

## MORPHOMETRIC STUDY IN THE VARIATIONS OF NUMBER, POSITION AND DIRECTION OF NUTRIENT FORAMEN IN THE CLAVICLE

Sanjeev Kumar Sinha<sup>1</sup>, Margaret Roshni Dhan<sup>\*2</sup>, S.M. Badar Hayat<sup>3</sup>, Vinod Kumar<sup>4</sup>.

<sup>1,2</sup> Assistant Professor, Department of Anatomy, Narayan Medical College, Sasaram, Bihar, India.

<sup>3</sup> Tutor, Department of Anatomy, Narayan Medical College, Sasaram, Bihar, India

<sup>4</sup> Professor, Department of Anatomy, Narayan Medical College, Sasaram, Bihar, India.

### ABSTRACT

**Background:** Clavicle is a curved modified long bone placed horizontally at the root of neck. It transmits the weight of upper limb to the axial skeleton. The aim of this study is to determine position, number, and direction of nutrient foramen.

**Material method:** The present study was conducted on 50 (25 right and 25 left) dried clavicles, in the department of Anatomy, Forensic medicine, Narayan Medical College, Jamuhar, Sasaram, Bihar.

**Result:** The nutrient foramen was present in all the clavicles. One nutrient foramen was present in 70%, two in 24% and three in 6% of clavicles. Predominant position of nutrient foramen was on the posterior surface (55.88%) and predominant location was in the middle one third (70.58%) of clavicles. Direction of all the nutrient foramina were towards the acromial end.

**Conclusion:** The study of number, position, location and direction of nutrient foramina of clavicles are useful to preserve the arterial supply during surgical procedure like internal fixation and vascularised bone graft.

**KEY WORDS:** Clavicle, nutrient foramen, foramen index, acromial end, sternal end, vascularised bone graft.

**Corresponding Author:** Dr. Margaret Roshni Dhan, Assistant Professor, Department of Anatomy, Narayan Medical College, Sasaram, Bihar, India. **E-Mail:** [margaret.dhan@gmail.com](mailto:margaret.dhan@gmail.com)

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### INTRODUCTION

The clavicle is a curved modified long bone placed horizontally at the root of neck. It acts as a sturt for holding the upper limb far from trunk so that it can move freely [1]. It also transmits the weight of upper limb to axial skeleton. The clavicle has a cylindrical shaft and two ends, sternal (medial) and acromial (lateral). The shaft is divided into lateral one third and medial two third. Lateral one third of shaft is flattened so that it has two surface (superior, inferior) and two borders (anterior, posterior). Medial two

third of shaft is cylindrical and has four surfaces (anterior, posterior, superior and inferior). Inferior surface of the shaft of clavicle has subclavian groove. The nutrient foramen usually lies lateral to the subclavian groove which is directed laterally [2]. The nutrient artery of clavicle is derived from suprascapular artery [3]. The long bone has nutrient foramen through which nutrient artery passes for that bone [4]. Nutrient artery is the main source of blood supply to long bone during its active growth [5]. The direction of nutrient foramen of

all bones are away from growing end [6]. Berard was the first to correlate the direction of canal with growth and ossification of bone [7]. Lutken observed that variable position of nutrient foramen and position of that foramen can be determined by the proper study on human bone [8]. The knowledge of position, direction and number of nutrient foramen is very important in surgical and orthopedical procedures like internal fixation of clavicle [9], and in vascularised bone grafting. Arterial supply must be preserved for proper repair of fracture and survival of osteocyte and osteoblast [10]. The main objective of this study was to determine the variation of position, direction and number of nutrient foramen in the clavicle and their clinical importance.

### MATERIALS AND METHODS

The study was conducted on 50 (25 right and 25 left) dried human clavicle, in the department of Anatomy, Forensic medicine, Narayan Medical College, Jamuhar, Sasaram, Bihar. The age and sex of bones were unknown.

Bones which were damaged, deformed and had gross pathological abnormality were excluded from the study.

All the clavicles were observed for the number, position, location and direction of nutrient foramina.

Foramen index was calculated by applying the Hughes formula [11]

$$FI = (DS/TL) \times 100$$

FI- Foramen index

DS- Distance of nutrient foramen from the sternal end of clavicle

TL- Total length of the clavicle (Ignoring curves of the clavicle)

All the observation were recorded with the help of

- a) Magnifying lens
- b) 0.24 gauge (0.56mm in diameter) hypodermic needle
- c) Digital vernier caliper

### RESULTS

The nutrient foramen was present in all clavicles. One nutrient foramen was present in

70%, two in 24%, and three in 6% of clavicles. One nutrient foramen was found in 64% of right and 76% of left clavicles. Two nutrient foramen was found in 28% of right and 20% of left clavicle. Three nutrient foramen was found in 8% of right and 4% of left clavicle. Total number of nutrient foramen observed was 68.

Nutrient foramen was present on posterior surface in 55.88%, inferior surface in 41.17%, and superior surface in 2.94%. On the right clavicles 61.11% nutrient foramen was found on posterior surface, 38.88% on inferior surface and no foramen on superior surface. On the left clavicles 50% nutrient foramen on posterior surface, 43.75% on inferior surface and 6.25% on superior surface.

10.29% nutrient foramen was present at the medial 1/3<sup>rd</sup> region, 70.58% at the middle 1/3<sup>rd</sup> and 19.11% at the lateral 1/3<sup>rd</sup> of the clavicle. 8.33% nutrient foramen was found at the medial 1/3<sup>rd</sup> of the right clavicle and 12.50% at the left clavicle. 72.22% nutrient foramen was found at the middle 1/3<sup>rd</sup> of right clavicle and 68.75% at the left clavicle. 19.44% nutrient foramen was found at the lateral 1/3<sup>rd</sup> of right clavicle and 18.75% at the left clavicle.

The average distance of the nutrient foramina from the sternal end was found to be 69.63 mm and average total length of the clavicle was 133.26 mm. The foramen index was 52.25. Direction of all nutrient foramina were away from the sternal end.

**Table 1:** Number of nutrient foramen in clavicle.

Number of nutrient foramen	Right(25)	Left(25)	Total(50)
1	16 (64.0%)	19 (76.0%)	35 (70.0%)
2	7 (28.0%)	5 (20.0%)	12 (24.0%)
3	2 (8.0%)	1 (4.0%)	3 (6.0%)

**Table 2:** Position of nutrient foramen of clavicle.

Surface	Right	Left	Total
Posterior	22 (61.11%)	16 (50.0%)	38 (55.88%)
Inferior	14 (38.88%)	14 (43.75%)	28 (41.17%)
Superior	0	02 (6.25%)	2 (2.94%)

**Table 3:** Location of nutrient foramen of clavicle.

Region of clavicle	Right	Left	Total
Medial 1/3 <sup>rd</sup>	3 (8.33%)	4 (12.50%)	7 (10.29%)
Middle 1/3 <sup>rd</sup>	26 (72.22%)	22 (68.75%)	48 (70.58%)
Lateral 1/3 <sup>rd</sup>	7 (19.44%)	6 (18.75%)	13 (19.11%)

**Table 4:** Foramen index (FI).

DS (in mm)	TL (in mm)	FI
69.63	133.26	52.25

**Fig. 1:** Clavicle with 3 nutrient foramen on Posterior and inferior surface



**Fig. 2:** Clavicle with 1 nutrient foramen on posterior surface



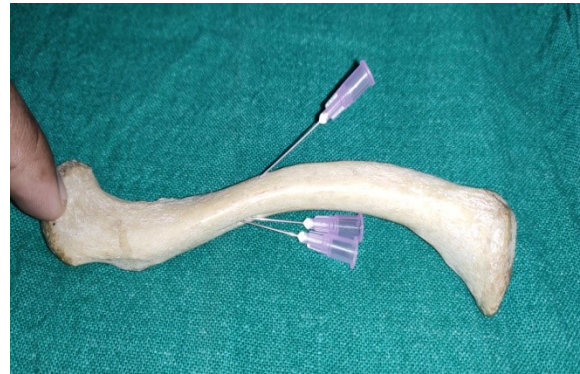
**Fig. 3:** Clavicle with 2 nutrient foramen on posterior surface and inferior surface



**Fig. 4:** Clavicle with 1 nutrient foramen on inferior surface



**Fig. 5:** Clavicle with 3 nutrient foramen on posterior and superior surface



**Fig. 6:** Clavicle with 1 nutrient foramen on posterior surface



## DISCUSSION

In the present study, we have found that 70% of clavicle had one nutrient foramen, 24% of clavicle had two foramen and 6% of clavicle had three nutrient foramen. This study is very close to the studies done by Malukar et al [12] and Ruchi ratnesh et al [13], but in the other study done by Rahul rai et al [14], one nutrient foramen was found in 42.5%, two foramen in 52.5% and three foramen in 5% of clavicle.

In our study the nutrient foramen was predominant on posterior surface (55.88%) which is similar to the studies done by Malukar et al [12] (56.3%) and Rahul rai et al [14] (64.6%). While in the other study done by Ruchi Ratnesh et al [13] predominant position of nutrient foramen on inferior surface was (72.9%).

In this study the location of nutrient foramen is maximum in middle one third (70.58%) which is similar to study done by Rahul rai et al [14] (73.8%).

In our study the average distance of nutrient foramen from sternal end was found to be 69.63 mm and foramen index was 52.25. Our finding was similar to studies done by Rahul rai et al [14] who found the average distance of

**Table 5:** Showing the comparison in reference to literature.

Parameter	Malukar et al, 2011 [12]	Rahul rai et al, 2014 [14]	Ruchi ratnesh et al,2018 [13]	Present study
<b>Number of foramina</b>				
<b>1</b>	68%	42.50%	65%	70%
<b>2</b>	21%	52.50%	26.66%	24%
<b>&gt;2</b>	10%	5%	8.33%	6%
<b>Position</b>				
<b>Superior</b>	1.40%	--	1.66%	2.94%
<b>Inferior</b>	42.50%	35.40%	72.90%	41.17%
<b>Posterior</b>	56.30%	64.60%	26.74%	55.88%
<b>Location</b>				
<b>Medial1/3<sup>rd</sup></b>	8.40%	15.40%	11.66%	10.29%
<b>Middle1/3<sup>rd</sup></b>	59.10%	73.80%	66.66%	70.58%
<b>Lateral1/3<sup>rd</sup></b>	32.30%	10.80%	21.66%	19.11%
<b>Direction of nutrient foramen</b>	Towards acromial end	Towards acromial end	Towards acromial end	Towards acromial end

foramen from sternal end was 67.6 mm and foramen index 48.01 and by Santosh k sahu et al [15] average distance of foramen from sternal end was 65.8 mm and foramen index 52.06.

### CONCLUSION

From this study we conclude that, usually clavicle exhibit one nutrient foramen which was predominant on the posterior surface. The location of nutrient foramen was maximum in middle one third followed by lateral one third and then medial one third of bone length. The direction of nutrient foramen was towards acromial end. The study of nutrient foramen of clavicle will be useful to preserve the arterial supply during surgical procedure like internal fixation and vascularised bone graft.

**Conflicts of Interests: None**

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