

Lecture

Histopathology of Dental Caries

Dr. Sherif Hassan

2026



Classification of Dental Caries According to Involvement of Hard Dental Tissues

Enamel Caries

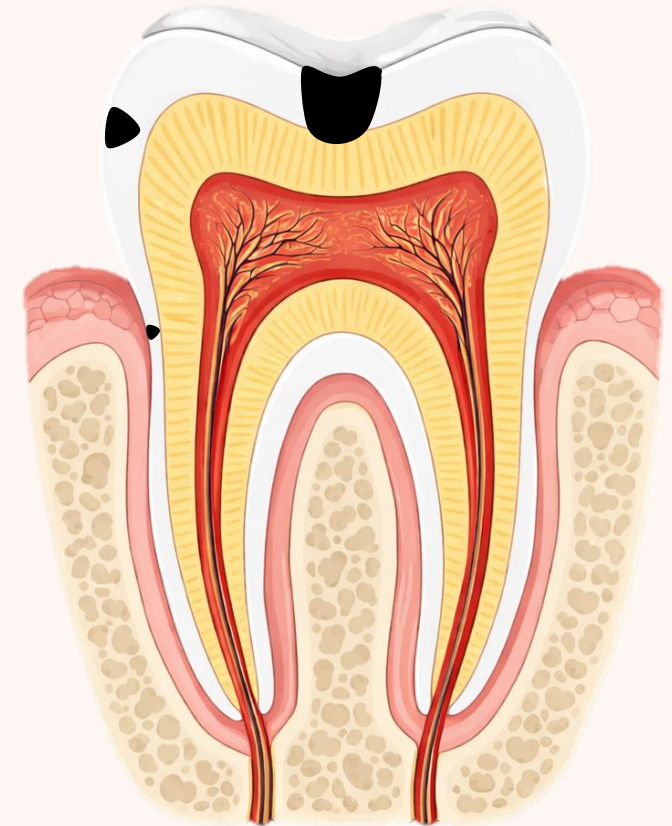
- Pit & fissure enamel caries.
- Smooth surface enamel caries.

Dentin Caries

- Shallow dentin caries.
- Deep dentin caries near the pulp.

Root Caries

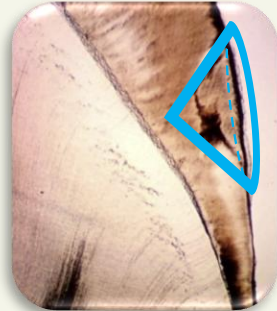
- **Dental caries affecting cementum.**
The root must be exposed to the oral cavity.



Enamel Caries

Histological shape of enamel caries:

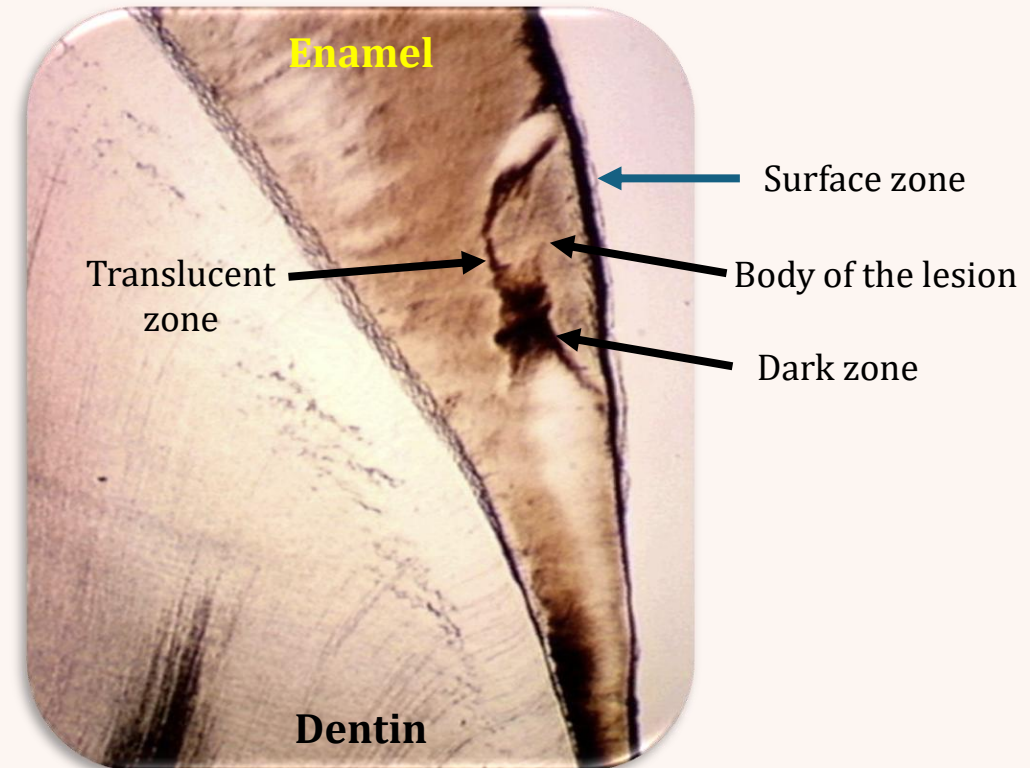
Appears as conical lesion with apex facing toward dentin.



Histological zones:

Four distinct zones:

1. Surface zone: relatively intact with partial mineral loss.
2. Body of the lesion: greatest degree of demineralization.
3. Dark zone: areas of remineralization.
4. Translucent zone: advancing front of the lesion.

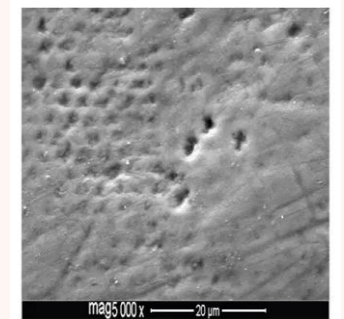
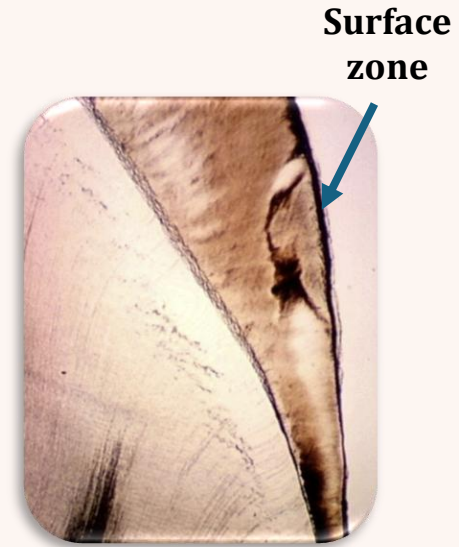


A) Surface zone enamel caries

- The outermost layer of enamel is highly mineralized and is known as structureless enamel.
- Its thickness ranges approximately from 20–30 μm .
- Due to its high mineral content, it shows greater resistance to dental caries.
- In the early stage, acidogenic bacteria create micropores (0.01–1%) on the enamel surface.
- These micropores allow acids to diffuse into the deeper enamel layers.
- This leads to the formation of the body of the lesion.
- As long as the surface layer remains intact, the lesion is considered non-cavitated

Reasons of intact surface zone:

1. The enamel prisms in this zone is highly calcified.
2. The integrity is maintained by remineralization from saliva.
3. It is rich in fluoride, which resists the acid dissolution.



**Micropores
(1%)**

B) Body of the lesion

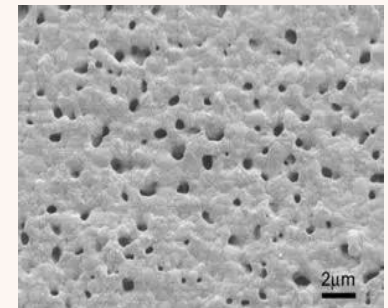
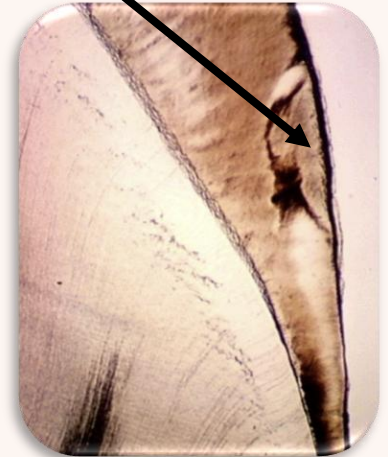
❑ Abacterial lesion until cavitation occurred:

- The body of the lesion lies beneath the surface zone and constitutes the main area of enamel caries.
- Food debris cannot pass through the micropores; therefore, bacteria are also unable to enter this zone.
- The surface layer permits diffusion of acids produced by bacteria in plaque through the micropores.

❑ Process:

- The body of the lesion undergoes demineralization more readily than the surface zone.
- It exhibits a significant increase in microporosity (approximately 5–25%), depending on the activity of the lesion and presence of minor cavitation.
- This increased porosity facilitates rapid diffusion of acids and dissolved mineral ions.
- Consequently, enamel prisms appear indistinct, disorganized, and structurally disrupted.

Body of the lesion



Micropores 5–25%

C) Dark zone (3rd layer)

- The dark zone is located between the body of the lesion and the translucent zone.
- Despite exposure to the acidic conditions of dental caries, it shows less mineral loss than the body of the lesion because it is farther from the surface zone.

Way of repair:

- It represents an area of **partial remineralization**, where calcium and fluoride ions come from saliva through the micropores.
- Enamel crystals demonstrate recalcification, resulting in decreased porosity.
- The pore volume ranges from **2-4%**, which is significantly lower than that of the body zone.
- The presence of a well-defined dark zone usually reflects a slowly progressing caries.



D) Translucent zone (4th layer)

- The translucent zone represents the deepest (innermost) area of enamel caries.
- The pores are elongated along the enamel prism axes, which facilitates the diffusion of acids into the deeper enamel layers.
- It shows a relatively low pore volume (approximately 1–2%), yet this is sufficient to permit further progression of the lesion.
- The enamel crystals remain structurally intact but are slightly separated, giving a translucent appearance.

Translucent zone



Stages of Enamel Caries

Stages of Enamel Caries

Stages of Enamel Caries

I. Early stage of Enamel Caries (incipient):

Characterized by subsurface demineralization with intact enamel surface.

II. Progressive (active) stage:

More acid attack increases mineral loss and enlarging subsurface lesion

III. Advanced enamel stage:

More demineralization of surface and subsurface layers with brownish color.

IV. Cavitation stage:

Formation of cavity with bacterial invasion with beginning of dentine caries.

I. Early stage of Enamel Caries (incipient):

Clinically:

- **Common site:**
 - Smooth surfaces.
 - Pits & fissures.
- **Color:**
 - White, opaque spot lesion.
 - Chalky and dull.
- **Surface appears:**
 - Intact and hard.
 - Non-cavitated.

II. Progressive (active) stage of enamel caries

Criteria:

- Continuous acid attack leads to increased mineral loss within the enamel.
- The body of the lesion enlarges.
- Leading to increased enamel porosity.

Clinically:

Color:

- The enamel lesion become wider appear more yellowish.

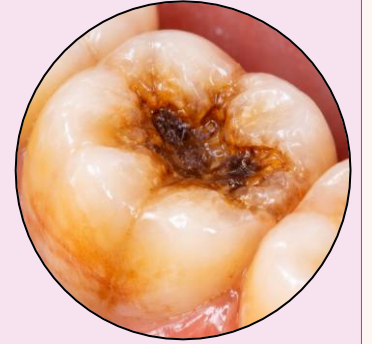
Surface appears:

- The enamel becomes pore rough and chalky.
- The enamel appears opaquer.



III. Advanced enamel caries:

- **Prolonged demineralization leads to** extensive mineral loss leads to enamel weakness.
- The surface layer becomes fragile and highly susceptible to breakdown and cavitation.
- Clinically, the lesion often appears brownish because of extrinsic staining.



IV. Cavitated stage enamel caries:

- Extensive demineralization leads to irreversible breakdown of the enamel surface in the form of cavitation.
- Loss of surface integrity promotes plaque and food retention.
- The cavity **allows rapid bacterial invasion** and increased acid penetration.
- This stage signifies the progression of caries from enamel toward dentine.
- Undermining of the enamel occurs as caries spreads within the dentine, resulting in loss of structural support.



Arrested enamel caries

Clinically:

Common site:

- Smooth surfaces (mainly proximal) with loss of adjacent tooth and improved plaque control.
- Pits & fissures **WITH** improved plaque control (rare).
- Appears as a white, brown, or darkly stained enamel area.
- No evidence of cavitation.
- Lesion remains stable over time.

Factors leads to transformation from active to arrested enamel caries:

- Improved oral hygiene.
- Healthy food intake with decreased acid production.
- Demineralization is halted and remineralization predominate.
- Remineralization from saliva occurred.
- Surface becomes more resistant to future carious attacks.
- Can remain inactive indefinitely if favorable conditions are maintained.

Histologically:

- Surface zone is thickened and highly mineralized.
- Reduced enamel porosity.
- Dark zone is prominent, indicating mineral deposition.





Welcome

