



Accessory flexor carpi ulnaris muscle with associated anterior interosseous artery variation: case report with the definition of a new type and review of concomitant variants

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Abstract

Purpose Knowledge of accessory flexor carpi ulnaris (AFCU) is not only important for proper orientation in the surgical field but it can be used for tendon transfer as well. AFCU commonly occurs with concomitant variants, and its presence should rise caution in order to prevent iatrogenic injury.

Methods During a routine dissection for research data collection at the Institute of Anatomy, a AFCU with concomitant variants was observed in a European cadaver fixed with Thiel's method. A thorough review of the literature concerning all the encountered variants was performed.

Results AFCU was found in the right upper limb with its insertion on the flexor retinaculum. Palmaris longus muscle was absent in this limb, and an accessory branch of the anterior interosseous artery coursed over the pronator quadratus muscle to anastomose with the ulnar artery 5 cm proximally to the pisiform. On the left hand, a variable lumbrical of the second finger originating from the flexor retinaculum was found, which was not described in the literature before.

Conclusions AFCU commonly occurs together with concomitant variants, and special attention is needed when performing surgery on such forearm.

Keywords Accessory flexor carpi ulnaris · Anterior interosseous artery · Anatomical variability · Lumbrical muscle

Introduction

Flexor carpi ulnaris muscle (FCU) is a two-headed and the most medial muscle in the anterior compartment of the forearm. Its humeral head originates on the medial epicondyle of the humerus and its ulnar head on the olecranon and posterior border of the ulna. Both heads fuse and insert on the pisiform and continue to the base of the fifth metacarpal and the hook of the hamate as the pisometacarpal and pisohamate ligaments, respectively.

We present a case of an accessory FCU with two concomitant variants. First is an accessory branch of the anterior interosseous artery (AIA), and second is the lumbrical

muscle for the second finger originating from the flexor retinaculum that to our best knowledge has not been previously described in the literature.

Clinical relevance of the FCU variants is indisputable even though they are very rare—after thorough review only 13 cases of true accessory FCU have been found in the literature. This knowledge not only helps surgeon be oriented in the operative field but also manages treatment of the conditions if FCU tendon transfer is needed. The relevance of the FCU variants was recently shown in a case report in which transposition of a double tendon of the FCU was used to improve thumb opposition and index finger flexion in patient with Volkmann's contracture [4].

Case report

Several variations in both forearms were encountered during dissection of a European 74-year-old male for the purpose of research data collection. The cadaver was fixed using Thiel's method of embalment. In the right upper limb, an

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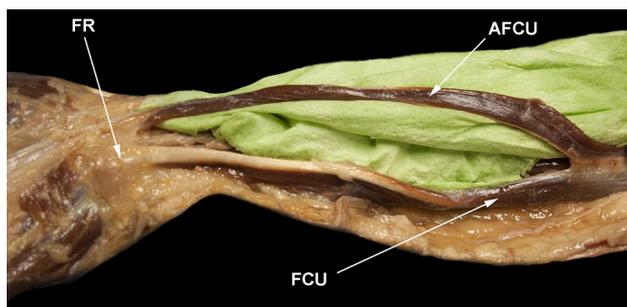


Fig. 1 The accessory flexor carpi ulnaris muscle inserting to the palmar aponeurosis. *AFCU* accessory flexor carpi ulnaris muscle, *FCU* flexor carpi ulnaris muscle, *FR* flexor retinaculum

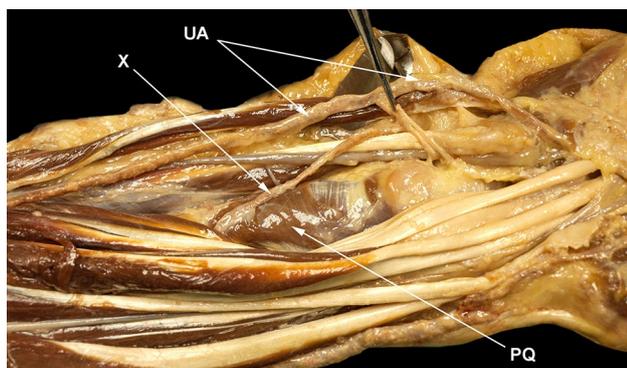


Fig. 2 The accessory branch of the anterior interosseous artery anastomosing with the ulnar artery. *X* anastomosing branch of anterior interosseous artery, *PQ* pronator quadratus muscle, *UA* ulnar artery; interarterial anastomose in pincers

accessory portion of the FCU separated from its proximal part and descended towards the flexor retinaculum, more particularly to the usual insertion site of the palmaris longus muscle (PL) which was absent. During the whole course, the accessory portion of the FCU consisted of muscular fibres featuring two narrow fibrous bands on both sides, medially and laterally (Fig. 1). Dissection of deeper structures revealed an accessory branch of the AIA coursing over the pronator quadratus muscle to anastomose with the ulnar artery 5 cm proximally to the pisiform (Fig. 2). Both palmar and dorsal terminal branches of the AIA were normal. The superficial palmar arch was of the radioulnar type according to Lippert and Pabst's classification [9]. The recurrent branch of the median nerve was of extra-ligamentous type according to Poisel's classification [13].

In the left upper limb, the PL was present without any anomaly, but there was a variable first lumbrical muscle originating from the flexor retinaculum and running towards the second finger. The recurrent branch of the median nerve (of subligamentous type according to Poisel's classification)

coursed between the tendon of the first lumbrical muscle and the flexor retinaculum [13].

Discussion

Bhardwaj's classification (based on a thorough review) distinguishes three types of the FCU. Type I is a single muscle with two tendons and was reported in four cases. Type II (digastric FCU) consists of two heads each forming a separate muscle and was observed in seven cases. Type III (accessory FCU) is a supernumerary muscle in addition to the usual FCU and was reported in 13 cases [4].

We would like to modify the Bhardwaj's classification and divided the Type III into Subtypes A and B according to the supernumerary muscle insertion as those subtypes differ significantly in their structure, course and insertion: Type IIIA with FCU-like insertion (pisiform, triquetral and abductor digiti minimi muscle) and Type IIIB with PL-like insertion (flexor retinaculum, palmar aponeurosis). The Type IIIA was previously described in 11 cases, Type IIIB in 2 cases.

Critically speaking we could consider Type IIIB as an aberrant PL with fusion of its belly with the FCU. Considering that the PL and FCU arise from separate embryologic muscular masses, we must agree with the previous case reports of Lemon, Arnold and Campos to call this muscle an accessory FCU [3, 5, 8].

Variability of the FCU is considered very rare. Ang et al. [2] state that they found one case in 5000 cadaveric hands in Australian population; on the other hand Mori [12] found four cases in 205 upper limbs in Japanese population.

A review of the literature was recently presented in Bhardwaj's study, and therefore we do not find it necessary to list all the previous cases in this case report [1]. What we found interesting was the susceptibility of patients with FCU Type III to have more concomitant variants (Table 1). It was not possible to list concomitant variants in all previous reports as some of them were performed only by MRI [5, 11] or during surgery [2, 6].

The AIA has palmar and dorsal terminal branches. The palmar terminal branch supplies the pronator quadratus muscle, running deep underneath and joining the anterior carpal arch. Immediately after the dorsal terminal branch penetrates the interosseous membrane of the forearm, it anastomoses with the posterior interosseous artery and forms the dorsal septocutaneous branch that can be used for free flaps. Then, it continues together with the posterior interosseous nerve towards the wrist where it joins the dorsal carpal arch. In our case, there was an accessory branch that coursed over the pronator quadratus muscle and anastomosed with the ulnar artery. This extremely rare variant could complicate surgical

Table 1 Review of reported insertions and coexisting variations with accessory FCU types IIIA and IIIB

| Author | Insertion | PL | Variants |
|-----------------------|-----------------|---------------|---|
| <i>Type IIIA</i> | | | |
| Ang et al. [2] | Triquetral | Not specified | Ulnar nerve running outside ulnar canal; its deep branch originating proximal to FR |
| Arnold and Zech [3] | FR and pisiform | Present | None described |
| Campos et al. [5] | ADM | Present | None described |
| Chong et al. [6] | Pisiform | Present | None described |
| Georgiev et al. [7] | Pisiform | Present | Median artery (palmar type) |
| Milena et al. [11] | Pisiform | Not specified | None described |
| Mori [12] | Not specified | | |
| <i>Type IIIB</i> | | | |
| Alvin et al. [1] | FR and PA | Present | PL insertion displaced more laterally |
| Lemon and Belcher [8] | FR and PA | Absent | None described |
| Kunc [this study] | FR and PA | Absent | Accessory branch of anterior interosseous artery |

ADM abductor digiti minimi muscle, FR flexor retinaculum; PA palmar aponeurosis

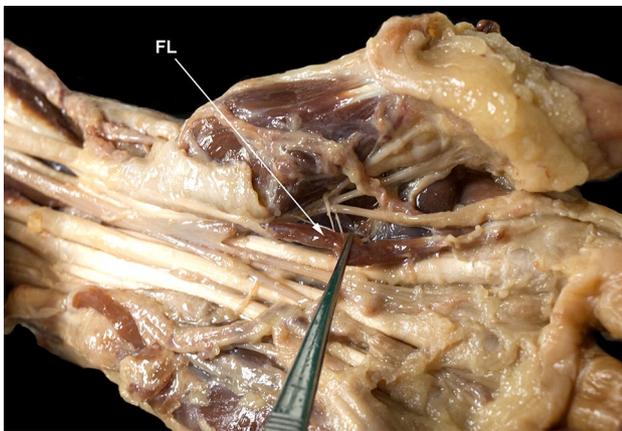


Fig. 3 Variant origin of the first lumbrical muscle (in pincers) with close relationship to the recurrent branch of the median nerve. FL first lumbrical muscle

approach towards the head of the ulna. We found only one case of such artery described in the literature [14] (Fig. 2).

To our best knowledge, the lumbrical muscle for the second finger originating from the flexor retinaculum has not been described in the literature before even though there are reports describing high (more proximal) origin of other lumbrical muscles [10]. In this case, the limited approach release of the flexor retinaculum in the carpal tunnel syndrome could be quite complicated as the subligamentous type of the recurrent branch of the median nerve was running under the origin of the first lumbrical muscle (Fig. 3). Similar muscle was described during operation of a woman having symptoms of the carpal tunnel syndrome. In this case, the median nerve was divided into two portions by an aberrant lumbrical muscle lying in between which then joined the usual lumbrical muscle. Proximal dissection was not performed as it was not necessary during the surgical

approach. Therefore, origin of the muscle remains unknown in this case [15].

AFCU commonly occurs together with concomitant variants, and special attention is needed when performing surgery on such forearm.

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Author's Contribution VK was involved in project development, dissection, and manuscript writing/editing. MS contributed to photo documentation, its processing and manuscript writing/editing. GF was involved in dissection supervision and manuscript writing/editing. DK contributed to manuscript writing/editing.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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