Cross-Finger Pedicle Flaps in the Hand

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Cross-Finger Pedicle Flaps in the Hand

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A full-thickness loss of the volar surface of the finger can be very difficult to repair. It has been treated in various ways. A paramount concern is the replacement of a tactile surface with skin that has an intact nerve supply. It is slightly less important to replace bulk and to obtain a satisfactory cosmetic result. The cross-finger pedicle flap satisfies these two requirements. Since its description by Gurdin and Pangman in 1950, it has been evaluated by several authors. All are in agreement that it satisfies the requirement of good appearance and replacement of bulk, but opinion varies with regard to the recovery of tactile sensation. Some reported series of cross-finger pedicle flaps did not include sensory evaluation, while others reported sensory evaluations in terms of subjective statements by the patients. In one series the opinion was expressed that tactilegnosis was lacking. Two series included two-point discrimination data and in one the sensory evaluation was quite thorough.

Because there still is a difference of opinion on the question of the return of sensation and function of the cross-finger pedicle flap, and because of other problems in the use of the technique, we have reviewed our series of twenty-two cases of cross-finger flaps. The return of sensation is the most important objective of the procedure, as Moberg stated, "if any area lacks tactilegnosis it cannot localize or identify objects. This area is blind." Moberg pointed out that the Weber two-point discrimination test is the best method for determining tactile gnosis.

Indications and Contraindications

The cross-finger flap technique is applicable in both primary and secondary repair. It is recommended for the following: (1) to cover an area requiring sensibility, (2) to preserve the length of the finger, (3) to cover exposed tendons or bones, (4) to replace an avulsed finger pad, (5) to release a scar, (6) to replace a hyperesthetic scar, and (7) to replace an inadequate skin graft.

The contraindications to the use of the cross-finger flap were enumerated by Horn, examples being arthritis, Dupuytren's contracture, and the vasospastic syndromes. Kislov and Kelly stated that the cross-finger-flap technique is not advisable in children under eight years of age, but Thomson and Sorokolit, in their series of seventy-five cases, thought this age limitation was unnecessary. We think the procedure should not be carried out on patients over the age of forty-five since prolonged immobilization frequently leads to permanent joint stiffness in this age group. The need for rapid return to work should not be a contraindication to the use of the technique, since, as Reid demonstrated in some cases, the disability time could actually be reduced.

Clinical Material

Twenty-two defects involving the full-thickness of the volar soft tissue of fingers were treated by the use of cross-finger pedicle flaps. In ten patients the pedicle was

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Fig. 1-A: Shows appearance of long finger before application of primary cross-finger pedicle flap.
Fig. 1-B: Shows appearance of long finger after application of primary cross-finger pedicle flap.

applied at the time of the initial injury, and in the other twelve from three to sixty-four weeks following the initial injury. There were five female patients ranging in age from twenty-one to twenty-eight years, and seventeen male patients ranging in age from fifteen to fifty-three years. Nine patients were laborers, four were machine operators, two were housewives, and two were students; the others had miscellaneous occupations.

All patients were followed at least until they returned to their previous occupation. Final sensory evaluation was carried out on only thirteen of the twenty-two. Nine patients had moved from the area and were unavailable for final examination.

All flaps were carried out for the purpose of resurfacing the index, long, or ring fingers. None were done for the thumb or little finger. The flap was used for the distal segment of the finger in sixteen patients, ten primary (Figs. 1-A and 1-B), and six secondary (Figs. 2-A and 2-B). In the remaining six patients, more than the
The distal segment was covered (Figs. 3-A through 3-D). As the donor site in flaps to the index finger, we consistently used the dorsum of the middle segment of the long finger. The flap to the long finger was from the dorsum of the ring finger. To cover the ring finger, six flaps were transferred from the dorsum of the long finger and one from the dorsum of the little finger. The donor site was covered by split-thickness skin grafts in the first six patients, but in the last sixteen we used a defatted full-thickness skin graft from the antecubital fossa of the same arm. The size of the transfer ranged from 1.9 centimeters by 1.3 centimeters (for a finger tip) to 5.0 centimeters by 3.8 centimeters in the two instances of resurfacing of the proximal, middle, and a portion of the distal segments.

Technique

The operation was carried out in a major operating room, using suitable regional or general anesthesia and a pneumatic tourniquet. The wound was debrided
and the defect prepared for grafting. The donor site was then selected on the adjacent finger by moving the injured finger into position. The size of the defect was measured and the size of the flap to fill the defect marked out. At this point it was determined that the proposed flap had to reach the defect with the finger in satisfactory position without tension.

The pedicle was then elevated. All tissue superficial to the deep fascia over the extensor expansion was elevated, as recommended by Curtis. The base of the flap was on the side of the involved finger. The dissection was carried far enough volarward so that no sharp angle was created in the flap after it was attached (Fig. 4).

A full-thickness skin graft was removed from the antecubital fossa of the same arm and the donor site was closed primarily with a subcuticular wire suture. The flap was sutured in place with 000000 nylon sutures. The full-thickness skin graft was sutured in place with 000000 nylon sutures and a stent was used. The hand was then immobilized in a bulky dressing with plaster splints. Bunnell and Kislov and Kelly recommended a Kirschner wire through the phalanges but we have not found this necessary.

The flap was released at approximately twenty-one days. The excess flap was reattached to the donor site and we avoided placing the scar on the dorsum of the finger.

Results have been evaluated on the basis of (1) sensory return, (2) general hand function, (3) rehabilitation, and (4) appearance.

Sensory

The first sign of sensory return generally was discrimination of light touch, which was tested by stroking of the pedicle with a cotton tip applicator. The earliest this occurred was six weeks following detachment of the pedicle and the latest, twenty-six weeks.

Discrimination of sharp from dull was tested with a pin and a dull metal object. In some instances this discrimination returned at the same time as light-touch discrimination, but usually it lagged three to four weeks behind.

Testing of two-point discrimination in the pedicle flap was carried out in the thirteen patients who returned for final evaluation. In all instances there was a return of two-point discrimination in the pedicle flap. In two instances two-point discrimination was present at nine weeks and in one instance at twelve weeks. In general the time of onset of two-point discrimination was six months or more following the time of detachment of the pedicle flap. Two-point discrimination was carried
CROSS-FINGER PEDICLE FLAPS IN THE HAND

out on (1) the pedicle flap, (2) the volar skin area equivalent to the flap area on the opposite normal hand, (3) the donor site, and (4) the area equivalent to the donor site on the opposite normal hand (Table I). In all thirteen patients examined, two-point discrimination was equal to or better than the equivalent donor area on the opposite normal hand. In four patients, two-point discrimination was normal compared with the equivalent pulp surface on the opposite hand (Cases 1, 2, 3, and 4—Table I). Two patients had a measurable difference in two-point discrimination of one millimeter (Cases 5, 6), four patients (Cases 7, 8, 9, and 10) a difference of two millimeters, two patients (Cases 11 and 12) a difference of three millimeters, and one patient (Case 13) a difference of four millimeters. The threshold values in the normal fingers are consistent with the normal values given by Omer in his series. The two-point discrimination of the donor site, covered by a full-thickness graft, is also included in Table I. It shows that the tactile gnosis returned in only two of these patients and in them to a lesser degree than in the equivalent area on the opposite, normal hand.

TABLE I

Two-Point Discrimination in Millimeters

<table>
<thead>
<tr>
<th>Patient</th>
<th>Size of Flap (Centimeters)</th>
<th>On</th>
<th>Area on Opposite Normal Hand</th>
<th>On Area Equivalent to Donor Site (Opposite Hand)</th>
<th>Millimeters on Area Equivalent to Donor Site (e.g. Dorsum of Donor Finger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.S.</td>
<td>1.9 by 1.9</td>
<td>2.6</td>
<td>2.4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>P.H.</td>
<td>1.6 by 2.2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>A.P.</td>
<td>5.0 by 3.8</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>J.O.</td>
<td>3.8 by 6.3</td>
<td>11</td>
<td>1</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>R.G.</td>
<td>2.5 by 1.9</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>E.G.</td>
<td>1.9 by 1.9</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>S.R.</td>
<td>2.2 by 2.2</td>
<td>7</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>R.P.</td>
<td>2.2 by 1.9</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>D.R.</td>
<td>2.5 by 1.9</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>M.F.</td>
<td>2.2 by 2.2</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>G.F.</td>
<td>1.9 by 1.3</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>E.P.</td>
<td>1.9 by 1.9</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>J.R.</td>
<td>2.5 by 2.5</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**

The over-all function of the involved finger was assessed and it was shown that there was satisfactory function. In the laborers, callous and wear marks showed that the digit was being used. In four patients the severe damage to the joint structures accompanied damage to the soft tissue. No further impairment in the function of the fingers was noted in these patients. All four patients showed a gradual increase in function in the finger after surgery. In all the other cases the finger was used normally, according to the patient, and this was evident when they were observed grasping objects.

**Rehabilitation**

The patients in all instances have returned to their former occupations. They also have returned to such avocations as playing the piano and guitar.
The flap was considered excellent in appearance in all patients except for one in whom it was too bulky. The appearance of the donor site was good in all sixteen patients in whom a full-thickness graft had been used (Figs. 5-A and 5-B). There was satisfactory healing of all antecubital donor sites, and in all instances the scar was considered cosmetically acceptable by the patient. In the six patients in whom split-thickness grafts were used on the donor site there were minor irregularities at the margins and in the grafts themselves (Fig. 6).

Complications

There were two complications in the series. The first was necrosis of the distal six millimeters of the flap in one patient, necessitating reapplication and advancement of the flap to cover the defect. The second complication occurred in a fifty-three-year-old man who had residual, iatrogenic stiffness in both the recipient and donor finger joints. There was some permanent impairment of range of motion of the involved fingers. Since that time, several other patients, not in this series, have been examined in whom the pedicle flap was used in a patient over the age of fifty; in all there was residual stiffness of both the recipient and the donor finger.

No cases of cold sensitivity or hyperesthesia in the flap were found in this series.

Discussion

In comparing this series with previous studies, certain points appear important. First, sensory function of the flap not only returned, as pointed out by previous authors 1,2,6,11,14,15,16, but tactile gnosis did also. The tactile gnosis was equal to or better than it was on the area analogous to the donor site. Second, the full-thickness skin graft was not reinnervated except minimally in two patients. This confirms the finding by Porter that sensation was better in cross-finger flaps and thenar flaps than in free skin grafts.

The appearance of the flap was excellent, but equally important, the appearance of the donor site was good when a full-thickness skin graft from the antecubital fossa was used. Third, the function of the digit was satisfactory in all patients, with minimum residual stiffness caused by the procedure in only one patient. This agrees with...
Irregular appearance of the donor site after coverage by split-thickness skin graft taken from volar surface of forearm.

the findings previously reported that in patients over the age of forty-five to fifty, this procedure is hazardous. Fourth, the scar at the donor site in the antecubital fossa was considered acceptable by the patients.

The functional rehabilitation of the patient was complete, as shown by their normal use of the repaired digit. This is in contrast to Brody and associates' patients where: "In all cases in which the index finger was injured, this digit's activity was suppressed and the middle finger was used for all actions requiring tactilegiosis."

Summary

The cross-finger pedicle flap technique provides good functional and cosmetic reconstruction to loss of volar digital tissue. A high degree of sensory rehabilitation including two-point discrimination is the usual end result.

References