

A STUDY OF PALMARIS LONGUS MUSCLE: ITS ANATOMIC VARIATIONS WITH EMBRYOLOGICAL SIGNIFICANCE AND CLINICAL IMPORTANCE

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ABSTRACT

Background: In the present study, variations in the Palmaris longus and the clinical implications of these are discussed.

Aim: To study the variations in the Palmaris longus and to discuss the embryological basis, clinical and surgical implications of these variations.

Materials and Methods: This study was conducted in Department of Anatomy of Hassan Institute of Medical Science, Hassan, Dr B.R.Ambedkar Medical college, Bangalore and Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar. Thirty formalin fixed cadavers (60 upper limbs); 25 males & 5 female cadavers were dissected for the study and it was conducted over a period of three years, i.e., from 2011-2014. The cadavers with visible trauma, pathology or prior surgeries were excluded from the study. Routine dissection of the upper limb was carried out following the Cunningham's Manual of Practical Anatomy. During the dissection of the anterior compartment of forearm, the Palmaris longus muscle was identified & carefully dissected. At first, the origin was confirmed and then, it was traced towards its insertion. Any variations found were noted and photographed. The results were analysed and compared to previous studies.

Results: Bilateral absence of palmaris longus was seen in one male cadaver and unilateral (right sided) absence in one female cadaver. Percentage of bilateral absence of palmaris longus is 3.3%. Total absence of palmaris longus is 5%. Right side absence is 3.3%, left side absence is 1.6%. Variations like split tendon of palmaris longus was observed in a female cadaver on right side, bilateral split tendon with fleshy belly in a male cadaver, reversed belly of right side palmaris longus in a male cadaver.

Conclusion: Precise knowledge of variations in the Palmaris longus is essential for surgeons, orthopaedicians, plastic surgeons, anatomists, researchers and interventional radiologist.

KEY WORDS: Palmaris Longus, Prevalance, Variation, Reconstructive Surgery.

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INTRODUCTION

Palmaris longus is described as a slender superficial flexor muscle of the forearm. The muscle belly is fusiform in shape which takes

origin from the anterior surface of medial epicondyle of humerus in common with the other superficial flexor muscles of forearm, just medial to flexor carpi radialis muscle. It converges

to form a long tendon, which passes superficial to flexor retinaculum and then the tendon broadens out to form a flat sheet which gets attached to the apex of palmar aponeurosis. Palmaris longus muscle is innervated by median nerve (C7, C8) and “phylogenetically it is a degenerate metacarpophalangeal joint flexor” and a weak flexor of the wrist joint. At the wrist, median nerve lies partly undercover of palmaris longus or between the tendons of flexor carpi radialis and palmaris longus [1].

Palmaris longus is often absent on one or both sides. The literature reports that the Palmaris longus muscle is a sex-linked dominant trait [2,3] more absent in females [4].

Sebastin and co-workers (2005) reported that the absence of the Palmaris longus is not correlated with a decrease in the strength of one’s grip or pinch [5].

The knowledge of the anatomical variations of palmaris longus is important due to its clinical significance. Variations of palmaris longus are common but asymptomatic; they may become important during surgeries and in some radiological procedures. Awareness of such variations is important for clinicians and surgeons.

This work was undertaken to throw more light for surgeons performing tendon grafting, plastic and reconstructive surgeries, orthopaedic surgeons, anatomists, maxillofacial surgeons, oncosurgeons and ophthalmologists.

The variations and related structures, many a times could pose problems in differential diagnosis, hence study of variations was given due importance.

MATERIALS AND METHODS

This study was conducted in Department of Anatomy of Hassan Institute of Medical Science, Hassan, Dr B.R.Ambedkar Medical college, Bangalore and Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar. Thirty formalin fixed cadavers (60 upper limbs); 25 males & 5 female cadavers were dissected for the study and it was conducted over a period of three years, i.e., from 2011-2014. The cadavers with visible trauma, pathology or prior surgeries were excluded from the study. Routine dissection of the upper limb was carried out

following the Cunningham’s Manual of Practical Anatomy. During the dissection of the anterior compartment of forearm, the Palmaris longus muscle was identified & carefully dissected. At first, the origin was confirmed and then, it was traced towards its insertion. Any variations found were noted and photographed. The results were analysed and compared to previous studies.

RESULTS

In our study, Dissection of 30 cadavers (25 male, 5 female cadavers) revealed the following details: **Table 1 & Table 2.**

Table 1: Absence of the Palmaris longus muscle.

Specimen no.	Gender	Right side/Left Side/ Bilateral	Absence (%)
12	Male	Right Side	1.6
26	Female	Bilateral	3.3
Total	-	-	5

By dissection method it was observed that there was bilateral absence seen in one male cadaver and unilateral (right sided) absence in one female cadaver. Percentage of bilateral absence of Palmaris longus is 3.3%. Total absence of palmaris longus is 5%.

Table 2: Variations in Palmaris longus muscle observed by dissection method (5 females & 25 male cadavers).

Specimen no.	Gender	Right side (a)	Left side (b)
17	Male	Distal part of tendon is split into two slips.	Normal
24	Female	Reversed belly	Normal
25	Male	Distal part of tendon is split, fleshy belly	Distal part of tendon is split, fleshy belly
26	Female	Bilateral absence	

By dissection method, Variation like split tendon of palmaris longus was observed in a female cadaver on right side, bilateral split tendon with fleshy belly in a male cadaver (Figure 1), reversed belly of right side palmaris longus in a male cadaver (Figure 2).

It was observed that palmaris longus was present in 95% and there was bilateral absence seen in one male cadaver specimen no.26 and unilateral (right sided) absence in one female cadaver specimen no.12.(Figure 3) Percentage of bilateral absence of palmaris longus is 3.3%. Overall, absence of palmaris longus was found in 5%. Duplication of Palmaris longus muscle is rare, but it was found in specimen no.12.(Fig 4).

Fig. 1: Split tendon of palmaris longus in a female cadaver.



Fig. 2: Reversal of palmaris longus in a male cadaver, Note the belly in distal part and tendon in proximal.

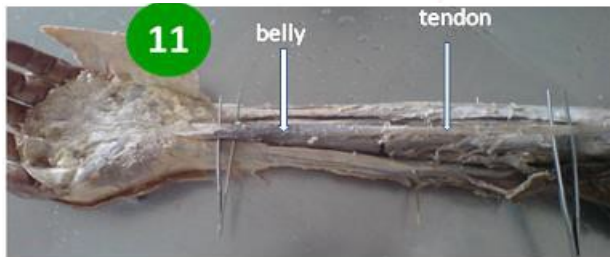


Fig. 3: Absence of palmaris longus muscle in a male cadaver (FCR- Flexor Carpii Radialis; FDS-Flexor Digitorum Superficialis; FCU-Flexor carpii Ulnaris).

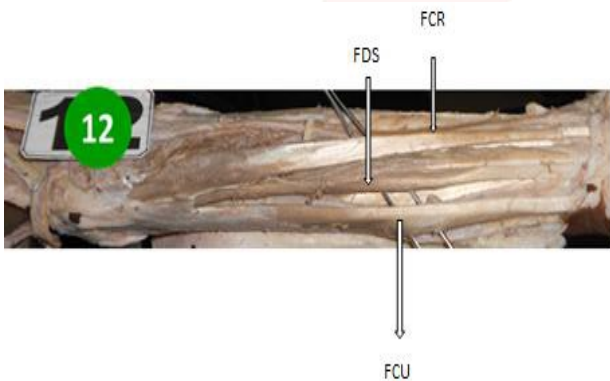


Fig. 4: Duplication of Palmaris longus muscle (PLM) in a male cadaver.



DISCUSSION

The focal point in the present study was to determine the incidence and morphology of the palmaris longus muscle in Karnataka. The results of the above-mentioned were then compared with what has been reported in the literature in studies done on other population groups. From the information gained from this study we hope to aid surgeons, using these muscles as grafts or flaps in reconstructive surgery, to make knowledgeable decisions based

on the morphology of these muscles as well as on the analysis of the presence and/or absence of these muscles in Karnataka.

The morphology of the palmaris longus muscle was described and slight differences were found between the current study and that reported in the literature. The prevalence of these muscles yielded the same results when compared to past studies conducted on samples/populations other than Karnataka.

Muscles are highly variable and are often found in the course of routine dissection of the human body. There are three types of variations in the muscles: it may be progressive, retrogressive and atavistic. The muscles which have tendency to become increasingly more complex represent progressive type. Deep flexor muscles of forearm belong to progressive group of variations. The muscles which tends to undergo degeneration with subsequent loss of its function represent retrogressive type, example for this type are palmaris longus and plantaris muscles. Atavistic muscles are the muscular elements which have been lost completely during the course of evolution and they make an abrupt appearance again. Axillary arch muscle, a remnant of panniculus carnosus is an example for atavistic type [6].

Variations of the palmaris longus can be a) complete agenesis of the muscle; b) variation in location and form of the muscle belly; c) aberrancy of attachment at its origin or its insertion; d) duplication or triplication [7]; e) accessory slips [8] Absence of palmaris longus has been reported in the literature in 11.2% of arms [8].

Palmaris longus is a functionally negligible muscle and is of morphological interest, it is absent in 13% of arms [9].

Variations in the morphology of the palmaris longus muscle were found only in a few cadavers in the present study. One case of 'reversed' palmaris longus was noted.

Similar variations have been described in previous studies on the palmaris longus muscle conducted by Reimann and co-workers (1955) [10]; Carlson and co-workers (1993) [11]; Depuydt and co-workers (1998) [12]; Oommen (2002)[13]; Tiengo and co-workers (2006) [14]; Natsis and

co-workers (2007)[15] and Mobarakeh and co-workers (2008)[16].

Distally, the palmaris longus muscle attached mostly on the palmar aponeurosis of the hand[10]. However, other points of insertion have been described in the literature. One of interest is an insertion on to the antebrachial fascia [17].

Since the palmaris longus is an expendable muscle, its absence will not affect the function of the wrist significantly [18]. However, the congenital absence of this muscle can be seen as a disadvantage when the use of this muscle is indicated for use in reconstructive surgery[11]. The prevalence of the palmaris longus muscle has been shown to differ between various population groups [18].

Upon investigation of the prevalence of palmaris longus, it was found that the percentage values, obtained in this study, correlated well with what has been reported in the literature (Table 3).

Another variation is the 'digastric type' of belly, with two bellies, proximal and distal, and a central tendon [10].

Carlson and co-workers (1993) even mentioned a Palmaris longus with more than one tendon [11].

Although palmaris longus is completely present on both or at least one arm in 95 % of the Karnataka population, the presence of the palmaris longus muscle does not guarantee its usefulness in reconstructive surgery[4]; instead its usefulness is determined by the morphology of this specific muscle. Thus the palmaris longus muscle needs to be present in the patient, in order for it to be used in a reconstructive procedure. However, even if present it might still not be viable for use in reconstructive surgery, as variation in the morphology of the palmaris longus muscle was found during this study and described in the literature.

Table 3: Prevalence of the palmaris longus muscle, a comparison between different studies found in the literature.

Study in different population	Total sample	Present bilaterally		Absent bilaterally		Unilateral Absence (left)		Unilateral Absence (right)	
		n	%	n	%	n	%	n	%
Zimbabwean[2]	890	-	-	5	0.6	-	-	-	-
Southern Indian [3]	30	-	-	1	3.3	3	10	-	0
Asian [5]	418	394	94.3	7	2	12	2.9	5	1.2
American [10]	362	302	83.4	30	8.3	13	3.6	17	4.7
North American [19]	120	-	-	6	5	-	-	-	-
North American[20]	186	156	83.9	18	9.7	0	0	4	2.2
Amazon Indian[21]	379	-	-	10	2.6	-	-	-	-
European [22]	300	228	76	26	8.7	20	6.7	29	9.7
Malaysian [23]	450	-	-	13	2.9	-	-	-	-
Indian [24]	500	414	82.8	40	17.2	31	6.2	15	3
Iranian [25]	64	-	-	5	7.8	-	-	-	-
Nigerian [26]	600	188	31.3	112	18.75	150	25	150	25
Global prevalence (Average %)	5005	-	75	-	7.6	-	7.8	-	6.6
Present study	30	28	93.3	1	3.3	-	-	2	6.6

Morphological significance:

With the development of forelimb as a prehensile organ, the long flexors muscles of the forearm, Palmaris longus muscle started degenerating in a caudo-cranial direction. Degeneration of functionless muscle occurred much earlier in

phylogenetic forebearers likes Gibbon and Orangutan [27].

Chimpanzees and apes shows maximum degeneration, only 25% of Gorillas have got Palmaris longus muscle. Palmaris longus is more degenerate in apes and monkeys than in man [27].

Embryological significance: The flexor muscles of the forearm develop from the flexor mass, which subsequently divides into 2 layers, superficial and deep. The deep layer gives rise to the flexor digitorum superficialis, flexor digitorum profundus and flexor pollicis longus. The superficial layer of flexor mass gives rise to the pronator teres, flexor carpi radialis, flexor carpi ulnaris and palmaris longus [28].

The embryological basis of duplication of Palmaris longus can be explained due to the additional cleavage of the superficial layer of forearm flexor mass during development, the basis of absence of Palmaris longus can be due to failure of cleavage of the superficial layer of forearm flexor mass during development [6].

Clinical Significance: The variation of palmaris longus were like palmaris longus inversus and duplication of palmaris longus can compress the median nerve mimicking carpal tunnel syndrome; other such variations can mimic conditions like Guyon canal entrapment syndrome (ulnar canal syndrome)[29]; ganglion swellings. Hence, the knowledge of this muscle is valuable for clinicians and surgeons.

The results of this study confirm that in Karnataka region, the palmaris longus tendons of ideal width and strength would be used as grafts in reconstructive surgery.

CONCLUSION

Palmaris longus muscle is one of the common flexor muscles of the forearm. Phylogenitically classified as retrogressive muscles because it has got a short belly and long tendon. The palmaris longus muscle is considered as the most variable muscle in the human body, not only in terms of absence but also in terms of its muscle variation and anomalies.

It has been the subject of several cadaveric as well as in vivo studies because of its clinical importance as a donor tendon. Although it is well known that there is a wide variation in the reported prevalence of palmaris longus absence in different ethnic groups, it is clear that a standard prevalence of absence of palmaris longus cannot be applied to all population.

The Variation of palmaris longus were like reversal of palmaris longus inversus and duplication of palmaris longus can compress the

median nerve mimicking carpal tunnel syndrome; other such variations can mimic conditions like Guyon canal entrapment syndrome (ulnar canal syndrome); ganglion swellings. Hence, the knowledge of this muscle is valuable for Clinicians and Surgeons, and herewith, an attempt has been made to throw more light about this muscle. Therefore, study of such variations including its presence or absence was taken up not only to update knowledge but also to help the Sonologists to keep in mind these variations, which may mimic other surgical conditions at the wrist.

Variation in form and attachment of the palmaris longus muscle was found in one male cadaver & one female cadaver. Duplication of palmaris longus was found in one male cadaver while reversed belly of palmaris longus in another male cadaver. Absence of palmaris longus unilaterally on right side in a male cadaver, bilaterally in a female cadaver, total absence is 5%. Knowledge of these variations is important for surgeons before harvesting the tendons for graft.

Conflicts of Interests: None

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