Original Research Article

Submental flap reconstruction for medium sized tongue defects: technique and surgical outcome-a retrospective study

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ABSTRACT

Background: Defects of the tongue has the major effect on speech and swallowing. Free flaps serve as an ideal choice for reconstruction but in developing countries, local flaps serve as an alternative in decreasing the morbidity and improving functional outcome with easy reproducibility by majority of head and neck surgeons. Surgical outcomes associated with submental flaps (SMF) used in the reconstruction of medium-sized defects of the tongue was evaluated as well a novel modification of the technique to safeguard the feeding vessel was presented.
Methods: A total of 40 patients with tongue cancer who underwent SMF reconstruction from 2014 to 2017 with minimum 2 year follow up were retrospectively studied. The patient characteristics, tumor stage, nodal status, intraoperative findings, postoperative complications, locoregional recurrence, cosmetic satisfaction and functional outcomes were noted.
Results: Out of 40 patients, 27 had pT2, 7 had pT3 and 6 patients had pT4 disease while 6 patients had pN1 and 2 patients had pN2 disease. Total flap necrosis, marginal skin paddle necrosis and total skin paddle loss were observed in 0, 5 and 1 patient(s), respectively. Venous congestion of the flap was the most common complication seen while no orocutaneous fistula or marginal mandibular palsy were seen. Five patients had locoregional recurrence and two patients had distant metastases. Functional and cosmetic outcome was excellent in most of patients.
Conclusions: The SMF is a reliable and convenient technique that can serve as an alternative to free flaps in the reconstruction of medium-sized defects of the tongue.

Keywords: Submental flap, Tongue, Cancer, Facial vein, Functional outcome

INTRODUCTION

Most patients with tongue cancer successfully undergo oncologic resection followed by free or local flap reconstruction, depending on the tumor's size and location.[1,2] The surgeon's aim in treating these patients is not only complete excision of the tumor but also to achieve minimal morbidity with acceptable functional and cosmetic outcomes by reconstruction. In the era of free flaps, many reliable, locoregional pedicled flaps are being less commonly used.[2,3] Depending on the size and location of mucosal defects various techniques such as primary suturing, secondary epithelialization, loco-regional flaps (pectoralis major muscle island flaps, SMF, infrahyoid, nasolabial flap) are widely used and free flaps (anterolateral thigh free flaps, radial forearm free flaps) are indicated at places where expertise of microvascular surgery is there.[1-3]

SMF has been introduced as a valuable technique for reconstruction of small to medium size defects of oral cavity especially tongue.[4,5] The hair bearing nature of this flap in men, makes it sometimes less appropriate for intraoral reconstructions.[4,6] SMF requires less technical expertise than free flaps and can be a valuable option of reconstruction for patients who cannot undergo

microvascular reconstruction due to factors such as cost, expertise and contraindications for prolonged anesthesia. Here, we presented our experience of reconstruction of tongue defects with SMF for medium size defects principally and conducted a retrospective review of reconstructions using SMF for tongue cancer resection defects performed during 3 year period at our institution and followed for 2 years. The objective of this study was to evaluate the functional and oncological outcomes of submental flap reconstruction for patients who underwent medium sized tongue resection.

Surgical anatomy

The SMF consists of skin, subcutaneous tissue, platysma and the mylohyoid muscle. It is located in the submental area with size varying on the redundancy of the submental skin facilitating primary closure. The entire pedicled flap is based on perforators from submental branch of facial artery. After emerging from below the digastric, facial artery takes a tortuous course around the submandibular gland giving numerous branches to the gland of which the first branch is quite sizable and proper careful ligation of 1st branch is required to release the genu of facial artery. In the superior part of the gland, it gives a submental branch which then courses between the mylohyoid and digastric. Thus, taking the ipsilateral anterior belly of digastric and mylohyoid muscle with the flap starting from contralateral side with the flap prevents pedicle injury. The venous drainage is through the submental vein and facial vein draining into internal jugular vein. However, sometimes facial artery distal to the origin of submental vessels is ligated to increase the flow to the flap or in other circumstances, common facial artery needs to be ligated to increase the reach of the flap, allowing reverse flow through submental vessels and distal facial artery especially for anterior ventral defects encroaching on floor of mouth.

METHODS

We retrospectively analyzed patients who underwent SMF reconstruction after excision of primary in oral tongue squamous cell carcinoma between January 2014 and November 2017 in the department of surgical oncology, Dr. RMLIMS, Lucknow. SMF was planned in medium size tongue defects. The defects were arbitrarily defined as small (3-5 cm), moderate (5-9 cm) and large (>9 cm), since no study had commented upon exact dimensions. Prior to flap harvesting, evaluation was done for presence of any nodal disease preoperatively by clinical and radiological examination and confirmed intraoperatively. Patients who underwent previous neck surgery on the ipsilateral side or in whom there were >N1 neck node disease or in whom palpable neck node in submental/submandibular region were excluded where the possibility of preserving the vessels is doubtful by maintaining oncological principles. All the flaps were harvested by a single head and neck surgeon using the same technique and under 2.5× magnification. Only

patients who underwent SMF reconstruction and had minimum follow up of 2 years with adequate data were included in the study. Due to retrospective nature of this study, it was granted an exemption in writing by institutional review board.

The technique of harvesting flap

After excision of the tumor, all the specimens were subjected to frozen section study and confirmed for adequacy of margins. The dimensions of the defect were measured. The corresponding dimensions of the flap was outlined in the submental region, extending superiorly around the inferior border of symphysis menti about 1 cm inferior to it and inferiorly till the level of hyoid and laterally merging with the neck dissection incision. A fair idea of the area of harvest can be outlined by index finger-thumb pinch test.[5] The average size of the flap was 6×4 cm. However, in our study, the maximum flap size harvested was about 9×5 cm. The technique of orthograde submental flap (Patel modification) was used.[7] The anterior belly of digastric and mylohyoid muscle were included on ipsilateral side. On the non-pedicle contralateral side, the flap was composed of platysma, subcutaneous fat tissue and skin. After resection of primary, neck incision was given and subplatysmal flaps were raised avoiding flap elevation in the submental area as marked for the flap. The neck dissection was completed in the usual way with utmost care not to injury the facial vein and facial artery. After the facial vein was preserved, attention was given to the submandibular area to dissect out the submandibular gland preserving the facial artery after ligating the sizable 1st branch and clipping or bipolarizing the other vessels supplying the submandibular gland. A point to note was that level IB nodes lied above the submental vessels and over it and inferiorly lied the submandibular gland, careful dissection in this area preserved the submental vessels supplying the flap. Once this was done flap elevation was started by incising the marked area up to the subplatysmal level. Attention was then diverted to the contralateral site, incising until opposite digastric was reached, the skin and platysma were elevated just short of midline starting from the contralateral side identifying mylohyoid muscle by its transverse fibers at the base. Once this was identified, ipsilateral anterior belly of digastric was taken with the flap and mylohyoid was divided superiorly along the mandible and inferiorly with the hyoid. Then the transverse fibers of mylohyoid were cut from the contralateral side and elevated preserving bilateral geniohyoid which can be identified by longitudinal fibers. The flap was elevated dividing other attachments. Mobility can be gained by dividing the attached mylohyoid muscle to the mandible which helped in creating the passage for delivery of flap into the oral cavity. The flap vascularity can be assessed by subdermal bleed. The neck flaps were mobilized to attain primary closure of the harvested site. Care should be taken not to mobilize the skin over the chin to prevent dropping of the lower lip. Sometimes, the facial artery was ligated distal

to the submental vessels to increase the flow to the flap. Alternatively, a reverse flow SMF can be elevated by ligating the facial artery proximal to the submental artery accomplishing the flow by the distal facial artery in a reverse fashion. The flap was inserted using a rail road technique taking interrupted absorbable sutures. The technique mastered by author was available online.[8]

Data analysis

Data was collected retrospectively from case records. Data regarding demographics, clinical and pathological staging, intraoperative findings, postoperative complications like flap necrosis, orocutaneous fistula were collected including details of functional and surgical outcome in the follow up period. Patients were followed up at 1 month, 3 month, 1st year and at 2nd year as per hospital protocol. Clinical examination and appropriate radiological examinations were performed to detect local and distant recurrence in the follow up period. Functional outcome with regards to chewing, swallowing and speech was calculated using FIGS score (functional intraoral Glasgow scale) at 3 months and 1 year.[9] Cosmetic satisfaction was evaluated using visual analog scale (VAS) with score 0: very good, 1-3: good, 4-6: average, 7-9: poor, 10 being intolerable. Continuous data were recorded in mean (SD) or median (IQR) depending upon normality of data. Categorical data were presented in frequencies, percentage or proportion. Appropriate charts and graphs were used for data representation. Results were analysed using SPSS (version 20) software which is available in the college.

RESULTS

A total of 49 patients underwent SMF reconstruction for tongue cancer between 2014 to 2017 for medium and large size tongue defect. Five patients lost to follow up and 4 patients had missing data. Hence 40 patients were finally included in the study whose demographic and pathological data are represented in Table 1. Out of these, 15 were male and 25 were female. Mean age of the patient was 50±5 years. The stage distribution was T2 in 27 patients, T3 in 7 patients, T4 in 6 patients. cT1 lesions were not included and were closed primarily. SMF reconstruction was done for T2, T3 and T4 lesions only. In final pathology report, 31 patients had pN0 disease, 6 had pN1 disease and 3 patients had pN2 disease. 22 patients underwent partial glossectomy, 10 patients underwent hemi-glossectomy and 8 patients subtotal glossectomy. The median operative time was 2 hours with 45 ml blood loss. Clips and bipolar was liberally used in all cases for ligation of branches to submandibular gland. Facial artery was preserved in all cases except 1 where retrograde flap was used. Common facial vein was preserved in 35 cases. The flap was inserted using the parachute technique due to limited space. 6 patients underwent paramedian mandibulotomy for exposure followed by miniplate fixation (out of these 2 patients had T3 lesion and 4 patients has T4 lesion).
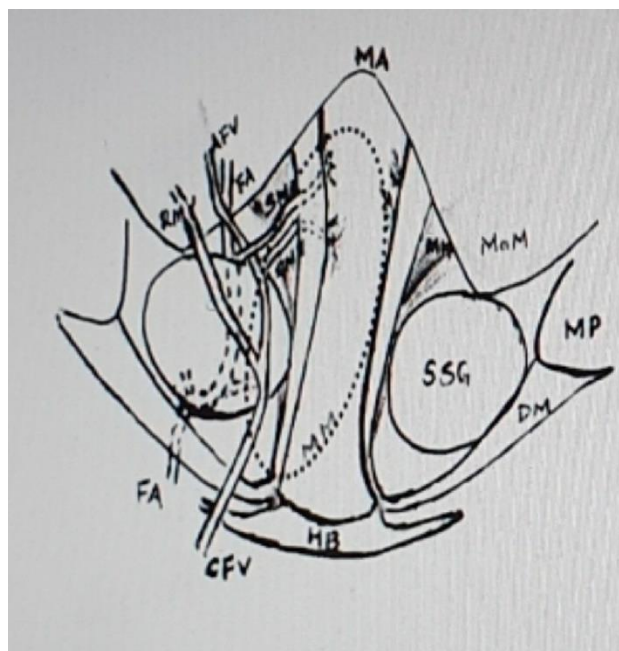

Figure 1: Diagrammatic representation of submental anatomy (FA facial artery, CFV common facial vein, HB hyoid bone, MA mandible, SMA submental artery, DM digastric muscle, MP mastoid process, RMV retromandibular vein, AFV anterior facial vein, SMV submental vein).

Figure 2: Incision marking for submental flap and neck dissection.

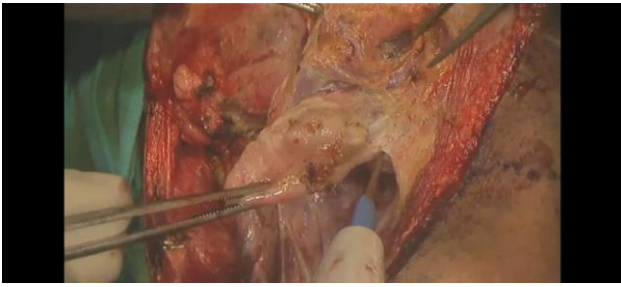**Figure 3: Pinch test for flap harvest.**

Figure 4: Level 1 neck dissection preserving facial artery and vein.
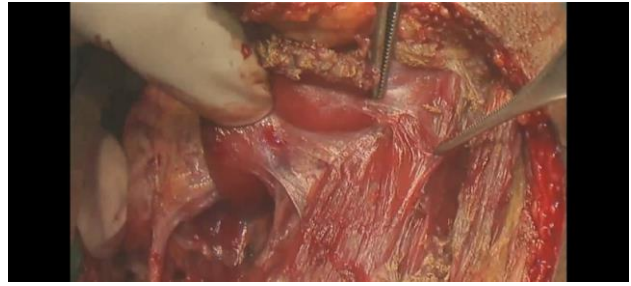

Figure 6: Lifting of mylohyoid muscle with the flap preserving geniohyoid and contralateral digastric muscle.
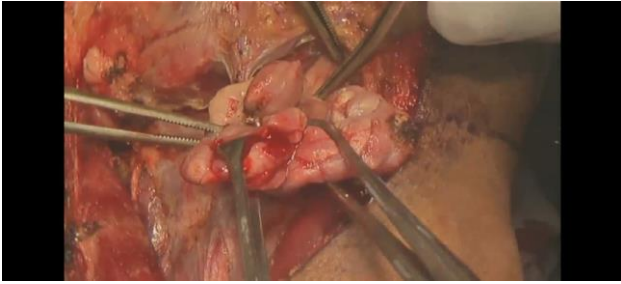

Figure 5: Submandibular gland excision after ligating first branch to the gland.

Figure 7: Submental flap after detaching myelohyoid supported only by the pedicle.

Table 1: Demographic and pathological characteristics.

Variables		Frequency, (%)
Sex	Male	15 (37.5)
	Female	25 (62.5)
Age (in years)		50±5 (24-78)
Histology	Moderately differentiated	29 (72.5)
	Well differentiated	6 (15)
	Poorly differentiated	5 (12.5)
Pathological T stage	pT2	27 (67.5)
	pT3	7 (17.5)
	pT4	6 (15)
Pathological N stage	pN0	31 (77.5)
	pN1	6 (15)
	pN2	3 (7.5)
LVI	Positive	4 (10)
	Negative	36 (90)
PNI	Positive	11 (27.5)
	Negative	29 (72.5)

Table 2: Surgical, functional and oncological outcome.

Outcomes		Frequency, (%)
Venous congestion		5 (12.5)
Marginal skin paddle necrosis		5 (12.5)
Total skin paddle loss		1 (2.5)
Total flap necrosis		0
Orocutaneous fistula		0
Marginal mandibular nerve palsy		0
FIGS score (mean)	At 3 months	9.6
	At 1 year	11.4

Continued.

Outcomes		Frequency, (%)
Neck cosmesis	Good	31 (77.5)
	Average	7 (17.5)
	Very good	2 (5)
Locoregional metastasis	Local	2 (5)
	Neck	3 (7.5)
Distant metastasis		2 (5)

Lateral suturing was done to the medial mandibular mucosa in 25 cases and to the gingiva in 15 cases after removing the teeth. Tracheostomy was done in 6 patients where the lesion was large and defect reached close to post 1/3 and crossed midline. Lymph node dissection was done till level IV in all T2 lesions and extending to level V in remaining patients. Care was taken such that the width of the flap does not exceed 5 cm in order to prevent difficulty in the primary closure of donor area. In our series, the donor site was closed primarily with adjacent skin mobilization. The postoperative complications, functional and oncological outcome are given in Table 2. During the postoperative period, no complete flap necrosis was noted. However, marginal skin paddle necrosis was observed in 6 patients which was managed conservatively. One patient had total skin paddle loss. Venous congestion of the flap was the most commonly observed complication which resolved by the 5th to 7th operative day in most cases. The facial vein was identified and preserved in 35 cases, rest of the 5 patients had venous congestion in postoperative period in which vein was not identified or sacrificed. Other risk factors for venous congestion apart from non-preservation of facial vein were large flap for a small defect, small contour of mandible due to which there was limited space to pass the flap. No orocutaneous fistula developed in any patient even in those who developed marginal flap necrosis as mylohyoid muscle plugs the communication between the oral cavity and neck. No flap complication occurred in 34 cases where the mylohyoid was taken liberally with the flap and facial vein was preserved. Marginal mandibular nerve palsy was not seen in any patient. Median hospital stay was 5±2 days. Ryle's tube feed was continued for 7 to 10 days. Patient received adjuvant radiation therapy in the form of RT in 18 cases without any major consequences on the flap (flap retraction). On follow up, there was locoregional recurrence in 5 patients (neck-3 patients; tongue-2 patients) and distant metastasis to the lung and bone were seen in 2 patients. None of the patients required corrective surgery. In our series, all the patients were on regular follow up with 3 patients succumbed to disease recurrence. The mean FIGS score at 3 month follow up was 9.6 which increased to 11.4 at 1 year. The neck cosmesis was good in majority (31 patients), with no restriction of neck movement. The overall satisfaction in terms of function and cosmesis were good in immediate and long term follow up.

DISCUSSION

Microvascular free flaps and myocutaneous flaps are most commonly used globally for reconstruction of oral tongue defects. Ideally, the flap for reconstruction of defect should be easy to harvest and preferably be done as a single-stage procedure. SMF can be used as an alternative to bulky pectoralis major flap and free flaps for reconstruction for moderate size tongue defects. The SMF introduced by Martin in 1993 can be used either as a pedicled or free flap.[5] It was a good alternative for reconstruction of midsize defects in the oral cavity and lower third of the face.[4,6] It can also be used to reconstruct defects in parotid region and upper face as reverse flow retrograde flap. This flap had several advantages like ease of flap elevation, inconspicuous donor site scar, simplicity, wide arc of rotation, axial blood supply, proximity to the oral cavity, short learning curve, better tolerance in elderly patients, aesthetically sound and economically more feasible.[4,10-12] Hair bearing nature of this flap in some races with heavy beards makes it unpleasant for intraoral reconstructions due to entrapment of the food and debris in hairs producing bad odor and sense. These can be removed by different methods like laser ablation, mechanical depilation and electrolysis.[13-15] Also, postoperative radiotherapy in malignant oral cavity lesions has inhibitory effect on hair growth of this flap. The other disadvantages are limited skin paddle size, difficulty in reconstructing defects of upper half of face. The approximate expenditure is about half as compared to free flap at our institute. The skin paddle necrosis of SMF ranges from 3% to 10% but the necrosis of muscles is rare.[4,16,17] The probable cause of skin necrosis is the damage of perforators supplying the skin paddle and inadequate venous was drainage.[18] Preoperative radiotherapy was not an absolute contraindication to SMF. In such cases, one should be vigilant about lack of pliability over the skin and radiation-induced fibrosis. If these features were present, then the flap was contraindicated. Few studies did not recommend SMF in case of nodal disease in neck.[19] We avoided SMF in the presence of extensive nodal disease, large submental or submandibular nodes, ENE (extranodal extension) with the involvement of mylohyoid, digastric muscles and in circumstances where the internal jugular vein was sacrificed.

Even though most studies in literature recommended only N0 patients to be planned for SMF ,in our series, we had performed flap harvesting after lymph node dissection till

level 1B without compromising the blood supply of flap.[19] Elzahaby et al studied SMF with ipsilateral selective neck block dissection of levels I, II, III and IV and the nodal yield of each level was tested pathologically, resulted nodal harvest was ≥12 in 88% of the patients.[20] Complications were encountered in two patients (5.5%). There data suggested that adequate cervical lymph nodes dissection, specifically level I and II cervical lymph nodes can be fulfilled with concomitant submental island flap elevation.

Oncological outcome of the submental flap remain a controversial field of discussion as the flap was in close proximity to draining lymph nodal basin and incomplete clearance will lead to transplantation of malignant cells along the flap. Few studies had raised concerns regarding the oncological outcome of this flap while many studies have shown no increase in local recurrence rate between submental flap and free flap.[13-15,19,21] In our study two out forty patients developed local recurrence in the native tongue (5%), none of them were from flap base. Functional outcomes in terms of swallowing and speech were excellent in our patients. Patients who underwent radiation were able to take liquid and semisolid diet without any additional difficulty. In our study, we found out that, even though SMF was one of the options for tongue reconstruction but comorbidities like diabetes and large flap size may lead to flap related complications. Our experience over 5 years has made this flap as a viable reconstructive option following tongue cancer surgery. This flap can be done by surgeon who was well versed in neck dissection because of anatomical familiarity. According to us, SMF can be a viable option for medium sized defects which usually requires free flap for reconstruction. Patients with uncontrolled diabetes should be optimized as much as possible for better outcomes of the flap. In our study, author became comfortable with flap harvesting and in-setting after doing three cases. This was a retrospective study and as a result it had its own inherent defects. Many precautions were taken while collecting data, but the actual frequency of events might be under represented due to limitation in documentation.

CONCLUSION

The SMF is a reliable and convenient flap, which can be used safely to reconstruct the medium-sized to large size defects of tongue even in patients undergoing lymph node dissection extending till level IV and V. The probable indications for SMF include lack of expertise for the free flap, high-risk elderly patients and financial constraints in low-income countries. Even though free flap reconstruction in head and neck is considered as ideal one, SMF is an important locoregional flap in the armamentarium of head and neck surgeons for small to medium-sized defects of oral tongue in elderly patients with co-morbidities.

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