

## THE MORPHOLOGICAL PARTICULARITIES OF THE SHANK AND FOOT MUSCLES AT THE BROWN BEAR

Spataru C.,<sup>1</sup> Mihaela Spataru,<sup>1</sup> Gh. Vlad<sup>2</sup>

<sup>1</sup>USAMV, Faculty of Veterinary Medicine, Iasi, Alea M. Sadoveanu, nr 8  
<sup>2</sup>DSV Bacău

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**Abstract:** The studies made on the shank and foot muscles at the brown bear show a lot of the morphological peculiarities of the regional muscles; directly correlated with the usual moving conditions: the plantigrad support; the passing from the patrupodal to the biped support; the climbing etc. Consequently; we can remarks the strong developing of the muscular groups that are structured by the muscles with a massive bodies continued with a short and strong tendons that deliver in contraction an extremely force. In addition to these; at the shank level; one can see; as the primates; the great developing of the solear muscle; its tendon being inserred in common with the gastrocnemian tendons on the calcaneum. Having the origin on the proximal extremity of the fibula; the fibularis longus muscle is continued with a long tendon that slides into a tendinal culisa and goes to the dorsal face of the maleola fibularis for insertion on the proximal extremity of the fifth metatarsal bone. The strong fibularis brevis muscle has its origin on the distal half of the fibula and its tendon goes; together with the tendon of the lateral digital extensor muscle; through the distal tendon ditch; to the dorsolateral tubercle of the fifth metatarsal bone for insertion. As the primates; at the foot level; one can observe the presence of a strong extensor brevis muscle. With the origin on the latero-cranial crest of the calcaneum; it is inserred to the dorsal face of the second phalanx of the II-V fingers. At the same; the flexor pedis brevis muscle; the same developed as the mentioned muscle; but with the antagonist action; plantary situated; its insertions being placed on the caudal limit of the calcaneum and the caudal face of the proximal extremity of the second phalanx of each finger. Under this are placed the adductors and the abductors finger muscles; structured by a strong fascicle and into two plans situated.

### INTRODUCTION

The brown bear; as the primates; is a pentadactil mammal with plantigrad support and possibility to passing from the patrupedal to bipedal support; used; for example in climbing. Taking into consideration the possibilities of the support and moving body; the study made concerning the muscle groups of the shank and foot wants to evidence the muscles developing and register the other muscles that contribute to the complexity of the autopodial moving and sustain the body weigh in biped position; too (1; 3). For identification the muscles and homologating were watched the origin; the way and the insertion; corroborated with the same from the carnivorous or primates (2; 4; 5).

### MATERIAL AND METHODS

The study was made on the two bears killed by hunting. The cadavers were processed through the classic anatomical methods represented by the dissection; the identification and preparation the origins and insertions of each muscle; the establishing the type of action; the comparing and at the final; the homologating in according with the main anatomical principles and the describing the muscles. The results were photographed.

## RESULTS AND DISCUSSIONS

In the case of bear; the shank muscles are very developed being structured by a short and massive bodies continued with a short tendons. That means that they produce in contraction; a powerful force (Figure 1).

The shank cranial muscles

*The tibialis cranialis* muscle is placed cranially; being in contact with tibia. Its origin is on the proximal extremity of tibia; tibial crest and the other fibular part is attached at the middle third part of the region. On the dorsal face of heel; the fibrous ring fixes the tendon and after this; it is inserted on the dorso-lateral tubercle of the first metatarsal bone (Figure 3).

*The extensor pedis longus* muscle; spindle as form; has the origin on the extensory fosse of the lateral condyle of the femur through a short tendon. Distally; above the heel; its widened tendon finishes by five tendons; inserted on the extensory eminence of the third phalanx of each finger (Figure 3).

*The fibularis longus* muscle has a spindle form and has the origin on the proximal extremity of the shank bones. It is distal continued with a long tendon; anterior positioned by the extensor pedis lateralis muscle (on the dorsal face of the fibularis maleolae) it goes through the tendon ditch that is completed with a fibrous blade. Plantary; the tendon crosses obliquely the tars for going to the axial muscular tubercle of the first metatarsus bone where function as adductor (Figure 1; 4).

*The extensor digitalis lateralis* is a muscle with a short body but a long tendon that goes from the proximal part of the tibia and fibula to proximal extremity of the last phalanx of the fifth finger producing the extension. In its way; together with the tendon of fibularis brevis muscle; go through a fibular tendinos ditch (Figure 4).

*The fibularis brevis muscle*; inserted on the distal half of the both shank bones; has a developed body having the fibers with a feather aspect it continues with a short tendon that traverses the maleolar ditch. It can do the extension and the rotation of the fifth finger; in opposition with the fibularis longus muscle (Figure 4).

*The extensor halucis longus* is triangular as aspect. Its origin is on the distal half of the shank bones. It has an oblique dorso-ventrally and latero-medially trajectory between the extensor pedis longus and the tibialis cranialis muscles; and afterwards; goes next to the tibialis cranialis tendon. Dorsally; it goes to the distal phalanx of the first finger where it actions as extensor (1; 5).

The caudal muscles of the shank at the brown bear

*The gastrocnemius muscles*; lateral and medial; are equal developing; each of both presents; inside the origin tendon; a sesamoid bone. The lateral muscle has the fibers as feather oriented towards a strong central tendon. The tendons of the gastrocnemius muscle fusion into a short tendon that makes an only union with the calcanean insertion of the solear and biceps tendons. Together produce the foot extension

*The solearus* muscle has a spindle form. It is very developed and its origin is on the proximal third of fibula. Caudo-laterally the tendon goes between the fibularis brevis and the gastrocnemius lateralis muscle. Distally; the tendon will attaches to the gastrocnemius tendon; creating together the Achille tendon (Figure 2).

*The flexor pedis superficialis* is inserted on the supracondylar tubercle of the femur; in common with the gastrocnemius lateralis muscle. It goes down between the gastrocnemius muscles; and then; under the medial gastrocnemius tendon; and helped by a calotte it crosses above the calcanean tuberosity. Here; it is separated into five tendons that go to second phalanx of each finger and action as flexor (Figure2). *The flexor halucis longus* has its origin

on proximo-caudal extremity of the fibula and the interbones fibrous blade. The tendon goes through the postarsal sheath and its insertion is situated at the flexor tubercle of the last phalanx of the first finger (Figure 2).

*The flexor pedis longus* has the origin on the caudal face of the tibia; goes through the great postarsal sheath for arriving under the tars. Here it is branches out into four fascicles inserred on the flexory tubercle of the last phalanx of the second to the fifth fingers (Figures 6; 7). In the plantary way; the each fascicle perforates the distal tendon of the flexor pedis brevis muscle. Beside a flexion; it can produce the autopodial adduction and pronation (4).

*The tibialis caudalis* muscle is little reduce; has the origin on the distal extremity of the tibia and fibula and the insertion at the tarsal central bone. It produces the flexion and the supination.

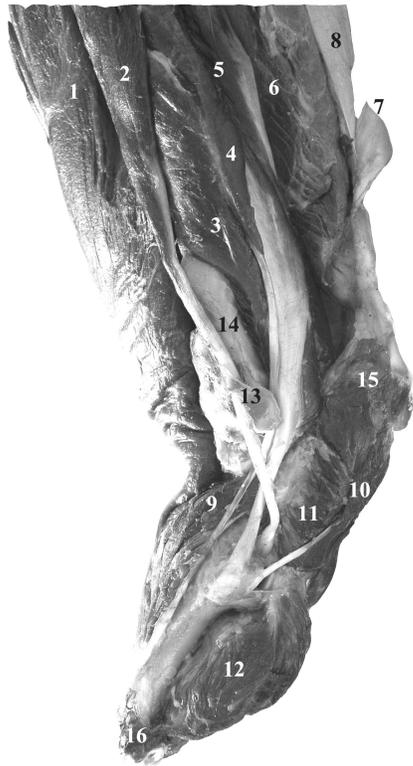


Fig. 1. The lateral view of the muscular complex of the shank and foot at the brown bear

1- m. extensor digitorum longus, 2- m. peroneus longus, 3- m. flexor digitorum, 4- m. extensor digitorum lateralis, 5- m. fibularis brevis, 6- m. soleus, 7- tendinis m. biceps, 8- tendinis m. flexor digitorum superficialis, 9- m. extensor digitorum brevis, 10- m. flexor digiti V, 11- m. flexor digitorum brevis, 12- m. abductor digiti I, 13- sulcus tendineus, 14- malleolus lateralis, 15- calcaneus, 16- os metatarsale V.



Fig. 2. The caudal view of the shank and foot at brown bear

1. m. biceps femoris, 2- 3. m. gastrocnemius-caput laterale and mediale, 4. m. soleus, 5. m. flexor digitorum profunde, 6. m. flexor digitorum superficialis, 7. tendo flexor digitalis superficialis, 8. m. adductor degeti I, 9. m. flexor digitalis brevis, 10. m. abductor digiti V. 11. m. abductor digiti I, 12-12' mm. adductor and abductor digiti.

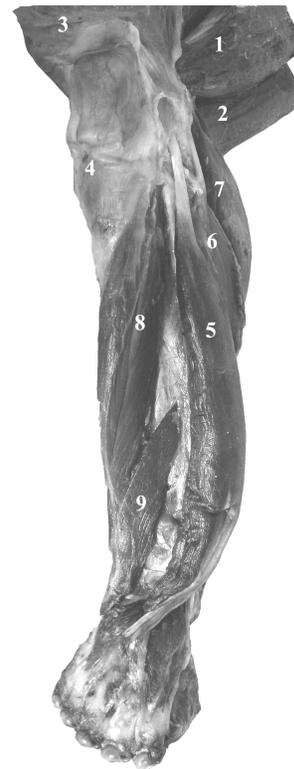


Fig. 3. The muscles of the shank at the brown bear, dorsal view

1- m. tensor fasciae latae 2- .biceps femoris, 3- m. quadriceps femoris, 4- patella, 5- m. extensor digitorum longus, 6- m. peroneus longus, 7- m. soleus, 8- m. tibialis cranialis- caput tibialis, 9- m. tibialis cranialis – caput peroneus.

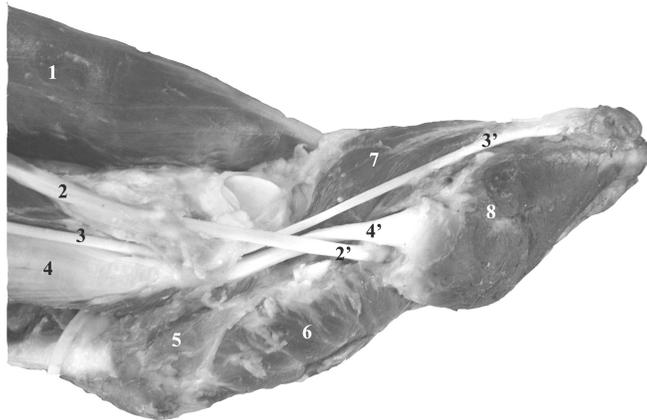


Fig. 4. The lateral view of the foot at the brown bear

1- m. tibialis cranialis, 2-2'- m. fibularis longus, 3- 3'-m. extensor digiti I, 4-4'- m. fibularis brevis, 5- m. extensor digiti V, 6- m. flexor digitorum brevis, 7- m. extensor digitorum brevis, 8- m. abductor digiti V.

The foot muscles at the brown bear

The dorsal muscles of the foot at the brown bear

*The digiti extensor brevis* is placed on the dorsal side of the foot. Its origin is situated on the cranio-lateral muscular crest of the calcaneum and by four thin tendons is inserted on the first phalanx of the second to fifth finger. Together with the extensor pedis longus and the extensor halucis longus; actions as extensors of the finger (Figure 4;5).

*The extensor digiti quinti* is represented by an only fascicle with origin on the calcaneum tuberosity and insertion at the proximal caudal tubercle of the fifth metatarsus bone.

*The plantary muscles of foot*

*The adductor halucis* muscle is extremely developed; being placed on the lateral face of the metatarsus bone and the first finger. Its origin is extended on whole first metatarsus and the insertion is on the second phalanx of that same finger. It produces the adduction of the first finger (Figure 6). The adductor halucis is origin on the axial face of the first metatarsus and the last insertion being on the second phalanx of the first finger. It is adductor; too (4).

The plantary muscles are represented by the adductor and abductor muscles that action on the fifth finger. The plantar adductor of the fifth finger is origin on the caudal face of calcaneum next to the proximal extremity. A long tendon continues the muscle that has the insertion on a tubercle; caudally placed by fibularis brevis insertion.

The middle plantary muscles (4). The flexor plantaris brevis is triangular and the origin is extended to the entire lateral face of the calcaneum. Its fibers; oblique dorso-medially oriented; are continued by a strong aponeurosis plantary structured; together with the fibres of the flexor profundus muscle.

*The adductor and abductor digitorum muscles* of the bear foot; by some wide tendons; are origin on the second row of the tarsal bones and the proximal extremity of metatarsus bones. Their tendons emerge with another tendon that goes from the distal extremity of the calcaneum and make together a common fibrocartilaginous structure (figure 7). From this; the adductor and the abductor muscles have the origin; being placed into two plans. The superficial plane is formed by two muscular fascicles in "V" structured. One fascicle is oriented to the axial face of the fifth metatarsus and the other goes to the axial face of the distal extremity of the first metatarsus. They lead to adduction towards the median plan for each finger. The deep muscular plan is represented by a muscular fascicles; axially and abaxially oriented; the bifid distal insertion on the big sesamoid bones and the proximal phalanx (Figure 6; 7).

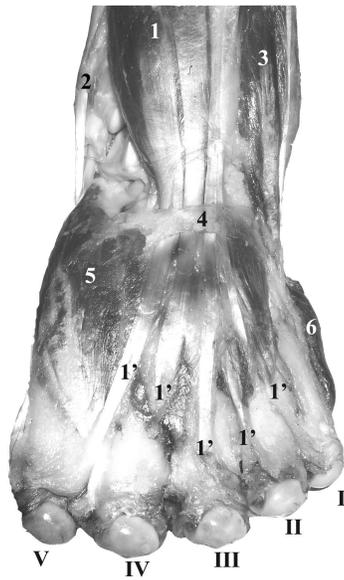


Fig. 5. Dorsal view of the heel and foot at the brown bear

1- m. extensor digitorum longus, 1'- tendo m. extensor digitorum longus, 2- m. peroneus longus, 3- m. tibialis cranialis, 4- vag. tendinis m. extensor digitorum longus, 5- m. extensor digitorum brevis, 6- m. abductor digiti I, I-V- ossa metatarsalia.

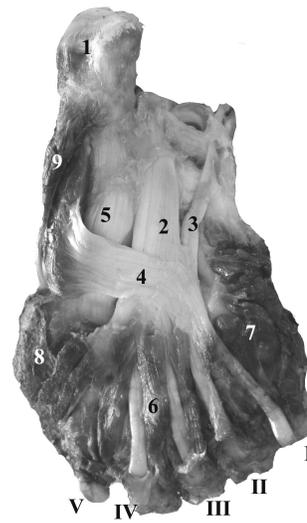
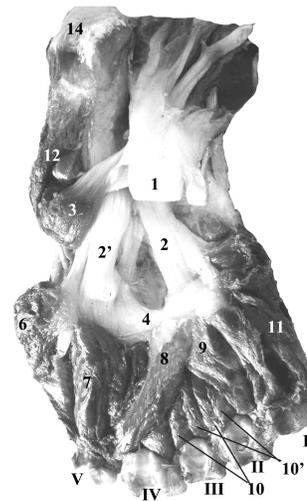


Fig. 6. The plantary aspect of the superficial muscles of the foot at the brown bear

1-calcaneus, 2- tendo m. flexor digitorum profunde, 3- retinaculum flexorum tarsale, 4- m. flexor digiti brevis, 5- tendo mm. adductoris, 6- m. adductor digiti, 7- m. abductor digiti I, 8- m. abductor digiti V.

Fig. 7. The plantary aspect of the deep muscles of the foot at the brown bear

1- tendo m. flexor digitorum profunde, 2-2'- tendo mm. adductoris and abductoris, 3- m. flexor digitalis brevis, 4- fibrocartilaginous structure, 6- m. abductor digiti V, 7- m. flexor digiti V, 8-9- m. adductor digiti I and V, 10- m. adductori digitalis, 10'- m. abductori digitalis, 11- m. flexor digiti I, 12- m. extensor digitalis brevis, 14- calcaneus.



## CONCLUSIONS

- In the case of bear; the shank and the foot muscles are represented by the developed and long muscular bodies continued with the short and strong tendons that deliver a great force in contraction.

- At the brown bear; the soleus muscle is very developed and; together with the gastrocnemius muscles create the Achille tendon; as the primates.
- From the first to the fifth fingers; each of them; present the own flexor and extensor muscles and; in consequence; the muscles lead to an independent activity to each finger; aspect so important for the body moving.
- As the primates; to the autopodial level one can see the extensor brevis muscle; dorsally placed; actioning in extension of the two to the fifth fingers; and plantary being; the flexor brevis muscle; together with the tendon of the flexor longus muscle; make a fibrocartilage shield.
- The adductor and abductor muscles by the plantary intermediary plan are positioned into two plans; one superficial and the other profound. The muscular superficial plan is structured by the fascicles that go and action to each finger. The profound muscular plan is formed by axial and abaxial fascicles that lead to the adduction and the flexion of the second to the fourth fingers.

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