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Nutrient Foramen on Adult Dry Left Femur and Its Clinical Implication

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ABSTRACT

Introduction: *The Femur bone is a highly vascular structure with unique features in its blood supply via numerous foramina located over its different segments, being named as vascular foramina. Among vascular foramina, nutrient foramen is an important one which gives way to the nutrient artery. Knowledge of vascular anatomy is helpful in early identification of vascular interruptions leading to osteonecrosis. The nutrient foramina are openings that conduct the nutrient arteries. The majority blood supply for femur originates from the nutrient arteries, mainly during the growing period and during the early phase of ossification. During bone grafts the nutrient blood supply is crucial and it should be preserved in order to promote the healing. So, the number of nutrient foramen of femur is indispensable for orthopaedic and vascular surgeons as well as to radiologist for planning of treatment. Thus, this data could be valuable as reference for surgical procedures of the lower limb.* ***Methods:*** *This is a purposive sampling type of study carried out in the Morphometric study of nutrient foramen in the Department of Anatomy, Sir Salimullah Medical College (SSMC), Dhaka, Bangladesh from July 2011 to June 2012. The study comprised of 199 fully ossified left sided dry femur (n=89 male, n=110 female). The bones were collected from the Department of Anatomy, Sir Salimullah Medical College Dhaka, foramen of all samples were studied by direct physical examination and photographic methods.* ***Results:*** *The nutrient foramen were observed as single in 84.7% male and 76.7% female samples, two in number in 13.3% male and 21.3% female samples and three in number in 2.4% male and 2% female samples of left femur respectively.* ***Conclusion:*** *The anatomical knowledge of nutrient foramen of this study is useful in certain surgical procedures to preserve the circulation. As microvascular bone transfer is becoming more popular, a convention for the anatomical description of nutrient foramen is important.*

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INTRODUCTION

Long bones are supplied by a nutrient artery that enter individual bones obliquely through a nutrient foramen. This foramen, in the majority of cases is located away from the growing end.[2] The foramina 'look for the elbow and flee from the knee'.[3] This is because one end of the limb bone grows faster than the other. Henderson[4] reported that their position in mammalian bones are variable and may alter during growth. Though the foramina are directed away from the growing end, their topography might vary at the non growing end. So, the topographical anatomy of the nutrient foramina may be of worth. The topographical knowledge of the number of nutrient foramina is useful in certain operative procedures to preserve the circulation.[5-7] Therefore it is important that the arterial supply is preserved in free vascularised bone grafts so that the osteocytes and osteoblasts can survive.[8] When a bone graft is taken, the vascularisation of the remaining bones has to be considered with the vascularity of this area allowing various options in grafting.[9] It has previously been reported that the ideal bone graft for the free transfer should include endosteal and periosteal blood supply with good anastomosis.[6] The bony defect which is left behind following traumatic injuries, tumour resection procedures and pseudoarthrosis can all be reconstructed by bone grafting procedures and the preferred modality is free vascularised bone graft.[10] The importance of preoperative angiography remains important to exclude the possible vascular anomalies in both recipient and donor bones for the microvascular bone transfers.[11] The study provides data on the morphology and topography of the number of nutrient foramina in bony specimens. The data is helpful for clinicians involved in vascular graft surgeries. This research emphasizes the anatomical description of number of nutrient foramina which are important as micro vascular bone transfer which is becoming more popular. The aim of the present study is counting the number of diaphyseal nutrient foramen, anatomy and morphometry of nutrient foramen of fully ossified left femur. Femur is ossified completely by the age of twenty five years.[1] So, it achieves its adult form and then any measurement can be taken for research after this age. According to the reported observation, left lower limb is functionally dominant in majority of human beings.[12] On this basis, left sided adult femur was considered as sample in this study.

METHODS

It was a purposive type of study performed on 199 fully ossified left sided dry femur (n=89 male, n=110 female). The bones were collected from the Department of Anatomy, Sir Salimullah Medical College (SSMC), Dhaka from July 2011 to June 2012. Sampling technique was purposive. The number of nutrient foramen on the shaft of left femur in male & female were considered as key variable. Instrument used for taking direct physical measurements by digital slide caliper, scale, and indirect photographic measurement by digital camera and computer. All measurements were recorded in metric unit-centimeters (cm). Bones which had gross pathological deformities were excluded from the study. All the bones were macroscopically observed for the number of the nutrient foramina. The number of nutrient foramina was identified by the presence of a well marked groove leading to them and by a well marked, often slightly raised, edge at the commencement of the foramen. Only diaphysial nutrient foramina were observed in all the bones. The number and topography of the foramina of the diaphysis were analyzed. An elastic rubber band was applied around these foramina (Figure 1 and 2) and the photographs were taken with a

digital camera, which was manufactured by Nikon (Coolpix S3000, made in China). The parameters were measured by using a scale bar.[13]

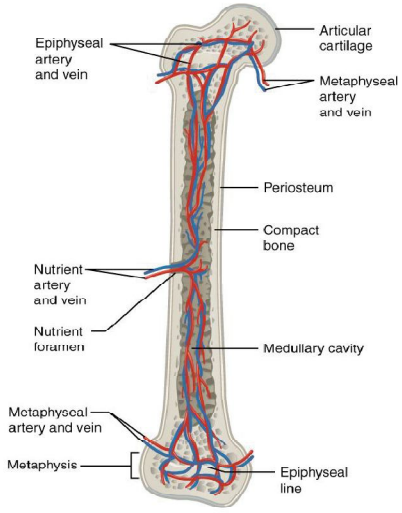

Figure 1. Showing the nutrient foramen, nutrient artery

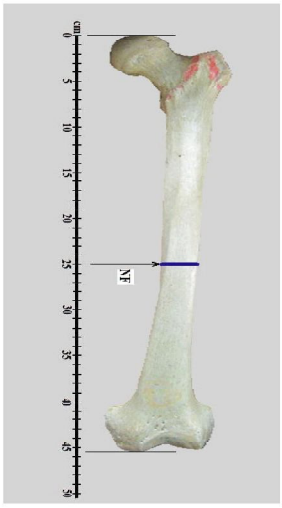

Figure 2. Procedure for identifies the number of nutrient foramen (NF)

RESULTS

The number of nutrient foramen were observed single in 82 (84.4%) male and 78 (76.7%) female samples, double in 13 (13.3%) male and 22 (21.3%) female samples and triple in 2 (2.4%) male and 2 (2%) female samples of fully ossified left femur respectively (Table I, Figure 3 & Figure 4).

Table I - Number of nutrient foramen in male and female

Nutrient foramen		Male	Female	*p* value
Number	Single	82 (84.4%)	78 (76.7%)	
	Double	13 (13.3%)	22 (21.3%)	0.481[ns]
	Triple	2 (2.4%)	2 (2.0%)	

Comparison between sex was done by unpaired Student's't' test.

ns = Correlation is not significant at the 0.05 level (2-tailed)

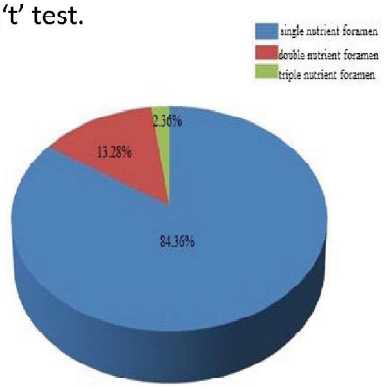

Figure 3. Pie chart showing frequency distribution of number of nutrient foramen in the shaft of left femur in male (n=89)

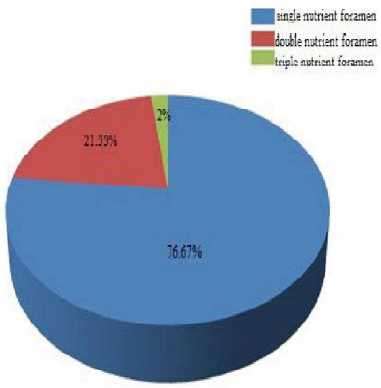

Figure 4. Pie chart showing frequency distribution of number of nutrient foramen in the shaft of left femur in female (n=110)

DISCUSSION

The diaphysis of femur is irrigated by one or more nutrient arteries that pierce the compact bone and divide in the medullary cavity into ascending and descending branches while accompanied by the terminal branches of numerous metasphyseal and epiphyseal arteries.[14] The transplant of the femoral diaphysis, the deep femoral artery can use, if the lateral circumflex femoral artery is protected. The variations and the division of the deep circumflex trunk and determined the number of nutrient foramina in 200 femur (n-95 males n+105 females). They found single number of nutrient foramen 35% in males, 40% in females, double nutrient foramen in 57% males, 50% in females and nutrient foramen in 8% in males, 10% in female's samples.[15] Single foramen was found in 60% males, 40% females.[16] 50% males, 50% females,[17] and 46% males, 56% females,[18] in comparison to 84% male,76% females of our studies. Single nutrient foramen in 47.7% male, 45.5% female of the sample , double foramen in 44.2% male, 43.5% female of the sample, triple in 3.5% male, 6% female of the sample and an absence of foramen in 4.6% male, 5% female of the sample were found in another study.[13]

CONCLUSION

The present study was an attempt to construct data on the number of nutrient foramen of fully ossified dry left femur for Bangladeshi Anatomists, orthopedic surgeons and vascular surgeons. To establish standard data, similar study with larger sample size and wider age group (including child group) and radiographic study is recommended.

Conflicts of Interest: None

REFERENCES

1. Mahadevan. Ankle and foot. In: Standing S, Borley, Healy, Collins P, Johnson, Crossman AR, et al, editors, Gray's Anatomy the Anatomical basis of clinical practice, 40th ed. Spin: Churchill Livingstone Elsevier; 2008, p. 1429-1462.
2. Mysorekar VR, Nandedkar AN. Diaphysial nutrient foramina in human phalanges. J Anat. 1979; 128: 315-322.
3. Patake SM, Mysorekar VR. Diaphysial nutrient foramina in human metacarpals and metatarsals. J Anat. 1977; 124: 299-304.
4. Henderson RG. The position of the nutrient foramen in the growing tibia and femur of the rat. J Anat. 1978; 125: 593–599.
5. Mysorekar VR. Diaphysial nutrient foramina in human long bones. J Anat. 1967; 101: 813–822.
6. Taylor GI. Sefarin D, Burke HJ, editors. Fibular transplantation. Microsurgical composite tissue transplantation. Mosby: St. Louis, USA. 1979: p. 418-423.
7. McKee NH, Haw P, Vettese T. Anatomic study of the nutrient foramen in the shaft of the fibula. Clin Orthop Rel Res. 1984; 184: 141-144.
8. Green DP. Operative hand surgery; 2nd ed. New York: Churchill Livingstone; 1988. p.1248.
9. Menck J, Dobler A, Dohler JR. Vaskularisation des Humerus. Langenbecks Arch Surg. 1997; 382: 123-127.
10. Pho RWH. Microsurgical technique in orthopaedics, 1st ed. Scotland: Butterworth; 1988: p. 128.

11. Gumusburun E, Yucel F, Ozkan Y, Akgun Z. A study of the nutrient foramina of lower limb long bones. Surg Radiol Anat. 1994; 16: 409-412.

12 Singh DJ. Asymmetry in bone weight in human lower limb. J Anat. 1971; 128: 278-280.

13. Murlimanju BV, Prashanth KU, Prabhu LV, Saralaya VV, Pai MM, Rai R. Morphological and topographical anatomy of nutrient foramina in human upper limb long bones and their surgical importance. Rom J Morphol Embryol. 2011; 52(3): 859-862.

14. Collipal E, Vargas R, Parra X, Silva H, Sol M. Diaphyseal nutrient foramina in the femur, tibia and fibula bones. Int J Morphol. 2007; 25(2): 305-308.

15. Kirschner MH, Menck J, Hennerbichler A, Gaber O, Hofmann GO. Importance of arterial blood to the femur and tibia for transplantation of vascularized femoral diaphysis and knee joints. World J Surg. 1998; 22: 845-852.

16. Gomez FEL, Gianonatti LM, Fernandez RA. Study of the nutrient foramina in human long bones. Surg Radial Anal. 1967; 9: 251-256.

17. Mysorekar VR. Diaphyseal nutrient foramina in human long bones. J Anal. 1967; 101: 813-822.

18. Sendemir E, Cimen A. Nutrient foramina in the shafts of lower limb long bones, situation and number. Surg Radiol. Anal. 1991; 75: 105.