Original Research Article

STUDY OF ABSENCE OF 4TH TENDON OF FLEXOR DIGITORUM BREVIS MUSCLE

Rakesh Kumar Agarwal 1, Seema Rani Khajuria *2, Hemant Saini 3.

1 Assistant Professor, Department of Anatomy, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti Solan (H.P.) India.
*2 Assistant Professor, Department of Anatomy, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti Solan (H.P.) India.
3 Demonstrator, Department of Anatomy, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti Solan (H.P.) India.

ABSTRACT

Background: Flexor digitorum brevis is an intrinsic muscle of the sole of foot that lies immediately deep to central part of plantar aponeurosis. The flexor digitorum brevis divided into four tendons for lateral four toes. Each tendon is divided into two slips at base of proximal phalanx, to allow the flexor digitorum longus tendons and get inserted on both sides of the shaft of middle phalanx. It helps to reinforce arch of foot by flexing the proximal interphalangeal and metatarsophalangeal joints of the lateral four toes. Flexor digitorum brevis muscular flap is used in the reconstruction of the heel pad and it is frequently used to correct crossover toe deformity so architecture of the foot is important because it may help in the surgical procedures during correction of above deformities.

Materials and Methods: This study was conducted on 50 feet in 25 healthy cadavers to see the variation of flexor digitorum brevis tendon.

Result: We observed that fourth tendon of flexor digitorum brevis for the fifth toe was absent in 37 cadaver feet. Out of these 14 cadavers (28 feet) showed bilateral absence of the 4th tendon while unilateral tendon absence was seen in 9 feet.

Conclusion: We concluded that such variation may occur as phylogenetic change due to minimal use of 5th toe in evolved bipedal posture. The action of flexor digitorum brevis being flexion of toes can be compensated by another long flexor of the foot.

KEY WORDS: 4th Tendon, 5th toe, Flexor digitorum brevis, Metatarsophalangeal joints.

Address for Correspondence: Dr. Seema Rani Khajuria, Assistant Professor, Department of Anatomy, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti Solan-173229 (H.P.) India. E-Mail: drrakeshagarwal@rediffmail.com

Introduction

Flexor digitorum brevis is an intrinsic muscle of the sole of foot that lies immediately deep to central part of plantar aponeurosis and inferior to the tendons of flexor digitorum longus. It takes origin from center part of plantar aponeurosis, medial tubercle of calcaneal tuberosity and medial and lateral intramuscular septa. The flexor digitorum brevis is divided into four tendons for lateral four toes. Each tendon...
is divided into two slips at base of proximal phalanx, to allow the flexor digitorum longus tendons and get inserted on both sides of the shaft of middle phalanx. Flexor digitorum brevis is supplied by medial plantar nerve. It helps to reinforce arch of foot by flexing the proximal interphalangeal and metatarsophalangeal joints of the lateral four toes [1]. Paralysis of flexor digitorum brevis results in distortion of arch of foot [2]. Due to bipedal posture the function of little toe is minimal and has no opposition action in humans. Hence, the tendon of little toe coming from flexor digitorum brevis muscle maybe absent sometime such variations of flexor digitorum is of clinical importance because it is often used in reconstruction of the heel pad and it is frequently used to correct cross over deformity and to treat painful toe disorders such as lateral ankle deformity [3,4].

Recent and ongoing advances in plastic and orthopedic surgeries of lower limb have created a need for detailed understanding of anatomical variations and morphometry of flexor digitorum brevis muscle. Bergman and Henle also describe the Anatomical variations and morphometry of flexor digitorum brevis in their studies [5,6].

MATERIALS AND METHODS

This study was conducted on total number of 50 feet on 25 healthy human cadavers in the department of anatomy, Maharishi Markandeswvar medical college and hospital, Kumarhatti, Solan (H.P).

Dissection of the sole of feet were performed according to the guidelines by Cunningham manual [1].

We took longitudinally incision through the skin and superficial fascia of the sole of foot from heel to the root of middle toe and reflected it. Then we cut the planter aponeurosis 2-3 cm from front of heal and split the distal part longitudinally away from the first layer of sole thus exposing the flexor digitorum brevis muscle and tendon [1].

RESULTS

This study was conducted on 50 feet of 25 healthy cadavers during this study we noticed that the 4th tendon which inserted on 5th toe was absent in 37 feet (74%) also see table no 1.

Bilateral absence of the 4th tendon shows in 14 cadavers in 28 feet (56%) (fig.1) and 9 (18%) show unilateral absence. Out of these 9 cadavers 5 (10%) were on right feet (fig.2) and 4(8%) were on left feet (fig.3).

**Table 1:** Frequency of variation in absence of 4th tendon of flexor digitorum brevis muscle Anatomical Variations.

<table>
<thead>
<tr>
<th>Total No. Of Feet</th>
<th>Normal Feet</th>
<th>Percentages (%)</th>
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</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>13</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>8%</td>
</tr>
</tbody>
</table>

**Fig. 1:** Bilaterally absent of 4th tendon of (FDB) flexor digitorum brevis muscle showing only 1st, 2nd, 3rd tendons.

**Fig. 2:** Unilateral (right side) absent of 4th tendon of (FDB) flexor digitorum brevis muscle showing only 1st, 2nd, 3rd tendons.
**DISCUSSION**

The knowledge of flexor digitorum brevis is essential in treating congenital abnormalities, pathological conditions and traumatic injuries of feet and ankle [7]. Flexor digitorum brevis is very important because it helps to control the changes in posture of foot and maintains the longitudinal arch of foot [8]. It carries out flexion of 2nd to 5th toe, a function maintained by flexor digitorum longus when former is expanded [9].

The incidence of absence of flexor digitorum brevis tendon of 5th toe is the commonest anatomical variation of this muscle. In our study we found incidence of 74% which is close to the incidence of 72% reported by Ilayperuma et al. [10] However lower incidences were seen in various other studies, 63%, 21%, 18% [11,5,12]. Lobo et al reported absence of 4th tendon in100% of the study population [13].

The incidence of bilateral absence of flexor digitorum brevis tendon of 5th toe in our study was 56% which is close to the incidence of 46% reported by Srivastava et al [14] and 38.2% reported by Yammine [15].

The incidence of unilateral absence of right flexor digitorum brevis tendon of 5th toe in our study was 18% out of which right sided absence was seen in 10% and left side in 8%. Srivastava el at reported similar findings 9% on right and 18% on the left [14].

During evaluation as brachiation is not used for locomotion, degenerative changes have occurred in muscle therefore, in man muscle is often absent unilaterally or bilaterally and incidences of agenesis is gradually increasing in different races and population [7]. The usage of 5th toe in human is minimal further more no opposition action in humans [16]. Thinking along these lines, it has been speculated that muscle acting on little toe are undergoing evolutionary changes [13]. This is further supported by the results obtained from an electromyographic investigation of foot muscles that reports three toe flexor muscles act together to resist extension of toes during the stance phase of locomotion. Despite the large flexor accessorius muscle in human, neither it nor the flexor digitorum brevis were preferentially recruited over the flexor digitorum longus for any normal posture or locomotion [17].

Sirasangandla SR et al evaluated the morphometry of 44 fixed limbs. He measured length and breadth of the muscle and the length of each tendon from its origin to distal attachment. He revealed that the tendon of the great toe had the highest mean length (9.5 cm) and the tendon of the fourth toe had the lowest mean length (6.3 cm). Four of the limbs studied (9.09%) had only three tendons. Three of the limbs studied (6.81%) had five tendons [18].

Clinically, the knowledge of anatomical variation of flexor digitorum brevis is necessary for surgical and diagnostic purpose because understanding about muscle attachment of the foot may assist in designing of surgical procedures such as tendon transfer, biomechanical modeling of foot, reconstruction of heel pad, correction of flexible claw and hammer toe deformity.

**CONCLUSION**

In our study we observe that flexor digitorum brevis variation is common because out of the 50 feet, 37 feet shows the fifth toe did not receive any tendon. Bilateral absence observed in 28 feet while unilateral absence was observed in 9 feet. Out of these 9, right side tendon absence in 5 feet and left side in 4 feet. On the basis of our study and review of other literatures we concluded that such variation may occurs as phylogenetic change due to minimal use of 5th toe in evolved bipedal posture [13]. The action of flexor digitorum brevis being flexion of toes can be compensated by another long flexor of the foot. An awareness of this
variation is important for the surgeons for the reconstruction of the heel pad by transferring the musculocutaneous flap of flexor digitorum brevis muscle.\(^{(19, 20)}\)

**Conflicts of Interests:** None

**REFERENCES**


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