

Cross-finger Flap for Reconstruction of Fingertip AmputationsShyam Kumar Satyapal¹, Radha Raman²¹Assistant Professor, Department of Burn and Plastic Surgery, Sri Krishna medical College and Hospital, Muzaffarpur, Bihar, India²Assistant Professor-cum-Head of Department, Department of Burn and Plastic Surgery, Sri Krishna medical College and Hospital, Muzaffarpur, Bihar, India

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Conflict of interest: Nil

Abstract:**Background:** Fingertip amputations are severe hand injuries. Their treatment must restore the sensation and metabolic activity needed for pain-free finger function. The cross-finger flap (CFF) can be used for this purpose. The goal of this study was to assess the long-term clinical outcome following use of this flap.**Methods:** This was a retrospective analysis of 26 patients operated because of fingertip amputation: 14 type 3, 8 type 2 and 4 type 4. The CFF was harvested from an adjacent finger on the dorsal side of the middle phalanx down to the epitenon. A dorso-palmar hinge was preserved to ensure vascularisation. The CFF was divided an average of 21 days later. The following parameters were evaluated: pulp volume (injured compared to contralateral finger), presence of neuroma, occurrence of complications (necrosis, infection, and donor site morbidity), cold discomfort, static and tactile discrimination, and patient satisfaction (0 to 10 on VAS).**Results:** The average follow-up was 2 years; all the patients were re-examined in person. The average healthy pulp to reconstructed pulp ratio was 1.03. No postoperative complications such as neuroma were found. Cold sensitivity was present in 7 patients. The flap was re-sensitised in all the patients. There was no donor site morbidity. The average patient satisfaction score was 9 (range 8–10).**Conclusions:** Over the long-term, use of the CFF results in nearly normal fingertip metabolism, no complications and good distal sensitivity without pain or neuromas. This is a simple, reliable, long-lasting reconstruction technique.**Keywords:** Fingertip amputation, Cross-finger flap.**DOI:** 10.25258/ijcpr.18.10.50

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Introduction

Fingertip amputation is a potentially serious injury to the hand that can lead to finger exclusion and significant functional consequences.

Allen's classification of fingertip injuries.

1	Type I	loss of only the pulp of the finger
2	Type II	pulp and nail loss without bone fragment in the distal amputated fingertip
3	Type III	, partial loss of the distal phalanx plus corresponding loss of the pulp and nail
4	Type IV	loss proximal to the germinal matrix

Fingertip amputations, particularly those distal to the distal interphalangeal joints, are significant clinical hand injuries. With the advancement of mechanization, the incidence of fingertip amputations caused by machines increased. Injuries involving distal finger defects, including soft tissues

and distal phalangeal bone loss, such as amputations distal to the distal interphalangeal joints that are classified as Allen's type IV according to the Allen classification of hand injuries are challenging to reconstruct.

The goal of treatment is restoration of a painless, functional digit with protective sensation. The amount of soft-tissue loss, the integrity of the nail bed, and the age and physical demands of the patient should be considered when selecting a treatment method.

The fundamentals of managing such injuries involve restoring a stable, mobile, and sensible fingertip [1]. However, there are controversies surrounding the optimal initial emergency treatment. The therapeutic options range from primary closure to secondary healing by occlusive dressing, reconstructive surgery with local, regional, or distant flaps, composite grafting, and finally microsurgical replantation [2], [3], [4]. Regardless of the specific treatment modalities used, adequate rehabilitation is necessary to avoid joint stiffness and contracture.

Although replantation surgery is now a routine procedure, it may be impossible due to several reasons, such as excessive crushing, contamination, multilevel injury, or other associated injuries [5]. Moreover, it is a technically challenging procedure that requires super microsurgical skills with a risk of replantation failure

If the amputated portion is not recovered or cannot be repositioned, treatment requires covering the defect as a minimum. Although there is no consensus as to the best way to treat fingertip amputation, treatment goals include reducing pain, optimising the healing time, preserving local tissue metabolism, pulp sensitivity and finger length, preventing neuromas and restoring an appearance that is acceptable to the patient.

The cross-finger flap (CFF) first described in the 1950s [6], [7], [8] is one of the flaps that can be used to treat fingertip amputations, as it provides a solution to the various criteria listed above. The goal of this study was to assess the long-term clinical results of using this flap.

Material and methods

This was a retrospective, single-centre, study carried out with 26 consecutive patients treated operatively between July 2024 and August 2026 because of single and double fingertip amputation, in the department of Burn and Plastic Surgery, Sri Krishna medical college and hospital, Bihar, India,

There were 18 men and 8 women, with an average age of 32.5 years (5–48). Twenty two were operated on an emergency basis and four patients are for a secondary reconstruction procedure due to pulp necrosis. The amputation level was determined using Allen's classification [9]. There were 14 type 3, 8 type 2 and 4 type 4 amputations. The following

fingers were injured: index in 11 cases, little finger in 4 cases, thumb in 4 cases, ring finger in 4 cases and middle finger in 3 cases.

The procedure was performed under local anaesthesia using an arm tourniquet. After debridement and lavage of the amputation site, the CFF was harvested on the dorsal side of the middle phalanx of an adjacent finger if the long fingers were injured, and on the dorsal side of the proximal phalanx of the index if the thumb was injured. Transverse skin incisions were made along the dorsal folds on the proximal and distal interphalangeal joints; a longitudinal incision was made along the volar/dorsal skin junction. A dorso-palmar hinge located on the interdigital side was preserved to ensure vascularisation of the CFF. The incision was continued down to the epitenon, which was plane along which the CFF will eventually be detached. Bipolar forceps were used to ensure haemostasis of the dorsal veins. The dorsal surface of the donor site was then covered with a full-thickness skin graft taken from the hypothenar eminence of the medial aspect of the forearm. The skin graft was sutured in place before CFF fixation.

The CFF was sutured to the injured finger to provide it with neo-pulp tissue. A thick dressing was placed on the site for 2 weeks to provide immobilisation and shock absorption. The CFF was later divided with the finger anaesthetised.

The following parameters were evaluated: occurrence of complications (necrosis, infection, stiffening or exclusion of injured or donor finger), pulp volume as a ratio of healthy contralateral finger to injured pulp measured on lateral X-ray views, static discrimination using the Weber index and tactile discrimination using microfilaments as described by Semmes and Weinstein [10] compared to contralateral finger, cold discomfort and presence of neuroma. Lastly, the patient's satisfaction with the appearance of the injured and donor fingers was evaluated using a visual analogue scale from 0 (not satisfied) to 10 (very satisfied). The presence of nail deformity was not evaluated.

Results

The average follow-up at the time of review was 2 years: 22 patients (84.6 %) were re-evaluated in person and 4 (15.3 %) were interviewed by phone for a total of 26 patients.

There were no postoperative complications such as necrosis, infection or wound dehiscence. There were no cases of neuroma or neuropathic pain. Of the patients evaluated in person (Table 1), the mean healthy pulp to reconstructed pulp ratio was 1.04 (0.84–1.26).

Table 1: Results of patients reviewed in person

Patients	Fingertip trophicity	Weber test Operated (contralateral finger)	Semmes & Weinstein Microfilament test Operated /contralateral finger
1	1.1	10(6)	3.61/ 3.61
2	0.85	8 (6)	3.61/ 3.61
3	0.95	6 (6)	3.61/ 3.61
4	1.15	8 (6)	4.31/ 3.61
5	0.85	10(6)	3.61/ 3.61
6	1.1	6(6)	3.61/ 3.61
7	1.1	6 (6)	4.31/ 3.61
8	0.95	6 (4)	4.31/ 3.61
9	0.95	6(6)	3.61/ 3.61
10	1.2	8 (8)	3.61/ 3.61
11	1.15	10(6)	3.61/ 3.61
12	0.85	10(6)	4.31/ 3.61
13	0.85	8 (6)	34.31/ 3.61
14	1.1	6 (6)	3.61/ 3.61
15	1.1	4 (4)	3.61/ 3.61
16	0.95	6 (4)	3.61/ 3.61
17	0.9	4 (4)	3.61/ 3.61
18	1	6 (6)	3.61/ 3.61
19	0.95	6 (4)	4.31/ 3.61
20	0.95	8 (6)	4.31/ 3.61
21	1.15	10(6)	3.61/ 3.61
22	1	8 (8)	3.61/ 3.61
23	0.85	4 (4)	3.61/ 3.61
24	0.9	10(6)	3.61/ 3.61
25	1.2	6 (6)	3.61/ 3.61
26	1.15	8 (8)	4.31/3.61

The flap was re-sensitised in all the patients. In the patients reviewed over the telephone, none reported feeling any subjective difference in the sensitivity of the injured finger relative to the other fingers. In the static two-point discrimination test, 16 patients (61.5%) had no difference, 8 patients had 2-mm difference and 2 had a 4-mm difference relative to the contralateral finger. In the tactile discrimination test, 20 patients (76.9%) had no difference and 6 had a difference of 1 microfilament diameter

(3.61/4.41). Cold sensitivity was reported by 6 patients (23.0%): 4 (15.3%) with mild sensitivity and 3 with moderate sensitivity (11.5%) . No any patient had proximal or distal interphalangeal joint flexion deformity . There was no donor site morbidity. Other than the cold sensitivity, all the patients stated that they had “forgotten” about their injured and donor fingers. The mean satisfaction with the fingers’ appearance was 9.4(8–10).

Photo Gallery

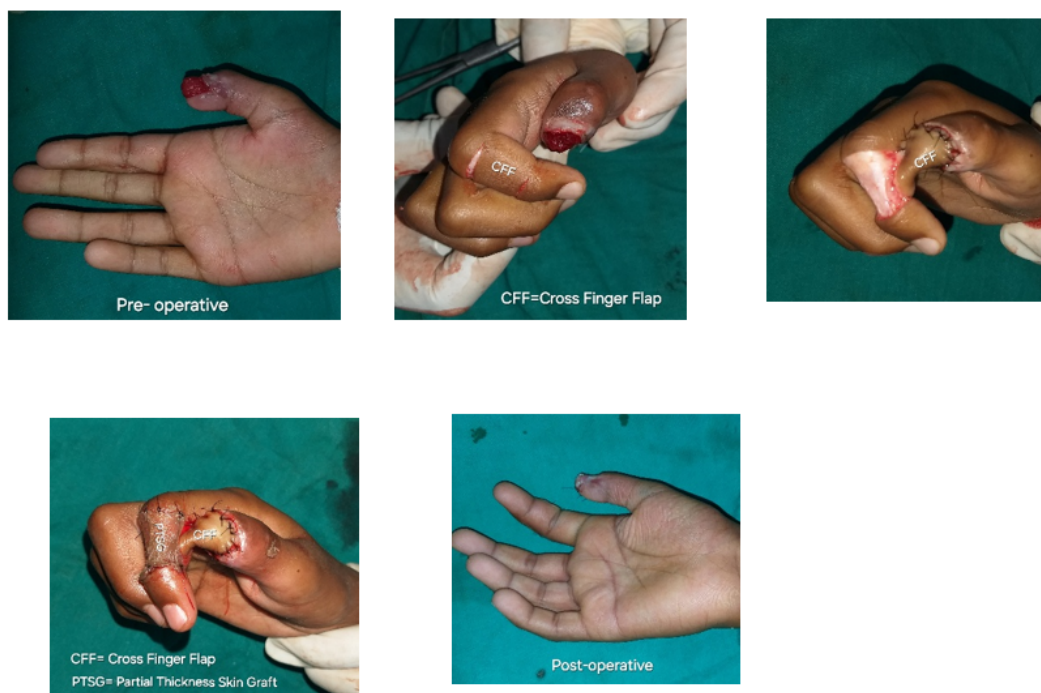
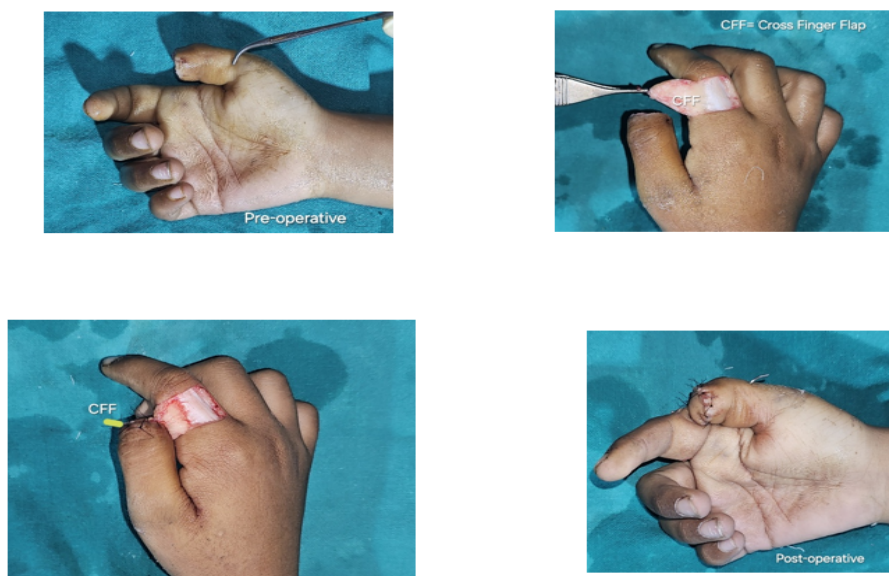


Figure 1. Cross Finger Flap for Thumb.



Figure 2: Cross Finger Flap for Index Finger



3: Cross Finger Flap for thumb



4: Cross Finger Flap for little Finger



5: Cross Finger Flap for thumb

Discussion

The CFF is a treatment method used to reconstruct the fingertip in cases of amputation. The reliability of this flap has been demonstrated through numerous studies [6], [7], [8], [11]. Our study confirms this reliability based on the absence of postoperative complications, in particular flap necrosis. The flap can be divided 15 days later without the risk of secondary necrosis. This method is reliable because of the relative simplicity of the procedure, which requires no microsurgery. However, we recommend that a fairly thick flap be raised, level with the extensor tendon epitenon, with a hinge that spans the entire length of the middle phalanx, to prevent hypovascularisation of the volar network of the flap. Gokrem et al. [12] used a thin CFF with significant venous damage, requiring trophic underlying tissue; this made it impossible to use this technique to achieve satisfactory coverage of bone tissue or poorly vascularised tissue.

The recovery of fingertip sensitivity after CFF reconstruction was previously documented [13], [14], [115]. Sensitivity reappears at 12–18 months postoperative [13], [14]. All of our patients regained normal subjective distal sensitivity. In those who were directly tested, more than half had no difference in static discrimination relative to the contralateral finger and nearly two-thirds had no difference in tactile discrimination. Increased sensitivity to cold persisted in one-third of our patients; Nishikawa [14] found the same in one-half of their patients.

The main criticisms of the CFF are the poor quality of the pulp, which is not metabolically active enough, the lack of recovery in sensitivity and the donor finger sequelae caused by harvesting [16], [17], [83]. Over the long-term, the pulp tissue metabolism is nearly the same as in the contralateral

finger; there was no pulp atrophy. We found no sequelae such as stiffening in the donor finger, as had been reported by Paterson [17]. The appearance of the harvest site was deemed very satisfactory, unlike the Koch study [18] where most patients had the site covered with a thin skin graft. We prefer using a full-thickness skin graft at the donor site.

Elliot [19] highlighted the high frequency of neuromas following fingertip amputation, but we did not find any painful neuromas in our patient, despite the serious crush and stretch injuries that had occurred. The pulp padding provided by the CFF seems to prevent neuroma development.

In cases of fingertip amputation, the CFF is a simple treatment method among the various available options [20]. Among the other options, same-finger advancement flaps with pulp islands are another approach to reconstructing the fingertip. Hamdi [21] reported comparable results in their 32 patients for restoration of sensitivity and satisfaction with the appearance; however 19% of fingers were stiff. In contrast, CFF provides pulp reconstruction with good local tissue metabolism, no pain, restoration of sensitivity and high patient satisfaction.

Conclusion

Over the long-term, use of the CFF results in nearly normal fingertip metabolism, no complications and good distal sensitivity without pain or neuromas. This is a simple, reliable, long-lasting reconstruction technique.

Ethical Approval: The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consents were obtained.

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