



STUDY OF ANATOMICAL AND MORPHOMETRIC VARIATIONS OF PALMARIS LONGUS AND PLANTARIS TENDONS IN BIHAR

Anatomy

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ABSTRACT

Background: The most desirable tendons in reconstructive surgery are the palmaris longus and plantaris tendons. These two muscles are also considered to be the easiest tendons to harvest, and therefore they remain the ideal choices for flaps or tendon grafts. **Material And Methods:** The study was done on 30 cadavers. The palmaris longus and plantaris muscles are indeed subject to variation, form, attachment, actions and/or prevalence. Parameters like muscle length, tendon length, total length, of both the muscle, Department of Anatomy, Dmch, Darbhanga, Bihar. **Conclusion:** Palmaris longus muscle is one of the common flexor muscles of the forearm and it is homologous with plantaris muscle of the leg. Both the muscles are most variable in humans.

KEYWORDS

Palmaris Longus, Plantaris, Prevalence variation.

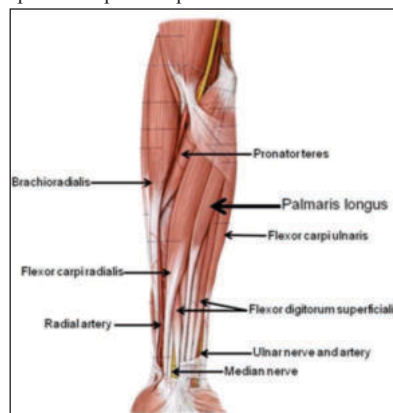
INTRODUCTION

The desire to replace missing tissue in the human body had existed since the beginning of medicine¹. The first efficient procedure of replacing a mutilated nose with a tissue flap was accredited to susruta who lived in the 6th or 7th century². The term flap originated from the dutch word flappe which means something that is loose and only attached by one side³. About 4 centuries ago, an Italian surgeon called Gaspere Tagliacozzi took a delayed flap from an arm and used it for reconstruction of the nose². In 1863, the first true axial pattern cutaneous flap was done by John wood in London, whose main interest was in reconstructive surgery. He reported a case of an 8 year old girl with severe burns to her hand. He attempted an operation to transplant a flap what he called a "groin flap"¹². At the end of the 19th century physicians realized that by transferring tendons, function of an extremity could be restored. The polio epidemic in Europe, in the 20th century, helped with the advancement of tendon transfers. Later tendon transfer surgery expanded not just to the patients with polio and cerebral palsy, but also to those who required reconstructive surgery for injuries during the first world war¹. Thus all the concepts, technical abilities and the anatomical knowledge were adequately established in the 1920s to make reconstructive surgery using flaps or tendon possible²⁴. Five principles of the flap surgery are described in the literature to consider before performing surgery. The fourth principle stands out clearly above the rest and states that one should "steal from peter to pay paul". But this is only true if "peter" can afford it³. That is why a donor flap is selected for transfer because it is thought to be nonessential in its original location⁴⁴, meaning that the donor site can survive without the presence of this structure and functionally is not compromised. This is the case with the plantaris and Palmaris longus muscles, which are found to be frequently absent without any adverse effects. Tendons are frequently used for reconstructive surgery⁶⁸. This includes Palmaris longus, plantaris, the long extensors of the toes and fingers⁹⁶⁸. The surgeon must base his or her selection of the donor tendon for grafting on what is needed, for example tendon size, length, and width. A tendon of more than 190mm cannot be harvested from the upper limb, while the lower limb can yield lengths upto 400 mm the upper extremity can provide tendons as wide as 6 mm compared to lower limb that provides a maximum of width of 4 mm. An important factor to consider is that a difference in strength between a 2 mm and a 3 mm tendon could be significant. Thus, according to Wehbe & Mawr (1992), tendons from upper limb should be considered when strength of width is important and the lower limb tendons when length is a factor⁶.

The most desirable tendons in reconstructive surgery are the Palmaris longus and plantaris tendons, while the long extensors of the toes and hands as well as the flexor digitorum superficialis are regarded as suitable⁹. These two muscles are also considered to be the easiest tendons, It is also said to be a dispensable tendon, which will not affect the function of the wrist significantly¹⁰.

REVIEW OF LITERATURE

The Palmaris longus muscle is described as a slender, fusiform muscle that is found medial to the flexor carpi radialis muscle in the anterior compartment of the forearm- meaning that the Palmaris longus muscle has a relatively short muscular belly in comparison to the length of the tendon. The Palmaris longus possesses a long tendon that has a uniform oval cross-sectional shape with an even taper along its longitudinal axis⁸ and flattens and broadens as it passes anterior to the flexor retinaculum (figure 1). Only a few of the tendon fibers interweave with the retinaculum. The tendon of the Palmaris longus muscle splits in the palm to form fibers that are longitudinally directed and part of the palmar aponeurosis¹⁵.



Relations Of The Palmaris Longus Muscle In The Forearm.

Variations of the Palmaris longus tendon may even confuse an experienced surgeon, and one should consider this if an abnormal swelling is located in the distal aspect of the forearm.

MATERIALS AND METHODS:

The present study was carried out on 30 adult cadavers of both sexes of Anatomy department of, darbhanga medical college and Hospital Darbhanga Laheriasarai Bihar. over a period of one & half years as a part of routine dissection teaching programme for undergraduate students.

Method Of Collection Of Data:

Dissection set, digital vernier calliper and measuring tape.

Inclusion Criteria:

Adult cadavers of both sexes without any limb deformity was studied. The sample consisted of 30 cadavers from the department of anatomy at Hassan Institute of medical sciences Hassan, and other medical

colleges of South Karnataka region as mentioned above. Cadavers were dissected by routine dissection method. The sample included 25 male and 5 female cadavers. The origin of palmaris longus is defined as the medial epicondyle of the humerus, most commonly known as the common flexor origin. The insertion is the distal half of the flexor retinaculum, at the apex of the palmar aponeurosis. The measurements of the length was done by using the measuring tape and width of tendon in centimeter by digital vernier calliper. Each data was recorded bilaterally. The specimens with variations were photographed. The collected data was statistically analysed.

Statistical Methods:

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean $\pm$ SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data is made, Assumptions: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, Cases of the samples should be independent.

	No. Of specimens	Mean (cms)	Std. Deviation	Minimum (cms)	Maximum (cms)
Rt TENDON_LENGTH	28	13.0143	2.06393	9.00	18.00
Lt TENDON_LENGTH	29	12.9207	1.85460	9.00	16.00

Comparison of Tendon length of Palmaris longus of both sides

	No. Of specimens	Mean (cms)	Std. Deviation	Minimum (cms)	Maximum (cms)
Rt BELLY LENGTH	28	11.4036	2.75647	9.00	21.50
Lt BELLY LENGTH	29	11.1828	2.26969	8.00	18.40

Comparison Of Belly Length Of Palmaris Longus Of Both Sides

	No. Of specimens	Mean (cms)	Std. Deviation	Minimum (cms)	Maximum (cms)
Rt TOTAL LENGTH	28	23.2224	5.13086	19.00	29.00
Lt TOTAL LENGTH	29	24.0517	2.30862	19.00	29.00

Comparison Of Total Length Of Palmaris Longus Of Both Sides

RESULTS

illustrates that the right palmaris longus tendon was present in 28 specimens, absent in 2 specimens. Mean is 13.0143 cm and S.D is 2.06393, interquartile range is 12 to 14 (Interquartile range is 25% to 75% percentile). The left palmaris longus tendon was present in 29 specimens, absent in 1 specimen. Mean is 12.9207 cm and S.D is 1.85460, interquartile range is 9 to 16. illustrates that the right palmaris longus tendon was present in 28 specimens, absent in 2 specimens. Belly length mean is 11.4036 cm and S.D is 2.75647, interquartile range is 9-21.50. The left palmaris longus tendon was present in 29 specimen, absent in 1 specimen. Belly length Mean is 11.1828 cm and S.D is 2.26969, interquartile range is 8 to 18.40. illustrates that the right palmaris longus was present in 28 specimens, absent in 2 specimens. Mean of right side total length is 23.2224 cm and S.D is 5.13086, interquartile range is 0.53-29. The left palmaris longus tendon was present in 29 specimens, absent in 1 specimen. Mean of left side total length is 24.0517 cm and S.D is 2.30862, interquartile range is 19-29. illustrates that the right palmaris longus was present in 28 specimens, absent in 2 specimens. Mean of right tendon width is 0.5722 cm and S.D is 0.21967, interquartile range is 0.20-1.28. The left palmaris longus was present in 29 specimens, absent in 1 specimen. Mean of left tendon 0.6177 is cm and S.D is 0.18295, interquartile range is 1.28-1.31. The mean and the range of measurements from minimum to maximum in centimeters for total palmaris longus muscle i.e n = 57 specimens (1 unilateral absence, 2 bilateral absence of palmaris longus muscle) are .Mean Tendon length is 13.0143 cm (9-18 cm)

Mean Tendon width is 0.5949 cm (0.38-1.31 cm)

Mean belly length is 11.2932 cm (8-21.50 cm)

Mean belly width is 1.383 cm (0.49-2.52 cm)

Mean Total length is 23.637 cm (19-29 cm)

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, reversed belly of right side palmaris longus in a male cadaver. There was presence plantaris in 98.7% cadavers and an unilateral absence of plantaris muscle on right side in a male cadaver. Percentage of unilateral absence is 1.3%. Variations in insertion of plantaris were present, like Small muscle belly, with thick short tendon. Distal part of the tendon is fused with medial margin of soleus in a female cadaver on left side. B/L multiple slips form the tendon, few slips inserted to deep fascia, few slips to medial margin of soleus muscle & a long slip to calcaneum in a male cadaver.

DISCUSSION

The morphology of the palmaris longus and plantaris muscles were 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. The palmaris longus is a slender, fusiform muscle with a long tendon and is likely to show variations in its structure, origin and insertion. Therefore one should expect some form of dissimilarity when investigating this particular muscle. It is also said that the tendon of the palmaris longus develops in proportion to the length of the forearm and this is determined genetically before birth. The morphology of the palmaris longus and plantaris muscles, examined on the cadaver specimens, correlated to that stated in the literature. White (1960) reported the length of the palmaris longus tendon to be between 100 mm and 150 mm long compared to the study conducted by Carlson and co-workers (1993) which had a slightly longer tendon, approximately 160 mm⁸.

The length and width of the palmaris longus tendon was also measured in paediatric patients undergoing ptosis correction¹⁰. The tendon lengths ranged from 90- 120 mm and the width ranged from 2-3 mm, depending on the age of the patient. Masaaki and co-workers (2001) reported that the average tendon length for adult Japanese males is 124.6 mm, 108.3 mm in females and 116.6 mm in the total sample. They further stated that the average tendon width is 4.5 mm in males, 4mm in females and 4.2 mm for the study. Mobarakeh (2008) measured the tendon length and width in an Iranian population. The length of the tendon in this study was 136.2 mm and the width was 4 mm. Stecco *et al.* (2009) measured the palmaris longus muscle and found that the muscle in total was 225-315 mm long. The muscular belly measured 95-230 mm long and the tendon between 80-155 mm. It was further stated that the length of the tendon represents about half of the total length of the palmaris longus muscle. The measurements taken for the palmaris longus muscle (tendon length, tendon width, belly length, belly width and total length) is shown and compared to the measurements recorded in the literature. 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 were noted. Similar variations have been described in previous studies on the palmaris longus muscle conducted by Reimann and co-workers (1955), Carlson and co-workers (1993)⁸, Depuydt and co-workers (1998), Oommen (2002), Tiengo and co-workers (2006), Natsis and co-workers (2007) and Mobarakeh and co-workers (2008) Georgiev *et al.*, (2009) reported a case of a male with Palmaris longus with a muscular belly, proximal and two tendons, distally on his left arm. The medial tendon inserted on the proximal aspect of the flexor retinaculum, while the lateral tendon passed superficial to the flexor retinaculum and inserted on the Palmaris aponeurosis

The plantaris muscle is vestigial and may show variation in its structure, as well as in its points of origin and insertion. This is important to realize when it is planned to use the plantaris tendon in reconstructive surgery.

CONCLUSION

Palmaris longus muscle is one of the common flexor muscles of the forearm and it is homologous with plantaris muscle of the leg. Both the muscles are most variable in humans. Phylogenetically classified as retrogressive muscles as both muscles have short belly and long tendon.

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