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The submental flap – Outcomes and oncologic safety in head and neck reconstruction

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ABSTRACT

Introduction: The submental flap is a reliable alternative to free flaps in the reconstruction of cutaneous facial and oral cavity defects. The thin, pliable, easily harvested flap has minimal donor site morbidity. The flap is controversial due to the potential involvement of level I lymph nodes within the flap. We describe 40 cases of head and neck reconstruction with the submental flap following resection of various cancers, and assess the oncologic safety of this flap at our centre.

Aims: To evaluate the outcomes of the submental flap and assess the oncologic safety of the flap on follow-up.

Material and methods: Pre-operative, post-operative and follow-up data of 40 consecutive patients with oral cavity and parotid malignancies, who underwent reconstruction with the submental flap between January 2017 and June 2019, was analysed.

Results: Oral cavity defects following resection of carcinoma tongue were predominant (n = 19). Patients were considered suitable for reconstruction with the submental flap only when level Ia and Ib nodes were clinically and radiologically negative for metastasis. Neck dissection was performed in all cases, with careful dissection of all level Ib nodes along the submental perforators. Flap complications were minimal. During a mean follow-up period of 14 months, no recurrences were noted within the flap.

Conclusions: The submental flap, although not the first choice, is a reliable alternative to free flaps in the reconstruction of oral defects. However, selection of patients with clinically node negative disease is extremely important, due to the potential risk of occult metastasis.

1. Introduction

Orofacial reconstruction following an ablative tumour surgery has both functional and morphological impacts. The introduction of microvascular free flaps revolutionized the field of head and neck reconstruction. Although microvascular free flaps remain the gold standard, their execution requires a high level of expertise, expense and time. In high volume and low resource centres, and when the patient population is unsuitable for prolonged microvascular surgery and the attendant risk of return to theatre, various pedicled flaps continue to play a crucial role in reconstruction.

The submental artery island flap was first described by Martin et al., in 1931 [1]. The submental artery island flap is a type 'C' fasciocutaneous flap with its dominant pedicle based on the submental artery, arising from the facial artery [2]. It has a long (up to 8 cm), consistent and reliable pedicle, and can be used as a cutaneous, musculofascial (cervicofacial and platysma), or osteocutaneous flap [3]. The flap has an excellent skin colour match and wide arc of rotation and hence can be used for covering defects on the ipsilateral side of the face and defects involving the oral cavity [3]. However, since it was described, it has struggled to gain a strong foothold as a reliable flap for the fear of potentially transferring the occult metastatic nodal disease to the recipient site [4].

In spite of the initial setback and intense criticism for nearly three years after its introduction, Sterne et al. [5] used this flap for the first time in the reconstruction for oral squamous cell carcinoma. Since then, for the past two decades, it has become a popular local flap of choice for reconstruction of oral cavity defects. Although it has been widely used,

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Fig. 1. Use of the submental flap for reconstruction of an auricular defect following resection of an external auditory canal malignancy.

the question of oncological safety of the submental flap remains unanswered [6]. The aim of our study was to share our experience of the use of submental flap in head and neck reconstruction following ablative cancer surgery, including flap complications and long-term oncological outcomes.

2. Materials and methods

This retrospective, observational study included 40 consecutive patients with head and neck cancer, who were reconstructed with the submental flap after resection of the cancer between January 2017 and June 2019. Data pertaining to patient demographics, nature of malignancy, subsite of involvement, relevant clinical and radiological findings was collected. Intraoperative findings, laterality of the flap and histopathological data were noted. We also looked at the adequacy of lymph node yield following neck dissection. This cohort of patients was followed up for a minimum period of 14 months, during which any occurrence of locoregional recurrence or distant metastasis was noted. The study was approved by the Institutional Review Board and Ethics Committee.

2.1. Surgical anatomy and technique

The submental artery is the largest branch of the facial artery with a luminal diameter of about 1.7 mm. It arises roughly 6 cm from the origin of the facial artery. The artery usually terminates either superficial (30%), deep (70%) or through the anterior belly of digastric muscle to end in the subcutaneous plane in the midline [7]. Anatomical variations include termination at the symphysis menti [8]. One to four cutaneous perforators supply the subdermal plexus and anastomose with the contralateral submental artery [9]. This enables harvest of a larger flap between the angles of the mandible on either side, about 7–8 cm width and 15–18 cm in length. Laxity of skin in older patients allows for harvest of such large sized flaps. The pedicle is usually 5–8 cm and provides a wide arc of rotation, and the flap can reach defects over the cheek or auricle with ease (Fig. 1). Venous drainage is through the accompanying submental vein, about 2.2 mm in diameter, draining into the facial vein, thus eventually into both the internal and external jugular systems [10].

Fig. 2. Completed flap harvest.

Apart from minor variations in the venous anatomy, no arterial anomalies were noted in our series.

Our surgical technique begins with marking of an elliptical submental skin paddle of the required size after testing the laxity of skin, to enable primary closure of the donor site, and designed such that the scar is hidden under the mandible. Subplatysmal harvest begins on the contralateral side over the anterior belly of digastric muscle. Ipsilateral subplatysmal flap is elevated, taking care to preserve the marginal mandibular nerve. Facial vessels and the submental vessels are identified. The submandibular gland along with any enlarged level Ib nodes are carefully dissected off the facial and submental vessels and sent for histopathological examination. Dissection proceeds to the midline, the ipsilateral anterior belly of digastric and mylohyoid muscles are detached from the mandible and hyoid, and included in the flap to preserve the perforators. Any nodes identified in the submental triangle at this point can be removed safely without flap compromise, by preserving the cutaneous perforator branches, which are better visualized through magnifying loupes. The flap is now ready to be transferred to the site of the defect (Fig. 2) through a tunnel either subcutaneously over the mandible, or under the mandible to reach the recipient site. To improve the arc of rotation and increase the reach of the flap to more posterior or superior defects, the facial artery is ligated cephalad to the origin of the submental branch, allowing only anterograde flow along the facial artery. This also improves flap perfusion, and is recommended by the authors when larger flaps are harvested. Another way of improving reach is by ligating the facial artery more proximally as it enters the submandibular gland; this generally yields an extra couple of centimetres of pedicle length and the reverse flow pattern of perfusion is adequate to sustain the flap, though not often practiced by our surgical team. Care is taken to preserve both the internal and external jugular venous systems. We harvest the flap within 45–60 min on an average.

The flap was usually harvested based on the ipsilateral submental artery. In certain cases of carcinoma of the oral tongue involving the sublingual space and the mylohyoid muscle, a compartmental resection of the tongue was performed and the mylohyoid muscle sacrificed as a result. Hence, a submental flap based on the ipsilateral submental artery was avoided and a contralateral submental artery-based flap was utilized. The reach of the contralateral flap could be improved by ligation of the facial vessels beyond the origin of the submental vessels. Venous drainage might be tenuous in such cases and every attempt was made to preserve the continuity of the external jugular system, while avoiding tension or torsion of the pedicle.

Table 1
Demographic, peri-operative data of the patients in the series of submental flaps (n = 40).

Age	20–70 years (mean 51 years)	
Gender	Male	26 (65%)
	Female	14 (35%)
Co-morbidities present	10 (25%)	
Site of resection	Tongue	19
	Buccal mucosa	12
	Lips and oral commissure	3
	Upper alveolus	1
	Lower alveolus	2
	Parotid	3
Neck dissection	Ipsilateral	31
	Bilateral	6
Histopathology	Malignancy	36
	Premalignant lesion (epithelial hyperplasia)	4
Pathological staging in malignancy	I	2
	II	8
	III	15
	IV	11
Pathological node positivity at levels Ia/Ib	1/36 (2.7%)	
Flap complications	Venous compromise	3
	Arterial compromise	2
	Partial flap loss	3
	Complete flap loss	2
	Conservative management and salvage	1
	Debridement and healing by secondary intention	2
	Donor site – wound dehiscence	Nil
	Limitation of neck movements	None

3. Results

The study includes 26 men and 14 women, with age ranging from 20 to 70 years (mean age of 51 years). Malignant lesions were 36 and oral premalignant lesions were four. Most of the oral cavity defects were in the oral tongue (19), followed by the buccal mucosa (12), lower alveolus (two), upper alveolus (one), and oral commissure (three). Three patients had defects following a parotidectomy. Four patients with oral cancer received neoadjuvant chemotherapy before undergoing surgery. 30 patients underwent ipsilateral selective neck dissection (SND) and six underwent bilateral SND.

There was complete flap loss in two patients secondary to ischemia and three partial flap losses owing to venous compromise (Table 1). Flap failure was managed conservatively by debridement and healing by secondary intention, without the need for a second reconstructive procedure. Hair growth has remained a problem in those patients who were spared post-operative radiotherapy.

Of the 40 patients in the study, 31 were followed up for a minimum of 14 months. Data from their out-patient follow up visits and teleconsultations was collected, to detect evidence of local, regional recurrence and/or distant metastasis. None of the patients developed local recurrence. Among the four patients who recurred in the neck, none developed recurrence in the subcutaneous tissues of the flap. One of the four had inadequate nodal yield and a positive perifacial node. Two had other risk factors for recurrence. Three of the four had received adjuvant therapy, and the fourth did not have adverse pathological factors meriting adjuvant treatment (Table 2). There were two deaths due to unrelated causes.

4. Discussion

Since its emergence, although much criticized, the submental flap has been a reliable option for reconstruction in the head and neck region. The flap is pliable and easy to harvest. It is comparable to radial artery forearm free flap in thickness and pliability when used for tongue or cheek reconstruction (Figs. 3 and 4).

Faltaous, Yetman and Magden et al. [10] found that the submental artery runs beneath the anterior belly of digastric muscle in most of the cases. This observation held true in our case series. To avoid potential damage to the submental perforator branches, we routinely harvest the mylohyoid and the anterior belly of the digastric muscle without separating them, to sandwich the vessels between these two structures. This also improves venous drainage through the muscular plexuses and increases the bulk of the flap, especially useful for reconstruction of hemiglossectomy defects. Since the perforators are safely protected between the muscles, undue torsion during flap inset and subsequent vascular compromise is avoided. The potential risk of injury to the marginal mandibular nerve during submental flap harvesting ranges from 0% to 17% [10,11]. Carefully elevating the fascia above the submandibular gland with sharp dissection and use of bipolar cautery has

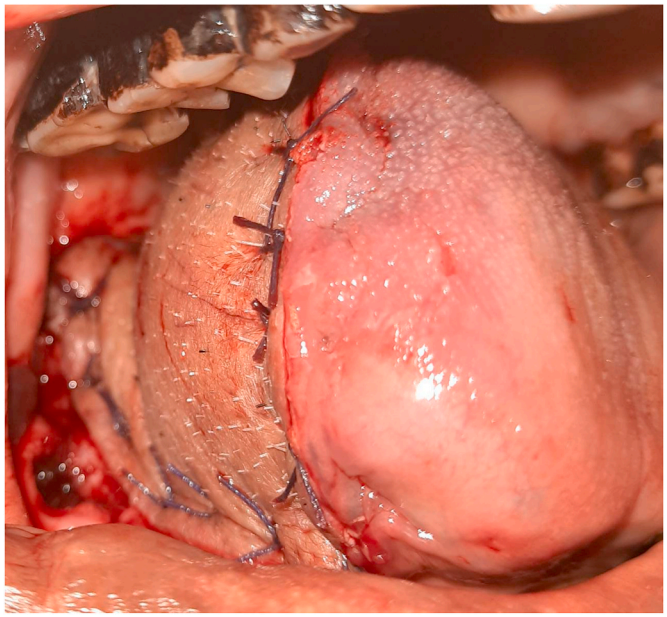

Fig. 3. The submental flap used for reconstruction for a glossectomy defect. The authors use a small volume closed suction drain between the flap and the remnant tongue to minimize collections beneath the flap, which could compromise flap survival.

Table 2
Pattern of recurrent and metastatic disease noted during follow-up of 14 months (n = 31).

Location of recurrent disease	Frequency	Site of primary tumor	pT	pN (1a, 1b –ve)	Close margins	Lymph node yield	Adjuvant Radiation
Local recurrence at flap	0	–	–	–	–	–	–
Local recurrence (away from flap)	1	Tongue	pT2	pN0	Nil	11	No
	1	Buccal mucosa	pT3	pN1	2	4	Yes
Ipsilateral nodal recurrence	1 (level 1b)	Tongue	pT3	pN2	Nil	10	Yes
Contralateral recurrence	0	–	–	–	–	–	–
Distant metastasis	1	Oral commissure	pT1	pN3b	Nil	11	Yes

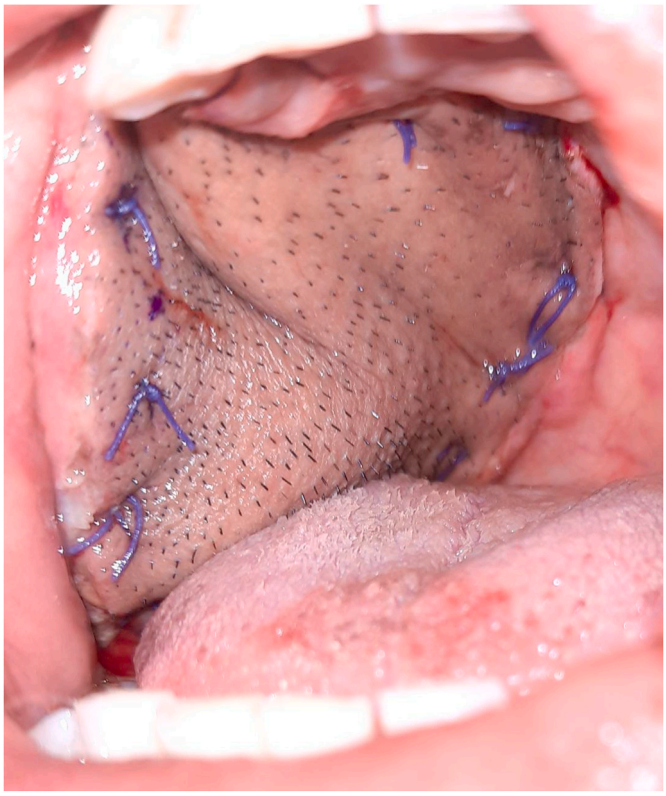

Fig. 4. The submental flap used for reconstruction of a buccal mucosa defect. The flap is tunnelled over the mandible.

saved the nerve is most of our cases.

The versatility and adaptability of the submental flap in the reconstruction of a variety of defects is reflected in our series. Some centres have successfully tried the flap in reconstruction of composite intraoral resection of the upper or lower alveolus. Our series includes one case of usage of the submental flap to provide the lining over a mandibular reconstruction plate following a segmental mandibulectomy. Although an adventurous feat, at our centre, we generally restrict our zeal to reconstruction of marginal mandibular defects. We have also utilized the bipaddled submental flap for a full thickness central cheek defect. Another adaptation in our series is the harvest of this flap based on the contralateral submental artery (n = 3), in cases where there was suspicious enlargement of ipsilateral level Ib nodes or disease abutting the ipsilateral mylohyoid muscle [12].

We found that the flap is an excellent alternative to free flaps, if not the first choice, particularly in the elderly and in high-ASA risk patients. In women, it is a good alternative to a free flap, owing to the limited donor site morbidity and aesthetic scar placement. In men, however, hair growth in a naturally hairless recipient site can be a cause of distress. In our patients, we noticed progressive sparsity of hair over the flap following adjuvant radiation therapy.

The major issue of concern with the use of submental flap in oral cancers is the potential risk of transfer of occult nodal disease to the recipient site. Proper flap harvest through the subplatysmal plane can minimize the risk of accidental transfer of disease from the neck to the surgical bed in the oral cavity [3]. Clearance of level 1a is possible without flap compromise [13]. All our cases were selected for submental flap harvest after clinical examination and pre-operative imaging showed no significant nodes at level Ia and Ib. We have adopted the practice of performing lymph node dissection before harvesting the flap, to be able to choose an alternative reconstructive method if level I nodes are highly suspicious. The enlarged but subcentimetric, benign-appearing nodes found and dissected carefully off the pedicle in every case have been pathologically negative for metastasis. However, in view of possible occult metastasis to these levels, it is essential that every patient is evaluated by pre-operative imaging, and even subcentimetric lymph nodes in the region be removed during flap harvest. None of the four recurrences in our series were at the recipient site.

Other studies correlate well with our findings and favour the oncologic safety of this flap [4,14]. The surgeon should be prepared to handle any oncological surprises, such as finding significant lymph nodes at level Ia, which could be proven to have metastatic deposits by frozen section. We strongly believe that the surgeon must not hesitate to abandon the flap when oncological safety is compromised. As said above, although the flap has been widely popularized for reconstruction, the flap should not be used haphazardly, especially with advanced nodal disease in the neck.

5. Conclusions

The submental artery island flap has shown promising results in head and neck reconstruction due to its versatile use, wide arc of rotation, colour match, and low donor site morbidity. Its use must not compromise the oncological safety of the procedure.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.adoms.2021.100082.

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