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An anatomical study of the nutrient foramen of adult human Tibia

Dr. Fatima Bhopalwala Ali
Assistant Professor, Department of Anatomy, Government Medical College, Ratlam, MP, India
Email: dr.fatimaali@ymail.com

Dr. Archana K. Tale
Assistant Professor, Department of Anatomy, Shri Vasantrao Naik Government Medical College, Yavatmal, Maharashtra, India
Email: drarchanatalefupare@rediffmail.com

Dr. Mustafa Ali
Assistant Professor, Department of Pathology, Government Medical College, Ratlam, MP, India
Email: dr.mustafa-ali@live.com

Dr. Mohit Kulmi
Assistant Professor, Department of Pharmacology, Government Medical College, Ratlam, MP, India
*Corresponding author email: mohit.kulmi@gmail.com

***Abstract*---**The nutrient artery for tibia is one of the largest nutrient vessels in the body. It enters the tibia through its nutrient foramen located over its proximal third, on its posterior surface, runs through nutrient canal and then enters the medullary cavity in the middle third of tibia. The aim of the present study was to determine the location, number and position of the nutrient foramen of tibia. The study was conducted in the anatomy department of Government medical college, Ratlam, M.P. Dry; preserved adult tibia bones of unknown age and sex were randomly selected. 60 tibia bones were studied, out of which 31 were on the left side and 29 of the right side. The presence of nutrient foramen was observed macroscopically and confirmed by passing a 24 gauge needle tip through it. Then, its number, location, position and direction were noted. Single nutrient foramen with downward directed nutrient canal was observed in all but one bone (one case of each exception). The foramen was present on the posterior surface in 93% of cases, and on the upper third of the bone in 98% of cases. Damage to the nutrient artery during fracture or surgical procedures may lead to delayed union or nonunion. Hence,

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the knowledge of the anatomy of nutrient foramen should be kept in mind during surgical procedures involving tibia.

***Keywords*---**nutrient artery, tibia, nutrient foramen.

Introduction

Tibia or shin bone is one of the bones of lower limbs in humans and has a rich blood supply. Same as other bones it also gets its blood supply chiefly from nutrient arteries besides other arteries. Nutrient arteries are branches of adjacent arteries running outside the periosteum. Nutrient arteries are in fact the main source of blood supply to long and specially young bones. [1, 2, 3] Many studies have been performed on nutrient foramina but it was Antonie van Leeuwenhoek who first identified nutrient foramen in the tibia of a calf in 1674. [4] Nutrient arteries enter the bone through Nutrient foramina; location, number and direction of which may vary in the same bones of every individual. In the long bones like tibia its direction is almost away from the growing end. [5] However as variation does occur it is important to have knowledge of its complete anatomy so that various surgical processes can be performed conveniently.

Material and Methods

The study was conducted in the anatomy department of Government medical college, Ratlam, M.P. Study material- 60 dried and preserved adult human tibia of unknown age and sex. After determination of sex, the presence of nutrient foramen was observed macroscopically with an aid of simple magnifying glass and its direction was confirmed by passing a 24 gauge needle tip through it. Number of foramen, its topography (upper, middle, lower 1/3 rd segment) and distribution of foramen (posterior/medial/lateral surface and (lateral/anterior/medial) borders was also studied. Results thus obtained were presented as frequencies in the form of tables.

Results

Out of 60 tibial bones, 31 were of the right side and 29 were of left side bones. Single foramen was observed in almost all bones (59/60) while double foramina were observed in single bone of the left side. [Table 1] 60 out of 61 nutrient foramina were located in the upper third of the tibia and only one was seen in the middle part of the bone. No foramen was observed in the lower part of bone. [Table 2] Maximum number of foramina were observed on posterior surface (57/61) followed by lateral border (4/61). No foramen was observed in medial/lateral surfaces and anterior/medial borders. [Table 3] Directions of foramina were downwards in 60 foramina and only in only 1 it was upwards in direction. [Table 4]

Table 1
Number of foramina in individual bones

Number of foramina present in individual bone	Right side	Left side	Frequency (%)
Single	29	30	98.33
Double	00	01	1.67
Total	29	31	100

Table 2
Location of nutrient foramina in individual bones

Part of tibia where nutrient foramina located	Number of foramina	Frequency (%)
Upper	60	98.37
Middle	01	1.63
Lower	00	00

Table 3
Distribution of foramina on surface/ border of bones

Surface/ border of bone where foramina are present	number of foramina N = 61	Frequency (%)
Posterior surface	57	93.4
Medial surface	00	00
Lateral surface	00	00
Lateral border	04	6.6
Anterior border	00	00
Medial border	00	00

Table 4
Direction of the foramina in individual bones

Direction of the foramina	number of foramina	Frequency (%)
Upwards	01	1.63
Downwards	60	98.37

Discussion

Tibia is a triangular shaped bone which is divided into three surfaces by three borders. [6] Nutrient foramen is a canal-like structure that carries nutrient arteries and nerves inside the bones. Term nutrient is itself explanatory that it carries nutrients for the proper growth of the bone. [7] Results of our study were in agreement with most of this kind of study done earlier in different regions of India with very little variation. Comparisons or results with few contemporary studies are elaborated in Table 5. [8, 9, 10]

Table 5
Comparison of study findings with other similar studies

Features		Kumar et al 2018	Jayaprakash T et al 2016	Chavda et al 2019	Current study 2021
Number of tibia		60	50	70	60
Number of foramina	0	00	00	00	00 %
	1	95	100	100	98.33 %
	2	05	00	00	1.67 %
Segment of bone involved	Upper	100	82	75	98.37 %
	Middle	00	18	25	1.63 %
	Lower	00	00	00	00 %
Surface / border	Posterior surface	100 %	100 %	98 %	93.4 %
	Medial / lateral surface	00	00	1 %	00
	Lateral border	00	00	1 %	6.4 %
	Anterior/ medial border	00	00	00	00
Direction of foramina	Upwards	00	00	2.8 %	1.63 %
	Downwards	100 %	100 %	97.2 %	98.37 %

Conclusion

This study was comparable with other studies in relation with number, position and direction of the nutrient foramen. Limited resources compelled us to conduct the study on a small number of bones. Measurement techniques and interventions such as CT or X-ray to determine the length of the nutrient canal could not be conducted. Variations in the nutrient foramina do occur and prior knowledge of it is must before operating on tibia in case of fractures, graft and other related surgeries.

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