The Presence of the Peroneus Tertius Muscle in Thai People

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Abstract : The peroneus tertius is a small partially separated portion of the extensor digitorum longus, as its fifth tendon, but has an important role in locomotion and in the evolution of human beings. It supports and stabilizes the longitudinal arches of the foot while standing and locomotion during bipedalism. In particular, it assists in everting the foot, which is a characteristically human movement. This study was performed by dissecting 247 legs from 144 cadavers. In these cadavers, we found a high percentage of the presence of this muscle, the peroneus tertius, (95.55%). The absence of the muscle was rare,; only in 4.45%. Regarding the muscle size, which was calibrated at the ankle joint and compared with the common tendon of the extensor digitorum longus at the same area, the proportion was very large at 34.77% in the right leg and 39.55% in the left leg. The results of this study emphasized and clarified the important role of this muscle.

Key words : Peroneus tertius

เรื่องย่อ : **กล้ามเนื้อ เพอโรเนียส เทอเชียส ของคนไทย**

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กล้ามเนื้อเพอโรเนียส เทอเชียส (peroneus tertius muscle) เป็นกล้ามเนื้อมัดเล็กๆ ที่ขา แยกมาจากส่วนของกล้ามเนื้อ เอ็กซเทนเซอร์ ดิจิตอลุ่ม ลองกัส (extensor digitorum longus muscle) เป็นกล้ามเนื้อที่มีบทบาทสำคัญต่อการเคลื่อนไหวและในเชิงวิวัฒนาการของมนุษย์ ทำหน้าที่ช่วยพยุงโค้งของเท้าขณะยืนและขณะมีการเคลื่อนไหวของร่างกาย เป็นกุญแจสำคัญเกี่ยวกับวิวัฒนาการของมนุษย์ที่สามารถยืนตรง และเดินบนเท้า ๒ ข้าง และสามารถหันฝ่าเท้าออกด้านนอกได้ อันเป็นลักษณะเฉพาะของมนุษย์ การทำงานของกล้ามเนื้อ เพอโรเนียส เทอเชียส จากการศึกษาโดยการชำแหละขาทั้งหมด รวม ๒๔๗ ข้าง ของศพที่นักศึกษาแพทย์ใช้เรียนในห้องปฏิบัติการมหกายวิภาคศาสตร์ จำนวน ๑๔๔ ร่าง พบจำนวนขาที่มีกล้ามเนื้อเพอโรเนียส เทอเชียส มากถึง ๙๕.๕๕ เปอร์เซ็นต์

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ส่วนจำนวนขาที่ไม่พบกล้ามเนื้อมัดนี้มีเพียงเล็กน้อยคือ ๔.๔๕ เปอร์เซ็นต์เท่านั้น จากการวัดขนาดของกล้ามเนื้อ เพอโรเนียส เทอเชียส ที่บริเวณหน้าต่อข้อเท้า พบว่ากล้ามเนื้อมัดนี้มีขนาดค่อนข้างใหญ่ ซึ่งเมื่อคิดเป็นสัดส่วนเปรียบเทียบกับขนาดของกล้ามเนื้อ เอ็กซเทนเซอร์ ดิจิตอลุ่ม ลองกัส ที่วัดในตำแหน่งเดียวกันแล้ว พบว่ามีสัดส่วนของกล้ามเนื้อ เพอโรเนียส เทอเชียส มากถึง ๓๔.๙๗ เปอร์เซ็นต์ในข้างขวา และ ๓๙.๕๕ เปอร์เซ็นต์ ในข้างซ้าย ผลจากการศึกษาแสดงให้เห็นถึงความสำคัญของกล้ามเนื้อ เพอโรเนียส เทอเชียส ชัดเจนมากยิ่งขึ้น

INTRODUCTION

The peroneus tertius, a muscle in the anterior compartment of the leg, is a small partially separated portion of the extensor digitorum longus, as if it were its fifth tendon[1]. It arises in common with the extensor digitorum longus, from the lower part of the anterior surface of the fibula and from adjoining fascia[2], interosseous membrane and anterior crural intermuscular septum. Its tendon runs with those of the extensor digitorum longus and passes behind the superior and in a loop of the inferior extensor retinaculum. It is inserted into the dorsum of the fifth metatarsal near its base, or into the deep fascia nearby[2] (Figure 1). It assists in dorsiflexion of the ankle joint and in everting the foot. Moreover, the peroneus tertius pulls upon the lateral longitudinal arch of the foot to stabilize the arch from the action of peroneus longus muscle, which acts to increase the general concavity of the sole[2]. This muscle, the peroneus tertius, is a muscle for which evolution may be rendering more important, for eversion, which is a characteristically human movement[2]. This muscle is often absent[2]. Discussion of this absence, however, is often neglected in most anatomy text, with the exception of, Gray's Anatomy[1], which states that the peroneus tertius was missing in 4.4% of dissections, according to Werneck (1957)[3]. Jungers et al (1993)[4] also said that the frequency of peroneus tertius in humans is approximately 95%.

The purpose of this study is to find the frequency of peroneus tertius presence, by dissecting the cadavers used for medical students of the Department of Anatomy, Faculty of Medicine at Siriraj Hospital. The study aims to determine the frequency of its presence and to describe its size, when compared with the size of the common muscle at the ankle joint.

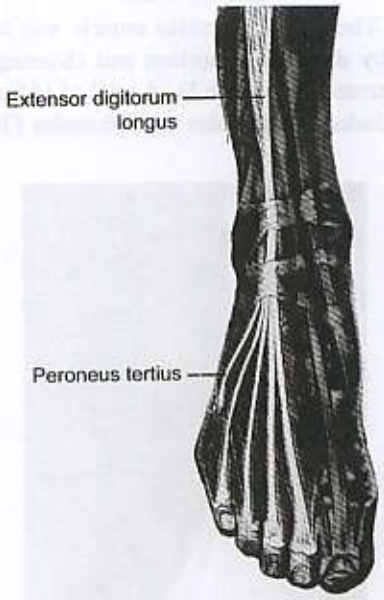

Figure 1. Diagram showing the attachment of the peroneus tertius.

MATERIALS AND METHODS

The anterior compartment of legs were dissected from cadavers used by medical students of the Department of Anatomy, Faculty of Medicine at Siriraj Hospital. This activity was performed over three education years, thirty-nine specimens in 1995, fifty-seven in 1996 and forty-eight in 2003. The dissection was done on both the right and left legs. The muscles in the anterior compartment are tibialis anterior, extensor hallucis longus, extensor digitorum longus and peroneus tertius. The peroneus tertius muscles, if present, were identified and cleaned. The calibration of the size of the common muscle of the

extensor digitorum longus and peroneus tertius were done by use of a vernier caliper at the ankle joint. Then the calibrations were done again at the peroneus tertius muscle. Finally, the peroneus tertius muscles were photographed, and the data were analyzed statistically.

RESULTS

The peroneus tertius muscle was carefully studied by detailed dissection and cleaning of the lower extremities (Figure 2). A total of 144 cadavers were included: 68 females and 76 males (Table 1).

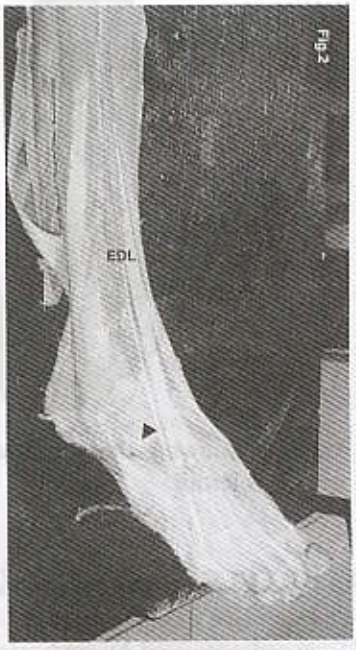

Figure 2. The presence of the peroneus tertius (arrow head).
EDL = Extensor digitorum longus.

The dissection was done on both legs in 113 cadavers, which were 48 females and 55 males. The dissection was done only on the right leg in 31 cadavers, which were 14 females and 17 males. Another 10 cadavers were dissected only at the left leg, for which 6 were females and 4 were males. In total, 247 legs were dissected, which were 116 female and 131 male legs. We found the absence of peroneus tertius on both legs in 4 cadavers, of which 1 was female and 3 were male. The absence of the peroneus tertius of only the right side (Figure 3) was found in 1 cadaver, which was female and the absence on the left leg, (Figure 4) were found in 2 cadavers, in which 1 was female and 1 was male. From 247 dissected legs, the absence of the peroneus tertius was present in 11 legs or 4.45%, 4 of which were females (3.45%) and 7 of which were males (5.34%).

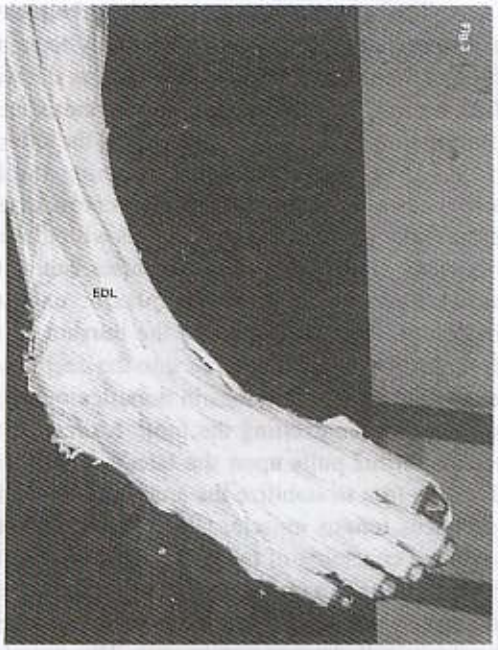

Figure 3. The absence of the peroneus tertius on the right leg.

The maximum width of the common fiber at the ankle joint was 19.6 mm., which was on the left leg of a male cadaver. The maximum of the right leg was 18.1 mm. and also in a male (Table 2). In females, the maximum width of the common fiber at the ankle joint was 14.4 mm., which was on the left leg, while the maximum width of the right leg was 14.0 mm. The minimum width of the common fiber at the ankle joint was 6.0 mm., which was on the left leg in a female, and the minimum width of the common fiber at the right leg in a female was 6.8 mm. The minimum width of the common fiber at the right leg was 6.3 mm., which was in a male, while the minimum width of the common fiber of the left leg in a male was 7.0 mm. The mean width of the common fiber of right

Table 1. Shows the numbers of the precense and the absence of the peroneus tertius.

Sex	Number of cadavers	Right peroneus tertius only	Left peroneus tertius only	Both peroneus tertius	Total dissected peroneus tertius	Absent right peroneus tertius only	Absent left peroneus tertius	Absent peroneus tertius, both sides	Total absence of peroneus tertius	Percentage of peroneus tertius absence
Male	76	17	4	55	131	0	1	3	7	5.34
Female	68	14	6	48	116	1	1	1	4	3.45
Total	144	31	10	113	247	1	2	4	11	4.45

Table 2. Shows the sizes of the extensor digitorum longus muscle and the peroneus tertius muscle at the ankle joint and their proportion.

	Common fiber (mm.)						Peroneus tertius (mm.)						Proportion of Peroneus tertius to Common fiber (%)					
	Male		Female		Both sexes		Male		Female		Both sexes		Male		Female		Both sexes	
	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg	Rt.leg	Lt.leg
Max	18.10	19.60	14.00	14.40	18.10	19.60	11.20	10.00	6.70	7.80	11.20	10.00	75.90	66.40	62.00	61.00	75.90	66.40
Min	6.30	7.00	6.80	6.00	6.30	6.00	1.70	2.00	1.00	1.00	1.00	1.00	17.90	18.30	12.50	12.20	12.50	12.20
Mean	11.29	11.40	9.76	10.36	10.59	10.89	4.18	4.79	3.25	4.01	3.75	4.41	36.27	40.92	32.96	38.13	34.77	39.55

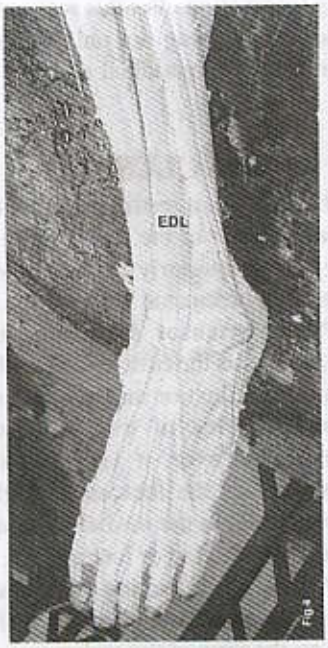

Figure 4. The absence of the peroneus tertius on the left leg.

leg was 10.59 mm. and of the left leg was 10.89 mm. In the males, the mean width of the common fiber of the right leg was 11.29 mm. and of the left leg was 11.40 mm. In the females, the mean width of the common fiber was 9.76 mm. on the right leg and 10.36 mm. on the left leg.

We found that the maximum width of the peroneus tertius was 11.2 mm., which was on the right leg, and the maximum width of the peroneus tertius on the left leg was 10.0 mm. Both were in male cadavers. In the females, the maximum width of the peroneus tertius on the right leg was 6.7 mm. and of the left leg was 7.8 mm. The minimum width of the peroneus tertius was 1.0 mm. on both right and left legs, which were found in a female cadaver, while the minimum width of the peroneus tertius in the males was 1.7 mm., which was on the right leg and 2.0 mm. on the left leg. The mean width of the peroneus tertius of the right leg was 3.75 mm. and of the left leg was 4.41 mm. In the males, the mean width of the peroneus tertius was 4.18 mm. on the right leg and 4.79 mm. on the left leg. In the females, it was 3.25 mm. on the right and 4.01 mm. on the left.

According to the ratio of the peroneus tertius to the common fiber, the maximum ratio was 75.9 which was the right leg of male and the maximum ratio of the left leg was 66.4. Both were in male cadavers. In the females, the maximum ratio of the peroneus tertius to the common fiber on the right leg was 62.0 and on the left leg was 61.0. The minimum ratio was found on the left leg of a female cadaver, which was 12.2 and the minimum ratio of the right leg was 12.5, which was also in female. In the males, the minimum ratio was 17.9, which was in the right leg, while the minimum ratio of the left leg was 18.3. The mean ratio of the peroneus tertius to the common fiber on right leg was 34.77 and on the left side was 39.55. In the males, the mean ratio on the right was 36.27 and on the left was 40.92. In the females, the mean ratio was 32.96 on the right leg and was 38.13 on the left leg.

DISCUSSION

From these results, the absence of the peroneus tertius muscle in Thai cadavers was 4.45%, which was similar to the report by Werneck (1957)[3]. From another point of view, the present of the peroneus tertius in Thai cadavers in this study was 95.55%, which was similar to the report of Jungers et al (1993)[4]. This indicates the indifference in race about this muscle. Furthermore, there is no evidence of evolutionary changes in this muscle over the last 5 decades (from 1957 according to Werneck to now at 2003).

The peroneus tertius is liked one of five tendons of the extensor digitorum longus muscle, which originates from the tibia and passes above and anteriorly to the ankle joint and inserts at the fifth metatarsal bone. Its mean width at the ankle joint was 3.75 mm. on the right leg and 4.41 mm. on the left leg. This indicates that it is rather large when compared with those of the common fiber of the extensor digitorum longus as shown in data (Table 2).

The mean proportion of the peroneus tertius to the common fiber was 34.77% on the right leg and 39.55% on the left leg. This large proportion indicates the functional significance of the human peroneus tertius muscle. This muscle, the peroneus tertius, occurs infrequently in other anthropoid primates, but in extremely high frequency in humans, representing a highly derived condition presumably linked to the evolution of terrestrial bipedalism[4]. The peroneus tertius muscle is one of the important muscles, which aid people to stand upright and walk. It is found in the human embryo early in its development. Therefore it must be a specific characteristic evolved from early humankind. We may be able to draw the conclusion that this contribution to the human upright posture was a significant process in early human development[5].

During bipedalism, the peroneus tertius functions in concert with the extensor digitorum longus and tibialis anterior as a swing-phase muscle in order to level the foot and help the toes clear the ground[4]. Its function is considered to be identical to the extensor digitorum longus in maintaining the ankle and subtalar joint in the neutral position at the beginning of the gait cycle, which is referred to as the initial contact[6] (Figure 5A-E).

In regards to the arches of the foot, the peroneus tertius acts as a sling to support the medial longitudinal arch, which is the highest and most important of the three arches. The medial longitudinal arch is a dynamic arch, which changes most during locomotion. For this reason this muscle plays a role in stabilizing not only the medial arch but also the lateral longitudinal arch[2].

CONCLUSION

The peroneus tertius is a muscle of the anterior compartment of the leg. It originates from the fibula, passes anteriorly to the ankle joint and inserts at the fifth metatarsal bone. It has a common origin with the extensor digitorum longus and sometimes appears as the fifth tendon of this muscle. It functions in dorsiflextion and eversion of the foot, which are key roles of evolution of human bipedalism. Moreover, it supports the lateral longitudinal arch of the foot as a weight bearing structure and stabilizes the medial longitudinal arch of the foot during walking or locomotion. This is an important finding in confirming that bipedalism is a specific property of human beings, which has been determined by the time of the embryonic period. In this study, the presence of the peroneus tertius is 95.55% and the absence is only 4.45%, which is harmonious to Junger[4] in 1993 and Werneck[3] in 1957. This study also demonstrates the large size of the

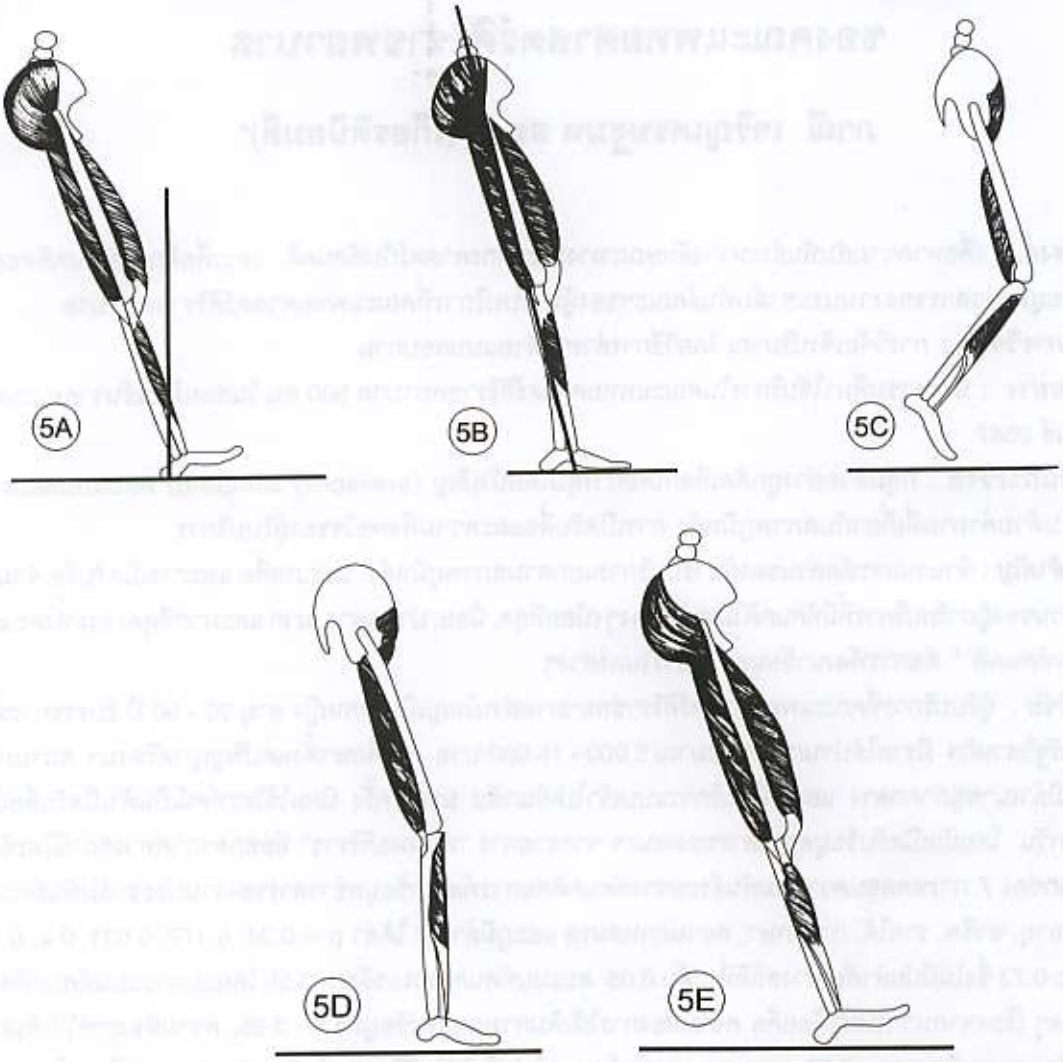

Figure 5. Action of the peroneus tertius, which is one of the pre-tibial muscles (arrow head) in different stages of walking. A = initial contact, B = loading response, C = initial swing, D = mid-swing, E = terminal swing

peroneus tertius in relation to the common fiber, which is 34.77% on the right and 39.55% on the left. This indicates that this muscle is still important to the function of the foot, especially when in the upright position, walking and in human evolution in regards to the development of eversion.

REFERENCES

1. William PL, Warwick R, Dyson M, Bannister LH. Gray's anatomy. 37th ed. London : Churchill Livingstone, 1992: 647.
2. Romanes GJ. Cunningham's textbook of anatomy. 12th ed. London : Oxford University Press, 1981: 390.
3. Werneck HJL. Contribuicao paro o estudo de alguns aspectos morfologicos de M. fibularis tertius. An Fac Med Univ Minas Gerais 1957; **17:** 417 - 520.
4. Jungers WL, Meldrum DJ, Stern JT. The functional and evolutionary significance of the human peroneus tertius muscle. J Hum Evolution 1993; **25:** 377 - 86.
5. Purucher G. Man in evolution: Theosophical University Press, Online edition, 1977. Chapter 7. Proof of Man's Primitive Origin.
6. Ayyappa E. Normal human locomotion. Part 2: Motion. Ground Reaction Force and Muscle Activity 1997; **9:** 49 - 60.