

Anatomical Study on the Foot Soeum Meridian Muscle in Human

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사람에 있어 족소음경근의 해부학적 고찰

박경식

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Abstract

Objectives : This study was investigated to observe Foot Soeum Meridian Muscle in human.

Methods : In order to expose components related to Foot Soeum Meridian Muscle, cadaver was dissected in the order of their depth; being respectively divided into superficial, middle, and deep layer.

Results : Anatomical components related to Foot Soeum Meridian Muscle in human are composed of muscles such as flexor digitorum brevis tendon, abductor hallucis muscle, psoas major m., erector spinae m., and flexor retinaculum, fascia such as plantar aoneurosis, ligament such as sacrotuberal ligament, sacrospinous lig., nuchal lig., nerves such as plantar cut. br. of med. plantar nerve, med. crural cut. br. of saphenous n., br. of tibial n., post. femoral cut. n., spinal n.(dorsal rami of C4-6, T7-12, L1-3, and S1-3), and autonomic nervous system(sacral plexus, pelvic splanchnic n., etc.), and etc.

Conclusions : This study shows comparative differences from established studies on anatomical components related to Foot Soeum Meridian Muscle, and the methodical aspects of analytic process. In addition, Foot Soeum Meridian Muscle in human is a comprehensive concept including the relevant nerves, but it remains questionable.

Key words : Foot Soeum Meridian Muscle, muscle, tendon, ligament, fascia, nerve

I . Introduction

This paper follows a series of research papers

which were reported on various journals with relation to "Twelve Meridian Muscles" until recently.

According to the classic text of Yellow Emperor's Classic, a term of "Twelve Meridian Muscles" is named on the basis of three Yins of the limbs and three Yangs of the limbs of "Twelve Meridians", involving muscles over the meridian pathway of the same name. Meridian Muscle is a general term of the muscular system, being distributed along the circulatory pathway of "Twelve Main

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Meridians” and classified in accordance with the pathway of the Twelve Main Meridians¹⁻³⁾. Meridian Muscle is a term of Meridians extended to the body surface^{2,4)}. Meridian Muscle is distributed on the arm, leg, trunk, and head, where the life energy(Qi) in the Twelve Main Meridians is knotted, gathered, collected, spreaded, linked at the muscular tissue, and directed from the tip of the limbs to the head⁵⁾.

The pathway of Foot Soeum Meridian Muscle originating at Yongcheon on the foot, gathers at the calcaneus via the internal malleolus, goes upward and knotts at the interoposterior tibia, continuou upward alongside the internal thigh, and knotts at the pudendum. Branch going further up alongside the vertebral column, is knotted at the occipital bone^{1,3)}.

The symptoms of a disease arising from the disfunction of Meridian Muscle, especially Foot Soeum Meridian Muscle, are explained in the theory of Sore. The involved symptoms are myokinesis dysfunction, myalgia in the lower leg, the dysfunction of waist bending¹⁻⁴⁾.

This study was carried out in order to investigate correct elements of Foot Soeum Meridian Muscle based on LingShue^{1,3)} from a viewpoint of human anatomy on the assumption that Meridian Muscle system is basically matched to Meridian Vessel system as a part of meridian system despite partially dissimilar to, and further to support the accurate application of acupuncture in the clinical practice, following Foot Taeyang Meridian Muscle⁶⁾.

II. Materials and Methods

1. Preservative preparations and injection

1 kg of Phenol is dissolved in 1 L of methylalcohol (The 1st. solution). 500 mL of glycerin is dissolved in 2 L of methylalcohol and thereafter additional 500 mL of glycerin is dissolved in this solution(The 2nd. solution). The 1st. and 2nd. solution is well mixed, and made warm(30 min, 20°C). 1 L of methylalcohol is added to this mixed solution, is stirred for 10 minutes. For the last time 1.5 L of formalin is added to this solution. 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 lower leg.

2. Embalmmnt of cadaver

Cadaver is immersed in the embalmmnt system for 40 hrs at 40°C and exposed for 1 hr at the normal temperature, and after that, is kept in refrigerated storage(3°C, 30% humidity).

3. Experimental procedure

Kidney Meridian in the body surface is labelled with latex at the surface of cadaver, being based on Korean standard acupuncture point locations, and being subsequently photographed. Pore is made by drill in the vertical direction at each meridian point. Skin and superficial fascia are

stripped off in order and the exposed deep fascia is thereafter labelled by latex, once more is photographed. Deep fascia is also removed. Subsequently muscle, tendon, and nerve are investigated and photographed, being divided into three layers(outer, middle, and inner or deep layer).

III. Results

Kidney Meridian was labelled at the surface of cadaver, and also related constituents were dissected with division in the order of three layers (outer, middle, inner or deep layer). The results were identified as follows.

1. Muscles linked to Main Meridian

1) Yongcheon(KI-1)

This meridian point is positioned on the hollow of the foot and at the V-shaped crease formed between the 2nd and the 3rd toes when the toes are flexed(Fig. 1, 2). Muscle group related to Yongcheon composed of plantar aponeurosis at outer layer, flexor(flex.) digitorum(digit.) brevis tendon(tend.), flex. digit. longus tend. and lumbrical muscle(m.) at middle layer. There are plantar interosseous m., transverse head and oblique head of adductor hallucis m. on both sides at inner layer, and also plantar cutaneous(cut.) branch (br.) of medial(med.) plantar nerve(n.) lies at outer layer as constituent nerve and plantar digit. n. at middle layer.

2) Yeongok(KI-2)

This point is positioned at the hollow just below the navicular tubercle(Fig. 1, 2). Muscle group constituting this Meridian Muscle are med.

plantar fascia at outer layer, abductor(abd.) hallucis m. at middle layer. There is med. plantar n. at middle layer.

3) Taegye(KI-3)

The acupuncture point is positioned between the medial mall and Achilles tend. behind the center of the medial malleolus(Fig. 1, 2). There are flex. digit. longus tend. and med. crural cut. br. of saphenous n. and tibial n. at outer layer.

4) Daejong(KI-4)

This point is located at posterior segment of medial malleolus and 0.5 chon superior to the calcaneal tuberosity(Fig. 1, 2). There are flex. retinaculum, med. crural cut. br. of saphenous n. at outer layer, and flex. hallucis longus tend., br. of tibial n. at middle layer.

5) Sucheon(KI-5)

This point is located at 1.0 chon below Taegye(Fig. 1, 2). There are flex. retinaculum, med. crural cut. br. of saphenous n., med. calcaneal br. of tibial n. at outer layer, and flex. hallucis longus tend., br. of tibial n. at middle layer.

6) Johae(KI-6)

This point is located at 1.0 chon below the medial malleolus(Fig. 1, 2). There are flex. retinaculum, med. crural cut. br. of saphenous n. at outer layer, and abd. hallucis m., med. calcaneal br. of tibial n. at middle layer.

7) Buryu(KI-7)

This point is located at 2.0 chon above Taegye(Fig. 1, 2). There are med. crural cut. br. of saphenous n. at outer layer. There are flex.



Fig. 1. Photograph shows Foot Soeum Meridian (KI 1-7), muscles, and other structures at the deep fascia of the foot and at the inside of deep fascia in case of dissection of leg.

△: Muscle, a: plantar aponeurosis, b: flexor retinaculum, c: abductor hallucis muscle, d: tibialis post. tendon, e: flex. digitorum longus m., f: flex. hallucis longus m., g: Achilles tend., h: soleus m., i: gastrocnemius m., j: tibialis anterior tend., ▲: other structure, k: cutaneous branch of plantar nerve. & artery, l: medial calcaneal br. of tibial n., m: tibial n. & a., n: med. malleolus, o: deep fascia, p: saphenous n.



Fig. 2. Photograph shows Foot Soeum Meridian (KI 1-9), muscles, and other structures at the excoriated deep fascia of the leg.

△: Muscle, a: flex. digit. brevis m., b: lumbrical m., c: flex. digit. brevis tend., and deeply flex. digit. longus tend., d: plantar aponeurosis, e: abductor hallucis m., f: flex. hallucis longus m., g: tibialis posterior tend., h: flex. digit. longus m., i: tibialis anterior tend., j: Achilles tend., tibialis ant. tend., k: soleus m., l: gastrocnemius m., p: tibialis post. tend., ▲: other structure, m: plantar digit. n., n: med. plantar n., o: med. calcaneal br. of tibial n., q: med. malleolus, r: tibial n., s: tibia, t: lateral plantar fascia.



Fig. 3. Photograph shows kidney meridian point (KI 10, Eumgok), muscles, and other structures at deep fascia level in case of superficial dissection of the leg.

△: Muscle, a: gastrocnemius m., b: semitendinosus tend., c: gracilis m., d: semimembranosus tend., ▲: other structure, e: tibial n., f: common peroneal n., g: med. sural cut. n., h: cut. br. of obturator n., i: post. femoral cut. n.

hallucis longus tend. and Achilles tend. on both sides, tibial n. at inner layer.

8) Gyosin(KI-8)

This point is located at 2.0 chon above the med. malleolus(Fig. 1). There are med. crural cut. br. of saphenous n. at outer layer. There are flex. hallucis longus tend. and flex. digit. longus tend. on both sides, tibial n. at middle layer. There are tibialis posterior(post.) tend. at inner layer.

9) Chukbin(KI-9)

The acupuncture point located at 5.0 chon above Taegye, between gastrocnemius m. and soleus m.(Fig. 2). There are med. crural cut. br. of saphenous n. at outer layer. There are gastrocnemius m., soleus m., br. of tibial n. at middle layer, and flex. hallucis longus m., tibial n. at inner layer.

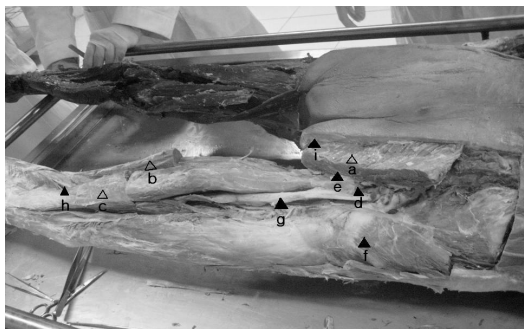


Fig. 4. Photograph shows muscles and other structures at the excoriated deep fascia in case of postero- medial dissection of femur.

△: Muscle, a: gluteus maximus m., b: semitendinosus m., c: long head of biceps femoris m., ▲: other structure, d: gemellus inf. m., e: ischial tuberosity, f: great trochanter of femor, g: sciatic n., h: tibial n., i: sup. fascia.

10) Eumgok(KI-10)

The acupuncture point is positioned at the crosspoint where semitendinosus tend. crosses the flexure crease formed upon knee bending(Fig. 3).

There are semitendinosus tend., semimembranosus tend., cut. br. of obturator n., post. femoral cut. n. at middle layer, and muscular br. of sciatic n. at inner layer(Fig. 4).

2. Foot Soeum Meridian Muscles at the lower vertebral column and the pudendum(pelvis)

There are gluteus maximus m., genitofemoral n., iliohypogastric n., middle cluneal n., at outer layer. There are piriformis m., gemellus inferior(inf.) m., sacrotuberal lig., post. femoral cut. n., sciatic n., muscular br. of sciatic n., inf. gluteal n., superior(sup.) gluteal n., at middle layer, and psoas major m., psoas minor m., levator ani m., rectococcygeus m., sacrospinous ligament(lig.), post.

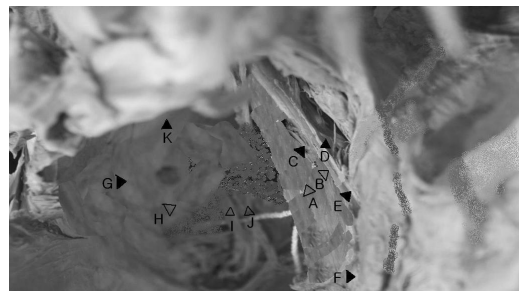


Fig. 5. Photograph shows muscles and other structures at the level of the lower vertebral column and pelvic cavity.

△: Muscle, A: psoas major m., B: psoas minor m., H: levator ani m., I: coccygeus m., J: piriformis m., ▲: other structure, C: lateral femoral cut. n., D: iliohypogastric n., E: genitofemoral n., F: ant. abdominal wall, G: pelvis, K: vertebral column.

sacroiliac lig. obturator n., genitofemoral n., autonomic nervous system(sacral plexus, pelvic splanchnic n., etc.) at inner layer(Fig. 4, 5).

3. Foot Soeum Meridian Muscles at the back

There are trapezius m., latissimus dorsi m., spinal n.(dorsal rami of C4-6, T7-12, L1-3, S1-3) at outer layer(Fig. 6).

There are rectus capitis post. minor m., splenius capitus m., semispinalis capitus m., rhomboideus m., serratus posterior superior m., serratus posterior inferior m., spinal n.(dorsal rami of C1-3) at middle layer, and erector spinae m.(spinalis m., longissimus m., iliocostalis m.), nuchal lig., supraspinous lig., interspinous lig., ant. & post. longitudinal lig., lig. flavum, autonomic nervous system at inner layer(Fig. 6, 7).

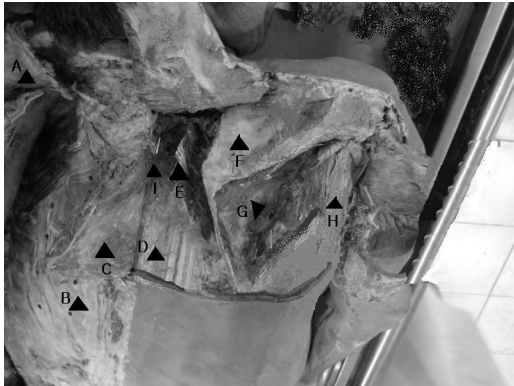


Fig. 6. Photograph shows muscles and other structures at the excoriated deep fascia of upper back.

▲: Muscle, A: trapezius m., B: latissimus dorsi m., C: rhomboideus major m., D: Erector spinae m. and fascia, E: serratus post. sup. m., F: supraspinatus fascia, G: infraspinatus m., H: teres major m., I: splenius capitis m.

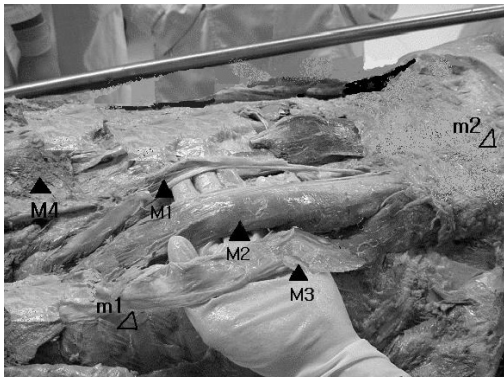


Fig. 7. Photograph shows muscles and other structures in case of deep dissection of back.

▲: muscle, M1: spinalis m., M2: longissimus m., M3: iliocostalis m., M4: trapezius m., △: other structure, m1: rib, m2: lumbar vertebral column.

IV. Discussion

As shown on the basis of the literature^{1,3)} on this Meridian Muscle and in view of the results so far achieved, the pathway of Foot Soeum

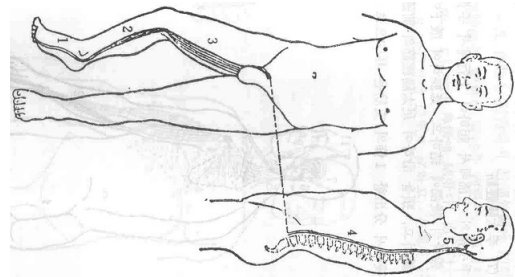


Fig. 8. The scheme of Foot Soeum Meridian Muscle in human^{1,3)}.

Meridian Muscle is considerably in accordance with the pathway of the meridian of the same name from the toe to the pudendum, but the path-way over the pubis is different from the meridian pathway of the same name(Fig. 8).

Meridian Muscle has relevance to 12 main meridians, but this does not enter the organ, runs together with other Meridian Muscle or runs into other Meridian Muscle^{1,3)}. The anatomical knowledge of Meridian Muscle will guarantee the exact and effective application of Meridian Muscle to clinics. Herein, when we study the element of Meridian Muscle, we should consider the symptoms of a disease arising from the disfunction of Meridian Muscle together with the pathway of Meridian Muscle. Furthermore, we should refer to nerve innervation for the muscle since it acts on nerves and myalgia is connected with nerves which innervate that muscle. Herein this study shows some differences from already existing data on Meridian Muscle (Table 1)⁷⁻⁹⁾; that is, constituent elements of Meridian Muscle such as muscle, fascia, ligament, nerve, and of course, another assay method divided into three layers according to the depth from the body surface.

On the other hand there are different opinions according to the disparity of real meridian point

Table 1. Differences from Existing Studies from a Viewpoint of the Muscular Components of Foot Soeum Meridian Muscle in Human

This paper		Sim et al.(2003)	Song et al.(2009)	Lee et al.(1999)	Remark	
1. Muscles linked to Main Meridian						
Meridian point	Muscle, ligament, fascia	Nerve	Muscle	Muscle	Components	
KI-1	Sup. layer Plantar aponeurosis Mid. layer flexor. digital tendon, flex. digit. longus tend., lumbrical muscle. Deep layer abductor. hallucis m., plantar interosseous m. Sup. layer med. plantar fascia Mid. layer abd. hallucis m.	Plantar cutaneous branch of medial plantar nerve plantar digit. n. muscle.	flex. hallucis longus m., flex. digit. longus m., semitendinosus tend., semimembranosus tend., gastrocnemius m.	flex. digit. brevis m., abd. hallucis m., lumbrical m., flex. digit. longus m., tibialis post. m., gastrocnemius m., add. brevis m., add. longus m., add. magnus m., gracilis m.	gastrocnemius m., sartorius m., tensor fasciae latae m., quadriceps femoris m.,	Whether or not nerve is involved
KI-2	Sup. layer Med. plantar fascia Mid. layer abd. hallucis m.	med. plantar n.	gastrocnemius m.	gastrocnemius m., add. brevis m., add. longus m., add. magnus m., gracilis m.		
KI-3	Sup. layer flex. digit. longus tend.	med. crural cut. br. of saphenous n., tibial n.				
KI-4	Sup. layer flex. retinaculum Mid. layer flex. hallucis longus tend.	med. crural cut. br. of saphenous n. br. of tibial n.				
KI-5	Sup. layer flex. retinaculum Mid. layer flex. hallucis longus tend.	med. crural cut. br. of saphenous n., med. calcaneal br. of tibial n. br. of tibial n.				
KI-6	Sup. layer flex. retinaculum Mid. layer abd. hallucis m.	med. crural cut. br. of saphenous n. med. calcaneal br. of tibial n.				

Table 1. Continued

	This paper	Sim et al.(2003)	Song et al.(2009)	Lee et al.(1999)	Remark
KI-7	Sup. layer Achilles tend., flex. hallucis longus tend. Mid. layer	med. crural cut. br. of saphenous n., tibial n.			
KI-8	Sup. layer flexor digit. longus tend., flex. hallucis longus tend. Mid. layer tibialis post. tend.	med. crural cut. br. of saphenous n., tibial n.			
KI-9	Sup. layer gastrocnemius m. Mid. layer soleus m. Deep layer flex. hallucis longus m.	med. crural cut. br. of saphenous n., br. of tibial n. tibial n.			
KI-10	Sup. layer gracilis m. Mid. layer semitendinosus tend., layer semimembranosus tend. Deep layer	cut. br. of obturator n., posterior femoral cut. n. muscular br. of sciatic n.			
2. Foot Soeum Meridian Muscles at the lower vertebral column and the pudendum (pelvis)					
	Sup. layer gluteus maximus m.	middle cluneal n., iliohypogastric n., genitofemoral n.	psoas major m., psoas minor m.		
	Mid. layer piriformis m., gemellus inferior(inf.) m., sacrotuberal lig.	post. femoral cut. n., sciatic n., muscular br. of sciatic n., inf. gluteal n., superior(sup.) gluteal n.			
	Deep layer psoas major m., psoas minor m., levator ani m., rectococcygeus m., sacrospinous ligament(lig.), post. sacroiliac lig.	obturator n., genitofemoral n., autonomic nervous system			

Table 1. Continued

This paper	Sim et al.(2003)	Song et al.(2009)	Lee et al.(1999)	Remark
3. Foot Soeum Meridian Muscles at the back				
Sup. layer	trapezius m., latissimus dorsi m.	spinal n.(dorsal rami of C4-6, T7-12, L1-3, S1-3)	ant. longitudinal lig.	Erector spinae muscle
Mid. layer	rhomboides m., rectus capitis post. minor m., splenius capitis m., semispinalis capitis m., serratus posterior superior m., serratus post. inf. m.	spinal n.(dorsal rami of C1-3)		
Deep layer	erector spinae m.(spinalis m., longissimus m., iliocostalis m.) nuchal lig., supraspinous lig., interspinous lig., ant. & post. longitudinal lig., lig. flavum.	autonomic nervous system		

or the angle of acupuncture on the section from the toe to the pudendum(pubis)^{10,11}. The standardization of the acupuncture point location was most recently arranged through the international conference between three countries, Korea, Japan and China¹², as present study was based on this standardization. Present study was performed with upright angle of acupuncture on as the basis.

Additionally, in spite of different opinions, it is considered that Meridian Muscle is theoretically another system from the hypothesis of Myofascial pain syndrome or Anatomy trains except the term of Qi. Myofascial pain syndrome(MPS), also known as chronic myofascial pain(CMP) by Travell¹³, is a syndrome characterized by chronic pain caused by multiple trigger points and muscular fascial constrictions. Among the symptoms are referred pain, limited range of motion, and sleep disturbance. MPS pain is still limited to trigger points and hot spots of referred pain. The precise causes of MPS are not yet fully documented, but some systemic diseases, such as connective tissue diseases can cause MPS. Poor posture and emotional disturbance might also instigate or contribute to MPS¹⁴. Anatomy trains is a anatomical map of larger functioning constituents within the musculoskeletal system. These constituents, termed Myofascial Meridians, wind longitudinally through the soft tissue. According to this theory, or in the view of Anatomy trains, additional information is added to single muscle theory: one muscle is an element in a continuous fascial plane or myofascial meridian which runs from one part to another part and beyond. This theory assumes body as assembled machine¹⁵. There is no reason why we associate Meridian Muscle with recent theories, namely, the hypothesis of myofascial pain syn-

drome or Anatomy trains. It is considered to be theoretically metaphysical from the viewpoint that Meridian Muscle is related to 12 Main Meridian and is dependent on the flow of Qi within the Meridian. On the other hand, it is considered to be physical from the viewpoint that Meridian Muscle is theoretically related to muscular and articular movements.

V. Conclusion

This study was carried to identify the component of Foot Soeum Meridian Muscle in human, dividing into outer, middle, and inner part. The foot, the pelvis and the back were opened widely to demonstrate muscles, nerves and the others, displaying the inner structure of Foot Soeum Meridian Muscle. We obtained the conclusions as follows;

1. This study shows some differences from already established study from the viewpoint of constituent elements of Foot Soeum Meridian Muscle.
2. Foot Soeum Meridian Muscle composed of the muscle, fascia, ligament and related nerves, namely Meridian Muscle is a comprehensive concept or is summarily designated related structures.
3. The distribution of Meridian Muscle is closely linked to 12 main meridian, but both are not coincident. The pathway of Foot Soeum Meridian Muscle is considerably in accordance with the pathway of the meridian of the same name in the course from the toe(Yongcheon, KI-1) to the pudendum(Eumgok, KI-10), but the pathway over the pubis is different from the meridian pathway of the same name.
4. In spite of different opinion, it is considered that Meridian Muscle is theoretically another system from the hypothesis of myofascial pain syndrom or Anatomy trains, and it seems to be no reason to consider Meridian Muscle in relation to these theories.

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국문초록

본 연구는 족소음경근의 구성요소에 대하여 문헌 해석과 인체의 층별 해부를 통하여 해부학적 관점에서 관찰해 보기 위하여 수행되었다. 그리하여 다음과 같은 결론을 얻을 수 있었다. 1. 본 연구 결과 족소음경근의 구성요소와 분석방법에 있어서 기존의 연구와 다소 차이를 보여준다. 2. 족소음경근의 경로와 병증 증상 등을 고려할 때 족소음경근은 근육, 근막, 인대, 그리고 관련 신경을 포함하는 포괄적 개념으로 보인다. 3. 족소음경근의 분포는 경락과 밀접한 관련성이 있으나 일치하지는 않는 것으로 보이며 특히 치골부위 이상의 부위에선 그러할 것으로 사료된다. 4. 이론적으로 MPS와 Anatomy train 같은 가설과는 약간의 차이가 있어 보이며 굳이 관련시켜 생각할 이유가 없다고 생각한다.