

ORIGINAL RESEARCH

A Study on Quantitative Analysis of the Variations of Nutrient Foramen in the Clavicle

Renuka Tripathi (Dubey)¹

¹Associate Professor, Department of Anatomy, Ananta Institute of Medical Sciences and Research Centre, Rajasthan

ABSTRACT

Background: The nutrient foramina of the clavicle have extensive clinical importance as these are involved in the repair of clavicular fracture. Therefore, the aim of the present study was to evaluate the morphometry and topography of nutrient foramen in clavicle.

Material and Methods: This study was conducted in department of Anatomy. In this study we were included total 60 dried human clavicle bones. The duration of study was over a period of one year.

Results: The result of this study was revealed that one foramen was present in 65% bone. While, two nutrient foramen present in 26.7% clavicle bones & three nutrient foramen present in 8.4% clavicle bone. Which were found macroscopically.

Conclusion: This study concludes that from all the findings that the nutrient artery should be preserved carefully while doing surgical procedure like internal fixation and vascularised bone graft.

Keywords: Nutrient Foramen, Clavicle, Upper Limb.

Corresponding Author: Dr Renuka Tripathi (Dubey), Associate Professor, Department of Anatomy, Ananta Institute of Medical Sciences and Research Centre, Rajasthan. Email: tmtripathi@rediffmail.com

INTRODUCTION

The clavicle is a slightly curved modified long and thin bone. It is positioned horizontally situated at the root of neck. Clavicle behaves like a sturt for the free movement of the upper limb away from the trunk.^[1] It helps in transferring the weight of upper limb to the axial skeleton. The clavicle has a thin, curved cylindrical shaft with one medial (sternal) and one lateral (acromial) ends. The shaft can be divided into lateral and medial parts. Lateral part is one third of the shaft and is flattened having two surfaces (superior, inferior) and two borders (anterior, posterior). The medial part is two third of the shaft. It has a cylindrical shape with four anterior, posterior, superior and inferior surfaces. On the inferior surface of the shaft, there is long groove known as subclavian groove and on its lateral side there is nutrient foramen.^[2] The nutrient artery of clavicle passes through this foramen,^[3] and it provides the clavicle's majority of the blood supply during its growth.^[4] This artery is a branch of suprascapular artery.^[5] The direction of the nutrient foramen of all the bones has been reported to be away from the growing end.^[6] The association of growth and ossification of bone with the direction of canal was first proposed by Bernard in 1835.^[7] In 1861, Humphrey was the first to describe the variations in direction of the nutrient foramina. He explained that the oppositional growth of bone and its interaction with interstitial growth of periosteum determine the direction of nutrient canal and the position of the nutrient artery. The utility of study of human bones to ascertain the variable positions of nutrient foramen were correlated by Lutken.^[8] Clavicular fracture is a problem presented not so uncommonly in orthopedic OPDs. All clavicular fractures don't heal normally and some develop serious neurovascular

complication like supraclavicular nerve entrapment syndrome and brachial plexus injury.^[9] Nonunions and deficits of shoulder functions have also been reported in some recent studies.^[10] The nutrient foramina of the clavicle have extensive clinical importance as these are involved in the repair of clavicular fracture. Therefore, the aim of the present study was to evaluate the morphometry and topography of nutrient foramen in clavicle.

MATERIALS & METHODS

Study Area: This study was conducted in department of Anatomy in tertiary care teaching hospital.

Study population: In this study we were included total 60 dried human clavicle bones.

Study duration: The duration of study was over a period of one year.

Data collection: 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.

Data analysis- Data was analysed by using Microsoft excel.

RESULTS

In this study we were included 60 dried human clavicle bones, which were macroscopically observed. We were found in 65% bone one foramen was present. While, two nutrient foramen present in 26.7% clavicle bones & three nutrient foramen present in 8.4% clavicle bone. The present study observed that 72.1% nutrient foramen was present in inferior surface, 26.7% nutrient foramen present on posterior surface & 1.16% was present on superior surface. 11.7% nutrient foramen present at medial 1/3rd, 66.7% present at middle 1/3rd & 21.7% present at lateral 1/3rd.

Table No 1: Distribution of cases according to Number of nutrient foramen in clavicle

| Number of nutrient foramen | Right (30) | Left(30) | Total(60) |
|----------------------------|------------|-----------|-----------|
| 1 | 20(66.7%) | 19(63.4%) | 39(65%) |
| 2 | 7(23.4%) | 9(30%) | 16(26.7%) |
| 3 | 3(10%) | 2(6.7%) | 5(8.4%) |

Table No 2: This table showed position of foramen in clavicle

| Surface | Right | Left | Total |
|-----------|------------|-----------|-----------|
| Inferior | 32 (71.2%) | 30(73.1%) | 62(72.1%) |
| Posterior | 12(26.7%) | 11(26.8%) | 23(26.7%) |
| Superior | 1(2.3%) | 0(0%) | 1(1.16%) |

Table No 3: Distribution according to nutrient foramen of clavicle

| | Right | Left | Total |
|---------------------------|---------|-----------|-----------|
| Medial 1/3 rd | 3(10%) | 4(13.4%) | 7(11.7%) |
| Middle 1/3 rd | 21(70%) | 19(63.4%) | 40(66.7%) |
| Lateral 1/3 rd | 6(20%) | 7(23.4%) | 13(21.7%) |

DISCUSSION

The nutrient arteries are the major source of blood supply to the bones. Generally, one or two nutrient arteries enter the clavicle shaft obliquely through the nutrient foramina. It runs into nutrient canal. Usually, the site of entry and angulations of this artery is constant and it typically moves away from the dominant growing end of epiphysis.^[11] In the present study,

the general rule of growing end theory was followed which states that the direction of the nutrient foramen is away from the growing end of the bone. Bernard was the first man to observe the association of the ossification and growth of the bone with the direction of nutrient foramen.^[12]

The clavicle present horizontally at the root of neck is a curved long and thin bone. It connects the arm to the trunk in a way that arm can swing freely.^[13] Along with it shifts the weight of the upper limb to the axial skeleton. The clavicle shaft is just like a long thin cylinder shaft which has sternal (medial) and acromial (lateral) ends. The medial two third of the shaft has four surfaces anterior, posterior, superior and inferior. While, the lateral one third of this shaft is somewhat flat having two surfaces superior and inferior and two borders anterior and posterior. A subclavian groove is present on the inferior surface of the shaft. Just lateral to the subclavian groove, the nutrient foramen is present that is directed laterally.^[14] The nutrient artery running into this foramen originates from the suprascapular artery.^[15] Nutrient artery is the main blood vessel of clavicle during its active growth. The direction of nutrient foramen in all the bones has been reported to be away from the growing end.^[16] The magnitude of the knowledge of number, direction and position of nutrient foramen has been described in surgical and orthopedic events.^[17] For the proper repair of fracture and survival of osteocyte and osteoblast, the impact of preservation of arterial supply has been clearly stated.^[18] The main objective of the present study was to evaluate the variation of number, direction and position of nutrient foramen in the clavicle and to establish their clinical importance. It has been observed in the present study that only one nutrient foramen was present in 70% of clavicles, two were present in 24% of clavicles and three were present in 6% of clavicles. These findings were supported by the results of Ruchi Ratnesh et al.^[19] Contrary to the findings of the present study, Rahul Rai et al reported one, two and three nutrient foramen respectively in 42.5%, 52.5% and 5% of clavicles.^[20] In the present study, the nutrient foramen was found on the posterior surface of clavicle in 55.88%. Findings of Malukar et al,^[21] (56.3%) and Rahul Rai et al (20) (64.6%) were of favor while Ruchi Ratnesh et al,^[19] observed nutrient foramen on the inferior surface in 72.9%. In the present study, the location of the nutrient foramen was found in 70.58% of cases in the middle one third of clavicle and this was supported by results of Rahul Rai et al of 73.8%. In the present study, the average distance of nutrient foramen from sternal end was 69.63 mm and the foramen index was 52.25. Almost similar results of average distance of 67.6 mm and foramen index of 48.01 were found in the study of Rahul Rai et al.^[20] The study of Santosh K Sahu et al,^[22] reported the similar findings of average distance of foramen from sternal end to be 65.8 mm and foramen index to be 52.06.

CONCLUSION

From the above findings, it can be concluded that only one nutrient foramen is present in most of the clavicles primarily on the posterior surface. In the present study, the main location of nutrient foramen was observed to be in the middle one third of the shaft followed by the lateral and medial one third respectively. The direction of nutrient foramen was found towards the acromial end of the clavicle. It can be advocated from all the above findings that the nutrient artery should be preserved carefully while doing surgical procedure like internal fixation and vascularised bone graft.

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