Chapter 6. Salivary Glands

The major salivary glands are the paired parotid, submandibular, and sublingual glands, with the minor salivary glands found diffusely through the mucous membranes of the upper aerodigestive tract. They are subjected to endogenous and exogenous influences. Although the pathology of salivary gland disorders is complex, the clinical presentation for such a diverse etiologic group is remarkably similar, being either a mass or a diffuse enlargement. Therefore, the clinical evaluation must stress the history, primarily with the physical examination, laboratory data, radiography, and biopsy when indicated, serving to confirm the initial clinical considerations.

I. Anatomy

A. Parotid gland and facial nerve. The parotid gland lies above the posterior aspect of the mandible anterior and inferior to the ear. It is divided into lobes and compartments by the deep cervical fascia. The deep portion of the gland is in proximity to the lateral pharyngeal space, which allows infections to spread from the gland into the neck. The distinction of superficial and deep lobes is based only on the relationship to the facial nerve, rather than on true anatomic divisions.

The parotid (or Stensen's) duct arises from the anterior portion of the parotid with the intraoral portion protruding at the level of the maxillary second molar. The punctum may be difficult to visualize.

The vessels of the parotid are the external carotid artery, which divides into the superficial temporal and internal maxillary arteries. The external jugular vein arises from the superficial temporal and internal maxillary veins, which join to form the posterior facial vein, as well as a branch from the postauricular vein.

The nerve supply to the gland is from the auriculotemporal nerve, a branch of the mandibular division of the trigeminal nerve. This is a parasympathetic secretomotor nerve arising from the otic ganglion. The otic ganglion receives branches from the lesser petrosal nerve and from the tympanic plexus, derived from the glossopharyngeal nerve.

The parotid gland is rich in lymph nodes, lying both superficial and deep to the glandular substance.

The facial nerve leaves the temporal bone at the stylomastoid foramen, entering into the posterior aspect of the parotid gland. It divides at the pes anserinus into the temporal, zygomatic, buccal, mandibular, and cervical branches. These provide motor function to the musculature of the face.

The greater auricular nerve is derived from the roots of C2 and C3 through the cervical plexus and is sensory to the auricle and the tragus.

B. Submandibular gland. This gland lies below the body of the mandible, between the anterior and posterior bellies of the digastric muscle. The marginal mandibular nerve lies superficial to it, as does a group of lymph nodes. The hypoglossal and lingual nerves are
found deep to the submandibular gland. The duct of the submandibular gland lies above the mylohyoid muscle coursing along the anterior floor of the mouth and terminating in a punctum just posterior to the symphysis of the mandible. Parasympathetic innervation is by the chorda tympani nerve, a branch of the facial nerve, with sympathetic supply through the lingual nerve.

C. Sublingual gland. The sublingual glands are found in the anterior floor of the mouth, superficial to the mylohyoid muscle and deep to the oral mucosa. Multiple small ducts arise from the gland penetrating into the oral mucosa.

D. Minor salivary glands

Minor salivary glands can be found throughout the mucosa of the oral cavity and pharynx, opening individually to the mucosa.

II. Embryology

The salivary glands appear in the fetus at 6-8 weeks and by birth all are functional.

III. Physiology

One to four liters of saliva can be produced daily. The parotid is primarily a serous gland; the sublingual gland primarily mucinous; secreting mostly mucoproteins. The submandibular is a mixed mucous and serous gland. The major protein in parotid secretion is amylase, but many other enzymes are produced as well. The greater the mucin content, the more viscous the saliva. Over 90% of total saliva is produced by the parotid and submandibular glands.

A. Increased salivary flow may be due to cigarette smoking, oral inflammation, heavy metal poisoning, oral muscular activity, or ingestion of highly seasoned foods.

B. Decreased Flow

1. Diminished salivary flow that causes xerostomia can be due to emotion (depression, fear, excitement), organic disease (brain tumors), or drugs.

2. Obstruction, infection, radiation therapy, or disorders such as Sjögren's syndrome may also decrease salivary flow.

3. Metabolic disorders such as diabetes insipidus, cardiac failure, uremia, or edema may decrease saliva flow.

4. Drugs responsible for xerostomia include analgesic, anticonvulsants, antihistamines, antihypertensives, diuretics, decongestants, muscle relaxants, and a number of psychotropic medications.
Evaluation

I. History must include the following: time of onset, periodicity, duration and extent of enlargement, nature of secretions, associated systemic pathology, and medications. Inquiry as to facial nerve function and trismus should be made. It is important to assess whether one or multiple glands are involved, whether there is pain or tenderness, whether the swelling has occurred only once, is persistent or recurrent, or if the patient has noted an isolated mass.

II. Physical examination. The normal parotid occupies the preauricular space extending from the zygomatic arch to beneath the earlobe. The normal gland is not palpable. Therefore, any palpable enlargement is by definition abnormal. The submandibular glands may be palpated below the body of the mandible, particularly in elderly patients, who may have ptotic glands. The glands should be symmetrical in size and location. Inspection and palpation are most important diagnostically. The puncta must be assessed, and the character of the saliva denoted. Specifically, paucity, ropiness, turbidity, and purulence must be recorded.

III. Laboratory data is history directed for these pathologic entities. Whenever indicated, cultures and microscopic evaluation of collected secretions should be obtained. Cultures should be submitted for aerobes and anaerobes as well as for tuberculosis, atypical mycobacteria, and fungi.

IV. Imaging studies are useful primarily in confirming clinical impressions, more so than establishing a diagnosis. Two notable exceptions are the findings of sialectasia, denoting a major diagnostic etiologic group, and enhanced radionuclide uptake by a suspected tumor mass, suggesting either an oncocytoma or a Warthin's tumor.

A. Plain films

1. Used primarily for the detection of calculi.

Eighty percent of submandibular and 40% of parotid stones are radiopaque.

B. Contrast sialography

1. Indications. Recurrent inflammation or recurrent enlargement of the parotid gland suggests a ductal stricture, calculus, or sialectasia. The diagnosis of these abnormalities can often be confirmed by sialography. A normal gland expels most contrast material within 5 minutes; retained dye indicates a functional abnormality. Sialography is inadequate for assessing space-occupying lesions.

2. Contraindications include acute inflammation or a known sensitivity to iodides.

3. Interpretation. The normal sialogram is best described as looking like a "bare tree." The normal ductal system progressively tapers, thins, and branches.
a. **Scout films** often show calculi. Calculi rarely fill the lumen totally; therefore, contrast flows around them. Radiolucent calculi show as a filling defect, and only meticulous techniques ensures that the abnormality observed is not an air bubble.

b. **Strictures** are frequently multiple and easily detected.

c. **Sialectasia** has been classified as punctate, globular, or cavitary. One stage does not necessarily progress to another, and, with fulminant infection, intermediate stages may be bypassed. Sialectasia is not a diagnostically specific finding. It can be congenital, and in such cases all the salivary glands are involved. Purulent infection, benign lymphoepithelial lesions, and Sjögren's syndrome are additional causes.

d. **Sialography** has limited merit as an isolated procedure in the evaluation of neoplasms, since little practical information is obtained. Some patients with neoplasms develop post-injection obstruction, inflammation, or both, which could delay necessary operative intervention. CT and MRI imaging have largely replaced sialography.

C. **Radionuclide scanning**

1. Technetium (Tc$^{99}$) is the most commonly used isotope for studying salivary gland pathology. As a rule, its use does not meaningfully influence the management of nonneoplastic lesions of the salivary glands.

2. With tumors, an excision will give all the needed information, although scanning can define a mass lesion as to its approximate size and depth. If the lesion is "hot," this finding suggests that the lesion is benign. If the lesion is irregular, destruction is suggested and therefore malignancy.

D. **Contrast-enhanced computed tomography** (CT)

1. Contrast-enhanced CT scanning is useful in differentiating deep lobe parotid tumors from other parapharyngeal space tumors.

2. Subtle masses can be detected as to their salivary gland origin. Parameters that suggest a benign diagnosis include well-defined tumor borders, homogeneous appearance, and high density.

3. The extent of malignant salivary lesions and their relationship to adjacent structures is suggested and may in fact alter surgical considerations.

E. **Ultrasonography** allows assessment of the solid/cystic nature of salivary gland masses. Sensitivity is high in detecting a mass; however, the specificity is poor in the characterization of inflammatory lesions. Its use is infrequent.

F. **Magnetic resonance imaging** (MRI)

1. Useful in defining the location of salivary gland masses (intraparotid versus extraparotid) and also the relationship of the tumor to the facial nerve.
2. Benign neoplasms and low-grade malignancies often have clearly defined margins, whereas high-grade parotid malignancies tend to have poorly defined margins. Preoperative diagnosis of high-grade tumors allows for an accurate assessment of the degree of surgical treatment needed.

3. MRI with gadolinium-enhanced contrast allows for the greatest soft tissue detail, does not expose the patient to radiation, and is valuable in evaluating the extent of deep parotid lesions, particularly in the parapharyngeal space.

V. Biopsy

A. **Excisional biopsy.** For mass lesions, definitive biopsy remains excision and must include a generous margin of the surrounding gland.

B. **Aspiration biopsy.** Needle (22-gauge) aspiration biopsies are as good as the pathologist reading them. They are easy to perform but more difficult to interpret. Seeding along the needle tract has not been a problem. This procedure is indicated for most tumors as an aid to surgical planning (extent of resection) for the patient who is a poor surgical risk and when a diagnosis is essential prior to initiating a multimodality therapeutic plan.

C. **Incisional biopsies** are rarely performed for salivary gland lesions. If needle aspiration fails diagnostically for the poor-risk patient or for one with extensive neoplasia, incisional biopsy may be warranted.

**Clinical Categories**

Categorizing salivary gland lesions into five major groups makes differentiation easier. Inflammations are characterized as either obstructive or nonobstructive and can be further subdivided into acute and chronic. Metabolic abnormalities, endocrinopathies, neoplasms, and trauma complete the diagnostic quintet.

I. Inflammations

A. **Acute nonobstructive**

1. **Viral**

   a. **Etiology.** Mumps serves as the prototype for this group. However, other viral agents have been documented serologically by acute and convalescent titers. These include Coxsackie, ECHO, and cytomegalic viruses.

   b. **Prodrome.** A known contact, a winter or spring tendency, and a 2- to 3-week incubation period are frequent. Most patients are 5-14 years old.

   c. **Signs and symptoms.** A mild temperature elevation and malaise can precede the sudden onset of acute distention with associated pain. Deep parotid involvement is associated with trismus. More than one salivary gland may be infected.
d. Physical examination. The affected gland is diffusely enlarged, tense to bimanual palpation, and tender. The puncta are acutely swollen and congested. The saliva is clear.

e. Diagnosis is made by the history and by the finding of an abrupt onset of an enlarged salivary gland.

Laboratory data. Confirmation is enhanced by an elevated serum amylase determination. The white blood cell count shows a relative lymphocytosis. Acute and convalescent sera show increased S&V titers.

f. Therapy. The disease is self-limited. Supportive measures are all that should be necessary. Hydration is the most important consideration, with analgesia as warranted.

g. Clinical course

(1) Immunity. One episode is believed to confer lifelong immunity in most instances. Sporadic documented cases of secondary infection have been reported, but serologic documentation is essential to make this diagnosis.

(2) Sequela. Unilateral sensorineural hearing loss is a known complication. Pancreatitis, meningitis, and gonadal involvement can occur but are infrequent.

2. Bacterial

a. Child. Acute bacterial sialadenitis of childhood may initially present a pattern similar to mumps.

(1) Signs and symptoms. The onset is marked by sudden painful swelling of the involved gland. Frequently, there is an associated temperature elevation. Bilateral involvement is not uncommon.

(2) Physical examination. The involved gland is firm, indurated, and tender. There may be associated trismus. The pertinent differentiating feature from a similar illness of viral origin is the observation of purulent salivary secretions.

(3) Diagnosis. Laboratory data. The secretions should be cultured. Staphylococcus aureus and Streptococcus pneumoniae are the most frequent organisms identified. A white blood cell count is elevated with the initial episode. Although recurrent episodes occur more frequently in children, a serum immunoprotein analysis is warranted. Radiographic studies are normal after the acute episode subsides.

(4) Therapy. Most children may be treated as outpatients. Severe trismus with poor hydration requires hospitalization, but the necessity for such is rare.

Antibiotic coverage is ultimately predicated on culture documentation. Although S. pneumoniae are common causative organisms, coverage must also include penicillinase-producing S. aureus. Amoxicillin clavulanate is a good initial drug. Hydration is essential, and fluids must be forced. Heat to the area is indicated. A heating pad or hot water bottle qid for
30 minutes is sufficient. Warmth is often soothing, and the patient may choose more frequent applications. Gentle massage 4-5 times daily is essential to help express purulent secretions.

(5) **Clinical course.** In childhood, repeated attacks are not infrequent and may span many years. These attacks often subside around puberty. Good oral hygiene, judicious dilatations in selected instances, and premeal massage frequently decrease the recurrence of attacks. Surgery is rarely indicated.

A variation of this pathology occurs in premature neonates. The organism involved in this setting is almost uniformly *Staphylococcus*, and the severity lies in the potential for abscess formation. High doses of a staphylococcus-specific antibiotic (ie, oxacillin administered IV along with hydration) usually leads to resolution. If there is no improvement after 3-4 days, as evidenced by decreased swelling, tenderness, and temperature elevation, drainage will have to be considered. This specific variant (acute neonatal bacterial sialadenitis), once adequately treated, is not prone to recur.

b. The **adult** variant is similar in both signs and symptoms to that of the child, yet it is not as prone to recurrence. One-third of the cases in the adult are associated with the postoperative state. These patients are often septic.

(1) **Etiology.** Predisposing considerations include debilitation, confinement to bed, and dehydration, often secondary to inadequate intraoperative fluid management.

(2) **Diagnosis.** Blood cultures should be obtained for the febrile patient. Stensen's duct should be cultured. In addition, a white blood cell count should be obtained and is usually markedly elevated. MRI is valuable in assessing the degree of involvement or presence of an abscess.

(3) **Treatment.** Penicillin-resistant *S. aureus* is the most common organism in this setting. IV oxacillin is imperative. For the penicillin-sensitive patient, clindamycin or a first-generation cephalosporin may be substituted in an appropriate dosage. IV hydration is essential and must be predicated on the patient's general status.

Progressive induration and continued temperature elevation unresponsive to appropriate antibiotic management requires the consideration of surgical drainage. A fluctuant mass is a rarity in the parotid, even in the most advanced stages of suppuration because of vertical fibrous septa within the gland. Thus, the clinical course dictates the appropriate time for surgical intervention; MRI is of exceptional assistance.

3. **Secondary acute inflammatory disease**

a. **Drugs.** Two types of responses are noted - direct and idiosyncratic.

(1) Iodides and heavy metals such as mercury and bismuth are known precursors. **Signs and symptoms.** A diffuse, tender enlargement is noted; on occasion, this enlargement occurs several days after exposure. The swelling frequently takes several days to resolve. For the **clinical course** the saliva remains clear, and spontaneous resolution usually occurs. Identification of the offending agent is essential to prevent recurrence.
(2) An idiosyncratic effect is related frequently to a diminished salivary flow. Atropine, as well as phenylbutazone and the phenothiazine derivatives that exhibit an atropinelike effect, can cause recurrent salivary gland enlargement. Discontinuing the offending agent will effect resolution.

(3) **Allergens.** Allergic phenomena are not infrequent precursors of sudden parotid enlargement.

(a) **Etiology.** Detailed considerations of food idiosyncrasies, such as berries and fish, and a positive family history are essential. Detecting "craving" for a specific food and eliminating such from the diet will often lead to resolution.

(b) **Signs and symptoms.** The period between contact and symptomatology is brief. Pain and associated sudden enlargement of the salivary glands are characteristic.

(c) **Physical examination.** All the salivary glands can be diffusely involved and tender. Mucous plugs may be expressed from the puncta.

(d) **Laboratory.** Eosinophils can in some instances be isolated from the saliva, and a white blood cell count differential may similarly show elevated eosinophils.

(e) **Therapy.** The illness resolves rapidly over several hours. Treatment is supportive, including hydration and analgesia only, because of the brief clinical course. Identification of the offending allergen is critical for management.

4. **Necrotizing sialometaplasia** is a benign inflammatory lesion of unknown etiology that usually affects the minor palatal salivary glands. It begins as a mucosal ulceration. It can be mistaken for malignancy both clinically and histologically. The lesion is self-healing, requiring no therapy; however, biopsy may be needed to rule out more serious disorders.

B. Chronic nonobstructive

1. **Childhood benign lymphosialadenopathy.** In childhood, this condition usually arises after age 5 years. The clinical picture differs somewhat from that of the adult, but the histologic findings are similar. The parotids are most often involved. The etiology is unknown, but an autoimmune mechanism is hypothesized.

   a. **Signs and symptoms.** The onset is usually abrupt and associated with discomfort. A slight temperature elevation is not infrequent.

   b. **Physical examination.** With the acute episode, tenderness and enlargement are noted. After several days, the tenderness resolves as does the degree of firmness. Enlargement frequently persists for weeks, and, after several recurrences, nodularity may be noted. Parotid massage frequently elicits turbid secretions.

   c. **Adjunctive studies**

      (1) **Culture.** *Streptococcus viridans* may be cultured, but often the saliva is sterile.
(2) Radiography. Sialography may be normal in the early stages of the disease. Classically, punctate sialectasia is observed both in the clinically involved and in the uninvolved glands. Cavitary change is rarely observed. Delayed emptying is frequently detected. CT or MRI reveals only diffuse glandular enlargement, frequently with cavitary changes.

(3) Pathology. Although biopsy is infrequent, it must evidence ductal metaplasia and parenchymal replacement by a chronic inflammatory infiltrate to be consistent with benign lymphosialadenopathy.

d. Therapy. Management should be conservative in most cases.

(1) Acute. Penicillin or a cephalosporin should be administered PO whenever turbid secretions are present. Massage and heat are indicated in the acute and subacute stages as well as for prophylaxis. Routine premeal massage is important, and increased hydration is mandatory.

(2) Chronic. Intraoral sites of irritation must be eliminated. Oral appliances or bite plates should be suggested for nighttime "grinding," particularly when interdentigerous ridges are present. Good oral hygiene is essential.

e. Clinical course. The frequency of recurrence has been correlated with the age of onset, an early onset heralding an increased incidence. With recurrent episodes, the amount of residual enlargement can progress, posing a cosmetic problem. If isolated nodularity persists, excision is warranted. In the childhood variant, spontaneous resolution is the rule during the teenage years, and progression to a full Sjögren's syndrome is unusual.

2. Adult benign lymphosialadenopathy. The adult features are similar to those of childhood, with the following exceptions:

a. Contrast to childhood disease

(1) The majority of adults suffer from chronic recurrent parotitis and do not develop more serious pathology.

(2) The disease tends to persist.

(3) Few develop a full Sjögren's syndrome.

(4) A smaller number develop aggressive lesions of either the epithelial components, eg, poorly differentiated carcinomas, or of the lymphoreticular apparatus. The development of lymphoma is not necessarily associated with evidence of a systemic autoimmune process.

(5) Having the childhood variant, a self-limited process, does not increase the probability of developing the adult form.
3. Bacterial

a. Etiology. Chronic recurrent bacterial sialadenitis most characteristically affects the parotids. Many clinical conditions, both local and systemic, are potential precursors. Three factors are common to most predisposing conditions: decreased salivary flow, stasis, and altered secretions. Thus, ductal obstruction, benign lymphosialadenopathy, recurrent acute bacterial sialadenitis, allergy, medications, fluid restriction, and psychic considerations (eg, bulimia) can be associated with this disease entity.

b. Signs and symptoms. Recurrent swelling, frequently while eating, often associated with mild to moderate discomfort, is suggestive.

c. Physical examination. The involved glands are initially tense and occasionally tender. With chronicity, the glands remain firm between exacerbations. Bimanual palpation reveals a diminished salivary flow. During acute episodes, pus may be expressed from the puncta.

d. Laboratory

(1) Cultures. When present, purulent secretions often yield a staphylococcal or a streptococcal organism.

(2) Radiography. Sialography shows ductal changes, with dilatation and sacculation of the ducts distal to areas of obstruction, caused by fibrosis. The retention of contrast for days to weeks is not uncommon in advanced disease. MRI discloses diffuse glandular enlargement.

e. Therapy

(1) Conservative therapy is the cornerstone of management. Judicious ductal dilatations with lacrimal dilators may provide protracted periods of relief. Hydration is essential. Four 8-oz glasses of water/day is the minimum for an affected adult. Sialogogues such as sour lemon candy maintain salivary flow, reducing stasis. Massage as often as possible, but at least 6 times daily, is essential. Adult exacerbations are treated as acute suppurative sialadenitis.

(2) For refractory disease, a consideration of surgical intervention must be predicated on a thorough understanding of the frequency, severity, and morbidity of the process.

Total parotidectomy remains the surgical procedure of choice. Dense fibrosis and increased vascularity make this procedure the most difficult of parotid surgery. Experience with the operating microscope is essential if preservation of facial nerve function is to be accomplished. Only total removal will ensure resolution.

Tympanic neurectomy disrupts the preganglionic parasympathetic innervation of the parotid. Therefore, secretory activity should cease, with resultant atrophy. The theory is sound, but clinically its effectiveness is limited; consequently, tympanic neurectomy is not advocated.
Radiation therapy has been suggested by some in small doses to minimize inflammation. The associated additional fibrosis makes definitive surgery for radiotherapy failures makes definitive surgery for radiotherapy failures all the more difficult. Therefore, radiation therapy is not recommended.

Ligation of Stensen's duct has not been successful in advanced cases. This procedure has also been associated with significant morbidity and acute distention, and therefore is not recommended.

4. Granulomatous disease

   a. Etiology. The more common granulomatous diseases affecting the salivary glands include tuberculosis, cat-scratch fever, atypical mycobacteria, and actinomycosis. The presenting pattern does have some specificity, and variations from the reference base should be thoroughly investigated.

   b. Signs and symptoms. As a group, the presentation is essentially that of a localized area of swelling within the gland. The enlargement is frequently present for a protracted period. Enlargement is slow, marked tenderness is uncommon, and significant associated external inflammation is unusual. In some instances, however, there may be mild superficial erythema that denotes underlying suppuration with cavitation. Spontaneous drainage and fistulization may occur.

   c. Physical examination. A localized palpable mass is usually denoted. Tuberculosis (TB) may be present in two forms: (1) a chronic mass lesion or (2) in the acute stage with acute inflammation and distention of the entire gland.

   d. Special studies

      (1) Skin tests are essential when this group of diseases is suspected. TB is readily identified, whereas atypical mycobacteria are more difficult to document.

      (2) Sialography, in most instances, reveals a normal ductal system unless there are specific site aberrations associated with pressure.

      (3) Fine-needle aspiration of fluctuant lesions with staining and appropriate cultures can identify TB, atypical mycobacteria, and actinomycosis.

      (4) For chronic nodularity, an excisional biopsy is warranted to establish the diagnosis.

   e. Therapy

      (1) Tuberculosis. If detected early, medial management will suffice. In chronic cases, surgical extirpation of the granuloma, in conjunction with appropriate antibiotic medication is necessary.
(2) **Actinomycosis.** In most instances, adequate doses of penicillin will control the disease. Limited adjunctive surgery rarely proves necessary.

(3) **Atypical mycobacterial infection** responds to excision. Curettage in conjunction with rifampin has been reported as being therapeutic, but known failures have led the authors to recommend excision as the treatment of choice for isolated parotid disease.

(4) **Cat-scratch fever** frequently resolves spontaneously. With suppuration, drainage and curettage usually suffice.

5. **Sjögren's syndrome**

   a. Sjögren's syndrome is an autoimmune disorder that affects the major and minor salivary glands; it is usually associated with rheumatoid arthritis, although can be seen with other connective tissue disorders, such as systemic lupus erythematosus or polyarteritis nodosa.

   b. **Signs and symptoms** involve the salivary glands, producing xerostomia, abnormal taste, dry tongue, and lingual papillary atrophy, and intermittent unilateral or bilateral salivary gland (usually parotid) enlargement. When the lacrimal apparatus is affected, xerophthalmia and keratoconjunctivitis sicca occurs.

   c. **Diagnosis.** Laboratory studies reflect an abnormal immune response with elevated rheumatoid factor, antinuclear antibody, and salivary duct antibody often being present. Sialography demonstrates bilateral punctate sialectasia of the parotid and submandibular glands, with prolonged retention of contrast medium. A gallium scan shows increased uptake by the salivary and lacrimal glands. Because the minor salivary glands are affected in over 70% of cases, a biopsy of the labial, nasal mucosal, or palatal glands is often diagnostic.

   d. **Therapy** is symptomatic. Artificial saliva may be helpful. Good dental hygiene is important. Xerophthalmia may require artificial tears or taping the eyelids shut at night to prevent exposure corneal ulceration.

6. **Sarcoidosis** is a granulomatous disease of unknown etiology, and salivary gland involvement may occur in up to one-third of cases. Uveoparotid fever (Heerefordt's disease) is a manifestation of sarcoidosis characterized by fever, parotid and lacrimal gland swelling, and uveitis. Associated cranial neuropathies, particularly facial nerve paralysis, are found. It begins in the third to fourth decade of life and may last months to years. Minor salivary glands may be involved, and biopsy of these may be diagnostic. Rarely, the major salivary glands are biopsied.

C. **Obstructive: acute and chronic**

1. **Calculi**

   a. **Etiology.** Calculi represent both a cause and sequelae of recurrent sialadenitis. Mucous plugs or cellular debris are thought to form a nidus for the deposition of inorganic calcium and phosphate salts. Submandibular gland stones are generally believed to occur far
more frequently than those in the parotid. This belief may be skewed by the fact that nearly 80% of submandibular stones are seen on radiographic studies, whereas only 35-40% of parotid stones are radiopaque. However, the submandibular gland is more predisposed to radiopaque calculus formation because of the mucoserous nature of the secretion, its concentration of organic salts, and its anatomic structure that may create salivary stasis from uphill positioning and length of Wharton's duct.

b. Signs and symptoms. Food ingestion is associated with a sudden painful enlargement of the affected gland. Further eating increases the distention. If the obstruction is not relieved, secondary infection soon occurs. Small fragments of stone may be passed intermittently.

c. Physical examination. Bimanual palpation may detect a calculus during a quiescent interval. Point tenderness may be denoted near the hilum. A diffusely enlarged tense gland is evident during acute obstruction.

d. Special studies

(1) Panorex or oblique soft tissue films may detect a stone in the submandibular glands.

(2) Sialography may show partial or complete filling defects, depending on the size and associated reaction. In long-standing cases, peripheral ductal change may also exist. Contrast retention on evacuation films is expected.

e. Complications include salivary fistulas, acute abscess formation, sinus formation, and stricture secondary to fibrosis.

f. Therapy

(1) Removal of the stone intraorally is recommended for stones within approximately 1 cm of the puncta. This removal is readily accomplished under local anaesthesia for the submandibular glands and with somewhat more difficulty for the parotid.

(2) Beyond 2 cm, internal removal is not indicated, as the lingual nerve's relationship to Wharton's duct and the buccal nerve's association with Stensen's duct render each subject to injury.

(3) Multiple stones occur in 25% of patients who present with an initial calculus. An association with renal stones should suggest hypercalcemia.

(4) With longstanding disease, appropriate removal of involved parenchyma must be considered.

2. Stricture

a. Etiology. Both external and internal strictures must be considered. Dental trauma from grinding, ill-fitting dentures, and poor hygiene are associated with external strictures,
whereas anomalous development, infection, trauma, calculi, and neoplasms may be associated with internal strictures.

b. Signs and symptoms. Periodic painful swelling with eating is frequent. Prolonged distention and infection may occur.

c. Physical examination. Usually, a diffusely swollen gland is present initially. Recurrent attacks lead to chronic enlargement.

d. Special studies. Sialography should be diagnostic.

e. Therapy

(1) External. Recognizing and eliminating known precursors are essential. Dilatations, judiciously performed under local anesthesia, are often all that is necessary. In the extreme, sialodochoplasty is effective.

(2) Internal. The therapeutic considerations are similar to those of chronic refractory sialadenitis.

3. Cysts

The parotid is the site of most salivary gland cysts, which account for up to 5% of parotid masses. Most are unilateral in children, and most cysts are benign and can be a lymphangioma, hemangioma, dermoid, or branchial cleft cyst (which arise from the first branchial cleft).

In the adult, either benign or malignant conditions may be cystic. Recurrent infections or ductal obstruction may lead to a cyst. They have also been found in association with tumors such as pleomorphic adenoma, adenoid cystic carcinoma, mucoepidermoid carcinoma, and cystadenoma lymphomatous (Warthin’s tumor). Cystic lesions of the parotid have been associated with HIV infections.

Minor salivary glands may become obstructed, producing dilatation. A ranula is such a condition of the sublingual gland, found in the floor of the mouth.

II. Metabolic and endocrine. Asymptomatic enlargement represents the typical clinical pattern for the entire group of metabolic and endocrine disorders. Although rare, early in the clinical course, size fluctuation may be evident. Pain and inflammation are most infrequent in this subset.

A. Metabolic-malnutrition. Dietary deficiencies are felt to be etiologic in the parotid enlargement associated with starvation, bulimia, and Laennec’s cirrhosis. The size of the gland frequently correlates with the clinical status of the primary disease. Improvement in the disease as a whole may be associated with a decrease in size.
1. **Physical examination.** The involved glands are diffusely enlarged, soft, and nontender to palpation. The saliva is of normal consistency, and Stensen's duct is normal in appearance.

2. **Laboratory.** With radiography the ductal system is normal on sialography. Amylase levels are frequently increased in alcoholic cirrhosis.

3. **Therapy.** Correcting the condition leading to the deficiency state must be the hallmark of management. Adjunctive supportive measures accomplish little. Surgery, except for rare diagnostic purposes, is not usually indicated. When size becomes of cosmetic significance, parotidectomy may become necessary.

B. **Endocrine.** Thyroid disease, diabetes, and aberrations of the pituitary adrenal axis are the most common conditions associated with parotid enlargement.

1. **Thyroid.** Parotid enlargement secondary to hypothyroidism does not relate to the magnitude of the deficiency but represents a true hypertrophy.

2. **Diabetes.** Although the association is reported, the evidence for a specific relationship remains inconclusive.

3. **Cushing's disease** has been associated with fatty infiltration of the gland.

III. **Trauma.** Lacerations represent the most significant form of injury to the salivary glands, and to the parotid in particular. The facial nerve, ductal, and parenchymal injury all warrant consideration.

A. **Facial nerve**

1. **Signs and symptoms.** The function of all branches must be assessed as soon as possible. Deficits can be compared to the normal side.

2. **Testing.** For the unconscious patient, the main trunk and peripheral branches can be assessed with a transcutaneous facial nerve stimulator.

3. **Repair**

   a. **Early** repair is most desirable and should be performed (if possible) at the time of glandular and skin closure. If performed within 48-72 hours, the nerve stimulator will assist in localizing distal segments.

   d. **Delayed.** Marking the distal branches is mandatory if delayed repair is a necessity. Surgical clips are readily identified at a later time. Parotidectomy aids in delayed repair by facilitating identification. The microscope and 8-0-10-0 monofilament sutures are recommended for the repair.
B. Ductal injury should be suspected when saliva is seen in the wound.

1. Diagnosis. Cannulating the duct intraorally and observing saliva in the wound confirms the diagnosis.

2. Repair

a. Direct. Suturing over a polyethylene catheter is the procedure of choice.

b. Secondary

(1) When primary closure is impossible, suturing the distal end to the buccal mucosa should be attempted.

(2) When the duct is severely traumatized, suturing a Penrose drain from the parotid adjacent to known ductal remnants into a large stab wound through the buccal mucosa frequently creates a permanent functioning fistula into the oral cavity. The drain must be left for a minimum of 2 weeks. This procedure is preferable to ligating the ductal segments.

C. Parenchyma

1. Isolated lacerations require meticulous debridement, being cognizant of Stensen's duct and the facial nerve. The closure should be layered. Multiple lacerations in a contaminated field may be best managed with parotidectomy.

2. Blunt injury. Following blunt injury to the side of the face in association with fracture of the maxilla or mandible, dysfunction can be anticipated in 80% of the cases. A pressure dressing is warranted to decrease complications.

Sialocele, or salivary cysts, can be treated with repeated aspiration and pressure dressings. If this fails, excision of the cyst, gland, or both may become necessary.

Chronic external fistulas can be excised.

Large fistulas. Intraoral diversion of saliva must be effected and pressure dressings applied. Soft tissue collections of saliva require aspiration after establishing an oral conduit. Tympanic neurectomy may provide a decrease in salivary flow to enable closure of the larger fistula. If more conservative measures fail, parotidectomy is indicated. Medications to reduce salivary flow have not been a meaningful adjunct. Radiation to decrease flow is not warranted for this condition.

IV. Neoplasia. The neoplasms affecting the salivary glands are sufficient in pathogenic complexity to make a complete discussion of such impractical for this text. The various types of salivary gland tumors have different biological courses, but in general tend to be slow growing.
Table 6-1. Classification of salivary gland tumors

I. Benign lesions

A. Mixed tumor (pleomorphic adenoma)
B. Papillary cystadenoma (Warthin's tumor)
C. Oncocytosis - oncocytoma
D. Monomorphic adenoma
   1. Basal cell adenoma
   2. Glycogen-rich adenoma and clear cell adenoma
E. Sebaceous adenoma
F. Sebaceous lymphadenoma
G. Papillary ductal adenoma
H. Benign lymphoepithelial lesion

II. Malignant lesions

A. Carcinoma ex pleomorphic adenoma (carcinoma arising in a mixed tumor)
B. Mucoepidermoid carcinoma
   1. Low grade
   2. Intermediate grade
   3. High grade
C. Hybrid basal cell adenoma/adenoid cystic carcinoma
D. Adenoid cystic carcinoma
E. Acinous cell carcinoma (acinic carcinoma)
F. Adenocarcinoma
   1. Mucus-producing adenopapillary and nonpapillary carcinoma
   2. Salivary duct carcinoma (ductal carcinoma)
G. Oncocytic carcinoma (malignant oncocytoma)
H. Clear cell carcinoma
I. Epithelial/myoepithelial carcinoma of intercalated ducts
J. Squamous cell carcinoma
K. Undifferentiated carcinoma
L. Miscellaneous (including sebaceous, Stensen's duct, melanoma, and carcinoma ex lymphoepithelial lesion)
M. Metastatic carcinoma.

A. Epidemiology

Salivary gland tumors account for 5% of all head and neck neoplasms (excluding skin). Most are benign. The predominant site is the parotid, followed by the submandibular, sublingual, and the minor salivary glands. Benign tumors comprise 80% of parotid growths but less than half of tumors in the other glands. A prior history of radiation exposure, even in the distant past, can predispose to the onset of a salivary gland tumor.

B. A classification of tumors of the salivary glands appears in Table 6-1 with staging shown in Table 6-2.
C. Diagnosis is based on history and examination, with the addition of imaging studies and biopsy by fine-needle aspiration, which often are exceptionally valuable (see I-V).

Table 6-2. American Joint Committee on Cancer staging of salivary gland tumors

<table>
<thead>
<tr>
<th>Tumor size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1:</td>
<td>less than 2 cm</td>
</tr>
<tr>
<td>T2:</td>
<td>2-4 cm</td>
</tr>
<tr>
<td>T3:</td>
<td>4-6 cm</td>
</tr>
<tr>
<td>T4:</td>
<td>&gt; 6 cm</td>
</tr>
</tbody>
</table>

All T categories are subdivided
(a) no local extension
(b) local extension (clinical or macroscopic evidence of invasion of skin, soft tissues, bone, or nerve)

<table>
<thead>
<tr>
<th>Nodal states</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1:</td>
</tr>
<tr>
<td>N2a:</td>
</tr>
<tr>
<td>N2b:</td>
</tr>
<tr>
<td>N2c:</td>
</tr>
<tr>
<td>N3:</td>
</tr>
</tbody>
</table>

Stage

I: T1a/T2a N0M0
II: T1b/T2b/T3a N0M0
III: T1/T2 N0M0
      T4a/T3b N0M0
IV: T4b, any N, M0
    Any T, N2/N3, M0
    Any T, any N, M1.

D. Tumors of the parotid gland

Eighty percent of parotid tumors are benign; 20% are malignant. The highest incidence of benign tumors is in the fifth decade of life, with malignancy being more predominant in the sixth decade.

1. Mixed tumor (pleomorphic adenoma). The benign mixed tumor accounts for nearly two-thirds of all parotid tumors and occurs predominantly in females. These are slow-growing, painless, well-circumscribed masses, often found in the tail of the parotid. Examination reveals a smooth, firm, mobile lesion, usually with normal facial nerve function. There is often an absence of other symptoms, and these tumors may grow to a considerable size before patients seek medical care. Treatment is by parotidectomy with a cuff of surrounding normal tissue that encompasses the microscopic outgrowths. Recurrence rate is low if this treatment plan is adhered to.

2. Papillary cystadenoma lymphomatosum (Warthin's tumor). This lesion represents the second most common benign tumor of the parotid gland. It appears to originate
from both ductal and lymphoid elements. Clinically, it presents as a round, smooth, mobile, firm mass in the tail of the parotid. Males are affected five times more than females. Although usually isolated, multiple tumors have been found, and surgical excision (parotidectomy) is the treatment of choice.

3. **Oncocytoma and monomorphic adenoma.** These two benign tumors are usually derived from a single cell type and represent a minority of benign lesions most often found in the parotid gland. They may appear in other salivary gland sites and are usually well circumscribed. Minimal associated symptoms occur, and total excision is usually required.

4. **Mucoepidermoid carcinoma** is the most common malignancy of the parotid gland. They may be slowly growing or quite aggressive. Low-grade tumors are usually well localized, rarely metastasizing; whereas distant spread occurs in 50% of the high-grade variety. They may occur in any age group and equally in the sexes. Survival is over 90% for low-grade tumors and only 20-30% for the more aggressive types. Surgical treatment is required, with wide resection, and at times sacrifice and grafting of the facial nerve are necessary. Postoperative radiation may also be needed for high-grade tumor types.

5. **Adenoid cystic carcinoma** is the most common malignant tumor of the submandibular, sublingual, and minor salivary glands. It accounts for less than 5% of all parotid neoplasms and over 30% of those in the minor glands. Symptoms are usually of a progressively enlarging mass with occasional associated pain and often with facial nerve weakness. The adenoid cystic carcinoma tends to invade nerve sheaths. Although slow growing, it has a high recurrence rate, with frequent local and systemic spread. Distal metastases have been found in 15% of patients, with the lungs most frequently affected. The course tends to be prolonged, and recurrences are common. Treatment is surgical, with nerve resection and grafting performed as needed. Neck dissection for palpable nodes should be considered. Radiation therapy is a valuable adjunct for positive surgical margins, local control for inaccessible tumors, and for patients not able to withstand large surgical procedures. Although a 5-year survival rate of 75% has been reported, by 20 years this diminishes to approximately 10%.

6. **Adenocarcinoma** represents various histologic patterns and occurs in up to 15% of parotid malignancies. No sex or age predilection occurs. Usually, the facial nerve function is normal.

7. **Malignant mixed tumor (carcinoma ex pleomorphic adenoma)** represents the malignant transformation of primarily the epithelial elements of a benign mixed tumor. A mass may be present for many years that suddenly will grow rapidly, accompanied by facial pain and weakness - both ominous signs. The recurrence rate is high and prognosis poor, even with therapy that is aggressive. Nodal metastases have been found in over 10% of patients and in distant sites (lung, bone, brain) in up to 30% of patients.

8. **Acinic cell carcinoma** is less common than other major types of salivary gland tumors. It is usually found in the parotid. It tends to be slowly progressive, painless, and rarely produces facial nerve weakness. It presents most often in women 60-70 years of age and is low grade in nature.
9. **Squamous cell carcinoma** is an uncommon cancer that presents in the parotid as a firm, hard mass fixed to the surrounding structures and skin. It is highly malignant, rapidly growing, producing facial pain and nerve paralyses with cervical lymphatic involvement in half of patients. Less than 20% 5-year survival rate occurs, despite radical therapy of resection, radiation, and chemotherapy.

10. **Lymphoma of the parotid gland** is rare, but may arise in extranodal tissue. Symptoms are nonspecific and usually mimic sialoadenitis. A complete evaluation for staging is mandatory prior to the beginning of treatment, because local disease requires radiation and a disseminated process mandates chemotherapy. Patients with Sjögren's disease exhibit a higher incidence of intraparotid lymphoma.

**E. Tumors of the submandibular gland**

Tumors of the submandibular gland comprise only 10% of all salivary gland neoplasms; however, up to 50% of submandibular gland tumors are malignant. Of the benign tumors, the overwhelming majority are pleomorphic adenomas.

Most lesions of the submandibular gland are inflammatory, with symptoms and signs of pain, erythema, intermittent swelling, and purulent secretions from Wharton's duct. Chronic inflammation may be difficult to differentiate from neoplasia. Nerve weakness is uncommon; however, paralysis of the marginal mandibular nerve with weakness of the corner of the mouth is seen in malignant tumors. Despite this, only 10% of submandibular malignancies manifest nerve involvement. Cervical lymph node metastases are not uncommon. Treatment requires wide surgical excision with contiguous resection of lymphatics, when appropriate.

**F. Tumors of the sublingual and minor salivary glands** are the rarest of the growths but are important in that malignancy is more common. Presentation is often a result of slowly growing mass. Treatment requires resection with preservation of maximal function for low-grade malignancies. As with other tumors, high-grade and advanced lesions require adjunctive radiation therapy for improved local control.

**G. Ancillary treatment measures.** Neutron beam irradiation appears to have efficacy for advanced, unresectable, or recurrent malignant salivary gland neoplasms. With progress in surgical rehabilitative techniques and adjunctive therapies, significant local and regional control is achievable. Chemotherapy is under investigation and, in certain settings, may have beneficial effects. Clearly advanced squamous cell carcinoma and high-grade mucoepidermoid carcinomas should be considered for neoadjuvant chemotherapy.