ORIGINAL RESEARCH PAPER

Anatomy

KEY WORDS:

COMPARISION OF ULNATO FIBULA WITH RESPECT TO MORPHOLOGY AND TOPOGRAPHY OF NUTRIENT FORAMEN

Dr. Anamika Gaharwar Assistant Professor, RML Institute, Lucknow.

Dr Priyanka Sinha* Associate Professor, T. S. Misra Medical College & Hospital. *Corresponding Author

ABSTRACT

INTRODUCTION: Nutrient foramen is an opening into the bone shaft which gives passage to nutrient artery. Nutrient artery is principal source of blood to a long bone during the growing period and early phase of ossification. Nutrient foramina reflects bone vascularization, thus the knowlwdge of number ,position ,location and direction of these foramina is useful in orthopaedic surgical procedure,s like joint replacement, fracture repair and vascularised bone grafts.

AIMS & OBJECTIVE- Fibula is most commonly used for bone graft purpses..Ulna being homologous to fibula, the present study aims to compare ulna and fibula with respect to morphology and topography of diaphysial nutrient foramen.

MATERIAL & METHODS.-This study was conducted in Department of Anatomy, GSVM Medical College, Kanpur. 100(50 right &50 left) ulna and fibula were examined for number, position, location and direction of Nutrient Foramen. Foramina Index was calculated.

RESULT-93%of ulna showed single nutrient foamen ,100% were present on anterior surface with the mean foramina index of 33.87+3.49 whereas 78% of fibula showed single nutrient foramen,97.5% foramen were present on posterior surface with mean foramina index of 45.86+4.55.

CONCLUSION-The present study exhibited higher percentage of single nutrient foramen in both ulna and fibula ,also they were positioned mostly on the flexor surface of middle one third of shaft of both the bnones. Thus ,it was an attempt to draw a parallel correlation between Ulna and Fibula for use as vascularised bone grafts in orthopaedic and plastic surgery

Bones are the structure that adapt to their mechanical environment, and from fetal age they adapt to the presence of naturally occurring holes, known as nutrient foramen, which allow blood vessel to pass through bone cortex (1). Nutrient arteries is the principal source of blood to a long bone mainly during the growing period and during the early phases of ossification (2,3,4,5) The blood supply of long bones, generally given by one or two diaphysial nutrient arteries, and numerous metaphysial, epiphysial and periosteal arteries.

Nutrient foramina reflect to certain degree of the bone vascularisation and knowledge about the location of these foramina is useful in certain operative procedure to preserve the circulation. In free vascular bone grafting, the nutrient blood supply is extremely important and must be preserved to promote fracture repair, a good blood supply being necessary for osteoblast and osteocyte cell survival, as well as facilitating graft healing in the recipient (6). It was reported that the ideal bone graft for the free transfer should include endosteal and periosteal blood supply with good anastomosis (7).

Vascularized fibular grafts (VFG) are most commonly used for reconstructive surgeries.The advantage of free vascularised fibular grafts include its ability to be shaped with relatively ease is known, and has been used for reconstructing a large bony defects like manibular reconstruction after hemimandibulectomy. In transplant techniques, the use of statistical data on the nutrient foramina distribution in long bones makes it possible for the professional to select the osseous section levels of the receptor in order to place the graft without damaging the nutrient arteries, preserving, thus, the diaphysial vascularisation (8.).However, there is still a need for a greater understanding of the morphology and morphometry of nutrient foramina in other long bones. Since Ulna is homologous bone to topography of nutrient foramen.

MATERIALS AND METHODS

This study was conducted in Department of Anatomy, G.S.V.M. Medical College, Kanpur. A total of 100 (50 right and 50 left) adult human fibula and 100 (50 right and 50 left) ulna were examined in the department. Following materials were used- a) Magnifying lens, b) Bone Osteometer, c) Metallic measuring scale, d) Guide wires, e) 24 hypodermic needle (0.56 mm in diameter), f) Digital camera for illustration.

With the help of above instruments following observation were done.

1. *Number of Nutrient Foramina:* The Nutrient Foramina were observed in all bones with the help of a hand-lens. They were identified by their elevated margins and by the presence of a distinct groove proximal to them. Only well-defined Foramina on the diaphysis were accepted. Foramina at the ends of the bone were ignored.
2. *Position of Nutrient Foramina:* Of all the Foramen present their distribution over different surface was observed by direct inspection.
3. *Location of Nutrient Foramina:* The location of only Dominant Foramina was considered and their distribution in bone length was determined by calculating a Foramen index (FI) using the formula:

FI = (DNF/TL) x 100 (Hughes, 1952; Shulman, 1959).

DNF - The Distance from the proximal end of the bone to the Nutrient Foramen.
TL – Total length of the bone.

Depending on foramina index, the location of nutrient foramen in relation to length of bone is classified as:

a. Type1 (0-33% of bone length)
b. Type 2(33%-66% of bone length)
c. Type 3(66%-99% of bone length)

RESULTS

NUMBER OF NUTRIENT FORAMEN:

Ulna: On right side, out of 50 bone, 46(92 %) bones shows single foramen and 4(8%) bones shows double foramen. On left side, out of 50 bone, 47(94 %) bones shows single foramen

and 3(6%) bones shows double foramen

Fibula: On right side, out of 50 bone, 40(80%) bones shows single foramen and 10(20%) bones shows double foramen . On left side, out of 50 bone, 38(76%) bones shows single foramen and 12(24%) bones shows double foramen.

POSITION OF NUTRIENT FORAMEN IN LONG BONE

Ulna: In ulna both on the right and left side all the foramina (100%) were present on anterior surface.

Fibula: On right side, out of 60 foramen, 59(98.3%) foramen was present on posterior surface and 1(1.6%) was present on medial crest. On left side, out of 62 foramen 60(96.7%) of foramen was present on posterior surface and 2(3.2%) was present on medial crest.

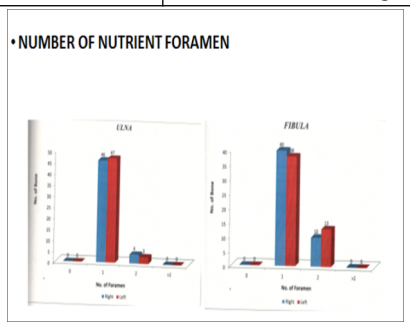
LOCATION OF NUTRIENT FORAMEN

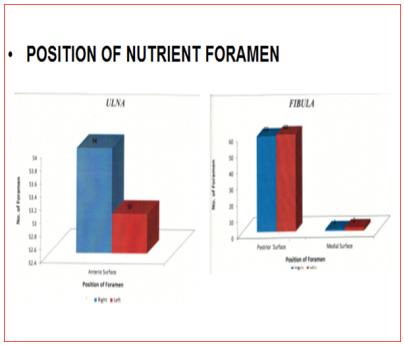
Ulna: On right side, out of 50 foramen, 21(42%) dominant foramen were of type I and 29(58%) were of type II. On left side, out of 49 dominant foramen, 20(40.8%) were of type I and 29(59.2%) were of type II

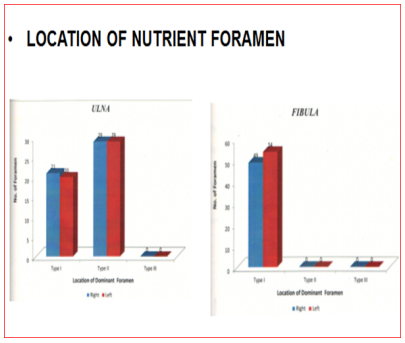
Fibula: Both on the right and left side all the foramen (100%) were of type I.

Table 1 Showing Morphometric & Topographic Observations Of Nutrient Foramen In Ulna

S.N	Parameter	Right (n=50)	Left (n=50)
1	Number of foramina		
	0	-	-
	1	46(92%)	47(94%)
	2	4(8%)	3(6%)
	>2	-	-
		P value >0.05 not significant	
2	Position of Nutrient Foramen		
	Anterior Surface	54(100%)	53(100%)
	Medial Surface	1	2
		P value >0.05 not significant	
3	Location of Dominant Foramen		
	Type I	21 (42.0%)	20 (40.8%)
	Type II	29(58%	29(59.2%)
	Type III	-	-
		P value >0.05 not significant	







Measurement of Total length of Ulna on Bone Osteometer

Measurement of Total length of Fibula on Bone Osteometer

Measurement of Distance of Nutrient Foramen from proximal end of Fibula using Vernier Caliper

DISCUSSION

Vascularized fibular grafts have been used for mandibular reconstruction.(11,12,13), ,used extensively in orthopaedic and plastic surgery. The advantage of free vascularized fibular flap include its ability to be shaped with relative ease and to be grafted at the same time tumors are resected, with consequent reduction in operation time. In addition, few complication occurs at donor site. Healing of fractures, as of all wounds, is dependent upon blood supply(14,15).)If surgeon could avoid a limited area of the cortex of the long bone containing nutrient foramen, particularly during an open reduction, an improvement in the management of this problem might be attained. Thus, knowledge of anatomy of nutrient foramen is significantly important for orthopaedic surgeons doing open reduction of fracture, in order to avoid injuring nutrient artery and there by lessens the chances of delayed or non union (16)

The major blood supply to long bones usually enters at particular points on the shaft that determines the number of nutrient foramen. .An absence of nutrient foramina in long bones has been constant feature , and in these cases the periosteal vessels become the sole source of blood supply(10,17,18).For Ulna, Forriol,1987;Nagel,1993 reported all the bones studied with single nutrient Foramen. In The present study, 93% of Ulna shows single Nutrient Foramen and 7% with double foramen which is in agreement with Shulman,1959 ; Longia et al,1980. In the Fibulae studied,78%of bone presented a single nutrient foramen and 22% of bone with double foramen similar to studies of Mysorekar,1967; Longia et al1980 ; Sendemir and Cimen, 1991..

Longia et al,1980 observed that the position of nutrient foramen on flexor aspect in their human long bone specimens. Kizilkant et al.,2007 stated that the position of nutrient foramen was directly related to requirement of continuous blood supply to specific aspects of each bone, where there were major muscle attachments . Forriol Campos et al., 1987 ; Shulman,1959; Kizilkanat et al., 2007 reported all the Ulna, in their study , present on anterior surface, which is in agreement with present study. In this study, 90.75% of foramen anterior suface. In Fibula, 97.5% of foramen were present on posterior surface and 2.4% on medial crest.

There is variations in the distribution of Nutrient Foramina and this is important preoperatively ,especially regarding fibula,used in bone grafting. Regarding Ulna, in present study,42% were located were located in proximal one third and 54.9% were present in middle one third similar to Mysorekar,1967. This is in disagreement with previous studies of Shulman,1959;Longia etal.,1980. For Fibula,Guo,1981 reported majority of foramina located in upper one third, whereas in all other studies, they were located in middle one third. In present study, all foramen were located in middle one third of bone length with foramina index between 36.3% to 58.2% .

CONCLUSION

In the study we found that 93% of ulna showed single nutrient foramen, and is most commonly located on anterior surface (90.75%)in the middle third of shaft. For Fibulae ,78% of bone presented single nutrient foramen.97% of foramen were present on posterior surface and in some of the case it is located in medial crest (2.5%.). Our research about correlation of nutrient foramina of ulna will be helpful to orthopaedic and plastic surgeons.

REFERENCES

1. Gotzen, N., Cross, A., Ifju, P., Rapoff, A. Understanding stress concentration about a nutrient foramen. J. Biomech. 2003; 36: 1511–1521.
2. Lewis, O.J. The blood supply of developing long bones with special reference to the metaphyses. J. Bone Jt. Surg, 1956; 38: 928-933.
3. Sendemir, E., Cimen, A.. Nutrient foramina in the shafts of lower limb long bones: situation and number. Surg. Radiol. Anat, 1991; 13: 105–108.
4. 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.
5. Kizilkanat Emine, NeslihanBoyana, Esin T. Ozsahina, Roger Soamesb, OzkanOguza. Location, number and clinical significance of nutrient foramina in human long bones. Ann. Anat., 2007; 189:87–95.
6. Craig, J.G., Widman, D., van Holsbeeck, M. Longitudinal stress fracture: patterns of edema and the importance of the nutrient foramen. Skeletal Radiol, 2003; 32:22-27.
7. Menck J, Schreiber HW, Hertz Bürgel N, Angioarchitechture of the Ulna and Radius and their practical Relevance. Langenbeck's Arch Surg: 1994; 379(2):70–75.
8. Wavreille, G., Remedios, Dos, C., Chantelot, C. Anatomic bases of vascularized elbow joint harvesting to achieve vascularized allograft. Surg. Radiol. Anat. 2006; 28: 498-510.
9. Hughes H. The factors determining the direction of canal for the nutrient artery in the long bones of mammals and birds. Acta Anat. (Basel) 1952; 15:261-280.
10. Shulman, S.S. Observations on the nutrient foramina of the human radius and ulna. Anat. Rec., 1959;. 134: 685 - 697.
11. Hidolgo DA. Fibula free flap: A new method of mandible reconstruction. Plast Reconstr Surg., 1989; 84:71–79.
12. Lyberg T, Olstad OA. The vascularized fibular flap for mandible reconstruction. J Craniomaxillo fac Surg, 1991; 19:113–118.
13. Zlotolow IM, Huryn JM, Piro JD, Lenchewski E, Hidolgo DA. Osseointegrated implants and functional prosthetic rehabilitation in microvascular fibula free flap reconstructed mandibles. Am J Surg 1992; 164:677–681.
14. Coolbaugh,C.C. Effects of Reduced Blood Suppy ofBone.American Journal Of Physiology, 1952; 169:26
15. Johnson,R.W..APhysiological Study Of the Blood Supplyof the Diaphysis,Journal of Bone &Joint Surgery 1927; 2:14-17
16. Joshi H,Doshi B,MalukarO. Astudy of nutrient foramen of Humeral diaphysis.NJIRM.2011; 2:14-17
17. Mysorekar V.R. Diaphysial nutrient foramina in human long bones. JAnat, 1967; 101: 813-822. Nagel A.The clinical significance of Nutrient Artery.Orthop.Rev1993; 22:557-561
18. Forriol Campos, F., Gomez Pellico, L., Gianonatti Alias, M., Fernandez-Valencia, R. A Study of the Nutrient Foramina in Human Long Bones. Surg. Radiol. Anat. 1987; 9:251-255.
19. Nagel A.The clinical significance of Nutrient Artery.Orthop.Rev1993; 22:557-561
20. Longia, G.S., Ajmani, M.L., Saxena, S.K., Thomas, R.J. Study of diaphyseal nutrient foramina in human long bones. Acta Anat. (Basel), 1980; 107:399-406.
21. Guo, F. Observation of the blood supply to the fibula. Arch. Orthop.Traumat. Surg., 1981. 98: 147-151.