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Original Research Article

Study of Morphology of Nutrient Foramina in Human Fibulae

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Abstract:

Background and Objectives: Nutrient artery enters the bone obliquely through the nutrient foramen, which is directed away as a rule from the growing end, to locate and describe as well as to observe any variation in the number and the position of nutrient foramen of fibula.

Material and Method: Present study was done on 189 human dried fibulae collected from Madhubani medical college Madhubani, Bihar. In this study we used magnifying hand lens and a thin stiff wire to confirm the number and direction of nutrient foramen.

Results: Out of 189 fibulae examined, 168 (88.88%) showed a single foramen while 17 (8.99%) possessed double foramina and 4 (2.11%) are having no nutrient foramen. Of the total 202 foramina, 197 (97.5%) existed in the middle third, 3 (1.5%) in upper third and 2 (0.99%) were in the lower third of the shaft.

Conclusion: This study has provided information on the morphology and topography of nutrient foramen in fibulae. This knowledge of nutrient foramen is useful in certain surgical procedures to preserve the circulation.

Keywords: Nutrient Foramen, Fibulae.

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 interosseous 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 are variable and may alter during the growth [4]. Knowledge about location of these foramina is useful in certain operative procedures to preserve the circulation [5,6,7]. The study is undertaken, as the knowledge of nutrient foramen of fibula is useful for anatomists, orthopedics and plastic surgeons.

Materials and Method

The present study consist of 189 dried adult human fibulae irrespective of sex and race, collected from Madhubani Medical College Madhubani, Bihar. Gross asymmetry either broken or mal- united 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. 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) x 100 (Hughes [8])

(DNF = the distance from the proximal end of the bone to the nutrient foramen. 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

Table 1: Number of nutrient foramen in Fibula

No. of nutrient foramina	Total Fibula (189)				Total Fibula (189)	
	Rt Side (98)		Lt. Side (91)			
	No.	%	No.	%	No.	%
0	2	2.04	2	2.19	4	2.11
1	84	85.71	84	92.3	168	88.88
2	12	12.24	5	5.5	17	8.99

Table 2: Distribution of nutrient foramen on the shaft of fibula

Side		No. of fibulae		No. of nutrient foramina	Length wise distribution	Number	%
Rt.		98		108	Upper1/3	2	1.9
					Middle 1/3	104	96.3
					Lower 1/3	2	1.9
Lt.		91		94	Upper1/3	1	1.1
					Middle 1/3	93	98.9
					Lower 1/3	0	0
Total	189	202	Upper 1/3	3			1.5
			Middle 1/3	197			97.5
			Lower 1/3	2			0.99

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

NF of Fibula (Total 202)	Position		
	Type I	Type II	Type III
No	3	197	2
%	1.48	97.52	0.99

Discussion

In our study, 189 fibulae studied, out of which 88.88% of the bones presented a single nutrient foramen, while 8.99% of the bones possessed double nutrient foramina and 2.11% 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 1 fibula (0.3%) had three foramina. Forriol et al[3] studied 33 fibulae and 100% of fib- ulae in his study had single foramen. Mysorekar[5] foundone 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 having4 foramen. Guo[10] studied 295 fibulae, out of which 10 fib- ulae (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 sit-uated 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, 197(97.5%) existed in the middle third (Type- 2),3(1.5%) in upper third (Type-1) and 2 (0.99%) were in the lower third (Type-3). Gumusburun et al[12] studied 60 fibulae and found that 92.3% of foramen were located in middle 1/3rd of fibulae.

McKee [5] also found that 96% foramen were located in middle 1/3rd of fibulae. while Guo [10] reported in his study that 66.4% foramen were in proximal 1/3rd, 15% in middle 1/3rd and 13.5% in distal 1/3rd of fibulae. Variations inthese 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 orthopaedic surgical procedures such as joint replacement therapy, fracture repair, bone grafts and vascularized bone microsurgery. Knowledge about this foramen is useful in the surgical procedures to preserve the circulation. The anatomical details of the nutrient foramina of the fibula could assist in harvesting vascularised graft of the bone. This study pro- vides data related to regional population that can be usedto compare with other ethnic groups; hence it is also im- portant for anthropologists and anatomists.

Figure 1: The fibula bone with rubber bands tied at the Level of Nutrient Foramen

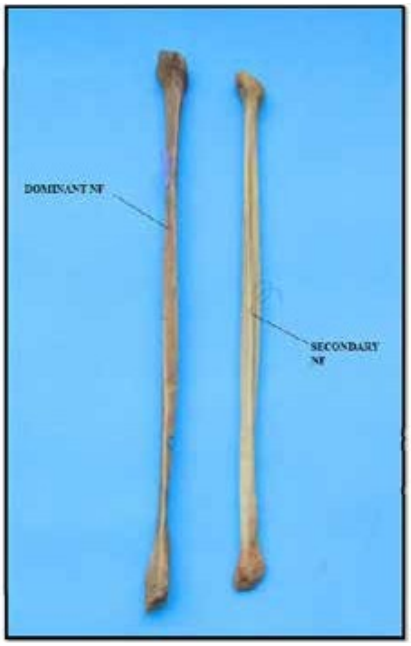

Figure 2: Fibula Showing Dominant and SecondaryNutrient Foramen

Figure 3: The Distance from the Head of Fibula to Nutrient Foramen

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