

## Case Report: Uncommon Insertion of the Extensor Pollicis Longus Muscle: Clinical and Anthropological Significance of this Variation

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**KEYWORDS** Anthropology. Extensor Pollicis Longus. Extensor Tendon Variation

**ABSTRACT** The role of the hand width anthropometric measurement in the estimation of grip strength is seen to be approximately fifty percent. Variation in the extensor pollicis longus muscle is important in daily life based on the fact that the thumb plays an important function, which is to grab objects and to hold them between two fingers. In this study, dissection was being performed on a male cadaver, approximately 55-year-old at the Department of Anatomy, Kocaeli University. Researchers encountered a unilateral extensor pollicis longus muscle variation that took origin from posterior of the radius and continued at medial side of the extensor pollicis brevis muscle and then ended at the tuberculum radii, whereas the extensor pollicis longus muscle had to end at distal phalange of the thumb. Therefore, information about the anatomic variations of hand and wrist muscles is not for anatomists alone but it is also important for surgeons. For these reasons, it is necessary to follow the variations in the forearm extensor region.

### INTRODUCTION

Anthropometric parameters are frequently used by physicians and health professionals to distinguish between healthy and sick persons. The differences in the proportion of the body are also important for diagnosis and treatment. Due to the fact that hand length and palm width are used for these measurements, muscle variations of the hand and wrist may cause misinterpretation of these measurements. For a correct diagnosis of hand and wrist anthropometric measurements, muscle variations should also be considered separately. In the estimation of grip strength, the role of hand width anthropometric measurement is seen to be approximately fifty percent. Due to the fact the thumb plays an important function to grab objects and to hold them between two fingers, variation of the Extensor Pollicis Longus (EPL) muscle is seen to be im-

portant to daily life. Additionally, it can be seen in the literature that the deficits of thumb interphalangeal joint extension could provoke the rupture of the EPL tendon. According to multiple cadaver dissections, the extensor pollicis brevis tendon insertion variation is highly seen. This variation varies from the thumb proximal phalanx as well as the extensor hood to the distal phalanx. Therefore, as the extensor pollicis brevis tendon extends to the thumb interphalangeal joint, it is far affordable to assume that a minority of the EPL tendon ruptures may be clinically ignored (Strauch and Strauch 2016).

Therefore, it is known that the hand and the wrist are used to perform daily activities. So any muscle variation may prevent movements of the hand and wrist, accessory muscles may also cause compressive neuropathy and it can be confused with soft tissue swelling (Tan and Smith 1999). Thus, in literature, variations in both extensor and flexor muscles of hand and wrist are frequently encountered, but the EPL tendon variations are viewed as the most steady structure with the minimum variety found among people. There have been some reviews concerning extraordinary varieties of supernumerary tendons, but according to a study by Kim et al. (2016)

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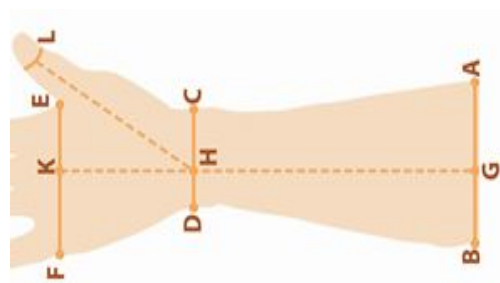
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an abnormal path of the EPL tendon is extremely uncommon.

All these aforementioned researchers performed this research, not only to aid anatomists, but also radiologists and hand surgeons during hand and wrist microsurgery.

### MATERIAL AND METHODS

On the cadaver desk of the anatomy lab in the Department of Anatomy at Kocaeli University, dissection was carried out on a male, approximately 55 years old in prone position, the upper extremity having 90° abduction, the elbow and the wrist were in full extension and the wrist was in neutral position, dissection was being performed. During the routine dissection of the forearm dorsal region, firstly, in order to remove the skin, a horizontal incision from elbow (A-B) level was done (Fig. 1). Then, a second horizontal incision was performed at the wrist (C-D) level, after that through center point of both incisions, a vertical incision (G-H) was also performed through the center point of both incisions (Noyan 1993). Likewise, aponeurosis of the forearm back side has been incised with a vertical incision and leaves folded to both sides. Extensor muscles have been seen under aponeurosis. As muscles in the first plan, respectively m. Anconeus, m. Extensor carpi ulnaris, m. Extensor digiti quinti proprius and m. Extensor digitorum communis have been seen. With an incision through the center point of each of them, as second plan muscles m. Abductor pollicis lon-

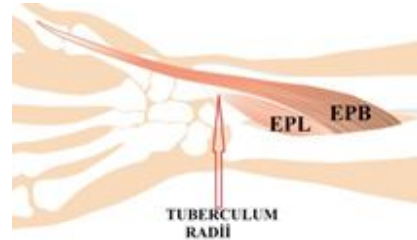


**Fig. 1. Dissection method of forearm and dorsum of the hand**

**A-B: Horizontal incision from the elbow level**  
**C-D: Horizontal incision from the wrist level**  
**G-H: Vertical incision through the center point of A-B and C-D**

Source: Author

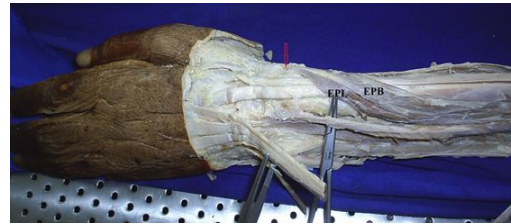
gus, m. Extensor pollicis brevis, m. Extensor pollicis longus, and m. Extensor indicis proprius have been seen as second plan muscles. During this fine dissection, the EPL muscle variation has been observed (Figs. 2 and 3).



**Fig. 2. Insertion variation of the extensor pollicis longus muscle**

**The EPL muscle was inserted on tuberculum radii instead of the distal phalange of the thumb (EPL: extensor pollicis longus; EPB: extensor pollicis brevis)**

Source: Author



**Fig. 3. Dorsal view of forearm and hand showing tendons of the extensor pollicis longus (EPL) and the extensor pollicis brevis (EPB).**

**The EPL muscle was inserted on the tuberculum radii instead of the EPL muscle phalange of the thumb**

Source: Author

### RESULTS

Researchers encountered a unilateral EPL muscle variation that took origin from posterior of the radius and continued at medial side of the extensor pollicis brevis muscle and ended at the tuberculum radii, whereas, the EPL muscle had to end at distal phalange of thumb.

### DISCUSSION

Hand anthropometric measurements have been particularly involved in many studies. The hand is an organ of both motion and sense. Shoulder, arm, elbow, forearm and wrist function should be normal and to a certain extent be able to demonstrate full hand functionality. Balanced pos-

tures of the hand are due to tendon forces and sutural-ligaments and consist of bone structures that are sequentially connected to each other (Shmidt and Lanz 2003). For example, in order to evaluate the gripping force of the finger, anthropometric measurements such as the forearm length and the finger length are performed (Nicolay and Walker 2005). Therefore, muscle variations of hand and wrist disrupt the functionality of fingers, gripping power of the finger and balance of upper extremity. The researchers found in this research variation of the EPL muscle, which gave a better understanding of topographic anatomy of the hand and wrist, and that taking into consideration the connection between grip force and hand anthropometric characteristics will be helpful for diagnosis and treatment of hand and wrist. Also, like the EPL muscle variation, forearm or hand dorsum muscle variations may cause pain and can be assessed incorrectly as soft tissue tumor, synovial cyst or tendovaginitis.

According to a research, the EPL anomalies are rarely shown in literature. The researchers assert that the most widely recognized variety is a gathering of various ligament duplications going through the fourth compartment without signs and symptoms. The second type of variation is related to direction of the EPL having critical clinical significance because of the inclination for making tenosynovitis. Furthermore, Rubin et al. have taken attention that the clinical symptoms of radial dorsal wrist pain mimicking intersection syndrome or de-Quervain disease with the absent snuff box sign should raise suspicions for an anomaly in the course of the EPL (Rubin et al. 2011).

The course variation of the EPL muscle that the researchers found during dissection may result in pain as highlighted above and can also be incorrectly assessed as soft tissue tumor, synovial cyst or tendovaginitis. Parallel to this research, an EPL tendon was found with an anomalous course. In their study, Hong et al. define that the EPL showed an abnormal insertion toward the radial side of the proximal phalanx, and not to the distal phalanx. It passes the wrist through the third compartment, but it is out of the third compartment at the carpal bone level and inserted on the radial side of the thumb as the first compartment (Hong et al. 2013). Also, they define a wrist pain as triggering tenosynovitis.

In order to evaluate better clinical symptoms of the extensor muscles, it is necessary to know alongside, the distribution of deep branches of radial nerve (Alport and Sander 2012). Based on this closeness to the extensor muscles, variations of extensor muscles are important. Tendon variations of the extensor indicis muscle are of significant importance to surgeons, because this muscle is often used in tendon grafts (Godwin and Ellis 1992; Celik 2008). Anatomically and mechanically, for reconstruction of the EPL muscle, graft of the extensor indicis muscle is better preferred, because both the length of fibers and physiological cross-section areas are the same for both muscle (Nigst and Linder 1989; Lieber et al. 1992). As in the EPL variation, the researchers found in this case report that these kinds of variations should be known by surgeons during hand and wrist surgery, and that extensor tendon injuries should be evaluated clinically.

The EPL muscle, while passing through the wrist, is located in the deep of third compartment of musculorum retinaculum extensorum. It takes origin from the radius and the ulna's posterior and ends at distal phalanges (Williams et al. 1998). It is the main extensor muscle of interphalangeal and metacarpophalangeal joints of thumb. Another important function of it is to ensure the thumb to be raised to the dorsal of palmar level. When looking at the EPL variations in literature, usually one has seen differences in the number of tendon and insertion (Abdel-Hamid et al. 2013). During dissection, the researchers encountered a unilateral EPL muscle variation. This muscle takes its origin from posterior of the radius and continued at medial side of extensor pollicis brevis muscle and ended at the tuberculum radii, whereas the EPL muscle had to end at distal phalange of thumb. In literature, in general, the hand and wrist extensor muscle variation are frequently encountered but the EPL muscle tendon variations are rare. Parallel to this study, Sevivas et al. had mentioned a tendon variation in their study. The EPL tendon passed as two separate slips from different compartmental levels of the wrist (Sevivas et al. 2009). In another cadaver study, in 95 dissected upper extremity, the EPL muscle has been observed in all specimens and 67.4 percent of them has single tendon while 32.6 percent has double tendon. In 94.7 percent of cadavers, the EPL muscle tendons ended at both proximal phalanges and distal phalanges and 5.3 percent end at distal phalanges (Abdel-Hamid et al. 2013). Similar to this research,

other researchers depict a case of a different course of a single EPL tendon, which has not been already reported. This case was watched by chance during wrist surgery, and shows an extraordinary variety of tendon course showing up in the second extensor compartment of the wrist. The information of this anatomic variety is beneficial in surgical case for correct diagnoses (Kim et al. 2016). In another case report study, researchers found an anomalous bilateral contribution from the EPL. There was an unusual bilateral contribution from a slender auxiliary tendon that crossed laterally under the extensor retinaculum, entered the first dorsal compartment of the wrist and merged with the tendon of the extensor pollicis brevis muscle. In the same cadaver, an anomalous muscle fusion of the abductor pollicis longus and the extensor pollicis brevis has been observed (Rosa et al. 2016).

### CONCLUSION

Among anthropometric measurements, hand width is the most effective factor, which affects grip force level and the thumb plays an important role. Therefore, the researchers consider taking into account the variation of the extensor pollicis longus muscle in such situations. Also, the extensor pollicis longus variation plays an important role in hand and wrist surgery, because during operations, surgeons may encounter these types of variations at operations such as tendon grafts. Furthermore, like the extensor pollicis longus variation, forearm or hand dorsum muscle variations may cause pain and can be assessed incorrectly as soft tissue tumor, synovial cyst or tendovaginitis.

### RECOMMENDATIONS

Because the anatomical and functional disorders of the human body can be assessed, also using anthropometric measurements, in aging and illness situations, anthropometric examination of the changes in these quantitative relationships become paramount. For these reasons, it is necessary to follow the variations in the forearm extensor region and more research need to be carried out on this topic.

### ACKNOWLEDGMENTS

The researchers would like to thank Fatma D. Cakirtas for her help in drawing the schematic figures.

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Paper received for publication on January 2016  
Paper accepted for publication on December 2016