

Oblique Triangular Neurovascular Island Flap for Fingertip Reconstruction in a Resource Limited Setting

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Abstract

Background: Fingers are highly specialized part of hand for prehension, allows certain sensations and important aesthetic feature. Fingertip injury causes significant functional and aesthetic defects with great impact on patient's quality of life. This study was conducted to evaluate the outcome of oblique triangular neurovascular island flap for coverage of fingertip defect distal to distal interphalangeal (DIP) joint.

Materials and methods: A quasi experimental study was conducted in the department of Plastic Surgery of Dhaka Medical College Hospital (DMCH) and National Institute of Burn and Plastic Surgery (NIBPS). Total 22 patients with 25 fingertip defects distal to DIP joint was included in the study from 1st September, 2020 to 31st August 2021.

Introduction

The human fingertip is a highly specialized anatomic structure which is most frequently used for exploration and interaction.¹ The pulp of finger is vital in performing finest daily activities.² Its exceptional capability of sensation, padding, and pinch grip has made it one of the precious parts of human body³. These functions can be distorted by unwanted incidents in form of burn, trauma or as a secondary defect after release of contracture.⁴ The injury of the distal segment may involve a different type of fingertip injury, amputation, digital pulp loss with exposed bone and tendons.²

The objectives of distal phalangeal or fingertip reconstruction included the preservation of functional length and protective sensation, prevention of symptomatic neuromas, acceptable donor site morbidity, adequate distal interphalangeal joint motion, absence of cold intolerance, minimization of aesthetic deformity and quick return to occupational activities.²

Results: The mean age was found 26.32 ± 9.91 years with range from 13 to 45 years. Majority 16(72.73%) cases were injured due to trauma. Mean dimension of wound was 1.40 ± 0.28 cm². The mean dimension of the flap was 2.54 ± 0.51 cm². Total 21(84%) cases had recovered without complications. More than two third (84%) cases were found good, 4(16%) were satisfactory.

Conclusion: The main advantages of oblique triangular neurovascular island flap replacing like with like tissue under less extensive surgery and under minimum resources, making it more feasible fingertip reconstruction.

Key words: Fingertip defects, neurovascular island flap.

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Reconstructive options for fingertip vary from the simplest conservative treatment to the most sophisticated microsurgical reconstruction techniques. Although there are various methods available to solve these problems, surgeons are still exploring most simple and reliable flaps for reconstruction of digital terminal segments.⁵

For reconstruction of fingertip, multiple coverage options are practiced. Local homodigital advancement flap including V-Y closure from ipsilateral or bilateral side of finger have been popular. Although this method is very convenient, major disadvantages are limited length of advancement and limited size of flap. Another local coverage option is cross-finger flap for same purpose, but it has other complications like, need of 2 stage procedure^{6,7}, increased rate of complications⁵ such as, joint stiffness, poor recovery of sensibility or an unacceptable aesthetic outcome. Other options like thenar flap⁸ require second stage operation. Heterodigital neurovascular island flap can provide similar texture and

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sensation for the recipient site; however the donor site morbidity is a major concern (sensory loss, cold intolerance, painful neuroma formation, scar contracture) and double sensibility of flap.^{5,9,10}

The goals of repairing defect of the fingertip with exposed bone are maintaining length and restoring sensation and appearance.¹¹ Oblique triangular neurovascular island flap, reported by Venkataswami and Subramanian¹² is one of the best choices to meet above condition. It is a vascularized flap that is harvested from mid-lateral aspect of finger preferably ulnar side of index, middle and ring finger or the radial aspect of the thumb and ring finger³. This flap can provide similar texture and sensory coverage for defects of fingertip.

Island flap means that the flap is circumferentially freed, except for the neurovascular pedicle¹³. This allows greater mobility of the flap than if the dermal connections are left intact. Neurovascular indicates that the flap has both blood supply and innervations, as opposed to flaps which maintain the blood supply but not the nerve supply.¹³

Oblique triangular neurovascular island flap has shown superiority over any other flap coverage to reconstruct fingertip distal to DIP joint. It gives same color and texture of recipient site, sensation and durable protection for underlying structure. The flap circulation is reliable and donor site can be closed primarily. Another advantage is this is a less extensive surgery, can be done under regional or local anesthesia, as a day case surgery. This limits less hospital stay, early return to work, less financial burden for the patient.

Materials and Methods

To evaluate the outcome of oblique triangular neurovascular island flap as for coverage of fingertip defect distal to distal interphalangeal (DIP) joint, a descriptive observational study was conducted in National Institute of Burn & Plastic Surgery (NIBPS) and Dhaka Medical College Hospital (DMCH). Total sample size was 25 fingers. This study took ethical committee permission from DMCH. Specific objective of this study was to assess the viability of the flap and adequate coverage of the defect. Patients with transverse and volar oblique defects of the fingertip distal to DIP joint were included. But those with poly trauma, life threatening injury or fracture, multiple co morbidity were excluded from the study.

This flap can easily be done with regional block. Though

brachial block or axillary block is preferred, but wrist or digital block can also be given. Tourniquet should be used for hemostasis and adequate exposure of operative field.

Before surgery, wound measurement is done using measuring scale, the highest dimension is recorded.

Initially oblique volar and later mid lateral incision is made for better exposure of neurovascular bundle, dissection proceeds from distal to proximal and is carried down to the flexor tendon sheath. After freeing up and releasing all fibrous septa and soft tissue attachment, the flap is advanced easily at least 1 cm and donor site is closed in V-Y fashion. Moist non compressive dressing is applied with posterior cast for tissue stabilization following inset.

Check dressing is done at 7th, stitch off at 14th postoperative day. The final follow up is on 45th postoperative day to check final outcome of flap and donor site.

All Surgeries and dressings were performed by experienced senior plastic surgeons. Data collection was done by a pretested written questionnaire after taking written consent from each patient. The flap outcome was measured by a scoring system based on flap salvage, presence of infection and donor site morbidity ranged from 0 to 10. Score less than 3 is considered poor outcome, 3-7 is satisfactory and more than 7 is considered good.

Results

Total 22 patients with 25 fingertip injuries were included in the study. The mean age was found 26.32 ± 9.91 years with range from 13 to 45 years. 86% cases were male and 14% were female. Majority 16 (72.73%) cases were injured due to trauma and 6 (27.27%) were due to machinery injury. In most cases (11), index finger was affected in our study; Ring finger was second predominant.

Table-I

Involvement of the finger of study population (N = 25)

Involved finger	No of fingers	Percentage
Index	11	44%
Middle finger	3	12%
Ring finger	6	24%
Little finger	5	20%
Thumb	0	0%

Most of the wound has average dimension of 1.4 cm², where average dimension of the flap was 2.54 cm². In our study most of the flaps (21) uneventfully covered the wound. Few cases (4) had minor complication like mild infection, marginal necrosis and venous congestion. The infection was subsided with oral antibiotic and at rest cases managed with dressing and secondary healing.

Table-II

Length and width of the wound and flap of the study population (N=25)

		Range	Mean	SD
Length (cm)	Wound	1.00-1.50	1.20	0.16
	Flap	1.40-2.50	2.11	0.31
Width	Wound	0.80-1.30	1.10	0.14
	Flap	0.90-1.40	1.20	0.14
Dimension	Wound	0.80-1.89	1.40	0.28
	Flap	1.65-3.50	2.54	0.51

Table-III

Distribution of complications of the flap (N = 25)

Complications of the flap	No. of cases	Percentage
Uneventful	21	84%
Infection	1	4%
Marginal necrosis	1	4%
Venous congestion	1	4%
Wound dehiscence	1	4%

Outcome of the flap was measured using a pretested questionnaire where outcome was marked as good, satisfactory and poor. In our study, in 84% cases were beyond satisfied for the outcome.

Table-IV

Outcome of flap of study population (N = 25)

Outcome of flap/ patient satisfaction	No. of cases	Percentage
Good	21	84%
Satisfactory	4	16%
Poor	0	0%



Figure 1: a. flap marking, b. Dissection of volar segment, c. Detachment of the flap, d. flap inset and closure of donor site

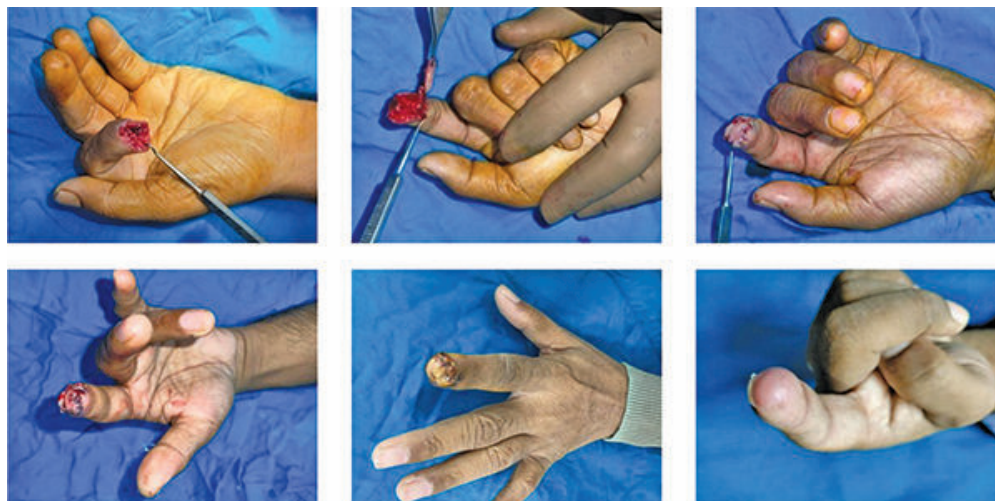


Figure 4: (??) : A 45 yrs old male patient had history of accidental trauma; figure a showing preoperative picture, figure b,c, showing per and postoperative condition; figure d(7th postoperative day), e(14th postoperative day), f(45th postoperative day) showing pictures at different follow up period.

Discussion

Fingertip defect is treated according to the extent of tissue loss and involved structures. Exposed phalanx and tendon require durable coverage for optimum function.¹⁴ There are many locoregional coverage options for fingertip reconstruction. including secondary healing, STSG, V-Y advancement flap, cross finger flap, DAP flap etc. All of these have their own limitations. Oblique triangular neurovascular island flap is suitable for repairing fingertip defect with good texture, fine fingertip sensation without sacrificing digital artery or nerve. The fingers which can be covered by the flap include thumb, index, middle, ring and little finger.

So to observe the outcome of this oblique triangular neurovascular island flap, this quasi experimental study was carried out in Department of Plastic Surgery and Burn unit, Dhaka Medical College Hospital, Dhaka and National Institute of Burn and Plastic Surgery, Dhaka during the period from September 2020 to August 2021. Total 22 patients with 25 fingertip defects were included in the study.

In this study observed that majority (40%) patients belonged to age 10-20 years. The mean age was found 26.32 ± 9.91 years with range from 13 to 45 years. Which indicates active age group was affected mostly. It may be due to involvement of this age group in different works which exposed them to this sort of injury. This finding was consistent with study of Zhao.¹⁴, who reported the mean age of the study population was 34.17 (21-48) years. Similarly Feng¹⁵ reported the mean age of the study population was 34.9 (20-53) years and Kayalar¹⁶ reported the mean age of the study population was 31.40 (03-65) years. In the contrary, study of Sano¹¹ observed that the average age of the patients was 44 (range: 18-60) years.

This study showed that majority 19 (86.36%) patients were male and 3 (13.64%) patients were female. Male female ratio was 6.3:1. The cause may be that the male people of this country are most active member of the family and thus they are more prone to trauma. Zhao¹⁴ reported 7 patients were male and 5 were female, showing male predominance in the study. Similarly, Usami¹⁷ reported 28 male and 3 female underwent elective surgery for fingertip defects. Most no. of female cases

were found in the study of Vartimidis², reported 14 female and 36 male patients.

The study showed that majority 16 (72.73%) patient's causes of injury were found trauma and 6 (27.27%) machinery injuries. The maximum number patients were suffered from fingertip injury due to accidental trauma. Kayalar¹⁶ reported crush type of industrial injuries as the most frequent (N = 70) causes of injury, followed by guillotine, saw and knife cuts and traffic accidents, conveyor belt, propeller and surface machinery. Vartimidis² mentioned the causes as agricultural, industrial and domestic injuries. Lok³ mentioned 6 cases had etiology of work related injuries.

In this study, more than one third (44%) patients were found injury of index finger followed by 6(24%) ring, 5(20%) little finger and 3(12%) middle fingers and 0(0%) thumb (table 1). Similar findings were observed on Kayalar¹⁶, reported index finger affected mostly (36.50%), followed by ring finger (27%). Sano¹¹ reported 6 index, 4 middle and 3 ring fingers out of 14 cases. In the study of Zhao¹⁴ also index finger is the most affected fingers (6 out of 14 cases).

Approximately one third (32%) cases were found length of wound 1.30 cm. The mean length of wound was found 1.20 ± 0.16 cm with range from 1.00 to 1.50 cm. majority (48%) patients were found width of wound was ≤ 1.00 cm, the mean width 1.10 ± 0.14 with the range from 0.80 to 1.30 cm (table 2). Mean dimension of the wound was 1.40 ± 0.28 cm², range from 0.80 to 1.89 cm² (table 2). Lok³ stated the mean area of defect was 2.80 cm², ranged from 1.50 to 5 cm².

In this study almost half (48%) of the patients were found length of flap 2.20-2.50 cm. The mean length of flap was found 2.11 ± 0.31 cm with range from 1.40 to 2.50 cm. Majority (48%) patients were found width of flap 1.10-1.20 cm. The mean width of flap was found 1.20 ± 0.14 cm with range from 0.90 to 1.40 cm (table 2), mean dimension was 2.54 ± 0.51 cm² with the range from 1.65 to 3.50 cm² (table 2). Werner¹⁸ reported mean area of flap was 4.70 ± 0.60 cm². Vartimidis² reported defect size was (1.50 × 1) cm² to (2 × 1.50) cm² which has quite resemblance to our study.

Fewer post-operative complication of the recipient site were observed while conducting the study, total rate

of complication was 16%, out of which venous congestion occurred in one (4%), marginal necrosis 1(4%), wound infection 1(4%) and wound dehiscence 1(4%) (table 3). All flaps survived without any complication. In most of the patients these complications resolved conservatively. The patient with venous congestion was managed by removal of stitches. Another study¹⁴ mentioned about superficial necrosis in one patient, which was managed by dressing and secondary healing.

Authors who have long term follow up have mentioned some common late postoperative complications, such as pain in the reconstructed area^{3,11}, cold intolerance^{2,11,14,16}, dysesthesia¹¹, hyperesthesia^{3,10,13,15}, scar contracture.^{16,17}

Here, in this study all the cases donor sites were closed primarily. At all cases (100%) the donor site healing was found uneventful.

The study showed that majority (84%) cases were found good and 4(16%) had satisfactory outcome. Vartimidis² found similar findings with total 63 fingers in 50 patients of fingertip defect by homodigital neurovascular island flap. All flaps survived completely, the appearance of flap was evaluated by patients and termed good in 53 cases and excellent in 9 cases. Usami¹⁷ also reported survivability of all flaps and no donor side morbidity. Kayalar et al.¹⁶ mentioned 91.7% patient satisfaction regarding functional and aesthetic result.

In this study the representative sample was small & follow up period was also limited, so precised neurological and aesthetic assessment could not be evaluated. A larger sample size with brief follow up is recommended. And also further comparative study may be conducted for more direct and strong evidence.

Conclusion

Oblique triangular neurovascular island flap can be a durable option for fingertip reconstruction. Like with like tissue replacement with least donor site morbidity can be expected in most of the patients. Satisfactory tissue coverage under limited resources is another positive concern. Further study with large sample size and longer follow up is recommended for more precise neurological assessment of flap.

Conflict of interest: None

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