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CASE REPORT

# ANATOMICO-CLINICAL INSIGHTS FROM A RARE UNILATERAL BIFURCATION OF THE FIBULARIS BREVIS TENDON: A DISSECTION REPORT WITH A PROPOSAL TO IMPROVE THE CLASSIFICATION SYSTEM

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***Abstract.*** *The lateral compartment of the foot encompasses two muscles: the fibularis brevis and fibularis longus (FB and FL). The FB originates from the distal two-thirds of the fibula in conjunction with the adjacent intramuscular septa. Variations concerning the origin, number of muscle bellies, and insertions of the FB have been frequently documented. However, bifurcation of the fibularis brevis tendon (FBT) represents a rare variant seldom described in the literature. The present dissection report details a rare occurrence of a FBT bifurcation. Following the passage beneath the inferior fibular retinaculum, the tendon bifurcates into a superior and an inferior slip. The superior slip is inserted into the fifth metatarsal base, while the inferior slip extends anteriorly and attaches to the extensor aponeurosis of the fifth toe. Such variations in the course and insertion of the FBT are of clinical significance, given the frequent involvement of this tendon in ankle injuries and its critical role in reconstructive surgery. Consequently, medical professionals need a comprehensive understanding of potential variants in the origin, trajectory, and insertion of the FB and its tendon.*

***Key words:*** *fibularis brevis muscle, tendon, bifurcation, variation, significance, classification*

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## INTRODUCTION

The fibularis (or peroneus) brevis muscle (FB) is one of two muscles in the lateral foot compartment. It is a slender muscle originating from the distal two-thirds of the lateral fibula and the anterior and posterior crural intermuscular septa, positioned anterior to the fibularis longus muscle (FL). The FB runs vertically downwards, transitioning into a tendon (FBT) that travels laterally and inferiorly to the lateral malleolus, anterior to the FL tendon (FLT). Wrapped in a common synovial sheath, FBT and FLT pass beneath the superior fibular retinaculum. The FBT then continues along the lateral aspect of the calcaneus,

superior to the fibular trochlea, and inserts into the fifth metatarsal (bone) tuberosity base (5th MTB) [1]. The FBT is a key structure in the lateral leg compartment that plays a significant role in foot mechanics, particularly in eversion and ankle stabilization [1].

Muscle variants in the human body are common, often involving aberrant slips, accessory muscle bellies, and variant origins or insertions [2, 3]. Several literature reports have documented variants in FBT insertion [4-6], including FBT bifurcation or trifurcation [4, 6-8]. Therefore, the present dissection report aims to present a rare unilateral FBT bifurcation with proximal and distal insertions of its slips, emphasizing the clinical relevance of FB and FBT variants.

## CASE PRESENTATION

An interesting muscle variant was identified during a standard dissection of the left foot of a 75-year-old male cadaver. The cadaver was donated to the Anatomy, Histology, and Embryology Department at the Medical University of Sofia after signed informed consent. The dissection, performed for educational purposes in the Anatomy Department, was approved by the Medico-Legal Office and the local Ethics Committee.

A FBT bifurcation was identified in the left foot. After carefully dissecting and removing the surrounding adipose tissue, the entire course and insertion of the FBT became visible. Following its course through the inferior FR, the FBT split into superior and inferior slips (SS and IS). The SS was traced to its insertion at the 5th MTB (typical insertion). The IS extended beyond the 5th MTB, body, and head, ultimately inserting into the extensor aponeurosis of the fifth toe (distal insertion) (Fig. 1). No other variants were observed in the left foot. The contralateral (right) foot examination showed a standard anatomical configuration, with no abnormalities in the origin, course, or insertion of the FB or FBT. The cadaver's medical history revealed no evidence of prior surgical intervention on the lower limbs, and no surgical scars were observed before the dissection.

## DISCUSSION

The fibularis muscle is recognized for its significant variability, as numerous reports describe the presence of accessory bands and muscles, such as the fibularis tertius (FT), quartus (FQ), and digiti quinti (FDQ) [9-12]. In particular, the FBT can show several clinically significant variants, especially regarding foot biomechanics, injury susceptibility, and surgical planning. These variants may influence the tendon's structure, insertion, or relationship with nearby anatomical features [13]. Ordinarily, the FBT inserts into the 5th MTB. However, multiple reports document deviations in the FBT insertion points, including insertion into the dorsum of the 5th MTB, the 4th dorsal interosseous muscle, or attachment to the flexor digiti minimi brevis [4-6]. Inserting at a higher point (closer to the 5th MTB) could change the mechanical advantage for foot eversion and may influence surgical approaches for 5th metatarsal fractures. The FBT insertion may be broader into the 5th MTB in some individuals and narrower and cord-like in others. Broader insertions might offer more stability, while narrower ones could heighten the risk of avulsion fractures [13].

More infrequent reports highlight FBT bifurcation or even trifurcation into accessory slips (AS) [7, 11, 14]. The FBT AS may be inserted into other bones, such as the 4th metatarsal or cuboid bone. These slips can alter the foot biomechanics, potentially affecting eversion strength or leading to pain syndromes [13]. Macalister described a case in which the FBT was bifurcated, with one AS adhering to the abductor digiti minimi and the other merging with the flexor hallucis longus tendon [7]. Humphry provided a distinctive case of FBT bifurcation,


**Fig. 1.** Photograph (**a**) and scheme (**b**) of the bifurcated tendon of the fibularis brevis muscle of the left foot. Black arrowhead–variant tendon

wherein one AS was inserted onto the outer edge of the 5th MTB. At the same time, another was attached to the proximal phalanges, with an accessory slip originating from the 2nd metatarsal and merging with the extensor digiti minimi tendon [15].

It is essential to recognize that the reports by Humphry [7] were produced during a time when variants were mainly recorded, with photographs and schematic drawings seldom used. Many of those created have not been preserved adequately quality. Verma et al. documented an FBT bifurcation proximal to its insertion, with two slips attaching to the medial and lateral aspects of the 5th MTB [16]. Rosser et al. described the presence of two bilateral accessory tendons inserted into the fifth metatarsal shaft and neck [14].

The FQ is one of the most common variants associated with the FBT. It originates from the fibula and can be inserted into the retrotrochlear eminence of the calcaneus, the cuboid bone, or other peroneal tendons. This may cause crowding in the retromalleolar groove, leading to tendon subluxation or tears due to increased friction [13].

## FBT VARIANT CLASSIFICATIONS

The FBT can be classified according to various anatomical criteria, emphasizing changes in its insertion site, tendon morphology, relationships with surrounding structures, and accessory muscles. These classifications are crucial for clinicians, particularly when diagnosing lateral ankle pain, planning surgeries, or interpreting imaging. Musial proposed a four-type classification (I-IV) based on the FBT insertion points and the number of tendinous slips. Type I represents the standard morphology (single tendon) with the most prevalent insertion point – the 5th MTB. Type II involves FBT bifurcation (split tendon), with the AS inserted into the dorsal fascia of the foot. Type III depicts bifurcation, yet in this instance, the accessory slip attaches to the extensor aponeurosis, as evidenced in the present report. Type IV describes an FBT trifurcation, with one slip inserted into the 5th MTB, a second into the dorsal fascia, and a third into the extensor aponeurosis. In our perspective, the Musial classification fails to encompass the variation described by Humphry, which may be proposed as a Type V.

A more recent and comprehensive classification of FBT variants (2 types and three subtypes) was proposed by Olewnik et al. [11] and consisted of two primary types. Type I describes the standard FBT insertion into the 5th MTB. Type II is further subdivided into three subtypes (A-C): subtype A, where an accessory band inserts onto the dorsal surface of the 5th MTB; subtype B, where the accessory band bifurcates into medial and lateral slips, which further insert into the middle part of the shaft and the 5th MTB, respectively; and subtype C, where the accessory band divides into a medial and lateral slips, with the medial slip merging with the FT and the lateral slip inserting onto the dorsal surface of the 5th MTB [11]. Similar to Musial's classification, the case described by Humphry is not included in this system and could be considered subtype 2D.

Zielinska et al. [8] expanded the classification of FBT variants proposed by Olewnik et al. [11] by adding more types and subtypes. Type I describes a single FBT attaching to the 5th MTB. Type II refers to a double FBT where the main tendon inserts into the 5th MTB and is further divided into subtypes based on the insertion of the 2nd tendon. In Subtype IIB, the AFBT is inserted into the dorsal part of the 5th MTB, while in Subtype IIB, the AFBT is inserted into the dorsal part of the 5th metatarsal shaft dorsal part (5th MSD). Subtype IIC involved the AFBT inserting into the 4th interosseous space's fascia; in Subtype IID, the AFBT joins the FLT. In Subtype IIE, the AFBT attaches to the extensor aponeurosis of the 5th digit, as described in the present report. Type III is a double FBT with a branching accessory tendon (AT). In this case, the main tendon inserts into the 5th MTB, and the AT splits into two slips. One slip attaches to the dorsal part of the 5th MTB, and in subtype IIIA, the second slip attaches to the medial part of the 5th metatarsal shaft medial part (5th MSM). Subtype IIIB is characterized by the second slip fusing with the FTT. Type IV refers to a triple FBT. The main tendon attaches to the 5th MTB.

In contrast, one of the two secondary tendons attaches to the fascia, covering the four-hip intercostal space. Two subtypes are identified based on the location of the distal attachment of the 2nd AFBT. In Subtype IVA, the 2nd AFBT attaches to the proximal part of the 5th metatarsal shaft. In contrast, in Subtype IVB, the 2nd AFBT attaches to the extensor aponeurosis of the 5th digit [8]. The bifurcation case described by Humphry, where one slip of the FBT inserts into the outer edge of the 5th MTB, and another slip attaches to the proximal phalanges, with an additional slip originating from the second slip and merging with the extensor digiti minimi tendon (EDMT), was not included in this classification. It could potentially be added as a subtype IVC.

Regarding the FBT's relationship with surrounding structures, typically, the FBT lies anterior to the FLT. However, variations may lead to intertwining or positional swapping of these tendons. An abnormal relationship with the FLT can complicate surgical procedures, such as tendon repairs or re-

constructions. Additionally, a more proximal musculotendinous junction of the FB may predispose individuals to a reduced stabilizing effect of muscle against the posterior lateral surface of the fibula, thereby increasing the likelihood of anterolateral subluxation, attrition, and the development of longitudinal tears [17].

The FB holds significant clinical importance despite its anatomical appearance due to its role in everting the foot and limiting inversion [1]. By maintaining foot posture, the FB helps to prevent excessive inversion while providing eversion, which reduces strain on the lateral talocalcaneal, lateral interosseous talocalcaneal, and calcaneofibular ligaments. This function is particularly critical when walking or running on uneven surfaces [1, 18]. Injuries to the FB or FBT are frequently misdiagnosed [19, 20], and damage to the FBT can lead to chronic ankle pain, instability, recurrent ankle sprains, and fractures [20, 21]. The FBM's rich vascularization makes it a valuable donor site for muscle flaps in reconstructive surgeries, especially in traumatic foot injuries [22].

## CONCLUSION

The FB, with its tendon, is one of the two muscles located in the lateral foot compartment and plays a crucial role in foot eversion and support. The present case report documents a rare anatomical variant of the FB tendon and offers an extensive review of its various presentations and classification schemes. This study aims to enhance the current understanding of these uncommon morphological variations. A comprehensive understanding of the variations in FB origin and insertion is essential for various medical specialties, including orthopedic and trauma surgeons, radiologists, and rehabilitation specialists. We hope our proposal to expand the existing classifications will enhance the knowledge surrounding this important muscle.

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