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ISSN: 0015-5659

e-ISSN: 1644-3284

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DOI: 10.5603/FM.a2017.0084

Article type: CASE REPORTS

Submitted: 2017-05-21

Accepted: 2017-07-18

Published online: 2017-09-06

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Unusual ending of the second dorsal metacarpal artery as proper palmar digital arteries

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ABSTRACT

Background: The proper palmar digital arteries arises infrequently from dorsal metacarpal arteries. This work reports the second dorsal metacarpal artery unusual ending and a vascular variation related to the superficial palmar arch.

Materials and methods: Fresh human upper limbs routine dissection, from a male cadaver, injected with colored elastomeric material immersed 10% formalin.

Results: The second dorsal metacarpal artery presented terminal branches, the index finger medial proper digital palmar artery and the middle finger lateral proper digital palmar artery. At the division point of both terminal branches, the second dorsal metacarpal artery anastomoses with a thin forth common digital palmar artery.

Conclusions: The value of this knowledge about the infrequent vascular disposition lies in vascularized flaps design using the second dorsal metacarpal artery.

Key words: second dorsal metacarpal artery, proper palmar digital arteries, superficial palmar arch, vascularized flap

Introduction

The origin of the proper palmar digital arteries (PPDAs) in dorsal metacarpal arteries (DMAs) is an infrequent event. Adachi [1], Coleman and Anson [2], Earley [3] and Libersa et al. [4] mentioned this possibility, but they give only inaccurate references. The second dorsal metacarpal artery (2DMA) it is important because it is the arterial vascular pedicle of the second dorsal metacarpal artery flaps, used to treat different injuries of hand and digits.

Materials and methods

Fresh male human cadaver, 64 years old. Right and left upper limbs were injected through brachial artery with elastomeric material using manual pressure, immersed in 10% formalin, and dissected using standard technique and 2× magnification lenses.

Results

In both hands the origin of 2DMA from the radial artery (RA) is found in the anatomical snuffbox. It passes under the extensor carpi radialis longus, surrounding the base of the second metacarpal bone, reaches the second interosseous space, between the extensors carpi radialis longus and brevis, giving muscular, osseous and cutaneous branches (Figs. 1 and 2).

Following its path, goes under the extensor indicis and the intertendinous connection between the index and middle finger. In the second web space, it follows as distal perforating artery and divides in the PPDAs medial of the index finger and lateral of the middle finger. In the point of division, it anastomoses with a very thin fourth common digital palmar artery (4CDPA).

In the right hand (Fig. 1), the first, second and third common palmar digital arteries (1, 2, 3CDPAs) originate in the ulnar artery, while the 4CPDA originates from the 3CDPA.

This last artery, anastomoses with the superficial palmar branch of the radial artery (SPBRA), which gives two branches: one is an anastomotic thin branch with the radial PPDA of the thumb; the other branch, anastomoses with *radialis indicis* artery (RIA), branch of the first interosseous palmar artery (1IOPA). In the left hand (Fig. 2), the ulnar artery anastomoses with the first interosseous palmar artery, at the origin point of a thin 4CPDA, similar to the right hand. The 4CPDA finishes with the 2DMA anastomosis at PPDA's division point.

Discussion

The 2DMA, founded in high percentages, originates from radial artery [3,5-8], dorsal carpal arch [1,5,6,9,10], deep palmar arch [11,12], and anterior interosseous artery [9]. Following the second dorsal interosseous space from these different sources, gives branches to the dorsal skin of the hand, the skin of next fingers, and 2nd metacarpal bone.

It arrives to the second web space and finish as distal perforating branch, anastomotic with branches from the deep palmar arch, which is mention for the authors as constant [1,2,5-7,11,13,], except Earley [3], that found it only in four specimens. Yang and Morris [14] considered the perforating branches with origin in the palmar metacarpal arteries.

Adachi [1] and Libersa et al. [4] mention the 2DMA as source of PPDA; Edwards [15] relates this origin could be possible due existing anastomoses at the second web space, but in his series of specimens, he did not find it. Coleman and Anson [2] described its presence limited to the first and second digital web spaces. In these papers, there are no images, draws or schemes illustrating the descriptions.

The 4CPDA shows a thin aspect in contrast with the gross development of the 2DMA. We can add the lack of a 2nd palmar metacarpal artery that compensates the low contribution of the 4CPDA.

We think the same as Rodríguez-Niedenführ et al. [15] that the beginning of arteries development, they came from buds, from an initial capillary plexus and it differentiates from proximal to distal, process that turns them in definitives blood vessels, while others disappear or have an incomplete development. In our case, the 4CPDA is insufficient to give the fingers blood supply and there not exists the 2PMA that supply the last artery

(possible regression as Rodríguez-Niedenführ et al. [15] have told), so the 2DMA increases its size and compensates the 4CPDA becoming in the dorsal origin of the PPDA, as Edwards [16] established.

One more time, we can appreciate variations in blood vessels in the radial side of the hand as Edwards sustained [16]. In the right hand, a superficial palmar arch takes place by the anastomoses between the superficial palmar branch of the radial artery (SPBRA) and the 4CPDA, which originates in the 3CDPA. Because of this disposition, the superficial arch could be named as complete but indirect, because the anastomoses exist, but in between the SPBRA and a collateral branch of the ulnar superficial artery. Literature about this anatomical disposition described above was not found.

The use of the second dorsal metacarpal artery flap is a technique widely used, to cover damage areas of hand or fingers because of the high presence of the artery (93-100%) [3,6,16]. We can design it as a proximal or distal vascularized cutaneous flap [5-9,10,11,17] or as a vascularized bone flap [5,18]. Regardless of flap type, the 2DMA or the distal perforant artery must be ligated [8,10]. In this case, this maneuver can be dangerous for the circulation of index and middle fingers, if 4CPDA, or another artery, is not sufficiently developed to correct the blood supply lost. There are reports using 2DMA as a vascular pedicle, in the index pollicization in case of congenital thumb aplasia [19].

The eco Doppler, was advised previous to the surgery [3,6,11,20] because of the variations of the metacarpal dorsal arteries. The disposition described in this case will be easy to detect, if this recommendation is followed, avoiding surprises at the moment to design the flap or planning surgery.

We were unable to find accurate descriptions of this disposition in the literature, except inaccurate references without any kind of illustration. The development of vascularized flaps with the 2DMA forces us to know the variations in the disposition of this artery and its connections with the superficial and deep palmar arches, no matter if they are, fortunately of low incidence.

Disclosure statement:

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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FIGURES

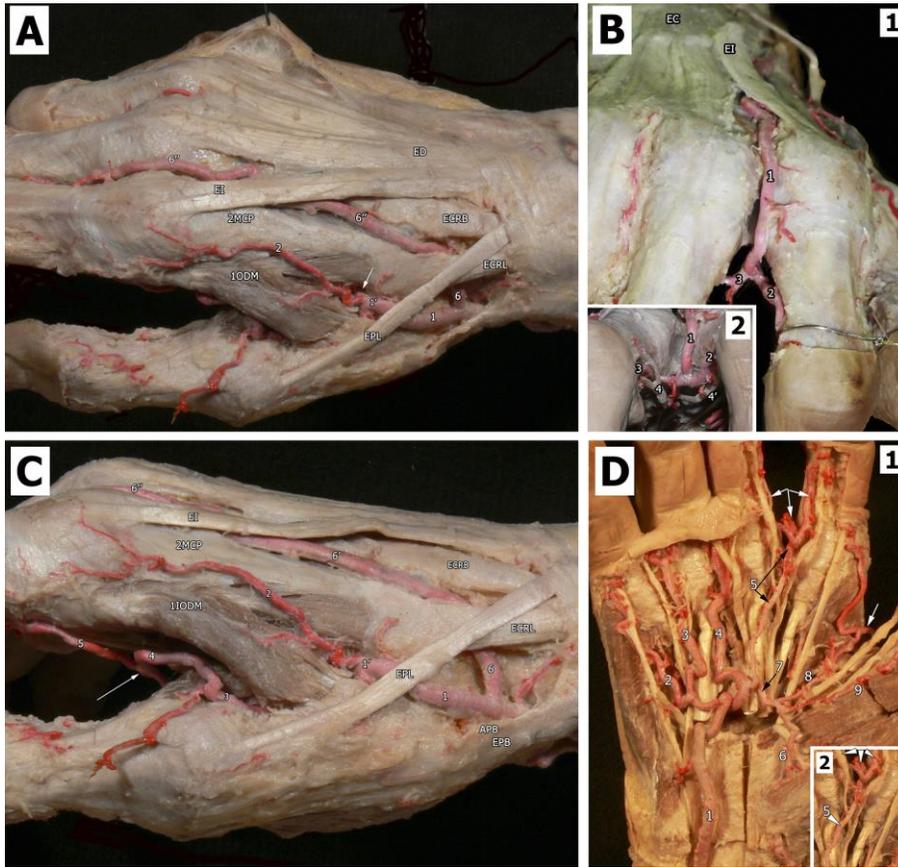


Fig. 1. A. Dorsal view of the right hand. 1 - 1', Radial artery; 2, First dorsal metacarpal artery (1DMA); 3, First interosseous palmar artery (1IOPA); 1 IOPA // 5 ARI; 6 - 6' - 6''. Second dorsal metacarpal artery (2DMA); APB, abductor pollicis brevis; EPB, extensor pollicis brevis; EPL, extensor pollicis longus; ECRL, extensor carpi radialis longus; ECRB, extensor carpi radialis brevis; 2MCP, second metacarpal bone; EI, extensor indicis; 1IODM, first interosseous dorsal muscle. **B. Latero-dorsal view of the right hand snuffbox.** 1 - 1', Radial artery; 2, First dorsal metacarpal artery (1DMA); 3, First interosseous palmar artery (1IOPA); 1 IOPA // 5 ARI; 6 - 6' - 6''. Second dorsal metacarpal artery (2DMA); APB, abductor pollicis brevis; EPB, extensor pollicis brevis; EPL, extensor pollicis longus; ECRL, extensor carpi radialis longus; ECRB, extensor carpi radialis brevis; 2MCP, second metacarpal bone; EI, extensor indicis; 1IODM, first interosseous dorsal muscle; ED, extensor digitorum. **C. 1. Second web space view.** 1, 2DMA in the second web space; 2 - 3, DPPA medial of index finger and lateral of middle finger; EC, extensor

digitorum; EI, extensor indicis. **2.** Detail of the second web space. 4 - 4', proper palmar digital nerves. **D. 1 & 2. Palmar view of the right hand.** 1, Ulnar artery; 2 - 3 - 4: 1-2-3 common palmar digital arteries (1, 2, 3 CPDA); 5, 4 CPDA; 6, radial palmar branch; 7, anastomoses of radial palmar branch with 4 CPDA; 8, anastomoses of radial palmar branch with radialis indicis artery from de 1 IOPA (white arrow); 9, anastomoses of radial palmar branch with PPDA radial of the thumb; Triangular arrows: central 2DMA laterals, DPPA medial of index finger and lateral of middle finger; RIA, radialis indicis artery.

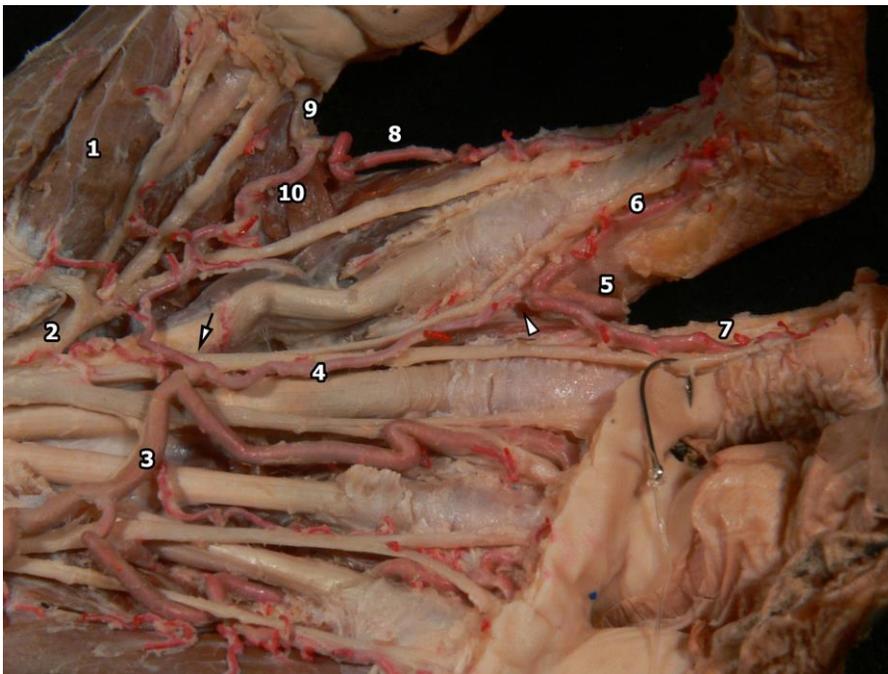


Fig. 2. Palmar view of the left hand. 1, tenar eminence; 2, lateral branch of the median nerve with branches to thumb and index fingers; 3, superficial palmar arch; 4, 4CPDA (proximal arrow shows the 4CPDA anastomoses with the branch of 1IOPA (10) and distal arrow shows anastomoses with 2DMA (5)); 6, medial PPDA to index finger; 7, lateral PPDA to middle finger; 8, radialis indicis artery; 9, medial PPDA of the thumb.