

## Comparison of Sensory Recovery in Fingertip Injuries with Bone Exposure Following Conservative Management versus Flap Cover

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### Abstract

**Background:** Treatment options for fingertip injuries range from healing by secondary intention to flap coverage by local, regional or distal flaps, or replantation. The purpose of this study was to evaluate the functional long-term results following surgical and conservative treatment methods of amputated fingertips with bone exposure in adult patients.

**Methods:** This was a prospective follow-up study conducted in the department of Plastic Surgery, Government Medical College, Thiruvananthapuram, to compare the sensory recovery in the form of static two-point discrimination in adult fingertip injuries with bone exposure following conservative and surgical treatment methods. 30 patients in both arms (conservative versus flap cover) were included in the study.

**Results:** The mean age of the patients was 35.33 years. 70 percent were males. The fingertip injury loss pattern most observed was PNB 355 (20%). The mean 2-point discrimination of injured finger after conservative management was significantly lesser with conservative management, mean value 4mm± 0.435 (p value <0.001), than that with flap cover (5.4mm ± 1.98). Scar tenderness and nail deformities were significantly lower with flap cover rather than conservative management (p value <0.001). However, there was no significant difference in joint stiffness in fingertip injuries managed conservatively or by flap cover. The DASH score was significantly better in fingertip injuries managed with flap cover (mean value 9.993 ± 3.82) than with conservative management (mean DASH score 14.37 ± 5.3), p value <0.001.

**Conclusion:** In this study, the mean 2-point discrimination of injured finger after conservative management was significantly less with conservative management than with flap cover. It was noted that the complications of scar tenderness and nail deformities were significantly lower in fingertip injuries treated with flap cover than those treated with conservative management. Also, the patient-rated outcome measure—the DASH score—is significantly better in fingertip injuries managed with flap cover than with conservative management.

**Keywords:** Fingertip Injury, Outcome, Sensory Recovery, 2 Point Discrimination.

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### Introduction

The fingertip is a unique structure that facilitates precise sensation, fine motor activity, and hand aesthetics. [1] One of the most frequent traumatic injuries that present for immediate care is a fingertip injury, which is defined as an injury distal to the flexor and extensor tendon insertion. [2] To address these deficiencies, a variety of therapeutic approaches have been employed; each has advantages and disadvantages of its own. The extent of the lesion, the surgeon's skill level, patient preference, culture,

and available resources are only a few of the many variables that influence the treatment decision. [3] Supporters of conservative treatment assert that there are fewer problems, less discomfort, less joint stiffness, and better sensory outcomes. [4] On the other hand, proponents of surgery report improved functional parameter outcomes. [5,6] The purpose of this study was to assess the functional and cosmetic results of various treatment modalities for fingertip injuries because there is currently insufficient evidence in the literature to support both treatment approaches.

Management of fingertip injuries is beset by difficulties like paucity of local soft tissue available for coverage and the amount of the remnant nail bed with adequate bone support. There are very few case reports in the literature that have compared the various modalities of treatment of fingertip injuries, especially with respect to neurological and functional outcomes. Hence, this study was conducted to gain insights into the outcomes by comparing the sensory recovery (in the form of static two-point discrimination) in adult fingertip injuries with bone exposure following conservative and surgical treatment methods.

**Materials & Methods**

This was a prospective study carried over a period of 1 year involving 60 patients (30 in conservative management, 30 in flap cover). Those with multiple levels of injury in a digit and the presence of associated hand or proximal upper limb injury or injuries with possible proximal nerve injury were excluded from the study.

Post-treatment, all patients were followed up biweekly in OPD for the first 6 weeks and then at

the 4<sup>th</sup> and 8<sup>th</sup> months. At the end of eight months, they are evaluated for long-term functional outcomes with the DASH score, clinical evaluation for scar appearance, nail deformity, static 2-point discrimination assessment with calipers, cold tolerance, tenderness, hyperesthesia, paresthesia, and joint stiffness.

**Statistical Analysis**

Statistical analyses were performed by using the statistical software package SPSS, version 27.0. Categorical variables were expressed in proportions (Percentage). Quantitative variables were expressed as mean ± standard deviation. Comparisons between the means of two groups were performed using the t test. A chi-square test was used to study the association between qualitative variables. P<0.05 was considered the threshold for statistical significance.

**Results**

The mean age of the patients was 35.33 years (SD 14.61), minimum 17 years, and maximum 83 years. Females in the study were 30%, males 70%. 8.3% (5 patients) had diabetes mellitus.

**Table 1: Age Distribution**

Age (in years)		
Number	Valid	60
	Missing	0
Mean		35.33
Std. Deviation		14.616
Minimum		17
Maximum		83

The most affected digit was the right middle finger (15%), followed by the right index finger (13.3%), left middle finger and right ring finger (11.7% each).

**Table 2: Frequency Distribution of Injured Finger**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right Middle Finger	9	15.0	15.0	15.0
	Right Index Finger	8	13.3	13.3	28.3
	Left Middle Finger	7	11.7	11.7	40.0
	Right Ring Finger	7	11.7	11.7	51.7
	Left Index Finger	6	10.0	10.0	61.7
	Left Ring Finger	6	10.0	10.0	71.7
	Right Little Finger	6	10.0	10.0	81.7
	Left Thumb	5	8.3	8.3	90.0
	Right Thumb	5	8.3	8.3	98.3
	Left Little Finger	1	1.7	1.7	100.0
	Total	60	100.0	100.0	

As per PNB classification, the fingertip injury loss pattern most observed was PNB 355 (20%), i.e., transverse pulp loss with distal 1/3rd nail matrix loss and bone tip exposure. The next most common pattern was PNB 555 (13%), i.e., dorsal oblique loss with distal 1/3rd nail matrix loss and bone tip exposure.

**Table 3: Frequency Distribution PNB Classification of Fingertip Injury Type**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	355	12	20.0	20.0	20.0
	555	8	13.3	13.3	33.3
	455	7	11.7	11.7	45.0
	566	7	11.7	11.7	56.7
	675	4	6.7	6.7	63.3
	456	3	5.0	5.0	68.3
	466	3	5.0	5.0	73.3
	556	2	3.3	3.3	76.7
	655	2	3.3	3.3	80.0
	666	2	3.3	3.3	83.3
	755	2	3.3	3.3	86.7
	356	1	1.7	1.7	88.3
	365	1	1.7	1.7	90.0
	405	1	1.7	1.7	91.7
	415	1	1.7	1.7	93.3
	465	1	1.7	1.7	95.0
	562	1	1.7	1.7	96.7
	636	1	1.7	1.7	98.3
	756	1	1.7	1.7	100.0
Total		60	100.0	100.0	

The mean 2-point discrimination of injured finger after conservative management (in millimetres) was significantly less ( $4\text{mm} \pm 0.435$  (p value  $<0.001$ )) than that with flap cover ( $5.4\text{ mm} \pm 1.98$ ).

**Table 4: Static 2 Point Discrimination of Injured Digit and Treatment Association**

	Treatment	N	Mean	Std. Deviation	P-Value
2PD injured part (in mm)	Conservative	30	4.000	0.4355	$<0.001$
	Flap cover	30	5.400	1.9801	

Tenderness was significantly less in fingertip injuries treated with flap cover than conservative management (p-value  $<0.001$ ).

**Table 5: Scar Tenderness and Treatment Option Association**

		Treatment		Total	
		Conservative	Flap Cover		
Tenderness	Absent	Count	14	28	42
		Expected Count	21.0	21.0	42.0
	Present	Count	16	2	18
		Expected Count	9.0	9.0	18.0
Total		Count	30	30	60
		Expected Count	30.0	30.0	60.0

There was no significant difference in joint stiffness in fingertip injuries managed with flap cover versus those managed conservatively (p-value 0.1).

**Table 6: Joint Stiffness and Treatment Option Association**

		Treatment		Total	
		Conservative	Flap Cover		
Joint Stiffness	Absent	Count	23	17	40
		Expected Count	20.0	20.0	40.0
	Present	Count	7	13	20
		Expected Count	10.0	10.0	20.0
Total		Count	30	30	60
		Expected Count	30.0	30.0	60.0

Nail deformity was significantly lower in fingertip injuries managed with flap cover rather than those conservatively managed. Chi square value: 15.22, p-value  $<0.001$ .

**Table 7: Nail Deformity and Treatment Option Association**

			Treatment		Total
			Conservative	Flap Cover	
Nail Deformity	Absent	Count	16	29	45
		Expected Count	22.5	22.5	45.0
	Present	Count	14	1	15
		Expected Count	7.5	7.5	15.0
Total		Count	30	30	60
		Expected Count	30.0	30.0	60.0

DASH score, mean value  $9.993 \pm 3.82$ , was significantly better in fingertip injuries managed with flap cover than with conservative management (mean DASH score  $14.37 \pm 5.3$ ),  $p$ -value  $<0.001$ .

**Table 8: DASH Score and Treatment Option Association**

	Treatment	N	Mean	Std. Deviation	P-Value
DASH	Conservative	30	14.377	5.3050	$<0.001$
	Flap Cover	30	9.993	3.8287	

## Discussion

In the present study, the mean 2-point discrimination of injured finger after conservative management was significantly lesser with conservative management, mean value  $4\text{mm} \pm 0.435$  ( $p$  value  $<0.001$ ), than that with flap cover ( $5.4\text{mm} \pm 1.98$ ). Of all the 60 healed fingertips, 6.7% had cold intolerance, 30% had scar tenderness, 33.3% had joint stiffness and 25% had nail deformity. Scar tenderness and nail deformities were significantly lower with flap cover rather than conservative management ( $p$ -value  $<0.001$ ). However, there was no significant difference in joint stiffness in fingertip injuries managed conservatively or by flap cover. The DASH score was significantly better in fingertip injuries managed with flap cover (mean value  $9.993 \pm 3.82$ ) than with conservative management (mean DASH score  $14.37 \pm 5.3$ ),  $p$ -value  $<0.001$ . The most commonly performed flap was Atasoy VY advancement (6 numbers, 10%), followed by Moberg palmar advancement (5 numbers, 8.3%). 4 flaps had complications (13.3%). 2 flaps had partial loss in the distal part (oblique VY) and thenar (superficial loss). 1 Kutler flap had superficial skin infection managed with exploration and ingrowing nail excision, following which it healed well. 1 cross-finger flap had partial dehiscence seen in 1st visit on post-operative day 3—one simple suture put under local anesthesia after informed consent, and the flap division was performed at 3 weeks uneventfully. No complete flap losses or pedicled flap losses after division were observed.

The majority of scholarly papers on treatment outcomes are retrospective case series that discuss the various flaps used to treat fingertip injuries and indicate that flap operation is the best course of action. In addition to being retrospective, the comparison investigations have focused on superficial tissue loss as opposed to composite loss. [7,8] Primary closure and split-thickness skin grafting were compared in 79 injuries in the Braun et al.[7] study; the two methods did not differ in

terms of functional results. Between 6 and 42 weeks following the surgeries, results remained consistent, and there was no statistically significant difference in the time it took to resume work.

MJ Allen studied conservative management in 60 adult fingertip injuries. The average sensory recovery was 6 mm 2-point discrimination. 50% of patients had decreased pain threshold. Nail deformities occurred in 46% of patients (only 9 cases requiring further surgery for this complaint). No joint stiffness was noted. Allen concluded that conservative management of fingertip injuries gave the best chance at allowing maximal fingertip length attainment. [9]

Soderberg et al., studied 36 surgically treated and 34 conservatively managed fingertip injuries. They found an increase of at least 3 mm in 2-point discrimination after surgery. There was no significant increase in cold intolerance or tenderness. They advocated occlusive zinc dressing to allow slow contraction of the defect to allow good stable scar and fingerprint regrowth. [8]

Amer et al., studied the sensory recovery in 64 fingertip injuries, comparing conservative management and local flaps. They found a statistically significant difference in two-point discrimination test and peak latency, amplitude, and conduction velocity of sensory nerves ( $p \leq 0.001$ ) with better results in conservatively managed cases. They also found no significant difference in cold intolerance or hypersensitivity. [4]

Van Den Berg et al., studied moving 2-point discrimination, grip strength, stiffness, cold intolerance, nail deformities, and time off work in days. They divided 59 injuries into three groups: conservative, reconstructive, and bone shortening. The mean reduction in strength, sensation, and stiffness for the injured fingers as compared to the uninjured finger were not found to be significantly different between the groups. 90% of cases had nail

deformity. There was no significant difference between the groups for cold intolerance and nail deformity. The aesthetic outcomes judged by patients and surgeons as per the visual analogue scale were found to be comparable. [10] More than half of each group received a score ranging from normal to decreased superficial sensibility. Even nearly 82% of the conservative group had normal sensibility to decreased superficial sensibility. The mean 2PD test score for the reconstructive group was 6 mm to 10 mm (fair), while the conservative group's was 1 mm to 5 mm (normal). These results were consistent with previous research. [11,12]

Gurinderjith Nagi et al. studied 50 patients with fingertip injuries, and all underwent reconstructive surgery. 27 patients had a 2-point discrimination of 3-6 mm, with 4% having scar tenderness and 3% with joint stiffness. [13] El-Shishtawy et al., studied 50 patients with fingertip amputations in two groups. 20 patients underwent reconstruction, and 30 patients underwent conservative management (platelet gel, hyaluronic acid, or fusidic acid local application as adjunct). Mean 2-point discrimination in the surgical group was  $5.25 \pm 0.72$  mm and that in the conservative group was  $4.3 \pm 1.18$  mm ( $p = 0.002$ ), range of motion being better with conservative management ( $p = 0.001$ ). Patient subjective satisfaction and subjective aesthetic outcome (on a two-point scale) were found to be better with the conservative group ( $p = 0.026, 0.035$ , respectively). [14]

200 fingertip injuries were the subject of research by Mennen and Wise [15] that assessed conservative treatment options. According to their findings, the two-point discrimination ranged from 2–3 mm in patients who were monitored for three months following recovery. Melone et al., study, [16] which examined 150 patients who had various surgical procedures for damage to their fingertips, found that the two-point discrimination in treated fingers was 7 mm.

The authors of two case series using local island flaps, Takeishi et al., [17] and Tuncali et al., [18] did not report any alteration of the range of motion. In retrospective research comparing the conservative and surgical care of 59 fingertip injuries in 53 patients, Van den Berg WB et al. [10] found no statistically significant change in range of motion. This might be explained by the longer follow-up period.

In line with the results of our investigation, Niranjana et al. [19] examined the use of the reversed homodigital island flap for fingertip reconstruction on 25 patients and reported that 2% of the patients experienced difficulties in the form of flap loss. In a study of conservative approaches as a treatment, Ipsen et al., [20] observed that superficial infections were present in 4 out of 53

cases. In their studies of conservative treatment for fingertip injuries, Mennen and Wiese [15] and Quell et al., [21] found that patients were satisfied with the treatment's results, which included good skin quality, normal feeling, and preserved motion. They also reported outstanding cosmetic outcomes. In a research comparing conservative and surgical approaches to treating fingertip injuries, Soderberg et al., [8] observed that there was no difference in the results following the first year of follow-up.

The optimal course of action for treating composite fingertip deformities is still not well established. There aren't any reliable prospective randomised clinical trials to compare the two approaches. In terms of evaluation techniques, subject counts, and objective and subjective criteria for analysis, the numerous case series with level IV evidence assessing the different approaches to composite tissue reconstruction are too dissimilar to permit comparison and draw firm conclusions. However, differences in the injuries themselves account for a large portion of the discrepancy in the research. Therefore, further standardised research is recommended.

### Conclusion

The mean 2-point discrimination of injured finger after conservative management was significantly less with conservative management than that with flap cover. Scar tenderness and nail deformities were significantly lower with flap cover rather than conservative management. However, there was no significant difference in joint stiffness in fingertip injuries managed conservatively or by flap cover. The patient-rated outcome measure—the DASH score—was significantly better in fingertip injuries managed with flap cover than with conservative management.

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