ORIGINAL ARTICLE

Fibularis Tertius Muscle: Cadaveric Study in Indians

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Abstract:

Background: Fibularis tertius is a small, unipennate muscle of the anterior compartment of the leg which is peculiar to human. It is highly variable muscle. It acts as a dorsiflexor and evertor of the foot. Fibularis tertius muscle flap is used for transposition and correcting any laxity in the ankle joint by foot surgeons. Distal attachment of it might play important role in causation of torsional stresses as observed in Jones fractures. *Aims:* It was aimed to study the incidence of fibularis tertius muscle and to observe variations in its proximal and distal attachments in Indian population. *Material and Methods:* We studied 100 (right: 50; left: 50) cadaveric lower limbs to observe the presence or absence of fibularis tertius muscle and variations in its proximal and distal attachments. *Results:* Fibularis tertius was absent in 13%. We observed variations in distal attachment of it. It was attached to 4th or 5th metatarsal or both. In some cases we observed bifurcated tendon and duplication of tendon of this muscle. *Conclusion:* Variations of fibularis tertius muscle are more frequent and its distal attachments are not absolutely at a fixed position therefore a precise and detailed knowledge of this muscle is important for foot surgeons and anatomists.

Keywords: Dissection, Extensordigitorumlongus, Fibularistertius, Variations

Introduction:

Fibularis tertius muscle (FTM) is a small, unipennate muscle of the anterior compartment of the leg which is peculiar to human [1]. Usually FTM is considered as a part of the extensor digitorum longus (EDL) muscle which arises from the distal third or more frequently, from the medial surface of the fibula; the adjacent anterior surface of the interosseous membrane and the anteriorcruralintermuscularseptum. It is inserted into the medial part of the dorsal surface of the base of the 5th metatarsal bone and extending into the nearby deep fascia [2, 3]. FTM act as a dorsiflexor when acting along with extensor digitorum longus and tibialis anterior. It also acts with fibularis longus and brevis muscles as a strong evertor of the foot which levels the foot and helps the toes to clear the ground and this action that improves the efficiency and enhances the economy of bipedal mode of locomotion [3-5].Also it has a special proprioceptive role in sensing sudden inversion and then contracting reflexively to protect the anterior tibio-fibular ligament which is the most commonly sprained ligament of the body [6].

According to Jungers *et al* [7] appearance of FTM is closely related to the development and evolution of EDL and its embryonic formation is based on progressive separation from EDL until final insertion into lateral border of the foot. But according to some researchers it is a migrated part of extensor digitorum brevis (EDB) of little toe [8, 9] or it represents extensor digiti minimi with displaced insertion to the base of 5th metatarsal [1]. Presence of FTM in human and absence of it in other primates is an evidence of evolution and supports its function of terrestrial bipedalism.

The frequency of presence of FTM has increased up to 95% in the human population. [10].

Different variations of the FTM are described in literature- absence, duplication, additional slip to the fascia the 4th interosseous muscle, 4th metatarsal bone and extensor aponeurosis of little toe. Literature describes absences of FTM in 10-18% population [2, 4, 9]. FTM shows variations in its proximal and distal attachment. Many researchers reported various modes of insertions [11, 12]. According to Vertullo et al [13] insertion site of FTM is an important factor in case of Jones fracture. FTM is used by plastic surgeons and orthopedic surgeons while performing tendoplasty, tendon transfer or resection surgeries on foot. Also, its muscle flap and tendon is used for transposition, for correcting any laxity in the ankle joint and in transplantation surgeries on in foot drop respectively [14].Therefore presence or absence of this muscle is important from the academic and clinical point of view.While searching the literature we found that there are very few studies regarding the anatomy of the fibularis tertius muscle in Indian population.

Material and Methods:

We studied 100 (right: 50; left- 50) cadaveric lower limbs of male gender and approximate age range was 45 to 70 years, to see the variation in the fibularis tertius muscle. The study was conducted in the Department of Anatomy, Krishna Institute of Medical Sciences Deemed University, Karad, Maharashtra. All lower limbs were free from any damage, fracture or pathology. We carefully dissected the anterior compartment and dorsum of the foot of each leg to see the presence or absence of fibularis tertius muscle. When FTM was present, we meticulously dissected it and cleaned to see its proximal and distal attachments. Observations of our study were noted and proper photograph were taken.

Results:

FTM was absent in 13 lower limbs. In remaining 87 lower limbs it was present on right side in 45 (51.72%) and on left side in 42 (48.27%).We observed three different types of FTM.

Type I- Completely formed independent belly of FTM which was clearly distinct from extensor digitorumlongus (Fig.1). It was present in 70 (80.45%) lower limb.

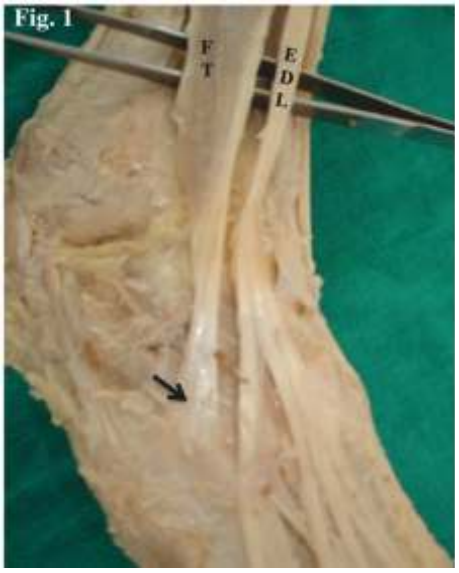

Fig. 1: Showing Type I - Clearly Distinct belly of Fibularistertius (FT), from Externaldigitorum-longus (EDL) and Distal Attachment of it on Dorsum of 4th Metatarsal Bone (Black arrow).

Type II- Subdivided into two types: a) Belly FTM was partially fused with the extensor digitorumlongus with the independent tendon (Fig. 2a). It was present in 5(5.74 %) cadavers and b) completely fused belly of FTM with EDL but independent tendon of FTM (Fig 2b) was present in 5 (5.74 %) cadavers.

Fig. 2a Showing Type II A-Partially Fused Belly (Thick Black Arrow) of Fibularis tertius (FT) with Externaldigitorumlongus (EDL), with Independent Tendon which was Attached on 5th Metatarsal Bone (Thin Black Arrow)

Fig. 2b: Showing Completely Fused Belly of Fibularis tertius (FT) with EDL (Blue Arrow) but Independent Tendon of Fibularis tertius (Black Arrow).

Type III- Complete absence of FTM belly but an independent tendon of FTM was arising from EDL (Fig.3). It was present in 7 cadavers (8.04%).

Fig. 3 Showing Type III- No Belly of Fibularis Tertius but Fibularis Tertius Tendon (Black arrow) was Arising as a 5th Tendon from Externaldigitorumlongus (EDL).

We did not observe any variations in proximal attachment of FTM but variations in its distal attachment were reported as follow:

1. Only on the dorsum of 4th metatarsal bone (Fig. 1) in 20 (22.98%) cases.
2. Only on dorsum of 5th metatarsal bone (Fig. 2a) in 39 (44.82 %) cases.
3. Two slips of fibularistertius muscle, i.e. medial and lateral slips.

a. Medial slip was merging with fascia and lateral slip getting attached on 4th MT (Fig. 4) in 1 case (1.14 %).

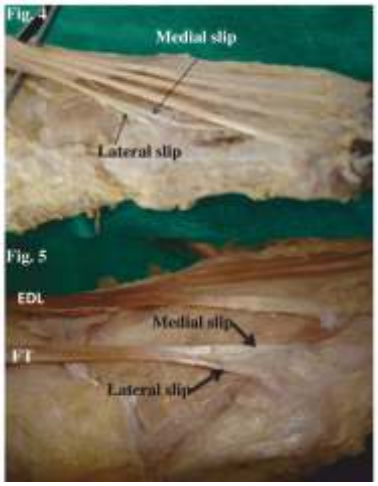

Fig. 4: Showing Bifurcated Tendon of Fibularis Tertius (FT)-Medial Slip (MS) Merging with Fascia While Lateral Slip (LS) Getting Attached on 4th Metatarsal.

Fig. 5: Showing Tendon of Fibularis Tertius Bifurcated Into Medial and Lateral Slips. Medial Part was Getting Attached to 4th Metatarsophalangeal Joint and Lateral Slip is Attached to Distal Part of Dorsum of 5th Metatarsal Bone.

b. Medial slip was getting attached to 4th metatarsophalangeal joint and lateral slip was attached to distal part of dorsum of the head of the 5th metatarsal bone (Fig. 5) in 2 (2.29%) cases.

c. Medial slip was attached to 4th metatarsal and lateral one was attached to 5th metatarsal (Fig. 6) in 20 (22.98%) cases.

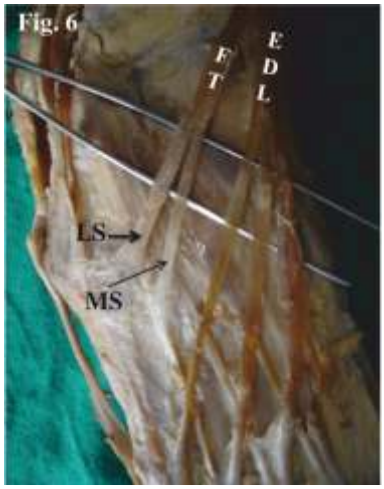

Fig. 6: Showing Tendon of Fibularis Tertius (FT) which was bifurcated into Medial Slip (MS) was attached to 4th Metatarsal and Lateral Slip (LS) was attached to 5th Metatarsal.

4. Fibularis tertius was giving 4th tendon of extensordigitorumlongus (Black arrow) and its tendon has separate insertion on distal part of 4th metatarsal (Fig. 7) in one (1.14%) case.

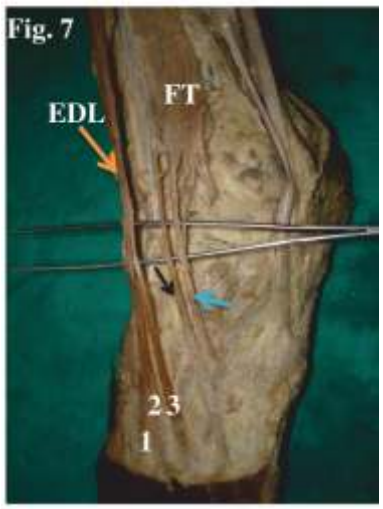

Fig.7: Showing Fibularis Tertius Muscle (FTM) and 4th Tendon of Extensordigitorumlongus Had a Single Belly. Fibularis Tertius Tendon was attached on Distal Part of 4th Metatarsal (blue arrow) and Black Arrow Shows 4th tendon of Extensordigitorumlongus (EDL).

5. Duplication of tendon of fibularis tertius. One tendon (Thin black arrow) was arising from EDL and getting inserted on 4th metatarsal and second tendon (Thick black arrow) was of fibularis tertius which was inserting on dorsum of 5th metatarsal bone (Fig. 8) in 3 (2.82%) cases.

Fig. 8: Showing Duplication of Tendon of Fibularis Tertius (FT), Black Arrow is Showing Separate Tendon which was Arising from Externaldigitorumlongus (EDL) and Getting Inserted On 4th metatarsal. Independent Tendon of Fibularis Tertius was Inserting on Dorsum of 5th Metatarsal Bone.

Fig. 9: Showing Distal Attachment of Fibularis Tertius (Ft) on 4th and 5th Metatarsals

6. In one case (1.14%) tendon of fibularis tertius was forming an aponeurotic expansion at insertion site (Fig. 9) and attaching on 4th and 5th metatarsals.

Discussion:

The fibularis tertius muscle is present in humans with much variation. Rarely it is found in apes and monkeys but its presence is increased in the gorillas [10]. Variations of this muscle suggest that it may be a primitive condition for anthropoids [7]. The frequency of FTM has increased with evolution and probably that is the reason why it might be found in 95% of the human population [10]. In the present study, the fibularis tertius muscle has been absent in 13% cases which is in line with the Joshi

et al [9] and other researchers who studied this muscle in cadavers (Table 1) except Rourke *et al* [12] and Kunnika *et al* [15] reporting lesser prevalence of it. Witvrouw *et al* [4] have studied the significance of this muscle in ankle injuries and concluded that, absence of FTM neither would affect the movements of foot nor increase the prevalence of ankle or 5th metatarsal bone injuries. According to Krammer *et al* [16] FTM is the most lateral fasciculus of the extensor digitorum longus, and it is a small muscle clearly separated from the latter. We reported three different types of FTM bellies. We have observed completely distinct belly of FTM from extensor digitorum longus (Fig.1) in 80.45 % while Joshi *et al* [9] have described it in 90%. In 8.04 % of lower limb there has been a complete absence of FTM belly but an independent tendon of FTM being arising from EDL (Fig. 3).

Variations in the distal attachment of the FTM have been reported by many researchers [4, 5, 9, 17]. We have observed the distal attachment of this muscle on dorsum of 4th metatarsal, 5th metatarsal or on both metatarsals. We have observed two slips of distal attachment of FTM (Fig. 4, 5, 6) in 23 (26.43 %) cadavers. Janna and Roy [18] have reported two slips of distal attachment of it; medial slip being attached to dorsal digital expansion of 5th toe and dorsum of the head of the 5th toe but we have not reported such type of attachment. The most common type observed by us has been medial slip which was attached to 4th metatarsal and lateral one being attached to 5th metatarsal (Fig. 6) which extended onto under surface of the 5th metatarsal and deep fascia of the foot. Rourke *et al* [12] also reported same type of attachment. Joshi *et al* [9] have observed that, tendon of FTM extended beyond fifth metatarsal up to metatarsophalangeal joint of fifth toe in 4%, but we have found extension of medial slip of tendon of FTM up to 4th metatarsophalangeal joint in 2.29 % (Fig. 5). Present study has reported duplication of tendon of fibularis tertius in 2.82% (Fig. 8) and reported incidence of it in literature is 1-2% [4, 11].

We have observed very rare and interesting variation of FTM in one cadaver. EDL has had only 3 tendons and tendon for little toe to be arising from FTM. FTM has had separate insertion on distal part of 4th metatarsal (Fig.7). While searching the literature we have not come across such type of variation which is unique. Though it is rare it should be kept in mind that FTM may give rise to tendon of EDL.Thus the precise knowledge of variations of FTM may be helpful for foot

Table 1: Showing the Incidence of Fibularis Tertius Muscle Reported By Various Authors

Author	Type of study	Population studied	Incidence of FTM (%)
Krammer *et al* (1979) [15]; (n= 169)	Cadaver dissection	Austria	92.2
Kunnika *et al* (2004) [17]; (n= 247)	Cadaver dissection	Thai	95.55
Domagala *et al* (2006) [19];(n= 193)	Cadaver dissection	Poland	83.16
Joshi *et al* (2006) [9]; (n= 110)	Cadaver dissection	Indian	89.55
Witvrouw *et al* (2006) [4]; (n= 200)	Surface anatomy	Belgium	81.5
Rourke *et al* (2007) [12]; (n=41)	Cadaver dissection	Swansea, UK	93.9
Ramirez *et al* (2010) [20]; (n= 168)	Surface anatomy	Chile	49.11
Present study (2014) (n=280)	Cadaver dissection	Indian	87

surgeons, radiologist and anatomist also.

Conclusion:

This study has been carried out to report the incidence and variations in its proximal and distal attachments in Indian population. We have observed three different types of FTM bellies and varieties of variations of its distal attachment. Because of the bipedal mode of locomotion the musculature of the lower limb of humans has greatly modified and some of muscles are still in progress of evolution and are appearing like the fibularis tertius. Frequent variations are seen in the FTM as regards their mode of attachment especially distal, which indicate that it has not reached its final stage of evolution and till searching its destination. Detailed study of this muscle should be carried out in different population groups with the help of cadaveric and fetal dissection, radiology and surface anatomy which will provide us additional knowledge.

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