



## **MORPHOLOGY AND TOPOGRAPHY OF NUTRIENT FORAMINA OF FEMUR**

Bhuvaneswari B.J. Sudha Seshayyan

Madras Medical College

### **Abstract:**

The major blood supply to long bones occurs through nutrient arteries which enter through the nutrient foramina. The knowledge about the morphology and topography of the nutrient foramen is essential in certain surgical procedures like fracture treatment and microvascular bone grafting. The present study analysed the number, position, location and direction of nutrient foramina in fifty adult dry Femur bones. 52 % showed the presence of single foramen. 46% showed double foramina and 2 % were with absent foramen. Out of the total 72 foramina 59 foramina were dominant. 80.56 % foramina were located in the middle one third of the shaft of Femur bone. 41.67 % were located within the two lips of linea aspera.

**Key words :** Femur, nutrient foramen, linea aspera

### **Introduction:**

Nutrient artery is the main blood supply to the shaft of the long bone. It is particularly important during its active growth period in foetus and during early phases of ossification.

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<sup>2</sup>.

The nutrient artery enters the shaft obliquely through an opening called nutrient foramen, leading into nutrient canal.

In majority of cases it is located away from the growing end<sup>5</sup>. Preservation of vascularisation is important for the healing of the fractured bone and the survival of bone graft. The knowledge about the morphology and topography of the nutrient foramen is essential in certain operative procedures to preserve the circulation<sup>5</sup>.

## MATERIALS AND METHODS

### 1. Number of foramina

Nutrient foramina were identified by the presence of their slightly raised edges and a groove proximal to the opening of the canal. Only well defined foramina of the diaphysis were taken for study. The number of foramina in each bone was counted and tabulated (figure-1&2).



Figure 1



Figure 2

Figure 1 : Femur with single foramen

Figure 2: Femur with double foramina

### 2. Size of foramina:

24 hypodermic needle was passed through the foramen. Foramina equal or larger than 24 hypodermic needle are dominant foramina (figure 3) and those that are smaller than the needle are secondary foramina (figure 4).



Figure 3: Femur with Dominant foramen



Figure 4: Femur with secondary foramen

### 3. Position of foramina:

Position of foramina were determined by calculating the Foraminal Index by applying Hughes formula

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

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 Femur

Based on the Foraminal Index the position of the foramen is of three types

In type I - FI is  $<33.33$ , foramen is present in upper one third of the shaft

In type II - FI is  $33.33 - 66.66$ , foramen is present in middle one third of the shaft

In type III - FI is  $>66.66$ , foramen is present in lower one third of the shaft



Figures 7 & 8 - Femur with foramen at the medial lip of linea aspera

#### 4. Location of foramina:

Topography of foramina in relation to specific borders and surfaces were noted. Foramen within 1mm from any border was taken to be lying on that border. (figure 5-10)



Figures 5 & 6 - Femur with foramen between the two lips of linea aspera



Figures 9 & 10 - Femur with foramen at the lateral lip of linea aspera

#### 5. Direction of the nutrient canal:

A stiff wire was passed through the nutrient canal to determine its direction (Fig-11).



Figure 11

## RESULTS:

### 1. Number of foramina:

Out of the 50 femur bone , 26 bones had single foramen, 23 bones had double foramina and one bone had absent foramen (table 1).

No. of foramina	No. of femur bones		Total	Percentage
	Right	Left		
Single foramen	16	10	26	52
Double foramina	8	15	23	46
Absent foramen	1	0	1	2

Table 1

### 2. Size of foramina:

Out of 72 foramina 59 were dominant foramina and 13 were secondary foramina (table 3).

### 3. Position of foramina:

The mean Foraminal Index was 41.63. Out of the 72 foramina 58 were located in the middle one third of the shaft which accounts for 80.56 % . No foramen was located in the lower third of the shaft (table 2).

Topography of foramina	No. of foramina		Total	percentage
	Right	Left		
Proximal third	12	2	14	19.44
Middle third	20	38	58	80.56
Lower third	0	0	0	0

Table 2

### 4. Location of foramina:

Out of 72 foramina 30 were located between the two lips of linea aspera, 23 were located at the medial lip of linea aspera, 7 were located at the lateral lip of linea aspera, 10 were located medial to the medial lip of linea aspera , 2 were located lateral to the lateral lip of linea aspera (table 3).

Location of foramina	Side	No. of foramina		Total	Percentage
		Dominant Foramina	Secondary foramina		
Between two lips of linea aspera	R	13	1	30	41.67
	L	13	3		
Medial lip of linea aspera	R	8	1	23	31.94
	L	12	2		
Lateral lip of linea aspera	R	1	3	7	9.72
	L	2	1		
Medial to medial lip of linea aspera	R	1	2	10	13.89
	L	7	0		
Lateral to lateral lip of linea aspera	R	2	0	2	2.78

Table 3

#### 5. Direction of foramina:

All the foramina were directed towards the proximal end.

#### Discussion:

In the present study, most of the Femur bones were with single nutrient foramen which is in accordance with the study done by Prashanth et al<sup>4</sup>, but differed with Mysorekar<sup>5</sup> and Kumar et al<sup>3</sup> where most of the bones were with double foramen. Mysorekar and Prashanth et al also reported the presence of triple foramina in Femur which was not noted in the present study (table 4).

Parameters	Mysorekar et al <sup>5</sup> (in percentage)	Prashanth et al <sup>4</sup> (in percentage)	Kumar et al <sup>3</sup> (in percentage)	Present study (in percentage)
Bones with single foramen	45	47.7	47.52	52
Bones with double foramina	50	44.2	50.49	46
Bones with triple foramina	1.6	3.5	Nil	Nil
Bones with absent foramen	3.33	4.6	1.9	2

Table 4

In the present study, most of the foramina were located in the middle one third of the shaft of Femur bone, directed towards the proximal end which is in accordance with Forriol Campos et al<sup>1</sup> , Prashanth et al<sup>4</sup> and Kumar et al<sup>3</sup> (table 5) .

In the present study and most of the other studies the major location of foramina is between the two lips of linea aspera except Forriol et al where the major site is the medial lip of linea aspera (table 5)

#### Conclusion:

Present study confirms the results of other studies that double nutrient foramina can occur in Femur. Majority of foramina are located along the linea aspera in middle one third of the shaft, directed towards the proximal end. Knowledge about the exact location and distribution of nutrient foramina in the diaphysis of Femur bone is important to avoid damage to the nutrient vessels during surgical procedures.

Parameters	Forriol campos et al <sup>1</sup>	Prashant h et al <sup>4</sup>	Ku-mar et al <sup>3</sup>	Pre-sent study			
Major location of foramina	Medial lip of linea aspera	Between the two lips of linea aspera					
Major position of foramina	Middle one third of the shaft of femur						
Direction of nutri-ent canal	Towards the proximal end						

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