



## MORPHOMETRIC STUDY OF NUTRIENT FORAMINA OF FIBULA

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**Abstract :** The major blood supply of a long bone is by the nutrient artery which enters the shaft through an opening called the nutrient foramen. Knowledge of the morphology and topography of the nutrient foramina of fibula is important as this bone is commonly used for vascularised graft in stabilisation of lost Mandible and spine, reconstruction after tumour resection, etc. In the present study the number, size, position and direction of nutrient foramina of 50 dry fibulae were analysed. Results - 84 percentage of fibulae showed single foramen, 10 percentage showed double foramina and in 6 percentage of fibulae foramina were absent. Out of 52 foramina 47 foramina were located in the middle one third of the shaft of fibula. 94.23 percentage of the foramina were located on the posterior surface.

**Keyword :** Fibula, Nutrient Foramen

### INTRODUCTION

The nutrient artery is the major blood supply of a long bone which enters the shaft through an opening called nutrient foramen, leading to nutrient canal. The nutrient foramen is directed away from the growing end. It provides 70-80 % interosseous blood supply to the bone. When this is compromised there is less vascularisation of the metaphysis, affecting the bone growth. Preservation of vascularisation is important for the healing of the fractured bone and the survival of bone graft<sup>1,6</sup>. The complication of harvesting the fibula for grafting are ankle instability, extensor hallucis longus weakness and peroneal nerve injury<sup>3</sup>. Knowledge of the morphology and topography of the nutrient foramen is essential in certain operative procedures to preserve the blood supply and to avoid complications.

### MATERIALS AND PARAMETERS

#### 1. Number of foramina

Nutrient foramen was identified by the presence of a well marked groove leading to the foramen with slightly raised edges. Only well defined foramen of the diaphysis were taken up for this study. The number of foramina in each bone was counted and tabulated (Figure 1 & 2).

Fig .1 Single

Fig 2. Double



#### 2. Position of the foramina

Position of a foramen was determined by calculating the Foraminal Index by applying

#### The Hughes formula<sup>4</sup>

$FI = (DNF/FL) \times 100$  where

FI is the Foraminal Index DNF is the distance of the foramen from the proximal end of the bone FL is the total length of Fibula

**Based on the foraminal index, the position of a foramen may be of three types**

**Type I:**  $FI < 33.33$  (Proximal third of shaft of fibula)

**Type II:**  $FI 33.33 - 66.66$  (Middle third of shaft of fibula)

**Type III:**  $FI > 66.66$  (Distal third of shaft of fibula)

#### 3. Location of foramina

Topography of a foramen in relation to specific borders and surfaces was noted (Figure: 3 & 4).



#### 4. Direction of foramina

A needle was passed through the nutrient canal to determine its direction (Figure: 5).



**Figure: 5**  
**RESULTS**

### 1. Number of foramina

Out of 50 fibulae, 42 fibulae had single foramen, 5 fibulae had double foramina and 3 fibulae with absent foramen (Table 1).

Table 1: Number of foramina

No. of foramen	No. of fibulae		Total	Percentage
	Right	Left		
Single foramen	22	20	42	84 %
Double foramina	2	3	5	10 %
Absent foramen	1	2	3	6 %

### 2. Position of nutrient foramina

The mean Foraminal Index was 44.73. Out of 52 foramina, 47 foramina were found in the middle third of the shaft of fibula. 5 foramina were found in the distal third of the shaft of fibula. No foramen was found in the proximal third of the shaft of fibula (Table 2).

Table 2: Position of the foramen

Position of the foramen	No. of foramina		Total	Percentage
	Right	Left		
Proximal third	0	0	0	0
Middle third	24	23	47	90.38 %
Distal third	2	3	5	9.61 %

### 3. Location of nutrient foramina

Out of 52 foramina, 49 foramina were located on the posterior surface, 3 foramina were located on the lateral surface and no foramen was located on the medial surface (Table 3).

Table 3: Location of the foramen

Location of foramen	No. of nutrient foramen		Total	Percentage
	R	L		
Posterior surface	25	24	49	94.23 %
Lateral surface	1	2	3	5.77 %
Medial surface	-	-	-	-

### 3. Direction of nutrient foramina

Out of 42 fibulae with single foramen, all the foramina were directed away from the growing end. Out of 5 fibulae with double foramina, in 2 fibulae both the foramina were directed away from the growing end and in 3 fibulae one foramen was directed away and other foramina were directed towards the growing end.

## DISCUSSION

### 1. Number of foramina

In the present study and study made by Kocabiyyik N et al (2014), Gupta Rakesh et al (2013) and Gumusburun et al (1996) majority of the fibulae showed single foramen (Table 4). In the study made by Gupta Rakesh et al (2013) more than 2 foramina (upto 5 foramina) were found, which was not found in the present study.

Table 4: Number of foramina

Parameters	Kocabiyyik N et al (2014)	Gupta Rakesh et al (2013)	Gumusburun et al (1996)	Present study
Bones with single foramen	90%	78.57 %	92.13 %	84 %
Bones with double foramina	6.6%	12.5 %	3.93 %	10 %
Bones with absent foramen	3.3%	1.79 %	3.93 %	6 %

### 2. Location of foramina

In the present study, 94.23% of foramina were located on the posterior surface which is in accordance with the observation made by Kocabiyyik N (2014), Umamaheswari (2013), Gupta Rakesh et al (2013). 5.77 % of foramina were found on the lateral surface which is in accordance with the study made by Gupta Rakesh et al (2013) and differed from study made by Kocabiyyik N (2014) (Table 5).

Table 5: Location of foramina

Parameter	Kocabiyyik N (2014)	Umamaheswari (2013)	Gupta Rakesh et al (2013)	Present study
Posterior	100 %	96.1 %	87.96 %	94.23 %
Lateral	-	1.95 %	5.26 %	5.77 %
Medial	-	1.95 %	6.77 %	-

### 3. Position of the foramina.

The present study and most of the other studies show the major location of the foramina to be in the middle third of the shaft of the fibulae (Table 6).

Table 6: Position of the foramina

Parameter	Umamaheswari (2013)	Gumusburun et al (1996)	Pereira et al (2011)	Present Study
Major position of foramen	Middle third of the bone (Type II)			
Foraminal index	47	46.14	46.1	44.73

### 4. Direction of foramina.

In the present study most of the nutrient foramina were directed away from the growing end which is in accordance with the study made by Umamaheswari (2013), Sameera Yasin (2009) and Gupta Rakesh et al (2013). In fibulae with single nutrient foramen, the foramina of all specimens were directed away from the growing end. In fibulae with double nutrient foramina, at least one foramen was directed away from the growing end which is in accordance with the study made by Umamaheswari (2013) (Table 7).

Table 7: Direction of foramina

Parameter		Umamaheswari (2013)	Sameera Yasin (2009)	Gupta Rakesh et al (2013)	Present study
Direction of foramen	Away from the growing end	85.36 %	77.80 %	79.70 %	94.23 %
	Towards the growing end	14.63 %	22.20 %	20.30 %	5.77 %

## CONCLUSION

In the present study, 84 % of fibulae showed single nutrient foramen. 94.23% of foramina were located on the posterior surface. In bones with single foramen, all the foramina were directed away from the growing end. In bones with double foramina, at least one foramen was directed away from the growing end. The knowledge about the exact location and distribution of nutrient foramina in the diaphysis of fibula is important to avoid damage to the nutrient vessels during surgical procedures such as fracture fixation and grafting of fibula for reconstructive surgeries.

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