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PATTERNS AND OUTCOMES OF FINGERTIP RECONSTRUCTION: A REVIEW OF 120 CASES

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ABSTRACT

Background: Fingertip injuries are frequent hand trauma encounters and can impair sensibility, fine pinch, and nail stability. In Bangladesh, electrical burns and machine-related injuries are prominent causes. Successful reconstruction aims to preserve length, provide durable sensate coverage, and restore contour with minimal morbidity. **Aim:** The study aims to note the pattern and outcome of finger tip reconstruction. **Materials and Method:** This retrospective study included 120 patients (≥12 years) treated between January 2017 and December 2023 across three private hospitals in Dhaka. Injury level was determined using the Allen classification. Minor tissue loss (Allen I–II) was treated conservatively, while exposed bone or larger volar defects required flap coverage. Reconstructive techniques included cross-finger flap, reverse cross-finger flap, first dorsal metacarpal artery (FDMA) flap, thenar flap, V-Y advancement flap, adipofascial flap, and distant options. Functional outcomes, two-point discrimination, return-to-use time, and early complications were assessed over 4–12 weeks. **Results:** Electrical burn was the leading mechanism of injury. Allen type IV was most common. Defect size ranged 1–5 cm². Conservative care produced minimal range-of-motion loss. Mean two-point discrimination was 5.7 mm. Early complications occurred in 28.3%, predominantly minor infection and partial flap necrosis, all managed without major re-operation. Most patients regained acceptable contour and sensibility. **Conclusion:** A stepwise reconstructive algorithm emphasizing the simplest suitable option yields predictable outcomes. Sensate flaps are valuable for thumb and index injuries. In resource-limited environments, thoughtful flap selection allows preservation of length and function with low complication rates.

Keywords: Injury of finger, Trauma, Allen classification, Reconstructive techniques, Functional outcomes, Preservation.

INTRODUCTION

Fingertip trauma accounts for a substantial share of hand injuries and can significantly compromise dexterity due to altered sensibility, pulp volume loss, and nail deformity.

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The fingertip encompasses all structures distal to the Distal interphalangeal joint (DIP) crease, including the glabrous pulp, fibrous septae, nail complex, and terminal phalanx[1]. In Bangladesh and similar regions, injuries are frequently related to electrical contact points and unguarded machinery used by young manual workers[2].

Multiple classification systems—most commonly Allen, and others such as Hirase and Ishikawa—help describe the level of soft-tissue and bony involvement. A clear understanding of fingertip architecture is essential, as the pulp's fibro-septal framework and dense sensory innervation enable precision grip and protective feedback[3,4].

No universal consensus exists on the optimal reconstructive method [5,6]. Reconstructive planning depends on defect characteristics, the presence of exposed bone, dominant-hand involvement, and occupational requirements. The decision depends on the defect size, exposed bone, patient occupation, and available resources [5,7]. While small dorsal wounds may tolerate non-sensate coverage, volar pulp defects typically demand glabrous, sensate tissue to restore friction and fine pinch [5,6]. The availability of trained microsurgeons and institutional resources also shapes decision-making in low-resource settings [8].

This study summarizes a single-surgeon experience with 120 fingertip injuries managed over seven years, emphasizing technique selection, early outcomes, and context-appropriate reconstructive strategies.

MATERIALS AND METHOD

Study Design and Setting

This retrospective review included all consecutive patients with fingertip soft-tissue loss treated between January 2017 and December 2023 in the Plastic and Reconstructive Surgery units of two private tertiary hospitals in Dhaka.

Ethical Approval

Written informed consent was obtained from each patient or legal guardian. The study followed the ethical principles of the Declaration of Helsinki. Patients were informed that anonymized photographs and outcome data might be used for academic publication.

Inclusion Criteria

- Traumatic fingertip defects (household, machinery, industrial, or electrical burn) involving one or more digits
- Time from injury ≤14 days at presentation
- Age ≥12 years

Exclusion Criteria

- Malignancy involving the fingertip
- Known drug allergy relevant to perioperative care

  Congenital deformities
- Old burn contractures
- Polytrauma requiring major systemic intervention
- Refusal to participate

Clinical Assessment and Classification

Mechanism of injury, digit involved, defect size, and number of injured fingers were documented. Injury level was categorized using the Allen classification[9] (Figure 1).

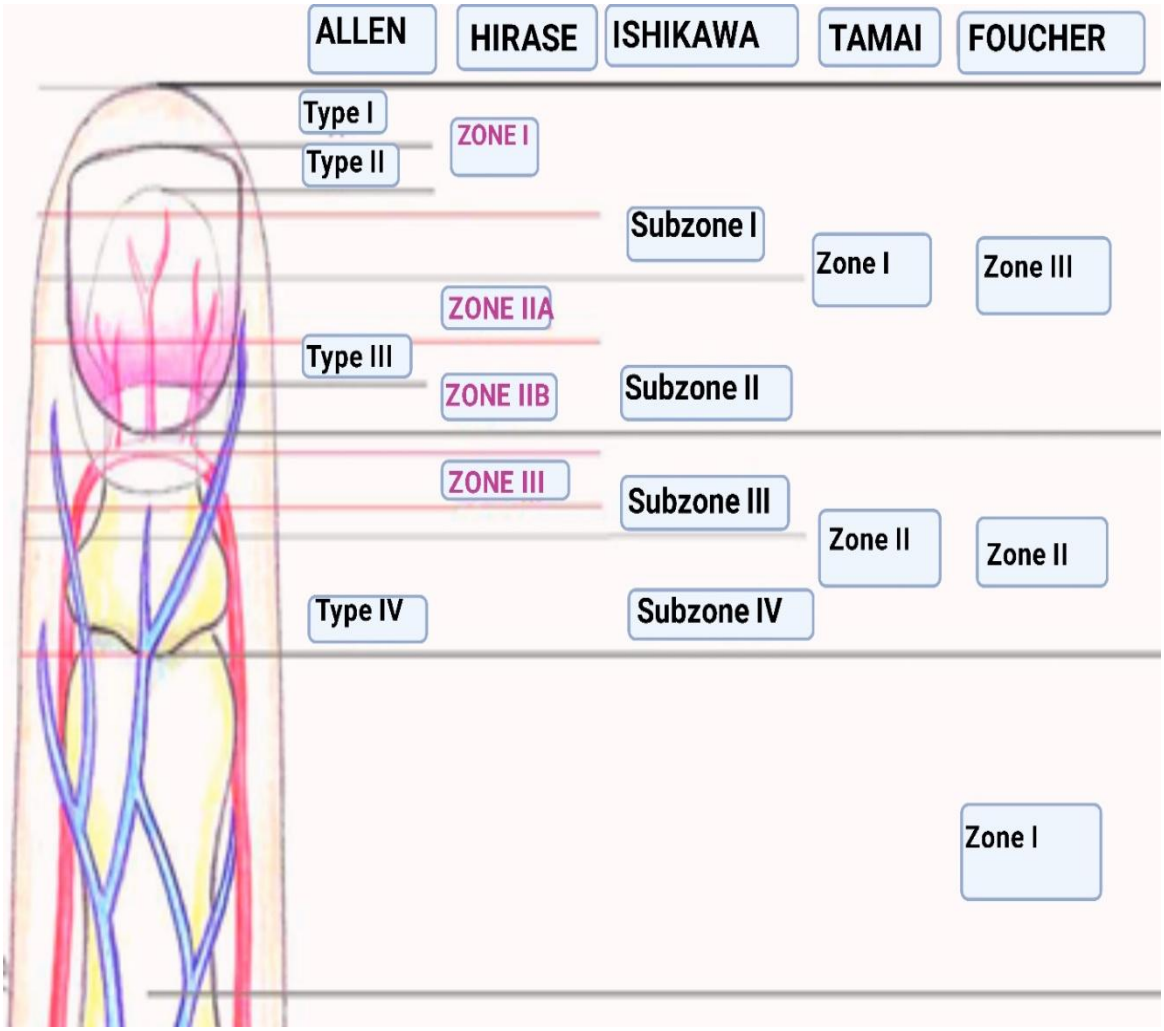

Figure 1: Various classifications of fingertip injury

Surgical Planning and Technique

All operations were performed by the same surgeon. Regional blocks (digital or axillary) were preferred, while general anesthesia was used for replantation and FDMA flaps. Procedures were carried out under loupe magnification with a pneumatic tourniquet.

Debridement was conservative, preserving viable pulp dermis and periosteum whenever possible. Technique selection was based on defect dimension, volar versus dorsal involvement, and patient preference after counseling.

- **Conservative care (Allen I–early II):** Moist-environment dressings and antibiotics guided by wound culture.

- **Flap reconstruction:** Vascular mapping with handheld Doppler when required; options included cross-finger and reverse cross-finger flaps,thenar flap,FDMA flap for thumb and index defects requiring sensate cover,volar V-Y advancement flap for transverse losses,adipofascial flaps,distant flaps for selected cases.Full-thickness skin grafts were harvested mainly from the wrist crease or groin. (Chart 1; Figure 2-5) Flap division was typically performed between 21 and 28 days.

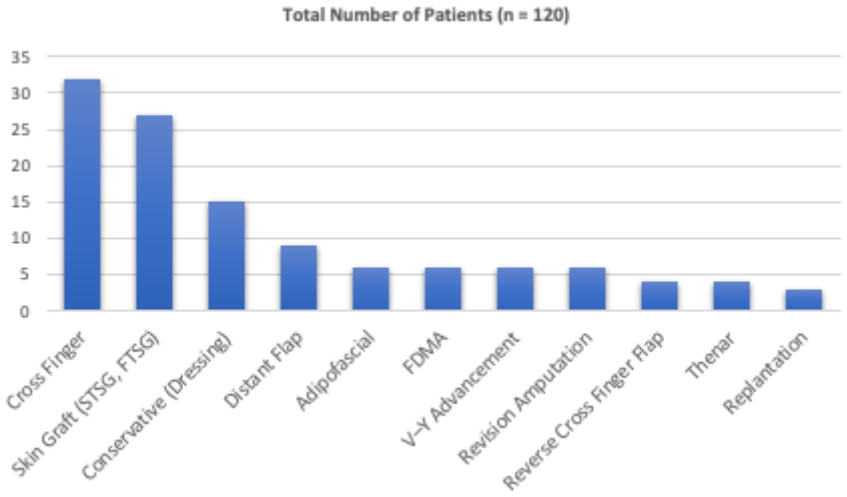

Chart 1: Graphical presentations of the various reconstruction done for different fingertip injuries.

Postoperative Care

Hand elevation was maintained for 72 hours. A protective splint was worn for two weeks. Fluids were restricted to ≤300 mL crystalloid initially.

Outcome Measures

Patients were reviewed for 4–12 weeks. Outcomes included:

- total active motion (TAM),
- two-point discrimination,
- time to resume normal hand use,
- early complications (infection, bleeding, flap compromise),
- patient-reported cosmetic satisfaction.

Statistical Analysis

Data were analyzed using SPSS v24. Descriptive statistics were generated, and two-point discrimination was compared with the contralateral finger using the Wilcoxon Z test. A *p*-value <0.05 was considered significant.

RESULTS

The study included 120 patients, predominantly male (93%), with a mean age of 30 ± 14.7 years. Electrical burns were the leading cause, followed by machinery-related injuries. Allen type IV was the most common category (Table 1).

Table1: Distributions of the fingertip injuries according to Allen type.

Allen Type	Description	n (%)
I	Pulp loss only	07 (5.8)
II	Pulp + partial nail loss	24 (20.0)
III	Pulp + partial nail + partial distal phalanx loss	32 (26.7)
IV	Pulp + nail + distal phalanx loss up to DIP	42 (35.0)
Mixed		15 (12.5)
Total		120

N = Total number of patients

Defects ranged from 1–5 cm², with thumb and index most frequently affected. Conservative management was adequate for most Allen I and early type II injuries. Larger volar pulp losses or exposed bone required flap coverage.

Treatment duration ranged from 2–6 weeks, with follow-up for 4–12 weeks. Most patients retained satisfactory length and contour. Postoperative nail changes were more frequent in surgically managed cases.

Secondary-healing cases demonstrated minimal ROM reduction. Mean two-point discrimination was 5.7 mm (range 4–9 mm). Most patients were satisfied with cosmetic appearance.

Complications were observed in 34 patients: superficial infection (n=12), minor bleeding (n=2), and partial flap loss (n=5) as shown in Chart 2. All healed without major secondary procedures.

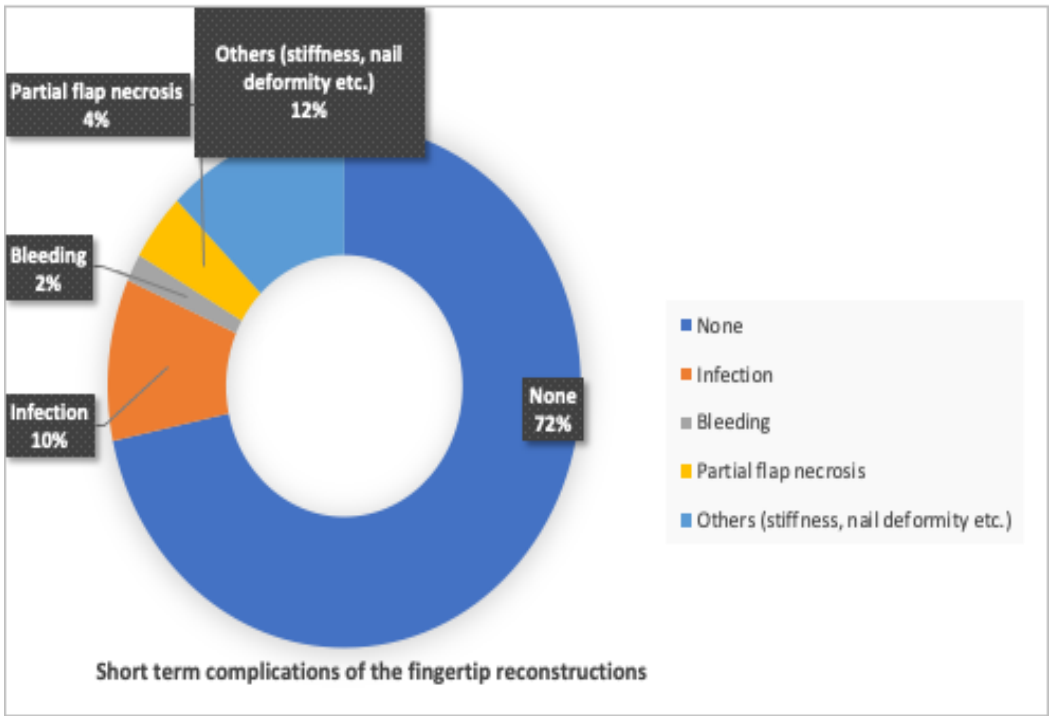

Chart 2: Pie-Graphical presentations of short-term complications of various reconstructions.

Representative Case 1: Cross-Finger Flap

A 35-year-old male with machinery-related injuries to the index, middle, and ring fingertips (Allen II–III) underwent cross-finger flaps from adjacent digits with full-thickness grafting of the donor site. At six weeks, he demonstrated supple, stable coverage and a two-point discrimination of 6 mm (Figure 2).

Figure 2. Cross-finger flap with skin graft cover for multiple volar pulp defects of the right index, middle and ring fingers (Allen II–IV), a -Pre-operative; b- Post-operative(Immediate); c- Post-operative(6 weeks).

Representative Case 2: Thumb Replantation

A complete Allen IV amputation of the thumb was replanted within four hours. Revascularization involved one artery, two veins, and K-wire fixation. Venous congestion was treated with a chest flap. At eight weeks, the patient recovered protective sensation and useful opposition (Figure 3).

Figure 3. Thumb replantation for Allen type IV machinery injury showing pre- and postoperative results.

Figure 4 shows the outcome of V-Y advancement flap for transverse volar fingertip injury and figure 5 demonstrates the outcome of FDMA Flap for lateral oblique injury.

Figure 4. V-Y advancement flap for transverse volar fingertip injury (Allen type III). (a) Pre-operative transverse pulp defect of the left ring finger. (b) Intra-operative view showing flap advancement and inset. (c) Early postoperative appearance demonstrating good flap viability and contour restoration.

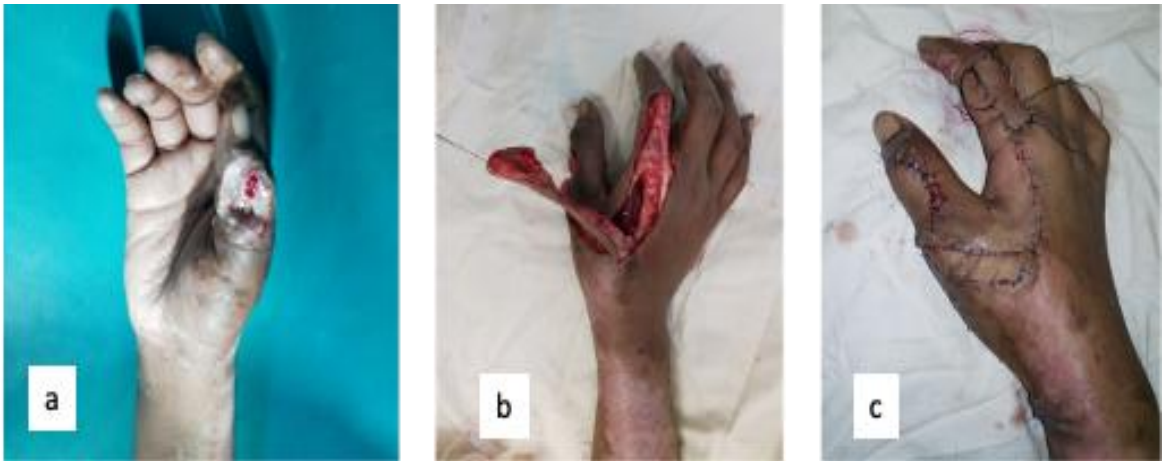

Figure 5. FDMA flap for Lateral oblique injury (Allen IV) – electric burn (a) Pre-operative transverse pulp defect of the right thumb. (b) Intra-operative view showing flap harvest (c) Immediate postoperative appearance demonstrating good flap viability and contour restoration.

DISCUSSION

Fingertip trauma has a major functional impact because the pulp–nail complex is responsible for fine pinch, stereognosis, and grip stability In our series, electrical burns predominated, reflecting occupational patterns in Bangladesh where manual labour and exposed wiring increase risk. Electrical burns were the dominant mechanism of injury, consistent with patterns described in South Asian and Middle-Eastern populations where unprotected machinery and domestic wiring injuries are common[7,8].

Reconstructive planning should always begin with the least complex option capable of achieving durable coverage. In our study, conservative management produced excellent early motion and protective sensibility in Allen type I and early type II injuries—findings that echo earlier reports showing that minimal tissue loss can heal effectively with secondary intention[9].

However, flap selection must balance sensibility requirements, donor-site morbidity, and patient expectations. Sensate flaps—particularly the FDMA and thenar flaps—remain valuable for thumb and index injuries due to their role in fine pinch and stereognosis[10,11]. The FDMA flap remains a powerful option for thumb reconstruction due to its sensate quality and stable surface characteristics. The method's sensory advantage, documented by study[7] was reflected in our patients, who regained protective discrimination suitable for pinch and opposition.

The volar V-Y flap was particularly effective for transverse injuries with sufficient advancement potential. This technique preserved local contour and color match while avoiding staged procedures. Chen and Wei have noted comparable advantages in their analysis of neurovascular V-Y flaps[11]. Cross-finger flaps were the workhorse procedure in our series. They provided reliable vascularity and stable glabrous coverage for volar pulp defects, similar to previously documented outcomes that describe this flap as dependable in resource-limited settings[12,13]. Our sensory results (two-point discrimination 6–7 mm) are also in line with the outcomes reported by Pandian et al[5]

Complications and Functional Outcomes

Complication rates in our series were modest. Partial flap necrosis occurred in 4.1% of cases—similar to reported international ranges (3–7%)[12] . Nail deformity occurred mainly in Allen III–IV injuries, consistent with earlier reviews that highlight nail-bed damage as a major determinant of postoperative appearance[13].

Overall, most patients achieved good functional recovery, with mean two-point discrimination of 5.7 mm, consistent with outcomes summarized in the systematic review by Sebastin and Chung[12] . The majority returned to manual work within 4–8 weeks depending on procedure type.

CONCLUSION

Fingertip reconstruction should progress from conservative options to more complex flaps only when necessary. Tailoring technique choice to defect characteristics, digit priorities, and available resources leads to predictable, functional outcomes. Most defects in this series were successfully treated with simple local flaps, with low morbidity and high patient satisfaction. Broader, multicenter studies with longer follow-up would help refine region-specific reconstructive pathways.

CONFLICT OF INTEREST

There is no conflict of interest.

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