

Original Article

Use of expanded deltopectoral skin flaps for facial reconstruction after sizeable benign tumor resections

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Abstract: The overall unsightliness of expansive benign facial tumors imposes both physical and mental suffering. Although excision is generally the optimal recourse in such instances, reconstructing the subsequent surgical defects is always a critical issue. Herein, we have described our experiences using expanded deltopectoral skin flaps to manage large facial wounds after excising benign tumors. Our endeavor called for retrospective review of 22 patients presenting between July 2007 and March 2017 with various facial growths, including hemangiomas, nevi, and neurofibromas. Depending upon areas of facial involvement, unilateral or bilateral deltopectoral skin flaps were expanded. The stepwise process was as follows: expander implantation, flap transfer, pedicle delay, and eventual separation. Ultimately, all 22 patients undergoing this procedure expressed satisfaction with the results in terms of skin texture, color, and flexibility. This particular method may thus be a reasonable choice for repairing sizeable defects in the wake of benign facial tumor excisions.

Keywords: Deltopectoral flap, pedicle flap, benign facial tumors, tissue expansion

Introduction

Benign but expansive facial tumors such as hemangioma, nevi, and neurofibromas severely impact the appearances and mental health of afflicted patients and require early intervention. Although nonsurgical treatments of these tumors help improve facial aesthetics [1], present clinical applications are limited by iatrogenic complications, such as unstable scars and depigmentation [2, 3]. Therefore, efforts to explore pertinent surgical treatments are still needed.

Ideal treatments in this regard should ensure satisfactory functional and aesthetic results. Surgical defects due to small benign facial tumors usually are amenable to primary closure (i.e., direct suturing), the results of which are acceptable. However, grafting of the sizeable voids left behind by expansive benign lesions often proves disappointing in terms of skin quality, color, and texture. A better and perhaps ideal treatment strategy in such instances is the use of full-thickness skin flaps for wound repair [4].

The deltopectoral flap was first described by Bakamjian (1965) [5] and has since become an ideal choice for repair of facial tumors, because the texture, color, and flexibility of skin in this region closely approximates that of facial skin. More recently, the knowledge acquired through anatomic [6] and clinical studies [7-10] dealing with repair of facial scars has underscored the two primary advantages of pre-expanded deltopectoral flaps. The first is that comparatively larger and thinner flaps can be developed in this manner for needed reconstruction. The other major benefit is that donor sites can be closed primarily. Herein, we share our experiences reconstructing large postsurgical facial defects stemming from benign tumor excisions through the use of pre-expanded deltopectoral flaps.

Patients and methods

Patients

Between July 2007 and March 2017, a total of 22 patients (male, 9; female, 13; age range, 14-45 years) presenting with expansive but

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Table 1. Complications of expanded deltopectoral skin flaps

Type of complication	Patients, n (%)
Expander exposure	-
Nerve injury	-
Extensive flap necrosis	-
Limited skin necrosis	3 (13.6)
Hematoma	2 (9.1)
Infection	-
Lower eyelid ectropion	1 (4.5%)

Table 2. Patient satisfaction survey (3 months postoperatively)

How do you rate the outcome of your facial operation?	Patients, n (%)
Poor	-
Average	-
Good	10 (45)
Very good	10 (45)
Beyond expectations	2 (10)

benign facial tumors underwent surgical excisions requiring pre-expanded deltopectoral flaps to repair related tissue defects. Overall, the procedures involved 11 patients with hemangiomas, 10 with nevi (pigmented, 8; verrucous, 1; sebaceous, 1), and one with neurofibromas. In 14 patients, unilateral flaps were raised, whereas the others were in need of bilateral flaps. The surgical defects spanned areas of 8×7 cm to 38×13 cm. Maximum and minimum sizes of unilateral pre-expanded deltopectoral flaps were 22×12 cm and 9×7 cm, respectively. All wounds at donor sites were closed by direct suturing. This study was approved by the Institutional Review Board of Xijing Hospital, with the informed consent of each patient.

Expander implantation

Generally, the superior border of a deltopectoral flap lies just below the clavicle; the inferior margin follows the axillary fold, extending to fourth or fifth costal bone; the medial boundary is set ~2 cm lateral to the ipsilateral parasternal line; and the lateral boundary can be expanded to the deltoid region of shoulder. When implanting an expander, an incision ~10 cm long is made along the inferior clavicular border, and a pocket is developed beneath the

deep fascia for expander and drainage tube placement. After the incision is closed, vacuum drainage is applied for 2-3 days. Once the fluid becomes clear, and the daily volume is negligible, the drainage tube is removed. Expander inflation begins on postoperative Day 5 or 6 and is achieved through twice weekly injections of normal saline. The volume of normal saline injected each time is ~15% of the rated total for the expander. We normally implant 600- to 800-ml expanders in deltopectoral flap of adults, reserving 200- to 450-ml expanders for children.

Transfer of expanded flap

After a facial tumor is excised, a plastic sheet is used to create a template of the wound defect, tracing its borders. We then mark the deltopectoral skin flap in a pre-expanded area (based on the template); the expander is extracted; and the skin flap is elevated, retaining intercostal vessels at its pedicle. After partly excising the fibrous capsular membrane on its underside, the flap is transferred to the facial defect for resurfacing, and the proximal pedicle is tubulated. The donor-site wound is closed by direct suturing, and the flap pedicle is separated ~3 weeks later.

Results

In none of the 22 patients were there any major complications, such as expander exposure, nerve injury, extensive flap necrosis, or infection; although three patients experienced blood perfusion disorders at distal ends of transferred flaps, resulting in topical depigmentation after secondary healing. One patient also displayed lower eyelid ectropion (corrected later by skin graft) after expanded flap transfer. These complications are listed in **Table 1**. During follow-up visits (range, 3 months to 8 years), transferred flaps matched well with facial skin in terms of texture and color. All patients were satisfied with clinical outcomes at the 3-month follow-up mark (**Table 2**).

Patient 1

A 19-year-old male patient presented with a slightly elevated right-sided black facial patch (12×10 cm). The lesion irregularly protruded in places (**Figure 1A**). Given a life-long diagnosis of verrucous nevus, the patch was excised, and



Figure 1. Patient 1: (A) 19-year-old male patient presenting with black skin patch (12×10 cm), slightly elevated with several irregular protrusions; (B) Right deltopectoral skin expander (500 ml) first implanted; (C) Deltopectoral flap (13×10 cm) raised after 2 months for transfer to face; (D) Pedicle divided 3 weeks later, completely replacing benign tumor; and (E) Aesthetically satisfactory facial contours at 6 months.

the defect repaired, after first implanting a right deltopectoral skin expander (500 ml) (**Figure 1B**). Two months later, the expander was removed, and a flap (13×10 cm) matching the facial defect in size and shape was raised for transfer to the face (**Figure 1C**). Wound edges at the donor site were then approximated and sutured. After 3 weeks, the pedicle was divided, leaving the expanded flap to fill the facial void (**Figure 1D**). The patient was pleased with the texture, color, flexibility, and contours of his reconstructed face.

Patient 2

A 12-year-old boy presented to our Department of Plastic and Reconstructive Surgery with an ulcerated facial scar (8×12 cm), the result of an irradiated hemangioma (**Figure 2A**). Two months after implanting a right deltopectoral skin expander (400 ml) (**Figure 2B**), we

designed a flap (9×13 cm) to match and fully replace the area of scar tissue (**Figure 2C**). The flap was raised from the expanded skin and transferred to the face, closing the donor site directly. Its pedicle was severed 3 weeks later. Once the surgical wounds healed, no contour deformity of the chest was apparent, and the patient was satisfied with the treatment outcome (**Figure 2D**).

Patient 3

A 19-year-old woman sought treatment at our department for a right-sided black, hairy facial patch (10×5 cm), which was congenital and subsequently showed histologic features of a pigmented nevus (**Figure 3A**). A skin flap was designed to replace the lesion, using an expander (800 ml) implanted into her right deltopectoral region (**Figure 3B**). Once sufficiently expanded, the lesion was resected, and the

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Figure 2. Patient 2: (A) 12-year-old boy presenting with ulcerated scar (8×12 cm) of right face after hemangioma irradiation; (B) Pre-expanded deltopectoral skin flap designed to replace lesion using 400-ml expander implanted into right deltopectoral region; (C) Deltopectoral flap (9×13 cm) raised from expanded skin 2 months later and transferred to face; and (D) Once healed, no apparent contour deformity of chest, and patient satisfied with outcome 8 years after surgery.

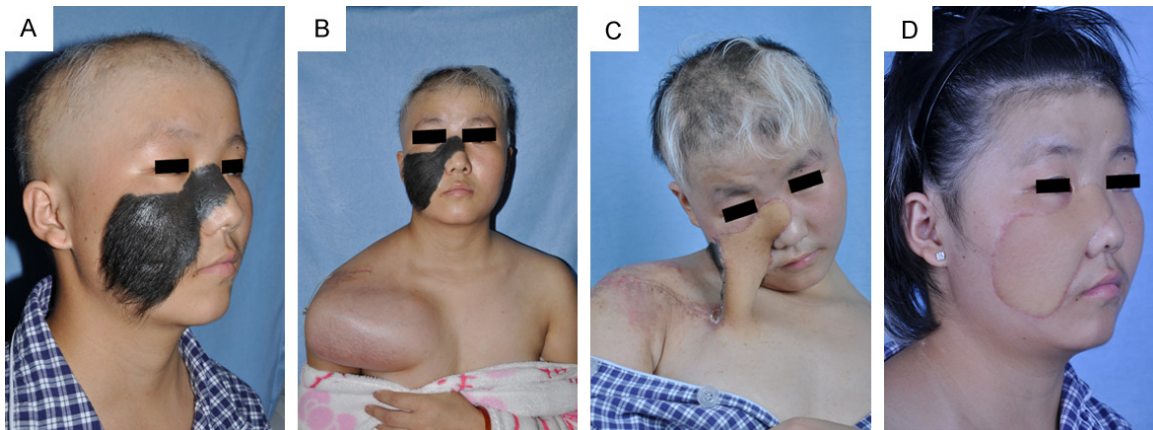


Figure 3. Patient 3: (A) 19-year-old woman presenting with black skin patch (10×5 cm) of right face; (B) Pre-expanded deltopectoral skin flap designed to replace lesion using 800-ml expander implanted into right deltopectoral region; (C) Expanded deltopectoral flap (11×7 cm) raised and transferred to facial defect after lesion resected; and (D) Pedicle division performed 3 weeks later, yielding aesthetically satisfactory facial contours 1 year after surgery.

planned deltopectoral flap (11×7 cm) was raised for transfer to the face, filling the surgical void. The donor-site wound was then sutured for closure (**Figure 3C**). Division of the pedicle took place 3 weeks later. At the 1-year follow-up mark, resultant facial contours proved aesthetically satisfactory (**Figure 3D**).

Discussion

A normal-appearing face is very important to one's self-image and sense of human beauty. Patients with expansive benign tumors of the face, such as nevi (pigmented, verrucous, or sebaceous) or hemangiomas consequently be-

ar immense psychologic burdens [11]. Furthermore, inappropriately treated hemangiomas may worsen the situation, resulting in unstable scars. Treatments addressing these sizeable growths must therefore be suitable. Skin transplants and local transposition skin flaps, with or without expansion, are the usual methods applied. However, there are disadvantages to either approach. For instance, skin transplants may culminate in graft contractures or poorly match the color and texture of surrounding facial skin. Although such issues may be avoided if expanded or non-expanded local skin flaps are used, available cervicofacial donor areas are generally insufficient to cover large defects.

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Therefore, an expanded distant deltopectoral flap is often preferred, given its excellent color/texture match potential and the inconsequential scarring produced at donor sites [12].

The size or volume of any expander used is dependent on tumor extent and the deltopectoral donor-site area [7]; and should unilateral coverage fall short, bilateral expansion deltopectoral flaps may suffice. Also, expander placement near the shoulder ultimately facilitates flap transfer at later stages of facial wound reconstruction. In clinical practice, larger expanders are often chosen for deltopectoral skin flaps, generally 600-800 ml in adults and 200-450 ml in children. Finally, we do not recommend dual expander implantation in one deltopectoral area due to the likelihood of significant fibroplasia within intervening subcutis and subsequent blood circulation disorders of distal flaps.

In our designs, expander implantation incisions are made along inferior clavicular borders to accommodate the local anatomy. The ideal tissue layer for expander placement is between deep fascia and the superficial surface of pectoralis major so that perforator vessels within deep fascia will not easily be damaged during surgical dissection. Effective hemostasis and complete drainage of wound fluids are also required for successful outcomes.

During transfers, expanded deltopectoral flaps must be sized 10-15% larger than corresponding surgical defects to allow for flap retraction. Also, the fibrous capsules should be partly removed to encourage revascularization between flaps and wound beds. Once an expanded flap is transferred, the patient's neck is usually secured in a flexed position to protect the flap pedicle. Delayed pedicle separation is essential, ensuring sufficient time for circulation to re-establish so that flaps remain viable. Pedicle division is generally undertaken 3 weeks after flap transfer.

In summary, pre-expanded deltopectoral flaps provide ample skin for the reconstruction of large facial defects and are especially useful after expansive benign tumor excisions. The texture, color, and flexibility of such flaps compare favorably with facial skin, yielding satisfactory aesthetic results.

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Disclosure of conflict of interest

None.

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