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Original paper

Morphological and topographical aspects of the pelvic limb muscles in coypu

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Abstract

The study aimed to identify and describe the particularities of the pelvic limb muscles in coypu. In order to emphasize the muscles of the pelvic limb, four coypu corpses were used. The working method used was the stratigraphic and regional dissection. During the dissection, the superficial structures were conserved in relation to the muscle insertions and with the adjacent neurovascular and lymphatic structures.

We noticed that the gluteal superficial muscle merged with the fascialata tensor muscle, as well as with the femoral biceps muscle in its caudal part. The obturator muscle and the lumbrical muscles were well developed, while the sartorius muscle was missing. The caudal tibial muscle did not participate in formation of the long flexor muscle of the leg. The two tendons of the short digital extensor lied along the long digital extensor tendons for fingers II and III. The origin of the long fibular muscle was on the caudal edge of the upper third of the fibula. Its tendon passed on the lateral side of the fibular malleolus, along with the short fibular muscle tendons and lateral digital extensor, and the final insertion was at the base of the first metatarsus and the medial cuneiform bones.

Keywords Thigh region, *coypu*, hip joint.

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Introduction

The coypu, with the scientific name of *Myocastor coypus*, is a semi-aquatic mammal (V. GHEȚIE & al [3]; R. GLOGOWSKI & al [4]). This animal is bred in captivity especially for its unique coat and also for its meat, which is very rich in haemoglobin. Our research was meant to complete the data existing in literature. (R. BARONE [1]; V. COTOFAN [2]). The coypu's pelvic limbs are longer than the thoracic limbs. Each of the pelvic limbs has five fingers, with four of them presenting interdigital membrane. In case of the pelvic limbs, the observed muscle particularities are related to the way this animal moves and refer to their conformation and insertion (A. ALISTAR [12]).

In coypu, due to movement in the aquatic environment, the autopodial region is subject to certain strong abduction movements of the fingers, provided by the interdigital membrane. Thus, an important toes muscles development can be noticed.

This species has short forelimbs showing four well-developed toes, with nonretractile claws, and one vestigial toe. The fingers of the forelimbs are quite small and they are used for coat hygiene and foodgrabbing (G. PREDOI & al [8]; G. PREDOI & al [9]). The hind limbs are much longer and stronger than the forelimbs, having four of the five clawed toes connected by interdigital webbing, while the fifth outer toe is free. Coypu is rather skilled in excavating soil and handling very small food items. (VALENTINA HRIȚCU & al [5]; K.W. LATSHAW [6]; E. PAȘTEA & al [7]; G. PREDOI & al [10]; G. PREDOI & al [11]).

The following muscles were taken under study: gluteal muscles, deep muscles of pelvis, caudo-lateral thigh muscles, medial thigh muscles and pelvic autopodial muscles.

Materials and Methods

Four coypu corpses were used for this study. Stratigraphic and regional dissections were performed. Besides naked eye observation, a Nikon stereo microscope was used. During the dissection, the superficial structures were conserved in relation to the muscle insertions and to the adjacent neurovascular and lymphatic structures.

After skinning and removing connective tissue and fat, every muscle was individually dissected, by incisions parallel with the muscular fibres, maintaining in the same time their relation with the neighbour muscles.

Results and Discussions

The appearance of the pelvic limb musculature is correlated with the way this animal moves.

The superficial gluteal muscle is merging cranially with the *fascialata* tensor muscle and caudally with the femoral biceps; the insertion reached the lower third of the femur.

The middle gluteal muscle, well developed, extends its origin on the spinous processes of the lumbar vertebrae and thoraco-lumbar fascia.

The piriform muscle appears to be independent, being placed caudal to the middle gluteal muscle. It is acting as a powerful extensor of the hipjoint.

The deep gluteal muscle presents a cranial portion whose origin reaches the iliac crest. The deep gluteal muscle acts as a rotator of the coxofemoral articulation (Fig. 1).

The obturator muscles, both extern and intern, are highly developed. The *quadratus femoris* has an unusually large volume. It originates on the ventral side of ischium and is inserted on the lateral edge of the caudal side of the femur.

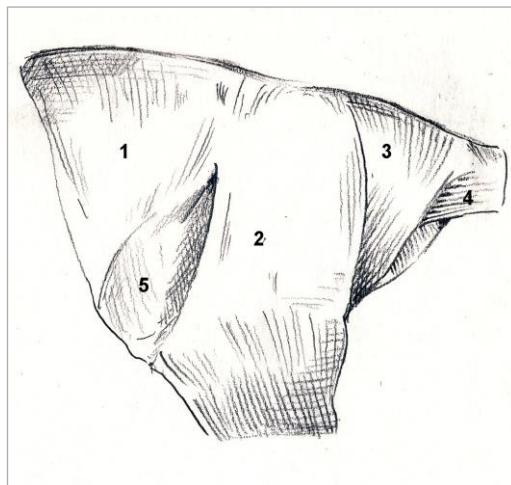
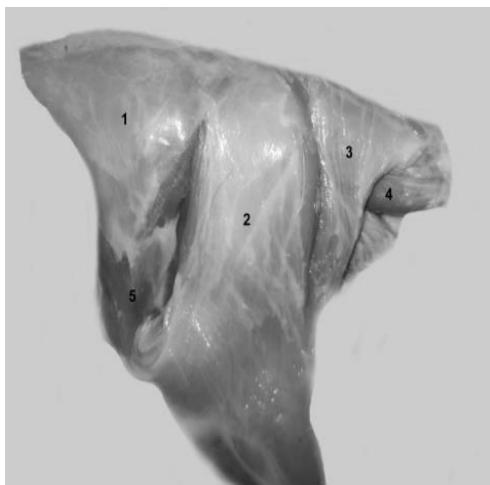


Figure 1. Superficial muscles of pelvis and thigh in coypu - lateral view (original)

1 – *fascialata* tensor muscle merged with the superficial gluteal muscle; 2 – femoral biceps muscle; 3 – semitendinosus muscle; 4 – ischio-pubo-coccygien muscle; 5 – femoral quadriceps muscle.

The *fascialata* tensor muscle is inserted caudally to the superficial gluteal muscle.

The femoral quadriceps muscle is characterized by a high development of the *vastus lateralis* muscle, while the *rectus femoris* muscle is proportionally reduced in size.

The femoral biceps presents two portions: cranial and caudal. The cranial portion has its origin on the transverse processes of the first two coccygeal vertebrae, and insertions on the coccygeal fascia, on the posterior edge of the superficial gluteal muscle and on the ischiatic tuberosity. The caudal portion, with the origin on the ischiatic arcade, lies over the semitendinosus muscle, partially combining its fibres with it.

The semitendinosus muscle, with the origin on the transverse processes of the first five vertebrae and on the coccygeal fascia, intersects the caudal portion of the femoral biceps. It inserts on the distal extremity of the tibial crest and on its cranial tuberosity.

The semimembranosus muscle does not exhibit any particularities (Fig. 2).

The dissection of muscles from the medial face of the leg was possible only after removing the femoral aponeurosis.

The *gracilis* muscle has a flat form, with the origin on the ischiatic arcade and on the ischio-pubic symphysis; the aponeurotic insertion is on the fascia of the leg.

The *sartorius* muscle was not found in this species.

As concerns the pectineus muscle, a convex aspect of the proximal part and a flattened posterior portion were observed after separation from the adjacent musculature.

The great adductor and small adductor muscles show no particularities (Fig. 3).

The cranial tibial muscle, similar to carnivores, has a superficial position. It is rather voluminous and shows

a bifid tendon insertion, on the first metatarsus and on the proximal phalange of the first toe.

The long digital extensor muscle is voluminous and fusiform. The long digital extensor muscle, placed lateral to the cranial tibial muscle, has a fusiform aspect. Its tendon spreads to the toes III, IV and V.

The long extensor of the *hallucis* is reduced and has a fusiform appearance, being deep situated. The tendon is spread to the first two fingers.

The short fibular muscle, located caudally to the *extensor pedis longus* muscle, is fusiform in shape. The tendon of the short fibular muscle inserts on the proximal end of the V metatarsus. The long fibular muscle originates on the upper third of the fibula. Its tendon passes over the fibular malleolus and, along with the tendons of the short fibular muscle and extensor digital lateral muscle, inserts on the basis of the first metatarsus and on the medial cuneiform bone.

The lateral extensor muscle of the leg, similar to the cat, presents two tendons that insert on the distal phalanges of the fourth and fifth finger (Fig. 4).

The digital superficial flexor muscle has a well-developed and located below the two gastrocnemius muscles. The tendon is divided into four parts, inserting on the proximal medial phalanges of the II, III, IV, V fingers, after they formed a ring for the deep flexor muscle tendons.

The *gastrocnemius* muscles are also prominent. The origin of the *soleus* muscles is on the caudal edge of the fibula and the body on the proximal third of the fibula. Their tendon interlace with the lateral *gastrocnemius* tendon, which is inserted on the calcaneus (Fig. 5).

The deep digital flexor muscle in coypu is composed only by the *flexor pedis longus* and by the long *flexor hallucis longus* muscles.

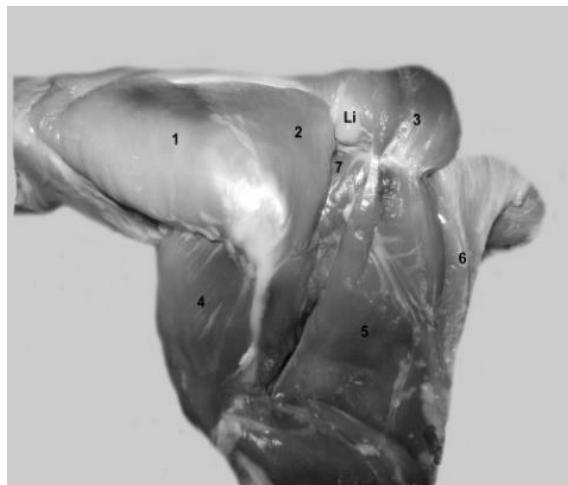
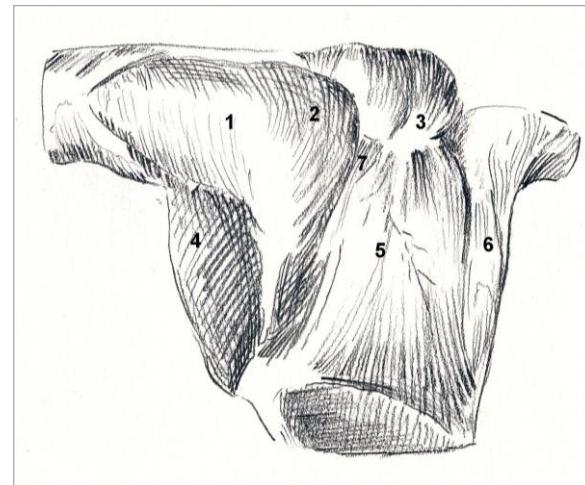


Figure 2. Deep muscles of the lateral face of the pelvis and thigh in coypu – lateral view (original)

1 – middle gluteal muscle; 2 – piriform muscle; 3 – sectioned femoral biceps muscle; 4 – femoral quadriceps muscle; 5 – semimembranosus muscle; 6 – semitendinosus muscle; 7 – the *gemelli* muscles; Li - ischiatic lymph nodes.



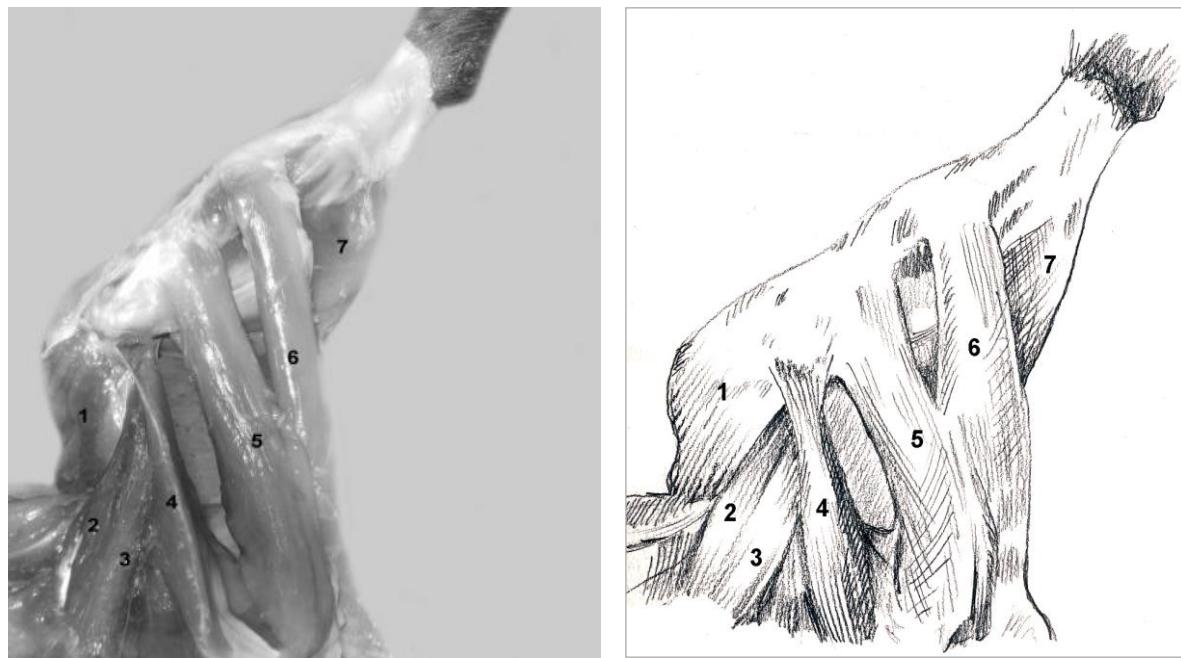


Figure 3. The deep medial thigh muscles in coypu – medial view (original)

1 – *vastus medialis* muscle; 2 – *pectineus* muscle; 3 – small adductor muscle; 4 – great adductor muscle;
5 – *semimembranosus* muscle; 6 – *semitendinosus* muscle; 7 – medial *gastrocnemius* muscle.

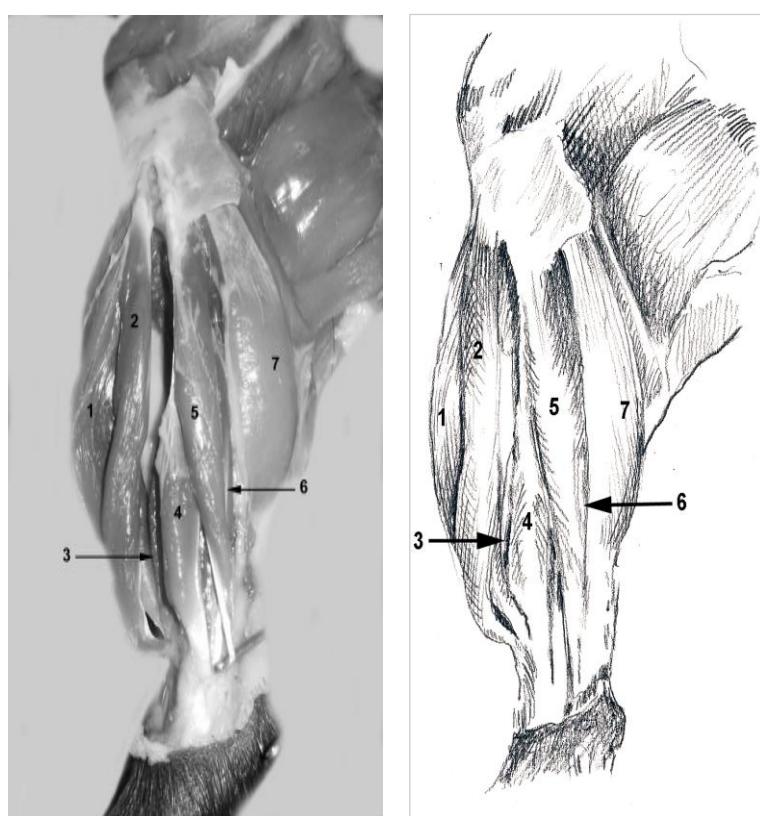


Figure 4. Cranio-lateral muscles of the leg in coypu – lateral view (original)

1 – cranial tibial muscle; 2 – long digital extensor muscle;
3 – short digital extensor muscle; 4 – short fibular muscle; 5 – long fibular muscle;
6 – lateral digital extensor muscle; 7 – *gastrocnemius* muscle-lateral portion.



Figure 5. Musculature of the leg in coypu – medial view (original)

1 – cranial tibial muscles; 2 – popliteal muscle; 3 – long flexor muscle of fingers; 4 – caudal tibial muscle; 5 – long flexor muscle of thumb; 6 – *soleus* muscle; 7 – *gastrocnemius* muscle-medial portion; 8 – digital superficial flexor muscle.

The long flexor muscle of leg originates on the medial side of tibia. Its powerful and widened tendon, passes to the plantar side of the tarsus, where it receives a bridle from the great flexor tendon, and divides into four, distributing itself to fingers II, III, IV and V.

The long flexor of *hallucis* (thumb) is partly covered by the previous. It presents a long distal tendon that joins the long flexor muscle tendon of the foot and inserts on the plantar tubercle of finger I.

Caudal tibial muscle originates from the caudal face of the tibia and the proximal insertion on the first metatarsus. It does not participate in the formation of the digital deep flexor muscle.

The short muscles of the pelvic autopodium are very well developed. The short digital extensor is represented by two muscular parts, median and lateral, continuing with a tendon that is accompanying the long digital extensor tendons of the foot, for toes II and III. The short digital flexor muscle is similar to that of the cat, which forms a thin and large layer of muscle, included in the superficial flexor muscle, distal to the calcaneal tuberosity. The lumbrical muscles are more developed than in the thoracic limb.

The plantar square muscle is the flat muscle that crosses obliquely and superficially the long flexor muscle tendon of the foot. The plantar square muscle merges with the long flexor muscle tendon of the hallux.

The interflexor muscles are represented by three groups of superficial flat muscle fibres which link the

tendon of the superficial flexor muscle with the tendon of the long flexor muscle.

Interosseous muscles are similar to those from the thoracic limb. These muscles are inserted on the plantar face of metatarsals II, III, IV and V, and play an important role in the flexion of the sesamoid-phalangeal joint.

We noticed an excessive development of the abductor and adductor muscles of finger V, finger that exceeds the dimension of the first finger, due to the swimming effort.

Conclusions

Regarding the muscles of pelvis, the most important features were those of the superficial gluteal muscle, piriform and deep gluteal muscle. The superficial gluteal muscle is merging cranially with the *fascialata* tensor muscle and caudally with the femoral biceps; the insertion is extended, reaching the third part of the femur. The piriform muscle appears to be independent, being placed caudally to the middle gluteal muscle. It is acting as a powerful extensor of the hip joint. The origin of the cranial portion of the deep gluteal muscle reaches the iliac crest. The deep gluteal muscle acts as a rotator of the coxo-femoral joint.

In coypu, a significant development of the muscles of the pelvic member fingers was confirmed. For swimming, the autopodial region is subject to strong abduction movements of the fingers provided with the interdigital membranes.

The abductor and adductor muscles of the fifth finger are well developed; this finger exceeds the dimensions of the first finger and is very important during swimming.

The deep digital flexormuscle is formed only by the long digital flexor muscle and the long flexor muscle of *hallux*. The caudal tibial muscle is not involved in the formation of the deep digital flexor muscle.

An important feature observed in this species is the absence of the *sartorius* muscle.

The semitendinosus muscle has an insertion on the ventral face of ischial tuberosity and can be easily separated from the femoral biceps muscle, in the femoral region.

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