Journal of the Anatomical Society of India 65 (2016) 114–117

Contents lists available at ScienceDirect

Journal of the Anatomical Society of India

journal homepage: www.elsevier.com/locate/jasi

Original Article

Morphometric analysis and surgical anatomy of coracoid process and glenoid cavity

Sunita Kalra [a,*], Swati Thamke [b], Ankit Khandelwal [c], Gitanjali Khorwal [a]

[a] *University College of Medical Sciences & Associated GTB Hospital, Delhi, India*
[b] *Government Medical College, Aurangabad, Maharashtra, India*
[c] *Formerly at University College of Medical Sciences & Associated GTB Hospital, Delhi, India*

ARTICLE INFO

Article history:
Received 18 November 2016
Accepted 7 January 2017
Available online 26 January 2017

Keywords:
Coracoid process
Glenoid cavity
Surgical anatomy
Latarjet procedure

ABSTRACT

Introduction: This study was designed to study the morphometric dimensions of coracoid process and glenoid cavity of scapula and to ascertain any correlation involving them. The comprehension of standard morphometric measurements of coracoid process and glenoid cavity is missing in the academic literature. Its awareness is imperative in trauma cases, surgical interventions and replacement surgeries in the shoulder region.
Methods: For this investigation 69 dry adult scapulae (45 of right side and 24 of left side) of Asian origin without any apparent damage to their osseous structure were studied. The present study demonstrates the analysis of various dimensions of coracoid process and glenoid cavity.
Results: Pearson correlation (*r*-coefficient) was positive for glenoid cavity vertical and horizontal dimensions. The interrelation between all the parameters was highly significant; sig (2-tailed) test was 0 and *p* value as 0.1, an interesting trend.
Discussion: Variation of dimensions of coracoid process and glenoid cavity are important for radiologist and orthopaedic surgeons for diagnosing various pathologies and plan for repair. The data base provided in the present study is not only helpful in the present day scenario, but with advancement of techniques and advent of various replacement procedures, these dimensions can serve as a baseline and potential prospect for coracoid process replacement surgeries in future.

1. Introduction

1.1. Coracoid process

The Gray's anatomy describes the origin of this process from pinnacle of the head of scapula.[1] It bends to some extent anterolaterally. With the arm by the side of the trunk, it points almost straight forwards. Its enlarged tip is conspicuous under the anterior fibres of deltoid. It is palpable approximately 2.5 cm below the clavicle at the junction of medial three fourth and lateral one fourth. There is well marked supraglenoid tubercle near the base of the coracoid process adjacent to the glenoid cavity. On the dorsal surface of coracoid process there is a marking produced due to the attachment of coracoclavicular ligament. The coracoid process is joined to clavicle by the coracoclavicular ligament.[1] The lateral border of coracoid process gives attachment to the coraco-acromial ligament and inferiorly to the coracohumeral ligament. The tip of coracoid provides attachment to coracobrachialis and the short head of biceps brachii muscles.

1.2. Glenoid cavity

The superior angle of scapula is covered by muscles. The lateral angle, truncated and wide-ranging, is the head', bearing the glenoid cavity of scapula and forming a glenohumeral joint with the humerus. Glenoid cavity provides a partial and superficial socket for the head of humerus.[1] Immediately, superior to glenoid cavity there is well marked supraglenoid tubercle close to the root of the coracoid process. The anatomical neck is the constriction adjacent to the boundary of glenoid cavity. The anatomical neck extends between the infraglenoid and supraglenoid tubercles. Surgical neck is described as beginning inferiorly, close to rim of glenoid cavity. It passes supero-laterally through the spinoglenoid notch and continues towards the suprascapular notch, hence medial to the coracoid, and is completed by an identical ill-defined ventral line.[1]

* Corresponding author at: Department of Anatomy, University College of Medical Sciences & Associated GTB Hospital, Delhi, India.
E-mail address: net31aug@yahoo.co.in (S. Kalra).

http://dx.doi.org/10.1016/j.jasi.2017.01.004
0003-2778/

The comprehension of standard morphometric measurements of coracoid process and glenoid cavity is missing in the academic literature. Its awareness is imperative in trauma cases, surgical interventions and replacement surgeries in the shoulder region. Henceforth, this investigation was designed to study the morphometric dimensions of coracoid process and glenoid cavity of scapula and to ascertain any correlation involving them.

2. Materials and methods

For this investigation, 69 scapulae (45 of right side and 24 of left side) available in the Department of Anatomy were studied. All scapulae were dry adult Asian in origin and without any apparent damage to their osseous structure. The measurements were taken manually with vernier callipers accurate to 0.1 mm. Observations were taken by two separate people to rule out any inter observer or intra observer variation (Fig. 1a and b).

The following parameters were measured:

1. Glenoid cavity – maximum vertical and horizontal dimensions.
2. Coracoid process – thickness at the base, total length of horizontal part and medio-lateral/width (M-L) and superio-inferior/thickness (S-I) dimensions of the horizontal part.

Data was tabulated and statistically correlated.

3. Results

The summary of the morphometric parameters measured is listed in Table 1, and statistical analysis in Table 2 and Fig. 2.

Glenoid cavity vertical dimensions (height) were varying from 2.8 mm to 4.3 mm with range of 1.5 mm and mean of 3.409 ± 0.3669 mm.

Horizontal dimensions (width) of glenoid cavity were varying from 1.7 mm to 3.5 mm with range of 1.8 mm and mean of 2.396 ± 0.3220 mm.

Thickness of coracoid process at the base was 0.6 mm to 1.8 mm with range of 1.2 mm and mean of 1.039 ± 0.2302 mm.

Horizontal length of coracoid process was 3 mm to 4.9 mm with range of 1.9 mm and mean of 4.045 ± 0.4434 mm.

Width (M-L) of horizontal part of coracoid process was 0.9 mm to 2 mm with range of 1.1 mm and mean of 1.416 ± 0.2386 mm.

Thickness of horizontal part of coracoid process (S-I) was 0.6 mm to 1.4 mm with range of 0.8 mm and mean of 0.854 ± 0.1705 mm.

The width of glenoid cavity was around 70% of glenoid height. The thickness of horizontal part of coracoid process was approximately 82% of thickness at its base. Also, thickness of horizontal part of coracoid was about 35% of width of glenoid cavity and just 25% of glenoid length. As compared to the length of horizontal part of coracoid process glenoid width was approximately 60% whereas glenoid height was around 85% of it.

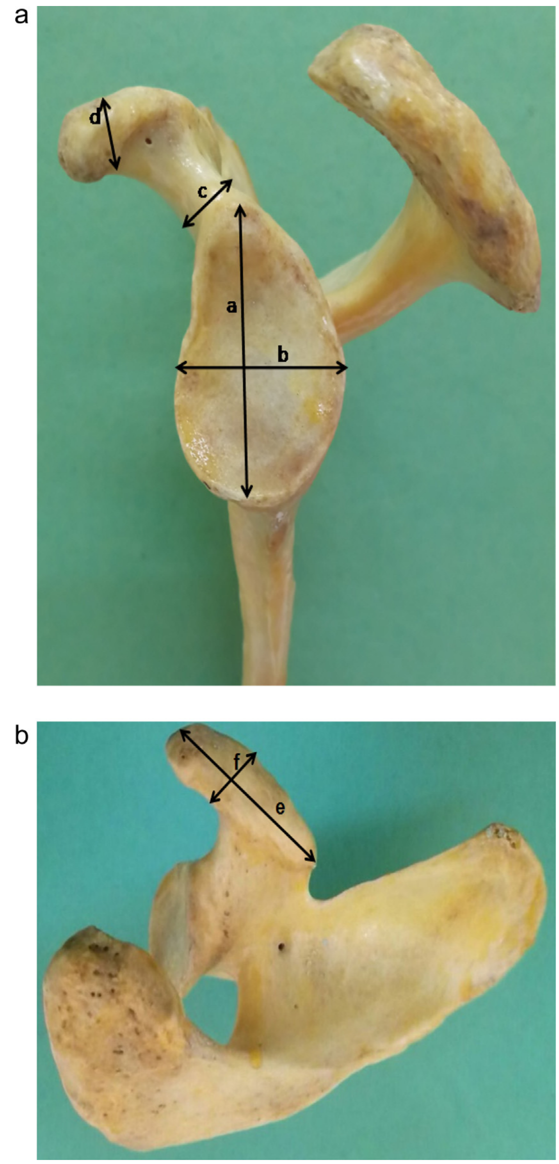

Fig. 1. (a) Lateral view of left scapula showing the dimensions measured of glenoid cavity and coracoid process {glenoid height (*a*), glenoid width (*b*), coracoid process thickness at base (*c*), coracoid process (horizontal part) superior-inferior dimension/thickness (*d*)}. (b) Superior view of left scapula showing the length of coracoid process (*e*), medial-lateral/width (*f*) dimension of horizontal part of coracoid process.

Pearson correlation (*r*-coefficient) was positive for glenoid cavity vertical and horizontal dimensions. The interrelation between all the parameters was highly significant; sig (2-tailed) test was 0 and p value as 0.1, an interesting trend.

Table 1
Morphometric measurements of coracoid process and glenoid cavity.

	Descriptive stats (n = 69)			Mean	Standard deviation	Variance (mm)
	Range	Minimum (mm)	Maximum (mm)			
Glenoid vertical (height)	1.5	2.8	4.3	3.409	0.3669	0.135
Glenoid horizontal (width)	1.8	1.7	3.5	2.396	0.322	0.104
Coracoid thickness (at base)	1.2	0.6	1.8	1.039	0.2302	0.053
Coracoid length	1.9	3	4.9	4.045	0.4434	0.197
Coracoid width (M-L)	1.1	0.9	2	1.416	0.2386	0.057
Coracoid thickness (S-I)	0.8	0.6	1.4	0.854	0.1705	0.029

Table 2
Pearson correlation between dimensions of glenoid cavity and coracoid process.

		Glenoid vertical	Glenoid horizontal	Coracoid thickness	Coracoid length	Coracoid M-L	Coracoid S-I
Glenoid vertical (height)	Pearson correlation	1	0.839	0.647	0.785	0.778	0.631
Glenoid horizontal (width)	Pearson correlation	0.839	1	0.619	0.688	0.629	0.613
Coracoid thickness (at base)	Pearson correlation	0.647	0.619	1	0.606	0.663	0.678
Coracoid length	Pearson correlation	0.785	0.688	0.606	1	0.691	0.584
Coracoid (width) M-L	Pearson correlation	0.778	0.629	0.663	0.691	1	0.599
Coracoid (thickness) S-I	Pearson correlation	0.631	0.613	0.678	0.584	0.599	1

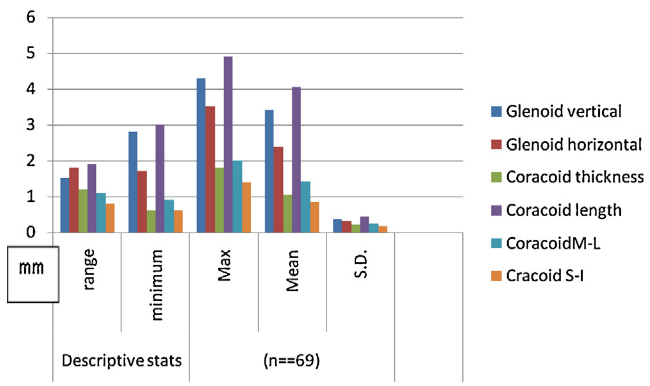

Fig. 2. Bar chart showing various parameters of glenoid cavity and coracoid process (in mm).

4. Discussion

This anatomic study presents the basic morphometric dimensions of the coracoid process and glenoid cavity in 69 dry adult scapulae. The observations in this series also revealed previously unreported anatomic study of these two processes along with correlations among these. The present study demonstrates the analysis of various dimensions of coracoid process and glenoid cavity. Coracoid process is a part of scapula and plays important role in functions of scapula and role of glenoid cavity in structure and functions of shoulder joint is undisputed. Although the dislocation of shoulder joint is a frequent occurrence in adults as well as children, coracoid process injuries though not very common, present a challenge to the operating surgeon to repair.

Fractures of coracoid have been described as sporadic injuries, in the literature.[2–4] However, lately reports about occurrence of coracoid fractures have increased.[5–7] The frequency of fracture of coracoid process has been estimated between 3% and 13% of all fractures involving scapula. These fractures of coracoid include 1% of all fractures reported and 5% of the bony injuries involving shoulder region.[8]

The fractures of the coracoid process involve more commonly the base of the coracoid. Furthermore, fractures occurring in distal parts of coracoid have been reported.[9] The data provided in present study demonstrates the dimensions of this process at base as well as the distal horizontal parts of coracoid and can help in deriving appropriate strategy for repair of these.

It has been observed that there is variable extent of bone loss involving glenoid in shoulder joints with anterior instability.[10] An important surgical method named as the Latarjet operation is inured to treat repeated dislocations of shoulder joint, characteristically caused by fracture of the glenoid or involving loss of bone from glenoid. The procedure is well-known as Latarjet–Bristow procedure.[11] This technique was first described by a French surgeon Dr Michel Latarjet in 1954. This procedure is known to have triple blocking effect, namely, short head of biceps brachii and coracobrachialis acts as a sling on the subscapularis muscle and capsule of shoulder joint, when the arm is abducted and externally rotated; increasing or restoring the glenoid bone; and repair of the capsule to the base of coracoacromial ligament.[11] It involves the removal and repositioning of a segment of the coracoid process and its attached muscles to the anterior aspect of the glenoid cavity. The placement of coracoid to the front of glenoid acts as a bone block which along with the transferred short head of biceps brachi and coracobrachialis substitutes as a support, facilitates to prevent repeated dislocations of the shoulder joint.

It has been estimated that the Latarjet procedure can likely be helpful to prevent recurring anterior instability of shoulder joint in more than 90% of cases.[12] The importance of the morphometric data provided in the current study about coracoid process and glenoid cavity is paramount in view of this Latarjet procedure being preferably used for recurrent shoulder dislocations more so with bone loss involving glenoid. The aetiology of these fractures has been suggested to be mainly associated either with straight trauma, aggressive contraction of the muscles attached to coracoid process or tearing of fibres of coracoclavicular ligaments during an acromioclavicular dislocation.[13,14] In contact athletes and rugby players also the Latarjet operation has also been established to be successful.[15,16]

It has been suggested that "Fractures of the coracoid process can easily be missed and should be kept in mind, particularly in patients with ongoing shoulder pain with no evidence of clavicular fracture".[17] There is existence of ambiguous proposals on management of fractures of coracoid process. Pertinent strategies for management of these can be derived from the morphometric analysis provided in the present study.

5. Conclusions

Variation of dimensions of coracoid process and glenoid cavity are important for radiologists and orthopaedic surgeons for diagnosing various pathologies and plan for repair. There are not many studies to demonstrate the various dimensions of coracoid process, which can help in repair of these. The data base provided in the present study is not only helpful in the present day scenario, but with advancement of techniques and advent of various replacement procedures, these dimensions can serve as a baseline and potential prospect for coracoid process replacement surgeries in future. Significant management protocols can be derived from the database provided in the present study.

Conflicts of interest

The authors have none to declare.

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