Article published online: 2021-06-24

Observation of the Absence of Ulnar Artery in a Patient Planned to Free Dorsoulnar Artery Perforator Flap for Finger Defect: Is Preoperative Doppler evaluation of Perforator Alone Sufficient?

Burak Ergün Tatar, MD[1] Can Uslu, MD[1] Mehmet Erdem, MD[1] Fahri Sabancıogullarından, MD[1] Caner Gelbal, MD[1] Mehmet Bozkurt, MD, PhD[1]

[1] Department of Plastic Surgery, University of Health Sciences, Bagcılar Training and Research Hospital, Istanbul, Turkey

J Reconstr Microsurg Open 2021;6:e45–e50.

Address for correspondence Mehmet Bozkurt, MD, PhD, Department of Plastic Surgery, University of Health Sciences, Bagcılar Training and Research Hospital, Istanbul, Turkey (e-mail: mehmetbozkurtmd@gmail.com).

Abstract

Background Volar finger defects where critical structures exposed are always challenging for plastic surgeons. In these types of defects, local flaps, cross finger flaps, abdominal flaps, and free flaps are used. Free dorsoulnar artery perforator (DUAP) flaps and superficial palmar branch of radial artery (SPBRA) flaps are also used. In this case, we present a patient who was scheduled to receive a DUAP flap to address defect on the second finger of right hand; however, we repaired the defect with a SPBRA flap because intraoperative absence of the ulnar artery was observed.

Materials and Methods A 34-year-old male patient was admitted with a wound that exposed the tendon and neurovascular bundle on the volar side of the second finger of the right hand. A free DUAP flap was planned for the patient. A perforator was detected during the preoperative Doppler ultrasound examination. While dissecting the perforator, we noted the absence of an ulnar artery proximal to the perforator vessel. The elevated SPBRA flap from same extremity and the defect were closed.

Results Postoperative computer tomography showed an absence of the ulnar artery distal to the right antecubital region. No complications were seen in the donor and recipient areas. Long-term motor movements were natural, and the patient's quality of life was good.

Conclusion Determining the perforator site using Doppler alone may not be sufficient in preoperative evaluation of patients scheduled to receive DUAP flaps. Performing an Allen test and using advanced imaging methods can prevent surgeons from encountering a bad surprise.

Keywords

- dorsoulnar artery perforator flap
- superficial palmar branch of radial artery flap
- finger defects

received
October 24, 2020
accepted after revision
January 11, 2021

DOI https://doi.org/10.1055/s-0041-1726303.
ISSN 2377-0813.

Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

Fig. 1 Preoperative view of the defect.

Fig. 2 Superficial palmar branch of radial artery flap was planned to center the thenar crease.

Flaps should be used in the reconstruction of volar finger defects in which bone, tendon, and neurovascular structures are exposed.[1] In previous years, local advancement, cross finger, dorsal metacarpal, and abdominal flaps were frequently used to repair large defects.[2] With the advancement of microsurgical techniques, the use of free flaps in volar finger defect reconstruction has increased in recent years.[3,4] General anesthesia is needed for flaps whose donor sites are generally in the lower extremities or truncal area. This type of flaps needs to be debulking procedure because of thickness also they are not compatible with the finger in terms of texture.[5] Studies have been conducted on the use of ipsilateral upper extremity free flaps due to the mentioned disadvantages such as needing for general anesthesia, texture, and thickness mismatch.[6–8]

Inada et al[8] first proposed the application of free dorsoulnar artery perforator (DUAP) flaps in finger defects; their advantages include thin skin, suitable lengths and diameter pedicles for the recipient area, and sensory features. However, like any perforator flap, they are difficult to dissect and the surgery itself requires experience.[9]

Free superficial palmar branch of the radial artery (SPBRA) flaps are also used in finger defect reconstruction[10]; they have the advantages of having glabrous skin and pedicle diameters that are compatible with digital arteries. Also, since they are axial flaps, they are easier to dissect than perforator flaps.[11]

In this study, we present a 34-year-old male patient who was scheduled to receive a free DUAP flap to repair the volar defect on the second finger of his right hand, but instead received a free SPBRA flap because the absence of an ulnar artery was observed during operation.

Case Presentation

A 34-year-old male patient was admitted to the emergency department of our hospital with a wound that exposed the tendon and neurovascular structure covering the distal phalanx and mid-phalanx in the volar of the second finger of the right hand. The results from motor, sensory, and circulatory examinations were normal and revealed that the patient did not have any fractures.

Initially, the patient was scheduled to undergo free DUAP flap surgery. During the preoperative evaluation, the Doppler detected a perforator flow 2 to 5 cm proximal to the pisiform bone and 1 cm dorsal to the flexor carpi ulnaris (FCU).

Under the axillary block, the volar side of the second finger of the right hand was debrided; the ulnar and radial neurovascular bundles were intact. The radial digital artery and two dorsal veins were isolated. Debridement revealed a defect with a size of nearly 3×2.5 cm (►**Fig. 1**). The radial side digital artery was closed with a vascular clamp, the finger's circulation was checked, and when the circulation seemed natural, the artery and vein were cut and prepared for anastomosis.

The line between the pisiform bone and the medial condyle of the elbow was drawn, and the axis of the flap was determined. Under the tourniquet, a dorsoulnar artery flap measuring 4×3 cm was centered on the perforator. The flap was starting to be elevated from the radial side of the subfascial plane, and then the perforator was detected. When the FCU was retracted to the radial side, the ulnar artery was not found. The tourniquet was opened. While the perforator's flow was detected, no axial artery was detected proximal to the perforator.

Since the patient had an axillary block, written consent was obtained from the patient to undergo free SPBRA flap surgery. Under the tourniquet, a flap measuring 4×3 cm was planned to center the thenar crease in the volar side of the hand (►**Fig. 2**). Dissection was started from the proximal of the flap, and the superficial vein was isolated. The dissection was deepened, and the radial artery and its branches were exposed (►**Fig. 3**). The flap was carefully elevated from the distal side. The distal pedicle was ligated while the flap was elevated over the transverse carpal ligament. Attention was paid to the motor branch of the median nerve around the palmaris brevis muscle. After the flap was completely elevated, a tourniquet was opened, and bleeding was controlled. After bleeding was observed in the flap, the flap was removed from the donor site. The donor area was primarily closed, and a Penrose drain was placed. The superficial vein was anastomosed to the dorsal vein because the comitant veins were not suitable for anastomosis. The flap artery was also

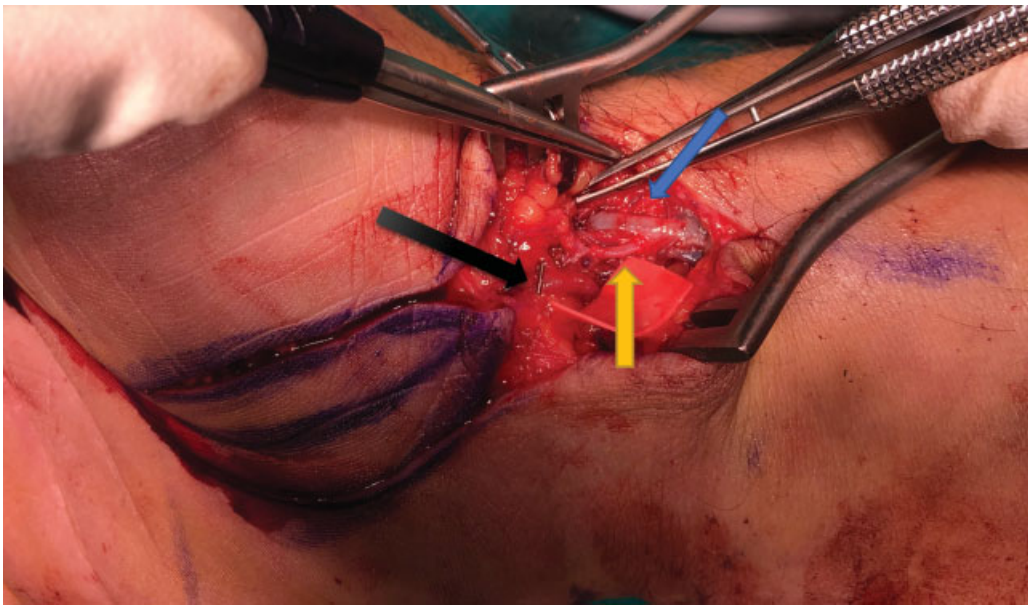

Fig. 3 Intraoperative view of superficial palmar branch of radial artery flap (blue arrow: radial artery, yellow arrow: superficial palmar branch of radial artery, black arrow: isolated superficial vein with vascular clip).

Fig. 4 The flap was adapted to the recipient area.

anastomosed to the radial digital artery. Flow was observed in the flap; the flap was inset (►**Fig. 4**), and the operation ended after the volar splint was applied.

Appropriate medical treatment which consists ıntravenous fluid, heparin, and antibiotic was provided to the patient during the early postoperative period. The Penrose drain was removed on the first postoperative day. No issues were noted regarding the flap's viability. The patient was referred to the physical therapy and rehabilitation center on the 10th postoperative day. The splint was removed in the second postoperative week. In the third week after the operation, the patient underwent upper extremity computed tomography (CT) angiography. Tomography showed the absence of an ulnar artery at the distal of the right antebrachial fossa (►**Figs. 5** and **6**). The patient's medical history was reviewed; however, the patient stated that he had no memory of any trauma to the right extremity.

In the first postoperative year, the flap's size and texture were natural, and the patient's motor skills were satisfactory (►**Figs. 7** and **8**).

Discussion

Although local flaps are sufficient for small finger defects, it is necessary to use free or regional flaps in defects that exceed a single phalanx level and where critical structures are exposed. Physical therapy is delayed due to limited mobilization in cross fingers or abdominal flaps, resulting in a contracture or joint freezing.[9]

With the advancement of microsurgery, the frequency of free flap use in finger defects has increased.[12] Anterolateral thigh flaps and medial sural artery perforator (MSAP) flaps can be used when lower extremities are used as donors. Since the subcutaneous tissues of these flaps are thick, debulking may be required. Although second toe flaps are the benchmark due to their texture, thickness compatibility, and glabrous skin, they are technically challenging.[13] In general, lower extremity flaps require general anesthesia. In addition, many of them have incompatible textures. Therefore, it is better to select a recipient site in the ipsilateral upper extremity. These flaps allow axillary block.

Free posterior interosseous artery flaps can be too bulky for fingers. It is difficult to perform surgery due to pedicle variations and leaves a noticeable scar on the forearm as a result of donor site grafting.[14] When the first free dorsal metacarpal artery flap and free digital artery flap are used, donor sites need to be grafted. Additional morbidity occurs in the ipsilateral upper extremity.[13,15,16] Although venous flaps are used in finger reconstruction, their application is limited due to the low number of successful cases in the literature.[17,18]

Inada et al first described the use of DUAP flaps in finger reconstruction,[8] and since then, they have been used in various studies over the years.[9,19] The dorsoulnar artery perforator is marked with a Doppler 2 to 5 cm proximal to the forward pisiform bone and 1 cm dorsal to the FCU. Arterial diameters are between 0.9 and 1.3 mm, and pedicle

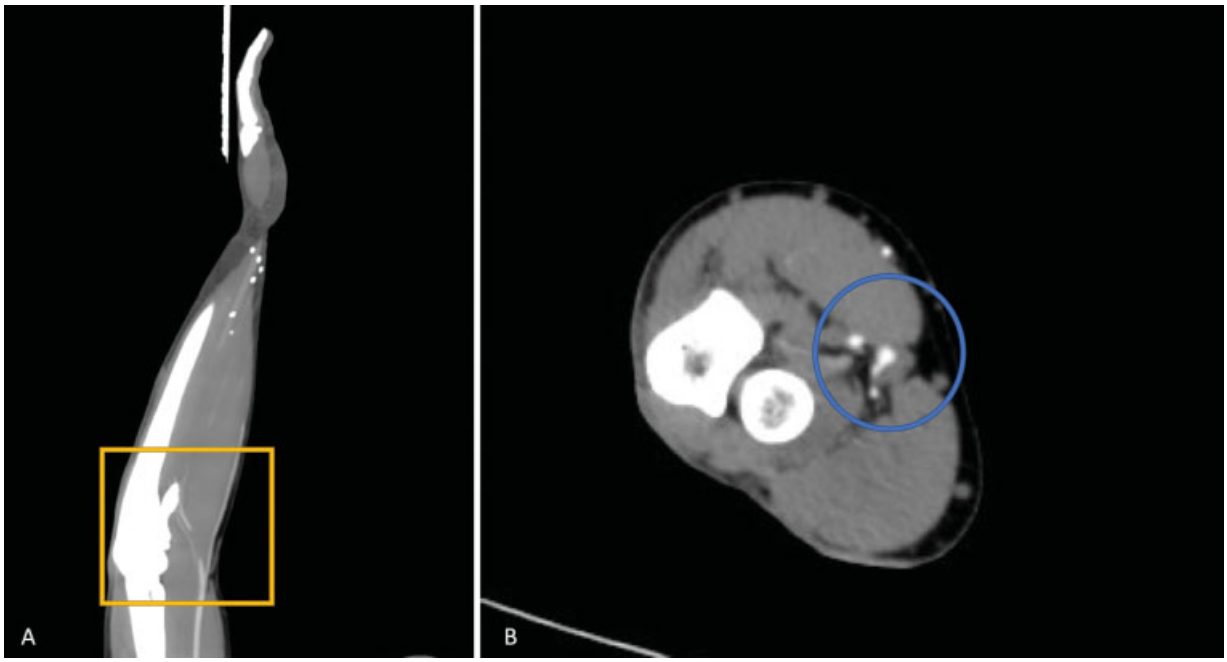

Fig. 5 Computed tomography view of the antecubital region. (**A**) Coronal section (yellow square: brachial artery bifurcation, separation of radial and ulnar artery). (**B**) Axial section (blue circle: brachial artery bifurcation, separation of radial and ulnar artery).

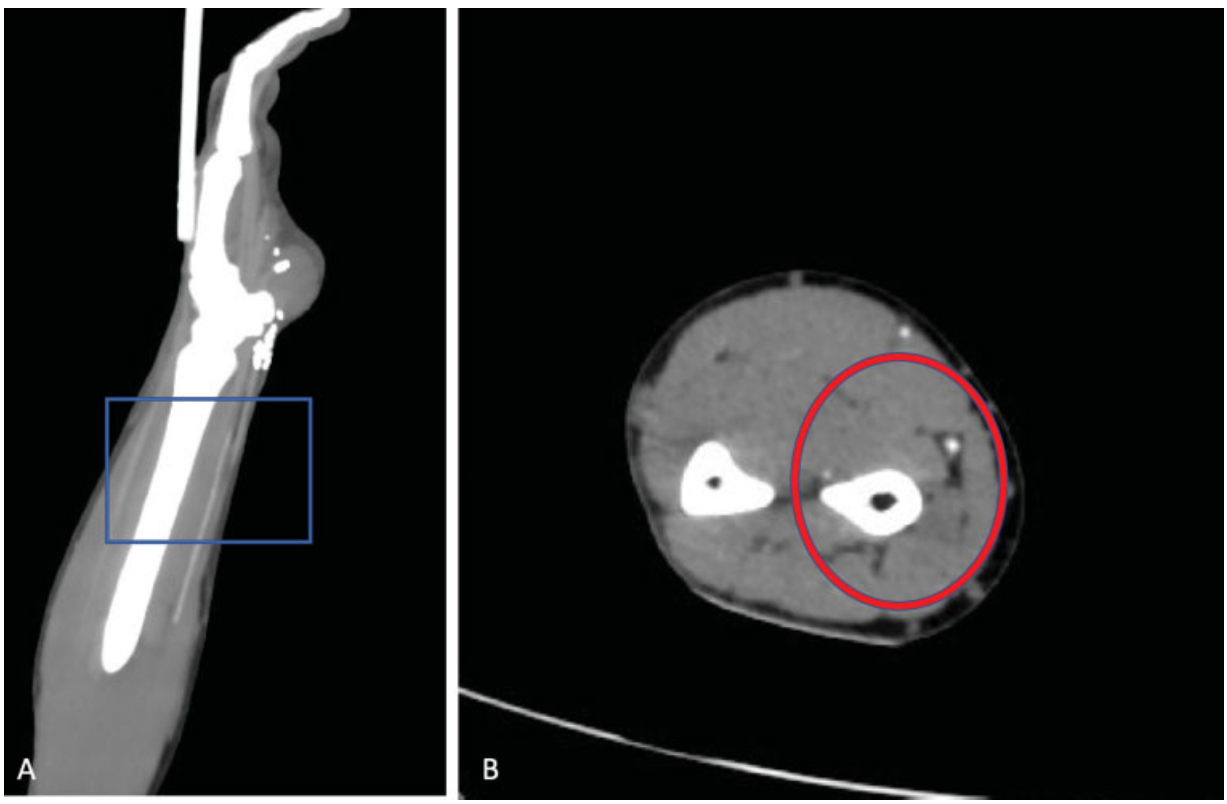

Fig. 6 Computed tomography view of the middle one-third forearm. (**A**) Coronal section (blue square: radial artery continuity, ulnar artery absent). (**B**) Axial section (red circle: radial artery continuity, ulnar artery absent).

length is 20 mm on average.[5] Although there are two comitant veins beside the artery, superficial veins are generally isolated by retrograde dissection and used in anastomosis because of the superficial vein's diameter (1.8–2.5 mm) is more compatible with the vein size in the recipient site. During preoperative evaluation, the FCU's axis is determined between the pisiform bone and the medial condyle. Perforators are marked with Doppler at 1 cm dorsal to the FCU axis

Fig. 7 Postoperative first year view of the flap.

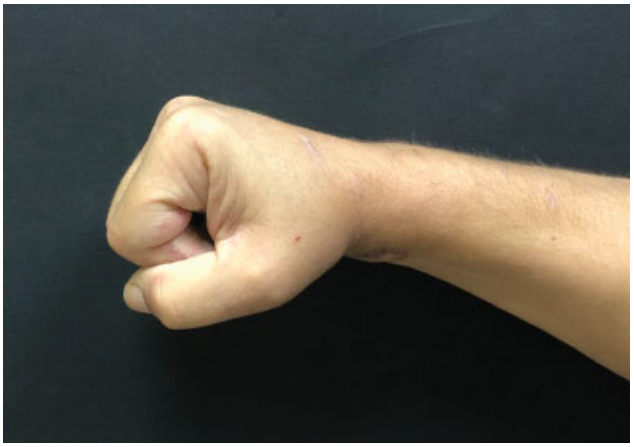

Fig. 8 Finger movements are natural in the postoperative first year.

and 2 to 5 cm proximal to the pisiform bone. Although DUAP flaps generally have glabrous skin, some patients may have hair on the donor site.

Free SPBRA flaps are also used in finger defects.[10,20,21] However, there is a possibility that the recurrent motor branch of the median nerve will be damaged during dissection. Although their pedicle diameters (0.9–1.4 mm) are compatible with the digital artery, their pedicle lengths may be too short in some cases.[11] Comitant veins or superficial veins can be used in vein anastomosis. If the palmar cutaneous branch of the median nerve is included, it becomes a sensory flap.[11] Palmaris longus may be included in the flap in tendon defects.[11] In cases with short proximal pedicle length, a flow-through SPBRA flap can be designed.[22] The pedicle distal to the flap is dissected until its junction with the superficial arch can be elevated reversely.[23]

Both flaps can be made with an axillary block and elevated from the ipsilateral extremity. Perforator dissection in the DUAP flap is relatively more difficult than axial pedicle dissection in SPBRA. Both flaps are similar in thickness and texture. Although the SPBRA flap is hairless, the DUAP may be hairy in some patients. Damage to the recurrent motor branch of the median nerve in SPBRA increases morbidity compared with the dorsal sensory branch of the ulnar nerve during DUAP elevation.[11]

In our case, a Doppler device detected a perforator near the proximal pisiform bone before the operation. During the operation, the DUAP flap started to be elevated from the radial side; however, during perforator dissection, it was found that no ulnar artery was near the ulnar nerve and no axial artery was attached to the perforator. Due to the presence of an axillary block, the patient's consent had to be obtained prior to surgery.

In the literature, no preoperative evaluation criteria have been found, except for using Doppler to determine the perforator before the DUAP flap operation.[5,9,19] Although perforator flow was detected via Doppler in our case, the absence of an ulnar artery was also observed. This situation reiterated that Doppler alone was not sufficient in the preoperative evaluation of patients scheduled for DUAP flap operations.

In conclusion, we suggest that surgeons should also consider using other methods in addition to Doppler, such as the Allen test or CT angiography, to avoid a bad surprise in the preoperative evaluation of patients undergoing DUAP flap surgery in the future. Our case will be a valuable for future studies which are about DUAP flaps.

Funding
None.

Conflict of Interest
None declared.

References

1 Özaksar K, Toros T, Sügün TS, Bal E, Ademoğlu Y, Kaplan I. Reconstruction of finger pulp defects using homodigital dorsal middle phalangeal neurovascular advancement flap. J Hand Surg Eur Vol 2010;35(02):125–129
2 Jackson IT, Brown GED. A method of treating chronic flexion contractures of the fingers. Br J Plast Surg 1970;23(04):373–379
3 Koshima I, Urushibara K, Inagawa K, Hamasaki T, Moriguchi T. Free medial plantar perforator flaps for the resurfacing of finger and foot defects. Plast Reconstr Surg 2001;107(07):1753–1758
4 Kimura N, Satoh K, Hasumi T, Ostuka T. Clinical application of the free thin anterolateral thigh flap in 31 consecutive patients. Plast Reconstr Surg 2001;108(05):1197–1208, discussion 1209–1210
5 Liu J, Zheng H. Free distal ulnar artery perforator flaps for the reconstruction of a volar defect in fingers. J Plast Reconstr Aesthet Surg 2014;67(11):1557–1563
6 Tsai T-M, Sabapathy SR, Martin D. Revascularization of a finger with a thenar mini-free flap. J Hand Surg Am 1991;16(04): 604–606
7 Cavadas PC. Posterior interosseous free flap with extended pedicle for hand reconstruction. Plast Reconstr Surg 2001;108(04): 897–901
8 Inada Y, Tamai S, Kawanishi K, et al. Free dorsoulnar perforator flap transfers for the reconstruction of severely injured digits. Plast Reconstr Surg 2004;114(02):411–420
9 Simsek T, Engin MS, Aslan O, Neimetzade T, Eroglu L. Finger pulp reconstruction with free dorsoulnar artery perforator (DUAP) flap. J Reconstr Microsurg 2011;27(09):543–549

10 Omokawa S, Ryu J, Tang J-B, Han J. Vascular and neural anatomy of the thenar area of the hand: its surgical applications. Plast Reconstr Surg 1997;99(01):116–121
11 Aksoy A, Sır E, Dagdelen D, Aksoy MK. Reconstruction of finger composite defects with perforator free flap from the superficial palmar branch of radial artery. Türk Plastik. Rekonstrüktif ve Estetik Cerrahi Dergisi Turk J Plast Surg 2018;26(02):44–49
12 Sassu P, Lin C-H, Lin Y-T, Lin C-H. Fourteen cases of free thenar flap: a rare indication in digital reconstruction. Ann Plast Surg 2008;60 (03):260–266
13 Lee DC, Kim JS, Ki SH, Roh SY, Yang JW, Chung KC. Partial second toe pulp free flap for fingertip reconstruction. Plast Reconstr Surg 2008;121(03):899–907
14 Pan ZH, Jiang PP, Wang J-L. Posterior interosseous free flap for finger re-surfacing. J Plast Reconstr Aesthet Surg 2010;63(05): 832–837
15 Pelzer M, Sauerbier M, Germann G, Tränkle M. Free "kite" flap: a new flap for reconstruction of small hand defects. J Reconstr Microsurg 2004;20(05):367–372
16 Wong C-H, Teoh L-C, Lee JY-L, Yam AK, Khoo DB, Yong FC. Free digital artery flap: an ideal flap for large finger defects in situations where local flaps are precluded. Ann Plast Surg 2008;60(03):254–259
17 Kushima H, Iwasawa M, Maruyama Y. Recovery of sensitivity in the hand after reconstruction with arterialised venous flaps. Scand J Plast Reconstr Surg Hand Surg 2002;36(06): 362–367
18 Iwasawa M, Ohtsuka Y, Kushima H, Kiyono M. Arterialized venous flaps from the thenar and hypothenar regions for repairing finger pulp tissue losses. Plast Reconstr Surg 1997; 99(06):1765–1770
19 Zheng D-W, Li Z-C, Sun F, Shi R-J, Shou K-S. Use of a distal ulnar artery perforator-based bilobed free flap for repairing complex digital defects. J Hand Surg Am 2014;39(11):2235–2242
20 Kamei K, Shimada K, Kimura T, Ueno T. Substantial volar defects of the fingers treated with free thenar flaps. Scand J Plast Reconstr Surg Hand Surg 1997;31(01):87–90
21 Kamei K, Ide Y, Kimura T. A new free thenar flap. Plast Reconstr Surg 1993;92(07):1380–1384
22 Liu Y, Jiao H, Ji X, et al. A comparative study of four types of free flaps from the ipsilateral extremity for finger reconstruction. PLoS One 2014;9(08):e104014
23 Orbay JL, Rosen JG, Khouri RK, Indriago I. The glabrous palmar flap: the new free or reversed pedicled palmar fasciocutaneous flap for volar hand reconstruction. Tech Hand Up Extrem Surg 2009;13(03):145–150