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CASE REPORT

Three in one — unusual palmaris longus muscle anatomical variation

Arkadiusz Kowalczyk, Nikola Topuzov, Three in one — unusual palmaris longus

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INTRODUCTION

The palmaris longus muscle (PLM) is one of the flexor muscles of forearm, typically originating at the medial epicondyle of humerus. It runs distally, first as a short fusiform belly, then as a long, thin tendon, which reaches the hand, passes superficially to the flexor retinaculum of wrist and ends inserting to the palmar aponeurosis.

PLM presents a wide range of morphological variability, including: reversed course where tendon originates on medial epicondyle of humerus and belly inserts usually to flexor retinaculum; bifurcated tendon where its tendon divides into two slips inserting commonly or separately into structures of the wrist; absence of the entire muscle [7].

Knowledge of those potential variations and its clinical impact is important for physicians dealing with hand and wrist problems as it may affect the patients' health and limit therapeutic options e.g. in reconstructive surgery. Numerous case reports of different anatomical variations of PLM can be found in the literature, along with propositions for systematic classification [8].

Regardless of the astonishing number of different variants described, new, previously unreported cases are being discovered. In this publication we present such a case of atypical

variation of PLM, that appears to be a combination of three variations usually described separately.

CASE REPORT

A routine dissection of upper extremity of male cadaver aged approximately 60 years and fixed in 4% formaldehyde solution was performed during anatomy class for first year medical students. After the skin and antebrachial fascia were removed in order to visualize the anterior forearm muscles, a biventer PLM was observed.

Figures 1 and 2 picture PLM reported. The muscle presented two distinct bellies divided by a narrow intermediate tendon. The 47 mm long superior belly (A in Fig. 1 and 3), located in the upper part of the forearm connected via tendon to the insertion site at the medial epicondyle of humerus, medially to flexor carpi radialis and superficially to flexor digitorum superficialis (FDS), furthermore short muscle fibers deriving from the belly were attached to antebrachial fascia.

The intermediate tendon (D in Fig. 1 and 3) formed as a continuation of the superior belly 51 mm from the medial epicondyle and traversed uninterrupted for 100 mm in the middle and lower third of the forearm, terminating slightly above the flexor retinaculum. The tendon transitioned into the inferior belly (E in Fig. 1 and 2), most of which was located deep to the flexor retinaculum. Short longitudinal incision in the retinaculum allowed for visualization of the full length of the inferior belly, as well as its terminal tendon.

The inferior belly tendon (F in Fig. 1 and 2) originated 14 mm below the superior border of flexor retinaculum, subsequently deviated medially and connected with FDS tendon for 5th finger (C in Fig. 2), passing over the tendons for remaining fingers. The total length of the inferior belly was 56 mm and the terminal tendon was 22 mm. No anatomical variations were found in FDS tendon distally to the connection site. Schematic diagram of PLM described is provided in Fig. 3.

Other anatomical variations in the specimen included interrupted superficial palmar arch (K in Fig. 2). Princeps pollicis artery and radial artery of index finger originated from the superficial branch of radial artery. The II–V common palmar digital arteries originated from the ulnar segment of superficial palmar arch with no connection to radial artery branches.

Furthermore a Berrettini-type anastomosis was found between common digital palmar nerves of median and ulnar nerve (J in Fig. 2).

DISCUSSION

When present, PLM typically inserts into palmar aponeurosis and by pulling it, creates tension which is believed to stabilize the skin of the palm, allowing for more secure grip. As it passes above the flexor retinaculum, it also has some effect on wrist flexion. The function of PLM has been also linked to thumb abduction, however this effect is marginal as well [4]. Due to its function being negligible, PLM has been used as donor material for tendon grafts. The muscle itself is known as being extremely variable with the most common variation being its agenesis. First description of this can be found in the famous 'De humani corporis fabrica' by Vesalius [1, 11]. The rate of PLM agenesis is different depending on the discussed population, with Polish being at 8.6%, while generalized European Caucasian being at 15.2% [3]. Effect of PLM agenesis on hand function has been widely studied. Most commonly, the conclusion is that its absence has no effect on measured hand function parameters like grip strength or fingers opposition, but in some very specific tests on specific populations, statistically significant differences are shown [2]. Other commonly described anatomical variations of PLM include: *musculus palmaris longus inversus*, where its belly is located distally on forearm, originating on flexor retinaculum, travelling towards medial epicondyle of humerus as long thin tendon; *musculus palmaris longus profundus*, where its tendon does not travel above flexor retinaculum, but instead it goes into carpal tunnel where it usually inserts to flexor retinaculum or joins other flexor tendon; *musculus palmaris longus biventer*, where on the course of normal PLM tendon another muscle belly appears, forming structure similar to digastric muscle. Numerous case reports of uncommon variations of PLM can be found in the literature, e.g. joining tendon of flexor carpi ulnaris muscle or inserting into thenar muscles fascia [5, 6, 9, 10]. Some of the variations mentioned above are clinically significant, like palmaris longus inversus or palmaris longus profundus which may contribute to carpal tunnel syndrome development [10]. There are also propositions of classification methods for anatomical variations of PLM [8]. In cited article possible variants of PLM were divided into type I described as normal morphology of the muscle, type II with bifurcated tendon inserting both to palmar aponeurosis and flexor retinaculum, and finally type III described as 'rare variants', not fitting criteria for types I and II. PLM reported in this case would be classified as type III.

This case report shows yet another anatomical variation of PLM. Its uniqueness comes from the combination of three usually separately existing variations which in this case are combined together. PLM described in this case can be classified as both biventer as another muscle belly arises on course of its tendon, and profundus as its tendon enters carpal tunnel before its termination. Third variation is a connection of tendons with FDS for the little finger.

Clinical significance of such variations may be discussed separately for each of them. First, biventer PLM disturbs the continuity of its tendon and makes it unavailable for grafting. Secondly, profundus PLM may cause a tendency to develop carpal tunnel syndrome as there is additional tendon entering carpal tunnel which increases pressure within the tunnel and may compress the median nerve. Finally, connection of tendons with FDS for the little finger appears most problematic as there seems to be no data in the literature discussing its significance. Most probably it would not have any impact on everyday activity and function of hand, however there are two details that should be discussed. First, the strength of FDS for the little finger might be enhanced, which may provide a more secure grip at the ulnar aspect of the hand. Second, it may hypothetically lead to limited range of extension of fifth finger in wrist flexion due to tendon tethering, however in case of this variation PLM may not serve as wrist flexor, instead contracting only in finger flexion together with FDS. Most of all, anatomical variations such as reported in this case may lead to confusion of the operating surgeon causing him or her to lose orientation and inadvertently damage surrounding structures during dissection.

In conclusion, we report a case of unusual anatomical variation of PLM consisting of three usually separately reported variants. There seems to be no case reports of such variation in the literature. This kind of variation may have an impact in specific situations but most probably would not cause any significant impairment of hand function. Surgeons performing operations in the volar aspect of the forearm should be aware of the extreme range of morphological variants of PLM.

Article information and declarations

Ethics statement

The research was conducted ethically in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Author contributions

AK — data collection, project development, manuscript writing. NT — data collection, manuscript writing, figures edition.

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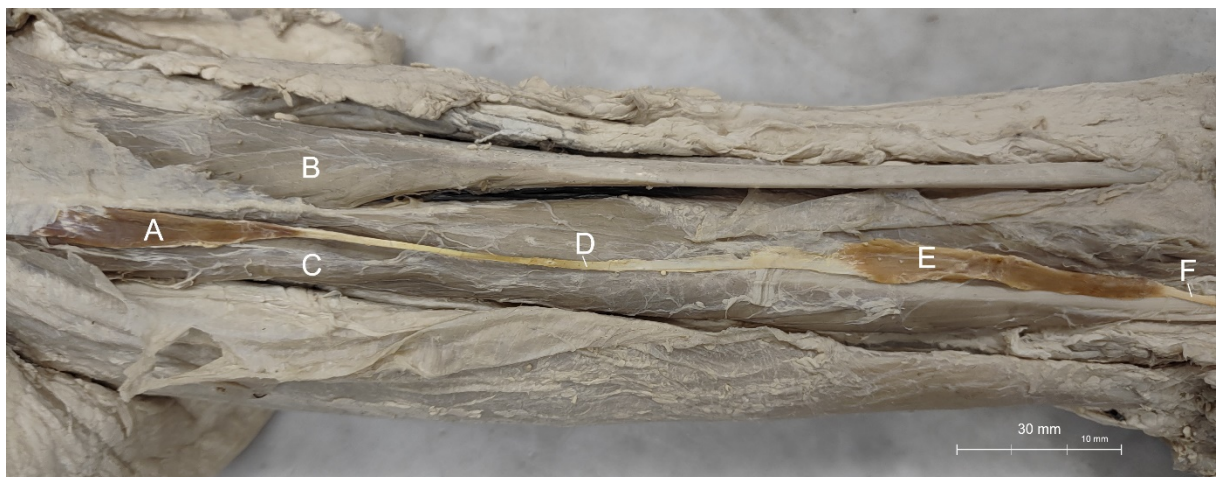


Figure 1. Anterior aspect of the left forearm with PLM highlighted. A — superior belly, B — flexor carpi radialis, C — flexor digitorum superficialis, D — intermediate tendon, E — inferior belly, F — terminal tendon.



Figure 2. Anterior aspect of the left hand with PLM highlighted. C — flexor digitorum superficialis tendon, E — inferior belly, F — terminal tendon, G — median nerve visibly flattened, H — flexor retinaculum, J — Berrettini type anastomosis, K — ulnar artery and ulnar part of superficial palmar arch, asterisk points the site of interruption of the arch.

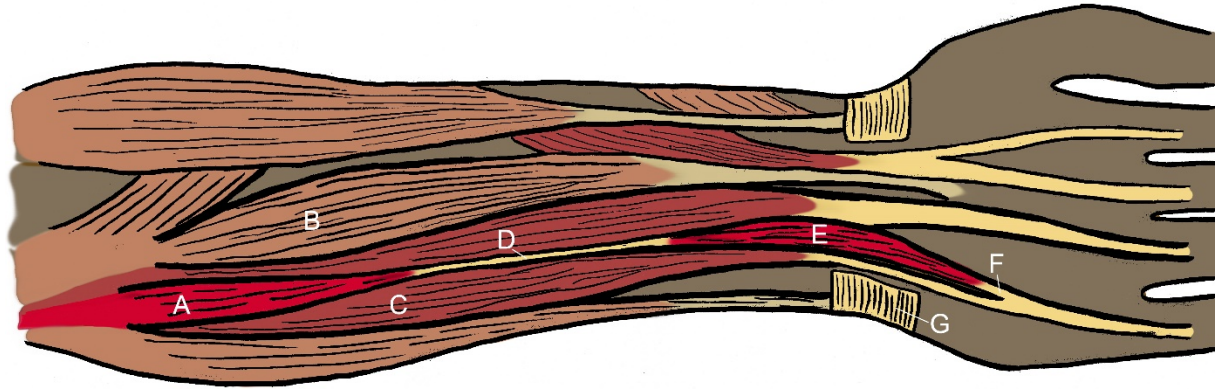


Figure 3. Diagram of described PLM. A — superior belly, B — flexor carpi radialis, C — flexor digitorum superficialis, D — intermediate tendon, E — inferior belly, F — terminal tendon, G — flexor retinaculum.