

Unilateral Accessory Plantaris Muscle: A Rare Anatomical Variation with Clinical Implications

Dr. Sherry Sharma¹, Dr. Meenakshi Khullar² and Dr. Sunil Bhardwaj³

¹ Punjab Institute of Medical Sciences, Jalandhar, Punjab, INDIA

Received: 12 December 2013 Accepted: 3 January 2014 Published: 15 January 2014

Abstract

Plantaris, a small muscle with its long slender tendon, is of interest not only from anatomical but also from phylogenetic view point. It is regarded as vestigial in man, believing that, with assumption of an erect posture, the tendon lost its original insertion into plantar aponeurosis and gained a secondary calcaneal attachment. The muscle is known to exhibit variations but there are few reports on the existence of complete duplication of plantaris. During the routine dissection for the undergraduate medical students we encountered unilateral accessory plantaris muscle in the right lower limb of an adult male cadaver. Though often dismissed as a small vestigial muscle, an injury to this muscle should actually be included in the differential diagnosis of the painful calf.

Index terms— vestigial, plantar aponeurosis, tendon transfer operations.

1 Introduction

The plantaris muscle consists of a small, thin muscle belly and a long thin tendon (approximately 2-4 inches long) that forms part of the posterolateral compartment of the calf.

The muscle originates from the lower part of the lateral supracondylar line of the femur just superomedial to the origin of the lateral head of the gastrocnemius muscle and from the oblique popliteal ligament of the knee joint. The muscle belly crosses the popliteal fossa inferomedially. In the proximal third of the leg, the muscle belly is situated between the popliteus muscle anteriorly and the lateral head of the gastrocnemius muscle posteriorly. The myotendinous junction occurs approximately at the level of the origin of the soleus muscle from tibia in the proximal part of the leg. Its long thin tendon then courses distally between the medial head of the gastrocnemius muscle and the soleus muscle in the middle third of the leg. Subsequently, it continues inferiorly along the medial aspect of the Achilles tendon up to its insertion on the calcaneum.

Finally, it gets inserted either independently or in association with Achilles tendon on calcaneus 1 .

The long, thin tendon of plantaris is humorously called the freshman's nerve, as it is often mistaken for a nerve by first-year medical students 2 . Neural innervation to this muscle is provided by the tibial nerve (S1, S2).

2 II.

3 Materials and Methods & Results

During the routine dissection of lower extremities for undergraduate medical students, we encountered an anomalous accessory plantaris muscle in the right lower limb of a male cadaver. The muscle was displayed by meticulous dissection. Morphometric measurements were taken and the specimen was photographed.

On the right side, the plantaris muscle showed complete duplication i.e. it had two separate bellies of origin (P1, P2) and two separate tendons of insertion (T1, T2). Out of the two bellies, P1 was thicker and much fleshy; measuring about 4 inches in length. It took origin from the lower part of the lateral supracondylar ridge of the femur just superomedial to the origin of the lateral head of gastrocnemius muscle. On the contrary, P2 was

42 comparatively thinner; measuring about 2 inches in length. It took origin from the posterior surface of the lateral
43 condyle of femur medial to the origin of the lateral head of gastrocnemius muscle.

44 Both the bellies terminated as separate tendons (T1 and T2) which travelled inferomedially between the
45 gastrocnemius and the soleus and got inserted into the upper part of the posterior surface of calcaneum (T2
46 inserting relatively above T1) ; medial to the insertion of tendocalcaneus (Table ??Fig 1). Dissection on the left
47 side revealed no such variation regarding plantaris muscle.

48 4 III.

49 5 Discussion

50 Plantaris muscle is known as vestigial muscle in human as its distal attachment has shifted secondarily well short
51 of plantar aponeurosis to calcaneus due to process of evolution for erect posture and bipedal locomotion 3 . In
52 some animals like the American bear, the plantaris muscle can be found to be attached to the plantar aponeurosis
53 4 . It is known to present several anatomical variations in terms of its occurrence, origin, course, relation with
54 surrounding neurovascular structures and insertion.

55 Reports are available in the literature stating numerous anomalous sites of origin of this muscle which include:
56 i) the lower part of the linea aspera; ii) the posterior ligament of the knee at the intercondylar space; iii) the
57 fascial covering of the popliteus; iv) the fibula, between the flexor hallucis longus and the peroneus longus; v) the
58 oblique line of the tibia, under cover of the soleus; or vi) the lateral condyle of the femur above the origin of the
59 lateral head of the gastrocnemius 4 . Similarly there are reports showing anomalous sites of insertion of plantaris
60 which include: i) the soft tissues between the muscle bellies of the gastrocnemius and the soleus; ii) the inner
61 border of the calcaneal tendon; iii) the dorsomedial surface of the calcaneal tendon at the latter's insertion; iv) the
62 bursa between the calcaneal tendon and the calcaneum; v) the fibrous and fatty tissues situated immediately in
63 front of the calcaneal tendon; and vi) the plantar aponeurosis 4 vii) Iliotibial tract or lateral patellar retinaculum
64 5 viii) As split attachments on posteromedial side of calcaneus 6 . The muscle is also reported to merge with the
65 flexor retinaculum or with the superficial fascia of the leg 3 .

66 Plantaris muscle belly directly forming an aponeurosis without an intermediate tendon which merged with the
67 soleus muscle close to its origin has also been reported 7 .

68 The plantaris muscle may even be unilaterally or bilaterally absent 2,4,8,9 . Embryological development in
69 man supports the idea advocated by McMurrich 10 that the plantaris is a derivative of the deeper portion of the
70 lateral head of gastrocnemius muscle. When absent, it's likely that this separation has failed to take place during
71 ontogeny. In many mammals, it is not differentiated (several edentates, carnivores etc.); in others especially in
72 some rodents, it is highly developed.

73 An additional tendinous slip of origin from the fascia covering popliteus along with the entrapment of plantaris
74 muscle belly between tibial nerve and its branch to soleus has also been reported separately by Das and Vasudeva
75 11 and Nayak et al 12 .

76 Unilateral / bilateral bicipital origin of this muscle has also been reported in which the muscle took origin
77 in the form of two separate bellies from two different sites but then joined to form a common tendon 13,14 .
78 Similar unilateral bicipital origin was recorded by Sawant et al 15 with a difference that in their case both the
79 bellies continued as separate tendons which then fused to form a common one which inserted on medial side of
80 calcaneus. Similarly Kwinter et al 6 recorded a second plantaris muscle in the right leg of 47 year old female
81 cadaver. The inner and outer bellies of the anomalous plantaris arose proximally from the medial condyle of the
82 femur and formed a short tendon that fused distally with the tendon of the lateral plantaris muscle. The main
83 tendon split forming three distinct attachments on the posteromedial aspect of the calcaneus anterior to the
84 medial side of the calcaneal tendon.

85 Reports on complete duplication of plantaris as seen in our case are extremely rare. During the review of the
86 relevant literature, we could find only one case report describing bilateral complete duplication of plantaris in a
87 45 year old male cadaver 16 .

88 Surgical intervention without knowledge of bicipital origin of plantaris or its complete duplication may lead to
89 inadvertent damage to surrounding structures. The additional plantaris muscle as in our case may also confuse
90 clinicians when diagnosing a posterior knee injury and / or tennis leg and create hindrances in surgical procedures
91 involving the popliteal fossa. Hence, prior knowledge of such variations may be helpful during surgical operations
92 involving the popliteal fossa and the posterior compartment of leg 11,14 .

93 IV.

94 6 Clinical Significance

95 In terms of function, the plantaris muscle acts with the gastrocnemius but is insignificant as either a flexor of the
96 knee, or a plantar flexor of the ankle. It has been considered to be an organ of proprioceptive function for the
97 larger, more powerful plantar flexors, as it contains a high density of muscle spindles 17 . The plantaris tendon
98 has elicited further interest because of its potential use as a graft 8 . Removal of the plantaris muscle does not
99 typically hinder the patient's lower extremity function in the presence of a normal soleus and gastrocnemius.
100 Surgeons have recognized the noticeable tensile strength of the tendon. They have used the structure successfully
101 in flexor tendon replacement in the hand and have suggested its use in atrioventricular valve repair 18 . Also it has

102 been established through MRI, sonography and surgical exploration that injuries to this muscle may in fact occur
103 in isolation as well as in association with tears of gastrocnemius, soleus and anterior cruciate ligament. Hence,
104 the observation made in our case report will supplement our knowledge of variations in the posterior aspect of the
105 knee joint, which may be useful for surgeons and orthopedicians performing tendon transfer operations, clinicians
106 and physiotherapists diagnosing muscle tears, and radiologists interpreting MRI scans.

107 V.

108 **7 Conclusions**

109 Considering the above facts, the existence and significance of the variations of plantaris muscle cannot be
110 undermined. The presence of complete duplication of plantaris, as seen in the present case may be of academic
111 interest too, as the standard textbooks of anatomy mention little about this fact. Also the advancements in
112 anatomical understanding of the structures that may influence a joint may subsequently lead to improved surgical
113 interventions and rehabilitative procedures.

-
- 114 [Sugavasi et al. ()] 'A case report of variant insertion of plantaris muscle and its morphological and clinical
115 implications'. R Sugavasi , K Latha , Indira Devi , J Sirasanagandla , S R Gorantla , VR . *J Morphol Sci*
116 2013. 30 (4) p. .
- 117 [Sharma et al. ()] 'Absence of plantaris muscle'. S Sharma , G D Sharma , S Bhardwaj . *Novel Science*
118 *International Journal of Medical Science* 2012. 1 (11-12) p. .
- 119 [Herzog ()] 'Accessory plantaris muscle: Anatomy and prevalence'. R J Herzog . *HSSJ* 2011. 7 p. .
- 120 [Nayak et al. ()] 'Additional tendinous origin and entrapment of the plantaris muscle'. S R Nayak , A Krishna-
121 murthy , L V Prabhu , S Madhyastha . *Clinics* 2009. 64 (1) p. .
- 122 [Upasna and Kumar ()] 'Bicipital origin of plantaris muscle -A case report'. Upasna , A Kumar . *IJAV* 2011. 4
123 p. .
- 124 [Moore and Dalley ()] 'Clinically oriented anatomy'. K L Moore , A F Dalley . *Philadelphia* 2006. Lippincott
125 Williams & Wilkins. p. . (5th Ed)
- 126 [Bardeen ()] 'Development and variation of the nerves and the musculature of the inferior extremity and of the
127 neighbouring regions of the trunk in man'. C R Bardeen . *Am J Anat* 1906. 6 p. .
- 128 [Rana et al. ()] 'Double plantaris muscle: A cadaveric study with clinical importance'. K Rana , S Das , R Verma
129 . *Int J Morphol* 2006. 24 (3) p. .
- 130 [Das and Vasudeva ()] 'Entrapment of plantaris tendon between the tibial nerve and its branch: a case report'.
131 S Das , N Vasudeva . *Eur J Anat* 2006. 10 p. .
- 132 [Mahadevan and Leg ()] 'Gray's anatomy. The anatomical basis of clinical practice. 40 th Ed'. V Mahadevan ,
133 Leg . *Philadelphia* Standing S (ed.) 2008. p. 1421.
- 134 [Shuhaiber and Shuhaiber ()] 'Plantaris tendon graft for atrioventricular valve repair. A novel hypothetical
135 technique'. J H Shuhaiber , H H Shuhaiber . *Tex Heart Inst J* 2003. 30 p. .
- 136 [McMurrich ()] 'The phylogeny of the crural flexors'. J P McMurrich . *Am J Anat* 1905. 4 p. .
- 137 [Daseler and Bj ()] 'The plantaris muscle: an anatomical study of 750 specimens'. E A Daseler , Anson Bj . *J*
138 *Bone Joint Surg* 1943. 25 (4) p. .
- 139 [Andreo and Spina ()] 'The plantaris muscle: anatomy, injury, imaging and treatment'. A Andreo , D C Spina .
140 *J Can Chiropr Assoc* 2007. 51 (3) p. .
- 141 [Simpson et al. ()] 'The plantaris tendon graft: an ultrasound study'. S L Simpson , M S Hertzog , R H Barja .
142 *J Hand Surg (Am)* 1991. 16 p. .
- 143 [Kwintar et al. ()] 'Unilateral double plantaris muscle: a rare anatomical variation'. D M Kwintar , J P Lagrew
144 , J Kretzer , C Lawrence , D Malik , M Mater . *Int J Morphol* 2010. 28 (4) p. .
- 145 [Srimani et al. ()] 'Unilateral variation of plantaris muscle: A case report'. P Srimani , R Meyur , De Bose , A
146 Kundu , B Sadhu , A . *JEMDS* 2014. 3 (3) p. .
- 147 [Sawant et al. ()] 'Unusual plantaris muscle: A cadaveric study report from medical college in Mumbai, India'.
148 S P Sawant , S T Shaikh , R M More . *Int J Biol Med Res* 2013. 1 (2) p. .