Foot and Ankle Surgery 25 (2019) 636–639

Contents lists available at ScienceDirect

Foot and Ankle Surgery

journal homepage: www.elsevier.com/locate/fas

Insertional anatomy of peroneal brevis and longus tendon — A cadaveric study

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ARTICLE INFO

Article history:
Received 27 May 2018
Received in revised form 17 June 2018
Accepted 13 July 2018

Keywords:
Peroneus Longus
Peroneus Brevis
Peroneal Tendon

ABSTRACT

Background: Peroneal Tendon (PT) complex is formed by the Peroneus Longus Tendon (PLT) and Peroneus Brevis Tendon (PBT), their synovial sheath, the superior and inferior retinaculum, and the Os Peroneum (OP). Their insertion is associated with some anatomic variability. Knowing these variants helps to understand the PT pathology and it may support the decision-making concerning the operative approach. The purpose of this study was to assess anatomical variability in PT insertion.
Methods: Twenty fresh-frozen cadaveric feet were used. The lateral part of the ankle, foot and sole were dissected to expose PLT and PBT course and distal insertions.
Results: Concerning the PBT, eleven feet had a normal insertion in the base of the fifth metatarsal; the other nine had a variability. Regarding the PLT, thirteen out of twenty had the normal insertion in the first metatarsal; the remaining seven had anatomical variants.
Conclusions: In this study, we found a great variability in the insertional anatomy of PBT and PLT.
Clinical relevance: It is important that orthopedic surgeons are aware of the great variability of PT anatomical insertion when performing foot and ankle surgery, in order to avoid possible complications, for instance a PLT injury during preparation of tarso-metatarsal arthrodeses.

1. Introduction

The Peroneal Tendon (PT) complex is formed by the Peroneus Longus Tendon (PLT) and Peroneus Brevis Tendon (PBT), their synovial sheath, the superior and inferior retinaculum, and the Os Peroneum (OP). The peroneal longus (PLM) and brevis (PBM) muscles are in the lateral compartment of the leg, being innervated by the peroneal superficial nerve and supplied by the anterior tibial and peroneal arteries [1].

The PLM originates from the proximal third of the fibula and intermuscular septum. At the median third, it extends through a superficial aponeurosis that covers the PBM. The PBM originates from the distal third of the fibula and intermuscular septum. The PBM myoaponeurotic junction is distally located in relation to that of the PLM [1].

At the malleolar region, both tendons curve beneath the posterior aspect of the lateral malleolus, inside an osteofibrous tunnel formed by the concave bony gutter and the fibrous superior retinaculum. Distal to the lateral malleolus, the PT travel along the lateral surface of the calcaneus, where the peroneal tubercle (PTub) is present; the PBT runs superiorly whereas the PLT runs inferiorly to it. At this level, both tendons travel inside another osteofibrous tunnel, covered by the inferior retinaculum. Distal to the PTub, the PBT runs directly to insert into the base of the fifth metatarsal bone, and the PLT curves beneath the cuboid, to reach the plantar region, which is usually attached to the first and second metatarsals [1].

2. Material and methods

The present study was conducted on twenty feet of fresh frozen cadavers (Table 1) in the Anatomy Department of a Faculty of

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https://doi.org/10.1016/j.fas.2018.07.005
1268-7731/

Table 1
Age, gender and laterality of the twenty feet.

	Age	Gender	Laterality
A	93	Male	Right
			Left
B	71	Male	Right
			Left
C	85	Female	Right
			Left
D	89	Male	Right
			Left
E	87	Male	Right
			Left
F	90	Male	Right
			Left
G	86	Male	Left
H	73	Male	Right
			Left
I	77	Male	Right
J	91	Female	Right
			Left
K	79	Male	Right
L	86	Female	Right

Medicine, in March 2017. The lateral part of the ankle, foot and sole were dissected to expose PLT and PBT course and distal insertions.

Photographs were taken to document anatomical variants.

Cadavers with a history or signs of previous ankle trauma or surgery, congenital or developmental deformities, or inflammatory arthritis were excluded.

3. Results

Concerning the PBT, in twenty feet we found that:

- Eleven had a unique insertion on the base of the fifth metatarsal (Fig. 1).
- Three had an insertion at the base of the fifth metatarsal and a slip to the extensor of the fifth toe (Fig. 2).
- Two had a fifth metatarsal base insertion, a slip to the extensor of the fifth toe and another slip to the fourth metatarsal (Fig. 3).
- Two had an insertion at the base of the fifth metatarsal and a slip also to the fifth metatarsal base.
- One had an insertion at the base of the fifth metatarsal and a slip to the fifth metatarsal diaphysis (Fig. 4).

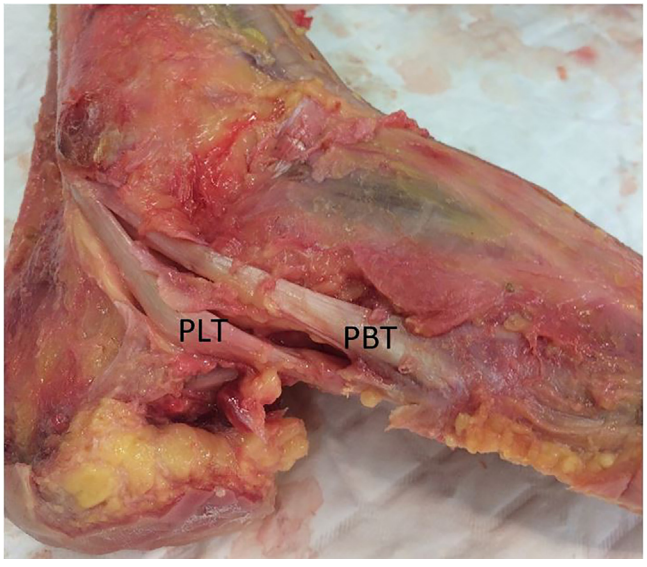

Fig. 1. Single insertion of PBT in the fifth metatarsal base.

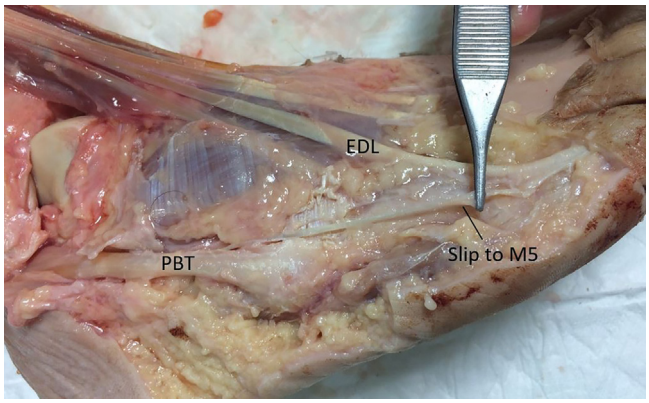

Fig. 2. Insertion of PBT in the fifth metatarsal base with a slip to the fifth toe extensor; (EDL — extensor digitorum longus; M5 — fifth metatarsal).

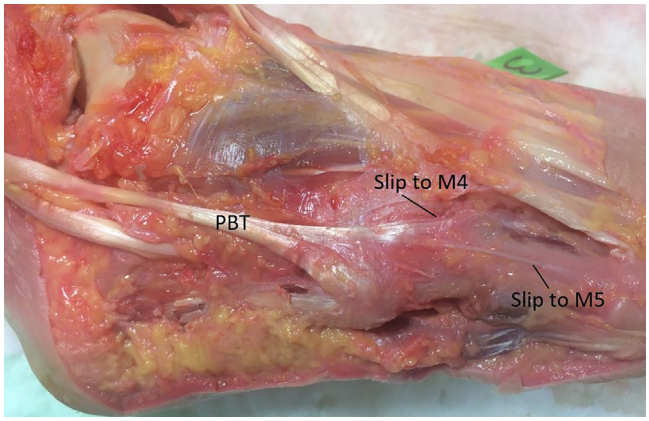

Fig. 3. Insertion of PBT in the fifth metatarsal base with a slip to the fifth toe extensor and another to the fourth metatarsal; (M4 — fourth metatarsal).

Fig. 4. Insertion of PBT in the fifth metatarsal base with a slip to the fifth metatarsal.

- One had a possible degenerative condition in Peroneal Tendons, and the PBT was merged with the PLT, lacking insertion on the fifth metatarsal.

Concerning the PLT, in twenty feet we found:

- Thirteen had a unique insertion on the base of the first metatarsal (Fig. 5).

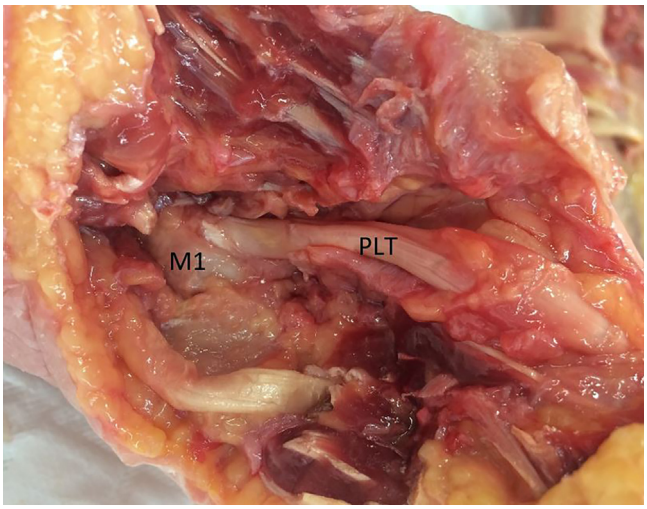

Fig. 5. Single insertion of PLT in the first metatarsal base; (M1 — first metatarsal).

- Three had an insertion on the first metatarsal and the medial cuneiform.
- Two had an insertion on the first metatarsal and the medial cuneiform, with slips to the basis of the second and fifth metatarsal (Figs. 6 and 7).
- One had a first and second metatarsal base insertion (Fig. 8).
- One had a wide insertion on the basis and diaphysis of the first metatarsal (Fig. 9).

We did not find in any of the specimens a mid-foot retinaculum or a peroneus quartus muscle.

4. Discussion

Imre described variations of PBT insertion at the fifth metatarsal, subdividing them into six groups, depending whether it inserts only on the fifth metatarsal base or it has slips to the proximal phalanx of the fifth toe. This is schematically illustrated in Fig. 10 [2]. Cecava and Campbell reported a congenital variant insertion of PBT on the calcaneal peroneal tubercle, that can occur in a small segment of the population [3].

In another cadaveric study concerning PLT, all twenty-six specimens had an attachment to the base of the first metatarsal by a strong band and a thin slip to the medial cuneiform was observed in eighty-five percent of the cases. Insertional slips were also observed to the lesser metatarsals. Shyamsundar et al. observed an extension of PLT to the plantar aspect of the first cuneiform, the base of the second metatarsal, and the first dorsal interosseous [4].

Additionally, in a cadaveric study with fifty feet, Swathi described a mid-foot retinaculum in twenty-two of them, distally to inferior retinaculum of extensor tendons. The authors hypothesize that this retinaculum could play an important role in preventing bowstringing of the extensor tendons, but could also cause deep peroneal nerve entrapment [5].

This study has its limitations, as we only studied fresh-frozen cadavers that were donated to our Faculty of Medicine, with an average age of 84,3 years old, which may represent a selection bias and limit our results to an elderly group. Therefore, we must be careful when generalizing results to the whole population.

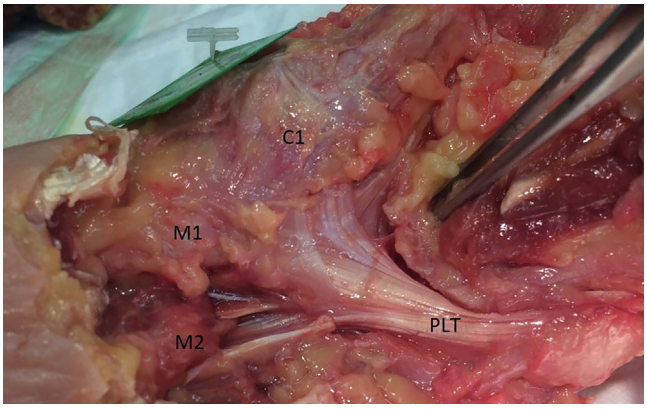

Fig. 6. Plantar view of insertion of PLT in the first and second metatarsal base and medial cuneiform; (M2 — second metatarsal; C1 — medial cuneiform).

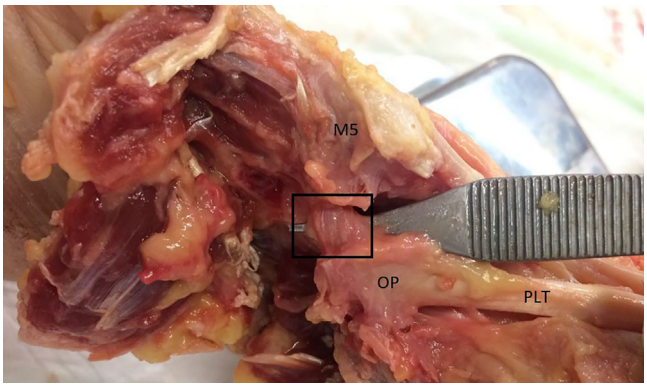

Fig. 7. Lateral view of expansion of PLT to the fifth metatarsal (OP — Os Peroneum).

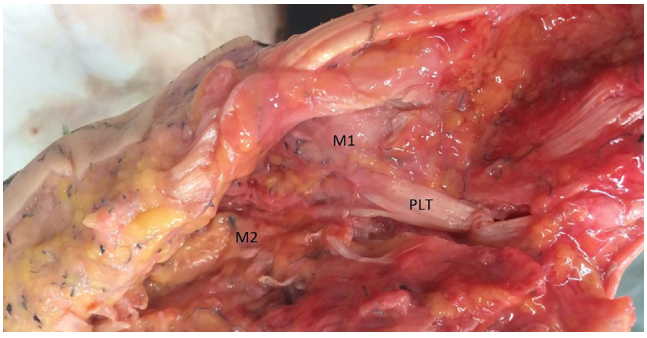

Fig. 8. Plantar view of insertion of PLT in the first metatarsal with an expansion to the second metatarsal.

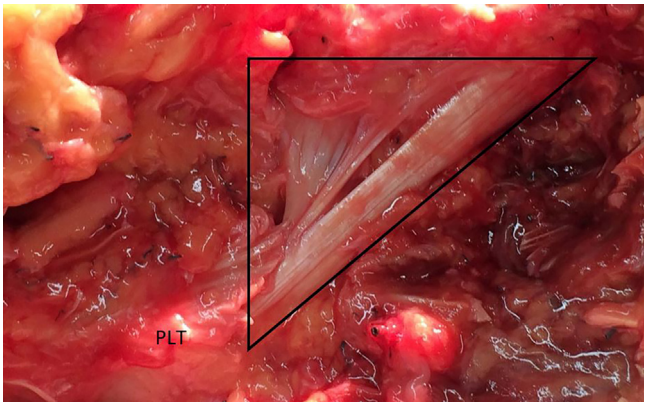

Fig. 9. Wide insertion of PLT in the first metatarsal base with a slip to the fifth metatarsal.

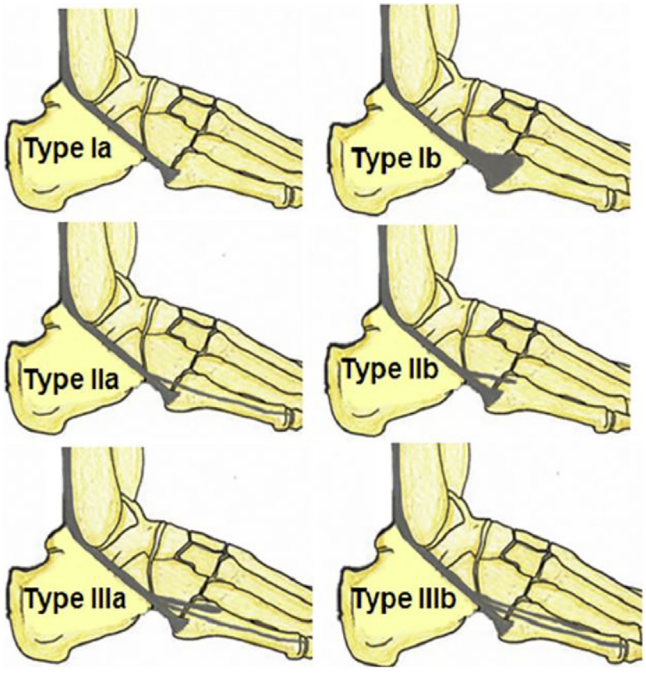

Fig. 10. Classification of PB insertion, as described by Imre et al. [2].

5. Conclusion

In our study, we found a great variability in the anatomy of PBT and PLT insertion, as described previously in the literature. Imre had already described most of the variants that we found on the PBT insertion. Concerning PLT insertion, we could not find any reference in the literature to an extension to the fifth metatarsal, as we encountered. Nevertheless, the majority of PBT had a unique insertion on the fifth metatarsal base and the majority of PLT had a unique insertion on first metatarsal base.

We believe that with this cadaveric study and with a significant sample of twenty cadavers, we were able to recognize the anatomical variations of PT insertional anatomy in our population. It is important that orthopedic surgeons are aware of this variability when performing foot and ankle surgery, in order to avoid possible complications, for instance, a possible PLT injury during tarso-metatarsal arthrodeses.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

None.

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