



Bipedicled “Superthin” Free Perforator Flaps for Facial Burn Scar Reconstruction: Expanded Scope of Superthin Flaps: A Case Series

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Background: “Superthin flap” is a distinctively thin flap that is thinned primarily to the point that the subdermal vascular network can be seen through a minimal fat layer. Reconstruction of severely disfigured neck and face can be performed using the occipito-cervico-dorsal superthin flap that is harvested from the dorsal region and supercharged by the circumflex scapular vessels. We used bipedicled superthin free perforator flaps to reconstruct scar contractures on half of the face, whole face, or the whole chin-neck area in 17 postburn patients.

Methods: This case series report includes all 17 cases. Flaps in the dorsal area were designed. In all cases, one pedicle consisted of the circumflex scapular vessels. In 11, 5, and 1 flaps, the second pedicle consisted of contralateral posterior intercostal perforators (type 1), ipsilateral posterior intercostal perforators (type 2), and ipsilateral circumflex scapular vessels (type 3), respectively. Four patients underwent whole-face reconstruction after acid burn with type 1 or type 3 perforator. The recipient vessels were the superficial temporal vessels and contralateral or ipsilateral facial vessels. Intraoperatively, all adipose tissue in the flap, including between the 2 pedicles, was thinned by scissors before the pedicles were detached from the donor sites. Maximum flap size was 35 × 15 cm. Donor sites were covered by a split full-thickness skin graft. Flap survival and functional and cosmetic results were assessed retrospectively.

Results: Fifteen of the 17 flaps survived completely. Two developed partial necrosis due to perforator thrombosis. Some patients developed hypertrophic scars around the flap, but these improved naturally over time. All patients were satisfied with both the cosmetic and functional outcomes of the reconstruction.

Conclusion: Bipedicled superthin free perforator flaps may be an excellent choice for reconstruction of severe neck scar contracture. This report expands the scope of previously used “superthin flaps.” (*Plast Reconstr Surg Glob Open* 2015;3:e493; doi: 10.1097/GOX.0000000000000449; Published online 25 August 2015.)

Reconstruction of the face and the neck after burn scars often mandates the use of an extremely large and thin flap. One possibility

is the use of “superthin flap,” which was introduced in 1994 by Hyakusoku and Gao¹ and its perforator-supercharged version reported in 1994 by Hyakusoku et al.² The superthin flap is a distinctively thin

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flap that is thinned primarily to the point that the subdermal vascular network can be seen through a minimal fat layer.^{2,3} The properties of “superthin flaps” have been defined as (1) being thicker than skin grafts, (2) thinner than conventional free flaps, and (3) composed of vascularized skin with a minimal thickness of adipose tissue that preserves the subdermal vascular plexus. To date, a number of different superthin flaps have been reported. Of these, the occipito-cervico-dorsal superthin flap has been used to reconstruct severely disfigured neck and face of patients with burn scars. This case series report describes the bipediced superthin free perforator flaps that were used to reconstruct extremely huge defects after scar resection. This report presents the expanded scope of previously used “superthin flaps.”

PATIENTS AND METHODS

This case series consisted of all patients who had huge face and/or neck burn defects and who underwent reconstruction with a bipediced superthin free perforator flap in Vietnam National Institute of Burn between June 2010 and December 2012.

Flap Design and Elevation

The flap was designed on the dorsal area to match the shape of the recipient site. For this, candidate perforator vessels were identified by handheld Doppler flowmetry. Three types of perforators are available on the dorsal area (this enhances the versatility of the superthin flap). Type 1 consists of the circumflex scapular vessels and the contralateral dorsal intercostal perforators. Type 2 consists of the circumflex scapular vessels and the ipsilateral dorsal perforators. Type 3 consists of the bilateral circumflex scapular vessels. During surgery, the recipient site was debrided, and the recipient vessels (the facial vessels and veins and/or superficial temporal vessels) were identified in the supine position. The position was then changed from supine to prone, and the flap was elevated from the periphery. The perforators that were found by handheld Doppler flowmetry to be anastomosis candidates were confirmed macroscopically. The dorsal intercostal perforators between the sixth and seventh costal spaces were found, and the circumflex scapular vessels were left attached to the flap with a length of approximately 4 cm. After complete elevation of the flap,

the flap was thinned by scissors to the point that the subdermal vascular network could be seen through a minimal fat layer. The donor site was covered with a split-thickness skin graft that was harvested from the thigh. The vessels were anastomosed under a microscope, after which the flap was sutured to the recipient site.

Study Variables

Flap survival was assessed. The functional and cosmetic results were evaluated retrospectively by 3 independent plastic surgeons. The patients were also asked to rate their functional and cosmetic outcomes.

RESULTS

Seventeen patients (12 men and 5 women, 13–48 years old) underwent reconstruction with bipediced superthin free perforator flaps (Table 1). For all flaps, one pedicle consisted of the circumflex scapular vessels. The second pedicle in 11, 5, and 1 flaps consisted of the contralateral posterior intercostal perforators (type 1), the ipsilateral posterior intercostal perforators (type 2), and the contralateral circumflex scapular vessels (type 3), respectively. Four patients underwent whole-face reconstruction after acid burn with type 1 and type 3 perforators. The recipient vessels were the superficial temporal vessels and contralateral or ipsilateral facial vessels. The average (SD) flap length and width were 31 (8) and 14 (4) cm, respectively. The maximum flap size was 35 × 15 cm.

Fifteen of the 17 patients were satisfied with the functional and cosmetic outcomes of the reconstruction. Fifteen (88.2%) experienced no complications such as infection and necrosis. Partial necrosis occurred in 2 cases. The patients in both cases underwent reconstruction with a skin graft. The cause of necrosis was damage to the vessels on either the recipient or donor site due to the initial burn injury. In 2 cases, hypertrophic scars developed on the flap margin postoperatively. However, these scars improved naturally over time.

REPRESENTATIVE CASES

Case 1

A 35-year-old woman (case 10 in Table 1) suffered an extensive acid burn on her whole face (Fig. 1). She received split full-thickness skin grafts, but scar contractures developed. After removing the whole scar from her face, the left superficial temporal and right face vessels were chosen as the recipient vessels. A type 1 bipediced free perfora-

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Table 1. Characteristics of the Cases in This Series

No.	Age/ Sex	Location of Reconstruction	Double Perforators		Recipient Vessels		Flap Dimensions	Complications
			P1	P2	STA	FA		
1	25/M	Chin and neck	CSAP (left)	Contralateral PICP VI	Left	Right	33×9 cm	None
2	40/M	Chin and neck	CSAP (left)	Contralateral PICP VII	Left	Right	30×14 cm	None
3	22/FM	Chin	CSAP (left)	Contralateral PICP VII	Left	Right	28×10 cm	None
4	29/M	Neck	CSAP (left)	Contralateral PICP VI	Left	Right	35×15 cm	Partial necrosis
5	20/M	Half face and neck	CSAP (left)	Ipsilateral PICP VII	Right	Right	22×17 cm	None
6	13/M	Half face and neck	CSAP (left)	Ipsilateral PICP VII	Right	Right	21×17 cm	None
7	16/M	Whole face	CSAP (left)	Contralateral PICP V	Left	Right	29×14 cm	None
8	48/FM	Half face	CSAP (right)	Ipsilateral PICP VII	Right	Right	17×14 cm	None
9	34/M	Chin and neck	CSAP (left)	Contralateral PICP VII	Right	Left	31×18 cm	None
10	35/FM	Whole face	CSAP (right)	Contralateral PICP VII	Left	Right	27×21 cm	None
11	41/M	Chin and cheek	CSAP (left)	Ipsilateral PICP VI	Left	Left	36×13 cm	None
12	24/M	Neck and half face	CSAP (left)	Ipsilateral PICP VII	Left	Left	26×17 cm	None
13	22/FM	Chin and neck	CSAP (left)	Contralateral PICP VI	Right	Left	34×19 cm	None
14	15/M	Whole face	CSAP (left)	CSAP (Right)	Right and left		41×13 cm	None
15	23/M	Neck and half face	CSAP (left)	Contralateral PICP VII	Right	Left	31×14 cm	None
16	26/FM	Whole face	CSAP (left)	Contralateral PICP VII	Left	Right	28×19 cm	Partial necrosis
17	25/M	Whole face	CSAP (right)	Contralateral PICP VI	Left	Right	31×20 cm	None

CSAP, circumflex scapular artery perforator; FA, facial artery; P, perforator; PICP, posterior intercostal perforator; STA, superficial temporal artery.



Fig. 1. Pre-, peri-, and postoperative views (case 10 in Table 1). A, The preoperative view reveals severe disfigurement of the whole face. B, Flap design. The right circumflex scapular artery perforator and the contralateral posterior intercostal perforator VII were chosen. C, After flap elevation. D, Postoperative view after 1 year. E, View of the donor site after 1 year.

tor flap was designed on her dorsal area. The flap measured 27×21 cm and bore the right circumflex scapular vessels and contralateral seventh intercostal perforators. These vessels were harvested with lengths longer than 4 cm to fit the sizes of recipient vessels. After harvesting, the flap was completely elevated and thinned between 2 vessels. The flap was thinned down with a curved scissors to the layer where the subdermal vascular plexus could

be observed. Then after anastomosis of the right circumflex scapular vessels and left superficial temporal vessels, the middle area of the flap was divided into 2 parts to match the open mouth and nose tip. The left intercostal perforators were then anastomosed with the right facial vessels. The flap survived completely. The eye could be opened, and the functional results 6 months after the operation were good.

Case 2

This 20-year-old man (case 5 in Table 1) suffered a flame burn and was given a lifesaving skin graft (Fig. 2). One year later, scar contractures had developed on the neck and half of the face. After removing the whole scar from his face, both the superficial temporal vessels and the right facial vessels were chosen as the recipient vessels. Muscles were intact, but large flaps were needed to cover the entire surface. A type 2 flap that measured 22 × 17 cm was designed on his dorsal area. The seventh intercostal perforators were identified and used. The left circumflex scapular vessels were attached to the flap. The circumflex scapular vessels and right superficial temporal vessels and the intercostal perforator vessels and right facial vessels were anastomosed one by one. The flap survived completely, and there were no complications. The flap matched well with the surrounding skin in terms of texture and color.

Case 3

A 15-year-old boy (case 14 in Table 1) suffered an extensive flame burn on the face (Fig. 3). The

face received split full-thickness skin grafts, but scar contractures developed. After the whole scar was removed from the face, the left and right superficial temporal vessels were chosen as the recipients. A type 3 bipediced free flap that measured 41 × 13 cm was designed on the dorsal area. The right and left circumflex scapular vessels were attached to the flap. After anastomosis of the vessels, the donor site was covered by a split full-thickness skin graft. The flap survived completely. Hypertrophic scars developed on the flap margin after surgery but improved naturally over time.

Case 4

A 40-year-old man (case 2 in Table 1) suffered an extensive flame burn on the face, chin, and neck (Fig. 4). Although his life was saved, scar contractures developed to the point that he could not move his neck or open his mouth. A type 1 bipediced free perforator flap that measured 30 × 14 cm was designed on his back. The left circumflex scapular vessels and the contralateral sixth and seventh



Fig. 2. Pre-, peri-, and postoperative views (case 5 in Table 1). A, The preoperative view reveals a scar on half of the face. B, After flap elevation. The recipient vessels that were dissected include the right superficial temporal artery and the ipsilateral facial vessels. C, Flap design. The left circumflex scapular artery perforator and the ipsilateral posterior intercostal perforator VI were chosen. D, Postoperative view after 1 year. E, View of the donor site after 1 year.



Fig. 3. Pre-, peri-, and postoperative views (case 14 in Table 1). A, The preoperative view. B, The right facial vessels served as the first recipient. The left superficial temporal artery served as the second recipient. C, Flap design. Flap dimensions were 41 × 13 cm, and the flap included both circumflex scapular artery perforators. D, One day after the operation. E, The left side 1 year after surgery. F, The right side 1 year after surgery.



Fig. 4. Pre-, peri-, and postoperative views (case 2 of Table 1). A, The preoperative view reveals severe disfigurement of the neck and the lower face. B, The scar was removed, and the recipient vessels were dissected. C, Flap design. Flap dimensions were 31 × 14 cm. D, One year after the operation.

intercostal perforators were attached to the flap. After anastomosis of the left circumflex scapular vessels, the bleeding from the intercostal perforators was checked. This revealed that the seventh intercostal perforator was better than the sixth intercostal perforator. Thus, the sixth intercostal perforator was ligated, and the seventh intercostal perforator was anastomosed with the left facial artery. The flap survived completely, and the functional and cosmetic outcomes 6 months after the operation were good.

DISCUSSION

Patients with extensive scar of the face or neck after a burn injury require resurfacing with extremely thin and huge flaps.^{4,5} Finding such flaps for whole-face and neck reconstruction remains a major challenge for plastic surgeons.⁶⁻¹¹ Although expanded flaps have been used widely for facial reconstruction and are satisfactorily thin, their size has been reported to be insufficient to cover the whole face.¹²⁻¹⁷ An alternative is the bipediced deep inferior epigastric perforator flap, which Jin et al¹⁸ introduced in 2009 for cicatricial microstomia reconstruction. However, this flap can be bulky, especially when it is harvested from obese patients. In 1994, a conventional belief that “flaps are generally bulky” was overthrown when the superthin flap and its perforator-supercharged version were developed by Hyakusoku et al.² Hyakusoku and Gao¹ also introduced several epoch-making approaches: they not only harvested the flap on the basis of anatomical arterial network territories but also ensured that their initial flap design would avoid leaving scars and allow free selection of perforators. Since 1994, various types of superthin flaps have been reported. The supercharged occipito-cervico-pectoral (OCP) superthin flap was reported in 2002, the double-supercharged superthin flap was described in 2003, and the bipediced superthin free flap was introduced in 2004.^{2,5,19} Finally, in 2009, the authors presented a hemifacial resurfacing method that was based on a perforator-supercharged occipito-cervico-dorsal superthin flap. This flap was found to be very useful for resurfacing the face of a patient with extensive burn scars. Its only limitation was that because it was a pedicled flap, its rotation arc was limited.²⁰

This case series report describes the outcomes of yet another type of superthin flap, namely, superthin free flaps that bear 2 perforators.²¹ These flaps have a highly flexible design and indeed could be termed “made-to-order” flaps. Our previous study showed that the circumflex scapular vessels and intercostal perforators are reliable perforators and that handheld Doppler flowmetry is useful for detecting

the position of such perforators preoperatively.²² Indeed, in most of the cases presented here, it was possible to find 2 posterior intercostal perforators with suitable pedicle lengths (2–4 cm) and diameters (1.5–1.8 mm). Moreover, all of the flap designs in the present case series included 2 territories, namely, those between the posterior intercostal perforator and the circumflex scapular artery. This ensured that the blood supply of the flap was reliable. In recent years, laser-assisted indocyanine green fluorescence angiography has been shown to be useful for the safe harvesting of perforator flaps.²³⁻³⁰ Because this imaging technology would also hold promise for the harvesting of our thin flap, we plan to implement its use in the near future.

This case series showed that it was safe to thin the fat tissue between these territories. The versatility and flexibility of the bipediced superthin free perforator flap was further evidenced by the fact that we could open and reconstruct the nose and the mouth in a single stage in a case with an extensive acid burn to the whole face. Finally, Angrigiani and Grilli³¹ reported that the entire area of the dorsum can survive only if the bilateral circumflex scapular vessels are intact. The efficacy of the bipediced superthin free perforator flap also suggests that extremely large flaps can be elevated from the dorsal area if they are based on the circumflex scapular vessels and the dorsal intercostal perforators.

CONCLUSIONS

This case series expands the scope of previously used “superthin flaps.” Bipediced superthin free perforator flaps are useful in cases where the cheek and the neck have been injured by burning, and they produce good cosmetic and functional outcomes. This case series also confirms that a flap survival area that covers the entire face can be achieved when the flap is augmented by 2 perforators. Moreover, even though the mouth and the nose were also opened during the same surgery, the blood flow in the flap was stable and the flap survived completely. Dorsal bipediced superthin free perforator flaps represent a novel choice for reconstruction of severe neck scar contracture.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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