

MORPHOLOGY OF PLANTARIS LONGUS WITH SPECIAL REFERENCE TO ITS CLINICAL IMPORTANCE

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ABSTRACT

Background: Plantaris is small fusiform muscle, with its long, slender tendon. Actually it's a vestigial muscle in human beings hence its rupture does not result in any significant loss of function. Muscle tear associated with bleeding and swelling leads to a posterior compartment syndrome. It can mimic other serious conditions like DVT, ruptured baker's cyst and calf neoplasms.

The present study aims to find out the various patterns of proximal and distal attachment of plantaris muscle, which will help the clinician deciding in diagnosis and the plastic & orthopaedic surgeons for different types of reconstructive surgeries.

Materials and Methods: Forty-eight limbs from 24 embalmed cadavers of known sex(male) & age (40-75 years) were dissected in the department of anatomy of Lady Harding medical college, New Delhi during 2016-2017. Plantaris muscle identified with its proximal and distal attachment. Length of muscle belly & tendon were recorded.

Result: In the present study out of 48 limbs specimens, Plantaris muscle was absent in 12.5%. Its proximal attachment to lateral supracondylar ridges observed in 29% & with lateral head of gastrocnemius muscle & fibrous capsule in 58.3%. Its distal attachment deep to tendocalcaneus was noted in 25% and superficial to tendocalcaneus in 62.4%. Length of muscle belly was 7- 9 cm in 37% and tendon length was 34- 36cm in 37.5%.

Conclusion: The Morphological aspects of the attachment of plantaris play a significant role in the Pathologies associated with Calf & knee region. Their exact attachment is importance for reconstructive surgeries to the repair of ankle joint injury and flexor tendon replacement in hand.

KEY WORDS: Plantaris Muscle, Morphology, Fusiform muscle.

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Access this Article online	Journal Information
Quick Response code  DOI: 10.16965/ijar.2019.314	International Journal of Anatomy and Research ICV for 2016 90.30 ISSN (E) 2321-4287 ISSN (P) 2321-8967 https://www.ijmhr.org/ijar.htm DOI-Prefix: https://dx.doi.org/10.16965/ijar 
	Article Information
	Received: 08 Sep 2019 Peer Review: 09 Sep 2019 Revised: 10 Sep 2019
	Accepted: 09 Oct 2019 Published (O): 05 Nov 2019 Published (P): 05 Nov 2019

INTRODUCTION

The plantaris muscle is one of the muscles of superficial compartment of back of leg, arises from the lateral epicondyle of femur. Its fusiform muscular belly is nearly 5-10 cm long but the slender tendon is very long, passes between

the gastrocnemius and soleus to insert on the calcaneus anteromedial to tendocalcaneus [1]. It acts with the gastrocnemius as a weak flexor of the knee and a plantar flexor of the ankle [2]. Plantaris has a high density of muscle spindles, provide proprioceptive feedback information to

the central nervous system regarding the position of the foot. Its, slender tendon is easily mistaken for a nerve known as (“freshman’s nerve”). Because of its accessory role, the plantaris tendon can be removed for grafting for reconstructive surgery of the tendons of the hand without causing disability [3-5]. Myotendinous injury associated bleeding and swelling leads to compartment syndrome can resemble other serious conditions like DVT, ruptured baker’s cyst and calf neoplasms [6]. The plantaris tendon is an extremely tensile structure used for flexor tendon replacement in hand surgery, and lateral ankle ligaments and for repairs on atrioventricular valves and it is not too thick for revascularization at the graft site [7-9].

Our aim of study to various patterns of proximal and distal attachment of plantaris with respect of their clinical implication as diagnosis and tendon autograft repair.

MATERIALS AND METHODS

Forty-eight limbs from twenty-four embalmed cadavers of known sex and age (40-75 years) were dissected in department of anatomy of Lady Hardinge medical college New Delhi, during 2016-2017.

The posterior aspect of the lower limbs was dissected using a dissection kit. The Plantaris muscle was Identified and carefully traced to the proximal & distal attachment. Any variations in the its attachment, or relationship to surrounding tissues were noted and photographed using a digital camera. Length of fleshy belly and tendon were measured. The variations observed on the dissected specimens were described in detail and then discussed according to clinical relevance.

RESULTS

Fig.1: Showing the proximal and distal attachment of plantaris.



Table 1: Result according to present classification.

	Absent	Proximal attachment		Distal attachment			Muscle belly	
		Type1	Type2	Type1(62.4%)		Type2	Single	Double
				Type1a	Type1b			
No of specimens	12.5%)	58.3%)	29.1%)	29.1%)	33.3.%	25%	66.60%	20.83%

With the respect of clinical and pathological view of point, proximal and distal attachment of plantaris is classified as:

Proximal attachment:

Type 1 = originated from interdigitations with muscle of lateral head of gastrocnemius, fibrous

capsule and oblique popliteal ligament.

Type 2 = it originated without interdigitations from lateral supracondylar region

In present study in most of cases type 1 is predominant, it is 58%. Type 2 is in 30% and 12% cases it is absent.

Distal attachment

Type 1 = it attached superficial to tendocalcaneus

Type 1a = Medial to tendocalcaneus

Type 1b = Merges with deep fascia of leg or flexor retinaculum

Type 2 = Attached to deep to tendocalcaneus

In present case distal attachment is in the form type 2 is 25%. Type 1a in 29.1% and Type 1b in 33.3%.

Length of muscle belly in 53% cases it ranges between 5-9 cm and in only 8% it lies between 3-5cm. Maximum length up to 12 cm in 25% case. Tendon length between 34-38 cm in 66.5% in minimum range 30-34 in 8% maximum range in 38-40 in 12%. In present study 21% cases it originated with two separate bellies and in 67% it is in the form in single belly. Table 1

DISCUSSION

Embryological muscle of limb develops from migratory somites of paraxial mesoderm and surrounding somatopleuric mesenchymal layer from connective tissue or tendon [10].

Interdigitation with lateral head of gastrocnemius muscle fiber show it may be part of lateral head of gastrocnemius further it separated from it [11]. During evolutionary process of erect posture, the insertion of the muscle got shifted to a higher position, become principally tendinous. The plantaris muscle attached to the plantar aponeurosis in the American bear [5,6].

In present study, proximal attachment of plantaris in 58%(Type1) with interdigitations with lateral head of gastrocnemius, with fibrous capsule of knee joint or both. This type of proximal attachment may influence the knee function and stability, consequently allowing the Plantaris muscle to have varying roles in knee dynamics, injury and rehabilitation. Pattern in terms of its distinct interdigitations with lateral head of gastrocnemius or having a strong fibrous extension to patella may be responsible for patellofemoral pain syndrome [12].

Distal attachment of plantaris includes deep (Type2) and superficial(Type1) to tendocalcaneus. Superficial attachment to fascia of leg and merges with flexor retinaculum, muscle may

get injured during surgical procedures. The part of distal attachment of plantaris to the flexor retinaculum can be explained on the basis of development as tendon developed from somatopluric mesenchyma. Injury to plantaris muscle and its tendon or associated tears of gastrocnemius, soleus and anterior cruciate ligament may be regarded as important cause of ‘Tennis leg’ [13]. Plantaris is stronger stiffer less extensible tendon than the adjacent Achilies. The mechanical property of plantaris have the potential to create repeated shear stress to the peritendinous tissue or to Achilles tendon itself. In repeated micro trauma surrounding peritendinous tissue can predispose to inflammatory process and type 2 distal attachment play important role in chronic tendoachillis injury. Under similar tensile stresses, the Achilles elongates a greater distance than plantaris and this biomechanical property explains that intact plantaris is in acute tendoachillis injury [14,15]. Rupture of its tendon may be presented as non-specific lower leg pain. Correct interpretation by newer imaging modality for diagnosing such type of clinical presentation needs detailed anatomical knowledge about the plantaris muscle. Tendon of plantaris due to its excellent tensile strength used as graft for reconstruction of flexor tendon in hand and anterior talofibular and calcaneofibular ligament of ankle and desirable substitute for the fascia lata in hernial repair [7-9]. Awareness regarding variations in distal attachment of the muscle is also important to surgeons undertaking reconstructive surgery.

Table 2: Comparison of presence/ absence of plantaris with other study.

Author	Absent in %
Sinnatamby, 1999 [3]	10%
Harvey (1983) [18]	19.14%
Simpson (1991) [19]	9%
Daseler (1943) [16]	6.67%
Present study	12.50%

Cummins and Anson (1946) described that in 47% inserted on calcaneus, 35% in front of tendocalcaneus & 6% medial margin of tendocalcaneus [16]. In present study, 58% inserted on calcaneus and out of 33.3% attach on medial margin. Similarly, Das et al (2006) observed that 60% the Plantaris muscle was inserted into the calcaneum, its normal site ¹⁷

In 40%, the insertion was into the superficial fascia of the leg. In present study superficial insertion pattern is 33.3 %. Table 2

CONCLUSION

Plantaris is vestigial structure but it originated with interdigitation with other muscle & fibrous capsule that role in different pathology of knee region and calf region. Morphology of plantaris muscle is, which could be important for anatomists, anthropologists, surgeons and orthopaedic surgeons performing reconstructive procedures.

Awareness of the distal attachment pattern of the Plantaris tendon is also important for clinicians in the diagnosis of muscle tears and for surgeons performing reconstructive procedures.

Conflicts of Interests: None

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How to cite this article:

Kumari Savita, Tuli Anita, Agarwal Sneh . MORPHOLOGY OF PLANTARIS LONGUS WITH SPECIAL REFERENCE TO ITS CLINICAL IMPORTANCE. Int J Anat Res 2019;7(4.2):7101-7104. DOI: 10.16965/ijar.2019.314