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MORPHOLOGICAL ANALYSIS OF SCAPULA WITH MULTIDETECTOR COMPUTED TOMOGRAPHY IN A TERTIARY CARE HOSPITAL OF SOUTH GUJARAT

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ABSTRACT **Background:** Precise knowledge of scapular and glenoid morphology is essential for shoulder arthroplasty, fracture fixation, and management of shoulder instability. Morphological variations of the glenoid cavity influence joint biomechanics and surgical outcomes. Multidetector computed tomography (MDCT) allows accurate three-dimensional assessment of scapular anatomy and glenoid morphology. [1,2] **Methods:** This observational cross-sectional study included 100 scapulae evaluated using MDCT at a tertiary care hospital in South Gujarat. Morphological parameters assessed included glenoid cavity shape, side-wise and gender-wise distribution, presence of glenoid notch, and glenoid version. Glenoid cavity shapes were categorized into pear, tear, inverted comma, and calabash types. Data were analyzed using descriptive statistics, and associations were assessed where applicable. **Results:** Among the 100 scapulae studied, 64 belonged to males and 36 to females. Pear-shaped glenoid cavities were the most common morphology, followed by tear-shaped and inverted comma types, while calabash shape was rare. Pear-shaped glenoid cavities predominated on both sides and in both sexes. A glenoid notch was present in the majority of cases. Retroversion of the glenoid cavity was observed more frequently than anteversion. **Conclusions:** MDCT-based morphological analysis demonstrates a predominance of pear-shaped glenoid cavities with frequent presence of glenoid notch and retroversion in the South Gujarat population. These findings provide region-specific anatomical data that may assist orthopaedic surgeons in surgical planning and prosthesis design.

KEYWORDS : Scapula, Glenoid cavity, Morphology, MDCT, Shoulder

INTRODUCTION

The scapula plays a pivotal role in shoulder biomechanics, contributing to stability and range of motion of the glenohumeral joint. Variations in glenoid cavity morphology significantly influence shoulder stability, predisposition to dislocation, and outcomes of surgical procedures such as shoulder arthroplasty and stabilization surgeries. Knowledge of population-specific morphological patterns is therefore essential. [3]

Multidetector computed tomography (MDCT) provides high-resolution multiplanar and three-dimensional images, allowing precise evaluation of scapular morphology. Compared to dry bone studies and plain radiography, MDCT enables in vivo assessment of anatomical variations. This study aims to analyze the morphological characteristics of the glenoid cavity using MDCT in a South Gujarat population. [1,2]

METHODS

Study Design And Participants

This cross-sectional observational study was conducted in the Department of Radiodiagnosis at New Civil Hospital, Surat, Gujarat. A total of 100 subjects undergoing MDCT of the chest or shoulder region for indications unrelated to scapular pathology were included. Subjects with scapular fractures, tumours, congenital anomalies, severe degenerative changes, or prior shoulder surgery were excluded from the study.

Imaging Technique

All examinations were performed using a multidetector 256 slice CT scanner. Thin-section axial images were acquired and reconstructed using multiplanar reformations and three-dimensional volume-rendered images for optimal visualization of the scapula and glenoid cavity.

Morphological Parameters

The following morphological parameters were evaluated:

Presence Or Absence Of Glenoid Notch As In Fig. 1.

Glenoid version, categorized as anteversion or retroversion: A line passing through the most medial point of the scapula to the middle of the glenoid fossa on an axial image inferior to the coracoid process is taken as the anatomic axis of the scapula and a second line drawn from anterior to posterior edge of the glenoid fossa (intermediate joint line). The angle between these two lines is interpreted as in Fig. 2. If the angle is > 90 degrees it is anteversion and < 90 degrees is retroversion.

Figure 1: Glenoid cavity notch; White arrow shows the presence of glenoid cavity notch.

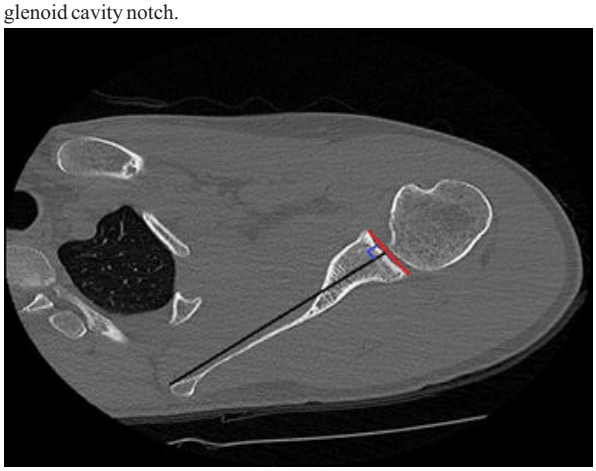

Figure 2: Glenoid version; Black line denotes anatomic axis of scapula; Red line denotes intermediate joint line and the angle between the two (blue) denotes glenoid version.

Glenoid cavity shape, classified as pear-shaped, tear-shaped, inverted comma-shaped, or calabash-shaped as in Fig. 3.

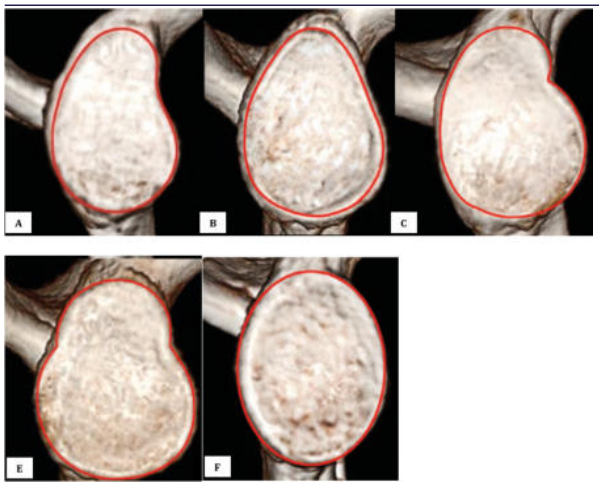

Figure 3: Classification of glenoid cavity; A. Pear shaped; B. Tear shaped; C. Inverted comma shaped; D. Calabash shaped; E. Oval shaped.

Ethics
Approval was obtained from the SRC and Ethical committee of Government Medical College, Surat. As this was a retrospective imaging-based study with anonymized data, informed consent was waived.

Statistical Analysis
Data were analyzed using descriptive statistics and expressed as frequencies and percentages. Associations between morphological parameters and side or gender were assessed where applicable. A P value of less than 0.05 was considered statistically significant.

RESULTS
Demographic Data
The study included 100 scapulae, of which 64 were from male subjects and 36 from female subjects. The age of the subjects ranged from 18 to 90 years.

Glenoid Cavity Morphology
Pear-shaped glenoid cavities constituted the most common morphological type, followed by tear-shaped and inverted comma-shaped cavities. Calabash-shaped glenoid cavities were rarely observed. This pattern was consistent across both right and left sides.

Side-wise Distribution
Pear-shaped glenoid cavities predominated on both sides. Tear-shaped and inverted comma-shaped cavities were less frequent, while calabash morphology was uncommon.

Gender-wise Distribution
Pear-shaped glenoid cavities were the most common morphology in both males and females. Tear-shaped and inverted comma-shaped cavities were observed with lesser frequency in both sexes.

Presence Of Glenoid Notch
A glenoid notch was present in the majority of scapulae studied, while absence of a notch was observed in a smaller proportion of cases.

Glenoid Version
Retroversion of the glenoid cavity was more frequently observed than anteversion in the study population.

DISCUSSION
The present study provides a comprehensive MDCT-based morphological evaluation of the glenoid cavity in a South Gujarat population. Knowledge of glenoid morphology is of considerable clinical importance, as variations in shape, presence of notch, and version influence shoulder stability, predisposition to dislocation, and outcomes of surgical procedures such as shoulder arthroplasty and stabilization surgeries. [1–3]

In the present study, pear-shaped glenoid cavities were the most common morphology, followed by tear-shaped and inverted comma-shaped types, while calabash-shaped cavities were rare. This pattern is consistent with several previous studies conducted on Indian populations. Mishra et al. reported pear-shaped glenoid cavities as the predominant type in their osteological study, followed by inverted comma and tear-shaped variants.[7] Similarly, Rajput et al. and Gupta et al. observed a higher prevalence of pear-shaped glenoid cavities, suggesting that this morphology is common among the Indian population.[8,9] Comparable findings have also been reported in international studies, including those by Coskun et al., indicating that pear-shaped morphology is frequently encountered across different ethnic groups.[10]

Side-wise analysis in the present study demonstrated a predominance of pear-shaped glenoid cavities on both right and left sides, with no marked asymmetry. This observation aligns with findings reported by earlier authors, who also noted minimal side-related variation in glenoid cavity morphology. [8, 9] Such symmetry may be clinically relevant during preoperative planning, particularly when contralateral imaging is used as a reference.

Gender-wise analysis revealed that pear-shaped glenoid cavities were the most common morphology in both males and females, although minor differences in the distribution of other shapes were observed. Similar gender-related patterns have been reported in previous Indian studies, suggesting that while overall morphology remains consistent, subtle variations may exist between sexes. [7–9] These variations may have implications for implant sizing and prosthesis design, especially in shoulder arthroplasty.

The presence of a glenoid notch was observed in the majority of cases in the present study. Prescher and Klümpen described the glenoid notch as an important anatomical feature related to the attachment of the glenoid labrum. [3]. The presence of a notch has been associated with an increased susceptibility to anterior shoulder instability due to reduced labral attachment area. [11, 12] The high prevalence of glenoid notch observed in the present study is in agreement with earlier anatomical and radiological studies and underscores its clinical relevance.

Regarding glenoid version, the present study demonstrated a higher frequency of retroversion compared to anteversion. This finding is consistent with CT-based studies by Nyffeler et al. and Churchill et al., who emphasized that retroversion is a common anatomical characteristic of the glenoid cavity. [2,13] Increased glenoid retroversion has been associated with shoulder instability and has important implications for prosthetic positioning during shoulder arthroplasty. [14,15] Accurate assessment of glenoid version using MDCT is therefore essential for optimal surgical planning.

Compared to dry bone and cadaveric studies, MDCT offers the advantage of in vivo three-dimensional evaluation of glenoid morphology. The findings of the present study reinforce the role of MDCT as a reliable and reproducible modality for evaluating glenoid anatomical variations, supporting its routine use in preoperative assessment. [4–6]

The limitations of the present study include its single-center design and lack of correlation with clinical outcomes. Additionally, the study population was limited to a specific geographic region, which may restrict generalizability. Nevertheless, the study provides valuable region-specific morphological data that may aid orthopaedic surgeons in surgical planning and implant selection.

CONCLUSION
MDCT-based morphological analysis of the scapula demonstrates a predominance of pear-shaped glenoid cavities, frequent presence of glenoid notch, and higher incidence of retroversion in the South Gujarat population. These findings may aid orthopaedic surgeons in understanding anatomical variations and optimizing surgical planning and prosthesis design.

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Conflict Of Interest: None declared.

Table 1: Side And Gender Wise Glenoid Cavity Shape Morphology Parameter Data:

Shape	Side		Gender	
	Right	Left	Male	Female

	N	%	N	%	N	%	N	%
Pear	66	66	71	71	81	63.28	56	77.78
Tear	21	21	16	16	30	23.44	7	9.72
Inverted Comma	12	12	12	12	15	11.72	9	12.50
Calabash	0	0	1	1	1	0.78	0	0.00
Oval	1	1	0	0	1	0.78	0	0.00
Total	100	100	100	100	128	100	72	100
P-value	0.5818				0.1234			

Table 2: Side And Gender Wise Glenoid Cavity Notch Data:

Glenoid Notch	Side				Gender			
	Right		Left		Male		Female	
	N	%	N	%	N	%	N	%
Present	78	78	83	83	97	75.78125	65	90.27778
Absent	22	22	17	17	31	24.21875	7	9.722222
P-value	0.3722				0.01213			

Table 3: Side And Gender Wise Glenoid Cavity Version Morphology Parameter Data:

Glenoid Version	Side				Gender			
	Right		Left		Male		Female	
	N	%	N	%	N	%	N	%
Retroversion	59	59	69	69	103	80.46875	42	58.33333
Anteversion	41	41	31	31	25	19.53125	30	41.66667
P-value	0.3722				0.0007649			

Table 4: Side And Gender Wise Average Values Of All Morphological Parameters From Our Collected Data.

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