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Posterior interosseous artery perforator-free flap: Treating intermediate-size hand and foot defects

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Summary *Introduction:* Ambiguous defects on the hand and foot, especially on the fingers and toes, are still challenging to treat despite achievements in reconstruction.
Aim: The purpose of this study was to evaluate the use of the posterior interosseous artery perforator flap for resurfacing intermediate-sized defects and provide adequate coverage over tendons and bones.
Method: Between October 2008 and March 2013, a total of 19 patients with soft-tissue defects on the hand or foot were treated. Flap elevation, anatomy, and clinical progress were evaluated.
Result: All flaps survived and covered the defects, which ranged in area from 12 to 45 cm^2. The freestyle approach was used to harvest the flaps. The average length of the pedicle was 2.5 cm, and the pedicle was harvested without affecting the source vessel. The average diameter of the artery was 0.8 mm, and the average thickness of the flap was 3.5 mm. Anastomosis was performed either end-to-end on the perforator, or end-to-side on deep vessels. No subsequent thinning or surgical flap correction was necessary. Ambulation was allowed at 3 days postsurgery. The donor site was closed primarily to leave an acceptable donor site.
Discussion: A posterior interosseous artery perforator-free flap is a suitable choice for intermediate-size defects that are too large to cover using a local flap or too small for a first-line perforator flap. Up to 45 cm^2 of adequate coverage can be provided using a thin posterior interosseous artery perforator-free flap that does not require additional debulking. The dis-

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advantages of a short pedicle can be overcome using perforator-to-perforator supermicrosurgery.

Introduction

Soft-tissue defects on the hand and foot, especially the fingers and toes, often present as a challenging reconstructive problem. Despite the many flaps available for hand and foot reconstruction, small defects ideally require a thin flap. In many cases, a local flap provides excellent coverage for small defects, such as those found on the finger tips.[1] However, relatively larger defects may require the use of skin grafts when the flap is unable to close properly. Furthermore, you may encounter partial loss over the region that you really need coverage due to overzealous design. The aim of any reconstruction that involves exposure of the tendons and bone is to regain function by providing adequate cover and early rehabilitation. Nowadays, in the era of care that considers not only function but also form, one must continue to seek options that will allow the best possible results. For small lesions that are too big to be covered with local flaps, various other types of flaps have been developed, that is, arterialized venous flap, pulp flap, toe-web-space flap, distant flap, and others. However, these flaps cannot be used when larger flaps are required, as donor-site morbidity increases and viability becomes uncertain. It is also obvious that distant flaps, such as the pocket flap and cross-finger flap, cause prolonged discomfort as well as the increased need for rehabilitation. The goal of this study was to identify the ideal flap for intermediate-size defects (average, 19.0 cm^2; range, from 6 $\times$ 2 to 5 $\times$ 9 cm) that can efficiently avoid further contour revisions and, thereby, minimize donor-site morbidity. Such flaps have to be thin and small.

Posterior interosseous artery (PIA) flaps do not require the sacrifice of a major artery in the upper limb and results in minimal donor-site morbidity.[2–4] The PIA is located in the intermuscular septum between the extensor carpi ulnaris and extensor digiti minimi muscles, and several anatomical studies confirm the rich presence of cutaneous perforator vessels.[5–7] The PIA is anatomically united by two main anastomoses: one proximal (at the level of the distal border of the supinator muscle) and one distal (at the most distal part of the interosseous space). The PIA joins the anterior interosseous artery to form the distal anastomosis. The posterior interosseous fasciocutaneous flap can be used as a reverse-flow island flap because it is perfused by anastomoses between the two arteries at the level of the wrist. However, local flaps may not be feasible if the defect is not in the proximal part of the hand.[8,9] Furthermore, posterior interosseous fasciocutaneous flap complications reportedly cause arterial inflow problems in reverse-pedicled flaps.[10,11] Use of the PIA flap as the free flap for reconstructing soft-tissue defects in the extremities is reportedly successful, especially for defects that require a thin flap in order to regain delicate hand functions.[12,13]

Despite the PIA flap being one of the thinnest perforator flaps, little has been reported regarding its application to intermediate-size defects on the hand and foot, especially the fingers and toes. Here, we evaluate the PIA perforator flap as an option for such defects, especially those on the distal foot and hand.

Methods

This retrospective study was performed after approval from the institutional review board of Asan Medical Center. Between October 2008 and March 2013, 19 patients were treated for soft-tissue defects in the upper or lower extremities due to various causes. All patients underwent reconstruction using short pedicled PIA perforator-free flaps. All flaps were anastomosed either end-to-end on the perforator (distal end of the vessel) or end-to-side on the deeper vessel. Multidetector-row computed tomographic angiograms of the upper or lower extremities were obtained before surgery if the vascular status was questionable. Handheld Doppler ultrasound was preoperatively used to mark potential recipient perforators around the soft-tissue defects and trace the perforator of the flap. Intensity was observed and marked during the tracing of the recipient perforator.

Surgical procedure

Surgeries were performed on all patients under general anesthesia by the same surgeon. In every case, the free-style approach was used. The preoperative identification of the vessel was made using Doppler ultrasound. Complete debridement was performed before any reconstructive procedure. The recipient vessels were identified after debridement or tumor excision. If large peripheral vessels or small branches from the peripheral vessels were already exposed within the defect, we used those vessels as the recipient vessel if a good pulse was detected; if not, we searched for a recipient vessel that was subfascial and adjacent to the defect margin. After securing the pulsating recipient artery and viable veins, the required length for the pedicle was estimated. The PIA perforator flap was designed according to the size of the defect around the Doppler-traced perforator. Cutaneous perforators could be found along the line extending from the lateral epicondyle to the radial border of the head of ulna.[14] Flap elevation began suprafascially from one margin, we prefer to start with the ulnar side, to confirm the location of the perforator under the designed area. If the perforator was not included in the original design, then a new design was made