Int. J. Morphol.,
42(1):17-20, 2024.

The Accessory Muscular Head of the Triceps Brachii Muscle with Tendinous Attachment

Cabeza Muscular Accesoria del Músculo Triceps Braquial con Inserción Tendinosa

Keiko Ogami-Takamura[1,2,3]; Kazunobu Saiki[1]; Daisuke Endo[1,2]; Kiyohito Murai[1] & Toshiyuki Tsurumoto[1,2]

OGAMI-TAKAMURA, K.; SAIKI, K.; ENDO, D.; MURAI, K. & TSURUMOTO, T. The Accessory muscular head of the triceps brachii muscle with tendinous attachment. *Int. J. Morphol., 42(1)*:17-20, 2024.

SUMMARY: Variations in the triceps brachii muscle are uncommon, and especially limited reports exist on the accessory heads of tendinous origin that attach near the upper medial part of the humerus. During anatomical training at Nagasaki University School of Medicine, the accessory head of the triceps brachii muscle was observed on the right upper arm of a 72-year-old Japanese female. It arose tendinously from the medial side of the upper humerus, then formed a muscle belly and joined the distal side of the long head. This accessory head had independent nerve innervation, and the innervating nerve branched from a bundle of the radial nerve, which divided the nerve innervating the long head and the posterior brachial cutaneous nerve. The origin of the innervation of the accessory head was the basis for determining that this muscle head was an accessory muscle to the long head of the triceps brachii muscle. Embryologically, we discuss that part of the origin of the long head of the triceps brachii muscle was separated early in development by the axillary nerve and the posterior brachial circumflex artery, and it slipped into the surgical neck of the humerus and became fixed there. The accessory head crossed the radial nerve and deep brachial artery. When clinicians encounter compression of the radial nerve or profunda brachii artery, they should consider the presence of accessory muscles as a possible cause.

KEY WORDS: Anatomic variation; Cadaver; Radial nerve; Triceps brachii muscle.

INTRODUCTION

The triceps brachii muscle (TB) consists of the long head, the lateral head, and the medial head (Simon, 2016). The long head of TB originates at the infraglenoid tubercle, the lateral head of TB originates proximal to the radial groove of the humerus, and the medial head of TB originates distal to the radial groove of the humerus. These three muscular heads join to form a common tendon that inserts into the olecranon of the ulna. The TB's main function is the extension of the elbow joint, and the predominant muscle works differently depending on the angle of shoulder elevation (Kholinne *et al*., 2018). In most cases, the long head of the TB is innervated by the radial nerve (Wade *et al*., 2018).

Few reports exist on the accessory head of the TB. An especially rare variation is an independent tendinous origin that arises from the medial side of the humeral shaft just below the surgical neck, which then becomes a muscular head and joins the other triceps muscle heads (Fabrizio & Clemente, 1997).

We present here a rare anomaly in which the accessory head of the TB originated as a tendon from the shaft of the humerus, descended spirally, and then became a muscle belly and joined into the long head og the TB. This muscle head had an independent origin and was innervated separately by a branch of the radial nerve. We also discuss its morphological and embryological background. Knowledge of this muscle head would be a useful diagnostic tool for clinicians.

CASE REPORT

The present study was approved by the ethics committee of the Nagasaki University Graduate School of Biomedical Sciences (approval number: 21092401), and written informed consent was received from the living cadaver donor and the family.

The authors hereby confirm that every effort was made to comply with all local and international ethical

[1] Department of Macroscopic Anatomy, Graduate School of Biomedical Sciences, Nagasaki University, 1-12-4 Sakamoto, Nagasaki, Nagasaki 852-8523, Japan.
[2] Center of Cadaver Surgical Training, School of Medicine, Nagasaki University, 1-12-4 Sakamoto, Nagasaki, Nagasaki 852-8523, Japan.
[3] Department of Anesthesiology and Intensive Care Medicine, Graduate School of Biomedical Sciences, Nagasaki University, 1-7-1 Sakamoto, Nagasaki, Nagasaki 852-8501, Japan.

Received: 2023-09-19 Accepted: 2023-10-28

guidelines and laws concerning the use of human cadaveric donors in anatomical research. An accessory head of the TB was detected in the right upper limb of a formalin-preserved cadaver of a 72-year-old Japanese female during dissection courses for medical students (Fig. 1). No visible surgical scars or abnormalities were observed on the right upper limb or pectoral girdle. The accessory head had a 1.5-cm wide tendinous origin in a cephalocaudal direction from the posteromedial aspect of the surgical neck of the right humerus (Fig. 1A). The tendinous origin descended 80.1 mm in a spiraling medial direction, crossing the radial nerve and deep brachial artery posteriorly. The tendinous origin became a muscle belly and joined the antermedial aspect of the long head of TB. The total length of the accessory head was 199.2 mm, and no connection with the shoulder joint capsule existed (Fig. 1B). The thinnest width of the tendon was 2.5 mm, and the thickest muscle width was 11.30 mm.

As shown in Figures 1A and B, the origin of the accessory head was located posteriorly above the fused tendons of the latissimus dorsi and teres major muscle insertions, anterior to the origin of the lateral head of the TB. The origin did not connect with the latissimus dorsi and teres major muscles or with the other TB muscle heads. Between the long head of the TB and the accessory head, the axillary nerve and the posterior brachial circumflex artery were present (Fig. 1A). The accessory head traveled separately from the ulnar nerve (Fig. 1C, D). A thin nerve was found to enter the proximal muscle belly (Fig. 1D). The origin of the nerve was one of the branches of the radial nerve, which—after producing the nerve for the accessory head—divided into the posterior brachial cutaneous nerve and the muscular branch innervating the long head of the TB (Fig. 1D).

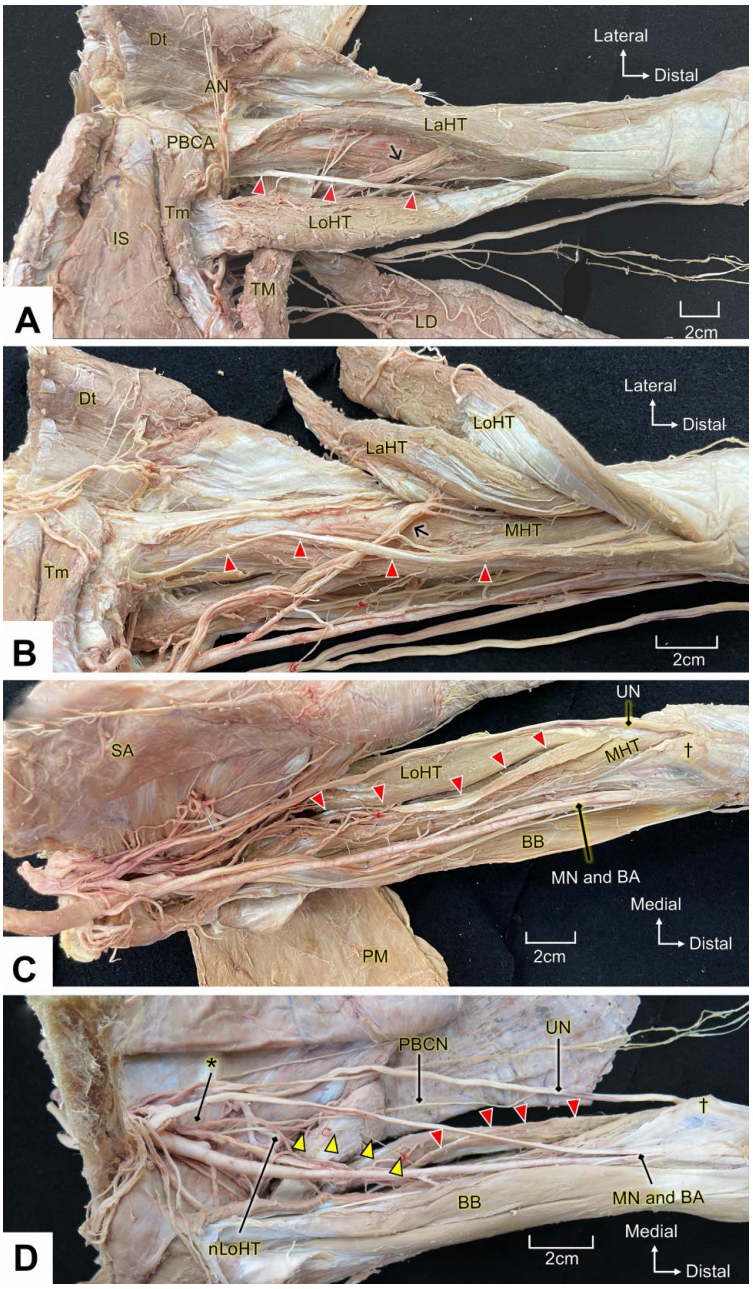

Fig. 1. Photographs of the accessory muscular head of the triceps brachii muscle. **A.** Posterior view of the right upper arm. The long and lateral heads of the triceps brachii muscle are partly divided. **B.** Posterior view of the right upper arm. The origins of the long and lateral heads of the triceps brachii muscle and the insertions of the latissimus dorsi and teres major muscles are separated from the humerus. The accessory muscular head can be observed from the origin to the joining of the long head of the triceps brachii muscle. **C.** Medial view of the right upper arm. **D.** Anteromedial view of the proximal part of the right upper arm. The accessory muscular head and its innervation can be observed. Asterisk, the area where the nerve bundle that becomes the innervating nerve to the accessory head, the long head, and the posterior brachiocutaneous nerve branches off from the radial nerve; Dagger, the medial epicondyle of the humerus; Red arrowheads, the accessory muscle of the triceps brachii muscle; Black arrow, radial nerve and posterior profunda brachii artery; Yellow arrowheads, innervating nerve of the accessory muscle of the triceps brachii muscle. AN, axillary nerve; BA, brachial artery; BB, biceps brachii muscle; Dt, deltoid muscle; IS, infraspinatus muscle; LaHT, lateral head of triceps brachii muscle; LD, latissimus dorsi muscle; LoHT, lateral head of triceps brachii muscle; MHT, medial head of triceps brachii muscle; MN, median nerve; nLoHT, nerve to long head of triceps brachii muscle; PBCA, posterior brachial circumflex artery; PBCN, posterior brachial cutaneous nerve; PM, inverted pectoral major muscle; SA, inverted serratus anterior muscle; TM, teres major muscle; Tm, teres minor muscle; UN, urner nerve.

DISCUSSION

In the present case, the accessory head of the TB originated as a completely independent tendon arising from the posteromedial aspect of the surgical neck of the humerus. It then became a muscle belly and joined the anteromedial part of the long head of the TB. Although the TB generally has few variations, several reports on variations have been published, and these variations can be divided into two types. The most common is called the dorsoepitrochlearis, which arises from the tendon of the latissimus dorsi and inserts at various regions, including the brachial fascia, olecranon, and lateral epicondyle of the humerus (Diogo *et al*., 2009; Natsis *et al*., 2012). The dorsoepitrochlearis is often present in quadrupedal mammals (Haninec *et al*., 2009) and in about 5 % of humans (Tountas & Bergman, 1993). In the present case, no connection with the latissimus dorsi muscle was observed along the entire length from origin to insertion, indicating that it was not of this type.

The second type is a muscular head that originates from the humeral shaft and joins the triceps muscle belly, as reported in the present case. Only a few reports exist of this type with a tendinous origin from the humeral shaft (Fabrizio & Clemente, 1997; Tubbs *et al*., 2006; Nayak *et al*., 2008; Cheema & Singla, 2011). Although Tubbs *et al*. (2006) and Nayak *et al*. (2008) concluded that these anomaly muscles were accessory heads of the medial head of the TB, the present case was determined to be an accessory head of the long head of the TB. For reasons, it was innervated by an independent nerve that shared its origin with the innervation of the long head of the TB (Fig. 1D), and it joined to the distally part of the long head of the TB.

According to Rodríguez-Niedenführ *et al*. (2001), at the end of the fourth embryonic week, the upper limb buds reveal their shape and become larger. As the limb buds elongate, the undifferentiated musculature separates into flexor and extensor muscle groups, and skeletal muscle develops by the sixth embryonic week. Regarding nerve and vascular development, the vascular structures originating from the central vein invade the upper limb buds in the fourth week, and the subclavian and axillary arteries develop in the sixth week. In the fifth embryonic week, the brachial plexus begins to elongate into the limb buds, and by the seventh week, the pattern is similar to that seen in adults. In the present case, the axillary nerve and posterior brachial circumflex artery were present between this muscular head and the proximal part of the long head of the TB (Fig. 1A). The branches of the subclavian artery are thought to cause variation in the branching morphology of the brachial plexus (Leijnse *et al*., 2020). Therefore, we hypothesize that part of the origin of the long head of the TB was separated by the axillary nerve and posterior brachial circumflex artery during early TB development and slipped into the humeral surgical neck, becoming fixed there.

During general anesthesia, compression from the tourniquet and positioning can injury the radial nerve (Shao *et al*., 2005), but there are few reports of proximal flexor nerve injury from muscular tissue placement. Lotem *et al*. (1971) reported radial nerve compression symptoms due to fibular arches caused by the lateral head of the TB, but these were transient during exercise and resolved during rest. Furthermore, in 15 of 20 upper limbs, Jenkins *et al*. (2021) reported the presence of a fibrous band that connected the lateral head of the TB to the long head of the TB and caused radial nerve compression. The accessory muscular head in the present case crossed the radial nerve and the profunda brachii artery, passing through the radial nerve groove and running behind them. The possibility was considered that the tonus of this muscular head contributed to the compression damage of the radial nerve and profunda brachii artery in daily life before death. When clinicians encounter cases of the radial nerve or profunda brachii artery compression, they should consider the presence of accessory musclular head as a potential cause. If necessary, diagnostic imaging, such as ultrasound or magnetic resonance imaging, should be used to examine the patient.

As few reports exist on independent accessory tendinous muscular head of TB originating from the humeral shaft, such as in the present case, the frequency of this variation is unknown, and further investigation is expected.

CONCLUSION

An accessory head with a tendinous origin in the TB is a rare anomaly. Based on an analysis of the innervation and site of insertion, as well as the embryological background, the present case was determined to be an accessory head of the long head of the TB. Given that this accessory muscular head ran across the radial nerve and the posterior brachial circumflex artery, we determined that it could potentially compress the nerve and artery. When patients present with radial nerve or posterior brachial circumflex artery compression, clinicians should assess the accessory head of the TB as a possible cause.

ACKNOWLEDGEMENTS

The authors sincerely thank that who donated the body to science so that anatomical research could be performed. Results from such research can potentially increase mankind's overall knowledge, that can then improve patient care. Therefore, the donor and family deserve our highest gratitude.

OGAMI-TAKAMURA, K.; SAIKI, K. ; ENDO, D.; MURAI, K. & TSURUMOTO, T. Cabeza muscular accesoria del músculo tríceps braquial con inserción tendinosa. *Int. J. Morphol., 42(1)*:17-20, 2024.

RESUMEN: Las variaciones en el músculo tríceps braquial son poco comunes y existen informes especialmente limitados sobre las cabezas accesorias de origen tendinoso que se insertan cerca de la parte medial superior del húmero. Durante un entrenamiento anatómico en la Facultad de Medicina de la Universidad de Nagasaki, se observó la cabeza accesoria del músculo tríceps braquial en la parte superior del brazo derecho de una mujer japonesa de 72 años. Se originaba tendinosamente desde el lado medial de la parte superior del húmero, luego formaba un vientre muscular y se unía al lado distal de la cabeza larga. Esta cabeza accesoria tenía inervación nerviosa independiente, cuyo nervio se ramificaba a partir de un ramo del nervio radial, que dividía el nervio que inervaba la cabeza larga y el nervio cutáneo braquial posterior. El origen de la inervación de la cabeza accesoria fue la base para determinar que esta cabeza muscular era un músculo accesorio de la cabeza larga del músculo tríceps braquial. Embriológicamente, discutimos que parte del origen de la cabeza larga del músculo tríceps braquial se separó tempranamente en el desarrollo por el nervio axilar y la arteria circunfleja braquial posterior, y se deslizó hacia el cuello quirúrgico del húmero y quedó fijado allí. La cabeza accesoria cruzaba el nervio radial y la arteria braquial profunda. Cuando los médicos encuentran compresión del nervio radial o de la arteria braquial profunda, deben considerar la presencia de músculos accesorios como una posible causa.

PALABRAS CLAVE: Variación anatómica; Cadáver; Nervio radial; Músculo tríceps braquial.

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Corresponding author:
Keiko Ogami-Takamura
Department of Macroscopic Anatomy
Graduate School of Biomedical Sciences
Nagasaki University, 1-12-4 Sakamoto
Nagasaki
Nagasaki 852-8523
JAPAN

E-mail: keiko.ogami@nagasaki-u.ac.jp