Sustantial Observation on Foot Taeyang Meridian Muscle in Human Lower Limb from a Anatomical Viewpoint

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ABSTRACT

Objective: This study was carried to identify the anatomical component of FTMM (Foot Taeyang Meridian Muscle) in human lower limb, and further to help the accurate application to real acupuncture.

Methods: FTM at the surface of the lower limb was labelled with latex. And cadaver was stripped off to demonstrate muscles, nerves and the others and to display the internal structures of FTMM, being divided into outer, middle, and inner layer.

Results: FTMM in human lower limb is composed of muscles, nerves, ligaments etc. The internal composition of the FTMM in human lower limb are as follows:

1) Muscle: Gluteus maximus, biceps femoris, semitendinosus, gastrocnemius, triceps calf, fibularis brevis tendon, superior peroneal retinacula, calcaneofibular ligament, inferior extensor retinaculum, abductor digitii minimi, sheath of flexor tendon at outer layer, biceps femoris, semimembranosus, plantaris, soleus, posterior tibialis, fibularis brevis, extensor digitorum brevis, flexor digiti minimi at middle layer, and for the last time semimembranosus, adductor magnus, plantaris, popliteus, posterior tibialis, flexor hallucis longus, dorsal calcaneocuboidal ligament at inner layer.

2) Nerve: Inferior cluneal nerve, posterior femoral cutaneous n., sural cutaneous n., proper plantar branch of lateral plantar n. at outer layer, sciatic nerve, common peroneal n., medial sural cutaneous n., tibial n. at middle layer, and for the last time tibial nerve, flexor hallucis longus branch of tibial n. at inner layer.

Conclusions: This study proves comparative differences from already established studies from the viewpoint of constituent elements of FTMM in the lower limb, and also in the aspect of substantial assay method. We can guess that there are conceptional differences between terms (that is, nerves which control muscles of FTMM and those which pass near by FTMM) in human anatomy.

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Key Words: Foot taeyang meridian muscle in human lower limb, BL 36-40, muscle, tendon, ligament, nerve.

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Ling Shu (Miraculous Pivot) of HUANDI NEI-JING (The Yellow Emperor’s Classic of Medicine: A bible in traditional Chinese medicine for about two thousand years) is almost connected with The Twelve Main Meridian (TMM)\(^1\). According to this theory, TMM, the twelve pathways, corresponds to and connects internally with one of the twelve organs (Zang Fu). This means that there are six Yin and Yang channels. There are three Yin and Yang channels on each arm and three Yin and Yang on each leg\(^2\). Hereinafter Foot Taeyang meridian is positive meridian with energy running from the head to the foot. This meridian has sixty seven bilateral acupoints.

Meridian Muscle (MM) is a general term of muscular system distributed in circulation of The Twelve Main Meridian, and is composed of muscular tissue such as muscle (involving tendon), fascia, ligament\(^3\), which Ch’i (Gie: Life energy) in TMM is collected or concluded or translated \(^4\). Taoist explains that good health depends on a free circulation of Ch’i throughout all the organs of the body. The Ch’i, in turn, depends upon a balance of the two opposing energies of yin and yang. The meridians are the main channels of Ch’i-flow. When this flow is impeded at any point, piercing the channels at the proper points is believed to correct the imbalance.

Acupuncture theory, especially the theory of TMM or MM, in traditional oriental medicine, although based on empirical studies, predates use of the modern scientific methods, has received various criticisms. There is not yet generally-accepted anatomical and histological basis for the their existence. And also it seems that the anatomical constituents of individual MM are wrongly known to the academic world of oriental medicine\(^5\). It brings about a mistaken clinical application or a wrong diagnosis as well as misunderstanding for the mode of action of acupuncture, though the term of MM means a lot to myology, arthrology, rehabilitation, and the other clinics.

This study was carried out in order to investigate correct elements of Foot Taeyang MM (FTMM) focused on it in the lower limb and to theoretically support the meridianology or the clinics of oriental medicine, following Lung MM\(^6\), Pericardium MM\(^6\), Triple Energizer MM\(^7\).

II. Materials and Methods

1. Preservative preparations and injection

   1) The preparation of a preservative
   1Kg of Phenol is dissolved in 1 l of methylalcohol (The 1st solution). 500ml of glycerin is dissolved in 2 l of methylalcohol and thereafter additional 500ml of glycerin is dissolved in this solution (The 2nd solution). The 1st and 2nd solution is well mixed, and made warm (30min, 20°C). 1 l of methylalcohol is added to this mixed solution, is stirred for 10minutes. For the last time 1.5 l of formalin is added to mixed solution of this.

   2) Injection
   The sheath of femoral artery & vein is exposed by vertical incision at the medial third of inguinal ligament, and femoral artery carefully is separated from femoral vein. A preservative is injected into femoral artery at the speed of 150 ml per minute. After 6 l of preservative is injected, a needle-inserted part is ligated, subsequently injector needle is inserted downwards for the preservation of the leg.

2. Embalmment of cadaver

   1) Cadaver is pending in the embalmment system for 40 hrs at 40°C

   2) Cadaver is exposed for 1hr at the normal temperature, and after that, is kept in refrigerated storage (3°C, 30% humidity).
3. Experimental procedure

1) Foot Taeyang Meridian in the lower limb is labelled with latex at the surface of cadaver, being subsequently photographed.

2) Pore is made by drill in the vertical direction at each meridian point.

3) Skin and superficial fascia are stripped off in order and the exposed deep fascia surface is thereafter labelled by latex, once more is photographed.

4) Deep fascia is also removed.

5) Subsequently muscle, tendon, and nerve are investigated and photographed, being divided into three layers (outer, middle, and inner or deep layer).

III. Results

Foot Taeyang MM in the lower limb was marked at the surface of cadaver, and also constituent elements were dissected, being divided into three layers (outer, middle, inner or deep layer). The results were identified as follows:

1. Seungbu (BL 36)

   As shown in fig. 5, this point is positioned in the middle of gluteal furrow and at the cross point between posterior median line of femur and gluteal furrow. There are gluteus maximus muscle, inferior cluneal nerve, posterior femoral cutaneous nerve and their perineal branch at outer layer (Fig. 1), biceps femoris muscle, sciatic nerve at middle layer, semimembranous muscle, and adductor magnus muscle at inner layer (Fig. 2).

2. Eunmun (BL 37)

   This point is positioned between semitendinous muscle and biceps femoris muscle (Fig. 5). At outer layer there is posterior femoral cutaneous nerve, with regard to muscle, space between biceps femoris muscle and semitendinous muscle corresponds to outer layer (Fig. 1). At middle layer there are semimembranous muscle, sciatic nerve, and at inner layer adductor magnus muscle (Fig. 2).

3. Bugeuk (BL 38)

   This point is positioned at the median edge of biceps femoris m. tendon and at 1.0 chon superior to popliteal line (Fig. 5). There are biceps femoris m. (long head), sural cutaneous nerve at outer layer, common peroneal nerve in middle layer (Fig. 1, 4), and plantaris muscle at inner layer (Fig. 2).

4. Wiyang (BL 39)

   This point is positioned at the median corner of biceps femoris m. tendon and at popliteal line (Fig. 5). With regard to muscle, space between gastrocnemius muscle (lateral head) and biceps femoris m. tendon corresponds to outer layer (Fig. 1, 4), at the same time here is lateral sural cutaneous nerve. There is common peroneal nerve in middle layer (Fig. 2).

5. Wijung (BL 40)

   This point is positioned at the center of popliteal fossa (Fig. 5). At outer layer posterior femoral cutaneous nerve is observed, and at middle layer medial sural cutaneous nerve and tibial nerve (Fig. 1, 2, 4).

6. Habyang (BL 55)

   This point is positioned at the median biceps of gastrocnemius muscle and at 2.0 chon inferior to popliteal line (Fig. 5). As regards to muscle a diverging point of biceps of gastrocnemius muscle
corresponds to outer layer (Fig. 1) and here is also medial sural cutaneous nerve. At middle layer there are plantaris muscle and tibial nerve, and at inner layer popliteus muscle (Fig. 4).

7. Seunggeun (BL 56)
This point is positioned at the median venter of gastrocnemius muscle (Fig. 5). There are the median venter of gastrocnemius muscle, medial sural cutaneous nerve at outer layer (Fig. 3), soleus muscle and soleus branch of tibial nerve at middle layer, posterior tibial muscle and tibial nerve at inner layer (Fig. 4).

8. Seungsan (BL 57)
This point is positioned at the lambdoidal point under the belly of gastrocnemius muscle (Fig. 5). As regards to muscle a diverging point of biceps of gastrocnemius muscle corresponds to outer layer and here is medial sural cutaneous nerve. At middle layer there is soleus muscle, and at inner layer, posterior tibial muscle and tibial nerve (Fig. 3).

9. Biyang (BL 58)
This point is positioned at the lower edge of lateral belly of gastrocnemius muscle (Fig. 5). As regards to muscle, outer layer corresponds to the lower edge of lateral belly of gastrocnemius muscle, here is also medial sural cutaneous nerve. There are soleus muscle at middle layer (Fig. 3), and flexor hallucis longus muscle, flexor hallucis longus branch of tibial nerve at inner layer.

10. Buyang (BL 59)
This point is positioned laterally to Achilles tendon, 3.0 chon superior to Gollyun (Fig. 5). As regards to muscle, outer layer corresponds to the lateral side of triceps calf muscle, here is also sural cutaneous nerve. At middle layer there is fibularis brevis muscle (Fig. 3).

11. Gollyun (BL 60)
This point is positioned at the furrow between lateral malleolus apex and Achilles tendon (Fig. 5). There are fibularis brevis tendon and sural cutaneous nerve at outer layer (Fig. 3).

12. Boksam (BL 61)
This point is positioned just under Gollyun, laterally to calcaneus (Fig. 5). There are superior peroneal retinacula, lateral calcaneal branch of sural cutaneous nerve at outer layer (Fig. 3).

13. Sinmaek (BL 62)
This point is positioned just under lateral malleolus (Fig. 5). There are calcaneofibular ligament, lateral dorsal cutaneous branch of sural cutaneous nerve at outer layer (Fig. 3).

14. Geummun (BL 63)
This point is positioned under anterior edge of lateral malleolus, posteriorly to cuboidal bone (Fig. 5). There are inferior extensor retinaculum and lateral dorsal cutaneous branch of sural cutaneous nerve at outer layer. At middle layer there is extensor digitorum brevis muscle, and at inner layer, dorsal calcaneocuboidal ligament (Fig. 3).

15. Gyeonggol (BL 64)
This point is positioned anteroinferiorly to styloid process of 5th metatarsal bone, at a boundary between foot dorsum and sole (Fig. 5). There are abductor digiti minimi muscle, fibularis brevis tendon, lateral dorsal cutaneous branch of sural cutaneous nerve at outer layer (Fig. 3).
16. Sokgol (BL 65)
This point is positioned posteriorly to 5th metatarsal-phalanges joint, at a boundary between foot dorsum and sole (Fig. 5). There are sheath of flexor tendon, abductor digiti minimi muscle, lateral dorsal cutaneous branch of sural cutaneous nerve at outer layer, and flexor digiti minimi muscle at middle layer (Fig. 3).

17. Joktonggok (BL 66)
This point is positioned anteriorly to 5th metatarsal-phalanges joint, at a boundary between foot dorsum and sole (Fig. 5). At outer layer there are sheath of flexor tendon, abductor digiti minimi tendon, flexor digiti minimi tendon, lateral dorsal cutaneous branch of sural cutaneous nerve, and proper plantar branch of lateral plantar nerve (Fig. 3).

18. Jieum (BL 67)
This point is positioned 0.1 chon lateroposterioly to the angle of toenail root (Fig. 5). There are lateral dorsal cutaneous branch of sural cutaneous nerve, and proper plantar digital branch of lateral plantar nerve (Fig. 3).

IV. Discussion

Foot Taeyang MM originates in the angulus oculi medialis, Jeongmyeong, goes upward to parietal part, and goes down from the head to the foot. Herein one fork goes down with the bilateral sides of vertebral column to the popliteal fossa via the lumbar part, another fork goes down to the outside of foot via the intrad of scapula, the greater trochanter of femur, the lateraloposterior surface, the posterior surface of lateral malleolus, and the tuberosity of the 5th metatarsal bone.

MM in oriental medicine means a concept comprising soft tissue such as muscle, fascia ligament, and nerve on the out skirts of them\(^9\). It is possible to know the mode of action of MM if we analyze the distribution of MM in connection with human anatomy\(^8\)\(^-\)\(^10\). In the view of clinical application, MM plays an important role in the flexion & extention of muscle or joint or limb, since the abnormality of MM is expressed as the abnormalities of MM-piercing part, such as stretching, convulsion, relax, rigidity, displacement\(^11\)\(^-\)\(^14\). Referring to the disability of MM, the chapter MM of Ling Shu (Miraculous Pivot) explains the following meaning "if Yang is over, the muscle extended and so long as Yin is over, then the muscle flexed. Cold brings about the muscle contraction, and hot, muscle slackness."\(^15\)

This means the symptom of disease induced by abnormal meridian muscle subsequent to Yang or Yin over.

As mentioned above, the anatomical knowledge of muscle is essentially required for the clinical application of MM. And also at the same time such a knowledge must be exact. Such a knowledge guarantees the exact and effective application of MM to clinics.

This study shows some differences from already established study\(^16\) on MM (refer to Table 1.) ; that is, constituent elements of MM such as muscle, fascia, ligament, nerve, and furthermore, different assay method. Above all the structure of each meridian point investigated in this study was divided into three layers according to depth from body surface but on the other hand we came across that it may be wide differences in opinion according to the disparity of real meridian point or the angle of acupuncture\(^17\). Present paper was performed with upright acupuncture position for a basis. The direction of the acupuncture needle at oriental medicine is generally composed of 3 types, upright position inserted vertical to the skin, down or transverse position, inclined position inserted at the angle of 45 degrees to the skin. For example upright position is required for the application of needle to BL-36,
37, 38, 39, 40, 55, 56, 57, 58, 59, 60, 61, 62, inclined or transverse position for BL-60, 64, 67, inclined position for BL-37, 38, 39, 55, 56, 57, 58, 59, 60, 61, 62.

Speaking for the last time, the conception of "blood vessel" was excluded from a constituent of meridian muscle at this paper.

V. Conclusion

This study was carried to identify the components of Foot Taeyang MM(FTMM) in the human lower limb, classifying into outer, middle, and inner part. The lower limb was opened widely to demonstrate such the internal structures as muscles, nerves and the others of FTMM in the lower limb. We obtained the conclusions as follows:

1. **FTMM** in the lower limb is composed of the muscle, and the related nerves.

2. This study shows comparative differences from already established studies from the viewpoint of the constituent elements of FTMM in the lower limb, and also in the aspect of substantial assay method.

3. In the dissection of human lower limb, it is present the conceptional difference between nerves which govern the muscle of MM and nerves which pass near by MM.

VI. Reference

Fig. 1 Photograph shows bladder meridian points (BL 36-40, BL 55) at the excoriated lower limb.
- ●: Meridian point, △: Muscle, ▲: Nerve
- A: Gluteus maximus muscle,
- B: Adductor magnus muscle,
- C: Long head of biceps femoris muscle,
- D: Semitendinosus muscle,
- E: Semimembranosus muscle,
- F: Gracilis muscle,
- G: Lateral head of gastrocnemius muscle,
- a: Common peroneal nerve, b: Tibial nerve.

Fig. 2 Photograph shows bladder meridian points (BL 36-40) at inner layer of excoriated lower limb.
- ●: Meridian point, △: Muscle, ▲: Nerve, etc.
- A: Gluteus maximus muscle,
- B: Long head of biceps femoris muscle,
- C: Semitendinosus muscle,
- D: Adductor magnus muscle,
- E: Lateral head of gastrocnemius muscle,
- F: Iliotibial tract, G: Gluteus medius muscle,
- a: Greater trochanter of femur, b: Sciatic nerve,
- c: Tibial nerve, d: Head of fibula.

Fig. 3 Photograph shows bladder meridian points (BL 56-67) at deep fascia in case of superficial dissection of lower limb.
- ●: Meridian point, △: Muscle, ▲: Nerve, etc.
- A: Medial head of gastrocnemius muscle,
- B: The venter of gastrocnemius muscle,
- C: Soleus muscle, D: Achilles tendon,
- E: Peroneus longus & brevis muscle,
- F: Abductor digiti minimi muscle,
- G: Extensor digitorum longus tendon,
- a: Apex of lateral malleolus,
- b: Styloid process of 5th metatarsal bone,
- c: Calcaneus bone, d: Tibial nerve.

Fig. 4 Photograph shows bladder meridian points (BL 38-40, 55, 56) at the level of deep fascia of lower limb.
- ●: Meridian point, △: Muscle, ▲: Nerve
- A: Long head of biceps femoris muscle,
- B: Semitendinosus muscle,
- C: Semimembranosus muscle, D: Gracilis muscle,
- F: Gastrocnemius muscle, G: Soleus muscle,
- H: Peroneus longus muscle, a: Sciatic nerve,
- b: Tibial nerve, c: Common peroneal nerve.
Table 1. Comparative differences from already established studies from a viewpoint of a constituent of Foot Taeyang Meridian Muscle in human lower limb.

<table>
<thead>
<tr>
<th>FTMM</th>
<th>Muscle Nerve</th>
<th>Ref. 1</th>
<th>Ref. 16</th>
<th>This result</th>
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<td>gluteus maximus, biceps femoris, semimembranosus, adductor magnus</td>
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<td></td>
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<td>biceps femoris, semitendinosus, semimembranosus,</td>
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<td>biceps femoris tendon</td>
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