Enamel

   1. Assigned Reading:
      i. Chapter 4.

B. Objectives: To recognize and apply the following concepts:
   1. Physical Properties of Enamel
   2. Enamel Rods
      - Rod Arrangement
      - Rod Morphology
      - Arrangement of Enamel Crystals
   3. Histology of Enamel
   4. Dentinoenamel Junction (DEJ)
      - Enamel Spindles
      - Enamel Tufts
      - Enamel Lamellae
   5. Gnarled Enamel
   6. Hunter-Schreger Bands
   7. Clinical Significance of Histology

C. Physical Properties: Enamel is the hardest tissue in the body
   1. 96% Calcium hydroxyapatite crystals (mineralized substance)
      i. Crystals are very large, when compared to those of dentin, cementum, or bone
      ii. Much longer, and look like rectangular 2x4s
   2. 4% organic materials (mostly enamelin, some tuftelin)
      i. Enamelin matrix is smeared on the surface of the crystals
   3. Enamel is light-blue in coloration (sort of like glaciers), more translucent
      i. It’s the yellowish hue of dentin that makes people’s teeth yellowish in color
      ii. Harder the enamel, more translucent the tooth, so more yellow the tooth
         a. This is indication that you have good, strong teeth
   4. Enamel of young person is more permeable to water, ions, and low MW substances than the enamel of an older person
   5.

D. Enamel Rods: Enamel is composed of enamel rods (enamel prisms)
   1. Enamel is made by ameloblasts (process called amelogenesis) in increments called rod segments → Rod segments make up enamel rods
   2. Rods are parallel to each other
   3. Perpendicular to enamel surface and to DEJ (thus have slight curvature)
   4. In 3D: look like extended cylindrical keyholes
      i. Bulbous region = head
      ii. Skinny region = tail (Interrod enamel)
5. Lines pass through the rods, called **Daily Imbrication Lines (DIL)**
   i. DIL shows diurnal rhythm of amelogenesis
   ii. The space in b/t each DIL = **enamel segments** (1 day’s worth enamel)
6. Enamel segments reflect the health status of the person (even systemic health)
   i. Sometimes you make healthy enamel, sometimes not so healthy.
   ii. The regions of rod segments representing differentiation of health are called = **Striae of Retzius** (concept like rings of trees)
a. S. of R. called **Neonatal Line** after birth has occurred
   1. The line is enlarged due to trauma occurring during birth

iii. On the surface, these striae overlap, forming parallel shallow grooves = **Perikymata** and parallel elevations = **Imbrication Lines of Pickerill**
   a. These are vestigial structures that disappear w/ age/use
   b. Reflects health of mother and/or health of child
   c. S. of R. called **Neonatal Line** after birth has occurred
      1. The line is enlarged due to trauma occurring during birth

iv. **Arrangement of Enamel Crystals**
   a. W/in enamel rod, the enamel crystals are oriented differently
   b. Crystals located w/in center of rod are parallel to long axis of rod
   c. At the periphery of rod, crystals are oriented obliquely to long axis
   d. At the center of the tail, crystals are perpendicular to long axis
e. Creates an optical illusion of rod shape (hard to tell head from tail)
f. Each crystal can be as long as 800-900n, in length / 25nm is breadth
   1. Each crystal is covered by thin layer of enamelin
   2. Thus, organic component of enamel is well distributed throughout enamel

E. Histology of Enamel:
   1. Cross Section: Enamel on outside, then dentin in middle, and pulp in center
      i. Enamel rods are parallel to each other in one plane, perpendicular from DEJ – surface
      ii. In parallel planes, rods diverge by 2 degrees for up to +/- 10 degrees
      iii. Rods shift just enough (from parallel) to prevent formation of cleavage planes
         a. This way the enamel can’t split so easily due to mechanical forces

2. Orientation/Rod Morphology:
   i. Keyhole shape of enamel rods allows them to be tightly packed
   ii. Enamel heads contact the enamel tails in cluster of 4
      a. Head of each rod is formed by 1 ameloblast => Head is actual enamel
      b. Tail is formed by 3 different ameloblasts => Tail is Interrod Enamel
      c. 4 tails end up surrounding 1 head
      d. Tails called Interrod enamel b/c w/in center of cluster arrangement
      e. Ameloblast orientation:
         1. Roughly hexagonally-shaped, almost mimics the head region of the enamel rod
         2. Again, they are clustered in 4
         3. Thus, it takes 4 ameloblasts to make 1 enamel rod
            i. Boxes are prismatic, the shear layer is aprismatic

3. Dentoenamel Junction: DEJ
   i. Junction is scalloped to allow the convexity of enamel to fit into concavity of dentin

   ii. 3 different structures:
      a. **Enamel Spindles** – short spindle-like structures = ends of dentinal tubules trapped in enamel
      b. **Enamel Tufts** – hypocalcified enamel rods (resemble tufts of grass)
         1. Extend ~1/3 way into enamel from DEJ
c. **Enamel Lamellae** – also hypocalcified enamel rods
d. **2 kinds: True or False**
   1. **F:** Enamel cracks that extend into dentin
      i. Starts at DEJ, ends at surface
   2. **T:** Areas of poorly calcified /undercalcified enamel due to developmental disturbances of the ameloblasts
      i. Starts at enamel surface, end at DEJ

4. **Gnarled Enamel**
   i. Located deep to cusps and made of enamel rods that intertwine as they pass from DEJ to tooth surface
   ii. Protects enamel from forming cleavage plates
5. Hunter – Schreger Bands
   i. When light is reflected (not transmitted) on undercalcified enamel, see dark and light bands whose significance is unknown/not understood
      a. Dark: diazones
      b. Light: parazones

6. Clinical Significance
   i. Floridation of Water supply
      a. 1ppm is optimum level of floride in water to allow the developing enamel to be resistant to the acid in caries producing plaque
      b. Florosis:
         1. Ameloblasts are very sensitive to Fluoride ions and high (above 5 parts/ million=Fluorosis) levels of fluoride can disturb or kill ameloblasts causing malformed enamel or “mottled” enamel.
   ii. Chronologic enamel hypoplasia:
      a. Childhood diseases causing high temperatures can disturb amelogenesis for the period of illness and cause a band of poorly formed enamel.