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## Case Report

# Reconstruction of extra-large severe punching hole injury in the palm: A case report

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## ABSTRACT

A 48-year-old man sustained a severe punching hole injury of 8 cm in diameter on the palm of his left hand using a punching instrument (for making the bottom of drink cans), and his middle and ring fingers were almost amputated. A flow-through type immediate ALT (anterolateral thigh) flap was used to bypass the distal blood flow and a titanium plate for mandibular reconstruction and plantar glabrous skin were used to preserve the floating amputated fingers. As there has been no report of reconstruction of a punching hole in the palmar region that exceeds 8 cm in diameter, this report is novel and educational.

## Case presentation

A 48-year-old man was injured when his left hand was caught in a punching machine (used to make the bottom of drink cans) during work. He was removed from the workshop and arrived at the emergency department of our hospital 50 min after the injury. On arrival, the patient's vital signs were as follows: BP, 96/63; HR, 51 beats/min; and SpO<sub>2</sub>, 99%.

The hand injury was a penetrating wound of approximately 8 cm in diameter, extending from the base of the left middle and ring finger to the middle of the left palm, causing extensive soft tissue loss. Bone defects included a proximal 1/2 and a distal 1/3 defect of the middle phalanx, a proximal major defect of the ring phalanx and a distal metaphyseal head defect. The flexor tendon defect was 20 mm in the middle finger and 30 mm in the ring finger, and the extensor tendon defect was 15 mm in the middle finger and 40 mm in the ring finger. The neurovascular bundle was continuous on the radial side of the middle finger, but 35 mm was missing on the ulnar side of the middle finger, 30 mm was missing on the radial side of the ring finger, and there was contusion damage on the ulnar side of the ring finger. This was accompanied by paresthesia of the left middle finger and ring finger, and blood flow disturbance in the ring finger. No other systemic trauma was observed. The initial hand injury severity score (HISS) [1] was 202 points and the injury was categorized as major (Fig. 1).

## Surgical interventions

On the day of injury, under general anesthesia, the ALT flap was harvested with the lateral vastus lateralis muscle so that the descending branch of the lateral circumflex femoral artery (LCFA) was pulled through. Bypass interposition of the descending branch

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of the LCFA from the base of the finger artery bifurcation in the superficial palmar arterial arch to the radial side digital artery of the ring finger was used to improve finger blood flow, with temporary pinning of the middle and ring fingers (Fig. 2). Two months later, reconstruction of the palmar raw surface was performed using plantar glabrous skin graft with a full layer of plantar. For rigid reconstruction, mandibular reconstruction using a titanium plate (thickness: 2.5 mm) was used to bridge the phalanx bones and metacarpal bones to maintain the finger length, without tendon reconstruction. The digital nerve was sutured only on the ulnar side of the ring finger, and the other injured digital nerves were not reconstructed due to the large length of the defect (Fig. 3).

### Assessment of the postoperative hand function

Although the finger axis of the middle finger remains misaligned, at one year and four months after the injury the active ROM is as follows: left-forearm supination, 90°; pronation, 70°; left-wrist (extension, 85°; flexion, 80°); radial flexion, 30°; ulnar flexion, 40°; thumb (MP flex, 72°; IP flex, 60°; IP add, 45°); index TAM, 185°; and little TAM, 192°. The patient achieved a HAND20 [2] score of 54, a Quick DASH [3] score of 29.5, a Semmes-Weinstein monofilament test score of 3.22 for both the middle finger and ring finger, and has returned to his previous position at work (Fig. 4). Vascularized iliac bone graft surgery to correct the finger axis was offered to the patient; however, he did not wish to receive the operation.

### Discussion

Treatments for injuries such as mangled hand and crushed hand are not standardized and still challenging [4]. In many cases it is acceptable to create a motorized prosthesis organizing a team approach without active surgical reconstruction of the injured area [5]. However, it is also said that options for limb preservation should be fully exhausted before considering amputation, which results in a significantly decreased function [6]. This case involved a massive palmar contusion injury with extensive bone and joint loss. In addition, the patient had tendon defects, multiple neurovascular bundle defects and an ischemic hand with a floating finger. However, the patient did not want a prosthetic artificial hand.

Regarding the reconstruction of smaller defects, there are 25 case reports describing the reconstruction of complex defects of the hand with posterior interosseous artery flaps and fascio-subcutaneous pedicles [7]. In general, however, the use of flow-through type immediate ALT flaps in severe limb trauma with large tissue loss is widely accepted as the gold standard operation due to their ability to improve blood flow to the damaged tissue and fill the large complex tissue defect [8,9]. In addition, if the bone defect is extensive, it may be difficult to achieve sufficient stability with a common plate and screw, and various staged treatments are usually required [10].

In our case, a flow-through type immediate ALT flap was used to bypass the distal blood flow and a titanium plate for mandibular reconstruction and plantar glabrous skin were used to preserve the floating amputated fingers. The titanium plate for mandibular reconstruction is bridged and fixed as a substitute for the grafted bone, and rigid bone stability has been achieved. In the future, vascularized iliac bone graft surgery could be considered as an additional treatment, but the patient does not wish to undergo bone harvest. No similar reports could be found in the past.

### Conclusion

Carefully planned surgical treatment combining a flow-through type immediate ALT flap for distal blood flow, a titanium plate for mandibular reconstruction for rigid reconstruction, and a plantar glabrous skin graft is useful for the reconstruction of large punching



Fig. 1. Photograph of the machine that caused the injury and the left hand of the patient on arrival at our hospital.



Fig. 2. A flow-through type immediate ALT flap was harvested and thereafter inserted as a blood flow bypass using the descending branch of LCFA.



Fig. 3. A plantar glabrous skin graft and mandibular reconstruction with a titanium plate (thickness: 2.5 mm) was used to bridge the phalanx bones and metacarpal bones.

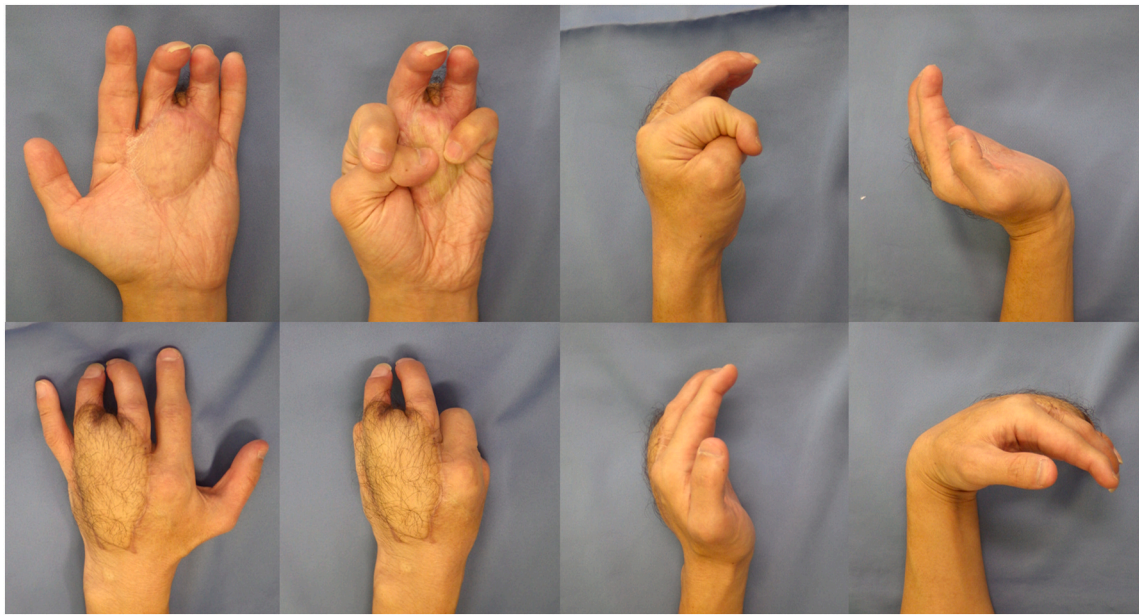


Fig. 4. The patient achieved a HAND20 score of 54, a Quick DASH score of 29.5, and has returned to his previous position at work.

hole injuries of the palmar region.

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#### Ethical approval

Not required.

#### Informed consent and patient details

Written informed consent was obtained from the patient for the publication of this case report and the accompanying images.

#### Declaration of competing interest

The authors declare no conflicts of interest in association with the present study.

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