



جامعة البصرة

كلية طب الاسنان



Oral histology

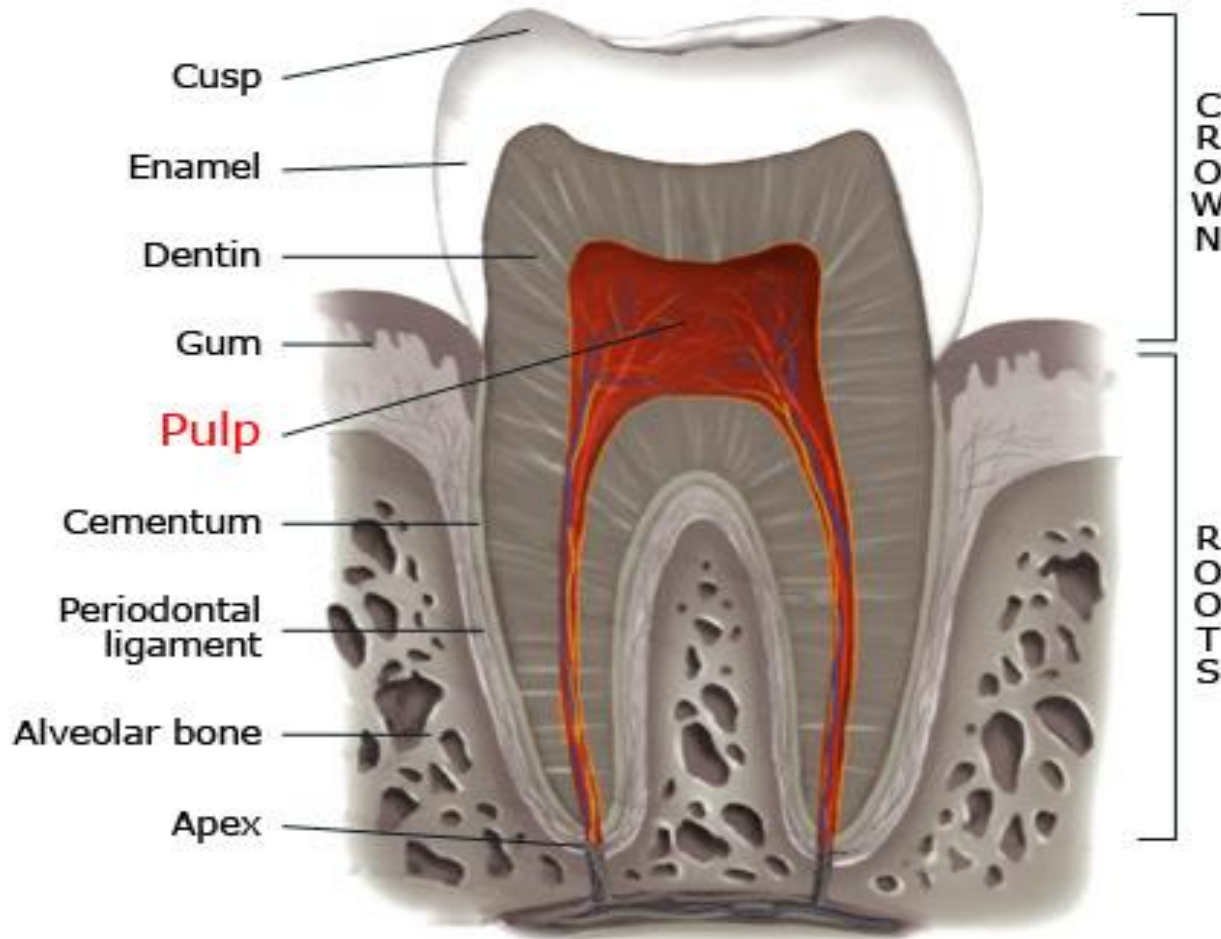
2nd stage

Lec. 8 Dental pulp

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lec. 8

Dental pulp



Introduction :

- The dental Pulp is an un mineralized oral tissue , soft mesenchymal connective tissue that supports the dentin and occupies pulp cavity in the central part of the teeth.
- It is a special organ because of the unique environment.
- The pulp has a background similar to that of dentin because both are derived from the dental papilla of the tooth germ during odontogenesis.
- It is initially called the dental papilla and designated as pulp only after dentin forms around it.
- Pulp has a soft, gelatinous consistency and the majority of pulp (75-80%) is water, there is little or no inorganic component in normal dental pulp.

GENERAL FEATURES

- Every person normally has a total of 52 pulp organs, 32 in the permanent & 20 in the primary teeth.
- Has ability to form dentin throughout life.
- Molar pulps are 3 to 4 times larger than incisor pulps.
- Cuspid has the longest pulp ,Mandibular central incisor has the smallest pulp. (The shape of each pulp chamber corresponds directly to the overall shape of the tooth).

Functions of the pulp

- **Inductive** : Pulp induces oral epithelium differentiation into dental lamina and enamel organ.
- **Formative**: Cells of the pulp produce dentin which surrounds and protects the pulpal tissue.
- **Nutritive** : Via dentinal tubules, pulp supplies nutrients that are essential for dentin formation and hydration.
- **Sensory** :Through the nervous system, pulp transmits sensations mediated through enamel or dentin to the higher nerve centers.
- **Protective**: The formation of reparative or secondary dentin (by the odontoblast).

The pulp cavity is divided into two main divisions:

1. Coronal pulp

2. Radicular pulp

1- Coronal pulp :-

- It is the pulp occupying the pulp chamber of the crown of the tooth
- It has six surfaces : occlusal, mesial, distal, buccal , lingual and floor.
- Pulp horns are projections into the cusp
- This pulp constricts at the cervical region where it continues as the radicular pulp
- Because of continuous deposition of dentin , the pulp become smaller.

Pulp horns or cornua

Pulp Chamber or coronal pulp, located in the crown of the tooth.

Root canal or radicular pulp, is the portion of the pulp located in the root area.

The apical foramen is the opening from the pulp at the apex of the tooth.

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

2- Radicular pulp:

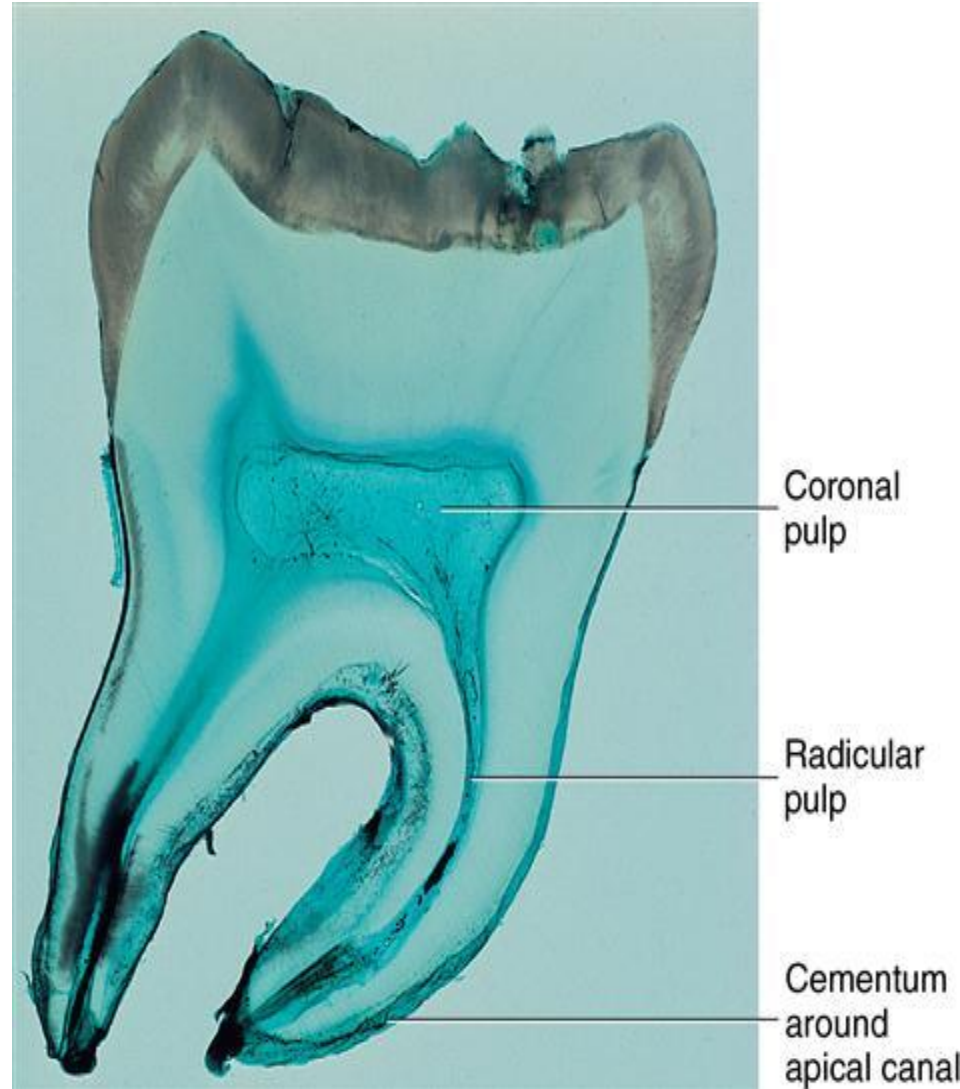
- Extending from the cervical region of the crown to the root apex.
- It is the pulp occupying the pulp canals of the root of the tooth.
- In the anterior tooth it is single and in the posterior teeth it is multiple.
- The radicular portions of the pulp is continuous with the periapical tissues through apical foramen.
- As age advances the width of the radicular pulp is reduced, and so is the apical foramen.

Apical foramen:

➤ Average size of apical foramen of the maxillary teeth in the adult is 0.4 mm , in mandibular teeth it is 0.3 mm.

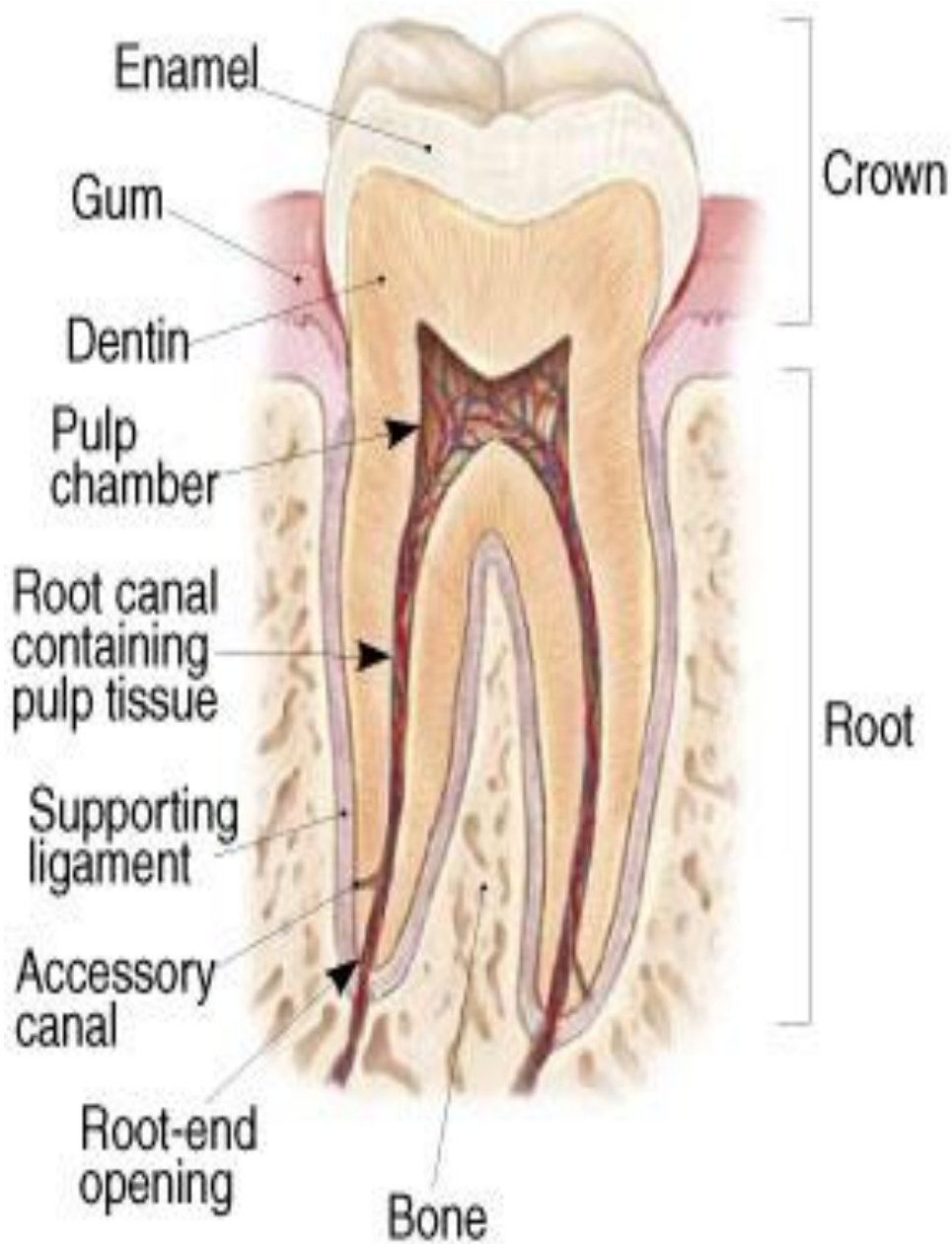
➤ Sometimes it is found on the lateral side of the apex although the root it self is not curved.

➤ Frequently there are two or more foramina separated by a portion of dentin and cementum or by cementum only.



Accessory canal :

- Leading from the radicular pulp laterally through the root dentin to the periodontal tissue.
- May be seen anywhere along the root but are most numerous in the apical third of the root
- Clinically significant in spread of infection, from the pulp to the periodontal ligament.
- Occur in areas where there is premature loss of root sheath cells; these cells induce the formation of odontoblasts which form dentin; May also occur where the developing root encounters a blood vessel.



Accessory canal (arrow)

HISTOLOGICAL ZONES OF PULP

Four distinct microscopic zones in pulp : *zones from outer to inner:*

1.Odontoblastic zone : At the pulp periphery lines the outer pulpal wall and consists of the cell bodies of odontoblast. Its function in dentin formation.

2.Cell- free zone of Weil – 40 microns wide & relatively free of cells ;This zone is found below the odontoblastic zone.

Which is rich in blood vessels & unmyelinated nerves ,It represents the space into which odontoblasts move during tooth development.

3.Cell-rich zone – seen easily in coronal pulp adjacent to the cell free zone -increased density of cells (fibroblast & undifferentiated mesenchymal cells) and also a more extensive vascular system also contain young collagen fibers during early dentinogenesis .

4.Pulpal core – Located in the center of the pulp chamber, which has many cells and an extensive vascular supply, similar to cell-rich zone ;Pulpal cells and fibroblasts are also seen.

Dentin

Odontoblasts layer

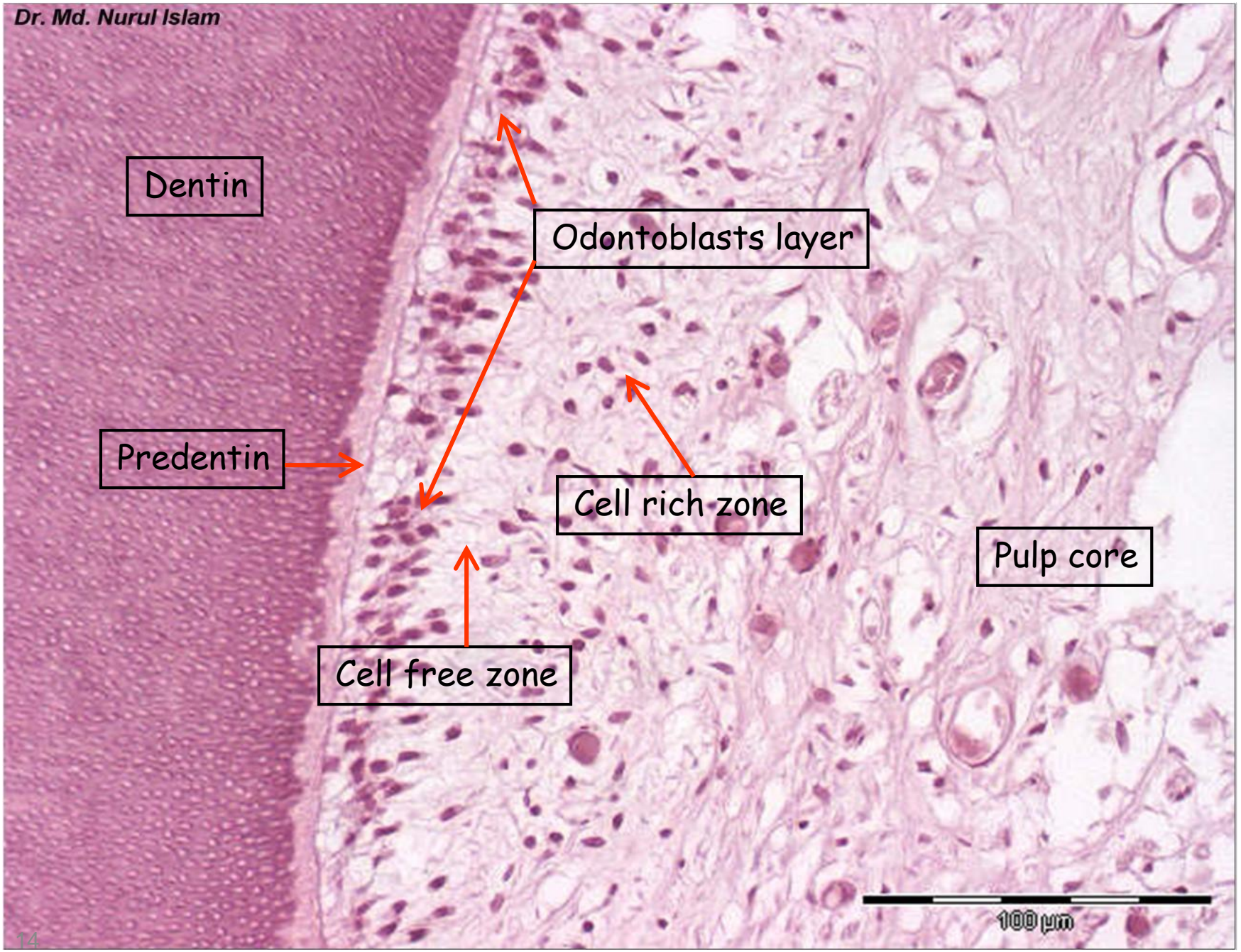
Predentin

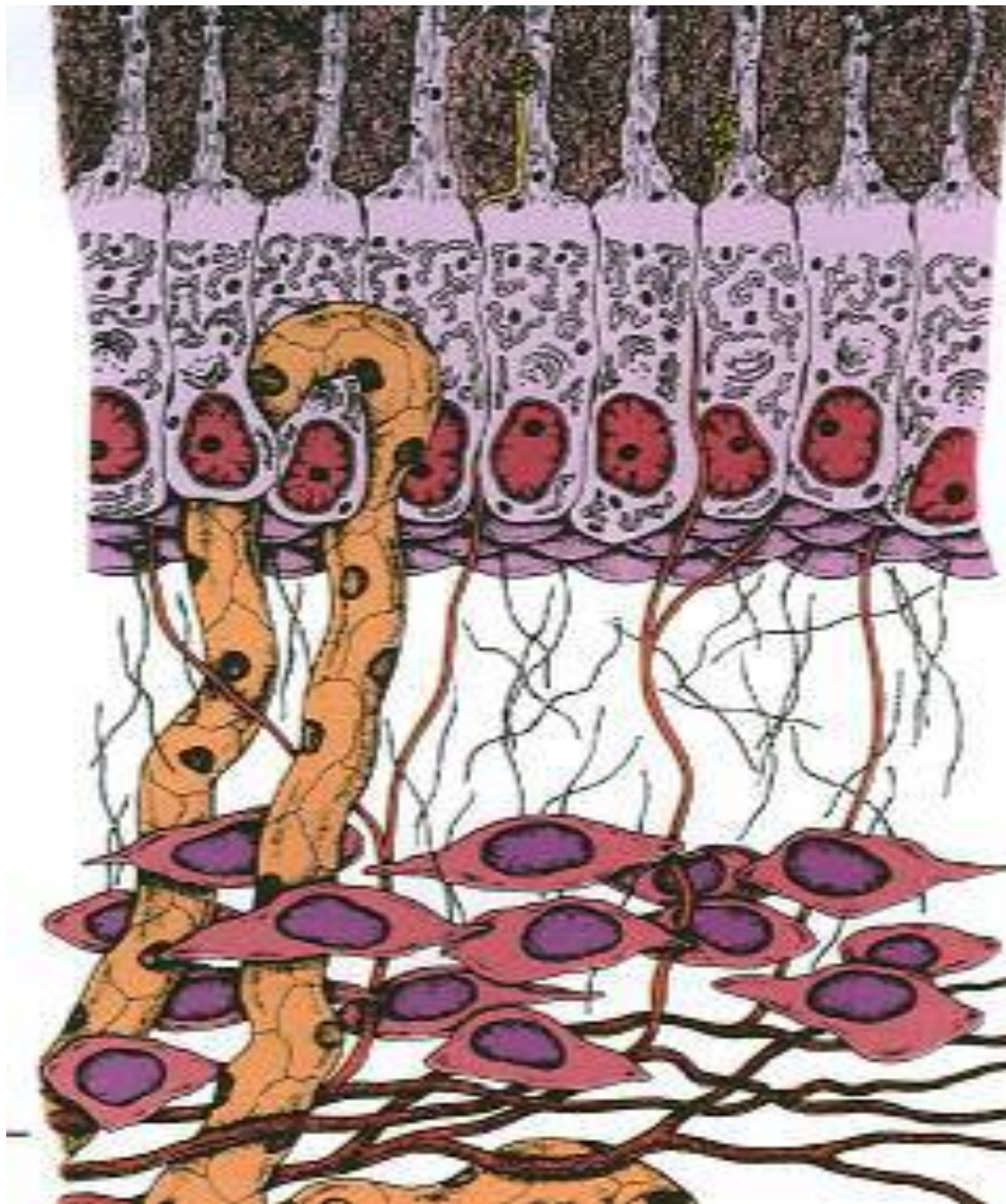
Cell rich zone

Pulp core

Cell free zone

100 μm





Predentin

Odontoblasts

Cell-free zone

Cell-rich zone

Parietal neural
plexus

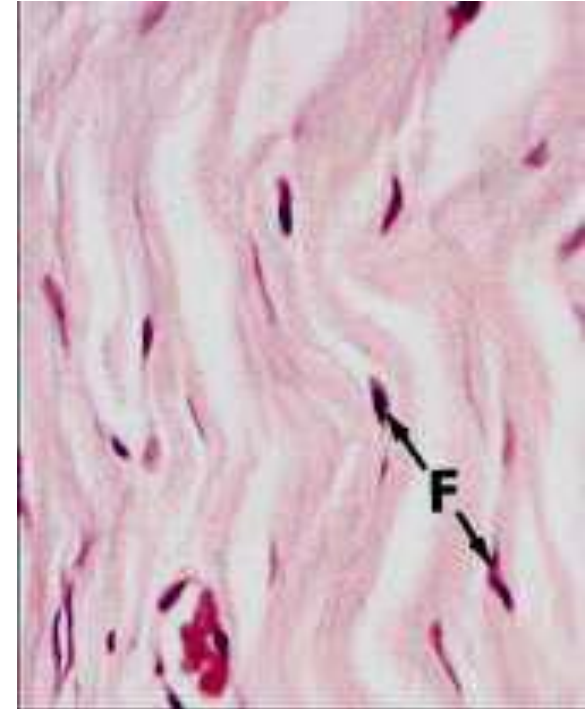
Contents of the Pulp

- 1. Cells:** odontoblast, fibroblast, undifferentiated cell, macrophage, dendritic cell.
- 2. Fibrous Matrix:** Mostly reticular fibers and collagen fibers (Type I and Type III).
- 3. Ground substance:** Act as a medium to transport nutrients to cells and metabolites of the cell to the blood vessels.
- 4. BLOOD VESSELS, NERVES, LYMPH VESSELS.**

Cellular components of pulp

1- Fibroblast:

- Are the **most numerous cell types** in the pulp; Particularly numerous in coronal portion of the pulp, where they form the cell rich zone.
- The function of fibroblast is to form and maintain the pulp matrix, which consist of collagen and ground substance.
- Also have the capability of **ingesting & degrading** the same matrix.
- Have the typical **stellate shape** with dense nuclei & extensive processes that contact & are joined by intercellular junctions.
- In the **older pulp**, fibroblasts appear rounded or spindle shaped with short processes & exhibit fewer intracellular organelles; termed **fibrocytes**.



2- Odontoblast

- A Peripheral area of the pulp where the odontoblasts reside is termed odontogenic zone
- Shape may vary depending on the functional activity of the cell (coronal pulp- columnar, mid portion – cuboidal ,Apical region – Flattened).
- Odontoblasts in the crown are larger than in the root.

□ Functions of odontoblasts:

- Odontoblasts form dentin continuously throughout the life of the tooth.
- Odontoblasts converts to osteoblasts in response to injury , such as occurs with caries.
- Odontoblasts provides nutrient for the dentin.
- It serves as the nerve for enamel.

3-DEFENSE CELLS

These cells emigrate from the pulpal blood vessels & develop characteristics in **response to inflammation**.

These cells are : T-lymphocyte , Macrophages , plasma cell, mast cell , neutrophils , monocyte , basophils , ect.

4- Undifferentiated mesenchymal cells:

- They are **the primary cells** in the very young pulp ; Represents the pool from which connective tissue cell of the pulp are derived .
- This cell are found throughout the cell-rich area and the pulp core and often are related to blood vessels
- Appear as large polyhedral cell possessing a large, lightly stained centrally placed nucleus ; Appear larger than fibroblasts.

GROUND SUBSTANCE

- ❑ It makes up the bulk of the pulp.
- ❑ Consists of complexes of mucopolysaccharides and proteins polysaccharides,
- ❑ Ground substance give support to the cells of the pulp and serves as a mean of transport of nutrients and metabolites between cells and blood vessels.
- ❑ Broadly classified as
 - Glycoaminoglycans
 - Proteoglycans
 - Other adhesion molecules: Fibronectin, laminin.

□ Glycosaminoglycans

GAGs :polysaccharides chains composed of repeating disaccharides linked covalently to proteins.

Its function:

- contributes to the high fluid pressure
- gives high support
- facilitates easy movement of water soluble materials and cells.

□ Proteoglycans :

- Core protein of variable sizes surrounded by GAG's and other sugars .

Fibronectin

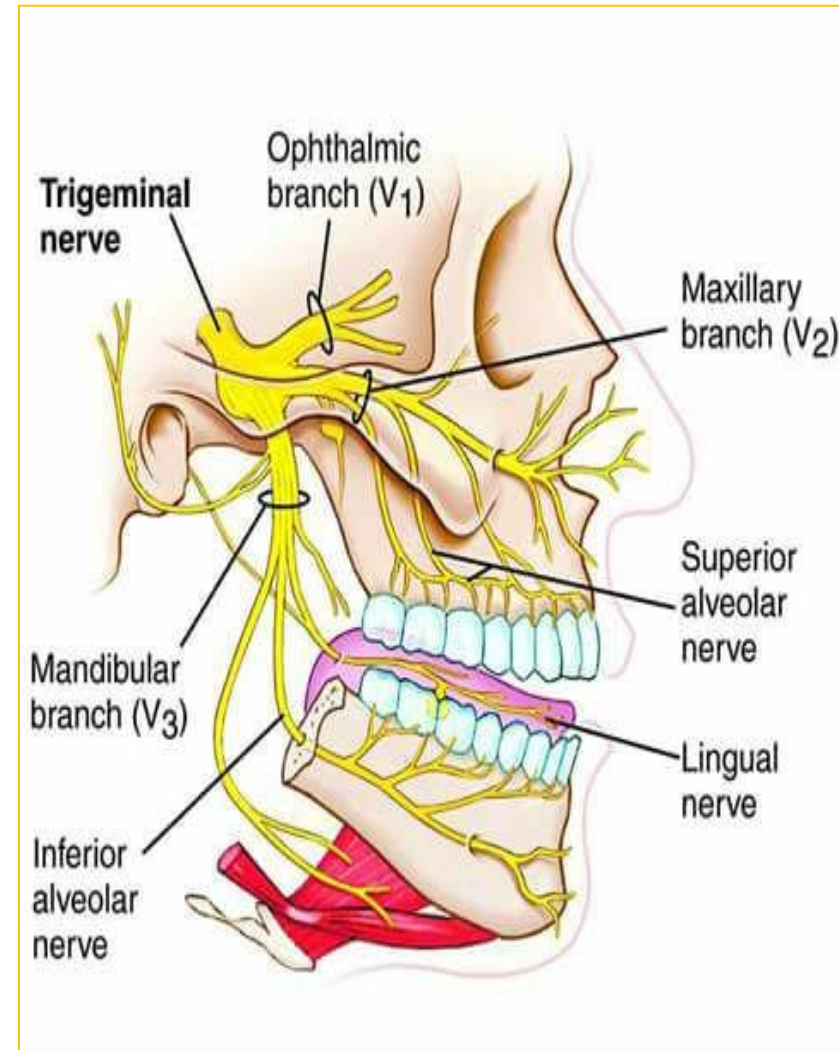
- It plays a role in cell-cell & cell-matrix adhesion
- Has a major effect on the proliferation, differentiation & organization of cells.
- Seen around the blood vessels
- Also found in odontoblast layer with fibers passing into predentin

Collagen in dental pulp

- Higher content in the middle and apical pulp.
- They scattered throughout the coronal or radicular pulp, or they appear in bundles.
- Type I: Present as thick striated fibrils & Responsible for pulp architecture
- Type III: Thinner fibrils , mainly distributed in cell free and cell rich zones &Contributes to the elasticity of pulp.

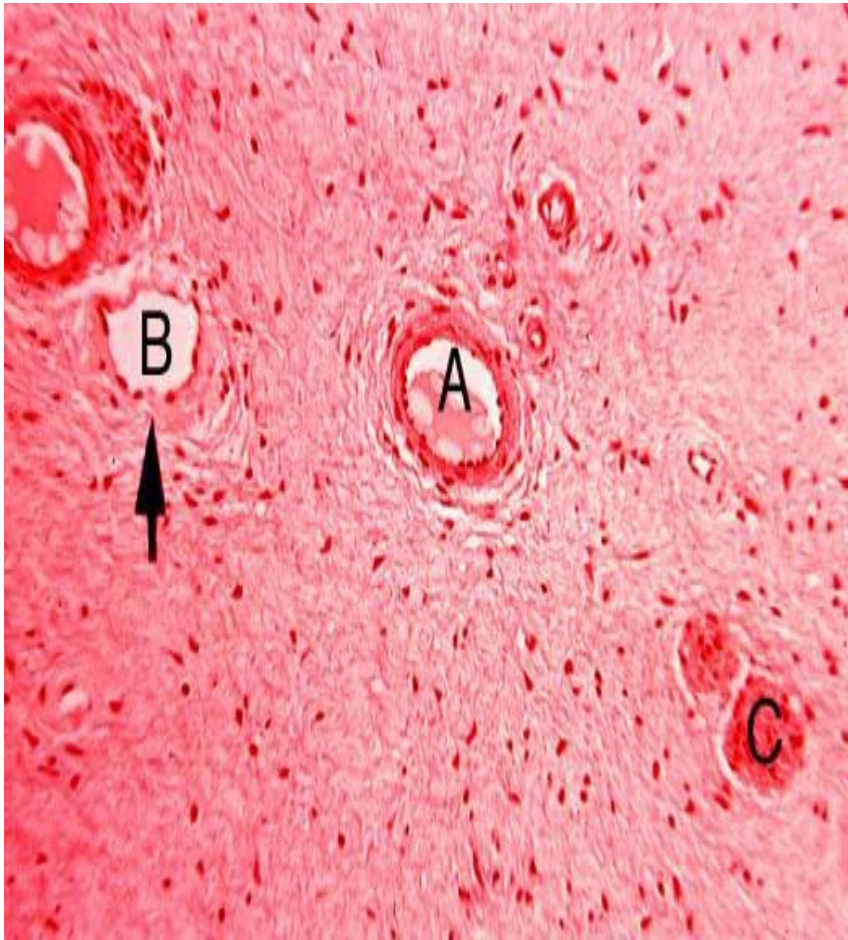
Blood supply of pulp cavity(vascularity)

- The pulp organ is extensively vascularized ; the main artery supply pulp is the **inferior or superior alveolar artery (also the same veins in both mandibular and maxillary regions)** that enters the apical foramen and courses directly to the coronal pulp.
- As the vessels enter the tooth their walls become thinner than those surrounding the tooth
- small arteries and arterioles enter the apical canal and along their course they give numerous branches in the radicular pulp that pass peripherally to form a plexus in the odontoblastic region.

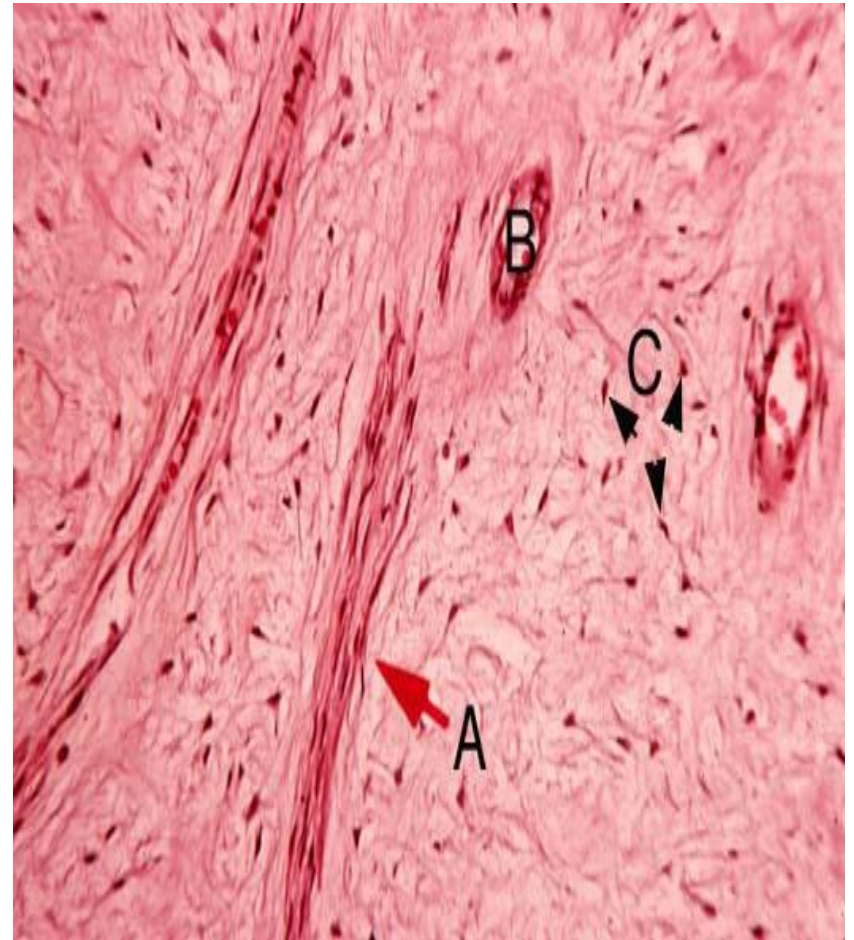


Nerve supply of Pulp

- ❖ Sensory nerve fibers that originate from inferior and superior alveolar nerves innervate the odontoblastic layer of the pulp cavity.
- ❖ These nerves enter the tooth through the apical foramen as myelinated nerve bundles.
- ❖ They branch to form the **nerve plexus of Raschkow** which is located at the central to the **cell-free zone of Weil**.
- ❖ In addition to the sensory nerves, sympathetic nerve bundles also enter the tooth to innervate blood vessels

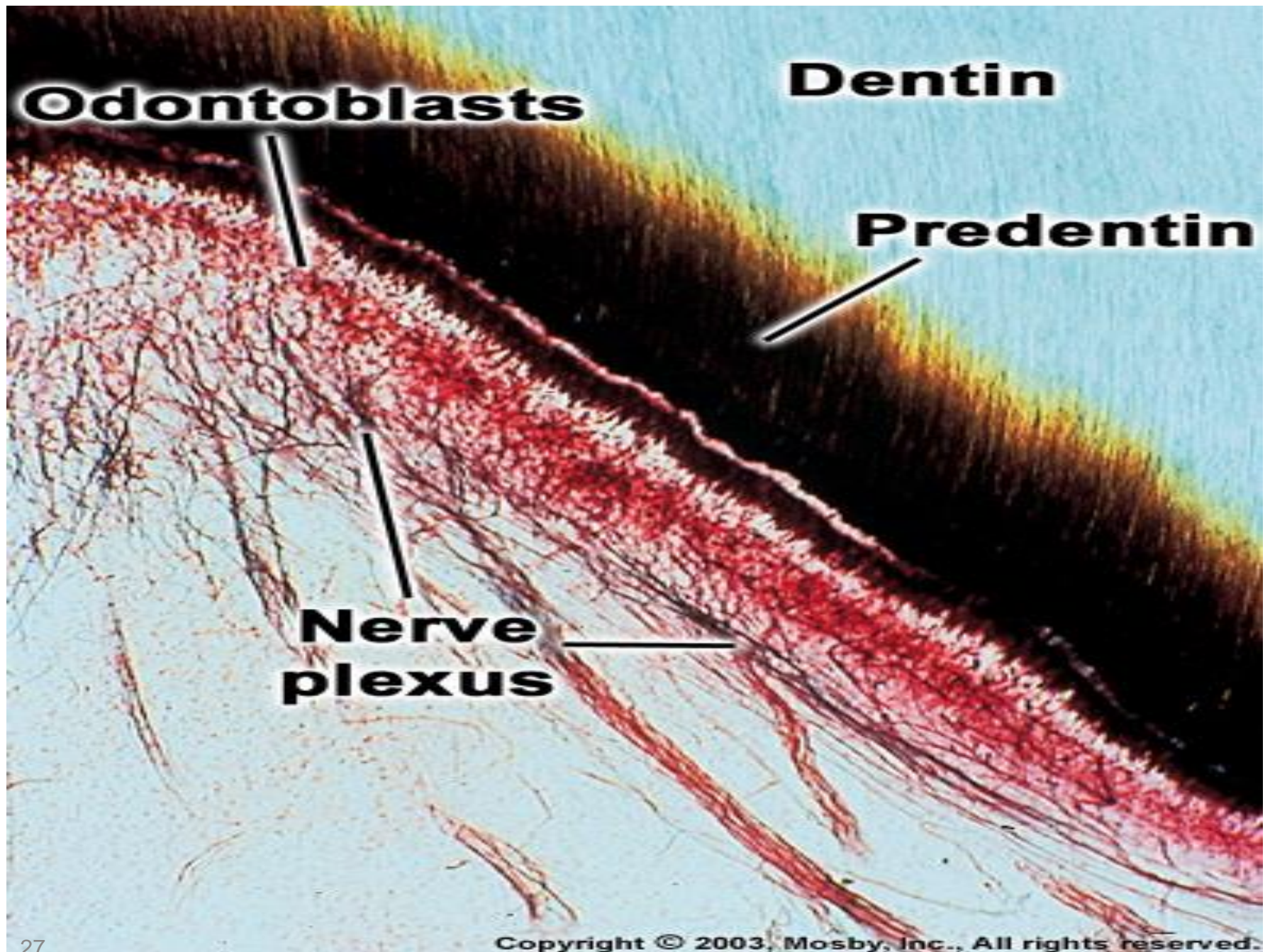


A, Arteriole; **B**, Venule;
C, Nerve bundle (cut in cross-section).



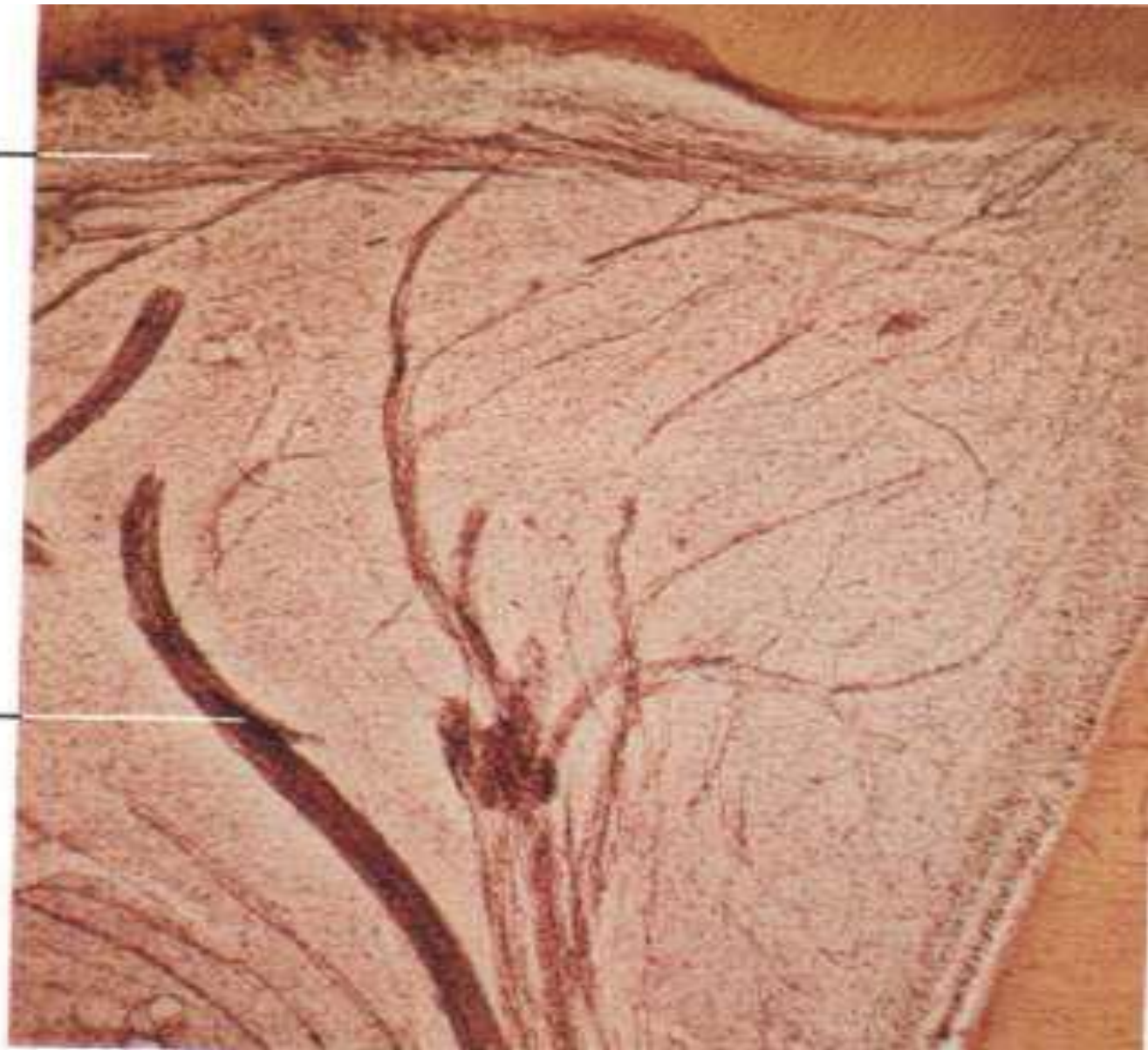
A- nerve bundle

B, Arteriole;
C, Fibroblasts



Parietal
layer
nerves

Nerve
trunks



Lymphatic supply

- Lymph vessels draining the pulp & periodontal ligament , those draining the **anterior teeth** pass to the **submental lymph nodes**;
- And those of the **posterior teeth** pass to the **submandibular and deep cervical lymph nodes**.



Disorders of the Dental Pulp

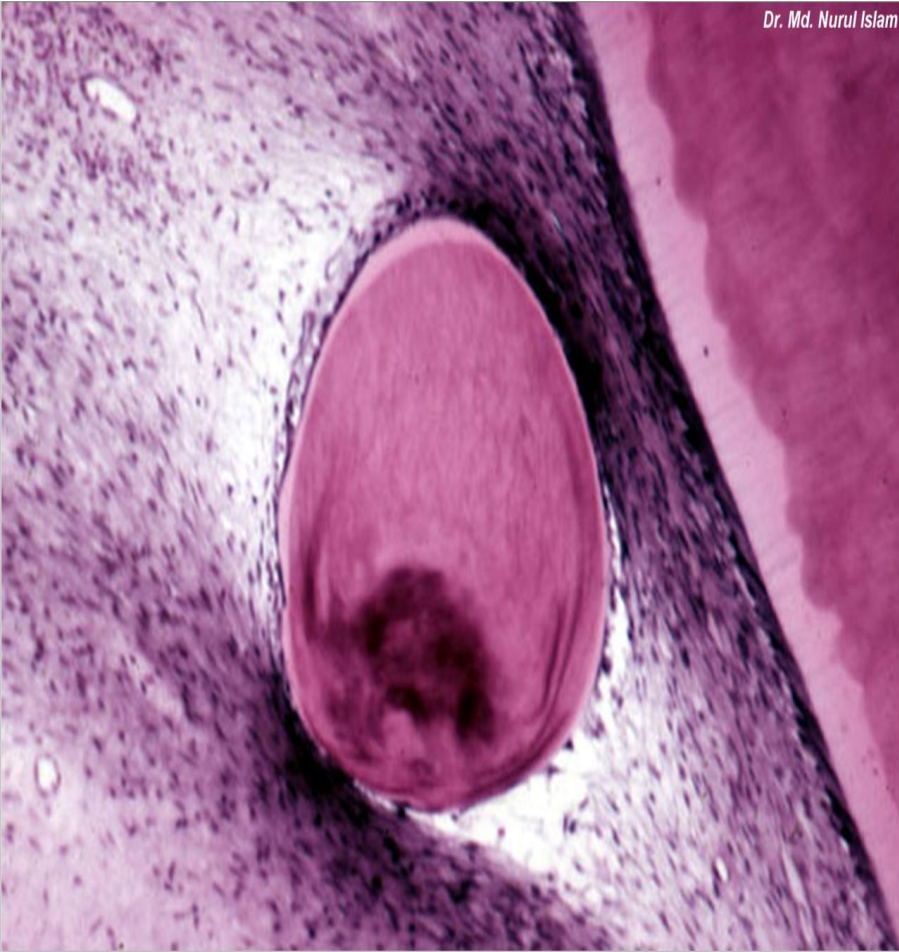
Pulp Stones or Denticles

- Pulp stones, or denticles, frequently are found in either or both coronal and root portions of the pulp organ
- Discrete calcified masses that have ***calcium phosphorus ratios comparable to that of dentin.***
- More frequently at the ***orifice of the pulp chamber*** or within the **root canal.**
- Pulp stones classified according to ***their structure*** into **true stone**, **false stone & diffuse calcification.**

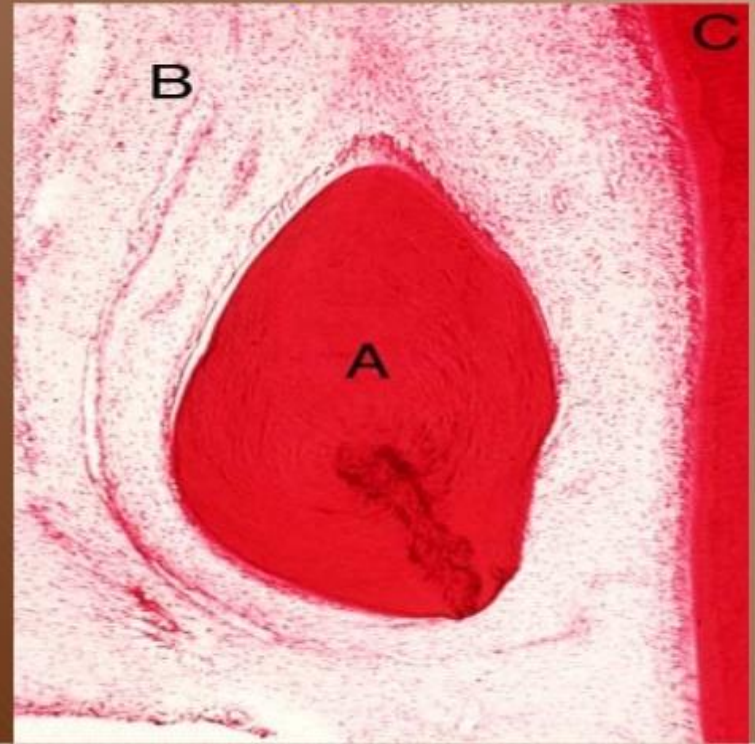
- **True** pulp stones : the structure of it is similar to dentin in that they exhibit dentinal tubules contain the process of odontoblast ; Such stones are rare and, if seen, occur close to the apical foramen of the tooth.
- **false** pulp stones having no cells associated with them & do not exhibit layers of calcified tissue.
- **Diffuse calcification** : appears as irregular calcified deposited in the pulp tissue diffuse denticles usually found in the root canal and less often in the coronal area.

Free True Denticle

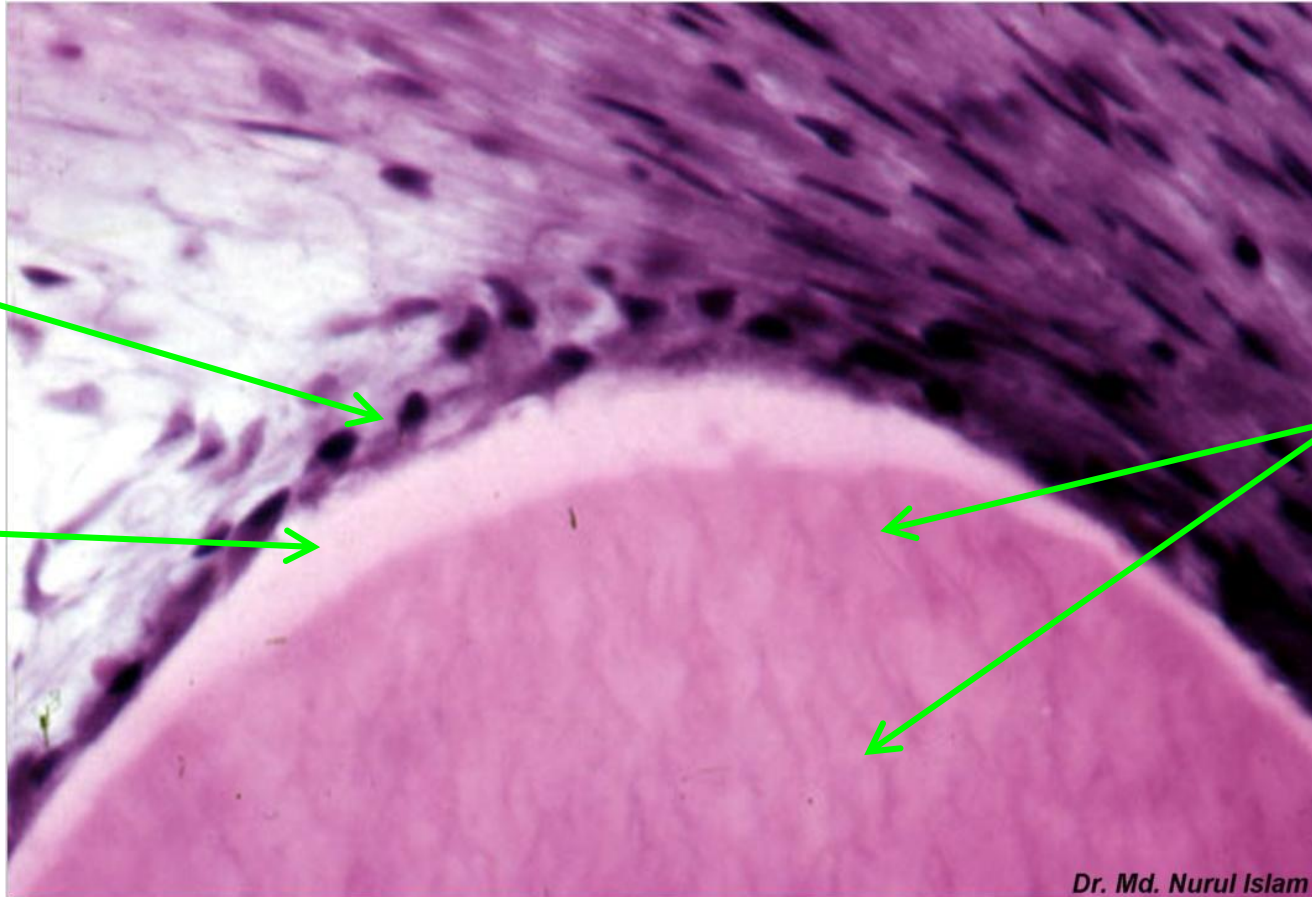
Dr. Md. Nurul Islam



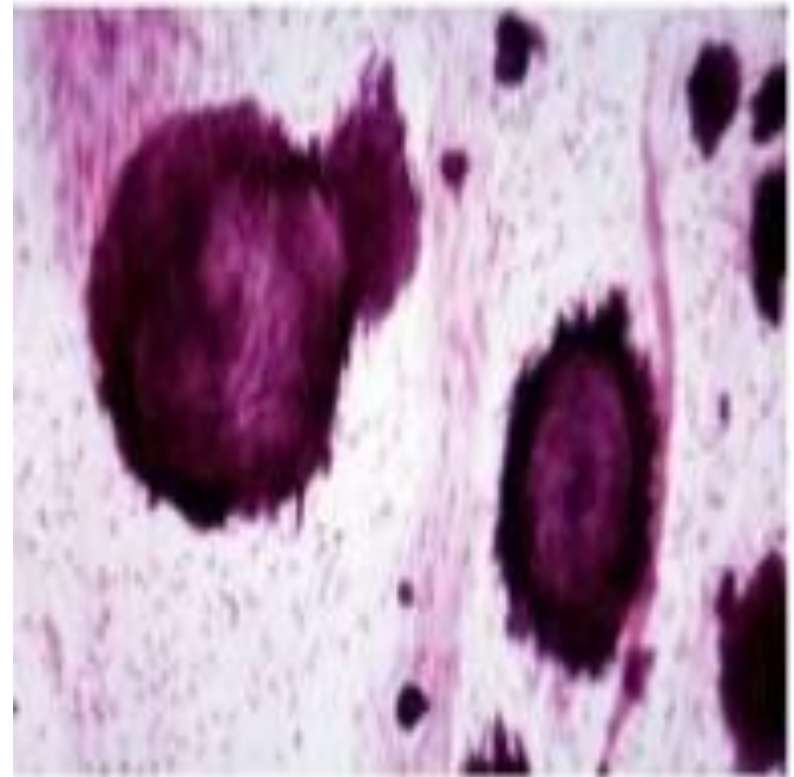
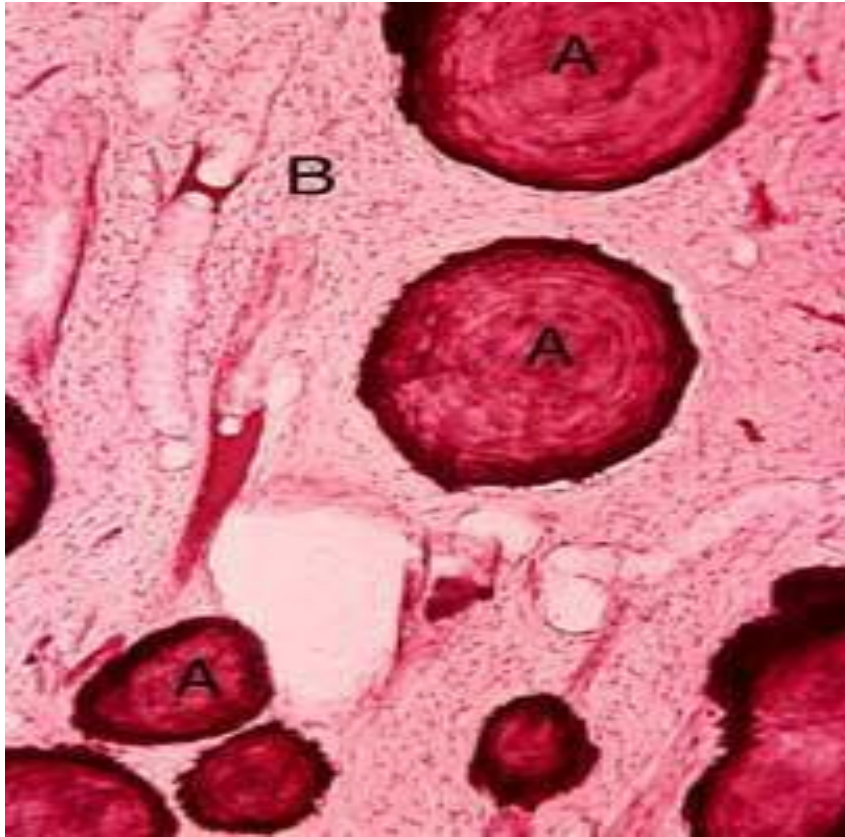
A, True pulp stone; B, Pulp cavity; C, Dentin

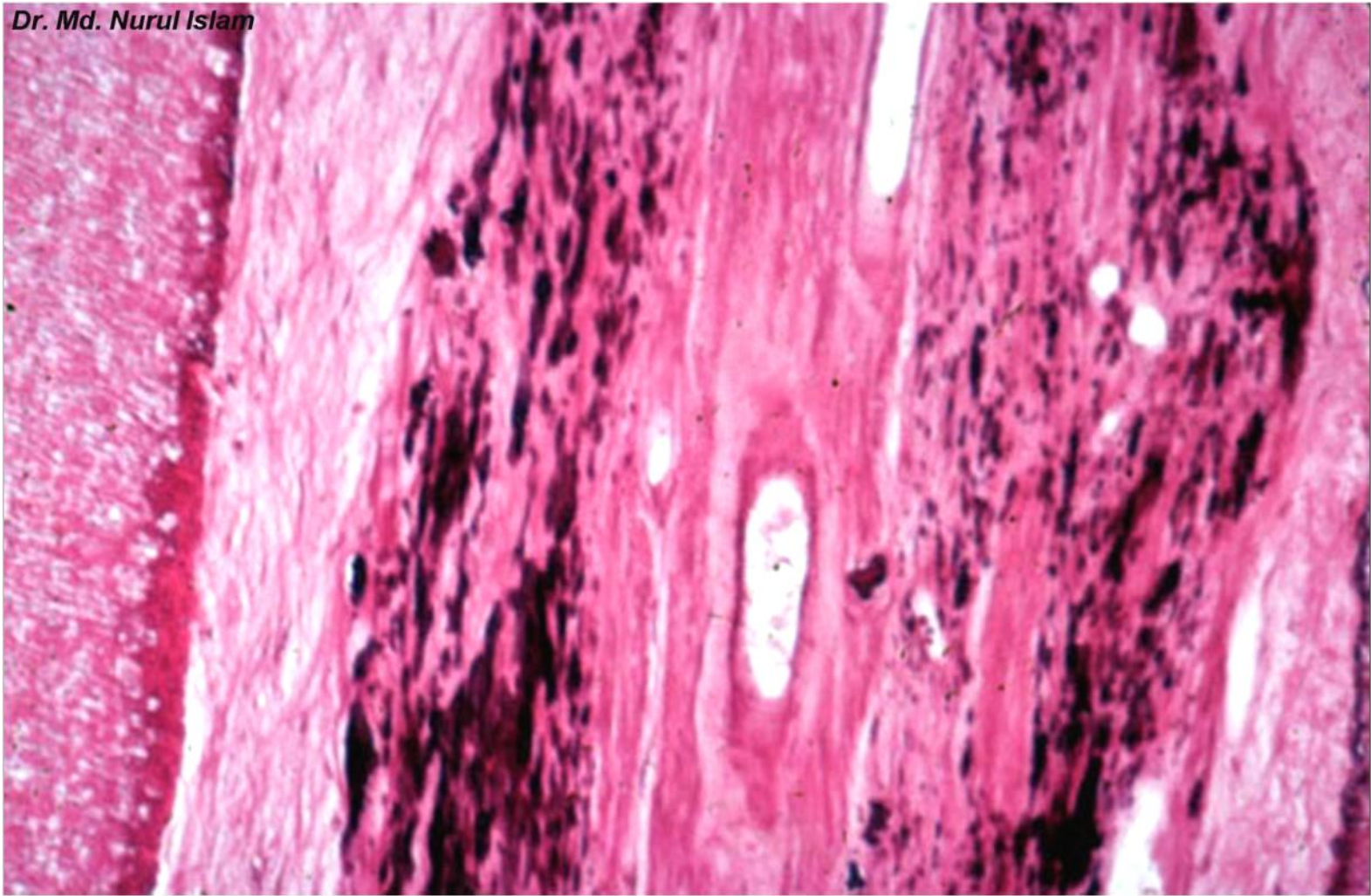


Free True Denticle



Free False Denticle





Diffuse Pulp Calcification

- **Pulp stones classified according to their location in relation to surrounding dentinal wall into :**
- 1- **Free denticles**– which are entirely surrounded by pulp tissue.
- 2- **Attached denticles** - are partly fused with dentin. If during the formation of a pulp stone, union occurs between it and the dentin wall, or if secondary dentin deposition surrounds the stone, the pulp stone is called an **attached stone**.
- 3- **Embedded denticles** – are entirely surrounded by dentin.

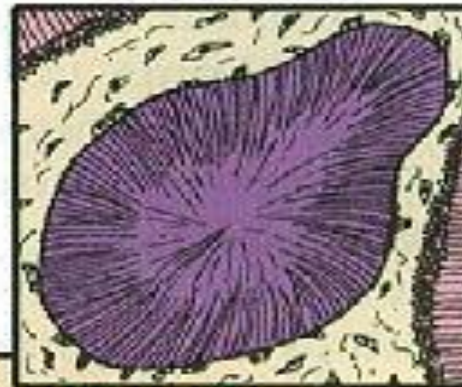
A

False pulp stone
(concentric)



B

True pulp stone
(denticles)



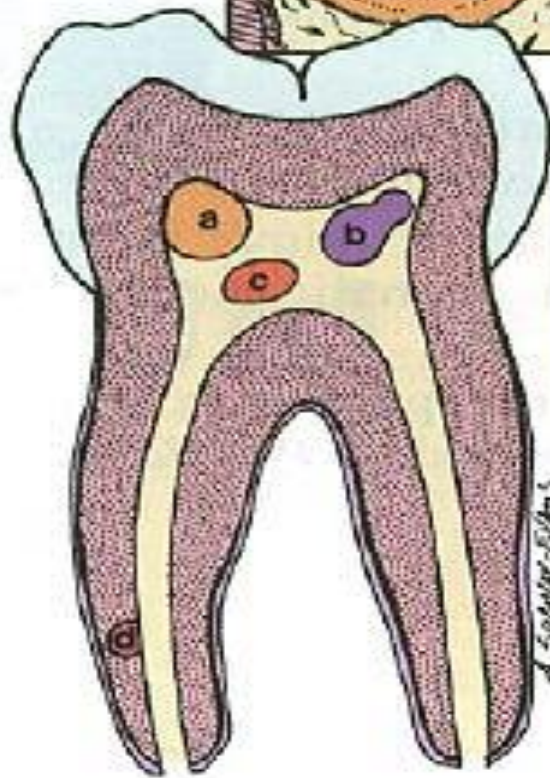
C

False pulp stone

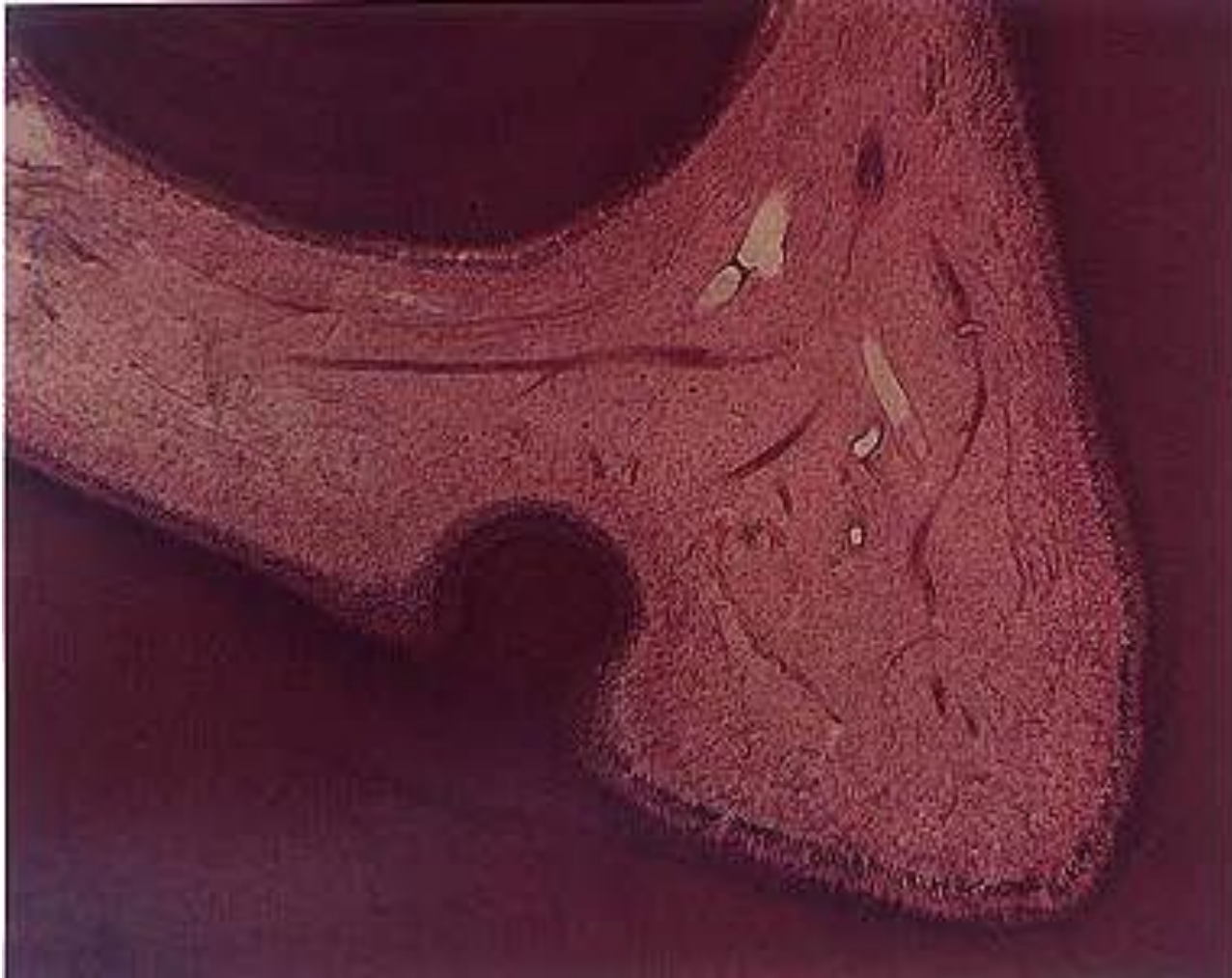


D

Embedded pulp stone



FALSE, ATTACHED PULP STONE IN CORONAL PULP



Clinically Importance features of the Dental Pulp

- ❑ With age the pulp becomes less cellular as cell death occurs with age.
- ❑ Reduction in the nerve fibers & blood vessels.
- ❑ Increase in number & thickness in collagen fibers particularly radicular pulp.
- ❑ The volume of the pulp chamber decreases in size with continued deposition of dentin; in some cases the pulp chamber can be obliterated.
- ❑ An increase in calcification in the pulp occurs with age.