THE ORIGIN OF THE LONG HEAD OF THE BICEPS FROM THE SCAPULA AND GLENOID LABRUM

AN ANATOMICAL STUDY OF 100 SHOULDERS

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We dissected 105 cadaveric shoulders to study the origin of the tendon of the long head of biceps, and examined histologically the interrelationship between the tendon, the supraglenoid tubercle and the superior labrum of the glenoid.

In all specimens approximately 50% of the biceps tendon arose directly from the superior glenoid labrum with the remainder attached to the supraglenoid tubercle. The main labral origin was from the posterior labrum in more than half of the specimens, and in a quarter this was the only labral attachment. On the basis of the biceps attachment to the anterior or posterior labrum, we distinguished four types of origin.

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.

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The tendon of the long head of biceps is usually described as arising from the supraglenoid tubercle of the scapula (Habermeyer et al 1987; Prodromas et al 1990; Rockwood and Matsen 1990), but more recent studies have shown a dual attachment to the superior glenoid labrum as well as the supraglenoid tubercle (Williams and Warwick 1980; Pal, Bhatt and Patel 1991; Cooper et al 1992). These authors reported only small numbers of cadaveric specimens (Hitchcock and Bechtol 1948). The purpose of this study was to define the normal anatomical attachment of the tendon of the long head of the biceps both grossly and histologically.

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MATERIALS AND METHODS

We studied 105 fresh-frozen shoulders from cadavers of both sexes aged from the third to the ninth decade. Five shoulders were discarded because of congenital defect or gross attrition of the biceps attachment, leaving 100 for study.

Each specimen was dissected to expose the intact shoulder capsule. We then photographed the tendon attachment to the supraglenoid tubercle, recording the percentage of fibres arising from the tubercle, the anterior labrum, and the posterior labrum.

Four types of attachment could be distinguished:

I. All the labral part of the attachment was to the posterior labrum, with none to the anterior labrum (Fig. 1a).
II. Most was to the posterior labrum, but with a small contribution to the anterior labrum (Fig. 1b).
III. Equal contributions to anterior and posterior labrum (Fig. 1c).
IV. Most attached to the anterior labrum, with a small contribution to the posterior labrum (Fig. 1d).

Specimens of each of the four types of tendon attachment, including the supraglenoid tubercle, were removed by transecting the scapular neck, leaving all capsular ligaments and tendon attachments intact, and photographed. After decalcification in 5% nitric acid, we made serial coronal sections of each type and of the upper sector of the glenoid perpendicular to its surface from 10 o'clock to 2 o'clock. The 5 μm sections were stained with haematoxylin and eosin and examined by light microscopy.

RESULTS

In all 100 shoulders, 40% to 60% of the biceps tendon arose from the supraglenoid tubercle and the remaining fibres were attached to the superior glenoid labrum.

This attachment of about half of the fibres varied considerably: type-I attachment, all posterior, was seen in

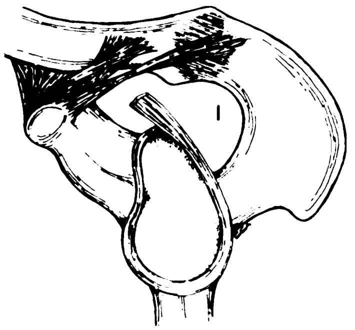

Fig. 1a

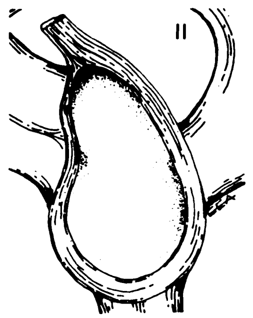

Fig. 1b

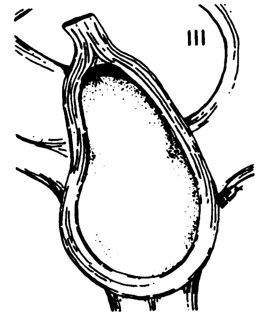

Fig. 1c

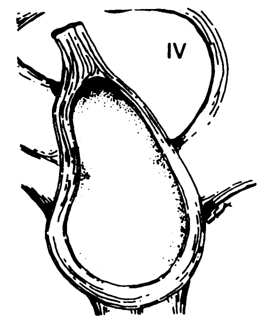

Fig. 1d

Figure 1a – **Type I**. The labral attachment is entirely posterior, with no contribution to the anterior labrum (22%). Figure 1b – **Type II**. Most of the labral contribution is posterior (33%). Figure 1c – **Type III**. There are equal contributions to both the anterior and the posterior parts of the labrum (37%). Figure 1d – **Type IV**. Most of the labral contribution is anterior, with a small contribution to the posterior labrum (8%).

Fig. 2

Fig. 3

Fig. 4

Figure 2 – Type-III labral attachment with equal anterior and posterior contribution. Figure 3 – Type-IV labral attachment with most fibres of biceps tendon attached to the anterior labrum and a small contribution to the posterior labrum. Figure 4 – Photograph showing the strong band of fibres coursing between the base of the coracoid and the supraglenoid tubercle.

22%; type-II in 33%; type-III in 37%; and type-IV, mainly anterior, in 8% (Figs 2 to 4).

The orientation of the tendon at its attachment to the superior glenoid, tubercle also varied. Looking at the left glenoid, as in all the illustrations, 51% were at 1 o'clock (posterior), 44% at 12 o'clock, and 5% at 11 o'clock (anterior). This correlated with the tendon attachment to the labrum: all type-III and type-IV attachments (mainly anterior) had either 11 o'clock or 12 o'clock orientation; type-I and type-II labral attachments were orientated around the 12 or 1 o'clock position.

In 35 specimens, there was a strong band of fibres running from the base of the coracoid process to the supraglenoid tubercle (Fig. 4); these fibres appeared to be distinct from the biceps attachment even on histological examination.

Radial sections taken through the glenoid tubercle, 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 medial to the labral attachment. The labrum consistently showed a flat 'meniscal' shape (Detrisac and Johnson 1986) (Figs 5 and 6). At the 12 o'clock position the supraglenoid tubercle was approximately 5 mm medial to the superior rim of the glenoid, and there was a synovial reflection between the biceps tendon and the superior aspect of the labrum.

DISCUSSION

The origin of the long head of the biceps from the supraglenoid tubercle (Hollinshead 1958; Hammond et al 1971; Williams and Warwick 1980; Last 1984) is described in standard texts, but shoulder arthroscopy has

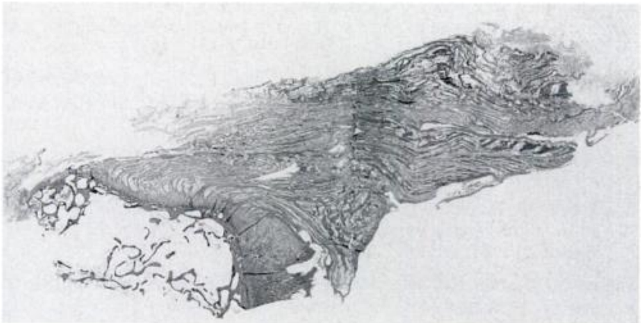

Fig. 5

Photomicrograph showing a cross-section of the glenoid labrum and biceps tendon at 12 o'clock. The dual attachment of the tendon of the long head to both the labrum and the supraglenoid tubercle is shown (haematoxylin and eosin).

Fig. 6

Gross cross-section of the glenoid and biceps tendon at 12 o'clock. The large attachment of the tendon to the glenoid tubercle is seen, with its additional origin from the labrum.

shown that there is often a dual attachment to the tubercle and glenoid labrum (Bankart 1938; Depalma, Callery and Bennett 1949; Williams and Warwick 1980; Detrisac and Johnson 1986; Pal et al 1991; Cooper et al 1992).

Our study has demonstrated the variability of the labral attachment, with strong posterior orientation (types I and II) in 55% and an even split between the anterior and posterior labrum (type-III) in 37%. Even type-IV tendon attachments (8%) had at least a small contribution to the posterior labrum.

An understanding of these normal anatomical variations is essential in evaluating and treating labral pathology in throwing athletes. Shoulder instability in baseball pitchers may be related to the forceful contraction of the injured biceps tendon during the deceleration phase of throwing (Andrews, Carson and McLeod 1985). Bankart (1938) described labral detachment in association with recurrent shoulder dislocation. The term 'SLAP lesion' (superior labrum-anterior to posterior) (Snyder et al 1990) is used to describe and grade injuries in which all or part of the superior labrum is avulsed from the glenoid, along with the origin of the long head of the biceps.

Recent biomechanical studies of shoulder instability have focused on the static capsuloligamentous restraints (O'Brien et al 1990). The inferior glenohumeral ligament complex has been shown to be the most important static structure providing anterior stability in the abducted and externally rotated position (Turkel et al 1981). More recently, the dynamic action of the biceps in producing shoulder stability has been shown by EMG studies in throwing athletes. The long tendon of biceps is most active in the late cocking phase of the throwing motion, when the shoulder is abducted and externally rotated (Gowan et al 1987), and higher biceps activity has been recorded in pitchers with known anterior instability (Glousman et al 1988). Biceps force has been shown to increase the torsional rigidity of the glenohumeral joint by 32% (Rodosky et al 1994). 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.

We have shown that shoulders with the tendon orientated at 12 or 1 o'clock on the left glenoid tubercle have significant fibre contribution to the posterior labrum, while those with more anterior orientation at 11 or 12 o'clock have a significant anterior labral attachment. Injuries to the tendon attachment to bone may also involve some portion of the labrum. This may explain why shoulder instability may be associated with various combinations of partial or complete detachments of the biceps tendon and/or the labrum. Further biomechanical research may demonstrate that different injury patterns result from variations in the anatomy of the biceps tendon attachment and the glenoid.

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