

Morphometric Assessment of the Variation in Insertion of Extensor Hallucis Longus in Human Cadavers

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Abstract

Aim: Anatomical study of variation in insertion of extensor hallucis longus in human cadavers.

Methods: The material for this study comprised of 50 lower limbs of 25 embalmed adult human cadavers obtained from the Department of Anatomy, GMC, Bettiah, Bihar, India. Muscles of anterior compartment of leg were dissected and the extensor hallucis longus was explored and studied.

Results: In the present study, out of 50 total limbs in the study, 46 (92%) belonged to male cadavers while 4 (8%) belonged to female cadavers. Variation was encountered in three male cadavers. In 4 female limbs, no variation was encountered. In the present study, in 6 (12%) limbs double tendons were present. The muscle was observed to divide into two tendons, lateral and medial at the level of ankle joint. The lateral tendon was inserted normally on the dorsum of base of distal phalanx of hallux, but the medial tendon was variable in its insertion. In 2 (4%) limbs, the medial tendon was inserted on the dorsal aspect of head of 1st metatarsal however in 4 (8%) cases, the insertion of medial tendon was on the dorsal aspect of base of proximal phalanx of hallux. Origin of extensor hallucis longus muscle was exactly in consonance with standard textbook pattern in all the 50 limbs. Table 2 summarizes that in 4 (8%) cases insertion was on dorsal aspect of base of proximal phalanx of hallux and in 2 (4%) cases insertion was on dorsal aspect of head of first metatarsal. The average length of this muscle was longer (28.6 cm) as compared to its tendinous part (13.6 cm). Deep peroneal nerve supplied this muscle in all the limbs of the present study.

Conclusion: The evidence of supernumerary tendons in the extensor hallucis longus have been well documented many years ago. However, our value is not significantly higher than that described recently by other authors.

Keywords: supernumerary tendons, extensor hallucis longus, cadavers.

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Introduction

The extensor hallucis longus (EHL) is a thin muscle situated deep between the tibialis anterior muscle (TAM) and the extensor

digitorum longus (EDL). The EHL takes origin from the middle half of the fibula and the interosseous membrane, just medial to

the EDL. The muscle belly becomes a long tendon, passes behind the superior and inferior extensor retinaculum. Near the ankle the anterior tibial artery and vein are crossed by EHL tendon from the lateral to the medial side and inserts on the dorsal aspect of the base of the distal phalanx of the big toe [1]. EHL extend the big toe, dorsiflex the foot, adjunct foot eversion and inversion and stretch the plantar aponeurosis [2]. The EHL is characterized by morphological variability with regard to the number of its additional bands and their insertion [3,7]. Most previous research has focused on its possible morphological variations, particularly those regarding the additional bands. One classification has been proposed for these variations [3], however, it requires systematization and upgrading to account for the identification of new band types.

Material and methods

The material for this study comprised of 50 lower limbs of 25 embalmed adult human cadavers obtained from the Department of Anatomy, GMC, Bettiah, Bihar, India. Muscles of anterior compartment of leg were dissected and the extensor hallucis longus was explored and studied. The origins of this muscle were cleaned from fibula and interosseous membrane. The tendon of this muscle was traced on the dorsal aspect of base of distal phalanx of hallux. The branch of deep peroneal nerve supplying it was also traced. Length of each muscle was measured as the distance from the origin of the most proximal muscle fibres to the insertion site of most distal muscle fibres by using unbraided silk thread and metal measuring ruler. Length of the tendons was also taken in a similar

manner. Tendon slips were defined as tendinous divisions of common tendon. Individual length of each slip was taken from a point at which the common tendon starts dividing upto its attachment to the bone. Any variation regarding the mode of origin, course, insertion and nerve supply of extensor hallucis longus was observed and photograph was taken.

Results

In the present study, out of 50 total limbs in the study, 46 (92%) belonged to male cadavers while 4 (8%) belonged to female cadavers. Variation was encountered in three male cadavers. In 4 female limbs, no variation was observed. In the present study, in 6 (12%) limbs double tendons were present (Table 1). The muscle was observed to split into two tendons, lateral and medial at the level of ankle joint. The lateral tendon was inserted normally on the dorsum of base of distal phalanx of hallux, but the medial tendon was variable in its insertion. In 2 (4%) limbs, the medial tendon was inserted on the dorsal aspect of head of 1st metatarsal however in 4 (8%) cases, the insertion of medial tendon was on the dorsal aspect of base of proximal phalanx of hallux. Origin of extensor hallucis longus muscle was exactly in consonance with standard textbook pattern in all the 50 limbs. Table 2 summarizes that in 4 (8 %) cases insertion was on dorsal aspect of base of proximal phalanx of hallux and in 2 (4 %) cases insertion was on dorsal aspect of head of first metatarsal. The average length of this muscle was longer (28.6 cm) as compared to its tendinous part (13.6 cm). Deep peroneal nerve supplied this muscle in all the limbs of the present study.

Table 1: Mode of insertion of extensor hallucis longus in the present study Total no of limbs- 50

Mode of insertion	No	Percentage
Normal mode of insertion	44	88%
Double tendons	06	12%



Figure 1: tendon of extensor hallucis longus **Figure 2: double tendon of extensor hallucis longus**

Table 2: Distribution of bilaterally symmetrical variations in extensor hallucis longus

Name of muscle	Variation encountered	No. of limbs [n(%age)]	Significance of variations
Extensor hallucis longus	Double tendons present		The clinical significance of these variations is that the accessory tendons can be used in cases of tendon rupture, the repair of main tendon, to increase and sustain the power of dorsiflexion and in hallux varus deformity.
	<ol style="list-style-type: none"> 1. Lateral inserted normally 2. Medial on dorsal aspect of proximal phalanx of hallux Double tendons present	4 (8%)	
	<ul style="list-style-type: none"> • Lateral inserted normally • Medial on dorsal aspect of head of 1st metatarsal 	2 (4%)	

Discussion

Supernumerary tendons in the hallucal extensor apparatus have been well documented for more than 125 years. (Macalister 1875) [8]. Tate described an accessory tendon of the extensor hallucis

longus in the majority of individuals (Tate et al. 1976) [9]. Hallisy (1930) [10] observed double tendons of extensor hallucis longus in 70 (24.13%) cases. The secondary tendinous slip of the extensor hallucis longus may arise from the medial aspect of extensor hallucis longus tendon

and insert into sling portion of the extensor apparatus [11]. Without giving incidence, Anson (1966) [12] also mentioned double tendons of extensor hallucis longus. More recently, these findings have been reproduced by several authors. The tendon of extensor hallucis longus may be double; the lateral tendon may be inserted to the middle of the dorsal aspect of the base of the distal phalanx of the hallux and medial tendon to the medial side of the insertion of the lateral tendon [13]. Notwithstanding the reported high frequency of these accessory tendons, their clinical importance has been considered relatively minor, and their description is even omitted from many modern, comprehensive clinical anatomy textbooks [14]. In the present study this muscle showed no variation in its mode of origin. The insertion was found normal on the dorsal aspect of base of distal phalanx of hallux in 44(88%) limbs dissected in the present study. 6 (12%) limbs depicted variations in their mode of insertion. In the present study the muscle was supplied by a branch of deep peroneal nerve in all the cases.

Al-saggaf (2003) [15] found various pattern of insertions in extensor hallucis longus muscle. In some cases, the muscle had a single tendon inserted on the dorsal aspect of the base of distal phalanx of the big toe, in other cases, the muscle terminated in two tendons while in few cases, the muscle terminated in three tendinous slips.

Aktekin (2008) [16] studied the incidence of accessory tendons of extensor hallucis longus muscle. In 23 (51%) out of 45 fetuses, there were accessory tendons. In all cases, the accessory tendons were always diverging to the medial side of the main EHL tendons and attached to the metatarsophalangeal joint capsule distal to the joint space. However, our value is not significantly higher than that described recently by other authors, who described accessory tendons of EHL in 70-87% of cases [15,18].

Conclusion

The evidence of supernumerary tendons in the extensor hallucis longus have been well documented many years ago. However, our value is not significantly higher than that described recently by other authors. As a conclusion, anatomical characteristics of EHL so found and mentioned in this study may be used as an additional source for tendon grafting procedures. These can be used in tendon ruptures, repair of main tendon, in tendon transfer operations in e.g., in Hallux varus deformity, ligament defects, to stabilize joints and maintain soft tissues in position. These double tendons may be regarded as an adaptation rather than a variation. These accessory tendons can also be used to increase and sustain the power of dorsiflexion.

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