



Pulpal Disease and Periapical Disease

Definitions

- Endodontics: is related to morphology and physiology of dental pulp and surrounded tissue of tooth.

Relationships

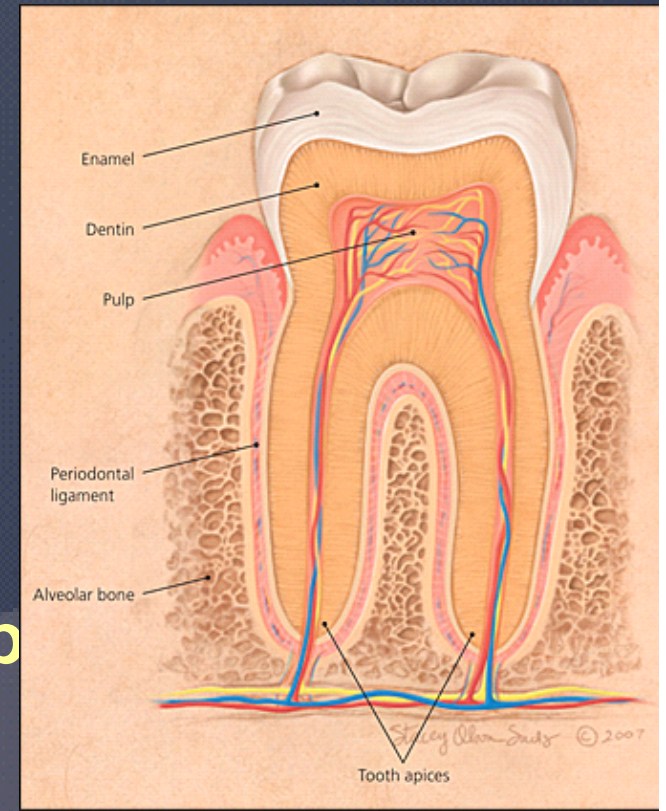
Anatomy—foramen

Etiology—caries

Pathology—inflammation

Symptom—pain

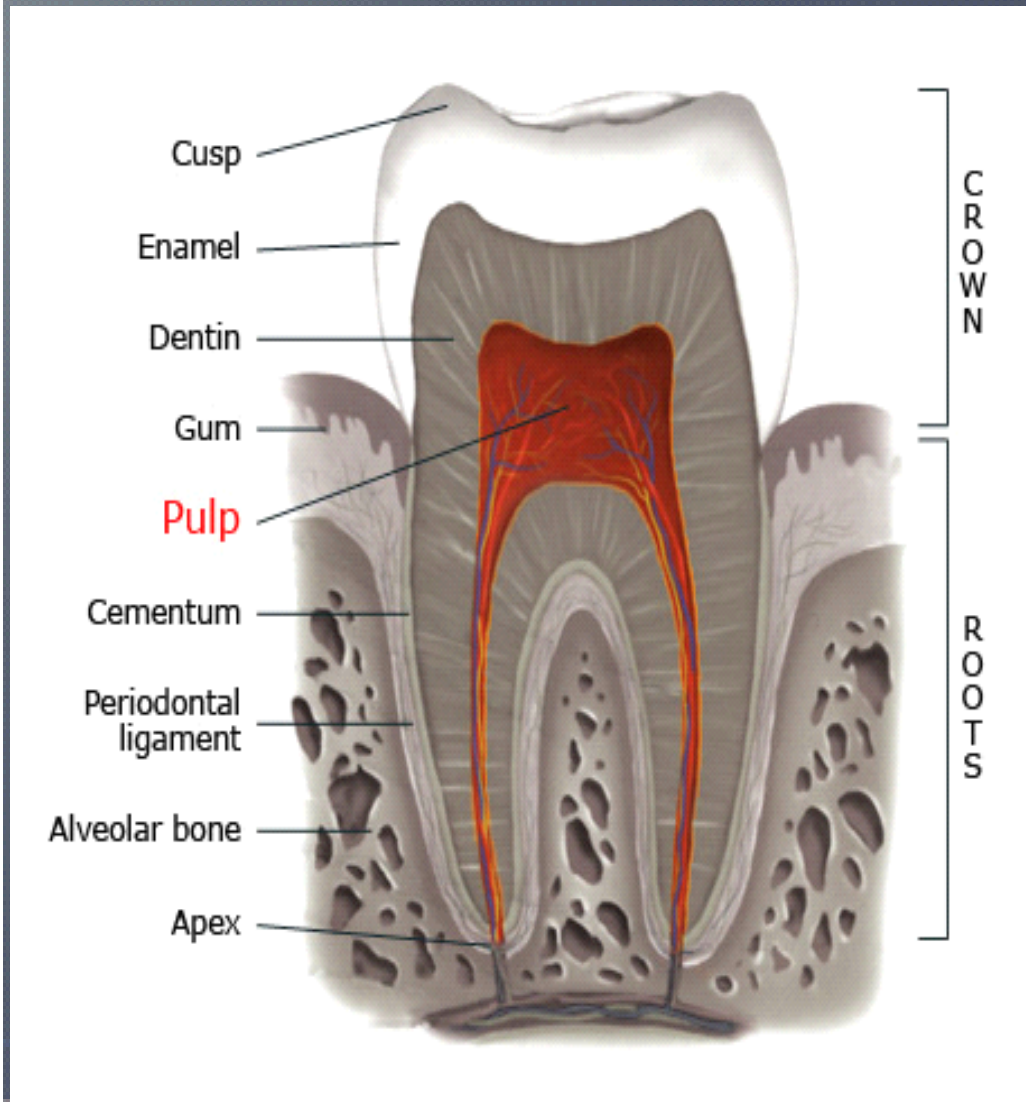
Treatment—root canal therap



Contents

- Histology and Physiology
- Etiology
- Diagnostic Procedures

Dental pulp

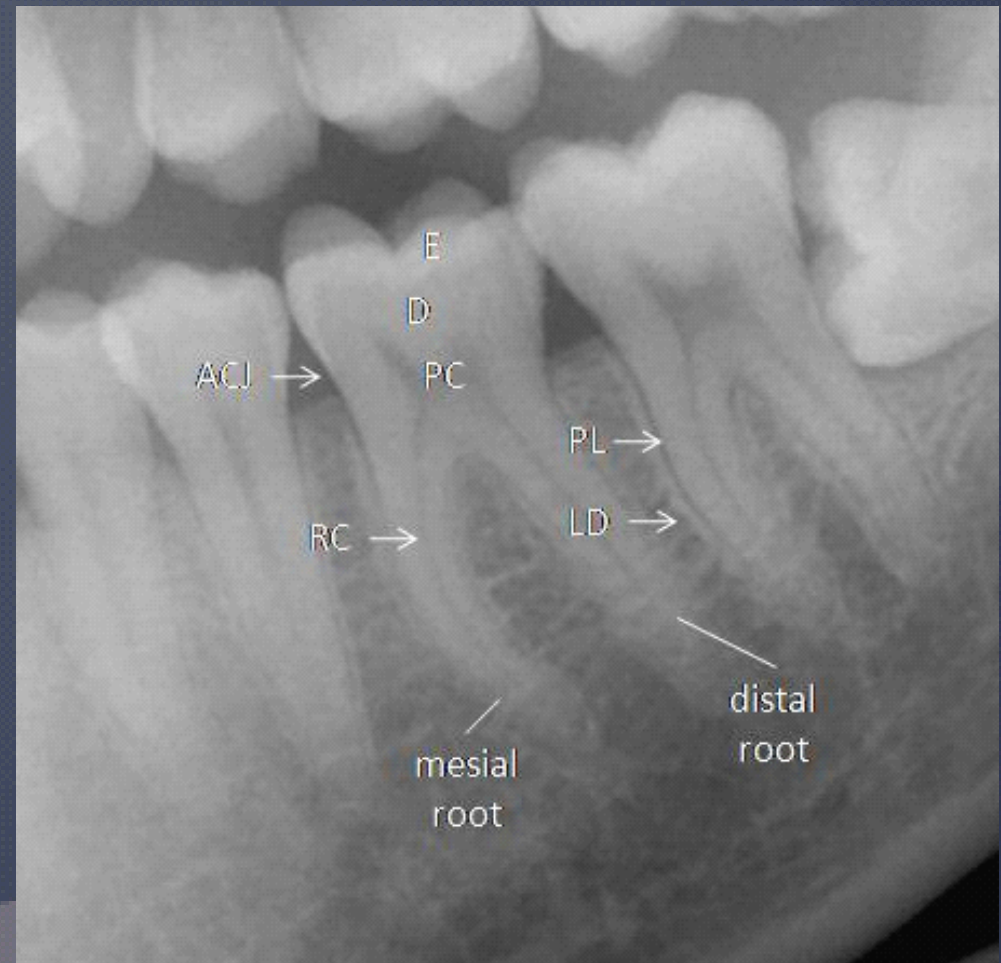


- the soft tissue located inside a tooth
- contains blood vessels, nerves and connective tissue

Dental pulp



•By its very location deep within the tooth, it defies visualization other than its appearance as radiolucent lines on radiographs. (PC)



Dental pulp

- It is a pink, coherent soft connective tissue
- Dependent on its normal hard dentin shell for protection



Dental pulp

- When pulp tissue is removed *en masse* from a tooth, it is rich in fluid and highly vascular.

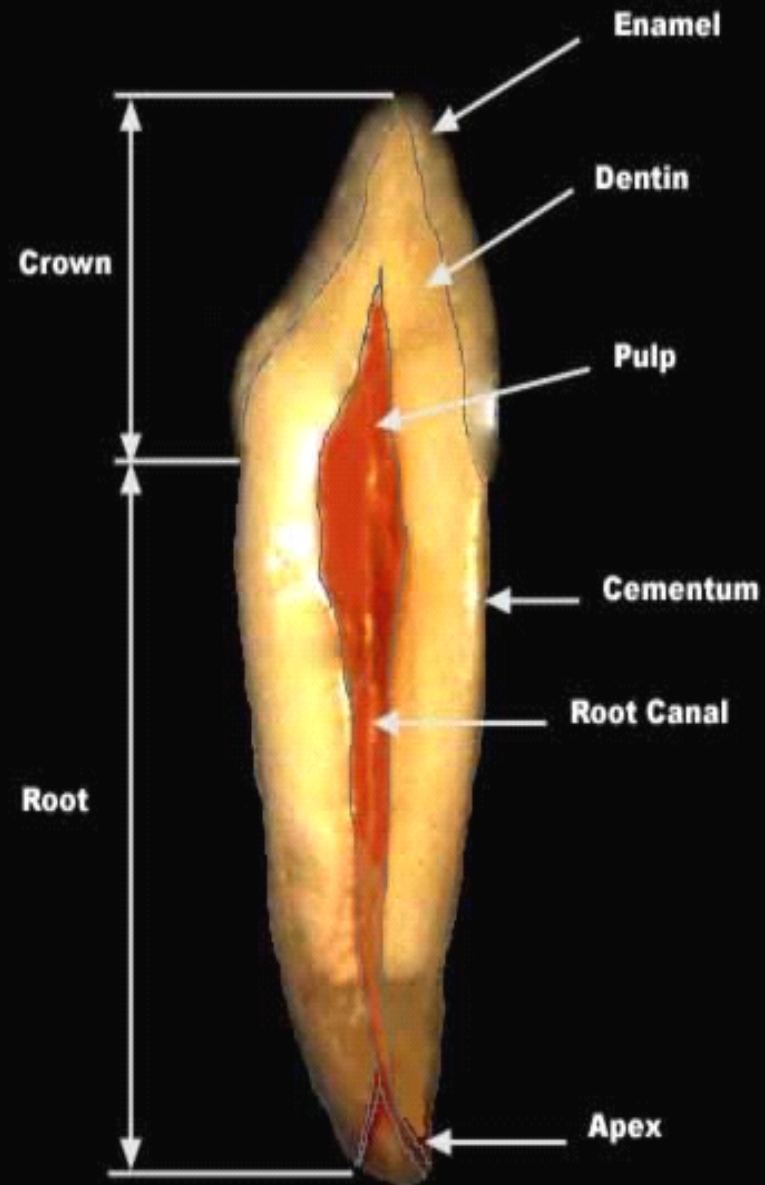


Histophysiology of the dental pulp



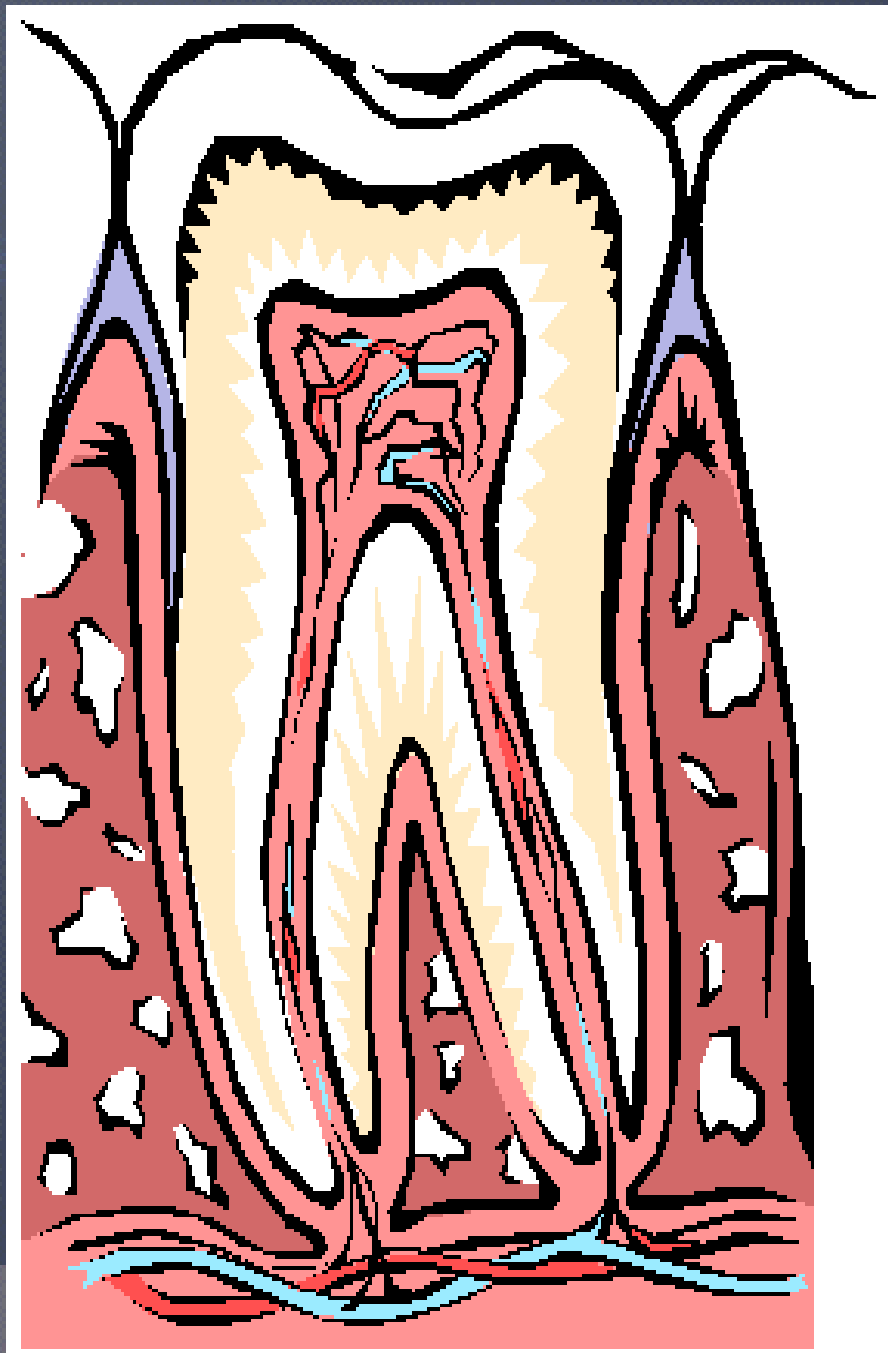
The dental pulp is one kind of loose connective tissue, and the respond to changes in environment should be the same as any other loose connective tissue. However, several factors make it unique and thus alter its ability to respond to irritation.

1. The pulp is almost totally surrounded by a hard tissue (dentin), which limits the area for expansion and restricts the pulp's ability to tolerate edema.

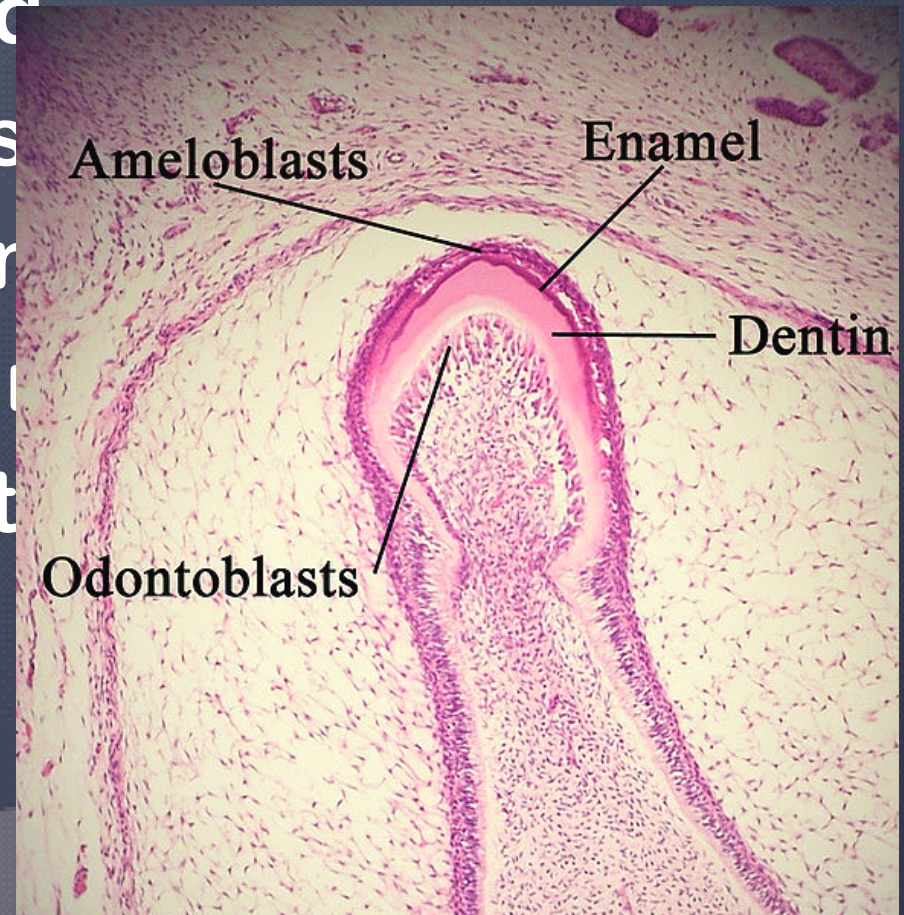


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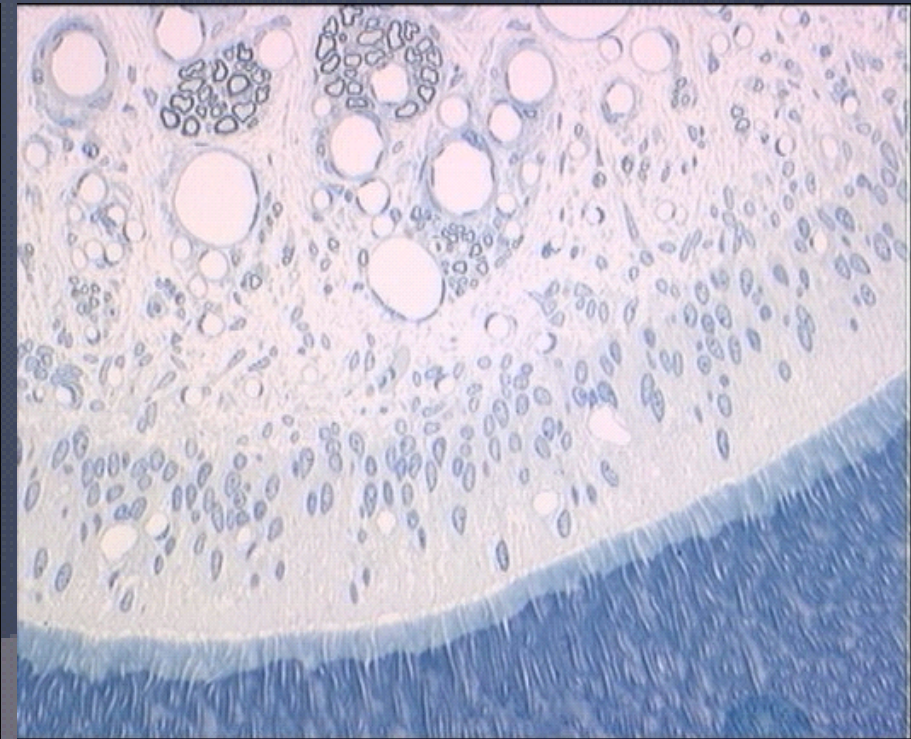
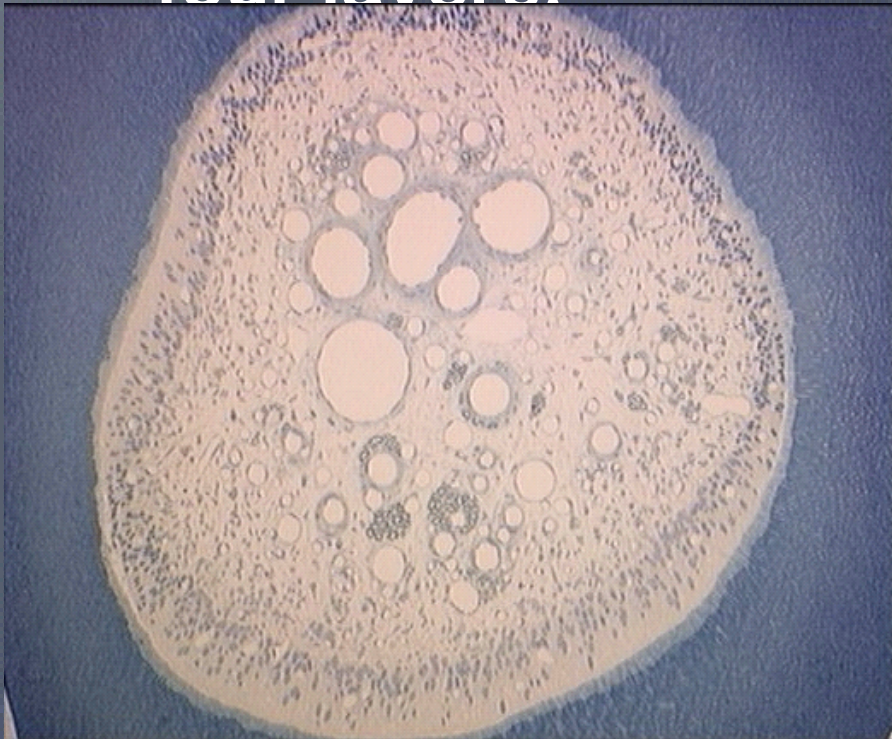
2. The pulp has almost a total lack of collateral circulation, which severely limits its ability to cope with bacteria, necrotic tissue, and inflammation.



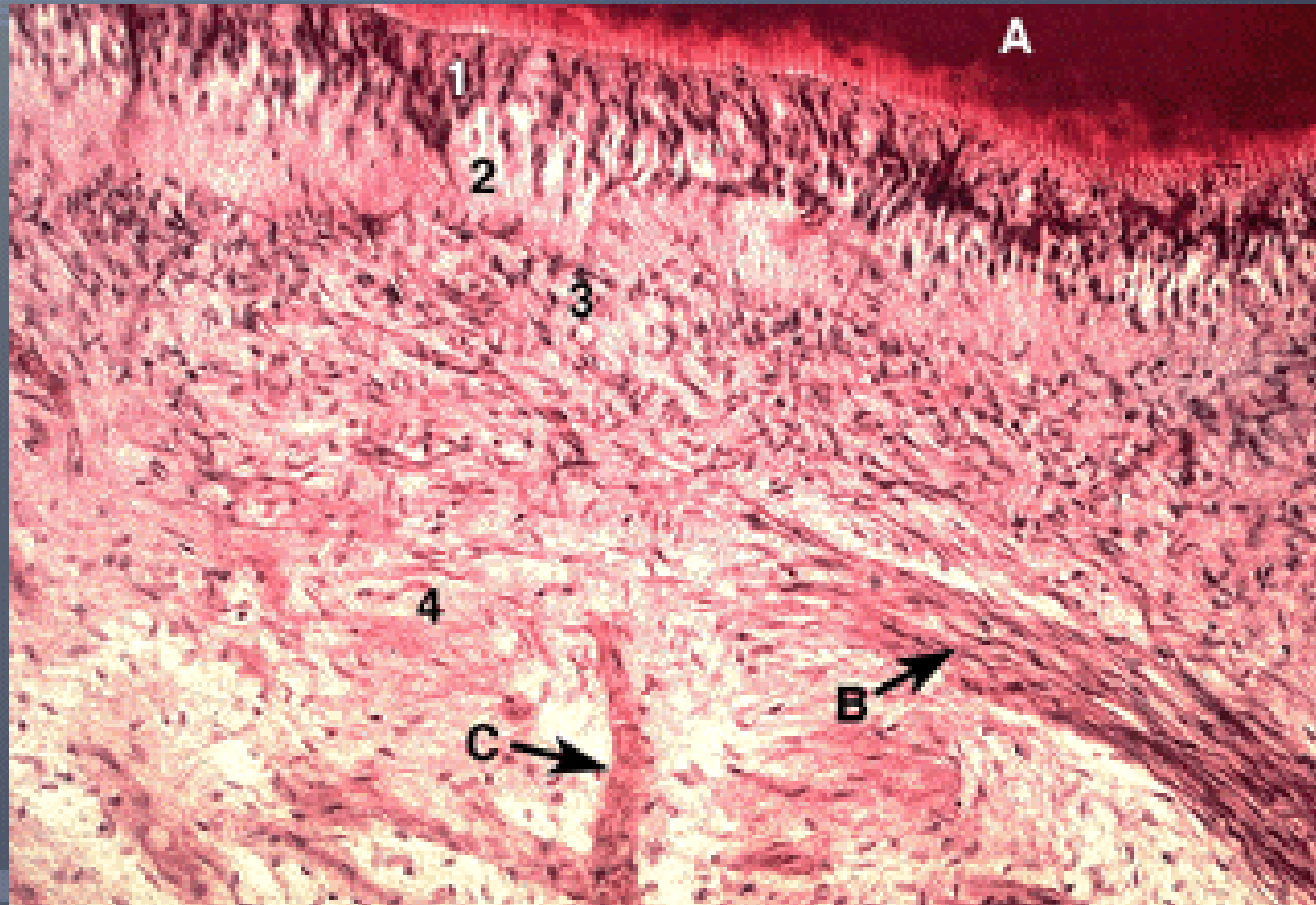
3. The pulp possesses a unique cell, the odontoblast, as well as cells that can differentiate into hard tissue-secreting cells that form more dentin and irritation dentin in an attempt to protect the pulp from injury.



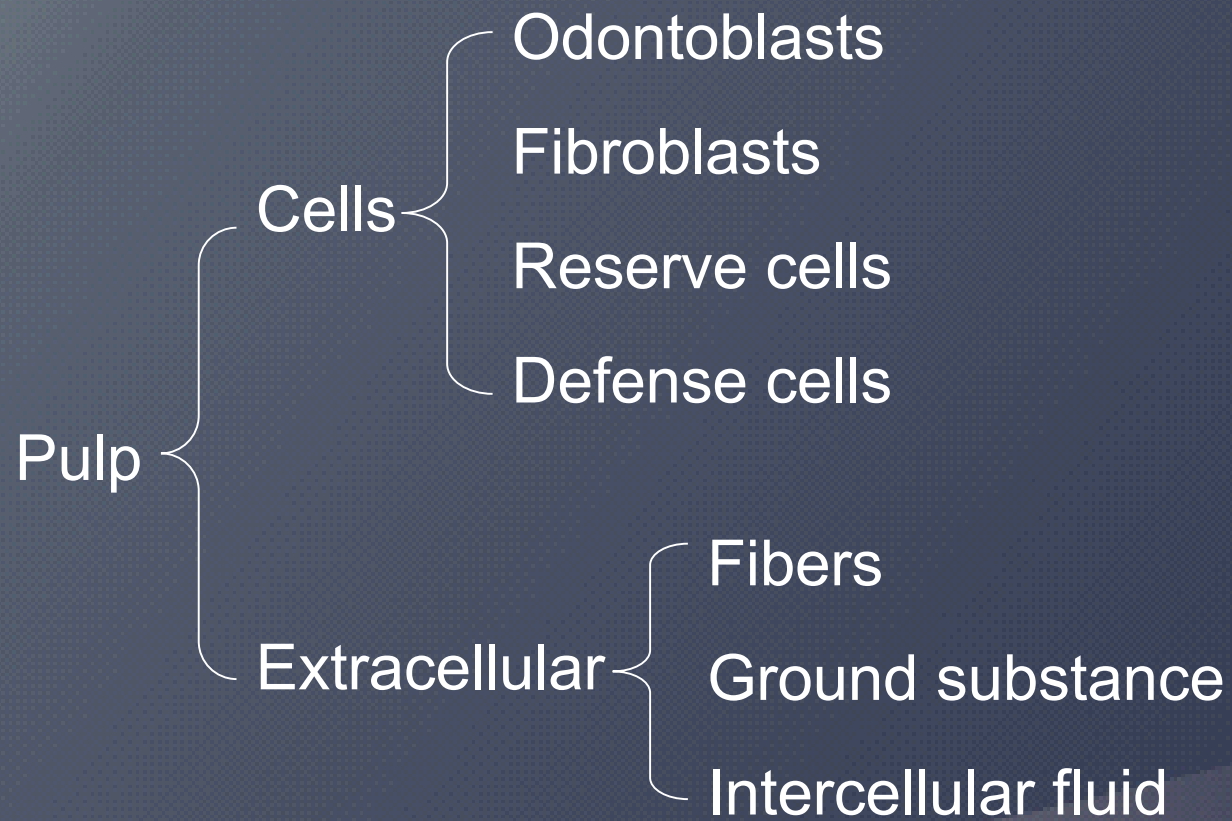
- The central region of the coronal and radicular pulp contains large nerve trunks and blood vessels.
- This area is lined peripherally by a specialized odontogenic area which has four layers.



Four zones



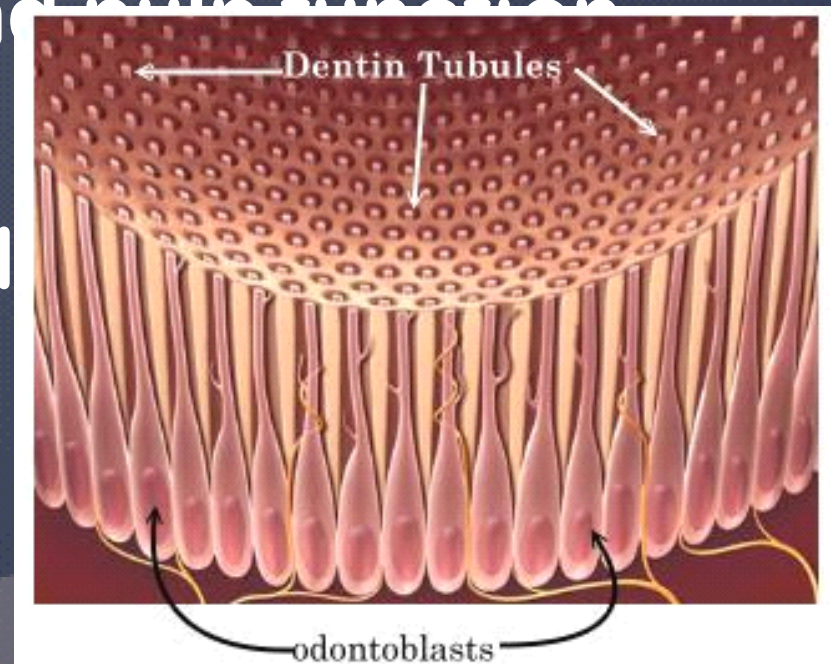
Structural elements



Odontoblasts

—The odontoblasts are highly specialized connective tissue cells of the dental pulp. They play the unique role in both dentin and pulp function

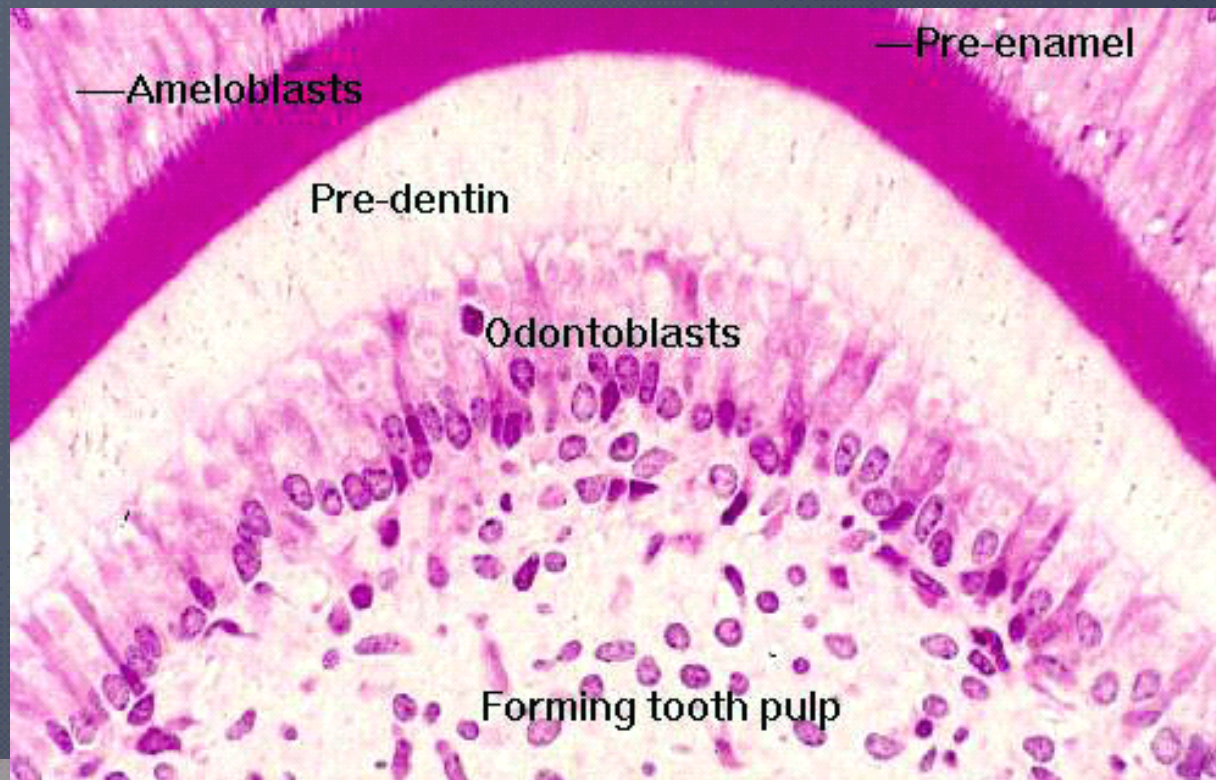
- Secretion of dentin
- Formation of dentinal tubules



Odontoblasts

Under a light microscope:

—The odontoblasts form a palisade arrangement at the pulp periphery.



Odontoblasts

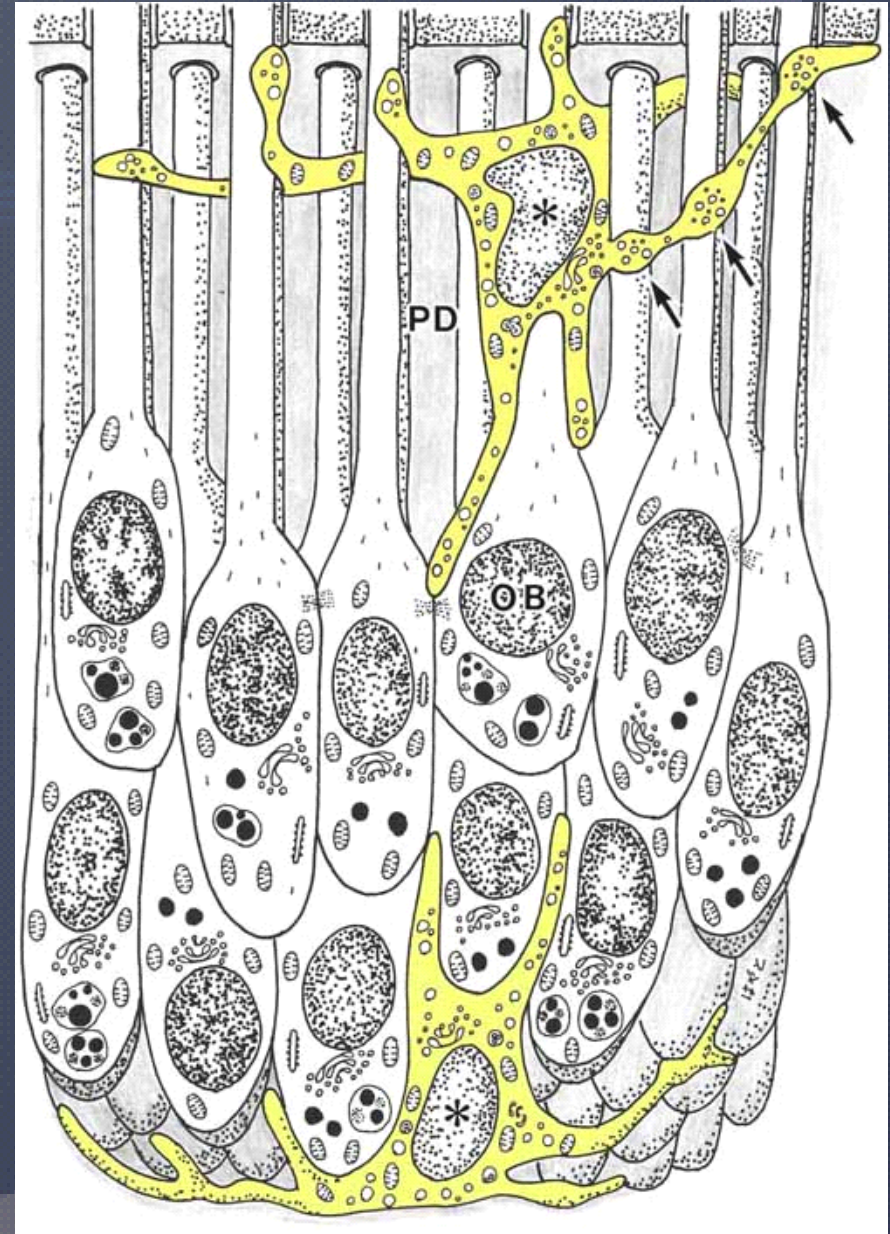


The side and shape of the cells vary on their location:

- Coronal pulp -- pseudostratified columnar
or high columnar
- Radicular pulp -- low columnar & cuboidal
- Apex -- flattened, almost squamous shape

Electron microscope:

- The large nucleus with a pear-shaped appearance, is located in the base of the cell.
- The cell body contains organelles that represent different stages of secretion of collagen, glycoproteins, and calcium salts.



Odontoblasts

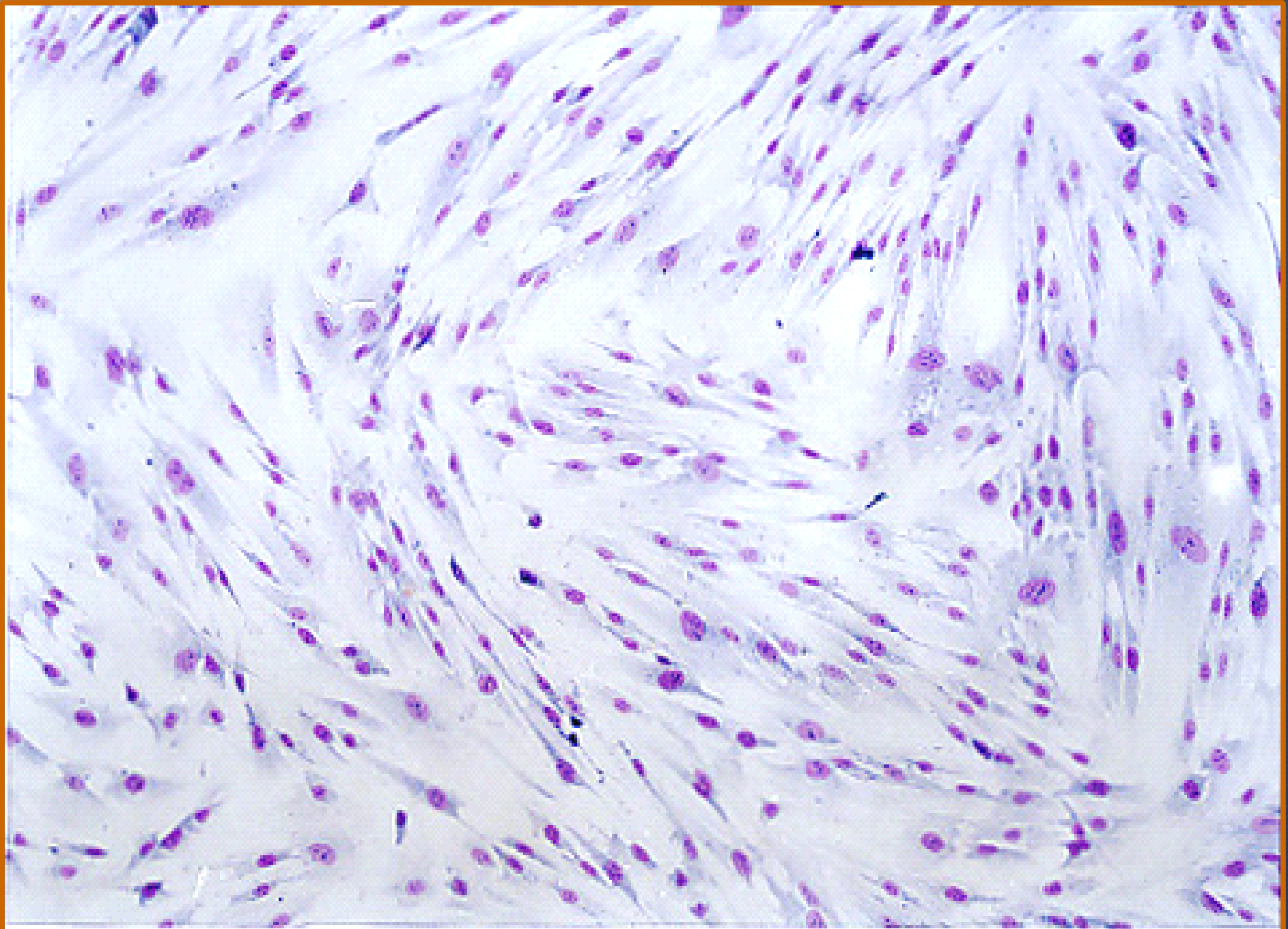


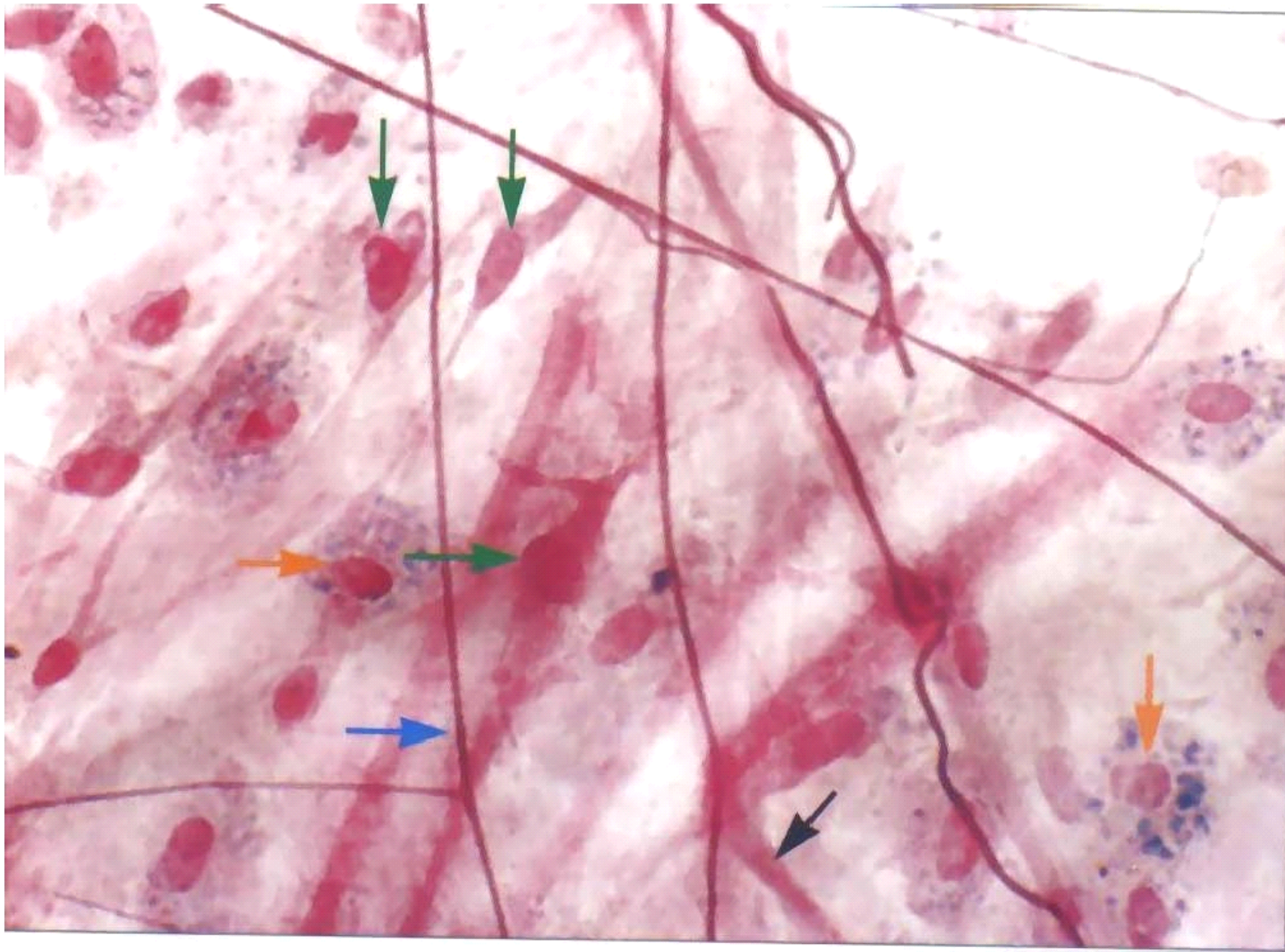
- The odontoblasts do not undergo mitosis and may therefore be considered postmitotic, or end cells.
- When they die, their function is carried out by neighboring odontoblasts or by new odontoblasts.

Fibroblasts



- The fibroblasts are the principal cells distributed throughout the pulp.
- These cells exhibit wide variation in their degree of differentiation.
- Pulpal fibroblasts are spindle-shaped cells with ovoid nuclei.
- They produce gelatinous intercellular matrix and collagen fibers.





Reserve Cells

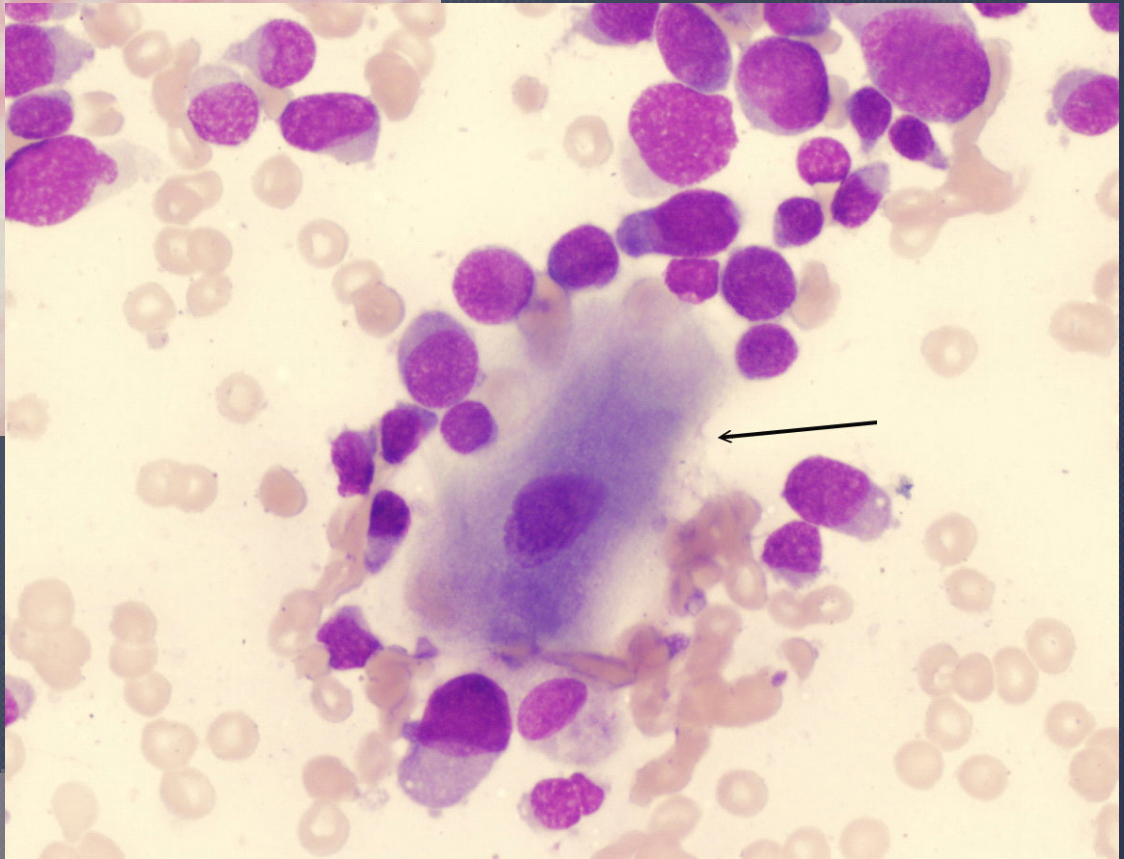
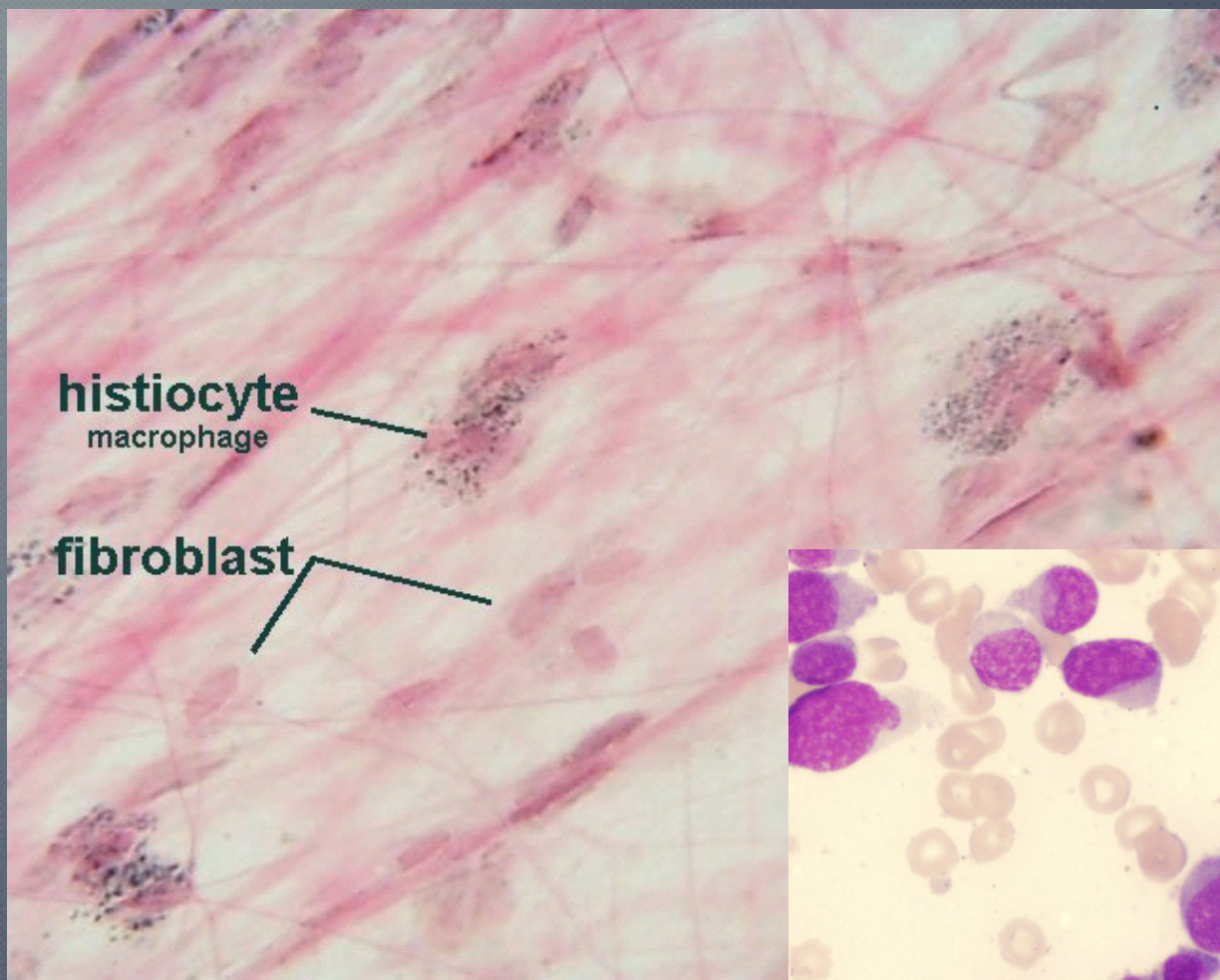
- principally along capillaries and in the cell-rich zone
- primitive undifferentiated cells
- can differentiate into fibroblasts or odontoblasts

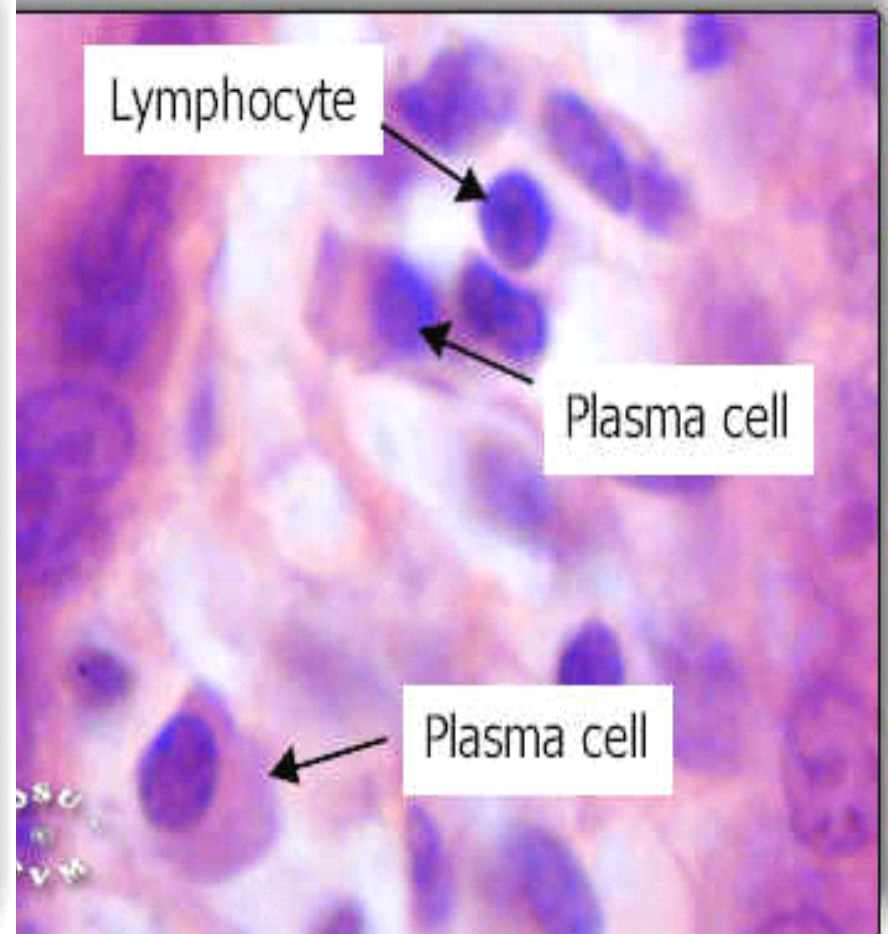
Defense Cells



The defense cell is in the normal pulp, including macrophages, dendritic cells, lymphocytes and mast cells.

- Engulf bacteria, foreign body & dead cells
- Participate in immune reactions





Intercellular

- The dental pulp has most of its volume primarily composed of fibers and ground substance.
- These form the body and integrity of the pulp organ.

Collagen Fibers

- Collagen fibers are the principal components in the pulp.
- These fibers form a loose, reticular network to support other structural elements of the pulp
- Collagen is synthesized and secreted by odontoblasts and fibroblasts
- The principal collagen fibers are type I and type III

Ground Substance

- It makes up the bulk of the pulp organ.
- The ground substance consists primarily of complexes of proteins and carbohydrates and water.
- More specifically, these complexes are composed of combinations of glycosaminoglycans and other glycoproteins.



Functions

Formative function

Nutritional function

Sensory function

Defense function





Formative function

- Primary dentin (initial)
- Secondary dentin (functional)
- Reparative dentin (irregular, defensive, irritation, tertiary)



Nutritive function

The dental pulp must maintain the vitality of the dentin by providing oxygen and nutrients to the odontoblasts and their processes, as well as providing a continuing source of dentinal fluid.



Sensory function

Vasomotor control—motor
nerves

Defense pain—sensory nerves



The sensory nerves of the pulp are branches of the maxillary and mandibular divisions of the fifth cranial nerve.

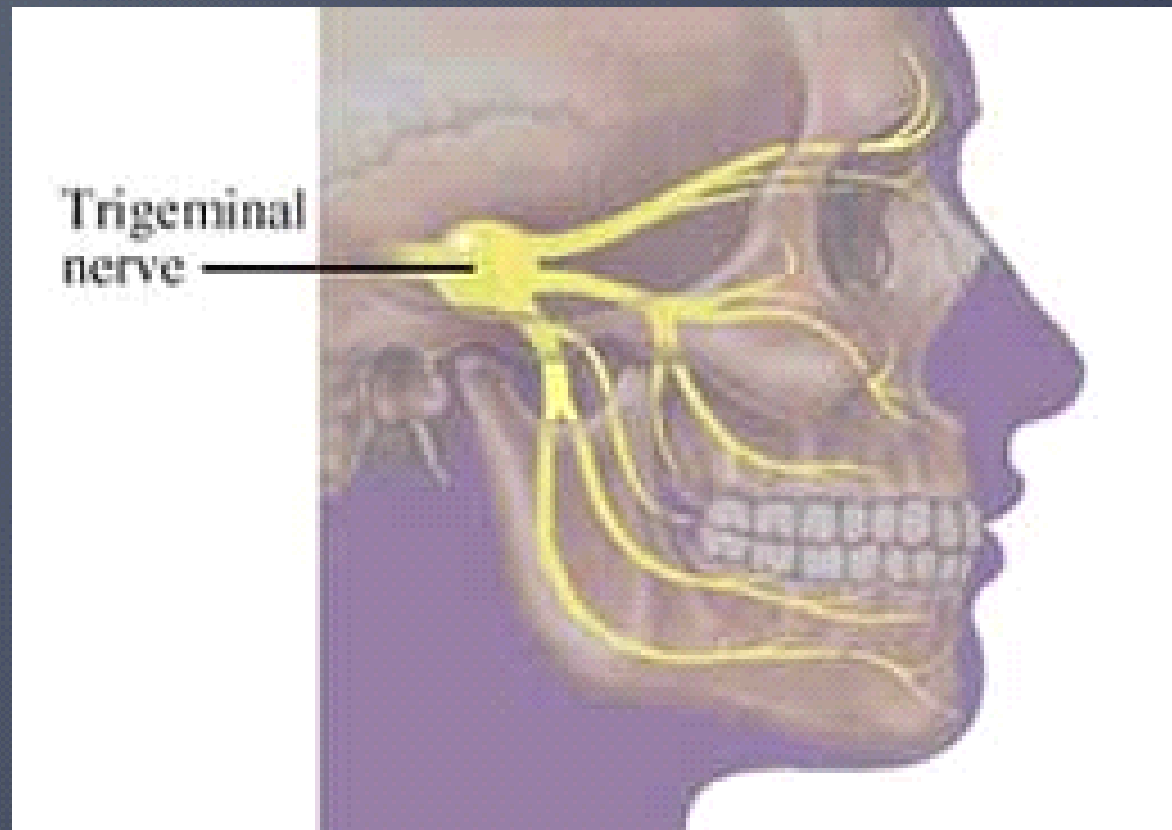


Table 1 Pain fibers in the pulp



	A- δ fibers	C-fibers
Diameter(μm)	2-5	0.3-1.2
Conduction velocity(m/s)	5-30	0.4-2
Myelinated	yes/no	no
Location of terminals	superficial	near vessels throughout pulp
Pain characteristics	sharp, pricking, aching,	throbbing,
	unpleasant, bearable	less bearable
Stimulation threshold	relatively low	high threshold

The gate control theory



It is the idea that the perception of physical pain is not a direct result of activation of nociceptors, but instead is modulated by interaction between different neurons.

The gate control theory



- A gating mechanism located in the spinal cord is called the *substantia gelatinosa*. It receives painful impulses from peripheral nerves and permits their passage to the brain by opening the gate, or prevents their passage by closing the gate.

The hydrodynamic theory



It states that the flow of fluid in dentinal tubules trigger receptors within the tooth. Sensory of the pulp and dentin is linked by the fluid and by its movement between the dentinal tubules and peripheral receptors, and thus to the sensory nerves of the pulp proper.



Defense function

- Defense pain
 - Reparative dentin formation
 - Inflammation
- 

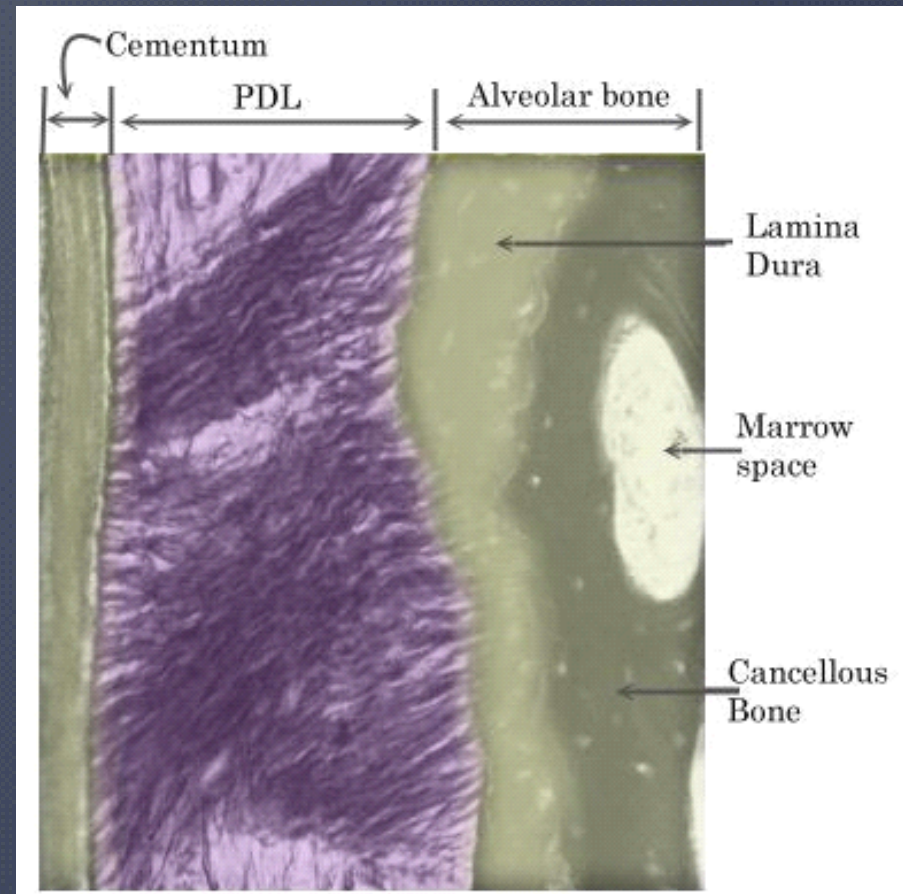
PULP CHANGES WITH AGE



- Dimensional — With time and/or injury, the pulp volume decreases by forming additional calcified tissues on the walls.
- Structural — The number of cells decreases and the fibrous component increases with aging of the pulp.
- Functional — Older pulps have been described as regressive and as having a decreased ability to combat and recover from injury.

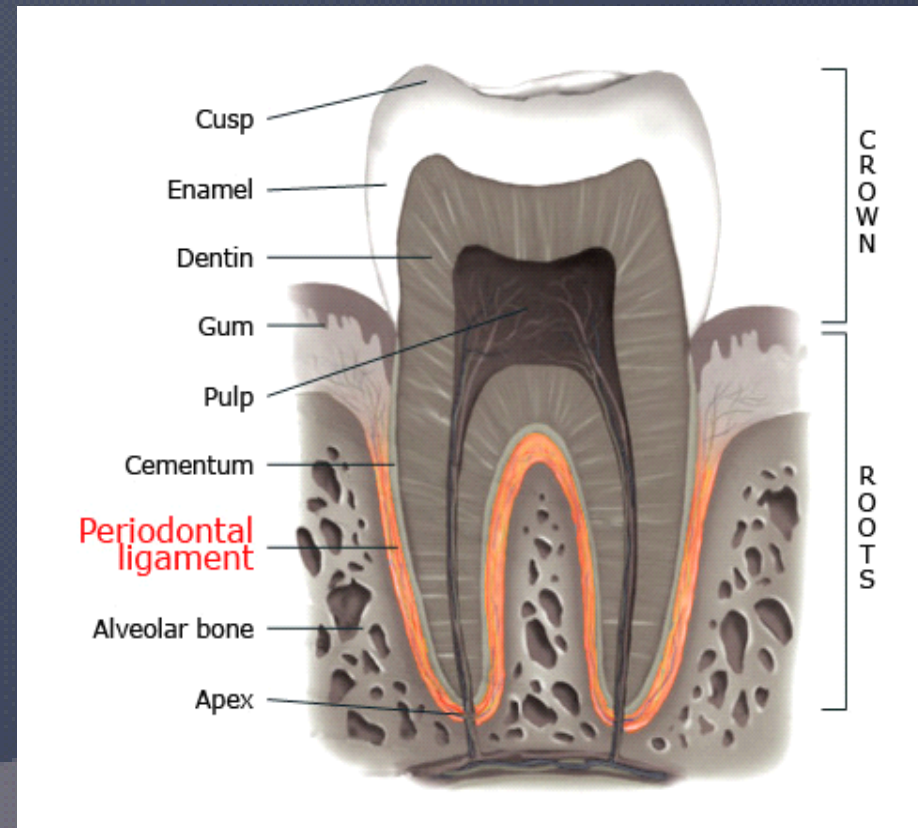
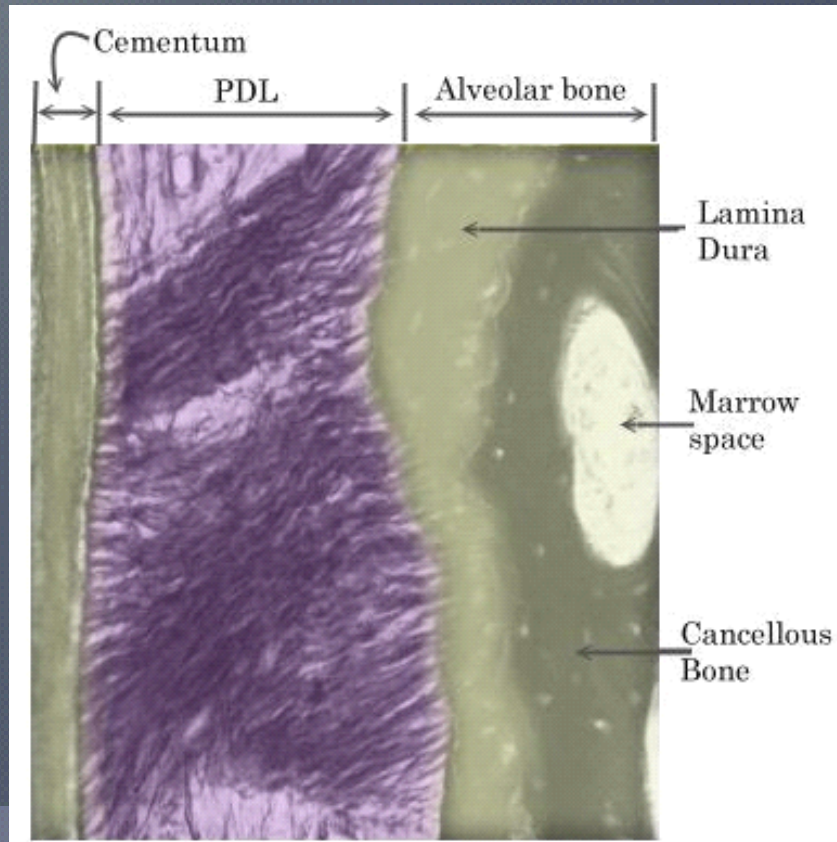
CEMENTUM

- To anchor the tooth to the alveolus via the periodontal ligament
- To compensate for tooth wear
- To contribute to continuous eruption of the teeth



Periodontal Ligament

— is a thin, fibrous ligament that connects the tooth to the bony socket.




To contrast the periodontal ligament from dental pulp:

- It is an organ of the finest tactile reception. The pulp contains no such receptors.
- Collateral blood supply is abundant in this area. While, it is so lacking within the pulp.
- The apical periodontium communicates with extensive spaces of alveolar bone.



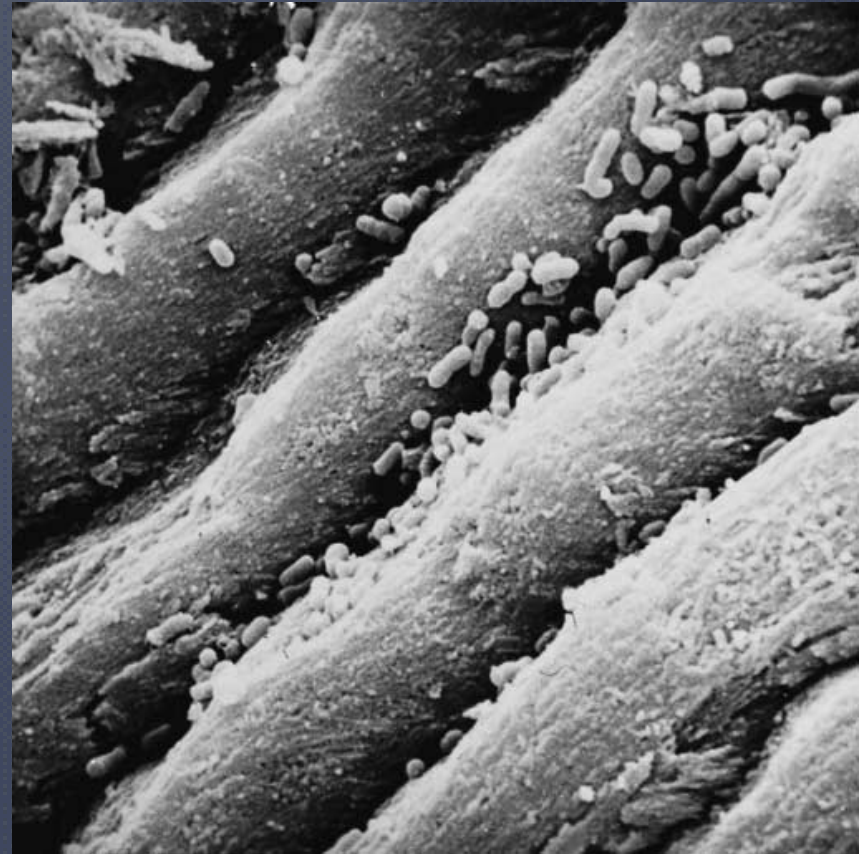
Etiology

- Microbial agents
 - Physical agents
 - Chemical agents
 - Others
- 

Role of bacteria



- Without question, bacterial invasion from a carious lesion is the most frequent initial cause of pulp inflammation.



Pathogenic Bacteria

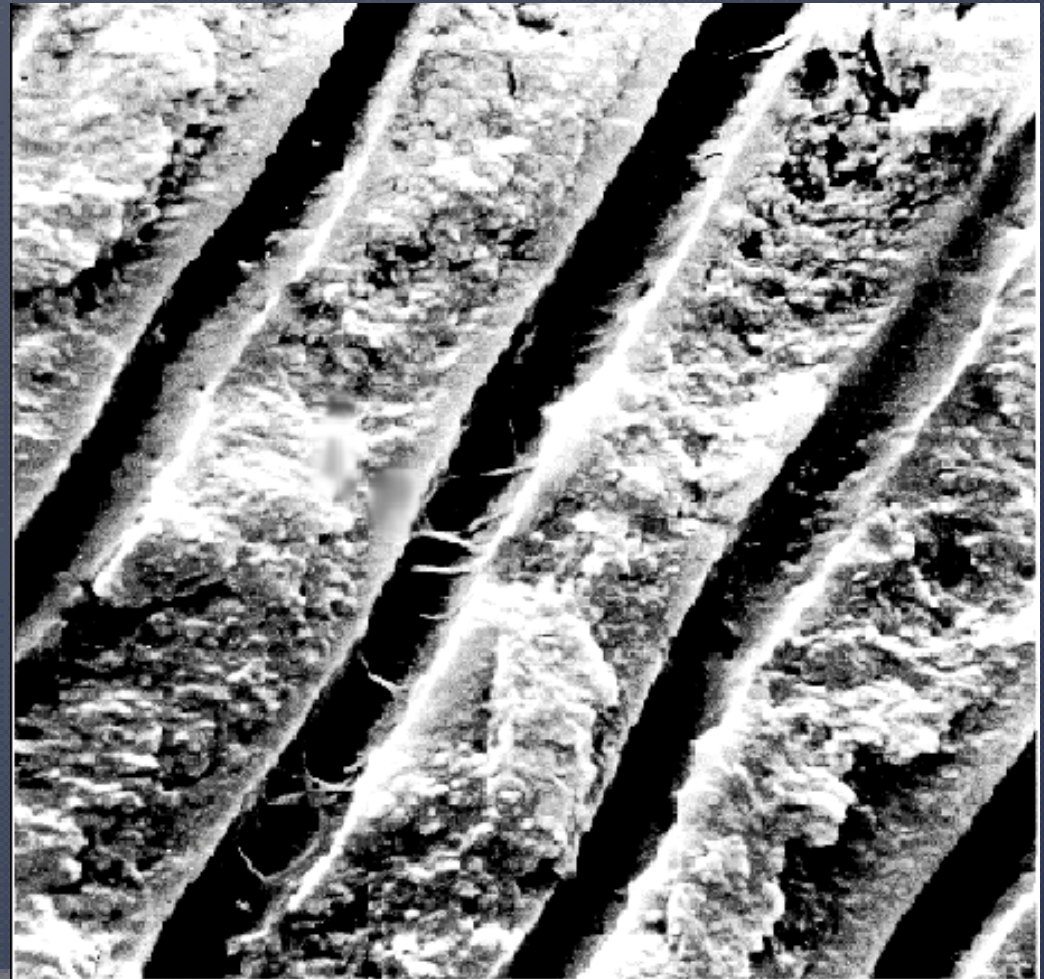
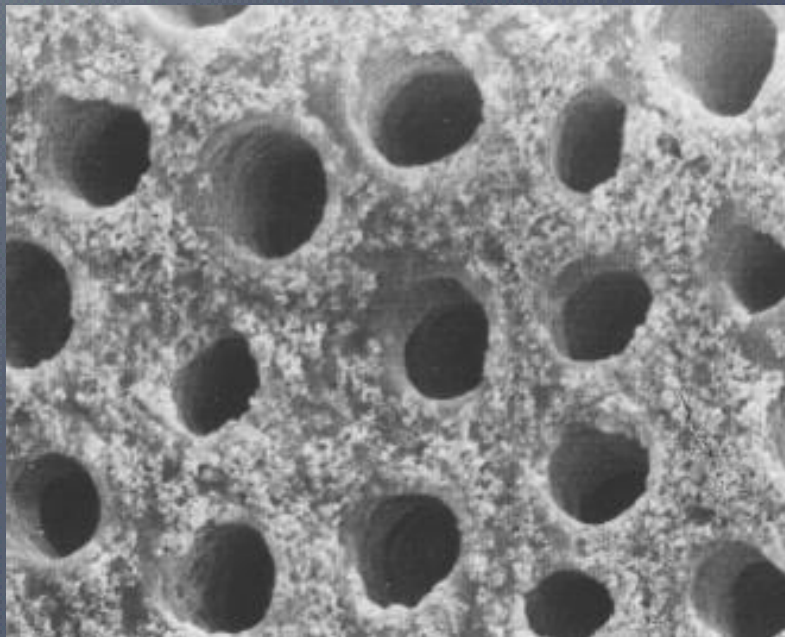


- Inflamed Pulp: Facultative anaerobes
e.g. Streptococcus, Actinomycete,
Lactobacillus, Gram-negative
bacteria
- Inflamed Root Canal: Obligate
anaerobes
e.g. Porphyromonas endodontilis,
Prevotella buccae
- Periradicular Region: Controversial

Pathways

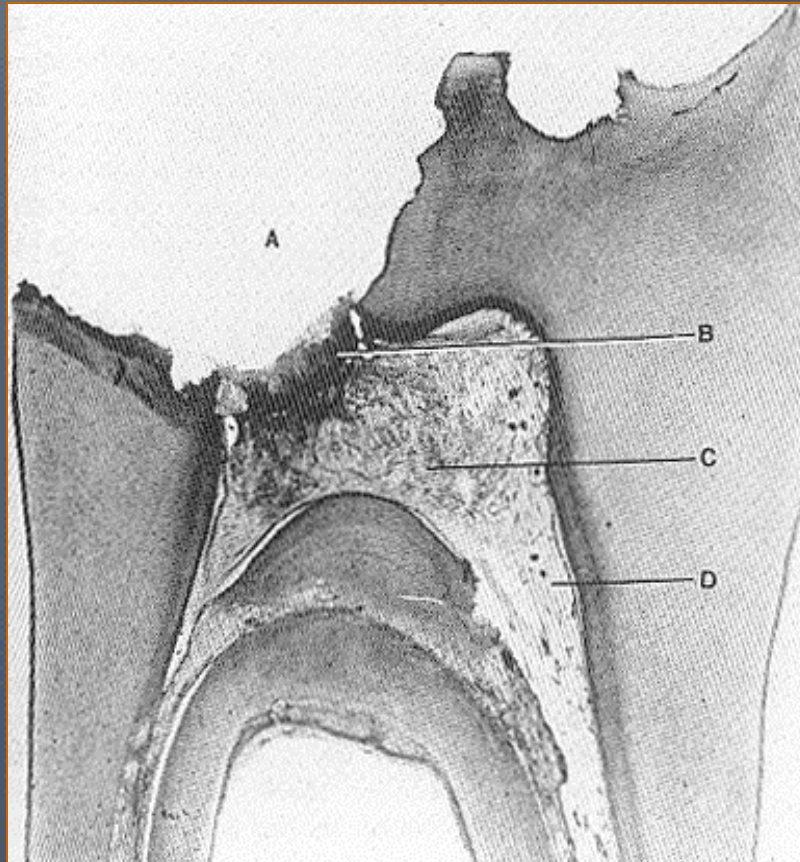


Dentinal tubules



Magnified(X5000) Longitudinal dentinal Tubules

Pulp exposure



- Tooth decay
- Traumatic injuries
- Abrasion
- Erosion
- Anomalies

Periodontal pocket



- Lateral canals
- Apical foramina
- Dentin

Anachoresis

Definition—a positive attraction of blood-borne microorganisms to inflamed or necrotic tissue during a bacteremia.

In 1939, found for the first time anachoretic effect of periapical inflammation in dogs.

In 1941, confirmed the similar effect of pulp tissue in rats.

Pathogenesis

- Bacterial Capsule: To protect bacterial cells from phagocytosis
- Cilia: Bacterial attachment
- Extracellular vesicles: To neutralize antibody

Pathogenesis



- LPS(lipopolysaccharide)
- Enzyme
- Metabolites

Responses of the tissues

Bacteria, their by-products and toxins will cause the responses and damages.

Pulpal disease state(formula)=

virulence $\frac{\text{number of bacteria} \times$

tissue resistance

Inflammation and immune responses


Physical agents

Cutting procedures

It can produce varying magnitudes of pulpal damage, depending on applied pressure, speed, bur size, temperature, cavity depth, and postoperative insulation protection.

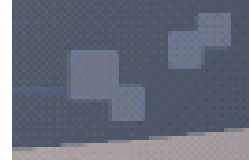


Thermal irritants

- Cutting procedures
 - Metal fillings without proper insulation
of liners and bases
 - Polishing restoration
- 


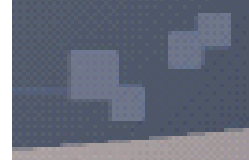
Other physical irritants



- Acute trauma
 - Chronic trauma (Traumatic occlusion, attrition, bruxism, erosion, abrasion)
 - High fillings, tooth drift, too rapid orthodontic movement
- 

Chemical agents

- Disinfecting chemical (phenol, alcohol, chloroform, hydrogen peroxide, silver nitrate)
- Dentin-conditioning and dentin-bonding agents(37% phosphoric acid)

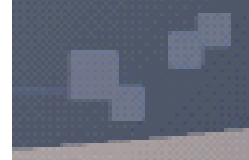
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- Acid-liquid components of cements(zinc phosphate cements, silicate cements, glass ionomer cements)
 - Eugenol released from ZOE
 - Composite resins
 - Restorative materials and microleakage
- 

Others

- Cancer
- AIDS, diabetes
- Internal or external resorption
- Immunologic factors
allergies or
hypersensitivities

Diagnostic Procedures



- **HISTORY:** Chief complain, Present dental illness and Medical history
 - **CLINICAL EXAMINATION:** Vital Signs, Extraoral Examination, Intraoral Examination, Clinical Endodontic Tests
 - **RADIOGRAPHIC EXAMINATION**
- 

Clinical Endodontic Tests



- Inspection:
- Probing:
- Percussion:
- Palpation:



Clinical Endodontic Tests

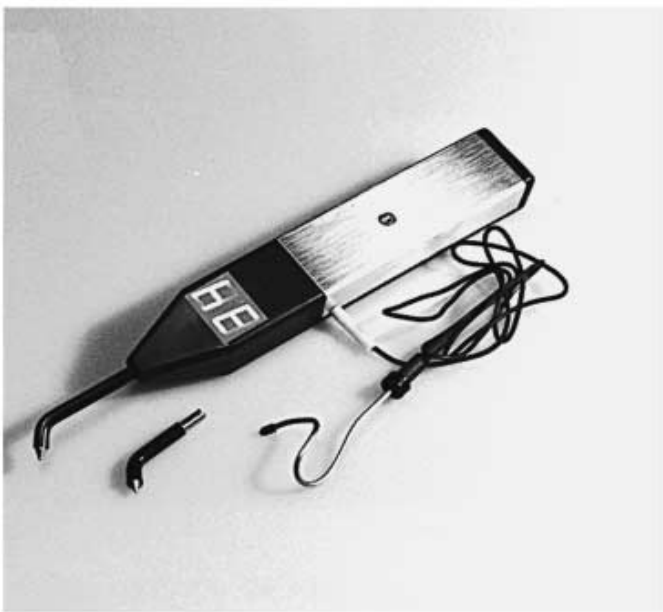


- Thermal Tests: Cold test and Hot test
 - Cold test is used to differentiate between reversible and irreversible pulpitis and to identify teeth with necrotic pulps.
 - Both can be used to differentiate between vital and necrotic pulps.

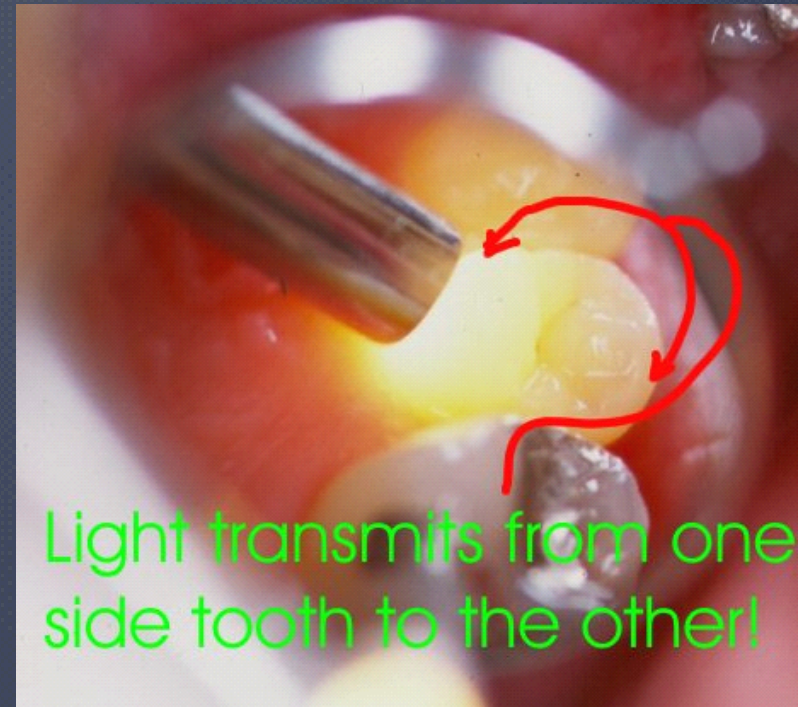
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Other Tests



Light transmits from one side tooth to the other!

RADIOGRAPHIC EXAMINATION

