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Morphological Study of Nutrient Foramina of Human Fibulae

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ABSTRACT:
Background: Nutrient artery enters the bone obliquely through the nutrient foramen, which is directed away as a rule from the growing end. **Aim & Objective**- To locate and describe as well as to observe any variation in the number and position of nutrient foramen of fibulae. **Material and Methods**- Present study was done on 107 human dried fibulae collected from Krishna Mohan Medical College & Hospital, Mathura. In this study we used magnified hand lens and a thin stiff wire to confirm the number and direction of nutrient foramen. **Results**- Out of 107 fibulae examined, 88(82.24%) showed a single foramen while 17(15.88%) possessed double foramina and 2(1.86%) are having no nutrient foramen of the total 122 foramina, 115(94.26%) existed in the middle third, 5(4.09%) in upper third and 2(1.63%) were in the lower third of the shaft. **Conclusion**- This study has provided information on the morphology and topography of nutrient foramen of fibulae. This knowledge of nutrient foramen is useful in certain surgical procedure to preserve circulation.
Keywords- Fibula, Morphological study, Nutrient foramen

INTRODUCTION

The nutrient artery is the principal source of blood supply to a long bone and is particularly important during its active growth period in the embryo and fetus, as well as during the early phase of ossification.[1] Nutrient artery enters the bone obliquely through the nutrient foramen, which is directed away as a rule from the growing end.[2] During childhood, the nutrient arteries provide 70-80% of the blood supply to long bones. When this supply is compromised, medullary bone ischemia occurs with less vascularization of the metaphysis and growth plate.[3] One end of long bone grows faster (at least twice) than the other. Their position in mammalian bones is variable and may alter during the growth. [4] Knowledge about location of these foramina is useful in certain operative procedures to preserve the circulation. [5-7] The study is undertaken, as the knowledge of nutrient foramen of fibula is useful for anatomist, orthopedics and plastic surgeons.

Material and Methods

The present study consists of 107 dried adult human fibulae irrespective of sex and race, collected from Krishna Mohan Medical College & Hospital, Mathura. Gross asymmetry either broken or malunited specimen were excluded. After determining the side of the bone, the nutrient foramina were observed in all bones with the help of a hand-lens. They were identified by their elevated margins and by the presence of a distinct groove proximal to them

(In figure 1 & 2). Only well defined foramina on the diaphysis were accepted. Number and position of nutrient foramen in relation to specific surfaces and growing ends of fibulae were analyzed.

The position of all nutrient foramina was determined by calculating a foraminal index (F.I.) using the formula:

FI = (DNF/TL) ×100 [Hughes][8]

(DNF= The distance from the proximal end of the bone to the nutrient foramina, TL= Total bone length).

The position of the foramina was divided into three types according to FI as follow:

Type 1: FI up to 33.33, the foramen was in the proximal third of the bone.

Type 2: FI from 33.33 up to 66.66, the foramen was in the middle third of the bone.

Type 3: FI above 66.66, the foramen was in the distal third of the bone.

All the data were first collected in a standardized sheet followed by tabulation for calculating the percentages of distribution of nutrient foramen along the length of fibulae.

Results

Table1- Number of nutrient foramen in fibula.

No. of nutrient foramina	Total fibula (107)				Total fibula (107	
	Right side (57)		Left side (50)			
	No.	%	No.	%	No.	%
0	1	1.75	1	2	2	1.86
1	44	77.19	44	88	88	82.24
2	12	21.05	5	17	17	15.88

Table 2- Distribution of nutrient foramen on the shaft of fibula.

Side	**No. of fibulae**	No of nutrient foramina	Lengthwise distribution	No.	%
Right side	57	68	Upper1/3rd	3	4.5
			Middle 1/3rd	63	92.6
			Lower 1/3rd	2	2.94
Left side	50	54	Upper 1/3rd	2	3.7
			Middle1/3rd	52	96.3
			Lower 1/3rd	0	0
Total	107	122	Upper 1/3rd	5	4.09
			Middle 1/3rd	115	94.26
			Lower 1/3rd	2	1.63

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Table 3- Position of nutrient foramina in the fibula according to foramina index

No. of fibulae (122)	Position		
	Type 1	Type 2	Type 3
Number	5	115	2
%	4.09	94.26	1.63

Discussion:

In our study, 107 fibulae studied, out of which 82.24% of the bones presented a single nutrient foramen, while 15.88% of the bones possessed double nutrient foramina and 1.86% had no nutrient foramen. McKee [7] reported that out of 323 fibulae in his study, 86.4% had one foramen, 7.7% had two, 6% had no foramen and only one fibula had three foramina. Forriol et al [3] studied 33 fibulae and 100% of fibulae in his study had single foramen. Mysorekar [5] found one foramen in 92.8% fibulae, 2 foramen in 3.3%and 3.9%fibulae showed no foramen. Gupta Rakesh [9] has studied 112 human dried fibulae they found that 4.46% of total fibulae were having no foramen, 12.5% were having 2 foramen, 2.67% were having 3 foramen and 1.79% were having 4 foramen. Guo [10] studied 295 fibulae, out of which 10 fibulae (3.39%) had double foramen and 5 fibulae (1.7%) had no foramen. It was reported that in instances where nutrient foramen is absent, the bone is likely to be supplied by periosteal arteries [11].

In the present study, the nutrient foramina of fibulae were situated on the shaft of the bone with a foramen index ranging between 14.97% and 70.78% of the bone length. Of the total 202 foramina, 115(94.26%) existed in the middle third (Type 2), 5(4.09%) in upper third (Type 1) and 2(1.63%) were in the lower third (Type 3). Gumusburun et al [12] studied 60 fibulae and found that 92.3% of foramen was located in middle 1/3rd of fibulae. McKee [5] also found that 96% foramen were located in middle one third of fibulae. Guo [10] reported in his study that 66.4%foramen were in proximal third, 15% in middle third and 13.5% in distal third of fibulae. Variations in these studies are of regional and racial importance.

Conclusion

An understanding of the position and number of the nutrient foramina in long bones is important in orthopedic surgical procedures such as joint replacement therapy, fracture repair, bone grafts and vascularized bone microsurgery. Knowledge about this foramen is useful in the surgical procedure to preserve the circulation. The anatomical details of the nutrient foramina of the fibula could assist in harvesting vascularized graft of the bone. This study provides data related to regional population that can be used to compare with other ethnic groups; hence it is also important for anthropologists and anatomists.

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Figure 1: The distance from the head Of Fibula to nutrient foramen.

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Figure 2: The fibula bone with rubber bands tied at the level of nutrient foramen.