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Case Report
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Atypical Tendon of Peroneus Tertius: Promising Autograft in Ligament Repair

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ABSTRACT

Introduction: variable insertions of peroneus tertius (PT) muscle tendon is described by various authors. Mention of extra PT tendon is also described in literature. Autologus tendon grafting is a blooming arena of clinical research at present time. Scarcity of auto graft and difficulty of choosing an appropriate auto graft often perplex reconstructive surgeons. There is paucity of data with regard to use of PT muscle tendon as auto graft.

Case Report: we report here an extra tendon of PT muscle joining with the extensor digitorum longus (EDL) tendon. The extra PT tendon with optimum length and thickness is indeed an additional advantage from the point of view of auto graft harvesting.

Discussion: we believe that though partial or total removal of the PT tendon might result in some degree of functional loss in maintaining steadiness and eversion, but presence of extra tendon will enable to use only the extra tendon not directly involved in primary action thereby minimising any possible functional impairment. An extra tendon of the PT muscle comparable in dimension with that of its primary tendon as reported here has promising opportunities in tendon grafting.

Conclusion: the anatomical variation of extra tendon of PT can be of tremendous future prospects to be used as an alternate tendon auto graft in ligament repair.

Keywords: Peroneus tertius; Fibularis tertius; Split peroneus tertius; Tendon grafting; Autologus tendon graft, Auto graft.

Introduction

Peroneus (Fibularis) tertius (PT) is a unipennate muscle of anterior leg distinctive to *Homo sapiens* owing to the adoption of terrestrial bipedal gait. PT is also observed in other genera of the *hominidae* family such as gorilla in variable forms[1]. The proximal attachment of PT is usually as a small muscle belly from the lower third to quarter of the extensor surface of the fibula, adjoining interosseous membrane and anterior crural inter-muscular septum, while the distal attachment is to the dorsum of the base of the 5th metatarsal bone[2]. The tendon of PT is located lateral to the 4th tendon of the extensor digitorum longus (EDL) and it runs below the superior and inferior extensor retinacula in separate tendon sheath[2]. Along its origin, muscle is in close association with the EDL, often seen arising together as a single muscle belly. It is considered a detached part of the EDL, peroneus brevis (PB) by some while others believe it as extensor digiti minimi with displaced attachment. PT exhibits anatomical variations in both proximal and distal attachments. Based on these variations, few classification systems of PT are described across literature which is summarized in table 1. On the basis of its association with EDL, three types of PT have been recognized which also have their unique surface appearance[3].

The PT is primarily a weak dorsiflexor and evertor of the foot. By virtue of dorsiflexion, PT muscle plays an important role in maintaining stability during the swing phase of walking cycle. It is also believed to be a factor for the maintenance of lateral longitudinal arch of the foot. The muscle is normally absent in up to 17% of the individuals[4,5]. Erstwhile studies have described variable prevalence of the PT across different population groups[3,6,7,8]. Presence of PT muscle is also linked with pathological conditions of the foot such as stress fracture, Jones fracture and tenosynovitis etc[9,10,11]. Typical insertion of the PT to the 5th metatarsal base is implicated for some of these pathologies like avulsion fracture[10,11]. Awareness of different possible anatomical variation of the PT is also crucial for understanding various foot pathologies[12]. Anatomical variation of PT tendon of this type may be important in the context of tendon and ligament repair surgery.

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Table 1. Classification system proposed by different authors based on the origin and insertion pattern of the PT.

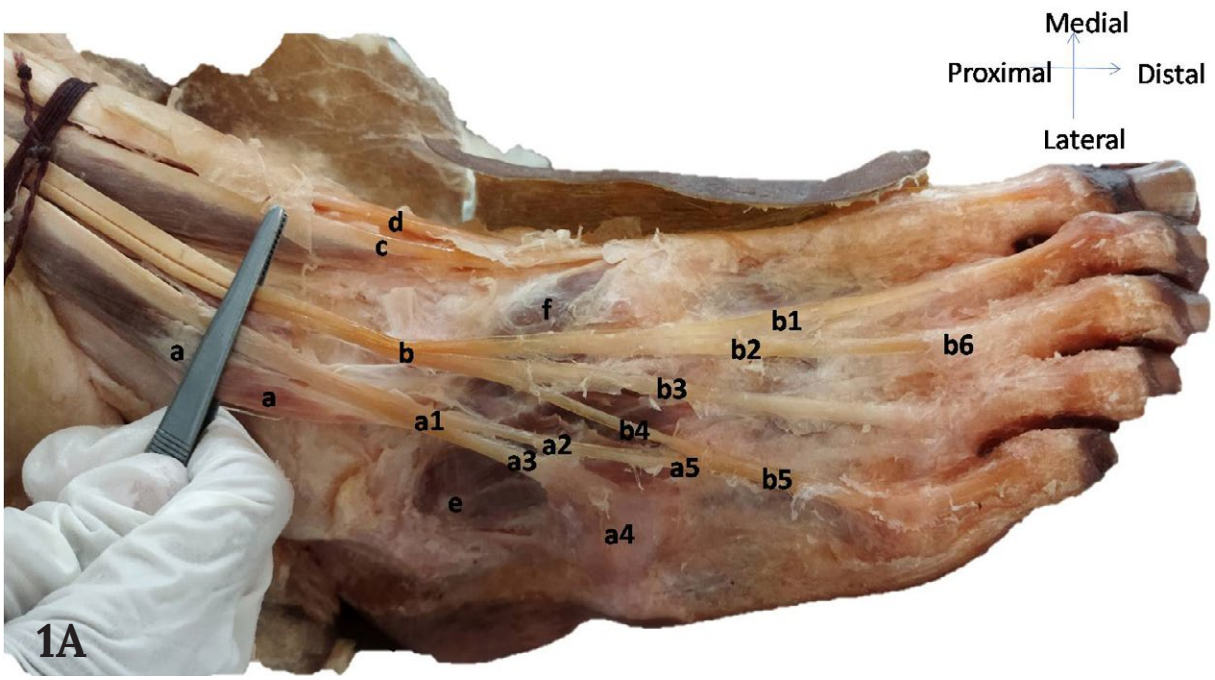
Classification system		
Joshi *et al.*[13] Based on PT muscle origin and insertion	Olewnik *et al.*[14] there is little information about the morphological variability of the fibularis tertius muscle (FTM Based on PT muscle insertion	Afroze MKH *et al.* 2020[15]
Very extensive origin (lower ¾ of extensor surface of fibula) Extensive origin (lower ½ of extensor surface of fibula) Normal origin (distal third of extensor surface of fibula) Insertion-base of 5th metatarsal Insertion-shaft of 5th metatarsal Insertion-base and shaft of 5th metatarsal of fourth interosseous space Others insertions	Type I: Single insertion to the 5th metatarsal shaft Type II: Single insertion to the 5th metatarsal base Type III: Single insertion to the 4th & 5th metatarsal. Type IV: Bifurcate insertion; the primary tendon inserts onto the 5th metatarsal base, the secondary to the 5th metatarsal shaft. Type V: Bifurcate insertion; the primary tendon has wide attachment on the 5th metatarsal base, secondary tendon attaches to the 4th metatarsal base. Type VI: Fusion with the tendon of the PB or EDL	Type IIa: Fleshy PT belly terminating as slender tendon with normal attachment Type Va: Bifurcate tendon; medial one interacting with the EDB tendon

Methods

Anatomic dissection of the PT was undertaken in a 71 year old male cadaver during the undergraduate teaching in the academic session 2021-2022 in a properly embalmed cadaver. The standard methods of dissections were adhered to and norms related to use of human cadavers in teaching and research were followed strictly as per the institutional guidelines. A skin incision on the anterior leg along the medial border continuing over the dorsum of the foot till the tip of the 2nd toe was made. Another transverse skin incision on the dorsum across the metatarsal head was also made. The extensor tendons were seen after carefully dissecting and reflecting the skin and the underlying fasciae. The observed anatomical variation of the PT was noted and photographed with a high-resolution cell phone camera.

Case Report

We report here an extra tendon of the PT encountered unilaterally in the right foot during cadaveric dissection (Figures 1). The PT muscle belly



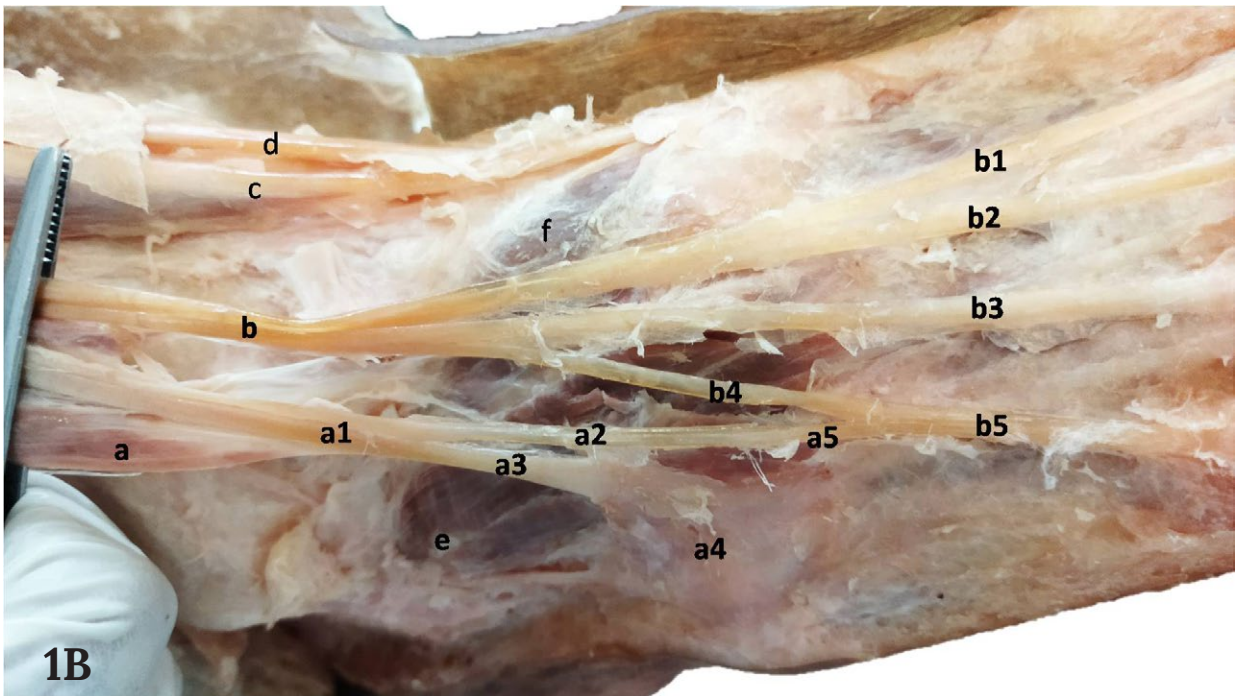


Figure 1. (1A and 1B): Dissected dorsum of the foot showing extensor tendons; a-peroneus tertius (PT) muscle belly, a1-PT tendon, a2-medial split tendon of the PT, a3-lateral split tendon of the PT, a4-usual distal attachment of the PT, a5- unusual distal attachment of the PT, b- extensor digitorum longus (EDL) tendon, b1-1st tendon of EDL, b2-2nd tendon of the EDL, b3-3rd tendon of EDL, b4-4th tendon of the EDL, b5 combined tendon of 4th tendon of EDL and the medial split tendon of the PT, b6-3rd tendon of EDL attached with dorsal digital expansion, c-extensor hallucis tendon, d- tibialis anterior tendon, e-extensor digitorum brevis muscle origin, f- extensorum hallucis brevis

originated from the lower quarter of the extensor surface of the fibula. The PT muscle belly continued for 13 cm until it forms the tendon and placed lateral to the 4th tendon of the EDL. The tendon then split into two parts; a lateral part representing the principal tendon and an additional medial part. The lateral part inserted distally in the usual manner on the dorsum of the 5th metatarsal base. The medial part joined the 4th tendon of the EDL to form a single unit which extended forward and got attached to the dorsal digital expansion of the little toe. The length of the lateral split tendon was 4.7 cm & its diameter at its beginning and insertion were 6 mm and 5.5 mm respectively. The length of the medial split tendon was 5.8 cm & its diameter at its beginning and insertion were 5 mm and 4.5 mm respectively. No other anatomical variation was noted in the leg and foot of both the sides.

Discussion

The two notable functions attributed to the PT are weak eversion and dorsiflexion. Whereas supernumerary or accessory PT is often linked with pathologies of the foot- ankle region but existence may be advantageous at times. In addition to that the anterolateral border of PT serves as an important anatomical soft tissue landmark for ankle arthroscopy[4]. Foot surgeons also usually use PT muscle flaps to repair lax ankle joint post trauma. Few studies have looked at the use of PT tendon in the tendon transfer and tendon grafting procedures. Successful ligament reconstruction with minimal complication is a challenging task. Graft scarcity is a practical problem faced in the plastic and reconstruction surgeries. We have a handful of auto grafts and allograft theoretically, but numerous disadvantages of the auto graft and allograft are often reported[16,17,18]. Auto graft is anyway better than the allograft in terms of graft cost, disease transmission and functional outcome. However, donor site morbidity, lengthy surgical time and hospital stay are some of the concerns of auto graft[19,20]. The task of choosing an appropriate graft is even more difficult. Repairing of anterior cruciate ligament of knee has been tried using different tendon grafts of the lower limb with variable outcome. Some of the commonly used grafts are hamstring tendon, semitendinosus-gracilis tendon, patellar tendon, fascia lata etc[21,22]. All these popular grafts are not devoid of technical difficulties related to graft harvesting. Therefore an alternate graft such as peroneus longus (PL) and PB tendon has emerged in recent times[23]. The tendon of the PL has been effectively used with variable outcome in tendon grafting in recent past[24,25]. The results are encouraging; even some studies reported them to be superior to the conventional grafts.

The ideal auto graft is the one which is not involved in the primary actions across a joint. The other prerequisites are easy and safe to harvest, attainment of optimum strength and more importantly devoid of any evident functional impairment at the donor site. The PT tendon seems to fulfil most of these criteria as it is superficial in the lateral dorsum of the foot, not in relation to important neurovascular bundles on

the region, easy to harvest and not directly bringing about primary movements across ankle and sub-talar joint. However, there is paucity of data regarding the use of PT as autologus tendon graft. Mabit *et al*. propounded that PT tendon with width greater than 4 mm is ideal for ligamentoplasty[26]. Joshi *et al*. found optimum thickness of the PT tendon in 12% of the dissected feet[13]. We also believe that PT tendon can be an effective graft, one of the reasons being expected relative ease of graft harvesting. Furthermore, being functionally an auxiliary dorsiflexor and evertor of foot, it can be sacrifice to yield a suitable tendon graft for smaller ligament lesion. PT muscle is normally absent in up to 17 % of populations, which further indicates its less-significant action. A prevalence study of level-I evidence has shown that individuals with absent PT are not more susceptible for ligament injury in ankle. In addition to that the study did not find decreased eversion and dorsiflexion power in those subjects[27]. Its absence is compensated in such individuals with an accessory or hypertrophied muscle which is suggestive of trivial functional loss that can occur following its use as a graft. Nevertheless, its role in lifting the foot off the ground especially during the swing phase of walking cannot be ignored. Presence of an extra tendon which joins with an already existing extensor tendon can make the situation more advantageous like in this present case. It is to be mentioned here that, ultrasound elastography is an excellent method to view the muscles and tendons in a distinctive manner[28]. Therefore, pre-procedure elastography to identify such extra tendon can also be employed. So, we assume that auto graft harvesting from functionally quiescent PT is an arena that has profound clinical ramification. Harvesting might be more feasible in the presence of extra tendon of optimum width, as it spares the main PT tendon.

Conclusions

A muscle with a wide spectrum of variation such as PT might indicate that the muscle is still in the process of evolution. A more precise and definite function can be attained by the PT later in course of evolution. The extra tendon of PT on the medial side in this case is of particular significance to reconstructive surgeons and in foot pathology. Presence of such tendon for preparing appropriate autologous graft can be looked for using ultrasound elastography before planning ligament or tendon repair.

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Mini Curriculum and Author's Contribution

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