

# The femoral artery and its branches in the baboon *Papio anubis*

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[Received 13 July 2007; Revised 19 October 2007; Accepted 19 October 2007]

*The aim of the research was to examine the anatomy of the arterial system in the inguinal region, hip and thigh of Papio anubis. No description of this was found in the available scientific literature, although, at the same time, the baboon is considered to be a good animal model in biomedical research.*

*Macroscopic anatomical research was carried out on 20 hind limbs (10 cadavers: 9 male and 1 female) of adult Papio anubis and the results were then compared with the anatomy of the arterial hind limb systems of other apes as described in the literature. The circulatory system of the whole body was filled with coloured latex via the common carotid artery and internal jugular vein, and traditional methods were then used to prepare the vessels. The arterial system in the hind extremity of Papio anubis was recorded. The anatomical names of human arteries were used as well as the names of those of apes as applied in the literature.*

*The femoral artery was the only artery supplying the hind limb of Papio anubis. It started under the inguinal ligament as a continuation of the external iliac artery. It went down and divided into the popliteal artery, which coursed in the popliteal fossa, and the saphenous artery, which passed on the medial side of the thigh and leg. The number of smaller branches and the way in which they issued from the larger arteries were documented. The external diameter and length of the hind limb arteries were measured.*

*It was observed that the cutaneous branches of the femoral artery supplied the inguinal and genital regions and the abdominal wall, while the deep artery of the thigh was the main vessel of the hip and thigh.*

**Key words:** anatomy, baboon, *Papio anubis*, femoral artery

## INTRODUCTION

The aim of the research was to examine the anatomy of the arterial system in the inguinal region, hip and thigh of *Papio anubis*. No description of the baboon's arterial system was found among documents dealing with the anatomy of apes, although the baboon is considered to be good animal model in biomedical research [4]. However, several similarities and differences were found between the vascu-

lar systems of humans, baboons and other apes [2, 3, 6, 9, 13]. We therefore decided to carry out research on the *Papio anubis* femoral artery and its branches in the hip and thigh. Our research was intended to document the place of origin of the artery of the *Papio anubis* hind limb, its course and division and the regions it supplies. We also compared the hind limb arteries of the baboon with the arterial supply of other apes and of humans.

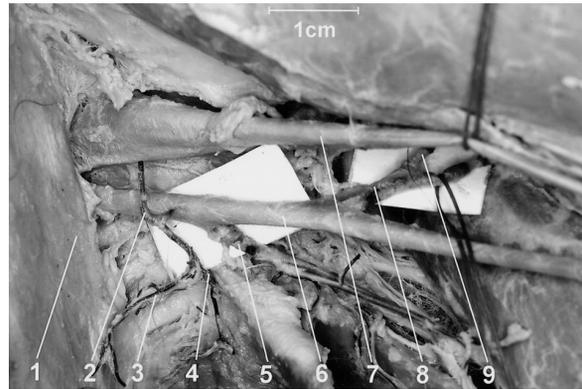
## MATERIAL AND METHOD

A macroscopic anatomical study was conducted on 20 hind limbs (10 cadavers: 9 male and 1 female) of adult *Papio anubis*. The circulatory system of the whole body was filled with coloured latex via the common carotid artery and the internal jugular vein and the hind limbs were then prepared by traditional methods. Details of the arterial system of the hind limb of *Papio anubis* were recorded. In this research the anatomical names for the arteries of apes were used according to their use in the literature of the subject. Observation was focused on the beginning of the vessels, their course and division and the regions they supplied. The external diameter at the beginning of the arteries was measured. Next, the results were compared with those presented in literature dealing with the arterial hind limb systems of other apes and of humans.

## RESULTS

All the arteries of the hind limb of *Papio anubis* were single vessels and the femoral artery was the only artery to supply the limb. This had its origin under the inguinal ligament, in the femoral sheet and was the continuation of the external iliac artery. It ran downwards and finished in the medial part of the femur, dividing into the popliteal artery and the saphenous artery. At the proximal part of its course the femoral artery gave off the following cutaneous (superficial) branches:

- the superficial epigastric artery in 8 specimens (40%) branching separately, in 12 specimens (60%), with other arteries;
- the external pudendal artery in 8 specimens (40%) branching separately, in 12 specimens (60%), with other arteries;
- the superficial circumflex iliac artery in 12 specimens (60%), branching separately in 8 specimens (40%), with other arteries.



**Figure 1.** The right femoral triangle in *Papio anubis*. 1 — the inguinal ligament, 2 — the external pudendal artery, 3 — the superficial epigastric artery, 4 — the superficial circumflex iliac artery, 5 — the lateral circumflex femoral artery, 6 — the femoral artery, 7 — the femoral vein, 8 — the deep artery of the thigh, 9 — the medial circumflex femoral artery. The medial view of the right femur in *Papio anubis*. Bare 1 cm.

It was difficult to estimate the leading branch when at least two arteries started with a trunk from the femoral artery. The following branches of the femoral artery were muscular (deep) arteries:

- the deep artery of the thigh in 4 specimens (20%) started at the same level of the femoral artery as other arteries, while in 16 specimens (80%) it was the main trunk for other arteries;
- the medial circumflex femoral artery in only 4 specimens (20%) started directly from the femoral artery;
- the lateral circumflex femoral artery was a branch of the femoral artery in 8 specimens (40%).

The femoral artery was 4–6 mm wide (Fig. 1).

We distinguished 4 variants in the origin of the cutaneous branches of the femoral artery (Table 1):

- variant I: The superficial epigastric artery, the external pudendal artery and the superficial circumflex iliac artery arose from the femoral artery separately (8 cases, 40%);

**Table 1.** Variants of the origin of the cutaneous branches of the femoral artery in *Papio anubis* (for details refer to the text)

Variants		Number of specimens (%)		
		Right limb	Left limb	Total
Variant I	SEA, EPA, SCIA separately from FA	3 (15%)	5 (25%)	8 (40%)
Variant II	SEA + EPA + SCIA together from FA	5 (25%)	3 (15%)	8 (40%)
Variant III	SEA + EPA together and SCIA separately from FA	2 (10%)	1 (5%)	3 (15%)
Variant IV	SEA + EPA together from FA, SCIA from LCFA	0	1 (5%)	1 (5%)

FA — the femoral artery; SEA — the superficial epigastric artery; EPA — the external pudendal artery; SCIA — the superficial circumflex iliac artery; LCFA — the lateral circumflex femoral artery

**Table 2.** Variants of the muscular branches of the division of the femoral artery in *Papio anubis* (for details refer to the text)

Variants		Number of specimens (%)		
		Right limb	Left limb	Total
Variant I	DAT from FA, MCFA and LCFA from DAT	6 (30%)	6 (30%)	12 (60%)
Variant II	DAT, LCFA and MCFA from FA	2 (10%)	2 (10%)	4 (20%)
Variant III	DAT and LCFA from FA, MCFA from DAT	1 (5%)	2 (10%)	3 (15%)
Variant IV	DAT and MCFA from FA, LCFA from DAT	1 (5%)	0	1 (5%)

FA — the femoral artery; DAT — the deep artery of the thigh; LCFA — the lateral circumflex femoral artery; MCFA — the medial circumflex femoral artery

- variant II: The superficial epigastric artery, the external pudendal artery and the superficial circumflex iliac artery branched from the femoral artery together (8 cases, 40%);
- variant III: The superficial epigastric artery and the external pudendal artery arose together from the femoral artery and the superficial circumflex iliac artery branched from the femoral artery separately (3 cases, 15%);
- variant IV: The superficial epigastric artery and the external pudendal artery arose together from the femoral artery and the superficial circumflex iliac artery branched from the lateral circumflex femoral artery (1 case, 5%).

The superficial epigastric artery branched off the femoral artery separately in 8 specimens (40%), in the trunk with the external pudendal and the superficial circumflex iliac arteries in 8 specimens (40%) and in the trunk with the external pudendal artery in 4 specimens (20%). It rose just below the inguinal ligament and supplied the skin of the inguinal region and the wall of the abdomen. It was less than 1 mm wide.

The external pudendal artery arose from the femoral artery separately in 8 specimens (40%), in the trunk with the superficial epigastric and the superficial circumflex iliac arteries in 8 specimens (40%) and in the trunk with the superficial epigastric artery in 4 specimens (20%). It went medially towards the genitals, supplying the skin of this region. It was 1 mm wide.

The superficial circumflex iliac artery was a branch of the femoral artery in 19 specimens (95%) and the lateral circumflex femoral artery in 1 specimen (5%). It left these vessels separately in 12 specimens (60%) and in the trunk with the superficial epigastric and external pudendal artery in 8 specimens (40%). After leaving the femoral artery, the lateral circumflex femoral artery or trunk, it passed laterally and surrounded the hip. It was 1–2 mm wide.

We distinguished four variants of the muscular branches of the division of the femoral artery (Table 2):

- variant I: The deep artery of the thigh began from the femoral artery, while the medial and lateral circumflex femoral arteries branched from the deep artery of the thigh (12 cases, 60%);
- variant II: The deep artery of the thigh and the lateral and medial circumflex femoral arteries branched from the femoral artery (4 cases, 20%);
- variant III: The deep artery of the thigh and the lateral circumflex femoral artery branched from the femoral artery, while the medial circumflex femoral artery branched from the deep artery of the thigh (3 cases, 15%);
- variant IV: The deep artery of the thigh and the medial circumflex femoral artery branched from the femoral artery, while the lateral circumflex femoral artery branched from the deep artery of the thigh (1 case, 5%).

The deep artery of the thigh mainly supplied the thigh muscles. It started in the proximal third of the femoral artery at 2.0–4.9 cm (mean 3.4 cm) below the inguinal ligament and descended posteriorly to the femoral artery, passing between the anterior and medial muscle compartments of the thigh. Both the medial and lateral circumflex femoral arteries were branches of this in 12 specimens (60%), while in 3 specimens (15%) only the former was a branch of it and in 1 specimen (5%) only the latter was a branch of it. The deep artery of the thigh was 3 mm wide.

The medial circumflex femoral artery arose from the femoral artery in 5 specimens (25%) and from the deep artery of the thigh in 15 specimens (75%). At the beginning it went medially. It then turned posteriorly and ended in the muscles of the posterior fascial compartment of the thigh. It was 1 mm wide.

The lateral circumflex femoral artery arose from the femoral artery in 7 specimens (35%) and from the deep artery of the thigh in 13 specimens (65%). It followed

into the anterior thigh muscles, running posteriorly to the quadriceps femoris. It was 2 mm wide.

The observations showed that the cutaneous branches of the femoral artery supplied the inguinal, abdominal, iliac and genital regions, while the deep artery of the thigh was the main vessel of the hip and the thigh. The terminal branches of the femoral artery, namely the popliteal artery and the saphenous artery, reached and supplied the knee, leg and foot of *Papio anubis* (Fig. 2).

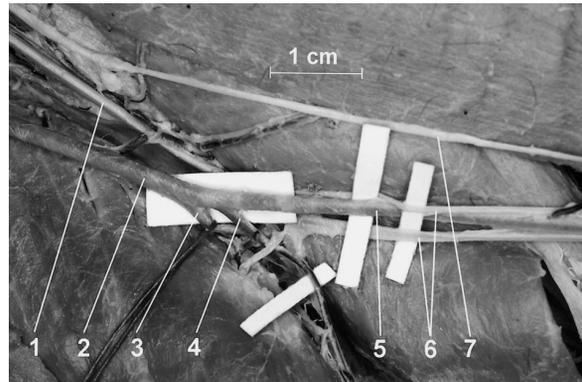
## DISCUSSION

The research showed many similarities between the arterial systems of the hind limb of *Papio anubis* and those of other apes. Although there were differences from the human lower extremity, especially in the distal part, several similarities were found between the human and baboon arterial systems. On these grounds the baboon may be considered a good animal model in biomedical research [4].

The femoral artery has been seen to be the continuation of the external iliac artery in *Papio anubis*, *Macaca rhesus*, *Macaca cynomolgus*, *Macaca cyclopsis* and humans [3, 6, 9, 13]. In all these species the branches of the femoral artery have been reported as supplying the inferior part of the abdominal wall, the inguinal and genital regions and the hind leg [12, 13].

During the phylogenesis of primates changes in anatomy are observable. The cutaneous (superficial) branches of the femoral artery are the superficial epigastric artery, the superficial circumflex iliac artery and the external pudendal arteries. In most cases of baboons and humans these arteries had separate beginnings [13]. The cutaneous branches in Prosimii, Ceboidea and the lower species of Cercopithecoidea (*Macaca*) began from one trunk [13]. Our study of the baboon's vessels showed four variants of the cutaneous branches of the femoral artery. The most frequently encountered were two opposite variants: variant I, where three branches left the femoral artery in sequence, and variant II, with all branches leaving the femoral artery together.

The superficial epigastric artery branches off the femoral artery in all species. The human artery is separate (in 58%), more often than that of *Macaca rhesus* (in 14%) or *Macaca cynomolgus* (in 8%). In humans this artery branches off the femoral artery in a trunk with the superficial circumflex iliac artery (36%) or, only in 2%, with the external pudendal artery [13].



**Figure 2.** The division of the femoral artery in the middle of the thigh in *Papio anubis*. 1 — the femoral vein, 2 — the femoral artery, 3 — the popliteal artery, 4 — the descending genicular artery (branch of the saphenous artery), 5 — the saphenous artery, 6 — two trunks of the long saphenous vein, 7 — the saphenous nerve. The medial view of the right femur in *Papio anubis*. Bare 1 cm.

In *Macaca* the external pudendal artery was a branch of the femoral artery or medial circumflex femoral artery and in most cases (66%) formed a common trunk with other arteries [6, 13]. In humans this artery is mainly (96%) a separate branch of the femoral artery [13]. The origin of this artery in *Papio anubis* is often in a trunk with other arteries (60%).

The superficial circumflex iliac artery branches off the femoral artery, the external iliac artery or the lateral circumflex femoral artery to make a common trunk with other arteries more frequently in *Macaca* (66%) than in humans, where it makes a common trunk with the superficial epigastric artery (36%), but was a separate artery from the femoral artery (36%) or, in 4%, from the external iliac artery [13].

The deep artery of the thigh and the medial and lateral circumflex femoral arteries give off the deep muscle branches of the thigh. It was found in Prosimii, Ceboidea and lower species of Cercopithecoidea that in the majority of cases these arteries were separate branches of the femoral artery. In most cases in *Macaca* and baboons the medial and lateral circumflex femoral arteries branched off the deep artery of the thigh [1, 11, 13]. As reported by Bloda et al. [1], the most frequently encountered version in humans is one in which the deep artery of the thigh, together with the lateral circumflex femoral artery, arises from the femoral artery (37.5%), while the less common cases (32.5%) showed one trunk formed together by the deep artery of the thigh and the lateral and the medial circumflex femoral arteries. Załuska and Urbanowicz [13] found the common

trunk formed by the deep artery of the thigh and the lateral and medial circumflex femoral arteries to be frequent (62%) in humans.

According to Suder and Nizankowski [10], the origin of the muscular branches of the femoral artery was as a common trunk in over 50% of human fetuses.

The deep artery of the thigh and its perforating and nutrient arteries supply the muscles of the thigh and the shaft of the human femur, and the medial and lateral circumflex femoral arteries surrounded and supplied the proximal part of the human femur [3].

In humans the deep artery of the thigh was found in all cases to be a branch of the femoral artery [8, 9]. In the majority of cases the lateral circumflex femoral artery branched off the deep artery of the thigh but sometimes arose from the femoral artery [3]. Tanyeli et al. [11] demonstrated that in 79% of cases the medial circumflex femoral artery was a branch of the deep artery of the thigh and in 15% of the femoral artery.

The human femoral artery continues as the popliteal artery when the former passes through the adductor hiatus [2], while in *Macaca* and *Papio anubis* it splits into the popliteal artery and the saphenous artery [12, 13].

As we demonstrated previously in baboons [5, 7], the region of the division of the femoral artery was that of the venous saphenofemoral junctions, where two similar trunks of the great saphenous vein surrounding the saphenous artery reached one femoral vein (Fig. 2).

## CONCLUSIONS

1. The main artery in the hind extremity of *Papio anubis* was the femoral artery.
2. The superficial epigastric artery, the superficial iliac artery and the external pudendal artery arose from the femoral artery separately with the same frequency (variant I, 40%) as they did together (variant II, 40%).

3. Of three variants of the muscular branching of the division of the femoral artery, the most common was variant I, where the medial and lateral circumflex femoral arteries branched from the deep artery of the thigh. This was found in 60% cases.

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