

Cap-Plasty Reattachment for Unreplantable Fingertip Amputations

M.G.Ibrahim, M.O.Hegazy, W.A.Kandel and O.Eisawy

Orthopedic Surgery, Dept., Faculty of Medicine, Benha Univ., Benha, Egypt

E-mail: Eisawy654@yahoo.com

Abstract

Background: Distal inter-phalangeal joint [DIPJ] amputation is the amputation of a portion of the finger distal to this joint. Patients should expect a painless recovery with minor shortening of the fingertip while yet maintaining its normal function and appearance. For the present investigation, it was determined that cap-plasty approach was effective for treating unreplantable fingertip amputations distal to the insertion of Flexor Digitorum Perimeter Muscle. During the months of April 2020 and April 2022, a prospective study of 40 patients who had digital replantation using the cap-plasty approach was carried out to assess the procedure's success. At the Benha Orthopedic Department and Heliopolis Hospital, we gathered all of the participants for this research. Results: The survival rate of the distal stump was 92.5 percent in this research. As the mean value for two-point discrimination ranged from 3 to 10 mm, 90% of patients were able to return to their pre-injury function. The reattached fingertip had a mean pinch power of 74.75%, ranging from 65.75% to 85.75%. A self-report questionnaire was used to measure the cosmetic results. Patients were happy with an average fingertip shortening of 3.25mm, with a range of one to five millimetres, and an 85 percent approval rating. Children's two-point discriminating and finger shortening decreased statistically significantly. Complications occurred in 2 patients (5%) who had a superficial infection that was treated medically without requiring debridement, and in 10 patients (25%) who had Tip necrosis, of whom 4 were cured through primary healing, 3 were cured through granulation tissue, and 3 were unable to receive successful grafts. From six to ten months, the median follow-up length was 7.85 months. Because no issues arose in the children, the difference between the two groups was statistically significant. Conclusion: When microsurgical anastomosis is not achievable, cap plasty may be a viable procedure for treating distal fingertip amputations in adults and children. Patients were able to resume to their daily routines quickly because to the high success rate, excellent functional and sensational results, and patient satisfaction.

Key words: Cap, Plasty Reattachment, Unreplantable Fingertip Amputations.

1. Introduction

Distal inter-phalangeal joint [DIPJ] amputation is the amputation of a portion of the finger distal to this joint. There are many patients who come to the ER with this issue on a regular basis. Patients should expect a painless recovery with little shortening of the finger while yet retaining its function and looking good[1].

Hand and orthopaedic surgeons have long discussed the best way to treat fingertip injuries [2].

Methods for repairing fingertip amputations have been developed. [3] Replantation is a useful yet complex technique. Replantation isn't an option in every situation. Lack of adequate vessels for microsurgery, inability to perform microsurgery and crush injuries might prevent the use of this procedure.

A single volar V-Y plasty or a bilateral V-Y plasty is a frequent procedure. In some cases, the fingertip must be cut off and the incision closed using a flap from the surrounding tissue. The right patient may benefit from cross-finger flaps or thenar flaps. Flap necrosis, donor site morbidity, and finger stiffness, especially in elderly individuals, are all possible problems. Secondary intention, or allowing the wound to heal on its own, is an alternative [5].

It's possible, however, that this technique may lead to a lack of tolerance, hypersensitivity, and bad aesthetics. Closing a wound by main purpose is also conceivable, although it necessitates the finger being shortened and generally results in an unappealing outcome.

Composite grafting entails preparing the distal end of the wounded finger as well as the severed tip for suture reattachment to the finger.

Because it is the patient's own skin and pulp in its usual place, a composite transplant has the benefit of being cosmetically pleasant. With this surgery, there is less finger length loss compared to previous procedures, and it may be done in the emergency room with local anaesthetic. Time- and cost-effective, with a high success rate and excellent recovery of function, this approach is also a viable option.

It has been shown that attempts to 'cap plasty' that relies on the restoration of the dermal circulation as well as optimising contact area between the graft and recipient finger are more effective and predictable in children [5,6].

According to the bulk of the studies, the success rate for this surgery was between 50% and 80% in adults [44].

Adults might benefit from a variety of procedures to increase the success of a composite transplant. A technique known as cap-plasty with Cooling, in which ice is used to reduce the graft's metabolic requirement, has been tested by certain writers [7]. The distal stump has also been bled in an attempt to reduce venous congestion while awaiting neovascularization.

Evaluation of cap-plasty outcomes in amputations distal to the flexor digitorum profundus muscle attachment is the goal of this study.

2. Patients and Methods

This was a prospective study performed on 40 patients who underwent digital replantation with cap-

plasty technique and evaluate the outcome of this procedure during the period from April of 2020 to April of 2022.

All the study population were collected from Benha Orthopedic Department and Heliopolis hospital.

The data of the patients were presented after informed consent achievement and the steps of research were explained for them with the protection of privacy and confidentiality approved by ethical committee of the Faculty of medicine at Benha University.

2.1. Inclusion criteria:

The patients that were included in this study were those who had amputations distal to insertion of flexor digitorum profundus half cm proximal to nail bed were not suitable for microvascular repair.

2.2. Exclusion criteria

We excluded

- Any patients had fingertip amputation proximal to insertion of flexor digitorum profundus.
- Any patients had fingertip amputation exceed 24 hours from the time of injury.

Patients data:

Age: The main age was 20.85 ± 13.98 ranged from 2 to 45 years.

Sex of patients were 26 Males and 14 females with 40 amputated digits [4 thumb, 12 index, 16 middle, 6 ring and 2 little]. Right side affected in 24 patients while left side affected in 16 cases. Mechanism of injury was cutting 12 [30%] and crushing 28 (70%). 2 patients (5%) had infection, and 10 patients (25%) had Tip necrosis which healed by Reepithelialization. The mean follow-up period 7.85 was ranging from 5 to 10 months.

2.3. Methods

A] Preoperative assessment:

All the 40 patients were carefully assessed in the form of detailed history and clinical examination, radiological and laboratory investigations were done and interpreted along with the history and clinical findings.

History

All included patients were subjected to detailed history including:

Personal history:

- Name

- Age
- Dominant hand.
- Special habits.
- Sex
- Occupation
- Address
- Contact number

Complaint

History of patients' complaints were fully analyzed:

- Onset - Course - Duration
- The mechanism of amputation was recorded, adopting Biemer's definitions, as: cut - from a sharp object with no loss of tissue and minimal crushing while crush - from a blunt object with some loss and crushing of tissues^[9].

Past & family medical history:

Assessment of medical comorbidities was done with assistance of physician for better control:

- Diabetes mellitus
- Hypertension.
- Ischemic heart disease.

Clinical examination

All participants in the research had a general and local examination. There were four categories for determining the amputation level: I, which is above the mid-nail (eponychium), II, which is halfway between the nail base (i.e., between the mid-nail and the DIPJ), and III, which is midway between the eponychium and DIPJ.

There are two subcategories of Ia: beyond the distal edge of the nail and between the mid-nail and distal edge of the nail. [10, 11]. [12, 13]. [14, 15].

The flaw has been quantified by us. Measurements of lesion size and two-point discrimination in millimetres (the mean was 12.95mm, with a range of 8 to 19mm).

Investigation

CBC, coagulation profiles, liver and renal function tests, and blood glucose levels were all conducted in addition to ECG and any medical or cardiac consultations recommended by anaesthesia.

All patients had plain AP and lateral radiographs of the afflicted finger taken.

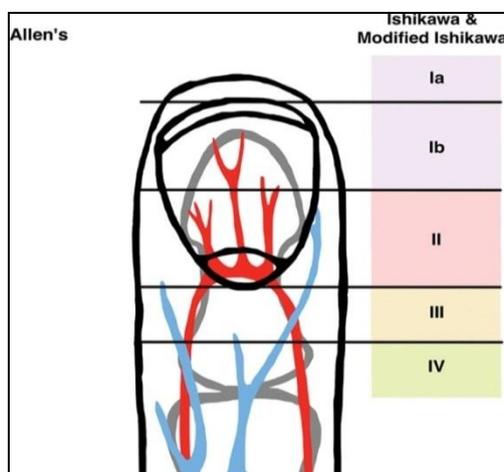


Fig. (1) Allen's/Ishikawa classification ^[11].

B) Surgical technique

We performed a digital block using 1 percent lidocaine (Xylocaine) without epinephrine administered on both sides of the proximal finger to achieve adequate anesthesia. If more extensive debridement was needed sedation with an agent such as midazolam [Versed] was done. Then we drained blood from the finger and applied a tourniquet using a rubber band or a small Penrose drain at the base of the affected digit.

We cleaned the wound thoroughly using saline with antibiotic and any devitalized tissue removed (fig 2A).

The amputated part was prepared on a separate table with debridement and irrigation (fig2B, followed by vessel identification under a microscope. When no suitable artery and vein could be found, the bone of the avulsed part is excised and the fat removed. The nail plate removed while the nail bed was preserved, and de-epithelialization of the proximal stump used to improve the take at the cap-nail complex. After the cap-nail complex was sutured to the proximal stump multiple punctures made in it and tie-over suturing used to improve survival of the cap.



Fig. (2) A proximal stump after debridement B distal stump after defatting.

2.4 Statistical Analysis

Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The data were presented as number and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution and median with inter quartile range (IQR) for the quantitative data with non-parametric distribution. *Chi-square test*, *Independent t-test* and *Mann-Whitney test* were used. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:
 P > 0.05: Non significant (NS)
 P < 0.05: Significant (S)
 P < 0.01: Highly significant (HS)

3. Results

Table (1) Demographic data of all patients

Demographic data		No	%
Sex	Female	14	35.0%
	Male	26	65.0%
Age	Mean± SD	20.85± 13.98	
	Range	2- 45	

Table (1) showed that there were 26 males (65%) and 14 females (35%). Mean of age was 20.85 with range from 2 to 45 years.

Table (2) Affected finger of all patients.

		No	%
Affected finger	Lt index	8	20.0%
	Rt index	4	10.0%
	Lt thumb	2	5.0%
	Rt thumb	2	5.0%
	Lt ring	2	5.0%
	Rt ring	4	10.0%
	Lt middle	2	5.0%
	Rt middle	14	35.0%

Table (2) showed that Affected finger was Lt index in 8 patients (20%), was Rt index in 4 patients (10%), was Lt thumb in 2 patients (5%), was Lt ring in 2 patients (5%), was Rt middle in 14 patients (35%).

used to improve the take at the cap-nail complex. After the cap-nail complex was sutured to the proximal stump multiple punctures made in it and tie-over suturing used to improve survival of the cap.

4.4. Post-Operative

The patient was shifted after surgery to the recovery area, where he was monitored for vital signs, and neurovascular status, then shifted to the ward after adequate recovery.

The wound was cared for with moist wound healing by applying an antibiotic ointment to the area. A

protective splint was applied to increase the graft survival then discharged after 24 hours.

4.5. Follow up

- First 2weeks repeated dressing was done every 3 days, the patient checked regularly for graft survival, finger function [static two-point discrimination was 7 mm &pulp pinch power was 65% & shortening in the finger length was 2mm [fig. 4].
- At 8weeks there were no complication.
- At 6 months the patient was satisfied and could use injured finger normally.

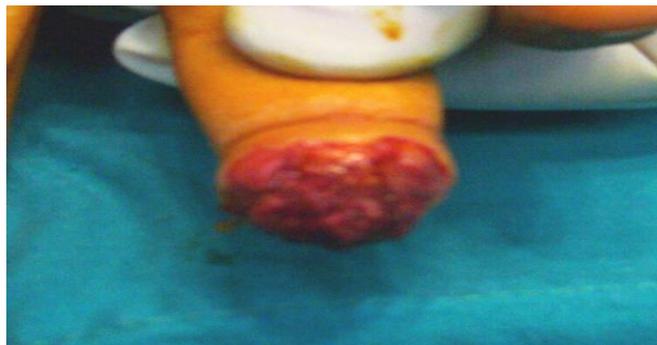


Fig. (3) amputation distal phalanx left ring finger at time of injury.



Fig. (4) the reattached fingertip after 2 weeks.



Fig. (5) follow up after 2months.

5. Discussion

The survival rate for the distal stump was 92.5 percent.

The survival of grafts, on the other hand, varied greatly across investigations.

86.95 percent of the patients in the trial by Uysal et al., which comprised 23 patients, 20 of whom were adults, obtained a success rate of 85 percent [5].

When 27 patients with 31 wounded fingers were included in a research, the overall transplant survival rate was 93.5 percent [4].

When it comes to paediatric patients, just 10 percent of the 97 individuals studied by Butler et al had full graft survival [12]. This was lower than the 22% overall complete graft survival rate reported by Moimen and Elliot in a prior large paediatric study [n=50] in 1997 [10].

Patients of all ages were included in the study design. The age varied from 2 to 45 years, with a mean of 20.85 13.98 years in the present research. A total of 26 males (65%) and 14 females (35%) were found in the sample. According to the results of a research done in 2020 by Hannah et al., the average age of the participants was 39.9 12.7 years (21–63) and the vast majority were men (n = 25, or 89.3%). [9].

According to a 2018 research by Borrelli and colleagues on 100 patients, the mean age was 4.413.98 years (range, 0.08–15.8). Males were (57 percent) and children under 4 y were (65 percent).

[11].

In 28 patients, 70 percent of the injury was caused by crushing, in 12 patients, 30 percent by cutting, and in 14 patients, 35 percent by the right middle finger. According to Chen et al., [67.7 percent] suffered crushing injuries, whereas [32.3 percent] suffered cutting injuries[4].

In Ng et al research, 31 damaged digits in 28 patients (32.3%), and nine of those patients had their middle fingertips injured.

As the mean value for two-point discrimination ranged from 3 to 10 mm, 90% of patients were able to return to their pre-injury function.

The reattached fingertip had a mean pinch power of 74.75%, ranging from 65.75% to 85.75%.

With an average fingertip shortening of 3.25mm ranging from 1 to 5mm, the self-report questionnaire results showed that 85% of patients were happy with the aesthetic results.

Children's two-point discriminating and finger shortening decreased statistically significantly.

Static two-point discrimination was found to be on average 6.5 mm [from 3 to 10 mm] and pulp pinch to be 67% of normal in previous investigations like Rosa et al. [6]. Fingertip shortening was on the order of 6.80 mm in Uysal et al's study [5] and the 2-point discrimination was 7.26 mm on average. The average 2-point discrimination was 6.3 mm (4) in Chen et al.

A research by Borrelli et al. found that the average finger shortening in 100 individuals was 3.93 2.84mm (1–10) [11].

A total of 12 individuals in the present research had complications, of whom, 2 (5 percent) had an infection that was superficial enough to be treated medically without requiring debridement, and 10 (25 percent) suffered from Tip necrosis. In addition, 3 patients had graft failure, 4 patients had primary healing, and 3 patients had granulation tissue healing. From six to ten months, the median follow-up length was 7.85 months.

Because no issues arose in the children, the difference between the two groups was statistically significant.

It has been reported by Borrelli and his colleagues that 17 percent of the 100 grafts were contaminated, 9 percent needed a re-operation, and 9 percent experienced wound healing difficulties [11].

Infection and necrosis are typical side effects of cap-plasty, and reoperation is usually limited to debridement or the insertion of additional skin grafts or flaps[13].

6. Conclusion

In our study we have concluded that cap plasty may be a useful technique in the management of distal fingertip amputations in adults and children when micro surgical anastomosis is not possible. Patients were able to resume to their daily routines quickly because to the high success rate, excellent functional and sensational results, and patient satisfaction.

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