Double cross finger flaps from the middle to the index or ring finger: A case series of 4 patients with an emphasis on donor finger morbidity

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ABSTRACT

INTRODUCTION: The use of two cross finger flaps from one digit has not been previously reported and the technique raises concerns regarding donor finger morbidity. In this paper, the authors report on a case series of double cross fingers flaps harvested from the middle finger to reconstruct large defects in the adjacent index or ring finger; with an emphasis on documenting morbidity in the donor middle finger.

METHODS: A total of four cases of double cross finger flaps were retrospectively reviewed. Demographic data, surgery, and postoperative complications were documented. Donor middle finger morbidity (stiffness, painful neuromas, skin graft instability, cold intolerance and cosmetic concerns) were also documented.

RESULTS: All patients were young male industrial workers. Two patients underwent reconstruction with de-epithelialized cross finger flaps and the other two patients had classic cross finger flaps. No postoperative complications were noted. Mild stiffness at the distal interphalangeal joints were noted in all patients. There were no painful neuromas and one donor site had occasional blistering at the site of the skin graft. Mild cold intolerance was seen in the two patients with electric burns. Hyperpigmentation of the skin grafts was noted in all patients.

CONCLUSIONS: Our paper introduces to the literature the technique of utilizing two cross finger flaps from the middle finger to reconstruct large dorsal or volar defects of the adjacent index or ring finger. The study shows that the technique is feasible and is easily executed. The results document an acceptable donor finger morbidity.

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1. Introduction

The cross finger flap was described several decades ago [1] and is an accepted method of reconstruction of small or medium-sized digital defects [2]. There are several advantages of cross finger flaps such as ease of dissection, simplicity, and the reliable blood supply. Furthermore, several modifications of the flap may be used to suit the defect, such as the use of innervated (sensory) cross finger flaps for fingertip reconstruction [3,4]. However, cross finger flaps also have disadvantages such as the need for two stages and donor finger morbidity [5,6]. To reduce donor site morbidity, cross finger flaps are usually harvested from the dorsal aspect (rather than the palmar aspect) of the donor digit, avoiding the skin over the interphalangeal and metacarpophalangeal joints.

Previous authors reporting on the use of cross finger flaps utilized one donor site per digit. The flap is usually designed on the dorsal skin between the distal and proximal interphalangeal joints or the area between the proximal interphalangeal joint and the metacarpophalangeal joint. The area distal to the distal interphalangeal joint is rarely used between it is small in size and also because of its proximity to the nail bed. Due to the relative size of the middle finger, large index or ring finger defects may be covered by two cross finger flaps from the middle finger. The use of two donor sites from a single donor digit has not been reported in the literature. We report on a series of 4 cases with an emphasis on donor digit morbidity. The case series is compliant with the PROCESS Guidelines [7].

2. Patients and methods

The study was performed at a hospital with a high volume of industrial accident patients. The current retrospective study was approved by the research committee of the hospital. Over the last
12 years (2006–2017, inclusive), four cases of large index or ring finger defects were reconstructed by two cross finger flaps harvested from the middle finger.

2.1. Surgical technique and postoperative rehabilitation

Double de-epithelialized cross finger flaps were used to reconstruct large dorsal digital defects. The flaps are marked on the dorsal aspect of middle and proximal phalanges of the middle finger; preserving the skin over the proximal interphalangeal joint. The flaps were marked with their bases (i.e. their blood supply) on the side adjacent to the defect. First, the marked flaps are de-epithelialized using a 10-blade. De-epithelialization is done carefully in order to preserve the dermis. Once de-epithelialization is complete, the flaps are raised preserving the paratenon over the extensor apparatus in the donor middle finger. The two flaps are then flipped and sutured to the far edges of the defect; with the dermal sides of the flaps directly covering the defect. Finally, the exposed subcutaneous sides of the flaps in the recipient finger as well as the exposed paratenon in the donor middle finger are covered with split-thickness skin grafts. The skin grafts are covered with wet gauze. Buddy-taping of the donor and recipient fingers completes the dressing. No splints are used and the patient starts active mobilization of all fingers on the first postoperative day.

The double classic cross finger flaps are used to reconstruct large volar digital defects. The technique and postoperative rehabilitation are similar to those described above for de-epithelialized flaps except that the flaps are not de-epithelialized. Hence, skin grafts are required to cover the donor defect only.

2.2. Data collection

The following data were collected: age, sex, mechanism of injury, site of the defect in the index/ring finger, concurrent injuries, time of surgery, donor sites from the middle finger, type of cross finger flap used, type of skin graft used, time of flap division, postoperative complications, and time of follow-up.

At final follow-up, the total range of motion of the donor and injured fingers were recorded. Furthermore, we documented donor finger morbidities such as painful neuromas, skin graft instability and cold intolerance. Finally, any reported cosmetic concerns were documented.

3. Results

The demographic data of the four patients are shown in Table 1. All patients were young (26–32 years) male industrial workers and were right hand dominant. Two patients (Cases #1&2) had dorsal digital defects (one in the ring finger and one in the index finger), and the other two patients (Cases #3&4) had volar digital defects (both in the index finger). Coverage of each defect required two cross finger flaps from the adjacent middle finger. Split-thickness skin grafts were used in all cases, and flap division was done 17–18 days later. This period of flap division was not specific for double cross finger flaps (the senior author also divides single flaps at the same period). No postoperative complications (such as bleeding, infection, skin graft loss, flap dehiscence, or complex regional pain syndrome) were noted. Follow-up ranged from 7 to 10 months (Table 1).

The ranges of motion of the donor and recipient fingers at final follow are shown in Table 2. Special emphasis was put on documenting donor middle finger range of motion. All donor fingers had full ranges of motion at the metacarpophalangeal and proximal interphalangeal joints. However, a variable degree of stiffness (see Table 2), were noted at the distal interphalangeal joints in all

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Mechanism of injury</th>
<th>Site of the defect in the index finger</th>
<th>Concurrent injuries</th>
<th>Type of flap division</th>
<th>Type of skin graft used</th>
<th>Time of follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29M</td>
<td>Male</td>
<td>Hand caught in a machine</td>
<td>Dorsal aspect of the index finger</td>
<td>De-epithelialized flap from the middle finger</td>
<td>STSG</td>
<td>17 days</td>
<td>8 months</td>
</tr>
<tr>
<td>2</td>
<td>26M</td>
<td>Male</td>
<td>Saw injury</td>
<td>Dorsal aspect of the index finger</td>
<td>De-epithelialized flap from the middle finger</td>
<td>STSG</td>
<td>18 days</td>
<td>7 months</td>
</tr>
<tr>
<td>3</td>
<td>28M</td>
<td>Male</td>
<td>Electric burn</td>
<td>Dissection of the index finger</td>
<td>De-epithelialized flap from the middle finger</td>
<td>STSG</td>
<td>17 days</td>
<td>7 months</td>
</tr>
<tr>
<td>4</td>
<td>32M</td>
<td>Male</td>
<td>Electric burn</td>
<td>Dissection of the index finger</td>
<td>De-epithelialized flap from the middle finger</td>
<td>STSG</td>
<td>18 days</td>
<td>10 months</td>
</tr>
</tbody>
</table>

STSG = Split-Thickness Skin Graft
Table 2

Range of motion of the donor and recipient fingers as well as donor middle finger morbidities in the 4 patients (numbered 1–4 as per Table 1).

<table>
<thead>
<tr>
<th>Case Number</th>
<th>TAM of recipient finger</th>
<th>TAM of donor (middle) finger</th>
<th>Donor middle finger morbidity</th>
<th>Cold intolerance</th>
<th>Cosmetic concerns reported by the patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>215°</td>
<td>245°</td>
<td>At DIPJ (0–45°) No</td>
<td>No</td>
<td>Hyperpigmentation of the grafted donor site</td>
</tr>
<tr>
<td>2</td>
<td>245°</td>
<td>250°</td>
<td>At DIPJ (0–50°) No</td>
<td>No</td>
<td>Not reported</td>
</tr>
<tr>
<td>3</td>
<td>235°</td>
<td>260°</td>
<td>At DIPJ (0–60°) No</td>
<td>No</td>
<td>Hyperpigmentation of the grafted donor site</td>
</tr>
<tr>
<td>4</td>
<td>245°</td>
<td>255°</td>
<td>At DIPJ (0–55°) No</td>
<td>No</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

TAM = Total active motion of the metacarpophalangeal and both interphalangeal joints (the average normal TAM is 275°: 90° at the MPJ, 110° at the PIPJ, and 75° at the DIPJ. DIPJ = Distal interphalangeal joint.

Fig. 1. Case #1 (Table 1).
A) The defect in the ring finger.
B) The large ring finger defect is covered by two de-epithelialized cross finger flaps from the middle finger. Both donor and recipient fingers were covered with split-thickness skin grafts.
C) The healed wounds at 8 months. Note the hyperpigmentation of the split-thickness skin grafts.
D) Range of motion at 8 months.
cases with loss in the arc of flexion (i.e. there were no flexion contractures). None of the patients complained of painful neuromas (at the site of the transected dorsal sensory nerves). One donor site in one patient had occasional blistering of the skin graft. The two patients with electric burns (both had thrombosis of one digital artery) complained of mild cold intolerance of both the donor and recipient fingers. Although the surgeon reported hyperpigmentation of all skin grafts, only two patients reported cosmetic concerns because of this hyperpigmentation. All patients were satisfied with the outcome and returned back to their original jobs after a mean of 8 weeks (range, 7–9 weeks) from the time of injury. Two demonstrative examples are shown in Figs. 1 and 2 (Cases # 1 and 3, respectively).

4. Discussion

The current paper introduces the use of two cross finger flaps from one donor finger. We also demonstrate the most common indication for this double cross finger flap procedure: large dorsal or volar skin defects involving the index or ring fingers. The ring finger is also longer that the adjacent little finger. Hence, double cross finger flaps from the ring finger can also be utilized for large little finger defects.

The literature only documents donor finger morbidities after harvesting single cross finger flaps. Koch et al [8] reported the following rates of donor finger morbidities in a series of 23 patients who underwent single cross finger flaps: mild stiffness in 68%, significant pain (visual analogue scale of >3) in 30%, skin graft instability in 13%, and cold intolerance in 30% of patients. Patterson et al [5] noted that patients older than 40 years of age were more prone to stiffness. Both authors [5,6] noted that the cosmetic outcome of the grafted donor finger was worse with the use of split-thickness grafts when compared to full-thickness grafts. Split grafts were used in our series because we believed that the “take” of split grafts would be better especially with our early postoperative mobilization of the fingers.

Although our series is small, we document acceptable donor middle finger morbidity following the harvest of two cross finger flaps in young industrial workers. The stiffness was mild and limited to the arc of flexion of the distal interphalangeal joint. It is important to emphasize that the lack of severe stiffness in the donor middle finger was probably related to several factors such as the young age, patient motivation, the absence of concurrent bony trauma, early postoperative mobilization, and early flap division. Pain has not been a problem and only one donor site had occasional instability of the skin graft. Mild cold intolerance was seen in the two patients with electric burns and this is may have been related to the...
nature of injury and the concurrent thrombosis of the digital artery. Our injured industrial workers were non-Caucasians, and hence hyperpigmentation of the split-thickness skin grafts was expected. This cosmetic donor finger morbidity would be of more concern in young females. Hyperpigmentation of the skin grafts should be mentioned to all non-Caucasians patients prior to surgery; and if there are cosmetic concerns, other reconstructive options may be offered such as dorsal metacarpal flaps, groin flaps and “mini” free flaps [8,9].

5. Conclusions

Our paper introduces to the literature the technique of utilizing two cross finger flaps from the middle finger to reconstruct large dorsal or volar defects of the adjacent index or ring finger. The study shows that the technique is feasible and is easily executed. The results document an acceptable donor finger morbidity.

Conflict of interest

None.

Funding

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Ethical approval

The study was approved by the Research Committee of National Hospital (Riyadh Care) Riyadh, Saudi Arabia.

Consent

Written informed consent was obtained from the patients for publication. A copy of the written consent is available for review by the Editor-In-Chief of this journal on request.

Authors contribution

The senior author (MMA) performed the surgery. All authors collected the data, did the literature review, and wrote the manuscript.

Guarantor

M.M. Al-Qattan.

References