

Innervated Digital Artery Perforator Flap: A Versatile Technique for Fingertip Reconstruction

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Purpose To demonstrate the advanced use of innervated digital artery perforator (IDAP) flaps for fingertip reconstruction.

Methods From August 2011 to May 2014, 65 fingers (59 patients) underwent fingertip or finger stump reconstruction using IDAP flaps. Sixty-one fingers from 55 patients who were followed up for more than 6 months were included in this study. The objective outcomes of patient evaluations consisted of the results of static 2-point discrimination tests, Semmes Weinstein monofilament tests, and extension loss tests. The subjective patient outcome evaluations consisted of the results of hypersensitivity and cold intolerance tests and patient satisfaction.

Results All flaps survived completely, and no patients required early secondary interventions. The mean follow-up period was 18 months (range, 6–36 months). The static 2-point discrimination in the flaps ranged from 2 to 6 mm (mean, 3.5 mm) compared with a range of 2 to 3 mm (mean, 2.5 mm) in the contralateral hands. The Semmes Weinstein monofilament test results ranged from 0.07 to 1.4 g compared with 0.04 to 0.4 g for the contralateral hand. One patient exhibited mild extension loss in the reconstructed finger, 4 patients experienced mild cold intolerance, and 2 patients exhibited mild hypersensitivity.

Conclusions The IDAP flaps are sensitive, reliable, and versatile and should be considered for reconstructing acute fingertip defects. The use of IDAP flaps for revisions of previously reconstructed defects is also possible. (*J Hand Surg Am.* 2015;40(12):2352–2357. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Therapeutic IV.

Key words Hand flap, homodigital flap, innervated flap, perforator flap, pulp reconstruction.

FINGERTIPS ARE SPECIALIZED STRUCTURES that are important for the overall function and aesthetics of the hand.¹ Fingertip injuries are among the most common types of injuries in all age groups in hand surgery practices. Such injuries affect patients both physically and psychologically, and secondary deformities can inconvenience daily activities.²

Therefore, treatment strategies should be devised to achieve the best functional and cosmetic outcomes.

Small fingertip or pulp defects with unexposed bone can be managed using split or full-thickness skin grafts and with dressing changes for secondary healing.^{1,3–5} Reconstruction of the defect should be considered when exposed bone, joint, tendon, or neurovascular structures are present.^{3–6} Several reconstructive techniques and modifications have been described for fingertip injuries and include primary skin closure, composite flaps, local advancement flaps, homodigital/heterodigital neurovascular island flaps, perforator flaps, and free flaps. However, all of these techniques have shortcomings and disadvantages that include limited flap size, inadequate sensation, donor site morbidity, flexion contractures, prolonged immobilization, and prolonged times to return to work.^{1,3–15}

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Although multiple techniques can be used successfully, only a few techniques fully accomplish the goal of replacing “like with like.”

Neurovascular island flaps (NIFs) are commonly used in fingertip reconstructions.^{3,14} Digital artery-preserving reconstruction techniques and free flaps have been successfully performed in fingertip reconstructions. Koshima et al⁷ reported a new entity called a digital artery perforator (DAP) flap that uses small perforators that arise from the digital artery. Mitsunaga et al⁸ demonstrated the use of DAP flaps and modifications in digital artery preservation.

We recently reported a successful acute fingertip reconstruction technique, the innervated digital artery perforator (IDAP) flap.⁹

In the present study, we demonstrate the use of IDAP flaps in acute and late reconstructions of fingertip injuries.

PATIENTS AND METHODS

Between August 2011 and May 2014, 65 fingers (59 patients, 52 males) underwent pulp reconstructions with IDAP flaps. Of these, 55 were followed up for more than 6 months and were included in this study. Our ethics committee approved the study, and informed consent was provided by all patients. This study included 61 fingers from 55 patients with a mean age of 35 ± 14 years (range, 16–65 years). The etiologies of the injuries were as follows: crush injuries (industrial, home, and school accidents) in 52 (95%) and postoperative necrosis in 3 (5%) patients. Thirty-seven right hand and 24 left hand injuries were evaluated. Single-finger defects were observed in 49 patients, and multiple-finger defects were observed in 6 patients. The defect types were transverse in 46 (75%) patients, volar oblique in 8 (13%) patients, dorsal oblique in 4 (7%) patients, lateral oblique in 2 patients, and pulp necrosis in 1 patient. The distribution of the finger injuries was 27 (44%), 18 (30%), 13 (21%), 2, and 1 in the middle, index, ring, small fingers, and the thumb, respectively. Fifty-two cases were acute, and 3 cases involved late reconstructions. The objective patient outcome evaluations consisted of a static 2-point discrimination (s2PD) test, the Semmes Weinstein monofilament (SWM) test, and an extension loss test. The subjective patient outcome evaluations consisted of assessments of hypersensitivity, cold intolerance, and patient satisfaction. Cold intolerance and hypersensitivity were classified into the following 5 grades: none, mild, moderate, disturbing, severe. The patients' levels of satisfaction were also evaluated with both functional and aesthetic means and were classified into

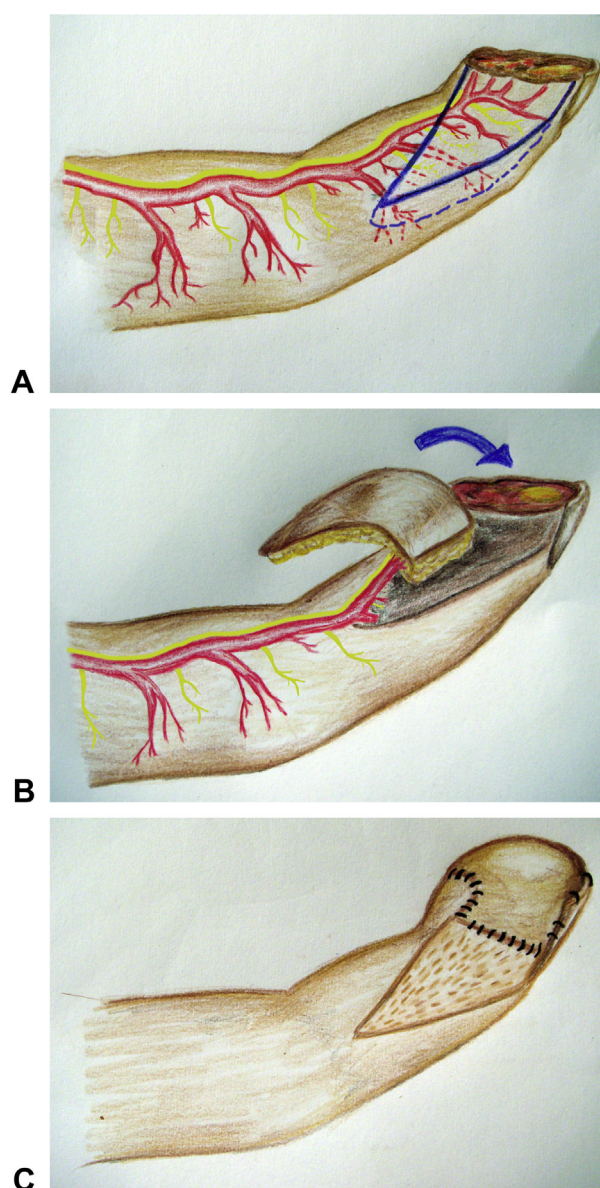


FIGURE 1: Illustration of an innervated digital artery perforator flap. **A** The pedicle of the flap includes the digital artery, perforators, and the digital nerve. **B** The entry of the perforators into the flap should be at least 4–5 mm in diameter, and the pedicle of the flap should consist of a 2- to 3-mm-wide cuff of subcutaneous tissue around the artery for venous return through the venous plexus. **C** The donor site of the flap was covered with a full-thickness skin graft.

the following 5 grades: highly dissatisfied, dissatisfied, moderate, satisfied, highly satisfied.

Surgical technique

All flap dissections were performed under digital block anesthesia in combination with loupe magnification. The surgical technique is depicted in Figure 1. An IDAP flap can be elevated from either side of the digit; however, we preferred elevation from the medial side of the finger because this area does not contact the

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