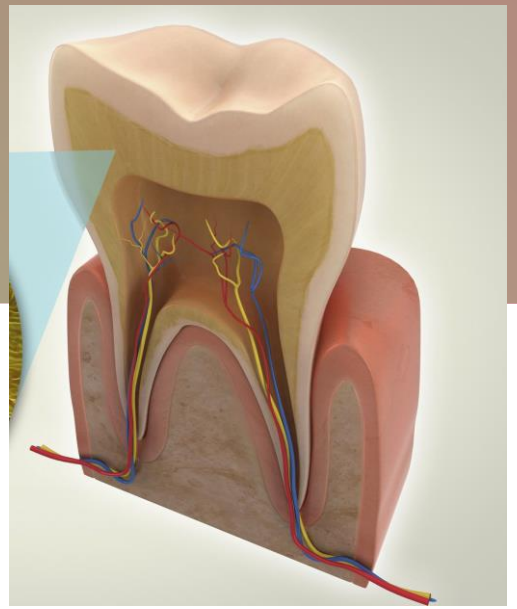
DENTIN

FATMA RASHED

LEARNING OBJECTIVES

- Physical properties and chemical composition
- Dentinogenesis
- Structure of dentin: -DT
  - Incremental lines
  - hypomineralized dentin
  -Functional changes.

INTRODUCTION



Second layer of the tooth

it provides the main bulk and general form of the tooth

It is closely similar to bone physicaly and chemically

It is a living tissue ??!

Yes (odontoblasts are still there)

· Dentin can be seen in decalcified and ground sections

PHYSICAL PROPERTIES

1. **Hardness:** Hard

   (less than enamel but more than cementum and bone).

2. **Resiliency and elasticity:** Resilient to prevent fracture of the overlying brittle enamel.

   -More elastic than enamel but still hard and brittle

3. **Permeability:** permeable due to the presence of DTs

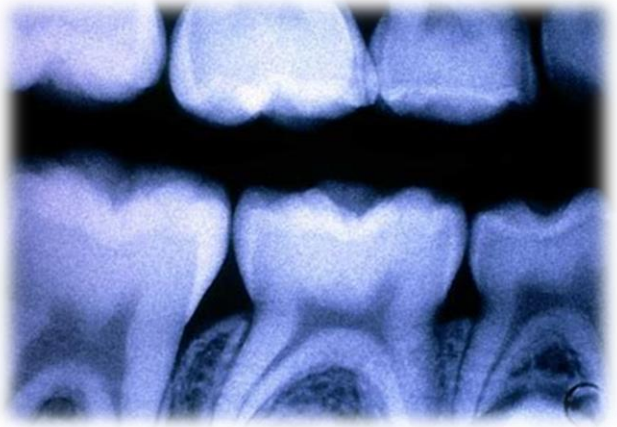
4. **Color:** yellow

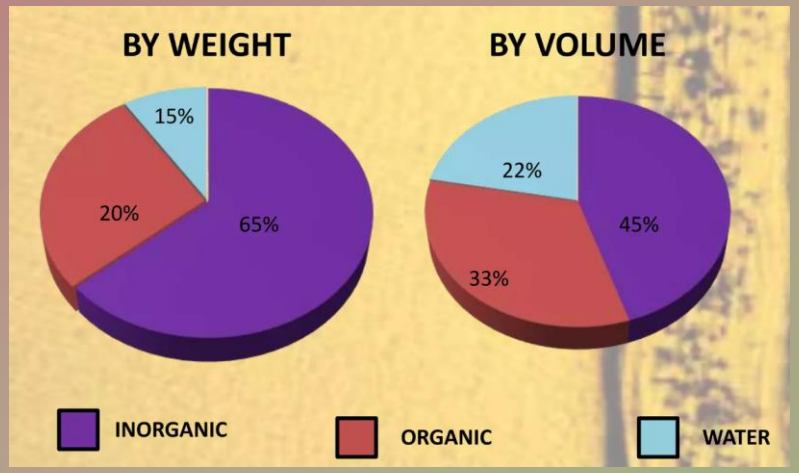
5. **Thickness:**3-10mm

6. **Radio opacity (by X-ray) :**

-more radiolucent than enamel

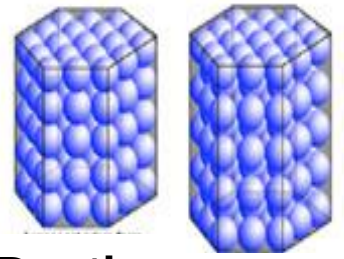
-more radio-opaque than cementum





CHEMICAL COMPOSITION

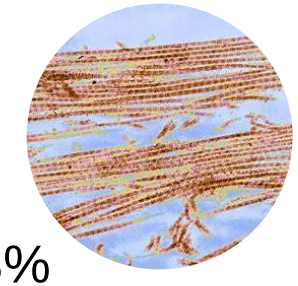
- **Inorganic components 65-70%**
- **Calcium hydroxyapatite crystals (HA):**
- Shorter and smaller than enamel



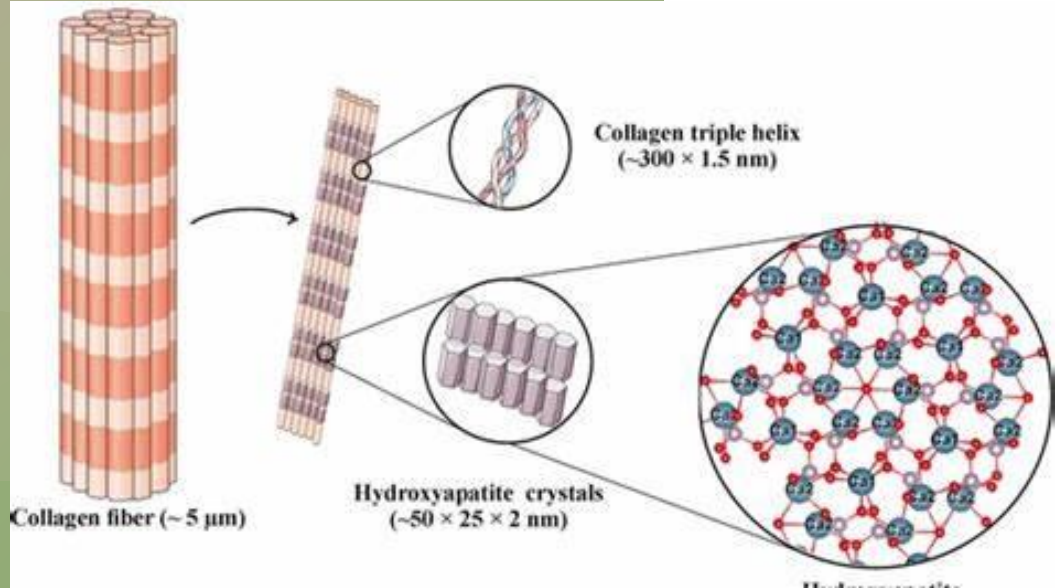
Dentin Enamel

- **Organic components 20%**
- ***Collagen:*** 82%

  Mostly Type I, type III and V



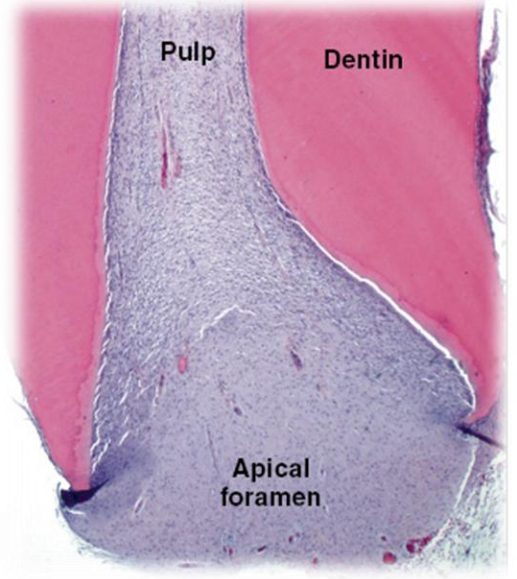
- ***Non collagenous matrix proteins:*** 18%
- **Water 10-15%**

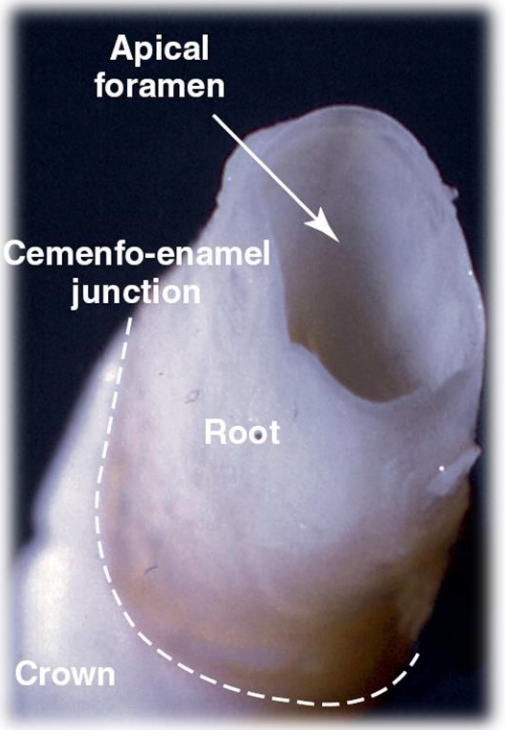


- The collagen fiber are arranged in a network
- The HA crystals calcifies the collagen network

DENTINOGENESIS

- *Start time: b*egins at bell stage
- *Start point*: cusp tips and incisal edge
- Completion of root dentin occurs after tooth eruption (open apex)
- Root dentin is completed 18 months after eruption in deciduous teeth
- Root dentin is completed 2-3 years after eruption in permanent teeth (during this period the tooth is said to have an open apex)
- Rate of dentin deposition varies within various regions of a tooth and among different teeth.
- Dentin formation **continues throughout the life** of the tooth resulting in a gradual and progressive **reduction in the size of the pulp cavity**





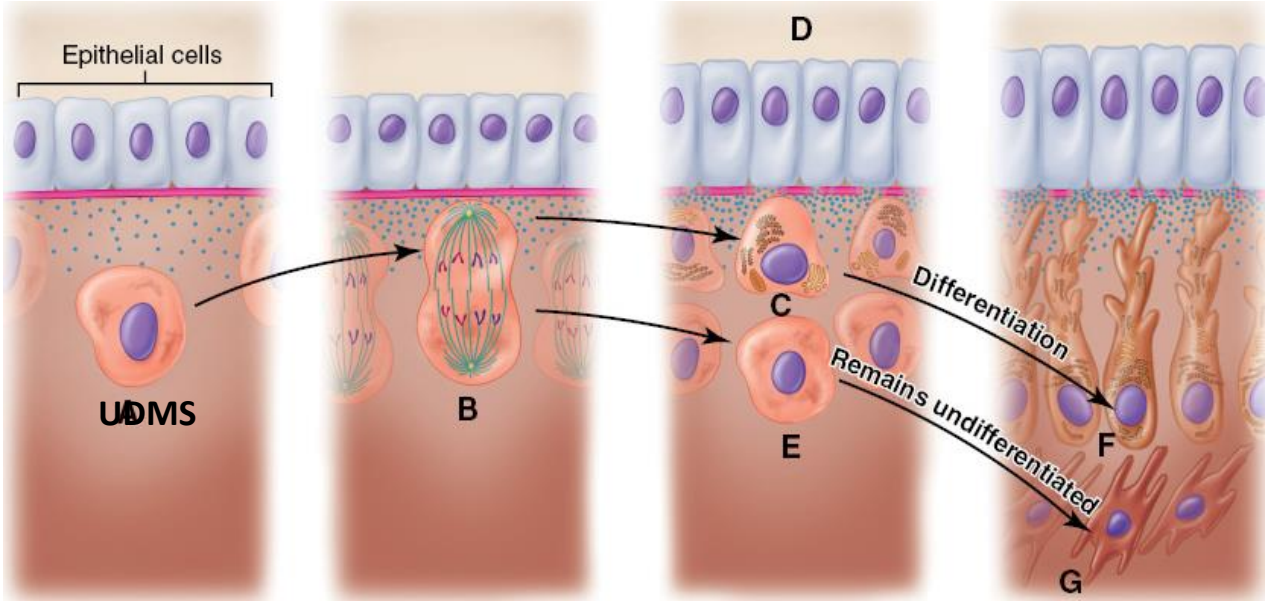
DENTINOGENESIS

1. Odontoblast differentiation:

Reverse polarity of IEE→ induces mitosis of *UDMS → pre-odontoblast →odontoblast →Pre-dentin(matrix) deposition →**odontoblastic process**.

undifferentiated mesenchymal cells

organic only



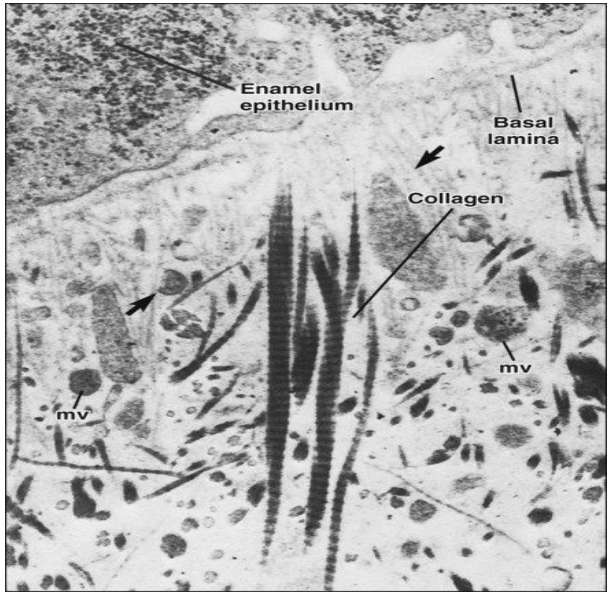
2. Formation of Mantle Dentin (1st layer)

(15-20 µm):

only present in mantle dentin.

A: Von Korff's fibers: Large, course, type III collagen fibers, **⊥ to ADJ**

B:Collagen type 1 fibrils: parallel to ADJ.



- first layer of dentin is called: Mantle dentin
- first layer of enamel is called: Radiers enamel

*UDMS: undifferentiated mesenchymal cells

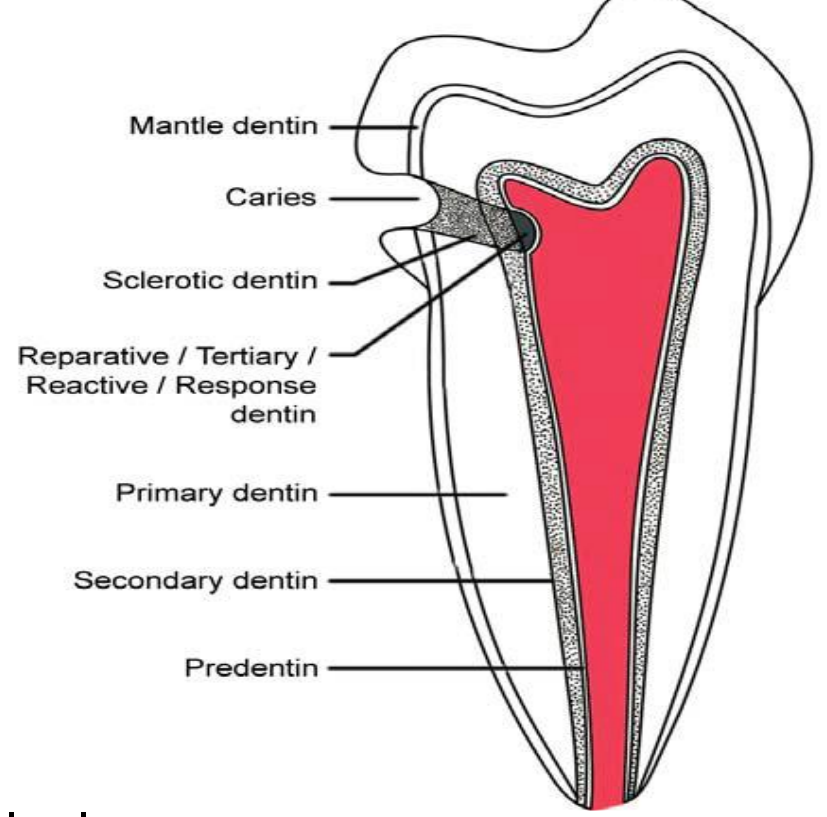
DENTINOGENESIS

3.Circumpulpal dentin: Collagen type 1 fibrils parallel to ADJ

A:Primary (1ry) dentin: formed before root formation completed

B: Secondary (2ry) dentin: formed after root formation completed

C:Tertiary (3ry)dentin: respond to an insult.



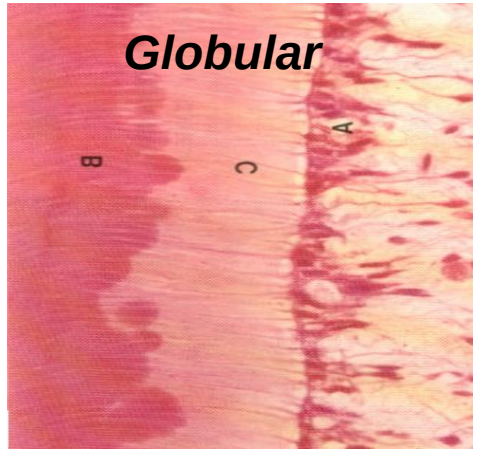
Patterns of dentin mineralization ⟶

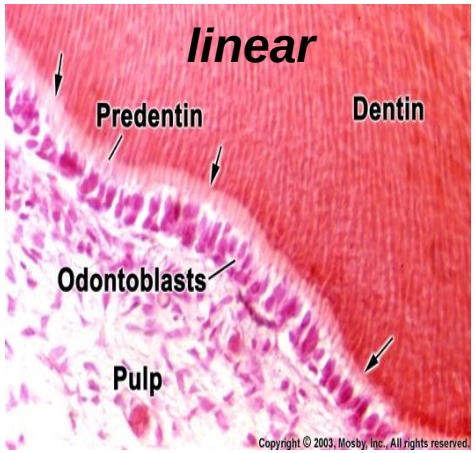
4. Mineralization: depend on the rate of dentin formation

A:Globular (fast):deposition of crystals in spheres, mainly in mantle dent

B:linear pattern (slow): mineralization is more uniform, mainly in circumpulpal dentin.

C: combination: in circumpulpal





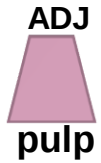
STRUCTURE OF DENTIN

- Main structural unit is **Dentinal Tubules (DT)**

1-Dentinal tubules:(contain Od. process)

1. Number: -at ADJ (~2 million) < near the pulp (~5 million).

-In crown > root

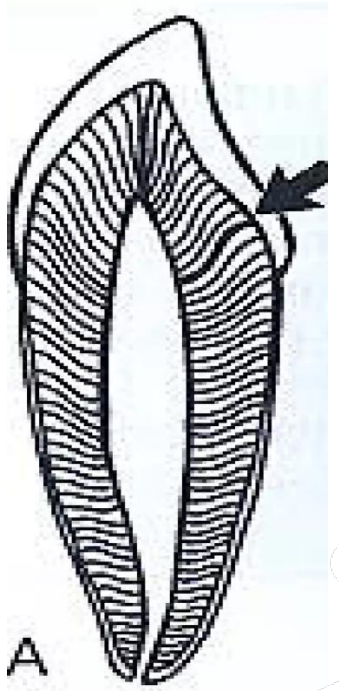


2. Shape: tapered (largest diameter near the pulp).

3. Course: **S-**shape from ADJ to pulp **except**

*They are perpendicular to DEJ &CDJ

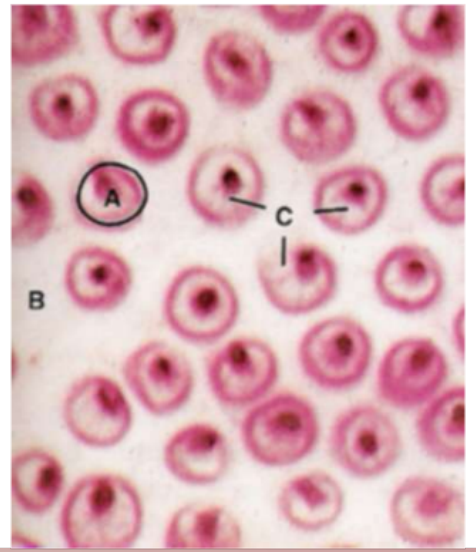
*They are straight at the root tip and incisal edges and cusp tip



4. Branching: lateral (canaliculi) & terminal (V-shaped) branching to form a network for nutrient diffusion and increase elasticity.

5.Content: A. odontoblastic process B. nerve endings C. dental lymph D. lamina limitans??

Prevents the calcification of the dentinal tubules.

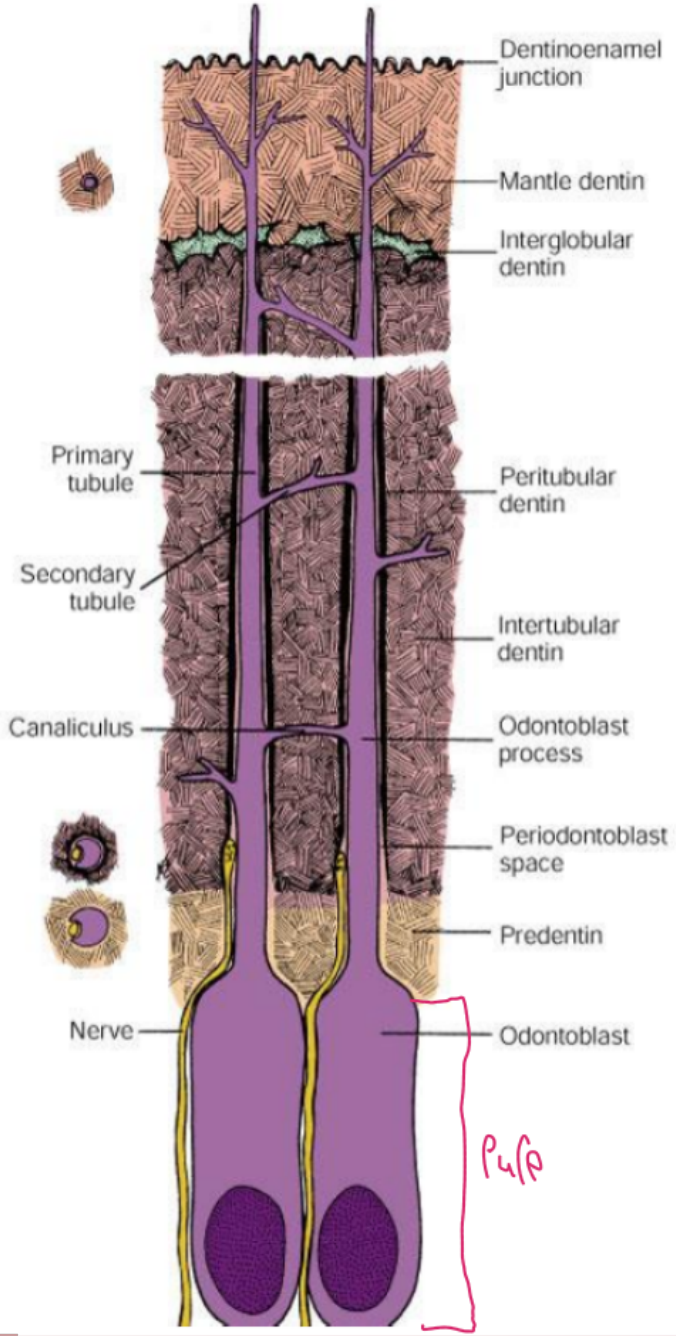


2-Peritubular dentin:

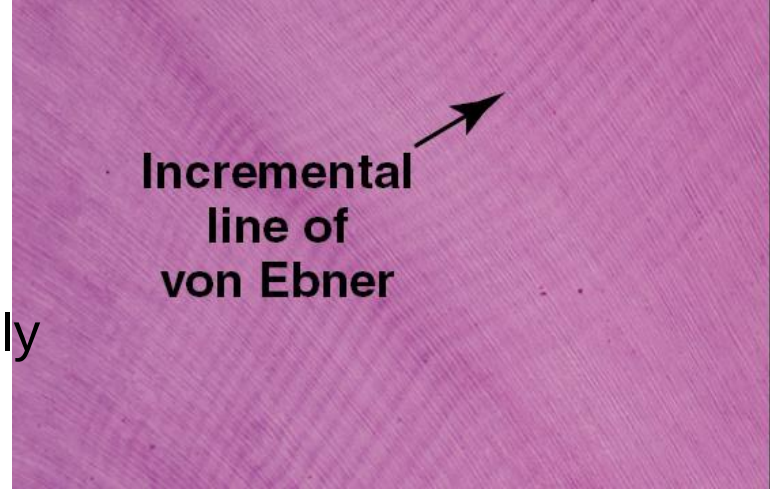
-Collar of hyper-mineralized dentin (Little collagen)

3- Intertubular dentin:

Primary secretory product of odontoblasts (between tubules)



INCREMENTAL LINES



1. Incremental lines of von ebner: :(5-day cycle, 20 µm apart)

Fine striations ⊥ to DT, due to minute change in collagen fiber orientation daily

*seen only by special stain.

2. Contour lines of owen

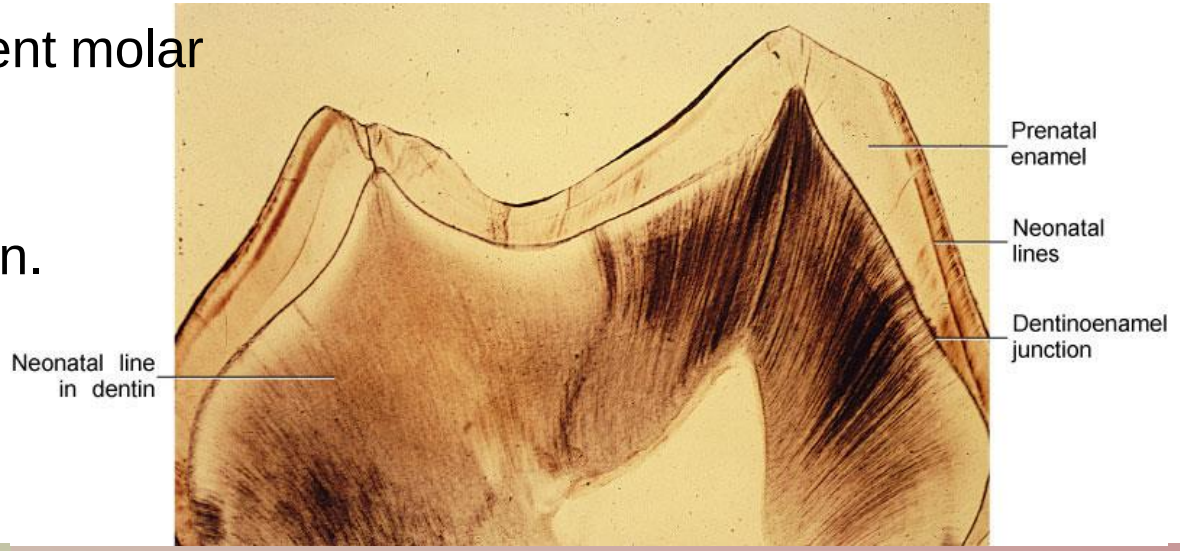
Accentuated von-ebner line, due to disturbance in matrix and mirenalization process.

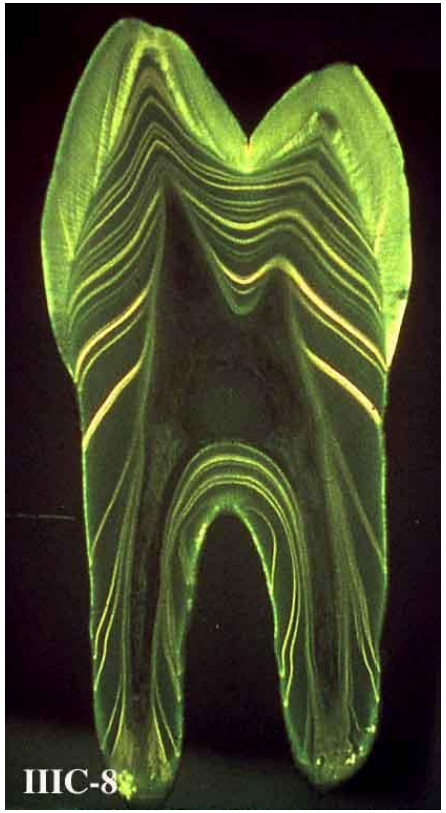
3. Neonatal line:

In deciduous teeth and 1st premanent molar

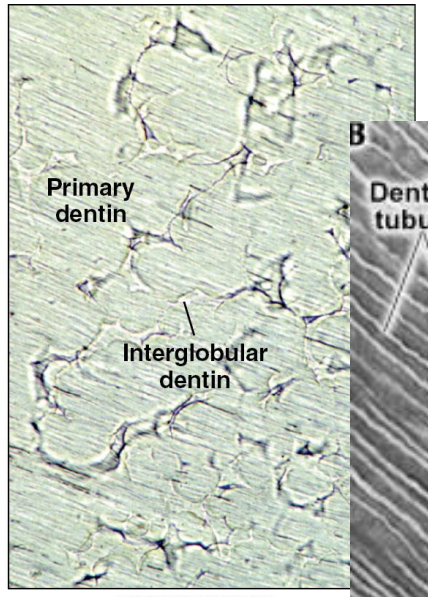
Accentuaed contour line of owen

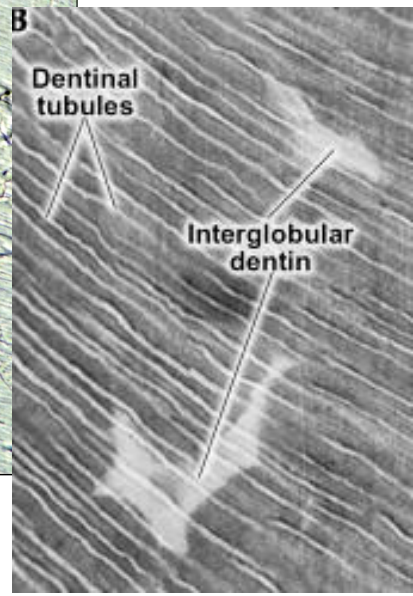
Separated pre-and post-natal dentin.





HYPOMINERALIZED DENTIN





1. Inter globular dentin: (defect in mineralization)

-Globules remain discrete and unfused. i.e. areas of organic matrix remain uncalcified

-Peritubular dentin only is absent, DT can be seen passing through it.

site: Crown near ADJ

Cause: A. deficiency in vitamin D,

B. exposure of high level of fluoride at time of dentin formation.

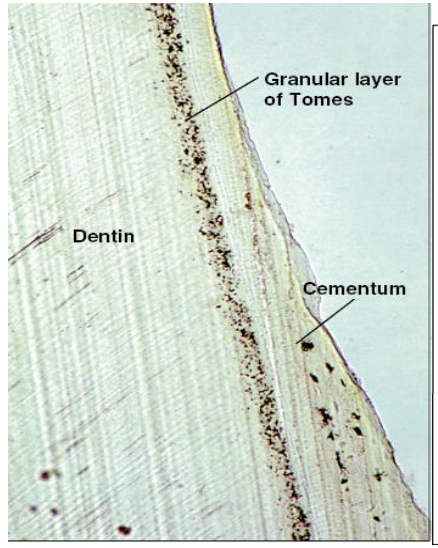
2. Granular layer of tomes: (only in root)

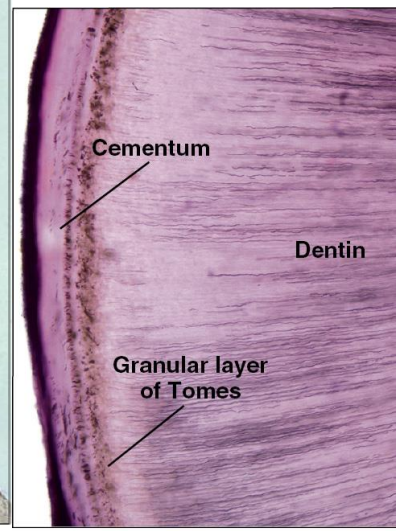
Site: just bellow CDJ, progressive increase from the CE junction to the apex of the tooth

Cause: A. minute interglobular dentin

B. Sections made through loops of dentinal tubules and an optical phenomenon

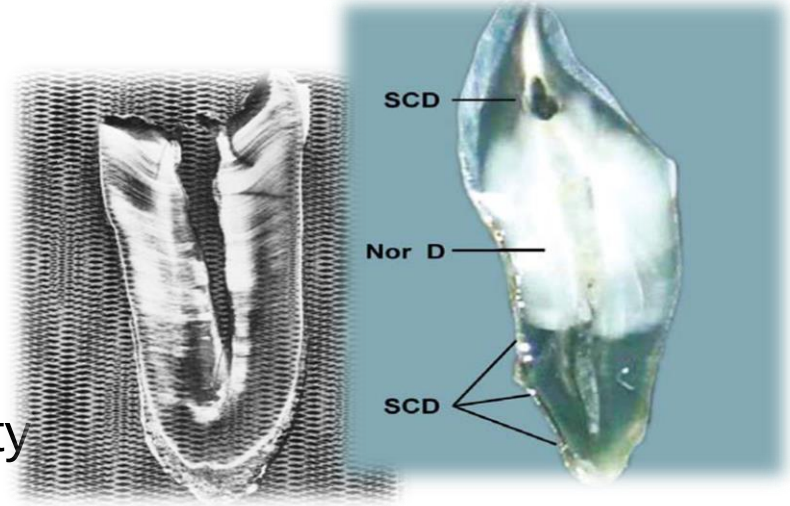
C. Special arrangement of collagen and non-collagen matrix proteins at the interface between dentin and cementum





3. Contour line of owens: see the slide before

FUNCTIONAL CHANGES



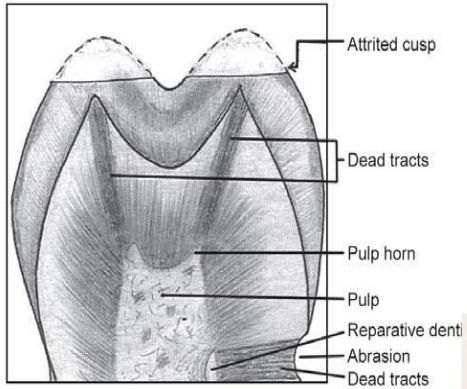
1. Sclerotic dentin (hypermineralized) physiologic

-glassy appearance of dentin and becomes translucent

-occlusion of DT by minerals in response to stimuli (decrease permeability

-the amount of sclerotic dentin increases with age

-most common in the apical third of the root.



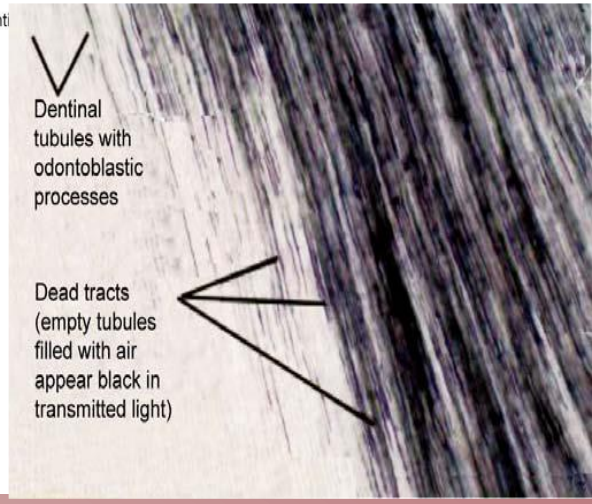
2. Dead tract: pathologic

-in response to fast, stronger stimuli

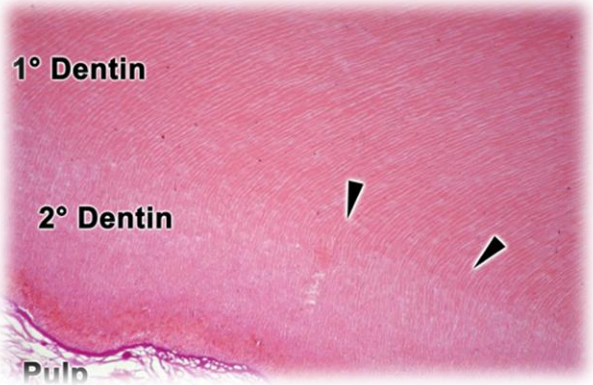
Destroyed or damaged odontoblast and death of odontoblastic process.

-empty dentinal tubules (appears black in transmitted light)

-sealed by deposition of 2ry dentin at pulpal end.



FUNCTIONAL CHANGES



3. Regular 2ry dentin: physiologic

Slow deposition of dentin through out the life of odontoblast after root formation, change in direction of DT from the 1ry

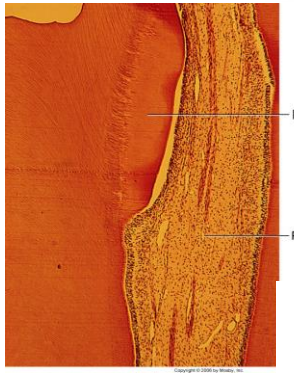
Reduction of pulpal chamber size (recession)

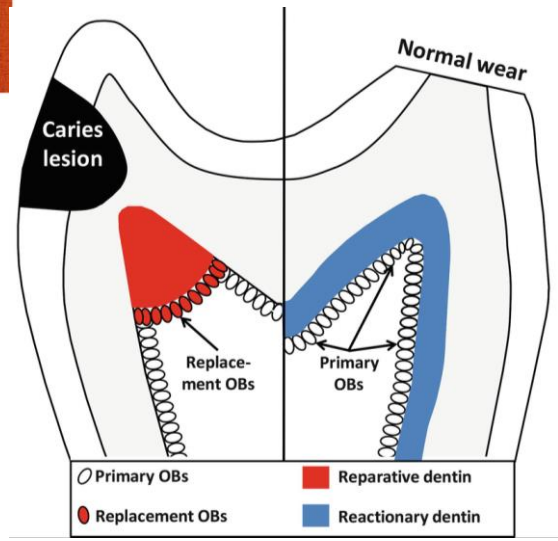
4. Tertiary dentin: (Pathologic)

-seals off the zone of injury and formation of dentinal bridge.

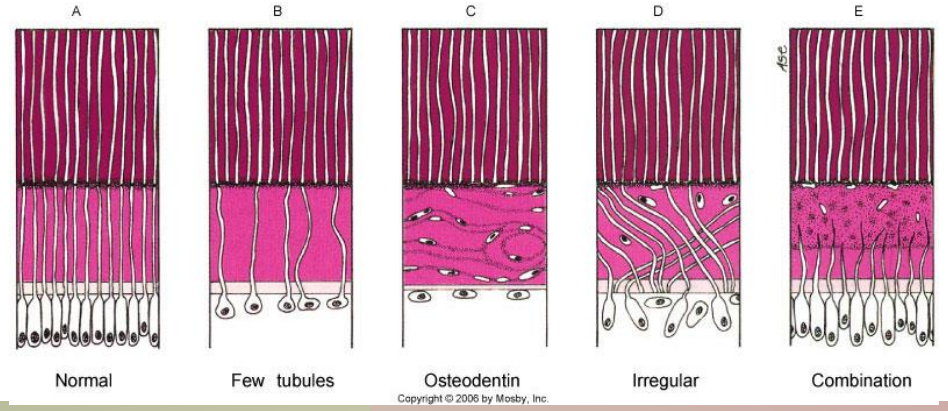
I]Reparative: UDMS of dental pulp will differentiate to odontoblast

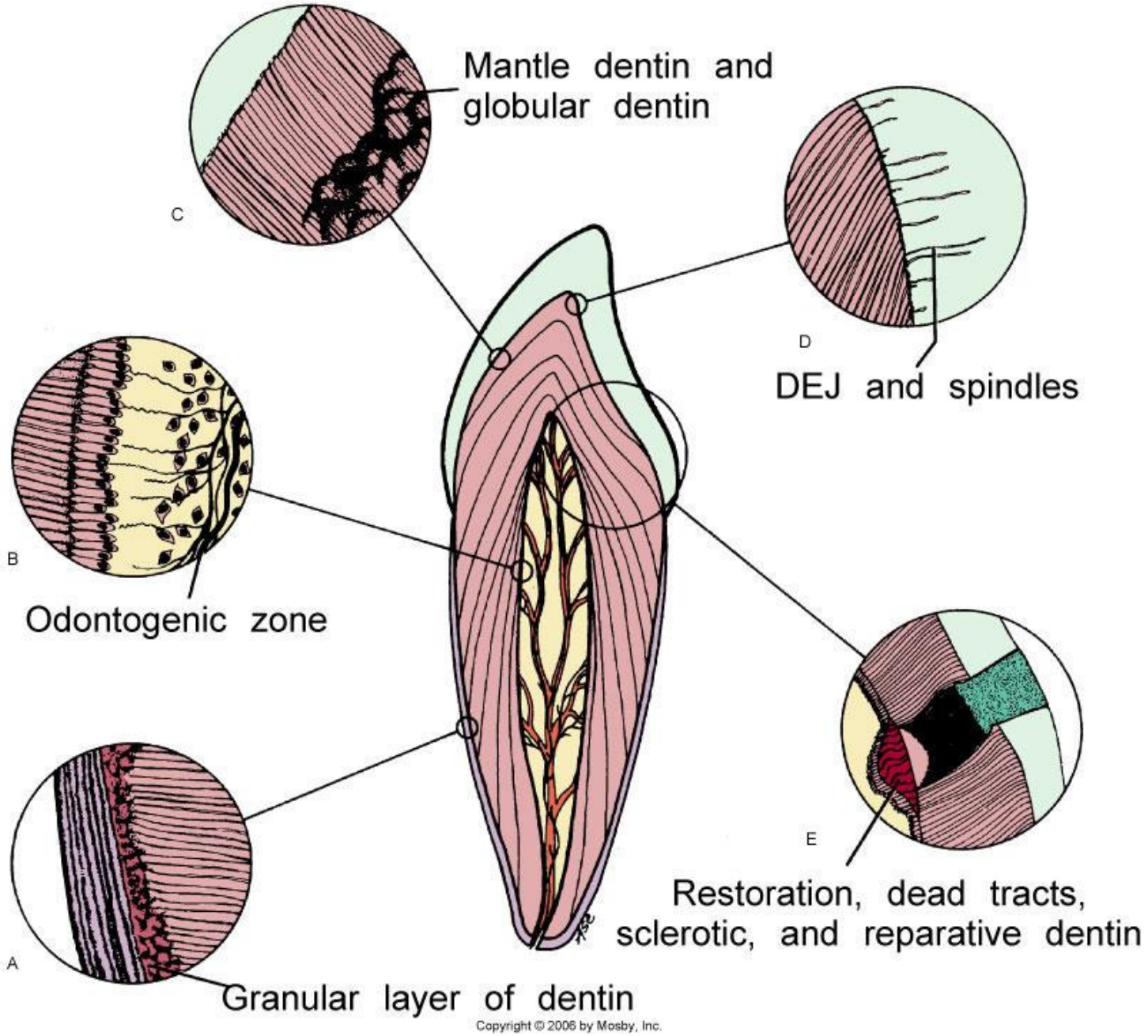
II]Reactive: already exciting odontoblast start secreting very fast dentin





It can be A)normal, B)few tubules, C)osteodentin, D)irregular, E)combination





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