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Frequency of the Palmaris Longus muscle in the Population of Islamabad, Pakistan

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Abstract

Background: The Palmaris Longus is a variable muscle with differing frequencies of presence in multiple ethnicities, populations and regions. Our study is a cross-sectional study that measures the frequency of the muscle in our sample size in Islamabad. Our aim is to determine the frequency of the palmaris longus muscle in the population of Islamabad, Pakistan. The absence of the palmaris longus does not result in any functional disability. Our objective is to improve our knowledge and spread awareness of the variability of the palmaris longus muscle and its use as a graft tissue at other sites of injury.

Methodology: The presence of the palmaris longus was determined using 4 tests involving various hand movements. Observation of the tendon of the palmaris longus at the inner wrist confirmed its presence. A sample of 389 participants from the residents of Islamabad was picked randomly. This study was conducted in 2019 at Shifa College of Medicine (Shifa Tameer e Millat University).

Results: Absence of palmaris longus in males and females was 4.7% and 6% respectively. Bilateral absence was seen only in 1% of the study population. Unilateral absence in the right and left hands were seen to be 1.3% and 3.3% respectively. In ambidextrous persons, palmaris longus was present in both hands. In right and left-handed persons, 4.80% and 19.2% of the study population exhibited palmaris longus absence, correspondingly.

Conclusion: Overall, the palmaris longus was absent in 5.7% of the entire sample. Further studies can be conducted to establish a relationship between the presence of the palmaris longus muscle and different determinants such as ethnicity and hand dominance etc.

Keywords: Palmaris longus muscle, Islamabad, Schaeffer's, Thompson's test, Pushpakumar test and Lotus Sign test

Introduction:

The palmaris longus (PL) is one of the most anatomically variable muscles of the body, in some cases being completely absent, either unilaterally or bilaterally.[1] Other variations include the muscle being double, digastric, split, tendinous and having various insertions. Over its course the muscle partially overlaps the median nerve and this may show variations as well.[2] In reference to the surgical and anatomical texts, the frequency of absence of the PL is said to be approximately 15%, however this may not account for all the world's populations.[3] This figure was initially reported by Reimann et al. in 1944.[4]The absence of the palmaris longus ranges from 0.6% in the Korean population to 63.9% in the Turkish population, demonstrating the large variability in the presence of the muscle around the world.[5] Variations have also been seen between different geographical regions as well as on a much smaller scale, between different areas in the same country. The muscle, originating at the medial epicondyle from a common flexor tendon, has a characteristically short belly giving way to a long slender tendon of variable length which inserts into the flexor retinaculum and palmar aponeurosis.[6] The palmaris longus is a superficial accessory flexor of the wrist and also aids in thumb abduction.[7] No physical or functional deficiency is noted with the function of the arm after its removal,[2,7] and thus it has the potential to be a frequently harvested muscle for transplantation in hand and reconstructive surgeries.[8] It has been used in procedures such as lip augmentation,[3] management of facial paralysis,[9] repairing ptosis and urinary incontinence.[10] However the potential as a graft is not the only reason for interest in the PL muscle. Specific types of variations of the PL muscle can have a role in median nerve entrapment neuropathy or stimulate a soft tissue tumor.[11]

Given the clinical application of the palmaris longus as a common source for tendon grafting in damaged tissue of other sites, our aim is to determine the frequency of absence of this muscle in a population of the city of Islamabad in Pakistan. This type of study has previously not been conducted in Islamabad.

Materials and Methodology:

A cross-sectional study was designed to investigate the frequency of the presence of the Palmaris Longus muscle in a multiethnic population of the capital city of Pakistan, Islamabad in the year of 2019. Approval for the research was obtained by the Institutional Review Board and Ethics Committee of Shifa International Ltd.

The total population of Islamabad is 1.015 million, according to the census done in 2017. Out of this

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population, a required sample size of 385 people was calculated using the WHO Calculator for the purpose of this study. A sum of 389 volunteers, between 15-65 years of age, were observed for the presence of the palmaris longus muscle. Our sample was obtained from different student populations and patients of Shifa International Hospital. The volunteers within these populations were picked according to convenience sampling. Data was collected from the volunteers over a time period of 4 weeks in September-October 2019.

Data of all volunteers who were compliant with the study, seemingly fit and healthy irrespective of their age, gender and ethnicity was included in the results. The data of volunteers who had a previous history of trauma to their hands and/or forearms, those showing any signs of inflammation, history of surgical intervention or presence of any other known birth defect/congenital anomaly was excluded. The investigators were trained in carrying out the tests for assessing the presence of the PL muscle and they provided a thorough explanation and demonstration to relieve the participants of any qualms concerning the tests.

The volunteers were provided information about the examinations and protocols of the research and informed consent was obtained from each participant. The participants' gender, age, ethnicity, hand dominance, history of previous surgery/injury and any apparent obesity affecting the results of the examination were recorded. Out of 422 participants initially recruited, 33 documented any history of previous injury or surgery. So, they were excluded from the study and our sample size of 389 was finalized.

There was no apparent obesity hindering the detection of the palmaris longus tendon in the volunteers. The tests were performed on both hands for the presence of PL. The result of each volunteer was entered in one of the following four parameters: (1) present bilaterally, (2) absent bilaterally, (3) unilaterally present in the right arm and (4) unilaterally present in the left arm.

The four tests used, Schaeffer's, Thompson's, Pushpakumar and Lotus Sign tests have varying accountability (Figure 1). These tests have been used in countless other researches with the same purpose of determining the presence of the PL muscle, therefore we can vouch for their reliability.[12, 13, 14]

1. Schaeffer's Test was done by stabilizing the arm at 90 degrees and bringing the thumb to the little finger with the wrist slightly flexed (Figure 1a).
2. Thompson's Test was performed by forming a fist followed by flexing of the wrist against resistance (Figure 1b).
3. Pushpakumar's Test was done by forming a "peace sign" with the hand or folding the first digit over the 4th and 5th digit and extending the 2nd and 3rd digits. Then the wrist was flexed (Figure 1c).
4. The Lotus Sign test was performed by bringing all the fingers and thumb together to point upwards (Figure 1d).

Data was entered and coded in IBM SPSS Statistics Version 23. Descriptive analysis was calculated as percentages and frequencies. There was no missing data that needed to be addressed.

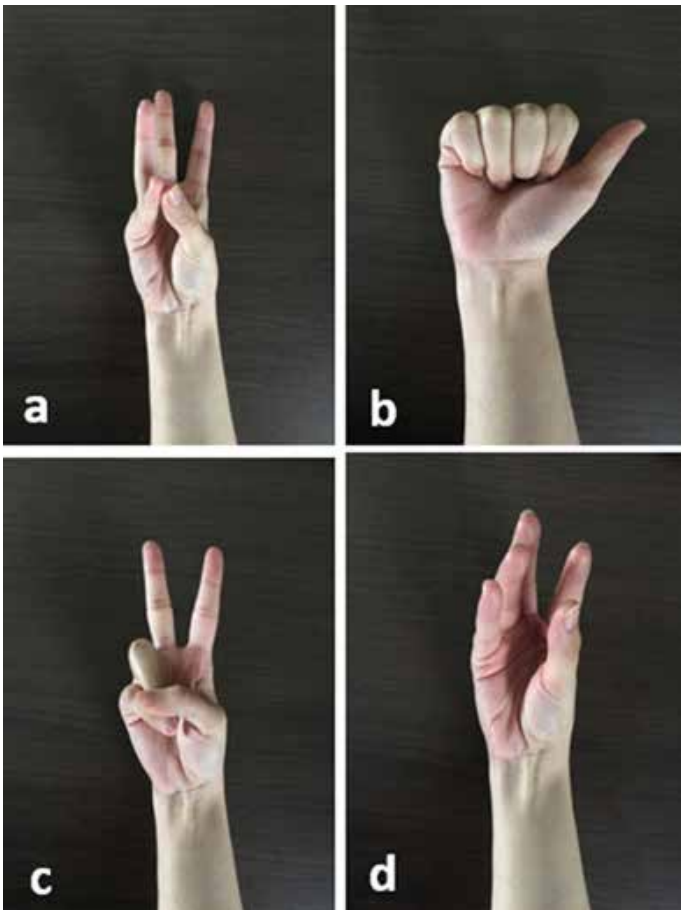

Figure 1: Schaeffer's (a), Thompson's (b), Pushpakumar's (c) and Lotus Sign (d) Tests for Prevalence of Palmaris Longus (PL) Muscle

Results

Out of 422 participants initially recruited, 33 documented a history of previous injury or surgery. So, they were excluded from the study and our sample size of 389 was finalized.

The study included a total number of 389 participants, of which 86 (22.1%) were males and 303 (77.9%) were females (Table 1). The reason for more females compared to male volunteers was in the collection of samples from a student body of nursing students, the majority of which consisted of women. The maximum age of our volunteers was 60 years. When presenting our results in relation to age, we divided the age of our participants into 3 groups; Most of our study participants (228/389 ~ 58.6%) belong to age bracket of 1-20 years, followed by (150/389 ~ 38.6%) 20-40 years and (11/389 ~ 2.8%) 40-60 years (Figure 2).

Most of our study participants were Punjabi (67.9%) followed by Pathan (16.2%), Kashmiri (5.4%), Gilgiti (3.3%), Urdu-speaking (3.3%), Saraiki (1.8%), Balochi (1%) and Sindhi (0.8%). The majority of our participants were right-handed, 351 (90.2%). Left-handed and ambidextrous participants were 26 (6.7%) and 12 (3.1%), respectively (Table 2). Most of the study participants (68.6%) were in the normal range of weight. However, 119/389 (30.6%) and 3/389 (0.8%) were reported to exhibit moderate and excessive obesity, correspondingly.

Regarding, test-wise data, overall PL prevalence was derived by combining the results of all four tests i.e. Schaeffer's test, Thompson's test, Pushpakumar's test, and Lotus sign. The percentage of prevalence is described with their 95% Confidence Interval (CI). Out of 389 participants, 367 or 94.30% (CI 92-96.6%) of the participants were seen to have the PL present in both hands. Only 4 out of 389 or 1% (CI 0.012-1.99%) participants reported bilaterally absent PL with all of these four tests conducted for the presence of PL. It was unilaterally present in the right hand in 13 out of 389 or 3.30% (CI 1.52-5.08%) of the participants; and unilaterally present in the left hand of 5 out of 389 or 1.30% (CI 0.17-2.93%) of study participants (Tables 1 & 2).

Figure 2 shows the presence or absence of the PL muscle in relation to age groups. In age recorded 1-20 years, PL was seen to be present in right hand only (10/228 ~ 4.39%), left hand only (5/228 ~ 2.19%), bilaterally present (210/228 ~ 92.10%) and bilaterally absent (3/228 ~ 1.32%). In age recorded 20-40 years, PL was seen to be present in right hand only (2/150 ~ 1.33%), left hand only (0/150 ~ 0%) bilaterally present (147/150 ~ 98%) and bilaterally absent (1/150 ~ 0.67%). In age recorded 40-60 years, PL was seen to be present in right hand only (1/11 ~ 9.09%), left hand only (0/11 ~ 0%) bilaterally present (10/11 ~ 90.91%) and bilaterally absent (0/11 ~ 0%) (Figure 2).

Figure 2: Age-wise distribution of frequency of PL presence or absenc

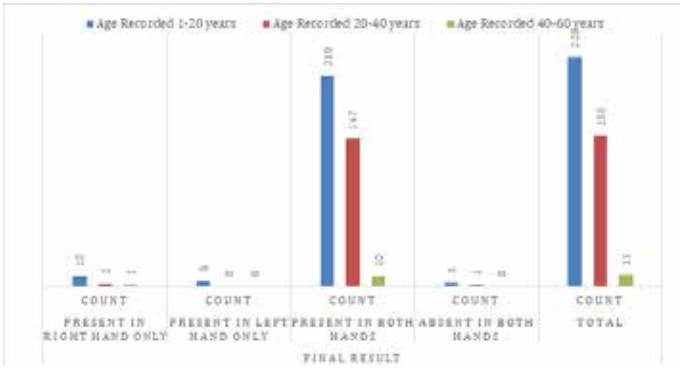

Table 1 shows the presence of the PL muscle in relation to gender in our sample. Out of 303 female participants, 18 (5.94%) showed PL agenesis either unilaterally (right/left hand only) or bilaterally. Most of the males have bilateral presence of PL. Only 4/86 (4.7%) showed presence of the PL muscle in the right hand only. None of the male participants showed PL agenesis bilaterally.

Table 1: Gender wise frequency of PL

			Palmaris Longus			
			Present in right hand only	Present in left hand only	Present in both hands	Absent in both hands
Gender	Male	Count (N)	4	0	82	0
		% within Gender	4.70%	0.00%	95.30%	0.00%
	Female	Count (N)	9	5	285	4
		% within Gender	3.00%	1.70%	94.10%	1.30%
Total Count (N)			13	5	367	4

Table 2 shows the presence or absence of the PL muscle in relation to hand dominance of an individual. Our study sample consisted of 351/389 (90.2%), 26/389 (6.7%), and 12/389 (3.1%) right-handed, left-handed and ambidextrous individuals respectively. None of the ambidextrous volunteers showed agenesis of the PL muscle. Rather, they had a bilateral presence of PL (100%). However, 17/351 right-handed individuals (4.8%) and 5/26 left-handed individuals (19.2%) demonstrated absence of the PL in their forearms either unilaterally or bilaterally. Most of the right- and left-handed individuals had bilateral presence of PL. PL agenesis (unilateral or bilateral) was seen in 22/389 (5.60%) of the total sample size.

Table 2: Hand-dominance wise frequency of PL

			Palmaris Longus			
			Present in right hand only	Present in left hand only	Present in both hands	Absent in both hands
Hand Dominance	Right Hand	Count (N)	9	4	334	4
		% within Hand Dominance	2.60%	1.10%	95.20%	1.10%
	Left Hand	Count (N)	4	1	21	0
		% within Hand Dominance	15.40%	3.80%	80.80%	0.00%
	Ambidextrous	Count (N)	0	0	12	0
		% within Hand Dominance	0.00%	0.00%	100.00%	0.00%
Total		Count (N)	13	5	367	4
		%	3.30%	1.30%	94.30%	1.00%

Discussion

The palmaris longus is the most variable muscle of the upper limb of the human body. The variants can be of many types, the most common being absence of the muscle either unilaterally or bilaterally. Other variations include bifurcation and Y-shaped tendons of the PL muscle. Factors such as gender and ethnicity of an individual may influence the presence of the PL muscle. Considering it plays a significant role as a source of tendon grafting and other surgical procedures, it is deemed important to determine the frequency of absence of this muscle in different populations. This conclusion was made as a result of numerous studies investigating whether the PL has any functional significance.

Our study found the overall frequency of absence of the PL muscle (unilateral or bilateral) to be 6% of the sample population of Islamabad, which is similar to the value of 6.7% in the Yoruba population.8 Bilateral absence in our study was found to be 0.9% (4 subjects of 389) and unilateral absence (either right or left) was found to be 4.6%. These results are also comparable with the Yoruba population, in which there was 1% bilateral absence and 5.7% unilateral absence. A study was done in a student population in Ghana which tested the association between the prevalence of absence of the PL muscle and different variables (e.g. gender, body size etc.). In this research, 8 out of a sample size of 210 subjects (3.8%) were seen to show congenital absence of the muscle. Unilateral absence was observed to be 2.8% (1.4% on each side) and bilateral absence was 1% which is comparable to our result of 1.1%.[15]

A study conducted within the Kashmiri population of Pakistan, showed agenesis in 132 subjects of a sample size of 700 (18.9%),

with 47 (6.7%) being males and 85 (12.1%) being females showing an almost double frequency of agenesis in females. In our study, 22 individuals were seen with agenesis, of which 4 (1.0%) were males and 18 (4.6%) were females. The population of Kashmir has an overall absence of 18.9%.[16] This is a much greater frequency of absence compared to the findings in the population of Islamabad. A similar study conducted in the Andhra population of India shows an overall agenesis of 28% which is almost 5 times greater than that seen in our study. Another feature of the result differing from our own was that there was a much greater frequency of absence seen in women compared to in men (40.2% in females and 14.7% in males).[17] A sample of the Punjabi population of India showed an overall absence of 11.3% which is much closer to our result compared to the Andhra population.[18] This indicates similarities in the prevalence of absence of the PL muscle in similar ethnic groups.

Many similar studies have been done in different parts of the world to determine the prevalence of the PL muscle. According to a study conducted in a South Indian population, the overall prevalence was 16% with a unilateral absence of 11.5%, bilateral absence of 3% and a total absence of 16.7% in males. Whereas in females it was absent unilaterally in 12.5%, bilaterally in 2.5% and overall it was absent in 15%.6 Another study conducted on the population of the US, focused on the ethnicity with a total of 516 volunteers, including 415 Caucasians, 55 African Americans, 35 Asians and 11 of other/mixed origin. The above study was able to prove that there was no significant difference in the absence of the PL muscle between non-Hispanic and Hispanic patients, with 14.9% and 13.1% absence respectively. [1]

A study conducted in a South African population, with a sample of 706 participants which were chosen at random, yielded a bilateral absence in 11.9% of the cases. The unilateral absence in the right arm and in the left arm was 6.94% and 7.65% respectively.[19] The results of a recent study conducted in Faisalabad, Pakistan on a sample of medical students can be compared with our own. Out of a total of 202 student volunteers were examined, bilateral agenesis was seen in 16 (7.9%) and unilateral agenesis was seen in 31 (15%).[20] Many future studies can be conducted using the frequency of absence of the PL muscle as a stepping stone. The conduction of a greater number of studies is imperative to determine the association between the presence or absence of the PL muscle with other factors such as gender, hand dominance, ethnicity etc. Sound knowledge on this subject will assist in the development of a better understanding of the variations of this surgically important muscle and consequently to improve the planning and efficiency of certain graft surgeries.

Conclusion

Further studies can be conducted to establish a relationship between the presence of the palmaris longus muscle and different determinants such as ethnicity and hand dominance etc.

Sound knowledge on this subject will help health care professionals gain a better understanding of the variations of the surgically important PL muscle and lead to an improvement in the planning of graft surgeries.

Limitations:

There are a few limitations to our study. The greater number of female participants compared to male participants can be the source of potential bias if our findings are extrapolated to consider the entire population of Islamabad. The skewed age distribution can also be the source of a potential bias.

Conflict of interest:

The authors declare that they have no competing interests.

Author's Contributions:

Shafi S. and Zahra T. conceived the presented idea and supervised the project, were in charge of overall direction and planning and approved the final version to be published. Sumra S. A., Amjad. A., Khan N., Saif A. and Khakwani N. K. collected, analyzed and presented the data of the project in the form of figures and tables. Sumra S. A. initially drafted the manuscript with contributions from all authors. Zahra T. finalized the manuscript. All authors agreed to be accountable for all aspects of work.

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Ethical Approval and Consent:

Ethical approval was sought and obtained for the present study from the Institutional Review Board (IRB) of our institute. Official IRB # was 089-579-2019.

Every participant signed a written informed consent form before participating in the study voluntarily. Sample consent form is made available as an annexure (Appendix

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