Original Article

A study of anatomical basis of Coraco-Acromial arch impingement

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Abstract

This Study Was carried out to study the morphology of Coraco-Acromial arch and to consider the functional implications of the structure of the arch. For this study 100 Dry Scapulae are taken. Out of which 60 scapulae are normal and 40 scapulae showing degenerative changes, Photographs of lateral view of scapulae taken and measurement is done by sliding callipers and semi rigid model wax used to simulate the Coraco-Acromial arch. In this study we found degenerative changes generally limited to the anterior third of the acromion. Spurs were present in 14 scapulae, pseudo articular facets were present in 31 scapulae. all our findings compared with those of previous workers

Key Word: Coraco-Acromial arch, Rotator cuff, Impingement.

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INTRODUCTION

Chronic tendinitis (painful arc syndrome), rotator cuff tears and frozen shoulders are the conditions closely associated with or are the implications of the variations of anatomy of coraco-acromial arch. This is the region of immense interest to the orthopaedic surgeons, as no satisfactory reason is attributed to these lesions.

Coraco-acromial arch impingement

The disorders of rotator cuff tendons have usually been grouped under the diagnostic phrase called Impingement Syndrome (Nevaiser R. J. and Nevaiser T.J. 1990) The space between the arch and the glenohumeral joint is 1 to 1.5 cms. In the middle range of abduction the tendon of supraspinatus one of the rotator cuff muscles impinges on the overlying coraco-acromial arch. The tendon and the subacromial bursa are supposed to be compressed between humerus and the arch. The former is most exposed to injury from friction against the acromion or the coraco-acromial ligament, the outcome of Impingement.

Rotator cuff muscles

The stability of joint is almost entirely dependent on the tone of the short muscles that bind the upper end of the humers to the scapula. These muscles are–supraspinatus, Infraspinatus, teres minor and subscapularis The tendons of these muscles together are collectively referred to as rotator cuff. Which fuse with the underlying capsule to form the musculotendinous cuff. (Snell. R.S.1992)

Function of rotator cuff

Inman *et al* (1944) described the function of rotator cuff. It not only stabilizes the glenohumeral joint, but it also fixes the fulcrum of the upper extremity against which the deltoid can contract and elevate the humerus. The long tendon of biceps and supraspinatus superiorly fix the fulcrum above, preventing inferior subluxation and cause the head to descend in the glenoid cavity on abduction. (Moselay H.F. 1969)

Supraspinatus Muscle

It arises from supraspinatus fossa of the scapula and passes beneath the coraco-acromial arch. It is inserted on the upper facet of the three facets of the greater tuberosity of the humerus. The muscle is separated from the overlying coraco-acromial arch and the deltoid muscle by the subacromial bursa. The broad tendon of supraspintus

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covers the top of the shoulder joint and is attached in part to the capsule of the joint. The tendon has two surfaces (Ellaman H. 1990)

1. An articular surface
2. The bursal surface
3. Blood Supply:- an articular branch of anterior circumflex artery.

Coraco-acromial arch

Directly beneath the origin of deltoid lies coraco-acromial arch. It consist of the acromion process, coraco-acromial ligament (C-A) and coracoid process. The coraco-acromial ligament spans the interval between acromion and the coracoid process. It is a triangular ligament, base attached to lateral border of the coracoid process and apex to the acromion. The ligament is firm and unyielding and it acts as a secondary socket for the head of the humerus, since it lies above the shallow glenoid cavity. The C-A arch with the underlying subacromial bursa and loose areolar tissue provides a gliding mechanism between deep and superficial muscle strata. Traction spurs may develop in the C-A ligament on the acromial side. Thus, it is suggested that because of its anatomical position and its physical rigidity the coraco-acromial ligament becomes a prime etiological factor in chronic impingement syndrome (Sarkar K. *Et al* 1990).The higher incidence of rupture of supraspinatus as compared with other muscle of supraspinatus as compared with other muscles of the cuff may well be due to two factors- (Hollinshead 1969).

1. Attrition against the overlying acromion and
2. The greater functional importance of the supraspinatus muscle. It ordinarily acts in any movement of the humerus being necessary to allow the free play of the arm.

The common conditions met with in orthopaedic practice are

1. Chronic tendinitis (painful arc syndrome)
2. Frozen shoulder (Adhesive Capsulitis)
3. Rotator cuff tears

Tears are common after the age of 40 years and also in young athletes. The causes of rotator cuff tear are (Nevaiser R. J. and Nevaiser T.J. 1990)

A. Anatomical or Mechanical
B. Traumatic
C. Degenerative
D. Vascular

The supraspinatus outlet is narrowed by following factors-

1. By a long hooked acromion
2. By a flat acromion where degree of curvature is decreased.
3. By decrease in the height of coracoid process.
4. By the cephalic migration of supra-glenoid tubercle.
5. By the inferior lipping of acromioclavicular joint.

MATERIAL AND METHOD

For, present study,100 adult dry scapule of unknown sex were obtained from the Anatomy departments of Government Medical College, Miraj , Vasantdada patil Dental college , sangli and Ayurvedic Medical college Sangli. Scapulae showing gross pathological deformity were excluded. The scapulae were divided into two sets.

1. One set comprising of normal scapulae.
2. The second set comprising of scapulae showing degenerative changes. The characteristic feature of this set were presence of spurs also called osteophytes and facets on the under surface of acromion (Edelson J.G. and Taitz. C. 1992).

Photograph of the lateral view of each scapula was taken showing glenoid cavity, acromion and coracoids process.

The acromions were classified depending on their shape as viewed from superior surface as (Edelson J.G. and Taitz C.1992).

I. Cobra shape
II. Square tipped
III. Intermediate shape

The following measurements in millimetres and degrees were taken both on dry scapulae and on photographs. The instruments and material used were sliding callipers, semi-rigid model wax which simulated the coraco-acromial ligament.

Measurement taken on dry scapulae were as follows

1. **Acromion- distance- (ad)-**
   The coraco-acromial ligament (C-A ligament) was simulated by a triangular insert of semi-rigid model wax. Then a point was marked on the wax insert, vertically against the tip of supra-glenoid tubercle. The distance is taken between this point and the tip of the supra-glenoid tubercle.
2. **Height of coracoids (c)-**
   It is the vertical distance between the tip of the supra-glenoid tubercle and a point at the junction of coracoid process with its horizontal part.

Figure a **Figure a** **Figure b** **Figure c**

Legend

Figure aand a: Cobra shaped; **Figure b:** Square tipped; **Figure c:** Intermediate

OBSERVATIONS

The observations regarding acromion, coracoid process in 100 adult dry scapulae, of which 60 scapulae were normal and 40 scapulae showed degenerative changes, are presented below Acromion-Degenerative changes were generally limited to the anterior third of the acromion. The middle and posterior areas were usually uninvolved. Spurs (osteophytes) were present in 14 scapulae and pseudo articular facet was present in 31 scapulae showing degenerative changes.

Table1: Length, Width and Thickness of acromion in millimetres

		No. of Scapulae	Range	Mean	S.D	P-Value
Length	N	60	33-57	42.86	4.9	≤ 0.05
	D	40	33-57	46.05	6.02	
Width	N	60	21-33	26.76	3.9	≥ 0.05
	D	40	20-34	26.5	6.6	
Thickness	N	60	5-10	7.5	1.3	≥ 0.05
	D	40	5-10	7.7	1.2	

N=Normal scapulae

D= Scapulae showing degenerative changes

It shows correlation between length and degeneration, which was statistically significant. Length depends upon the shape of the acromion. The longest specimens were cobra-shaped, shortest were square-tipped and the intermediate specimens between the two. All scapulae having length of acromion more than 51 mm showed degenerative changes. Such observation was found in 10 scapulae.

DISCUSSION

The coraco-acromial arch overhangs the shoulder joint. It prevents upward displacement of the head of the humerus during abduction. Acromion being placed in a unique position, provides a space for the attachement of muscle deltoid which can act as an abductor and its position helps to stabilize the humerus in overhead abduction. otherwise the arch is not directly involved in the movements of the shoulder joint. Like deltoid, rotator cuff muscles and head of humerus are closely related to the coraco-acromial arch. Hence, close relation of the arch can be a cause of pathological lesions of the soft tissues of and around the actively working shoulder joint. Variations in the structure, position of components of the arch can become a causative factor. These variations in structure of the arch and position of the components of the arch are those which occur in the length, width, thickness of the acromion, height of coraco-acromial arch, height of the coracoids process with the reference plane of the glenoid cavity.

Acromion

According to the above table it is clear that length has significant role in the causation of degenerative changes. The greater tuberosity of humerus with supraspinatus tendon can impinge on the acromion. Increase in the length of acromion would provide more bony cover and further facilitate impingement. Impingement further enhances degeneration Length is in turn related to the shape of the acromion. The longest specimens were cobra–shaped with a mean length of 47mm. These constituted 24% of specimens of which 50% showed degenerative changes. The shortest specimens were square tipped with a mean length of 43mm. They constituted about 27% of total specimens. of which 37% showed degenerative changes. The remaining were of intermediate type with a mean length of 45mm. They constituted about 50% of total scapulae, of which 36% showed degenerative changes. Incidence of scapulae showing degenerative changes is almost the same in square tipped and intermediate type of scapulae. This indicates that both almost equally influence the process of degeneration. Similar observations were made by Edelson J. G. and Taitz C. (1992) after studying 200 Scapulae.

Table 2: This table showing length of acromion of different shape in the study of Edelson J. G. and Taitz C. (1992) series and present study

Shape of the acromion		Range	Mean length
Cobra	Edelson J. G. and Taitz series	50-77.5mm	62mm
	Present series	36-57mm	47mm
Square tipped	Edelson J. G. and Taitz series	45-62.5mm	52mm
	Present series	33-50mm	43mm
Intermediate	Edelson J. G. and Taitz series	50-72.5mm	58mm
	Present series	39-55mm	45mm

Table I also shows considerable variations in thickness and width of the acromion. Neither of them appeared to correlate with degenerative changes and hence no influence on degeneration. This is parallel with the inference draw by Edelson J. G. And Taitz C.(1992) and Wuh Snyder (1992).

coraco-acromial arch

Present study revealed no correlation between height of C-A arch and degeneration.

The height of coracoid process

Present study revealed no correlation was found between the height of coracoid process and degenerative changes.

SUMMARY AND CONCLUSION

In the present work, attempt has been made to study the anatomical role of coraco-acromial arch as mechanical causative factor in coraco-acromial impingement syndrome, leading to rotator cuff tears. For this, 100 dry adult scapulae were collected and divided into two groups. One group consisted of normal scapulae and another of those showing degenerative changes, like presence of osteophytes and psuedoarticular facets on acromion and coracoids process. There were 60 normal scapulae and 40 scapulae showing degenerative changes. All these scapulae were subjected to different measurements like length, thickness of acromion, the coraco-acromial arch distance, height of coracoid process. All scapulae were further classified depending on shape of the acromion, like cobra, square and intermediate types. Statistical analysis was done to find any correlation between these parameters and degenerative changes. It was found that length of acromion showed correlation with degenerative changes. It indicated that acromion acts as a mechanical factor causing coraco-acromial impingement. The significant observation was 50% of cobra type scapulae showed degenerative changes. Other parameters had no association with degenerative changes leaving scope for consideration of other factors as vascular, degenerative and traumatic. All these observations were compared with those of other workers especially Edelson J.G. and Taitz C; (1992).These results may from the rationale to modify the previously performed acromionectomy for the subacromial decompression resulting in unnecessary loss of a major part of deltoid. Depending on similar observation Neer C.S. II (1990) suggested anterior acromioplasty to decompress the supraspinatus outlet. In conclusion, acromion acts as a mechanical factor to cause rotator cuff tear.

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