ORAL HISTOLOGY Lect.7 2023 ا.د.عذراء

TOOTH DEVELOPMENT

Tooth development can be divided into three phases:

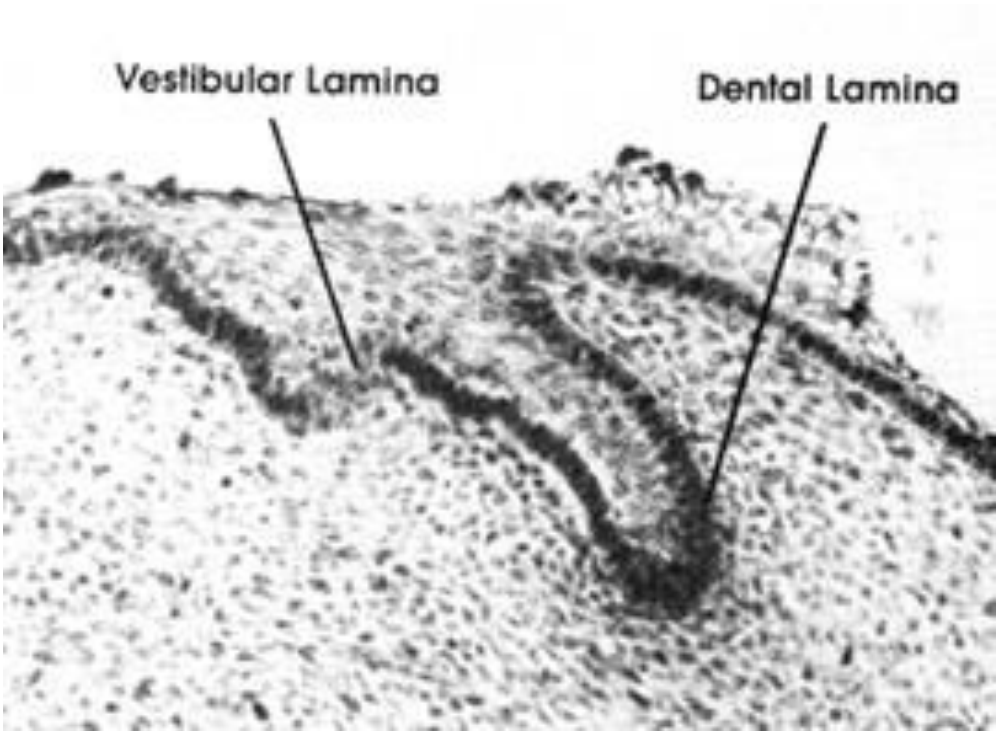
1. **initiation**
2. **morphogenesis**
3. **histogenesis.**

During initiation, the sites of the future teeth arc established with the appearance of tooth germs along an invagination of the oral epithelium called the dental lamina. During morphogenesis, the shape of the tooth is determined by a combination of cell proliferation and cell movement. During histogenesis, differentiation of cells (begun during morphogenesis) proceeds to give rise to the fully formed dental tissues, **both mineralized (i.e. enamel, dentine and cementum) and unmineralized (i.e. dental pulp and periodontium). Tooth development is characterized by complex interactions between epithelial and mesenchymal tissues.**

By **6th week** of development the oral epi. Thickened and invaginate into the mesenchyme to **form a primary ep. band**. By **7th week** the primary band divides into **two processes a buccally located vestibular lamina and a lingual one the dental lamina**.

The **vestibular lamina** form **the vestibule of the mouth, delineating the lips; cheeks from the tooth-bearing regions.**

The **dental lamina that contributes to the development of the teeth as by the eighth week the dental lamina appears as an arch shaped band of epithelial tissue carrying a series of swellings.**



• ***Initiation of Tooth Development***

Teeth develop from two types of cells—

1.**oral epithelial cells that give rise to the enamel organ**

2. **mesenchymal cells with neural crest cell form ectomesenchymal tissue form the dental papillae and dental follicle (sac).**

In the jaws ,dental lamina invaginates as a sheet of epithelial cells into the underlying mesenchyme ,a**long the lamina 20 areas of enlargement next appear, which are the forming buds of the 20 primary teeth**

Function of dental lamina

1. forming buds of the 20 primary teeth

2. Form the buds of permanent dentition lingual to the buds of the primary teeth

3. form the permanent molar buds.The last teeth to arise from the dental lamina are the third molars, which develop in about the fifteenth year after birth

The dental lamina is thus functional in developing the 52 teeth from the sixth prenatal week until 15 years after birth.

After the primary teeth have developed and their crowns erupt and become functional, the permanent tooth buds are just beginning to develop, permanent molar teeth are not succedaneous replacements for the primary teeth.

***Clinical* Comment**

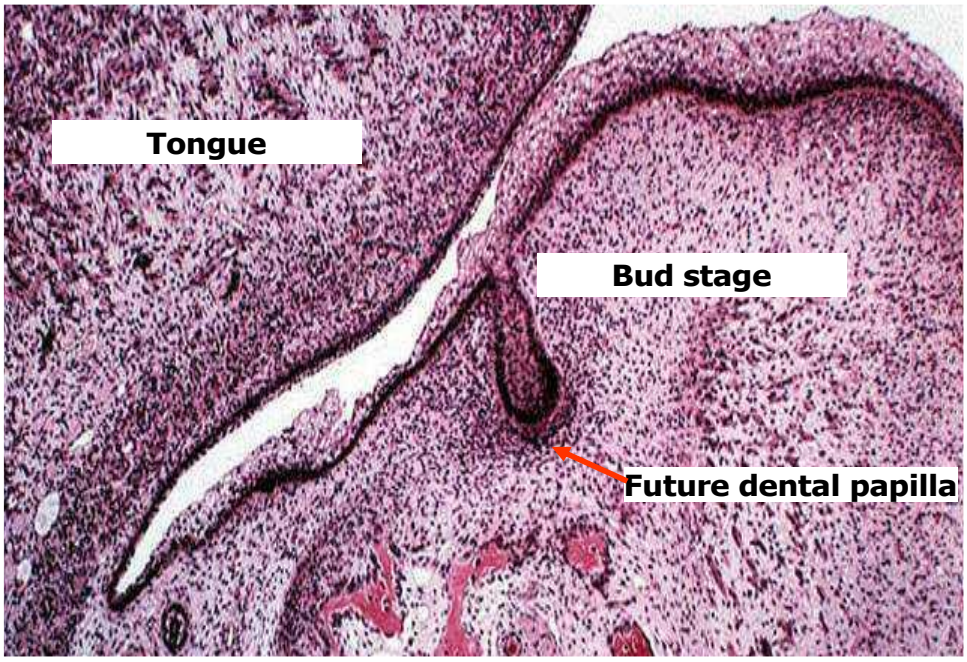
Tooth formation is dependent on both oral epithelial and adjacent mesenchymal cells for development. Factors such as x-rays, nutritional deficiencies, and drugs can alter the ability of these cells to function, thus affecting tooth development.

Stages of tooth development

For descriptive purposes, tooth germs are classified into **bud, cap and bell stages according to the degree of morphodifferentiation and histodifferentiation of their epithelial components (enamel organs)**. Leading up to the **late bell stage**, the tooth germ changes rapidly both in its size and shape; the cells are dividing and morphogenetic processes are taking place. **At the late bell stage, hard tissues are forming** and further growth of the crown is related mainly to the deposition of enamel, the rate of cell division being reduced.

1.Bud Stage

The enamel organ in the bud stage appears as a simple, spherical to ovoid, epithelial condensation that is poorly morphodifferentiated and histodifferentiated. It is surrounded by mesenchyme. The epithelial bud is induced by the underlying mesenchyme and the successful development of the tooth germ relies upon a complex interaction of the mesenchymal and epithelial components since, should these components be separated and cultured individually, neither will differentiate further. **The epithelial component is separated from the adjacent mesenchyme by a basement membrane.**



2.Cap Stage

By the **11th week**, **morphogenesis** **has progressed, the deeper surface of the enamel organ invaginating to form a cap-shaped structure**.

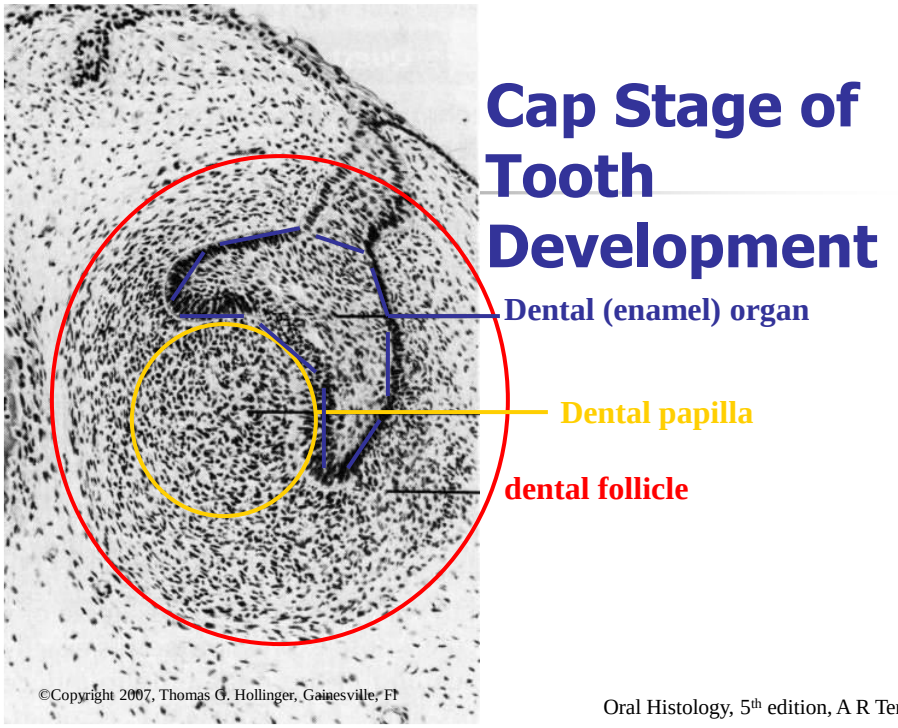
Enamel organ are arranged to form the

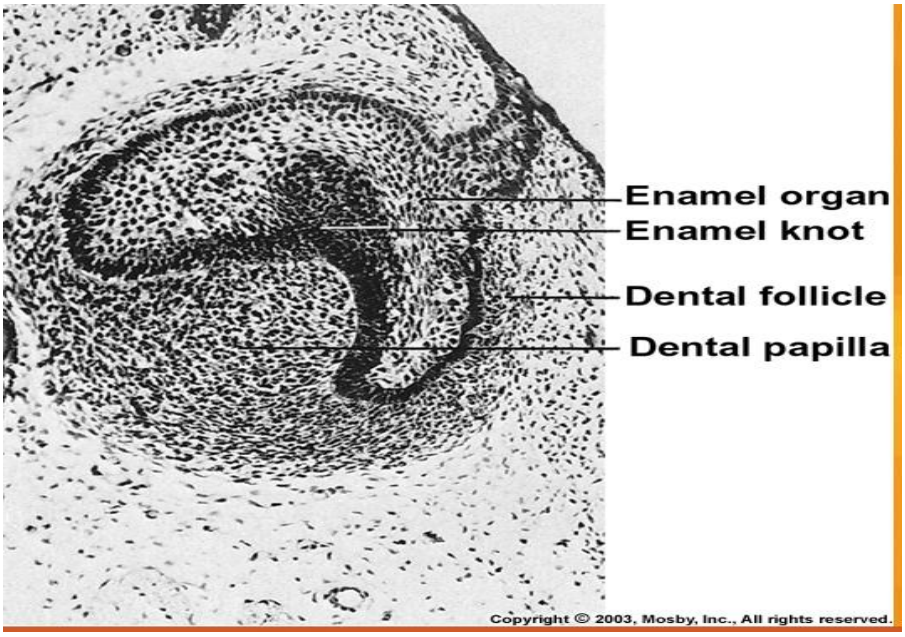
1.Outer enamel epithelia (cuboidal cell)

2.inner enamel epithelia(columnar cell).

3.Stellate reticulum(cell contain glycosaminoglycans)

While the adjacent mesenchymal cells continue to proliferate and surround the enamel organ. The part of the mesenchyme lying beneath the internal enamel epithelium is termed the **dental papilla**, while that surrounding the tooth germ forms the **dental follicle(dental sac).**





Temporary structures (transitory structures) that disappear before enamel formation begins

1.Enamel knots are clusters of non dividing epithelial cells visible in sections of molar cap stage tooth germs.

- **enamel knot forms a bulge into the dental papilla, at the centre of the enamel organ. It was once thought that the enamel knot played a role in the**

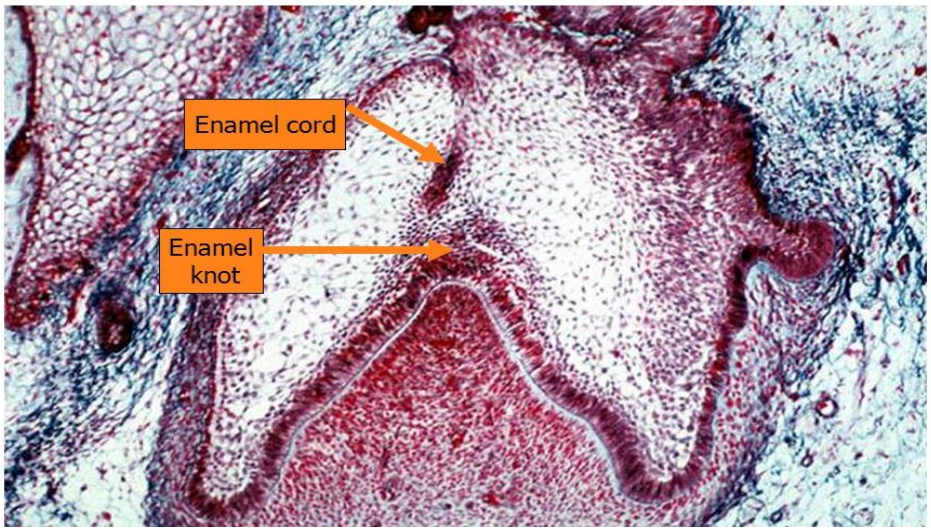
1. play in formation of crown pattern by outlining the central fissure. Therefore , it play an important role by the cuspal morphogenesis.

2.it may represent an important signaling Centre during tooth development

However, the enamel knot a transitory structure soon disappears and seems to contribute cells to the enamel cord .

2.Enamel cord(enamel septum): In some planes of section, one can see cells extending from the enamel knot across the stellate reticulum to the outer enamel epithelium .This structure is part of the enamel knot organizational center forming enamel navel like umbilicus.

3. enamel niche (seen in bell stage) is an apparent structure in histologic sections, created because the dental lamina is a sheet rather than a single strand and often contains a concavity filled with connective tissue. A section through this arrangement creates the impression that the tooth germ has a double attachment to the oral epithelium by two separate dental strands .



3.Early bell stage

By the **14th week**, further morphodifferentiation & histodifferentiation of the tooth germ **Differentiation produces four types of cells within the enamel organ**

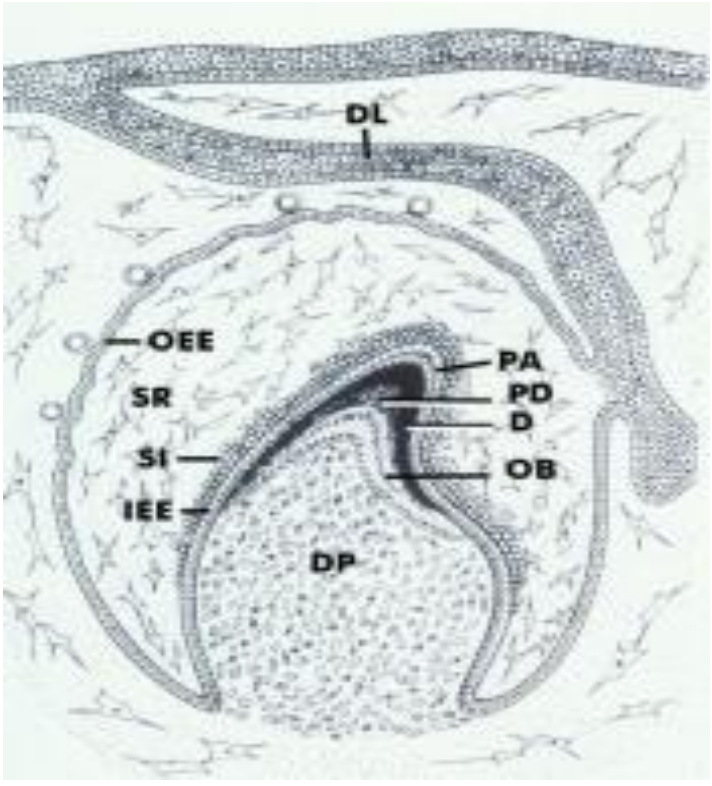
1. inner enamel epithelium(IEE) short, columnar cells differentiates into the enamel secreting cells = **ameloblasts** separated from the dental papilla below it by a basement membrane

2. outer enamel epithelium(OEE) cuboidal shape cells ,are separated from the dental follicle by a basement membrane.

3. stellate reticulum :star-shaped cells in many layers,center of the enamel organ forms a network = reticulum,supports production of enamel

4. stratum intermedium :layer of compressed flat to cuboidal cells

very high levels of the enzyme alkaline phosphatase ,supports production of enamel & share in calcification of enamel



The **dental lamina breaks down and the enamel organ loses connection with the oral epithelium**. The mesenchymal tissue of the **dental follicle**, which is generally considered to have **three layers**.

(1)The inner investing layer is avascular, fibro-cellular condensation.

(2)The outer layer is vascular mesenchymal layer

(3)Between the two layers is loose connective tissue with no marked concentration of blood vessels. Other structure appears in bell stage **is cervical loop:**which is a region that IEE and OEE are continuous

4.Advanced bell stage

This stage is characterized by the

1- **commencement of mineralization and 2- root formation.**

- **During the advanced bell stage, the boundary between inner enamel epithelium and odontoblasts outlines the future dentinoenamel junction.**
- **The formation of dentin occurs first as a layer along the future dentinoenamel junction in the region of future cusps and proceeds pulpally and apically.**
- **After the first layer of dentin is formed, the ameloblast which has already differentiated from inner enamel epithelial cells lay down enamel over the dentin in the future incisal and cuspal areas.**
- **The enamel formation then proceeds coronally and cervically, in all regions from the dentinoenamel junction (DEJ) towards the surface.**
- **the cervical portion of the enamel organ gives rise to the epithelial root sheath of Hertwig. The Hertwig's epithelial root sheath (HERS) outlines the future root and is thus responsible for the shape, length, size, and number of roots.**

Ectoderm ……..> Oral ep. ……> Dental lamina ……>Enamel organ ……. .> Inner E Ep. ……..> Ameloblast …….> Enamel

Mesoderm + Neural crest cell ……> Ectomesenchymal tissue …….> Dental papilla and Dental Sac

Dental papilla ……> Dentine & Pulp
Dental sac …….> Cementum , periodontal ligament (pdl) and Alveolar bone.

Formative cells for tooth structures
Ameloblast …… Enamel
Odontoblast…… Dentine
Cementoblast …… Cementum
Fibroblast …… Periodontal ligament (pdl)
Osteoblast …….. alveolar bone