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**Original article**

# Number of diaphyseal nutrient foramen on fully ossified dry left femur and their surgical importance

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**Abstract :**

**Background :** The femur is the strongest and longest bone of the human body which extends from the pelvis to the knee. It is the weight bearing typical long bone. The nutrient foramina are cavities 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[1]. In bone grafts the nutrient blood supply is crucial and it should be preserved in order to promote the healing.

**Objective :** The anatomy and number of nutrient foramen of femur is very essential for orthopedic & vascular surgeons as well as to radiologist for planning of treatment. This data could be useful as reference for surgical procedures of the lower limb.

**Material & Methods :** This is a purposive sampling type of study carried out in the Department of Anatomy, Sir Salimullah Medical College (SSMC), Dhaka from July 2011 to June 2012. The study comprised 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. Morphometric study of nutrient foramen was carried out on all samples by direct physical and photographic methods.

**Result :** The nutrient foramen were observed single in number in 84.36% male and 76.67% female samples, double in number in 13.28% male and 21.33% female samples and triple in number in 2.36% male and 2% female samples of left femur respectively. The anatomical knowledge about the study is useful in certain surgical procedures to preserve the circulation. As micro vascular bone transfer is becoming more popular, a convention for the anatomical description of nutrient foramen is important.

***Keywords*:** Nutrient foramen, diaphysis morphometry.

**Introduction :**

Long bones are supplied by a nutrient artery that enters individual bones obliquely through a nutrient foramen. This foramen, in the majority of cases is located away from the growing end[2]. The foramina 'seek 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 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 emphasis's the anatomical description of number of nutrient foramina which is important as micro vascular bone transfer is becoming more popular. Since there are few reports available in the morphometry of number of nutrient foramen of the femur. The aim of the present study is the counting the number of diaphyseal nutrient foramen, anatomy and morphometry of number 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 fixed measurement after this age. According to reported observation, left lower limb is functionally dominant in majority of human beings[12]. On this basis left sided adult femur were considered as sample.

**Materials &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&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].

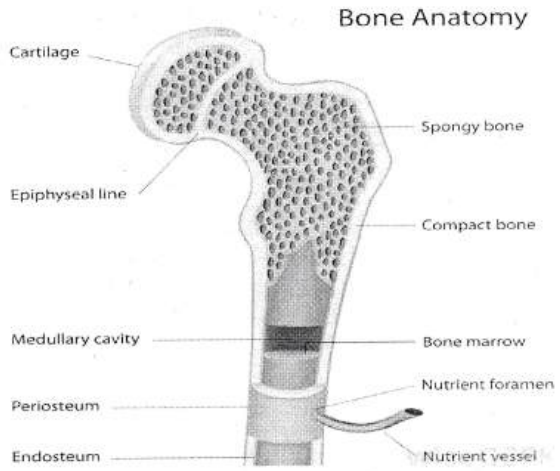


Fig 1. Showing the nutrient foramen, nutrient artery.

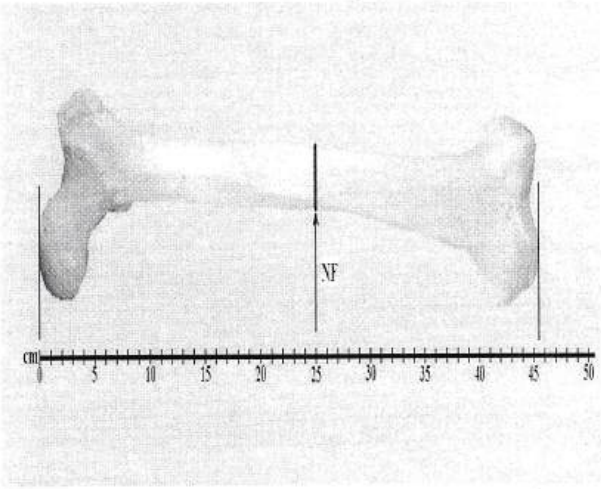


Fig 2. Procedure for identifies the number of nutrient foramen (NF)

**Result :**

The number of nutrient nutrient foramen were observed single in 84.36% male and 76.67% female samples, double in 13.28% male and 21.33% female samples and triple in 2.36% male and 2% female samples of fully ossified left femur respectively.

**Table 1 - Number** of nutrient foramen in male and female

| Nutrient foramen | | Male | Female | P-value |
|---|---|---|---|---|
| Number | Single | 82 (84.36%) | 78 (76.67%) | 0.481[ns] |
| | Double | 13 (13.28%) | 22 (21.33%) | |
| | Triple | 2 (2.36%) | 02 (2.00%) | |

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

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

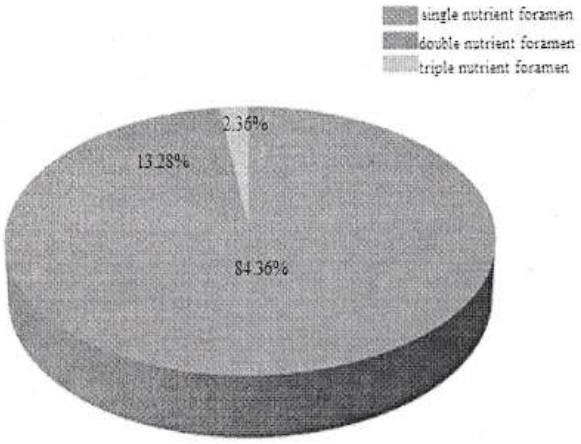


**Figure 3.** Pie chart showing frequency distribution of number of nutrient foramen in the shaft of left femur in male (n=89).

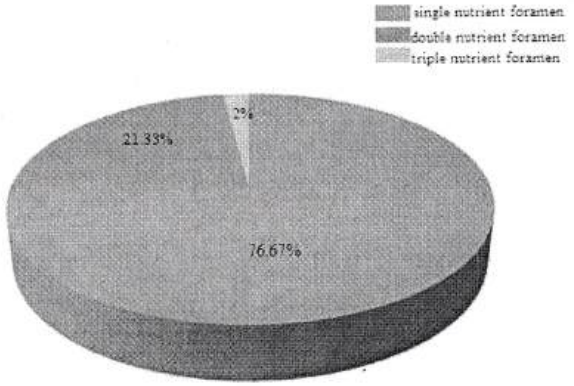


**Fig 4.** Pie chart showing frequency distribution of number of nutrient Foramen in the shaft of left femur in female (n=110).

**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 metaphyseal 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 number of nutrient foramen in 57% males, 50% in females and triple number of nutrient foramen in 8% in males, 10% in female's samples [15]. Single number of nutrient 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[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 Anatomist, orthopedic surgeon and vascular surgeon. To established standard data, similar study with larger sample size and wider age group (including child group) and radiographic study is recommended.

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