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Original Research Article

ROLE OF CLAVICLE CURVATURES IN FRACTURE STABILISATION: A STUDY IN EAST INDIAN POPULATION

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ABSTRACT

Clavicle is the only long bone which is horizontally placed. These stresses have led to the formation of curvatures, longer medial and shorter lateral curvatures. 70-80% of these fractures occur at the junction of medial two-third and lateral one-third of the shaft. This study was conducted in the Department of Anatomy, AIIMS, Patna. Both the curvatures i.e. medial and lateral had more mean angulation on the left side as compared to the right side. The dominant hand side clavicle was found more curved and hence less-angled than the non-dominant hand side clavicle (i.e., left-hand side clavicle). Modes of life include the conditions and occupations embracing all spheres of human activity and labour. Various studies have confirmed the existence of morphometric asymmetries in different anthropometric or osteometric measurements, fingerprint patterns, skeletal maturation rates etc.

KEY WORDS: Clavicle, Curvatures, Anthropometric, Osteometric.

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INTRODUCTION

Clavicle is the only long bone which is horizontally placed, subcutaneous throughout its length and frequently shows high variability in its shape and size compared to long bones of human skeleton. It has a shaft and two ends- sternal end and acromial end. Forensic anthropologists have widely explored its anatomical variability. The adult morphological features of this bone is mostly attained in early foetal life i.e. before birth. 80% of the clavicle length is attained by the age of 12 yrs. in males and by the age of 9 yrs. in females. Variations in mechanical forces, asymmetric vascularization, lateralized behaviour, activity-induced changes or more stress loadings of the dominant hand side of the clavicle may be factors responsible for asymmetrization of various clavicular features due to longer period of skeletal growth during which it responds to a variety of stresses as mentioned [1-4].

These stresses have led to the formation of curvatures, longer medial and shorter lateral curvatures. Fracture of clavicle is common in both adults and children, constituting 44 – 66% of all the fractures. 70-80% of these fractures occur at the junction of medial two-third and lateral one-third of the shaft [2]. The objective of this study is to focus on the differences between the two clavicles of the human body which can be of help in reducing the fractures and other orthopaedic procedures on the bone.

MATERIALS AND METHODS

This study was conducted in the Department of Anatomy, AIIMS, Patna. The sample size was of 50 adult clavicles. Bones showing obvious pathological deformities were excluded from the study.

Parsons [5] method was followed to measure the curves of the clavicle.

1. The bone was placed on the cardboard in such a position that its anterior and posterior borders were in the same horizontal plane.

2. The clavicle was illuminated from above with the help of a pen torch so that its image appeared on the paper placed under it and the outline of the image was drawn on the paper. Care was taken that the light source, the bone and its image were in the same straight line. The distance of the cardboard from the light source was fixed.

3. The midpoints at the sternal and acromial ends were obtained and marked as points "A" and "B" and were joined by a straight line.

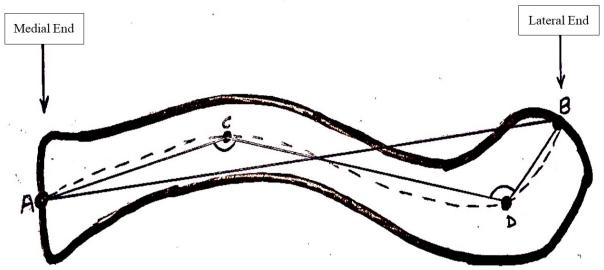
4. The central axis of clavicle was drawn as a curved line, midway between the anterior and posterior borders throughout the length of the clavicle.

5. The deepest point on the two curves of the clavicle where the bone had maximum convexities were marked as points "C" and "D" and were joined by a straight line. Finally, these points were joined with mid points "A" and "B" at the corresponding ends with lines CA and DB (**Fig. 1**).

6. Thus two angles were formed-medial angle ACD which measured curvature of medial 2/3rd and lateral angle CDB which measured curvature of lateral 1/3rd. These angles were measured with the help of a protractor. (as shown in the **Fig. 1**). The same procedure was repeated for all the bones.

Collected data was entered in the MS Excel spreadsheet and coded appropriately in SPSS (Statistical Package for Social Sciences) for Windows version 20.0. Normally distributed quantitative data was presented as means and standard deviation. All tests were performed at 5% level significance; thus an association was significant if the value was less than 0.05 (p value< 0.05).

Fig. 1: Contour of the Right Clavicle as seen form above.



A: Midpoint of sternal End, **B**: Midpoint of acromial end, **C**: Deepest point of Medial Curvature **D**: Deepest point of Lateral Curvature: **ACD**: Medial Angle: **CDB**: Lateral Angle

RESULTS AND OBSERVATIONS

Table 1: Mean Medial angle of clavicles of right and left side.

	Medial Angle (in Degrees)	
	Right	Left
Mean ± S. D.	137.25 ± 10.85	151.5 ± 1.66
p value	0.11	

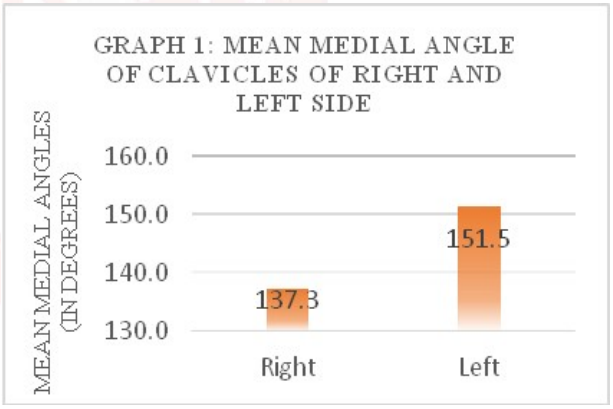


Table 1, shows the mean medial angle of clavicles of right and left side. The mean medial angle was observed to be 137.25° on the right side and 151.5° on the left side with standard deviation of 10.85 and 1.66 respectively. So, on the left side the medial curvature was more as compared to the right side (Graph 1). The difference in medial angle was not found to be significant on statistical analysis when compared between both sides.

Table 2: Mean Lateral angle of clavicles of right and left side.

	Lateral Angle (in Degrees)	
	Right	Left
Mean ± S. D.	148.87 ± 5.04	151.62 ± 5.63
p value	0.35	

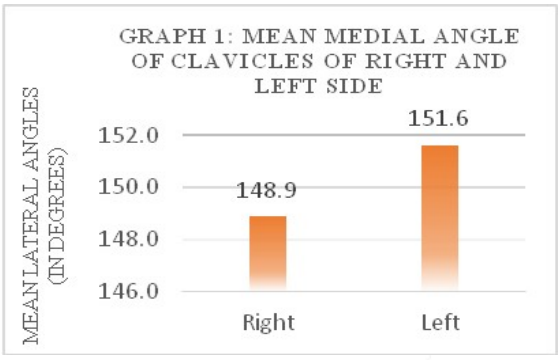


Table 2, shows the mean lateral angle of clavicles of right and left side. The mean medial angle was observed to be 148.87° on the right side and 151.62° on the left side with standard deviation of 5.04° and 5.63° respectively. So, the lateral curvature was found to be more on left side as compared to the right side (Graph 2). The difference in medial angle was not found to be significant on statistical analysis when compared between both sides.

Hence, in the present study both the curvatures had more mean angulation on the left side as compared to the right side.

DISCUSSION

The human clavicle exhibits very high degree of variability in its shape [1] among individuals with different age, sex, race and occupation affiliations. Interventionists and anthropologists have widely explored these variabilities in order to modify the design of fixative devices, the use of which would have been restricted in absence of accurate knowledge of the anatomical structure and behaviour of the collarbone. Various genetical, endocrinal, activity pattern and nutritional factors are responsible for influencing skeletal maturity. Type of physical work or activity patterns of the deceased might have inculcated right-left differences in different clavicular dimensions. The varied effects of genetic endowments, mechanical loadings and the impacts of muscular attachments might be responsible for variabilities [3].

The present study mean values was found in close agreement with previous studies for the medial angle (Table 3) of left sided clavicle, but was lesser than the North Indian population. The medial angle on the right side was found to be much lesser compared to previous studies, this can be explained by the relatively shorter height of the East Indian population.

Table 3: Comparison of medial angle of clavicle on right and left side as reported by previous authors.

Authors	Medial Angle (in Degrees)	
	Right	Left
Parsons (English)	M=153	M=153
	F=155	F=155
Terry (American Negroes)	M=153.52	M=151.58
	F=151.12	F=153.62
Terry (American Whites)	M=153.12	M=151.42
	F=-------	F=-------
Olivier (French)	M=150.2	M=151.4
	F=151	F=-------
Kaur H et al (Chandigarh zone)	M=150.76	M=150.94
	F=152.61	F=152.82
Sehrawat & Pathak	M=151.68 ± 2.90	M=153.08 ± 2.65
	F=152.00 ± 3.98	F=153.37 ± 2.33
Kaur K et al	M=151.33 ±6.51	M=153.67 ±5.69
	F=149.81 ±5.84	F=153.21 ±5.41
Present Study	**137.25 ± 10.85**	**151.5 ± 1.66**

Table 4: Comparison of lateral angle of clavicle on right and left side as reported by previous authors.

Authors	Lateral Angle (in Degrees)	
	Right	Left
Parsons [5] (English)	M=148	M=148
	F=150	F=151
Terry [6] (American Negroes)	M=138.42	M=143.54
	F=144.06	F=145.82
Terry [6] (American Whites)	M=139.25	M=142.66
	F= -------	F= -------
Olivier [7] (French)	M=141.8	M=143
	F=145	F= -------
Kaur H et al [8] (Chandigarh zone)	M=143.27	M=148.2
	F=144.65	F=148.73
Sehrawat & Pathak [3]	M=141.1803 ± 1.81	M=143.4606 ± 1.72
	F=142.56 ± 4.64	F=143.96 ± 6.49
Kaur K et al [2]	M=150.75 ±8.56	M=153.45 ±8.94
	F=153.18 ±8.33	F=155.47 ±7.79
Present Study	**148.87 ± 5.04**	**151.62 ± 5.63**

In the present study as shown in Table 4, lateral angle of clavicle on the left side is larger than the right side. On comparing the mean values of the present study with the previous ones we can see that the North Indian parameters mentioned in the study of Kaur et al are higher than the present study population of Eastern India, but they are higher when compared with western population of America and France.

The dominant hand side clavicle was found more curved and hence less-angled than the non-dominant hand side clavicle (i.e., left-hand side clavicle). Modes of life include the conditions and occupations embracing all spheres of human activity and labour. Various studies have confirmed the existence of morphometric asymmetries in different anthropometric or

osteometric measurements, fingerprint patterns, skeletal maturation rates etc. Such asymmetries, probably, develop in early gestational life of an individual when certain physiological, nutritional or disease factors disturb the genetic control of symmetric development of the human body, which may continue even up to adulthood. Besides the environmental, genetical and hormonal factors, some mechanical loadings during growth and development also influence the morphological features of human skeleton; however, exact role of external biomechanical factors, intrinsic genetic and endocrinal stimuli on bilateral asymmetry remains still unknown [3,7,8].

Table 4 clearly depicts that lateral end of the clavicle is more curved than the medial one and lateral angle showed wide variations among different studies compared here. Angular differences in the clavicle are important for designing clavicle fixation devices to treat fractures of clavicle. Although usually treated non-operatively by bone settlers or orthopedicians, increased morbidity rates have been recognized with displaced fractures. So, a renewed interest of orthopedicians in fixation of such fractures has stimulated closer scrutiny of clavicular anatomy. Knowledge of clavicular length and its curvature is required for fixing external plates. Fracture fixation plates need be anatomically contoured and locked.

The findings reported in this study will help anatomists, orthopaedic surgeons and forensic anthropologists in their professional endeavours, and will also help design more accurate clavicle fixation devices. Designing the fixation devices requires in depth knowledge of anatomical and physical characteristics of the clavicle.

Conflicts of Interests: None

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