Textbook of Oral and Maxillofacial Surgery

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Chapter 14

Cysts of bone and soft tissues of the oral cavity and contiguous structures

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A cyst is a cavity occurring in either hard or soft tissue with a liquid, semiliquid, or air content. It is surrounded by a definite connective tissue wall or capsule and usually has an epithelial lining. The contained substance is a predominant feature in proportion to the size of the entire mass of tissue.

Classification

Congenital, developmental, and retention types of cysts occur within the oral cavity and about the face and neck. Cysts of detnal origin are by far the most common. In the combined grouping of these cystic lesions, the following classification, modified from that given by Robinson and Thoma and others, is offered for discussion.

A. Congenital cysts
    1. Thyroglossal
    2. Branchiogenic
    3. Dermoid
B. Developmental cysts
    1. Nondental origin
        a. Fissural types
            (1) Nasoalveolar
            (2) Median
            (3) Incisive canal (nasopalatine)
            (4) Globulomaxillary
        b. Retention types
            (1) Mucocele
            (2) Ranula
    2. Dental origin
        a. Periodontal
            (1) Periapical
            (2) Lateral
            (3) Residual
        b. Primordial (follicular)
        c. Dentigerous
        d. Keratocysts.

Killey and Kay include the solitary bone cyst, idiopathic bone cavity cyst, and aneurysmal bone cyst in their classification of cysts of the jaws. These lesions are well

described in their text, and their review of other classifications is comprehensive.

Neoplasms that may appear to be cystic are not included in the previous classification. These tumors are discussed elsewhere, but the most common ones encountered are the ameloblastoma and the mixed salivary gland tumor. The ameloblastoma, a true dental neoplasm, may have no clinical characteristics other than appearing to be a cystic lesion. This neoplasm involves bone primarily, with displacement of the adjacent soft tissue by erosion and expansion.

Other than the parotid area, the mixed cell, salivary neoplasms appear more often on the hard and soft palates than in any part of the oral cavity except perhaps the cheek. They occur rarely in the lips, where they form a palpable swelling and appear similar to a mucocele.

Various benign tumors of the soft tissues of the oral cavity that may have the clinical appearance of a cyst include the fibroma, lipoma, myoma, hemangioma, lymphangioma, and papilloma.

Additional neoplasms and dysplastic conditions of bone may appear roentgenographically as cystic lesions. These neoplasms include the giant cell tumor, fibrous dysplasia, ossifying fibroma, metastatic and invasive carcinoma, osteolytic sarcoma, other rare primary bone tumors, and multiple myeloma.

Metabolic or systemic dysfunctions that may give rise to lesions having the radiographic appearance of a cyst are osteitis fibrosa cystica (hyperparathyroidism) and the diseases of the reticuloendothelial system (histiocytosis X).

Hemorrhagic or traumatic bone cavities as well as the idiopathic bone cavities described by Stafne and others may also enter into the differential diagnosis of true cysts of the jaws.

Congenital cysts

Thyroglossal duct cysts. Thyroglossal cysts may arise from any portion of the thyroglossal duct. They are therefore in a midline positon and are usually of dark color. They may be so vascular as to resemble hemangiomas. One frequent important symptom is hemorrhage into the mouth, resulting from the rupture of the overlying veins.

The thyroglossal duct lies in the line between the thyroid gland and the foramen cecum on the tongue. A cyst or sinus tract derived from this structure is located in the midline at any point between the thyroid isthmus and the base of the tongue. The tract is usually attached to or in close relationship with the hyoid bone. The cyst may be asymptomatic or may cause symptoms as a result of pressure on other structures. Swallowing will cause the mass to move upward.

Because of the thyroglossal duct the cyst may become infected. If so, the lesion may drain spontaneously but also may be incised. Ideally, it should be removed before infection occurs or after acute symptoms have subsided. Complete excision of the tract to the base of the tongue, frequently including a portion of the hyoid bone, is necessary for a cure.

Branchiogenic cysts. Several theories have been advanced concerning the origin of branchiogenic cysts, but most of the evidence supports the belief that they arise from persistencies of the second branchial cleft. They are characteristically located along the anterior border of the sternocleidomastoid muscle at any level in the neck. A fistulous tract may extend up to the digastric muscle and terminate in the tonsillar fossa. These cysts or tracts are lined with ciliated and stratified squamous epithelium and contain a milky or mucoid fluid. An external fistula may be present. Treatment consists of complete surgical excision.

Dermoid cysts. Dermoid cysts are relatively uncommon in the oral cavity. The dermoid cyst consists of a fibrous wall lined with stratified squamous epithelium. The cyst frequently contains hair, sebaceous and sweat glands, as well as tooth structures. They may occur on the hard and soft palates, on the dorsum of the tongue, or more commonly in the floor of the mouth. They cause swelling in the same location as the sublingual retention cysts and must be differentiated from them. They do not give the vesicular appearance of the ranula. The dermoid cyst may be located either above or below the geniohyoid muscle. Dermoids usually occur in the midline but may be displaced laterally during development and, as such, must be differentiated from cysts of branchial origin.

Dermoid cysts are not easily discovered unless they cause swelling beneath the chin or up into the floor of the mouth. On palpation, these cysts have a rubberlike sensation. They generally contain a yellow cheesy material. This yellow color aids sometimes in differentiation of the dermoid cyst from the ranula, which has a bluish hue. X-ray examination may be helpful in distinguishing a dermoid cyst from other lesions of similar nature because of their contents, which frequently include radiopaque objects.

Treatment is the surgical removal of the entire tumor.

Developmental cysts

Nondental origin

Nasoalveolar cysts. A nasoalveolar cyst forms at the junction of the globular, lateral nasal, and maxillary processes. It produces a swelling at the attachment of the ala of the nose, and as it expands it encroaches on the nasal cavity. Since these cysts are not central bony lesions, x-ray findings are negative. The cysts are usually lined with nasal type epithelium but may also contain some stratified squamous cells. On clinical observation they may be mistaken for cysts of dental origin or dental alveolar abscesses on the maxillary anterior teeth.

Treatment consists of complete surgical excision. The nasoalveolar cyst is usually removed intraorally by carefully incising the overlying mucous membrane and enucleating the cyst.

Median cyst. The median cyst is a bone cyst that forms in a median fissure of the palate from embryonic remnants. Median alveolar cysts have also been described. Robinson maintains that these are not true median cysts since the bones uniting in these areas have their origin deep within mesenchymal tissue with no chance for inclusion of epithelial rests. Robinson presumes that they are primordial cysts of supernumerary tooth buds. Median cysts of the mandible have been described; they are extremely uncommon.

Median cysts are differentiated from incisive canal cysts primarily by their location, since they usually occur more posteriorly in the palate. X-ray findings are often misleading because of the overlapping shadows of the paranasal sinuses. Injection of a radiopaque material will definitely outline this cyst.

Surgical excision of these cysts is the preferred treatment, although the Partsch method may be used. Frequently, these cysts have to be approached by reflecting a mucoperiosteal flap from the labial aspect of the maxilla as well as from the palate. These cysts are in close proximity to the floor of the nose and bulge into the nasal cavity. The median cyst has a connective tissue sac lined by squamous epithelium. Like other cysts, cholesterol crystal spaces may be surrounded in some instances by foreign body cells.

Incisive canal cysts (nasopalatine cysts). Cysts located in the center of the bone are named incisive canal cysts. Occasionally a soft tissue cyst forms in the palatine papilla. These cysts do not expand inside the bone, nor do they alter significantly the overlying mucosa. They are called cysts of the papilla palatini and are differentiated from a bone cyst by x-ray and surgical examination.

The radiograph is of great value in diagnosis of incisive canal cysts. However, the size of the incisive canal is by no means constant, and many a large canal and foramen may give the appearance of a cyst. In edentulous jaws, because of resorption, the cyst may appear closer to the surface. Differential diagnosis from radicular cysts is necessary to prevent devitalization or extractions of these teeth.

These cysts usually give no clinical symptoms unless they become secondarily infected. A persistent discharge, or pus escaping under pressure, may be noted. Probing or puncturing the area will usually allow the accumulation of fluid to escape, but swelling will recur unless the cyst is removed surgically. For the surgical approach to these cysts, a palatal flap is usually retracted after incising along the lingual gingival margins. By careful elevation of the flap, the continuity of the nerves and vessels, which lie in the foramen and emerge at the papilla, can be preserved. Frequently, the nerves and vessels must be interrupted for better access to the cystic tissue. This does not cause any undesirable sequelae. Usually the cyst can then be teased away gently from the soft tissue or the bony bed, as the cause may be. Nasopalatine cysts usually contain a thick membrane of connective tissue. The lining of the lumen varies in type from squamous to transitional to ciliated columnar epithelium. In many cases marked inflammatory infiltration takes place as a result of secondary infection from the oral cavity.

Globulomaxillary cysts. Globulomaxillary cysts are epithelial-lined sacs formed at the junction of the globular and maxillary processes betweenthe lateral incisor and canine teeth. They usually cause a divergence of the roots of these teeth and appear as pear-shaped radiolucencies on x-ray film. As is true with other cysts of the oral cavity, they become secondarily infected and undergo acute inflammatory changes.

Diagnosis of the globulomaxillary cyst depends almost entirely on its location between the lateral incisor and canine plus a clinical evaluation of the adjacent teeth to differentiate it from one of dental origin. These teeth usually respond favorably to vitality tests. The cyst consists of a connective tissue membrane lined with stratified squamous epithelium. Treatment is surgical and consists of careful excision, although the Partsch method may be used. Generally the adjacent teeth need not be disturbed if the operation is planned and carried out properly. A mucoperiosteal flap must be reflected from the labial bone so that adequate access

to the pathology may be obtained and the cyst carefully enucleated. The majority of these incisions heal by first intention, and primary closure can be obtained without the use of dressings or other substances to obliterate the cavity.

Mucoceles. Mucocysts or mucoceles result from the obstruction of a glandular duct and are commonly located in the lip, cheek, and floor of the mouth. They may also be found on the anterior portion of the tongue, where glands are located at the inferior surface. These are small, round or oval, translucent swellings, sometimes having a bluish color, and may be mistaken for a hemangioma. The mucocele is freely movable and usually found right underneath the mucosa. Occasionally it may be punctured accidentally or will rupture spontaneously, only to recur. The preferred treatment is complete excision. If the mucocele is incompletely removed, it has a marked tendency to recut, but the lesion is not known to become malignant.

Ranulas. A ranula is a cyst forming in the floor of the mouth, generally from a sublingual gland. The ranula forms in a manner similar to the mucocele but develops to a much larger size.

When it attains a large size, the mucosa is thinned out, and the cyst assumes a bluish color. It is a nonpainful lesion, but the tongue may be raised and its motion hindered, thus impairing mastication and speech. The ranula is subject to rupture when injured, with escape of a mucoid fluid that reaccumulates as the area heals.

The size of the ranula cannot be determined from the appearance within the mouth. It is tense and fluctuant but does not pit on pressure. The ranula seldom causes any external swelling and rarely becomes infected. It is painless and contains a stringy, mucoid fluid. A ranula is much more firm than the angioma occasionally found in the floor of the mouth. Dermoid cysts have a doughy feeling on pressure and occur more often in the medial line. Lipomas are more firm. Cysts of the submandibular duct usually cause swelling in the gland. They develop more rapidly than the true ranula and are associated with pain and other symptoms of inflammation. The best treatment for a ranula is surgery in the form of marsupialization.

dental origin (odontogenic cysts)

Harris and Toler recognize three major types of odontogenic cysts and state that they have distinct developmental identities. Periodontal or inflammatory cysts appear to be a lymphoepithelial barrier to the spread of periapical infection and may possibly regress with the removal of the causative agent. Disturbances in the eruptive process, including formation of clefts in the enamel epithelium and reduction of this tissue before tooth eruption, may give rise to follicular and dentigerous cysts. Keratocysts appear to arise from submucosal cells that have the features of dental lamina rests. These rests could have a role in normal tooth formation and eruption.

According to the classification being discussed in this chapter, the following types of cysts are important.

Periodontal cysts. A periodontal cyst is formed from epithelial rests or remnants in the periodontal membrane. These cysts are all of inflammatory origin. The usual location is at the apex of the tooth, where they are termed radicular cysts, but they also may be formed along the lateral surface and are then termed lateral cysts. Cysts of inflammatory nature in

edentulous areas are termed residual. These result from incomplete surgical removal of pathological tissue at the time an infected tooth is extracted.

Inflammatory cysts are a result of dental infection, with necrosis of pulpal tissue and resultant degeneration into granulomas or cysts. All epithelial granulomas do not develop into cysts. The formation of a cyst depends, first, on the dissolution of the central part of the granuloma and, second, on transudation of fluid through the epithelium-lined connective tissue sac into the lumen. These cysts are commonly lined by stratified squamous epithelium. Round cell infiltration and other signs of chronic inflammation are usually found. The periodontal cyst, being primarily inflammatory in nature, will not show any progression toward neoplastic formation of the epithelial cells lining the cyst wall.

The small periodontal cyst can often be enucleated through the alveolar socket after removal of the involved tooth. However, it is frequently much better to elevate a surgical flap and remove the cyst by the labial or buccal approach. This ensures better visibility of the pathological region and allows for more definite removal of all the cyst tissue.

Large periodontal cysts usually appear to involve several teeth, and it is extremely important that vital teeth not be removed unnecessarily. This overlapping as visualized on the x-ray film may extend buccally, labially, or palatally to the apparently involved teeth, and, as such, access to and removal of the cyst can be gained by sacrificing sound dental structures. In these large cystic areas the Partsch method of treatment is preferred if adjacent teeth are in danger of damage.

Many of these inflammatory cysts become chronically infected and form fistulas through the alveolar bone to the overlying mucoperiosteum. In some instances, expansion of the cyst is great enough that all overlying bone has disappeared, and the cyst wall is adherent to the mucoperiosteum. In these instances the dissection involved in reflecting a mucoperiosteal flap becomes somewhat tedious, and care must be taken to strip the cystic lining cleanly from the soft tissue covering the bone.

Tooth roots that protrude into a bone cavity after enucleation of a cyst should be amputated after proper root canal therapy has been instituted, or the teeth should be extracted. Complete removal of cystic tissue in inaccessible areas is difficult, since often the involved region cannot be too clearly visualized or approached surgically, because of tooth root interference.

Residual periodontal cysts cannot be diagnosed from x-ray findings alone and are often verified only on microscopic examination. Treatment in all cases, however, is either by enucleation or marsupialization.

Primordial cysts (follicular). Primordial cysts differ from periodontal and dentigerous cysts in that they contain no calcified structures. The term follicular has often been applied to this type of lesion and can be used synonymously with it. In primordial cysts the retrogression of the stellate reticulum in the enamel organ takes place before any calcified tooth structure is formed. The word primordial means most simple and most undeveloped in character. These cysts are lined by stratified squamous epithelium and may be either locular, multilocular, or multiple. Odontogenic cysts, such as primordial and dentigerous cysts, are formed from primitive oral eptihelium and are therefore closely related to each other and to the ameloblastoma, a true dental neoplasm. In these cysts, epithelial cells have a definite potential for developing into a neoplasm.

Except for the absence of dental structures resulting from the period in development when cystic changes took place, these primordial and dentigerous cysts are basically identical in all respects so far as surgical treatment is concerned, and their differential diagnosis, to a large degree, is purely academic.

Dentigerous cysts. A dentigerous cyst contains a crown of an unerupted tooth or dental anomaly such as an odontoma. These cysts develop after deposition of enamel and are probably a result of degenerative changes in the reduced enamel-forming epithelium. The fact that the epithelium of a dentigerous cyst is attached to the neck of the tooth is fairly strong evidence that in most cases the cyst is formed by the enamel organ and not independently of it.

If cysts form when a tooth is erupting, they are called eruption cysts. These cysts interfere with normal eruption of the teeth. Eurption cysts are more commonly found in the child and young adult and may be associated with any tooth. If treatment is indicated, simple incision or "deroofing" is all that is needed.

Enlarged dentigerous cysts can cause a marked displacement of teeth. Pressuure of accumulated fluid usually displaces the tooth in an apical direction, and, frequently, the root formation becomes stunted. Dentigeroous cysts may be found anywhere in the mandible or the maxilla but are more frequently located at the angle of the jaw, the cuspid regions, maxillary third molar areas, the antral cavity, and also in the floor of the orbit.

Cysts may be produced by several tooth germs acting together in their formation, giving a multiple follicular-type appearance. The tooth bud given off from the dental lamina or outer epithelial layer of the enamel organ of the tooth may branch and form a number of follicles. Each follicle may form a cyst, causing a formation of so-called daughter cysts, which necessitate careful exploration at the time of surgery. It should be remembered that the primordial or dentigerous cyst is a potential ameloblastoma. The formation of buds at the basal layer of the epithelium and papillary outgrowth into the lumen may be the beginning of this dental tumor.

Keratocysts. Many follicular and dentigerous cysts contain keratinizing material and are known as keratocysts. Keratocysts differ from other odontogenic cysts in their microscopic appearance and clinical behavior. They may resemble periodontal, primordial, or follicular cysts. Usually they cannot be distinguished radiographically. The term odontogenic keratocyst was first used by Phillipsen in 1956. Pindborg and Hansen in 1963 described the essential features of this cyst. Stoelinga and Peters report a histological study of six keratocysts. Their findings strengthen the idea that oral mucosa plays an important role in the origin of keratocysts. As a result of this study it is advocated that wide excision of overlying mucosa in the area where the cyst wall is adhered to mucosa is a treatment of choice. Nonkeratinized cysts increase in size primarily because of degenerative characteristics of the lining. Keratocysts increase in size principally by a process of epithelial cell multiplication and have a greater tendency toward recurrence.

Basal cell nevus syndrome

Multiple cysts are a common finding in basal cell nevus syndrome. The cyst may be follicular, primordial, or periodontal in nature, with all types of histological variations in the epithelial linings. There is a preponderance of the keratocyst type.

The basal cell nevus syndrome is a hereditary complex embracing various manifestations of cutaneous and skeletal abnormalities. Congenital cysts generally develop earlier than the skin lesions. Therefore, the dentist may be the first to encounter and identify this syndrome when he or she discovers multiple cystlike radiolucencies in the jaws. Multiple conventional jaw cysts occur more frequently than do those of basal cell nevus syndrome. In these cases of multiple cystic lesions one must be aware, however, that the other associated skeletal and cutaneous lesions may develop later to tie in with the syndrome.

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Developmental cysts have a marked tendency to recur. Frequently, cysts with thickly epitheliated linings are more likely to recur than cysts with a thin layer of epithelium, especially if they are multiple.

Complete enucleation of the cyst sac is indicated in developmental dental cysts. A partial exision is dangerous, and any small part left behind may contain the potential of developing into a true dental tumor. When, because of anatomical considerations, combined Partsch and enucleation techniques are used, multiple biopsies should be taken from the area and the postoperative course thoroughly followed with x-ray examination every 6 months. Any pathological tissue that is removed should not be discarded. It should be placed in a bottle of 10% formalin and prepared for complete microscopic examination. Carcinomas have been reported as developing in the epithelial cells of this type cystic lesion.

Many of these cysts give no clinical symptoms until noticeable asymmetry of the face develops. These cysts can reach rather large proportions to involve the entire body or ramus of the mandible as well as a large portion of the maxilla, displacing the orbital and paranasal sinus cavities rather than invading them. Many times, radiographs will show marked expansion of bone so that the overlying cortical plate is paper thin.

Treatment of choice, even in the extremely large cystic lesions, is careful enucleation. If one cortical plate of bone is entirely destroyed by expansive pressure, the periosteal tissue is left intact, which serves as an excellent aid for regeneration of bone. When marked expansion and asymmetry have occurred, in the repair process, nature will reestablish normal jaw contour and complete regeneration of bone if the surgery is adequate and no recurrence of the cystic lesion takes place.

Each care presents its own individual problems in diagnosis and treatment, but if both are adequate, the prognosis should be excellent and complications kept to a minimum. The patient must be given every consideration, and he should have as good an understanding of the surgeon's problems as the surgeon has of the patient's concern for a satisfactory prognosis.

General Consideration of Cystic Lesions

This discussion will include problems in differential diagnosis, x-ray examination, surgical technique, postoperative treatment, and complications of surgery.

Diagnosis

Diagnosis in each individual case should rest on a combination of physical findings, history, x-ray evaluation, and tissue biopsy. Histological examination is desirable and often essential to establish a correct diagnosis, but other clinical laboratory studies are often

necessary. A patient should not be subjected to biopsy immediately to eliminate other studies; biopsy should be deferred until indications for it are clear. Clinical symptoms are generally absent unless the cyst reaches large proportions and causes a facial deformity. Pain may be caused by the pressure of a cyst on a nerve, and, likewise, paresthesia or numbness may be a clinical complaint. Cysts may be multiple, each from a separate anlage, but, conversely, multiple cysts may be indicative of systemic disease.

Because cysts of soft tissues inthe neck are often tense, the differentiation between cystic and solid tumors may be difficult. The presence of inflammation and tenderness on pressure is a better sign of a cyst than of a tumor because cysts become secondarily infected more frequently. However, the tenderness of a cyst and mobility of the neck structures frequently make fluctuation of fluid an unreliable sign. Location, mobility, fixation, consistency, regional changes, and associated diseases are the most important factors in diagnosis.

In large, cystic, bony defects that produce facial asymmetry, expansion takes place usually along the line of least resistance in bone and generally in one direction. A true neoplasm will usually grow and expand in and through bone in any and all directions. Structures such as nerves, blood vessels, and paranasal sinuses are usually displaced by the pressure exerted by the fluid contents of the cyst; a neoplasm invades and surrounds these tissues.

X-ray findings

The x-ray examination gives information about thelocation and extent of a bone cyst and involvement of other teeth. Overlying shadows may be misleading when many teeth appear involved in a cystic area, and a thorough clinical examination, including vitality tests, should be made. Pressure of the cystic fluid within the cavity may cause the formation of a compact layer of bone in which the cyst sac is contained. This dense lamina is seen on the x-ray film as a thin white line outlining the area containing the radiolucent cyst. A diagnosis can never be made positively from the x-ray findings, since many neoplastic and metabolic diseases appear radiographically cystic. The jaws have been frequently referred to as an area of surgical romance because of the complexity of disease entities they contain, all of which present a problem in differential diagnosis. Cysts usually have a smooth, rounded, lobular outline and may be multilocular in appearance. However, if secondary infection exists, the margins can be irregular.

Cysts occurring in the maxilla are often difficult to visualize because of the overlapping shadows cast by the paranasal sinuses on x-ray examination. A radiopaque substance such as iodized oil (Lipiodol) may be injected into the cystic cavity after aspiration of the cystic contents. A large 19- or 20-gauge needle is used on a 3 or 5 mL Luer syringe. After the fluid is aspirated from the cyst, the syringe is removed from the needle, which is left in place, and another Luer syringe containing iodized oil attached to it. The opening made for entry into the cavity must be immediately stopped with a hemostat or sponge and the x-ray film taken as soon as possible to avoid escape of the fluid. This technique can also be used to visualize soft tissue cysts and sinus tracts that otherwise would not be outlined on the x-ray film. Dermoid cysts may contain radiopaque objects.

Newer x-ray machines and technology have made possible the taking of laminagrams of the head and neck area. This is a series of exposures by a machine that has the ability to focus in on a small area and clearly delineate the location of the pathological lesion. By

review of the series of films and comparison of associated anatomical landmarks, the nature and extent of the lesion can be determined readily. This is helpful in planning a surgical procedure and frequently predetermines the need of a nasal antrostomy when the cyst occurs in the maxillary sinus area.

Occasionally a radiolucent, irregularly outlined, small, punched-out type of area seen radiographically is mistaken for a recurrence of a cystic lesion. This radiographic appearance results when both cortical plates of bone are involved in the cystic defect or else removed during surgical excision of the lesion. Complete regeneration of these cortical plates rarely occurs, and the defect will always be seen on the x-ray film. Here a history of previous surgery or treatment is important. It is wise to inform a patient of this finding so that it can be explained if he is examined by another dentist, thereby avoiding further and needless operations on these areas.

Surgical technique

Regardless of the etiology, nature, or location of the cyst, two methods of treatment are generally accepted:

1. Enucleation of the cystic sac in its entirety.

2. The Partsch operation or marsupialization, by which the cyst is uncovered or "deroofed" and the cystic lining made continuous with the oral cavity or surrounding structures.

In either case the surgical procedure must be based on sound fundamental principles - preservation of the blood supply to the area, avoidance of undue trauma to nerve filaments and nerve trunks in the region, control of hemorrhage, aseptic technique, atraumatic handling of the soft tissues, planning of a surgical flap so that adequate relaxation may be obtained to allow good access to a cystic area, avoidance of important anatomical structures such as muscle attachments and large blood vessels, and proper suturing and readaptation of the soft tissues. A sharp, clean incision planned so that the soft tissues are readapted over a firm bony bed will always heal better with less postoperative discomfort than when tissue is torn, lacerated, or sutured directly over a bony defect.

All excised lesions should be examined microscopically. When a neoplasm is noted on pathological examination, more aggressive surgery may be necessary.

The discussion on surgical technique will include the treatment of both soft tissue and bone cysts.

Soft tissue cysts

Soft tissue cysts include those of congenital origin, which occur primarily in the neck, and the retention-type cysts, mucoceles and ranulas, which occur primarily in the oral cavity. The surgical techniques described for the treatment of congenital cysts are presented primarily to indicate correct procedure rather than to describe the detailed discussion frequently necessary in the structures of the neck.

Congenital cysts. Congenital cysts occur usually in the neck and submandibular and submental regions. They are benign entities, but thorough dissection and excision are

necessary for a cure.

Thyroglossal cysts. Thyroglossal duct abnormalities should be treated by surgical excision. Repeated lancing of the cyst, except to alleviate an acute inflammatory condition, is ineffective. The use of sclerosing agents and irradiation is also contraindicated.

Surgical excision is accomplished through a transverse incision over the cyst. Overlying tissues are carefully separated and the fibrous tract identified and followed by further dissection. Injection of a dye to more definitely outline the sinus tract has one disadvantage - the dye frequently spills over and stains other tissues, obscuring the operative field. Usually the fibrous tract can be followed without this additional aid. To facilitate exposure the hyoid bone is separated to aid in dissection above this point and allow excision of the foramen cecum, which is the terminating point of the thyroglossal duct.

In closing the wound the musculature of the tongue is brought together with interrupted silk or chromic sutures, the severed edges of the hyoid bone are approximated with sutures through periosteum or adjacent fascia, and a small rubber tube drain is placed deep in the muscles of the tongue and through the skin incision.

Branchiogenic cysts and fistulas. In excising branchiogenic fistulas, a radiopaque substance such as iodized oil (Lipiodol) or iophendylate (Pantopaque) is used to identify the extent and location of the fistula and sinus tract. A probe may also be passed in the tract to aid in identification as the dissection proceeds. A stepladder technique, as developed by Bailey, aids in following the sinus tract to its termination in the pharyngeal wall. This two-step procedure minimizes resultant scar formation.

The tract is ligated with fine silk or catgut at its entrance into the pharynx, and the wounds are closed in the usual manner with dependent drainage. The drain is usually removed in 2 or 3 days.

The best approach to a branchiogenic cyst is through an incision centered over the most prominent part of the cyst and parallel to the anterior border of the sternomastoid muscle. The cyst may have attachments to important nerve trunks and vessels, and it is therefore necessary to have adequate exposure in visualizing the cyst. Care must be taken to prevent rupture of the cyst during the dissection. Any epithelium left behind will give rise to a recurrence. The wound is closed in layers and skin sutured in such a manner as to give the best cosmetic result. A small drain is left in the wound for 1 or 2 days.

Dermoid cysts. Dermoid cysts are as a rule more superficial to the branchiogenic cleft cysts and are not attached to the lateral pharyngeal wall. They can occur either above or below the mylohyoid muscle. Surgical removal is the treatment of choice in either case. The sublingual dermoid cysts are usually excised intraorally. Those occurring below the floor of the muth are usually excised extraorally.

Retention cysts. Retention cysts are generally located in the oral cavity and are treated by simple excision or marsupialization, depending on their size and location.

Mucoceles. The preferred treatment is complete surgical excision. An incision must be carefully made through the thin, overlying epithelium, which is usually stretched tight over the underlying mucous cyst. An alternate incision preserving the overlying mucous membrane, to aid in grasping tissue during enucleation of the mucocele, sometimes facilitates dissection.

Usually the mucous cyst will tend to pop out of its soft tissue bed and can be carefully teased free, using blunt dissection with a small curved hemostat, curet, or periosteal elevator. Care must be taken not to rupture the sac, since then the dissection becomes more difficult and one cannot be positive that the cyst has been removed in its entirety. Recurrences of these lesions is common. Shira has described a technique in which he aspirates the contents of the mucocele and injects a thin mix of alginate or rubber-base impression material. This hardens and clearly outlines the entire extent of the lesion and aids in the dissection.

Ranulas. Simple incision and drainage of the ranula always results in its recurrence. Enucleation of a ranula without rupturing the thin cystic wall is practically impossible and fraught with considerable complications. Once a cyst ruptures, it is difficult to pick up the continuity of a lining, and if all is not thoroughly removed, the ranula is likely to recur. A seton in the form of a wire loop may be used to attempt to reestablish an epithelial-lined duct opening, but this frequently fails. The use of radium for treatment of ranulas is known to be effective.

The Partsch operation or marsupialization of a ranula is generally agreed on as the best surgical procedure. This consists of excising the superior wall of the ranula and suturing the cystic lining to the mucous membrane of the floor of the mouth to make it continuous with the oral cavity.

The following technique is used. A series of sutures is placed around the peripheral margins of the cyst. The sutures go through the normal mucosa of the floor of the mouth and the cyst lining. When the cyst outline is well marked with sutures, the superior wall is excised just inside the sutures. The bottom of the cyst then elevates into a normal position, with escape of the fluid contents, and becomes continuous with the floor of the mouth. The cystic membrane undergoes transformation and assumes the characteristics of the adjoining structures.

Some operators like to remove a small portion of the superior wall, aspirate the contents of the cyst, and outline the defect by filling it with sterile, selvage-edged gauze. The dissection of the superior cyst wall is then completed, and peripheral sutures are placed. This procedure is best done using a local anesthetic with lingual nerve block. Supplemental local infiltration is generally unnecessary. If the swelling occurs across the midline, bilateral block is necessary.

Catone and co-workers recognized that some ranulas are deeper in origin that others and that often it is necessary to remove the associated sublingual gland. They emphasized that logical surgical care is based on pathogenesis and pathological anatomy of the lesion and that a dogmatic approach to the treatment of cystic lesions of the floor of the mouth is not justified.

Bone cysts

Access to a bone cyst must be gained by incising and reflecting the mucoperiosteum. The nature of the surgical approach is governed by the location and extent of the cyst. Whether a bone cyst is completely enucleated or treated by the Partsch method or its modifications depends more on its size and location than on the actual diagnosis of the cyst.

When enucleation is the method of choice, overlying bone must be removed with chisels, rongeur forceps, or bone bur. Many times the bone is of tissue paper thickness and

can be removed readily with a hemostat. Frequently, the bone is entirely eroded through, and the cystic membrane becomes attached to the periosteum or soft tissue covering and has to be cleanly dissected from it. This is further complicated by secondary infection on occasions, with the formation of a fistulous tract and considerable scar tissue. The cystic sac must be well exposed so that it can be carefully teased from its bony bed.

Moose has advocated the use of an osteoperiosteal flap in operating on large tumors and cysts of the jaw that exhibit thin cortices. This technique consists essentially of incising through the mucoperiosteum and the thin cortical plate of bone at the same time. This may be done with a knife if the bone is thin or by placing a sharp chisel on the flap outline and carefully tapping it so that the chisel penetrates the bone. The bone is then reflected, adherent to the mucoperiosteum, to expose the cystic area. This procedure is best carried out on the labial and buccal sides of the maxilla and mandible. After removal of the lesion the flap is returned to its original position and sutured. The preservation of this bone attached to the periosteum increases the osteogenic surface of tissues surrounding the blood clot filling the cystic cavity. This enhances the possibility of primary healing and also forms a better nucleus for regeneration of bone. Fractures occurring in this thin bone as the flap is reflected are not important as long as the pieces do not become entirely detached from the periosteum. If they do become detached, they are removed and discarded.

A thin-blade curet is a suitable instrument for removing a cystic lining from bone. The largest curet that can easily be placed inthe defect should be used. The concave side of the curet is usually placed against the bone as the thin blade is teased in between the cyst wall and tbe bone cavity. Care must be utilized to avoid tearing the cystic sac and allowing escape of the fluid contents if possible. Good lighting and direct vision are essential so that it can be determined that the entire cystic sac is removed from bone. Frequently, in large cysts a suction tip can be used in dissecting the cyst free from its bony bed. In large defects, nerves and vessels are usually found pushed to one side, and they should not be traumatized unduly. The bony edges of the defect should then be saucerized and smoother before the soft tissues are reapproximated with sutures and the wound is closed. This may be done with a rongeur, antrum bur, or bone file. Local antibiotic therapy in the form of dusting the walls lightly with topical drugs may aid in wound healing. Systemic antibiotic medication is favored in the presence of inflammation or infection. Any local use of an antibiotic drug should be augmented by systemic therapy.

The size and location of the cyst usually governs whether primary closure is attempted or the resultant cavity is packed with gauze, Gelfoam, bone chips, or other substitutes to obliterate the defect. There is a marked trend toward primary closure, with bank bone being the material of choice for placing in the defect. Dressings of any kind tend to control bleeding, prevent hematoma formation, control septic drainage, and at the same time promote healing.

Van Doorn discusses results and problems encountered in primary closure of large bone cysts. The smaller cyst up to 15 to 20 mm in size usually heals by primary intention with no complications. An organized blood clot forms in the cavity, which leads to proliferation of young connective tissue and ultimate new-bone formation. In the larger cavity the wound heals by secondary intention, with gradual apposition of tissue obliterating the defect. If primary closure is the method of choice, hemorrhage and oozing must be well controlled, and the wound must be free from infection. Bone edges must be well saucerized to allow mucoperiosteal flaps to collapse into the cavity. The use of a closed system continuous suction is helpful in controlling hematoma formation. Either the Hemovac or

Jackson Pratt system may be used.

Generally, in large cysts a substitute dressing in the form of gauze, resorbable cellulose products such as Gelfoam and Surgicel, bone chips, plaster of paris, and other anorganic substitutes have been utilized.

When a gauze dressing is used, 12- to 24-mm selvage iodoform or plain gauze with a medication such as balsam of Peru incorporated in it is satisfactory. This gauze is well placed in the cavity to exert pressure against any points that may show some tendency toward bleeding and is usually removed, either entirely or partially, on the fifth to seventh postoperative day. If considerable bleeding is encountered at the time of surgery, it is usually best to loosen the dressing gradually and remove it in sections over a period of 10 to 12 days. The defect can be carefully irrigated whent he dressing is removed, and these areas are usually redressed twice a week until healing takes place over the bony walls where the cyst has been removed. This time interval usually involves 15 to 20 days.

The large cystic area may also be packed with bone chips obtained from the bone bank. Freeze-dried bone in small fragments suitably prepared from cancellous or cortical bone can be packed into the bony crypt. Cancellous bone is preferred. Antibiotics or sulfa drugs may be incorporated into the mass before replacingthe soft tissue flap and carefully suturing the wound closed. Occasionally some of the small chips may act as foreign bodies and be exfoliated. However, the great majority of the chops will remain to serve as a supporting structure for the blood clot. Also some stimulation of the young connective tissue seems to occur, increasing fibroblastic and osteoblastic activity and further enhancing the rate of healing.

The Oral Surgery Service at Mount Sinai Hospital in Detroit had been utilizing cancellous band bone from the head of the femur as a scaffolding on which the repair process could carry out remodeling of the defect. The marrow was curetted and rongeured from the femur and placed in a solution containing 5 million units of penicillin and about 30 mL of saline solution. The wound was irrigated thoroughly with penicillin solution prior to packing the defect with as much bank bone as possible. An attempt was made to obtain watertight closure of the mucosa, utilizing a continuous, horizontal mattress suture and an overlying and running baseball stitch.

Various bone substitutes have been used to obliterate cystic cavities after removal of the pathological tissue. None of these has proved as satisfactory as freeze-dried or preserved bank bone. For example, heterogenous processed bone has been given extensive trial. Plaster of paris has been used to obliterate bone cavities. Bahn has published a review of the literature and reported many clinical cases in which results have been favorable.

The search continues for a suitable bone substitute that can be used to fill large cystic cavities in bone so that the overlying tissues can be sutured tightly without the need for packing and removing gauze strips. The substitute ideally should be made from lower species' tissue to be commercially available. It should be treated in such manner that the immune reaction will not cause graft rejection, and still it should be capable of stimulating host osteoclastic and osteoblastic activity.

The marsupialization technique as previously described for surgical treatment of ranula is also applicable to bone cysts. This cyst is "deroofed" and the surrounding mucoperiosteum sutured to the margins of the cyst wall or held in place with dressings. This, in effect, makes

the cyst wall continuous with the oral cavity.

After reflecting the oral mucoperiosteal flap, the bone overlying the cyst is carefully removed, taking care not to penetrate the cyst. When the periphery of the cavity is reached, a sharp pair of scissors can be used to cut out the exposed membranous wall. This tissue is sent to the laboratory for histological examination. After the contents of the cyst are evacuated, the mucoperiosteum is allowed to fold into the defeft and is sutured to the lining of the cyst. Apposition is maintained by pressure, using gauze dressings.

If gauze dressings are used, they may be removed in about 7 to 10 days, although it may be necessary to change the dressings in the interim. If a large opening has been made in the marsupialization of the cyst, usually nothing more is necessary as healing progresses. If only a small window is made to gain access to the cystic cavity, it sometimes becomes necessary to construct an acrylic plug that can be drilled and made hollow to maintain drainage in the area and also keep the opening patent as healing progresses. The wound can be kept irrigated and clean through this opening.

With the relase of fluid pressure in bone, regeneration occurws beneath the defect, and the cystic epithelial lining is transformed into normal mucous membrane by evagination from adjacent areas. The tube drainage technique of treating large cysts, as advocated by Thomas, is also a modification of the Partsch method. A small opening is made into the defect, and a soft metal or polyethylene tube is inserted and held in place by ligation to adjacent teeth to maintain drainage. Either tube is easily adapted to the cyst opening. This relieves pressure from inside the cyst, and gradual obliteration of the cavity occurs by apposition of soft and bony tissue to close the defect. Periodic irrigation of the cavity is accomplished through the tube. The tube may be shortened as healing progresses.

Indications for marsupialization of a cyst include those conditions in which adjacent vital structures such as teeth may be involved if the cystic contents are completely enucleated, or danger exists of entering adjacent paranasal sinuses, or a marked bone defect is to be avoided. The possible occurrence of paresthesia from surgical trauma or severeance of a nerve is also eliminated.

This technique is applicable to a large number of cysts occurring in the oral cavity. However, it must be used with some reservation in those cystic lesions that have potential to develop into tumor. In these instances adequate exposure should be made so that the cyst lining can be thoroughly examined clinically, and in many cases biopsy should be taken from any suspicious section. This type of lesion should be followed closely postoperatively with clinical and x-ray examination.

Archer has long been an advocate of the marsupialization technique for treating large cysts of the jaws to prevent the loss of involved teeth and other complications that result in the so-called dental cripple. He offers statistics to support his contention that few benign or malignant tumors occur in retained cystic membranes.

Olson and co-workers have reported the successful treatment of a large odontogenic keratocyst by the Partsch operation and delayed enucleation. In 4 years of observation there was no evidence of recurrence.

Some operators will remove the cystic or epithelized lining in a second operation when enough bone apposition has occurred after relief of pressure from the cystic lesion. This

eliminates the danger sometimes encountered in primary enucleation but submits the patient to a second surgical procedure and does not materially affect the final outcome of treatment.

In the Partsch operation the actual filling in of a bone defect may take a longer period of time. However, in most instances no contraindication exists for not going ahead with whatever prosthetic restoration might be necessary. Maintenance of good oral hygiene and care in keeping the area clean should be all that is necessary after normal epithelialization of the defect has occurred.

Postoperative complications

Complications that may result after enucleation or marsupialization of congenital and developmental cysts include swelling, infection, hematoma formation, sensory and motor nerve injury, primary or secondary hermorrhage, oral fistula, fracture of bone, and obstruction of the airway. Motor nerve injury and airway obstruction occur primarily in removal of lesions involving dissections in the neck and submandibular areas.

The best way to avoid complications is to prevent them by thorough diagnostic study, good surgical judgment, and proper surgical technique. However, complications will occur, and it is well to know how to treat them when they develop.

Postoperative edema is normal and physiological after most surgical procedures on the jaws. Most of this surgery is of a traumatic nature, and prolonged retraction of tissues adds to the interference of normal lymphatic drainage of the area. This, coupled with inflammatory reaction, is bound to produce edema and swelling. The patient should be advised of this beforehand. The height of the swelling should be reached about the second postoperative day, with gradual subsidence if no secondary infection or hematoma formation develops. The immediate application of cold is of doubtful benefit but may be used for the first 8 to 10 hours postoperatively. Antiinflammatory agents such as corticosteroid drugs and animal and plant enzymes may be helpful in certain instances in controlling postoperative edema. These agents must be administered with a complete knowledge of possible side effects and contraindications.

The possibility of infection can be minimized by antibiotic therapy, good surgical technique, and strict adherence to rules of asepsis. Any acute infection occurring in these lesions should be well controlled before surgical intervention is done. Antibiotics must be carefully chosen and administered in therapeutic dosage, either empirically or by organism sensitivity tests.

Hematoma formation can be prevented by controlling the bleeding initially and by the additional use of dressings and applied pressure. Large blood vessels should be tied off, but most of the bleeding that might be encountered comes from areas inaccessible for ligation, and pressure is utilized for its control. Soft tissue flaps should be well sutured and adequate external pressure placed on the operative area for the first few postoperative hours.

A persistent hematoma that is readily accessible should be aspirated and drained. Otherwise a breakdown of the blood clot will occur, with septic drainage. The use of enzyme therapy, such as hyaluronidase, might be of some value in early hematoma formation but should be avoided if any question of secondary infection is present. This substance, injected into the tissues, opens up the interstitial spaces and promotes a more rapid absorption and diffusion of fluids from an involved area.

Sensory nerve trunks are usually displaced by cystic lesions, and many times the cyst linings are stripped free of this nerve by careful dissection. When a sensory nerve trunk is exposed in a cavity, a paresthesia usually results. This may be of unknown duration, since the rate of recovery to nerve injury varies considerably. However, large nerve trunks are usually not severed in careful surgical procedures, and return of sensation almost universally occurs. Small nerves that are sacrificed in these surgical areas usually have some cross innervation so that the immmediate effect is not noticed by the patient. The patient should be thoroughly forewarned of this complication; he then is able to accept the resultant numbness much more graciously. One should carefully explain that possible fifth nerve injury involves sensation only and not any motor function, so that no outward changes to the appearance of the face will occur. However, in soft tissue dissection the anatomy of the facial nerve must be thoroughly understood. Injury to this motor nerve will result in muscle paralysis.

Primary hemorrhage must be controlled at the time of surgery. Secondary hemorrhage usually occurs in those cases in which injury to a large vessel has occurred at the time of surgery. It can also occur by inadvertent trauma of newly proliferated blood vessels during removal of surgical dressings. This complication is usually again controlled by pressure. Care should be taken to remove large blood clots and determine the site of bleeding before applying pressure in the correct manner. Occasionally a blood vessel can be identified and tied off with a ligature.

Oronasal and oroantral fistulas sometimes result from injudicious choice of surgical procedure or human error in surgical technique. They can also result from a normal anatomical relation of pathology to existing structures. This complication can often be avoided by careful dissection, and often cystic linings can be carefully peeled from other membranous linings without penetration into nasal or antral cavities. Use of the Partsch method of treatment, if applicable, may be helpful. If small openings occur, proper healing can usually be attained by careful attention to wound closure and detailed instructions to the patient. Postoperative care is of paramount importance in many instances in preventing permanent fistula formation, which necessitates secondary closure. Secondary infection should also be prevented. The patient should be cautioned about excessive sneezing and coughing and instructed to keep his mouth open, should these episodes occur, to equalize the pressure in the paranasal sinuses and prevent undue force on the area where the wound communicates with the oral cavity.

Bone is weakened by the presence of a cyst, with the exact amount of weakening dependent on the size and extent of the pathology. Usually the possibility of fracture occurring during surgery is remote unless undue trauma is exerted on the jaw or both cortical plates are excessively thin. Trauma in the form of a twisting movement producing torque is much more likely to fracture bone than is direct pressure. Because of the nature of a cyst, which expands primarily in a single direction, one cortical plate of bone is likely to be intact. This preserves the continuity of the jaw. Prevention agin is the best form of treatment, and careful surgical technique must be used, particularly in those cysts in which unerupted teeth are present and difficult to remove. Should a fracture occur, proceed with the enucleation of the cyst, and then pack the defect well with suitable gauze dressings or bone chips to maintain the position of the fragments and prevent unnecessary displacement. The jaw should also be immobilized. A patient with a large cystic involvement of the jaws should be cautioned to avoid any undue trauma, both preoperatively and postoperatively, since a blow is more likely to cause fracture in a weakened jaw than in a normal one.

Postoperative airway obstruction may follow surgical procedures involving the jaws, tongue, and tissues of the neck. Massive edema, hematoma formation, and infection are contributing factors. Should signs of labored breathing and inadequate respiratory exchange be evident, tracheostomy must be done. This should, so far as possible, be an elective procedure rather than an emergency one.

Proper postoperative care is just as important a part of the patient's overall problem as the diagnosis and surgical treatment.