

## Morphological study of nutrient foramen in adult human clavicles

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### ABSTRACT

**Introduction:** The Clavicle is a modified long bone and only long bone which is placed horizontally and subcutaneously at the root of neck. It transmits the weight from upper limb to the axial skeleton. Nutrient foramen is the largest foramen on the long bones through which nutrient artery for the bones passes. The nutrient artery is the principal source of blood supply to a long bone, particularly important during its active growth period in the embryo and foetus, as well as during the early phase of ossification. The bone has a cylindrical part called the shaft and two ends, lateral and medial. The shaft is divisible into the lateral one-third and the medial two-thirds. The inferior surface of shaft of clavicle presents a subclavian groove. A Nutrient foramen lies at the lateral end of the groove running in a lateral direction.

**Aims & objectives:** To note the position, number and direction of nutrient foramen

**Materials and Methods:** The present study was performed on 100 adult human clavicles of unknown sex and age collected from the department of anatomy, Mysore medical college and research institute, Mysore. Clavicles were examined by direct observation to note the position, number and direction of nutrient foramen. A magnifying lens was used to observe the foramina.

**Results:** The study was conducted on 100 adult human clavicles (50 right and 50 left), and we observed the following results: Nutrient foramina were present in 97 clavicles - 49 clavicles (right) and 48 clavicles (left). Single foramina was present in 80 clavicles, 41 clavicles (right) and 39 clavicles (left) Double foramina were present in 17 clavicles, 8 clavicles (right) and 9 clavicles (left). Absence of nutrient foramina were found in 3 clavicles, 1 clavicle (right) and 2 clavicles (left). All foramina were directed towards the acromial end of the clavicle.

**Conclusion:** The knowledge of anatomical variations of nutrient foramina in clavicles are important for surgeons for performing surgical procedures like bone grafting and microsurgical vascularised bone transplantation.

**KEY WORDS:** Clavicle, Nutrient Foramen, Bone Graft.

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### INTRODUCTION

The Clavicle is a modified long bone and only long bone which is placed horizontally and subcutaneously at the root of neck. It transmits the weight from upper limb to the axial

skeleton [1]. Nutrient foramen is the largest foramen on the long bones through which nutrient artery for the bones passes. This foramen transmits the nutrient artery and at times, the supraclavicular nerve [2].

The nutrient artery is the principal source of blood supply to a long bone, particularly important during its active growth period in the embryo and foetus and also during the early phase of ossification [3].

The bone has a cylindrical part called the shaft, and two ends, lateral and medial. The shaft is divisible into the lateral one-third and the medial two-thirds. The inferior surface of shaft of clavicle presents a subclavian groove. A Nutrient foramen lies at the lateral end of the subclavian groove running in a lateral direction [1].

The knowledge of nutrient foramen is important in operative procedures like free vascularised bone grafts, bone transplantation and also in placement of internal fixation devices [4]. The knowledge of the neurovascular foramina of the clavicle is clinically important as these are involved in the supraclavicular nerve entrapment syndrome [5]. The aim of this study is to know the variations in position, number and direction of the nutrient foramina in adult human clavicles.

**MATERIALS AND METHODS**

The present study was performed on 100 adult human clavicles of unknown age and sex collected from department of anatomy, Mysore medical college and research institute, Mysore. All the bones were macroscopically observed for position, number and direction of the nutrient foramina. A magnifying lens was used to observe the foramina. The data was collected, tabulated and statistically analyzed.



**Fig. 1:** Right side clavicle showing nutrient foramen on inferior surface of shaft of clavicle.

**RESULTS**

**In our present study, we observed the following findings:**

1. Nutrient foramina were present in 97 clavicles - 49 clavicles (right) and 48 clavicles (left)
2. Single foramina was present in 80 clavicles - 41 clavicles (right) and 39 clavicles (left)
3. Double foramina were present in 17 clavicles - 8 clavicles (right) and 9 clavicles (left).
4. Absence of nutrient foramina were found in 3 clavicles, 1 clavicle (right) and 2 clavicles (left).
5. All foramina were directed towards the acromial end of the clavicle.

In 96 clavicles, the nutrient foramen was observed in the medial 2/3<sup>rd</sup> of the clavicle and in 1 clavicle, the foramen was observed in the lateral 1/3<sup>rd</sup> of the clavicle. In 85 clavicles, the foramen was observed on the posterior surface and in 12 clavicles on the inferior surface.

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

Number of foramina	Right	Left	Total
Absent	1	2	3
One	41	39	80
Two	8	9	17

**Table 2:** Position of nutrient foramen in clavicles.

Side of clavicle	Medial 2/3 <sup>rd</sup>				Lateral 1/3 <sup>rd</sup>		total
	Superior surface	Inferior surface	Anterior surface	Posterior surface	Superior surface	Inferior surface	
Right	-	4	-	45	-	-	49
Left	-	7	-	40	-	1	48
Total	-	11	-	85	-	1	97



**Fig. 2:** Left side clavicle showing two (2) nutrient foramen on posterior surface of shaft of clavicle.



**Fig. 3:** left side clavicle showing nutrient foramen in lateral 1/3<sup>rd</sup> of shaft of clavicle.

**DISCUSSION**

The nutrient foramen is regarded as the largest foramen present on the shaft of long bone allowing nutrient artery to enter the bone is important in providing nutrition for the growth of long bones. The healing of fractures is also dependent upon blood supply [6]. The nutrient foramen, which is the external opening of the nutrient canal has a particular position for each bone [7].

Nutrient arteries which are the main blood supply to long bones are particularly vital during the active growth period and at the early phases of ossification.[2] These nutrient arteries pass through the nutrient foramina, the position of nutrient foramina and the direction of nutrient canal in mammalian bones are variable and may alter during the growth process [8].

In the present study, out of 100 clavicles, single nutrient foramen was present in 80 clavicles, double nutrient foramen was present in 17 clavicles, absence of nutrient foramen was observed in 3 clavicles which is almost similar to the study done by Dinesh et al [9].

Our study observed that the position of nutrient foramen was more common on posterior surface which is similar to the studies done by Rahul Rai et al [10], PK Saha et al [11] and Murlimanju et al [7]. As the clavicle is the source for bone grafting procedures, the knowledge and

awareness of localisation of position of nutrient foramen is useful to preserve the circulation. The maximum number of nutrient foramina were located on the medial 2/3<sup>rd</sup> of the clavicle which is almost similar to studies of KRS Prasad Rao et al[12] and Rahul Rai et al [10]. In all the clavicles, nutrient foramen were directed towards acromial end which is in consistence with the studies of Rahul Rai et al [10], Malukar et al [13] and Murlimanju et al [7]. In contrast to these studies, PK Saha [11] observed direction of nutrient foramen towards sternal end in 3.7% of the clavicles.

**Table 3:** Comparison of number of nutrient foramen in clavicle with previous studies.

Authors	Number of bones studied	Absent (%)	Single (%)	Double (%)
Malukar (2011) [13]	100	-	68	20
Murlimanju(2011) [7]	52	-	38.5	44.2
Rahul Rai (2014) [10]	40	4.7	42.5	52.5
KRS Prasad (2016) [12]	58	-	48.3	32.7
Present study (2020)	100	3%	80	17

**Table 4:** Comparison of position of nutrient foramen in clavicle with previous studies.

Authors	Number of bones studied	Superior surface (%)	Inferior surface (%)	Anterior surface (%)	Posterior surface (%)
Malukar (2011) [13]	100	1.4	41.5	-	56.3
Murlimanju (2011) [7]	52	1.9	55.8	-	69.2
Rahul Rai (2014) [10]	40	-	35.4	-	64.6
KRS Prasad (2016) [12]	58	6.9	40.3	2.7	50
Present study	100	-	12.4	-	87.6

**CONCLUSION**

In the present study, it was observed that most of the clavicles had single nutrient foramen and was more common on posterior surface. All the foramina were directed towards acromial end which gives us an idea that sternal end is the growing end. The basic knowledge of anatomical variations of nutrient foramen in clavicles are of great importance for surgeons in surgical procedures such as bone grafting and in microsurgical vascularized bone transplantation.

**Conflicts of Interests: None**

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