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Refining the cross-finger flap: Considerations of flap insetting, aesthetics and donor site morbidity

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Summary We described a laterally based cross-finger flap for reconstruction of soft tissue defects in the fingers. This modification enables coverage of volar or dorsal soft tissue defects at the distal, middle or proximal phalanx. From March 2015 to January 2017, a total of 12 patients (13 fingers) underwent soft tissue reconstruction of the fingers with a laterally based cross-finger flap. The flap dimensions ranged from 13 ×7 mm to 43 ×13 mm. Eleven of the 13 flaps survived completely. The two flap failures were attributed to injuries in the donor fingers, rendering the blood supply of the flaps unreliable. All donor sites were closed primarily without the need for skin grafting, negating the problem of donor site morbidity that is associated with skin graft harvesting. The laterally based cross-finger flap is a versatile flap with less donor site morbidity and better aesthetics than a conventional cross-finger flap. We described the design of the flap, as well as the advantages and disadvantages, in doing a laterally based cross-finger flap.
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Introduction

Fingertip injuries constitute a significant portion of cases that present to the Hand Surgery Service. These injuries are commonly associated with soft tissue loss. Critical defects in the presence of an exposed tendon, bone or joint obligate the need for early soft tissue reconstruction. Conventional cross-finger flap is the workhorse flap for resurfacing of pulp loss.

Soft tissue defect over the dorsal aspect of the distal or middle phalanx is a challenging area to reconstruct. Various reconstructive methods have been described to address these dorsal defects, including reverse cross-finger flap,[1] reverse dorsal digital island flap,[2] and adipofascial flap.[3] These

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methods necessitate skin grafting, thus creating an additional donor site from which to harvest a skin graft. A proximally based lateral digital flap has been described as a homodigital flap for a volar soft tissue defect following Dupuytren's fasciectomy.[4] The authors described a technique of modified cross-finger flap for soft tissue reconstruction of volar or dorsal defects using soft tissue from the lateral or dorsolateral aspect of the adjacent finger.

Blood supply to the dorsum and lateral aspect of finger

The dorsum of the proximal and middle phalanges are supplied by an arterial network with contributions from the terminal branches of the dorsal metacarpal artery, dorsal branches originating from the volar digital arteries, dorsal branches originating from the digital arches and digital artery perforators.[2,5–7]

The terminal branches of the dorsal metacarpal artery either terminate at the proximal third of the proximal phalanx or anastomose to the plexiform anastomoses formed by dorsal branches of the volar digital arteries.[2]

There are four constant branches and one inconstant dorsal branch from the volar digital artery. The inconstant branch arises at the level of the middle third of the proximal phalanx. Of the four constant branches, two arise at the distal third of the proximal phalanx, while the other two branches arise at the proximal half of the middle phalanx (Figure 1). These four constant dorsal branches arise at predictable distances from the proximal interphalangeal joint (PIPJ).[5] There is also description of dorsal branches originating from the digital arches that pass below the phalangeal necks of the proximal and middle phalanges.[6]

In addition to the dorsal branches described above, there are many branches from the digital arteries in the lateral aspect of the fingers. These branches perforate the thin fascia and adiposal tissue, terminating in multiple arterioles in the subdermal layer. Koshima et al. named these digital artery perforators rather than branches. Rich perforating arterioles and venules between these perforators exist in the subcutaneous tissue through the midlateral line of the finger. The venules connect to the cutaneous venous system in the subcutaneous tissue.[7]

These vascular systems form a rich plexiform network supplying the dorsum and lateral aspect of the fingers, enabling elevation of a modified cross-finger flap for coverage of the volar or dorsal defects at the distal, middle or proximal phalanx.

Patients and methods

Surgical technique

The adjacent finger that is closest to the soft tissue defect is selected as the donor finger. The size of the defect is measured. The flap is designed based on whether the defect is on the volar or dorsal aspect of the recipient finger.

For coverage of the volar defect, an outline of the midlateral line is drawn on the donor finger (Figure 2). Mark a spot on the intersection between the distal interphalangeal joint (DIPJ) crease and midlateral line, D. Mark a second spot on the intersection between the PIPJ crease and midlateral line, P. Mark a third spot on the intersection between the neck of the middle phalanx and a line 2–3 mm volar to the midlateral line, V. A dorsal curvilinear line is drawn from mark D to mark P, centered along the midlateral line. A volar curvilinear line is drawn from mark V to mark P, centered along the midlateral line. The base of the flap should be at least 5 mm in width. The maximum width of the flap for primary closure of the donor site is 13 mm in our series. Start with the dorsal incision and diathermize the vessels along the incision line. Elevate the subcutaneous fat along with the overlying skin using a pair of blunt scissors, preserving the attachment of the subcutaneous tissue to the dermis. Complete the volar incision, proximally to distally, diathermizing the perforating branches but preserving the branches at the neck of the phalanx. It is not necessary to dissect the neurovascular bundle or to identify the dorsal branches of the proper volar digital arteries. The donor site is closed primarily, and the flap is sutured to the recipient defect. The base of the flap is inclined to reduce tension at the base of the flap after flap insetting.

For coverage of a dorsal defect, marks D and P were identified as described above. Mark a third spot on the intersection between the neck of the middle phalanx and a line 2–3 mm dorsal to the midlateral line, C (Figure 3). A volar curvilinear line is drawn from mark D to mark P, centred along the midlateral line. A dorsal curvilinear line is drawn from mark C to mark P, centred along the midlateral line. The subsequent steps are as described for volar coverage.

Similar landmarks are identified on the lateral aspect of the PIPJ if the flap was to be elevated from the proximal phalanx instead of the middle phalanx. Care is taken to preserve the webspace when elevating the flap from the proximal phalanx.

With the techniques described above, the length of the flap is limited by the length of the phalanx. Moreover, when a laterally based cross-finger flap is harvested from the proximal phalanx, the length of the flap is limited by the need to

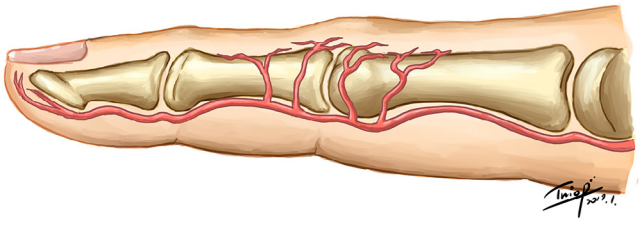

Figure 1 Origins of dorsal branches from the digital artery of the middle finger.

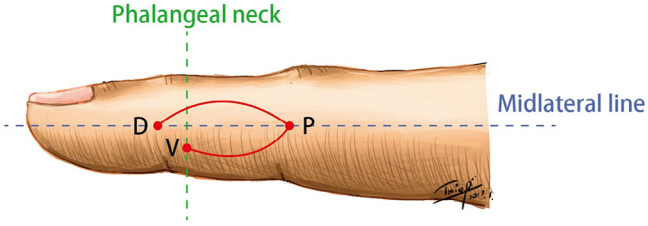

Figure 2 Surgical incision of laterally based cross-finger flap for coverage of a volar defect.

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