ORIGINAL RESEARCH PAPER

Anatomy

KEY WORDS: Nutrient Foramen, Forminal Index, Fibula.

STUDY OF POSITION OF NUTRIENT FORAMEN ON FIBULA, ITS VARIATION AND DISTANCE FROM THE STYLOID PROCESS AND ITS CLINICAL IMPORTANCE IN VASCULAR GRAFTING.

Uzma Rasool * Tutor Demonstrator, Department of Anatomy, SKIMS Medical College, Srinagar. *Corresponding Author

Arish Nazir Shora Tutor Demonstrator, Department of Anatomy, SKIMS Medical College, Srinagar

ABSTRACT

introduction- Bones are structures that adapt to their mechanical environment and from the fetal age adapt to the presence of naturally occurring holes. These holes are called as nutrient.

Method-The study was conducted on 100 fibulae, using osteometric board, vernier caliper, and hand lens. Adult fibulae were examined for position of nutrient foramen from the styloid process by calculating forminal index using Hughs formula and its variation.

Result- most common distribution of nutrient foramina was on middle one third of the bone (Type-2), seen in 86.59% of fibulae, followed by 7.2% in lower one third (Type-3), and then 6.18% on upper one third of bone (Type-1) with mean Forminal Index(FI) 43.04±9.35, mean length of fibulae is 35.87 (SD 2.35), distance of nutrient foramina (DNF) is 15.41 (SD 3.63).

Conclusion-. Most common location of nutrient foramen was in the middle 1/3rd of posterior surface of fibula. Thus middle 1/3rd of fibula must be used for transplant to reconstruct mandible, stabilization of spine and tibia, as well as for dental implants, and also in avascular necrosis of femoral head.

Introduction: Bones are structures that adapt to their mechanical environment and from the fetal age adapt to the presence of naturally occurring holes. These holes are called as nutrient foramen; they allow blood vessels to pass through the bone cortex[1]. Nutrient arteries are the main blood supply to long bones, and are particularly important during the active growth period, as well as during the early phases of ossification[2]. Bone grafting is a very well established surgical procedure that replaces missing bone. Bone grafts are used to treat various disorders, including delayed union and non union of fractures, congenital pseudoarthrosis, and osseous defects from trauma, infection, and tumors. Bone grafts are also used in plastic and facial surgery for reconstruction[3]. The morphometric analysis of the position of the nutrient foramen of fibula will help in harvesting vascularized graft of the bone to reconstruct and close the bony defects.

Material and method: The material for present study comprised 100 fibulae available in the Postgraduate Department of Anatomy, Government Medical College, Jammu.

Inclusion criteria

The fibula bone for the study fulfilled the following criteria.

1. Bones were dry and properly cleaned.
2. Bone with incomplete ossification, fragmented, or any gross pathology was excluded.

Instruments used: Following instruments were used for the study.

1. Vernier caliper: used to measure distance from proximal end of the bone to the nutrient foramen.
2. Osteometric board: to measure length of bone.
3. Hand lens: used to locate nutrient foramen.
4. Black marker pen: for marking the position of foramen on the bone.

METHOD: After determining the side of fibula, the length of fibula was measured by osteometric board. Nutrient foramina were identified by the presence of well marked groove leading to them, often slightly raised edge at the commencement of that canal. The nutrient foramen was studied in regards with position of nutrient foramen, its variation and distance from the styloid process. The position of all the nutrient foramina was determined by calculating a Forminal index (FI) by applying the Hughes formula.

Calculation of the Foraminal index (FI)

The position of all nutrient foramina was determined by calculating Foraminal Index (FI) using the formula:-

FI = DNF/ TL× 100(Hughes 29 formula)

DNF = the distance from the proximal end of the bone to the nutrient foramen measured by Vernier caliper.

TL = Total length of fibula from proximal end of bone to the tip of lateral malleolus in cm by using osteometric board.

According to FI, position of nutrient foramen was divided into 3 types.

Type 1 FI up to 33.33%, the foramen was in proximal one third of bone.

Type 2 FI from 33.33% to 66.66%, the foramen was in middle one third of bone.

Type 3 FI above 66.66%, foramen was in distal one third of bone.

Measurement with vernier caliper from tip of styloid process to the nutrient foramen.

Result :

Table 1: Length Of Fibulae, Distance Of Nutrient Foramina With Forminal Index (fi)

Parameter	Mean ± SD	Minimum	Maximum
Fibula length	35.87 ± 2.35	33.52	38.22
Distance of nutrient foramen	15.41 ± 3.63	11.78	19.04
FI	43.05 ± 9.35	33.7	52.4

Table 1: shows mean length of fibulae 35.87 (SD 2.35), distance of nutrient foramina (DNF) is 15.41 (SD 3.63), Forminal Index (FI) 43.05 (SD 9.35).

Table 2: Length of right fibula, with Distance of nutrient foramina and Forminal Index (FI)

Parameter	Mean±SD	Minimum	Maximum
Fibula length	35.76±2.35	30	41.5
Distance of nutrient foramen	15.78±3.69	11.1	30
FI	44.07±9.45	30.2	77.9

Table 3: Length of left fibula, with Distance of nutrient foramina and Forminal Index (FI)

Parameter	Mean±SD	Minimum	Maximum
Fibula length	35.99±2.36	30.2	40.2
Distance of nutrient foramen	15.05±3.58	12	25.22
FI	42.04±9.26	33.33	69.1

Table 4: Distribution of the nutrient foramina based on Forminal Index (FI) of the fibulae

	Upper 1/3 (Type 1)	Middle 1/3 (Type 2)	Lower 1/3 (Type 3)	Total
Right	3 (5.45%)	47 (85.45%)	5 (9.09%)	55
Left	3 (7.14%)	37 (88.09%)	2 (4.76%)	42
Total	6 (6.18%)	84 (86.59%)	7 (7.2%)	97

Picture showing presence of nutrient foramen in middle one third of bone.

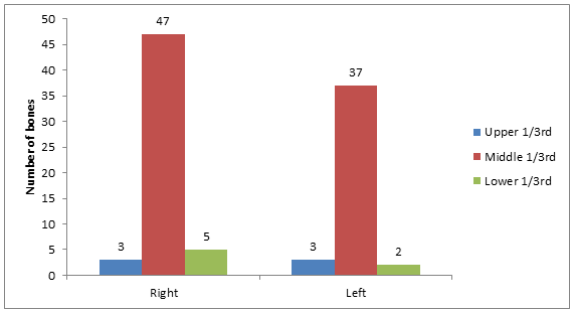
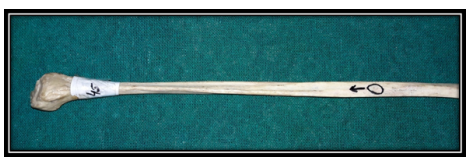


Fig 1: Bar diagram showing distribution of the nutrient foramina based on Forminal Index (FI)

Table 4 (Fig. 1) shows that most common distribution of nutrient foramina was on middle one third of the bone (Type-2), seen in 86.59% of fibulae, followed by 7.2% in lower one third (Type-3), and then 6.18% on upper one third of bone (Type-1).



Picture showing presence of nutrient foramen in lower one third of bone.

Discussion:

In the present study most of the nutrient foramen were located in the middle third of the bone 86.5% (84), the rest of the nutrient foramen were located in the lower third of the bone 7.2% (7) and in 6.1% (6) was placed on the upper third of bone, with mean Forminal Index 43.04±9.35. So these observations prove the fact that nutrient artery of fibula enters the bone mostly in the middle third segment.

Our study is very close to the study conducted by **Gupta et al.,**[4] who observed 81.95% of nutrient foramen located in the middle third of bone. Similarly another author, **Malukar and Joshi** [5] found 74% of nutrient foramen in middle 3rd of bone which is in accordance with our study. The location of nutrient foramen were also in agreement with the previous studies done by Mysorekar6, **Gumusburun et al.,**[7] **Bilodi and Reddy**[8] , **Bhatnagar et al.,**[9]as they also found that most common location of nutrient foramina were in middle 1/ 3rd of bone. While as, **Guo**[10] reported that majority of nutrient foramen were located in the proximal 1/ 3rd of bone which is not in agreement with our study.

Knowing the variation in the distribution of nutrient foramen is important preoperatively, especially regarding the fibula used in bone graft. In the majority of the specimen, the nutrient foramen were located in the middle 3rd of the fibula, which is the segment that must be used for the transplant, if one desires that the implant include both endosteal and peripheral vascularization Collipal et al.,[11].

The mean length of fibulae in the present study was found to be 35.8 ± 2.35cm. The mean distance of nutrient foramen from proximal end of the bone to the nutrient foramen (DNF) was 15.4 ±3.63cm.Compared to the mean length of fibula, the nutrient foramen was 35.8÷15.4=2.32.The half length of the fibula was estimated by dividing the total length by 2, i.e. 35.8÷2=17.9cm .So the location of nutrient foramen is 17.9-15.4=2.5cm. It means that nutrient foramen is located 2.5cm proximal to the midpoint of bone.

Conclusion: Exact knowledge of position and distribution of the nutrient foramina in bone is important to avoid damage to the nutrient vessels during surgical procedures like vascularized free fibular grafts. Most common location of nutrient foramen was in the middle 1/3rd of posterior surface of fibula. Thus middle 1/3rd of fibula must be used for transplant to reconstruct mandible, stabilization of spine and tibia, as well as for dental implants, and also in avascular necrosis of femoral head.

References

1. Gotzen N, Cross AR, Ifju PG, Rapoff AJ. Understanding stress concentration about a nutrient foramen. J. Biomech. 2003; 36: p 1511-21.
2. 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: p 87-95.
3. Hughes H. The factors determining the direction of the canal for the nutrient artery in the long bones of mammals and birds. Acta. Anat. 1952; 15: p 261-80.
4. Gupta R, Singh AK, kumar R. Morphological study of nutrient foramen in human fibulae of North Indian region. Int. J. Med. Health Sci. 2013; 2(2): p 205-9.
5. Malukar O and Joshi H. Diaphysial nutrient foramina in long bones and miniature long bones. NJ. Integ. Res. Med. 2011; 2(2): p 23-6.
6. Mysorekar VR. Diaphyseal nutrient foramina in human long bones. J. Anat. 1967; 101(4): p 813-22.
7. Gumusburun E, Adiguzel E, Erdil H, Ozkan Y, Gulec E. A study of the nutrient foramina in the shaft of the fibula. Okajimas Folia Anat. Jpn. 1996; 73(2-3): p 125-8.
8. Bilodi AKS and Reddy BS. A study of nutrient foramina of fibula, its medicolegal aspect and clinical importance in dentistry. WJPPS 2014; 3(2): p 2133-44.
9. Bhatnagar S, Deshwal AK, Tripathi A. Nutrient foramina in the upper and lower limb long bones: a morphometric study in bones of Western Utter Pradesh. IJSR 2014; 3(1): p 301-3.
10. Guo F. Observations of the blood supply to the fibula. Arch. Orthop. Trauma Surg. 1981; 98(2): p 147-51.
11. 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): p 305-8.