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Fingertip replantation using artery-only anastomosis: case series

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Abstract

The fingertip is a complex organ compacted with precise functional roles of fine movements and fine touch sensory functions. Fingertip injury commonly occurs in machinery work, and presents as crush injuries or amputations. Even though it is a challenging procedure due to the area of injury relative to the size of vessels for restoration, fingertip replantation has been developing as a newer method for both functional and aesthetic restoration, with better success rates and improved long-term outcomes. Artery-only replant has been emerging as a suitable option in many cases, which allows the blood to flow out of the injury site, allowing the natural venous revascularization, owing to the difficulty in small venous anastomosis. Here, we present two cases with fingertip replantation using artery-only anastomosis who underwent fingertip replantation at Tamai level II without venous anastomosis.

Keywords: Artery only replantation; Fingertip replantation; Revascularization



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Introduction

The fingertip is an essential appendage, crucial for function as well as for cosmetic appearance. Komatsu and Tamai reported the inaugural digital replantation in 1968, while the first successful fingertip replantation was performed by Yamano in 1985.^{1,2} Fingertip amputations and injuries are common encounters in an Emergency setting of major hospitals.³ The primary goal for fingertip replantation incorporates maintenance of digital length, adequate soft tissue coverage, sensibility, and nail preservation, whereas the treatment options for these amputations range from conservative management and local flaps to replantation of the fingertip.^{3,4} Primary considerations for the procedure include strong patient desire, especially beneficial for musicians, professionals in business-related roles, and individuals reliant on finger dexterity for public-facing occupations or specialized tasks. On the contrary, severe vascular disorders, mangled finger, and segmental amputation are the absolute contraindications.⁵ Relative contraindications include prolonged warm ischemia time of more than 12 hours, tissue contamination, crush amputations, and relative health risks of the patient.^{5,6} The functional and aesthetic outcome of replantation can provide a high degree of patient satisfaction, especially in Asian countries where body integrity and physical appearance are valued as much as their function.^{6,7} Hence, the advancement of microsurgery techniques has resulted in the popularity of replantation of an amputated fingertip distal to the distal interphalangeal joint.⁷ However, the highly specialized anatomy of a fingertip, identification of submillimeter vessels, and technically demanding surgical skills make it a challenging procedure.⁸ In this paper we present two cases of fingertip replantation using artery-only anastomosis.

Case 1

A 29-year-old male presented with total crush amputation of fingertip Tamai II amputation of the left ring finger, Figure 1, replantation of the fingertip with single k wire fixation with 1.2 mm on the single digital vessel on dominant side was repaired using 10/0 nylon was done with magnification of 8x and 5000 IU heparin was administered at the time of vessel clamps were released and both digital nerves were also repaired, the suitable vein was not found, hence, artery only anastomosis replantation was done, skin was closed with few loose simple sutures along with continuous intensive postoperative care, Figure 2. The patient was discharged after

the replanted finger was pink and well-perfused; however, lost to long-term follow-up.



Figure 1. Preoperative findings of patient with Left ring finger amputation; Figure 2. Immediate postoperative result

Case 2

A 15-year-old male presented with a history of crush amputation of left thumb at Tamai level 2, fingertip amputation of left long finger, near total amputation of left ring finger at Dista Inter-phalangeal (DIP) joint at Tamai II and laceration on left small finger, Figure 3. The replantation procedure was similar to Case 1 with used of single k wire of size 2 mm with an additional eponychial flap for the left long finger, single k wire fixation of left long finger with extensor tendon repair was done on left finger and simple suture was done for laceration of left small finger, Figure 4. On 6 months follow-up, the replanted thumb was smaller in length compared to the normal side (2.6 cm vs 2.2 cm) and, width (2 cm vs 1.5 cm), sensation had returned comparable to the unaffected side, Figure 5. Other injured fingers also made a good recovery.



Figure 3. Preoperative findings of the patient with crush amputation of left thumb; Figure 4. Immediate postoperative findings

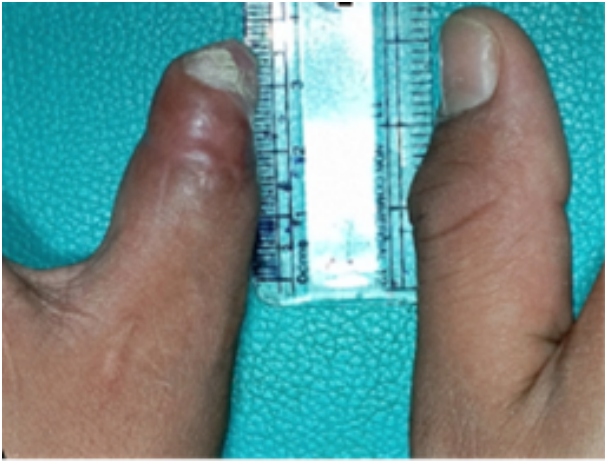


Figure 5. Postoperative result at 6-month follow-up period

Postoperative venous outflow management

Dressing changes were done every half an hour with gauze soaked in a solution containing 100 ml of normal saline, 1 ml of heparin, and 160 mg of gentamicin until chemical leeching and external bleeding were needed. Leech therapy was started to relieve intermittent congestion along with 0.1 ml of heparin injected into and around the stab incision (2-3 mm) on the axial plane along lateral nail fold; daily 3-4 times along with wound dressing, necessary in both cases, the frequency of the leeching and chemical leeching was tapered as venous congestion was not present. Systemic anticoagulants such as IV heparin 5000 U QID were used until the patient was discharged. Later, on improved condition with the normal flow of blood with CRT <2 seconds, pink nail bed, the patients were discharged in 17 days and 18 days in Case 1 and Case 2 respectively after 24 hours period of venous equilibrium was achieved. Both patients were satisfied with the outcome of the surgery and appearance of finger.

Discussion

Preserving finger length and ensuring stable sensation and soft tissue coverage are the main factors to consider in fingertip reconstruction. Numerous techniques exist for fingertip reconstruction, such as local flap, regional, distant, or free flaps, each with its own set of advantages and drawbacks.^{2,9} A study on single-finger injuries, replantation showed better outcomes in range of motion, pain, disabilities of arm shoulder and hand (DASH) scores, finger usage, and satisfaction compared to amputation closure. Although replantation patients had longer hospital stays and follow-up periods, his study showed grip strength, paresthesia, and cold intolerance were similar in both groups, thereby regarding replantation as the preferred approach whenever feasible.^{2,10,11}

As a highly demanding procedure in terms of concentration, specialized microsurgical skills and skilled support staff are a requisite.⁸ Functional outcomes following fingertip replantation surpass those at other levels due to unneeded tendon repair requirements, excellent sensory recovery, and maintenance of joint function without compromising overall hand functionality, in contrast to replantation of more proximal digits.^{2,7,9,11} Technical difficulty of replantation increases as the amputation level becomes more distal, and anastomosis of veins and arteries becomes more challenging due to the smaller diameter of the vessels.¹²

Replantation of the fingertip, in instances where appropriate veins are lacking, may be addressed through the utilization of external bleeding or the establishment of an arteriovenous or cutaneous-venous fistula.^{4,8,12} The success of artery-only replant relies on being adept at maintaining flow across the small arterial anastomosis and through the fingertip all while venous outflow can reestablish naturally usually around 5-7 days, and can be reliable if low-resistance bleeding through the replant is maintained.¹³ The success rates in fingertip replantation undergoing artery and vein repair are reported at 70% to 90% whereas artery-only has been reported at 64% to 87%.^{3,4,6,8,9,11,12,14}

External bleeding techniques employed to sustain outflow during the restoration of venous outflow consist of puncturing, scrubbing, chemical leeching, inducing external bleeding from the nail bed or incising the replantation site to encourage bleeding, implementing controlled nail bed bleeding protocol (CNBBP), and forming a cutaneous-venous fistula.¹⁵ Controlled bleeding from the fingertip is crucial for achieving consistently high success rates in fingertip replantation. The protocol is considered safe and reliable as it eliminates the need for medical leeches and the removal of the nail plate from the replanted finger.¹²

In our cases, we used chemical leech as well as medicinal leech following artery-only fingertip replantation. Chemical leech protocol was first described in a retrospective study done in a Hospital of Taiwan, the technique that promoted external bleeding from a 2 mm incision over the fingertip in two cases over 15 and 16 days.¹² Matsuzaki used this method for 7 days in 15 fingertips with 13 of them surviving, with other studies stating the range of 4-7 days of external blood leeching. However a study done in a medical college of Korea stated that extensive crush injuries necessitate a prolonged duration of external bleeding due to the extended process of

angiogenesis, particularly within the venous system. External bleeding is considered safe, however, the amount of bleeding should be closely monitored. Although none of our patients required any blood transfusion, the transfusion rate can range from 0 to up to 88% in various studies.^{2,13}

Conclusion

In cases of fingertip amputations, an artery-only replant can be done as an alternative when a suitable vein is not found. A successful replantation includes aesthetic results and good functional outcomes in short and long-term consequences. Intensive postoperative care contributes to a higher success rate.

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