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ORIGINAL RESEARCH

Variations in the Position, Number, and Orientation of Nutrient Foramina in Adult Human Clavicles

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ABSTRACT

Introduction: The clavicle, uniquely among long bones, is a modified structure positioned horizontally and beneath the skin at the base of the neck. It serves as a supportive structure, keeping the upper limb away from the trunk to enable free movement. It also makes it easier for the axial skeleton to absorb the weight of the upper limb. The clavicle possesses a cylindrical shaft and two distinct ends: the sternal (medial) end and the acromial (lateral) end. **Aims & objectives**: The objective of this investigation is to detect and comprehend the variations in the position, number, and orientation of the nutrient foramina in the clavicles of adult humans.**Materials & Methods:** This study utilised 60 adult human clavicles of undisclosed age and gender, sourced from the Department of AnatomyCareer Institute of Medical Sciences and Hospital Lucknow. Each of the bones underwent a macroscopic examination to assess the position, number, and orientation of the nutrient foramina.**Results:**The nutrient foramen was noted in all clavicles that were examined. Among them, 78% had one nutrient foramen, 13% had two, and 8% had three. In 73% of right clavicles and 83% of left clavicles, one nutrient foramen was discovered. Meanwhile, two nutrient foramina were found in 17% of right clavicles and 10% of left clavicles. In 10% of the right clavicles and 7% of the left, three nutrient foramens were found.**Conclusion:** The findings of this study lead us to the conclusion that the clavicle generally exhibits a singular nutrient foramen, primarily situated on its posterior surface. The nutrient foramen was most commonly found in the middle third of the bone length, followed by the lateral third, and then the medial third.

Keywords: Clavicle, Nutrient foramen.

INTRODUCTION

The clavicle, uniquely among long bones, is a modified structure positioned horizontally and beneath the skin at the base of the neck. It serves as a supportive structure, keeping the upper limb away from the trunk to enable free movement [1]. It also makes it easier for the axial skeleton to absorb the weight of the upper limb. The clavicle possesses a cylindrical shaft and two distinct ends: the sternal (medial) end and the acromial (lateral) end. The shaft is divided into two sections: approximately one-third on the lateral side and two-thirds on the medial side. The lateral portion of the shaft is flattened, producing superior and inferior surfaces as well as anterior and posterior boundaries. The medial two-thirds of the shaft are cylindrical and feature four surfaces: anterior, posterior, superior, and inferior.The lower surface of the clavicle shaft contains a subclavian groove. Typically, the nutrient foramen is positioned to the side of this groove, facing outward in a lateral direction [2].The nutrient foramen represents the largest opening on long bones, serving as the passage

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for the nutrient artery supplying the bone [3].The nutritive artery provides the majority of a long bone's blood supply during the embryonic and foetal stages as well as the initial stages of ossification, which is vital to the growth and development of the bone [4].Lutken noted that the position of the nutrient foramen varies, and this position can be discerned through careful examination of human bones [5]. When performing surgical operations such as internal fixation device installation, bone transplantation, and free vascularized bone grafts, it is essential to comprehend the position and features of the nutritional foramen [6]. Understanding the neurovascular foramina of the clavicle holds clinical significance, as they play a crucial role in conditions like supraclavicular nerve entrapment syndrome [7].The objective of this investigation is to detect and comprehend the variations in the position, number, and orientation of the nutrient foramina in the clavicles of adult humans.

MATERIALS & METHODS

This study utilized 60adult human clavicles of undisclosed age and gender, sourced from the Department of Anatomy. Career Institute of Medical Sciences and Hospital Lucknow. Each of the bones underwent a macroscopic examination to assess the position, number, and orientation of the nutrient foramina.Bones exhibiting damage, deformities, or significant pathological abnormalities were excluded from the study. To examine the foramina closely, a magnifying lens was used. The information was then compiled, tallied, and statistically examined.

RESULTS

The nutrient foramen was noted in all clavicles that were examined. Among them, 78% had one nutrient foramen, 13% had two, and 8% had three. In 73% of right clavicles and 83% of left clavicles, one nutrient foramen was discovered. Meanwhile, two nutrient foramina were found in 17% of right clavicles and 10% of left clavicles. In 10% of the right clavicles and 7% of the left, three nutrient foramens were found. There were 78 nutritional foramina in all that were seen. Table 1 illustrates the distribution of nutrient foramina in clavicles.

Table 1: Distribution of Nutrient Foramina in Clavicles.

No. of Nutrient foramen	Right (30)	Left (30)	Total (60)
1	22(73%)	25(83.3%)	47(78.3%)
2	5(17%)	3(10%)	8(13.3%)
3	3(10%)	02(6.7%)	05(8.3%)

Value is expressed as n (%).

The medial third of the clavicle included 12.8% of the nutritional foramen, the middle third contained 67.9%, and the lateral third contained 19.2%.In the right clavicle, 16.3% of the nutrient foramina were located in the medial third, 65% in the middle third, and 18.6% in the lateral third. As seen in Table 2, 8.6% of the nutritional foramina on the left clavicle were located in the medial third, 71.4% in the middle third, and 20% in the lateral third. Table 3 illustrates that the majority of the nutritional foramens (62.8%) identified in our investigation were located on the posterior surface.

Table 2: Location of Nutrient Foramen in Clavicles.

Region of Clavicle	Right	Left	Total
Medial 1/3rd	7(16.3%)	3(8.6%)	10(12.8%)
Middle 1/3rd	28(65%)	25(71.4%)	53(67.9%)
Lateral 1/3rd	8(18.6%)	7(20%)	15(19.2%)

Value is expressed as n (%).

Table 3: Position of nutrient foramen of clavicle

Region of Clavicle	Right	Left	Total
Posterior	30(70%)	19(54.3%)	49(62.8%)
Inferior	12(28%)	13(37.1%)	25(32%)
Superior	01(2%)	03(8.6%)	04(5.1%)

Value is expressed as n (%).

DISCUSSION

The nutrient foramen, recognized as the most significant opening on the shaft of a long bone, permits the entry of the nutrient artery, essential for supplying the necessary nutrition to foster the growth of long bones. The mending of fractures also relies on blood circulation [8]. The nutrient foramen, serving as the external aperture of the nutrient canal, occupies a specific location for each bone [9]. By using our current analysis, we were able to find that 78.3% of clavicles had one nutritional foramen, 13.3% had two, and 8.3% had three. This study closely aligns with the findings of Malukar *et al*[10] and Ruchi Ratnesh *et al* [11], however, in another study conducted by Rahul Rai *et al* [12], it was observed that 42.5% of clavicles had one nutrient foramen, 52.5% had two foramina, and 5% had three foramina.In our study, the nutrient foramen was predominantly situated on the posterior surface (62.8%), a finding consistent with the studies conducted by Murlimanju *et al* [9], Malukar *et al* [10], Rahul Rai *et al* [12] and P K Saha *et al* [13]. Contrastingly, in the study conducted by Ruchi Ratnesh *et al* [11], the predominant position of the nutrient foramen was on the inferior surface, accounting for 72.9%. In the present study, the location of the nutrient foramen is predominantly in the middle one-third (67.9%), a trend consistent with the findings of the study conducted by Rahul Rai *et al* [12] (73.8%).

CONCLUSION

The findings of this study lead us to the conclusion that the clavicle generally exhibits a singular nutrient

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foramen, primarily situated on its posterior surface. The nutrient foramen was most commonly found in the middle third of the bone length, followed by the lateral third, and then the medial third. The orientation of the nutrient foramen was directed towards the acromial end. Studying the nutrient foramen of the clavicle proves beneficial for preserving arterial supply during surgical procedures such as internal fixation and vascularized bone grafting.

Conflicts of Interests: None

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