Primary Reconstruction of Extensive Forehead Defects Using Supraorbital Artery Propeller Perforator Flap

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Purpose: Extensive resection of skin carcinomas in the periorbital and forehead regions often results in complicated defects involving the upper eyelid, superciliary arch, and nasal dorsum. The aim of this study is to report our experience with the use of supraorbital artery perforator propeller flaps for primary repair of complicated forehead defects.

Methods: A total of 6 patients underwent carcinoma resection with primary surgical reconstruction using supraorbital propeller flap at the Peking University School and Hospital of Stomatology from December 2015 to December 2018. We describe the technique and retrospectively review the outcomes.

Results: A single propeller flap was used in 5 patients and 2 propeller flaps (supraorbital and nasolabial artery propeller flaps) in 1 patient. Two patients developed venous congestion of the flap on the first postoperative day; however, in both cases it was relieved by multiple needle punctures. All flaps had survived well at 1-year follow-up. Five patients had a normal eyelid closure, but 1 patient presented with lagophthalmos, which required correction by secondary surgery.

Conclusions: Propeller flap based on the supraorbital artery is a feasible option for primary reconstruction of supraorbital–forehead defect.

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The face is a common site for skin cancer, especially basal cell carcinoma. Treatment is usually with surgical resection followed by primary reconstruction. The method chosen for reconstruction depends on the size and depth of the defect, and the functions of adjacent structures. Small defects can be closed directly or with local flaps. However, large complicated defects involving the upper eyelid, superciliary arch, and nasal dorsum can be difficult to restore. The concave–convex surface in the periorbital and forehead regions and need to ensure upper eyelid mobility are the principal challenges. Propeller perforator flaps constructed from donor tissues located near the defect are based on the concept of like-with-like reconstruction, and are therefore ideal for reconstruction in this region. Propeller flaps based on the supratrochlear artery are well suited for primary reconstruction of nose defects, because the meandering path of the vascular bundle is very convenient for vertical rotation.[1-4] However, propeller flaps are less suitable for lateral forehead and upper eyelid reconstruction because of the limited scope for lateral rotation.

We have used propeller flaps based on the supraorbital artery for primary reconstruction of complicated forehead defects. Because the supraorbital artery runs lateral to the supratrochlear artery, it is less likely to be damaged during lesion resection in the forehead region. Furthermore, the large number of anastomoses between the supraorbital artery and the frontal branch of the superficial temporal artery makes it possible for the supraorbital bundles to extend to the temporal area.

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The aim of this study is to report our experience with the use of propeller perforator flaps based on the supraorbital artery for primary repair of complicated forehead defects resulting from resection of skin carcinomas.

Materials and Methods

PATIENTS

A total of 6 patients (3 female and 3 male) underwent skin carcinoma resection followed by primary surgical reconstruction with supraorbital artery perforator propeller flaps at the Peking University School and Hospital of Stomatology between December 2015 and December 2018 (Table 1).

This study followed the Declaration of Helsinki on medical protocol and ethics, and the regional Ethical Review Board of the Peking University School and Hospital of Stomatology approved the study. All patients provided written informed consent before surgery.

SURGICAL TECHNIQUE

Preoperatively, the area to be resected, the size and thickness of the flap, the feasibility of closure of the recipient area, and the health of the pedicle vessel were thoroughly assessed. The perforator artery was identified with a portable Doppler probe and marked.

Surgery was performed under general anesthesia. The lesion was resected extensively, and negative margin was confirmed by intraoperative frozen section examination. The size and shape of the lesion were recorded with sterilized nonwoven fabric. With the aid of a template, the propeller flap was designed at the donor site, with the marked pedicle vessel in the middle. A local flap for closure of the donor wound was also designed when necessary. The harvesting procedures were performed with the loupe magnification technique. The skin harvest process was initiated from the distal edge, and the superficial galea aponeurotica was raised toward the supraorbital vascular bundle. The flap was carefully dissected within the same layer. Once the vascular bundle was identified, the medial boundary of the flap was incised and dissected. The perforator vessels were skeletonized to their points of origins at the inferior orbital foramen to allow rotation without torsion (Fig 1). When the flap could be rotated freely by 180°, the pedicle exploration was terminated, and the flap was transferred to the defect area. The larger lobe of the flap was rotated to repair the defect area, including the upper eyelid; the smaller lobe was used to close the donor site. The wound was closed in layers using 4-0 and 5-0 absorbable sutures and 7-0 nylon thread. A corrugated rubber drain was placed to prevent hematoma formation, and compressive dressing was applied to close dead space.

Results

In 5 patients, the defects were repaired by using single propeller flaps; in 1 patient, the defect was repaired using a supraorbital artery propeller flap plus a nasolabial artery propeller flap. Venous congestion of the flap developed in 2 patients at 48 hours after surgery; in both patients, multiple needle punctures at the site were sufficient to relieve the congestion and re-establish venous circulation. At follow-up 1 year after surgery, all flaps had survived well.

Eyelid closure was a key factor for assessing outcome. Five patients had a normal eyelid closure. One patient had lagophthalmos (with a gap of 2.5 mm) due to vertical soft tissue deficiency. A secondary local flap was needed to enable full eye closure.

Table 1. DATA AND RECONSTRUCTION DETAIL OF PATIENTS

Patient No	Age, yr	Cause	Defect Location	Flap	Size, cm	Complication
1	60	BCC	Upper eyelid and supraorbital skin	SPPF	4 × 8	Venous congestion
2	65	BCC	Forehead, eyebrow, upper eyelid, nasal dorsum, and cheek	SPPF FPF	4 × 8 3 × 7	Flap bulkiness
3	70	BCC	Forehead and eyebrow	SPPF	3 × 8	None
4	68	MEL	Forehead, eyebrow, and upper eyelid	SPPF	4 × 7	Venous congestion
5	69	BCC	Forehead and eyebrow	SPPF	3 × 8	None
6	73	BCC	Forehead	SPPF	3 × 7	None

Abbreviations: BCC, basal cell carcinoma; FPF, facial artery propeller flap; MEL, melanoma; SPPF, supraorbital artery propeller perforator flap.

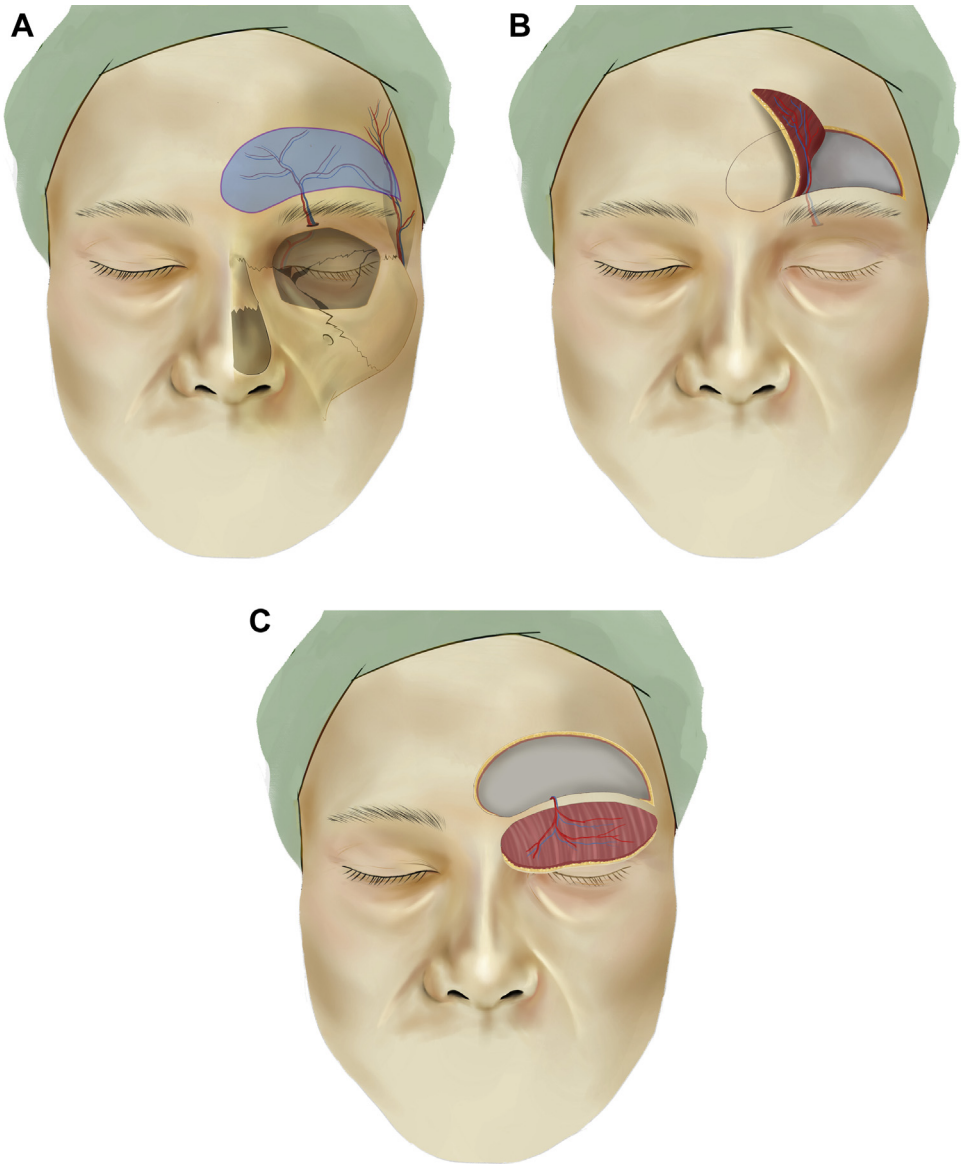

FIGURE 1. Design of a propeller flap based on the supratrochlear artery. *A*, The meandering path of the supratrochlear artery and its anastomoses with the superficial temporal artery laterally. *B*, The skin harvest process is initiated from the distal edge. The superficial galea aponeurotica is then raised toward the supraorbital bundles. The flap is carefully dissected within the same layer. *C*, The fully raised flap, along with the preserved supratrochlear vascular bundle.

Liu, Liu, and Zhang. Reconstruction of Extensive Forehead Defects. J Oral Maxillofac Surg 2021.

CASE PRESENTATION

Case 1

A 60-year-old man presented with 1-year history of a growth on the right upper eyelid and the skin of the right supraorbital region. Biopsy revealed basal cell carcinoma. The lesion was resected extensively, with safe margins confirmed by frozen section examination. The defect area was 3.5 × 4 cm in size and involved the right forehead, temple, eyebrow, and upper eyelid. The orbicularis oculi was cut, but the palpebralis and canalis nasolacrimalis were preserved. An extensive lateral forehead–temporal flap, measuring 4 × 8 cm, was designed with the supraorbital bundle in the middle. The flap was extended to the temporal area, based on the anastomoses between the supraorbital artery and the frontal branch of the superficial temporal artery. The large lobe was rotated to repair the defect area, including the upper eyelid, and the small lobe was used to repair the medial part of the donor site; the lateral donor area was closed directly. Redundant tissue above the left upper eyelid was left untreated to avoid damage to the vessel bundle. Sutures were removed 7 days after surgery. Postoperative pathology confirmed the diagnosis and the negative margin. The patient was followed every 3 months. At the end of the first year, the concave surface of the

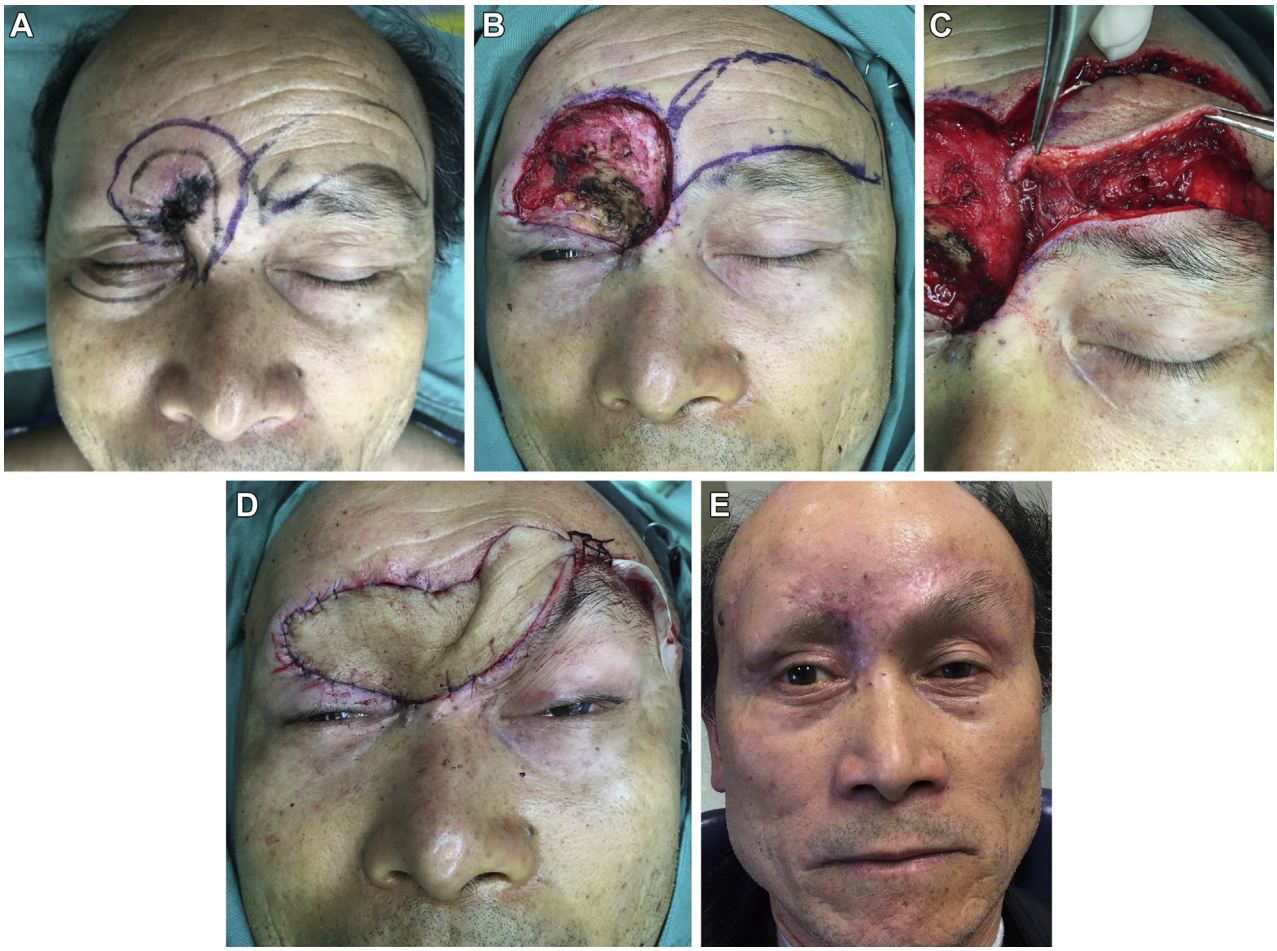

FIGURE 2. *A*, Patient with basal cell carcinoma in the right orbital area. *B*, The defect area was 3.5 × 4 cm and involved the right forehead, temple, eyebrow, and upper eyelid. The orbicularis oculi was cut, but the palpebralis and canalis nasolacrimalis were preserved. *C*, The propeller flap was designed and raised. *D*, The defect after repair. *E*, At 1-year follow-up.

Liu, Liu, and Zhang. Reconstruction of Extensive Forehead Defects. J Oral Maxillofac Surg 2021.

eyebrow region was smooth, the mobility of the upper eyelid was normal, and the excess tissue above the left eye had remodeled very well (Fig 2).

Case 2

A 65-year-old woman presented with 1-year history of a growth involving the right forehead, eyebrow, upper eyelid, nasal dorsum, and right cheek. Biopsy revealed basal cell carcinoma. In preoperative planning, we decided to use 2 propeller flaps for the reconstruction: a left superior orbital artery propeller flap to repair the forehead defect and a right facial artery propeller flap to repair the nasal dorsum defect. The paths of the arteries were detected by portable Doppler and marked. The lesion was resected extensively. The left superior orbital artery propeller flap was designed to be 4 × 8 cm, and the right facial artery propeller flap was designed to be 3 × 7 cm. Both flaps were rotated 180° to cover the defect area without tension. The donor sites were closed with parts of the respective flaps. The patient was followed every 3 months after surgery. There was no recurrence during the year after the surgery. At 1 year after surgery, the shape and mobility of the upper eyelid were good (Fig 3).

Discussion

The "propeller flap"—so called because it is designed with 2 "blades" and is rotated to repair the defect—was introduced by Hyakusoku et al. in 1991 and has proved to be useful for reconstruction when a conventional local flap is not an option.[5] The large paddle of the flap is used to repair the defect area, and the smaller paddle is used to close the donor site.[6] With improved understanding of vascular anatomy over recent years, propeller perforator flaps are being increasingly used in the reconstruction of the trunk, extremity, and breast defects.[5] Feasibility depends on the availability of perforator vessels near the defect area[7]

Propeller flaps that can be used in the head and neck region include the occipital artery propeller flap,

FIGURE 3. *A*, A 65-year-old woman with basal cell carcinoma in the right forehead, eyebrow, upper eyelid, nasal dorsum, and right cheek. *B*, The skin defect after excision. *C*, The defect was repaired with 2 flaps: a 4 × 8 cm left superior orbital artery propeller flap and a 3 × 7 cm right facial artery propeller flap. *D*, At 1-year follow-up.

Liu, Liu, and Zhang. Reconstruction of Extensive Forehead Defects. J Oral Maxillofac Surg 2021.

superficial temporal artery propeller flap, supratrochlear artery propeller flap, and supraorbital artery propeller flap.[1] There are several reports of primary reconstruction of nose defects using the supratrochlear artery propeller flap.[2-4,8] D'Arpa et al.[9] reported repair of 11 cases of nasal defects with propeller flaps based on the supratrochlear artery. The flaps ranged in size from 4.8 × 1.3 cm to 8 × 13.3 cm, and all survived. Similarly, Cordova et al.[10] used propeller flaps for repair of 15 cases of nasal defect, and all the flaps survived.

The supratrochlear artery propeller flap may not be feasible when the vascular bundle is too close to the resection margin. In such cases, a supraorbital artery propeller flap is an alternative. Since the supraorbital vascular bundle is situated away from the midline, a relatively large propeller lobe can be designed to cover defects in the lateral forehead or temporal area. In addition, the anastomoses between the frontal branch of superficial temporal artery and the supraorbital artery make it possible for the larger lobe to be extended to the temporal or the preauricular region. Yet another advantage is that the skin from the temporal area is very suitable for upper eyelid reconstruction.

The main disadvantage of the supraorbital propellor flap is scar contraction which will induce incompetent eye closure and inner canthus dislocation. According to our experience, a protruding curve at the upper

border of the temporal area is efficient to repair the upper eyelid defect. The protrusion of the curve should match the height of the defect. An anchoring suture at the eyebrow is necessary to ensure that the eyelid does not shrink during the postoperative contraction. In 1 of our patients (Case 1), the vertical concavity was not designed. Although the wound was closed without tension, the vertical skin quantity decreased due to scar contraction and resulted in a 2-mm gap 3 months after the surgery. An overly thick eyelid and blepharoptosis could result from excessive flap thickness or tissue redundancy. According to our experience, the skin of the forehead, raised at the level of galea aponeurotica, has thickness similar to that of the upper eyelid and can therefore provide satisfactory cosmetic and functional restoration. The second disadvantage is the numbness of the reconstructed area due to supraorbital nerve injury. Therefore, the nerve bundle should be carefully protected during the flap raising procedure.

Common complications of local flap such as vascular crisis and dog ear also happen to propeller flap. In our experience, and as also confirmed by others,[8] poor venous drainage of the flap is usually the cause. Among the 6 patients in our series, 2 developed purplish discoloration of the distal border of the flap on the first postoperative day. Needle punctures at the site were sufficient to relieve the congestion and restore blood flow. Epidermal bullae and crusting occur occasionally, but never to an extent that it negatively impacts wound healing. Dog earing and redundant tissue at the pedicle are common problems in the local flap. We faced the problem in both patients described in the Case Presentation section. At 1 year after surgery, the redundant tissue at the forehead had remodeled well, but at the cheek it had contracted to form a pouch; a secondary surgical procedure will be required for correction. Appropriate flap thickness and underlying skeleton support were probably responsible for the satisfactory remodeling of redundant forehead tissue.

In conclusion, propeller flap based on the supraorbital artery is a feasible option for primary reconstruction of supraorbital–forehead defects.

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References

1. Dancey A, Blondeel PN: Technical tips for safe perforator vessel dissection applicable to all perforator flaps. Clin Plast Surg 37: 593, 2010
2. Karsidag S, Ozcan A, Sumer O, Ugurlu K: Single-stage ala nasi reconstruction: Lateral nasal artery perforator flap. J Craniofac Surg 21:1887, 2010
3. Lombardo GA, Tamburino S, Tracia L, et al: Lateral nasal artery perforator flaps: Anatomic study and clinical applications. Arch Plast Surg 43:77, 2016
4. Moschella F, Toia F, Massimiliano T, et al: A propeller flap for single-stage nose reconstruction in selected patients: Supratrochlear artery axial propeller flap. Facial Plast Surg 30: 332, 2014
5. Yoshimura YNT, Yoneda K: Propeller flap for reconstruction of the tubercle of the upper lip. Br J Plast Surg 44:113, 1991
6. Lonie S, Grinsell D, Mah E: Propeller flap reconstruction of irradiated sarcoma defects: A comparison. J Plast Reconstr Aesthet Surg 72:181, 2019
7. Okada M, Ikeda M, Uemura T, et al: A propeller flap based on the thoracoacromial artery for reconstruction of a skin defect in the cervical region: A case report. J Plast Reconstr Aesthet Surg 66: 720, 2013
8. Vandersteen C, Culie D, Dassonville O, et al: An original procedure for orbitonasal cutaneous infiltrative tumor repair, using combined forehead and melolabial propeller flaps. Eur Arch Otorhinolaryngol 276:535, 2019
9. D'Arpa S, Cordova A, Pignatti M, Moschella F: Freestyle pedicled perforator flaps: Safety, prevention of complications, and management based on 85 consecutive cases. Plast Reconstr Surg 128:892, 2011
10. Cordova A, D'Arpa S, Moschella F: A new one-stage method for nose reconstruction: The supratrochlear artery perforator propeller flap. Plast Reconstr Surg 129:571e, 2012