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## **An accessory slip of the fibularis tertius to the extensor digitorum longus – an unreported variant**

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## CASE REPORT

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Andrzej Węgiel et al., An unreported variant of fibularis tertius

### **An accessory slip of the fibularis tertius to the extensor digitorum longus — an unreported variant**

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## **ABSTRACT**

The fibularis tertius (FT) is one of three muscles which constitute the anterior compartment of the leg. The anatomical variants of this muscle usually pertain to its origins, number of final tendons or points and shapes of insertions. In this case, it had an additional slip (AS) which originated from the same area as the main muscle belly and after descending along the extensor digitorum longus (EDL) it fused with one of its main tendons. The main muscle belly and its tendon, in its usual manner, reached the proximal dorsal surface of the fifth metatarsal bone. To our knowledge, no similar case had been described before. This case reveals that human anatomy, though it may be thoroughly described, can still be a surprise and a vast field for new discoveries. Knowledge about these variants is important from both the scientific and clinical points of view.

**Keywords:** fibularis tertius, variant, accessory slip, extensor digitorum longus, tendon, lower limb

## **INTRODUCTION**

The fibularis tertius (FT) is a muscle located in the anterolateral aspect of the leg. Together with the extensor hallucis longus (EHL) muscle and the extensor digitorum longus (EDL) muscle it constitutes its anterior compartment. The muscle usually originates at the level of the distal half or the distal third of the fibula from its shaft and interosseous membrane but some fibers may also arise from the anterior intermuscular septum [7, 10]. Thereafter, the FT descends laterally to the EDL running within the superior and inferior extensor retinacula. In the most common variant, the single distal attachment of the FT inserts onto the base of the fifth metatarsal on the medial part of its dorsal surface.

The muscle can be completely absent or its size can be similar to that of the EDL [12]. Its prevalence in adult specimens is estimated to be 93.2% in cadaveric studies and approximately 80% in clinical studies. This difference is presumably caused by a close relationship between the FT and the EDL. The FDL can be easily considered a segment of the EDL, not a separate muscle [10]. These numbers vary depending on the region and are highest in Japan and South America (95% and 97% respectively) and lowest in Africa and China (90% and 89%).

The FT works together with the EDL and the EHL during dorsiflexion of the foot and supports the fibularis longus and fibularis brevis muscles in foot eversion. The main function of the FT is to enhance the effectiveness of bipedal locomotion [10].

The muscle is innervated by the deep branch of the fibular nerve. Its blood support comes from the branches of the anterior tibial artery and the perforating branch of the fibular artery. More distally, at the level of the foot, it is supplied by the arcuate and the fourth dorsal metatarsal arteries [5, 10].

## **CASE REPORT**

A female body donor was admitted to the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland and underwent a routine procedure of

examination for didactic and scientific purposes including the skin and the subcutaneous tissue removal, muscle separation and exposure of the tendons. The cadaver was preserved in 10% formaldehyde solution. During the dissection of the lower limb the accessory muscle slip (AS) was spotted. In subsequent steps, the lower limb was prepared for an assessment; measurements and high-quality photos were taken.

The FT consisted of two parts: the main muscle belly with its own tendon and the AS consisting of the muscular and tendinous segments (Fig. 1).

The main part of the muscle originated on the lower 1/3 portion of the shaft of fibula from the anterior intermuscular septum laterally and the interosseous membrane medially. It revealed a close relationship to the adjacent EHL. The initial portion of the muscle was fibrous and progressively morphed into muscular fibers. The thickness of the fibrous part was 0.54 mm. The length of the muscle belly was 145.54 mm. The muscle descended separately from the EDL in the manner typical for the FT, under the superior extensor retinaculum and within the inferior extensor retinaculum. The length of the tendon was 53.1 mm. The width of the myotendinous junction was 2.05 mm and its thickness was 0.97 mm. Eventually, the FT inserted into the proximal dorsal surface of the fifth metatarsal bone ending in a shape of a fan with the thickness of 0.73 mm and the width of 9.25 mm. The insertion consisted of numerous small, tightly adhering slips with fibrous tissue between them.

The AS originated from the anterior intermuscular septum and was located superficially to the main belly. Its initial part was a 0.23 mm thick fibrous band which next passed into a muscle belly of 110.64 mm long (Fig 2). The myotendinous junction was 1.65 mm wide and 0.51 mm thick. The EDL had two main tendons: the medial and the lateral ones. Both of them consecutively split into two terminal slips which reached their respective digits. The tendon of the AS headed collaterally to the EDL and inserted into the posterior side of its lateral tendon. The length of the tendon of the AS was 17.13 mm. At its end, it was 0.46 mm wide and 0.63 mm thick (Tab. 1).

## **DISCUSSION**

The FT presents a highly variable morphology. Yet, some of its aspects have not been fully explained.

One of the most important aspects of the FT anatomy is its relation with the EDL. In most cases, the FT originates from the fibula or adjacent fibrous structures. However, it is also known to start its course directly from the EDL [17]. Some even consider the FT a part of the EDL and its fifth tendon due to the fact that these two are often practically inseparable [2, 4, 10]. In a study by Jadhav et al. [3], the EDL, being clearly distinct from the FT, was found in 80% of cases.

Due to a synergistic character of dorsiflexion and eversion of a foot, the FT can be utilized without serious repercussions in muscle flap transpositions, tendinoplasties, resections or in reconstructive procedures by orthopedic or plastic surgeons. It is also used in correction of ankle joint ligamentous laxity and in treatment of claw foot deformity [7, 18].

Accessory heads are not common among muscles of the anterior compartment of the leg. However, there were reports confirming their presence. Ruzik et al. [9] discovered the case of double-headed EHL. The additional tendon inserted medially to the main one on the dorsal surface of the proximal phalanx of the hallux. Węgiel et al. [14] described a case of a two-headed variant of the EDL with an equivalent tendon arising from both of them. The tendons further split into smaller ones that reached the proper digits and gave origins to additional slips making connections between the terminal tendons. Besides, the FT was found to have additional heads [12]. In a study by Mehta et al. [6], two heads fused together giving off one mutual tendon. Other studies [1, 11] revealed that the EDL directly connects with the FT either with a contributory slip or an intertendinous connection.

In variant with the absent FT, it is replaced by an additional slip deriving from the EDL. It is presumably an adaptative structure [4]. In 95% of cases, the absence can be associated with the occurrence of one of two accessory muscles: the fibularis digiti minimi or the fibularis quartus muscles [16, 17]. Lack of the FT does not affect the foot function. It was not evidenced that such absence predisposes to more frequent ankle ligament injuries. Furthermore, the strength of the eversion and dorsiflexion is the same as in the subjects with the FT [15]. However, it would be advisable to reevaluate these data due to the fact that there is a considerable difference regarding the FT prevalence between clinical and anatomical studies. Some specimens with a close connection between the EDL and the FT could be misinterpreted and regarded as if the FT was absent, especially when its presence was confirmed in a palpation examination [17]. For that reason, some of the subjects could have been qualified to the wrong group, which disrupted the data.

The FT ends its course with a single or a bifurcated attachment inserting mainly onto the base or the shaft of the fifth metatarsal bone. But it can also reach the fourth interosseous membrane, the base of the fourth metatarsal bone, the head of the fifth metatarsal bone or the fifth proximal phalanx [7, 12, 17]. The FT was reported to connect with the most lateral, terminal tendon of the EDL which reaches the fifth digit or to replace it completely [8, 13]. There are reports on a type where the FT fuses with the tendon of the fibularis brevis muscle [7].

The shape of the insertion of the FT can occur in two variants: fan-shaped, in which the insertion is at least twice the width of the tendon and band-shaped, characterized with the insertion which less than twice the width of the tendon. Wider end attachment may presumably result in stronger foot eversion action [7, 17].

## **CONCLUSIONS**

Many of the variants of the FT have already been described. However, this topic still needs extensive research as still many discoveries are waiting to be made. This case is an example of a previously unreported variant of a separate FT merging with the EDL tendon. Not only anatomy professionals but also practicing surgeons and radiologists should be knowledgeable of detailed foot anatomy.

## **ARTICLE INFORMATION AND DECLARATIONS**

### **Ethics statement**

The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz.

### **Authors' contributions**

Andrzej Węgiel — project development, data collection and management, data analysis and manuscript writing. Nicol Zielinska — data analysis and manuscript editing. Krystian Maślanka — manuscript editing. Konrad Kurtys — data collection. Łukasz Olewnik — data analysis and management, manuscript editing.

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## **Conflict of interest**

The authors declare that they have no competing interests.

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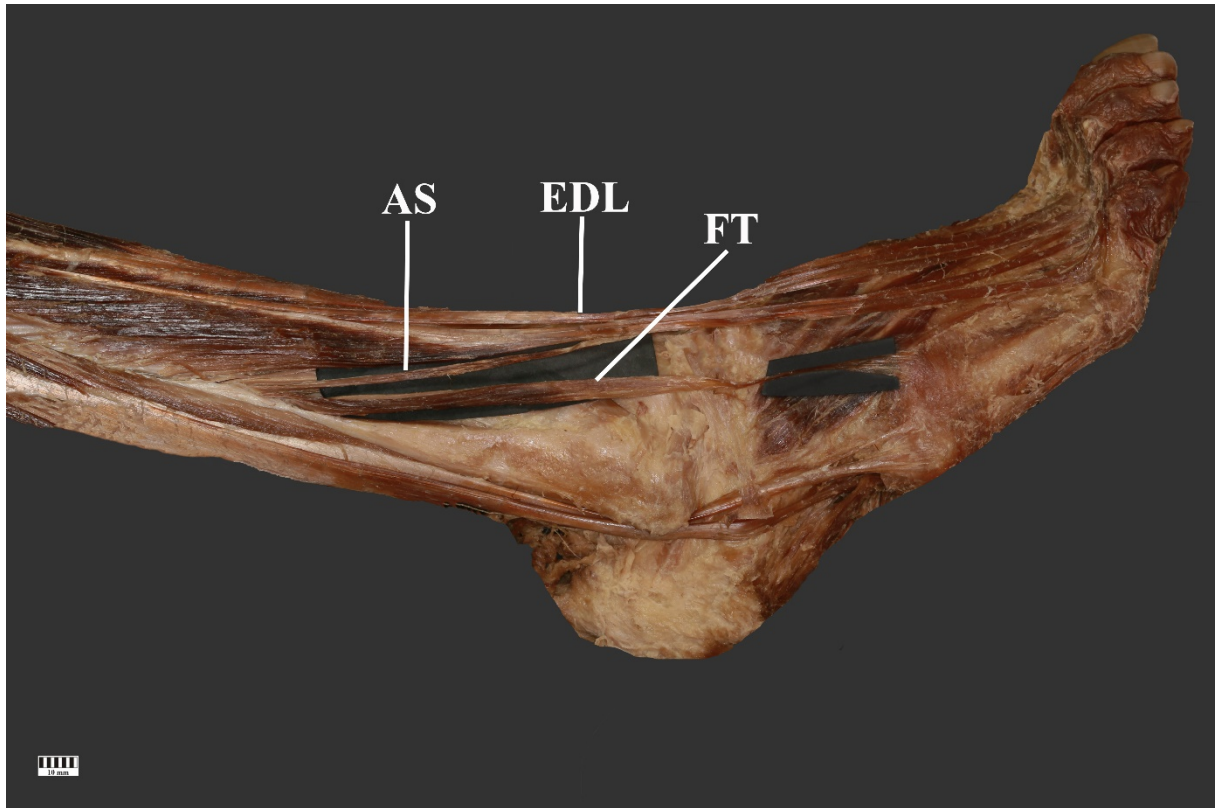
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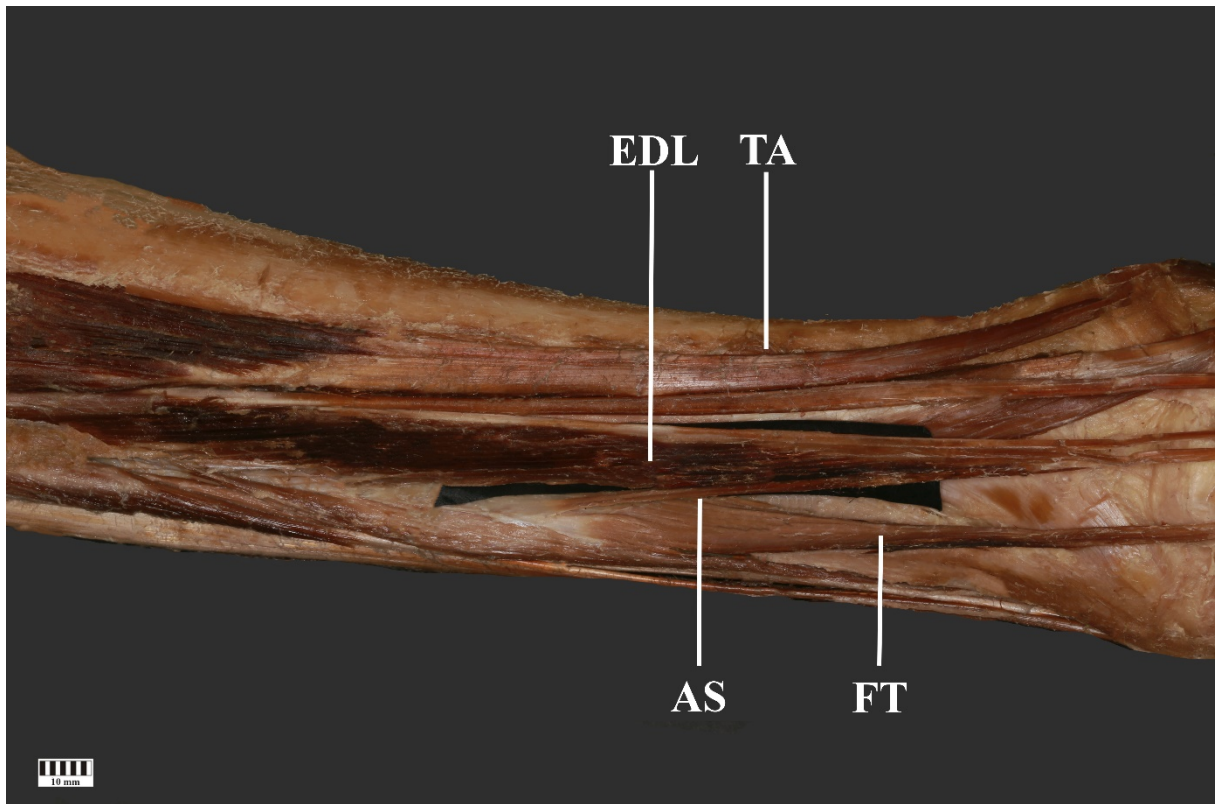


<b>The structure</b>	<b>Value [mm]</b>
Belly length	<b>145.54</b>
Tendon length	<b>53.1</b>
Miotendinous junction	
Width	<b>2.05</b>
Thickness	<b>0.97</b>
Insertion	
Width	<b>9.25</b>
Thickness	<b>0.73</b>
Origins	
Thickness	<b>0.54</b>
<b>The accessory slip</b>	
Belly length	<b>110.64</b>
Tendon length	<b>17.13</b>
Miotendinous junction	
Width	<b>1.65</b>
Thickness	<b>0.51</b>
Insertion	
Width	<b>0.46</b>
Thickness	<b>0.63</b>
Origins	
Thickness	<b>0.23</b>

**Table 1.** Measurements of the presented case.



**Figure 1.** FT with the adjacent muscles. AS — accessory slip of the fibularis tertius muscle; EDL — extensor digitorum longus muscle; FT — fibularis tertius muscle.



**Figure 2.** Proximal part of the FT. AS — accessory slip of the fibularis tertius muscle; EDL — extensor digitorum longus muscle; FT — fibularis tertius muscle; TA —tibialis anterior muscle.