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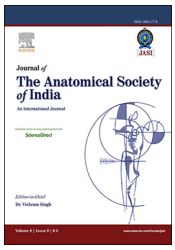

Original Article

Variations in the insertion of peroneus longus muscle

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ABSTRACT

Introduction: Peroneus longus (PL) in man assumes special significance as it helps in maintaining the foot in plantigrade position and simultaneously maintains the arched character of foot. During evolution, insertion of PL has migrated from the lateral border of foot to reach its medial border, through the deep part of sole, getting purchase on the contiguous parts of lateral surface of the medial cuneiform and base of 1st metatarsal in its lower part. Hence, it was expected that some interesting variations in the insertion of PL may be found.

Methods: Thirty-eight (38) feet from 19 adult embalmed cadavers, without any deformity of foot, were utilized for this study. Soles were dissected to expose the distal part of tendon of PL from the lateral margin of foot up to its insertion.

Results: PL tendon at its insertion showed interesting variations in about 61% cases. In 23% feet, the tendon flared out into a triangular expansion, and in half of them, it received a slip from the tendon of tibialis posterior (TP) along its proximal border. The main tendon of TP was superior to the triangular expansion. In 8% specimens, a tendinous slip from the tendon of PL, near its insertion, continued with first dorsal interosseous muscle.

Discussion: Variations of PL muscle are more common than they are supposed. Findings of this work will be of interest to the morphologist and of great help to the orthopedicians in correcting the foot deformities.

1. Introduction

Peroneus longus (PL) is a superficial muscle of lateral compartment of the leg. It arises from the head of fibula, proximal two-thirds of the lateral surface of shaft of fibula, from the deep surface of fascia cruris, anterior and posterior crural intermuscular septae, and few fibers from lateral condyle of tibia. It is inserted by two slips – one on the lateral side of base of 1st metatarsal and the other on the medial cuneiform.[1] According to Verma et al., morphologically, PL should be inserted on the lateral border of the foot but has shifted its insertion from the base of the 5th metatarsal, across the sole, to the base of 1st metatarsal and also to the medial cuneiform. The muscle may get inserted anywhere between these two bones and also give fibrous expansions to the

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neighboring structures.[2] The function of PL is eversion and plantar flexion of foot and it also helps in stabilizing the ankle joint and in maintaining the arches of foot.[1]

Multiple pathologies are associated with the PL tendon, including traumatic injury, tendinitis, tenosynovitis, dislocation, acute rupture, chronic tear, and avulsion fractures.[3] It is the main contributor to the plantarflexed position of foot, as seen in pes cavus.[4]

2. Material and methods

Thirty-eight (38) feet from 19 adult embalmed cadavers, without any deformity of foot, available in Anatomy department of SAIMS, were utilized for this study. Approval was obtained from the Institutional Ethics Committee for undertaking this work. Soles were dissected to expose the distal part of tendon of PL from the lateral margin of foot up to its insertion. Simultaneously, the tendon of tibialis posterior (TP) with its expansion was also cleaned. Details of insertion of PL tendon and its variations were noted and photographed.

3. Results

Table 1 shows incidence of variations of insertion of PL. In the present study, in about 61% cases, PL tendon showed variations.

4. Discussion

Variations of PL muscle are more frequent than are supposed and its distal attachments show a number of variations. The peroneal muscles may show variations as a whole or share, in certain measure, the general prerogatives of the muscular system.

Bergman et al. have cited the following variations: (1) PL inserted by 3 tendinous slips to 5th, 3rd, and 1st metatarsal; (2) 3 slips of insertion, one of which may be attached to intermediate cuneiform, or 5th metatarsal behind the peroneus brevis, or the PL may be fused with it. It may give slips to metatarsals or to the lateral malleolus.[5]

Verma et al.[2] in their article have cited the work of Borley et al. (2008), who described that additional slips may be inserted on the base of 2nd metatarsal or to the bases of the 3rd, 4th, and 5th metatarsals. Further, the authors have quoted the work of Bhargava et al. (1961) who observed insertion of PL on all the metatarsals and that Anson (1966) found the slips to 2nd and 3rd metatarsals.[2]

The study of insertion of PL tendon is clinically important because of its importance in maintaining the arches of the foot.[2,4] PL has shifted its insertion from the base of the 5th metatarsal, across the sole, to the base of 1st metatarsal, and finally, also to the medial cuneiform. As stated by Verma et al.,[2] the migration of the tendon of this muscle across the sole of the foot from lateral to the medial border is a gradual process in the ontogeny of man and a repetition of the phylogeny of the muscle. The morphological evolution of the muscle can be readily followed in the mammalian series.[2] Variations of insertion of PL clinically are relevant to surgeons undertaking reconstructive procedures in the leg and foot.[6] Jayakumari et al.[6] citing the work of Goss (1973), has stated that the incidence of variation of the insertional slips of PL is not uncommon in human beings, and that the variations in the muscles of fibular compartment range from 13% to 20%. In our study, in 61% cases, PL tendon showed variations, which was quite higher than described by Goss.

Jayakumari et al.[6] described the main tendon of PL getting inserted on the lateral side of base of 1st metatarsal bone and two additional slips – the lateral slip blending with the first dorsal interosseous muscle, whereas, the medial slip was inserted on the plantar aspect of base of 1st metatarsal bone. In 39% (Table 1.), we found normal insertion, i.e. on the lateral surface of base of first metatarsal bone and medial cuneiform (Fig. 1). In 10% cases, in the present series, insertion was found only on 1st metatarsal.

Table 1 – Incidence of variations of insertion of peroneus longus (PL), $n = 38$ (Rt = 19; Lt = 19).

Insertions of PL	Right side No. of cases	Left side No. of cases	Total incidence (%)
Normal insertion [Lateral surface of base of 1st metatarsal and medial cuneiform]	6 (15.7%)	9 (23.6%)	39.4
Triangular expansion with normal Insertion	1 (2.6%)	3 (7.8%)	10.5
Triangular expansion with normal insertion getting a slip from tibialis posterior	6 (15.7%)	3 (7.8%)	23.6
Slip joining flexor hallucis brevis	Nil	1 (2.6%)	2.6
Slip going towards 1st interosseous space	1 (2.6%)	2 (5.2%)	7.8
Insertion only on 1st metatarsal	2 (5.2%)	2 (5.2%)	10.5
Tendon giving origin to oblique head of adductor hallucis	2 (5.2%)	Nil	5.2

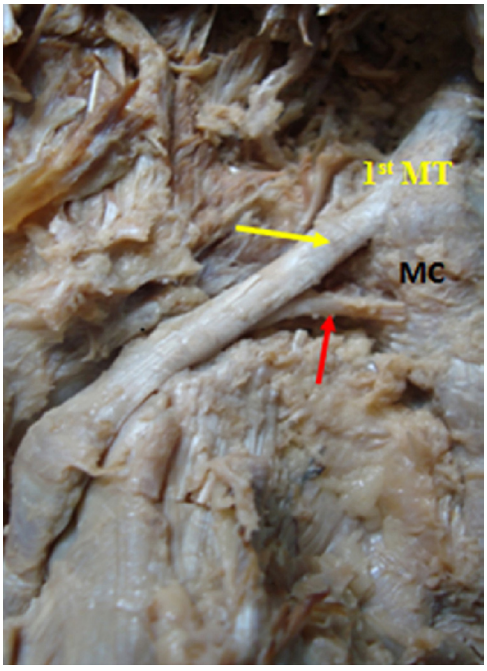

Fig. 1 – Main tendon (yellow arrow) getting attached to lateral aspect of base of 1st metatarsal (MT). Prominent slip (red arrow) of the tendon is getting attached to medial cuneiform (MC).

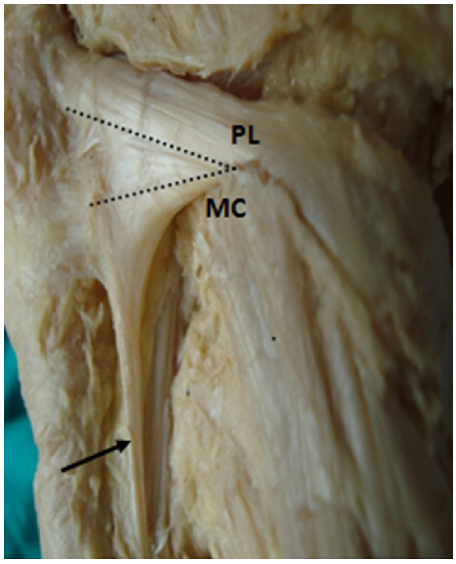

Fig. 2 – A very thick and massive tendon of PL joining the base of 1st MT. Also seen is an expansion from its proximal border reaching MC. This expansion is joined by a strong tendinous slip of TP (black arrow).

In our study in 7.8% (Table 1) cases, tendinous slip from tendon of PL near its insertion was seen to enter the proximal part of first interosseous space, which became continuous with first dorsal interosseous muscle (Fig. 4). Harbeson in Toldt's Atlas of Human Anatomy (1938)[7] contains an illustration in which the medial head of the first dorsal interosseous muscle appears as if it had an origin from the tendon of the PL. amont[8] also described that PL expands into slip, which becomes intimately blended with the first dorsal interosseous muscle.

The insertion of PL into first dorsal interosseous muscle may increase the power of abduction of second toe and may contribute in accentuating the concavity of foot. Altered geometry of proximal and distal attachments of PL muscle may also enhance the stability of talocalcaneonavicular joint.[6]

PL muscle was also noted to give a tendinous slip of origin to the oblique head of the adductor hallucis muscle in 5% of our cases. Harbeson[7] described that in 25% cases the PL muscle gave a tendinous slip of origin to the oblique head of the adductor hallucis muscle. He also described that in one foot the tendon of the PL divided into two equal parts, one of which was inserted in the usual manner, and the other was inserted into the tuberosity of the 5th metatarsal bone. This was not seen in our study. In one specimen a slip was found joining with flexor hallucis brevis, a finding that has not been described in the literature reviewed.

In the present study, in 10% feet, the PL tendon flared out into a triangular expansion (Table 1, Fig. 2). In 23% cases, a slip from the tendon of TP (Table 1, Fig. 3) joined the edge of expanded tendon of PL along its proximal border. The main tendon of TP was superior to the expansion (Fig. 3), which compares favorably with the findings of Raheja et al.[9] who mentioned that the PL tendon, after emerging from the cuboid tunnel, received an accessory triangular slip from the TP tendon attached to its proximal border.

PL is often stretched and injured from traction during inversion of foot. These tendinous slips at the insertion may act as an additional support and protect against twisting injuries of the ankle joint and may also help to enhance the stability of talocalcaneonavicular joint.[4,6]

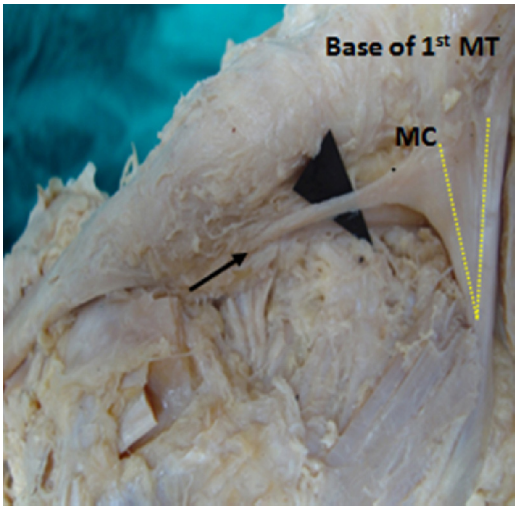

Fig. 3 – Main slip of PL tendon going to the base of 1st MT. From its proximal border a triangular expansion, in the continuity with main tendon, reaches the MC, similar to Fig. 2. Superficial slip of TP (black arrow) spreads out to join the expansion.

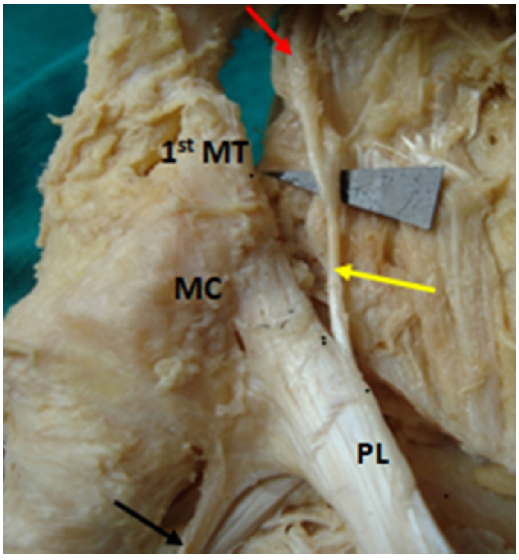

Fig. 4 – The thick main tendon of insertion of PL reaching the base of 1st MT. Near its insertion, it fans out to reach the MC, which is joined by superficial slip of TP (black arrow). Deeper part of tendon of TP is also seen. From the distal margin of main tendon, a tendinous slip (yellow arrow) is seen reaching the proximal part of 1st interosseous space, where it joins fleshy fibers of 1st dorsal interosseous muscle (red arrow).

5. Conclusion

Variations of this muscle are more frequent than they are supposed, and at its distal attachment, a number of variations are found, which are not described in textbooks of anatomy. The variations at its insertion in the form of expansion of tendon will provide extra leverage and support to the foot and thereby play an important role in the stability and protection of ankle and subtalar joints against twisting injuries.

The findings of the present study favor the assumption that the process of evolution for a bipedal gait is still progressing and that nature is attempting to provide adjustments for a better evolved plantigrade foot in man!

Conflicts of interest

The authors have none to declare.

REFERENCES

1. Susan S, Borley NR, Collins P, et al. *Leg Muscles – Fibularis Longus in Gray's Anatomy*. 40th ed. London: Churchill Livingstone Elsevier; 2008:1419.
2. Verma P, Arora Ak. An anatomic variant insertion of peroneus longus in a cadaver – a case report International. *J Anat Variat*. 2012;5:18–19.
3. Patil V, Frisch NC, Ebraheim NA. Anatomical variations in the insertion of the peroneus (fibularis) longus tendon. *Foot Ankle Int*. 2007;28:1179–1182.
4. Shyamsunder S, Wazir A, Allen PE. Variations in the insertion of peroneus longus tendon – a cadaver study. *Foot Ankle Surg*. 2012;18(December (4)):293–295.
5. Bergman RA, Afifi A, Miyauchi R. Illustrated Encyclopedia of Human Anatomic Variation: Opus I: Muscular System: Alphabetical Listing of Muscles: P. Peroneus Brevis and Longus. http://www.anatomyatlases.org/AnatomicVariants/MuscularSystem/Text/P/17Peroneus.shtml (accessed March 2011).
6. Jayakumari S, Suri RK, Rath G, Arora J. Accessory tendon and tripartite insertion pattern of fibularis longus muscle. A case report. *Int J Morphol*. 2006;24:633–636.
7. Harbeson AE. Further studies on the origin of the first dorsal interosseous muscle of the foot from the tendon of the peroneus longus. *J Anat*. 1938;72(April (Pt 3)):463–464.
8. Lamont JC. Note on a tendon found in association with the insertion of the peroneus longus, and origin of the first dorsal interosseous muscles. *J Anat Physiol*. 1908;42(January (Pt 2)):236.
9. Raheja S, Choudhry R, Singh P, Tuli A, Kumar H. Morphological description of combined variation of distal attachments of fibulares in a foot. *Surg Radiol Anat*. 2005;27 (2):158–160. http://dx.doi.org/10.1007/s00276-004-0290-7.