

FUNCTIONAL OUTCOME OF NON-MICROSURGICAL FINGERTIP FLAPS FOR FINGERTIP AMPUTATIONS – A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: To evaluate the functional outcome of Fingertip amputation patients treated by non- microsurgical flaps for coverage of bone and to evaluate the complications associated with non- microsurgical flap covers in fingertip amputations for bone coverage. **Materials and Methods:** Patients who underwent non microsurgical flap cover for fingertip amputations from July 1st, 2022 to June 30th, 2023 were recruited for the study. Sample size calculated was 25. Age group selected was from 18 to 70. Patients were followed up during post-operative period, regular dressings were done, post-operative expert hand therapy was initiated under occupational therapist specialized in doing hand therapy. Patients were looked for development of any complications during the post-operative period. **Result:** Out of the 25 cases we operated, 20 cases were males and 5 were females. Age group ranged from 19 to 70, mean age being 42. All the cases in our series had either excellent or good functional outcome according to Fingertip injury outcome score. 16 out of 25 cases had excellent outcome and 9 cases had good functional outcome. About sensations, 16 patients had two-point discrimination within 6 mm. 9 cases had two-point discrimination in the range 7 to 10 mm. No patients had cold intolerance or absent sensation/hyperalgesia. Among the VY flap patients, 12 patients had two-point discrimination <6 mm and 4 patients had two-point discrimination of 7-10 mm. **Conclusion:** Non microsurgical flaps are good and reliable options for bone coverage in Fingertip amputations and good alternative for shortening and stump closure.

INTRODUCTION

Fingertip amputations are common cases in the emergency department, mechanism of injury being worksite accidents like injury with cutter machines, crush injuries, road traffic accidents, injuries with mixer grinder, bike chain etc.^[1] In many of the rural centres in our country, patients often won't get any microvascular support or plastic surgery support for replantation of amputated parts or soft tissue coverage with microvascular flaps.^[2] So shortening and stump closure is a commonly done method in treating many of the fingertip amputations. Non microsurgical flaps provide a good option for coverage of soft tissue defects compared to bone shortening and stump closure.^[3] Eponychial flap

separation which is done occasionally along with fingertip flaps to expose the nail bed which is otherwise hidden under eponychial fold will help to regain the length of nail to some extent.^[4]

The advantages of shortening and stump closure are these can be done under local anaesthesia in OP or casualty procedure rooms, patient can restart their work early and procedure can be done at a lower cost. Disadvantages are we are shortening the bone, so there will be shortening of finger length and nail length and permanent loss of nail in some cases and poor cosmetics. Local flaps have the advantages of better cosmetic appearance, preservation of nail and finger length. But flap covers need expertise, needs more time to get back to work especially in flaps requiring a second procedure like flap division.^[5]

These flaps can be done in small centres without microvascular backup. Motivating more Orthopaedic and General surgeons working in peripheral centres with limited facilities for doing non microsurgical fingertip flaps and training them in doing these procedures will be helpful to so many patients who can't afford going to higher centres for treating fingertip injuries and those end up in shortening and stump closure otherwise. These surgeries are done under local or regional anaesthesia with the help of a loupe magnification microscope.^[5,6]

The flaps used in our series include Atasoy VY flap, Cross finger flap, Thenar flap and Moberg volar advancement flap. In some cases, eponychial fold recession was also used to expose part of nailbed which is hidden under eponychial fold.

MATERIALS AND METHODS

Patients who underwent non microsurgical flap cover for fingertip amputations from July 1st, 2022 to June 30th, 2023 were recruited for the study. Sample size calculated was 25.

In a similar study done with the same scoring system⁷, 186 out of 199 patients got either excellent or good functional outcome

- So $P = 186/199 = 0.93$

- $Q = 1 - p = 0.07$

- $D = 10\%$ (allowable error)

- $\alpha = \text{significance level} = 5\%$

- $Z = 1.96$

- $N = Z^2 \cdot pq/d^2 = 1.96^2 \times 0.93 \times 0.07$
0.12

Minimum sample size = 25

Age group selected was from 18 to 70. Patients were followed up during post-operative period, regular dressings were done, post-operative expert hand therapy was initiated under occupational therapist specialized in doing hand therapy. Patients were looked for development of any complications during the post-operative period. The functional outcome was calculated at the end of 6 months using fingertip injury outcome score. Fingertip injury outcome score was published in June 2022 in Plastic and Reconstructive Surgery Global Open Journal.

Inclusion and Exclusion Criteria

All the patients who underwent non microsurgical flap cover for fingertip amputations from October 1st, 2021 to March 31st, 2023 coming in age group 18-70 were recruited for the assessment. Those who were lost to follow up are not included in this series. The variables used in Fingertip injury outcome score includes

1. Status of nail – whether it is normal, small, split or deformed nail, hook nail or absent nail.
2. Finger length compared with normal side length from volar crease to fingertip – whether the tip is upto distal third, middle third or proximal third of normal finger.

3. Pulp is looked for whether it is well padded or having pulp atrophy.
4. Bone status is looked from Xray for – whether fracture is united (consolidated) or normal, whether non-union or bone shortening present.
5. Cosmesis is assessed – whether the finger cosmesis is satisfactory or not satisfactory (colour mismatch).
6. Sensations (2 Point Discrimination) is studied, whether patient is able to appreciate <6mm, 7-10mm, whether cold intolerance or absent sensation/hyperalgesia is present.
7. Status of pain is asked for – whether no pain, mild, moderate or severe pain is present.
8. Range of motion of each joint of affected finger is measured with goniometer and compared with that of normal side and categorised into 75-100% of that of normal side, 50-74% and less than 49%.
9. Similarly grip strength of both hands is measured with a Hand dynamometer and categorized into 75-100%, 50-74% and <49% of the affected side.
10. Whether the patient returned to regular job, whether his job got restricted or whether he is unable to work is also asked and data taken.

All these variables were categorized and score given according to Fingertip injury assessment score. Final outcome is considered as excellent when score is less than or equal to 12, Good when the score is between 13 and 18, Fair when the score is between 19 and 24, Poor when the score is more than 24.

Results	Score Value
Excellent	≤ 12
Good	13-18
Fair	19-24
Poor	≥ 24

Statistical Analysis

The statistical analysis was performed using SPSS for windows version 22.0 software (Mac, and Linux). The findings were present in number and percentage analyzed by frequency, percent, and Chi-squared test. Chi-squared test was used to find the association among variables. The critical value of P indicating the probability of significant difference was taken as <0.05 for comparison.

RESULTS

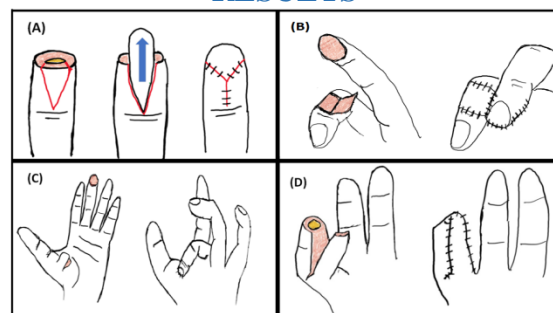


Figure 1: Diagrammatic representation of (A) VY (B) Cross finger flap (C) Thenar flap (D) Moberg volar advancement flap.

Cross Finger, (C) Thenar and (D)Moberg flaps

Out of the 25 cases we operated, 20 cases were males and 5 were females. Age group ranged from 19 to 70, mean age being 42. All the cases in our series had either excellent or good functional outcome according to Fingertip injury outcome score. 16 out of 25 cases had excellent outcome and 9 cases had good functional outcome.



Figure 2: (A) A volar favourable type of thumb tip amputation: (B) VY flap, (C) Eponychial fold separation (D) Result at 6 months



Figure 3: Mixer grinder injury in a housewife treated by cross finger flap and result at 6 months



Figure 4: (A) Fingertip amputation following RTA. (B) Flap separation at 3 weeks (C) Result at 6 months

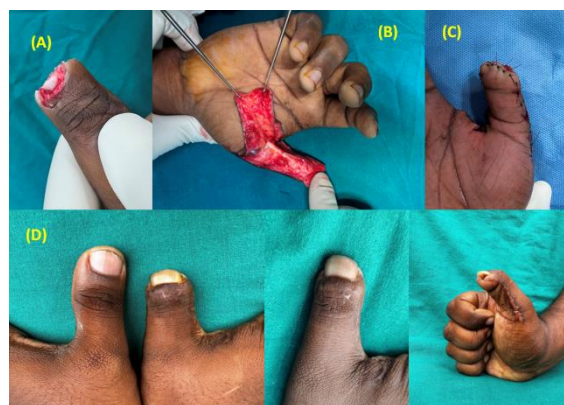


Figure 5: Palmar advancement flap (Moberg) for thumb (A) 19 year old boy with bike chain injury (B) Raising flap (C) after inset (D) Result at 6 months

About the mechanism of injury, 13 cases were worksite injuries, 8 of them were with wood cutting machines and 5 cases due to weight falling on hand. 5 cases happened while cleaning bike chain, 3 with mixer grinder, two were door crush and two were road traffic accidents.

Out of the 25 cases, 16 cases were VY flaps, 6 cross finger flaps, two thenar flaps, one case was volar advancement flap (Moberg) for thumb. In 8 cases, eponychial fold recession was added along with flap. 9 VY flaps were done under local anaesthesia, other cases were done under Brachial plexus block.

Time delay since injury to operation varied from 3 hours to 20 hours in cases treated primarily with flap cover, average time gap being 11.71 hours. One case was a delayed presentation due to gangrene of fingertip following conservative management of crush injury in which debridement and flap cover was done after 18 days of injury.

As per [Table 2] Out of the 16 VY flaps, 13 cases (81%) had excellent outcome and 3 cases (19%) had good functional outcome. Out of the six cross finger flap cases, one case (17%) had excellent outcome and 5 (83%) cases had good outcome. Both Thenar flaps had excellent outcome and the only one Moberg flap in the series had good outcome.

About sensations, 16 patients had two-point discrimination within 6 mm. 9 cases had two-point discrimination in the range 7 to 10 mm. No patients had cold intolerance or absent sensation/hyperalgesia. Among the VY flap patients, 12 patients had two-point discrimination <6 mm and 4 patients had two-point discrimination of 7-10 mm. Among the cross finger flap patients, one patient had two-point discrimination <6 mm and 5 patients had two-point discrimination of 7-10 mm. All the thenar flap and Moberg flap patients had two-point discrimination <6mm. [Table 3]

Six patients had mild pain and there was no pain in remaining 19 patients. Out of these patients with mild pain, three patients were those who underwent Cross Finger Flap and remaining underwent VY flaps. Three out of six patients who underwent Cross

Finger Flap was having mild pain at the end of six months but there was no statistical significance for that. [Table 4]

Table 1: Fingertip Injury Outcome Score

		Score
Nail	Normal	1
	Small nail	2
	Split nail or deformed nail	3
	Hook nail	4
Finger length	Distal third	1
	Middle third	2
	Proximal third	3
Pulp	Well padded	1
	Pulp atrophy	2
Bone	Fracture united or normal	1
	Nonunion	2
	Bone shortening	3
Cosmesis	Satisfactory	1
	Not satisfactory	2
Sensation (2-PD)	<6mm	1
	7-10 mm	2
	Cold intolerance	3
	Absent sensation/Hyperalgesia	4
Pain	No pain	1
	Mild	2
	Moderate	3
	Severe	4
Range of motion (TAM)	75%-100%	1
	50%-74%	2
	<49%	3
Grip strength	75%-100%	1
	50%-74%	2
	<49%	3
Return to work	Regular job	1
	Restricted job	2
	Unable to work	3

Table 2: Distribution of Flaps and functional outcome

Outcome	Type of flap				Total	P Value	Remark
	VY flap	CFF	Thenar	Moberg(Palmar advancement flap)			
Excellent	13 (52%)	1 (4%)	2 (8%)	0 (0%)	16 (64%)	0.013	Significant
Good	3 (12%)	5 (20%)	0 (0%)	1 (4%)	9 (36%)		
Total	16 (64%)	6 (24%)	2 (8%)	1 (4%)	25 (100%)		

Table 3: Sensations in different types of Flaps

Sensation (2PD)	Type of flap				Total	P Value	Remark
	VY flap	CFF	Thenar	Moberg			
1	12 (48%)	1 (4%)	2 (8%)	1 (4%)	16 (64%)	0.039	Significant
2	4 (16%)	5 (20%)	0 (0%)	0 (0%)	9 (36%)		
Total	16 (64%)	6 (24%)	2 (8%)	1 (4%)	25 (100%)		

Table 4: Pain status in different types of flaps

Type of flap	Pain		Total	P Value	Remark
	Mild	No			
VY flap	3 (12%)	13 (52%)	16 (64%)	0.332	Not Significant
CFF	3 (12%)	3 (12%)	6 (24%)		
Thenar	0 (0%)	2 (8%)	2 (8%)		
Moberg	0 (0%)	1 (4%)	1 (4%)		
Total	6 (24%)	19 (76%)	25 (100%)		

DISCUSSION

We operated 25 cases of non-microsurgical flap covers for fingertip amputations during 01-10-2021 to 31-03-2023. Four flaps are involved in our series of cases which include the Atasoy VY flap, Cross finger flap, Thenar flap and Palmar advancement

flap by Moberg. VY flaps were done in patients with transverse amputations or volar favourable type of amputations. These are comparatively less severe injuries compared to the cases undergoing other types of flaps. This may be the reason why patients who underwent VY flaps had better outcome compared with other types of flaps.

Nail deformity was noted in 4 cases out of 25 cases. One patient had hook nail deformity, one patient had nail deformity (pincer nail) and three cases had small nail. This is due to the significant loss of bone and not due to the problem with the surgical method. All the cases in our series had some amount of nailbed remaining and hence were Allen type 3 amputations, So the length of finger was reaching upto distal one third in all cases compared to corresponding finger on the normal side.

At the end of 6 months, all the patients regained full ROM, except Moberg flap patient in whom, ROM of thumb was 67 % of that of the other thumb. All the patients regained full grip strength and all the patients returned to normal work. Return to work after in number of weeks after injury is studied for different flaps. Among VY flap patients, 12 patients out of 16 (75%) returned to work in less than 6 weeks and 4 (25%) patients in 6-8 weeks' time. Among Cross Finger flap patients, five (83%) patients returned to work at 8 weeks or more after the injury and one patient (17%) returned to work in 6-8 weeks. In thenar flap, 50% of patients returned to work at 6-8 weeks and rest of them returned to work at 8 weeks. One Moberg flap patient was there, who returned to work at 8 weeks. These results are similar to the study done by Elliot D, O'Connor.^[8,9]

One patient who underwent VY flap had skin edge necrosis which was treated by release of tight sutures and allowing edges to granulate by secondary intention. Even in such case, we got acceptable cosmetic outcome. One patient who underwent VY flap and a nail template was put instead of the lost nail, there was localised infection under eponychial fold. Once pus collection was noted, nail template was removed and area washed with hydrogen peroxide and normal saline and infection got subsided completely.

In the study done by Keim and also by Marks the patients who had bone shortening at the time of injury naturally gets higher score according to the distribution of scores in this scoring system and hence lower outcome in scoring system which is similar to our study.^[10,11] Patients who underwent cross finger flap continue to have discoloration in the pulp for lifelong. Three patients got small nail in our series and 1 patient had hook nail. All patients underwent postoperative hand therapy and regained near normal ROM within 3-6 months. Most of the patients had persistent pain in initial few months which gradually subsided over a period of time. Grip strength was poor in initial period in most of the patients, which gradually improved to normal in 3-6 months. All the patients returned to normal work in 3 months.

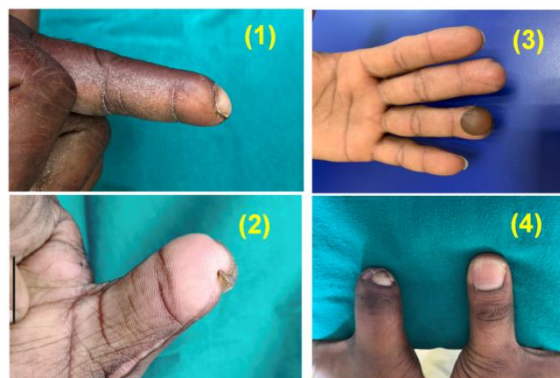


Figure 6: Some of the negative outcomes (1)Hook nail (2)Pincer nail (3)discolouration in cross finger flap (4)Small nail

CONCLUSION

Non microsurgical flaps are good and reliable options for bone coverage in Fingertip amputations and good alternative for shortening and stump closure. Proper selection of flaps according to the pattern of injury will provide excellent and good functional outcome in most of the cases. Good length of nail can be regained even from a very small amount of germinal matrix remaining. Eponychial flap separation will help to expose the nailbed hidden under eponychial fold and hence to regain good length of nail and better cosmetic appearance. All the patients undergoing non microsurgical flap covers following fingertip amputations return to normal work in period of two months' time. Cross Finger flap in dark skinned people will lead to permanent colour mismatch in fingertips. Non microsurgical flaps are reliable options for reconstructions in fingertip amputations. It provides excellent to good functional outcome and reasonable cosmetic acceptance and is a far better option than bone shortening and stump closure option in most of the cases.

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