

MORPHOLOGY OF DISTAL THIRD OF CLAVICLE IN DRY BONE AND CORRELATION WITH LENGTH: A CROSS-SECTIONAL STUDY.

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ABSTRACT

Background

The human clavicle is the only transversely placed cancellous bone long bone of the body. The fracture of the distal end of the clavicle accounts for 12% to 15% of all fractured clavicles. Approximately 25% of distal clavicle fractures are unstable. This study aims to measure the dimensions and proportions of the distal third of the clavicle and correlate these measurements with the total length of the bone to aid in the development of better surgical interventions and prosthetics.

Methods

In this study, 40 left-side & 40 right-side human clavicles were included. The total length of the bone, the distance of the medial border of the conoid tubercle, and the center of the trapezoid tuberosity from the lateral edge of the clavicle were measured. Analysis of data was done by SPSS version 22 for Windows.

Results

The mean total length of right & left clavicle was 125.5 ± 11.9 mm & 136.5 ± 10.4 mm. The mean length of the medial border of the conoid tubercle (CD) from the lateral edge was 43.0 ± 7.3 mm & 43.5 ± 4.9 mm and the mean length of the center of the trapezoid tuberosity (TD) from the lateral edge was 18 ± 4.1 mm & 18 ± 4.10 mm of right & left clavicle respectively. The average of the mean of the proportion of the medial border conoid tubercle from the lateral edge of the clavicle & the total length of the clavicle was 0.33 ± 0.045 & that of the center of the trapezoid tuberosity was 0.14 ± 0.025 .

Conclusion

The mean length of the left clavicle is more. The CD & TD will provide a guide for resection of the distal end of the clavicle in fracture and displacement of the acromioclavicular joint during repair.

Recommendation

Future research should involve larger, diverse samples to validate findings and refine surgical techniques, considering anatomical variations for improved patient outcomes.

Keywords: Human Clavicle, Proportion, Distal End, Anterior Border

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Background

The human clavicle is the only transversely placed cancellous bone long bone of the body. Both ends of the clavicle have anatomical variations in shape. The distal end is flat but the sternal end is rounded. It has a longer period of skeletal growth. It transmits the weight from the upper limb to the axial skeleton, so subjected to a variety of stress.

It is the most common bone for fracture. The fracture of the distal end of the clavicle accounts for 12% to 15% of all fractured clavicles [1,2,3]. Approximately 25% of distal clavicle fractures are unstable [4]. The cortex of the distal end of the clavicle is very thin & reaches full thickness earlier than the sternal end [5]. The support of the trapezoid & conoid ligaments of the acromioclavicular joint is an

important factor for the stability of the fracture repair of the distal end of the clavicle [6]. The purpose of this study is to measure the distance of attachment of the trapezoid ligament and the conoid ligament from the distal end of the clavicle and to find the thickness along with the anterior-posterior length of the distal end of the clavicle.

Material and Methods

Study design

A cross-sectional study.

Study setting

The study was conducted at the Department of Anatomy, Uma Nath Singh Autonomous State Medical College, Jaunpur, and Uttar Pradesh, India.

Variables

Side of the clavicle (right, left), the total length of the clavicle, the distance of the medial border of the conoid tubercle from the lateral edge, the distance of the center of trapezoid tuberosity from the lateral edge, supero-inferior thickness, anterior-posterior width, and proportions of these measurements relative to the total length.

Procedure

This study was done to examine the dimensions of the distal end of the clavicle of the western Uttar Pradesh population on dry clavicles. In this study, 80 unbroken dry human clavicles were included. 40 clavicles were on the left side and 40 clavicles were on the right side. The clavicles were collected from the Department of Anatomy and the first-year MBBS students of MDBAS Medical College, Deoria. The bones were unpaired. The age and sex of the bone were not considered. Bones with broken distal ends were excluded from the study. The total length of the bone was

measured as the maximum distance between the two ends & was measured to the nearest millimeter by using a ruler. The distance of the medial border of the conoid tubercle and the center of the trapezoid tuberosity from the lateral edge of the clavicle were measured to the nearest millimeter by using a vernier caliper. The super-inferior surface thickness and anterior-posterior width were measured 1cm medial to the lateral end using a vernier caliper to the nearest millimeter.

Statistical analysis

Analysis of data was done by Statistical Package of Social Sciences (SPSS) version 22 for Windows, using computer software. The analysis involved mean and standard deviation.

Results

The mean total length of the right clavicle was 125.5 ± 11.9 mm. The mean length of the medial border of the conoid tubercle (CD) was 43.0 ± 7.3 mm & the mean length of the center of the trapezoid tuberosity (TD) was 18 ± 4.1 mm from the lateral edge of the right clavicle. The mean thickness from superior surface to inferior surface (S/I) was 10.5 ± 2.24 mm & the mean width from anterior border to posterior border (A/P) was 20.5 ± 5.1 mm of right clavicle (Table 1).

The mean total length of the left clavicle was 136.5 ± 10.4 mm (p-value - significant). The mean length of the medial border of the conoid tubercle (CD) was 43.5 ± 4.9 mm (p value not significant) & the mean length of the center of the trapezoid tuberosity (TD) was 18 ± 4.10 mm (p value not significant) from the lateral edge of the left clavicle. The mean thickness from superior surface to inferior surface (S/I) was 10 ± 00 mm (p value not significant) & the mean width from anterior border to posterior border (A/P) was 21.0 ± 4.47 mm (p value not significant) of the left clavicle (Table 1).

Table 1: Comparison of measurements of right and left clavicle

	Right side(in mm)	Left side(in mm)	Average(in mm)	p-value
Total length	125.5 ± 11.9	136.5 ± 10.4	131 ± 11.15	0.004
CD	43.0 ± 7.3	43.5 ± 4.9	43.2 ± 6.1	0.801
TD	18 ± 4.1	18 ± 4.10	18 ± 4.1	1.000
S/I	10.5 ± 2.24	10 ± 00	10.25 ± 1.12	0.324
A/P	20.5 ± 5.1	21.0 ± 4.47	20.75 ± 4.78	0.744

CD: Conoid distance, TD: Trapezoid distance, S/I: superior to inferior surface, A/P: anterior to posterior border, mm: millimeter

The mean of the proportion of the medial border of the conoid tubercle from the lateral edge of the clavicle & the total length of the clavicle was 0.34 ± 0.06 of the right clavicle (CD/TL). The mean of the proportion of the center of trapezoid tuberosity from the lateral edge of the clavicle

& the total length of the right clavicle (TD/TL) was 0.16 ± 0.03 (Table 2).

The mean of the proportion of the medial border of the conoid tubercle from the lateral edge of the clavicle & the total length of the left side clavicle was 0.32 ± 0.03 (p value

not significant). The mean of the proportion of the center of trapezoid tuberosity from the lateral edge of the clavicle & the total length of the left clavicle was 0.12 ± 0.02 (p value not significant) (Table 2).

Table 2: Proportion of conoid and trapezoid distance with the total length of the clavicle

	Right Clavicle	Left Clavicle	Average	p-value
CD/TL	0.34 ± 0.06	0.32 ± 0.03	0.33 ± 0.045	0.240
TD/TL	0.16 ± 0.03	0.12 ± 0.02	0.14 ± 0.025	0.091

CD: conoid distance, TD: trapezoid distance, TL: total length

Discussion

Out of the three bones around the shoulder joint, fracture of the clavicle is 44-66% [7,8,9]. The mean length of the clavicle was 125.5 ± 11.9 mm & 136.5 ± 10.4 mm on the right & left sides respectively in this study (Table 1). The length of the clavicle on the left side is longer than the right side and it is statistically significant ($p = 0.004$).

The results reveal significant anatomical variations in the distal third of the clavicle among the Western Uttar Pradesh population, with the left clavicle being generally longer than the right. These findings align with some global studies but differ from others, indicating possible genetic or environmental influences. The measured distances of the conoid tubercle and trapezoid tuberosity provide valuable

surgical guidelines. The mean length of the clavicle in different countries as noted from different studies is 145mm for the right clavicle & 146.5mm for the left clavicle in the English population study [10]. In a study, the mean length of the clavicle was 146.5mm & 146.85mm on the right and left sides in the French population [11]. In the Belgian population, it is 158mm and 159.8mm in the right and left side clavicle [12]. In the Kenyan population [13] the mean clavicle length was 146.8 mm & 150.4mm while in Nepalese, [14] it was found to be 143.21mm and 145.53mm respectively on the right side & the left side. The left bones were longer than the right ones in these studies, similar to this study. The mean length of the clavicle in this study is a little lower than in these countries (Table 3).

Table 3: Comparison of the length of the clavicle in different countries

Author	Population	Length of right clavicle in mm	Length of left clavicle in mm
Present study	Indian	125.5 ± 11.9	136.5 ± 10.4
Haque MK et.al ^[14]	Nepal	143.21	145.53
Parsons ^[10]	English	145	146.5
Oliver G ^[11]	French	146.05	146.85
Bernat A et al ^[12]	Belgian	158	159.8
Beryl S. Omindeet. al ^[13]	Kenyan	146.8	150.4

There is variation in the length of the clavicle in different locations of the Indian population as stated by different studies tabulated in Table 4. It is smaller than this study in the Eastern Indian Population, 124.3 mm on the right side & 124.0mm on the left side [15]. A study recorded the mean lengths of the clavicles of people of Varanasi as 138.63mm and 135.97 mm [16] & in the Telangana zone [17] it was 138.71mm and 137.83 mm on the right & left sides. In these studies, the right clavicle is longer than the left. Study [18]

in Amritsar zone were 137.97mm of right clavicles & 138.69mm of left clavicles. In a study, the values of people of Chandigarh were 141.96mm and 143.67mm for right and left-sided clavicles respectively [19]. The average lengths of clavicles in the Gujarati population were found to be 142.28mm on the right and 145.14mm on the left side in the study [20]. In all these studies in India, the length of the left bone was longer than the right one, similar to this study.

Table 4: Comparison of length of clavicle in different locations in India

Author	Population	Length of right clavicle(mm)	Length of left clavicle(mm)
Present study	Western U.P.	125.5±11.9	136.5±10.4
Sen Sushmitaetal ^[15]	Eastern Indian	124.3	124.0
Singh et al ^[16]	Varanasi zone	138.63	135.97
Jit I et al ^[18]	Amritsar zone	137.97	138.69
Chavda HS et al ^[20]	Gujarat zone	142.28	145.14
Kaur H et al ^[19]	Chandigarh zone	141.96	143.67
Kamdi A et al ^[17]	Telangana zone	138.71	137.83

In dislocation of the Acromioclavicular joint and fracture of the lateral end of the clavicle, injury to the coracoclavicular ligaments is common. This ligament is attached to the clavicle in two parts, the conoid part and the trapezoid part. The positions of attachment may vary in different races of the population. Hence the knowledge of the position of these parts will help create the conoid tunnel & trapezoid tunnel which is the procedure for the two-ligament repair in the acromioclavicular joint dislocation [13]. As mentioned in a study, the conoid tunnel is created 40-45mm from the lateral end of the clavicle & the trapezoid tunnel is created 15mm lateral to this [21,22]. In this study, the mean length of the medial border of the conoid tubercle from the lateral edge of the clavicle was 43.2±6.1mm. It is 39.52±5.93mm in the Kenyan population [13] & 41.4mm in the Korean population [23], which is similar to this study. It is less than the measurements taken in the population of German [24] and British [25] which were 50.5mm and 46.3mm respectively. In this study, the mean length of the center of trapezoid tuberosity from the lateral edge of the clavicle

was 18±4.1mm. This measurement is 17.96±3.42mm in the Kenyan population, similar to this study. The study, in the Korean population [23] it is 22mm (Table 5). In the population of Germans and British, it was 29mm and 24.9mm respectively which is higher than this study, where the length of the clavicle was also higher.

The mean of the proportion of the medial border of the conoid tubercle from the lateral edge & the total length of the clavicle is 0.33±0.045 in this study, which is 0.31 in the British population & 0.34 in the German population similar to this study. This measurement is 0.27 in the Kenyan & Korean populations which is lower than this study.

The mean of the proportion of the center of trapezoid tuberosity from the lateral edge & total length of the clavicle is 0.14±0.025 in this study. It is 0.12 in the Kenyan population, 0.14 in the Korean population & 0.17 in both the German population & British population, similar to this study. The mean of the proportion may help to find the total length of the clavicle in skeletal remains.

Table 5: Comparison of proportion conoid and trapezoid distance with total length of clavicle in different countries

Author	Population	CD/TL	TD/TL
Present study	India	0.33±0.045	0.14±0.025
Rios CG et al. ^[25]	British	0.31	0.17
Boehm TD et al. ^[24]	German	0.34	0.17
Beryl S.Ominde et al. ^[13]	Kenyan	0.27	0.12
Chung et al. ^[23]	Korean	0.27	0.14

The cortex reaches the full thickness earlier in the distal end. The cortex of the distal clavicle is not dense. Hence, the distal end of the clavicle may not hold the prosthesis well due to thinness. The cortex is visible at the mean distance of 12.3mm anteriorly-posteriorly & 7.8mm superiorly-inferiorly from the distal end facet [5]. In this study, the mean thickness from superior surface to inferior surface(S/I) of the lateral edge of the clavicle was 10.5±2.24mm&10±00mm (p value not significant) on the right & left side clavicle. The mean width from anterior border to posterior border (A/P) of the lateral edge of the

clavicle was 20.5±5.1mm& 21.0±4.47mm (p value not significant) on the right & left clavicle. These measurements will help in designing a prosthesis of the distal end of the clavicle for repair.

Generalizability

Applying these findings to a broader population suggests that anatomical variations observed in a specific regional sample could reflect broader trends across different populations. The significant differences in clavicle length

and proportions can inform the development of more universally applicable surgical techniques and prosthetic designs. Understanding these variations is crucial for improving the accuracy of anatomical models used in medical education and clinical practice globally. By expanding the study to include diverse populations, we can ensure that surgical interventions and prosthetics are more precisely tailored to individual anatomical differences, enhancing patient care and surgical outcomes worldwide.

Conclusion

The mean length of the clavicle is variable in different countries and in different locations in India. It may be a reflection of the body size. The measurement of the distal end like the conoid and trapezoid distance and the mean proportion of these may predict the length of the clavicle. Superior surface to inferior surface thickness and the mean width from anterior border to posterior border will help in designing the prosthesis for distal end fracture fixation.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendation

Future research should focus on a larger and more diverse sample to validate these findings and further refine surgical techniques and prosthetic designs. Additionally, clinicians should consider these anatomical variations when planning surgical interventions to improve patient outcomes.

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List of abbreviations

CD: Conoid Distance
TD: Trapezoid Distance
TL: Total Length
S/I: Superior-Inferior Thickness
A/P: Anterior-Posterior Width
mm: Millimeter
MBBS: Bachelor of Medicine, Bachelor of Surgery

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Conflict of interest

The authors have no competing interests to declare.

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