

Pulp De-epithelialization for Venous Outflow Augmentation after Digital Replantation

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Summary: Traumatic amputation injuries account for a substantial portion of emergency department visits. This includes digital amputations that may be considered for replantation. Following surgery, venous congestion is the most common cause of replant failure. To address this, several methods have been proposed to augment venous outflow. In this article, a simple and straightforward method that can be utilized to establish or augment venous outflow in cases of venous insufficiency is described. This method entails de-epithelialization of the replanted digit pulp skin with use of postoperative anticoagulation. The area can be further expanded or stimulated to increase bleeding as needed and is allowed to heal by secondary intention. This method allows for reliable venous outflow with relative ease of implementation. (*Plast Reconstr Surg Glob Open* 2021;9:e4016; doi: 10.1097/GOX.0000000000004016; Published online 10 December 2021.)

From 1997 to 2016, the annual incidence of digit amputations was estimated to be over 23,000 in the United States.¹ Indications for replantation of these injuries include any amputation of the thumb, multiple digit involvement, and pediatric amputation. The mechanism of injury, level of injury, occupation and preferences of the patient, presence of contamination, and ischemia time contribute to suitability for replantation. The most common cause of failure after digital replantation is inadequate venous outflow. This challenge is even greater in cases where there is a lack of suitable veins for successful anastomosis. Several techniques have been described to address venous insufficiency.²⁻⁴ However, each technique carries downsides to implementation and success. An easy-to-employ technique for venous outflow augmentation in digital replantation that may improve upon the currently utilized techniques is described.

TECHNIQUE

Once digital replantation has been performed, a large portion of the replanted pulp skin (typically 1 × 1 cm or greater) is de-epithelialized using a scalpel in a tangential

fashion. Care is taken to ensure enough surface area is de-epithelialized to promote adequate bleeding. A heparin bolus is administered intraoperatively (5000 units), and therapeutic anticoagulation is continued postoperatively for 5–7 days to promote continuous bleeding. The anticoagulation regimen is initially dosed with a goal heparin anti-Xa assay of 0.2–0.5 IU/mL, and then titrated to maintain bleeding of replanted digit. Aspirin (81 mg) is initiated on postoperative day 1 and continued for 30 days per the senior author's protocol. Monitoring of the replanted digit is performed by assessing the color and briskness of bleeding. The wound is scrubbed with gauze or freshened with a scalpel every 12–24 hours to improve outflow if bleeding slows. Dressings are changed every 12–24 hours, as needed. Hemoglobin levels are monitored every 12 hours during the bleeding process and transfusion is administered for Hgb less than 8. When sufficient intrinsic venous outflow has been established, anticoagulation is tapered over a 24-hour period, and the digit is monitored for venous congestion. The digit is monitored closely for venous congestion during this period, and bleeding is re-instituted if necessary. When stable, the patient is discharged with local wound care instructions, and the pulp wound is allowed to heal by secondary intention.

CASE 1

A 35-year-old woman sustained a traumatic thumb amputation secondary to a dog bite. One artery and two dorsal veins were anastomosed. The thumb pulp was prophylactically de-epithelialized to augment venous outflow (Fig. 1A). The patient required one unit of packed red blood cells. Heparin was discontinued on postoperative day 5. Aspirin was continued for 30 days. The pulp wound

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Received for publication September 23, 2021; accepted November 3, 2021.

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DOI: 10.1097/GOX.0000000000004016

Disclosure: The authors have no financial interest to declare in relation to the content of this article.

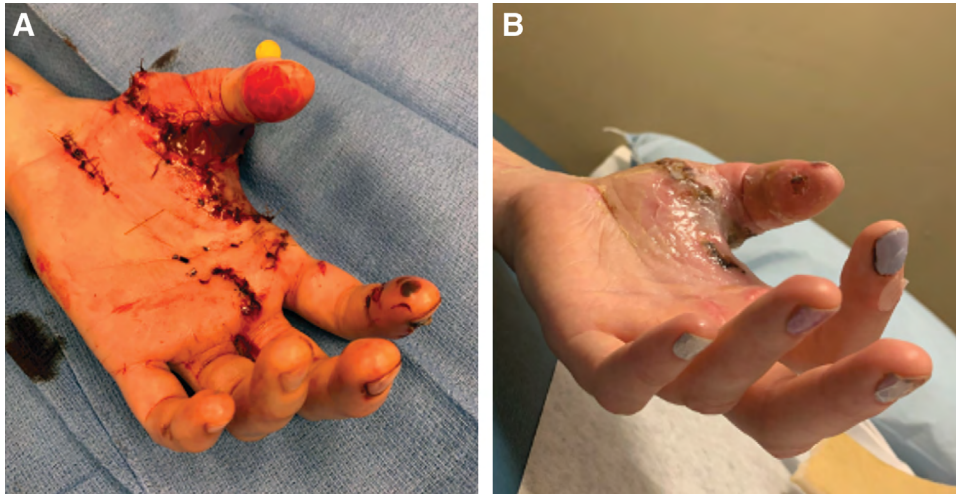


Fig. 1. Left thumb replantation after traumatic amputation, A, Pulp de-epithelialization with healthy bleeding from thumb pulp. B, Four weeks after surgery with healing of the de-epithelialization site.

was allowed to heal by secondary intention without complication (Fig. 1B).

CASE 2

A 30-year-old man sustained zone I amputations of the index and middle fingers secondary to a metal-cutting press (Fig. 2A). No suitable veins were identified for anastomosis. The pulp of each replanted digit was de-epithelialized to establish venous outflow, and anticoagulation with heparin and aspirin was initiated. The patient required a total of 10 units of packed red blood cells in the postoperative period due to ongoing losses from the bleeding protocol. The heparin drip was weaned on postoperative day 8, and the patient was discharged. The index finger demonstrated signs of necrosis requiring

amputation, whereas the middle finger remained viable and healed uneventfully (Fig. 2B).

CASE 3

A 39-year-old man sustained a traumatic thumb amputation from a work-related saw accident. One dorsal and one volar vein were anastomosed, along with a single digital artery. After completion of the anastomoses, signs of venous congestion were present. The thumb pulp skin was de-epithelialized, and the patient was started on therapeutic anticoagulation with aspirin and heparin. Heparin was discontinued on postoperative day 6. No transfusions were required during the bleeding process. The patient was discharged on postoperative day 8 with complete survival of the replanted thumb.

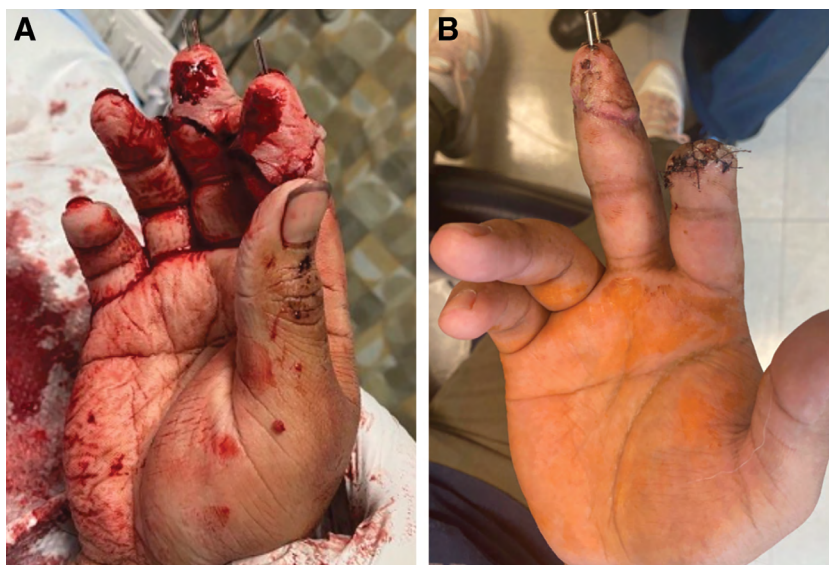


Fig. 2. Right index and middle finger zone I replantation A, Pulp de-epithelialization with bleeding from the finger tips. B, Four weeks after surgery with healing of the middle finger and status post amputation of the index finger.

DISCUSSION

Pulp de-epithelialization may provide a straightforward technique to augment venous outflow after digital replantation. To achieve appropriate external bleeding, this is paired with therapeutic anticoagulation and oral aspirin. This technique can be applied in standard replantations as well as artery-only digital replantations. Monitoring the quality of bleeding is an effective way to assess the digit postoperatively, and the amount of bleeding can be adjusted based on the size of the de-epithelialized wound and the frequency of wound stimulation. It is our belief that the replanted digit tends to bleed more in the initial postoperative period, and begins to naturally decrease as intrinsic venous outflow is re-established. No complications from systemic anticoagulation have been encountered.

A number of techniques have been described to address venous insufficiency after replantation, including nail plate removal,^{5,6} repeated pin pricks for continuous bleeding,⁷ and use of leech therapy.⁸ In our experience, the amount of bleeding achievable and ease of implementation with this technique is felt to be superior to nail plate removal or leeching. In addition, future nail complication is reduced by preserving the nail plate.

Other described methods have incorporated aspects of pulp de-epithelialization. In the dermal pocketing technique, a selected area of the amputated digit is de-epithelialized and sutured to a subdermal skin flap.^{9,10} In addition to requiring a second procedure for division, this technique carries the risk of joint contracture. In the crater method, a 3 × 3 × 3 mm wound is created in the replanted digit's pulp.³ Our technique encourages creation of a larger surface area of de-epithelialization (generally 1 cm × 1 cm), with the possibility for postoperative stimulation or further expansion if needed.

CONCLUSIONS

Pulp de-epithelialization may serve as a better method of venous outflow augmentation when compared with other methods. Important points to be considered include ensuring that the de-epithelialized surface area is large enough to sustain adequate bleeding, maintaining

postoperative anticoagulation, and freshening up the wound at the bedside with a scalpel (if needed) to promote additional bleeding. The senior author utilizes this technique in every replantation until intrinsic venous outflow is confirmed to be adequate.

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ACKNOWLEDGMENT

The principles and ethics documented in the Declaration of Helsinki were followed throughout this research study.

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