

Prevalence of the palmaris longus muscle and its relationship with grip and pinch strength: a study in a Turkish pediatric population

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Abstract Clinical studies generally reveal a trend of variation in the reported prevalence of the palmaris longus (PL) muscle absence. The aim of this study was to find an answer to the question of whether the congenital absence of tendon would affect hand functions or not. A total of 585 subjects, comprised of 305 males and 280 females, were included in our study. Mean age was 8.9 ± 1.4 standard deviation within a range of 6–11. For both sexes, the groups were divided further into three subgroups including 6–7, 8–9, and 10–11 years of age ranges. The grip strength of each hand and pinch strength of all fingers of each subject were measured separately. The absence of PL tendon in the right hand was 35.4 % in females, 25.9 % in males, and 30.4 % in overall average. The distribution of absence of the palmaris longus muscle between both genders was statistically significant. The *p* value for the right hand was 0.013. The absence of PL tendon in the left hand was 37.5 % in females, 27.9 % in males, and an overall average of 32.5 %. The *p* value for the left hand was 0.017. In terms of grip strength, a comparison between females and males did not reveal a significant

difference. The pinch strength of the second fingers of both hands did not show any difference in both sexes. Pinch strength of the third finger of the right hand was different only in girls of subgroup 6–7 ages ($p=0.024$). In girls, the pinch strength of the fourth finger of the right hand of subgroups 6–7 and 10–11 ages showed difference ($p=0.009$ and $p=0.026$, respectively). In boys, the fourth finger in subgroup of 8–9 ages showed significant difference in both hands ($p=0.011$). The fifth fingers of both hands were found different in males for only subgroup of 8–9 ages ($p=0.001$). Pinch strength of the fifth finger of the right hand was different in females for only subgroups of 6–7 and 10–11 ages ($p=0.023$ and $p=0.047$, respectively). While grip strength of the hand was not affected in the case of absence of the palmaris longus, in both sexes, pinch strength of the fourth and fifth fingers of both hands decreased.

Keywords Children · Grip strength · Palmaris longus · Pinch strength · Prevalence

Introduction

Palmaris longus is often described as one of the most random muscles in the human body [8]. Its absence appears to be hereditary but the genetic transmission is not clear [15]. Its absence can easily be determined clinically; it is easy to harvest and it has a long and flat tendon allowing good revascularization. For these reasons, it is commonly used as a tendon graft by plastic and hand surgeons [11]. It has also been used for a wide variety of procedures including lip augmentation, ptosis correction, and in the management of facial paralysis [13]. Another important attribute of the tendon of the palmaris longus muscle is its somewhat superficial protective role over the median nerve [4].

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Table 1 Presence of the palmaris longus muscle by sexes

	Right hand*				Left hand**			
	Absent		Present		Absent		Present	
	N	%	N	%	N	%	N	%
Boys	79	25.9	226	74.1	85	27.9	220	72.1
Girls	99	35.4	181	64.6	105	37.5	175	62.5
Total	178	30.4	407	69.6	190	32.5	395	67.5

* $p=0.013$ ($\chi^2=5,727$); ** $p=0.017$ ($\chi^2=5,727$)

Some authors have studied the absence of the palmaris longus in different populations. It is well known that individuals may have either unilateral or bilateral absence of the palmaris longus [14]. The prevalence of this absence of the palmaris longus is reported as 22.4 % in Caucasian, 4.8 % in Asian, 3.0 % in Black, 7.1 % in Native American, 26.6 % in Turkish, and 17.2 % in Indian population (8 % bilateral and 9.2 % unilateral) [5, 6, 11]. A recent study conducted in 2009 has reported the prevalence of the absence of the palmaris longus in Zimbabwe blacks as 1.5 % [4].

The absence of palmaris longus muscle (PLM) has been reported not to affect grip strength and pinch strength [11]. The prevalence of the absence of the palmaris longus tendon is around 15 % according to the standard textbooks but widely varies in different populations and ethnic groups. Sebastin et al. [12] have reported the prevalence of the absence of the palmaris longus tendon in Chinese population as 4.6 %, and the same authors have recorded the prevalence of the absence of the palmaris longus (PL) tendon in the Caucasian race as 22.4 %, in the Black population as 3 %, and in the Native

American race as 7.1 %. In a study conducted with Amazon Indians, Machado and Di Dio [7] found the absence of the palmaris longus to be 4.8 % in women and 0.9 % in men. There have been different reports regarding the prevalence of the absence of the palmaris longus in both sexes such as 15 % [1], 26 % [10], and 11.5 % [9].

Considering that the palmaris longus tendon is used while using a pencil, we intended to study the presence of this tendon in the Turkish elementary school student population, as well as the probable effects of its absence on the grip strength of the hand and the pinch strength of the fingers. In this study, we aimed to find out the prevalence of the absence of PLM in the Turkish population and the effect of this absence on both the grip strength of the hands and the pinch strength of the fingers.

Materials and Methods

We included 585 students, comprised of 305 males and 280 females, in our study. Mean age was 8.9 ± 1.4 standard deviation (SD) within a range of 6–11. For both sexes, the groups were divided into three subgroups including 6–7, 8–9, and 10–11 years of age ranges. This study was conducted in three elementary schools in Malatya, Turkey. We excluded 16 students having neurologic dysfunctions, orthopedic diseases, and deformities. First, we asked the children to oppose the thumb to the little finger while flexing the wrist. If the tendon was not visible or palpable, it was considered as absent. The presence or absence of the palmaris longus tendon was recorded for both the left and right hands.

We handed a dynamometer and a pinch meter to the children to test their strength. The examination for each child was

Table 2 Comparison of grip strength between absence and presence of the palmaris longus muscle in the right and left hands

	Years	PLM	Number of boys	Grip strength (kg) Mean \pm SD	<i>p</i> value	Number of girls	Grip strength (kg) Mean \pm SD	<i>p</i> value
Right	6–7	Present	40	11.36 \pm 1.98	0.097	39	10.35 \pm 2.12	0.365
		Absent	14	11.03 \pm 1.84				
	8–9	Present	86	14.31 \pm 2.78	0.168	68	12.13 \pm 2.48	0.066
		Absent	35	13.51 \pm 3.10				
	10–11	Present	100	17.56 \pm 3.31	0.802	74	16.14 \pm 3.93	0.763
		Absent	30	17.73 \pm 3.31				
Left	6–7	Present	40	10.73 \pm 1.92	0.240	37	9.55 \pm 2.24	0.837
		Absent	14	9.96 \pm 2.54				
	8–9	Present	86	13.56 \pm 3.06	0.344	66	13.28 \pm 16.05	0.824
		Absent	35	12.98 \pm 3.04				
	10–11	Present	95	17.16 \pm 3.19	0.828	72	15.15 \pm 3.69	0.555
		Absent	35	17.02 \pm 3.39				

PLM palmaris longus muscle, SD standard deviation

Table 3 Comparison of pinch strength of the second finger between absence and presence of the palmaris longus muscle in the right and left hands

	Years	PLM	Number of boys	Pinch strength of the second finger (kg) Mean \pm SD	<i>p</i> value	Number of girls	Pinch strength of the second finger (kg) Mean \pm SD	<i>p</i> value
Right	6–7	Present	40	1.95 \pm 0.51	0.472	39	1.90 \pm 0.76	0.531
		Absent	14	1.83 \pm 0.63				
	8–9	Present	86	2.17 \pm 0.62	0.267	68	1.82 \pm 0.56	0.195
		Absent	35	2.03 \pm 0.62				
	10–11	Present	100	2.56 \pm 0.72	0.501	74	2.27 \pm 0.64	0.518
		Absent	30	2.46 \pm 0.55				
Left	6–7	Present	37	1.83 \pm 0.63	0.425	37	1.64 \pm 0.58	0.809
		Absent	17	1.69 \pm 0.55				
	8–9	Present	88	2.16 \pm 0.60	0.604	66	1.73 \pm 0.60	0.297
		Absent	33	2.10 \pm 0.63				
	10–11	Present	95	2.55 \pm 0.77	0.530	72	2.24 \pm 0.68	0.087
		Absent	35	2.46 \pm 0.63				

PLM palmaris longus muscle, SD standard deviation

done by the same person. We asked them to squeeze it as hard as they could. The measurement was repeated three times with the Jamar dynamometer and pinch meter. Then, the average of these values was recorded. Grip strength was measured using a calibrated Jamar dynamometer at level 2 in a standardized position, as described by the American Association of Hand Therapists [11].

The pinch strength between thumb and the second, third, fourth, and fifth fingers was measured by using a pinch meter. We asked the following question to the children who had PL absence: “Do you have any difficulty performing any task during your life?”

Statistical analyses were performed by using SPSS for Windows (version 13.0), the statistical software program. Continuous variables were reported as mean \pm standard deviation (SD) and categorical variables were reported as number and percent. Normality for continuous variables in groups was determined by the Shapiro–Wilk test. Unpaired *t* test and Mann–Whitney *U* test were used for comparison of continuous variables between the studied groups. Pearson chi-square test or Fisher’s exact test was used for comparison of categorical variables between the studied groups. A value of $p < 0.05$ was statistically significant.

Table 4 Comparison of pinch strength of the third finger between absence and presence of the palmaris longus muscle in the right and left hands

	Years	PLM	Number of boys	Pinch strength of the third finger (kg) Mean \pm SD	<i>p</i> value	Number of girls	Pinch strength of the third finger (kg) Mean \pm SD	<i>p</i> value
Right	6–7	Present	40	1.64 \pm 0.50	0.190	39	1.64 \pm 0.62	0.024
		Absent	14	1.42 \pm 0.55				
	8–9	Present	86	2.08 \pm 0.75	0.152	68	1.60 \pm 0.61	0.471
		Absent	35	1.87 \pm 0.61				
	10–11	Present	100	2.43 \pm 0.77	0.549	74	2.11 \pm 0.65	0.168
		Absent	30	2.34 \pm 0.46				
Left	6–7	Present	37	1.59 \pm 0.52	0.682	37	1.45 \pm 0.51	0.139
		Absent	17	1.53 \pm 0.59				
	8–9	Present	88	1.93 \pm 0.68	0.095	66	1.50 \pm 0.59	0.771
		Absent	33	1.71 \pm 0.49				
	10–11	Present	95	2.31 \pm 0.68	0.603	72	1.94 \pm 0.61	0.191
		Absent	35	2.24 \pm 0.74				

PLM palmaris longus muscle, SD standard deviation

Table 5 Comparison of pinch strength of the fourth finger between absence and presence of the palmaris longus muscle in the right and left hands

	Years	PLM right	Number of boys	Pinch strength of the fourth finger (kg) Mean \pm SD	<i>p</i> value	Number of girls	Pinch strength of the fourth finger (kg) Mean \pm SD	<i>p</i> value
Right	6–7	Present	40	0.85 \pm 0.41	0.689	39	0.87 \pm 0.46	0.009
		Absent	14	0.80 \pm 0.43		26	0.59 \pm 0.35	
	8–9	Present	86	1.40 \pm 0.67	0.001	68	0.97 \pm 0.50	0.924
		Absent	35	0.98 \pm 0.52		36	0.98 \pm 0.56	
	10–11	Present	100	1.55 \pm 0.65	0.584	74	1.31 \pm 0.60	0.026
		Absent	30	1.48 \pm 0.53		37	1.04 \pm 0.58	
Left	6–7	Present	37	0.92 \pm 0.48	0.302	37	0.80 \pm 0.52	0.094
		Absent	17	0.78 \pm 0.33		28	0.59 \pm 0.44	
	8–9	Present	88	1.13 \pm 0.59	0.011	66	0.81 \pm 0.45	0.919
		Absent	33	0.88 \pm 0.42		38	0.82 \pm 0.54	
	10–11	Present	95	1.44 \pm 0.59	0.244	72	1.03 \pm 0.54	0.355
		Absent	35	1.30 \pm 0.59		39	0.93 \pm 0.51	

PLM palmaris longus muscle, SD standard deviation

Results

In the right hand, the prevalence of the absence of the palmaris longus tendon was 25.9 % in males, 35.4 % in females, and an overall average of 30.4 %, while in the left hand, the prevalence of the absence of the palmaris longus tendon was 27.9 % in males, 37.5 % in females, and an overall average of 32.5 % (Table 1). Considering both hands, the difference between males and females in terms of the prevalence of the absence of the PL was significant. The dominant hand was the right one by 96 %.

As for the grip strength, the absence or presence of the palmaris longus tendon in the right and left hands of both

males and females did not reflect any significant difference (Table 2). As for the pinch strength of the second finger, there was no significant difference between two genders (Table 3). For the third finger of the right hand, only for females of 6–7 years old group, the absence of PL tendon showed a difference ($p=0.024$). There was no difference for the left hand (Table 4).

The relation of the palmaris longus with pinch strength at the fourth finger in the right hand was only significant in males at the age of 8–9 ($p=0.001$). For females, only at ages of 6–7 and 10–11, there was a significant relation between pinch strength and the palmaris longus ($p=0.009$, $p=0.026$, respectively) (Table 5). The pinch strength value of the

Table 6 Comparison of pinch strength of the fifth finger between absence and presence of the palmaris longus muscle in the right and left hands

	Years	PLM right	Number of boys	Pinch strength of the fifth finger (kg) Mean \pm SD	<i>p</i> value	Number of girls	Pinch strength of the fifth finger (kg) Mean \pm SD	<i>p</i> value
Right	6–7	Present	40	0.23 \pm 0.15	0.305	39	0.25 \pm 0.25	0.023
		Absent	14	0.18 \pm 0.17		26	0.13 \pm 0.13	
	8–9	Present	86	0.67 \pm 0.54	0.001	68	0.35 \pm 0.32	0.782
		Absent	35	0.33 \pm 0.26		36	0.33 \pm 0.36	
	10–11	Present	100	0.73 \pm 0.47	0.457	74	0.57 \pm 0.42	0.047
		Absent	30	0.66 \pm 0.42		37	0.41 \pm 0.29	
Left	6–7	Present	37	0.26 \pm 0.20	0.118	37	0.23 \pm 0.26	0.096
		Absent	17	0.17 \pm 0.17		28	0.13 \pm 0.17	
	8–9	Present	88	0.46 \pm 0.44	0.001	66	0.19 \pm 0.20	0.127
		Absent	33	0.27 \pm 0.18		38	0.28 \pm 0.36	
	10–11	Present	95	0.62 \pm 0.44	0.839	72	0.38 \pm 0.38	0.233
		Absent	35	0.60 \pm 0.47		39	0.30 \pm 0.24	

PLM palmaris longus muscle, SD standard deviation

fourth finger (left hand), when the palmaris longus was absent, was significant only in males at the age 8–9 ($p=0.011$) (Table 5).

For the fifth finger of the right hand, in females, the difference was significant at ages of 6–7 and 10–11 ($p=0.023$ and $p=0.047$, respectively). The relation of pinch strength and the palmaris longus was significant in males only at the age of 8–9 ($p=0.001$) (Table 6).

In the left hand, the relation of pinch strength and the palmaris longus was also significant in males only at the age of 8–9 ($p=0.001$) (Table 6). No subject with PL absence complained of difficulty performing any task in the study group.

Discussion

Previously, the prevalence of the absence of the palmaris longus tendon in the Turkish population was reported as 26.6 % [6]. In our study, in the right hand, the prevalence of the absence of the palmaris longus tendon was 25.9 % in males, 35.4 % in females, and an overall average of 30.4 %, while in the left hand, the prevalence of the absence of the palmaris longus tendon was 27.9 % in males, 37.5 % in females, and an overall average of 32.5 %. In a study, it has been shown that the prevalence of the palmaris longus absence on the right and left side was similar in men, whereas in women, it was significantly more common on the left side [2].

The frequent use of the palmaris longus tendon by surgeons brings to mind the question of whether the removal of the tendon of this muscle would affect the hand functions or not. Palmaris longus was reported to play an important role in thumb abduction through an extension onto the thenar eminence [3]. It is also believed that a weak flexor of the wrist and divided palmaris longus is of little importance and need not to be repaired [11]. We have determined that grip strength of the hand wrist was not affected in the absence of PLM. It has been reported that patients requiring a palmaris longus tendon graft could be divided into two main groups depending on the functional status of the donor's upper extremity [11]. In the first group, the donor's upper extremity was normal and the palmaris longus was needed for reconstruction elsewhere, e.g., lip augmentation, ptosis correction, management of facial paralysis, tendon reconstruction in the opposite extremity, etc. The second group of patients was those in whom the donor's upper extremity was not normal. This group could further be subdivided into two subgroups: one where the primary pathology did not involve the wrist flexors or thumb abductor muscles, e.g., ulnar collateral ligament reconstruction, interposition tendon grafts, and CMC joint arthroplasty and the other subgroup included those patients where the primary pathology

involved the wrist flexors or thumb abductor muscles, e.g., high ulnar and low median nerve palsies.

The probable effects of the palmaris longus muscle on hand functions have been studied and no clinically significant difference was observed [11]. We tried to answer the question of whether the functional value of the palmaris longus muscle bears a statistical value and significance in healthy subjects or not. To this end, we examined both grip and pinch strengths. As for the grip strength, the presence or absence of the palmaris longus muscle did not create a difference in general. In both sexes, the palmaris longus muscle increased pinch strength in the fourth and fifth fingers of the hands (especially in the right hand). Based on these findings, we have concluded that the palmaris longus muscle may impact the opposition movement of the fingers. In our study, we did not find out any complaints of PLM absent cases about performing their daily activities. So we think that using PL for a reconstructive surgery of any pathology may not result in any important functional disorder of the hand.

In our study, we did not find out any complaints of PLM absent cases about performing their daily activities. That is why we think that using PL for a reconstructive surgery of any pathology may not result in any important functional disorder of the hand.

The subjects were chosen from the elementary school students who may be expected to use their finger muscles for handwriting much more than the adults. In order to determine whether the removal of the palmaris longus muscle leads to any change in the grip and pinch strengths of these patients or not, the test must be conducted twice (one before and the other after the removal of this tendon). To do such a study, one needs to have ethical approval and informed consent from every subject. Having a big population study with well-analyzed statistics will possibly take a long time for completing it. That is why we have had to conduct this test on healthy subjects. This was the weak point of our study.

Conflict of interest The authors of this article have no conflicts of interest to disclose.

References

1. Caughell KA, Mcfarlane RM, Mcgrouter DA, Martin AH. Developmental anatomy of the palmar aponeurosis and its relationship to the palmaris longus tendon. *J Hand Surg-Am.* 1988;13A:485–93.
2. Eric M, Krivokuca D, Savovic S, Leknan I, Vucinic N. Prevalence of the palmaris longus through clinical evaluation. *Surg Radiol Anat.* 2010;32:357–61.
3. Fahrer M. Proceedings: the role of the palmaris longus muscle in the abduction of the thumb. *J Anat.* 1973;116:476.

4. Gangata H. The clinical surface anatomy anomalies of the palmaris longus muscle in the Black African population of Zimbabwe and a proposed new testing technique. *Clin Anat.* 2009;22:230–5.
5. Kapoor SK, Tiwari A, Kumar A, Bhatia R, Tantuway V, Kapoor S. Clinical relevance of palmaris longus agenesis: common anatomical aberration. *Anat Sci Int.* 2008;83:45–8.
6. Kose O, Adanir O, Cirpar M, Kurklu M, Komurcu M. The prevalence of absence of the palmaris longus: a study in Turkish population. *Arch Orthop Traum Su.* 2009;129:609–11.
7. Machado AB, Di Dio LJ. Frequency of the musculus palmaris longus studied in vivo in some Amazon Indians. *Am J Phys Anthropol.* 1967;27:11–20.
8. Natsis K, Levva S, Totlis T, Anastasopoulos N, Paraskevas G. Three-headed reversed palmaris longus muscle and its clinical significance. *Ann Anat.* 2007;189:97–101.
9. Ndou R, Gangata H, Mitchell B, Ngcongco T, Louw G. The frequency of absence of palmaris longus in a South African population of mixed race. *Clin Anat.* 2010;23:437–42.
10. Pai MM, Prabhu LV, Nayak SR, Madhyastha S, Vadgaonkar R, Krishnamurthy A, et al. The palmaris longus muscle: its anatomic variations and functional morphology. *Rom J Morphol Embryo.* 2008;49:215–7.
11. Sebastin SJ, Lim AYT, Bee WH, Wong TCM, Methil BV. Does the absence of the palmaris longus affect grip and pinch strength? *J Hand Surg-Brit Eur.* 2005;30B:406–8.
12. Sebastin SJ, Puhaindran ME, Lim AYT, Lim IJ, Bee WH. The prevalence of absence of the palmaris longus—a study in a Chinese population and a review of the literature. *J Hand Surg-Brit Eur.* 2005;30B:525–7.
13. Thompson NW, Mockford BJ, Cran GW. Absence of the palmaris longus muscle: a population study. *Ulster Med J.* 2001;70:22–4.
14. Thompson NW, Mockford BJ, Rasheed T, Herbert KJ. Functional absence of flexor digitorum superficialis to the little finger and absence of palmaris longus—is there a link? *J Hand Surg-Brit Eur.* 2002;27B:433–4.
15. Wehbe MA. Tendon graft donor sites. *J Hand Surg-Am.* 1992;17A:1130–2.