***Oral Histology***

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***Dentin***

 Dentin is covered by enamel on the crown and cementum on the root and surrounds the entire pulp. As a living tissue, dentin contains within its tubules the processes of the odontoblasts (odontoblastic process). By weight, 70% of dentin consists of the mineral ( hydroxylapatite crystallites), 20% is organic material(which include 90% collagen fibers and 10% ground substances) and 10% is water. Yellow in appearance, it greatly affects the color of a tooth due to the translucency of enamel. Dentin, which is less mineralized and less brittle than enamel, is necessary for the support of enamel.

 Enamel and dentin form a cohesive unit that successfully transmits forces through the enamel, and spreads them through the more deformable dentin. Those stresses are subsequently transmitted through the root to the mandibular and maxillary bone. Unlike enamel, dentin continues to form throughout life and can be initiated in response to stimuli, such as tooth decay or attrition . Because dentin is softer than enamel, it wears away more quickly than enamel.

**Dentin structures :-**

**1- Dentinal tubules and its odontoblastic process:**

 Dentin consists of microscopic channels, called dentinal tubules(D.T.), which radiate outward through the dentin from the pulp to the exterior cementum or enamel border. These tubules contain tissue fluid and cellular structures (odontoblastic process or Tome’s fiber).

 D.T. make the D. permeable and providing a pathway for enterance or invasion of bacteria caused dental caries and also play an important role in D. sensitivity. The strongest held theory of D.hypersensitivity suggests that it is due to changes in the dentinal fluid associated with the processes, a type of hydrodynamic mechanism.

 The course of D.T. is resembling an *S shape* known as *primary curvature*. Starting at right angles from pulpal surface, the first convexity of this doubly curved course directed toward the apex of the root ending perpendicular to D.E.J, this course taken by odontoblasts during dentinogenesis. *Secondary curvature* also can be distinguished over the entire length of D.T., they reflect the minor changes in the direction of movement of odontoblasts. In the root and in the area of incisal edge or cusps, the tubules are almost *straight.*

 The ratio between surface areas at the *outside to inside* of the D. is about 5:1, so the tubules are farther apart in the peripheral layers and are more closely packed near the pulp. In addition they are larger in diameter near the pulpal cavity (3-4µm) and smaller at their outer ends( 1µm).

 The *terminal part* of D.T. branched into 2-3 branches near D.E.J resulting in the increase number of tubules in this area. Also there are *lateral branches* of D.T.which called *canaliculi .*

**2-Peritubular D.**:

It’s the D. that surrounds the D.T. and form 1µm thick sheath around each tubule. It is missing in D.T. in interglobular D. indicating that this is a defect of mineralization in this area.Peritubular D. is highly calcified and its about 40% more calcified than adjacent intertubular D.

**3-Intertubular D.:**

 It’s the D. located between the D.T., and its formed the most of the body of D.

Its less mineralized than the peritubular D., and it consist of network course of collagen fibers in which apatite crystals deposited on it.

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 **Cross section represent dentin structure , A: light microscopic picture, B: electron microscopic picture**

**Incremental lines in D.**

**1- von Ebner lines (Imbrication lines) :**

 It appear as fine lines, which in cross section run at right angles to the D.T. The course of the lines indicates the growth pattern of the D. The distance between the lines corresponds to the daily rate of opposition, which in crown varies from *4-8 µm* and becomes decreasingly less as root formation progress.

**2-Counter lines of Owens:**

 Its hypocalcified line, it distinguish in longitudinal ground section as accentuated few lines. These lines may be arises due to disturbances either in D. matrix and/or mineralization process.

**3-Neonatal lines:**

 This line separating between prenatal and postnatal D., and mostly found in deciduous and first permanent molar. This line is the result of incomplete calcification, due to metabolic disturbances at the time of birth to the abrupt changes in environment and nutrition.

***Interglobular D.:***

 Mineralization of the D. sometimes beings in small globular areas that normally fused to form a uniformly calcified D. layer. If fusion does not take place, unmineralized or hypomineralized regions remain between the globules, which termed *interglobular D.*This type of D. is found in the crown in both sections (decalcified and ground sections) near the D.E.J. and in the root near C.D.J. In ground sections is sometimes lost and replaced by air , so it appear black.

***Tomes’ granular layer:***

In the ground sections a thin layer of D. adjacent to the cementum almost appears granular and only found in the root, this is known as Tomes’ granular layer. Its thought to represent an interference with mineralization of the entire surface layer of the root D. prior to the beginning of cementum formation.

***Types of D. :-***

 ***1-Primary dentin***

 Its the most prominent dentin in the tooth, lies between the enamel and the pulp chamber. The outer layer of this primary D. which closest to enamel in the crown and closest to the cementum in the root is known as *mantle dentin*. Mantle dentin is formed by newly differentiated odontoblasts and forms a layer approximately *150* µm wide, and its less mineralized.

 Below it lies the *circumpulpal dentin*, a more mineralized dentin which makes up most of the dentin layer and is secreted after the mantle dentin by the odontoblasts. Circumpulpal dentin is formed before the root formation is completed.

***2-Secondary dentin***

 Secondary dentin is formed after root formation is complete, normally after the tooth has erupted and is functional. It grows much more slowly than primary dentin, but maintains its incremental aspect of growth. It has a similar structure to primary dentin, although its deposition is not always even around the pulp chamber. It is the growth of this dentin that causes the decrease in the size of the pulp chamber with age.

***3-Tertiary dentin (Pathologic dentin):***

 Tertiary dentin is dentin formed as a reaction to external stimulation such as cavities. It is of two types, either *reactionary*, where dentin is formed from a pre-existing odontoblast, or *reparative*, where newly differented odontoblast-like cells are formed due to the death of the original odontoblasts, from a pulpal progenitor cell. Tertiary dentin is only formed by an odontoblast directly affected by a stimulus; therefore, the architecture and structure depend on the intensity and duration of the stimulus, e.g., if the stimulus is a carious lesion, there is extensive destruction of dentin and damage to the pulp, due to the differentiation of bacterial metabolites and toxins. Thus, tertiary dentin is deposited rapidly, with a sparse and irregular tubular pattern and some cellular inclusions of odontoblasts in its matrix because of rapid formation; in this case it is referred to as "*osteodentin*".

 Stimuli of different nature not only induce additional formation of reparative D. but also 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 demonstrated only in ground sections. It appear light in transmitted light and dark in reflected light, because the light passes through the transparent D. but reflected from the normal D.

 In ground section of D., the odontoblastic process 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 light and white in reflected light, this type of D. called *dead tracts*andits area of decreased sensitivity. Reparative D. seals these dead tracts at their pulpal end.





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