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Location and Clinical Significance of Nutrient Foramina of Human Long Bones of Lower Limb

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Abstract: ***Introduction: The nutrient artery is the chief source of blood of a long bone particularly during its active growth period. Nutrient canal normally slanted during growth. The direction of slant from outer surface to marrow cavity points towards the end that has grown relatively slowly. This is due to greater longitudinal growth at the rapid growing end. Material and methods: The material of present study consisted of 150 (50 femur + 50 tibia + 50 fibula) adult human long bones of lower limb. The location of nutrient foramina is determined by using foraminal index formula and number of foramina were examined of all the bones. Foraminal index = (DNF/TL) x 100. DNF- distance from the proximal end of the bone to the nutrient foramina, TL – total bone length. Results: 150 adult human dried bones were taken for the study. Among 64 nutrient foramina of femur 90.62% were on the medial lip of linea aspera (Expected site) and 9.38% on lateral lip and anterior surface (Variant site). In 53 nutrient foramina of tibia 100% were located on posterior surface (Expected site). In 52 nutrient foramina of fibula 100% were located on posterior surface (Expected site). Conclusion: The knowledge about nutrient foramina of long bones of lower limb is useful in certain surgical procedure to preserve the circulation.***

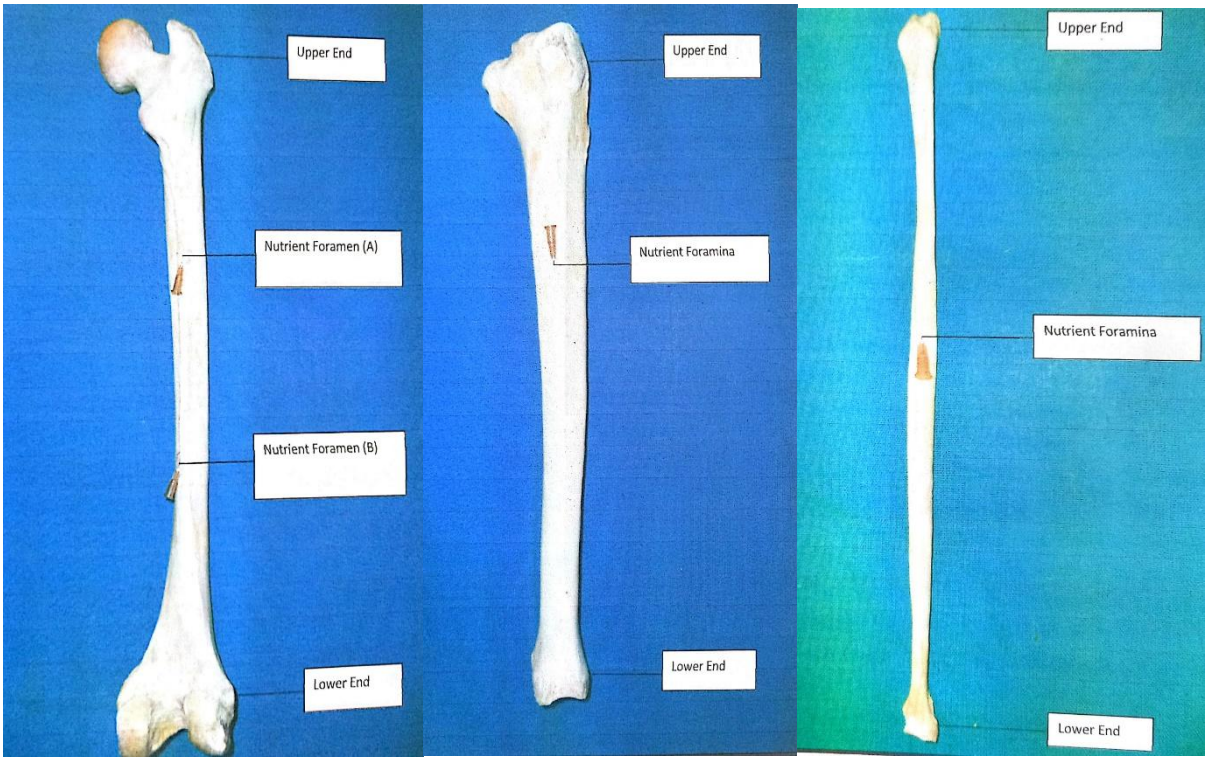
Keywords: Diaphysis, Femur, Tibia, Fibula, Nutrient foramina.

1. Introduction

The role of nutrient foramina is nutrition and growth of the bones is evident from the term Nutrient itself. Knowledge of position of nutrient foramina can be useful in certain surgical procedures. Their probable role in few cases of vascular necrosis was pointed out.[1] The nutrient artery is the chief source of blood of a long bone particularly during its active growth period. Nutrient canal normally slanted during growth. The direction of slant from outer surface to marrow cavity points towards the end that has grown relatively slowly. This is due to greater longitudinal growth at the rapid growing end. The direction of nutrient foramina of all bones is away from rapidly growing end.[2,3] The nutrient canals are cavities that conduct the nutrient arteries and peripheral nerves. The major blood supply for long bones originates from the nutrient arteries, mainly during the growing period and during the early phases of ossification.[4] Importance of nutrient foramen is relevant to fracture treatment. Combined periosteal and medullary blood supply to the bone cortex helps to explain the success of nailing of long bone fractures particularly in the weight bearing like femur and tibia and deploying graft of vascularized fibula bone in bony defects due to trauma.[12]

2. Material and methods

The material of present study consisted of 150 (50 femur + 50 tibia + 50 fibula) adult human long bones of lower limb obtained from osteology lab of department of anatomy SMMH medical college Saharanpur. All selected bones were normal without any appearance of pathological changes. The nutrient foramina observed with the help of a hand lens. Well defined foramina on the shaft/diaphysis were recoded. The location of nutrient foramina is determined by using foraminal index formula and number of foramina were examined of all the bones. Osteometric board was used for determination of length of femur, tibia and fibula. Foraminal index = (DNF/TL) x 100. DNF – distance from the proximal end of the bone to the nutrient foramina, TL – total bone length. The data were analysed and tabulated using range mean and standard deviation of foraminal index.



Femur Tibia Fibula

3. Results

Among 64 nutrient foramina of femur 90.62% were on the medial lip of linea aspera (Expected site) and 9.38% on lateral lip and anterior surface (Variant site) of diaphysis of femur. In 53 nutrient foramina of tibia 100% were located on posterior surface (Expected site) of tibia. In 52 nutrient foramina of fibula 100% were located on posterior surface (Expected site) of fibula.

Bone (150)	No of Foramina	Expected site	Variant site
Femur (50)	64	58 (90.62%)	6 (9.38%)
Tibia (50)	53	53 (100%)	0 (0%)
Fibula (50)	52	52 (100%)	0 (0%)

Among the 64 nutrient foramina 14.06% were on the proximal one third (type 1), 82.81% were on the middle one third (type 2) and 3.13% were on distal one third (type 3) on diaphysis of femur. In the tibia among 53 nutrient foramina 90.57% were found on proximal one third (type 1) and 9.43% were found on middle one third (type 2) of diaphysis of tibia. In the fibula among 52 nutrient foramina 96.16% were found on middle one third (type 2) and 3.84% were found on distal one third (type 3) of diaphysis of fibula.

Bone	No of Foramina	Mean ±sd	Type 1	Type 2	Type 3
Femur (50)	64	46.60 ±11.25	9 (14.06%)	53 (82.81%)	2 (3.13%)
Tibia (50)	53	34.49 ±4.42	48 (90.57%)	5 (9.43%)	-
Fibula (50)	52	45.73 ±12.26	-	33 (96.16%)	2 (3.84%)

Type -1 foramina index up to 33.33, foramen present in proximal one third of bone. Type -2 foramina index up to 33.33 - 66.66, foramen present in middle one third of bone. Type -3 foramina index above 66.66, foramen present in distal one third of bone.

4. Discussion

In the present study most of the foramina 82.81% were located in the middle one third of the femur, rest were in the proximal and distal one third of the diaphysis of femur. Our findings are almost similar to findings of the previous studies.[6,7,8] 90.57% nutrient foramina of the tibia were in the proximal one third. Rest of nutrient foramina 9.43% were located in the middle one third and no foramina in the distal one third of the diaphysis of tibia. Previous studies also stated that most of the nutrient foramina located in the proximal one third of the tibia.[6,9,10] The rate of healing of a fracture is related to the blood supply. The area or region with a good blood supply are rapidly healed in comparison to a poor blood supply. Tibia is best example of such cases, because there is no nutrient foramina in the distal one third of diaphysis of tibia so fracture in distal one third of tibia show delayed or malunion.[11] Most of the nutrient foramina in fibula were situated in the middle one third of the shaft 96.16% and rest of foramina were located in the distal one third of the shaft, these results were similar to the previous studies.[7,8,10,12] In the bones of lower limb most of the nutrient foramina located on the posterior surface, Kizilkanat E. et al. stated that the position of nutrient foramina was directly related to the requirement of a continue blood supply to specific aspect of each bone.[13]

5. Conclusion

The analysis of the nutrient foramina distribution indicates that in the majority the foramina are located on the posterior surface of long bones of the lower limb. The knowledge about nutrient foramina of long bones of lower limb is useful in certain surgical procedure to preserve the circulation.

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