

## Morphometric analysis of peroneus brevis muscle in adult human cadavers

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### Abstract

**Introduction:** Keeping in view the frequency of variations in morphometry of musculature of the lower limb, Peroneus Brevis, the present work has been taken up. Under the research study of Peroneus brevis muscle in adult human cadavers of Punjab, the dissection of sixty limbs was done. This muscle takes origin from distal  $\frac{2}{3}$  of the lateral surface of fibula anterior to the Peroneus Longus and anterior and posterior crural intermuscular septa and its insertion on the lateral aspect of base of fifth metatarsal.

**Aim:** To converse surgical relevance of dissimilarities in the morphometry of this muscle. The present paper is for the curiosity for the disciples of orthopedics, radiology and sports medicine.

**Materials and Methods:** Material consists of 60 lower limbs related to 30 embalmed adult human cadavers (20-70 years) of known sex got from Government Medical College, Amritsar. The muscle was exposed by dissection steps provided by Cunningham's manual of practical anatomy from origin to insertion and length and width was taken.

**Results:** Peroneus brevis muscle was detected in all the cases (60 limbs). Mean value of muscle belly length was 18 cm and width was 1.9 cm. While the mean length of the tendon with no muscle fibers up to insertion was 11 cm, and the mean width was found to be 0.5 cm.

**Conclusion:** The clinical significance of this muscle is that the rebuilding of superior peroneal retinaculum can be done by using a portion of Peroneus brevis. The understanding of these variations will also help the surgeons to avoid post-operative problems such as persistence of pain and improper foot movements.

**Keywords:** Morphometry, Orthopedics, Retinaculum, Reconstruction, Peroneal.

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### Introduction

Discrepancies within the musculature of the peroneal compartment of the leg are unusual. However, clinicians and radiologists should be attentive of anatomical alterations in this section when involved in diagnosis or imaging interpretation<sup>[1]</sup>. The present study is a nice attempt to find the morphometric evaluation of peroneus brevis tendons with its clinical importance. Awareness of such anatomical differences is important for surgeons undertaking reconstructive trials of superior peroneal retinaculum which can be done by using a portion of Peroneus brevis in anterolateral subluxation of peroneal tendons which occurs most frequently in skiers<sup>[2]</sup>. The awareness of variation of the tendon of the peroneus brevis is also significant because of their role in discomfortness around ankle and disability<sup>[3]</sup>. The management of chronic Achilles tendon tears by a less-invasive procedure with the use of peroneus brevis is precisely demanding now a days<sup>[4]</sup>. Human bipedalism is exclusive character with

which we are able to stand and walk with trunk upright and knees nearly straight. Another unusual feature is that we are plantigrade, put down the whole length of the foot on earth or flat surface. Some of the muscles because of the course of progression are either disintegrating or appearing. Frequent variations seen in the mode of origin and insertion of the muscles indicate that they have yet to attain their final transformative stage<sup>[5]</sup>. Peroneus brevis muscle is still in an evolutionary period and the tendon of insertion attached to the proximal or the intermediate phalanx of little toe signifies the inclination of the muscle to develop a Peroneus digiti quinti, a muscle present in the monkeys. Similarly fibrous slip to fourth metatarsal demonstrates tendency to imitate Peroneus digiti quarti, a muscle present which is present in tarsius but not in monkeys<sup>[6]</sup>. Variant insertion of Peroneus brevis can result in ankle pain characterized as radiating from the ankle to the base of the fifth metatarsal bone<sup>[7]</sup>.

### Material Methods

Our study was a confirmation based study which involved 60 lower limbs belonging to 30 embalmed adult human cadavers of known sex (28 male and 2 female) obtained from the Anatomy Department of Government Medical College, Amritsar. The cadavers were marked from one to thirty with suffix R (right) or L (left) and M (male) or F (female). The muscles of peroneal compartment of leg were exposed as per the

dissection steps stated in Cunningham’s manual of practical Anatomy<sup>[8]</sup>. The peroneus brevis muscle was identified in all the 60 dissected lower limbs and was investigated for the following features: proximal attachment (origin), distal attachment (insertion), morphometry of muscle and tendon and any variation regarding the muscle. The muscle belly was evaluated both for total length (from origin up to extent of muscle fibers) and width. Factors evaluated during tendon exploration were, extent of the tendon part without muscle fiber up to insertion and width of tendon (Fig. 2). Length of the fleshy part of the muscle was measured as the distance from the origin of the most proximal muscle fibers to the insertion part of most distal muscle fibers. Silk thread was placed along length of the fleshy part of the muscle. The most proximal and most distal points on the muscle were marked with ink. The length and width was calculated by keeping the marked silk thread on measuring ruler. Length and width of the tendons was also taken in a same way. Any variation from the normal pattern was photographed when felt essential. The observations were noted and gathered, evaluated and compared with the standard textbooks and other existing literature.



Fig. 2: Normal insertion of Peroneus brevis (PB)

**Results**

**Frequency:** Out of the 60 cadaveric dissected human lower limbs, this muscle was found in all the lower limbs (100% cases). **Morphology and variations:** In all the 60 cases muscles took origin normally but insertion in one left limb (1.66%) was on the base of 5<sup>th</sup> metatarsal and also a slip of extension of its tendon was inserted on whole shaft of 5th metatarsal on its dorsal aspect and in rest (98.35%)cases it was normally inserted. The mean length of the muscle belly was 18 cm, and the mean width was 1.9 cm. The mean length of the distal tendon with no muscle fibers was 11 cm, and the mean width was 0.5 cm.



Fig. 1: Peroneus brevis (Extra slip of insertion at head of 5<sup>th</sup> metatarsal)

**Table 1: Comparison of length of fleshy belly and tendon of Peroneus Brevis**

| S. No | Parts of muscle | Range of length (cm) | Average length (cm) |
|-------|-----------------|----------------------|---------------------|
| 1     | Fleshy part     | 9-27cm               | 18                  |
| 2     | Tendinous part  | 4-18cm               | 11                  |
|       | Total           | 13-45cm              | 29                  |

**Table 2: Length of fleshy belly of Peroneus Brevis muscle (Sex wise distribution)**

| S. No. | Length of fleshy belly (cm) | No. of limbs in that range |        |        |       |        |       |        |       |
|--------|-----------------------------|----------------------------|--------|--------|-------|--------|-------|--------|-------|
|        |                             | Male                       |        |        |       | Female |       |        |       |
|        |                             | Rt (n)                     | % age  | Lt (n) | % age | Rt (n) | % age | Lt (n) | % age |
| 1.     | 9-13                        | 4                          | 13.8%  | 4      | 14.8% | --     | --    | --     | --    |
| 2.     | 13.1-17                     | 3                          | 10.3%  | 2      | 7.4%  | 1      | 50%   | --     | --    |
| 3.     | 17.1-21                     | 10                         | 34.5%  | 7      | 25.9% | --     | --    | 1      | 50%   |
| 4.     | 21.1-25                     | 7                          | 24.13% | 10     | 37%   | 1      | 50%   | 1      | 50%   |
| 5.     | 25.1-29                     | 5                          | 17.24% | 4      | 14.8% | --     | --    | --     | --    |
|        | Total                       | 29                         | 100%   | 27     | 100%  | 2      | 100%  | 2      | 100%  |

**Table 3: Length of tendon of Peroneus Brevis mscl (Sex wise distribution)**

| S. No. | Length of tendon (cm) | No. of limbs in that range |        |        |        |        |       |        |       |
|--------|-----------------------|----------------------------|--------|--------|--------|--------|-------|--------|-------|
|        |                       | Male                       |        |        |        | Female |       |        |       |
|        |                       | Rt (n)                     | % age  | Lt (n) | % age  | Rt (n) | % age | Lt (n) | % age |
| 1.     | 4-7                   | 9                          | 33.3%  | 7      | 24.13% | 1      | 50%   | 1      | 50%   |
| 2.     | 7.1-10                | 13                         | 48.14% | 18     | 62%    | 1      | 50%   | 1      | 50%   |
| 3.     | 10.1-13               | 3                          | 11.1%  | 2      | 6.89%  | --     | --    | --     | --    |
| 4.     | 13.1-16               | 1                          | 3.7%   | 1      | 3.44%  | --     | --    | --     | --    |
| 5.     | 16.1-19               | 1                          | 3.7%   | 1      | 3.44%  | --     | --    | --     | --    |
|        | Total                 | 27                         | 100%   | 29     | 100%   | 2      | 100%  | 2      | 100%  |

### Discussion

Peroneus Brevis (PB) muscle of lateral compartment of leg, not only provide eversion movement of foot but also prevents undue inversion and defends the lateral ligament from being put to stretch by such kind of movement. PB muscle acts like a ligament in performing such type of action, but by its energetic, attentive and flexible action, it is much superior to a ligament<sup>[5]</sup>. Peroneal tendon complaints are rare, are frequently missed, and can be a source of lateral ankle pain. Magnetic resonance imaging is the usual technique of radiographic assessment of peroneal tendon disorders<sup>[9]</sup>. It is important to identify these variations especially during fasciotomies, making fascio cutaneous flaps and in traumatic pain of leg. Sometimes Peroneus brevis can be merged with Peroneus longus.<sup>[10,11]</sup> As the average length of fleshy part was 18cm whereas that of tendinous part was 11cm. Thus the contractile component of the muscle was of more length. The average length of fleshy belly reported by **Wickiewicz** was 23cm although it was lower in the present study. The reason may be that Wickiewicz took length of the muscle in maximum stretched state of the limb and also less no. of limbs were taken in consideration by them<sup>[12]</sup>. The length of fleshy belly of this muscle in maximum number of cases was detected in the range of 17.1-25cm in males as well as in females. Regarding length of tendon maximum no. of limbs were found in the range of 7.1-10cm (Table 2, 3). No such comparison of length of fleshy belly and tendon is obtainable in accessible literature. Because of less no. of female bodies available, no inference of comparison of length in male and female was thinkable. Mean value of muscle belly width was 1.9 cm. While the mean width of the tendon was 0.5 cm.

**Table 4: Variation in insertion of Peroneus Brevis (comparative study)**

| Year | Author                      | Variations   |
|------|-----------------------------|--|
| 1907 | Bardeen <sup>13</sup>       | Expansion to Tendon of 4 <sup>th</sup> and 5 <sup>th</sup> toe and on 4th metatarsal.  |
| 1966 | Anson <sup>14</sup>         | Slip to Middle phalanx of 5 <sup>th</sup> toe, Distal phalanx of 5 <sup>th</sup> toe, head of 5 <sup>th</sup> metatarsal, on Cuboid, on 4 <sup>th</sup> metatarsal.  |
| 1961 | Bhargava et al <sup>5</sup> | Slip to Head of 5 <sup>th</sup> metatarsal, Middle phalanx of 5 <sup>th</sup> toe. Extensor tendon of 5 <sup>th</sup> toe, Cuboid bone, Calcaneus bone, 4 <sup>th</sup> metatarsal, Extensor tendon of 4 <sup>th</sup> toe and Posterior tibio-fibular ligament. |
| 1993 | Johnson et al <sup>15</sup> | Accessory Peroneus Brevis tendon present.  |
| 2004 | Bergman et al <sup>11</sup> | Slip of Peroneus Brevis joined to Peroneus Longus and Slip to Abductor Digiti Minimi.  |
| 2016 | Present study               | Slip of Peroneus Brevis tendon to shaft of 5 <sup>th</sup> metatarsal  |

### Conclusion

The clinical significance of this muscle is that the renewal of superior peroneal retinaculum can be done by using a part of Peroneus brevis. The knowledge of the variations in relation to this muscle will also help the surgeons to avoid post-operative problems such as persistence of pain and improper movements of foot. Tears of the peroneus brevis tendon may cause ankle pain, swelling, and instability so in repair of the tendon

tear of peroneus brevis, lateral ankle ligament stabilization should always be combined in the surgery. The muscle can be used for tendon transfer and muscle transposition. In such type of tendon transfer or muscle transposition surgeries, the degree of normal function regained depends on architecture of the muscle used for transposition.

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