

Outcomes of the Reverse Homodigital Island Artery Flap in Fingertip Reconstruction: A Retrospective Study

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ABSTRACT

Introduction: Fingertip injuries are common hand traumas that often necessitate surgical reconstruction to restore both form and function while preserving sensation. The Reverse Homodigital Island Artery (RHDIA) flap has emerged as a reliable option for such defects.

Aim: To evaluate the outcomes of the RHDIA flap in fingertip reconstruction.

Materials and Methods: The present retrospective study was conducted between January 2024 and December 2024 in the Department of Plastic Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India, including 15 patients with post-traumatic fingertip defects. Patients with prior surgery, burns, or contractures of the affected finger and immunocompromised status were excluded. The RHDIA flap was raised from the proximal phalanx of the same finger and transposed to resurface the fingertip defect, with donor sites closed primarily or covered with split-thickness skin grafts. Demographic, operative, and postoperative parameters were

analysed using EPI info 7.2. Continuous data were presented as mean \pm Standard Deviation (SD) or median (IQR), and categorical variables were presented as frequencies and percentages.

Results: All 15 patients underwent fingertip reconstruction using the RHDIA flap with 100% flap survival. One patient (6.6%) developed partial distal necrosis that healed secondarily. The mean flap size was 3.7 ± 0.22 cm², and mean healing time was 17.1 ± 2.1 days. Functional outcomes were rated good to excellent in 93.3% (n=14) of cases, with high patient satisfaction in 86.6% (n=13). Aesthetic outcome was assessed using a 5-point Likert scale and the median score was 4 (IQR=2), indicating overall good aesthetic satisfaction. No donor-site complications, stiffness, or contracture were observed.

Conclusion: The RHDIA flap is a reliable, single-stage option for fingertip reconstruction, offering good tissue match and satisfactory functional and aesthetic outcomes. Although limited by small sample size and retrospective design, this study reinforces the role of RHDIA as an effective reconstructive modality for fingertip defects.

Keywords: Grafts, Hand trauma, Local flap, Reconstruction surgeries

INTRODUCTION

Fingertip injuries represent one of the most frequently encountered forms of hand trauma in emergency and reconstructive surgery, accounting for nearly one-third of all traumatic hand presentations. These injuries may arise from crush, avulsion, or laceration mechanisms and often involve a combination of soft-tissue loss, bone exposure, and nail-bed damage. Because fingertips play a crucial role in tactile sensation, fine motor activity, and aesthetics, their reconstruction demands a delicate balance between functional restoration and cosmetic refinement. The ideal reconstruction should provide durable, sensate, and supple coverage, restore the digital contour, and allow early return to work and daily activity [1-3].

Over the years, a wide range of reconstructive options have been described-ranging from healing by secondary intention and skin grafting to the use of local, regional, and free flaps [4,5]. Each technique carries inherent advantages and limitations. Local advancement flaps such as the V-Y (Atasoy or Kutler) flaps and cross-finger flaps have been used extensively for distal defects, but they are limited by defect size and often compromise finger length or cause donor-site morbidity. Regional flaps such as thenar and hypothenar flaps, while reliable, require immobilisation and staged division, often resulting in stiffness and prolonged rehabilitation. Free flaps, though offering excellent coverage for large composite defects, are technically demanding, time-consuming, and not always feasible in fingertip-level injuries [6].

In 1989, Lai CS et al., [7] first described the RHDIA flap, a distally based axial-pattern flap raised on the retrograde flow of the digital artery of the same finger. This technique allows single-stage sensate coverage using tissue of similar colour, texture, and thickness

without sacrificing adjacent digits or necessitating prolonged immobilisation. Subsequent refinements by Foucher G et al., [8] and Tsai TM et al., [9] have validated its use in various fingertip and distal phalangeal reconstructions. Despite these promising outcomes, the current literature reveals several gaps. Patient reported outcomes like patient satisfaction, return to work, functional outcome and aesthetic evaluation have not been consistently reported. Moreover, there is inadequate data from Indian and South Asian patient populations, where the industrial and agricultural crush injuries are prevalent and timely microsurgical expertise is often unavailable. Given these limitations, there is a need to re-examine the clinical utility of the RHDIA flap in contemporary practice and look at the outcomes from a patient's perspective. This study presents the authors' experience with 15 consecutive cases of fingertip injuries reconstructed using the RHDIA flap.

The present study aimed to report the outcomes of RHDIA flap in covering the fingertip defects in terms of patient satisfaction, time to return to work, functional outcome, and aesthetic outcomes.

MATERIALS AND METHODS

The present retrospective study was conducted from January 2024 to December 2024 at the Department of Plastic Surgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India on patients presented with post-traumatic finger-tip defects and operated with RHDIA flap. Data acquisition and analysis were performed between April 2025 to June 2025. Institutional ethics committee approval was granted by the IEC, Sri Venkateswara Medical College (Lr. No. 21/2025). Written, informed consent was obtained from all the participants included

in the study. The study abides by the guidelines laid by the Declaration of Helsinki.

Inclusion and Exclusion criteria: Patients of all age groups presenting with post-traumatic finger tip injuries were included in the study. Patients with previous surgery, burns or contracture of the same finger and, patients who are immunocompromised were excluded from the study. All consecutive patients who underwent RHDIA flap coverage for finger tip injuries during the study period (n=15) were included in the study.

Study Procedure

Demographic data, flap dimensions, and flap outcome data were collected. Patient satisfaction was categorised as high, moderate, or low. Functional outcomes were graded as excellent, good, fair, or poor. Aesthetic outcome was graded using a 5-point Likert scale (ranging from poor to excellent).

Surgical technique: Surgical procedure was done under local anesthesia and under finger tourniquet. Preoperative doppler was not done in any of the cases. The digital artery on the finger was presumptively marked 2 mm volar and parallel to the lateral digital axis. After debridement of the wound and assessing its dimensions, a flap of appropriate dimension was marked on the proximal phalanx of the finger (on radial or ulnar side depending on the location of the defect). A loupe magnification (2.5X) was used for the dissection. An incision was made at the proximal end of the flap to identify the neurovascular axis and it is ligated. Incision was further made over the rest of the circumference of the flap, and an islanded flap was raised along with the artery till 2-3 mm proximal to the distal interphalangeal joint crease line. The flap was then transposed onto the defect by either sectioning the intervening bridge of skin or by passing through a subcutaneous tunnel, and priority is given to resurface the tip of the finger, and any leftover raw area was grafted

RESULTS

A total of 15 cases were operated using RHDIA flap. 12 (80%) were males and 3 (20%) were females. The mean age of the study population was 42.56 ± 5.3 years. The most common age group was 30-40 years. All patients incurred the injury post-trauma. 9 were due to road traffic accidents and the rest were due to machine injury. The mean size of the flap was 3.7 ± 0.22 cm². The mean size of the wound was 5.23 ± 0.68 cm². The max dimensions of the flap were 2.6x1.6 cm. The mean time taken in days for complete healing was 17.13 ± 2.1 days. All the flaps survived. Partial flap necrosis of distal 2/5th of the flap was observed in one case due to infection, which eventually healed with a short course of intravenous cephalosporins [Table/Fig-1].

All 15 patients were followed for a minimum of 6 months postoperatively. Patients were able to resume routine daily activities within 3 weeks, and no joint stiffness or flexion contracture was observed. Patient satisfaction was reported as high in 86.6% (n=13) cases. Fourteen patients (93.3%) rated their functional outcome as good to excellent, with 1 patient (6.7%) rating it as fair due to partial flap necrosis and delayed wound healing. The mean return to work was 14.3 ± 2.3 days. Aesthetic outcome was assessed using a 5-point Likert scale, and the median score was 4 (IQR=2), indicating overall good aesthetic satisfaction.

The flap provided good contour and soft-tissue bulk, with a satisfactory colour and texture match to the surrounding fingertip skin. Donor site healing was uneventful in all patients; 10 sites were closed primarily, while 5 required split-thickness skin grafting, all of which healed without contracture or significant scarring. No patient expressed dissatisfaction with the appearance of either the reconstructed fingertip or the donor site. The photographs of the fingertip injury, flap elevation and postoperative results are shown in [Table/Fig-2,3].

S. No.	Age (years)	Gender	Mode of injury	Flap length (cm)	Flap width (cm)	Flap size (cm ²)	Wound size (cm ²)	Time taken for complete healing (days)	Complications
1	62	Female	Machine cut	2.5	1.5	3.75	3.9	15	Nil
2	43	Male	Machine cut	2.6	1.4	3.64	5.75	14	Nil
3	29	Male	Machine cut	2.5	1.5	3.75	5.25	20	Nil
4	33	Male	Machine cut	2.5	1.5	3.75	5.67	17	Nil
5	26	Male	RTA	2.6	1.4	3.64	4.32	20	Nil
6	25	Female	RTA	2.5	1.5	3.75	6.16	18	Nil
7	45	Male	RTA	2.7	1.6	4.32	5.04	16	Nil
8	25	Male	RTA	2.4	1.4	3.36	5.94	20	Nil
9	44	Male	RTA	2.5	1.5	3.75	5.04	18	Distal necrosis
10	25	Female	RTA	2.4	1.5	3.6	5	18	Nil
11	30	Female	RTA	2.5	1.4	3.5	6.16	15	Nil
12	46	Male	RTA	2.6	1.5	3.9	5.46	14	Nil
13	39	Male	RTA	2.5	1.5	3.75	5.51	15	Nil
14	37	Male	RTA	2.4	1.4	3.36	5	19	Nil
15	40	Male	RTA	2.5	1.5	3.75	4.25	18	Nil

[Table/Fig-1]: Demographic data, flap measurement and flap survival.

RTA: Road traffic accident

with a split-thickness skin graft. The donor site was either closed primarily or covered with a split-thickness skin graft harvested from the hypothenar area of the same hand. Dressing was secured hand was immobilised in a plaster of paris splint for 2 weeks.

STATISTICAL ANALYSIS

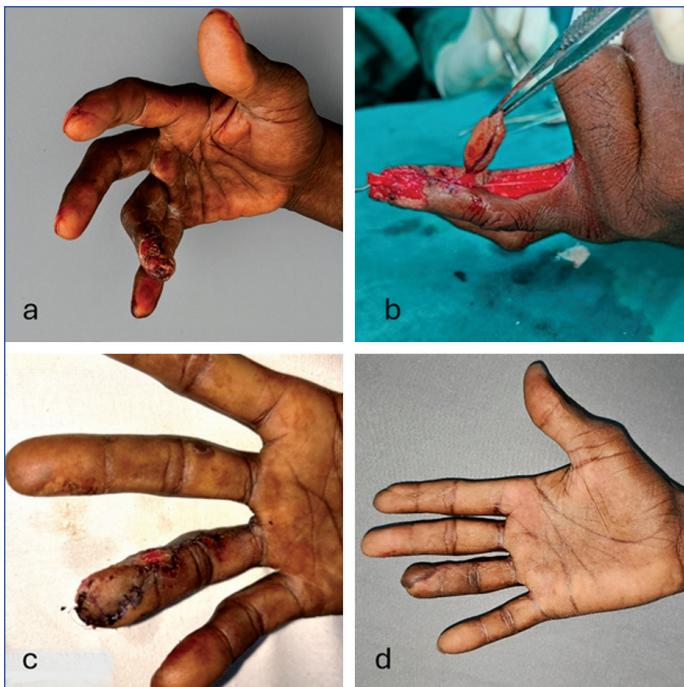
Data were entered in excel sheets and statistical analysis was done using EPI Info 7.2.6 by CDC Atlanta. Descriptive statistical analysis was done for demographic data. Continuous data are presented as mean \pm Standard Deviation (SD) or median (IQR), and categorical variables are presented as frequencies and percentages.

DISCUSSION

In this series of 15 patients with post-traumatic fingertip injuries reconstructed using the RHDIA flap, all flaps survived, demonstrating the reliability of this technique. Only 1 case (6.6%) developed partial distal necrosis that healed secondarily with conservative management. The mean time to complete healing was 17.1 ± 2.1 days, and the average return to work was 14.3 days, indicating rapid recovery and early functional restoration. Patient satisfaction was rated as high in 86.6% of cases, while 93.3% achieved good-to-excellent functional outcomes. Aesthetic outcome assessed using a 5-point Likert scale showed a median score of 4 (IQR=2),



[Table/Fig-2]: a) Figure showing the defect; b) Immediate postoperative result; c) 2 weeks postoperative; d) At 4 months follow-up.



[Table/Fig-3]: a) Figure showing the defect; b) Intraoperative flap elevation; c) 2 weeks postoperative; d) At 4 months follow-up.

reflecting overall good cosmetic results. No donor-site contracture, flexion deformity, or venous congestion was observed. These findings affirm that the RHDIA flap provides durable coverage, with sensory perception, excellent colour and texture match, achieving both functional and aesthetic success with minimal morbidity in a single-stage procedure.

The robust vascular anatomy of the digital arteries forms the foundation for the success of RHDIA flaps. Each proper digital artery gives rise to three consistent transverse palmar arches and dorsal skin branches, providing a reliable vascular network for retrograde perfusion [10,11]. This anatomy allows the flap to be safely based on reverse flow through distal anastomoses. In the thumb, the dorsoradial and dorsoulnar arteries communicate with the palmar digital system, creating additional options for reverse-flow fasciocutaneous or osteocutaneous flap design [12].

The reverse homodigital artery island flap is based on the proper digital artery and its reliable anastomotic network. Each digital

artery contributes approximately four palmar branches and four dorsal branches per phalanx, forming a consistent vascular pattern. However, three major transverse palmar arches exist at constant locations namely, the proximal arch at the level of the A1 pulley the middle arch near the A3 pulley and the distal arch just distal to the insertion of the flexor digitorum profundus tendon. These arches communicate with dorsal skin branches, which consistently arise at the mid-phalangeal regions to supply the dorsal skin. In the thumb, the dorsal skin branch originates from the palmar digital artery at the proximal phalanx and anastomoses with the distal arcade, allowing reliable reverse perfusion without sacrificing the entire digital artery. This anatomical arrangement permits safe elevation of a retrograde pedicle flap, relying on reverse flow through the distal transverse arch. Venous return is facilitated by the accompanying venous plexus around the digital artery, which must be preserved during dissection [11].

The outcomes of the present study are consistent with, and in some respects favorably aligned with, prior literature. 100% flap survival with 6.6% partial distal necrosis was observed, similar to the series by Lai CS et al., [7] that reported no flap loss in 11 reconstructions and highlighted the technique's single-stage reliability. Foucher G et al., [8] in their study of 64 homodigital neurovascular island flaps emphasised reliable vascularity and normal sensibility at the distal pulp, supporting the low complication profile and functional recovery in the present study. Tsai TM et al., [9], in their volar-oblique finger-tip defects, series have reported good patient satisfaction in 14 out of 16 patients but noted cold intolerance, hypersensitivity, and stiffness in a few cases. In contrast, the patients in this study encountered no stiffness or donor-site morbidity, suggesting comparable satisfaction with fewer complications. Contemporary evidence also places the complication rate of this study within expected ranges. A systematic review of reverse-flow homodigital flaps for thumb defects was done in 2024 [12] found 0.5% complete and 6.5% partial failures, which is nearly identical to partial-necrosis rate reported in this study. Indian data by Sundaramurthy N et al., [13] documented 17 out of 18 complete flap survivals, similar to the results in this study. Notably, few series have prospectively captured patient-reported outcomes; beyond general satisfaction in the study by Tsai TM et al., [9]. Inclusion of aesthetic outcome scoring and graded satisfaction offers novel PRO granularity that addresses a recognised reporting gap.

The cross-finger flap necessitates a two-stage procedure, prolonging treatment duration, and involves raising a flap from the adjacent finger, leaving a donor defect on the adjacent finger. Additionally, it is two-staged, and immobilisation of both the donor and recipient fingers can lead to stiffness and reduced range of motion, and transferring non-glabrous dorsal skin to the fingertip may cause sensory discrepancies [14-16]. The commonly done V-Y advancement flap is suitable only for small defects due to limited tissue mobility. Hook nails are a common problem in cases where the V-Y flap is inadequate and is responsible for patient dissatisfaction [17].

Harvesting a groin flap necessitates creating a secondary surgical site, which can lead to complications such as infection, haematoma, or unsightly scarring at the donor location, and is non-innervated, resulting in diminished sensory recovery in the reconstructed fingertip. Moreover, the skin from the groin area often differs in texture, colour, and thickness from that of the fingertip, potentially leading to less satisfactory cosmetic results [18,19]. Furthermore, groin flaps typically require immobilisation of the hand in proximity to the groin for an extended period to ensure proper flap integration, resulting in patient discomfort and an increased risk of joint stiffness. This extended immobilisation can also postpone the initiation of rehabilitation protocols, potentially leading to prolonged recovery times and reduced functional outcomes [20].

RHDIA flaps use adjacent skin from the same finger, providing a better match in texture, colour, and thickness compared to distant flaps.

This “like-with-like” reconstruction enhances aesthetic outcomes. By incorporating the digital nerve, RHDIA flaps can restore sensation to the reconstructed fingertip, which is crucial for functional recovery. This sensory restoration is often superior to that achieved with non-innervated flaps. Unlike distant flaps that require multiple staged surgeries, RHDIA flaps are typically performed in a single stage, reducing hospital stays and overall recovery time. Since the flap is harvested from the same finger, there is no need to sacrifice tissue from other fingers or body parts, minimising the morbidity. The use of local tissue allows for earlier initiation of rehabilitation protocols, which can lead to better functional outcomes and reduced stiffness [13,21].

Limitation(s)

The present study is limited by a relatively smaller sample size, which reduces the generalisability of the findings. This flap cannot be used for large defects involving the finger tips and needs to be supplemented with additional skin grafting. Flap necrosis can occur due to any inadvertent injury to the digital artery, as they are very narrow. This flap also carries risk of injury to the digital nerve, while separating it from the artery and can lead to loss of sensations on that side of the finger. The retrospective nature of the study is also another limitation and, in the future, prospective, comparative studies are needed to compare the efficacy of this flap over other options for covering fingertip defects.

CONCLUSION(S)

The reverse homodigital artery island flap is a reliable, single-stage technique for fingertip reconstruction that offers excellent tissue match and restoration of function with high patient satisfaction, early return to work time, and good aesthetic outcomes. The current study demonstrated complete flap survival with minimal complications and early rehabilitation, reaffirming this flap as a versatile and effective option for managing fingertip defects.

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