

# FREQUENCY OF THE AGENESIS OF PALMARIS LONGUS AND FLEXOR DIGITORUM SUPERFICIALIS TENDONS AMONG INDIVIDUALS

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## ABSTRACT

**Objective:** To find out the frequency of hereditary absence of palmaris longus and flexor digitorum superficialis tendons among individuals visiting physiotherapy clinics of 2 hospitals in Pakistan.

**Methods:** This cross-sectional study was conducted in Government hospitals in twin cities (Islamabad and Rawalpindi), Pakistan from September 2018 to March 2019. For examination, a standardized clinical Schaeffer's test and three additional tests were used for the assessment of palmaris longus (PL), and a standardized simple, and the modified test was used for flexor digitorum superficialis (FDS). Data were analyzed by using SPSS 23.

**Results:** Out of 619 individuals, 51.7% were men and 48.3% women were examined. The mean age of males was 33.4 years  $\pm$  14.5 and of females 35.9 years  $\pm$  13.4. Palmaris longus muscle was absent in 49.3% of participants with bilateral absence being more common. Unilateral absence of the PL muscle was found to be more in the left hand. Its absence in the left hand was found more common in females than in males (11.7% females, 9.1% males). This research showed agenesis of PL is gender dependent. ( $p < 0.05$ ), and no association was found among the standard FDS and PL tendon test, that is  $r = 0.046$ ,  $p = 0.249$ .

**Conclusion(s):** The absence of palmaris longus muscle is more frequently found in women and in the left hand. Agenesis of FDS is rare in individuals and has no association with agenesis of palmaris longus.

**Keywords:** Association, agenesis, humans, muscle, population.

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## INTRODUCTION

"Musculus" and "little mouse" is the Latin name for muscle <sup>1</sup>. Muscle fibers are longitudinal, thin structures with the ability of extensibility. Every muscle in the body differs in its form and its representation according to its purpose or its attachment location <sup>2</sup>. One of the muscles, in our body, with maximum variations, is the superficially weak forearm flexor, the palmaris longus (PL) muscle <sup>3</sup>. The absence of PL is found in 0.6% to 63.9% of individuals, with marked variations in its genesis found worldwide <sup>4</sup>. Its common variations include complete absence unilaterally or bilaterally, abnormalities in the structure or the site of attachment of PL like inverted, central sited, triple head in-

verted, enlarged, or abnormal attachment to the adjacent structures specifically, tendons, fascia, ligaments, bones, etc<sup>5,6</sup>. Various research has shown a close association between PL absence and many hand abnormalities like carpal tunnel syndrome (CTS), Volkmann's ischemic contracture, and Dupuytren's contracture <sup>7,8</sup>.

PL agenesis can be ruled out by clinical evaluation via standardized Schaeffer's test and through three other tests performed for more authorization <sup>9,10</sup>. The Palmaris longus, median nerve, and flexor carpi radialis are considered together as a landmark that is often used as an injection site of the carpal tunnel or to block the median nerve at the wrist. PL tendon protects the median nerve which passes deep under it. With agenesis of the PL tendon, the median nerve becomes exposed and most superficial in the wrist and eventually can be at risk of getting injured during any surgical procedure of the hand <sup>11</sup>.

The flexor digitorum superficialis (FDS) is another superficial flexor muscle of the hand. The FDS covers the bone's "radius/ulna" and gets divided into 4 tendons to the medial 4 fingers <sup>12</sup>. The FDS tendon of the fifth dig-

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it might be absent in most persons<sup>13</sup>. The FDS muscle can occasionally cause neurovascular disorders because of its different nature, such as neurovascular pressure caused by carpal tunnel syndrome<sup>14,15</sup>. Studies show that in the case of agenesis of the FDS muscle in the fifth digit, carpal tunnel syndrome becomes fairly common, but the severity of the CTS is not associated with FDS tendon absence or presence<sup>16</sup>.

Different hand injuries evaluation can be done by the examination of the flexor digitorum superficialis muscle via clinical tests and observing the person if he/she could perform flexion of the involved finger. The tendons can be identified appropriately whenever several parts of the superficialis tendon are cut<sup>17</sup>. It has been documented that the FDS tendon is a very useful graft for reconstruction and hand surgeries<sup>18-20</sup>. The FDS tendon is assessed via two different tests, that is standardized or simple FDS test which shows the independent role of FDS in the fifth digit. Another test is the modified FDS test which shows the dependent and mutual role of all FDS muscles in a hand<sup>21,22</sup>.

While much research has been conducted worldwide, local data are scarce regarding the data related to the absence or presence of PL & FDS in the general population. The purpose of this research is to assess the frequency of genetic absence or presence of PL and FDS tendon among participants. This will provide baseline data for all the clinical practitioners including surgeons and help them in formulating better treatments for different hand problems.

## MATERIALS AND METHODS

This cross-sectional study was conducted at Fauji Foundation Hospital and Pakistan Railway General Hospital, Rawalpindi, Pakistan for a duration of 6 months from September 2018 to March 2019. The study was approved by the Riphah Ethical Committee, Riphah College of Rehabilitation Sciences, Riphah International University, Islamabad, ref no: Riphah/RCRS/REC/00479.

The sample size of 619 was calculated through epitool in this study. Individuals, less than 60 years of age and both genders were included. Informed consent was taken. Participants having any diseases/abnormalities of the upper limbs or those who had undergone upper limb surgery were excluded from the study. The data was collected by performing Schaeffer's Test (Standardized Test) for PL and a simple test, along with a modified test for the FDS tendon. Additional tests that were performed included Thompson's test and Mishra's I and II test.

PL muscle examination was performed using the following methods:

1. Schaeffer's Test: flexion of the wrist and opposition of thumb to the little finger.

2. Mishra's I Test: flexion of the wrist and passive extension of the metacarpophalangeal joint.
3. Mishra's II Test: Performing thumb abduction against resistance while maintaining the wrist in flexion.
4. Thompsons Test: making a fist, then performing wrist flexion.

FDS muscle examination was performed using the following methods:

Clinical evaluation of the little finger FDS tendon was done by performing flexion of the little finger while keeping the wrist supine and other digits extended. For evaluation of the independent function of the little finger FDS tendon, flexion of the proximal interphalangeal joint (PIP) joint alone was considered positive. In the modified test, flexion of the PIP joint of the fifth digit along with the fourth digit was considered a dependent function of the FDS tendon of the fifth digit.

## RESULTS

A total of 619 individuals (51.7% men and 48.3% women) with a mean age of male were  $33.4 \pm 14.5$  and females of  $35.9 \pm 13.4$  were examined. Amongst 619, 18.9% were laborers and 81.1% were non-laborers. According to hand domination, 94% were right-hand dominant and 6% were left-handed.

The study showed that the palmaris longus muscle was absent in 305 (49.3%), of which 22.7% were males and 26.4% were females. Bilateral hand absence was more common. It was absent bilaterally in 202 (32.6%) individuals, in which 29.4% were males and 36.1% were women, while unilateral absence was observed in 103 (16.6%) individuals (7.58% men and 9.04% women). Unilateral absent palmaris longus muscle was greater in the left-handed than in the right hand with 9.1% in males, and 11.7% in females. The absence of palmaris longus muscle in the right-handed was again greater in females as compared to males (7.0% females and 5.6% men). The p-value was 0.009 which is significant. It showed that the agenesis of the PL tendon in general is greater in women as compared to men. (Table 1)

About 77.8% of laborers showed the presence of PL, out of which 14.5% showed the bilateral absence of PL, 3.4% right-sided, and 4.3% left-sided absence. While 36.9% of non-laborers showed bilateral absence of PL, 7% right-sided and 11.8% showed left-side absence. The presence of PL was significantly greater in laborers ( $p=0.000$ ) as compared to non-laborers.

In the case of the FDS tendon, 467 individuals were examined, with 79.4% being men. In 146 individuals (23.6%) individuals, there was a bilateral absence of flexor digitorum superficialis in the fifth digit. While unilat-

eral absence was noted as 0.96%. In the modified test of FDS, 139 (22.46%) individuals established a dependent FDS role in the fifth digit, and in (0.48%) individuals bilateral absence of the flexor digitorum superficialis function in the fifth digit. (Table 2) The current study showed that there is no association between the standard FDS and the

PL tendon's test, that is  $r(617) = 0.046$ ,  $p = 0.249$ , which showed that the PL agenesis and standard FDS agenesis are independent of each other. (Table 3)

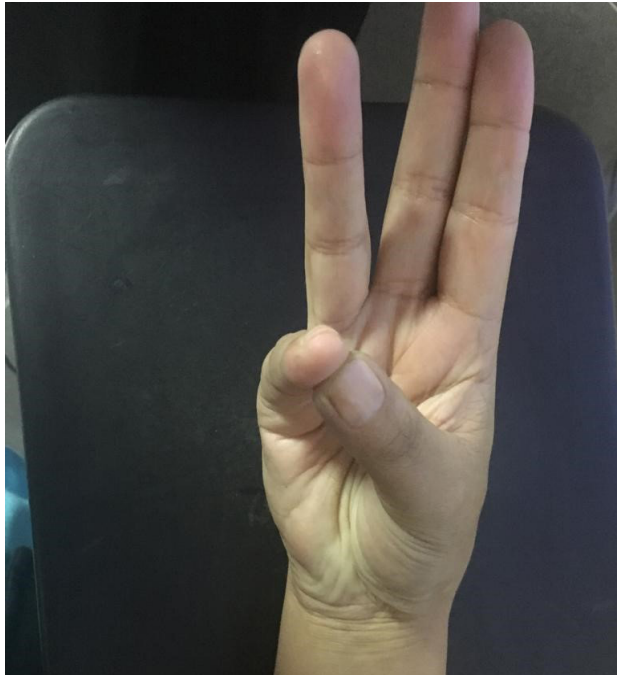


Fig 1: Schaeffers test, Showing agenesis of PL tendon



Fig 2: Absent FDS tendon in the little finger

Table 1: Distribution of Agenesis of Palmaris Longus Muscle

			All Agenesis	Bilateral Agenesis	Unilateral agenesis	Agenesis on LF Hand	Agenesis on RT Hand
Gender	Male	Frequency	141	94	47	29	18
		% Within Gender	22.7%	29.4%	7.5%	9.1%	5.6%
	Female	Frequency	164	108	56	35	21
		% Within Gender	26.4%	36.1%	9.0%	11.7%	7.0%
Total		Frequency	305	202	103	64	39
		% Within Gender	49.3%	32.6%	16.6%	10.3%	6.3%

Table 2: Independent and Common function of FDS and its agenesis to little finger

		Standard FDS Test					Modified FDS Test			
			Both Presence	Both Absence	RT Absence	LT Absence	Both Presence	Both Absence	RT Absence	LT Absence
Gender	Male	Count	254	66	0	0	61	1	0	0
		% Within Gender	79.4%	20.6%	0.0%	0.0%	19.1%	0.3%	0%	0%
	Female	Count	213	80	1	5	78	2	4	2
		% Within Gender	71.2%	26.8%	0.3%	1.7%	26.1%	0.7%	1.3%	0.7%
Total		Count	467	146	1	5	139	3	4	0
		% Within Gender	75.4%	23.6%	0.2%	0.8%	22.5%	0.5%	0.7%	0.3%

**Table 3: Correlation between PL and FDS**

		Schaeffer's Test	Simple FDS Test
Schaeffer's Test	Pearson Correlation		0.05
	Sig. (2-tailed)		0.25
	N		619
Simple FDS Test	Pearson Correlation	0.05	
	Sig. (2-tailed)	0.25	
	N	619	

## DISCUSSION

Several researches have been conducted in various geographical areas of the world to find out the frequency of palmaris longus absence. It is apparent from their findings that it differs greatly compared to the other muscle in the human body. A greater occurrence of PL agenesis (63.9%) was stated in the Turkish individuals & lowest occurrence (0.6%) was in the Korean individuals. Agensis of PL is lower in African and eastern Asian individuals (China) compared to individuals in Iran, Bahrain, India, Turkey, and North American Caucasians<sup>23</sup>. Our study showed that the palmaris longus muscle was absent in 305 (49.3%), of which 22.7% were males and 26.4% were females. Bilateral hand absence was more common. It was absent bilaterally in 202 (32.6%) individuals, in which 29.4% were males and 36.1% were women.

Mai s. Sater et al. conducted a study in 2010 that showed that out of 1043 individuals, in 385 (162; 34.0% males, 223; 39.2% females) palmaris longus muscle was absent. The study also stated a marked correlation between PL muscle absence with gender and hand domination in the individuals. Bilateral absence was more common than unilateral absence and the majority was found in females. The left-hand absence was more common as related to the left hand<sup>24</sup>. This research is quite similar to the current research as it also shows bilateral absence (32.6%) more than unilateral absence (16.6%). In another research, 386 Egyptians were assessed, and the total frequency of the absence of PL (unilateral or bilateral) was 50.8% which is somewhat similar to current research findings which are 49.9%. The bilateral PL absence in 120 (31.1%) individuals (7.8% men and 23.3% women) whereas the unilateral absence was significantly lower than is 76 (19.7%) individuals (14.2% men and 15.5% women) as compared to current research 202 (32.6%) individuals (29.4% men and 36.1% women) and 103 (16.6%) individuals (7.58% men and 9.04% women) respectively. The general frequency of PL absence was (46; 11.9% men and 150; 38.9% women) in this research while it was (141; 22.7% men and 164; 26.4% women) stated its agenesis typically in women<sup>25</sup>. In the current study agenesis of FDS was 2.1% and there was no correlation between the absence of FDS to the fifth digit and the presence or absence

of PL. Concerning the FDS tendon, out of the 772 fingers studied, FDS was absent in 10 fingers (1.3%), had a dependent role in 544 fingers (70.5%), & an independent role in 218 fingers (28.2%). Evaluation of 467 hands showed its independent role of FDS and the study of 139 hands showed a dependent FDS role on the fifth digit. The previous research showed a total of 266, and the total frequency of the absence of PL was 27.5%. No individual found agenesis of FDS to the fifth digit. Though, in 14 subjects (5.2 %) FDS tendon to the fifth digit was dependent. However, the frequency of agenesis of PL in Indian individuals is relatively higher, and agenesis of FDS to the fifth digit is still a rare phenomenon<sup>26</sup>. Significant differences were examined among men and women agenesis ( $p < 0.05$ ) that is relatively significant; it showed that the agenesis of PL tendon is greater in women as compared to men. The PL tendon was not relatively prominent in obese individuals so there is a necessity to palpate for confirmation its presence or absence.

## CONCLUSION

Our research concluded that the palmaris longus muscle was unilaterally absent in 32.6% & bilaterally in 16.6% of individuals with a complete absence in 49.3%. The absent palmaris longus muscle was more frequently observed in women and on the left side. Comparison of agenesis of PL, and FDS to the fifth digit was a rare phenomenon. No association was observed between agenesis of PL and FDS.

Researchers recommend that further study be conducted on other types of disparities of this peculiar tendon.

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#### AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

**Rafique N:** Result Analysis  
**Rafique A:** Article Writing  
**Bilal HB:** Literature Search, Data collection  
**Nawaz I:** Literature Search, Data collection  
**Ali M:** Critical review

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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