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All authors abide by the Association for Medical Ethics (AME) ethical rules of disclosure.
Sublingual gland flap for reconstruction of anterior and antero-lateral floor of mouth defects

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Abstract:

Background:

Functional closure of floor of mouth defects remain a challenge. A new method of reconstruction of the anterior and antero-lateral floor of mouth and mandibular defects after ablative surgery is described.

Methods:

Six consecutive patients with suitable T1 and T2 floor of mouth and mandibular alveolar carcinomas were investigated regarding the use of the sublingual gland as a flap for the coverage of the resection defects.

Results:

In all patients it was possible to mobilize the remaining part of the sublingual gland or contra lateral sub lingual gland to such an extent that full coverage of the defect was possible. Vascular perfusion could be maintained in all cases and further healing was uneventful apart from a mucocele development in one patient.

Conclusions:

The sublingual flap should be considered as a reliable reconstructive option for most T1 and smaller T2 lesions for the anterior and antero-lateral floor of mouth or mandible.
Introduction:

Floor of mouth defects; especially when combined with anterior mandibular defects may be challenging to reconstruct. Often the defects are closed primarily, left to granulate or covered by local or regional or even distant flaps.

Most commonly, floor of mouth malignancies such as squamous cell carcinomas lead to wide resection of the floor of mouth mucosa and submucosal structures (1). Same can be said for the anterior or antero-lateral mandibular region where the lingual or buccal mucosa may be involved leading to resection of the mandibular alveolar bone as well as part of the floor of mouth. For smaller lesions direct closure may be possible with the aid of local or regional tissue flaps or left to heal by secondary intention, however larger defects are most commonly covered by split thickness skin grafts, nasolabial flaps (2-5) or free flaps, mostly radial forearm free flaps.

Lesions may be unilateral; however the resultant defects may then extend over the midline to the contra lateral side. Anatomical structures that may be involved are multiple and include the mucosa, submandibular and sublingual ducts and orifices(6), peripheral lingual as well as hypoglossal nerve branches, lingual and deep lingual arteries, the lingual and sublingual veins, sublingual gland (SLG), genioglossus muscle as well as the anterior mandibular alveolar bone and mucosa.

Nearly all reconstructive efforts that do not involve the transfer of vascularised tissue have the potential of scarring with resultant limited mobility of the tongue and potential speech or chewing impairments. When the labial mucosa is mobilized the lower lip may be retracted lingually. Ideal reconstructive efforts will utilize local and or regional tissues with minimal donor site morbidity.
The purpose of this paper is to describe the use of the sublingual gland, mobilized sufficiently to be utilized as a vascularised flap with an axial blood supply for coverage of anterior or antero-lateral floor of mouth and mandibular defects. To the authors knowledge it is the first description of the use of the sublingual gland flap for reconstructive purposes.

Anatomical basis:

The sublingual gland is paired and located in the anterior most position of the floor of mouth. It is wedged between the mandible and genioglossus muscle medially and lies on the mylohyoid muscle, covered by a thin layer of mobile mucosa. It is separated from the genioglossus muscle by the lingual nerve as well as the submandibular duct. Vascular supply comes from the sublingual artery, a branch of the lingual artery that also supplies the mylohyoid muscle and surrounding mucosa with a midline arterial anastamosis between the left and rights arterial systems. Venous drainage is through the sublingual and lingual venous system and lymphatic drainage is to the submental lymph nodes. Parasympathetic innervation exists through the submandibular ganglion and sympathetic innervations through the superior cervical ganglion(7). Extension through the mylohyoid muscle may exist with contact and in some cases apparent fusion with the submandibular gland (SMG) as the SLG is not bordered by a capsule. Most commonly the sublingual gland is described to have 8-20 secretory ducts (ducts of Rivinus) while the smaller ducts fuse into a major duct (Bartholin’s duct). Three variants of ductal anatomy can be identified with the most common variant where the SLG as well as SMG have major ducts that merge. Second commonest appears to be multiple small diameter ducts without a major duct. Least common is where both the SLG and SMG have major ducts that do not appear to fuse.(6)
Size of the SLG varies greatly with hypertrophy being described frequently, possibly more in edentulous patients (8, 9). Age related changes do occur with progressive increase in ductal structures, acinar atrophy and an increase in adipose tissue that is often not related to an increase in alcohol intake(10). Herniation of the SLG through the mylohyoid muscle often occurs and should be considered when performing mobilization of the SLG (11, 12).

Patients and methods:

Patients with T1 or T2 floor of mouth or anterior alveolar tumors where resection would lead to a significant defect requiring reconstruction were identified. All patients routinely received detailed informed consent for tumor resection as well as reconstruction with either local or regional flaps as well as a possible free flap reconstruction, mostly a radial forearm free flap if the defect size was greater than expected. After tumor resection with frozen sections, confirming clear and safe margins of 5mm or more the defects were accessed for possible reconstructive options. As the submandibular duct orifices were frequently involved in the resection, transection of the ducts and more posterior displacement was performed when indicated. Resections may have involved none or in larger tumors a lesser or larger component of the component of the SLG.

Careful mobilization of one or both of the whole or remaining part of the SLG from the overlying mucosa, submandibular duct, the lingual nerve and mylohyoid muscle as well as from the mandible was then performed, with careful preservation of the feeding and draining vasculature that can be seen entering the SLG from the side of the lingual artery. No attempt was made to identify the ducts of the SLG. In most cases significant mobilization of the SLG could be achieved, even past the anterior border of the mandible that allowed passive positioning of the SLG flap without
significant tongue displacement (Fig 2a). Where herniation of the SLG through the mylohyoid muscle was present the dissection was extended to this level and separation from the SMG was performed. Fixation was achieved with resorbable sutures, either to surrounding soft tissues or to the mandibular bone through bur holes. Surgery was completed by ensuring adequate haemostasis and covering the defect with a layer of fibrin glue and iodine gauze packing sutured in place and removed after 7-10 days, further healing took place by secondary intent. Where a marginal mandibular resection was performed a partial denture was placed as soon as possible to act as a soft tissue expander. Three patients had concurrent supraomohyoidal neck dissection and one patient received a sentinel lymph node biopsy.

Results:

Five patients with defects in the anterior or lateral floor of mouth with concurrent bony defect and one patient without marginal mandibular resection were treated by this method. Four patients had T2 and two patients had T1 lesions. In three patients the resented area was within the canine to canine region and two had more posterior defects. (Fig 1a) All patients recovered well, one patient presented with a retention cyst six weeks after surgery that was treated by de-roofing of the retention cyst under local anesthesia. (Fig 2 b) All patients were partially or fully dentate. Even where an extensive surface of uncovered bone was involved this could be covered without a problem.

Table I:
Where the flap was used to cover a mandibular defect a substantial thickness of tissue was achieved, but in all cases the placement of a partial denture would be possible after the removal of the iodine gauze packing. A vestibuloplasty may be indicated to lower the floor of mouth at time of implant placement or exposure. Tongue mobility was not inhibited significantly and no secondary revisions were necessary. No oro-cutaneous fistulas developed and no patients complained of xerostomia. Slight elevation of the floor of mouth could be observed, but was of little clinical significance.

Figure 1a

Figure 1b

Figure 2a

Figure 2b

Discussion:

Anterior floor of mouth and anterior mandibular resection defects may pose significant challenges to the surgeon. Smaller defects can be left to heal by secondary intention or covered by a split thickness skin graft that fairly consequently leads to scar contraction. Increasing depth of tumor invasion leads to a deeper resection and the likelihood of a partial or full resection of the one or both sublingual glands increases. Microscopic infiltration of the SLG is significantly more common when the tumor infiltration depth exceeds 5mm (13). Generally reported infiltration rates of the SLG are as low as 27% (13) or may be as high as high as 48%(1). Intraoperative clinical judgment of the invasion of the SLG may be correct in up to 88% of cases (13) which can possibly be increased by pre-operative MRI examination. Due to the various infiltration rates the recommendation to routinely excise the sublingual
gland as well as the genioglossus muscle (1) cannot be universally accepted. An individualized approach probably is a wiser way of approaching the different scenarios regarding infiltration of deeper structures. In most of the smaller tumors involving the floor of mouth as well as the lingual mucosa of the mandible a significant portion of the sublingual gland can be preserved. Uncovered mandibular bone after a marginal resection remains a challenge and has to be covered by local or regional flaps(14). In smaller defects mobilization of the labial mucosa is an option, however retraction of the lower lip may be problematic. Regarding regional flaps, the nasolabial and facial artery musculo-mucosal (FAMM) flaps are the most useful, however may be problematic in dentate patients. A possible solution to this may be the island variation of the FAMM flap (3, 4) where the vascular pedicle may be tunneled through a space of an absent tooth.

Further options are the various tongue flaps (15) or the mere mobilization of the floor of mouth tissues anteriorly (16). All these options have the risk of impaired tongue mobility. Another regional flap that allows adequate reconstruction of larger defects of the floor of mouth is the submental island flap (17) that may be comparative to the radial forearm free flap. Potential problems with the submental island flap are the potential excess of adipose tissue and limitations when performing a simultaneous neck dissection. In our experience the radial forearm free flap stays the flap of choice for larger defect coverage (18) due to the thin pliable skin that undergoes minimal scarring and allows for maximal tongue mobility. All of the mentioned options for defect closure have some component of donor site morbidity or has to be performed as a two stage procedure.

As the sublingual gland or remnants thereof are freely available and can be utilized with minimal morbidity, the sublingual salivary gland flap has been demonstrated as
an option for the closure of defects in the anterior or even the lateral floor of mouth and anterior or lateral part of the mandible. Significant defects of the mandible as well as unilateral or contra lateral defects may be covered with adequate mobilization of this available glandular tissue. Depending on the size of the SLG (8, 9), sizable defects can be closed in this manner with minimal morbidity and scarring. In this series no significant complications were noted and the one mucus retention cyst was treated with minimal effort. As the SLG lends itself to adequate mobilization it has been demonstrated to be a flap option in the reconstruction after extirpation of T1 and T2 lesions.

In conclusion, many options exist for the reconstruction of anterior and antero-lateral floor of mouth and mandibular defects and all have their specific advantages and disadvantages. The sublingual flap should be considered as a reliable reconstructive option for all T1 and smaller T2 lesions for the anterior and antero-lateral floor of mouth or mandible.

List of abbreviations:

SLG: Sublingual gland

SMG: Submandibular gland

FAMM: Facial artery musculo-mucosal

Competing interests:

None

Author’s contributions:

Marius Bredell initiated the surgical principle, surgery and drafted the paper
Astrid Kruse Gujer contributed to the surgery and contributed to the paper

Klaus Grätz contributed to the drafting of the paper

References:

Legends:

Table 1: Overview of patients with floor of moth defects and reconstruction with sublingual gland flaps

Figures:

Fig 1a: Lateral mandibular and floor of mouth defect with rotation of the SLG to cover the premolar and molar area

Fig 1b: Healing 10 days after surgery

Fig 2a: Mobilized sublingual flap for coverage of large anterior mandibular defect

Fig 2b: Mucus retention cyst evident 6 weeks after initial surgery (mirror image)
<table>
<thead>
<tr>
<th>Patient</th>
<th>TNM</th>
<th>Concurrent Neckdissection</th>
<th>Depth of infiltration</th>
<th>Age</th>
<th>Area</th>
<th>Functional restriction</th>
<th>Complications</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>T1N0M0</td>
<td>No</td>
<td>not reported</td>
<td>54y</td>
<td>Mouth floor right</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>T1N1M0</td>
<td>Yes</td>
<td>5mm</td>
<td>47y</td>
<td>Anterior floor of mouth</td>
<td>Slight tongue movement restriction</td>
<td>Small area of bone exposure (healed spontaneously)</td>
</tr>
<tr>
<td>3</td>
<td>T2N2bM0</td>
<td>SLN (sentinel lymph node)</td>
<td>not reported</td>
<td>81y</td>
<td>Anterior floor of mouth</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
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<td>SLN</td>
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<td>59y</td>
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<td>None</td>
</tr>
<tr>
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<td>Yes</td>
<td>5mm</td>
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<td>Mucus retention cyst</td>
</tr>
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<td>9mm</td>
<td>73y</td>
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</table>
Figure legends:

Fig 1a: Lateral mandibular and floor of mouth defect with rotation of the SLG to cover the premolar and molar area

Fig 1b: Healing 10 days after surgery

Fig 2a: Mobilized sublingual flap for coverage of large anterior mandibular defect

Fig 2b: Mucus retention cyst evident 6 weeks after initial surgery (mirror image)

Table I: Patient data and respective functional results