THE MUSCULATURE OF THE HIP AND THIGH OF THE CHIMPANZEE
A COMPARISON TO MAN AND OTHER PRIMATES

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Introduction

The purpose of this thesis is to present an anatomical description of the musculature of the hip and thigh of the chimpanzee, and a morphological comparison of this primate to the Rhesus monkey, orang, gorilla and man.

The description of the muscles has been done in order to add to the present knowledge of primate musculature. The research, in preparation for this description, was done upon two chimpanzees. One of the specimens was an adult and had been preserved for several years before the dissecting was done. The specimen was extremely well kept up, although it was quite dry. The other specimen was a very young adolescent, which had been obtained recently. This animal was quite small and therefore was not used for any of the measurements cited in the descriptive parts of this paper.

For the purpose of comparison to the other primates mentioned, i.e., macaque, orang, gorilla and man, various sources were used. For the macaque, Hartmann & Straus' Anatomy of the Rhesus Monkey, was used, and a macaque was dissected for comparative purposes. Boyer's paper on the orang was referred to as the main source for information on this animal. The Anatomy of the Gorilla, as edited by Gregory was the source for references to this animal. Gray's Anatomy and several specimens on hand at the University of Wisconsin's anatomy laboratory were used for the comparison with man.

The muscles described in this paper are those of the one adult chimpanzee studied. Sonntag's description of the muscles was used for comparative purposes, although his descriptions were by no means complete. Hepburn's articles were also valuable.

The muscles are described in relation to the three axes at the hip joint, and the one axis at the knee joint. This is done, rather than using an action description, since we are not sure that any muscle will act as it theoretically could.

The purpose of comparing the chimpanzee, man, the orang, the gorilla and the macaque, is to attempt to gain some insight into the muscles that make for erect posture in man. The gorilla, of the primates mentioned in this paper, seems to come the closest to man in assuming a bipedal, erect position. The chimpanzee would be next in closeness to man's posture. The orang, a large tree-dwelling primate would show some features of specialization toward arboreal living and the macaque is referred to because it offers an excellent example of a semi-biped, i.e., it is quadrupedal and bipedal in its locomotion, depending upon its needs.

Hip and Thigh Muscles of the Chimpanzee

Muscles of the Iliac Region:

M. psoas major(psoas magnus): This is a long muscle attached proximally to the thirteenth thoracic vertebra, the inner inch of the last rib, and the transverse processes and centra of the lumbar vertebrae. The fibers blend with those of the iliacus, more so than in man. Distally it attaches, as the iliopsoas, into the lesser trochanter and along the femoral shaft for a few millimeters. The muscle passes laterad to the longitudimal axis and there is a ventro-dorsal component to the pull. The muscle passes ventrad to the transverse axis and there is a longitudinal component to the pull. The muscle passes slightly laterad to the ventro-dorsal axis and again there is a longitudinal component to the pull. The action on the ventro-dorsal axis would be quite weak since the muscle fibers are in close proximity to this axis.

In the orang, the psoas is so intimately fused with the iliacus that Boyer (1) refers to them as one muscle, the m. iliopsoas. Sonntag (6) describes a proximal attachment similar to the chimpanzee for this muscle, but Boyer only found attachments to the four lumbar vertebrae.

In the gorilla, the proximal attachment is also on the medial side of the ilium.

In man, the situation is quite similar to that in the chimpanzee.

In the macaque, the muscle attaches proximally to the bodies of the seven lumbar vertebrae and several of their transverse processes, its fibers then passing down and fusing with those of the iliac muscle.

M. psoas minor (psoas parvus): This is a long slender muscle, passing ventral to the m. psoas major. Its proximal attachments are the last thoracic and first lumbar vertebrae. The distal attachment is on the ilio-pectinal line and according to Sonntag (6) the insertion is more ventrad in the chimpanzee. The muscle passes ventral to the transverse axis of the intervertebral joints and has no action on the hip or knee.

M. iliacus: The iliac fossa, in man, is filled by this muscle. In the chimpanzee, one can say it covers the entire abdominal surface of the wing of the ilium. Its fibers blend with those of the m. psoas major. The muscle passes ventral to the transverse axis, and slightly lateral to the ventro-dorsal axis and the fibers have a longitudinal component to their pull. At the longitudinal axis the muscle passes laterad and has a horizontal component to its pull on this axis.

Muscles of the Thigh:

The Anterior Femoral Group:

M. sartorius: This is a long slender muscle, attached proximally to the ilium slightly below its anterior superior spine. Distally it is attached to the anterior border of the tibia, about nine centimeters below the knee joint. The muscle runs obliquely across the medial surface of the thigh and then along the medial surface of the knee joint. The muscle passes ventrad to the longitudinal axis of the hip and has a small horizontal component to its pull. The muscle passes ventrad to the transverse axis of the hip joint and laterad to the ventro-dorsal axis and has a longitudinal component to its pull on both these axes.

At the knee, the muscle passes dorsad to the transverse axis of the knee joint, and there is a longitudinal component to the pull.

In the macaque, the distal attachment is proportionally lower than in the chimpanzee. In man, orang and the gorilla the distal attachment is somewhat higher.

M. quadriceps femoris: This muscle, in man, as well as in all other mammals, is made up of the usual four parts. These will be taken up as individual muscles.

M. rectus femoris: In both the specimens dissected, this was a multipennate muscle, that is, the muscle fibers converge upon several tendons running through the length of the muscle. This gives the individual fibers a shorter contractile length. The tendons thin out toward the distal attachment.

The proximal attachment is by two tendons (both of which give rise to the several smaller tendons coursing through the length of the muscle), one inserting into the front of the ilium, the other directly behind it on the posterior surface of the ilium. The two tendons form an arch over the upper border of the acetabulum. The distal attachment is on the base of the patella, and through the and the patellar ligament to the tuberosity of the tibia.

The muscle passes ventrad to the longitudinal and the transverse axes and laterad to the ventro-dorsal axis. There is a longitudinal component to the pull in relation to the ventro-dorsal and transverse axes. The muscle is almost parallel to the longitudimal axis and therefore would have a very weak horizontal pull.

At the knee joint, the muscle is ventral to the transverse axis and has a longitudinal pull on this axis.

There is little difference in the m. rectus femoris of the orang, gorilla and man. Goss (3) states that in man the rectus is bipennate. No mention is made of muscle fiber arrangement in the description of the gorilla and orang. Sonntag (6) states that the mm. quadriceps are more fused in the other primates as compared to the human. The macaque has a single proximal attachment, but is otherwise like the other primates.

M. vastus lateralis: (vastus externus): This is a heavy muscle on the femur of the chimpanzee,, it is approximately fifteen millimeters thick near its middle. The proximal attachment is from the antero-lateral aspect of the great trochanter,and along the back of the shaft of the femur to a point about two and one-half centimeters from the lateral condyle of the femur. It receives slips from the m. vastus intermedius. Its distal attachment is into the lateral base of the patella, where it blends with the quadriceps tendon. It is also ventral to the transverse axis of the knee joint and has a longitudinal component to its pull.

In the chimpanzee and the orang, the proximal attachment is split into two heads by the insertion of the m.scansorius whereas in the gorilla, it is split into two heads by the m. glutaeus minimus (blended with the m. scansorius) insertion. In man the proximal attachment is a broad aponuerosis. In the macaque, the muscle is extremely heavy as compared to other anterior femoral muscles, and, as in man, it too has a single proximal attachment. The distal attachments are similar as regards area of attachment in all the primates under discussion.

M. vastus medialis (vastus internus): This is a heavy muscle on the antero-medial aspect of the femur, although it is not as heavy as the m. vastus lateralis, being only one centimeter in thickness at its heaviest part. Its proximal attachment is from the intertrochanteric line, except at the extreme upper end. It also attaches proximally along the postero-medial surface of the shaft of the femur. Its distal attachment is into the medial base of the patella, and the tendon of the quadriceps. It too, is ventral to the transverse axis of the knee joint and therefore has a longitudinal component to its pull.

In the macaque, the proximal attachment is from the lesser trochanter, on its medial aspect, and from one-third to one-half of the length of the femoral shaft. This is much shorter on the length of the shaft than in the corresponding muscles in the chimpanzee, gorilla, man and orang. In the larger apes there isn't too marked a difference.

M.vastus intermedius (crureus): This is a muscle situated between the mm. vastus lateralis and vastus medialis. It is eight centimeters thick at its center. Its proximal attachment is from the upper two-thirds of the shaft of the femur between the other vasti. As Boyer so aptly put it in har description of this muscle in the orang, " the intermedius seems to be crowded in between the other two more distinct muscles." Its fibers join to form, with the rectus, the middle portion of the quadriceps tendon.

It too, is ventral to the transverse axis of the knee joint, and has a longitudinal component to its pull.

Sonntag (6) states that there is no subcrureus present in the chimpanzee. None was noticed in either of the two specimens, bur Hepburn (5) claims it was found in his speciman as small, pale, but distinct fasiculi. No mention is made of it by Boyer (1) or by Hartmann and Straus (4). This muscle is found in both the gorilla and man. It is variable in man, and may often be blended with the m. vastus intermedius.

The Medial Femoral Group:

M. gracilis: This is a long, flat, wide muscle in the chimpanzee. Its proximal attachment is from the heavy aponuerosis inserted into the symphysis pubis and the upper part of the pubic arch. The muscle fibers run along the medial surface of the thigh. Its distal attachment, twenty-three millimeters wide, is on the anterior part of the tibia about six centimeters below the knee joint and just superior to the distal attachment of the m. sartorius. The m. gracilis gives off a slip to the fascia of the leg. The muscle is about seventy-seven millimeters at its widest point. Its greatest thickness is five millimeters.

At the hip joint, the muscle passes ventrad to the longitudinal and transverse axes and mediad to the ventro-dorsal axis. It has a longitudinal component to its pull on the transverse and ventro-dorsal axes, and a small horizontal component to its pull on the longitudinal axis.

At the knee joint, the muscle passes dorsad to the transverse axis and the pull is longitudinal.

In man this muscle is not as strong, and it is attached much higher distally. In the orang the muscle is attached distally, below the attachment of the m. sartorius. The attachment to the fascia is also greater in the orang than in the chimpanzee. The gorilla offers no striking difference from the chimpanzee. The macaque also has a more distal attachment on the tibia.

M. pectineus: This is a flat muscle, much the same as in man. Its proximal attachment is on the pectineal line and the bone in front of it. The fibers run latero-inferiorly and the distal insertion is on the postero-medial surface of the femur about two centimeters below the lesser trochanter and two centimeters laterad.

The fibers pass ventrad to the longitudinal and transverse axes of the hip joint, and mediad to the ventro-dorsal axis. The fibers are oblique and there are both longitudinal and horizontal components to the pull.

There is very little variation in the mm. pectini of all the primates involved.

M. adductor longus: In the chimpanzee this muscle's proximal attachment is on the upper border of the superior pubic rami for about three centimeters. Its distal attachment is on the third quarter of the linea aspera. This is slightly more distad than in man. The fibers fuse with those of the m. adductor magnus.

At the thigh, the muscle passes ventrad to the transverse and longitudimal axes, and mediad to the ventro-dorsal axis. At the transverse and ventro-dorsal axes there is a longitudinal component to the pull. At the longitudinal axis the muscle has a horizontal pull.

Hepburn (5) claimed a round tendon for the proximal attachment in the chimpanzee, but in the specimens dissected and as claimed by Sonntag (6), the attachment is similar to the other anthropoid apes by being flat and fleshy. Sonntag (6) also stated that there is much variation in this muscle from speciman to speciman, as seen from the various writings. In the macaque the distal attachment of the m. adductor l longus is entirely aponuerotic, whereas in the great apes, this attachment is somewhat more fleshy.

M. adductor brevis: In the chimpanzee, three interlocking bellies compose the proximal attachments of this muscle. They are deep to the proximal attachments for the m. graeilis and the m. adductor longus. These three bellies unite to form a flat tendon which has its distal attachment into a line from the lesser trochanter to the linea aspera.

At the thigh, the muscle passes ventrad to the transverse and longitudinal axes, and mediad to the ventro-dorsal axis. At the transverse and ventro-dorsal axes there is a longitudinal component to the pull. At the longitudinal axis, the muscle has a horizontal component to its pull.

In man and the gorilla, the m. adductor brevis is attached proximallyto the inferior ramus of the pubis. In the gorilla, there is a belly of the m. adductor brevis known as the m. adductor minimus. It is found between the mm. adductor longus and brevis, and the m. obturator externus.

<u>M. adductor magnus</u>: This is the most powerful of the adductor muscles in the chimpanzee. It has three heads at its proximal end. These attach to the body of the pubis, the pubic arch, and the upper and lower parts of the tuber ischii.

The heads from the body of the pubis, the pubic arch, and the upper part of the tuber ischii; attach distally to the greater part of the shaft of the femur.on the linea aspera. The head from the lower part of the tuber ischii has its distal attachment on the medial condyle of the femur. This separate belly can be easily separated from the rest of the m. adductor magnus.

The upper part of the muscle is dorsad to the longitudinal axis, the component of the pull is horizontal. The muscle is ventrad to the transverse axis and mediad to the ventro-dorsal axis, and the components of the pull on these axes are longitudinal.

The lower part of the muscle is dorsad to the longitudinal and transverse axes, its pull being horizontal on the longitudinal axis and longitudinal on the transverse axis. The muscle is mediad to the ventro-dorsal axis and the componentsof its pull is longitudinal.

The m. adductor magnus is quite similar in man and the orang, except that Boyer (1) found a distal attachment at the intertrochanteric surface of the lesser trochanter. Also the proximal area of attachment is greater in the orang. Both man and the orang have three fasiculi making up the body of the muscle.

The gorilla has two heads of origin in comparison to the three for the other large primates. The postero-medial portion of this muscle corresponds with the same portion in the chimpanzee.

The m. adductor magnus in the macaque is divided into two portions. The postero-medial portion borders the major extent of the pubis symphysis. The lateral portion is divided into three fasiculi.

The orang has also a muscle known as the m. adductor accessorius. It lies between the m. adductor magnus and the m. adductor brevis. It fuses with the middle fasiculus of the m. adductor magnus at the distal point of attachment. The m. adductor minimus is also present in the orang.

The Muscles of the Glutael Region:

<u>M. glutaeus maximus</u>: This is a flat, broad muscle at its proximal attachment at the sacrum, coccyx, sacro-sciatic ligament and ischial tuberosity; its attachment at the crest

is by fascia. The muscle thickens and attaches along the lateral side of the shaft of the femur to a point about seven centimeters from the knee joint. In the speciman dissected here the glutaeus gave rise to the long head of the biceps and the m. semi-tendinosus. It also blended with the fibers of the short head of the biceps. The muscle is quite heavy and triangular in shape along the shaft of the femur. It is about two and one half centimeters thick at its heaviest point on the side of the femur.

At the hip joint the muscle passes dorsad to the longitudinal axis and has a horizontal component to its pull. It is also dorsad to the transverse axis and mediad to the ventro-dorsal axis and has a longitudinal componentto its pull on these axes.

In the orang the distal attachment only reaches to the middle of the femur. There is no attachment to the iliac crest.

The distal attachment in the gorilla extends down to the lateral epicondyle. The muscle is not segmented in the gorilla, the chimpanzee or man, but it is segmented in the orang.

In the macaque the proximal attachment is from the transverse processes of the upper two or more caudal vertebrae, and by fascia over the dorsal part of the sacrum. It attaches distally to the fascia lata, greater tuberosity of the femur, and along the linea aspera.

In man this muscle is very thick and heavy. The muscle also attaches proximally at the ilium. Its distal attachment is at the glutael tuberosity. The muscle does not extend as far down as in the chimpanzee. The prominent appearence of the anus in apes, as compared with man, is due to the flattened form of this muscle in the former.[1]

M.glutaeus medius: In the apes this is a heavier muscle than the m. glutaeus maximus. Its proximal attachment is the entire dorsal surface of the wing of the ilium and from the fascia covering it. Its distal attachment is the most superior part of the greater trochanter of the femur. The m. piriformis of the chimpanzee may be fused with the m. glutaeus medius. This was the case with the two specimens dissected here. The m. glutaeus medius was approximately eighteen millimeters thick at its heaviest point and was more constant in its thickness than was the m. glutaeus maximus. The muscle passes ventrad to the longitudinal and transverse axes and is laterad to the ventro-dorsal axis. It has a horizontal component to its pull on the longitudinal axis and a longitudinal component to its pull on the transverse and ventro-dorsal axes.

The muscle is quite similar in all the apes and man. There are, however, a few small differences worth noting. In the chimpanzee, the tendon, at the distal attachment is

1:: Symington-- Rep. British Assoc. 1890, p 630 split by the m. vastus externus. In the gorilla, the muscle is bi-pennate. In the macaque, it fuses with fibers of the m. tensor fascia latae. In the orang, the m. piriformis is intimately fused with the m. glutaeus medius. Hepburn (5) claims this fusion for all the apes.

M. glutaeus minimus: This muscle is divisable into three parts in the chimpanzee, two of these may be called anterior and posterior, while the third part lies deep to the anterior portion. The proximal attachment of this muscle is on the posterior surface of the innominate bone. The distal attachment is on the upper border of the great trochanter. The muscle lies deep to the m. glutaeus medius. The muscle passes ventrad to the longitudinal and transverse axes and laterad to the ventro-dorsal axis. The muscle has a longitudinal component to its pull on the ventro-dorsal and the transverse axes, and a horizontal component to its pull on the longitudinal axis.

In man the muscle may divide into an anterior and a posterior part, but the m. scansorius is seldom found blended with it as is the case with the apes.

In the orang the muscle is much the same as in the chimpanzee. The scansorius muscle, although it fuses to some extent with the m. glutaeus minimus still can be separated. In the gorilla, it blends completely with the m. glutaeus minimus.

In the macaque, the more ventral fibers may be easily segragated from the rest of the m. glutaeus minimus so it may be safe to suppose that this muscle may correspond somewhat to the m. scansorius, although its distal attachment is blended in with the attachment of the m. glutaeus minimus.

M. scansorius: This muscle is separate from the m. glutaeus minimus in the chimpanzee and the orang. It is intimately blended with the m. glutaeus minimus in the gorilla. No mention is made of the muscle in man except by Testut, who describes it in relation to the m. glutaeus minimus (Boyer (1)) The proximal attachment for the m. scansorius is on the posterior rim of the wing of the ilium. Its fibers run ventrad to those of the m. glutaeus minimus. Its distal attachment is on the greater trochanter, distad and slightly ventrad to the distal attachment of the m. glutaeus minimus.

The muscle passes ventrad to the longitudinal and transverse axes and laterad to the ventro-dorsal axis. The muscle has a longitudinal component to its pull on the ventro-dorsal and the transverse axes, and a horizontal component to its pull on the longitudimal axis.

M. piriformis: This muscle may or may not be fused with the m. glutaeus medius. The proximal attachment of this muscle is on the anterior surface of the sacrum, extending as high as the second sacral segment and as low as the fifth sacral segment. The muscle passes dorsad and its distal attachment is on the upper border of the greater trochanter.

The muscle passes dorsad to the longitudinal and the transverse axes and laterad to the ventro-dorsal axis. It has a horizontal component to its pull at the longitudinal and ventro-dorsal axes and a very small longitudinal pull at the transverse axis.

In man the proximal attachment is only as far down as the fourth sacral segment, and, as in the apes, it may be united with the m. glutaeus medius.

In the gorilla its proximal attachment is as high as the first sacral vertebra and as low as the first coccygeal.

The muscle fuses in the orang, and according to Boyer(1) some anatomists have found this muscle lacking in the orang.

In the macaque this muscle is quite robust. Its proximal attachment is to the last twosacral vertebrae. It remains quite distinct till it attaches distally with the deep fibers of the m. glutaeus medius.

M. tensor fasciae latae (tensor fasciae femoris): This muscle was present in the chimpanzee specimens. Its proximal attachment is on the anterior spine of the ilium, the muscle fibers run downward and backwards inserting on the fascia lata of the thigh.

The muscle fibers pass ventrad to the longitudinal and transverse axes and mediad to the ventro-dorsal axis. There is a horizontal component to their pull on the longitudinal axis and a longitudinal component to their pull on the transverse and the ventro-dorsal axes.

The m. tensor fasciae latae is absent in the orang.

There is little difference between the chimpanzee, man, the gorilla, and the macaque.

M. obturator internus: This is a flat, thin fan-shaped muscle occupying the greater part of the inner surface of the ischium and most of the pubis, except for an area near the symphysis and along the border of the superior ramus. The distal attachment is, with the fibers of the mm. gemelli, on the femur above the trochanteric pit.

The muscle passes dorsad to the longitudinal and the transverse axes, and laterad to the ventro-dorsal axis. The muscle has a horizontal component to its pull on the longitudinal axis and at the ventro-dorsal axis. It may have an extremely small longitudinal component to its pull on the transverse axis, if it acts on this axis at all.

This muscle showed little inter-primate variation.

Mm. gemelli: These muscles are in close association with the m. obturator internus. In the chimpanzee the m. gemellus superior is the largest of the mm. gemelli. The proximal attachment for the m. gemellus superior is from the rudimentary ischial spine and the ligament associated with it. The proximal attachment for the m. gemellus inferior is on the deep surface of the ischium and the outer surface of the tuber ischii. Both muscles blend with the m. obturator internus and attach distally to the femur, above the trochanteric pit.

The muscles pass dorsad to the longitudinal and the transverse axes, and laterad to the ventro-dorsal axis. The muscles have a horizontal component to their pull on the longitudinal axis and on the ventro-dorsal axis. Like the internal obturator muscle it may have a longitudinal pull at the transverse axis.

In the orang the m. gemellus inferior is the larger of the two mm. gemelli. This is also true in man. The m. gemellus superior is absent in the gorilla. In the macaque the mm. gemelli form a continuous muscle sheet and are not differentiated into the separate inferior and superior elements.

M. quadratus femoris: This is a distinct muscle in the chimpanzee, attaching proximally to the ramus and the outer surface of the tuber ischii. The muscle fibers pass laterally to attach, distally onto the posterior surface of the great trochanter and on the posterior surface of the femur along a line passing outward from the small trochanter.

The muscle is dorsad to the longitudinal and transverse axes and mediad to the ventro-dorsal axis. The component of its pull on the ventro-dorsal and longitudinal axes is horizontal. That of its transverse axis would be very small if at all as a longitudinal pull.

In the gorilla this muscle is partly fused with the mm. gemellus inferior and the obturator internus. It blends somewhat with the m. adductor minimus in the orang. There is little difference among the apes and man as regards this muscle.

M. obturator externus: In the chimpanzee as well as the orang and gorilla, the muscle arrangement is similar to man's. Its proximal attachment is from the margin of bone on the medial side of the obturator foramen and the medial two-thirds of the obturator membrane. The muscle fibers run laterally and the distal attachment, in the apes, blends with that of the m. obturator internus.

The muscle passes dorsad to the longitudinal and the transverse axes, and laterad to the ventro-dorsal axis. The muscle has a horizontal component to its pull on the longitudinal and ventro-dorsal axes. It may also have an extremely weak pull on the transverse axis.

In man and the macaque, the distal attachment does not unite with that of the m. obturator internus.

The Posterior Femoral Group::

<u>M. biceps femoris:</u>This is, as the name indicates, a two headed muscle. The proximal attachment for the long head of this muscle is from the tuber ischii where it fuses with the m. glutaeus maximus. In the adult chimpanzee the long head seemed to arise fom the m. glutaeus maximus, The muscle is oval shaped in the chimpanzee and is approximately fourteen millimeters thick. Its distal attachment is about two centimeters below the knee joint on the lateral side of the leg. At its distal attachment it has joined with the short head of the biceps to insert into the aponuerosis of the leg, the lateral aspect of the head of the tibia and the head of the fibula. The proximal attachment for the short head is from the lower fourth of the femur on its lateral side, where it also seems to derive itself from the m. glutaeus maximus.

At the hip joint the fibers of the long head pass dorsad to the longitudinal and transverse axes and mediad to the ventro-dorsal axis. It has a horizontal component to its pull on the longitudinal axis, and a longitudinal component to its pull on the transverse and ventro-dorsal axes.

At the knee joint, the muscle passes dorsad to the transverse axis and the component of its pull on the axis is longitudinal.

In man the proximal attachment of the short head is higher than in the chimpanzee, although in both cases this results in the short head being in approximation with the distal attachment of the m. glutaeus maximus. In man the distal attachments of the two heads are fused, this was the case with the adult chimpanzee, but in the younger chimpanzee, the attachments were separate as is the case with the other apes and the chimpanzee dissected by Hepburn. (5)

In the orang the distal attachment is mush more extensive than in either the chimpanzee or the human.

The gorilla's biceps is much the same as the chimpanzee.

The macaque has no short head of the biceps. The proximal attachment is the same as in the other animals. As the fibers of the long head pass downward, they receive fibers from deeper fasiculi. This forms two muscles which are easy to separate. The distal attachment is quite broad and extends in the fascia for about half the distance to the ankle.

M. semitendinosus: This is a triangular shaped muscle in the chimpanzee. It is about eighteen millimeters in thickness.Its proximal,attachment is just posterior to that of the long head of the m. biceps femoris, often there is a connection between these two muscles. In the adult specimen , this muscle seemed to arise from the m. glutaeus maximus, just behind the attachment of the bicipital long head. Sonntag (6) says that the proximal attachment of this muscle, like that of the long head, is on the tuber ischii.

The muscle runs along the posterior surface of the thigh. Its distal attachment is on the medial side of the tibia about seven centimeters below the knee joint.

The muscle is dorsad to the longitudimal axis and the transverse axis of the hip joint, and it is mediad to the ventro-dorsal axis of this joint. The muscle has a longitudinal component to its pull on the transverse and ventro-dorsal axes and a horizontal component to its pull on the longitudinal axis.

The muscle passes dorsad to the transverse axis of the knee joint and it has a longitudinal component to its pull on this joint.

Sonntag (6) says that the fascial attachment in the apes is far more extensive than in man and that this helps to prevent these animals from assuming an erect posture.

M. semimembranosus: This is a flattened ovoid muscle in the chimpanzee. At its heaviest part it is about fifteen millimeters thick and about thirty-five millimeters wide. The proximal attachment is by a heavy tendon on the tuber ischii,superior and medial to the attachments of the mm. biceps femoris and semitendinosus. The muscle passes along the postero-medial side of the thigh. Its distal attachment is by a rounded tendon on to the tibia just below the medial condyle.

At the hip joint the muscle passes dorsad to the longitudinal and transverse axes and mediad to the ventro-dorsal axis. It has a longitudimal component to its pull on the transverse and ventro-dorsal axes, and a horizontal component to its pull on the lòngitudimal axis.

The muscle passes dorsad to the transverse axis of the knee joint and has a longitudinal component to its pull.

In man the distal attachment of this muscle gives off fibrous expansions, one is attached to the posterior part of the lateral condyle of the femur. This forms part of the oblique popliteal ligament of the knee joint. Another fibrous expansion extends down along the leg into the fascia covering the m. popliteus.

In the macaque this is a double muscle composed of two distinct parts, the m. semimembranosus propius and the m. semimembranosus accessorius. The propius is similar to the m. semimembranosus in man; the accessorius attaches ventally to the proximal attachment of the propius, it runs medial to the latter and it attaches distally upon the femoral shaft, medial to the linea aspera, to the medial condyle.

The preceeding part of this paper has dealt with a description of the hip and thigh muscles of the chimpanzee, and the differences observed in this animal as compared to man, the gorilla, the orang, and the macaque. The remainder of this paper will attempt to deal with the differences observed in these five animals in regard to those muscles which are important for the assumption of erect posture in man.

It is realized that erect posture is dependent upon other factors than the muscles of the hip and knee joints. A well developed ground walking foot is necessary before an animal can assume an erect stance with ease. The orang walks erect with a little more difficulty than does the more flat footed chimpanzee.

Although all the muscles of the hip and thigh were discussed in the preceeding pages, only the extensor and their antagonists, the flexor muscles need be considered. From a purely mechanical viewpoint, those muscles passing dorsad to the transverse axis of the hip joint, and those passing ventrad to the transverse axis of the knee joint, having, in both cases, a longitudinal component to the pull are extensors of the hip joint or the knee joint. The flexors pass ventrad to the transverse axis of the hip joint and also have a longitudinal component to their pull. At the knee joint the flexors pass dorsad to the transverse axis andcagain have a longitudinal component to their pull.

Most important of the extensor muscles of the hip joint, in relation to erect posture, is the m. glutaeus maximus. This muscle, in man, completes extension of the trunk. It is far more massive in man than in any of the other primates.

Washburn (7) says that in man, if the m. glutaeus maximus is paralyzed, the trunk will jack-knife, thereby forcing the individual to assume a bent knee type of locomotion. It must be pointed out here that paralysis of the m. quadriceps femoris would likewise result in a bent knee form of locomotion due to flexion occuring at the knee.

From this it becomes evident that erect posture is a function of the knee joint as well as the hip joint. Also in order to get a more complete picture of erect posture the other muscles, both flexors as well as extensors, must be considered.

The other extensors of the hip joint are the lower part of the m. adductor magnus and the hamstring muscles. The hamstrings, since they are at the same time flexors of the knee joint, can be ignored in relation to erect posture due to the negating quality these muscles have upon the two joints. This leaves the m. adductor magnus,(lower part) which is a strong extensor of the hip joint. In the chimpanzee, this lower part was quite well developed and seemed very capable of providing a strong extension of the hip joint. It would seem quite plausable for this muscle, assisted by a

m. glutaeus maximus as is found in the apes, to have the power of providing the drive to finish extension of the hip joint. In fact apes have been observed to stand erect at times when it seemed to suit the animal to do so.

The picture at the knee joint is also different as regards man and the apes. Here the flexors in man do not have distal attachments as low on the leg as are found in the apes and the macaque. The lower distal attachment in the apes allows for a longer torque arm, thereby giving to these muscles a mechanical advantage on the transverse axis of the knee joint not enjoyed by the homologous muscles in man. This, since the size and the weight ratio of flexors and extensors is roughly similar in man and the apes, permits the flexors to use their pull to better advantage in the apes. This may account for the almost constant bent knee found among the great apes. Sonntag (6) states that the semitendinosus, with its extensive fascial attachment prevents the chimpanzee from assuming an erect attitude, If this is so, it could only have this action by maintaining flexion of the knee joint.

In summary therefore, it can be seen that in any consideration of erect posture as it exists in man, a variety of factors must be considered. Talking only in terms of the m. glutaeus maximus presents only a part of the whole pisture even though, in man, this muscle is an important element. Other muscles, especially in the apes may compensate for this muscle as regards extension of the hip joint. The muscles of the knee joint can by no means be neglected, for they provide the other vital half of the picture of erect posture. Pelvis shape is important but here it must be remembered that muscle shapes bone in the living animal, and that the pelvis is only an indicator of the muscles attached to it, not the originator.

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