Chapter 4: The mouth

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The normal mouth

The normal adult mouth contains 32 teeth, supporting structures, tongue and oral mucosa. All are easily examined and any abnormalities may be a good indicator of local or systemic disease.

The ideal mouth has both perfect appearance of the soft tissues and occlusion, the teeth having erupted into their correct positions. Structural defects of the teeth are not common: anomalies of the development of teeth include an abnormal number (less or more than normal), disorders of eruption, and defects of structure.

The third molars, second premolars or the upper lateral incisors are the most common teeth to be missing in the adult. If young girls have missing upper lateral incisors the upper canines are very prominent. Anodontia or the complete failure of the growth of any permanent teeth is extremely rare; such patients keep their deciduous teeth for a long time, but need dentures at an early age. Anhidrotic hereditary ectodermal dysplasia and Down's syndrome are both associated with anodontia or hypodontia, as in cleft palate.

The deciduous teeth usually begin erupting at about 6 months; the process is complete by about 2.5 years. The permanent dentition starts erupting at the age of 6 years and usually by the age of 21 all the teeth have erupted.

Delayed eruption of the teeth is associated with cretinism, rickets, cleidocranial dysplasia and cherubism. In hereditary gingival fibromatosis the teeth appear not to have erupted because of the nature of the proliferating tissue of the gingiva. More commonly, delayed eruption is the result of local obstruction.

Structural defects

Hypoplasia and hypocalcification of the teeth are the most common diseases. The deciduous teeth are not often affected except in severe illness such as neonatal jaundice when the teeth erupt with a yellow colour; in congenital porphyria the teeth may be red, and after large doses of tetracycline the teeth may be discoloured.

The permanent teeth may be affected by local or systemic influences. The systemic disease amelogenesis imperfecta is often divided into two groups: hereditary enamel hypoplasia and hereditary enamel hypocalcification. Both have a variable pattern of inheritance. In the former, the teeth although of an unusual appearance are reasonably strong, whereas in the latter the enamel is very weak and the teeth crumble.

Dentinogenesis imperfecta, an uncommon autosomal dominant hereditary disease, is associated with osteogenesis imperfecta. The enamel of the teeth appears normal but because of the weak underlying dentine the enamel has no support and the teeth collapse.
In congenital syphilis the appearance of the teeth is characteristic: the incisor teeth of the permanent dentition have a notch in the incisal edge (Hutchinson's incisors) and the first molars may be dome-shaped (Moon's molars).

Although rickets, hypothyroidism and scurvy are uncommon, during the time of the illness the structure of the developing teeth is altered and areas of defective enamel with pits and grooves can be seen when the tooth erupts. The antibiotic tetracycline, although known to cause discoloration of teeth, is still often given to children, causing subsequent abnormality of the teeth. In these patients the teeth are of normal strength but the bright yellow banding turns to brown, and the teeth may need to be crownd to cover the unsightly appearance.

Dental fluorosis is a result of too much fluoride in the water supply, appearing at levels greater than 2 parts per million, which is achieved in certain geographical areas. The teeth have a mottled appearance and these are usually permanent teeth. The mottling may be minimal but in severe cases the enamel is grossly affected.

Dental caries

dental caries is probably the commonest disease of western society and results in the premature loss of millions of teeth each year. Caries insidiously causes the breakdown of the enamel, then rapidly spreads in the softer dentine and ultimately affects the dental pulp causing the infection and death of the neurons and blood supply to the teeth. The infection so caused will affect the supporting tissues of the teeth resulting in abscess formation.

Although many theories are adduced it is generally agreed that the carbohydrates in the diet are the underlying cause of the disease and that three factors are important: a bacterial plaque containing cariogenic bacteria, a bacterial substrate (commonly sugar), and susceptible tooth surfaces.

The importance of cariogenic bacteria was confirmed by experiments on germ-free animals on a sugar rich diet who subsequently had cariogenic bacteria introduced and then developed caries. It is probable that the most likely mediators of dental caries are strains of Streptococcus mutans producing insoluble glucans.

Much research work has been directed to find a suitable vaccine that might control these bacteria but the work is still only showing success in monkey models.

Dental plaque is the adherent deposit which forms on teeth and consists of bacteria in a matrix of organic material, and is instrumental in starting both dental decay and periodontal disease. If teeth are cleaned correctly the plaque is removed from most of the surface of the teeth, although it is very difficult to remove from the pits and fissures. Plaque forms very quickly and if left alone for 48 hours it contains active growth of streptococci, lactobacilli, actinomyces, diphtheroids and various Gram-negative anaerobes.

Sugars (sucrose) diffuse rapidly into plaque and it has been shown that the pH of plaque after an oral rinse of 10% glucose will drop within 5 minutes from a pH of 6-8 to that of about 5 and the return to normal pH takes over an hour. When the pH is so low the enamel may become decalcified by the acid production of the plaque. Of course if the mouth is
exposed longer to sugar the pH of the plaque remains low for longer, which is why toffees or a high carbohydrate diet are associated with a high caries rate. A famous study was carried out in Vipeholm in 1947 in which children were given different diets and those fed toffees between meals had a very marked increase in their caries rate. In addition, a study in Turku indicated that caries activity fell by 90% when xylitol was substituted for sucrose.

Dental caries affecting the enamel usually causes no symptoms and although examination might show some slight discoloration, there is initially no bacterial invasion. When the caries reaches the dentine there may be some symptoms and if there is a break in the enamel, the dentine, having a good nerve supply, responds to hot and cold stimulation. This stage is treated conservatively by removal of the decay and replacement with either an amalgam restoration or with a composite repair of an anterior tooth. It is important at this stage to remove all the decay and to line the cavity with a material so that heat or cold are not passed to the dentine through the metal restoration.

If the caries is allowed to progress it leads ultimately to a pulpitis or inflammation of the pulp, resulting in a severe toothache often only relieved by analgesics. Even at this stage the vital nature of the tooth may occasionally be saved by the removal of the irritant caries and placing a calming dressing over the pulp. The dentine layer can grow actively to protect the pulp, and a layer of secondary dentine may be laid down.

If the pulp is left alone, the pain disappears as the inflammation turns to necrosis and the pulp dies. The tooth is now non vital. When the caries has reached this extent it has destroyed a large amount of the dentine of the tooth, the support for the enamel disappears, the enamel starts to fall away and the patient is left with a big cavity.

As the infection reaches the apex of the tooth an abscess may form causing pain, made worse by touching the tooth. There may be also a generalized reaction and inflammation affecting the relevant jaw. In the upper jaw, the swelling may reach the orbit and may mimic a frontal sinus infection. Cervical lymphadenopathy may also be found.

Although at this stage it may be prudent to remove the tooth, the pain will be eased by cleaning out the canal of the root and releasing the pus at the apex. If the tooth settles down it may later be saved by root filling the canal down to the apex.

**Oral hygiene (periodontal disease)**

Periodontal disease is nearly as destructive of teeth as caries and is characterized by gingivitis, inflammation of the gums, destruction of the periodontal membrane and loss of alveolar bone. It is classified into gingivitis (acute and chronic) and periodontitis (acute, chronic and juvenile).

Gingivitis may start in childhood. Although it may not be obvious at first, it progresses insidiously and leads eventually to periodontitis with the subsequent loss of the teeth.

It is very difficult to draw a dividing line between gingivitis and periodontitis. Local factors cause most periodontal disease but systemic disease such as diabetes, leukaemia and scurvy have a very profound effect on the gingiva and supporting tissues.
Gingivitis is usually chronic but acute ulcerative gingivitis or Vincent's gingivitis is occasionally seen. This infection of the mouth is caused by *Borrelia vincentii* and *Fusobacterium nucleatum*, both part of the normal flora of the mouth. The infection is more common in young adults and in neglected mouths. The mouth is painful, the dental papillae bleed and are ulcerated, and the smell of the breath is usually quite startling. Fortunately, the infection is quickly controlled by good oral hygiene and metronidazole.

Chronic gingivitis, which is extremely common, is the result of accumulation of plaque and may be controlled by good oral hygiene: good tooth brushing, interdental flossing and ensuring that all infectants are removed. In man, the severity of gingivitis is related to the amount of plaque present on the surface of the teeth; even if plaque has been present for some time, the inflammation around the teeth will subside if it is removed. In chronic gingivitis the bacterial flora around the teeth changes as the inflammation becomes more severe: it is thought that endotoxins from these bacteria cause the damage to the tissue which leads to periodontitis.

Periodontitis, like gingivitis, may be acute or chronic. In acute periodontitis the tooth is traumatized by biting heavily on something and the supporting periodontal ligament is stretched and damaged. A periodontal abscess forms by infection in a deep periodontal packet and causes acute pain.

Chronic periodontitis is characterized by destruction of the periodontal fibres, resorption of the alveolar bone, migration of the epithelial attachment along the root towards the apex and the formation of pockets around the tooth. The most common feature is the formation of plaque which extends into the pocket: some of this plaque is calcified, forming calculus. The attached epithelium migrates away from the enamel and subsequently exposes the cementum, and the periodontal membrane and alveolar supporting bone are destroyed. The subgingival calculus is an important feature of the disease: it is a source of infection, helps to perpetuate inflammation and retards healing.

Often the first symptom is loosening of the teeth because the destruction below the gingival surface is not painful and to the patient's eye the gingiva looks no different than it has done for years. To save the teeth, treatment at this stage must be vigorous: the subgingival calculus is removed and good oral hygiene instituted. Diet, irregularities of the teeth, prosthetic appliances, cavities and poor restorations are all aggravating factors which should be corrected.

Surgery may be needed including removal of the pockets around the teeth, and exposure of the teeth to remove the subgingival calculus. There are several procedures but the reattachment of the gingival and periodontal tissues to the tooth is the aim; after a successful operation there is evidence of new bone formation and repair of the periodontal membrane.

Nowadays, dental surgeons are much more aware of the ravages of periodontal disease, the care of the gingival tissue has a high priority, and instruction in good oral hygiene is now very important. (The method of payment of dental surgeons in the National Health Service is changing to take account of this new emphasis on mouth care.)
Prevention of dental caries and periodontal disease depends on the common denominator of dental plaque, and patients must understand the purpose of plaque control. Although fluoride and measures to remove stagnant areas from the teeth help to combat these diseases, good oral hygiene with removal of all plaque keeps caries and periodontal disease away.

**Stomatitis**

Stomatitis is a collective name for inflammatory disease of the oral mucous membrane. The skin and oral mucous membrane are both epithelial surfaces so that some diseases affect both.

**Primary herpetic stomatitis**

Herpetic infection is the commonest acute stomatitis in children and is caused by the virus herpes simplex type 1. It begins with vesicles distributed singly or in clumps over the oral mucous membrane. The vesicles are normally 3-4 mm in diameter, dome-shaped and circular; as they rupture they ulcerate to form lesions with a red edge. At this stage they are painful. The patient is often pyrexial and does not feel well, but usually within a week the lesions are fading. Direct smears from early lesions confirm the diagnosis, but this is usually made on the clinical appearance. Antiviral agents (idoxuridine and acyclovir) may be used locally on the lesions but this is difficult with small children.

**Herpes labialis**

Recurrent herpetic infections after primary herpes is thought to affect 30% of those initially infected. The recurrence usually affects the lip. These so-called 'cold sores' are common after a cold, local infection, emotional upsets, heat and various unknown factors. The virus is thought to be dormant in the ganglion of the trigeminal nerve. The lesions are usually preceded by a prickly sensation, then a cluster of vesicles appear which may discharge exudate. The vesicle ruptures and then crusts over. Treatment should be started as soon as the prickly sensation begins and idoxuridine 1% or acyclovir should be applied. Although they do not always abort the lesions, the cycle of events does not appear to be so severe.

**Hand, foot and mouth disease**

This viral infection is common among school children. It presents with ulceration of the mucosa and a vesicular rash on the extremities. It has no connection with the disease of similar name in cattle. It is caused by A strains of the Coxsackie virus, has an incubation period of between 3 and 10 days and is highly contagious. The small scattered ulcers in the mouth are not very painful and the rash often affects the hands and feet. No treatment is required and there is often a mini-epidemic in a school when every child has the disease.

**Herpes zoster**

The infection caused by the varicella-zoster virus usually affects the skin of the face in the distribution of the trigeminal nerve in adults. When it affects the mucous membrane the patient experiences pain before the rash appears and thinks that he has a toothache. The
vesicles are present in the mouth but there is a sharp demarcation line in the midline; they may coalesce within the mouth and form a large ulcerative area. A cervical lymphadenopathy is frequent. The treatment of the intraoral lesions is difficult but analgesics help until the infection resolves.

**Candida**

Acute and chronic candidiasis is common in the mouth and nowadays a systemic Candida infection is often seen in those patients undergoing treatment for leukaemia or malignancy with powerful drugs. This is a ‘disease of the diseased’.

The Gram-positive hyphae of Candida are a normal commensal in about 40% of mouths, the most common strain being *Candida albicans*.

The most usual infection is acute oral candidiasis, commonly referred to as thrush. It presents in the mouth as soft, creamy-yellow patches which form on the surface of the oral mucous membrane. It is common in the elderly and the newborn and those on antibiotic therapy, particularly the tetracyclines. If the plaques are rubbed off a red area of mucosa remains, with the antibiotic form the whole mucosa is red, oedematous and sore, the *Candida albicans* not being immediately obvious. Nystatin pastilles or amphotericin B lozenges are both used to combat this infection.

In chronic candidiasis, persistent white plaques, which on initial observation are indistinguishable from leukoplakia, form on the tongue. The plaques are thick layers of parakeratotic epithelium invaded by hyphae of Candida, with chronic inflammation beneath. These chronic lesions cannot be wiped off and their most common site is at the angle of the mouth; the infection is often associated with angular stomatitis. Scrapings of the lesions submitted for histology confirm the diagnosis.

The management of chronic candidiasis is difficult. In those patients with diseases of cell-mediated immunity or Addison's disease, the underlying condition should be corrected first; in those with chronic mucocutaneous candidiasis the most recent drug to show any improvement in the condition is miconazole.

Angular stomatitis is a cracking of the lips at the commissure. Although it is often associated with iron deficiency anaemia, it is a common manifestation of oral candidiasis. It presents in older people and is the result of the general lack of tone in the facial muscles, allowing the skin of the face to sag causing folds at the corners of the mouth. There is a great temptation to keep these cracks moist by touching with the tongue. Both bacterial and Candida infections thrive in these cracks. The condition may be aggravated by grossly overclosed dentures; some patients wear the same dentures for 30 years, they wear down a great deal and this may add to the problem. The lesions are treated locally with antifungal cream and any disease within the mouth is also treated. The bacterial element must be treated too, with antibiotic creams.
**Denture stomatitis**

This very common condition affects those patients who wear their dentures for long periods. It is characterized by an area of bright uniform erythema exactly corresponding to the upper denture-bearing area of the mucous membrane. It is not seen under lower dentures as these are not so tightly fitting and saliva may wash under them. Occasionally the condition is associated with iron deficiency anaemia and is rarely a reaction to the material of which the dentures are made. The treatment is to encourage the patient to remove the dentures as much as possible, to keep the dentures clean, to take antifungal pastilles or lozenges when the dentures are out of the mouth, and to practice good oral hygiene after the infection has settled.

**The acute specific fevers**

Chicken-pox, and previously smallpox, cause a skin rash as well as intraoral vesicles. In the prodromal stage of measles tiny white spots on a bright red base, called Koplik's spots, are seen. Ulceration of the oral mucosa may also be seen in glandular fever.

**Benign oral ulceration**

There are three main types of this common condition: minor aphthae, which probably affect about 10% of the population, herpetiform aphthae, and the major aphthae which are uncommon.

**Minor aphthae (Mikulicz's aphthae)**

Small painful shallow ulcers appear at more or less regular intervals in the mouth. Their underlying cause is not known but several have been suggested.

No viral or bacterial infection has been isolated, but the ulcers in the mouth may be secondarily infected by bacteria. In women it has been noticed that the aphthous ulcers disappear during pregnancy. Oestrogens have been tried but no real progress in treatment has been made.

Several immunological abnormalities have been reported in patients with aphthous ulcers but the findings are not consistent. It has been shown that patients with these ulcers have higher titres of circulating antibodies, mainly IgM, to crude extracts of fetal oral mucosa. In other reports circulating lymphocytes sensitized to fetal oral mucosa have been found and it is postulated that the antigen responsible is in or on the epithelial surface. It may also represent a cross reaction between an antigen of an oral microorganism and an antigen of oral epithelium. The sequence of cellular changes described in biopsies of aphthous ulcers is regarded as characteristic of a delayed hypersensitivity reaction (type IV). The ulcers to not respond well to immunosuppressive drugs.

About 10% of patients with these ulcers have iron, folic acid or vitamin B\textsubscript{12} deficiency. Of the three, folic acid deficiency seems the only one that clears the ulcers up for good when it is corrected.
Most patients who suffer from aphthous ulcers come from the clerical, semiprofessional and professional groups of people and it is well observed that periods of stress are associated with exacerbations of the ulcers. The disease also appears to be more common in non-smokers, and is particularly apparent in people when they first give up smoking. Aphthous ulcers are uncommon in those who wear full dentures or in manual workers. The ulcers are more common in women. Because there is often a considerable period of time between each attack it is often difficult to assess the benefits of treatment. It is unusual for the lesions to affect the tongue and they are usually located on the non-keratinized areas of the oral mucosa. The ulcers are usually about 2-3 mm in diameter with a yellow floor and a sharply defined red margin; they also have a crater appearance.

**Herpetiform ulcers**

These ulcers are characterized by a very large number of small ulcers which are less sharply defined than the minor aphthae. The ulcers may be confluent and there is a widespread erythema of the mucous membrane. Compared with the similarly named herpes simplex ulcers there are no preceding vesicles and the ulcers are much less regular in size and shape than the simplex ulcers. These ulcers are not caused by the herpes virus and the term herpetiform describes the appearance of the lesion. The condition is uncommon.

**Major aphthae**

These ulcers are usually several centimeters in diameter, persist for many months, and scarring may follow their resolution. They involve the masticatory mucosa. Because of their appearance they may be confused with carcinoma: a biopsy may be the only way to confirm the diagnosis. These aphthae are not indurated like malignant ulcers.

**Management of benign oral ulceration**

The management of these ulcerative conditions is difficult: nothing has been found to cure them although many drugs have been tried. Those patients with blood deficiencies must be treated effectively, but for most the treatment is empirical.

Corticosteroids in different forms give relief: they can be taken topically as hydrocortisone hemisuccinate 2.5 mg pellets or as a topical paste in the form of triamcinolone in orabase, which sticks to the lesion. Although not encouraged, the continual use of intraoral steroids does not give rise to the side-effects of systemic steroids.

Mouthwashes containing tetracycline, chlorhexidine 0.2%, or choline salicylate have all been tried. They relieve symptoms in some people probably because of their anti-inflammatory effect.

Diazepam has been tried, to reduce the anxiety of the patients with recurring ulcers, but the results are poor.

Sodium cromoglycate as a topical agent theoretically cuts down the release of histamine from the ulcers, reducing the amount of pain. It has helped some patients but the incidence of the ulcers is not reduced.
Levamisole enhances both cellular and humoral immune responses. For reasons not understood it reduces the number, frequency and severity of attacks of aphthous ulcers, although it has little effect on major aphthae.

Despite the large number and different types of treatment available the ideal medicine has yet to be found.

**Miscellaneous oral lesions**

**Tuberculous ulceration**

When advanced pulmonary tuberculosis was more common, ulcers were seen on the tongue, but they are now rare. The ulcer has a stellate shape with overhanging edges and watery granulations in its floor. It may be mistaken for a malignancy, because it may be indurated. Biopsy confirms the diagnosis. The oral lesions heal with systemic treatment.

**Syphilitic ulceration**

Oral manifestations of syphilis may be seen in the three phases of the disease. Although not common, the initial infection may arise from oral sexual contact and a primary chancre may then be found on the lips or within the mouth. The chancre begins as a firm nodule 3-4 weeks after infection and when the surface breaks down a few days later a rounded ulcer with raised indurated edges remains. The ulcer is characterized by being painless, although often there are enlarged lymph nodes in the neck. The chancre eventually heals and the diagnosis of syphilis may be made by demonstrating *Treponema pallidum* in material from the chancre because serological tests are not positive at this stage.

Secondary syphilis develops a few months after the primary infection, and in this phase the patient may experience constitutional upset with a mild febrile illness, headache and sore throat. There may be a skin rash of pinkish macules and the oral lesions, which particularly affect the tongue and palate, take the form of flat ulceration covered by a greyish membrane.

These ulcers may lie all over the palate and are described as snail track ulcers. They may coalesce to form well-defined rounded areas described as mucous patches. The diagnosis may be confirmed at this stage by direct examination for spirochaetes, and by serology.

Tertiary syphilis usually appears after 3 years or considerably longer. The characteristic lesion is the gumma, affecting any part of the skin or oral mucous membrane and starting as a swelling which undergoes necrosis leaving a deep ulcer. The ulcer is rounded with soft punched out edges, its floor is pale and resembles wash leather. Although the lesion may heal, it may cause severe scarring of the oral tissues.

In congenital syphilis, painful fissures may also develop at the mucocutaneous junctions and these result in characteristic radiating scars at the angles of the mouth. Saddle nose, frontal bossing and interstitial keratitis may also be seen in this condition. Abnormal teeth have already been described.
**Behçet's syndrome**

Behçet's syndrome consists of anterior uveitis and genital and oral ulcers. The oral ulcerations are usually very similar in appearance to the major aphthae and their treatment is the same.

Associated with the condition are erythema nodosum, erythema multiforme, non-suppurative arthritis, and neurological involvement in 20% of patients.

**Lichen planus**

This condition is very common, particularly in women beyond middle age; its cause remains a mystery. Lymphocytic infiltration and the so-called liquefaction degeneration of the basal layer suggest an immunological cause of a cell-mediated type but experimental immunological tests have been inconclusive. Some studies have shown a correlation with diabetes and rheumatoid arthritis and, like aphthous ulceration, there is a known link with anxiety.

The lesions are characteristic both in their appearance and distribution. Three types are commonly seen: the strial, atrophic and erosive types. In the strial type the striae show hyperkeratosis, parakeratosis, starry and annular patterns.

The atrophic lesions are often combined with the strial type. The epithelium is severely thinned and red, but in the erosive type there are shallow irregular areas of total destruction of the mucous membrane. This type heals by fibrosis. In all types the underlying rete pegs tend to be pointed and saw-toothed and there may be degeneration and liquefaction with beads of fluid accumulating along the basement membrane at the junction between the epithelium and connective tissue. There is also infiltration by chronic inflammation.

In the mouth the lesions are usually symmetrical, commonest on the buccal mucosa and tongue, but uncommon on the floor of the mouth. The symptoms vary: in some patients it is an incidental finding, others complain of roughness of the mouth. The atrophic and erosive types are more painful and sometimes eating is difficult.

Patients with lichen planus of the skin rarely have oral disease as well, although the disease is the same. Lichen planus, particularly the atrophic type, commonly affects the gingiva. Because of the discomfort on cleaning the teeth the gingiva becomes more inflamed, gingivitis ensues setting up a vicious circle. If there is any doubt about the diagnosis particularly with the erosive type, then a biopsy should be taken. This disease is often difficult to differentiate from leukoplakia. The erosive variety has a poorly defined relationship with the development of oral cancer.

The treatment is by pellets of beclomethasone valerate three times a day. The results are good. In severe cases potent steroid preparations may be necessary.
**Pemphigus vulgaris**

Pemphigus vulgaris is rare and is fatal if untreated. It is characterized by vesicles or bullae on the skin and mucous membranes. Of all the oral diseases pemphigus vulgaris has the most compelling evidence that it is caused by immunological failure. The two main findings to support this are, first, a raised titre of antibodies (predominantly of the IgG class) to the intercellular substance of the epithelium, and second, antibodies that can be demonstrated by fluorescence in the intercellular area of the epithelium.

Histology shows that the epithelial cells lose their attachment to each other, a phenomenon called acantholysis. These intraepithelial changes begin just above the basal layer appearing as clefts within the epithelium and as this split widens vesicles and bullae form. The epithelial cells which lose their attachments become rounded in shape and the cytoplasm contracts around the nucleus. These cells are characteristic of pemphigus vulgaris.

The disease may affect either sex, and the mouth lesions often precede the skin lesions. Nikolsky's sign is diagnostic: stroking the mucous membrane induces a vesicle or bulla to appear.

The disease may be mild or severe and in severe cases there is widespread ulceration in the mouth and of the skin. After rupture of the vesicles the underlying erosions are painful. In severe cases protein, fluid and electrolytes are lost causing a systemic upset.

Immunosuppressive therapy has made this disease less life threatening: corticosteroids and azathioprine have both been used successfully, but treatment must be continued for life. When the disease is at its worst the patient cannot eat or drink, and food and fluid must be given by nasogastric tube.

**Mucous membrane pemphigoid**

Although it has a very similar name this disease must be separated from pemphigus vulgaris. It may be serious, but it is not fulminating like pemphigus vulgaris. Bullae and erosions of the mucous membrane are found but the skin is not usually affected.

As a vesicle forms there is a loss of attachment of the epithelium to the connective tissue. The epithelium after separation remains intact, and unlike pemphigus vulgaris there is no acantholysis. Whereas in pemphigus vulgaris the separation is intraepithelial, in mucous membrane pemphigoid the individual cells do not separate from each other. Although an immunological cause is suspected the evidence is not as strong as in pemphigus vulgaris.

The disease affects mainly women, the mouth being the commonest site; it also affects the eyes, larynx, pharynx and oesophagus. After the vesicles have become erosions the membrane heals with a certain amount of scarring. It may be difficult to distinguish this disease from pemphigus vulgaris as in certain cases Nikolsky's sign is positive. A biopsy may be needed to confirm the diagnosis. The most serious sequela of this disease is affection of the eye for the scarring may cause blindness.
Fibrosis and then stenosis of the larynx and pharynx have been reported. In most cases treatment is of limited value but if the eyes are affected systemic corticosteroids may have to be used.

**Acute erythema multiforme (Stevens-Johnson syndrome)**

This disease generally affects young people. It usually has a prodromal period with fever and constitutional disturbances, and the patient may be acutely ill. The oral lesions include split, crusted and bleeding lips and widespread erythema and erosions within the mouth. The eyes and the skin are often affected, the skin lesions being red macules with a bluish cyanotic centre, and these lesions may become bullous in nature. The disease tends to recur every few months for 2 or 3 years.

The cause of the disease is still being studied: reaction to drugs, particularly the sulphonamides and barbiturates, has been implicated. It is also thought that the disease is a sequel to herpes and mycoplasmal pneumonia. Histologically the oral lesions are characterized by widespread necrosis with eosinophilic colloid change in the superficial epithelium, and an inflammatory response in the cells of the dermis.

**Fordyce's spots**

Small creamy spots representing small sebaceous glands are very common and seem to increase with age. They have no significance.

**The effects of drugs on the oral mucosa**

**Local effects**

Patients commonly treat toothache with aspirin, but instead of swallowing it they place it beside the affected tooth, causing local damage with superficial necrosis of the mucosa. The subsequent damage resembles leukoplakia. Other tablets have a similar effect.

Antibiotic mouthwashes, especially tetracycline, alter the local oral flora and a Candida infection may supervene 2 or 3 days after antibiotic therapy begins.

**Systemic effects**

**Bone marrow depression**

Several drugs suppress white cell production, the most severe form being agranulocytosis. In the latter form the gingiva and pharyngeal mucosa undergo necrotizing ulceration. The drugs which have this potential are the antibacterials, analgesics (amidopyrine), phenothiazines and the anti-thyroid agents. The resultant leucopenia has the same oral presentation as in leukaemia described later in the chapter.

Red cell production may be reduced, this being a known side-effect of phenytoin leading to anaemia and, in some cases, to aphthous ulceration and Behçet's syndrome. If folic
acid deficiency is found to be the underlying cause it should be corrected and the drugs stopped. The ulcers then heal.

**Drugs affecting the immune system**

Patients taking steroids in large doses are prone to infections, herpes and Candida infections in the mouth are common in such patients. These oral manifestations are common in patients having transplant operations.

**Specific effects**

Some drugs give specific reactions. Gold, sometimes used in the treatment of rheumatoid arthritis, may cause oral lesions resembling lichen planus. Sulphonamides and barbiturates are held responsible for erythema multiforme. Phenolphthalein drug derivatives commonly used in purgatives may cause sharply circumscribed skin lesions, the lesions appearing every time the drug is used. Arsenical, mercurial and gold-containing drugs may give rise to a serious systemic reaction with exfoliative stomatitis and dermatitis. The epithelium of the skin and the oral mucous membrane are lost and, if not corrected, the disease may be lethal. Similar reactions have been reported to the barbiturates and phenylbutazone.

Phenytoin is used commonly in the treatment of epilepsy. A well-known side-effect is progressive fibrous hyperplasia of the gingiva. Metals such as mercury, bismuth and lead may cause pigmentation of the gingiva, usually affecting the gingival sulcus, a result of the formation of the metal sulphides and bacterial products. The most commonly seen nowadays, though rarely, is the blue line along the gingiva caused by lead. Topical antibiotics may give the tongue a dark appearance due to an overgrowth of pigment-forming bacteria.

**Oral manifestation of systemic disease**

**Haematological disorders**

**Anaemia**

In a patient presenting with a history of a sore tongue, anaemia must be excluded as an underlying cause. Deficiency states characterized by low serum levels of iron, folic acid or vitamin B₁₂ but without actual anaemia may be found in patients complaining of sore tongue.

The mechanism by which these deficiencies affect the oral mucosa and lingual tissues is not understood, but these factors have an important trophic effect in the oral cavity, as shown by the gross atrophic changes of the tongue seen in anaemia. Iron, folic acid, and vitamin B₁₂ are essential for the nutrition of the tongue mucosa, and even though the haemoglobin levels remain normal, deficiency of some of these other factors shows in the mucosa of the tongue. Thus glossitis may be characterized by virtually complete atrophy of the filiform papillae of the dorsum of the tongue. A deficiency must be investigated further.
**Acute leukaemia**

The oral symptoms in many cases of this disease may be quite dramatic. The gingiva becomes very swollen and ulcerated, and painful. The gingiva may also bleed as a result of both the infection and the associated purpura. The gingiva are infiltrated with leukaemic cells. Because of the associated anaemia the oral mucosa may appear pale.

**Chronic leukaemia**

The oral mucosa is not often affected.

**Agranulocytosis**

This is a very uncommon condition with symptoms similar to acute leukaemia.

**Thrombocytopenia purpura**

Sudden bleeding from the gingiva may be the first sign of this disease which is characterized by a low platelet count, normal clotting and an extended bleeding time. Evidence of bleeding may be seen at the posterior border of an upper denture where it presses on the palate.

**Haemophilia and Christmas disease**

Although bleeding may be experienced in the mouth after the shedding of deciduous teeth, the diagnosis has usually been made previously. But this disease must be suspected with persistent haemorrhage after tooth extraction.

**Endocrine disorders**

**Pituitary hyperfunction**

Acromegaly and gigantism usually have obvious presenting features but a change in the occlusion of the teeth may indicate the onset of acromegaly. The condylar growth centre of the mandible is affected so that eventually the lower jaw protrudes. A comfortable eating position is not easy to find as the teeth change position. The patient may also complain that his dentures no longer fit.

**Pituitary hypofunction**

The only effect in the mouth is that the teeth erupt slowly and late.

**Hypothyroidism**

Eruption of the teeth is delayed and the tongue is large in cretinism.
Hyperparathyroidism

This is usually caused by a tumour of the parathyroid glands. Areas of decalcification cause osteitis fibrosa cystica, that is cystic areas of bone resorption.

Hypoparathyroidism

In this rare condition of hypoparathyroidism in children, the disease is present during the development of the teeth and there may be aplasia or hypoplasia of the enamel.

Addison’s disease (adrenal hypofunction)

The main clinical features of this disease are lassitude, anorexia, loss of weight and low blood pressure. Pigmentation, either brown or black, is distributed over the gingiva, buccal mucosa and the lips, and it may be an early sign of the disease.

Diabetes

Although these patients are more prone to infections than normal, periodontal disease is common only in severe uncontrolled diabetes.

Acquired immune deficiency syndrome (AIDS)

Although this disease was only recognized in 1981, infection with human immunodeficiency virus (HIV), formerly known as human T-cell lymphotrophic virus type III (HTLV-III), is increasing at an alarming rate and over the next few years patients will present outside specialist centres. The oral cavity may be an initial indicator of the disease and when examining the mouth this should be considered (Croser and Farthing, 1986).

Suspicion should be raised if the patient, particularly a young male, has evidence of oral thrush, angular cheilitis, gingivitis, a scaly red dermatitis or persistent aphthous ulceration. These symptoms, evidence of possible immunosuppression, are called an AIDS-related complex (ARC). To meet the definition of AIDS the patient either must have a Kaposi’s sarcoma or have had a life-threatening opportunistic infection such as pneumocystis. Hairy leukoplakia, particularly on the side of the tongue, is very suggestive of AIDS infection. The only totally safe way to treat such patients is to assume that all blood and saliva are infected. The Government guidelines define appropriate precautions.

Vitamin deficiencies

Riboflavin (vitamin B₂ deficiency)

Angular stomatitis consisting of red, painful fissures at the angles of the mouth and shiny redness of the mucous membranes are characteristic. Although not common, it is seen in patients with the malabsorption syndrome.
Nicotinic acid deficiency

This disease, commonly known as pellagra, is seen in the UK in alcoholics. Stomatitis and glossitis are presenting features as well as defects of the skin and gastrointestinal tract. The lip, lateral and gingival margins of the tongue become red, swollen and ulcerated.

Vitamin B\textsubscript{12} deficiency

Pernicious anaemia, which is a result of lack of absorption of vitamin B\textsubscript{12}, is characterized by a tongue that is red, painful and smooth caused by atrophy of the papillae. The oral symptoms may be the first sign of the disease.

Folic acid deficiency

The oral symptoms resemble those of pernicious anaemia but the disease is also associated with severe aphthous ulceration as seen in Behçet's syndrome.

Vitamin C deficiency

Commonly known as scurvy this disease is rarely seen nowadays. The main features of the disease are dermatitis and purpura but the gingiva may also swell and bleed.

Vitamin D deficiency

Rickets, although not common in the UK, is still seen in other parts of the world. Although the development of the teeth is not hindered, the structure of both the dentine and enamel is altered causing grooving or pitting of the enamel. The zone of uncalcified pre-dentine is altered making the teeth weaker.

Miscellaneous conditions

Rheumatoid arthritis

Rheumatoid arthritis may be associated with Sjögren's syndrome and a persistently dry mouth.

Rare conditions

Wegener's granulomatosis may produce gingival changes; polyarteritis nodosa may produce oral lesions; and sarcoidosis and Crohn's disease have been found in the mouth.

Effects of radiotherapy on the mouth

Irradiation is one of the main treatments of malignancy of the mouth and neck and it has well recognized effects on the oral tissues. Both cobalt and neutron therapy affect the tissues of the mouth directly and indirectly. The direct effects are reduction of mitosis of the normal cells: some cells undergo total degeneration and then die. The indirect effects are the
result of local damage to the blood vessels, causing thrombosis of the vessels and ischaemia of the oral tissues which therefore take a long time to heal.

The oral mucosa initially shows an inflammatory reaction with a developing area of erythema. The cells which die produce a yellowish-white membrane over the surface of the mouth. If the damage is more severe the full layers of the epithelium is lost producing raw painful areas. The oral discomfort is further increased because saliva is quantitatively and qualitatively reduced making the mouth dry and uncomfortable. Direct effects of radiation make the teeth brittle, and combined with relative xerostomia, hygiene is compromised and rampant caries may develop. It is therefore of prime importance that the mouth and teeth be kept as clean as possible during radiotherapy.

Ranula

A ranula is a uni- or multilocular, mucus-filled cyst in the floor of the mouth. It is classified into two varieties according to its lining and extent:

(1) a 'simple' ranula has an epithelial lining and is confined to the floor of the mouth, in contrast to

(2) a 'plunging' ranula or 'burrowing' ranula which is lined by connective tissue and not epithelium. Although it may be confined to the floor of the mouth, it can extend through the mylohyoid muscle into the neck.

These cysts are considered to arise from the sublingual salivary gland, although several alternative theories have been proposed, such as development from embryonic epithelial rests, a submucosal bursa, or a form of dermoid cyst. The plunging variety results from extravasation of cyst contents into the tissues.

There is no age limit, but they are generally seen in children and young adults. Typically, the appearance is of a bluish, translucent cyst on one side of the frenulum. This appearance has led to the name 'ranula' because of the likeness to the belly of a small frog (Latin rana, meaning a frog). They can burst and recur, and may reach a large size before attention is sought. Examination should include bimanual palpation, in particular, looking for extension into the neck.

The treatment of a ranula is surgery. Marsupialization is often used, and several operations are needed in many cases. Although marsupialization may be effective for a simple ranula, it will invariably fail if used alone for the plunging variety, because the remaining sublingual gland continues to secrete. However, differentiation of a simple from a plunging ranula can be difficult clinically. The following treatment plan has therefore been proposed (Black and Croft, 1982):

(1) a ranula confined to the mouth should be excised (the sublingual gland is often included in the excised tissue)
(2) a ranula extending into the neck should be marsupialized, and the sublingual gland excised. More extensive surgery is not only unnecessary, but carries the risk of damaging the submandibular duct and lingual nerve.

**Disorders of the temporomandibular joint**

The temporomandibular joint lies between the condyle of the mandible and the articular surface of the temporal bone. The capsule of the joint is attached below to the neck of the condyle and above to the margins of the articular area of the temporal bone, extending to the anterior edge of the articular eminence in front and to the squamotympanic fissure behind. The articular disc or meniscus is a dense sheet of fibrous tissue dividing the joint cavity into a large upper and smaller lower compartment. The lateral pterygoid muscle is inserted partly into the front of the disc and partly into the fossa on the front surface of the neck of the condyle below the articular surface. Therefore, when the muscle contracts the disc and condyle are pulled forwards. The commonest disorders of the temporomandibular joint are limitation of movement, pain and clicking sounds.

Trismus means limitation of movement: this feature may be temporary or long term. Temporary trismus may be the result of a bone infection caused by either a buried or an erupting wisdom tooth giving rise to pericoronitis. Following visits to the dentist an injection of local anaesthetic directed at the inferior dental nerve may be the cause of local inflammation near the joint and a fracture of the condyle near the joint also causes trismus. Although acute trismus is not common, tetanus should always be excluded as a cause.

Permanent limitation of movement of the temporomandibular joints may be caused by extra- or intra-articular causes. Fibrosis may occur around the temporomandibular joints during radiotherapy and in the more severe forms may result in complete ankylosis. Although not common in the UK but common in India, oral submucous fibrosis results in the formation of a dense collagenous connective tissue of the buccal and palatal mucous membranes causing thick, hard mucosa and later difficulty in opening the mouth.

Intra-articular fracture followed by bleeding and acute pyogenic arthritis may permanently limit movement of the joints. Rheumatoid arthritis may affect the temporomandibular joints, with crepitus and some limitation of movement, and the extent of the disease is related to the severity of the general illness. Pain does not seem to be a major feature, but X-rays may show erosions of the bone and flattening of the joint surfaces. Treatment is as for the generalized disease.

Pain around the joint may be the result of infection or temporal arteritis but the most common cause is given the name of temporomandibular pain dysfunction syndrome.

This condition, which is commoner in women than in men, consists of pain, clicking of the joints and limitation of opening of the mouth. The onset of the disease is gradual, although some patients report that the symptoms start after yawning. The pain is usually related to one side, is not severe but is worse on eating. The patients may complain of otalgia but point to the pain being first in front or just behind the temporomandibular joint. The joint is heard to click when the mouth is opened and closed and the patient finds it difficult to open the mouth fully.
Abnormalities of occlusion are said to be a common cause of this condition but have not been proven. Missing posterior teeth cause overclosure and a forward posture of the lower jaw. This causes joint strain during mastication. Bruxism of the teeth may also strain the temporomandibular joint and its surrounding musculature. These factors, although not proven, may give rise to a neuromuscular incoordination causing spasms or areas of fatigue in the muscles and subsequent pain.

X-rays are of limited help but at least they can exclude organic disease. It is also important to check that the teeth themselves are sound and that it is not toothache, and the ear should also be examined to exclude otalgia. On palpation of the masseter muscle between the fingers the patient will complain of pain and one can feel the tenseness of the muscle.

The management of these cases is often difficult, but the majority of the symptoms will settle with conservative measures in this self-limiting condition. If an occlusal cause is suspected, detailed occlusal reconstruction may be carried out, but a more practical approach is the fitting of an acrylic overlay appliance which allows free occlusion without cuspal interference. These appliances although simple, will replace missing posterior teeth, correct a severe overbite and often stop grinding of the teeth. Although these appliances may be regarded initially as cumbersome, difficulties of speech and eating are soon overcome and they usually provide an effective treatment. The spasm associated with the masseter muscle may be eased by heat treatment to the area.

The temporomandibular joint pain dysfunction syndrome is a disease of the young. If an elderly patient presents with similar symptoms then the diagnosis of temporal arteritis, osteoarthritis or rheumatoid arthritis should be considered. Irradiation for malignancies of the head and neck may result in fibrosis of the structures surrounding the joints and may result in difficulty in opening or even complete ankylosis. It may require surgery to release the joint or even create a false joint. Trauma to the jaw may result in meniscal tears which can be demonstrated by arthrography.

Although a variety of operations have been described for this disease, including injections of steroid, condylotomy, condylectomy and arthroplasty, they are now regarded as a last resort and conservative treatment is tried for as long as possible.

Cysts of the jaw

Cysts are common in the jaws, arising from proliferation of epithelial rests left from the developing teeth. Cysts may be described as odontogenic or non-odontogenic depending on whether they are in tooth-bearing regions of the jaws. Most cysts have an epithelial lining with the exception of the solitary bone cysts.

The commonest cysts of the jaws, accounting for about 68% of these lesions, are periodontal cysts. They are rarely seen before the age of 10 years and are commoner in men than women. They affect the maxilla three times more often than the mandible and develop as a result of irritation originating at the apex of an infected root canal associated with chronic inflammatory periapical changes. The cyst wall consists of collagenous fibrous connective tissue. The fluid present is usually watery and opalescent and it may contain cholesterol crystals which give it a shimmering appearance. As they grow they give rise to
slowly progressive painless swellings, and there are no symptoms until the cyst becomes large enough to be conspicuous. When the overlying bone thickness has become thinned a crackling sensation may be felt on pressure with the fingers over the cyst.

If a dead tooth, which has been a cause of the cyst, has been extracted for some reason, the lesion that is left is called a residual cyst. X-rays will confirm a rounded, clearly radiolucent area with a sharply defined outline, the only difficulty in outlining the cyst is in the region of the maxillary antrum and the demarcation between the cyst and the antral wall may be difficult.

Dentigerous cysts surround the crown of a tooth and are attached to the neck of the tooth. They account for about 15% of the cysts of the jaws. These cysts are common in the first 10 years of life and usually cause no symptoms. X-rays confirm that the crown of a tooth is usually not in its normal erupting position. It lies in a rounded and unilocular cavity and the cyst is surrounded by sclerotic bone.

Eruption cysts, as the name implies, may involve the deciduous or permanent molar teeth and the cysts lie superficially in the gingivae and appear as soft, rounded, bluish swellings.

Primordial cysts or odontogenic keratocysts which are uncommon, account for about 5% of jaw cysts and usually present in the second and third decade in men. These cysts arise from the remains of the dental lamina or the enamel organ and the cyst is characterized by the growth of finger-like processes along the lines of least resistance and, therefore, the cysts may be of considerable size before they become clinically apparent. X-rays show a radiolucent, multiloculated, area with a scalloped margin; this may cause confusion with ameloblastoma. The bony wall is sclerotic.

Nasopalatine cysts, although uncommon, form in the midline of the anterior part of the maxilla and are thought to arise from the epithelium of the nasopalatine ducts in the incisive canal. They are slow growing and give rise to a salty taste in the mouth when they discharge. Nasolabial cysts are rarely seen.

The treatment for all these cysts is enucleation, but with very large cysts it may be necessary to marsupialize the cyst so that the jaw is not weakened enough to fracture. Marsupialization allows the formation of new bone and when this has formed the cyst may be enucleated. Although ideally all involved teeth should be extracted, this may not be acceptable, particularly when anterior teeth are involved, and therefore conservative management of the teeth may be carried out with root filling and apicectomy. It is uncommon for cysts to recur, except primordial cysts, of which up to 60% recur; this is common daughter cyst formation, thus it is important that these particular cases are followed-up long term.

Solitary bone cysts are characterized by not having an epithelial lining. The cause of these cysts is unknown, although trauma is often thought to be the origin. The cyst cavity has a rough bony wall and the lining may be of thin connective tissue. On X-ray, these lesions are rounded, unilocular radiolucent areas which may arch upwards between the roots of the teeth. They usually present in teenagers, are frequently symptomless and are more common
in females. Attempted removal will find a cavity containing no fluid and as a result of the bleeding so incurred, the cyst cavity will heal up.

Cysts of the soft tissues of the mouth are commonly seen. The most common are called mucous retention cysts which originate in the minor salivary glands of the lip, and the ranula which arises from the sublingual salivary gland in the floor of the mouth. A sublingual dermoid cyst is seen in a similar position to a ranula but the cyst is filled with desquamated keratin and it has a semi-solid feel to it. They are also seen between the hyoid and the mandible and are symptomless until difficulty is experienced with eating and drinking. All these cysts are treated by enucleation, but the mucous retention cysts of the lips have a habit of recurring, probably because of damage to adjacent mucous glands.

**Tumours of the jaw**

Apart from the tumours normally found in bone in other parts of the body, both benign and malignant, the maxilla and mandible contain odontogenic tissues from which tumours may develop.

Fibromata of the jaws are uncommon and may be either endosteal or subperiosteal and they grow slowly often with no symptoms until they are conspicuous by their size or are picked up by routine X-ray. Treatment is by removal and the histology is confirmed by a mass of fibroblasts and collagen fibres. An ossifying fibroma is sometimes seen in children and may present as facial deformity and histologically the calcified masses closely resemble cementum of the tooth.

Chondromata and osteomata of the jaws are uncommon but exostoses of the hard palate, called torus palatinus, and of the mandible, called torus mandibularis, are seen frequently. These exostoses consist of lamellae or compact bone. The torus palatinus is found at the posterior end of the hard palate and is usually apparent when dentures are first fitted, and the torus mandibularis is found on the lingula side of the mandible in the region of the mental foramen. Both these exostoses are removed easily with either a drill or chisel.

Giant cell granuloma of the jaw is uncommon. It arises in young people and mainly affects the mandible. Histologically the lesion forms a lobulated mass which consists of proliferating connective tissue in which there are rounded foci of giant cells. Although the presenting complaint is usually a swelling in the mandible, because of its rapid growth it may present as paraesthesia of the mental nerve. Biopsy is the only way to confirm the diagnosis, for its X-ray appearance of loculation and erosion makes it difficult to differentiate from malignancy. It also has a similar appearance to the effects of hyperparathyroidism; a blood test will confirm normal calcium levels.

Odontogenic tumours arise from either epithelial or connective tissue of the mandible. The most common epithelial tumour is the ameloblastoma, this is a benign tumour which is locally invasive. The tumour originates in odontogenic epithelium, is slow growing and invades cancellous bone. Histologically, the tumour consists of islands of epithelial cells in a connective tissue stroma. The outer layer of epithelial cells has an ameloblast appearance with basally placed nuclei. Cyst formation is common within the ameloblastoma. The X-ray appearance is very similar to that of a multilocular cyst although there may be a honeycomb
pattern of radiolucency. These tumours are more common in middle-aged individuals and, in 80% of cases, are found in the region of the mandibular ramus as expanding swellings, which will destroy much bone and may even present as pathological fractures of the mandible. Biopsy will confirm diagnosis. Complete removal of the tumour achieves a cure but if any of the tumour is left then it will recur. Very large tumours may need extensive surgery with bone grafting if large amounts of the mandible are removed.

Adenomatoid odontogenic tumour is a benign tumour which affects young people and has a well-defined capsule and contains whorls and strands of epithelial cells. Some of the cells look very similar to ameloblasts and give rise to its previous name of adenoameloblastoma, but it has no real relationship to ameloblastoma and simple enucleation is the treatment of choice.

Calcifying epithelial odontogenic tumours are very rare but histologically very interesting in that they consist of epithelial cells in a connective tissue stroma, but they have homogeneous hyaline areas within the tumours which look like amyloid. There are also areas of calcification in which tooth-like structures may be seen. Biopsy is required to differentiate from malignancy and treatment is by excision.

Cementomata or cemental dysplasia are lesions characterized by continued proliferation of cementum. Usually four named types are known - benign cementoblastoma, cementifying fibroma, peripheral cemental dysplasia, and gigantiform cementoma. These lesions are characterized by their radiopaque nature on X-ray and rarely result in expansion of the bone. All can be readily removed and recurrence is not a problem.

Myxomata of the jaws are seen in young people and have a characteristic soap bubble appearance on X-ray. They are slow-growing tumours and consist of spindle-shaped cells scantily distributed in a loose mucoid intercellular material and clinically there is a fusiform swelling of the jaw. Like ameloblastoma wide excision is necessary as they tend to recur.

Other benign masses presenting in the jaw may be odontomas and these are hamartomata. They appear as a radiopaque structure on X-ray and, usually, like teeth, when fully developed grow no further and have no symptoms.

A variety of odontomas are recognized based on their development. The commonest are enameloma, dentinoma and cementinoma, which develop as their names imply from the various tissues of the teeth.

More complicated odontomas called germinated, compound composite and complex composite are reported, which are varieties of distorted teeth. The germinated odontoma is only slightly abnormal and the complex composite odontoma is made up of multiple small simplified teeth called denticles.

**Malignant tumours of the jaws**

Primary malignant tumours of the jaws are uncommon. The jaws are involved in 4% of cases of osteogenic sarcoma. It tends to occur in slightly older patients than those with long bone disease and in the mandible or maxilla of the elderly as a complication of Paget's
disease (Garrington et al, 1967). Histologically the tumours contain osteoblasts, fibroblasts and cartilage cells, but osteoid is also present. The cellular activity is very irregular. Characteristically a fast growing swelling in the mouth is accompanied by severe pain in some instances. X-ray show patchy irregular bone formation and resorption, and biopsy confirms the diagnosis. These tumours have a high metastatic potential and so the prognosis from any treatment is poor, but is better than long bone disease.

Non-Hodgkin's lymphoma, sarcomata and chondrosarcomata of the mandible have been reported very rarely. Multiple myeloma is rarely diagnosed from jaw involvement, but commonly the characteristic lytic areas are found on a total body scan for evaluation of the extent of the disease. Burkitt's lymphoma most frequently affects the jaws of African children. It is characterized by a proliferation of undifferentiated stem cells which cause destruction and swelling of bone and loosening and movement of teeth. The Epstein-Barr virus is well known as a possible aetiological factor. Treatment with methotrexate has had some success.

The mandible and maxilla are uncommon sites for secondary carcinoma but should be considered particularly in patients with carcinoma of the bronchus, thyroid and kidney. The patients usually present with pain and, if the inferior alveolar nerve is involved, paraesthesia may be present. The previous medial history of the patient will give the clue as to whether the disease is primary or secondary although a primary tumour is rarely found. X-rays show an area of bone resorption with a hazy outline. Treatment may be hormonal or by radiotherapy: surgery is not often recommended.

**Osteodystrophies of the jaws**

Rickets, hyperparathyroidism and scurvy may cause metabolic bone disease but in all three, mandibular or maxillary involvement is uncommon. Rickets, although not seen in the UK very often, does not cause soft teeth as is sometimes thought, and those children affected do not have a higher incidence of caries. However, the teeth may be slow to erupt. The gingival inflammation of scurvy is well known but the deformation of collagen and osteoid matrix does not cause any bony lesion.

The jaws are a common site for the cyst-like lesions found in hyperparathyroidism, although the renal symptoms usually bring the patient to the doctor. X-rays of the jaws show generalized bone resorption and a loss of density giving a ground glass appearance. A blood test will often confirm the diagnosis, and histology distinguishes a giant cell granuloma from an ameloblastoma. Removal of the parathyroid adenoma is the primary treatment.

Osteogenesis imperfecta is an hereditary disorder transmitted as an autosomal dominant trait in which bones are poorly formed and fragile. Blue sclerae, deafness and dentiginous imperfections are associated with the disease. Dental extractions must be carried out with great care.

Achondroplasia is a failure of normal proliferation of cartilage in the epiphyses and the base of the skull. It causes the characteristic face of the dwarf: the middle third of the face is retrusive and the profile concave. Disparity in the growth of the jaws causes a severe dental malocclusion.
Cleidocranial dysplasia is characterized by a deformed clavicle and retrusion of the mandible. It is also a well-known cause of the delayed eruption of teeth.

Paget's disease of bone, more commonly seen in the elderly, may affect the mandible and maxilla. The alveolus of the jaws are symmetrically and grossly enlarged as a result of the continual resorption and deposition of the bony tissue in a rapid, irregular and exaggerated fashion. Gross hypercementosis of the tooth roots is also seen and the first indication may be difficulty in extracting a tooth. On X-ray the bones have a cotton wool appearance. Osteogenic sarcoma is a well-known but rare complication of this disease.

Monostotic fibrous dysplasia may present as a painless swelling in the mandible or maxilla. The disease is usually self-limiting and is thus probably better left alone, apart from confirming the diagnosis, unless the swelling becomes very large and unsightly. The lesions of polyostotic fibrous dysplasia may be multiple and are accompanied by pale pigmentation of the skin; like the monostotic type, the disease is self-limiting when associated with endocrinopathies.

Cherubism (Albright's syndrome) is a disease inherited as an autosomal dominant trait and is not now regarded as a fibrous dysplasia. The lesions are highly cellular with many giant cells. As the lesions resolve new bone is laid down at the angle of the lower jaws and also in the region of the tuberosities of the upper jaws. This new bone causes the fullness of the cheeks. The maxillary swelling causes the eyes to turn upwards producing the characteristic cherubic appearance. Like the other two types there is a tendency to natural regression, although surgery may be necessary for severe abnormalities. In fibrous dysplasia and cherubism blood chemistry is normal.

**Tumours of the mouth**

**Benign tumours of the mouth**

Although not true tumours, polyps, epulides and granulomata are common swellings within the mouth, usually the result of chronic inflammatory hyperplasia caused by injury or infection. The lesion begins as a nodule covered by epithelium; the original granulation tissue then becomes replaced by collagenous fibrous tissue. A fibrous epulis or denture granuloma are the different names for a similar histological reaction. A fibrous epulis is usually seen protruding between the teeth on the buccal or labial aspect of the gingival margin whereas a denture granuloma lies near the edge of a denture which is irritating the mucosa. These lesions may be easily excised and any known cause should be removed.

A giant cell epulis is seen during the period when the deciduous teeth are being shed. The swelling is rounded, soft and purplish in colour, may grow rapidly and bleed easily. Histologically the epulis consists of multinucleated cells in a vascular stroma of plump spindle-shaped cells, and the lesions may be easily excised. It may be difficult to differentiated these lesions from an endosteal giant cell granuloma which has eroded through bone and appears as a broad-based flattened nodule. Radiographs show evidence of the underlying bony destruction in the case of the granuloma.
Benign epithelial lesions

A squamous cell papilloma presents as a warty white or pink swelling with finger-like processes of stratified squamous epithelium supported by a core of vascular connective tissue. It is treated by removal.

Pleomorphic adenoma

These tumours are usually well circumscribed or encapsulated and over 60% of the intraoral adenomata arise from the hard palate. They can usually be excised by a large defect in the palate may require flap repair or obturation.

Benign connective tissue tumours

Fibromata are commonly seen on the buccal mucosa, are slow growing, sessile or pedunculated and may be soft or hard. Neurofibromata are rarely found in the mouth but when present appear as a soft lobular swelling. Lipomata are uncommon in the mouth. Various types of haemangiomata may be seen in the mouth: the capillary haemangioma consists of a mass of fine capillary vessels in a connective tissue stroma, and the cavernous haemangioma consists of large, thin-walled blood sinuses separated by septa of connective tissues and the mass resembles a blood-filled sponge. These lesions are often associated with similar skin lesions. Small or moderate-sized haemangiomata may be removed simply by surgery or cryosurgery. The treatment of large lesions is very difficult: injection of sclerosing agents may be helpful. Lymphangioma may affect the tongue and result in a very large tongue; there may also be small lesions of the buccal mucosa. Small lesions may be easily removed, but large lesions of the tongue are difficult to treat.

Premalignant lesions of the mouth

Under normal circumstances healthy oral epithelial cells progress towards the surface and desquamate without appreciable keratin accumulation. Thickening of the superficial mucosal layer (stratum corneum) is called hyperkeratosis; increase of the proportion of nucleated cells near the surface is called parakeratosis, and accentuation of the basal layer (stratum granulosum) with elongation of the rete pegs into the submucosa is called acanthosis. All of these changes are common but harmless.

A white patch in the mouth is commonly called leukoplakia. Such a patch can persist and a few become malignant. The term 'premalignant' is not really appropriate for it is only in retrospect when a carcinoma is present that the leukoplakia has been premalignant. There is no doubt about the potential for malignant change in leukoplakia, but the difficulty lies in estimating the risk. In one large series of white patches in the mouth only 2.4% became malignant in the first 10 years and 5% in 20 years (Banoczy and Sugar, 1972). This rate is 50 times the risk of malignant change in the normal mouth. In another large series of biopsies taken from areas of leukoplakia, the diagnosis was carcinoma in situ in 2% and invasive squamous cell carcinoma in 8%. Leukoplakia of the anterior floor of the mouth should be regarded with suspicion as the incidence of malignant change is in the region of 20-25%. Red lesions are called erythroplasia, a disease with a greater risk of malignant change than leukoplakia.
The basis of the potential of these lesions to change their nature is related to the degree of dyskeratosis of the tissue. Although the interpretation of biopsies varies widely between pathologists, dyskeratosis causes disordered proliferation, maturation and organization of the epithelium and may be present in small or large lesions. The features which may be present are nuclear hyperchromatism, nuclear pleomorphism, mitosis, loss of polarity, deep cell keratinization and loss of intercellular adherence. In cases where there is little disorganization of the epithelium it is called mild atypia, but in true dyskeratosis or severe atypia the epithelium is conspicuously disorganized with irregular-shaped nuclei scattered throughout the thickness of the epithelium.

The lesions of erythroplasia are red and sharply defined and the texture of the lesion is very different from the surrounding mucosa. Most of these lesions when biopsied are carcinoma in situ or carcinoma.

**Candidal leukoplakia**

Speckled leukoplakia are white lesions on an atrophic erythematous base and are thought to be a combination of leukoplakia, erythroplasia and candidal infection. The potential for malignant change lies somewhere between that for leukoplakia and erythroplasia.

If the dyskeratosis is described as moderate or severe, the lesions must be observed closely over a long period of time and any change in nature should be confirmed by biopsy. It is not practical to remove large areas of leukoplakia, particularly in the elderly in whom these patches are common and which are unlikely to undergo malignant change in the patient's lifetime.

Carcinoma in situ is the worst type of dyskeratosis: here the abnormalities extend through the thickness of the epithelium. All the cellular abnormalities characteristic of malignancy may be present but the underlying connective tissue is not invaded. The disease is not often seen in the mouth but should be treated as a true carcinoma.

**Carcinoma of the lip**

The lips form the upper and lower anterior walls of the oral cavity and are composed of the mucosa stretching from the mucocutaneous junction to the line of contact of the opposing lips, including the commissures. They may be divided into upper and lower lips and right and left commissures.

The 600 cases a year reported in the UK are predominantly in men, with a male:female ratio of 8:1. Keller (1970) confirmed an association with farming and outdoor occupations as well as confirming a higher incidence in tobacco users. The lower lip was more vulnerable to the effects of the sun either because of the angle at which the ultraviolet rays strikes the vermilion surface or because the lower lip was larger. Carcinoma of the lip is twice as common in Israel as in the UK. Farmers in Texas and Australia have a particularly high incidence and the risk of acquiring the carcinoma doubles for every 250 miles nearer the equator the patient lives (Szpak, Sonte and Frenkel, 1977).
Squamous cell carcinoma is often preceded or accompanied by a white or reddish plaque, called leukoplakia and erythroplasia respectively. Generally carcinomata remain localized for extended periods, and tend to grow slowly. The tumour can invade the deeper layers of the lip, adjacent skin and oral sites, and bone, with extension down the mental nerve.

The UICC classification is shown in Table 4.1.

**Table 4.1 UICC classification of lip cancer**

**TNM pre-treatment clinical classification**

**T - primary tumour**

- Tis: Pre-invasive carcinoma (carcinoma *in situ*)
- T0: No evidence of primary tumour
- T1: Tumour limited to the lip: 2 cm or less in its greatest dimension
- T2: Tumour limited to the lip: more than 2 cm but not more than 4 cm in its greatest dimension
- T3: Tumour limited to the lip: more than 4 cm in its greatest dimension
- T4: Tumour extending beyond lip to neighbouring structures, e.g., bone, tongue, skin of neck, etc
- Tx: The minimum requirements to assess the primary tumour cannot be met.

The lymphatic drainage from the lower lip anastomoses across the midline and therefore a lesion of the lower lip may spread to nodes on both sides or the opposite side of the neck.

Removal of the tumour is the accepted treatment, particularly if the tumour has spread to the mandible or lymph nodes. Leukoplakia or erythroplakia should be watched carefully.

A lesion smaller than 1 cm can usually be removed with adequate clearance by a modified V-shaped incision followed by primary closure. There is usually enough elasticity in the tissues of the lip to prevent compromise of function or aesthetics. Because the mucosa of the lip is usually widely damaged by actinic cheilitis a lip shave is usually performed in addition. The Abbe-Estlander flap is useful for reconstructing the lip after removal of the carcinoma, allowing up to two-thirds of one lip to be resected. Modifications of this flap operation are described for upper and commissure lesions of the lips. Removal of larger lesions may require reconstruction by a cheek or tongue flap. Radiotherapy may be used for the infirm and for very extensive lesions, but because of early detection most may be removed surgically. For early lesions the prognosis is excellent with either surgery or radiotherapy.

**Cancer of the oral cavity**

Over 90% of all malignancies of the oral cavity are squamous cell carcinomata, the remainder include tumours of the minor salivary glands, sarcomata, lymphomata and melanomata.
In the UK and the USA malignant tumours of the oral cavity account for less than 2% of all malignancies, whereas in India they account for more than 40% (Mahboubi, 1977). On average in the UK almost 1500 cases of intraoral cancers and about 600 cases of cancer of the lip are seen in one year.

**Squamous cell carcinoma of the oral cavity**

The mouth is divided anatomically into the lip, the buccal or cheek mucosa, the gingivae, the hard palate, the oral tongue and the floor of the mouth. The floor of the mouth is the crescent-shaped area between the lower gingiva and the under surface of the tongue. There is also an area called the retromolar trigone which is the small area of mucosa attached to the anterior surface of the ascending ramus of the mandible posteriorly, running forward to the upper and lower molar teeth including the edge of the maxillary tuberosity.

**Aetiology**

Over 95% of patients with squamous cell carcinoma are over the age of 40 years and, in this age group, one in 20,000 of the general population will be affected, whereas the chances of acquiring the disease over the age of 75 are one in 1100.

Smokers are six times more likely to develop intraoral cancer than non-smokers (Silverman and Griffiths, 1972; Wynder and Stellman, 1977). In the USA, it has been shown that 40% of those who develop a squamous cell carcinoma of the mouth and who continue to smoke after treatment will develop a second head and neck malignancy, while those who give up smoking have only a 6% chance of a second primary tumour (Moore, 1971). These results have not been confirmed in the UK where there has been no apparent increase in the incidence of oral carcinoma over the last few years. Fewer men and more women are now affected, and the large increase in smoking over the last 20 years does not correlate with the falling or static incidence of the disease.

The decline in pipe smoking has mirrored the decline in mouth cancer. Reverse smoking in India, Sardinia, Venezuela and Panama is associated with a high incidence of hard palate malignancy (Reddy, 1974), and the habit of holding raw tobacco against the mucous membrane in one area of the mouth is also associated with a high incidence of the verrucous variant (Stecker, Devine and Harrison, 1964).

In India and Southeast Asia the high incidence of oral cancer is related to the habit of chewing betel nut, which is a mixture of the nut, tobacco and slaked lime wrapped in betel leaves. This mixture is extremely cheap and available at every street corner. Its interesting and refreshing taste particularly after eating, makes it practically addictive. It is taken in India by whole cross sections of society, being packaged very much like peanuts in the UK.

In the USA the relation between squamous cell carcinoma of the mouth and high alcohol consumption has been known for some years. Whether this is because of a direct effect or whether it reflects an underlying nutritional deficiency is not known (Wynder, 1971; Lowenfels, 1974). In the UK the figures are not so convincing and, as with tobacco consumption, there has been no corresponding increase in oral cancer with the increasing alcohol consumption in recent years.
The aetiology of oral cancer is still little understood, but dietary and metabolic factors have been studied. There is an increased incidence in patients with cirrhosis of the liver, particularly in France. This may be because of the lack of the vitamin riboflavin which may result in a degenerative mucosa. There is a higher incidence of disease in Scandinavia in women and related to the Plummer Vinson syndrome (Wynder et al, 1957; Wynder and Stellman, 1977), and a higher incidence is also reported in textile workers exposed to wool fibres.

Although theoretically poor oral hygiene, mechanical irritation by sharp teeth or dentures would be thought to be implicated, there is no evidence to prove this. The decline of oral cancer over the years may be attributed to less pipe, smoking, improvement in oral care and the effective treatment of syphilis.

**Pathology**

The typical squamous cell carcinoma is an obvious ulcerated lesion with a greyish rough base. The tumour may protrude above the surface (exophytic) or infiltrate deeply with minimal projection above the surface (endophytic).

Histologically there is invasion of the deeper tissues of epithelial cells with cellular abnormalities, including pleomorphism and intense nuclear staining. Tumour cells invade deeper tissues including muscle, glands, nerves and eventually bone. Low grade tumours (well-differentiated) are those with minimal pleomorphism and few mitoses, and high grade (poorly differentiated) tumours have much cellular and nuclear pleomorphism and negligible keratinization. This differentiation is important in prognosis (Arthur and Farr, 1972). Verrucous carcinoma refers to certain exophytic tumours that have a papillary and micronodular appearance and tend to spread laterally. Some regard these tumours as the most well-differentiated squamous cell carcinomata.

The lateral border of the tongue is the commonest site inside the mouth. Over 70% of intraoral tumours lie in the lower half of the mouth. Because symptoms may be minimal or absent when an oral cancer is small, diagnosis and treatment are often delayed until the cancer is large or cervical lymph node metastasis is apparent.

**Clinical features**

Bruun (1976) at the Royal Dental Hospital in Aarhus, Denmark, found that the average delay from the onset of symptoms in a patient with a malignant lesion in the oral cavity to actual consultation with a general practitioner was 4.9 months. He also showed that a further 5.6 months elapsed after this consultation before actual therapy began.

General dental and medical practitioners may only see one or two intraoral malignancies in their careers; 70% of carcinomata had not been suspected of being malignant at the patient's first visit to their practitioner. Not all the blame is to be laid on the practitioners as the patients are often late in presenting with their complaints. Education of patients, medical and dental practitioners might produce early diagnosis of these tumours.
Lesions of the lip, anterior cheek, floor of the mouth and gingivae tend to spread to the submandibular lymph nodes; carcinomata of the tongue and retromolar trigone spread to the upper digastric nodes. The presence of lymph node metastases at diagnosis halves the survival changes of the patient. Distant metastases are uncommon in cancer of the oral cavity, but some have put the distant metastases rate at post-mortem as high as 47% (Merino, Lindberg and Fletcher, 1977).

Reporting of survival is based on accurate staging of the disease. The problem with staging is that there is a large subjective element, particularly in the assessment of oral cancer and it is often forgotten that these tumours are three dimensional. The TNM classification of the UICC is shown in Table 4.2 (Manual for Staging of Cancer, 1977). The N status is the same for other head and neck tumours and is shown in Table 4.3.

Table 4.2 TNM classification for oral carcinoma

**TNM pre-treatment clinical classification**

| Tis  | Pre-invasive carcinoma (carcinoma in situ) |
| T0   | No evidence of primary tumour              |
| T1   | Tumour 2 cm or less in its greatest diameter |
| T2   | Tumour more than 2 cm but not more than 4 cm in its greatest dimension |
| T3   | Tumour more than 4 cm in its greatest dimension |
| T4   | Tumour with extension to bone, muscle, skin, antrum, neck, etc |
| Tx   | The minimum requirements to assess the primary tumour can not be met. |

Survival curves show that the highest mortality is in the first 2 years after diagnosis. The actuarial survival for carcinoma of the lip for 5 years is 77% and that for the tongue 26%. Over 10% of patients with oral cancer develop a second primary tumour.

Table 4.3 N status - TNM classification

**N - regional lymph nodes**

| N0   | No evidence of regional lymph node involvement |
| N1   | Evidence of involvement of movable homolateral regional lymph nodes |
| N2   | Evidence of involvement of movable contralateral or bilateral regional lymph nodes |
| N3   | Evidence of involvement of fixed regional lymph nodes |
| Nx   | The minimum requirements to assess the regional lymph nodes can not be met. |

**Features of specific sites**

**Carcinoma of the tongue**

Most squamous cell carcinomata arise from the lateral borders or central aspect of the tongue, origin from the dorsum is uncommon and midline lesions are rare. Fewer than 1% of patients are less than the age of 30 years, although cases in adolescence have been reported (Byers, 1975). Usually the lesion starts as a small white or red patch and the only symptom
the patient experiences is some discomfort with spicy foods. As the ulcer forms it is firm with raised edges, has an inflamed granular floor which bleeds easily and the base is indurated. The lesion is usually larger on palpation than thought on observation. In larger lesions the ulcer spreads into the adjacent floor of the mouth and mandible and may be so extensive that the exact site of origin cannot be ascertained. Unfortunately most lesions are already T2 in size at diagnosis. It is often only when eating and swallowing become difficult that the patient seeks help.

The lymphatic network of the tongue is well developed and, classically, lymph drainage from the tip of the tongue is to the submental nodes and then to the jugular omohyoid group, and from the side of the tongue to the submandibular nodes and then the jugulodigastric nodes.

It is important to palpate both sides of the neck as tumour may spread by an abnormal route to the other side. Nearly 30% of patients at presentation have evidence of neck involvement.

**Carcinoma of the floor of the mouth**

These are tumours of the sixth and seventh decades, and over the last 10 years the male:female ratio has dropped (Fu, Lichter and Galante, 1976). As the carcinoma grows, ulceration becomes more prominent with lateral spread, and the tongue and mandible are invaded. If the tumour is not freely mobile the periosteum of the mandible is invaded until proven otherwise and an orthopantomogram may give an indication of such invasion. Pain indicates deeper infiltration. At presentation more than half the lesions are classified T3 and T4 and fewer than 10% are T1.

**Carcinoma of the alveolar ridge**

Over 80% of these lesions affect the lower alveolus and the first symptoms are a poorly fitting denture. As for the floor of the mouth fewer than 20% of the lesions are T1 in size at diagnosis (Cady and Catlin, 1969). The important point in pathology of tumours arising from or extending to the lower alveolus is invasion of the mandible. The tumour can erode directly into bone, frequently through the healed extraction sockets, or may enter the inferior dental canal through the mental foramen. The foramen lies close to the mucosal surface in edentulous patients whose alveolar ridge has atrophied. Once in the canal the tumour spreads along the inferior alveolar nerve as far back as the base of the skull. Invasion of the lower cortical strut of bone is uncommon.

The 5-year survival rate for T1 lesions is over 78% but for T4 lesions is less than 15% (MacComb and Fletcher, 1967).

**Carcinoma of the buccal mucosa**

This is the lesion common in betel nut chewers in India. Small lesions are completely asymptomatic but if the lesion is posterior, trismus may be the presenting feature caused by invasion of the pterygoid muscles (Paymaster, 1956). Over 40% of these patients present with
lymph node enlargement (Conley and Sacoyanna, 1973). There is a 90% cure rate for T1 lesions and only 15% for T4 lesions (MacComb and Fletcher, 1967).

**Carcinoma of the hard palate**

Over 80% of these tumours present in patients over the age of 70 years, affecting men and women equally. They are common in those parts of the world where reverse smoking is practised (Reddy, 1974) and particularly in India. One in five reverse smokers has either a premalignant or malignant condition.

**Carcinoma of the retromolar trigone**

The trigone is a very small area so that at presentation most of these carcinomata have already spread to the surrounding areas of the soft palate, tonsil, buccal mucosa and tongue. These tumours are aggressive and over half have neck nodes at diagnosis.

**Clinical diagnosis of oral malignant conditions**

The initial evaluation of a patient with a suspected malignant oral condition is a comprehensive history, directed to the duration of the symptoms and their nature. The history must include questions about the social habits, particularly smoking and drinking, and also any relevant occupation or hobbies. It is important that any previous exposure to chemical or radioactive irritants be noted.

The patient's medical history must be carefully recorded, especially any previous syphilitic, severe cardiac, nervous or respiratory problems. Surgery or medication in the past for an illness may limit the use of one of the treatment modalities available. Prior treatment for cancer should be reviewed in great detail and if radiotherapy has been used, the exact dosage and treatment fields must be available for treatment planning. The history should indicate the sort of support that will be available to the patient after treatment for this could equally influence the treatment.

The physical examination of the patient should include not only the oral lesion and the neck, but also the cardiopulmonary, renal, gastrointestinal, hepatic and metabolic systems. It is important at the beginning of the clinical evaluation to examine the dental and gingival status of the mouth, an examination which is often totally neglected.

The superficial structures of the oral cavity, lip and tongue are amenable to inspection and palpation: a biopsy of the mouth or lip may be easily taken without general anaesthesia, and the histological diagnosis may be made very early in the assessment of the patient. The biopsy usually confirms the high suspicion of malignancy on examination.

The patient's general health must be assessed and any evidence of malignant spread to other sites in the body or the possibility of a second primary tumour must be sought.

The haemoglobin, white cell count, erythrocyte sedimentation rate, electrolytes, urea, total protein, albumin and glucose levels in the blood are recorded. Urine analyses should also be carried out. Anteroposterior and lateral X-rays of the chest are important to exclude
secondary disease or a primary malignant condition. Orthopantomograms of the mandible will show any evidence of bony invasion. Roughly half of the patients with clinical involvement of the lower alveolus by an intraoral carcinoma show radiological evidence of bone involvement. This is usually an irregular invasive bony defect, so-called 'moth-eaten appearance', but a smooth pressure erosion is also common. 'Floating teeth', displaced bony fragments, pathological fractures, and rarely an expanded inferior canal are less common radiological signs. The floor of the mouth is often difficult to evaluate directly and computerized tomography will show the extent of submucosal infiltration, although teeth, if present, distort the image. Computerized tomography is also useful in determining response of the tumour to chemotherapy and radiotherapy during treatment.

The place of magnetic resonance in diagnostic imaging has not yet been determined and its full potential has yet to be realized. Xeroradiography and ultrasound have little place in intraoral lesions. Radionucleotide scanning of bone and liver may be used to exclude metastasis.

An examination under anaesthetic to demonstrate the extent of disease is useful and a full panendoscopy of the upper respiratory and alimentary tracts including bronchoscopy can be carried out to search for a second tumour. It is also useful while the patient is anaesthetized to examine the neck again.

Most lesions are either squamous cell carcinomata or of minor salivary gland origin. If the biopsy confirms a rare malignant melanoma, the prognosis is very poor and surgery is the only treatment that might control the disease. Lymphomata of the oral cavity are very uncommon: they must be typed accurately, and further investigations of the lymphatic system and bone marrow carried out. Treatment depends on the exact histology and extent of the disease: chemotherapy or radiotherapy or a combination of both are the mainstays of management.

Treatment of mouth cancer

The selection for treatment for squamous cell carcinoma of the mouth must be based on a number of factors in addition to the extent of the disease. General health, nutritional status, smoking, drinking habits and the patient's mental and psychological make up must also be considered in deciding individual treatment modalities. The prognosis of advanced oral carcinoma is universally very poor: furthermore mutilation and loss of function from either surgery or radiotherapy can be conspicuous.

Irradiation

The radiotherapeutic methods for treating squamous cell carcinomata are telecobalt units or low megavoltage linear accelerators. Most squamous cell carcinomata are radiosensitive and exophytic lesions are more radiosensitive than erosive lesions. Bone and muscle invasion adversely affects the radio responsiveness of the tumours and therefore subsequently decreases the radiocurability (Chu and Fletcher, 1973).

T1 and T2 lesions in all sites within the mouth respond equally to surgery and radiotherapy, the latter usually accomplished with a dose of about 6,500 cGy given in
fractions over 4-5 weeks. Lesions of the lateral border of the tongue and anterior floor of the mouth can be successfully treated with interstitial implants to deliver a dose of up to 10,000 cGy. A combination of external beam and implants may be used. If nodes in one side of the neck are enlarged, surgery should be considered as the first line of treatment.

Radical radiotherapy can be used for T3 and T4 lesions: some are radiosensitive but the overall survival rates are poor. Preoperative or postoperative radiotherapy has been advocated in an effort to increase survival. Preoperatively radiotherapy is advocated to reduce tumour size and to limit seeding and embolic spread of tumour cells, but this has not been demonstrated in practice. Roscuit et al (1972) using a preoperative radiation dose of 4,000 cGy showed no increased survival in the large T4 tumours. In 1986 Robertson et al presented a series of patients given postoperative radiotherapy 6 weeks after removal of T3 and T4 tumours and showed a reduction of recurrence at 18 months from 50% to 18% compared to a previous series. Snow et al (1980) found no difference in recurrence rates at 18 months between preoperative, postoperative or radical radiotherapy.

The use of neutron therapy with the cyclotron is still controversial. Initial results from both the USA and the UK were encouraging; recurrence of disease at the primary site was reduced, but the survival of the patients was not increased. Further trials have shown that the survival rates for fast neutrons are no better than those for photons.

Surgery

The standard procedures for mouth cancer are a glossectomy (partial or total) and a resection of the mandible with the adjacent floor of the mouth, called a commando procedure by the Americans or, more elegantly, a pelvimandibulectomy by the French.

Hemiglossectomy

Before any operation on the tongue, the use that the patient makes of his voice must be considered. If he depends on his voice for his livelihood then attempts must be made to leave a good tip to the tongue and to supply a sulcus so that he can wear teeth, either immediately or later.

The proposed lines of clearance of the tumour inside the mouth are tattooed, since it is easy to become disoriented while removing the primary tumour from the tongue if there are not marks to follow.

If the patient has enlarged cervical nodes a standard radical neck dissection is performed and left attached at the submandibular region. When the radical neck dissection is completed it may be thought best to split the lip to improve access. It is quite possible to do this operation without splitting the lip, which is preferable since it prevents oedema of the lip and a scar. The skin is elevated off the mandible and bleeding from the mental foramen prevented by first isolating and dividing the vessels which pass through the foramen. The mucosa in the gingivobuccal sulcus is cut thereby opening the mouth.

Excision of the primary tumour, if it is large, may require a mandibulotomy.
The primary tumour is removed by holding the tip of the tongue in a towel clip and pulling it forward. Cutting diathermy is used to remove the tumour. It will be necessary to stop and tie the lingual artery. A margin of at least 3 cm is needed and the margin must be in depth as well as width.

**Operations for tumours of the floor of the mouth and alveolus**

Tumours of this area are dealt with in a very similar manner by the commando operation or pelvimandibulectomy.

Under general anaesthesia, a temporary tracheostomy is inserted. If the patient has an enlarged node in the neck a radical neck dissection is carried out and left with its pedicle on the submandibular area.

The superior cervical flap is raised well up over the mandible, with or without splitting the lower lip. The oral mucosa is divided in the gutter lateral to the mandible well away from the tumour.

It is often possible to preserve the lower border of the mandible thus preserving bony continuity (marginal resection) which is superior to division of the mandible and grafting.

If the tumour affects the alveolar ridge the alveolus is removed in the appropriate area using a Stryker saw or a fissure burr. The segment of mandible is left in continuity with the primary tumour which is removed with a wide margin, including part of the tongue if necessary.

After removal of a small tumour (less than 2 cm in diameter) it is often possible either to close the defect primarily or to repair it with a split skin graft.

The quilting technique is particularly useful. Its principles are as follows. A split skin graft must be immobilized and fluid, mainly serum and blood, must be prevented from collecting between it and its bed. This can best be achieved in the mouth by stitching the graft with numerous black silk sutures about 1 cm apart, and making small nicks in the graft between these stitches.

Resection of the vast majority of tumours produces a large defect. While it is technically possible to close the defect in the mouth by suturing the remnant of the tongue to the cheek, this results in a very crippled tongue, particularly in two circumstances: in resection of a carcinoma of the lateral border of the tongue; or in resection of tumours involving the anterior part of the floor of the mouth. In the first case loss of the greater part of the bulk of the tongue leads to severe crippling if the small remnant is sewn down, and in the second instance, if the tongue is sewn to the internal surface of the lower lip to close the defect of the anterior part of the floor of the mouth, the tip of the tongue is immobilized leading to unsightly swellings and subsequent difficulty in articulation of dentolabial consonants. This result can be improved by a later epithelial inlay, but for the last 20 years or so it has been generally agreed that the defects remaining in the mouth after a partial glossectomy or resection of a tumour involving the anterior part of the floor of the mouth (a
pelvimandibulectomy) require reconstruction of the soft tissue defect, with local or distant flaps. The principles of reconstruction are as follows:

1. The reconstructive techniques should neither interfere with nor limit the excisional surgery
2. Form and function should be quickly restored
3. The morbidity and mortality should not be increased by the reconstructive phase
4. A secondary cosmetic deformity should not be produced
5. The reconstructive phase should be completed as quickly and as simply as possible, especially if a cure is doubtful
6. Prolonged reconstructive procedures should not ordinarily be carried out in patients for whom a prosthesis would provide satisfactory rehabilitation. Numerous different types of flap are available for achieving those ends.

Local mucosal flaps

The main local flap for reconstruction within the mouth is the lingual flap. It requires that all or virtually all of the tongue has been preserved. The tongue flap is outlined by marking a line lengthwise on the tongue, of about 20-40% of the width of the tongue to include the lingual artery in its base. The lingual flap is then rotated into the defect of the floor of the mouth or of the oropharynx. The edges of the anterior one-third or free portion of the tongue are then closed, primarily avoiding producing a pointed tip of the tongue. The raw edges of the remaining part of the donor site are usually covered by a split skin graft to prevent the mobile portion of the tongue adhering to the flap. This flap has a high success rate as a result of the very rich vascular supply to the tongue from the lingual artery; there is unfortunately little cross-over across the midline except for one small artery which crosses the midline at the tip of the tongue and on which thin bipedicled flaps can occasionally be raised.

Regional random flaps

The following regional random flaps have been described for the repair of defects within the mouth: nasolabial flaps, lateral cervical flaps and median cervical flaps based superiorly.

The nasolabial flap is particularly useful for reconstruction of the anterior part of the floor of the mouth because simple closure of the remaining part of the tongue to the lip binds the tongue, makes speech and the fitting of a denture difficult and causes salivary incompetence. At the end of the resection, inferiorly based flaps are raised from the nasolabial fold. A tunnel is then developed beneath the mucosa of the cheek and the lingual alveolar sulcus so that the flap can be turned downwards to be passed through the tunnel into the floor of the mouth. The point at which the flap appears in the mouth is marked by methylene blue, the flap is taken out again and the epidermis is removed with an electric dermatome. The
flaps are then re-introduced into the mouth and sewn in place one behind the other, the one placed anteriorly being sewn to the edge of the incision in the lip and the posterior one being sewn to the edge of the defect in the tongue. If the pedicle is denuded in this way the flaps can be regarded as 'subcutaneous pedicle flaps' and the defect can be closed primarily so that it is not necessary to divide the pedicle and return it. Alternatively a small orocutaneous fistula can be left as originally described, 3 weeks later the flap is divided, the pedicle returned and the fistula closed. The defect in the nasolabial area is easily closed by primary suture and the scar rapidly becomes inconspicuous since it is placed in a skin crease. Indeed, the enthusiasts for this operation claim that the patient derives a bonus since he gets a face-lift at the same time!

Lateral cervical flaps and the median cervical (apron) flap are now rarely used.

**Distant axial flaps**

Two axial flaps have proved extremely useful for reconstruction of large defects in the mouth and the oropharynx: the temporal flap and the deltopectoral flap. The temporal flap is a true axial flap based on the superficial temporal vessels. The flap is raised at the end of the excisional phase, turned into the mouth through the zygomatic foramen, and is sewn into the intraoral defect. Three weeks later the temporary fistula is closed by division or return of the pedicle. Although only just over half of the forehead is required to resurface most deficiencies within the mouth, the cosmetic defect on the forehead is less if the entire forehead skin is removed and replaced by a split skin graft laid directly on the pericranium which must be carefully preserved. This flap can be used for reconstructing any defect in the mouth or oropharynx. It is very successful, rarely undergoing necrosis, and has enjoyed great popularity. Facial palsy is a potential hazard but is rare. The external salivary fistula is not a real complication since it is placed high in the mouth. A persisting external fistula after the second stage is uncommon. The skin of the flaps is difficult to keep clean at first but it settles rapidly, softens and then behaves like a free skin graft within the mouth. The only real disadvantage is the very obvious cosmetic defect on the forehead (McGregor, 1963).

The deltopectoral flap may be used in several ways, but in the original description it was passed upwards beneath the cervical skin, the distal end was sewn into the defect in the mouth with its skin surface facing into the pharynx, and the rest of the flap was formed into a tube, skin surface inwards, running beneath the cervical skin, although it is now more usual to create an external skin tube. At a second stage, 3 weeks later, the pedicle was divided and the orocutaneous fistula closed (Bakamjian, Long and Rigg, 1971). The deltopectoral flap and the temporal flap were until recently the most successful soft tissue replacements available. The temporal flap, however, leaves an unsightly appearance to the forehead of the patient. The process of insertion and dividing of these flaps takes time and patients are in hospital for some time.

Over the last few years axial flaps have been largely superseded by myocutaneous flaps particularly the pectoralis major flap.

The myocutaneous flap, as with any other, may be lost through technical error or vascular compromise. If technical errors are avoided, the security, speed of development, and success rate of undelayed myocutaneous flaps surpasses any direct cutaneous or microvascular
flap. The donor site of a myocutaneous flap is closed primarily if possible, or covered by a split skin graft from the thigh 5 days later.

**Pectoralis major myocutaneous flap**

The pectoralis major myocutaneous flap (PM flap) is now the 'workhorse' of most oral cavity and oropharyngeal reconstruction. The primary blood supply is from the pectoral branch of the acromiothoracic artery.

When developing the flap, the incisions must be so placed that they will not compromise a deltopectoral flap if it should be needed later. The technique of elevation of the flap is described in Volume 1.

The defect is closed primarily with suction drainage in most circumstances. When the skin of the chest wall overlying most of the pectoralis muscle is used for reconstruction, the defect is usually closed by a skin graft.

The skin paddle can be orientated to the defect not only in contour but also in its relation to the muscle. For the oropharynx, the skin is usually orientated in the long axis of the muscle, whereas in the floor of the mouth it is orientated in the horizontal axis. Between the horizontal and vertical axis, the surgeon can orientate the paddle of skin obliquely. Various designs for conformation to tongue, floor or mouth, and retromolar trigone defects can easily be accomplished without jeopardizing vascularity.

Intraoral and extraoral defects can be lined by splitting the flap and folding in upon itself. The skin paddle is made equal to the area of the two defects.

Sternomastoid and trapezius myocutaneous flaps are now little used.

**The free vascular forearm flaps**

The free vascular forearm flap is an axial pattern free flap based on the radial artery or one or two of the forearm veins (basilic or cephalic vein or one of the interconnecting branches). The blood vessels are large. The radial artery measures 2 or 3 mm in diameter and the veins measure 3-5 mm. Each has a long pedicle and consistent anatomy.

The hand and fingers derive their blood supply mainly from the ulnar artery by means of the deep palmar arch. Allen's test of compressing the radial artery at the wrist may prove whether the hand's arterial supply is sufficient through the ulnar and interosseous arteries.

**Technique of raising the flap**

The required size and shape of the flap are mapped out on the flexor or radiodorsal surface of the forearm. A pneumatic tourniquet is placed around the upper arm to facilitate dissection. The radial artery is first identified at the wrist, and the flap is then raised by following the course of the radial artery proximally. Care must be taken to include the fascia of the forearm in the flap. The deeper branches to muscles and tendon sheaths must be ligated. The venae commitantes should also be ligated, for they do not drain much of the
venous blood of the forearm. The flap may be raised up to the level of the elbow joint, identifying the bifurcation of the brachial artery. The artery is normally raised throughout the entire length of the flap, but it can be extended proximally or distally as desired. The veins of the flap are ligated distally, and one of the major veins of the forearm (cephalic or basilic vein) is dissected beyond the upper edge of the skin flap as far as is necessary. Anastomosis of one vein is sufficient to provide drainage for the flap.

At this stage the tourniquet is released and the viability of the flap is assessed. The remaining blood supply of the hand may also be tested by clamping the radial artery at its origin and at the wrist before dividing it finally. Simultaneous preparation of donor and recipient sites by two teams saves much operating time. After the flap has been set in place, either end of the radial artery may be anastomosed to the recipient vessel. As stated earlier, one venous anastomosis is enough to drain the entire flap.

The donor site in the forearm is either closed directly or covered with split skin graft.

Immediate reconstruction of the radial artery with a vein graft has not been abandoned.

**The mandible**

When excising a large tumour in the mouth it may be possible to preserve a rim of mandible maintaining the shape of the face. It is often necessary to excise the horizontal ramus posterior to the mental foramen, but this defect does not require reconstruction. However, removal of the anterior arch causes a severe deformity (Andy Gump) and must be reconstructed.

Two main groups of indications for mandibular reconstruction may be described:

(1) restoration of the function of the resected part of the mandible

(2) rehabilitation of cosmesis, that is prevention of an unacceptable change in the shape of the face after partial or total resection of the jaw.

In conjunction with mandibular resection a considerable part of the soft tissue of the mouth, the tongue and the oral vestibule are also resected. It is therefore not sufficient merely to bridge the bony defect but, in addition, the soft tissue must be replaced. The spread of cancer of the mandible is prevented by the cortical bone, but the mandibular nerve serves as a pathway for spread of the tumour. This nerve should therefore be followed up to the base of the skull and divided at that point. It can be concluded from this that carcinoma of the floor of the mouth lying close to the mandible does not always require resection of the whole width of the mandible and a strut of cortical bone can often be preserved.

This technique has been in use for some time, but osteomyelitis can arise from the poor blood supply of the strut of cortical bone and as a result of the effects of irradiation. The remaining strut of bone which is responsible for maintaining the shape of the face must then be resected later because of infection (Flynn, 1977).
**Temporary replacement of the mandible**

Metal plates can be used for this purpose and they can even be used to replace the head of the condyle. The main principles are absolute stable anchoring of the plate to the mandibular remnant and tension-free closure of the soft tissues of sufficient thickness over the plate. If these principles are observed such plates can provide a sound mandibular prosthesis which is stable for many years.

The temporary mandibular reconstruction can provide stable scar tissue which maintains the mandibular fragments in an acceptable position after the plate has been removed. However, the plate can also be used for a planned replacement of the bone. This technique is now largely obsolete.

**Definitive mandibular reconstruction**

Free autologous, homologous and pedicled autologous transplants may all be used.

A large portion of the transplanted bony tissue of a free autologous transplant is not primarily revitalized, but is revived by insidious replacement and it provides a framework for new bone formation. The transplanted bone requires a good recipient area from which new bone formation can arise. The distance to be bridged by regenerating bone should not exceed 8 cm. If longer defects are bridged, the free graft is usually resorbed over several months without being replaced by bone.

Free bone grafts may be inserted intraorally in certain favourable situations such as benign bony tumours and osteomyelitis. In the hands of an experienced surgeon the danger of infection is no greater by the intraoral route than by the extraoral route. Young women in particular are grateful for the absence of visible scars achieved by a procedure of this type. Donor sites for free grafts include the iliac crest, the ribs with or without pieces of cartilage, and the vault of the skull.

Absolute stability of the opposing bony surfaces of the bone and the graft are a prerequisite for success. This stability is best achieved with plates and screws. However, these plates must be removed 6 months later, otherwise the bone graft undergoes disuse atrophy because of an absence of functional load.

Attempts have been made to broaden the indication for free grafts using cancellous bone which has an enormous osteogenic potential. Metal carrier systems or dacron mesh trays (perforated) have been developed in the shape of the mandible which are sufficiently stable, despite the presence of perforations, and which hold cancellous bone chips. The mesh system consists of titanium. The metal gutter is removed after 4-6 months. This method of reconstruction is particularly suitable for the anatomically difficult region of the chin. The success rate is variable.

Homologous lyophilized mandibular bone may also be used for reconstruction. Sensational results have been claimed in the Soviet literature. Unfortunately this method appears only to be applicable in the USSR.
**Pedicled bone grafts**

Rib from the anterior wall of the thorax combined with a pectoralis major flap can be considered, but a combined osteomyocutaneous latissumus dorsi flap has proved superior. The donor defect is less noticeable for the patient and the rib is well vascularized. The rib is fastened into the defect with a plate. The latissimus dorsi island flap guarantees a good blood supply to the rib and also offers sufficient soft tissue for reconstruction of the floor of the mouth or other soft tissue defects. The muscle pedicle of this flap is led under the pectoralis major muscle to the lateral part of the neck to increase the length of the pedicle.

The vault of the skull is an important donor site of bone to the mandible. The blood supply of this bone is provided by the temporalis muscle. A temporary osteotomy of the zygoma is carried out and the bone together with the muscle is then transplanted into the mouth.

**Free bone grafts**

The microvascular free bone transfer shows a rapid rate of healing and subsequent strength and tolerance to stress is good. These bone flaps have the ability to retain their normal bony architecture with the survival of their original osteogenic cells. The operative time is increased because of the microvascular anastomosis but the use of two teams, one carrying out the excision, the other raising the necessary flap, speeds up the procedure. The forearm flap is the most popular. The segment of bone available lies distal to the insertion of pronator teres and the maximum length available is about 10-12 cm. It can be difficult to modify the bone to the shape of the mandible but good immobilization after insertion increases the chances of success. The bone is also often too thin. Iliac crest free bone grafts, and recently the scapular free bone graft, have become popular.

**Other treatments**

**Cryosurgery**

The use of cryosurgery for intraoral carcinoma has waned as its results are usually poor. This method has been found useful in palliation because it decreases the size of the tumour, reduces the tendency to bleed, and it relieves pain.

**Laser**

During the last 10 years surgical laser systems have become available for clinical application; the continuous wave CO₂ laser is the most commonly used now. The CO₂ laser fulfills the requirements of the surgeon for removal of soft tissue and in some units is the preferred method for removal of intraoral tumours (Strong et al, 1979).

The laser has many advantages; there is little bleeding, no postoperative oedema, the wound heals quickly, tissue can be sent for histology, there is little postoperative pain, and the patients are often ready for discharge earlier than those treated surgically. Leukoplakia, erythroplakia, carcinoma in situ, and early invasive carcinomata are suitable lesions for
treatment; precise and orderly dissection may be carried out. Removal of larger lesions has been reported but there are few results available for comparison.

Chemotherapy

Chemotherapy has not been used as a curative method for carcinoma of the oral cavity, but many trials have been carried out using cytotoxic drugs in combination with radiotherapy (adjuvant or induction therapy); many tumours respond but increased survival has not been demonstrated (Wolf, Jacob and Makuch, 1984).

Methotrexate and cisplatin are recognized as the most active drugs in controlling oral cancer, and these drugs have been used alone or in combination with bleomycin and 5-fluorouracil, and initial response rates as high as 90% have been reported.

Management of neck metastases

The spread of cancer from the oral cavity to the lymph nodes of the neck is a poor prognostic sign (Kalnins et al, 1977). Most patients have no neck metastases at diagnosis and fewer than 10% of these patients die later because of neck disease. Thus prophylactic radical neck dissection has not been proved to increase survival, but may be useful as a means of acquiring adequate access to the oral cavity for surgical resection. If the primary site is being irradiated then elective irradiation of the neck may be carried out and this has been shown to reduce the incidence of later metastases, but the effect on survival is less certain (Stell, 1979).

In the presence of unilateral neck glands, surgical removal of the primary lesion and radical neck dissection is the treatment of choice provided the patient is fit and the primary tumour is resectable. A further advantage of radical neck dissection in these cases, apart from improving access, is that it provides space for the pedicle of myocutaneous flaps and vessels for anastomoses in free flaps.

Bilateral neck nodes carry a dismal prognosis whichever treatment method is used. Irradiation to both sides of the neck is possible and bilateral radical neck dissection may also be carried out usually with preservation of one jugular vein. This operation has many dangers including raised intracranial pressure if a jugular vein is not preserved.

The prognosis of a fixed mass in the neck is very poor, with survival to 5 years at less than 5%. Resection of the mass may be extremely difficult, but not impossible. Internal jugular vein invasion means the disease is not curable, but the common carotid artery may be resected and replaced with a graft, or even tied off if a good retrograde flow has already been shown on angiogram. Skin invasion may require the use of a flap to repair the defect. On occasion fixed cervical nodes can be radically irradiated and any residual disease may then be excised.

The problems of the dentition

The dental status and awareness of the patient must be assessed at an early stage of treatment planning.
When surgery is to be undertaken the suitability of the teeth to support a future prosthesis must be considered. The use of an obturator, whether immediate or definitive, has to be planned in advance and cooperation between the prosthodontist and surgeon is required. The use of precision dental attachments on healthy teeth has become more popular and very acceptable dental reconstruction can be carried out of both upper and lower jaws. If part of the mandible is removed the jaw deviates to the resected side and it may be necessary to fit an appliance to the maxilla to guide the mandible into its previous intercuspal position.

Of those patients who have received radiotherapy approximately 20% have a significant morbidity from osteoradionecrosis and this must be considered in treatment planning (Coffin, 1983). Pain, trismus, loss of taste and dry mouth are common after-effects of radiotherapy and these should be treated symptomatically. Anaesthetic mouthwashes may help and artificial saliva makes the mouth more comfortable. It is unlikely that anyone who has neglected his teeth in the past is suddenly going to mend his ways, so that all broken and loose teeth should be removed. Extraction of teeth should be carried out as gently as possible with the minimum damage to the supporting bones under cover of prophylactic antibiotics. Ten days should be left between the extraction and the start of treatment to ensure good healing (Starcke and Shannon, 1977). During treatment of patients with good dentition scrupulous oral hygiene must be carried out including regular fluoride treatment to protect the enamel of the teeth. A mouthwash of 0.2% chlorhexidine is both comforting and bacteriostatic and may control infection.

The ravaging form of dental caries which can follow irradiation can be eliminated in cooperative patients. In young patients with a full good dentition, construction of acrylic overlay splints has been shown to protect the teeth (Coffin, 1973). If teeth must be removed after treatment, once again atraumatic removal with good wound closure and prophylactic antibiotics should be carried out. It is often forgotten that osteoradionecrosis of the jaws may be stimulated by ill-fitting dentures. Thus it is imperative that dentures are kept clean, any signs of mucosal irritation should be investigated, and the dentures trimmed or relined accordingly. New dentures should be reviewed at 24 and 48 hours to ensure that no area is being traumatized.

In those patients receiving chemotherapy the mucous membranes are particularly susceptible to breakdown under the toxic influence of the chemotherapeutic agents and severe stomatitis often occurs. Dental extractions during and after treatment should be carried out with the same care as for patients receiving radiotherapy. It is important to maintain meticulous oral hygiene during treatment. The effect of chemotherapy is short-lived, whereas the effects of radiotherapy persist.

Management of recurrent disease

Recurrence of disease at the primary site is the result of inadequate surgery or failure of radiotherapy in the initial management of the patient. After failed surgery, radical radiotherapy is rarely effective. Surgical salvage after failed radiation is possible but the complication rate is high and survival poor, with a median survival time of 8-10 months (Hong and Bromer, 1983; Krespi, Wurster and Sisson, 1985)
Chemotherapy is being used with some success in the treatment of recurrent disease. Cisplatin increases survival times but no dramatic breakthrough in disease control has been identified. It is important that the symptoms of depression and pain in patients with recurrent disease are treated effectively and the patient made as comfortable as possible.

*The second primary tumour*

Cancer of the mouth tends to be multiple in both time and space: second tumours within the mouth at the time of presentation or later are common. The incidence of a second primary tumour is about 10%; the interval between diagnosis of the first cancer and the second may be many years but most will show themselves within 3 years. The most common site for a second primary is another site in the head and neck particularly in the mouth itself, but the oesophagus and lung are also other common sites (Tepperman and Fitzpatrick, 1981).

**Management of carcinoma of the minor salivary glands**

Within the oral cavity there are 400 to 500 secreting minor salivary glands, about half of which lie on the palate. These glands all have the potential for malignant change forming 10% of malignant tumours of the oral cavity that are not squamous cell in origin.

These lesions usually present as an asymptomatic swelling, but if there is perineural involvement, pain or palsy may be the presenting symptom.

The most common tumour of these glands accounting for over half of these malignancies is adenoid cystic carcinoma and this usually arises from the hard and soft palate. The tumour tends to invade adjacent structures so that total removal is difficult, but they are sensitive to irradiation. Spread to the neck and the rest of the body is a late sequel.

Mucoepidermoid carcinomata are found predominantly in the palate and are classified as high and low grade: the low grade metastasize late and are treated effectively by excision. The high grade tumour is locally aggressive and will metastasize early to the lymph nodes. Treatment is by a combination of surgery and irradiation.

Adenocarcinomata occur most commonly on the hard palate and in about the sixth decade of life. Local recurrence after either surgery or radiotherapy is common and the prognosis is very poor.

Malignant mixed cell tumours are more common in females and must be suspected on the sudden growth of a long-standing slowly growing mass. They have a high recurrence rate after treatment and distant metastases are common.