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# *Review about Cyst in Oral and Maxillofacial region*

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كلية طب الأسنان

# قسم جراحة الفم

# *Cyst in Oral and Maxillofacial region*

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# شكر وتقدير

الحمد لله العزيز الكريم الذي منَّ علينا إتمام هذا العمل المتواضع والصلاة والسلام على خير خلق الله سيدنا محمد وعلى آله وصحبه وسلم وصدق الله العظيم إذ يقول وقوله الحق:

" وَلَا تَنسَوُا الْفَضْلَ بَيْنَكُمْ ۚ إِنَّ اللَّهَ بِمَا تَعْمَلُونَ بَصِيرٌ"

(البقرة/ آية ٢٣٧)

وإنَّه ليتوجب علينا إزاء هذا الفضل أن نخُصَّ بالشكر والعرفان الدكتور (علاء عباس مهدي) لإشرافه على هذا العمل المتواضع وعلى ملاحظاته الدقيقة الذي لولاه ما أُنجز هذا العمل اذ كان العونُ الكبير وفاض علينا من كرم علمه ما يعجز القلم عن الوصف جزاه الله علينا خير الجزاء وله منَّا جزيل الشكر والاحترام.

وشكرنا الموصول الى اساتذتنا الافاضل الذين نهلنا منهم طوال سنوات الدراسة ونتمنى لهم العمر المديد ووافر الصحة والعافية.

بسم الله الرحمن الرحيم

"وَنُنَزِّلُ مِنَ الْقُرْآنِ مَا هُوَ شِفَاءٌ وَرَحْمَةٌ لِّلْمُؤْمِنِينَ"

(سورة الإسراء/آية ٨٢ )

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## Odontogenic Cysts

An odontogenic cyst is a pathological, epithelial-lined cavity containing fluid or semi-fluid, which arises from the epithelial remnants of tooth formation.(Nayyer et al., 2015)

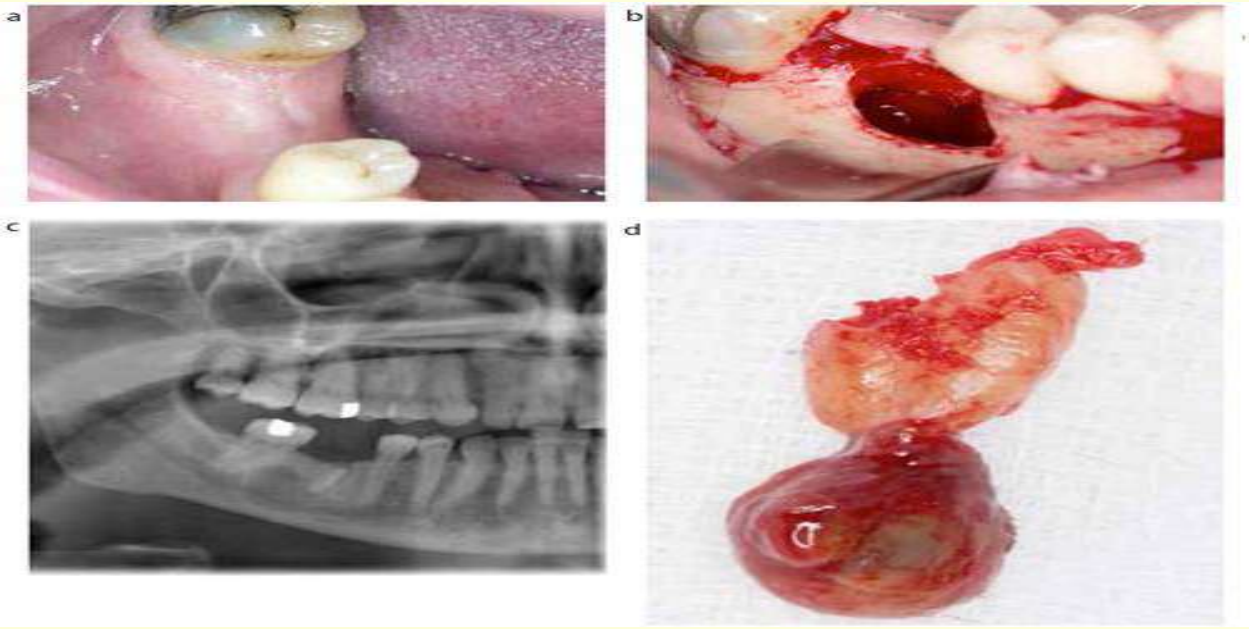
The 1992 World Health Organization (WHO) classification of odontogenic cysts is widely recognized and categorizes them as developmental or inflammatory in nature. (Nayyer et al., 2015)

Odontogenic cysts are often asymptomatic and therefore may expand to a large size before any clinical signs are noted and, as such, their presence is often an incidental finding on radiographic examination. These cysts may become increasingly obvious clinically as they increase in size, initially creating a bony hard swelling. As this gradually and slowly enlarges, the bony covering becomes increasingly thin, which clinically may be demonstrated on palpation by the classic 'egg shell cracking' as the thin bone gives way. As the lesion expands beyond its bony confines, it then becomes a fluctuant swelling. The slow expansion of the cyst usually causes displacement of related structures, such as the inferior alveolar bundle in the mandible and thus altered sensation is not a common feature of mandibular cysts. When altered sensation occurs, it can be an indication of infection or pathology that is more aggressive.(Nayyer et al., 2015)

The pathogenesis for the development and expansion of cysts is often debated and the authors aim to give a brief outline of this.

There is a myriad of cyst-like lesions, which can manifest in the jaws. These include odontogenic tumors, such as ameloblastomas (Figure.1) and osteolytic lesions, such as metastatic cancer. Therefore, careful diagnosis and treatment planning of these lesions is essential.

**Figure 1**. Ameloblastoma affecting right mandible.




**Enulceation of radicular cyst: (a) no clinical evidence of pathology; (b) cyst cavity following surgical removal of retained LR6 root and enucleation of associated lesion; (c) evidence of corticated radiolucency associated with retained root of LR6; (d) extracted root of LR6 with associated radicular cyst attached to apex.(Nayyer et al., 2015)**

Further investigations are often required to establish a definitive diagnosis. For example, sensibility testing can be useful, particularly in the diagnosis of a radicular cyst. Radiographic imaging plays a significant role in determining features, which can aid diagnosis. While plain radiographic films are useful, the advances in cone beam computed tomography (CBCT) have allowed for greater detailed imaging of, not only the lesion, but also the surrounding structures.2 Biopsies of the cyst lining allows for a definitive diagnosis prior to appropriate treatment planning in extensive lesions and this is essential where the diagnosis is unclear. Aspiration of cyst contents can be carried out and visual inspection can give an indication of what type of lesion is present. Electrophoresis is rarely carried out on cyst contents (Nayyer et al., 2015).

**Pseudo Cysts**: tissues that are not lined by epithelium are the mucous extravasation cyst of the salivary glands, the aneurysmal bone cyst and the solitary bone cyst. Despite these examples, most pathologists prefer to describe those pathological cavities not lined by epithelium as "pseudo cysts(Shear and Speight, 2008).

## Odontogenic cysts of inflammatory origin

This group of lesions result from the proliferation of epithelium due to inflammation. The most common is the radicular cyst in which the source of inflammation is apical periodontitis following the death of a tooth and necrosis of the pulp. The source of the epithelium in the collateral cysts remains a matter of some debate (Nayyer et al., 2015)

## Cyst Formation

Two phases have been recognized in the pathophysio logy of cystic lesions

• Cyst initiation-which results in the proliferation of the epithelial lining and the formation of a small cavity.

• Enlargement or expansion of this cystic cavity then occurs.

These processes have been clearly defined for epithelium lined cysts, where the initiation is different for each group of cysts, the enlargement process is most likely similar for all epithelium lined cysts, though there may be some variations in the mode of enlarge ment. Regarding, the bone cysts, little information is available for certain, about their origin and mode of enlargement (Borle, 2014)

## Cyst Initiation

The stimulus for the phenomenon of cyst initiation is not known, other than the inflammatory odontogenic cysts, where clearly it is the infection that is considered as the precipitating factor that results in cystic initiation. In others, it is possible that there is a predisposition in some individuals to form cysts from developing odontogenic epithelium, i.e. from the following:

- Dental lamina and its remnants.
- Enamel organ.
- Extensions of basal cells from the overlying oral epithelium.
- Reduced enamel epithelium.
- Cells rests of Molasses,etc.

Whatever may be the precipitating factor in the initiation of the cystic lesion, it is followed by cyst for mation, the factors responsible for which are as follows:

- Proliferation of the epithelial lining
- Fluid accumulation within the cyst cavity and Bone resorption.(Borle, 2014)

## Cyst Enlargement

Once cyst formation has been initiated, it continues to grow and enlarge, irrespective of its type and its origin. Following mechanisms have been forwarded, regarding enlargement of cystic lesions :-

- Increase in the volume of the contents.
- Increase in the surface area of the sac or epithelial proliferation.
- Resorption of the surrounding bone and at times
- Displacement of the surrounding soft tissues.

**Secretions** Mucus secreting cyst, where the lining is mucus secreting, an accumulation of mucus explains the increase in volume.

Transudation and exudation Inflammatory cysts or the presence of infection Inflammatory cells, which are commonly present in the capsule, release cofactors, lymphocytes release the lymphokine,osteoclast acti vating factor (OAF) and monocytes release interleukin I which stimulates the fibroblasts to release the prosta glandins. These epithelial cells breakdown products produce a-hyperosmolar cyst fluid (Borle, 2014)

• Increased hyperosmolarity, further draws in the fluid from the surrounding tissues, as the cyst wall is a semipermeable membrane: thus, the increased hydrostatic pressure, which is much dependent on the type of cystic lining, its permeability and the cystic contents causes cystic enlargement.

• Increased osmolarity of the cyst fluid may play a role in its enlargement, osmotic differences between the serum and cystic fluids is related to the proteins pre sent within the cystic fluid, such as large molecules of globulins, albumin, fibrinogen and fibrin degradation products, which are responsible for the increase in osmotic pressure of a cyst, which in turn results in cystic expansion(Borle, 2014).

## Epithelial Proliferation

Mural growth in the form of epithelial proliferation, is one of the essential processes by which the surface area of the sac increases, basically by peripheral cell division or by accumulation of cellular contents.

A multicentric pattern of cyst growth brought about by the proliferation of local groups of epithelial cells as in the keratocysts, results in cystic expansion

• Collagenase activity in some cysts such as the primordial and radicular cysts by way of increased collagenolysis could result in cyst expansion

Unremitting growth of certain epithelial linings due to high mitotic values as in keratocysts plays a role in cystic enlargement.

• Presence of low grade infection stimulates cells such as the cell rests of Malassez to proliferate and form arcades. The number of epithelial layers is then determined by the period of viability of each cell and the rate of maturation and desquamation (Borle, 2014)

## Bone Resorption

As the epithelial cells divide, the cyst is able to enlarge within the rigid bony cavity by the release of bone resor bing factors from the capsule, which stimulate osteoclast function, e.g. prostanoids like PGE, and PGI, and certain leucotrienes. Differences in the sizes of various cystic lesions could possibly be dependent upon the quantity of release of prostaglandins and other bone resorbing factors (Borle, 2014)

## Cyst Regression

Any process that leads to the involution of the cyst epithelium, e.g. extraction of the necrotic tooth or conversion of the epithelial lining to oral mucosa and reduction of intracystic pressure as with marsupiali zation may cause the connective tissue capsule to regress and the cavity to be filled by bone or scar tissue (Borle, 2014)

## A classification of the Odontogenic cyst (Martin and Speight, 2017)

### Odontogenic cysts of inflammatory origin

- Radicular cyst
- Residual cyst

### Inflammatory collateral cysts

- Paradental cyst
- Mandibular buccal bifurcation cyst

### Odontogenic & non-odontogenic developmental cysts

- Dentigerous cyst
- Eruption cyst
- Odontogenic keratocyst

Lateral periodontal cyst

- Botrytis Odontogenic cyst
- Gingival cysts
- Gingival cysts of adults
- Gingival of infants (alveolar cyst)
- Glandular odontogenic cyst
- Calcifying odontogenic cyst
- Orthokeratinised odontogenic cyst

## Radicular cyst

Radicular cysts are the most common jaw cyst comprising about 60% of all odontogenic cysts.Chronic inflammation in the periradicular tissues results in a periapical granuloma and stimulates proliferation of the epithelial rests of Malassez. This is followed by central degeneration and necrosis to produce a cavity that becomes lined by epithelium. Cyst expansion then occurs due to hydrostatic pressure as debris accumulates centrally. Radicular cysts are always associated with a non-vital tooth, and this is an important diagnostic criterion for radiolucent lesions at the apex of the teeth (Martin and Speight, 2017)

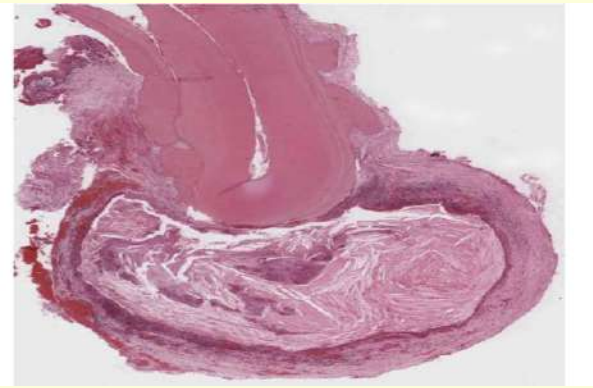


**Figure 2. Radicular and residual cyst**

## Residual cysts

Residual cysts are radicular cysts that remain in the jaws after extraction of the affected tooth. The histopathological features are similar in both lesions .However, as the source of inflammation has been removed, the wall of a residual cyst may mature and become relatively uninformed and the epithelial lining becomes thin and regular .In these cases they may be mistaken for developmental odontogenic cysts, but radiological examination and the clinical history can determine that they are located at a site of a previous tooth extraction. Treatment of radicular and residual cysts is by simple enucleation (Martin and Speight, 2017, Chi et al., 2017)

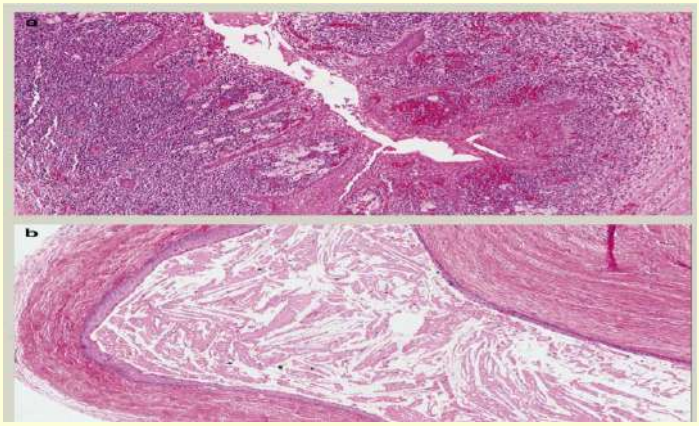


**Figure 3. The epithelial lining of radicular cysts. (a) The lining is typically hyperplastic with branching arcading rete pegs. Chronic inflammatory cells including numerous histocytes are seen in the wall. (b) Low power image of a residual cyst with uninflamed wall and thin epithelial lining (Martin and Speight, 2017)**

## Inflammatory collateral cysts

Collateral cysts occur on the lateral, usually buccal, aspect of a partially erupted vital tooth and comprise about 5% of odontogenic cysts. The aetiopathogenesis of these lesions is uncertain and there is some controversy regarding their classification. They most frequently occur in the posterior mandible associated with partially erupted

mandibular third molars (wisdom teeth) where they are usually called paradental cysts.The inflammatory stimulus is therefore pericoronitis, but the source of epithelium is uncertain.

Inflammatory collateral cysts are divided into two main types. About 60% are associated with partially erupted lower third molars and are called **paradental cysts.** Most of the remainder (over 35%) occur in children, usually at the buccal aspect of an erupting first molar, and are now called **mandibular buccal bifurcation cysts**. Rarely, collateral cysts may arise in association with partially erupted teeth at other(Martin and Speight, 2017)

## Developmental odontogenic cysts

Odontogenic cysts with a developmental aetiology occur with no obvious clinical cause. Many of the developmental cysts show overlapping histopathological features, and a diagnosis may only be reached after careful consideration of clinical and radiographic evidence, particularly in the presence of secondary inflammation(Martin and Speight, 2017).

## Dentigerous and eruption cyst

Dentigerous cysts embrace the crown of an unerupted tooth and are lined by epithelium that derives from the reduced enamel epithelium. Dentigerous cysts are the most common developmental odontogenic cyst comprising almost 20% of all odontogenic cysts and 60% of developmental odontogenic cysts.In paediatric populations they account for 30% of the total number. Overall, dentigerous cysts are most frequently encountered in association with impacted third molar (wisdom) teeth, but their distribution is, not surprisingly, directly comparable to the frequency of impacted teeth. The most common type of dentigerous cyst develops around the crown of an unerupted, impacted tooth and attaches to it at the cementoenamel

junction. The second type overlies an erupting tooth and is called an **eruption cyst**. These are most frequently found overlying deciduous incisors or first permanent molars (Martin and Speight, 2017).

Dentigerous cysts are usually enucleated and the associated tooth removed. Eruption cysts however can be treated conservatively by simple marsupialisation, and the associated tooth may then erupt normally(Chi et al., 2017).

**Figure 4. Dentigerous cyst**

## Odontogenic keratocyst

The term " odontogenic keratocyst " (OKC) was first used in the 1950s to describe any odontogenic cyst in which keratin had formed Subsequently, however, it became apparent that keratinization was quite often seen in a range of jaw cysts and the term keratocyst became reserved for a specific cyst type with a range of features which distinguish it as a distinctive entity. The odontogenic keratocyst thus appeared in both the 1st (1971) and 2nd (1992) editions of the WHO classifications. The OKC is the third most common odontogenic cyst (Martin and Speight, 2017, Chi et al., 2017)

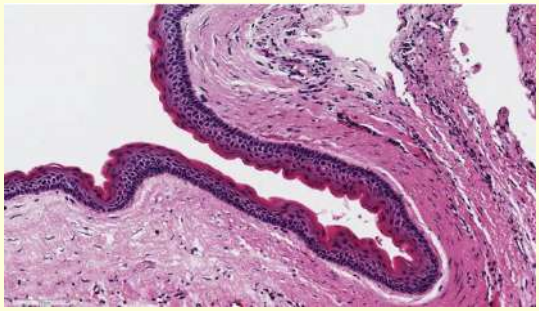


**Figure 5. Odontogenic keratocyst**

An autosomal dominant inherited condition that exhibits high penetrance and variable expressivity. The syndrome is caused by mutations in **patched** *(PTCH)*, a tumor suppressor gene that has been mapped to chromosome 9q22.3-q31. Approximately 35% to 50% of affected patients represent new mutations. One of the most common clinical features is development of OKCs, which can lead to early diagnosis. The prevalence of Gorlin syndrome is estimated to be anywhere from 1 in 19,000 to 1 in 256,000 depending on the population studied.

## Major Clinical Features of the Nevoid Basal Cell Carcinoma Syndrome :

**50% or Greater Frequency**

- Multiple basal cell carcinomas
- Odontogenic keratocysts (OKCs)
- Epidermal cysts of the skin
- Palmar/plantar pits
- Calcified falx cerebri
- Enlarged head circumference
- Rib anomalies (splayed, fused, partially missing, and/or bifid)
- Mild ocular hypertelorism
- Spina bifida occulta of cervical or thoracic vertebrae

15% to 49% Frequency

- Calcified ovarian fibromas
- Short fourth metacarpals
- Kyphoscoliosis or other vertebral anomalies
- Pectus excavatum or carinatum
- Strabismus (exotropia)

**Less than 15% Frequency (but Not Random)**

- Medulloblastoma

• Meningioma

• Lymphomesenteric cysts

• Cardiac fibroma

• Fetal rhabdomyoma

• Marfanoid build

• Cleft lip and/or palate

• Hypogonadism in males

• Intellectual disability

**A diagnosis can be made if the patient has**

1. Two major criteria

2. One major and two minor criteria

3. One major criterion and genetic confirmation

**Major Criteria**

1. Five or more basal cell carcinomas or one before the age of 30 years

2. Odontogenic keratocyst (OKC)

3. Lamellar calcification of the falx cerebri

4. Two or more palmar or plantar pits

5. First degree relative with the nevoid basal cell carcinoma Syndrome

**Minor Criteria**

1. Macrocephaly

2. Congenital malformation: Cleft lip or palate, frontal bossing, coarse facial features, and/or hypertelorism

3. Preaxial or postaxial polydactyly

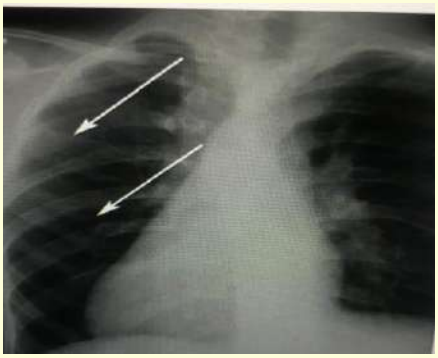
4. Rib or vertebral abnormalities: bifid, splayed, or extra ribs, bifid vertebrae

5. Ovarian or cardiac fibromas

6. Medulloblastoma

7. Ocular anomalies: Cataract, coloboma, and/or microphthalmia

8. Lymphomesenteric or pleural cysts



**Lateral periodontal cyst and botryoid odontogenic cyst (Chi et al., 2017)**

Lateral periodontal cysts arise in association with the lateral surface of a tooth root. They are usually asymptomatic and found as incidental radiographic findings, where they appear as a well demarcated corticated radiolucency usually about 5 mm in diameter. They account for just 0.4% of odontogenic cysts, and are found predominantly in the mandibular premolar area, followed by the anterior maxilla.

The lateral periodontal cyst is lined by a simple stratified squamous epithelium, but may also show characteristic epithelial plaques or thickenings with whorling of the epithelial cells, often with clear cell change

The botryoid odontogenic cyst (BOC) is a multilocular variant of the lateral periodontal cyst, which presents in similar sites, favouring the premolar mandibular region and anterior maxilla. The BOC differs somewhat from the lateral periodontal cyst due to its larger size and multicystic nature, often with a multilocular appearance on radiographs. Histologically BOC show multiple cystic spaces lined by thin non-keratinised stratified squamous epithelium, with occasional plaque-like thicken- ings (Figure 4). Lateral periodontal cysts rarely recur after simple enucleation, but the multicystic nature of BOC results in a ten dency to recur, with a reported recurrence rate of 40%, likely due to incomplete removal, and long term follow-up is recommended after surgical excision.(Martin and Speight, 2017)

## Gingival cysts

Gingival cysts are derived from remnants of the dental lamina (rests of Serres) in the gingival or alveolar soft tissues. They may arise in adults or in infants. Gingival cysts of adults are uncommon and are frequently confused with the lateral periodontal cyst. Most are found on the mandibular attached gingivae as small (<1 cm) pink or bluish sessile swellings. Histological examination shows a thin lining of stratified squamous epithelium supported by an uninflamed wall of fibrous connective tissue. Gingival cysts of infants are common and may arise in as many as 90% of neonates. They present as small yellow or cream nodules on the edentulous alveolar mucosa and are often referred to as Bohn’s nodules. Similar small cysts also develop on the palate of neonates and are called Epstein’s pearls, but these are not odontogenic. No treatment is required as these cysts naturally degenerate or fuse with the overlying surface epithelium and expel their contents(Martin and Speight, 2017)

## Glandular odontogenic cyst

The glandular odontogenic cyst (GOC) is a rare lesion, accounting for just 0.2% of all odontogenic cysts.The lesion is important however, because it shares features with lateral periodontal and botryoid odontogenic cyst, but may also resemble central (intraosseous) mucoepidermoid carcinoma. Eighty percent occur in the mandible, particularly in the anterior region, and they may reach a large size with erosion of the cortical plates. The GOC shows a variety of histological features, but is typically multilocular with an uninflamed fibrous wall lined by epithelium with variable appearances. Microcysts or duct-like structures, which often contain mucus are common and most lesions also show plaque like thickenings or spheres, with whorling of the epithelial cells, similar to the lining of lateral periodontal or botryoid cysts .

A characteristic feature is the presence of superficial eosinophilc columnar cells, sometimes called “hob- nail’ cells which, although not specific are seen in all lesions and are considered necessary for the diagnosis. Studies have shown that the GOC has a high recurrence rate and multiple recurrences are not unusual. This behaviour and the histological features of a cystic lesion with squamous and mucous elements may lead to confusion with intraosseous mucoepidermoid carcinoma and it has been suggested that GOC and mucoepidermoid carcinoma may be part of the same spectrum or that mucoepidermoid carcinoma may arise from GOC(Martin and Speight, 2017, Chi et al., 2017)

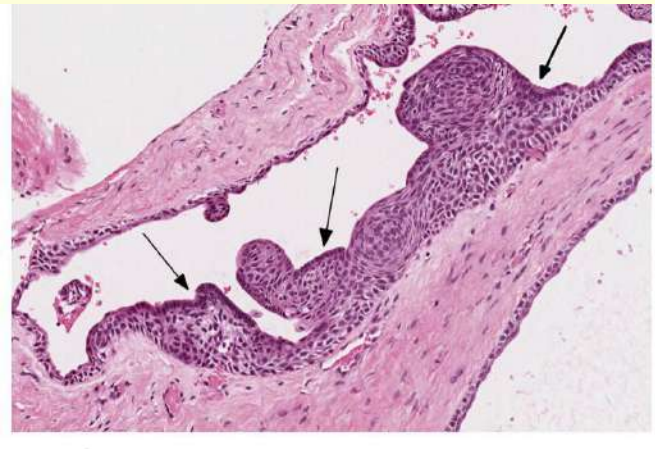


**Figure 6.** **Glandular odontogenic cyst**

## Calcifying odontogenic cyst (Chi et al., 2017)

Calcifying odontogenic cyst (COC) is a member of the "ghost cell family" of odontogenic lesions, the classification of which has always received much debate. The 2nd edition of the WHO classification regarded these cystic lesions as non-neoplastic, but also described a solid variant with ameloblastomatous proliferations, which they regarded as a true neoplasm and called dentinogenic ghost cell tumour. In the 2005 WHO classification5 these two lesions were described as separate entities, and the calcifying odontogenic cyst was redesignated as a neoplasm and was renamed calcifying cystic odontogenic tumour (CCOT). However no evidence for a neoplastic origin has ever been presented, and in a detailed multicentre review of ghost cell lesions and their terminology Ledesma-Montes et al.19 showed that over 85% of "CCOTs" are simple cysts either alone (65%) or associated with odontomes. There seems, therefore, to be good evidence that simple cystic lesions should be regarded as developmental cysts, which arise alone or in association with other developmental lesions, especially odontomes .

The solid lesions, which show ameloblastomatous proliferations and may recur, are still regarded as neoplasms and are classified among the odontogenic tumours

## Orthokeratinised odontogenic cyst

First described in 1981 the orthokeratinised odontogenic cyst (OOC) is an uncommon developmental cyst, which has always been regarded as a variant of OKC. Although OOC has a similar clinical presentation to OKC, it is histologically distinct, with prominent orthokeratinisation, and a flattened basal cell layer without evidence of palisading or reversal of nuclear polarity. They are unilocular without epithelial pro- liferations or satellite cysts. There is no recorded case of OOC occurring with the naevoid basal cell carcinoma syndrome and, unlike OKC, the lesions very rarely recur even following simple enucleation. OOC has now finally been recognised as a distinct entity under the new WHO Classification (Martin and Speight, 2017)

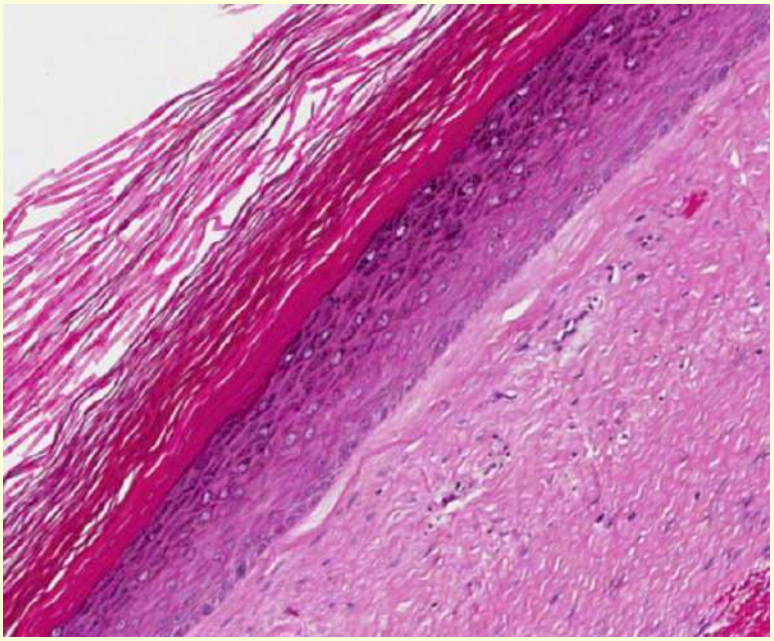


**Figure 7. Orthokeratinised odontogenic cyst**

## Patient history

The importance of an accurate, detailed history cannot be overemphasized because it provides the framework on which the clinician builds an accurate diagnosis and treatment plan. An inaccurate or incomplete evaluation may lead to a delay in treatment, unnecessary testing, or misdiagnosis (Andersson et al., 2012))

**Questioning of the patient who has a pathologic condition should include the following:**

1. **How long has the lesion been present?** The duration of a lesion may provide valuable insight into its nature. For instance, a lesion that has been present for several years might be congenital and is more likely benign, whereas a rapidly developing lesion is considered more ominous.
2. **Has the lesion changed in size?** A change in the radiographic or clinical size of a lesion, or both, is an important piece of information that the dentist must determine. An aggressive, enlarging lesion is more likely to be malignant, whereas a slower-growing lesion suggests a possibly benign lesion.
3. **Has the lesion changed in character or features (e.g., a lump becoming an ulcer or an ulcer start as a vesicle)?** Noting changes in the physical characteristics of a lesion can often assist in the diagnosis. For example, if an ulcer began as a vesicle, it could suggest a localized or systemic vesiculobullous or viral disease.
4. **What symptoms are associated with the lesion (e.g., pain, altered function, anesthesia or paresthesia, abnormal taste or odors, dysphagia, or tenderness of cervical lymph nodes)?** If painful, is the pain acute or chronic, constant or intermittent? What increases or decreases the pain? Lesions with an inflammatory component are most often associated with pain.

5. **the mouth or in the parapharyngeal tissues**. Swelling can often result from and occur with oral lesions, indicating an expansile process from any of a number of causes, including inflammation, infection, cysts, or tumor formation. The patient may indicate feeling a sensation of fullness even before the doctor can actually visualize or verify the swelling during clinical examination. Painful lymph nodes usually indicate an inflammatory or infectious cause but may also be a manifestation of malignancy.
6. **What anatomic locations are involved?** Certain lesions have a predilection for certain anatomic areas or tissues. Noting whether the lesion is confined to keratinized or nonkeratinized tissues, regions with salivary gland tissues, or areas of neural or vascular anatomy can sometimes provide clues to the diagnosis.
7. **Are there any associated systemic symptoms (e.g., fever, nausea, or malaise)?** Has the patient noted any similar or concurrent changes elsewhere in the body or had similar lesions in the oral or perioral tissues in the past? The dentist should look for possible relationships or manifestations from related systemic diseases or conditions.
8. **Is there any historical event associated with the onset of the lesions (e.g., trauma, recent treatment, exposure to toxins or allergens, or visits to foreign countries)?** One of the initial steps the dentist should take when a lesion is noted is to seek a possible explanation based on the patient's medical, dental, family, or social histories. Frequently, oral and perioral lesions can be caused by parafunctional habits, hard or hot foods, application of medications not intended for topical use, recent trauma, conditions involving the dentition (e.g., caries, periodontal disease, or fractured teeth), or an identified event or exposure (Hupp et al., 2013)

## Clinical and radiographic feature of cyst

Most jaw cysts behave similarly and usually grow slowly and expansively. They differ mainly in their relationship to a tooth, and the radiographic features, site, size, morphology, symptom, consistency are usually a good guide as to their nature. However, it is particularly important to distinguish between cyst.These occasionally have identical radiographic appearances, and diagnosis ultimately depends on histopathology. Typically, patients with **periapical cysts** have no symptoms unless there is an acute inflammatory exacerbation. In addition, if the cyst reaches a large size, then swelling and mild sensitivity may be noted. Movement and mobility of adjacent teeth are possible as the cyst enlarges. The tooth from which the cyst originated does not respond to thermal and electric pulp testing. The radiographic pattern is identical to that of a periapical granuloma. Cysts may develop even in small periapical radiolucencies, and the radiographic size cannot be used for the definitive diagnosis. A loss of the lamina dura is seen along the adjacent root, and a rounded radiolucency encircles the affected tooth apex (Cawson and Odell, 2017) (Chi et al., 2017).

**Figure 8. Per apical Cyst. Radiolucency associated with the maxillary central incisor, which exhibits significant root resorption**

**Lateral periodontal cysts** are usually asymptomatic and identified radiographically between the roots of teeth, often in the mandibular canine and premolar area. The adjacent teeth are vital and the cysts are thought to arise from the cell rests within the periodontal ligament(Chi et al., 2017)

While the **dentigerous or follicular cysts** account for approximately one sixth of dental cysts. They are a fluid filled expansion of the dental follicle and are attached to the crown of the tooth at the cemento enamel junction. As the cyst expands it prevents the eruption of the tooth and may even displace the tooth into the jaw. The most commonly involved teeth are the mandibular third molar and maxillary canine. Dentigerous cysts are more common in men than women and usually these cysts present as an asymptomatic swelling, found when non-eruption of a tooth is investigated or incidentally with panoramic survey radiographs. Infection is uncommon, but it may present as a dentoalveolar or facial abscess. Radiographically, a circumscribed, unilocular, radiolucent area is seen with a thin radiopaque lamina dura associated with the crown of the involved tooth (Andersson et al., 2012)

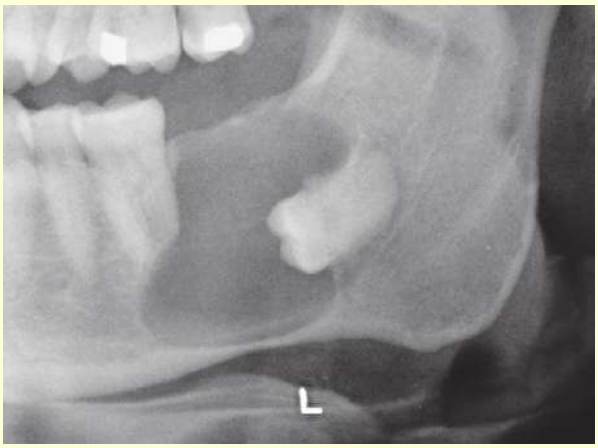



**Figure 9. Dentigerous cyst. The soft cystic swelling, usually blue or purple in color seen in children is eruption cyst (Chi et al., 2017)**

**Figure 10. Eruption cyst in children (Chi et al., 2017)**

In newborns small nodules are frequently seen on the alveolar crest. These lesions arise from proliferation of the cell rests of Serres is a variation of **gingival cyst**. In adults,the gingival cyst usually in the fifth decade, soft tissue cysts can occasionally be found overlying the alveolus. These may cause local resorption of bone resulting in small saucer shaped depressions in the alveolar plate. These cysts are treated by local excision (Andersson et al., 2012)

**The calcifying epithelial odontogenic cyst** may be found at any age and in either gender. It may be intraosseous or be found within the gingiva eroding the jaw. The radiographic appearance may have little calcification within it in early lesions, giving a similar appearance to other jaw cysts, but with increasing calcification may have the appearance of an odontome or calcifying odontogenic tumor (Andersson et al., 2012)

**Figure 11. calcifying epithelial odontogenic cyst of the mandible.**

**(Shear and Speight, 2008)**

The **residual periapical cyst** appears as a round to oval radiolucency of variable size within the alveolar ridge at the site of a previous tooth extraction. As the cyst ages, degeneration of the cellular contents within the.(Chi et al., 2017)

**Figure 12. Residual Periapical Cyst Well-circumscribed radiolucency of the maxilla at the site of previous tooth extraction (Chi et al., 2017)**

At least 50% **of keratocysts** form in the angle of the mandible, extending forwards into the body and upwards into the ramus. Most series have recorded a peak incidence between ages 20 to 30 years but other large series have shown peaks between 50 and 70 years. Keratocysts, like other jaw cysts, are symptomless until the bone is expanded or they become infected. The main difference is that expansion of the jaw is much less than the radiographic extent of the cyst. Hence clinical signs often fail to appear until the cyst is well advanced, and relatively extensive cysts are occasionally found by chance in radiographs which appear as well defined radiolucent areas, either more or less rounded with a scalloped margin, or multiloculated and simulating an ameloblastoma (Andersson et al., 2012)

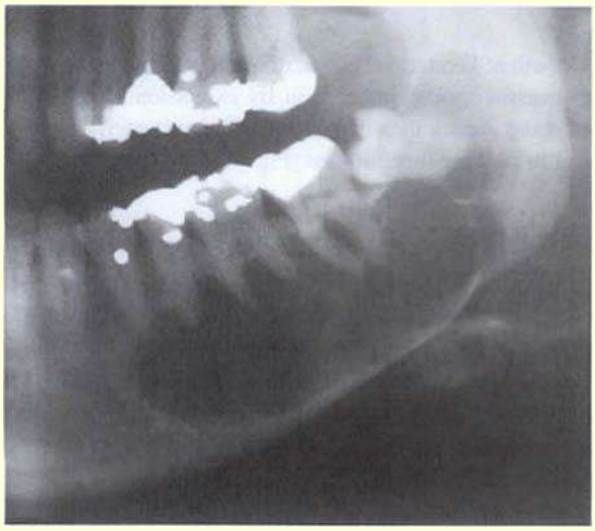


**Figure 13. Odontogenic keratocyst. Part of a panoramic tomogram showing typical appearances. ((Chi et al., 2017)**

The **glandular odontogenic cyst** is another rare entity with many features in common with botryoid odontogenic cysts but there are pools of mucin and mucous cells in variable numberswithin the epithelium. It is frequently also multilocular and has a strong tendency to recurrence.(Cawson and Odell, 2017)

At presentation the oral soft tissues with **radicular cyst** are often normal, but careful examination may reveal a firm, hard, smooth swelling at the apex of the tooth. As the cyst enlarges the overlying bone may become resorbed leaving a soft swelling or even a thin layer of bone that may be felt to give way on palpation (egg shell crackling). As the cyst is palpated the patient may report pain.

**Figure 14. Radicular cyst arising from non-vital roots of lower left first molar tooth. Note displacement of inferior dental canal by cyst posteriorly. (Chi et al., 2017)**

**The paradental cyst** which occurs on the buccal, distal, or (rarely) mesial aspects of partially erupted and impacted mandibular third molar teeth. In most cases there is an associated history of recurrent pericoronitis and absence of generalized periodontal disease (Cawson and Odell, 2017).

**Figure 15. paradental cyst. (Mufeed et al., 2009)**

**The histopathologic features of cyst** of all types of inflammatory cysts are similar. The cyst is lined by stratified squamous epithelium, which may demonstrate exocytosis, spongiosis, or hyperplasia. As seen in dentigerous cysts, scattered mucous cells or areas of ciliated pseudostratified columnar epithelium may be noted in periapical cysts.

Although some maxillary periapical cysts lined by pseudostratified columnar epithelium may have originated from the adjacent sinus lining, the presence of mucous cells or respiratory like epithelium also can be observed in mandibular cysts. The ability of odontogenic epithelium to demonstrate such specialized differentiation represents an example of *prosoplasia* (forward metaplasia) and highlights the diverse potential of odontogenic epithelium. The cyst lumen may be filled with fluid and cellular debris.

**Figure 16. Periapical Cyst. Cyst lined by stratified squamous epithelium. Note connective tissue wall, which contains a chronic inflammatory infiltrate and numerous cholesterol clefts. ((Chi et al., 2017)**

On occasion, the lining epithelium may demonstrate linear or arch shaped calcifications known as Rushton bodies. The wall of the cyst consists of dense fibrous connective tissue often with an inflammatory infiltrate containing lymphocytes variably intermixed with neutrophils, plasma cells, histiocytes, and (rarely) mast cells and eosinophils. Dystrophic calcification, cholesterol clefts with multinucleated giant cells, red blood cells, and areas of hemosiderin pigmentation may be present in the lumen, wall, or both. Due to the inability of macrophages and

giant cells to remove cholesterol, its presence may be partially responsible for failure of healing of cysts in which the original focus of infection was treated appropriately.

Intramural islands of odontogenic epithelium that closely resemble squamous odontogenic tumor rarely have been noted, which could be misdiagnosed as a neoplastic process. Studies have shown these proliferations are not neoplastic and mandate no further treatment beyond the usual standard of care for periapical cysts.

Occasionally, the walls of inflammatory cysts will contain scattered **hyaline bodies (pulse granuloma, giant cell hyaline angiopathy).** These bodies appear as small circum scribed pools of eosinophilic material that exhibits a corrugated periphery of condensed collagen often surrounded by lymphocytes and multinucleated giant cells. Initially, these foci were thought to be a vascular degenerative process or a foreign body reaction to machinery oil or vegetable matter. Subsequently, these bodies have been shown to represent pools of inflammatory exudate (i.e., extravasated serum) that ultimately undergoes fibrosis and occasionally dystrophic calcification. The multinucleated giant cells are drawn to the site for removal of insoluble hemosiderin granules. Hyaline bodies may be found in any area of chronic intraosseous inflammation, especially periapical inflammatory disease.(Chi et al., 2017) (Cawson and Odell, 2017)

The epithelial lining the radicular cyst consists of stratified squamous epithelium of variable thickness. It lacks a well-defined basal cell layer and is sometimes incomplete. Early, active epithelial proliferation is associated with obvious chronic inflammation and may then be thick, irregular and hyperplastic .

**Figure 17. Radicular cyst lining epithelium (Fowler et al., 2011)**

Histologically, lateral periodontal cysts have three to eight cell layers of nonkeratinized squamous or cuboidal luminal epithelium that often contains some focal thickening (swirls) with clear cells, which contain glycogen(Tambawala et al., 2014)

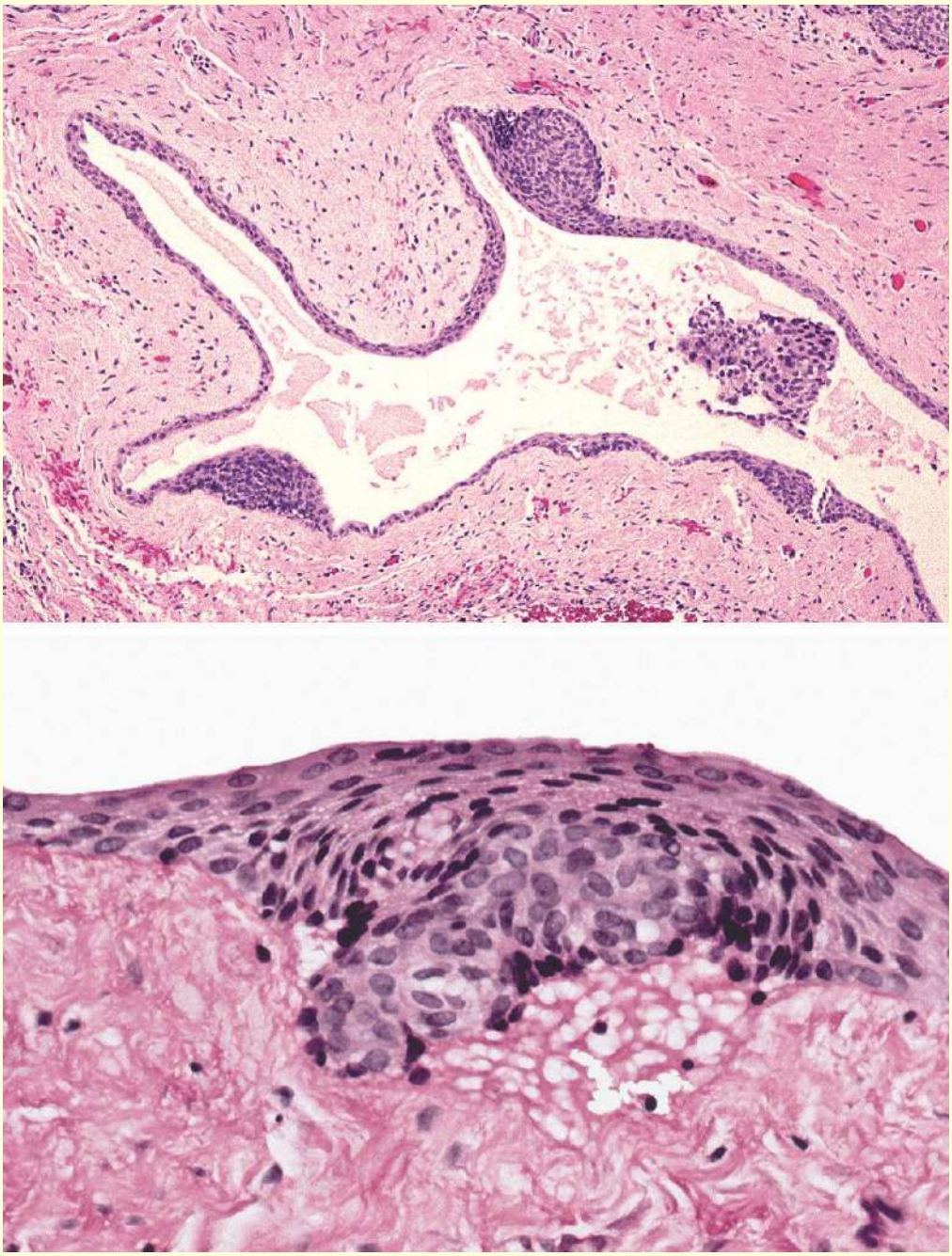


**Figure 18. lateral periodontal cyst histopathology appearance. (Borle, 2014)**

Keratocysts probably arise from any of the primordial epithelia (the dental lamina or its remains) or, as originally believed, from the enamel organ before tooth formation. However, it is difficult to reconcile such origins with the appearance of keratocysts in middle age and their relatively rapid epithelial turnover.

The aetiology of keratocysts is therefore speculative. Epithelial lining of uniform thickness.

Flat lower border of epithelium, clearly defined basal layer of tall cells in parakeratinised cyst , Thin eosinophilic layer of prekeratin in parakeratinised cysts. Cyst lining typically much folded, epithelial lining weakly attached to the fibrous wall. Abundant orthokeratin formation and well-defined granular cell layer in orthokeratinised cysts, thin fibrous wall Inflammatory cells typically absent or scant.

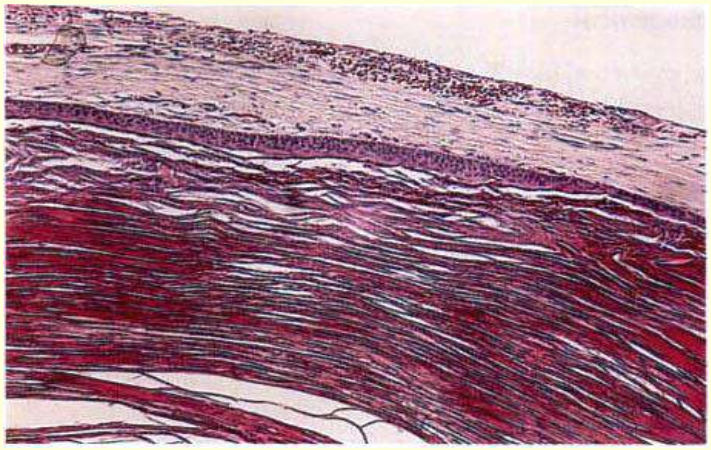


**Figure 19. Odontogenic keratocyst (orthokeratinised variant). There is a thick layer of** keratin at the epithelial surface and filling the lumen. (Cawson and Odell, 2017)

Histologically, glandular odontogenic cysts show varied thicknesses of squamous epithelium lined with hobnail cells or surface eosinophilic cuboidal cells. Commonly, epithelial spheres or plaque-like thickenings are observed within the cyst wall.

Glandular odontogenic cysts often contain mucus goblet cells, respiratory epithelium, or duct-like structures.(Cawson and Odell, 2017) (Bilodeau and Collins, 2017)

**Figure 20. glandular cyst lining epithelium. (Chi et al., 2017)**

## Aspiration

The primary reason for a needle aspiration of fluid is to see if the radiolucent or fluctuant soft tissue lesion contains blood or pus. When it contains **blood only**, the chances of the lesion being due to proliferation of vascular tissues (arteries and veins) are much higher.

More importantly, controlling the bleeding that will occur when the oral biopsy is performed is hard and potentially dangerous in the case of a hemangioma or other vascular lesion. Appropriate referral should be made.

Assuming you aspirate and withdraw non-blood based fluids, the color of the fluid may be helpful in determining the nature of the lesion.

For example, extraction of a **light, straw-colored** fluid containing cholesterol crystals (known by their characteristic "shimmering" effect in light) is consistent with a cyst-like process.

Aspiration of a **whitish to pale yellow** material that appears similar to pus usually reveals an odontogenic keratocyst that contains desquamated cells and keratin.

An infected cyst that has been present for a long time contains a **thicker yellow/brown** material that is more difficult to aspirate.

If upon aspiration a lesion feels **pneumatized**, this may indicate a traumatic bone cavity as opposed to a cyst, and if aspiration yields nothing this may indicate a solid tumor-like growth.(Scher et al., 1988)

## Surgical technique

### 1- Enucleation

#### The advantage

- The cavity usually heals without complications
- Little aftercare is necessary
- The complete lining is available for histological examination
- A vailable for histological examinations.

#### The disadvantage

- Infection of the clot filling the cavity
- Recurrence due to incomplete removal of the lining serious haemorrhage (primary or secondary)
- damage to apices of vital teeth projecting into the cyst cavity.
- Damage to the inferior dental nerve.
- Projecting into the cyst cavity.
- Opening the antrum when enucleating a large maxillary cyst.

- Fracture of the jaw exceptionally large mandibular cyst.(Ackermann et al., 1988)

## Technique

The clinician must address special considerations. The use of antibiotics is unnecessary unless the cyst is large or the patient's health condition warrants it.The periapical (i.e., radicular) cyst is the most common of all cystic lesions of the jaws and results from inflammation or necrosis of the dental pulp. Because it is impossible to determine whether a periapical radiolucency is a cyst or a granuloma, removal at the time of the tooth extraction is recommended. Caution is used in teeth with apices that are close to important anatomic structures such as the inferior alveolar neurovascular bundle or the maxillary sinus because the bone apical to the lesion may be very thin or nonexistent. With large cysts, a mucoperiosteal flap may be reflected and access to the cyst obtained through the labial plate of bone, which leaves the alveolar crest intact to ensure adequate bone height after healing. Once access to a cyst has been achieved through the use of an osseous window, the dentist should begin to enucleate the cyst(Hupp et al., 2013).

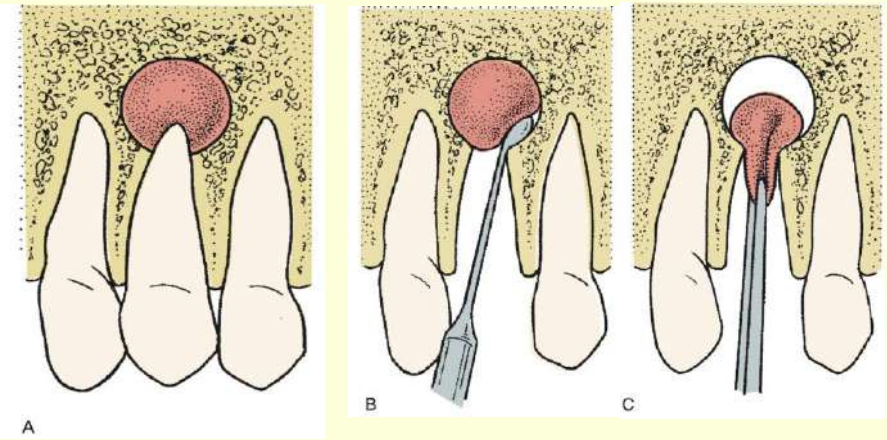



**Figure 21. Surgical technique (Encleatuion)**

Apical cystectomy performed at time of tooth removal. A to C, Removal of a cyst with curette via a tooth socket is visualized. An apical cystectomy must be performed with care because of the proximity of the apices of teeth to other structures such as the maxillary sinus and the inferior alveolar canal(Hupp et al., 2013).

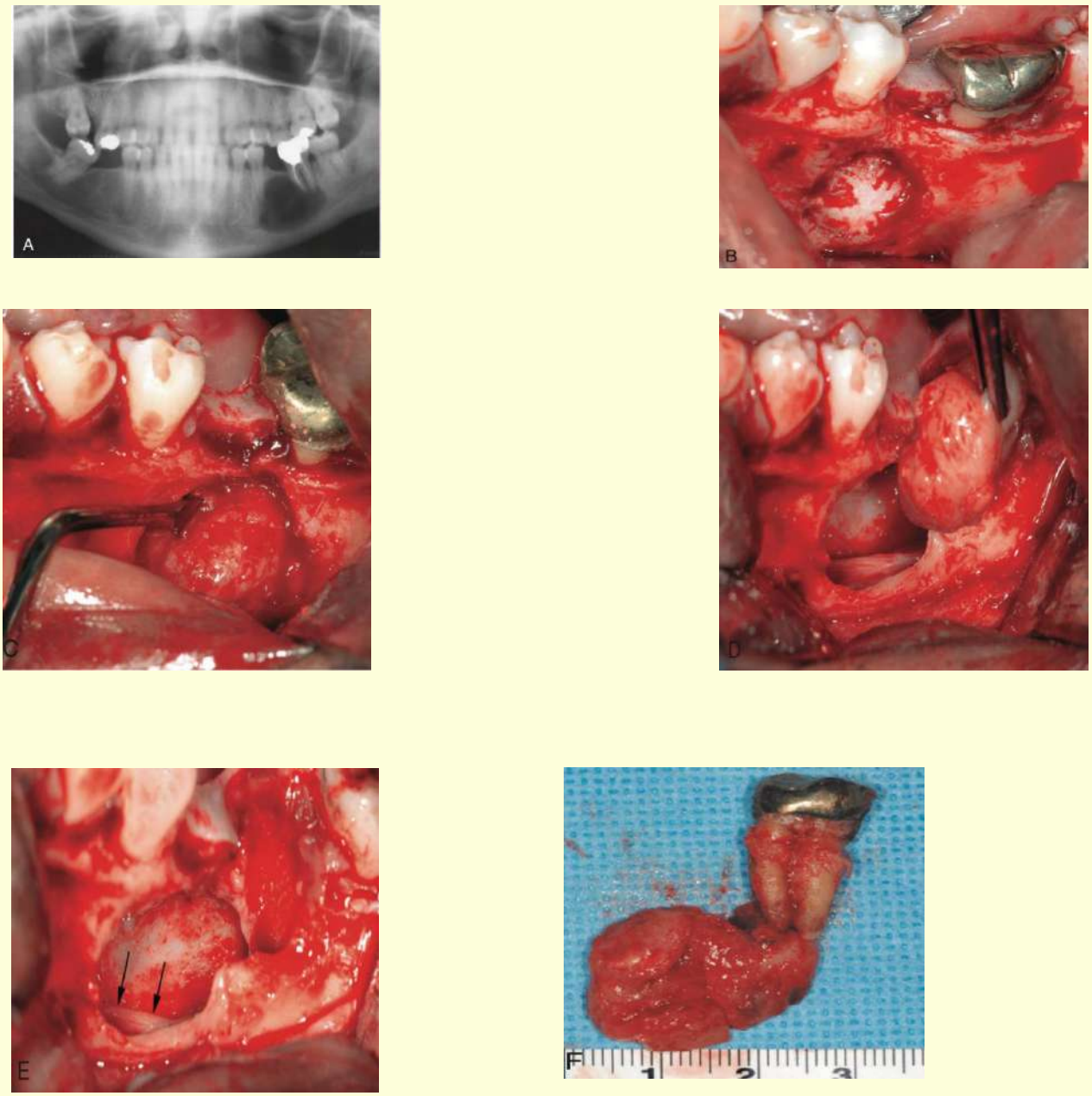



**Figure22. Surgical technique (Encleatuion)**


Fig. Photographs of a clinical case of apical cystectomy performed at time of tooth extraction. A, Pretreatment panoramic radiograph showing large radiolucent lesion at the apices of teeth No. 18 and 20. B, Appearance of lesion after buccal flap elevated. Note that the lesion has eroded the bone. C, Curette used to elevate the lesion from the bony walls. D, Cyst being removed. E, Note the inferior alveolar neurovascular bundle passing along the inferior aspect of the bony cavity. F, Surgical specimen. G, When opened, the specimen appeared to be cystic. H, Postoperative panoramic radiograph showing defect. The patient should be monitored with periodic radiographs to ensure bone fill and no recurrence of the lesion(Hupp et al., 2013).

## 2- Marsupialization

Marsupialisation is a largely outmoded treatment for radicular cysts. The cyst is opened essentially as for enucleation but the lining is sutured to the mucous membrane at the margins of the opening. The aim is to produce a self-cleansing cavity which becomes in effect, an invagination of the oral tissues. However, considerable aftercare is needed to keep the cavity clean. The cavity is initially packed with ribbon gauze and after the margins have healed a plug or extension to a denture is made to close the opening. Food debris has to be regularly washed out but once the cavity has filled up from the base and sides sufficiently to become self-

cleansing the plug can be removed. The cavity usually becomes closed by regrowth of the surrounding tissue and restoration of the normal contour of the part. However, the orifice may close and the cyst re-form .**(Ackermann et al., 1988)**

## Indications '' (Hupp et al., 2013)

- Amount of tissue injury. Proximity of a cyst to vital structures can mean unnecessary sacrifice of tissue if enucleation is used. For example, if enucleation of a cyst would create oronasal or oroantral fistulae or cause injury to major neurovascular structures (e.g., the inferior alveolar nerve) or devitalization of healthy teeth, marsupialization should be considered

- Surgical access. If access to all portions of the cyst is difficult portions of the cystic wall may be left behind, which could result in recurrence. Marsupialization should, therefore, be considered.

- Assistance in eruption of teeth. If an unerupted tooth that is needed in the dental arch is involved with the cyst (i.e., a dentigerous cyst), marsupialization may allow its continued eruption into the oral cavity.

- Extent of surgery. In a patient with ill health or any debilitation marsupialization is a reasonable alternative to enucleation because it is simple and may be less stressful for the patient.

## Technique

The author favors removal of overlying bone and cyst roof, creating an opening into the cyst that is as wide as possible. A 1” (2.5 cm) Penrose drain is cut to a length just long enough to reach the depth of the lesion. Its periphery is sutured to the gingival and alveolar mucosa around the defect with approximately eight 2-0 silk sutures. The patient is instructed in wound irrigation with saline and the drain is allowed to

spontaneously exfoliate, which usually occurs within 1–2 months. In cases of extensive mandibular destruction, an ipsilateral coronoidectomy may help avoid pathologic fracture(Hupp et al., 2013).

## Advantages

- The main advantage of marsupialization is that it is a simple procedure to perform.
- Marsupialization may also spare vital structures from damage should immediate enucleation be attempted.

## Disadvantages

- The major disadvantage of marsupialization isthat pathologic tissue is left in situ, without thorough histologic examination.
- Although the tissue taken in the window can be submitted for pathologic examination, a more aggressive lesion may be present in the residual tissue.
- Another disadvantage is that the patient is inconvenienced in several respects.
- The cystic cavity must be kept clean to prevent infection because the cavity frequently traps food debris.

In most instances, this means that the patient must irrigate the cavity several times every day with a syringe. This may continue for several months, depending on the size of the cystic cavity and the rate of bone fill. Main DMG 1970.

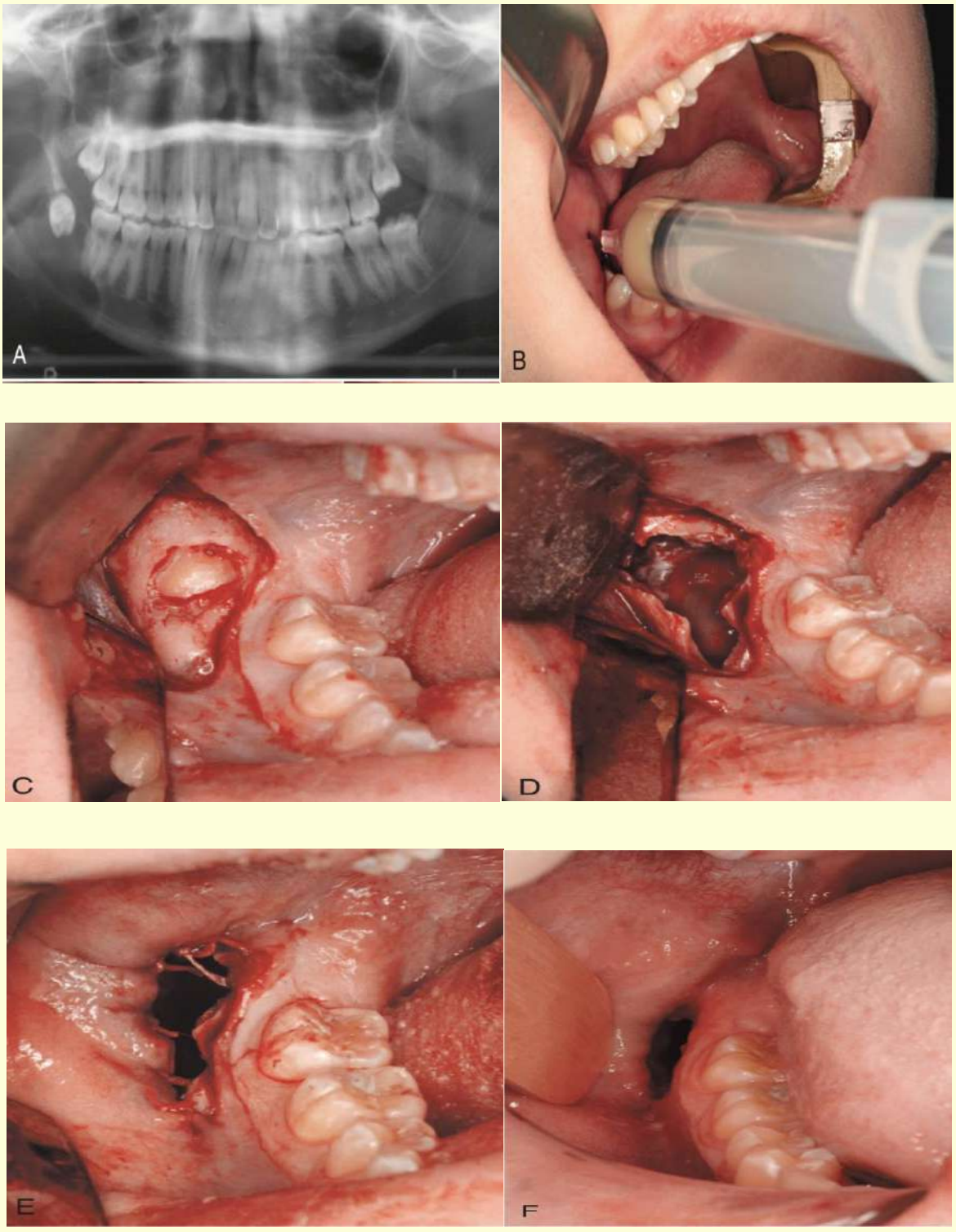



**Figure23. Surgical technique (Marsupialization)**

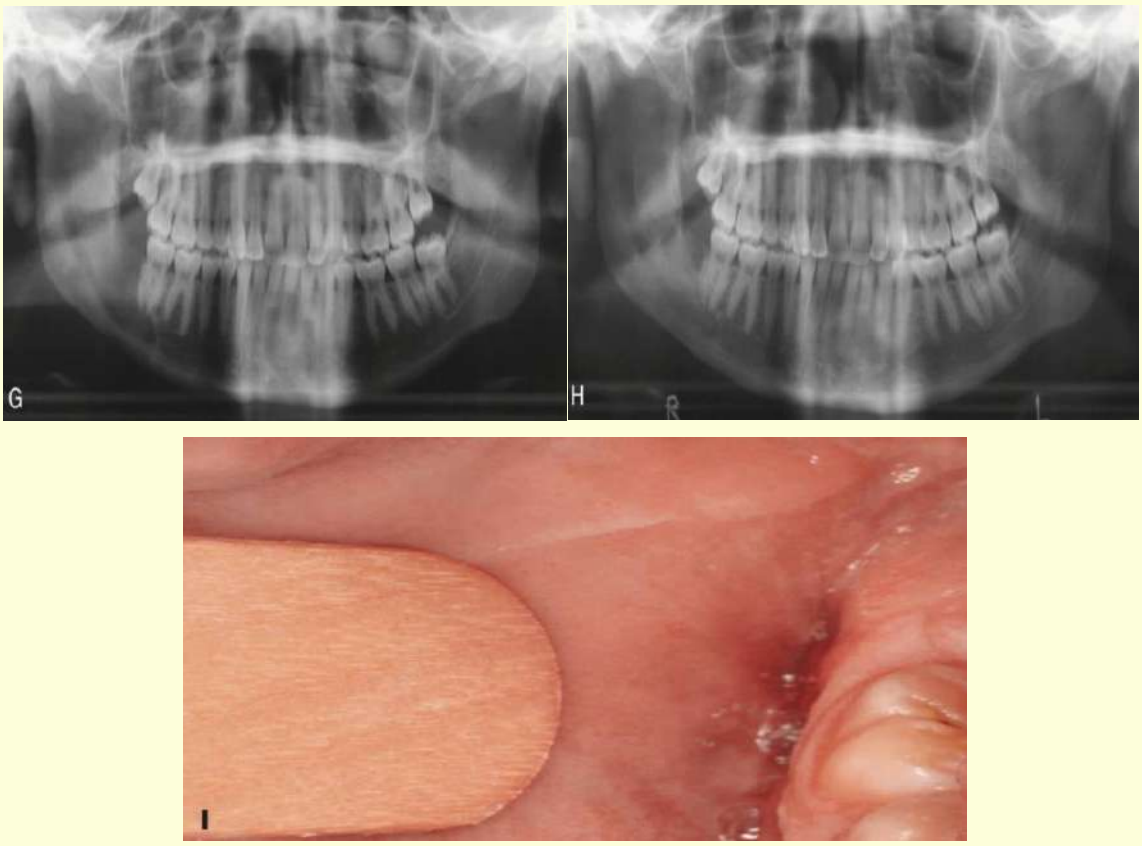



**Figure24. Surgical technique (Marsupialization)**

Marsupialization of an odontogenic keratocyst in right mandible associated with an impacted third molar. A, Panoramic radiograph showing large multilocular radiolucent lesion associated with tooth No. 32. B, Aspiration of the lesion reveals a creamy liquid (keratin). C, Exposure and removal of bone behind the second molar reveals the impacted third molar crown. D, The impacted tooth was removed, and additional bone was removed to provide a large window into the lesion. A portion of the lining was excised and sent for pathologic examination. The cavity was inspected through the opening to ensure there was no solid mass that might indicate tumor. E, Holes were drilled around the periphery of the bony opening to pass sutures from the oral mucosa, through the holes in the bone, and through the cyst lining. This provided a stable opening from the oral cavity into the cyst. F, Patent opening into the cavity 1 month after surgery. G, Panoramic radiographs taken at 5

months after surgery show bone fill. H, At 10 months. I, By 10 months, the opening into the cyst has completely closed (Hupp et al., 2013)

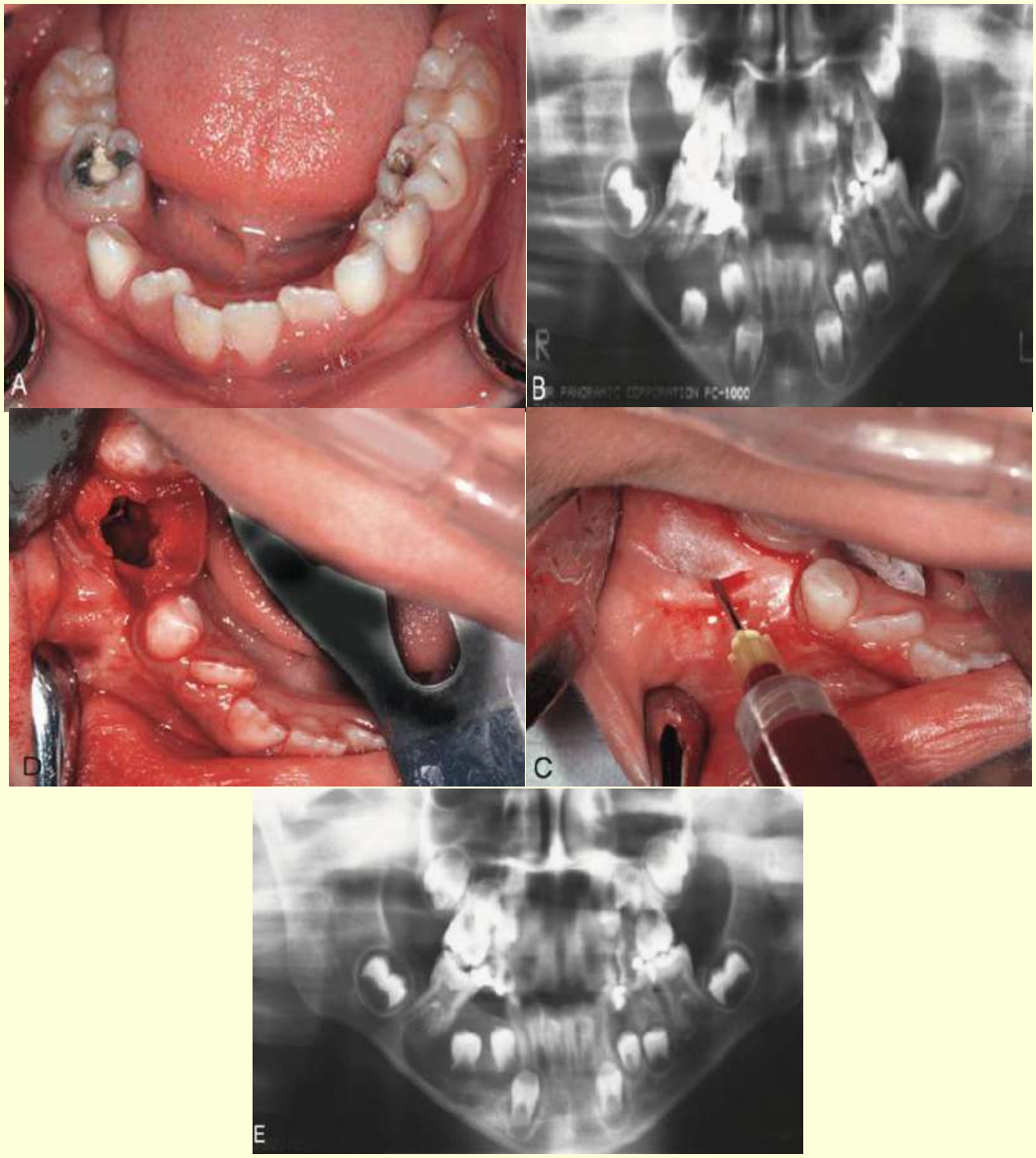



**Figure25. Marsupialization of cyst in right mandible associated with unerupted teeth. A- Photograph showing swelling around right second deciduous molar. B- Radiographic appearance before marsupialization.**

Note the large radiolucent lesion and displacement of the second right premolar toward the inferior border (compare with the opposite side). Cystectomy would probably injure or necessitate the removal of premolars, so it was decided to perform

marsupialization of the cyst instead. C, Aspiration performed to determine whether the lesion was fluid filled cystic D, The lower right deciduous second molar was removed, and the cyst was opened through the socket (decompressed). E, Panoramic radiograph taken 5 months after surgery showing bone fill and eruption of the premolars(Hupp et al., 2013).

## Enucleation and curettage

Enucleation and curettage has been the traditional and time-honored method for managing odontogenic cysts and some jaw tumors. The technique offers the patient a minimally invasive procedure, with little associated morbidity and few complications. Most odontogenic cysts can be effectively removed by simple enucleation of the cystic lining and meticulous curettage of the bony cavity. However when used alone, this technique is usually inadequate for tumors with true neoplastic potential and its use in entities such as ameloblastoma or keratinizing odontogenic tumor should be accompanied by adjuvant treatment such as peripheral ostectomy, cryotherapy, or chemical fixation with Carnoy's solution fixation with Carnoy's solution. Wide exposure is necessary to allow complete access to the bony cavity. Every effort must be made to thoroughly remove the cyst lining as well as epithelial remnants that may be present between the cyst wall and overlying mucosa. One of the difficulties encountered when attempting to remove these cysts lies in the nature of the thin cystic lining which, at times, is readily removed in toto, but more often comes out in multiple soft tissue. Gunham O, Erseven G,ETL 1990 oral and maxillofacial surgery(Mufeed et al., 2009, Hupp et al., 2013)

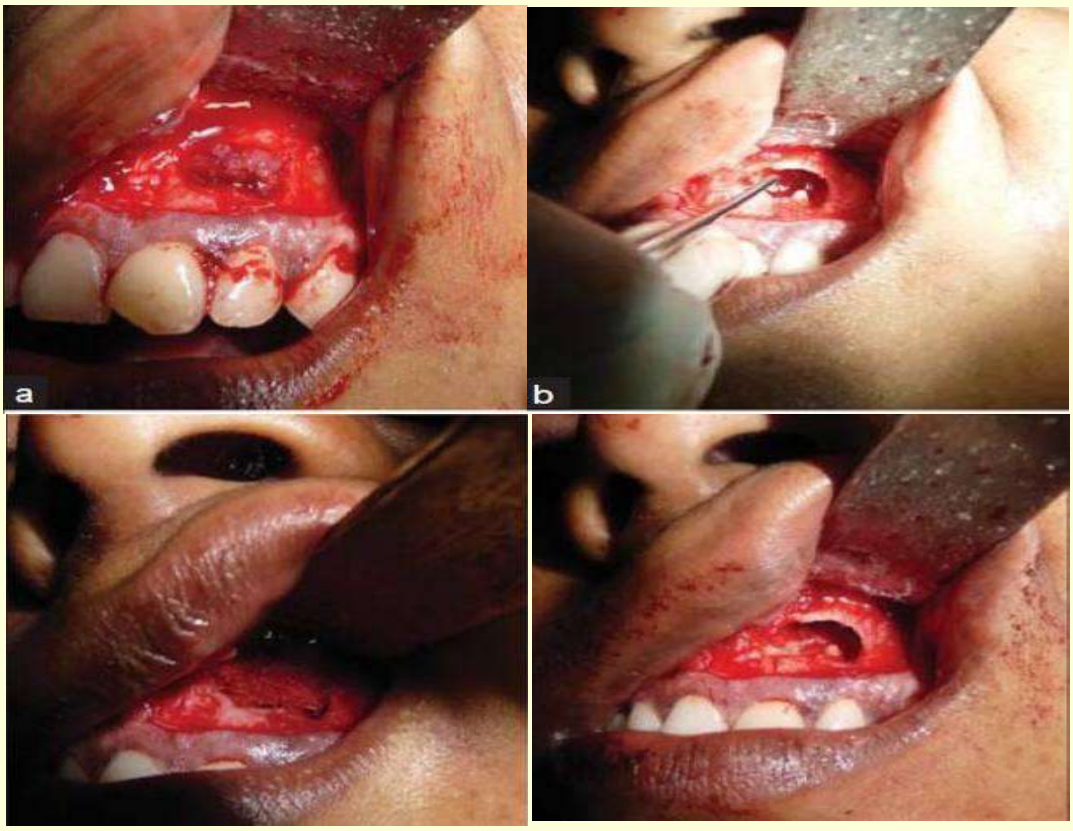



**Figure 26. (a) Exposure of the cyst, (b) Enucleation and curettage, (c) Soaking of the saline pack placed in the cystic cavity within seconds, (d) Achieving optimal hemostasis for retrograde filling (Hupp et al., 2013)**

## Enucleation after Marsupialization

This is a technique which is used taking advantage of both marsupialization and enucleation. When complete access to the whole cystic lining is not possible or fracture of jaw could take place, etc. the initial surgery done is marsupialization. Once the cystic size decreases, enucleation can be done, making sure the whole cystic lining is sent for pathological examination(Hupp et al., 2013)

## Indications

for this combined modality of surgical therapy are the same as those listed for the technique of marsupialization. These indications are predicated on a thorough evaluation of the amount of tissue injury enucleation would cause, the degree of access for enucleation, whether impacted teeth associated with the cyst would benefit from eruptional guidance with marsupialization the medical condition of the patient, and the size of the lesion. However, if the cyst does not totally obliterate after marsupialization enucleation should be considered. Another indication for enucleation of a cyst after marsupialization is a cystic cavity that the patient is finding difficult to cleanse. The clinician may also desire to examine the entire lesion histologically. (Shafer, 1983)

## Advantages

The advantages of combined marsupialization and enucleation are the same as those listed for marsupialization and enucleation. In the marsupialization phase, the advantage is that this is a simple procedure that spares adjacent vital structures. In the enucleation phase, the entire lesion becomes available for histologic examination. Another advantage is the development of a thickened cystic lining, which makes the secondary enucleation an easier procedure(Hupp et al., 2013).

## Disadvantages

The disadvantages of this modality of surgical intervention are the same as those for marsupialization. The total cyst is not removed initially for pathologic examination. However, subsequent enucleation may then detect any occult pathologic condition.(Main, 1970)

## Technique

Technique. First, marsupialization of the cyst takes place, and osseous healing is allowed to progress. Once the cyst has decreased to a size that makes it amenable to complete surgical removal enucleation is performed as the definitive treatment. The appropriate time for enucleation is when bone is covering adjacent vital structures, which prevents their injury during enucleation, and when adequate bone fill has provided enough strength to the jaw to prevent fracture during enucleation The initial incisions for enucleation of the cyst differ, however from those when marsupialization of the cyst does not take place first. The cyst has a common epithelial lining with the oral cavity after marsupialization. The window initially made into the cyst contains the epithelial bridge between the cystic cavity and the oral cavity. This epithelium must be removed completely with the cystic lining; an elliptical incision completely encircling the window must be made down to sound bone. The clinician then has the opportunity to begin stripping the cyst from the window into the cystic cavity. The plane of dissection is easily established with this approach, and the cyst can be enucleated without difficulty Once the cyst has been enucleated, the oral soft tissues must be closed over the defect, if possible, which may require the development and mobilization of soft tissue flaps that can be advanced and sutured in a watertight manner over the osseous window. If complete closure of the wound cannot be achieved, packing the cavity with strip gauze impregnated with an antibiotic ointment is acceptable This packing must be changed repeatedly with cleansing of the cavity until granulation tissue has obliterated the opening and epithelium has closed over the wound (Hupp et al., 2013)

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