ا.م.د. علي الحسيني

Benign cystic lesion of the oral cavity

Cyst is a pathologic cavity within hard or soft tissue, lined by epithelium and contain fluid, semifluid or gas and surrounded by connective tissue wall or capsule.
Whatever the precipitating factor for the initiation of the cystic lesion, it is followed by cyst formation due to proliferation of the epithelial lining and fluid accumulation within the cyst cavity. The cyst continues to enlarge due to increase in the volume of the contents and resorption of the surrounding bone that might cause displacement of the adjacent vital structures.

Classification of cyst

I. Intraosseous cysts

1. Epithelial Cysts:
   A. Odontogenic epithelial origin
      i. Developmental
         a. Primordial cyst (keratocyst)
         b. Dentigerous (follicular) cyst
         c. Lateral periodontal cyst
         d. Calcifying odontogenic cyst
      ii. Inflammatory
         a. Radicular cyst (apical)
         b. Residual cyst
   B. Nonodontogenic epithelial origin (Fissural cyst):
      i. Median mandibular
      ii. Median palatal
      iii. Globulomaxillary
      iv. Incisive canal (nasopalatine duct cyst)
2. Nonepithelial cysts:
   A. Solitary bone cyst (traumatic)
   B. Aneurysmal bone cyst
   C. Stafne's bone cavity

II. Soft tissue cysts

1. Odontogenic:
   Gingival cysts (Adult and Infant)
2. Nonodontogenic (fissural):
   A. Anterior median lingual cyst
   B. Nasolabial cyst
3. Retention cysts:
   Salivary gland cysts (Mucocele and Ranula)
4. Developmental/congenital cysts:
   A. Dermoid and epidermoid cysts
   B. Branchial cyst (cervical/intraoral)
   C. Thyroglossal duct cyst
   D. Cystic hygroma

Primordial Cyst (Keratocyst)

Primordial cyst is a developmental anomaly, which arises from odontogenic epithelium, the main sources being: Dental lamina or its remnants, enamel organ (by degeneration of the stellate reticulum) prior to the formation of calcified structures, thus, this cyst is found in place of a tooth (from the normal series or supernumerary).

Incidence: It is about 5 to 10% of odontogenic cysts of the jaws, more in the second to fourth decades of life with males' predilection.

Site: Mostly affect the mandible, involve the angle, the ascending ramus and body of the mandible, however, it can occur anywhere in the jaws.

Clinical features: It is symptomless until the cysts have reached a large size. This is because the primordial cyst initially tends to grow in an anteroposterior direction within the medullary cavity and clinically observable expansion of the bone occurs late. The enlarging cyst may lead to displacement of the teeth, percussion of the teeth overlying the cyst may produce a dull sound. A single missing tooth from the normal series, and the teeth adjoining the cyst are vital. Large infected mandibular cysts result in labial paresthesia or anesthesia.

Radiological features: unilocular or multilocular radiolucency

Cyst contents (aspirate): contain cheesy like material, viscoid suspension of keratin.

Recurrence: Keratocyst have a pronounced tendency to recur. The recurrence rate may vary from 5-60% with most occurring in the first 5 years. Some of the possible reasons reported for recurrence are as follows: Presence of satellite or daughter cysts, cystic lining is very thin and fragile, portions of which may be left behind after enucleation, epithelial lining of keratocysts have an infiltrative growth potential.

Patients with nevoid basal cell carcinoma syndrome, have a particular tendency to form multiple keratocysts (*Gorlin-Goltz syndrome*).

Treatment

Treatment should always be based on proper clinical assessment. *Marsupialization is incorrect for the treatment of keratocysts,* owing to their high tendency to recur.

Bramly (1971-1974) outlined the surgical management of odontogenic keratocyst as follows:

- Small single cysts with regular spherical outline:
  Enucleated from an intraoral approach, provided the access is good.
- Larger or less accessible cysts with regular spherical outline:
  Enucleated from an extraoral approach.
- Unilocular lesions with scalloped or small multilocular lesions:
  Marginal resection. The defect is closed primarily, left to heal by secondary intention or can be filled with bone graft.
- Large multilocular lesions with or without cortical perforation:
  En bloc segmental resection of the involved bone followed by a reconstruction plates and bone grafting.
  Carnoy's solution or 5-fluorouracil can used as conservative approach for large keratocysts to reduce recurrence.
  The patient should be reviewed regularly over a long follow-up.

Dentigerous (Follicular) Cyst

Dentigerous cyst developed as a result of enlargement of the follicular space of the whole or part of the crown of an impacted tooth and is attached to the neck of the tooth.

Incidence: More common than keratocyst but less common than the inflammatory types. The common age affected are the first to third decades. Incidence is slightly more in males.

Site: It occurs more frequently in the mandible than the maxilla. The most frequent teeth involved in descending order are the lower third molars, upper canines, upper third molars and the lower premolar teeth.

Clinical features: Dentigerous cysts have the potential, to attain a large size, results in facial asymmetry. Pain may be a presenting symptom, if secondary infection present. Missing a tooth from the normal series, unless the cause is a supernumerary tooth. Adjacent teeth may be tilted. Later as the cyst expands the cortical bone becomes thinned. This fragile outer shell of bone gives sound described as *egg-shell crackling*.

Radiological features: Radiographs will generally reveal a unilocular radiolucency associated with crowns of impacted tooth; at times a multilocular radiolucency can be seen when the cyst is of irregular shape due to bony trabeculations. Cysts have a well-defined sclerotic margin unless when they are infected then the margins are poorly defined. As compared to the other jaw cysts, dentigerous cysts have a higher tendency to cause root resorption of adjacent teeth. Radiolucency around the impacted tooth presents in three variations (circumferential, lateral or coronal).
Cystic contents: Consist of clear yellowish fluid, in which cholesterol crystals may be present, or purulent material, if infection has occurred.
Treatment: Treatment via an intraoral or extraoral approach. Treatment is decided according to the size of the cyst, adequate access and whether it is desirable to save the involved tooth:

- Marsupialization: If the cyst is very large in size and the involved tooth/teeth are to be maintained. The tooth may erupt into occlusion as the defect heals with normal bone.
- Enucleation: the cyst can be enucleated together with the involved tooth when the cyst is small and its removal not damage adjacent vital structures.

Prognosis: Recurrence is a possibility if some epithelium remains.

Lateral Periodontal Cysts

Lateral periodontal cysts are rarely occurring, found lateral to the roots of vital teeth, and mostly found in adults.
Site: It occurs more often in the mandible. Mostly affect mandibular canines, premolars and third molar roots, followed by the anterior region of the maxilla.
Clinical features: Mainly symptomless, and are discovered accidentally on radiographs. A gingival swelling may occur on the buccal or lingual aspect, and this must be differentiated from a gingival cyst.
Radiological features: Radiographs reveal a well-defined round or ovoid radiolucency with a sclerotic margin, the lamina dura of the involved tooth is destroyed. Most of the cysts are smaller than 1 cm in size and are seen to be present between the cervical margin and apex of the root and in the bifurcation of lower third molar roots.
Cystic contents (aspirate): It has a serous cheesy content.
Treatment: Enucleation is the method of choice.

Calcifying epithelial odontogenic cyst

The calcifying odontogenic cyst, also called odontogenic ghost cell cyst or Gorlin cyst. It has many features of tumors so it is placed in the category of tumors in the latest WHO classification as Calcifying cystic odontogenic tumor.

Incidence: It occurs more commonly in children and young adults.

Site: Most common site of occurrence is in the anterior part of both jaws.

Clinical features: Mainly symptomless, and discovered accidentally on radiographic examination. Swelling is the most frequent complaint, rarely there is pain. A peripheral or intraosseous lesion may be seen, the latter produce a hard bony expansion, in a few cases displacement of the teeth may be seen.

Radiological features: Cyst will be seen between the roots of the teeth and might reveals resorption of the roots of the adjacent teeth. The periphery may be well demarcated or irregular, it is either unilocular or multilocular in pattern.

Cortical perforation may be evident and calcifications may be seen within the bone cavity. The cyst may be associated with a complex odontome or impacted tooth.

Treatment: Surgical excision of the intraosseous cyst.

Radicular Cysts

The radicular cyst is an inflammatory cyst which results due to infection extending from the necrotic pulp into surrounding periapical tissues. It may develop apically and termed as a *periapical radicular cyst*, or on the side of the root and termed as a *lateral radicular cyst*, this cyst should be differentiated from a developmental lateral periodontal cyst which is associated with a vital tooth.

Incidence: This is the most common cysts of odontogenic origin, males more affected and the peak incidence is in the second and third decades.

Site: The incidence is highest in the anterior maxillary and the posterior mandibular teeth.

Clinical features: It is symptomless and may be discovered by radiographical examination. The involved tooth is nonvital and slowly enlarging swellings. Pain may be a significant in the presence of suppuration. In the maxilla, buccal and palatal or only palatal expansion might be noted in lateral incisor or a palatal root of molars. An intraoral sinus tract may be identified with discharging pus when the cyst is infected.

Radiological features: A round or ovoid shaped radiolucency, generally outlined by a narrow radio-opaque margin that extends from the lamina dura of the involved tooth/teeth.

Cystic contents (Aspirate): A straw colored or brownish fluid and cholesterol crystals. In case of infection pus may be present.

Treatment: Nonvital teeth that are associated with the cyst, can either be extracted, preserved by endodontic treatment or apicoectomy. External sinus tracts should always be excised to prevent epithelial ingrowth. The commonly employed surgical procedure for radicular cysts is enucleation, with primary closure. Small cyst can be removed through the socket after extraction of the affected tooth.

Residual Cyst

It occurs when incompletely enucleated periapical granuloma or cyst, that potentially enlarges after extraction of nonvital tooth which is associated with periapical lesion.
Incidence: It is identified mainly in elderly patients with no sex predilection.
Site: The incidence is greater in the maxilla than in the mandible. It is typically seen in edentulous sites.
Clinical features: Majority of the cases are asymptomatic and are discovered on radiographic examination.
Treatment: Enucleation

Median palatal cyst

Arises as a result of epithelial inclusion or entrapments during the fusion of the palatine processes of the maxilla.
Incidence: It is a rare cyst mainly affect adults with no sex predilection.
Site: It is seen in the hard palate, between the incisive fossa and the posterior border of the hard palate.
Clinical features: No complaint unless the cyst becomes large, with expansion of bone and a palpable ovoid swelling in the mid-palatal region.
Radiological features: A maxillary occlusal view will help to identify the ovoid, or irregular radiolucency in the mid-palatal region, often it is difficult to distinguish the cyst from an extensive incisive canal cyst.
Treatment: Enucleation with primary closure.

Globulomaxillary Cyst

It arises from epithelium inclusions at the site of fusion of the globular process of the medial (frontonasal) process and the maxillary process.
Incidence: It is uncommon, appear at adult life.
Site: It is seen between the maxillary lateral incisor and canine teeth.

Clinical features: The maxillary lateral and canine teeth are tilted coronally with root divergence and associated with vital teeth.
Radiological features: If the cyst is small, it is spherical in shape, as it enlarges a typical pear-shaped radiolucency between the maxillary lateral incisor and canine. The roots reveal divergence and the lamina dura of both teeth is intact.
Treatment: Enucleation and primary closure.

Nasopalatine Duct Cyst (Incisive canal cyst)

It arises from epithelial remnants within the nasopalatine canal, which connects the oral and nasal cavities in the embryonic stage.
Incidence: More in male, mostly seen in fourth to sixth decades.
Site: The cyst may arise at any point along the incisive canal, between the apices of the maxillary central incisors. *Cyst of the palatine papilla*, is another variant which is located solely within the soft tissues in the region of the incisive papilla, at the opening of the canal.
Clinical features: Majority is asymptomatic, it does not attain a very large size, beyond 1.5 to 2 cm. The common symptom is a recurrent swelling, on the labial aspect between the central incisors. Displacement of the teeth is common, the patients complain of swelling, pain and a 'salty taste'. Burning sensations or numbness may present, which is due to pressure exerted by the cyst on the nasopalatine nerves. The central incisors are vital.
Radiological features: The nasopalatine duct cyst is seen as a well-defined cystic outline, between or above the roots of the maxillary central incisor teeth. It can be round or ovoid, some may appear as heart-shaped. Kay (1972) reported that any radiograph of the fossa which showed a shadow less than 6 mm wide may be considered within normal limits as incisive canal fossa in the absence of specific symptoms. The roots of the central incisors may show divergence and an intact lamina dura around the tooth apices.
Cystic contents (Aspirate): Aspiration reveals viscous mucoid fluid or even pus if the cyst has been infected.
Treatment: Enucleation, by raising a palatal flap from canine to canine.

Solitary bone cyst

It is also termed as traumatic or hemorrhagic bone cyst.

Etiology: Mainly due to trauma and hemorrhage with failure of organization.

Incidence: It is uncommon lesion, occurs particularly in children and adolescents, males are more affected.

Site: Often seen in the long bones. It is rarely seen in the maxilla. The majority are seen in the subapical region, above the inferior alveolar canal, in the cuspid and molar region.

Clinical features: Usually symptomless and detected incidentally during a radiographic examination. The cortex is usually thinned but expansion occurs later on and may first involve the lingual aspect below the mylohyoid ridge and the associated teeth are vital.

Radiological features: The cyst appears as a unilocular cavity, with a characteristically scalloped outline to the border around the roots of the teeth. In the anterior region, the outline is usually regular and general shape is round or oval, with no indentations. The roots of related teeth may be displaced, lamina dura is intact.

Cystic contents (Aspirate): A deep yellow colored fluid or fresh blood may be obtained. Some cysts may be reported *empty.* It is suggested that they may contain gas such as nitrogen, oxygen and carbon dioxide.

Treatment: Surgical exploration is required for diagnosis and treatment. Gentle curettage stimulates hemorrhage which results in rapid obliteration of the defect and eventual healing by new bone formation.

Aneurysmal Bone Cyst

Often seen in the long bones and spine, it is rarely seen in the jaws.

Etiology: Mainly due to trauma, possible relationship with the giant cell lesion, or variation in the hemodynamics of the area.

Incidence: It is rare, there is no specific sex predilection. It is seen mainly in children, adolescents or young adults.

Site: More commonly seen in the posterior region of the mandible.

Clinical features: Firm swellings, rapid enlargement, and displacement of the teeth which are vital. Egg-shell crackling may be exhibited.

Radiological features: The lesions are usually unilocular, oval or spherical in shape, causing considerable ballooning of the cortex. At times internal ridges or incomplete septae may give a multilocular appearance described as *honey-comb* or *soap-bubble* appearance. Teeth may be displaced and root resorption. The outer cortical plate may be destroyed.

Cystic contents (Aspirate): Dark venous blood can be aspirated.

Treatment: Curettage is the choice of treatment, though, incomplete removal in large lesions is liable to result in recurrence.
Local excision with bone grafting has been suggested in very large lesions. Radiotherapy is contraindicated as it may result in the occurrence of post radiation sarcoma.

Stafne's Bone Cavity

Although, Stafne's bone cavity is not a cyst, it is included because of their clinical similarity to cysts of the jaw bones and the frequent difficulty in differential diagnosis.
Etiology: Stafne cavities may be due to failure of the normal deposition of bone during development of the jaws in an area formerly occupied by cartilage, or by a lobe of normal submandibular salivary gland.
Incidence: Relatively uncommon, the majority have been reported in males over 40 years of age.
Site: Below the inferior alveolar canal, mainly unilateral.
Clinical features: These are symptomless lesions discovered during routine radiological examination, the lesions are non-progressive.
Radiological features: The depression is rounded or oval, 1-3 cm in size, below the inferior alveolar canal, posterior to the mandibular first molar.
Cystic contents (Aspirate): Empty cavity will yield air
Treatment: No surgical intervention is required. Regular radiological follow-up is advised, as they constitute an area of weakness and pathologic fracture may occur.

Gingival Cysts

The only specific criterion for these lesions is its location in the gingival tissues. There are two types of gingival cysts:

Gingival Cyst of the Adult

Etiology: Arise from remnants of the dental lamina.
Incidence: It is relatively rare and has no sex predilection. It is known to occur in adults in the fifth or sixth decades.
Site: Occurs more frequently in the mandible than in the maxilla. They appear particularly in the canine and premolar region of the mandible.
Clinical features: The cysts are seen in the attached gingiva or the interdental papilla on the labial aspect. The lesions are painless, slow-growing swellings that have a smooth surface, may be of normal color or bluish. They are soft and fluctuant and the adjacent teeth are vital.

Treatment: Surgical excision is curative and there is no tendency for recurrence.

Gingival Cyst of Infants

Gingival cysts of infants are frequently referred to as Bohn's nodules or Epstein's pearls.

Etiology: The cysts arise from epithelial remnants of the dental lamina.

Incidence: Mainly seen in newborn infants, rarely seen after 3 months of age.

Site: *Bohn's nodules* are found on the buccal or lingual aspects of the dental ridges, whereas *Epstein's pearls* are seen along the mid-palatine raphe.

Clinical features: They appear as discrete white swellings. They may be single or multiple and clinically resemble a mucocele.

Treatment: No treatment is required as they rupture spontaneously on eruption of the underlying teeth.

Nasolabial Cyst

Nasolabial cyst is a true soft tissue fissural cyst that does not occur within bone.

Incidence: Uncommon lesions, mainly seen in the third to fifth decades of life and predominantly affects female.

Site: They are seen above the buccal sulcus under the ala of the nose, at the junction of the lateral nasal and the maxillary processes.

Clinical features: Majority of the cases are unilateral, the swelling is seen involving the lip, that lifts up the nasolabial fold and obliterates the labial sulcus. The cysts are fluctuant and painless unless infected secondarily.

Cystic contents: The cyst contains straw-colored or whitish mucinous fluid.

Treatment: The cyst should be enucleated surgically by an intraoral approach. Care should be taken while separating the cystic lining from the nasal mucosa.

Retention (Salivary Glands) Cysts

Mucocele

Two types of distinct entities described are, the true retention cyst which is lined by epithelium and the other is the mucous extravasation cyst which occurs because of the pooling of mucus, it does not have any epithelial lining and is surrounded by connective tissue.

Etiology: Mainly due to either obstruction of a salivary duct or trauma.

Incidence: Affect the minor salivary gland, no age or sex predilection. However, retention cysts occurred more frequently in older patients, whereas the extravasation cysts occur more commonly in the younger age group.

Site: Majority of mucocele are seen to affect the lower lip. However, they can occur anywhere in the oral cavity.
Clinical features: Small superficial, painless, well circumscribed swellings beneath the mucosa of lower lip. Often vary in size from 1 mm to 2 cm. In deep seated, fluctuation is positive. Color is variable, it may be translucent or bluish. The mucocele may rupture spontaneously with the liberation of a viscous fluid.
Treatment: Enucleation of mucocele is frequently followed by recurrences. They are best treated by surgical excision together with the associated minor salivary gland tissue and surrounding connective tissue. The mucosal margins are then undermined and sutured in apposition.

Ranula

Ranula is variant of a mucocele that is present on the floor of the mouth, beneath the tongue.
Two types have been identified: Superficial ranula and plunging ranula.
Etiology: It has been reported that the majority of ranula occur because of extravasation of mucous due to trauma to the excretory ducts of the sublingual salivary gland. In the plunging type, this extravasated mucus passes through the mylohyoid muscle and collects in the submandibular region.
Clinical features: A dome-shaped bluish swelling of a superficial ranula may be seen located laterally in the floor of the mouth beneath the tongue. The tongue may be raised or displaced as it enlarges. The swelling may cross the midline. At times, if the swelling is punctured or traumatized, a mucous secretion may be evident. In the 'plunging' type a fluctuant extraoral, submandibular swelling will be seen.
Treatment: Marsupialization results in recurrence. It is advisable to surgically remove the sublingual gland from an intraoral approach for both the superficial or plunging variety. This removes the secreting source and thereby avoids any recurrence.

Dermoid Cysts

The dermoid cyst is a form of cystic teratoma, which is lined by epithelium and in addition reveals the presence of skin appendages (hair, sebaceous glands, sweat glands). The epidermoid cyst is also lined by epithelium but does not contain any skin appendages.
Incidence: It is uncommonly seen. Age of occurrence is in young adolescents, however, there is no sex predilection.
Site: Dermoid are seen in the midline in the floor of the mouth above or below the geniohyoid muscle in the neck.

Clinical features: Those above the geniohyoid muscle, elevate the tongue, causing difficulty with mastication and speech. Those present inferior to the geniohyoid muscle, cause a submental swelling that has been described as a double chin. On palpation, a dough-like feel is appreciated

Treatment: Surgical excision is the best line of treatment. For cysts present in the floor of the mouth an intraoral approach. For very large cysts present inferior to the geniohyoid muscle, an extraoral approach.

General Principles of Treatment

Clinical Presentation (Summary of Signs/Symptoms)

- Before cyst expansion of the jaw is noticeable, most cysts are discovered accidentally on radiographs.
- In case of a smooth rounded expansion of the jaw bones, a cyst should be suspected until proved otherwise.
- Swelling and absence of a tooth from its place in the arch suggests the presence of a keratocyst or dentigerous cyst, particularly in the young.
- Presence of a carious, discolored, fractured or heavily filled tooth related to the swelling is suggestive of an apical periodontal cyst.
- Tilting of the crowns of the teeth suggests that their roots have been displaced by the expansion of a cyst/tumor.
- Infected cysts may present as painful, tender swellings and may already have discharging sinuses.
- Percussion of the teeth overlying a solitary bone cyst produces a dull or hollow sound.
- Dentigerous cysts are mainly associated with impacted third molars, canines and premolars.
- Solitary bone cyst is virtually assigned to the mandible above the inferior alveolar canal.
- Stafne's bone cavity is located beneath the inferior alveolar canal.
- Odontogenic keratocysts are most often seen in the lower third molar area and extending into the ramus.
- Large cysts usually deflect the neurovascular bundle, paresthesia and anesthesia is rare.
- Expansion of both cortical plates is generally indicative of a lesion, other than a cyst.
- Egg-shell crackling is a term used to describe the fragile outer shell of bone that has thinned out due to cyst expansion.

- Fluctuation is elicited when the cystic lining lies immediately beneath the mucosa.

Vitality of Teeth

- It is essential to perform preoperative and postoperative vitality tests on all teeth related to the cyst regardless of the treatment method.
- Teeth adjoining an odontogenic keratocyst, fissural cyst, solitary bone cyst and other non-odontogenic cysts will have vital pulps, unless there is coincidental disease of these teeth.
- Apical periodontal cysts are associated with nonvital tooth/teeth.

Radiographic Examination

- Periapical radiographs provide a clear and accurate image of small cystic lesions.
- Occlusal films of the maxilla, will disclose the amount of palatal bone destruction by a cystic process.
- An occlusal view of the mandible, reveals the expansion of the inner or outer cortical plates.
- Extraoral radiographs, provide the full extent of the cystic lesion and help in assessing the damage caused to the adjacent structures, e.g. oblique lateral views, panoramic radiograph, and posteroanterior mandible view helps to reveal both lateral and medial expansion of the ramus.
- Cyst in the maxillary sinus is best visualized in the occipitomental projection.
- CBCT scans may be helpful for precise assessment of large and multilocular lesions.
- In multilocular lesions, differential diagnosis of cyst with other lesions such as giant cell lesions, myxomas, hemangiomas and ameloblastomas should be considered.

Radiopaque Dyes

When the size and relations of a cyst are in doubt, its contents may be aspirated and radiopaque dye, e.g. lipiodol, triosil, can be injected prior to further radiography. Contrast medium is also useful to follow the progress of regression of a marsupialized lesion.

Aspiration

Aspiration is a valuable diagnostic aid, which may be helpful in distinguishing various cysts. Aspiration is done with a wide bore needle (18 gauge), 5- or 10-ml syringe. A failure to aspirate liquid usually means that a solid tumor is present.

Biopsy

The excised tissue sent to the pathologist for histopathological examination and to confirm the provisional diagnosis. Biopsy prior to surgery is generally advisable for large cystic lesions and when doubt exists.

Operative Procedures

Cysts of the jaws, may be treated by one of the following basic methods:

1.Marsupialization (decompression)

2. Enucleation

Marsupialization (Decompression)

Marsupialization refers to creating a surgical window in the wall of the cyst, and evacuation of the cystic contents. This process decreases intracystic pressure and promotes shrinkage of the cyst.

Indications:

1. Age: In a young child with developing tooth germs, enucleation would damage the tooth buds. In the elderly and in debilitated patient, marsupialization is less stressful and a reasonable alternative.
2. Proximity to vital structures: When proximity of the cyst to vital structures, could create an oronasal or oroantral fistula, injure neurovascular structures or damage vital teeth then marsupialization should be considered.
3. Eruption of teeth: In a young patient with a dentigerous or keratocyst, marsupialization will permit the eruption of the unerupted tooth or any other developing teeth that have been displaced.
4. Size of cyst: In very large cysts where enucleation could result in a pathological fracture, marsupialization can be accomplished through a more limited bony opening.
5. Vitality of teeth: When the apices of many adjacent erupted teeth are involved within a large cyst, enucleation could loss the vitality of these teeth.

Advantages:

1. Simple procedure to perform and reduces operating time.
2. Preserve vital structures and prevents oronasal and oroantral fistulae.
3. Alveolar ridge is maintained and allows eruption of teeth.
4. Helps shrinkage of cystic lining and prevents pathological fracture.
5. Allows for endosteal bone formation to take place.

Disadvantages:

1. Pathologic tissue is left in situ.

2. Histologic examination of the entire cystic lining is not done.
3. Prolonged healing time and prolonged follow-up visits.
4. Periodic changing of pack, periodic irrigation of cavity.
5. Inconvenience to the patient.
6. Secondary surgery is needed.
7. Formation of slit-like pockets that may harbor of food accumulation.

Surgical technique

• Anesthesia: simple local anesthesia of the area or administration of general anesthesia.

• Incisions: A circular, oval or elliptic incision can be taken, 1 cm or larger in size leaving a margin of 0.5 to 1 cm from the gingival margins of the teeth or alveolar crest in the edentulous patient.

Alternatively, an inverted U-shaped incision can be taken with a broad base toward the buccal sulcus, the mucoperiosteum is then reflected in this case.

• Removal of bone: When the bone is expanded and thinned out, the initial incision can be extended through the mucoperiosteum, bone and cystic lining into the cystic cavity. When the overlying bone is thick, bur holes are drilled in a circular shape to made a window buccally.

• Removal of cystic lining specimen: The cystic lining is then removed by a scalpel through the lining against the bone edge, the specimen of lining is then sent for histopathological examination.

• Irrigation of the cystic cavity with normal saline.

• Suturing: The remaining cyst lining is sutured with the edge of the oral mucosa by continuous sutures or interrupted sutures. Alternatively, when a U-shaped incision is taken, then the mucoperiosteal flap which is based on the buccal sulcus can be turned into the cyst cavity covering the margin. The remaining cyst lining is sutured to the oral mucosa.

• Packing: The cavity is then packed with a half or one inch width ribbon gauze, which may be impregnated with an antibiotic ointment, White head's varnish or tincture of benzoin. The pack helps to prevent contamination of the cavity with food debris and also provides coverage of the wound margins. With the help of a non-toothed forceps, the ribbon gauze is first laid along the floor of the cavity and is then inserted running from side to side. All packs are generally secured by sutures. The pack is left in-site for 7 to 14 days. By the end of 2 weeks, the junction between the lining of the cyst and the oral mucosa around the periphery of the window will have healed.

• Maintenance of cystic cavity: Careful instructions are given to the patient regarding cleansing and irrigation of the cavity by regular flushing with an oral antiseptic rinse, preferably with a disposable syringe.
• Use of plug: A plug may be designed to prevent the contamination of the cystic cavity and preserve the patency of the cyst orifice. The cavity may or may not obliterate totally.

Enucleation

Completely removes the whole cyst with its capsule. It allows for the cystic cavity to be covered by a mucoperiosteal flap and the space fills with blood clot, which will eventually organize and form normal bone.

Indications:

For removal of the entire cyst that can be safely removed without unduly damaging adjacent structures.

Advantages:

1. Primary closure of the wound.
2. Healing is rapid and postoperative care is reduced.
3. Thorough examination of the entire cystic lining can be done.

Disadvantages:

1. In young persons, the unerupted teeth in a dentigerous cyst will be removed with the lesion.
2. Removal of large cysts will weaken the mandible, making it prone to jaw fracture.
3. Damage to adjacent vital structures.
4. Pulpal necrosis.

Surgical techniques:

1. Enucleation and packing:

This technique is advocated in infected large cysts, in which a primary closure would be unsuccessful as it could lead to a breakdown of the wound; or where there is difficulty in approximating the wound edges. In such instances, enucleation is performed and then the cavity is packed as in marsupialization. The wound heals with granulation tissue until epithelization is complete. This method is also used as a secondary measure, when there is a dehiscence after primary closure.

2. Enucleation with primary closure:

•Enucleation of small cystic lesions from an intraoral approach:

Surgery can be performed under local anesthesia, conscious sedation or general anesthesia by an intraoral approach. Depending upon the location of the cyst, incision is placed buccally or palatally followed by flap reflection. Bone is then removed to expose the underlying cystic lesion. In some instances, a window in the

bone may already exist, this is expanded with the help of a rongeur. In cases where the bone is intact a broad opening is made with the help of bone burs. The underlying cyst lining is now gently eased away from the cavity wall using curettes. The instrument is applied in such a manner that the convex surface faces the cystic lining. Care should be taken to prevent rupture of the lining. Alternately, the cystic contents can be aspirated, so that the size of the sac shrinks and visibility improves. Teeth that required to be removed are now extracted. In case of endodontically restored teeth, retrograde apicoectomy is done. Root apices other than planned, if they get exposed during surgery may later require to be filled endodontically. The cyst cavity is then inspected, any residual remnants are excavated. The cavity may be left to heal or various filling materials have been recommended for packing to obliterate the cavity prior to closure, e.g. resorbable sponge, hydroxyapatite crystals, autogenous bone chips, allogeneic bone graft, etc. The flap is now replaced and the wound closed by suturing.

•Enucleation of large, inaccessible mandibular lesions from an extraoral approach:

Large cystic lesions like the keratocysts and the dentigerous cysts that involve the ascending ramus, body and angle mandible are best accessible from an extraoral approach.

Surgery is performed under general anesthesia. Injection of local anesthesia with vasoconstrictor of 1:100,000, this helps in local hemostasis. A submandibular incision, is done 1.5 to 2 cm below the inferior border of the mandible. The incision extends through skin and subcutaneous tissues. Blunt dissection is carried out through tissue planes, i.e. superficial cervical fascia, platysma and deep cervical fascia. Care is taken to salvage the marginal facial nerve, and facial artery and vein are clamped and ligated.

Small bleeders are cauterized with a diathermy. The pterygomasseteric sling is divided, the periosteum is incised down to bone and the flap is raised superiorly to expose the underlying bone. Commonly, a bony window already exists, which is then enlarged as described earlier. If not, a suitably sized window is created with bone burs to expose the underlying cystic lining.

Depending upon the extent of the cystic lesion and involvement of surrounding tissues, the surgical procedure of enucleation or marginal resection is performed. The tissue is sent for histopathological examination.

The wound is then inspected. Any remnants of tissue are curetted out as the cystic lining is often thin and easily fragmented. A sharp curette or a bone bur, e.g. round bur with constant normal saline irrigation is used to remove 1 to 2 mm layer of bone around the complete periphery of the cyst cavity wall.

Carnoy's solution (60% ethanol, 30% chloroform and 10% glacial acetic acid, 1g of ferric chloride) used as a complementary treatment after the conservative

enucleation of keratocysts. The application of this solution promotes a superficial chemical necrosis which reduce the recurrence rate of keratocysts. The cavity is then cleansed and closed in layers. In very large cysts beyond 4 to 5 cm in size, it is advisable to maintain a vacuum drain in place through the submandibular skin where it is fixed in place. This helps to reduce the dead space and prevents hematoma formation. Deeper layers are sutured with absorbable sutures, skin is approximated with interrupted sutures. Subcuticular sutures done for an esthetic area. The drain is left in place for 48 to 72 hours.

•Enucleation and primary closure with reconstruction/bone grafting:

In large cystic lesions that have perforated and destroyed the cortical plates and inferior border of the mandible that is beyond salvage. It is advisable to reconstruct primarily with a stainless steel or titanium reconstructive plate. Occasionally, autogenous bone grafts, e.g. iliac crest or costochondral grafts can be used for reconstruction procedures, replacing the lost bone. A water-tight closure has to be achieved both intra and extraorally. Intermaxillary fixation (IMF) is necessary to help provide immobilization during the healing phase for 4 to 6 weeks.

Complications of cystic lesions

1. Pathological fracture.
2. Postoperative wound dehiscence.
3. Loss of teeth vitality.
4. Neuropraxia in infected cysts.
5. Postoperative infection.
6. Recurrence in some cysts.
7. Dysplastic, neoplastic or even malignant changes.