ORIGINAL RESEARCH PAPER

VOLUME-6 | ISSUE-5 | MAY - 2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

NUTRIENT FORAMINA OF ADULT HUMAN TIBIA IN TELANGANA REGION– ITS POSITIONAL ANATOMY AND CLINICAL IMPLICATIONS

Anatomy

DR. APARNA VEDA PRIYA. K. Associate Professor ,dept of anatomy, Osmania Medical College, HYDERABAD. TELANGANA STATE.

DR. V.JANAKI Associate Professor ,dept of anatomy, Kakatiya Medical College, WARANGAL. TELANGANA STATE.

ABSTRACT

Introduction: Nutrient foramen is the external opening of the nutrient canal in a bone. An understanding of the location, number, direction of diaphyseal nutrient foramina in Tibia is very important clinically, especially in orthopedic surgical procedures.

Method: This study was conducted on 92 (48 Right and 44 Left) Dry Adult human Tibia. All the parameters like number, the most common location and the frequency of the location on the anatomical surfaces and borders of each of the Tibia and the direction of each diaphyseal nutrient foramina and the frequency of the cases not obeying the Berard's rule in Tibia is studied.

Results: In the present study among the 92(48 Right and 44 Left) bones, 10 bones are with second nutrient foramina . 89.2% had single nutrient foramina and 10.8% had 2 nutrient foramina. in all these second nutrient foramina 40% only directed upward . The location of nutrient foramina observed was 99.3% on the posterior surface.

Conclusion: No author has reported tibia without NF and therefore the average number was always reported as greater than one. secondary nutrient foramina , where we report that the second nutrient foramina Berard's rule was not followed and only primary or dominanat nutrient foramina only following the berard's rule.

KEYWORDS:

Diaphyseal nutrient foramen, tibia, nutrient artery

INTRODUCTION

All arteries supplying the long bones are 'nutrient' but the artery to the diaphysis is known as '*nutrient artery*'. The main blood supply to long bones is from these diaphyseal arteries, especially during the active growing period in the embryo and fetus, and during the early phases of ossification. The principal nutrient foramen is commonly displaced nearer to one extremity of a long bone than the other and the canal is usually oblique with respect to the long axis of the bone.

Berard (1835)[1] was the first to point out that in the human long bones the nutrient canals were obliquely disposed, pointing towards the elbow in the upper limb and away from the knee in the lower limb. The dissection room jingle "*To the elbow I go; from the knee I flee*" is originally in French, "Au coude je m'appuis, du genou je m'en fuis". This is called the Berard's rule of canal direction.

In 1674, Antonie van Leeuwenhoek[2], first observed and documented nutrient foramen in a tibia of a calf. A few authors have studied nutrient foramina in human long bones. Kizilkanat et al (2007)[3] and Mysorekar (1967)[4] have studied nutrient foramina of the six long bones in humans including tibia while Nelson et al (1960)[5], Longia et al. (1980)[6], Forriol et al. (1987)[7], Sendemirand Cimen (1991)[8], Hallock et al (1993)[9], Nagel (1993)[10], Gümüsburun et al. (1994)[11] and Kirschner et al. (1998)[12] have studied the nutrient foramina in tibia. The aim and objective of this study was to An understanding of the location, number, direction of diaphyseal nutrient foramina in Tibia .

MATERIALS AND METHOD

This study was conducted on 92 (48 Right and 44 Left) dry Adult human Tibia. Each tibia was numbered serially and their side (Left or Right) was determined. The diaphysial nutrient foramina were observed in all the bones with a hand-lens and encircled with a marker pen.

1. total number of nutrient foramina,
2. The location (on which surface) and position of the nutrient foramina was also recorded in terms of the fraction of the bone it occupied from the upper end. The tibia was divided into three fractions each and denoted as I, II and III.
3. The direction of the obliquity of the nutrient foramina was to be noted. It would be recorded as 'upward' or 'downward' with respect to the proximal end of the long bone

The observations were recorded and the data was compiled and is presented in tables.

RESULTS

In the present study among the 92(48 Right and 44 Left) bones, 10 bones have second nutrient foramina . 89.2% had single nutrient foramina and 10.8% had 2 nutrient foramina(Table-3). In these second nutrient foramina 40% only directed upwards Out of 92 tibia in 86 bones nutrient foramina present on posterior surface, in 6 bones nutrient foramina present on medial surface(Table-1). All the bones show their dominant nutrient foramina in upper 1/3rd only. In second nutrient foramina 40% are in upper 1/3rd, another 40% in the middle 1/3rd, 20% are present in lower 1/3rd(Table-2, Figure-1a&1b).

Table 1: Table showing the location of nutrient foramina in relation to the vertical line on the posterior tibial shaft

	Location of Nutrilent Foramina						
	Total no of bones	Medial surface	Lateral surface	Posterior surface			
				Medial to vertical line	On the vertical line	Lateral to vertical line	Total no of bones
Right tibia	48	4	-	-	4	40	44
Left tibia	44	2	-	-	2	40	42
	92	6	-	-	6	80	86

Table 2: Table depicting the situation of nutrient foramina in relation to length of tibia in various studies with special reference to the present study. *U/M- Upper and Middle

Authors (year)	Race	Situation of nutrient foramina		
		Upper 1/3rd	Middle 1/3rd	Junction between U/M third
Mysorekar (1967)	Indian (Poona)	141	39	2
Kate (1971)	Indian (Nagpur)	-	-	200

Longia (1980)	Indian (Jhansi)	96	97	17
Collipal (2007)	Chile	50	-	-
Swati Gandhi (2013)	North indian	100	-	-
Present study (2017)	South indian	92	-	-

Table 3: Table showing the number of nutrient foramina in tibial shaft by different authors with special reference to the present study.

Authors (year)	Race	No of Bonesw with Nutrient foramina		
		One	Two	Three
Mysorekar (1967)	Indian (Poona)	49	-	-
Kate (1971)	Indian (Nagpur)	178	02	
Longia (1980)	Indian (Jhansi)	160	30	10
Collipal (2007)	Chile	190	10	-
Kizilkanat (2007)	Turkish	98	02	
Swati Gandhi (2013)	North Indian	98	2	-
Present study (2017)	South Indian	82	10	-

DISCUSSION:

Gray's Anatomy text book[13] describes the location of nutrient foramina, and the direction of being obliquely downwards. Morris' Text book of Human Anatomy[14] states that 'the tibia is a very vascular bone. The nutrient artery of the shaft is furnished by the posterior tibial artery and is the largest of its kind in the body'.

In the present study the 10.8% tibia bone was found to have two nutrient foraminas. We find that no author reports more than 2 NFs and tibia without NF is not reported earlier. Our present study also confirmed this. In this study in 10 (2 Left and 8 right) bones have two nutrient foramina. It may be very small and obscured and escaped detection.

The majority of tibiae had a single nutrient foramen in this study similar to earlier studies.[6-12] and we find a similar value near to 1, which denotes that the tibia has only one nutrient artery supplying it mostly.

The nutrient foramina were located on the posterior surface of the tibia (in 90 tibia out of 92 tibial bones)in most of the bones, only 2 tibia show nutrient foramina on medial surface. On comparing the result of this study with the other authors, Mysorekar (1967)[4] reports 1 NF on anteromedial surface and records a few cases with nutrient foramina on the interosseous border and the antero-lateral surface also. Nelson et al (1960)[5] also report nutrient artery penetrating the posterolateral cortex at a point just below the oblique line of the tibia, below the origin of the soleus muscle,in their study of 14 amputed limbs.

On studying location most of the Nutrient Foramina on the upper 1/3rd of the tibia and on comparing this result with Mysorekar (1967)[4], we get a nearly similar result. Location is most frequently on the 1st part, also reported earlier [6,9] which is of much clinical significance because this explains why the lower end of tibia is less vascular with no nutrient foramina located in whole study, and therefore non-unions are common on the lower part of shaft of tibia..

In all the bones studied the direction of the nutrient foramina was directed downwards signifying that the upper end (near the knee joint) is the growing end. None of the other authors have reported tibia with nutrient foramina directed upwards but in 40% of second nutrient foramina directed upwards only.

An understanding of the location, number, direction and caliber of diaphyseal nutrient foramina in long bones is very important clinically, especially in orthopedic surgical procedures. Accidental ligation of the nutrient artery of a long bone leads to an immediate decrease in the bone blood flow. Non-unions happen when the bone lacks adequate stability and/or blood flow. The tibia is a good example to illustrate the rate of healing in relation to vascular supply, with those areas or regions with a good blood supply showing more rapid healing than those with a poor blood supply.[15] Fractures in the distal third of the tibial shaft tend to show delayed union or malunion: one suggestion being that there may be a tear of the nutrient artery at the fracture line, thus reducing the blood supply to distal site[16]. Injury to the nutrient artery at the time of fracture, or at subsequent manipulation, may be a significant factor predisposing to faulty union[17-21].

CONCLUSION:

The findings of this study do confirm the observations reported in earlier studies but some significant differences are also observed. 89.2% had single nutrient foramina and 10.8% had 2 nutrient foramina. In these second nutrient foramina 40% directed upwards only.



Fig-1a



Fig-1b

Fig 1a &1b showing double nutrient foramina- Primary nutrient foramina on posterior surface near vertical line, Second nutrient foramina on lateral to vertical line.

REFERENCES:

1. Berard A.; 'Memoire Sur Le Rapport Qui Existe Entre LaDirection Des Conduits Nourriciers Des Os Longs Et L'ordre Suivant Lequel Les Epiphyses See Soudent Au Corps De L'os.' Archives Generales De Medicine, Series 2, 7, 176-183, 1835
2. Leeuwenhoek Antonie Van; Microscopical Observations From M. Leeuwenhoek Concerning Blood, Milk, Bones, The Brain, Spittle And Cuticula Etc.' Letter To Royal SocietyDated 1 June. Phil. Trans. R. Soc. 9, 121-128, 1674
3. Kizilkanat et al (2007) Kizilkanat E, Boyan N, Ozsahin ET, Soames R, Oguz O,Location, number and clinical significance of nutrient foramina in human long bones, Ann Anat, 2007, 189(1):87– 95.
4. Mysorekar, V.R.; Diaphysial Nutrient Foramina In Human Long Bones. J. Anat. 101, 813–822. 1967
5. Nelson Ge, Kelly Pj, Peterson Lfa, Janes Jm ; Blood Supply Of The Human Tibia. Journal Ofbone And Joint Surgery 42A, 625-635. 1960
6. Longia, G.S., Ajmani, M.L., Saxena, S.K., Thomas, R.J.; Study Of Diaphyseal Nutrient Foramina In Human Long Bones. Acta Anat. (Basel) 107, 399–406. 1980
7. Forriol Campos, F., Gomez Pellico, L., Gianonatti Fernandez-Valencia, R.; A Study Of The Nutrient Foramina In Human Long Bones. Surg. Radiol. Anat. 9, 251–255.1987
8. Sendemir, E., Cimen, A.; Nutrient Foramina In The Shafts Of Lower Limb Long Bones: Situation And Number. Surg. Radiol. Anat. 13, 105–108. 1991
9. Hallock, G.G., Anous, M.M., Sheridan, B.C.; The Surgical Anatomy Of The Principal Nutrient Vessel Of The Tibia. Plast Reconstr. Surg. 92, 49–54. 1993
10. Nagel A; The Clinical Significance Of The Nutrient Artery. Orthop. Rev. 22, 557–561.1993
11. Gumusburun, E., Yucel,F.,Ozkan,Y., Akgun, Z; A Study Of The Nutrient Foramina Of Lower Limb Long Bones. Surg. Radiol. Anat. 16, 409–412. 1994
12. Kirschner, M.H., Menck, J., Hennerbichler, A., Gaber,O., Hofmann, G.O., Importance Of Arterial Blood Supply To The Femur And Tibia For Transplantation Of Vascularized Femoral Diaphyses And Knee Joints. World J. Surg. 22, 845–852. 1998
13. Gray's Anatomy; 35th Edition, Edited By Roger Warwick & Peter L. Williams, Longman Group Ltd., 1973
14. Morris' Human Anatomy, 11th Edition, By J Parsons Schaeffer, Philadelphia, USA. Mcgraw Hill Book Company Inc. P91, P217, P253,255,262, 1953
15. Trueta J, Blood Supply And The Rate Of Healing Of Tibial Fractures. Clin. Orthop. Rel. Res. 105, 11–26, 1974
16. Snell, 1986; Clinical Anatomy For Medical Students, Third Ed. Little, Brown And Company, Boston, P. 686,1986
17. Stewart, M. J., And Hundley. J. M, Fractures Of The Humerus; A Comparative Study In Methods. Of Treatment. Journal Of Bone And Joint Surgery, 37-A, 681.1955

18. Watson-Jones, Sir R. Fractures And Joint Injuries. Fourth Edition. Edinburgh And London : E. & S. Livingstone Ltd. 1955
19. Kennedy, J. C., Wyatt, J. K.An Evaluation Of The Management Of Fractures Through The Middle Third Of The Humerus. Canadian Journal Of Surgery, 1, 26. 1957
20. Mercer, Sir W. , Orthopaedic Surgery. Fifth Edition. London: Edward Arnold (Publishers) Ltd. 1959
21. Turek, S. L.; Orthopaedics, Principles And Their Application.Philadelphia And Montreal: J. B. Lippincott Company
22. Swati Gandhi ., Diaphyseal nutrient foramina of tibia. Rev Arg de Anat Clin; 2013, 5 (3): 222-228