International Journal of Medical and Health Research
ISSN: 2454-9142, Impact Factor: RJIF 5.54
www.medicalsciencejournal.com
Volume 3; Issue 1; January 2017; Page No. 111-112

A study of anatomy of nutrient foramen of tibia

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Abstract
The understanding of the nutrient foramen location might be useful in particular surgeries like fracture management. In vascular bone grafts, the arterial supply is essential to the osteoblasts and osteocytes. The bone graft should have the periosteal and endosteal blood vessels along with the plenty of anastomosis.
The present study was conducted on 50 adult dry tibia of both sexes, obtained from the Anatomy department of Anatomy Nalanda Medical College& Hospital. The presence of nutrient foramina was confirmed by identifying a well-marked grove which led to the commencement to the foramen.
There are about 84.29% of the cases in which the nutrient foramen was located in upper 3rd part. In the middle 3rd part about 15.71% of the nutrient foramen was observed. In the lower 3rd of the part no nutrient foramen was seen. The posterior surface has more dense nutrient foramen as compares to medial and the lateral surfaces.
The morphological knowledge about the nutrient foramen is essential to proceed with the free vascular bone grafting, as these have been used for the procedures like mandibular reconstruction and dental implants. The anatomical details about the nutrient foramen are required to the operating surgeon.

Keywords: nutrient foramen, Human Tibiae, Bones, Lower limb, etc

Introduction
Nutrient foramen is an opening over which the nutrient artery enters and supplies the shaft of the long bones. It is the main arterial supply and is predominantly significant throughout the active growth period, as well as throughout the initial phases of ossification [1].
It is designated as going towards the slow growing end of the long bone which understandably requires more blood to keep pace with the opposite end of the long bone. "To the elbow I go, from the knee I flee" is a popular mnemonic among the medical fraternity. Most of the long bones have at least one NF, sometimes double and occasionally none. The position is described as somewhat in the middle of the shaft and this position is calculated by Hughes' foraminal index. Using this index, ulna is divided into three parts [2]. Nutrient artery can be in surgical danger in cases of isolated ulnar shaft fractures (though rare but can happen while trying to fend off a blow leading to delay in fracture union).
The understanding of the nutrient foramen location might be useful in particular surgeries like fracture management. In vascular bone grafts, the arterial supply is essential to the osteoblasts and osteocytes [3]. The bone graft should have the periosteal and endosteal blood vessels along with the plenty of anastomosis [4]. The topographical evidence about the nutrient foramen will help the surgeon in fixing the bony defect with the grafts, tumor removal. This is mainly important in selecting the grafts without injuring the nutrient artery. This conserves the vascularization of the shaft [5, 6].
Comprehensive information about the blood supply of long bones is one of the vital factors for success of new techniques in bone transplant and resection in orthopaedics. During transplant techniques, the variants of distribution of nutrient foramina guides the operating surgeons to place the graft without injuring the nutrient arteries. The topography of nutrient foramina may contrast in its growing and non-growing end, specific understanding of this becomes essential in certain surgical procedures to conserve the circulation.

Methodology
The present study was conducted on 50 adult dry tibia of both sexes, obtained from the Anatomy department of Anatomy Nalanda Medical College & Hospital. The presence of nutrient foramina was confirmed by identifying a well-marked grove which led to the commencement to the foramen. Number, distribution and direction of nutrient foramen in relation to specific surfaces of tibiae were analyzed. Only diaphyseal nutrient foramina were observed in all tibiae. Direction of the nutrient foramen was carefully observed by using a magnifying hand lens and then passing a fine needle (25 gauge) through the foramen to confirm its patency and direction.

Results & Discussion
The study of the 50 tibia is collected and presented as below. The 22 bones of the right and 28 bones of the left were evaluated in the study. In the right side 32 nutrient foramen were observed and in left side 28 nutrient foramens were found.

Table 1: Distribution of nutrient foramina in the Femur

Side	Right	Left	Total
Total no. of bones	22	28	50
Total Nutrient Foramen	32	38	70

Table 2: Lengthwise distribution of nutrient foramen in tibia

Lengthwise distribution	Right	Left	Total	Percentage
Upper 3rd	25	34	59	84.29
Middle 3rd	7	4	11	15.71
Lower 3rd	0	0	0	0

There are about 84.29% of the cases in which the nutrient foramen was located in upper 3rd part. In the middle 3rd part about 15.71% of the nutrient foramen was observed. In the lower 3rd of the part no nutrient foramen was seen.

Table 3: Location of nutrient foramina

Location	Right	Left
Post Surface	27	29
Medial Surface	3	7
Lateral Surface	2	2

The posterior surface has more dense nutrient foramen as compares to medial and the lateral surfaces.

Collipal found NF under the soleal line in 94.33%, in the soleal line in 3.77% and in the lateral border in 1.88% [7]. In Mysorekar VR study, 74% NF were lateral to vertical line, 10.98% on the line and the rest either just near the interosseous border or on the medial border or over the medial surface [8]. Thus the highlight of the present study on NF of tibia is its constant position below soleal line in upper third and normal direction away from the knee joint. The present study gains clinical significance as the anatomy of the NF especially its consistent location and large size becomes important because fractures involving upper third of tibia through nutrient canal which disrupts the blood supply to the shaft and results in delayed union [9] and during transfer of a large, straight, high density cortical bone graft as its predictable location favors easy manipulation [5].

The morphological knowledge about the nutrient foramen is essential to proceed with the free vascular bone grafting, as these have been used for the procedures like mandibular reconstruction and dental implants. The anatomical details about the nutrient foramen are required to the operating surgeon.

Conclusion

We believe that the present study has provided relevant information about the nutrient foramen of lower long bones. The two nutrient foramen were seen often in the femur than the tibia and fibula.

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