

Anatomical variation in position, direction, and number of nutrient foramina in clavicles

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Abstract

Background: The clavicle is a modified long bone. It is the most important bone for transmission of weight from upper limb to the axial skeleton and for muscle attachments and is significant source for bone grafting.

Objective: To determine the position, direction, and number of nutrient foramina in human clavicles.

Materials and Methods: The study comprised 50 clavicles of unknown sex, which were obtained from the Department of Anatomy, Smt. BK Shah Medical Institute & Research Centre, Piparia, Vadodara, Gujarat, India. The foramen index was calculated using the Hughes formula.

Results: The nutrient foramen was observed in all 50 (100%) clavicles. Total 82 foramina were observed. In 18.3% clavicles, nutrient foramen was present at medial 1/3rd region, in 72% at the middle 1/3rd, and in 9.8% at the lateral 1/3rd. Single nutrient foramen was present in 40% clavicles, whereas two and three nutrient foramina were present in 54% and 6% clavicles, respectively. The nutrient foramen was found on inferior surface in 49.2% clavicles and on posterior surface in 50.8% clavicles. The average distance of the foramen from the sternal end was 69.8 mm (6.98 cm) and the mean foraminal index was 49.01.

Conclusion: The knowledge of nutrient foramina in clavicles is important in surgical procedures such as bone grafting and in microsurgical vascularized bone transplantation.

KEY WORDS: Foramen index, clavicle, nutrient foramen

Introduction

The clavicle is a long bone. It supports the shoulder so that the arm can swing clearly away from the trunk. The clavicle transmits the weight of the upper limb to the sternum. The bone has a cylindrical part called the shaft, and two ends, lateral and medial.^[1] The shaft is divisible into the lateral one-third and the medial two-thirds.

The lateral one-third of the shaft is flattened from above downward. It has two borders, anterior and posterior. The anterior border is concave forward and the posterior one is convex backward. This part of the bone has two surfaces, superior and inferior. The superior surface is subcutaneous and the inferior surface presents an elevation called the conoid tubercle and a ridge called the trapezoid ridge.

The medial two-thirds of the shaft is rounded and has four surfaces. The anterior surface is convex forward and the posterior surface is smooth. The superior surface is rough in its medial part and the inferior surface has a rough oval impression at the medial end. The lateral half of this surface has a longitudinal subclavian groove. The nutrient foramen lies at the lateral end of the groove.^[2]

The lateral or acromial end is flattened from above downward. It bears a facet that articulates with the acromion process of the scapula to form the acromioclavicular joint. The medial or sternal end is quadrangular and articulates with the clavicular notch of the manubrium sterni to form the sternoclavicular joint. The articular surface extends to the inferior aspect, for articulation with the first costal cartilage.

This study was designed to find out the anatomical variation in position, direction, and number of nutrient foramina in clavicles, as topographical knowledge of these foramina is useful in certain operative procedures to preserve the circulation.^[3] It is important that the arterial supply be preserved in free vascularized bone grafts, so that the osteocytes and osteoblasts survive.^[4] With the knowledge of variations in the nutrient foramina, placement of internal fixation devices can be appropriately done.^[5]

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Materials and Methods

Fifty clavicles of unknown sex were collected from the Department of Anatomy, Smt. BK Shah Medical Institute & Research Centre, Piparia, Vadodara, Gujarat, India, after the approval from the ethical committee of the institute. The clavicles were observed for the position, direction, and number of nutrient foramina. The foramen index was calculated using the Hughes formula, dividing the distance of the foramen from the proximal end (D) by the total length of the bone (L), which was then multiplied by 100^[6]:

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

Results

The nutrient foramen was observed in 50 (100%) clavicles. Single foramen in 21 (42%) clavicles and double foramina in 26 (52%) clavicles. Most of the right-sided clavicles contained single foramen (50%), whereas left-sided clavicles contained two foramina (63.3%). Three foramina could be obtained only in three right-sided clavicles [Table 1].

Total number of nutrient foramen observed was 82. Of which, 36.6% foramina were on inferior surface and 63.4% were on posterior surface of the clavicles. When percentage of clavicles was determined, we found 50.8% clavicles contained nutrient foramen on posterior surface and 49.2% on inferior surface. Total number of clavicle was 61 as some clavicles contained nutrient foramina on both inferior and posterior surfaces [Table 2].

We found that 18.3% foramina were present at medial 1/3rd region, 72% at middle 1/3rd region, and 9.8% at lateral 1/3rd region. Similarly, we also calculated percentage of clavicles containing these foramina at different regions of clavicle. Total number of clavicle considered was 59 as some clavicles contained more than one foramen located at different regions (medial, middle, and lateral). We found that 66.1%

Table 1: Number of nutrient foramen in clavicle

Number of nutrient foramen	Clavicle		
	Right (n = 20)	Left (n = 30)	Total (n = 50)
1	10 (50%)	11 (36.7%)	21 (42%)
2	7 (35%)	19 (63.3%)	26 (52%)
3	3 (15%)		3 (6%)

Table 2: Location of nutrient foramen

Surface	Number of nutrient foramen	Number of clavicle
Inferior	30 (36.6%)	30 (49.2%)
Posterior	52 (63.4%)	31 (50.8%)
Total	82	61

Table 3: Length-wise distribution

Part of clavicle	Number of nutrient foramen	Number of clavicle
Medial 1/3 rd	15 (18.3%)	12 (20.3%)
Middle 1/3 rd	59 (72%)	39 (66.1%)
Lateral 1/3 rd	8 (9.8%)	8 (13.6%)
Total	82	59

clavicles contained nutrient foramina at middle 1/3rd region, 20.3% at medial 1/3rd region, and 13.6% at lateral 1/3rd region [Table 3].

The average distance of the foramen from the sterna end was 69.8 mm (6.98 cm), and the mean foraminal index was 49.01. All the foramina were directed away from the growing end.

Discussion

The external opening of the nutrient canal, usually referred to as the nutrient foramen, has a particular position for each bone. In this study, all the clavicles had at least one nutrient foramen.^[7] Total number of foramina in clavicles was 82, and we observed that most of the clavicles (52%) had two foramina. Most of the foramina were in middle 1/3rd region (72%) and in 66.1% clavicles. Also, most of the nutrient foramina were in posterior surface (63.4%) and in 50.8% clavicles.

Rai et al.^[6] observed nutrient foramen in all 40 (100%) clavicles. Total 65 foramina were observed. They found that 15.4% foramina was present at the medial 1/3rd region, 73.8% at middle 1/3rd region, and 10.8% at lateral 1/3rd region; 35.4% foramina was on inferior and 64.6% on posterior surface of clavicles. The foramen was single in 17 (42.5%) clavicles, two in 21 cases (52.5%), and more than two foramina in 2 clavicles (5%). The foramen was on inferior surface in 42.6% clavicles and on posterior surface in 57.4%.

Murlimanju et al.^[7] observed that nutrient foramen was single in 20 (38.5%) clavicles, two foramina in 23 cases (44.2%), and more than two foramina in 7 clavicles (13.4%). The foramen was 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%. It was 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 sterna end was 64.4 mm, and the mean foraminal index was 44.72. This study observed that the foramina were more common on posterior surface and were often multiple, directed toward the acromial end.

In our study, the average distance of the foramen from the sterna end was 6.98 cm and the mean foraminal index was 49.01. The findings of this study were similar to those of Rai et al.^[6] who found the average distance of the nutrient foramen from the sterna end to be 6.76 cm and the mean foraminal index to be 48.01.

CONCLUSION

Most of the clavicles contained nutrient foramina at the middle 1/3rd region and on the posterior surface. The foramen index was 49.01. It gives the position of the nutrient foramen. The knowledge of these foramina is necessary as it is useful in the surgical procedures to preserve the circulation. The findings of this study may be useful for the surgeons who used to perform bone graft surgical procedures. The anatomical data of this study are useful to the surgeons as the microvascular bone transfer has become very popular.

References

1. Chaurasia BD. *Human Anatomy: Upper Limb and Thorax*, 5th edn. New Delhi: CBS Publishers. 2009 pp. 7–8.
2. Standring S. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 40th edn. London, UK: Elsevier, 2008 pp. 791–5.
3. Mysorekar VR. Diaphysial nutrient foramina in human long bones. *J Anat* 1967;101(Pt 4):813–22.
4. Green DP (Ed.). *Operative Hand Surgery*, 2nd edn. New York: Churchill Livingstone, 1988. p. 1248.
5. Vinay G, Kumar AS. A study of nutrient foramina in long bones of upper limb. *Anatomica Karnataka* 2011;5(3):53–6.
6. 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.
7. 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.

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