

## MORPHOMETRIC ANALYSIS OF PALMARIS LONGUS MUSCLE BELLY AND ITS TENDON: A CADAVERIC STUDY IN NORTH INDIA

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### ABSTRACT

**Background:** The Palmaris Longus Muscle is the first option in tendon graft procedures, for it fulfills the necessary criteria of length, breadth and easy surgical accessibility. Therefore, the present study was performed with the purpose to determine the morphometry of PL in North Indian population.

**Materials and methods:** Material for the present study consisted of 40 limbs of different age group and sex (28 Males & 12 Females). The limbs were made available in the Anatomy department for dissection purpose at SGRDIMSAR, Amritsar, Punjab. The length and width of the PL-Muscle Belly (PL-MB) and PL-Tendon (PL-T) were measured with the help of digital Vernier caliper. The unpaired t test was used to study the significance of the differences in male and females and right and left PLM.

**Results:** The mean MBL and MBW of the PL was more (6.195±1.788cm & 2.095±0.723cm) on right side than (5.895±1.748cm & 1.920±0.740cm) on the left side. The mean TL on left side (15.690±1.336cm) was slightly more than the right side (15.625±1.489cm) whereas TW on right side (0.435±0.099cm) was found to be slightly more than the left side (0.426±0.108cm). It was also observed that the mean MBL, MBW, TL and TW was more in male cadavers as compared to female cadavers.

**Conclusion:** PLM has importance in medical clinic, surgery, radiological analysis and has great significance when used as a donor tendon in reconstructive surgeries. Thus there are advantages to know the length and width of the PL tendon for being the ideal choice for tendon graft procedures.

**KEY WORDS:** Palmaris longus, Wrist flexors, Vestigial, Muscle Belly, Tendon, Graft Procedures.

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### INTRODUCTION

Palmaris longus (PL) is a muscle of anterior compartment of the forearm that arises from the medial epicondyle of the humerus and gets inserted into palmar aponeurosis [1]. Among vertebrates the palmaris longus is restricted to

the mammals and well developed in species with weight-bearing gait like in the orangutans, but is variably absent in chimpanzees and gorillas. Described as one of the muscles with most anatomical variations it is classified as a muscle in phylogenetic regression. Morphogenetically

its tendon and muscle are developed and regulated by a HOX gene [2,3]. In human beings, it is considered to be a tensor [4] of the palmar aponeurosis as it possibly contributes to wrist flexion [5]. Though it plays a role in carpal flexion, its main function appears to be as an anchor for skin and fascia of hand, in resisting horizontal shearing forces in a distal direction as in holding a golf club [6]. It is also utilized as a simple static support in the treatment of facial paralysis, and some surgeons utilize the tendon in digital pulley reconstruction, lip augmentation, ptosis correction and in various nerve palsies [7].

The Palmaris Longus is also the first option in tendon graft procedures, for it fulfills the necessary criteria of length, breadth and easy surgical accessibility which make harvesting its tendon much easier than its counterpart, the Plantaris muscle in the leg. Its superficial location makes the process of harvesting easier and also less complicated and safer. It is also said to be a disposable tendon which will not affect the function of wrist significantly [8]. The Palmaris longus muscle (PLM) allows stretching without splitting as the tendon may stretch up to 50 mm width [9,10]. So when it comes to the surgical aspect it is suggested that the PLM is used when wider tendon is preferred as compared to its counterpart plantaris muscle when a longer tendon is needed. Therefore, the present study was performed with the purpose to determine the morphometry of PLM in North Indian population.

## MATERIALS AND METHODS

Material for the present study consisted of 40 limbs of North Indian origin of different age group and sex (28 Males & 12 Females). The limbs were made available in the department of Anatomy for dissection purpose for the first year medical students at Sri Guru Ram Das Institute Of Medical Sciences and Research (SGRDIMSAR), Amritsar, Punjab. The flexor compartment of the forearm of the upper limb was dissected using standard procedure [11].

A vertical incision was made in the center of the anterior surface of the forearm from the cubital fossa to the distal transverse crease of the wrist. Careful dissection was done for the

isolation of the Palmaris Longus Muscle (PLM). The PL muscle was dissected away from the surrounding structures, exposing its origin at the medial epicondyle of the humerus, the musculotendinous junction and its insertion on the volar aspect of the hand. The length of the tendon of the palmaris longus muscle was defined, in its distal part, as a point at which it crosses the distal wrist fold and in its proximal part as the most distal point between the muscle and the tendon. The Morphology i.e, origin, course and insertion of PL-Muscle Belly (PL-MB) and PL-Tendon (PL-T) was observed. The length and width of the PL-Muscle Belly (PL-MB) and PL-Tendon (PL-T) were measured with the help of digital Vernier caliper with a least count of 0.02 mm, thread and measuring scale.

**PL-MB Length (PL-MBL):** It is the dimension taken in Proximal-Distal plane from the medial epicondyle of the humerus to the musculotendinous junction and marked as 'AB' (Figure 1).

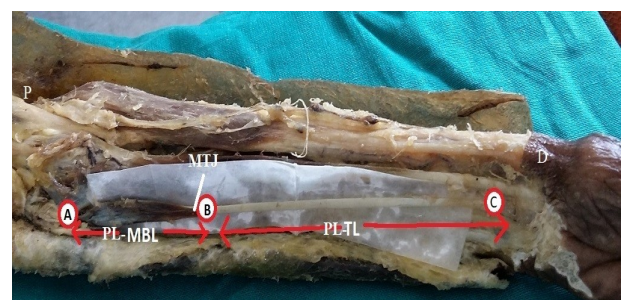
**PL-T Length (PL-TL):** The point of measurement taken for the tendon is in Proximal-Distal plane from the musculotendinous junction to its distal attachment. It was marked as 'BC' (Figure 1).

**PL-MB Width (PL-MBW):** It is the dimension taken in Medio-lateral plane at the maximum width of the muscle belly and marked as 'EF' (Figure 2).

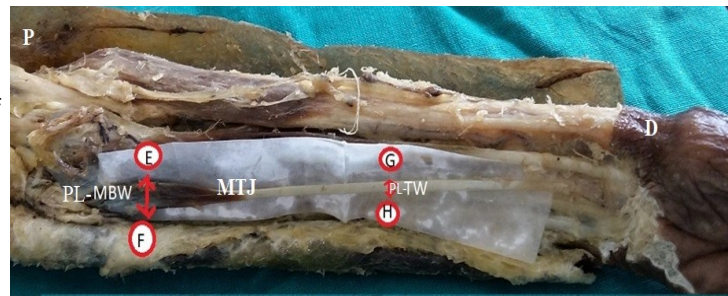
**PL-T Width (PL-TW):** It is the dimension taken in Medio-lateral plane at the maximum width of the tendon and marked as 'GH' (Figure 2).

All the measurements were taken and then the data was stored on the computer sheet. The unpaired t test was used to study the significance of the differences in male and females and right and left PLM.

**Fig. 1:** Showing Length of Palmaris Longus-Muscle Belly (PL-MBL) as 'AB' and Length of Palmaris Longus-Tendon (PL-TL) as 'BC' MTJ- Musculotendinous Junction, P-Proximal, D- Distal.



**Fig. 2:** Showing Width of Palmaris Longus-Muscle Belly (PL-MBW) as 'EF' and Width of Palmaris Longus-Tendon(PL-TW) as 'GH'MTJ- Musculotendinous Junction, P-Proximal, D-Distal.



## RESULTS

**Table 1:** Showing the palmaris longus (muscle belly & tendon) mean length & width on right & left sides of the cadavers.

PRESENT STUDY 2019										
Variable	Side	Mean	± SD	Sem	95% CI		Range		't' value	P value
					Lower	Upper	Minimum	Maximum		
MBL	Right	6.195	1.788	0.4	5.36	7.03	3.1	9.1	0.537	0.595
	Left	5.895	1.748	0.391	5.08	6.71	2.9	9.1		
	Total	6.045	1.752	0.277	5.48	6.61	2.9	9.1		
MBW	Right	2.095	0.723	0.162	1.76	2.43	0.9	3.9	0.756	0.454
	Left	1.92	0.74	0.166	1.57	2.27	0.7	3.3		
	Total	2.008	0.728	0.115	1.77	2.24	0.7	3.9		
TL	Right	15.625	1.489	0.333	14.93	16.32	13.2	18.8	0.145	0.885
	Left	15.69	1.336	0.299	15.06	16.32	13.7	18.5		
	Total	15.658	1.397	0.221	15.21	16.1	13.2	18.8		
TW	Right	0.435	0.099	0.022	0.39	0.48	0.29	0.61	0.259	0.797
	Left	0.426	0.108	0.024	0.38	0.48	0.29	0.63		
	Total	0.43	0.102	0.016	0.4	0.46	0.29	0.63		

SD: Standard Deviation; SEM: Standard Error of Mean, 95% CI : Confidence Interval; Unpaired 't' test : p>0.05; Not Significant.

**Table 2:** Showing the palmaris longus (muscle belly & tendon) mean length & width in male & female cadavers.

PRESENT STUDY 2019										
Variable	Sex	Mean	± SD	SEm	95% CI		Range		't' value	P value
					Lower	Upper	Minimum	Maximum		
MBL	Male	6.536	1.789	0.338	5.84	7.23	2.9	9.1	2.964	0.005*
	Female	4.9	0.992	0.286	4.27	5.53	3.2	6.3		
	Total	6.045	1.752	0.277	5.48	6.61	2.9	9.1		
MBW	Male	2.243	0.739	0.14	1.96	2.53	0.7	3.9	3.563	0.001*
	Female	1.458	0.261	0.075	1.29	1.62	1.1	1.9		
	Total	2.008	0.728	0.115	1.77	2.24	0.7	3.9		
TL	Male	15.918	1.462	0.276	15.35	16.48	13.2	18.8	1.856	0.071
	Female	15.05	1.046	0.302	14.39	15.71	13.3	16.4		
	Total	15.658	1.397	0.221	15.21	16.1	13.2	18.8		
TW	Male	0.463	0.1	0.019	0.42	0.5	0.29	0.63	3.441	0.001*
	Female	0.355	0.06	0.017	0.32	0.39	0.29	0.47		
	Total	0.43	0.102	0.016	0.4	0.46	0.29	0.63		

SD: Standard Deviation; SEM: Standard Error of Mean, 95% CI : Confidence Interval; Unpaired 't' test : p>0.05; Not Significant; \*p<0.05; Significant; \*\*p<0.001; Highly significant.

The mean MBL and MBW of the PL was (6.195±1.788cm & 2.095±0.723cm) on right side and (5.895±1.748cm & 1.920±0.740cm) on left side respectively. The dimension on the right side was slightly more as compared to the left side and these differences were statistically not significant. (Table 1)

The mean TL and TW of the PL (15.625±1.489cm and 0.435±0.099cm) on right side and (15.690±1.336cm & 0.426±0.108cm) on left side respectively. The mean TL on the left side was slightly more than the right side whereas TW of right side was slightly more than the left side but these differences were statistically not

significant. (Table 1)

The mean MBL and MBW in male cadavers ( $6.536 \pm 1.789\text{cm}$  &  $2.243 \pm 0.739\text{cm}$ ) was found to be more than in female cadavers ( $4.900 \pm 0.992\text{cm}$  &  $1.458 \pm 0.261\text{cm}$ ). (Table 2)

The mean TL and TW in male cadavers ( $15.918 \pm 1.462\text{cm}$  &  $0.463 \pm 0.100\text{cm}$ ) was found to be more than in female cadavers ( $15.050 \pm 1.046\text{cm}$  &  $0.355 \pm 0.060\text{cm}$ ). The differences observed in the morphometric dimensions of PL-MB and PL-Tin the context of gender of cadavers were statistically not significant. (Table 2).

## DISCUSSION

PL muscle is the most desirable tendon in reconstructive surgery and remains the ideal choice for tendon graft [12,13]. Its superficial location makes the process of harvesting easier and makes the process less complicated and safer [8]. PL is believed to be functionally redundant typically comprising of three sections: Proximal- short muscular attachment to the medial epicondyle of humerus i.e. a common origin of flexor tendons, a Musculotendinous junction – at the level of the distal segment of pronator teres and a distal slender tendinous insertion across front of flexor retinaculum into palmar aponeurosis. [14] The origin of the muscle is variable, proximally may be from the medial intramuscular septum, the biceps or brachialis muscles, the fascia of the forearm, and the coronoid process of ulna or the radius. The muscle may be doubled at its proximal end; with the additional head arising from one of the sites mentioned above [1]. The insertion is equally variable as the muscle may be attached to the fascia of the forearm [1], the tendon of flexor carpi ulnaris, [15] the flexor retinaculum, pisiform or the scaphoid bones [16] the middle phalanx of the 4<sup>th</sup> digit, short abductor of the thumb, the fascia and muscles of the hypothenar eminence, one of the flexor tendons, or near the metacarpophalangeal joints [1]. In the carpal region it may split into two fascicles. The more voluminous internal fascicle attaches to the anterior surface of the transverse carpal ligament and the external fascicle is confused with the origin of the thenar muscles, especially the abductor pollicis brevis. To a lesser extent it

also inserts into the distal antebrachial aponeurosis and into fibrous walls that separate it from the neighboring muscles [17].

From ontogenic view point the long digital flexor muscle in the forearm are arranged in three layers. The flexor digitorum profundus (the deep layer) flexes the distal interphalangeal joints; the flexor digitorum sublimis (intermediate layer) flexes the proximal interphalangeal joints; and the palmaris longus (representing the superficial stratum), the primitive function of which is flexion of the metacarpo-phalangeal joints by means of a tendon that fans out in the palm to be inserted by a slip to the base of each proximal phalanx. In the development of the forelimb as a prehensile organ this function has been taken over by the intrinsic muscles of the hand and the palmaris longus muscle has become degenerate. The attenuated muscle belly is largely replaced by tendon and the degenerated radiating tendons of the palm have become the central portion of the palmar fascia, which retains the five distinct slips of attachment [18,19].

Several authors have described the PL muscle as a mere phylogenetically degenerate metacarpophalangeal flexor because of its clinical insignificance and its numerous anatomical variations. However, the less common variants can lead to pathological conditions due to the narrow topographical relationship between the PL and the median nerve, causing median nerve compression. Understanding the anatomical variations of the PL is important because it often plays a crucial role during reconstructive surgeries due to its suitable length and diameter, ease of harvesting and lack of donor site morbidity. Though it is also said to be a disposable tendon which will not affect the function of wrist significantly [8] and the tendon has little functional use to upper limb in humans but has great significance when used as a donor tendon in reconstructive surgery. It is essential to clinically examine reconstructive patients for potential PL anatomical variations to avoid inappropriate surgical procedures and prevent disappointing surgical results [20]. Patients who complain of wrist pain with a palpable mass at the volar aspect of wrist should be examined thoroughly for variations of their

Palmaris Longus musculature and therefore it is important for physicians, surgeons, radiologists and therapists to be aware of this possibility of variations. Occupation of the person like those who are machine operators or doing repetitive manual work are potentially at risk for the compression of the median nerve and ulnar nerves as overuse of such reversed Palmaris longus may cause its local hypertrophy and localized pressure on the nerves [14, 21].

## CONCLUSION

Tendon grafts or tendon transfer procedures are frequently needed in reconstructive surgeries on hand like in the replacement of long extensors of the fingers or thumb so there are advantages to know the length and width of the PL tendon for the usefulness in planning preoperatively and to determine the proximal site for incision during grafting procedures. Palmaris longus muscle is also an ideal donor in cosmetic and plastic surgeries like in the treatment of facial paralysis, in digital pulley reconstruction, lip augmentation etc.

## ABBREVIATIONS

**PL** - Palmaris Longus, **MB** - Muscle Belly  
**T** - Tendon, **MBL** - Muscle Belly Length  
**MBW** - Muscle Belly Width, **TL** - Tendon Length  
**TW** - Tendon Width

**Conflicts of Interests: None**

## REFERENCES

- [1]. Bergman RA, Thompson SA, Afifi AK. Catalog of human variation. Urban & Schwarzenberg: Baltimore. 1984.
- [2]. Hall BK, Miyake T. All for one and one for all: condensations and the initiation of skeletal development. *Bioessays* 2000;22(2):138-47.
- [3]. Marecki B, Lewandowski J, Jakubowicz M. Formation of extensor digitorum muscle proportions before and after birth. *Gegenbaurs Morphol Jahrb* 1990;136(6):735-51.
- [4]. Eric M, Koprivic I, Vucinic N, Radic R, Krivokuca D, Lekcan I, et al. Prevalence of the palmaris longus in relation to the hand dominance. *Surg Radiol Anat* 2011;33(6):481-4.
- [5]. Tountas CP, Bergman RA. Anatomic variations of the upper extremity. New York: Churchill Livingstone; 1993.
- [6]. Ellis H, Healy J C, Johnson D, Williams A. In: Standring S Edinburg, editor. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*. 39<sup>th</sup> Ed. Elsevier Churchill Livingstone, Philadelphia. 1995: 873-887.
- [7]. Kaufman R A, Pacek C A. Pulley reconstruction using palmaris longus autograft after repeat trigger release. *J Hand surg Br* 2006; 31(3): 285-287.
- [8]. Lam DS, Lam TP, Chen IN, Tsang GH, Gandhi SR. Palmaris longus tendon as a new autogenous material for frontalis suspension surgery in adults. *Eye (Lond)* 1996;10 (1):38-42.
- [9]. George R. Co-incidence of palmaris longus and plantaris muscles. *Anat Rec* 1953;116(4):521-523.
- [10]. Vanderhooft E. The frequency of and relationship between the palmaris longus and plantaris tendons. *Am J Orthop* 1996; 1: 38-41.
- [11]. Romanes G J. *Cunninghams Manual of Practical Anatomy Vol 1*. 15th Ed. India. Oxford Medical Publications 2012: 74-75.
- [12]. White WI. 1960. Tendon Grafts: A consideration of Their Source, Procurement and Suitability. *Surg Clin North Am* 40:403-13.
- [13]. Wehbé MA. Tendon graft donor sites. *J Hand Surg Am* 1992;17(6):1130-2.
- [14]. Reimann AF, Daseler EH, Anson BJ, Beaton LE (1944) The Palmaris longus muscle and tendon. A study of 1600 extremities. *Anat Rec* 89, 496-505.
- [15]. Lemon M, Beicher H J. An anomalous flexor carpi ulnaris. *J Hand Surgery (Br)* 2002; 27(2): 194-197.
- [16]. Durgan B et al. An unusual insertion of palmaris longus muscle. *Kaiboyaku zasshi* 1993; 68(1): 104-106.
- [17]. Stecco C, Lancerotto L, Porzionato A, Macchi V, Tiengo C, Parenti A et al. The palmaris longus muscle and its relations with the antebrachial fascia and the palmar aponeurosis. *Clin Anat* 2009;22(2):221-9.
- [18]. Humphrey GM. The muscles of vertebrates. *J Anat and Physiol* 1872; 6: 293-376.
- [19]. Jones F W. The principles of anatomy as seen in the hand. Second Edition. London: 1941; Bailliere, Tindall and Cox.
- [20]. Murabit A, Gnarra M, Mohamed A. Reversed palmaris longus muscle: Anatomical variant - case report and literature review. *Can J Plast Surg* 2013; 21(1):55-6.
- [21]. Janet M. Median nerve compression and the reversed palmaris longus. *IJAV* 2009; 2: 102-104.

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