Int. J. Morphol.,
40(3):851-854, 2022.

Variation of Plantaris Muscle: A Case Report with Clinical Significance

Variación del músculo plantar: Reporte de un caso con Significado Clínico

Chen, Hui-Guang[1]; Xue, Pei-Ran[1]; Wang, Cheng-Tao[1]; Liu, Xiao-Liu[2] & Li, Ming-Zhe[2]

CHEN, H.; XUE, P.; WANG, C.; LIU, X. & LI, M. Variation of plantaris muscle: a case report with clinical significance. *Int. J. Morphol., 40(3)*:851-854, 2022.

SUMMARY: The plantaris muscle is located between the soleus and gastrocnemius muscles, within the posterior calf group. Due to degeneration and its loss of plantar-flexion function, the muscle is vestigial in human beings, but it retains clinical significance. Few cases of variation in the plantaris muscle have been reported, and this, therefore, appears to be rare. Nonetheless, absence of this muscle was identified via the dissection of a left lower limb (male), which also indicated the absence of an attachment in the usual position. The present report, which addresses such variation, may provide both inspiration and reference points for the clinical treatment of so-called "tennis leg", and for the use of plantaris muscle for the purposes of clinical, autologous graft repair.

KEY WORDS: Anatomical variation; Plantaris muscle; Absent; Clinical significance.

INTRODUCTION

The plantaris muscle found in the flexor muscle group of the leg. While it runs in an oblique manner through the space between the gastrocnemius muscle (or, more precisely, the lateral head of the latter) and the soleus muscle, it originates in the lateral condyle of the femur and the popliteal ligament. The tendon is slender, it descends alongside the medial margin of the calcaneal tendon, before joining, or terminating in, the calcaneal tendon distal. The beally, meanwhile, is fusiform and small (Standring, 2005).

Textbooks have referenced the degeneration and loss of the plantar flexion function in human plantaris muscles, and indeed, the muscle appears to be absent in around 10 % of lower limbs. Nonetheless, the volume of literature pertaining to the topic is small. Some researcherss, admittedly, have suggested that unilateral plantar-muscle loss is less common than the bilateral equivalent (Kwinter *et al*., 2010).

Generally, the muscle plantaris provides a good foundation for autologous grafts. Furthermore, in terms of clinical treatment for "tennis leg" and chronic tendinopathy, the plantaris muscle and its anatomical relationships are clinical significance.

CASE REPORT

During a routine dissection in a regional anatomy course for medical students, it was observed in an adult male cadaver that the plantaris muscle of the left lower limb was absent.

The dissection was performed in the posterior area of the leg and in the popliteal fossa. The skin and superficial fascia were dissected and the small saphenous vein and sural nerve were exposed. The popliteal fascia was then removed and the popliteal fossa was cleaned. In addition, cleaning of the lateral and medial head of the gastrocnemius muscle was performed. As indicated in Figure 1A, a cut was made in the gastrocnemius muscle about 5 cm below the lateral head. To expose the soleus muscle, the lateral margin of the gastrocnemius muscle was dissociated and rotated medially.

Near the superior margin of the tendinous arch of the soleus muscle, and deep to the lateral head of the gastrocnemius muscle, no belly of the plantaris muscle was detected. There was also no plantaris tendon present above the medial margin of the soleus muscle.

[1] Clinical Medicine, Medical College of Wuhan University of Science and Technology, Wuhan Hubei, 430065, P.R. China.
[2] Department of Anatomy, Medical College of Wuhan University of Science and Technology, Wuhan Hubei, 430065, P.R. China.
Chen Hui-Guang and Xue Pei-Ran contributed equally to this article.

Received: 2021-11-24 Accepted: 2022-03-08

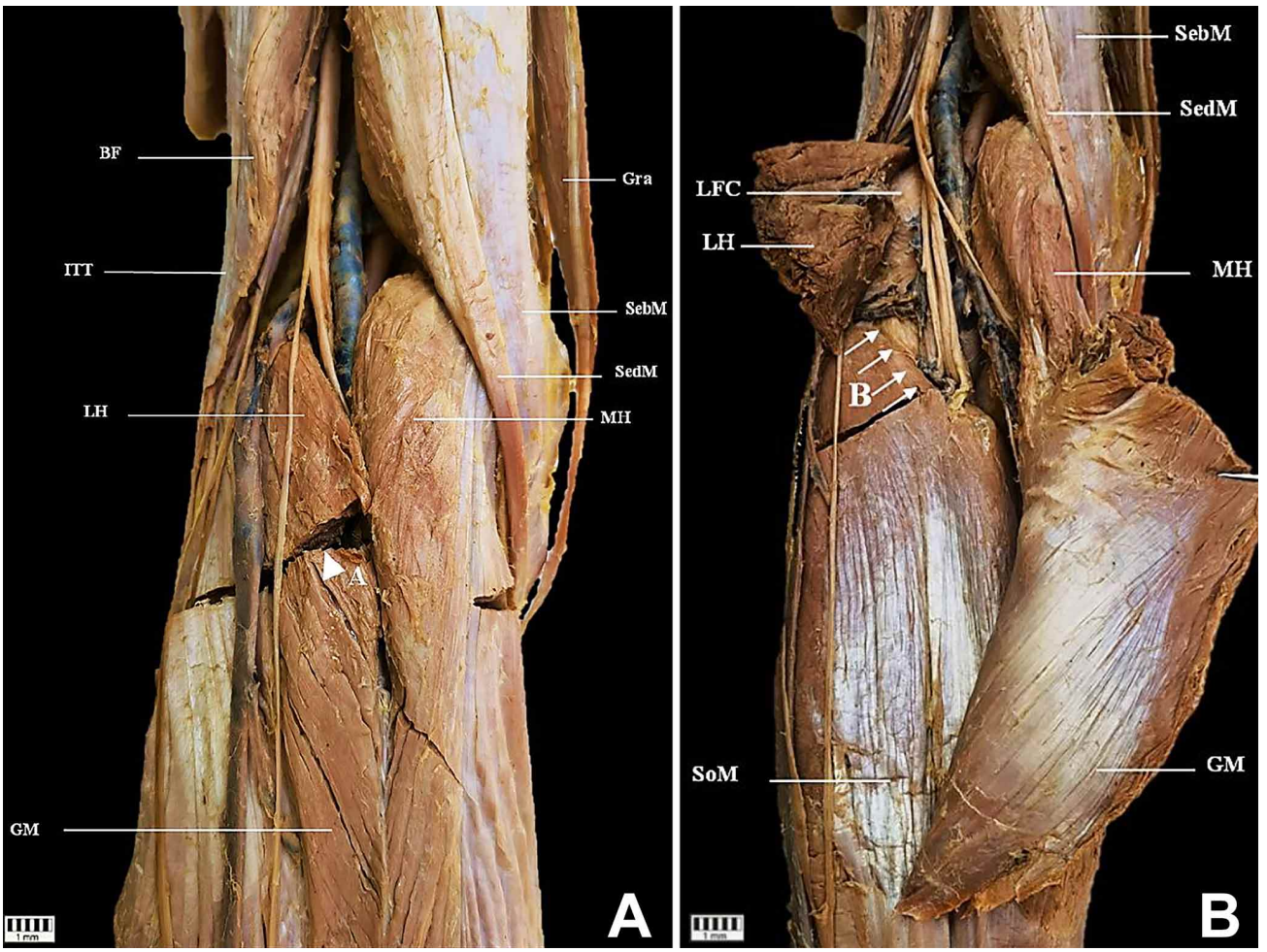

Fig. 1 A& B BF The biceps femoris, GM the gastrocnemius muscle, Gra The Gracilis, ITT the iliotibial tract, LFC the lateral femoral Condyle, LH. The lateral head of gastrocnemius, Mh the medial head of gastrocnemius, SebM the semimembranosus muscle, SedM the semitendinosus muscle, SoM the soleus muscle. A. An Incision was made about 5 cm below the beginning of the gastrocnemius muscle and the lateral head Dissociate the lateral margin of the gastrocnemius muscle and turn it inward to reveal the soleus muscle. B. No attachment of the plantaris muscle was found at the cammon starting point.

In addition, although the soleus muscle and gastrocnemius muscle were normal, no attachment of the plantaris muscle was identified at the origin or insertion. There was no evidence of union of the gastrocnemius or soleus muscles with the plantaris muscle (Fig. 1A). On the contrary, when the right lower limb was dissected, the plantaris muscle and its tendon were observed, normal in its origin and insertion, position and shape (Fig. 1B).

DISCUSSION

Plantaris muscle variation is common, although several of the standard textbooks in China fail to reference the plantaris muscle. Absence of the plantar muscle is estimated to occur in around 10% of individuals. It has been posited by researchers that the plantaris muscle was originally attached to the plantar aponeurosis, but that its position "moved backwards" during the process of evolution.

Interest has been aroused by the plantaris tendon and its morphological characteristics, especially, in terms of its potential use, in surgery, for autologous transplantation or transposition repair. This potential is connected to its selective convenience, and its advantageous length, thinness, and shallow surface (Ma Shuangtao, *et al*., 2007; Janco M *et al*., 2002). In the treatment of lower-limb venous insufficiency, for instance, a plantaris muscle loop may be deployed. In terms of rejection risk, material selection and performance, this loop is preferable to the pedicled fascia lata loop or the semitendinosus-biceps femoris loop (Wang

Fan *et al*.,1994). There is some expectation, moreover, that the plantaris muscle may be deployed in future as an autologous transplantation material for the repair of heart-valve defects (Li *et al*., 2000).

The calcaneal tendon usually serves as the insertion for the plantarismuscle tendon. In recent years, there has been a noticeable increase in cases of calcaneal tendon disease, with associated weakening and functional impairment , and this is true not happy only of athletes, but also of the wider population (van Dijk *et al*., 2011). Histopathological changes were apparent in only 34 % of asymptomatic tendons (van Sterkenburg & van Dijk, 2011). Here, in fact, some scholars have posited that the insertiont of the plantaris muscle was closely associated with the aetiology (Kurtys *et al*., 2020). The most recent literature has noted positive results in treating chronic pain around the middle of calcaneal tendon, with these results stemming from the excision of the plantar muscle, its surrounding soft tissue and its tendon, together with a reduction in tendon tension. Follow-up, moreover, remains satisfactory after one year (Spang *et al*., 2016).

From a morphological perspective, the plantaris muscle is degenerative, as reflected in short muscle belly and tendon elongation. Thus, the muscle has failed to adapt to rapid muscular contraction. According to pertinent research, so-called “tennis leg”, such as swelling and acute leg pain, may result from the passive stretching of the plantaris muscle, notably with knee-joint extension and ankle dorsiflexion below 90 degrees. Indeed, plantaris tendon rupture can arise from violent plantar flexion not only in athletes, those who exercise heavily, etc., but also in middle-aged individuals in poor physical shape. In any case, the fact that the plantaris muscle can be damaged by excessive elongation and contraction of the triceps surael muscle is well established. Nonetheless, this may be misdiagnosed as deep vein thrombosis or triceps surae muscle injury, in the absence of MRI and US (Kwinter *et al*., 2010). Non-surgical treatments are currently favoured for “tennis leg”. Symptoms may ameliorate sooner, however, if the damaged plantaris muscle is removed in the super-acute period, or if the muscle is simply absent.

Conversely, some scholars maintain that, because of its high-density muscle spindle, the plantar muscle is likely to comprise the proprioceptive organ of the larger, more powerful plantar flexors (Spina, 2007). This is because, rather than generating power, most slender tendons regulate finer motor functions (Kannus, 2000). Meanwhile, the major stable knee ligaments may be more prone to injury in the absence of the plantar muscle, via increased relaxation of the knee during lateral and medial rotation, and weakened, initial knee flexion (Olewnik *et al*., 2020).

High research value and wide prospective application for disease treatment are associated with resection, absence or transplantation of plantar muscle. Absence of the muscle and its tendon obviously obstructs transplantation or removal, but the potential graft status of the plantaris muscle can be observayted via pre-operative US or MRI. Clinical references will also be derived from case reports.

CKNOWLEDGEMENTS

This study received financial supports by:

1. 2021 National College Students Innovation and Entrepreneurship Training Program (No.202110488026)2. 2021 Undergraduate Innovation and Entrepreneurship Training Program of Wuhan University of Science and Technology (No.21SB004).
3. Philosophy and Social Science Research Project of Hubei Education Department (No.20Y018).

CHEN, H.; XUE, P.; WANG, C.; LIU, X. & LI, M. Variación del músculo plantar: reporte de un caso con significado. *Int. J. Morphol., 40(3)*:851-854, 2022.

RESUMEN: El músculo plantar se ubica entre los músculos sóleo y gastrocnemio, dentro del grupo posterior de la pierna. Debido a la degeneración y la pérdida de la función de flexión plantar, el músculo es un vestigio en los seres humanos, pero conserva su importancia clínica. Se han informado pocos casos de variación en el músculo plantar y, por lo tanto, esto parece ser raro. No obstante, se observó la ausencia de este músculo durante la disección de un miembro inferior izquierdo (masculino). El presente informe, que aborda dicha variación, puede proporcionar puntos de referencia para el tratamiento clínico de la llamada "pierna de tenista" y para el uso del músculo plantar con fines de reparación clínica con injerto autólogo.

PALABRAS CLAVE: Variación anatómica; Músculo plantar; Ausencia; Significación clínica.

REFERENCES

Cui, H. & Li, R. Local Anatomy. 9th ed. Beijing, People's Medical Publishing House, 2018. pp.269-70.

Janco, M. & Pikus, P. Achilles tendon suturing and reconstruction with the plantaris muscle. Acta Chir. Orthop. Traumatol. Cech., 69(4):264-6, 2002.

Kannus, P. Structure of the tendon connective tissue. Scand. J. Med. Sci. Sports, 10(6):312-20, 2000.

Kurtys, K.; Gonera, B.; Olewnik, ?.; Karauda, P. & Polguj, M. A highly complex variant of the plantaris tendon insertion and its potential clinical relevance. Anat. Sci. Int., 95(4):553-8, 2020.

Kwinter, D. M.; Lagrew, J. P.; Kretzer, J.; Lawrence, C.; Malik, D.; Mater, M. & Brueckner, J. K. Unilateral double plantaris muscle: a rare anatomical variation. *Int. J. Morphol., 28(4)*:1097-9, 2010.

Li, Q.; Xu, J. & Zhang, D. Transplantation of vascularized plantar tendon at donor site. *Chin. J. Microsurg., (01)*:54-56, 2000.

Olewnik, ?.; Kurtys, K.; Gonera, B.; Podgórski, M.; Sibin´ski, M. & Polguj, M. Proposal for a new classification of plantaris muscle origin and its potential effect on the knee joint. *Ann. Anat., 231*:151506, 2020.

Spang, C.; Alfredson, H.; Docking, S. I.; Masci, L. & Andersson, G. The plantaris tendon: a narrative review focusing on anatomical features and clinical importance. *Bone Joint J., 98-B(10)*:1312-9, 2016.

Spina, A. A. The plantaris muscle: anatomy, injury, imaging, and treatment. *J. Can. Chiropr. Assoc., 51(3)*:158-65, 2007.

Standring, S. Gray's Anatomy. *The Anatomical Basis of Clinical Practice.* 39th ed. Philadelphia, Elsevier Churchill Livingstone, 2005. pp.1499-500.

van Dijk, C. N.; van Sterkenburg, M. N.; Wiegerinck, J. I.; Karlsson, J. & Maffulli, N. Terminology for achilles tendon related disorders. *Knee Surg. Sports Traumatol. Arthrosc., 19(5)*:835-41, 2011.

van Sterkenburg, M. N. & van Dijk, C. N. Mid-portion Achilles tendinopathy: why painful? An evidence-based philosophy. *Knee Surg. Sports Traumatol. Arthrosc., 19(8)*:1367-75, 2011.

Corresponding author:
Professor Mingzhe Li
Department of Anatomy
Medical College of Wuhan University of Science and Technology
Hongshan District
Wuhan, Hubei Province, 430065
P.R. CHINA

E-mail: 727417629@qq.com