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ANATOMIC VARIATIONS

Double origin of the extensor hallucis longus muscle: a case report

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Abstract
Most of the anatomic variations of the extensor hallucis longus (EHL) muscle are related to the tendon of insertion. We show a double origin of the EHL from the medial aspect of the fibula and the lateral aspect of the tibia. A 27-year-old male with a double closed fracture of tibia and fibula showed an involuntary extension of the big toe during foot plantar flexion after surgery. A tendon fibrosis by the fixation plates could be the cause of the foot functional alteration. Interestingly, the anatomic variation described could be related to the postsurgical foot dysfunction, since when the fibrotic tissue was removed the normal extension of big toe recovered. As illustrated in this case report, knowledge of anatomic variations is very useful, particularly in the context of foot surgery.

Keywords Hallucis longus muscle · Anatomic variations · Foot dysfunction · Foot surgery

Introduction

The extensor hallucis longus (EHL) muscle, one of the four muscles of the anterior compartment of the lower limb, is a deep and thin muscle that lies between the extensor digitorum longus and the tibialis anterior muscles. The EHL is responsible for the extension of the big toe, but it also assists in dorsiflexion and inversion of the foot. In addition, its contraction contributes to stretching the plantar aponeurosis [14]. Anatomic variations of the EHL tendons may have significant clinical implications. Therefore, their knowledge is relevant for clinicians, particularly for radiologists and surgeons.

Case report

A 27-year-old male with a closed fracture of the distal third of the left tibia and fibula involving the ankle joint was successfully treated by placing plates on the tibia and fibula (Fig. 1). After 3 months, the patient complained of involuntary extension of the big toe during foot plantar flexion (Supplementary material 1: Video). Entrapment of the EHL tendon was suspected as a complication of the fracture. Nine months later, surgery for plate removal and tendon release was performed. Following surgical incision of the anterior aspect of the ankle, an anatomic variation of the EHL tendon was observed (Fig. 2). The muscle had a double origin with two fleshy bellies, one arising from the medial aspect of the fibula and the other one from the lateral aspect of the tibia. The latter passed over the distal end of one of the fixation plates and was fibrotic. Removal of the plates and detachment of the fibrotic tissue were performed. After surgery, the patient fully recovered from the muscle functionality, and normal flexion–extension of the foot was restored (Supplementary material 2: Video).

Jose M. Egea and Laura Cabeza have the same contribution.

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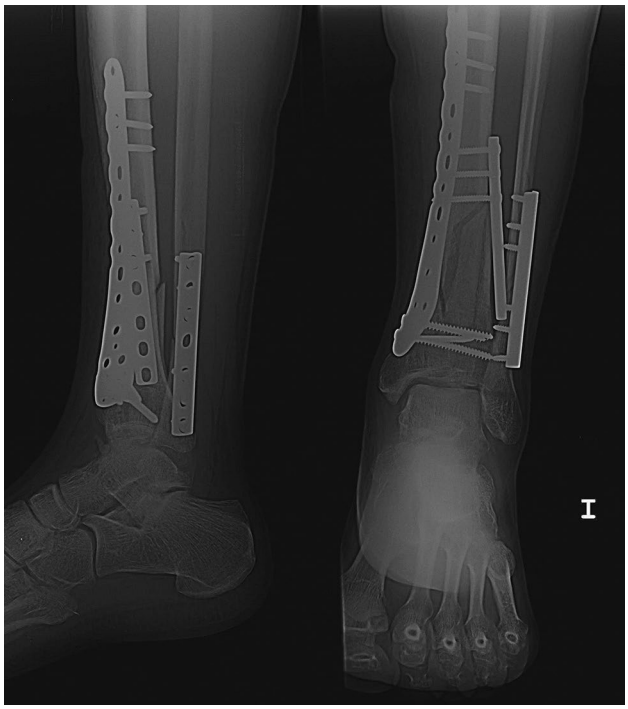

Fig. 1 Anteroposterior and lateral X-ray projections of the distal left lower limb. Traces of comminuted fracture with internal fixation material: locking plate, placed on the medial tibia, and one-third tubular plates, placed on the anterolateral tibia and on the lateral fibula

Discussion

Although uncommon, anatomic variations of the EHL muscle, and especially its tendons, need to be acknowledged by many specialists given their potential clinical implications. Most anatomic variations of the EHL reported to date concern its tendon of insertion rather than its tendon of origin. The most frequent configuration (65%) consists of a single tendon that inserts into the dorsal surface of the base of the distal phalanx of the hallux. However, the presence of two or three tendinous slips has been reported, with a prevalence of 26.7% and 8.3%, respectively [15]. In these cases, an accessory tendon to the second toe has been described [2, 4]. These variations may have specific clinical implications in some foot conditions (e.g., hallux varus and clawed hallux associated with a cavus foot) [2]. Natsis et al. [11] found an association between the presence of an accessory tendon and the prevalence of hallux valgus deformity. No statistically significant correlation with the severity of this condition was found, though.

Moreover, an EHL terminal tendon with three contributions has been reported [8]. This variation consists of a main tendon, a medial tendon that joined to the main one,

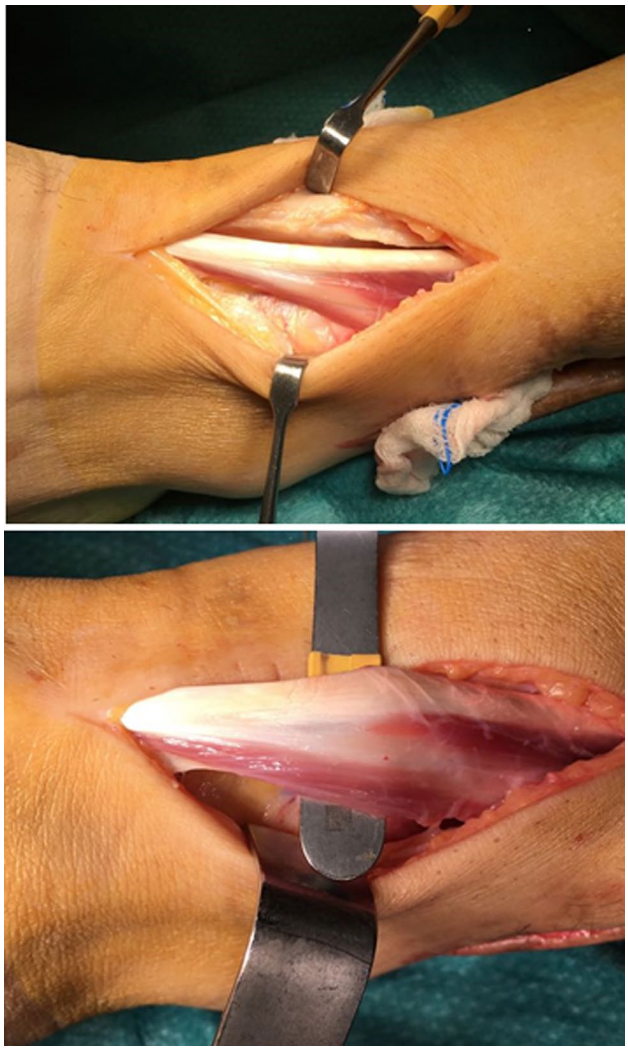

Fig. 2 Surgical opening of the anterior aspect of the ankle. Incision along the EHL and opening of the retinaculum revealed a main tendon originating from two thinner tendons merging proximally (upper). Exposure of the tendons with the aid of a surgical retractor (lower)

and a lateral tendon that originated from a supernumerary muscle belly and merged with the tendon of the extensor hallucis brevis. Besides, a variation of the EHL termed EHL tricaudatus has been described. In this case, the muscle has three tendons from three independent muscle bellies, the smaller of which is named EHL minor [4]. Other anatomic variations of the EHL include the extensor primi internodii hallucis of Wood (EPIH) and the extensor primi metatarsal of Gruber (EPM). The EPIH is an accessory muscle that runs parallel and lateral to the main muscle, and may insert into the base of the proximal phalanx of the hallux, the first metatarsus, or both phalanges of the hallux [4, 9, 10]. When the insertion site is the capsule of the first metatarsophalangeal joint, the EHL variation is named extensor hallucis capsularis [3, 5, 6, 10]. On

the other hand, EPM is a rare variant that inserts distally into the dorsal aspect of the head of the first metatarsal [7, 10]. Furthermore, an accessory tendon, the extensor digiti secundus muscle, has been described. This variation presents a tendinous bifurcation near the base of the second metatarsal and insertions in both the first and second toes, which simultaneously extend when the muscle is contracted [13]. Recently, Zdilla et al. [15] described a unique variation in which the tendons of the EPIH and the extensor hallucis brevis merged together proximal to the tarsometatarsal (Lisfranc) joint in a cavus foot with a clawed hallux. Notably, few studies on the bilaterality of EHL accessory tendons have been carried out, but Aktekin et al. [1] reported a frequency of 33% in foetuses.

On the other hand, although anatomic variations of the origin of the EHL have been reported including the presence of a double origin [12], few cases have been related with the clinic. We described a double origin of the EHL with two fleshy insertions arising from the medial aspect of the fibula and the lateral aspect of the tibia, respectively. Fibrosis of the tibial tendon by fracture healing and osteosynthesis of the distal third of the tibia and fibula could explain the postsurgical foot dysfunction in our patient. In fact, the detachment of the fibrotic tissue allowed the normal big toe functionality. As illustrated in this case report, knowledge of anatomic variations is very useful, particularly in the context of foot surgery.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest to disclose.

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