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Anatomy

LOCATION AND POSITION OF NUTRIENT FORAMEN IN TIBIA, A STUDY ON 70 TIBIAE BONES OF NORTH INDIA.

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ABSTRACT tibia, a long bone in medial aspect of lower limb, weight bearing in nature with rich blood supply is responsible for its early healing if fractured. This study on 70 tibiae (Right=35 &Left =35) after obtaining approval from ethical committee of govt medical college Jammu in anatomy department was initiated to know the position and location of nutrient foramen in young adult tibiae. various instruments used were. a) Magnifying lens, b) Vernier calliper. c) Osteometric board. d) Thin Stiff wires. e) black marker pen) f) 20, 24 & 22 Gauge hypodermic needle e) Digital camera for illustration . After cleaning thoroughly broken and deformed bones were excluded. Nutrient Foraminae were identified by the presence of elevated margins. The directions of the foraminae were found out by inserting the thin stiff wire, location of foraminae were seen with the help of hand (magnifying) lens. black marker to mark the position of the foraminae on the bones finally the size of the foraminae are determined by inserting the hypodermic needles and vernier calliper was used to measure the distance (DNF)of nutrient foramen from proximal end of bone. **Observations and results:** (a) Distribution of number of nutrient foramen was found to be 0 in 2(2.86%), 1 in 67 (95.71) and 2 in 1 (1.43%) tibial bones out of 100% bones. (b) the tibial bones are categorised in 3 subtypes type 1, type 2, and type 3 according to the location of nutrient foramina Where Type 1: F.I up to 33.33% where the foramen was in proximal one third of bone Type 2: F.I from 33.33% to 66.66%, foramen was in middle one third of bone. Type 3: F.I above 66.66% where foramen was located in distal one third of bone. The position of the foramen, was found out to be in the upper third of 85.71% bone, while as the foramen is present in middle third of one in 14.20%. with mean foraminal index 31.59±3.25 cm variation of distribution in nutrient foramen is exploited during the bone grafting. In the majority of the tibia the nutrient foramen found out to be in upper 3rd of the bone

KEYWORDS :

Introduction

Nature has made lower limbs in such a way that the whole body weight is carried while standing in erect posture, walking, running, dancing and other activities.1 (Standring S)

The tibia (shin) bone or shank bone, the pre-axial bone situated on medial side in leg. Present subcutaneously, consists of three parts upper end, shaft and lower end. The upper end is expanded and bears prominent medial and lateral condyles and tibial tuberosity. The two condyles articulate with condyle of femur. The shaft has three borders anterior, medial and lateral and three surfaces medial, lateral and posterior. The anterior border is the sharpest. The lower end is small and projects down as medial malleolus. The NF is located in specific position in each bone. .In tibia the foramen is present on soleal line in posterior surface directed distally2(Chaurasia BD)

The bone (tibia), with a highly vascular mineralized connective tissue is hard, resilient and well known for its regenerative capacity as well as its characteristic growth mechanisms. Bone consists of cells and an intercellular matrix. Osteocytes forms majority of its cells lying embedded within it. The matrix is composed of organic materials mainly collagen fibres and the rest consists of inorganic salts rich in calcium and phosphate. Together these, give bone a unique mechanical property .Vascular canals ramify within bone providing its cells with metabolic support and creating entry for other cells like osteoclast and osteoblast. Bones collagen framework is different in young adults(gumusburun E3).

In young it is in the form of coarse bundles, but in mature bone it is like parallel fibred sheets. The bone is lined on the outside by fibrocellular layer the periosteum and on the inner surface is lined by the endosteum. The mature bone is of two types. It can be either dense (compact) or spongy (cancellous).

Naturally occurring holes named as nutrient foramen allow blood vessels to pass through the bony cortex 4(GOTZEN) Previously study was done to determined the location, number of dominant foramina in 60 tibiae and come out with the statement that nutrient foramen of tibia was found under the soleal line in 94.33 at an average distance of 117.8 mm from intercondylar eminence to the nutrient foramen in the superior third of bone, on the soleal line of bone in 3.77% and on the lateral border in 1.88%. (collipal5)

A Planned study to know the role of periosteal and interosseous blood supply which is used to improve the operating techniques for transplantation of allogenic vascularised femoral diaphysis and knee joints in human (Krischner MH6) .

Aim and Objectives: This study started with aims to locate, record and find the number of nutrient foramina in young adult tibia bones of human beings. Also, it stressed upon observing the direction variations along with obliquity of running nutrient canal.

Material and methods:

After obtaining ethical clearance from ethical committee of Govt Medical College Jammu, the study named morphology and morphometry of nutrient foramen in adult tibia and clinical importance started on 70 (Right =33& Left= 35) dried tibia bone of adult humans. The instruments used were

a) Magnifying lens. Used to locate the nutrient foramen
b) Vernier calliper. Used to measure distance from proximal end of bone to nutrient foramen
c) Osteometric board for measuring the length of bone
d) Thin Stiff wires used to know the direction of nutrient canal
e) Black marker pen) was used for making the position of foramen on the bone
f) 20, 24 & 22 Gauge hypodermic needle were used to know the size of foramen
e) Digital camera for illustration

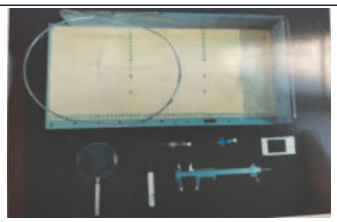

Fig 1 : Showing Materials used in the Study

METHEDOLOGY:

The study starts with using Bones labelled, cleaned thoroughly .Broken and Deformed bones were excluded. Nutrient Foraminae were identified by the presence of elevated margins. The directions of the foraminae were found out by inserting the thin stiff wire, location of foraminae were seen with the help of hand (magnifying) lens. With the help of black marker the position of the foraminae on the bons finally the size of the foraminea are determined by inserting the hypodermic needles. With the help of vernier calliper was used to measure the distance (DNF) of nutrient foramen from proximal end of bone.

Fig 2: Showing the methodology of measurement of length of bone by vernier caliper.

Fig 3: Showing nutrient foramen on upper 3rd of bone on posterior surface

Foraminal Index(F.I) = DNF/TOTAL LENGTH X 100 ie Hughes 29 formula.

Observations and results: (a) Distribution of number of nutrient foramen was found to be 0 in 2(2.86%), 1 in 67 (95.71) and 2 in 1 (1.43%) tibial bones out of 100% bones.

(b) According to the location of nutrient foramina the tibial bones are categorised in 3 subtypes type 1 , type 2, and type 3

Where Type 1 : F.I up to 33.33% where the foramen was in proximal one third of bone

Type 2: F.I from 33.33% to 66.66%, where the foramen was in middle one third of bone.

Type 3: F.I above 66.66% where foramen was located in distal one third of bone.

(c) Distribution of nutrient foraminea in right and left tibia

Table 1 Showing the distribution of nutrient foramina in right and left tibia.

No. of foramen	Right Tibiae		Left Tibiae	
	Number	Percentage	Number	Percentage
0	2	6.06	0	0
1	31	93.94	34	97.14
2	0	0	1	2.86
Total	33	100	35	100

Above table is showing the distribution of most common nutrient foramen was single in 97.14% on left side tibiae. Where as 0 in left tibiae. Double NF was present only in left tibiae 2.86%.

(d) Distribution of direction of nutrient foramina towards and away from growing end of the tibiae

Table 2. Distribution of direction of nutrient foramina towards and away from growing end of the tibiae.

Tibiae	No. of tibiae	Towards growing end		Away from growing end	
		No.	(%)	No.	(%)
Right	33	1	3.03	32	96.97
Left	35	1	2.86	34	97.14
Total	68	2	100	66	100

Above table shows that 97.14% foramina were directed away from the growing end and 2.86 % towards growing end.

DISSCUSSION:

Long bones of lower limbs are known for many variations and Tibia is most common. Present study is having evidence of finding 95.71% of these bones with 1 nutrient foramen which was supported by study by Gupta RK and Kumari GA (2014)7 are supporting the fact in their studies on 312 tibiae and observed 96.5% of bone with a single foramen. Mysorekar VR (1967)8 conducted a study on 178 tibia and observed 98.00% of bones with single nutrient foramen. Tejaswi HL et al.,(20149) estimated single nutrient foramen in 98.66% of tibia. Similar study by Kizil Kant E et al (200610) & Pareira G et al (201111) observed that 98.00% and 98.6% have single foramen which is in unison with our findings.

The position of the foramen, was found out to be in the upper third of 85.71% bone, while as the foramen is present in middle third of one in 14.20%. with mean foraminal index 31.59±3.25 cm. these observations concluded with the fact that nutrient artery of tibia enters the bone in the upper third of bone on its posterior surface which agreeable with discriptions present in previous studies.

Table 3 Showing the comparison of present study with previous studies. For location of nutrient foramen.

Author	Year	No of bone	Upper 3rd	Middle 3rd	Lower 3rd
Mysorekar VR[8]	1967	178	80%	21.60%	0 %
Longia GS et al[12]	1980	210	91.90%	8.10 %	0 %
Kirschner MH et a[16]	1998	200	93.50%	6.50 %	0 %
Collipal E et a[15]	2007	50	100%	0 %	0 %
Tejaswi HL et a[19]	2014	150	94.90%	5.10 %	0 %
Present study	2020	70	85.71%	14.2 %	0 %

Present study shows less or more resemblance with Mysorker VR (19678) Who observed 80% of be nutrient foramen located in upper 3rd of the bones. Also it shows similar observation (in table) for different studies on different times and number of bones.

CONCLUSION:

Advantages of study: variation in distribution of nutrient foramen is exploited during the bone grafting. In the majority of the tibia the nutrient foramen found out to be in upper 3rd of the bone. Hence the orientation of nutrient foramen must be in mind during the surgical procedure like vascularised bone micro surgery, fracture repaired joint replacement and bone grafting procedures. Thus, it prevent intraoperative injuries in orthopaedic as well as in plastic and reconstruction surgery.

Limitations: study material (bones) were less in number, for efficient analyses of variation in distribution, location and position of nutrient foramen need about doubles the bones have studied in this research.

Study might be used as data base for the future references while doing work on the identifications of bones in debries of earthquakes, natural calamities and war like situations for human skeletons.

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