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Anatomical evaluation of the dorsal ulnar artery

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Aim: To contribute to the literature about the anatomy of the dorsal ulnar artery and to clarify the anastomosis pattern between the descending branch of this artery and the vascular network of the hand. The distally pedicled dorsoulnar forearm flap can be a useful surgical flap for repairing hand and wrist defects. The vascular pedicle of this flap is the dorsal cutaneous branch of the ulnar artery (the dorsal ulnar artery). However, there is confusion about the anatomy of the vascular pedicle of this flap, since different findings have been reported in various anatomical studies.

Materials and methods: The upper extremities of 5 cadavers were studied. The ulnar artery and its dorsal cutaneous branch were dissected, the entire arborizations of the dorsal ulnar artery were revealed, and measurements of the length and diameter of the dorsal ulnar artery were performed.

Results: The dorsal ulnar artery was divided into ascending and descending branches. The descending branch was divided into 2 terminal branches after passing beyond the pisiform bone, and 1 of the terminal branches turned to the radial side at an angle of about 90° and anastomosed with the deep branch of the ulnar artery.

Conclusion: The descending branch of the dorsal ulnar artery can be dissected as a flap pedicle up to the point at which the artery divides into its 2 terminal branches. This is the pivot point of the flap, and surgical dissection should be discontinued at this point.

Key words: Dorsal ulnar artery, surgical anatomy, flap, hand defects

Dorsal ulnar arterin anatomik değerlendirmesi


Anahtar sözcükler: Dorsal ulnar arter, cerrahi anatomi, flep, el defektleri
Introduction

The artery known as the dorsal ulnar artery (DUA) in clinical practice is the dorsal cutaneous branch of the ulnar artery. The DUA branches off distally as a constant dorsoulnar perforator vessel, and it supports a flap of skin on the medial aspects of the distal forearm just proximal to the wrist (1).

The skin flap that extends from the medial aspects of the distal forearm, which is based on the DUA, was described by Becker and Gilbert (2). To extend the vascular pedicle, this flap was later modified by ligating and dividing the DUA, and thus the distally pedicled dorsoulnar forearm flap was created (3). The distally pedicled dorsoulnar forearm flap is ensured by the descending branch of the DUA retrogradely, and it can be quite a useful flap for the repair of hand and wrist defects. This flap has been used for the closure of dorsal (3-5) and palmar (4-6) hand defects, to cover complex wounds that compromise the dorsal side or partial amputations of the hand (7), and for the treatment of chronic web space, finger, and palmar contractures (3,4,8,9).

The main advantage of this flap is that it does not require the sacrifice of a major artery. However, it needs a pedicle as long as possible to reach the distal hand. Therefore, some anatomical studies were performed to reveal the blood supply of this flap (2-4,7). Different findings have been reported regarding the anastomosis pattern of the descending branch of the DUA, which has led to confusion in planning clinical actions involving the flap.

This anatomical study was designed to contribute to the literature about the anatomy of the DUA and to be a guide for surgeons with regards to repair of hand defects, by clarifying the anastomosis pattern between the descending branch of the DUA and the vascular network of the hand.

Materials and methods

This study was carried out in the Anatomy Department of the Medical School of Atatürk University, and the upper extremities of 5 male cadavers (10 extremities in total), each of which had been fixed with 10% formalin, were studied. The ulnar artery and its dorsal cutaneous branch were dissected from the middle of the forearm through the distal palmar region of the hand. The distance from the pisiform bone to the origin of the DUA was measured, as well as the lengths of the common trunk of the DUA and its branches. Distal anastomosis between the descending branch of the DUA and the vascular network of the hand was a particular area of focus. After the entire arborization had been revealed, small branches were transected, and both the ulnar artery and the DUA were cut out en bloc in such a manner that the connections between them could be shown. Measurements of the diameter of the DUA were performed at 3 different sites: at the common trunk, from the origin point of the descending branch, and from the distal end of the descending branch.

Results

The DUA was identified in all of the dissected specimens. In each case, it originated from the ulnar artery at a mean distance of 4.1 cm (range: 3.2-5.5 cm) proximal to the pisiform bone. The mean diameter of the DUA was 1.06 mm (range: 0.65-1.64 mm) at the origin. It ran in an oblique fashion dorsally and distally under the flexor carpi ulnaris muscle at a mean of 1.2 cm (range: 0.5-2 cm), and it was divided into ascending and descending branches (Figure 1).

![Image of the origin of the dorsal ulnar artery and its ascending and descending branches (DUA: dorsal ulnar artery, P: pisiform bone, Desc: descending, Acs: ascending, Br: branch).](image.png)
The ascending branch of the DUA was divided into multiple ramifications and provided the vascularization of skin on the ulnar side of the forearm. The dorsoulnar forearm flap is extracted from the skin of this region and is nourished by ramifications of the ascending branch of the DUA.

The descending branch of the DUA ran distally with the dorsal branch of the ulnar nerve along the ulnar side of the forearm to the wrist at a mean of 4.8 cm (range: 4.7-5 cm), and it branched off to the flexor carpi ulnaris muscle, the distal end of the ulnar bone, the distal radioulnar joint, and the pisiform bone (Figure 2). It was divided into 2 terminal branches after passing beyond the pisiform bone. One of them ran distally and ended in the abductor digiti minimi muscle as multiple ramifications. The other terminal branch turned to the radial side at an angle of about 90° and anastomosed with the deep branch of the ulnar artery (Figure 3). This anastomosis is the blood source of the distally pedicled dorsoulnar forearm flap (Figures 4 and 5). The mean diameter of the descending branch of the DUA was 0.76 mm (range: 0.46-1.20 mm) from the point of its origin, and 0.59 mm (range: 0.40-0.91 mm) at the distal end of the descending branch just before the terminal ramification.

There was no significant difference between the right and left extremities in terms of size and the course of the artery.

**Discussion**

An anatomical study was carried out in 1988 by Becker and Gilbert, in which the ulnar flap was described based on the DUA for reconstruction of the dorsum of the hand, the wrist, and palmar aspects of the wrist (2). The authors reported that the ulnar artery gives off the DUA at 2-4 cm from the pisiform bone, and, after 3-6 cm of a common trunk, the DUA gives off 3 collateral branches. The fasciocutaneous branch, which is one of the collateral branches, divides into ascending and descending branches. The ascending branch of the DUA divides into multiple ramifications and provides the vascularization of a large area of skin on the ulnar side of the distal forearm, while the descending branch of the DUA takes a longitudinal course distally and then anastomoses with the dorsal carpal arch (2).

Although the ulnar flap, which does not require the sacrifice of a major artery, is quite useful for reconstruction of the wrist region, the shortness of the pedicle is an important disadvantage of the flap.
for procedures in which distal defects in the hand must be covered. Since the initial study was published, some modifications of Becker’s flap have been developed to eliminate this drawback. Karacalar and Özcan ligated and divided the DUA at its origin from the ulnar artery, and described a “distally pedicled dorsoulnar forearm flap” ensured by the descending branch of the DUA as retrograde in their preliminary report in 1999 (3). They could obtain a longer pedicle by providing retrograde flow. They rehearsed their procedure in 9 cadaver hands, and they reported that the descending branch of the DUA connects with the dorsal carpal arch.

Vergara-Amador also described a very similar modification of the ulnar flap in 2008; however, in contrast, the author reported that the descending branch of the DUA anastomosed with the deep branch of the ulnar artery (7). In another anatomical study, Bertelli et al. reported that the dorsal branch of the ulnar artery anastomosed with the cutaneous perforators of the dorsal wrist vascular network (4).

Taking these studies together, there is confusion about the anastomosis pattern of the descending branch of the DUA. This anastomosis pattern is very important for hand surgeons who try to repair defects of the hand, because they plan the pivot point of the surgical flap and decide the end of the dissection according to the anastomotic vessels that provide a blood supply to the reverse-flow flap.

We designed this anatomical study to clarify the blood supply of the distally pedicled dorsoulnar forearm flap, and we found the following results.

1. The descending branch of the DUA anastomosis with the deep branch of the ulnar artery and the distally pedicled dorsoulnar forearm flap is supplied by the deep branch of the ulnar artery via the descending branch of the DUA using the anastomosis between them. This result is similar to findings of Vergara-Amador, but slightly different from the other studies mentioned above.

2. The descending branch of the DUA can be dissected as a flap pedicle up to the point at which the artery is divided into its 2 terminal branches (Figure 5). This is the pivot point of the flap (P point) and is localized at a mean of 1.16 cm distal to the pisiform bone. The artery has sufficient diameter (mean: 0.59 mm) to supply the flap at this point. Surgical dissection should be discontinued at this point. We do not recommend further dissection because the diameter of the artery is too small to dissect safely, and any attempt at surgical dissection would be very difficult.
The number of specimens used in this study was not enough to produce a statistical conclusion: therefore, a statistical evaluation could not be done. We acknowledge that some statistical variations may be more apparent if we were to repeat this study with more specimens.

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