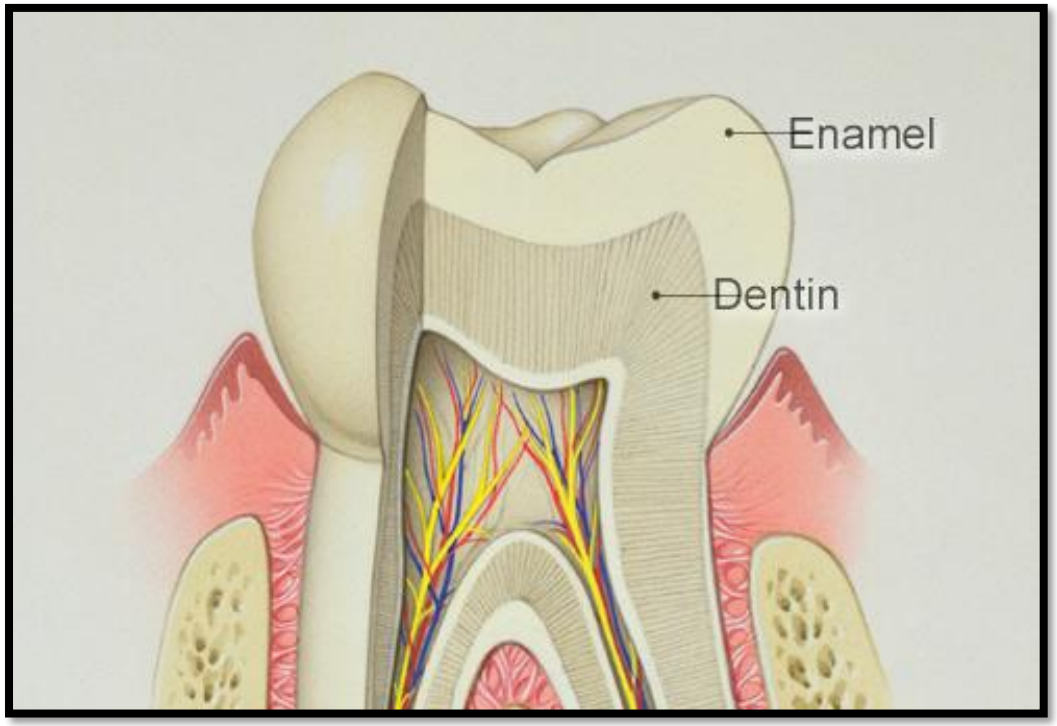
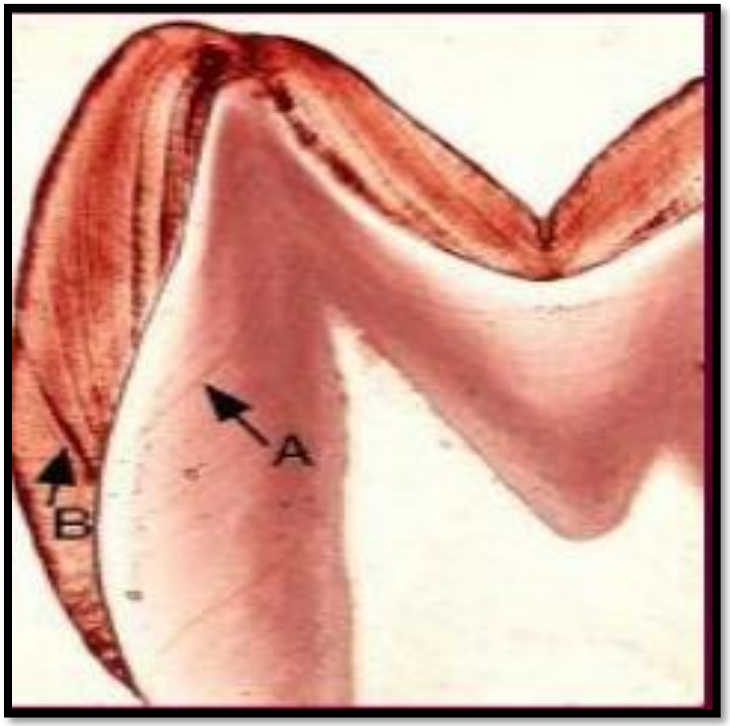
ENAMEL

PART-1





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LECTURE LEARNING OUTCOMES

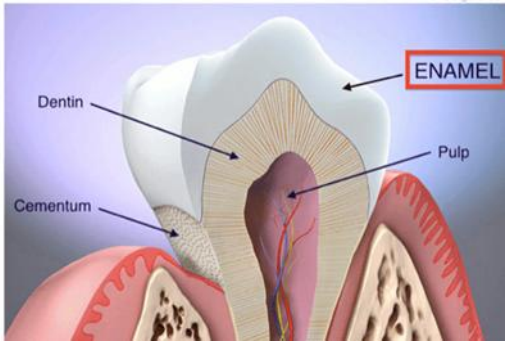
Dental Enamel-1		
LLO	By the end of this Lecture , students should be able to:	
1.	Describe physical properties of enamel	
2.	Discuss chemical composition of enamel.	
3.	Discuss steps in preparation of ground section	
4.	Describe the structures of enamel	

Essential reading:

- **Tencate's Oral histology ; pages 122 - 164**
- **James Avery textbook; 97-108**

INTRODUCTION

Definition: The hardest calcified tissue in human body. Forming the protective covering of anatomical crown.



It is an **unique tissue** because:

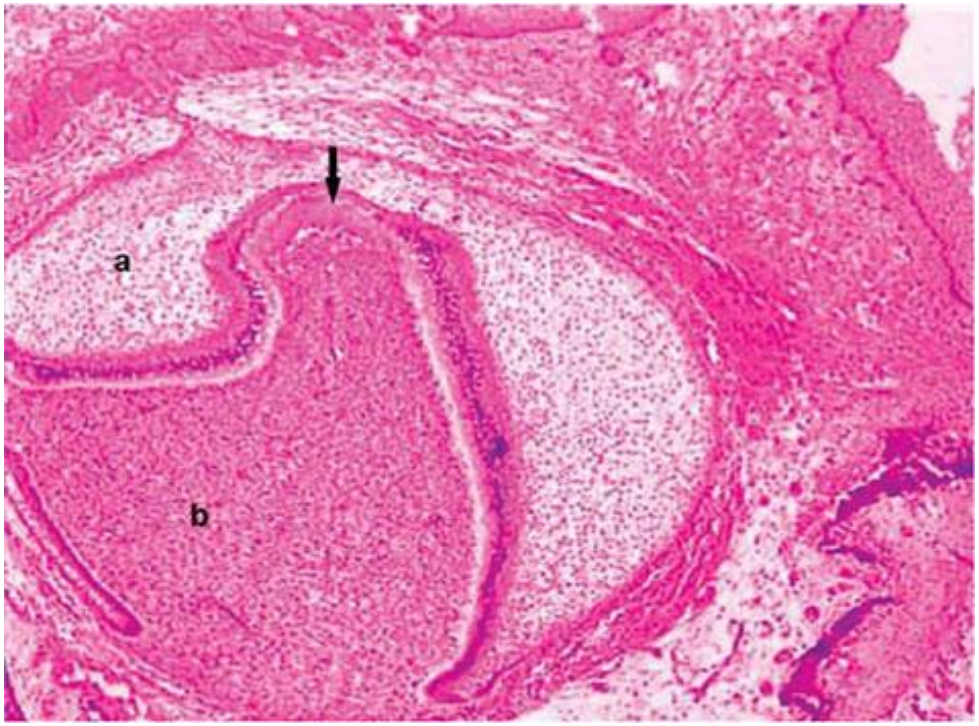
1) Calcified epithelial tissue

2) NO cells, blood vessels, nerves or collagen in enamel structure.

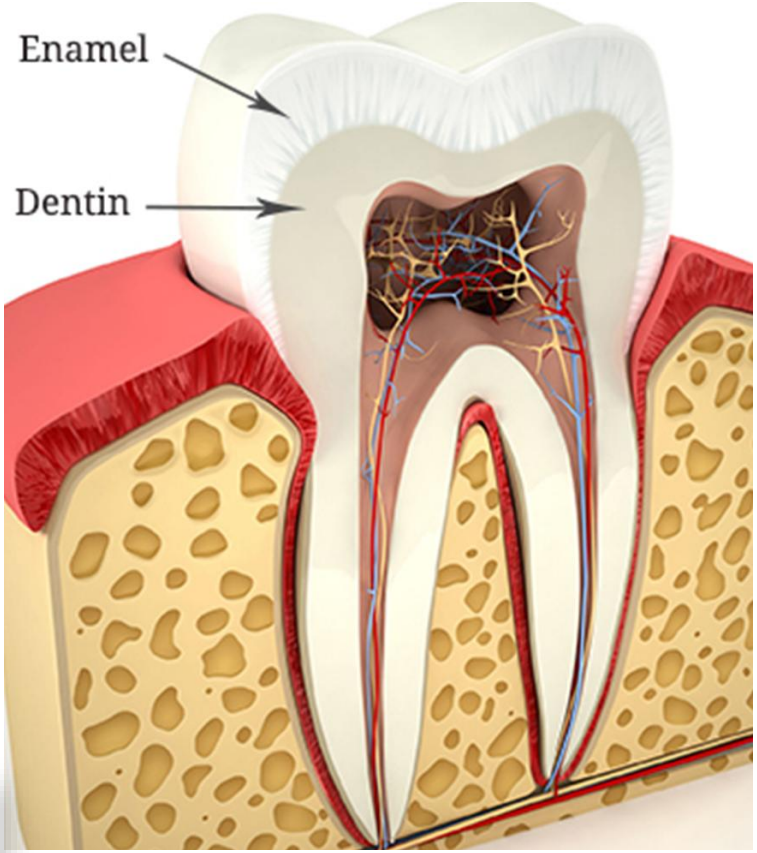
Clinical consideration (CL) : Enamel cannot regenerate because the forming cells are lost (it should be preserved as possible)

- ✓ **Origin: Ectoderm (oral ectoderm)**
- ✓ **Derived from: Epithelium (Ameloblast or Inner Enamel Epithelium of enamel organ.)**
- ✓ **Protective covering of teeth, Covers the anatomic crown of the tooth.**
- ✓ **Hardest and highly mineralized substance of the body.**
- ✓ **Mature enamel – Acellular, avascular, non vital tissue.**

Amelogenesis: synthesis of enamel



Advanced bell stage



PHYSICAL PROPERTIES

✓**Thickness**

✓**Colour**

✓**Hardness**

✓**Tensile strength**

✓**Permeability**

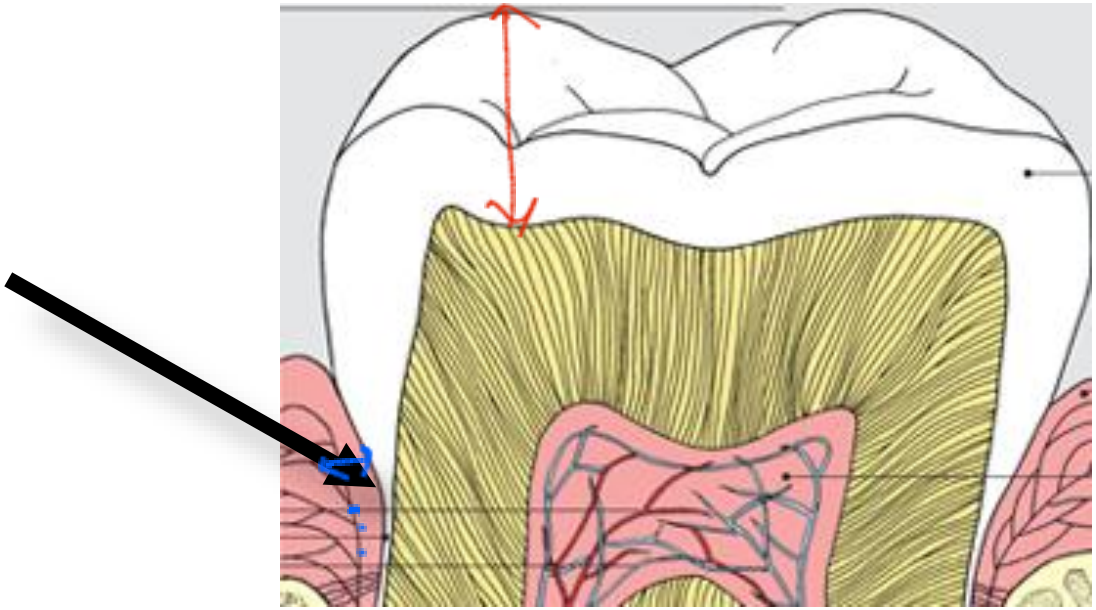
✓**Neither undergo repair nor replacement.**

✓The **specific gravity** of enamel is **2.8**

THICKNESS

- **It is thick at the incisal edge and cusp tip of molars and premolars (2-2.5 mm) and ends cervically as knife edge**
- **Functional cusp-thicker enamel than non functional cusp.**

(Palatal cusp of maxillary teeth and Buccal cusp of mandibular teeth)



COLOUR

✓**Thick enamel-Grayish white (opaque)**

✓**Decrease in thickness-Yellowish white (translucent) because it reflects colour of underlying dentin. Dentin is yellow. So - color of tooth is due to thickness of Enamel.**

✓**Degree of mineralization –high calcified: Opaque-greyish white**

Low calcified: Translucent-yellow

Thick enamel and

More calcification

↓

Opaque

↓

White colour teeth

Thin enamel and Less calcification

↓

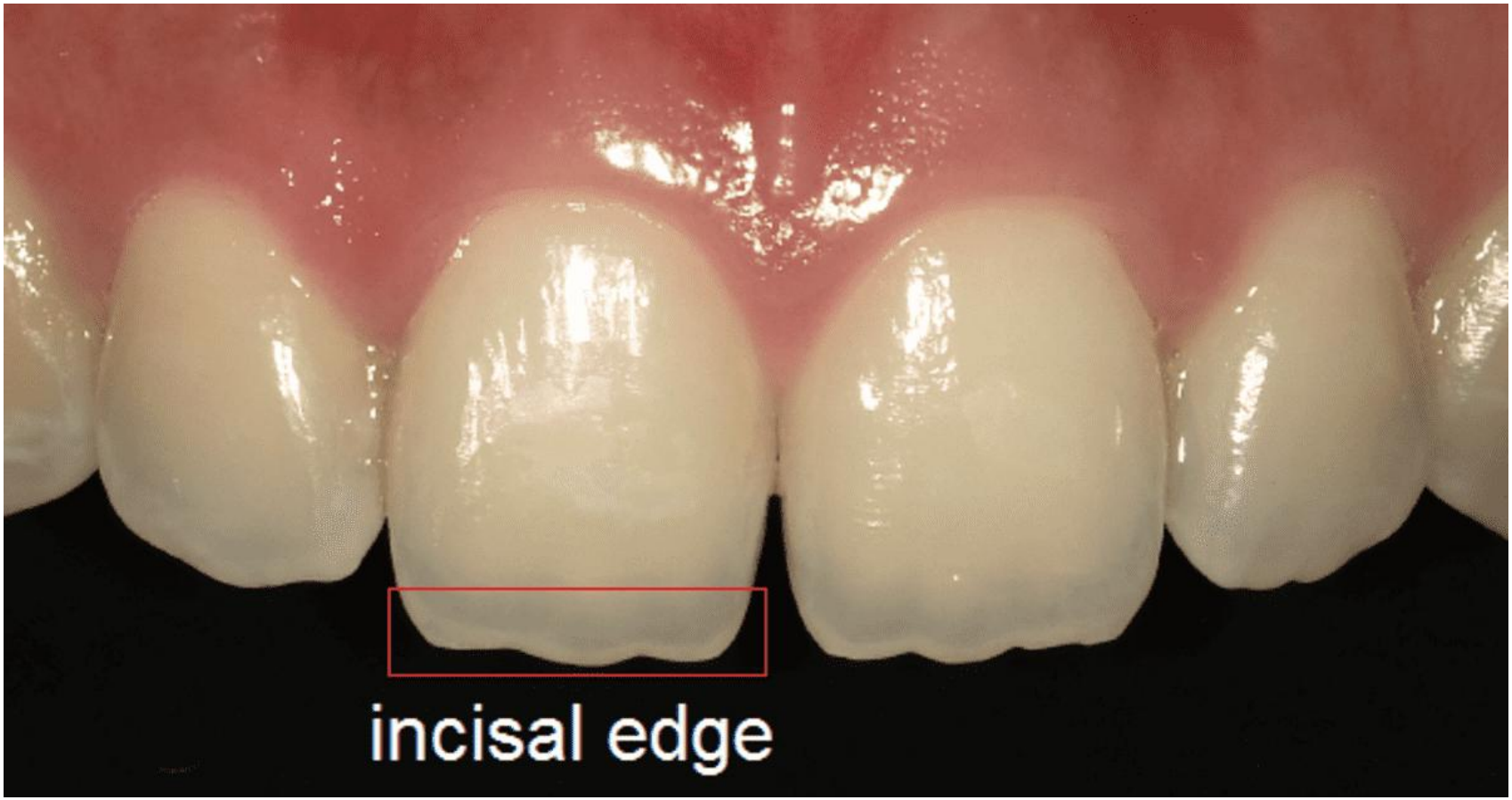
More translucent

↓

Yellow colour teeth

Translucent or bluish white

Same tooth surface may have different color (change in enamel thickness (the incisal edge is translucent due to the absence of dentin)



HARDNESS

✓**Hardest calcified tissue in the body.**

✓**Because of its high inorganic content and the crystalline arrangement.**

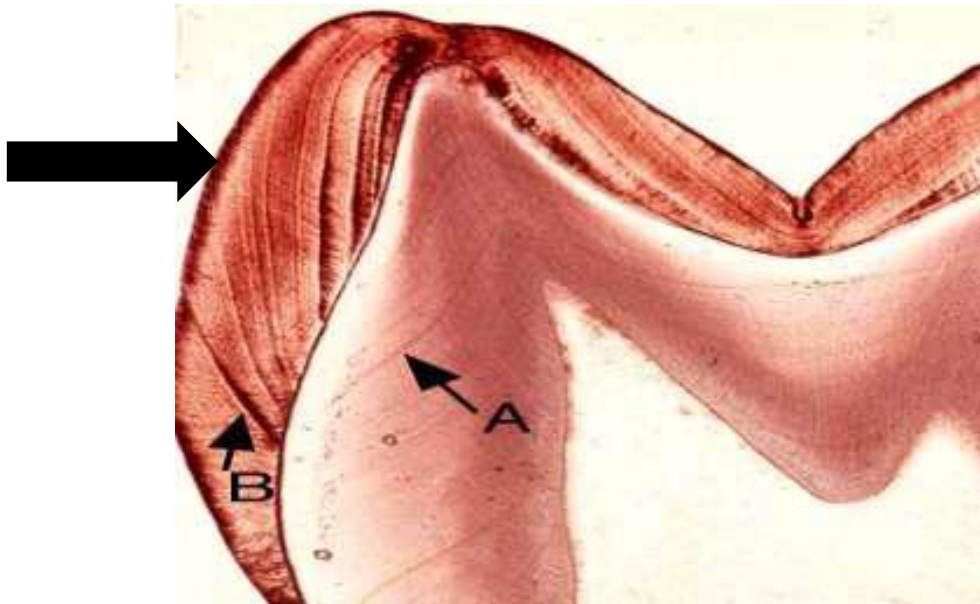
✓**Hardness increases with fluoride application**

TENSILE STRENGTH

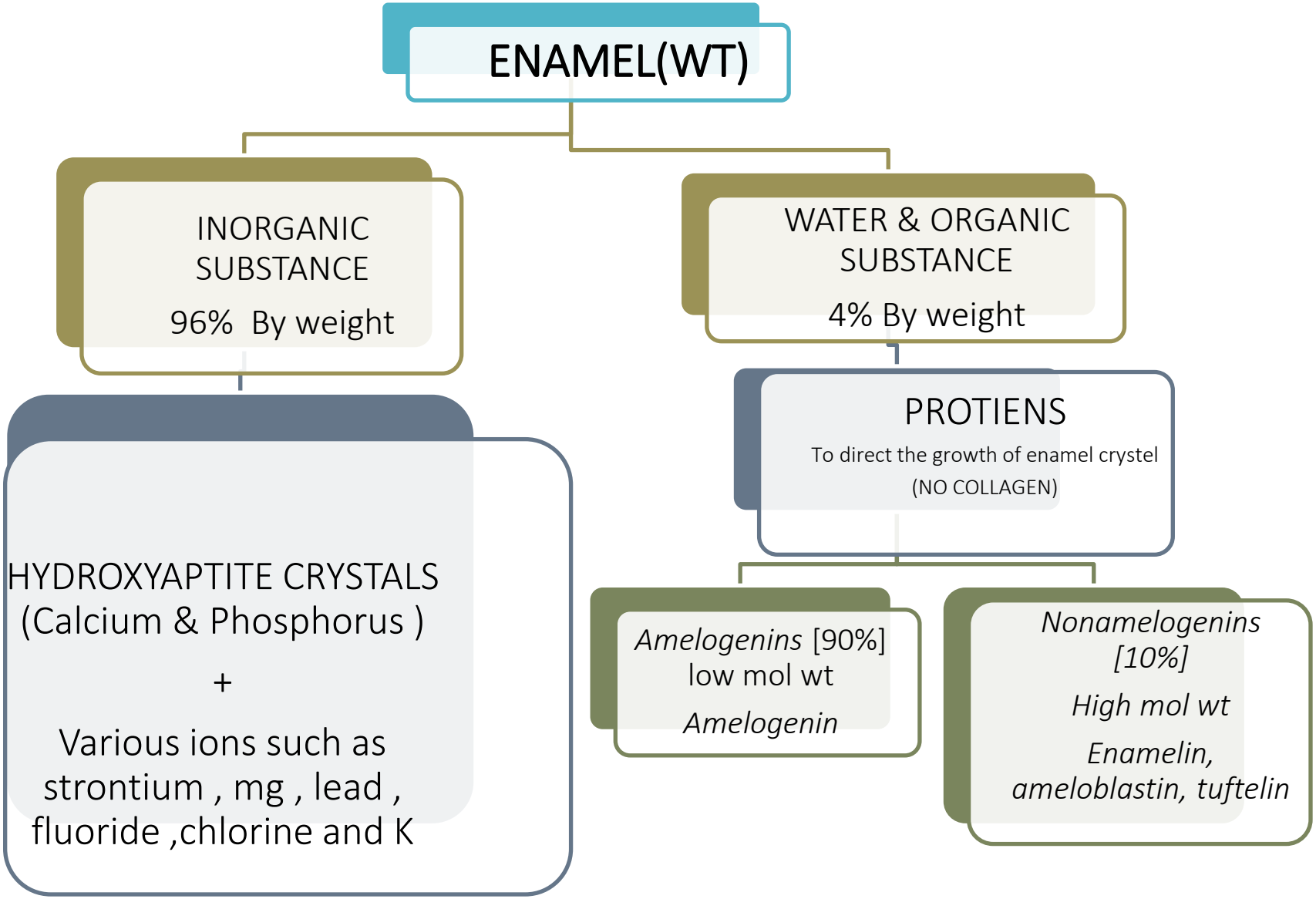
- LOW tensile strength
- Less than dentin
- Although it is hard , enamel is extremely brittle and integrity depends on strength of underlying dentin

PERMEABILITY

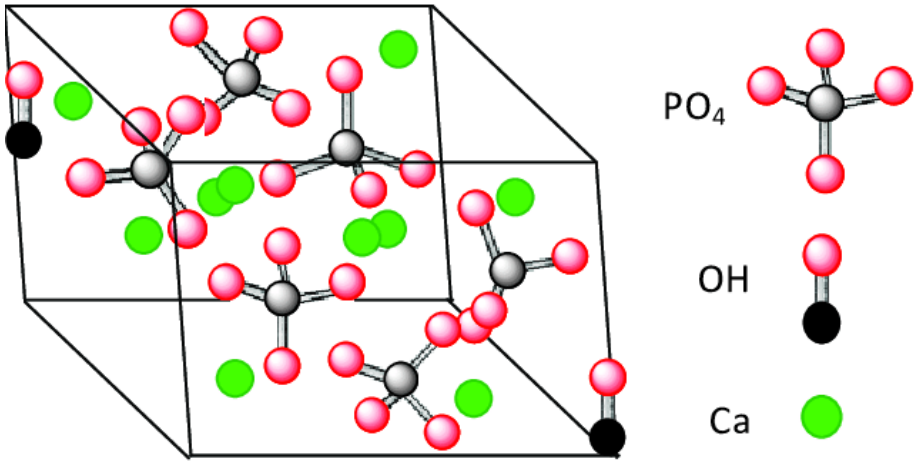
- **Enamel is selectively permeable(microscopic pores).**
- **Due to presence of cracks and microscopic spaces.**
- **The permeability of enamel decreases and hardness increases with age.**

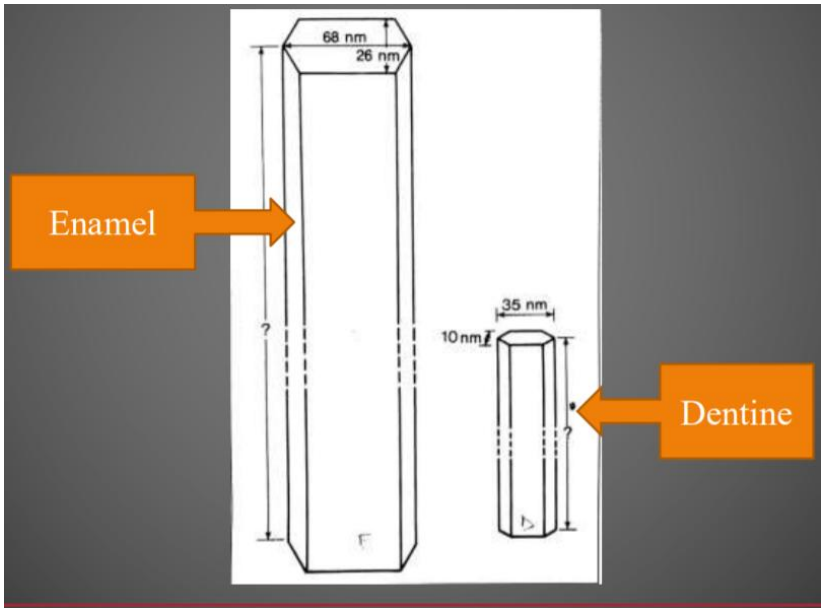


CHEMICAL PROPERTIES

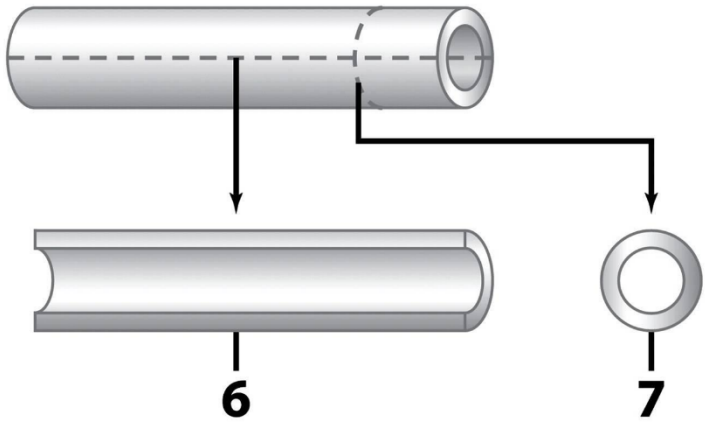


- Enamel is comprised almost entirely by hydroxyapatite crystals (HC).
- Enamel HC are the **largest HC of** all calcified tissue of body.(they are hexagonal in cross section)
- HC are composed of **calcium and phosphate.**

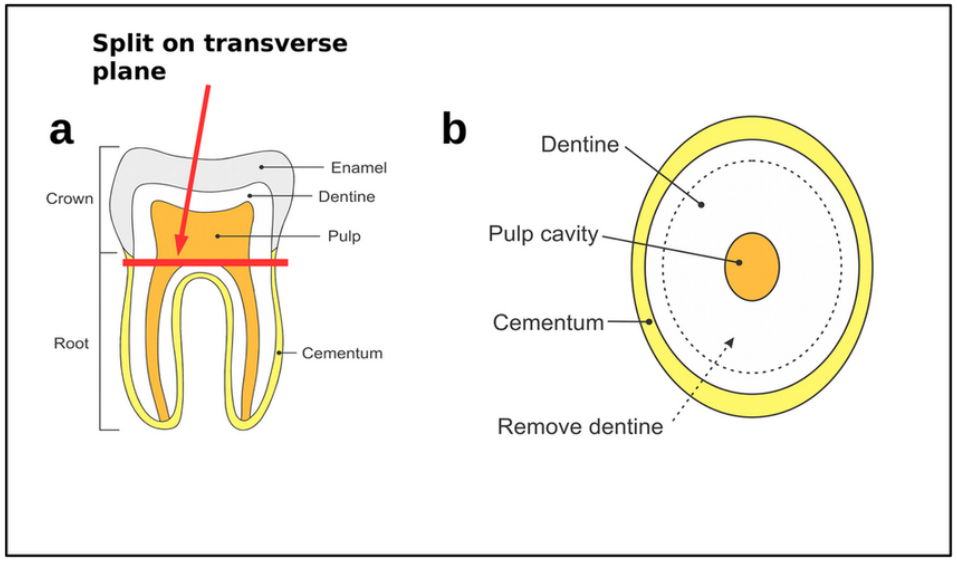




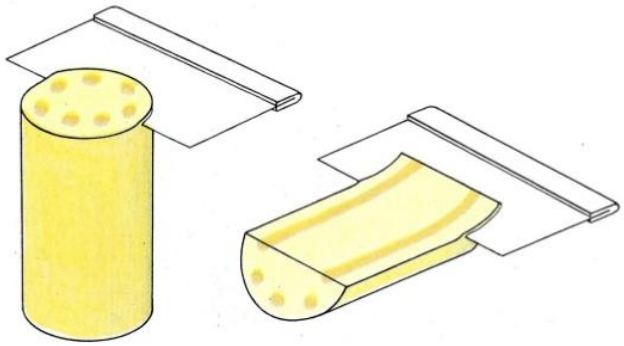
HOW DO YOU STUDY STRUCTURE ENAMEL UNDER MICROSCOPE????



Longitudinal and cross-sections

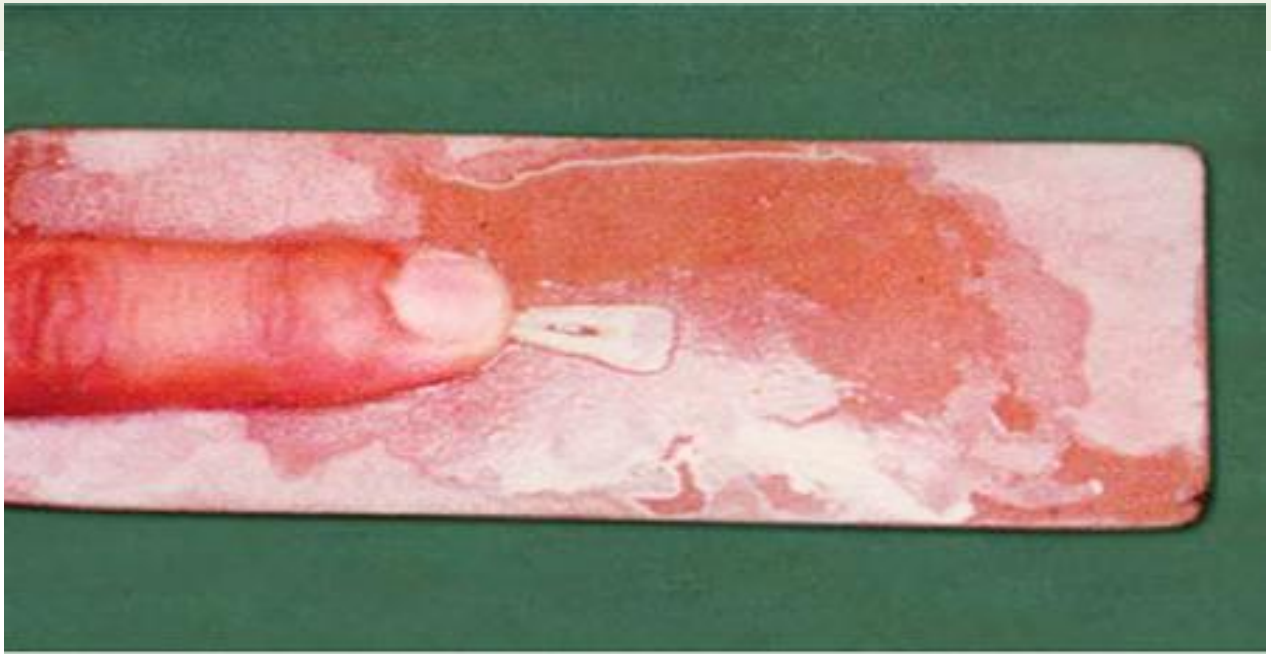


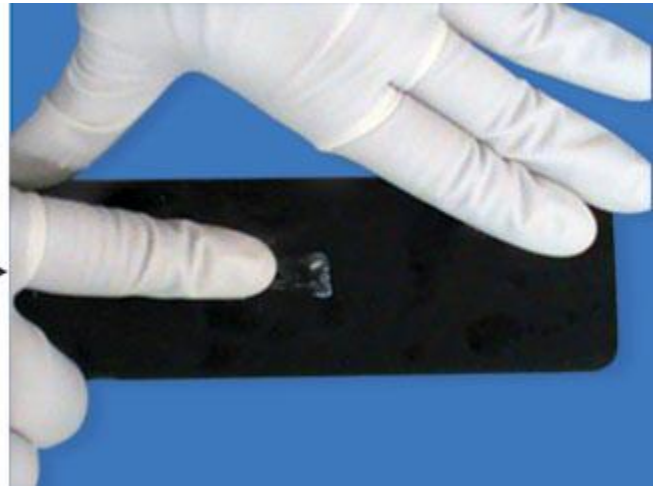
Cutting sections

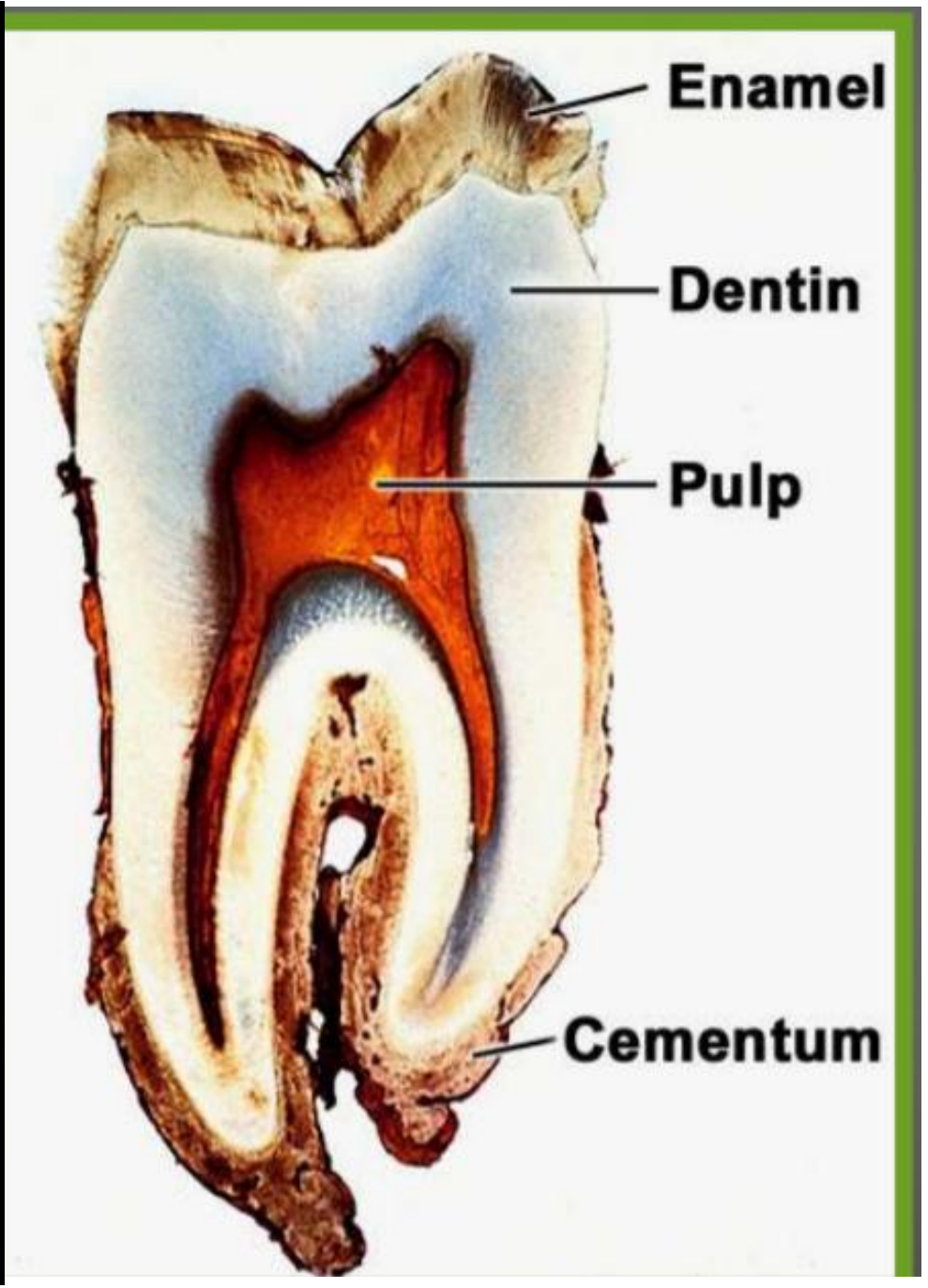


Transverse section Longitudinal section

GROUND SECTION



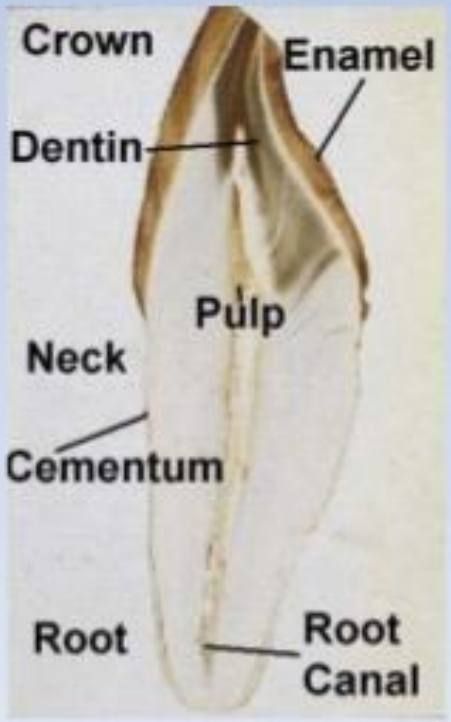



Enamel
Dentin
Pulp
Cementum


1 mm

Ground section

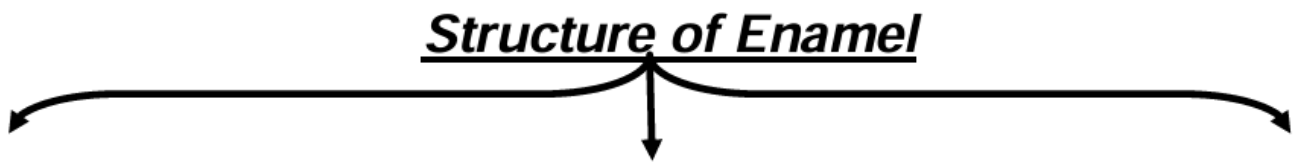
the organic substance is burnt and the inorganic substance remain



Decalcified section

the inorganic substance is dissolved and the organic substance remain

Structure of enamel



Basic units

1- Enamel rods (prisms)
2- Inter-rod region
3- Rod sheath

Features in enamel

1- Incremental lines
2- Hunter Schreger bands
3- Enamel tuft
4- Enamel spindle
5- Dentino-enamel junction
6- Enamel lamella

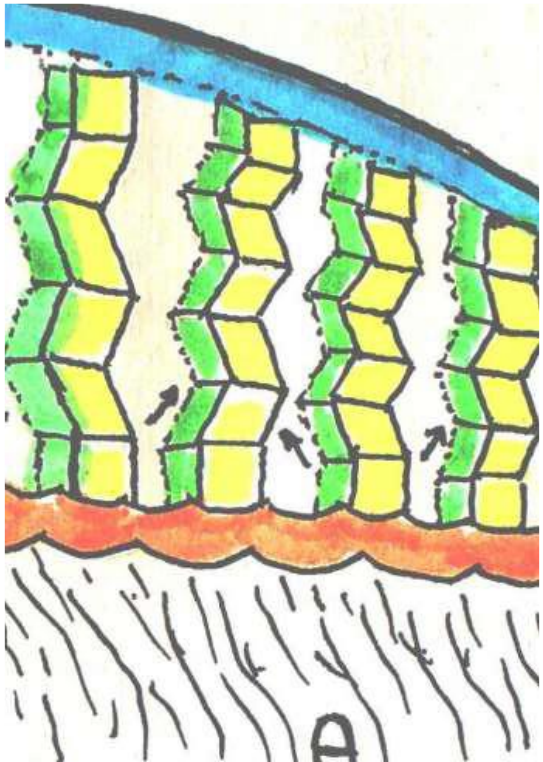
Surface structures

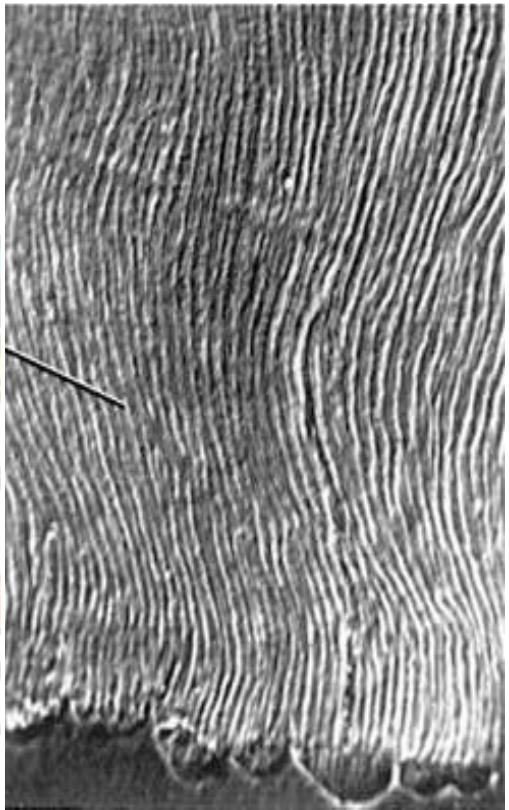
1- Perikymata
2- Enamel rod end
3- Crack
4- Primary enamel cuticle
5- Salivary pellicle
6- Afibrillar cementum

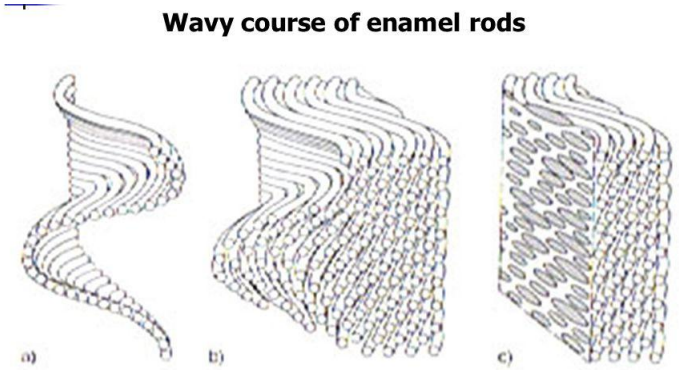
ENAMEL RODS

Basic Fundamental unit of enamel.

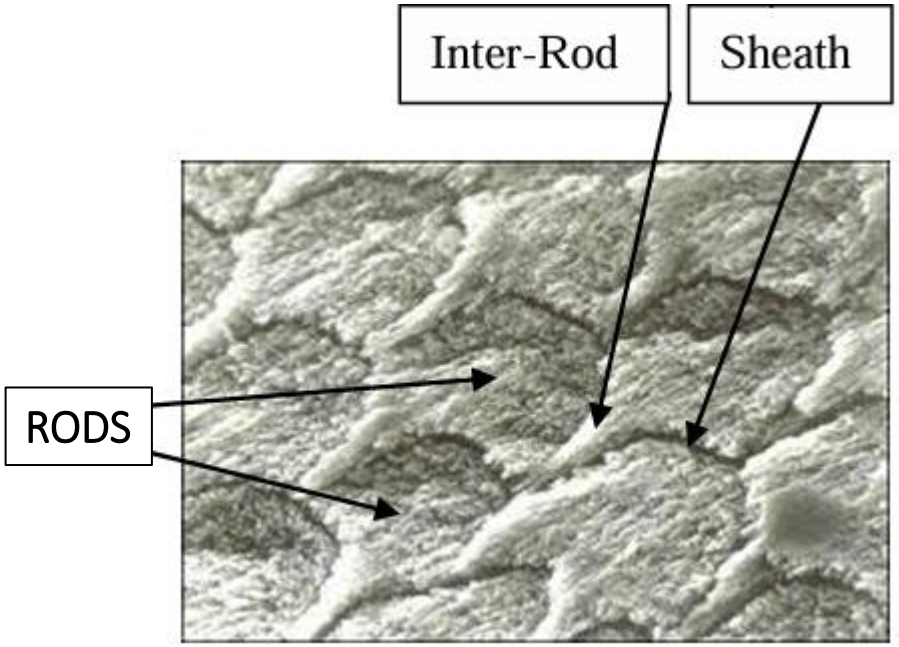
The enamel under microscope doesn't appear homogenous but has closely packed linear structures called "enamel rods"

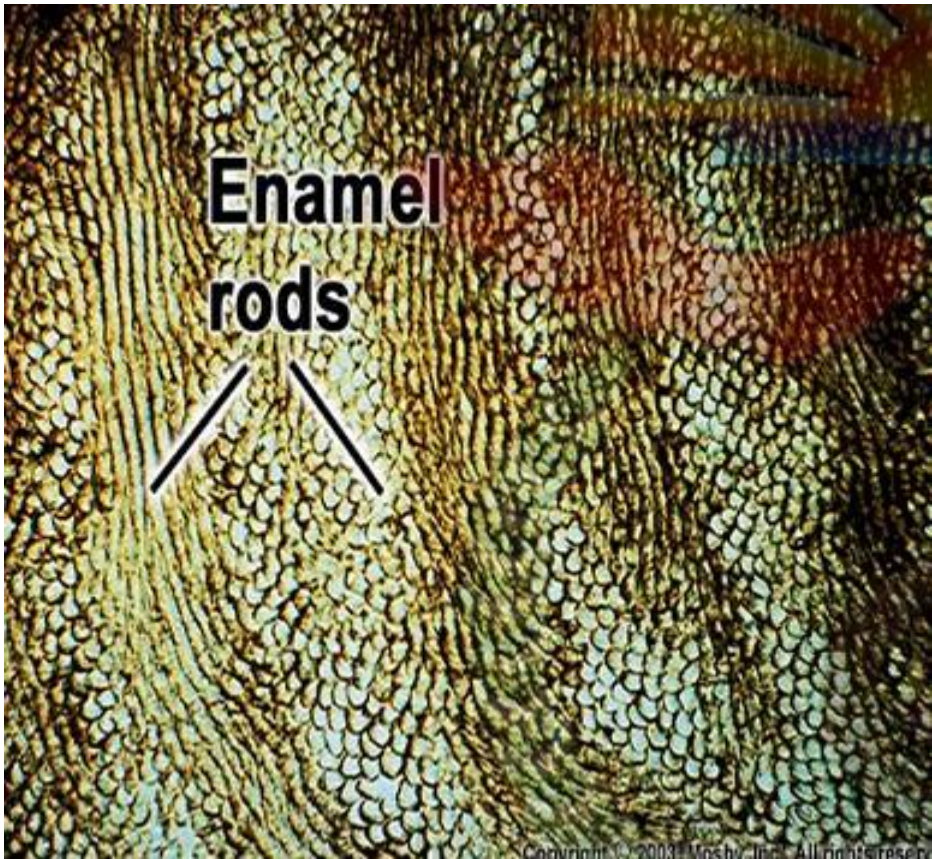




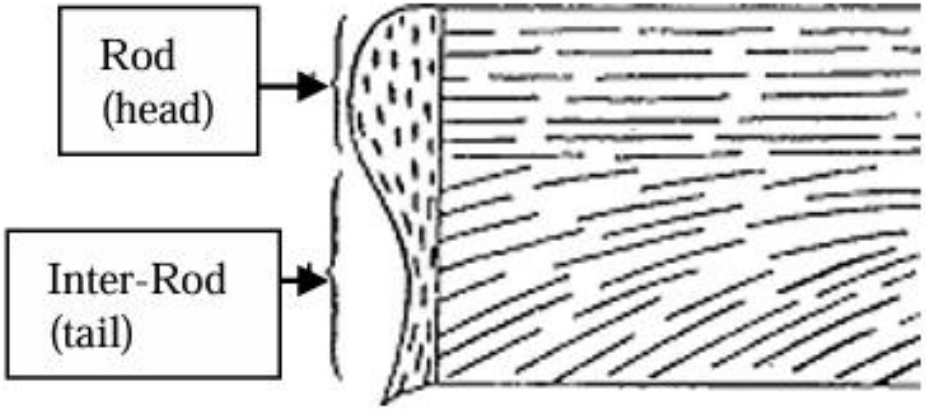


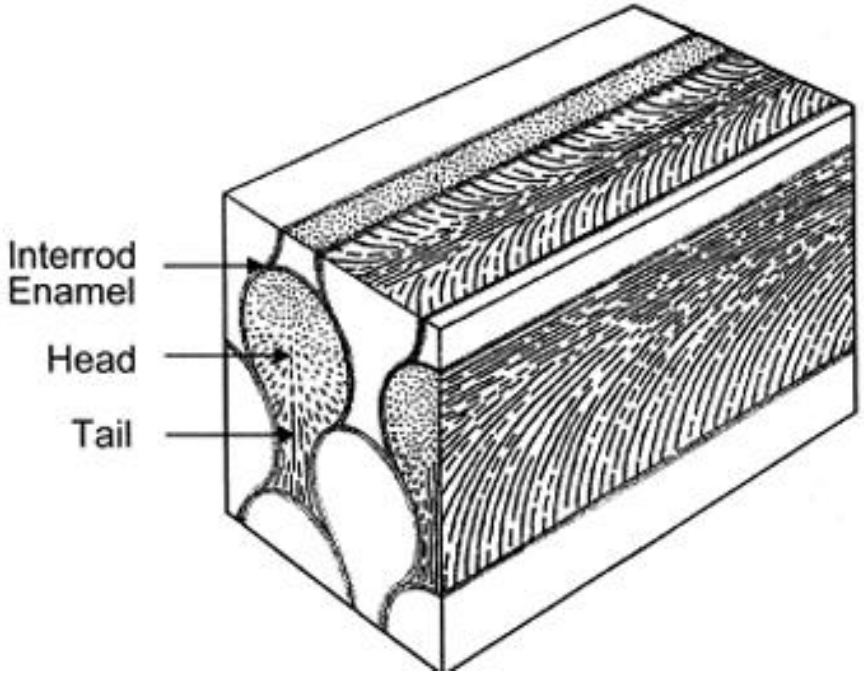
- No. 5 million to 12 million
- Wavy course from DEJ- outer surface
- Longer in the cuspal region compared to cervical area
- Avg diameter- 4-5 micron.
- Cross section hexagonal round to oval
- FISH SCALE APPEARANCE





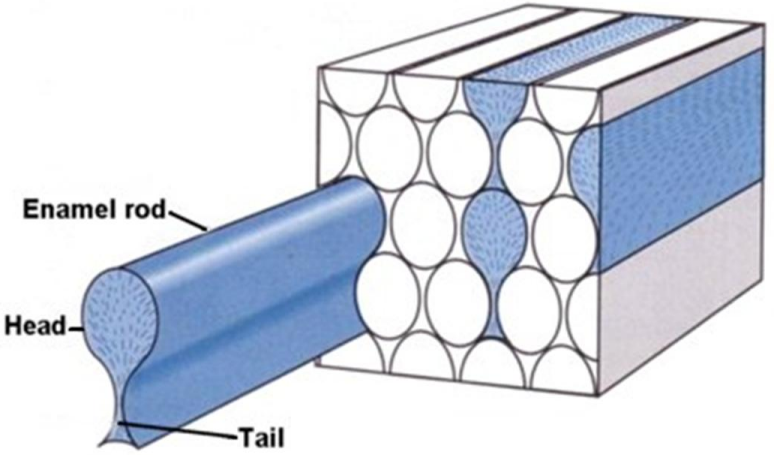
- **Enamel rod consists of head / body and tail**
- **Bodies are nearer occlusal surface whereas tail points cervically**
- **Dimensions- 9 microns X 5 microns**

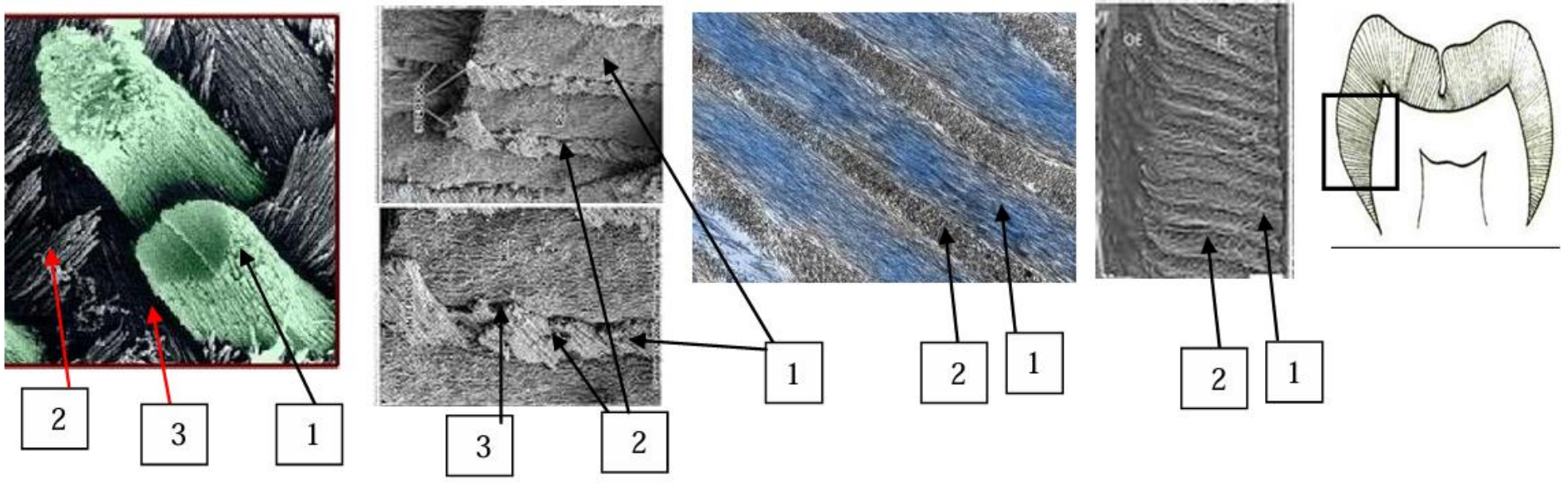




Electron microscopy

KEYHOLE shaped arrangement of enamel rods



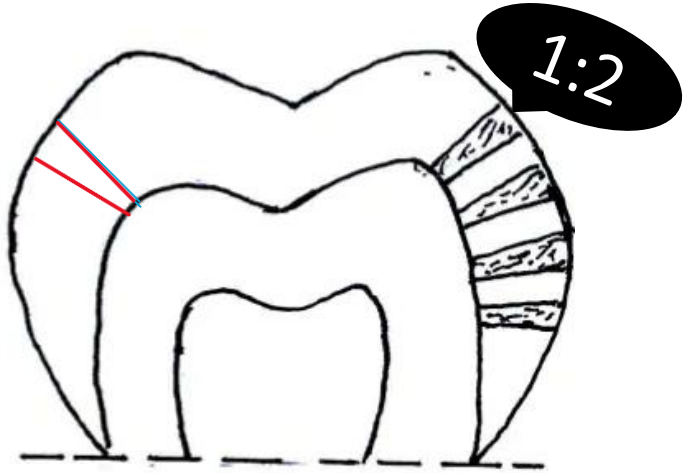


1. Enamel rod or “enamel prism” is a cylinder filled with hydroxy apatite crystals (1).

2. Between enamel rods, there are inter-rod regions or “interprimatic region” which have crystals but with different orientation (2).

3. The area surrounding each rod is of less packed crystals (has more enamel proteins) and called “rod sheath” or “prism sheath” (3).

- **Enamel rods varies from 5 millions in lower lateral incisor to 12 millions in the upper first perm molars.**
- **DEJ : outer surface 1:2 (Diameter of rods: Diameter of road at outer surface is double the diameter at DEJ**



Direction of rods

Direction: Generally circumferentially around long axis of the crown.

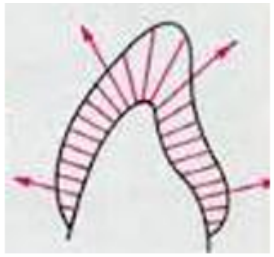
*** In deciduous**:

a) Cervical & middle E: [almost horizontal]

Then change gradually to oblique direction

b) In incisal & occlusal E [Vertical (Fan shaped)]

deciduous

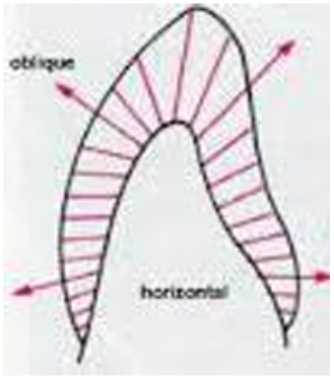


*** Permanent**:

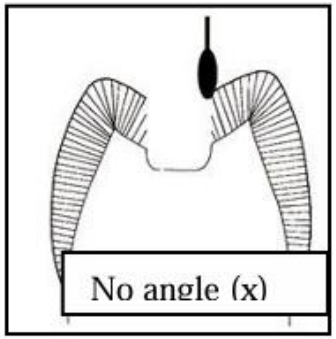
a) In cervical E → Tilted apically

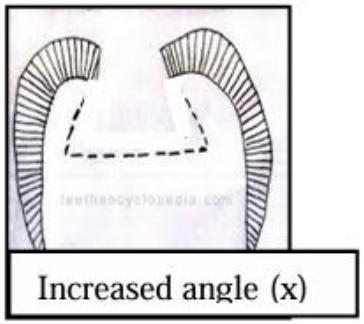
b) Middle & occlusal & Incisal → as in decide.

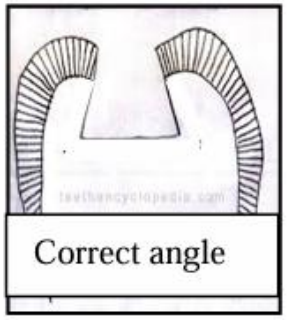
Permanent



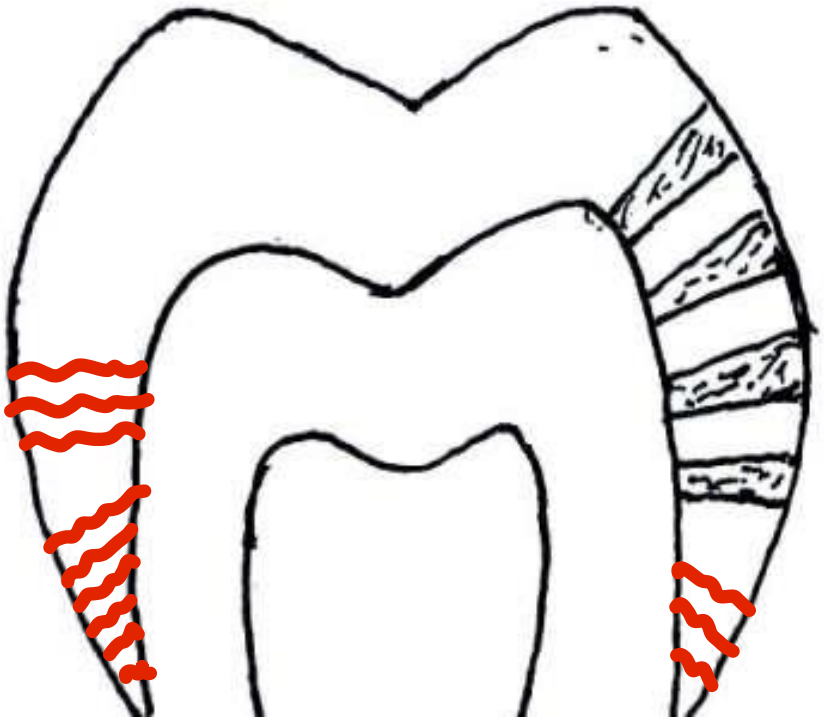
CL: the cutting in enamel during cavity preparation for tooth restoration, the cutting is in the direction of the enamel rods (so, the dentist should be aware of this direction)



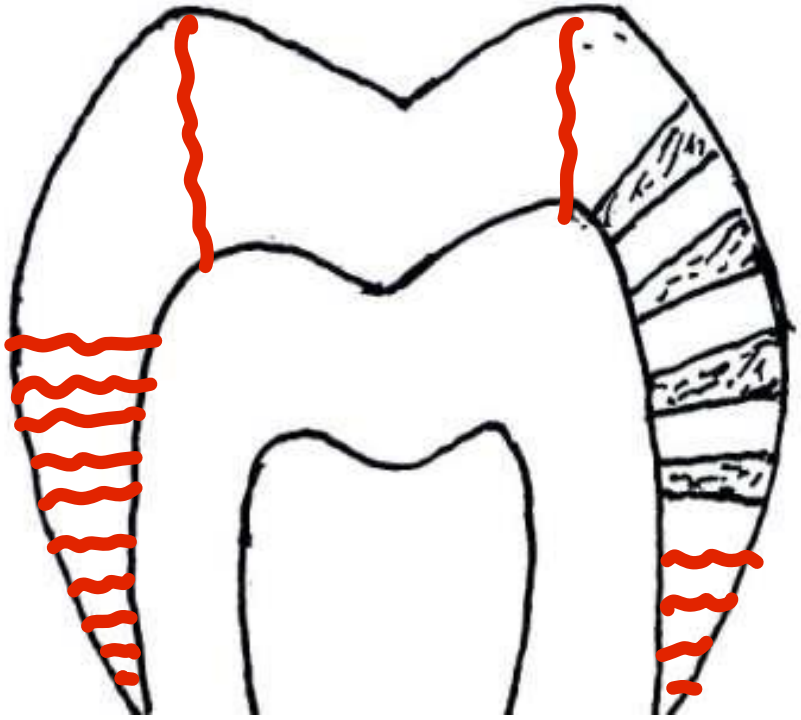




Direction of rods at cervical third



Permanent tooth

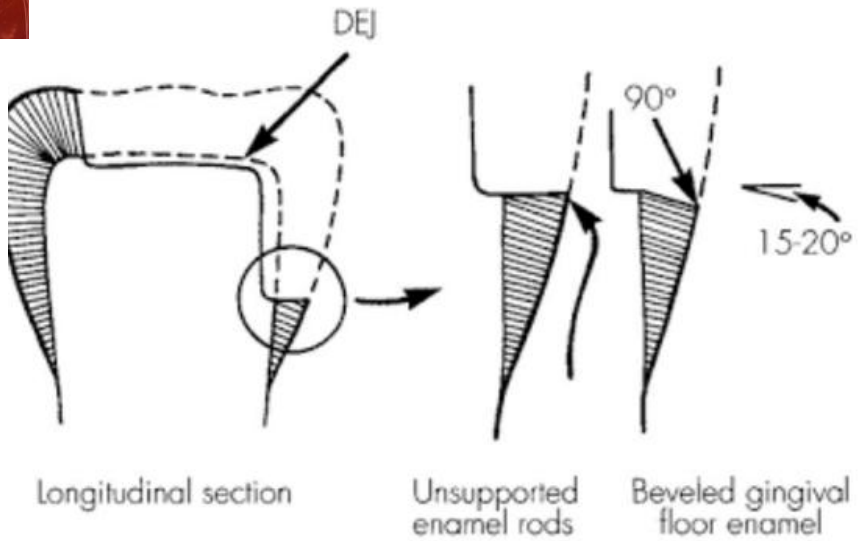


Deciduous tooth

Permanent: a) In cervical E Tilted apically
b) Middle & occlusal & Incisal as in deciduous.

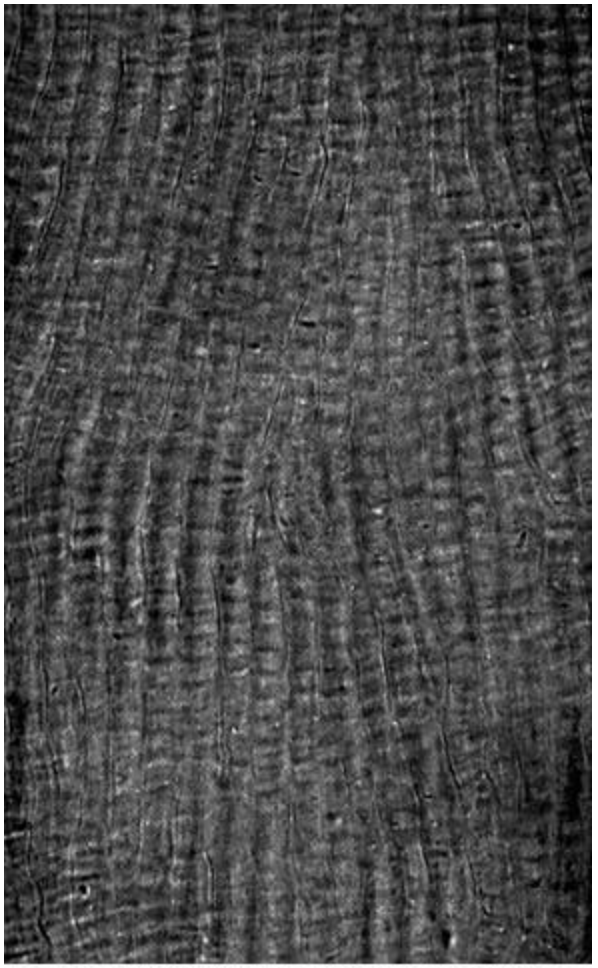
- In deciduous: a) Cervical & middle E: [almost horizontal] Then change gradually to o

CLINICAL SIGNIFICANCE



Striations

- Enamel rod is built up of segments separated by dark lines that give it a striated appearance.
- The segments are of uniform length.
- About 4 microns (4 microns /day)



From Orban (1949) Oral Histology and Embriology. St. Louis: C.V. Mosby.

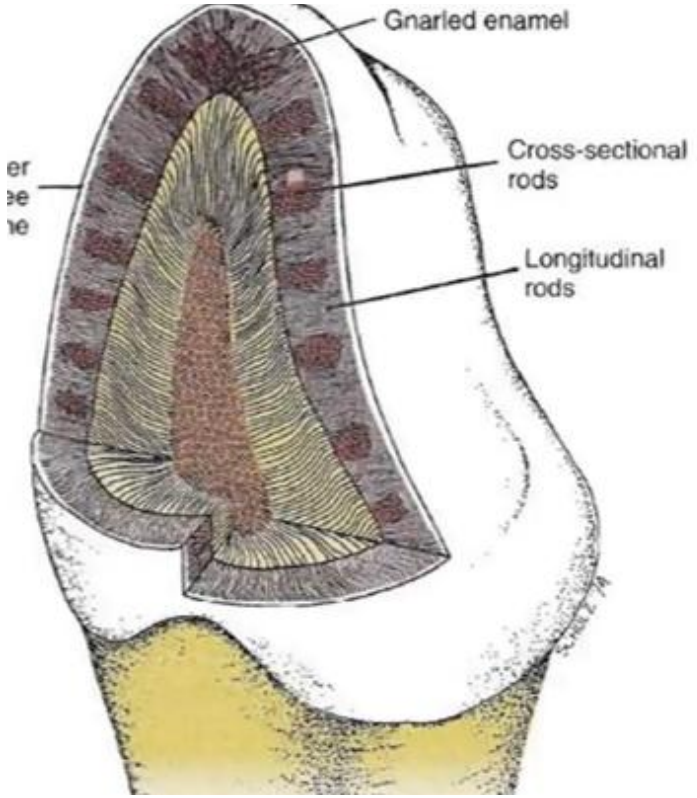
Gnarled Enamel.

- Most enamel rods travel in a wavy, undulating pathway from the dentinoenamel junction (DEJ) to the tooth surface.
- However, at the cusp tips of molars and the incisal edges of anterior teeth, these enamel rods don't just move straight — they **twist and swirl around each other.**
- This unique, spiral-like arrangement is called Gnarled Enamel.

Why is it important?

- This twisting pattern gives enamel extra strength
- It makes enamel much more resistant to fracture, especially in areas exposed to heavy chewing forces.

Gnarled Enamel.



Q & A time

THANK YOU