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CASE REPORT

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A very rare case of the accessory palmaris longus muscle and clinical significance

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The palmaris longus muscle is located in the forearm region. Its morphological variability was noted during standard anatomical dissection of the upper limb. The muscle was characterised by a normal course, i.e. originating from the medial humeral epicondyle and inserting into the palmaris aponeurosis, but a small additional tendon attached to the flexor retinaculum was observed in its distal part. An accessory palmaris longus muscle was also observed nearby. Interestingly, this accessory muscle was reversed, and the first part was not muscular, but tendinous, represented by 2 tendons originating from the common muscular mass attached to the medial epicondyle of the humerus; these later connected together, creating one muscle belly distally attached to the flexor retinaculum. This additional structure was innervated by a neural branch from the median nerve, and the ulnar artery was responsible for blood supply. The course of the median nerve is also clinically important because, before entering the carpal tunnel, it was located directly under the accessory palmaris longus muscle. In turn, the ulnar artery passed through a special hole created by the flexor digiti minimi brevis and flexor retinaculum, before passing under the palmaris brevis muscle. (Folia Morphol 2024; 83, 2: 489–495)

Keywords: accessory palmaris longus, bifurcated palmaris longus, median nerve compression, morphological variations, Palmaris longus, palmaris profundus, reversed palmaris longus

INTRODUCTION

The palmaris longus muscle (PML), located on the forearm region, is characterised by a high level of morphological variability. Together with 4 other muscles: the pronator teres, the flexor carpi radialis, the flexor carpi ulnaris, and the flexor digitorum superficialis, it belongs to the anterior compartment of the forearm. This is more specifically known as the superficial muscular group [8].

In most cases, the PML is innervated by the median nerve. Its proximal attachment is located on the medial epicondyle of the humerus. In turn, its insertion is represented by a flattening of the flexor retinaculum and the lower part of the palmar aponeurosis. The PML takes part in flexing the wrist joint and small joints of the hand; however, its absence does not result in any significant weakness of wrist flexion [8].

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As it mentioned above, the PML is morphologically variable. The most common variation is its absence. According to Adachi [1], the frequency of PML absence is influenced by the studied population (from 4 to 20%), the side of the body, or sex, with the PML being absent more often among female subjects. Interestingly, the PLM may also be doubled; in these cases, one muscle follows a normal course, while the accessory may originate from various other structures, e.g. the biceps brachii or brachialis muscles, medial intermuscular septum, or from the fascia of the forearm [3].

The clinical significance of the PLM depends on its morphological presentation. For example, its absence prevents its use when the muscle is absent; however, when the PML is doubled or tripled, there is additional material for a tendon autograft. In addition, the presence of a reversed PLM, bifid or trifid PML, digastric PML, PML with accessory slips, or reversed PLM with an additional adductor digiti minimi muscle may increase the chance of median nerve compression [5].

An accessory PML innervated by the median nerve was found during standard anatomical dissection of the upper limb. The muscle was reversed, and the first part was not muscular but represented by 2 tendons originating from the common muscular mass attached to the medial epicondyle of the humerus. These 2 tendons then joined, creating one muscle belly distally attached to the flexor retinaculum. In turn, the standard PLM was characterised by a normal course, but a small additional tendon attached to the flexor retinaculum was observed in its distal part. The course of the median nerve is also clinically important, because before entering the carpal tunnel, it was located directly under the accessory palmaris longus muscle. In turn, the ulnar artery passed through the special hole created by flexor digiti minimi brevis and flexor retinaculum and then under the palmaris brevis muscle.

CASE REPORT

A female cadaver, 88 years old at death, donated to science, was subjected to routine anatomical dissection for research and teaching purposes at the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland. The right upper limb was subjected to traditional anatomical dissection [10]and its tendon crosses the median nerve (MN, and morphological variations in the forearm region were recorded.

The PLM was characterised by a normal course. In addition, a small additional tendon was observed in its distal part; it originated from the medial epicondyle of the humerus, and at this point it was 5.87 mm wide and 1.87 mm thick. It consisted of a muscle belly (length 126.56 mm) followed by a tendinous part; in the musculotendinous junction, the PLM was 2.97 mm wide and 0.97 mm thick. The PML tendon was 111.75 mm long, i.e. extending to the palmaris aponeurosis. The small additional tendon was 0.97 mm wide and 0.29 mm thick at the point connecting it with the general tendon of the PML. This small additional structure was 15.48 mm long. Its insertion was connected with the flexor retinaculum, where it was 2.89 mm wide and 0.25 mm thick.

The 'standard' PLM was accompanied by a nearby APLM. Interestingly, this accessory muscle was reversed, and the first part was tendinous instead of muscular. This APLM originated as 2 tendons originating from a common muscular mass formed by the proximal parts of the muscles of the superior layer of the superficial compartment of the forearm; this was attached to the medial epicondyle of the humerus. The first tendon, located laterally to the other, was 90.57 mm long. Its tendon passed into the muscle belly by the tendinomuscular junction, where its width was 3.41 mm and thickness was 0.65 mm. The second tendon, located medially to the first, was 111.59 mm long; it also passed into the muscle belly, and in the tendinomuscular junction its width was 3.52 mm and its thickness was 1.25 mm. These 2 tendons later connected together, creating a single muscle belly with length 131.56 mm, distally attached to the flexor retinaculum. The APLM was innervated by the neural branch from the median nerve. Blood supply was provided by ulnar artery.

The course of the median nerve may be clinically important because, before it entered the carpal tunnel, it was located directly under the APLM. Its width was 7.03 mm, and its thickness was 2.08 mm. The ulnar artery passed through a special hole created by the flexor digiti minimi brevis and flexor retinaculum and then passed under the palmaris brevis muscle. Its diameter was 3.25 mm (Figs. 1–3).

The flexor retinaculum had a unique shape. It was 4.78 mm wide and 0.45 mm thick where it connected to the carpi ulnaris flexor muscle (A), and it was 6.48 mm wide and 0.18 mm thick at the point between the attachment of the APLM and flexor digiti minimi brevis (B). These 2 points (A-B) were 8.71 mm apart. The

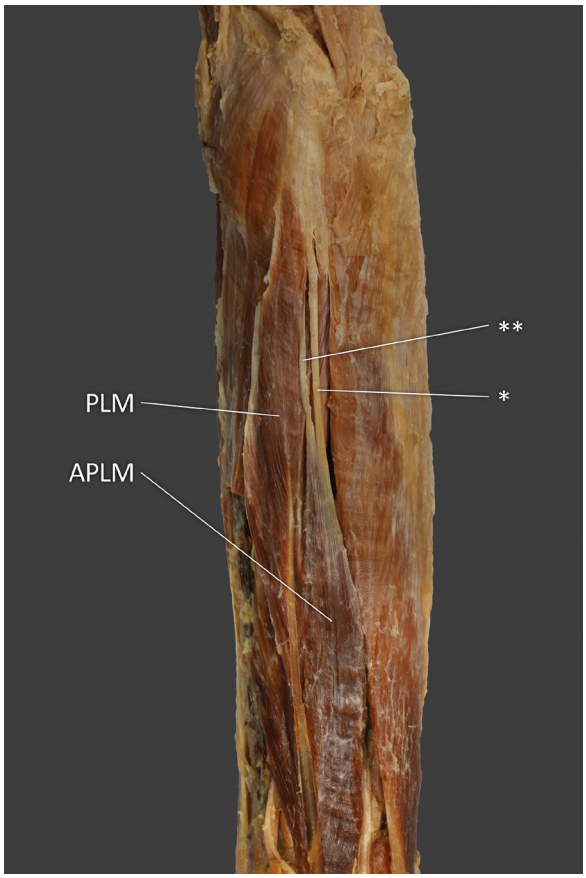

Figure 1. *First tendon of accessory palmaris longus muscle; **second tendon of accessory palmaris longus muscle; PLM — palmaris longus muscle; APLM — accessory palmaris longus muscle.

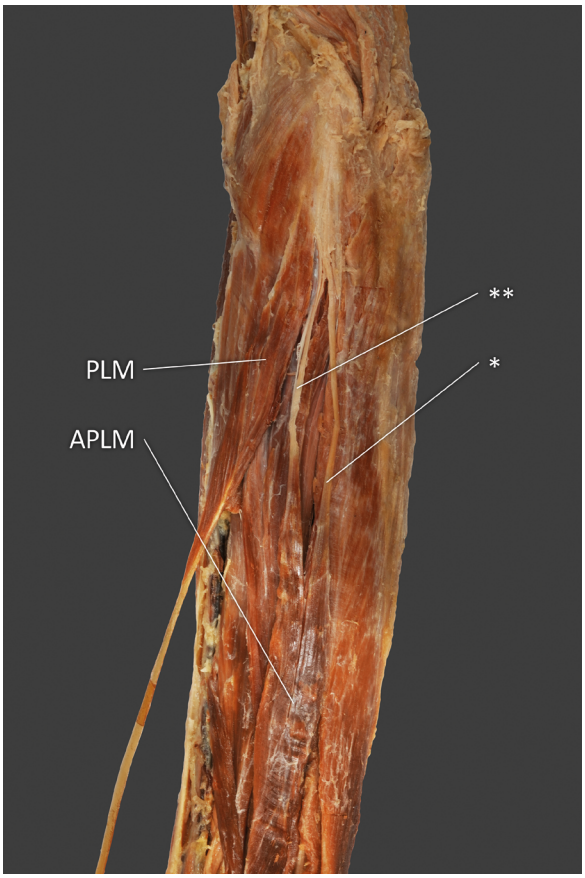

Figure 2. *First tendon of accessory palmaris longus muscle, **second tendon of accessory palmaris longus muscle; PLM — palmaris longus muscle; APLM — accessory palmaris longus muscle.

distance from point B to the point of attachment of the abductor pollicis brevis and the flexor retinaculum (C) was 19.76 mm. Therefore, the total distance from point A to point C was 28.47 mm. The width at point C was 11.77 mm, and the thickness was 0.44 mm.

These measurements were collected using a Mitutoyo Corporation electronic calliper (Kawasaki-shi, Kanagawa, Japan). Each measurement was repeated 2 times with an accuracy of up to 0.01 mm.

When dissecting the upper limb, no other morphological variabilities were found. The morphometric measurements are given in Table 1.

DISCUSSION

The morphological variations of the PLM have high clinical significance. For example, alterations in the course or presentation of the PLM may result in median nerve compression, leading to neuropathy.

One such change is its duplication or even triplication (occurring very rarely), first observed by Reimann et al. [12]. The available literature includes many descriptions of an accessory PLM. For example, Takanashi et al. [14] found a bilateral duplicated PLM located medially to the standard PLM and attached to the flexor retinaculum, with a palmaris profundus muscle also found in the right upper limb, located laterally to the flexor digitorum superficialis muscle. The palmaris profundus was proximally attached to the anterior surface in the middle of the radius, and its tendon coursed radially to the median nerve, through the carpal tunnel. Its insertion was located on the distal part of the flexor retinaculum [14]. Georgiev et al. [5] reported that PLM duplication/triplication occurred in 1.79% of studied upper limbs.

Another morphological variation of the PLM is a digastric muscle, where 2 muscle bellies are located proximally and distally to the tendinous part of the PLM located in its middle part. Such variation was found to occur with a frequency of 0.89% [5]. In addition, the PML may also be reversed, i.e. it originates as

a tendinous part and inserts as a muscular part. Such variation sometimes occurs together with the coexistence of an additional abductor digiti minimi. This variant was observed in 0.89% of cases [5]. Another morphological variation is an intermediate muscle belly, where that first part of the PML is tendinous, the second muscular, and the third again tendinous [5].

Some PLM variations significantly decrease the risk of occurrence of median nerve compression. One example is the absence of the muscle due to embryological agenesis. Olewnik et al. [9] found the PML to be absent in 37.5% of studied upper limbs among foetuses. Interestingly, this value was found to be only 7.5% among adults [10]and its tendon crosses the median nerve (MN. Similar results (8.33%) were obtained by Mathew et al. [7]. In contrast, the PML was found to be absent in 63.9% of studied cases in a Turkish population [4], and at a similar frequency in an Egyptian population [11]correlate it with gender and body side and to determine its association with other anatomical variations in the Egyptian population. The presence of PL was clinically determined in 386 Egyptians using the standard technique. All subjects were examined for the presence of the flexor digitorum superficialis (FDS. However, low levels of absence were noted in a Zimbabwean population (1.5%) [12], a Ghanaian population (3.1–3.8%) [2], and an Asian population (4.6%) [13]most studies have been done in Caucasian populations. Materials and Methods: The presence of the PL was clinically determined in 329 normal Chinese men and women using the standard technique. In subjects with an absent PL, 4 other tests were performed to confirm absence and an Allen's test was done to assess the palmar arches. All subjects were examined for the presence of the flexor digitorum superficialis (FDS.

Olewnik et al. [10]and its tendon crosses the median nerve (MN created a classification of PLM insertion with 3 types. Type I (78.8% of upper limbs) demonstrated a standard course, i.e. the muscular part originated from the medial epicondyle of the humerus and inserted as a tendinous part on the palmaris aponeurosis [10]and its tendon crosses the median nerve (MN. Type II PLMs (12.5%) were characterised as being proximally attached to the medial epicondyle, with a tendinous part divided into 2 tendons: a lateral one (which always predominated) distally attached to the palmar aponeurosis, and

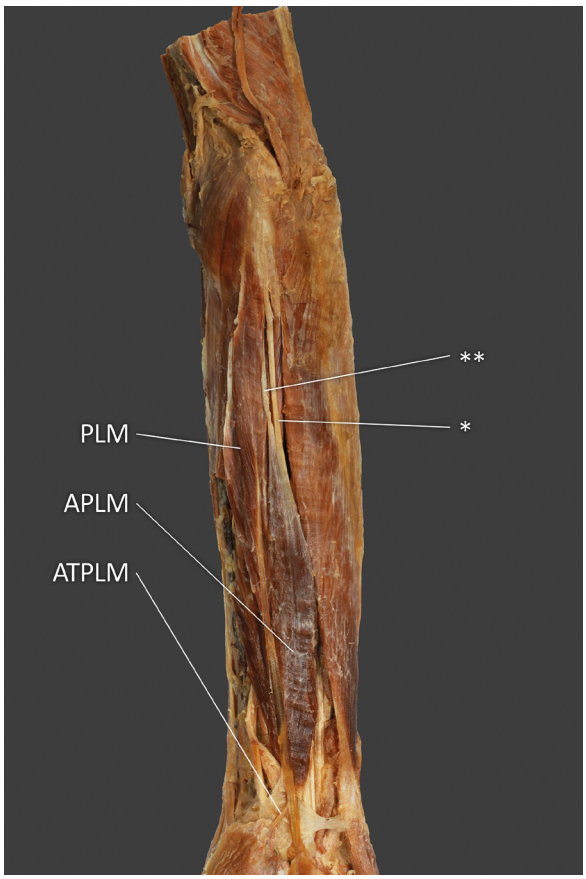

Figure 3. *First tendon of accessory palmaris longus muscle, **second tendon of accessory palmaris longus muscle; PLM — palmaris longus muscle; APLM — accessory palmaris longus muscle; ATPLM — accessory tendon of palmaris longus muscle.

Table 1. Morphometric measurements of the present case

	PLM	APLM	
Length of the first part	126.56 mm (muscle belly)	90.57 mm (tendon 1)	111.51 mm (tendon 2)
Connection between muscular and tendinous part			
Width	2.97 mm	3.41 mm	3.52 mm
Thickness	0.97 mm	0.65 mm (tendon 1)	1.25 mm (tendon 2)
Length of the second part	111.75 mm (tendon)	131.56 mm (muscle belly)	
Distal attachment	**Palmaris aponeurosis**	**Flexor retinaculum**	

PLM — palmaris longus muscle; APLM — accessory palmaris longus muscle.

a medial one inserted in the flexor retinaculum. Type III (1.2%) was fused with the flexor carpi ulnaris muscle. This common structure was distally attached to the pisiform bone and the palmar aponeurosis [10] and its tendon crosses the median nerve (MN.

Type I and type II were additionally divided into 3 subtypes based on variations in the tendon to muscle length ratio. Subtype A had a tendon to muscle ratio < 1, subtype B had a ratio of 1–1.5, and subtype C had a ratio > 1.5, i.e. the tendon length was more than 1.5× greater than the muscular part [10]and its tendon crosses the median nerve (MN. Such information is helpful during palmaris tendon grafts, in which PLMs with a longer tendon (subtype C) seem to be better than those with a shorter tendinous part (subtype A) [10]and its tendon crosses the median nerve (MN.

Olewnik et al. [9] also classified 8 types of morphological variation of the PLM among foetuses. Type 1, which was the most common (52%), was a standard type originating from the medial epicondyle of the humerus as a muscle belly, then passing into tendinous part inserted in the palmaris aponeurosis. Type 2 (22%) was the same as the adult type 2 classification above [10]and its tendon crosses the median nerve (MN. This type was characterised as a PLM proximally attached to the medial epicondyle, but its tendinous part was divided into 2 tendons: a lateral one (which always predominated) – distally attached to the palmar aponeurosis, and a medial one inserted in the flexor retinaculum. Type III (10%) had a similar course as type 2; however, the first tendon was attached to the palmar aponeurosis, and the second was fused with the abductor pollicis brevis muscle. Type 4 (6%) was a PLM with an intermediate muscle belly. It originated by tendon from the medial humeral epicondyle passing into the muscle belly and then passed into the tendinous part inserted into the palmaris aponeurosis. Type 5 (3%) followed the same course as type 4, but its distal tendon was divided into 2 small tendons and attached as in type 2 — the lateral one (predominated) to the palmar aponeurosis, and the medial one in the flexor retinaculum. Type 6 (2%) was a reversed PLM, i.e. the proximal part was represented by a tendon passing distally into a muscle belly. Type 7 (1%) was a bifid PLM, represented by 2 muscle bellies, distally turning into 2 tendons connecting and inserting into the palmar aponeurosis. Type 8 (3%) had a similar proximal point as types 1–3; however, its tendinous part was divided into 3 elements: the first attached to the palmar aponeurosis, the second attached to the abductor pollicis brevis, and the third attached to the opponens pollicis muscle. The final type 9 (1%) was characterised by the distal part of the PLM coursing above the palmar aponeurosis. Its insertion was labelled as a communication tendon fusing with the flexor carpi ulnaris muscle [9].

Median nerve compression may arise in response to morphological variation of the PLM. Patients usually complain about numbness, tingling, and pain in this region. Sometimes weakness in the hand is also observed. Moreover, a lack of sensation may also occur, especially in the region of the thumb, index finger, middle finger, and the thumb side of the ring finger. Although this pathology may have various causes, the specific course of the PLM (digastric PLM, reversed PLM, intermediate muscle belly, reversed PLM with accessory abductor digiti minimi) [5] is one of them. Moreover, the occurrence of additional structures like accessory PLM (duplication/triplication of PLM) or palmaris profundus may also result in median nerve compression.

Another point of clinical significance is that the PLM tendon is also used in various tendon and joint reconstructive surgeries, which are not possible when the muscle is absent. In contrast, the occurrence of an accessory PLM provides additional material for this procedure [15].

In the studied case, the PLM was represented by a normal course but with a division of the tendinous part in its distal part: it originated from the medial epicondyle of the humerus, passing into the tendinous part, and dividing into 2 tendinous structures. After division, the main tendon was ended by the palmar aponeurosis, and the other was attached to the flexor retinaculum.

An accessory PLM was also observed. Its structure resembled a 'combo' variation: it appeared to be an APLM with a reversed course, in which the proximal part was represented by 2 tendons attached to the medial humeral epicondyle. These 2 structures were connected to each other creating one muscle belly distally attached to the flexor retinaculum.

The most important observation of the present case, from a clinical point of view, is that the median nerve was located directly under the APLM, indicating a high risk of median nerve compression. In addition, the presence of an accessory structure may be beneficial as a source of additional material for reconstructive surgeries such as injuries of the flexor

tendons, ligament reconstructions, reconstruction of the flexor pollicis longus and ocular defects, as well as thumb and elbow ligaments, blepharoptosis, and other surgical reconstructions [6, 15]. This additional structure may also be used to treat facial paralysis or in plastic surgery during lip augmentation. However, regardless of the purpose of using the APLM or standard PLM, knowledge about its course and possible morphological variations is necessary.

CONCLUSIONS

The PLM is characterised by several morphological variations, some of which may cause median nerve compression, resulting in numbness, tingling, and pain in this region. One such variation is the APLM. This structure may be also useful during various types of reconstructive surgery, and as such, accurate knowledge about the morphological variability of the PLM and APLM is needed to provide safe and successful reconstructions.

ARTICLE INFORMATION AND DECLARATIONS

Availability of data and materials

Please contact the authors for data requests (Łukasz Olewnik PhD — email address: lukaszolewnik@gmail.com).

Ethics statement

The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz.

Author contributions

Nicol Zielinska (student): project development, data collection and management, data analysis and manuscript writing; Andrzej Borowski (MD, PhD, Professor): data collection, data analysis and manuscript editing; Marek Drobniewski (MD, PhD, Assisntant Professor): data collection, data analysis and manuscript editing; Piotr Karauda (DPT, PhD): data analysis and manuscript editing; Krystian Maślanka (student): data analysis and manuscript editing; Łukasz Olewnik (MD, PhD, Professor): data analysis and manuscript editing. All authors have read and approved the manuscript.

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Conflict of interest: The authors declare that they have no competing interests.

REFERENCES

1. Adachi B. Beitrage zur anatomie der Japaner. XII. Die statistic der muskelvarietten. Z Morphol Anthr. 1909; 12: 261–312.
2. Osonuga A, Mahama HM, Brown AA, et al. The Prevalence of Palmaris longus agenesis among the Ghanaian population. Asian Pacific J Trop Dis. 2012; 2(22): S887–S889, doi: 10.1016/s2222-1808(12)60286-2.
3. Bergman R, Thompson S, Afifi A. Compendium of human anatomic variation. Urban & Schwarzenberg, Baltimore 2018.
4. Ceyhan O, Mavt A. Distribution of agenesis of palmaris longus muscle in 12 to 18 years old age groups. Indian J Med Sci. 1997; 51(5): 156–160, indexed in Pubmed: 9355719.
5. Georgiev GP, Iliev AA, Dimitrova IN, et al. Palmaris longus muscle variations: clinical significance and proposal of new classifications. Folia Med (Plovdiv). 2017; 59(3): 289–297, doi: 10.1515/folmed-2017-0035, indexed in Pubmed: 28976893.
6. Lam DS, Lam TP, Chen IN, et al. Palmaris longus tendon as a new autogenous material for frontalis suspension surgery in adults. Eye (Lond). 1996; 10 (Pt 1): 38–42, doi: 10.1038/eye.1996.5, indexed in Pubmed: 8763301.
7. Mathew AJ, Sukumaran TT, Joseph S. Versatile but temperamental: a morphological study of palmaris longus in the cadaver. J Clin Diagn Res. 2015; 9(2): AC01–AC03, doi: 10.7860/JCDR/2015/11212.5542, indexed in Pubmed: 25859436.
8. Moore KL, Dalley AF. Clinical Oriented Anatomy. 4th ed. Lippincott Williams&Wilkins, Philadeplphia 1999.
9. Olewnik Ł, Waśniewska A, Polguj M, et al. Morphological variability of the palmaris longus muscle in human fetuses. Surg Radiol Anat. 2018; 40(11): 1283–1291, doi: 10.1007/s00276-018-2069-2, indexed in Pubmed: 30022223.
10. Olewnik Ł, Wysiadecki G, Polguj M, et al. Anatomical variations of the palmaris longus muscle including its relation to the median nerve — a proposal for a new classification. BMC Musculoskelet Disord. 2017; 18(1): 539, doi: 10.1186/s12891-017-1901-x, indexed in Pubmed: 29258498.
11. Raouf HA, Kader GA, Jaradat A, et al. Frequency of palmaris longus absence and its association with other anatomical variations in the Egyptian population. Clin Anat. 2013; 26(5): 572–577, doi: 10.1002/ca.22186, indexed in Pubmed: 23339087.
12. Reimann AF, Daseler E, Anson B, et al. The palmaris longus muscle and tendon. A study of 1600 extremities. Anat Rec. 2005; 89(4): 495–505, doi: 10.1002/ar.1090890408.
13. Sebastin SJ, Lim AYT. Clinical assessment of absence of the palmaris longus and its association with other

anatomical anomalies — a Chinese population study. Ann Acad Med Singap. 2006; 35(4): 249–253, indexed in Pubmed: 16710495.
14. Takanashi Y, Eda M, Kaidoh T, et al. A case of the bilateral duplicate palmaris longus muscles coupled with the palmaris profundus muscle. Yonago Acta Med. 2012; 55(4): 75–80, indexed in Pubmed: 24031143.
15. Zeybek A, Gürünlüoglu R, Cavdar S, et al. A clinical reminder: a palmaris longus muscle variation. Ann Plast Surg. 1998; 41(2): 224–225, indexed in Pubmed: 9718165.