



A TOPOGRAPHIC AND ANATOMICAL STUDY OF NUTRIENT FORAMINA OF CLAVICLE AND THEIR CLINICAL SIGNIFICANCE IN HARYANA POPULATION

Ms. Shivani Chawla^{1*}, Dr. Prachi Saffar Aneja², Dr. Susmita Saha³, Dr. Neetu Arora⁴,
Dr. Savita Bansal⁵, Dr. Vibhash Kumar Vaidya⁶,

Abstract:-

Background: Clavicle is subcutaneous throughout its length and makes a contour of the neck and upper chest¹. The most frequently fractured bone in human skeleton is clavicle. Middle third of the shaft of clavicle is the most common region of fracture². Nutrient foramen is the largest foramen on the shaft of long bones through which nutrient artery for that bone passes³. The nutrient artery is the principal source of blood to a long bone particularly during its active growth period⁴.

Materials and Methods: The study comprises of 50 clavicles, out of which, 26 belong to right side and 24 left side. The bones were obtained from the bone bank of Department of Anatomy at FMHS, SGT University, Budhera, Gurugram, Haryana. All the bones were observed for the number of foramina, position, location and direction. Hughes formula was applied for calculation of foramen index for each clavicle.

Results: The NF were observed in 50 (88%) clavicles and found absent in 6 (12%). The foramen was single in 28 (56%) clavicles, double NF was found in 16 (32%) clavicles and we didn't found more than 3 NF in any clavicle. The foramen was observed at the middle 1/3 region in 49 (88.66%) clavicles, at the medial 1/3 region in 8 clavicles (13.33%) and at the lateral 1/3 part in 3 clavicles (5%). The foramen was on the inferior surface in 39 (65%) clavicles, on the posterior surface in 21 (35%) clavicles. The average distance of the foramen from the sternal end was 63.38 mm (6.33 cm) and the mean foramina index was 46.77. All the foramens were directed away from the growing end.

Conclusion: In our analysis, all of the bones followed the general norm that nutrition foramina flowed away from the growing end. The nutrient foramina information is clinically important, especially in surgical operations such as microvascularised bone transplantation and bone graft.

Keywords: Clavicle, Nutrient foramen, Hughes Formula, Foramina Index.

¹*PhD Scholar, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Gurugram, Haryana 122018, Email: shivanichawla170@gmail.com, Mob- +91 8440006409

²Professor & Head, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Gurugram, Haryana 122018, Email: dranejaprachi@gmail.com, Mob- +91 9205568648

³Professor, Department of Anatomy, Faculty of Medicine & Health Sciences, SGT University, Gurugram, Haryana 122018, Email: drsusmita.sh@gmail.com, Mob- +91 9811398278

⁴Professor & Head, Department of Anatomy, SHKM Govt. Medical College, Nalhar, Mewat, Haryana, 122107, Email: drneetuara@gmail.com, Mob- +91 9728353436

⁵Professor & Head, Department of Pathology, MRDC, Faridabad, Email: drsavitabansal@yahoo.com
Mob- +91 9971410980

⁶Tutor and PhD scholar, Department of Anatomy, FMHS, SGT University, Gurugram, Haryana, 122107
Email: vibhashc455@gmail.com, Mob- +91 8077409384

***Corresponding Author:** Ms. Shivani Chawla

*PhD Scholar, Department of Anatomy, SGT Medical College, Hospital and Research Institute, Faculty of Medicine & Health Sciences, SGT University, Budhera, Gurugram, Haryana 122018.

E mail: shivanichawla170@gmail.com, Mob- +91 8440006409

DOI: 10.53555/ecb/2023.12.si10.0050

Introduction:

Clavicle is long and subcutaneous collar bone with specific embryological features¹. The most frequent fractured bone in human skeleton is clavicle. Middle third of the shaft of the clavicle is mostly the region of fracture². Shaft of the clavicle contain well defined canal. These canals results of variant passing supraclavicular nerves and vessels³. Nutrient foramen is the largest foramen present on the shaft of the clavicle, through these foramens nutrient artery for bone passes⁴. The rule, to the elbow I go, from the knee I flee obeys by the most of the nutrient arteries⁵. Nutrient foramina’s direction is always opposite to the direction of growing end⁶. Knowledge of the foramina is very essential because not only nutrient artery is important even the supraclavicular nerve can get entrapped and cause supraclavicular nerve entrapment syndrome⁴ and for preserving the arterial supply in free vascularized bone grafts, so that the osteocytes and osteoblast survive⁷. Our study aimed to the variation of position, direction and number of nutrient foramen (NF) of clavicle.

Materials and Methods:

The present study was conducted on 50 dry clavicle bones. Convenience sampling is used. The bones were obtained from the bone bank in the Department of Anatomy at FMHS SGT University, Budhera, Gurugram, Haryana. The sample of bones were anonymized and randomly coded so as to ensure delinking with any identity at source (vide Materials and methods section), and approval is sought by institutional Ethics Committee for waiver of informed consent. All the bones were observed for the number of

foramina, position, location and direction. The foramina was examined by using a magnifying lens. The existence of a well-marked groove leading to the nutrient foramina and a well-marked, generally somewhat elevated, edge at the canal's beginning was used for identification. A 24-gauge needle was passed through each foramen to confirm their patency. The foramen index was computed by dividing the foramen's distance from the proximal end (D) by the entire length of the bone (L) ×100 using Hughes formula.⁸

$$\text{Foramen index (FI)} = D/L \times 100$$

The FI was determined for all the clavicles and the foramina were topographically classified with respect to 1/3 regions (medial 1/3, middle 1/3 and lateral 1/3). The data were collected on a standardized sheet and range, mean and percentage were tabulated and analyzed statistically by using microsoft excel software.

Results:

The NF were observed in 50 (88%) clavicles and found absent in 6 (12%). The foramen was single in 28 (56%) clavicles, double NF was found in 16 (32%) clavicles and we didn’t found more than 3 NF in any clavicle. The foramen was observed at the middle 1/3 region in 49 (88.66%) clavicles, at the medial 1/3 region in 8 clavicles (13.33%) and at the lateral 1/3 part in 3 clavicle (5%). The foramen was on the inferior surface in 39 (65%) clavicles, on the posterior surface in 21 (35%) clavicles. The average distance of the foramen from the sternal end was 63.38 mm (6.33 cm) and the mean foraminal index was 46.77. All the foramina were directed away from the growing end.

Table no. 1 shows the number of NF in Right and left clavicle.

Number of NF	Side of clavicle		Total (n=50)	%
	Right (n=26)	Left (n=24)		
0	4	2	6	12%
1	15	13	28	56%
2	7	9	16	32%
3 or more	0	0	0	0

Table no.2 shows the location of NF

Side of clavicle	Inferior surface	Posterior surface
Right	23	12
Left	16	09
Total	39	21
%	65%	35%

Table no. 3 shows the Position of NF in relation to length of the clavicle

Position of NF	No. of NF	%
Middle 1/3	49	81. 66 %
Medial 1/3	08	13.33%
Lateral 1/3	03	5%

Table no. 4 shows the Distance from sternal end to NF and foramen index (FI).

End	Distance (mm)	FI (mm)
Sternal end	63.38	46.77



Figure 1

Fig 1. Shows the number of NF is one and the location of the NF is on the posterior surface of the clavicle, position of NF on the middle one third of the clavicle and direction of NF towards the medial end of the clavicle and nutrient canal directed towards the sternal end of the clavicle.



Figure 2

Fig 2. Shows the number of NF are two and present on the posterior & inferior surface and position of NF on the middle one third and lateral one third on the clavicle respectively.



Figure 3

Fig 3. Shows the distance of NF from the sternal end (in mm).



Figure 4

Fig 4. Shows the total length of clavicle (in mm).

Discussion:

Nutrient foramen has a particular position of each bone⁷. Clavicle doesn't depend on nutrient artery because it has no medullary cavity. Clavicle has spongy (trabecular) bone with a shaft of compact bone⁹. Main diaphyseal arteries enter in the shaft of the clavicle through NF, which lead into nutrient canal. Direction of NF is always directed away from the dominant growing epiphysis¹⁰.

Number of NF: Our study found that, we have total 50 clavicles and total number of NF were 60
Eur. Chem. Bull. 2023, 12(Special Issue 10), 454 –457

in which the clavicles with no NF was found 12%, single NF was found 56% and with double NF was found 32% with correlating with other studies Rai R⁷ found single foramen in 17 (42.5%), double foramen in 21(52.5%) and more than 2 found only on 2(5%) clavicles. Nita A Tanna⁶ found single NF in 21(42%) of the clavicles and double NF in 26(52%) and there was no clavicle found with more than two NF.

Location of NF: Present study shows position of NF was more on the inferior surface (65%) and (35%) on the inferior surface, when we compare with the other studies we found that Summa M.P¹¹ observed 39(62.9%) on inferior surface, 21(33.8%) on posterior surface and 2 (4%) of NF

were found on anterior surface. Rai R⁷ found 35.4% of NF on inferior surface and 64.4% on posterior surface of clavicle. Clavicle showed more variation as to the surface on which NF was present¹². It is very important and knowledgeable to found location of NF because it is use in surgical procedures to preserve the circulation¹.

Position of NF: Our study showed the position of NF on middle one third was 81.66%, on medial one third 13.33% and on lateral one third 5% as correlating with other studies Maulkar¹³ found that 72% of NF were present on middle one third and on lateral one third there were 9.8% and they didn't found any NF on medial one third.

Mean Foramen index: Present study explained the average distance of NF from sternal end was 63.88 mm and Foramen index was 46.77mm. Our findings was similar to the Rai R⁷ who found average distance of NF from sternal end was 67.6 mm and Foramen index was 48.01 mm and similarly when we compared with Murlimanju¹ who found average distance of NF from sternal end to be 64.4 mm and Foramen index to be 44.72 mm.

Conclusion:

The location of the NF on most of the clavicles were found on the inferior surface and NF found 81.66% on the middle one third of the clavicle and Foramen index was 46.77 mm. It gives knowledge of position of NF. It is also useful for surgical procedures to preserve the circulation and in bone grafting and microvascularised bone transplantation.

References:

1. 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
2. Andermahr J, Jubel A, Elsner A, Johann J, Prokop A, Rehm KE et al. Anatomy of clavicle and the intramedullary nailing of midclavicular fractures. *Clin Anat*. 2007; 20(1):48–56.
3. Jeleve L, Surchev L. Canal through the clavicle—result of the variant passing of the supraclavicular nerves, First study in Bulgaria. *Medicine morphologie*. 2004; 57(8)
4. Chatrapathi DN, Mishra BD. Positions of nutrient foramen on the shaft of the human long bones. *Journal of Anatomical society of India*. June 1965; 14: 54-63.
5. BD Chourasia's - Handbook of General Anatomy 3rd edition, page 35-36 CBS Publications.
6. Nita A Tanna, Vilpa A Tanna. Anatomical variation in position, direction and number of nutrient foramina in clavicles. *International Journal of Medical sciences and public health*. 2015 vol.4 issue 3.
7. 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.
8. 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.
9. Moore KL, Dalley AF, Agur AMR. Clinically oriented anatomy 5th edn Lippincott Williams and Wilkins 2006: 1,729.
10. Standing S. Gray's anatomy: the anatomical basis of clinical practice. 40th edn. London, UK: Elsevier 2008: p. 791
11. Summa M.P, Usha Veera, Sangeetha Srinivasan. The study of nutrient foramina in human clavicle. *J. evid. based med. Health*. 2018; 5 (2), 107-109.
12. Pereira GAM, Lopes PTC, Santos AMPV. Nutrient foramina in the upper and lower limb long bones: morphometric study in bones of southern Brazilian adults. *Int J Morphol* 2011;29(2):514-520.
13. Maulkar O, Joshi H. Diaphyseal nutrient foramina in long bones and miniature long bones. *Nat. J Integr Res Med* 2011, 2 (2): 23-26.