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DEVELOPMENT OF TEETH: Sylabus for foreign students – Dental medicine

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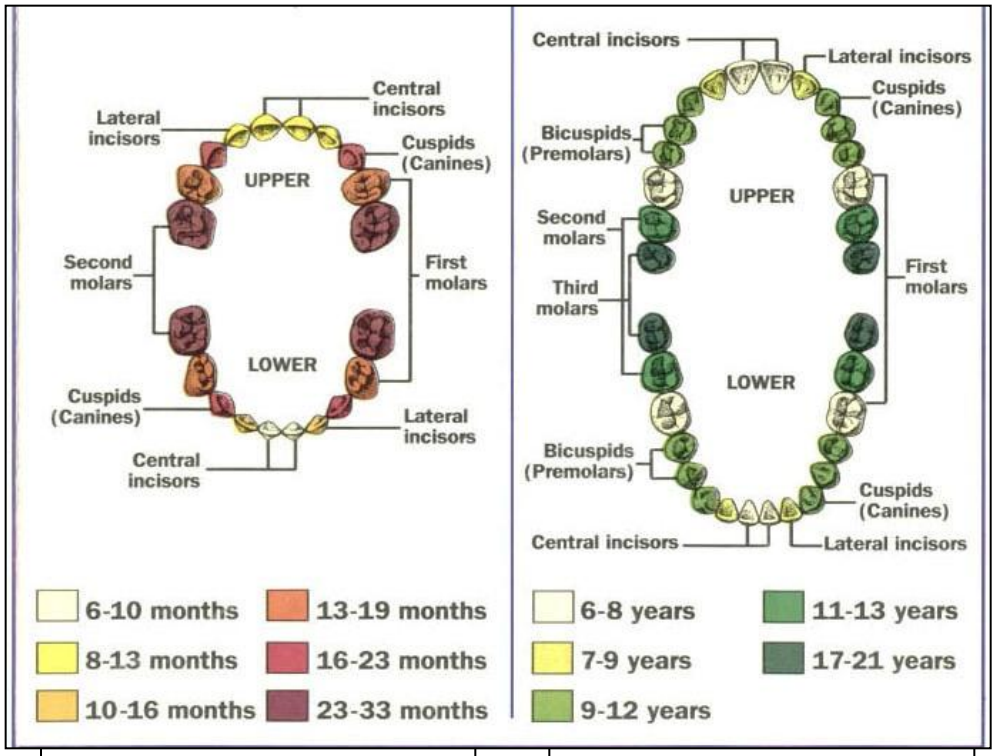


Primary dentition – deciduous teeth - 20

Secondary dentition – permanent teeth - 32

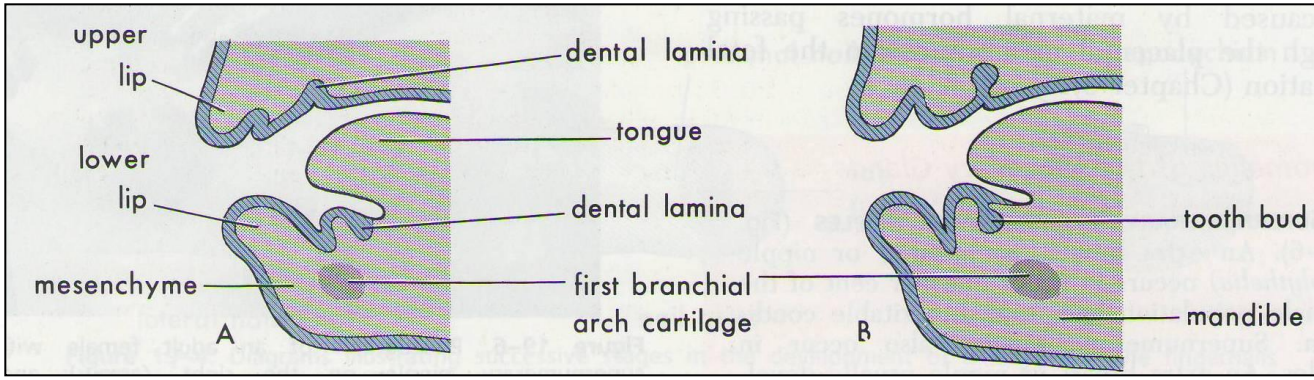
ODONTOGENESIS – tooth development

- **enamel (ameloblasts)** developes from the oral **ectoderm**
- **dentine, cementum, pulp, periodontal membrane** originate from the **mesenchyme**

Mesenchyme derives from the* mesoderm *and* neural crest cells *(ectomesenchyme)

TOOTH DEVELOPMENT

6th w



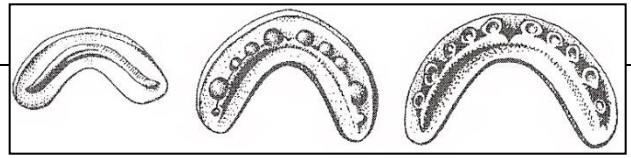
ECTODERM of oral cavity forms:

LABIODENTAL LAMINA - lamella parallel to the lip edge
- is divided by longitudinal labiodental sulcus

labiobuccal lamina (lips)	gingival lamina (gingiva)

proliferation of ectodermal cells toward the mesenchyme

tooth buds



DENTAL LAMINA

„U“- shaped band

Upper and lower jaw with 10 centers of ectodermal proliferation:

tooth buds of deciduous teeth develope at 6th w.

tooth buds for permanent teeth develope at 10th w.

DEVELOPMENTAL POINTS OF THE TOOTH:

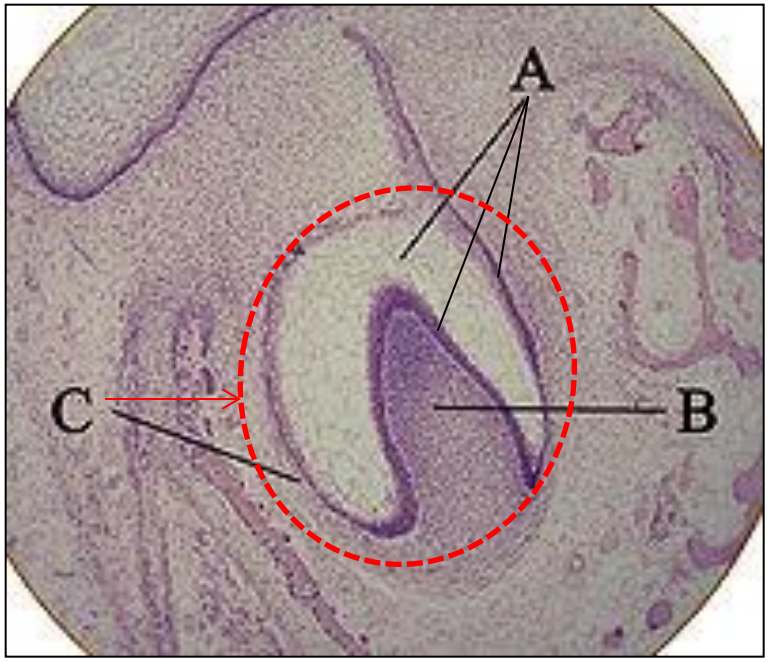
1. **Development of the tooth primordia:**
   - **a. enamel organ**
   - **b. dental papilla**
   - **c. dental sac**
2. **Development of tooth crown:**

   dentinogenesis, amelogenesis
3. **Development of the root:**

   dentinogenesis, cementogenesis, development of periodontium
4. **Development of tooth pulp and bone socket** (in maxilla and mandible)

   in the same time like development of crown and root

Tooth developes from 3 sources:
(A) enamel organ, (B) dental papilla, (C) dental sac



A. Enamel organ:

a. outer enamel epithelium
b. enamel reticulum (stellate reticulum)
c. stratum intermedium
d. inner enamel epithelium – AMELOBLASTS (enamel, crown)

B. Dental papilla:

- differentiation of odontoblasts (dentine of the crown and root)
- dental nod in the concave part of enamel organ induces differentiation of odontoblasts
- connection between dental papilla and inner enamel epithelium defines shape of the tooth crown
- mesenchymal dental papilla gives rise to tooth pulp

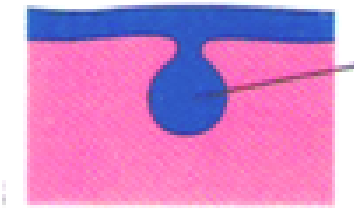
C. Dental follicle (sac):

1. CEMENTOBLASTS - cementum (outer surface of the root)
2. OSTEOBLASTS - alveolar bone (around the root)
3. FIBROBLASTS – periodontium (collagen fibers)

Tooth development is divided into 4 stages: bud, cap, bell stages and maturation

1. Bud stage

6 – 8 w.



Ectodermal epithelial cells proliferate into the mesenchyme of the jaw and forms TOOTH BUD

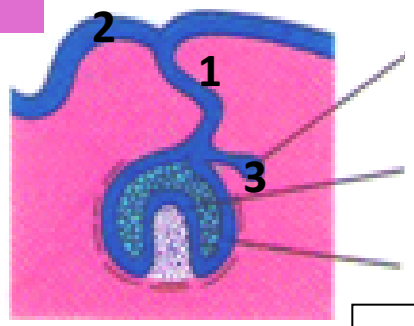
2. Cap stage

9 – 10 w.

- **Condensation of mesenchymal dental papilla beneath the „bud“**
- **invagination of tooth bud by mesenchyme**
- **ectodermal tooth bud grows around dental papilla**
- **„cap–shaped“ ectoderm becomes enamel organ**

3. Bell stage

11 – 12 w.



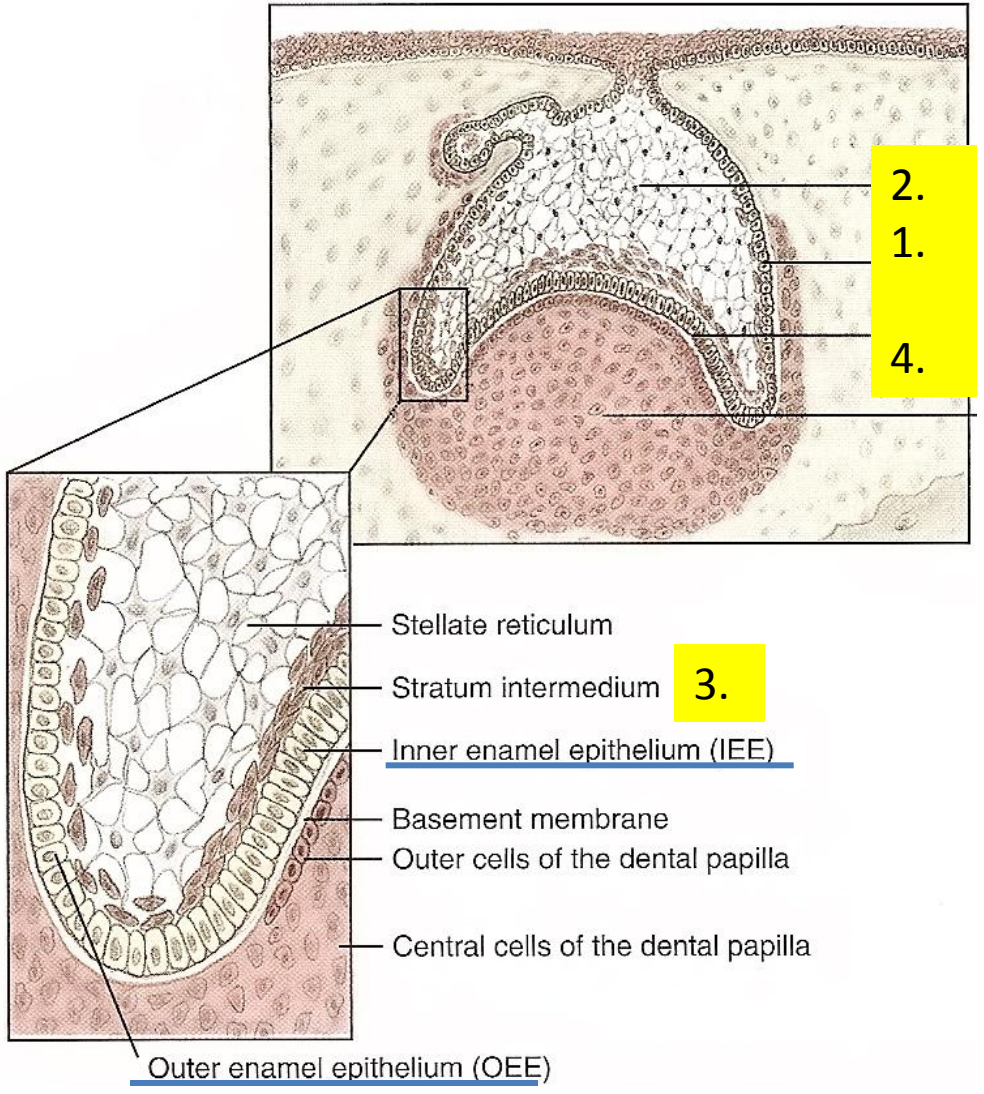
- **Enamel organ is „bell-shaped“**

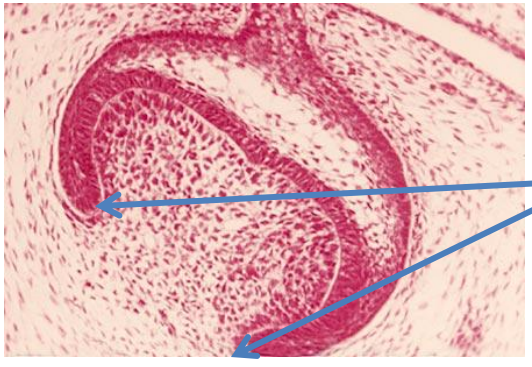
  connected with dental lamina (1) and superfitial ectoderm (2).

- **Formation of permanent tooth bud (3)**

A. Enamel organ (bell stage):

1. **outer enamel epithelium** (convex site) = outer ameloblasts ; cuboidal cells
   protective layer
2. **enamel reticulum** – star shaped cells ,
   glycosaminoglycans, water
   serves for metabolism of ameloblasts
3. **stratum intermedium**
   appears at the bell stage
   2-3 layers of flattened cells
   close to inner ameloblasts;
   transport of material,
   secretion of alcaline phosphatase
4. **inner enamel epithelium** (concave site)
   = inner ameloblasts: produce enamel
   on the surface of the crown





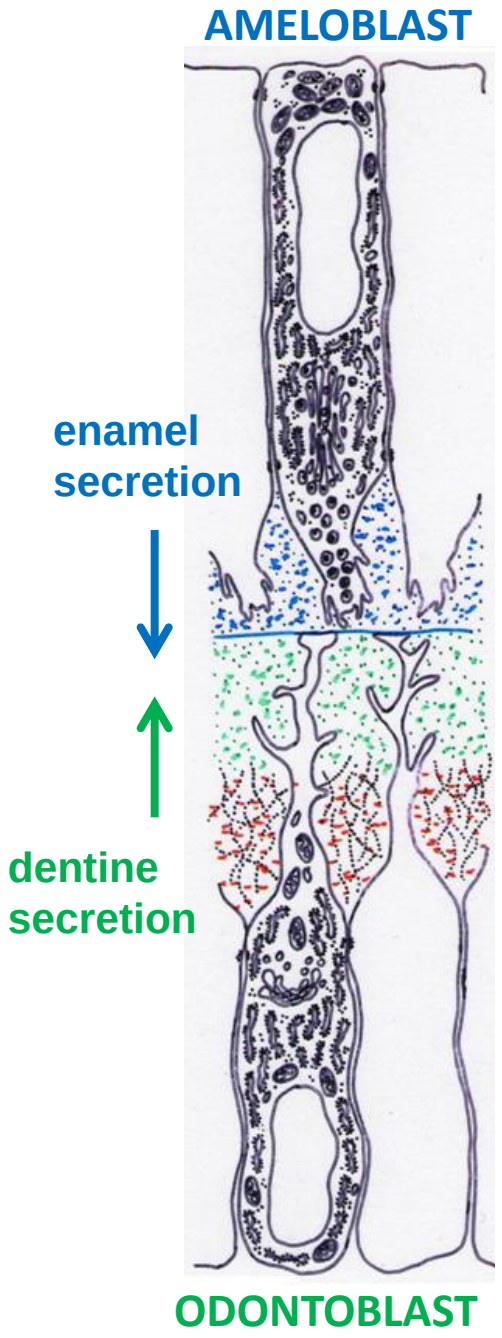
HERTWIG SHEATH = epithelial root sheath:
- place of contact between outer and inner enamel epithelium
- defines the shape and formation of the root

4. Stage of aposintional growth and maturation of tooth
- **a) formation of the crown**
- **b) formation of the root**

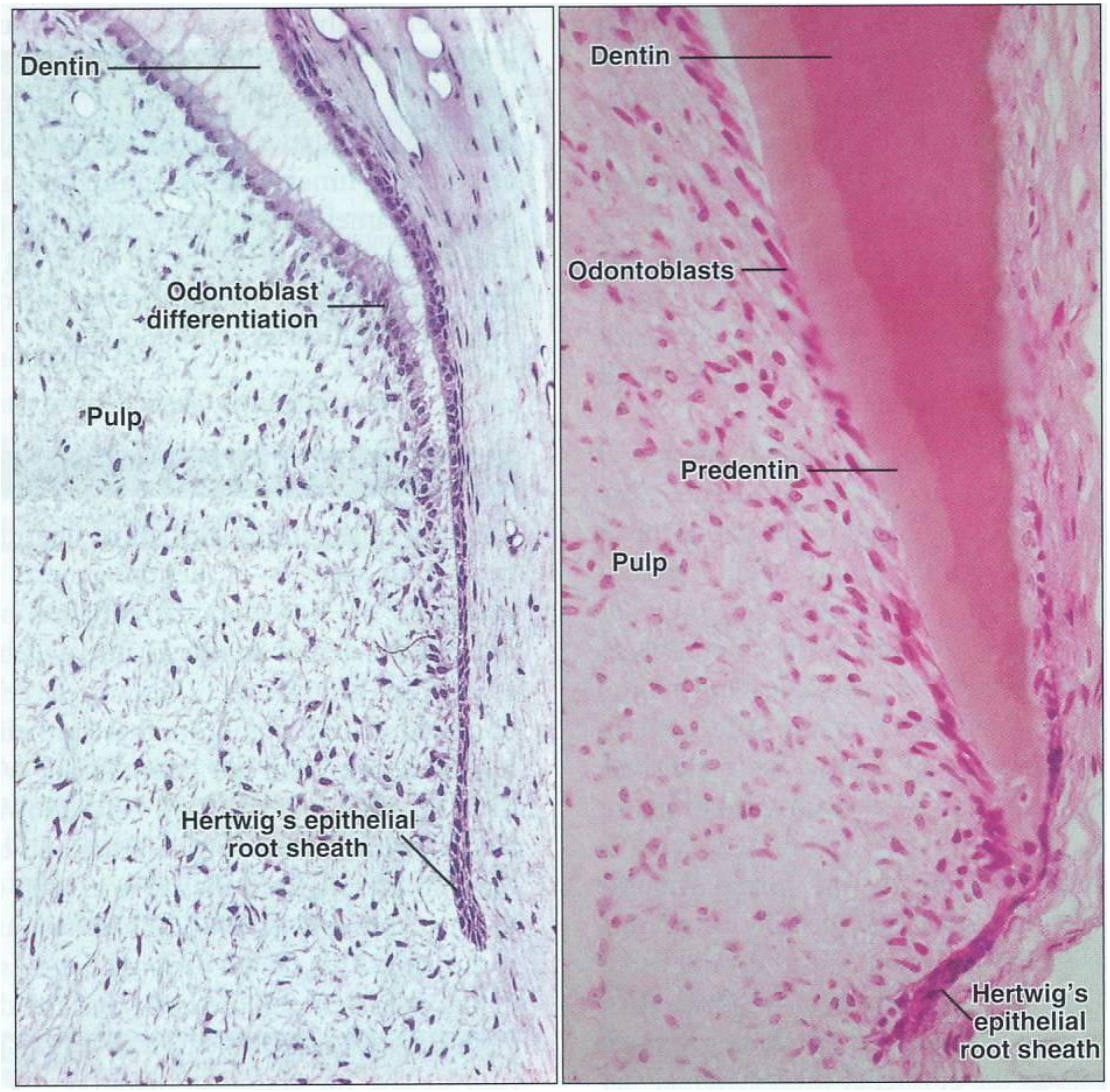
DENTINOGENESIS: odontoblasts produce dentine toward inner ameloblasts

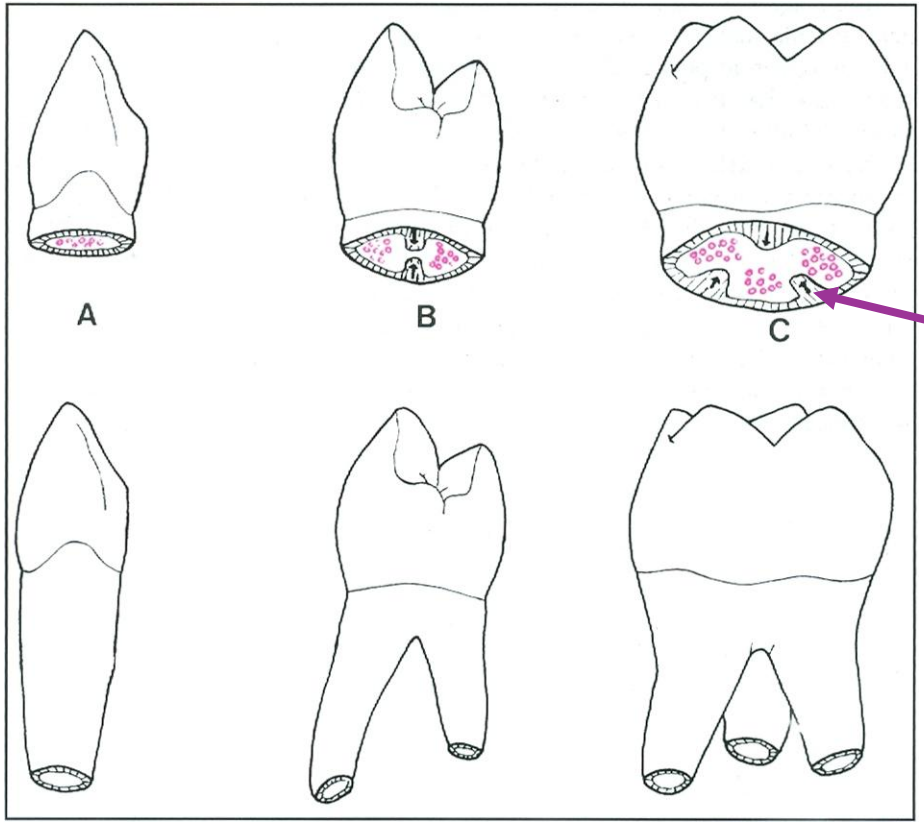
AMELOGENESIS: inner ameloblasts produce organic substance of enamel against the dentine, formation of the crown.

Ameloblasts retreat off the layer of enamel!!!



The location where the outer and inner enamel epithelium join is called the cervical loop. The growth of cervical loop cells into the deeper tissues forms Hertwig's epithelial root sheath, which determines the root shape.





ROOT FORMATION

- starts later - when crown is formed
- after eruption of tooth only 2/3 of the root is comleted

ingrowth of epithelial shelves

Teeth are:

single-, two-, three-rooted

- **primary apical foramen at the growing end of epithelial root sheath is wide**
- **ingrowth of epithelial shelves divide single root cavity and continue 2 or 3 root development**
- **growing epithelial root sheath enclose dental papilla except apical foramen**

Dental sac (follicle) that lies external to the root sheath gives rise to:

1. **cementum - mesenchymal cells adjacent to dentin differentiate to cementoblasts – lay down layers of cementum**
2. **periodontal ligaments - collagen fibers are produced by fibroblasts**
3. **alveolar bone is formed by intramembranous ossification by osteoblasts**

TOOTH ERUPTION

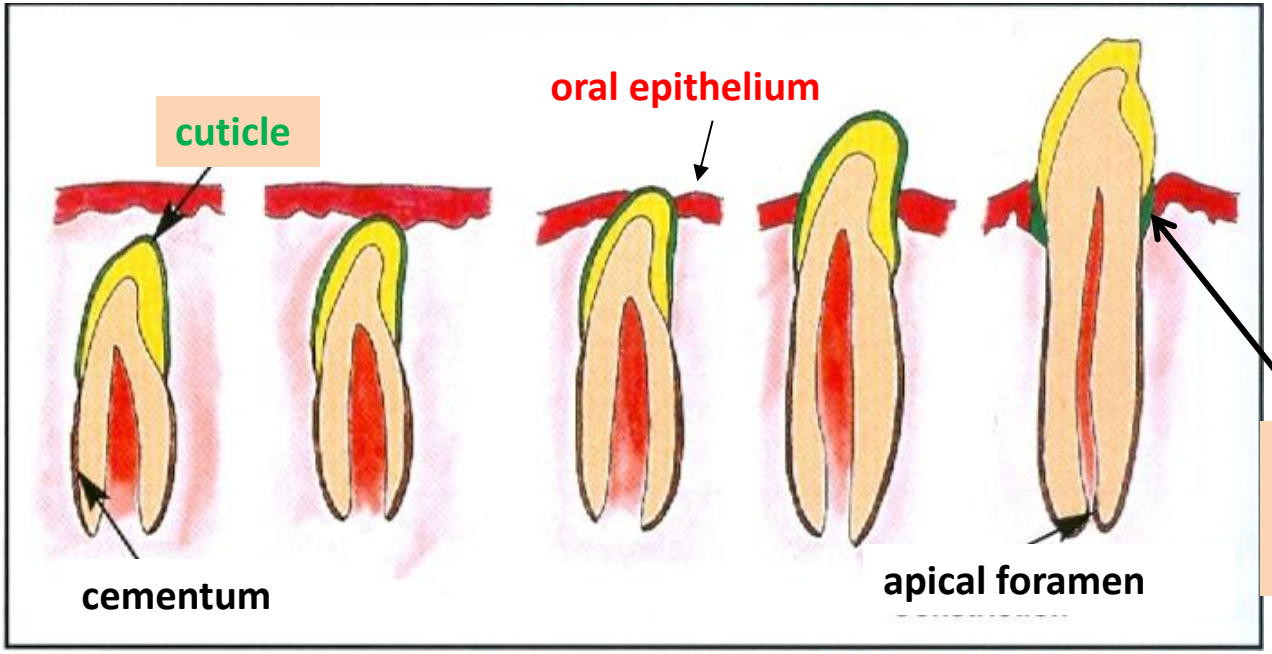
DECIDUOUS TEETH

When the tooth crown is fully developed, enamel organ is reduced. Inner and outer ameloblasts meet each other and form thin layer on the surface of the crown called enamel cuticle or Nasmyth membrane.

Enamel cuticle:

1. **protects enamel from resorption by cells of the dental sac**
2. **secretes enzymes for elimination of the dental sac**
3. **allows fusion of reduced enamel epithelium and oral epithelium**
4. **disrupt oral epithelium and allows eruption of the tooth**

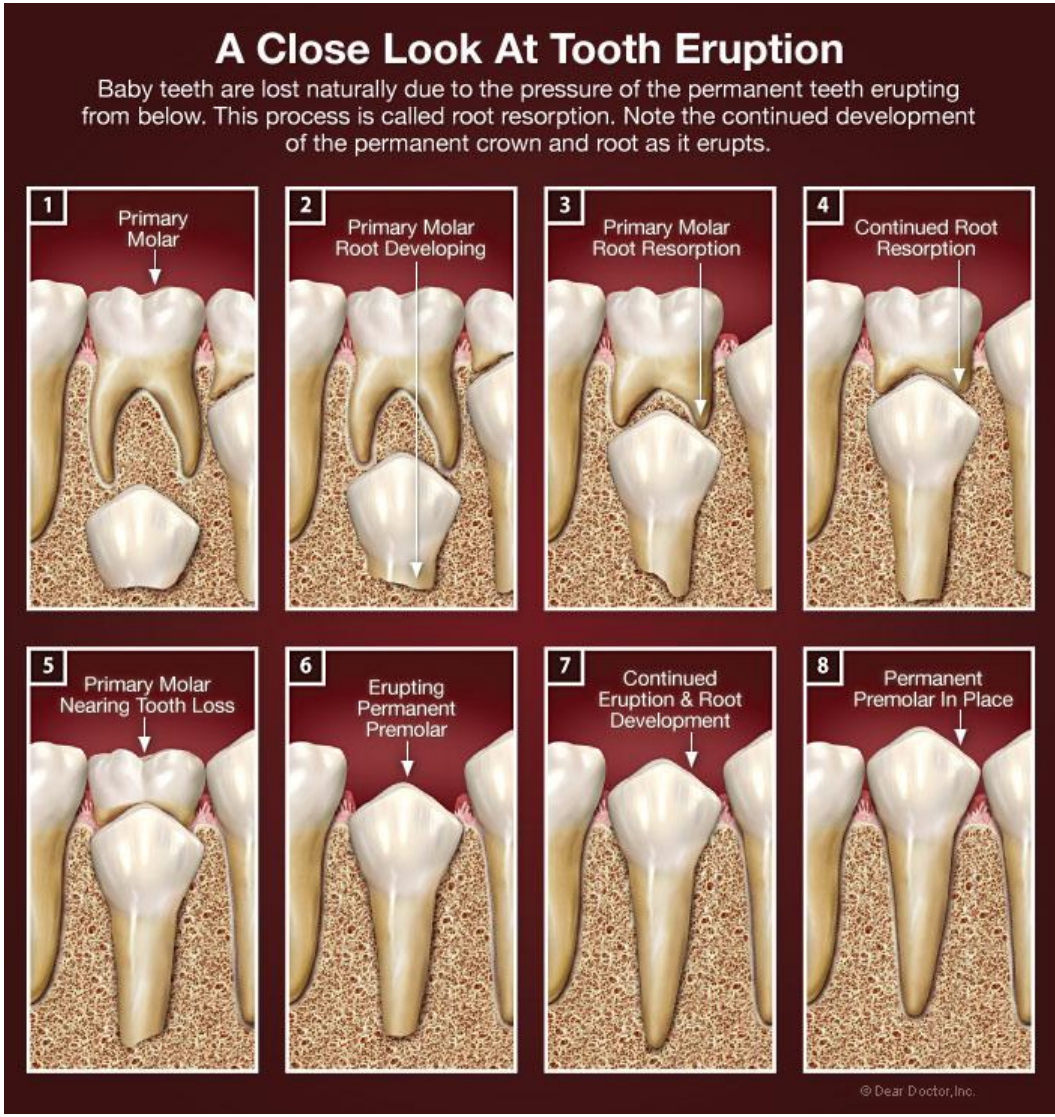
As the root of the tooth grows, its crown gradually erupts through oral epithelium.



remnants of cuticle – form dentino-gingival junction

PERMANENT TEETH

As the permanent tooth grows, the root of deciduous tooth is resorbed by osteoclasts.

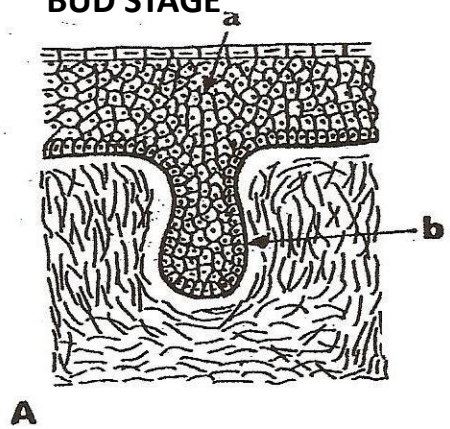


DEVELOPMENT OF TOOTH SOCKET - ALVEOLUS

- **development of maxilla and mandible by intramembranous ossification**
- **starts when enamel organ is developed**
- **dental sac cells induce and activate alveolar bone development**

Tooth development detailed schematic description

BUD STAGE

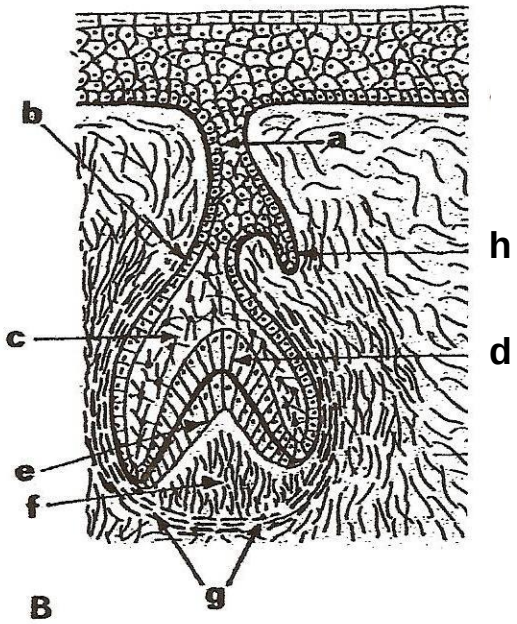


A.

a - oral epithelium, ectoderm

b - tooth bud

CAP STAGE



B.

(a) – primary dental lamina

(b) - outer enamel epithelium

(c) - stellate reticulum

(d) – inner enamel epithelium

(e) – odontoblasts

(f) - dental papilla

(g) – dental sac

(h) – secondary dental lamina for development of permanent tooth

BELL STAGE of tooth development

(a) - dental sac

(b) - outer enamel epithelium

(c) - stellate reticulum

(d) - inner enamel epithelium (inner ameloblasts)

(e) - layer of odontoblasts

(f) - dental papilla

(g) - primary dental lamina

(h) - bud for permanent tooth, secondary dental lamina