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## Case Report

# A cadaveric case study of the fibulo calcaneus internus muscle as a rare accessory muscle of calf region

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### ABSTRACT

The fibulocalcaneus (peroneocalcaneus) Internus (FCI) muscle which is also called as Peroneo calcaneus Internus (PCI) muscle (of MacAlister) is a rare variation of calf muscle with a low prevalence of <1%-3% in cadaveric dissection and imaging studies. The FCI arises from the posterior-medial aspect of the distal 1/3 of the fibula, descends posterior and lateral to the flexor hallucis longus (FHL) muscle. It then traverses the tarsal tunnel inferior to the sustentaculum tali of the Calcaneus, and get inserted into the plantar surface of the calcaneus. However, controversy exists concerning the exact location of the insertion site of FCI muscle. Recently the insertion of the FCI muscle has been described as distal to the coronoid fossa, a small depression between the anterior tuberosity and the anterior apex of the sustentaculum tali of the calcaneus. However, chronological descriptions described the FCI as inserting into either the sustentaculum tali itself or a small tubercle on the medial surface of the calcaneus distal to the sustentaculum tali.

During routine dissection for under graduate students, about 56-year old Indian male, a Fibulocalcaneus (peroneocalcaneus) Internus (FCI) muscle was identified, which originated from the posterior medial surface of distal third of the fibula and tendon merges with 2<sup>nd</sup> slip of flexor digitorum longus and get inserted on base of distal phalanx of second toe. Knowledge of the FCI muscle is important due its involvement with various ankle pathologies, including predisposing individuals to tarsal tunnel syndrome, FHL tenosynovitis, and posterior ankle impingement and pain. The FCI muscle is one of the least common muscular variants associated with the ankle joint, and it has been implicated in posterior ankle pain and impingement. This muscle is often confused with the flexor digitorum accessorius longus (FDAL) muscle. Additionally, this study describes ways to differentiate between the FCI and FDAL muscles in the lower leg. Radiologists and clinicians should be aware of this anomalous muscle when considering various diagnoses, interpreting radiographs, and pursuing surgical involvement to reduce symptoms of posterior ankle region.

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## 1. Introduction

A fibulocalcaneus (peroneocalcaneus) internus (FCI) muscle was identified and photographed in the left leg of a 78-year-old male cadaver. This cadaveric case study provides the first gross anatomical photo of this anomalous leg muscle and represents the first gross anatomical

dissection of this muscle since 1914. The FCI muscle get originates from the posterior medial surface of distal 1/3 of the fibula, below the origin of Flexor Hallucis Longus Muscle, Posterior Intermuscular Septum of the leg, and Flexor Hallucis Longus Muscle. The FCI muscle inserted into the inferior surface of the medial calcaneus distal to the coronoid fossa, a small depression between the anterior tuberosity and the apex of the sustentaculum tali.<sup>1</sup> This

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insertion point differs from the historical literature, which usually refers to the muscle inserting into the inferior surface of the sustentaculum tali of the calcaneus bone or simply distal to the sustentaculum tali into the medial aspect of the Calcaneus.<sup>2</sup>

The FCI muscle is one of the rare common muscular variants associated with the ankle joint, and it has been implicated in posterior ankle pain and impingement, as well as it has involvement in tarsal tunnel syndrome. This muscle is frequently mystified with the flexor Digitorum Accessorius Longus (FDAL) muscle.<sup>3</sup> Additionally, this study describes ways to differentiate between the FCI and FDAL muscles in the lower leg. Radiologists and clinicians should be aware of this atypical muscle when considering various diagnoses, interpreting radiographs, and pursuing surgical interference to relieve calf region symptoms.<sup>4</sup>

### 1.1. History and etymology

The Peroneo Calcaneus Internus muscle was firstly identified by German Anatomist Johann Friedrich Meckel in 1815 and then additional described by the Irish Anatomist Alexander MacAlister (1844–1919) in year 1872.

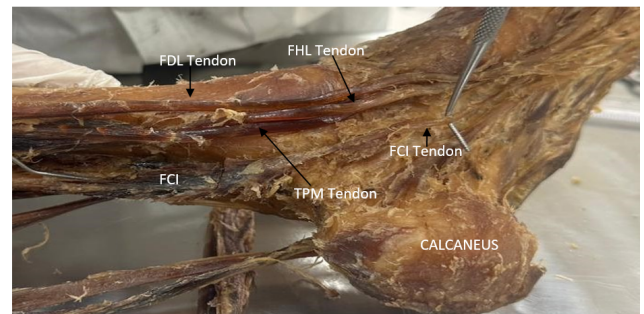
## 2. Materials and Methods

During routine cadaveric dissection of approximately 84-year-old male cadaver of North Indian origin, a Fibulo Calcaneus (peroneocalcaneus) Internus (FCI) muscle was identified. The muscle get origin from the posterior medial surface of distal 1/3 of the fibula, below the origin Flexor Hallucis Longus muscle in left lower extremity were observed during routine dissection for undergraduate B.A.M.S. students at Department of Rachana Sharir, National Institute of Ayurveda Deemed University, Jaipur, Rajasthan.

## 3. Case Description

During routine dissection for BAMS Graduate Scholars of Department of Rachana Sharir, National Institute of Ayurveda Deemed University, Jaipur,, it was observed that while dissecting the posterior compartment left lower leg and its musculature a fibulocalcaneus (peroneocalcaneus) internus (FCI) muscle was identified in an 84 year-old north Indian male. This rare variation muscle originates from the distal 1/3 of the medial surface of fibula, the posterior intermuscular septum of the leg, and below the origin Flexor Hallucis longus(FHL) muscle. In the distal leg, this anomalous muscle paralleled the inferomedial course of the FHL on its lateral side to become tendinous and pass later to the medial malleolus. The tendon of the FCI muscle continued downward to pass superior to the sustentaculum tali of the Calcaneus in separate fibro-osseous tunnel (Figure 1). This tendon merges with 2<sup>nd</sup> slip of

Flexor Digitorum Longus and gets inserted on the base of distal phalanx of second toe. The length of muscle was 27.5 cm with the muscle belly measuring about 08 cm and the tendon 19.5 cm in length, determined with a scale as well as 6-inch digital caliper. The innervations of the FCI muscle was derived from a branch of the Tibial nerve which entered the distal to FHL muscle belly and continued to innervate the anomalous muscle proximally.<sup>5</sup>



**Fig. 1:** Showing origin of Fibulo Calcaneus Internus (FCI) muscle from medial surface of lower 1/3rd of shaft of Fibula and get inserted on base of distal phalanx of 2<sup>nd</sup> toe



**Fig. 2:** Showing length of Fibulo Calcaneus Internus (FCI) muscle from medial surface of lower 1/3rd of shaft of Fibula and get inserted on base of distal phalanx of 2<sup>nd</sup> toe

## 4. Discussion

The atypical calf muscle discovered in our case study was determined to be the fibulocalcaneus internus (FCI) for all of the following reasons: (1) it originated from the medial surface of lower 1/3 of the fibula. It paralleled and remained medial to the course of the Flexor Hallucis Longus and FDL muscles in the distal leg; (3) it was located medially within the tarsal tunnel; and merges with 2<sup>nd</sup> slip of flexor digitorum longus and get inserted on base of distal phalanx of 2<sup>nd</sup> toe which is different case from the previous descriptions of the FCI muscle (Meckel, 1815; MacAlister, 1872; Curnow, 1873; Testut, 1884; Hartmann, 1888; Thane, 1891; LeDouble, 1897; Perkins, 1914; Bejjani and Jahss,

1985).<sup>6</sup> After thorough review of the literature, this rare case study with different insertion may be represent the first photograph of this rare muscle in a cadaveric specimen. The Fibulo Calcaneus Internus muscle has been also seen in cross-section in MRI studies (Mellado et al., 1997;<sup>7</sup> Cheung and Rosenberg, 2001; Best et al), a digital three-dimensional reconstruction (Carroll, 2008),<sup>8</sup> and artistic drawings of the muscle (Thane, 1891; Perkins, 1914); however, no gross anatomical photograph of the muscle existed until this case study. This article also uses current terminology concerning the bony landmarks of the Calcaneus bone to list specifically the insertion of the Fibulo Calcaneus Internus muscle as being into the inferior surface of the medial Calcaneus distal to the Coronoid Fossa. It is a small depression between the anterior tuberosity and the anterior apex of the sustentaculum tali (Kelikian, 2011). The previous descriptions of the insertion point of the Fibulo Calcaneus Internus muscle remain vague and vary between inserting into the sustentaculum tali of the calcaneus (MacAlister, 1872; Best et al.) into a small tubercle on the medial surface of the calcaneus distal to the sustentaculum tali (Thane, 1891; Curnow, 1873; Perkins, 1914; Mellado et al., 1997; Cheung and Rosenberg, 2001; Carroll, 2008; Sookur et al., 2008; Amini, 2011).<sup>9</sup> The determination of the insertion point of the Fibulo Calcaneus Internus muscle seems to rely on what historical reference was used, rather than the actual dissection of the insertion of the muscle. The extremely low incidence of the FCI muscle has created confusion in the literature, mainly due to the existence of other anomalous muscles in the deep posterior leg compartment. Frequently, the Fibulo Calcaneus Internus is misidentified as the Flexor Digitorum Accessorius Longus (FDAL), another variation on posterior calf muscle which is also passes underneath the flexor retinaculum of the leg, or within the tarsal tunnel (Porter, 1996; Mellado et al., 1997; Cheung and Rosenberg, 2001; Seipel et al., 2005; Sookur et al., 2008). The incidence of the FDAL muscle is much more prevalent than the Fibulo Calcaneus Internus with the FDAL being present in 6% of asymptomatic individuals during MRI studies (Cheung et al., 1999) and 2%–8% of lower limbs in cadaveric studies (Wood, 1868; Driver, 1914; Lewis, 1962; Nathan et al., 1975; Peterson et al., 1995; Cheung and Rosenberg, 2001; Sookur et al., 2008). The FDAL muscle has been mistakenly portrayed as being synonymous with the Fibulo Calcaneus Internus due to both muscles coursing within the tarsal tunnel deep to the flexor retinaculum (Schaeffer, 1953; Bergman et al., 1988; Cheung and Rosenberg, 2001), despite the original 1884 work by French physician Testut describing the differences between the FCI and FDAL muscles (Testut, 1884; Mellado et al., 1997). Although it is rarely seen in cadaveric or MRI studies, the Fibulo Calcaneus Internus muscle has important clinical implications. In two separate MRI studies of adolescent athletes who presented with posterior ankle

pain and impingement, marked fluid distension of the FHL tendon sheath (FHL tenosynovitis) was noted above its fibro-osseous tunnel, with associated synovial debris, due to the presence of bilateral Fibulo Calcaneus Internus muscles. Surgical excision of the Fibulo Calcaneus Internus muscles relieved the posterior ankle pain and impingement in these patients (Best et al., 2005; Seipel et al., 2005). Some Researchers hypothesized that, as this variation muscle courses inferomedially in the distal calf, it may dislodge the muscle belly of the FHL anteriorly and medially, impinging on the neurovascular bundle to cause Tarsal Tunnel Syndrome (Mellado et al., 1997; Seipel et al., 2005).<sup>10</sup> Evidence supporting this theory came in a 2010 case study, which implicated the presence of two atypical muscles, the Fibulo Calcaneus Internus and FDAL muscles, as the etiology of tarsal tunnel syndrome, or compressive entrapment of the tibial nerve (Duran Stanton and Bui-Mansfield, 2010).<sup>11</sup> Athlete with unusual cause of pain connected with an anomalous muscle Fibulo Calcaneus Internus muscle seen in MRI.<sup>9</sup> Though, the presence of the FDAL muscle, which overlies the neurovascular bundle, has more often been implicated in causing Tarsal Tunnel Syndrome by acting as a space occupying lesion (Sammarco and Stephens, 1990; Sammarco and Conti, 1994; Wittmayer and Freed, 2007;<sup>12</sup> Bowers et al., 2009). Additionally, clinicians performing posterior foot Endoscopy, a minimally invasive surgical approach for diagnosis and treatment of posterior calf pathology, often use the FHL as a landmark (van Dijk et al., 2000). These surgeons operate lateral to the FHL muscle to evade iatrogenic damage to the Tibial Nerve and posterior Tibial vessels; therefore, the Fibulo Calcaneus Internus, which resides at this location, is placed at danger during this surgical practice (van Dijk et al., 2000; Phisitkul and Amendola, 2010). A Fibulo Calcaneus Internus muscle was identified in our cadaveric dissection, and the first gross anatomical photo of this anomalous muscle with different insertion point has been presented (Figure 1). This muscle is one of the slightest common muscular variants associated with the ankle joint, and it has been implicated in posterior calf pain and impingement, as well as potential involvement in Tarsal Tunnel Syndrome. So, Radiologists and clinicians should be aware of this strange muscle when considering various diagnoses, interpreting radiographs, and pursuing surgical intrusion to relieve symptoms or pathologies of the posterior compartment of leg.<sup>13</sup>

## 5. Conclusion

The Fibulo Calcaneus Internus (FCI) muscle was originally discovered by the German anatomist Johann Friedrich Meckel in 1815 and then further described by the Irish anatomist Alexander MacAlister in 1872. This muscle displaces the flexor hallucis longus muscle anteromedially and might have be erroneous for a pathological conditions like Tarsal Tunnel Syndrome, posterior ankle impingement,

flexor hallucis longus tenosynovitis etc. and a potential altered approach during ankle arthroscopy with the danger of neurovascular damage. So Radiologists and clinicians should be aware of this uncommon muscle when considering various diagnoses, interpreting radiographs, and pursuing surgical procedure to relieve symptoms or pathologies of the posterior compartment of leg.

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## 7. Conflict of Interest

None.


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