Paparella: Volume III: Head and Neck

Section 2: Disorders of the Head and Neck

Part 2: The Oral Cavity

Chapter 17: Carcinoma of the Oral Cavity

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In the USA in 1988, carcinoma of the oral cavity and pharynx constituted approximately 4 per cent of all cancers in males and 2 per cent of all cancers in females. In many other countries, this malignancy is far more common and is usually related to unusual habits related to tobacco practiced in these societies. In recent years, there has been a change in the demographic characteristics of this disease, with younger patients being more commonly seen, as well as a change in the male to female ratio from 10:1 to 4:1.

Of the 29.000 new cases/year seen in the USA, 9500 individuals will die of the disease, invariably because of late presentation. This is most unfortunate, as this area is most amenable to routine examination, and therefore these cancers should be detected early. Unfortunately, the type of individual who suffers from this disease is unlikely to subject himself or herself to regular dental checkups, when the early lesions would most likely be detected.

Although squamous cell carcinoma is by far the most common malignancy, minor salivary gland tumors and other tumors arising from the mesenchymal tissues may develop.

Anatomy of the Oral Cavity

The anterior boundary of the oral cavity extends from the vermilion border of the lips to the oropharynx posteriorly. The oropharyngeal isthmus is formed by the junction of the hard and soft palates superiorly, the anterior tonsillar pillars laterally, and the line of circumvallate papillae inferiorly. The oral cavity may be divided into the following sites:

1. *Lips:* The mucosal surfaces of the lips, that is, the portions that come into contact with each other, are regarded as part of the oral cavity. Lesions of the lip are discussed in great detail elsewhere in this book and will not be considered in this chapter.

2. *Buccal mucosa:* This mucous membrane lines the interior surface of the cheek and lips and extends from the posterior line of contact of the opposing lips to the retromolar trigone posteriorly, that is, at the pterygomandibular raphe. It connects with the gingival mucosa (gingivobuccal sulcus) superiorly and inferiorly.

3. *Retromolar trigone:* This triangular area is situated posterior to the last molar tooth and extends superiorly to the maxillary tuberosity. It overlies the ascending ramus of the mandible

and is bounded laterally by the buccal mucosa and medially by the mucosa of the anterior tonsillar pillar.

4. *Upper and lower alveolar ridges:* The inferior alveolar ridge is formed by the mucosa overlying the alveolar process of the mandible. It extends from the gingivobuccal sulcus laterally to the free mucosa of the floor of the mouth medially. Superiorly it consists of mucosa overlying the alveolar process of the maxilla and extends from the gingivobuccal sulcus laterally to the junction of the hard palate medially.

5. *Floor of the mouth:* This horseshoe-shaped area extends from the lingual surface of the alveolar ridge to the ventral surface of the anterior two thirds of the tongue. Posteriorly it is limited by the base of the anterior tonsillar pillar but communicates with the oropharynx via the tonsillolingual sulcus. The floor of the mouth is divided in the anterior midline by the frenulum of the tongue, with the submandibular gland ducts opening on either side of the midline. Submucosally, the submandibular and sublingual salivary glands, together with the mylohyoid and hyoglossus muscles, can be found.

6. *Hard palate:* This structure consists of mucosa covering the palatine process of the maxilla. It is perforated by the greater and lesser palatine foramina, as well as the incisive foramen. A large number of minor salivary glands are present in this region.

7. *Anterior portion of the tongue:* The oral cavity contains the mobile anterior two thirds of the tongue, extending anteriorly from the sulcus terminalis (line of the circumvallate papillae). Descriptively, it can be divided into the dorsum, lateral border, ventral surface, and tip.

Mucosa

The whole oral cavity is lined by nonkeratinizing squamous epithelium. Although for the most part the mucosa consists of a thick layer of squamous cells with well-developed rete pegs and a prominent superficial keratine layer, the floor of the mouth and the ventral surface of the tongue are lines by thin, atrophic mucosa with shallow rete pegs and little surface keratin. This phenomenon, together with the fact that this area is constantly bathed by a pool of saliva containing potential carcinogens, is a possible reason for the high incidence of carcinoma in these areas. The submucosa contains minor salivary glands that can be serous, mucinous, or mixed. There are also sebaceous glands present that can be quite prominent, particularly in the buccal mucosa (Fordyce's spots).

Musculature

The floor of the oral cavity is supported by a sling formed by the mylohyoid muscles, which arise from the mylohyoid line on the mandible and insert into the hyoid bone and a midline raphe anteriorly.

The tongue consists of three extrinsic muscles (genioglossus, styloglossus, hyoglossus) and four intrinsic muscles (superior and inferior longitudinal, transverse, vertical). These muscles are separated by a midline septum, except anteriorly at the tip, at which point transverse fibers from both sides communicate.

Nerve Supply

The main *sensory* supply to the oral cavity is via the second and third divisions of the trigeminal nerve. The second division of this nerve supplies the hard palate and upper gingiva via the greater and lesser palatine nerves. The third division is the sensory supply to the lower portion of the buccal mucosa and the inferior gingiva via the inferior alveolar nerve. The lingual nerve, also a branch of the third division, supplies the anterior two thirds of the tongue.

Motor supply to the oral cavity is derived from the 5th, 7th, and 12th cranial nerves. The fifth cranial nerve supplies the muscles of mastication including the masseter and both internal and external pterygoids. The seventh cranial nerve supplies the lip musculature and helps in maintaining oral competence. The 12th cranial nerve innervates all the intrinsic and extrinsic muscles of the tongue.

An understanding of the anatomy of these nerves is essential, as they may be involved by the cancer, causing neurologic deficit, or may be a conduit for tumor spread to the base of the skull. In addition, identification and preservation of these nerves during tumor resection may be vital if adequate rehabilitation is to be obtained.

Lymphatic Drainage

The lymphatic drainage of the oral cavity has been extensively studied and documented. Although it is predominantly to the ipsilateral side, there is significant contralateral drainage, especially for lesions near the midline. The anterior portion of the oral cavity drains to the submental and submandibular nodes and then subsequently to the upper and midjugular chains. The more posterior regions of the oral cavity drain directly into the upper deep jugular nodes.

Alteration in the lymphatic drainage may occur if lymphatic channels become occluded by malignancy or radiotherapy. In addition, metastatic spread of oral cavity tumors does not always follow a logical sequence from first-echelon to second-echelon nodes and may skip to lower areas of nodal involvement. The classic lymphatic drainage for each area will now be described.

Buccal Mucosa

The buccal mucosa has a rich lymphatic capillary bed. The collecting vessels penetrate the buccinator muscle and form two main trunks. The anterior trunk drains into the facial, retroglandular, and preglandular submandibular nodes. The posterior trunk drains into the facial nodes but can occasionally drain into the preauricular or intraglandular parotid nodes.

Alveolar Ridge

The upper and lower alveolar ridges have both a superficial and deep collecting lymphatic network. The drainage of the lingual and buccal surfaces follows different routes. The *buccal surface of the upper alveolar ridge* anterior to the molars drains into the prevascular group of facial nodes, whereas the molar region drains into the retrovascular group. The lymphatics of the *lingual surface of the upper alveolar ridge* blend with the lymphatics of the hard and soft palates. These vessels drain into the internal jugular chain and posteriorly may drain into the lateral retropharyngeal nodes. The *buccal surface of the lower alveolar ridge* drain into the prevascular and retrovascular facial nodes. More anteriorly in the incisor area, the lymphatics also drain into the submental nodes. The *lingual surface of the lower alveolar ridge* lymphatics perforate the mylohyoid and drain into the preglandular and subdigastric nodes. Those of the molar region tend to drain directly into the upper jugular nodes.

Palate

The collecting lymphatic vessels of the palate have been divided into anterior, middle, and posterior groups. The *anterior* groups perforate the buccinator muscle to drain into the prevascular and retrovascular facial nodes. The *middle* group also penetrates the buccinator muscle but drains into the upper jugular nodes. The *posterior* group drains the soft palate into the lateral retropharyngeal group.

Floor of the Mouth

The lymphatics of the floor of the mouth can be arbitrarily separated into an anterior and a posterior group. The vessels of the anterior floor of the mouth have poor midline separation and are contiguous with the lymph vessels of the sublingual region. The lymph vessels pierce the mylohyoid and drain into the preglandular submandibular nodes and occasionally the submental nodes. The posterior floor of the mouth may drain into either the subdigastric nodes or the low internal jugular nodes by a group of collecting vessels that pass over the hyoid bone and follow the omohyoid muscle.

Spread of cancer from the floor of the mouth, therefore, most frequently involves the ipsilateral submandibular nodes. When contralateral spread occurs, the upper jugular nodes are more frequently involved, and the submandibular nodes are bypassed.

Tongue

The collecting vessels of the tongue also have superficial and deep components and are divided into anterior, lateral, central, and posterior groups. The *superficial* lymph vessels drain the whole surface of the tongue and on the ventral surface blend with the floor of the mouth vessels. There is significant crossover on the dorsum of the tongue. The *deep* vessels communicate readily with the superficial group and in the posterior portion of the tongue are of a larger caliber. The *anterior* (or apical) group of vessels drain the tip of the tongue. After

traversing the floor of the mouth, these vessels may either perforate the mylohyoid to drain into the submental nodes or perforate the genioglossus and follow the omohyoid muscle to the low jugular nodes. This latter route is probably more common. The *lateral* (or marginal) deep vessels travel medial to the stylohyoid and digastric muscles to empty into the submandibular and internal jugular group of nodes. The *central* vessels descend between the genioglossus and hyoglossus and pass laterally to the submandibular group or posteriorly to the anterior midjugular group bilaterally. The *posterior* lymphatics originate in the base of the tongue and extend bilaterally to the jugular chain of nodes. In general, the more anterior neoplasms have a higher probability of draining directly into the lower jugular lymph nodes.

The Mandible

The mandible is the major supporting structure of the oral cavity. Its anatomy is described in some detail elsewhere in this book. The blood supply of the body is from the inferior alveolar artery, which enters via the inferior alveolar canal, and from periosteal vessels arising from vessels supplying the muscles arising and inserting into the mandible. Periodontal lymphatics run with the inferior alveolar canal vessels and nerves.

Carcinogenesis

Many life style, environmental, and genetic factors are implicated as important etiologic agents in the development of oral cavity cancer. The vast majority of these cancers arise in susceptible persons after prolonged exposure to known environmental carcinogens. Tobacco - in the form of cigarette smoking, pipe, or cigar smoking - has been implicated with a specific dose-response relationship; that is, the risk rises in a linear fashion with the amount of tobacco smoked. Smokeless tobacco is becoming increasingly popular among the youth of North America, particularly snuff dipping and chewing tobacco. An association between cancer of the oral cavity and smokeless tobacco has been confirmed. In addition, certain other tobacco-related habits are associated with a high incidence of oral cavity cancers, for example, reverse chutta smoking, bidi smoking, and the use of betel nut and pan chewing.

Ionizing radiation has long been acknowledge as a cause of cancer. Low-dose radiation to the head and neck was an extremely popular therapy many years ago for benign lesions, for example, enlarged thymus, acne, adenoid enlargement, and eustachian tube dysfunction. The sequelae of this therapy are only now becoming apparent, as it induces not only thyroid and salivary gland cancer but also mucosal cancers of the upper aerodigestive tract. Likewise, radiation-induced cancer following high-dose therapeutic radiation is occasionally seen, with the radiation acting as a double-edged sword, curing and at the same time potentially inducing cancer.

Although dental trauma and poor oral hygiene have been implicated as a cause of oral cavity cancer, this has never been definitely proved.

The consumption of alcohol is linked to the development of cancer in the upper aerodigestive tract, particularly the oral cavity and oropharynx. The exact mechanism is unclear, but it is thought to be due to a combination of a local toxic effect on the mucosa and systemic effect from the associated dietary deficiencies, hepatic damage, and a possible alteration in the patient's immunity. It appears to act synergistically with tobacco, causing a disproportionate increase in cancer as the alcohol and tobacco consumption increases.

Infectious agents have also been implicated as possible causes of cancer in the oral cavity.

Tertiary *syphilis* has been associated with cancer of the tongue, but thankfully this condition is rarely seen today. Its association with leukoplakia and oral cancer involves mainly the tongue. Nielsen reported a 19 per cent incidence of syphilis among patients with cancer of the tongue. The syphilitic infection becomes manifested as an endarteritis with interstitial glossitis and atrophy of the overlying mucosa. Carcinoma may arise without antecedent leukoplakia. Although antibiotic treatment is effective for active syphilis, once established the oral mucosal changes are said to be irreversible.

Of greater interest is the role of the human *papilloma virus* as a carcinogenic agent, which has been well documented in the gynecologic literature, and isolated cases of malignant transformation of papilloma in the upper aerodigestive tract have been reported.

Another infective agent that has been described as having an association with oral cancer is *Candida albicans.* This fungus is a normal commensal in the oral cavity. It may, however, cause two forms of pathologic oral infections: acute oral candidiasis or thrush, and chronic hyperplastic candidiasis. Acute oral thrush is seen most commonly in patients taking broad-spectrum, in immunosuppressed patients undergoing chemotherapy, in debilitated patients, and in some denture wearers. It is characterized by yellow-white plaques on an erythematous base, which when wiped off may reveal a bleeding base. Chronic hyperplastic candidiasis, in contrast, presents as a dense, thick, chalky white plaque of keratin that is thicker and more opaque than most other forms of leukoplakia. It may present, however, as nodular leukoplakia or erythroplakia. Cawson first pointed out the high rate of malignant transformation in chronic hyperplastic candidiasis. There may be some form of T-cell immunologic defect that allows the *Candida* to invade the epithelium. Treatment with antifungal agents may lead to regression of the lesions and a reduced risk of malignant change.

Exposure to environmental factors alone does not necessarily result in cancer, and there appears to be a need for individual susceptibility for the development of cancer. This susceptibility may be hereditary, familial, or acquired, for example, immunosuppression.

Some nutritional factors are thought to predispose to the development of cancer. The Plummer-Vinson syndrome (Paterson-Kelly syndrome, sideropenic dysphagia) occurs most commonly in nonsmoking Scandinavian women and is characterized by iron deficiency anemia, dysphagia associated with an anterior postcricoid web, and abnormal esophageal motility and angular cheilitis. Mucosal atrophy with an increased incidence or oral leukoplakia and squamous

cell carcinoma of the oral cavity, pharynx, and esophagus has also been described. A carcinoma will develop in approximately 10 per cent of persons with this syndrome. Other nutritional factors, such as riboflavin deficiency, may contribute to the cause. Treatment with iron will improve the anemia but will have no effect on the mucosal changes.

Oral submucous fibrosis is an uncommon disorder found mainly in persons of East Indian origin who indulge in betel nut chewing. It is characterized by the slowly progressive development of fibrous bands beneath the oral mucosa with secondary mucosal atrophy. The cause remains uncertain, but it is felt to be due to a hypersensitivity to betel nut, or tobacco, or to be caused by a vitamin deficiency. Paymaster first noted the development of oral cancer in about one third of these patients, and Pindborg subsequently pointed out the precancerous nature of this condition. He postulated that the secondary mucosal atrophy was the predisposing factor for the development of cancer. Treatment of the fibrotic bands consists of excision or intralesional steroid injection. This does little, however, to improve the mucosal atrophy or decrease the risk of malignant transformation. Any identifiable etiologic factors should be eliminated.

Certain dermatological conditions are regarded as potentially premalignant. They include lichen planus, discoid lupus erythematosus, dystrophic epidermolysis bullosa, and dyskeratosis congenita.

Lichen planus is a disease of unknown cause that affects the skin or oral mucosa, or both. Oral lesions may be present without the skin lesions. In the oral cavity it most commonly appears as multiple small papules with radiating thin white lines (Wickham striae), which characterize the usual reticular form of the disease. It may also present in bullous, atrophic, and erosive forms. The status of lichen planus as a premalignant lesion has not been definitively proved, and though it does appear to be premalignant, the transformation is certainly rare. Controversy exists as to whether there is initially transformation to leukoplakia or candidal leukoplakia and only then transformation to malignancy. In addition, erythroplakia may have been misdiagnosed as lichen planus, thereby distorting the incidence in some series. The erosive form is thought to have the highest incidence of malignant transformation. Oral lichen planus can be treated with topical, systemic, or intralesional steroids. Although this will reduce the irritation associated with the disease, it is unlikely that it will reduce the risk of malignant transformation. All erosive lesions should be carefully watched and biopsies performed as indicated.

Discoid lupus erythematosus is a rare systemic disorder that may present in the oral cavity as circumscribed, slightly elevated white patches often surrounded by a telangiectatic halo. Epithelial dysplasia may be seen histopathologically. Malignant degeneration is rare, is most often seen on the lower labial mucosa adjacent to the vermilion, and is more common in men. Patients should be advised to avoid bright sunlight and to apply sunscreen to the lips if malignant transformation is feared.

Dystrophic epidermolysis bullosa is a rare hereditary disease with either an autosomal dominant or recessive pattern of inheritance. It becomes manifested as bullous and vesicular

eruptions of the skin and mucous membranes shortly after birth. The tongue is most often affected, though the buccal mucosa, lips, gingivae, and palate may also be affected. Upon healing, keloid scars with gray smoothness, thickening, and deformity of the tongue may develop. Squamous cell carcinoma of the tongue has occasionally been noted in older patients.

Dyskeratosis congenita is a rare sex-linked hereditary condition characterized by oral mucosal atrophy and leukoplakia, reticular cutaneous hyperpigmentation, nail dystrophy, and pancytopenia. There is an increased incidence of oral epidermoid carcinoma associated with it.

Multiple etiologic factors, therefore, play a role in the development of carcinoma of the oral cavity. In 1944, Willis stated that when carcinogenic stimuli affect epithelial tissue, all the epithelium in that area is affected similarly, but not necessarily equally. A neoplasm, therefore, is more likely to develop in tissue in which the stimuli have been maximal; however, similar neoplastic change may occur at a later stage in adjacent tissue that was exposed to the same carcinogens. The mucosa of the upper aerodigestive tract should, therefore, be regarded as a field of growth that is constantly being bathed by the carcinogens and, therefore, will potentially have numerous areas of premalignant and early malignancy change ("condemned mucosa" or "field cancerization" concept). Multiple tumors may arise simultaneously or metachronously in this field, necessitating constant vigilance and long-term follow-up, particularly if the patient continues to smoke and drink.

Pathologic Features

Oral Premalignancy

Leukoplakia

Leukoplakia is defined as "a white patch or plaque that cannot be characterized clinically or pathologically as any other disease". Although leukoplakia may occur anywhere in the oral cavity, it is most commonly noted on the buccal mucosa and oral commissures. It is seen more frequently in men older than 50 years of age. Leukoplakia has been clinically divided into several varieties. Pindborg and associates describe two varieties: (1) homogenous leukoplakia, which is characterized by a white patch, the surface of which may be smooth or wrinkled and which may be traversed by small cracks or fissures, and (2) speckled or nodular leukoplakia, which presents as white patches or nodules on an erythematous base.

Tobacco abuse is a known predisposing factor in the development of leukoplakia. In contrast, alcohol alone is not known to result in leukoplakia. Chronic trauma, for example, chronic cheek biting or ill-fitting dentures, may cause leukoplakia, as can electrogalvanism among various alloys used in dental work. Other conditions cited as possible etiologic factors include chronic hyperplastic candidiasis, syphilitic glossitis, the Plummer-Vinson syndrome, and submucosal fibrosis.

The overall incidence of malignant transformation of oral leukoplakia is extremely low, varying from 0.13 to 6 per cent. A number of factors are felt to increase the incidence of malignant transformation.

Site. Leukoplakia involving the floor of the mouth, ventral surface of the tongue, mucosal surface of the lip, and gingivobuccal sulcus (if smokeless tobacco is used) demonstrates a higher rate of malignant transformation than does leukoplakia arising in other sites of the oral cavity.

Appearance. The nodular or speckled variety of leukoplakia has a higher rate of malignant transformation than does the homogenous variety.

Age and Sex. Older patients demonstrate a high rate of malignant transformation, as do women despite the fact that leukoplakia is more common in men.

Length of Observation. The longer the period of observation of patients with oral leukoplakias, the higher the incidence of malignant transformation: 2.4 per cent over a 10-year period compared with 4 per cent over 20 years.

Histologic Appearance. Some form of epithelial dysplasia is noted in 8 to 24 per cent of oral leukoplakias, varying from mild dysplasia through carcinoma in situ. The reported incidence of malignant transformation in lesions demonstrating dysplasia is higher than if dysplasia is not present and varies from 9 to 36 per cent. The precise risk associated with different grades of epithelial dysplasia is unknown, but the risk of malignant transformation is presumed to increase with increasing grades of dysplasia, though there is no exact correlation between histopathologic appearance and clinical behavior.

The management of leukoplakia is controversial and varies from observation to local excision, depending on the philosophy and experience of the oncologist. The first step should consist of the elimination of any identifiable causative factor. Sixty per cent of all leukoplakias associated with smoking will disappear within 1 year of the cessation of smoking. Since the incidence of malignant transformation is low, it is reasonable to just observe, particularly if the lesion does not look suspicious and is not in a site associated with a high incidence of malignant transformation. If one is concerned, repeated punch biopsies of any suspicious areas should be performed. If the whole area is worrisome, excision biopsy should be performed. This can be done by means of a cold knife, CO2 laser, or even cryosurgery. Excision biopsy using the CO2 laser is probably best, as it enables the specimen to be evaluated histologically. Ablation using the CO2 laser or cryosurgery, of course, does not allow this luxury. The area can then be allowed to heal by secondary intention or a skin graft procedure can be performed.

Erythroplakia

Erythroplakia is defined as "a lesion which presents as a bright red, velvety plaque, which cannot be characterized clinically or pathologically as any other recognizable condition". Shear has classified erythroplakia into three varieties: homogenous erythroplakia, erythroplakia

interspersed with patches of leukoplakia, and granular or speckled erythroplakia. The latter two forms may not be distinguishable from nodular leukoplakia. Erythroplakia has a much closer relationship to dysplasia and carcinoma than does leukoplakia. Shafer and Waldron demonstrated that 91 per cent of erythroplakia lesions were histologically proven invasive carcinoma, carcinoma in situ, or severe epithelial dysplasia. The remaining 9 per cent were all diagnosed as mild or moderate dysplasia. The incidence of malignant change in erythroplakia is 17 times higher than in leukoplakia. There appears to be no high-risk type of erythroplakia as exists for leukoplakia.

Because of the close correlation between erythroplakia and premalignancy and frank malignancy, the therapy is very straightforward. All areas of erythroplakia should undergo excision biopsy and be carefully followed.

Mucosal Atrophy

Several conditions are felt to be associated with a higher than normal incidence of oral carcinoma by causing mucosal atrophy, thereby rendering the epithelium more susceptible to other known carcinogens. These conditions include syphilitic glossitis, submucosal fibrosis, and the Plummer-Vinson syndrome. Although these lesions can be treated, once established the mucosal atrophy appears to be refractory to therapy.

Benign Lesions

Obviously, multiple benign tumors may present in the oral cavity, varying from the simple papilloma to benign tumors of minor salivary glands to mesenchymal tumors arising from the submucosal tissue in this area. These lesions may occasionally pose a diagnostic dilemma for the clinician. Likewise, the torus palatinus or torus mandibularis may be confused with a minor salivary gland tumor.

In addition, two benign conditions may produce a dilemma for the pathologist. They are necrotizing sialometaplasia and pseudoepitheliomatous hyperplasia.

Necrotizing sialometaplasia usually presents as an ulcerating lesion at the junction of the hard and soft palates, although it may occur anywhere salivary tissue is present. Clinically, it is usually misdiagnosed as a minor salivary gland tumor, and pathologically it may resemble a mucoepidermoid or squamous cell cancer. Microscopically, it is characterized by ductal squamous metaplasia with or without surface hyperplasia, lobular necrosis of the acini with mucous pooling, and acute and chronic sialoadenitis. In spite of the extensive inflammatory changes, the lobular architecture of the salivary tissue is preserved. Spontaneous remission occurs, usually within several months.

Pseudoepitheliomatous hyperplasia may result from local injury or may be associated with granular cell tumors and confused with a squamous cell carcinoma.

Malignant Lesions

Squamous Cell Carcinoma

Squamous cell carcinoma is by far the most common malignancy of the oral cavity, the most common sites being the lower lip, the tongue, and the floor of the mouth. Grossly there are three types of squamous cell carcinoma: (1) superficial exophytic, (2) infiltrative and ulcerative, and (3) fungating.

The *superficial exophytic tumors* are characterized by a superficial spreading type of lesion and can attain a large size without deep infiltration. The surface is usually irregular and may have areas of ulceration. The most likely explanation for the lack of deep infiltration is that the tumor develops by coalescence of multicentric sites of origin. These tumors are less aggressive in their behavior and are less likely to metastasize.

The more aggressive *infiltrative* and *ulcerative* and *fungating* cancers usually present with ulceration or fungation and prominent surrounding induration suggestive of infiltration. There is a high incidence of regional metastases and aggressive behavior. If arising in the tongue, direct extension of the tumor will result in involvement of the deep musculature and limitation of tongue mobility. The root of the tongue may be involved and even the preepiglottic space. Perineural spread is not uncommon. If arising in the floor of the mouth, the periosteum of the mandible provides a temporary barrier to tumor spread, but once breached the tumor will extend into the cortex and then into the medulla of the mandible, with rapid extension in this space.

There have been several attempts to correlate histopathologic findings with cure rate and survival. Squamous cell carcinomas are traditionally graded as well differentiated, moderately differentiated, and poorly differentiated based on the amount of keratinization, and intercellular bridging and the degree of nuclear pleomorphism. Some authors have noted better prognosis with well-differentiated cancers; however, this has not been a universal experience. Others feel that the pattern of invasion at the host-tumor interface is the most important prognostic parameter; that is, carcinomas that invade in small aggregates have a greater propensity to infiltrate blood and lymphatic vessels when compared with those that invade with a broad pushing border, and subsequently they have a worse prognosis. In addition, the frequency of mitoses appear an important predictor of survival.

At present, it is probably fair to state that the clinical staging parameters are better prognostic indicators than the histologic criteria.

Cancer of the Buccal Mucosa

Tumors of the buccal mucosa classically arise at the commissures or the occlusal plane of the teeth. In patients who indulge in smokeless tobacco, they occur in the lower gingivobuccal sulcus. They may be exophytic, arising in conjunction with leukoplakia, or they may be more aggressive, particularly if they arise in the posterior buccal mucosa, at which point they behave

like retromolar trigone lesions. They may infiltrate deeply into the buccinator muscle, causing trismus, invade the bone of the mandible or maxilla, or extend into the pterygomaxillary fossa. Metastases to regional lymph nodes occur in 50 per cent of cases.

Cancers of the Gingiva and Alveolar Ridge

Lesions of the gingiva and alveolar ridge more commonly arise in the lower ridge and in the molar and retromolar areas. They account for 10 per cent of all oral cavity neoplasms. They are usually well differentiated and exophytic and spread superficially. If left to progress, they will invade the underlying bone with spread to regional nodes in approximately 30 per cent of cases.

Cancers of the Lip

Lip cancers arising from the mucosal surfaces of the lip are included in cancers of the oral cavity. They are dealt with in detail elsewhere in this book.

Cancer of the Hard Palate

Cancers of the hard palate are usually seen in elderly men and are not as common as minor salivary gland tumors in this area. They are usually well differentiated and are associated with leukoplakia. They tend to be superficial and spreading but may infiltrate into the underlying bone.

Cancer of the Anterior Portion of the Tongue

Squamous carcinoma of the anterior portion of the tongue is the most common oral cavity cancer. These lesions most commonly arise on the lateral borders and the ventral surface. If detected early, they are relatively easily treated and have a good prognosis. Conversely, once they extend into the underlying musculature, they spread rapidly throughout the substance of the tongue, into the floor of the mouth, and into the posterior portion of the tongue and preepiglottic space.

There is a much higher incidence of regional metastases than is generally appreciated; 40 per cent on the initial presentation, with more than 20 per cent demonstrating bilateral involvement.

Cancer of the Floor of the Mouth

The floor of the mouth is the second most common site of origin of cancer in the oral cavity, with the lesions usually arising in the anterior floor of the mouth just off the midline. They may originally be superficial exophytic lesions related to leukoplakia, but once they extend deeply, the loose submucosal tissues of the submental and submandibular spaces facilitate extension. They infiltrate into the tongue and, if left long enough, into the soft tissues of the neck. The mandibular periosteum is usually a barrier to spread, and the cancer will frequently

spread along the surface of the periosteum into the oropharynx before breaching this barrier. Once the periosteum is penetrated, the mandible is rapidly invaded. The tumor may occlude the submandibular ducts early in their development, and a unilateral enlargement of the submandibular gland may be the first sign of such a tumor. The tumor may even extend into the ducts.

The incidence of regional node metastases is high, ranging from 35 to 70 per cent, although the exact number is difficult to determine because of the high incidence of mistaken diagnoses resulting from the difficulty in differentiating regional adenopathy from submandibular gland enlargement.

Two variants of squamous cell carcinoma warrant separate consideration.

Verrucous Carcinoma

Verrucous carcinoma represents a distinct variant of squamous cell carcinoma, with a characteristic appearance, indolent biologic behavior, and deceptive histopathologic features. It was first described by Ackerman in 1948 as a papillary lesion with microscopically well-differentiated epithelium and intact basement membrane. There is a heaping up of keratin on the surface, with the hyperplastic epithelium pushing rather than infiltrating the deeper tissues. Mitoses are rare. There is typically an associated inflammatory reaction in the stroma. Because of the small superficial biopsies usually taken, these lesions may be misinterpreted pathologically as being benign.

The oral cavity, particularly the buccal mucosa, appears to be the most common site in the head and neck. If allowed to progress, the lesion will deeply invade the surrounding structures, including bone. Surgery is the treatment of choice, but if it is not feasible radiation can be used. The described anaplastic transformation of these lesions from radiation appears exceedingly rare.

Sarcomatoid Carcinomas

Pseudosarcoma, metaplastic carcinoma, and epidermoid carcinoma spindle cell variant are other names for sarcomatoid carcinomas. In the oral cavity, the lip, tongue, and alveolar ridge are the common sites of origin. These lesions are usually fungating but may be ulcerative. They are usually rapidly growing. They usually occur in older men. Those that are superficial have a good prognosis, but those with deep infiltration cause death from uncontrolled local disease or metastases. Tumors of the oral cavity have a 37 per cent incidence of metastases, with the metastases usually being as squamous cell carcinoma.

The histologic diagnosis requires evidence of a squamous cell carcinoma and identification of the spindle cells in the lesion.

Minor Salivary Gland Tumors

The next most common malignancies occurring in the oral cavity are salivary neoplasms. They arise from minor salivary glands of which there are 450 to 750 within the oral cavity. They are predominantly in the palate but also are seen in the lips, buccal mucosa, and tongue. The incidence of malignancy varies from 50 to 70 per cent.

Of the benign tumors, *pleomorphic adenoma* is by far the most common, composing 50 per cent of all intraoral minor salivary gland tumors. They usually present as a slowly growing, painless mass, which if firm and lobulated on palpation. Occasional reports of multicentricity and presentation as a pedunculated mass are noted in the literature. Warthin's tumors have been described in the lower lip and palate, and basal cell adenoma has been seen in the upper lip.

Adenoid cystic carcinoma constitutes 42 per cent of the malignant minor salivary tumors, and it is not only the most common but also the most lethal. Its clinical course is characterized by aggressive and invasive local growth with multiple and persistent recurrences and a propensity for perineural invasion and the late development of distant metastases. Macroscopically these tumors appear well circumscribed; however, this is deceiving, as they are unencapsulated and there is usually significant infiltration into adjacent tissue. Clinically, the disease may demonstrate two different behavior patterns. On the one hand, the disease may be extremely aggressive with early local recurrence, regional and distant metastasis, and rapid progression to death. On the other hand, it may be slowly growing, with the patient and the tumor existing in symbiosis for many years. There does appear to be a correlation between the histologic appearance and the clinical behavior. Those that demonstrate a predominantly solid epithelial component (high-grade malignancy) have a more aggressive behavior, whereas those with a predominantly cribriform pattern (low-grade malignancy) have a slower, more deliberate course.

Mucoepidermoid carcinoma composes 10 per cent of all minor salivary gland tumors, with the palate being the most common site of development. It can present at any age, but characteristically occurs between the fourth and fifth decades. Clinical behavior and subsequent prognosis appear to be directly dependent on the histologic appearance of the tumor. The low-grade tumors consist of cystic areas lined by columnar or goblet cells without solid sheets of neoplastic cells. These more differentiated tumors tend to have a relatively benign course, with a 5-year survival rate of 80 to 90 per cent. High-grade tumors, in contrast, consist of solid sheets of epidermoid, clear, and intermediate-grade cells. These lesions behave in an aggressive fashion with a high rate of recurrence and a tendency to local and distant metastases. There is approximately a 20 per cent 5-year survival rate.

Adenocarcinoma occurs less frequently than adenoid cystic or mucoepidermoid carcinoma. Unfortunately, for many years, the term *adenocarcinoma* was used as an all-encompassing term for many ill-defined salivary neoplasms. For this reason, the true incidence of adenocarcinoma in minor salivary glands is obscure. This lesion may arise de novo or may arise from pre-existing neoplasms, for example, pleomorphic adenoma or adenoid cystic carcinoma. Based on the local infiltrative features, it is divided into high- and low-grade lesions. The high-grade variety is far

more aggressive, with a 50 to 60 per cent local recurrence rate and a significant incidence of lymphatic and hematogenous metastasis. The low-grade lesion is less aggressive with a better prognosis.

Acinic cell tumors rarely occur in minor salivary glands. Although they may behave in either a benign or malignant fashion, it is impossible to predict the biologic behavior from the histologic features. The more benign variant has excellent 5- and 10-year survival rates, but long-term follow-up is essential because there may be delayed recurrence years later. The more aggressive variant may spread early by both lymphatic and hematogenous spread.

Small cell carcinoma is exceedingly uncommon, composing 3.5 per cent of all malignant tumors. Metastases to lymph nodes are not uncommon. Although morphologically these tumors resemble the bronchogenic oat cell carcinoma, the prognosis appears better than for these tumors.

Malignant pleomorphic adenomas can occur as either a primary malignant pleomorphic adenoma or, more commonly, malignant transformation of the epithelial component of an already established benign pleomorphic adenoma. This tumor has a very poor prognosis.

Malignant Melanoma

Oral melanomas constitute 7.5 per cent of all melanomas and 34.4 per cent of all mucosal melanomas. Melanocytes, which are the precursor cells, have been extensively documented within the oral cavity. Eighty per cent of oral melanomas arise in the mucosa of the upper jaw, that is, the palate and the upper alveolar ridge. Unlike cutaneous melanomas, it is not clear whether there are well-defined clinicopathologic entities, but certainly mucosal melanomas appear to behave in a more aggressive manner with an extremely poor prognosis. They tend to present at an advanced stage with a bulky nodular appearance, but a superficial spreading variant has occasionally been described.

Unfortunately, various levels of invasion, such as those used for cutaneous melanomas, cannot be used as a prognostic sign because of the lack of the histologic landmarks found in skin. If invasion is deeper than 0.5 cm, however, there does appear to be decreased survival. Shah and co-workers noted that intralesional vascular or lymphatic invasion was present in nearly all their patients with mucosal melanomas.

Fortunately, most pigmented areas in the oral cavity are not malignant melanomas, and the differential diagnosis of these lesions should always be considered (Table 1).

Patient Evaluation

Cancer of the oral cavity can present in a variety of ways. Exophytic lesions may gradually present as a palpable mass within the oral cavity or a feeling of irritation on being exposed to alcohol or spicy food or drink. Often patients will complain of ill-fitting dentures caused by an increasing tumor mass.

Table 1. Differential Diagnosis of Pigmented Lesions in Oral Cavity

Racial
Amalgam tattoo
Nevi
Addison's disease
Neurofibromatosis
Peutz-Jeghers syndrome
Malignant melanoma
Ingestion of drugs and heavy metals
    Heavy metals: bismuth, mercury, silver, gold, arsenic, lead.
    Drugs: antimalarials, chlorpromazine, phenolphthalein.

More commonly the presentation will be a nonhealing ulcer resulting in pain and halitosis. Pain becomes more prominent with deep infiltration into muscle and bone. Lesions in the retromolar trigone and buccal mucosa classically produce trismus and referred pain to the preauricular region as a consequence of deep infiltration into the underlying musculature. Invasion of the muscles of the tongue will also produce pain and, as the invasion progresses, dysarthria and problems with deglutition will arise. Loosening of the teeth may be a sign of alveolar ridge or maxillary sinus carcinomas.

All too frequently, the initial presentation is with a metastatic node in the neck usually from posterior oral cavity lesions that may be missed in their early stages because of their inaccessible position. Also, unilateral submandibular gland enlargement may be an early sign of a small cancer in the floor of the mouth.

Although it would seem that oral cavity lesions would rarely be allowed to achieve a large size without being detected, unfortunately many of these patients are not overly concerned with oral hygiene and are unlikely to submit themselves to biannual dental examinations, in which the oral cavity could be checked.

A complete head and neck examination is essential in evaluating patients with oral cavity cancer. The neck should be palpated for regional node metastases, which may have to be differentiated from an enlarged submandibular gland by bimanual palpation. Direct tumor extension into the neck can also sometimes be appreciated, although bimanual palpation may be painful and this can better be performed under general anesthesia.

Inspection of the oral cavity may reveal the lesion as an exophytic plaque, fungating mass, nonhealing ulcer, or submucosal mass in the case of minor salivary gland cancers. Palpation, however, supplies the greatest information, as a relatively innocuous lesion may demonstrate deep invasion. Conversely, large superficial ulcers may demonstrate no invasion and be easily mobile. The patient should be asked to protrude the tongue and any limitation should be noted. The "hot potato" voice may signify root of the tongue involvement.

An attempt should be made to determine proximity to the mandible, as this may determine the surgical approach. The state of the dentition should be noted.

The presence of trismus should be noted, as this signifies deep infiltration into the masseter or pterygoid musculature.

In a lesion closely related to the mandible, the mental nerve should be tested for anesthesia, as this may indicate involvement of the inferior alveolar nerve either at the base of the skull or within the substance of the mandible.

Obviously, a full examination of the rest of the upper aerodigestive tract is essential, as is evaluation of the cranial nerves.

A complete medical history and physical examination are essential in the evaluation of patients with oral cancer. The tobacco and alcohol habits of these patients put them at significant risk for chronic lung disease, heart disease, peripheral vascular disease, and liver disease. Poor oral intake and alcoholism may cause malnutrition. All of these problems must be addressed, as they may influence the therapeutic modality selected. The age distribution of this patient population necessitates screening for colorectal and prostate cancer by rectal examination and stool hemoccult testing. Radiographic screening for lung cancer is also necessary. A psychologic evaluation is occasionally helpful in the overall management of these patients.

Special Investigations

A complete blood count, renal profile, liver profile, and chest x-ray studies are routinely performed. Pulmonary function tests are performed if indicated.

Panoramic tomography of the mandible is helpful in determining any overt tumor erosion or widening of the mental foramen signifying tumor spread along the nerve. It also aids in determining the status of the dentition. An x-ray film of the paranasal sinuses may also be helpful in differentiating primary alveolar ridge or palatal cancers from maxillary sinus malignancies eroding into the oral cavity. Computed tomography (CT), though not always necessary, may be helpful in selected cases. CT may depict the extent of the primary tumor, particularly in determining extension into the tongue and soft tissues of the neck, and the presence of regional adenopathy, although these findings should always be correlated with the clinical findings and not relied upon exclusively. Magnetic resonance imaging (MRI) offers better resolution of soft tissue planes and thus is potentially better in demonstrating the extent of tongue involvement by tumor.

Controversy continues to rage as to when to perform a metastatic workup and what that workup should consist of. Our experience has been that the incidence of distant metastases with oral cavity cancers at the time of the initial presentation is low. In general, if the index of suspicion for metastases is great - that is, advanced staging of primary and nodal disease, symptoms of bone pain, elevated bone and hepatic enzymes - a full metastatic workup is

indicated. In our hands, this consists of a chest and abdominal CT scan and a bone scan. Certainly if the index of suspicion is not great, chest x-ray studies and a blood workup may suffice. The occurrence of misleading findings, particularly with the chest scans, remains a problem.

Examination Under Anesthesia

All cases of cancer of the oral cavity should be examined under anesthesia irrespective of size or whether it is amenable to assessment in the office. The major reason for this is to allow the tumor to be accurately evaluated with regard to size and degree of infiltration and particularly in determining the relationship to the mandible. The tumor can be accurately tattooed and multiple biopsies taken under anesthesia. The tattooing is performed with India ink using an 18-gauge needle and puncturing 2 cm from the *palpable* margin. This was particularly useful when preoperative radiation and chemotherapy were routinely performed; however, it is no longer essential since the use of postoperative radiation has become the norm. If there is any doubt as to whether the patient will consent to surgery, it is better to tattoo in case salvage surgery will become necessary in the future. Always perform the biopsy at the end of the procedure, as the resultant bleeding may interfere with the rest of the examination. When possible, it is best to take a biopsy at the host-tumor interface by excising a wedge with a knife.

A further reason for evaluation under anesthesia is the ability to perform panendoscopy - that is, laryngoscopy, bronchoscopy, esophagoscopy, and nasopharyngoscopy - while the patient is anesthetized, looking for multicentric cancers that are noted in approximately 10 per cent of patients presenting with a cancer of the upper aerodigestive tract.

Immediately following examination under anesthesia, tumor mapping is performed using a preprinted diagram of the oral cavity. This is helpful in staging the tumor, in the entry in a computerized registry, and in surgical planning - especially in teaching institutions in which multiple physicians may be involved in the care of the patient.

Staging

Following examination under anesthesia, the cancer is staged according to the TNM (tumor, node, metastasis) system. Accurate staging is essential to aid the clinician in the planning of therapy, to provide a prognosis for the patient, and to assist in the evaluation of treatment results and the exchange of information among treatment centers. Two major systems are currently in use, that is, the International Union Against Cancer (UICC) and the American Joint Committee on Cancer Staging and End Results Reporting (AJC). The T category descriptions are the same for both systems, with tumor size forming the basis for oral cancers (Table 2). The criteria for node classification are, however, completely different in the two systems, with the size and number of nodes being important in the AJCC system and mobility versus fixation in the UICC. Distant metastases carry the same significance in both systems. There are obviously significant intrinsic weaknesses in both staging systems, with there being no allowance for differences in tumor behavior and host response. Also, clinical evaluation of the extent of the

disease is far from optimal and is not very objective or reproducible. Unfortunately, these systems remain the best we have to offer at this time.

Table 2. T Classification for Cancer of the Oral Cavity

T0	No evidence of primary tumor.
Tis	Carcinoma in situ.
T1	Greatest diameter of primary tumor 2 cm or less.
T2	Greatest diameter of primary tumor 4 cm or less.
T3	Greatest diameter of primary tumor more than 4 cm.
T4	Massive tumor more than 4 cm in diameter with deep invasion of antrum, pterygoid muscles, base of tongue, skin of neck.

Evaluation of the Mandible

Detecting involvement of the mandible prior to definitive therapy is a difficult problem but is essential knowledge, as it might determine not only the type of therapy used but also the type of surgery, that is, marginal resection versus segmental resection. The diagnostic modalities available include clinical examination, panoramic tomography, bone scans, and intraoperative evaluation.

Certainly the clinical impression is most valuable, and if the patient has severe pain, anesthesia in the distribution of the mental nerve, or if the bone is obviously expanded, direct invasion is most likely. Panoramic tomography may show overt erosion or expansion of the inferior alveolar canal. It is associated, however, with a high rate of misleading findings. Bone scans are more accurate in predicting tumor invasion but have an even higher rate of misleading findings. With this in mind, it is probably reasonable to defer the final decision to the intraoperative exploration when a definitive decision can be made by raising the periosteum and directly inspecting the bone.

Management

In spite of multiple advances in diagnostic techniques, the improved capability to resect increasingly advanced cancers and then reconstruct the resultant defect, and new and ever changing radiation and chemotherapy protocols, the selection of the ideal therapy for the patient with oral cavity cancer is as confusing today as it was 25 years ago. The disease is better understood as are the needs of the patient, and yet this knowledge has not really been translated into improved survival rates as yet. This disappointment should not, however, deter the oncologist from using all the powerful new tools that have been placed at his or her disposal to better help the stricken patient. If in the end, the only goal that can be accomplished is effective palliation with improved quality of life for the remaining days, this is a laudable accomplishment and worth pursuing. The basic premise of management is to maximize the results of treatment while at the same time minimizing the morbidity associated with the treatment.

Therapeutic Options

Therapeutic options available to the physician are myriad but essentially can be categorized as follows: (1) surgery; (2) radiation; (3) combination surgery and radiotherapy; (4) chemotherapy, either alone or as an adjunct to surgery and radiation therapy; and (5) symptomatic palliative therapy.

Each of these modalities has its proponents and detractors, but in the final analysis, because of the lack of any proven definitive approach, the oncologist uses the regimen that he or she feels most comfortable with and that seems best for the individual patient in an individual setting.

Factors Affecting Choice of Therapy

Type of Neoplasm

Squamous cell carcinoma is the most common cancer, and much of this management section is devoted to the treatment of these lesions. However, the other lesions, for example, malignant melanomas and minor salivary gland tumors, have their own unique characteristics, which determine therapy. These lesions, therefore, deserve some attention.

Because the behavior of minor salivary gland tumors varies so much and because the site of origin often determines the therapy, it is impossible to develop a "cookbook" approach to their management. In general, however, it can be stated that surgical ablation, if feasible, remains the definitive therapy. Radiotherapy can be used as a first line of treatment if surgery is not deemed feasible, with occasional surprisingly good results.

Once the diagnosis has been established, all benign tumors, as well as tumors of low-grade malignancy - for example, low-grade mucoepidermoid carcinoma and possibly acinic cell carcinoma - should be treated with wide local excision with a generous surrounding cuff of normal tissue. Although the lesions are submucosal, at no stage should any attempt be made to preserve the overlying mucosa. Enucleation, no matter how tempting, is to be condemned.

If the lesions are malignant, surgery needs to be more radical with a wider margin of resection. Because of the propensity for perineural spread, the regional nerves should be dissected out and biopsied in order to obtain clear margins. Although wide radical ablation is advocated, mutilating surgery is not recommended, since the overall prognosis does not appear to be improved, and death occurs from distant metastases.

Neck dissection should be performed in those lesions with clinical or histologic evidence of cervical metastases, but a prophylactic neck dissection is probably contraindicated.

Postoperative radiation is recommended for residual macroscopic or microscopic disease following excision or routinely in the management of any of the high-grade malignancies.

Chemotherapy has little or no role in the therapy of these lesions.

Malignant melanomas require wide surgical excision and elective neck dissection. The role of prophylactic neck dissection is controversial.

Staging of the Neoplasm

The site and extent of the tumor are most important in deciding the optimal regimen. Smaller, less advanced lesions can be cured by either radiation or surgery and therefore, the choice of which approach to use would be entirely dependent on other factors. The large, more advanced tumors, in contrast, are associated with a poor prognosis irrespective of the therapy used. In this situation, though every attempt at cure should be made, one does not want to subject the patient to mutilation and subsequent impaired quality of life in a futile attempt at cure. Conversely, the patient who is in agony from extensive bone involvement may well benefit from a palliative radical resection.

Presence of Associated Disease

Head and neck surgery, though complex in nature, in general does not result in a profound disturbance of body metabolism postoperatively. The patient in whom the cancer develops, however, is frequently poorly nourished and may have significant pulmonary, cardiovascular, and hepatic disease. If severe, these conditions may prevent surgery from being a therapeutic option or may influence the type of surgery proposed; for example, poor pulmonary reserve may necessitate a total laryngectomy in association with glossectomy to prevent aspiration.

The Psychologic Attitude of the Patient

The fear of cancer usually outweighs the fear of surgery or radiotherapy. This is, unfortunately, not always the case, and irrational fear may dictate a change in policy. The patient must never be forced into an option that is not desired, as this decision will come back to haunt the physician when the outcome is deemed unsatisfactory.

Attitude of Family and Support System

The family must be involved in the decision-making process. If they fail to live up to their obligations in aiding the patient in rehabilitation and acceptance back into society, the therapy will be judged a failure, no matter how successful it might appear to the oncologist.

The Philosophy and Experience of the Oncologist

Each oncologist develops his or her own philosophy of management based on past experience and intuition in dealing with a particular oncologic problem in a particular setting. Until a fail safe, guaranteed "cookbook" cure for cancer is available, a diversity of opinion is to be expected and should, in fact, be encouraged.

Facilities Available

It is a fact of life that many head and neck tumors are managed away from the "ivory towers" of academic institutions, in which enormous backup and support systems are in place for the management of these patients. Not every oncologist has access to dedicated nurses, prosthodontists, social workers, speech therapists, and so on. Although a case can perhaps be made for the management of all cases in a controlled centralized environment, at this time it is not occurring. The lack of an experienced surgeon, radiotherapist, or chemotherapist, and the lack of support facilities (eg an intensive care unit and so on) should all be taken into consideration in making the final decision as to how best to treat the patient.

Radiation Therapy

As surgical techniques for ablation and reconstruction have advanced in the past decade, so too have radiotherapeutic techniques. As in surgery, the results of radiation vary according to the skill and experience of the radiotherapist and the facilities at his or her disposal. The results of radiation alone in the treatment of early lesions of the oral cavity are comparable to those obtained from surgery. This usually consists of delivering a dose of 60 to 70 Gy through a shrinking field to the primary lesion and to both sides of the neck over the course of 6 to 7 weeks as indicated. Reduced external radiation (50 to 55 Gy) can be combined with radium implants thereby boosting the tumor dose. These implants consist of radium or 192Ir. Alternatively, intraoral cone irradiation can be used. Although involvement of periosteum of the mandible, or the mandible itself, does not preclude the use of radiation, the incidence of radionecrosis definitely increases dramatically, and surgery should be the treatment of choice for these lesions. As the stage of the tumor increases, the efficacy of radiotherapy alone declines, and planned combined radiotherapy and surgery appears to offer a better chance for cure.

Radiation alone, therefore, may be used effectively for (1) early limited cancers, (2) when surgery is not an option because of the lack of an experienced head and neck surgeon or adequate facilities for surgery, (3) when the patient is physically or emotionally unable to undergo extensive surgery, (4) when the patient refuses surgery, and (5) for palliation in the case of an extremely advanced tumor.

Radiation should not, however, be indiscriminately used with a view to salvaging the patient with surgery later. The success rate with surgical salvage is extremely poor, and surgery after high-dose curative radiation is associated with high morbidity.

Radiation itself is not without complications and may be associated with unpleasant sequelae, for example, xerostomia, loss of taste, mucosal ulceration with bone exposure, osteoradionecrosis, orocutaneous fistula formation, and hemorrhage. Osteonecrosis is a formidable complication that may develop up to 1 year following the administration of radiation. The risk increases as the dose of radiation exceeds 75 Gy and in those patients who undergo dental extractions either during or after radiation. The most important risk factor is, however, the dose of radiation to bone, particularly in the less vascular mandible.

Newer radiation techniques, including the use of hyperthermia, electron beam therapy, and twice-daily therapy, all await long-term follow-up in order for their precise role to be properly defined.

Combination Surgery and Radiation Therapy

The concept of combined therapy for advanced cancer is not new; however, only in the past 20 years has it been used on a consistent basis. The rationale for its use is based on the following observations:

The major reason for surgical failure is the fact that residual viable tumor cells are left in the patient. This occurs because of unrecognized peripheral projection of malignant cells, undetected lymphatic or hematogenous metastasis, or the implantation of tumor during surgery. Conversely, the major reason for radiation failure is the projection of tumor outside the treatment field or the presence of anoxic cells in the center of the neoplasm that remain untreated. Therefore, theoretically, planned combined radiation and surgery should be able to minimize the source of failure in each method.

Although theoretically it is strongly suggestive that combined therapy would offer the best prognosis for advanced tumors, there have as yet been no properly controlled trials that definitely support this concept.

In addition, it is not yet clear whether preoperative or postoperative radiation should be used. In favor of preoperative radiation is the fact that the tumor would be theoretically more radiosensitive if the blood supply were not compromised by previous surgery. In addition, radiation may seal off the lymphatics, thereby allowing subsequent surgical manipulation without fear of tumor seeding.

In recent years, however, the trend has been to perform the surgery first followed by postoperative radiation. The advantage of this approach is that the operative morbidity is significantly diminished, a slightly higher dose of radiation can be given, and there is less chance of inadequate resection, as the margins are more easily identified. A disadvantage exists, however, in that if a surgical complication occurs, the radiation may be delayed sufficiently to become ineffective. In fact, however, open wounds may be irradiated without fear of worsening the situation and preventing healing, even though this is not very pleasing aesthetically.

Overall, though combined therapy would seem to be more effective in advanced tumors, there seems to be little difference in survival rates between patients treated with preoperative radiation and those treated with postoperative radiation.

Adjunctive Chemotherapy

Chemotherapy has been used as a last resort for terminal cancer patients for many years, with its role being palliative in relieving pain and obstructive symptoms. The use of

chemotherapeutic agents as an adjunct to both surgery and irradiation in the treatment of head and neck cancer continues to provoke interest. Unfortunately, though many drugs have shown tremendous promise in this role in terms of causing tumor regression, there is no definitive evidence that this approach has any influence on ultimate long-term prognosis. Whether adjunctive chemotherapy will aid in the control of local disease or prevent tumor dissemination as yet remains unanswered. It is to be hoped that chemotherapy will one day take its place as part of a multimodality treatment regimen for head and neck cancer.

Surgery

Myriad surgical approaches to cancer of the oral cavity are available (Table 3). Which approach is optimal for a particular cancer is dependent on the site and size of the tumor, as well as whether a concomitant lymph node dissection is needed. In this day and age, every attempt should be made to eradicate the tumor and also pay attention to preserving function and form.

Table 3. Surgical Approaches to the Oral Cavity

Intraoral Resection
Mandible-sparing Procedures
- "Pull-through" operation

Mandible-splitting procedures
- Lateral osteotomy with mandibular swing
- "Midline" osteotomy with mandibular swing

Composite Resection (jaw-neck procedure).

Intraoral Resection

Most early cancers of the oral cavity are amenable to intraoral resection. The lesions may take the form of areas of leukoplakia with multicentric areas of premalignancy or frank malignancy to superficial exophytic T1 and even T2 tumors. In some areas in which tridimensional excision is possible, for example, the tip and lateral aspects of the tongue, lesions can adequately be excised even if there is a moderate amount of infiltration into the underlying musculature. It is even possible, on occasion, to perform a discontinuous neck dissection with the local intraoral resection.

This resection can be performed under local or general anesthesia, depending on the size and site of the tumor and the preference of the patient and surgeon. A cold knife, cautery, or CO2 laser are the instruments of choice, and all can be used with equally good results. The CO2 laser certainly offers some advantages, including improved hemostasis and less edema and perhaps the advantage of being more precise, but it is certainly not essential for the treatment of these lesions. In one area, it may offer a true advantage, that is, in excising tumors in the anterior floor of the mouth closely related to the submandibular ducts. If the ducts are transected with a knife, there appears to be a tendency for subsequent stenosis with troublesome secondary submandibular sialadenitis. If the CO2 laser is used, however, this does not occur, and this

problem is virtually eliminated. If the duct is transected using a knife or cautery, the cut end should be isolated and tacked to the edge of the defect with two absorbable sutures to prevent stenosis. As always, frozen section control should be performed when excising these tumors, not only from the periphery but also from the depths of the resection. Occasionally, in dealing with tumors closely related to the alveolar ridge, a marginal mandibulectomy can be performed as part of the resection.

After resection, the defect is usually allowed to heal by secondary intention, particularly if a CO2 laser has been used. Other defects may be closed primarily by mobilizing the surrounding mucosa or using a split-skin graft, which can be quilted into position or stented with a bolster.

Rarely, a nasogastric tube may be necessary for a few days to facilitate healing.

Pull-Through Operation

The pull-through operation is an excellent surgical procedure that is ideal for the removal of moderately enlarged anterior floor of the mouth tumors, particularly if concomitant neck dissections and an anterior marginal mandibulectomy need to be performed. It is technically unsatisfactory in dealing with more posterior oral cavity cancers.

After performing the neck dissections as required, essentially three approaches can be used to gain access to accomplish this procedure:

1. A visor flap can be developed and this flap retracted superiorly over the mandible, bringing the primary tumor into view. This flap allows good exposure, but it does have the disadvantage of severing the mental nerves with resultant anesthesia of the mentum. Also, an uncomfortable lymphedema frequently persists postoperatively.

2. A lip-splitting incision can be used to gain access to the tumor. This allows preservation of at least one and sometimes both mental nerves, depending on the extent of the marginal mandibulectomy performed. Also, if the incision is properly placed, it is cosmetically acceptable.

3. Finally, the lesion can be exposed intraorally without either of the above preceding maneuvers by performing release incisions along the floor of the mouth, after the tumor has been delineated, and dropping the tumor, tongue, and floor of the mouth into the neck. This may not be feasible with larger lesions, but it does protect the mental nerves.

Once the tumor is visualized, mucosal cuts around it are made; a marginal mandibulectomy is then performed, if needed, and the tumor is excised in continuity with the underlying neck dissections. In general, if the lesion is in the midline, both necks need to be treated. If unilateral, an ipsilateral complete neck dissection is performed together with at least a contralateral suprahyoid dissection to allow composite resection.

Reconstruction can be performed using skin flaps, regional skin flaps, tongue flaps, or regional myocutaneous flaps.

Mandible-Splitting Procedures

If the tumor cannot be readily accessed by leaving the arch of the mandible intact, it may be necessary to split the mandible to obtain adequate exposure. After the resection and reconstruction have been completed, the mandible is then reapproximated and either wired or plated into position. Two types of osteotomies may be performed.

Lateral Osteotomy. Classically known as Trotter's operation, the lateral osteotomy technique necessitates a stepped osteotomy of the body of the mandible, with the exact site depending on the size and site of the tumor and the state of the patient's dentition. It may be combined with a concomitant neck dissection, and after the mandible has been splayed apart, the tumor is removed in continuity with the neck dissection. After resection, the mandible is approximated using wire or plating. Access to the mandibular osteotomy site may be obtained using a visor or lip-splitting incision.

The ideal indications for this procedure are moderately sized lesions of the lateral floor of the mouth and tongue that are not in close proximity to the mandible or obviously directly invading the mandible itself. If postoperative radiation is to be given, this type of osteotomy is contraindicated because it will be in the radiation field, and nonunion may result. It would, therefore, be better to perform a midline osteotomy that would be out of the radiation field.

A further, if somewhat minor, sequela of this approach is that the inferior alveolar nerve is transected with resultant anesthesia in its distribution.

Midline Osteotomy. Perhaps a more useful technique for splitting and preserving the mandible is the midline osteotomy. Access to the osteotomy site is attained by a lip-splitting incision. Much controversy exists as to whether the osteotomy should be symphyseal or parasymphyseal or whether it should be straight or stepped. It is our opinion that the actual osteotomy is best performed in a stepped manner just anterior to the mental foramen, ensuring that the inferior alveolar nerve is preserved. In a dentulous patient, it is better to extract a tooth and perform the osteotomy through the dental socket rather than attempt to cut between two teeth and risk damage to both nerve roots. The mandible is then swung apart after a release incision is made along the lateral floor of the mouth, leaving and adequate cuff of mucosa on the lingual surface of the alveolar ridge to allow primary closure or flap reconstruction. After the lesion has been excised and reconstructed, the mandible is reapproximated and plated.

This technique is likewise indicated for moderately sized lesions of the tongue that do not involve the mandible. A marginal mandibulectomy can, however, be included in this technique.

Composite Resection (Jaw-Neck Procedure)

By definition, the jaw-neck procedure used in dealing with oral cavity cancers consists of not only removing the primary tumor and the concomitant neck dissections but also performing a segmental resection of the anterior arch of the mandible. As this segmental resection usually consists of a significant part of the mandible, the result is a severe cosmetic and functional defect (the Andy Gump deformity). If combined with a partial or even total glossectomy, and multiple other cranial nerve deficits, the result can be such severe impairment of the quality of life that it is unacceptable for the patient and physician alike. Even under the most ideal circumstances, reconstruction is a formidable task and rarely completely successful. For this reason, segmental jaw resection should be performed only if there is overt tumor invasion of the mandible. For the preceding reasons, an extended marginal mandibulectomy may be the ablative procedure of choice in some patients, even in the presence of overt early cortical involvement.

Once it has been decided that a segmental mandibulectomy should be performed, one should not be conservative in this resection. Once the tumor has extended into the marrow cavity, it rapidly spreads in this space and, therefore, if it is unilateral, a true hemimandibulectomy to incorporate the whole marrow space and inferior alveolar canal should be performed. If reconstruction is contemplated, the ideal posterior osteotomy cut should be vertical just posterior to the opening of the inferior alveolar canal. If bilateral involvement is present, perhaps angle to angle resection will be necessary. Certainly a sample of bone marrow can be taken intraoperatively and checked for any margins with tumor cells.

The reconstruction would depend on the extent of resection and what concomitant structures have been removed and is addressed elsewhere in this book.

Reconstruction

If there has been any advance in the past decade in the management of head and neck cancer, it has been in the realm of reconstruction. Adequate reconstruction is not only important from the aesthetic point of view but also is vital functionally. Poorly conceived reconstruction will result in significant alteration in speech, mastication, and deglutition. Never, however, should the resection be tailored to fit the preconceived reconstruction plan, as any compromise will result inevitably in recurrent cancer and subsequent death.

Healing by Secondary Intention

Small defects of the mucosa of the oral cavity following intraoral resection can comfortably be allowed to heal by secondary intention particularly if the area excised is relative superficial, for example, the mucosa and submucosa. This is frequently preferable to primary closure, particularly if advancing the edges of the defect will lead to distortion of the pharynx. It certainly appears to be the approach of choice when using the CO2 laser.

Primary Closure

Almost any defect in the oral cavity can be repaired by primary closure. However, the resultant distortion of the mouth may be so significant that all the vital functions, including mastication, speech, and deglutition, are compromised. Small superficial and through-and-through defects are, however, quickly and easily managed in this way. This is particularly applicable for closure of relatively small tongue defects. In this modern day, it is rare for any defect of significant size to be closed primarily.

Free Skin Graft or Dermal Graft

Free skin grafts and dermal grafts are extremely useful in closing defects of the oral cavity. Although they are ideal for superficial defects, their use has also been described in closing through-and-through defects of the oral cavity and oropharynx. When used to close superficial defects of the floor of the mouth and buccal mucosa, the grafts can be maintained in position by stenting with cotton impregnated with an antibiotic ointment or quilted in place. Although stenting is a more effective method of immobilization, it may interfere with tongue movement and if large enough can compromise the airway, necessitating the prophylactic use of a tracheostomy.

Split-skin graft reconstruction following a through-and-through resection uses a large redundant pouch of either split skin or dermal graft, which is sutured into the defect with a layer of absorbable suture. This pouch is then packed with a bolster consisting of antibiotic ointment-impregnated iodoform gauze. This results in a saliva-tight anastomosis and minimal shrinkage. Although excellent results have been reported, and the technique is certainly quickly and easily performed, a regional flap is probably preferable in the vast majority of cases.

Tongue Flaps

The tongue, because of its size, composition, and situation, is ideal for reconstruction of regional defects in the oral cavity and oropharynx. The advantages of the tongue flap follow:

1. It has a rich blood supply that ensures viability even under the most adverse circumstances.

2. No additional defect is created, as is the case if regional flaps are used.

The major disadvantage is that speech and deglutition will be adversely affected to a greater degree than when using other forms of reconstruction. If it is thought that this may be a major factor in the postoperative rehabilitation of the patient, it is better not to use these flaps.

Numerous tongue flaps are available for reconstruction. The easiest technique for reconstructing buccal mucosa and the retromolar trigone area consists of dividing the tongue longitudinally in the midline and basing the flap laterally on the floor of the mouth. The flap is

filleted to increase its surface area and is then rotated 180 degrees into the surgical defect and sutured into position. The remaining portion of the tongue is then closed upon itself. Another alternative is to base the tongue flap posteromedially and then rotate the flap into the defect in the posterior oral cavity. Some controversy still exists as to whether to denervate the tongue flap by cutting the hypoglossal nerve in order to decrease its movement and, therefore, its metabolism, increasing its chances of survival. This is routinely practiced by us if a large tongue flap is to be used.

Many useful and innovative tongue flaps are available to close floor of the mouth defects. A simple advancement of half the tongue is easiest, but it tends to tether the remaining part of the tongue. A midline pull-through flap based on the tongue base is simple, effective, and most reliable.

Regional Cutaneous Flaps

The advantage of regional skin flaps is that they enable tension-free reconstruction using viable nonirradiated healthy tissue.

The inferiorly based *nasolabial flap* is effective for closing small anterior superficial and through-and-through defects. Bilateral flaps can be used if the defect is larger, but they result in multiple suture lines.

For many years, the *forehead flap* was the definitive flap for reconstruction of oral cavity defects. It was enormously popular because of its reliability. The donor site defect, however, was unacceptable cosmetically. Even though it is hardly used today, some knowledge of this flap is essential, as it may still be indicated if no other flap is available. If this flap is to be used, every effort should be made to preserve the superficial temporal artery during the neck dissection so that there will be adequate blood supply to the flap. The flap is carefully elevated from the forehead down to the pericranium, ensuring that the postauricular vessels are incorporated in the flap. This is then rotated into the oropharynx through a separate incision 2 cm below the zygoma. Care must be taken to ensure that the incision is large enough so that it does not constrict the flap. Although the flap is used to close the defect, the pedicle is tubed externally. Split skin is then placed over the donor site.

An alternative technique is to deliver the flap under the zygoma, or occasionally the zygomatic arch may need to be resected to prevent constriction of the flap. In 2 to 3 weeks, the pedicle is compromised with a tourniquet to determine its viability and then, as a second stage, the unused portion is severed and returned to the forehead.

The versatile *deltopectoral flap* is an alternative means of reconstructing a through-and-through defect of the floor of the mouth. It may be used in the following ways:

1. The first consists of a two-stage procedure whereby the flap is sutured into the defect after inversely tubing its pedicle under the skin flaps. This creates a controlled pharyngostoma

that has to be closed as a second stage. This technique is rarely used today.

2. A one-stage procedure, in which the pedicle is de-epithelialized prior to suturing the flap into the defect, can also be done. This allows the pedicle to be buried within the wound and eliminates the need for a second stage. Great care should be exercised when deepithelializing the pedicle to avoid compromising the blood supply to the flap.

Myocutaneous Flaps

In the past decade, myocutaneous flaps have gained increasing popularity as the definitive method of reconstruction for large through-and-through defects in the oral cavity. The pectoralis major, trapezius, sternocleidomastoid, and latissimus dorsi flaps all have a role. Of these flaps, the pectoralis major remain the most popular because of its reliability and ease of harvesting. The sternocleidomastoid is the least useful because of its rather tenuous blood supply as it is increasingly mobilized. In addition, it may well be contraindicated in patients who will require a radical neck dissection for ablation of the tumor. Trapezius myocutaneous flaps are not quite as reliable as the pectoralis major flap, and since the patient requires positioning intraoperatively, it is not very convenient.

The advantage of these flaps are that a large defect may be closed and that the bulkiness of the pedicle not only protects the carotid system but also camouflages the cosmetic defect created by the neck dissection. The bulkiness of the flap is an advantage, particularly after total glossectomy, as it diminishes the vertical dimension between hard palate and flap, thereby aiding in deglutition rehabilitation. The bulk also helps direct the bolus of food away from the larynx into the lateral food gutters.

Free Flaps with Microvascular Anastomosis

Free-flap reconstruction of the oral cavity has always been an attractive concept. The groin flap, dorsalis pedis flap, latissimus dorsi flap, radial forearm flap, and free jejunal graft have all been used with great success, with the radial forearm flap increasing in popularity. Many of these flaps may be used not only on their own but also combined with bone to provide reconstruction of the mandible if indicated. The major advantage is the ability to harvest an almost limitless amount of tissue that can be used to close almost any defect. The disadvantages are that it is time-consuming, requires a two-team approach with personnel well trained in microvascular technique, and the recipient site must have at least one artery and vein available for use. Although the artery poses no difficulty, the venous component may not be readily available after a radical neck dissection, and a vein graft may become necessary. The popularity of this technique will, therefore, always be limited because of the inconvenience associated with the procedure. When facilities for this technique do exist, however, it is a most attractive alternative approach to reconstruction.

The free jejunal graft can be used as a patch graft for limited repair of the oral cavity or as an intact tube for reconstruction following total laryngopharyngectomy and total glossectomy

for extensive tumors. The major disadvantage as a patch graft is that hypersecretion from the jejunum results in severe aspiration problems, rendering postoperative management complicated.

Reconstruction of the Mandible

A whole chapter in this book is devoted to the complicated topic of reconstruction of the mandible. As has already been discussed, every effort should be made to preserve the arch of the mandible if at all possible. If not, the decision has to be made to reconstruct the defect primarily or secondarily. None of the multiple techniques available is ideal, but obviously reconstruction is vital in attaining a satisfactory quality of life. The techniques vary from the use of free osteocutaneous flaps to osteomyocutaneous flaps to a recent resurgence of interest in using mandible replacement plates.

Palliation

The management of the patient whose disease is incurable because of either late presentation or failed therapy is a tremendous challenge to the oncologist. Every effort should be made to alleviate suffering and to allow the patient to spend his or her last days with dignity. The use of radiation or chemotherapy to obtain tumor shrinkage or to alleviate pain should be considered. Tracheostomy, esophagostomy, or gastrostomy may be indicated. Placement in an institution even for short periods to relieve the burden on relatives and friends may be necessary. The patient's medication, for example, analgesics, must be constantly re-evaluated to ensure that pain is controlled.

Rehabilitation

For too long, the act of ablating the carcinoma to attain cure, no matter how radical the procedure, was regarded as the goal of both the oncologist and the patient. In recent years, however, great emphasis has been placed on the total rehabilitation of the patient. In order to accomplish this, probably the most important factor is the motivation of the patient. Without the patient wanting to be rehabilitated, the oncologist and the rehabilitation team are helpless. Total rehabilitation is the function of a team of professionals, with the surgeon playing a lesser but coordinating role. Speech therapists, physical therapists, social workers, occupational therapists, prosthodontists, and nurses, together with the patient's immediate family, are all vital members of this team. A number of factors have to be considered.

Cosmetic Appearance

With younger patients and more women being treated for this disease, there is an increasing awareness of the cosmetic appearance after therapy. Although much of the surgery is mutilating to some degree, modern reconstructive techniques have been able to minimize the deformity created; however, the ablative surgery must never be compromised in an attempt to minimize the defect created. Scars in the neck can be covered with scarves, and hair may be styled to cover the defect. In men, a beard may be grown.

Speech

Dysarthria is a consequence of oral cavity and oropharyngeal resection, with the degree of tongue removal being the dominant factor in determining the severity of the speech defect. The articulation defect most apparent is in the formation of speech fricatives (eg this, that) that require lingual-dental approximation. The interposition of flaps or grafts to provide more mobility of the tongue is the best form of prevention. If a tongue tie does result, however, the problem can be improved by dividing the scar tissue and placing a generous split-thickness skin graft to release the tongue or by using a CO2 laser for tongue release. A speech therapist is invaluable in aiding these patients postoperatively.

Prosthetic devices to artificially lower the hard palate or fill a soft or hard palate defect can be a great aid in improving speech and swallowing.

Deglutition

If a large portion of the tongue has been removed and the remaining tongue is tethered, the posterior propulsion of food into the oropharynx and hypopharynx becomes awkward. The bolus has a tendency to be propelled down the side of the surgical defect and often directly into the larynx. This, combined with the anesthesia of the flap, results in aspiration problems with all the sequelae of repeated low respiratory tract infections, fear of eating, and debility. Most patients can be trained to correct this problem by swallowing therapy. Occasionally a cricopharyngeal myotomy may be necessary as a secondary procedure if the swallowing problem continues. This has, unfortunately, been of only limited value in our experience. Velopharyngeal incompetence with reflux of food through the nose is also a problem and may be helped by the use of a dental appliance.

Mastication

In patients in whom partial posterior mandibulectomy has been performed, the mandible is frequently deviated by scarring, resulting in interference with mastication. Various dental devices may be used to correct this.

Prevention, however, is far more important, and without doubt the best prophylactic measure is the judicious use of flap reconstruction to prevent scarring and tethering of the soft tissues of the oral cavity. In our experience, one of the best methods of functional rehabilitation is the fitting of dentures. Prior to this procedure being satisfactorily performed, an alveoloplasty may be necessary, particularly if a marginal mandibulectomy has been performed. One of the more difficult problems is the fitting of dentures after segmental mandibular resection and reconstruction using autografts.

Psychosocial Functioning

Too often insufficient attention is devoted to the tremendous psychological adjustments the patient has to make, with attention zeroing in on his or her physical adjustments. The emotional status of the patient in the postoperative period is important. He or she is frequently depressed, and this interferes with motivation for physical rehabilitation. An experienced and understanding nursing, medical, and paramedical staff are, therefore, important in aiding the patient to overcome this problem. If necessary, psychiatric guidance should be sought.

In addition, there may be a change in the relationship with the immediate family driven by fear of being rejected by them. Adequate family counseling is vital. The patient must learn to accept the situation and make the necessary alterations in life style to compensate for the particular disability.

The Problem of a Total Glossectomy

Total glossectomy is the most mutilating of all surgical procedures performed in the head and neck. The tremendous physical disability and the concomitant psychological problems render this a most traumatic event for both the patient and the physician. By far, the most common indication is advanced cancer of the tongue, which is, unfortunately, associated with an extremely poor prognosis regardless of the therapeutic regimen used. Because of this poor prognosis and the magnitude of surgery needed to excise the lesion, the oncologist may seek alternative forms of therapy (ie radiation alone or in combination with chemotherapy) in order to avoid glossectomy, with usually predictably poor results. Even if surgery is decided upon, knowledge of the resultant disability from total glossectomy may sway the surgeon to compromise this resection in an attempt to retain some functioning tongue. This course also is courting disaster and results in subsequent recurrence and further suffering.

Because of difficulties in adequately assessing large tumors of the tongue, as well as the alarming tendency for spread by local microembolization, which results in islands of tumor cells outside the obvious area of resection, wide margins of resection are necessary, even if this means total glossectomy.

Total glossectomy is extremely disabling and affects many vital functions including mastication, speech, and swallowing. These problems are frequently compounded by additional surgery that may be needed to ablate the tumor (eg mandibulectomy, palatectomy, and laryngectomy), usually together with neck dissection. Each of these associated ablative techniques has its own set of problems in regard to rehabilitation, and combined with total glossectomy the result may be devastating.

Reconstruction of so complex a structure is obviously a formidable task that has challenged surgeons for decades. The basic problem consists of replacing a dynamic sensitive structure that is intricately involved in many finely coordinated functions with an inert mass of tissue. The aim, therefore, is not only to close the defect and prevent fistula formation but also

to preserve as many of the functions of the tongue as possible. The ideal methods of reconstruction should use a flap that gives predictable results, is bulky, and can be reinnervated to replicate the movements of the tongue. Unfortunately, no such flap exists, with the pectoralis major myocutaneous flap probably being the best available.

Speech is very difficult to restore, and rehabilitation is dependent on the speech therapist and the motivation of the patient to learn a new technique. It is frequently surprising to note how well total glossectomy patients can be understood with proper training.

Deglutition, however, is another problem entirely, chronic aspiration being a potentially lethal complication of the procedure. Postoperative swallowing therapy is essential to train the patient in alternative swallowing techniques. Palatal prosthetics may be of help in lowering the palate, thereby facilitating this maneuver to allow commencement of the swallowing process.

In considering the prevention of aspiration, the role of total laryngectomy needs to be considered. In making this decision, the patient's emotional status, particularly with regard to motivation, and general physical condition, with emphasis on pulmonary reserve and ability to withstand aspiration, need to be considered. Two courses are therefore available: (1) a prophylactic laryngectomy in patients who both physically and emotionally would not be able to tolerate aspiration and (2) a trial of leaving the larynx in situ and a vigorous attempt at rehabilitation. The latter course is preferable in many patients, with the knowledge that if it is not successful after a time, an interval total laryngectomy may be performed. Alternatively, a gastrostomy combined with cuffed tracheostomy or other laryngeal or tracheal procedures to prevent chronic aspiration may suffice. Biller and colleagues recently described a prophylactic laryngoplasty performed at the time of the total glossectomy that allowed a good voice but minimized the chances of aspiration. This procedure may be a satisfactory compromise in these situations.

Prognosis

Controversy still exists as to the relative advantages and disadvantages of one form of therapy over another. Reporting of end results continues to be nonuniform, which complicates comparisons. Results of therapy are frequently reported in terms of *local control* as opposed to *survival.* Survival is reported as absolute, actuarial, and determinate. Consequently, one is forced to review results carefully and with some skepticism and in the final analysis be compelled to make recommendations based on personal experience. Hopefully, these factors will become standardized over the years and allow more meaningful interpretation of the results.

The prognosis for oral cavity carcinoma depends on the location of the primary tumor and the stage at the time of presentation. What is known is that early cancers do very well whether treated by local excision or radiation - for example, T1 and T2 cancers of the floor of the mouth treated with surgery result in an 89 per cent cure rate, and if treated with radiation, a 64 per cent cure rate results. Larger lesions do not do particularly well if treated by a single modality and usually warrant combination therapy. Even then the cure rate varies from 27 to 50 per cent,

depending on the series reviewed. Tumors with histologic nodal metastases, erosion of bone, and deep extension into the tongue musculature are all associated with a very poor prognosis.