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Cross-finger subdermal pocketplasty as a salvage procedure for thumb tip replantation without vascular anastomosis: a case report

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Abstract

Objectives: Fingertip amputation is often encountered in emergency departments, especially in hospitals located near industrial areas. Replantation of the fingertip can be considered when the normal architecture is preserved in cases of sharp amputation. The goal of replantation is to preserve cosmesis and function, especially for the thumb because of its involvement in grasping and the key pinch. Even when microsurgical vascular anastomosis is applied, the absence of venous anastomosis along with the high rate of failure of arterial anastomosis in zone 1A fingertip amputation may lead to replantation failure.

Methods: We herein present a case report of thumb tip amputation salvaged via a modified cross-finger technique. The recipient site was on the ipsilateral radial side of the intermediate phalanx of the middle finger.

Results: The thumb tip was successfully replanted with no vascular anastomosis, and this new technique prevented stiffness in the metacarpophalangeal and interphalangeal joints of the thumb and middle finger.

Conclusions: This procedure can be performed in local clinics and emergency departments without the need for arterial and venous anastomoses.

Keywords

Thumb tip amputation, cross-finger, subdermal pocket, vascular anastomosis, replantation, fingertip amputation zones

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Introduction

Fingertip amputation is often encountered in emergency departments, especially within hospitals located near industrial areas. Replantation of the fingertip can be considered when the normal architecture is preserved in cases of sharp amputation.[1] Functional preservation is crucial for fingertip amputation, especially in cases involving the thumb, which requires replantation as soon as possible. Microsurgical vascular anastomosis remains a widely applied technique for replantation.[2] However, venous congestion is the primary cause of replantation failure because of the lack of suitable veins for microsurgical anastomosis,[3] which requires surgeons well-trained in the proper technique and the use of appropriate microscopic devices, neither of which is attainable at local clinics or emergency departments. Microsurgical replantation of the fingertip can be challenging even with the proper equipment and an experienced surgeon.

Sebastin and Chung[4] performed a systematic review of digital amputation and introduced a new classification that divided fingertip amputations into zones 1A to 1D. Within zone 1A, the superficial dorsal veins are unavailable; in zones 1B to 1D, venous anastomosis is easily achievable and significantly improves the survival rate of the replantation.[4,5] When suitable dorsal veins are unavailable, alternative methods of replantation include the use of an arteriovenous shunt, subcutaneous pocket, and subdermal pocket, and each procedure has its advantages and disadvantages.[6]

The subdermal pocket procedure was first reported by Lin et al.[7] in 2004. Unlike the subcutaneous pocket, the subdermal pocket provides a vascular-rich subdermal plexus that enhances the neovascularisation and venous outflow of the replanted finger. Easy monitoring of the replanted finger, a short operation time, and feasible wound care have influenced the increased performance of this procedure in recent years for very distal amputations without venous anastomosis, even in cases of arterial anastomosis failure. The subdermal pocket was initially designed in the abdominal area.[7] However, shoulder, arm, and finger stiffness caused by secure fixation were noted when the abdominal pocket site was used. Therefore, in 2010, Puhaindran et al.[8] described the use of a modified palm subdermal pocket site. Reduced shoulder and arm stiffness were noted after this procedure, but phalangeal joint stiffness remained. Additionally, we do not believe that this technique was meant to be applied to the thumb because of the thumb's limited range of motion and shorter length compared with the other digits.

We herein introduce the first reported case of cross-finger subdermal pocketplasty without the use of arterial and venous anastomoses. This technique is more suitable for thumb tip amputation and has the advantages of preserving the range of motion and preventing joint stiffness.

Case report

The patient provided written informed consent to undergo the surgical procedure described in this report and for publication

Figure 1. The amputated level of the thumb is distal to the lunula and failed to undergo microsurgical revascularisation because no artery and vein were available.

of his case. Because of the need to make a rapid decision regarding treatment, an ethics committee was not contacted before the procedure.

A 29-year-old man sustained a traumatic amputation of his right thumb (cut-crush injury). The thumb was amputated distal to the lunula (zone IA) and failed to undergo microsurgical revascularisation because of the unavailability of an artery and vein (Figure 1). De-epithelialisation was performed in the pulp area of the thumb tip, leaving partial thickness of the dermis (Figure 2). Direct composite graft replantation was performed, and the graft was sutured with 4-0 nylon. Next, two skin flaps were designed as a trapdoor and were elevated on the ipsilateral third intermediate digit with the epidermis and part of the deep dermis. The replanted thumb tip was attached to the designed subdermal pocket in a cross-finger manner on the third intermediate phalanx. The lifted flap was designed to cover the de-epithelialised area with sutures in the periungual area of the thumb tip. Sufficient contact between the de-epithelialised area and the subdermal plexus was ensured (Figure 3). Bulky dressings were applied to keep the two fingers opposed and absorb oozing.

Figure 2. De-epithelialisation was performed on the pulp area of the fingertip, leaving partial thickness of the dermis, and direct composite graft replantation was performed with 4-0 nylon.

On postoperative day 9, division was performed with the patient under local anaesthesia (Figure 4). The donor site was primarily closed. The patient was followed up at 18 weeks postoperatively, and the replanted finger was confirmed to have survived with proper functioning and appearance (Figure 5). Static two-point discrimination was 6.5 mm, and the range of

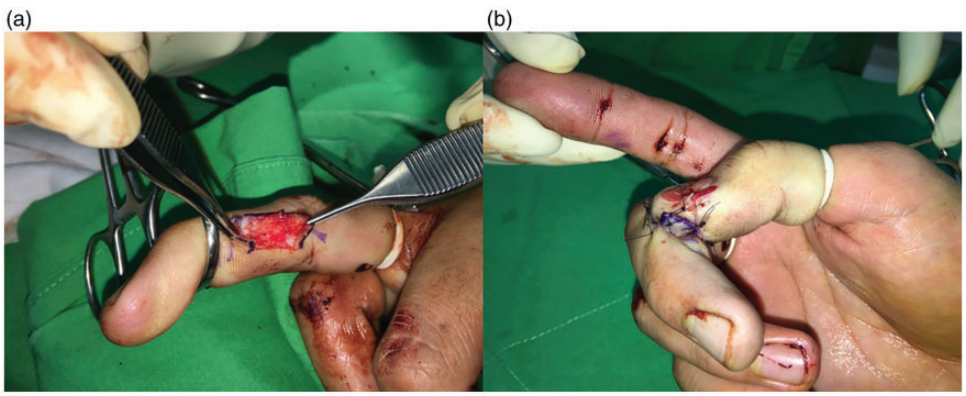

Figure 3. Good contact was ensured between the de-epithelialised area and the subdermal plexus. (a) Two skin flaps were designed as a trapdoor and were elevated on the ipsilateral third intermediate digit with the epidermis and part of the deep dermis. (b) The replanted fingertip was attached to the designed subdermal pocket.

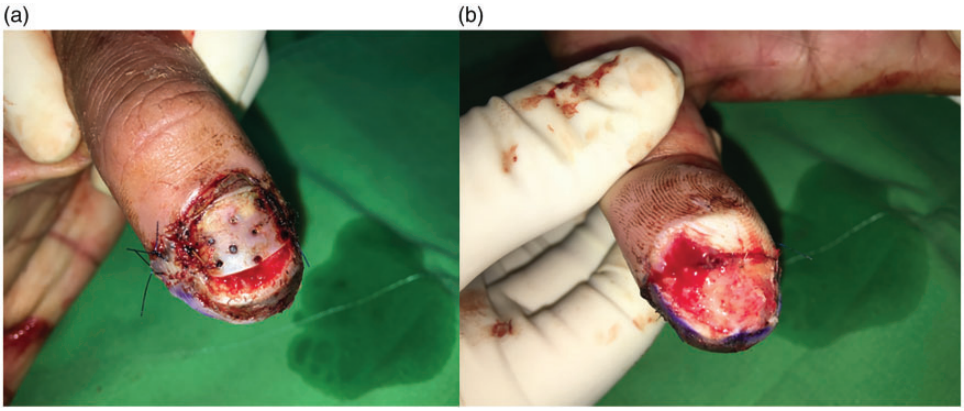

Figure 4. On postoperative day 9, division was performed under local anaesthesia. (a) Oozing was present at the fingertip. (b) The pulp region showed spotting bleeding.

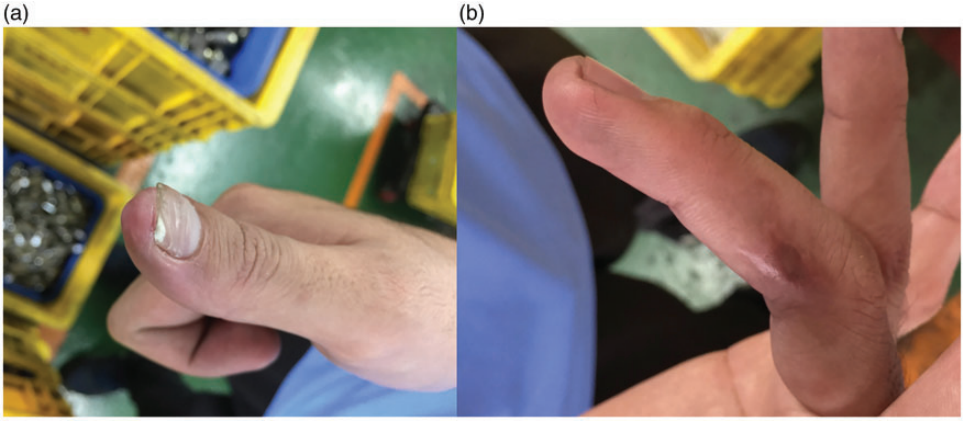

Figure 5. Eighteen weeks postoperatively. (a) The replanted finger was confirmed to have survived with good function and appearance. (b) Acceptable appearance without comorbidity over the pocket site.

motion of the thumb interphalangeal joint was 70 degrees at 12 months of follow-up.

Discussion

Replantation can be performed in certain cases of fingertip amputation, especially in cases of sharp amputation. In 2011, a systemic review by Sebastin and Chung[4] revealed that the mean survival rate among 2273 distal digital replantations was 86%, and no difference was observed in the survival rate between Tamai zone I and II amputations. The pattern and level of injury, time of ischemia, and presence of anastomotic vessels affect the survival rate of replanted digits.[9] Clean-cut (sharp) injuries show better outcomes than crushing or avulsion injuries. A warm ischemic time of <12 hours or a cold ischemic time of <30 hours is associated with an improved survival rate.[10] In one study, the repair of venous outflow improved the survival rate in both zone I and II replantations.[4]

However, the use of current classifications using the nail base as the dividing line makes the evaluation of long-term outcomes challenging, and amputations occurring at the middle phalanx distal to the flexor digitorum superficialis are excluded. The novel classification by Sebastin and Chung[4] that includes amputations distal to the insertion of the flexor digitorum superficialis may be more useful for determination of outcomes after digital replantation. Distal digital amputations are classified as zone 1A (distal to the lunula), zone 1B (between the nail bed root and the lunula), zone 1C (between the insertion of the flexor digitorum profundus and the middle phalanx neck), and zone 1D (between the middle phalanx neck and the flexor digitorum superficialis). In the present case of a zone 1A amputation, anastomosis of the arteries was remarkably challenging with no possibility of venous anastomosis. However, although venous anastomosis from zones 1B to 1D is difficult, such anastomosis can still be achieved, and it significantly increases the survival rate of replants.[4,6] If no dorsal vein is available for anastomosis, alternative techniques include arteriovenous shunting, subcutaneous pocketplasty, and subdermal pocketplasty. The arteriovenous shunt requires microsurgical skills[11] and is not feasible in emergency departments or local clinics.

In 1979, Brent[12] introduced the subcutaneous pocket in the first report of fingertip replantation without vascular anastomoses. However, in six cases of fingertip amputation across or proximal to the lunula reported by Muneuchi et al.[13] in 2005, only one finger survived and it became atrophic after 4 months. The authors concluded that subcutaneous pocketplasty should be performed carefully for fingertip amputation across or proximal to the lunula because of the poor survival rate and the possibility of digit stiffness.[13]

In 2004, Lin et al.[7] reported a subdermal pocketplasty technique wherein microsurgical anastomosis was performed only when an artery was available. When an artery was unavailable, the composite graft technique was applied prior to subdermal pocketplasty. The abdomen was chosen as the replantation flap site. Prior to division, the fingertip was punctured with a 25-gauge needle to confirm its viability. Division was performed after 1 week (with arterial revascularisation) or 2 weeks (without arterial revascularisation) from the time of subdermal pocketplasty. This procedure was dependent upon high vascularity of the subdermal plexus, which could enhance the venous outflow of the replant. If composite graft necrosis occurred during the pocket period, the procedure could be prematurely terminated. This technique was extended to use as an alternative salvage procedure for venous insufficiency after revascularisation.[14] However, this technique had the drawbacks of joint stiffness over the finger, elbow, and even the shoulder because of the limited range of motion and a high rate of joint contracture if division was delayed. General anaesthesia was suggested, and it was necessary to perform the procedure in the operating room.

In 2010, Puhaindran et al.[8] made extensive use of subdermal pocketplasty in the palm and achieved complete survival of 11 of 14 digits. The advantages of this modification are that the palm has the highest capillary density in the dermis and provides the best bed for neovascularisation,[15] and only local anaesthesia is required in cases of single-digit replantation. The perfusion of the composite graft could be directly monitored without needle puncture. However, interphalangeal joint stiffness could not be resolved, and arterial anastomosis was still required in this case series. Moreover, in our opinion, this technique was not meant to be applied to the thumb because of the thumb's limited range

of motion and shorter length compared with the other digits.

In the present case, attachment of the thumb-tip composite graft to the palm was difficult. We improved upon the previous technique by making a cross-finger subdermal pocket that preserved the range of motion of the thumb metacarpophalangeal and interphalangeal joints. We chose the pocket site over the ipsilateral radial side of the intermediate phalanx of the middle finger, which prevented stiffness of the metacarpophalangeal and interphalangeal joints. Preservation of the index finger was necessary because it is used as a pointer and has multiple functions in daily life. To the best of our knowledge, this is the first use of a subdermal pocket in a cross-finger manner without the use of vascular anastomosis in zone IA with complete survival.

Conclusion

The advantage of this procedure is that it can be performed without arterial and venous anastomoses in a local hospital or emergency department without an experienced microsurgeon. This technique can only be applied to zone IA thumb tip amputation; according to the literature, arterial and venous anastomosis should be performed for zones 1B to 1D to achieve a better outcome and function. A limitation of this study is that it was based on a single case of a young patient without comorbidities. Further studies are required to prospectively assess the functional outcomes, two-point discrimination of other fingertips, and survival rate with or without arterial anastomosis.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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