Tooth Development
Initiation to eruption

Head and Neck embryology
Review head and neck embryology
Skip Review

Initiation
stomodeum
During 6th week, ectoderm in stomodeum forms horseshoe shaped mass of oral epithelium.
Initiation of anterior primary teeth begins the sixth to seventh week of development, initiation of additional teeth follows and continues for years.

Dental Lamina – Initiation

Dental Lamina begins growing into mesenchyme at site where tooth will be.

Supernumerary tooth
Mesiodens

PREDICT what would happen if an extra tooth was initiated.
Bud Stage – eighth week

Dental lamina grows down into mesenchyme at site of tooth.
Mesenchyme starts to change composition in response

Predict what would happen if two tooth buds fused together or one tooth bud split in half.

Fusion/Gemination

Fusion
Gemination

Predict how you would know if it was fusion or gemination

Cap stage – week 9

By week 9, all germ layers of future tooth have formed

Enamel organ (enamel only)
Dental papilla (dentin and pulp)
Dental sac (cementum, PDL, Alveolar bone)

Cap Stage

Successional Dental Lamina

Each primary tooth germ has a successional lamina that becomes a permanent tooth
Succedaneous teeth replace a deciduous tooth, nonsuccedaneous do not

Identify nonsuccedaneous teeth

Predict What occurs if no successional lamina forms?
**Congenitally missing teeth**

What tooth is missing? Identify tooth C

**Bell Stage – Enamel Organ**

- Outer enamel epithelium (OEE)
- Protective coating
- Inner enamel epithelium (IEE)
- Will become ameloblasts
- Stratum Intermedium
  - Helps make enamel
- Stellate reticulum
  - Supports enamel formation

**Bell Stage**

**Bell Stage – Dental Papilla**

- Outer cells of papilla
  - Will become odontoblasts
- Inner cells of papilla
  - Will become pulp

**Formation of enamel and dentin**

- Basement membrane
- Inner enamel epithelium
- Outer cells of papilla

When nuclei of IEE move away from basement membrane, they become preameloblasts.

Nuclei of outer cells of papilla then move away from basement membrane and become odontoblasts.

The odontoblasts then begin laying down dentin matrix.
Dentin formation

- Odontoblast starts here (at what once was basement membrane)
- And ends up in pulp chamber
- As it moves and lays down dentinal matrix, it leaves part of itself behind so it ends up looking like this
- Odontoblastic process
- Body of cell

Types of dentin

- Peritubular dentin - Highly mineralized dentin surrounding tubule
- Intertubular dentin - dentin between tubules
- Mantle dentin - first dentin to be laid down

Dentin Formation

- The dentin that is present when a tooth erupts is called “primary dentin”.
- Odontoblasts continue to produce dentin after eruption making pulp chamber smaller. This is “secondary dentin”.
- Odontoblasts also make “reparative dentin” in response to trauma. It has no tubules.
- Dead odontoblasts make empty tubules called “dead tracts”.

Types of dentin

- A – Enamel
- B – Primary dentin
- C – Secondary dentin
- D – Mantle dentin
- E – Circumpulpal dentin

Calcified dentin cross section

Dentinal tubule (occupied by odontoblastic process)
Peritubular dentin (highly mineralized)
Intertubular dentin (bulk of dentin)
**Dentinogenesis Imperfecta**
- Autosomal dominant defect
- Enamel chips off because it is unsupported
- Teeth have bluish color

**Pulp Abnormality**
- “Pulp stone” is calcified mass in pulp
- Few are true “denticles” produced by odontoblasts.
- Most are layers of calcium surrounding dead cells

**Formation of Enamel**
- After odontoblasts lay down predentin, basement membrane disintegrates and preameloblasts become ameloblasts
- Ameloblasts then begin moving away from what was basement membrane, secreting enamel matrix from Tome’s process

**Formation of Enamel**
- Millions of ameloblasts start here at what was basement membrane
- They end up here, each leaving enamel matrix behind
- Dentin and enamel matrix later replaced with hydroxyapatite crystals of calcium, phosphorus, and fluoride (if available)

**Enamel Rods**
- Key shaped enamel matrix (enamelon) is replaced with hydroxyapatite crystals of calcium, phosphorus, and fluoride (if available) to form an enamel rod
- Enamel matrix not laid down evenly so calcification varies. Variations seen as Stria of Retzius and incremental lines

**Enamel Cuticle and Reduced Enamel Epithelium**
- Last thing ameloblasts do is produce primary enamel cuticle which coats tooth
- IEE then joins with OEE to form reduced enamel epithelium (REE)
Eruption

• REE joins with oral epithelium
• REE then produces enzymes that dissolve epithelium, creating eruption tunnel
• Enzymes cause inflammation which causes “teething” pain

Attachment apparatus

• As tooth erupts, REE becomes part of attachment apparatus

Enamel Abnormalities - Amelogenesis Imperfecta

• Genetic defect
• Imperfect enamel matrix or hypocalcification or hypomaturation

Enamel Abnormalities - Hypocalcification

• Appear as white spots
• The spots can be as hard as normal tooth

Enamel Abnormalities – Turner’s tooth

• Enamel hypoplasia caused by injury to succedaneous tooth

Enamel Abnormalities – high temperature

• Enamel hypoplasia caused by high fever during illness
• At what age was the fever
Enamel Abnormalities – Fluorosis

- In large amounts, fluoride can cause staining or pitting (enamel hypoplasia)

Root Formation

- Root formation begins at the “cervical loop”
- IEE and OEE join together to make Hertwig’s root sheath
- Root formation begins after enamel matrix is laid down but before calcification

Cervical loop and Hertwig’s root sheath

- Epithelial diaphragm
- Cervical loop grows down into mesenchyme to form Hertwig’s root sheath.
- Number of roots is determined by the way it grows.

Root Formation

- As root sheath grows, it stimulates dental papilla cells to become odontoblasts and form dentin
- The odontoblasts cause the sheath to dissolve
- When the odontoblasts contact the dental sac, they create cementoblasts that start making cementum

Cementum Formation

- 60% of the time, cementum overlays enamel
- 30% of the time cementum meets enamel
- 10% of the time cementum does not meet enamel exposing dentin
- PREDICT what a patient might experience when cementum does not meet enamel
Cementum Formation
- In cervical 2/3 of tooth, cementoblasts dissolve, so its acellular cementum
- In the apical 1/3, cementoblasts get trapped in developing cementum as cementocytes, can later lay down more cementum

Root abnormalities - Concrescence
- A form of fusion
- Teeth joined by cementum

Dilaceration
- Abnormal shape of root
- Problem for dentist during extraction

Enamel pearl
- Hertwig root sheath cells differentiate into ameloblasts
- Can be confused with calculus

Supernumerary roots
- Most often seen in third molars

Taurodontism
- Also called “bulls teeth”
- Extra large pulp chamber
- No constriction at CEJ
- Genetic link
Lateral abnormalities

- Dens in dente
- Microdontia

Talon Cusp

- On axillary laterals and central incisors
- Cusp contains pulp horn

Cysts

- Radicular (periapical) cyst
- Radicular cyst clinically

Dentigerous Cyst

- Also called follicular cyst
- Associated with unerupted tooth
- Arises from reduced enamel epithelium
- Most common in mandible

Dentigerous cyst

- Can lead to ameloblastoma

Odontogenic Keratocyst

- Arises from enamel organ, contains keratin
- Frequently reoccurs!
- Multilocular
- Grows aggressively
Primordial cyst
- Cyst develops instead of tooth,
- Most common in third molar region
- Always associated with a missing tooth
- Can become ameloblastoma

Residual cyst
- A radicular cyst that was not enucleated when tooth removed
- Differentiate from a primordial cyst

Eruption cyst
- Fluid trapped between tooth and reduced enamel epithelium
- Resolves when tooth erupts

Lateral periodontal cyst
- Arises from Hertwig’s root sheath
- Found in bone
- Most often near mandibular cuspid or premolar

Gingival cyst
- Found in soft tissue
- Same as lateral periodontal cyst

Eruption Rules
- Teeth of girls erupt sooner than boys
- Permanent teeth start forming 6 years before eruption, deciduous 2.5 years
- Mandibular teeth erupt before maxillary
- Roots not completely formed when tooth erupts
- The permanent crown is completely formed 3 years before it erupts

PREDICT why cohort girls have a higher DMF than boys