

Six Asymmetric Bilateral Additional Heads of Biceps Brachii Muscle Observed in a Cadaver

Seis Cabezas Adicionales Bilaterales Asimétricas del Músculo Bíceps Braquial Observadas en un Cadáver

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KIM, J. Y. & LEE, J. H. Six asymmetric bilateral additional heads of biceps brachii muscle observed in a cadaver. *Int. J. Morphol.* 40(3):674-677, 2022.

SUMMARY: Anatomic variation of the biceps brachii muscle (BBM) is frequently observed; its pattern is diverse and clinically important. During the educational dissection of a 78-year-old Korean male cadaver, six additional asymmetrical heads of the biceps brachii muscle (BBM) were found on both sides. On the right side, two additional heads originated from the humerus; the musculocutaneous nerve passed between these heads and the short head of the BBM. Four additional heads were found on the left side, anterior to the BBM, one of which originated from the pectoralis major muscle. Posterior to the BBM, two heads of tendons originated from the coracobrachialis muscle and one head of the muscle belly originated from the humerus. The left musculocutaneous nerve pierced the coracobrachialis muscle and continued distally passing between the short head of the BBM and the additional heads located posterior to the BBM. It then gave off the variant musculocutaneous nerve to the median nerve. On both sides, the short and long heads of the BBM had normal origins, insertions, and courses. This novel variation has various clinical and embryological implications.

KEY WORDS: Anatomic variation; Biceps brachii muscle; Musculocutaneous nerve.

INTRODUCTION

The biceps brachii muscle (BBM) is an important two-headed muscle in the anterior compartment of the arm. Its long head originates from the supraglenoid tubercle of the scapula and its short head originates from the tip of the coracoid process of the scapula. The two tendons merge and are inserted into the rough posterior area of the radial tuberosity. This tendon shows a broad medial expansion, known as the bicipital aponeurosis, and merges with the antebrachial fascia.

Among all muscles in the human body, the BBM shows the greatest variation in terms of the number and attachment of its heads (Rodríguez-Niedenführ *et al.*, 2003); three to seven additional heads have been reported. Depending on the population, a third head has been reported to occur in 8 % to 37.5 % of cadavers (Kosugi *et al.*, 1992; Rodríguez-Niedenführ *et al.*, 2003). These additional heads are usually accompanied by variations in the musculocutaneous nerve (MCN) (Kosugi *et al.*, 1992; Catli *et al.*, 2012). The coexistence of these heads is clinically

important because it may compress neurovascular structures or cause confusion during surgical procedures on the arm (Heo *et al.*, 2020). Here, we report six asymmetric bilateral heads of BBM that had a unique pattern and discuss their clinical and embryological significance.

CASE REPORT

During an educational dissection for medical students, additional heads of the BBM were found bilaterally in a 78-year-old Korean male cadaver. Each upper limb was dissected using a longitudinal incision in the anterior aspect of the arm from the level of the acromion to the elbow joint. The skin, subcutaneous fat, and fascia were removed to expose all heads of the BBM. The nerves and blood vessels supplying each head were carefully examined, findings were photographed, and the length and width of the muscles were measured in millimeters.

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Funding. This research was supported by grants from the National Research Foundation of Korea (NRF-2021R1/1A3048089).

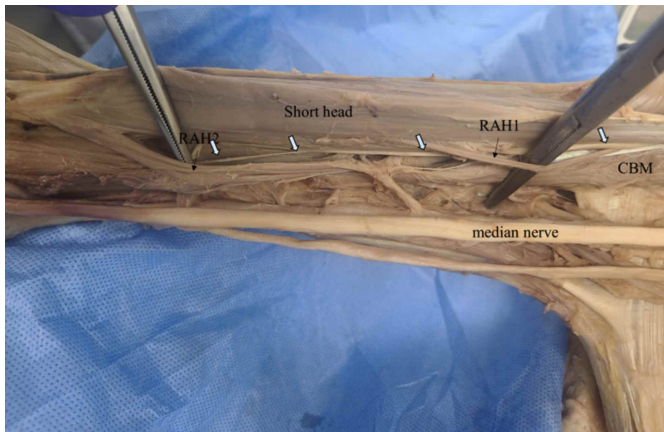


Fig. 1. Two additional heads of the biceps brachii muscle on the right side. The musculocutaneous nerve (white arrow) pierces right additional head 1 (RAH1) and right additional head 2 (RAH2). CBM, coracobrachialis.

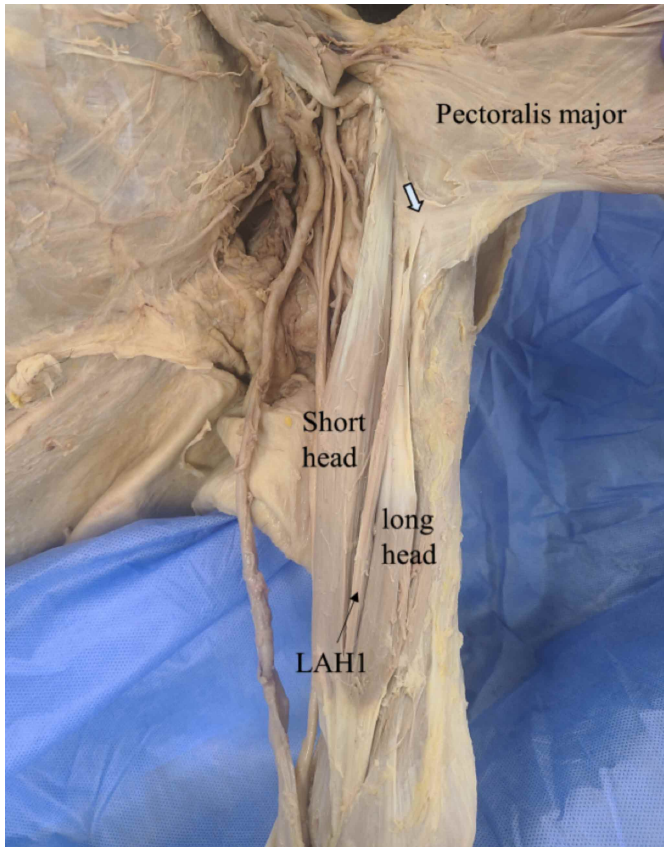


Fig. 2. Left additional head 1 (LAH1) of the biceps brachii muscle from the pectoralis major on the left side. White arrow: origin of LAH1.

On the right side, two additional heads originated from the humerus. One additional head of the muscle belly (right additional head 1, RAH1) originated from the bicipital groove of the humerus and continued inferiorly for 61 mm (Fig. 1). It merged with the inferior surface of the short head

of the BBM at the mid-humeral level. At this level, another muscle belly (right additional head 2, RAH2) originated from the humerus and continued inferiorly for 84 mm, merging with the inferior surface of the BBM tendon. After the MCN pierced the coracobrachialis muscle, it passed between RAH1 and RAH2, and the short head innervated the brachialis muscle. The short and long heads of the BBM had normal origins, insertions, and courses.

Four additional heads were observed on the left side. One additional head of the muscle belly (left additional head 1, LAH1) originated from the posterior surface of the fascia of the pectoralis major muscle (Fig. 2). It continued inferiorly between the long and short heads of the BBM and these three heads merged to form a tendon that was inserted into the radial tuberosity. Under the short head, two heads of tendons (left additional heads 2 and 3, LAH2 and LAH3) originated from the coracobrachialis muscle and continued inferiorly for approximately 30 mm (Fig. 3). These were inserted into the inferior surface of the short head of the BBM. At this level, one head of the muscle belly (left additional head 4, LAH4) originated from the humerus and merged with the inferior surface of BBM. The MCN pierced the coracobrachialis muscle and continued distally between the short head of the BBM and the LAH2–4 located posterior to the BBM. After the MCN pierced the LAH4, it gave off the variant musculocutaneous nerve (MCN2) to the median nerve. The short and long heads of the BBM had have normal origins, insertions, and courses.

DISCUSSION

Supernumerary heads of the BBM have been reported in 8 % of Chinese, 10 % of European, 18 % of Japanese, 20.5 % of African, and 37.5 % of Colombian cadavers (Kosugi *et al.*, 1992; Asvat *et al.*, 1993; Rodríguez-Niedenführ *et al.*, 2003). In the Korean population, this variation is found in 14 of 214 (6.5 %) cadavers, and this frequency is relatively lower than that seen in other races (Lee *et al.*, 2008, 2013). Rodríguez-Niedenführ *et al.* (2003) have been classified supernumerary heads of the BBM according to their location as superior, inferomedial, and inferolateral.

Bilateral supernumerary heads of the BBM have been reported to occur in 1 of 48 cadavers by Kumar *et al.* (2008) and in 1 of 120 cadavers by Jayanthi & Elezy (2012). Consistent with previous reports, we demonstrated six bilaterally asymmetric supernumerary heads of the BBM

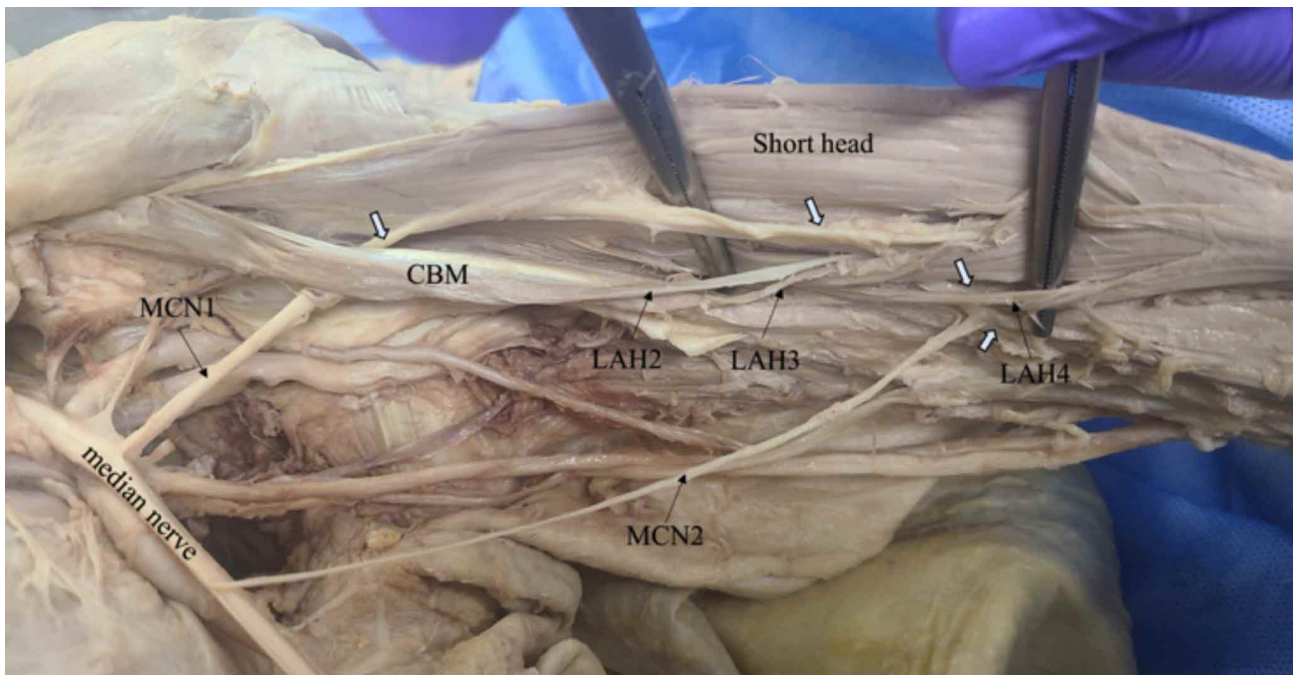


Fig. 3. Two additional heads of the biceps brachii muscle on left side. Left additional head 2 (LAH2) and left additional head 3 (LAH3) originate from the coracobrachialis (CBM). The musculocutaneous nerve (MCN1) pierces the left additional head 4 (LAH4) and communicates with the median nerve via variant musculocutaneous nerve (MCN2). White arrow: course of the musculocutaneous nerve.

with a variant musculocutaneous nerve (MCN2) between the MCN and the median nerve.

In some cases, the supernumerary head originates from the humerus between the insertion of the coracobrachialis and the origin of the brachialis. In the present case, three additional heads, RAH1, RAH2, and LAH4, originated from the humerus and formed a muscle belly.

Rarely, this muscle variant originates from the tendon of the pectoralis major or deltoid muscle, articular capsule, or the crest of the greater tubercle (Rodríguez-Niedenführ *et al.*, 2003; Fraser *et al.*, 2015). In our case, one additional head (LAH1) originated from the pectoralis major.

Many studies have suggested a strong relationship between the supernumerary heads of the BBM and variations in MCN (Kosugi *et al.*, 1992; Yamamoto *et al.*, 2018; Jang *et al.*, 2019). Communication between the MCN and the median nerve shows a wide variability of 5 % to 54.7 % (Kosugi *et al.*, 1992; Catli *et al.*, 2012). Our results showed that five supernumerary heads, all except LAH1, originated inferior to the BBM origin, and the courses of these heads were associated with those of the MCN or MCN2. Based on this finding, the supernumerary heads of the BBM seem to affect the course and branching of the MCN.

Moreover, it was postulated that the co-development of BBM and MCN may lead to such a variation. This hypothesis is supported by the fact that the BBM is split by the MCN (Kosugi *et al.*, 1992; Catli *et al.*, 2012; Jang *et al.*, 2019). Embryologically, the mesoderm invades the upper limb bud and condenses into ventral and dorsal muscle masses during the fifth week of development. The biceps muscle is derived from the ventral muscle mass of the upper limb bud. Therefore, the variation reported here may have occurred because of inappropriate cleavage of the ventral muscle masses caused by MCN development.

Here, we present a rare case of six asymmetric bilateral additional heads of the BBM with MCN variation. This variation may result in reduced muscle strength and restricted elbow joint movement owing to MCN compression (Fraser *et al.*, 2015; Heo *et al.*, 2020). BBM variation tends to be associated with MCN variation; therefore, knowledge of this variation may help clinicians in surgical and diagnostic procedures.

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RESUMEN: Con frecuencia se observa una variación anatómica del músculo bíceps braquial (MBB); su patrón es diverso y

clínicamente importante. Durante la disección de un cadáver masculino coreano de 78 años, se encontraron seis cabezas asimétricas adicionales del músculo bíceps braquial en ambos lados. En el lado derecho, dos cabezas adicionales se originaban en el húmero; el nervio musculocutáneo atravesaba entre estas cabezas y la cabeza corta del MBB. Se encontraron cuatro cabezas adicionales en el lado izquierdo, anterior al MBB, una de las cuales se originaba en el músculo pectoral mayor. Posterior al MBB, dos cabezas tendinosas se originaban en el músculo coracobraquial y una cabeza de vientre muscular se originaba en el húmero. El nervio musculocutáneo izquierdo perforaba el músculo coracobraquial y continuaba distalmente pasando entre la cabeza corta del MBB y las cabezas adicionales ubicadas por detrás del MBB. Luego emitía la variante el nervio musculocutáneo al nervio mediano. En ambos lados, las cabezas corta y larga del MBB tenían orígenes, inserciones y trayectos normales. Esta nueva variación tiene varias implicaciones clínicas y embriológicas.

PALABRAS CLAVE: Variación anatómica; Músculo bíceps braquial; Nervio musculocutáneo.

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