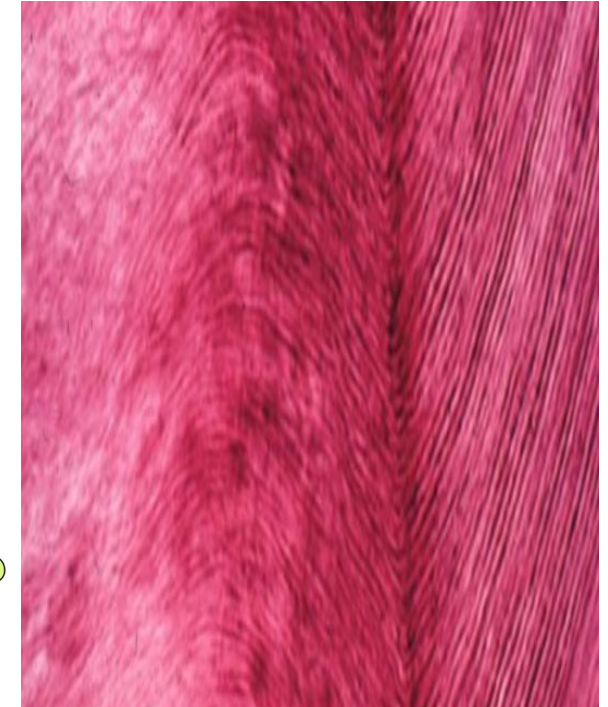
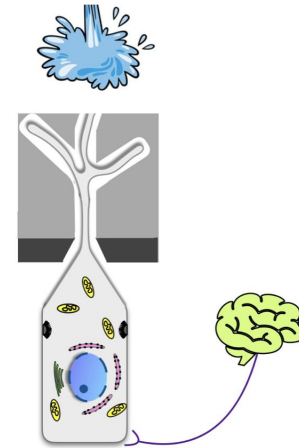


2

Dentin

Structure and Functions

Dr. Sherif Hassan
2026



Trigeminal Innervation Of the teeth



Neve supply of maxillary teeth:

1. **Posterior superior alveolar nerve** for maxillary molars.
2. **Middle superior alveolar nerve** for maxillary premolars.
3. **Anterior superior alveolar nerve** for maxillary anteriors.

Neve supply of mandibular teeth:

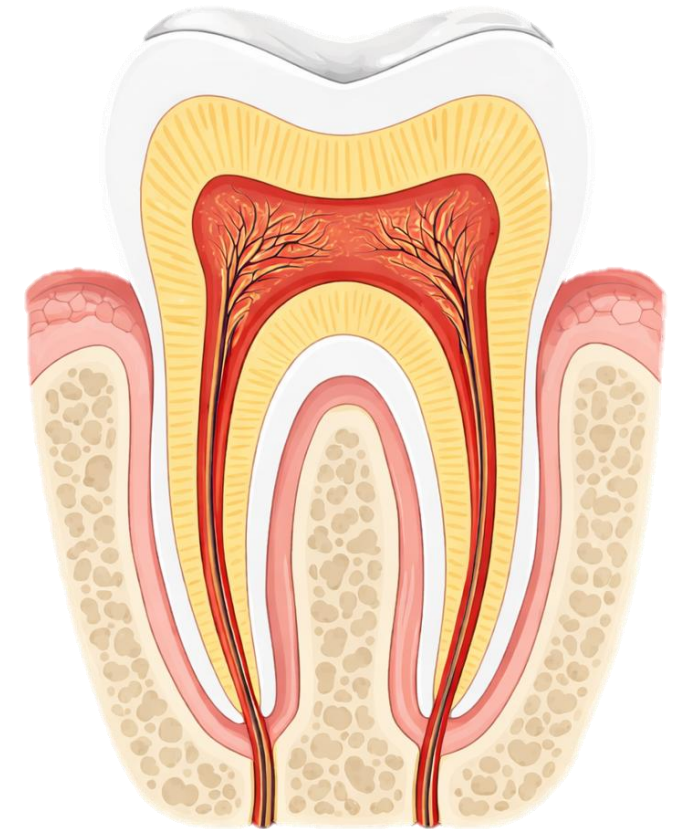
1. **Inferior alveolar nerve.**



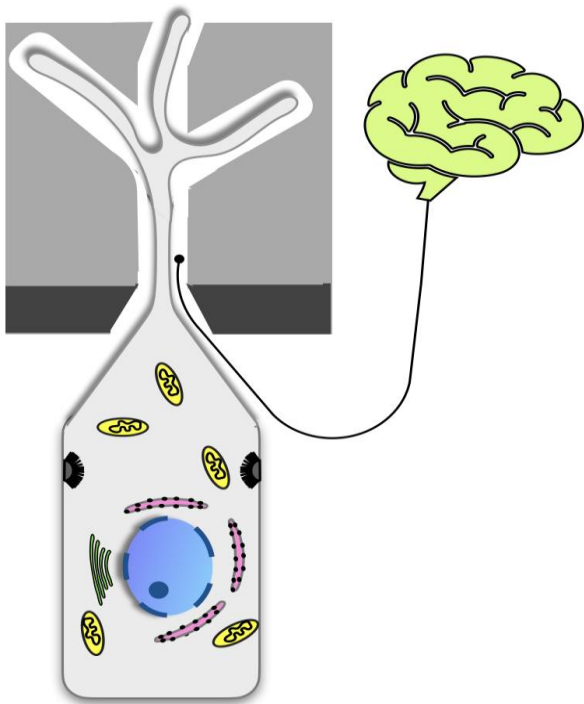
Innervation Of Dentin



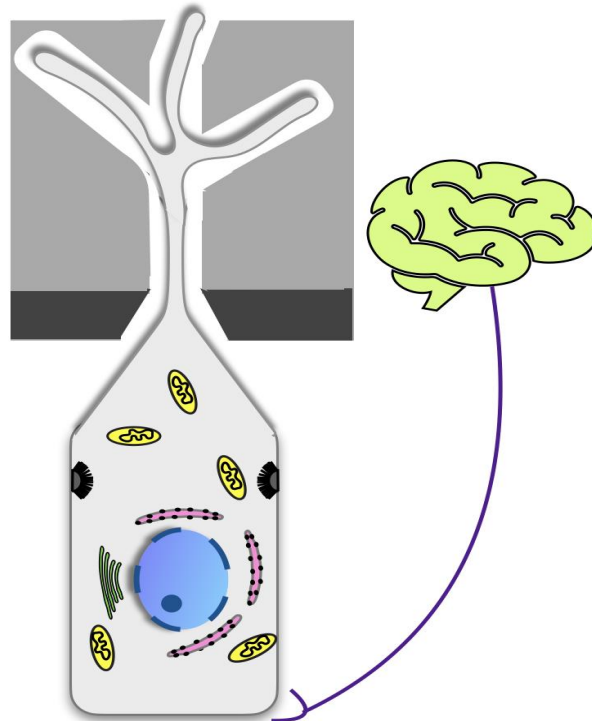
- Myelinated nerve fibers enter the tooth through the apical foramen.
- They travel within the center of the pulp toward the pulp chamber.
- The nerve fibers branch extensively to form a rich network within the root canal.
- Within the pulp chamber, they form a dense collection of near the odontoblast cells termed **Plexus of Raschkow**.
- Then, the nerve loses the myelinated sheath and goes to the odontoblast cell layer.
- Few nerve fibers enter to the dentinal tubule (**1/10**).
- The nerve sensation of dentin is **translated as pain only (Imp)**.



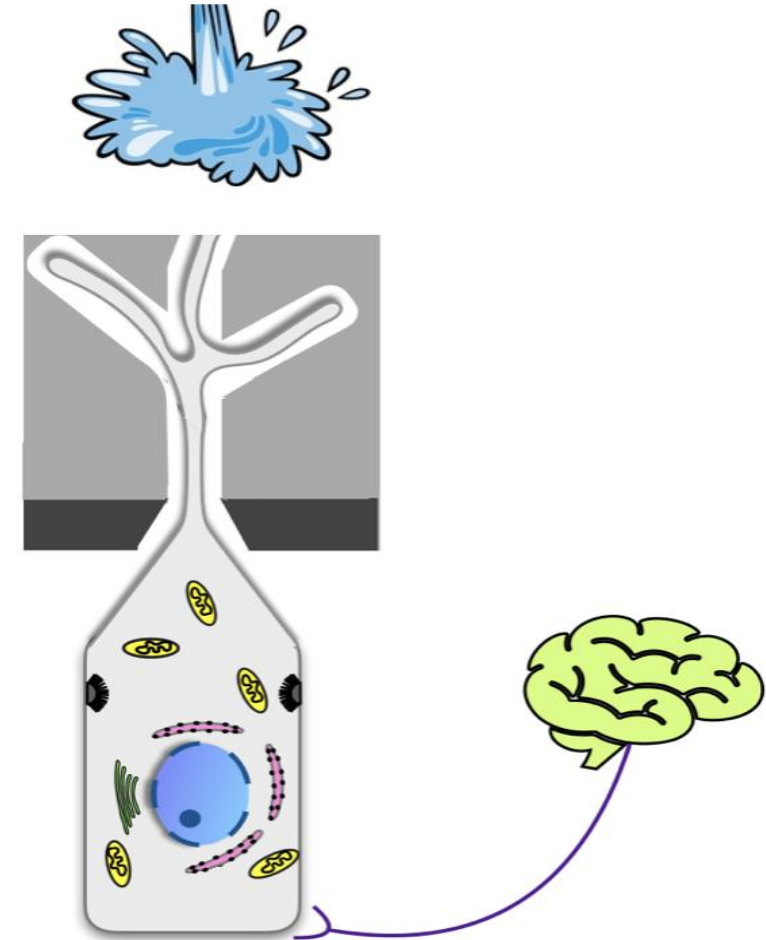
Theories of Dentin Sensitivity



Direct innervation Theory

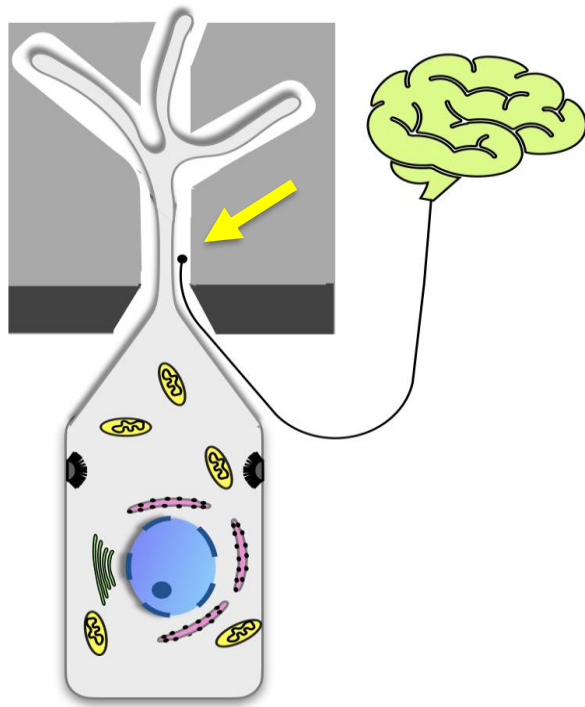


Transduction Theory



Hydrodynamic Theory

1. Direct innervation theory



Direct innervation Theory

Explanation of the theory:

- Nerve fibers pass between odontoblasts and extend for a short distance into the DT.
- These nerve fibers do not pass the full thickness of the DT.
- Nerve endings within the DT are stimulated and transmit impulses to the brain.

Theory antagonist:

1. The numbers of nerve fibers entering the dentinal tubules is not enough.
2. Newly erupted teeth often exhibit sensitivity even though the plexus of Raschkow has not yet fully developed.
3. Application of local anesthetics to exposed dentin does not eliminate pain.

2. Odontoblast Transduction Theory

Explanation of the theory:

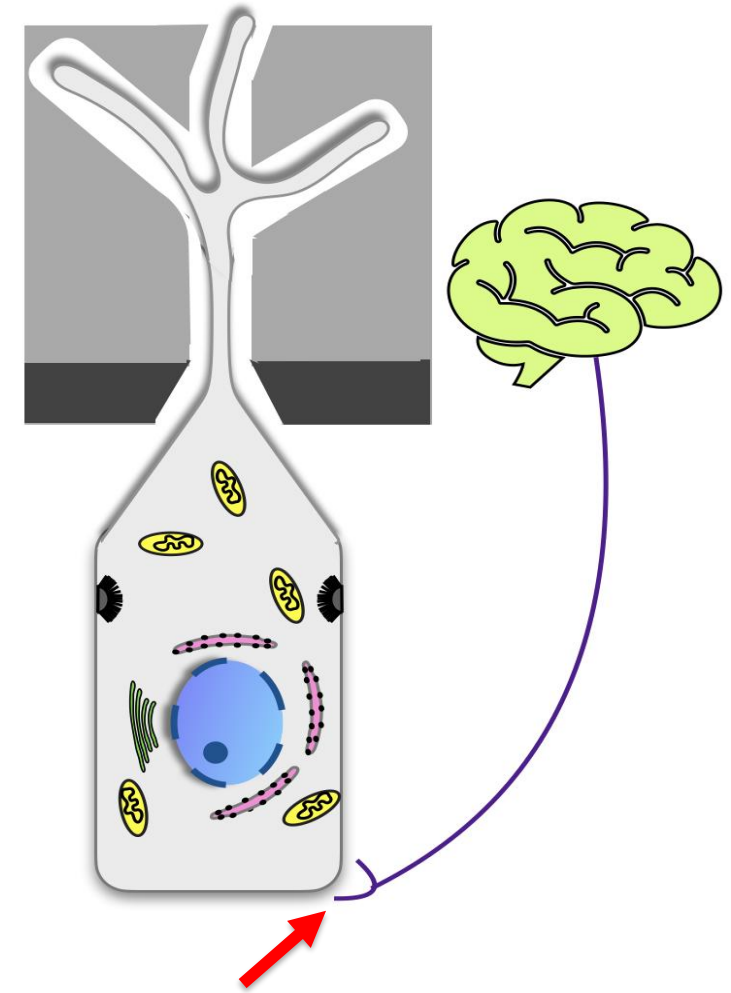
- Nerve fibers terminate close to odontoblasts.
- Odontoblasts function as sensory receptor cells.
- A synapse-like is present between the odontoblast and the nerve ending.

Evidence supporting the theory:

- Odontoblasts originate from neural crest cells.
- Odontoblasts show morphological similarity to nerve cells.

Arguments against the theory:

- No definite neurotransmitters have been identified within odontoblasts.
- Odontoblastic processes do not extend throughout the full thickness of dentin.



3. Hydrodynamic Theory of Dentin Sensitivity

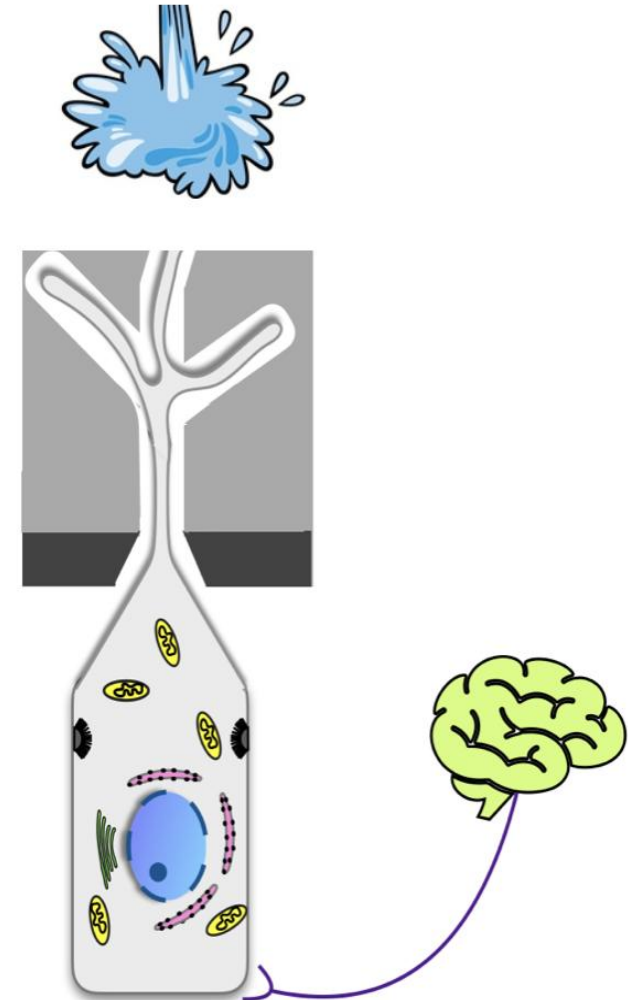
- The hydrodynamic theory is the most widely accepted for dentin sensitivity.
- It proposes that pain arises from the movement of fluid within the dentinal tubules, which stimulates sensory nerve endings in the pulp.

Explanation of the theory:

- Dentin contains many dentinal tubules filled with fluid.
- Heat, cold, touch, or air cause this fluid to move.
- Movement of the fluid stimulates nerve endings pulpal to the odontoblast.
- This stimulation produces a sharp and short pain.
- Sensitivity is higher when dentinal tubules are carious.

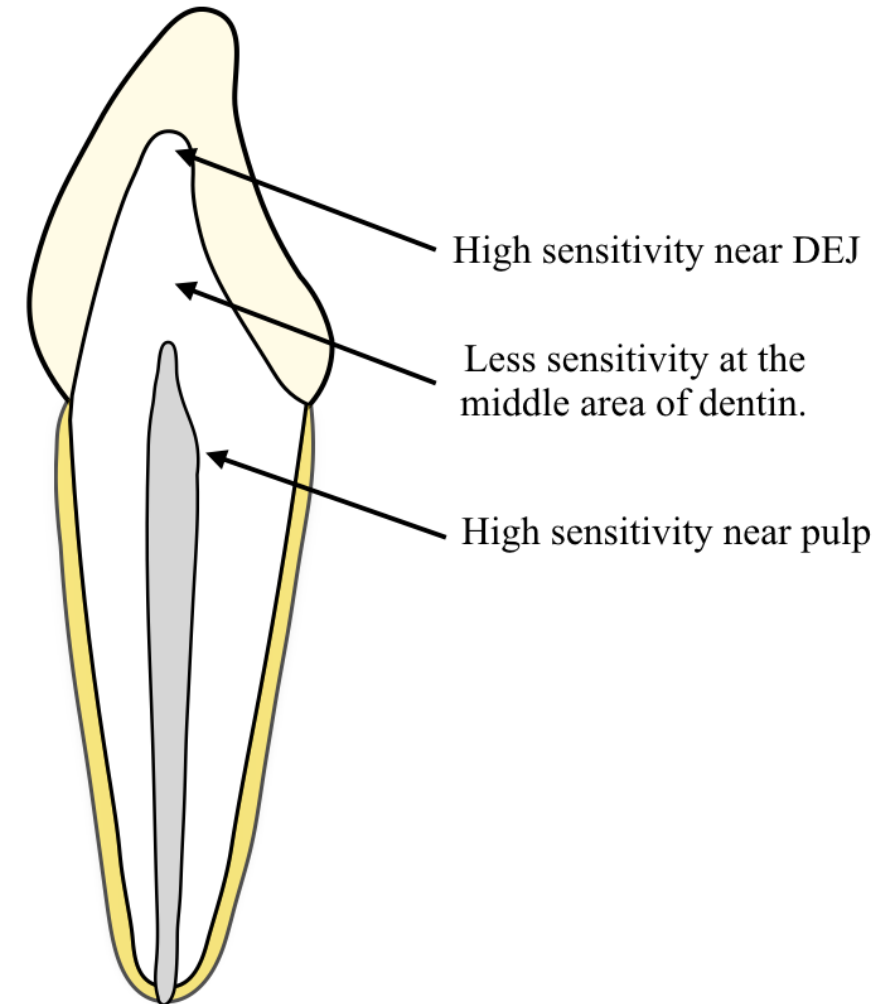
Evidence supporting the theory:

- Cold stimuli cause outward movement of dentinal fluid and produce sharp pain.
- Heat usually causes inward fluid movement and a less intense response.
- Treatments for dentin hypersensitivity aim to reduce fluid movement by occluding dentinal tubules through the filling materials.



Hypersensitivity of Dentin at DEJ

- Dentin at the DEJ contains numerous terminal branches of dentinal tubules, which increases the fluid content and raises the likelihood of pain in this area.
- This is evident when dental caries reaches the dentin, as the patient experiences pain initially, which gradually subsides even though the decay has not yet been removed.
- Similarly, when the dentist begins drilling for caries removal and reaches the dentin, the patient experiences momentary pain despite anesthesia, but the sensation subsides rapidly.



Age changes of dentin

1. With advancing age, dentine continues to be deposited throughout life, leading to a gradual increase in dentin thickness.
2. Dentinal tubules narrowed due to the deposition of peritubular dentin.
3. The permeability of dentin decreases with age because of tubular narrowing.
4. The sensitivity of dentin is reduced because of tubular narrowing.
5. Decrease in dentin elasticity due to increase in mineral content.
6. **Secondary dentin** is formed after root completion, resulting in a progressive reduction in the size of the pulp chamber and root canals.
7. **Reparative dentin** is formed due to progression of caries and irritation.
8. **Dead tracts and sclerotic dentin.**

Regular Secondary Dentin

Physiologic Secondary Dentin

Definition:

- It is a type of dentin continuously formed after root completion.
- It represent a physiologic process and not required any external stimulus.

Site:

- It occurs uniformly along the dentin surface leading to reduction in the pulp size.
- It is more common in pulp chamber, specifically at the pulp horns.

Functions:

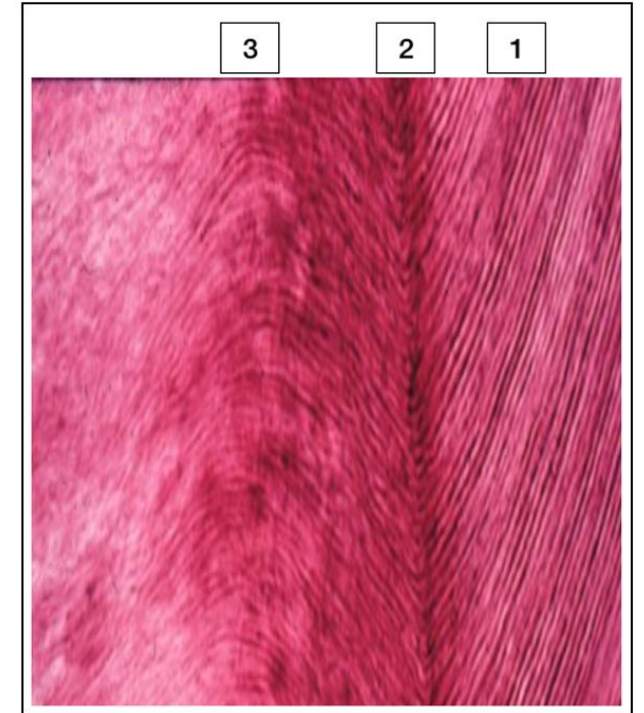
- This type of dentin functions as a protective barrier, helping to maintain pulp vitality.
- It decreases dentin permeability and reduces the transmission of stimuli to the pulp.

Regular Secondary Dentin

Physiologic Secondary Dentin

Histology:

- Regular secondary dentin is slowly formed.
- Regular secondary dentin less calcified.
- It contains less dentinal tubules.
- Dentinal tubules run in a wavy course.
- Demarcation line is found between it and primary dentin.



LS decalcified section of tooth shows:

1. Primary dentine with straight DT
2. Demarcation line.
3. Secondary dentine with wavy DT.

Irregular Secondary Dentin

Reparative Dentin

Definition:

It is a localized deposition of newly formed dentin in response to external stimuli.

Terminology:

1. Reparative dentin.
2. Tertiary dentin.
3. Reactive dentin.

Etiology:

1. Deep or rapid progressive caries.
2. Rapid attrition or trauma
3. Restorative trauma from the dentist.

Histogenesis:

- The attack of the stimulation leads to degeneration of the odontoblast cells under the localized area.
- Ectomesenchymal cells of cell rich zone within the pulp differentiated to odontoblast-like cells.
- Odontoblast-like cells form the reparative dentin layer.

Irregular Secondary Dentin

Reparative Dentin

Functions:

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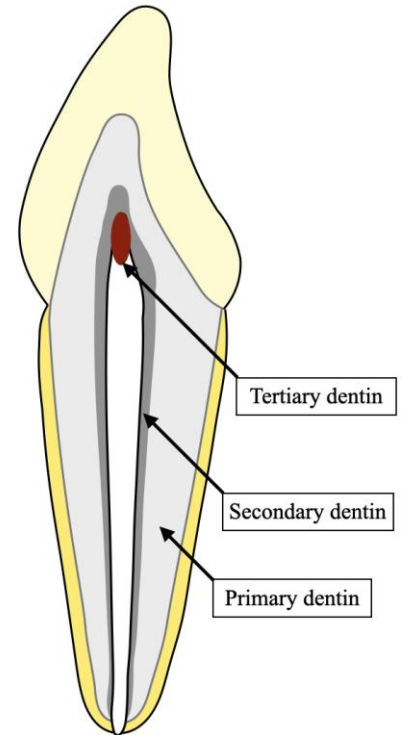
Histology:

- Reparative dentin contains fewer of dentinal tubules than the secondary dentin.
- Dentinal tubules move in an irregular wavy course .
- Dentinal tubules might be absent completely which are called atubular dentin.
- Sometimes, odontoblast-like cells become incorporated within the dentine which are called osteo-dentin.
- Sometimes, reparative dentin contains blood vessel which are called Vaso-dentin.

Types of reparative dentin:

1. Atubular dentin.
2. Osteo-dentin.
3. Vaso-dentin.

Remember



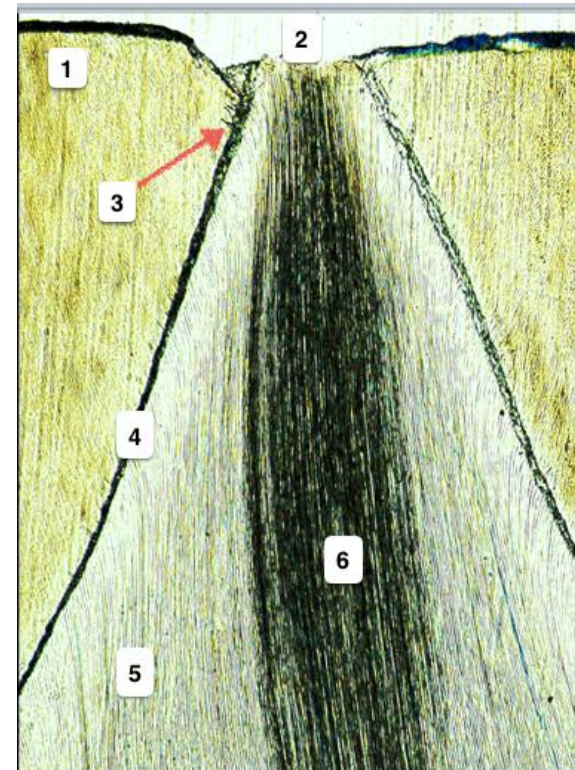
Dead tracts

Definition:

Dead tracts are areas of dentin with degenerated odontoblastic processes and hypocalcified dentinal tubules.

Causes:

It result from moderate chronic irritation such as caries, attrition, abrasion, erosion, or restorative procedures.

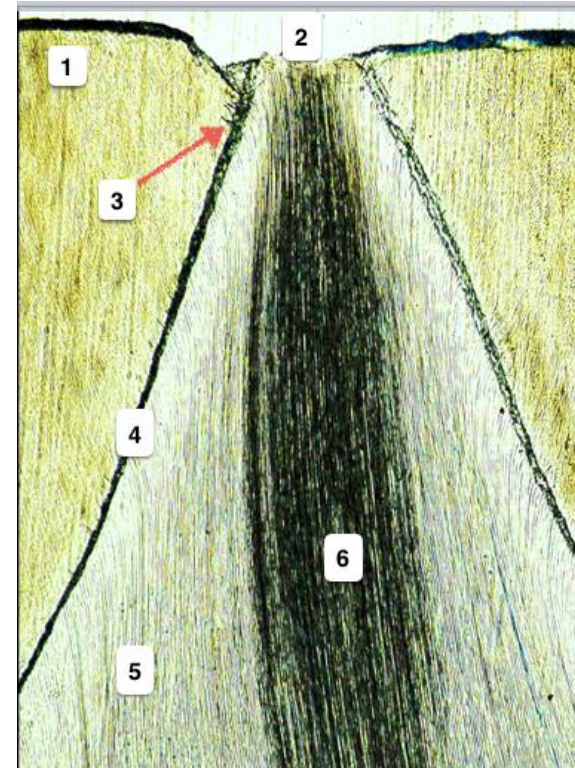


1. Enamel
2. Attrition.
3. Enamel spindle.
4. DEJ.
5. Dentin and DT.
6. Dead tract.

Dead tracts

Histology:

- It appear as empty dentinal tubules that contain air.
- In ground sections, they appear dark.
- Dead tract is a hypocalcified tissue.
- It extend from the site of irritation toward the pulp but do not reach it.
- Dead tracts often stimulate a defensive response in the pulp, leading to the formation of reparative dentin beneath the affected area.



1. Enamel
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3. Enamel spindle.
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Sclerotic dentin

Definition:

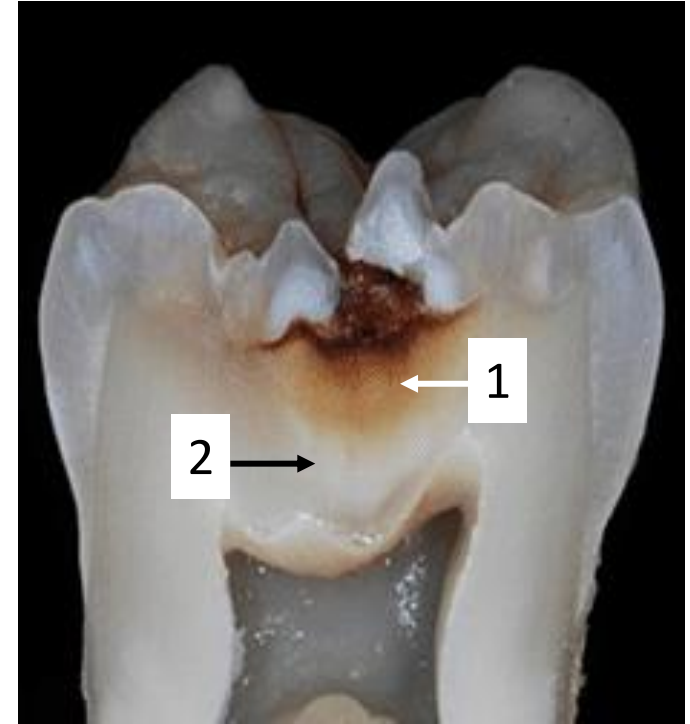
- Sclerotic dentin is a highly mineralized regions of peritubular dentin characterized by partial or complete closure of the dentinal tubules.
- Due to increased calcification, it appears transparent or translucent when viewed under light.

Terminology:

- Transparent dentin.
- Translucent dentin.

Causes:

- It occurs as a protective response under slowly or mild progressive caries.



1. *Dead tract*
2. *Sclerotic dentin*

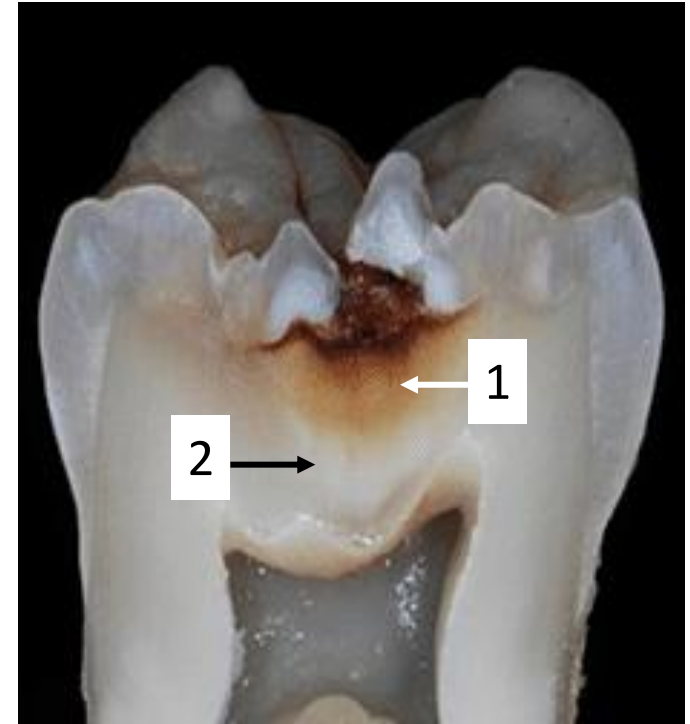
Sclerotic dentin

X-ray appearance:

Sclerotic dentin appeared more radiopaque in the x-ray film due to its higher calcification.

Histology:

- The dentinal tubules appear narrow or completely closed due to the increased deposition and calcification of peritubular dentin.
- Sclerotic dentin appears white in the ground section under the light microscope.
- Sclerotic dentin appears dark under the reflected light microscope.



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2. *Sclerotic dentin*

