

Spare Parts Surgery with a Free Posterior Interosseous Artery Perforator Flap for Thumb Tip

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Summary: Replantation is an ideal method for treating fingertip amputation. However, in some cases, replantation is known to be a challenging issue. This report described a successful thumb tip reconstruction performed with bone and nail bed salvaged as spare parts, and a free posterior interosseous artery perforator (PIAP) flap. A 75-year-old man accidentally amputated his left thumb with an electric saw, and emergency replantation was started under brachial plexus block. However, the distal stump of digital artery was unable to be identified, forcing the initial plan to change to flap reconstruction. After vascular anastomosis, complex tissue containing nail bed and side nail fold was grafted on the adipofascial tissue of PIAP flap. Both PIAP flap and the complex tissue survived completely. At 12 months after surgery, only a slight deformity in the nail plate was observed. Spare parts surgery is a surgical procedure effectively salvaging and utilizing tissue that is going to be discarded in severe limb trauma. This idea can be applied to treatment for the finger amputation. In this case, replantation would be difficult in the thumb tip amputation, so spare parts surgery was performed with a PIAP flap. The innervated PIAP flap is reported, including the posterior antebrachial cutaneous nerve. In this case, the cutaneous nerve was able to be identified, neurotomy was performed, and sufficient sensory recovery was obtained. Surgical procedure with PIAP flaps was found to be a useful method for immediate reconstruction with salvaged spare parts after fingertip replantation was considered to be difficult intraoperatively. (*Plast Reconstr Surg Glob Open* 2021;9:e3624; doi: 10.1097/GOX.0000000000003624; Published online 7 June 2021.)

Replantation is an ideal method for treating fingertip amputation, from functional and aesthetic viewpoints.¹ However, in some cases, including severe crush and dorsally directed fingertip amputation, replantation surgery is difficult. Patients who undergo no replantation surgery are known to have a longer period of hospitalization than patients who receive finger replantation,² and the replanted site may require fingertip reconstructive surgery later, resulting in the prevention of early rehabilitation and extension of the treatment period. This report presented a thumb tip reconstruction with bone and nail bed salvaged from the amputated thumb as spare parts with a free posterior interosseous artery perforator (PIAP) flap immediately on the day of the patient's injury.

CASE REPORT

The patient was a 75-year-old man who was a carpenter, and his left thumb was amputated with an electric saw accidentally. His left thumb tip was completely amputated at zone 1 level according to Tamai's classification (Fig. 1). Upon arrival at hospital, the amputated thumb was wrapped in a wet handkerchief in a plastic bag, which was cooled with ice water, for 2 h after injury. Emergency replantation was started under brachial plexus block at 3 h after the patient's arrival at the hospital. However, the distal stump of digital artery was unable to be identified with a microscope, and emergency flap reconstruction was performed instead of replantation. The PIAP was found easily by ultrasonography in the distal part of ipsilateral forearm on a line connecting the lateral epicondyle of humerus to the distal radio-ulnar joint, then a 45 × 15-mm spindle-shaped PIAP flap was designed, including the perforator (Fig. 2). The PIAP flap was harvested from the ulnar side, and then the posterior antebrachial cutaneous nerve and PIAP were identified in the subcutaneous layer and under the subfascial layer, respectively. The ulnar proper digital artery, the dorsal cutaneous vein as the recipient vessels, and the branch of digital nerve in the distal part of interphalangeal joint area were prepared. From the amputated thumb, the distal phalanx

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Fig. 1. Preoperative findings. The photograph shows the left thumb of a 75-year-old male patient, and the injury was found to be zone 1 amputation according to Tamai's classification. Although the nail matrix was fortunately preserved, most of the nail bed and part of the distal phalanx were found on the amputated thumb side.

and nail bed combined with side nail fold were collected carefully as spare parts. The bone was fixed with a 0.7-mm K-wire, then the tip of the distal phalanx was covered with the skin paddle, and the dorsal side of distal phalanx was wrapped with the adipofascial tissue of the PIAP flap. After covering the exposed bone, the PIAP was anastomosed to the ulnar proper digital artery, and the concomitant vein was anastomosed to the dorsal cutaneous vein in an end-to-end anastomosis fashion with a 11-0 nylon, and end-to-end neurotomy was performed with the 10-0 nylon. The salvaged complex tissue consisting of the nail bed and side nail fold was grafted on the adipofascial tissue of the PIAP flap (Fig. 3). Postoperatively, the patient received 10,000 IU heparin and 60- μ g alprostadil per day by continuous intravenous drip for 7 days. At 7 days after surgery, the PIAP flap was found to survive completely on the thumb tip, and the combined tissue of nail bed and side nail fold grafted on the flap survived completely. At 10 days, the patient was discharged from the hospital without any trouble. At 12 months, because the Semmes-Weinstein monofilament test showed blue, the flap transplanted to the thumb tip was confirmed to obtain the protective sensation. Slight deformity was observed in the nail plate (Fig. 4).

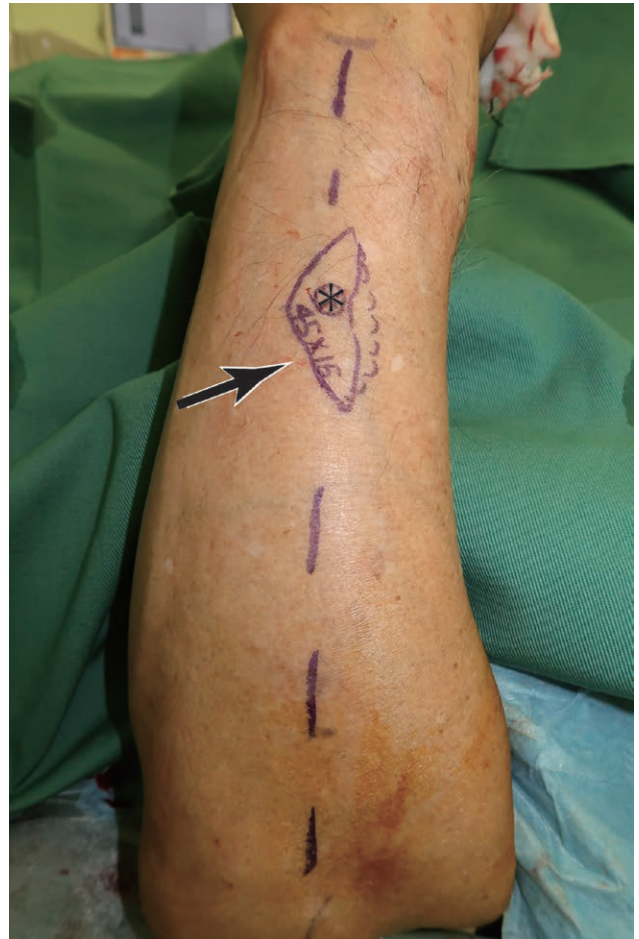


Fig. 2. During surgery, the perforator of posterior interosseous artery was identified on a line connecting the lateral epicondyle of the humerus to the distal radioulnar joint by ultrasonography and a handheld Doppler device, as marked by an asterisk (*). A free PIAP flap was designed to include the perforator and the surrounding adipose tissue, as shown by the black arrow.



Fig. 3. Intraoperative findings. Immediately after transplantation, the flap was observed to be resupplied with blood flow, expressing a healthy skin color.



Fig. 4. Postoperative findings 12 months after surgery. The length of the thumb was preserved after reconstruction. Although a slight nail deformity was observed, the functional and sensory recoveries were found to be practically sufficient.

DISCUSSION

Replantation is the most suitable method for treating fingertip amputation.³ Successful replantation gives the satisfactory results of both function and appearance of the fingertips. Although highly successful rates are reported frequently,⁴ in some cases, the sites could progress to necrosis and require reconstructive surgery later. Despite many reports, when the nail matrix is found to be preserved with defects in the bone or nail bed, simply covering the stump with flaps will give the fingertips deformities and shorter finger length, resulting in poor satisfaction. In addition, homodigital and heterodigital flaps for fingertip reconstruction need longitudinal incisions on the injured finger, and the incisions may cause scar contracture and flexion contracture of the interphalangeal joint due to the volar deviation of the neurovascular bundle. In this case, if the harvest of a short pedicle free flap and the preparation of recipient vessels were performed, the best functional and aesthetic prognosis would be obtained. Furthermore, the secondary transplantation of bones and nail beds needs the sacrifice of autologous tissue. Spare parts surgery is a surgical procedure effectively salvaging and utilizing tissue going to be discarded. Normal tissue other than injury zone can be used as a flap, and tissue in the injury zone is used as a graft.^{5,6} In this case, distal

phalanx and nail bed were recovered from the amputated thumb as spare parts and used as a graft. Actually, spare parts surgery is first described in fingertip amputation.⁷ Surgery with PIAP flaps is a useful fingertip reconstruction method. The morbidity is lower at the donor site, and the vascular pedicle is highly reliable.⁸ In addition, compared with other free flaps,^{9–11} the PIAP flap is easily collected with the thin and wide adipofascial tissue. As an advantage, the PIAP flap can sufficiently cover the exposed distal phalanx with the adipofascial tissue. The innervated PIAP flap is reported to include the posterior antebrachial cutaneous nerve for the purpose of reconstructing finger skin defect and sensory recovery.⁸ After fingertip replantation was found to be difficult, the PIAP flap surgical procedure was a useful method for immediate reconstruction with salvaged spare parts. Interestingly, hair growth was noticed at the thumb tip due to hair follicles in the transplanted flap, and laser hair removal was performed.

CONCLUSION

After replantation was found to be difficult intraoperatively for treating fingertip amputation, immediate reconstruction was performed with a PIAP flap, and the bone and nail bed in the separated fingertip were salvaged as spare parts.

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