Lecture 11: **Tooth sensation: Pulp-dentin complex**

By

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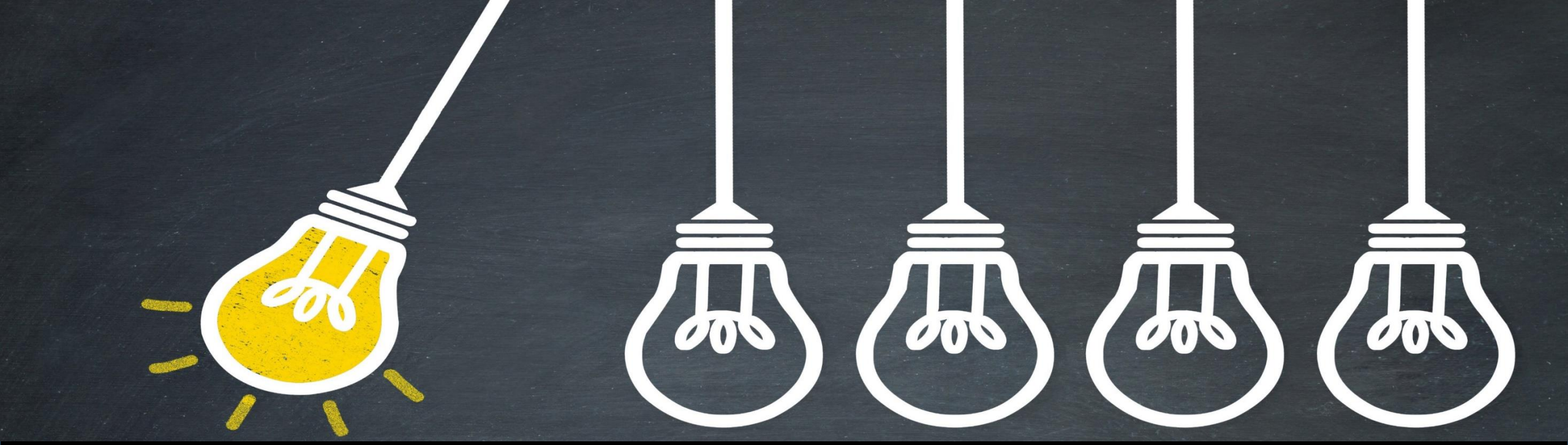
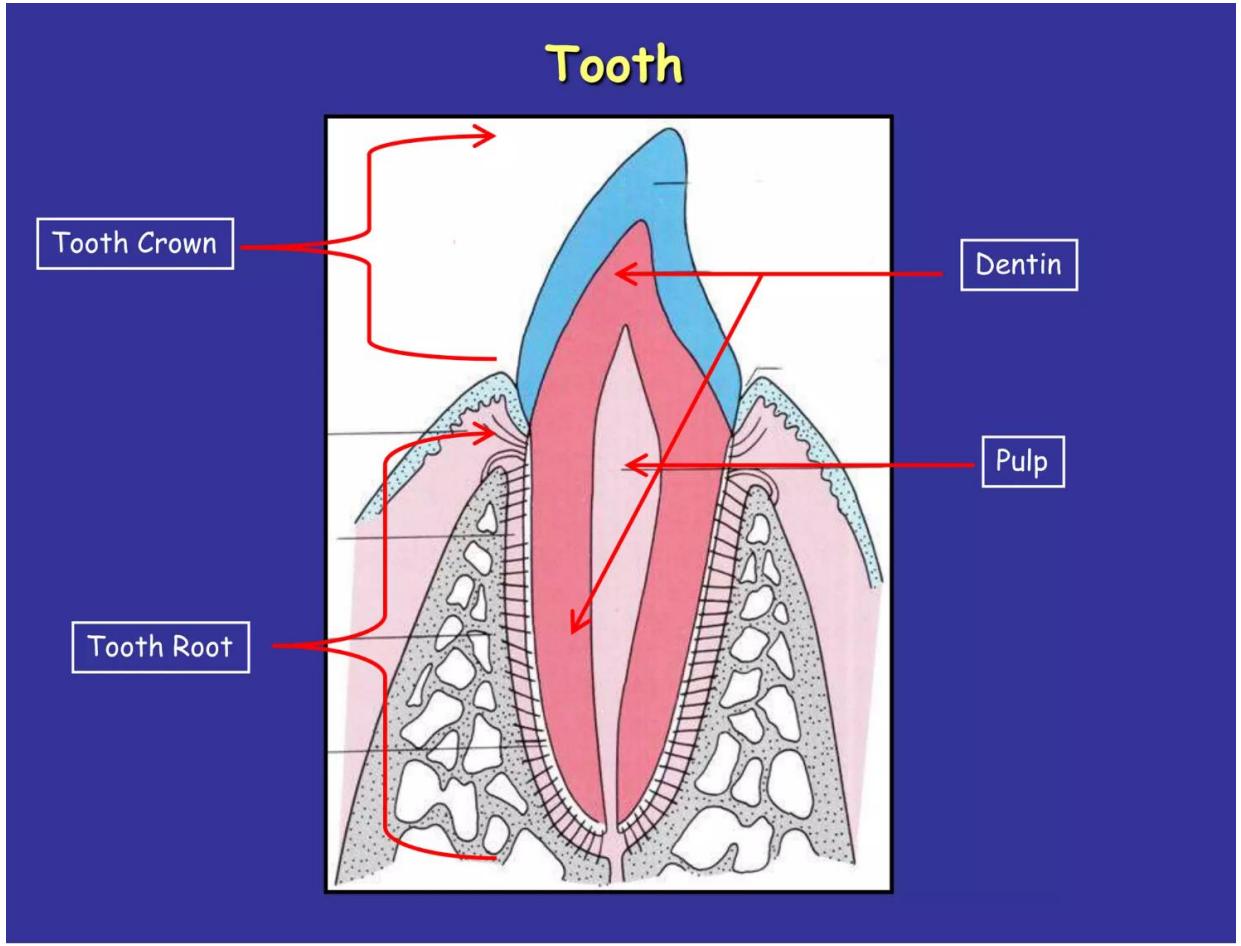


Learning Outcomes

- Understand why dentin and pulp tissues consider a single complex structure
- Understand mechanisms of dentin sensitivity including; transduction theory, hydrodynamic, and Direct innervations theories.

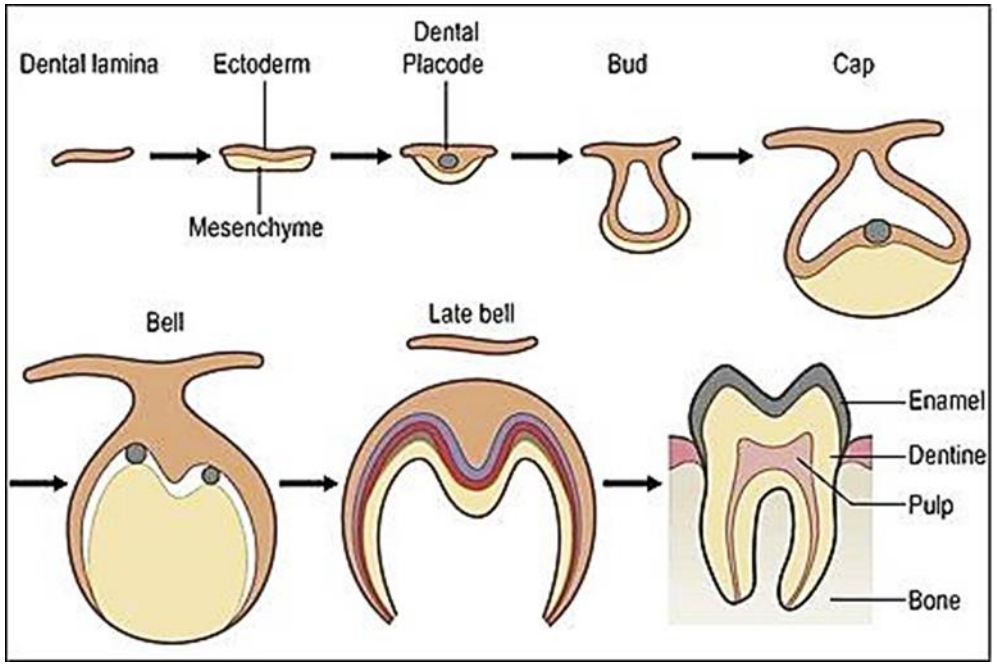
Physiology of the Dentin-Pulp Complex

- Dentin and pulp are related to each other **embryologically**, **histologically**, and **functionally**.
- And therefore referred to as **Dentin-pulp complex**



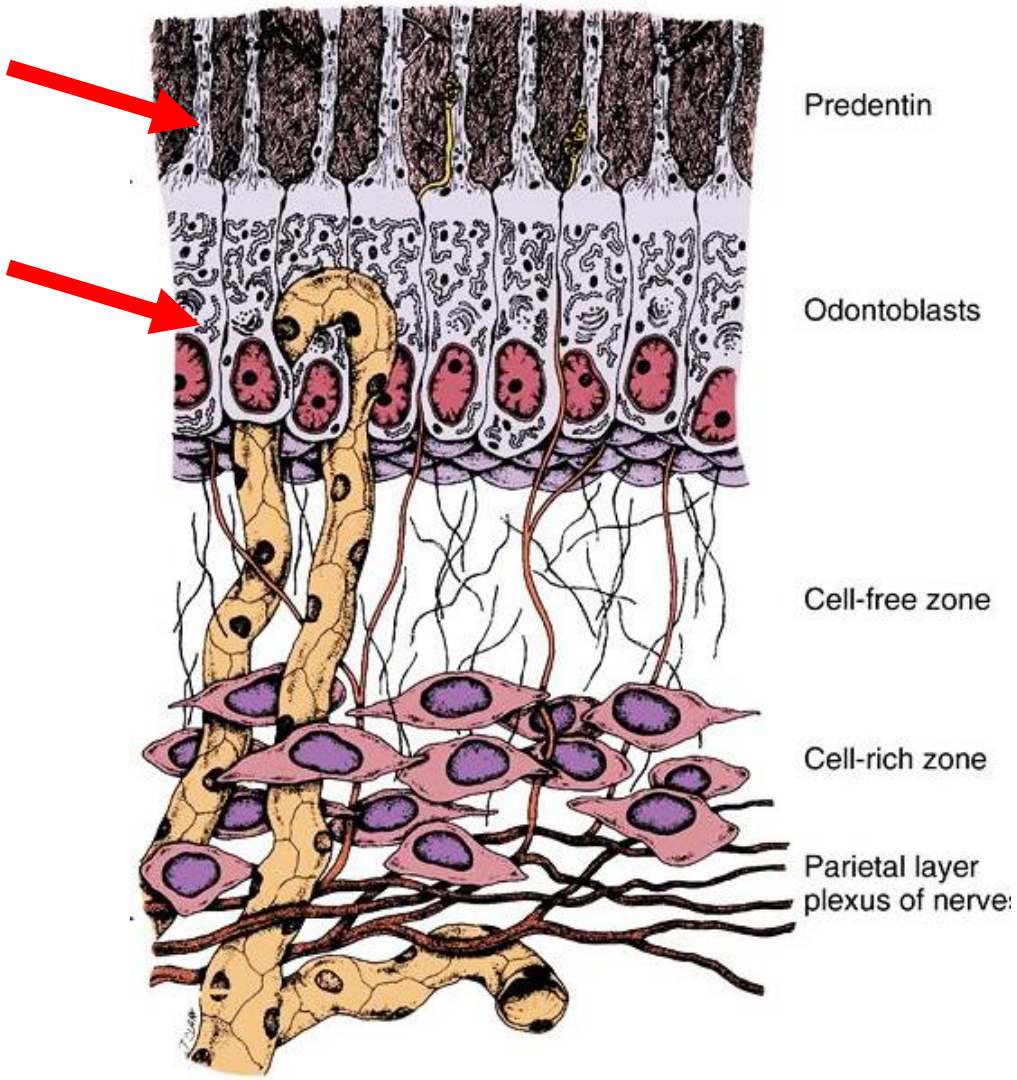
1: Embryologic relationship of dentin and pulp

- Both dentin and pulp have common origin from the **dental papilla**.
- Both are **neural crest-derived ectomesenchyme**
- In early development the dental papilla → give odontoblasts → secrete dentin



2: Histological relationship of dentin and pulp

- Odontoblast that secrete all types of dentin are **located** in the dental pulp.
- The **odontoblastic processes** of the odontoblasts extends into dentin.



3: Functional relationship of dentin and pulp

1. **Inductive** function of the pulp:

   In early development, the dental pulp interact with the surrounding tissues

   Dental papilla → Dental lamina → Enamel organ formation …….. **The tooth**

2. **Nutritive** function of the pulp

- Nutrients to the **odontoblasts**
- Continuous source of **dentinal fluid**
- Pulp contains **blood vessels** that help to prevent the tooth from becoming brittle by keeping it **moisturized** and **nourished**.

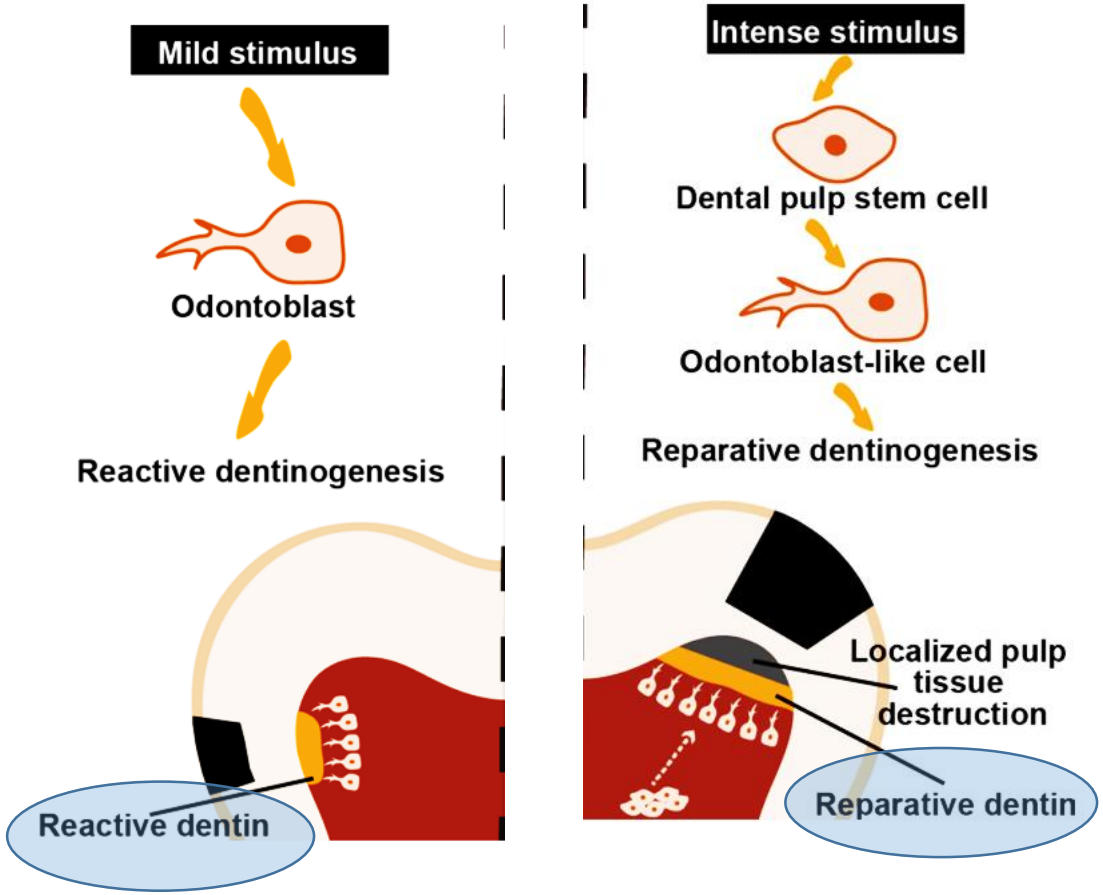
3. **Formative** function of the pulp

Odontoblasts, the outermost layer of the pulp, form **dentin** which **protect** pulp

3: Functional relationship of dentin and pulp

4. **Defensive (reparative)** function of dentin

- Three types of dentin; Primary, Secondary and Tertiary
- **Tertiary dentin** is the newly formed dentin in response to external stimulus such caries, trauma and abrasion



3: Functional relationship of dentin and pulp

5. **Sensory (protective)** function of the pulp and dentin

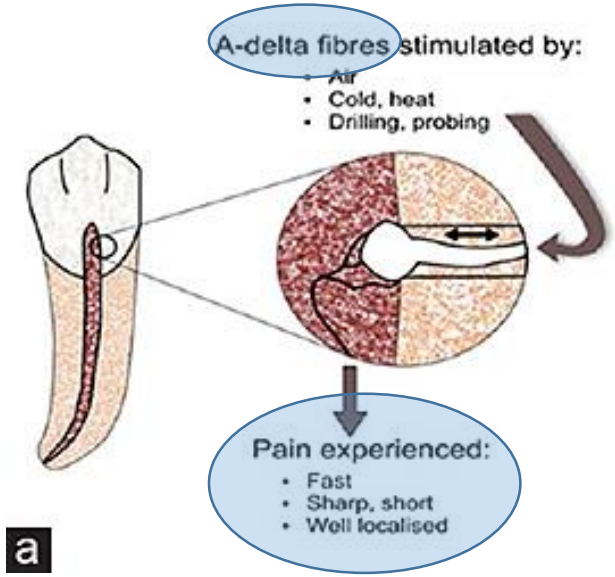
- The pulp-dentin complex is **innervated** by a high density of **trigeminal** free nerve endings.

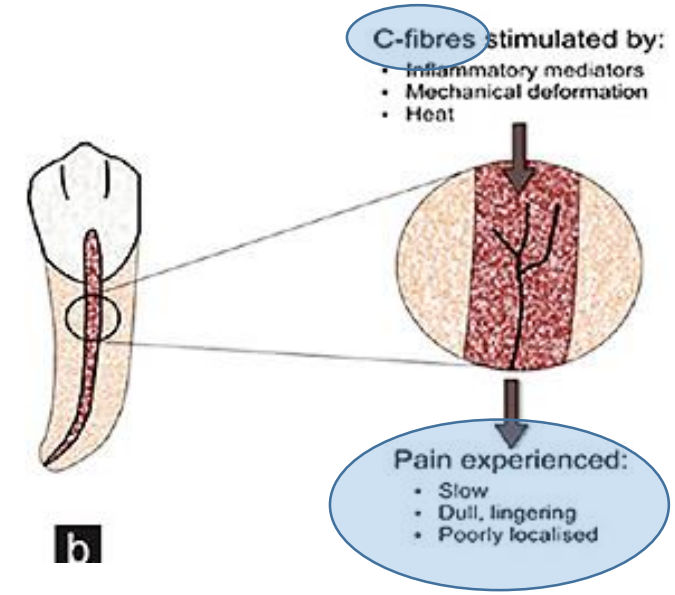
❖ Sensory nerves

- Highly specialized to sense **noxious stimuli** such as thermal, mechanical, chemical, and biological
- The pulp is usually does **not differentiate** between heat, touch, pressure, or chemicals
- They are unique because various stimuli elicit **only pain** as a response sensory nerves

❖ Motor nerves

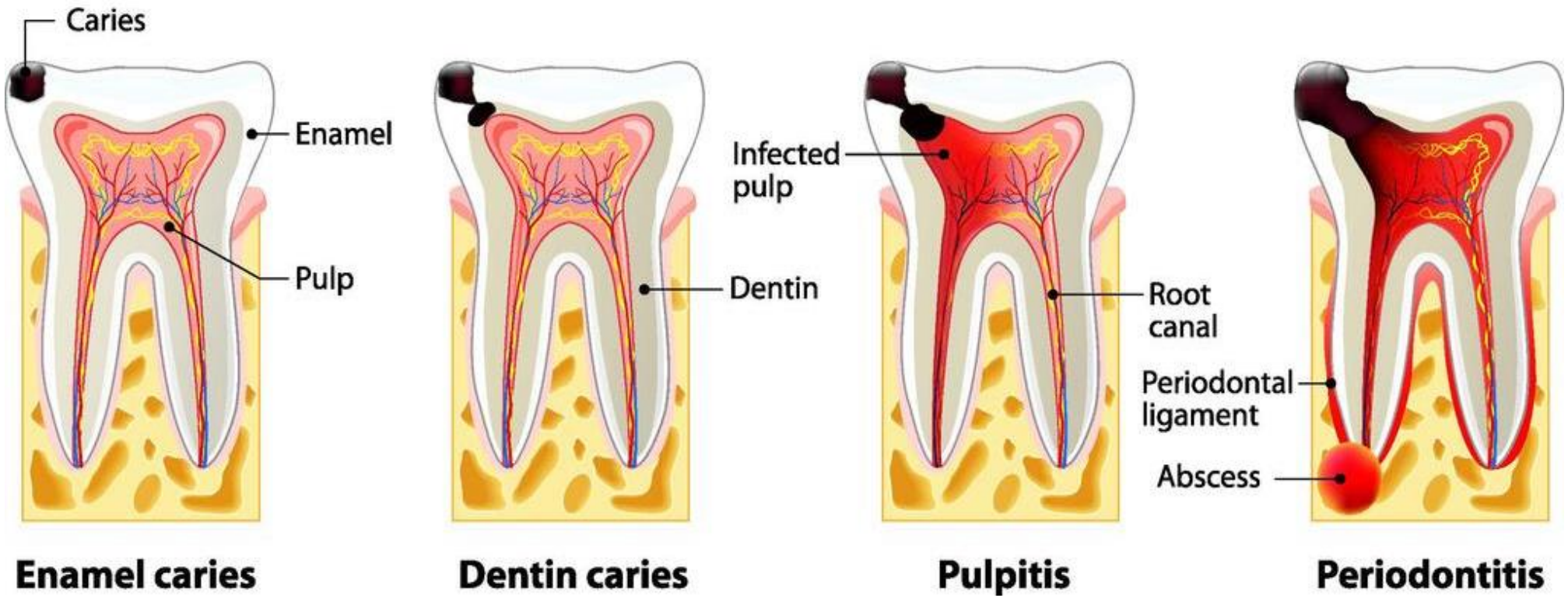
- Initiate **reflexes** to the **muscles** of the **blood vessels** walls for the control of circulation in the pulp cavity.





Role of Odontoblasts in Dental pulp innate immunity

- Teeth contains both hard and soft tissues and susceptible to **damage** by **caries** that cause degradation of the mineralized tissues of enamel and dentine



Stages of tooth damage

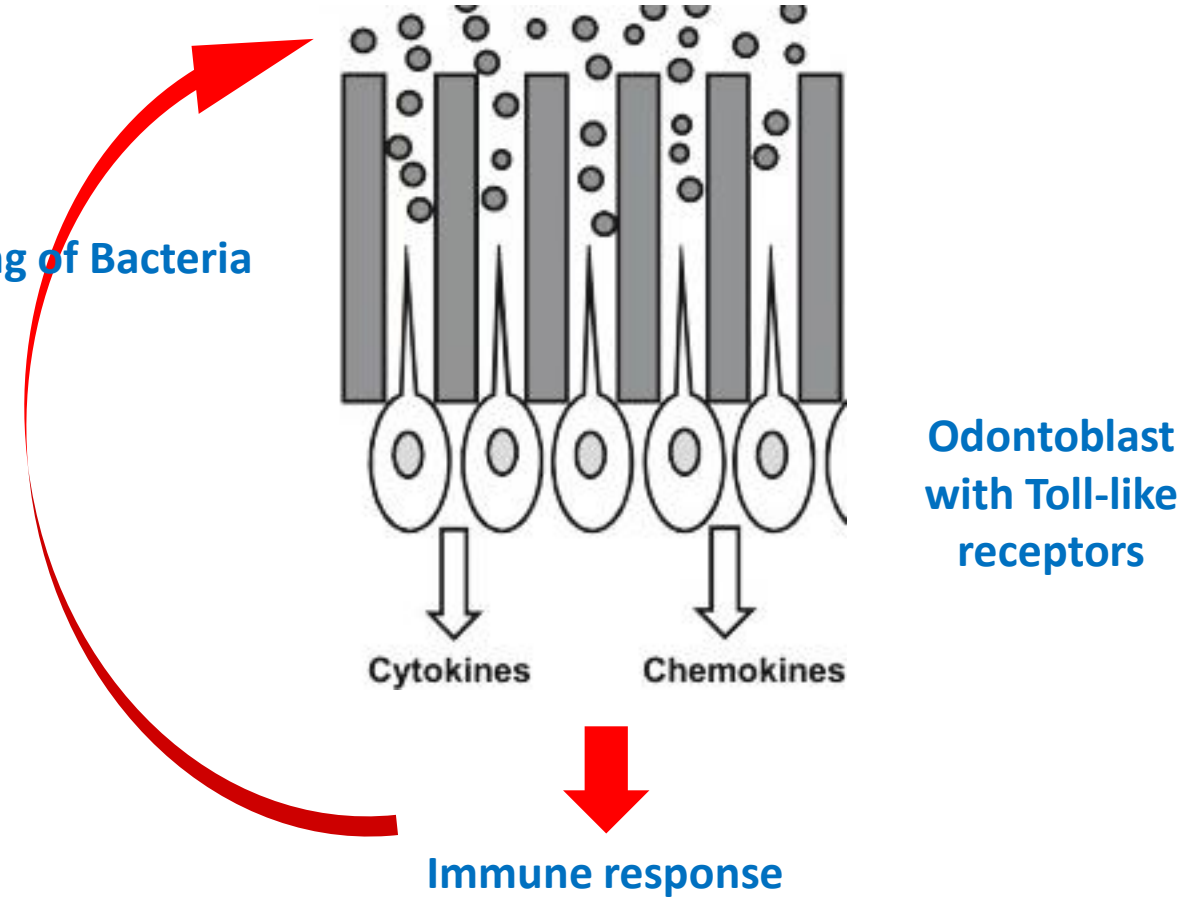
Role of Odontoblasts in Dental pulp innate immunity

- **Odontoblasts** located in the outermost layer of dental pulp form a **natural barrier** between **mineralized** tissues (enamel, dentin) and **soft tissues** (dental pulp).

- Odontoblasts are able to first **recognize** caries related **pathogens** through **Toll-like receptors** that able to:

On the surface of odontoblasts

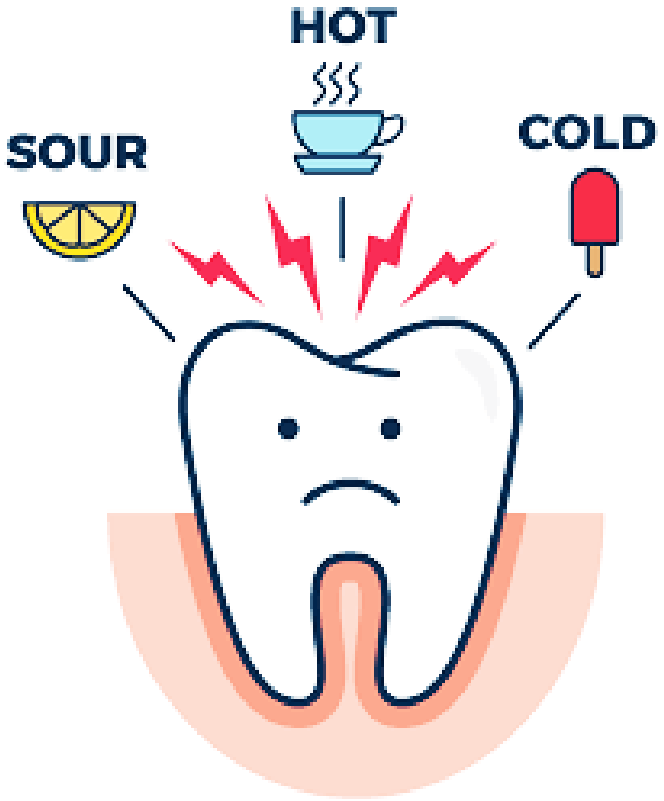
- **1) Trigger immune response**
- **2) Kill bacteria**
- **3) Neutralize bacterial toxins**



Dentin Sensitivity

- One of the most unusual features of the pulp-dentin complex is its **sensitivity**
- Usually **pain sensation** only
- Dentin is **more sensitive at DEJ** because of the abundant **branching** of the tubules
- Its sensitivity is increased when supported by an **inflamed pulp**.

Mechanism of Dentin Sensitivity



- The exact **reason** for dentin sensitivity is **not known** as yet
- Several **different theories** regarding dentin sensitivity are presented

1. **Direct innervation theory**
2. **Transduction theory**
3. **Hydrodynamic theory**

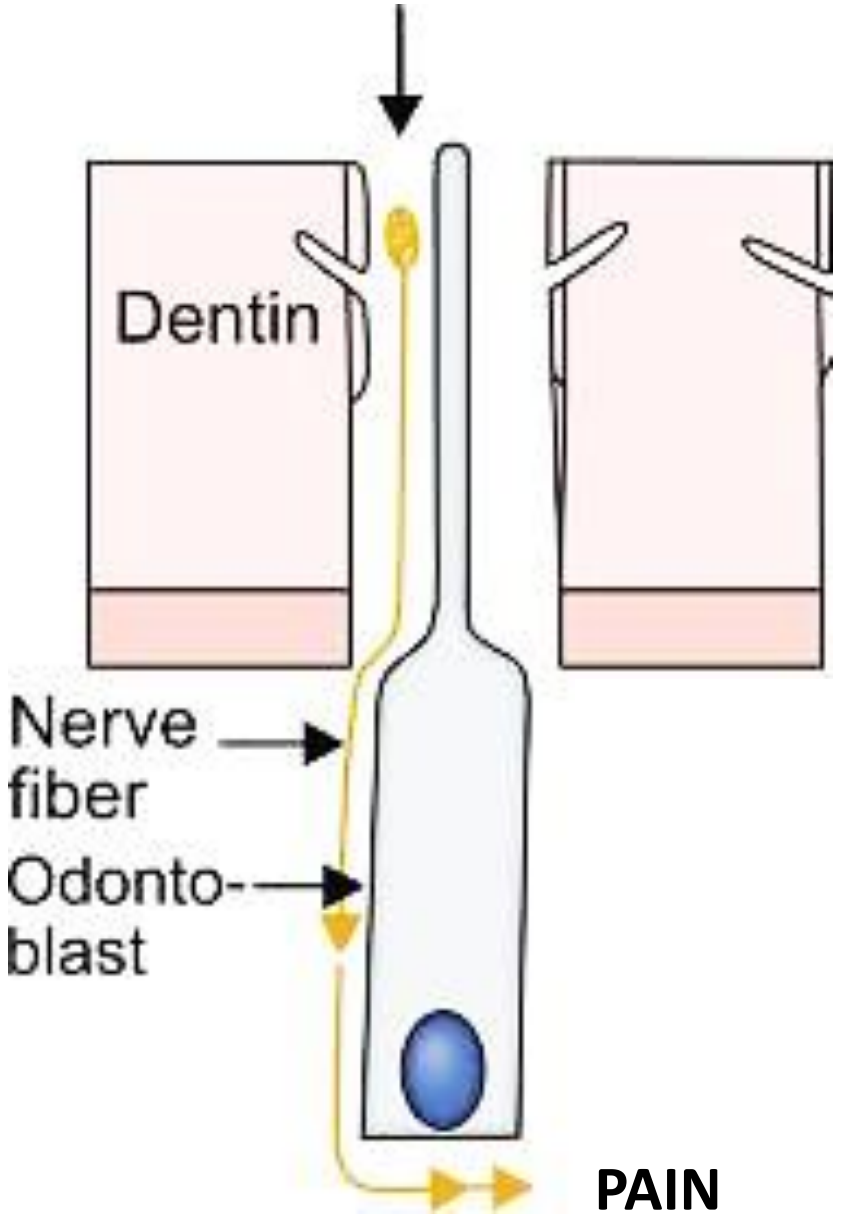
a) Direct innervations theory

Direct stimulation of nerve endings found in the inner dentin and among the odontoblasts.

This theory may **not be accepted**

Nerves in DTs not commonly seen

Thus, topical application of local anesthetics does not eliminate sensitivity



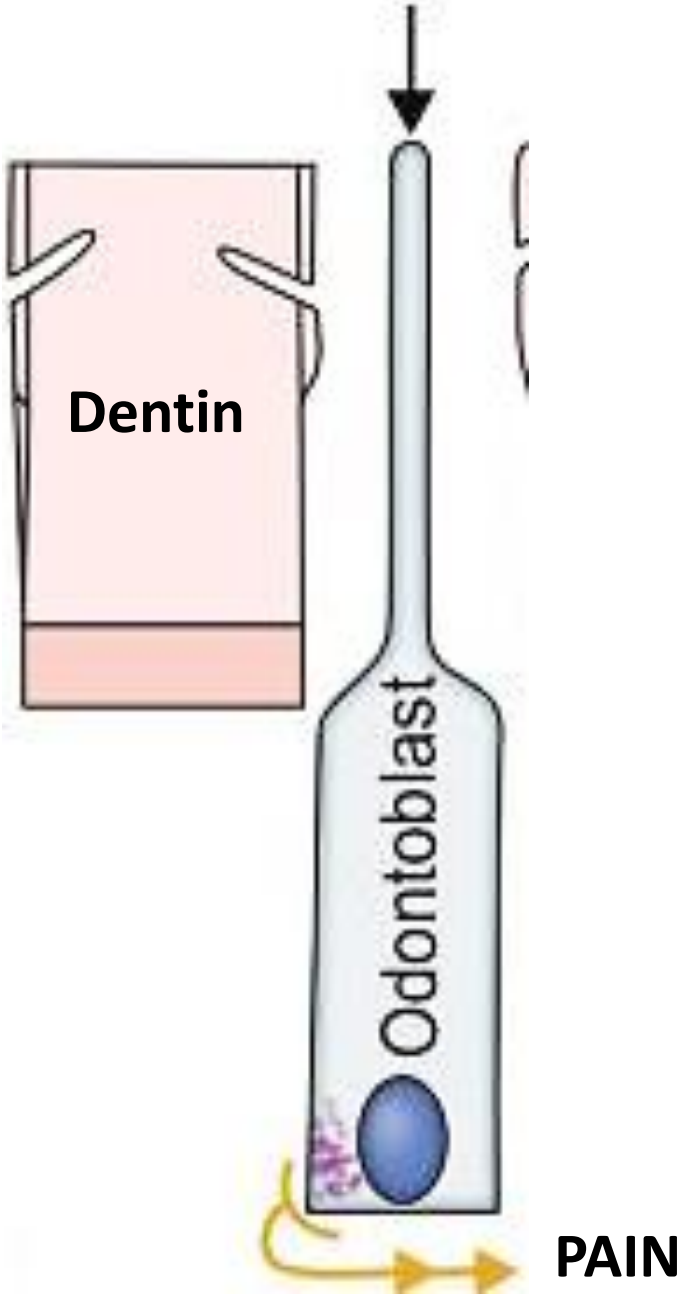
a) Transduction theory

Odontoblast process serves as a receptor

They conducts an impulse from DEJ via the odontoblastic process to its cell body where it contacts with nerve endings.

(Not popular) as no neurotransmitter vesicles in the odontoblast process

Odontoblasts may by modifying the local ionic environment



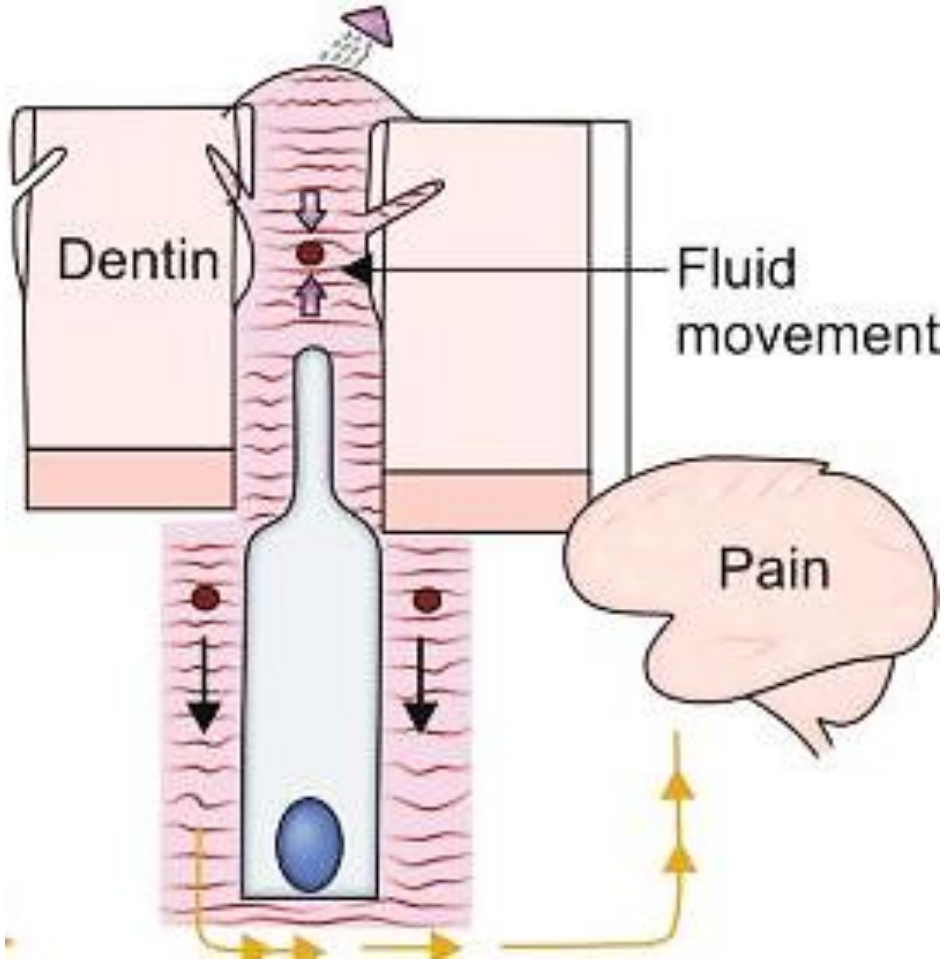
c) Hydrodynamic theory

The most accepted

Fluid movement in DTs …. odontoblast displacement ….stimulation of nerve endings

Inward (cold stimuli) or outward (drying of exposed dentinal surface)

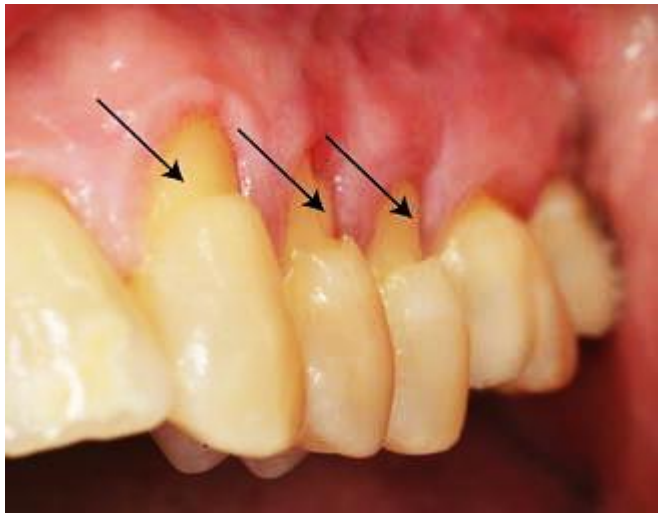
Nerve endings thus may respond as mechanoreceptors



Dentin hypersensitivity

Dentin hypersensitivity

- **Dentin hypersensitivity:** is a common **clinical** condition usually associated with **exposed dentin** or **gingival recession.**
- **Exposed dentin:** loss of protective covering over the dentin, thereby exposing the dentin to external environment. It includes **loss of enamel** via attrition, abrasion, or erosion.
- **Gingival recession:** **loss of the gingival and/or bone tissue** covering the tooth root due to toothbrush, abrasion, pocket reduction surgery, tooth preparation for crown, excessive flossing or secondary to periodontitis.



Types of Dentin hypersensitivity

1. **Thermal Hypersensitivity:** caused by sudden changes in **temperature**, such as when drinking very **cold** or **hot** beverages.
2. **Physical Hypersensitivity:** occurs when something physically **touches** the exposed dentin root surface, such as a **toothbrush** bristle or **food** particles.

Types of Dentin hypersensitivity

3. Chemical Hypersensitivity: caused by contact with **acidic substances**, such as citrus fruits and sodas.

4. Occlusal Hypersensitivity: when the teeth are exposed to extreme temperatures, acids, or mechanical forces during everyday activities such as **eating and drinking**.

- **Canines and premolars** of both the arches are the most affected teeth. **Buccal aspect of cervical area** is the commonly affected site.

- Develop due to **pulpal inflammation …….. severe and persistent pain**, as compared with typical short sharp pain.

PAIN

severe & persistent

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