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Original Research Article

MORPHOLOGICAL VARIATIONS OF THE CORACO-ACROMIAL LIGAMENT: A CADAVERIC STUDY

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ABSTRACT

Introduction: The coraco-acromial ligament forms coraco-acromial arch along with acromion and coracoid process of scapula which prevent the superior humeral head displacement. It plays a key role in the patho-etiology of sub-acromial impingement syndrome when there are no significant bony abnormalities.

Material and Methods: In the present study we have studied 120 formalin preserved upper limbs (right: 60; left: 60) of unknown age and sex. Each shoulder was dissected carefully to see coraco-acromial ligament. The CAL was identified with careful blunt dissection to prevent overlooking any thinner bands. We observed the number of bands present and shape of the ligament. Photographs were taken.

Results: Different morphological subtypes of coraco-acromial ligament were observed and classified according to Kesmezacar et al. Type II (28.33 %) was the most common then type I (25 %), type IV (17.5 %), type V (15 %), type III (11.66%). Anterolateral band of ligament extended antero-laterally to form coracoacromial falx in 51%.

Discussion: Coraco-acromial ligament shows different morphological variations in Indian population. Knowledge of morphological variations of coraco-acromial ligament will be helpful for orthopedic surgeon for clinical and intraoperative decision while dealing with sub-acromial impingement syndrome.

KEY WORDS: Coraco-Acromial Ligament, Sub-Acromial Impingement Syndrome, Acromion, Coracoid, Coraco-Acromial Arch, Morphology.

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INTRODUCTION

The coraco-acromial ligament (CAL) forms an osseo-ligamentous (coraco-acromial) arch along with acromion and coracoid process of scapula which prevent the superior humeral head displacement from the glenoid cavity [1,2]. CAL is the central part of the coracoacromial arch and it is an anatomical site of stenosis. Recurrent contact between CAL and rotator cuff may lead to degenerative changes in this structure [3]. CAL plays a key role in the patho-etiology of sub-acromial impingement syndrome when there are no significant bony abnormalities present in patient [4]. Morphological variations of CAL may be the cause of sub-acromial impingement syndrome or the result of impingement [5]. CAL may become thicker, developed calcified enthesopathy and undergo microscopic changes

in chronic impingement syndrome [4,6,7]. Numerous studies have discussed the role of acromion and CAL in rotator cuff tear and impingement syndrome. But, only few articles are available regarding the morphology of the CAL especially in Indian population. This ligament shows variable morphology and it plays a significant role in the development of sub-acromial impingement syndrome. Considering the clinical importance of morphology of CAL we worked on this topic.

MATERIALS AND METHODS

One hundred and twenty formalin preserved upper limbs (right: 60; left: 60) of unknown age and sex were used for present study. Each shoulder was dissected through an antero-superior incision followed by total detachment of the deltoid muscle from the clavicle and scapula. The CAL was identified with careful blunt dissection to prevent overlooking any thinner bands. We observed the number of bands present and shape of the ligament. Photographs were taken.

RESULTS

In the present study we observed three main types of CAL: undivided, bipartite and multiple banded (Table 1). We further classified them into five morphological subtypes according to Kesmezacar et al. (2008) [8]. We also observed triangular shaped CAL described in anatomy textbooks. Thus six different morphological subtypes of CAL were observed in the present study (Table 2).

Following are the five different types of CAL according to Kesmezacar et al. (2008) [8].

Type I: 'Y'-shaped ligament- Single band at acromion but truncated into 2 separate bands before its insertion onto coracoid. A thin membranous tissue may or may not be present between the separate bands. (Fig.1)

Type II: Broad banded ligament- Single band with almost equal widths of attachment at coracoid and acromion. (Fig. 2)

Type III: Quadrangular- Single band as in the broad band type, but the width of the attachment to the coracoid is 1.5 times more than acromial attachments. Lateral and medial borders of the ligament were curved slightly rather than straight. (Fig.3)

Type IV: 'V' shaped- Acromial attachment starts as a single band then it divides into two completely separate bands as it reach coracoid. (Fig. 4)

Type V: Multiple-banded- More than two bands are present. (Fig.5)

Type VI: Triangular type- The tip of ligament is attached to the acromion and broader base is attached to coracoid process. (Fig.6)

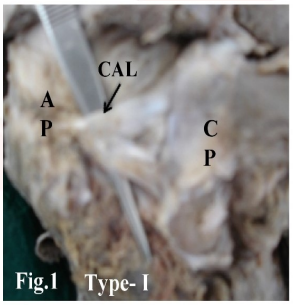
We observed two distinct bands which are anterolateral band and postero-lateral band (Fig. 1, 4). Anterolateral band extended antero-laterally to form coraco-acromial falx (Fig.7) in 51 % of upper limb specimen.

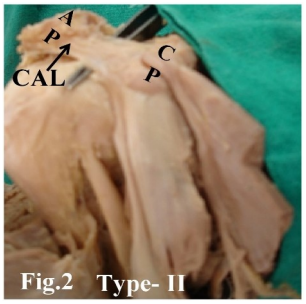
Fig. 1: Y'-shaped (bipartite) coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process

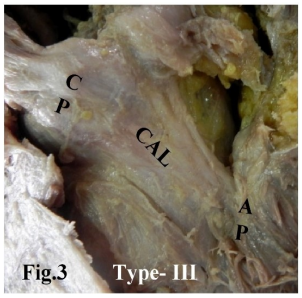
Fig. 2: Broad banded (Undivided) coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process

Fig. 3: Quadrangular (Undivided) coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process

Fig. 4: 'V' shaped (bipartite) coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process







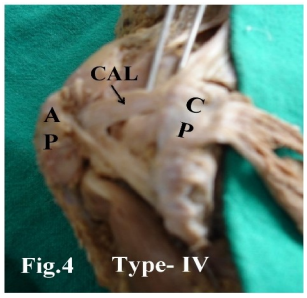


Fig. 5: Multiple-banded coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process

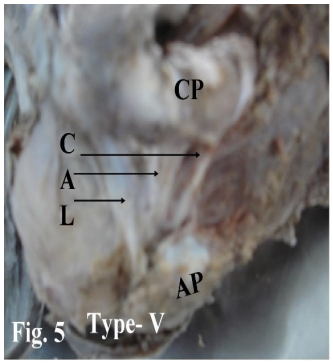


Fig. 6: Triangular type (Undivided) coraco-acromial ligament (CAL) AP- Acromion process, CP- Coracoid process

Fig. 7: Showing coraco-acromial falx (CAF): black arrows AP- Acromion process, CP- Coracoid process, CT- Conjoint tendon of short head of bicep brachii and coracobrachialis muscles

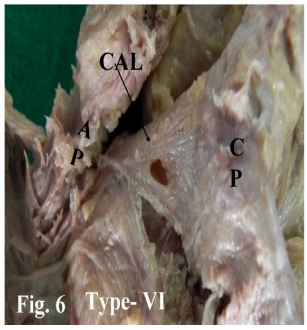


Fig. 6 Type- VI

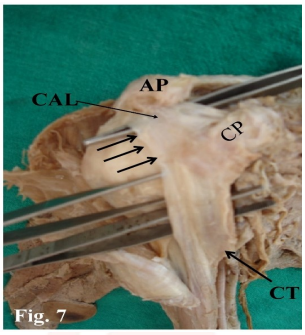


Fig. 7

Table 1: Showing number and percentage of three main types of Coraco-acromial ligament.

Type	Number (n=120)	Percentage
Undivided	51	42.5
Bipartite	51	42.5
Multiple-banded	18	15

Table 2: Showing number and percentage of morphological sub- types of Coraco-acromial ligament.

Type	Number (n=Rt:60; Lt: 60)		Total (n=120)	Total Percentage
	Right	Left		
I	16	14	30	25
II	16	18	34	28.33
III	7	7	14	11.66
IV	10	11	21	17.5
V	9	9	18	15
VI	2	1	3	2.5

Table 3: Showing percentage of different types of coraco-acromial ligament reported in literature

Author	Type I	Type II	Type III	Type IV	Type V	Type VI
	Bipartite	Undivided		Bipartite	Multiple banded	Triangular
Fealy et al. (2005) [7]	7.5	7.5	-	-	7.5	3
Kesmezacar et al. (2008) [8]	41.3	22.5	-	13.8	11.2	11.2
Pieper et al. (1997) [11]	59.7	25.8	-	-	14.5	-
Holt & Allibone (1995) [16]	21	8	48	21	2	-
Salter et al. (1987) [17]	100	-	-	-	-	-
Gagey et al. (1993) [18]	100	-	-	-	-	-
Alraddadi et al. (2017) [20]	38	6	10	-	46	-
Present study (2018)	25	28.33	11.66	17.5	15	2.5

DISCUSSION

The coraco-acromial ligament is a strong fibrous band which is a ligamentous component of coraco-acromial arch that forms part of roof of the glenohumeral joint [2, 4, 7]. This ligament may have two distinct bands which are classified anatomically into anterolateral and postero-medial bands [2, 9]. Most of the researchers along with us observed these two bands of CAL [7, 10, 11, 12]. Lateral fibers of the CAL blends with fibers of the conjoined tendon of the short head of the biceps and coracobrachialis to form coraco-acromial falx [7, 13, 14]. Our observations are similar to these researchers. CAL is one of the contributing factors in the pathophysiology of pain associated with painful rotator cuff or external impingement syndrome which was first described by Neer (1972) [3]. Literature describes variety of CAL types. Kesmezacar et al. (2008) described five types of CAL [8] and we observed all these types in the present study. Additionally we observed typical triangular CAL which was described in textbooks of anatomy [2]. Johnson (1997) observed that when arthroscope is inserted into the subacromial bursa, it is clearly seen that CAL is attached to under surface of acromion [15]. Present study reported the same observation regarding the attachment of CAL. (Fig. 5, 6)

Kopuz et al. (2002) studied the anatomic variations of CAL in neonatal cadavers and described three types of CAL undivided, bipartite, and multiple banded [5]. Holt and Allibone (1995) found three main patterns of CAL: quadrangular, Y-shaped, and broad band but they noted multiple-banded ligament in only one shoulder [16]. Salter et al. (1987) [17] and Gagey et al. (1993) [18] observed only a Y-shaped type of ligament in all the specimen they studied. We observed six different types of CAL in the present study. Many researchers agree that CAL shows significant morphological variation and differences in the distribution pattern may exist because of number of specimen used for study, age, race, and developmental factors. Variation in prevalence of CAL morphology is shown in

Table: 3. Moon et al. (2017) reported a case of ossified CAL in subacromial impingement syndrome [19]. According to them ligament ossification is because of degenerative changes due to trauma and repeated stress.

When CAL had multiple bands, its medial part was not easily visible during dissection and there are chances to miss this part of CAL during surgery especially arthroscopy which could be the cause for persisting sub acromial pain postoperatively [11]. A variation in morphology of CAL is one of the contributing factors in the patho-physiology of subacromial impingement syndrome [5,20]. It is clear that the variations of the acromion and the coraco-acromial ligament are important since, in turn, they can lead to the impingement syndrome. Prolonged impingement syndrome leads to a serious restriction of movements and eventually to osteoarthritis of the shoulder joint. Therefore, in these patient, presence of variation of CAL should be kept in mind as a reason.

CONCLUSION

Present study reported six different patterns of CAL in Indian population which may be helpful for orthopedic surgeon for clinical and intraoperative decision while dealing with sub-acromial impingement syndrome.

ABBREVIATIONS

CAL - Coraco-acromial ligament

Conflicts of Interests: None

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