

Extended Pedicled Perforator Plus Submental Flap for Large Cheek Defect Reconstruction

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Background: The submental flap is an alternative repair technique in the maxillo-facial region when microsurgical reconstruction is not required or is difficult to apply. The purpose of this study was to illustrate the benefits of restoring the cheeks with an extended pedicled submental flap.

Method: Eight patients aged 58 to 81 years with cheek cancer presented to the surgery department at the Benha University Hospital in Egypt, from May 2019 to October 2021 for the removal of their tumors and reconstruction of the resulting defects, using the extended submental perforator plus pedicled artery flap.

Results: The average blood loss was 250 cm³ (range: 50–400 cm³). The average operation took 3 hours to complete, including excision and rebuilding (a range of 2.5 to 3.5 hours). The length of the postoperative hospital stay was 2 to 4 days. Fortunately, there was no complete flap loss; nonetheless, distal flap necrosis in one case left a raw area, which was allowed to heal naturally, and hemorrhages in two cases were conservatively handled.

Conclusions: For the reconstruction of cheek abnormalities, the submental flap is a viable alternative, particularly in older patients or patients whose overall health has declined and who need less severe therapies and quicker surgery. The submental flap, which conceals the donor site, provides a dependable supply of skin for facial resurfacing with excellent color, shape, and texture matching. The flap is quick, and easy to raise. (*Plast Reconstr Surg Glob Open* 2023; 11:e4997; doi: 10.1097/GOX.0000000000004997; Published online 22 May 2023.)

INTRODUCTION

Due to the site's prominence and the scarcity of nearby tissue, defects of the cheek pose a reconstructive challenge. The skin of the anterior neck is used in a variety of flaps for face reconstruction because the cheek adjoins various structures with expressive functions, including the eye, mouth, and surrounding facial musculature. These include flaps with random patterns.¹

Basal cell carcinoma, squamous cell carcinoma, and malignant melanoma are the three most prevalent malignant cutaneous lesions of the face, in descending order of frequency.²

Martin et al first described the submental island flap for soft-tissue head and neck reconstruction in 1993.³ The

submental artery is a constant branch of the facial artery that emerges 27.5 mm distal to the facial artery's origin from the external carotid artery. At the level of the anterior digastric muscle belly, this artery releases one to four cutaneous perforators and anastomoses with the contralateral artery in 92% of cases along its path toward the midline,⁴ and, in 60% of cases, serves as the primary blood vessel for the floor of the mouth.⁵

According to blood supply, the submental artery flap can be pedicled, free, or perforator based, and according to the composition of the flap, it can be myocutaneous or osteocutaneous.⁶ The submental pedicled flap can be pedicled superiorly (reverse flow), which depends on an anastomosis between the external and internal carotid arteries via the angular artery, or inferiorly (antegrade), which depends on facial artery integrity. The retromolar pad, tongue, floor of mouth, and buccal mucosa are all reconstructed using a pedicled submental flap with orthograde blood supply. The retrograde variant's significant mobility enables rebuilding of the palate and maxillary

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alveolar ridge, as well as the midface, periorbital, inferior temple, auricle, and oropharynx.⁷

The flaps that are created using a perforator input plus additional vascular supply from a retained base are known as perforator “plus” flaps. This perforator plus flap with dual supply ensured flap survival and did not suffer loss. The current method of perforator plus flap enables the successful use of fascial flaps in ratios of 1:4 or higher. Comparing these flaps with muscle and fasciocutaneous flaps reveals many advantages.⁸

Because the integrity of the facial artery and vein is required for the success of this approach, the use of this flap is contraindicated in patients with metastases and in patients with a history of neck dissection.⁹ It is therefore essential to utilize a hand-held Doppler to locate skin perforators.¹⁰

In addition, this flap minimizes the possible risks associated with microsurgical techniques in older individuals, reduces submental fullness, and produces a favourable donor outcome.¹¹

This article describes the outcomes of using a submental flap as a perforator plus flap with its pedicle intact for cheek reconstruction, defining the surgical technique used to raise the flap, the postoperative complications, and the final results obtained.

PATIENT AND METHODS

From May 2019 to October 2021 at Benha University Hospital, Egypt, a total of eight patients with cheek carcinoma presented to the surgery department for the resection of their tumors and reconstruction of the resultant defects with the submental perforator plus pedicled artery flap.

Patients gave their consent after being fully informed about the surgical procedure, the likely outcome, and any potential complications. Written informed consent was obtained from patients for inclusion in the study and accompanying images. The study proposal has been approved by our research and ethical committee.

Patients with a nodal stage greater than N0 at presentation were excluded from the study. Flap viability, complications, functional and cosmetic results, and locoregional control rate were all evaluated.

The lower eyelid and temple (zone 1), lateral nose (zone 2), nasolabial fold or oral commissure (zone 3), and central cheek (zone 4) are the four zones of the cheek that are classified according to the location of the abnormalities. (See figure, Supplemental Digital Content 1, which displays the anatomy of the submental vessels. <http://links.lww.com/PRSGO/C554>.) Large defects are defined as those that span multiple zones.¹²

ANATOMY

The submental artery emerges from the facial artery deep to the submandibular gland, measuring an average of 2mm in diameter at its origin and 6cm long. (See figure, Supplemental Digital Content 2, which displays the cheek subunits. <http://links.lww.com/PRSGO/C555>.) It runs

Takeaways

Question: Why choose the pedicled perforator plus submental flap for large cheek defect reconstruction?

Findings:

1. The cheek is a special site for tumors, benign and malignant.
2. It includes vital structures such as lacrimal puncta, ducts, and lacrimal sac, very near to the eyeball and eyelid canthal ligament.
3. Important aesthetic area in the face.
4. Few tissues available for reconstruction.

Meaning: Extended pedicled perforator plus submental flap is an effective, quick, simple single stage technique for cheek region reconstruction. It is a perforator plus flap maintaining its pedicle, so additional blood supply, venous and lymphatic drainage, and sensory supply need to be ensured.

medially and forward on the mylohyoid muscle in a gradual curve, releasing one to four cutaneous perforators that puncture the platysma muscle above them before creating a subdermal plexus that anastomoses widely with the branches on the opposing side. The submental artery terminates just lateral to the midline, behind the mandibular symphysis, on the anterior belly of the digastric muscle, from which it distributes branches to the sublingual gland and the lower lip.

The submental vein, which emerges from the surface of the submandibular gland, empties the flap into the common facial vein.¹³

SURGICAL TECHNIQUE

The patient is positioned supine with the head stretched and twisted to the other side.

After removing the cheek mass or ulcer with a safety margin indicated by an intraoperative pathological investigation, loupe magnification is performed to guarantee full removal.

Flap Design

The sites of the facial artery and submental perforators were marked with the help of a hand-held Doppler.

In the midline of the submental region, a skin ellipse is taken; the top incision is 1.5cm below the mandible, and the side incisions are 3.5cm below the mandibular angles. A pinch test is used to assess the flap's maximum width, which is primarily used to close the donor site. The flap's length is calculated based on the magnitude of the defect and, if necessary, may extend from one mandibular angle to the other. Additionally, the skin paddle might be made to support either unilateral or bilateral neck dissection.

Harvesting the Flap

Dissection of the flap starts in the subplatysmal plane on the opposite side of the pedicle at the level of the opposite mandibular angle.

Typically, the submental vessels and the ipsilateral anterior digastric muscle bellies are situated 5.5 cm anterior to the mandibular angle. Starting from the side opposite of the pedicle, flap dissection begins at the subplatysmal level, and the flap is split until the submandibular gland and the digastric muscle are revealed. At this point, it is necessary to identify the marginal mandibular nerve to be protected.

To ensure that the perforators are included in the flap, care is taken to locate and dissect the submental artery and vein that run along the medial margin of the anterior belly of the digastric muscle, which is included in the flap. The flap may occasionally contain a strip of the myelohyoid muscle; it is dissected bluntly from the ipsilateral geniohyoid muscle after being separated from the mandible and the hyoid. The flap is completely mobilized as a result.

Neck Dissection

Flap harvest is done first with caution by ligating the branches leading to the submandibular gland and protecting the submental vessels. The facial artery and vein are carefully separated from the submandibular gland as soon as they reach the submandibular triangle, and then nodal dissection proceeds.

Outcome measures included ability to completely close the defect with minimal tension, cosmetic appearance, complications, and the need for further surgery. Acute and chronic postoperative complications such as hematoma, infection, skin necrosis, or hypertrophic scars were assessed. Tumor surveillance was performed with a physical examination every three months following surgery.

In addition, ultrasonography was performed every 3 months for the first year after surgery. Scars were managed postoperatively with tape, silicone gel, and silicone sheets to reduce scar visibility. A Likert scale of patient satisfaction was also used to assess patient satisfaction.

The Statistical Package of Social Science (SPSS), version 22.0, was used to analyze the data (SPSS Inc., 2013). Nominal data were presented as frequency and percentage, whereas continuous data were presented as mean and SD.

RESULT

All patients underwent surgical resection and immediate reconstruction with an extended submental perforator

plus flap. The largest flap size taken in our series was 15×5 cm. The flap was used for the reconstruction of a cheek defect. Simultaneous neck dissection was performed in five patients after flap harvest. [See figure, Supplemental Digital Content 3, which displays the (a) preoperative view of an older patient with ulcerating cheek mass, (b) outline of mass excision, (c) the cheek defect after excision of the mass and anterior maxillary wall. <http://links.lww.com/PRSGO/C556>.] [See figure, Supplemental Digital Content 4, which displays the (a) outline of the submental flap, (b) flap elevation after complete dissection conserving the skin pedicle, (c) the flap containing submental vessels (black arrow), also containing anterior belly of digastric muscle which includes submental perforators to skin (blue arrow). <http://links.lww.com/PRSGO/C556>.] [See figure, Supplemental Digital Content 5, which displays the (a) flap after inset to the defect, (b) intraoperative final view of the flap. <http://links.lww.com/PRSGO/C556>.] [See figure, Supplemental Digital Content 6, which displays the (a) view of the flap after 6 months, (b) view of the donor site. <http://links.lww.com/PRSGO/C556>.]

The age of patients at presentation ranged from 58 to 81 years (the mean was 68 years). Of the eight patients, there were five men and three women. Comorbid diseases were present in six patients (three were diabetic and three were hypertensive and cardiac, but all diseases were controlled).

The most common presenting symptoms were a cheek mass in three patients and a cheek ulcer in five. All patients had a preoperative histological diagnosis of basal cell carcinoma, squamous cell carcinoma, sebaceous carcinoma, merkel cell carcinoma, or porocarcinoma (Table 1). All of our patients were clinically N0, and all patients were nonmetastatic (M0) at presentation.

All patients had intraoperative microscopic tumor-free margins by frozen section. The mean operative blood loss was 250 cm³ (range: 50–400 cm³). The mean operative time, including resection and reconstruction, was 3 hours (a range of 2, 5 to 3.5 hours). Postoperative hospital stays ranged from 2 to 4 days. Fortunately, there was no complete flap loss, but there was distal flap necrosis in one case, leaving a raw area which was left to heal by secondary intention; hematoma in two cases, managed conservatively; and prolonged seroma after removal of drain in one case, managed by aspiration and compression. Regarding late complications, one patient developed

Table 1. Summary of Demographic, Operative, and Postoperative Data

Age	Gender	Pathology	Neck Dissection	Site	Flap Size	Hospital Stay	Complications		Radiotherapy
							Early	Late	
1	72	Man	BCC	No	Cheek	12×5	2	Hematoma	No
2	65	Woman	Sebaceous carcinoma	Done	Cheek	10×5	3	Distal flap necrosis	No
3	75	Man	BCC	No	Cheek	13×6	2	None	No
4	64	Man	SCC	Done	Cheek	12×7	4	None	Yes
5	58	Man	Porocarcinoma	Done	Cheek	15×5	2	Hematoma	No
6	60	Woman	SCC	Done	Cheek	12×6	3	Seroma	Lower lid ectropion
7	81	Woman	BCC	No	Cheek	14×5	3	None	No
8	69	Man	Merkel cell tumor	Done	Cheek	13×6	2	None	No

Table 2. Results of VSS

VSS	Patient Overall Score	Physician Overall Score
Excellent	5	14
Good	12	4
Moderate	2	1
Hypertrophied	1	1
Keloid	0	0

lower eyelid ectropion, which was managed operatively 3 months later by lateral tarsal strip excision and full thickness skin graft.

At 3 and 6 months postoperatively, the patients' aesthetic condition and function were examined. An aesthetic assessment was performed by two physicians using the Vancouver Scar Scale (VSS). The VSS consists of four parameters: pigmentation, vascularity, pliability, and height (Table 2). The highest possible score is 13, indicating the worst possible scar condition, whereas a lower score indicates a more desirable scar. Other assessments were functional satisfaction (involving the actions of the facial muscles while closing eyes, smiling, and making other facial expressions) and patient aesthetic satisfaction, which was evaluated by a Likert scale of patient satisfaction (Tables 1 and 3).

DISCUSSION

A surgeon must exercise extra caution when undertaking reconstruction of the cheek because it occupies a sizable portion of the face and is situated close to the lips, eyes, and other nearby facial muscles with expressive roles. However, a significant cheek defect is challenging to restore since the cheek has a small amount of the tissue. Additionally, the texture of the cheeks changes according to gender and age. A woman's cheek skin is soft and smooth, but a man's cheek has a noticeable hair-bearing area.

Direct closure is the best method for skin and soft-tissue reconstruction after skin cancer excision because it maintains the surrounding tissue's color and textural balance. Direct closure, however, is frequently not achievable without altering the surrounding critical tissues, such as the eyelids, nose, and mouth, because a large safety margin is needed when excising skin cancer. For a defect larger than 2 cm, direct closure is challenging to complete. A local flap is preferred for larger abnormalities to maximize color and texture matching with the surrounding tissue.

Distinct writers have each described a different flap for the reconstruction of cheek cutaneous abnormalities. However, a common drawback to all of these is their lack

of mobility and dependability. The submental flap has a long pedicle, a large rotation arc, and can cover a large surface, making it a reliable and legitimate alternative to microvascularised flaps, especially in older patients or patients with deteriorated general condition who require less aggressive treatments and shorter surgical times.

Sterne et al divided facial vessels proximal to the submental artery's origin. As a result, the blood supply relied on retrograde flow from the distal end of the facial vessels. This variation is known as "flap with reverse flow," and it allows for an additional lengthening of the pedicle, which covers defects in the upper half of the face. The potential risk of this flap is transferring cervical metastatic disease to the recipient site, as well as the impossibility of performing a rigorous level I neck dissection, are both debated in the literature. The dissection plane of the flap, on the other hand, is subplatysmal, as is the plane used for neck dissection. Therefore, if anatomical planes are respected, the chances of tumor dissemination may be reduced.¹⁴

Choi et al reviewed 10 cases of submental flap reconstruction after resection of aggressive oropharyngeal tumors and discovered that disease recurrence was more related to the aggressiveness of the primary tumor than to the oncological "transgression" caused by this flap. In our series, no cases of locoregional tumor disease recurrence or tumor disease transfer to the recipient site were found. As a result, our findings support the oncological safety of this flap in patients with no cervical lymph node disease at the time of surgery (clinical and radiological results of N0). If surgeons observe suspicious nodes during neck dissection, they should refrain from performing a submental flap and choose another reconstructive option.¹⁵

The main drawbacks of this flap, despite its efficacy, are the possibility of damaging the marginal mandibular nerve and venous obstruction. Submental lymph nodes are located in the deep layers of the flap and could be exposed when it is elevated. Therefore, a submental artery flap and a cervical dissection cannot be performed simultaneously.¹⁶ But in our cases, we did meticulous lymph node dissection with preservation of submental vessels, and depending on the addition of the pedicle to the flap (perforator plus not island), this ensured extra blood supply, venous drainage, and lymphatic drainage.

Because this tissue transfer usually results in an acceptable donor tissue volume and adequate blood supply, free flaps have been the preferred approach for post oncological restoration of tissue defects in oral cancer patients.¹⁷ Patients with a vessel-depleted irradiation neck and those with a high ASA risk score should not undergo

Table 3. Likert Scale of Patient Satisfaction

Likert Scale	Very Satisfied	Satisfied	Fair	Unsatisfied	Very Unsatisfied	P
Shape	4 (50%)	2 (25%)	1 (12.5%)	1 (12.5%)	0	0.075
Irregularities	6 (75%)	1 (12.5%)	1 (12.5%)	0	0	0.060
Scar	4 (50%)	2 (25%)	1 (12.5%)	1 (12.5%)	0	0.075
Symmetry	3 (37.5%)	2 (25%)	3 (37.5%)	0	0	0.035

*Data are presented as mean ± SD. Numbers, ranges and percentages are in parentheses.

this free flap procedure. Surgery takes longer than the submental flap, resulting in a longer hospital stay, higher costs, and worse postoperative medical issues.¹⁸

Another common surgical procedure that is easy to perform and has a good blood supply is the use of pedicled myocutaneous flaps, such as the pectoralis major flap.¹⁹ These flaps have drawbacks, including bulky volume, the need for revision procedures, and a higher incidence of problems.¹⁹

However, the submental artery flap demonstrated several potential benefits. Due to its thinness, pliability, and adaptability in design, which are characteristics shared with the radial forearm free flap, it is the perfect flap for soft-tissue head and neck reconstruction. Additionally, it has a great color match for the head and neck region and is simple to lift.²⁰ Submental flap risks include facial palsy, which can range from 0% to 17% and is brought on by surgically inflicted facial nerve injury and marginal mandibular nerve damage.

The supraplatysmal dissection significantly lessens this injury to the marginal mandibular nerve. The risk of damaging these nerves and blocking the innervations of the supplied muscles is reduced by the use of nerve stimulators in conjunction with a thorough dissection.²¹ Also, Kim et al prove the reliability of the reversed submental perforator-based island flap as a versatile option in mid-face reconstruction,²² agreeing with Pistre et al, who stated that the submental flap is simple and can be raised rapidly. It produces good color, texture, and contour match without a conspicuous site. Its versatility and its rotational arc explain its large application in facial surgery.^{23,24}

The advantages of the perforator plus flap with intact skin pedicle include preservation of sensory nerves, subcutaneous arteries, veins, and lymphatic vessels during flap elevation. This will add dual blood supply to the flap, ensure good venous drainage and lymphatic drainage, and preserve sensation in the flap, making it simple and able to be raised rapidly

CONCLUSIONS

The submental artery perforator plus flap has emerged as a viable reconstructive option in the management of head and neck cancers. It exhibits many advantages for the use of reconstruction of complex facial and oral defects and has been shown to be a safer, relatively simpler alternative to free flaps, especially in older patients. So the submental perforator flap is a reliable, simple, quick, and safe flap that provides excellent color, thickness, and texture matching to the face with minimal donor site morbidity. Furthermore, no revisional surgery is required.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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