OPEN

CASE REPORT

Hand/Peripheral Nerve

Muscular Pedicled Lateral Chest Composite Flap—A New Nonmicrosurgical Option for Forearm Salvage

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Summary: Posttraumatic upper or lower limb salvage is still challenging. Under difficult situations in which only one vessel supplies the hand or foot, free microvascular reconstruction might damage not only the transferred tissue but also the terminal hand or foot. Two cases of incomplete amputation of the unilateral forearm with large radius bone and soft tissue loss were reconstructed using a newly-refined pedicled osteomyocutaneous flap including vascularized rib, lateral part of the latissimus dorsi muscle, and skin as a lateral chest flap. After insetting of the flap, the transferred limb is fixed with a soft bandage, and the flap is divided no less than 4 weeks after the first operation. The flap completely survived, and bone union between the rib and radius was observed. Although our treatment needed a two-stage procedure, safe and secure reconstruction with an appropriate amount of tissue for salvage was accomplished. *(Plast Reconstr Surg Glob Open 2014;2:e267; doi: 10.1097/GOX.0000000000000232; Published online 9 December 2014)*

Posttraumatic upper or lower limb salvage is still challenging. Although microsurgical techniques can provide healthy living tissue to restore the functional morphology and enough blood circulation,[1–3] the presence of recipient vessels is an indispensable requirement for microvascular reconstruction.

Herein, we report 2 traumatic cases of incomplete amputation of the unilateral forearm with large bone and soft-tissue loss which were reconstructed using a pedicled composite flap on the lateral chest where the injured forearm could be set in place.

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SURGICAL TECHNIQUES

With the patient in the lateral position, anatomical landmarks such as the 10th rib and lateral margin of the lattissimus dorsi muscle are identified. The position of the lateral muscular perforator of the 10th intercostal artery (ICP) is geometrically indicated at the intersection of the costal margin of the 10th rib and the posterior axillary line.[4] The skin paddle is designed with ICP on the center point, and the muscular pedicle under the skin paddle is set to be 10 cm wide from the lateral margin of the muscle, containing the ICP-thoracodorsal axis at its center.

On elevation, the flap should include the posterior-lateral segment of 10th rib with periosteum for sufficient vascularization via the thoracodorsal perforator vessels (Fig. 1). The rib segment is then trimmed and fixed to the recipient bone by metal plates, and the muscle flap is transferred (Fig. 2).

After insetting of the flap, the transferred limb is fixed with a soft bandage, and the flap is divided no less than 4 weeks after the first operation. Rehabilitation exercises are started soon after flap division to recover from joint contracture of the limb.

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Fig. 1. Raised lateral chest flap including lateral portion of latissimus dorsi muscle and the 10th rib.

Fig. 2. View of flap coverage following rib-radius fixation. Several Penrose drains were inserted in the periphery (distal margin) of the flap, and the forearm was stabilized in the elbow-flexed position.

CASE REPORT

Patient 1

A 21-year-old man had compressor crush injury of his left arm, having extensive skin and soft-tissue avulsion of the forearm and hand, and brachius and radioulnar complex bone fracture. (**See Supplemental Digital Content 1**, which displays a plain radiograph depicting radial bone defect, ***http://links.lww.com/PRSGO/A64***.) After primary limb salvage and wound treatment, wide defect of skin and soft tissue and 7 cm of radial bone gap were noted. Angiography showed no radial artery in the forearm, with only the ulnar artery feeding the left hand (Fig. 3). We considered that there was a high risk of peripheral vascular damage by using a microvascular free flap. Instead, muscle pedicled lateral chest composite flap reconstruction was applied.

The flap design was marked with an $8 \times 8\,cm^2$ skin paddle and attached rib on the lateral chest area of the patient. The 10th rib was raised 10 cm with the flap (Figs. 2, 3). During limb fixation, the flap circulation was stable, and the flap pedicle was divided on the 30th postoperative day. The flap completely survived, and bone union between the rib and the radius was observed in 12 months postoperatively (Fig. 4).

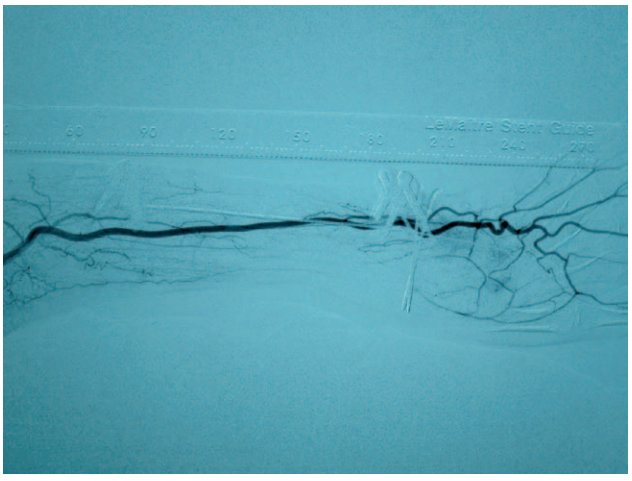

Fig. 3. Patient 1: Arterial angiography demonstrates the total absence of the radial artery.

Patient 2

A 48-year-old man had his left arm mangled by an industrial mixer. After primary treatment, $13 \times 15\,cm^2$ soft-tissue defect and 3 cm of radial bone loss were noted in his forearm. (**See Supplemental Digital Content 2**, which shows a view after

Fig. 4. Postoperative state (patient 1). Radiograph 1 year after surgery shows bony union of the transferred rib graft.

primary treatment using an external fixation device, ***http://links.lww.com/PRSGO/A65***.) The ulnar artery was the only remaining artery of the forearm on angiography (**See Supplemental Digital Content 3**, in which arterial angiography demonstrates the defect of the radial bone and total absence of the radial artery, indicating the ulnar artery as the only vessel to perfuse the distal extremities, ***http://links.lww.com/PRSGO/A66***.)

A lateral chest flap was raised and transferred and was divided 35 days after the flap inset. The flap fully survived, and bone union was confirmed 6 months postoperatively on radiographic inspection. At 1-year postoperative period, his left hand and finger flexion recovered by functional improvement of the remaining muscle. (**See Supplemental Digital Content 4**, which displays results 1 year after surgery. Recovery of the hand motion was noticed, ***http://links.lww.com/PRSGO/A67***.)

DISCUSSION

To salvage an extensively injured extremity, microvascular free composite tissue reconstruction is the ideal treatment option for complex soft-tissue and bone defects.[1–3] However, they are technically demanding and require at least a pair of artery and vein in healthy condition for the flap survival. Under difficult situations in which only one vessel supplies the hand or foot, we might hesitate to apply such microsurgical procedure that might damage not only the transferred tissue but also the terminal hand or foot.

We developed a newly refined pedicled osteomyocutaneous flap including vascularized rib, lateral part of the latissimus dorsi muscle and skin, as a lateral chest flap. In our cadaver angioanatomic study,[4] ICP was consistently located, and it was possible to split the lateral part of the latissimus dorsi muscle while preserving the intramuscular arterial axis, which was continuous with the lateral branch of the thoracodorsal artery. Furthermore, the split lateral muscle pedicle increases the rotation arc and the flexibility of forearm posture.

Conventional rib-latissimus dorsi composite flap had been applied as microvascular free flap and pedicled flap.[5–10] The flap demands en bloc harvest including the intercostal muscle, vessels, and nerve and sacrifices them on elevation. However, our method is more advantageous because it preserves the intercostal neurovascular bundles and muscles, avoiding the risk of donor-site thoracotomy and postoperative pain due to intercostal nerve damage. As far as we have searched, no similar concept to our flap or single case of application for a forearm reconstruction has been reported previously.

Reports of other 2-stage pedicled flap limb reconstruction indicated that the duration of the fixation should be 3–4 weeks.[11,12] To recover the joint constriction of recipient limb, rehabilitation should be performed soon after the division.

The flap described permits the safe and secure reconstruction of composite defects of forearm with less risk of peripheral ischemia.

SUMMARY

We experienced 2 cases of forearm reconstruction with newly refined pedicled composite flap. After reconstruction, the flap fully survived and well covered the salvaged upper limb without using feeding vessels of the periphery. Although our treatment needed 2-stage procedure, safe and secure reconstruction with an appropriate amount of tissue for salvage was accomplished.

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