

A Comparative study of plantaris and palmaris longus in South Indian population and their clinical applications

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Abstract

Background: The Plantaris and Palmaris longus muscles are small vestigial muscles having a small muscle belly and a long tendon, the Plantaris muscle is sandwiched between the Soleus and Gastrocnemius muscles present in the calf whereas, the Palmaris longus is present in the flexor compartment of the forearm. Though vestigial they are being used as autografts in various reconstructive surgeries. The aim of this study was to compare the percentage of agenesis of Palmaris longus and Plantaris in South India population and to discuss their clinical importance.

Method: The Plantaris and Palmaris longus muscles were dissected in 30 adult embalmed cadavers (60 lower limbs), 10 females and 20 males, the average age of the cadavers was between 40-60 years. Variations pertaining to agenesis, aberrancy of its attachment in its origin and insertion were observed and noted.

Result: It was observed that in each specimen there were variations in the thickness and length of Plantaris muscle and tendon. Agenesis of Plantaris was observed bilaterally in a male cadaver only, with the incidence of 3.33%. Whereas, agenesis of Palmaris longus was unilateral right sided 3.33% and on the left side 1.66%, seen in female cadavers only.

Conclusion: The tendons of Plantaris and Palmaris longus muscles, which were once thought to be vestigial and degenerating structures, can be of maximum use as graft materials in various plastic & reconstructive surgeries, without producing residual defects. After reviewing the literature it was noted that the Palmaris longus muscle has been well understood and discussed compared to the Plantaris muscle.

Keywords: Autografts, Palmaris longus, Plantaris, Tendon grafts.

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Introduction

The Plantaris muscle has a short muscle belly and a long slender tendon. It lies between the Soleus and Gastrocnemius. It takes its origin from the lower one-third of the lateral supracondylar line and the adjoining part of the oblique popliteal ligament. Its tendon blends with the medial margin of tendocalcaneus and inserted into the calcaneum medial to the attachment of tendocalcaneus. It is supplied by the tibial nerve. Its action is weak plantar flexion of the ankle joint. It can be easily mistaken for a nerve by the medical students; hence, it is often termed as "freshman's nerve".^[1]

The Palmaris longus is a slender, fusiform muscle present in the superficial compartment of the forearm. It originates with a small belly from the medial epicondyle of the humerus and its long tendon gets inserted into the apex of the palmar aponeurosis. It is innervated by the median nerve. Palmaris longus is a phylogenetically degenerated metacarpophalangeal joint flexor its main function is to anchor the skin and fascia of the hand, in resisting horizontal shearing

forces in a distal direction, which would tend to deglove the skin of the palm.^[2]

The agenesis of Palmaris longus is well studied in various regions of the world and documented, compared to the Plantaris muscle which is not discussed much in the literature.

The Palmaris longus has a highly variable prevalence in different ethnic populations. It was studied that the African American population had a statistically significantly lower rate of absent Palmaris longus (4.5%) and Asians (2.9%) compared to the Caucasians having unilateral absence of 16% and bilateral absence of 9%, with males being more affected.^[3]

Palmaris longus muscle is the most variable muscle in the body; its absence was reported as early as 1559, in 800 cases, it was absent in 7.7% of cases, absent on right side in 4.5% and absent on left side in 5.2%, it was absent more often in the females and on the left side in both sexes.^[4]

In 1975 it was revealed that there was an increased incidence of absence of the Palmaris longus muscle in patients suffering from manic-depressive psychosis and endogenous depression, it was stated that the defect was genetically determined, inherited in a monofactorial way, and determined by an autosomal gene of a dominant character with incomplete penetrance. The absence of the Palmaris longus muscle was a dominant trait, its presence a recessive trait.^[5]

Materials and Methods

The present study was carried out in the Department of Anatomy, JSS Medical College, Mysore, Karnataka State, India. The Plantaris and Palmaris longus muscles were dissected in 30 adult embalmed cadavers (60 limbs), 10 females and 20 males, the average age of the cadavers was between 40-60 years. The duration of the study was one year. The materials used were as follows: Dissection instruments like Scalpel; Toothed forceps; Blunt forceps; Pointed forceps; Small pointed scissors; Large blunt Scissors; Divider and Scale; Vernier's Caliper; Measuring tape; Hand gloves and Cotton thread.

These embalmed cadavers were given for dissection to undergraduate medical students in the department of Anatomy, J.S.S. Medical College, Mysore, Karnataka state, India.

Each muscle was identified and meticulously traced taking care not to disturb its surrounding structures like blood vessels and nerves; first blunt dissection was done later followed by fine dissection. The origin, insertion and its nerve supply was noted and

documented with utmost care. The length, breadth and the thickness of the muscle and tendon were measured using Vernier's caliper, Divider, Measuring scale and Cotton thread. Each muscle belly was measured from its point of origin to the myotendinous junction and for the tendon from the myotendinous junction to its point of insertion. The presence and absence of the Plantaris and Palmaris longus muscles were noted. The length, breadth and thickness of each muscle belly and tendon was carefully noted. Any variations in the origin, insertion, duplication of the muscle was also noted and documented.

Observation and Results

The Plantaris and Palmaris longus muscles were dissected in 30 adult embalmed cadavers (60 limbs), 10 females and 20 males, the average age of the cadavers was between 40-60 years.

The mean length of the tendons and muscle bellies was measured and documented, the mean girth of the muscle bellies was also noted for both muscles, and the results were compared.

Table 1: Comparison of the measurements of Plantaris and Palmaris longus muscles

Name of the Muscle	Mean length of the tendon (cms)	Mean length of the muscle belly (cms)	Mean girth of the muscle belly (cms)
Plantaris	32.32	7.65	0.40
Palmaris longus	14.87	11.32	3.62

It was observed that the mean length of the tendon of plantaris was more compared to the plantaris tendon, therefore, the tendon of plantaris is a better choice for various extensor tendon repairs which require more tendinous part for harvesting before grafting. The mean length and girth of muscle bellies is more in Palmaris longus compared to the plantaris. In our present study all the muscles dissected showed normal origin and insertion, no accessory muscle or slips or duplication were noted. The plantaris muscle was supplied by the tibial nerve whereas, the Palmaris longus was supplied by the median nerve. Agenesis of Plantaris was observed bilaterally in a male cadaver only, with the incidence of 3.33%. Whereas, agenesis of Palmaris longus was unilateral right sided 3.33% and on the left side 1.66%, seen in female cadavers only.

Table 2: Comparison of the frequency of Agenesis of Plantaris and Palmaris longus muscles in the present study (Unilateral – UL, Bilateral (BL))

Muscles	Right side			Left side			
	Agenesis	Presence	%	Muscles	Agenesis	Presence	%
Dissection of plantaris (60 limbs)	UL=00 BL=01 (male)	58	3.33	Dissection of plantaris (60 limbs)	UL=00 BL=01 (male)	58	3.33
Dissection of Palmaris longus (60 limbs)	UL=01 BL=01	58	3.33	Dissection of Palmaris longus (60 limbs)	UL=01 BL=01	59	1.66



Fig. 1: Arrows showing the muscle belly of Plantaris muscle (no: 7, right limb, male), its tendon is held above the forceps



Fig. 2: Arrow showing the Palmaris longus muscle (no: 8, right limb, female)

Discussion

A comparative study of Plantaris and Palmaris longus in the same region is not found in the previous literature, but in fact the agenesis of Plantaris and Palmaris longus has been studied separately in different regions.

In 2010, it was studied that there was unilateral absence of Palmaris longus tendon in 16.9% and bilateral absence was 3.3% in Indian population.^[6]

In 2014, the prevalence of agenesis unilaterally and bilaterally in the two sexes was 15.3%. The bilateral absence was 8.1%, unilateral absence was 7.29%. The unilateral absence on right and left were 3.5% and 3.7% respectively among the Ethiopian population.^[7]

In 2013, Nazeer et al studied 50 lower limbs, six types of origin and five types of insertions of the tendon were observed. The agenesis of the plantaris muscle was seen bilaterally of a male cadaver, an incidence of 4% was reported.^[8]

In, 1932 Glissan was the first person to utilize the plantaris tendon as a living suture for the repair of gaps in the flexor tendons of the palm, in tendon transplants above the ankle, in repair of a ruptured coracoclavicular ligament, and in repair of a slipping patella by Gallie's

technique. The author explained that the plantaris can be used for hernia repair due to its property of lateral stretching.^[9]

In 2003, it was put forth that Plantaris can be used as an autogenous donor graft for heart valve repair. Most clinical studies recommend valve repair as an alternative to replacement. The use of Plantaris as an autograft would increase the supply of autogenous donor tissue for valve repair, thereby enhancing the surgeon's armamentarium. Tendon tissue, due to its bulk and its smooth surface, can even be used to perform an annuloplasty. Splitting or lateral stretching encourages collagenous adhesions that in theory can provide superior dynamics through an anatomic on lay that surpasses a synthetic on lay. Moreover, the availability of the plantaris makes it an inexpensive source of material to cover tissue defects after removal of calcified atrioventricular valves, which should render plantaris tissue of particular use in resource-poor nations.^[10]

In 1912, free tendon grafts were apparently first used in the hand, the surgeons used grafts to repair ruptured flexor tendons, old lacerations and "hopeless cases" of ischaemic contractures. In 1918, the surgeons preferred the Palmaris longus tendon as the donor graft for the repair of ruptured flexor and extensor tendons.^[11]

The first free autogenous tendon graft removed & used at a different site was reported as early as 1889 wherein, the surgeon transplanted 4 1/2 inches of a flexor tendon from a damaged finger to restore extensor function in the index finger. The first series of free flexor tendon grafts in the hand was reported in 1912. For tendon material the surgeon used Palmaris longus tendon.^[12]

In 1987, the donor tendons for grafting, in order of preference, were the Palmaris longus, the Plantaris, the long extensors of the toes & the flexor digitorum sublimis. The Palmaris longus tendon was the tendon of choice because it fulfills the requirements of length, diameter, and availability without producing a deformity.^[13]

The incidence of velopharyngeal incompetence (VPI) following cleft palate surgery was fairly high in India. Surgeons performed circumferential sling pharyngoplasty using denervated Palmaris longus, since this procedure narrowed the port circumferentially. The result in such patients was gratifying, speech rating improved and electromyographic tracings after 6 months showed evidence of reinnervation of the Palmaris longus.^[14]

In 1991, it was reported that from the past 15 years, free muscle transplantation was being performed in the treatment of anal incontinence in children. This method implied transposition of a striated muscle, usually the Palmaris longus muscle, which was used as a u-sling to the perirectal area around the rectum corresponding to the location of pubo-rectalis muscle. Free muscle

transplantation offers a good chance of achieving acceptable continence in a majority of incontinent children.^[15]

In 1995, a radial forearm Palmaris longus composite free flap was used to reconstruct full-thickness defects of the heel & tendo-Achilles. Rapid healing & return of function were obtained without significant donor site disability.^[16]

In 1995, the Palmaris longus tendon with a segment of Palmaris longus muscle was used to augment upper lip. The Palmaris longus tendon – muscle grafting was used exclusively to augment volume, while not interfering with motion normally present in the lip.^[17]

In 2003, Palmaris longus tendon was constantly used for correction of hand deformities in leprosy. Even though several anomalies have been reported, it is frequently used, because of its accessibility, as a graft & also as motor to restore function in cases having paralytic hand deformities.^[18]

From the above mentioned literature it was observed that the Palmaris longus tendon is the most preferred tendon compared to the plantaris, because of its easy approach and availability, and less percentage of graft rejection. However, the length of the plantaris tendon is an advantage to the surgeons for extensive extensor tendon repair, ligament repair and heart valve repair. The percentage of agenesis of both Plantaris and Palmaris longus varies from region to region; this makes it important for the surgeons to update their knowledge about the muscles.

Conclusion

The Palmaris longus and Plantaris muscles which were once thought to be vestigial structures can now be used as suitable graft materials in various reconstructive surgeries. Both the muscle tendons can be used as autografts by the surgeons. Plantaris tendon is used due to its highly tensile, stretchable property, without leaving any residual deformity in the donor. Therefore, it becomes very important not only for the surgeons, but also for the clinicians, radiologists and anatomists to update their knowledge about the agenesis of both the muscles.

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