Study of Diaphyseal Nutrient Foramen in Human Tibia in People of Gujarat

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Abstract :

Introduction : Nutrient foramen is an external opening of the nutrient canal in a bone. During routine teaching of osteology to the under graduate students, mention is always made of the nutrient foramen on the shafts of long bones, its causation, direction and its importance in relation to the growing end of the bone. **Material and Methods :** For this study 300 tibias were collected randomly. Length, number of nutrient foramina and distance of nutrient foramen from upper end and lower end of tibia were measured. **Results :** In present study we have observed that maximum length of tibia was 420mm and minimum length was 310 mm. In majority of bones, the foramina were located on the posterior surface little below the soleal line. Only in 4 bones, two nutrient foramina were present (1.33%). All other bones had single nutrient foramen. The distance of foramen from upper end varies from 87.4mm to 146.6mm and distance of nutrient foramen from lower and varies from 206.4mm to 290.8mm.**Conclusion :** The proportion between total length of tibia and distance of nutrient foramen from upper end is constant. The proportion between total length of tibia and distance of nutrient foramen from lower end is not constant.

Introduction :

Skeleton gives structural framework to the body. Study of bones serves important information. Anatomical study of tibia serves helpful data to understand different aspect of clinical conditions including common site of fractures, changes in osteoporosis, associated congenital anomalies as well as in medico legal cases.

During routine teaching of osteology to the under graduate students, mention is always made of the nutrient foramen on the shafts of long bones, its causation, direction and its importance in relation to the growing end of the bone. Even most of the books in anatomy have not given any definite information regarding the number, position and situation of the nutrient foramen in relation to either upper end or lower end of a long bone. The artery which supplies the diaphysis of bone is known as nutrient artery.

Berard[1] was the first to point out that in the humanlong bones, the nutrient canals were obliquely disposed, pointing towards the elbow in theupper limb and away from the knee in the lowerlimb. An understanding of the position and number of the nutrient foramina inlong bones is important in orthopedic surgical procedures such as joint replacement therapy,fracture repair, bone grafts and vascularized bone microsurgery.[2] An absence of nutrient foramina in some bones has been observed, in which case the periosteal vessels become the sole source of the blood supply. [3]

The surgeon must acquire the detailed knowledge of the anatomy of the part on which he is to operate since the success of these operations depends to a large extent on a minimal interference with the blood supply of the bone. [4]The role of nutrient foramina in the nutrition and growth of the bones is evident from the term"nutrient" itself.[5]

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Material and Methods :

Study Materials :

For this study 300 tibias were collected randomly not knowing the sex and age of bone. Out of 300 human tibias, 250 tibias were studied from B.J. Medical College, Ahmedabadand 50 were studied in Smt. N.H.L. Municipal Medical College, Ahmedabad. The bones were cleaned thoroughly over a screen bottomed tray using water with brush. Bones were dried and macerated. Damaged, incomplete and un-ossified bones were excluded. All the bones, intact and fully ossified belonging to the adult persons were collected for study.

After labeling cleaned bones with site number, 300 tibias were studied for following measurements:

Distance of Nutrient foramina from both the ends: Distances from both ends were measured and noted down separately.The inter-condylar eminence and the tip of medial malleolus were used as bony landmarks to define the upper and lower ends of tibia respectively. For the sake of convenience the total length of the tibia was interpreted as "L" & Distance from upper end "D_u" and lower end "D_l".

Observation :

Keeping in view the aim of the study mentioned earlier, following observations were recorded for all the tibia:

1. Total length of tibia from tip of tubercular eminence to the tip of medial malleolus were measured on the osteometric board.
2. Distance of nutrient foramen from upper end and lower end is measured with the help of osteometric board.

The position of nutrient foramen was seen and its distance from both the ends was taken.Where there was more than one foramen they were observed for their distances from both ends. Their frequency in number was tabulated.

Table 1: Total length of tibia

Total No. of Tibia measured	Mean Length (mm)	SD	CI (mm)	CV(%)
300	365	± 24.5	316 - 414	6.7

Mean tibia length was 365mm with standard deviation ± 24.5 &CV 6.7%. Range of data at 95% confidence interval was 316mm to 414mm. From above data it was interpreted that the maximum length of tibia was 420mm & minimum length was 310mm assuming all are adult bones. The maximum tibias are between 340mm to 390mm.

Table 2 : Distance of nutrient foramina from upper and lower end of tibia

Variables	Distance from Upper end D_u (mm)	Distance from Lower end D_l(mm)
Mean Length (mm)	117.0	248.6
SD	± 14.8	± 21.1
CI	87.4mm to 146.6mm	206.4mm to 290.8mm
CV(%)	12.64	08.48

Table 2 shows that the distance of nutrient foramina from upper end, mean was calculated 117mm with standard deviation ± 14.8 CV 12.64. Range of data at 95% confidential interval is 87.4mm to 146.6mm.Distance of nutrient foramina from lower end, as calculated mean was 248.6mm with SD ± 21.1 CV 8.48mm. Range of data at 95% confidential interval is 206.4mm to 290.8mm. In present study, it was found two nutrient foramina in four bones.

Discussion :

Bones are the framework of the vertebrate body and thus contain much information about man's adaptive mechanics to his environment.

Length of tibia :

In study by E Sendemir and A Cimen[6] mean length was 359mm and in study of Gupta and Gupta[7] it was 364mm. In present study, maximum length of tibia was 420mm and minimum length was 310mm.So mean length in present study was 365mm.

Situation and numbers of nutrient foramen :

In study of Gupta and Gupta[7]they found 0.97 % double number of foramina. While Mysorekar[8] reports out of 180 bones only 2 had double foramina (1%).In the study of E Sendemir and Cimen[6] double nutrient foramina were found in 5.2% tibia out of 305 tibia studied.In present study, in majority of bones the foramina were located on the posterior surface little below the soleal line on the posterior surface. In 4 bones two nutrient

foramina were present(1.33%). All other bones had single nutrient foramina. This shows that presence of more than one nutrient foramen is rare.

Position of Nutrient Foramen :

Mysorekar[8] reports 1 nutrient foramen on anteromedial surface and records a few cases with nutrient foramina on the interosseous border and the antero-lateral surface also. The nutrient foramina were located on the posterior surface of the tibia in this study in most of the bones.

Distance of Nutrient Foramen from upper and lower ends:

In the study by Gandhi et al[9] distance of nutrient foramen from upper end was found from 97.28mm to 127.65mm and from lower end was found from 213.28mm to 276.02mm.In the study by Chhatrapati and Misra[10]distance of nutrient foramen from upper end is 82mm to 141mm and from lower end is 211mm to 302mm. In the study by Gupta and Gupta, [7]the distance of nutrient foramen from upper end was found in the range 100mm to 149mm (mean 119.8mm). In our study, the ratio between average length of the bone and the average distance from upper end i.e. L/D_u = 3.12. The ratio between average length of the bone and the average distance from lower end i.e. L/D_l = 1.47.The distance of nutrient, foramina from the upper end of the tibia and lower end of tibia were measured. The distance of foramen from upper end varies from 87.4mm to 146.6mm and distance of nutrient foramen from lower and varies from 206.4mm to 290.8mm. Mean values of D_u (distance from upper end) was 117mm and the mean values of D_l(distance from lower end) was 248.6mm. These values suggest that nutrient foramen nearer to upper end than lower end.

Kizilkanat et al[2]emphasized upon the importance of location of nutrient foramina in longitudinal stress fractures of tibia as these fractures can either initiate from the nutrient foramen or its superomedial aspect. They further related the delayed or nonunion in the middle or lower diaphysis following trauma to the absence of nutrient arteries entering the bones. Clinical fracture of a long bone is usually accompanied by rupture of the nutrient artery with variable disruption of the peripheral vessels associated with periosteal detachment. Following fracture the ruptured nutrient artery and periosteal vessels, together with those in the adjacent soft tissue, start local bleeding (Trueta et al[11]).

The anatomic situation of the nutrient foramina always appeared on the posterior surface of tibia below the soleal line.[12]

Conclusion :

From the study of 300 human tibias, on basis of observation and discussion, the following general conclusions can be derived for all tibia studied. The proportion between total length of tibia and distance of nutrient foramen from upper end is constant. The proportion between total length of tibia and distance of nutrient foramen from lower end is not constant. The presence of more than one nutrient foramen in tibia is not a rare phenomenon. The findings of this study do confirm the observations reported in earlier studies but some significant differences are also observed. In our study we observed that 1.3% tibia had double nutrient foramen.In majority of bones the foramina were located on the posterior surface little below the soleal line.

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