0
			Upper third	60	100
Total	60	63	Middle third	0	0
			Lower third	0	0

Table 2: Lengthwise distribution of nutrient foramina of tibia

All the tibia on the right and left side showed nutrient foramen on the upper one third.

**Table 3:** Position of nutrient foramina in relation

 to vertical line of tibia

	Right	Left
Lateral to vertical line	36 (97.3%)	25 (96%)
On vertical line	0	0
Medial to vertical line	1 (2.7%)	1 (4%)

All the bones showed the foramina on the posterior surface. Among 35 right tibia, the most common position of nutrient foramina was found lateral to vertical line which was 36 (97.3%) and 1 (2.7%) tibia had nutrient foramina medial to vertical line. Among the 25 left tibia, 24 (96%) had nutrient foramina lateral to vertical line and 1 (4%) had nutrient foramina medial to the vertical line.

**Table 4:** Distance of nutrient foramen from upperand lower end of tibia

Mean	Right (n=35)	Left (n=25)
Foraminal index	32.48	32.36
Length	359.2±14.73	357.28±21.15
Distance from upper end	116.14±7.26	116.92±6.09
Distance from lower end	245.97±10.18	244.36±9.08
Range of distance from upper end	98-133	99-133
Range of distance from lower end	235-281	236-283

Mean length of right tibia was 359.2 mm and left tibia was 357.28mm. Mean of the distance between nutrient foramen and highest point of intercondylar eminence on the right tibia was 116.14 mm and on the left tibia was 116.92mm.. Foraminal index on the right tibia was 32.48 and on the left side was 32.36.



Fig.1 Nutrient foramen lateral to the vertical line



**Fig 2.** Two nutrient foramen one on either side of vertical line

#### Discussion

In this study, we found single nutrient foramina on the posterior surface in most of the tibia. This result corresponds to the earlier studies by Chattarapati & Misra [17], Mysorekar [18], Longia et al [19], Collipal et al [20] and Tejaswi et al [21] which also found in majority of bones single nutrient foramina was present. In the present study nutrient foramina was found on the upper one third in all 60 bones. Mysorekar [18], longia et al [19] and Tejaswi et al [21] also found the nutrient foramina in upper one third of all the tibia. Average length of right tibia was 359.2mm and left tibia was 357.28. Average distance of nutrient foramina from intercondylar eminane on right side was 116.14 mm and on left side was 116.92.

In this study nutrient foramina was found on leteral side in majority of tibia.this is very similar to study done by a number of authers like Chattrapati and Mishra [17], Mysoreker [18], kate [24] and Longia et al [19]. In this study, minimum length of tibia was 336 mm, maximum length of tibia was 383 mm and mean length was 359.2 mm on the right side and on the left side minimum length was 352 mm, maximum length was 382 mm and mean length was 357.28 mm. This is very close to the study done by E Sendemir and A Cimen [22] mean length was 359 and Gupta & Gupta it was 364.

#### Conclusion

Nutrient foramen of all the tibia was found on the upper one third. Most of the nutrient foramen was located on lateral to the vertical line of tibia. Knowledge about the number, position, distance from upper and lower end of nutrient foramen is important clinically during vascularised bone grafting to preserve the blood supply of graft.

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