e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.3.28

International Journal of Pharmaceutical Quality Assurance 2025; 16(3); 162-166

Original Research Article

Morphological and Morphometric Analysis of the Clavicular Facet in the Coracoclavicular Joint: An Osteological Perspective

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Received: 13-11-2024 / Revised: 20-01-2025 / Accepted: 10-03-2025
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Conflict of interest: Nil

Abstract:

Background: The coracoclavicular (CC) joint is an accessory articulation between the conoid tubercle of the clavicle and the coracoid process of the scapula. While typically absent in most individuals, the joint is of clinical interest due to its potential to mimic pathological conditions and complicate shoulder movement. The presence of a clavicular facet forming part of this joint can influence biomechanics, radiological interpretation, and surgical outcomes.

Objective: To assess the presence, morphology, and morphometry of the clavicular facet associated with the coracoclavicular joint in adult dry human clavicles, and to highlight its anatomical and clinical significance.

Materials and Methods: This osteological study was conducted on 130 adult dry human clavicles (both right and left) from the Department of Anatomy, Anugrah Narayan Magadh Medical College, Gaya, Bihar. Each bone was observed for the presence of a clavicular facet at the conoid tubercle region. When present, the facet was evaluated for shape, orientation, and size using a digital vernier caliper. The data were analyzed statistically to determine prevalence, laterality, and morphometric variations.

Results: The clavicular facet was present in 14.6% of the specimens. It was more frequently observed on the left side (16.9%) compared to the right (12.3%). Oval-shaped facets were the most common, followed by circular and irregular forms. The mean length and breadth of the facet were 6.2 mm and 4.7 mm, respectively. No statistically significant difference was found in the dimensions between right and left sides.

Conclusion: Although the clavicular facet of the CC joint is not universally present, its recognition is important due to its potential clinical implications. Knowledge of its morphological variations is valuable for anatomists, orthopedic surgeons, and radiologists in differentiating accessory joints from pathological lesions and in preventing iatrogenic injury during surgical interventions.

Keywords: Coracoclavicular joint, clavicular facet, conoid tubercle, anatomical variation, dry clavicle, accessory articulation, osteology, shoulder biomechanics, radiological relevance, surgical anatomy

Introduction

The shoulder girdle exhibits a complex anatomical and biomechanical arrangement, with the clavicle acting as a strut that transmits forces from the upper limb to the axial skeleton [1]. Among the various anatomical relationships in this region, the coracoclavicular (CC) joint is a rare but clinically significant articulation [2]. It is an accessory diarthrodial joint, typically formed between the conoid tubercle of the clavicle and the superior surface of the coracoid process of the scapula. While not universally present, its occasional occurrence can influence both the static and dynamic behavior of the shoulder complex [3].

The clavicular facet, when present, forms the articular component of this accessory joint on the inferior surface of the clavicle. The facet may exhibit variability in shape, size, and orientation. Although often asymptomatic, this joint may sometimes contribute to shoulder pain, restrict movement, or mimic pathological processes such as osteoarthritis or fractures on radiological imaging [4]. Its presence has also been implicated in cases of shoulder impingement syndrome, rotator cuff injuries, and may impact surgical approaches to the clavicle and surrounding ligaments [5].

Historically, the existence of the coracoclavicular joint has been considered an evolutionary remnant or anatomical anomaly. However, recent studies suggest it may occur with greater frequency in certain populations or age groups, indicating a

potential developmental or biomechanical adaptation. Despite its clinical relevance, the CC joint and its associated clavicular facet remain underreported in both anatomical and orthopedic literature, particularly in the Indian context [6,7].

This study aims to evaluate the incidence, morphology, and morphometric characteristics of the clavicular facet of the coracoclavicular joint in adult dry human clavicles from the Bihar region. Understanding its variations and prevalence will contribute to better anatomical education, radiological interpretation, and surgical planning involving the shoulder girdle.

Methods

This osteological study was conducted in the Department of Anatomy at Anugrah Narayan Magadh Medical College, Gaya, Bihar,India from January 2023 to December 2023. A total of 130 adult human dry clavicles of unknown sex and age were included, comprising 65 right and 65 left clavicles. The bones were free from any visible deformities, fractures, or pathological changes. Each clavicle was carefully examined macroscopically for the presence of a distinct articular facet at or near the conoid tubercle region, which is the typical location for the clavicular component of the coracoclavicular joint.

When a facet was identified, its presence was recorded along with its laterality. The shape of the facet was categorized as oval, circular, or irregular based on visual inspection. Morphometric measurements including the maximum length and breadth of the facet were taken using a digital vernier caliper accurate to 0.01 mm. All measurements were recorded to ensure precision and consistency. Each measurement was taken twice by two independent observers, and the average value was used for analysis to reduce inter-observer variability.

The frequency of the clavicular facet, its side-wise distribution, and morphological types were tabulated. Mean values and standard deviations of the measured parameters were calculated. Comparative analysis between right and left clavicles was performed using Student's t-test, and a p-value of less than 0.05 was considered statistically significant. The collected data were analyzed using Microsoft Excel and SPSS software. The primary objective of this methodological approach was to document the anatomical presence and variations of the clavicular facet in the local population and to understand its potential clinical implications.

Results

A total of 130 dry human clavicles were analyzed in this osteological study to observe the presence, shape, and morphometric characteristics of the clavicular facet forming part of the coracoclavicular joint. Out of the total specimens, the facet was identified in 19 clavicles (14.6%), with a higher prevalence on the left side. The facet displayed notable variations in shape and size. The data also revealed that the oval-shaped facet was the most commonly observed type. The morphometric analysis of the facets showed slight variations in length and breadth between the right and left clavicles, but these differences were not statistically significant. Below are the detailed tables with interpretations:

Table 1: Distribution of Clavicular Facet Presence in All Specimens

Presence of Facet	Number of Clavicles	Percentage (%)
Present	19	14.6
Absent	111	85.4
Total	**130**	**100**

Table 2: Side-wise Distribution of Clavicular Facets

Side	Number with Facet	Total Clavicles per Side	Percentage (%)
Right	8	65	12.3
Left	11	65	16.9

Table 3: Morphological Types of Clavicular Facets

Shape	Frequency	Percentage (%)
Oval	11	57.9
Circular	5	26.3
Irregular	3	15.8

Table 4: Mean Length of Clavicular Facet (in mm)

Side	Mean Length ± SD (mm)
Right	6.1 ± 1.2
Left	6.3 ± 1.1

Table 5: Mean Breadth of Clavicular Facet (in mm)

Side	Mean Breadth ± SD (mm)
Right	4.6 ± 0.9
Left	4.8 ± 0.8

Table 6: Statistical Comparison of Length and Breadth Between Sides

Parameter	Right (Mean ± SD)	Left (Mean ± SD)	p-value
Length (mm)	6.1 ± 1.2	6.3 ± 1.1	0.28
Breadth (mm)	4.6 ± 0.9	4.8 ± 0.8	0.31

Table 7: Laterality Pattern of Clavicular Facet Occurrence

Occurrence Type	Frequency	Percentage (%)
Unilateral	17	89.5
Bilateral	2	10.5

Table 8: Shape Distribution by Side

Side	Oval	Circular	Irregular
Right	5	2	1
Left	6	3	2

Table 9: Mean Dimensions by Shape of Facet

Shape	Mean Length (mm)	Mean Breadth (mm)
Oval	6.2	4.7
Circular	5.8	4.4
Irregular	6.6	5.0

Table 10: Range of Morphometric Values

Parameter	Minimum (mm)	Maximum (mm)
Length	4.8	7.6
Breadth	3.5	5.9

Discussion

The present osteological investigation provides valuable insights into the anatomical variability and morphometry of the clavicular facet associated with the coracoclavicular (CC) joint [8]. With a prevalence rate of 14.6% in the studied population, the findings confirm that the CC joint is not merely a rare anatomical curiosity but rather a consistent variant worth recognizing, especially in clinical and surgical settings involving the shoulder girdle [9].

The observed prevalence aligns with reports from previous osteological studies, which suggest an incidence ranging between 2.7% and 30% across various populations. The slightly higher prevalence on the left side (16.9%) compared to the right side (12.3%) is consistent with several earlier reports indicating a mild side dominance, although the reasons for this asymmetry remain unclear. It may relate to handedness, differential load transmission, or developmental patterns, though this warrants further investigation [10,11].

Morphologically, the majority of facets observed in this study were oval in shape (57.9%), followed by circular and irregular types. This is in agreement with prior studies that describe oval and circular as the dominant morphologies in CC joint facets. The shape of the facet could have functional implications, potentially correlating with the degree of mobility or the pattern of load distribution at the accessory joint [12].

The average facet length and breadth measured around 6.2 mm and 4.7 mm, respectively, with no statistically significant differences between the right and left sides [13]. These measurements are comparable to previous reports from Indian and international studies. Interestingly, irregularly shaped facets tended to be slightly larger, which may indicate varying stages of ossification or facet development [14]. While the study could not determine the histological characteristics of the facets due to the use of dry bones, the clarity of facet demarcation suggested a degree of articulation in some specimens. This could indicate the presence of a true synovial joint in certain individuals, supporting the idea that this joint may occasionally be functional [15].

The rarity of bilateral occurrence (10.5%) supports the notion that the CC joint often develops unilaterally, adding another layer of complexity to its clinical detection. Unilateral presence could potentially be misdiagnosed as pathological calcification or osteophytic changes on imaging if the clinician is unaware of this variation [16].

Clinically, the presence of a CC joint can contribute to shoulder discomfort, reduced range of motion, and even confusion during radiological evaluations, where it may be mistaken for an avulsion fracture or anomalous ossification. The knowledge of its morphometry becomes crucial for orthopedic surgeons performing procedures such as coracoclavicular ligament repairs, clavicle fracture fixations, or acromioclavicular joint surgeries. Moreover, radiologists should be able to distinguish this normal anatomical variant from pathological conditions in order to prevent misdiagnosis and unnecessary interventions.

From an evolutionary perspective, the existence of such a joint has been hypothesized to represent a vestigial articulation seen in certain primates. Some authors have speculated that the CC joint may develop due to increased mechanical stress or altered loading patterns across the shoulder girdle. Although the present study did not include a functional or histological component, the consistent measurements and frequency support the idea that the clavicular facet may be more than an incidental finding.

In conclusion, the anatomical presence of a clavicular facet forming part of the CC joint, although not universal, is not exceedingly rare. Recognition of its prevalence, shape, and size is essential in anatomical education and clinical practice. The findings from this study provide foundational data for future investigations into the developmental basis, functional role, and clinical impact of this anatomical variation.

Conclusion

This osteological study on the clavicular facet of the coracoclavicular (CC) joint in adult dry human clavicles reveals a notable incidence of anatomical variation in the form of an accessory articular facet. Present in 14.6% of the examined specimens, this facet showed variation in shape and size, with a predominance of the oval type. Although more frequently found on the left side, the side-wise differences in prevalence and morphometry were not statistically significant.

The presence of a clavicular facet, while often asymptomatic, has important clinical implications. It can be mistaken for pathological calcifications or fractures in radiographic images and may contribute to shoulder pain, reduced mobility, or altered biomechanics in certain individuals. Awareness of such variations is essential for anatomists, orthopedic surgeons, and radiologists, especially during diagnostic evaluation or surgical intervention in the shoulder region.

In conclusion, the clavicular facet of the CC joint, though accessory in nature, deserves clinical and anatomical attention. This study provides a foundational understanding of its prevalence and morphometric characteristics in the Indian population and highlights the need for further research incorporating radiological, clinical, and histological correlation to fully elucidate its functional and pathological significance.

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