

The ulnar head of the pronator teres muscle originating from the third head of the biceps brachii: a very rare case

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The biceps brachii is located in the anterior compartment of the arm, which can show numerous morphological variations. During anatomical dissection, an interesting additional muscle was found: the third head of the biceps brachii originated from the short head of the same muscle. The 97.77 mm long muscle belly was directed medially over the arm and then passed into the common tendon (15.97 mm), which thereafter split into aponeurosis and tendon. The 26.33 mm aponeurosis passed and joined the fascia of the forearm. The tendon of the third head of the biceps brachii then gave rise to the ulnar head of the pronator teres muscle. Such an accessory structure could cause neurovascular compression involving the brachial artery and median nerve. Knowledge of the morphological variability of this region is essential not only for anatomists but also for clinicians. (Folia Morphol 2023; 82, 1: 225–230)

Key words: anatomical variations, biceps brachii, third head

INTRODUCTION

It seems that the biceps brachii (BB), next to the plantaris or palmaris longus, is one of the most morphologically variable muscles [29, 30]. Standard anatomy books describe it as consisting of two heads, short and long [27].

There are frequent morphological variations of the BB involving both the proximal and distal attachments, and also additional heads [2, 6, 9, 10, 15, 17, 19, 21–23, 36, 38, 39, 44, 48]. Arguably the greatest degree of morphological variation concerns the number of supernumerary heads, which can range

from three to five [2, 17]. Accessory heads can also arise from the deltoid muscle, the pectoralis major, the coracoid process or the humerus [4, 6, 8, 9, 12, 16, 17, 22]. The supernumerary heads of the BB have functional and clinical implications arising from their potential to influence certain muscle functions or induce symptoms of neurovascular compression [6].

The present case report describes a very rare variant of the third head of the BB, the tendon of which gives origin to the ulnar head of the pronator teres. The brachial artery and the median nerve (MN) could be compressed between the tendon and the aponeurosis.

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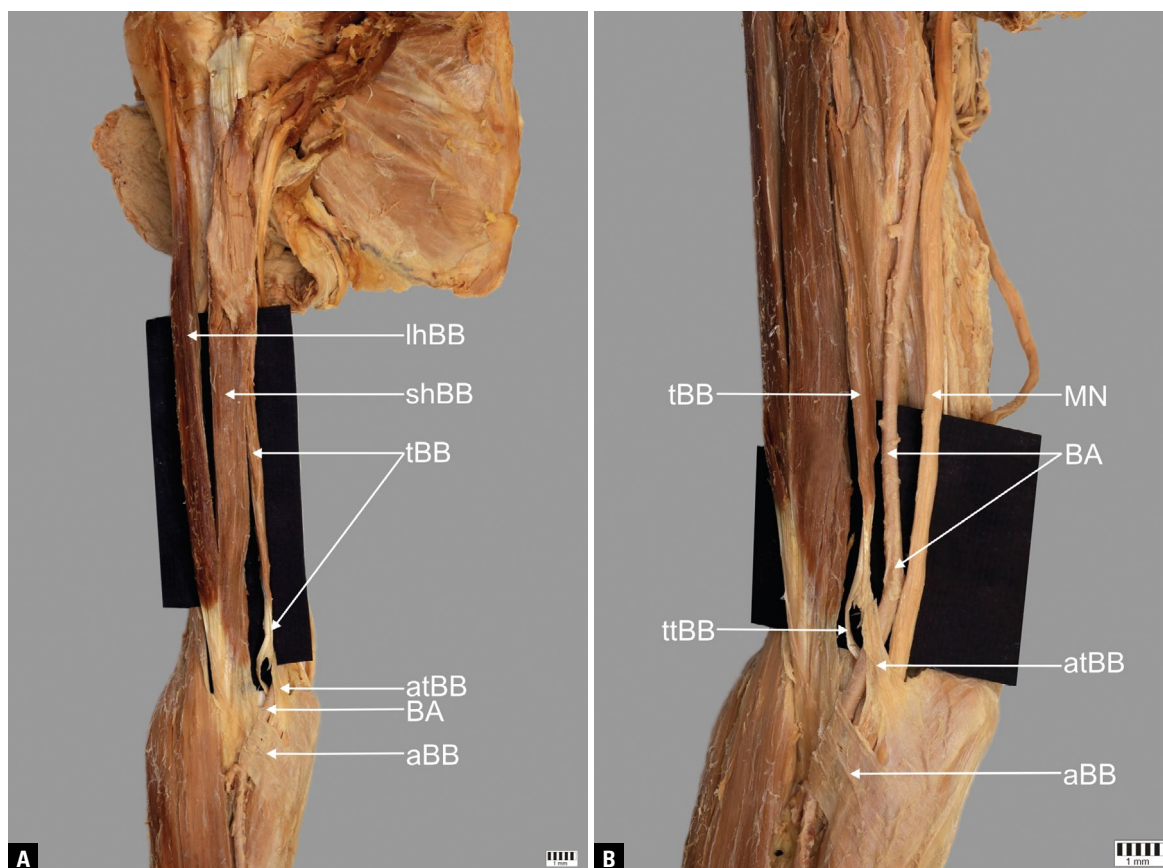


Figure 1. A, B. A third head of the biceps brachii; lhBB — long head of the biceps brachii; shBB — short head of the biceps brachii; tBB — third head of the biceps brachii; atBB — aponeurosis of the third head of the biceps brachii; BA — brachial artery, aBB — aponeurosis of the biceps brachii; ttBB — tendon of the third head of the biceps brachii; MN — median nerve.

Ethical approval and consent to participate

The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland.

CASE REPORT

A female cadaver, 77 years old at death, was subjected to routine anatomical dissection for research and teaching purposes at the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland. The right upper limb underwent traditional anatomical dissection and a morphological variant of the third head of the BB was found [33–35, 45–47]. The next stage of the investigation involved a detailed assessment of this structure. The third head of the BB originated from the shBB. The 97.77 mm long muscle belly was directed medially over the arm and then passed into the common tendon (15.97 mm), which then split into aponeurosis and tendon (Fig. 1). The myotendinous junction was 3.72 mm wide and 1.19 mm thick. The 26.33 mm

aponeurosis passed and joined the fascia of the forearm (Fig. 1).

The brachial artery and the MN ran between the aponeurosis and the tendon. The diameter of the brachial artery between the aponeurosis and the tendon was 4.78 mm, and the diameter of the MN was 5.03 mm. The 69.29 mm tendon then gave rise to the ulnar head of the pronator teres muscle (Fig. 2).

An electronic calliper (Mitutoyo Corporation, Kawasaki-shi, Kanagawa, Japan) was used for these measurements. Each measurement was repeated twice with an accuracy of up to 0.1 mm.

No other morphological variations were found.

DISCUSSION

The BB is characterised by numerous morphological variations that concern both its proximal and distal attachments, and the number of bellies [2, 4–6, 17, 22, 29, 37].

Knowledge of the embryological development of the muscle elucidates the occurrence of accessory

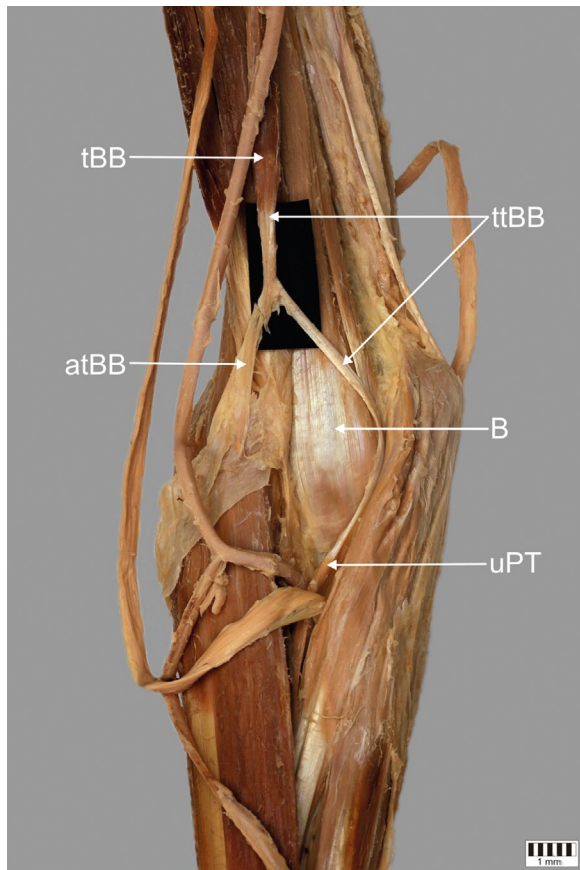


Figure 2. Distal part of the third head of the biceps brachii and proximal part of the anterior compartment of the forearm; tBB — third head of the biceps brachii; ttBB — tendon of the third head of the biceps brachii; atBB — aponeurosis of the third head of the biceps brachii; B — brachialis muscle, uPT — ulnar head of the pronator teres muscle.

heads of the BB. The BB, coracobrachialis, and brachialis muscles are intimately fused during very early stages and probably arise from a common pre-muscular mass. At this early stage, the two heads of the BB are close together and only become separated by the later growth of the scapula. The three muscles can be recognised in embryos measuring 14–16 mm in length, and the long tendon of the caput longum can be recognised in embryos 14 mm long. The distal end of the common muscle mass differentiates later than the proximal end [7]. The third, fourth and fifth heads of the BB are believed to arise from the brachialis muscle. In such instances, the distal attachment is translocated from the ulna and radius [40].

The third head of the BB was first described by Theile [41], Wood [42] and Macalister [26]. Many subsequent authors have reported cases and the incidence of additional heads. The most common variation of

the BB is a third head, occurring in 4.2% to 19.8% [2, 5, 6, 12, 22, 29, 37, 40, 42]. Many cases of third heads have been described. Both Macalister [26] and Wood [42] described a separate slip from the coracobrachialis continuous with the short head of the BB. Macalister [26] also found a third head arising directly from the brachialis muscle and this head crossed the brachial artery; the third head also originated from the deltoid muscle and from the outer tuberosity. Testut [40] reported acromial, labial and pectoral supernumerary heads of the BB. Kosugi et al. [22] found three- and four-headed BB muscles and created a classification system. Type I, three heads, was divided into distinct subtypes. Subtype a was characterised by an origin on the shaft of the humerus (between the coracobrachialis and brachialis muscles). Subtype b was proximally attached to the medial brachial intermuscular septum. Subtype c included cases with different locations of origin, for example from the tendinous part of the pectoralis major, deltoid muscle, or greater tubercle.

Rodriguez-Niedenfuhr et al. [37] distinguished three various origins of the third head of the BB. The first type, originating from the antero-medial surface of the humerus, was the most common (frequency 9%). It was characterised by an inferomedial head distally fused with the insertion of the coracobrachialis muscle. The second type occurred in 1.5% of the population; the superior humeral head was attached to the surface of the humerus between the lesser tubercle and the proximal attachment of the brachialis and coracobrachialis muscles. The third type, occurring in only 0.3% of cases, was an infero-lateral humeral head. Its origin was located on the lateral intermuscular septum between the proximal attachment of the brachioradialis muscle and the insertion of the deltoid muscle [38].

In the third head of the BB we have described, a proximal attachment on the short head of the BB headed towards the medial side of the arm and the muscle belly turned into a common tendon and then split into two parts: the aponeurosis, which connected to the fascia of the forearm, and the tendon, which passed directly into the ulnar head of the pronator teres muscle. A similar case was described by Macalister [25], where the accessory third head originated from the upper border of the pronator teres.

The atypical course of the aponeurosis and tendons could cause pressure on the brachial artery and

the MN. Entrapment of the brachial artery between the aponeurosis and the tendon of the BB could cause acute or chronic intraluminal arterial thrombosis, further leading to acute distal embolisation.

Other pathologies could result from compression the MN [3, 27]. For example, when the MN is compressed by the pronator teres heads, ulnar and humeral, the result is pronator teres syndrome [32] manifested by pain in the volar forearm region and weakness. Another pathology, referred to as the most common, is carpal tunnel syndrome characterised by pain, numbness and paraesthesia's, especially in the fingers, though it can also radiate up the affected arm [11, 27]. MN compression in the arm region is much less frequent. It can be associated with Struthers' ligament and is known as supracondylar process syndrome [20, 32]. Additional structures such as a third head of the biceps brachii can also lead to MN neuropathy [43]. An accessory head of the coracobrachialis muscle is another example, but it occurs at the level of the lateral cord of the brachial plexus [13, 14, 24, 34, 35].

In this case, we are dealing with an even higher likelihood of pressure, which could perturb the innervation of most of the forearm muscles. A typical symptom is pain in forearm reversal movement and sensory disturbances in the fingers and the inner surface of the hand.

A fourth head is much rarer than a third head [1, 12, 22, 37]. Kosugi et al. [22] report that the fourth head of the BB can originate from the pectoralis major tendon or the greater tubercle or articular capsule. A fifth head of the BB has very rarely been described [37].

Accessory heads of the BB can increase the risk of pathologies such as bicipital injury. Moreover, such morphological variations are clinically significant for surgeons, especially for orthopaedics. A possible change in the biomechanical forces applied to the humerus should be considered among patients with humeral fracture with bone displacement. It is worth mentioning that additional structures usually entail some neurovascular compression. An accessory head of the BB can potentially compress the brachial artery, musculocutaneous nerve, and MN, leading to pain and various nerve compression syndromes.

CONCLUSIONS

The BB is highly morphologically variable. The case described is unique in that it gives origin to the

ulnar head of the pronator teres and could also cause pressure on the brachial arteries.

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