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Original Research Article

A STUDY OF UPPER LIMB MUSCLE ANOMALIES AND THEIR EFFECTS ON THE NEUROVASCULAR STRUCTURES

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ABSTRACT

Background: Variations in the morphology of the upper limb muscles are not uncommon. These variant muscles may compress the adjacent neurovascular structures by their anomalous positions. The knowledge of supernumerary heads of biceps brachii, variant bicipital aponeurosis and an abnormal tendinous insertion of coracobrachialis may cause clinical conditions like median nerve entrapment, compression of brachial artery, pronator syndrome etc.

Materials and Methods: The present study was undertaken to observe the anomalous origin and insertion of upper limb muscles and their relation to neurovascular structures in vicinity. This study was carried out in 60 upper limbs of 30 formalin fixed human cadavers in the Department of Anatomy, KAPV Government Medical College, Trichy.

Results: Among the sixty upper limbs, variations were found in three separate limbs. The variations included an accessory head of biceps brachii, a muscular slip from the bicipital aponeurosis which gave extensions to the forearm muscles and an anomalous origin and tendinous extension of coracobrachialis muscle to the medial epicondyle of humerus.

Conclusion: Knowledge of supernumerary heads of biceps brachii, accessory slips from bicipital aponeurosis and anomalous origin and insertion of coracobrachialis is essential in preoperative diagnosis and surgery of upper limbs, as they may cause compression of neurovascular structures like brachial artery, median nerve and ulnar nerve.

KEY WORDS: Accessory head of biceps, bicipital aponeurosis, anomalous coracobrachialis, neurovascular compression.

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INTRODUCTION

Among the three muscles of the anterior compartment of the arm, biceps brachii has been stated as one of the muscles that shows frequent anatomical variations [1,2]. It is a weak flexor of shoulder joint, powerful supinator of forearm and a flexor of the elbow. The tendon of the biceps brachii has a broad medial expansion, the bicipital aponeurosis which descends medially across the brachial artery to fuse with the deep fascia over the origins of the flexor muscles of the forearm [3].

The bicipital aponeurosis attaches the biceps brachii to the posterior border of the ulna, the distal end of which is drawn medially in supination. Thus it becomes the main tendon of the biceps during supination. The coracobrachialis muscle has a common origin from the coracoid process of the scapula along with the short head of biceps brachii muscle. The coracobrachialis muscle is morphologically representative of adductor group of muscles in the arm, but during evolution its function has become insignificant in man.

Awareness of the presence of accessory tendon of the biceps is important while performing tendon reconstruction in cases of avulsion[4].

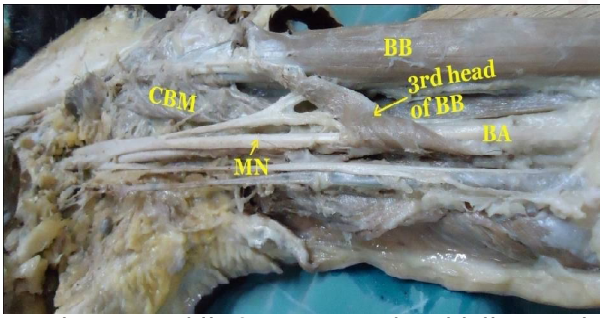
MATERIALS AND METHODS

The present study was undertaken to observe the anomalous origin and insertion of upper limb muscles and their relation to neurovascular structures in vicinity. This study was carried out in 60 upper limbs of 30 formalin fixed human cadavers in the Department of Anatomy, KAPV Government Medical College, Trichy, Tamilnadu, India.

OBSERVATIONS

In the left upper limb of a male cadaver, aged 65, a third head of the biceps brachii was found to be arising from the anteromedial surface of the humerus between the insertion of the coracobrachialis and upper part of origin of brachialis. It crossed over the brachial artery and median nerve to merge with the tendon of long head of biceps brachii. All the muscles of the anterior compartment including the third head of the biceps were supplied by median nerve. There was no musculocutaneous nerve found in this limb (Fig. 1).

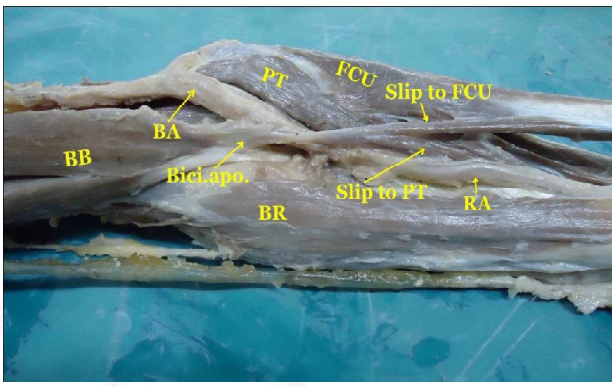
Fig. 1: The left arm in extended attitude showing the third head of Biceps Brachii.



BB: Biceps Brachii; **CBM:** Coracobrachialis muscle; **MN:** Median nerve; **BA:** Brachial artery.

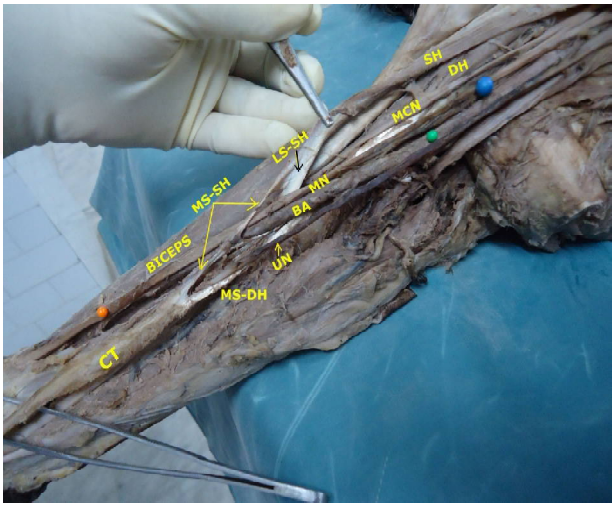
In the right upper limb of a female cadaver, aged 60, a tendinous slip arose from the bicipital aponeurosis which crossed the brachial artery in the cubital fossa and gave rise to two muscular slips. The medial slip merged with flexor carpi ulnaris and the lateral slip merged with the pronator teres (Fig. 2).

Fig. 2: The right upper limb in extended attitude showing the tendinous slip from Bicipital aponeurosis.



BB: Biceps Brachii; **Bici.apo:** Bicipital aponeurosis, **BR:** Brachioradialis; **FCU:** Flexor Carpi Ulnaris; **PT:** Pronator Teres; **Slip to FCU:** Slip to Flexor Carpi Ulnaris; **Slip to PT:** Slip to Pronator Teres. **BA:** Brachial artery; **RA:** Radial artery.

Fig. 3: The right arm in extended attitude showing the variations in origin and insertion of Coracobrachialis.



LS-SH: lateral slip of Superficial head of coracobrachialis, **MS-SH:** Medial slip of superficial head of coracobrachialis, **MS-DH:** Medial slip of deep head of coracobrachialis, **MCN:** Musculocutaneous nerve, **MN:** Median nerve, **BA**: Brachial artery, **UN:** Ulnar nerve, **CT**: Common Tendon.

In the right upper limb of a female cadaver, aged 55, the coracobrachialis was found to arise by two heads. The superficial head arose from the medial side of tendon of short head of biceps. After a short distance,it divided into two slips. The median nerve and brachial artery passed in

between the two slips. The lateral slip got inserted into the middle of the anteromedial surface of the humerus. The deep head arose from the coracoid process and divided into two slips. The medial slip of deep head joined with the medial slip of superficial head to form an aponeurotic tendon which was attached to the medial epicondyle. The lateral slip attached to the medial intermuscular septum (Fig. 3).

DISCUSSION

Nerves of the upper extremity have considerable mobility throughout their length. Compression by adjacent structures may tether a nerve and restrict its mobility, thereby causing stretching in response to joint motion [5,6].

The most common variation is the humeral head or third head of biceps brachii muscle, arising from proximal humerus. According to Gray's Anatomy, the incidence of this variation is said to be as much as 10%[7] which coincides with our observation.

Asvat et al reported that the third head of biceps brachii originated from the humeral shaft either in common with the insertion area for the coracobrachialis, or in common with brachialis muscle [2].

Rodriguez-Niedenfuhr et al, classified the supernumerary heads from humerus based on origin and location into superior, inferomedial and inferolateral types [8].

The most common type of third head is described as the inferomedial type that arises from the anterior surface of the humerus between the insertion of coracobrachialis and origin of brachialis.

Abu-Hijleh reported that the supernumerary bicipital head originated from the anteromedial surface of the humerus just below the insertion of coracobrachialis [9].

In the present study the third head of the biceps brachii comes under the most common inferomedial type.

The information on such variation is of importance for the differential diagnosis of other compression causes such as enlarged veins[10] or a fibrovascular band [11].

The presence of supernumerary head of biceps may cause compression on the median nerve and brachial artery. The compression of the median nerve and brachial artery by various types of structures leading to clinical neurovasculopathy has been found in literature [12,13].

Biceps brachii with a supernumerary head would be of more value in flap surgery where it can be expanded during elevation or transferring of flaps.

Paval and Mathew (2006) reported a variant biceps brachii insertion in which some of the muscle fibers formed two tendinous slips. One slip passed superficial to the brachial artery and median nerve and merged with the fascia covering the Flexor carpi ulnaris and the other slip passed deep to the nerve and the vessel and attached to medial supracondylar ridge of the humerus [14].

Bhat et al (2012) reported a tendinous slip originating from the undersurface of the bicipital aponeurosis which becomes muscular and gave extensions to both pronator teres and flexor carpi radialis. They suggested that the knowledge of the muscular variations, in any region might be important for explaining the uncommon neurovascular symptoms, due to their unusual association with the neurovascular bundles in that area[15].

In our study the muscular slip arose from the long head of bicipital aponeurosis and divided into two slips. One slip passed superficial to the brachial artery and merged with the flexor carpi ulnaris and the other slip merged with pronator teres muscle. This may compress the median nerve as found in the Pronator syndrome.

The clinical implication of the accessory slips of coracobrachialis is that it has the potential to cause median nerve entrapment and brachial artery compression. According to Henry Hollinshead[16] the commonest variation is the most superficial part to extend downward farther than usual, sometimes even as far as the medial epicondyle.

Bhagath K Potu [17] et al has observed an unusual insertion of coracobrachialis with an accessory slip which extended from the superficial fibres of coracobrachialis muscle downwards and medially in front of the median

nerve and brachial artery and finally inserted on the anteromedial aspect of the medial epicondyle.

Mostafa M El Naggar [18] has mentioned a case which showed a splitting of the deep head into two bellies shortly after its origin, where the muscle appeared as being formed of three heads. Variations in the insertion were present as an additional aponeurotic insertion above the usual insertion and an aponeurotic extension to the deep fascia on the medial aspect of the arm.

Williams et al [19] described accessory slips of the coracobrachialis which may be attached to the lesser tubercle, medial intermuscular septum or the medial epicondyle of the humerus.

Guha et al [20] in his report describes an additional slender tendon which passed inferiorly, crossing anterior to the median nerve and brachial artery, before attaching to the medial epicondyle of the humerus.

In our case, the coracobrachialis muscle had two heads of origin, and each head in turn divided into two slips, the lateral slips inserted into the humerus and medial intermuscular septum separately , while the medial slips joined together for insertion into the medial epicondyle. The brachial artery and median nerve together and the ulnar nerve separately, passed through the gaps formed by these slips.

Developmental basis: The muscles of the upper limb develop from the mesenchyme which is derived from dorsolateral cells of somites that migrate into the limb bud to form the muscles. With the elongation of limb buds the muscle tissue splits into flexor and extensor components. Initially the muscles are segmental, with time they fuse to form the single muscle mass. As soon as the limb buds form, ventral primary rami from the appropriate spinal nerves penetrate into the mesenchyme. Immediately after the nerves have entered the limb buds, they establish an intimate contact with the differentiating mesodermal condensations, and the early contact between the nerve and muscle cells is a prerequisite for their complete functional differentiation[21]. However some muscle primordia disappear through cell death despite the fact that cells within them have differentiated to the point of containing myofilaments. Failure of muscle primordia to disappear during development may result in the accessory muscles.

CONCLUSION

The existence of these variations should be kept in mind by the surgeons attending patients of neurovascular compression syndromes and while performing surgical repair, flap surgery and tendon grafts. This study will also be useful for the orthopaedicians dealing with fracture of the humerus, and for radiologists while doing radiodiagnostic procedures and angiographic studies.

Conflicts of Interests: **None**

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