

# The prevalence of the palmaris longus muscle and analysis of palmar grip strength in medical students

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## ABSTRACT

**Introduction:** The palmaris longus muscle (PL) is located at the anterior compartment of the forearm, originated at the medial epicondyle of the humerus and inserts itself at the palmar aponeurosis, acting as wrist flexor muscle. Our aims were to evaluate the prevalence of the PL muscle and the palmar grip strength (PGS) in adult Brazilian medical students. **Material and Methods:** The present study is observational and transversal in fashion and was performed at the Laboratório de Habilidades e Simulação of the Medical School of Estácio de Sá University. The subjects included in the research were medical students of any gender, ethnicity, age and biotype, in agreement with the consent form. Individuals whom possessed any physical impairment that compromised the analysis were excluded from the study. The evaluated outcomes were: anthropometry, visualization and palpation of the PL and dynamometry for measurement of the PGS. **Results:** 111 volunteers were evaluated (79 women), the mean age was  $22.2 \pm 3.9$  years-old and mean body mass index (BMI) was  $23.2 \pm 3.7$  kg/m<sup>2</sup>. The PL was found in 81.9%, both right and left (79.7% in women and 87.5% in men). The means of the PGS in women and men were on the right side  $27.5 \pm 4.9$  and  $47.2 \pm 9.3$  kg/f and on the left side  $25.5 \pm 4.9$  and  $44.4 \pm 9.4$  kg/f, respectively. A positive correlation between BMI and PPS ( $p < 0.001$ ;  $r = 0.35$ ) and by comparing the groups it was obtained exclusively at the right side a significant difference between the PPS in men with or without the PL ( $p = 0.002$ ). **Conclusion:** A high prevalence of the palmaris longus muscle was found on the population of this study and there was a direct association between BMI and PGS.

**Keywords:** anatomical variation, muscle strength, palmaris longus muscle, palmar grip strength

## INTRODUCTION

The palmaris longus muscle (PL) is located at the anterior space of the forearm and is one of the most superficial in the region. It originates from the medial epicondyle of the humerus and inserts itself into the palmar aponeurosis, with the function of flexing the wrist and tensing the palmar aponeurosis [1, 2].

It can be easily identified and tested during wrist flexion associated with opposition between the thumb and the little finger [2, 3]. This muscle is small and fusiform, with short belly and long tendon. It is innervated by the median nerve and serves as a topographic guide to the location of this nerve, since the tendon of the PL lies superficially and medially to this nerve [2].

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## Palmaris longus muscle prevalence and strength

The PL is only found in vertebrate mammals and is more developed in those that uses the upper limb for locomotion. It is known to be as one of the anatomical structures of greater variability and those can be related to race, gender and side of the body. Variations regarding position, duplication (digastric), presence of accessory PL, as well as unilateral or bilateral agenesis have been described [4-6].

In view of the most recent findings, the muscle in question is identified as a small vestigial muscle of the forearm that is degenerating phylogenetically [4, 6, 7]. Its prevalence is of great interest, considering that its use has already been described in the repair of oncological head and neck abnormalities, thumb arthritis and palpebral ptosis in children. Furthermore, the PL tendon can be used as a graft for treatment of facial paralysis and urinary incontinence, as well as reconstruction of lips and chin [5].

This study aims to evaluate the prevalence of the PL muscle and its correlation with palmar grip strength in Brazilian medical students.

### **MATERIAL AND METHODS**

The present study is a cross-sectional and observational. It was approved by an Ethics Research Committee (47707015.8.0000.5284) and was performed at the Laboratório de Habilidades e Simulação (LHS) do Campus Arcos da Lapa (LHS) from the Medical School of the Estácio de Sá University (UNESA). Individuals whom were university students of any gender, ethnicity, age and biotype which signed the informed consent term were included. We excluded individuals with physical limitations that prevented the analysis. The following outcomes were analyzed: anthropometry, visualization and palpation of the PL as well as palmar grip strength (Table 1).

The analyses were performed by at least two researchers and always in the presence of the principal investigator aiming for greater accreditation of the finding and optimization of the records.

#### **Research protocol**

After reading and signing the informed consent form, the participant's weight and height

were measured with the aid of a stadiometer scale (Filizola®).

**Table 1:** Collected data.

Registration form	a) Age
	b) Gender
	c) Race
Anthropometric data	d) Body mass (kg)
	e) Height (m)
	f) Body mass index (kg/m <sup>2</sup> )
Opposition test	g) PL visualization
	h) Tendon palpation
Dynamometry	i) Palmar grip strength (kg/f)

Then, the participant was submitted to an opposition test, with the purpose of observing the PL. At this stage, photography of the forearm was taken for registering the finding.

Afterwards, the subject was submitted to a dynamometry test, which was used to evaluate the muscle strength of palmar grip or manual grip strength (PGS). The equipment used in the procedure was a hydraulic hand dynamometer (Sammons Preston; Jamar, Bolingbrook, IL, USA), formed by a system of tensioning sealers and made up of two interlocking steel bars.

When the individual compresses the equipment through palmar grip, the bars bend, promoting alteration in the resistance of the sealers, and as such, the voltage changes in proportion to the force exerted by the grip.

The subject remains seated, with the dominant arm adducted parallel to the trunk, forearm flexed at 90°, supported in a neutral position and the hand between 0° and 30° of extension and between 0° and 15° of ulnar deviation.

Participants were instructed to remain seated on a height-adjustable bench, as well as on the maintenance position of the equipment during gauging. Then, the subject was instructed to perform palmar hold movement for each attempt.

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Three repetitions were performed with duration of five seconds. At least one minute of interval was taken between measurements, in order to avoid interference of fatigue during the test. The force measure obtained is expressed in kg/f.

All analyzes were performed by Sigmastat 3.1 (SYSTAT Software Inc., Point Richmond, CA, USA). The distribution of variables was analyzed using the Kolmogorov-Smirnov test. The measures of association between variables were analyzed by the Pearson correlation tests. For the comparisons, the student t test was used. A value of  $p < 0.05$  was considered significant for all analysis.

### RESULTS

A total of 111 volunteers (79 women and 32 men) were evaluated. Anthropometric characteristics, data on PL prevalence and palmar grip strength are shown in Table 2.

**Table 2:** Anthropometric data, prevalence of the palmaris longus muscle and palmar grip strength.

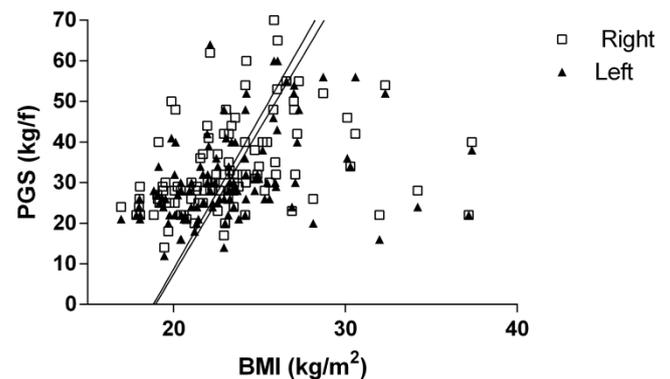
	F	M	Total
Age (years)	22.1±3.8	22.3±4.0	22.2±3.9
Weight (kg)	59.6±9.6	77.7±11.6	64.8±13.1
Height (m)	1.63±0.05	1.74±0.06	1.66±0.07
BMI (kg/m <sup>2</sup> )	22.4±3.5	25.3±3.6	23.2±3.7
PL prevalence (R) (%)	63 (79.7%)	28 (87.5%)	91 (81.9%)
PL prevalence (L) (%)	63 (79.7%)	28 (87.5%)	91 (81.9%)
PGS R (kg/f)	27.5±4.9	47.2±9.3	33.2±11.0
PGS L (kg/f)	25.5±4.9	44.4±9.4	30.9±10.7

Data is presented as mean±SD (standard deviation).

Considering the prevalence of PL and laterality, it was observed that four men (12.5%) and 10 women (12.6%) had only one of the limbs, where there was 50% of prevalence to the right and 50% to the left.

When we correlated the variables obtained, we observed a positive association between BMI and FPP bilaterally (Figure 1).

When comparing groups with PL and without PL, no significant differences were observed in women on both sides ( $p = 0.527$  on the right and  $p = 0.888$  on the left) and on the men on the left ( $p = 0.773$ ); however, a significant difference was found in the right side of the men evaluated ( $p = 0.002$ ) (Figure 2).



**Figure 1:** Correlation between body mass index (BMI) and palmar grip strength (PGS) on the right and left forearms ( $p < 0.001$ ;  $r = 0.35$ ).

### DISCUSSION

The presence of the PL may be associated with a higher risk of presenting Dupuytren's disease, carpal tunnel syndrome and Guyon's channel [7,8] and its agenesis is described in the classical literature in approximately 14% of individuals [2], corroborating with the findings of this study, whose prevalence was 81.9% - thus, in 18% of the individuals, this structure was not palpable nor observed.

Studies regarding its agenesis in specific populations have different results [8], for instance: 23% in North America, 4.6% in China, 63.9% in Turkey, 9.3% in Iran, 52.3% in Serbia, 31, 2% in Nigeria and 4.4% in the East African population [4, 5, 9-13].

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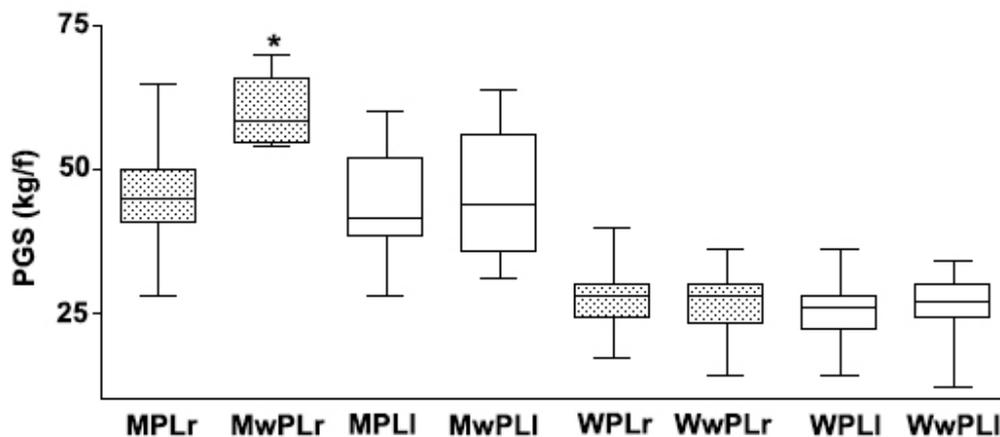


Figure 2: Comparison of palmar grip strength (PGS) between groups with and without the palmaris longus muscle (PL). Legend: MPLr - men with PL on the right side; MwPLr - men without PL on the right side; MPLI - men with PL on the left side; MwPLI - men without PL on the left side; WPLr - women with PL on the right side; WwPLr - women without PL on the right side; WPLI - women with PL on the left side; WwPLI - women without PL on the left side. \*Significant differences in the comparison between MPLr and MwPLr ( $p = 0.002$ ).

In addition, a study regarding its prevalence in Iran showed that 22.8% of the study participants had agenesis of this muscle. Among these, 10.2% had right agenesis, 5.9% left and 6.7% bilateral [5]. Nasiri et al. (2016) [14], also analyzed Iranians and found 3.9% bilateral agenesis and 9.3% unilateral, while Vucinic et al. (2016) [11] and Vercruyssen et al. (2016) [15] observed more bilateral agenesis than unilateral. This shows that even studies from the same region or country show different results.

Among the 18% of the Brazilian population with PL agenesis in our study, 5.4% were bilateral and 6.3% unilateral from either side. Furthermore, agenesis of PL was observed mostly in women, as opposed to observations of studies in Iranians, in which absence of muscle was predominant in men [5, 14].

According to a study carried out by Mbaka and Ejiwunmi (2009) [6], bilateral agenesis in Africans was more common in men (1.5%) than in women (0.4%), which conflicts with our results (bilateral agenesis only in women - 30%). Their study also showed a prevalence of left agenesis was found to be relatively greater than the right one, corroborating the findings in Serbs [11] and Belgians [15], while in our sample the agenesis between sides were similar in both genders.

The absence of this muscle, however, is not associated with any significant functional deficit (decreased strength, resistance to fatigue or

proprioceptive alteration), since this muscle seems only to assist the flexor compartment of the forearm and its absence does not make it impossible to perform this movement nor perform it with difficulty [1, 4, 16]. As such, it was suggested that this muscle has lost its function throughout human evolution and nowadays, the PL is considered functionally insignificant [8, 15].

However, this muscle - especially its tendon - is still clinically and surgically relevant, as it is quite useful during reconstructive procedures in orthopedic surgeries. Hence, knowledge of its prevalence for medical-surgical practice is extremely relevant [8, 17, 18].

## CONCLUSION

In summary, there was a high prevalence of the PL in the sample studied herein. The body mass index had a direct association with the palmar grip strength, however, the latter did not correlate with the prevalence of the muscle studied, a fact that reinforces the recommendation of its use for medical-surgical procedures without risk of functional deficit.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## ACKNOWLEDGMENTS

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## RESUMO

*A prevalência do músculo palmar longo e a força de preensão palmar em estudantes de medicina*

**Introdução:** O músculo palmar longo (PL) localiza-se no compartimento anterior do antebraço, origina-se no epicôndilo medial do úmero e insere-se na aponeurose palmar, atuando como flexor do punho. O objetivo deste trabalho foi avaliar a prevalência do músculo PL e a força de preensão palmar em adultos brasileiros estudantes de medicina. **Material e Métodos:** Estudo observacional, transversal, realizado no Laboratório de Habilidades e Simulação do Curso de Medicina da Universidade Estácio de Sá. Os participantes incluídos na pesquisa foram estudantes do curso de medicina, de qualquer gênero, etnia, idade e biótipo, em concordância com o termo de consentimento livre e esclarecido. Foram excluídos indivíduos com limitações físicas que impediram a análise e avaliados os seguintes desfechos: antropometria, visualização e palpação do PL e dinamometria para medida da força de preensão palmar (FPP). **Resultados:** Foram avaliados 111 voluntários (79 mulheres), médias de idade =  $22,2 \pm 3,9$  anos e índice de massa corporal (IMC) =  $23,2 \pm 3,7$  kg/m<sup>2</sup>. O PL foi encontrado em 81,9%, tanto à direita quanto à esquerda (79,7% em mulheres e 87,5% em homens). As médias de força de preensão palmar em mulheres e homens foram respectivamente: à direita  $27,5 \pm 4,9$  e  $47,2 \pm 9,3$  kg/f e à esquerda  $25,5 \pm 4,9$  e  $44,4 \pm 9,4$  kg/f. Identificou-se uma correlação positiva entre o IMC e a FPP ( $p < 0,001$ ;  $r = 0,35$ ) e ao comparar os grupos obteve-se exclusivamente à direita uma diferença significativa entre a FPP em homens com e sem PL ( $p = 0,002$ ). **Conclusão:** Constatou-se uma alta prevalência do músculo palmar longo na população estudada e uma associação direta entre o IMC e a FPP.

**Palavras-chave:** variação anatômica, força muscular, músculo palmar longo, força de preensão palmar