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ORIGINAL PAPER

New technique for the reconstruction of the finger tip amputation: the double wing transposition flap

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Abstract

Background Fingertip amputations are common injuries of the hand and their surgical treatment can be challenging due to their unique structure, composite content, and scarcity of available tissue. We describe the double wing transposition flap, a new technique for fingertip reconstruction, and report 1-year outcomes.

Methods This is a retrospective study of patients who underwent a double wing transposition flap for fingertip reconstruction following amputation. Data with regards to the injured digit, size of the defect, level of amputation (Ishikawa), and plane of amputation was recorded. Any early complications of surgery were documented. The outcomes measured included time to return to work/ normal activities, the arc of motion at the distal interphalangeal joint (DIPJ), two-point discrimination (2-PD), and late complications like cold intolerance, pain, and nail deformity.

Results A total of 46 patients (mean age: 28 years; 38 men and 8 women) with 46 fingertip amputations were reconstructed with a double wing transposition flap. The mean defect size was 2.2×1.9 cm. There were no partial or total flap losses. The mean arc of motion at the DIPJ was 73°, and the mean 2-PD was 4.8 mm. A total of 8 patients had a hook nail deformity. No patient complained of pain or cold intolerance.

Conclusions The double wing transposition flap is a simple procedure for fingertip reconstruction. It can be done relatively fast, which does not need dissection of the neurovascular pedicles, and can be used in the reconstruction of transverse, volar oblique, and dorsal oblique fingertip amputations.

Level of evidence: Level IV, Therapeutic study.

Keywords Fingertip injury · Pulp reconstruction · Double wing transposition flaps · Hand surgery

Introduction

Acute hand injuries account for approximately 10% of all emergency room cases [1], and fingertip amputations are among the most common injuries to the hand [2]. The management of fingertip amputation can be challenging due to the unique structure and the composite content of the fingertip and the scarcity of locally available tissue. The potential complications that may occur in the repair of this area include sensory impairment, cold intolerance or hypersensitivity, and joint stiffness. Various approaches have been suggested in the literature for the reconstruction of fingertip amputation. These include healing by secondary intention, skin grafting, flap reconstruction, and replantation. Different flaps such as heterodigital or homodigital neurovascular island flaps [3–6] have been described although they can be associated with sensory loss and the need for grafts at the donor site. Other techniques include cross-finger and thenar flap, or distant flaps from the groin or abdomen can be used; however, they need two stages and the immobilization can lead to stiffness. Smaller defects are amenable to V–Y advancement flaps [7–10] although these flaps can be used only for transverse or dorsal oblique amputations.

We have been using a double wing transposition flap for reconstructing fingertip amputations. This flap can be used for dorsal oblique, volar oblique, and transverse amputations and does not require dissection of

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the neurovascular pedicle. The aim of this study is to share our experience with this flap and report outcomes at 1 year.

Patients and methods

A retrospective study was carried out among patients that underwent a double wing transposition flap for fingertip reconstruction following amputation at our institution in the period from 2010 to 2020. Institutional review board approval was sought, and informed consent was obtained from patients/parents. Only patients with at least 1-year follow-up were included. Patients with multiple digit injuries, h/o previous injury to the same digit, or those that underwent reconstruction due to non-traumatic pathology were excluded. Data with regards to the injured digit, the size of the defect, the level of amputation (Ishikawa), and the plane of amputation (transverse, volar oblique, or dorsal oblique) was recorded. Any early complications of surgery (infection, partial, or total flap necrosis) were documented. The outcomes measured included time to return to work/ normal activities, the arc of motion at the distal interphalangeal joint (DIPJ), two-point discrimination (2-PD), and late complications like cold intolerance, pain, and nail deformity.

Surgical technique

The patients were operated under a digital block using a rubber glove as a tourniquet. The exposed bone was not shortened in any of the patients, and only sharp ends were trimmed. Double wing transposition flaps were planned after debridement. An incision was made starting from the edge of the amputation on both sides of the nail, continuing along the paronychium line and extending to the volar distal phalangeal joint line by turning towards the midline of the finger, and the incisions were united at this line (Fig. 1). This incision was made till the subcutaneous fat. The incision on the lateral aspect was extended along the lateral nail fold and deepened till the periosteum. The glabrous skin palmar to the nail fold on either side was elevated as a wing. There was no need for mobilizing the neurovascular pedicle during flap elevation. The two wings were advanced distally in a V–Y fashion based on the proximal V-shaped incision and sutured to each other in the midline and distally to the remnant nailbed. This transposition of the wing flaps allowed coverage of the stump (Figs. 2 and 3). The wing flaps on both sides of the finger were advanced with rotation, and the advancement of the flap in the volar area contributed to the closure of the donor sites of the rotation flaps (Fig. 4).

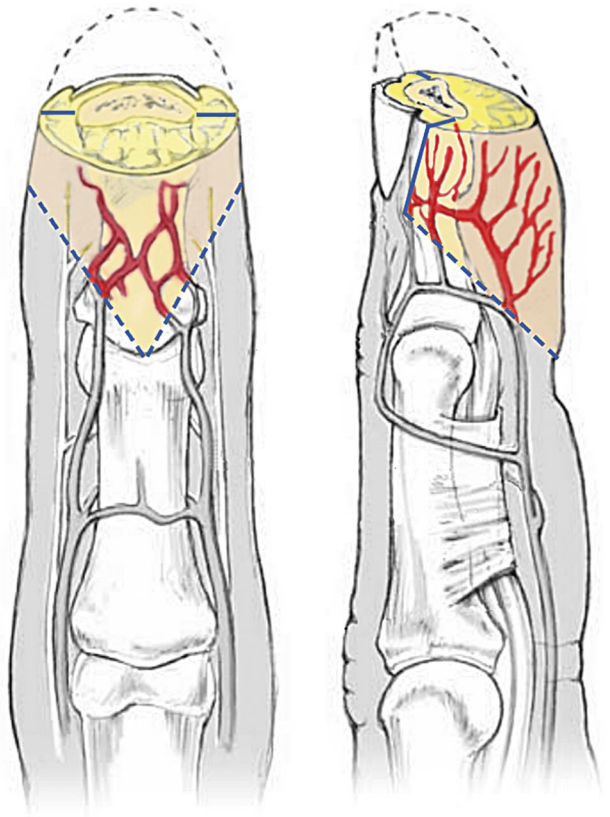

Fig. 1 Schematic drawing of the incisions of the double wing transposition flaps in a fingertip injury

Results

A total of 46 patients with 46 fingertip amputations were reconstructed with a double wing transposition flap. This included 38 men and 8 women with an average age of 28 years (range: 2–72 years). A total of 15 amputations were to the non-dominant hand, and 31 injuries were to the dominant hand. The injuries involved 13 thumbs, 17 index fingers, 10 middle fingers, and 6 ring fingers. The data with regards to the injury, treatment, and outcomes have been summarized in Table 1. The mean defect size of the patients was 2.2×1.9 cm (range: 1.2×1.4–2.6×2.3). No partial or total necrosis of the flap occurred in any of the patients. The mean follow-up period was 15 months. The mean arc of motion at the DIPJ was 73°, and the mean 2-PD was 4.8 mm

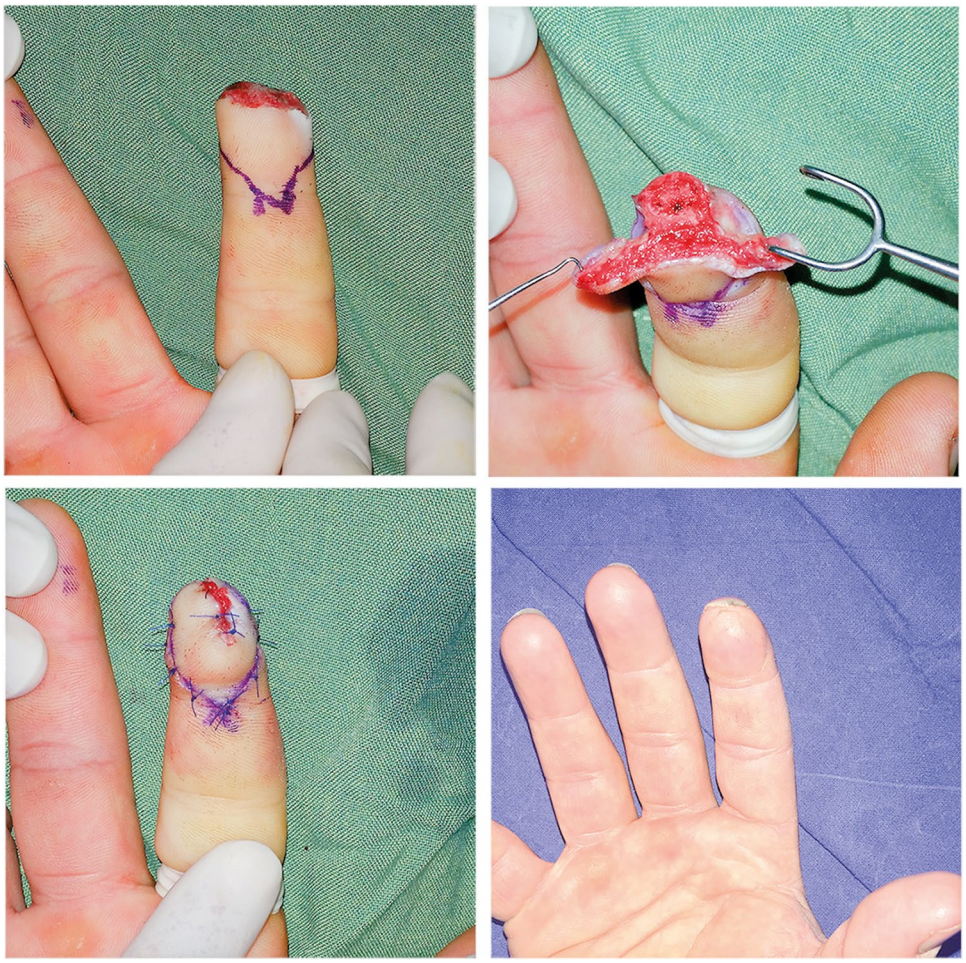

Fig. 2 (Above, left) A transverse injury, index finger, distal fingertip amputation, and flap design. (Above, right) The flap is fully elevated. (Below, left) Intraoperative view after the flap inset. (Below, right) Volar view at 15 months postoperatively

(range: 3–8 mm) [11]. Eight patients reported a hook nail deformity. No patients reported cold intolerance or pain.

Discussion

The double wing transposition flaps offer safe circulation and neural support by allowing supply from both neurovascular bands and can provide sufficient skin filling in the reconstruction of the fingertip. In double wing transposition flaps, the wings are used as a rotation flap and the volar flap as an advancement flap, combining the advantages of both flap styles. The double wing transposition flaps can be used safely for both transverse injuries and for volar or dorsal oblique flaps.

Wings in the technique are formed from the paronychium on the radial and ulnar aspects, and the circulation of the flap is very safe due to this arterial network. Once again, the digital nerve branches accompanying this arterial structure provide the necessary sensory support to the flap [12]. Being a direct-flow homodigital neurovascular flap, like other advancement flaps, it offers better mobility than the advancement flaps used previously in fingertip reconstructions and produces excellent results in the repair of medium-sized defects. All skin tissue on the flap is volar, and therefore the reconstruction site distal to the finger has sufficient fullness and thickness.

The flap option that is closest to the composite content of the fingertip, and that has sufficient sensation and fullness, would be the most appropriate choice for patients. Tranquilli-Leali [7], Atasoy, [13] Segmüller [14] and Venkataswami [15] advancement flaps are well-established and highly practical and are frequently used for fingertip injuries, but each has its specific limitations. Although they are applied also in reconstructions of the thumb, these flaps are more often used for the other fingers. The Tranquilli-Leali and Atasoy flaps are effective in defects amputated with a slope of 30%, and those extending only to the nail fold in distal fingertip defects [16], while the Segmüller flap, with extended

Fig. 3 (Above) A volar oblique, middle finger, distal fingertip amputation, and flap design. (Below, left) Intraoperative view after the flap inset. (Below, right) Volar view at 18 months postoperatively

lateral V–Y flaps, is a small flap with a low level of advancement. The Venkataswami flap, on the other hand, can cause flexion contracture of the finger, which is a significant disadvantage [16].

In fingertip injuries, it is generally accepted that injuries larger than 1 cm in which the bone is exposed should be closed with neurovascular flaps [17]. Local advancement flaps are useful for the repair of fingertip and pulp defects, while advanced techniques such as heterodigital or homodigital neurovascular island flaps [3–5] and sensory dorsal metacarpal artery flaps [6] have been described for the repair of medium-sized defects. Moberg [9] described a volar advancement flap using both digital neurovascular pedicles on the thumb for good sensory and sufficient pulp filling, and Snow [10] applied the same technique to the other fingers. Since the dorsal skin is not supplied from a different vascular source in the circulation of the fingers, there may be a lack of circulation to the dorsal skin when the Moberg advancement flap approach is applied [18].

The reconstructive surgeon must choose the most appropriate method for the patient among the many available procedures, ranging from secondary healing to complicated procedures such as replantation, to best meet the needs of the patient. Several reconstruction methods have been described for injuries when replantation is not possible for various reasons, each with different advantages in different aspects. In many of these methods, however, reconstruction can be challenging due to the specific structure and importance of the fingertip. The repair of fingertips, as one of the most important components of the hand that is involved in production, processing, touching, feeling, and grasping activities, is very important for the patient.

The technique is a simple, one-step procedure involving a short duration of surgery. Circulatory and sensory support to the flap is excellent and it offers better mobility than other advancement flaps. It can be used safely to repair Ishikawa [19] zone I- and II-type defects up to 2.5 cm in transverse, volar oblique, and dorsal oblique fingertip amputations.

Fig. 4 (Above, left) A volar oblique, thump tip amputation. (Above, right, and below, left) Intraoperative view after the flap inset. (Below, right) Volar view at 16 months postoperatively

This technique is not a superior flap in all its features that can be applied to all fingertip injuries, although we believe it to be an important surgical method that can be applied in eligible patients. The double wing transposition flaps provide good sensory support and sufficient fullness in the reconstruction of the fingertip in eligible patients, enabling recovery without dysfunction of the fingers.

Table 1 Patient summary

Patient characteristics		Injured finger		Amputation level*		Amputation type		Defect size (cm)	Postoperative static 2-PD (mm)	Complaints and complications	
Total patient	46	Thumb	13	Type I	11	Transverse	25	2.2×1.9 cm (range, 1.2×1.4 cm to 2.6×2.3 cm)	4.8 mm (range, 3×8 mm)	Hook nail deformity	8
Age (yr) (range, 2 - 72 years)	28	Index	17	Type II	35	Volar oblique	19				
Sex		Middle	10			Dorsal oblique	2				
Male	38										
Female	8										
		Ring	6								

2-PD 2-point discrimination

*Numbers designate Ishikawa classification (Ishikawa, K., Ogawa, Y., Soeda, H., and Yoshida, Y. A new classification of the amputation level for the distal part of the finger. J. Jpn. S.R.M. 3: 54, 1990.)

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Declarations

Conflict of interest The author has no relevant financial or non-financial interests to disclose.

Patient consent Patient consent was obtained from study participants.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Due the retrospective nature of the study, it was exempted from ethical approval by The Human Investigation Committee (IRB) of Adimayan University Faculty of Medicine (Doc. No: E-53911808-903-2698).

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