

Two-headed extensor digitorum longus with coexisting additional tendinous slips

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The extensor digitorum longus is a source of much anatomic variation, mostly related with extra tendinous slips or their unusual insertions. This report describes a new configuration of the extensor digitorum longus with two heads and two main tendons which bifurcate into five slips. These slips undergo further divisions and establish connections between the each other. Our findings provide a greater insight into the intricacies of human morphology. (Folia Morphol 2024; 83, 1: 231–234)

Keywords: extensor digitorum longus, double-head, variation, variant, tendinous slip, additional tendon, muscle belly

INTRODUCTION

Together with the extensor hallucis longus (EHL), tibialis anterior and fibularis tertius muscles, the extensor digitorum longus (EDL) is a muscle that constitutes the anterior compartment of the leg. It takes its origins at the inferior surface of the tibial lateral condyle and the proximomedial part of the fibula and three membranes: the anterior interosseous membrane, the deep fascia of the leg and the anterior intermuscular septum. The course of the EDL to the distal part of the lower limb takes it under the superior extensor then inside the inferior extensor retinaculum alongside the fibularis tertius. As it passes under the superior extensor retinaculum, the EDL typically splits into the two tendons, both of which subsequently divide into two final slips which reach the second and the third phalanges of the second, third, fourth and fifth toes. The tendons to the third, fourth and fifth toes fuse on their lateral side with the slips from the extensor digitorum brevis [7].

The EDL is supplied by the anterior tibial artery, and its distal part by branches deriving from the fibular artery. The innervation is provided by the deep fibular nerve. The main functions of the mus-

cle are to extend the toes and allow dorsiflexion of the foot.

The present case illustrates a constellation of different morphological variants of the EDL, in which the presence of an atypical muscle belly is accompanied by fusions between the EDL tendons after their bifurcation.

CASE REPORT

A female body donor was admitted to the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland for scientific and didactic purposes. A routine anatomical dissection of the right lower limb was performed. It revealed a two-headed variant of the EDL with the tendinous connections in its distal part. The further steps of the case assessment include detailed measurements, characterization and photography.

The EDL originated in a typical manner from the anterolateral aspect of the proximal tibia and consisted of upper and lower bellies. The length of the upper belly was 127.59 mm. The width of its myotendinous junction was 6.85 mm and the thickness 1.3 mm. The length of the tendon from the point of junction

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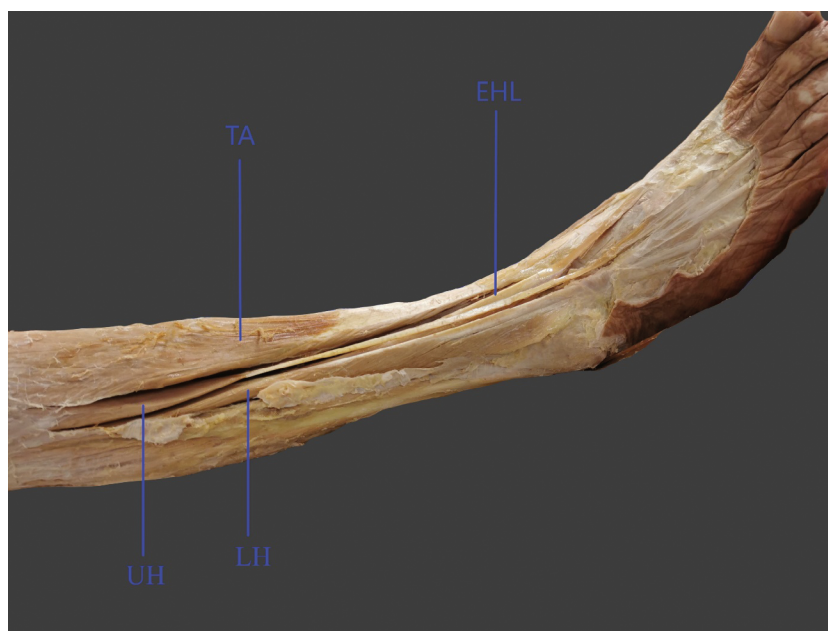


Figure 1. The lower limb before the distal dissection; TA — tibialis anterior; EHL — extensor hallucis longus; UH — upper head of the extensor digitorum longus; LH — lower head of the extensor digitorum longus.

to its bifurcation was 232.94 mm. After bifurcation, the tendons reached the second and the third digits with respective lengths of 74.95 mm and 69.92 mm.

The length of the lower belly was 140.90 mm. Its myotendinous junction was 4.97 mm wide and 1.91 mm thick. The tendon was found to be 153.86 mm long at its division, which split it into the three parts. The first slip was the most medial part. It was 35.62 mm in length. It divided into its two terminal parts, i.e. medial and lateral, which both fused with the tendinous slip to the third digit of the upper head's tendon. The medial part was 32.65 mm long and the lateral part 66.66 mm long. The length of the common part after the fusion of the three tendons was 40.31 mm, and it reached the third digit.

The second slip from the lower head's tendon reached the fourth digit and was 124.62 mm in length. Similarly, the third and the most lateral slip was 100.74 mm long and inserted the fifth digit (Figs. 1–3).

Ethical approval and consent to participate

The study protocol was accepted by the Bioethics Committee of the Medical University of Lodz. The cadavers were the property of the Department of Anatomical Dissection and Donation, Medical University of Lodz. Informed consent was obtained from all participants before they died.

DISCUSSION

The typical anatomical variations related to the EDL are present in its slips, which demonstrate variable numbers, points of insertion and fusions within the EDL or with the surrounding structures. The duplicated slip may reach the corresponding toe, creating a bifid tendon, or contribute to the adjacent toe. In some cases, it was found to insert to nearby muscles, such as the EHL, the fibularis tertius or the extensor digitorum brevis [9].

The tendinous division of the EDL may extend sufficiently proximally to divide it into the smaller, separate muscles. In the most pronounced form, the toes from the second to the fifth are all supplied by individual small muscles instead of a large, singular extensor [2].

The EDL has been reported to receive a contribution from the other muscles but also to give off its own accessory slips. Węgiel et al. [10] describe an accessory, tendinous band of the EDL which originated from its proximal part and fused with the distal part of the EHL; this was accompanied by the presence of an additional tendon deriving from the EHL and inserting the dorsal surface of the first proximal phalanx.

Tezer and Cicekcibasi [8] reported a case of an extensor digiti secundus muscle which originated from the EHL and bifurcated into two slips. The smaller,

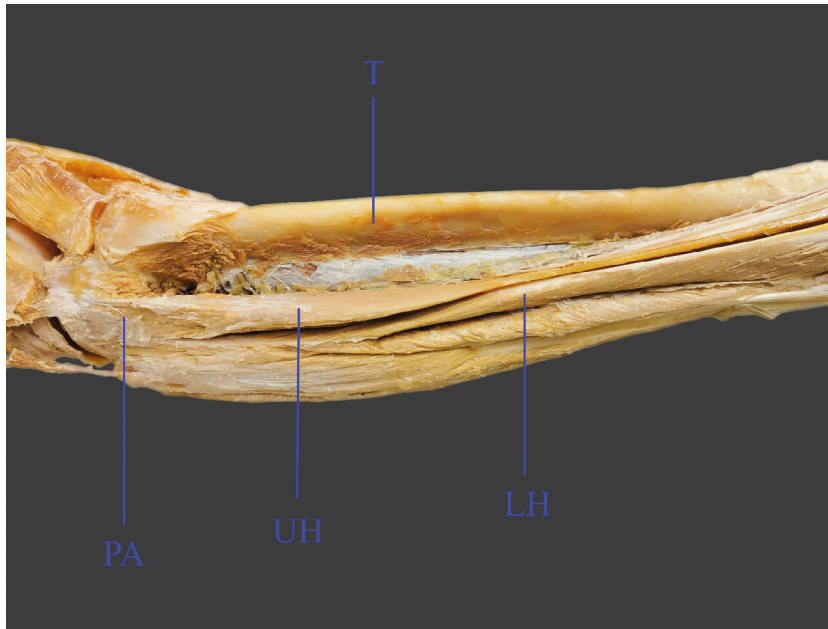


Figure 2. The proximal part of the lower limb; T — tibial shaft; PA — proximal attachment of the extensor digitorum longus; UH — upper head of the extensor digitorum longus; LH — lower head of the extensor digitorum longus.

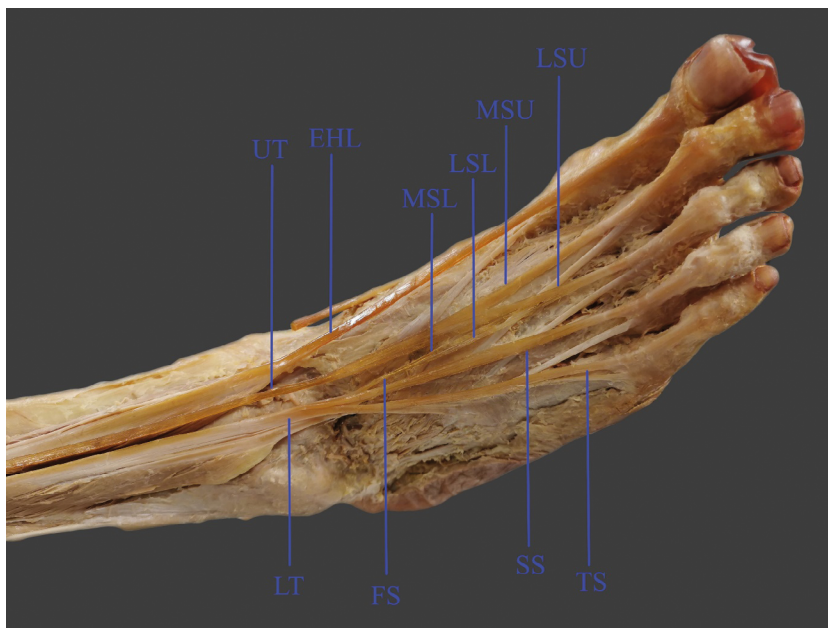


Figure 3. The distal part of the lower limb; UT — upper tendon of the extensor digitorum longus; EHL — extensor hallucis longus; MSL — medial slip of the lower tendon; LSL — lateral slip of the lower tendon; MSU — medial slip of the upper tendon; LSU — lateral slip of the upper tendon; LT — lower tendon of the extensor digitorum longus; FS — first slip; SS — second slip; TS — third slip.

medial slip fused with the tendon of the EHL, while the lateral slip merged with the second toe tendon of the EDL.

Typically, the EDL reaches the phalanges from the second to the fifth toe. However, it is possible that one of the tendons may be absent [6], in which case,

the role of the toe extensor can be performed singularly by the extensor digitorum brevis. If the absence refers only to the fifth digit, the missing tendon can be replaced by the accessory muscle, the peroneus quinti digiti, which arises with the fibularis tertius from the common muscle belly [9].

Table 1. The measurements of the presented case

Structure	Value
The upper head of the EDL	
Belly	127.59
Myotendinous junction width	6.85
Myotendinous junction thickness	1.3
Tendon	232.94
The medial slip	74.95
The lateral slip	69.92
The lower head of the EDL	
Belly	140.90
Myotendinous junction width	4.97
Myotendinous junction thickness	1.91
Tendon	153.86
The first slip	35.62
The medial slip	32.65
The lateral slip	66.66
The common tendon	40.31
The second slip	124.62
The third slip	100.74

EDL — extensor digitorum longus

The presence of an additional muscle belly is an unusual finding among the muscles of the anterior compartment of the leg; however, it is not limited only to the EDL. Ruzik et al. [5] present an EHL muscle with two heads (upper and lower), each of which with its own innervating branch: the tendon from the main belly inserted the distal phalanx of the hallux while the accessory tendon was located medially and reached the proximal phalanx of the same toe.

The muscles of the anterior compartment can be sometimes accompanied by supernumerary accessory muscles. Plochocki and Bodeen [4] reported the presence of an accessory fibularis tertius which originated from the shaft of fibula and inserted to the fibular diaphysis and the anterior interosseous membrane. This muscle is also known as the fibularis (peroneus) quartus. Its occurrence varies from 3% up to 21.7% of specimens [1].

Typically, the fibularis tertius takes its origin at the distal half of the fibula and the intermuscular septum, or at their distal third. However, in some cases, the muscular fibres of the fibularis tertius merge with the

EDL belly, and it arises directly from the tendon of the EDL as an independent tendon with no separate muscle belly. This variant was found in 11% of the lower limbs and can be classified as type 3 according to Olewnik [3].

CONCLUSIONS

Despite the many years of refinement of anatomical classifications, the results of dissection still have the potential to surprise. The presented variant is a rare finding which expands our knowledge about the structure of the lower limb and is an important example of a complex pattern of the tendons and their connections within the same muscle.

Conflict of interest: None declared

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