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NUMBER,DIRECTION AND LOCATION OF NUTRIENT FORAMINA OF ADULT FIBULA AND ITS CLINICAL SIGNIFICANCE.

Anatomy

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ABSTRACT

Introduction: Nutrient foramen is the external opening of the nutrient canal present on the surface of bone. The nutrient arteries, which is the main blood supply of bone enters into the bone through this foramen. An understanding of the number, direction and location of nutrient foramen in fibula is clinically very important, especially in vascular grafting.

Method: The study was conducted on 100 fibulae, using osteometric board, vernier caliper, thin stiff wire and hand lens. Adult fibulae were examined for number, direction and location of nutrient foramen.

Result: Out of 100 bones,96% showed single nutrient foramen,1% showed double foramen and in 3% nutrient foramen were absent.62.89% foramen were present on posterior surface and 30.93% 0f foramen were present on medial crest. 92% of nutrient foramen was directed away from the growing end.

Conclusion: In the study we found that most of the foramen was single, located commonly on the posterior surface and is directed away from the growing end.

KEYWORDS:

Fibula, nutrient artery, nutrient foramen.

Introduction –

The nutrient artery is the principal source of blood supply to the 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]. During childhood, the nutrient arteries provide 70-80 % of the interosseous blood supply to long bones. When this supply is compromised, medullary bone ischaemia occurs with less vascul arization of the metaphysis and growth plate[2].It has been suggested that the direction of the nutrient foramina is determined by the growing end of the bone. The growing end is supposed to grow at least twice as fast as the other end. As a characteristic, the diaphyseal nutrient vessels move away from the growing extremity dominant in the bone[3]. In bone grafts, the nutrient blood supply is crucial and it should be preserved in order to promote the fracture healing [4], a good blood supply being necessary for osteoblast and osteocyte cell survival as well as facilitating graft healing in the recipient[5].

Material and method-

The material for present study comprised 100 fibulae available in the Postgraduate Department of Anatomy, Government Medical College, Jammu.

Inclusion criteria

The fibula bone for the study fulfilled the following criteria.

1. Bones were dry and properly cleaned.
2. Bone with incomplete ossification, fragmented, or any gross pathology was excluded.

Instruments used: Following instruments were used for the study.

1. Vernier caliper: used to measure distance from proximal end of the bone to the nutrient foramen.
2. Osteometric board: to measure length of bone.
3. Hand lens: used to locate nutrient foramen.
4. Black marker pen: for marking the position of foramen on the bone.
5. Thin stiff wire: to know direction of nutrient canal.
6. Digital camera.

METHOD:

After determining the side of fibula, the length of fibula was measured by osteometric board. Nutrient foramina were identified by the presence of well marked groove leading to them, often slightly raised edge at the commencement of that canal. The nutrient foramen was studied in regards with, the number of foramina on the shaft, surface, or border on which it is present. Number, distribution and direction of the nutrient foramen in relation to specific surfaces, border and growing ends of fibulae were analyzed. Keen observation was made for direction of nutrient foramen by using magnifying hand lens and then a thin stiff wire was passed through the foramen to confirm its direction. Then it was noticed that which part/parts of bone possessed single, multiple or absent foramen. Nutrient foramen in each fibula was encircled using black marker pen. Nutrient foramina directed away from the growing end was marked with the downward arrow and nutrient foramen directed towards the growing end was marked with upward direction. All the 100 dry adult human fibulae were digitally photographed, variation with regard to location, direction, number of nutrient foramen were noted and photographed separately using digital camera.

RESULTS

Table 1: Number of nutrient foramina in studied fibulae

No. of Foramen	No. of Fibulae	Percentage
0	3	3%
1	96	96%
2	1	1%
Total	100	100

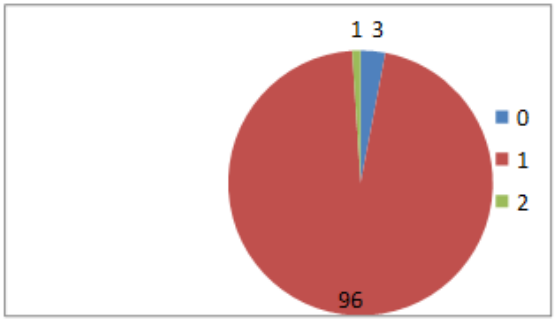


Fig 1: Pie diagram showing percentage of number of nutrient foramina in fibulae.

3% of fibulae nutrient foramen was absent, 96% fibulae showed single nutrient foramen, 1% had double nutrient foramina. Table 1(Fig. 1, Fig. 2)

Fig 2. Fibula showing double nutrient foramen on posterior surface having direction away from growing end.

Table 2: Distribution of nutrient foramina in right and left fibulae

No. of foramen	Right Fibulae		Left Fibulae	
	No.	Percent	No.	Percent
0	1	1.78	2	4.55
1	54	96.4	42	95.45
2	1	1.78	0	0
Total	56	100	44	100

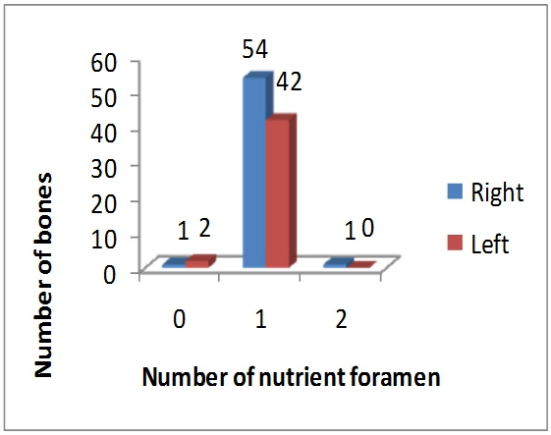


Fig. 3: Bar diagram showing number of nutrient foramina in right and left fibulae.

Most common nutrient foramen was single in 96.4% on right and 95.4% on left fibulae. Absent nutrient foramen was seen in 1.78% on right and 4.55% on left fibulae. Only right fibula showed 1.78% of double nutrient foramina. Table 2(Fig.3)

Table 3: Location of nutrient foramina on surfaces and borders in both right and left fibulae.

Location of foramen	Right	Percent	Left	Percent	Tota	Percent
PS	36	65.45	25	59.52	61	62.89
MC	15	27.28	15	35.72	30	30.93
PB	3	5.45	2	4.76	5	5.15
IB	1	1.82	0	0	1	1.03
Total	55	100	42	100	97	100

Fig 4: Pie diagram showing distribution of nutrient foramina on different surfaces and borders in right fibulae.

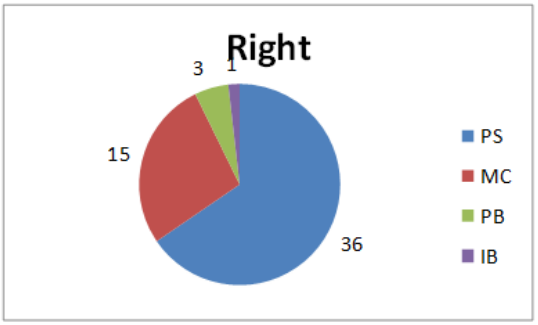
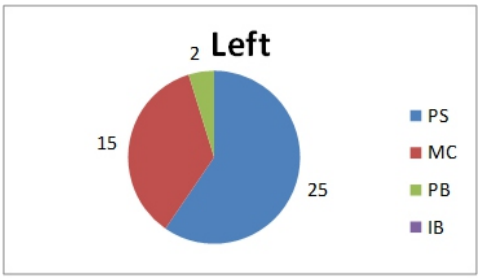


Fig 5: Pie diagram showing distribution of nutrient foramina on different surfaces and borders in left fibulae.



Nutrient foramen on posterior surface were frequent with 65.4% on right and 59.52% on left fibulae, followed by medial crest, 27.28% on right and left side, then posterior border 5.45% on right and 4.76% on left. Least frequent location was on interosseous border seen only in right fibula. Table 3(Fig. 4, Fig. 5, Fig.7)

Table 4: Direction of nutrient foramina towards and away from the growing end of fibulae

Fibula	No. of fibula	Towards growing end		Away from growing end	
		No.	%	No.	%
Right	56	4	7.14	51	94.44
Left	44	1	2.27	41	93.18
Total	100	5		92	

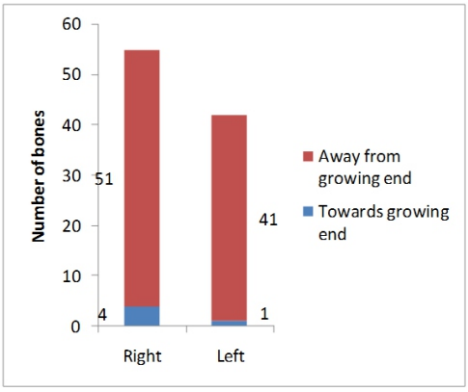
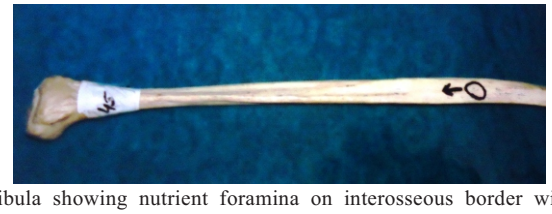
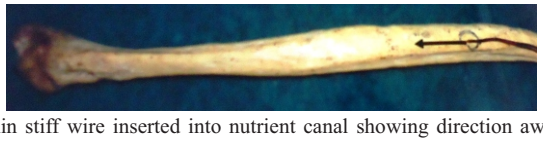


Fig 6: Bar diagram showing percentage and direction of nutrient foramina in right and left fibulae 92% foramina were directed away from the growing end and 5% foramina were towards the growing end. Table 4(Fig. 6, Fig. 7, Fig 8)



Fibula showing nutrient foramina on interosseous border with direction towards the growing end. (Fig.7)



Thin stiff wire inserted into nutrient canal showing direction away from the growing end. (Fig. 8)

Discussion-

In the present study 96% (96) of the fibulae possessed single nutrient foramen, which is closer to those reported by **Mysorekar**[3] who conducted study on 180 fibulae and observed that 92.8% of bones have single nutrient foramen.

Gumusburun et al., [6] estimated single nutrient foramen in 92.2% of fibulae which is also quite similar to our study. Similarly **Kocabiyik et al.,** [7] and **Murlimanju et al.,** [8] observed that 90% and 90.2% of fibulae respectively had single nutrient foramen which is also in unison with our findings. Similarly **Forriol et al.,** [2] and **Pereira et al.,** [9] observed 100% and 99.1% of fibulae respectively had single nutrient foramen

which is not in agreement with our study. **Kumar et al.,** [10] found single nutrient foramen in 17% bones, which is also not in agreement with our study. In the present study double nutrient foramina was present in 1% (1) fibula which is inconsistent to the study conducted by **Mysorekar**[3] who observed 3.3% double nutrient foramen. Location of nutrient foramen was common on posterior surface of bone, followed by the medial crest. In this present study, 62.8% of fibular foramina were located on the posterior surface, followed by 30.93% on medial crest and then on posterior border (5.15%). **Gumusburun et al.,** [6] found that 48.3% foramen were on posterior surface, and 1.6% on interosseous border. Similarly **Mysorekar** [3] observed that 56% of nutrient foramen was located on medial crest and 26% on posterior surface, while **Forriol et al.,** [2] found almost equal distribution of foramen in posterior and medial surface, and then posterior border. Similarly **Collipal et al.,** [11] observed 68% of nutrient foramen on posterior surface and 2% on lateral border which is in accordance with present study. The present study varies from other studies in presence of 5.15% of nutrient foramen located on posterior border and 1% on interosseous border.

In the present study, the direction of 92% nutrient foramen was away from growing end of bone i.e. distally, while as only 5% of nutrient foramen was directed towards the growing end of bone i.e. proximally. So present study is in relation with the classic description, as direction of nutrient foramen is always away from growing end.

Conclusion-

The findings of the present study were compared with that of the results of the previous researches study of nutrient foramen with regards to the number, location and direction is of great importance for clinicians, radiologists, and vascular surgeons. Exact knowledge of distribution of the nutrient foramina in bone is important to avoid damage to the nutrient vessels during surgical procedures like vascularized free fibular grafts.

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