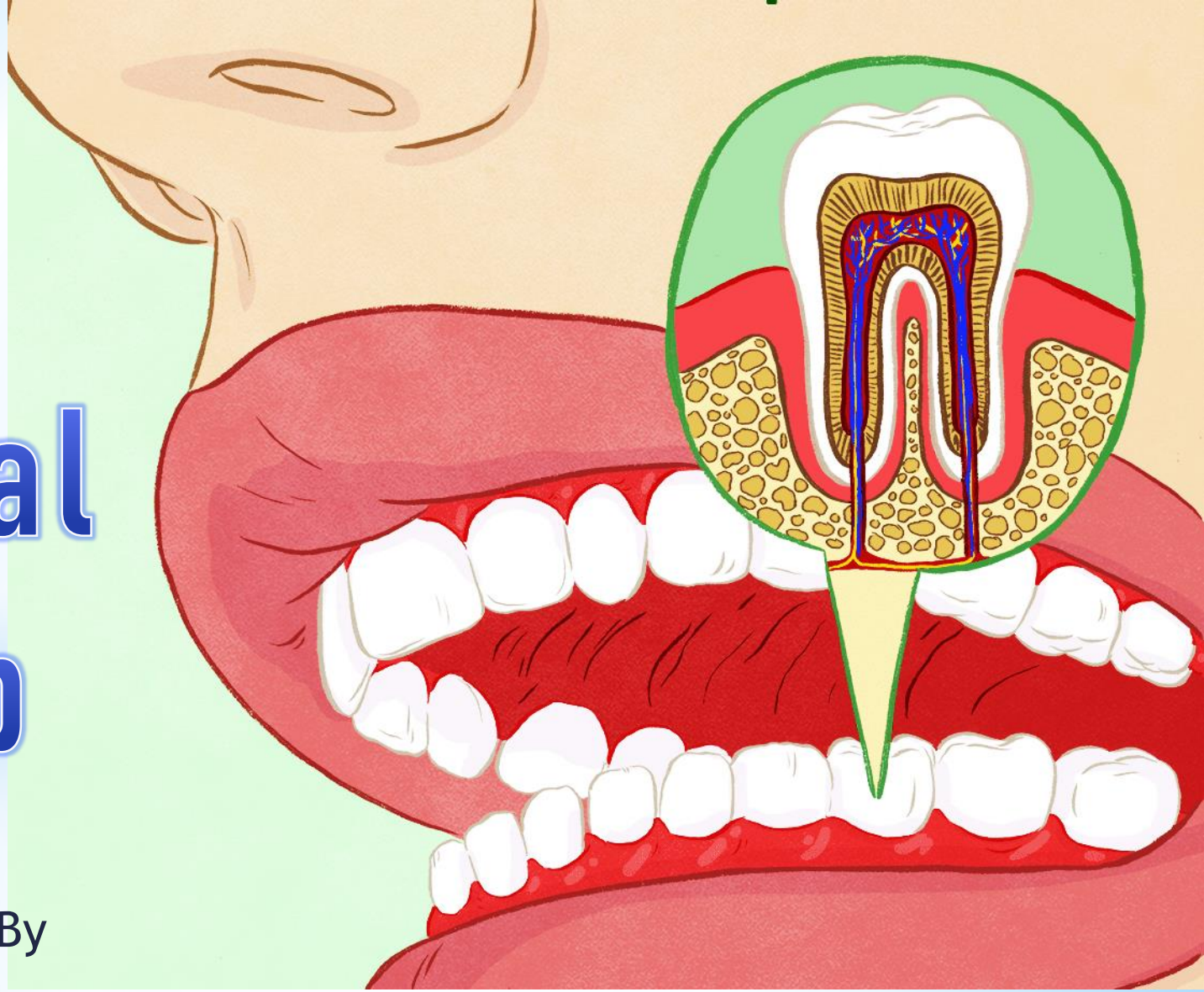
# Dental Pulp



By

Dr. Wafaa Alghonemy

Asst.Prof. of Oral Biology

# Dental pulp

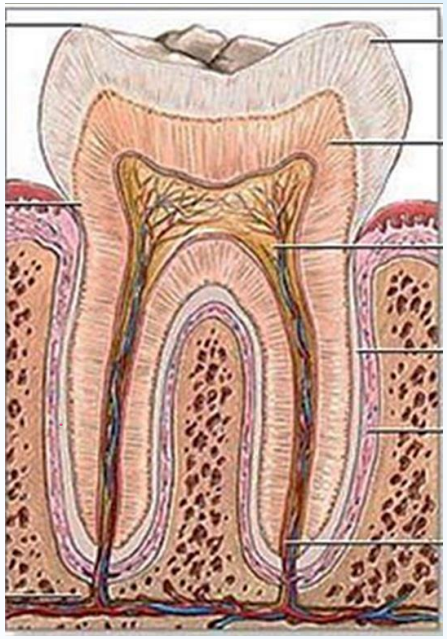
## Lecture outline

1. Def. & Functions
2. Development
3. Form and relations of the pulp
4. Histology
5. Age changes in the pulp.

# Definition of Dental Pulp

It is soft, specialized, loose connective tissue that is confined within tooth pulp space (pulp chamber and root canals), with communications to the periodontal ligament.

- Communicates with the Periapical region via the apical foramen.

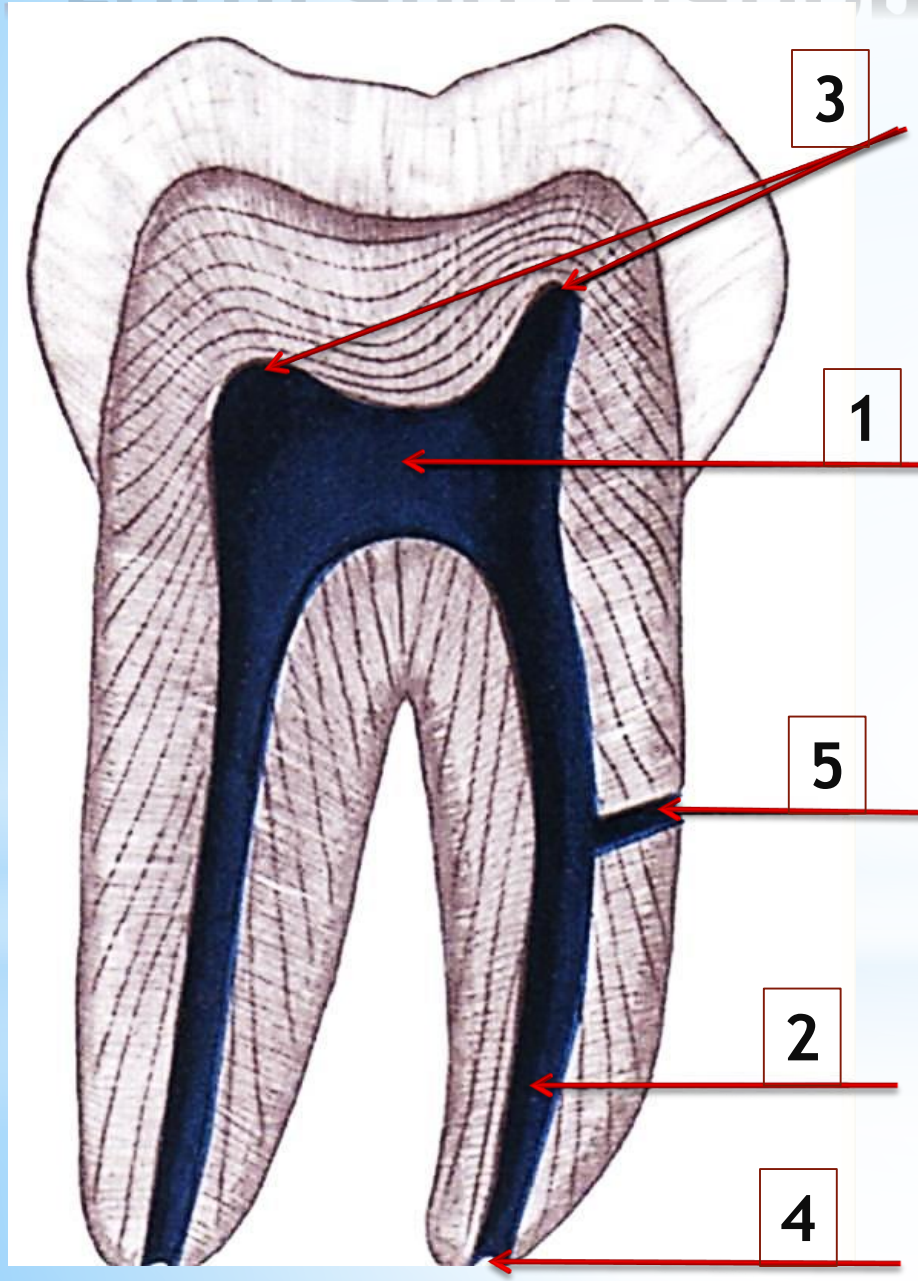


# Functions of the dental pulp

1. **Inductive**:
2. **Sensory (protective)**:
3. **Nutritive**:
4. **Formative**:
5. **Defensive (reparative)**:


# Development of the pulp.

# Form and relations of developed pulp.




Pulp horns narrow projections under cusps and incisal edges.

Pulp Chamber (coronal pulp) located in the crown of the tooth.

تختلف من مريض لآخر م

Accessory canals or lateral canal, extra canal located on the lateral portions of the root.

Root canal (radicular pulp) is the portion of the pulp located in the root.

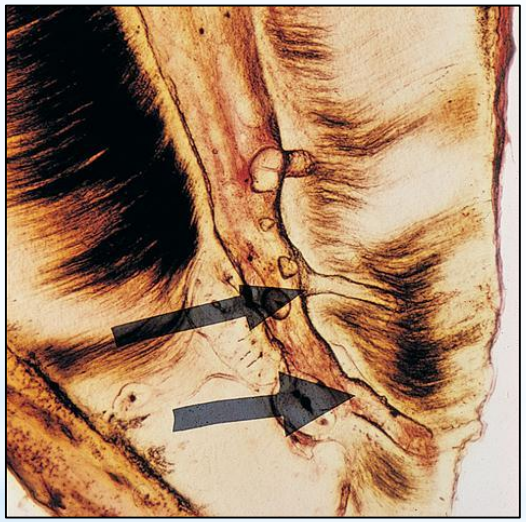
The apical foramen, opening of the pulp at the tooth apex.

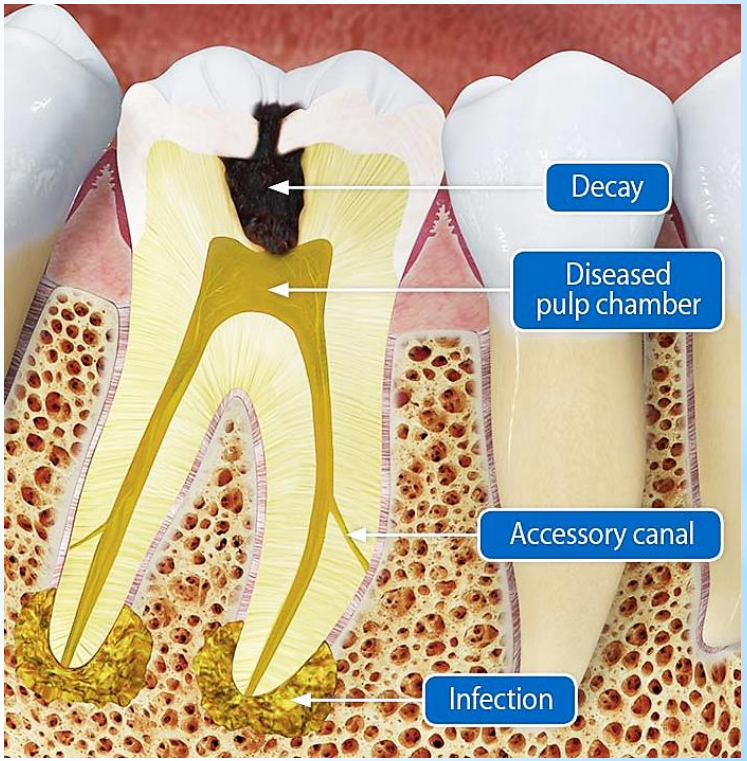
# Etiology of accessory root canals:

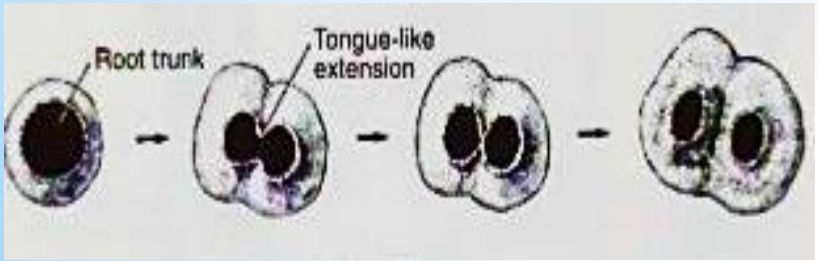
Clinical significance:
1) Spread of infection
2) Failure of endodontic treatment.

1. Where the developing root encounters a large blood vessel, where dentin will be formed around it.
2. Early degeneration or failure of HERs before the differentiation of the odontoblasts.
3. Lack of complete union of the epithelial diaphragm at the floor of the pulp chamber.

↳ Results in accessory canals at the furcation area.



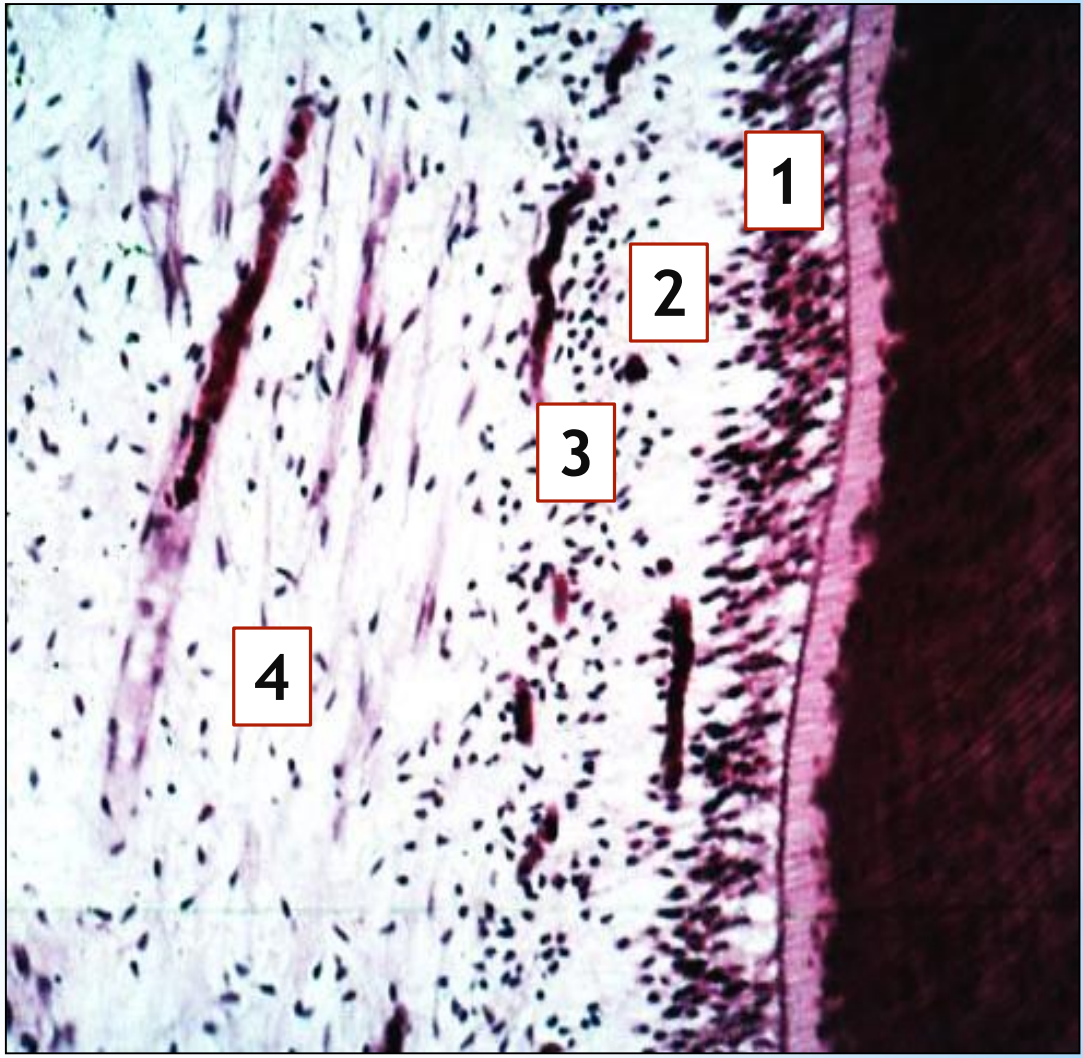


# Histological Structure of the Pulp:

* On **decalcified** H&E stained section: 4 distinct zones:

1. **Odontoblastic zone** at the pulp periphery.
2. **Cell free zone** (basal layer of **Weil**) beneath the odontoblasts, prominent in the coronal pulp. · No cells · ECM (fibers + ground substance)
3. **Cell rich zone**, high cell density. prominent in the coronal pulp. لأنه أوسع من الـ root canal
4. **Pulp core**, contain the major BLvs and nerves of the pulp.



# Structural features:

**Cells** + **Intercellular substances**

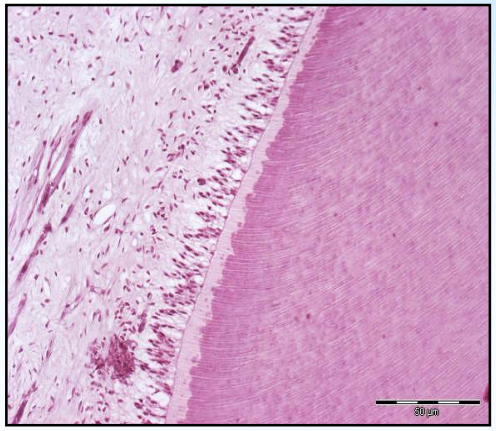
1. Odontoblasts
2. Fibroblasts
3. Undifferentiated ectomesenchymal cells Multipotant stem cells
4. Dendritic cells
5. Defense cells.

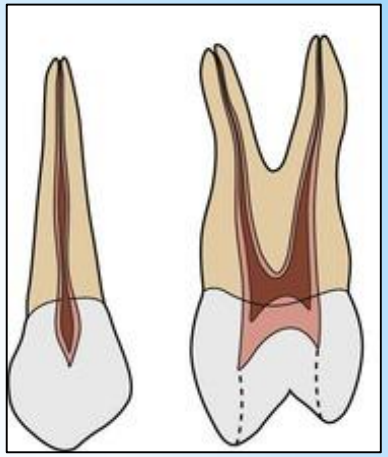
1. Fibers.
2. Ground substance.

Plus

**Blood vessels, nerves & lymphatics**

# 1) Odontoblasts (OB)

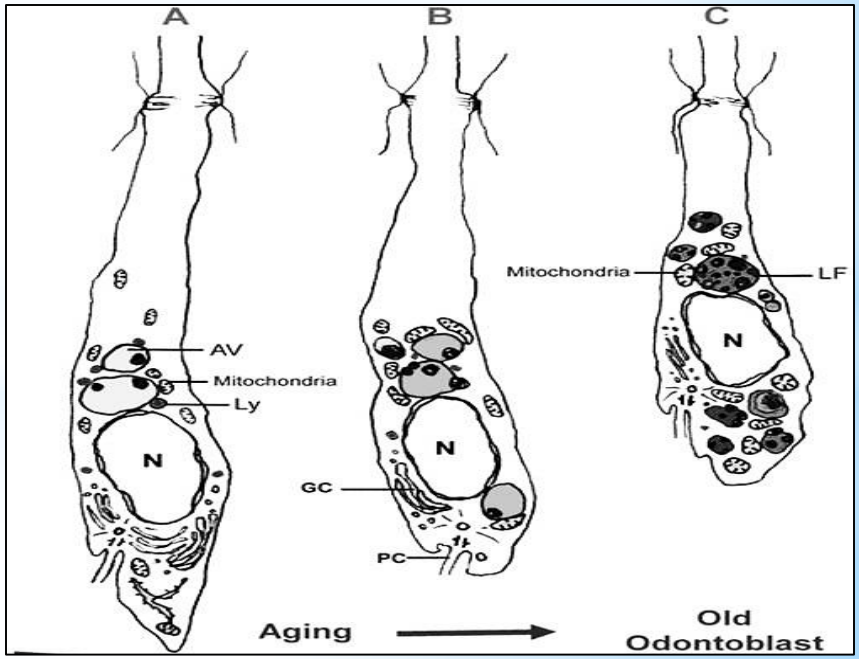




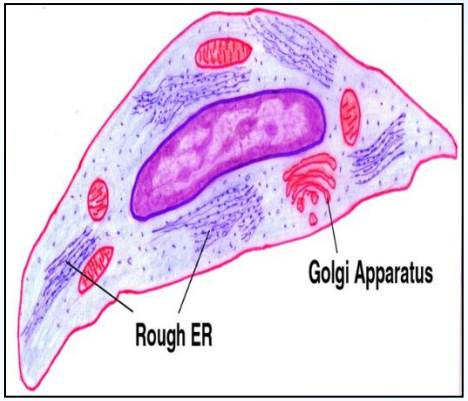
* The most distinctive.
* in the crown **larger** than in the root.
* In coronal pulp ➡ columnar.
* in the mid portion ➡ cuboidal.
* In the apical part ➡ flattened.

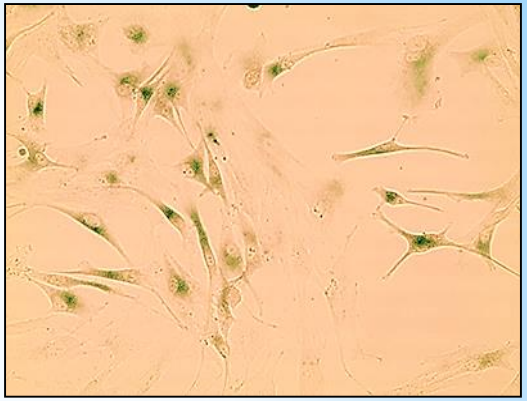
## ❑ Morphology of odontoblasts:

* By LM : **Active cell** ➡ elongated & possess a basal nucleus, much basophilic cytoplasm, a prominent Golgi zone.
* **Resting cell** ➡ with little cytoplasm, more closed face nucleus.
* By EM, another, **A transitional stage** intermediate between the active and resting states also possible.
* ***What are cell organelles in active ones ?*** RER, Golgi apparatus, ribosomes and mitochondria



# 2) Fibroblasts (FB).



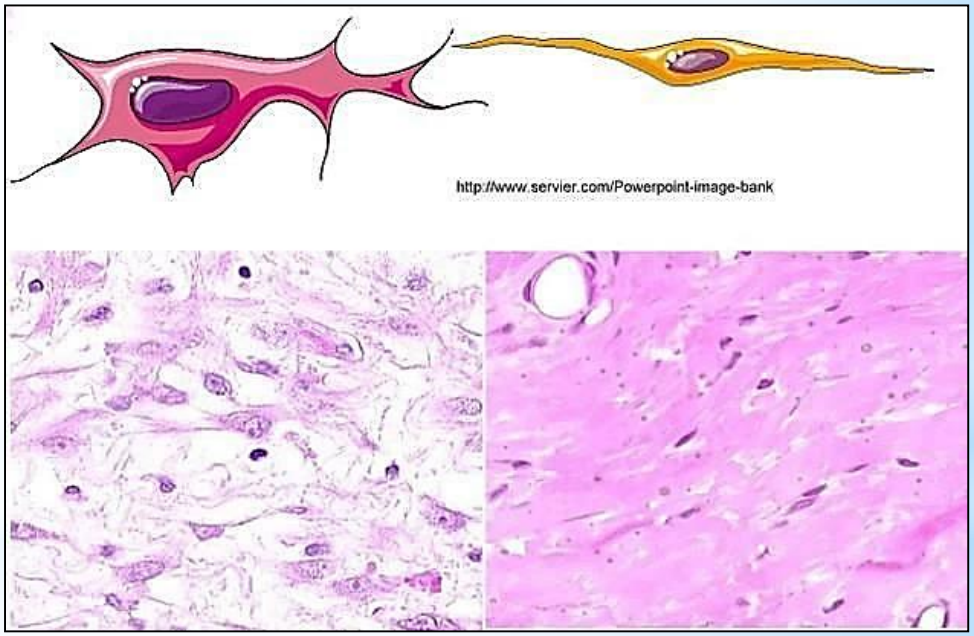



* The most numerous.
* form the cell-rich zone.
* **In young pulps (active)**

**L/M:** Stellate branched cell, Oval nucleus, Basophilic cytoplasm, long processes anastomosing with each others.

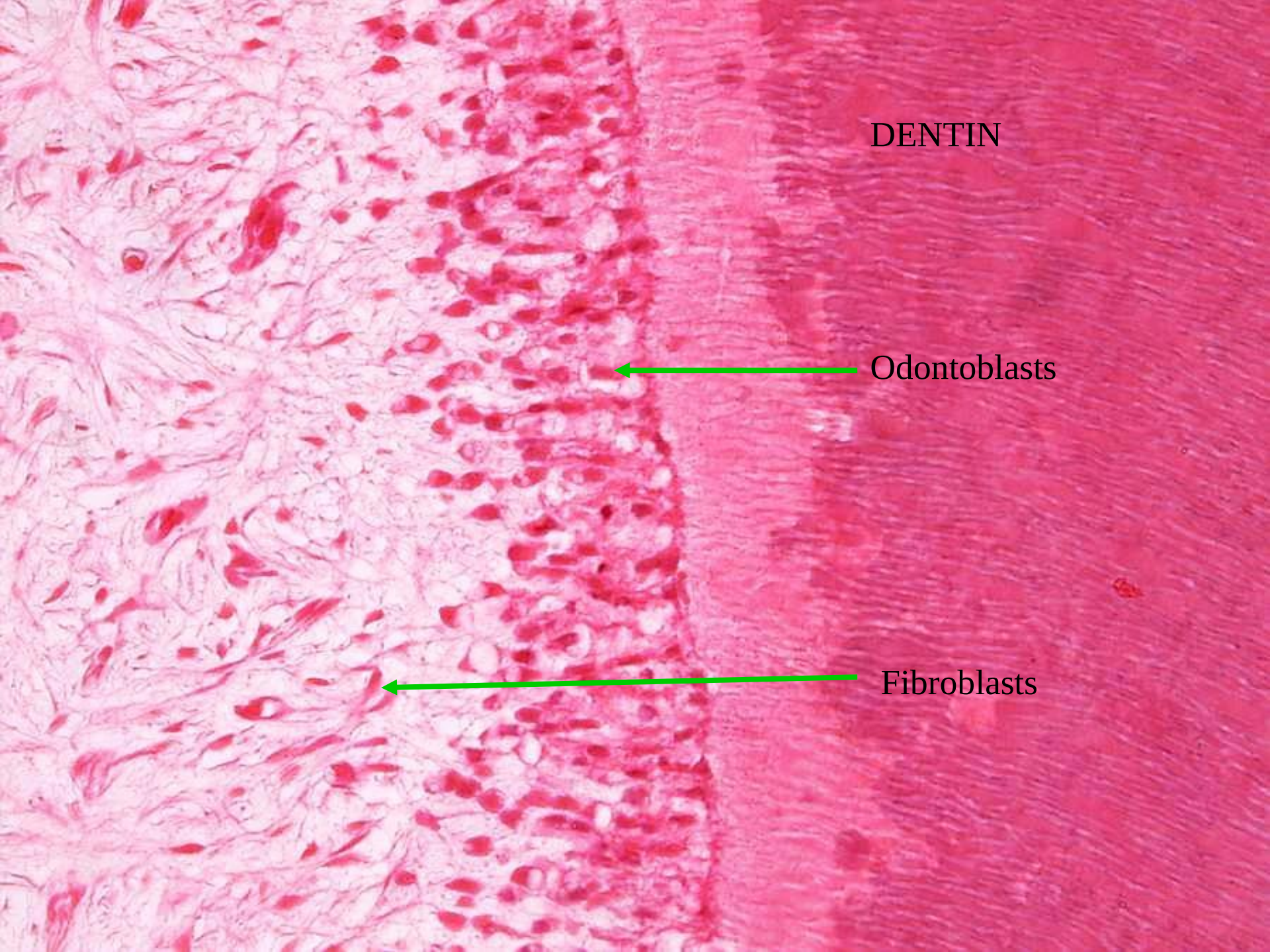
**E/M:** Abundant RER, Mitochondria, Golgi.

* **Function**: formation & degradation of pulp matrix. (fibers and ground substance)



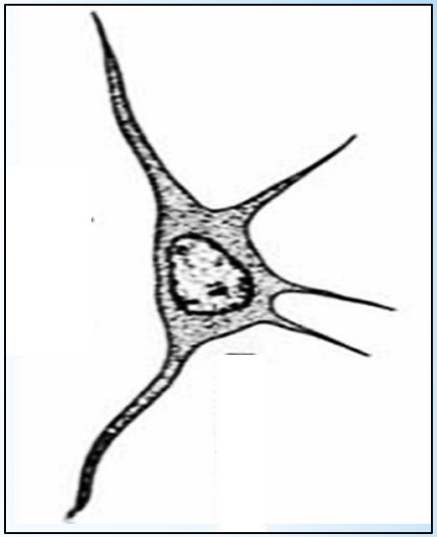

* **In old pulp (Fibrocyte) (resting cells):**

spindle shaped, Short processes, Few organelles


DENTIN
Odontoblasts
Fibroblasts

# 3) Undifferentiated mesenchymal cells

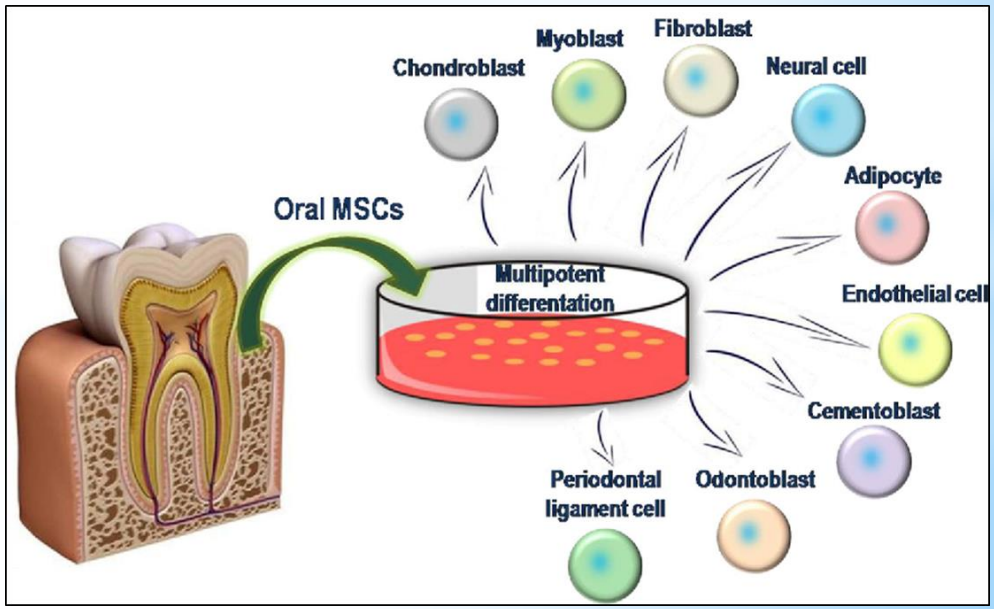
- Give CT cells of the pulp (OD & FB). .There're considered uniPotent stem cells
- In the **cell-rich zone** and the pulp core (perivascular).



- **L/M**: large polyhedral cells. large, lightly stained, central nucleus. abundant cytoplasm. peripheral cytoplasmic extensions.

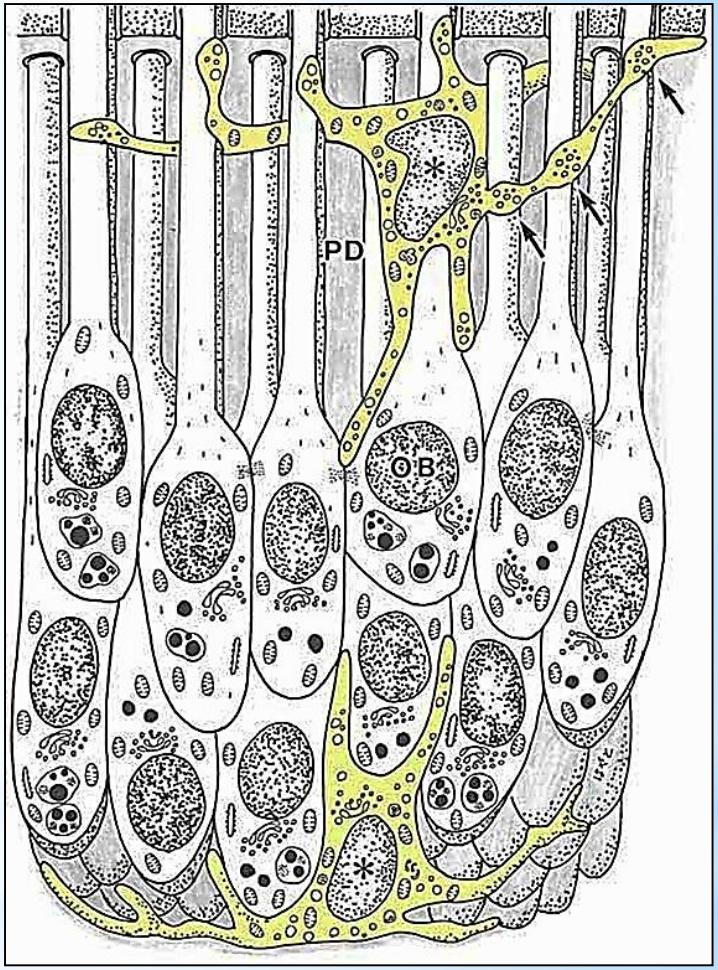
# 4) Multipotent Stem Cells

* embryonic cells which have the ability to change to any other **epithelial or CT cells.**
* **L/M:** spindle in shape similar to FB but smaller in size.
* Found in the pulp of the primary and permanent teeth.



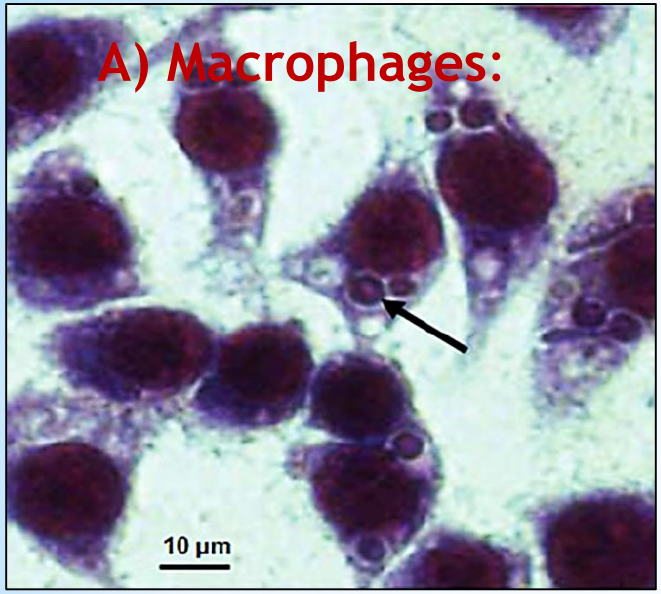
# 5) Bone marrow-derived antigen-presenting dentritic cells

* **In non erupted teeth** around OB
* **In erupted teeth** beneath OB
* Function: (similar to) = Langerhans` cells in epith, they capture and present foreign antigen to the T cells.
* ↑ in carious teeth, where they infiltrate the odontoblast layer and project their processes into the tubules.
* With macrophages have = 8% of the total pulp cell population.



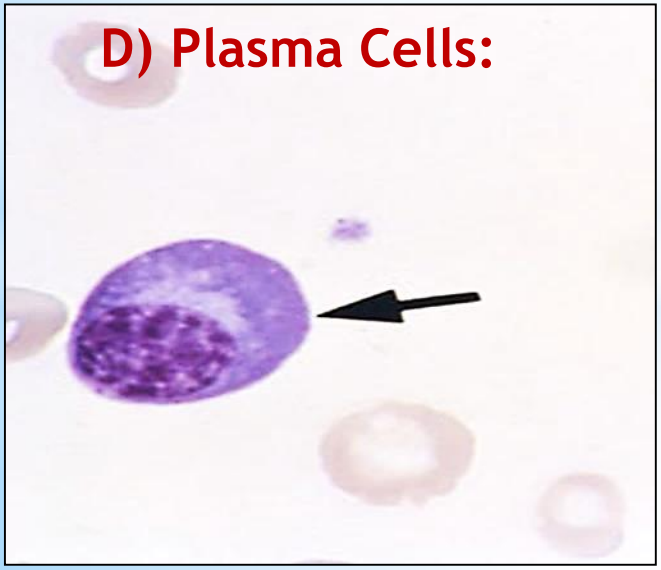
# 6) Defense (Inflammatory) Cells:

A) Macrophages:

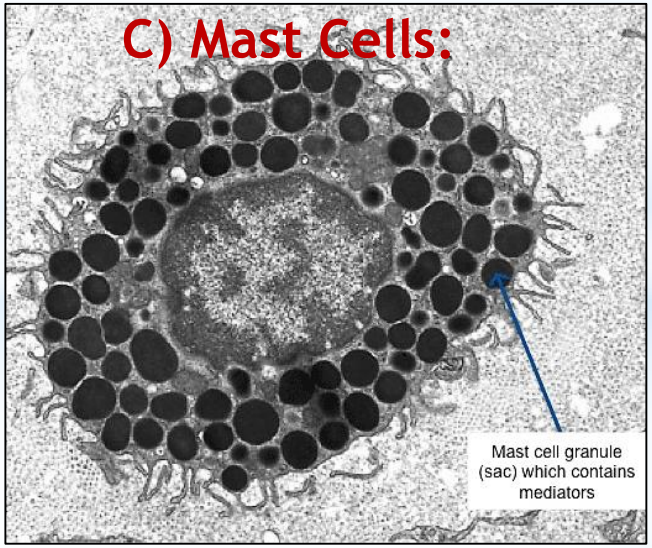


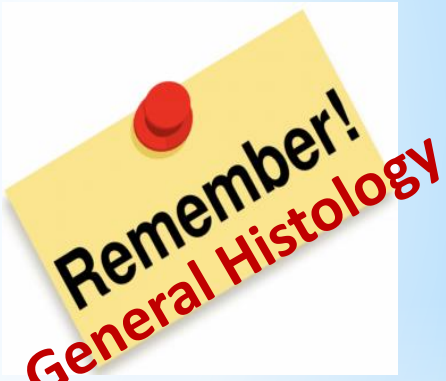

B) Histocytes:

D) Plasma Cells:



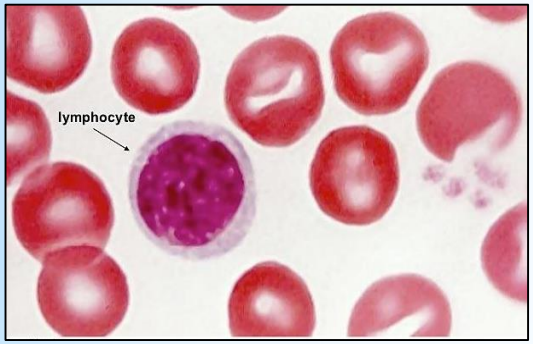
C) Mast Cells:

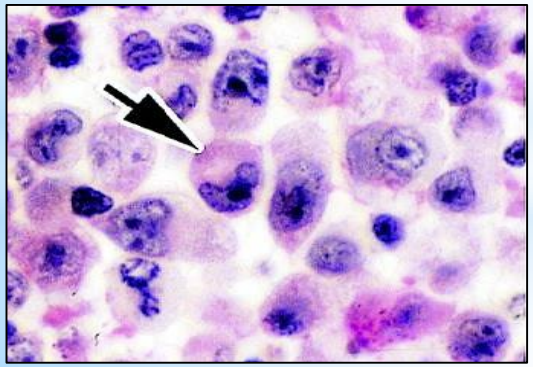


# E) Blood leucocytes

## Lymphocytes

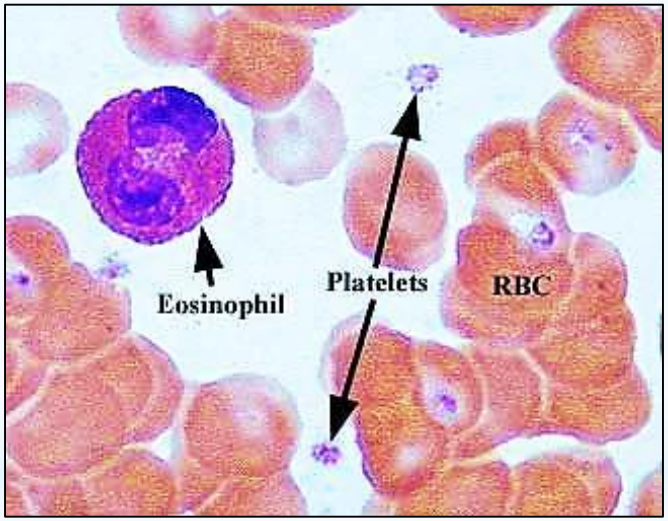


In normal pulps, **T lymphocytes** (large number) & **B lymphocytes** (rare)

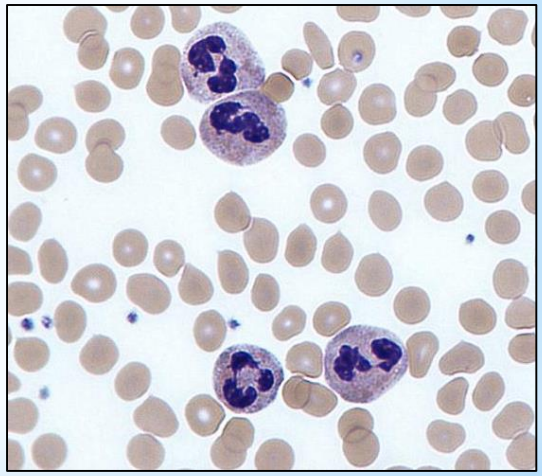
T > B

## Eosinophils

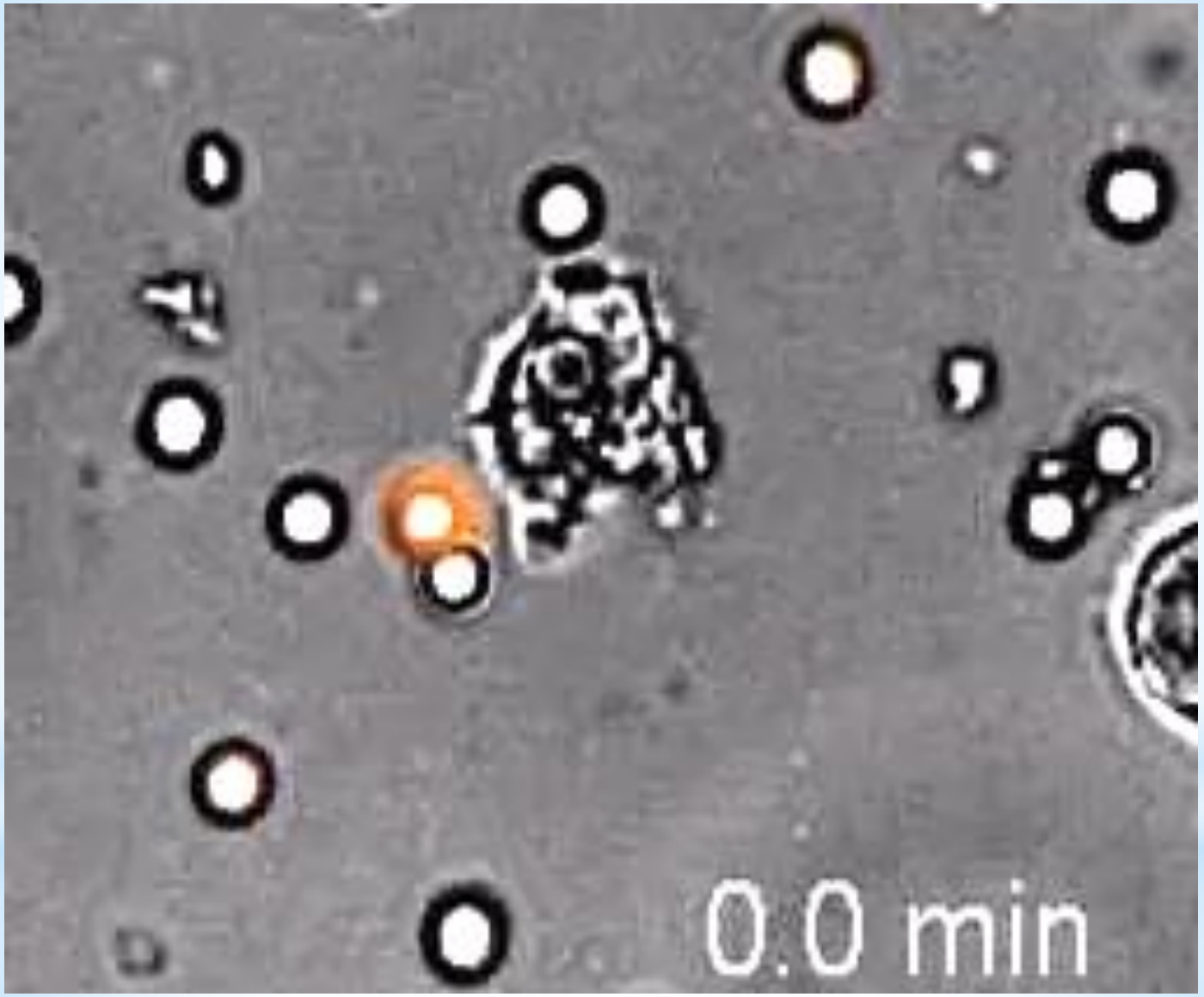



Increase in **allergic conditions**

## Neutrophils



In case of **acute infection**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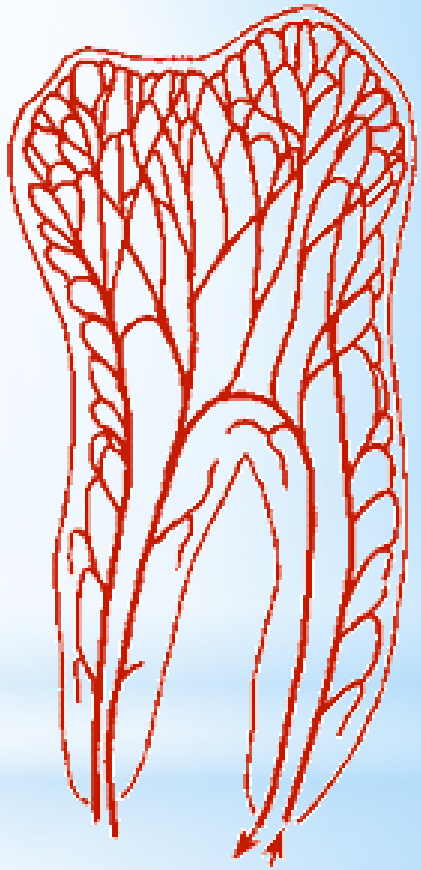
# Extracellular component of the pulp

**1) Ground substance:**

**2) Fibers:** Collagen fibers : type I (60%) + type III (40%). **No elastic** fibers in the pulp except for those in the walls of the large BLvs.

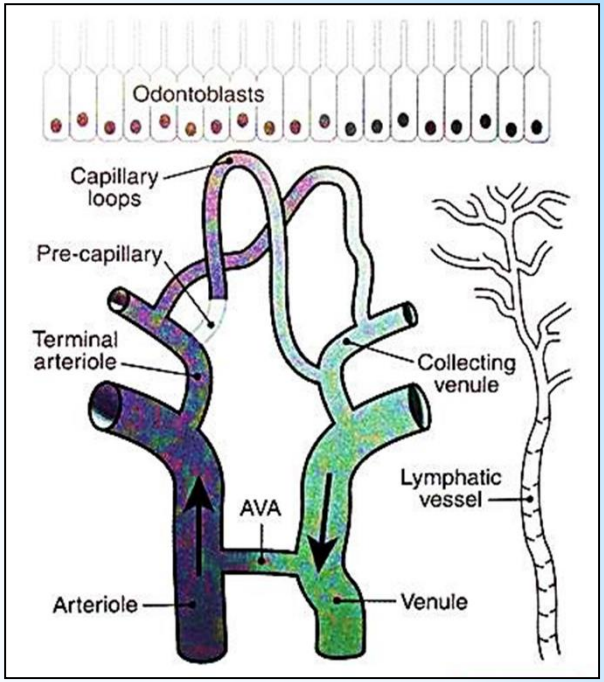


# Blood vessels:

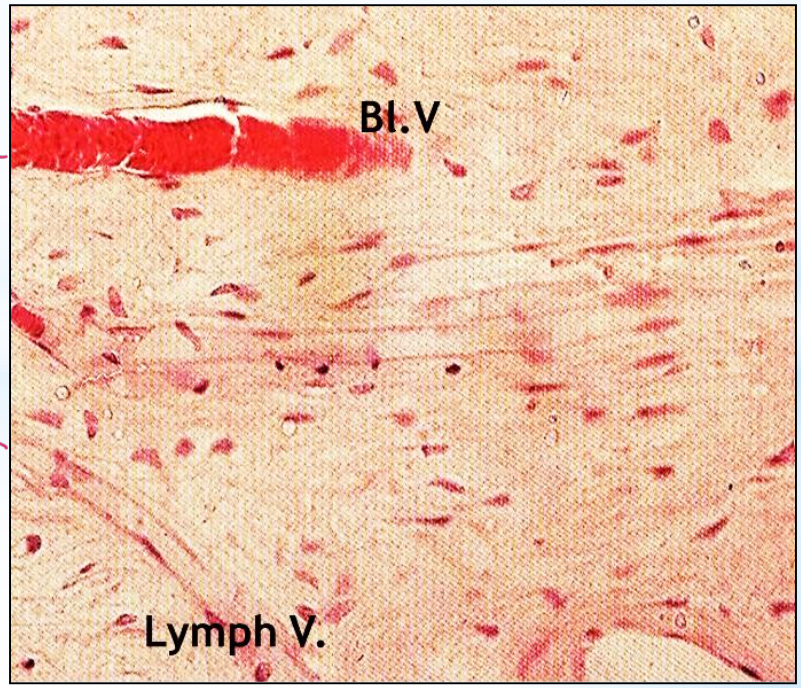
* The pulp is **extensively vascularized**.
* As **BLvs** enter the tooth, small **arteries** and **arterioles** enter the apical canal and take a direct course to the coronal pulp & their walls become thinner.
* Along their course they send off numerous branches that pass peripherally to form a rich **subodontoblastic capillary plexus.**
* From this plexus **looping** branches pass between the odontoblasts.
* Pulpal **blood flow is more rapid** than in most areas of the body.
* The capillary plexus drains into relatively large thin-walled **venules**, escaping through each foramen.

# Lymphatic Vessels:

* present in pulp.
* arise as **small, blind, thin-walled** vessels in the coronal region of the pulp.
* They pass apically exit via one or two large vessels through the apical foramen.

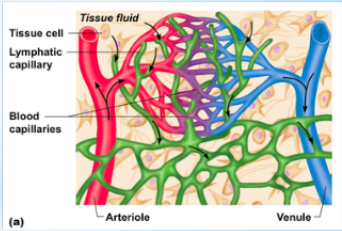



They are differentiated from small venules by:
1) presence of discontinuities in their vessel walls.
2) absence of RBCs in lumen.

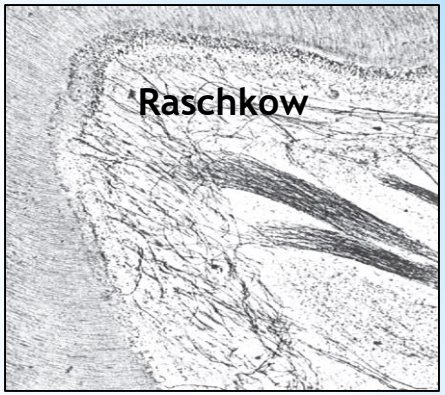



1) Presence of RBCs give red color
2) Continuous wall

1) No RBCs
2) Discontinuous wall.



# Pulp Innervation :




* Two types of nerve fibers:

1- Unmylinated fibers: (motor) along BLvs.

2- Mylinated fibers: (sensory) somatic nerves.

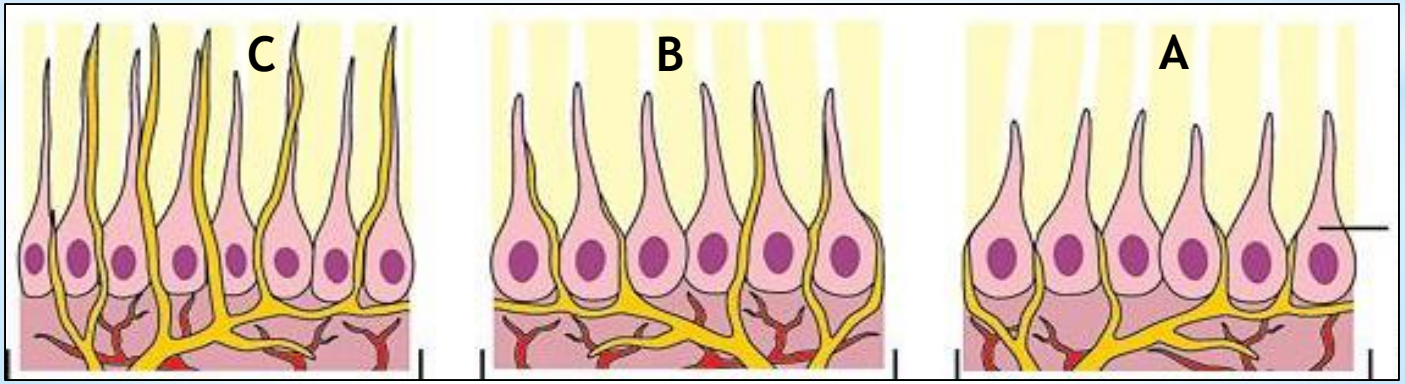
* nerve supply in the pulp **follows the distribution of BLvs** form an interlacing network of fibres adjacent to the cell-rich zone. (**parietal layer of nerves or plexus of Raschkow**) → Subodontoblastic

* **End of fibers arising from the plexus:**

**A)** cross the cell free zone, reach **between odontoblasts** towards the dentin or back towards the pulp.

**B) On reaching predentin**, the fibers divide again forming a marginal plexus.

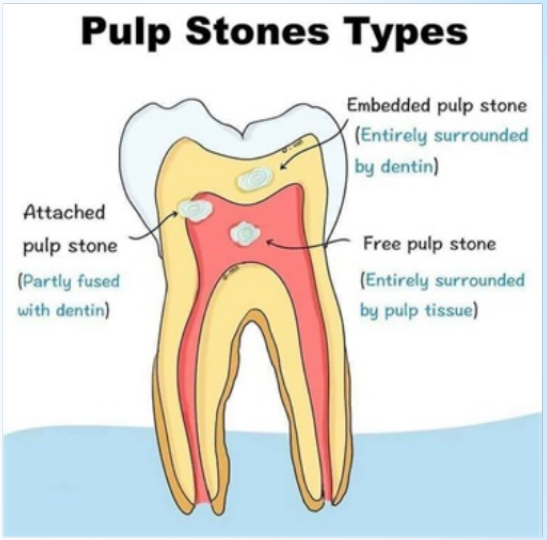
**C)** Some branches can **enter dentinal tubules.**



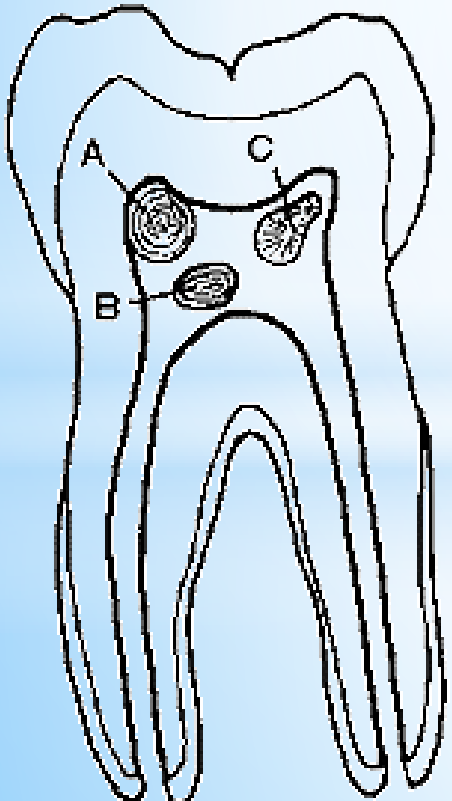
## 6) Pulp stones or Denticles:

*Results from ectopic calcification due to micro trauma or aging.

*Normally are asymptomatic, unless they impinge on BLvs or nerves.




*Acc. to their number
- single
- multiple




attachment
- free (surrounded by pulp tissue)
- attached (partially fused with D)
- embedded (entirely surrounded by D)

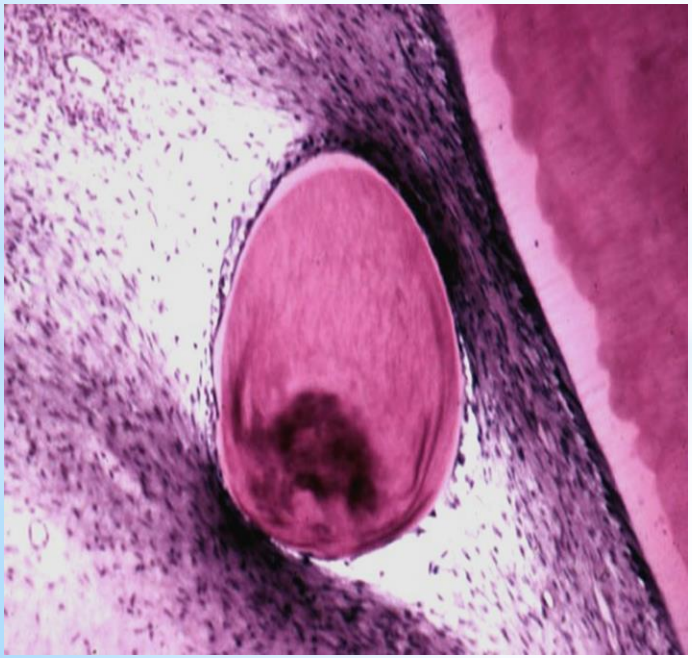
* According to their structure
  - True denticles
  - False denticles
  - Diffuse calcification

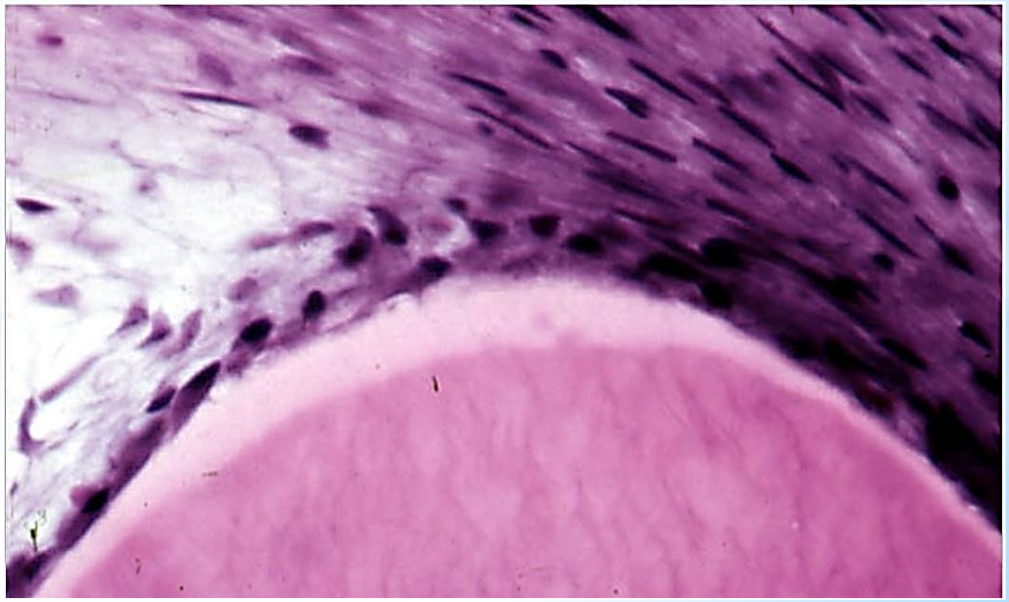
## A) True denticles:

* similar to dentine, exhibit DT & odontoblastic processes on their surface.
* rare and located near the apical foramen.

Epithelial Rests of Malassez

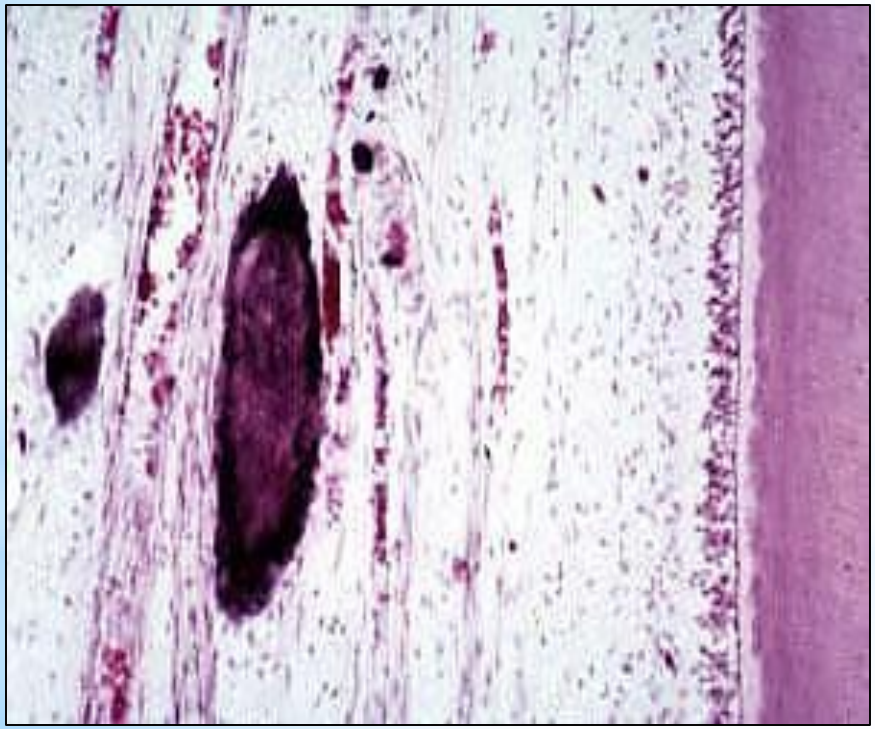
* cause: ERM have become enclosed in the pulp as a result of local disturbance at the root apex during development. Then they induce pulp cells to differentiate into OB that form masse of D.

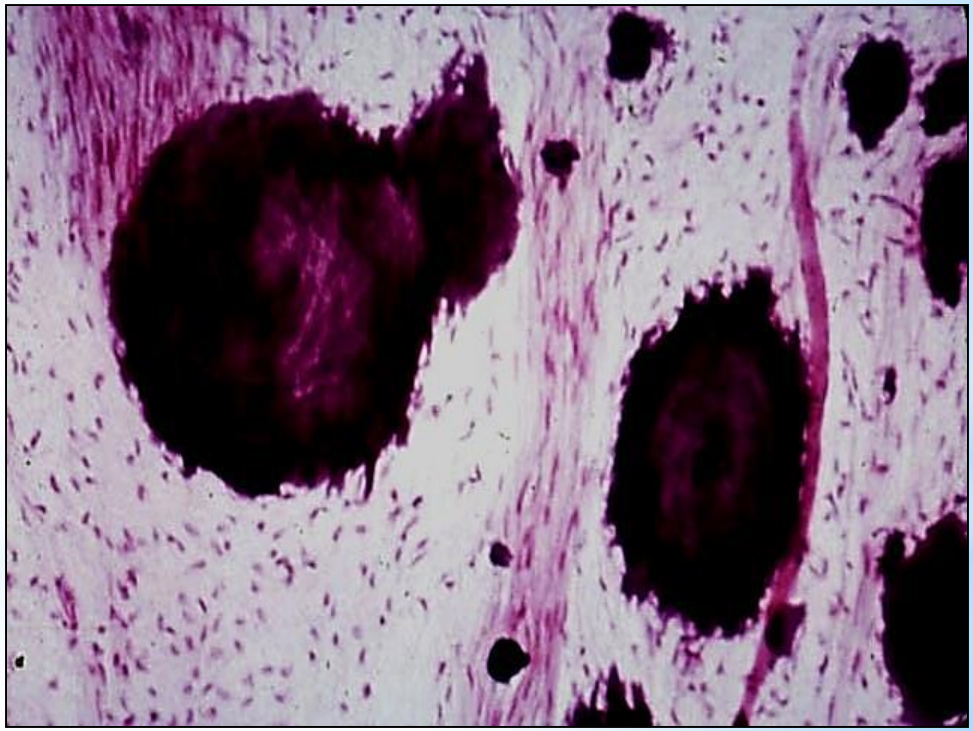




## B) False Denticles:

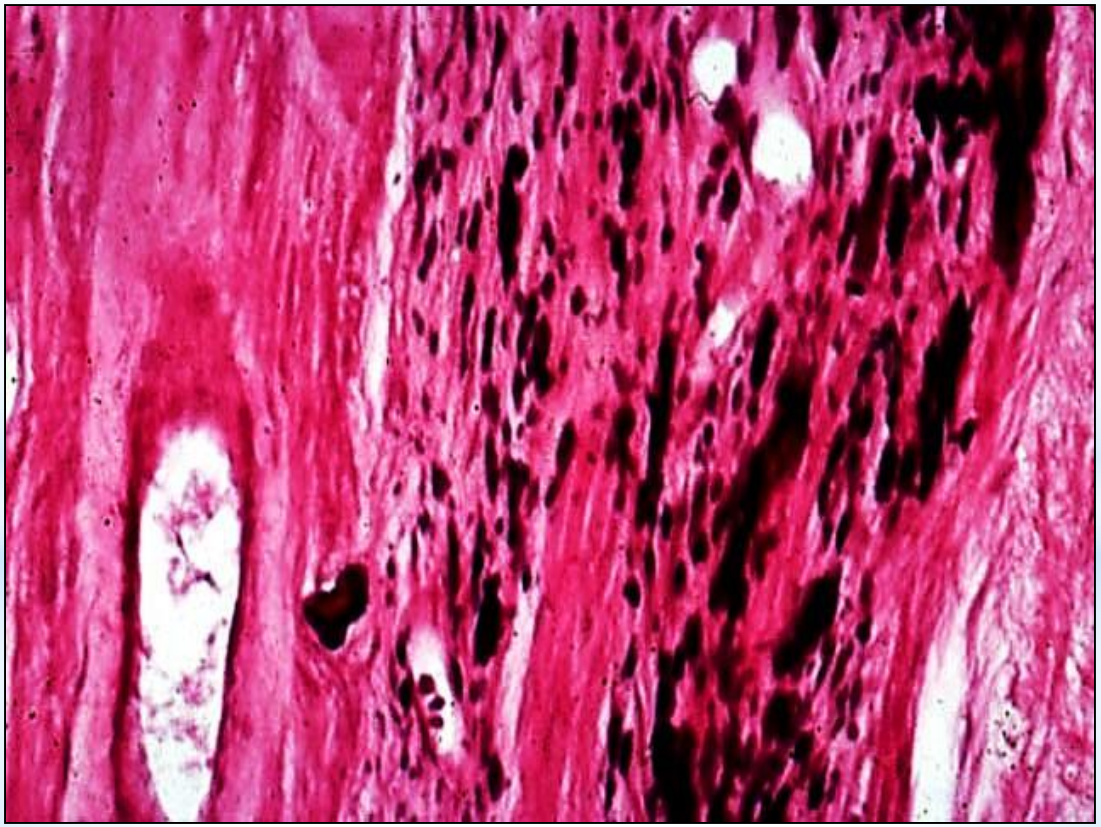
* not exhibit dentinal tubules
* appear as **concentric layers** of calcified tissue around necrotic and calcified cells **or** calcification of thrombi in BLvs
* They increase in size by **incremental growth** on their surface.
* They are seen more frequently in the **coronal pulp**.

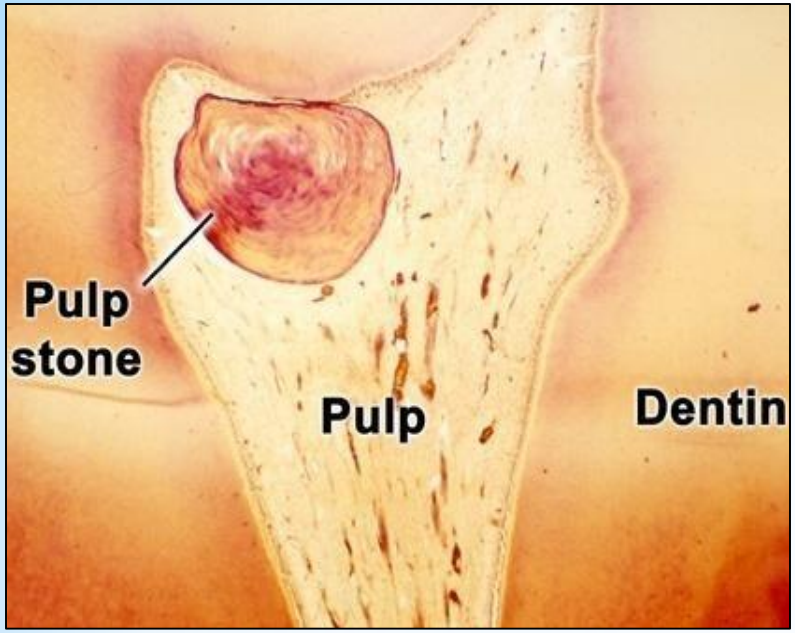




## C) Diffuse calcification:

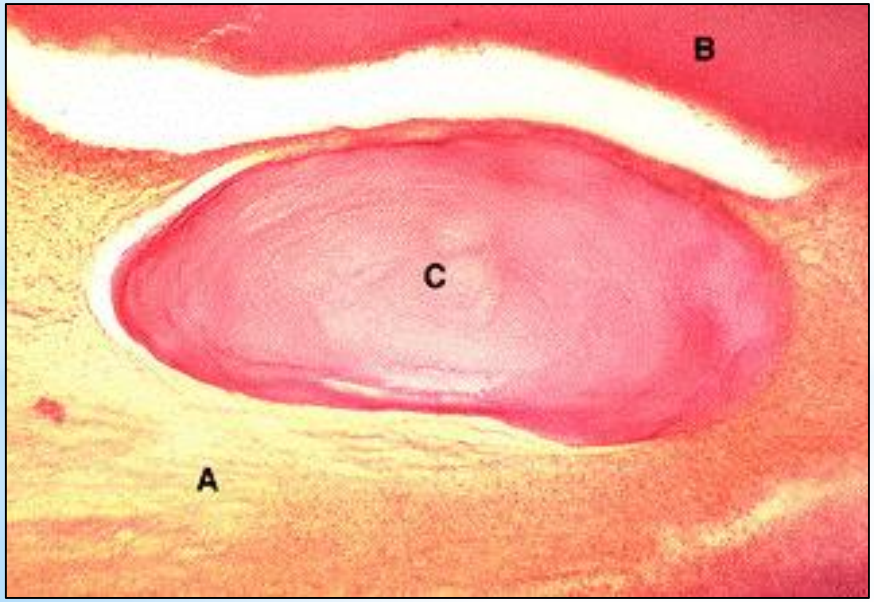
* amorphous **irregular calcific deposits** in the pulp tissue, usually following collagenous fiber bundles or BLvs.
* usually found in **root canals** and less often in the coronal area.
* Diffuse pulp calcification commonly occurs on the top of hyaline degeneration (large masses or fine spicules).






True


False




False

What are the histolgic types of these pulp stones?


Thank
you