



Superficial course of the medial plantar nerve: case report

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Abstract: The medial and lateral plantar nerves are branched from the tibial nerve and move to the tip of the toes. A variation of medial plantar nerve was found on the left side of a 78-year-old Korean male cadaver. The tibial nerve was divided into the lateral and medial plantar nerves beneath the plantar flexor. The medial plantar nerve passed deep to plantar aponeurosis and superficial to the flexor digitorum brevis. It gave off a common plantar digital nerve and then divided into three proper plantar digital nerves near the metatarsal bases. In this article, we report a superficial course of the medial plantar nerve and describe its unique morphology and discuss the clinical significance of this variation.

Key words: Tibial nerve, Medial plantar nerve, Abductor hallucis muscle, Flexor digitorum brevis, Variation

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Introduction

The tibial nerve in the foot terminates by dividing into medial and lateral plantar nerves. The medial plantar nerve (MPN) is the larger of the two terminal divisions of the tibial nerve, which accompanies the medial plantar artery. From its origin under the lacinate ligament, it passes deep to the abductor hallucis muscle, and, appearing between this muscle and the flexor digitorum brevis. And then it gives off a proper digital plantar nerve and finally divides opposite the bases of the metatarsal bones into three common digital plantar nerves. Though the anatomy of foot and sole is clinically important, there is few studies and case reports about the plantar nerves on sole [1-4].

The MPN supplies the abductor hallucis, flexor hallucis

brevis, flexor digitorum brevis and the first lumbrical. All the remaining intrinsic muscles including the adductor hallucis are supplied by the lateral plantar nerve. Therefore, knowledge of the anatomy and variations of the plantar nerve will help in the future planning of treatments to correct the congenital or post-injury partial loss of the foot functions [5]. In this article, we report a superficial course of MPN and described its unique morphology and discuss the clinical significance of this variation.

Case Report

During a routine educational dissection of the foot, variation of MPN was found on the left side of a 78-year-old Korean male cadaver. The skin and soft tissues of the plantar area were elevated over the plantar area of the feet. The subcutaneous fat and the plantar aponeurosis were carefully removed. The tibial nerve divided into lateral plantar nerve and MPN under flexor retinaculum of foot (lacinate ligament). The MPN were located superficial to the first layer of the sole (Fig. 1A). It passed under plantar aponeurosis and the abductor hallucis muscle, and run superficial to the flexor digitorum brevis (Fig. 1B). At the master knot of Henry, MPN gave off

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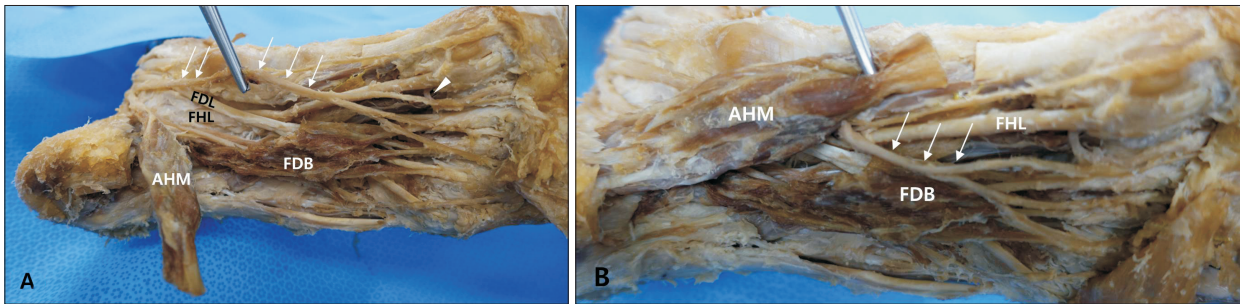


Fig. 1. Photograph of variant course of the medial plantar nerve. (A) After cutting abductor hallucis muscle (AHM), the medial plantar nerve (arrows) continued superficial to flexor digitorum brevis (FDB). And its branches accompanied the branches of the medial plantar artery (arrowhead). (B) Superficial course of the branches of the medial plantar artery (arrows). FDL, flexor digitorum longus; FHL, flexor hallucis longus.

the a common plantar digital nerve and then divided into three proper plantar digital nerves near the metatarsal bases. These proper planter digital nerves accompanied with the plantar metatarsal arteries from the deep plantar arch. There was no variation in the other neurovascular structures.

Discussion

We demonstrated superficial course of MPN in Korean cadaver. From its origin under the laciniate ligament, it passes between the abductor hallucis muscle and the flexor digitorum brevis normally. And then it gives off a common plantar digital nerve, cutaneous branches, and muscular branches, and then finally divides into three proper plantar digital nerves. Only cutaneous branches pierce the plantar aponeurosis between the abductor hallucis and the flexor digitorum brevis and are distributed to the skin of the sole of the foot.

However, our case showed that MPN passed superficial to the flexor digitorum brevis like cutaneous branches. Similar case was extremely rare and only one case has been reported [4]. The course of MPN has been studied by some authors. About half of MPN ran under the abductor hallucis in the sole (entire course in 27% or emerged from its lateral edge and stayed close to the abductor hallucis in 24%). Others showed that it went further lateral to the space under the flexor digitorum longus to the crossover of the flexor hallucis longus and flexor digitorum longus tendons [6]. The presence of a connecting branch between the deep branch of the lateral plantar nerve and the MPN penetrates the oblique head of the adductor hallucis in 86% [7]. Therefore, superficial course of MPN like cutaneous nerve in this report is particularly unique case and it may have clinical significances.

Variant course of MPN may be involved in medial heel pain including plantar fasciitis, heel pain syndrome and fat pad disorders [8]. The course of MPN is clinically important because of its course adjacent to the master knot of Henry (intersection territory, where the tendon of flexor digitorum longus crosses over the tendon of flexor hallucis longus). The master knot of Henry has been widely used as a surgical landmark during the tendon graft harvesting. Therefore, variant MPN may also be visualized in magnetic resonance and ultrasonography image, causing iatrogenic injuries or misdiagnosis [9]. Normal and variant anatomic knowledge of MPN is extremely essential not only to anatomist but also to clinicians.

Though the anatomy of the nerves of the foot and ankle is quite complex, we demonstrated a superficial course of MPN in Korean cadaver for the first time. Various compression syndromes may involve foot nerves, and this report may assist in diagnosis. Further study with more cadavers should be performed and its embryological consideration also should be investigated.

References

1. Jones JR, Klenerman L. A study of the communicating branch between the medial and lateral plantar nerves. *Foot Ankle* 1984; 4:313-5.
2. Davis TJ, Schon LC. Branches of the tibial nerve: anatomic variations. *Foot Ankle Int* 1995;16:21-9.
3. Govsa F, Bilge O, Ozer MA. Variations in the origin of the medial and inferior calcaneal nerves. *Arch Orthop Trauma Surg* 2006;126:6-14.
4. Astik RB, Dave UH, Gajendra KS. Variant position of the medial plantar nerve. *Int J Anat Var* 2011;4:1-2.
5. Saeed MA, Gatens PF. Compound nerve action potentials of the medial and lateral plantar nerves through the tarsal tunnel. *Arch*

Phys Med Rehabil 1982;63:304-7.

6. Ghosh SK, Raheja S, Tuli A. Potential sites of compression of tibial nerve branches in foot: a cadaveric and imaging study. *Clin Anat* 2013;26:768-79.
7. Arakawa T, Sekiya S, Terashima T, Miki A. Pseudoganglion on the connecting branch between the deep branch of the lateral plantar nerve and medial plantar nerve. *Clin Anat* 2011;24:646-51.
8. Flanigan RM, DiGiovanni BF. Peripheral nerve entrapments of the lower leg, ankle, and foot. *Foot Ankle Clin* 2011;16:255-74.
9. De Maeseneer M, Madani H, Lenchik L, Kalume Brigido M, Shahabpour M, Marcelis S, de Mey J, Scafoglieri A. Normal anatomy and compression areas of nerves of the foot and ankle: US and MR imaging with anatomic correlation. *Radiographics* 2015;35:1469-82.