

## Case Report

# Anomalous Insertion of Extensor Hallucis Longus and Its Clinical Importance

Shikha S, Vandana M (✉), Shweta K, Suri RK

Department of Anatomy, Vardhman Mahavir Medical College, New Delhi-110029, India

### Abstract

Frequent variations are reported in muscles and ligaments of lower limb suggesting that these muscles are yet to achieve the evolutionary fate. Extensor Hallucis longus (EHL) is one such muscle exhibiting anomalies which prove to be of importance while explaining functional anatomy and clinical correlations of the foot. The current study reports unilateral presence of variant EHL tendon encountered during cadaveric dissection of dorsum of foot for undergraduate teaching. The tendon bifurcated into two slips (medial and lateral) at the base of first metatarsal. The main tendinous slip (lateral) was found to be inserted as usual on the dorsal aspect of the terminal phalanx of great toe. The thin medial slip was attached to the medial half of dorsal aspect of base of proximal phalanx of the great toe medial to the insertion of extensor hallucis brevis. An attempt is made to discuss the clinical implications of the variation in the light of available anatomical literature. The results of current study are of clinical relevance to orthopedicians and reconstructive surgeons.

**Keywords:** Accessory tendon; Hallux valgus; Extensor hallucis longus; Reconstructive surgery; Tendon repair

### Correspondence:

Vandana Mehta. Department of Anatomy, VMMC & Safdarjung Hospital, Ansari Nagar, New Delhi-110029, India. Tel: +91-9910061399 Fax: +011-25927323 E-mail: drvandanamehta@gmail.com

Date of submission: 21 July, 2018

Date of acceptance: 9 Oct, 2018

### Introduction

Muscles and ligaments of the lower limb play an important role in maintaining erect posture of humans. Frequent variations are observed in these muscles in their arrangement, manner of attachment and degree of subdivision (1). These variations suggest that these muscles are yet to achieve their ultimate evolutionary fate (2).

The extensor hallucis longus muscle (EHL) originates from the middle half of anterior surface of the fibula and from the interosseous membrane and is inserted into the dorsal aspect of base of distal phalanx of the great toe. It plays role in the extension of great toe and dorsiflexion of the foot at the ankle joint. It also helps in the inversion of the foot at the subtalar and transverse tarsal joints (3,4).

Anomalies relating to EHL insertion such as double tendon are of prime importance while explaining functional anatomy of foot and its correlation with

clinical aspects. The muscle maybe implicated in the management of hallux varus deformity (5). Besides, the additional tendon can be used by orthopaedicians in reconstructive surgeries, plastic, maxillofacial, burns and heart surgery (6-8). The other uses of the EHL include reconstruction of tendons, repair of ligament defects, stabilization of joint and maintenance of position of soft tissue (9).

Awareness about such muscular variations will benefit the surgeons in understanding and avoiding post-operative complications. This will aid in better outcomes of transposition, neurotisations and fasciotomies and also for creating better fasciocutaneous flap operations.

### Case Report

During the routine dissection hall teaching programme of medical undergraduate students, an anomalous

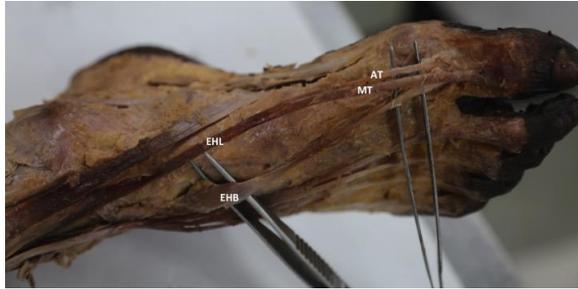


Figure 1: Dissection of the dorsum of Right Foot showing the tendinous insertions (Superior view) (EHL: Extensor Hallucis Longus; EHB: Extensor Hallucis Brevis; AT: Accessory tendon of Extensor Hallucis Longus; MT: Main tendon of Extensor Hallucis Longus)

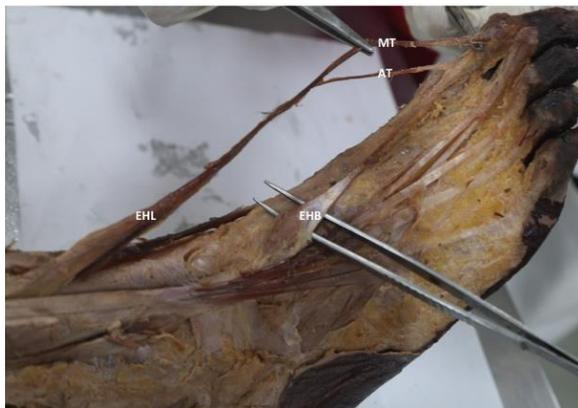


Figure 2: Dissection of the dorsum of Right Foot showing the tendinous insertions (Lateral view). (EHL: Extensor Hallucis Longus; EHB: Extensor Hallucis Brevis; AT: Accessory tendon of Extensor Hallucis Longus; MT: Main tendon of Extensor Hallucis Longus)

morphology of extensor hallucis longus tendon in the right foot was observed in a 63-year old Indian male cadaver. The deep fascia of front of leg was carefully divided and the extensor retinaculum approached. The tendons were followed upwards and downwards and individual muscles studied. The extensor hallucis longus tendon was found originating from the middle half of the anterior surface of fibula and from the interosseous membrane. On reaching the base of first metatarsal, the tendon bifurcated into two slips (medial and lateral) (Fig. 1). The main tendinous slip (lateral) was longer and was found to be inserted as usual on the dorsal surface of base of distal phalanx (Fig. 2). The thin medial slip was attached to the medial half of dorsal aspect of base of proximal phalanx of great toe medial to the insertion of extensor hallucis brevis. The main tendon measured 3.5 cm whereas the accessory tendon 2.9 cm in length. The innervation of the muscle (EHL) was derived from the deep peroneal nerve as usual. The other tendons in the vicinity displayed

normal anatomical disposition. No neurovascular variations were observed. The other foot exhibited normal anatomical profile.

## Discussion

Various anatomy textbooks describe extensor hallucis longus tendon as a penniform muscle of anterior compartment of leg.

The presence of accessory tendon can be attributed to subdivision of the primitive tendon plate during embryogenesis (10). Additionally, the occurrence of supernumerary tendons especially in the lower extremity may be considered as an evolutionary change occurring in alteration to bipedal locomotion in humans.

Conflicting reports have been mentioned concerning the incidence of accessory tendons of EHL. Few textbooks describe accessory tendon (AT) as an occasional occurrence (11) whereas few others claim it to be commonly present (12). Various cadaveric studies have documented variable frequencies ranging from 35% to 81% (10,13-15).

Apart from its usual site of insertion at the dorsal aspect of the base of the distal phalanx various other insertion sites are reported in literature such as the dorsal aspect of the base of the proximal phalanx, capsule of the first metatarsophalangeal joint, or a connection with the tendon of extensor hallucis brevis muscle. A study (13) reported the splitting of tendon into two at the ankle joint, just beneath the inferior extensor retinaculum and attachment of both the tendons to middle of the dorsal aspect of the base of the distal phalanx of the hallux. It was further observed in this study that the lateral tendon was thicker as compared to the medial tendon in only 15 out of 44 legs. Boyd (15) observed accessory tendon to be diverging either from the muscle belly or from proximal part of EHL. He also observed AT to be thinner than main tendon in all the cases. Boyd (15) further documented origin of AT from muscles such as anterior tibial and extensor hallucis brevis muscles. Wood (16) reported doubling of EHL tendon along the muscle length with accessory fibres running parallel and lateral to the main tendon. Fibres may join EHB or terminate by inserting into first meta-tarsal, proximal phalanx or both phalanges of the big toe. Another study reported presence of three bellies and three tendons and was termed extensor hallucis longus tricaudata (17).

Hallux valgus is a clinical condition associated with the lateral deviation of the great toe at the metatarso-

phalangeal joint which leads to progressive disability and painful condition by the pull of the flexor hallucis longus and the extensor hallucis longus muscle (18). It is suggested that accessory tendons (especially medial) apart from extending the proximal phalanx, also pulls base of proximal phalanx medially. This reduces the lateral pull exerted by the main tendon resulting in imbalance on line of movement and increased tendency to the development of hallux valgus.

Among various operations developed to cure the condition of hallux valgus, one is to displace and suture the tendon of extensor hallucis longus medially in order to keep the big toe in alignment by its contraction (19). Various contradicting reports concerning role of accessory tendon of EHL in hallux valgus have been put forward with a few suggesting the positive association (14) where as others who do not support any such association (10).

The accessory tendon inserted on the base of proximal phalanx of the big toe directly or through its connection to or capsule of first metatarso-phalangeal joint adds to the flexibility during the movement of extension of big toe that usually accompanies walking and running. It is suggested that the accessory tendon(AT) may help in bringing the pull of EHL muscle in line with long axis of the great toe thereby maintaining a strong dorsiflexion of great toe.

The authors hypothesize that since the accessory tendinous insertion of EHL was disposed at the dorsal aspect of proximal phalanx, it may be regarded as an adjuvant to the action of Extensor hallucis brevis. This may possibly influence the biomechanics of the foot and also altering the course of surgical interventions in EHL injuries.

Although these accessory tendons are reported frequently but their explanation and clinical importance in rarely discussed in clinical anatomy textbooks undermining its importance. Thus Surgeons should be vigilant about variant extensor hallucis tendon and their probable use in management of various clinical pathologies.

Accessory tendons are useful during clinical management of various conditions such as tendon ruptures, tendon repairs, tendon transfer operations e.g. in Hallux varus deformity. (5)

The additional functions include repair of ligament defects, stabilizing joints and maintenance of position of soft tissues (9). Double tendons can be considered as an adjustment rather than a variation

(20) and hence can also be used to increase and sustain the power of dorsiflexion.

Prior awareness of these variations is vital for surgeons in order to avoid postoperative complications. Moreover, it is expected that these tendinous variations will improve the outcome of surgical procedures like transposition, neurotisations and fasciotomies as well as in creating fasciocutaneous flap operations. The present report is an attempt to reinforce awareness of such tendinous variations which is beneficial while performing reconstructive procedures. Knowledge of such anatomical variants also contributes to successful outcome of rehabilitative ventures.

## Conclusion

The reporting of anomalous tendons in the lower extremity are extremely vital as they may alter the biomechanics of the foot as well as be valuable for the reconstructive surgeons.

## References

1. Borley NR, Healy JC, Collins P, Johnson D, Crossman AR, Mahadevan V. Leg. In: S Standring (Ed.): Gray's Anatomy. 40th Edition. New York: Churchill Livingstone Elsevier.2008; p 1418.
2. Bhargava, KN., Sanyal, KP.,Bhargava, SN. Lateral musculature of the leg as seen in hundred Indian Cadavers. Ind J Med Sci. 1961; 15(3): 181-185.
3. Moore KL, Dalley AF. Clinically oriented anatomy. 4th ed. Lippincott Williams & Wilkins.1999; p. 577
4. Woodburne RT, Burkel WE. Essentials of human anatomy, 9th ed. Oxford University Press, New York Oxford.1994; p. 610.
5. Casal D, Pais D, Almeida M, Bilhim T, Santos A, Neil G. Morphometric analysis of the extensor tendons of the hallux and potential implications for tendon grafting. Eur J Anat, 2010; 14 (1): 11-18.
6. Wehbe M. Tendon graft anatomy and harvesting. Orthop Rev.1994 23: 253-256.

7. Schenk, S., Meizer, R., Kramer, R., Aigner, N., Landsiedl, F., Steinboeck, G. Resection arthroplasty with and without capsular interposition for treatment of severe hallux rigidus. *Int Orthop.* 2009;33: 145-150.
8. Terzis JK, Kyere SA. Minitendon graft transfer for suspension of the paralyzed lower eyelid: our experience. *Plast Reconstr Surg.* 2008; 121: 1206-1216.
9. Breek JC, Tan AM, Thiel TP, Daantje CR. Free tendon grafting to repair the metacarpophalangeal joint of the thumb. Surgical techniques and a review of 70 patients. *J Bone Joint Surg Br.* 1989;71: 383-387.
10. Bibbo C, Arangio G, Patel DV. The accessory extensor tendon of the first metatarsophalangeal joint. *Foot Ankle Int.* 2004;25: 387-390.
11. Romanes GJ. *Cunningham's Textbook of Anatomy.* 12th Ed. Oxford: Oxford University Press. 1981; p 390.
12. Standring S, Berkovitz BK, Borley NR, Crossman AR, Davies MS, FitzGerald MJ, Glass J, Hackney CM, Ind T, Mundy AR, Newell RL, Ruskell GL, Shah, *Gray's Anatomy.* 39th Ed. Edinburgh: Elsevier, 2005, p 1495.
13. Denk CC, Oznur A, Surucu HS. Double tendons at the distal attachment of the extensor hallucislongus muscle. *Surg Radiol Anat.* 2002;24: 50-52.
14. Al-Saggaf S. Variations in the insertion of the extensor hallucislongus muscle. *Folia Morphol.* 2003; 62(2): 147- 155.
15. Boyd N, Brock H, Meier A, Miller R, Mlady G, Firoozbakhsh K. Extensor hallucis capsularis: Frequency and identification on MRI. *Foot Ankle Int.* 2006; 27:181–184.
16. Wood J. Variations in human myology observed during the winter session of 1866–67 at King's College. *Proceedings of the Royal Society.* London. 1867, 15: 518–546.
17. Gruber W. Ein neuer Fall von Musculus extensor hallucis longus tricaudatus. *Arch Anat Physiol Wissen Med.* 1876; p 750–752.
18. Snell RS. *Clinical anatomy for medical students.* 6th ed. Lippincott Williams & Wilkins, 2000, p. 561.
19. Thorek PH. *Anatomy in surgery.* 2nd ed. J.B. Lippincott Company, 1962, p. 845.
20. Kaneff A, Stephanoff A. Comparative anatomical investigation of the M. extensor hallucislongus in man. *Gegenbaurs Morphol Jahrb.* 1982; 128(5): 690-701