

# Study on Curvatures of Clavicle With Its Clinical Importance

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## ABSTRACT

### Background

The clavicle is the most frequently fractured bone of the human skeleton. 70–80% of fractures occur at the middle third of the shaft of the bone. Anatomical variations in the clavicle of relevance to form intramedullary fixation.

### Objectives

The purpose of this study was attempted to know about comparative differences between curvatures of the right and left clavicles, from certain metrical parameters.

### Methods

The materials for the present study consisted of 257 (135 right and 122 left) adult clavicles, which were collected from the Department of Anatomy and from the students of the first year M.B.B.S during the period 2010 - 2011, Department of Anatomy, Kathmandu University School of Medical Sciences, Dhulikhel, Nepal. The deepest points of the curvatures of the clavicle, where the convexities were the maximum. These angles were measured with the help of a protractor. The sum of the two angles constituted the total curvature of the bone.

### Results

The average medial angle, lateral angle and sum of the two angles of right side were  $150.97^{\circ} \pm 6.16$  SD,  $139.76^{\circ} \pm 7.55$  SD and  $290.73^{\circ} \pm 11.14$  respectively and that of the left side were  $151.50^{\circ} \pm 5.67$ SD,  $141.73^{\circ} \pm 8.44$  SD and  $293.23^{\circ} \pm 11.69$ SD respectively. The present study revealed that the medial and lateral angles of the left clavicle were greater than that of the right clavicle and medial curvature was more than the lateral curvature of the same clavicle.

### Conclusions

It is important to recognize anatomical variations in the curvatures of clavicle when considering intramedullary nailing techniques. It also helps Anthropologists in their study of evolution.

## KEY WORDS

*clavicles, card board, scale, thread, vernier caliper*

## INTRODUCTION

The human clavicle is described as a long bone.<sup>1</sup> It has a shaft and two ends (sternal and acromial ends). The shaft is gently curved with convexity forwards in its medial two-thirds and concavity forwards in its lateral third. The clavicle is thicker and more curved in manual workers and its ridges for muscular attachment are better marked.<sup>2</sup>

The clavicle is the most frequently fractured bone of the human skeleton. 70–80% of fractures occur at the middle third of the shaft of the bone. Intramedullary fixation is used increasingly to treat clavicular fractures. Along with the accepted treatment of plate fixation, intramedullary fixation with a titanium elastic nail (TEN) is

gaining popularity. It is important to recognize anatomical variations of the clavicle.<sup>3</sup>

The length of the left clavicle is usually greater than that of the right.<sup>4,5</sup> Similar observations were recorded by Jit I et al and Singh S.<sup>6,7</sup> The reason for the same is not understood. Not much attention has been paid to the curvatures of the clavicle. For this reason, we have examined the anatomy of the human clavicle to focus on curvatures of clavicle for intramedullary nailing.

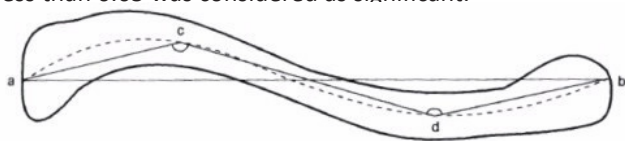
The purpose of this study was attempted to know about comparative differences between the right and left clavicles

and differences between medial and lateral curvatures of the clavicle, from certain metrical parameters.

**METHODS**

The materials for the present study consisted of 257 (135 right and 122 left) adult clavicles, which were collected from the Department of Anatomy and from the students of the first and second year M.B.B.S during the period 2010 - 2011, Department of Anatomy, Kathmandu University School of Medical Sciences, Dhulikhel, Nepal. The Clavicle showing any pathology, e.g. a healed fracture or malunion, had been excluded. To measure the curves of the clavicle, the method described by Parsons (1916) was followed.<sup>4</sup> The clavicle was placed on a card board in such a position that its anterior and posterior borders were in the same horizontal plane (Figure. 1) The midpoints at the sternal and acromial ends were obtained and were marked as points ‘a’ and ‘b’ and were joined by a straight line; the central axis of the clavicle was drawn as a curved line, midway between the anterior and posterior borders throughout the length of the clavicle. This curved line had two convexities, the medial two-thirds was convex anteriorly while the lateral one-third was convex posteriorly. The deepest points on the two curves of the clavicle where the convexities were the maximum, were marked as points ‘c’ and ‘d’ which were joined by a straight line. Finally these points were joined with midpoints ‘a’ and ‘b’ at the corresponding ends with lines c a and d b, thus two angles were formed: a medial angle a c d which gave the curvature of medial two-thirds, and a lateral angle c d b which indicated the curvature of the lateral one-third. These angles were measured with the help of a protractor. The sum of the two angles constituted the total curvature of the clavicle.

The data were entered in FOX-based Statistical Programme for Social Sciences (SPSS) computer programme. For assessing the correlation between the right and left clavicles, the Pearson’s correlation coefficient was calculated and its significance was tested by students “t” test. “p” value of less than 0.05 was considered as significant.



**Figure 1.** Contour of the Right Clavicle as seen from above.

- a: Midpoint of sternal End
- b: Midpoint of acromial end
- c: Deepest point of Medial Curvature
- d: Deepest point of Lateral Curvature
- a c d: Medial Angle
- c d b: Lateral Angle

**RESULTS**

**Medial angle/curvature**

The medial angle of the right clavicle varies between 135° and 165° with the mean of the medial angle of the right clavicle was 150.97° ±6.16 S.D. and the medial angle of the left clavicle varies between 135° and 168° with the mean of the medial angle of the left clavicle was 151.50° ±5.67 S.D. (Table 1) The medial angle of the left clavicle was greater than that of the right clavicle. The side differences were not statistically significant (p=0.478).

**Table 1.** Statistical measurements of the medial angle of the right and the left clavicles.

Details of Measurements	Right	Left
Numbers	135	122
Range	135° - 165°	135° - 168°
Mean	150.97°	151.50°
Standard deviation	6.16°	5.67°
‘p’ value	0.478	
‘t’ value	0.714	

**Lateral angle/curvature**

As shown in table 2, the lateral angle of the right clavicle varies between 120° and 158° with the mean of the lateral angle of the right clavicle was 139.76° ±7.55 S.D. and the lateral angle of the left clavicle varies between 128° and 170° with the mean of the lateral angle of the left clavicle was 141.73° ±8.44 S.D. As the lateral angle of the left clavicle was greater than that of the right clavicle, it was showed that the lateral one-third of the clavicle on the left side was longer than the right side.

**Table 2.** Statistical measurements of the lateral angle of the right and left clavicles.

Details of Measurements	Right	Left
Numbers	135	122
Range	120° - 158°	128° - 170°
Mean	139.76°	141.73°
Standard deviation	7.55	8.44
‘p’ value	0.05	
‘t’ value	1.97	

From above data it was concluded that medial curvature was greater than the lateral curvature of the clavicle.

**Sum of two angles of the right and the left clavicles**

As shown in table 3, Sum of the two angles of right clavicles varies between 262° and 318° with the mean of the sum of the two angles of the right clavicles was 290.73° ±11.14 S.D and the sum of the two angles of the left clavicle varies between 265° and 325° with the mean of the sum of the two angles of the left clavicle was 293.23° ±11.69 S.D. The sum of the two angles was statistically more on the left than on the right side.

**Table 3.** Statistical measurements of the sum of the two angles of the right and the left clavicles (n=257).

Details of Measurements	Right	Left
Numbers	135	122
Range	262° - 318°	265° - 325°
Mean	290.73°	293.23°
Standard deviation	11.14°	11.69°
'P' value	0.081	
't' value	1.751	

## DISCUSSION

Several authors have attempted to determine side differences in course of their research. This has been performed in a variety of ways, including direct measurement of dry clavicles, direct measurement of clavicles from fresh or embalmed cadavers, radiographic measurement of clavicle harvested from cadavers and radiographic measurement in living patients. These studies have been performed on different populations. Evaluation and comparison of present data with the previous study reveals several differences as well as similarities.

In a comparative study of the work of other authors, regarding the average angle of curvature of the clavicles in large number of racial groups, these measurements of clavicle were not the same even in closely related racial groups and these were different in different races.

Observation made by Parsons FG showed that the medial angle of English clavicle was 154° on the right side and 154° on left side which was higher than the value got in the present study. There was no side difference in his study. He also found the lateral angle of clavicle was 149° on right and 149.5° on left side which was higher than the value got in the present study. There was almost no side difference in his study. He also calculated the sum of both angles of the clavicle was 302.5° on right and 303.5° on left side which was higher than the value got in the present study. This suggested that the clavicle of Nepalese population was more curved than the clavicle of English population. Therefore, the clavicle of Nepalese was shorter than the clavicle of English population.<sup>4</sup>

Terry RJ found that the mean medial and lateral angles of clavicle of American Negroes were 152.32° and 141.24° on the right and 152.60° and 144.68° on the left side respectively. Similarly he also calculated the average sum of both angles was 292.94° on the right and 296.42° on the left side.<sup>8</sup> The finding of present study was less than the finding of his study. Therefore the clavicle of Nepalese population was shorter than the clavicle of American Negro because curvature of the clavicle of Nepalese population was more than the American Negro.

In France, Olivier G observed that the average medial angle of French clavicle was 150.60° on the right side and 151.40° on the left side which was almost same as the value got

in the present study. He also measured that the average lateral angle was 143.40° on the right and 143.00° on the left side which was greater than the value recorded in the present study. He also calculated the average sum of both angles of the French clavicle which was 294.25° on the right and 294.4° on the left side which was greater than the value recorded in the present study.<sup>5</sup> Therefore the clavicle of Nepalese was slightly more curved than the French clavicle. There was almost no difference between right and left side which was not in accordance with the present study.

Kaur H et al recorded that the average medial angle of clavicle was 151.68° on the right and 151.89° on the left side. The findings of right clavicle was greater but left was almost same as that which was recorded in the present study. The side differences in the mean medial angle on the two sides were statistically insignificant which were not in accordance with present study. They recorded that the average lateral angle of the clavicle of the north-west India was 143.96° on right and 148.46° on the left side which was greater than the value recorded in the present study. They also calculated the sum of the angle of the clavicle of the north-west Indian was 292.55° on right and 297.18° on the left side which was greater than the value recorded in the present study. Therefore the clavicle of Nepalese was slightly more curved than the clavicle of the north-west India. This suggested that the right clavicles were more curved than the left clavicles which were in accordance with the present study.<sup>9</sup>

Dzhigora S observed a larger depth (1.7 cm) of curvature on the medial curvature than the lateral curvature which was in accordance with the present study.<sup>10</sup> Therefore, the present observations showed that curvatures of right clavicle became greater than that of left clavicle so that the left clavicle was longer than the right clavicle. With use of more right hand which leads to shorter right clavicle as compared to the left clavicle.<sup>10</sup>

## CONCLUSION

In present study, it was observed that the medial angle of the left clavicle was greater than that of the right clavicle; the lateral angle of the left clavicle was greater than the right clavicle; the sum of the two angles of the left clavicle was greater than right side; medial curvature was larger than lateral curvature in both sided clavicle.

From the observations we infer that with the use of right hand, the curve of the right clavicle became greater than that of left side which led to a shorter right bone as compared to the left. These parameters have great importance when considering intramedullary nailing techniques. It also helps the anthropologists in their study of evolution of mankind and migration of races.

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