ENAMEL

Is the hardest calcified tissue in the human body, it form a protective covering of variable thickness over the entire surface of the crown, rendering them suitable for mastication.

Physical properties:
  1-color: The color ranges from yellowish white to grayish white. The color is determined by differences in translucency of enamel, yellowish teeth having a thin, translucent enamel which reflect the yellow color of the dentin, while grayish teeth having a more thick opaque enamel.
  2-permeability: The enamel can act in a sense like a semipermeable membrane, permitting complete or partial passage of certain molecules
  3-thickness: The thickness of enamel varies according to location. It’s thickest over the incisal edge & cusps (up to 2.5 mm ) & thins to a knife-edge at the cervical margin.
  4-specific gravity is 2.8 g/ml

Chemical properties:

1-mature enamel is highly mineralized. It contains by weight 96% inorganic material, 1% organic & 3% water.

2-the inorganic component is mainly calcium phosphate in the form of hydroxyapatite crystals. Small amount of carbonate, magnesium, potassium, sodium & fluoride are also present.

3-organic component, 2 groups of proteins are found in developing enamel, the amelogenins & much smaller amounts of non-amelogenins.
The amelogenins are removed during the enamel development, although small amounts persist in the fully formed tissue.

**Structures of enamel:**

1- **Enamel rods (prisms), rod sheaths, & interprismatic substances:**
The enamel rod is the basic histological unit of enamel. Each rod is formed by 4 ameloblasts. One forms the rod head; a part of 2 ameloblasts forms the neck; & the tail is formed by a fourth one. Give the rod a keyhole shape.
The broadest part is the head, about 5 µm in width, while the length including both head & tail is 9 µm long.
Each rod interdigitates with its neighbor, the head of one rod against the neck of the adjacent rod in the left & right sides.

![Enamel rod diagram](image)

The number of enamel rods ranging from 5 million in the lower lateral incisor to 12 million in the upper first molars.
The enamel rod surrounded by rod sheaths & separated by interprismatic substance.
Generally, the rods are oriented at right angles to the dentin surface.
In the cervical & central parts of the crown of a deciduous tooth they are approximately horizontal, near the incisal edge or tip of the cusps they change gradually to an oblique direction until they become vertical.
The arrangement of the rods in permanent teeth is similar except in the cervical region, in which the rods deviate from the horizontal to an apical direction.

The length of most rods is greater than the thickness of the enamel because of the oblique direction & wavy course of the rod. The rods run almost perpendicular to the enamel surface at the cervical region but are gnarled & intertwined near the cusp tips, this is called gnarled enamel.

The enamel is formed as a rhythmic recurrent deposition, as the enamel matrix deposition & provides the growth lines called cross striations of Retzius. In transverse section the striae of Retzius appear as concentric rings, like the growth rings in a tree.

2- Incremental lines
A- Hunter-Schreger bands:
These bands are produced by changes in rod direction. They are seen most clearly in longitudinal ground section as dark & light alternating zones.
Hunter-Schreger bands extend about half to 2/3 of the enamel thickness.

B- Neonatal line:
It’s a line result due to change in the environment & nutrition of the newborn infant. It separate between the enamel that develop before & after birth in the deciduous teeth & in the larger cusps of the permanent 1st molar. The enamel that adjacent to the dentin was formed before birth, & the external to the neonatal line was formed after birth.

3- Enamel lamellae:
These are thin, leaf like structures that extend from the enamel surface toward the dentino-enamel junction. They extend, & sometime into the dentin. It consists of organic material, with little mineral content, because of not fully calcified rod formation which leads to formation of the lamellae. These lamellae appear as cracks in the surface of enamel.

4- Enamel tufts
Is another defect in enamel which is hypomineralized & filled with organic material. They arise at the dentino-enamel junction & extend 1/5 to 1/10 of enamel thickness toward the enamel surface. They so termed because resemble tufts of grass. The dentino-enamel junction is scalloped, & often tufts arise from the scalloped
peaks.

5- Enamel spindles
These originate from processes of odontoblasts that extended into enamel before hard substances formed. It arise at the dentino-enamel junction either singular or in groups & are shorter than tufts, only a few mm in length.

6- Surface structures:

Enamel surface differs markedly from subsurface enamel. It's harder, less porous, less soluble & more radiopaque; it’s richer in trace elements, especially fluoride. However, the enamel surface characterized by several formations:

A- Prismless enamel: a relatively structureless layer of enamel, found in 70% of permanent teeth & all deciduous teeth. It is somewhat more heavily mineralized than the bulk of enamel beneath it. The prismless enamel is the outermost layer & is 20-40 µm thick.

B- Perikymata: are transverse, wave like grooves, result from the termination of the striae of Retzius on the enamel surface. This structure is more prominent on the facial surface of the tooth, near the cervical region parallel to each other & to the cemento-enamel junction.
C- **Cracks:** narrow, fissure like structures that are seen on almost all surfaces. It represents the outer edges of lamellae.

D- **Enamel cuticle:** A delicate membrane called Nasmyth’s membrane, cover the entire crown of the newly erupted tooth but is probably soon removed by mastication. This membrane is a typical basal lamina secreted by the ameloblasts when enamel formation is completed.

E- **Salivary pellicle:** is an organic on the surface of teeth of salivary proteins. This pellicle re-formed within hours after enamel surface is mechanically cleaned. Within a day or two, after the pellicle has formed, it becomes colonized by microorganisms to form a bacterial plaque.

**Age change**
1- **Attrition:** is the most common age change in enamel in the occlusal surfaces as a result of mastication. This is evidenced by a loss of vertical dimension of the crown.
2- **Discoloration:** occurs due to the addition of organic material to enamel from the environment, it also may be due to a deepening dentin color seen through the progressively thinning layer of translucent enamel.
3- **Permeability:** the enamel becomes less permeable with age. Young enamel behaves as a semipermeable membrane, permitting the slow passage of water & substances of small molecular size through pores between the crystals. With age the pores diminish
4- **Surface change:** during aging the composition of the surface changes as ionic exchange with the oral environment occurs. Especially, there is a progressive increase in the fluoride content of surface enamel that affects the surface layer & their resistance to caries.