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دراسة مورفولوجية على العضلات الوحشية والامامية

للحوض والفخذ في الجمل ودورها في الحركة

أشرف صبحـــي ، أحمد قنـاوي

وصفت في هذه الدراسة منبت ومنضغم وتركيب وعلاقات عضلات الناحية الوحشـــية والأماميـة للحوض والفخـذ في الجمـل.

وقد قورنت النتائج مع مثيلاتها في الحيوانات المجترة الأخرى، كما نوقش الـــدور الذي تلعبـه هذه العضلات في الحركة وتأثيرهـا على طريقة المشـي في الجمل.

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MORPHOLOGICAL STUDY ON THE LATERAL AND CRANIAL MUSCLES OF THE HIP AND THIGH OF THE DROMEDARY AND THEIR ROLE IN LOCOMOTION

(With 5 Figs.)

By
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SUMMARY

The origin, insertion, structure and relations of the muscles of the lateral and cranial aspect of the hip and thigh regions of the camel were completerly described. The obtained results were compared with those reported in other ruminant animals and the role of these muscles in locomotion was also discussed.

INTRODUCTION

The dromedary is characterized by a special type of movement which may depend upon the position and structure of the muscles of the limbs. Whether the thoracic or pelvic limbs have the main force of locomotions is still a matter of investigation. FRAGUIER (1955) affirmed that the camel's main force of locomotion is in the fore quarters, rather than as in the horse, the hind quarters.

The scope of this study, however is to examin the origin, insertion and structure of the lateral and cranial muscles of the hip and thigh regions and their relation to locomotion in camel.

MATERIAL and METHODS

The study was carried out on eight pelvic limbs of the dromedary of both sexes and of different ages. The animals were bled and injected with 10% formalin solution through the common carotid arteries. The dissection of th limbs was carried out after three days to examin the origin, insertion and structure of the muscles of the hip and thigh regions.

The nomenclature given by the Nomina Anatomica Veterinaria (1983) have been used in this work. The obtained results were explained by five Figures.

RESULTS

I- LATERAL MUSCLES OF THE HIP AND THIGH

M. tensor fasciae latae (Figs. 1,4,5/1)

The muscle originates from the coxal tuber and the most cranial part of the crest of the ilium lateral to the origin of M. gluteus medius.

The insertion of the muscle is indirectly into the patella and tibia by means of the fascia latae.

The M. tensor fasciae latae is situated on the craniolateral aspect of the thigh, its fleshy part descends for about 11-19 cm before it becomes thinner and ends in the fascia latae. The muscle is related laterally to M. gluteobiceps and medially to th sartorius. The deep face of the muscle lies on Mm. vastus lateralis, rectus femoris and vastus medialis.

The action of the muscle is to flex the hip and extends the stifle and tenses the fasciae latae. It receives the arterial blood through A. circumflexa ilium superficialis, R. superficialis of the caudal branch of A. circumflexa ilium profunda and Rr. musculares of the femoral artery. The venous blood is returned through R. caudalis of V. circumflexa ilium profunda.

The innervation of the muscle comes from N. gluteus cranialis.

M. gluteus medius (Figs. 1-4/2,2')

It is a thick fleshy muscle which composed of a large superficial head and a deep smaller one (M. gluteus accessorius).

The superficial head originates from the gluteal surface of the ilium between the coxal and sacral tubers parallel to the vertebral border of the ilium and from the aponeurosis of M. longissimus lumborum. The deep head originates from the faint gluteal line and a triangular area on the gluteal surface of the ilium (between the origin of the superficial head and the lateral border of the ilium).

The superficial head of the middle gluteal muscle is inserted into the summit of the greater trochanter and the trochantric crest of the femur, while the deep head is inserted by a strong flat tendon into the femur just cranial and distal to the greater trochanter under cover of the proximal part of M. vastus lateralis.

The muscle is large and fleshy at its origin and its insertion is narrow and tendinous. The muscle fibers are arranged in fine bundles which are directed caudodistally. The deep head is thin and strap-like.

The action of the muscle is to extend the hip joint, abduct the limb and rotate the femur. Its arterial blood comes from the cranial gluteal artery and R. caudalis of A. circumflexa ilium profunda, while the nerve fibers are detached from the cranial and caudal gluteal nerves.

M. gluteus profundus (Figs. 1,2/3)

It is a thick prysmatic muscle which covers the hip joint and extends cranially till about the tuber coxae. It originates from the gluteal surface of the wing, distal to M. gluteus intermedius, as well as from the body of the ilium and the lateral surface of the trochanter major.

The muscle is composed of a short fleshy portion which continues distally by several tendinous fibers that unite to form the single tendon of insertion. The muscle fibers are directed caudodistally at its cranial part and craniodistally caudally. The muscle is covered by the middle gluteal muscle and is related deeply to the hip joint, ilium and M. iliacus.

The action of the muscle is to abduct and rotate the thigh medially. The cranial gluteal nerve is responsible for the innervation of the muscle, while the blood comes from the cranial gluteal artery.

M. semitendenosus (Fig. 4/4)

It is a long, narrow and fleshy muscle which lies between the gluteobiceps and semimembranosus muscles.

MUSCLES OF THE HIP AND THIGH OF THE DROMEDARY

The muscle originates from the caudolateral and caudoventral aspects of the ischial tuber together with M. gluteobiceps. The tendon of the muscle is attached to the Tuber calci, crural fascia and the medial surface of the tibial crest.

The proximal third of the muscle is fleshy in structure and is interrupted by a single tendinous inscription. The muscle fibers are arranged in a lamellar form. Distal to the level of the stifle joint near its insertion the muscle fibers become tendinous. A synovial bursa is present between the cranial part of the insertion tendon and the tibial crest.

The action of the muscle is to extend the hip and hock joints, flex the stifle and rotate the thigh medially. The arterial blood comes from R. descendens of A. profunda femoris distalis. The nerves of the muscle are detached from N. ischiadicus and N. gluteus caudalis.

M. semimembranosus (Figs. 1,4/5)

It is a long volumenous muscle which occupies the proximal part of the caudomedial aspect of the thigh. It originates from two tuberosities on the ventral surface of tuber ischii and an area ventral to the caudal border of the ischium. The muscle has a proximal insertion into the medial epicondyle of the femur and a distal one into the caudal margin of the medial condyle of the tibia.

The massive muscle is divided by a constriction about its middle into a proximal part and a distal part. The proximal part is four-sided and is marked proximally by a tendinous mass of about 5 cm long which the muscle fibers diverge cranio- and caudodistally. The proximal part, when hardened in situ, presents a spiral groove within which M. semitendenosus lies. The distal portion of the muscle is three-sided and is related craniomedially to the adductor and caudomedially to the gracilis, while laterally it is related to the gluteobiceps and semitendenosus.

The action of the muscle is to extend the hip and adduct the limb as well as fix the stifle. The arterial blood is derived from Aa. profunda femoris, circumflexa femoris medialis and caudalis femores proximalis, media and distalis. The innervation comes from N. ischiadicus.

M. gluteobiceps (Figs. 1,4,5/6)

It is a long broad muscle which originates from intermuscular septum between Mm. tensor fasciae latae and gluteus medius, gluteal fascia, tuber ischii, sacrotuberous ligament and sacral and caudal spines. The muscle is inserted by an aponeurosis into the lateral border of the patella, tibial tuberosity, tuber calcis, crural fascia and the intermuscular septum between Mm. extensor digitorum longus and lateralis.

The muscle is massive, rectangular in shape and covers the largest part of the lateral aspect of the thigh. Its cranial part which covers M. gluteus medius is considered as the caudal head of M. gluteus superficialis which is fused with M. biceps femoris in the dromedary. The insertion of the muscle in the tibial tuberosity is by a tendinous strip about 5 cm wide. The fibers of M. gluteobiceps are directed cranioventrally in its cranial portion and caudoventrally in the caudal part of the muscle. The arterial blood comes from R. descendes of A. circumflexa femoris medialis, R. ascendens of A. circumflexa femoris lateralis and A. profunda femoris. The muscle is innervated from Nn. ischiadicus and gluteus caudalis.

II- CRANIAL MUSCLES OF THE HIP AND THIGH

M. vastus lateralis

As in other domesticated animals the quadriceps femoris muscle consists of the three vasti in addition to M. rectus femoris.

M. vastus lateralis (Figs. 2-5/7)

The muscle originates from the lateral surface of the femur from the level of the trochanter major till the supracondyloid fossa and from the lateral surface of the trochanter major.

In additon, some fibers originate from M. vastus intermedius.

The insertion of the muscle is in the base and lateral border of the patella, in common with Mm. rectus femoris and gluteobiceps.

The muscle is long, massive and occupies the craniolateral aspect of the femur. The muscle fibers are directed cranioventrally till the middle of the muscle where they intermingle with those of the lateral portion of M. rectus femoris. The muscle is separated from M. gluteobiceps by a white glessening tendinous sheath which desends from the origin of the muscle.

The vastus lateralis muscle extends the stifle joint and receives its blood supply from A. profunda femoris, A. circumflexa femoris lateralis (Rr. descendens and transversus) and recei-

M. rectus femoris (Figs. 1,5/8)

The rectus femoris muscle extends from the ilium to the patella and originates from the craniolateral part of the shaft of ilium (about 1 cm away from its lateral border and 2 cm dorsal to the acetabulum). About 13 cm from its origin, the muscle divides into a large lateral head and a small medial one. The lateral head is inserted at the cranial surface and apex of the patella, while the medial one ends at the medial side of the patella.

The rectus femoris is a long cylendrical muscle situated at the cranial aspect of the thigh. The muscle fibers run in a regular longitudinal direction along the whole length of the muscle. At its distal third some muscle fibers join those of the vastus lateralis through an intermuscular septum.

The M. rectus femoris extends the stifle joint and flexes the hip. It receives its blood supply from R. transversus of A. circumflexa femoris lateralis and its innervation through the femoral nerve.

M. vastus intermedius (Figs. 2,3/9,11')

The muscle is the smallest of the quardriceps femoris group and consists of a lateral and medial heads. The lateral head takes its origin from the cranial and lateral surfaces of the femur, from the neck till the level of the supracondyloid fossa. The medial head originates from the caudolateral surface of the femur from the level below the trochanter major till the middle of the femur.

The lateral and medial heads of the muscle are inserted into the lateral and medial borders of the patella in common with Mm. vasti lateralis and medialis respectively. Moreover, strong fibers are inserted into lateral aspects of the femoropatellar joint capsule.

The vastus intermedius is a fleshy muscle which consists of two separate heads which are partially fused at their proximal parts. They are elongated and covered with glessening tendinous fibers which converge distally to form the insertion of the muscle. From the distal part of both the medial and lateral aspects of M. vastus intermedius as well as from the caudal surface of the femur between the nutrient foramen and supracondyloid fossa, well developed muscle fibers are detached, run distally to insert into the lateral and medial aspects of the femoropatellar joint capsule at the level of the proximal half of the patella.

The vastus intermedius supports the action of the other vasti group as well as the femoropatellar joint capsule. It receives its blood supply from A. profunda femoris, A. circumflexa femoris lateralis (Rr. descendens and transversus). The nerve supply comes from the femoral nerve.

M. vastus medialis (Figs. 2,5/10)

It is the medial division of the quadriceps group. It originates from the proximal fourth of the craniomedial surface of the femur (from the neck of the femur to about 8 cm distal

to the trochanter minor). The muscle is inserted by an aponeurotic tendon into the medial border of the patella and the medial patellar ligament.

The muscle is fleshy and increases in size distally, its fibers run in a cranioventral direction. It extends the stifle joint and receives its blood supply from A. circumflexa femoris lateralis, as well as A. femoralis. The nerve supply comes from N. femoralis.

M. articularis genus (Fig. 2/11)

Is a very thin muscle which begins at the cranial surface of the distal fourth of the femur about 12 cm proximal to the trochlea femoris and ends at the suprapatellar pouch of the femorotibial joint capsule. This small, week muscle is situated between the most medial and distal muscle fibers of M. vastus intermedius craniolaterally and the suprapatellar pouch and femur caudally. It tenses the suprapatellar pouch.

M. articularis coxae (Figs. 1,2/12)

It is a very well developed muscle in the camel, originates from the ilium just proximal to the head of M. rectus femoris. Its tendon of insertion dips between M. vastus intermedius and M. vastus lateralis and attaches to the proximal part of the cranial surface of the femur till the level of the trochanter minor. It passes on the lateral side of the hip joint where some fibers attach to its fibrous capsule.

The muscle is related laterally to Mm. gluteus profundus and vastus lateralis; medially to Mm. rectus femoris and vastus intermedius and the capsule of the hip joint.

The muscle raises the joint capsule and prevents its being pinched by the articulating bones during flexion.

DISCUSSION

The M. tensor fasciae latae of the camel resembles in structure that described in small and large ruminants by McLEOD (1960), NICKEL/SCHUMMER/SEIFERLE (1968); MAY (1970) and GETTY (1975). However, the additional origin from the cranial part of the crest of ilium in camel gives more support to the muscle and its strength. The aponeurotic insertion of the muscle shares in the formation of a strong tendinous sheath formed by Mm. gracilis, sartorius, vastus medialis, rectus femoris, vastus lateralis and gluteobiceps which covers the stifle joint and attaches to the patella (SABER/BOLBOL, 1982).

McLEOD (1960) stated that M. semitendenosus in ox is succeeded beyond the level of the stifle, by two fibrous bands. The cranial band is ribbon-like and attaches to a rough area near the tibial crest, while the caudal band is narrow and extends to the tuber calcis. These two fiberous bands are fleshy in nature in the camel.

NICKEL, et al. (1968) stated that the biceps femoris is divided in small ruminants and to a certain limit in large ruminants into cranial (vertebral) and caudal (pelvic) parts. The cranial part unites with M. biceps femoris forming M. gluteobiceps. This is in agreement with the findings in the camel. LEESE (1927) mentioned that the gluteus maximus (superficialis) of the camel is not inserted into bone, but to the fascia of the thigh.

The M. rectus femoris in ruminants arises by two tendons from the Os coxae proximally and cranial to the acetabulum, as well as from the ventral surface of the body of the ilium (GETTY, 1975). In the sheep, MAY (1970) mentioned only one tendon of origin from a depression on the ventral border of the shaft of ilium, moreover and after about 13 cm from its

origin the rectus femoris muscle inserts into the apex and cranial surface and medial side of the patella.

In small and large ruminants the belly of M. vastus intermedius divides into two portions in the distal third of the femur and merge with the insertions of the medial and lateral vasti muscles respectively (GETTY, 1975 and MAY, 1970). This separation becomes clear in the camel at both the origin and insertion of the muscle. The two portions of the muscle detach well developed fibers which end in the femoropatellar pouch and this adds more function to M. vastus intermedius i.e. tencing the joint capsule.

GETTY (1975) considered M. articularis genus as unseparable portion from M. vastus intermedius. In the dromedary, the M. articularis genus have a separate origin and insertion. However, the action on the femoropatellar joint capsule is performed, in addition, from M. vastus intermedius.

The M. articularis coxae is absent in small and large ruminants and is found only in carnivores and horse (NICKEL, et al. 1968 and McLOD, 1960). The dromedary, unlike the ruminants and like carnivores and horse is characterized by a well developed articularis coxae.

CONCLUSIONS

BONE (1979) stated that the running animals have their muscles of locomotion attached closer to the joints than do nonrunners. This results in a shorter and quicker muscle contraction. It also results in a longer arc of movement of the distal end of the bone in which the muscle is inserted. He also added that this arrangment sacrifies power which is not particularly disadvantageous, since running animals do not need the power developed by climbers, burrowers and swimmers. In agreement with BONE (1979) and owing to the relative length of camel's bones, the muscles of the hip and thigh of the camel were found to be relatively and absolutly long. This feature makes the muscle contraction slower and also results a long arc of the movement of the distal end of the limb, i.e. performing a relatively wide stride in longer time. This arrangement manifests why camel is not among the fastest mammals but able to walk about 150 Kilometers in 15-20 hours, as reported by DANIS (1970).** Moreover, pace which camel generally do, allows the muscles on one side of the body to work almost in union to pull the legs forward (GAUTHIER-PILTERS and DAGG, 1982). This declears also that the weight of the camel is supported by the legs on one side of the body and then those on the other side, the matter which minimizes this load on the limbs.

From the findings of this study it is also obvious that the dromedary have a peculiar muscular features of its own which differs to a certain extent from that of the small and large ruminant:

1- The M. tensor fasciae latae originates, in addition to the tuber coxae, from the cranial part of the iliac gluteal surface.

2- Both the Mm. rectus femoris and vastus intermedius are clearly divided into two separate heads slightly after their origin and till their insertions.

3- Each of the distal part of the two portions of M. vastus intermedius detach well developed muscle fibers which end on the femoropatellar joint capsule. The lateral fibers originate, in addition, from the caudal surface of the femur.

** DAGG (1974) mentioned that more propulsion for the gait comes from the hindquarters than from the forequarters.

4- The presence of M. articularis coxae which is absent in the small and large ruminants.
5- The well developed muscle fibers detached from M. vastus intermedius support the action of M. articularis genus which have a separate origin in the dromedary.

From the above mentioned results and discusion we can conclude that the hip and thigh muscles have a main role on the mode of locomotion and the length, frequency and duration of strides which characterizes the gait of the dromedary.

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LEGENDS

Fig. (1): Left pelvic bone of the camel illustrating the muscle attachment (lateral view).

Fig. (2): Left femur of the dromedary illustrating the muscle attachment (cranial view).

Fig. (3): Left femur of the dromedary illustrating the muscle attachment (caudal view).

Fig. (4): Muscles of the thigh of the dromedary (lateral view).

Fig. (5): Muscles of the thigh of the dromedary (cranial view).

1 M. tensor fasciae latae, 2 M. gluteus medius, 2' M. gluteus accessorius (of 2), 3 M. gluteus profundus, 4 M. semitendenosus, 5 M. semimembranosus, 6 M. gluteobiceps, 7 M. vastus lateralis, 8 M. rectus femoris, 9 M. vastus intermedius, 10 M. vastus medialis, 11 M. articularis genus (cranial portion), 11' lateral portion of 11, 12 M. articularis coxae, 13 M. sartorius, 14 M. gracilis.

a Tuber sacrale, b Tuber coxae, c Tuber ischiadicum, d acetabulum, e Foramen obturatum, f Caput ossis femoris, g Trochanter major, h Fossa trochanterica, i Trochanter minor, j Fossa supracondylaris, k Condylus, l Trochlea ossis femoris, m Foramen nutricium, n Os femoris, o Patella.
(Dots denote origin & Lines denote insertion).

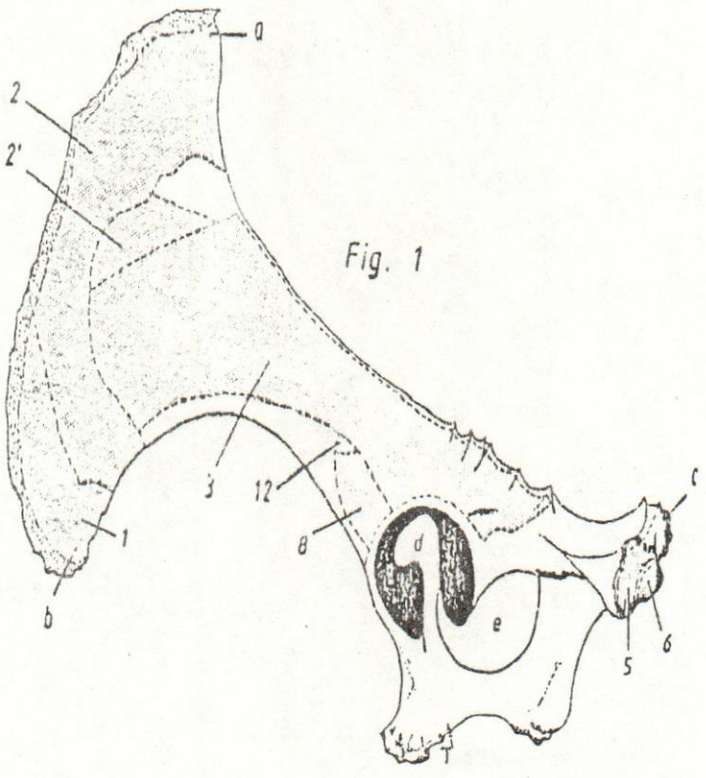

Fig. 1

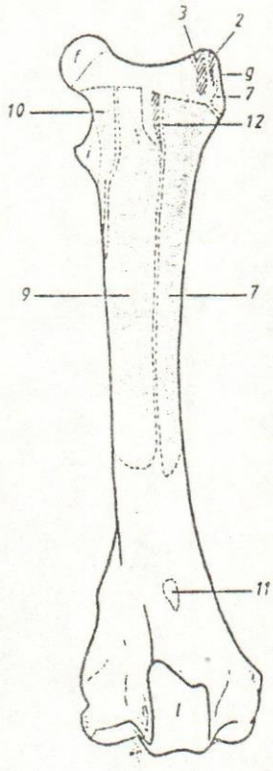

Fig. 2

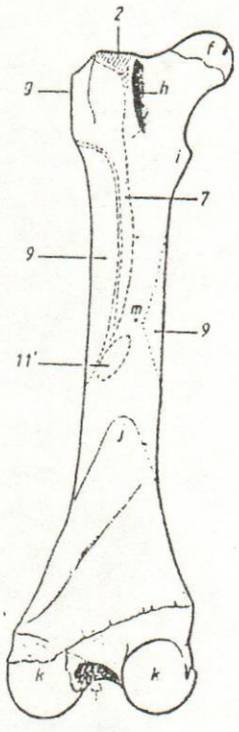

Fig. 3

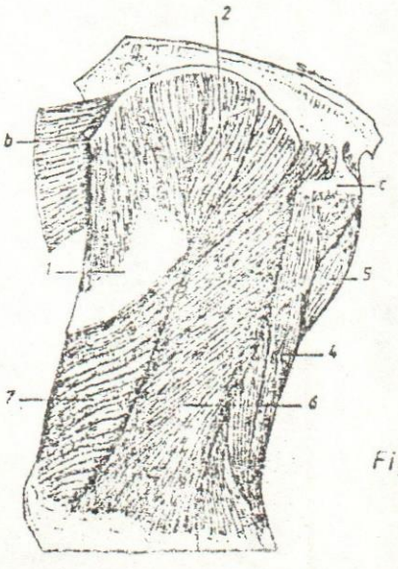

Fig. 4

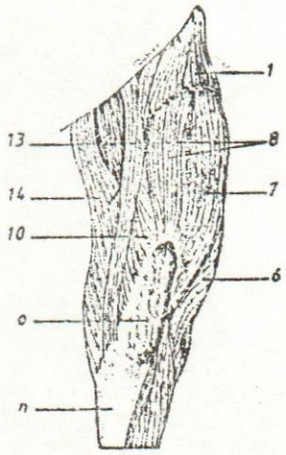

Fig. 5