Biologic considerations of Enamel and its clinical significance in practice of Operative Dentistry
Good knowledge of The 4 main dental tissues and their relationships to each other and of the supporting structures is necessary for excellence in the performance of operative procedures.

- Enamel
- Dentin
- Cementum
- Dental Pulp
**Enamel structure**

- **Structure**
  - Highly calcified and hardest tissue in the body
  - Crystalline in nature
  - Enamel rods
- **Insensitive**—no nerves
- **Acid-soluble**—will demineralize at a pH of 5.5 and lower
- **Cannot be renewed**
- **Darkens with age as enamel is lost**
- **Fluoride and saliva can help with remineralization**

*Dental Enamel at maturity is about 90% inorganic hydroxyapatite mineral by volume and small amount of organic matrix and 4% to 12% water*
Morphologic & Histological review

Enamel provides a hard, durable shape for the functions of teeth and a protective cap for the vital tissues of dentin and pulp. Both color & form contribute to the esthetic appearance of Enamel.

Permeability:

At maturity, E. is about 90% inorganic hydroxyapatite mineral by volume. E also contain a small amount of organic matrix and 4% to 12% water which is contained in the intercrystalline spaces and in a network of micro pores opening to the external surface. the micropores form a dynamic connection between the oral cavity & the systemic pulpal & dentinal tubule fluids. Various fluids, ions and low molecular weight substance can diffuse through the semi permeable enamel.

Solubility: Enamel is Acid-soluble—will demineralize at a pH of 5.5 and lower, the solubility of surface enamel is decreased when fluorides are present.
Clinical Appearance & Diagnosis:

Key diagnostic signs includes:

1- Color changes associated with demineralization.

1. A tooth surface without caries.
2. The first signs of demineralization.
3. The enamel surface has broken down.
4. A filling has been made but the demineralization has not been stopped.
5. The demineralization proceeds and undermines the tooth.
6. The tooth has fractured.
2- Cavitations.
3- Wear: depending on many factors such as bruxism, malocclusion, age and diet. Enamel may be completely lost & abraded away so that dentin is exposed.
4- Faults & Fissures:
5- Cracks:

Pronounced cracks that extend from developmental grooves across marginal ridges to axial walls or from the margins of large restorations may cause cuspal fracture.
Enamel structure

Structurally enamel is composed of millions of E. rods or prisms are densely packed and have a wavy course. The structural component of E. prisms are million of apatite crystals which are tightly packed.

A, Its rod structure as seen in ground sections with the light microscope. B, Electron micrography shows that enamel consists of a mass of crystallites organized into rod and interrod enamel.
• One rod is pulled out to illustrate how
• individual enamel rods interdigitate with neighbouring rods.

Enamel rods appear wavy in section of enamel as they extend from the dentinoenamel junction on the left to the enamel.
Each rod has a sheath and core. The rod sheath surrounds rod head and tail. This enamel sample has been etched to reveal organic matrix.
Starting at 1 mm from CEJ the rods run occlusally or anisole at 60 degree inclination and progressively incline approaching the marginal ridges and cusp tips where the rods are parallel to the long axis of the crown.
In the cervical region the rods are oriented slightly in apical direction.
Understanding enamel orientation is very important in restorative dentistry, because enamel unsupported by underlying dentin is prone to fracture.
Figure 11-9.  

A, Diagram of proximal view of a Class I composite restoration preparation using a standard amalgam-type 90-degree exit. This preparation is appropriate when only small lesions extend into dentin. Note that enamel rod ends are exposed owing to the angle of the cusps. 

B, Diagram of a larger Class I restoration on a worn tooth. Note that few rod ends are exposed.
ENAMEL BOND

Bonding to enamel has been done for over 40 years. Enamel consists of organic and inorganic components. The inorganic component, hydroxyapatite, varies from 86% to 98% depending on the age of the enamel. Application of 37% phosphoric acid removes about 10 microns of enamel to expose prisms of enamel rods and create the classic honeycomb effect. Acid also increases surface energy for better wetting of the enamel. Resins flow into micromechanical retentive areas. Resin tags fill microscopic holes to provide retention. Retention is about 30 MPa.

Acid etching is done for a minimum of 15 to 20 seconds. Etching is most effective when the acid is activated by movement such as mixing. Thorough rinsing for 10 seconds removes acid and dissolved calcium phosphates. 37% Phosphoric acid is used to enamel etch, however, other acids including nitric, polyacrylic, oxalic, and maleic acids are effective. Use of acids for self etching materials on dentin often is much less effective on enamel.
Figure 8–3. Schematic diagram depicting how acid etching produces microporosities in enamel.

Figure 8–4. Schematic diagram depicting how resin tags penetrate the microporosities produced by acid etching of enamel.
Figure 8-9. Photograph showing typical appearance after drying of an acid etched surface 2 mm past the prepared margins.
Dental Caries

- Enamel Caries
  - Smooth surface caries
- Dentin Caries
  - Pit and fissure caries
- Cementum Caries (Root caries)
Clinical sites for caries initiation

1- Pits & fissures of Enamel.

2- Smooth Enamel surface.
3-Root surface.