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Morphometric and Topographic Study of Nutrient Foramen in Human Clavicle in North India

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ABSTRACT

Background& Aims: The Clavicle also known as Collar bone is the only long bone of the human skeleton which is placed horizontally. The vascularized bone like clavicle helps principally in bone grafting and joint allograft. The morphometrical and topographical knowledge of nutrient foramina is very important in surgical and orthopaedical procedures. The aim of this study is to determine the number, position, location and direction of nutrient foramen in human clavicle bones.

Material and methods: The present study was conducted on 60 human dry adult clavicle bones of unknown age and sex, which were obtained from the Department of Anatomy, Govt Medical college, Jammu.

Results: The nutrient foramen was present in all 60 (100%) clavicle bones. One nutrient foramen was present in 63.3%, two in 28.3% and three in 8.3% of clavicles. Total 87 nutrient foramina were observed in our study. The nutrient foramina were predominantly located in the middle 1/3rd of the clavicle bones. In addition, the predominant position of nutrient foramen was on inferior surface of clavicle. The direction of nutrient foramina in all clavicle bones was towards the acromial end in present study.

Conclusion: The knowledge of nutrient foramina is very important in surgical and orthopaedical procedures like bone grafting and more recently in microsurgical vascularised bone transplantation.

Keywords: Morphometric and topographic study, nutrient foramen, human clavicle

INTRODUCTION

The clavicle bone receives its name from the words 'CLAVIS' (means a key) and 'ICLE' (means a diminutive) i.e. a little key. Roman key was 'S' shaped. It is also known as collar bone and is denoted as the beauty bone as its visibility depicted the so called skinny beauty of female. It is one of the bones of shoulder girdle in humans and in those mammals who use their hands for prehension. The clavicle bone is longer in broad shouldered male and curvatures are more pronounced in males thanfemales. The length and curvatures of clavicle varies between right and left sides which is usually significant in case of adults (Sen S *et al.*, 2018). The clavicle bonehas not appealed to anthropologists to any such degree as it has to comparative anatomists. Anatomical studies of the clavicle are at the present time pursued with vigor (Terry RJ, 1932).

The clavicle bone is the only long bone of the human skeleton which is placed horizontally. The adult morphological features of clavicle bone are mostly attained inearly fetal life i.e. before birth. 80% of the total clavicle length is attained by the ageof 12 years in males and by the age of 9 years in females. It exhibits high variability in its

shape and size more frequently than other long bones of human skeleton. Its mean dimensions may be similar in unrelated races which are geographicallyseparate or it may be of different dimensions in related racial groups. The in-depth knowledge of variations in clavicular shape, size and its dimensions are very important from both clinical as well as forensic anthropological perspectives. The metric and non-metric features of clavicle can have decisive role in forensic identifications and clinical interventions (Sehrawat JS and Pathak RK 2016).

Clavicle bone has a longer duration of skeletal growth during which it may respond to a variety of mechanical loadings and shear stresses. Variations in mechanical forces, lateralized behaviour, asymmetric vascularisation, activity induced changes or more stress loadings of dominant hand side of the clavicle may be the factors which are responsible for asymmetrization of various clavicular features. These stresses have led to the formation of curvatures, longer medial and shorter lateral curvatures (Kumari S *et al.,* 2018). The clavicle is the first bone to undergo primary ossification in the 5^{th} or 6^{th} week ofintrauterine life and is the last bone to completely ossify. Complete fusion occurs between the ages of 22 to 30 years, its medial epiphysis is the last to fuse. The medial clavicular epiphysis has proven useful in estimating skeletal age in young adults (Udoaka AI and Nwokediuko AU 2013). The direction of nutrient foramen follows the rule,' to the elbow I go, from the knee I flee' and is away from the growing end. Inferior surface of the shaft of clavicle presents a subclavian groove and a nutrient foramen usually lies at the lateral end ofthe groove which is directed laterally. The morphometrical and topographical knowledge of nutrient foramina is very important in surgical and orthopaedical procedures like bone grafting and more recently in microsurgical vascularised bone transplantation in order to preserve the circulation of affected bone which facilitates the graft healing in the recipient as well as for osteocyte and osteoblast cell survival. Vascularized bone like clavicle helps principally in bone grafting and joint allograft(Sahu SK and Meher D 2017). The topographical knowledge of nutrient foramina of clavicle is useful to preserve arterial supply during radiation therapy (Joshi P and Mathur S 2018). The internal fixation devices can be appropriately placed for the treatment of fractures of clavicle with the knowledge of variations in the nutrient foramina (Tanna NA and Tanna VA 2015).

Aims and Objective

Morphometric and Topographic Study of Nutrient Foramen in Human clavicle

MATERIAL AND METHODS

The present study was conducted on 60 human dry adult clavicle bones of unknown age and sex, which were obtained from Department of Anatomy, Government Medical College, Jammu over a period of one year from 2019-2020. The bones selected for the study were 32 of right side and 28 of left side and they were properly labeled.

Inclusion criteria:

The clavicle bones used for the study fulfilled the following criteria as:

1) The bones were dry and macerated.
2) They were thoroughly cleaned.
3) They were complete in all respects so as to give correct morphometry.

Exclusion criteria:

1) The deformed bones were excluded.

Each bone was examined for important morphological and morphometric features. Measurements were recorded in millimetres, grams and degrees.

Nutrient Foramen

Number: Total number of nutrient foramina present in each clavicle were looked for and their number noted down.

Location: The shaft of bone was divided into three segments and location of nutrient foramina was noted whether it was present in medial 1/3rd, middle 1/3rd or lateral 1/3rd .

Position: It was noted in relation to the various surfaces of clavicle bone i.e. anterior, superior, inferior and posterior surface.

Direction: It was examined whether nutrient foramen was directed towards or away from acromial end. A fine stiff wire was used to confirm the direction of the foramen.

RESULTS

Number of nutrient foramen in right, left and total clavicle bones

Out of 32 right bones, 3 (9.37%) bones are with three nutrient foramina, 7 (21.87%) are with two nutrient foramina and 22 (68.75%) are with one nutrient foramen. Out of 28 left bones, 2 (7.14%) bones are with three nutrient foramina, 10 (35.71%) with two nutrient foramina and 16 (57.14%) are with one nutrient foramen. In total 60 bones, 5 (8.33%) bones are with three nutrient foramina, 17 (28.33%) are with two nutrient foramina and 38(63.3%) are with one nutrient foramen.(Table 1)

Table 1: Showing number of nutrient foramen in right, left and total clavicle bones

No of nutrient foramen	Right clavicle (n=32)	Left clavicle (n=28)	Total (n=60)
One	22(68.75%)	16(57.14%)	38(63.3%)
Two	7(21.87%)	10(35.71%)	17(28.33%)
Three	3(9.37%)	2(7.41%)	5(8.33%)

Distribution of nutrient foramina according to location

The number of nutrient foramina according to location in right, left and total clavicles. In 32 right bones, 35 (77.77%) nutrient foramina are present in middle one third, followed by 7 (15.5%) in medial one third and 3 (6.66%) nutrient foramina in lateral one third. In 28 left bones, 31 (73.80%) nutrient foramina were present in middle one third followed by 7 (16.6%) in medial one third and 4 (9.52%) in lateral one third. In total 60 bones, 66 (75.86%) nutrient foramina were present in middle one third followed by 14 (16.09%) nutrient foramina in medial one third and 7 (8.0%) nutrient foramina in medial one third. (Table 2)

Table 2: Showing distribution of nutrient foramina according to location in right, left and total clavicle bones.

Side			Location of nutrient foramen		
	No ofBones	No of nutrient Foramina	Medial1/3rd	Middle1/3rd	Lateral1/3rd
Right	32	45	7 (15.5%)	35 (77.77%)	3 (6.66%)
Left	28	42	7 (16.6%)	31 (73.80%)	4 (9.52%)
Total	60	87	14 (16.09%)	66 (75.86%)	7 (8.0%)

Distribution of nutrient foramina according to position

The number of nutrient foramina according to position in right, left and total clavicles. In 32 right sided clavicles 29 (64.4%) nutrient foramina were present on inferior surface and 16 (35.55%) on posterior surface. Out in 28 left sided clavicles 28 (66.66%) nutrient foramina were present on inferior surface and 14 (33.33%) onposterior surface. In total 60 bones, 57 (65.5%) nutrient foramina were present on inferior surface and 30 (34.48%) nutrient foramina on posterior surface.(Table 3)

Table 3: Showing distribution of nutrient foramina according to position in right, left and total clavicle bones.

Side	No ofBones	Numberof nutrient foramina	Position of nutrient foramina			
			Superiorsurface	Inferiorsurface	Anteriorsurface	Posteriorsurface
Right	32	45	0	29(64.4%)	0	16(35.55%)
Left	28	42	0	28(66.6%)	0	14(33.33%)
Total	60	87	0	57(65.5%)	0	30(34.48%)

Table 4: Showing direction of nutrient foramina towards or away from the acromial end.

Side	No. ofbones	No of nutrient foramina	Direction of nutrient foramen	
			Towards acromial end	Away from acromial end
Right	32	45	45	0
Left	28	42	42	0
Total	60	87	87	0

DISCUSSION

The topographic knowledge of nutrient foramina is useful in certain operative procedures, in orthopaedics, as well as in plastic and reconstructive surgery, to avoid damage to the nutrient vessels. The total number of nutrient foramen observed in the present study (60 clavicles) was 87. Out of which 45 nutrient foramina were present in right sided clavicles and 42 in left sided clavicles. Most of the clavicles (63.3%) in the present study, showed the presence of single nutrient foramen which was in accordance with the studies of Ratnesh R *et al.,* (2018) and Sinha SK *et al.,* (2020).Studies done by Rai R *et al.,* (2014), Tanna NA and Tanna VA (2015) and Sahu SK and Meher D (2017) found that in majority of bones, double nutrient foramina was present which was not in agreement with the present study. We observed that maximum nutrient foramina were located in the middle 1/3rd of the clavicle which was in accordance with the studies done by Rai R *et al.,* (2014), Tanna NA and Tanna VA (2015), Sahu SK and Meher D (2017), Ratnesh R *et al.,* (2018), Suma MP *et al.,* (2018) and Sinha SK *et al.,* (2020). In the present study, maximum number of nutrient foramina were present on the inferior surface which was in consonance with the studies done by Sinha P *et al.,* (2015), Ratnesh R *et al.,* (2018), Suma MP *et al.,* (2018). Earlier studies done by Rai R *et al.,* (2014), Tanna NA and Tanna VA (2015), Sahu SK and Meher D (2017), Sinha SK *et al.,* (2020) showed that the maximum nutrient foramina were present on the posterior surface which was not in agreement with the present study. Nutrient foramina were also present on the superior surface in the study done by Ratnesh R *et al.,* (2018), Sinha SK *et al.,* (2020).Suma MP *et al.,* (2018) studied nutrient foramina

were also present on anterior surface. The direction of nutrient foramina in all bones was towards the acromial end in present study. Tanna NA and Tanna VA (2015), Sinha SK *et al.*, (2020) also reported in their studies that the nutrient foramina were directed towards acromial end.

CONCLUSION

The total number of nutrient foramen observed in the present study (60 clavicles) was 87. Out of which 45 nutrient foramina were present in right sided clavicles and 42 in left sided clavicles. Most of the clavicles (63.3%) in the present study, showed the presence of single nutrient foramen. In the present study maximum nutrient foramina were located in the middle 1/3rd of the clavicle. The present study demonstrated that maximum number of nutrient foramina were present onthe inferior surface. And the direction of nutrient foramina in all bones was towards the acromial end in present study.

Declaration by Authors

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