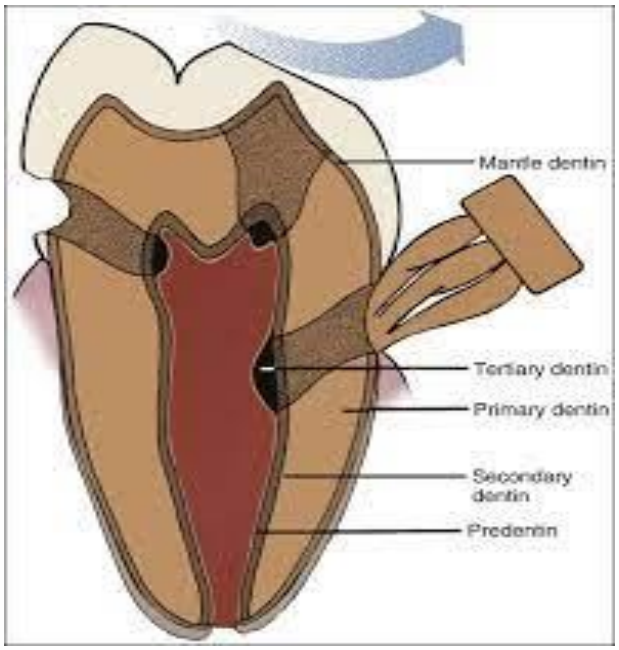
Oral histology Lect.6 أ. د. عذراء

Types of dentine



1- Primary D:

This represent that D. formed from the beginning of dentinogenesis till the eruption of the tooth. It composed of mantle D- and circumpulpal D.

Mantle D:

1. It's the initial D. formed adjacent to D.EJ

2.it contain large diameter collagen fibrils called von Kroffs fibers which run perpendicular to the D .E.J, These fibers consist of collagen *type* I11 and fibronectin,

3. Less mineralized than the reminder of primary D, and their mineralization occur by matrix vesicles,

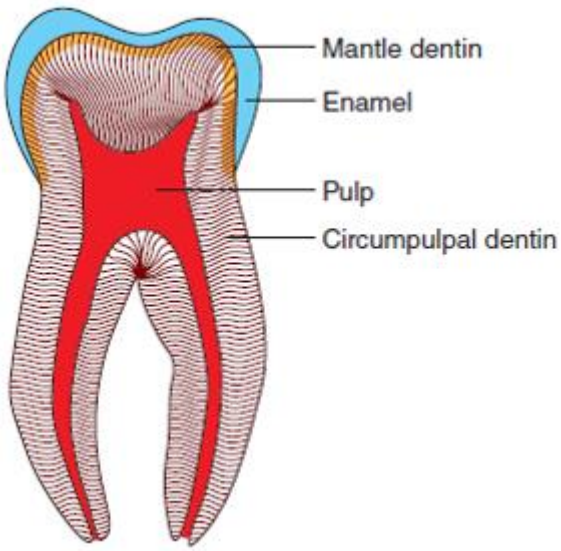
4. Mantle D. is formed in a layer approximately 15-20 micrometer thick onto which then is added the primary circumpulpal D.

Circumpulpal D.:

1.It form the remaining primary *D*

2.it contain small collagen fibers which run parallel to the D.E.J.

3.Slightly more mineral than mantle D., and their mineralization show globular pattern (calcospherites). Failure of such globule to fuse together result in appearance of interglobularD.



PRIMARY DENTINE

Formed before root completion

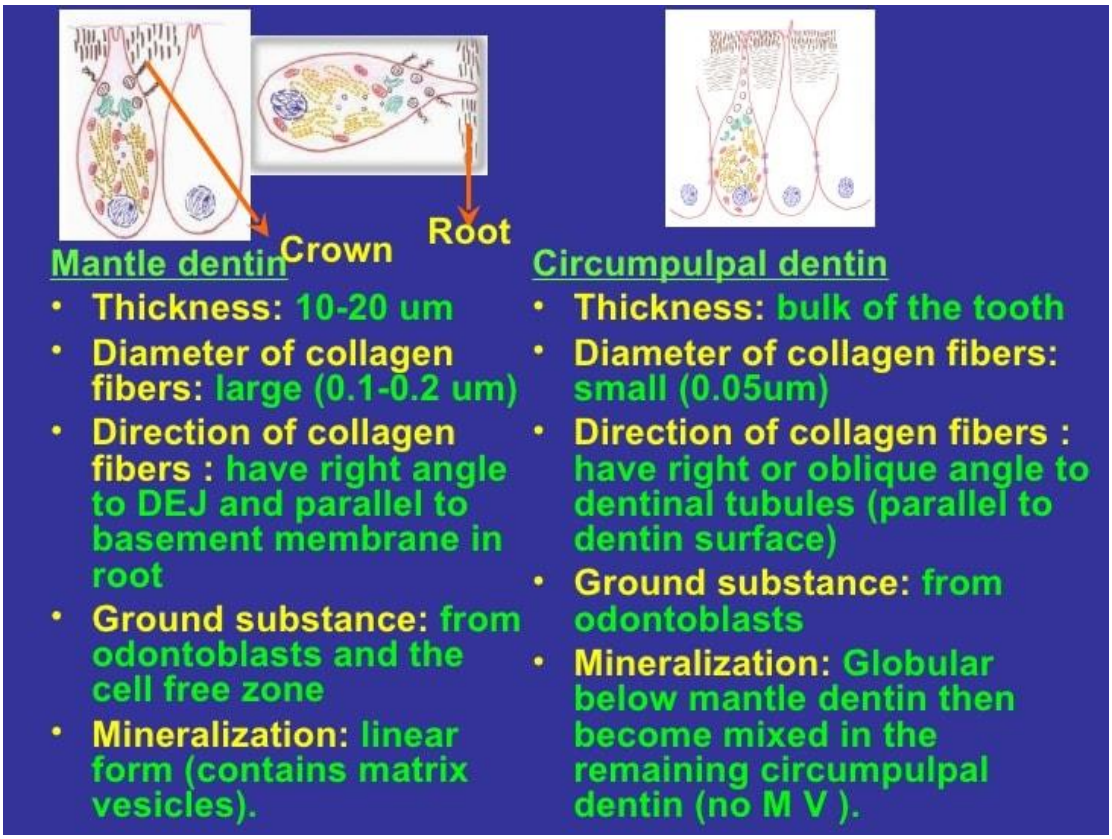
Consists of mantle dentine and circumpulpal dentine

(1) MANTLE DENTINE

- First formed dentine in crown
- Underlying DEJ
- 20 µm thick
- Fibrils are perpendicular to DEJ
- Organic matrix – von korffs fibres(large dia fibrils-type III collagen fibrils)
- Less mineralized compared to circumpulpal dentine.
- Matrix vesicles involved in mineralization.

(2) CIRCUMPULPAL DENTINE:

- **Circumpulpal dentin** forms the remaining primary dentin or bulk of the tooth.
- The fibrils are much smaller in diameter (0.05micrometer) & are more closely packed together.



2-Secondary D

1.This type of D. develops after root formation has been completed and the crown has come into clinical function. It represent the continuing, but much slower, deposition of D. by odontoblasts causing a reduction in the size of the pulp cavity.
2.It formed internal to the primary D. of the crown and ,root.

The D,T. of the primary and secondary D, are generally continuous.

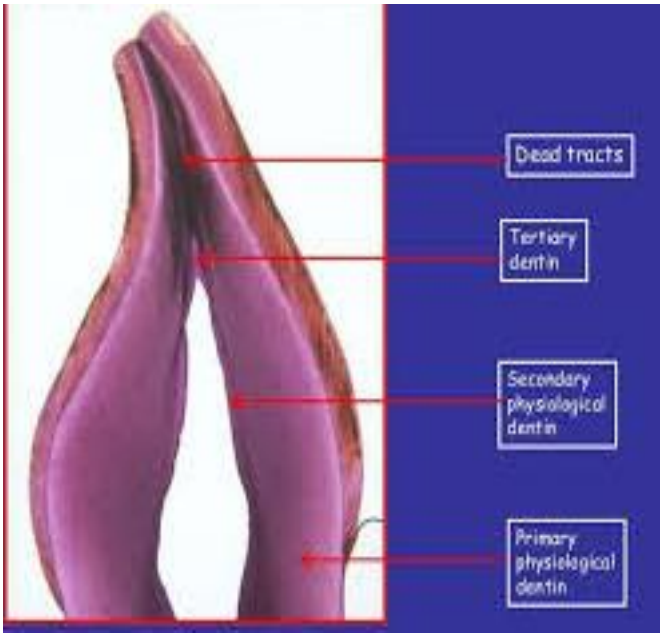
3-Tertiary or reparative D.:

• Its produced in reaction to various stimuli, such as attrition, caries, or a restorative dental procedure.

• Unlike primary or secondary D. that forms along the entire pulp-dentin border, tertiary D. is produced only by those cells directly affected by the stimulus.

• It may have tubules continuous with those of secondary D. tubules sparse in number and irregularly arranged, or no tubules at all.
• The cells forming tertiary D, line its surface or become included m the D, and so in this case is referred to as **osteodentin**
• Stimuli of different nature not only induce additional formation of reparative D. but may lead to changes in the D, itself, **calcium salts may be deposited in or around degenerated odontoblastic processes and may obliterate the tubules. This type of D. called Transparent or sclerotic D.** and can be observed in teeth of **elderly people**, especially **in the roots**. Transparent D. can be demonstrated only in **ground sections**. It appears light in transmitted and dark in reflected light, because the light passes through the transparent D. but reflected from the normal D.

Dead tracts: In **ground sections** of D, the odontoblastic processes disintegrated as a result of sever stimuli to the pulp like caries, attrition or abrasion, and the **empty tubules are filled with air**. They **appear dark in transmitted and white in reflected light this type of D**, called dead tracts and its area of decreased sensitivity. **Reparative D. seals these dead tracts at their pulpal end.**



	Primary	Secondary	Tertiary
Definition	Dentin formed before root completion	Formed after root completion	Formed as a response to any external stimuli such as dental caries, attrition and trauma
Type of cells	Usually formed by primary odontoblasts	Formed by primary odontoblasts	Secondary odontoblasts or undifferentiated mesenchymal cells of pulps
Location	Found in all areas of dentin	It is not uniform, mainly present over roof and floor of pulp chamber	Localized to only area of external stimulus
Orientation of tubules	Regular	Irregular	Atubular
Rate of formation	Rapid	Slow	Rapid between 1.5 and 3.5 μm/day depending on the stimuli
Permeability	More	Less	Least

Dentinogencsis(Dentin formation):

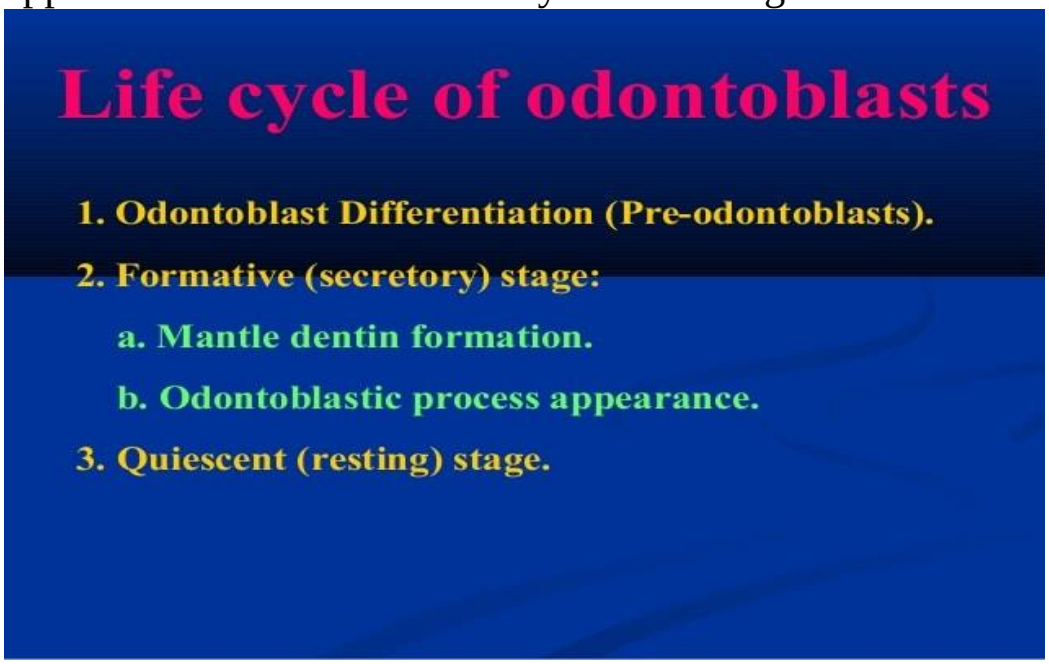
Dentinogenesis occur at late bell stage.**The first dental hard tissue to be formed is the dentin**, This needs a specialized type of cells which is called odontoblasts (D. forming cells). They are present in the peripheral cell layer of dental papilla as an undifferentiated ectomesenchymal cells. They differentiated into odontoblasts by an induction from adjacent I.E.E. cells at late bell stage,

Characteristic features of Odontoblasts:

* Odontoblasts are highly specialized C.T.cells that differentiated from the peripheral cellular layer of dental papilla.
* They are protein synthesis and secreting cells. They are rich in R,E.R.ʔ containing large mitochondria with abundant Golgi apparatus.
* As the odontoblasts differentiated and begins collagen production they change from an ovoid to a columnar shape, and their nuclei become basely oriented. The length of the

odontoblasts then increase to **40 (µm)micrometers**, although its width remain constant (7 **µm** micrometer).

* One or several odontoblastic process arises from the apical end of the cell in contact with basal lamina.
* Odontoblasts are a single cell layer, but mostly in the cusp region, they are crowded. This results in pseudo stratified appearance which occurs mostly in crown region.



Dentinogenesis is a 2-phase sequence

1.**organic matrix** called predentin .

2.**mineralization,** does not begin until a fairly wide band of predentin has been laid down.

Uncalcified matrix formation (predentin):

Unmineraiized matrix which secreted by odontoblasts is of two types:

- ❖ collagenous amino-acids (main one)
- ❖ the other is non-collagenous protein which forms the ground substance (mucopoly saccharide, glycoprotein and proteoglycans).

As each increment of predentin is formed along the pulp border, it remains a day before it is calcified and the next increment of predentin forms. **Initially daily increments of approximately 4 micrometer per day**, this continuous until the crown is formed

and the teeth erupt and move into occlusion. **After this time D, production slows to about 1 micrometer,**
Korff s fibers have been described as the initial predentin deposition along the cusp tips and these fibers represent the major constituent of the first formed matrix, due to the fanlike arrangement of the fibrils near the distal end of the odontoblasts.

Mineralization:

D. is the first tissue to be deposited , so it needs a nucleus for initiation of mineralization, this is achieved by matrix vesicles to start calcification of D.

Matrix vesicles are an electron microscopical structure forming by budding off a number of small, membrane-bound vesicles from odontoblasts which come to lie superficially near the basement membrane. The mineral phase first appears within matrix vesicles as a single crystals believed to be seeded by phospholipids present in the vesicles membrane.

These crystals grow rapidly and rupture from the confines of the vesicles to spread as a cluster of crystallites that fuse with adjacent clusters to form a continuous layer of mineralized matrix.

Pattern *of* mineralization:

Histologically, two patterns of D. mineralization can be observed, **globular and linear calcification**. It seem to depend on the rate of D, formation. **Globular or (calcospheric) calcification** involve the deposition of crystals in several discrete areas of matrix by capture in collagen. With continued crystal growth, globular masses are formed that continue to enlarge and eventually fuse to form a single calcified mass.
In the mantle D. region, where matrix vesicles give rise to mineralization foci that grow and coalesce.
In circumpulpal D. the mineralization can progress in a globular or linear pattern. The size of the globules seems to depend on the rate of D, deposition, with the largest globules occurring where D. deposition is fastest. When the rate of formation progress **slowly, the mineralization appears more uniform and the process is be linear.**

Formation of D. of the root:

D. of the root is differing than the D. of the crown in followings:

1. Odontoblasts differentiation is initiated by the cells of Hertwigs root sheath.
2. Collagen fiber run parallel to C.D.J.
3. The rate of D. deposition is slower.
4. Less minerlization.

Dentin sensitivity:

There are three theories of pain transmission through D, which are:

1. Direct neural stimulation:

This theory mean that the D. contains nerve endings that respond when it is stimulated.

2-Transduction theory:

This theory presumes that the odontoblasts serve as receptors and are coupled to nerves in the pulp.

3-Hydroclynamic theory;

This is the most accepted theory. The stimuli such as heat, **Cold,** or mechanical pressure will affect fluid movement inside D.T. which in turn produce movement of the odontohlastic **process** and its cell. Therefore the pain will occur by mechanical **disturbance** of nerve closely associated with process and its cell.