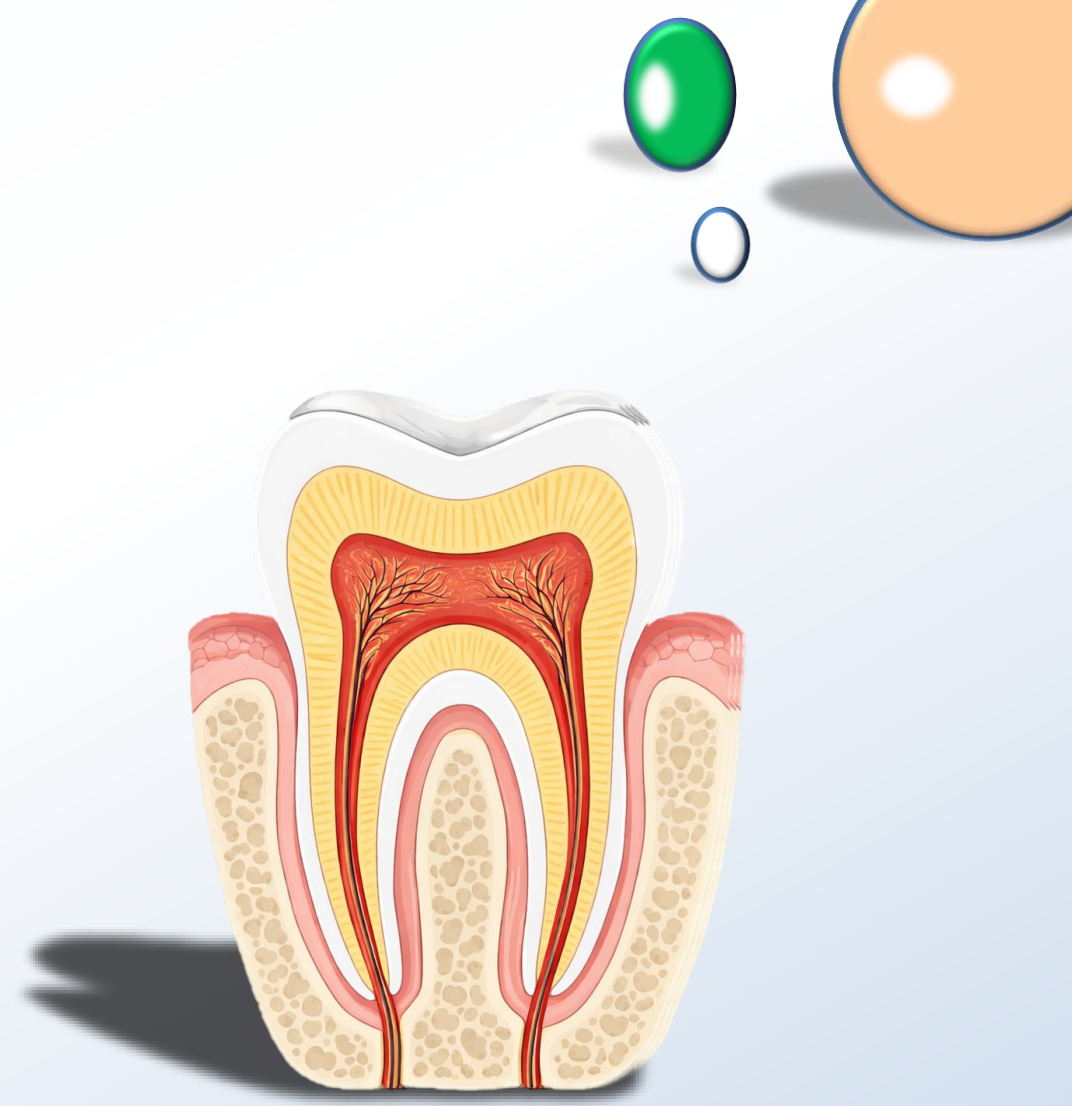


Lecture

Reaction of dentin to dental caries

Dr. Sherif

2026



Reaction of dentin to dental caries



Dentin exhibits a dynamic defensive response to dental caries.



These defense mechanisms are linked to the vitality and cellular activity of the pulp tissue.



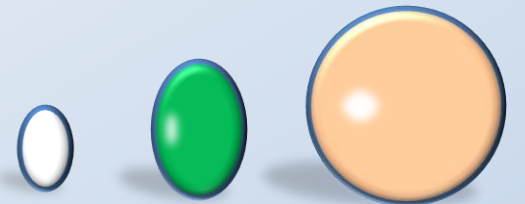
The cells involved in this response include the odontoblast cells and stem cells within the pulp.



So, dentin response is accurately described as the response of the dentin–pulp complex.

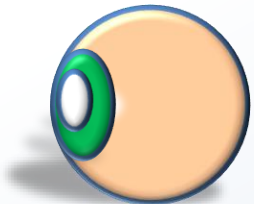
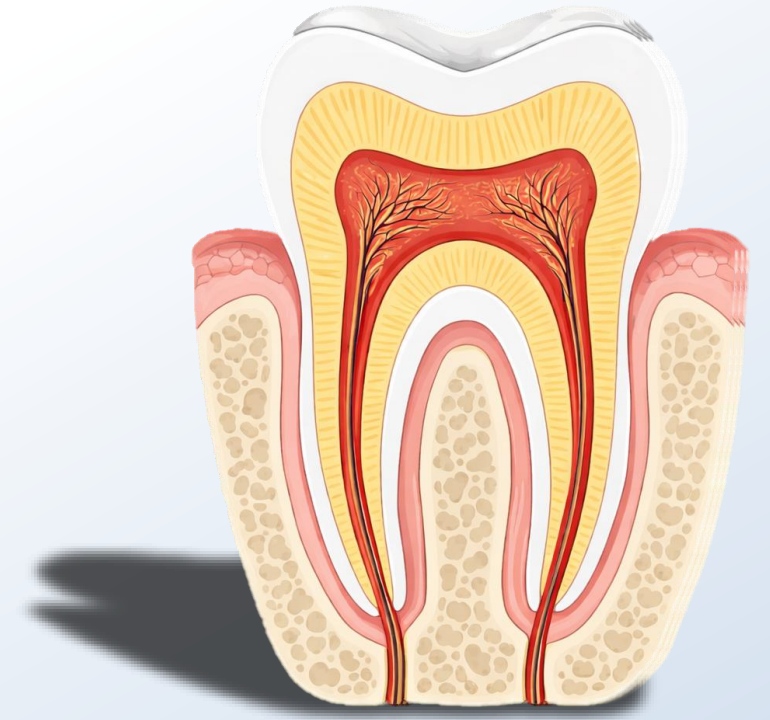


The overall aim of these reactions is to preserve pulp vitality.



Scenario of dentin reaction

The progression of dental caries from the dentino-enamel junction (DEJ) toward the pulp represents a dynamic interaction between bacterial invasion and host defense mechanisms. Clinically, once caries crosses the DEJ into dentin, tooth sensitivity increases due to the extensive branching of dentinal tubules in this region. Diffusion of bacterial toxins through dentinal tubules stimulates the pulp tissue to initiate defensive responses.



Defense mechanism of pulp-dentin complex



1. **Reactionary dentin formation** by surviving odontoblasts in cases of slow, mild caries.



2. **Sclerotic dentin**, which reduces permeability and slows lesion progression.



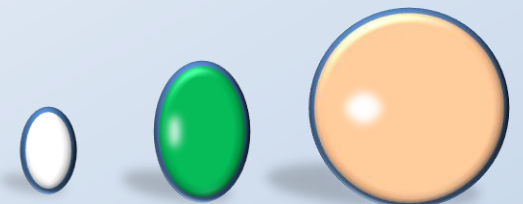
3. **Dead tract** results from degeneration of odontoblastic processes and failure of maintenance calcification in moderate to severe caries.



4. **Reparative dentin formation** by newly differentiated odontoblast-like cells from the cell-rich zone in moderate to severe caries.

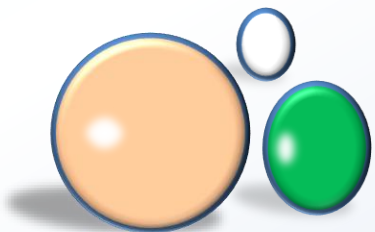
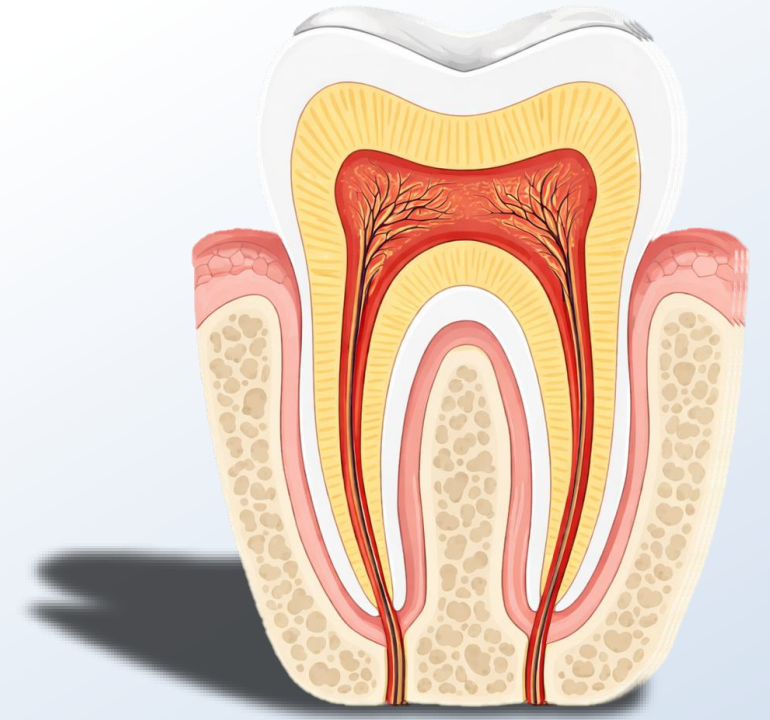


These combined responses reflect the coordinated effort of the pulp–dentin complex to protect the pulp and maintain tooth vitality.



Factors affecting dentin reaction

1. Type and rate of dental caries.
2. Activities of the cariogenic bacteria.
3. Extension and spreading of caries within the dentin.
4. Improving dental hygiene and lifestyle.
5. Carbohydrates intake.
6. Genetic factor.
7. Age.



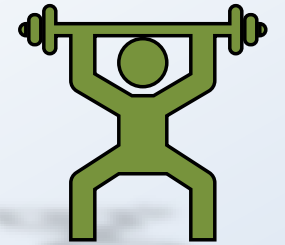
Rate of caries progression:

1. Slow caries allow time for defensive responses which stimulate sclerotic dentin and reactionary dentin formation.
2. Rapid caries suppresses the defense responses, leading to poorly organized reparative dentin.



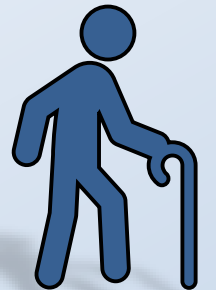
Pulp vitality and healthy state:

1. A healthy, vital pulp is essential for an effective defense response.
2. Compromised or inflamed pulp reduces the ability to form tertiary dentin.



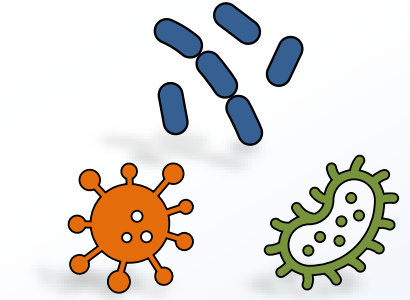
Age:

1. Younger person with wider DT and active odontoblasts have stronger response.
2. Older person with less cellular activity have decreased the chance of repair.



Bacterial load and virulence:

- High numbers of aggressive bacteria produce more toxins, leading to faster tissue destruction and weaker defense responses.



Remaining dentin thickness:

- The thicker the remaining dentin between the caries and pulp, the better the protective effect and the milder the pulpal response.

Presence of previous restorations:

- Teeth previously subjected to stimuli may already have secondary or tertiary dentin, which can either enhance protection or reduce responsiveness depending on the condition.

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:

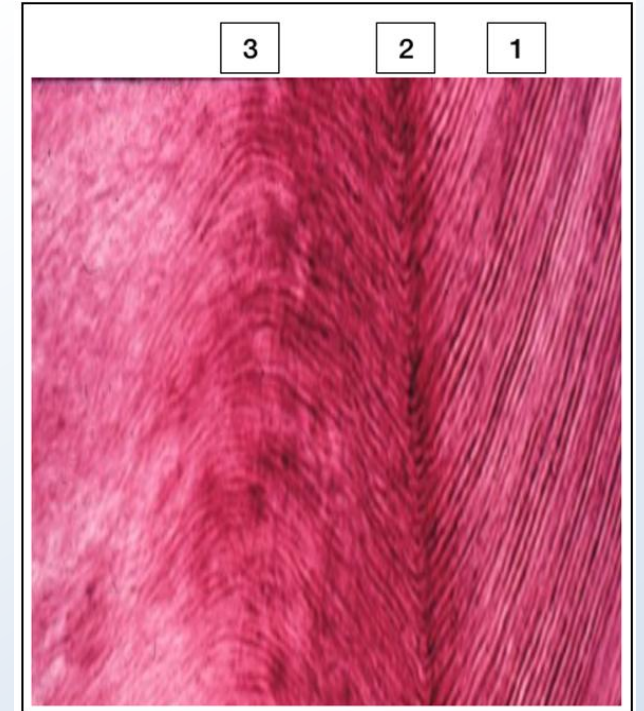
- This type of dentin functions as a protective barrier, helping to maintain pulp vitality.
- It decreases dentin permeability and reduces the transmission of stimuli to the pulp.

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:

- 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.

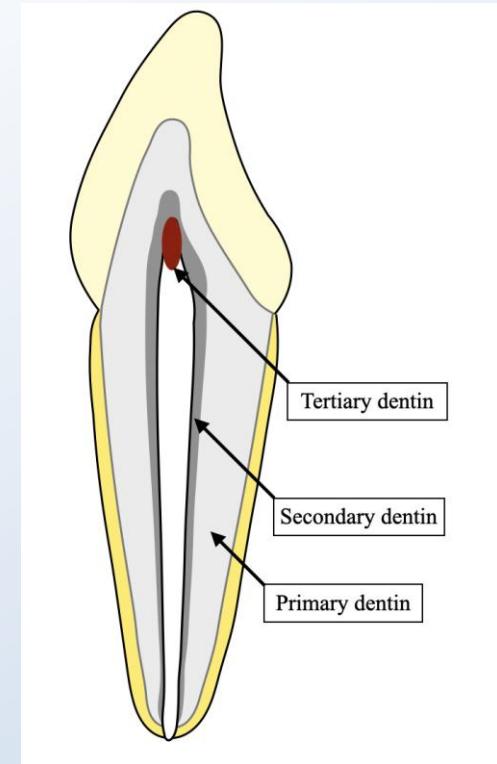
Histology:

- 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



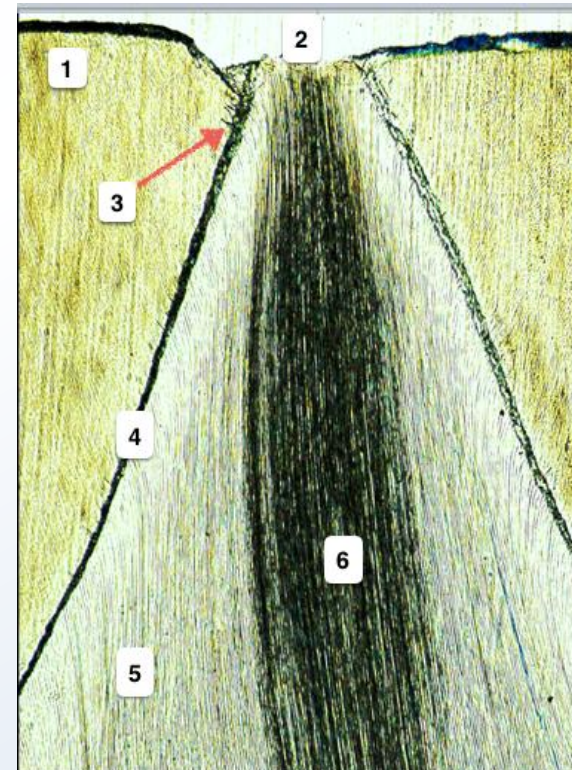
Dead tracts

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.

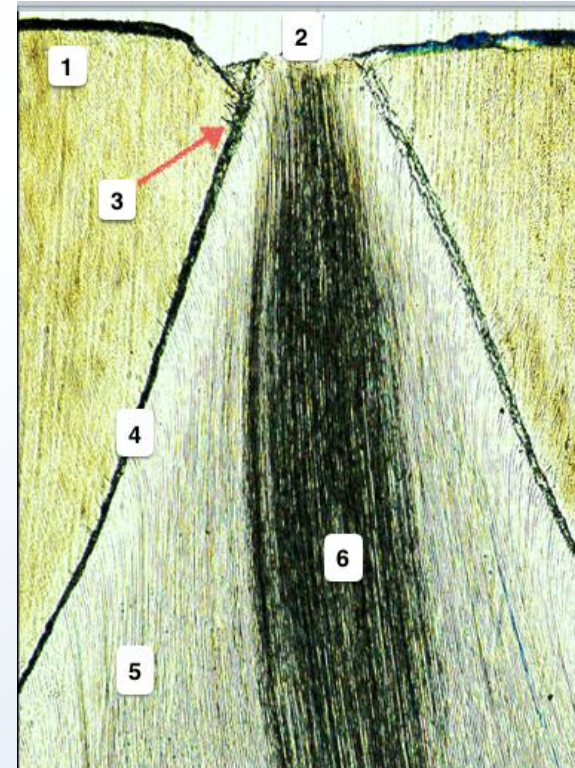


1. Enamel
2. Attrition.
3. Enamel spindle.
4. DEJ.
5. Dentin and DT.
6. Dead tract.

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.
- Leads to the formation of reparative dentin beneath the affected area.



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

Sclerotic dentin

Definition:

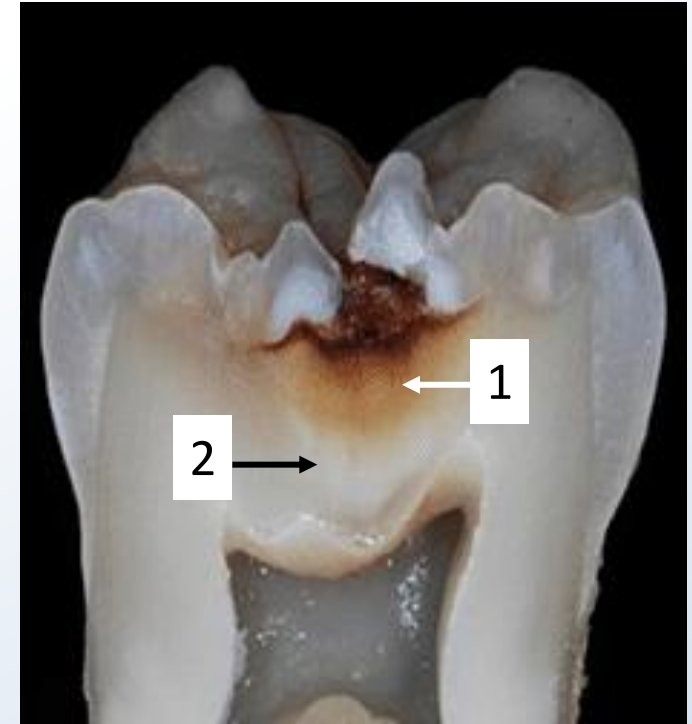
- Sclerotic dentin is a highly mineralized regions of peritubular dentin characterized by partial or complete closure of the dentinal tubules.
- Due to increased calcification, it appears transparent or translucent when viewed under light.

Terminology:

- Transparent dentin.
- Translucent dentin.

Causes:

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



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

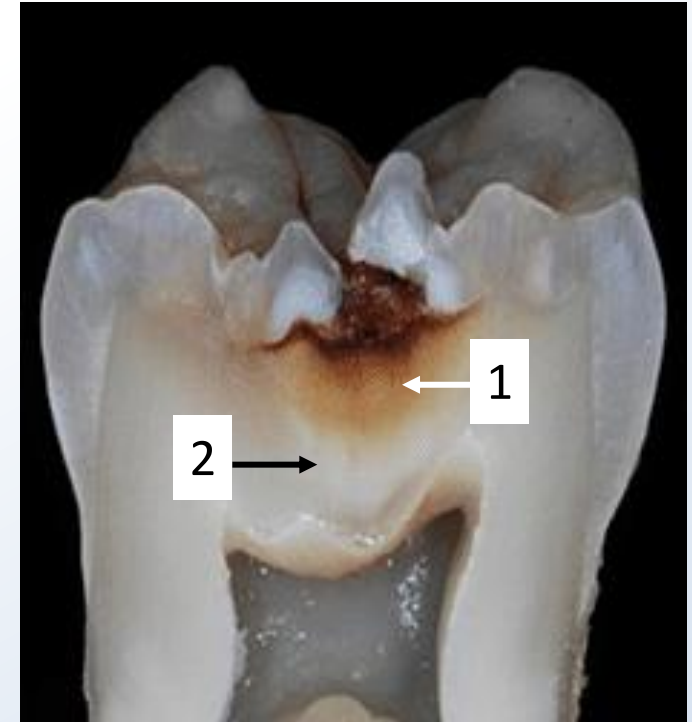
Sclerotic dentin

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.



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



THANK YOU