

# Reconstruction of Distal Phalangeal Soft Tissue Defects with Reverse Homodigital Artery Island Flap

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**Purpose:** Soft tissue reconstruction is essential for recovery of finger function and aesthetics in any traumatic defect. The authors applied a reverse homodigital artery island flap for soft tissue defect on distal part of digits. The aim of this study is to evaluate the efficacy of the procedure.

**Materials and Methods:** Seven cases of soft tissue defects of finger tip were included in this study. There were six male and one female, mean age was 43 years and mean follow-up period was 38 months. The length of flaps ranged from 2.0 to 2.5 cm and width ranged from 1.0 to 2.0 cm. Flap survival, postoperative complications were evaluated.

**Results:** All flaps survived without loss. Donor sites were repaired with primary closure in five cases and skin graft in two cases. None of the patients showed significant complications and their average finger motion was 255° in total active motion at the last follow-up.

**Conclusion:** The authors suggest that the reverse homodigital artery island flap could be a versatile treatment option for the soft tissue defect on distal part of digits.

**Key Words:** Fingers, Soft tissue injury, Reverse homodigital artery island flap

## INTRODUCTION

Fingers are susceptible to have traumatic injury because they are exposed constantly during manipulating objects and machinery. Crushed injury and soft tissue defects often occur and mistreatment or delays in treatment can lead to functional disabilities.<sup>1</sup> The treatment goals for the soft tissue defect of distal part of phalanges are to maintaining the length as much as possible, protecting deep structure with covering the exposed tissue and preserving the function with sensation and avoiding joint contracture. Various surgical methods have been applied for treating soft tissue defect of finger tip such as trimming, skin graft, V-Y advancement flap, thenar flap, cross-finger flap, pedicle flap, and free flap. Surgeons have to consider

the strengths and weaknesses of each surgical procedure while selecting an appropriate surgical method.<sup>2</sup>

The reverse homodigital artery island flap was first introduced in 1973 by Weeks and Wray<sup>3</sup> and advantages of this procedure include using the soft tissue near the damaged area, completing as a single procedure, early starting of joint motion.<sup>3</sup> Based on those benefits, the authors performed reverse homodigital artery island flap procedures for distal phalangeal soft tissue defects and reported the results of clinical analysis.

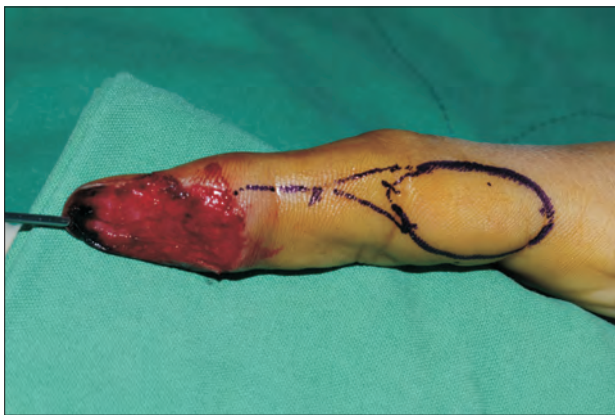
## MATERIALS AND METHODS

The data of 7 patients who had reverse homodigital artery island flaps for distal phalangeal soft tissue defects were analyzed

**Table 1.** Patient characteristics

Case No.	Age (yr)/sex	Cause	Site of defect	Flap size (cm <sup>2</sup> )	Pedicle length (cm)	Complication	Donor closure
1	24/M	Trauma	RLF	1.5×2.0	3	Transient swelling	FTSG
2	41/M	Trauma	LLF	2.0×2.5	3	None	FTSG
3	68/F	Verruca	RIF	1.0×2.0	4	None	Primary closure
4	54/M	Trauma	RIF	1.0×2.0	4	None	Primary closure
5	54/M	Trauma	LRF	2.0×2.5	4	None	Primary closure
6	17/M	Trauma	LSF	1.0×2.0	3	None	Primary closure
7	22/M	Trauma	RIF	2.0×2.5	3	None	Primary closure

M: male, F: female, RLF: right long finger, LLF: left long finger, RIF: right index finger, LRF: left ring finger, LSF: left small finger, FTSG: full thickness skin graft.

**Fig. 1.** Debridement, washing, and flap construction in the defect area.**Fig. 2.** Avulsion of the dorsal flap.

(Table 1). There were 6 males and 1 female and mean age at the time of surgery was 43 years (range, 17~68 years). The mean follow-up period was 38 months, ranging 16 to 60 months. Injured finger, defect size and coverage procedure of donor site were analyzed and flap survival, finger joint motion, recovery of sensation, cold intolerance and any other postoperative complications were evaluated as results of this procedure.

### Surgical procedure

Considering the possibility of a skin graft, surgery was performed under general anesthesia with the aid of pneumatic tourniquet control and microsurgical loupes. After adequate debridement, size and shape of the defect were measured and the flap was designed along the midlateral axis of the proximal phalanx. Less contact part by the neighbor finger was selected between ulnar and radial side (Fig. 1). The pivot point of the flap was set at 5 mm proximal to the skinfold of the distal interphalangeal joint. The flap was usually designed ovoid and the distal part of the flap was teardrop-shaped to allow

skin suturing without tension above the pedicle. Flap was raised following proximal identification of the neurovascular bundle in a proximal to distal direction starting from the volar surface. Tendon sheath area was preserved and digital nerve was separated from the flap with taking precautions against damages. With this vascular pedicle attached to the flap, dissection was carefully continued to the dorsal side (Fig. 2) and the digital artery was ligated at the proximal area. Flap was raised following identification of the vascular bundle in a proximal to distal direction with preservation of a generous cuff of subcutaneous tissue around the vascular pedicle to allow for adequate venous drainage (Fig. 3). Dissection was never carried out beyond 5 mm proximal to the distal interphalangeal joint as this area corresponds to the distal transverse digital artery. Following complete flap elevation the flap the tourniquet was loosened to confirm blood circulation in the flap and it was transferred to the defect. Skin was closed without tension to avoid pressure on the vascular pedicle (Fig. 4). Primary closure was attempted on the donor site in the first place and

full thickness skin graft was applied when it needed too much tension to repair directly by the surgeon's decision.

## RESULTS

Six patients had the defect by the direct trauma and one patient by the surgery of verruca excision. Injured fingers were 3 cases in index, 2 cases in middle, 1 case in each ring and small finger. Defect size ranged 2.0 to 2.5 cm long and 1.0 to 2.0 cm

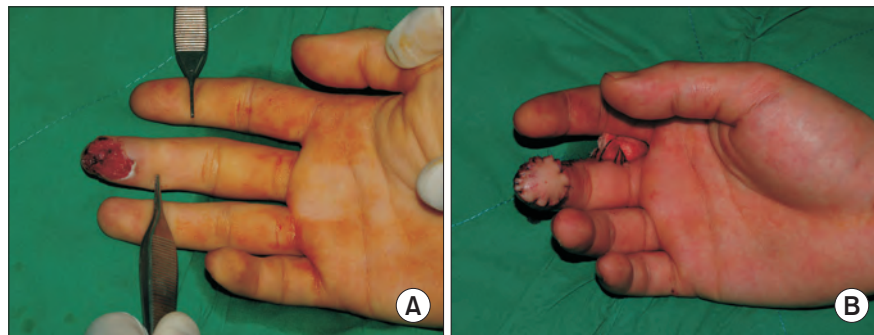
wide. Direct closure of the flap donor site was possible in 5 cases and full thickness skin grafts were performed in 2 cases. All flaps successfully survived without necrosis and any other additional reconstructive surgery. There were no cold intolerances in the flap area and one case of transient flap swelling was improved in 1 week postoperatively. Protective sensation was restored in all flaps as there were no complaints of sensory problem. The total active motion of the phalangeal joint averaged 255° (range, 245°~260°) without joint contracture that could hinder



**Fig. 3.** Proximal ligation of the digital artery, distal avulsion of the flap with blood vessels.

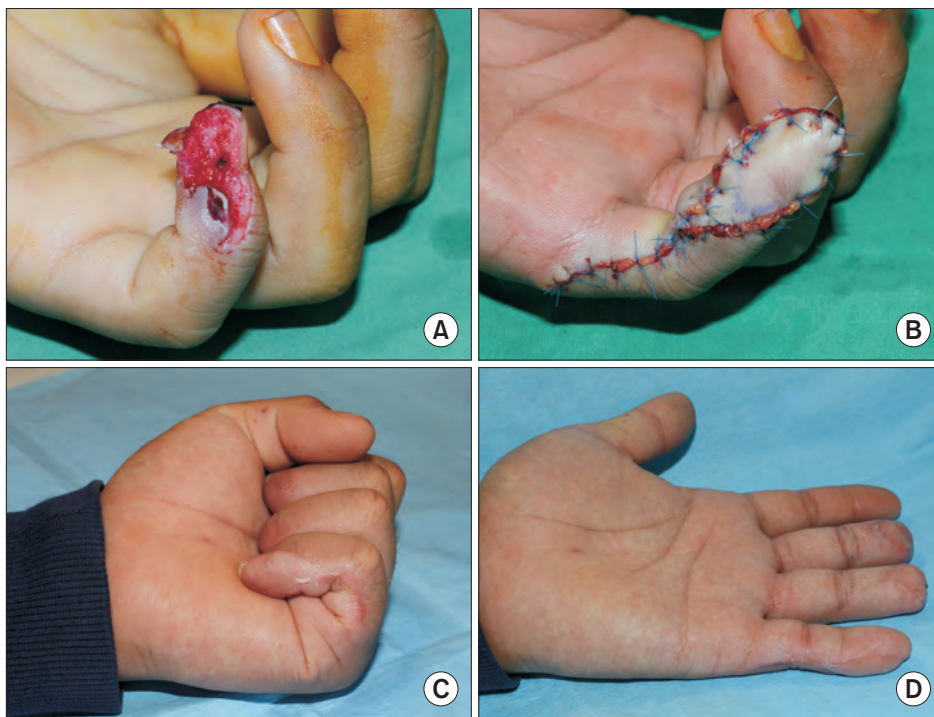


**Fig. 4.** Closure of the defective flap area.



**Fig. 5.** (A) A 24-year-old male patient with a soft tissue defect in the distal part of the right third finger. (B) Full thickness skin graft of the donor area after flap procedure. (C~E) Flap and finger joint motion 1 year after surgery.





**Fig. 6.** (A) A 17-year-old male patient with a soft tissue defect in the distal part of the left fifth finger. (B) Simple closure after flap procedure. (C, D) Flap and finger joint motion at the final follow-up.

daily life. All donor area showed complete healing without complications.

### Case 1

A 24-year-old male patient visited emergency room with soft tissue defect on the tip of middle finger, injured by a steel cutting machine. Reverse homodigital artery island flap was applied for coverage the defect with a flap size of 1.5×2.0 cm. Pedicle length was approximately 3 cm, and the donor area was covered with full thickness skin grafting. The flap survived and there was no problem on donor site. His sense of touch was recovered and the overall phalangeal range of motion was 260°, indicating no finger function problem at the final follow-up (Fig. 5).

### Case 2

A 17-year-old male patient injured his left small finger tip while working with a hand plane. Soft tissue defect on the distal portion was covered with a 1.0×2.0 cm sized reverse homodigital artery island flap and donor site was repaired by direct suture. There was no significant complication and total active motion of the finger was 250° (Fig. 6).

## DISCUSSION

Various different techniques have been introduced for reconstruction of finger tip injuries and appropriate treatment should preserve functional digital length and sensibility, as well as minimize aesthetic loss.<sup>1</sup> Reconstructive procedures include various advancement flaps, regional flaps and free tissue transfers. Advancement flaps, however, often display limitations in size and arc of rotation as well as persistent cold intolerance.<sup>4</sup> Regional flaps such as thenar flap or cross-finger flap require a two stage surgery along with the associated risk of residual joint stiffness particularly in the elder patient.<sup>5</sup> Free tissue transfers require not only significant microsurgical expertise but also prolonged surgery time.

Initially described in 1973 by Weeks and Wray<sup>3</sup> and modified by others, the distally based homodigital island flap offers multiple advantages for fingertip reconstruction. It allows one stage surgical approach confining surgery to the involved digit only. The thin and glabrous skin of the lateral surface of the proximal phalanx is comparable in texture and thickness with the volar pulp. Due to its wide arc of rotation the most distally located defects can be easily covered allowing functional length preservation. Moreover, in comparison to other flap procedures, finger joint motion can be initiated relatively early.

Disadvantages of this flap include the potential risk of venous insufficiency as well as the necessity to sacrifice one digital artery. However if it is applied properly, its advantages can overcome the shortcomings.

Although transferring the reverse homodigital island flap as a sensate flap has been described, we no longer perform such a transfer as long-term analysis has revealed no significant difference regarding sensation recovery. Furthermore, collateral sprouting from adjacent intact nerves with concomitant central adapting mechanisms has been demonstrated, which obviate the transfer of sensate flaps for fingertip reconstruction. In the study by Yildirim et al.,<sup>6</sup> reverse homodigital artery island flap without neurorrhaphy showed recovery of 2-point discrimination to 6.0 to 8.8 mm over 1 year follow-ups. Based on those study, the authors did not perform nerve reconstruction procedure for the sensate flap during this flap procedure. In our study, all the patients recovered protective touch sensation, but the results of 2-point discrimination test could not be analyzed due to the inconsistent responses from the test during the follow-up, which need future reevaluation with more cases and follow-up.

In our study, direct closure of the flap donor site was possible in 5 cases and full thickness skin grafts were performed in 2 cases. We closed donor site directly when tension of the closure site was acceptable. Size of the donor site is important factor for selection of donor site closure method. We choose the donor site closure method by the patient's skin reliability and condition in the operation.

Momeni et al.<sup>2</sup> reported that complete flap survival in 10 cases out of 11 cases of reverse homodigital artery island flap, and Chen et al.<sup>7</sup> reported complete survival in 26 out of 30 cases, with 4 cases of partial necrosis. In the present study, the number of patients was relatively small, but all 7 cases exhibited successful flap survival with no major complications, indicating

outstanding results comparable to other reports.

The limitations of this study include small sample size, making significant statistical analysis of each result impossible. In addition, most phalangeal soft tissue defects are trauma-related cases without any particular systemic diseases, thus requiring more studies for generalized application in patients with defects due to diverse causes and those with comorbidities.

The authors obtained satisfactory outcomes in treating soft tissue defect on the distal part of digit with the reverse homodigital artery island flap. We suggest that this surgical procedure could be one of the versatile treatment options for reconstruction of distal phalangeal soft tissue defect.

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