



Unilateral absence of an extensor digitorum longus muscle and variations of toe tendons

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Abstract

The extensor digitorum longus and brevis (EDL, EDB) muscles, along with the extensor hallucis longus and brevis, extend the toes. During routine dissection in our anatomy course, the author found the EDL muscle and tendons were absent in the right leg; but the left leg had a small EDL muscle with a single fifth toe tendon. The left EDL also gave rise to a fibularis tertius muscle. In the right foot, the EDB had a variant tendon slip to the fifth toe that crossed superficial to its tendon to the fourth toe. The left EDB had an extra muscle belly whose tendon inserted on the second toe by crossing an additional EDB tendon to the second toe. Each foot had a fibularis digiti minimi tendon arising from the fibularis brevis. The lack of an EDL muscle and/or tendons may have caused this person to have foot drop during the swing phase of walking, as well as causing unexpected problems for surgeons who use EDL tendons for grafts.

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Introduction

During routine dissection in the gross anatomy course, the author was called to confirm the absence of the right extensor digitorum longus (EDL) muscle in a 49-year-old Caucasian male who died of pneumonia. Once confirmed, the author also noted the left foot had only a single EDL tendon to the fifth toe. Further dissection by the author revealed other tendon variations. During the dissection of almost 1,400 cadavers, this was the first time these variations were seen.

The EDL muscle is found in the anterior compartment of the leg and is the primary extensor of the second-fifth toes; it is innervated by the deep fibular nerve. The function of the EDL is assisted by the extensor digitorum brevis (EDB) muscle that sends tendons to the second-fourth toes. Much like the tibialis anterior and fibularis tertius muscles, the EDL functions to dorsiflex the foot and toes for ground clearance during the swing phase of walking [1]. The fibularis tertius tendon can be absent in up to 10% of the population, and it often appears to be part of the EDL where it has been described as its “fifth tendon” [2]. During surgical procedures, EDL tendons can be used for tendon grafts [3]. Although its presence has not been questioned by surgeons, its potential absence could

present a surgical hindrance if EDL tendons are used for ankle stabilization.

Case Report

After the variants were discovered, the author verified there was no trauma or surgical interventions to the lower limbs. The author verified all lower limb muscles had a typical blood supply and innervation.

Figure 1 shows the right distal leg and foot variations. There was no muscle belly for the EDL in the anterior compartment of the leg, but the extensor hallucis longus and tibialis anterior muscles were present. The EDB was present, and its fifth toe tendon crossed superficial to the fourth toe tendon. All tendons of the EDB to the second-fifth toes had a normal insertion into the lateral aspect of the digital extensor expansion. The extensor hallucis brevis had a normal appearance and tendinous insertion. Although there were no EDL tendons, a fibularis tertius was present and the tendon crossed superficial to the EDB muscle belly to insert onto the base of the fifth metatarsal. There was a rare fibularis digiti minimi tendon slip (not shown) arising from the fibularis brevis [2]; it coursed deep to the tendon of the tibialis anterior

to insert into the lateral aspect of the fifth toe digital extensor expansion.

Figure 2 shows the left distal foot and leg variations. Unlike the right leg, a single EDL tendon arose from a small muscle belly that also gave rise to the fibularis tertius tendon. The EDL tendon had an unusual broad expansion to the head of the fifth metatarsal, and then terminated in the fifth toe digital extensor expansion and the middle and distal phalanges. The single EDL tendon crossed superficial to the EDB muscle and tendons, and was seen immediately lateral to the tendon for the fibularis tertius (white arrowhead). The EDB had no tendon to the fifth toe (which is the normal for this muscle), and the EDB tendons to the second-fourth toes entered the lateral digital extensor expansion. Unlike the right foot, the EDB had an additional long, thin muscle belly whose tendon inserted on the second toe. This fleshy belly (cut during the

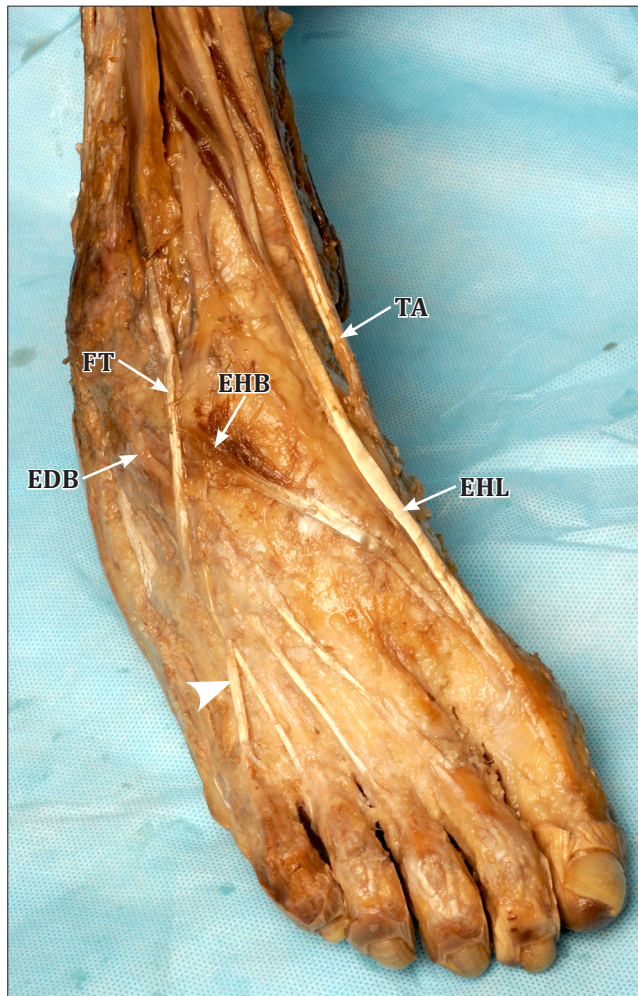


Figure 1. Muscle and tendon variants on the right distal leg and foot. The extensor digitorum longus is absent, but the *fibularis tertius* (FT) and *extensor hallucis longus* (EHL) are present. (TA: *tibialis anterior*; EDB: *extensor digitorum brevis*; white arrowhead: *unusual fifth toe EDB tendon*; EHB: *extensor hallucis brevis*)

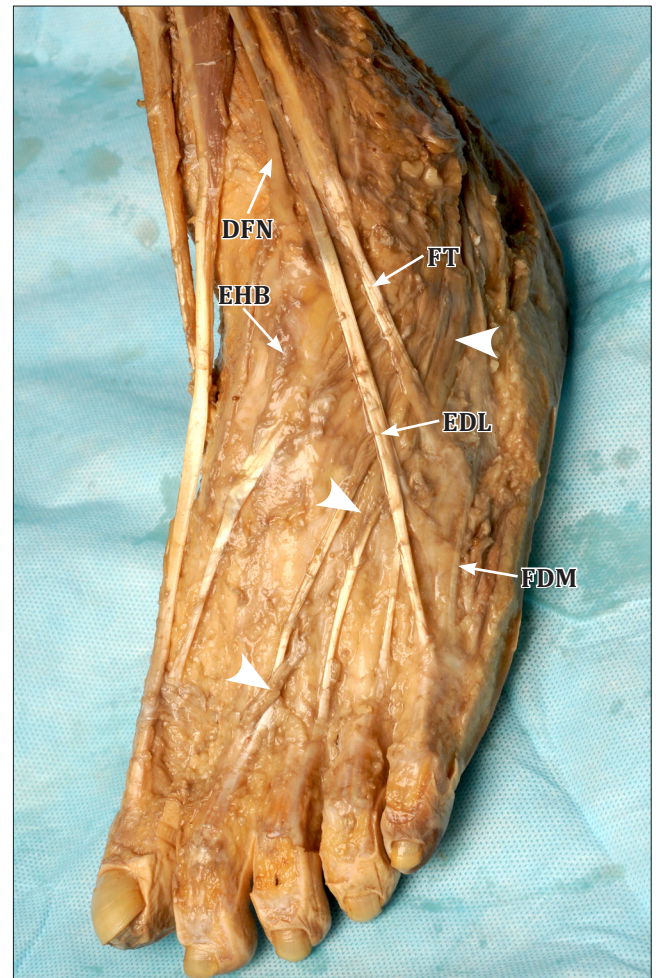


Figure 2. Muscle and tendon variants on the left distal leg and foot. There is a single *extensor digitorum longus* tendon to the fifth toe (EDL) as well as a *fibularis tertius* muscle (FT). (White arrowheads: *extensor digitorum brevis* with extra muscle belly to second toe; FDM: *fibularis digiti minimi*; EHB: *extensor hallucis brevis*; DFN: *deep fibular nerve*)

initial student dissection) crossed superficial to the other EDB tendon to the second toe. The *extensor hallucis longus*, *extensor hallucis brevis* and the *tibialis anterior* muscles were present and had normal tendinous insertion points. Like the right foot, there was a *fibularis digiti minimi* tendon slip arising from the *fibularis brevis*. A portion of the deep fibular nerve is shown.

Discussion

There have been previous reports of EDL variations; duplication of the tendon to the second and fifth toes, or the absence of the fourth and/or fifth toe tendons [4, 5]. Sarrafian [6] reports EDL tendons to the toes may be bifid and insert on adjacent toes. None of the above studies described the variations for the EDL muscle and tendons mentioned in this report. Despite the rarity of absent EDL tendons, the absence

of an EDB tendon is not uncommon [2]. Although the normal EDB muscle has no tendon to the fifth toe, this individual did on the right foot, and its unique course crossed superficial to the fourth toe EDB tendon. In addition, the left EDB sent two tendons to the second toe with the fleshy muscle belly crossing over the other second toe tendon.

There are reports of bilateral flexor digitorum longus muscle absence in the posterior compartment of the leg [7], but none regarding the absence of an EDL muscle. Recently, the unilateral absence of a fibularis tertius muscle has been reported [8]. One possible explanation for the unilateral absence of a muscle would be the interruption of the blood supply to the developing muscle. However, the anterior tibial arteries were of normal size and had typical distribution patterns in the anterior compartment of each leg.

The absence of the EDL muscle or its tendons could have hampered dorsiflexion of the foot during the swing phase of walking. Since the author has no knowledge of the man's medical history, it is unknown if he had a foot-drop during his lifetime. It is quite likely the tibialis anterior may have partially compensated for the lack of EDL tendons, or that the EDB assumed the function of the absent EDL tendons. However, the EDB muscles were of normal size when compared to EDB muscles observed in numerous other cadavers. Therefore, if the EDB did assume the function of the absent EDL tendons, there was no evidence of compensatory EDB hypertrophy.

These unique variations, especially for the EDL, should be added to the compendium of variants to be anticipated by

foot and ankle surgeons. The absence of EDL tendons would compromise the ability of a surgeon who intended on using these tendons for correcting ligament tears [3].

Acknowledgments

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