

Acta Medica Okayama

Volume 42, Issue 4

1988

Article 5

AUGUST 1988

Homology of the adductor pollicis and contrahentes muscles: a study of monkey hands.

Chugo Yamamoto*

Takuro Murakami[†]

Aiji Ohtsuka[‡]

*Okayama University,

[†]Okayama University,

[‡]Okayama University,

Homology of the adductor pollicis and contrahentes muscles: a study of monkey hands.*

Chugo Yamamoto, Takuro Murakami, and Aiji Ohtsuka

Abstract

The deep palmar muscles in monkey hands were studied. The contrahentes muscles mainly arose from the capitate bone, descended palmar to the deep palmar branch of the ulnar nerve and the palmar metacarpophalangeal nerves, and attached to the proximal phalanges or wing tendons of the second, fourth and fifth fingers. In relation to the deep palmar branch of the ulnar nerve and the palmar metacarpophalangeal nerves, the contrahentes muscles are homologous with the adductor pollicis and flexor indicis radialis muscles. The contrahentes muscles occasionally gave off some accessory slips which blended with the interosseous muscles. These findings suggest that the human adductor pollicis muscle is a well-developed remnant of a contrahens muscle, and that the human interosseous muscles contain some remnant of the contrahentes muscle. In fact, a well-developed remnant of a contrahens muscle was found in the fourth finger of a human hand. It is further considered that the human adductor pollicis muscle contains an element of the interosseous muscle of the thumb.

KEYWORDS: monkey hands, contrahentes muscles, adductor pollicis muscle, flexor indicis radialis muscle, interosseous muscles

*PMID: 3177007 [PubMed - indexed for MEDLINE]

Copyright (C) OKAYAMA UNIVERSITY MEDICAL SCHOOL

Homology of the Adductor Pollicis and Contrahentes Muscles: A Study of Monkey Hands

Chugo Yamamoto*, Takuro Murakami and Aiji Ohtsuka

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

The deep palmar muscles in monkey hands were studied. The contrahentes muscles mainly arose from the capitate bone, descended palmar to the deep palmar branch of the ulnar nerve and the palmar metacarpophalangeal nerves, and attached to the proximal phalanges or wing tendons of the second, fourth and fifth fingers. In relation to the deep palmar branch of the ulnar nerve and the palmar metacarpophalangeal nerves, the contrahentes muscles are homologous with the adductor pollicis and flexor indicis radialis muscles. The contrahentes muscles occasionally gave off some accessory slips which blended with the interosseous muscles. These findings suggest that the human adductor pollicis muscle is a well-developed remnant of a contrahens muscle, and that the human interosseous muscles contain some remnant of the contrahentes muscle. In fact, a well-developed remnant of a contrahens muscle was found in the fourth finger of a human hand. It is further considered that the human adductor pollicis muscle contains an element of the interosseous muscle of the thumb.

Key words : monkey hands, contrahentes muscles, adductor pollicis muscle, flexor indicis radialis muscle, interosseous muscles

The short muscles situated palmar to the deep palmar branch of the ulnar nerve are referred to as the contrahentes muscles. These contrahentes muscles occur widely in the hands of mammals, including the monkey and gorilla (1). However, it is generally believed that the contrahentes muscles are not present in the human hand (2, 3). The present study examines the contrahentes and adductor pollicis muscles of three species of the monkey, and confirms that the contrahentes and adductor pollicis muscles are homologous. The present find-

ings suggest that the human adductor pollicis muscle is a well-developed remnant of a contrahens muscle and that the human interosseous muscles contain some elements of the contrahentes muscles.

Materials and Methods

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

*To whom correspondence should be addressed.

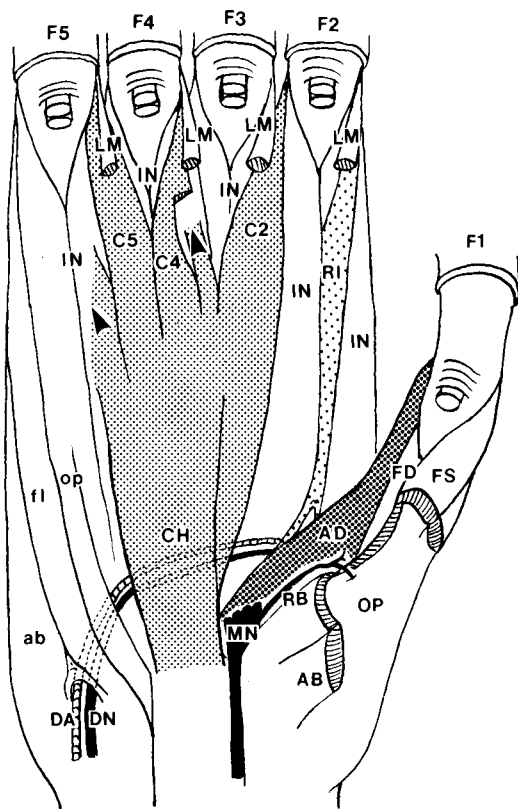


Fig. 1 A diagram of the muscular arrangements in the deep palm of the *Hylobates lar* (palmar view). See text and footnotes.

Results

The intrinsic or short muscles in the hands of the *Hylobates lar*, *Macacus cynomolgus* and *Macacus fuscatus* included the thenar muscles (thumb), hypothenar muscles (little finger), contrahentes muscles, palmar

and dorsal interosseous muscles and lumbrical muscles.

The short muscles of the thumb included the abductor pollicis brevis (AB), flexor pollicis brevis (superficial and deep heads, FS and FD), opponens pollicis (OP) and adductor pollicis (AD) muscles (Figs. 1, 8, 15). The short muscles of the little finger included the abductor digiti minimi (ab), opponens digiti minimi (op) and flexor digiti minimi brevis (fl) muscles (Figs. 1, 8, 15). There were three palmar interosseous muscles (IP), one attached to the ulnar side of the second finger (Figs. 4, 11, 18), one to the radial side of the fourth finger (Figs. 6, 13, 20) and one to the radial side of the fifth finger (Figs. 7, 14, 21). The dorsal interosseous

Fig. 2 A diagram showing the positional relations of the contrahentes and related muscles of the *Hylobates lar* (radial view). See text and footnotes.

Fig. 3 A diagram of the short muscles of the first finger of the *Hylobates lar* (dorsal view). See text and footnotes.

Fig. 4 A diagram of the short muscle of the second finger of the *Hylobates lar* (dorsal view). See text and footnotes.

Fig. 5 A diagram of the short muscles of the third finger of the *Hylobates lar* (dorsal view). See text and footnotes.

Fig. 6 A diagram of the short muscles of the fourth finger of the *Hylobates lar* (dorsal view). See text and footnotes.

Fig. 7 A diagram of the short muscles of the fifth finger of the *Hylobates lar* (dorsal view). See text and footnotes.

Abbreviations used in Figs. 1-22. AB, abductor pollicis brevis muscle; AD, adductor pollicis muscle; BH, Brook's head of the interosseous muscles (13); C2, C4 and C5, contrahentes muscles of the second, fourth and fifth fingers; CB, capitate bone; CH, contrahentes muscles; DA, deep palmar branch of the ulnar artery; DN, deep palmar branch of the ulnar nerve; DT, deep transverse ligament; F1-F5, first-fifth fingers; FD, deep head of the flexor pollicis brevis muscle; FS, superficial head of the flexor pollicis brevis muscle; ID, dorsal interosseous muscle; IN, interosseous muscle; IP, palmar interosseous muscle; LM, lumbrical muscle; M3, third metacarpal bone; MN, median nerve; OP, opponens pollicis muscle; RB, recurrent branch of the median nerve; RH, radial head of the interosseous muscle; RI, flexor indicis radialis muscle; RW, radial wing tendon of the extensor apparatus; TE, tendon of the extensor digitorum muscle; UH, ulnar head of the interosseous muscle; UW, ulnar wing tendon of the extensor apparatus; ab, abductor digiti minimi muscle; fl, flexor digiti minimi brevis muscle; op, opponens digiti minimi muscle; arrow, deep palmar branch of the ulnar nerve or artery; arrowhead, accessory bundle of the contrahentes muscles.

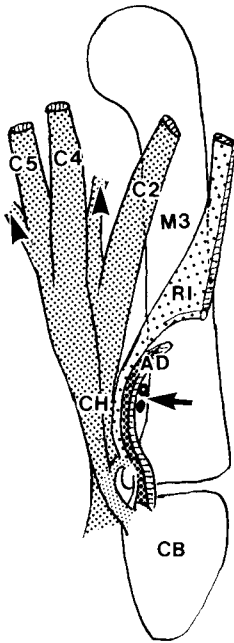


Fig. 2

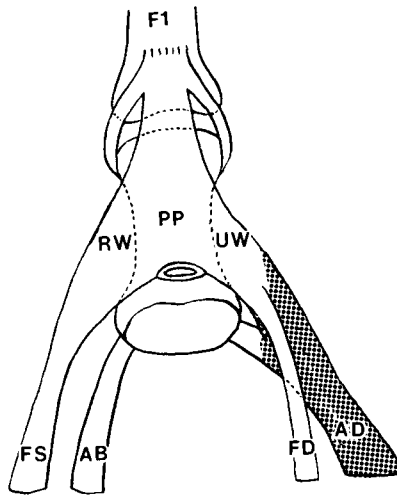


Fig. 3

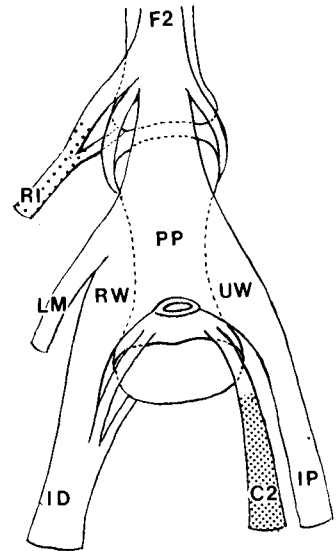


Fig. 4

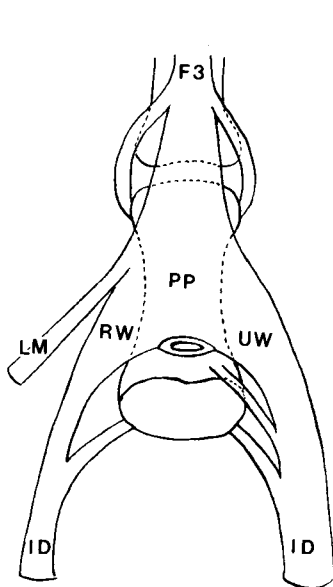


Fig. 5

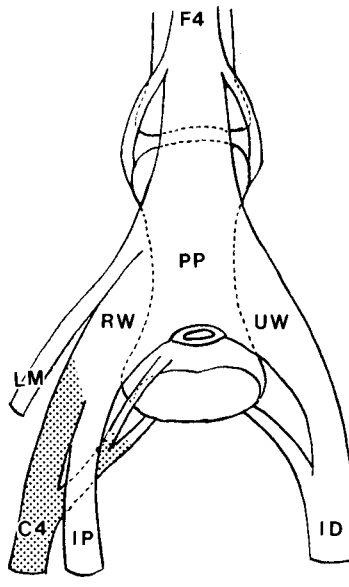


Fig. 6

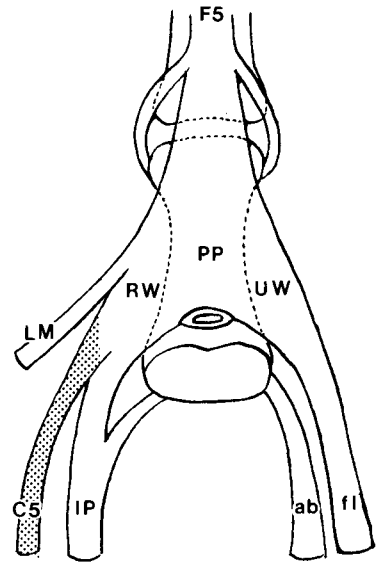


Fig. 7

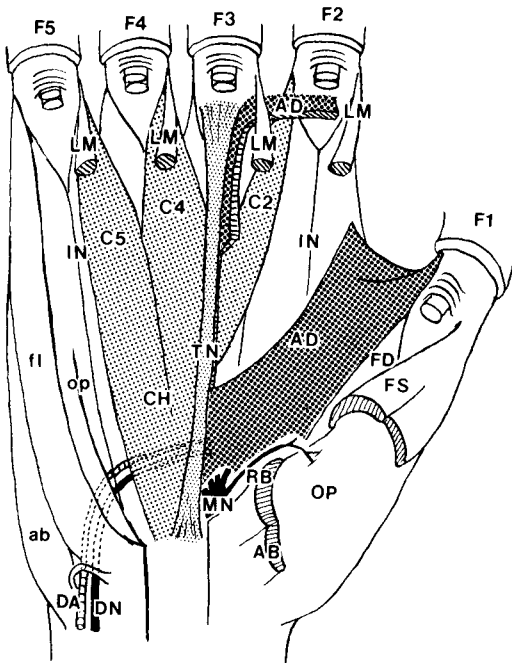


Fig. 8 A diagram of the muscular arrangements in the deep palm of the *Macacus cynomolgus* (palmar view). See text and footnotes.

muscles (ID) were four in number, one attached to the radial side of the second finger (Figs. 4, 11, 18), one to the radial side of the third finger (Figs. 5, 12, 19), one to the ulnar side of the third finger (Figs. 5, 12, 19) and one to the ulnar side of the fourth finger (Figs. 6, 13, 20). The lumbrical muscles (LM), which also numbered four, attached to the radial sides of the second to fifth fingers (Figs. 1, 4-8, 11-15, 18-21). In addition to these short muscles,

the *Hylobates lar* had the flexor indicis radialis muscle (RI) (Figs. 1, 2, 4).

The hypothenar muscles, contrahentes muscles, interosseous muscles and flexor indicis radialis muscle were supplied by the deep palmar branch of the ulnar nerve (DN) (Figs. 1, 8, 15). The thenar muscles, except the deep head of the flexor pollicis brevis muscle, which was supplied by the deep palmar branch of the ulnar nerve, were supplied by the recurrent branch (RB) of the median nerve (MN) (Figs. 1, 8, 15). The two ulnar lumbrical muscles were supplied by the deep palmar branch of the ulnar nerve, and the two radial lumbrical muscles by the digital branches of the median nerve.

Positions and courses of the nerves were similar in the hands of the *Hylobates lar*, *Macacus cynomolgus* and *Macacus fuscatus*. The deep palmar branch of the ulnar nerve (DN), together with the deep palmar branch of the ulnar artery (DA), passed deeply between the abductor (ab) and flexor digiti minimi brevis (fl) muscles and through a fibrous arch in the proximal end of the opponens digiti minimi muscle (op) (Figs. 1, 8, 15). The deep palmar branch of the ulnar nerve continued transversely on the palmar surfaces of the interosseous muscles (IN) (Figs. 1, 8, 15). In its course on the palmar surfaces of the interosseous muscles, the deep palmar branch of the ulnar nerve gave off the second to fifth palmar metacarpophalangeal nerves which descended on the palmar sur-

Fig. 9 A diagram showing the positional relations of the contrahentes and related muscles of the *Macacus cynomolgus* (radial view). See text and footnotes.

Fig. 10 A diagram of the short muscles of the first finger of the *Macacus cynomolgus* (dorsal view). See text and footnotes.

Fig. 11 A diagram of the short muscle of the second finger of the *Macacus cynomolgus* (dorsal view). See text and footnotes.

Fig. 12 A diagram of the short muscles of the third finger of the *Macacus cynomolgus* (dorsal view). See text and footnotes.

Fig. 13 A diagram of the short muscles of the fourth finger of the *Macacus cynomolgus* (dorsal view). See text and footnotes.

Fig. 14 A diagram of the short muscles of the fifth finger of the *Macacus cynomolgus* (dorsal view). See text and footnotes.

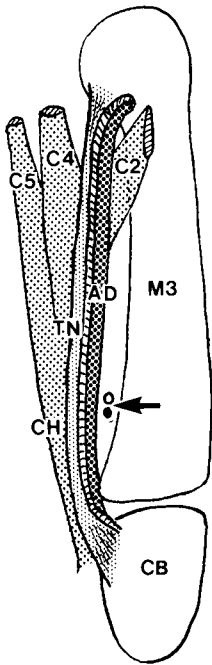


Fig. 9

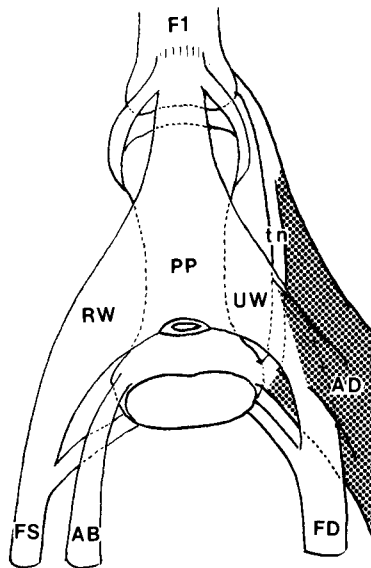


Fig. 10

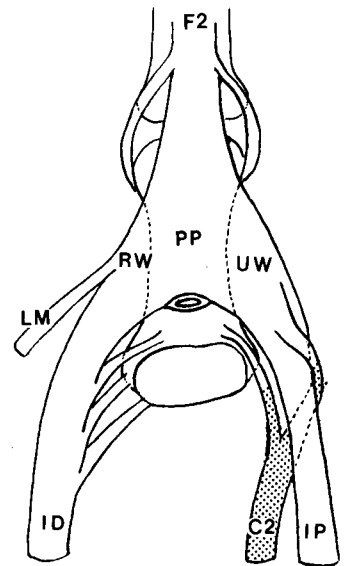


Fig. 11

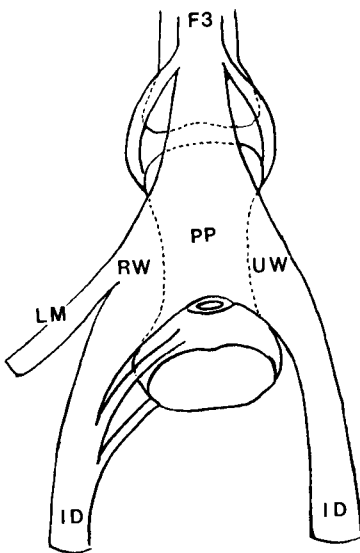


Fig. 12

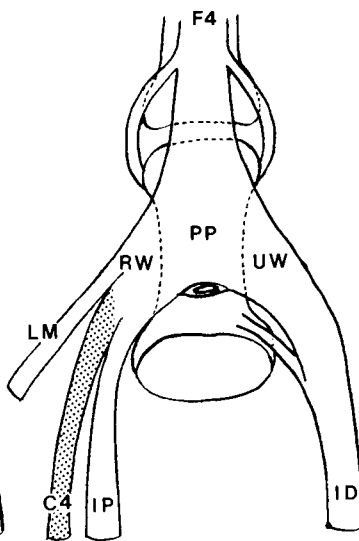


Fig. 13

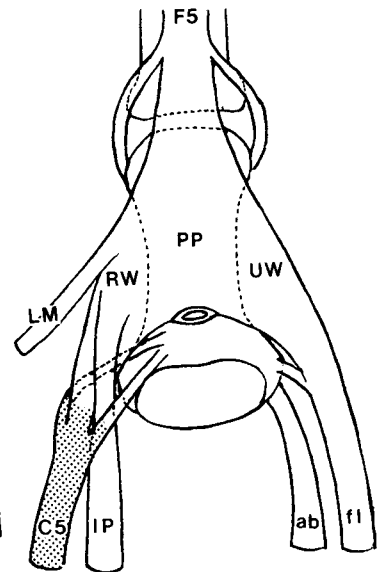


Fig. 14

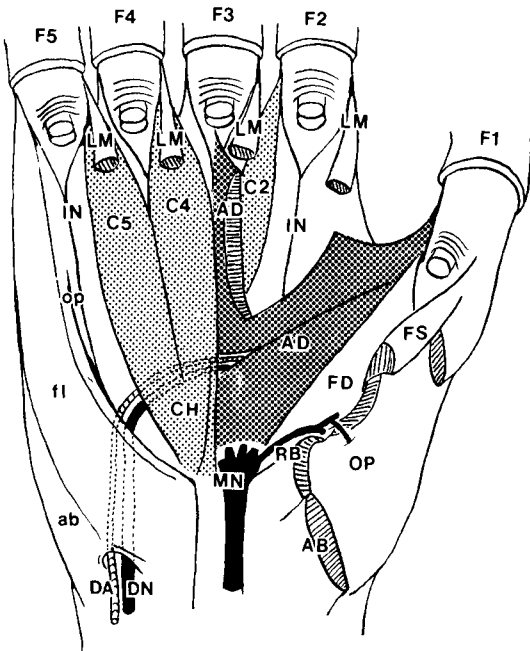


Fig. 15 A diagram of the muscular arrangements in the deep palm of the *Macacus fuscatus* (palmar view). See text and footnotes.

faces of the interosseous muscles and terminated in the metacarpophalangeal joints of the second to fifth fingers. The recurrent branch of the median nerve gave off the first palmar metacarpophalangeal nerve descending along the dorsal surface of the long flexor tendon of the thumb and terminating in the metacarpophalangeal joints of the thumb.

The forms and positions of most intrinsic muscles were similar in the hands of the *Hylobates lar*, *Macacus cynomolgus* and *Macacus fuscatus* (Figs. 1, 8, 15). However, those of the contrahentes (CH) and adductor

pollicis (AD) muscles differed in each monkey (Figs. 1, 2, 8, 9, 15, 16), so the present descriptions are concentrated on these muscles as well as the flexor indicis radialis muscle (RI) (Figs. 1, 2, 4).

Hylobates lar.

M. adductor pollicis. The adductor pollicis muscle (AD) mainly arose from the capitate bone (CB) and from the bases of the second and third metacarpal (M3) bones (Figs. 1, 2). It descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the palmar metacarpophalangeal nerve of the second finger (Fig. 2), and inserted upon the ulnar side of the base of the proximal phalanx (PP) and the ulnar wing tendon (UW) of the first finger (F1) (Fig. 3).

Mm. contrahentes. The contrahentes muscles (CH) mainly arose from the capitate bone and adjacent carpal ligaments (Fig. 1), descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the palmar metacarpophalangeal nerves of the second, third and fourth fingers, and were divided into three main slips (C2, C4, C5) (the contrahentes muscles of the second, fourth and fifth fingers) and two additional bundles (arrowheads) (Figs. 1, 2).

The contrahens muscle of the second finger (C2) inserted upon the dorsal part of the base of the proximal phalanx (PP) of the second finger (F2) (Fig. 4). The contrahens muscle of the fourth finger (C4) inserted upon the radial wing tendon (RW)

Fig. 16 A diagram showing the positional relations of the contrahentes and related muscles of the *Macacus fuscatus* (radial view). See text and footnotes.

Fig. 17 A diagram of the short muscles of the first finger of the *Macacus fuscatus* (dorsal view). See text and footnotes.

Fig. 18 A diagram of the short muscle of the second finger of the *Macacus fuscatus* (dorsal view). See text and footnotes.

Fig. 19 A diagram of the short muscles of the third finger of the *Macacus fuscatus* (dorsal view). See text and footnotes.

Fig. 20 A diagram of the short muscles of the fourth finger of the *Macacus fuscatus* (dorsal view). See text and footnotes.

Fig. 21 A diagram of the short muscles of the fifth finger of the *Macacus fuscatus* (dorsal view). See text and footnotes.

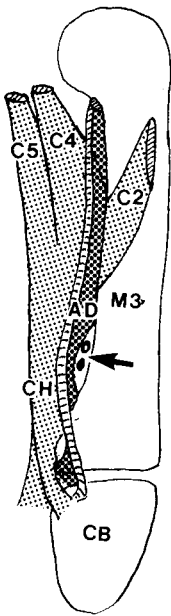


Fig. 16

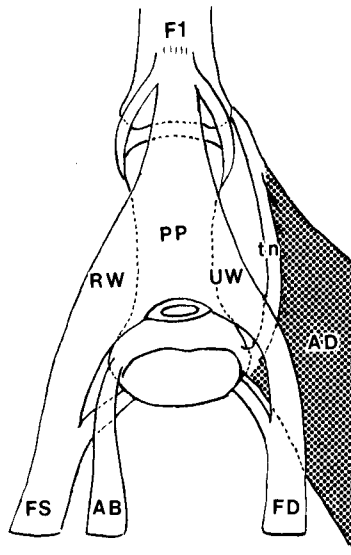


Fig. 17

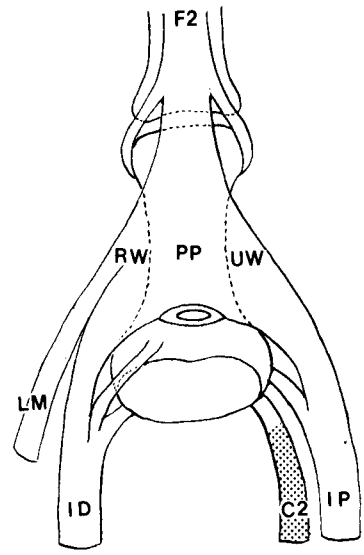


Fig. 18

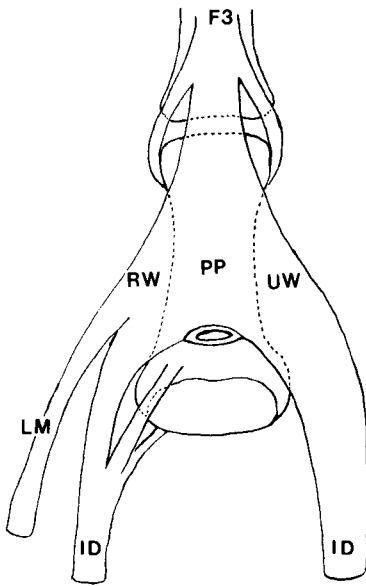


Fig. 19

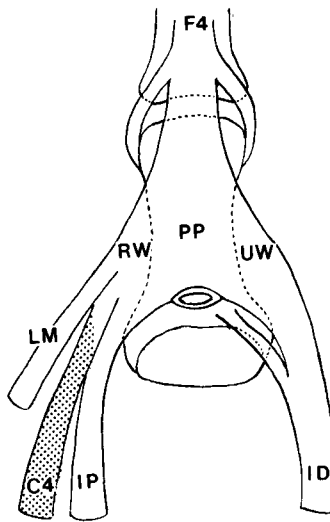


Fig. 20

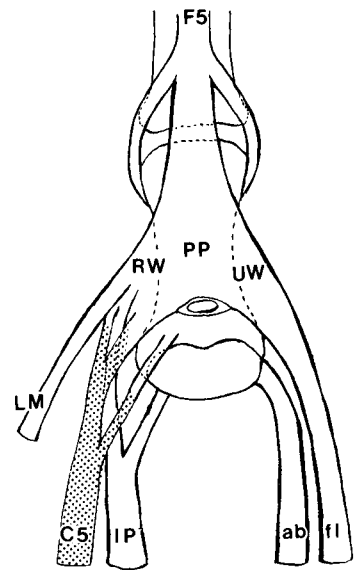


Fig. 21

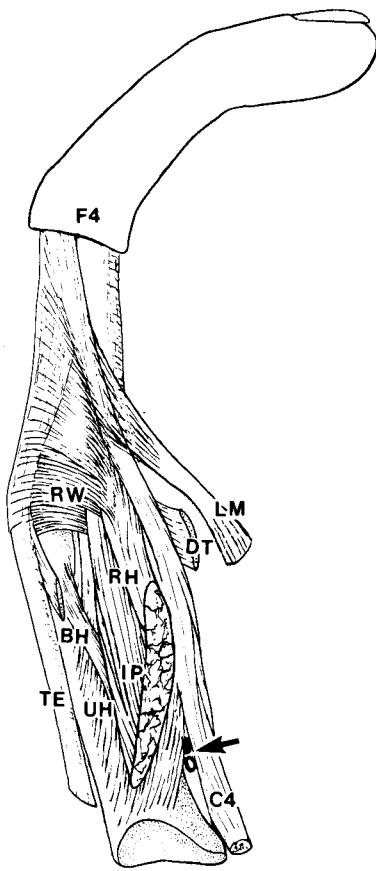


Fig. 22 A contrahens-like slip (C4) observed in a human hand. See text and footnotes.

and the dorsal and palmar parts of the base of the proximal phalanx (PP) of the fourth finger (F4) (Fig. 6). The contrahens muscle of the fifth finger (C5) inserted only upon the radial wing tendon (RW) of the fifth finger (F5) (Fig. 7).

The two additional bundles (arrowhead) of the contrahentes muscles blended with the palmar interosseous muscles of the fourth finger and fifth finger, respectively (Figs. 1, 2).

M. flexor indicis radialis. The flexor indicis radialis muscle (RI) consisted of two heads (Figs. 1, 2). One head arose, together with the adductor pollicis (AD) and contrahentes (CH) muscles, from the base of

the third metacarpal bone (M3), and descended palmar to the deep palmar branch (arrow) of the ulnar nerve (Figs. 1, 2). The other head arose from the longitudinal ridge on the front of the second metacarpal bone, and descended palmar to the second palmar metacarpophalangeal nerve (Fig. 1). Both heads (RI) blended with each other at the level of the proximal portion of the second metacarpal bone, and inserted, at the level of the proximal interphalangeal joint, upon the radial aspect of the extensor apparatus and the radial part of the base of the middle phalanx of the second finger (Figs. 1, 2, 4).

Macacus cynomolgus.

M. adductor pollicis. The adductor pollicis muscle (AD) mainly arose from the capitate bone (CB), from the bases of the second and third metacarpal (M3) bones and from the radial side of the central tendon (TN) of the contrahentes muscles (CH) (Figs. 8, 9). It ran palmar to the deep palmar branch (arrow) of the ulnar nerve and the second palmar metacarpophalangeal nerve (Figs. 8, 9), and inserted upon the ulnar part of the base of the proximal phalanx (PP), the ulnar wing tendon (UW) and a tendinous arch (tn) which spanned, from the ulnar aspect, between the bases of the proximal and distal phalanges of the first finger (F1) (Fig. 10).

Mm. contrahentes. There were three contrahentes muscles (C2, C4, C5) which mainly arose from the tendon (TN) attached proximally to the capitate bone (CB) (Figs. 8, 9). This tendon (central tendon of the contrahentes muscles, see above) continued forward along the third metacarpal bone to its neck (Figs. 8, 9).

The contrahens muscle of the second finger (C2) arose from the radial side of the central tendon (TN) of the contrahentes muscles, descended palmar to the third palmar metacarpophalangeal nerve (Figs. 8, 9), and

inserted upon the dorsal part of the base of the proximal phalanx (PP) and the ulnar wing tendon (UW) of the second finger (F2) (Fig. 11).

The contrahens muscle of the fourth finger (C4) arose from the ulnar side of the central tendon (TN), descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the fourth metacarpophalangeal nerve (Figs. 8, 9), and inserted upon the radial wing tendon (RW) of the fourth finger (F4) (Fig. 13).

The contrahens muscle of the fifth finger (C5) arose from the capitate bone (CB) and the central tendon (TN) of the contrahentes muscles, descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the fourth and fifth palmar metacarpophalangeal nerves (Figs. 8, 9), and inserted upon the dorsal part of the base of the proximal phalanx (PP) and the radial wing tendon (RW) of the fifth finger (F5) (Fig. 14).

Macacus fuscatus.

M. adductor pollicis. The adductor pollicis muscle (AD) mainly arose from the capitate bone (CB), from the base of the second and third metacarpal bones and from the longitudinal ridge on the front of the third metacarpal bone (M3) (Figs. 15, 16). It ran palmar to the deep palmar branch (arrow) of the ulnar nerve and the second and third metacarpophalangeal nerves (Figs. 15, 16), and inserted upon the ulnar part of the base of the proximal phalanx (PP) and a tendinous arch (tn) which spanned, from the ulnar aspect, between the bases of the proximal and distal phalanges of the first finger (F1) (Fig. 17).

Mm. contrahentes. There were three contrahentes muscles (C2, C4, C5) (Figs. 15, 16).

The contrahens muscle of the second finger (C2) arose from the longitudinal ridge on the front of the third metacarpal bone

(M3) at a level distal to the deep palmar branch (arrow) of the ulnar nerve (Figs. 15, 16), descended palmar to the third and second metacarpophalangeal nerves, and inserted upon the ulnar part of the base of the proximal phalanx (PP) of the second finger (F2) (Fig. 18).

The contrahens muscle of the fourth finger (C4) arose from the longitudinal ridge on the front of the third metacarpal bone (M3) (Figs. 15, 16), descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the fourth palmar metacarpophalangeal nerve (Figs. 15, 16), and inserted upon the radial wing tendon (RW) of the fourth finger (F4) (Fig. 20).

The contrahens muscle of the fifth finger (C5) arose from the capitate bone (CB) and from the longitudinal ridge on the front of the third metacarpal bone (M3) (Figs. 15, 16), descended palmar to the deep palmar branch (arrow) of the ulnar nerve and the fourth and fifth palmar metacarpophalangeal nerves (Figs. 15, 16), and inserted upon the radial wing tendon (RW) and the palmar and dorsal parts of the base of the proximal phalanx (PP) of the fifth finger (F5) (Fig. 21).

Discussion

The present study confirms the occurrence of the contrahentes and adductor pollicis muscles in the hands of the *Hylobates lar*, *Macacus cynomolgus* and *Macacus fuscatus*, though their origins, forms and insertions vary in each monkey and also in each case. It also confirms that these contrahentes and adductor pollicis muscles have a common origin from the capitate bone. The present study further clarified that the contrahentes and adductor pollicis muscles are located palmar to the deep palmar branch of the ulnar nerve and also palmar to the palmar metacarpophalangeal nerves of the

second to fifth fingers. It has been evidenced in man and various animals, including the monkeys, that the muscles are more intimately related to the nerves than to the arteries, veins and other elements (the theory of neuro-muscular relationship) (4-6). This theory indicates that the contrahentes and adductor pollicis muscles are homologous since they descend or run palmar to both the deep palmar branch of the ulnar nerve and the metacarpophalangeal nerves. In this respect, the flexor indicis radialis muscle of the *Hylobates lar* is also homologous with the contrahentes and adductor pollicis muscles since it descends palmar to the deep palmar branch of the ulnar nerve or palmar to the second palmar metacarpophalangeal nerve. Similar findings have been obtained in the rhesus monkey (*Pfthecus rhesus*) by Howell and Straus, though they did not describe the positional relationships between the muscles and nerves in detail (7).

The present study discloses that the adductor pollicis muscle has a more extended origin in more highly evolved monkeys. The adductor pollicis muscle of the *Hylobates lar* arose solely from the carpus; that of the *Macacus cynomolgus* from the carpus and from the central tendon of the contrahentes muscles; and that of the *Macacus fuscatus* from the carpus and the third metacarpal bone. The origin and form of the adductor pollicis muscle of the *Hylobates lar* are similar to those of the dog and other lower mammals (1, 8). The origin and form of the adductor pollicis muscle of the *Macacus cynomolgus* are similar to those of the rhesus monkey (7). The origin and form of the adductor pollicis muscle of the *Macacus fuscatus* are similar to those of the gorilla (1) and man (1-3, 9). As discussed above, the contrahentes and adductor pollicis muscles are homologous in their relationships to the deep palmar branch of the ulnar nerve and to the palmar metacarpophalangeal nerves.

The human adductor pollicis muscle, like that of the monkeys examined in this study, is located palmar to the deep palmar branch of the ulnar nerve and the second and third metacarpophalangeal nerves (1-3, 9). Thus, it can be said that the human adductor pollicis muscle is a well-developed remnant of a contrahens muscle (or is the contrahens muscle of the thumb), though it has lost the insertion upon the distal phalanx of the first finger.

In accordance with our view, the contrahentes muscles are sometimes referred to as the Mm. adductores digitorum, especially in lower animals such as the dog (8). Regardless of the nomenclature, the contrahentes muscles show varieties in animals. In the dog, the contrahens muscle of the fourth finger is not present. However, this contrahens muscle of the fourth finger is clearly identified in the cat and rabbit (see Figs. 3 and 4, Murakami *et al.*, 1987) (10). Furthermore, it should be noted that the contrahentes muscles may have their origin on either the carpus or metacarpal bones. As observed in the *Macacus fuscatus*, the contrahens muscle of the second finger (C2) arises from the shaft of the third metacarpal bone (M3) (Figs. 15, 16).

It is generally believed that the contrahentes muscles are not present in the human hand (1, 2). As discussed above, however, it is strongly suggested that, in man, the adductor pollicis muscle is a contrahens muscle of the thumb. In addition, the present findings, especially those of the *Hylobates lar*, show that the contrahentes muscles can fuse with the interosseous muscles. Such fusions of the contrahentes muscles and interosseous muscles are also observed in lower animals such as the dog and cat (see Figs. 1 and 3, Murakami *et al.*, 1987) (10). These facts and the fact that the contrahentes muscles can arise from the metacarpal bones (see above) strongly sug-

gest that the human interosseous muscles, especially the palmar ones, contain some elements of the contrahentes muscles. In fact, we found a contrahens-like slip in a preliminary dissection of human hands. This slip arose from the carpus, descended palmar to the deep palmar branch of the ulnar nerve, and blended with the palmar interosseous muscle of the fourth finger (Fig. 22). A preliminary dissection of human hands also has shown that a tendinous membrane always arises from the carpus, runs palmar to the deep palmar branch of the ulnar nerve, and blends with the interosseous muscles of the fourth and fifth fingers. This tendinous membrane also seems to be a remnant of the contrahentes muscles.

The contrahentes muscles, including the adductor pollicis muscle, have generally been described to insert upon the bases of the proximal phalanges (1, 3, 8). However, the present study shows that the contrahentes muscles as well as the adductor pollicis muscle can attach to the wing tendons of the extensor apparatuses of the fingers. As seen in Figs. 7, 13 and 20, all of the slips of the contrahens muscle of the fourth or fifth finger insert upon the wing tendon. Thus, such generalizations of the phalangeal insertions of the contrahentes muscles of monkey hands cannot be made. The same is true of generalizations of insertions of the interosseous muscles of man and other mammals, including monkeys (11, 12). According to Landsmeer, the dorsal interosseous muscle has insertions upon the base of the proximal phalanx and upon the wing tendon, while the palmar interosseous muscle has a sole insertion upon the wing tendon (12). The present study shows that the interosseous muscles, regardless of whether dorsal or palmar ones, always have insertions upon the wing tendon, though their insertions upon the proximal phalanges are

occasional or inconsistent. As seen in Figs. 12 and 19, the dorsal interosseous muscle has no insertion upon the proximal phalanx.

The flexor indicis radialis muscle is a rare muscle which appears a limited number of species such as the *Hylobates lar* and *Hylobates hulok* (1). This muscle, previously called the "Interosseous volaris radialis longus des Index" or "Abductor tertii internodii indicis" (1), usually arises from the second metacarpal bone and inserts upon the base of the middle phalanx of the second finger (1). The present paper shows that the flexor indicis radialis muscle can arise from the carpus and may insert even upon the extensor apparatus. As discussed above, we regard this muscle as a contrahens muscle. However, previous authors have regarded it as an interosseous muscle (1).

It has been questioned whether the palmar interosseous muscle occurs in the thumb (1). The present study shows that in monkeys, a fleshy slip is clearly separable between the adductor pollicis muscle and the first metacarpal bone. This muscle has been called the palmar interosseous muscle of the thumb or the deep head of the flexor pollicis brevis muscle (7). The present study also shows that the contrahentes or adductores muscles can fuse with the interosseous muscles (see above). These findings obtained by dissection of monkey hands strongly support our previous view that the palmar interosseous muscle occurs even in the human thumb (9). In the human thumb, an anastomosis exists between the deep palmar branch of the ulnar nerve and the recurrent branch of the median nerve. This anastomosis penetrates between the adductor pollicis muscle and the palmar interosseous muscle of the thumb (9). In the monkey hands of this study, such an anastomosis was not observed.

References

1. Forster A: Die Mm. contrahentes und interossei manus in der Säugetierreihe und beim Menschen. *Arch Anat Physiol* (1916) Jahrgang 1916, 101-378.
2. Frohse F und Fränkel M: Handmuskeln; im Bardeleben Handbuch der Anatomie des Menschen, Die Muskeln den Menschlichen Armes. Verlag von Gustav Fischer, Jena (1908) ss 198-239.
3. Kaplan EB: The fingers and thumb; in *Functional and Surgical Anatomy of the Hand*. 2nd Ed., J. B. Lippincott Co., Philadelphia and Montreal (1972) pp 23-105.
4. Haines RW: A consideration of the constancy of muscular nerve supply. *J Anat* (1935) **70**, 3-55.
5. Fujita T: Problems on the neuro-muscular relationship. *Morphol Jahrbuch* (1962) **102**, 312-326.
6. Nishi S: Typology of the muscular system (Japanese text). *Nitishin Igaku* (1961) **48**, 137-145 (in Japanese).
7. Howell AB and Straus WL, Jr: Muscles of the hand; in *The Anatomy of Rhesus Monkey*, Hafner Publishing Co., New York (1933) pp 141-148.
8. Miller ME, Christensen GC and Evans HE: The muscles of the forepaw; in *Anatomy of the Dog*, W. B. Saunders Co., Philadelphia and London (1964) pp 222-230.
9. Yamamoto R, Taguchi T and Murakami T: Palmar interosseous muscle of the human thumb. *Acta Med Okayama* (1987) **41**, 99-103.
10. Murakami T, Kikuta A and Nakai T: Deep palmar arteries of some mammals, with special reference to the palmar metacarpal arteries. *Okajimas Fol Anat Jpn* (1987) **64**, 193-202.
11. Lewis OJ: The evolution of the mm. interossei in the primate hand. *Anat Rec* (1965) **153**, 275-288.
12. Landsmeer JMF: Structural analysis of the fourth dorsal interosseous of the human hand. *Acta Anat* (1965) **62**, 176-214.
13. Brooks HSJ: On the morphology of the intrinsic muscles of the little finger, with some observations on the ulnar head of the short flexor of the thumb. *J Anat* (1886) **20**, 645-661.

Received April 13, 1988; accepted May 10, 1988