

## Chapter 32 – Marginal Mandibulectomy

### Eugene N. Myers

The therapeutic goals in the management of cancer of the oral cavity are eradication of the cancer and restoration of form and function. Crile<sup>[1]</sup> first described the marginal mandibulectomy in 1923 as an incision that is “carried down to the underlying bone, and thence into the bone by a sharp chisel or saw, so that a slice of bone can be split off in one piece, bearing the undisturbed cancer off as on a bone platter.” Greer and colleagues,<sup>[2]</sup> in 1953, also described the marginal mandibulectomy in a study of 21 patients in whom he resected a part of the mandible in the treatment for intraoral cancer. Marginal resection of the mandible can be used to obtain adequate exposure for resection of certain lesions in the oral cavity, as well as to obtain additional margins of resection that otherwise would not have been possible by leaving the bone in place. The three most common locations of cancer of the oral cavity in which marginal mandibulectomy plays a role include the floor of the mouth, the gingival ridge, and the retromolar trigone.

Squamous cell carcinoma in the oral cavity and oropharynx often abuts or invades the mandible. In 1951, Ward and Robben<sup>[3]</sup> advocated segmental mandibulectomy for tumors that involved or were close to bone for adequate oncologic resection. The philosophy of the authors was based on the understanding that cancers of the tongue and floor of mouth drained through lymphatic channels in the periosteum into the mandible. However, segmental mandibulectomy produced severe functional and cosmetic defects. At that time, reliable reconstructive techniques had not been developed.

Marchetta and colleagues<sup>[4]</sup> later demonstrated that mandibular involvement with tumor occurred only with direct invasion of the periosteum. This eliminated the mandate for segmental mandibulectomy. Marginal mandibulectomy is now accepted as an oncologically sound approach in the management of cancer adjacent to or involving the periosteum of the mandible.<sup>[5–11]</sup>

The advantage of the marginal mandibulectomy is that it encompasses only a portion of the mandible, either the alveolar process or the lingual cortex, while leaving the mandibular arch intact. A segmental rather than a marginal resection of the mandible is necessary for tumor clearance if physical examination or imaging reveals that the bone is invaded by cancer or that the bone of a tooth socket is invaded. Guerra and associates<sup>[12]</sup> analyzed a series of 106 patients with cancer of the oral cavity who required either a marginal or segmental resection of the mandible. The authors found that patients having marginal mandibulectomy had cancers smaller than those of patients undergoing segmental mandibulectomy.

I frequently use marginal mandibulectomy in the surgical management of early squamous cell carcinoma of the floor of the mouth. Schramm and colleagues<sup>[13]</sup> described this procedure in 12 of 26 patients undergoing transoral resection of cancer and split-thickness skin graft reconstruction. McGuirt and associates,<sup>[14]</sup> in a more extensive series, reported the use of marginal mandibulectomy with transoral excision of cancer of the floor of the mouth in 92 of 135 patients to obtain tumor-free margins.

Petruzzelli and colleagues<sup>[15]</sup> reported the use of posterior marginal mandibulectomy in the surgical treatment of cancer of the retromolar trigone or oropharynx. Good oncologic results were achieved without significant changes in the patient's appearance (Fig. 32-1).

The following are indications for the use of this technique:

- Inability to obtain an adequate anterior margin of resection without removing the alveolar process of the mandible (Fig. 32-2A). This is particularly true in dentulous patients.
- Attachment of the lesion to the lingual aspect of the periosteum of the mandible (see Fig. 32-2B).
- In the edentulous patient, tumor that crosses the alveolus and involves the gingivobuccal sulcus (see Fig. 32-2C).

A striking advantage of this technique is that marginal mandibulectomy with split-thickness skin graft does not eliminate the possibility of dental rehabilitation. After adequate healing, patients can be fitted with complete (Fig. 32-3) or partial removable dentures (Fig. 32-4) or dental implants.

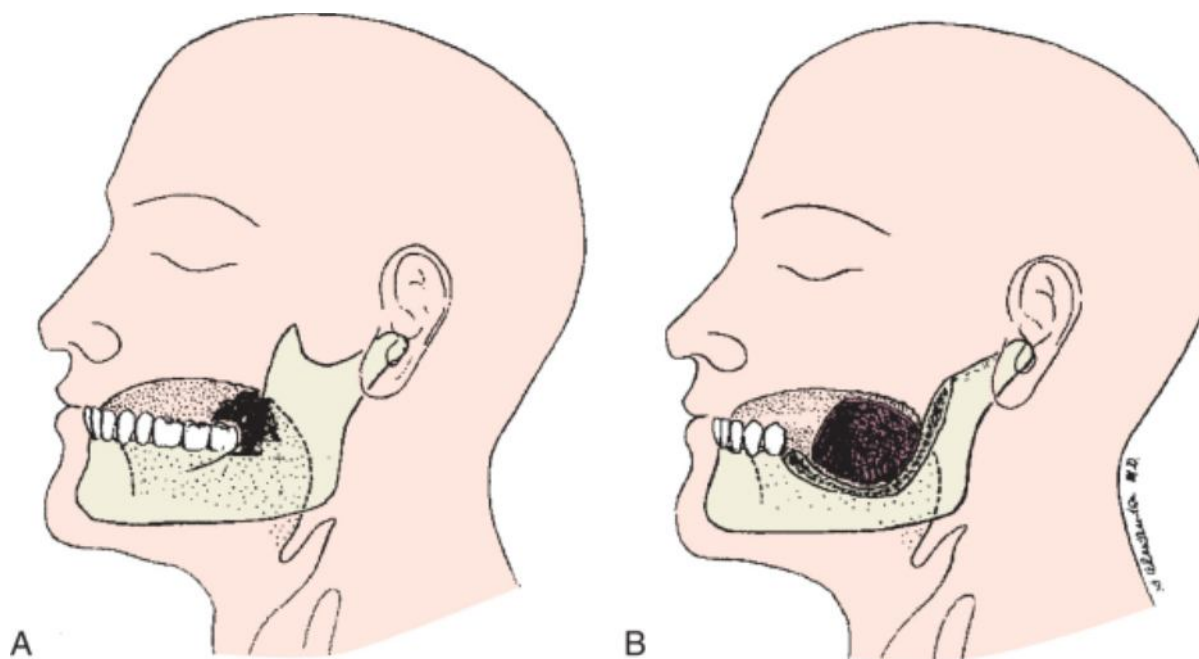
Care must be taken preoperatively to make certain that there is no bone invasion to avoid local recurrence. McGregor and MacDonald<sup>[16]</sup> pointed out that when the tumor originates in the gingival ridge mucosa, the vascular channels in the tooth roots in the alveolar bone permit early invasion of bone. Dubner and Heller report that tumors

invading deeply into the bone from cancer of the floor of the mouth require segmental mandibulectomy and that “superficially invasive cancer and those cancers arising close to the bone may sometimes be treated with marginal mandibulectomy.”<sup>[6]</sup> They studied the patterns of recurrence and local tumor control following mandibulectomy for treatment of squamous cell carcinoma of the oral cavity and oropharynx. Fifteen of 79 patients (19%) who underwent marginal mandibulectomy had local recurrence. In our series,<sup>[14]</sup> only 5 of 130 patients (4%) undergoing transoral resection of squamous cell carcinoma of the floor of the mouth developed local failure, all of which developed within soft tissue not bone. We believe that our good results were due to adhering to the concept of never using the marginal mandibulectomy when mandibular bone has been invaded, even superficially. Similar results were reported by Ord and associates.<sup>[5]</sup> Muñoz Guerra and colleagues<sup>[12]</sup> believe that the final decision of which mandibulectomy technique should be used should be based on clinical judgment in the operating room. The authors studied their patients and found that a positive surgical margin and bone invasion have a significant negative influence on survival (Figs. 32-5 and 32-6).

Using a similar concept, Lorel<sup>[17]</sup> described a marginal mandibulectomy including the removal of the entire inner cortex and alveolar ridge of the hemimandible to resect the tumor and preserve the continuity of the mandibular arch. Our experience with this type of procedure is limited, because most tumors approach but do not actually involve the bone along the body of the mandible. These tumors may be successfully separated from the mandible by undermining the mucoperiosteum off the lingual plate of the mandible and excising the tumor. If the bone of the mandible is involved by deep invasion, a segmental resection is indicated.

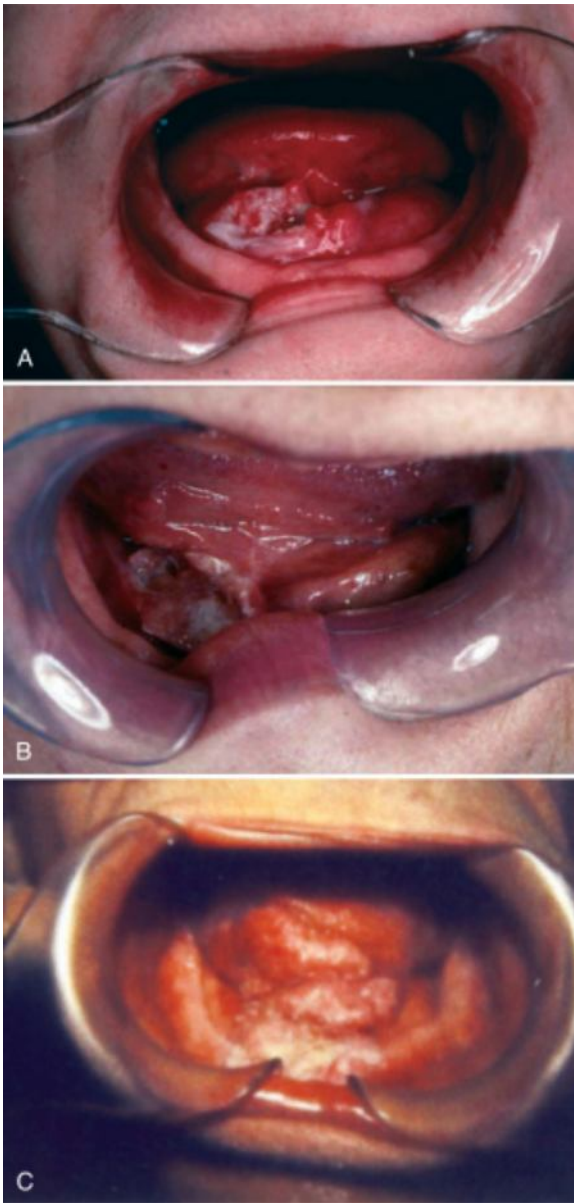
Brown and colleagues<sup>[18]</sup> showed that larger tumors are more likely to have a more aggressive pattern of invasion of the bone. In these cases, segmental resection is a safer oncologic option. Marginal mandibulectomy can provide not only good oncologic outcome but also greatly improves the patient's postoperative function and cosmesis by preserving a viable segment of mandible.<sup>[11]</sup> To maintain the long-term viability of the remnant mandibular rim and prevent pathologic fractures, it is important to be aware of the blood supply to the mandible.<sup>[8]</sup>

In contrast, a series by Song and Har-El<sup>[11]</sup> included four pathologic fractures—two associated with osteoradionecrosis and two secondary to technical error. The authors strongly recommend preservation of the facial artery, if oncologically possible, in patients undergoing neck dissection with marginal mandibulectomy. This goal is certainly achievable during elective neck dissection for the N0 neck. The authors' results confirm that marginal mandibulectomy provides an oncologically sound approach to tumors abutting the mandible, with very good local control rates. Attention should be given to the preservation of the periosteum of the remaining segment, as well as the facial artery, to prevent the immediate postoperative morbidity of mandibular fractures. When postoperative radiation is given, the surgeon should take into account the potential long-term complication of osteoradionecrosis.

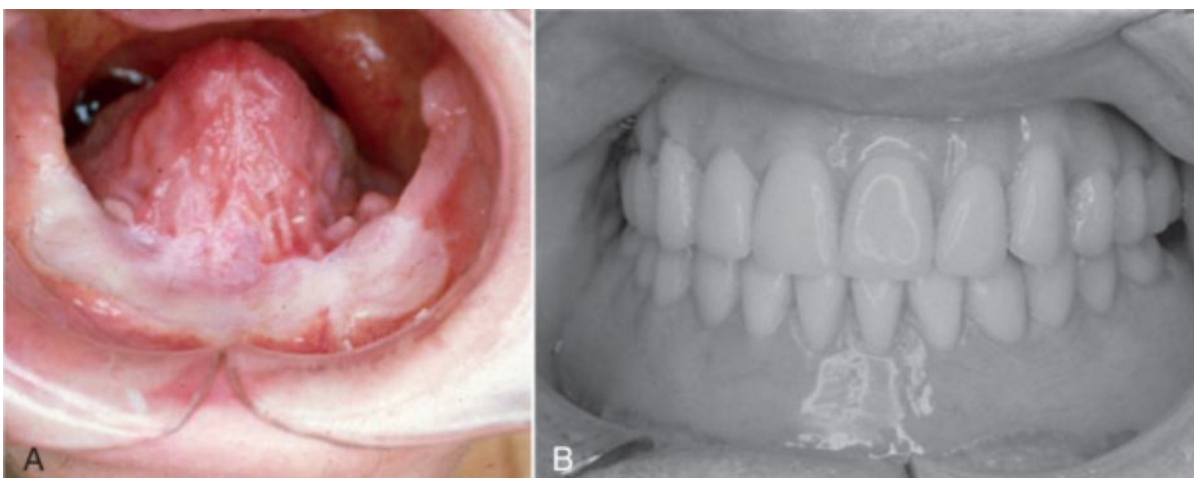


**Figure 32-1** A, Schematic representation of retromolar trigone lesion amenable to resection with posterior marginal mandibulectomy. B, Diagram of surgical defect after posterior marginal mandibulectomy.

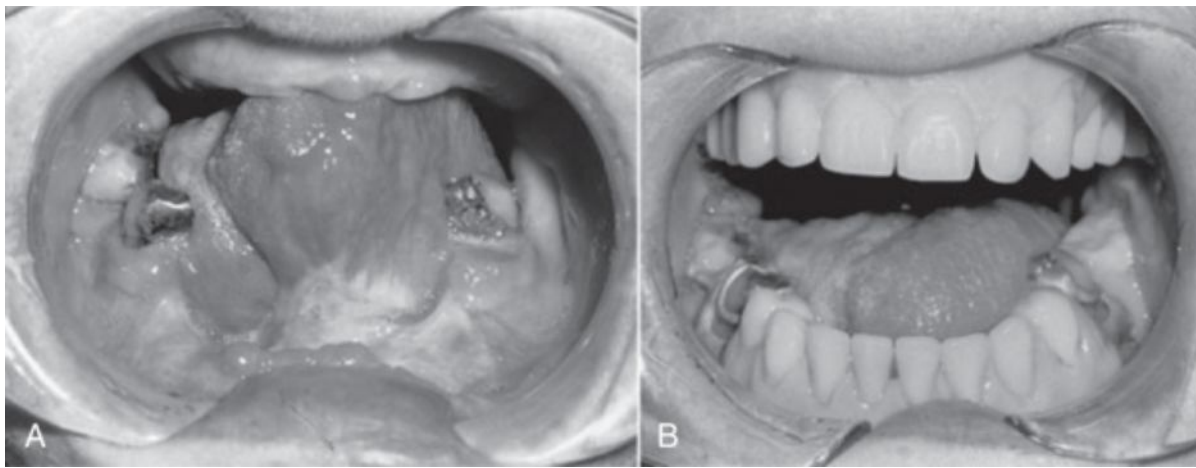
(Reprinted with permission from Petruzzelli GJ, Knight FK, Vandevender D, et al: *Posterior marginal mandibulectomy in the management of cancer of the oral cavity and oropharynx. Otolaryngol Head Neck Surg* 129:713-719, 2003.)



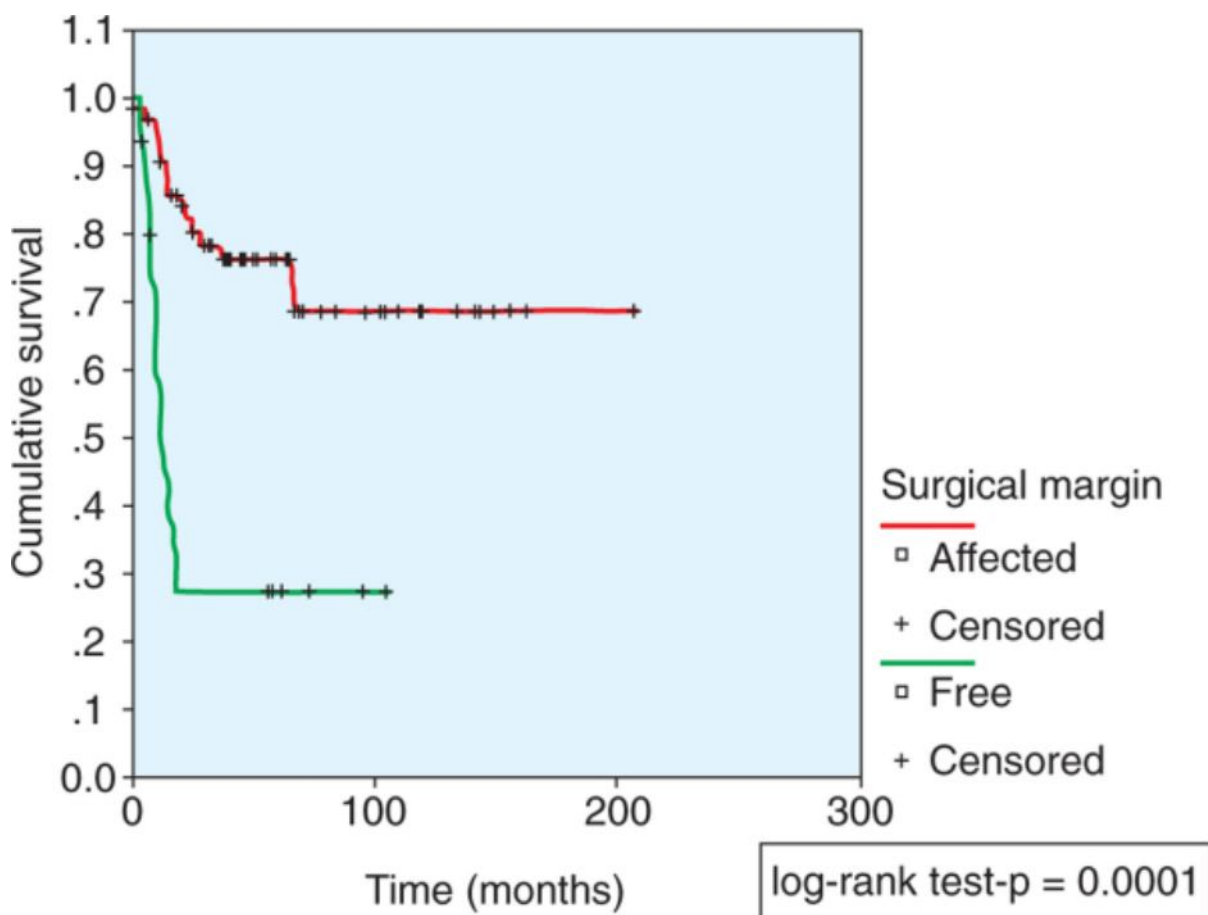
**Figure 32-2** A, Cancer of the floor of the mouth too close to the mandible to resect without marginal mandibulectomy. B, A tumor adherent to the mandibular periosteum. C, A tumor crossing but not invading the mandible.



**Figure 32-3** Complete dentures (B) in a patient following marginal mandibulectomy excision of the cancer and a split-thickness skin graft (A).

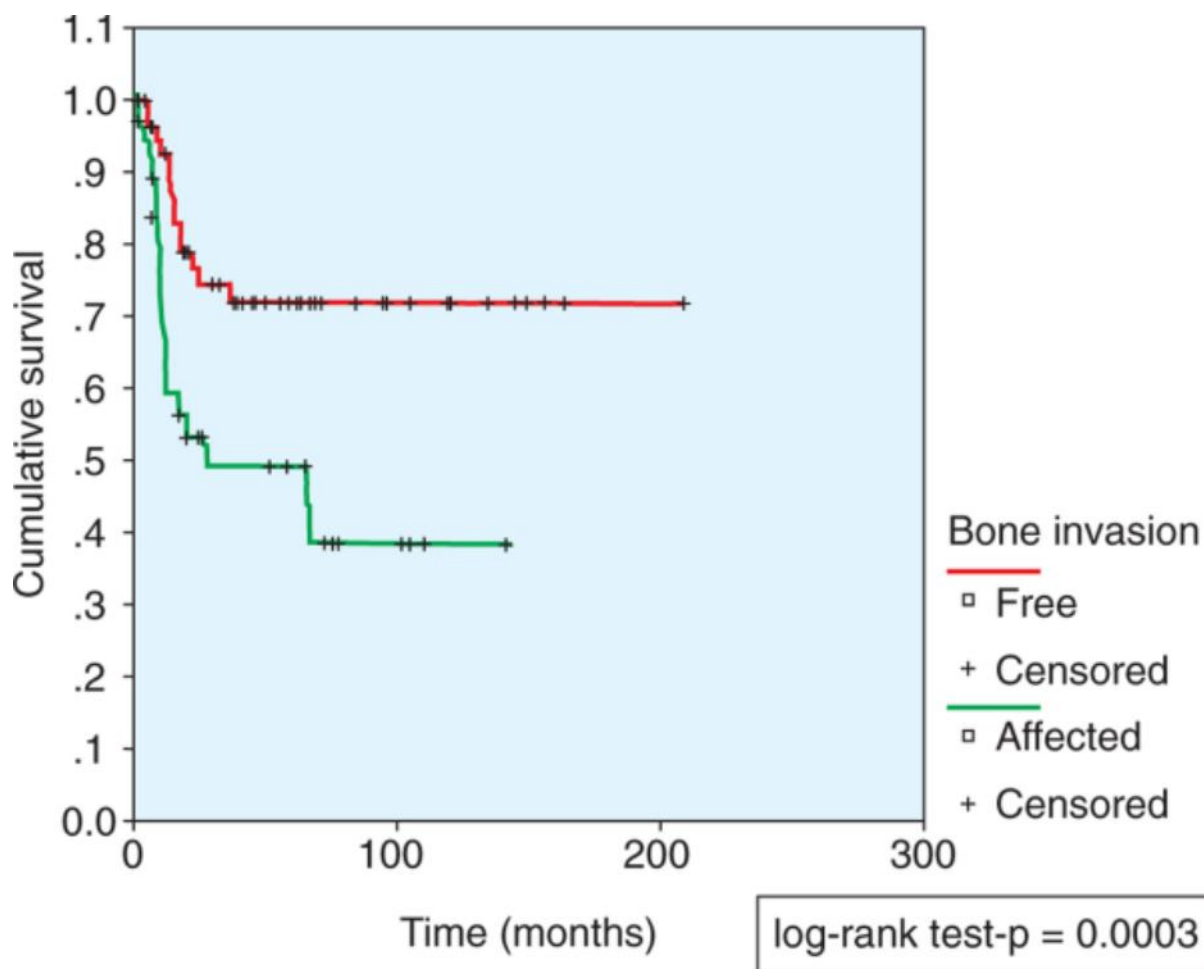


**Figure 32-4** Partial removable dentures (B) in a patient following marginal mandibulectomy and a split-thickness skin graft (A).



**Figure 32-5** Kaplan-Meier estimate of survival by surgical margin status. Tumor infiltration beyond the margin of resection had a negative effect on survival.

(Reprinted with permission from Muñoz Guerra MF, Naval Gías L, Rodríguez Campo F, Sastre Pérez J: Marginal and segmental mandibulectomy in patients with oral cancer: A statistical analysis of 106 cases. *J Oral Maxillofac Surg* 61:1293, 2003.)



**Figure 32-6** Kaplan-Meier estimate of survival related to bone invasion. Tumor infiltration beyond the margin of resection had a negative effect on survival.

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## PATIENT SELECTION

Surgical extirpation can have significant functional and cosmetic implications, but failure to resect a mandible invaded by cancer leads to progression of disease.<sup>[19]</sup> Patients who are to undergo resection of the floor of the mouth with the indications described above may benefit from marginal mandibulectomy. Marginal mandibulectomy may also be used safely in patients who fail radiation therapy for carcinoma of the anterior floor of the mouth. Reconstruction with a split-thickness skin graft in such cases is contraindicated, however, because of the possibility of graft failure, exposed bone, and subsequent osteoradionecrosis. Defects that expose irradiated bone to oral cavity secretions should be covered by full-thickness vascularized tissue. My preference is a radial forearm free flap.

## PREOPERATIVE PLANNING

Physical examination remains the mainstay in decision making. In a patient with an ulcerative lesion overlying the mandible or adjacent to the lingual cortex of the mandible, the mandible must be palpated to determine whether there is exposed bone. Topical anesthesia or analgesia may be required to facilitate evaluation. Occasionally, bone invasion can be felt even when it cannot be seen. Lesions that are adjacent to the mandible or attached to the mandibular periosteum can be identified by bimanual palpation demonstrating that the tumor is mobile. If the tumor appears to be fixed to the bone, it is suggestive of bone invasion. Modern imaging with computed tomography (CT) or magnetic resonance imaging (MRI) still lacks the sensitivity to identify subtle bone invasion. The best technique to detect bone invasion is the periapical radiograph. A CT scan can identify gross invasion of bone as well as perineural involvement, whereas MRI can identify tumors invading bone marrow. Gomez and colleagues<sup>[20]</sup> observed that clinical evaluation and Panorex radiographs (87% sensitivity) remain their most reliable methods in evaluation of bone invasion. Weisman and Kimmelman<sup>[21]</sup> have stressed that one third of the cases of histologically proven invasion of the mandible do not show clinical signs of bone invasion preoperatively. A new diagnostic

method known as multiplanar re-formation (Dentascan) CT is now becoming more popular for assessing the mandible in cancer of the oral cavity.[22,23]

Perhaps the most accurate method of clinical assessment of invasion of the mandible involves undermining the periosteum and directly inspecting the area suspected as invasion of the mandible. Studies in the last 10 years generally agree that direct intraoperative inspection after periosteal stripping has a high degree of sensitivity.[19]

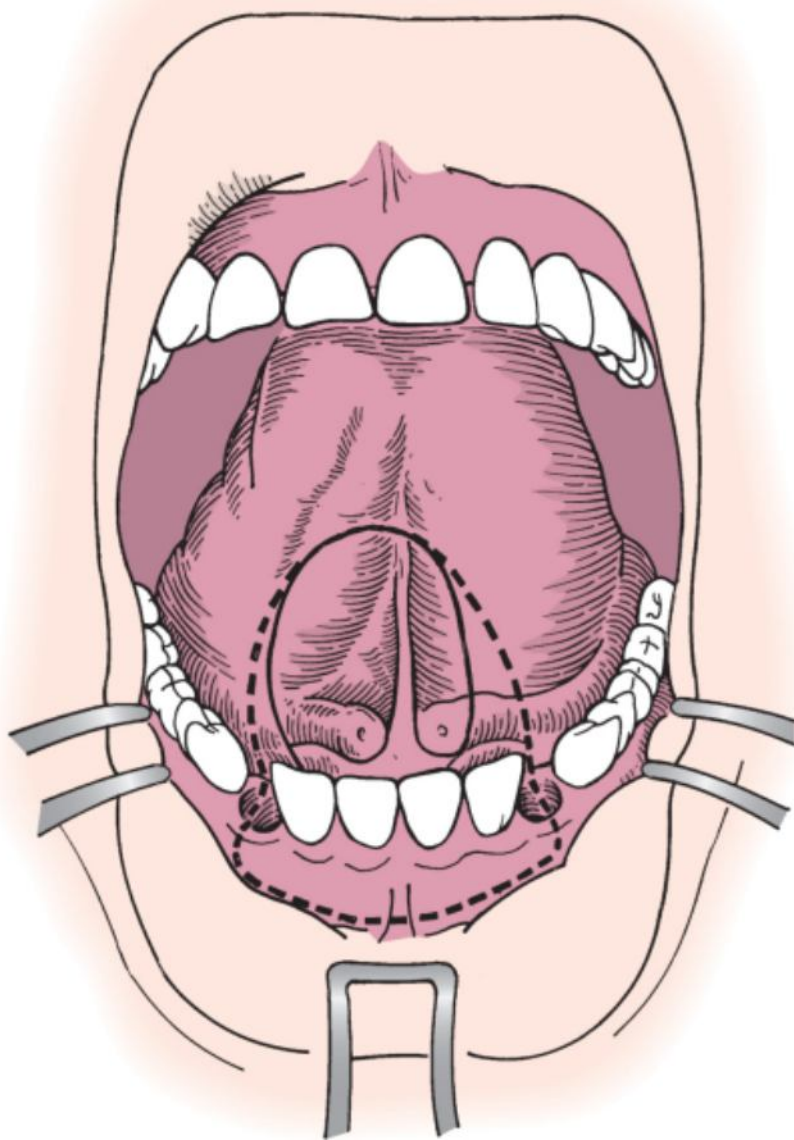
Perineural invasion has been reported as being significantly influenced by the presence of dentition.[24,25] Neoplastic spread related to the inferior alveolar nerve was four times greater in the edentulous mandible than in the partially dentate mandible. This appeared to be related to the resorption of the alveolar ridge, which places the inferior alveolar nerve in a more superficial position making it more susceptible to invasion by cancer.[19]

Preoperative counseling must include a discussion of the postoperative requirement for a temporary tracheostomy, and placement of a nasogastric tube, and the different types of reconstructive techniques.

## ***SURGICAL TECHNIQUE***

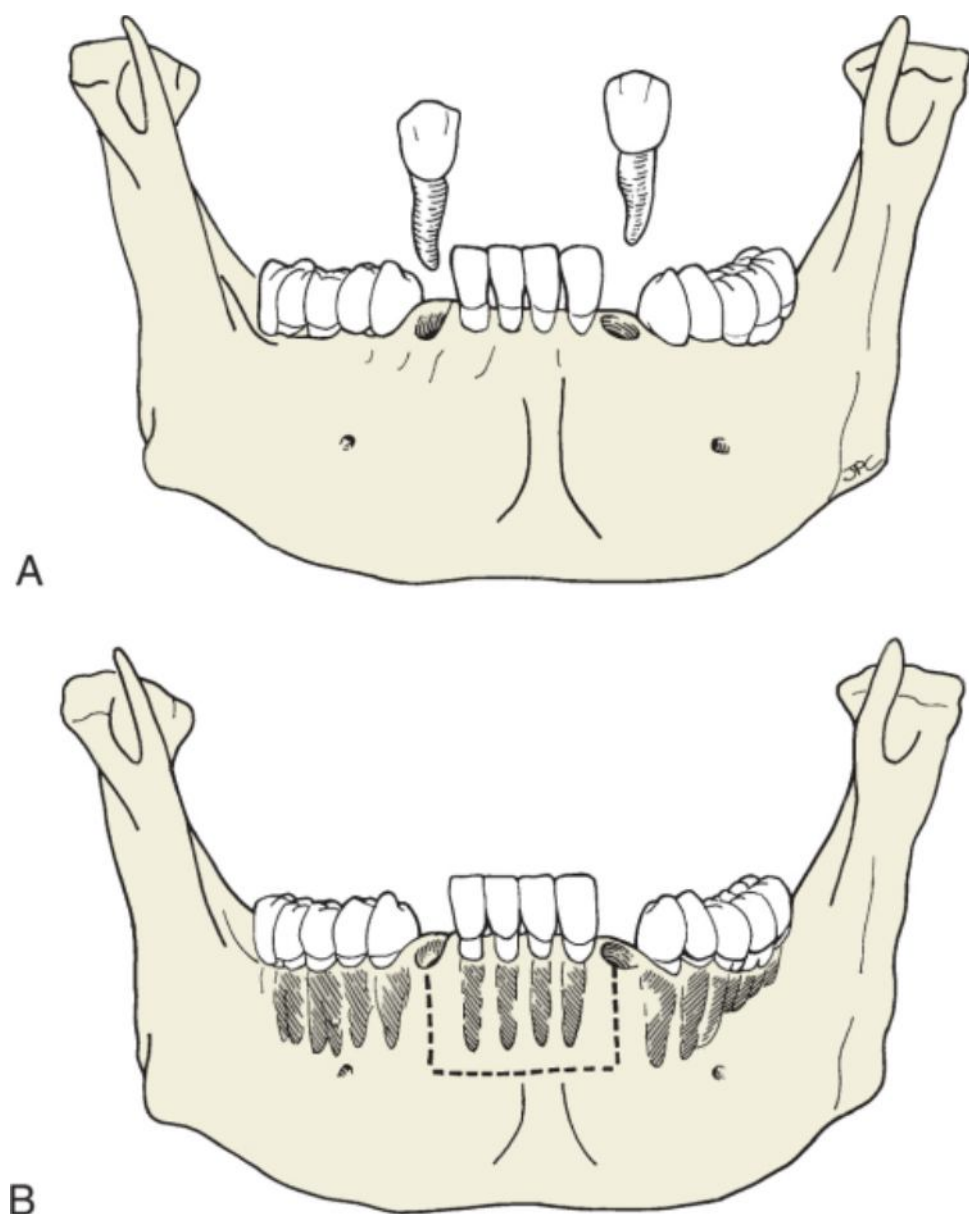
The patient is placed under general anesthesia, and perioperative antibiotics are administered intravenously. Following direct laryngoscopy, esophagoscopy, and tracheotomy, right-angled retractors are employed to provide exposure. A silk suture is placed in the midline of the tongue approximately 1 cm posterior to the tip to retract the tongue. The lesion is identified, the mucosa is dried with gauze, and the extent of the resection is marked with methylene blue or marking pen. The marginal mandibulectomy is always in continuity with the soft tissue excision, and the anterior incision is placed in the gingivobuccal sulcus. I have occasionally encountered superficial tumors that cross the alveolar process and extend into the mucosa of the gingivobuccal sulcus and even onto the buccal surface of the lower lip (see Fig. 32-2C). In such cases, the incision must be extended to encompass this area.

Incisions are made with the coagulating current using a needle tip electrode. A black silk suture is placed in the anterior margin of the specimen before removing it to orient the pathologist who will be examining the specimen with frozen sections. Anteriorly, the incision is carried down through periosteum to bone. A broad, sharp periosteal elevator is used to elevate the mucoperiosteum off the anterior mandible, thereby exposing the alveolar process (Fig. 32-7).



**Figure 32-7** An incision in soft tissue with dissection of the periosteum off the bone.

If the patient has full, or almost full, lower dentition, the osteotomies for an anterior marginal mandibulectomy will usually include the central and lateral incisors. In such cases, both of the canine teeth should be extracted and the osteotomy made in the middle of the tooth socket (Fig. 32-8A) This preserves bone around the remaining adjacent tooth, which will later allow application of partial removable dentures with clasps. If the osteotomy is made just next to the remaining tooth, bone support for this tooth will be weakened. Eventually, the tooth will become loose and require removal, thereby losing the support for a partial denture. If the incisor teeth are removed with the specimen, the residual bone must be inspected for the presence of residual tooth roots, which will interfere with healing if not removed.

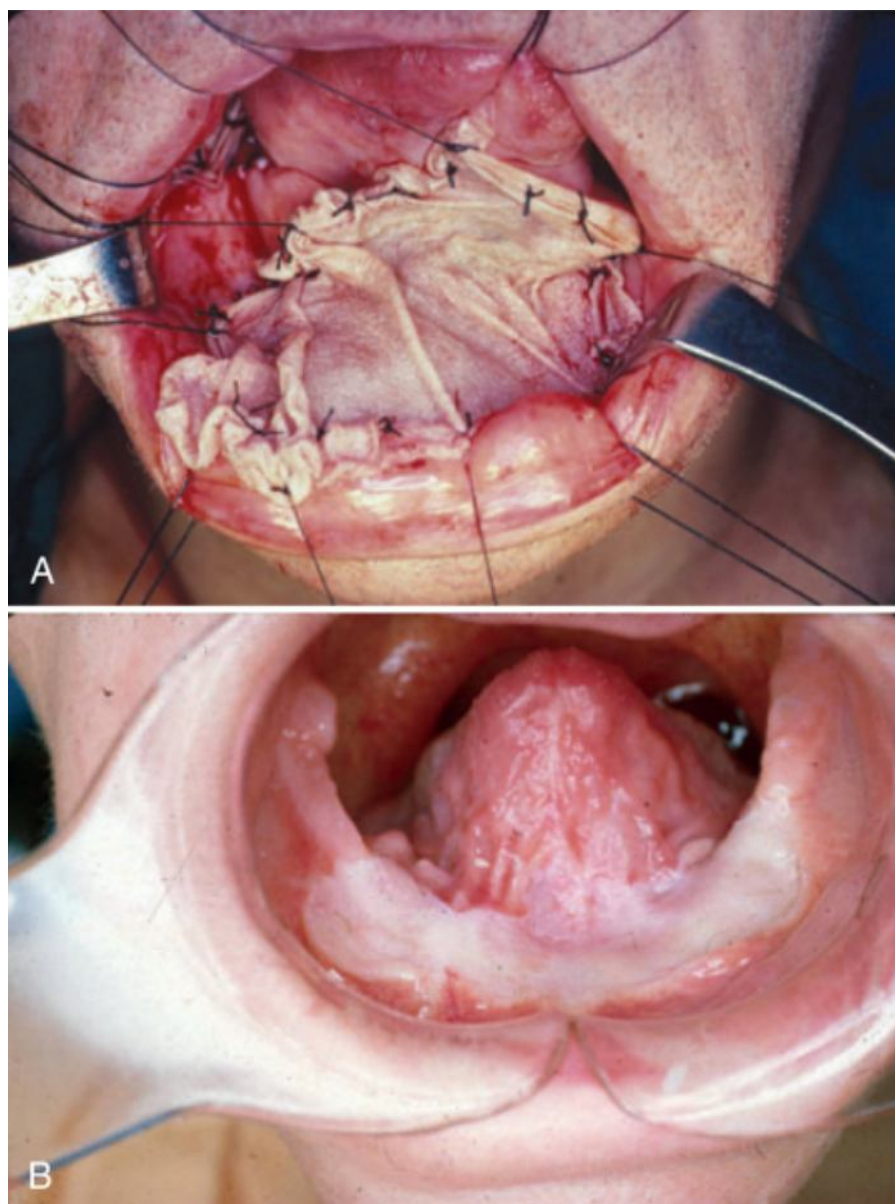


**Figure 32-8** A, Teeth are extracted and osteotomies are placed in the tooth sockets to avoid eventual loss of support to the remaining teeth. B, Vertical and horizontal osteotomies are made with an oscillating saw.

An oscillating saw with a right-angle blade is used for both the vertical osteotomies and the transverse osteotomy (see Fig. 32-8B). During the transverse osteotomy, the bone must be cut through until the tip of the blade is felt in the soft tissues of the floor of the mouth. This is an important step, because trying to pry the alveolar process off of the lingual cortex instead of completing the osteotomy may lead to fracture of the mandible. Once free of the mandible, the bone fragment is left attached to the soft tissues of the floor of the mouth, and excision of the cancer by sharp and blunt dissection is carried deep to the sublingual glands and up onto the ventral surface of the tongue and then delivered.

While the frozen sections of the soft tissues are being examined by the pathologist, hemostasis is obtained and any sharp edges surrounding the osteotomies are smoothed with a bone file or a drill. Closure is carried out in the appropriate manner, either with a split-thickness skin graft (Fig. 32-9A) in an unirradiated case or a radial forearm flap in an irradiated case (see Chapter 31). A split-thickness skin graft will heal on this bone, because most of the cut surface is cancellous rather than cortical bone and provides an adequate blood supply to the graft (see Fig. 32-9B). Pogrel and associates<sup>[26]</sup> describe the use of the split-thickness skin graft and introduce the idea of using bilateral inferiorly based nasolabial flaps and island platysma flaps in reconstruction of floor of the mouth defects. Galati and Myers<sup>[27]</sup> have also described their good outcome with the use of platysma flaps for this purpose.





**Figure 32-9** A, A split-thickness skin graft is sewn into place over the defect. B, The skin graft overlying soft tissue and bone.

## **POSTOPERATIVE MANAGEMENT**

Postoperative care for the remainder of the procedure can be found in the description of transoral resection of the floor of the mouth (see Chapter 31).

## **COMPLICATIONS**

The major complication that must be considered is fracture of the mandible. Fracture can occur with an excessive vertical osteotomy even if the transverse osteotomy is in proper position. The edentulous mandible with its decreased vertical height is particularly vulnerable to this injury. The second possibility is failure to complete the osteotomies with the saw, then trying to pry up and fracture off the alveolar process and the lingual cortex of the bone. In such cases, the bone must be repaired with a compression plate or wires to ensure proper healing. Mandibulotomy in conjunction with marginal mandibulectomy is to be avoided so that bone is not devascularized.

### **PEARLS**

- Every effort should be made to rule out invasion of the mandible by preoperative imaging studies to have the most accurate preoperative planning.
- Osteotomies must be planned, in a detailed manner, in advance of the surgery.
- In dentate patients, extraction of appropriate teeth with osteotomies carried out through the tooth sockets is important in providing long-term preservation of the residual teeth for prosthetic rehabilitation.

- The systematic use of intraoperative frozen section analysis should be used to prevent recurrence in the soft tissues.
- The use of the split-thickness skin graft is the mainstay of reconstruction in cases in which marginal mandibulectomy is used.

#### **PITFALLS**

- Invasion of bone may be underestimated and positive bone margins may occur.
- If intraoperative frozen section control of soft tissue margin is not practiced systematically, the incidence of positive margins and recurrence will be unacceptably high.
- Osteotomies placed adjacent to the remaining tooth rather than in extraction sites in dentate patients will weaken the bone and lead to loss of the tooth.
- Fracture of the mandible from prying the fragment off the bone may occur if the horizontal osteotomy is not carried out completely.

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