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What is This?
Oncologic Safety of the Submental Flap for Reconstruction in Oral Cavity Malignancies

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

Abstract

Objectives. To evaluate the oncologic safety of the submental flap regarding potential transposition of involved nodes to the reconstruction site and recognize the submental flap as an excellent option for oral cavity reconstruction.

Study Design. Case series with chart review.

Setting. Tertiary academic referral center.

Subjects and Methods. All patients undergoing reconstruction with submental flaps following the resection of primary and recurrent malignancies of the oral cavity between 2002 and 2012 were reviewed. Analysis included tumor location, staging, reconstructive details, postoperative course, and outcomes.

Results. Fifty patients were identified having undergone submental flap reconstruction of defects following resection for oral cavity malignancies. No patient had identifiable clinical or radiographic level I nodal involvement preoperatively. Patients’ ages ranged from 35 to 88 years (mean, 70 years). American Joint Committee on Cancer staging of patients included stage II (n = 16, 32%), stage III (n = 10, 20%), and stage IVa disease (n = 28, 48%). All patients underwent a level 1A and 1B dissection with removal of the nodal basin and submandibular gland. The prevalence of occult lymph node metastasis involving level I was 10%. On follow-up, there were no local recurrences associated with submental flap transposition to the oral cavity. One patient with multifocal oral disease had a tongue recurrence geographically separate from the submental flap reconstruction. There was 100% flap survival.

Conclusions. The submental flap provides a rapid and reliable option for oral cavity defect reconstruction. With appropriate management of the level I nodal compartment, oncologic outcomes are not compromised.

Keywords
oral cavity neoplasm, oral cavity carcinoma, squamous cell carcinoma, oropharyngeal neoplasm, oral cavity reconstruction

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The submental flap was originally introduced by Martin et al1,2 in 1990 and, since that time, has gained popularity for use in reconstruction of head and neck defects. The flap has many favorable characteristics, lending itself to head and neck reconstruction, including location within the surgical field, reduced operative time, low donor site morbidity, optimal skin color and texture match, and ability to be used as a pedicled, free, or hybrid flap.3 Given its optimal location, ease of harvest, and favorable arc of rotation, the submental flap has been increasingly used for reconstruction of oral cavity cancer defects.4,5 However, controversy exists regarding the oncologic safety of the submental flap in oral cavity cancer reconstruction. This is due to its proximity to the at-risk nodal basins of levels 1A and 1B and the potential transfer of occult metastatic disease to the recipient bed during reconstruction.6-8 The oncologic safety of the submental flap for reconstruction in oral cavity patients has not been well established. We present our 10-year experience with use of the submental flap for reconstruction of oral cavity cancer defects and its oncologic safety.

Methods

Institutional review board approval was obtained from the Mayo Clinic Institutional Review Board, and a retrospective chart review was performed of patients undergoing submental flap reconstruction for oral cavity malignancies. All patients undergoing submental flap reconstruction for oral cavity cancer defects were reviewed. Analysis included tumor location, staging, reconstructive details, postoperative course, and outcomes. The prevalence of occult lymph node metastasis involving level I was 10%. On follow-up, there were no local recurrences associated with submental flap transposition to the oral cavity. One patient with multifocal oral disease had a tongue recurrence geographically separate from the submental flap reconstruction. There was 100% flap survival.

Conclusions. The submental flap provides a rapid and reliable option for oral cavity defect reconstruction. With appropriate management of the level I nodal compartment, oncologic outcomes are not compromised.
flap reconstruction for oral cavity defects. All patients underwent treatment at a single academic tertiary referral center between July 2002 and 2012. For inclusion, the patients’ oral cavity defect had to be secondary to an oral cavity malignancy. Preoperatively, all patients were without evidence of clinical and/or radiographic metastatic disease in levels 1A and 1B. Patients undergoing submental flap reconstruction for traumatic defects, defects secondary to benign disease, and defects at other head and neck sites were excluded. Patients included within this study represent a consecutive sample, and no patients were excluded for missing or limited data. Records were reviewed for demographics, malignancy, flap size, and clinical and oncologic outcomes.

Surgical Technique

The submental flap is raised as per our technique previously described by Patel et al9 and Hayden et al.5 The submental flap can be raised as a cutaneous, musculocutaneous, or osseocutaneous flap as dictated by the needs of the recipient site. During flap elevation, the ipsilateral submandibular gland can be removed after the submental venous and arterial vascular pedicle is identified and separated from the superiomedial aspect of the gland. To address the level 1A and 1B lymph node basin, the submental vascular pedicle is carefully skeletonized along the lateral aspect of the mylohyoid muscle, preserving cutaneous and osseous branches. Meticulous removal of all lymphoid tissue and fat from the nodal basin is then preformed. The ipsilateral level 1A and 1B lymphoid packet is sent to pathology separately from the rest of the neck dissection for microscopic examination. On the contralateral side, the dissection plane is maintained supraplatysmal to avoid transfer of any potentially involved contralateral lymph nodes with the submental flap. This technique also protects the contralateral marginal mandibular nerve from any risk of injury. Regarding the neck dissection technique, a thorough neck dissection of indicated levels is undertaken using techniques similar to a neck dissection during microvascular reconstruction.

Results

Review of records identified 50 patients undergoing resection of oral cavity malignant disease with submental flap reconstruction between 2002 and 2012. Patients’ age ranged from 35 to 88 years (mean, 70 years; median, 74 years). There were 31 men and 19 women in the study population.

Oral cavity malignant neoplasms undergoing resection included squamous cell carcinoma (n = 47), basal cell carcinoma (n = 1), adenoid cystic carcinoma (n = 1), and malignant solitary fibrous tumor (n = 1). The neoplasms included new primaries (n = 30; 60%), recurrent disease (n = 14; 28%), and second primaries (n = 6; 12%). Oral cavity subsites involved were buccal (n = 12), mobile tongue (n = 11), retromolar trigone (n = 8), hard palate (n = 5), floor of mouth (n = 4), inferior alveolar ridge (n = 3), superior alveolar ridge (n = 3), lip (n = 3), and mandible (n = 1). American Joint Committee on Cancer (AJCC) staging of patients included stage II (n = 16; 32%), stage III (n = 10; 20%), and stage IVa disease (n = 28; 48%). Tumor characteristics are detailed in Table 1. During primary tumor resection, composite defects of the oral cavity were created in 30 patients, including marginal mandibulectomy (n = 15), partial maxillectomy (n = 6), segmental mandibulectomy (n = 5), subtotal maxillectomy (n = 3), and coronoidectomy (n = 1). At the time of resection, all patients had a unilateral neck dissection, and 8 underwent bilateral neck dissections.

Submental flap reconstruction of defects included 44 pedicled musculocutaneous flaps (Figure 1), 3 pedicled osseomusculocutaneous flaps (Figure 2), and 2 hybrid submental osseomusculocutaneous flaps with a pedicled artery and free vein anastomosis (Figure 3). The flap skin paddle ranged in size from 3 × 3 cm (9 cm²) to 11 × 11 cm (121 cm²). Primary closure was achieved on all flap donor sites. An orocutaneous fistula developed in 3 patients with a history of prior radiation, 2 of which resolved with conservative management. One fistula required operative debridement and repeat primary closure for complete resolution. One patient developed a hematoma at their neck dissection site requiring surgical intervention. There was 100% flap survival.

Preoperatively, there was no clinical or radiographic evidence of metastatic disease involving the level 1 nodal basin in any patient. Occult metastases were identified in level 1 on pathologic review in 5 patients (10%). Of the 5 patients with occult metastases within level 1, 1 patient developed a regional recurrence and 2 patients developed distant metastases. The other 2 patients are alive without evidence of recurrence. Of note, the patients who developed regional and distant metastases had advanced nodal disease and were all staged as N2b. One patient had evidence of extracapsular extension of nodal metastases within the level 1 dissection. That patient underwent adjuvant chemoradiation therapy and is currently disease free with no evidence of recurrence.

Postoperative adjuvant therapy was recommended in 25 patients (50%) secondary to multiple lymph node metastases, lymphovascular invasion, and/or perineural invasion. Of those, 7 refused adjuvant therapy. An additional 17 patients met criteria for adjuvant therapy but were not candidates due to prior radiation therapy or chemoradiotherapy. Eight patients had no indication for adjuvant therapy.

Follow-up ranged from 8 to 114 months (mean, 35 months; median, 24 months). There were no local recurrences associated with the submental flap. Recurrent disease and/or second primaries developed in 16 patients (32%). Second primaries were defined as neoplasms developing at a separate site or subsite from the original tumor. One patient with an extensive history of multifocal oral cavity cancer developed a local recurrence within the mobile tongue that was discrete from the submental flap. Regional recurrence alone developed in 6 patients (12%). One patient (2%) developed recurrent regional and distant disease. One patient (2%) developed regional recurrence associated with a second primary. Distant disease alone developed in 2 patients (4%). Second primaries alone developed in 4 (8%).
patients, of whom 3 had a history of multifocal disease. One patient (2%) with a second primary developed concurrent distant disease. Recurrence patterns related to primary, recurrent, and second primary tumors are detailed in Table 2.

Regional recurrences were the most common form of recurrence within our study population. Of the 8 regional recurrences, 3 occurred in patients being treated for recurrent disease with a history of chemoradiotherapy. Based on pathologic findings, all patients who developed regional recurrences had indications for adjuvant therapy following their surgical resection. However, only 3 received adjuvant therapy. Two patients declined therapy, and 3 were determined to not be candidates for adjuvant therapy due to prior chemoradiotherapy treatment. Only 1 patient with regional recurrence had a level 1 node that was positive for metastatic disease. Regional recurrences occurred most commonly in the ipsilateral level II (3/8), ipsilateral level III (3/8), contralateral level II (3/8), and less commonly in the ipsilateral level IV (1/8).

Discussion

The submental flap can provide an oncologically sound option for oral cavity reconstruction if level 1 nodes are removed. In 11 years of using the flap for reconstruction of oral cavity cancer defects, we have had no local recurrences related to transfer of metastatic disease with the flap. In this study, 1 patient with an extensive history of multifocal oral cavity disease had a local recurrence within the mobile tongue following submental flap reconstruction of the contralateral anterior tongue. This recurrence was discrete from the submental reconstruction and was limited to the surface mucosa.
Careful patient selection and surgical technique are paramount to maintain oncologic safety when using the submental flap in the setting of oral cavity cancer. The submental flap is contraindicated in any patient with clinical or radiographic evidence of level 1 metastatic disease. During flap harvest, it is imperative to complete a thorough level 1A and 1B lymph node dissection as occult disease can be present on final pathology (10% of cases in this study). This is achieved by meticulous skeletonization of the submental vascular pedicle with removal of all nodal and fatty tissue from this basin. To ensure adequate treatment of the regional lymph node basin, a meticulous dissection of indicated levels should be completed following flap elevation. This can be completed utilizing the same techniques used during neck dissection with microvascular reconstruction, in which there is thorough treatment of the nodal basin while maintaining all key vascular structures.

The submental flap has the benefit of providing low donor site morbidity. Due to the removal of redundant cervical skin, there is a resultant tightening of the anterior cervical region, creating a positive esthetic outcome. Lee et al confirmed the low morbidity of the submental flap as perceived by patients and clinicians.

The submental flap provides an excellent option for reconstruction of head and neck defects. This is especially true in the case of oral cavity defects where the flap can be rapidly harvested, has a favorable arc of rotation, and is reliable with a 100% flap survival in our experience. Compared with radial forearm free flaps, the submental flap is associated with decreased length of operation and hospital stay. In addition, the tissue characteristics of the flap, with its thin...

Table 2. Details Regarding Recurrent Disease.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>TNM Stage</th>
<th>Disease Type</th>
<th>Prior XRT or CRT</th>
<th>Level I Disease</th>
<th>Adjuvant Therapy</th>
<th>Recurrence Type</th>
<th>Regional Recurrence Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T2N0M0</td>
<td>SP</td>
<td>XRT</td>
<td>No</td>
<td>None</td>
<td>LR</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>T4aN2bM0</td>
<td>Primary</td>
<td>None</td>
<td>Yes</td>
<td>Declined</td>
<td>RR</td>
<td>IL level II</td>
</tr>
<tr>
<td>3</td>
<td>T4aN0M0</td>
<td>Recurrence</td>
<td>CRT</td>
<td>No</td>
<td>None</td>
<td>RR</td>
<td>IL level III</td>
</tr>
<tr>
<td>4</td>
<td>T2N1M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>RR</td>
<td>CL level II</td>
</tr>
<tr>
<td>5</td>
<td>T4aN1M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>CRT</td>
<td>RR</td>
<td>IL and CL level II</td>
</tr>
<tr>
<td>6</td>
<td>T4aN1M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>CRT</td>
<td>RR</td>
<td>IL level II</td>
</tr>
<tr>
<td>7</td>
<td>T3N2bM0</td>
<td>Recurrence</td>
<td>CRT</td>
<td>No</td>
<td>None</td>
<td>RR</td>
<td>CL level II</td>
</tr>
<tr>
<td>8</td>
<td>T4aN2bM0</td>
<td>Primary</td>
<td>None</td>
<td>Yes</td>
<td>CRT</td>
<td>DM</td>
<td>NA</td>
</tr>
<tr>
<td>9</td>
<td>T3N2bM0</td>
<td>Primary</td>
<td>None</td>
<td>Yes</td>
<td>XRT</td>
<td>DM</td>
<td>NA</td>
</tr>
<tr>
<td>10</td>
<td>T3N0M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>SP</td>
<td>NA</td>
</tr>
<tr>
<td>11</td>
<td>T3N0M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>SP</td>
<td>NA</td>
</tr>
<tr>
<td>12</td>
<td>T3N0M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
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<td>SP</td>
<td>NA</td>
</tr>
<tr>
<td>13</td>
<td>T3N0M0</td>
<td>Recurrence</td>
<td>None</td>
<td>No</td>
<td>None</td>
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<td>NA</td>
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<tr>
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<td>None</td>
<td>No</td>
<td>XRT</td>
<td>RR and DM</td>
<td>IL levels III and IV</td>
</tr>
<tr>
<td>15</td>
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<td>Recurrence</td>
<td>CRT</td>
<td>No</td>
<td>None</td>
<td>RR and SP</td>
<td>IL level III</td>
</tr>
<tr>
<td>16</td>
<td>T2N0M0</td>
<td>Primary</td>
<td>None</td>
<td>No</td>
<td>None</td>
<td>SP and DM</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviations: CL, contralateral; CRT, chemoradiotherapy; DM, distant metastases; IL, ipsilateral; LR, local recurrence; NA, not applicable; RR, regional recurrence; SP, second primary; TNM, tumor, nodes, distant metastases; XRT, radiotherapy.
and pliable skin paddle, are well suited to resurfacing the oral cavity. When greater bulk is needed, the flap can be raised as a musculocutaneous flap with inclusion of the mylohyoid muscle, or it can be harvested as an osseomusculocutaneous flap when bone stock is required. The submental flap provides a further option for oral cavity cancer reconstruction without compromising oncologic outcomes.

This is a retrospective study and has several inherent weaknesses as a result. Identification of recurrences and complications is limited by documentation within the medical record and thus potentially underrepresents the actual frequency of events.

Conclusions
The submental flap provides an ideal reconstruction option for oral cavity cancer defect reconstruction given its location within the surgical field, ease of harvest, low morbidity, and reliable outcomes. With appropriate management of the level 1 nodal compartment, oncologic outcomes are not compromised.

Author Contributions
Brittany E. Howard, developed study design, compiled data, analyzed data, compiled manuscript, and contributed to final approval of the manuscript; Thomas H. Nagel, developed study design, participated in data compilation, participated in drafting the manuscript, and contributed to final approval of the manuscript; Carrlene B. Donald, developed study design, participated in data compilation, participated in drafting the manuscript, and contributed to final approval of the manuscript; Michael L. Hinni, developed study design, participated in data analysis, participated in drafting the manuscript, and contributed to final approval of the manuscript; Richard E. Hayden, developed study design, participated in data analysis, participated in drafting the manuscript, and contributed to final approval of the manuscript.

Disclosures
Competing interests: Rights to Michael L. Hinni’s invention of a laryngoscope are held by his institution, which has contracted with Karl Storz for possible manufacture of the design.
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References