

Submental artery island flap for reconstruction of lateral oropharyngeal carcinoma in patients with severe anesthesiological risk factors: Functional and oncologic outcomes

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Abstract. The submental arterial island flap (SMIF) is used mostly for closing defects in the oral cavity, but also has its uses for oropharyngeal reconstruction. Since the duration of surgery is shorter compared with that for free flaps, it appears to be a good option for patients with severe anesthesiological risk factors. Therefore, the present study evaluated the functional and oncological outcomes of reconstructing defects after oropharyngeal carcinoma resection with a SMIF in these patients. A total of 10 patients underwent resection of lateral oropharyngeal carcinoma and ipsilateral neck dissection with closure of the defects using a SMIF. Oncological evaluation consisted of endoscopic and radiological standard-of-care restaging, while functional evaluation included a phoniatric swallowing examination with penetration-aspiration scale-score 6 months after surgery. All patients had T2 or T3 carcinoma, while 7 out of 10 patients had nodal involvement. Additionally, 7 out of 10 patients exhibited p16 expression. Pathological clear margins could be achieved in all patients. In all patients, no local, regional or distant recurrence occurred (median follow-up time, 26 months; range, 12-33 months). All patients had complete oral intake with their feeding tubes removed, with 1 patient restricted to dysphagia diet. Despite the severe comorbidities, there were no surgery-related or anesthesia-related complications. One patient who refused the recommended postoperative radiation developed enoral hair growth requiring regular trimming to avoid dysphagia. The SMIF is a reliable flap for

reconstruction of lateral oropharyngeal defects with good oncological and functional outcomes. The reduced anesthesia duration appeared to be beneficial for patients with severe cardiac or pulmonary comorbidities. Male patients should be selected to undergo postoperative radiation to prevent enoral hair growth.

Introduction

Being introduced by Martin *et al* (1) in 1993, the submental artery island flap (SMIF) has seen a lot of experimentation ever since. While it is possible to use the SMIF as a free flap, it is usually harvested as a pedicled regional flap (2). Due to the proximity of the donor site, reconstruction of oral cavity defects is the most frequently used application for the pedicled variant (3,4). However, the pedicle length allows for reconstructing defects from the hypopharynx up to the upper areas of the face as well as the cervical skin (2,3,5-7).

Although the lateral oropharynx and especially the tonsillar region is well within reach of the pedicled submental flap, reconstruction of oropharyngeal defects still remains dominated by free radial forearm flaps, mainly because of them being thinner and offering more flexibility (8,9). Yet, free flaps require a microvascular anastomosis, resulting in an extended duration of time in general anesthesia. A high percentage of head and neck cancer patients are frail or have severe cardiac or pulmonary comorbidities, sometimes limiting the therapeutic options due to increased risk of therapy-associated complications (10,11). Several studies could extensively demonstrate the relationship between comorbidities and complications during and after extended surgical procedures (12-14). Those patients with comorbidities would presumably profit from a reduced duration of surgery and thereby reduced time in general anesthesia. Several studies, including 2 systematic reviews, could already demonstrate a shorter duration of surgery for oral cavity or lateral skull base defects reconstructed with SMIF compared to free flaps (15-21). The same studies could also show no difference between free flaps and SMIF regarding flap loss, partial flap necrosis, donor site dehiscence, wound healing disorder or rate of recurrence (15-21). While the free radial forearm flap still is the working horse for most of head and

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neck reconstruction, several studies indicate that reconstruction with a SMIF is an almost equivalent alternative in many areas of reconstruction (15,17,22). Moreover, reconstructions using a SMIF were shown to also decrease health care costs compared to free flaps, at least for oral cancer (19). For oropharyngeal reconstruction using a SMIF, however, data is very limited and rarely centered around functionality like swallowing.

Hence, the aim of the present study was to evaluate the oncologic safety and functional outcome regarding swallowing for patients with lateral oropharyngeal carcinoma who were not deemed good candidates for free flap transfer due to severe anesthesiological comorbidities and were therefore reconstructed with a SMIF.

Materials and methods

Data collection and study population. Approval of the Würzburg University's Hospital Institutional Review Board and local ethics committee was obtained before data acquisition (20240705-02).

Observational period ranged from November 2022 until July 2025. Inclusion criteria were confirmed squamous cell carcinoma of the lateral oropharynx that were deemed resectable transorally with the need for reconstruction and no radiological sign of distant metastasis. Reasons for reconstruction included expected large soft palate defects or exposed vessels after resection. Patients included needed to have severe anesthesiological comorbidities with an ASA-Score (American Society of Anesthesiologists) of at least 3, defined as a patient with severe systemic disease (23) and therefore high anesthesiological risk profile, as well as an ECOG-Score of 2 or more, and therefore being classified as bad candidates for free flap reconstruction.

All patients included received a transoral resection of the tumor, a reconstruction with a pedicled SMIF and an ipsilateral Neck dissection of the levels II, III, IV and Va according to Robbins. Due to the need for removal of the submandibular gland in elevating the flap, the surrounding lymph nodes of the level Ib were also removed if not too close to the vascular pedicle. The facial vessels were preserved proximally as well as distally of the submental vessels to keep the possibility of a reverse flow in case of vascular complications of the proximal facial vessels. In one patient, the proximal facial vein had to be ligated due to an aberrant course medially into the anterior jugular vein that offered no acceptable arc of rotation, and thus only had a reverse flow venous drainage.

No routine placement of a PEG-probe was conducted before surgery. A nasogastric feeding tube remained for 7-10 days to allow wound healing and to reduce the risk for fistula-formation.

Re-Staging was conducted according to national guidelines 6 month after surgery with contrast enhanced computed tomography of the neck, thorax and abdomen as well as a panendoscopy to exclude recurrence. Also, a phoniatic swallowing assessment according to the PAS (penetration-aspiration scale) standardized by Rosenbek *et al* (24) was done to evaluate swallowing function 7-14 days after surgery, 6 months after surgery and, in case of no complete oral intake after 6 months, again 12 months after surgery.

Results

Demographics and tumor stages. 10 patients met the inclusion criteria with an ASA-Score of at least 3 due to severe comorbidities. The patients' performance scores and their leading medical conditions are listed in Table I. The mean age of the patients was 75.5 with a median of 76.5 (range 61-86), and a female/male ratio of 7:3. The majority of the tumors were HPV-associated (70%), classified via p16 immunohistochemistry. Pathologic TNM classification revealed 70% pT2 and 30% pT3 tumors. 30% showed no sign of nodal disease, 60% were classified as pN1 and one patient as pN2a. Extranodal extension (ENE) was present in only 20% of the patients. Only one patient had secondary pathological risk factors with a lymphangiosis and hemangiosis. All tumors were resected with clear pathological margins of at least 5 mm (Table II).

Surgical complications and time in anesthesia. One patient had a postoperative bleeding which required surgery and also a temporary tracheostomy due to compromised airway, which could be closed after 14 days. Another patient had a small partial flap necrosis but did not require intervention. A dehiscence at the donor site developed in one patient, which could be resolved without additional surgery. There was no flap loss and no fistula formation in the cohort. The mean duration of anesthesia was 235 min with a median of 250 min (range 185-291 min). There were no cardiovascular, pulmonary or infectious general complications like pulmonary embolism, pneumonia or myocardial infarction for the whole duration of treatment and the follow-up.

Fig. 1 shows 3 examples of reconstruction using a SMIF in this cohort 3 months postoperatively (Fig. 1).

Adjuvant therapy. Postoperatively, all patients were presented in the interdisciplinary tumor conference. The two patients with ENE received adjuvant chemoradiation and 5 patients were recommended for an adjuvant radiotherapy. Two patients did not need adjuvant therapy due to their tumor stage, while one patient with pT3 pN0 refused the recommended adjuvant radiation.

Oncologic outcome. Oncologic results were evaluated during regular staging with computed tomography of neck, thorax and abdomen every 6 months in the first 2 years after surgery. The follow-up was at least 12 months in all patients, with a median of 26 months (range 12-33 months). No patient developed local, regional or distant recurrence in the follow-up time frame.

Swallowing function. The first phoniatic assessment of swallowing function was conducted at the time the nasogastric tube was removed 7-14 days after surgery. In this first assessment 8/10 patients had a PAS-Score of 2 or less with minor impairment of oropharyngeal transport, and could immediately start with oral intake. Those 8/10 patients had complete oral intake during their respective adjuvant treatment and did not need a PEG-probe. 6 months after surgery, those 8 patients had a PAS-score of 0 or 1 with no impairment of oropharyngeal transport and continued complete oral intake. Two patients having a PAS-Score of 2 and 4 however experienced a severe impairment of oropharyngeal transport, which led

Table I. Medical comorbidities and performance status of the patients.

Sex	Age, years	ECOG score	Medical comorbidity
Female	74	3	Heart failure NYHA 3, COPD
Female	61	2	COPD, renal failure
Male	68	2	COPD recurrent myocardial infarctions
Female	77	2	Heart failure NYHA 2
Male	80	2	Heart failure NYHA 2, renal failure
Male	86	2	Heart failure NYHA 2, recurrent myocardial infarctions
Female	77	2	Coronary heart disease
Female	72	3	Recurrent myocardial infarctions, COPD, heart failure NYHA 2, renal failure
Female	76	3	Heart failure NYHA 3, coronary heart disease
Female	84	2	COPD, recurrent myocardial infarctions

COPD, chronic obstructive pulmonary disease; ECOG, Eastern Cooperative Oncology Group; NYHA, New York Heart Association Functional Classification.

Table II. Patient characteristics and tumor stages.

Sex	Age, years	HPV	pT	pN	Number of lymph nodes	ENE	L	V	Pn	Margin
Female	74	+	2	1	1/24	-	-	-	-	Clear
Female	61	+	2	1	1/15	-	-	-	-	Clear
Male	68	+	2	1	2/23	+	-	-	-	Clear
Female	77	+	2	1	1/25	+	-	-	-	Clear
Male	80	+	3	0	0/20	-	-	-	-	Clear
Male	86	-	3	0	0/17	-	-	-	-	Clear
Female	77	-	2	0	0/31	-	-	-	-	Clear
Female	72	+	2	1	1/43	-	-	-	-	Clear
Female	76	-	2	2a	1/19	-	+	+	-	Clear
Female	84	+	3	1	2/29	-	-	-	-	Clear

ENE, extranodal extension; HPV, human papillomavirus; L, lymphangiosis; V, hemangiosis; Pn, perineural invasion.



Figure 1. Postoperative results. Reconstructive results at 3 months after surgery in 3 patients from the cohort following resection of a left-sided lateral oropharyngeal carcinoma.

to the insertion of a PEG-probe. 6 months after surgery, the PAS-Score of those two patients had increased to 1 and the

oropharyngeal transport had improved, resulting in at least a partial oral intake. 12 months after surgery, both patients



Figure 2. Unwanted hair growth. Hair growth on the transplant of a male patient who rejected the recommended adjuvant radiation.

had complete oral intake with the PEG removed, a restored oropharyngeal motility and a PAS-Score of 1.

One patient who rejected adjuvant radiotherapy developed enoral hair growth on the transplant (Fig. 2) with intermittent dysphagia, and thus needs regular trimming of the hair to prevent recurring dysphagia episodes.

Discussion

This study investigated the use of submental artery island flaps for reconstruction of defects after resection of lateral oropharyngeal carcinoma in patients with severe anesthesiological risk factors. Results were evaluated regarding oncologic outcomes and swallowing function.

Surgical resection of many oropharyngeal carcinoma results in defects that require reconstruction, often because of exposed neck vessels or insufficient soft palate tissue. Several surgical techniques have been developed to reconstruct these defects, with free flaps like the radial forearm flap and the anterolateral thigh flap representing the mainstay because of being thin and pliable (25,26). However, the required microvascular anastomosis leads to a longer duration of surgery, which not every patient can tolerate due to low performance status or severe comorbidities, thus needing a different approach with a regional flap (16).

The SMIF represents an easily available alternative for radial forearm flaps, since its arc of rotation allows for good reconstruction of the lateral oropharynx (2,3). This was reflected in the present study as well, where all locations of the tumor resection could be comfortably reached. No flap loss was seen in this collective, confirming the reliability of the SMIF documented by other authors (2,5,27). The rate of complications (bleeding, partial flap necrosis, donor site healing disorder) was comparable to data in literature regarding both SMIF and RFFF (28), supporting the safety of the SMIF in usage for head and neck defects. This also aligns with previous studies showing no relevant differences in complications between SMIF and RFFF (15,17,22), therefore rendering the SMIF a viable option in head and neck reconstruction.

In the collective investigated, all tumors could be removed with clear margins of at least 5 mm. Accordingly, no local or regional recurrence was observed. There have been discussions about the oncologic safety of the SMIF in oral cancer reconstruction, because the pedicle contains

tissue and therefore possibly small lymph nodes of the Level Ib, the main way of lymphatic spread of cancers of the tongue or the floor of mouth (20,27,29). However, until now all available literature hints at no increased risk of local or regional recurrence (20,21,29). For lateral oropharyngeal tumors, even this risk does not apply because of the different levels of nodal spread in this entity, where Level Ib is rarely involved. Hence, the oncologic safety of the SMIF for oropharyngeal cancer seems to be comparable to free flap transfer.

A main focus of the present study was the need for shorter durations of surgery for frail patients with poor performance status or ones with severe comorbidities. With an average of 235 min in general anesthesia (e.g. from intubation until extubation), the duration of surgery was much shorter than compared to standard free flap transfer, even when taking two-team approaches into consideration. Most authors confirm the reduced surgical duration when using a SMIF compared to free flap transfer (15,16,19). A lot of studies could already demonstrate the strong relationship between perioperative complications and comorbidities as well as extensive surgery (14,30,31). Thus, it can be assumed that these patients at risk for perioperative complications due to comorbidities or poor performance status should clearly benefit from using a SMIF rather than free flap transfer in oropharyngeal cancer reconstruction.

Data regarding functional outcomes of reconstruction of oropharyngeal defects with a SMIF remains scarce. While several studies indicate comparable functional results when using a SMIF or a RFFF (16,22), most used dependency on a gastric tube as a surrogate parameter for swallowing function, if any. Phoniatriac swallowing examinations were rarely ever conducted. In the present study, 80% of the patients could achieve complete oral intake 10-14 days after surgery and maintained complete oral intake without the need for a gastric tube even during adjuvant radiation. Accordingly, in phoniatriac swallowing assessment they achieved a PAS-Score of 2 or better immediately after surgery as well as 1 or better 6 months after surgery. The 2 patients with a PAS Score of 2 and 4 respectively 10-14 days after surgery required a gastric tube which stayed in place during radiation. Main problems were the decreased elevation of the base of tongue and the impaired oropharyngeal transport due to the initially voluminous flap. 6 months after surgery these impairments were greatly reduced with a PAS Score of 1 or better and at least partial oral intake, which completely normalized 12 months after surgery. These functional assessments show that a consistently good swallowing function can be achieved when using a SMIF for lateral oropharyngeal reconstruction.

One factor to note, however, should be the hair growth on the flap in male patients. Most flaps, free or pedicled have some kind of hair growth in man. Due to being in the region of facial beard growth, the donor site of the SMIF has a very thick and dense hair growth. The patient refusing the recommended adjuvant treatment developed dense hair growth enorally with the hair extending into the laryngeal space, causing dysphagia and coughing. This required regular trimming of this enoral hair growth, which is inconvenient for the patient, but at least completely removed the resulting swallowing disorder.

Therefore, if using a SMIF, male patients should be restricted to those who, according to the tumor stage, will require postoperative radiation, thereby removing the hair growth in nearly all cases.

The limitations of the present study are its retrospective design with a limited sample size. Also, no control group with similar patients receiving a free flap was included, so the conclusion of non-inferiority is solely based on literature. Hence we can primarily state that the SMIF is a good option for these patients without definitively proving an inferiority/non-inferiority compared to free flaps. Therefore, future comparative prospective studies are required to explore this further. Although a selection bias cannot be excluded, all patients at our institution with these ASA- and ECOG-Scores are primarily treated with pedicled flaps, if the defect can be reached safely with them, reducing this bias as far as possible. The rate of p16-positive tumors (70%) was also higher than in most other collectives, which could be attributed to the high number of non-smoking females in this collective. Additionally, the follow-up of at least 12 months cannot project the oncologic outcome in the following years, though it has to be noted that the vast majority of recurrence occurs in the first 12 months after initial therapy.

We conclude that the SMIF is a viable alternative to the RFFF in reconstructing defects of the lateral oropharynx after tumor surgery, both oncologically and functionally. Additionally, this flap decreases the duration of surgery, making it ideal for patients with high risks of perioperative complications. This could be demonstrated by noting no serious perioperative complications in this collective despite all patients having an ASA-Score of at least 3 and ECOG-Scores of 2 or more. Further studies, preferably in a prospective and randomized design, are recommended to investigate the suitability of the SMIF in high-risk patients.

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Availability of data and materials

The data generated in the present study are included in the figures and/or tables of this article.

Authors' contributions

SS and CM conceptualized and designed the study, collected data, drafted the initial manuscript, and reviewed and revised the manuscript. FK, MG, SH and AS collected data, and reviewed and revised the manuscript for important intellectual content. TG conceptualized and designed the study, coordinated and supervised data collection, critically reviewed the manuscript for important intellectual content and gave final approval of the version to be published. SS and TG confirm the authenticity of all the raw data. All authors have read and approved the final version of the manuscript.

Ethics approval and consent to participate

Approval from the Würzburg University's Hospital Institutional Review Board and local ethics committee (approval no. 20240705-02; Würzburg, Germany) was obtained before data acquisition. Written informed consent for participation was obtained from the patients.

Patient consent for publication

Although patient consent was not mandatory for this publication according to the Bavarian university hospitals data management law for pseudonymized retrospective studies, informed consent for data acquisition and publication was nonetheless obtained verbally and in written form.

Competing interests

The authors declare that they have no competing interests.

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