

## **Chapter 73: Malignant Neoplasms of the Oral Cavity**

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Malignant tumors of the oral cavity account for only 4% of all cancers occurring in men and 2% in women. Except for nonmelanotic skin cancer and carcinoma in situ, approximately 19,000 new cases of cancer of the oral cavity are diagnosed each year, and 5,000 persons die of the disease annually (Cancer Statistics, 1984). The relatively small number of deaths is offset by the severe functional and cosmetic disabilities that many of these patients endure in coping with their disease. The disease primarily is preventable. Unfortunately, when first seen, most patients have an advanced tumor, partly because of self-neglect and partly because of the primary physicians' lack of training in the early detection of oral cancer. The oral cavity is one of the most accessible areas to inspection and palpation. A sore or lump that persists, especially if the lesion is nontender, or evidence of nerve dysfunction should alert the physician to the probable existence of a malignant neoplasm rather than an inflammatory process. The dental profession is more conscious of oral cancer and often discovers intraoral malignancies even before the patient suspects their presence.

### **Anatomy**

The oral cavity is divided into a number of distinct sites (American Joint Committee on Cancer, 1980), allowing formulation of treatment modalities and prognosis in a more defined fashion (Fig. 73-1). Classification also enables more accurate statistical collection and evaluation. The oral cavity extends from the cutaneous vermilion junction of the lips to the junction of the hard and soft palate above and to the line of the circumvallate papillae below. It is divided into lips, buccal mucosa, upper and lower alveolar ridges, the retromolar trigone, floor of the mouth, hard palate, and anterior two thirds of the tongue. This chapter considers each of these sites separately.

### **Lymphatics of oral cavity**

Several important groups of lymph nodes act as first-echelon nodes of the oral cavity (Fig. 73-2). Two or three submental nodes lie on the mylohyoid muscle and are located in the submental triangle. This triangle is bounded by the anterior bellies of the digastric muscles and the hyoid bone. Six or more submandibular nodes lie on the anterior surface of the submandibular gland or between the gland and the lower jaw adjacent to the facial artery. The nodes on the surface of the gland are pre glandular nodes; those adjacent to the facial artery are facial nodes. They extend upward along the course of the facial artery and are subdivided into prevascular and retrovascular nodes, depending on their relationship to the facial artery. The facial nodes are small and inconstant, except one or two at the lower border of the jaw.

Another important first-echelon nodal group that receives afferent vessels from the oral cavity is the upper deep jugular nodes located along the upper internal jugular vein, between the levels of the digastric and omohyoid muscles. The uppermost node is the jugulodigastric or tonsillar node; the lowest is the juguloomohyoid node. The jugulocarotid node, the principal node of the tongue, is located between these nodes just below the level of the greater horn of the hyoid bone at the level of the bifurcation of the common carotid artery. Additional but less common nodal groups receiving primary lymphatics from the oral cavity

include the lateral retropharyngeal lymph nodes and nodes adjacent to the inferior portion of the parotid gland (periparotid nodes).

In general, regional metastatic squamous cell carcinoma of the oral cavity demonstrates an orderly progression from neck nodes located in the upper regions of the neck toward nodes in the lower region. Malignancies of the lips and anterior floor of mouth and adjacent gingiva and buccal mucosa tend to metastasize to submandibular lymph nodes first. Tumors situated more posteriorly in the oral cavity usually metastasize initially to upper deep jugular lymph nodes. As multiple cervical nodes become involved with metastatic disease, spread to the middle and lower deep jugular nodes occurs. It is unusual for a single metastatic node from an oral cavity cancer to metastasize to lower or posterior cervical nodes initially.

## **Lips**

The lips begin at the junction of the vermilion border with the skin and form the anterior boundary of the oral vestibule. The lip includes only the vermilion surface, or that portion of the lip that comes into contact with the opposing lip.

Lip musculature is derived from the second branchial arch, which migrates to the facial processes. The orbicular mouth muscle is the sphincter lying within the lip and encircling the oral aperture. This muscle extends upward almost to the columella of the nose and downward to the mental crease. The muscle fibers decussate in the midline and occasionally form a raphe in the lower lip (Fig. 73-3).

The infraorbital branch of the maxillary nerve (V2) supplies sensation to a major portion of the skin and mucous membrane of the upper lip. The buccal branch of the mandibular nerve (V3) supplies the oral commissure area. Portions of this nerve pierce the buccinator muscle to supply the mucous membrane of the commissure. The mental branch of the mandibular nerve emerges through the mental foramen to supply the skin and mucous membrane of the lower lip and provides an important pathway for spread of lip cancer into the interior of the mandible.

The seventh (facial) nerve (CN VII) is the motor supply to the muscles of the lip. The buccal branch of the facial nerve is superficial to the masseter muscle but runs in the same direction as the buccal branch of CN V to supply the upper lip musculature.

The major blood supply of the lips is from branches of the facial artery, which include the inferior and superior labial arteries. These vessels, along with those of the opposite side, encircle the mouth between the orbicularis mouth muscle and the submucosa of the lip. The anterior facial vein runs posterior to the facial artery and gives off branches corresponding to the artery, providing venous return from the lip.

The lymphatic drainage of the lips has been well described (Most, 1906; Rouvière, 1938). The upper and lower lips have a cutaneous and a mucosal system of lymphatics, both arising from a fine capillary network beneath the vermilion border. The medial portion of the lower lip drains to submental lymph nodes, whereas the lateral portion drains into submandibular lymph nodes (Fig. 73-4). Numerous anastomoses from the lymphatic vessels of the two lip halves are present near the midline and account for bilateral metastases from

tumors that are close to or cross the midline. Collecting lymphatic trunks have been shown to enter the mental foramen in 22% of cases (Ward and Hendrick, 1950). The upper lip lymphatics drain to preauricular, infraparotid, submandibular, and submental lymph nodes. In contrast to the lower lip, only a few of the upper lip cutaneous lymph trunks drain to contralateral nodes. No crossing of the midline has been documented for the mucosal lymphatics of the upper lip. Lymphatic channels from nodes located in the submental, submandibular, and periparotid areas drain into the lymph nodes of the upper and occasionally the middle deep jugular lymphatic chain.

### **Buccal mucosa**

The buccal mucosa includes all the membrane lining of the interior surface of the cheek and lips, from the opposing lip's line of contact to the pterygomandibular raphe posteriorly, and to the line of attachment of the alveolar ridge mucosa above and below. It forms the lateral wall of the oral vestibule. The buccinator muscle is the lateral muscular wall of the oral cavity and, along with the orbicularis mouth muscle, helps to determine oral competence. It extends from the superior constrictor of the pharynx and blends with orbicular muscle fibers in the upper and lower lips. Tumors of the buccal mucosa may extend laterally through the buccinator muscle to involve the buccal fat pad posteriorly or subcutaneous tissues and skin of the cheek.

The buccal branch of CN VII is the motor supply to the buccinator muscle. It runs in the same direction as the buccal branch of CN V (V2), which provides sensory innervation to the cheek. The infraorbital (V2) and mental (V3) nerves provide additional sensory innervation to the anterior buccal mucosa.

The vascular supply of the buccal mucosa is derived from branches of the facial artery and the transverse facial artery and their respective companion veins. Lymphatics of the buccal mucosa arise from a submucosal capillary network and drain to lymph nodes located in the submental and submandibular triangles.

### **Upper and lower alveolar ridges**

The alveolar ridges include the alveolar processes of the mandible and maxilla and their mucosal covering that, in the case of the lower alveolar ridge, extends from the line of attachment of mucosa in the buccal gutter to the line of free mucosa in the floor of the mouth. Posteriorly, the lower alveolar ridge's mucosa extends to the ascending ramus of the mandible. The upper alveolar ridge's mucosa extends from the line of attachment of mucosa in the upper buccal gutter to the junction of the hard palate. Its posterior margin is the upper end of the pterygopalatine arch. Malignancies of the upper gingiva readily invade underlying bone and may extend upward into the floor of the nasal cavity or into the maxillary antrum. Lateral spread will result in involvement of the upper buccal sulcus and buccal mucosa. Medial extension will involve the hard palate.

The maxillary nerve (V2) provides innervation to the teeth of the upper jaw through the posterior and anterior superior alveolar nerves. Different sensory branches of the maxillary nerve innervate the lingual and labial gingiva of the upper alveolus. The greater palatine nerve supplies the lingual side of the alveolus behind the premaxilla. The nasopalatine nerve

supplies the lingual gingiva of the premaxilla; two different branches of the maxillary nerve innervate the labial surface of the upper alveolar gingiva. The posterosuperior alveolar nerve, which descends on the infratemporal surface of the maxilla, supplies the gingiva posterior to the premaxilla. Branches of the infraorbital nerve supply the labial gingiva.

The mandibular nerve (V3) innervates the teeth and gingiva of the lower jaw. The teeth also are supplied by the inferior alveolar nerve, which enters the mandibular foramen and runs the length of the mandible in the mandibular canal to exit the mental foramen. Malignancies arising on the alveolus may infiltrate bone and reach the mandibular canal, where the tumor may follow the mandible along the nerve toward the skull base or through the mental foramen and into the skin of the lower lip and chin. In edentulous persons the alveolar bone is absorbed, and the mandibular canal may be only a few millimeters from the mandible's upper margin, providing for early access of the tumor into the mandible's medullary portion.

Branches of the lingual nerve supply the entire lingual gingiva of the lower alveolus. The buccal nerve (V3) supplies the labial surface behind the canine tooth; the mental nerve supplies that in front of the canines.

The posterosuperior alveolar artery and vein provide the blood supply to the upper alveolus. The greater palatine artery and vein contribute to the lingual aspect. The inferior alveolar artery and vein primarily supply the lower alveolus.

Lymphatics of the buccal aspect of the upper and lower alveolar ridges drain to submental and submandibular lymph nodes. Lymphatics from the lingual aspect of the upper and lower gingiva pass chiefly to upper deep jugular and lateral retropharyngeal lymph nodes. Some channels may drain to lymph nodes adjacent to the tail of the parotid gland (subparotid). Lymphatics from the lingual surface of the lower alveolus may end in submandibular nodes.

### **Retromolar trigone**

The retromolar trigone is the attached gingiva overlying the ascending ramus of the mandible. The distal surface of the last lower molar tooth forms the base of this triangular area, and its apex terminates at the maxillary tuberosity. The upward extension of the oblique line of the mandible to the coronoid process forms the triangle's lateral side, and a line connecting the distal lingual cusp of the last molar and the coronoid process forms the medial side. The triangle's base is continuous laterally with the gingivobuccal sulcus. The triangle's lateral side is continuous with the buccal mucosa, and the medial side blends into the anterior tonsillar pillars.

The mucosa adheres closely to the underlying bone in the region of the retromolar trigone, and malignant tumors arising in this area may readily infiltrate the mandible. The inferior alveolar nerve enters the mandibular foramen at a point just posterior to the midpoint of the trigone's medial side and may be affected by neoplasm early in the course of disease.

Nerve twigs from the ninth cranial (glossopharyngeal) nerve (CN IX) and branches of the lesser palatine nerve (V2) provide sensory innervation to the retromolar triangle. The

contribution of CN IX accounts for the referred ear pain that may be observed in patients with cancer arising in this region.

The tonsillar and ascending palatine branches of the facial artery supply blood to the retromolar trigone. The dorsal lingual, ascending pharyngeal, and lesser palatine arteries also may contribute to this region's vascularity. Venous drainage is through the tonsillar bed to the pharyngeal plexus of veins and to the common facial vein.

The lymphatic drainage of the retromolar trigone is similar to that of the tonsillar fossa, passing to the upper deep jugular chain of lymph nodes. Some lymph channels also may end in subparotid and lateral retropharyngeal lymph nodes.

### **Hard palate**

The hard palate is a semilunar area consisting of mucous membranes covering the horizontal laminae of the palatine bones (Fig. 73-5). The upper alveolar ridge partly surrounds it, and it extends from the inner surface of the superior alveolar ridge to the posterior edge of the palatine bone. Each palatine bone is somewhat L shaped. The palate's horizontal lamina meets the other side's lamina in the midline, forming the secondary palate, and the perpendicular lamina runs upward, forming the posterolateral wall of the nasal passage. The fusion of the palatine processes of the two maxillae, known as the primary palate, forms the bony palate in front of the palatine bone's horizontal laminae. The primary palate is part of the premaxilla, or the bone that bears the incisor teeth. Its union with the posterior portion of the hard palate is marked in the midline by the incisive fossa.

Two or more foramina are located posterolaterally on either side near the junction of the hard and soft palate. The larger is the greater palatine foramen, and behind this are one or two lesser palatine foramina. These foramina represent the lower end of the pterygopalatine canal, through which nerves and vessels are conducted from the pterygopalatine fossa to supply the hard and soft palate. The foramina provide access for tumor spread into the pterygopalatine fossa and regions of the skull base. Likewise, the incisive fossa and canal provide a pathway for tumor extension into the nasal cavity.

Similar to the alveolar ridge, the periosteum of the hard palate adheres more intimately to the mucosa than the bone; thus the two are referred to as mucoperiosteum. The mucoperiosteum acts as a temporary barrier to the deep spread of tumor; however, cancers of the hard palate frequently extend into the underlying bone as the disease progresses. Contiguous spread of tumor may involve the upper gingiva laterally and the soft palate posteriorly.

The hard palate receives its vascular supply from the greater palatine artery and vein, which are terminal branches of the sphenopalatine vessels. They gain access to the palate through the greater palatine foramen. The greater palatine nerve supplies the secondary palate and also exits the foramen. The nasopalatine nerve, a branch of the maxillary nerve (V2) that descends through the incisive canal from the nasal passage, innervates the primary palate.

Lymphatics of the hard palate are sparse compared to other sites in the oral cavity. Drainage is similar to that of the lingual surface of the upper alveolus. Most of the lymphatics

drain into upper deep jugular (subdigastic) or lateral retropharyngeal nodes. Lymph channels draining the primary palate may terminate in the prevascular and retrovascular group of submandibular nodes.

### **Floor of mouth**

The floor of the mouth is a crescent-shaped region of mucosa overlying the mylohyoid and hyoglossus muscles, extending from the inner aspect of the lower alveolar ridge to the underside of the anterior two thirds of the tongue. Posteriorly, the floor of the mouth is continuous with the base of the anterior tonsillar pillar, and anteriorly the frenulum of the tongue divides it into two sides. On either side of the frenulum is the sublingual caruncle, marking the orifices of the submandibular duct. Posterolaterally from the orifices is a rounded ridge called the sublingual fold, which overlies the upper border of the sublingual salivary glands.

The paired mylohyoid muscles constitute a muscular diaphragm and provide the structural support of the anterior floor of mouth. They arise from the mylohyoid lines of the mandible and insert into the hyoid bone. Their borders unite in the midline as a median raphe that extends from the symphysis of the mandible to the hyoid bone (Fig. 73-6). The hyoglossus muscle partly supports the extreme posterior floor of the mouth; it is a flat, quadrilateral muscle extending upward into the tongue from the body and greater horn of the hyoid, partly above and partly behind the mylohyoid muscle. An important point of surgical anatomy is that the lingual nerve, submandibular duct, sublingual gland, and twelfth cranial (hypoglossal) nerve (CN XII) lie lateral to the hyoglossus muscle, whereas the lingual artery runs deep (medial) to it.

Medially, the space between the mylohyoid muscle and the mucosa of the mouth's floor contains the three extrinsic muscles of the tongue, the hyoglossus, genioglossus, and the styloglossus (Fig. 73-6). Laterally, this space contains the sublingual gland, the submandibular gland duct, the lingual nerve, and branches of the lingual artery.

The lingual artery and vein supply the floor of the mouth. The artery arises from the external carotid and enters the oral cavity deep to the hyoglossus muscle (Fig. 73-7). After giving rise to the dorsal lingual artery, which supplies the base of the tongue, the artery terminates in the sublingual and deep lingual arteries, which supply the floor of the mouth. A branch of the mandibular nerve (V3) supplies the mylohyoid muscle. Branches of the lingual nerve provide sensory innervation to the floor of the mouth.

The lymph vessels of the mouth's floor spring from an extensive submucosal plexus that forms two discrete systems: a superficial mucosa and a deep collecting (Rouvière, 1938). The superficial system has crossing afferent lymphatic vessels in the anterior floor of mouth, where no definite midline exists. These channels drain to ipsilateral and contralateral preglanglular lymph nodes. The deep collecting system drains into the ipsilateral preglanglular nodes. Only the most anterior collecting vessels of the deep system cross the midline. Lymph channels from the posterior portion of the floor of the mouth drain directly into the jugulodigastric and jugulocarotid nodes.

Malignant tumors of the mouth's floor usually occur anteriorly near the midline and spread to such contiguous structures as the root of the tongue and the mandible. Tumors near the orifice of the submandibular duct frequently track along the duct. Tumors also may extend far along the lingual nerve. As cancer encroaches on the lingual cortex of the mandible, it extends downward through the mylohyoid into the submandibular space to involve the submandibular gland and occasionally the subcutaneous tissues and skin. The tongue is no barrier to the spread of cancer from the anterior floor of the mouth. The tumor frequently invades the anterior musculature of the tongue and tracks inferiorly as far as the hyoid bone and, in rare instances, into the prelaryngeal space.

### **Anterior two thirds of tongue**

The anterior two thirds of the tongue are known as the oral tongue and are included within the oral cavity. The oral tongue is the freely mobile portion of the tongue that extends anteriorly from the line of the circumvallate papillae to the root of the tongue. The root is the undersurface of the tongue at its junction with the floor of the mouth. The oral tongue consists of four anatomic regions: the tip, the lateral borders, the dorsum, and the undersurface (nonvillous surface). The base of the tongue is that portion posterior to the circumvallate papillae and is considered a structure of the oropharynx.

Three extrinsic and three intrinsic muscles on each side compose the tongue. The extrinsic muscles are the genioglossus, hyoglossus, and styloglossus; these move the tongue body and alter its shape. The intrinsic muscles are the inferior lingual, vertical, and transverse; these alter the shape of the tongue during deglutition and speech. The tongue has a relatively avascular midline marked by a median fibrous septum that is attached to the hyoid bone and does not reach the dorsum.

The lingual artery alone provides the arterial supply to the tongue (see Fig. 73-7). It arises from the external carotid at the level of the greater horn of the hyoid bone and runs forward immediately adjacent to the middle pharyngeal constrictor, which separates it from the mucosa of the pharynx. The lingual artery runs deep to the hyoglossus muscle, giving rise to two dorsal lingual arteries and a single sublingual artery, and continues as the deep artery to supply the anterior two thirds of the tongue. Its only anastomosis is with its fellow artery at the tip of the tongue. Small companion veins accompany the lingual artery. The chief vein of the tongue, however, is the deep vein, which follows the hyoglossus and then is joined by the companion veins to form the lingual vein, which ends in the internal jugular vein.

CN XII runs forward between the submandibular gland and the hyoglossus muscle well below the lingual nerve. As it crosses the hyoglossus, the nerve innervates the three extrinsic muscles of the tongue; at the anterior border of this muscle it plunges into the tongue to supply the intrinsic muscles.

The sensory nerve supply of the oral tongue is the lingual branch of the mandibular nerve (V3). The chorda tympani, a branch of CN VII, travels with the lingual nerve and provides the sensation of taste. The posterior one third of the tongue (tongue base) has a different origin than the oral tongue and is supplied by CN IX and the superior laryngeal nerve. Both of these nerves provide sensation and taste to the tongue base.

Lymphatics of the tongue arise from an extensive submucosal plexus, and all vessels drain ultimately into the deep jugular lymph nodes between the levels of the digastric and omohyoid muscles (Fig. 73-8). The nearer the tip of the tongue the lymphatics arise, the lower is the first-echelon node; and the further posterior, the higher the node. Lymphatic collecting channels of the tongue are the anterior (apex), lateral (marginal), central, and posterior groups. Vessels from the apex pierce the mylohyoid muscle and partly drain to first-echelon submental nodes. The lateral or marginal trunks partly pierce the mylohyoid to end in submandibular nodes. The remaining trunks drain on either side of the hyoglossus muscle to deep jugular nodes. The central trunks descend in or near the septum of the tongue and follow the lingual artery to the deep jugular nodes. Lymph channels from the tongue base pass through the pharyngeal wall laterally below the tonsil to reach principally the jugulodigastric nodes.

Cancer of the tongue frequently metastasizes bilaterally, primarily because of the rich lymphatics in the submucosal plexus, which freely communicate across the midline. In addition, collecting lymphatics trunks from the apex, central, and posterior groups have many collecting channels that cross over to terminate in contralateral lymph nodes (see Fig. 73-8).

Malignancies of the tongue frequently grow to considerable size before producing symptoms. The relatively loose connective tissues separating the intrinsic musculature provide little barrier to the advance of cancer. Symptoms do not occur until the tumor has grown to a size that interferes with movement, producing dysfunction of speech and deglutition, or when the tumor has involved the lingual nerve, producing pain.

Cancer of the tongue or the mouth's floor involving the lingual nerve causes pain that typically is referred to the ipsilateral ear. The lingual nerve is a branch of the mandibular nerve (V3) that also provides sensation to the external auditory meatus, tympanic membrane, and temporomandibular joint through the auriculotemporal nerve. Likewise, cancer of the tongue base also may produce referred ear pain because CN IX provides sensory innervation to the middle ear.

### **Etiology**

The incidence of oral cavity cancer varies widely in the world. In Europe, the Americas, and Australia, the incidence is relatively small, composing less than 5% of all malignancies; whereas in Asia the incidence approaches 50% (Shanta and Frishnamurthi, 1959) (Fig. 73-9). The high incidence in Asia may be related to the habit of chewing betel nut and fresh betel leaf and habitual reverse smoking, in which the lighted end of the cigarette is held within the oral cavity.

### **Tobacco**

Several etiologic factors are linked to squamous cell carcinoma of the oral cavity, but the disease is correlated most closely with the use of tobacco in any form. Various studies have shown that 90% of patients with oral cancer use tobacco, and the relative risk of developing such cancers increases with the amount smoked and the duration of the habit (Silverman and Griffith, 1972; Trieger et al, 1958; Wynder and Stellman, 1977). The incidence of oral cancer in smokers is approximately six times that of non-smokers



(Silverman and Griffith, 1972). Exposure to tobacco causes progressive sequential morphologic changes in the oral mucosa extending over a long period, with eventual neoplastic transformation (Incze et al, 1982). Such changes in the mucosa may be reversible if tobacco exposure is eliminated. To support the theory of continued mucosal injury, approximately 40% of patients who persisted in smoking after presumable cure of their oral cancer developed second cancers of the upper aerodigestive tract, compared to 6% of those who stopped smoking (Moore, 1971).

Early literature suggested pipe smoking as a possible etiologic agent for carcinoma of the lip (Broders, 1920; Ebenius, 1943; Molnar et al, 1974). The high temperature that the smoke generates within the stem may cause irritation sufficient to induce carcinomatous degeneration. Moderate to heavy cigarette smoking now is observed more frequently among lip patients than is pipe smoking.

In the southwest United States the use of snuff intraorally is a common habit and accounts for "snuff dippers" cancer. The snuff is typically held between the mucosa of the cheek or lower lip and the jaw. Thick areas of leukoplakia appear in these areas, which eventually undergo malignant transformation into a verrucous squamous cell carcinoma. Snuff dippers frequently have one or more invasive carcinomas and multiple areas of leukoplakia involving the mucosa of the cheek and the floor of the mouth. Histologic changes of the oral mucosa of rats exposed to snuff demonstrate morphologic changes similar to those observed in human studies. Hyperkeratosis, hyperkeratotic lesions, dysplasia, and squamous cell carcinoma have been noted (Hirsch and Johansson, 1983; Hirsch and Thilander, 1982).

### **Alcohol**

Numerous studies have correlated alcohol consumption, particularly hard liquor, and oral cavity cancer (Schmidt and Popham, 1981). Approximately 75% to 80% of all patients developing oral cavity cancer consume alcohol (Trieger et al, 1958). The disease is observed six times more often in drinkers compared to nondrinkers (Kissin et al, 1973).

Alcohol probably acts in various ways to induce neoplastic changes in the mucosa, including acting as a direct irritant and causing underlying nutritional deficiencies. Ultrastructural analysis of oral mucosa in nonsmoking alcoholic patients demonstrates epithelial dysplasia, including an increase in nuclear cytoplasmic ratio, prominent nucleoli, and fragmentation and proliferation of the basal layer. This suggests that alcohol alone is carcinogenic (Mascre and Franchebois, 1979).

Alcohol and tobacco are synergistic rather than just additive in their effect of causing dysplastic changes in the mucous membranes, so persons who smoke and also consume excessive amounts of alcohol have a higher risk of developing oral cancer than persons using only alcohol or tobacco alone.

## **Ultraviolet light**

More than one third of patients with carcinoma of the lip have outdoor occupations (Baker, 1980; Burkell, 1950; Martin et al, 1941). Prolonged exposure to sunlight has been suggested as a major contributing factor to the development of carcinoma of the lip. Damaging effects of solar exposure are found in most patients with lip cancer regardless of their age. Loss of elastic fiber, atrophy of fat and glandular elements, and hyperkeratosis with atypical cells are common features. Approximately 66% of patients with two or more independent lip tumors demonstrate leukoplakia, hyperkeratosis, or actinic cheilitis (Baker, 1980).

## **Other factors**

Earlier patient series have reported an association between lip or tongue carcinoma and a positive Wassermann reaction or clinical signs of syphilis to be as high as 20%. Other series, however, indicate that not more than 2% of patients with carcinoma of the lip have syphilis, and it may play no significant role in the development of this disease (Baker, 1980; Baker and Krause, 1980; Burkell, 1950).

Poor oral and dental hygiene may be etiologic factors in the development of oral cavity cancer. It is difficult to single out hygiene from other more important etiologic influences, however, because many persons who use alcohol and tobacco in excess also neglect oral hygiene. Ill-fitting dentures, sharp jagged teeth, and chronically infected gingiva may cause persistent irritation of the oral mucosa. In a study of 131 patients with lip cancer, only 11% demonstrated natural dentition with fair to good oral hygiene (Baker and Krause, 1980).

Certain dietary deficiencies such as riboflavin deficiency and iron deficiency anemia have been associated with carcinomas of the oral cavity. Riboflavin deficiencies produce dysplastic changes of the oral mucosa and may in part explain the relationship between alcoholism, which causes riboflavin deficiencies, and oral cancer (Wynder and Klein, 1965). Likewise, achlorhydric iron deficiency anemia associated with Plummer-Vinson syndrome, observed most frequently in women, produces dysplasia of oral and pharyngeal mucosa. These changes account for the increased incidence of oral and pharyngeal cancer in this group (Wynder et al, 1957).

Oral cavity cancer in patients with recurrent herpes stomatitis type I has been observed in the absence of alcohol and tobacco consumption and suggests that viruses occasionally may be etiologic factors. Viruslike particles have been isolated in mucosal epithelial hyperplasia of the oral cavity (Morency et al, 1982; Petzoldt and Dennin, 1980). Nuclear localization of papilloma viruses has been confirmed in proliferative squamous epithelial lesions of the oral mucosa, suggesting that these viruses may play an important role in the etiology of some cases of squamous hyperplasia and perhaps neoplasia (Jenson et al, 1982).

The possible contribution of occupational and environmental exposures to the development of cancer is an ever-enlarging field of study. A substantial list of agents or processes has been identified as associated with cancer of one organ or another, and no doubt more will be discovered. Changes of the oral mucosa have been studied in 385 men exposed

occupationally to petroleum products, sulfa, and epoxy paints. The incidence of leukoplakia was 40 in 187 of those exposed to epoxy paint and 6 in 105 of those exposed to sulfa dust (Witek et al, 1979).

Various chemical agents have been shown to have a chemical carcinogenic effect on the oral mucosa in animals (Eveson, 1981; Fisker and Karring, 1981; Konstantinidis et al, 1982; Meng et al, 1981; Mock and Main, 1980; Mock et al, 1983; Odajima et al, 1980). Interestingly, oral mucosa is more resistant to the action of chemical carcinogens than skin. Table 73-1 lists some of the more recent studies of chemically induced cancer of the oral mucosa. Commonly used agents include 4-nitroquinolin-N-oxide (4NQO), and 7-12-dimethylbenzanthracene (DMBA). The incidence of developing a chemically induced oral cancer is significantly higher in areas that are mechanically irritated compared to nonirritated regions (Konstantinidis et al, 1982). This constitutes evidence for a carcinogenic mechanism in which malignant transformation may require the promotional effects of a nonspecific, nonmutagenic stimulus.

Immunologic factors may influence the etiology of oral cavity neoplasms. One study found that some patients with precancerous oral lesions have increased blood levels of IgA and either elevated or depressed levels of secretory IgA in saliva specimens (Brusenina and Rudakova, 1982). Immunologically depressed individuals also may be subject to a higher risk of developing oral cavity cancer. Carcinoma of the lip has been reported in a 27-year-old male and 17-year-old female following renal transplantation; both were receiving immunosuppressive drugs. Immunologic systems may provide a "surveillance" function, by which neoplastic cells are identified and either destroyed or contained. Immunosuppressive therapy may prevent this system from recognizing tumor-specific antigens located on the surface of the neoplastic cells, thus increasing the risk of neoplasia.

## **Pathology**

As with other regions of the aerodigestive tract, more than 90% of oral cavity cancers are squamous cell carcinomas. The remaining malignancies are primarily various types of adenocarcinomas arising from minor salivary glands. Additional rare tumors include lymphomas, melanomas, and a variety of sarcomas. All statements in this chapter refer to squamous cell carcinoma unless otherwise stated.

## **Premalignant lesions**

Leukoplakia and erythroplakia are the two lesions in the mouth that have potential for malignant degeneration. The term *leukoplakia* clinically describes a white patch in the mouth or on the lips. Grossly, leukoplakia may have the appearance of being heaped up and exophytic (Fig. 73-10) or thin and filmy. Leukoplakia is considered a premalignant condition resulting from chronic irritation of the mucous membranes that stimulates epithelial and connective tissue proliferation. It is twice as common among men than women (Kennett, 1980). Histologic examination of leukoplakic areas demonstrates a variety of morphologic patterns, ranging from benign hyperkeratosis to invasive squamous cell carcinoma. The most common histologic alteration is epithelial hyperplasia, which is observed in 80% of cases (Rodriguez-Perez and Banoczy, 1982). Epithelial dysplasia occurs in one third of leukoplakic lesions, and approximately 2% of biopsies show carcinoma in situ. One study showed up to

8% of leukoplakic lesions demonstrated invasive squamous cell carcinoma (Waldon and Shafer, 1975).

An adequate biopsy should be performed initially in every case of leukoplakia for histologic assessment to ensure that malignant transformation has not occurred. Excisional biopsy is the choice for all lesions less than 2.5 cm. Management of larger areas of leukoplakia depends on the size and location and may require extensive mucosal stripping and grafting.

*Lichen planus* is a disease of the mucosa and skin manifested by a white, filmy lace pattern on the buccal mucosa. Some otolaryngologist - head and neck surgeons consider it to have the potential for malignant transformation. This potential is small, as a study of 725 patients who had lichen planus of the oral cavity and labial mucosa for up to 32 years (Vas'Kovskaia and Abramova, 1981) substantiates. Only 29 (4%) of these patients showed malignant transformation of their lesion. All transformed to squamous cell carcinoma.

In contrast to leukoplakia, other white patches involving the oral mucosa are not considered premalignant. These lesions include white spongy nevus, leukoedema, candidiasis, systemic lupus erythematosus, and psoriasis. Leukoedema is filmy white, transparent, nonpalpable, and not raised above the level of the surrounding mucosa. Candidiasis is more frequently observed in infants or immunologically suppressed individuals. It consists of heaps of white aggregates that appear to be stuck to the underlying mucosa.

*Erythroplakia* is a nonwhite, premalignant lesion of the oral cavity. It has a much greater potential for malignancy than leukoplakia, and many are already carcinoma in situ. It appears as a slightly raised, red granular area that bleeds easily when scraped with an instrument. It typically occurs on the retromolar trigone, anterior tonsillar pillars, and soft palate. Additional nonwhite lesions of the oral mucosa include inflammatory papillary hyperplasia of the palate, inflammatory fibrous hyperplasia, pyogenic granuloma, papillomas, and pigmented nevi. Other conditions in the oral cavity that occasionally produce a reddened appearance are Kaposi's sarcoma, leukemia, hemangiosarcoma, mycosis fungoides, and polycythemia vera.

### **Gross pathology**

Three gross morphologic growth patterns of squamous cell carcinoma occur in the oral cavity: exophytic, ulcerative, and infiltrative. Malignancies often display more than one of these manifestations. The *exophytic* form is least common, except on the lip. It tends to grow more superficially and metastasizes later than the other types. This form begins as an area of thickened epithelium, which heaps up and can protrude 1 cm or more above the surrounding mucosa (Fig. 73-11). Ulceration occurs early in its development. Exophytic carcinomas gradually become deeply infiltrative in more advanced cases. On the lip this form of tumor may reach a size of 6 or 7 cm, with little local destruction of tissue.

The *ulcerative* type is the most common form of squamous cell carcinoma in the oral cavity. It begins as a round or oval ulcer with a gray, shaggy base that bleeds readily (Fig. 73-12). Ulcerative types manifest a greater tendency for rapid infiltration and usually have a higher histologic grade than the exophytic type. The ulcer eventually may heap up and

become exophytic or remain lower than surrounding mucosa.

*Infiltrative* malignancies are common in the tongue and initially appear as a firm mass or plaque covered by mucosa. This type of tumor extends deeply into underlying tissues, with minimal elevation above surrounding mucosa. As the neoplasm progresses, ulceration and exophytic manifestations may be observed.

A fourth morphologic type of oral cancer is *verrucous* carcinoma, which is a clearly defined but uncommon variant of squamous cell carcinoma. It typically occurs in elderly patients with poor oral hygiene or ill-fitting dentures and most commonly affects the buccal mucosa of males and females with a history of tobacco chewing or snuff dipping (Table 73-2) (Kraus and Perez-Mesa, 1966). The tumor has a warty, bulky, elevated, and fungating appearance. It may grow considerably through lateral spread and occasionally may be multifocal; it does not invade deeply into underlying tissue. Verrucous carcinomas have an indolent biologic behavior and do not metastasize. The characteristic histologic pattern is an undulating, densely keratinized outer layer covering large papillary fronds and a sharply circumscribed, deep margin composed of rows of bulbous, well-oriented rete ridges. The advancing margin appears to push through rather than invade and infiltrate deep tissue. Tumors must be sectioned serially so that the entire specimen is examined for a more invasive squamous cell carcinoma (Fig. 73-13).

### **Histopathology**

In 1920 Broders established a microscopic grading of carcinoma of the lip. He later made a slight revision, and for the most part this system is used today in assessing squamous cell carcinoma, not only of the lip but also elsewhere in the oral cavity (Broders, 1941). Broders classified tumors into one of four groups depending on cellular differentiation, as based on the percentage of total cellular elements (Table 73-3) (Baker, 1981a). The presence of minimal pleomorphism and few mitoses indicates a well-differentiated grade I neoplasm. Poorly differentiated neoplasms show extreme pleomorphism, minimal or no keratinization, and frequent mitoses and are classified as grade IV. Most oral cavity cancers are grade I or II.

### **Regional metastases**

The poorer the differentiation of carcinoma of the oral cavity, the greater the incidence of metastases and the worse the prognosis for survival. This is particularly true for tumors of the lip (Ashley et al, 1965; Broders, 1920, 1941). A prognostic factor more important than histologic grade is the extent of disease at the time of initial therapy. In particular, the most important factor is the presence or absence of regional metastases. The survival rate in patients with regional metastases is approximately half that of patients without clinical evidence of metastases. A poorer prognosis is seen in patients with massively enlarged nodes, with multiple nodal involvement, or with metastases to low jugular or supraclavicular lymph nodes. In addition to these parameters, mounting evidence indicates that extracapsular spread of lymph node metastases is the most important prognostic factor of neck node metastases in influencing survival (Johnson et al, 1981; Noone et al, 1974; Snow et al, 1982). Despite the extracapsular spread being directly related to the size of cervical nodes, it is apparent that spread is more common in small (N1) cervical nodes (see Table 73-5) than previously

appreciated. Extracapsular spread may indicate depressed immunologic surveillance and failure to contain tumor spread. Several studies indicate that the survival rate of patients with cervical metastases in which the tumor is limited to the node ranges from 50% to 70% for 5 years. If extracapsular spread of neoplasm occurs, however, the number of patients who survive for 5 years is reduced to 25% to 30% (Johnson et al, 1981; Noone et al, 1974; Snow et al, 1982).

Regional metastases are present on initial evaluation in approximately 30% of patients with oral cavity cancer, except for cancers of the lip and hard palate. The incidence of regional metastases is related to size of the primary tumor, with larger tumors manifesting a higher incidence. Contralateral or bilateral metastases may develop when the primary tumor is near or crosses the midline. Approximately 25% of patients who show no evidence of regional metastases when first evaluated will eventually develop nodal disease despite control of their original primary tumor. Thus frequent periodic examinations must be performed, since most metastases appear within 2 years after treatment.

Clinically apparent cervical lymph node metastases occur in 10% to 15% of patients with squamous cell carcinoma of the lip (Baker and Krause, 1980) and 15% to 25% of patients with cancer of the hard palate (Chung et al, 1980). Subsequent development of regional metastases following control of lip cancer ranges from 5% to 15%. The lower incidence of metastases from hard palate tumors is related to the rather sparse lymphatic supply to this region. The lower metastatic rate of lip cancer occurs because most lip cancers are small and well differentiated when first evaluated.

### **Distant metastases**

Until advanced stage, metastatic disease from carcinoma of the oral cavity tends to remain above the level of the clavicle. General dissemination of the tumor eventually occurs in 15% to 20% of patients dying of oral cavity cancer. In such instances regional cervical metastases have been present for prolonged periods. Disseminated neoplasm affects bone and lungs most frequently.

### **Multiple primary neoplasms**

Approximately 15% of patients with carcinoma of the oral cavity have multiple primary cancers. The tumors may be *synchronous*, occurring simultaneously, or *metachronous*, occurring within 6 weeks after therapy for the initial tumor. The second primary tumor occurs in the upper aerodigestive tract in 50% to 75% of cases and is related to the effects of alcohol and tobacco on the mucosa. It appears that the greatest risk of developing a second primary tumor occurs in patients who smoke and drink heavily for many years (Schottenfeld et al, 1974; Wynder et al, 1977). The risk of developing additional malignancies in patients who discontinue smoking after control of their first malignancy is one sixth the risk for those who continue to smoke (Moore, 1971). However, this risk does not appear to decrease until 5 years after ceasing the habit, suggesting that carcinogenic factors are long-term influences.

The greatest risk of developing a second primary tumor occurs within the initial 3 years following therapy for the first cancer; the most common location is the esophagus (Marchetta et al, 1965; Odette et al, 1976). Other common sites for second primary cancers

include the lung, larynx, and other regions of the oral cavity.

### **Diagnosis**

The most common symptom of cancer of the oral cavity is a persistent sore in the mouth. The diagnosis is frequently delayed, however, probably because pain associated with ulceration occurs rather late in the course of disease. Dentists usually see patients first because of loosening of the teeth or pain around the teeth or in the jaw. Occasionally, dysphagia may be seen, particularly if the tumor is located posterior in the oral cavity or is extending into the oropharynx. A neck mass appears in one third of patients. Weight loss eventually occurs as the disease progresses, interfering with deglutition.

Physical examination is the essence of diagnosing and evaluating oral cavity cancer. Thorough inspection and bimanual palpation assist the physician in assessing the extent of the tumor, particularly in the tongue musculature and the floor of the mouth. Pharyngoscopy and laryngoscopy should be performed to evaluate the tumor's extension into regions of the oropharynx.

Radiologic evaluation is an important adjunct in assessing oral carcinoma that encroaches on the mandible or involves the hard palate. Occasionally, polytomography is indicated to discern erosion of the palatal bone. Computed tomography (CT) scan is often helpful in assessing soft tissue and bony extension of the tumor, particularly when it occurs on the hard palate and concern exists about the tumor extending into the maxillary sinus or floor of the nose. The pterygopalatine fossa is an important pathway for spread of neoplastic disease originating in the posterior hard palate (Fig. 73-14). The soft tissue structures and bony landmarks of this region are well demonstrated by CT scan.

CT scan also are helpful in assessing extension into the tongue base by tumors arising in the tongue or posterior floor of the mouth. The anatomy of the tongue and floor of the mouth is readily discernible by CT because of low-density fascial planes that outline the extrinsic musculature, lingual arteries, and hypoglossal nerves (Fig. 73-15). The physician must note, however, that normal variation in the structures of the oral pharynx and floor of mouth and particularly the lingual and faucial tonsils may be potential sources of asymmetry and may lead to misinterpretation of the CT scan (Muraki et al, 1983). CT scans also may be useful in the evaluation of cervical adenopathy in patients with muscular or obese necks.

Special radiologic procedures occasionally are necessary in evaluating large neoplasms extending outside the oral cavity. Contrast sialography may be used to assess extension of the tumor posterolaterally toward the parotid gland. Selective angiography may be warranted if the physician suspects that neoplasm or metastasis involves the common or internal carotid artery. Technetium-99m-pyrophosphate bone scanning of the mandible may provide information relative to early invasion by neoplasm; however, inflammation of the bone will produce similar bone scan findings.

Biopsy of an oral cancer is mandatory before treatment. An elliptic incision encompassing a portion of the lesion as well as adjacent normal-appearing tissue is obtained with the patient under local anesthesia. The biopsy specimen should be sufficiently deep to assess the invasiveness of the tumor. Biopsy in the center of an ulcerated or exophytic tumor

may reveal only keratin or necrotic debris and show no evidence of malignancy.

### **Differential diagnosis**

A number of benign and malignant lesions occasionally may be confused with squamous cell carcinoma of the oral cavity. Melanoma of the oral cavity is rare. Melanin-producing melanomas must be differentiated from benign melanosis of mucous membranes. Melanomas demonstrate less tendency for necrotic ulceration than do squamous cell carcinomas. Sarcomas and lymphomas arising anew in soft tissues of the oral cavity are rare and appear as painless, smooth, mucosa-covered masses. Malignant minor salivary gland tumors have a similar appearance and most often occur on the hard palate or floor of the mouth.

Pyogenic granuloma, tuberculous ulcers, and primary or secondary chancre are benign diseases but occasionally may be confused with cancer. Pyogenic granuloma has a bluish red tint and occurs on the gingiva or tongue protruding above the epithelium similar to a cupola (Fig. 73-16). It bleeds copiously when manipulated and has a softer consistency than cancer.

Extragenital chancre or tuberculous ulcers may appear on the lips and the tip of the tongue, which can present diagnostic difficulties. The history of a rapidly developing, ulcerated, firm lesion with evidence of spirochetes on dark-field examination should establish the diagnosis of syphilis. Acute tuberculous ulcers can occur on the buccal mucosa and tongue and are associated with an active pulmonary focus. Tuberculous ulcers tend to be less shaggy and more painful and have less debris in the depth of the ulcer than chancres.

Benign papillomas and keratoacanthomas typically are confused with lip cancer because they are exophytic and occur on the vermilion border or adjacent skin. Papillomas are more exophytic for their size than carcinomas and tend to be pedunculated. Because the base of the papilloma is situated chiefly in the epithelium of the lip, minimal induration of the lip occurs.

*Keratoacanthoma* (molluscum sebaceum) can occur on the cutaneous aspect of the lip and can resemble a squamous cell carcinoma (Fig. 73-17). These lesions are usually circular with a central crater and may grow rapidly. They have a tendency to regress spontaneously, but malignancy should be suspected until growth has ceased and signs of involution appear. Histologically, they are well circumscribed and have a central keratinizing core.

Two benign lesions of the hard palate may be misinterpreted as malignant: follicular lymphoid hyperplasia and necrotizing sialometaplasia. Follicular lymphoid hyperplasia appears as a slowly growing, nonpainful mass of the hard palate that represents a reactive lymphoid proliferation. Histologically, it closely resembles follicular lymphoma, and both disease display similar clinical findings. It is imperative that the pathologist be familiar with the features that separate these two entities. In equivocal cases, immunoperoxidase staining helps determine whether the lesion is monoclonal (neoplastic) or polyclonal (reactive) (Wright and Dunsworth, 1983).



Similar to follicular lymphoid hyperplasia of the hard palate, necrotizing sialometaplasia is a reactive lesion involving the hard palate and most frequently is observed in smokers. The lesion may also occur in the floor of the mouth or the buccal mucosa and appears as an ulcerative lesion sometimes confused clinically and histologically with squamous cell carcinoma. A biopsy differentiates it from squamous cell cancer and shows inflammation and metaplasia of minor salivary gland tissue with no evidence of malignancy. Necrotizing sialometaplasia is a self-limiting disease and regresses over several weeks.

Granular cell tumor may be seen anywhere in the oral cavity but most frequently occurs in the tongue. This benign tumor consists of pleomorphic cells with granular cytoplasm and has the gross appearance of a firm, nontender, pedunculated or sessile mass (Batsakis, 1974). Its most significant feature is the presence of extensive hyperplasia of the overlying surface epithelium in 50% to 65% of cases. This hyperplasia can be misdiagnosed as squamous cell carcinoma, particularly if the biopsy is shallow (Fig. 73-18).

### **Clinical Staging**

Both grading and staging of neoplasms provide the physician with information concerning the prognosis of cancer. Grading designates the relative differentiation of cells that compose the tumor and has not been found to be highly correlated with prognosis of head and neck cancer. Staging refers to the extent of tumor spread and has been standardized into the T (tumor), N (nodes), M (metastases) system by the International Union Against Cancer (UICC). The American Joint Committee on Cancer Staging and End Results Reporting (AJC, now AJCC) was organized in 1959 under the auspices of several professional organizations. A TNM system of staging was adopted similar to the UICC, but emphasis was placed on simplicity and practicability. In the USA the AJCC staging system is the most widely accepted method of staging head and neck cancers (American Joint Committee on Cancer, 1980). All references to TNM and staging in this chapter are to the AJCC system.

The purpose of staging cancer of the head and neck is to determine treatment planning and provide common terminology in reporting end results and in comparing treatment methods. The various TNM categories are grouped into stages that reflect both the extent and prognosis of the tumor. The categories are based almost entirely on the anatomic extent of the tumor, as determined by inspection, physical examination, and other diagnostic methods. Regardless of subsequent findings, the original clinical classification cannot be altered if the staging system is to have any clinical significance. Although surgical and pathologic classifications are possible, they are less important in the overall management of cancer.

For the oral cavity the system provides for staging only squamous cell carcinomas. No staging system is perfect because clinical examination requires human judgment with the potential for inherent imperfections. In addition, the present staging system considers only anatomic factors. Other factors such as cell kinetics and the immunologic and nutritional status of the host may play an important role in prognosis. These parameters may become important components of future staging system. Table 73-4 depicts the T classification of oral cavity cancer, which indicates extent of the primary tumor as determined by its size. T1 tumors are 2 cm or less in greatest diameters, T2 are between 2 and 4 cm, T3 are greater than 4 cm, and T4 represent massive tumors greater than 4 cm in diameter with deep invasion involving structures outside the oral cavity.

Clinical classification of cervical lymph nodes is the same for oral cavity cancer as for carcinoma of all other head and neck areas (Table 73-5). The clinical evaluation is based on the actual size of the nodal mass as measured, recognizing that most nodes larger than 3 cm in diameter are not single but confluent nodes or represent direct tumor extension into soft tissues of the neck. Clinically positive nodes are classified as N1, N2, or N3. The use of subgroups a, b, and c is not required but is recommended. Midline nodes are considered as ipsilateral. Metastases to lymph nodes peripheral to the head and neck, such as the axilla or mediastinum, are considered distant metastases. The status of distant metastatic disease is denoted by the M classification (Table 73-5). Distant metastases are uncommon among patients who first have oral cavity cancers.

The clinical stage grouping for oral cavity cancer is depicted in Table 73-6. Stages I and II represent tumors confined to the primary site. Stage III denotes large primary tumors or represents a single ipsilateral cervical metastasis 3 cm or less in diameter. Stage IV disease represents massive primary tumor or more extensive regional or distant metastases.

### **Management**

A number of therapeutic modalities currently are available for the management of oral cavity cancer. The most important of these include surgical excision, radiation therapy, chemotherapy, or a combination of two or more of these modalities. The treatment employed depends on the tumor's extent and location, the patient's physical and social status, and the physician's experience and skill. In general, either surgery or irradiation are equally successful in controlling small tumors confined to the site of origin (stage I). The advantage of radiation therapy is that the patient's resulting overall functional disability is usually less compared to that following surgery, particularly for stage II tumors of the oral cavity. Speech and deglutition tend to be better after radiation therapy than after surgery. Radiation therapy is particularly advantageous for ill-defined neoplasms located posteriorly that make surgical exposure and resection more difficult. The major disadvantage of radiation therapy is the often permanent xerostomia. Full-mouth tooth extractions may be required before instituting therapy to avoid the risk of progressive deterioration of the teeth (Fig. 73-19) and the development of osteo-radionecrosis. Xerostomia may prevent some patients from wearing dentures following radiation therapy.

Small anteriorly located cancers of the oral cavity may be surgically resected even with the patient under local anesthesia. This procedure is often easier on the patient and requires less time than radiation therapy. The surgical defect may be closed primarily, skin grafted, or allowed to heal by secondary management without significant functional impairment. The advantages of surgery include the avoidance of xerostomia and the rapid rehabilitation of the patient. The major disadvantage is the functional disability, which is directly related to the extent of resection of the mandible or tongue.

### **Radiation therapy**

General principles govern the use of radiation therapy in the treatment of oral cancer (Wang, 1979): (1) most squamous cell carcinomas are radiosensitive, although high doses of radiation are required for local control; (2) well-oxygenated neoplasms are more radioresponsive than hypoxic ones; (3) bone or deep muscle invasion decreases

radiocurability; and (4) cervical metastases are better managed by neck dissection, with or without adjunctive radiation therapy.

Contemporary radiotherapeutic modalities include the use of the telecobalt-60 unit, low-megavoltage linear accelerators, or interstitial implants of radioactive substances. Kilovoltage radiation from 200 kV x-ray machines is useful for treatment of lip cancers and for peroral cone therapy.

Radiation therapy is indicated when survival is equal to and morbidity is less than surgery alone or combined therapy. To surgically debulk tumor or perform limited resections of neoplasms in combination with radiation therapy is not appropriate. When using a cobalt source or linear accelerator, doses of 6500 to 70000 rad are considered curative. These doses may be modified by the tolerance of the patient; they usually are delivered through bilateral, opposing parallel cervicofacial fields. Fields usually include all of the oral cavity and cover at least the primary echelon of draining lymphatics. The fields are expanded to include the entire neck for treatment of larger tumors or when used in a combined therapy format. A supplemental low anterior cervical field covering the supraclavicular area and upper mediastinum is employed when positive surgical nodes are present in the lower neck region.

Radiation therapy is usually given in 200 rad per day quanta over 5 to 7 weeks. A dose of 4000 to 4500 rad in 4 weeks is given when radiation therapy precedes planned surgical resection as part of a combined therapy regimen. It is inappropriate, however, to administer a preliminary "trial of irradiation", since no correlation exists between the response of a tumor after receiving 4000 to 4500 rad and ultimate survival rates.

Interstitial irradiation (brachytherapy) is frequently used in combination with external radiation therapy to treat cancers of the tongue and floor of the mouth (Fig. 73-20). Much larger doses are given to local tissues than to the surrounding region with use of radium needles or other radioactive substances such as radon seeds, gold-198 seeds, tantalum-182 wires, iridium-192 seeds, and cobalt or cesium needles. Brachytherapy is usually accompanied by at least 5000 rad of external radiation to prevent seeding by the implants.

### ***Prophylactic neck irradiation***

Management of the clinically negative neck in the patient with primary squamous cell carcinoma of the oral cavity remains an active debate. Occult metastases consist of microfoci tumors in cervical nodes that are not clinically detectable. The incidence of occult metastases varies with site and size of the primary tumor in the oral cavity and ranges from 15% to 60% (Lyall and Schetlin, 1952; Ward et al, 1959). Elective neck dissection has been advocated in the management of oral cancer in 30% or more of patients with probable occult metastases. Recent reports have advocated the use of prophylactic neck irradiation for the treatment of occult metastases. These reports indicate that radiation therapy of the clinically negative neck to a level of 5000 to 5500 rad will control occult disease and prevent later occurrence of cervical metastases (Fletcher, 1972; Million et al, 1963). Provided the primary remains controlled, development of cervical nodal disease occurs in less than 5% of oral cavity cancer patients undergoing prophylactic neck irradiation (Bagshaw and Thompson, 1971; Million, 1974; Rabuzzi et al, 1980). This statistic is in contrast to an expected 25% failure rate in patients initially having N0 classified necks and receiving no neck treatment.

The minimal morbidity associated with 5500 rad delivered to the neck has encouraged me to replace elective neck dissection with prophylactic irradiation for T3, T4, and selected T2 malignancies of the oral cavity. Elective neck dissection remains the treatment of choice when composite resections are necessary and in some instances where regional myocutaneous flaps necessary for reconstruction may prevent adequate evaluation of the neck in follow-up examinations. Prophylactic irradiation of the neck relieves the patient of the functional and cosmetic deformity of neck dissection. Neck fibrosis is not a serious problem when 5000 rad are administered over 5 weeks; however, transient xerostomia may occur as a result of encompassing submandibular and parotid glands in the irradiated fields. Although prophylactic neck irradiation appears to be at least as effective as elective neck dissection in the management of occult neck disease, prospective randomized studies are needed for conclusive evidence in support of one modality or the other.

### **Surgery**

Local surgical excision may be used for malignancies of the oral cavity measuring 2 cm or less. Most small oral cavity cancers can be exposed and resected perorally; however, tumors extending toward or into the oropharynx may require a transcervical approach.

Surgical resection is the preferred treatment of oral carcinoma in patients who use excessive tobacco and alcohol and who admit that they will not reduce or stop this consumption after treatment. Persistent severe mucositis and edema of the mucous membranes are observed when such patients are treated with radiation therapy. These patients are at high risk for developing additional primary tumors of the upper aerodigestive tract. If the initial tumor is small, surgery alone would reserve radiation therapy for use in a combined regimen to manage subsequent primary neoplasms that might warrant treatment of greater magnitude.

Carcinoma of the oral cavity with invasion of the mandible is less radiocurable than neoplasms confined to soft tissue. Thus, when a neoplasm directly invades the mandible, surgery is the preferred treatment. Conventional radiography, including dental Panorex views, is most helpful in determining invasion of bone, although normal radiographic findings do not preclude bone involvement. As high as 30% of patients with oral cavity cancer encroaching on the mandible and with normal radiographic findings have microscopic invasion of bone. Bone scanning with technetium-99m-phosphate is sensitive enough to be positive in bone involved with tumor before these lesions can be detected by conventional radiographic examination. However, specificity to differentiate between tumor, infection, trauma, and inflammation is lacking.

The high incidence of microscopic invasion of the periosteum and cortical layer of the mandible in light of normal radiographic findings has warranted guidelines for the surgical management of the mandible. Tumors that encroach on the mandible and do not provide a margin of 1.5 cm of normal tissue between tumor and bone usually require that at least a portion of the mandible be resected (Fig. 73-21). Depending on the location of the neoplasm, a marginal resection of the upper portion of the mandible or resection of the inner or outer cortical plate of the jaw may provide an adequate margin around the tumor while still preserving mandibular continuity. Specimens of cancellous bone from the remaining mandible should be submitted for histologic examination. Direct invasion of the mandible demonstrable by radiography requires a full-thickness segmental resection of the mandible. In such

instances, samples of the inferior alveolar nerve from the remaining mandibular segment should be submitted for frozen section analysis to check for tumor tracking in the medullary portion of the mandible.

Preservation of the bony architecture of the jaw is particularly important in the region of the anterior arch to preserve facial contour and deglutitional function through continued support of the tongue and the floor of the mouth. The arch is preserved when possible by marginal resection. Complete preservation of the mandible is possible using pull-through resections when it is not necessary to include a portion of the mandible to conform to en bloc procedures (Fig. 73-22). Combining the peroral and transcervical approaches obviates the need to divide and rewire the mandible in the midline for surgical access when performing an en bloc resection of oral cavity cancer.

Resection of the anterior arch of the mandible results in disability that is directly related to the amount of bone removed. In most instances, reconstruction of the mandible is necessary to restore function and cosmesis. Minimal resection of the arch may allow primary anastomosis without the need for bone grafting. In contrast, lateral resection of the mandible produces only moderate disability, and reconstruction for restoration of function often is necessary. The entire body and ascending ramus of the mandible may be removed without incurring significant deglutitional disability. Proper occlusion of the remaining mandible is maintained through exercise and occasionally through oral prosthetic devices that prevent migration of the mandibular segment.

Largely because of the potential for bone involvement, cancers of the hard palate generally are managed by surgery. Removal of portions of the maxilla and upper alveolus may be necessary to encompass the neoplasm. Small tumors can be resected perorally. Subtotal maxillectomy may require an extended Caldwell-Luc incision that allows mobilization of the upper lip and cheek on both sides to expose the entire maxilla (Fig. 73-23). Full-thickness resection of the hard palate results in a fenestration of the nasal passage or maxillary sinus. Oral prostheses are very effective in obturating the hard palate and can be attached to removable partial or full upper dentures (Fig. 73-24).

Surgery is indicated in patients who have completed a full course of radiation therapy and demonstrate persistent tumor or suffer recurrence at the primary site or in the neck. Incomplete healing of the primary site immediately following full-course radiation therapy should be observed closely, allowing 8 to 12 weeks to elapse before biopsy. If tumor is persistent, en bloc resection is indicated, including the entire area of the original tumor. If clinically positive lymphadenopathy was present before irradiation, neck dissection also is performed. If radiation therapy controls the primary tumor but the patient continues to have palpable lymphadenopathy, neck dissection without resection of the primary site is indicated.

### *Neck dissection*

Some physicians claim that radiation therapy can cure clinically positive cervical nodes less than 3 cm in diameter (Schneider et al, 1975; Wizenberg et al, 1972). Most agree, however, that the presence of cervical metastases is an indication for surgical treatment. Although cervical metastases may be treated with brachytherapy or external roentgentherapy, these modalities are less successful than surgery. The success rate in surgically controlling

metastatic neck nodes, once they are histologically confirmed, ranges from 25 to 50%. Although recurrences after surgery are managed by radiation therapy, cure is rare. In patients with nodes developing after initial therapy, treatment by neck dissection is about as successful as for patients surgically treated for nodes found at the initial evaluation.

Although metastases from oral cavity cancer usually are confined to submandibular and upper jugular nodes for extended periods before spread to lower cervical lymph nodes occurs, supraomohyoid neck dissection is not recommended. Such surgery offers a higher recurrence rate than a complete neck dissection. When the tumor involves or approaches the midline, however, the therapeutic neck dissection on the affected side should include a prophylactic contralateral suprahyoid dissection. The presence of bilateral metastases calls for bilateral neck dissection.

Prophylactic neck irradiation of clinically negative (N0) necks to control occult regional metastases has created greater controversy over indications for elective neck dissection. The purpose of an elective neck dissection is to remove microscopic metastases from the neck before they become clinically manifested. Theoretically, this should improve cure rates. Although the efficacy of elective neck dissection has not been proved, it appears to be indicated in the following situations:

1. Recurrent oral cancer following full-course radiation therapy for the primary tumor and neck.
2. Large tumors requiring segmental mandibulectomy, when the neck must be surgically violated.
3. Reconstruction requiring use of bulky myocutaneous flaps under the cervical skin, which would prevent easy detection of adenopathy.
4. When a high probability of occult metastases exists, and prophylactic neck irradiation is not part of the treatment plan.

The classic neck dissection involves the en bloc removal of the lymphatic vessels of the lateral neck. The dissection removes the internal jugular vein, submaxillary gland, sternocleidomastoid muscle, and the eleventh cranial (spinal accessory) nerve (CN XI). Modifications of the standard radical neck dissection have been described and involve preservation of one or more of these structures. Preservation of CN XI appears to be the most important contribution of a conservative (modified) neck dissection because it prevents to some degree the painful shoulder syndrome. Controversy over conservative neck dissection continues; most studies suggest that failure rates in the neck after conservative neck dissection are similar to those following radical neck dissection (Jesse et al, 1978; Lingeman et al, 1977). Other surgeons have noted no difference between types of surgery in patients with clinically negative necks but found a 4% failure rate in patients with palpable disease who underwent radical neck dissection, compared to 26% failure rate for patients who underwent conservative dissection (André et al, 1975). A prospective randomized trial is needed before this dilemma can be resolved. My conservative neck dissection involves preservation of CN XI only and is performed when surgery is used to treat N0 and selected N1 disease.

## Combined therapy

Most physicians have advocated the combination of radiation therapy and surgery in treating advanced stage III and IV disease of the oral cavity in hope of reducing local recurrence and improving survival rates. Preoperative radiation therapy has been shown to reduce neck recurrence significantly (Strong, 1969). Improved results also have been noted when using preoperative radiation therapy in the management of supraglottic laryngeal and pharyngeal carcinoma (Biller et al, 1969; Goldman and Friedman, 1969).

Debate over the timing of irradiation either preoperatively or postoperatively continues. No prospective randomized studies demonstrate the superiority of preoperative versus postoperative irradiation in the management of oral cavity cancer. Preoperative irradiation usually consists of 4500 to 5000 rad delivered at 200 rad/day. Surgery is initiated after a 4-week interval following radiation therapy. Resection encompasses a 2 cm margin of normal tissue around the entire area of the neoplasm, as determined before the administration of teletherapy. Theoretic advantages of preoperative irradiation in combined therapy include the following: (1) tumor cells may have better oxygenation before surgery and thus be more sensitive to irradiation; (2) malignant cells at the periphery of the neoplasm are destroyed; (3) tumor seeding at the time of resection may be decreased by forming an "envelope" of fibrosis around the neoplasm; and (4) there may be fewer and less viable cells intravascularly and within lymphatics at the time of surgery, which could lower the frequency of distant metastases.

The disadvantages of preoperative irradiation center around wound-healing problems, which increase as preoperative doses exceed 4000 rad. An increased incidence of tissue necrosis, wound infection, and fistula formation occurs when surgery is performed in an irradiated region. Because of fibrosis, inflammation, and decreased blood supply, reconstruction usually is more difficult. An additional disadvantage of preoperative irradiation is that changes in the size of the neoplasm as well as general inflammatory responses elicited by the radiation therapy may obscure tumor margins.

The disadvantages of preoperative irradiation have resulted in most surgeons preferring postoperative radiation therapy delivered to the primary site and neck over 6 weeks. Radiation therapy is commenced 3 to 4 weeks following surgery. Theoretic advantages of postoperative irradiation include (1) a higher total dose of irradiation may be safely administered; (2) subclinical residual tumor, which may remain following surgery are destroyed; (3) fewer wound infections are experienced; (4) tumor margins remain distinct, facilitating more accurate and complete surgical removal; and (5) irradiation may be directed to specific areas observed intraoperatively where tumor-free surgical margins are questionable.

The major disadvantage of postoperative irradiation is that theoretically surgery may interrupt the blood supply of remaining tumor cells and lessen their sensitivity to radiation therapy. Wound breakdown or other operative complications may delay the onset or prevent the delivery of radiation therapy. I currently use combined therapy for management of stage III and IV cancers of the oral cavity, consisting of surgical resection and postoperative irradiation with a dose of 6000 rad delivered to the primary site and neck.

Special precautions are taken for patients with oral cavity cancer undergoing combined therapy. Dental evaluation, including instruction in oral care, should be done before irradiation. Preoperative, intraoperative, and postoperative systemic antibiotics are administered. When the mouth or pharynx is exposed in combination with neck dissection, dermis grafting of the carotid artery is indicated if the patient has received preoperative irradiation. In cases of extensive resections, a controlled fistula or liberal use of regional skin flaps is advocated. Nonirradiated tissue should be used to cover regions of exposed bone.

Early complications of combined therapy include mucositis and poor nutritional maintenance. In the case of preoperative radiation therapy, wound infection, fistula, flap necrosis, and carotid rupture may occur. Late complications usually are chronic and the result of radiation therapy. These include xerostomia, rampant dental caries, and osteoradionecrosis.

### **Chemotherapy**

The effectiveness of chemotherapy in the treatment of oral cavity cancer is determined by objective measurable parameters. A *complete response (CR)* to drug refers to the disappearance of all measurable tumor mass. A *partial response (PR)* is the regression of at least 50% but less than 100% of all measurable tumor. A number of single agents can produce objective tumor reduction in patients with squamous cell carcinoma of the oral cavity. The most active agents include methotrexate, 5-fluorouracil, cisplatin, bleomycin, adriamycin, and cyclophosphamide. Methotrexate and cisplatin are the two most active agents in head and neck cancer (Carter, 1977; Panettiere et al, 1978; Wittes et al, 1977). Overall, 30% to 50% of patients respond to methotrexate given weekly, and 30% respond to cisplatin. Patients having received no previous chemotherapy or irradiation demonstrate higher response rates to these agents.

Until recently, randomized studies comparing various drug combinations with single-agent methotrexate have not demonstrated increased efficacy of combination regimens (Baker and Al-Sarra, 1979; Lehane et al, 1980). The Eastern Cooperative Oncology Group has now shown that the three-drug combination of methotrexate, bleomycin, and cisplatin produces significantly higher objective response rates than methotrexate alone (Kaplan et al, 1981). The improved response rate, however, has not resulted in increased survival. Many drug combinations have used methotrexate or cisplatin along with other agents in the treatment of head and neck cancer. Several drug combinations now can achieve a 45% to 65% response rate, with about 10% to 20% CR rates (Table 73-7) (Wheeler et al, 1983).

Increasing interest in the use of chemotherapy as an adjunct to conventional treatment of patients with advanced oral cavity cancer has occurred because approximately half of these patients continue to die of their disease, despite combined therapy with radical radiotherapy and surgery. Adjuvant chemotherapy consists of induction chemotherapy given before conventional treatment or maintenance chemotherapy administered following surgery and radiation therapy. Adjuvant chemotherapy occasionally may be sandwiched between surgery and radiation therapy.

Induction chemotherapy has been advocated in anticipation that substantial tumor regression from initial chemotherapy would result in a decreased incidence of local and regional tumor recurrence (Baker et al, 1981a). Maintenance chemotherapy is given for



systemic effects on the theoretic basis that it will eradicate susceptible occult metastases when they are microfocal. Although adjuvant chemotherapy theoretically should prolong disease-free intervals and increase overall survival rates, no study has yet supported this. It is evident that chemotherapy regimens that produce a high CR rate will be necessary to increase survival rates over those achieved by conventional combined therapy.

### *Intraarterial chemotherapy*

Intraarterial chemotherapy has been used to treat head and neck cancer for 3 decades. Tumors of the oral cavity are particularly suited for intraarterial chemotherapy because the entire primary neoplasm can be infused through the external carotid arteries. Theoretic advantages of intraarterial therapy compared to systemic chemotherapy include the following: (1) the concentration of drug in the infused region is higher than when the drug is administered for systemic effect; (2) systemic toxic effects are less pronounced; (3) larger quantities of drug can be tolerated with fewer local and systemic toxic effects when administered over several days than when given in a single injection; and (4) phase- or cycle-specific drugs may be more effective in destroying tumor cells when administered intraarterially over prolonged intervals.

Not all physicians are convinced, however, that intraarterial chemotherapy has significant advantages over chemotherapy administered by more conventional methods of bolus intravenous administration (Carter, 1977; Donegan and Harris, 1972; Tindel, 1967). Intraarterial infusion chemotherapy has not been widely accepted because of the need for prolonged hospitalization and the many complications accompanying its use. Most of the complications are related to the use of an indwelling catheter that must remain in place, thus requiring constant nursing care and a cooperative patient.

The difficulties of long-term hospitalization and the potential for infection, bleeding, or neurologic sequelae as the direct result of an external indwelling catheter can be avoided by using a totally implantable infusion system that can be maintained on an outpatient basis (Baker et al, 1981b; Baker et al, 1982). The pump consists of a hollow titanium disk separated into two chambers by a metal bellows. The inner chamber contains the drug; the outer one has a charging liquid in equilibrium with its vapor phase. The vapor pressure exerts pressure on the bellows and forces the drug out through a Silastic catheter and into the arterial system. The pump is placed beneath the skin, and the drug chamber is periodically refilled by percutaneous injections through a self-sealing silicone rubber septum in the top of the pump. The pump delivers 45 mL of infusate over 1 to 5 weeks, depending on the calibrated flow rate.

By infusing both external carotid arteries, a dual-catheter pump allows complete infusion of oral cavity cancer located in the midline or extending bilaterally. Likewise, complete unilateral infusion of the head and neck may be accomplished by using one catheter to infuse the external carotid system, which provides vascularity to the head and upper neck, and another catheter to infuse the thyrocervical trunk (Fig. 73-25). The thyrocervical trunk arises from the subclavian artery and provides the blood supply to the hypopharynx and the lower and midneck regions.

The infusion pump circumvents many of the complications previously associated with percutaneous intraarterial chemotherapy. The pump offers convenient access to arteries and veins. Drug dosage can be altered easily by emptying and refilling the pump with a different concentration of infusate. Similarly, a therapy can be intermittently discontinued by replacing the drug infusate with saline. Intraarterial bolus chemotherapy can be accomplished through an auxiliary injection port of the pump that allows direct access to the infusion catheter, bypassing the drug chamber.

### **Cancer of Lip**

The incidence of carcinoma of the lip in the USA is 1.8:100,000 (Szpak et al, 1977). The disease occurs most frequently on the lower lip of elderly males. Cancer most frequently originates in the exposed vermilion border just outside the line of contact with the upper lip. Tumors arising from the commissure represent less than 1% of reported cases (Longenecker and Ryan, 1965; Wilson and Kemble, 1972). When tumors occur on the upper lip, they frequently arise near the midline and account for 2% to 8% of all lip cancers (Jørgensen et al, 1973; Ward and Hendrick, 1950). More than one third of patients with carcinoma of the lip have outdoor occupations (Baker, 1980); prolonged exposure to sunlight has been implied as a major etiologic factor. The lip is susceptible to actinic changes because it lacks a pigmented layer for protection. Blacks have pigment in the lips, which may explain the rare occurrence of carcinoma of the lip in this population.

Most neoplasms of the lip are squamous cell carcinoma. The remainder of the malignant epithelial neoplasms originate from the minor salivary gland, predominantly adenoid cystic carcinoma, adenocarcinoma, or mucoepidermoid carcinoma.

The two most common morphologic types of squamous cell carcinoma of the lip are exophytic and ulcerative. The exophytic type is slightly more common than the ulcerative, grows superficially, and tends to metastasize late. The superficial portion of the tumor eventually becomes necrotic, and frank ulceration usually occurs when the lesion has reached 1 cm in size. The ulcerative type begins like the exophytic type, as an epithelial thickening; however, ulceration occurs earlier (Fig. 73-26). The tumor manifests a relatively greater tendency for rapid infiltration and invasion and is usually of a higher histologic grade than the exophytic type.

### **Diagnosis**

Carcinoma of the lip tends to have a protracted course. In early stages it usually demonstrates rather indolent behavior and frequently the only symptom is a blister or induration arising in an area of leukoplakia. A history of recurrent lip crusting that bleeds readily on removal is characteristic of this lesion. Such crusting may exist for many years before evidence of infiltration develops.

As carcinoma of the lip progresses, involvement of the mandible may occur. The patient must be closely examined for hypesthesia in the distribution of the mental nerve. Even in the absence of cortical bone destruction, tumor may grow along the mental nerve into the medullary portion of the mandible. Perineural invasion or direct extension from mandibular involvement may spread the neoplasm to the mental nerve.

Carcinomas of the upper lip and commissure grow more rapidly, ulcerate sooner, and metastasize earlier than lower lip cancer. Lesions larger than 2 cm or involving the upper lip or extending to the lateral commissure thus have a poorer prognosis. Mandibular involvement with the tumor also results in a poor prognosis and a higher incidence of regional metastases.

Cervical metastases occur in fewer than 10% of patients with squamous cell carcinoma of the lower lip (Jørgensen et al, 1973; MacKay and Sellers, 1964). Approximately 20% of patients with cancer of the commissure have cervical metastases on initial evaluation (MacKay and Sellers, 1964). Subsequent development of cervical metastases following treatment of carcinoma of the lip ranges from 5% to 15% (Jørgensen et al, 1973). Most metastases appear within 2 years following treatment of the primary tumor. The likelihood of their occurrence increases with increased duration and size of the primary tumor and with repeated local recurrences.

As a rule, metastases occur later in the course of disease with lip cancer than with malignancies found in other sites within the oral cavity; further dissemination also tends to occur later. When tumors occur in the midportion of the lower lip, the submental nodes usually are involved first; whereas when tumors arise on the lateral portion of the lip, the submandibular triangle nodes most frequently are involved. Metastatic spread from upper lip carcinomas tends to occur first to the preauricular and infraparotid lymph nodes. Spread then occurs more rapidly to the submandibular nodes and upper deep jugular nodes than is seen with lower lip tumors. Contralateral or bilateral metastases may develop when the primary lesion is near to or crosses the midline of the lip.

### **Management**

Small carcinomas of the lip may be treated successfully by either surgery or irradiation; the results are cosmetically acceptable with both methods. Radiotherapeutic treatment consists of brachytherapy or external radiation therapy. Electron beam irradiation with 7 to 18 million electron volts (meV) has been particularly useful for treating lip cancer. The advantage of 7, 9, or 11 meV electron beams over conventional teletherapy is the additional depth of penetration. The electron beam results in 80% to 100% of delivered energy at a depth of 2 cm with 7 meV and 3 cm with 11 meV. An added advantage is the rapid falloff in dose beyond those depths. Thus the mandible is irradiated very little in the treatment of most lip carcinomas. Regardless of the form of radiation therapy used, care must be taken to protect uninvolved tissues by the use of a cutout lead shield. The shield limits the beam to the desired region of the tumor and confines the side effects of radiomucositis and radiodermatitis to a minimal area of the lip.

Small tumors of the lip may be treated surgically by making a V-shaped excision and performing primary closure. A full-thickness, wedge-shaped excision of the tumor with at least a 0.5 cm normal tissue margin beyond the recognized limits of the tumor can be performed with the patient under local anesthesia. Advanced tumors should be managed by surgery or a combination of surgery and irradiation. Surgery offers the advantage of eradication of disease, pathologic survey of margins, and reconstruction of the defect in a single procedure.

Cervical metastases should be managed surgically, which offers a 5-year control rate of 50%. If neck dissection confirms the presence of histologically positive nodes, postoperative radiation therapy should be considered. Elective neck dissection for occult metastatic disease is not indicated for two reasons. First, the percentage of patients who subsequently develop cervical metastases following treatment of the primary tumor is less than 10% (Gladstone and Kerr, 1958; Jørgensen et al, 1973). Second, the cure rate of therapeutic neck dissection compared favorably with the cure rate in patients undergoing an elective dissection for confirmed occult metastases (MacKay and Sellers, 1964). Elective neck dissection may be advised, however, for large, undifferentiated tumors that involve the oral commissure and the upper lip.

## **Results**

The extent of disease governs the prognosis for cure in carcinoma of the lip. Tumors less than 2 cm in diameter that involve the lower lip have an excellent prognosis. Cure rates for T1 and T2 lesions without evidence of cervical node metastases generally are greater than 90% when surgery or radiation therapy is performed (Table 73-8) (Baker and Krause, 1980). If the population with lip cancer is considered as a total group, the average 5-year absolute and determinate survival without evidence of disease is approximately 65% and 80%, respectively, in a combined series of 10,230 patients (Baker, 1981a).

The incidence of recurrent disease increases and the cure rate drops significantly in large cancers of the lip (Fig. 73-27) (Baker and Krause, 1980). This is partly a result of the magnitude of the primary tumor and the higher incidence of metastases. Control of cervical metastases is more difficult. The overall curability of patients with cancer of the lip and regional metastases approaches 50% (Table 73-9) (Cross et al, 1948; Jørgensen et al, 1973; Mahoney, 1969; Modlin, 1950). The poorest results are obtained when cervical node metastases are fixed to the deep structures of the neck and when radiographic evidence of mandibular involvement exists. A statistical review of 3166 patients with confirmed squamous cell carcinoma demonstrated that when regional nodes were not involved on the patient's admission, the primary tumor was controlled in 93% of patients. Of the patient with lymph node involvement on admission, the primary tumor was controlled in 75%; however, control of cervical metastases was achieved only in 59% of patients (MacKay and Sellers, 1964).

## **Cancer of Oral Tongue**

The oral tongue is the mobile portion of the tongue anterior to the circumvallate papillae. It is the second most common site, after the lip, of oral cavity malignancies. Three quarters of all tongue cancers occur in the oral tongue. Squamous cell carcinoma makes up 97% of all malignant tumors. The disease predominates in males and has a peak incidence in the sixth and seventh decades of life; however, it may occur in patients younger than age 30 (Newman et al, 1983). When it occurs in the young, the usual causal agents of tobacco and alcohol may not be as influential or may involve a greatly reduced latency. Failure to perform a biopsy of tongue lesions in young persons often leads to delay of diagnosis. Cancer of the tongue has been correlated with poor oral hygiene, alcohol and tobacco use, and syphilitic glossitis. It is also associated with cirrhosis and Plummer-Vinson syndrome (Triegeer et al, 1958).

Infiltrative and exophytic are the two most common morphologic types of cancer involving the oral tongue (see Fig. 73-11). Exophytic types have less tendency to infiltrate deeply. Early in the disease they appear as an area of focal thickening or clinical leukoplakia or as a painless superficial ulceration. The infiltrative type may show minimal or no surface ulceration until late in its development. Squamous cell carcinoma of the oral tongue tends to be better differentiated than cancers of the tongue base and is usually grade I or II, moderately well differentiated. Lymphoepitheliomas do not occur in the oral tongue.

Carcinoma of the oral tongue most commonly arises from the lateral border of the middle third of the tongue; approximately 45% of all tongue cancers occur here. In contrast, 20% of cancers occur in the anterior third, and only 4% on the dorsum of the tongue (Frazell and Lucas, 1962).

Cervical metastases occur more frequently from cancer of the tongue than any other site within the oral cavity. Forty percent of patients have nodal metastases on admission (Yves and Ghossein, 1981b). Bilateral or contralateral metastases are uncommon, in contrast to tumors of the tongue base, but may be present when the tumor involves the midline of the tongue. Metastases usually occur first in upper deep jugular (subdigastric) lymph nodes and then spread downward along the jugular chain. Tumors arising from the anterior third of the tongue tend to metastasize slightly less frequently than those arising from the middle third (Batsakis, 1974). Unlike in the lip, the size of the primary lesion in tongue cancer is not necessarily correlated with the presence or likelihood of cervical metastases.

### **Diagnosis**

The intrinsic musculature of the tongue provides a minimal barrier to tumor growth, and thus malignancies may grow to considerable size before causing symptoms (Frazell and Lucas, 1962). In the early stages carcinoma of the tongue often is asymptomatic. Pain usually is not an early symptom and does not occur until branches of the lingual nerve become directly involved with neoplasm. Pain may either occur in the tongue or be referred to the ipsilateral ear. Referred ear pain is caused by the common origin from the trigeminal nerve (V3) of the lingual nerve, which supplies sensation to the oral tongue, and the auriculotemporal nerve, which supplies sensation to the external auditory canal and tympanic membrane.

Overall, approximately 30% of patients initially have symptoms of pain (Frazell and Lucas, 1962). In 10% of cases growth is rapid with minimal discomfort, so initial symptoms are a lump or mass in the mouth. Approximately 5% of patients complain of dysphagia, and 6% note an enlarged cervical lymph node. The presence of bleeding, slurred speech, and dysphagia suggest far-advanced disease.

Most cancers of the tongue are at least 2 cm in diameter when first seen. Neoplasms arising from the ventral aspect of the tongue frequently extend directly into the floor of the mouth and may involve the mandible. Extension posteriorly toward the tongue base onto the anterior tonsillar pillar and retromolar trigone areas is common. The incidence of regional metastases is higher when posterior spread occurs. Palpation reveals the neoplasm's true extent, which invariably is much greater than appreciated by inspection.

Biopsy is imperative in the diagnosis of carcinoma of the tongue. Tumors extending posterior to the tonsillar pillars require direct laryngoscopy and biopsy of the vallecula and tongue base to determine accurately the extent of spread.

### **Management**

Surgery and radiation therapy have been the mainstays for the treatment of carcinoma of the tongue. Optimal management of tongue cancer controls the primary tumor and neck disease while maximizing preservation of function. Small (stage I) tumors may be treated with surgery or radiation therapy with equal effectiveness. Surgical excision is most expeditious and rarely causes significant dysfunction. More infiltrative (stage II) neoplasms also may be managed surgically, but this results in greater speech impairment. Thus radiation therapy usually is preferred for most stage II tumors. It is imperative that radiation therapy include prophylactic neck irradiation because of the high incidence (40%) of occult metastases of T2N0 tongue cancers (Leipzig et al, 1982). When radiation therapy is administered in this fashion for stage II disease, elective neck dissection is not indicated. Surgery only for stage II tumors usually warrants an elective neck dissection.

Radiation therapy of oral tongue carcinoma can be accomplished with 6500 to 7000 rad of external beam or combined megavoltage radiation therapy and brachytherapy. Brachytherapy requires accurate spacing of interstitial seeds or needles to prevent overlapping of the radiation points. More precise dosimetry can be achieved by using afterloading techniques, in which the radioactive source is inserted into previously implanted hollow nylon tubes (Fig. 73-28). The tubes are positioned with the patient under general anesthesia. As much as 10,000 rad may be delivered to the tongue cancer. Considerable edema may occur in the tongue, necessitating tracheotomy at the time of initiating brachytherapy.

Combined treatment with surgery and radiation therapy appears to give better results than either surgery or radiation therapy alone for stage III and IV carcinoma of the tongue (Fletcher and Jesse, 1962; Leonard et al, 1968). No controlled prospective study, however, has confirmed the superiority of combined therapy over single-modality treatment. In our institution we administer postoperative radiation therapy of 5500 to 6000 rad to the primary site and neck. Tumors near the midline should have fields that cover both sides of the neck. In addition to postoperative radiation therapy, preoperative induction chemotherapy has been used in advanced stage IV tumors.

Surgery consists of pull-through partial glossectomies or, if the mandible is involved with neoplasm, a mandibulectomy along with neck dissection. To an extent not possible 10 years ago, better techniques now permit more aggressive surgery and tongue repair through reconstruction with composite flaps. Total glossectomy without the need for laryngectomy is now feasible with these techniques (Biller et al, 1983). Unfortunately, more aggressive surgical intervention has not improved survival of patients with advanced tongue cancer. The recurrence rate for cancer of the oral tongue is high and approaches 40% at the primary site. Persistent and recurrent uncontrolled primary disease is responsible for the death of most patients dying from tongue cancer.

## **Results**

Control of oral tongue cancer is closely correlated with the extent of the primary tumor and the status of regional lymph nodes. The presence of clinically positive nodes lowers survival by half. Because patients with large tumors have a higher incidence of regional metastases, survival is related to the T class as well as the disease stage. A recent report of 602 previously untreated patients with cancer of the mobile tongue noted that most patients (48%) had tumors classified as T2. Thirty-six percent had T3, and only 16% presented with small, T1 malignancies; 64% had no palpable nodes (N0). Five-year determinate survival rates for T1, T2, and T3 tumors were 80%, 56%, and 25%, respectively (Table 73-10) (Yves and Ghossein, 1981a). Overall 5-year determinate survival was 48%. Of the patients with clinically negative necks, 59% survived 5 years. Primary tumors usually were managed by brachytherapy and external beam radiation therapy. Surgery was the most common method used in the management of neck nodes.

In many studies survival rates of patients with cancer of the oral tongue are difficult to clarify because no clear distinction is made between treatment results from the anterior two thirds of the tongue and from the floor of the mouth or base of the tongue. It is apparent, however, that the approximate 5-year survival rates for stage I disease is 70% and stage II is 50%. Survival rates for stages III and IV range from 15% to 35% (Table 73-10). Overall survival rate, considering all patients with carcinoma of the oral tongue, is near 50%. In the past, tumors of the anterior two thirds of the tongue were thought to have a more favorable prognosis than carcinoma of the tongue base. Recent reports have refuted this and have found that those cancers are no less dangerous than posterior tongue carcinomas. Since base of tongue tumors tend to be discovered at a later stage of disease, this probably is the source of the misconception that these cancers are more lethal (Leipzig and Hokanson, 1982; Leipzig et al, 1982).

Only 10% to 15% of patients who develop local recurrence at the primary site following treatment of oral tongue cancer are amenable to surgical resection. Even when feasible, salvage surgery for recurrence of the primary tumor usually is not successful, controlling disease in only 30% of cases (Wang, 1979; Yves and Ghossein, 1981a). This is related partly to confusing residual tumor with scar, resulting in delayed diagnosis of recurrent disease.

### **Cancer of Mouth Floor**

Approximately 500 persons die each year in the USA from cancer of the mouth floor (Barton, 1962). Floor of mouth cancers predominate in males in the fifth and sixth decades of life. The male/female ratio of occurrence is between 3 and 4:1 (Nakissa et al, 1978; Panje et al, 1980). Two thirds of patients are moderate to heavy smokers, and approximately 50% are heavy alcohol consumers. Many have poor nutritional habits.

Multifocal carcinomas are more common in patients with cancer of the mouth floor than in those with cancer of other oral cavity sites. A 20% incidence of second primary tumors occurs, with more than half of these in the head and neck area (Nakissa et al, 1978).

Most cancers of the mouth floor are squamous cell carcinoma. The majority are grade I or II, well or moderately well differentiated. The most common morphologic type is a superficial exophytic tumor. As the tumor enlarges, ulceration occurs. The loose connective tissues in the submental and submandibular spaces facilitate tumor extension. Advanced cancers frequently appear with direct extension into soft tissues and skin of the submandibular triangle (Fig. 73-29). Fixation of tumor to bone shows mandibular involvement with the neoplasm. Spread along the periosteum is common once the infiltrative growth has reached the mandible. Restricted mobility marks invasion into the root of the tongue. The tumor may descend into the tissue plane between the tongue and the mouth floor as far as the hyoid bone.

Metastases to cervical lymph nodes from cancer of the mouth are observed in approximately 50% of patients when first evaluated. The submandibular lymph nodes most frequently are involved, followed by upper deep jugular nodes (Nakissa et al, 1978). Submental nodes rarely are involved with metastases. Tumors classified as T2N0 have a 40% occult metastatic rate, and 70% of T3N0 tumors have occult metastases. Table 73-12 shows the distribution according to stage from a series of 273 patients with cancer of the mouth floor (Applebaum et al, 1980; Guillaumondegui et al, 1980; Panje et al, 1980). One half of patients have advanced stage III and IV disease.

### **Diagnosis**

Carcinoma of the mouth floor most frequently is located in the anterior portion of the floor and usually extends to the root of the tongue and into the mandible. Posterior extension along the gutter of the mouth is less common. Palpation demonstrates the depth of infiltration. Similar to tongue carcinoma, cancers of the mouth floor usually do not cause pain until they become deeply infiltrative enough to involve periosteum or branches of the lingual nerve. The most common symptom encountered on initial evaluation, however, is a painful mass in the mouth. Patients occasionally complain of ill-fitting dentures. A lump in the neck and impairment of speech are late symptoms.

Cancers located near the midline may spread along the duct of the submandibular gland or obstruct the duct. When obstruction occurs, the gland swells and becomes indurated and may be difficult to discern from metastases or direct tumor extension. Fine-needle aspiration and cytologic examination may be helpful in determining whether the submandibular mass represents a metastatic node or an enlarged submandibular gland.

Radiographic evaluation of the mandible is unreliable in detecting early bone involvement by cancer. This involvement is best assessed clinically by thorough palpation of the tumor. Immobility related to the lingual cortex of the mandible suggests at least involvement of the periosteum. Tumor invasion of the gingiva automatically is restricted in mobility because the gingiva adheres to the underlying alveolar bone. In these situations the physician must rely on radiographic findings and histologic assessment at the time of surgery. When floor of the mouth cancers involve mucosa of the mandible, bone involvement by the neoplasm is common: approximately 7% of T1, 55% of T2, and 63% of T3 tumors. Among T2 cancers demonstrating bone erosion on radiography, approximately 70% show only destruction of the compact layer with a superficial bone defect, whereas 75% of T3 tumors having bony erosion show extensive basinlike defects or complete rarefaction of the mandible



(Otten and Duker, 1981). Whenever bone erosion is noted before treatment, the prognosis is poorer and a T4 designation is given.

### **Management**

Stage I and small (T1, T2) squamous cell carcinomas of the mouth floor involving mucosa alone may be treated effectively by either surgery or irradiation with equal results. Peroral, wide local resection of stage I tumors usually is more convenient than radiation therapy. Defects are closed primarily or with the help of skin grafts or local flaps. Radiation therapy of stage I and II disease usually consists of a combination of megavoltage and brachytherapy. A dose of 6000 to 7000 rad is administered by external beam to the primary tumor and at least the upper echelon of lymph nodes over 6 to 7 weeks.

Stage I and II cancers of the mouth floor that are attached to or invade the mandible should be surgically treated because bone involvement by the tumor compromises radiation therapy. Tumors that appear to involve periosteum or superficially invade the mandible usually can be excised along with a partial-thickness resection of the mandible. Depending on the site of tumor attachment, either the superior one half or the lingual cortical plate of the bone is removed (see Fig. 73-21). If evidence of bone destruction exists, a full-thickness segmental resection of the mandible should be performed (Fig. 73-30). Frozen section control of the inferior alveolar nerve at the resected mandibular margins should be obtained.

Stage II malignancies of the mouth floor managed by surgery usually require a transcervical approach. An en bloc resection should remove the contents of the entire submandibular triangle, anterior belly of the digastric, portions of the mylohyoid and hyoglossus muscles, and the floor of the mouth tumor together (Barton, 1969). The high occult metastatic rate (40%) of stage II floor of mouth cancers warrants elective neck dissection or prophylactic neck irradiation.

Combined surgery and radiation therapy is the preferred treatment of stage III and IV cancer of the floor of the mouth, although preoperative radiation therapy does not appear to influence the outcome significantly (Kolson et al, 1971; Panje et al, 1980). We administer postoperative radiation therapy which consists of 6000 to 6500 rad to the primary site and both sides of the neck. Induction chemotherapy is added to the regimen for stage IV disease.

Advanced tumors frequently require segmental resection of the anterior arch of the mandible and neck dissection. Functional disability associated with loss of the anterior arch is significant and is directly related to the amount of bone removed. Bulky regional myocutaneous flaps are useful for reconstruction of the mouth floor and provide adequate soft tissue coverage for subsequent autogenous bone grafts. Mandibular reconstruction should be delayed until intraoral suture lines are well healed. Meanwhile, the remaining mandibular segments should be stabilized by an external appliance (Fig. 73-31). This prevents migration of the segments and maintains proper dental occlusion.

Neck dissection is indicated when clinical evidence of regional metastases exists. Anterior floor of mouth tumors near the midline with unilateral metastases require removal of the lymph nodes in the contralateral submandibular triangle. If these nodes contain tumor, bilateral neck dissection is indicated. Simultaneous bilateral neck dissection carries a high

morbidity (Razack et al, 1981). When possible, dissection should be staged at an interval of 4 to 6 weeks.

## **Results**

Five-year survival rates for stage I and II cancer of the mouth floor range from 60% to 80% in patients treated with irradiation or surgery. As expected, a poorer prognosis for stage III and IV disease exists despite aggressive combination therapy. Table 73-13 summarizes the five-year survival rates in three recent series (Harrold, 1971; Panje et al, 1980; Tribble, 1978). Cancers were treated by surgery, radiation therapy, or both modalities. The largest series consisted of 634 patients treated over 29 years (Harrold, 1971). The study noted a 5-year survival rate of 69% for 135 patients with stage I tumor, 49% for 205 patients with stage II, 25% for 233 patients with stage III, and 7% for 70 patients with stage IV disease.

Overall, approximately 40% of all patients with floor of mouth cancers are cured (see Table 73-13). Ipsilateral node involvement markedly reduces survival rates to 25%. Other factors that appear to lessen survival are involvement of the tongue and mandible with neoplasm. Tumor extension out of the oral cavity posteriorly or anteriorly is a serious prognostic factor (Table 73-14) (Panje et al, 1980). Approximately 90% of recurrences occur within 2 years following treatment.

### **Cancer of Alveolar Ridge**

Squamous cell carcinoma of the gingivae (gum, alveolar ridge) is an uncommon oral cavity malignancy when compared to cancer arising from the lip, tongue, or floor of the mouth. It represents approximately 10% of all oral cancers. The disease has a prevalence for males, generally in a 4:1 ratio over females, and predominates in the sixth and seventh decades of life (Batsakis, 1974). Among users of tobacco, it tends to be found in pipe and cigar smokers. As many as half of all cases, however, occur in persons who do not use alcohol or tobacco (Byers et al, 1981). In these patients irritation caused by the lengthy use of ill-fitting dentures is the likely etiologic factor.

Eighty percent of carcinomas of the gingivae occur on the lower gum. Most tumors occur in the molar area or the posterior third of the dental arch. Most gingival cancers develop in edentulous areas. Because the gingival mucosa adheres directly to the periosteum of the mandible, tumors arising from this region are likely to invade the underlying bone. From 35% to 50% of patients will have neoplastic destruction of the mandible that is demonstrable radiographically or histologically (Byers et al, 1981; Swearingen et al, 1966). Similarly, because the gingivae represents a small regions of the oral cavity, 90% of cancers extend beyond the gum to involve adjacent structures.

Carcinoma of the gingivae is commonly associated with leukoplakic changes and may arise from areas of leukoplakia or severe periodontal disease. Most malignancies are well-differentiated grade I neoplasms. The typical morphologic type is an exophytic papillary (Fig. 73-32) or ulcerating tumor with a tendency toward peripheral spread rather than deep extension into the soft tissues. Some tumors may appear as a nodular or disklike lesion.

Cancers of both the upper and the lower gingiva metastasize first to the submandibular lymph nodes. Upper gingival cancers may spread initially to upper deep jugular lymph nodes. Clinical evidence of metastases is present or develops in the course of disease in 30% of cases (Byers et al, 1981; Lee, 1973). An occult metastatic rate of 15% probably exists. Metastases are slightly more common from tumors of the lower gingiva.

### **Diagnosis**

The clinical diagnosis of alveolar ridge cancer may be more difficult than for tumors elsewhere in the oral cavity because of confusion with benign inflammatory or reactive lesions of the gums. Occasionally, maxillary sinus cancers may appear as upper gingival lesions (Fig. 73-33). In certain circumstances, discerning whether the tumor is of gingival or antral origin may be impossible. Radiographic evaluation with both conventional polytomography and CT scan may be helpful in this regard and also will provide precise information concerning the extent of bone involvement.

Cancers arising from the alveolar mucosa in regions bearing teeth appear to occur at the free gingival margin adjacent to the tooth surface. In such instances the first clinical sign may be loosening of the tooth. In edentulous patients the first symptom is usually inability to obtain proper denture fitting or difficulty with mastication. Pain is an early symptom of gingival cancer because of neoplastic involvement of periosteum as the tumor progresses. Late symptoms include bleeding and a complaint of a mass in the mouth.

Radiographs of the mandible are required to assess lower gingival malignancies. Smooth, erosive pressure defects of the alveolar bone or upper cortical surface of the mandible should be distinguished from the "mothly" type of bone destruction that tumor infiltration of bone causes. The latter finding suggests tumor extension toward the medullary portion of the mandible and usually necessitates segmental resection. Normal radiographic findings must be interpreted with caution. One third of patients without radiographic evidence of bone erosion will have histologic evidence of tumor involving bone (Swearingen et al, 1966).

### **Management**

Treatment of gingival cancer is governed by the extent of tumor, degree of bone involvement, and status of cervical lymph nodes. Most physicians prefer surgery for stage I and II disease. Small, localized (stage I) tumors of the lower alveolus may be excised perorally in conjunction with a marginal resection of the mandible. Neoplasms requiring segmental resection of the mandible are best approached externally. Upper alveolar cancers also may be removed perorally. An alveolectomy or partial maxillectomy may be accomplished in most cases without the need for facial incisions. In 60% of surgically treated patients with gingival cancers, less than a full segment of bone is necessary for adequate tumor resection with little cosmetic or functional impairment (Byers et al, 1981).

External beam irradiation of teletherapy directed through a peroral cone may be used to treat small, superficial stage I neoplasms if no significant bony involvement exists. However, tumors that show radiographic evidence of minimal bone erosion as a result of pressure on the cortical bone also may be managed by irradiation (Whitehouse, 1976). With

more extensive bone involvement, the increased risk of osteoradionecrosis precludes the use of radiation therapy as the primary mode of treatment.

Surgery alone can provide a satisfactory local control rate for large T2 and T3 tumors; however, segmental mandibulectomy or partial maxillectomy usually is necessary. Combined surgery and radiation therapy also have been advocated for treatment of stage III and IV cancers of the gingivae. Neck dissection is indicated in all patients with clinically positive nodes. If nodes are found to contain tumors, postoperative radiation therapy is warranted. Elective neck dissection probably is unwarranted in the initial management of stage II gingival cancer because of the low incidence of occult metastases. Patients with T3N0 and T4N0 neoplasms, however, should be considered for elective neck dissection or prophylactic neck irradiation.

## **Results**

Overall 5-year survival rates for all patients with carcinoma of the gingiva range from 50% to 65%. No significant difference in survival exists between malignancies of the upper and lower jaw. Of 101 determinate patients with cancer of the lower gingiva, 5-year survival was 78% for stage I, 64% for stage II, 35% for stage III, and 15% for stage IV disease (MacComb and Fletcher, 1967). Surgical results appear clearly superior to those cases treated by radiation therapy only, probably because of the frequent early bone involvement of these neoplasms.

## **Cancer of Buccal Mucosa**

Buccal carcinoma is an uncommon form of oral cavity cancer, representing 5% of all oral cancers in the USA. In patients with more advanced disease, the mean age is in the seventh decade of life (O'Brien and Catlin, 1965). It occurs more often in men, at a 3:1 or 4:1 ratio over females. Buccal carcinoma is more common in the southeast compared to the rest of the USA: snuff dipping by rural southern women is a common habit and is held responsible for the higher incidence in this region. In support of tobacco chewing as the main etiologic factor, women in the southeastern USA have almost the same incidence of buccal cancer as men. Another etiologic factor may be local irritants from poor oral hygiene. Jagged carious teeth causing chronic irritation may explain why many buccal carcinomas occur in the area of the cheek mucosa marked by the occlusal plane (Martin and Pflueger, 1935). Most recent studies, however, implicate tobacco and alcohol consumption as the major causative factors for buccal cancer.

Buccal carcinomas often arise with leukoplakia and frequently occur in the central posterior portion of the cheek. In tobacco chewers tumors more frequently may be located in the lower sulcus of the buccal mucosa where the quid is retained. Most tumors are well-differentiated grade I or II squamous cell carcinomas. Three distinctive morphologic types are recognized: exophytic, ulceroinfiltrative, and verrucous (Batsakis, 1974). The exophytic type is more common, appearing as a heap of soft, white outgrowth, often in an area of leukoplakia. Exophytic tumors are papillary, have a benign appearance, and usually do not ulcerate until they have reached 3 to 4 cm in size. Ulceroinfiltrative carcinomas penetrate into the deep, soft tissues of the cheek early and appear as deep, excavating ulcers surrounded by diffuse induration. They are more destructive than the exophytic type and may ulcerate

through the skin of the cheek or invade adjacent bone or masticatory muscles.

Although the least common morphologic type of buccal cancer, verrucous carcinoma occurs more frequently in the cheek mucosa than other sites within the oral cavity. It is a low-grade squamous cell carcinoma that rarely metastasizes. It has an indolent growth pattern, often arising in regions of leukoplakia, and therefore may be misdiagnosed as a benign hyperplasia. The clinical appearance of verrucous carcinoma is described earlier in this chapter. Briefly, it appears as a piled-up growth or papillary mass with considerable keratinization that usually gives it a whitish appearance. It grows by progressive enlargement as a single mass and penetrates the soft tissue to invade underlying bone and muscle and may extend to the skin of the cheek.

Approximately 65% of patients with cancer of the buccal mucosa have extensive disease beyond the cheek mucosa (Martin and Pflueger, 1935; O'Brien and Catlin, 1965). From 40% to 50% of patients have stage I and II disease (Bloom and Spiro, 1980; Conley and Sadoyama, 1973). Clinically, regional lymph nodes are involved, with metastases in about 50% of cases (Bloom and Spiro, 1980; Paymaster, 1956). The occult metastatic rate approaches 10% overall and is near 20% for stage II disease (Bloom and Spiro, 1980). Metastases occur to submandibular lymph nodes first. Tumors located posteriorly in the cheek, however, may spread initially to upper deep jugular lymph nodes.

### **Diagnosis**

Cancer of the buccal mucosa clinically tends to be insidious, and until ulceration occurs, pain may not be a symptom. Many tumors arise in regions of leukoplakia that presumably are less sensitive to pain as a result of hyperkeratosis. By the time pain or bleeding occurs, the tumor may be so advanced as to involve the entire cheek from the superior to the inferior gingival buccal sulcus. Extension beyond the buccal mucosa occurs most commonly on the upper or lower alveolus, particularly in edentulous patients (Table 73-15) (Bloom and Spiro, 1980). Additional regions of extension include the floor of the mouth, retromolar trigone, and hard palate.

Symptoms of buccal cancer include a complaint of a painful ulcer or roughening of the cheek mucosa. If the tumor arises posteriorly, infiltration of the masseter or pterygoid musculature may cause trismus and swelling of the posterior face. Tumors occurring anteriorly may appear as a white mass near the oral commissure or inner aspect of the lip. Late symptoms include swelling of the cheek with induration, a through-and-through defect of the cheek, a foul-smelling, bleeding intraoral mass, or a mass in the submandibular triangle.

The frequent concomitants of leukoplakia and buccal cancer may necessitate multiple biopsies to assess the possibility of multiple cancers in the buccal region. Excisional biopsies with removal of large areas of leukoplakia may be necessary if cancer is suspected. Patients with a tumor extending on the mandible or hard palate should have appropriate radiographs to look for bone involvement by neoplasm. Trismus is an ominous sign and may require CT scan or conventional polytomographs to assess the possibility of tumor extension into the pterygoid fossa or infratemporal fossa.

## Management

Management of stage I and II cancer of the buccal mucosa may be by surgery or radiation therapy. Stage I lesions may be more conveniently resected, whereas stage II tumors probably are better managed by radiation therapy. The advantage of radiation therapy is that the draining lymphatics may be treated prophylactically and overall morbidity from a functional standpoint may be less. Trismus of varying severity may follow the administration of full tumoricidal doses of irradiation to fields that encompass the masseter and pterygoid musculature. Therapy by intraoral cone is feasible for small tumors; however, larger neoplasms are usually managed by external beam teletherapy consisting of 6500 to 70000 rad delivered to the primary tumor and at least the first-echelon lymph nodes. Brachytherapy may be an effective method of treating larger buccal cancers that have not invaded the alveolus or pterygoid fossa.

Surgery is the treatment of choice for stage II tumors that have encroached on bone of the upper or lower jaw or have extended posteriorly into the masseter muscle. Smaller stage II tumors are excised perorally, and closure is primarily by split-thickness skin graft or local oral mucosal flaps. Stage II tumors may require a cheek flap for proper exposure to allow for a marginal mandibulectomy, segmental mandibulectomy, or partial maxillectomy, depending on the extent of the malignancy. Elective neck dissection for stage I and II buccal carcinoma is not warranted because of the relatively low incidence of occult metastases (Bloom and Spiro, 1980).

En bloc resection of verrucous carcinoma of the buccal mucosa is the therapeutic modality of choice. Some reports suggest that radiation therapy is contraindicated for this type of cancer (Kraus and Perez-Mesa, 1966). Presumably irradiation of verrucous carcinoma may result in the development of a highly malignant carcinoma with anaplasia, metastases, and death in some patients.

Surgery is the preferred treatment for stage III and IV cancer of the buccal mucosa, with or without radiation therapy. The superiority of combined therapy over surgery alone for advanced disease has not been established. Because of the high local recurrence rate of advanced buccal carcinoma, however, I prefer to manage these tumors with combined surgical resection and postoperative irradiation. The primary tumor and neck are treated with 6000 to 6500 rad over 4 to 6 weeks. Induction chemotherapy also may be used for extensive or bulky primary tumors. In previously untreated patients, one-stage surgical resection and reconstruction are indicated. Several skin or myocutaneous flaps can repair the mucosal defect. In the past the forehead, cervical, and deltopectoral flaps were used most frequently; more recently, regional myocutaneous flaps have been found to be useful. Two flaps occasionally are necessary to provide internal and external coverage of the cheek.

Neck dissection is indicated in patients with clinically positive cervical nodes. An en bloc resection along with neck dissection is performed and may necessitate partial mandibulectomy or partial maxillectomy for advanced tumors. Total parotidectomy may be indicated for tumors extending posterolaterally toward the masseter muscle. Postoperative radiation therapy should be considered if lymph nodes are confirmed to contain metastases.

## Results

As with other cancers of the oral cavity, results of treatment depend on the extent of the primary tumor and the presence or absence of nodal metastases. Overall survival of patients with carcinoma of the buccal mucosa has improved from 28% (Martin and Pflueger, 1935) - when most tumors were treated primarily with radiation therapy - to 50%, when surgery replaced irradiation as the preferred treatment for most tumors (O'Brien and Catlin, 1965). The nodal status is the most important diagnostic factor (Bloom and Spiro, 1980). Only 25% to 30% of patients developing cervical metastases are cured (Bloom and Spiro, 1980; O'Brien and Catlin, 1965).

Surgery is effective when the tumor is confined to the cheek mucosa. The approximate 5-year determinate survival rate for stage I and II disease is 75% and 65%, respectively. In contrast, 5-year determinate survival is near 30% for stage III and 20% for stage IV tumors (Bloom and Spiro, 1980). Local recurrences affect 40% of patients (Conley and Sadoyama, 1973; O'Brien and Catlin, 1965). Retreatment for cure, when feasible, yields a 25% cure rate.

## Cancer of Hard Palate

The hard palate is the site of various malignant neoplasms, although the incidence of primary malignancies is low. Malignant salivary gland tumors of the hard palate occur about as frequently as squamous cell carcinoma. Salivary gland malignancies are discussed elsewhere in this chapter. Statements concerning palatal cancer in this section refers to squamous cell carcinoma of the hard palate occurring in the western hemisphere.

Squamous cell carcinoma of the hard palate is rare, comprising only 0.5% of oral cancers in the USA (New and Hallberg, 1941). Although uncommon in western cultures, it is prevalent in India, representing approximately 40% of all oral cancers (Ramulu and Reddy, 1972). This difference undoubtedly is related to the habit of reverse smoking, in which the lighted end of a cigarette is held within the mouth.

In the USA, squamous cell carcinoma of the hard palate is a disease of elderly men, usually appearing in the seventh decade of life. Approximately 80% of these patients smoke cigarettes (Chierici et al, 1968). No significant association appears to exist between alcohol consumption and hard palate cancer.

Most carcinomas of the hard palate are well-differentiated to moderately well-differentiated grade I and II squamous cell carcinoma. A granular superficial ulceration is the predominant morphologic type seen on the hard palate. Despite proximity to bone, periosteum of the palate acts as a barrier to early tumor involvement. Initial growth tends to be superficial, and tumors usually grow to considerable size before bony destruction is observed (Fig. 73-34). A less common morphologic type of hard palate cancer is an exophytic, heaped-up tumor. Approximately half of all patients with cancer of the hard palate have neoplasm extending beyond the palate into adjacent regions of the oral cavity.

Approximately 10% to 25% of patients with hard palate carcinoma show clinical evidence of cervical metastases (Chung et al, 1980; Ratzner et al, 1970). Metastases from cancers located in the primary palate occur first to the prevascular and retrovascular group

of submandibular lymph nodes. From the secondary palate, metastases occur initially to the upper deep jugular (subdigastric) or the retropharyngeal nodes. The occult metastatic rate appears to be very low, possibly because of rather sparse lymphatics of the hard palate.

### **Diagnosis**

The most common complaint of patients with cancer of the hard palate is a painless lump or ulcer in the roof of the mouth. Less common symptoms include a sore mouth, bleeding, pain, and poorly fitting dentures. The mean duration of symptoms is approximately 4 months; despite this short time, half of all patients have stage III and IV disease. Posterior extension into the soft palate may cause odynophagia. Trismus or a lump in the neck signals advanced tumor.

More advanced cancer of the hard palate may invade through the palatal bone into the floor of the nose or maxillary antrum. Lateral extension may occur into the cheek mucosa. Posterior extension may result in the tumor tracking up the greater palatine nerve or behind the maxillary tuberosity into the pterygopalatine fossa. When this is a possibility, the integrity of the various branches of the trigeminal nerve's (CN V's) second division (V2) should be assessed carefully. CT scan and conventional polytomography are helpful in assessing the tumor extension into the pterygopalatine fossa and maxillary sinus (Fig. 73-35). Polytomography is also useful to delineate bony erosion of the hard palate and maxilla. Before instituting therapy, biopsy of all palatal tumors is necessary. Two benign lesions of the hard palate that may be misinterpreted as malignant are follicular lymphoid hyperplasia and necrotizing sialometaplasia, previously discussed in this chapter. Both may be differentiated from malignancy on histologic examination.

### **Management**

Radiation therapy by external beam teletherapy can be used to treat small (stage I) tumors without bone involvement. Proximity to underlying bone may limit total dosage to minimize the risk of osteoradionecrosis. One report, however, suggests that supervoltage radiation therapy may be effective in treating cancer of the hard palate (Chung et al, 1980). In general, however, surgery is the preferred method of managing most cancers of the hard palate. Small tumors can be resected perorally. The tumor, surrounded by a 2 cm margin of normal tissue, is removed. If periosteum is involved with malignancy, at least a partial-thickness removal of the underlying palatal bone is required; this can be accomplished best with an electric burr or chisel. The resulting defect may be allowed to heal by secondary intention. Tumors invading into the bone require a full-thickness resection of the palatal bone. Mucosa on the nasal or antral surface of the bone specimen should be carefully examined for penetration by tumor. Frozen section analysis of pterygoid muscles and the greater palatine nerve is warranted to assess the possibility of tumor extension toward the pterygopalatine fossa when the tumor is near the greater palatine foramen or maxillary tuberosity. More extensive tumors may require partial or total maxillectomy. Defects following maxillectomy are lined with a split-thickness skin graft. Sizable palatal defects are rehabilitated best by a dental prosthesis, which is preferred over reconstruction of the palate with regional flaps. Postoperative radiation therapy should be considered in all cases when the adequacy of surgical margins is questioned.



The rare occurrence of neck metastases is managed best by neck dissection. Patients with histologically confirmed cervical metastases may benefit from postoperative radiation therapy. Elective neck dissection is not warranted because of the low occult metastatic rate of hard palate cancer.

## **Results**

Accurate assessment of the results of treating hard palate cancer is difficult because many series group tumors of the hard and soft palate together or do not differentiate between minor salivary gland malignancies and squamous cell carcinoma. In addition, because squamous cell carcinoma of the hard palate occurs in the elderly, many patients die of unrelated causes within 5 years following the diagnosis of cancer.

In a recent report, the overall 5-year determinate survival of patients with hard palate squamous cell carcinoma was approximately 60% (Table 73-16) (Chung et al, 1980). Five-year determinate survival rates for patients without cervical metastases was 75%. When the neck was clinically positive, determinate survival was 33%. The overall survival of 60% is markedly higher than an earlier study of 123 patients, which showed a 5-year determinate survival of only 31% (Ratzer et al, 1970). The earlier study may reflect the use of less efficacious orthovoltage irradiation. In this study the size of the primary tumor was important in determining survival. Patients with tumors smaller than 3 cm had a 5-year cure rate of 54% versus 16% for patients with tumors larger than 3 cm. Similarly, in cases where the tumor was confined to the primary site, cure rates were nearly twice those of cases where the tumor invaded the gingiva, tongue, or buccal mucosa. The predominant site of failure was locally recurrent disease.

## **Cancer of Retromolar Trigone**

Because of the small size of the retromolar trigone, tumors arising here usually involve adjacent anterior tonsillar pillar, tonsillar fossa, or soft palate. Distinguishing a single site of origin often is not possible; thus many physicians group retromolar trigone cancers with those of the palatine arch. The literature is sparse concerning malignancies specifically arising from the retromolar trigone. In general, tumors with epicenters over the retromolar trigone should be considered to arise from this site.

Most retromolar trigone malignancies are squamous cell carcinomas that tend to be less well differentiated than similar malignancies located more anteriorly in the oral cavity. Moderately differentiated grade II and III squamous cell carcinoma is encountered most frequently. Occasionally, minor salivary gland malignancies may arise from this region. Exophytic neoplasms are rare. The most common morphologic type is ulcerative and infiltrative; thus small T1 tumors may be very inconspicuous, being little more than areas of erythroplakia (Batsakis, 1974).

Cancer of the retromolar trigone is predominantly a disease of elderly males in the sixth and seventh decades of life who use tobacco and alcohol excessively. Neoplasms in this area are part of a regional diathesis of upper aerodigestive tract carcinoma resulting from "field cancerization" (Strong et al, 1971). Thus bilateral cancer in the palatine arch region is not rare, and multiple primary tumors of the aerodigestive tract in general may be as high as

20%.

Cancers of the retromolar trigone display biologic properties that more closely resemble squamous cell carcinoma of the oropharynx than of the oral cavity. Thus cancer arising from this site most often appears with advanced (T3) disease. Approximately 50% to 60% of patients with such malignancies have clinical evidence of regional metastases when first seen. Occult metastases are present in 10% to 20% of patients (Shumrick and Quenelle, 1979). Metastases occur first to the upper jugular (subdigastric) lymph nodes. The submandibular and middeep jugular nodes become involved secondarily. About 7% of patients develop contralateral metastases (Shumrick and Quenelle, 1979). Finding distant metastases at the initial evaluation is rare.

### **Diagnosis**

Most patients with cancer of the retromolar trigone primarily complain of pain. A persistent sore in the mouth, odynophagia, and burning sensation when drinking citrus juice are other common symptoms. Referred otalgia may be encountered as the tumor extends medially into the tonsil. Trismus, a mass in the neck, or hearing loss suggest advanced disease. Trismus usually indicates that the neoplasm has infiltrated deeply into the pterygoid musculature. Hearing loss is the result of tumor extension toward the nasopharynx and involving the region of the eustachian tube. The frequent involvement of the tongue base by neoplasm and the high incidence of multiple primary tumors require endoscopic evaluation, including direct laryngoscopy, esophagoscopy, and bronchoscopy.

As with other sites in the oral cavity, evaluation of patients with carcinoma of the retromolar trigone involves thorough inspection and palpation. Radiographic evaluation of the mandible is necessary, since the periosteum of the ascending ramus is involved with malignancy in essentially all but the most superficial tumors because of the adherent overlying mucosa.

Malignancies arising from the retromolar trigone frequently spread onto the soft palate, anterior tonsillar pillar, and tonsillar fossa. As the tumor progresses, inferior extension occurs into the tongue base, as well as superior extension toward the maxillary tuberosity. Tumor may track up into the pterygopalatine fossa, resulting in trismus, hypesthesia of the maxillary nerve (V2), and erosion of the skull base. In these instances one must evaluate by conventional polytomography or CT scan.

### **Management**

Small stage I tumors may be treated equally well by surgery or radiation therapy. Because the mucosa adheres closely to underlying bone, stage I tumors treated with surgery are reconstructed with local tongue flaps or split-thickness skin grafts. Larger stage II neoplasms frequently require resection of portions of the soft palate, which enhances the morbidity from the standpoint of speech and deglutition. For this reason the preferred method of managing most stage I and II squamous cell carcinomas of the retromolar trigone is by full-course radiation therapy using external beam irradiation. Patients with stage II tumors treated by radiation therapy also should receive irradiation of the neck prophylactically. Approximately 6500 to 7000 rad are delivered to the primary tumor and neck over 5 to 6

weeks. In general, radiation therapy does not cure deeply infiltrating cancers causing trismus regardless of their size, and they should be treated surgically. In addition, stage I and II tumors that demonstrate bone erosion on radiographs are managed best by surgical resection. In most instances sagittal split of the ascending ramus, preserving the external cortical plate, is not feasible, and segmental resection is indicated.

Stage III and IV cancer of the retromolar trigone usually is managed by combined surgery and radiation therapy. In our institution surgery followed by postoperative radiation therapy is the preferred method. Induction chemotherapy frequently is administered for extensive primary tumors. Surgery consists of mandibulectomy along with neck dissection. The neck specimen is pedunculated along the periosteum of the mandibular angle.

Some surgeons routinely split the lower lip to improve surgical access. To accomplish this, the surgeon makes a broken line incision, using natural skin lines for better cosmesis. A cheek flap is then elevated off the mandibular periosteum. Another approach is to make an incision in the floor of the mouth along the lingual plate of the mandible to the midline to the midline or beyond. This incision allows the intraoral structures to drop below the mandible for better exposure. A typical resection includes the mandible from the subcondylar area to the midbody, the retromolar trigone, the tonsillar fossa, and a portion of the mouth floor, soft palate, and buccal mucosa. The majority of the pterygoid musculature should be included with the specimen (see Fig. 73-30). Tooth extraction at the anterior bone resection margin permits saw cuts through tooth sockets, which prevents injury to adjacent tooth roots. Preserving as much of the mandible body as is oncologically prudent will decrease resulting functional and cosmetic deformity.

Primary closure frequently is possible. Retaining adequate mobility of the tongue and soft palate is the prime functional concern. The surgeon should be careful not to position the tongue too far anteriorly or posteriorly. Large resections of the soft palate and oral pharynx may require reconstruction with regional flaps for maximal rehabilitation. An oral prosthesis may be necessary to obturate defects of the soft palate.

## **Results**

Specific 5-year survival rates for cancer of the retromolar trigone rarely are reported because of the tendency to group malignancies from this site with tumors of the anterior palatine arch. Because of the close association with the palatine arch, survival rates probably are similar for tumors originating from either region; 3- to 5-year determinate survival rates for all tumors range from 25% to 40% (Batsakis, 1974; Strong et al, 1971).

## **Nonepidermoid Malignancies of Oral Cavity**

Nonepidermoid malignancies make up less than 10% of all oral cavity cancer and consist of a variety of different histologic types. The most common malignancies are of minor salivary gland origin; lymphomas, melanomas, and sarcomas also may occur. Metastatic cancer of the oral cavity is rare, occurs most often to the mandible, and is almost always from primary tumors located below the clavicle. The most prevalent source of the primary tumor is the breast, followed by the kidney and lung (Clausen and Poulsen, 1963). Pain may precede radiographic abnormalities of the mandible by several months.

## **Lymphoma**

Determining the incidence of primary lymphoma arising in the head and neck is difficult. In most cases patients with such tumors are in their fifth or sixth decade of life. The majority arise in Waldeyer's ring and appear as masses in the oropharynx or nasopharynx. Primary lymphomas of the oral cavity are rare and arise in the tongue; the most common site is the tongue base. Extension forward into the oral tongue may occur. A more common oral cavity manifestation of lymphoma is lymphomatous involvement of submandibular lymph nodes. When this occurs, patients often have an asymptomatic mass in the submandibular triangle extending toward the floor of the mouth. Ulceration of the mucosa does not occur. Other lymph nodes in the neck may or may not be enlarged.

## **Melanoma**

Melanoma of oral mucosa is rare, representing 0.4% to 1.4% of all melanomas (Chaudhry et al, 1958). From 25% to 50% of mucosal melanomas occur in the oral cavity (Shah et al, 1977), and the hard palate is the most common site within the mouth. Benign forms of pigmentation of the oral mucosa are common, especially in blacks (Fig. 73-36). Pigmentation is much less common in whites and should heighten the physician's suspicion. Melanoma must be differentiated frequently from focal pigmentation caused by iatrogenic amalgam tattooing, which may result from the filling of a tooth. Oral radiographs may be helpful in detecting a metallic fragment in the area of the focal pigmentation. When the pigmented mucosa is obviously benign, excisional biopsy is indicated.

Melanoma of the oral cavity characteristically occurs in males between 50 and 70 years of age. It is rarely achromatic and appears as a tan or black, smooth, nonulcerated lesion. Tumors are soft and painless and manifest minimal induration.

The treatment of melanoma of the oral cavity is wide surgical excision. Neck dissection is indicated in patients with clinical findings of cervical metastases. Survival rates are extremely poor, with only 5% to 15% of patients surviving 5 years (Chaudhry et al, 1958; Shah et al, 1977). Most patients die within 1 to 2 years after onset of disease, with local recurrence and often with concurrent regional and distant metastases.

## **Minor salivary gland malignancies**

Minor salivary gland malignancies are an uncommon form of oral cavity cancer. Approximately 80% to 90% of all minor salivary gland tumors of the oral cavity are malignant (Table 73-17) (Spiro et al, 1973), and most occur on the hard palate.

Irradiation of the head and neck may result in both benign and malignant salivary gland tumors. A fivefold increase is expected in the incidence of salivary gland neoplasms in survivors of Hiroshima and Nagasaki (Belsky et al, 1972). Most malignant minor salivary gland tumors, however, are of unknown etiology.

The most common clinical setting of minor salivary gland cancer is a slowly enlarging, painless, mucosa-covered mass. In the oral cavity most tumors occur in the posterior aspect of the hard palate near the greater palatine foramen. Midline tumors are rare. Pain is

inconsistent, and ulceration is uncommon. Except for those of the hard palate, tumors usually are mobile. Pain or hypesthesia may occur when perineural or bone invasion is present. Tumors occurring on the palate may appear as only a small neoplasm; however, CT may show extensive invasion into the paranasal sinuses or pterygopalatine fossa (Fig. 73-37). Only 14% of patients with minor salivary gland cancer have initial evidence of cervical metastases (Spiro et al, 1973).

*Adenoid cystic carcinoma* is the most common minor salivary gland malignancy, composing 40% of all such cancers. The tumor exhibits slow growth and recurs locally, sometimes after many years. Adenoid cystic carcinoma is prone to follow the routes of cranial nerves in the vicinity of the neoplasm, and thus local recurrence is almost inevitable. Distant metastases are common, occurring to the lung, brain, and bone in more than 50% of patients by the time of death.

*Adenocarcinoma* represents approximately 30% of all minor salivary gland cancers. They are firm, locally aggressive malignancies occurring more often in patients over 60 years of age. Low-grade tumors have a good prognosis, in contrast to a poor prognosis for poorly differentiated adenocarcinoma.

*Mucoepidermoid carcinoma* is the third most common minor salivary gland malignancy, composing about 20% of all such tumors. It occurs more frequently in females, with a peak age in the fifth decade. From 50% to 65% are histologically considered low-grade tumors, which have an excellent prognosis with a low probability of recurrence and low propensity for cervical metastases. High-grade tumors have aggressive local growth patterns and frequently recur at the primary site. Metastases are more common but tend to be confined to cervical nodes.

Wide field surgical excision is indicated for malignancies of minor salivary gland origin. Surgical procedures are similar to those employed for squamous cell carcinoma of the oral mucosa. Therapeutic neck dissections are performed for histologically confirmed cervical metastases. Elective neck dissection is not warranted, since only 9% of patients later develop cervical metastases.

Radiation therapy to the primary tumor site is indicated when the tumor is unresectable or when gross or microscopic surgical margins are involved with neoplasm. Many surgeons also favor postoperative radiation therapy for high-grade malignancies and for adenoid cystic carcinoma because of their proclivity for local recurrence. No controlled study has demonstrated the superiority of treating such malignancies with combined therapy. I routinely irradiate the primary site with 6000 to 6500 rad following surgical resection of adenoid cystic carcinoma, intermediate and high-grade mucoepidermoid carcinoma, and adenocarcinomas of the oral cavity.

Five-year survival of patients with oral cavity cancer of minor salivary gland origin is 40% (Spiro et al, 1973). Because nearly 15% of malignant tumors recur more than 5 years after diagnosis, long-term follow-up is essential. Taking all minor salivary gland malignancies of the head and neck into consideration, 5-, 10-, and 15-year survival rates are 45%, 33%, and 21%, respectively (Spiro et al, 1973). Patients with local recurrence may be helped with further surgery in approximately 20% of cases.

The AJCC does not provide for the staging of minor salivary gland malignancies. Survival is related to histology, tumor size, and the presence of regional or distant metastases. Poor survival is associated with adenoid cystic carcinoma and high-grade mucoepidermoid carcinomas and adenocarcinomas. Cervical metastases are observed less frequently in minor salivary gland malignancies than in squamous cell carcinoma; however, when metastases do occur, they are more likely to be associated with a fatal outcome. Treatment failure is usually at the primary site initially, and later nodal and distant metastases occur (Fuk et al, 1977).

### **Surgical Reconstruction**

Reconstruction of the oral cavity after major ablative surgery continues to be a challenge for the head and neck surgeon. Advanced planning is essential in reviewing the several options available. The optimal goal of reconstruction is to achieve maximal restoration of function and cosmesis with minimal morbidity to the patient.

#### **Local flaps**

Moderately sized defects that cannot be closed primarily or by split-thickness skin grafts often can be repaired with local mucosal flaps. The tongue flap is the most common local flap used to reconstruct defects of the oral cavity. Although this is an effective method of repairing defects of limited size in the floor of the mouth and retromolar trigone, defects requiring larger tongue flaps may significantly reduce tongue mobility and create greater disability for the patient.

A skin flap consists of skin and underlying subcutaneous tissue, which is transferred from one site to another, retaining its vascular attachment to the body at all times during the transfer. This allows transfer of a greater bulk of tissue than would be possible with a free graft and allows transfer to an area of impaired circulation. Skin flaps may be classified as local, regional, or distant, depending on the proximity of the donor site to the recipient site. Flaps may be attached on a single side as a unipedunculated flap or may remain attached on two sides as a bipedunculated flap. Flaps may be elevated and transferred into the defect in a single procedure, or a portion of the blood supply may be gradually interrupted in one or more delaying procedures before the actual transfer.

The use of local skin flaps for oral cavity reconstruction is confined primarily to the lip. Local flaps are preferred to regional flaps for closing defects of less than two thirds of the lip width because of their close color and texture match and the availability of mucous membrane. Defects located medially are best closed using an Abbé flap, consisting of a full-thickness flap from the opposite lip pedunculated on the vermilion border and containing the labial artery (Fig. 73-38) (Baker and Krause, 1983). Estlander's original operation was devised for closure of lower lip defects near the commissure of the mouth. Since the original description of the Abbé and Estlander flaps, the operations have been modified in many ways to accommodate surgical defects anywhere on the lower or upper lip.

The Abbé and Estlander flaps should be constructed so that the height of the flap equals the height of the defect. The width of the flap should be approximately one half that of the defect to be reconstructed, so that the two lips are reduced in width proportionately. The pedicle should be made narrow to facilitate rotation, but care must be taken not to injure

the labial artery. The secondary defect should be closed in three layers. Accurate approximation of the vermilion border of the lip with that of the defect prevents a notched appearance.

The pedicle of the Abbé flap crosses the oral stoma and may be severed in 2 or 3 weeks. During this time the patient is maintained on liquids or a soft diet that does not require excessive chewing. Ensuring precise approximation of the vermilion border at the time of pedicle severance is essential.

The superiorly based Estlander flap may be modified from its original description by designing the flap so that it lies within the nasolabial fold (Fig. 73-39). This modification provides better scar camouflage of the donor site and also allows early rotation of the flap into the lower lip defect. The Estlander flap causes oral commissure distortion. When necessary, this distortion, or microstomia, may be corrected with a secondary commissuroplasty.

### **Regional flaps**

Surgical defects that result from resection of stage III and IV tumors of the oral cavity usually require regional and distant flaps for reconstruction of soft tissue deficits. In addition, mandibular reconstruction may be necessary. Many techniques are useful for oral reconstruction, and only a few are described. An in-depth discussion of reconstruction of the oral cavity and mandible is beyond the scope of this chapter; Chapter 82 deals with the topic in detail.

A regional flap is one that originates in an area close to, but not adjacent to, the defect. Much of the recent advancement in head and neck reconstruction is the result of the development and wide-spread use of regional flaps. In most cases these flaps possess sufficient blood supply to be transferred without prior delay, allowing immediate reconstruction. Several regional flaps have been described; the most useful in reconstruction of the oral cavity are discussed.

### ***Forehead flaps***

The forehead flaps, based on the superficial temporal artery, offers a large area of non-hair-bearing skin that may be readily used without delay within the oral cavity. When an area of flap is to be lined, split-thickness skin graft may be placed beneath that portion of the flap 10 days before the definitive procedure.

The incision is begun at the outer end of the eyebrow to a similar point on the opposite side of the forehead. The incision next moves vertically to the hairline and then is followed closely toward the pedicle side again. Here it may be brought downward in a wide sweep to the pinna, or it may be continued posteriorly, remaining 3 cm above the pinna (Fig. 73-40). The latter technique is particularly important when it is necessary to ligate the external carotid artery distally, since it incorporates a blood supply from the posterior auricular artery. The flap is elevated in a plane just above the periosteum of the frontal bone. Care must be taken to avoid injury to the superficial temporal artery during elevation over the temporal fascia.

The forehead flap may be placed within the oral cavity in several ways. A simple method of entry is via a cheek incision paralleling the branches of CN VII (facial nerve). Although this method often offers rapid access to the anterior mouth, a usable length of flap is sacrificed, and placement for defects posteriorly in the mouth may be awkward. The flap may be turned on itself and brought over the zygomatic arch and into the mouth through the buccal mucosa. When this route is chosen, it is important to avoid the zygomatic branch of CN VII and to be certain that an adequate opening is made through the cervical fascia as it attached to the zygomatic arch. When the flap is in place within the mouth, the pocket should admit two fingers along with the flap.

A third method is to place the flap behind the zygomatic arch and then through an incision in the gingival buccal sulcus (Fig. 73-41). This method is possible only when the ascending ramus of the mandible has been removed. The space behind the zygomatic arch may be small, requiring outfracturing of the arch or resection of a portion of the temporal muscle. The donor site is covered with a split-thickness skin graft. Three weeks later, the pedicle is transected within the mouth, and the proximal portion is returned to cover the temporal area. Several techniques may be used to improve the cosmetic appearance of the donor site, including preserving the frontal muscle when elevating the flap, beveling the peripheral incisions, and returning only enough pedicle to make the forehead defect symmetric.

### *Deltopectoral flaps*

The deltopectoral flap is based on three or four perforating branches of the internal mammary artery (Fig. 73-42). When designed in a length/width ratio of more than 2.5:1, it may be used without a delay. When greater length is required or when the surgeon desires a greater width at the end than at the base, delaying the procedure is advisable. An incision is carried laterally from the sternal border just at the lower edge of the clavicle. If neck dissection has been performed at the same surgery, the lower transverse section of the neck incision should be used for the upper incision of the flap. The desired flap length should be evaluated carefully preoperatively but may extend well out over the lateral surface of the upper arm. The lower incision is carried medially, staying above the axilla, and along the fifth rib to the sternal border. The flap is elevated in a plane beneath the pectoral fascia within approximately 2 cm of the sternal border, where the perforating arteries are carefully exposed.

The deltopectoral flap is brought inside the mouth through a submandibular incision or used for external defects (Fig. 73-43) (Baker and Krause, 1983). The pedicle is tubed, and the donor site covered with a thick split-thickness skin graft. Three weeks later the pedicle may be divided and returned to the chest. When the defect is large, bilateral deltopectoral flaps may be used simultaneously.

### *Pectoralis myocutaneous flaps*

In recent years there has been considerable interest in the design of myocutaneous flaps. The cutaneous portion of these flaps is nourished by small feeding vessels from the underlying muscle (Ariyan and Krizek, 1977). This nourishment allows the flap to be used as either a unipedicle or island flap and has the added advantage of providing considerable muscle bulk to the flap itself. The most commonly used myocutaneous flap at present for



reconstruction of large oral cavity defects is the major pectoral flap based on the acromiothoracic and occasionally the lateral thoracic arteries (Fig. 73-44). The major pectoral myocutaneous flap has the advantage of being an axial flap, which may be elevated as a strip of muscle and an attached segment of overlying skin for one-stage reconstruction. A portion of the flap may be turned on itself to provide tissue for the inner and outer aspects of the oral cavity. The flap has sufficient bulk to provide structural support when a mandibulectomy is necessary for tumor exenteration.

The desired skin and subcutaneous tissue are incised circumferentially down to the fascia of the major pectoral muscle. Horizontal mattress sutures are placed about the periphery of the flap to attach the cutaneous portion to the underlying muscle. The pectoral muscle is then detached from the sternum medially, the ribs inferiorly, and across the deltoid head laterally. The muscle then may be turned upward to give good visualization of the acromiothoracic and lateral thoracic vessels before transecting the clavicular attachments of the muscle. The myocutaneous flap then may be rotated 180 degrees beneath a neck flap. The major pectoral myocutaneous flap readily reaches the oral cavity, and the muscle pedicle provides good coverage for the carotid artery when a neck dissection has been included in the procedure. The secondary cutaneous defect on the chest wall usually can be closed primarily (Fig. 73-45).

#### ***Trapezius myocutaneous flaps***

The trapezius myocutaneous flap has been introduced as another useful flap for oral cavity reconstruction. The flap can be based inferiorly on the transverse cervical artery and vein or superiorly on branches of the posterior occipital and deep cervical vessels. The flap consists of skin, subcutaneous tissue, and the underlying trapezius muscle. It is particularly suited for reconstruction of full-thickness defects in the lower portions of the oral cavity and may incorporate the scapular spine for one-stage mandibular reconstruction.

The incision for a superiorly based trapezius myocutaneous flap is started at the mastoid tip and carried laterally to the scapular spine, following the anterior edge of the trapezius muscle. The posterior incision begins at the occiput, 2 cm across the midline, extending laterally to the scapular spine. The skin and underlying muscle are mobilized as a single unit (Fig. 73-46). The blood supply to the trapezius muscle via the transverse cervical artery of the thyrocervical trunk is so abundant that an inferiorly based trapezius myocutaneous flap may be created. The surgeon must be certain, however, that the blood supply remains intact if a neck dissection has been performed (Fig. 73-47). For superiorly based flaps, the pedicle may be detached at 3 weeks and returned, although it is frequently more desirable to excise the intervening skin and leave the pedicle in place permanently (Fig. 73-48). Split-thickness skin grafts are used to cover the donor site.

#### ***Sternocleidomastoid myocutaneous flaps***

The sternocleidomastoid myocutaneous flap is useful for reconstruction of small defects of the oral cavity. The sternocleidomastoid muscle receives its blood supply from branches of the thyrocervical trunk, the superior thyroid, and the occipital arteries. To elevate this composite flap, which consists of sternocleidomastoid muscle and overlying skin, preserving two of the three vascular pedicles is prudent. The flap usually is based superiorly for the

purpose of reconstructing the oral cavity and can be elevated without delay (Fig. 73-49). The major disadvantage of the sternocleidomastoid myocutaneous flap is the limited amount of skin that can be harvested; usually a flap of only 3 cm or less in width can be used. A sternocleidomastoid myocutaneous flap is contraindicated if a neck dissection is performed, unless the flap is harvested from the contralateral neck. Portions of the clavicle may be mobilized with the muscle as a composite flap for reconstruction of limited mandibular defects.

### **Distant flaps**

The origin of distant flaps is removed considerably from the location of the defect. In the past the tubed abdominal flap was the most common distant flap used for oral cavity reconstruction. The flap was transferred to the head by first attaching it to the radial aspect of the wrist.

Development of microvascular surgery has permitted free distant flaps to be transferred to the oral cavity; these are revascularized by anastomosing the vascular pedicle of the flap to recipient vessels located in the neck (Baker, 1981b; Panje et al, 1977). Free flaps can provide large amounts of tissue for oral cavity reconstruction. Donor site deformity is minimal and usually can be closed primarily. The donor site is far removed from the head and neck region and is well hidden by clothing.

### **Mandibular reconstruction**

Several methods for reconstructing the mandible are available, as are philosophies concerning indications for reconstruction following surgical ablation of oral cavity cancer. Although the use of the regional myocutaneous flaps and the deltopectoral flap has resulted in acceptable function and contour in some patients without restoring the mandibular arch, usually reconstruction of the arch is necessary to restore function and cosmesis. Lateral resection of the mandible, however, produces only moderate disability, and reconstruction for restoration of function is not usually necessary.

Small defects of the mandible may be reconstructed primarily, but in most cases bone grafting of the jaw is delayed until the oral mucosa has healed and risk of contamination by saliva is minimal. Sizable resections require soft tissue augmentation before bone grafting. Regional myocutaneous flaps provide a recipient site of abundant tissue with a rich blood supply or subsequent bone grafts. I prefer to use an iliac crest bone graft to restore the mandibular arch in a separate surgical stage after achieving soft tissue healing of the oral cavity. An acrylic biphase appliance and the graft itself, using figure-eight wires, provide stabilization of the mandibular segments (Fig. 73-50) (Baker and Krause, 1983). More recently, regional composite osteomyocutaneous flaps have been developed to provide vascularized bone grafts for mandibular reconstruction. Various methods of design and use of such flaps have been suggested, with the most popular being the pectoralis osteomyocutaneous flap conveying portions of the fourth or fifth rib and the trapezius osteomyocutaneous flap conveying portion of the entire scapular spine.

Perhaps the greatest future for revascularized free flaps in the reconstruction of the oral cavity lies in the restoration of the mandible. In recent years experience with microvascular surgery has enabled the use of free vascularized bone grafts to bridge mandibular defects. Such grafts have several advantages over conventional nonvascularized bone grafts: improved survival and more rapid healing in poorly vascularized recipient sites, less risk of absorption, and greater resistance of the graft to infection and subsequent extrusion. Free osteocutaneous rib grafts have been reported for mandibular replacement (McKee, 1978), as have free osteocutaneous groin flaps containing iliac crest (Fig. 73-51) (Baker, 1981c; Baker, 1983). The ability to transfer a free osteocutaneous flap that contains iliac bone to a distant site by microvascular techniques has considerable appeal in solving some of the difficult problems encountered in mandibular reconstruction. The large amount of cortical bone available from the iliac crest affords more structural superiority when compared to rib grafts, which have limited cortical bone. Contouring rib grafts for restoration of the mandibular anterior portion may be a problem that requires notching of the rib, which further limits the structural support of the graft. The natural curvature of the iliac crest frequently enables mandibular grafting without excessive graft contouring. In addition, this prevents the need for an intrathoracic procedure, which is required for free osteocutaneous rib grafts.