A CADAVERIC STUDY ON VARIATIONS OF PALMARIS LONGUS AND ITS CLINICAL SIGNIFICANCE
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ABSTRACT

BACKGROUND
Palmaris longus is a member of superficial group of flexor compartment of forearm muscles. It is a weak flexor of wrist and tensor of palmar aponeurosis. Its absence does not affect the strength or grip. However, its anomalous variants may cause clinical syndromes. Also, its long tendon with short muscle belly favours its use in tendon grafts and repair. Since it is a highly variable muscle, its variations must be studied.

The aim of the study is to evaluate the different variations in palmaris longus muscle in cadavers and its possible clinical implications.

MATERIALS AND METHODS
This study was conducted in the Department of Anatomy of Madurai Medical College, Madurai. 30 formalin preserved cadavers were dissected during the period 2015-2018. A total of 60 upper limbs were studied. Both female and male cadavers of all age groups were included. Specimens damaged during dissection were excluded. The anterior compartment of forearm in all specimens were dissected step by step as per the directions given in Cunningham’s manual of dissection. The palmaris longus muscle was identified by tracing out its origin and insertion. Anatomical variations encountered in the due course were documented and analysed using chi square test for statistical significance. The prevalence and significance of variations from the other studies done so far have also been studied.

RESULTS
Bilateral absence of palmaris longus along with palmar aponeurosis which is a rare occurrence was observed in a female cadaver. Bilateral duplication of palmaris longus was noted in one male cadaver. Duplication is more common in males. Absence is more common in females. In general, Variations are more common in females.

CONCLUSION
With variations of palmaris longus being more common, adequate knowledge about its prevalence and significance is needed in multiple medical specialities for its reconstructive use and clinical syndromes caused by it at times. Therefore, diagnosing and treating them appropriately is very important.

KEYWORDS
Anatomical Variations, Clinical Significance, Palmaris Longus.


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Inclusion Criteria
1. Both female and male cadavers were studied.
2. Cadavers of all age groups were included.

Exclusion Criteria
Specimens damaged during dissection were excluded.

The anterior compartment of forearm in all specimens were dissected step by step as per the directions given in Cunningham's manual of dissection. The palmaris longus muscle was identified by tracing out its origin and insertion. Anatomical variations encountered in the due course were documented. Photographs of the same were taken and analysed with respect to its prevalence and significance from the previous studies. Chi-square test was applied to analyse the statistical significance of the results.

RESULTS
Among the 60 upper limb specimens dissected, Palmaris longus (PL) was present in 58 (96.6%) and absent in two specimens. Duplication of palmaris longus which is a rare occurrence was observed in one male cadaver bilaterally (Figure 1) wherein both PL inserted separately into palmar aponeurosis.

We have found bilateral absence of palmaris longus along with palmar aponeurosis (PA) in a female cadaver (Figure 2 & Figure 3). Usually when PL muscle is absent, PA is always present and formed by other flexor muscles say commonly by flexor carpi ulnaris. Absence of both PA and PL has not been reported so far. Thus, it is a new and rare finding in our study.

Both of the variations were seen bilaterally in the respective cadavers. Thus, we found no laterality in variations of PL in our study.

In most studies, absence of PL was seen more commonly on the left side in women while there was no laterality in men. Also, bilateral absence was slightly higher in men.

No other variations like split tendons, variable origin, insertions and reversed muscle were noted during our study.

<table>
<thead>
<tr>
<th>Status of PL</th>
<th>Male Cadavers</th>
<th>Female Cadavers</th>
<th>Total Cadavers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Duplicated</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Present normally</td>
<td>21</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>8</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 1. Observed Frequency of Variations in Cadavers in Relation to Gender

Chi square test was applied, and the p value was <0.0001 for the confidence interval of 99%. Hence the following observed results are statistically significant.
1) Duplication is more common in males
2) Absence is more common in females
3) Variations are more common in females
DISCUSSION

Palmaris longus is functionally more important in animals with weight bearing forelimbs during climbing, grasping, etc. It is well developed in orangutans while mostly absent in gorillas and chimpanzees. As the forelimbs became prehensile, the functions of Palmaris longus has been taken over by intrinsic muscles of hand. In humans, it is a weak flexor of metacarpophalangeal and carpometacarpal joints, cupping of the palm, tensor of palmar aponeurosis. However, its absence does not significantly affect the strength or grip of the hands. Its long tendinous part and short belly indicates it is phylogenetically a degenerative muscle while the same favours as a muscle of interest for surgeons in tendon transfers and other reconstructive surgeries.

Variations in Palmaris longus are more common with respect to its presence or absence, origin, anomalous insertions, duplication, triplication, etc. Absence of PL being the most common variations, has been reported in 14% of humans. In a study conducted among 3 different age groups namely young, middle and old age people, incidence of presence of Palmaris longus was found to be lower in younger age group indicating that it is disappearing in humans slowly.4

Embryology

The muscles of the upper limb are developed by migration of myoblasts from the somites into the limb buds which aggregate into dorsal and ventral masses. Dorsal mass develops into extensor and supinator muscles i.e. posterior compartment of arm and forearm while the ventral mass develops into flexor and pronator muscles of upper limb i.e. anterior compartment of arm and forearm. Flexor muscle mass of forearm in turn divides into superficial and deep groups. The superficial group gives rise to flexor carpi ulnaris, flexor carpi radialis, Palmaris longus and pronator teres.5 The basis of absence or duplication of Palmaris longus is considered to be failure of or excess cleavage of superficial muscle mass into appropriate segments respectively.

The development of Palmaris longus is regulated by HOX gene6 and its possible genetic inheritance is under research.

Clinical Significance

In our study, bilateral duplication in a cadaver (3.3%) and bilateral absence of PL (3.3%) in a cadaver were noted which is lesser than the rate among world population and slightly higher than the rates among the Asian population. In a multi-ethnic study by Ali M. Soltani et al., it was found that there was no significant difference in the absence of the PL muscle between White non-Hispanic & Hispanic patients, with prevalence of 14.9% and 13.1%, respectively while the African American (4.5%) and Asian (2.9%) patients had significantly fewer absence of the PL.7

Sebastian SJ stated that absence of palmaris longus does not affect the grip and pinch strength.8

A study by O’Sullivan says that in 47% of persons with absent Palmaris longus, Abnormal superficial palmar arches were noted which needs further research.9

Median nerve lies deep to the Palmaris longus tendon. In case of absence of Palmaris longus, median nerve is the most superficial in the midline at the wrist which becomes easily prone for injuries.10

Other variations in Palmaris longus have been reported in various studies.

Sunil et al. reported variable insertions like bifurcation or trifurcation of PL tendon.11

In such cases, PL tendon harvesting for graft often fails.

Mobin N. reported Accessory palmaris longus, duplication of PL, Conjoint tendons of PL and flexor carpi ulnaris.12

Mathew et al. mentioned reverse palmaris longus in their study.13

Anomalous insertion of PL deep to flexor retinaculum, reversed belly, Accessory PL and duplicated PL when present may cause carpal tunnel like syndrome compressing the median nerve.14

In such cases among people whose occupation involves repetitive wrist movements like modern day IT professionals, PL muscle undergoes hypertrophy which presents as volar swelling causing carpal tunnel or Guyon’s canal syndrome compressing the median or ulnar nerve respectively.13

Depuydt et al. states that whenever a patient complains of effort related carpal tunnel symptoms despite adequate tunnel release, an anomalous muscle should be suspected.15

While considering anomalous muscle, Palmaris longus variations must be differentiated from other anatomical variants such as Palmaris profundus and epifascial accessory Palmaris longus. Palmaris profundus muscle may originate from Radius/ulna or flexor digitorum superficiais fascia, runs deep to pronator teres and enters carpal tunnel to get inserted deep to palmar aponeurosis which produces same effects as that of a reversed or hypertrophied Palmaris longus compressing median nerve.16

PL tendon is used as grafts in various surgeries like extensor tendon repair in rheumatoid arthritis patients,17 injuries of flexor tendons and repair,18 lip augmentation,19 pulley reconstructions,20 etc.

Palmaris longus is used as Frontalis suspension sling in patients with ptosis due to chronic external ophthalmoplegia,21 Kearns-Sayre syndrome, etc.

Bifid PL with ‘V’ shaped arrangement favours its use in correcting oral and lid angles in facial palsy.22

CONCLUSION

Variations like absence of palmaris longus must be made aware to the surgeons as it makes the option of using it for reconstruction unavailable and to plan for another donor muscle as graft necessary. In our study, we have found variations being more common among females than males. As we have mentioned earlier, there was bilateral absence in a female cadaver and bilateral duplication in a male cadaver. Variations like duplication and reversed muscle...
belly are clinically important as they might compress the structures beneath it i.e. median nerve causing symptoms of carpal tunnel syndrome. Since the absence of PL does not cause functional loss of grip/hand strength, it favours the use of PL in various reconstructive surgeries. Hence even though the palmaris longus is functionally less significant, being the most variable muscle, its anatomical knowledge should be studied for its reconstructive use and clinical syndromes caused by it at times.

REFERENCES