ORIGINAL RESEARCH

Anatomical Assessment of Palmaris Longus Tendon Length for Preoperative Evaluation in Reconstructive Surgery: A Cadaveric Study

[1]Dr. Smita Balsurkar (Mali), [2]Dr. Ramdas Gopalrao Surwase

[1,2]Associate Professor, Department of Anatomy, Maharashtra Institute of Medical Science and Research Medical college, Latur, Maharashtra, India

Corresponding author
Dr. Ramdas Gopalrao Surwase
Associate Professor, Department of Anatomy, Maharashtra Institute of Medical Science and Research Medical College, Latur, Maharashtra, India
Email: rgcsurwase@gmail.com

Received: 19 March, 2023 Accepted: 24 April, 2023

ABSTRACT

Background: The palmaris longus muscle, the thinnest of the carpus flexor muscles, originates from the medial epicondyle of the humerus and is located in the anterior part of the forearm, covered by fascia. It occupies the space posterior to the superficial flexor digitorum and lies medial to the radial flexor of the carpus. In distal part of forearm, its small, fleshy belly stretches downward and becomes a tendon. **Aim:** The purpose of this cadaveric research is to develop a method for accurately estimating the length of the palmaris longus tendon prior to reconstructive surgery. **Material and Methods:** 50 limbs (25 right and 25 left) representing a variety of age groups and sexes (33 male cadavers and 17 female cadavers), made up the study's subject matter. The Department of Anatomy made the limbs accessible. In the research, only limbs that displayed the whole anatomy of PLM were considered. Limbs lacking PLM or exhibiting any other abnormality were not included in the research. The FAL was measured from the top of the olecranon to the ulnar styloid apophysis (the styloid process of the ulna that extends from posteromedial aspect at its distal end). **Results:** Male cadavers had mean PL-TL and PL-TW measurements of 16.01±1.11 cm and 0.51±0.03 cm, respectively, whereas female cadavers had mean measurements of 15.15±1.01 cm and 0.38±0.02 cm. In comparison to female cadavers, male cadavers were found to have greater of these measurements. The mean FAL was found to be greater in male cadavers than in female cadavers, measuring 24.01± 2.18 cm in male cadavers and 20.89± 2.08 cm in female cadavers. The mean PL-TL was somewhat larger on the left (16.03±2.05 cm) than the right (15.98±1.01 cm). The mean PL-TW on the right side was somewhat higher (0.52±0.03 cm) than the left (0.44± 0.04 cm). The average FAL on the right side was somewhat higher (23.05±1.69 cm) than the average FAL on the left side (22.85±1.55 cm). **Conclusion:** There was a link that was statistically significant between the TL-PL and the FAL that was noticed. The findings suggest that it is possible to make an estimate of the PL-TL prior to undergoing surgical intervention in cases where the tendon has to be used as a transplant. Even in situations when there is no PL to be found, a suitable donor will be the one from whom a required TL may be taken and used for reconstruction.

Keywords: Palmaris longus tendon, reconstructive Surgery, Cadaver

Abbreviations: PL-palmaris longus, TL-tendon length, BL-belly length, TW-tendon width, FAL-forearm length, MBL-muscle belly length

INTRODUCTION

The palmaris longus muscle, the thinnest of the carpus flexor muscles, originates from the medial epicondyle of the humerus and is located in the anterior part of the forearm, covered by fascia. It occupies the space posterior to the superficial flexor digitorum and lies medial to the radial flexor of the carpus.[1] In lower half of the forearm; its small, fleshy belly stretches downward and becomes a tendon.[1] This tendon crosses across the lateral border of the flexor digitorum superficialis tendons and the median nerve in the distal portion of the forearm. A single branch or trunks of the median nerve that travel in the direction of the pronator teres and flexor carpi radialis, perforating the flexor digitorum superficialis en route, innervate it and having arterial supply from from the ulnar recurrent arteries. These trunks eventually reach the palmaris longus posteriorly.[1] It separates into two

fascicles in the carpal area. The exterior fascicle is mistaken for the origin of the thenar muscles, particularly the abductor pollicis brevis, whereas the internal, more voluminous fascicle connects to the anterior surface of the transverse carpal ligament.[1] Due to its topographical significance, it serves as a reference in wrist surgery. It likewise enters, although less deeply, into the distal antebrachial aponeurosis and into the fibrous walls that divide it from the surrounding muscles.[1-4] Given that it is regarded as an auxiliary muscle, is not necessary for normal function, and has not been linked to a decrease of grip and pinch strength[2], This tendon is utilised as a graft in a wide range of surgical operations, including chronic injuries to the flexor tendons, ligament reconstructions, pulley reconstructions, eye abnormalities, reconstructions of the thumb and elbow, blepharoptosis, and other surgical reconstructions.[5,6]

The palmaris longus is only seen in mammals and is well developed in creatures that walk with weight on their feet. For instance, gorillas and chimpanzees may lack the palmaris longus whereas orangutans always have it. Numerous experts believe it to be a tensor[7] of the palmar aponeurosis in humans and that it may help with wrist flexion.[8] It is categorised as a muscle in phylogenetic regression and is one of the muscles with the largest anatomical variety. A HOX gene controls the morphogenetic development of the tendon and muscle in this organism.[9, 10]

AIM

The purpose of this cadaveric research is to develop a method for accurately estimating the length of the palmaris longus tendon prior to reconstructive surgery.

MATERIAL AND METHODS

50 limbs (25 right and 25 left) representing a variety of age groups and sexes (33 male and 17 female), made up the study's subject matter. The Department of Anatomy made the limbs accessible. In the research, only limbs that displayed the whole anatomy of PLM were considered. Limbs lacking PLM or exhibiting any other abnormality were not included in the research.

The FAL was measured from the top of the olecranon to the ulnar styloid apophysis (the styloid process of the ulna that extends from posteromedial aspect at its distal end). The upper limb's forearm's flexor compartment was dissected according to protocol.[11] With blunt dissection, the PLM was detected and followed from its beginning until its insertion. The most distal point between the muscle and the tendon was designated as the TL of the PLM in its proximal portion and the point at which it crossed the distal wrist fold in its distal component. During the anatomical dissection, measurements of the TL and TW were acquired using a sliding Vernier calliper that was accurate to 1 mm. A measuring tape and weighing scale were used to measure the FAL. Following the completion of all measurements, the data were entered into the computer sheet. The Pearson correlation coefficient was used to determine the degree of relationship between the measurements. The Student's t statistical approach was used to examine the ratio between TW, TL, and FAL.

RESULTS

Male cadavers had mean PL-TL and PL-TW measurements of 16.01±1.11 cm and 0.51±0.03 cm, respectively, whereas female cadavers had mean measurements of 15.15±1.01 cm and 0.38±0.02 cm. In comparison to female cadavers, male cadavers were found to have greater of these measurements [Table 1]. The mean FAL was found to be greater in male cadavers than in female cadavers, measuring 24.01± 2.18 cm in male cadavers and 20.89± 2.08 cm in female cadavers [Table 1]. The mean PL-TL was somewhat larger on the left (16.03±2.05 cm) than the right (15.98±1.01 cm). The mean PL-TW on the right side was somewhat higher (0.52±0.03 cm) than the left (0.44± 0.04 cm) [Table 2]. The average FAL on the right side was somewhat higher (23.05±1.69 cm) than the average FAL on the left side (22.85±1.55 cm) [Table 2]. The tendon length (PL-TL), tendon width (PL-TW), and FAL were shown to be correlated between the sexes using the test for equality of means of the measures.

Figure 1 Mean length and width of palmaris longus tendon and forearm length in male and female cadavers

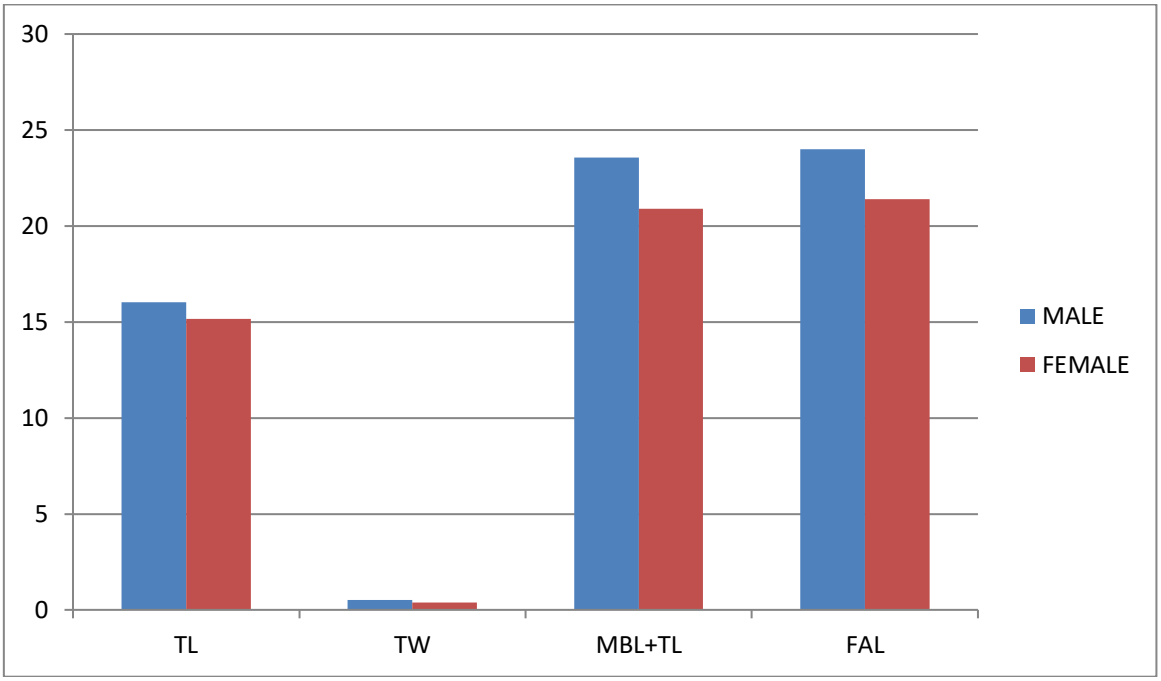

Table 1: Mean length and width of palmaris longus tendon and forearm length in male and female cadavers

Parameter	Sex	Mean	SD	P
TL	Male	16.01	1.11	0.06
	Female	15.15	1.01	
TW	Male	0.51	0.03	0.001
	Female	0.38	0.02	
MBL + TL	Male	23.58	2.54	0.001
	Female	20.89	2.08	
FAL	Male	24.01	2.18	0.001
	Female	21.41	1.11	

Table 2: Mean length and width of palmaris longus tendon and forearm length on the right and left sides of the cadavers

Parameter	Side	Mean	SD	P
TL	Right	16.03	2.05	0.45
	Left	15.98	1.89	
TW	Right	0.52	0.03	0.63
	Left	0.44	0.04	
MBL + TL	Right	22.63	1.11	0.47
	Left	22.17	1.09	
FAL	Right	23.05	1.69	0.47
	Left	22.85	1.55	

DISCUSSION

The fact that there are such wide differences in the predominance of the PL in humans may be a sign that this muscle is deteriorating, and its tiny belly may imply that it is a vestigial muscle.[12, 13] Only a small number of research have been conducted to measure and compare the TL and TW with FAL and to preoperatively predict the diameters of these tendons, despite many studies looking at the occurrence of PL in people. This is the first research in Maharashtra, to the best of our knowledge. This might simplify preoperative planning at the location of reconstructive surgery by designating the ratios as the correlation between the length or breadth of the extremity and the tendon to be harvested. In our research, the average PL-TL and PL-TW measures for male cadavers were 16.01 cm and 0.51 cm, respectively, whereas the average measurements for female cadavers were 15.15 cm and 0.38 cm. Male cadavers were discovered to have larger values for these dimensions

than female cadavers. It was discovered that the gender-related variations in the morphometric dimensions of PL-TW were statistically significant. The average FAL measured 24.01± 2.18 cm in male cadavers and 20.89± 2.08 cm in female cadavers, showing that the mean FAL was higher in male cadavers. The mean TL in male and female cadavers was found to be 123.6 mm and 111.4 mm, respectively, in a research conducted in 2008. The mean value for the male sex in respect to the FAL was 277.5 mm, while the mean value for the female sex was 270.8 mm.[14] The mean FAL was found to be greater in male cadavers than in female cadavers, measuring 24.01± 2.18 cm in male cadavers and 20.89± 2.08 cm in female cadavers. The mean PL-TL was somewhat larger on the left (16.03±2.05 cm) than the right (15.98±1.01 cm). The mean PL-TW on the right side was somewhat higher (0.52±0.03 cm) than the left (0.44± 0.04 cm). The average FAL on the right side was somewhat higher (23.05±1.69 cm) than the average FAL on the left side (22.85±1.55 cm)**.** The current research backs up the connections proposed by Angelini Junior (2008), who also noted a strong association between TL and FAL between the sexes.**[14]**

By examining the tendon in vivo in 379 Amazon Indians, 200 Chileans, and 300 Caucasians, respectively, Machado and DiDio,[15] Alves et al,[16] and Thompson et al.[17] evaluated the frequency of the musculus PL, where the sole agenesis of PL was reported. Clinical investigations may be used to determine if the PL is present prior to harvesting grafts, although these studies might be difficult to interpret.[18] Additionally, Milford[19] noted in his research that the PL provides grafts with a length of around 15 cm; however, TW was not indicated. The same investigation was conducted by several authors[20, 21] using black or Japanese cadavers, with the major emphasis being on the presence or absence of PLM. The measuring of the PLM tendon has the benefit of making it possible to estimate its length and breadth before to removal for surgical transplant treatments, as well as favoring the potential of removing it with only two excisions. With the help of the current research, one may recommend that the TL be extracted for use in grafts.

Although PL tendons are perfect for use as tendon grafts and flaps in reconstructive procedures, it is crucial to keep in mind that PL muscles and tendons might vary or even go missing. Since it is a vestigial tendon and won't cause any functional problems for the donor, it may be removed from a compatible donor in circumstances where it is absent. The tendon may be harvested more easily, less complicatedly, and safely thanks to its superficial placement.[22, 23] The fourth of the five flap surgery tenets stated in the literature, "One should steal from Peter to pay Paul," sticks out clearly. This is only true if Peter has the money, which is why a donor flap is often chosen for transfer since it is deemed unnecessary at its original position. The PL tendon, according to Kapoor et al.[24], has limited practical value for the human upper limb but is very significant when employed as a donor in reconstructive surgery.

CONCLUSION

There was a link that was statistically significant between the TL-PL and the FAL that was noticed. The findings suggest that it is possible to make an estimate of the PL-TL tendon prior to undergoing surgical intervention in cases where the tendon has to be used as a transplant. Even in situations when there is no PL to be found, a suitable donor will be the one from whom a required TL may be taken and used for reconstruction.

CONFLICT OF INTEREST

None declared

SOURCE OF SUPPORT

Nil

REFERENCES

1. 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.
2. Sebastin SJ, Puhaindran ME, Lim AY, Lim IJ, Bee WH. The prevalence of absence of the palmaris longus--a study in a Chinese population and a review of the literature. J Hand Surg Br. 2005; 30(5):525–7.
3. Pulvertaft RG. Tendon grafts for flexor tendon injuries in the fingers and thumb; a study of technique and results. J Bone Joint Surg Br. 1956; 38(1):175–94.
4. Wehbé MA. Tendon graft donor sites. J Hand Surg Am. 1992; 17(6):1130–2.
5. Kaufmann RA, Pacek CA. Pulley reconstruction using palmaris longus autograft after repeat trigger release. J Hand Surg Br. 2006; 31(3):285–7.
6. 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 (Pt 1): 38–42.
7. Erić M, Krivokuća D, Savović S, Leksan I, Vucinić N. Prevalence of the palmaris longus through clinical evaluation. Surg Radiol Anat. 2010; 32(4):357–61.
8. Tountas CP, Bergman RA. Anatomic variations of the upper extremity. New York: Churchill Livingstone; 1993.
9. Hall BK, Miyake T. All for one and one for all: condensations and the initiation of skeletal development. Bioessays. 2000; 22(2):138–47.
10. Marecki B, Lewandowski J, Jakubowicz M. Formation of extensor digitorum muscle proportions before and after birth. Gegenbaurs Morphol Jahrb. 1990; 136(6):735–51.
11. Romanes G J. Cunninghams Manual of Practical Anatomy. 15th ed., Vol. 1. India: Oxford Medical Publications; 2012. p. 74-5.
12. Bergman RA, Thompson SA, Afifi AK. Catalog of Human Variation. Urban and Schwarzenberg: Baltimore; 1984.

13. Kigera JW, Mukwaya S. Frequency of agenesis Palmaris longus through clinical examination – An East African study. PLoS One 2011; 6:e28997.
14. Angelini Júnior LC, Angelini FB, de Oliveira BC, Soares SA, Angelini LC, Cabral RH. Use of the tendon of the palmaris longus muscle in surgical procedures: Study on cadavers. Acta Ortop Bras 2012; 20:226-9.
15. Machado AB, DiDio LJ. Frequency of the musculus palmaris longus studied *in vivo* in some Amazon Indians. Am J Phys Anthropol 1967; 27:11-20.
16. Alves N, Ramirez D Deana NF. Study of frequency of the palmaris longus muscle in Chilean subjects. Int J Morphol 2011; 29:485.
17. Thompson NW, Mockford BJ, Cran GW. Absence of the Palmaris longus muscle: A population study. Ulster Med J 2001; 70:22-4.
18. Sebastin SJ, Lim AY. Clinical assessment of absence of the palmaris longus and its association with other anatomical anomalies – A Chinese population study. Ann Acad Med Singapore 2006; 35:249-53.
19. Milford L. Palmaris longus. In: Edomonson AS, Crenshaw AH, editors. The Hand. St. Louis: Mosby; 1982. p. 134.
20. Kyung DS, Lee JH, Choi IJ, Kim DK. Different frequency of the absence of the palmaris longus according to assessment methods in a Korean population. Anat Cell Biol 2012; 45:53-6.
21. Ndou R, Gangata H, Mitchell B, Ngcongo T, Louw G. The frequency of absence of palmaris longus in a South African population of mixed race. Clin Anat 2010; 23:437-42.
22. Lam DS, Ng JS, Cheng GP, Li RT. Autogenous palmaris longus tendon as frontalis suspension material for ptosis correction in children. Am J Ophthalmol 1998; 126:109-15.
23. Chrysopoulo M T. Classification and Principles of Flap Surgery. Drugs & Diseases Plastic Surgery; 2008. Available from: https:// emedicine.medscape.com/article/1284474-overview. [Last accessed on 2008 Jan 20].
24. Kapoor SK, Tiwari A, Kumar A, Bhatia R, Tantuway V, Kapoor S. Clinical relevance of palmaris longus agenesis: Common anatomical aberration. Anat Sci Int 2008;83:45-8