ORIGINAL ARTICLE

Semi-occlusive Dressing as Non-operative Treatment vs. Operative Treatment for Fingertip Amputations: A Retrospective Cohort Study

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ABSTRACT

Introduction. Treatment of fingertip amputations have demonstrated good outcomes with both surgical and non-surgical management.

Objective. The objective of this study was to compare non-operative treatment with semi-occlusive dressing with any surgical treatment for fingertip amputations in adult fingers, Allen types I-III in a retrospective cohort review.

Methods. A retrospective chart review was done on adult patients with fingertip amputations Allen types I-III from January 1, 2018 to December 31, 2020. Patients included in the studies were distributed into two treatment groups: non-operative and operative groups. Outcomes to be measured were time to full healing, range of motion, nail deformities, Tinel's sign, and discoloration of the reconstructed fingertip.

Results. A total of 38 patients with 40 digits were included (19 patients with 20 digits for each treatment group). The results showed a larger defect for the operative group (3 cm^2 vs 2.1 cm^2), with shorter time to healing (1.4 months vs 2.2 months). There were more complications in the operative group like the Tinel's sign, nail deformity and discoloration, as well as joint contractures. Range of motion was better for patients treated non-operatively.

Conclusion. Treatment with semi-occlusive dressing showed similar results in terms of wound healing but takes a longer time and less complications compared to operative treatment.

Keywords: fingertip, semi-occlusive dressing, non-operative treatment

INTRODUCTION

Fingertip amputations are a common cause for consultation at the emergency department, especially in young men who perform manual labor.[1] It is defined as any soft tissue, nail and bony injury distal to the insertion of the long flexor and extensor tendons of a finger or thumb.[2,3] Common mechanisms of injury include crush injuries to the fingertip, sometimes accompanied by a subungual hematoma, nail bed laceration, partial or complete amputation of the fingertips, pulp amputations, and distal phalangeal fractures.[4,5]

The treatment options for fingertip amputations range from healing by secondary intention flap coverage, or replantation.[6] Healing by secondary intention has been reported to have good aesthetic appearance with minimal morbidity[7-9] and near normal recovery of sensation.[8,10] However, issues arise when the defect is larger or with exposed bone. In such cases, other authors would advocate

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flap coverage to provide a more robust and stable cover for the fingertip. Proponents of flap coverage argue that these procedures provide a more stable cover for the fingertip and replace the appearance of the fingertip[11] while skin closure with bone shortening can provide the shortest treatment and patient can return to work early.[6,11] Although a variety of treatment options are available, the ideal treatment will still be dependent on the patient, injury pattern, and surgeon experience.

The objective of this paper was to compare the outcomes of treatment using semi-occlusive dressing as non-operative versus operative treatment of fingertip amputations in a retrospective cohort design.

METHODS

A retrospective chart review was done on patients seen between January 1, 2018 to December 31, 2020 who had fingertip amputations. The inclusion criteria were as follows: adult patients aged ≥18 years old with single or multiple fingertip amputations with a classification of Allen Type I to Type III fingertip amputation,[12] treated within one week of the injury with surgery (any surgery for coverage of the fingertip amputation or non-operative treatment with semi-occlusive dressing or clear film). Exclusion criteria were fingertip injuries with associated injuries requiring surgical intervention like displaced distal phalangeal fractures and tendon lacerations; amputations that were grossly contaminated necessitating multiple debridement, and those with active infection at the time of initial consultation.

Treatment categories

All included patients were categorized into non-operative group with semi-occlusive dressing and operative group management to cover the defect. Non-operative management included washing of the wound with saline solution and wrapping the wound with a transparent sterile film or any hydrocolloid dressing. It is important that during dressing changes, the accumulated 'film' over the defect at the fingertip was not disturbed to encourage epithelization, where the film dressing acts as an artificial skin. Motion of the proximal joints was encouraged and no splint was applied. In the operative group, any surgery that was done to cover the defect was included. All follow-ups were done until complete epithelialization or healing of the defect was observed. Immobilization of the proximal joints in the operative group was advised as needed, depending on the method of coverage. All nailbed lacerations were repaired using 7-0 or 8-0 absorbable suture regardless of the management of the amputation. In the non-operative group, this was done in the emergency room setting under local anesthesia before sending the patient home. All exposed and protruding bone were cut flush with the soft tissue using a small rongeur.

Outcomes Assessment

The following outcomes were evaluated for each patient: time to full epithelialization (in days), range of motion (ROM) of the interphalangeal joints (in degrees), presence or absence of the following: discoloration, nail deformity, and Tinel's sign. Time to full epithelialization for the non-operative groups was assessed with full healing of the previous soft tissue defect.

Range of Motion (ROM)

Range of motion was measured during the follow-up period using a standard finger goniometer for the DIPJ (distal interphalangeal joint) and PIPJ (proximal interphalangeal joint) and was compared to the same finger of the contralateral side. The percent difference between the two was reported in this paper in the final follow-up examination. Discoloration and nail deformities were observed during follow-up. Discoloration was assessed as hypo or hyperpigmentation of the reconstructed fingertip. Nail deformity was assessed when full nail growth has occurred. Tinel's sign was elicited by gently tapping the reconstructed fingertip where patients will report any pain or pin-prick like sensation. All patients with Tinel's sign were referred for desensitization rehabilitation. Although Tinel's sign was present in almost all of the patients during the follow-up period, we considered its presence or absence on latest follow-up.

Statistical Considerations

All continuous data were reported as means with corresponding standard deviations. Frequencies were reported as percentages for categorical variables. No statistical significance was tested between the two treatment groups was attempted.

The study was approved by the institution's Ethics Review Board.

RESULTS

A total of 38 patients were identified that fulfilled the inclusion and exclusion criteria. Nineteen patients with 20 digits for each treatment group were included. The dominant hand was involved in more than half of the injuries. The defect was larger in the operative group (3 cm^2 vs. 2.1 cm^2). The Moberg flap was done on all thumb amputations (n=6) followed by V-Y advancement flap (n=6). Most amputations were of the Allen type III and the index finger was the most commonly affected finger. Crush amputation was the most common mechanism of injury (n=35 fingers), with blunt cut in 2, sharp cut in 2 fingers, and animal bite in one. In the non-operative group, the time to complete epithelization was 2.2 months compared to only 1.4 months for the operative group. A summary of the demographic characteristics of included patients are found in Table 1.

Table 2 summarized the outcomes in terms of appearance (nail deformity, discoloration), ROM, Tinel's sign, and other complications. Key findings showed that more nail deformities, discoloration and Tinel's sign were observed in the operative group. The percent difference of the ROM between the normal and injured finger was lower in the non-operative group.

A total of five complications (excluding the nail deformities, discoloration and Tinel's sign) were observed in the operative group. One flexion contracture of the DIPJ was revised to address severe hook nail deformity. The other hook nail deformities were not operated on.

Case Example 1

Non-operative treatment with semi-occlusive dressing

Patient 1 is a right-handed, 48-year-old female businesswoman who had a crushing injury from a heavy door on her left small finger five days prior to consultation. She sustained an Allen type III fingertip amputation (defect 1.4 x 1.5 cm) with a nailbed laceration (Figure 1A). The x-ray showed a displaced tuft fracture (Figure 1B) which was removed and the nailbed was repaired. The defect was managed with non-operative semi-occlusive dressing. The image at 18 days was shown in Figure 1C. At 5 weeks, the pulp has healed completely, but there was still some nail deformity (Figure 1D). The nail has healed completely without deformity at 6 months and this was the appearance at 14 months after injury (Figure 1E). Full range of motion was started on day 1. Figure 2 shows the comparison of the small finger with contralateral at 14 months (Figures 2A and 2B) and side view of the finger (Figure 2C). The color match was very good and there was no Tinel's sign and nail deformity.

Case Example 2

Patient 2 is a 38-year-old seaman, left-handed, who sustained a crush amputation of the left index finger, with an Allen type II and a defect size of 2 cm x 2 cm. A cross-finger flap was advised to create the lost pulp substance (Figures 3A-3D). The flap was released after 3 weeks and ROM was allowed minimally to avoid tethering the flap. At 4 months post release, there was full ROM with slight Tinel's sign and slight nail deformity (Figure 4A). There was also note of hyperpigmentation (Figures 4B and 4C) of the flap and slight Tinel's sign and slight nail deformity. Slight hair growth was observed on the flap (Figure 4C).

Table 1. Demographic Data on the Treatment Groups

	Non-operative (n=20)	Operative (n=20)
Age, years Mean (range)	42.8 (28-65)	33.4 (19-52)
Sex (Male:Female)	13:6	16:3
Dominant hand involvement (%)	59% (11/19)	63% (12/19)
Allen Classification		
I	2	1
II	4	8
II	14 (70%)	11 (55%)
Defect Area, cm^2 Mean (range)	25 (1.1-5)	3 (1-7.5)
Finger		
Thumb	4	6 (30%)
Index	7 (35%)	6 (30%)
Middle	4	5
Ring	2	1
Small	3	2
Time to healing (mean months, range)	2.2 (0.75-4.7)	1.4 (0.7-2.7)
Follow-up (mean months, range)	3.5 (0.75-26)	3.8 (0.75-24)
Surgery Performed		V-Y advancement flap – 6 Moberg flap – 6 Full thickness skin graft – 4 Cross-finger flap – 2 Release of flap – 2 Reverse Island flap with skin graft – 1 Spiral Flap – 1 Revision – 1

Table 2. Outcome in terms of Tinel's, Nail deformity, Discoloration, ROM, and other Complications

	Non-operative	Operative
Tinel's Sign (%)	20 (4/20)	30 (6/20)
Nail Deformity# (%)	15 (3/20)	25 (5/20)
Discoloration (%)	0 (0/20)	20 (4/20)
ROM DIPJ (% difference, SD)	n=20 (29.7, 29)	n=17 (36.2, 32)
Other complications	None	Delayed healing – 1 IPJ Flexion contracture (thumb) – 1 Extension contracture PIPJ – 2 Flexion contracture DIPJ with revision – 1

ROM – Range of Motion; DIPJ – distal interphalangeal joint; SD – standard deviation; IPJ – interphalangeal joint; PIPJ – proximal interphalangeal joint. #nail horn and hook nail

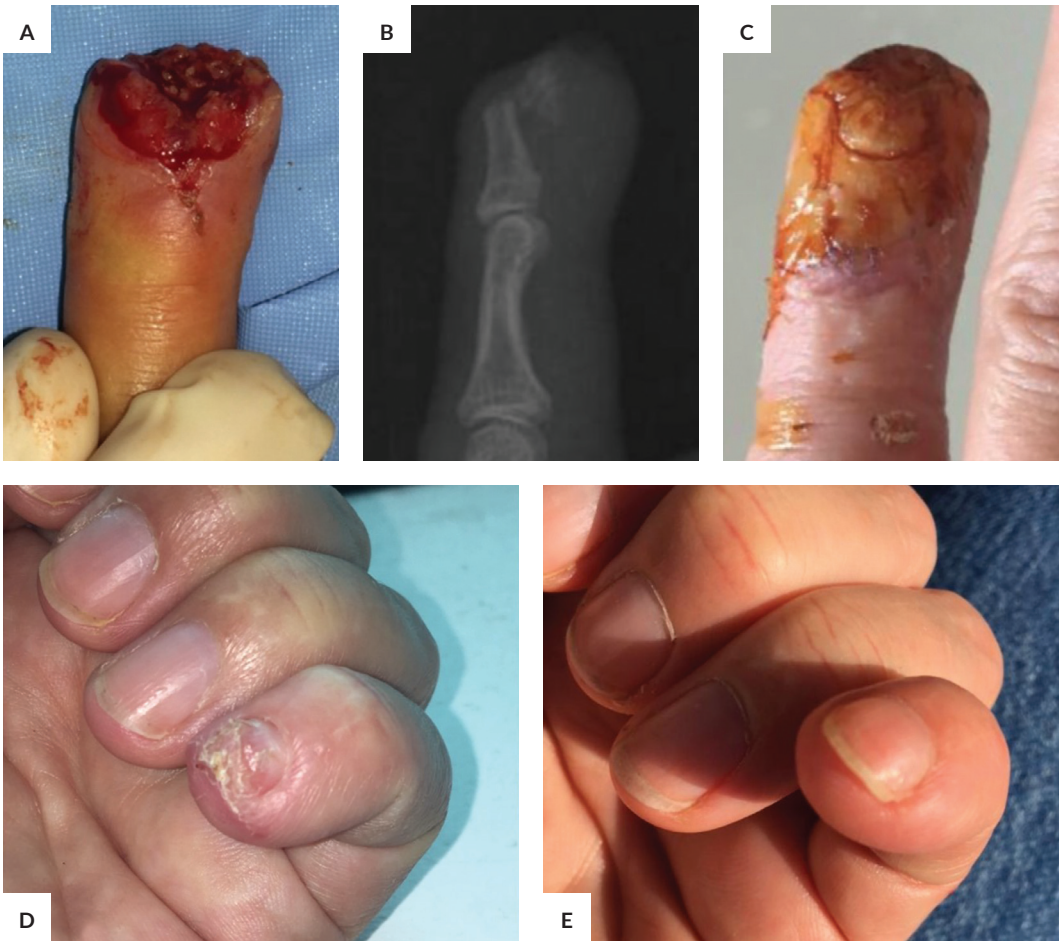

Figure 1. **(A)** Dorsal view of Allen type III fingertip amputation with nailbed laceration. **(B)** X-ray view showed a displaced tuft fracture. **(C)** Appearance at 18 days after initiation of semi-occlusive dressing. **(D)** Appearance at 5 weeks with complete healing of pulp defect but still with nail deformity. **(E)** Appearance at 14 months after semi-occlusive dressing with excellent nail growth and pulp reformation.

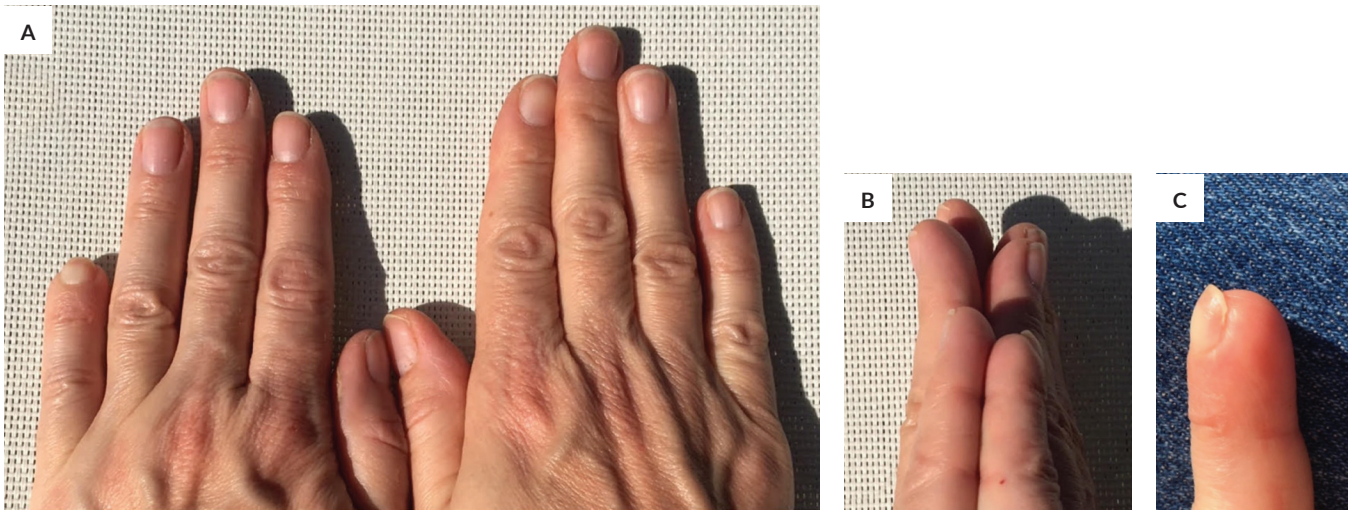

Figure 2. **(A)** Comparison of the injured small finger with the contralateral side at 14 months. **(B)** Side-to-side comparison at 14 months of small finger with note of shortening of the finger. **(C)** Side view with very good pulp growth at 14 months.

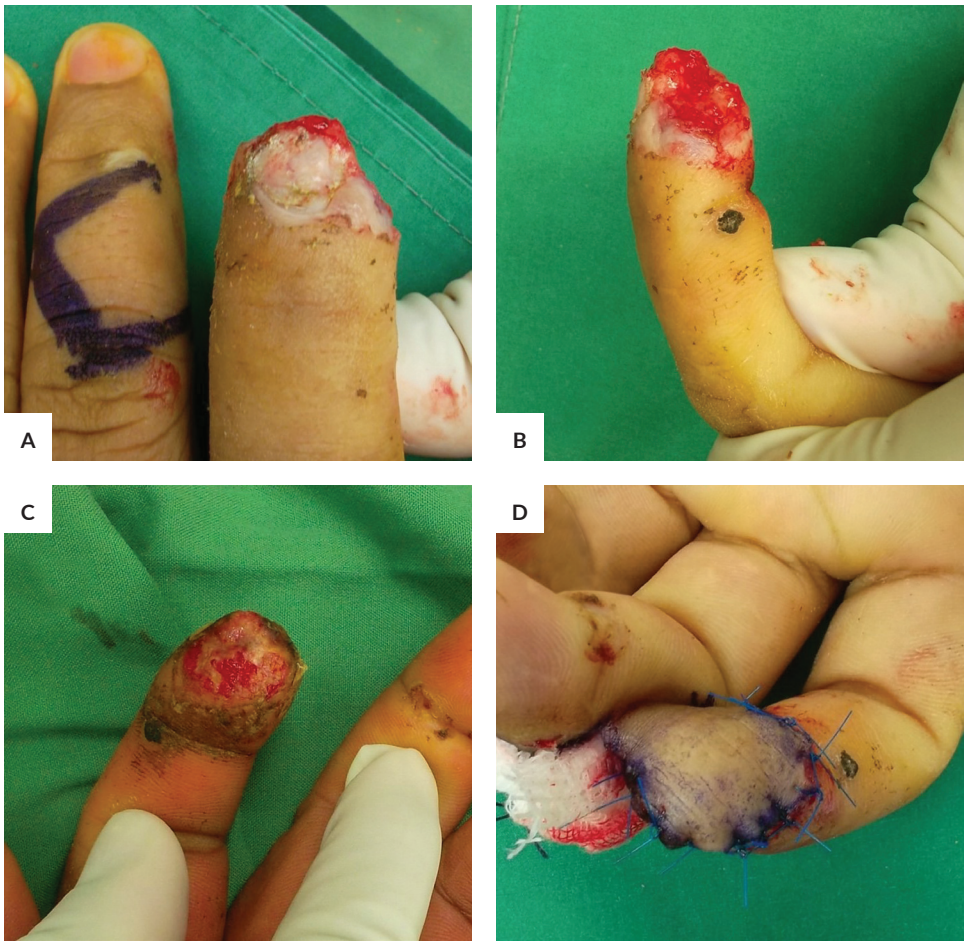

Figure 3. **(A)** Dorsal view of Allen type II fingertip amputation, with partial loss on radial side. **(B)** Radial view of the pulp defect. **(C)** Volar view of the pulp defect. **(D)** A cross-finger flap over the defect from the middle finger.

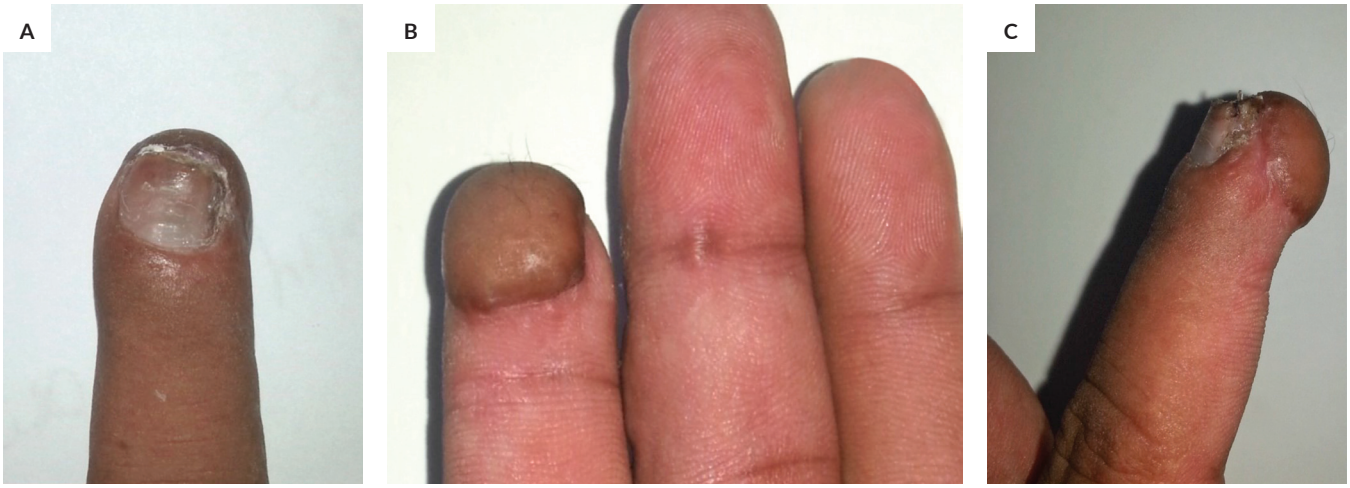

Figure 4. **(A)** Dorsal view at 4 months after release of flap with slight nail deformity. **(B)** Slight hair growth with discoloration/ hyperpigmentation of the cross-finger flap. **(C)** Radial view of the finger with discoloration of the flap.

DISCUSSION

Fingertip injuries are among the most common cause of emergency room consultations.[1] However, controversies still exist as to the choice of treatment for fingertip amputations. Recent studies have proposed novel non-surgical ways of managing these injuries in the form of petroleum jelly gauze dressings, semi-occlusive dressings (using Opsite), silver sulfadiazine cream or bacitracin ointment with gauze or a finger glove, and paraffin gauze dressing.[13]

The conservative treatment of fingertip amputations is not a new concept and was reported by Douglas[14] in 1972 and by Fox et al.[15] in 1977. Douglas[14] concluded that fingertip amputations in children are best treated with simple dressings. Although the level of fingertip amputations was not indicated, the author documented whether a bone was exposed or not. He noted a longer average time to complete healing with those with exposed bone compared to those without exposed bone.

There were no randomized control trials comparing surgical versus non-surgical options in treating fingertip amputations in adults. Comparative studies[14,16,17] are few and these studies showed that conservative treatment of fingertip amputations, even with exposed bone[17] are similar with operative treatments. Söderberg et al.[17] studied 36 surgically and 34 conservatively treated fingertip amputations with bone exposure. There were no differences in outcomes at follow-ups of more than one year. A retrospective study by van den Berg et al.[18] compared the outcomes of three treatment modalities: 1) reconstruction, 2) bone shortening and primary closure, and 3) healing by secondary intention, in Allen II-IV fingertip amputations. The mean reduction in strength, the Semmes-Weinstein monofilament test, and the reduction in mobility for the injured fingers compared with those of the uninjured finger were not significantly different between the groups. Cold intolerance, nail distortions, as well as aesthetic outcomes were comparable.[8]

A review on secondary healing of fingertip amputations by Krauss and Lalonde[13] showed that time to complete healing was on average 4 weeks, but with smaller defects (<1 cm^2) with no exposed bone; these healed within 2 weeks. Residual nail deformity was found to occur in 6% of the injuries, with the hook nail occurring in more proximal amputations, as well as in flap treatment. Sensation using two-point discrimination tests showed comparable results to the uninjured fingers. Cold intolerance was found in both surgically treated and conservatively managed fingers, which frequently resolved within one year.[13]

In 2017, a review was done by Sindhu et al.[19] and the authors reported that although non-operative treatment was a viable option, surgical treatment may be needed for larger defects and each injury should be treated in a case-to-case basis. Lee et al.[10] in 1995 used a 'cap' made from chitin, a biodegradable polymer, to cover fingertip defects in 156 fingertip injuries of more than 1 cm^2 defect. Their average healing time was 32 days.

In the present study, we found that most injuries occurred on the thumb and index finger, and most commonly from a crushing mechanism. On average, surgery led to healing after 1.4 months, while treatment with semi-occlusive dressing took 2.2 months. Although the time to healing in this series was reportedly longer compared to those reported in literature of around 20-30 days for non-operative treatment.[8,17] The reason for this is probably the definition of complete healing. Usually at 4 weeks, the wound or defect has been completely covered but with slightly hyperpigmented skin. Although stable, we defined 'complete epithelization' as very similar to the surrounding skin. We found that the reconstitution of the pulp bulkiness was also achieved with the non-operative treatment. The technique is simple and works in amputations of up to Allen type III. During dressing changes, we advised the patients not to remove the "film" that has covered the wound. This "film" served as an artificial skin that preserves the pH, temperature, moisture and immunoglobin concentration that is necessary to create epithelialization and new skin growth.[8] Although during dressing changes, the fluid may look and smell like pus, we advise them to just clean the part that is on normal skin and leave the "film" on the wound to induce granulation and epithelialization. Some studies have extended this technique up to Allen type IV amputations with good result but with longer duration of treatment until epithelization of up to 10 weeks.[20] A possible advantage of semi-occlusive dressing would be the ability to address these injuries in an outpatient setting or emergency room setting, without any need for admission. The present study demonstrated that despite having exposed bone (with majority of our samples presenting with Allen Type III injuries), healing was achieved with no significant cosmetic and functional impairments when compared with surgery. Although non-surgical treatment took longer, there were lesser complications of joint stiffness and contractures, nail deformities, and discoloration. These complications were most likely from the different procedures done. For example, joint stiffness may have resulted from the two-stage surgery of cross finger flaps where the finger is immobilized for two weeks before flap release, which is probably the reason of joint stiffness, flexion contracture or extension contracture. In the non-operative treatment with semi-occlusive dressing, immediate range of motion was started after the application of the dressing. Although there are no established protocols in the authors' institution, the type of treatment for fingertip amputations is usually determined by the surgeon and the patient.

This study has many limitations. Aside from the small sample size and the retrospective nature, other outcomes such as patient acceptance, pain, pulp thickness, sensory recovery, and functional score were not measured in the two treatment groups. Other outcomes may also include costs of non-

surgical versus surgical management, as well as comparing the time to return to work. A randomized controlled trial with adequate sample size may be able to answer the question on which treatment will give the best outcome for fingertip amputations.

CONCLUSION

Both non-operative treatment with semi-occlusive dressing and operative treatment are good options in the management of fingertip amputations. However, the operative group tend to have joint contractures, nail deformities, and discoloration compared to the non-operative treatment. The longer time to healing of non-operative treatment compared with operative treatment is one of the disadvantages and may be considered when deciding which treatment will be most appropriate.

Statement of Authorship

EPE contributed in the conceptualization of work, acquisition and analysis of data, and drafting and revising of manuscript; PVSJR contributed in the conceptualization of work, acquisition and analysis of data, and initial draft of manuscript.

Author Disclosure

Both authors declared no conflicts of interest.

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