



Preservation of the mandible in the management of cancer of the oral cavity

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Tumors of the oral cavity often involve or are in close proximity to the mandible. Treatment of the tumor will require addressing the mandible. For tumors that are not in proximity to the mandible a mandibulotomy may be required. This procedure will allow for adequate exposure of the tumor. Other tumors that abut or minimally involve the tumor may require removal of a piece of the mandible. When a full segmental resection is not required, a marginal resection can be performed. The techniques described in this article are useful adjuncts in the treatment of patients with head and neck tumors.

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The oral cavity is a complex structure that begins at the lips and ends at the surface of the anterior faucal arch. Although the major structural component of the oral cavity is the tongue, it also contains the dental alveolar complex. The oral cavity is the predominant location for malignant tumors in the head and neck. Squamous cell carcinoma predominates with the most common locations being the tongue or the floor of the mouth (Figure 1).

The proximity of the mucosa of the floor of the mouth and its continuation with the dental alveolar structures mandates that one must consider management of the anterior mandible as part of the treatment paradigm for oral cavity tumors.¹

The mandible is an essential part of the oral cavity. Proper structural integrity is essential for all the normal physiologic functions of the oral cavity. These include deglutition, chewing, and speech. The structural integrity of the mandible makes an important contribution to the cosmetic appearance of the face. Patients with oromandibular discontinuity are perceived by society as deformed and may become social recluses as a result.

The ability to reconstruct the mandible with free tissue transfer using vascularized bone has allowed the reconstructive surgeon to rehabilitate patients that require resection of the mandible.² Preservation of the native mandible yields a better overall functional as well as cosmetic result. However, our experience has shown that by using free tissue transfer in patients with dentition, we are able to reconstruct and functionally rehabilitate them to a near-normal return to preoperative function. However, the bite is often off by 1 to 2 mm, which is noticeable by the patients.² Many authors have been able to rehabilitate their patients with dental implants. However, many other reconstructive surgeons are unable to offer this service. Reconstruction of the soft tissues of the floor of the mouth or tongue is best accomplished with similar tissue such as a radial forearm free flap. This allows for the best sensate tissue match. Thus, preservation of the mandible when oncologically sound is the ideal technique.

Issues in mandibular preservation

The proximity of the soft tissue of the oral cavity to the mandible requires evaluation of the potential involvement of the bony structure by contiguous spread of the tumor. Marchetta et al³ and Carter et al⁴ have demonstrated that cancer spreads to the mandible by direct invasion rather than through lymphatic spread. Thus, preservation of the

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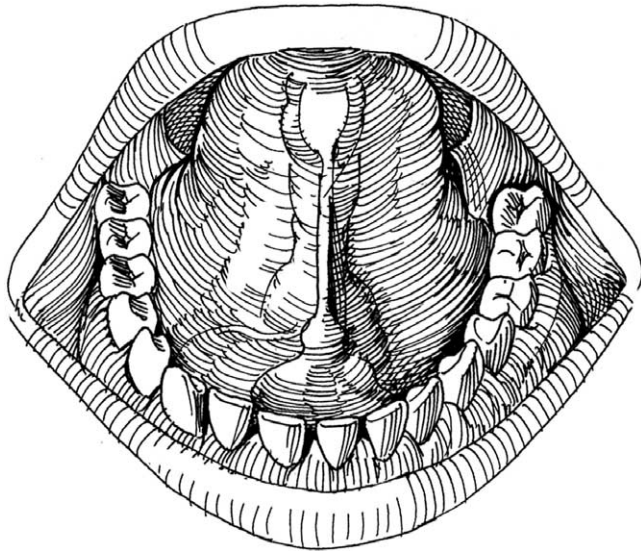


Figure 1 The predominant structures of the oral cavity are depicted with special emphasis on the relationship of the floor of the mouth to the mandible.

entire mandible or partial resection of the mandible is oncologically feasible (Figure 2).

In the dentate mandible, invasion of the bone takes place mainly through the occlusal surface via the dental interstices. Thus, fixation of the tumor to the cortex of the mandible and direct invasion are unusual. Conversely, when the mandible is grossly eroded by tumor, a segmental resection is required. Another indication for segmental mandibulectomy is the patient who has received radiation to the oral cavity. In these patients, when the oral cancer abuts the previously radiated mandible, histological examination often shows multifocal involvement of the bone by the tumor. Thus, a segmental mandibulectomy is indicated.^{6,7}

Thus, in patients who have had previous radiation and present with cancer that abuts or is fixed to the mandible, preservation of the mandible is not oncologically feasible. Tumors that directly invade the mandible, as evidenced by preoperative radiographic evaluation, are also not candidates for conservation procedures.

Indications for mandibular preservation

Oncologic margins

An understanding of the mechanism by which tumor invasion of the mandible occurs has led to two mandible-sparing approaches. These include the following:

1. Mandibulotomy for improved access to the oral cavity/oropharynx
2. Marginal mandibulectomy for oncologic margins with normal bone or for periosteal or minimal invasion of the bone

Mandibulotomy for access

Mandibulotomy is a surgical approach that allows access to the oral cavity or oropharynx for resection of tumors that cannot be completely removed through the open mouth or a lower lip/cheek flap. The majority of oral cavity cancers can be resected transorally with good retraction. Some tumors will require division of the lip. Large bulky tumors or those that extend posterior into the oropharynx, whether into the tongue base or into the soft palate, require better exposure to adequately excise the posterior extent of the tumor. This is necessary if oncologic margins are going to be obtained. Occasionally, trismus will limit access to the posterior margin and will require mandibulotomy.

Mandibulotomy is a procedure that divides the mandible and allows access to all the structures of the oral cavity. Reconstruction of soft tissues is another indication for mandibulotomy. Free tissue transfer allows replacement of composite tissue defects with like tissue. Proper orientation and inset of the donor tissue may necessitate exposure gained by mandibulotomy.

Technical approach

Many techniques and skin incisions have been used for this procedure. These range from lazy-c incisions to z-plasties. All incisions heal well and result in excellent cosmesis. We routinely use a straight-line incision from the lip inferiorly down the chin. The only place that requires specific attention is the vermilion border. This must be realigned exactly or a noticeable cosmetic defect will be present. We score this to facilitate closure at the end of the case. A lip-splitting incision is used. Once the lip has been divided, we elevate cheek flaps bilaterally off the anterior symphysis. The soft tissue of the chin is

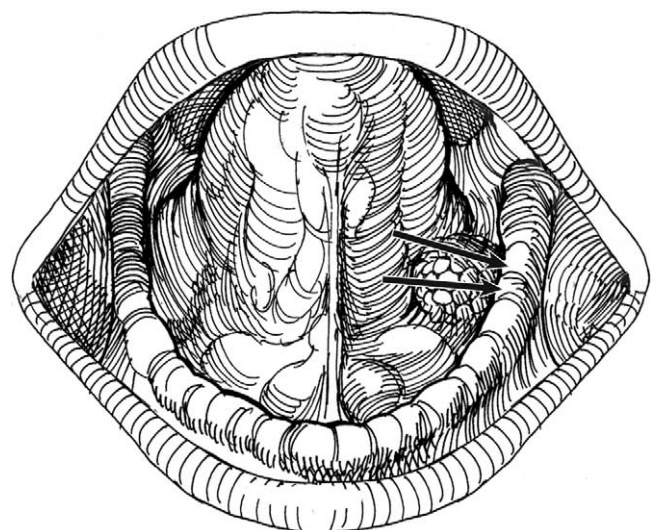


Figure 2 A tumor near the mandible and the routes of invasion are demonstrated. The top arrow shows direct invasion into the cortical bone (rare). The bottom arrow shows invasion through the alveolar ridge.

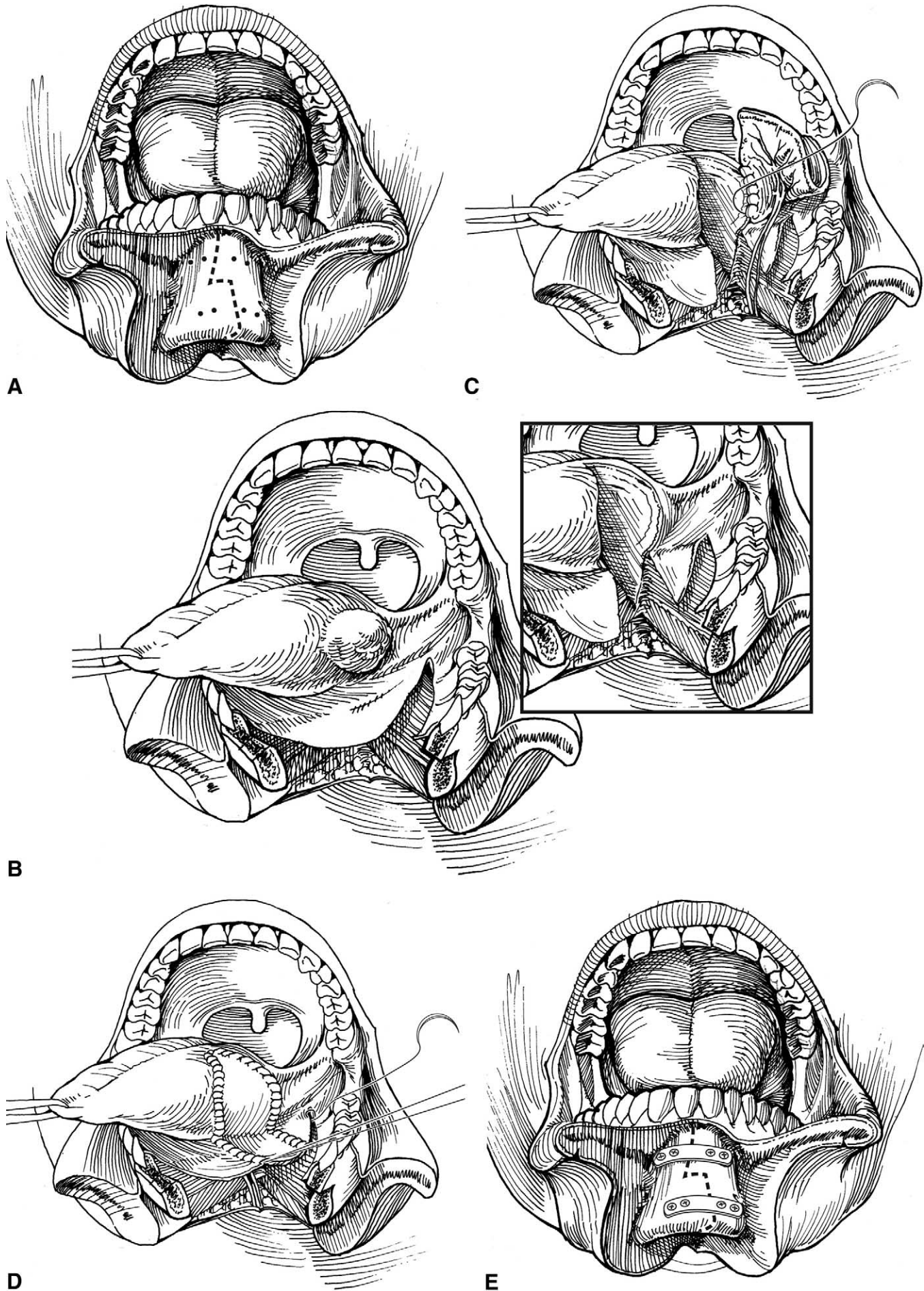


Figure 3 (A) The lip has been split after marking the vermilion border. The bone is exposed and the proposed osteotomy is marked. Holes have been drilled to accommodate the plating device. (B) The mandible fragments are retracted and the tumor exposed. (C and D) Tumor has been resected and a radial forearm free flap is being inset. (E) The mandible has been plated. Notice the marking in the vermilion border that will facilitate accurate closure of the lip.

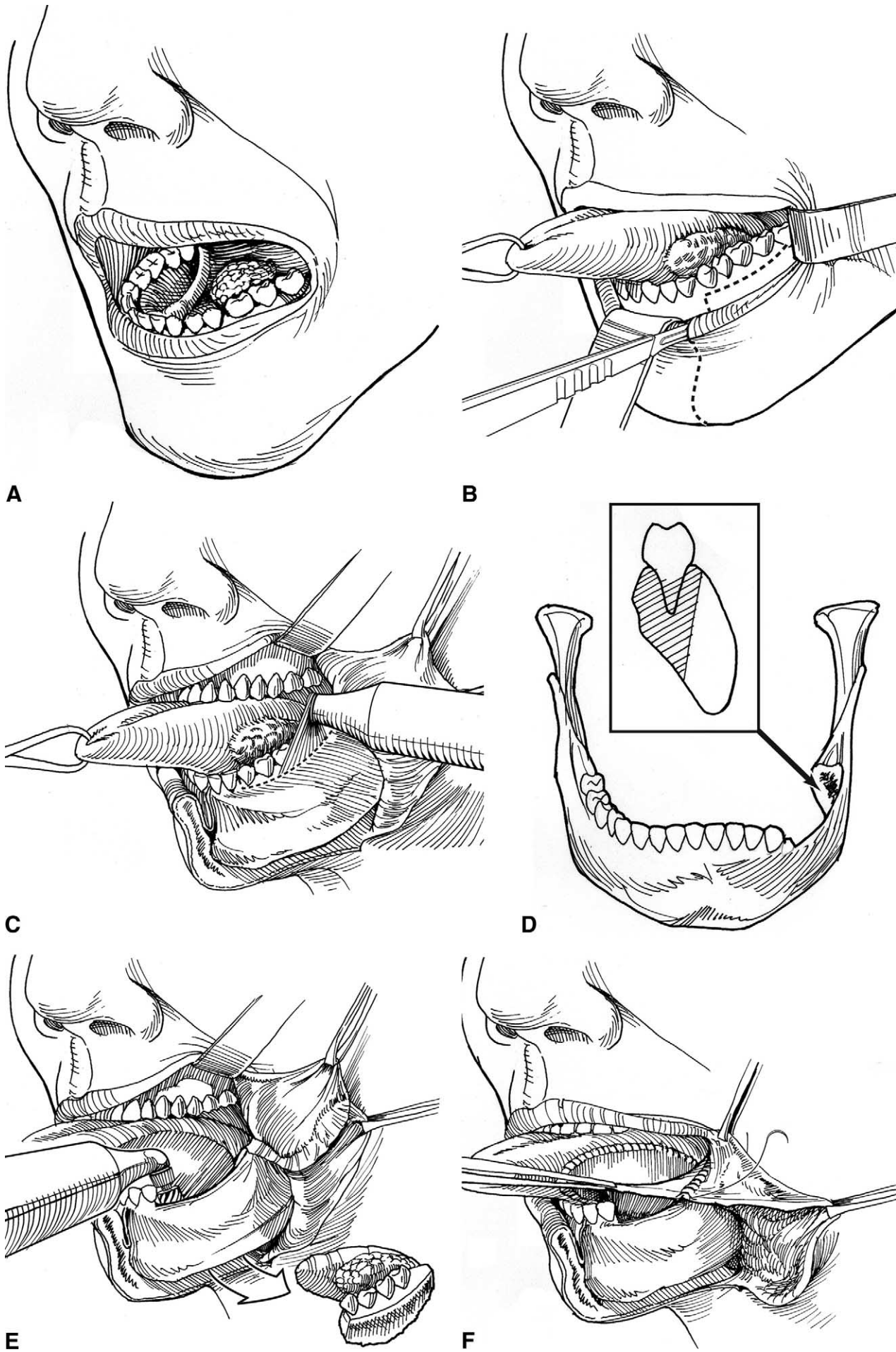


Figure 4 (A) This cancer of the floor of the mouth abuts the mandible. The presence of teeth requires removal of bone to obtain an adequate oncologic margin. (B) The lip is being retracted and the osteotomy made. Notice the markings between teeth. (C-E) The tumor with the attached bone is being removed and the edges smoothed out. (F) The defect is demonstrated with a radial forearm flap being inset.

elevated from the anterior aspect of the mandible. Care must be taken to preserve the mental nerve. Once the cortex is exposed, the proposed osteotomy is outlined with either cautery or a marking pen. Two-millimeter plates with two screws on either side of the proposed osteotomy site are positioned and holes drilled. Two plates are used (Figure 3A). The plates are tagged to allow proper orientation at the end of the case. The osteotomy is then performed in a step fashion. This allows for preservation of the genioglossal attachment to the genioglossal tubercle. It also prevents superior and inferior movement of the mandibular segment after plating. The mandible is divided with an oscillating saw and copious irrigation for temperature control. Once the mandible is divided, the two segments are retracted laterally, and an incision is made in the mucosa of the floor of the mouth (Figure 3B). Adequate mucosa is left attached to the mandible to reconstruct the soft tissue (Figure 3C,D). At the end of the procedure, reconstruction of the mandible is undertaken with the two previously measured and bent plates. These are fixed to the mandible with 8-mm, 2.0 monocortical screws (Figure 3E). We do not place the patient in intermaxillary fixation or restrict diet in the immediate postoperative period. Eating and chewing is more limited by the tumor resection and reconstructive technique than by the repair of the mandible.

Marginal mandibulectomy

Marginal mandibulectomy is indicated in the following settings:

- To obtain a 3-dimensional margin around a primary tumor of the oral cavity
- When the primary tumor approximates the mandible
- When there is minimal erosion of the alveolar process of the mandible

In any of these settings, preservation of the inferior margin of the mandible is possible with a resultant preservation of continuity of the mandible. Stress and biomechanical studies have demonstrated that a minimum of 1 cm of vertical height is all that is necessary to maintain structural integrity. In some elderly edentulous patients, the reduced vertical dimension of the mandible may preclude a marginal resection, and a mandibulectomy may be required. Free osteocutaneous tissue transfer should be used in these instances.

Occasionally, one encounters a patient with a tumor of the floor of the mouth that is free of the mandible on both clinical and radiology assessment, but because of either poor dental hygiene or proximity to the dental structures, adequate margins cannot be obtained. In these instances, a marginal mandibulectomy with removal of carious teeth in continuity with tumor resection is often required.

Tumors of the alveolar ridge or those of the floor of the mouth that extend over the alveolar ridge with minimal or no invasion of the mandible can be adequately treated by a marginal mandibulectomy. Resection of the tumor with a rim of mandible ensures an oncologic procedure.

Technique

A transoral excision is often possible. Limiting factors are whether the lateral and posterior extent of the tumor resection can safely be resected (Figure 4A). With this technique, if resection or reconstruction is not possible or will be compromised, another approach should be used. In the dentulous mandible, determination is made as to which teeth are going to be removed with the specimen and which are going to be removed due to carries. An incision is made between the teeth that are to remain and those that are to be removed (Figure 4B). This incision is through the mucosa between these teeth and carried down and through the periosteum to the mandible. The incision is extended inferiorly to encompass both the roots of the teeth and an adequate margin for oncologic ablation. A sagittal or oscillating saw is used to make the osteotomies in a 3-dimensional continuous fashion (Figure 4C,D). The edges of the bone are carefully rounded so no sharp edges are present (Figure 4E). This will facilitate healing and rehabilitation. A 3-dimensional excision is completed through the floor of the mouth and may involve the mylohyoid or musculature of the genioglossus (Figure 4F). Because mandibular continuity has been maintained, no particular attention needs to be paid to buttressing the mandible, and soft tissue reconstruction can take place.

Reverse marginal mandibulectomy

Occasionally, one will encounter patients who have evidence of lymphatic invasion secondary to an oral cavity carcinoma. The lymph node may be fixed to the lower portion of the mandible. In these instances, if radiology and clinical evaluation ascertain that the mandible superior to the invaded lower portion is adequate to maintain mandibular continuity, a "reverse marginal mandibulectomy" may be performed. Once again, the principle of maintaining a smooth rim with no sharp edges is followed.

In general, a 1-cm bicortical surface of residual mandible should remain. This applies to both superior and reverse marginal mandibulectomy. In instances where less bone remains, free osteocutaneous tissue transfer should be considered.

Conclusion

Marginal mandibulectomy has proved to be an efficacious procedure in the oncologic management of oral cavity carcinoma. The local regional recurrence rate is low, and the maintenance of mandibular continuity with native mandible facilitates oral rehabilitation.

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