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Cancer of the floor of the mouth

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KEYWORDS
Oral cancer;
Floor of the mouth;
Surgery;
Reconstruction

BACKGROUND Most floor of the mouth (FOM) cancers originate within 2 cm of the anterior midline with extension toward the gingiva and periosteum of the mandible occurring early with even small lesions becoming attached to periosteum.
OBJECTIVES Review the current methods of treatment for cancer of the FOM, focusing on surgical techniques with emphasis on management of the mandible and reconstruction.
RESULTS Early tumors (T1-2) located in the anterior aspect of the FOM are amenable for peroral excision, while larger tumors (T3-4) with lateral and posterior extension requires a surgical approach (cheek flap or visor flap) in order to adequately expose the primary tumor and its boundaries (vicinities) to allow tridimensional resection. Adequate evaluation of tumor invasion of the mandible is critical for treatment planning. Reconstruction of the surgical defect is of utmost importance to prevent fibrosis and contracture-impairing function, particularly when deep portions of the FOM (reaching the underlying musculature) are included in the surgical specimen. High rates of regional metastases, even in early stages, and the poor salvage rates found despite the use of aggressive therapy are strong arguments in favor of elective treatment of the neck in FOM cancer patients.

Treatment options in the management of cancer of the floor of the mouth (FOM) consists of radiotherapy alone, surgery alone, or a combination of these two modalities.[1,2] Presently, the role of chemotherapy remains investigational. Early tumors are equally amenable to treatment by surgical resection or radiotherapy; therefore, a single modality is preferred as the definitive treatment in T1 and T2 tumors. Other factors such as potential complications, cost, convenience, compliance, long-term sequelae of treatment, and willingness of the patient must be considered for selection of the initial treatment. On the other hand, advanced-stage tumors require combined therapy with radical surgery and adjuvant radiotherapy for a successful outcome. In these cases, the factors that influence the choice of surgical approach for the primary tumor are the size of the primary tumor, its depth of infiltration, its location in the oral cavity (anterior versus lateral/posterior), and its proximity to the mandible. Both tumor growth and treatment significantly compromise speech and deglutition, particularly when the tumor involves FOM and the mandible. Newer concepts of immediate reconstruction and use of microvascular techniques have dramatically improved the results of treatment for this group of patients.

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Selection of treatment modality

Leukoplakia

Patches of thin homogeneous leukoplakia are usually observed (intervention on possible causal factors, including tobacco/alcohol use, chronic trauma, and alimentary habits, as well as biopsy is performed if areas becomes symptomatic or if appearance changes [eg, development of a grossly irregular surface with or without erythroplakia], and malignancy is suggested). Premalignant lesions of the mucosa of the oral cavity such as hyperkeratosis, dysplasia, and even carcinoma in situ can be treated by peroral excision, if it is localized and of a relatively small extent (Figure 1). On the other hand, diffuse or multifocal lesions involving a large surface area preclude complete conventional excision. The carbon dioxide laser is an effective method for excision or vaporization of such lesions. The desired depth of tissue

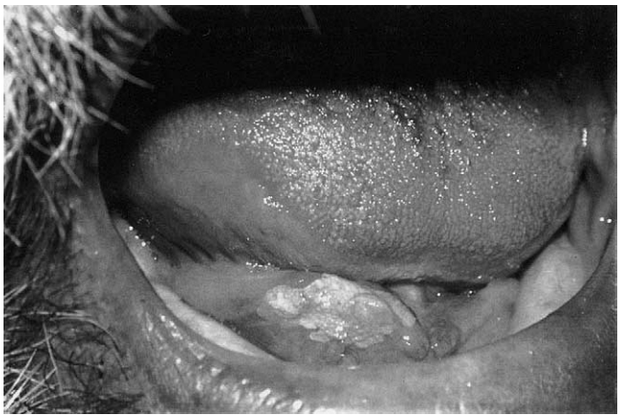


Figure 1 Hyperkeratosis (leucoplakia) of the anterior aspect of the floor of the mouth.

destruction for leukoplakia is approximately 1 to 2 mm in thickness. Complete hemostasis is obtained by controlling focal bleeding points by defocusing the laser beam. Radiation therapy plays no role in the treatment of premalignant lesions of the oral cavity.

Early lesions

Similar to cancer of the oral tongue, small FOM cancers may be treated effectively with either radiation therapy or surgery, with equivalent cure rates of 70% to 95%.[1,3] The proximity of the mandible and the risks of radiation-induced bone and soft tissue necrosis, in addition to severe xerostomia, are the main reasons for selecting surgery in the majority of cases. The mandible is considered at risk when the primary lesion overlies the mandible. If the lesion extends to the gingiva without fixation to the periosteum, the resection should include the periosteum and spare the mandible. In cases of lesions adherent to the periosteum, a rim of mandible should be included in the specimen (Figure 2). As a general rule, early invasion of the mandible can be treated by marginal mandibulectomy, because the cortical part of the mandible inferior to the roots of the teeth remains uninvolved and can be spared safely. In edentulous patients, the feasibility of marginal mandibulectomy depends on the

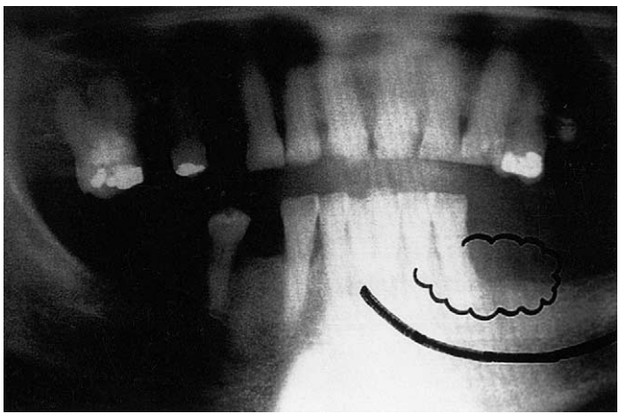


Figure 2 Panoramic x-ray of the mandible revealing an early invasion of the lower alveolus. The diagram outlines the location of the rim resection of the mandible, in this particular case.

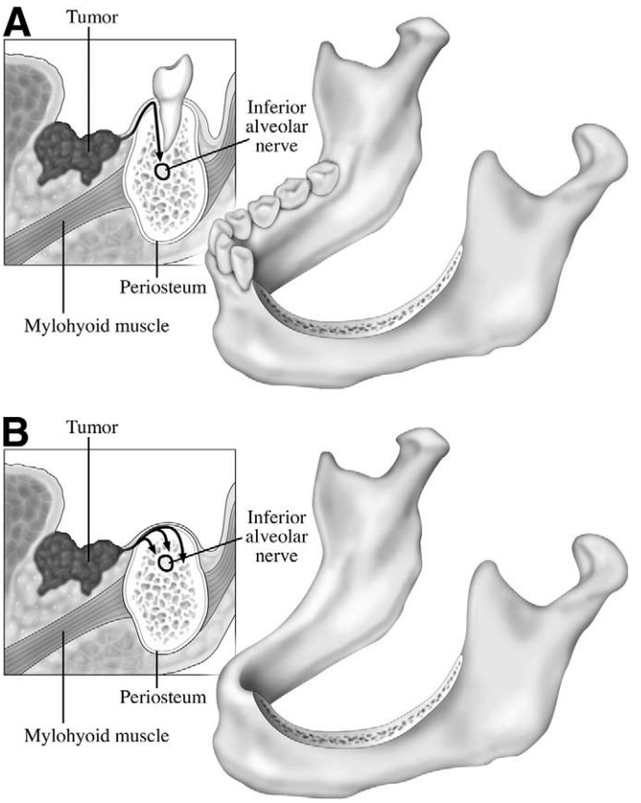


Figure 3 (A) Tumor invasion of the dentate mandible occurs through the dental socket to the cancellous bone and then to the alveolar canal. (B) Tumor invasion of the edentulous mandible occurs through the dental pores on the alveolar process to the cancellous bone and then to the alveolar canal.

vertical height of the body of the mandible (Figure 3a and b). The involvement of the narrow lateral FOM is less common.

Advanced and moderately advanced lesions

The majority of these lesions involve the gingiva and are tethered or fixed to the mandible. Rim resection, whenever possible, preserves continuity of the mandible and offers acceptable speech and swallowing in addition to a good cosmetic result (Figures 4 and 5). Preoperative irradiation is not advis-

Figure 4 Ulcerative/infiltrating (T3) tumor of the anterior aspect of the floor of the mouth.

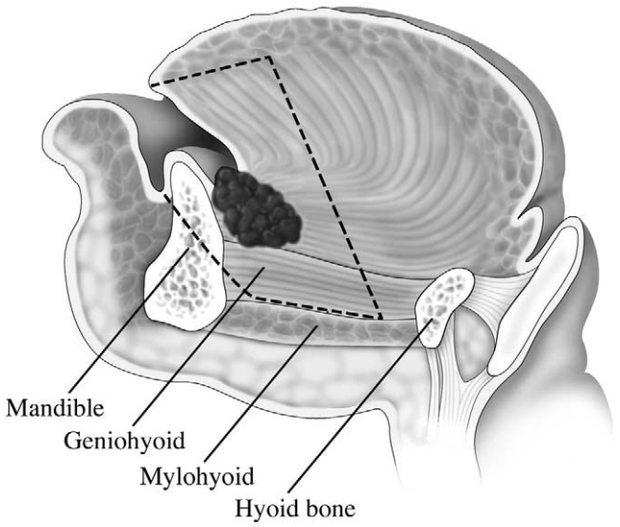
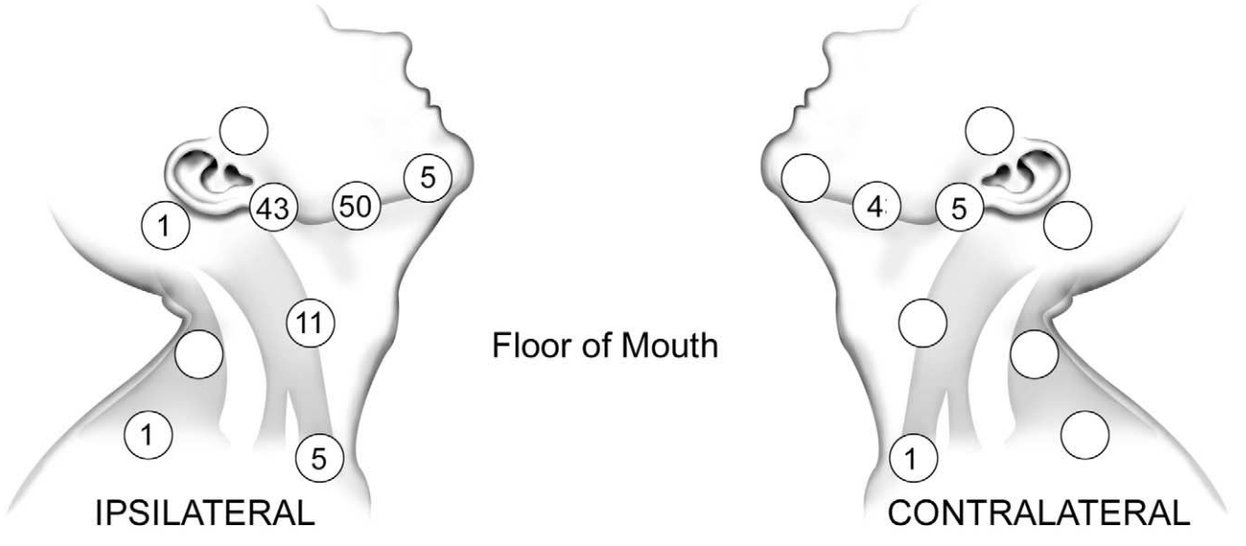


Figure 5 Schematic for rim resection of the arch of the mandible.

able in these cases, because of the high risk of pathological fracture or osteoradionecrosis, particularly in elderly patients. Patients who have tumors staged T4 only because of bone invasion have a better chance of cure compared with those with large, infiltrative tumors grossly involving the suprahyoid musculature or with deep infiltration of the tongue. Radical surgery of the primary tumor with segmental mandibulectomy and partial or subtotal glossectomy, combined with adjuvant radiation therapy, is the preferred modality of treatment. Reconstruction of the mandible and soft tissues are better achieved through a composit osteocutaneous free flap (usually with iliac crest or fibula). Postoperative radiation portals often include the entire oral tongue and FOM with a total tumor dose ranging from 6500 to 7000 cGy (daily dose of 180 cGy). Clinically positive cervical nodes are managed by a small field boost of radiation with a dose ranging from 4500 to 5000 cGy after neck dissection. Acute mucositis, with debilitating effects on the patient, should be expected. The current indications for segmental mandibulectomy in FOM include the following: (1) tumors extending up to the alveolar process in elderly edentulous patients in which marginal mandibulectomy is not feasible; (2) gross invasion by the oral cancer; (3) invasion of the inferior alveolar nerve or canal by the tumor; and (4) massive soft tissue disease adjacent to the mandible. Palliative treatment has usually been radiation therapy with two fractions of 1000 cGy delivered at a 7- to 10-day interval.

Considerations regarding lymphatic spread in FOM cancer

The rate of regional cervical metastases associated with FOM is high, with approximately 30% of patients having clinically positive nodes on presentation. The reported incidence of conversion of the neck nodes from clinically negative to clinically positive with no neck treatment is equally high and varies from 20% to 35%.[4,5] Several authors have correlated histologic features with the risk of metastatic disease in lymph nodes.[6-9] The depth of invasion and thickness, the characteristics of the tumor–normal tissue boundary (ie, well-demarcated vs diffuse invasion at the boundary), lymphatic or vascular space invasion, perineural invasion, and the degree of inflammatory (lymphoplasmocytic) response are considered predictive factors for lymph node metastases, as well as diameter and grade. The first nodes involved are the submandibular and subdigastric nodes. The submental nodes are bypassed in most cases; Lindberg[10] reported 2% clinically positive submental nodes



N_0	N_1	N_{2A}	N_{2B}	N_{3A}	N_{3B}	N_1 - N_3 / Total
179	38	4	17	9	11	79 / 258+30.5%

Figure 6 Carcinoma of the floor of the mouth: nodal distribution on admission, MD Anderson Hospital, 1948-1965.

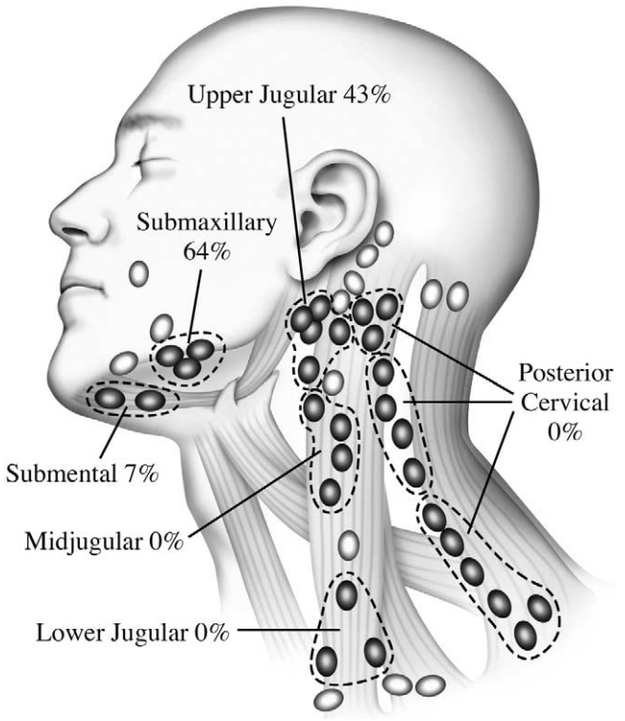


Figure 7 The distribution of uninvolved neck nodes in the N0 neck when electively dissected from 62 patients with carcinoma of the floor of the mouth.

in 258 cases of FOM cancer, and Byers et al[11] reported a similar low rate for elective neck dissection (Figures 6 and 7). Because of the rich lymphatic network of the tongue and FOM, the risk of development of lymph node metastases in these particular sites varies between 6% and 46%, even in early stages.[4,5,8,10,13-15] Lesions more than 1 cm away from the midline present a low risk of bilateral/contralateral metastases (7%). In cases of lesions crossing the midline by less than 1 cm, the risk increases to 16% and reaches 46% in those where the crossing is more than 1 cm. Risk of contralateral metastases is greater than 20% in N2 or higher-stage tumors.[5,15,16] The occurrence of lower level (IV and V) metastases or "skip metastases" in early oral cancer series ranges from 3.5% to 15.8%.[5,13,15-18] Poor salvage rates ranging from 11% to 40%, despite the use of aggressive therapy, also play an important role in the controversy over elective treatment of the neck in oral cancer.[3-5,8,10-15]

Surgical approaches

1. *Peroral excision* is the approach of choice for smaller lesions that are easily accessible, usually in the anterior aspect of the FOM.
2. *Cheek flap* is used for larger lesions with lateral and posterior extension involving the FOM, tongue, mandibular gingiva, and retromolar area. Anesthesia of the skin of the chin and lower lip, ipsilateral to the sacrifice of the mental nerve, is expected (Figure 8).
3. *Visor flap* is most suitable for large, infiltrating lesions restricted to the anterior part of the oral cavity involving the FOM, undersurface of the tongue, and anterior aspect of the alveolar gingiva. The primary advantage of this approach is avoidance of an incisional scar over the lip and/or chin. The relative devascularization of the mandible (due to the large exposition of the periosteum) and the anesthesia of the skin

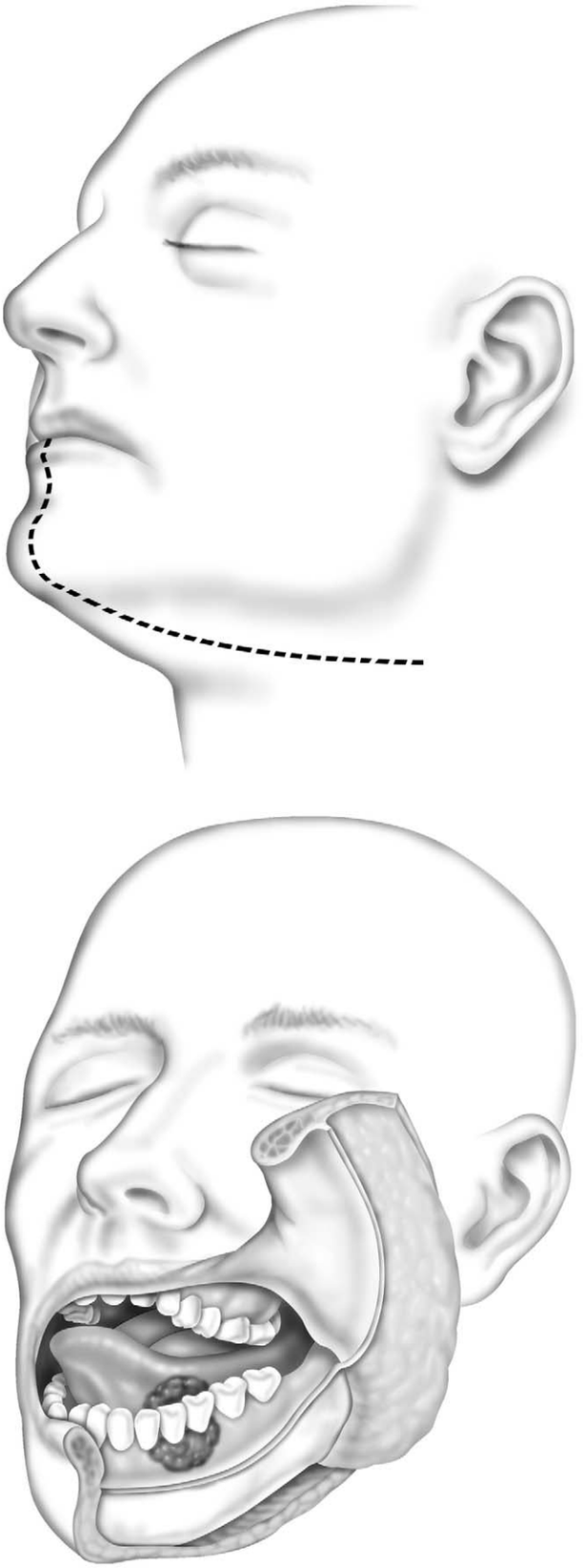


Figure 8 The lower cheek flap approach.

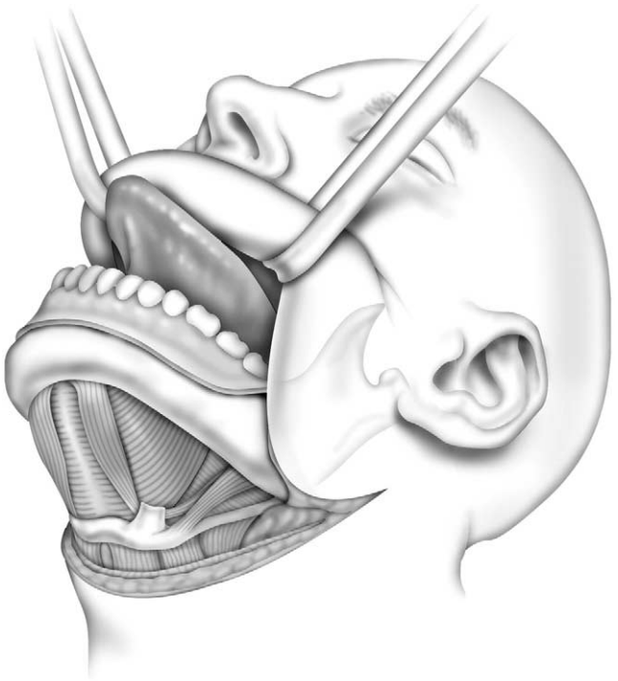


Figure 9 The visor flap approach.

of the chin and lower lip are important undesirable features to be considered (Figure 9).

Excision of FOM cancer and full-thickness graft

Peroral excision for small superficial lesions of the FOM can be performed with the surgical defect safely left open to granulate and heal by secondary intention. However, when such an excision includes deep portions of the FOM reaching the underlying musculature, or when the lesion is located in certain critical areas where mobility is essential, secondary healing leads to fibrosis and contracture impairing function. In these cases, immediate coverage of the surgical defect is indicated (Figure 10). Under general anesthesia and naso-tracheal intubation, the oral cavity is exposed and opened with a self-retaining mouth retractor. Packing the oropharynx with a humid gauze bolster is advisable to prevent aspiration during the procedure. The proposed area of surgical excision is marked out with the electrocautery to obtain adequate surgical margins. A 3-dimensional resection of the primary tumor is performed, with care taken not to disrupt the surgical specimen, which makes it difficult to evaluate the surgical margins at the frozen-section examination. As the Wharton's ducts become visible, they are obliquely transected (to provide a wider opening) and the ducts' posterior halves are anastomosed to the remaining mucosa of the FOM with interrupted absorbable 4-0 sutures on its posterolateral aspect. A full-thickness skin graft is harvest from the supraclavicular area of the neck or from the inguinal/abdominal area (if its a hairless area) and, after appropriately trimmed, it is sutured to the mucosal edges of the surgical defect with absorbable 3-0 sutures. Anastomosis of the anterior halves of the Wharton's ducts is then accomplished. After the graft is sutured in place, several stab incisions are made in the skin graft to permit drainage of blood and/or serum that may accumulate beneath the graft. A Xeroform gauze bolster is made to fit the area of the skin graft and is anchored in position with 2-0 silk tie-over sutures. The nutritional intake will be provided by a nasogastric tube for approximately 1 week (period of boslter dressing use). Intense oral irrigations and rinses with saline solution are advisable to maintain optimal oral hygiene, even after the removal of the

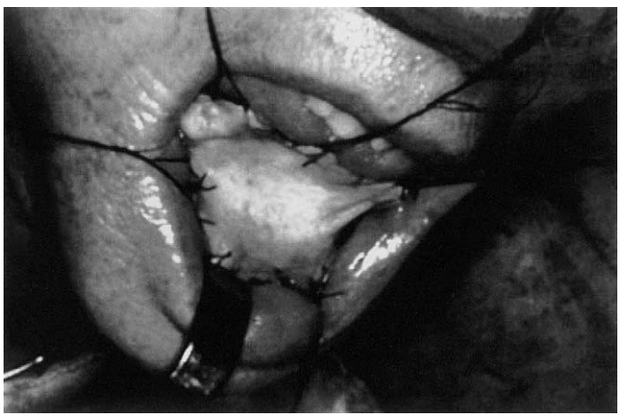


Figure 11 The skin graft is trimmed and sutured to the mucosal edges of the surgical defect.

Figure 10 Hyperkeratosis of the right anterior aspect of the floor of the mouth and undersurface of the tongue with squamous carcinoma. This tumor is amenable to perioral excision.

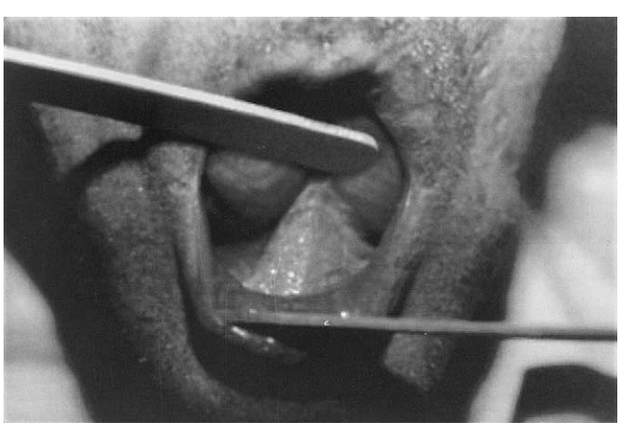


Figure 12 The appearance of the skin graft 6 months after surgery.

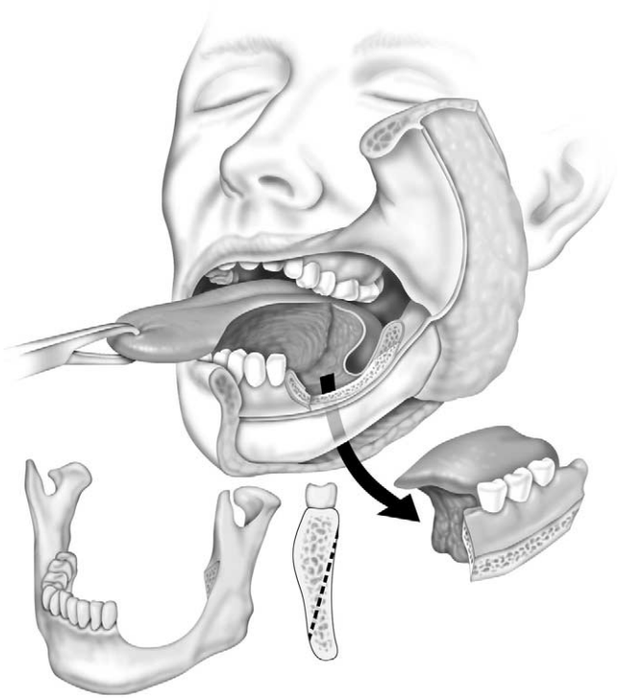


Figure 13 Schematic diagram of marginal mandibulectomy for cancer of the lateral floor of the mouth, through a lower cheek flap approach.

bolster dressing. Feeding by mouth will be made initially with clear liquids and pureed foods. Even when skin grafts do not take completely, they still play an important role in providing a biological dressing of the surgical defect in the immediate postoperative period (Figures 11 and 12). Other options for FOM reconstruction with locoregional flaps include the following: (1) nasolabial flap, (2) tongue flap, and (3) platisma flap.

Excision of FOM cancer with marginal mandibulectomy in continuity with neck dissection (pull-through operation)

Excision of moderately advanced FOM tumors usually requires wide exposure for access to the primary tumor and satisfactory resection. A lower cheek flap approach or a visor flap approach is indicated, depending on the location of the primary tumor. The lower cheek flap approach involves splitting the lower lip and the chin in the midline through its full thickness up to the symphysis of the mandible. The incision continues in the midline up to the thyrohyoid membrane, where it turns toward the ipsilateral neck along an upper skin crease. This transverse component of the incision should be at least two fingerbreadths below the body of the mandible to prevent inadvertent injury to the mandibular branch of the facial nerve during elevation of the cheek flap (Figure 13). With the visor flap approach, the oral cavity is exposed via a single transverse skin incision extending from the mastoid process on one side to that on the other side, along an upper neck skin crease. The visor flap requires another incision in the gingivobuccal and gingivolabial mucosa with division of all soft tissue lateral to the mandible, permitting elevation and retraction of the visor flap to expose the oral cavity (Figure 14). The operative procedure planned for a moderately advanced FOM cancer consists of a neck dissection (bilaterality and extent of the procedure depends on the location of the primary tumor and the presence or absence of lymph node metastases) together with marginal resection of the mandible and resection of the FOM. The neck dissection is completed in the usual fashion except for level I, through which the specimen is attached to the primary tumor. All attachments of the specimen inferior and deep to the digastric tendon are divided at this point. The upper neck flap is already elevated, with careful identification and preservation of the mandibular branch of the facial nerve. The periosteum of the body of the mandible is exposed, and a close-up view of the primary tumor and its limits with the lingual surface of the mandible and with the other intraoral structures facilitates the planning of 3-dimensional resection. To outline the extent of intraoral mucosa to be resected, an incision is made in the mucosa of the undersurface of the tongue, extending from the alveolar process of the body of the mandible from one side to another, keeping a generous cuff of normal mucosa around the primary tumor. The musculature is completely divided, and a power saw is used for marginal mandibulectomy. This specimen should include the alveolar process and as much of the lingual plate of the mandible as possible, which is made through an oblique cut. Such an oblique cut permits resection of the musculature attached to the mandible in a monobloc fashion. With a skin hook, the portion of the mandible to be resected is elevated from the body of the mandible, revealing the deep muscular attachments to the genial tubercle and other parts of the mandible. At this point, a more precise evaluation of the tumor borders (and their relation to the mandible) is possible, confirming or not the indication for marginal resection instead of segmental resection. The remaining soft tissue attachments between the surgical specimen and the patient are detached with an electrocautery at this point. The excised specimen, in a monobloc fashion, should include a marginal mandibulectomy and through-and-through resection of the FOM, in continuity with the cervical lymph nodes excised by neck dissection. Frozen sections are obtained from appropriate areas of the surgical field. The goals

Figure 14 Visor flap approach for exposure of the anterior oral cavity.

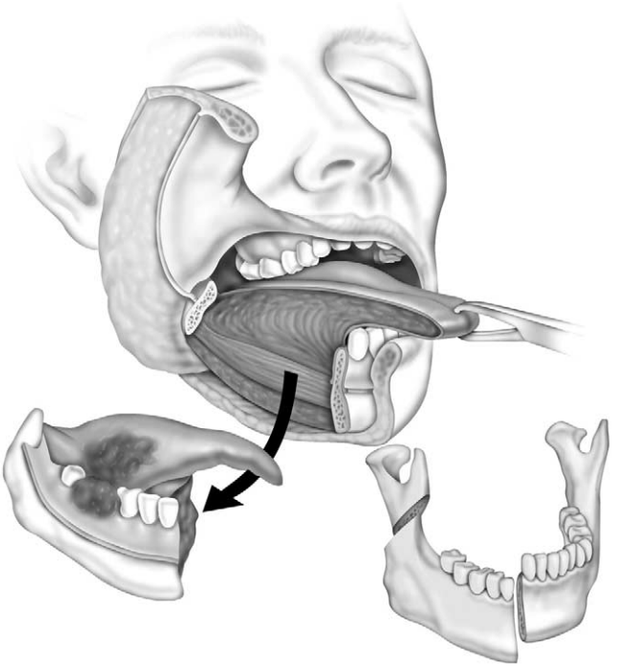


Figure 15 Schematic for a composite resection with segmental mandibulectomy.

of reconstruction for intraoral defects include covering the exposed area of muscle and bone, releasing the tongue and restoring its mobility for speech, mastication, and swallowing. Primary closure can be used if it does not cause tethering of the tongue. Alternative methods of reconstruction include the following: (1) skin grafts, (2) nasolabial flaps, (3) platisma flap, and (4) radial forearm flap. If adequate vertical height of the marginally resected mandible is available, the patient should be considered for secondary placement of osseointegrated dental implants and a permanent fixed denture. A tracheostomy is usually necessary and us performed at the conclusion of the operation for provision of a satisfactory airway and to facilitate clearance of pulmonary secretions.

Figure 16 Aspect of the surgical field after a composite resection with mandibulectomy of the symphysis of the mandible.

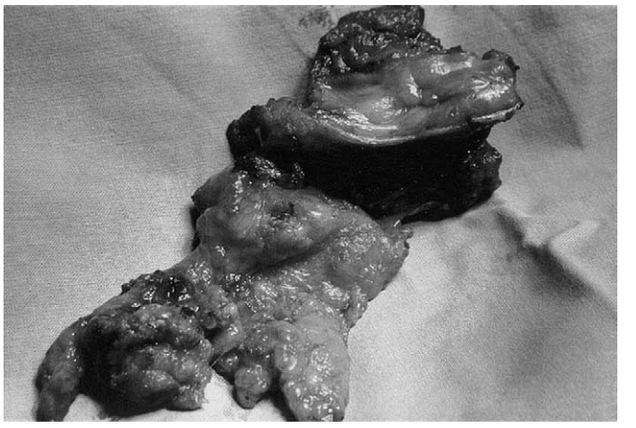


Figure 17 The surgical specimen of composite resection for a adenoid cystic carcinoma of the lateral floor of the mouth.

Composite resection with segmental mandibulectomy (commando operation)

This procedure entails excision of the FOM tumor along with a segment of the intervening mandible performed in conjunction with ipsilateral (or bilateral) neck dissection as a monobloc surgical resection (Figure 15). Once again, either a visor flap approach or a lower cheek flap approach can be used, depending on the location/extension of the primary tumor (see above). In cases of indication for a more comprehensive neck dissection, a standard trifurcate incision is made with a vertical curvaceous component beginning at a transverse line incision on the upper neck (original transverse part of the visor flap or lower cheek flap incision), at the level of the anterior border of the sternocleidomastoid muscle, and extending down to the midclavicular point. The anterior skin flap of the neck is elevated and lymph node dissection proceeds cephalad, as usual, toward level I, without dissecting the submandibular triangle, which remains attached through the FOM and the soft tissues medial to the mandible and to the primary site. The upper skin flap is elevated (either through the visor flap or the cheek flap approach described above), exposing the lateral cortex of the mandible. Detaching the masseter muscle from the lateral aspect of the ascending ramus of the mandible provides exposure of the entire lateral cortex from the mandibular notch up to the midline at the symphysis menti. A close-up view of the surgical field shows the primary tumor and its limits and enables precise evaluation for the 3-dimension resection. A sagittal saw is now used to divide the mandible at the designated locations. The mandible is divided with straight cuts to facilitate introduction of a vascularized free bone graft for reconstruction. Once the mandible is divided, the primary tumor is easily delivered into the surgical field. A 3-dimensional resection is made with the electrocautery, including the primary tumor along with the underlying soft tissues and musculature of the tongue and FOM, which remains in continuity with the mandible and the contents of the dissected neck (Figure 16). A monobloc resection of the primary tumor in conjunction with the contents of the dissected neck and mandible is thus accomplished (Figure 17). Frozen sections are obtained from appropriate areas of the surgical defect. Immediate reconstruction of the mandible and the resected portion of the oral cavity is accomplished with a com-

posite fibula or iliac crest free flap, depending on the mandibular portion to be reconstructed, and its attached musculature and overlying skin. A tracheostomy is always performed at the conclusion of the surgical procedure for provision of a safe airway and to facilitate clearance of pulmonary secretions.

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