# A STUDY ON LOCATION OF NUTRIENT FORAMEN IN TIBIA

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**ABSTRACT**

The nutrient foramen (NF) of the tibia is located in the proximal third of its diaphysis. With the objective of complementing the information delivered by other authors, we investigated the location, the number of diaphyseal foramina, the distance and position of the foramina in relation to the length of the bone and the proximal epiphysis and the lateromedial diameter and anteroposterior diameter of the bone at the level of NF. For that purpose, we used 50 adult dry tibia of both sexes from the Anatomy department and museum of JVWU. The mean length of the right tibia was 373mm, left tibia 387mm. Location of the NF was found over the soleal line in 5/25 (15.38%) left tibia and 2/25 (12.5%) right tibia, medial to the soleal line in 6/25 (24%) left tibia and 5/25 (20%) right tibia. In all the remaining cases, it was lateral to the soleal line. The NF was located in the upper third of the shaft in 23/25 (92%) left tibia and 22/25 (88%) right tibia, in the middle third 2/25 (8%) left tibia and 3/25 (12%) right tibia. Mean of maximum diameter of NF was 0.6mm in left tibia and 0.7mm in right tibia. Mean of lateromedial diameter at the level of NF was 28mm in left tibia and 26mm in right tibia. Mean of anteroposterior diameter of the shaft at the level of NF was 88mm on the left tibia and 92mm on the right tibia. Mean of the distance between NF and the highest point of intercondylar eminence was 130mm in left tibia and 134mm in right tibia. The FI of the right tibia was 36 and of the left tibia was 33.72. This data could be useful as reference for surgical procedures of the lower limb. **Keywords:** Bones, Diaphysis, Lower limb, Nutrient foramen, Tibia

## INTRODUCTION

The nutrient arteries, usually one or two in number, vascularize the long bones. In addition to these arteries, the metaphyseal, epiphyseal and periosteal arteries also provide nourishment to the long bones. During young age, long bones primarily receive about 80% of its blood supply from the nutrient arteries, and in their absence, the vascularisation occurs through the periosteal vessels. These nutrient arteries enter the long bones through the nutrient foramen. The NF, in most of the cases is located away from the growing end derivation of the axiom saying that direction of foramina 'towards the elbow I go and from the knee I flee'. Thorough knowledge about the blood supply of long bones is one of the important factors for success of new techniques in bone transplant and resection in orthopaedics. During transplant techniques, the variants of distribution of nutrient foramina guides the operating surgeons to place the graft without damaging the nutrient arteries. The topography of nutrient foramina may differ in its growing and non-growing end, precise understanding of this becomes essential in certain surgical procedures to conserve the circulation.

## MATERIAL AND METHOD

The present study was conducted on 50 adult dry tibia of both sexes, obtained from the Anatomy department and museum of JVWU. Only diaphyseal nutrient foramina were observed in all tibiae. Direction of the nutrient foramen was carefully observed by using a magnifying hand lens and then passing a fine needle (25 gauge) through the foramen to confirm its patency and direction. The following measurements were taken using digital caliper.

1. Length of the tibia

2. Number of nutrient foramina (primary or secondary). The foramina smaller than the size of a 24 hypodermic needle were considered as secondary foramina.

3. Location of nutrient foramen with respect to the soleal line (medial/lateral/over), with respect to the shaft of the tibia (Upper/middle/lower)

4. Direction of nutrient foramen

5. Maximum diameter of nutrient foramen

6. The lateromedial diameter of the shaft at the level of nutrient foramen

7. The anteroposterior diameter of the shaft at the level of nutrient foramen.

8. Distance between the nutrient foramen and the highest point of intercondylar eminence.

 

9. Foramen index (FI) – By applying Hughes formula, dividing the distance of the foramen from the proximal end (D) by the total length of the bone (L) which was multiplied by hundred. FI=D/Lx100

**RESULTS AND OBSERVATION**

1. Mean length of the tibia – Of the right tibia was 373 mm, of the left tibia was 387 mm.

2. Number of nutrient foramina– In all tibias only single nutrient foramen was observed.

3. Location of nutrient foramen –

i. With respect to the soleal line (medial/lateral/over) – The nutrient foramen in 5/25 left tibia and 2/25 right tibia was located over the soleal line. In 6/25 left tibia and 5/25 right tibia it was located medial to the soleal line. In all the remaining tibia it was located lateral to the soleal line. In one right tibia the nutrient foramen was located on the interosseus border and in one right tibia it was located on the vertical line.

ii. With respect to the shaft of the tibia (Upper/middle/lower) – 2/25 left tibia and 3/25 right tibia it was situated in the middle 1/3rd of the shaft, in 22/25 left tibia and 20/25 right tibia it was situated in the upper 1/3rd of the shaft.

4. Direction of nutrient foramen – In all the cases (100%), it was directed vertically downwards.

5. Mean of maximum diameter of nutrient foramen – On the left tibia, it was 0.6 mm and on the right tibia it was 0.7 mm.

6. Mean of lateromedial diameter of the shaft at the level of nutrient foramen – On the left tibia it was 28 mm and on the right tibia it was 26 mm.

7. Mean of anteroposterior diameter of the shaft at the level of nutrient foramen – On the left tibia it was 34 mm and on the right tibia it was 34.5 mm.

8. Mean of distance between the nutrient foramen and the highest point of intercondylar eminence – On the left tibia it was 130 mm and on the right tibia it was 134 mm.

9. Foramen index (FI) – The FI of the right tibia was 36 and of the left tibia was 33.72.

**Table 1: Location of nutrient foramen in the tibia**

| | **Sample size** | **Location of nutrient foramen on shaft** | | |
|---|---|---|---|---|
| | | **Upper 1/3** | **Middle 1/3** | **Lower 1/3** |
| **Right Tibia** | 25 | 20 | 03 | 02 |
| **Left Tibia** | 25 | 22 | 02 | 01 |
| **Total** | 50 | 42 | 05 | 03 |

**Table2: Direction & relation of Nutrient Foramen (NF) with Soleal line (SL) on tibia**

| | **Direction of NF** | | **Relation of NF with Soleal line** | | |
|---|---|---|---|---|---|
| | **Downward** | **Upward** | **Medial to SL** | **Lateral to SL** | **On SL** |
| **Right Tibia** | 25 | 00 | 5 | 18 | 02 |
| **Left Tibia** | 25 | 00 | 6 | 14 | 05 |
| **Total** | 50 | 00 | 11 | 32 | 07 |

**Table 3: Distance of nutrient foramen from Junction of Upper 1/3 & Middle 1/3 of shaft**

| | **Sample size** | **Mean distance of NF from U/M Junction in mm(Range)** | **Relation of NF with Soleal line** |
|---|---|---|---|
| **Right Tibia** | 25 | 18 ± 7.4 (5 to 35) | 13 ± 3.2 (6 to 19) |
| **Left Tibia** | 25 | 18.5 ± 9.2 (1 to 33) | 9.1 ± 3.9 (0 to 18) |

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**Fig.1: Location of nutrient foramen on the soleal line**

**Fig.2: Nutrient foramen below the soleal line**


**Fig.3: Morphometrical analysis of Tibia**

## DISCUSSION

The nutrient artery plays cardinal role in blood supply of a long bone. The nutrient artery to tibia is derived from posterior tibial artery near its origin. It is one of the largest of the nutrients arteries. Rhinelanderet al (1972) have reported that the nutrient artery to the tibia supplies the inner two-thirds of the cortex and is the chief blood supply of cortical bone. A single nutrient foramen on the shaft of the tibia is a common observation of the past studies.

Few researchers have also reported the double diaphysial nutrient foramen on the tibia as a rare occurrence. In the present study, a single nutrient foramen on shaft was a rule in all 50 tibias. All of these nutrient foramina were directed downwards towards the lower end of the tibia. The nutrient foramen was located in upper one third of tibial shaft in 84% of the present study sample. Thus our study shows that the data from Rajasthan region on location of nutrient foramen of tibia is in concurrence with many previous studies done in the different parts of the world.

## CONCLUSION

We believe that the present study has provided relevant information about the nutrient foramen of lower long bones. As techniques such as microvascular bone transfer are becoming more popular, information relating to the anatomical description of these foramina is vital to preserve the circulation of affected bony structures. In bone grafts, the nutrient blood supply is crucial and it should be preserved in order to promote the fracture healing. Moreover, the presence of preserved nutrient blood flow is essential for the survival of osteocytes in cases of tumor resection, traumas. It is also of relevance for those clinicians involved in surgical procedures where patency of the arterial supply to long bones is important.

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