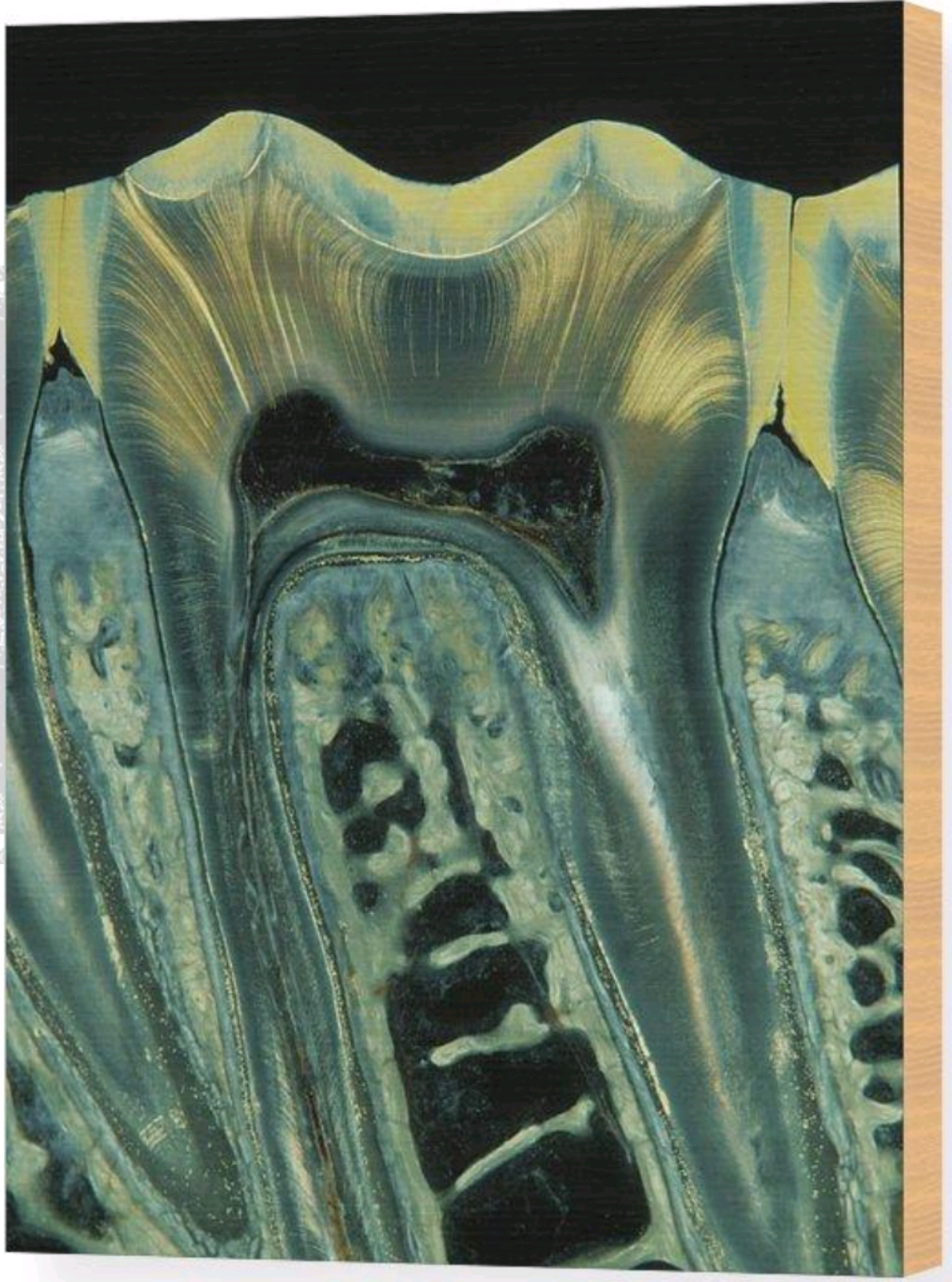
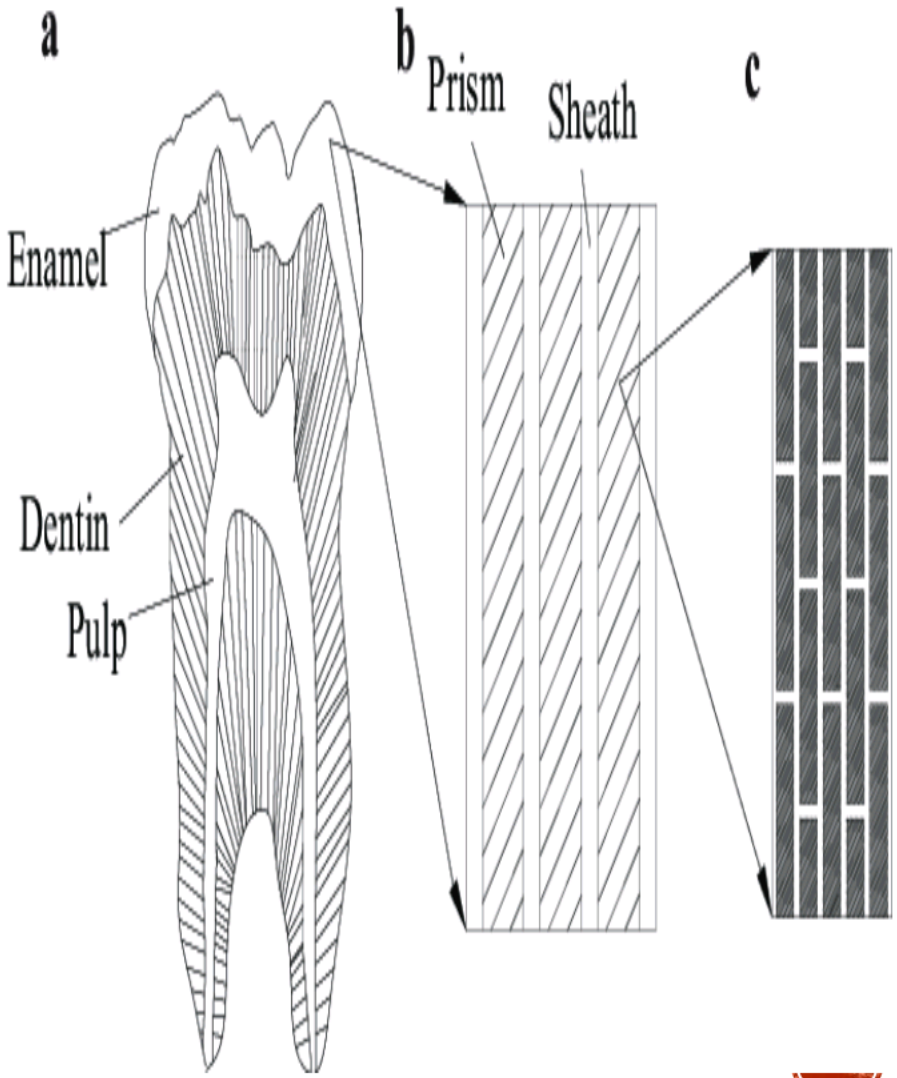
ENAMEL 2

Omyma Mohamed

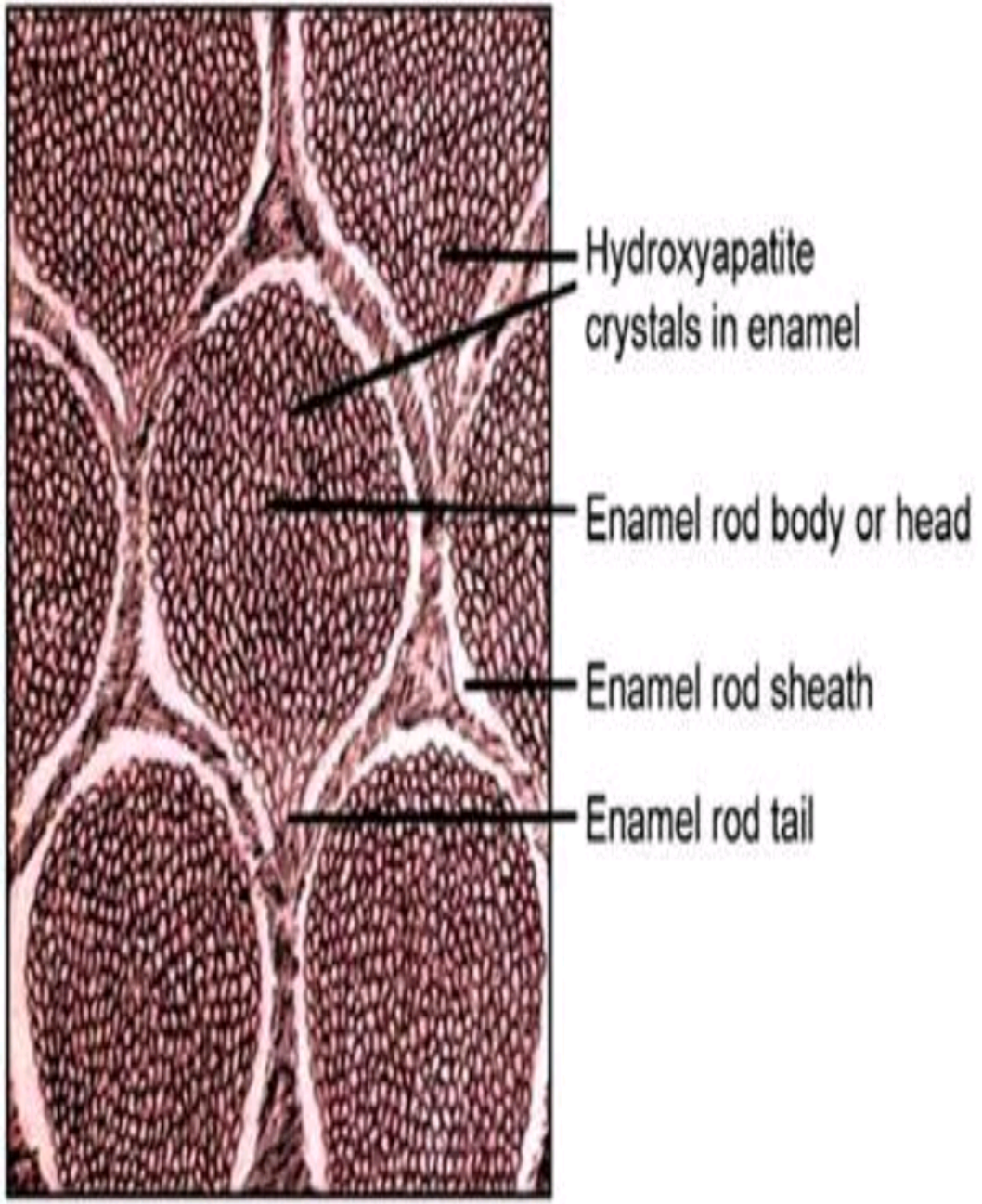


HISTOLOGICAL STRUCTURE OF ENAMEL

- An enamel prism, or enamel rod, is the basic unit of tooth enamel. Measuring 3-6 μm in diameter, enamel prism are tightly packed hydroxyapatite crystals.
- The hydroxyapatite crystals are hexagonal in shape, providing rigidity to the prism and strengthening the enamel.
- hydroxyapatite crystals closely packed and long ribbon-like measuring 60 to 70 nm in width and 25 to 30 nm in thickness.
- These crystals are grouped together as rod or interrod enamel
- The boundary between rod and interrod enamel containing organic material known as the rod sheath

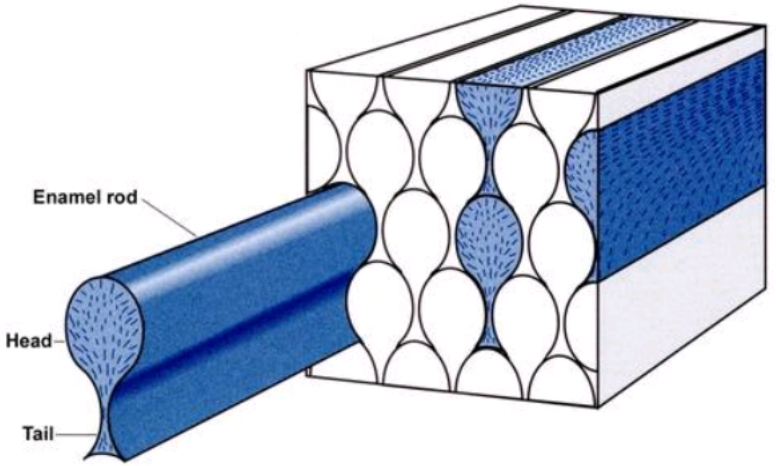


- **In cross-section, it is best compared to a complex "keyhole" or a "fish-scale" shape. The head, which is called the prism core, is oriented toward the tooth's crown; The tail, which is oriented toward the tooth cervical margin.**
- **The prism core has tightly packed hydroxyapatite crystals.**
- **the prism sheath has its crystals less tightly packed and has more space for organic components.**
- **These prism structures can usually be visualised within ground sections.**



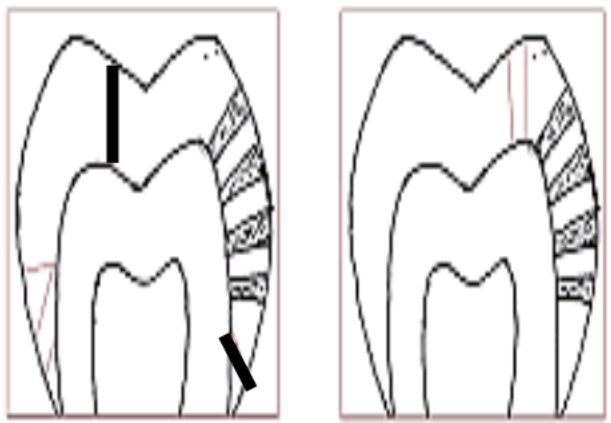
❖Number:

- The number of enamel prisms range approximately from 5 million to 12 million in the number between mandibular incisors and maxillary molars.

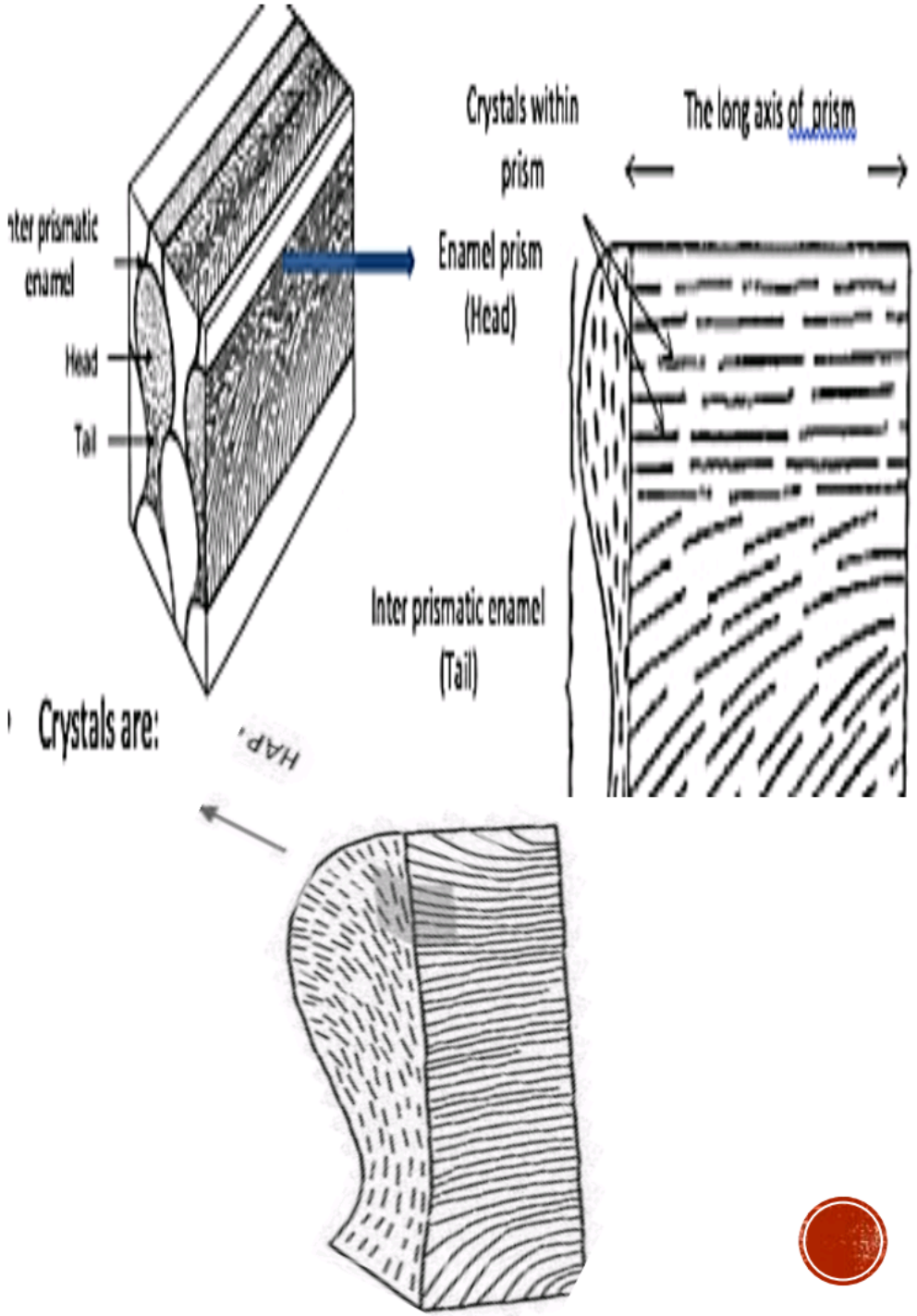


❖Direction:

- Enamel prism are found in rows along the tooth. Within each row, the enamel prism's long axis is generally perpendicular to the underlying ADJ amelo-dentinal junction, which is also called the dentino-enamel junction.
- In both permanent and primary dentitions; the enamel prisms following the path of the ameloblasts
- In permanent teeth, the enamel prisms near the cemento-enamel junction (CEJ) tilt slightly more apically toward the root of the tooth.
- In primary dentition near CEJ it becomes horizontal
- Knowing the orientation of enamel is very important in restorative dentistry because enamel unsupported by underlying dentin is prone to fracture and usually is avoided.

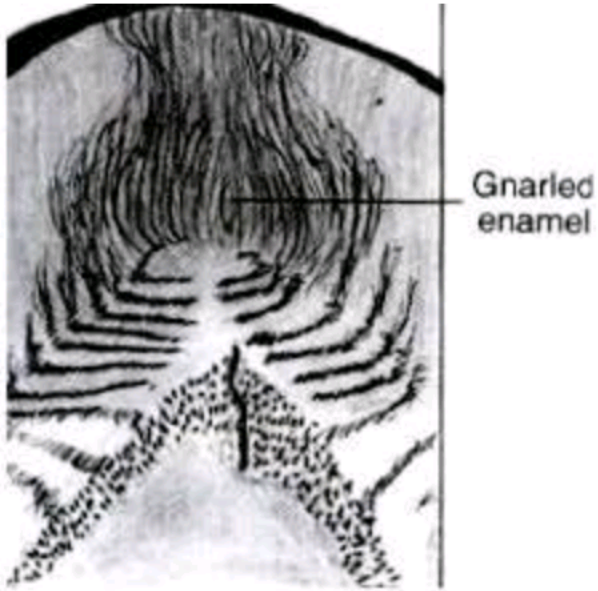


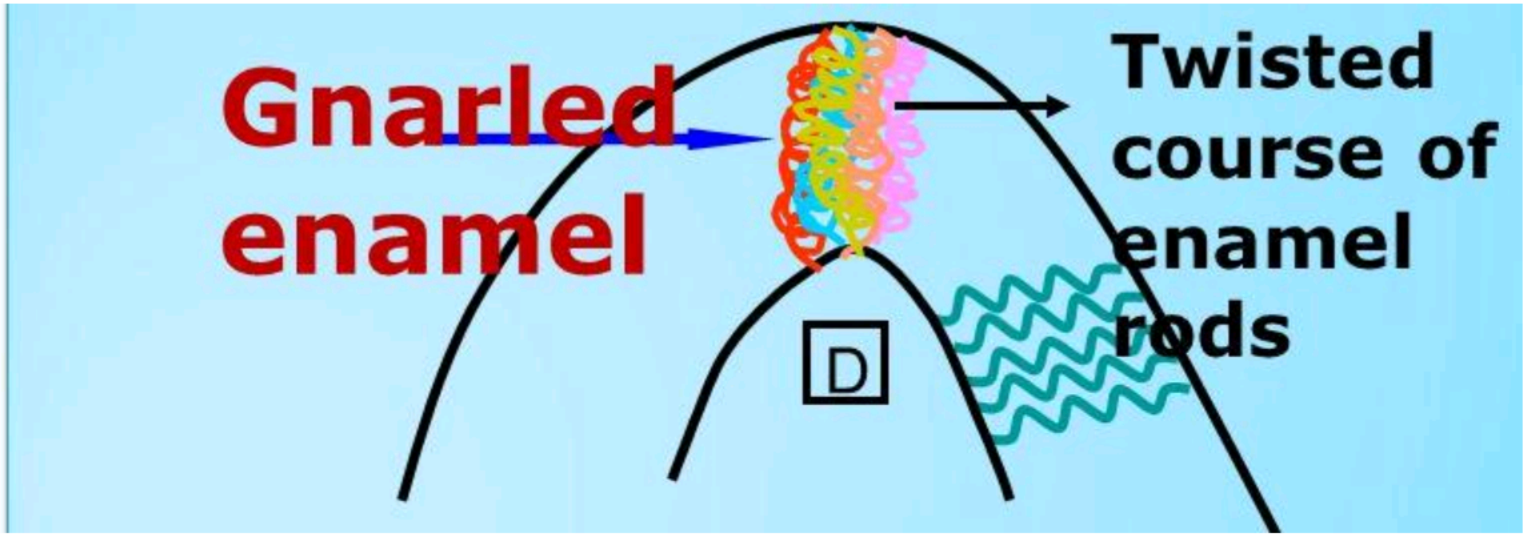
- **The arrangement of crystals within each enamel prism is highly complex. the enamel crystals are oriented parallel to the long axis of the prism. The further away the crystals are from the central axis, the more their own orientation diverges.**
- **The area around the enamel prism is known as interrod enamel. Interrod enamel has the same composition as the enamel prisms**
- **Difference between rod and interrod is crystal orientation. The crystals lie nearly perpendicular to the enamel prism.**
- **The enamel rod was first described as hexagonal and prism-like in cross section, and the term enamel prism still is used frequently. This term is a wrong scientific term because rods do not have a regular geometry and hence are not prismatic.**



GNARLED ENAMEL

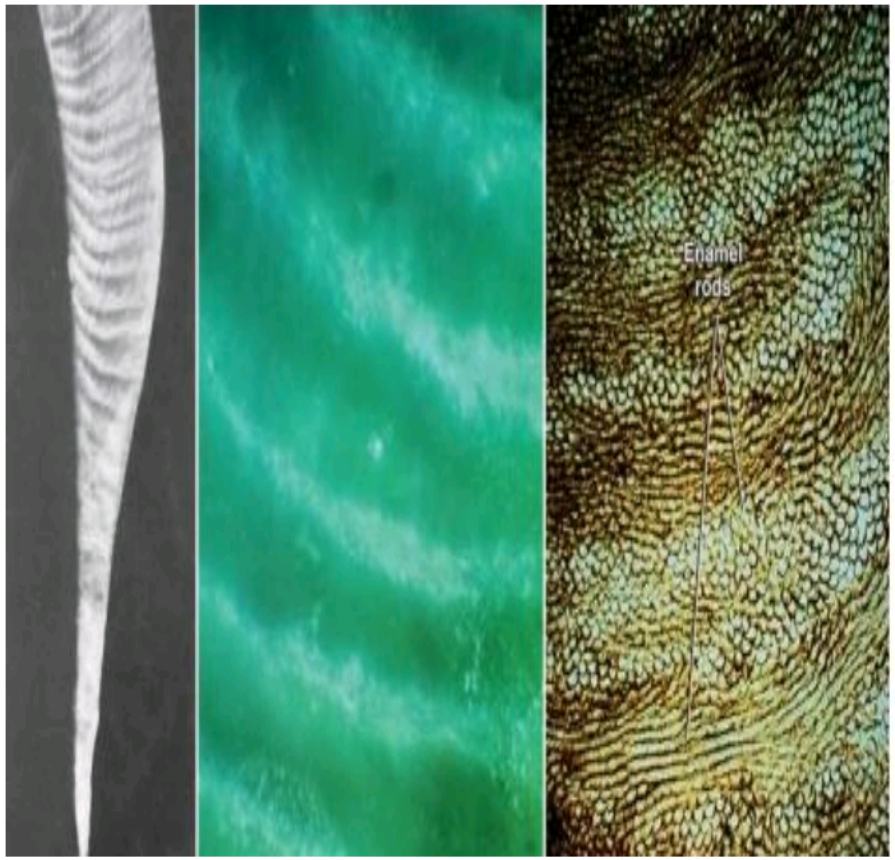
- **Within ground sections of teeth, prisms appear to be twisted and interwoven around each other at the cusps or incisal edge. Such allows teeth to be able to resist strong masticatory forces without fracturing, teeth able to resist forces up to 20-30 pounds per tooth . This part of the enamel is called Gnarled enamel.**





BANDS OF HUNTER AND SCHREGER

- **Hunter Scherger bands are an optical phenomenon produced by changes in direction between adjacent groups of rods.**
- **The bands are seen most clearly in longitudinal ground sections viewed by reflected light and are found in the inner two thirds of the enamel.**
- **These bands appear as dark and light alternating zones.**
- **Scanning electron microscopy clearly reveals the difference in orientation of groups of rods within these zones.**



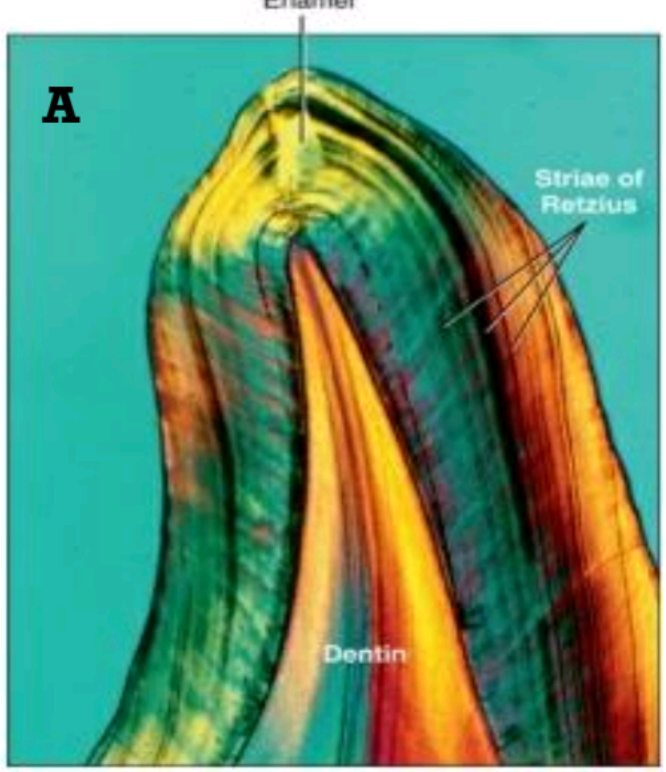
HYPOCALCIFIED STRUCTURE OF ENAMEL

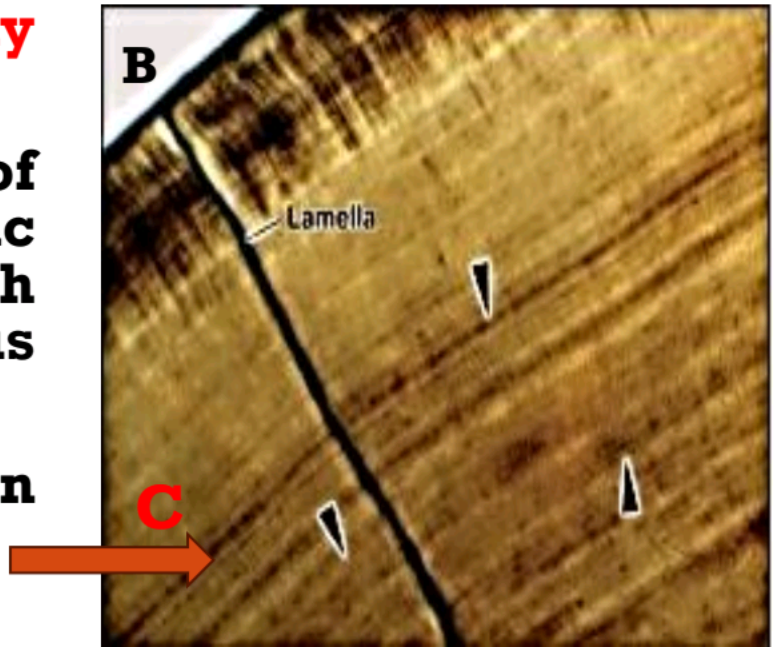
1-Striae of Retzius:

- **The striae of Retzius generally are identified using ground sections of calcified teeth.**
- **In a longitudinal section of the tooth, they are seen as a series of lines extending from the dentinoenamel junction toward the tooth surface (A)**
- **in a cross section, they appear as concentric rings (B)**
- **Striae of Retzius generally are described as a weekly rhythm of enamel production.**

2-The neonatal line (C):is an enlarged or accentuated stria of Retzius that apparently reflects the great physiologic changes occurring at birth. Systemic disturbances after birth (e.g., fevers) affect amelogenesis. It appears in deciduous teeth and first permanent molars.

- **The quality of enamel formed before birth is higher than that formed after birth.**

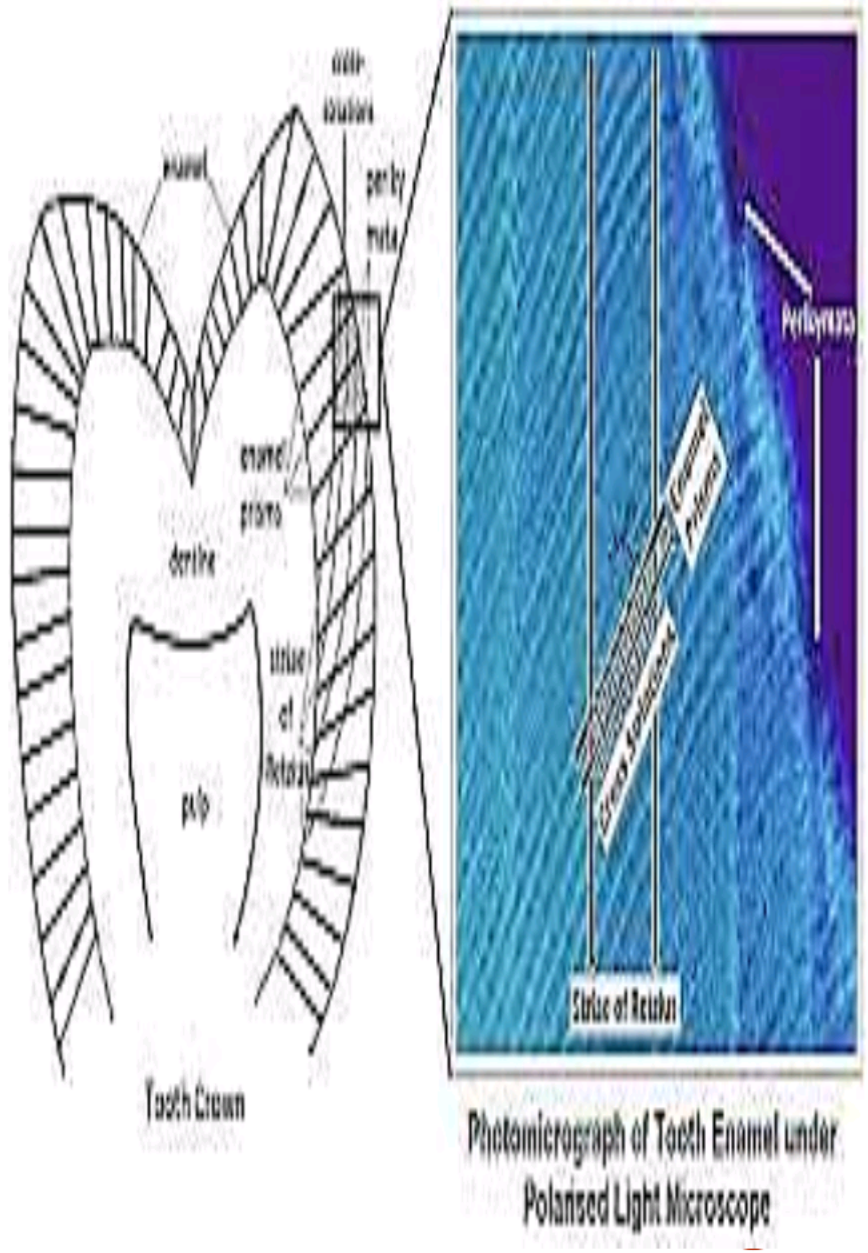


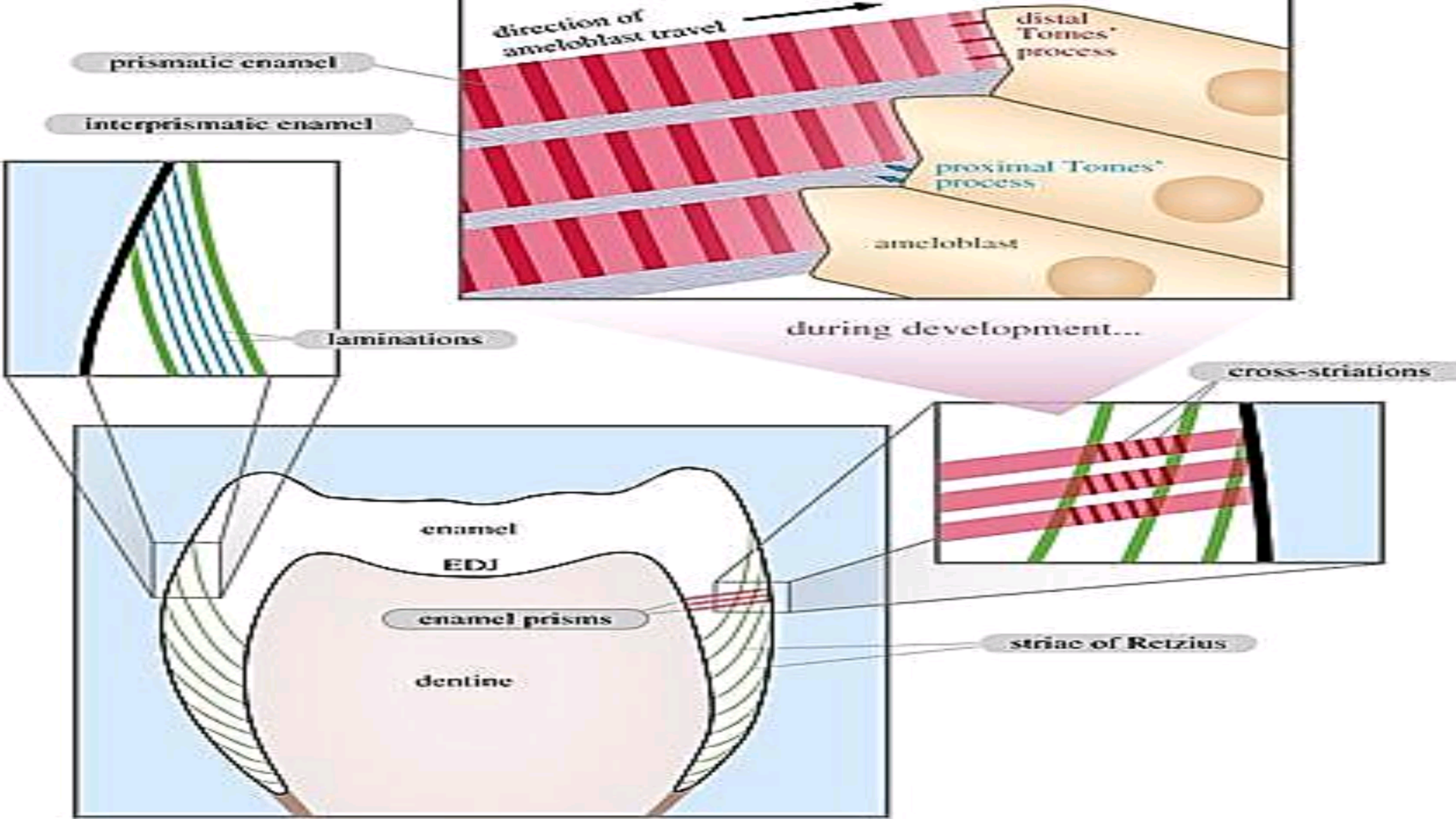


HYPOCALCIFIED STRUCTURE OF ENAMEL

3-Cross Striations

- **Human enamel is known to form at a rate of approximately 4 μm per day.**
- **Ground sections of enamel reveal what appear to be periodic bands or cross striations at 4-μm intervals across rods.**
- **What may seem to be cross striations on longitudinally sectioned rods**
- **With a scanning electron microscope, alternating constrictions and expansions of the rods are visible; Such a pattern could reflect a daily rhythmicity enamel formation.**



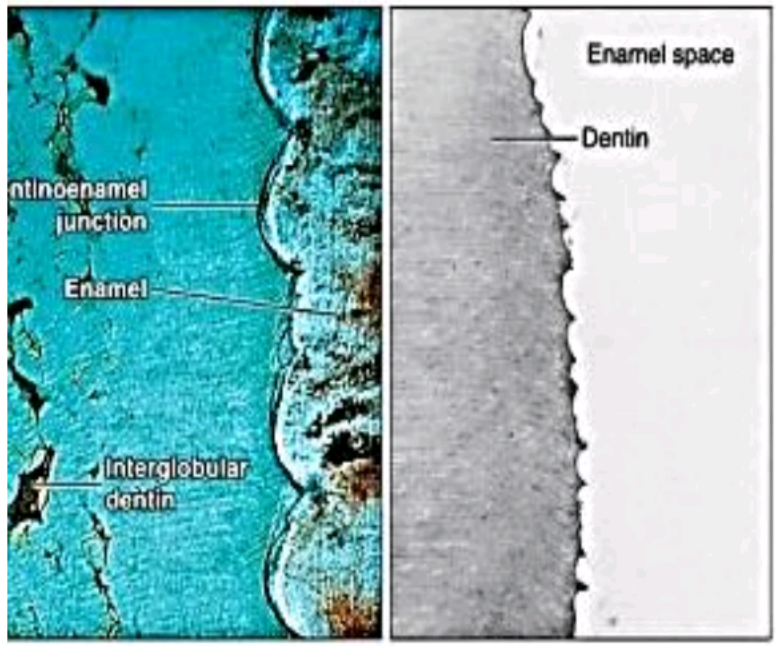

direction of ameloblast travel
distal Tomes' process
prismatic enamel
interprismatic enamel
proximal Tomes' process
ameloblast
laminations
during development...
cross-striations
enamel
EDJ
enamel prisms
striae of Retzius
dentine

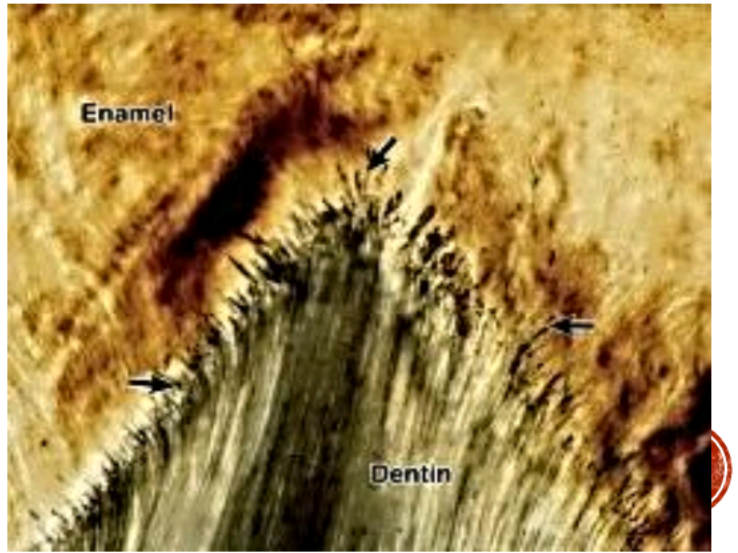
HYPOCALCIFIED STRUCTURE OF ENAMEL

4-Dentino-enamel Junction DEJ: The junction between enamel and dentin is established as these two hard tissues begin to form and is seen as a scalloped profile in cross section convex toward dentin concave toward enamel.

- **The electron microscope reveals that crystals of dentin and enamel intermix**
- **The scanning electron microscope reveals the junction to be a series of ridges rather than spikes, an arrangement that probably increases the adherence between dentin and enamel.**

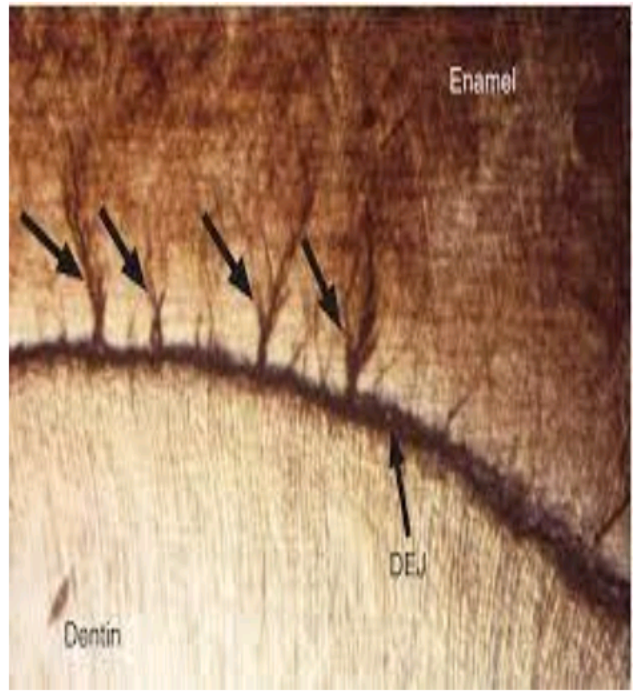
5-Enamel Spindles: Before enamel forms, some developing odontoblast processes extend into the ameloblast layer and, when enamel formation begins then enamel calcified odontoblasts trapped and form enamel spindles.





HYPOCALCIFIED STRUCTURE OF ENAMEL

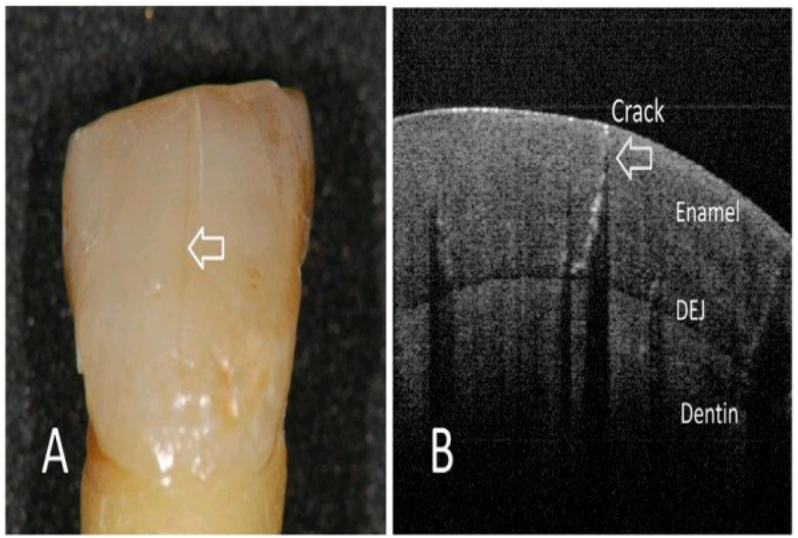
- **Enamel tufts and lamellae may be geologic faults without clinical significance. They are best seen in transverse sections of enamel.**
- **6-Enamel tufts project from the dentinoenamel junction for a short distance into the enamel. They appear to be branched and contain greater concentrations of enamel proteins than the rest of the enamel. Because a special protein called tuft protein has been reported at these sites. Its length from 1/3to 1/5 from enamel.**
- **tufts are believed to occur developmentally as a result of abrupt changes in the direction of groups of rods that arise from different regions of the scalloped dentinoenamel junction**. Appeared clearly in thick sections at low power of magnification.



HYPOCALCIFIED STRUCTURE OF ENAMEL

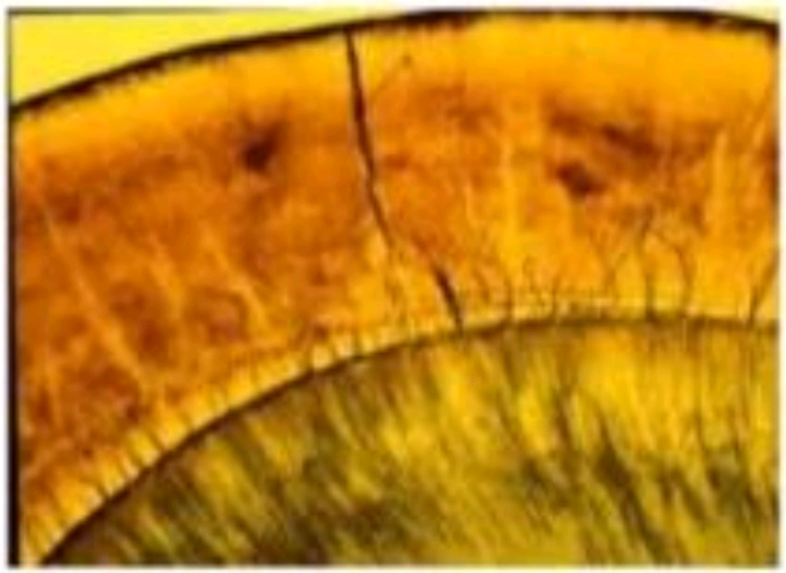
- **7-Enamel Lamellae: Lamellae extend for varying depths from the surface of enamel and consist of linear, longitudinally oriented defects filled with organic material.**
- **This organic material may derive from trapped enamel organ components or connective tissue surrounding the developing tooth.**
- **Tufts and lamellae are usually best demonstrated in ground sections, but they also can be seen in carefully demineralized sections of human enamel because of their higher protein content.**

Cracks

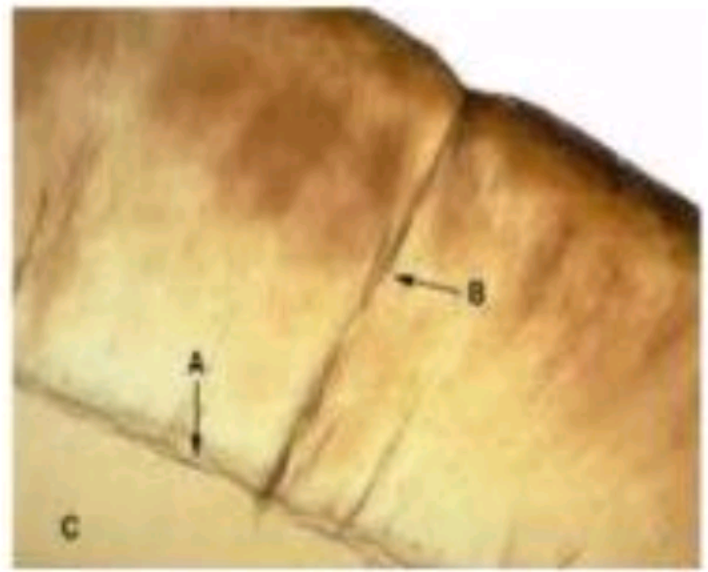


TYPES OF LAMELLAE

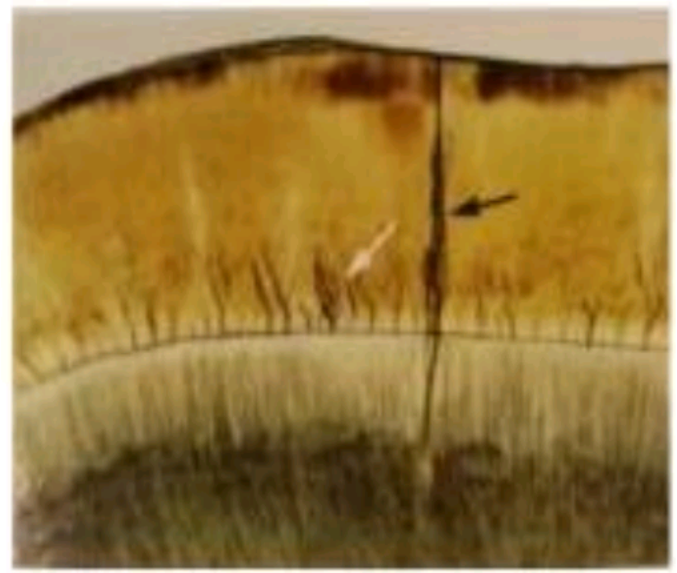
Type A



Type B



Type C

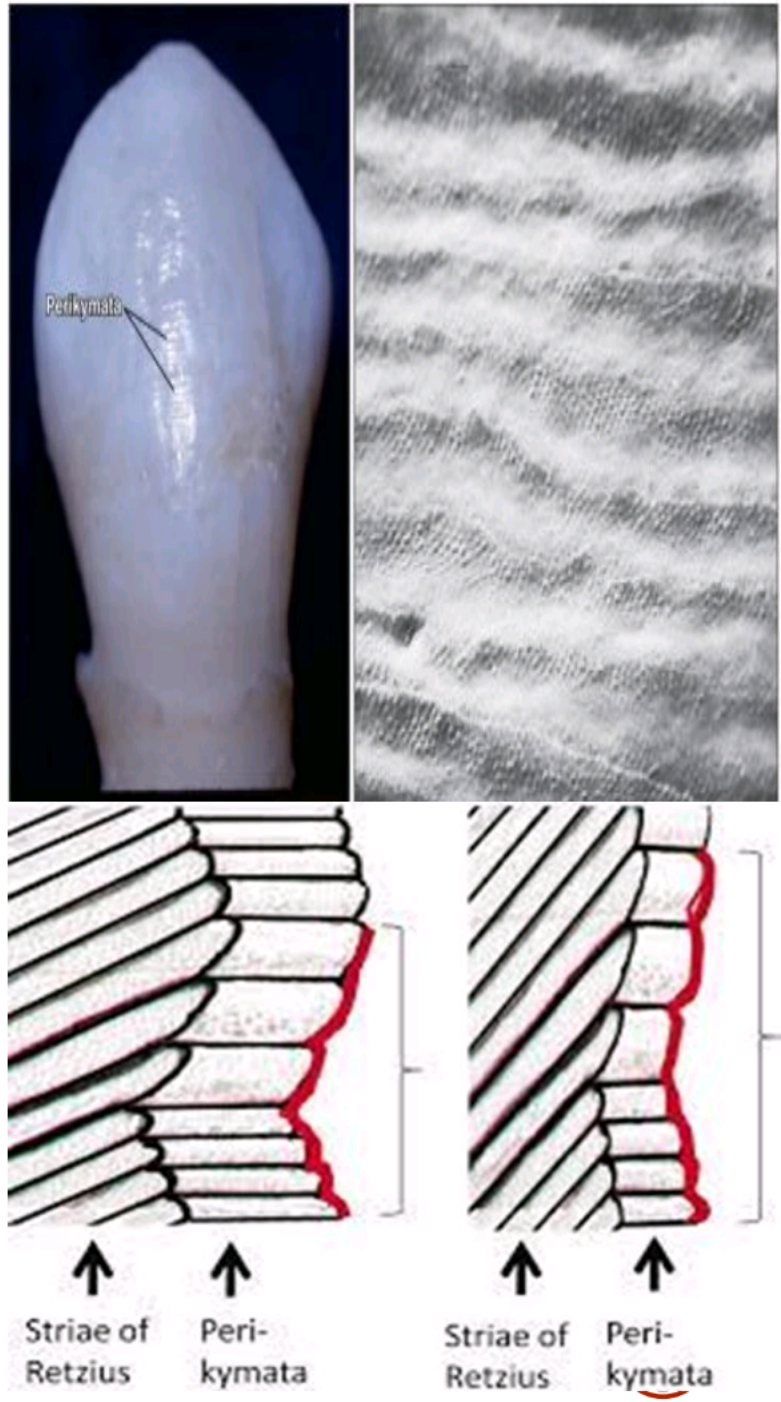


Enamel lamellae	Type A	Type B	Type C
Stimulus	Mild	Moderate	Severe
Time of incidence	During enamel formation but before calcification	After enamel formation but before eruption	After eruption
Extension	Enamel	Reach ADJ to dentin	May cross ADJ to dentin
Content	Enamel matrix and inter rod substance	Cells of enamel organ and may be cementum	Organic materials from saliva
Tooth	Un-erupted	Un-erupted	Erupted
Occurrence	Less common	Less common	More common

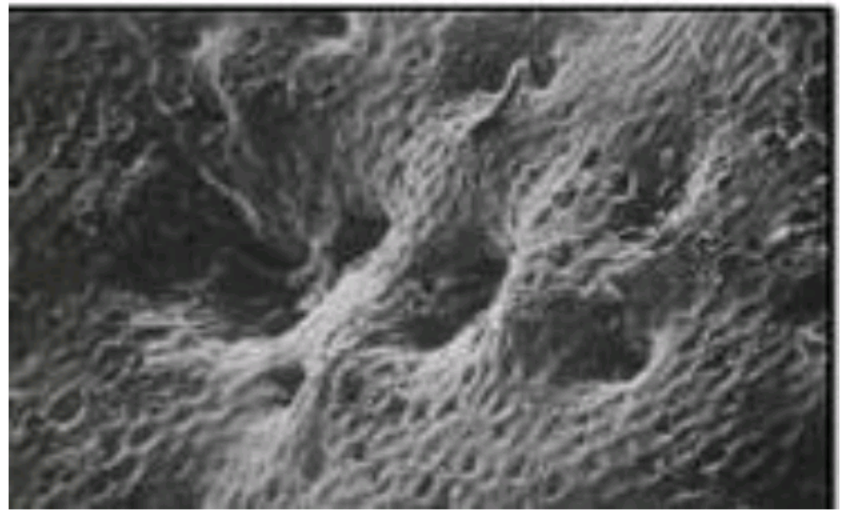
ENAMEL SURFACE

- **The surface of enamel is characterized by several structures. The striae of Retzius often extend from the dentinoenamel junction to the outer surface of enamel, where they end in shallow furrows known as perikymata**

1. **Perikymata run in circumferentially horizontal lines across the face of the crown.**
2. **In addition, lamellae or cracks in the enamel appear as jagged lines in various regions of the tooth surface.**
3. **The surface structure of enamel varies with age. In unerupted teeth the enamel surface consists of a structureless surface layer (final enamel) that is lost rapidly by abrasion, attrition, and erosion in erupted teeth.**

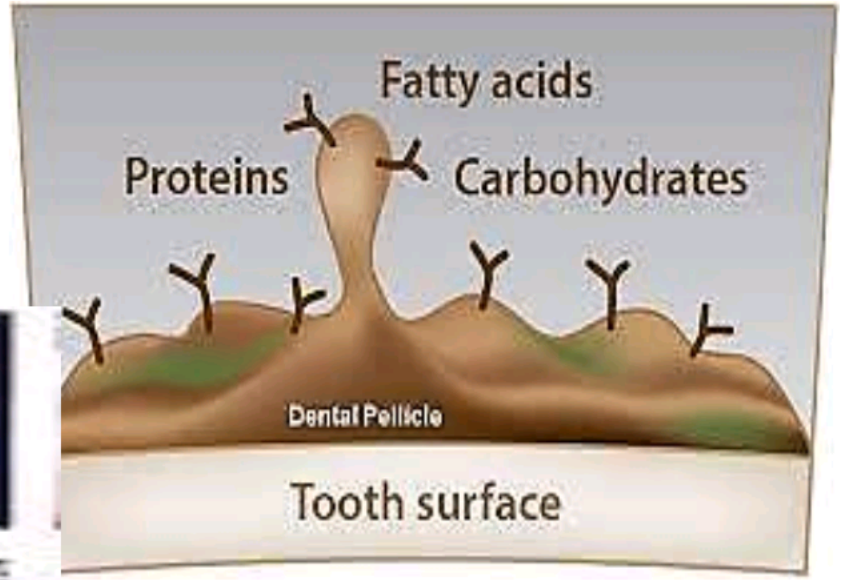


4. **Rod end: Enamel rod ends are concave vary in depth Shallower cervically, Deeper incisally or occlusally**



5. **Salivary pellicle : Appears shortly after tooth brushing as an organic deposit on the surface of teeth**

6. **Dental plaque is formed on this pellicle**



AGE CHANGES

- **Enamel is a nonvital tissue that is incapable of regeneration.**
- **With age, enamel becomes progressively worn in regions of masticatory attrition.**

1. **Wear facets increasingly are pronounced in older persons.**
2. **erosion.**
3. **discoloration**
4. **reduced permeability**
5. **Linked to these changes is an apparent reduction in the incidence of caries.**

- **Teeth darken with age. Whether this darkening is caused by a change in the structure of enamel is debatable. Although darkening could be caused by**

1-the addition of organic material to enamel from the environment.

2-deepening of dentin color (the layer becomes thicker with age) seen through the progressively thinning layer of translucent enamel.

- **No doubt exists that enamel becomes less permeable with age. Young enamel behaves as a semipermeable membrane,**
- **The surface layer of enamel reflects the changes within this tissue. During aging, the composition of the surface layer changes as ionic exchange with the oral environment occurs. In particular, a progressive increase in the fluoride content affects the surface layer (and that, incidentally, can be achieved by topical application).**

DEFECTS OF AMELOGENESIS

- **Amelogenesis imperfecta (AI) is a group of inherited defects that cause disruption to the structure and clinical appearance of tooth enamel .**
- **The classification of AI reflects the stage of enamel formation during which the problem occurs, giving rise to hypoplastic, hypocalcified**

HYPOPLASTIC ENAMEL	HYPOCALCIFIED ENAMEL
Defect in secretory stage	Defect in maturation stage
formation of thin enamel sheets 	Defect in quantity of minerals Low mineral content 

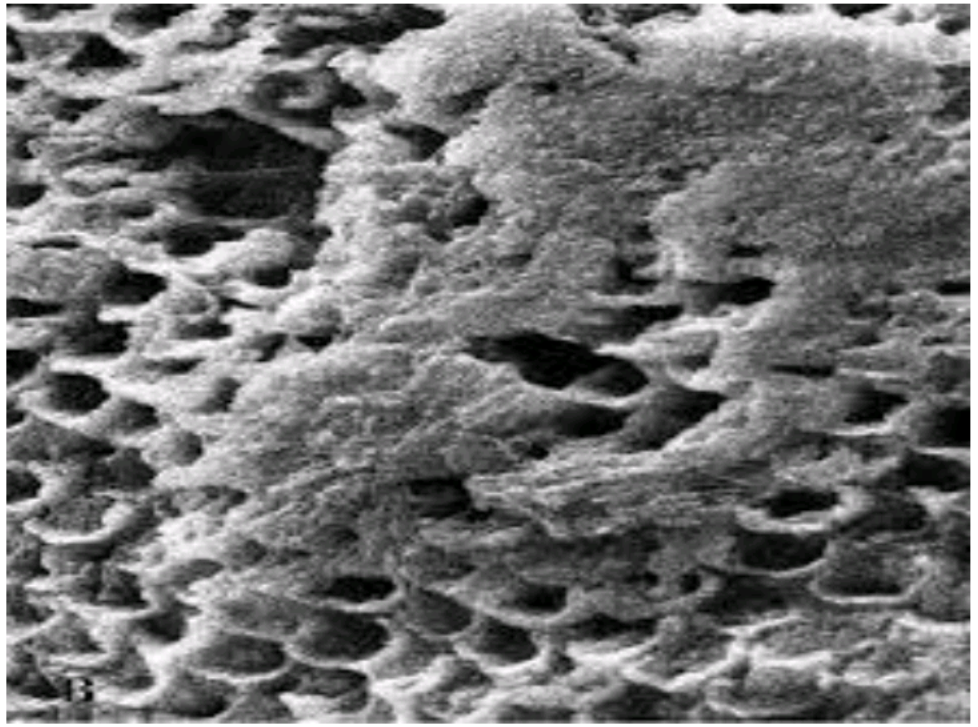
CLINICAL IMPLICATIONS

1-Fluoridation

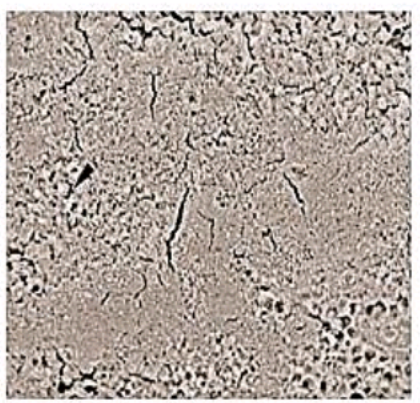
- **If the fluoride ion is incorporated into or adsorbed on the hydroxyapatite crystal, the crystal becomes more resistant to acid dissolution.**
- **This reaction partly explains the role of fluoride in caries prevention, because the caries process is initiated by demineralization of enamel. Obviously, if fluoride is present as enamel is being formed, all the enamel crystals will be more resistant to acid dissolution.**
- **The amount of fluoride must be controlled carefully, however, because of the sensitivity of ameloblasts to the fluoride ion and the possibility of producing unsightly mottling. The semipermeable nature of enamel enables topical application to provide a higher concentration of fluoride in the surface enamel of erupted teeth.**

2-Acid Etching

- **Acid etching of the enamel surface, or enamel conditioning, has become an important technique in clinical practice. bonding of restorative materials to enamel, and cementing of orthodontic brackets to tooth surfaces involve acid etching.**
- **The process achieves the desired effect in two stages: first, acid etching removes plaque and other debris, along with a thin layer of enamel.**
- **second, it increases the porosity of exposed surfaces through selective dissolution of crystals, which provides a better bonding surface**



Enamel after 37 % phosphoric acid etching Enamel after 10 % polyacrylic acid etching




thank
YOU
SO
much