

Acta Medica Okayama

Volume 41, Issue 5

1987

Article 6

OCTOBER 1987

Deep palmar arteries of monkeys, with special reference to the palmar metacarpal arteries.

Takafumi Nakai*

Akio Kikuta†

Takuro Murakami‡

*Okayama University,

†Okayama University,

‡Okayama University,

Deep palmar arteries of monkeys, with special reference to the palmar metacarpal arteries.*

Takafumi Nakai, Akio Kikuta, and Takuro Murakami

Abstract

The palmar metacarpal arteries in monkey hands were studied. The palmar metacarpal arteries arose from the deep palmar arch or catella palmaris proximalis and descended in the deep palm, forming the catella palmaris distalis at the distal end of the metacarpus. The palmar metacarpal arteries could be classified into four kinds in relation to the interosseous muscles and metacarpal bones: (i) the superficial palmar metacarpal (sM) arteries descending on the palmar surfaces of the interosseous muscles along the metacarpal bones, (ii) the superficial palmar intermetacarpal (sI) arteries descending on the palmar surfaces of the interosseous muscles along the intermetacarpal spaces, (iii) the deep palmar metacarpal (dM) arteries descending deep in the interosseous muscles along the metacarpal bones, and (iv) the deep palmar intermetacarpal (dI) arteries descending deep in the interosseous muscles along the intermetacarpal spaces. These findings largely coincide with those obtained from studies of the human hand by Murakami (1969).

KEYWORDS: monkey hand, palmar metacarpal arteries, perforating branches, catella palmaris proximalis, catella palmaris distalis, proper palmar digital arteries

*PMID: 3120492 [PubMed - indexed for MEDLINE]

Deep Palmar Arteries of Monkeys, with Special Reference to the Palmar Metacarpal Arteries

Takafumi Nakai, Akio Kikuta and Takuro Murakami

Department of Anatomy, Okayama University Medical School, Okayama 700, Japan

The palmar metacarpal arteries in monkey hands were studied. The palmar metacarpal arteries arose from the deep palmar arch or catella palmaris proximalis and descended in the deep palm, forming the catella palmaris distalis at the distal end of the metacarpus. The palmar metacarpal arteries could be classified into four kinds in relation to the interosseous muscles and metacarpal bones: (i) the superficial palmar metacarpal (sM) arteries descending on the palmar surfaces of the interosseous muscles along the metacarpal bones, (ii) the superficial palmar intermetacarpal (sI) arteries descending on the palmar surfaces of the interosseous muscles along the intermetacarpal spaces, (iii) the deep palmar metacarpal (dM) arteries descending deep in the interosseous muscles along the metacarpal bones, and (iv) the deep palmar intermetacarpal (dI) arteries descending deep in the interosseous muscles along the intermetacarpal spaces. These findings largely coincide with those obtained from studies of the human hand by Murakami (1969).

Key words : monkey hand, palmar metacarpal arteries, perforating branches, catella palmaris proximalis, catella palmaris distalis, proper palmar digital arteries

The deep layer of the human hand is generally regarded as being supplied by the palmar metacarpal arteries (1, 2). Murakami classified the palmar metacarpal arteries in relation to the interosseous muscles and metacarpal bones into (i) the superficial palmar metacarpal (sM) arteries descending on the palmar surfaces of the interosseous muscles along the metacarpal bones, (ii) the superficial palmar intermetacarpal (sI) arteries descending on the palmar surfaces of the interosseous muscles along the intermetacarpal spaces, (iii) the deep palmar metacarpal (dM) arteries descending deep in the interosseous muscles along the metacarpal bones, and (iv) the deep palmar intermetacarpal (dI) arteries descending deep in the interosseous muscles

along the intermetacarpal spaces (3). This classification system is also applicable to the human foot (4). The present paper describes these four kinds of arteries in monkey hands.

Materials and Methods

An aged *Macacus cyclopsis*, an aged *Cynopithecus niger* and an aged *Hylobates lar* were obtained from Ritsurin Park Zoo (Takamatsu, Kagawa, Japan) after their death. They were fixed with 10% formalin by vascular perfusion. After immersion in an ethanol bath for a year or longer, the left hands of these monkeys were dissected.

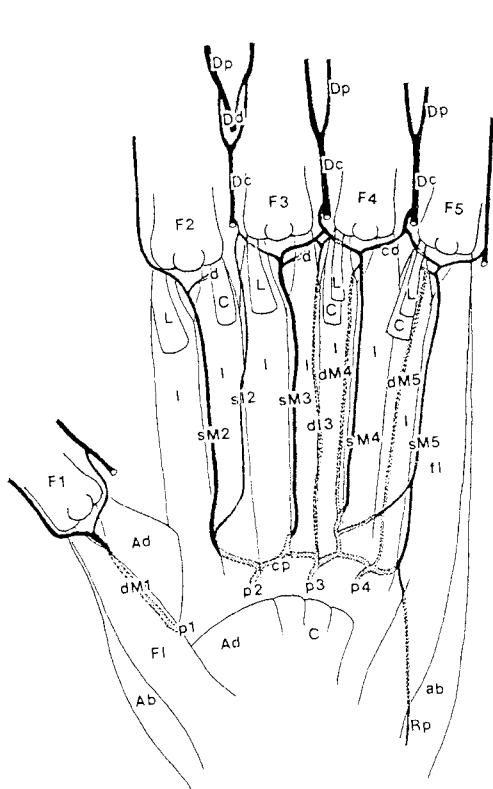


Fig. 1 A diagram showing the arterial pattern in the deep palm of the *Macacus cyclopsis* (view from the palmar side). For abbreviations, see footnotes.

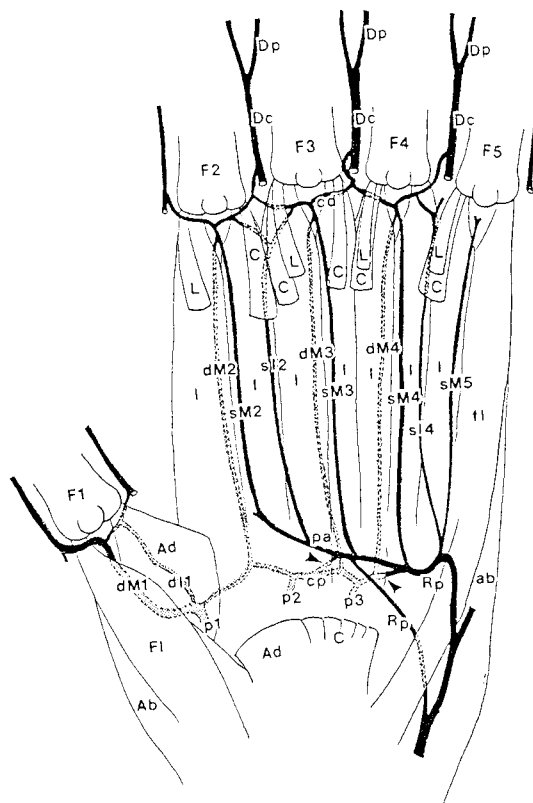


Fig. 2 A diagram showing the arterial pattern in the deep palm of the *Cynopithecus niger* (view from the palmar side). For abbreviations, see footnotes. Arrowheads, Anastomoses between the catella volaris proximalis and deep palmar arch.

Results

Main arteries of the monkey hand. The main arteries of the fingers (proper palmar digital arteries) arose from the palmar digital arteries, particularly the common palmar digital arteries. These palmar digital arteries arose from the superficial palmar arch formed by the palmar branches of the

radial and ulnar arteries.

The dorsal branch of the radial artery reached the proximal ends of the first, second, third and fourth intermetacarpal spaces from the dorsal aspect, and gave rise to the dorsal metacarpal arteries and proximal perforating branches. The dorsal metacarpal arteries ran along the dorsal surface

Abbreviations used: C, Contrahentes muscles; I, Interosseous muscles; L, Lumbrical muscles; F (1-5), First to fifth fingers; P (1-4), First to fourth proximal perforating branches; Ab, Abductor pollicis brevis muscle; Ad, Adductor pollicis muscle; Dc, Palmar digital arteries (common palmar digital arteries); Dd, Well-developed dorsal metacarpal artery; Dp, Proper palmar digital arteries; Fl, Flexor pollicis brevis muscle; F1, Deep palmar branch of the ulnar artery; sM (1-5), Superficial palmar metacarpal arteries; sl (1-4), Superficial palmar intermetacarpal arteries; dM (1-5), Deep palmar metacarpal arteries; di (1-4), Deep palmar intermetacarpal arteries; d, Distal perforating branches; ab, Abductor digiti minimi brevis muscle; cd, Catella volaris distalis; cp, Catella volaris proximalis; fl, Flexor digiti minimi brevis muscle; pa, Deep palmar arch.

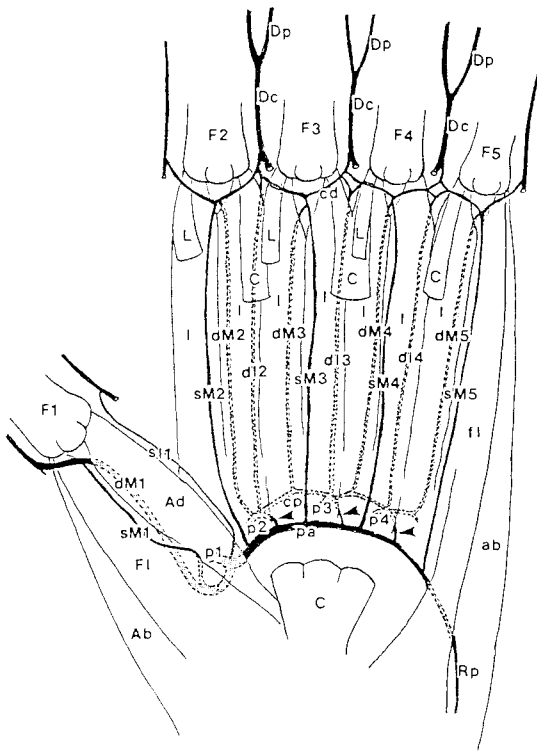


Fig. 3 A diagram showing the arterial pattern in the deep palm of the *Hylobates lar* (view from the palmar side). For abbreviations, see footnotes. Arrowheads, Anastomoses between the catella volaris proximalis and deep palmar arch.

of the interosseous muscles and gave rise to the proper dorsal digital arteries. It was rather rare that the dorsal metacarpal arteries gave rise to the proper palmar digital arteries (Fig. 1).

The dorsal metacarpal arteries gave off faint distal perforating branches which ran around the necks of the metacarpal bones and continuing into the catella volaris (palmaris) distalis (Fig. 1). The proximal perforating branches were rather well developed (Figs. 1-3). They penetrated the interosseous muscles, forming the catella volaris (palmaris) proximalis on the palmar surfaces of the metacarpal bones and in the intermetacarpal spaces at the levels just dis-

tal to the bases of the metacarpal bones (Figs. 1-3). The dorsal branch of the ulnar artery was poorly developed and ended in the rete articularis of the carpus.

Palmar metacarpal arteries of the monkey hand and their classification. The deep layer of the monkey hands was supplied by the palmar metacarpal arteries, including the princeps pollicis artery. These palmar metacarpal arteries arose from the catella volaris proximalis or the deep palmar arch (Figs. 1-3). Regardless of their origins, the palmar metacarpal arteries descended in the deep layer of the hand and formed the catella volaris distalis near the distal end of the metacarpus to connect with the palmar digital arteries and the distal perforating branches (Figs. 1-3).

In relation to the interosseous, adductor pollicis, flexor pollicis brevis and flexor digiti minimi muscles and metacarpal bones, the palmar metacarpal arteries could be classified into (i) the superficial palmar metacarpal (sM1-sM5) arteries descending on the palmar surfaces of the muscles along the first to fifth metacarpal bones, (ii) the superficial palmar intermetacarpal (sI1-sI4) arteries descending along the first to fourth intermetacarpal spaces on the palmar surfaces of the muscles, (iii) the deep palmar metacarpal (dM1-dM5) arteries descending deep in the interosseous muscles along the first to fifth metacarpal bones, and (iv) the deep palmar intermetacarpal (dI1-dI4) arteries descending deep in the muscles along the first to fifth intermetacarpal spaces (Figs. 1-3). The details of these arteries observed in each monkey hand are described below.

Palmar metacarpal arteries of the Macacus cyclopsis. The dorsal branch of the radial artery gave off the first, second, third and fourth proximal perforating branches (Fig. 1). The first perforating branch was fairly independent and continued

into the princeps pollicis (dM1) artery (Fig. 1). The second, third and fourth perforating branches formed the catella volaris proximalis between the second and fifth metacarpal bones (Fig. 1). This catella volaris proximalis gave off the sM2, sI2, sM3, dI3, sM4, dM4, sM5 and dM5 arteries. The deep palmar branch of the ulnar artery was poorly developed and continued only into the proximal portion of the sM5 artery.

*Palmar metacarpal arteries of the *Cynopithecus niger*.* The dorsal branch of the radial artery gave off the first, second and third proximal perforating branches and formed the catella volaris proximalis between the first and fourth metacarpal bones (Fig. 2). This catella volaris proximalis gave off the princeps pollicis (dM1), dI1, dM2, dM3 and dM4 arteries (Fig. 2). The well developed deep palmar branch (deep palmar arch) of the ulnar artery gave off the sM2, sI2, sM3, sM4, sI4 and sM5 arteries, and had two anastomoses with the catella volaris proximalis on the third and fourth metacarpal bones (Fig. 2). This deep palmar branch took an unusual course medial to the flexor digiti minimi muscle and received another deep palmar branch which took the usual course between the flexor digiti minimi and abductor digiti minimi muscles.

*Palmar metacarpal arteries of the *Hylobates lar*.* The dorsal branch of the radial artery gave off the first, second, third and fourth proximal perforating branches (Fig. 3). The well developed first perforating branch formed the deep palmar arch together with the deep palmar branch of the ulnar artery, and gave rise to the princeps pollicis (dM1), sM1 and sI1 arteries (Fig. 3). The deep palmar arch gave off the sM2, sM3, sM4 and sM5 arteries. The second, third and fourth proximal perforating branches formed the catella volaris

proximalis between the second and fifth metacarpal bones and gave off the dM2, dI2, dM3, dI3, dM4 and dM5 arteries (Fig. 3). The catella volaris proximalis sent off three branches which anastomosed in the second, third and fourth intermetacarpal spaces into the deep palmar arch (Fig. 3).

Discussion

This study clarified that the basic vascular architecture of the palmar and dorsal layers of the monkey hand is similar to that of the human hand (1, 2). In man and the monkey, the proper palmar digital arteries (main arteries of the fingers) arise from the palmar digital arteries which are derived from the superficial palmar arch formed by the anastomosis of the palmar branches of the ulnar and radial arteries (1, 2, 5, 7). Also in man and the monkey, the proper dorsal digital arteries (accessory arteries of the fingers) arise from the dorsal metacarpal arteries that are derived from the dorsal branch of the radial artery (1, 2, 5, 7).

This study also clarified that the basic vascular architecture of the deep palm of the monkey hand is similar to that of the human hand (3, 5, 7). The vascular system of the deep palm in the monkey hand, like that in the human hand (3), is composed of deep and superficial layers. The only difference is that in the monkey hand, the catella volaris proximalis is relatively well developed, while it is poorly developed in the human hand (3).

As described above, the deep vascular layer of the deep palm in the monkey hand is composed of the catella volaris proximalis and its branches descending between the interosseous muscles on the palmar surfaces of the metacarpal bones (dM arteries) or between the interosseous muscles deep in

the intermetacarpal spaces (dI arteries). The dM and dI arteries of the monkey hand correspond well in position and course to the dM and dI arteries of the human hand and foot (3, 4).

Also as described above, the superficial vascular layer of the deep palm in the monkey hand is composed of the arcus palmaris profundus (deep palmar arch) and its branches descending on the palmar surfaces of the interosseous muscles along the metacarpal bones (sM arteries) or along the intermetacarpal spaces (sI arteries). These sM and sI arteries also correspond well in their positions and courses to the sM and sI arteries in the human hand and foot (3, 4). The sM arteries, like those of the human hand and foot (3, 4), are accompanied by the palmar articular nerves which arise from the deep palmar branch of the ulnar nerve and terminate in the palmar surfaces of the metacarpophalangeal joints. This intimate relationship between the sM arteries and articular nerves shows that the sM arteries of the monkey hand and human hand and foot are quite homologous. The sI, dM and dI arteries are not accompanied by such articular nerves in the monkey hand, as in the human hand and foot (3, 4).

As shown in Figs. 1-3, the monkey hand has the contrahentes muscles. The sM and sI arteries descend dorsal to the contrahentes muscles, together with the palmar articular nerves of the metacarpophalangeal joints. The human hand and foot do not have contrahentes muscles (3, 4).

Nishi and Koch studied the hands and feet of certain monkeys, including the *Macacus cyclopsis*, and described the deep arteries (aa. interossea) which descended deep in the interosseous muscles and probably correspond to the dI arteries (5-7). Nishi and Koch, however, did not describe any arteries corresponding to the dM arteries (5-7). The dM arteries are rather

important vessels which send off the main nutrient arteries to the metacarpal bones and occasionally give rise to or connect with the main arteries of the fingers via the catella volaris distalis.

The present study, moreover, clarified that the catella volaris proximalis sometimes gives off the sM and sI arteries (superficial arteries), which are clearly seen in the hand of the *Macacus cyclopsis*. It is noticeable that in the hands of the *Cynopithecus niger* and *Hylobates lar*, two or more anastomoses were observed between the deep palmar arch and catella volaris proximalis. These anastomoses may be important routes for the sM or sI arteries to arise from the catella volaris proximalis. These anastomoses may also be important because the dM or dI arteries arise from the deep palmar arch. The deep palmar arch was shown to give off the dM or dI arteries in the human and foot (3, 4), but not in the monkey hands observed herein.

The catella volaris distalis seems to be a collateral route from the deep palm to the fingers. In the human hand and foot, this catella and the catella volaris proximalis are both poorly developed (3, 4).

In the monkey hands, the adductor pollicis muscle was poorly developed, so that the sII and dII arteries ran along the ulnar and radial margins of this muscle, respectively. The dM1 artery runs along the palmar surface of the first metacarpal bone. The sM1 artery runs on the palmar surfaces of the adductor pollicis and flexor pollicis brevis muscles together with the first palmar articular nerve which arises from the median nerve and terminates in the first metacarpophalangeal joint.

References

1. Johnston TB and Whillis J: The ulnar artery; in Grays' Anatomy, Descriptive and Applied. Longmans.

- Green and Co., London/New York/Toronto (1949) pp 766-771.
2. Romanes GJ: Arterial arches of hand; in Cunningham's Textbook of Anatomy. Oxford University Press, London (1964) pp 892-893.
 3. Murakami T: On the position and course of the deep palmar arteries, with special reference to the so-called palmar metacarpal arteries. *Okajimas Fol Anat Jpn* (1969) **46**, 177-199.
 4. Murakami T: On the position and course of the deep plantar arteries, with special reference to the so-called plantar metatarsal arteries. *Okajimas Fol Anat Jpn* (1971) **48**, 295-322.
 5. Nishi S: Über die Arterien der Affenhand. Ein Beitrag zur vergleichenden Angiologie. *Jpn J Med Sci I. Anatomy* (1939) **7**, 81-97.
 6. Nishi S: Über die Arterien des Affenfusses. Eine typologisch-anatomische Studie. *Jpn J Med Sci I. Anatomy* (1943) **11**, 127-148.
 7. Koch K: Das Verhalten der Arterienbögen in der Vola manus und Planta pedis bei Affen. *Zeitschr Anat Entwicklungsgesch* (1939) **110**, 81-97.

Received: April 18, 1987

Accepted: June 26, 1987

Correspondence to:

Takafumi Nakai
Department of Anatomy
Okayama University Medical School
2-5-1 Shikatacho
Okayama 700, Japan