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REVIEW OF EXTENSOR PRIMI INTERNODDI HALLUCIS AS A VARIANT OF EXTENSOR HALLUCIS LONGUS

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ABSTRACT

The Extensor Primi Internoddi Hallucis (EPIH) is a rare and often disregarded accessory muscle in the foot which is located between Extensor Hallucis Longus (EHL) and Extensor Digitorum Longus (EDL) tendons. Studies on anatomical structures and clinical cases have confirmed its existence despite its rarity. The purpose of this article is to present a thorough analysis of the EPIH muscle, including its anatomical characteristics, development, and clinical significance. Understanding the anatomy of the EPIH is essential for surgeons and clinicians, particularly in cases of dorsal foot pain, deformities, or during surgical interventions. The article also explores the potential implications of this accessory muscle in conditions such as hallux valgus, extensor tendinopathy and its role in misdiagnosis during imaging. The article highlights the need for awareness of anatomical variations in the foot by discussing case studies to ensure accurate diagnosis and appropriate treatment strategies.

Keywords: *Extensor Primi Internoddi Hallucis, Hallux valgus, tendinopathies, dorsal foot pain*

Abbreviations*: Extensor Primi Internoddi Hallucis (EPIH), Extensor Hallucis Longus (EHL), Extensor Digitorum Longus (EDL), Peroneus Tertius (PT)*

INTRODUCTION

The muscle extensor hallucis longus (EHL) is among the muscles of the anterior compartment of the leg, along with the tibialis anterior, extensor digitorum longus and peroneus tertius as the rest of the three. The anterior tibial artery supplies the anterior compartment and is innervated by a deep peroneal nerve. Muscles in this compartment dorsiflex the ankle and extend the toes. EHL mainly dorsiflex the foot and extends the metatarsophalangeal and interphalangeal joints of the big toe. These actions of the muscle are possible because of its origin and insertion, which allows the swing phase of the gait since it allows the foot to clear the ground.

EHL has piqued the interest of various anatomists and medical professionals because of its variable morphology. The presence of one or more tendinous structures is amongst the most common variations of EHL. The first accurate classification, created by [1]Al-Saggaf (2003), distinguished three types of the EHL with divisions into subtypes. However, Olewnik et (2019a) found new types, creating a new classification that complemented the previous system. The clinical issues related to EHL are frequently associated with pathologies such as tendinosis or closed tendon ruptures, which can be caused by active tendon contraction against resistance. Peroneal severe nerve damage is another disease that weakens this muscle. The various variants are named based on their variable origin and insertion. Suppose the accessory tendinous slip inserts distally into the base of the proximal phalanx of the hallux, distal to, medial to, or directly into the extensor hallucis brevis (EHB) tendon distal attachment. In that case, it will be termed **Extensor Primi Internoddi Hallucis**. It will be known as **Extensor Hallucis Capsularis Tendon, Secondary Extensor hallucis Longus, Accessory Extensor Tendon** of the first metatarsophalangeal joint**, Extensor Ossis Metatarsi Hallucis** if it inserts into a dorsomedial aspect of the first metatarsophalangeal joint capsule and the base of the first proximal phalanx.

The primary objective of this review is to explore data from the current literature regarding the variants of the insertion of the EHL. Another aim is to add new data about EHL, which can be the basis for further anatomical, clinical, and functional studies. This article also includes descriptions of the most prevalent disorders linked to the EHL.

CASE REPORT

A routine dissection was done in the Sharir Rachana department of the National Institute of Ayurveda, Jaipur. These variations were found while dissecting a 79-year-old formalin-fixed male cadaver of North Indian Origin. The body was donated voluntarily, and the formalin-fixed lower limbs were observed for this study. The variant muscle, which had its muscular belly that originated from the EHL at the middle and lower one-third of the anterior surface of the fibula and interosseous membrane, passed through the capsule of the metatarsophalangeal joint and entered the base of the hallux's proximal phalanx inserting deep into the hallux along with EHL was observed in the left leg. This muscle was later identified as Extensor Primi Internoddi Hallucis (EPIH). This EPIH shared its tendon with EHB as well. As the tendon of EHB is inserted into the tendon of the EPIH at the first metatarsophalangeal joint, right next to the prominence created by the second metatarsal base, both medially and proximally, as shown in Fig 1

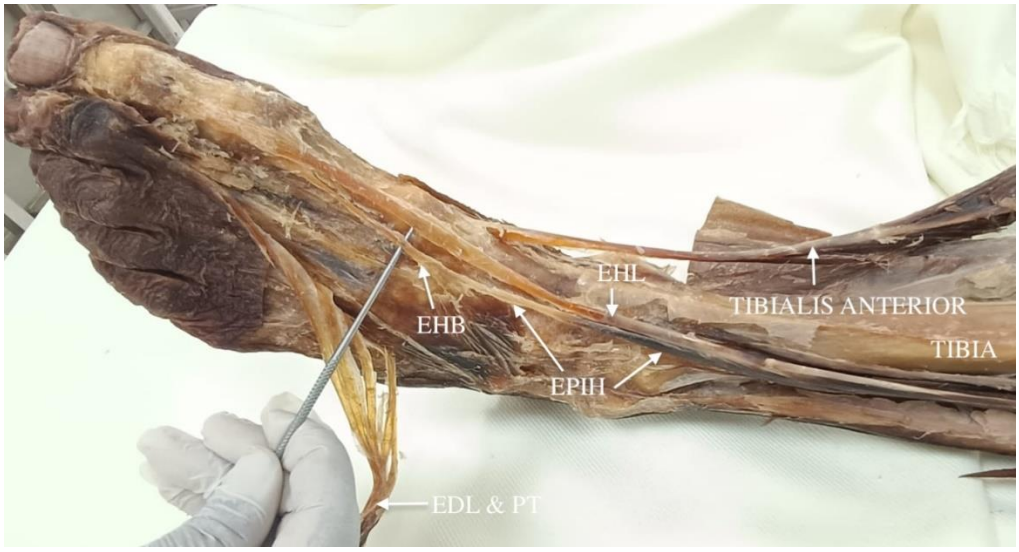

Fig 1: Anterior view of left leg: figure depicting Tibialis anterior, Tibia bone, Extensor Hallucis Longus (EHL), Extensor Primi Internoddi Hallucis (EPIH), Extensor Digitorum Longus (EDL) and Peroneus Tertius (PT)

The total length of the muscle belly of EPIH measured 15.3 cm, with 2.3 cm being the widest part of the belly. The tendon arising from EPIH before joining the tendon of EHB measured 4.3 cm. Later, this composite tendon of EPIH and EHB traversed a total of 6.6 cm and entered the base of the proximal phalanx of the hallux. Thus, the total length of the EPIH tendon was 10.9 cm. The width of the EHB tendon measured 0.2 cm. and that of the EPIH was 0.5 cm. The entire length of the EPIH, from its origin at the distal one-third and middle one-third of the fibula to its insertion at the first metatarsophalangeal joint, measured 26.2 cm.

DISCUSSION

The muscle EPIH itself is among the rare variations. Embryologically, the prevalence of EPIH might result from incomplete muscle development during the intra-embryonic life of the foetus. EPIH is among the accessory muscles that are leftover forms of evolutionary structures or polymorphisms that exhibit population-to-population variability. These exhibitions of polymorphisms of EPIH among people directly suggest uncertain genetic and developmental factors.

The information we had put forth concerning EPIH is exceptional in itself since it bestowed its muscle belly, which is extremely rare. EPIH generally described so far has been found medially to EHL in the majority of the cases, but in the case report we presented, it was found to be lateral to the tendon of EHL along with its amalgamation with the tendon of EHB at the base of the second metatarsal enhanced its intricacy. Understanding the EPIH's position and function is of utmost importance as it might be a factor in dysfunctions or functional adaptations related to the extensor mechanism of the foot. Because of this, surgeons and anatomists need to be aware of this muscle during dissection or surgery to prevent surprise discoveries.

CONCLUSION

Although the presence of EPIH may not always cause symptoms, it can surely hamper the function of the foot and hence alter the clinical outcomes in specific diseases. In hallux, valgus, altered tensions in the tendon due to EPIH may exacerbate the deformity or complicate its surgical repair. It could also imitate or mask conditions like tendinopathies, thus making it challenging to conclude radiological investigations. In patients with unusual swelling, dorsal foot pain or toe deformity, this EPIH might be incorrectly diagnosed as a mass, leading to unnecessary investigations.

Due to the rare presence of EPIH, raising awareness among physicians and surgeons can reduce the possibility of misdiagnosis and enhance patient outcomes. More research will be required to learn more about the incidence of EPIH in various populations and its biomechanical function in foot diseases.

CLINICAL SIGNIFICANCE

Surgeons face several difficulties due to the EPIH. The auxiliary muscle may need to be exercised during treatments like hallux surgery to reduce mechanical strain or repair abnormalities brought on by the poor biomechanics of the tendons. An auxiliary muscle may interfere with normal anatomic expectations, which surgeons doing tendon transplants or foot reconstructions should know. If the EPIH is causing discomfort or functioning, surgical removal may be necessary in some circumstances. Clinicians and radiologists must exercise caution when diagnosing pathogenic entities like tumours, ganglia, or tendon tears by accurately identifying accessory muscles like EPIH on imaging tests. Accurate diagnosis and treatment planning requires a detailed grasp of typical anatomical variances and their possible impact on foot mechanics.

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