International Journal of Applied Research 2017; 3(4): 521-523

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(4): 521-523
www.allresearchjournal.com
Received: 17-02-2017
Accepted: 18-03-2017

Santosh K Sahu
Department of Anatomy, SCB Medical College, Cuttack, Odisha, India

Dali Meher
Department of Anatomy, SCB Medical College, Cuttack, Odisha, India

Correspondence
Santosh K Sahu
Department of Anatomy, SCB Medical College, Cuttack, Odisha, India

Morphological and topographical anatomy of nutrient foramina in human clavicles of Eastern Odisha

Santosh K Sahu and Dali Meher

Abstract
Background: Human clavicle is a modified long bone placed almost horizontally at the root of the neck. Nnutrient artery enters the bone through the nutrient foramen which is directed away from the growing end as a rule. Vascularized bone like clavicle helps principally in bone grafting and joint allograft.
Objective: To analyze nutrient foramen in adult human clavicle of Eastern Odisha in relation to their number, position, direction and distribution over bone length.
Material & methods: The present study was undertaken in 53 clavicles of unknown sex which were collected from the department of Anatomy, S.C.B. Medical College, Cuttack, Odisha, after the approval from the ethical committee of the institute. Mean foramen index was calculated using Hughes formula.
Result: Total number of foramina in all 53(100%) clavicles were 84, and we observed that most of the clavicles (50.9%) had two foramina. Most of the foramina were in middle 1/3rd region (71.4%) and in 66.10% clavicles. Also, most of the nutrient foramina were in posterior surface (63.1%) and in 50.82% clavicles. This study observed that the foramina were more common on posterior surface and were often multiple, directed towards the acromial end. In our study, the average distance of the foramen from the sternal end was 65.8 mm. and the mean foramen index was 52.06.
Conclusion: Nutrient foramina vary in their position, number and distribution on the bone surface. Knowledge of nutrient foramen is helpful in surgical procedures like bone grafting and in microsurgical bone transplantation.

Keywords: Clavicle, nutrient foramen, foramen index, sternal end, growing end

Introduction
The clavicle is a subcutaneous and sinuously curved modified long bone of pectoral girdle placed horizontally at the root of neck. It acts as a prop to place the scapula laterally, so that the upper limb can swing freely from the side of the trunk. It also transmits the forces from the upper limb to the axial skeleton through coraco-clavicular ligament and medial two-thirds of the bone. It has a shaft and two ends, sternal and acromial. Inferior surface of the shaft presents a subclavian groove and a nutrient foramen usually lies at the lateral end of the groove which is directed laterally [1]. Through this foramen usually passes the nutrient artery derived from suprascapular artery and at times, the medial supraclavicular nerve [2, 3]. The principal source of blood to a long bone is the nutrient artery whose direction follow the rule, 'to the elbow I go, from the knee I flee' and is away from the growing end [4, 5, 6, 7]. Berard first correlated the direction of the nutrient canal with the ossification and growth of the bone [8]. Humphrey working on the direction and obliquity of nutrient canals postulated periosteal slipping theory wherein the canal finally directed away from the growing end [9]. The location and number of nutrient foramina is not constant in long bones [10]. Lutken pointed about the variability of the positions of the nutrient foramina & stated that typical position of nutrient foramina can be determined after a proper study on human bones [11].
The morphometrical and topographical knowledge of nutrient foramina is very important in surgical and orthopaedical procedures like bone grafting and more recently in microsurgical vascularized bone transplantation where preservation of the circulation of affected bone is of vital importance for facilitating graft healing in the recipient as well as for osteoblast and osteocyte cell survival [12, 13, 14, 15].
Accordingly the present study was conducted to determine the morphometrical and topographical variations of nutrient foramina in human clavicles of Eastern Odisha.

Material and methods

The study material consisted of 53 dry human clavicles of unknown age and sex, without any deformity or fracture, which were collected from the Department of Anatomy, S.C.B. Medical College, Cuttack, Odisha, after approval from the Ethical Committee of the Institute. All the bones were macroscopically observed using magnifying handlens for the number, position and direction of the nutrient foramina. The nutrient foramina were identified by the presence of a well marked groove and often with slightly raised edge at the commencement of the canal. The distance of foramina from the sternal end & the total length of the clavicle were measured in millimeters, ignoring curves of clavicle. The foramen index was calculated by applying the Hughes formula: FI = (DNF/TL) x 100.

DNF = the distance from the proximal end (sternal end) of the clavicle to the nutrient foramen. TL = total length of clavicle [16].

Results

Nutrient foramina were observed in 53 (100%) clavicles as bellow

Number of Nutrient Foramen - The foramina were single in 23 (43.38%) clavicles, double in 27 cases (50.93%), and more than two foramina in 3 clavicles (5.65%). Most of the right clavicles contained single foramina (24.52%) whereas left clavicles contained double foramina (35.84%). Three foramen were found in one clavicle of right side (Fig, 3) and 2 clavicles in left side (Table 1).

Table 1: No. of Nutrient Foramen in Clavicles

Number of Nutrient Foramen	Right Clavicle (n=22)	Left Clavicle (n=31)	Total (n=53)
One	13 (24.52%)	10 (18.86%)	23 (43.38%)
Two	8 (15.09%)	19 (35.84%)	27 (50.93%)
Three	1 (1.88%)	2 (3.77%)	3 (5.65%)

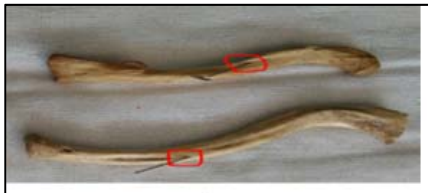

Fig.1 showing one foramen

Fig.3 showing three foramina

Fig.2 showing two foramina

Fig.4 measurement of DNF

Position of Nutrient Foramen- Total 84 number of nutrient foramen was found, out of which, 36.9% foramen were on inferior surface and 63.1% foramen were on posterior surface of the clavicles. Percentage of clavicle containing nutrient foramina on inferior surface was 49.18% and on posterior surface was 50.82%. Total number of clavicles considered was 61 as some clavicles contained nutrient foramen on both posterior and inferior surfaces (Table 2).

Table 2: Showing surface-wise distribution of Nutrient Foramen in Clavicles

Surface	Number of Nutrient Foramen	Number of Clavicle
Inferior	31 (36.9%)	30 (49.18%)
Posterior	53 (63.1%)	31 (50.82%)
Total	84	61

Location of Nutrient Foramen - We found 19.04% foramens at the medial 1/3 region, 71.42% at the middle 1/3 region and 9.52% at the lateral 1/3 region of the shaft of the clavicles. Percentage-wise calculation of clavicles containing these foramens at different regions was also done. Total number of clavicles were 59 as some clavicles contained more than one foramina at different regions (medial, middle or lateral). In our study 67.10% of clavicles contained nutrient foramen in middle one third region, 20.34% contained on medial one third and 13.56 % on lateral one third (Table 3).

Table 3: Showing length-wise distribution of Nutrient foramen in clavicle

Region of Clavicle	Number of Nutrient Foramen	Number of Clavicle
Medial 1/3 rd	16 (19.04%)	12 (20.34%)
Middle 1/3 rd	60 (71.42%)	39 (66.10%)
Lateral 1/3 rd	8 (9.52%)	8 (13.56%)
Total	84	59

Foramen Index -Average distance of the foramina from the sternal end was found to be 65.8 mm (6.58 cm) and the average total length of clavicles was 12.65 cm resulting in the mean foraminal index of 52.06 (Table 4).

Table 4: Foramen Index

DNF in mm.	TL in mm.	FI
65.8	126.38	52.06

Direction of Nutrient Foramen – Direction of all nutrient foramina were found to be away from the growing end i.e. away from the sternal end.

Discussion

The nutrient foramen leading into the nutrient canal, has a definite position for each bone [17]. In the present study, all the collected clavicles presented at least one nutrient foramen [18]. Total 84 number of foramina were found in all 53 clavicles and most of the clavicles (50.9%) presented double foramina. Most of the foramina were present in middle third region (71.4%) and also on posterior surface (63.10%) of the study clavicles. Similarly most of the study clavicles presented the nutrient foramina in middle third region (66.10%) and also in posterior surface (50.82%).

Rai *et al*. studied total 65 foramina in 40(100%) clavicles where 15.4% foramina were present at medial 1/3rd region, 73.8% at middle 1/3 rd region and 10.8% at lateral 1/3 rd region; 35.4% foramina were on inferior surface and 64.6% on posterior of clavicles [19]. Single foramina were present in 17 (42.5%) clavicles, double foramen in21(52.5%) specimens and more than two foramina in 2 clavicles (5%).Foramina were present on inferior surface in 42.6% clavicles and on posterior surface in 57.4% of clavicles.

Murlimanju *et al*. found single nutrient foramina in 20 (38.5%) clavicles, two foramina in 23 (44.2%) specimens, and more than two foramina in 7 (13.4%) clavicles (18). Foramina were present at middle 1/3rd region in 92.3% clavicles, at medial 1/3rd region in 9.6%, and at lateral 1/3rd region in 1.9% clavicles; on inferior surface in 55.8% clavicles, on posterior surface in 69.2%, and on superior surface only in 1.9%. The average distance of the foramen from sternal end was 64.4 mm, and the mean foraminal index was 44.72. Thus foramina were more common on posterior surface and were often multiple, directed toward the acromial end.

In our study, the average distance of the foramina from the sternal end was found to be 65.8 mm (6.58 cm) and the mean foraminal index was 52.06.The findings of the present study are similar to those of Rai *et al*. who found the average distance of the nutrient foramen from the sternal end to be 67.6 mm and the mean foraminal index to be 48.01.

Conclusion

Most of the clavicles contained nutrient foramina at middle one third region and on posterior surface. The foramen index was 52.06. The position of the nutrient foramen is determined by it. Knowledge about these foramina is helpful in the surgical procedures involving the clavicle to preserve the circulation. The findings of this study may be useful for the clinicians who are involved in bone graft surgical procedures, as the microvascular bone transfer is becoming more popular now a days.

Conflict of interest - None declared.

References

1. Gray's Anatomy. The Anatomical Basis of Clinical Practice. 40th ed. Standring S, Healy JC, Johnson D, Collins P, *et al* editors, London: Elsevier Churchill Livingstone, 2008, 792.
2. Standring S. (ed) Gray's anatomy. The anatomical basis of clinical practice, 39th Ed Churchill Livingstone, Spain, 2006, 817-81.
3. Rockwood CA, Matsen FA, Lippitt SB *et al*. (eds) Theshoulder, 4th Ed. Saunders Elsevier, Philadelphia, 2009, 77.
4. Chaurasias BD. Hand book of General Anatomy. 3rd Edition, 35-36.
5. Gray"s. Anatomy 38th Ed. 1992, 469.
6. Murlimanju BV, Prasanth KU, Prabhu LV, Saralaya VV, Pai MM, Rai R. Morphological and topographical anatomy of nutrient foramina in human upper limb long bones and their surgical importance. Rom J Morphol Embryol. 2011; 52(3):859-862.
7. Malukar O, Hemang Joshi H. Diaphysial Nutrient Foramina in Long Bones and Miniature Long Bones. NJIRM. 2011; 2(2):23-26.
8. Berard Arch, Gener De. Med II Serie. 1835; 2(7):176-183.
9. Humphrey GM. Observations on the growth of the long bones and of the stumps. Medico Chir. Trans. 1861; 44:117-134.
10. Bokariya Gudadhe P, Kothari Murke, Shende MR. Comparison of Humerus and Femur with Respect to Location and Number of Nutrient Foramina. Indian Journal of Forensic Medicine and Pathology 2012; 2:79-81.
11. Lutken P. Investigation into position of nutrient foramen & direction of the vessel canals in the shaft of the humerus and femur in man. Acta. Anat. 1950; 9:57-68.
12. Longia GS, Ajmani ML, Saxena SK, Thomas RJ. Study of diaphyseal nutrient foramina in human long bones. Acta Anat. Basel. 1980; 107:399-406.
13. 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.
14. Al-Motabagoni. The arterial architecture of the human femoral Diaphysis. J. Anat. Soc. India. 2002; 51(1):27-31.
15. Craig JG, Widman D, van Holsbeeck M. Longitudinal stress fracture: patterns of edema and the importance of the nutrient foramen. Skeletal Radiol. 2003; 32:22-27.
16. Hughes H. The factors determining the direction of the canal for the nutrient artery in the long bones of mammals and birds. Acta Anat (Basel). 1952; 15(3):261-280.
17. Payton CG. The position of the nutrient foramen and direction of the nutrient canal in the long bones of the madder-fed pig. J Anat. 1934; 68(4):500-510.
18. Murlimanju BV, Prabhu LV, Pai MM, Yadav A, Dhananjaya KVN, Prashanth KU. Neurovascular foramina of the human clavicle and their clinical significance. Surg Radiol Anat. 2011; 33(8):679-82.
19. Rai R, Shrestha S, Kavitha B. Morphological and topographical anatomy of nutrient foramen in human clavicles and their clinical importance. IOSR-JDMS. 2014; 13(1):37-40.