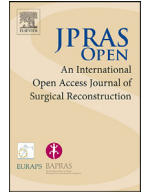




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Case Report

Treatment of a patient suffering from posttraumatic painful neuromas formed at the bilateral digital nerves of the left middle finger using two neurovascular island flaps

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ABSTRACT

Hand surgeons often encounter painful posttraumatic neuromas in daily practice and the treatment of these neuromas is still challenging for them, because of the tendency of recurrence.^{1,2} The patient injured his left middle finger and was treated by amputation in a previous hospital. After this operation, the patient started to feel pain at the fingertip and complained of severe electric radiating pain when the radial and ulnar ends of the finger were touched. We treated painful neuromas formed on both palmar digital nerve stumps using a reverse pedicle island flap containing subcutaneous nerves, which were connected to the nerve stumps after removal of the neuromas of the finger. This maneuver relieved the finger pain completely.

Removal of finger digital nerve neuromas, connecting the nerve stumps to the subcutaneous nerves included in a skin island flap and, covering the neurotomy sites with the flap may have

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reduced the chance of the recurrence of neuromas and resulted in restoration of considerable function of the hand.

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Introduction

Painful peripheral neuromas are troublesome for patients and hand surgeons. Some patients continue to feel pain even after removal of neuromas.¹ Moreover, there is no consensus on the most effective surgical procedure for the treatment of recurrent painful cutaneous neuromas.² This pain is caused by regeneration of small nerve fibers extending from the recurrent neuromas formed at the end of an amputated nerve stump.³

Our strategy for the treatment of painful neuromas is to prevent formation of a new neuroma at the amputated nerve stump and to remove any target tissue for nerve fibers regenerated from the nerve stump.

In this study, we report a surgical treatment for painful neuromas formed at the bilateral digital nerve stumps using a reverse pedicle island flap containing two subcutaneous nerves that were connected to the digital stumps after removal of the neuromas.

Case report

A 63-year-old man crushed his left middle finger in a car door and received an open fracture of the distal phalanx. He was treated conservatively. Because he complained of strong and continuous pain at the finger even three months after the injury, he underwent amputation of the finger at the level of the distal interphalangeal (DIP) joint. Only two weeks after surgery, he again began to feel spontaneous pain and electric pain induced by tapping the radial and ulnar end of the amputated fingertip. We thus diagnosed posttraumatic painful neuromas of the amputated bilateral palmar digital nerves of the finger and performed surgery by using a pedicle island flap containing two subcutaneous nerves, which were harvested from the base of the injured finger.

Surgery

Before surgery, Allen's test confirmed the patency of the bilateral palmar digital arteries of his left middle finger. A schematic diagram of the operation is shown in [Figure 1](#). Scarred skin at the tip of the finger (1.5 × 0.5cm) was discarded because the scar tissue can be a target tissue of small nerve fibers extending from amputated digital nerves, which is considered to be a cause of pain.³ Neuromas were formed at the distal ends of the bilateral palmar digital nerve stumps approximately 5 mm proximal to the DIP joint level ([Figure 2](#) left). A skin island flap (2 × 1cm) nourished by reverse flow of the radial palmar digital artery was harvested from the dorsoradial aspect of the middle finger base including the radial dorsal digital nerve and the dorsal branch of the radial palmar digital nerve of the finger ([Figure 2](#) middle). The distal stumps of the dorsal digital nerve and the dorsal branch of the radial palmar digital nerve were coagulated with an electric coagulator and left in situ in the dorsum of the finger. After being separated from the radial palmar digital nerve, the radial palmar digital artery and the surrounding fatty tissue were ligated and cut at the level of the proximal margin of the flap. The flap with the vascular pedicle was raised distally and transplanted to the site of the skin defect created after removal of the scar tissue at the fingertip.

After the excision of the neuromas of the bilateral palmar digital nerves, the transected radial and ulnar digital nerve stumps were sutured to the radial dorsal digital nerve and the dorsal branch of the palmar digital nerve, respectively using a 10-0 nylon suture. The skin island was sutured at the tip of

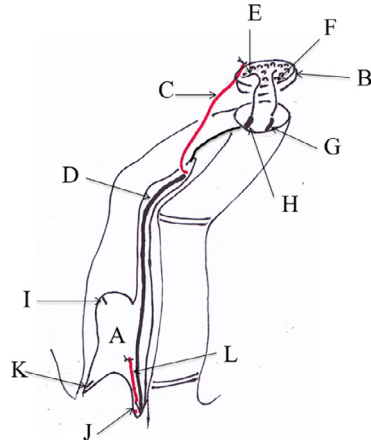


Figure 1. Schematic diagram of the operation. A: donor site of the flap. B: neurovascular island flap, C: radial palmar digital artery, D: radial palmar digital nerve, E: dorsal branch of the radial palmar digital nerve, F: radial dorsal digital nerve, G: a stump of the ulnar palmar digital nerve, H: a stump of the radial palmar digital nerve, I: distal stump of the dorsal branch of the radial palmar digital nerve (coagulated), J: proximal stump of the dorsal branch of the radial palmar digital nerve, K: proximal stump of the dorsal digital nerve (coagulated), L: proximal stump of the radial palmar digital artery (ligated).

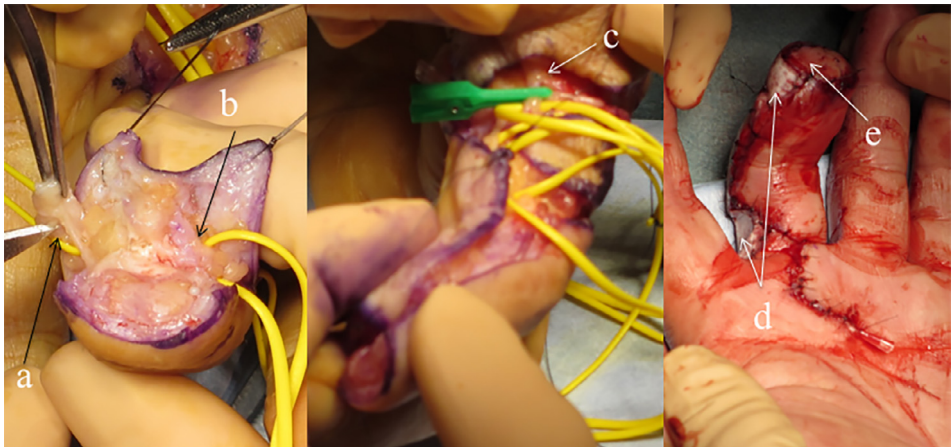


Figure 2. Left: Exploration of the amputated finger tip. The amputated stumps of the bilateral palmar digital nerves were identified. a: stump of the ulnar palmar digital nerve, b: stump of the radial palmar digital nerve. Middle: the radial palmar digital artery and the surrounding fat tissue were separated from the radial palmar digital artery. c: the radial palmar digital artery. Right: Skin defects at the flap donor site and over the vascular pedicle of the flap were covered by an artificial dermis (d). e: the neurovascular flap was drastically reduced.

the finger to cover the sites of the neurorrhaphy. The donor site of the skin island and a skin defect over the vascular pedicle of the flap were obliterated by transplantation of artificial dermis (Figure 2 right). One year after the operation, the patient recognized a slight pain when the fingertip was tapped (Figure 3). The sensation of the transplanted island flap was 3.61 (blue zone) as determined by the Semmes-Weinstein monofilament test. The patient was very satisfied with the outcome of the operation.



Figure 3. The left middle finger tip one year after surgery. The flap survived, and pain was represent.

Discussion

Pain due to neuroma formation in peripheral nerves is irritating and often deteriorates the patient's activity of the daily life.⁴ There are many reports about the treatment of painful neuromas, such as excision only; excision and transposition of the nerve stump into bone, muscle, or vein; excision and repair of the transected nerve stumps with or without nerve graft; and neurolysis and coverage with transplanted soft tissue using muscle, fascia, or adipose flap.^{1,2}

Louis et al.² performed a meta-analysis for the treatment of painful neuromas and concluded that the outcomes of neuroma excision followed by transposition of the proximal nerve stumps or neurolysis followed by the soft tissue coverage were significantly more likely to result in a meaningful pain reduction than those of other operative techniques in patients who have had pain for more than two years or had undergone multiple operations more than twice before definitive neuroma related pain surgery.

Mackinnon et al.³ reported that small nerve fibers sprouting from neuromas preferred to extend to the scar tissue, which often caused pain. They suggested that the scar tissue should not be left around the nerve stump.³ Kakinoki et al.⁵ reported excellent outcomes after the treatment of posttraumatic painful neuromas at the fingertips using neurovascular island flaps. Because a neuroma is formed when axon sprouting from the stump is inhibited, the amputated digital nerve stump was sutured to a subcutaneous nerve included in the neurovascular island, which can lead the axons to the subcutaneous nerve of the island. Replacement of the scar tissue over the neuroma with the transplanted skin island removed the target tissue of the axons sprouting from the amputated nerve stump.³ In addition, the coverage of the neuroorrhaphy site with the vascularized adipose tissue of the skin island

might have protected the site from the mechanical stimulation, thereby leading to a reduced chance of occurrence of pain.⁵

In this study, the patient had neuromas at the amputated ends of the bilateral palmar digital nerves of the middle finger. Two nerves included in the skin island were sutured to the bilateral digital nerve stumps after removal of the neuromas. This technique is recommended for treatment of painful neuromas formed at the bilateral digital nerve stumps in the distal end of a finger.

Conflict of interest

None.

Funding

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