

Odontogenic cysts II

- Classification
- Historical aspects
- Odontogenic keratocyst
- Gingival cyst of infants & mid palatal cysts
- Gingival cyst of adults
- Lateral periodontal cyst
- Botryoid odontogenic cyst
- Glandular odontogenic cyst

- Dentigerous cyst
- Eruption cyst
- COC
- Radicular cyst
- Paradental cyst
- Mandibular infected buccal cyst
- Cystic fluid and its role in diagnosis

Gingival cyst and midpalatal cyst of infants

Clinical features

- Frequently seen in new born infants
- Rare after 3 months of age
 - Undergo involution and disappear
 - Rupture through the surface epithelium and exfoliate
- Along the mid palatine raphe → *Epstein's pearls*
- Buccal or lingual aspect of dental ridges → *Bohn's nodules*

- 2-3 mm in diameter
- White or cream coloured
- Single or multiple (usually 5 or 6)



Pathogenesis

Gingival cyst of infants

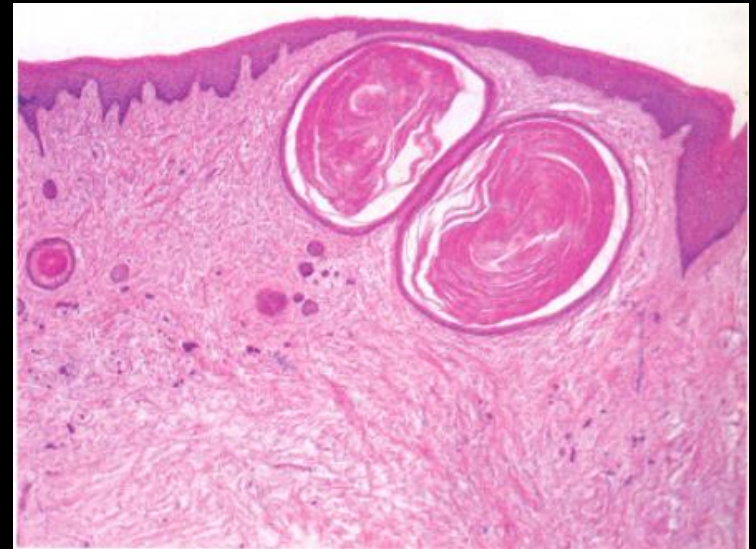
- Arise from epithelial remnants of dental lamina (cell rests of Serre)
- These rests have the capacity to proliferate, keratinize and form small cysts

Midpalatal raphe cyst

- Arise from epithelial inclusions along the line of fusion of palatal folds and the nasal process
 - Usually atrophy and get resorbed after birth
 - May persist to form keratin filled cysts

Histopathology

- Round or ovoid
- Smooth or undulating outline
- Thin lining of stratified squamous epithelium with parakeratotic surface
- Cyst cavity filled with keratin (concentric laminations with flat nuclei)
- Flat basal cells
- Epithelium lined clefts between cyst and oral epithelium
- Oral epithelium may be atrophic



Gingival cyst of adults

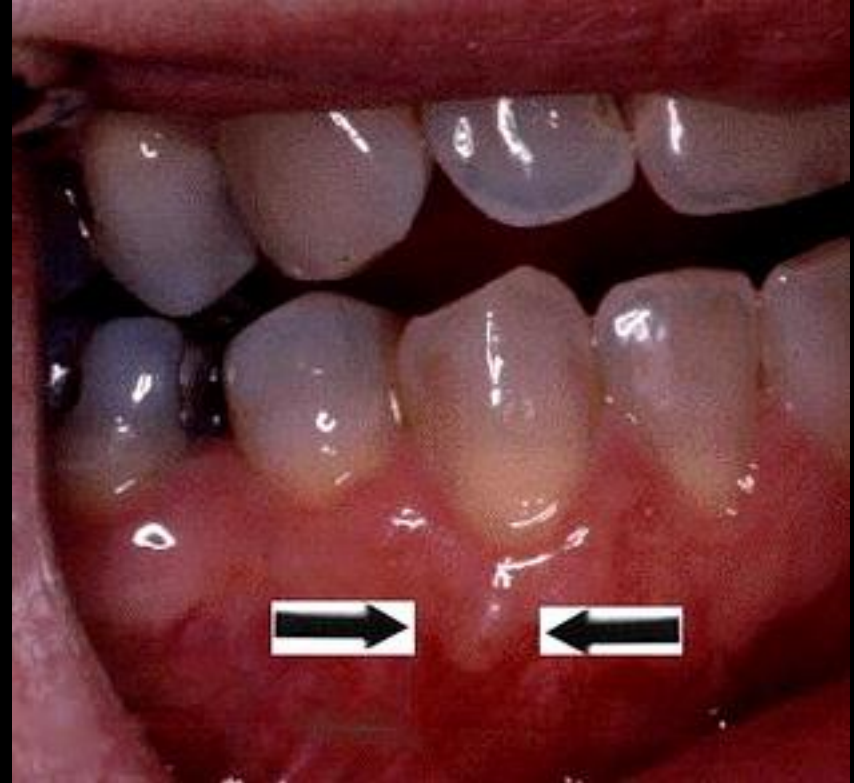
Clinical features

- Frequency
 - 0.5%
 - May be higher as all cases may not be submitted to histopathological examination
- Age
 - 5th and 6th decade
- Sex
 - No predilection
- Site
 - Much more frequent in mandible
 - Premolar-canine region

- **Clinical presentation**

- Soft and fluctuant
- Well circumscribed, slowly enlarging, painless swelling
- Attached gingiva or interdental papilla
- Facial aspect
- Usually less than 1 cm
- Smooth surface
- Colour of overlying mucosa → normal
- Adjacent teeth usually vital
- Slight erosion of surface of the bone





Radiological features

- No change
- Faint round shadow



Pathogenesis

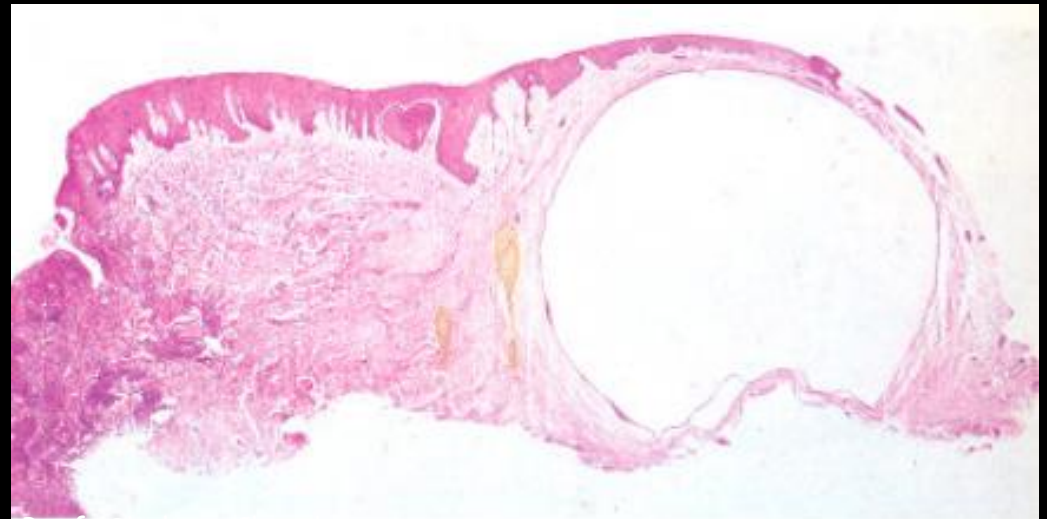
- Odontogenic epithelial cell rests
- Traumatic implantation of surface epithelium
- Cystic degeneration of deep projections of surface epithelium
- From glandular elements
- Junctional epithelium
- May be derived from *reduced enamel epithelium*

Histopathology

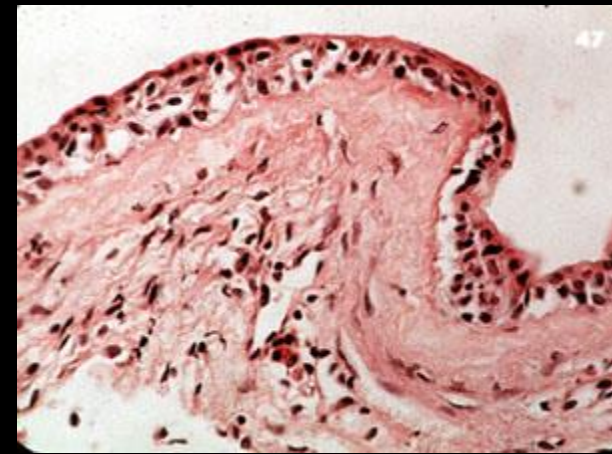
- Extremely thin epithelium resembling REE
 - 1-3 layers of flat to cuboidal cells
 - Darkly staining nuclei

Or

- Thicker stratified squamous epithelium without rete ridges



- Epithelial cells may show
 - Pyknotic nuclei
 - Perinuclear cytoplasmic vacuolization
 - Atrophic with ghost outlines
- Localized epithelial thickenings or plaques
 - Some protrude in the cystic lumen
 - Some extend into fibrous cyst wall
 - Cells
 - Whorled configuration
 - Compact and fusiform
 - Swollen and clear (**water clear cells**)
- Low columnar cells on the surface of epithelium → origin from ameloblasts



Attachment of epithelium to connective tissue is
tenuous



Easily peels off



Epithelial discontinuities

- Fibrous connective tissue wall
 - Usually uninfamed
 - Except close to junctional epithelium → chronic inflammatory cell infiltrate
- May contain epithelial islands

Dentigerous cyst

A dentigerous cyst is one which encloses the crown of an unerupted tooth by the expansion of its follicle, and is attached to the neck



Clinical features

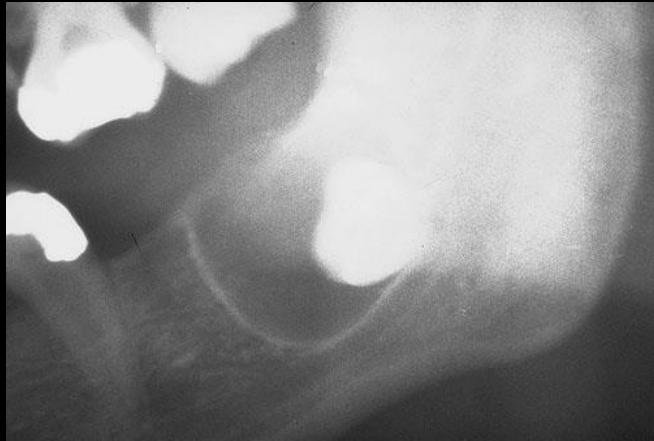
- Frequency
 - 16.6%
- Age
 - Peak between 2nd-4th decade
 - Most common jaw cyst in the first decade
- Sex
 - Male predilection (1.6: 1)
- Race
 - More common in whites

- Site
 - Mandibular third molar
 - Maxillary canine
 - Mandibular premolars
 - Maxillary third molars
 - Others
- Supernumerary teeth
 - Mesiodens → 90%

- Clinical presentation
 - May be asymptomatic
 - Slowly enlarging swelling
 - Painful if infected

Radiographic features

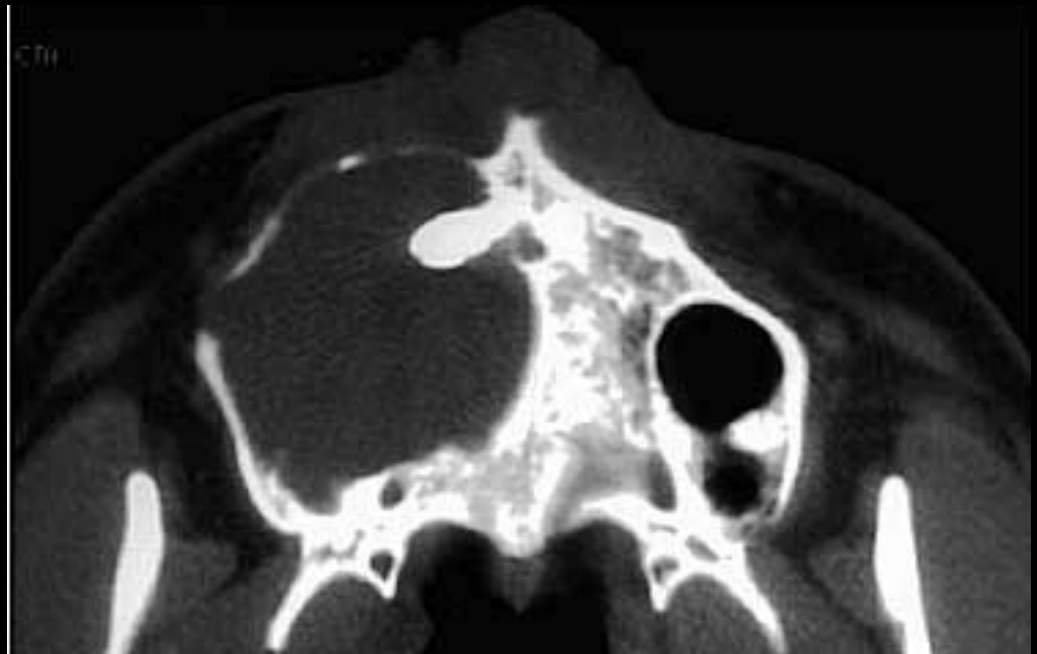
- Unilocular radiolucent area associated with crown of an unerupted tooth.



- Erroneous impression of multilocularity







- Dentigerous cyst vs dilated follicle
 - Pericoronal radiolucency greater than 4mm → cyst
- Radicular cyst in deciduous teeth → may mimic dentigerous cyst

- Three variants
 - Central
 - Lateral
 - Circumferential



Central



Lateral

Circumferential



- Greater tendency to produce root resorption
 - Derivation from dental follicle
- Release of bone resorbing factors from the cyst wall
 - Prostaglandins E2 and E3
 - Interleukin 1
 - TNF



Pathogenesis

- Intrafollicular

- Develop by accumulation of fluid between
 - Reduced enamel epithelium and enamel
 - Within the enamel organ itself i.e cystic degeneration of stellate reticulum

- Extrafollicular

- Envelopmental or follicular keratocysts???



- Enamel hypoplasia
 - Cyst arising from degeneration of stellate reticulum → enamel hypoplasia
 - Cyst arising from accumulation of fluid between REE and enamel → no enamel hypoplasia

Presence of enamel hypoplasia



Diminished the adherence of REE to the crown



Accumulation of fluid



Cyst formation

Superficial cells of the cyst lining sometimes show projections resembling Tomes' process

↓
Derived from ameloblasts

↓
Origin from REE

Extrafollicular hypothesis

- Crown of a permanent tooth may erupt into a radicular cyst of its deciduous predecessor
- Not very popular because
 - Radicular cyst in deciduous teeth are very uncommon
 - Erupting tooth may indent rather than penetrate the cyst

- How does the separation between the REE and enamel takes place????

Pressure exerted by erupting tooth on impacted follicle

↓
Obstruction of venous outflow

↓
Rapid transudation of serum across the capillary walls

↓
Increased hydrostatic pressure

↓
Separation of REE from the crown
(Main, 1970)

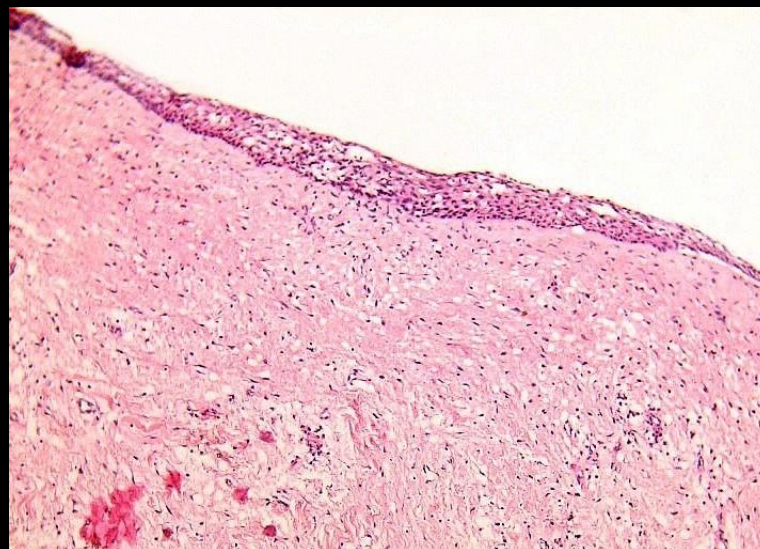
- Dentigerous cyst fluid contains
 - Glycosaminoglycans
 - Hyaluronic acid
 - Heparan and chondroitin sulphate
- Increases the osmolality of the cyst fluid and thought to play a role in the expansion of the cyst.

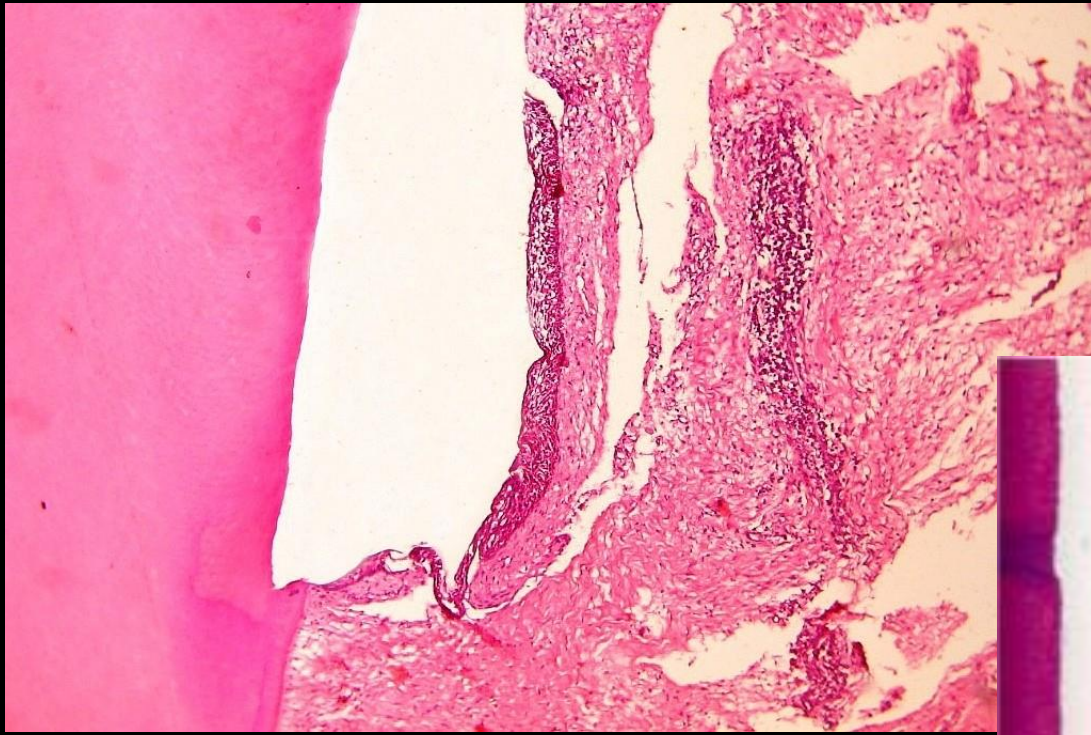
Histopathological features

- Thin fibrous cyst wall derived from dental follicle
 - Young fibroblasts
 - Abundant stroma and ground substance rich mucopolysachharides



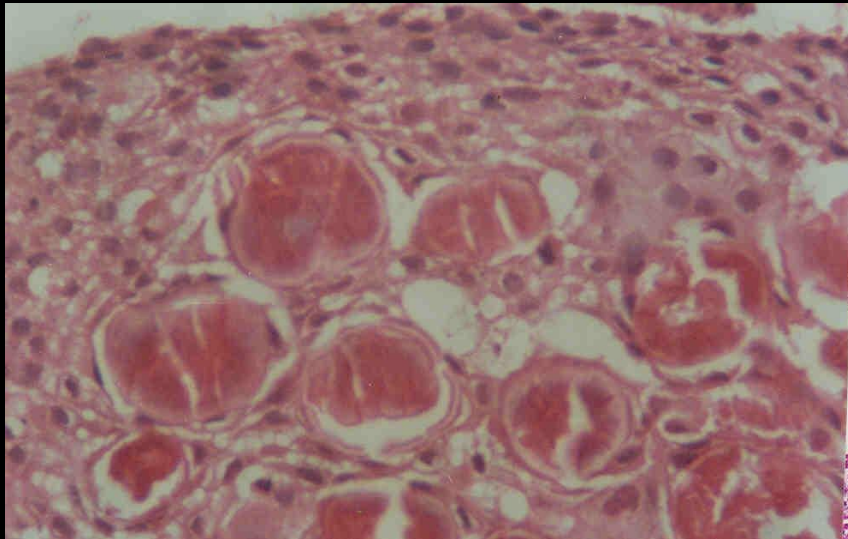
- Epithelial lining derived from REE
 - 2-4 layers of flat cuboidal cells
 - Characteristically non keratinized
 - May have discontinuities
 - Sometimes superficial layers may be low columnar → retains morphology of ameloblast layer



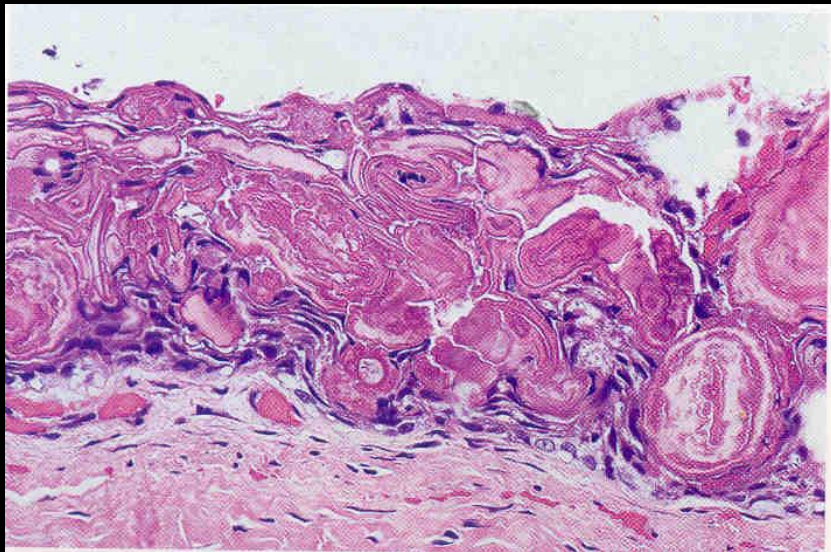


- Variations

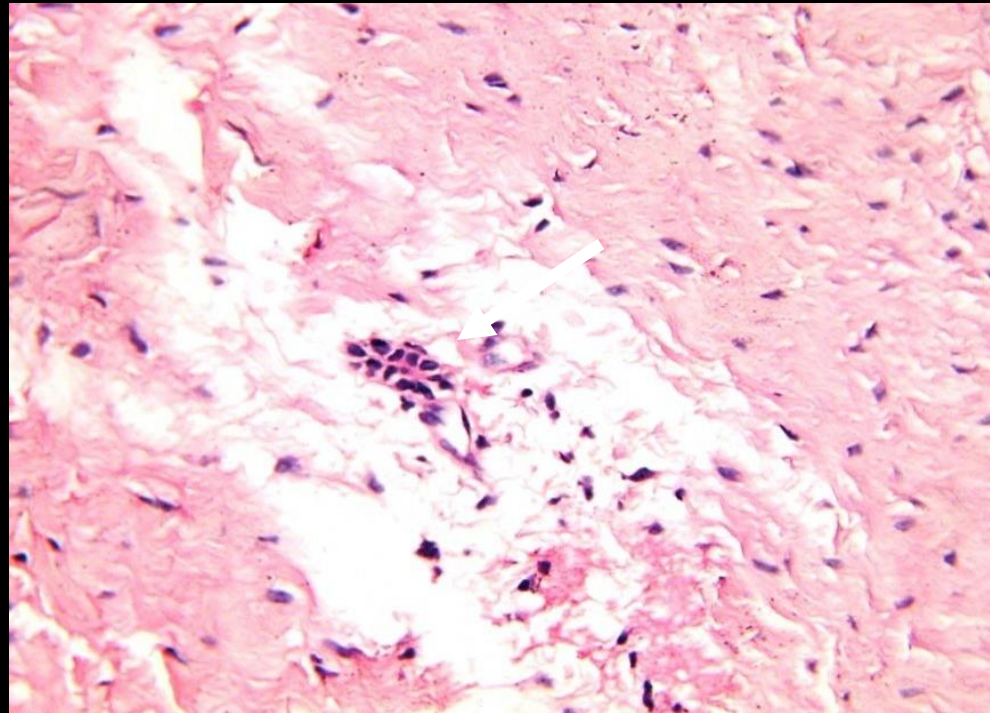
- Mucous cells in epithelial lining
 - More common in maxilla
- Ciliated cells in epithelial lining
- Sebaceous glands in cyst wall



- Rushton bodies
 - Found within
 - The epithelium or its surface
 - Connective tissue wall
 - Appear as
 - Irregular, eosinophilic, glassy structures
 - Often showing a granular center



- Localized proliferation of epithelial lining in response to inflammation
- Bud-like thickenings of the epithelium in absence of inflammation
- Budding of the basal cells into the fibrous capsule
- Epithelial proliferations resembling SOT



- Nests, islands and strands of odontogenic epithelium in the connective tissue capsule

Eruption cyst

- Dentigerous cyst occurring in the soft tissues
- Occurs when tooth is impeded in eruption within the soft tissues

Clinical features

- Frequency
 - 0.8%
- Age
 - Children of different ages
 - Occasionally adults → delayed eruption

- Clinical presentation

- Most frequently anterior to the 1st permanent molar
- Smooth swelling over erupted tooth
- Normal colour or bluish
- Soft and fluctuant
- Usually painless unless infected





- Sometimes more than one cyst may be present
- Brief history of about 3-4 weeks
- Usually 1-1.5 cms

Radiographic features

- May have a soft tissue shadow
- No bone involvement

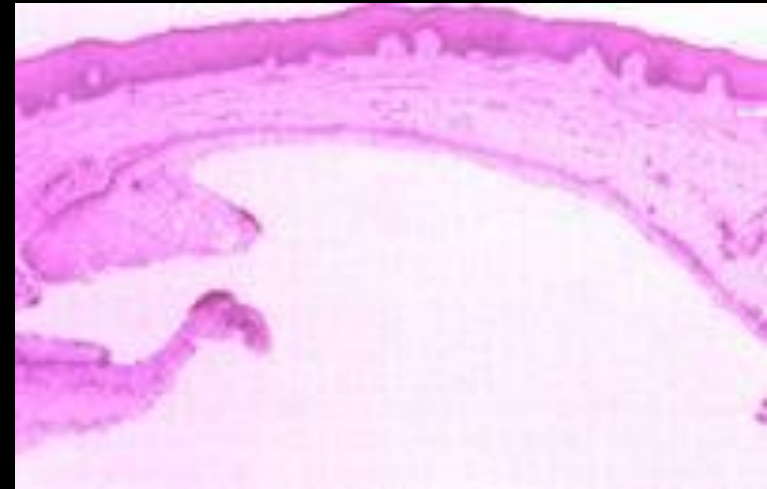


Pathogenesis

- Similar to dentigerous cyst
- Dense fibrous soft tissue may be responsible for impedance in eruption

Histopathological features

- Superficial aspect covered by gingival epithelium
- Cyst is lined by REE
- Intensely inflamed → may form arcades
- Connective tissue capsule merges with gingival connective tissue
 - Gingival connective tissue → pink
 - Cyst connective tissue → blue



Lateral periodontal cyst

Cysts which occur in the lateral periodontal position and in which an inflammatory etiology and a diagnosis of collateral keratocyst have been excluded on clinical and histopathological grounds

Clinical features

- Frequency
 - 0.7%
- Age
 - Prominent peak in the 6th decade
- Sex
 - No sex predilection
 - Some studies show slight male preponderance
- Site
 - Mandibular premolar area
 - Anterior maxilla

• Clinical presentation

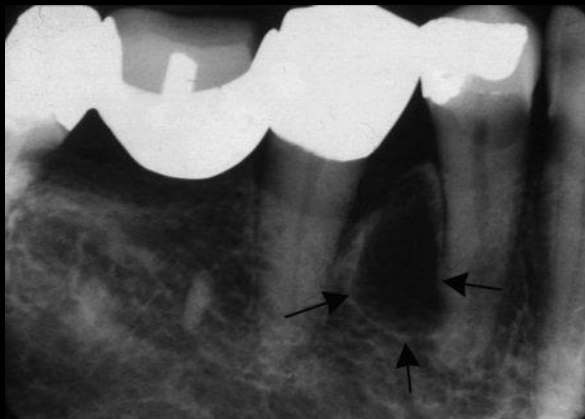
- Asymptomatic
- Gingival swelling on facial aspect
- Pain, tenderness on palpation
- Consistency
 - Springy with egg shell crackling
 - Gelatinous feel
- Associated teeth usually vital



Radiographic features



- Round or oval, well circumscribed radiolucency
- Sclerotic margin
- Between the apex and cervical margin of tooth
- Usually less than 1 cm in diameter
- Mean growth \rightarrow 0.7mm per year

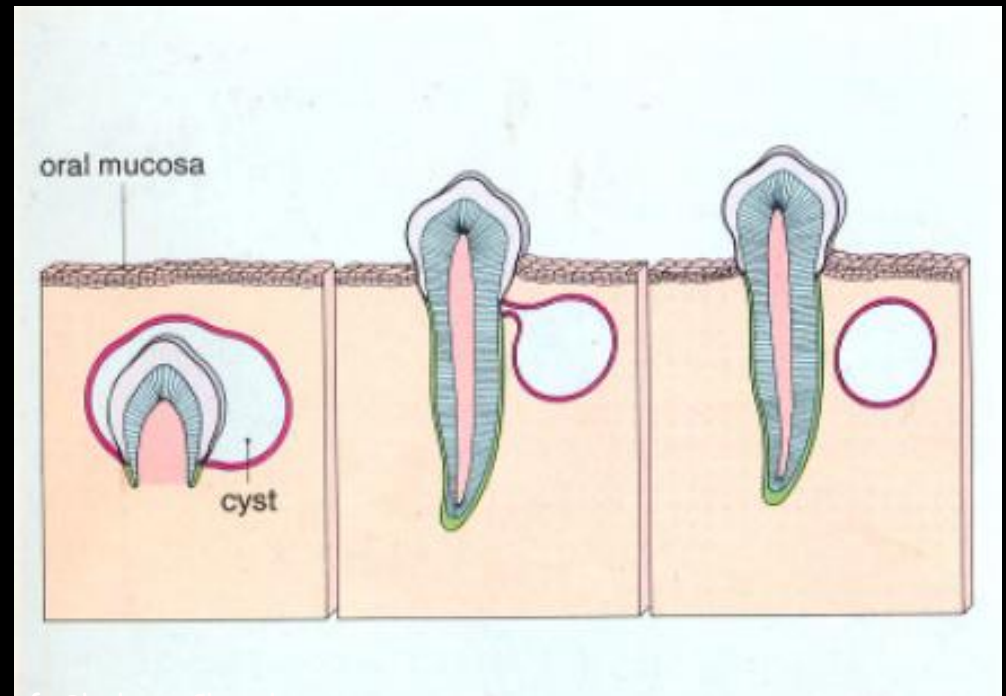


Pathogenesis

- Developmental odontogenic origin
- Three possibilities
 - Reduced enamel epithelium
 - Remnants of dental lamina
 - Cell rests of Malassez

- **Reduced enamel epithelium**

- Arises initially as a dentigerous cyst developing by expansion of the follicle along the lateral surface of crown



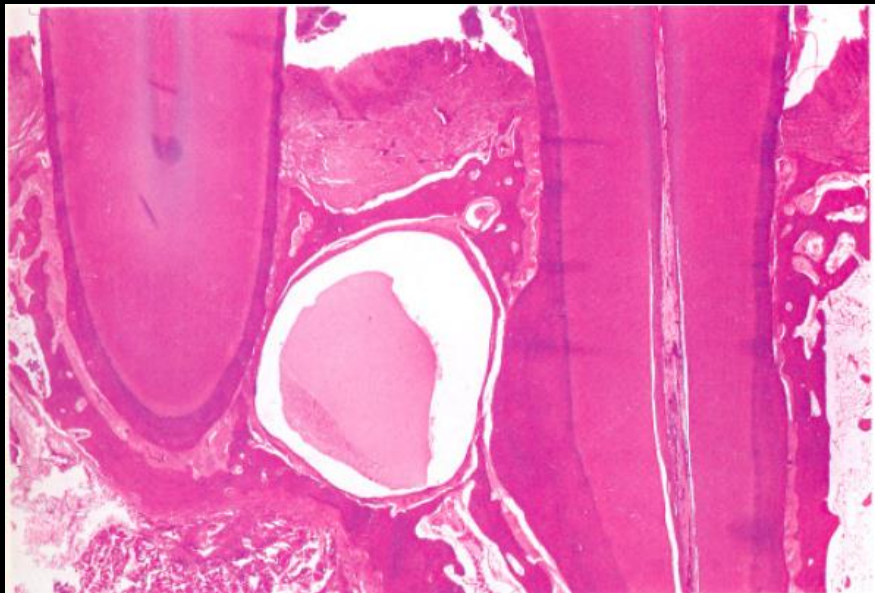
- Support of this hypothesis
 - LPC occur in areas where dentigerous cysts are likely to be associated with vertically impacted teeth
 - Epithelial plaques similar to those seen in LPC may also be seen sometimes in dentigerous cysts

- **Cell rests of dental lamina**
 - Cystic change in a single rest → **unicystic forms**
 - Concomitant changes in several adjacent rests → **polycystic**
- Support for this hypothesis
 - Limited growth potential of LPC → derivation from post functional cells of dental lamina

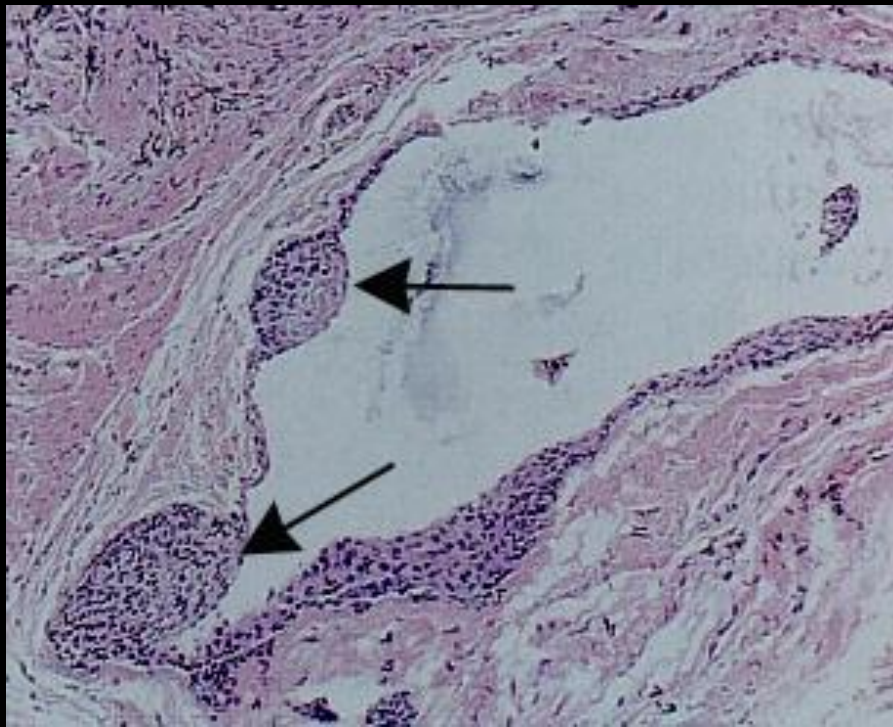
- Cell nests of Malassez

- Occur in the periodontium
- Well positioned for a lateral periodontal cyst
- Has not received much support

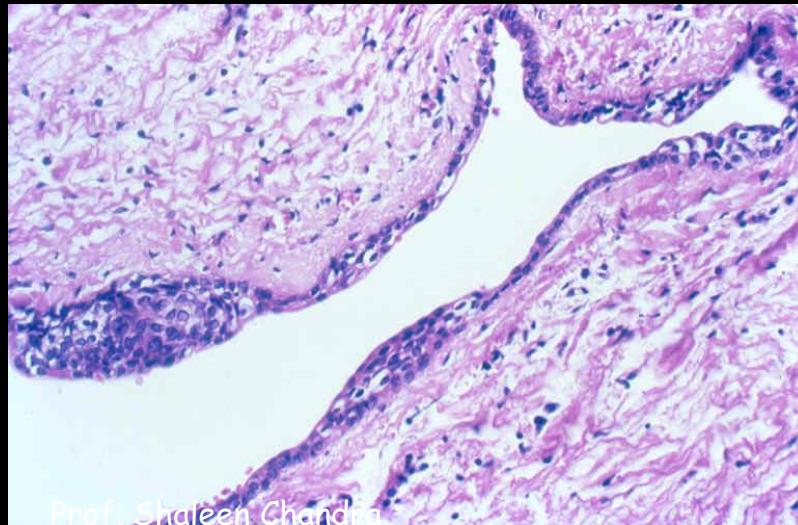
Histopathology

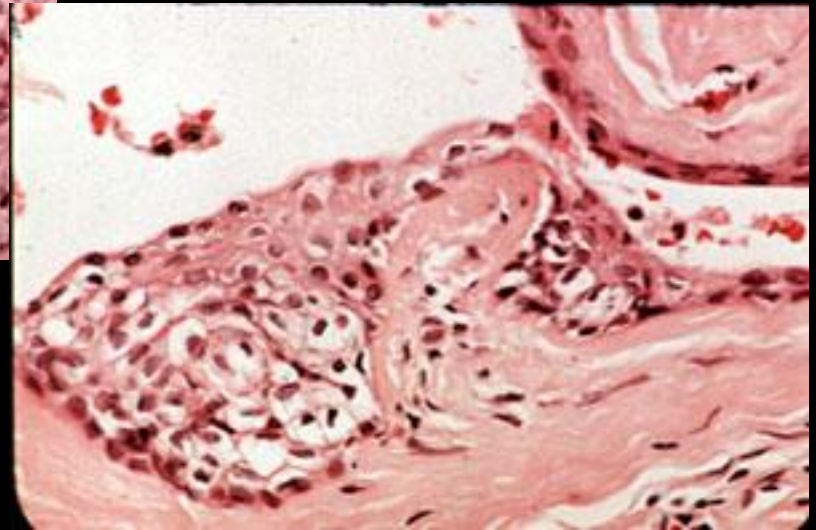
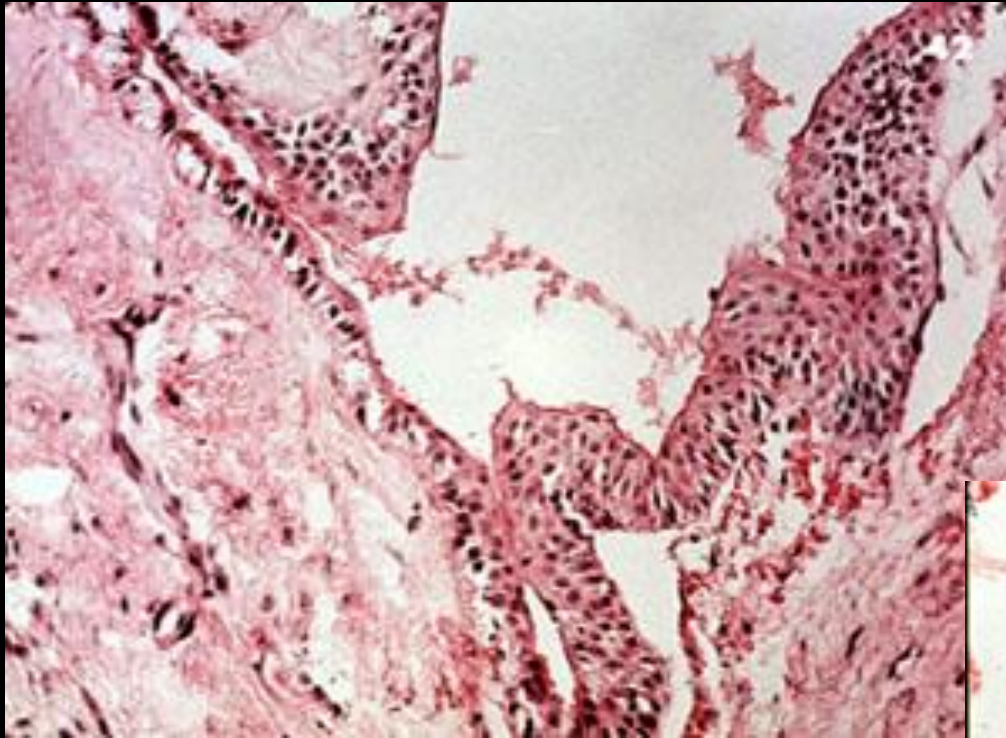


- Thin, non-keratinized squamous or cuboidal epithelial lining
- 1-5 cell layers
- Resembles reduced enamel epithelium
- Sometimes stratified squamous
- Usually free of inflammation



- Localized plaques or thickenings of the epithelial lining
 - Extend into the surrounding cyst wall
 - Mural bulges





- Glycogen rich clear cells in the epithelial lining

Botryoid odontogenic cyst

- First reported by *Weathers and Waldron, 1973*, who also proposed the name → resemblance to cluster of grapes
- Variant of LPC
- Microscopically similar to LPC with some differences

- Multilocular with thin fibrous connective tissue septa
- Smaller cyst cavities are oriented towards the larger ones
- Usually lined by thin non-keratinized epithelium, 1-2 layer thick
- In some areas thicker stratified squamous epithelium

- Foci of plaque like thickenings
- Flat fusiform cells
- Clear cells are unusual

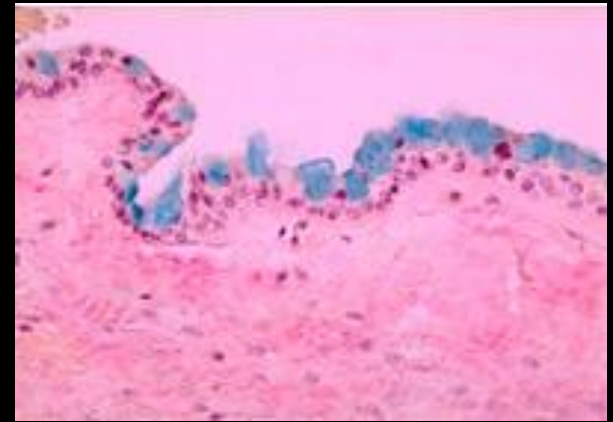
Glandular odontogenic cyst

- Sialo-odontogenic cyst
- Glandular odontogenic cyst
- Mucoepidermoid odontogenic cyst

- Wide age range
- Can occur in either jaws
- Propensity to grow to a large size and to recur
- Radiologically
 - Unilocular or multilocular
 - Smooth or scalloped margin



Histologically



- Non-keratinized stratified squamous epithelium
- Chronic inflammatory infiltration of connective tissue wall
- Superficial layer of epithelial lining
 - Columnar or cuboidal cells, occasionally with cilia
 - Glandular or pseudoglandular structure
 - Intraepithelial crypts or microcysts

may open onto the surface of epithelium



Papillary or corrugated surface



- Numerous goblet cells may be present
- Occasionally epithelium resembles REE
- Epithelial thickenings or plaques may be present
 - Protrude into the cyst cavity
 - Extend into the connective tissue wall
- Islands of odontogenic epithelium
- Microcysts
- Irregular calcifications

Calcifying odontogenic cyst

- First described by Gorlin, 1962
- Cyst or Neoplasm ??????

Clinical features

- Frequency
 - 1% of all jaw cysts
- Age
 - Peak in 2nd decade
 - Bimodal age distribution (6th-7th decade)
 - Extrasosseous lesions → over 50 years
- Sex
 - Equal sex distribution

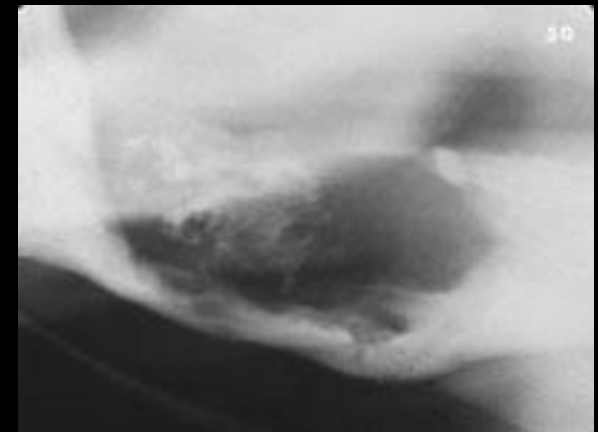
- Race
 - No racial predilection
- Site
 - Equal frequency in maxilla and mandible
 - Anterior jaw
 - Peripheral lesions → gingiva and alveolar mucosa anterior to molars

- Clinical presentation
 - Asymptomatic
 - Pain is rare
 - Bony hard swelling
 - May be fairly extensive
 - Occasionally may perforate cortical
 - Displacement of teeth



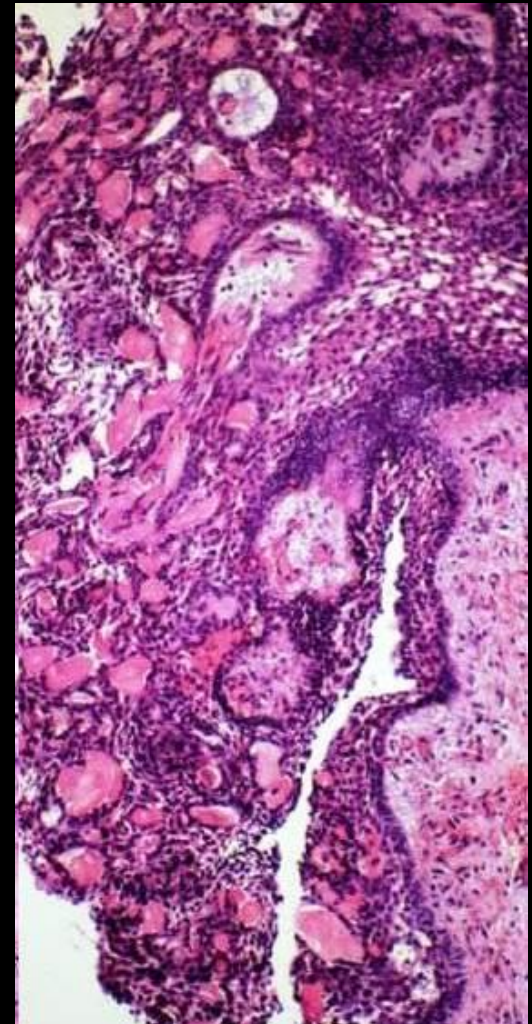
Radiological features

- Regular or irregular radiolucency
- Usually unilocular
- Irregular calcified bodies of varying sizes may be seen
- If associated with odontome → dense radiopacity
- Displacement of teeth
- Resorption of root



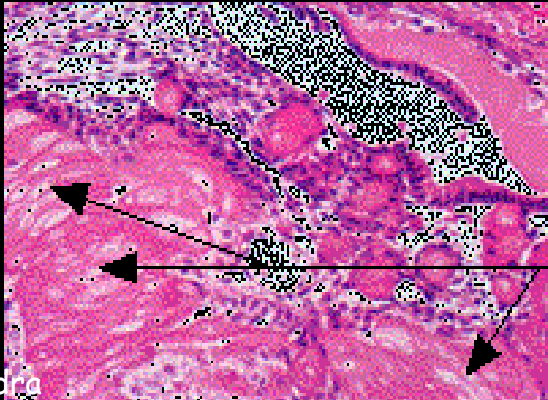
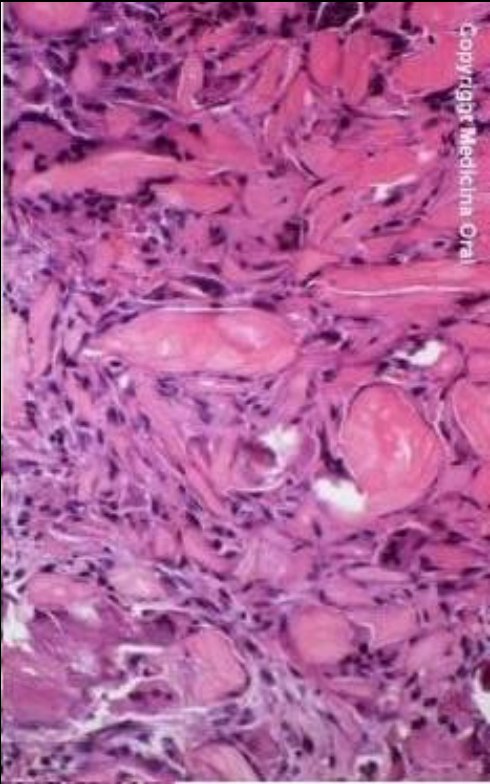
Histopathological features

- The epithelial lining shows
 - 6-8 cell layers
 - Prominent basal layer
 - Palisaded columnar or cuboidal cells
 - Hyperchromatic nuclei polarized away from basement membrane
 - Budding from basal layers
 - Epithelial proliferations

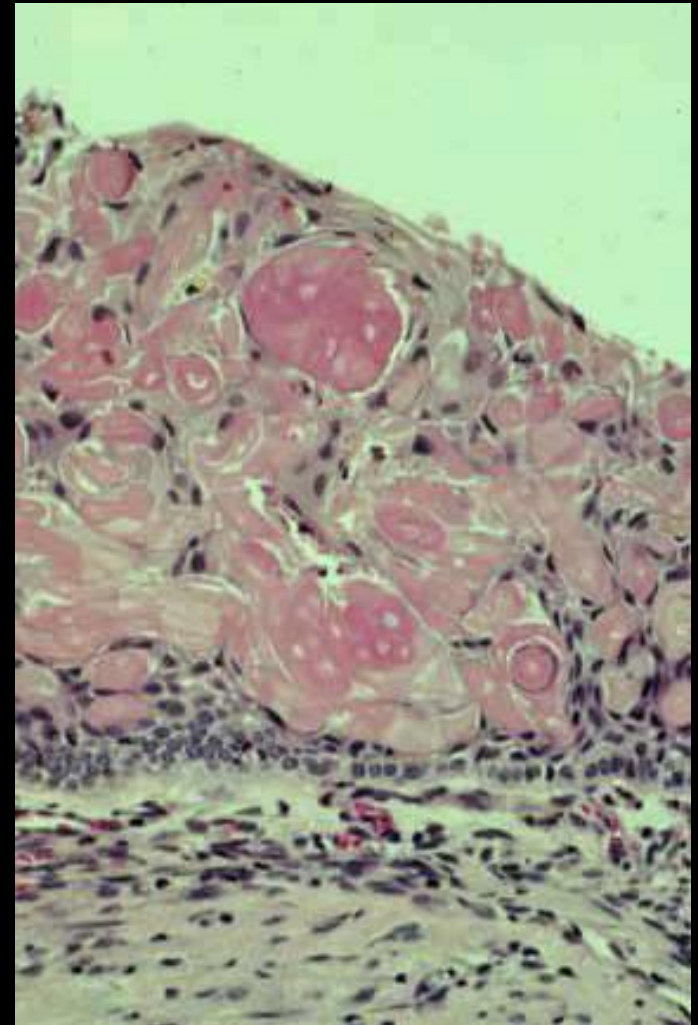


- Ghost cells
 - Essential characteristic for the diagnosis of COC

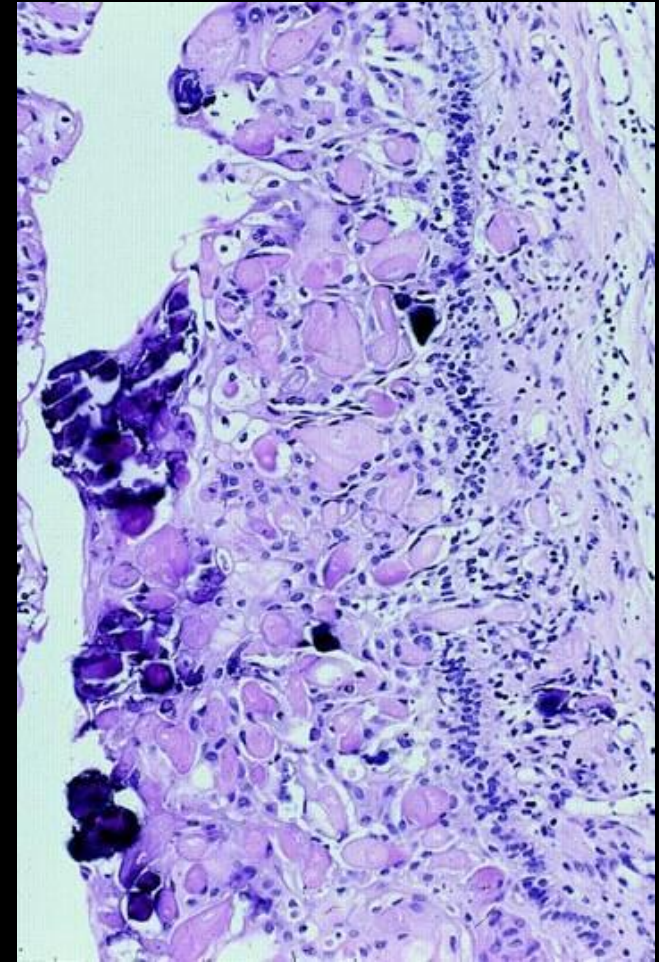
- May also be found in
 - Cutaneous epithelioma of Malherbe
 - Odontoma
 - Ameloblastoma
 - Ameloblastic fibro-odontoma
 - Ameloblastic fibroma



- Found singly or in groups
- Enlarged, ballooned, ovoid or elongated pleptoid
- Eosinophilic
- Cell outline usually well preserved
- Very faint nuclear outline (may contain nuclear remnants)



- Have an affinity for calcification
- May also be seen in the connective tissue
- Evokes a foreign body response in connective tissue with formation of giant cells
- May herniate into the cystic lumen



- Nature of ghost cells??????????
- Abnormal keratinization
- Squamous metaplasia with subsequent calcification caused by ischemia
- Metaplastic transformation of odontogenic epithelium
- Product of abortive enamel matrix
- Product of coagulative necrosis of odontogenic epithelium

- Other histological features
 - Satellite cysts
 - Atubular dentinoid close to the epithelial lining
 - Complex odontomes in the walls
 - Melanin deposits in the epithelial lining

Classification of COC

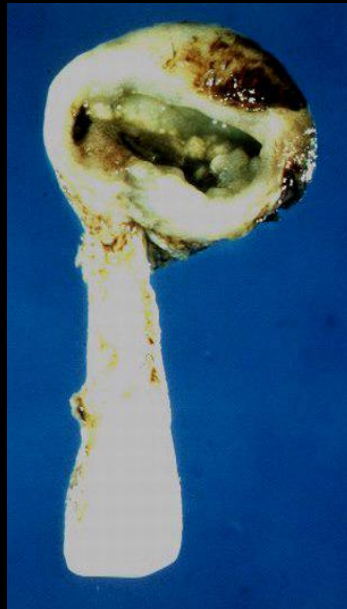
- Praetorius et al, 1981
 - Type 1 → cystic
 - Type 1A → simple unicystic type
 - Type 1B → odontome producing type
 - Type 1C → ameloblastomatous type
 - Type 2 → solid neoplasm
 - Ameloblastomatous epithelium with secondary cyst development

- Buchner, 1991
 - A. Peripheral (extraosseous) COC
 1. Cystic variant
 2. Neoplastic (solid) variant

 - B. Central (intraosseous) COC
 1. Cystic variants
 - a. Simple (unicystic or multicystic)
 - b. Associated with odontoma
 - c. Associated with odontogenic tumors (other than odontoma)
 - d. Other variants (clear cell variant, pigmented variant)
 2. Neoplastic (solid) variant
 3. Malignant COC

RADICULAR CYST

A radicular cyst is one which arises from the epithelial residues in the peridontal ligament as a result of inflammation



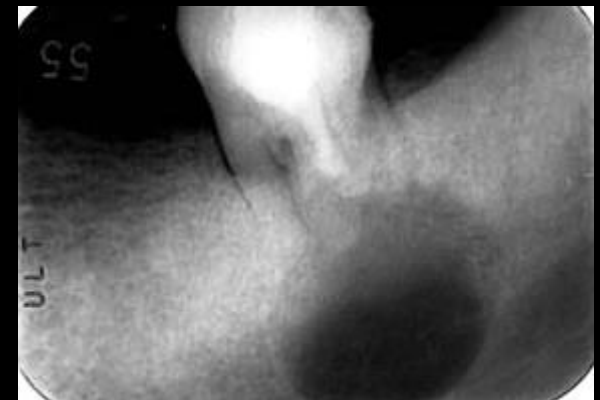
CLINICAL FEATURES

- Frequency
 - Most common cystic lesions in the jaws (52 - 68%)
- Age
 - Third decade
- Sex
 - Male preponderance
- Site
 - 60% Maxilla > 40% mandible

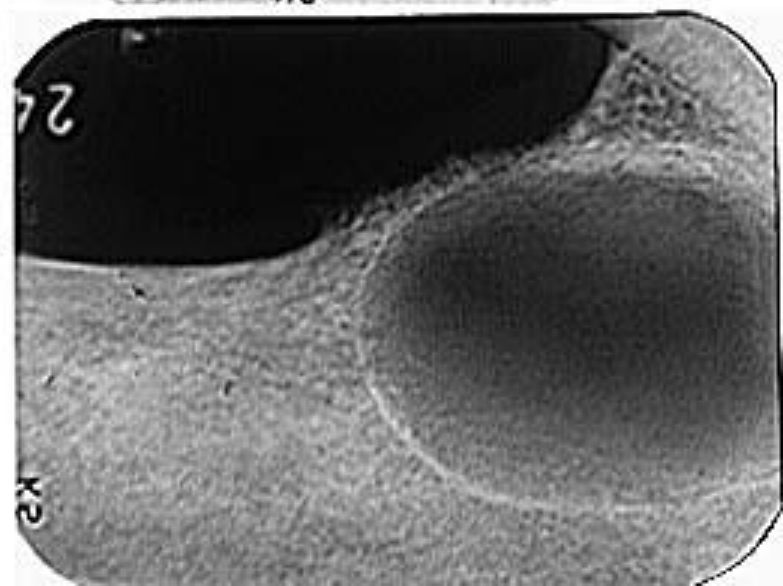
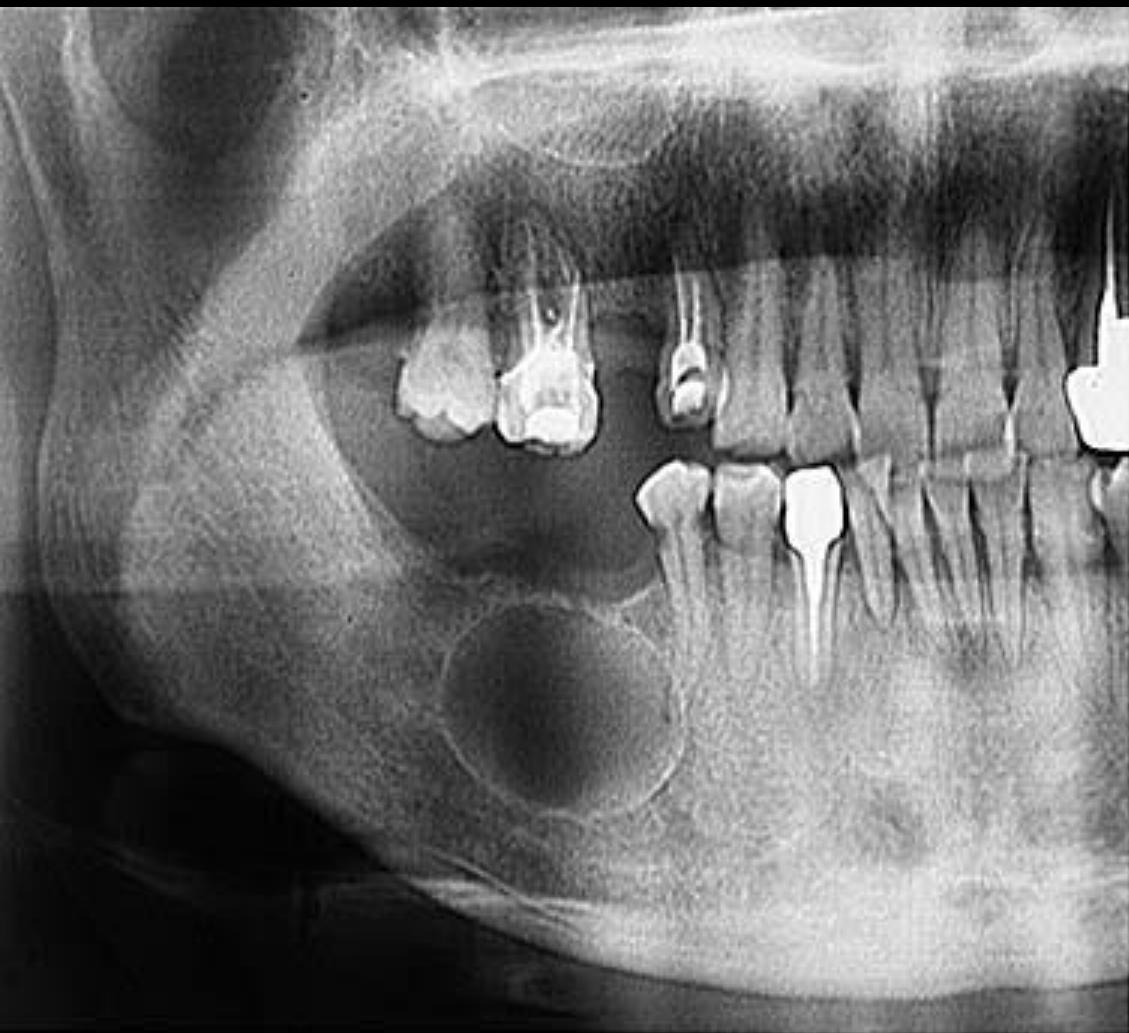
- Clinical presentation
 - Many are symptomless
 - Slowly enlarging swelling
 - Springiness & fluctuation
 - Tooth with a non vital pulp.
 - Sinus tract occasionally

RADIOLOGICAL FEATURES

- Round or ovoid radiolucencies bounded by a radio - opaque margin which extends from lamina dura of involved tooth.
- Root resorption is rare, but may occur.
- Infection causes diffuse radiographic margin



- Residual cyst
 - Those which are retained after removal of the offending non-vital tooth
 - Approximately 10% of all odontogenic cysts
 - Usually asymptomatic
 - Decrease in size with increase in age



PATHOGENESIS

- Epithelial cell rests of Malassez
- Three phases :
 - Phase of Initiation,
 - Phase of Cyst formation
 - Phase of Enlargement

- Phase of initiation:

Some product of a dead pulp evokes an inflammation reaction

Proliferation of odontogenic epithelium



- Local changes in the supporting C.T.
 - Decreased Oxygen
 - Increased Carbon dioxide Tension
 - Local Reduction In PH
- Role of immune factors
 - IgG
 - Compliment C3

Bacterial antigens from the infected pulp



Bind with antibodies



Form antigen-antibody complexes



Co-activate complement



Increased vascular permeability and leukotactic response

- Role of anaphylactic hypersensitivity reaction
 - Presence of IgE containing cells and mast cells
- Humoral & cell - mediated reactions
 - T cells are more
 - Low B cell activity
 - In areas of intense inflammation, greater number of S-100 and HLA-Dr positive cells

Activated T cells in periapical granulomas



Produce lymphokines



Act on rests of Malassez



Proliferation and altered differentiation



Cyst formation

- Phase of cyst formation:
 - Breakdown of connective tissue by proteolytic enzyme activity
 - Central degeneration in the proliferating epithelium
 - Proliferating epithelial masses show considerable intercellular edema.
 - High levels of acid phosphate activity in the central cells of PG
 - Sheets of epithelial cells with distinct clefts are seen

- Phase of enlargement:
 - Osmosis could play role in enlargement
 - Cyst walls have properties of semipermeable membranes
 - In vivo dialysis experiments showed crystalloid diffusion was rapid and colloid retained
 - Mean osmolality is greater than serum
 - Plasma proteins
 - Hyaluronic acid
 - Products of cell breakdown
 - Osmotic imbalance is due to absence of lymphatics
 - Internal cystic pressure is higher than capillary blood pressure

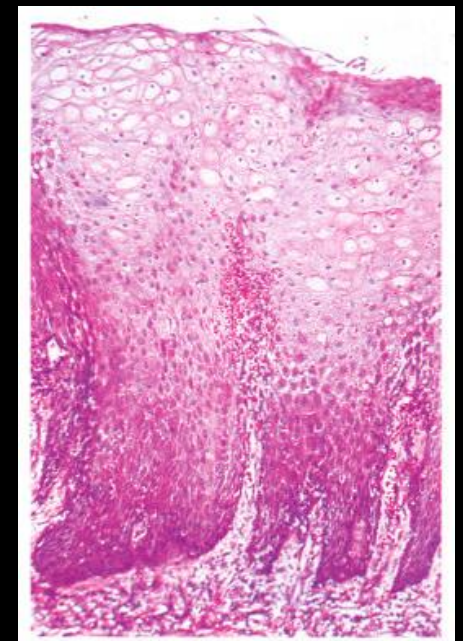
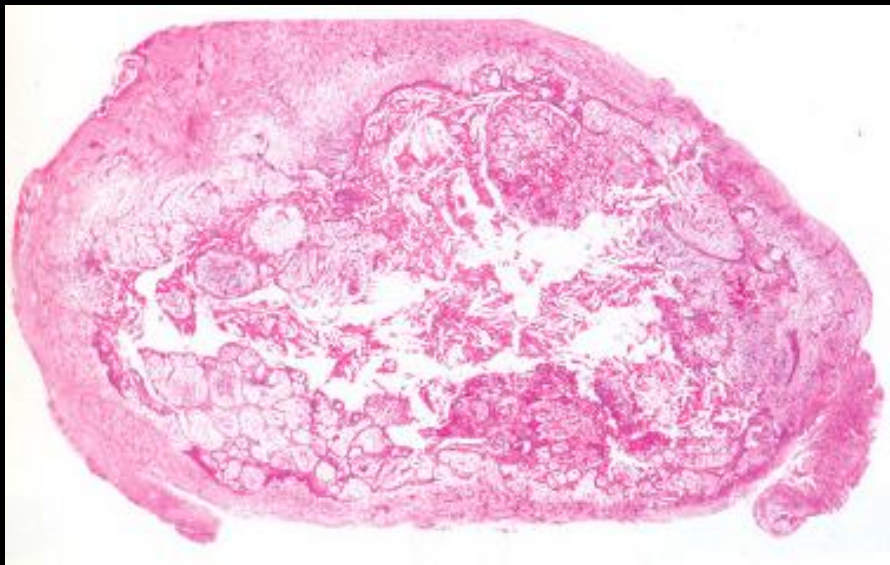
- As the cyst expands there is resorption of the surrounding bone
- Intraosseous expansion is facilitated by
 - Local enzymes
 - Hormone-induced bone resorption
 - Lipoperoxides
 - Prostaglandins
 - Collagenolytic activity
 - MMPs
- Rate of growth → 5mm per year

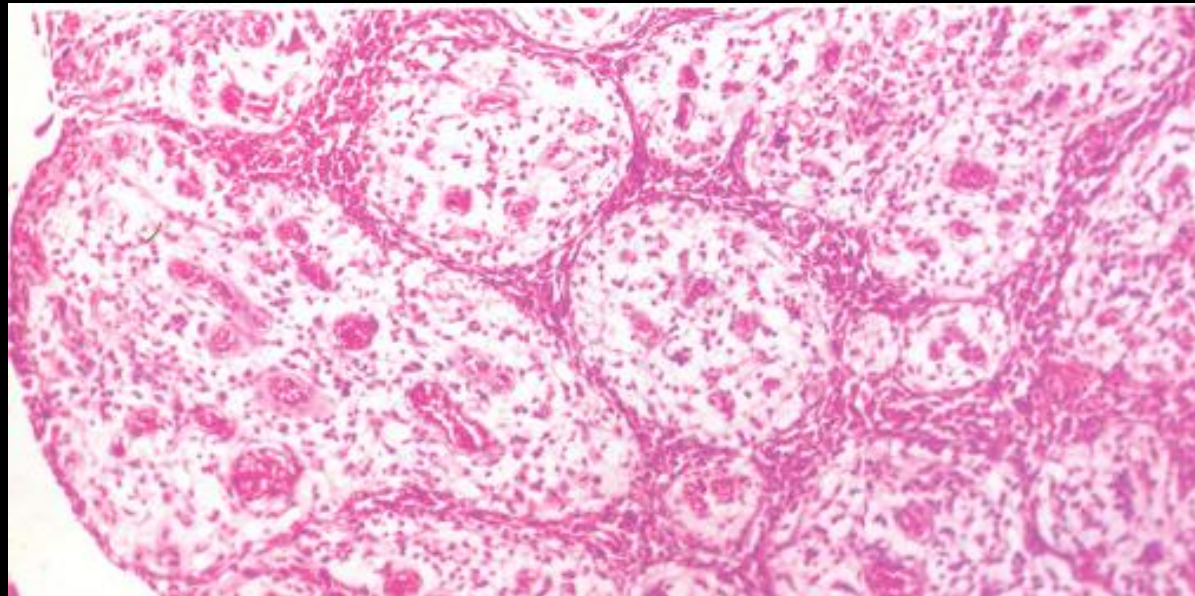
Histopathological features

- Gross
 - Spherical / ovoid intact masses
 - Walls are thick
 - Yellow mural nodules of cholesterol

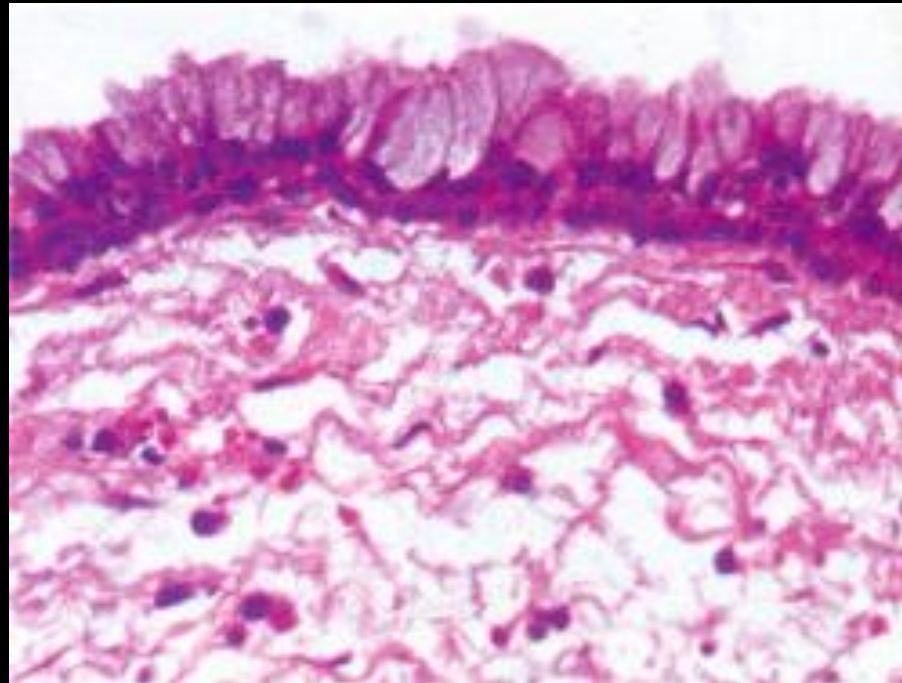


- St. sq. epithelium, range from 1to 50 cell layer

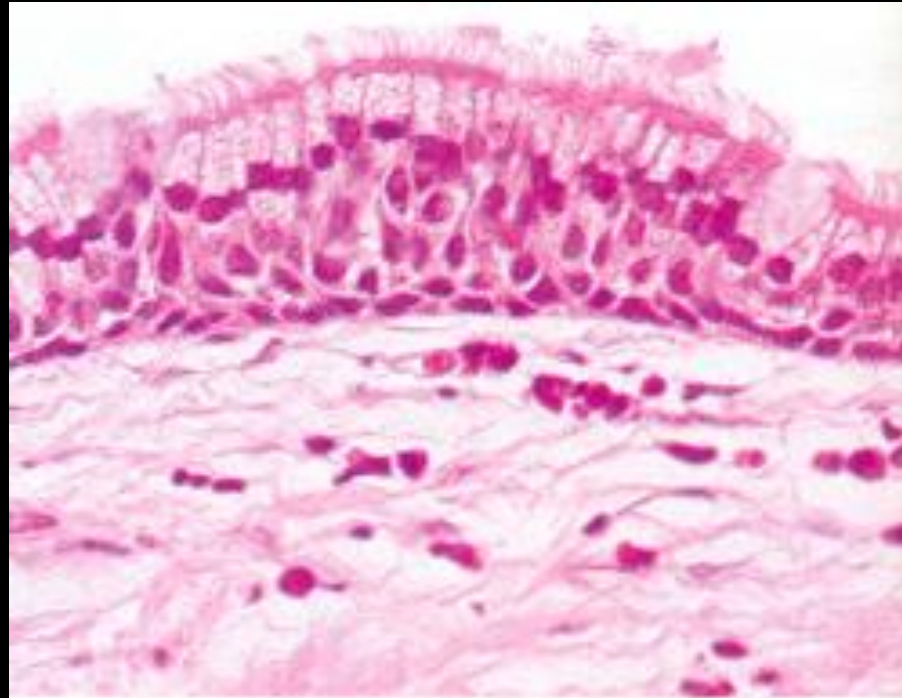




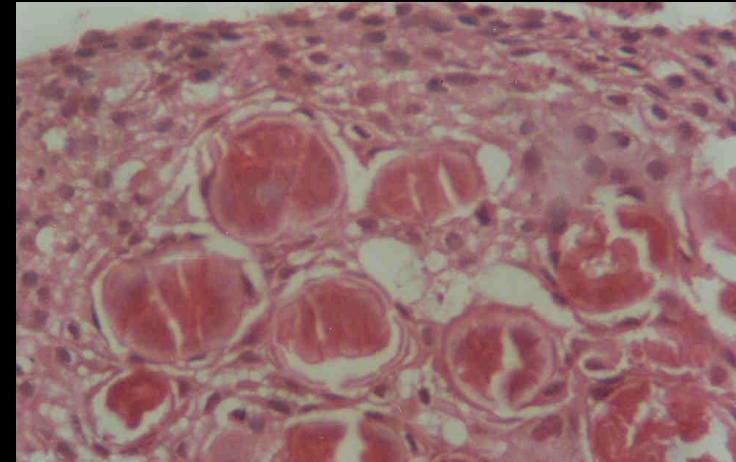
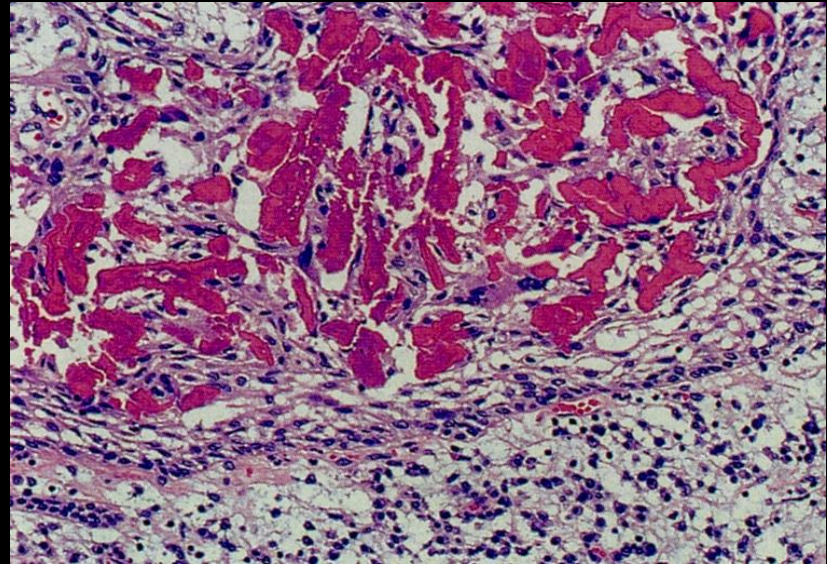
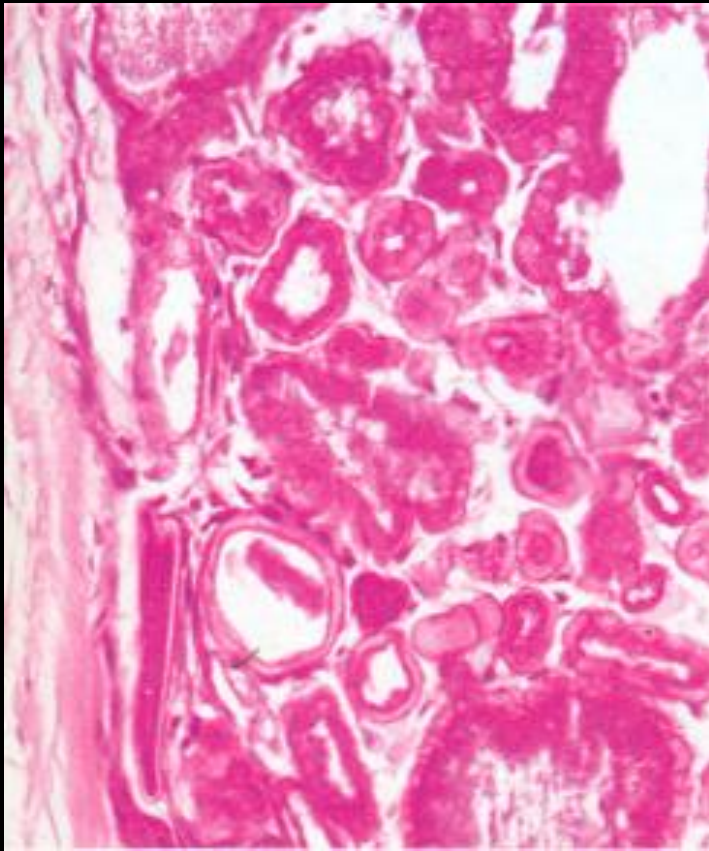
- Arcading pattern
- Spongiosis



- Mucous cells
- Increased incidence with age



- Ciliated cells
- Mostly in maxilla

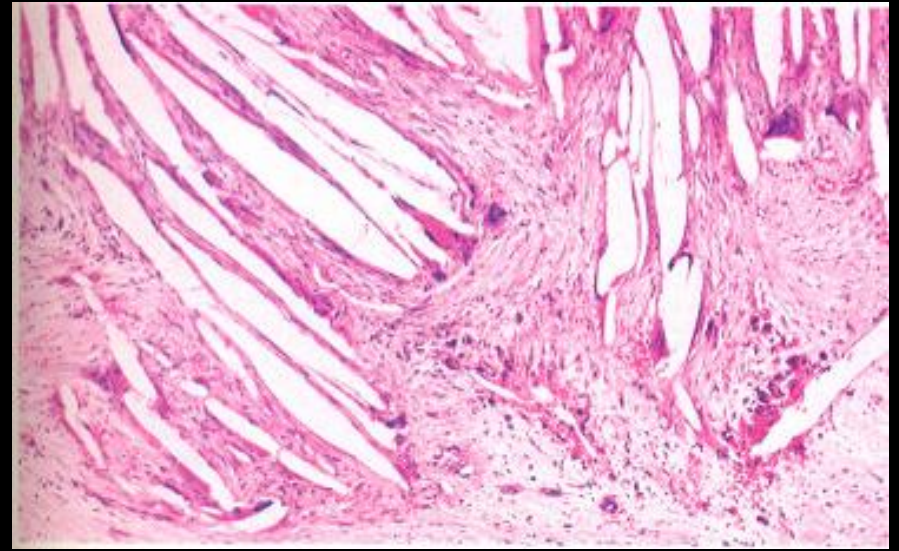
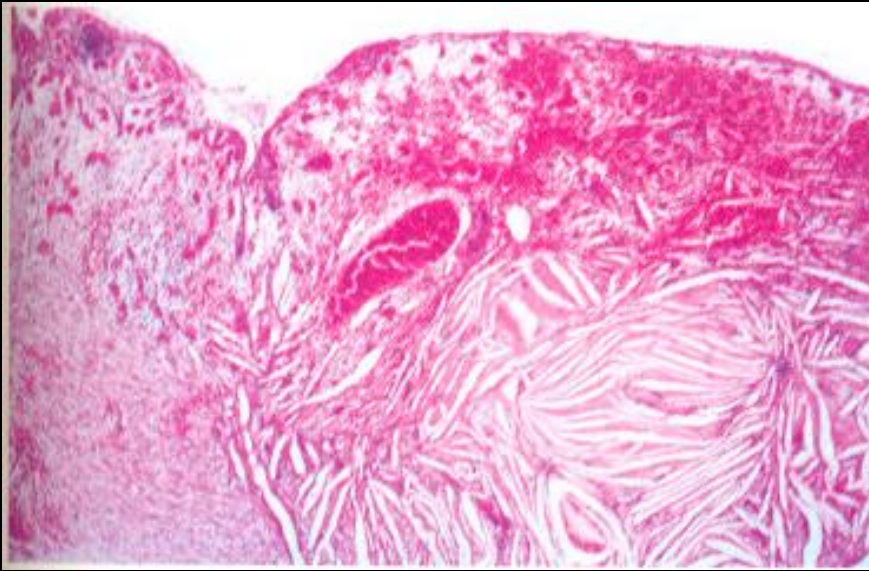


- Hyaline or Rushton's bodies

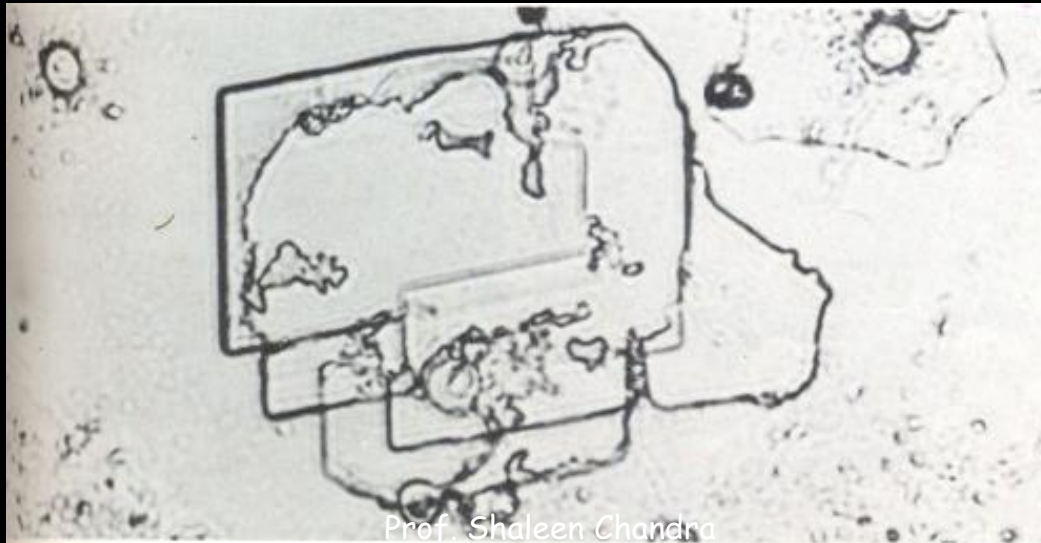
- Origin of Rushton bodies
 - Secondary enamel cuticle
 - Keratin
 - Hemotagenous origin
 - Non keratinous secretory product of the odontogenic epithelium

- Type I → homogenous with no central granular component
- Type II → encloses coarse grained foreign material

- Some characteristic shapes
 - Linear, straight or curved
 - Broken up pieces of plate
 - Circular or polycyclic
 - Elongated type lining cleft like spaces



- Cholesterol crystals and clefts



- Sources of cholesterol
 - Disintegrating RBCs
 - Lymphocytes
 - Plasma cells
 - Macrophages
- Behaves as foreign body and elicits a giant cell reaction
 - Derived from pericytes

- Pigmented cells in the epithelial lining
 - Macrophages containing lipid pigment ceroid

Small periapical lesions

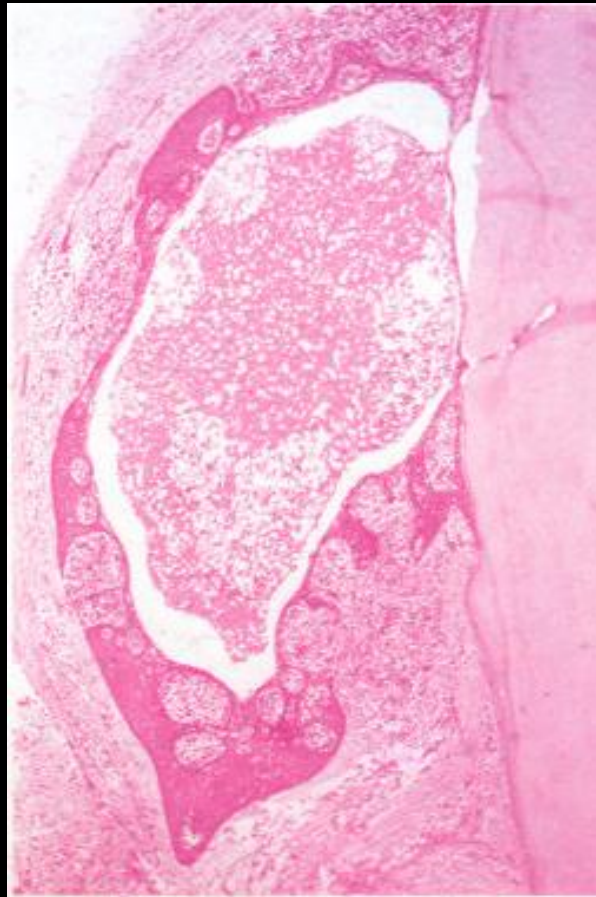


Cavity lined by epithelium
opening into the root
canal



Bay cyst





- Lateral radicular cyst

- Fibrous capsule is composed of
 - Condensed collagen peripherally
 - Loose connective tissue adjacent to the epithelial lining
- Divided into 3 layers
 - Inner granulomatous layer
 - Moderately fibrous intermediate layer
 - Densely fibrous outer layer

- Varying degrees of acute and chronic inflammatory cells
 - Areas of epithelial proliferation → acute
 - Fibrous capsule → chronic
- Mast cells → subepithelial zone

- Remnants of odontogenic epithelium
- Satellite microcysts
- Hemorrhage and hemosiderin deposits
- Calcifications

- Microbial flora
 - Mostly gram positive anaerobic cocci
 - Gram negative anaerobic rods
 - Gram positive aerobic cocci

Carcinomatous change

- Few cases of squamous cell carcinoma arising from radicular cyst has been reported
- Keratin metaplasia in long standing cyst may precede carcinomatous transformation
- Very rare → can not be considered as precancerous lesion

PARADENTAL CYST

Cyst which occurs on the lateral aspect of roots of partially erupted mandibular 3rd molar when there is a history of associated pericoronitis

- Main → Inflammatory collateral cyst
- Craig → Paradental cyst

Clinical features

- 3% of cysts
- 3rd decade.
- Males
- Mandibular 3rd Molars with history of pericoronitis

Radiologically

- Well demarcated radiolucency distal to partially erupted 3rd molar
- Often buccal superimposition
- Intact periodontal ligament space

Histologic features

- Indistinguishable from radicular cyst

Pathogenesis

- Reduced enamel epithelium
- Rests of Malassez

Mandibular infected buccal cyst

- Permanent mandibular 1st and 2nd molars rather than wisdom teeth
- Younger age
- Similar to paradental cyst
- More extensive & severe clinical features

Cystic fluid and its role in diagnosis

Investigation	OKC	Dentigerous cyst	Radicular cyst
Color	Clear - transudative	Clear - transudative	Straw colored - exudative
Consistency	Viscous - not free flowing.	Viscous - Not free flowing	Watery - Free flowing
Quantity	< radicular & dentigerous C	< radicular C	> All Dev. Odont. cysts
osmolality	296 milliosmoles	286m.os	290m.os
Intracystic pressure	Increased. > dentigerous & Rad.	Same as radicular.	Same as DC

Investigation	OKC	Dentigerous cyst	Radicular cyst
Soluble protein	2.09g/100ml	5.40gm/100ml	4.86g/100ml
Albumin	78.03	61.35	51.19
β globulins	7.52	13.98	17.52
γ globulins	7.91	12.70	22.02
Immunoglobulins	Decreased IgG cell ↓ IgA cell ↑	Increased IgG cell ↑ IgA cell ↓	Increased IgG cell ↑ IgA cell ↓
Cholesterol crystals	absent	present	present
Keratin	present	Usually absent	May be present

Investigation	OKC	Dentigerous cyst	Radicular cyst
Collagenolytic inhibitor	Decreased	Increased	Increased
Prostaglandin	Decreased	Increased PGE2 & PGE3	Increased PGE2 & PGI2
Lactoferrins	Higher	Lesser	Lesser
Mucopolysaccharides	++ (heparin sulphate increased)	++ (hyaluronic acid increased)	+
Crystalline deposits	Present Increased phosphate	Absent	Present
Interleukin -1 like material	+	++	+

Lesion	Aspirate	Other findings
Dentigerous	Clear pale, straw coloured fluid	Cholesterol crystals Total protein > 4g/100ml(resembling serum)
OKC	Dirty, creamy white viscid suspension	Parakeratinised squames. Total protein < 5g/100ml most of which is albumin
Radicular cyst	Clear pale yellow straw coloured fluid	Varying amounts of cholesterol crystals. Total protein b/n 5- 11g/100ml
Infected cysts	Pus or brownish fluid, seropurulent/sanguinopurulent fluid, at times paste like or caseous consistency.	PMNL, Foam cells cholesterol clefts
Solitary bone c	Serous or sanguinous fluid, blood or empty cavity	Necrotic blood clot

Gingival cysts	Clear fluid
Fissural cysts	Mucoid fluid
Mucocele, ranula	Mucus
Dermoid cysts	Thick sebaceous material
Stafne's bone cavity	Empty cavity will yield air
Vascular cysts walls	Fresh blood
Intramedullary cavernous hemangioma	Syringe full of venous blood
Arterial or arteriovenous malformation	Bright red blood, pulsatile, pushes plunger

References

- Cysts of Oral regions- Shear
- OKC- Clinics of NA
- *Odontogenic keratocyst : Review of 256 cases for recurrence and clinicopathologic parameters. 000: 91: March 2001*
- R.M. Browne: The odontogenic keratocyst, histological features and their correlation with clinical behaviour. Brit dent J. 1971 131, 249.

- Crowley et al. Odontogenic keratocyst: a clinical comparison of the parakeratinized and orthokeratinized variant. JOMS 1992; 50: 22-26
- Hong et al. calcifying odontogenic cyst: a review of 92 cases with reevaluation of their nature as cysts or neoplasms. Triple 'O' 1991; 72: 56-64
- Buchner A. the central calcifying odontogenic cyst: an analysis of 215 cases. JOMS 1991; 49: 330-339

- Lucas
- Shafer
- Neville
- Regezi



thank you