INTERNATIONAL JOURNAL OF CURRENT ADVANCED RESEARCH
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 13; Issue 1; January 2024; Page No.2765-2768
DOI: http://dx.doi.org/10.24327/ijcar.2024.2768.1602

Research Article

MORPHOMETRIC STUDY OF NUTRIENT FOR AMEN OF HUMAN TIBIA BONE

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ARTICLE INFO

Article History:
Received 28rd November, 2023
Received in revised form 9th January, 2024
Accepted 13th January, 2024
Published online 28th January, 2024

Key words:
Nutrient artery, Nutrient foramen, Measurement.

ABSTRACT

Background: The nutrient foramen of the tibia is located over the proximal third of its posterior surface. The nutrient artery provides nutrition to the long bones. The nutrient foramen has been subjected to various clinical manipulations, such as bone grafting and both internal and external fixation of fractures. Proper knowledge about its location, size, number, and distance from the proximal end is crucial. This knowledge reduces the chances of ischemia in the bone and diminishes vascularization of the metaphysis and bone plate during procedures. **Aim of the Study:** To understand the precise topography of the nutrient foramen, aiding surgeons in minimizing the risk of damaging the tibial vasculature during surgeries. **Study Design:** Cross-sectional observational study. **Materials and Methods:** For this study, 50 dry tibias of unknown age and sex were examined in the Department of Anatomy at Government Medical College, Srinagar. The study focused on determining the size, segmental position, distance from the proximal end, number of nutrient foramen, and their direction. **Results:** The study analyzed 50 dry tibias of unknown age and sex from the Postgraduate Department of Anatomy at GMC Srinagar. Out of these, 26 right tibias and 21 left tibias had a single nutrient foramen. Additionally, one right tibia and two left tibias had two nutrient foramina. Observations revealed that in 70% (22right and 13 left) of the tibias, the nutrient foramen was located in the upper third of the shaft. In 30% (9right and 6 left) of the tibias, the location was in the middle third of the shaft. Across all 50 tibias, the direction of the nutrient foramen consistently pointed downwards, towards the lower end.
Conclusion: Accurate knowledge of the nutrient foramen is crucial for procedures such as bone grafting, knee replacement surgery, and tumor resection. Understanding its location assists surgeons in minimizing the risk of damage to the tibial vessels.

INTRODUCTION

Tibia also known as the Shin bone is the second largest long bone. It is the medial bone of the leg homologous to the radius, bone of the forearm. The tibia is the weight-bearing bone of the leg and transmits weight from the femur to the foot[1]. It takes place in the formation of the knee joint from above and below it forms the medial malleolus and most of the bony surface for articulating the leg with the foot at the ankle joint[2]. The tibia consists of 3 parts: upper end, lower end and the intervening shaft. The shaft further has 3 borders and 3 surfaces. Proximal end: The proximal end has a medial and lateral condyle, intercondylar area and tibial tuberosity. The medial and lateral condyles widen and overhang the shaft medially, laterally and posteriorly and form a superior articular surface of the tibial plateau. The plateau consists of two smooth articular surfaces that articulate with the large condyles of the femur[3]. The tubercles fit in the intercondylar fossa between femoral condyles. They provide attachment of menisci, ligaments of the knee which hold the femur and fibula together. The anterolateral aspect of the lateral tibial condyle bears an anterolateral tibial tubercle which provides attachment for dense fascia covering the lateral thigh[4].

SHAFT

The shaft is triangular in section and has three surfaces: anteromedial, anterolateral, and posterior separated by anterior, lateral ((interosseous) and medial border. It is narrowest at the junction of the middle and distal third and gradually expands towards the end[5].

Antero lateral border

Descends from the tuberosity to the anterior margin of the medial malleolus and is subcutaneous.

Interosseous border

Descends to the anterior border of the fibular not chandis attached to the interrosseus membrane.

Medial border

Descends from the anterior end of the groove on the medial condyle to the posterior margin of the medial malleolus.

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Antero medial surface

The surface between the anterior and medial border. It is broad, smooth and entirely subcutaneous[6].

Lateral surface

The surface between the anterior and interosseous border.

Posterior surface

Lies between interosseous and medial surface, widest, crossed by an oblique line (Sole al line).A large vascular groove adjoins the end of the line and descends distally into a nutrient foramen[7].

DISTALEND

The distal end of the tibia has the following surfaces anterior, medial posterior, lateral and distal.

Like other long bones, tibia has a rich blood supply and is supplied chiefly by the Nutrient artery which is the branch of adjacent arteries running outside the periosteum. The nutrient artery of the tibia is the largest nutrient vessel in the body and a branch of the posterior tibial artery or peroneal artery[8]. The Nutrient artery enters the shaft of the tibia through the Nutrient Foramen, which is a small, smooth-walled opening found in the upper one-third part, posterior surface of the tibia directed away from the growing end of the bone. The presence of a nutrient artery in the upper part makes the lower part of the bone more prone to nonunion in case of fractures[9]. The brief knowledge of the nutrient foramen is important to the surgeons for the least interference with the vascularity of bone during various surgical procedures like bone grafting, knee replacement, bone resection for tumors, internal and external fixation of fractures[10].

METHODS

Ethics

Clearance was taken from the Institutional Review Board of Government Medical College Srinagar under **Reference no.: IRBGMC/ANAT67**.Thisobservational cross-sectional study was conducted in the Department of Anatomy Government Medical College Srinagar. For the study, 50 dry tibia bones were taken. Side determination was done using existing universally accepted criteria. Sliding Vernier Caliper was used for all distance measurements.
The following parameters were measured:

1. Appropriate size of nutrient foramen.
2. Variation in no of nutrient foramen
3. Variation in direction.
4. Segmental location of the nutrient foramen.

Approximate Size of Nutrient Foramen

The size of the nutrient foramen was measured with the help of a gauge needle of varying sizes 16G, 18G, 20G, 22G, 24G G.

Segmental Location of Nutrient Foramen

Calculate dusing Hughes Formula

FI = PL/TL* 100 (PL = nutrient foramen distance from the upper end of tibia)
TL=Total length of tibia.

Length of Tibia

using verniers caliper If the index is more than33.33 -the foramen is at the upper end of the bone if the index is between 33.33- and 66.66the foramen is in the middle of the bone If the index is more than 66.66 the foramen is at the lower end of the bone.

RESULT

The present study was done on 50 dry tibias of unknown age and sex, obtained from the Department of anatomy of GMC Srinagar. Among those, 26 right tibia and 21 left tibia have single nutrient foramen.1 right tibia and 2 left tibia have two nutrient foramen. We also noticed that in 70% (22 right and 13 left) tibia, the nutrient foramen was located in the shaft, in its upper one-third, 30% (9 right and 6 left) tibia, the location was on the middle one-third of the shaft. In all 50 tibias, the direction of nutrient foramen was observed to be downwards towards its lower end.

Table 1 Approximate size of a nutrient foramen in gauze, measured by hypodermic needle.

Approximate size of Foramen	Right Tibia	Left Tibia	Total
32G	1	2	3
28G	0	1	1
26G	0	0	0
24G	7	4	11
22G	3	1	4
20G	9	9	18
18G	2	4	6
16G	5	2	7

Table 2 Variation in the number of nutrient foramina in Tibia

No.of nutrient Foramen	Right Tibia	Left Tibia	Total
Single	26	23	47
Double	1	2	3

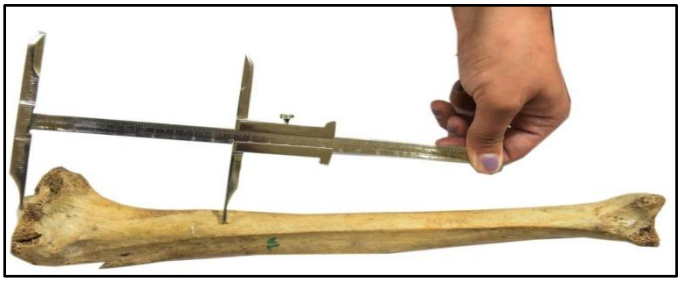
Table 3 Variation in Direction

Direction of nutrient Foramen	Right Tibia	Left Tibia	Total
Downward	27	23	50
Upward	0	0	0

Table 4 Segmental location of the nutrient Foramen

(Calculated by Hughes Formula)(n=50)

Segmental location of NF on the shaft	Right Tibia	Left Tibia	Total	Percentage
Upper1/3rd	22	13	35	70
Middle1/3rd	9	6	15	30
Lower1/3rd	0	0	0	0



CONCLUSION

The nutrient artery plays an important role in the blood supply of a long bone derived from the posterior tibial artery near its origin. During any surgical intervention, fracturere pair the exact location of the nutrient foramen in the tibia is important without damaging the nutrient artery which can lead to ischemia and interfere with the healing process.

DISCUSSION

In the present study, 27 right tibias and 23 left tibias are included. The result was compared with other studies. The approximate size of the nutrient foramen in gauze was measured. The results of my current study were compared with the previous study done by Barjatya Ranjana[etal, 4] which are shown in Tables 1 and 2 respectively.

Table 1 Approximate size of nutrient foramen in gauze, measured by hypodermic needle

Approximate size of Foramen	Right Tibia	Left Tibia	Total
32G	1	2	3
28G	0	1	1
26G	0	0	0
24G	7	4	11
22G	3	1	4
20G	9	9	18
18G	2	4	6
16G	5	2	7

Table 2 Barjatyaranjana, Purohitjaya, Katariasushma[4]

Approximate size of nutrient foramen in gauze, measured by hypodermic needle

Approximate size of Foramen	Right Tibia	Left Tibia	Total
32G	2	1	3
28G	0	0	0
26G	11	6	17
24G	0	0	0
22G	0	0	0
20G	0	0	0
18G	28	12	40
16G	19	11	30

In the present study, the number of nutrient foramen was seen. Single nutrient foramen was observed in 94% of bones and double in 6% of bones as compared with other studies such as, in the case of Chavda et al., who found 100% of bone having single nutrient foramen.

In the present study, the direction of the nutrient foramen was observed which was downward directed in100% as compared with Chavdaetal, who observed 97.14% was downward and 86% were upward. In the present study, the segmental location of the nutrient foramen was studied and was compared with previous studies as shown in Tables no 3 and 4 respectively.

Table 3 Calculated by Hughes Formula (n=50)

Segmental location of NF on the shaft	Right Tibia	Left Tibia	Total	Percentage
Upper1/3rd	22	13	35	70
Middle1/3rd	9	6	15	30
Lower1/3rd	0	0	0	0

Table 4 Barjatyaranjana, Purohitjaya, Katariasushma[4]

Calculated by Hughes Formula (n=50)

Segmental location of NF on the shaft	Right Tibia	Left Tibia	Total	Percentage
Upper1/3rd	51	24	75	83.3
Middle1/3rd	9	6	15	16.6
Lower1/3rd	0	0	0	0

Acknowledgement

We thank with due reverence the entire teaching faculty and non-teaching staff from the postgraduate department to f Anatomy for suggestions and advice. They helped us in preparing the manuscript.

Financial support and sponsorship

Nil

Conflict of interest

None

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How to cite this article:

Mahak MushtaqKanyu, Mohd SaleemItoo, Ghulam Mohammad Bhat, Javeed Ahmad Khan., 2023, Morphometric Study of Nutrient Foramen of Human Tibia Bone.*International Journal of Current Advanced Research.*13(1), pp.2765-2768.