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Indore, Madhya Pradesh
INDIA



MODULE PLAN

- TOPIC :PULP AND PERIAPICAL PATHOLOGY
- SUBJECT:OMDR
- TARGET GROUP: UNDERGRADUATE DENTISTRY
- MODE: POWERPOINT – WEBINAR
- PLATFORM: INSTITUTIONAL LMS
- PRESENTER: DR.TANVI DOSI

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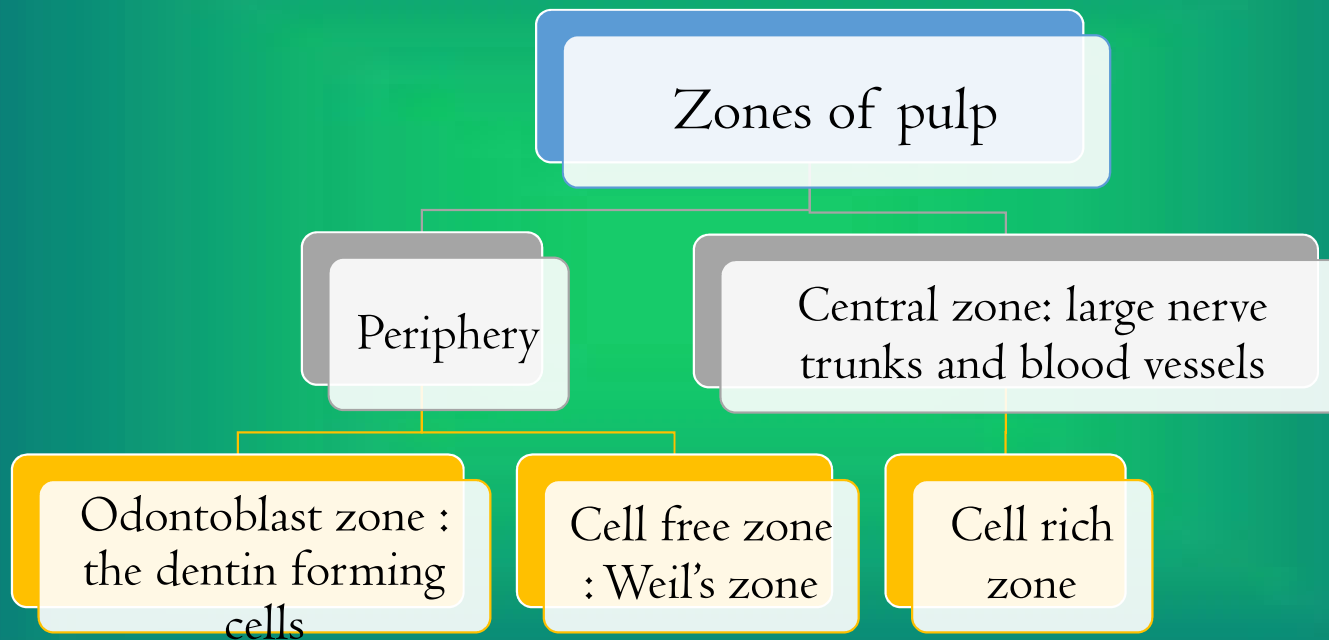
- Introduction
- Zones of Pulp & Histology
- Cells of Pulp
- Functions of Pulp
- Diseases of Pulp and Periradicular tissue.
- Age Changes in Pulp
- Conclusion

INTRODUCTION

- The dental pulp is a connective tissue like other connective tissues in the body.
- It consists of nerves, blood vessels, ground substances, interstitial fluid, odontoblasts, fibroblasts, and other cellular components.
- On a radiograph, the dentist sees the pulp as a dark space running coronal to apical in the center of the root.

- **Pulp:** Any soft, spongy tissue such as that contained within the spleen, the pulp chamber of tooth or distal phalanges of finger and toes.
- **Dental pulp:** It is defined as the richly vascularized and innervated connective tissue contained in the pulp cavity of a tooth, constituting the formative, nutritive and sensory organ of the dentin.

Zones of pulp and their Histology



Cells Of the Pulp

- Odontoblasts
- Odontoblast Process
- Fibroblast
- Macrophage
- Dendritic Cell
- Lymphocyte
- Mast cells

ODONTOBLASTS:-

- **Odontoblasts, the second most prominent cell in the pulp**, reside adjacent to the predentin with cell bodies in the pulp and cell processes in the dentinal tubules.
- They are approximately 5 to 7 μ m in diameter and 25 to 40 μ m in length.
- They have a constant location adjacent to the predentin that is termed the **“odontogenic zone of the pulp”**.

- The odontoblast appears to synthesize mainly type I collagen, although small amounts of type V collagen have been found in the extracellular matrix (ECM).
- In addition to proteoglycans and collagen, the odontoblast secretes dentin sialoprotein and phosphophoryn, a highly phosphorylated phosphoprotein involved in extracellular mineralization.
- The odontoblast also secretes both acid phosphatase and alkaline phosphatase.

- The latter enzyme is closely linked to mineralization, but the precise role of alkaline phosphatase in dentinogenesis is not completely understood.
- Acid phosphatase, a lysosomal enzyme, may be involved in digesting material that has been resorbed from predentin matrix.
- In contrast to the active odontoblast, the resting or inactive odontoblast has a decreased number of organelles and may become progressively shorter.

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ODONTOBLAST PROCESS:-

- A dentinal tubule forms around each of the major odontoblastic processes.
- The odontoblast process occupies most of the space within the tubule and coordinates the formation of peritubular dentin.
- The plasma membrane of the odontoblast process closely approximates the wall of the dentinal tubule.

- Localized constrictions in the process occasionally produce relatively large spaces between the tubule wall and the process.
- Such spaces may contain collagen fibrils and fine granular material that presumably represents ground substance.
- In restoring a tooth, the removal of enamel and dentin often disrupts odontoblasts. It would be of considerable clinical importance to establish the extent of the odontoblast processes in human teeth, because with this knowledge, the clinician would be in a better position to estimate the impact of the restorative procedure on the underlying odontoblasts.

FIBROBLASTS:-

- The pulp organ consist of specialized connective tissue because it lacks elastic fibers.
- Fibroblasts are the most numerous cell type in the pulp.
- They function in collagen fiber formation in the pulp throughout the life of the tooth.
- In the young pulp the cells divide and are active in protein synthesis, but in the older pulp they appear rounded or spindle shaped with short processes and exhibit fewer intracellular organelles. They are then termed **Fibrocytes**.

- In the embryonic and immature pulp the cellular elements predominate while in the mature pulp the fibrous components predominate.
- The fibroblasts of the pulp matrix, also have the capability of ingesting and degrading this same matrix.
- These cell thus have a dual function with pathways for both synthesis and degradation in the same cell.

DEFENSE CELLS:

MACROPHAGES :-

- Is an irregularly shaped cell with short blunt processes.
- When the macrophages are inactive and not in the process of ingesting foreign materials, one has difficulty distinguishing them from fibroblasts.
- Usually associated with small blood vessels and capillaries.
- The distinguishing feature of macrophages is aggregates of vesicles, or phagosomes, which contain phagocytized dense irregular bodies.

DENDRITIC CELLS :-

- Similar to Langerhans cells. They present antigen to T cells.
- In deciduous teeth they were shown to be closely associated with odontoblasts.
- Dendritic process sometimes extend into dentinal tubules and contact with odontoblastic process.
- Their number will increase in areas affected by attrition, caries and restorative procedures.

LYMPHOCYTES AND EOSINOPHIL'S:-

- Found extravascularly in the normal pulp, but during inflammation they increase noticeably in number.

MAST CELL:-

- Seen along vessels in the inflamed pulp. And their no. increase during inflammation.

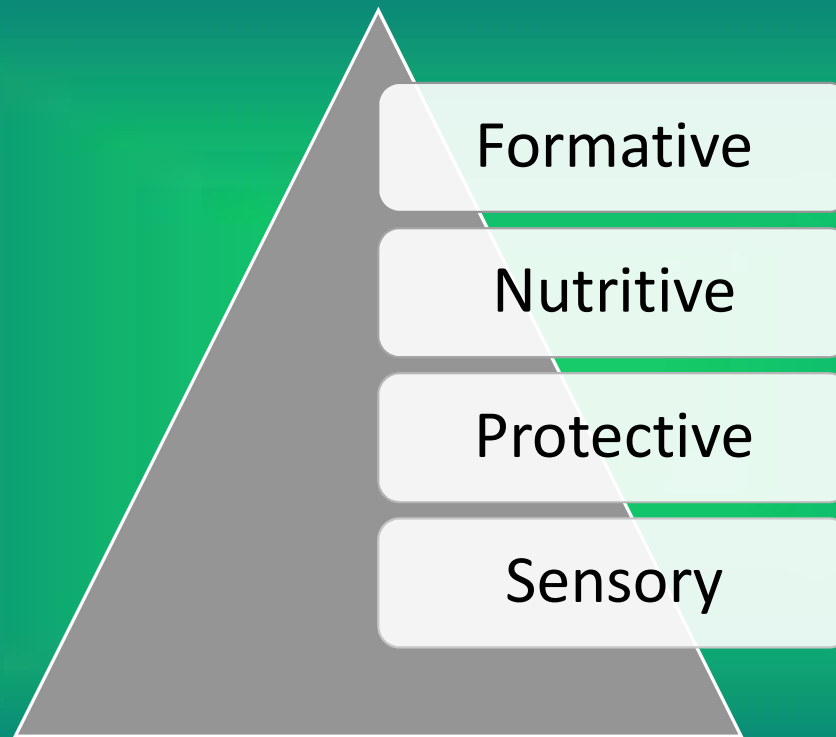
PLASMA CELLS:-

- Seen during inflammation of the pulp.
- The chromatin of the nucleus is adherent to the nuclear membrane and gives the cell a **cart wheel appearance**.
- **The plasma cells function in the production of antibodies.**

FIBERS:-

- Collagen is the predominant extracellular matrix component comprising 25-32% of the dry weight.
- Both type I and type III collagen have been found.
- About 56% of pulpal collagen is type I and 46% type III.
- Small amounts of type V and type VI collagen are also present.

Functions:



***Diseases of Pulp and Periradicular
tissue***

Diseases of Pulp and Periradicular tissue

- **ETIOLOGY OF PULPAL DISEASES**

- *According to Ingle,*

- **1. BACTERIAL**

- **CORONAL INGRESS**

- Caries
- Fracture
- Non fracture trauma
- Developmental Anomalies

- **RADICULAR INGRESS**

- Caries
- Retrogenic infection – periodontal pocket & abscess
- Hematogenic

2.TRAUMATIC

- ACUTE
- Coronal fracture
- Radicular fracture
- Vascular stasis
- Luxation
- Avulsion

- CHRONIC
- Adolescent female bruxism
- Traumatism
- Attrition or abrasion
- Erosion

3.IATROGENIC

- Cavity preparation: Heat of preparation,
- Depth of preparation, dehydration, pulp exposure
- Restorations: Insertion, fracture , forces of cementing, heat of polishing
- Periodontal curettage
- Orthodontic movement
- Electrosurgery
- Laser burn
- Periradicular curettage
- Osteotomy

4.CHEMICAL

- Restorative materials – Cements, Cavity liners, Etching agents, bonding agents
- Disinfectants – Silver nitrate, phenol, sodium fluorides.
- Desiccants – Alcohol, ether and others.

- IDIOPATHIC

- Aging.
- Internal resorption.
- External resorption.
- Sickle cell anaemia.
- Herpes zoster infection.
- HIV

Endodontics 5th edition John I. Ingle

CLASSIFICATION OF PULPAL DISEASES

According to Grossman,

- I] PULPITIS (Pulp Inflammation)
 - 1) REVERSIBLE
 - a) Acute (symptomatic)
 - b) Chronic (asymptomatic)

2. IRREVERSIBLE

- a) Acute
- b) Abnormally responsive to cold
- c) Abnormally responsive to heat
- d) Chronic
- e) Asymptomatic with pulp exposure
- f) Hyperplastic pulpitis
- g) Internal resorption

- II] PULP DEGENERATION

- a) Calcific (Radiographic diagnosis)

- b) Others (Histopathologic diagnosis)

- III] PULP NECROSIS

According to Cohen:-

1. Reversible pulpitis
2. Irreversible pulpitis
3. Asymptomatic Irreversible pulpitis
4. Symptomatic Irreversible
5. Hyperplastic pulpitis
6. Internal resorption
7. Pulp necrosis

REVERSIBLE PULPITIS

Definition:

- A mild to moderate inflammatory condition of pulp caused by noxious stimuli in which pulp is capable of returning to the uninflamed state following removal of the stimuli. Also, referred as “PULP HYPERAEMIA”.

Causes:-

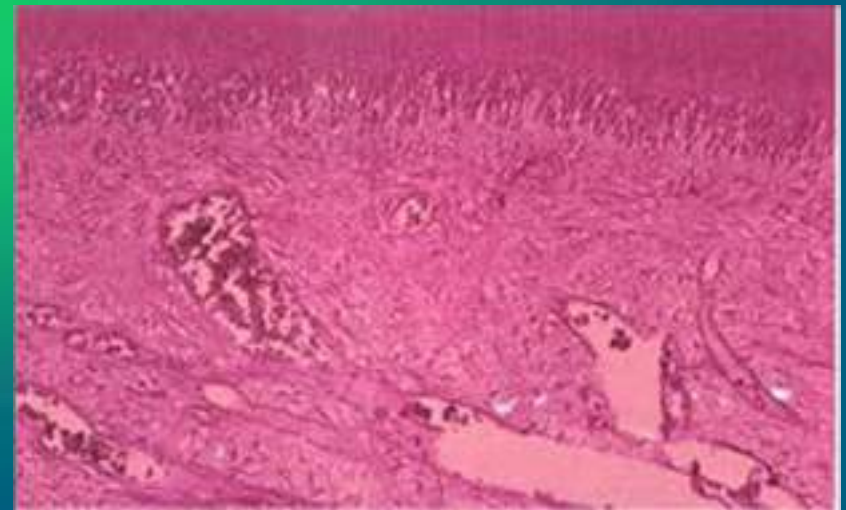
- Trauma – as a blow / a disturbed occlusal relationship
- Thermal shock – as from preparing a cavity with a dull bur / keeping the bur in contact for too long /from overheating during polishing
- Excessive dehydration
- Galvanism
- Chemical stimulus –sweet or sour foods / silicate or self curing acrylic filling.
- Bacteria – as from caries.
- Circulatory disturbances- during pregnancy (transient periodic hyperaemia).
- Local vascular congestion- (common cold / sinus disease)

Symptoms :-

- Sharp pain lasting for a moment
- More often brought on by cold (cold air, cold beverages) than hot food
- Does not occur spontaneously
- Does not continue when stimulus has been removed

Histopathology :-

- Hyperaemia - mild to moderate inflammatory changes are limited to the area of involved dentinal tubules
- Reparative dentin, dilated blood vessels, disruption of odontoblast layer
- Extravasation of edema fluid
- Immunologically competent chronic inflammatory cells
- Presence of acute inflammatory cells



Differential diagnosis:-

- Irreversible Pulpitis
- History of pain – onset, duration, character
- Thermal tests are useful - as reversible pulpitis responds readily to cold.

Treatment:-

- Prevention
- Removal of the noxious stimuli

Prognosis:-

- Good - if irritant is removed earlier
- Otherwise condition may develop to Irreversible pulpitis

IRREVERSIBLE PULPITIS

- **Definition** - A persistent inflammatory condition of the pulp, symptomatic or asymptomatic, caused by noxious stimulus.

❖ May be

- acute, subacute or chronic
- Partial or total
- Infected or sterile

Asymptomatic Irreversible Pulpitis:-

- Uncommon
- May be the conversion of symptomatic irreversible pulpitis

Causes:-

- Caries and trauma (dental history & radiographs)
- Chemical, thermal or mechanical causes

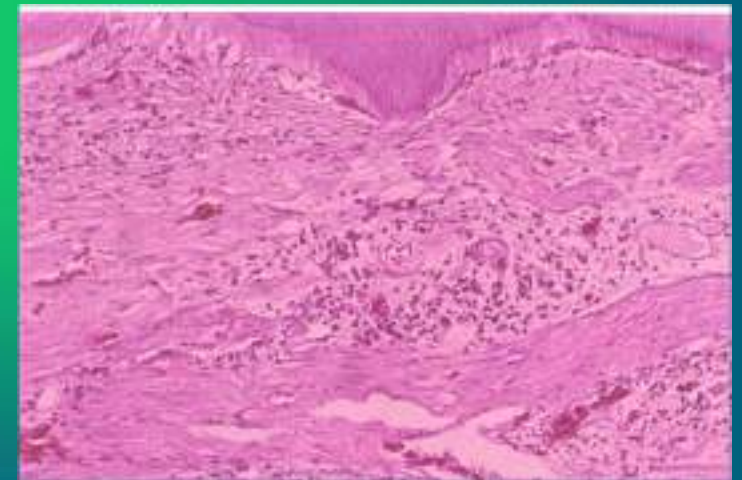
Symptomatic Irreversible Pulpitis:-

- Spontaneous , intermittent, or continuous paroxysms of pain
- Moderate to severe pain (sharp or dull, localized or referred)
- Sudden temperature changes (cold) elicit prolonged episodes of pain
- Pain that lingers after the stimulus is removed
- Pain may be relieved by the application of heat or cold
- Postural change induces pain (lying down or bending over)

Histopathology:-

1. Chronic inflammatory response
2. Postcapillary venules become congested,
3. Affect circulation within the pulp and cause necrosis.
4. Attract PMN and start acute inflammatory reaction.

- PMN : short life span , die and release lysosomal enzymes – it lyse some of the pulp stoma, together with cellular debris.
- Produces micro abscess (acute pulpitis).
- Microscopically : areas of abscess, zone of necrotic tissue, microorganism, lymphocyte, plasma cell, macrophages.
- Zone of fibroblast forming wall of lesion.



Differential Diagnosis :- Reversible pulpitis

Treatment:-

- Pulpectomy and the placement of an intracanal medicament to act as a disinfectant or obtundent.
- Surgical removal should be considered if the tooth is unrestorable.

Prognosis:-

- Favourable if the pulp is removed & tooth undergoes proper endodontic therapy & restoration.

	POTENTIALLY REVERSIBLE	PROBABLY IRREVERSIBLE
Pain	Sharp, Momentary : dissipates readily after removal of stimulus	Continuous, throbbing : Persists minutes to hours
Stimulus	Requires external stimulus (cold, heat, sugar)	Spontaneous : dead or injured tissue in chambers or canal. Intermittent : Spontaneous pain of short duration.
History	Recent dental procedure, cervical abrasion	Extensive restoration, pulp capping, deep caries, trauma
Electric test	Premature response	Premature, delayed or mixed response
Referred pain	Negative	Common
Lying down	Negative	Increases pain
Color	Negative	May be present due to tissue lysis & intrapulpal haemorrhage.
Radiograph	Restoration ,caries, periodontal pocket, cupping of alveolar crest	Restoration, caries
	Periapex - Normal	Periapex – widening of PDL

CHRONIC HYPERPLASTIC PULPITIS (Pulp Polyp)



Definition : Chronic hyperplastic pulpitis is a productive pulpal inflammation due to an extensive carious exposure of a young pulp.

- Characterized by - development of granulation tissue, covered at times with epithelium and resulting from long standing, low grade irritation.

Causes:-

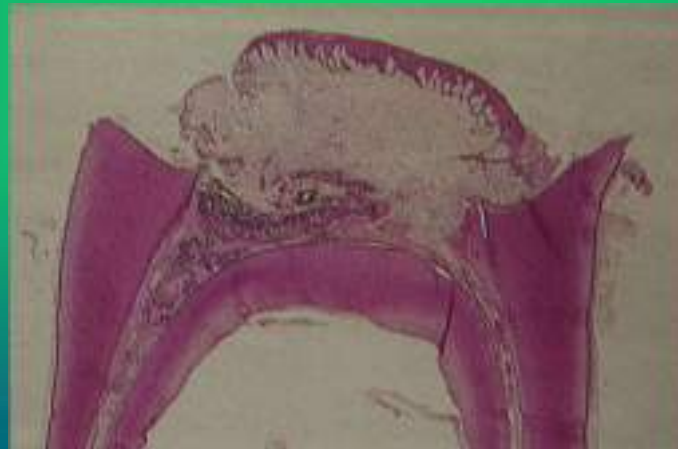
- Slow, progressive carious exposure.
- Pulp polyp develops in a tooth with large, open cavity having a young resistant pulp & a chronic low grade stimulus
- Mechanical irritation (chewing) & bacterial infection provide stimulus.

Symptoms:-

It is asymptomatic, except during mastication, when pressure causes discomfort.

Histopathology:-

- Budding capillaries, proliferating fibroblasts & inflammatory cells are seen.
- Presence of granulation tissue – which is young vascular connective tissue containing PMNL's, lymphocytes & plasma cells.
- Collagenous fibres rooted in deeper tissue of pulp chamber.
- Sensory nerve fibres are almost absent near surface.
- Surface is usually covered by stratified squamous epithelium.



Treatment:-

- Elimination of polyp tissue with a sharp curette or spoon excavator, followed by extirpation of the pulp, provided the tooth can be restored.
- Bleeding can be controlled with pressure.
- Then radicular pulp is extirpated.

Prognosis:-

The prognosis of pulp is unfavourable, but prognosis of tooth is favourable after endodontic treatment & adequate restoration.

NECROSIS OF PULP

Definition:

Necrosis or death of the pulp tissue is a sequela of acute and chronic inflammation of the pulp or an immediate arrest of circulation by traumatic injury .

- It may be partial or total.

Causes:-

1)As a **Sequelae to inflammation**

2) **Bacteria, trauma and chemical irritation.:** causing an ischaemic infarction & resulting in dry gangrenous necrotic pulp.

Symptoms:-

- No painful symptoms.
- Discolouration of tooth is first indication that pulp is dead.
- Dull or opaque appearance of the crown – lack of normal translucency
- Grayish or brownish discoloration & may lack its usual brilliance and luster

Histopathology:-

- Necrotic pulp tissue, cellular debris and microorganisms are seen
- Periapical tissue may be normal or slight evidence of inflammation of apical PDL

PERIAPICAL LESIONS

CLASSIFICATION:-

According to GROSSMAN

1) ACUTE PERIRADICULAR DISEASES

- Acute alveolar abscess
- Acute apical periodontitis - Vital
- Nonvital

2) CHRONIC PERIRADICULAR DISEASES WITH AREAS OF RAREFACTION

- Chronic alveolar abscess -Granuloma- Cyst

3) Condensing osteitis

4) External root resorption

5) Diseases of periradicular tissues of nonendodontic origin

Ingle's classification

Painful pulpoperiapical lesions

1. Acute apical periodontitis
2. Advanced stages of acute periodontitis:
 - a. Acute apical abscess
 - b. Phoenix abscess
 - c. Chronic apical abscess

Nonpainful pulpo- periapical pathoses

3. Condensing osteitis
4. Chronic apical periodontitis
5. Chronic apical periodontitis (both incipient & advanced stages)
 - a. Periapical granuloma
 - b. Apical cyst
 - c. Suppurative apical periodontitis

ACUTE PERIRADICULAR DISEASES

ACUTE ALVEOLAR ABSCESS

(Synonyms: Acute periapical abscess, Acute dentoalveolar abscess)

Definition:

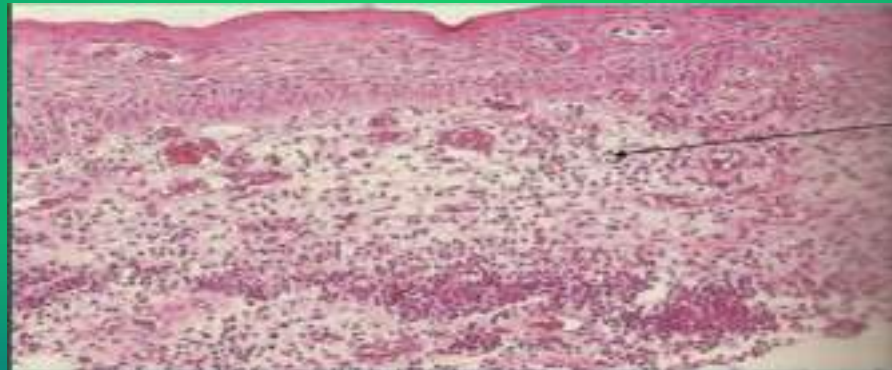
Localised collection of pus in the alveolar bone at the root apex of tooth following death of pulp, with extension of infection through apical foramen into periradicular tissues.

Causes:-

Bacterial invasion , trauma, chemical or mechanical irritation.

Histopathology:-

Marked infiltration of PMN, rapid accumulation of inflammatory exudate in response to an active infection distend the periodontal ligament and thereby elongate the tooth.



- If the process continues PDL fibers will separate and the tooth will become mobile.
- Periapical bone resorption, PMN die, microorganism = pus.
- Microscopically: empty spaces (suppuration), surrounded by PMN, root canal devoid of tissue, clumps of microorganisms and debris.

Symptoms:-

- First symptom - is tenderness
- Later - patient has severe throbbing pain with swelling of the overlying soft tissue
- As the infection progresses, swelling becomes more pronounced and extends beyond the original site
- Tooth becomes more painful, elongated and mobile
- If untreated - progresses to osteitis, periostitis, cellulitis or osteomyelitis
- Sinus tract - opens to buccal mucosa
- When Maxillary anterior teeth - swelling of upper lip (extend to both eyelids)
- When Maxillary posterior teeth - the Cheek may swell distorting facial features.
- Mandibular posterior teeth- swelling extends around border of jaw into submaxillary region

ACUTE APICAL PERIODONTITIS

Is a painful inflammation of periodontium as a result of trauma, irritation or infection through root canal regardless of pulp is vital or non-vital.

Causes:-

1. Occlusal trauma
2. Wedging of foreign object between teeth
3. Non-vital tooth (diffusion of bacterial by- products)
4. Iatrogenic: during over instrumentation & extrusion of irritating medicaments
5. Perforation of root

Symptoms:-

- Pain and tenderness
- Tooth may be slightly sore, when percussed.

Diagnosis:-

- Tooth is tender to percussion
- Symptoms are due to Overinstrumentation, Irritating medicament or Overfilling
- Radiographically: thickened periodontal ligament or small area of rarefaction

Histopathology:-

Inflammatory reaction in apical periodontal ligament

Blood vessels are dilated, PMNL's are present

Accumulation of serous exudate distends the periodontal ligament

Osteoclasts are present

Treatment :-

Consists of determining the cause and relieving the symptoms

When acute phase has subsided the tooth is treated with conservative means

Prognosis:-

Is favourable

ACUTE EXACERBATION OF A CHRONIC LESION (PHOENIX ABSCESS)

An acute inflammatory reaction superimposed on an existing chronic lesion, such as a cyst or granuloma

Cause

1. Noxious stimuli from a diseased pulp with chronic periradicular disease.
2. Because of influx of necrotic products or bacteria and their toxins, the dormant lesions (granuloma & cyst) may become reactive & cause an acute inflammatory response.
3. Lowering of the body's defenses in the presence of bacteria - may also trigger an acute inflammatory response.
4. Mechanical irritation during root canal instrumentation

Symptoms:-

- Tooth - tender to touch & elevated in its socket
- Mucosa - sensitive to palpation & appears red & swollen

Differential diagnosis:- Acute alveolar abscess, Acute irreversible pulpitis

Histopathology:- Liquefaction necrosis with disintegrating PMNL & cellular debris (pus), surrounded by infiltration of macrophages, lymphocytes & plasma cells

Treatment - is same as that of an acute alveolar abscess.

Prognosis – is good (once the symptoms subside)

CHRONIC ALVEOLAR ABSCESS (Chronic Suppurative Apical Periodontitis)

Definition - A chronic alveolar abscess is a long-standing, low-grade infection of the periradicular alveolar bone.

Cause

1. Death of the pulp with extension of the infective process periapically
2. A pre-existing acute abscess

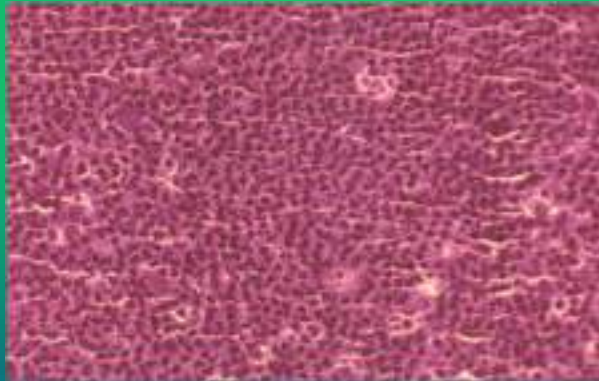
Signs & symptoms:-

- Asymptomatic tooth
- Associated with little discomfort
- Sinus tract associated with
 - Mandibular anterior teeth - opens near the symphysis
 - Mandibular posterior teeth - inferior border of mandible
- If the sinus tract drainage becomes blocked – pain & swelling
- Range of sensitivity to percussion & palpation – depends on the sinus tract is open, draining or closed

A radiograph with a gutta-percha cone into the sinus tract often shows involved tooth by tracing the sinus tract to its origin.

Histopathology:-

- Periodontal fibers at root apex are detached / lost destruction of the apical PDL
- Apical cementum may be affected.
- Lymphocytes , plasma cells at the periphery & PMNL's at the center
- Fibroblasts - form a capsule at periphery



Treatment:-

- Treatment consists of elimination of infection
- The sinus tract ultimately heals by granulation

When sinus tract does not heal while the tooth is under endodontic treatment, it is curetted with a small spoon excavator.

Prognosis:-

- Depends on proper cleaning, shaping and obturation of the root canals
- Good

RADICULAR CYST

Is a slowly growing epithelial sac at the apex of a tooth that lines a pathologic cavity in the alveolar bone.

The lumen contains a low-concentration of proteinaceous fluid.

Cause:

Physical, chemical or bacterial injury (death of pulp), followed by stimulation of epithelial rests of Malassez

Symptoms:

- No symptoms, except those seen in necrosis of pulp.
- A cyst may become large enough, to be obvious as a swelling.
- Pressure of cyst causes movement of affected teeth
- Teeth are mobile.
- If left untreated - continues to grow at expense of maxilla or mandible.

Histopathology:-

Shows central cavity lined by stratified squamous epithelium.

Connective tissue is infiltrated by lymphocytes, plasma cells, PMNL, cholesterol clefts, macrophages, & giant cells.

Cystic cavity contains cellular debris and pale eosinophilic fluid.

Differential Diagnosis:-

Periapical granuloma , Globulomaxillary cyst.

CHRONIC PERIRADICULAR DISEASE WITH AREA OF CONDENSATION

CONDENSING OSTEITIS:

Condensing osteitis is the response to a low-grade, chronic inflammation of periradicular area as a result of a mild irritation through the root canal.

Characterized as a localized overproduction of apical bone.

Cause:-

Mild irritation from pulpal disease - stimulates osteoblastic activity

Symptoms:-

Usually asymptomatic , discovered during routine radiographic examination.

Histopathology:-

An area of dense bone with trabecular borders lined with osteoblasts

Chronic inflammatory cells, plasma cells and lymphocytes are also seen



Age Changes

Age Changes:

1. The most conspicuous change is the decreasing volume of the pulp chamber and root canal brought about by continued dentin deposition.
 - In old teeth the root canal is often no more than a thin channel.
 - Sometimes it can appear to be almost completely obliterated.

Cell changes:-

- They are characterized by decrease in the number and size of cytoplasmic organelles.
- The pulpal Fibrocytes or fibroblasts have abundant rough endoplasmic reticulum, prominent Golgi apparatus and numerous mitochondria.
- The fibroblasts of aged pulp have less perinuclear cytoplasm with long, thin cytoplasmic processes.
- The intracellular organelles are reduced in size and number.

Fibrosis:-

- With aging of the pulp, fiber content increases and cellular content decreases.
- The fiber increases in the pulp slowly and it is generalized through the pulp tissue.

Vascular changes:-

- Vascular changes in the form of decreased vascularity also exist with aging pulp.
- The calcification occurs in the walls of blood vessels near the apical foramen.

Pulp Stones or Denticles:-

- Nodular, calcified masses appearing in either or both the coronal or root portions of the pulp organ.
- They may be singular or multiple in any tooth and are found more frequently at the orifice of the pulp chamber or within the root canal.
- *seen in functional as well as embedded unerupted teeth.*

Classification of Pulp stone:-

Pulp stones are classified according to their structures –

1. True Denticles
2. False Denticles/ diffuse calcifications

Pulp stones are also classified according to their location in relation to the surrounding dentinal wall.

1. Free Denticles
2. Attached Denticles and
3. Embedded Denticles

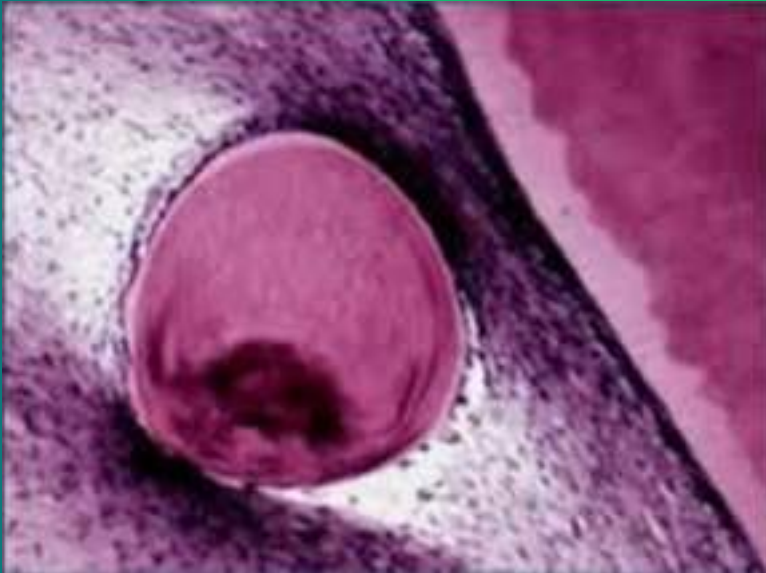


Figure :- PULP STONE

- The incidence as well as the size of pulp stones increases with age.
- According to one estimate,
 - 66% of teeth in persons 10 to 30 years of age,
 - 80% of those between 30 and 50 years and
 - 90% in those over 50years of age contain calcification of some type.
- One pulp may have all three types of denticles (free, attached or embedded).

- Most denticles are false stones that are free in the pulp.
- Pulp stones are normally asymptomatic unless they impinge on blood vessels or nerves and usually do not present a problem to the dentist.
- **Endodontic significance of pulp calcification:**
Perhaps the greatest endodontic significance of pulp calcification is that it may hinder root canal shaping.

Conclusion:

Dental pulp is the most important tissue as far as tooth is concern. Most of the dental pathologies are responsible because of the insult to the dental pulp.

Thus the knowledge of pulp is essential not only for providing dental treatment , but also to know the rationale behind the treatment provided.

THANK YOU