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Thumb reconstruction via a pedicled flap based on the superficial palmar branch of the radial artery from the wrist crease area

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KEYWORDS

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Summary *Background:* The free flap based on the superficial palmar branch of the radial artery (SPBRA) has been extensively reported. A reversed pedicled flap based on the SPBRA, harvested from the wrist crease area, can be a potential candidate for the reconstruction of the soft-tissue and artery defects in the thumb.

Method: Between January 2012 and October 2013, this flap was used in seven patients to reconstruct soft-tissue defects in the thumb. In three patients, blood circulation of the thumb was reestablished using flow-through flaps. The Michigan Hand Outcomes Questionnaire was used for patient self-evaluation.

Results: In one patient, the surgery was abandoned due to blood vessel variation. All the flaps and thumbs survived in the other six patients. The wounds healed primarily. All patients were followed up for a mean of 16.5 months (range, 12–26 months). At the last follow-up, the mean static two-point discrimination was 7.3 ± 0.9 mm on the affected side and 4.6 ± 0.7 on the contralateral side. The range of motion of the metacarpophalangeal joint and the interphalangeal joint were $66.8 \pm 8.4^\circ$ (contralateral, $85.2 \pm 3.8^\circ$) and $67.0 \pm 6.9^\circ$ (contralateral, $80.5 \pm 5.0^\circ$), respectively. Patient self-evaluations were good in five cases and fair in one case.

Conclusion: The reverse island flap based on the SPBRA is feasible for soft-tissue defects and establishing blood circulation in the thumb. The donor site can be closed primarily, and the scar is inconspicuous in the wrist crease.

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Introduction

The thumbs are responsible for at least 40% of hand function. Because of the lack of perfect flaps, the reconstruction of the thumb is still a great challenge,^{1,2} although various flaps have been used.^{3–7} In 2003, for the reconstruction of finger defects, Sakai⁸ reported the use of a free flap from the flexor aspect of the wrist, based on the superficial palmar branch of the radial artery (SPBRA). This flap has been used since then for its lower donor-site morbidity and good reconstruction outcomes.^{9,10} However, most of the previously reported SPBRA flaps are free flaps. Herein, we describe a reverse island SPBRA flap from the wrist crease area. Seven patients were treated with this island flap for thumb reconstruction.

Flap anatomy

The course of the SPBRA is consistent in the wrist. The SPBRA originates from the radial artery with its surface projection, about 1–2 cm proximal to the distal wrist crease.¹¹ The mean outer diameter of the SPBRA at its site of origin is 1.2 mm (range, 1.0–1.4 mm).¹²

The SPBRA descends along the ulnar side of the tubercle of the scaphoid bone, and it divides into a superficial and a deep branch (the major branch). The deep branch runs along the proximal superficial surface of the thenar muscles, or perforates its fibers, and it descends beneath the palmar aponeurosis to join the superficial palmar arch.¹³ The superficial branch nourishes the palmar side of the wrist region.¹⁴ The deep branch eventually communicates with the radial common palmar digital artery of the index finger, and with the deep palmar arch at the first web space (42%) or with the common palmar digital artery of the thumb (85%).¹⁵

These perforating arteries join each other at the proximal side of the second web space, and they are the reverse blood supply for the flap; their surface projection is the merging point of the central palmar crease and the thenar crease. The flap will also be rotated around these perforating arteries. As its drainage system, the flap has two venae comitantes of the SPBRA and subcutaneous superficial veins.¹⁶

The palmar cutaneous branch of the median nerve innervates the central carpal area.¹⁷ The medial antebrachial cutaneous nerve and the superficial branch of the radial nerve innervate the radial aspect of the wrist region and the dorsum of the hand.¹⁸

Materials and methods

Patients

From January 2012 to October 2013, seven patients were treated with the reverse island SPBRA flap for thumb reconstruction (Table 1). There were five men and two women, with a mean age of 31.8 years (range, 16–53 years). There were three cases of crush, three cases of avulsion, and one case of twisting. Two patients had injury to the metacarpophalangeal joint, three to the proximal phalanx, and two to the interphalangeal joint. The defect areas ranged from 1.2 × 3 cm to 2.5 × 7 cm. In three patients, the blood circulation of the thumb was compromised due to the defect of the proximal digital arteries. The mean time from injury to surgery was 3.2 h (range, 2.0–4.5 h). Informed consent was obtained from all patients.

Surgical technique

The injured thumb was cleaned with debridement, and the defect area was measured. A line was drawn, beginning 2 cm from the styloid process of the radius to the ulnar side of the tubercle of the scaphoid bone (Figure 1). This line was the surface projection of the pedicle vessel. On the projection line, 1 cm proximal to the tubercle of the scaphoid bone was the perforation point. A line through the perforation point and parallel to the wrist crease was the axis of the flap. The merging point of the thenar crease and the central palmar crease was the rotation point of the pedicle. The flap size was designed as 110% of the defect area.

A brachial plexus block was performed. A tourniquet was used to achieve a bloodless surgical field. The flap was dissected from its proximal radial side to reveal the radial artery. The SPBRA was carefully dissected from the ulnar side of the radial artery. Then the flap was raised from the superficial surface of the palmaris longus tendon. Caution was used to make sure that the perforating arteries were in the flap. The SPBRA was distally dissected along the ulnar side of the thenar crease incision until reaching the rotation point. The tourniquet was temporarily released to check the blood circulation of the flap. Then the flap was transferred through a subcutaneous tunnel to the defect area.

In the three patients with defect of the proximal digital arteries, the SPBRA of the flap was anastomosed to the distal stump of the digital artery to rebuild blood supply in a

Table 1 Patient information.

Case	Gender	Age, years	Injury	Injury site	Defect, cm ²	Ischemia, h	Flap, cm ²	Complications
1	M	35	Crush	Proximal phalanx	1.8 × 5.5	—	2.0 × 6.2	Nil
2	M	53	Avulsion	Metacarpophalangeal	2.5 × 7.0	4.5	3.0 × 7.5	Nil
3	F	42	Crush	Interphalangeal	2.5 × 6.0	—	—	Change of operation
4	M	16	Avulsion	Proximal phalanx	2.5 × 6.5	3.5	3.0 × 7.0	Nil
5	M	36	Crush	Metacarpophalangeal	1.8 × 5.2	3.5	2.5 × 6.0	Nil
6	M	29	Twisting	Proximal phalanx	1.2 × 3.0	—	1.5 × 3.5	Nil
7	F	22	Avulsion	Interphalangeal	2.5 × 5.0	—	3.0 × 6.0	Donor-site numbness
Mean	—	31.8	—	—	2.1 × 5.4	—	2.5 × 6.0	—

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