

Randomized controlled trial comparing frequency of post operative infection in patients undergoing nail bed repair with nail replacement versus non replacement

Sobia Yasmeen, Moiz Sadiq, Mirza Shehab Afzal Beg

ABSTRACT

Introduction: Finger tip entrapment injuries are common in children and represent approximately two thirds of all the hand injuries in children. The nail plate is crucial for normal functioning of hand; it protects from injury to fingertip, regulates the circulation of fingertip, helps to hold small objects by giving counterforce and adds to the tactile sensation of fingertip. If not treated properly, nail complex injury can potentially cause considerable dysfunction and/or deformity. Despite the common occurrence, controversy remains around the appropriate treatment of nail bed injuries.

Objective: To compare the frequency of post operative infection in patient undergoing nail bed repair with nail replacement versus non replacement

Materials and Methods: It was a Randomized controlled trial conducted at the Emergency and outpatient department of plastic and reconstructive section of Liaquat national hospital, Karachi. Total 152 patients with acute nail bed injury were included in this study. These patients were randomly allocated into two groups, 76 patients in group A received nail replaced after nail bed repair and 76 patients in group B had the nail discarded. Post operatively all patients were given antibiotic for three days. Participating patients were advised to attend plastic surgery clinic for the assessment of post operative infection at one week after surgery.

Results: Mean age of the patients in group A was 8.98 ± 4.59 years and in group B was 7.01 ± 4.02 years. Rate of post-operative infection was significantly high in group A than to group B (38.16% vs. 21.05%; $p=0.021$).

Conclusion: Management of a fingernail injury should be selected on the basis of injury type and extent, and requires accurate knowledge of nail anatomy and physiology. Nail replacement after nail bed repair is controversial and resulted in increased morbidity, but long term results of nail replacement are not available and need further studies.

Key Words: nail bed injuries, Finger tip, post operative infection, nail replacement

Liaquat National Hospital, Karachi
Pakistan.

Corresponding author: Mirza Shehab Beg.
shehabbeg@hotmail.com

Introduction

Finger tip entrapment injuries are common in children and represent approximately two thirds of all the hand injuries in children. Among them, nail bed injuries proposed to happen in 15-24 percent of cases.^[1,2] The nail plate is crucial for normal functioning of

hand , it protects from injury to fingertip, regulate the circulation of fingertip, helps to hold small objects by giving counterforce and adds to the tactile sensation of fingertip.^[3-6] If not treated properly, nail complex injury can potentially cause considerable dysfunction and/or deformity.^[4,7,8-10] Despite the common occurrence, controversy remain around the appropriate treatment of nail bed injuries.^[3,11,12] The usual practice is to remove the nail plate ,repair nail bed laceration with fine absorbable suture and replacing the nail under the eponychium (that is the proximal nail fold).^[1,13-16] The replaced nail plate has no capacity of regeneration but the rationale for replacing it is to protects the nail bed repair as it acts as a splint by holding open the nail fold and preventing scarring (synechae) between the nail fold & the nail bed.^[17,18] However there is no evidence that replacing the nail has better result than not replacing it and non replacement of the nail did not appear to adversely affect the nail re-growth and nail appearance.^[16] A recent retrospective study by Miranda et al in 111 patients of pediatric age group (patients younger than 16 years of age) proposed that replacing the nail plate is associated with increased complication (17.6%) in particular the development of post operative infection(7.8%).^[19] The authors advocated simply discarding the nail plate and dressing the repaired nail bed with non adherent dressing . The reason for this complication is that the replaced nail plate works as a foreign body to trap bacteria and increases the risk of infection. Since there is paucity of convincing data regarding frequency of infection after nail bed repair with or without nail plate replacement, and except Miranda's study, no other study has been done to document the increased infection rate after nail replacement in nail bed repair cases; this

study will compare the frequency of post operative infection following both of these methods. Depending on the results, if nail plate replacement is found to be associated with increased frequency of post operative infection, then this study may change the current practice of nail plate replacement after nail bed repair and discarding the nail plate may reduce the overall morbidity, cost, hospital burden with less follow up visits and readmissions.

Materials and Methods

A Randomized controlled trial was held at the emergency and outpatient department of plastic and reconstructive section of Liaquat national hospital, Karachi, from July 2017 to June 2018. Total 152 patients (Both male and female), from age 01 month to 16 were years enrolled in the study.The sampling technique was non-probability consecutive sampling. All patients with acute nail bed injury, presenting within 48 hours of injury were included with various types of injuries including laceration, crush and avulsion injuries of nail-bed with or without associated pulp laceration /tuft fracture of distal phalanx (defined on radiological examination). Patient with already infected nail bed injury, underlying nail disease or deformity prior to surgery, an associated distal phalanx fracture requiring fixation with a kirschner wire, complete amputation of the distal fingertip including all or part of the nail bed which requires repair as a composite graft or replantation, loss of part or all of the nail bed requiring a nail bed graft or flap reconstruction and patients who are on Immunosuppression therapy were excluded from study. Informed and written consent was taken for inclusion in the study. Patients demographics were recorded in emergency department including hospital record

number, age, gender, digit involved, handedness, nature and mechanism of injury and the presence or absence of fracture. Nail bed repair was performed after adequate washout & debridement and repair was completed with 6-0 vicryl rapide interrupted sutures. The nail was either discarded or replaced with figure of eight suture.

Randomization was done using sealed envelopes (picked up by treating doctor) with allocation to either group determined just prior to surgery. Group A had nail replaced after nail bed repair and Group B had the nail discarded. Neither the patient, family nor the treating doctor was blinded and consent was taken for both the methods.

The fingertip was dressed with the same non adherent dressing in both groups. Peri operative medical treatment were standardized. All patients were given prophylactic antibiotic (injection Augmentin). Details of operation carried out including whether or not the nail was replaced, was recorded on a pre-designed form. Post operatively all patients were given antibiotic (tablet/syrup amoxicillin+ clavulanic acid according to weight) for three days. Participating patients were advised to attend plastic surgery clinic for the assessment of post operative infection at one week after surgery. Assessment was done by a consultant Plastic surgeon at 01 week post-operative using subjective assessment. Presence of two or more of the following signs was labeled as post-operative infection:

1. Cellulitis (Presence of at least one of the following; tenderness, localized swelling, redness or heat when compared with the contra lateral normal finger)
2. Purulent discharge
3. Malodor^[33]

All data analysis was performed using SPSS statistics version 20. Mean +/- SD of age, time duration since injury and operative time were assessed. Frequency and percentages were calculated for qualitative variables like gender, hand involved, finger involved, distal phalanx fracture, pulp laceration, cellulitis, purulent discharge, malodor and post operative infection. Effect modifier like age, gender, involved hand and finger, distal phalanx fracture and operative time were controlled through stratification. Post stratification, Chi square test was applied to compare the frequency of post operative infection in both groups taking p-value ≤ 0.05 as significant.

Results

There were 152 patients with acute nail bed injury included in this study. These patients were randomly allocated into two groups, 76 patients in group A had nail replacement after nail bed repair and in 76 patients in group B the nail was discarded. Mean age of the patients in group A was 8.98 ± 4.59 years and in group B was 7.01 ± 4.02 years. Mean time since injury to the presentation in Emergency department (Hours) was $22.04 (\pm 6.29)$ and $17.67 (\pm 6.54)$ for group A & group B respectively. The operative time for group A (minutes) was $76.44 (\pm 27.69)$ and for group B was $72.59 (\pm 29.69)$. There were 61.8% (94/152) male and 38.2% (58/152) female. Affected hand fingers statistics of the patients is reported in *table 1*. Regarding mechanism of injury, most of the fingers were crushed by door (23.7%, 36/152) and by machine (16.4%, 25/152), followed by sharp cut 30.9% (47/152), other were slip (14.5%, 22/152) and sport injury 14.5%, 22/152). Frequency of mechanism and nature of injury with respect to group is presented in *figure 1 and 2*. Distal phalanx fracture was

observed in 55.3% (50% in group A & 60.63% in group B)) cases and pulp laceration was reported in 47.4% (50% in group A & 44.74% in group B).

Rate of cellulites, purulent discharge, and malodor was significantly high in group A than group B as shown in *table 2*. Infection was assessed at 01 week post-operative using subjective assessment. Presence of two or more of the signs like cellulites, purulent discharge, and malodor was labeled as post-operative infection. Rate of post-operative infection was significantly high in group A than to group B (38.16% vs. 21.05%; $p=0.021$).

Stratification analysis was performed according to age, gender, hand and finger involvement, distal phalanx fracture, pulp laceration and operative time. Rate of post-operative infection was not significant between groups in age stratum, gender stratum, finger involved stratum as shown in *table 3* respectively while rate of post-operative infection was significantly high in group A than to group B in right hand stratum and those patients with fracture cases, pulp laceration and prolonged operative time as shown in *table 4*.

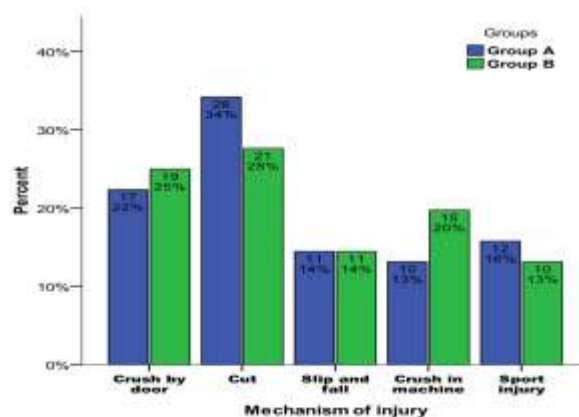


Figure 1: Mechanism of Injury (n=152)

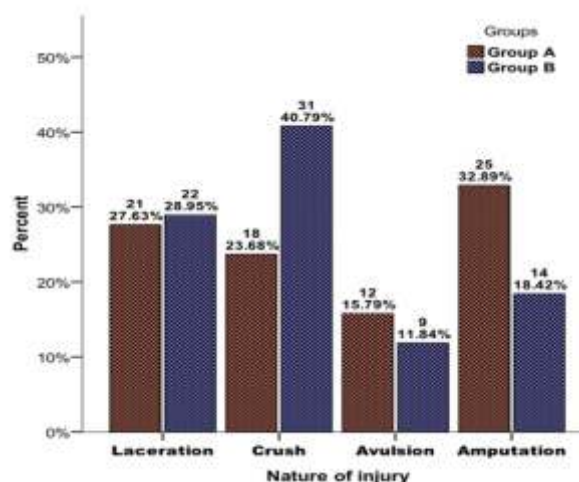


Figure 2: Nature of Injury (n=152)

Table 1: Hand and Finger Involvement with Respect to Groups

Variables	Group A n=76	Group B n=76	Total
Hand Involved			
Right	39(51.3%)	50(65.8%)	89(58.6%)
Left	37(48.7%)	26(34.2%)	63(41.4%)

Variables	Group A n=76	Group B n=76	Total
Hand Involved			
Right	39(51.3%)	50(65.8%)	89(58.6%)
Left	37(48.7%)	26(34.2%)	63(41.4%)
Finger Involved			
Thumb	9(11.8%)	13(17.1%)	22(14.5%)
Index Finger	28(36.8%)	15(19.7%)	43(28.3%)
Middle Finger	20(26.3%)	23(30.3%)	43(28.3%)
Ring Finger	16(21.1%)	18(23.7%)	34(22.4%)
Little Finger	3(3.9%)	7(9.2%)	10(6.6%)

Table 2: Subjective Assessment of Fingers with Respect to Groups

Variables	Group A n=76	Group B n=76	P-Value
Cellulitis	38(50%)	24(31.6%)	0.021
Purulent discharge	22(28.9%)	9(11.8%)	0.009
Malodor	30(39.5%)	18(23.7%)	0.036

Table 3: Comparison of Post Operative Infection Between Groups

Groups	Post Operative Infection	Group A	Group B	P-Value
<i>Age Groups</i>				
1 to 6 Years	Yes	15(34.9%)	4(15.4%)	0.079
	No	28(65.1%)	22(84.6%)	
	Total	43	26	
7 to 12 Years	Yes	9(45%)	6(20.7%)	0.070
	No	11(55%)	23(79.3%)	
	Total	20	29	
13 to 16 Years	Yes	5(38.5%)	6(28.6%)	0.54
	No	8(61.5%)	15(71.4%)	
	Total	13	21	

<i>Male vs Female</i>				
Male	Yes	14(31.8%)	9(18%)	0.120
	No	30(68.2%)	41(82%)	
	Total	44	50	
Female	Yes	15(46.9%)	7(26.9%)	0.174
	No	17(53.1%)	19(73.1%)	
	Total	32	26	
<i>Involved fingers</i>				
Thumb	Yes	4(44.4%)	2(15.4%)	0.178
	No	5(55.6%)	11(84.6%)	
	Total	9	13	
Ring Finger	Yes	8(50%)	6(33.3%)	0.487
	No	8(50%)	12(66.7%)	
	Total	16	18	
Middle Finger	Yes	5(25%)	3(13%)	0.440
	No	15(75%)	20(87%)	
	Total	20	23	
Index Finger	Yes	10(35.7%)	4(26.7%)	0.735
	No	18(64.3%)	11(73.3%)	
	Total	28	15	
Little Finger	Yes	2(66.7%)	1(14.3%)	0.183
	No	1(33.3%)	6(85.7%)	
	Total	3	7	

Table 4: Comparison of Post Operative Infection Between Variables

Variables	Post-Operative Infection	Group A	Group B	P-Value
<i>Hand Involved</i>				

Right	Yes	15(38.5%)	8(16%)	0.027
	No	24(61.5%)	42(84%)	
	Total	39	50	
Left	Yes	14(37.8%)	8(30.8%)	0.56
	No	23(62.2%)	18(69.2%)	
	Total	37	26	
<i>Distal phalanx fracture</i>				
No	Yes	11(28.9%)	11(23.9%)	0.601
	No	27(71.1%)	35(76.1%)	
	Total	38	46	
Yes	Yes	18(47.4%)	5(16.7%)	0.008
	No	20(52.6%)	25(83.3%)	
	Total	38	30	
<i>Pulp laceration</i>				
Yes	Yes	18(47.4%)	7(20.6%)	0.017
	No	20(52.6%)	27(79.4%)	
	Total	38	34	
No	Yes	11(28.9%)	9(21.4%)	0.438
	No	27(71.1%)	33(78.6%)	
	Total	38	42	
<i>Operative time</i>				
>90 minutes	Yes	23(48.9%)	12(21.1%)	0.003
	No	24(51.1%)	45(78.9%)	
	Total	47	57	
≤90 minutes	Yes	6(20.7%)	4(21.1%)	0.976
	No	23(79.3%)	15(78.9%)	
	Total	29	19	

Discussion

Fingernails have an important role in hand function. They protect the dorsal surface of the distal phalanges of the fingers and increase sensitivity of the fingertip. The fingernails facilitate the pinch of small objects, allow scratching, and have a fundamental cosmetic role. Fingertip injuries might result in significant morbidity due to causation of moderate-to-severe pain, distortion of body image, loss of work & recreational hours and financial burden. Suboptimal management of these injuries can result in persistent pain, excessive tenderness, abnormal sensation, atrophy of soft tissue, finger shortening, nail deformity, joint stiffness in the affected digit and reduced grip strength.^[20] Despite the frequency of crush injuries to the fingertip, there remains significant controversy regarding the appropriate management of these injuries. The decision to remove the nail and repair the nail bed is often based on personal preference.^[21,22] To compare the frequency of post-operative infection in patient undergoing nail bed repair with nail replacement versus non replacement, we included 152 patients, Age 01 month to 16 years, with acute nail bed injury. These patients were randomly allocated into two groups, 76 patients in group A had nail replacement after nail bed repair and 76 patients in group B had the nail discarded. From the epidemiological point of view, most fingernail injuries are caused by crush trauma and involve children and young adults ^[14, 23]. In about 50% of cases, fingernail injuries are associated with phalangeal fractures. ^[24] Similar to the previous data, in our study the mean age of the patients in group A was 8.98±4.59 years and in group B was 7.01±4.02 years. Distal

phalanx fractures were observed in 55.3% (84/152) cases. Literature shows that with respect to the pediatric population, fingertip injuries account for approximately two-thirds of all hand injuries^[25,26] with the commonest mechanism being jamming or crushing the finger between a door and its frame in the home setting.^[27,28] Damage to the nail bed occurs in 15–24% of all fingertip injuries in children.^[1] The most frequent causes of finger amputations in children aged less than 3 years were bicycles and other mechanical sports equipment with spoked wheels and chains.^[29] The majority of fingertip injuries in adults are caused by domestic and occupational accidents. Regarding mechanism of injury in our study, most of the fingers were crushed by door (23.7%) and by machine (16.4%), followed by sharp cut 30.9%, other were slip (14.5%) and sport injury (14.5%), and pulp laceration was reported in 47.4% cases.

Presence of two or more of the sign like cellulites, purulent discharge, and malodor was labeled as post-operative infection and this study showed a higher rate of post-operative infection in group A than to group B (38.16% vs. 21.05%; p=0.021). Our results are supported by a recent study by Miranda et al. In this retrospective study, they examined the outcomes of nail bed repairs in 111 children. In particular, the occurrence of delayed wound healing (11.7 versus 3.3 %; p = 0.004) and post-operative infection (7.8 versus 0 %; p < 0.0001) was significantly greater in the nail replacement group. There were significantly more outpatient visits and a longer overall follow-up period required in the nail replacement group compared to the nail discarded group.^[30] In contrast to this in a retrospective observational study, nail

replacement as a dressing following nail bed repair was compared with non-replacement.^[31] No significant difference was found in terms of nail appearance or nail re-growth.

The reason for this apparent increase in infective and wound healing complications is thought to be that the replaced nail plate acts as a foreign body to 'trap' bacteria and procedure infection more likely. If this is the case, the simple act of discarding the nail plate could result in a significant reduction in the overall morbidity associated with this procedure, as well as a reduced burden on patient's family due to follow-up visits, antibiotic courses and, in severe cases, hospital readmission.

Conclusion

Nail bed injuries are the most common pediatric hand injury, yet there is a limited evidence base to guide treatment. Management of a fingernail injury should be selected on the basis of injury type and extent, and requires accurate knowledge of nail anatomy and physiology. An effective emergency treatment is mandatory to prevent secondary deformities and reduce the chances of secondary reconstruction of the nail bed, which often gives unpredictable results. It is common practice to replace the nail after repairing the nail bed, but this is not known to improve the outcome and associated with increased morbidity and post-operative complications including infection but long term results of nail replacement are not available and need further studies.

References

1. Inglefield CJ, D'Arcangelo M, Kolhe PS. Injuries to the nail bed in childhood. *J Hand Surg Br.* 1995;20(2):258-61.

2. De Alwis W. Fingertip injuries. *Emerg Med Australas.* 2006;18(3):229-37.
3. Gellman H. Fingertip-nail bed injuries in children. *J Craniofacial Surg.* 2009;20(4):1033-5.
4. Masters FW, Ashbell TS, Kleinert HE, Putcha SM, Kutz JE. The deformed finger nail, a frequent result of failure to repair nail bed injuries. *Plast Reconstr Surg.* 1967 Aug 1;40(2):196.
5. Verdan CE, Egloff DV. Fingertip injuries. *Surg Clin North Am.* 1981 Apr;61(2):237-66.
6. Zook EG. Anatomy and physiology of the perionychium. *Clin Anat.* 2003;16(1):1-
7. Hart RG, Kleinert HE Fingertip and nail bed injuries. *Emerg Med Clin North Am.* 1993;11(3):755-65.
8. Beasley R. Fingernail injuries. *J Hand Surg Am.* 1983;8(5):784-85.
9. Grad JB, Beasley RW. Fingertip reconstruction. *Hand Clin.* 1985;1(4):667-76.
10. Shepard GH. Management of acute nail bed avulsions. *Hand Clin.* 1990;6(1):39-56; discussion 57-8.
11. Mignemi ME, Unruh KP, Lee DH. Controversies in the treatment of nail bed injuries. *J Hand Surg Am.* 2013;38(7):1427-30.
12. Capstick R, Giele H. Interventions for treating fingertip entrapment injuries in children. *Cochrane Database Syst Rev.* 2014;30(4):CD009808.
13. Brown RE. Acute nail bed injuries. *Hand Clin.* 2002;18(4):561-75.
14. Zook EG, Guy RJ, Russell RC. A study of nailbed injuries: causes treatment, and prognosis. *J Hand Surg Am.* 1984;9(2):247-52.
15. Shafritz AB, Hayes EP. Fingertip and nail bed injuries. *Hand Surg.* 2004:1101-18.
16. Bindra RR. Management of nail-bed fracture-lacerations using a tension-band suture. *J Hand Surg Am.* 1996;21(6):1111-3.

17. Weinand C, Demir E, Lefering R, Juon B, Voegelin E. A comparison of complications in 400 patients after native nail versus silicone nail splints for fingernail splinting after injuries. *World J Surg.* 2014;38(10):2574-9.
18. Miranda BH, Vokshi I, Milroy CJ. Pediatric nail-bed repair study: part 2. fact or fixation? *Plast Reconstr Surg.* 2015 Nov;136(5):717e-9e.
19. Miranda B, Vokshi I, Milroy CJ. Pediatric nailbed repair study. *Plast Reconstr Surg.* 2012;129(2):394e-96e.
20. Kligman AM. Why do nails grow out instead of up?. *Arch Dermatol.* 1961;84:313-5.
21. Peterson SL, Peterson EL, Wheatley MJ. Management of fingertip amputations. *J Hand Surg.* 2014;39(10):2093-101.
22. Mennen U, Wiese A. Fingertip injuries management with semi occlusive dressing. *J Hand Surg.* 1993;18:416-22.
23. Hedges JR. Subungual hematoma. *Am J Emerg Med.* 1988;6(1):85.
24. Doraiswamy NV, Baig H. Isolated fingertip injuries in children: incidence and aetiology. *Injury.* 2000;31(8):571-3.
25. Salazard B, Launay F, Desouches C, Samson P, Jouve JL, Magalon G. Fingertip injuries in children: 81 cases with at least one year follow-up. *Rev Chir Orthop Reparatrice Appar Mot.* 2004;90(7):621-7.
26. Ljungberg E, Rosberg H, Dahlin L. Hand injuries in young children. *J Hand Surg.* 2003;28:376-80.
27. Laflamme L, Eilert-Petersson E. Injuries to pre-school children in a home setting: patterns and related products. *ActaPaediatr.* 1998;87:206-11.
28. Routley V, Valuri J. Home injuries. victorian injury surveillance system. Hazard: Monash University Accident Research Centre; March 1993.
29. Fetter-Zarzeka A, Joseph M. Hand and fingertip injuries in children. *Pediatr Emerg Care.* 2002;18(5):341-5.
30. Baker G, Kleinert J. Digit replantation in infants and young children: determinants of survival. *Plast Reconstr Surg.* 1994;94(1):139-45.
31. Miranda BH, Vokshi I, Milroy CJ. Pediatric nail bed repair study: nail replacement increases morbidity. *Plast Reconst Surg.* 2012;129(2):394e-6e.
32. O'Shaughnessy M, McCann J, O'Connor TP, Condon K. Nail re-growth in fingertip injuries. *Ir Med J.* 1990;83(4):136-7.
33. Stevenson J, McNaughton G, Riley J. The use of prophylactic flucloxacillin in treatment of open fractures of the distal phalanx within an accident and emergency department: a double-blind randomized placebo-controlled trial. *J Hand Surg Br.* 2003;28(5):388-94.