Thin Superficial Circumflex Iliac Artery Perforator Flap and Supermicrosurgery Technique for Face Reconstruction

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Abstract: Distant free flaps have become a routine option for reconstruction of large, complicated facial soft tissue defects. The challenge is to find a flap that is pliable to provide good contour and function. The purpose of this paper was to evaluate the use of superficial circumflex iliac artery perforator (SCIP) flaps for facial defects.

From November 2010 to June 2013, facial reconstruction was performed on 6 patients (age range, 15–79 years). The harvesting technique was modified to elevate above the deep fat, and the pedicles were taken above or just below the deep fascia. The mean size of the flap was 75.6 cm^2, with a thickness of 7 mm; the mean pedicle length was 4.9 cm; and the mean artery caliber was 0.7 mm. The supermicrosurgery technique was used successfully in all 6 cases. Donor sites were all closed primarily. The mean follow-up was 16.7 months.

All flaps survived without flap loss, and the donor sites healed without complications including lymphorrhea. The patients were satisfied with contour and function after reconstruction.

The result of these 6 cases suggested that the SCIP flap can be a reliable flap for moderate-sized to large defects in the face. The use of new instrumentation and supermicrosurgical techniques allows use of the SCIP flap reliably while providing patients with a good contour, function, and minimal donor site morbidity.

Key Words: Superficial circumflex iliac artery perforator free flap, face reconstruction, supermicrosurgery

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Reconstruction of facial defects remains a challenge, as this is a region of intricate cosmetic and functional interface, where skin contour and color match are difficult to obtain. Small or moderate-sized defects can be covered by local and rotational flaps resulting in excellent cosmetic and functional results. However, for large and extensive defects, which require bone and soft tissue bulk, microvascular flaps are essential.[1] The radial forearm and scapular flaps are commonly used.[2,3] However, these flaps often require additional revisions to reach acceptable contour. Problems related to color and texture remain even after successful closure of the defect.

The superficial circumflex iliac artery perforator (SCIP) flap evolved from a groin flap. The groin flap was first described as a pedicled flap by McGregor and Jackson and then introduced as a free flap by Daniel and Taylor.[4,5] The groin flap can provide a large area of cutaneous tissue while allowing closure of the donor site, which is easily hidden. Most of all, it is a rapid and easily elevated flap. It was one of the first free flaps described and approached for obvious advantages; but the short pedicle, variable pedicle anatomy, and the bulkiness of the flap limited the use in various situations including facial soft tissue reconstruction.[6–9]

With the recent advances in perforator flaps, soft tissue coverage of facial defects has shifted from traditional flaps to perforator flaps such as anterolateral thigh flaps.[10] Such perforator flaps can provide a large territory of thinned skin with a modest donor site scar. As we evolve with increasing knowledge of anatomy and microsurgical skills, the search for a better alternative continues. We hypothesized that the SCIP flap can provide a thinner flap, which is more suited for facial contouring and color match with even less donor site morbidity. By understanding the anatomy of the groin flap, we are able to overcome the inherent disadvantages of the groin flap while maximizing its advantage. The adoption of supermicrosurgical concepts plays a crucial role to maximize the advantages of the SCIP flap in facial reconstruction.

MATERIALS AND METHODS

Patients

Between November of 2010 and June of 2013, soft tissue defects of the face of 6 patients that could not be covered with regional flaps were reconstructed using SCIP free flap. Two male and 4 female patients with a mean age of 43.2 years (range, 15–79 years) had soft tissue defects at preauricular (1), cheek (2), nose (1), chin (1), and postauricular (1) regions.

Surgical Technique

Preoperative computed tomography angiograms were taken in all patients to evaluate their vascular status of the groin area. A preoperative Doppler scan was used to mark the potential recipient vessels of the face and the pedicle of the donor SCIP flap. During the tracing, the intensity and flow velocity of the recipient vessel and the pedicle were recorded. Upon completion of resection, the dimension of the defect was accurately template, taking into consideration the contours and thickness of the defect. After the flap dimension is determined, a 2-team approach allows one team to elevate the SCIP flap, whereas the other team works on the recipient vessels.

The dissection of the recipient vessels begins by targeting the marked vessels with highest intensity from the preoperative duplex scan. One can use any vessels from small perforating vessels to deeper vessels around or within the defect.[11] The recipient vessels

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TABLE 1. Summary of Cases

Case	Age/Sex	Primary Tumor	Flap Size (cm)	Pedicle Length (cm)	Recipient Vessels	Complication	Duration (Months)
1	15/F	DFSP, chin	5 × 7	3	Branch of inferior labial artery (e-s)	(−)	28
2	79/F	BCC, left preauricular	7 × 15	5	STA (e-s)	Facial nerve palsy	3
3	55/M	BCC, nose	4 × 13	5	Branch of angular artery (e-e)	(−)	6
4	30/F	Sturge-Weber syndrome, Rt.	18 × 6	6	STA (e-s)	(−)	31
5	55/F	Capillary malformation, Lt. cheek	13 × 6	5	Nasolabial branch of facial artery (e-e)	(−)	3
6	19/M	Soft tissue defect, left postauricular	5 × 11	5.5	Postauricular artery (e-e)	(−)	32

STA, superficial temporal artery; DFSP, dermatofibrosarcoma protuberans; BCC, basal cell carcinoma; e-e, end-to-end anastomosis; e-s, end-to-side anastomosis.

are searched under loupe magnification and must be confirmed with having a firm pulse. Further dissection can be carried out under a microscope to prevent damage to the perforator or the recipient vessel. The goal at this phase is to find a recipient vessel with a firm pulse that is situated adjacent or within the defect minimizing the required length of the flap pedicle. After the pedicle length of the flap is measured, the other team can harvest the SCIP flap with adequate pedicle length. The SCIP flap elevation begins by marking the groin region with a line drawn from the inguinal crease to the anterior superior iliac spine. This marking represents the topographical pathway of the perforator. The preoperative markings of the perforator guide the overall design of the flap in relation to the recipient vessel and the defect. If the recipient vessel is located peripheral to the defect, the flap design can be based on the pedicle located medially and the skin paddle extending laterally toward or beyond the anterior superior iliac spine. A pinch test of the skin ensures primary closure of the donor site and helps to determine the width of the flap. One can further extend the flap width by 2 to 3 cm by flexing the hip joint during closure and maintain this flexed position until the donor site is healed. The flap elevation begins with an incision of either superior or inferior border. The depth of incision is made until a superficial fascia, a thin white film layer between the deep and superficial fat. This approach, modified from the previously described method by Koshima et al,[12] aims to save the deep fat and elevate the plane between the deep and superficial fat. This modification preserves the lymph nodes and the channels during harvest and allows for elevation of very thin flap.[13] While elevating the flap, one may come across multiple perforators from either the superficial branch, located medially, or the deep branch, located more laterally. The perforator from the deep branch usually penetrates the deep fascia laterally, whereas the perforator from the superficial branch penetrates more medially. Although both branches are usually from the superficial circumflex iliac artery and will generally meet, our experience has shown that one perforator is sufficient.[13] Once perforators are identified, the elevation may be approached medially and laterally to completely isolate the perforators. We recommend taking the perforator with the strongest pulse anatomically located medial to the center of the flap. Once the perforator was determined, the dissection proceeds toward the source vessel to obtain an adequate length. By opening the deep fascia, one may obtain a longer pedicle with an increased vessel diameter. The cutaneous vein in the fat layer may be included to enhance venous drainage of the flap.

RESULTS

The defects were caused from cancer resection in 3 cases, vascular malformation in 2 cases, and contour deformity caused by trauma in 1 case. The mean size of the SCIP flap was 75.6 cm^2, with a range of 5 × 7 to 6 × 18 cm. The mean length of the pedicle was 4.6 cm, with a range of 3 to 6 cm. The mean diameter of the artery was 0.7 mm, with a range of 0.4 to 1.2 mm. The mean thickness of the flap was 5 mm. with a range of 3 to 12 mm. A perforator or a small distal vessel was used as a recipient vessel in 4 cases with end-to-end anastomosis, and the superficial temporal artery was used in 2 cases with end-to-side anastomosis.

All of the flaps survived completely without any complications directly involved from the reconstruction. The donor site healed well after primary closure in all cases. There was a case of facial nerve palsy caused from intentional neurectomy during cancer resection by the ear, nose, and throat team. During the mean follow-up of 16.7 months (range, 3–32 months), all surviving flaps showed relatively good contour. There was no request for secondary debulking surgery, but 2 patients requested and underwent scar revisions for the flap margins and laser treatments for remaining vascular lesions. Summary of the patients is shown in Table 1.

CLINICAL REPORT

Patient 1

A 79-year-old woman had a diagnosis of incomplete resection of basal cell carcinoma on the left preauricular area including the external auditory canal (Fig. 1A). Wide excision, radical parotidectomy, neurectomy of facial nerve, external auditory canal wall resection, and neck dissection were performed by the ear, nose, and

FIGURE 1. A, A 79-year-old woman had a diagnosis of incomplete resection of basal cell carcinoma on the left preauricular area including the external auditory canal. B, After wide resection, the superficial temporal artery and vein was already exposed with a firm pulse within the defect. C, A SCIP flap with a dimension of 15 × 7 cm, a pedicle length of 5 cm, and a thickness of 4 mm was elevated. Anastomoses were performed in end-to-side manner on the superficial temporal artery and end-to-end to the branch of superficial temporal vein. The patient at 3 months after operation shows good contour of the face but still with mild swelling (D, E). Note how the thin flap contours with the auditory canal.

throat team. After a wide resection, the superficial temporal artery and vein were already exposed, with a firm pulse within the defect (Fig. 1B). A SCIP flap with a dimension of 15 × 7 cm, with a pedicle length of 5 cm, and a thickness of 4 mm was elevated (Fig. 1C). Anastomoses were performed in an end-to-side manner to the superficial temporal artery and in an end-to-end manner to the branch of superficial temporal vein. The patient at 3 months after operation showed good contour of the face but still with mild swelling (Figs. 1D, E). Note the thinness of the flap contours near the auditory canal. The donor site with a linear scar is cosmetically acceptable.

Patient 2

A 30-year-old woman with Sturge-Weber syndrome of the right cheek was presented. Resection of the lesion was performed over the severe portion of the deformity involving the cheek and part of the nose (Fig. 2A). After resection, an SCIP flap was designed on the left groin with a dimension of 18 × 6 cm (Figs. 2B, C). The superficial temporal artery was located on the edge of the defect and dissected. Microvascular anastomosis was performed on the superficial temporal artery in an end-to-side fashion to a pedicle of 6-cm length and an artery of 0.8-mm diameter, and superficial temporal vein was used in an end-to-end manner to a superficial vein of the SCIP flap. The patient at 31 months did not require any debulking procedures and maintains good facial contour while redeveloping a distinct nasolabial fold (Fig. 2D). The donor site was acceptable with a linear scar and hidden under plain clothes (Fig. 2E). Secondary procedure with dye laser therapy is currently underway to improve the remaining lesion on the forehead.

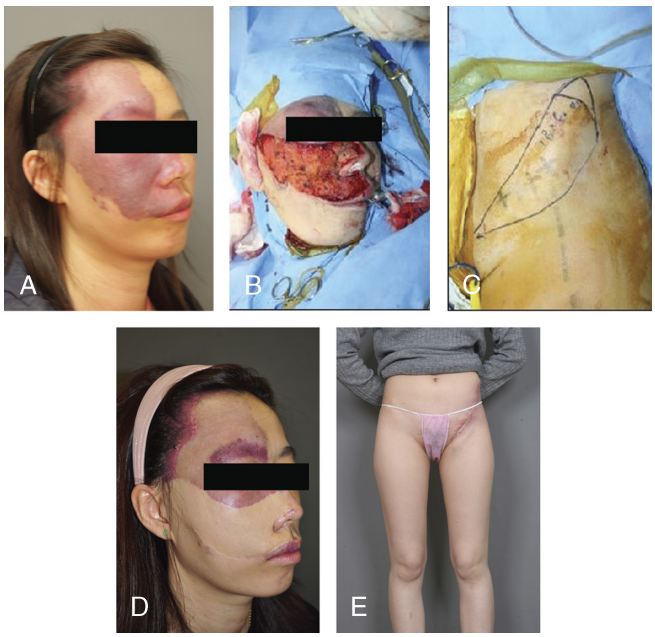

FIGURE 2. A, A 30-year-old woman with Sturge-Weber syndrome of the right cheek is presented. After resection, the SCIP flap, with a dimension of 18 × 6 cm, was used for reconstruction (B, C). The superficial temporal artery was located on the edge of the defect and dissected. Microvascular anastomosis was performed on the superficial temporal artery in an end-to-side fashion to a pedicle of 6-cm length and artery of 0.8-mm diameter, and superficial temporal vein was used in end-to-end manner to a superficial vein of the SCIP flap. D, The patient at 31 months maintains good facial contour and redeveloped a nasolabial fold. Secondary procedure with dye laser therapy is underway to improve the remaining lesion on the forehead. E, The donor site is acceptable with a linear scar and hidden under plain clothes.

DISCUSSION

The results of successful facial reconstructive surgery are determined by restoration of facial contour, skin texture, and functional expression. It is not about just filling the defects but replacing defect tissues providing the function as well as cosmesis. In cases where composite defects occur, the best replacement is with composite tissues. The same principle applies to resurfacing the skin defects of the face. An ideal flap will provide a thin flap with similar thickness compared to the surrounding skin while being able to regain its sensation. For small to moderate-sized defects, the use of local or regional rotation flaps is far most the best choice. For larger defects or defects that cannot be covered with local flaps, free flaps are inevitable. Any flaps with a skin paddle can provide good outcomes given numerous secondary operations such as debulking and scar revisions. Perforator flaps from the anterolateral thigh and the thoracodorsal region or classical flaps such as the scapular or the radial forearm flaps provide excellent resurfacing options.[1,3,10] However, these flaps are frequently thicker compared to the surrounding skin and may require secondary debulking procedures. The other disadvantage is that these flaps have donor site scars that can be unsightly or are difficult to hide. With exception of radial forearm flap, most other flap options are much thicker than the facial skin. This affects the facial contour, giving a swollen appearance while limiting the normal facial expressions when the facial muscle is moving beneath the resurfaced skin. The SCIP flap can provide a very thin skin paddle, which can be ideal to meet these requirements.

The groin flaps were successfully used to cover various regions of the body.[12,14,15] Despite the introduction as one of the first-line free flaps for reconstruction, the groin flap lost its popularity because of short pedicle, small caliber vessels, variable vascular anatomy, and bulkiness of the flap.[6,8] Additionally, donor site complications such as lymphorrhea and wound dehiscence often were a problem despite its excellent concealment. These inherent shortcomings caused most surgeons to refrain from using this flap in reconstruction of facial defects. Various efforts to modify and overcome the disadvantage of the groin flap have been made.[6,8] Efforts to reduce the thickness of the flap was addressed by Koshima et al,[12] as he harvests the flap above the deep fascia based on a perforator from the superficial circumflex iliac artery. Without deep fascia, SCIP flap may increase the pliability of the skin and reduce the thickness of the flap at the same time. Reports now show that a superficial as well as a deep branch from the superficial circumflex iliac artery supplies this region to nourish the flap.[7,8,12] Based on this finding, we are currently able to elevate this flap on these perforators above the deep fascia. Raising the flap above the deep fascia allows for elevation of a thin flap, and the clear anatomy of the perforator allows for additional debulking into a thinner flap.[12,16] However, even with these evolved approaches, problems such as short pedicle, recipient-to-donor pedicle discrepancy, and donor-site complications such as lymphorrhea remain to be a problem. We have further modified this approach by elevating the flap above the deep fat on the superficial fascial plane.[13] This approach can make the flap thinner and more pliable as the deep fat layer is not included during the harvest. In this series, the mean thickness was 5 mm, ranging from 3 to 12 mm. When harvesting flap, there was a clear distinction between the large deep fat lobules and the small lobules of the superficial layer. This apparent filmlike layer makes the elevation easier and more reliable.[13] Because the flap is thin, it anchors to the base and allows showing of the wrinkles of the face from the muscle movement beneath, mimicking the facial expression. Although there was no request for additional debulking procedure in this series, obese patients can have thicker superficial fat layer observed from other series of patients with SCIP flap. One may argue for the use of full-thickness skin grafts, but in our hands, contracture and lack of volume become a problem in large defects.

Matching the skin color surrounding the reconstruction site is a very difficult task. For large defects, which prohibit the use of adjacent tissues, less optimal skin color match is inevitable. In these cases, one must consider the other goals of reconstruction of the face such as less donor morbidity. The donor site morbidity of the SCIP flap is low; the donor site is located in an inguinal area, and primary closure is possible. Dissection is limited to the subcutaneous layer and no muscle dissection is necessary. Additionally, the flap thickness is adjustable to the defect depth, and the SCIP flap can be elevated with a lymph node, which is useful for reconstruction. These advantages make the SCIP flap a good option for face reconstruction. Additionally, a simultaneous 2-team approach can be performed in supine position without altering position. The first team began by searching for recipient perforators based on the intensity of the Doppler sound. Perforators can be found in the same manner as elevating the flap above the fascia.[11] The recipient perforators were searched for under loupe magnification; upon location, dissection was carried out under a microscope to prevent damage of the perforator. The required pedicle length of the flap was then predicted. The second team simultaneously began the SCIP flap elevation.

Most of the literature on the SCIP flap show its application on defects in which recipient vessels are located superficially, such as the foot, ankle, genital area, and upper extremities.[12,15,16] This is due to the short pedicle. Usually, the face reconstruction involves using major vessels like facial and superficial temporal artery and vein. If the defect lies far from these vessels, it will be difficult for the SCIP pedicle to reach these vessels without vascular grafts. As seen in this study, the mean length of the pedicle was only 4.8 cm. Additionally, the mean diameter of the artery was 0.7 mm, which made end-to-end anastomosis to the major vessel very difficult. Thus, to use this flap advantageously, we used the supermicrosurgery concept of anastomosing perforator-to-perforator or perforator-to-distal end arteries within or near the zone of injury/defect. This approach allowed us to reconstruct the face without additional vascular grafts and provide ideal anastomosis, as the vascular diameter had minimal discrepancy.[13] A strong visible pulse of the recipient perforator/end vessel is a signal for adequate flow.[17,18] Monitoring the fluid intake and systemic blood pressure is important, as the perforators can be very sensitive to dehydration and low blood pressure, which may lead to constriction of peripheral arteries. When elevating the SCIP flap, the superficial vein can be used, with assurance of good venous drainage and ease of anastomosis.[19]

The introduction of the perforator flap concept and the evolution of the groin flap to the superficial circumflex iliac artery perforator (SCIP) flap overcame disadvantages such as bulkiness and variable arterial anatomy by using the free-style free-flap approach.[12,16,20,21] We used the supermicrosurgery technique by anastomosing perforator-to-perforator and modified the SCIP flap by harvesting above the superficial fascia.[17,18] This paper reports the efficiency of the thin SCIP flap using the supermicrosurgery technique to reconstruct face defects.

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