Anatomical variation in position, location and number of fibular nutrient foramen

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ABSTRACT

Background: Fibula is a slim bone. Its shape varies with the strength of the muscles attached. The fibula though transmits insignificant force in walking, fibula is an important bone for muscle attachment and significant source of bone graft. It has a proximal head narrow neck, long shaft and a distal lateral malleolus. The knowledge and position of the nutrient foramina of fibula is important to proceed with the free implant of the vascularized bone graft In harvesting the fibula, this segment is always taken, as the graft is more reliable regarding anastomosis, which includes endosteal and peripheral vascularization and associated with less post operative morbidity. **Material and methods:** 240 adult fibula of unknown sex. from: Govt. Medical college-Bhavnagar, K.J.Mehta Dental College, Amargadh Bhavnagar, Smt. N.H.L. Municipal Medical college Ahmadabad, B.J.Medical college, Ahmadabad, Gujarat were studied Above mentioned. Measurements were taken with Vernier Caliper. **Results:** Number: Out of 240 fibulae examined, 192(80%) showed a single foramen while 48(20%) possessed double foramina. **Position:** The nutrient foramina of fibulae were situated in the middle third of the bone with a foramen index ranging between 35.23% and 67.69% of the bone length of the total 288 foramina, 280(97.2%) existed in the middle third and8 (2.7%) were in the distal third There were no foramina in the proximal third of the whole fibular foramina, 192 (66.6%) were on the medial crest of the posterior surface, 88(30.5%) on the posterior surface between medial crest and interosseous border and 8 (2.7%) on lateral surface Size: Of all fibular foramina, 32(11.1%) were dominant foramina while 256(88.8%) were secondary. Direction: Of the total 288 nutrient foramina observed in the fibulae, 224 (77.71%) was directed distally; while the direction of 64(22.2%) was proximally Obliquity: There was no change in the obliquity of the foramina, whether they were in the centre of bone or nearer to the ends. **Conclusion:** Fibula of 35.23 cm – 67.69 cm is available for grafting among Indians. The metric estimation of the position of the nutrient foramen of the fibula could assist in harvesting vascularised graft of the bone.

Key words: Anastomisis, fibula, Nutrient foramen , variation in position, location

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INTRODUCTION

Fibula is a slim bone. Its shape varies with the strength of the muscles attached. The fibula though transmits insignificant force in walking, is an important bone for muscle attachment and significant source of bone graft. It has a proximal head, narrow neck, long shaft and a distal lateral malleolus . Nutrient foramina in the long bones of human limbs are described directed towards the elbow and away from the knee. This is due to, one end of limb bones growing faster than other. This blood supply is essential during the growing period, during the early phase of ossification and in procedures like-bone grafts, tumour resection, traumas, congenital pseudoarthrosis and in transplant techniques in orthopaedic and plastic surgeries. The fibula reverses the ossificatory pattern in respect to other long bones. The knowledge and position of the nutrient foramina of fibula is important to proceed with the free implant of the vascularized bone graft. Commonly, the nutrient foramen is located in the middle third of the posterior surface of the fibula. Thus, middle third of fibula must be used for transplant to reconstruct mandible. In harvesting the fibula, this segment is always taken, as the graft is more reliable regarding anastomosis, which includes endosteal and peripheral vascularization and associated with less post operative morbidity.

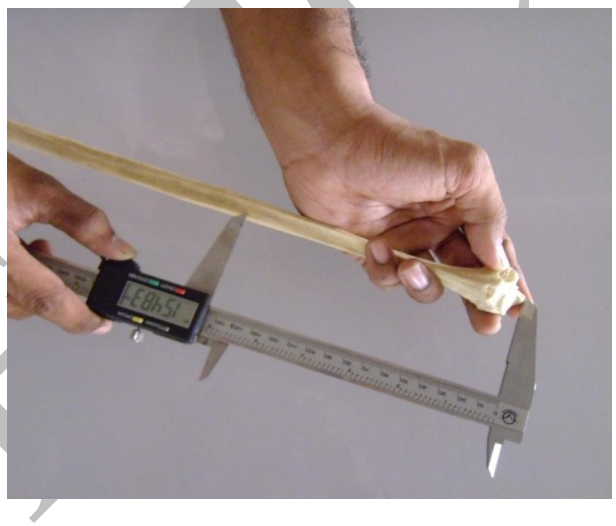
MATERIAL AND METHODS

Fibula bones were collected from Department of Anatomy, Govt. Medical College, Bhavnagar, B.J.Medical college, Ahmadabad. K.J.Mehta Dental College, Amargadh, Bhavnagar. Smt. N.H.L. Municipal Medical College Ahmadabad. Measurements were made by using the Vernier Caliper to the nearest millimeter in the following manner. Full bone length adult fibulas were included in this study. Broken, unlabelled bones were excluded from this study. We reviewed 200 adult fibulas and determined the presence, number and position of the nutrient foramina using

Vernier calipers (precision 0.01). We measured the length of the fibula and the location of the nutrient foramen from the tip of the head using a tape.

Figure1 : Level of nutrient foramina in different fibula bone.

Figure 2 : Measurements of distance between head of fibula to level of nutrient foramina.



The collected data was recorded on data sheets. The collected data was coded and analyzed using the statistical program SPSS. The Students T-test will used to determine the significance of the means, Levenes test for the equality of variances while the Pearson's test will be used for correlation of symmetry. Tables, charts and scatter graphs will be used to illustrate the findings.

RESULTS: Out of 240 fibulae examined, 192(80%) showed a single foramen while 48(20%) possessed double foramina.(Table – 1), The nutrient foramina of fibulae were situated in the middle third of the bone

with a foramen index ranging between 35.23% and 67.69% of the bone length (Table – 4) of the total288 foramina, 280(97.2%) existed in the middle third (Type-2) and 8 (2.7%) were in the distal third (Type-3). There were no foramina in the proximal third (Type-1) (Table– 3) of the whole fibular foramina, 192 (66.6%) were on the medial crest of the posterior surface, 88(30.5%) on the posterior surface between medial crest and interosseous border and 8 (2.7%) on lateral surface (Table – 2) Of all fibular foramina, 32(11.1%) were dominant foramina while 256(88.8%) were secondary. Of the total 288 nutrient foramina observed in the fibulae, 224 (77.71%) was directed distally; while the direction of 64(22.2%) was proximally.

Table 1 : . Number of nutrient foramina observed in the fibula bones of the lower limb.

Bone	Number of Bone	Number of Foramina	Percentage
Fibula (n = 240)	192 48	1 2	80% 20%

Table 2: Position and number of dominant (DF) and secondary (SF) nutrient foramina observed in the fibula.

Position	Total number of foramina	%	Number of Foramina			
			Single Foramina		Two Foramina	
			DF	SF	DF	SF
Posterior surface (on the medial crest)	192	66.66	8	152	16	16
Posterior surface (between medial crest &interosseous border)	88	30.55	---	32	---	56
Lateral surface	08	2.77	---	---	8	---

Table 3: Position and direction of nutrient foramina in the fibula bones of the lower limb.

Bone	Position			Direction
	Type – 1	Type – 2	Type – 3	
Fibula	------	280(97.2%)	08 (2.7%)	224 distally, 64 proximally

Table – 4: The range, mean ± standard deviation (SD) of foraminal indices of the fibula.

Position	Side	Range	Mean + / - SD
Posterior surface (on the medial crest)	R L	35.23 - 61.45 36.18 - 50.15	45.52 + / - 6.68 43.85 + / - 4.09
Posterior surface (between medial crest & interosseous border)	R L	36.39 - 65.33 40.25 - 67.69	45.66 + / - 6.61 47.53 + / - 6.26

DISCUSSION: In the fibulae studied, 80 % of the bones presented a single nutrient foramen, while 20 % of the bones possessed double nutrient foramina. Similar data had been reported by Mysoreka[1], Longia et al[2], Guo[3],Mckeeet al[4], Forriol Campos et al[5] and Sendemir andCimen[6], while Mckeeet al[4]. reported fibulae with three nutrient foramina.

On the otherhand,Mysorekar[1],Mckeeetal[4].,Gumusb urunetal[7].and Kizilkanat et al[8] reported fibulae with no nutrient foramina. In the present series, most of the nutrient foramina of the fibula were situated in the middle third of the bone (97.2%), with a foramen index ranging between 35.23% and 67.69% of the bone length. The rest of the nutrient foramina (2.7%) were located in the distal third of the bone. These results were in agreement with most of the previous studies[1-8] .

On other hand, Guo et al.[3] reported that the majority of foramina were located in the proximal third of the fibula. In this study, 66.66% of the fibular foramina were located on the medial crest and 30.55% on the posterior surface. Similarly, Mysorekar[1] reported that 56 % of nutrient foramina were located on the medial crest while 33% lied on the posterior surface of fibula. However, some authors observed more nutrient foramina on the posterior surface compared to those on the medial crest[1-5,7,8] Others[6], reported that the majority of foramina were on the medial surface of the fibula. Knowing the variations in the distribution of the nutrient foramina is important preoperatively, especially regarding the fibula used in bone grafting

The present results showed that most of all fibula bones of lower limb Possessed a majority of secondary nutrient foramina. These results were in

agreement with those of Carroll[9] (1963)[l] and Longia et al[2] who reported that about two third of the nutrient foramina were secondary.

The present results contradicted with those of kizilkanat et al[8] who state that most foramina were of the dominant type. They added that wherever a single nutrient foramen was observed, it was always dominant. This was not the case in the present study. The direction of fibula 77.71 % of nutrient foramina was distal while22.2% had a proximal direction. In accordance with the present results, Longia et al[2] reported nutrient foramina having a proximal direction in 9.5 % of fibula examined. Mysorekar[1] added that variations, in the direction of nutrient foramina were found only in the fibula. The commoner position of the nutrient foramen, posterior should always be noted to avoid injury to the nutrient foramen. Other positions of the nutrient foramen should be however anticipated. Adequate dissection around the position and the location of the nutrient foramen will minimize the length of the incision in harvesting the fibula vascularised graft. This will minimize the complication of the procedure such as compartment syndrome (5).In conclusion, the location of the nutrient foramen is important if a free vascularised fibular graft is to include endosteal as well as periosteal blood supply.

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