



Insertional Characteristics of the Peroneus Tertius Tendon: Revisiting the Anatomy of an Underestimated Muscle



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ABSTRACT

The present study was performed to describe the morphologic characteristics of the peroneus tertius (PT) tendon, evaluate the variations in its insertion point, investigate the interconnections with the tendons of the extensor digitorum longus, and discuss whether these insertion differences of the muscle tension might have an effect on fracture formation. The length and width of the PT tendon and the width at its midpoint were measured in 44 lower extremities. The data obtained were compared statistically. The PT was found to occur in 2 types according to the number of tendons: type 1, a single tendon without a slip; and type 2, 2 tendons with a slip. It has been suggested that the PT tendon could contribute to avulsion fractures of the tuberosity of the fifth metatarsal bone. Therefore, to understand the mechanism of Jones fracture, knowledge of the PT tendon would be beneficial to determine the insertion points.

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The peroneus (fibularis) tertius (PT) shows differences among individuals regarding the muscle size, origin, and tendon configuration between the right and left feet (1). The PT is the part of the extensor digitorum longus muscle and is defined as the fifth tendon of this muscle (2,3). Werneck (4) reported that the PT did not exist in 4.4% of cases. The muscle fibers of the PT begins from the one-third distal part of the fibula or its upper part and the frontal surface of the part of the membrana interossea cruris, which shows adhesion to the fibula, and from the anterior intermuscular septum of the leg. The tendon passes through the ring of inferior extensor retinaculum by sharing with superior extensor retinaculum and extensor digitorum longus. It inserts into the medial part of the dorsal surface of the fifth metatarsal base. Therefore, it works as the dorsiflexor and evertor of the foot (1,2).

Eliot and Jungers (5) showed that the muscle was active solely in the swing phase of bipedal locomotion. Consistent with the tibialis anterior and extensor digitorum longus, it works to dorsiflex the foot without inverting it (5). Fracture of the base of the fifth metatarsal bone can occur in inversion injuries of the foot. This fracture was first described by Dr. Sir Jones in 1902, and the bone fracture in this

portion was termed the “Jones fracture” (6). Although the fracture is common and has been well demonstrated in previous studies, the insertion characteristics and the morphologic variations of the PT tendon have been underestimated in published studies. The present study was, therefore, performed to describe the morphologic characteristics of the PT tendon, evaluate the variations in its insertion point, investigate the interconnections between the tendons of the extensor digitorum longus, and discuss whether these insertion differences in muscle tension might have an effect on fracture formation.

Materials and Methods

The present study included a total 44 lower extremities from 17 cadavers (15 males, 2 females, aged 64 to 78 years; mean age 67 years) and 11 isolated lower extremities fixed with 10% formalin. The measurements were taken using a digital caliper. None of the cadavers showed any gross pathologic features or surgical procedures in the examined area. The morphology and insertion point of the PT tendon were studied in all the specimens. Each cadaver and cadaveric leg was placed supine, and the skin and subcutaneous fat over the feet were cut and removed completely through an incision along the tarsometatarsal joints on the dorsum of the feet. The superior and inferior extensor retinacula and PT tendons were exposed for additional measurements as follows: (1) width of the PT tendon at its insertion; (2) length of PT tendon from its musculotendinous junction to its insertion; and (3) width of the PT tendon at its midpoint. Next, the morphologic characteristics of the PT tendon were classified according to the number of tendons present and the insertion points.

Statistical analysis was performed using Student's *t* test to observe whether the differences correlated with the side, age, and/or gender of the specimens.

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Results

The mean ± standard deviation width of the insertion of the PT tendon on the right and left side measured 14.22 ± 3.19 mm and 15.69 ± 5.52 mm, respectively. The mean length of the tendon on the right and left measured 62.17 ± 8.65 mm and 57.66 ± 10.79 mm, respectively, and the width of the PT tendon at its midpoint measured 3.11 ± 1.18 mm on the right and 3.32 ± 1.32 mm on the left (Table 1).

Four different insertion characteristics of the PT tendon (Table 2) were observed:

1. Insertion at the base of the fifth metatarsal bone (in 23.8% of the specimens on the right and 31% on the left)
2. Insertion at the base of the fifth metatarsal bone and the fascia covering the fourth interosseous interval (in 11.9% of the specimens on the right and 4.8% on the left)
3. Base of the fourth metatarsal (in 9.9% of the specimens on the right and 2.4% on the left)
4. Other: insertion at the base and body of the fifth metatarsal, the base of the fifth metatarsal bone and its body, the fascia covering the fourth interosseous space and to the base of the fourth metatarsal bone, the body of the fifth metatarsal bone, the fascia covering the fourth interosseous space, and to the base of the fourth metatarsal bone (in 7.1% on the right and 9.5% on the left)

Accordingly, we have classified the tendon insertion points according to the number of tendons and insertion points as type 1 (single tendon without a slip) and type 2 (double tendon with a slip). Both types had 2 further subtypes (Table 3):

Type 1: Single tendon without a slip (Figs. 1 and 2)

Type 1a: Insertion to the base of the fifth metatarsal bone and/or to the fascia on the interosseous space and/or to the fascia on the fourth interosseous space

Type 1b: Insertion outside of the base of the fifth metatarsal bone (to the body of the fifth metatarsal or the fascia covering the fourth interosseous space or the base of the fourth metatarsal bone)

Type 2: Two tendons with slip a (Figs. 1 and 2)

Type 2a: The main tendon inserted at the base of the fifth metatarsal bone and a tendinous slip inserted at the fifth metatarsal bone (to the dorsal face of its corpus and/or its base)

Type 2b: The main tendon inserted at the base of the fifth metatarsal bone and a tendinous slip inserted at the base of the proximal phalanx of the fifth toe

Accordingly, 38 feet (86.4%) had type 1 and 4 (9.1%) had Type 2 (Table 3); the PT did not exist bilaterally in 1 of the cadavers (Fig. 3). Comparing the female and male groups, a statistically significant

Table 1
Mean, minimum, maximum, and standard deviation of the measurements

Side	Maximum (mm)	Minimum (mm)	Mean (mm)	SD (mm)
PTiw				
Right	20.48	9.06	14.22	3.19
Left	30.73	10.43	15.69	5.52
PTl				
Right	78.7	45.71	62.17	8.65
Left	82.83	39.9	57.66	10.79
PTtw				
Right	6.04	1.66	3.11	1.18
Left	7.11	2.13	3.32	1.32

Abbreviations: PTiw, width of peroneus tertius tendon at its insertion; PTl, length of peroneus tertius tendon measured from its musculotendinous junction to its insertion; PTtw, width of peroneus tertius tendon at its midpoint.

Table 2
Insertion points of peroneus tertius tendon

Insertion Point	Right (%)	Left (%)
B5MB	10 (23.8)	13 (31)
B5MB + FFIS	5 (11.9)	2 (4.8)
B5MB + FFIS + B4MB	4 (9.5)	1 (2.4)
Other	3 (7.1)	4 (9.5)

Abbreviations: B5MB, base of fifth metatarsal bone; FFIS, fascia covering fourth interosseous space; B4MB, base of fourth metatarsal bone.

difference was found for the left feet in the exact midpoint width of the PT tendon ($p = .04$) and in the length of the PT tendon on the right ($p = .011$). In addition, we observed intertendinous connections between the PT and extensor digitorum longus in 2 of the 44 extremities (1 right, 1 left) studied (Fig. 4).

Discussion

Wood Jones (6) referred to PT as a curiously human muscle. Although topographically it is intimately associated with the extensor digitorum longus in the leg, it is not a member of the superficial layer of extensor digitorum longus. In actuality, it is a proximally expatriated deep extensor digitorum brevis of the fifth toe (6). The PT demonstrates differences in muscle trunk size, origin, and tendon configuration and contributes to the dorsal flexion and eversion movements of the foot (1). Williams et al (7) and Romanes (8) defined PT as a part of the extensor digitorum longus. They also acknowledged that the PT was lost in the adhesion to the fifth toe and that it adhered to the fascia on the lateral side of the foot in variable structure but in a strong manner.

Williams et al (7) noted that the insertion of the PT was on the part of the dorsal side of the base of the fifth metatarsal bone, and they acknowledged the slight width that lay along the medial side of the trunk. Romanes (3) reported that the adhesion of the PT was toward the close dorsal side of the base of the fifth metatarsal bone or toward the almost neighboring deep fascia. Bryce (9) reported that the PT partially or completely adhered to the fourth metatarsal. Also, Werneck (4) reported in a study of the lower extremities of 45 cadavers that the PT tendon inserted into both the fourth and fifth metatarsal bones in wide range of lower extremities (64%). Reimann (10) stated that the PT adhered to the base of the fourth metatarsal bone and fourth to fifth metatarsal bones. Raheja et al (11) reported that the PT could have a sickle-like extension holding onto the fascia in the fourth interosseous space or the neck of the fifth metatarsal bone. Rourke et al (1) reported in their study that all 77 PT tendons adhered to the dorsal face of both the fifth and the fourth metatarsal bone, and all PT tendons opened in a fan shape to hold onto the dorsal side of the trunks of the fourth and fifth metatarsal bones by a hockey stick-shaped curved and wide extension around the fifth metatarsal (1).

Joshi et al (12) reported that the PT adhered to the base of the fifth metatarsal bone in 50% of the cases, to the base and trunk of the fifth metatarsal bone in 12% of the cases, and to the base and trunk of the

Table 3
Classification of peroneus tertius according to its insertion characteristics

Type	Right (%)	Left (%)	Total (%)
I			
Ia	18 (42.8)	15 (35.7)	33 (78.5)
Ib	2 (4.8)	3 (7.1)	5 (11.9)
II			
IIa	2 (4.8)	1 (2.4)	3 (7.2)
IIb	0 (0)	1 (2.4)	1 (2.4)
Total			42 (100)

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