Morphometric study of Nutrient foramen in dry human Clavicle Bones of Jammu Region

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ABSTRACT: *Clavicle commonly called as collar bone which is the only long bone that lies horizontally in the body at the root of neck. The major blood supply to the clavicle bone is through nutrient artery, which enters the bone through the nutrient foramina for its nourishment and growth. The shaft of the clavicle usually presents one nutrient foramen for the passage of main nutrient artery. The study was conducted on 21 adult clavicles (10 right sides and 11 left side) which were kept for teaching purpose in the department of the Anatomy, GMC Jammu. All the bones were macroscopically observed for the number, location and direction of the nutrient foramen.Total number of foramen in 21 clavicle bones were 27. Most of the clavicles had single nutrient foramen located in the middle third of the shaft on its inferior surface and directed towards acromial end. Only one clavicle had nutrient foramen directed towards sternal end against the law of ossification and in one of them it was absent. The study will be of immense importance for the orthopaedic surgeon who performs surgeries of bone like transplant techniques and bone grafting specially free vascular bone grafting where the nutrient blood supply is extremely important.*

Key Words: *Clavicle, nutrient foramen, nutrient artery*

INTRODUCTION

Clavicle commonly called as collar bone which is the only long bone that lies horizontally in the body at the root of neck and some what resembles the Latin letter 'f'. It differs from other long bones as it develops in membrane (dermal bone) and is also devoid of medullary cavity. The major blood supply to the clavicle bone is through nutrient artery, which enters the bone through the nutrient foramina for its nourishment and growth. Nutrient foramen is the opening present in the inferior surface of the shaft, lateral to the subclavian groove of clavicle[1]. The shaft of the clavicle usually presents one nutrient foramen for the passage of main nutrient artery[2]. With respect to the blood supply to the clavicle, there could be nutrient artery to the primary centres of ossification and to the late secondary centre at the sternal end of the clavicle. The nutrient artery is derived from the suprascapular artery or clavicular branch of acromiothoracic artery[3,4]. In contrast, Knudsen et al. reported that clavicle is supplied by periosteal arteries and the nutrient artery is not found [5].. However, the nutrient foramina of the clavicle are clinically important as these are involved in the repair of clavicular fracture, which produces obvious neurovascular complication like supraclavicular nerve entrapment syndrome and brachial plexus injury.[6] The traditional view that the vast majority of clavicular fractures heal with good functional outcomes following nonoperative treatment is no longer valid. Recent studies have identified a higher rate of nonunion and specific deficits of shoulder function in subgroups of patients with these injuries[7]. and more recently microsurgical vascularized bone transplantation are becoming popular.

Thus the knowledge of these foramina is important in orthopaedic procedures like nail plating, K wire fixation in surgical approach for internal fixation and coracoclavicular ligament repair. It also makes the operating surgeon more vigilent in the free vascularised bone grafts and in microsurgical vascularised bone transplantation.

MATERIAL AND METHOD

The study was conducted on 21 adult clavicles (10 right sides and 11 left side) which were kept for teaching purpose in the department of the Anatomy, GMC Jammu. The age and sex of the clavicles were not determined. All the bones were macroscopically observed for the number, location and direction of the nutrient foramina. A magnifying lens was used to observe the foramina. The data was collected and morphologically analyzed.

RESULTS

In this study the Total number of clavicles studied were 21 out of which10 were of right side and 11 left sided and total number of foramin including all the clavicles were 27. Various parameters were tabulated as below

Table 1. Number of Nutrient Foramen

Number of Nutrient Foramina	Clavicle		Total	Percentage
	Right	Left		
0	None	1	1	4.7
1	6	8	14	36.5
2	3	2	5	28.3
3	1	0	1	4.7

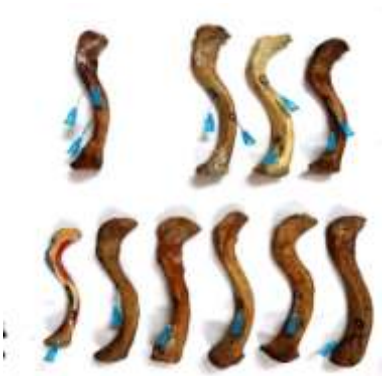

Figure 1. Clavicles showing Single, Double and Triple nutrient Foramen

Table 2. Location of the Nutrient Foramen

Clavicle Side	Surface		
	Inferior	Posterior	Anterior
Right	5	6	1
Left	8	4	Nil
Total	39	21	1
Percentage	62.9%	33.8%	3.22%

Table 3. Position of the Nutrient Foramen

Position of the Nutrient Foramen	Number of Foramen			Percentage
	Right	Left	Total	
Medial 1/3	3	4	7	19%
Middle 1/3	8	2	10	33.3%
Lateral1/3	1	3	4	66.6%
At the junction of lateral and middle1/3	3	3	6	28.5%

Table 4.Direction of the Nutrient Foramen

Direction of the Nutrient Foramen	Right	Left	Percentage
Towards Sternal end	0	1	4.7
Acrominal end	10	9	90.47

Figure2: clavicle with direction of nutrient foramen towards sternal end.

DISCUSSION

Nutrient arteries are the major source of blood supply to the bones. The clavicle bones usually have one nutrient foramen present on the shaft for the passage of main nutrient artery[2]. The clavicle has no medullary cavity. It consist of spongy (trabecular) bone with a shell of compact bone, so does not depend on a nutrient artery[8]. One or two main diaphyseal nutrient arteries enter the shaft obliquely through nutrient foramina, which lead into nutrient canals. Their site of entry and angulation are almost constant and characteristically directed away from the dominant growing epiphysis[1]. Our study obeyed the general rule of growing end theory that the direction of the nutrient foramen is away from the growing end. Bernard was the first to correlate the direction of nutrient foramen with the ossification and growth of the bone[2].

Number of Foramina- Our study was concomittant with that of Suma MP where single foramen were found more as compared to the double[12]. Where as in other studies done by Rahul Rai and PK Saha it was double foramen which were more than single foramen in contrast to our study.[2,3,9]

Table 5. Comparison of Number of Nutrient Foramina

Number	Suma MP	Rahul Rai	PK Saha	Our study
Single	78%	42.5%	53.70%	36.5
Double	12%	52.5%	40.74%	28.3
Triple	6%	5%	5.56%	4.7%
None	0	0	0	4.7%

Position of Nutrient Foramen- In our study, the position was more on the inferior surface in consistence with study done by Suma MP et al, but in other studies, the foramen were situated more on the posterior surface[2,3,9]. Clavicle showed more variation as to the surface on which nutrient foramen was present. Knowledge of localisation of nutrient foramen is useful in surgical procedures to preserve the circulation[10].

Since, the clavicle is significant source for bone grafting, the awareness of position of nutrient foramen is very helpful[9].

Table 6. Comparison of Position of Foramina

Position	Suma MP	Rahul Rai	PK Saha	Our study
Inferior surface	62.9%	35.4%	30.49%	62.9%
Posterior surface	33.8%	64.6%	59.76%	33.8%
Anterior surface	4%	0%	4.8%	3.2%

Location of Nutrient foramen in relation with length of clavicle. The maximum number of nutrient foramina were located on the lateral 1/3 of the clavicle(66.6%) in contrast to the other studies as tabulated in the table no. 7. Our study also showed presence of nutrient foramina at the junction of middle and lateral 1/3rd in 28.5% clavicles which were not observed in other studies. It is of great clinical importance as the clavicle is commonly fractured by falling on the out streached hand (indirect voilence). The most common site of fracture is the junction of two curvatures of bone,which is the weakest point. The lateral fragment is displaced downwards by the weight of the limb as trepezius muscle alone is unable to support the weight of upper limb.

Table 7. Comparison of Location of Nutrient Foramen in relation with length of clavicle

Location in Relation with the Length of the Clavicle	Suma MP	Rahul Rai	PK Saha	Our study
Middle one third	85.5%	73.8%	74.39%	33.3%
Medial one third	6.5%	15.4%	17.07%	19%
Lateral one third	8%	10.8%	8.53%	66.6%
At the junction of middle and lateral 1/3rd	-	-	-	28.5%

Direction of Nutrient Foramen. PK Saha observed 3.70% of clavicles with the direction of nutrient foramen at the sternal end which is similar to our study that is 4.79%. Whereas Rahul Rai and Suma MP observed 100% clavicles with their direction of nutrient foramen towards acromial end.

Table 8. Comparision of direction of nutrient foramen

Direction of Nutrient Foramen	Rahul Rai	Suma MP	PK Saha	Our study
Sternal end	Nil	Nil	3.70%	4.79%
Acromial end	100%	100%	96.29%	90.47%

Nutrient vessels occupying the nutrient foramina are usually derived from the vessels, which have taken part in the initial invasion of the ossifying cartilage, so that the nutrient foramen is at the original centre of ossification[11].

Clinical knowledge of nutrient foramen is helpful for the professionals to select the osseous section levels of the receptor in order to place the graft without damaging the nutrient artery, thus preserving the diaphysis vascularisation.

CONCLUSION

In this study it was seen that most of the clavicle bones had single nutrient foramen present on the lateral 1/3rd and few of them were also present at the junction of middle and lateral 1/3rd on the inferior surface directed towards the acromial end, it was also observed that one of the nutrient foramen was directed towards the growing end against the law of ossification and one of the clavicle bones didn't had any nutrient foramen. The study will be of immense importance for the orthopaedic surgeon who performs surgeries of bone like transplant techniques and bone grafting specially free vascular bone grafting where the nutrient blood supply is extremely important.

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