



An unusual variation of the tendons of extensor digitorum with clinical significance

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Abstract

There are many variations of the tendons of extensor muscle group of the forearm. During routine dissection in the section hall of the Department of Anatomy and Histology in Medical University – Sofia we came across a very interesting variation of the tendons of common extensor digitorum muscle. We observed two additional tendons of extensor digitorum inserting to the ring finger on the left upper limb. The radial tendon is thicker than two additional tendons located medially. Moreover the ulnar tendon divided distally into two bellies, one to the ring finger and the other inserting to the little finger. We also observed two additional intertendinous connections, one between the radial slip and the middle slip, and the other between the middle slip and the ulnar slip of extensor digitorum inserting to the ring finger. In hand surgery the tendon of extensor indicis usually is used to restore the loss of function in other digits especially for the tendons of the thumb. All described previously variations including our case have great significance in hand surgery, because they may use as a material for graft in case of injury of the extensors and flexors of the forearm and the hand.

Keywords: Common extensor digitorum, variations, clinical significance, hand surgery.

Introduction

The common extensor digitorum muscle is one of the muscles belonging to the posterior muscle group of the forearm so called extensor-supinator group. The main function of common extensor digitorum is extension of the I-IV fingers as in opening the clenched fist. In addition, it abducts the index, ring and little finger during a spreading

action away from the middle finger. This muscle is also is the main extensor of the hand at the wrist. The common extensor is supplied by a branch of the deep radial nerve (Clemente, 1985). In this way the muscle plays an important role in hand dexterity during object manipulations. Many variations concerning extensor muscle group of the forearm are described in the literature.

Materials and Methods

Experimental material

The material for the present study was taken from human cadaveric material. Fixation of cadaveric material in the dissecting room training for students and graduates of each medical university in the European Union is very specific and regulated by the principal politic of state law. During routine dissection in March 2019 in the section hall of the Department of Anatomy and Histology in Medical University, Sofia, we came across a very interesting variation of the tendons of extensor digitorum. As a material for the present study was used upper limb from human cadaveric material.

The observations were made in accordance to the ethical principles applied by the Sofia's Medical University. All legislative requirements to protect human rights have been respected as well.

Macroscopic observations

The presented unusual anatomical variation of the tendons of extensor digitorum was photographed

using a Nikon Colpix 95 camera with a 3.34 Megapixels. We take some pictures to describe this observation.

Results

We came across the presence of two additional tendons of extensor digitorum inserting to the ring finger on the left upper limb (Figure 1). The radial tendon is thicker than two additional tendons located medially. For this reason we called the radial tendon – main tendon and the two additional tendons middle and ulnar, in relation to the inserting of the ring finger. Moreover the ulnar tendon divides distally into two bellies, one to the ring finger and the other inserting to the little finger together with the tendon of extensor digiti minimi for the little finger. In addition, a very thin belly arose from the main radial tendon. This thin tendon belly joined to the tendon for the middle finger. The intertendinous connections between the tendons were more than three as usual. We observed two additional intertendinous connections, one between the radial slip and the middle slip, and the other between the middle slip and the ulnar slip of extensor digitorum inserting to the ring finger (Figure 2 and 3).



Figure 1. Two additional tendons of extensor digitorum inserting to the ring finger on the left upper limb. Radial tendon (**marked with white hand**), middle tendon (**marked with arrow**) which is partially covered by the radial and finally ulnar tendon (**marked with white hand with asterisk**). There were seen intertendinous connections between the tendons and they were more than three as usual (the first connection between slip to the index and the middle finger was cut).



Figure 2. A very thin belly (**marked with arrow**) arose from the main radial tendon. This thin tendon belly joined to the tendon for the middle finger. Here are seen two additional intertendinous connections one between the radial slip and the middle slip (**marked with white hand**), and the other between the middle slip and the ulnar slip (**marked with stripped red-white hand**) of extensor digitorum inserting to the ring finger (the first connection between slip to the index and the middle finger was cut).



Figure 3. The radial tendon is thicker than two additional tendons located medially. Moreover the ulnar tendon divides distally into two bellies, one to the ring finger (**marked with arrow**) and the other inserting to the little finger (**marked with white hand**) together with the tendon of extensor digiti minimi for the little finger.

There are many variations of the tendons of extensor muscle group of the forearm. In 1995 von Schroeder and Botte described the most common distribution patterns of the extensor tendons of the fingers. According to them the most common distribution patterns of the extensor tendons of the fingers were as follows: (1) a single extensor indicisproprieus (EIP) tendon that inserted ulnar to the extensor digitorumcommunis (EDC) of the index; (2) a single EDC-index; (3) a single EDC-long; (4) a double EDC-ring; (5) an absent EDC-small; and (5) a double extensor digiti quinti (EDQ) with a double insertion. Frequent variations included, a double EIP tendon; a double or triple EDC-long tendon; a single or triple EDC-ring tendon; and a single or double EDC-small tendon. The extensor mediopropraeus was noted in 5 specimens.

Later Celik et al. (2008) described, that the most common distribution patterns of the extensor tendons of the fingers were as follows: a single extensor indicisproprieus (EIP) tendon which inserted ulnar to the extensor digitorum (ED)-index; a single ED-index; a single ED-middle; a single ED-ring; an absent ED-little; a double extensor digiti minimi (EDM), and a single ED-ring to the little finger. The frequency of the number of tendons is as follows: a single (87.03%) EIP, a single ED-index (100%), a single (92.6%) ED-middle, a single (75.9%) ED-ring, and an absent (68.5%) or a single (24.1%) ED-little. A double (88.9%) EDM tendons were seen.

Dhuria et al. (2009) described another interesting variation with partial absence of common extensor digitorum muscle to the index and little finger combined with double slip to the middle finger and usual dorsal expansion of ring finger. In addition, an accessory muscle was found with an aponeurotic origin from the upper part of the posterior surface of radius, running along with the superficial muscles of the back of the forearm.

Similar variations were described previously in an anatomical study comprising 50 hands. The extensor digitorumcommunis provided one tendon to the index finger, one to the middle

finger, two to the ring finger, and none to the little finger. The extensor indicis exhibited one tendon, whereas the extensor digiti minimi exhibited two tendons. The extensor indicis was absent in both hands of one cadaver. A tendon slip from the extensor digiti minimi to the ring finger was observed in one hand (Zilber and Oberlin, 2004).

Irrespective of described variations of their tendons particularly on the ulnar side of the hand extensor muscles have a relatively consistent architecture and function. The extensor tendons, juncturaetendinum, intertendinous fascia, and soft tissue function as a plexiform construct to provide stability during power grip and allow for laxity in performing independent fine finger tasks. The greater independence of index finger motion relates to its two tendons, one (EDC-index) with a thin transverse juncturaetendinum, the other (EIP) without a junctural connection. It is also more independent because of a more mobile metatarsal, and because it is confined by only one web. The first dorsal interosseous also functions to rotate the index finger. The lumbrical to the index finger has only a single origin on the flexor profundus tendon (von Schroeder and Botte, 1997).

It is interesting to mention the case where extensor carpi radialis brevis muscle had an accessory head. Tendon of this accessory head attached to dorsum and proximal phalanx of the index finger. In addition to this variation, extensor digitorumcommunis muscle divided into three tendons distally. These three tendons went to middle, ring and little fingers, whereas the tendon of index finger was absent (Yaşaret al., 2017).

Our results are similar to the variations described in 1995 by el Badavi et al. According to their results extensor digitorum often had multiple tendons for both the middle and ring fingers. Its contribution to the little finger was usually by a bifurcating tendon common with that of the ring finger. The index finger always received a single tendon. Intertendinous connections between the various tendons of the extensor digitorum were

variable but were most frequent between ring and middle fingers. Extensor indicis had one tendon in most of the specimens and it was always on the ulnar side of the extensor digitorum tendon. This remained true even when there were multiple tendons. Extensor digiti minimi had two tendons in most cases. It was always linked to extensor digitorum either by receiving one or part of its tendon or by an intertendinous connection.

It is known that the extensor indicis tendon is frequently used to restore the loss of function in other digits especially for the tendons of the thumb. However, it shows many variations which include splitting of the extensor indicis proprius (EIP) into two or three distal slips, attachment to fingers other than the index such as the extensor medii proprius (EMP), attachment onto the index and the third finger such as the extensor indicis et medii communis, or attachment to both the index and the thumb such as the extensor pollicis et indicis (EPI) (Yamine, 2014).

Discussion

As it is seen the variations of the extensor muscle group of the forearm are too many. These variations comprise not only the common extensor digitorum but also extensor indicis proprius and extensor digiti minimi. In the literature there are variations of the muscles inserting to the thumb, but these variations are not the subject of this discussion.

All described previously variations of the extensor muscle group of the forearm, including our case have great significance in orthopedics and traumatology especially in hand surgery, because they may use as a material for graft in case of injury of the extensors and flexors of the forearm and the hand. The ruptures of the extensors (especially on the tendon of the extensor pollicis longus) like the ruptures of the flexors need surgery as soon as possible.

Knowing of these variations of course can help surgeons in correctly choosing the appropriate tendon to transfer in hand surgery.

Conflict of Interest Statement

The authors do not have any conflicts of interest to declare.

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