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Absence of Palmaris Longus Muscle and Flexor Digitorum Superficialis Muscle Tendon to the Little Finger – Incidence in the Bulgarian Population

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Palmaris longus (PL) and flexor digitorum superficialis muscles (FDS) are some of the variable muscles in the human body. The absence of PL and FDS tendon of the little finger are the two most frequently reported variations. The aim of the study was to analyse the absence of PL and absence of FDS tendon of the little finger with clinical tests. We examined 100 cases using three tests to visualize the tendons of PL and FDS. We found bilateral absence of PL in 29% of the cases and bilateral absence of FDS tendon of the little finger in 15% of cases. In conclusion, absence of PL in the Bulgarian population is higher than this in other Caucasian populations (5.5% - 24%). Conversely, our results for absence of tendon of the little finger FDS showed that it is approximately the same as in other Caucasians (15% - 22%).

Key words: upper limb, palmaris longus muscle, flexor digitorum superficialis muscle, variations, clinical significance

Introduction

The palmaris longus muscle (PL) has a thin, elongated muscle body which is located medially to the flexor carpi radialis muscle. It arises from the medial epicondyle of the humerus via the common flexor tendon and is attached to the distal portion of the flexor retinaculum and the palmar aponeurosis [4]. This muscle body prolongs into a short tendon between the flexor carpi radialis and the flexor carpi ulnaris. PL is described as an additional weak flexor of the wrist which cramps the palmar aponeurosis [4]. In the human body, PL is one of the most variable muscles and the main reported variation is its absence [4]. Earlier reports have pointed out that absence of PL is found in 5.5% to 24% of Caucasian populations (European and North American) and 4.6% to 26.6% of Asian populations (Chinese, Japanese, Indian, Turkish and Malaysian) [4, 14, 15].

The flexor digitorum superficialis muscle (FDS) of the forearm has a flat muscle body, which arises from the medial epicondyle of the humerus and passes through the

carpal tunnel. FDS is one of the largest superficial flexor muscles of the forearm and is situated medially and deep to the PL and flexor carpi ulnaris muscle [8]. The terminal tendons of FDS split into smaller ones that insert at the bases of the intermediate phalanges of the second to fifth fingers. The function of FDS is to flex the proximal interphalangeal joints and the metacarpophalangeal joints of the hand [8]. Similar to PL, FDS is also a very variable muscle. The most frequently observed variation is the absence of its tendon to the little finger [8, 9]. According to one study in the Indian population, FDS tendon to the little finger was bilaterally absent in 42% of subjects [1, 13]. Unilateral absence was reported in 6.1% of cases on the right side and 8.6% of cases on the left. The prevalence of the absence of FDS tendon to the little finger has also been studied in other studied populations – for instance, in the Caucasian population (15–21%) and in the Chinese population (6.4%) [14, 15].

Considering the fact that both muscles share the same innervation, have similar functions, belong to the same muscle lodge and are highly variable in existence and function, it has been hypothesised that their absence may be related [17]. Embryologically, the flexor muscles of the forearm expand from the flexor mass following its division into two layers – superficial and deep. FDS, the flexor digitorum profundus (FDP) and the flexor pollicis longus arise from the deep layer, while the pronator teres, PL, flexor carpi radialis and flexor carpi ulnaris muscle arise from the superficial one [8, 9]. Failure of cleavage of the superficial layer of the forearm flexor mass during the embryological development could be a possible reason for the absence of PL. Failure of cleavage of the deep layer of the forearm flexor mass could, respectively, lead to anatomical variations of FDS [10].

The tendon of PL can be observed through several clinical tests. One of the methods is by touching the pads of the little finger and thumb and flexing the wrist. The presence of the tendon can be seen in the middle of the anterior wrist. This examination is known as Schaeffer's standard test [14]. Thompson's test is another test, where a person clenches his/her fist, followed by flexing the wrist against resistance with the thumb flexed over the fingers [11, 12]. The presence of FDS's tendon for the little finger is usually examined by asking the patient to flex the little finger with the rest positioned in extension at the interphalangeal joints to neutralize the action of FDP. FDS tendon of the little finger is reported absent when there is no ability to flex the little finger within 20° of the passive range of motion of the finger [11, 12].

The aim of the current study was to analyse the absence of PL and FDS tendon of the little finger and functional deficiency of FDS through different clinical tests and to establish a possible correlation in the Bulgarian population.

Materials and Methods

In the present study, we examined 100 students from both sexes at the Department of Anatomy, Histology and Embryology of the Medical University of Sofia. All participants provided their informed consent. The examinations were performed through Schaeffer's standard test and Thompson's test for visualisation of the tendon of PL and the test for visualization of FDS tendon of the little finger as described above. Photos were taken and the obtained data were summarised and analysed through Microsoft Excel 2010. The obtained quantitative data were demonstrated with diagrams.

Results

In the present study, we reported absence of PL in 29 cases (29%). Absence of FDS tendon of the little finger was noted in 15 cases (15%). In 2 cases (2%), we noted bilateral absence of PL and absence of FDS tendon of the little finger. Only 2 cases (2%) had unilateral absence of PL and FDS on the left or right hand. Bilateral presence of these muscles was documented in 38 cases (38%). Furthermore, 12 (12%) of the examined cases had bilateral absence of PL and bilateral presence of FDS. On the other hand, there were 10 cases (10%) that had bilateral presence of PL and bilateral absence of FDS (**Fig. 1; Fig. 2; Fig. 3**).

In line with the above findings, we divided the cases into six different groups. The groups were distinguished according to the absence or presence of each of the examined muscles. Thus, we established the following groups:

Group 1: Bilateral presence of PL and bilateral presence of FDS – 21 males and 17 females (38%);
Group 2: Bilateral absence of PL and bilateral presence of FDS – 7 males and 5 females (12%);
Group 3: Right presence of PL (left absence) and bilateral presence of FDS – 8 males and 4 females (12%);
Group 4: Bilateral presence of PL and right presence of FDS (left absence) – 4 males and 6 females (10%);
Group 5: Bilateral presence of PL and bilateral absence of FDS – 1 male and 9 females (10%);
Group 6: Bilateral presence of PL and left presence of FDS (right absence) – 2 males and 4 females (6%).

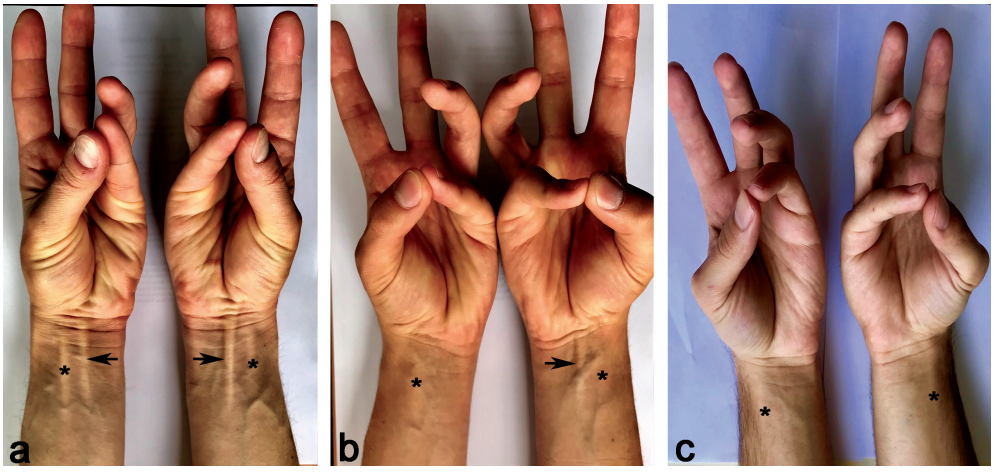

Fig. 1. Schaeffer's standard test for visualization of the tendon of the palmaris longus muscle (PL): bilateral presence of PL (a); right presence of PL (b); bilateral absence of PL (c); arrows - tendons of the tested muscles; asterisks – flexor carpi radialis muscle

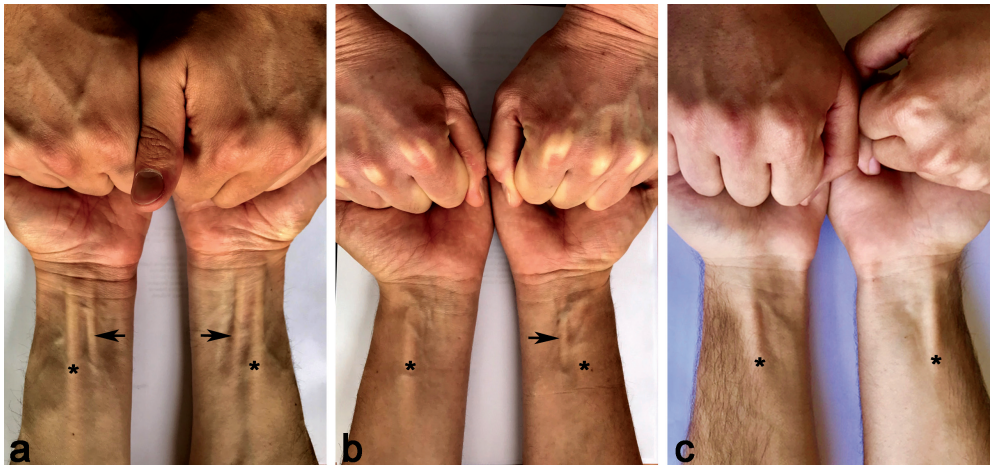

Fig. 2. Thompson's test for visualization of the tendon of the palmaris longus muscle (PL): bilateral presence of PL (a); right presence of PL (b); bilateral absence of PL (c) arrows - tendons of the tested muscles; asterisks – flexor carpi radialis muscle

Fig. 3. Test for visualization of the tendon of flexor digitorum superficialis muscle (FDS) for the little finger: bilateral presence of FDS tendon (a); right presence of FDS tendon (b); bilateral absence of FDS tendon (c)

The distribution of the cases in the groups after cluster analysis is summarized in the following tables (**Table 1; Table 2**) and figures (**Fig. 4; Fig. 5**):

Table 1. Data on the examination of palmaris longus muscle in males and females.

Palmaris longus muscle	Schaeffer's standard test		Thompson's test	
	Males (%)	Females (%)	Males (%)	Females (%)
Bilateral presence	42	64	52	66
Right absence	2	8	6	8
Left absence	18	8	16	8
Bilateral absence	38	20	26	18

Table 2. Data on the examination of flexor digitorum superficialis muscle in males and females.

Flexor digitorum superficialis muscle	Males (%)	Females (%)
Bilateral presence	74	56
Right absence	6	10
Left absence	12	12
Bilateral absence	8	22

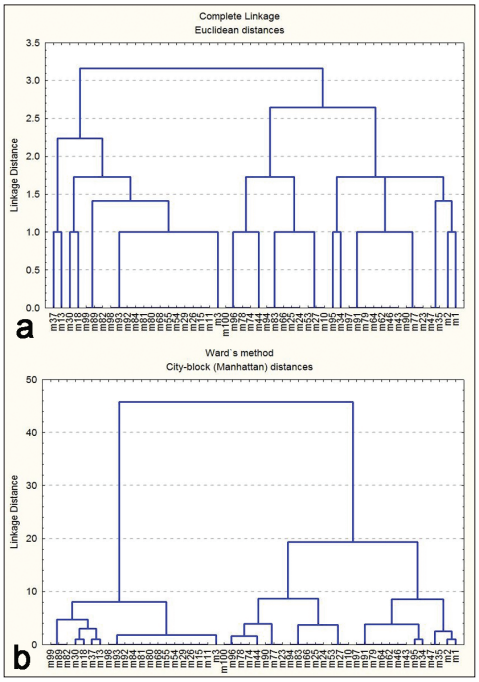

Fig. 4. Cluster analysis of male cases: Complete-linkage clustering (a); Ward's method (b); m-male

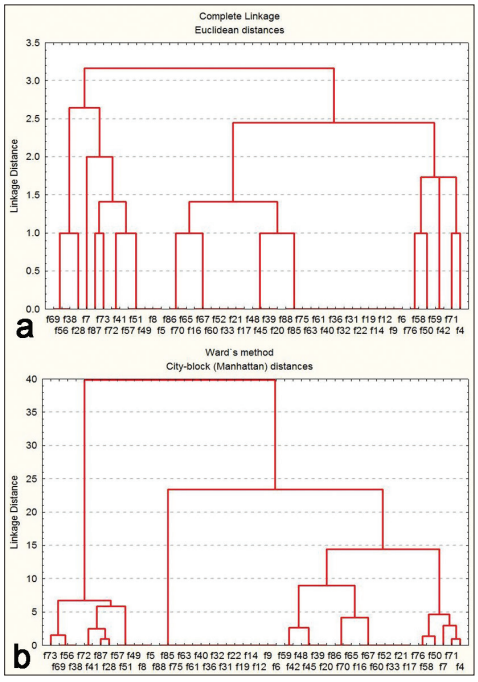

Fig. 5. Cluster analysis of female cases: Complete-linkage clustering (a); Ward's method (b); f-female

Discussion

Muscular variations of the flexor compartment of the forearm are often encountered and could result in multiple clinical conditions limiting the functions of the forearm and hand. In cases in which the median nerve represents the most superficial structure in this compartment, an injury to it is often possible which may compromise the innervation of the respective region [1].

The PL is the most variable muscle in the human upper limb and in the human body. In the literature, there are examples of an aberrant PL occurring together with other anatomical variations, such as persistent median artery and flexor carpi

ulnaris muscle [5]. PL is a retrogressive muscle, the presence of which is restricted to mammals and especially to those that use load to walk [2]. A number of species (such as orangutan) still use the muscle to snatch different items while climbing. Other primate relatives (such as the chimpanzee and gorilla), like humans, do not actively use the muscle which provides the basis for the multitude of observed variations [16]. One really important advantage of the PL tendon is the protection of the median nerve which passes deep to it. In case of an absence of the PL tendon, the median nerve, which would be the most superficial structure in the wrist, could be injured during trauma and surgical incisions [1]. PL plays an important role in orthopaedic and plastic surgeries. Its presence in most of the population and its superficial location makes it the most common donor material for tendon and joint reconstructive surgeries [1].

According to our results, 29% of all subjects (male and female) tested with Schaeffer's standard test had bilateral absence of PL. Only 5% had right absence and 13% had left absence of the muscle. The majority of the examined subjects (53%) had bilateral presence of PL. While there was a slight difference in the results as measured by the two tests (as evident by **Table 1**), PL was present in both upper limbs of the predominant number of subjects. These results also demonstrate that minimal differences exist between the different tests used for visualization of the tendon of PL.

The FDS is also a variable muscle [8, 9]. Our findings of concomitant variations of PL and FDS lead to the conclusion that there could be a connection between the absence of one muscle or the other. The absence of FDS tendon to the little finger may compromise hand function in case of an injury to the tendon of FDP, which would lead to an impaired flexion of the little finger, thus causing difficulties in grip function. This injury may necessitate the use of a tendon graft that would usually be easily mobilised from the PL of the same hand. Therefore, hand surgeons should be aware if any link exists between the absences of the two muscles [8, 9]. During physiotherapy, therapists should take into account the lower results achieved when examining grip strength of FDS-absent or FDS-common individuals [3].

Independent FDS function, as some studies suggest, is important for professional musicians [6]. Also, in patients with absolute little finger FDS functional deficit, special attention should be paid when the little finger is injured. As a result, it is of utmost importance that FDP tendon be properly treated in order to avoid any permanent functional deficit [7].

According to our study, 65% of cases had bilateral presence of FDS. Bilateral absence of FDS tendon to the little finger was observed in 15% of cases, 8% of cases had right absence of the muscle and 12% had left absence. Bilateral absence of both muscles was only observed in 2% of the examined cases. In addition, our observations revealed that PL is more variable in males than females, while FDS is more variable in females than males. The dominance of hands was not related to the tested variables.

Conclusion

In conclusion, the majority of the examined subjects (62%) had either bilateral absence or absence of either PL or FDS tendon of the little finger in one of their upper limbs. The remaining cases had bilateral presence of both muscles.

PL muscle absence was an independent entity for FDS muscle absence. Bilateral absence of PL and FDS was observed in 29% and 15% of cases, respectively. For PL, these results are higher than those previously observed in Caucasian populations (European and North American), which range between 5.5% and 24%. For FDS, our results are similar to those reported for other Caucasian populations (15% – 22%).

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