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Free multilobed posterior interosseous artery perforator flap for multi-finger skin defect reconstruction

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Posterior interosseous artery (PIA);
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Summary *Background:* The posterior interosseous artery (PIA) perforator flap can be used for reconstruction of soft-tissue defects of fingers. Based on the multiple perforators from the posterior interosseous artery, we describe a technique to reconstruct the multi-finger defect in the use of the free multilobed PIA perforator flap.
Methods: PIA perforators from different areas of the forearm were used to design a free multilobed skin paddle for multi-finger skin defect reconstruction. Each paddle without the deep fascia had separate perforators. To increase the perforator pedicle length, the courses of the PIA perforators were dissected from the superficial layer of the deep fascia to the subcutaneous layer.
Results: The flap was raised as a unilateral free bilobed PIA perforator flap in 10 cases of two-finger defects, a free trilobed PIA perforator flap in two cases of three-finger defects, and a bilateral free bilobed PIA perforator flap in one case of four-finger defects. The average effective vascular pedicle length and trunk pedicle length were 8.3 and 3.1 cm, respectively, for the bilobed flap, and 6.3 and 4.0 cm, respectively, for the trilobed flap. All flaps survived except one paddle with tip necrosis. At 10.8 months (range, 4—27 months) after surgery, 10 cases showed satisfactory cosmetic appearance, while the fingers were bulky in the remaining three cases. The average score of static two-point discrimination in 10 innervated paddles was 12.9 mm. The remaining 20 paddles recovered only protective sensation. The average total

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active motion (TAM) of each finger was 164° before surgery and 187° at the latest follow-up. *Conclusions:* Free multilobed PIA perforator flap is a good candidate for reconstruction of multi-finger skin defect.

Clinical question/level of evidence: Therapeutic, IV.

Multi-finger soft-tissue defect reconstruction has always been a challenge for hand surgeons. The traditional method uses multiple local island flaps for resurfacing,[1,2] which can be performed without difficulty. However, it is often limited by the flap size for the long defect reconstruction. The use of an abdominal flap is an alternative method used in practice,[3,4] which exhibits low donor-site morbidity. However, the patient's body position is uncomfortable during repair of palmar skin defects and sensation reconstruction is poor. A third option is to use a large flap for coverage and a secondary division,[5] but it is characterized by several drawbacks, such as long recovery time, bulky appearance, and poor sensory return.

The posterior interosseous artery (PIA) flap has been widely applied in hand wound reconstruction[6–17] because of its convenient dissection and high survival rate. Besides, it is thin and pliable and conforms well to the texture of the hand. In the conventional PIA flap method for multi-finger skin defect resurfacing,[8] multi-finger wounds are combined and covered during the first stage. The fingers are divided in the second stage. Ishiko et al.[18] used two free perforator flaps based on the PIA system for reconstructing two-finger defects to avoid a second finger-division surgery. Additionally, the use of multilobed PIA flaps to repair two independent hand wounds has been reported.[19,20] Compared to the composite defect reconstruction with multiple free flaps, the multilobed flap method decreases the risk of synanastomosis. However, because of the limited length of the vascular pedicle, its application in multi-finger defect reconstruction is difficult, especially for middle or distal phalanges on which few clinical cases have been reported.

In the present study, we improved the method for harvesting the multilobed PIA perforator flap by microdissecting the perforator segment from the deep fascia. Moreover, adjusting the point of the perforator entering the skin at the proximal part of each paddle and ensuring only a single perforator for each paddle improved the rotation range. Thus, the effective pedicle length between paddles was increased and adequate distal reach was obtained for each paddle. Overall, the usefulness of free multilobed PIA perforator flap for reconstruction of multi-finger defects was improved.

Table 1 Demographic details of 13 cases.

Case	Gender	Age (y)	Defect location	Cause	Defect size (cm) Radial side→Ulnar side	Distance crossing the finger web between the adjacent defect (cm)
1	M	46	Left index and middle	Chainsaw injury	3.5 × 2.2, 2.5 × 2.2	10.3
2	M	45	Right middle and ring	Crush	2.5 × 2.2, 5.5 × 2.2	8.4
3	F	43	Right thumb and index	Electrical injury	3.5 × 1.8, 6.5 × 3.2	9.0
4	M	42	Left ring and little	Crush	3.5 × 2.7, 2.5 × 2.2	5.7
5	M	49	Left index and middle	Crush	2.7 × 1.2, 7.7 × 2.3	6.4
6	M	33	Left middle and ring	Crush	2.7 × 2.2, 3.2 × 1.8	10.8
7	M	41	Left index and middle	Chainsaw injury	6.7 × 2.7, 3.0 × 1.7	9.7
8	M	40	Right index and middle	Crush	4.2 × 2.7, 4.8 × 2.7	5.0
9	M	47	Left middle and ring	Crush	4.8 × 2.3, 2.8 × 2.3	3.0
10	M	55	Left middle and ring	Crush	3.6 × 2.2, 3.6 × 2.2	10.6
11	M	35	Left index, middle	Crush	5.0 × 2.5, 10.0 × 3.0	6.2
			Left ring and little		9.0 × 3.0, 8.0 × 3.0	0
12	M	53	Right middle, ring, and little	Burn	4.8 × 2.3, 6.5 × 3.2	5.3[a]
					3.0 × 2.7	4.0[b]
13	M	30	Left middle, ring, and little	Crush	5.6 × 3.2, 6.0 × 2.7	0[a]
					5.3 × 2.5	0[b]

M, male; F, female.
[a] The distance crossing the finger web between the defect of the middle and ring fingers.
[b] The distance crossing the finger web between the defect of the ring and little fingers.