The Incidence of Palmaris Longus Muscle and Its Association with the Biodemographic Data of Medical and Allied Health Science Students

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ABSTRACT

**Background:** The Palmaris longus (PL) muscle is one of the most anatomically variable muscles in the human body. The presence or absence of the muscle tendon is relevant information to hand and plastic surgeons. The muscle tendon can be harvested for reconstructive surgeries, tendon transfer and tendon surgeries, facial paralysis, repair ptosis, arthritis of the thumb and to repair oncologic defects of the head and neck. Therefore, this study aimed at identifying the incidence of PL and its association with the study participant’s age, gender and geopolitical region of origin.

**Methods:** This cross-sectional study was performed on students that were taught ‘muscles of the forearm’ during the 2021/2022 academic session of the Edo state university, Uzairue, Nigeria. Bio-demographic data was retrieved using a self-structured hard-copy questionnaire. Schaeffer’s, Thompson’s and Pushpakumar’s testing methods were used to assess the absence/presence of PL. Data was entered into Microsoft Office Excel 2019 and exported to IBM SPSS version 23 for analysis. Fisher’s and Pearson chi-square tests were used to determine association. Probability values < 0.05 were accepted as significant.

**Results:** Of the 294 enrolled students taught the topic “muscle of the forearm” during the 2021/2022 academic session, 269 (91%) students willingly participated in this study. 155 were females (57.6%), and 114 were males (42.4%). Out of the 269 students assessed, 253 (94.1%) students had the PL tendon in both hands, nine (3.3%) students didn’t have the tendon in both hands, seven (2.6%) students didn’t have the tendon in either the left hand (2.2%) or the right hand (0.4%). While, gender was a significant predictor for left- and right-hand values of the absence or presence of PL muscle tendon (p < 0.05), age and geopolitical zone of origin was not (p > 0.05).

**Conclusion:** The Palmaris muscle varied in only 5.9% of our study population. It was found that the occurrence of PL is gender dependent but not dependent on age or the individual’s region of origin. The absence of the muscle was common in females and on the left hand.

**Keywords:** Anatomical variations, palmaris longus, plastic surgeons, schaeffer’s test, tendon grafting.

I. INTRODUCTION

The palmaris longus (PL) is one of the five superficial muscles of the front of the forearm [1]. It originates from the medial epicondyle of humerus, converges into a long and slender tendon and inserts into the distal half of the flexor retinaculum and apex of the palmar aponeurosis [2], [3]. The PL muscle is situated between the flexor carpi ulnaris medially and flexor carpi radialis tendons laterally [1], [4].

The functions of the PL muscle are to flex the wrist joint, tense the palmar aponeurosis and protects the nerves and vessels of the palmar aponeurosis [1], [2]. The muscle is also crucial for anchoring the skin and fascia of the hand to resist distal horizontal shearing pressures that would tend to shave off the palm's skin [5], [6]. Owing to the muscle’s superficial location, length, diameter, and the unobstructed functionality of the upper limb if the PL is removed, it can be used for reconstructive surgeries, tendon transfer and tendon surgeries [7]. It is also used by plastic surgeons in treatment of facial paralysis, lip augmentation, restoration of lip and chin defects and in repairing ptosis [8], [9]. In addition, the PL tendon can also be harvested to repair arthritis of the thumb and to repair oncologic defects of the head and neck [10].

Despite the functions and clinical importance of this muscle, it notably has many variations which includes; absence or presence, duplicated or with anomalous insertions, an additional belly or fusion with another muscle, reverse tendinous and muscular location or even muscular location in the center [5], [11]. More so, this muscle variation can lead to
medial and/or ulnar nerve syndromes, since the PL muscle is innervated by median nerve (C7, C8) [12].

In humans, the absence of Palmaris longus was reported in 1559 by [13]. Previous literatures, reported its absence on one or both sides (usually the left) in approximately 10-14% of people globally [2], [5]. This number varies across different populations. The least incidence was observed in Korean subjects (0.6%) while the highest incidence was observed in Turkish population (64%) as mentioned in a meta-analysis [14]. The Palmaris Longus muscle is commonly reported to be absent in women [4], [12]. Right hand dominance is reported to be more common with about 70-90% of people being right-handed [9], [15].

For Nigeria, the largest black nation in the world, several studies reported 3.7% - 31.25% as the incidence of PL absence within 2008 – 2017 [6], [10], [16], [17]. Nigeria has 36 states grouped into 6 geo-political zones as follows: North-Central region (Benue, Kogi, Kwarar, Nasarawa, Niger, Plateau, and Federal Capital Territory, Abuja), North-Eastern region (Adamawa, Banch, Borno, Gombe, Taraba and Yobe), North-Western region (Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara), South-Eastern region (Abia, Anambra, Ebony, Enugu, and Imo) South-South (Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers) and South-Western region (Ekiti, Lagos, Ogun, Ondo, Osun and Oyo). The incidence of PL could vary among different regions of Nigeria.

Globally, attempts have been made to correlate the absence of Palmaris longus with ethnicity [6], [18], median nerve [7], gender [4], [19], body side [9], [20], age [8], [9] and dominant hand [15]. Only a few studies associated the muscle’s absence with some or all of these parameters. In this part of the world, no recent analysis on the incidence of this muscle tendon have been reported. Also, taking into consideration that the presence or absence of this muscle is relevant information to hand and plastic surgeons in our study area, this present study aimed to investigate the absence/presence of palmaris longus muscle using physical examination methods. In addition, our study aims to ascertain whether the absence/presence of the muscle has an association with age, gender, body side and geo-political region of origin in a Nigerian students’ population.

II. METHODOLOGY

A. Study Area

This study was conducted at the Edo State University, Uzairue, which is located in Estako-West local government area of Edo State, Nigeria. The university accepts application for admission from all regions of Nigeria.

B. Study Design and Population

This cross-sectional study was performed on the medical and health-related science students of Edo State University that were taught the topic ‘muscles of the forearm’ in their gross anatomy module for the 2021/2022 academic session. These students belonged to the department of anatomy, department of medical laboratory science, department of medicine and department of nursing. These students included both male and female gender.

C. Instrumentation

A self-structured hard copy questionnaire was designed by the authors and reviewed by two experts. The questionnaire contained 3 sections. The first section was designed to seek students’ informed consent before carrying out the tests for this study. The second section contained 3 bio-demographic questions and the third section contained a table to input data obtained from the three tests which was carried out.

The three testing methods used to assess the absence/presence of the palmaris longus (PL) muscle tendon were the Schaeffer’s test, Thompson’s test and the Pushpakumar’s test [8]. Schaeffer’s test was performed by asking the student to oppose the thumb to the little finger and then flex the wrist slightly. Thompson’s test was performed by asking the student to make a fist and then flex the wrist and finally the thumb is opposed and flexed over the fingers. Pushpakumar’s test was performed by asking the student to fully extend the index finger and middle finger, the wrist and other fingers are flexed and finally the thumb is fully opposed and flexed. Students with hand and wrist deformities, previous injuries or surgeries in the forearm and wrist, were excluded from the study.

D. Data Collection

Immediately after one of the authors delivered the lecture to these students, the aim of the study was told to the students. Questionnaire was then distributed by another author. The testing methods were explained to the students again before they carried out the test. All authors oversaw the students while they carried out the test. The authors recorded the testing resulting on each student questionnaire.

E. Data Analysis and Presentation

The responses were collated and entered into Microsoft Office Excel 2019 spreadsheet and then exported to IBM SPSS version 23 program for statistical analysis. Fisher’s exact test and Pearson chi-square test ($\chi^2$) was used to determine association. Probability values of $P < 0.05$ were accepted as significant. Figures and tables were used to present the results.

III. RESULT

A total of 294 enrolled students were taught the topic “muscle of the forearm” during the 2021/2022 academic session, 269 willingly participated in the assessment, which gave a response rate of 91%. Fig. 1 show the department in which the participants assessed for PL gained admission into. Nearly half of the students (47%) studies medicine and surgery. Among all, anatomy department had the least number of students (6%).

Fig. 2 displays the frequency of the presence and absence of palmaris longus. From the 269 students assessed, 253 (94.1%) students had the PL tendon in both hands; 141 (52.42%) were females, 112 (41.64%) were males. Nine (3.3%) students didn’t have the tendon in both hands, seven (2.6%) students didn’t have the tendon in either the left hand (2.2%) or the right hand (0.37%). Therefore, the overall incidence of the absence and presence of the PL tendon was
5.9% and 94.1% respectively.

Table I shows the frequency and percentage of students by gender and age with the absence and presence of palmaris longus muscle tendon. Age ranged from 15 to above 30 years. Almost all the students, (91%) belonged to two age groups; 15-18 years (128, 47.5%) and 19-22 years (117, 43.5%). PL was absent in both hands of nine participants (3.3%), of which all were female within the age group of 15-22 years. The tendon was absent in only the left hand of 6 students (2.2%), of which 4 (1.5%) were females and 2 (0.7%) were males. PL was present in only the right hand of a female student (0.4%), whose age fell under the 15-18 years category.

Table I: The incidence of absence and presence of the Palmaris Longus muscle tendon among participants

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age (years)</th>
<th>Absence on both hands</th>
<th>Absence on left hand only</th>
<th>Absence on the right hand only</th>
<th>Presence on both hands</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>N = 269</td>
</tr>
<tr>
<td>Female</td>
<td>15-18</td>
<td>8 (2.9)</td>
<td>3 (1.1)</td>
<td>1 (0.4)</td>
<td>71 (26.4)</td>
<td>83 (30.8)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>23-26</td>
<td>1 (0.4)</td>
<td>1 (0.4)</td>
<td>0</td>
<td>61 (22.7)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>27-30</td>
<td>0</td>
<td>0</td>
<td>4 (1.5)</td>
<td>4 (1.5)</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>&gt; 30</td>
<td>9 (3.3)</td>
<td>4 (1.5)</td>
<td>1 (0.4)</td>
<td>141 (52.4)</td>
</tr>
<tr>
<td>Male</td>
<td>15-18</td>
<td>0</td>
<td>1 (0.4)</td>
<td>0</td>
<td>0</td>
<td>44 (16.4)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>19-22</td>
<td>0</td>
<td>0</td>
<td>33 (19.7)</td>
<td>54 (20.1)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>23-26</td>
<td>0</td>
<td>0</td>
<td>11 (4.1)</td>
<td>11 (4.1)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>27-30</td>
<td>0</td>
<td>0</td>
<td>2 (0.7)</td>
<td>2 (0.7)</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>&gt; 30</td>
<td>0</td>
<td>0</td>
<td>2 (0.7)</td>
<td>112 (41.6)</td>
</tr>
</tbody>
</table>

Table II: Comparison of the presence/absence of the Palmaris Longus muscle tendon with participant’s gender, age and geo-political zone of origin

<table>
<thead>
<tr>
<th>Gender</th>
<th>Absent</th>
<th>Present</th>
<th>Statistical Analysis</th>
<th>Absent</th>
<th>Present</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>13 (4.8)</td>
<td>142 (52.8)</td>
<td>$\chi^2 = 5.488$</td>
<td>10 (3.7)</td>
<td>145 (53.9)</td>
<td>$\chi^2 = 7.639$</td>
</tr>
<tr>
<td>Male</td>
<td>2 (0.7)</td>
<td>112 (41.6)</td>
<td></td>
<td>0</td>
<td>114 (42.4)</td>
<td></td>
</tr>
</tbody>
</table>

Age in years

<table>
<thead>
<tr>
<th>Gender</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>11 (4.1)</td>
<td>117 (43.5)</td>
<td>9 (3.3)</td>
<td>119 (44.3)</td>
<td>4.088</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4 (1.5)</td>
<td>113 (42)</td>
<td>1 (0.4)</td>
<td>116 (43.1)</td>
<td>4.088</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>0</td>
<td>15 (5.6)</td>
<td>0</td>
<td>15 (5.6)</td>
<td>0.537</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>4 (1.5)</td>
<td>0</td>
<td>4 (1.5)</td>
<td>0.537</td>
<td></td>
</tr>
</tbody>
</table>

Geo-political region of origin

<table>
<thead>
<tr>
<th>Region</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
<th>Absent</th>
<th>Present</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>North-Central</td>
<td>1 (0.4)</td>
<td>12 (4.5)</td>
<td>1 (0.4)</td>
<td>12 (4.5)</td>
<td>0.592</td>
<td></td>
</tr>
<tr>
<td>North-East</td>
<td>0</td>
<td>11 (4.1)</td>
<td>0</td>
<td>11 (4.1)</td>
<td>0.592</td>
<td></td>
</tr>
<tr>
<td>North-West</td>
<td>0</td>
<td>10 (3.7)</td>
<td>0</td>
<td>10 (3.7)</td>
<td>0.592</td>
<td></td>
</tr>
<tr>
<td>South-East</td>
<td>3 (1.1)</td>
<td>33 (12.3)</td>
<td>3 (1.1)</td>
<td>33 (12.3)</td>
<td>4.088</td>
<td></td>
</tr>
<tr>
<td>South-South</td>
<td>12 (4.5)</td>
<td>161 (60)</td>
<td>7 (2.6)</td>
<td>166 (61.7)</td>
<td>4.088</td>
<td></td>
</tr>
<tr>
<td>South-West</td>
<td>0</td>
<td>26 (9.7)</td>
<td>0</td>
<td>26 (9.7)</td>
<td>0.592</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>16 (5.9)</td>
<td>253 (94.1)</td>
<td>11 (4.1)</td>
<td>258 (95.9)</td>
<td>0.592</td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at p-value < 0.05
Table II shows the result obtained from associating the presence/absence of PL on the right and left hand of participants with their gender, age and geo-political region of origin. From the Fishers exact test analyses, it is observed that gender was a significant predictor for left- and right-hand values of the absence or presence of PL muscle tendon (p < 0.05) in this population study. The prevalence of absence of PL was common in females than males.

There was no statistical evidence to show the association between age and the frequency of absence or presence of PL (p > 0.05 on both hands). For the participant’s geo-political region of origin, the result was also not statistically significant (p > 0.05). Although, the frequency was higher in students’ whose state of origin is the south-south region of Nigeria (Table II).

IV. DISCUSSION

Several researchers have described the Palmaris longus (PL) muscle as one of the most anatomically variable muscles in the human body. Amongst so many of this muscle tendon’s variations, its absence appears to be the most common variation [5], [7], [11]. Till now, surgeons use this tendon for tendon grafting, as well as for orthopedics, otolaryngology, plastic and ophthalmologic surgeries [16].

In this present study which included medical and health-related science students that were well knowledgeable in Anatomy, it was easy to use the three combined physical tests as used by [8], for examining the presence or absence of the palmaris longus (PL) muscle tendon. Although, it was observed that individuals with large body size required palpation as the final confirmatory examination for the absence or presence of PL. This gives a hint for clinicians to further consider ultrasonography before harvesting the PL tendon in grafting surgery. For instance, a recent study in southeastern United States [21], reported two false positive and seven false negative PL result via physical examination.

The appearance of the PL muscle was commonly reported to be variable in population, races and hereditary traits [8], [9], [22]-[24]. In our study, the palmaris longus muscle was present in 253 subjects (94.1%). The value is comparable to the Arabian Gulf region [22], Punjabi [24] and the Pakistan population [25]. A lower incidence of presence (36.1%) was reported in Turkey population [26], [27]. On the other hand, many studies have recorded the incidence of absence of the PL muscle tendon on human subjects. The overall incidence of its absence in our study (5.9%) is slightly higher than the incidence of studies recorded in East Africa (4.4%) [28], Ghana (3.8%) [20], Nigeria (3.7%) [17], Zimbabwe (1.5%) [29] - all in Africa. Compare to the high reports from Asian populations (Iran, Gaziantep, Napel, India) [18], [26], [30], [31], the Yoruba population [10], South African population [32], and Ethiopians [33]-all in Africa, recorded a lower frequency of palmaris longus absence. It would be safe to say, the absence of palmaris longus muscle tendon is lower in Africans. Moderate value of the muscle’s absence was reported in Punjabi population (11.3%) [24], southeastern United States (14%) [21] and in North Cyprus (17.4%) [9]. Other studies reported higher prevalence 31.05% in Turkish subjects [20], 28% in Palestine subjects [34], and 40.5% in Saudi Arabia [8].

Several studies have attempted to correlate the occurrence of the PL with gender or handedness. Our present study showed a statistically significant relationship (p < 0.05) which is analogous to reports from quite a lot of studies [9], [18], [19], [25], [34], [35]. However, there were still contradicting results reporting no statistically significant difference in gender or handedness [20], [31]. The result from this study conform to the existing knowledge that the absence of PL muscle is common in females and in the left side [14], [19], [35]. Although, another study [22] reported a high frequency of absence in females but on the right side. In some other studies, the frequency of absence occurred more in males than in females [36], [37]. Interestingly, a study in Nigeria also documented same [10] (6.9% in males and 6.4% in females) which is contrary to our present study conducted in Nigeria.

Age is another factor to consider in the absence of palmaris longus. Most of the authors who tried to relate age with the absence of PL, failed to support their conclusions with statistical analysis of the data. In our study, age was not statistical proven as a significant predictor for left- and right-hand values of the absence or presence of PL muscle tendon (p > 0.05). Even though this finding is similar to Erdagi’s [19], it is still likely that age could have an effect on the absence or presence of palmaris longus since 91% of our study participants belonged to 2 age groups.

We hypothesized that there would be a relationship between participants’ geo-political zone of origin and the absence of PL on either hand; but based on our findings, we cannot completely fail to reject the hypothesis because majority of the participants in our study are from the south-south geo-political zone. Also, the frequency of absence in participants’ geo-political zone of origin could not be compared as there were no similar studies to compare.

V. CONCLUSION

We evaluated that palmaris longus muscle was present in majority of our sample population (94.1%). The lower incidence of the PL absences from our study was in agreement to previous studies, which reported that Palmaris Longus muscle tendon is predominately present in African population. The occurrence of the PL muscle was seen to be gender dependent but not dependent on age or the individual’s region of origin. The absence of the muscle was common in females and mainly on the left hand than the right hand. There was no association with participant’s geo-political zone of origin possibly because the majority of students are from one geo-political zone.

AVAILABILITY OF DATA

Data supporting our findings is contained in the manuscript excluding confidential participants photographic data. If you wish to obtain the photographic data for research purpose, data can be shared upon request by contacting the corresponding author.
ACKNOWLEDGMENT

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CONFLICT OF INTEREST

Authors do not have any conflict of interest.

REFERENCES
