

Anatomical Variations in the Labral Attachment of the Long Head of Biceps Brachii

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Abstract: The proximal attachment of the long head of biceps brachii was studied in 61 formalin preserved joints to see the extent of its attachment to the labrum glenoidale. In all specimens, the biceps tendon was found to be attached to the supraglenoid tubercle as well as to the labrum glenoidale. In 67% of specimens, the major part of the tendon was attached to the posterior part of the labrum while in 33%, it was seen in the anterior part as well. Further study of the labrum showed that the posterior labral attachment extended up to the lower part where as the anterior attachment was limited to the upper & middle part only. The awareness of the posterior attachment till the lowest part of labrum glenoidale might help the clinicians in planning their surgical procedures. It might be of immense clinical interest in sports medicine.

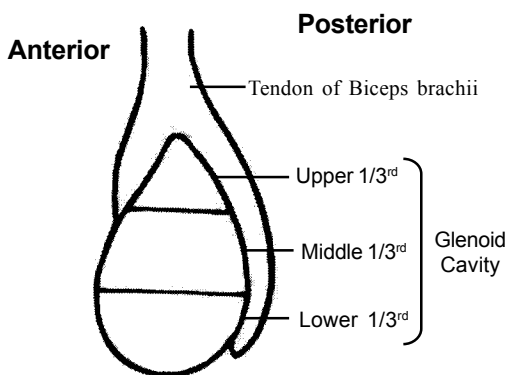
Key words : labrum glenoidale, biceps brachii, labral attachment.

Introduction:

The tendon of the long head of Biceps brachii muscle has been described in most anatomical texts as taking origin from the supraglenoid tubercle Hollinshead (1958), Woodburne (1961), Hamilton (1978), Snell (1981), Habermeyer (1987), Prodromas et al (1990), Rockwood & Matsen (1990). Other studies have however shown its additional attachment to labrum glenoidale Gardner et al (1975) Williams & Warwick (1980) Romanes (1981) Last (1984) Pal et al (1991) Cooper et al (1992). The purpose of the present study was to define the extent of the labral attachment of the tendon of biceps brachii.

Material and Method:

The specimens for the present study consisted of 61 shoulder joints of adult humans of both sexes. The joint cavity was exposed by making an incision in the anterior part of the capsule of the joint. The long head of biceps was dissected and its attachment studied. The glenoid cavity was divided into upper, middle & lower parts to see the extent of the attachment of the tendon to the labrum glenoidale as illustrated below.



Labral attachment of Biceps brachii Tendon

Observations & Results:

The biceps tendon was seen to arise from the supraglenoid tubercle which extended onto the labrum glenoidale (both anteriorly & posteriorly) in all the specimens, although the extent of this labral attachment varied (Fig.1). An anterior labral attachment was observed

in 33% specimens while a posterior labral attachment was seen in 100% of the shoulder joints studied. Isolated posterior labral attachment was seen in 67% specimens (Fig.2). None of the specimens showed isolated anterior labral attachment. The anterior and posterior labral margins were examined to see how far the attachment extended i.e., upper, middle or lower third. The results are summarized in Table-I. To the best of our knowledge the extension of attachment up to lower third of posterior glenoid labrum has not been reported earlier. In 30% of specimens, the labrum glenoidale was complete and firmly adherent to the margin of the glenoid cavity. Many specimens showed a gap between the tendon and glenoid cavity where the labrum itself was deficient.

Table-I:

Percentage distribution of attachment of biceps brachii to different parts of labrum glenoidale.

Labral attachment	Upper third	Middle third	Lower third
Anterior	27%	6%	0%
Posterior	22%	46%	32%

The present study revealed that the tendon of long head of biceps brachii has a dual attachment to the supraglenoid tubercle as well as labrum glenoidale which conforms with the arthroscopic analyses of Bankart (1980), Detrisac & Johnson (1986), Pal et al (1991) and Cooper et al (1992).

Anatomical variations in the labral attachment of the biceps tendon help us to explain the association of recurrent shoulder dislocation & labral detachment. This aids interpretation of biomechanical electromyographic (EMG) data showing maximum activity of long tendon of biceps in the late phase of throwing when the shoulder is abducted & externally rotated, Gowan et al (1987) and record of a higher, biceps activity in pitchers with known anterior instability Glousman et al (1988), wherein the biceps force has been shown to increase the torsional rigidity of the glenohumeral joint by 32%, Rodosky et al (1994).

Many specimens showed a deficient glenoid labrum and presence of a gap between the tendon and the

glenoid cavity posterosuperiorly, which corroborates the findings of Pal et al (1991). Observations on dry, macerated scapulae done by the author, Paul et al (1988) revealed the presence of a small crescentic facet on the posterosuperior margin of the glenoid cavity in 70% cases which corresponds well with the percentage showing a deficient labrum.

The biceps tendon courses over the head of the humerus to continue with the labrum, thus helping to retain the head in the glenoid fossa and assisting the "rotator cuff". Our study has demonstrated that in 32% of specimens the posterior labral attachment of the tendon extended up to the lower third of the glenoid cavity (Fig.3), a finding which has not been reported earlier. This extensive attachment in the posterior glenoidal labrum is expected to provide a better stability to the shoulder .

Boyd & Sisk (1972) have made surgical use of this labral attachment in patients with detached posterior labrum by combining an operative posterior capsulorrhaphy with a transfer of tendon of long head around the neck of the humerus and across the posterior capsule to be re-attached to the posterior scapular neck. The tendon may be elongated by as much as 1 cm. to achieve this procedure due to the presence of its labral attachment.

The present study has successfully accomplished its purpose of demonstrating the variability of the labral attachment and has shown that this attachment has a strong posterior orientation, which is comparable with the findings of Vangsness et al (1994). In all specimens, the tendon extended posteriorly, mostly up to the middle third of the posterior glenoidal margin.

In 33% it was attached to the anterior part as well but limited in most cases to the upper third only (Fig.4). None of the specimens showed isolated anterior attachment. An understanding of the labral attachment of the long tendon of biceps brachii plays an important role in evaluation and surgical correction of labral pathology.

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ORIGINAL ARTICLE

VARIATIONS OF ORIGIN OF LONG HEAD OF BICEPS BRACHII MUSCLE FROM GLENOID LABRUM OF SCAPULA

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ABSTRACT

Introduction: The origin of the long head of the biceps brachii tendon in the majority of literature is not same. The relationships of the tendon with the glenoid labrum of the scapula also vary.

Methodology: Dissection of 50 shoulder joints of adult human cadavers of both sexes done. The joint cavity was exposed by making an incision in the posterior part of the capsule of the joint to see the extent of its attachment on glenoid labrum.

Results: In all specimens, the biceps tendon was found to be attached to the supraglenoid tubercle as well as to the glenoid labrum. In 74% of specimens, the major part of the tendon was attached to the posterior aspect of the labrum while in 26% it was seen in the anterior aspect as well. The posterior labral attachment extended up to the lower part whereas the anterior attachment was limited to the upper part only. On the basis of the biceps attachment to the anterior or posterior labrum, we categorized them into three types of origin. **Conclusion:** The awareness of these normal anatomical variations are significant for arthroscopic diagnosis and may help to explain the various patterns of injury seen in partial or complete detachment of the tendon, the labrum or both.

Key words: glenoid labrum, biceps brachii, anterior labrum, posterior labrum.

INTRODUCTION

The descriptions of the origin of the long head of the biceps brachii tendon in the majority of textbooks and in anatomical works show disagreements, in special, as the relationships of the tendon with the glenoid labrum of the scapula. Anatomical variations of the glenoid bicipital/ labrum complex and the continuity of the superior labrum with the tendon have been described¹. The tendon of the long head of biceps is usually described as arising from the supraglenoid tubercle of the scapula²⁻⁸ but later on studies have shown a dual attachment to the superior glenoid labrum as well as the supraglenoid tubercle⁹⁻¹².

Arthroscopy studies have admitted that the long head of biceps brachii plays an important role in the properly functioning shoulder and in the pathologic mechanism of action in the superior insertion of the glenoid labrum¹³. In arthroscopic examinations, the assessment of the origin of the long head at the supraglenoid tubercle or labrum is important¹. Snyder *et al.*¹⁴ was who first described the SLAP (superior labial, anterior and posterior) lesions. That may be detected if the stability of the biceps/labrum complex is compromised or if the biceps and labrum are frayed. Our objective of

this study is to characterize the anatomical origin of the long head of biceps brachii in humans especially on the glenoid labrum of the scapula.

MATERIAL AND METHOD

We dissected 50 shoulder joints of adult human cadavers of both sexes belonging to the Department of Anatomy, Government Medical College, Surat. The joint cavity was exposed by making an incision in the posterior part of the capsule of the joint. The origin of long head of biceps was dissected and its attachment studied. The glenoid cavity was divided into upper & lower parts to see the extent of the attachment of the tendon to the glenoid labrum i.e. the anterior labrum, and the posterior labrum. We come across three types of attachment:

- I. All the labral part of the attachment was to the posterior labrum.
- II. Most was to the posterior labrum, but with a small extension from the anterior labrum.
- III. Equal contributions to anterior and posterior labrum.

OBSERVATIONS

The long head of biceps tendon was seen to arise from both the supraglenoid tubercle and the glenoid labrum in all the specimens. We found that the origin of long head of biceps is from posterior labrum margin in 100% specimens and in 74% specimens it was arising only from posterior labrum margin (Fig. 1).

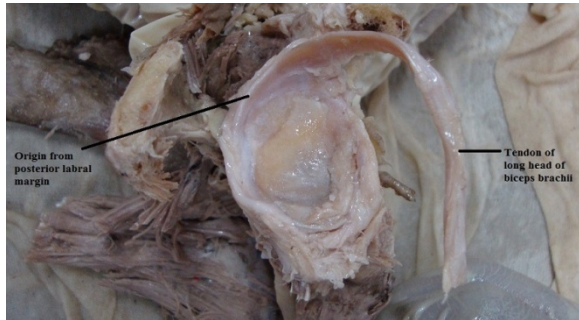


Fig. 1 All the labral part of the attachment was to the posterior labrum

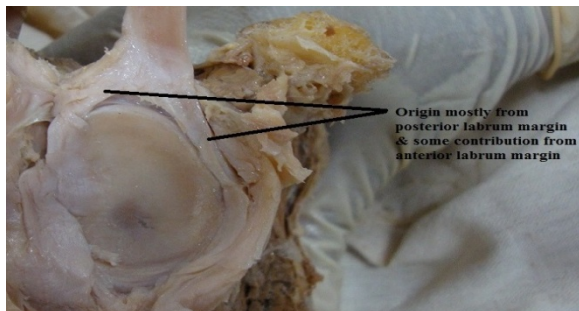


Fig. 2: Most was to the posterior labrum, but with a small extension from the anterior labrum

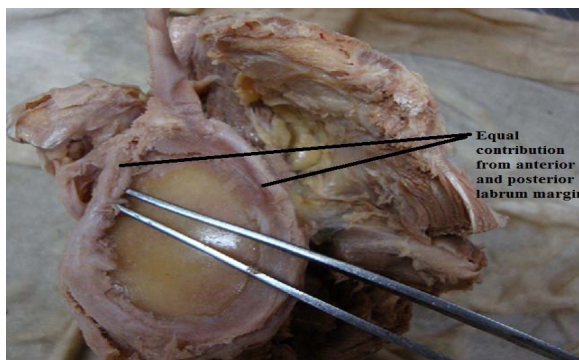


Fig 3: Equal contributions to anterior and posterior labrum

While in 26% specimens it has dual origin from anterior and posterior labral margin. In 20% specimens it arises mostly from posterior labrum and some contribution from anterior labrum (Fig. 2). While in 6% there is equal contribution from anterior and posterior labrum (Fig. 3).

Table 1: Specimens (percentage/frequency) showing origin of long head of biceps from anterior and posterior margin

Origin from labral margin	Specimens(%)
Only from posterior margin (type 1)	37 (74)
Most from posterior labrum & some contribution from anterior labrum (type 2)	10 (20)
Equal contribution in origin from anterior and posterior labrum (type 3)	3 (6)

The anterior and posterior labral margins were examined to see how far the attachment extended i.e., upper or lower half. In 30% specimen long head arises from upper half of anterior labral margin (Fig. 3). 60% specimen shows origin of long head from upper half of posterior labral margin (Fig. 1) while in 40% it arises from lower half of posterior labral margin (Fig. 4)

Table 2: Percentage distribution of origin of biceps brachii from glenoid labrum

Origin from glenoid labrum	Upper half	Lower half
Anterior labral margin	30% (15)	0% (0)
Posterior labral margin	60% (30)	40% (20)

DISCUSSION

The origin of the long head of the biceps from the supraglenoid tubercle ^{5,10,15} is described in standard texts, but shoulder arthroscopy has revealed all or part of the superior labrum is avulsed from the glenoid, along with the origin of the long head of the biceps during operative procedures.

Anatomical variations in the labral attachment of the biceps tendon help us to explain the association of recurrent shoulder dislocation & labral detachment. The biceps tendon courses over the head of the humerus to continue with the labrum. Thus helping to retain the head in the glenoid fossa and assisting the “rotator cuff”. Our study has demonstrated that in 40% of specimens the posterior labral attachment of the tendon extended up to the lower half of the glenoid cavity. This extensive attachment in the posterior glenoidal labrum is expected to provide a better stability to the shoulder.

Boyd & Sisk ¹⁶ have made surgical use of this labral attachment in patients with detached posterior labrum by combining an operative posterior capsulorrhaphy with a transfer of tendon of long head around the neck of the humerus and across the posterior capsule to be re-attached to the posterior scapular neck. The tendon may be elongated by as much as 1 cm. to achieve this procedure due to the presence of its labral attachment.

In our study we also found that in 30% long head of biceps was attached to the anterior part as well but limited in all cases to the upper half only. None of the specimens showed isolated anterior attachment.

Interpretation of biomechanical electromyography (EMG) data showing maximum activity of long tendon of biceps in the late phase of throwing when the shoulder is abducted & externally rotated¹⁷ and record of a higher, biceps activity in pitchers with known anterior instability¹⁸, wherein the biceps force has been shown to increase the torsional rigidity of the glenohumeral joint by 32%¹⁹. The long head of the biceps may also play a protective role by diminishing the stress placed on the inferior glenohumeral ligament. These studies suggest that the biceps tendon has an active role in anterior shoulder stability.

Shoulder instability in baseball pitchers may be related to the forceful contraction of the injured biceps tendon during the deceleration phase of throwing¹³. Bankart (1938)²⁰ described labral detachment in association with recurrent shoulder dislocation. The term 'SLAP lesion' (superior labrum-anterior to posterior)¹⁴ is used to describe and grade injuries in which biceps tendon, and labrum showed intermingling of the fibres of the biceps with those of the labrum in addition to their definite attachment to the supraglenoid tubercle.

CONCLUSION

Anatomical variations in the labral attachment of the biceps tendon help us to explain the association of recurrent shoulder dislocation & labral detachment. An understanding of variations is essential in evaluating and treating labral pathology in throwing athletes. Recognizing abnormalities of the biceps tendon is important because they are a common source of shoulder pain both alone and in combination with abnormalities of the rotator cuff, labrum and other structures. As incomplete/ wrong diagnosis can lead to treatment failure, it is important to recognize this entity which can aid the surgeon in focusing the treatment on the actual pathology. Hence, knowledge of the existence of this anatomic variant is necessary to avoid errors in shoulder arthroscopy, surgery and evaluation of MRI scans.

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The glenoid labrum

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ABSTRACT

The glenoid labrum is a critical structure within the gleno-humeral joint and commonly requires treatment by the shoulder surgeon. This review presents a concise summary of the embryology, anatomy, microscopy, biomechanical properties and clinical lesions involving the glenoid labrum. This knowledge will aid the clinician in understanding its function and pathology.

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Conflicts of Interest

None declared

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INTRODUCTION

The improvement in clinical imaging and the continual development of shoulder arthroscopy has allowed clinicians to diagnose and treat more subtle pathologies of the glenohumeral joint. Specifically, injuries to the labrum have been more recognized during this period as a source of symptoms and the optimal treatment of these lesions is evolving at a rapid pace. This review presents the current knowledge of the glenoid labrum.

EMBRYOLOGY

Synovial joints develop by the formation of a primitive anlage composed of the cartilaginous precursors to the individual bones, with a transverse band of flattened cells (interzone) separating these two sides of the joint. For the shoulder, the interzone within the anlage appears at 11 mm to 12 mm (crown–rump length (CRL) (6 weeks) with a vascular periphery, whereas the centre remains avascular and begins to cavitate at approximately 22 mm CRL (8 weeks) [1]. The dehiscence of the two sides is said to be complete by 34 mm CRL (9 weeks) [2]. The fibrous capsule is evident at 16 mm CRL (7 weeks) [2] and the anlage of the labrum by 17 mm CRL (7 weeks) [1]. By 21 mm CRL (8 weeks), the labrum can be seen to be deficient in the region deep to the coracoid process; in the rest of the circumference, a few collagenous strands start to appear. At 27 mm CRL (8.5 weeks), the labrum is more pronounced posteriorly than anteriorly. At this stage, it has been postulated that the anterior labrum deep to the subscapularis tendon has been formed from the synovial mesenchyme, as apposed to the labral anlage, because it does not join the cartilage of the glenoid [1].

More recent work [3] has specifically looked at the progression of the labrum and other intra-articular structures from 9 weeks

gestation onwards. At 9 weeks (30 mm CRL), the glenoid labrum and biceps tendon can be visualized, with the biceps tendon inserting into the superior aspect of the labrum. At this stage, the glenoid fossa and humeral head are poorly developed. Microscopic assessment shows the labrum as a primitive fibrous condensation on the margin of the glenoid fossa, with intermingling of both the biceps and triceps tendons. A fibrocartilagenous transition zone can be seen between the fibrous labrum and the hyaline articular cartilage.

By 12 weeks (60 mm CRL), the fossa has become pear-shaped with increasing concavity. The humeral head is now a hemisphere and the surgical neck can be identified. The labrum has thickened, except in the anterosuperior part, where it appears meniscus-like. The superior, middle and inferior glenohumeral ligaments are beginning to appear as thickenings in the joint capsule.

At 16 weeks (120 mm CRL), the labrum has thickened again, the biceps appears as an extension of the superior labrum and the inferior ligament has a wide attachment to the anterior and inferior part of the labrum. Microscopically, at 16 weeks, the superior labrum has become more fibrous and vascular, whereas the posterior labrum appears more fibrocellular.

By 23 weeks (198 mm CRL), all the intra-articular structures had taken on the form that is seen in the adult shoulder, except the biceps tendon, which still appeared cord shaped. The posterior labrum is now more fibrocartilagenous and the whole of the labrum is more vascular.

At full term (40 weeks and 370 mm CRL), the labrum forms a well defined ring, deepening the concavity of the glenoid fossa. However, the thickness is still less anteriorly. The posterior labrum has become hypercellular with groups of chondrocytes,