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|  | **Inflammatory Cysts** | | | | **Developmental Odontogenic Cysts** | | | | | | | **Cysts of Maxillary Antrum** | | | | **Non-Epithelial Primary Bone Cyst** | | |
|  | **RADICULAR CYST**   * Periapical Cyst * Dental Cyst * Apical Periodontal Cyst | **RESIDUAL CYST** | **LATERAL RADICULAR CYST** | **INFLAMMATORY COLLATERAL CYST**   * Paradental Cyst * Mandibular Infected Buccal Cyst * Buccal Bifurcation Cyst | **DENTIGEROUS CYST**   * Follicular Cyst | **ERUPTION CYST**   * Eruption Hematoma | **ODONTOGENIC KERATOCYST**   * Keratocystic odontogenic tumor | **Lateral Periodontal Cyst** | **Gingival Cysts of Adults** | **Dental Lamina Cyst of New Born** | **Glandular Odontogenic Cyst** • Sialo-odontogenic Cyst | **Mucocele** | **Retention Cyst** | **Pseudocyst** | **Postoperative Maxillary Cyst** | **Solitary Bone Cyst (Simple or traumatic or hemorrhagic bone cyst)** | **Aneurysmal Bone Cyst (ABC)** | **Stafne’s Idiopathic Bone Cavity** |
| **DEFINITION** |  | • It is a radicular cyst that has remained in the jaw and failed to resolve following extraction of the involved tooth.  • 20% of radicular cysts are of residual variety. | • It is very uncommon & arises as a result of extension of inflammation from the pulp into the lateral periodontium along a lateral root canal. |  | • Formed around the crown of unerupted tooth.  • Asymptomatic  • 5% of DC associated with supernumerary teeth, mostly with mesiodens. | • An odontogenic cyst with the histologic features of dentigerous cyst that surrounds a tooth's crown that has erupted through bone but not soft tissue & is clinically visible as a soft fluctuant mass on the alveolar ridge.  • It may involve both the deciduous & permanent dentition.  • Mastication will occasionally induce hemorrhage in an eruption cyst giving rise to term "Eruption Hematoma" for this cyst. | • Age 2nd - 3rd decade.  • Tumor like characteristics of lining epithelium. | • uncommon  • asymptomatic  • share gingival cyst in clinical & morphological features  • Arise in canine & premolars region of mandible of mid-aged individuals |  | • Uncommon soft tissue raised nodules on  edentulous alveolar ridges  of the infants |  | Occupies the entire sinus. Cystic structure filled with mucus and lined by antral epithelium. Associated with blockage of the ostium and may be secondary to chronic sinusitis. Expansile and may destroy and perforate adjacent bone. | Epithelial lined cyst caused by mucus retention as a result of blockage of a duct. Often small and clinically silent and found associated with thickened mucosa in sinusitis or in polyps. Dome shaped radiopacity of antral wall, may be indistinguishable from a pseudocyst of polyp | Inflammatory in origin caused by accumulation of exudates that raise the mucosa from the bone of the antral floor. Most often secondary to odontogenic infection. Dome-shaped radiopacity on the floor of the sinus. | Secondary to an operative procedure. Most often a Caldwell-luc incision into the antrum or an osteotomy. Probably arises from entrapped antral lining. True cyst filled with mucus and lined by antral epithelium | • Seen in children & adolescents  • Asymptomatic • Chance radiographic finding | • Rare  • Affect children & young adults  • Painless |  |
| **ORIGIN** | Epithelial cell rest of Malassez -- proliferate by inflammation | Epithelial cell rest of malassez |  | Epithelial Cell Rests in PDL or buccal bifurcation of mandibular molars. | Fluid accumulation in the layers of REE or between epithelia and crown of unerupted tooth. | Reduced Enamel Epithelia | Dental lamina | Dental Lamina | Dental lamina | Dental lamina & composed of keratin producing epithelia | Dental Lamina |  |  |  |  |  |  |  |
| **CLINICAL FEATURES** | • Most common odontogenic cyst  • Associated with non-vital tooth  • Asymptomatic unless secondarily infected.  • On palpation:  Hard; when outer bony cortex is intact.  Crepitant; when cortex is thin (egg shell crackling)  Rubbery & fluctuant; if outer cortex is perforated. |  |  | • Found near the cervical margin on the lateral root surface of a vital tooth  • Develops subsequent to periodontitis or pericoronitis (cf partially erupted third molar)  • Age of detection: within third decade. |  |  | • Present as a single lesion, it can occasionally occur as multiple cysts that sometimes occupy all four quadrants of  the jaw. | • chance radiographic finding  • can cause bony expansion | Firm, but compressible, fluid-filled swelling on mandibular or maxillary facial gingival in premolar & canine region |  | • Aggressive  • Large  • Solitary or multilocular |  |  |  |  | • **Surgical Exploration:** rough bony-walled cavity devoid of any detectable soft tissue lining  • Cavity is empty or with little clear or blood stained fluid | • Firm | Symptomless |
|  |  |  |  |  |  |  | • Multiple OKC are one of the consistent features of the **Nevoid Basal Cell Carcinoma Syndrome (Gorlin-Goltz Syndrome)** (4-5%)  1. Multiple OKC of jaws.  2. Multiple Basal cell carcinoma of skin.  3. Bifid ribs & vertebral deformities.  4. Calcification of Falx cerebri.  5. Palmer & planter dyskeratosis.  6. Frontal bossing.  7. Hypertelorism.  8. Ovarian fibromas.  9. An important clinical feature of OKC is their tendency to recur after surgical treatment. |  |  |  |  |  |  |  |  |  |  |  |
| **LOCATION** | • At the apex of non-vital tooth, occasionally on mesial  or distal.  • 60% in maxilla (esp. incisors & canines)  • Buccal to developing bicuspid if deciduous molars  are affected. |  |  | • in association with mand molars.  • Occasionally bilateral | • Just above the crown of the involved tooth.  • Mostly, mand or max M3 or Max canine.  • Dx feature: cyst attach at CEJ.  • Some DC are eccentric (beside the crown)  instead of above the crown.  • May grow into maxillary sinus, attain large size  before discovered. (associated with which tooth?)  • May extend into considerable distance into  ramus. |  | • Any site in the jaw with about 2/3 of the cases occurring in the mandible, primarily in the posterior body & ramus areas.  • Well-defined solitary lesion or as multilocular/polycystic radiolucencies exhibiting a thin corticated margin.  • Many present in apparent dentigerous relationship associated with unerupted third molar, but the crown of such teeth are usually separated from the cyst cavity. | 50-75% in the mandible (canine & PM  region) |  |  | • Anterior Mandible  • Anterior Maxilla |  |  |  |  | • Arise in premolar & molar regions of mandible | • posterior part of body  • angle of mandible | Between premolar region and angle of jaw just below inferior dental canal. |
| **PERIPHERY & SHAPE** | • Well defined cortical border which is lost  when secondarily infected.  • The outline is usually curved or circular,  unless influenced by surrounding structures  such as cortical boundaries. |  |  | Circular shape with well –defined cortical border | • Well defined cortex with a curved or circular outline.  • If infected: the cortex may be missing. |  | • Smooth, round or oval  • May have scalloped outline | Well- defined, round, oval RL | • None,  • sometimes saucerization  of the underlying bone |  | • smooth or scalloped  • cortical boundaries |  |  |  |  | Radiolucency of variable size  Irregular Outline  **Scalloping (prominent feature) around & between roots of teeth** well defined margins | Multilocular radiolucency with a **characteristic ballooned out appearance due to gross cortical expansion** | Chance radiographic finding  Appear as round or oval well demarcated radiolucency  Saucer shaped depression or concavity of varying depth on lingual aspect of mandible |
| **INTERNAL STRUCTURES** | • Mostly radiolucent  • Occasionally with dystrophic calcification  (long-standing cyst) [sparsely distributed  particulate RO). |  |  | Radiolucent | Completely Radiolucent |  | • Radiolucent  • Sometimes, curved internal septa from the ML appearance |  |  |  | • Uni or multilocular  • Radiolucent |  |  |  |  |  |  |  |
| **EFFECTS ON SURROUNDING STRUCTURES** | • Displacement & resorption of roots of  adjacent teeth (if large).  • Resorption pattern have curved outline.  • Sometimes cyst may resorb the roots of the  related non-vital tooth.  • Cyst may displace the IDC inferiorly. |  |  | Striking diagnostic characteristic:  • tipping of the involved root tips into lingual cortical plate & the occlusal surface toward buccal aspect of the mandible( Occlusal proj.)  • Lingual cusp tip positioned higher than buccal tips  (OPG). | • Displace & resorb adjacent teeth  • Displace the associated tooth in an apical direction.  • Max Canine & Max 3: Involved tooth may be pushed to the floor of the orbit.  • Mand M3: May be moved to condylar or coronoid region or to the inferior cortex of the mandible.  • May invaginate the antrum or may displace the IAN canal inferiorly. |  | • Minimal expansion of cortical plates (late detection)  • Occasionally displace & resorb teeth  • Displacement of Inferior Alveolar Canal | Teeth  displacement if large |  |  | • Teeth displacement  • Cortical peroforation |  |  |  |  |  |  |  |
| **DIFFERENTIAL DIAGNOSIS** | **Small cysts (< 1 cm)**  I. apical granuloma  II. Periapical pocket cyst  **Larger cyst ( > 2cm)**  I. Apical scar  II. PA cemental dysplasia (early stage)  **Cyst with upper lateral may be position palatal or between laterals and canine:**  I. Small OKC  II. Lateral Periodontal cyst |  |  | • Developmental lateral periodontal cyst,  • Inflammatory lateral radicular cyst  • Odontogenic keratocyst | • Hyperplastic tooth follicle. (cf. displacement, bone expansion)  • OKC (degree of expansion is less, tooth resorption, more apically)  • Cystic Ameloblastoma (biopsy to confirm)  • Adenomatoid odontogenic tumor (to be discussed later) |  | • Dentigerous cyst  • Ameloblastoma (ML KOT)  • Odontogenic Myxoma (ML )  • Simple bone cyst ( Scalloping with minimal expansion) | • Small okc  • Mental foramen  • Radicular cyst |  |  | • Ameloblastoma  • KOT  • Central muco-eoidermoid carcinoma |  |  |  |  |  |  |  |
| **MANAGEMENT** | 1. Tooth extraction  2. Endodontic therapy  3. Surgical removal or marsupialization |  |  | •Extraction &/or curettage  • Removed by conservative curettage.  • Involved molar should not be removed | • Surgical removal which include the  tooth as well.  • Large cyst: Marsupialization before  removal.  • Cyst lining should be submitted to  histo exam why? | • Most of these cysts require no treatment because they spontaneously rupture & become exteriorized as a result of normal mastication.  • Otherwise, surgical exposure of the crown of tooth is done to allow its eruption. | •Surgical enucleation  • in severe cases surgical resection. | Enucleation | Enucleation | Resolved without treatment | Resection |  |  |  |  | Rapid healing following surgical exploration & cyst resolve spontaneously with time. |  |  |
| **RECURRENCE** | Rare or unlikely if cyst has been removed  completely. |  |  | • Does not recur |  |  | • Exhibits a recurrence rate of 25-69% similar to that of a neoplasm (Keratotic Odontogenic tumor)  • Recurrence rate is high & close clinical follow –up of the surgical site is advisable.  • RECURRENCE COULD BE DUE TO:  1. Thinness of the cyst wall & its low tensile & rupture. Strength compared to Radicular cyst make enucleation more difficult & recurrence may thus follow retention of fragments of torn lining.  2. Presence of daughter cysts in cyst wall.  3. Focal separation of epith. Lining from underlying C.T make surgical removal very difficult. | Uncommon |  |  | High recurrence rate |  |  |  |  |  |  |  |
| **PATHOGENESIS** | The phase of initiation  • **Endotoxins and inflammatory cytokines** that are the main stimulators of the epithelial proliferation  • The epithelial cell rests are initiated to proliferate by inflammation as a result of necrotic debris and bacterial antigens (endotoxins) derived from the dead pulp.  • Endotoxins from *Actinobacillus actinomycetemcomitans, Porphyromonas gingivalis and Escherichia coli* could directly stimulate epithelial proliferation in a dose-dependent manner.  •Both humoral and cell-mediated reactions have been implicated in the pathogenesis.  • Inflammatory cytokines in the proliferation of epithelial cell rests ( mainly IgGs)  • Complement activation may also occur directly under the influence of endotoxins.  • T cells predominated and that helper cells predominated over cytotoxic/suppressor cells in most periapical granulomas and cysts.  • In cysts, however, they found increased numbers of plasma cells suggesting that humoral immune reactions may take on a more important role in cysts.  • Studies confirmed that the epithelial lining of radicular cysts may synthesize cytokines that are known to be important in bone resorption.    Phase of cyst formation  • Two possibilities , both are feasible and may operate independently of one another.  • First: epithelium proliferates and covers the bare connective tissue surface of an abscess cavity or a cavity which may occur as a result of connective tissue breakdown by proteolytic enzyme activity.  • The other, “more widely supported theory “, postulates that a cyst cavity forms within a proliferating epithelial mass in an apical granuloma by degeneration and death of cells in the center.  • MMP-13 may have a role in the pathogenesis of cysts by facilitating epithelial cell proliferation and invasion of the granulation tissue.    Phase of enlargement:  • Osmosis makes a contribution to the increase in the size of cysts with absence or inadequate lymphatic drainage  • Lytic products of the epithelial and inflammatory cells in the cyst cavity provided the greater numbers of smaller molecules which raised the osmotic pressure of the cyst fluid.  • Intra-cystic pressure in the cyst is inversely correlated to the cyst size. Therefore , increased pressure played a pivotal part in early cyst growth. |  |  | **Histopathology**  • Similar histopathologic features to radicular cyst  • Non-keratinised squamous epithelium with fibrous CT capsule that is commonly inflamed    **Histogenesis**  • Epithelium derived from rests of Malassez in superficial periodontium or REE in the case of partially erupted molar teeth. | The cyst is attached to the CEJ. The  crown of the associated tooth is related  to the cyst in one of three ways:  • Central type: The most common type, in which cyst is completely surrounds the crown of the tooth.• Lateral type: The cyst projects laterally from the side of tooth & does not completely enclose the crown.  • Circumferential type: Cystic changes occurs in a band around the circumference of CEJ producing a doughnut-shaped lesion (rare). |  | • Possess a remarkable growth potential greater than other odontogenic cysts  • Can attain a large size resulting in massive bone destruction. | • uncertain, but it could arise  initially as lateral dentigerous cyst which for  unknown reasons retained in bone when the  tooth erupts. • Occasionally , polycystic “Bortryoid odontogenic  cyst” can be seen which represents simultaneous  cyst changes in multiple adjacent rests of dental  lamina. |  |  |  |  |  |  |  | Uncertain but possible relationship to trauma in 50% of cases. (Trauma may produce intramedullary hemorrhage which for unknown reasons fails to organize & that cavitation occurs by subsequent hemolysis & resorption of clot. | Uncertain but many ABCs are produced by some other primary bone lesions like **Fibrous Dysplasia or Central Giant Cell Granuloma**  It is thought that the primary lesion initiates a vascular malformation leading to hemodynamic disturbance resulting in the development of this cyst.  There may be a history of trauma |  |
| **CYST** | **Cyst Lining:**  • In newly formed cysts the epithelial lining is:  - Irregular and may vary in thickness .  - Hyperplasia is a prominent feature resulting in long anastomosing cords of epithelium forming complex arcades extending into the surrounding capsule.  - The capsule is richly vascular and diffusely infiltrated by inflammatory cells.  • In established cysts the epithelial lining is:  - More regular in appearance and of fairly even thickness.  - Metaplasia of the epithelial lining may give rise to mucous cells, found in about 40 % of radicular cyst linings  -In approximately 10 % of cases the lining contains hyaline eosinophilic bodies - Rushton bodies - of varying size and shape . They appear to have no clinical or diagnostic significance and their origin is unknown, but they represent a secretory product of odontogenic epithelium  - Deposits of cholesterol crystals are common within the capsules of many radicular cysts.  - Mural cholesterol clefts are associated with foreign-body giant cells.  - As in periapical granulomas the cholesterol is probably derived from the breakdown of red blood cells as a result of haemorrhage into the cyst capsule, and deposits of haemosiderin are commonly associated with the clefts .    **Cyst Contents**  • It varies from a watery-straw colored fluid through a semi-solid brownish material of paste-like consistency.  • It is hypertonic compared with serum & contains:  - Breakdown products of degenerating epithelia & inflammatory cells &C.T components.  - Serum proteins , derived from inflammatory exudates & contains high levels of immunoglobulins due to local production from plasma cells in the capsule.  - Water & electrolytes.    **Cyst Expansion**  • Once cyst is formed, it tends to continue to expand equally in all directions like a balloon.  The rate of expansion is governed by:  a- Rate of local bone resorption.  b- Hydrostatic pressure of the cyst content.  • Cyst lining release bone resorbing factors that stimulate osteoclastic activity (like prostaglandins PGE2, PGF2 & PGI) which probably derived from fibroblasts in the cyst capsule.  • Bone matrix degradation is by the action of various proteinase (collagenase) which may also synthesized by capsule's fibroblasts.  • Both prostaglandins & collagenases are increased by the action of various cytokines generated locally like (IL-1 & IL-6) synthesized by epithelial lining of cyst & the macrophages in the capsule.  • Because of large number of osmotically active molecules in cyst fluid, the cyst contents are hypertonic compared with serum.  **Cyst Wall**  • Cyst wall acts as a semipermeable membrane, freely allowing the passage of water & crystalloid but restraining the passage of colloids.  • As a result, osmotically active molecules are retained within the cyst lumen.  • The high osmolality of the cyst contents & the semipermeable nature of the wall results in the movement of the fluid from the tissue into the lumen along the osmotic gradient.  • This movement of fluid increases the hydrostatic pressure within the cyst causing it to expand in a unicentric ballooning pattern. |  |  |  | **Cyst Lining**  • Uniform layer of non-keratinized stratified squamous epithelial (2-10 cell thick.)  • Atrophic or ulcerated in inflamed **Cyst Content**  • Proteinaceous  • Yellow fluid  • Cholesterol crystals  **Cyst Wall**  • Composed of dense fibrous CT free from inflammatory cells unless secondarily infected.  • Long standing dentigerous cyst will occasionally exhibit areas of keratinization or premalignant (dysplastic) changes of their epith. Lining with mucous cell metaplasia.  **Cyst Expansion:**  • The mechanism is similar to that of radicular cyst & it is dependent on bone resorption & hydrostatic pressure.  • The contents are hypertonic compared with serum & bone resorbing factors including PGE2, PGF2 & IL-1 are produced by dentigerous cysts.  • The rate of cyst expansion may be rapid in children than adults. |  | **Cyst Expansion**  •Expansion is due to growth potential of lining epithelium + osmotic pressure.  • Although hydrostatic forces are probably involved in expansion. Other hypothesis have been suggested to account for the peculiar growth pattern of the lesion.  Possible factors involved in expansion include:  1. Hydrostatic forces: Same mechanism suggested for radicular cyst.  2. Keratocyst contents are hypertonic when compared with serum & the lining acts as an efficient semipermeable membrane. However, hydrostatic pressure alone would result in a unicentric ballooning pattern of expansion.  3. Active epithelial growth  Epith. Lining of keratocyst exhibits greater mitotic activity than other odontogenic cysts. Proliferation of local groups of epith. Cells could account for folding in the cyst lining & projection of the cyst along cancellous spaces resulting in a multicentric pattern of growth.  4. Production of bone resorbing factors: Including Prostaglandins & IL-1 & 6.  5. Accumulation of mural squames: Which might result in localized areas of increased pressure that lead to resorption of bone. | **Cyst Lining**  • Non-keratinized squamous epith. |  |  |  |  |  |  |  | Empty or fluid filled cavity |  |  |
| **NOTES** |  |  |  |  | **Prognosis:** Although infrequent, epithelial neoplasm such as Ameloblastoma, Mucoepidermoid carcinoma & squamous cell carcinoma can arise in dentigerous cyst. |  | • The microscopic appearance of OKC is distinctive & characterized by:  1. A thin, uniform lining of parakeratinized squamous epith. (6-10 cells in thickness).  2. A palisaded layer of columnar or cuboidal basal cells.  3. Corrugated layer of parakeratin on its luminal surfaces.  4. Lack of rete pegs.  5. Focal separation of epithelial lining from the adjacent C.T which is often loose & fibrillar & usually free of inflammation.  6. The cystic lumen contains variable amount of desequamated parakeratin & gray /white cheesy materials consisting of keratinous debris.  7. Remnant of dental lamina, microcyst formation, satellite "daughter" cyst present in capsule wall.  8. Epithelial budding from basal cell area. |  | **Histologically:** similar to lateral periodontal cyst |  | **Histologically:** 1. Uniform thickness of squamous epith.  With focal thickening.  2. Variable number of small glandular  structures or microcysts within the lining  epith.  3. A single layer of columnar or cuboidal  cells lining the glandular structure,  replacing the surface layer of stratified  squamous epith. Of cyst lining.  4. Occasionally, goblet-like mucous  secreting cells like in intestinal mucosa  are present. |  |  |  |  | **Histologically:**  Lack of epithelial lining therefore it is not a true cyst. Fibrous connective tissue with occasional chronic inflammatory cells lining the bone cavity Empty or fluid filled cavity | **Histologically:** Numerous non-endothelial lined blood-filled spaces of varying size separated by cellular fibrous tissue  Multinucleated giant cells & evidence of old & recent hemorrhage are common in fibrous septa | **Sialography is useful in identification** |