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

Authors: Nicol Zielinska, Andrzej Borowski, Marek Drobniewski, Krystian Maślanka, Piotr Karuda, Łukasz Olewnik

DOI: 10.5603/fm.96136
Article type: Case report
Submitted: 2023-06-21
Accepted: 2023-07-28
Published online: 2023-11-08

This article has been peer reviewed and published immediately upon acceptance. It is an open access article, which means that it can be downloaded, printed, and distributed freely, provided the work is properly cited. Articles in "Folia Morphologica" are listed in PubMed.
A very rare case of the accessory palmaris longus muscle and clinical significance

Nicol Zielinska et al., Accessory palmaris longus

Nicol Zielinska¹, Andrzej Borowski², Marek Drobniewski², Krystian Maślanka¹, Piotr Karauda¹, Łukasz Olewnik¹

¹Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland
²Orthopaedics and Paediatric Orthopaedics Department, Medical University of Lodz, Poland

Address for correspondence: Łukasz Olewnik, MD, PhD, Department of Anatomical Dissection and Donation, Chair of Anatomy and Histology, Medical University of Lodz, ul. Żeligowskiego 7/9, 90–410 Łódź, Poland, e-mail: lukasz.olewnik@umed.lodz.pl

ABSTRACT

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 characterized by a normal course, i.e. originating from the medial humeral epicondyle and inserting to 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 two 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.

**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 characterized by a high level of morphological variability. Together with four 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].

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 4-20%), 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 an additional material for 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 has been found during standard anatomical dissection of the upper limb. The muscle was reversed, and the first part was not muscular, but represented by two tendons originating from the common muscular mass attached to the medial epicondyle of the humerus. These two tendons then joined, creating one muscle belly distally attached to the flexor retinaculum. In turn, the standard PLM was characterized 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

An 88-year-old at death female cadaver 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 body had been donated to science. The right upper limb was subjected to traditional anatomical dissection [10], and morphological variations in the forearm region were recorded.

The PLM was characterized 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. 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 two 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 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 thickness 1.25 mm. These two tendons later connected together, creating a single muscle belly, 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 thickness 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 – Fig. 1, 2, 3.

The flexor retinaculum had an unique shape. It was 4.78 mm wide and 0.45 mm thick where it connects 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 two points (A-B) were 8.71 mm apart. The distance between point B, to the attachment of the abductor pollicis brevis to 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 thickness 0.44 mm.

These measurements were collected using a Mitutoyo Corporation electronic caliper (Kawasaki-shi, Kanagawa, Japan). Each measurement was repeated two 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.
**Table 1.** Morphometric measurements of the present case.

<table>
<thead>
<tr>
<th></th>
<th>PLM</th>
<th>APLM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of the first part</strong></td>
<td>126.56 mm (muscle belly)</td>
<td>90.57 mm (tendon 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>111.51 mm (tendon 2)</td>
</tr>
<tr>
<td><strong>Connection between muscular</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>and tendinous part</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>2.97 mm</td>
<td>3.41 mm</td>
</tr>
<tr>
<td></td>
<td>0.97 mm</td>
<td>0.65 mm (tendon 1)</td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td></td>
<td>1.25 mm (tendon2)</td>
</tr>
<tr>
<td><strong>Length of the second part</strong></td>
<td>111.75 mm (tendon)</td>
<td>131.56 mm (muscle belly)</td>
</tr>
<tr>
<td><strong>Distal attachment</strong></td>
<td>Palmaris aponeurosis</td>
<td>Flexor retinaculum</td>
</tr>
</tbody>
</table>

PLM – palmaris longus muscle; APLM – accessory palmaris longus muscle

**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] report that PLM duplication/triplication occurred in 1.79% of studied upper limbs.

Another morphological variation of the PLM is a digastric muscle, where two 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. Sometimes such variation occurs together with coexistence of the 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].

Of course 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 fetuses. Interestingly, this value was found to be only 7.5% among adults [10]. 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]. 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].

Olewnik et al. [10] created a classification of PLM insertion with three types. Type I (78.8% of upper limbs) was demonstrated a standard course, i.e. the muscular part originates from the medial epicondyle of the humerus, and inserts as a tendinous part on the palmaris aponeurosis [10]. Type II PLMs (12.5%) were characterized as being proximally attached to the medial epicondyle, with a tendinous part divided into two tendons: a lateral one (which always predominated) distally attached to the palmar aponeurosis, and 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].

Type I and Type II were additionally divided into three subtypes based on variations in the tendon to muscle length ratio. Subtype A had a tendon to muscle ratio <1, subtype B with the ratio 1-1.5, and subtype C with a tendon to muscle ratio >1.5, i.e. tendon length was more than 1.5 x greater than the muscular part [10]. 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].

Olewnik et al. [9] also classified eight types of morphological variation of the PLM among fetuses. Type I, 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 II (22%) was the same as the adult Type II classification above [10]. This type was characterized as a PLM proximally attached to the medial epicondyle, but its tendinous part was divided into two 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 II; however, the first tendon was attached to the palmar aponeurosis, and the second was fused with the abductor pollicis brevis muscle. Type IV (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 to the palmaris aponeurosis. Type V (3%) followed the same course as Type IV, but its distal tendon was divided into two small tendons and attached as in Type II - the lateral one (predominated) to the palmar aponeurosis, and the medial one in the flexor retinaculum. Type VI (2%) was a reversed PLM, i.e. the proximal part was represented by a tendon passing distally into a muscle belly. Type VII (1%) was a bifid PLM, represented by two muscle bellies, distally turning into two tendons connecting and inserting into the palmar aponeurosis. Type VIII (3%) had a similar proximal point as Types I-III, however, its tendinous part was divided into three 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 (1%) was characterized by the distal part of the PLM coursing above the palmar aponeurosis. Its insertion was labelled a communication tendon fusing with the flexor carpi ulnaris muscle [9].

Median nerve compression may be 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 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, dividing into two tendinous structures. After division, the
main tendon was ended by 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 two tendons attached to the medial humeral epicondyle. These two structures were connected together 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 characterized by a number of 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.

DECLARATIONS

Ethical approval and consent to participate: The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz.

Consent to publish: Not applicable

Availability of data and materials: Please contact authors for data requests (Łukasz Olewnik PhD - email address: lukasz.olewnik@umed.lodz.pl).
Competing interests: The authors declare that they have no competing interests.

Funding: The authors have no financial or personal relationship with any third party whose interests could be positively or negatively influenced by the article’s content. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors’ contribution: 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, Assistant 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.

REFERENCES


**Figure 1.** PLM - palmaris longus muscle, APLM - accessory palmaris longus muscle, *first tendon of accessory palmaris longus muscle, **second tendon of accessory palmaris longus muscle

**Figure 2.** PLM - palmaris longus muscle, APLM - accessory palmaris longus muscle, *first tendon of accessory palmaris longus muscle, **second tendon of accessory palmaris longus muscle

**Figure 3.** PLM - palmaris longus muscle, APLM - accessory palmaris longus muscle, ATPLM - accessory tendon of palmaris longus muscle, *first tendon of accessory palmaris longus muscle, **second tendon of accessory palmaris longus muscle