



Multiple variations of extensor muscles in a single hand

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Abstract

Multiple variations of extensor muscles on one hand are very rare.

We found in the right hand: 1. M. extensor digitorum was split into two separate muscles; 2. M. extensor pollicis et indicis; 3. M. extensor indicis et digiti medii. All their tendons were in the 4th compartment. The extensor digiti minimi muscle showed a doubled tendon.

Besides, we classified the course of tendons in the fourth compartment into a superficial and a profound level.

Moreover, we defined the innervation by dissecting the deep branch of the radial nerve having direct branches into the muscles.

In our case the extensor pollicis longus muscle was double innervated by a branch of the deep radial nerve and also by a small branch of interosseus antebrachii posterior nerve.

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Introduction

The extensor muscles of the hand showed many variations in shape. Its of peculiar interest for surgeons in the field of tendon repair, transfer or reconstruction. In literature several forms of anatomical variations were described: variations of long muscles, supernumerary tendons and additional muscles [1].

Different classification systems were developed by Kosugi [2], Yoshida [3], Komiyama [4] and Türker [5].

Case Report

In our dissection course we found in the right hand of an 81-year-old male multiple variations of extensor muscles. The left hand did not show any variations.

In the superficial level there were regular extensor carpi radialis longus and brevis (ECR) as well as extensor carpi ulnaris (ECU) muscles.

The extensor digitorum muscle (ED) was split into two portions.

One was originated at the lateral epicondyle of the humerus together with ECR brevis and runs on the radial side of the fourth compartment and adds to extensor apparatus of the

index finger. This tendon was located radial to the tendon of the extensor indicis and digiti medii muscle (EIME).

Moreover, there was an intertendinous connection to the tendon of ED of the middle finger. (Figure 1) We called this part extensor indicis longus muscle (EIL).

The second part arose from the ulna and the interosseous membrane. One tendon, separating in the half of the muscle, runs in the superficial level of the fourth compartment to the middle finger. Furthermore, there was a second tendon to the ring finger. Both tendons expanded and add to the intertendinous connection and inserted in the extensor tendon apparatus of the third and fourth finger (Figure 1).

Furthermore, we found a strong intertendinous connection to the tendon of the extensor digiti minimi muscle (EMi).

Each part was innervated by an own direct short branch of deep branch of radial nerve.

Additional we found an EMi with a doubled tendon (Figure 1).

In profound level we found a regular extensor pollicis brevis (EPB), abductor pollicis longus (APL) and extensor pollicis longus muscle (EPL) (Figure 2).

An additional muscle arising from the lower third of the ulna and interosseal membrane was the extensor pollicis and indicis muscle (EPI). Its tendon was separating on the base of the metacarpale bone: one part, led to the thumb and the other smaller part to the tendon of the index finger. The part to the thumb meets the tendon of EPL. The tendon of the index finger inserted to the extensor apparatus radial from the tendon of the extensor digitorum (Figure 1).

The muscle was innervated by a long ulnar branch of profound radial nerve.

Distal to the EPI the additional EIMe arose from the ulna and the interosseus membrane. Its belly ended directly in front of the fourth compartment of extensor retinaculum. From this point there were two tendons, one running to the extensor apparatus of the index finger adding deeper, ulnar to the tendon of ED. Some fibers inserted to the capsule of the carpometacarpal joint. The smaller one led to the middle finger. The second tendon was covered from the tendon of ED and becoming expanded till insertion.

This muscle was also innervated by the long ulnar branch of deep branch of the radial nerve.

We classified a superficial and a deep level of tendons in the fourth compartment. From radial to ulnar there were in superficial level the tendons of ED to the index, the middle finger and to the ring finger. In the deep level we found tendons of EPI, EIMe, from radial to ulnar.

It is remarkable that the tendon of ED to the index intersects the tendon of EPI in the compartment. Both levels were divided by tendon sheaths. The deepest structure in compartment was posterior interosseus nerve (Figure 3).

The dimensions of the variant muscles shown in Table 1.

In our case extensor EPL, EPI, also EIMe were innervated by a branch of deep branch of radial nerve running ulnar (Figure 2). Exceptional was that the EPL was additionally innervated in the lower third by another branch of deep radial

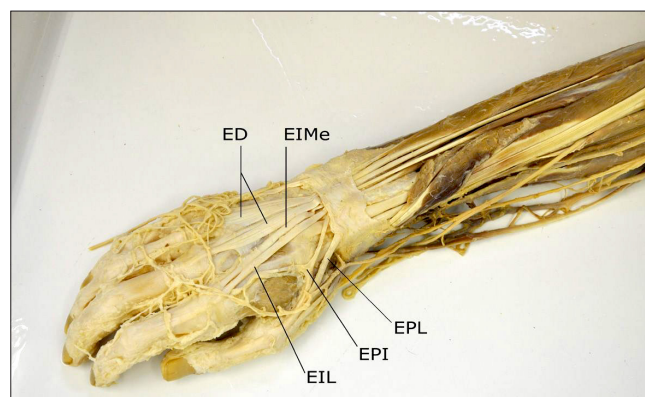


Figure 1. Extensor muscles of the right hand running in the 4th compartment. (**ED:** extensor digitorum; **EIMe:** Extensor indicis et digiti medii; **EIL:** Extensor indicis longus; **EPI:** Extensor pollicis et indicis; **EPL:** Extensor pollicis longus)

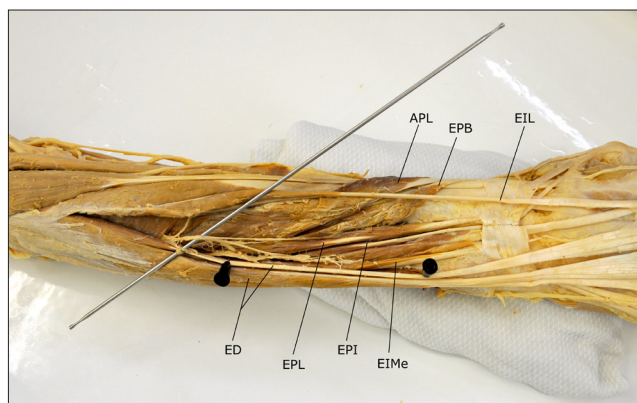


Figure 2. Radial nerve (probe) and deep extensor muscles. (**APL:** abductor pollicis longus; **EPB:** extensor pollicis brevis; **EIL:** extensor indicis longus; **ED:** extensor digitorum; **EPL:** extensor pollicis longus; **EPI:** extensor pollicis et indicis; **EIMe:** extensor indicis et digiti medii)



Figure 3. The deepest structure in compartment was the posterior interosseus nerve (**NID**). (**EPI:** extensor pollicis et indicis; **EPL:** extensor pollicis longus; **EIL:** extensor indicis longus; **ED:** extensor digitorum longus)

nerve running radial. We could identify this radial branch as posterior interosseus nerve (Figure 3).

Discussion

The muscle variations in the present case were individual described in literature but not combined on one hand.

Metha described an ED which accords to our case. He named this profound muscle extensor indicis [6].

In our case the intertendinous connections in the second intermetacarpal space (between index and middle finger) were in accord to Schroeder [7] case 1; the intertendinous connection in the 3. and 4. intermetacarpal space were described as type 3r.

Remarkable is, that humans in contrast to some vertebrates always have an EPL, EPB and EI when there is a complete EPI [1, 3].

Based on classification systems of Yoshida [3], Komiyama [4] and Türker [5] we classified our EPI as Yoshida type 2b, Komiyama type 2b or rather Türker type 1e.

Table 1. Dimensions of the variations of the extensor muscles of the forearm.

	Compartment	Belly of the muscle		Tendon	
		Length (cm)	Width (cm)	Length (cm)	Width (cm)
M. extensor indicis „longus“	4.; radial, superficial	13,0	0,9	17,0	0,35
M. extensor digitorum	4, ulnar , superficial	middle finger 20,0 ring finger 10,0	2,5	middle finger	11,5 0,5 to 2,0
				ring finger	25,0 0,4 to 1,2
M. extensor pollicis et indicis	4.; radial, deep	5,5	0,3	before splitting	8,0 0,2
				thumb	2,5 0,2
				index finger	5,0 0,15
M. extensor indicis et digiti medii	4.; ulnar, deep	8,5	0,4	index finger	10,5 0,4
				middle finger	10,0 0,07 to 0,2
M. extensor digiti minimi	5.	15,0	0,9	14,0	proximal the compartment 0,3 distal 2 x 0,4

When a classification of the compartment was mentioned, all authors described that the EPI running through the fourth compartment, as well. Merely Gruber [9] found in one out of 408 hands a tendon running through the third compartment. In anatomical studies the frequency of EPI was very different between 0.5 and 5.1% [1].

The EIMe muscle was described quite often in literature. The prevalence of this muscle is between 0.5 and 16% [1]. Yoshida [3] classified this muscle in nine types. Our case equates type IIa which Yoshida [3] found in 3.3 % of his cases. Komiyama [4] classified this case as type 3a. Kosugi [2] described our variation as type IIIb-1.

An EMI with a doubled tendon Kosugi [2] found in 78 % of cases (403 of 516), Mesdagh [9] found only 2 out of 150 extensor digiti minimi muscles with only one tendon and Zilber [10] found doubled tendons in all 50 hands he prepared. In contrast to the literature we could identify exactly the innervation (Figure 2 and 3).

Conclusion

The described variations of extensor muscles were asymptomatic in most cases. But the knowledge is important for surgical interventions.

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