CLINICAL CHARACTERISTICS AND RESULT OF LOCAL FLAP RECONSTRUCTION FOR FINGERTIP INJURY IN ADULTS

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ABSTRACT

Background: Fingertip injury at different levels is a common injury and management varies with different outcomes. Local flap reconstruction techniques are the most commonly used method of treatment with satisfactory results in most. The current study aimed to analyze the clinical characteristics and results of different local flap reconstruction techniques in the treatment of fingertip injuries.

Methods: This was a retrospective observational study of 31 fingertip injuries in 24 patients treated with one of the three local flap reconstruction techniques; V-Y advancement flap, thenar flap, and Moberg flap, performed by a single orthopedic surgeon in a tertiary care teaching hospital over 2 years period. The variables analyzed were demographic and injury characteristics, flap take-up function, and cosmesis of the finger and nail using descriptive statistics.

Results: There were a total of 31 fingertip injuries at different levels and morphology with a mean age of 35.79 years (range 18-55). Household tools or machine-related injury was the most common mode of injury. A total of 23 (74%) fingertip amputations at a different level were treated with V-Y advancement local flap, 5 cases with thenar flap, and 3 cases of thumb tip amputation and laceration with Moberg flap. All the flaps survived well with preservation of sensation, function, and acceptable cosmesis.

Conclusions: Local flap reconstruction techniques can give rise to consistently good results in the management of fingertip injury. They are technically simple, and reliable and should be practiced by all orthopedic trauma surgeons whenever it is indicated.

INTRODUCTION

Fingertip injury (also known as fingertip amputation) at the different levels of distal to distal interphalangeal (IP) joint is a very common injury and comprises 1.8-2.2% of emergency orthopedic visits.1-2 It results in loss of pulp and variable length of the nail with or without distal phalanx. Preservation of sensation at the pulp, finger length, and cushion effect of the pulp are the most important consideration in the management of fingertip injuries to restore function and cosmesis.1,3 There are different methods of treatment for fingertip injuries starting from secondary healing to Atasoy V-Y advancement flap, Cutler flap, cross finger flap, thenar flap, and Moberg flap.4 Other inferior but easy choices are skin graft and shortening of digits and primary closure. The choice of treatment is dependent upon the morphology of the tissue loss, level of amputation, size of the defect, availability of the expertise, patient’s demand, and fingers involved.5 Smaller defects, <1 cm can be treated with secondary intention whereas defects <2 cm with transverse amputation of the tip, dorsal oblique, or even volar oblique can be treated with V-Y advancement local flap. Moderate defect (<2 cm) in the thumb can be treated with the Moberg neurovascular advancement local flap.6 Larger pulp defects in the index and middle fingers are better treated with a thenar flap when V-Y advancement flap is not suitable.7 There lacks consensus about the best method of treatment and there are variable results in terms of function and cosmesis in the different studies.4,7-11 The current study was carried out to analyze the clinical characteristics and results of these three local flap reconstruction techniques in the treatment of fingertip injuries performed by an orthopedic surgeon.

METHODS

It was a retrospective observational study of a total of 31 cases of fingertip injury treated with local flap reconstruction by one of the three methods; V-Y advancement flap, thenar flap or Moberg flap, performed by a single senior trained orthopedic surgeon (the first author).

Inclusion criteria were fingertip injury due to trauma distal to DIP joint of any finger within 1 week of trauma amenable to reconstruction with local flap procedure between the age...
Exclusion criteria were patient <15 years or >70 years, patient with peripheral vascular disease, wound nature not amenable to reconstruction with local flap, patient operated elsewhere, patient refusing the study, or patient with incomplete data.

Informed consent was taken from the patient for the operative procedure after a proper explanation and ethical clearance was taken from the institutional review committee for the study.

Operative Details

The operation was carried out under the finger block or brachial plexus block with an application of a tourniquet either at the base of the finger in V-Y and Moberg flap and at the arm for the thenar flap. The defect with loss of <2 cm in medial 4 fingers and <1 cm in the thumb was operated with local V-Y advancement flap, index and middle fingertip amputation injury with loss of >2 cm was treated with thenar flap and thumb defect of 1-2.5 cm was treated with Moberg neurocutaneous advancement local flap.

V-Y advancement Flap: After prepping and draping following standard technique, wound debridement was done and the incision was marked in V fashion with a base of the flap at the medial and lateral margin of the defect and apex at the level of DIP joint crease or even below in larger defect (Figure 1). An incision was made at the marked site with no 15-blade dividing epidermis and dermis, Skin hook was used to apply gentle traction at the base of the flap distally while dividing the tight subcutaneous septae till acceptable apposition of the flap to nail bed was achieved. Direct skin closure with 4-0 prolene was done at flap margin and nail bed or nail plate, 2-3 in number and on either side 2 each. V incision was converted to Y after distal advancement and one or two stitches were applied at the apex. Care was taken to avoid any tight closure or apposition to avoid margin necrosis.

Thenar Flap: This local flap technique was chosen for the moderate defect (>2cm) in the index and/or middle finger where V-Y flap would not be suitable. The defect was marked at the thenar area at the base of the thumb with flexion of the finger and the flap was raised keeping the base on the radial border at the level of the 1st metacarpophalangeal (MCP) joint crease on the palmar side. The donor site defect was closed with primary suture and the defect at the fingertip was closed with prolene 4-0 taking bites at the flap margin and intact finger skin margin keeping the injured finger fully flexed (Figure 2).

Moberg Flap: This is neurocutaneous palmar advancement local flap suitable for the moderate-size defects at the thumb. After proper wound debridement and assessment of the defect size, flap incision was marked along the line parallel and dorsal to the line joining IP joint and MCP joint crease of the thumb. The flap was incised to tendon sheath protecting digital nerves and vessels on both the radial and ulnar border of the thumb, Depth of the flap was till a flexor tendon sheath was seen. Distal advancement of the flap was done and the defect was closed with 30° flexion of the IP joint of the thumb (Figure 3).

A loose dressing was applied with adequate padding in all the local flaps and the limb was kept in arm pouch for elevation for 5 days. Postoperative wound inspection and the dressing was done on the 2nd and 4th day and the patient was discharged once the flap looked viable. Follow-up in OPD was made at 2 weeks for suture removal and range of motion exercise. Thenar flap was divided at 18-21 days postoperatively and ROM exercise was started thereafter.
Demographic data, injury characteristics, and treatment details were taken from the inpatient chart, and flap outcome, function, complications, two-point discrimination, and ROM were taken from the OPD chart and OPD assessment during the OPD visit after the phone call.

All the data regarding demography, injury and treatment details, and postoperative outcomes were entered into the master chart and data analysis was done using SPSS version 20.0. Frequency and percentage were calculated.

**RESULTS**

There was a total of 35 fingertip injuries operated on with one of the three local flap techniques in the study period from which 31 fingertip injuries in 24 patients with a mean age of 35.79 years (range 18-55) were available for the final analysis. The mean follow-up period was 7.7 months (range 3-18). There was male dominance 19 (79.2%) over female 5 (20.8%). Right-sided dominance was present in 20 (83.3%) cases compared to 4(16.4%) left-sided dominant hands. Table 1 shows the rest of the demographic and clinical characteristics of the fingertip injury.

**Table 1: Clinical characteristics of fingertip injuries**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number (%)</th>
</tr>
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<tbody>
<tr>
<td>Right side</td>
<td>19 (79)</td>
</tr>
<tr>
<td>Left side</td>
<td>5 (21)</td>
</tr>
<tr>
<td>Single finger injury</td>
<td>17 (70.8)</td>
</tr>
<tr>
<td>Multiple finger injury</td>
<td>7 (29.2)</td>
</tr>
<tr>
<td>Mode of Injury</td>
<td></td>
</tr>
<tr>
<td>Domestic/machinery tools</td>
<td>25 (80)</td>
</tr>
<tr>
<td>Door Trapping</td>
<td>6 (20)</td>
</tr>
<tr>
<td>Allen’s type</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>14 (45)</td>
</tr>
<tr>
<td>II</td>
<td>10 (32)</td>
</tr>
<tr>
<td>III</td>
<td>7 (23)</td>
</tr>
<tr>
<td>Morphology</td>
<td></td>
</tr>
<tr>
<td>Transverse</td>
<td>12 (38.7)</td>
</tr>
<tr>
<td>Dorsal Oblique</td>
<td>8 (25.8)</td>
</tr>
<tr>
<td>Volar oblique</td>
<td>11 (35.4)</td>
</tr>
</tbody>
</table>

There were single fingertip amputations in 17 (70.8%) cases and two fingertip amputations in 7 (29.2%) cases. The index finger was the most commonly injured, in 9 (37.5%) followed by the thumb in 4, the index and middle finger in 4, both middle and ring fingers in 3, and the ring and little finger separately in 2 cases each. A total of 23 (74%) fingertip amputations at a different level were treated with V-Y advancement local flap, 5 cases (3 index finger and 2 middle fingers) with thenar flap, and 3 cases of thumb tip amputation and laceration with Moberg flap.

There was good flap take up in all the 31 (100%) fingertip amputations except there was partial margin necrosis in one case of thenar flap after division and in-setting which healed with secondary intention and one case of Moberg flap with 5mm of defect at the tip due to large size wound defect which also healed with secondary intention. The sensation was present in all the cases of the flap. Static two-point discrimination test revealed a mean of 4.42 mm (range 3-6 mm) at the reconstructed finger pulp. There was cold sensitivity in 6 cases (19.35%), residual off-and-on pain in 2 (6.45%) cases, tenderness in 6 (19.35%) of the cases, and mild hook nail in 7 (22.5%). The mean range of motion (ROM) at DIP joint was 70.46 degrees (range 70-80). Two cases of Moberg flap in the thumb had a loss of active hyperextension at the interphalangeal joint of the thumb but there was no functional or cosmetic issue.

**DISCUSSION**

Fingertip injury results in loss of variable length of pulp, fingertip, and nail with or without part of the distal phalanx and is a common scenario in an orthopedic emergency. The aim of treatment is preservation of length, sensate and cushioned pulp, restoration of function, and cosmesis. Simple local flap reconstruction techniques can achieve these objectives to a large extent.

The options of local flap available for the reconstruction of fingertip injuries are V-Y advancement flap, Cutlery lateral V-Y flap, cross finger flap, thenar flap, and Moberg flap. The most commonly used local flap for relatively smaller defects of the pulp (up to 2 cm) is V-Y advancement flap. It was first described by Tranquilli-Leali in 1935. It is technically simple and gives rise to consistently good results with minimal risk of failure.

The present study showed excellent flap take-up in all 23 cases of V-Y flap for fingertip amputation. The defects were mostly transverse amputation (12 cases) in the present study but this flap technique can be used for dorsal oblique or even volar oblique. Allen type I-III defects. Allen’s classification is the most commonly used classification for fingertip amputation which classifies loss of the tip of the pulp as type I, Pulp and part of the nail as type II, pulp, part of nail and nailbed, and distal phalanx as type III and amputation just distal to the insertion of flexor digitorum profundus is type IV. Gupta S et al in their study of 80 patients of fingertip injury reconstruction showed V-Y advancement flap as the most common procedure followed by Moberg flap. All V-Y flaps had good take up and healing but there was tenderness in 30% of them and cold sensitivity in 20% of the cases. The present study showed the presence of sensation in all the cases of different local flaps. Static two-point discrimination test revealed a mean of 4.42 mm (range 3-6 mm) at the reconstructed finger pulp. There was cold sensitivity in 6 cases (19.35%), residual off and on pain in 2 (6.45%) cases, tenderness in 6 (19.35%) of the cases, mild hook nail in 7 (22.5%) cases which are comparable to the findings of Gupta S et al and Atasoy E et al. But none had disabling symptoms or an inability to do activities of daily living. Sensation on the reconstructed pulp was normal in 97% and 93% of the cases in the study done by Atasoy E et al and Gupta S et al respectively in the treatment of fingertip amputation with V-Y flap. Two-point discrimination test showed ≤4mm
Moberg flap is a local adipofasciocutaneous neurovascular flap from the thenar space and division of the flap after 2-3 weeks. It is technically more complex than V-Y flap and carries a slightly increased risk of flap necrosis, donor site morbidity, and finger stiffness. Present study had 5 cases of thenar flap reconstruction for the moderate defect in the index and middle finger. The defects were not amenable for V-Y flap and hence lateral based thenar flap was chosen for the reconstruction. One case had partial margin necrosis after flap detachment which healed by secondary intention in our study. There is an increased risk of flap necrosis and stiffness at interphalangeal joint in thenar flap reconstruction as shown in the studies done by Melone et al and Sahu RK et al. Melone et al in their study of 12 cases of thenar flap reconstruction showed partial margin necrosis in 2 cases and stiffness of interphalangeal joints in 2 cases after flap detachment. Melone et al in their study of 150 patients of thenar flap reconstruction showed excellent results when the base of the flap was modified to a lateral base at the thumb base crease.

The mean range of motion (ROM) at DIP joint was 70.46 degrees (range 70-80) in the present study and stiffness is likely to occur in the thenar and Moberg flap. Rinker B in his study of thenar flap reconstruction showed that stiffness of the interphalangeal (IP) joint and metacarpophalangeal (MCP) joint improved with time and returned almost normal at 1-2 years.

Machinery injury or domestic tools injury and accidental trapping in the door are the most common mode of injury. Data regarding the exact incidence of these injuries in developing country like ours is lacking but statistics from the USA states its incidence as 7.7 cases/100000 population per year. The current study showed domestic tools-related injury (cut by a knife, sickle, kitchen tools such as mixture grinder or saw machine in woodworkers) as the most common mode of injury (25 fingers) followed by accidental trapping on the door (6 fingers).

Only 3 cases of thumb pulp injury were treated with Moberg flap in the present study. Out of them, 2 healed with primary intention, and 1 case with 5 mm of remaining defect healed with secondary intention. There was a loss of hyperextension at the IP joint of the thumb in 2 cases but function and cosmesis were within acceptable limits. Moberg flap is a local adipofasciocutaneous neurovascular advancement flap suitable for the thumb tip amputation with a defect <2 cm where the flap is raised from the base of the defect to proximal along with the whole of volar side skin, digital nerve, and vessels and the defect is covered with distal advancement and flexion at the interphalangeal joint. Moberg first described it in 1964 and is a popular option for local flaps for thumb tip reconstruction.

Only a smaller defect in the thumb is suitable for V-Y flap owing to relatively less mobile fibrous septae. Baumester at al in their study of 36 patients of thumb tip reconstruction with Moberg flap showed good take up in all the cases with the restoration of normal sensation in 74% of the cases. There was a minor issue of loss of active hyperextension but there was no functional issue or flexion contracture at the interphalangeal joint. Modification of this flap with a combination of V-Y advancement or Z-plasty can increase some length and can be useful for moderate-size defects for the avoidance of possible flexion contracture at the interphalangeal joint of the thumb.

There were no complications in terms of flap infection, complete necrosis, or complete loss of sensation in any of the cases in the present study. There was some degree of hook nail in 6 fingers (19%). The prevalence of hook nails after fingertip reconstruction is variable (30-60%) and it can be minimized with avoidance of tension suture to nail plate or nail bed. All the patients were able to perform activities of daily living in the current study.

The limitations of the present study were the retrospective nature of the study, the relatively less number of cases, heterogeneity in local flap techniques, and the operating surgeon evaluating the results. A prospective study with a larger number of cases and longer follow-up is recommended to substantiate the results of this study further.

CONCLUSION

The V-Y advancement flap, thenar flap, and Moberg flap are reliable methods of local flap techniques for the treatment of fingertip amputation of variable nature with consistently good results in most cases. The V-Y advancement flap is the most common and simple technique for the restoration of sensate and functional pulp in mild to moderate-size defects without much cosmetic concern and can be practiced routinely by trained orthopedic surgeons.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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