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Research Paper

# Nutrient Foramina of the Dry Human Clavicle and Their Clinical Significance

Medical

KEYWORDS : Clavicle, Foraminal Index, Nutrient Foramen.

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## ABSTRACT

*Aim of the study: To study the number, direction and position of nutrient foramen of the dry human clavicle.*

*Material and Method:The study comprised 75 clavicles which were obtained from anatomy department of B.J.Medical College and grossly observed for the number,location and direction of the nutrient foramina. The Foraminal Index was calculated for each clavicle by applying the Hughes formula. All the measurements were taken by using digital Vernier Calipers in millimeters.*

*Results: In present study the foramen was single in 56(74.66%) clavicles,double in11(14.66%) clavicles,more than two in 6(8%) clavicles and absent in 2(2.66%) clavicles.The foramen was present in 79(82.29%) claviclesat middle 1/3, in 8(8.33%)at medial 1/3 and in 9(9.37%) clavicles at lateral 1/3 of clavicle.The foramen was present on inferior surface in 18(18.75%) clavicles on posterior surface in 76 (79.16%) clavicles and on superior surface in 2(2.08%) clavicles. Mean Foraminal Index was 52.66.*

*Conclusion: Most of the foramina were on posterior surface and on middle 1/3(proved by Foraminal Index). Undoubtedly all foramina were directed towards the acromial end, so nutrient foramina ofclavicle follow the growing end theory. Theknowledge from the present study will be helpful in certain surgical procedures to preserve circulation, for bone grafting,surgical approach for internal fixation and coracoclavicular ligament repair.*

**Introduction:**

The clavicle lies almost horizontally at the root of the neck and is subcutaneous throughout its whole extent. The role of nutrient foramen in nutrition and growth of the bones is evident from term "Nutrient" itself [6]. Nutrient foramen is the largest foramen on the shaft of long bones through which nutrient artery for that bone passes [4]. The nutrient artery is the principal source of blood supply to a long bone particularly during its active growth period [1]and during the early phases of ossification and some pathological bone conditions such as developmental abnormalities, fracture healing and acute hematogenic osteomyelities are closely related to the vascular supply of the bone [14].

A nutrient foramen is found in the lateral end of the subclavian groove running in lateral direction and transmits nutrient artery which is derived from suprascapular artery [15].The foramina of the clavicle do not always transmit the supraclavicular nerve; only in some occasions the medial supraclavicular nerves pass through the foramina in the clavicle on their way to the anterior of the chest [13]. The nutrient foramen of the clavicle was found at the junction between the lateral and middle third regions[5].

Most of the nutrient foramen follow the rule, 'to the elbow I go, from the knee I flee' but they are very variable in position. Berard was the first to correlate the direction of the canal with the ossification and growth of the bone [3]. Humphrey who worked on the direction and obliquity of nutrient canals postulated periosteal slipping theory and stated that nutrient canal finally directed away from the growing end [9].

The topographical knowledge of nutrient foramina of clavicle is useful to preserve arterial supply during radiation therapy,appropriate placement of internal fixation devices for treatment of fracture[7] and in free vascularized bone grafts, so that the osteocytes and osteoblasts can survive [16]

**Aims of study:**

1. To study the number and position of the nutrient foramina of Clavicle.
2. To determine the size, the direction of the nutrient canal running from nutrient foramen.
3. To correlate the knowledge of position of nutrient foramina with their clinical aspects.

**Material and Method:**

The study material consisted of clavicles of unknown age and sex obtained from the collection of the Anatomy Department of B.J. Medical College of Gujarat. Clavicles which were damaged, deformed or with apparent abnormalities were excluded from the study. After excluding only 75 dry clavicles were suitable for the study. All the bones macroscopically observed using magnifying lens for the number,location and direction of the nutrient foramina.The nutrient foramina were identified by presence of a well marked groove,leading to them and by well marked often slightly raisededge at the commencement of the canal. The following data were studied for nutrient foramina of each bone:

(1)Clavicles were examined for the number of nutrient foramina.

(2)The position of all nutrient foramina was determined by calculatinga foraminal index (FI)applying Hughes formula [8].

FI = (DNF/TL) x 100

DNF = the distance from the proximal end (sternal end) of the clavicle to the nutrientforamen.

TL = total length of clavicle.

The total length of the clavicle measured in millimeters using digital vernier callipers ignoring curves of clavicle.Nutrient foramina equal or larger than the size of 24 hypodermic needlewere accepted as being dominant nutrient foramina (0.56 mm in diameter)smaller than the size of 24 hypodermic needle were considered as being secondary nutrient foramina. A fine stiff wire was used to confirm the direction and obliquity of the foramen.

**Results:** In present study nutrient foramina were observed in 75 clavicles and following results were obtained.

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**Table:1 Numbers of nutrient foramina in clavicles**

| Value | No of foramina | | | |
|---|---|---|---|---|
| | 0 | 1 | 2 | 3 |
| No. of Clavicles | 2 | 56 | 11 | 6 |
| Percentage (%) | 2.66 | 74.66 | 14.66 | 8 |

**Table:2 Direction of nutrient foramen in clavicles**

| Value | Towards the growing end | Away from the growing end |
|---|---|---|
| No.of clavicles | 0 | 73 |
| Percentage(%) | 0 | 97.33 |

**Table:3 Lengthwise distribution of nutrient foramina on the shaft of clavicles.**

| Value | Medial third | Middle third | Lateral third |
|---|---|---|---|
| No of foramina | 8 | 79 | 9 |
| Percentage(%) | 8.33 | 82.29 | 9.37 |

**Table:4 Location of nutrient foramina on various surfaces of shaft of clavicles.**

| Value | Expected Site | Variant Site | |
|---|---|---|---|
| | | 1 | 2 |
| | Inferior Surface | Posterior Surface | Superior Surface |
| No of foramina | 18 | 76 | 2 |
| Percentage (%) | 18.75 | 79.16 | 2.08 |

**Figure 1. Clavicle showing the nutrient foramina (arrow mark) at the inferior surface (Inferior view of the clavicle)**

**Figure 2. Clavicle showing the nutrient foramina (arrow mark)at the posterior surface (Posterior view of the clavicle)**

In present study average length of the clavicle was 140.73mm and average distance of the foramen from the sternal end was 74.11 mm.So mean foraminal index was 52.66.

**Discussion:**

Nutrient arteries are main blood supply during the active growth period and at the early phases of ossification [10]. During childhood, long bones receive about 80% of the interosseous blood supply from the nutrient arteries, and in the case of their absence, the vascularization occurs through the periosteal vessels .Knudsen et al. stated that the clavicle gets nourishment through the suprascapular, thoracoacromial and internal thoracic arteries. According to them the clavicle is supplied by periosteal arteries and not by the nutrient artery.The absence of nutrient artery to the clavicle explained by that clavicle has no medullary cavity so does not depend on a nutrient artery [11]. Few authors hypothesize that with respect to the development of the blood supply to the clavicle, there could be nutrient artery to the primary centers of ossification and to the late secondary center at the sternal end of the clavicle[11].It was explained that the clavicle growth would be in an acromio-sternal direction; in young patients sternal epiphyseal end displacement of the clavicle is more common that suggest the presence of sternal growth [2].In present study it was observed that all foramina were directed towards the acromial end, which shows that the sternal end of the clavicle is the growing end.The standard textbook of anatomy states that the nutrient foramen of the clavicle is present at the inferior surface [15]. But in the present study observed that the position of the foramen was not constant.It is mostly at the posterior surface. In present study nutrient foramen was found on posterior surface in 79.16% clavicles and in middle 1/3 region in 82.29%.This is in accordance with previous studies of B.V.Murlimanju [2]and Malukar [12].

**Conclusion:**

Most of the nutrient foramina were on posterior surface and on middle 1/3(proved by Foraminal Index). Undoubtedly all foramina were directed towards the acromial end, so nutrient foramina of clavicle follow the growing end theory. The knowledge from the present study will be helpful in certain surgical procedures to preserve circulation, for bone grafting,surgical approach for internal fixation and coraco-clavicular ligament repair.

## REFERENCE

1. B.D.Chaurasia's – Hand book of General Anatomy. 3rd Ed.35-36 | 2. B.V.Murlimanju. Neurovascular foramina of the human clavicle and their clinical significance,surg Radiol Anat 2011;33:679-682. | 3. Berard. Arch, Gener, De Med II Series 1835;2(7): 176-183. | 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. Fischer LP, Carret JP. Vascularisation arte´rielle des oschez l'homme. Bull Assoc Anat 1978; 62:419–454 | 6. Fraizer, Ernest J. The Anatomy of Human Skeleton. 4th Ed. 1964;5 | 7. Green DP (ed). Operative hand surgery. 2nd Ed. Churchill Livingstone, New York. 1988; 1248. | 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. Humphrey GM. Observations on the growth of the long bones and of the stumps. Medico Chir. Trans.1861; 44: 117-134. | 10. Kizilkanat E, Boyan N, Ozsahin ET et al. Location, number and clinical significance of nutrient foramina in human long bones. Ann Anat 2007;189:87–95 | 11. Knudsen FW, Andersen M, Krag C.The arterial supply of the clavicle. Surg Radiol Anat 1989;11: 211–214. | 12. Malukar O, Hemang Joshi H. Diaphysial Nutrient Foramina in Long Bones And Miniature Long Bones. NJIRM 2011; 2(2):23-26 | 13. Rockwood CA, Matsen FA, Lippitt SB et al. (eds) Theshoulder, 4th Ed. Saunders Elsevier, Philadelphia,2009:77. | 14. Skawina, A, Wyczolkowski, M. Nutrient foramina of humerus, radius and ulna in Human Fetuses. Folia Morphol 1987; 46: 17 - 24. | 15. Standring S (ed) Gray's anatomy. The anatomical basis of clinical practice, 39th Ed Churchill Livingstone, Spain,2006: 817–81 | 16. Vinay G, Kumar AS. A Study of Nutrient Foramina in Long Bones of Upper Limb. Anatomica Karnataka. 2011; 5 (3) 53-56 |