Oral Histoliogy

Root formation

Lect 9 ***Dr.Enas Fadhil Kadhim***

The development of the roots begins after enamel & dentin formation has reached the future cementoenamel junction.

The enamel organ plays an important part in root development by forming Hertwig's epithelial root sheath, which molds the shape of the roots & initiates radicular dentin formation.

Hertwig's epithelial root sheath consists of the outer & inner enamel epithelia only

Prior to the beginning of root formation, the root sheath forms the epithelial diaphragm. The outer & inner enamel epithelia bend at the future cementoenamel junction into a horizontal plane, narrowing the wide cervical opening of the tooth germ. The plane of the diaphragm remains relatively fixed during the development & growth of the root.
The proliferation of the cells of the epithelial diaphragm is accompanied by proliferation of the cells of the C.T. of the pulp, which occurs in the area adjacent to the diaphragm.
The differentiation of odontoblasts & the formation of dentin follow the lengthening of the root sheath .
At the same time the C.T. of the dental follicle surrounding the root sheath proliferates & invades the continuous double epithelial layer (Hertwig's epithelial root sheath) dividing it into a network of epithelial strands.
Then the epithelium is moved away from the surface of the dentin so that C.T. cells come into contact with the outer surface of the dentin of the root & differentiate into cementoblst that deposit a layer of cementum onto the surface of the root dentin.
In the last stages of root development, the proliferation of the epithelium in the diaphragm lags behind that of the pulpal C.T.
The wide apical foramen is reduced first to the width of the diaphragmatic opening itself & later is further narrowed by apposition of dentin & cementum to the apex of the root.

Formation of multi-root

When the Hertwig's epithelial root sheath formed from a double layer of inner & outer enamel epithelium. This sheath grows around the dental papilla between the dental papilla & the dental follicle.

Differential growth of the epithelial diaphragm in multirooted teeth causes the division of the trunk into 2 or 3 roots.

To understand multiple root formation, imagine the root sheath as a collar or skirt hanging from the enamel organ.

Two tongues like extension of the horizontal diaphragm develop in teeth with 2 roots & 3 tongues like extension develop in teeth with 3 roots.

The free ends of these horizontal epithelial flaps grow toward each other & fuse.

On the pulpal surface of the dividing epithelial bridges, dentin formation starts, & on the periphery of each opening.

the root sheath determines whether a tooth has single or multiple roots, is short or long, or is curved or straight.

Single roots formation

For single-rooted teeth the root sheath grows like a cuff

or tube around the newly forming pulp

Development of multi-rooted teeth takes place in a same

manner until the furcation area.

When the furcation area is reached the epithelial

diaphragm develops tongue like extensions that grow until

If the continuity of the root sheath is broken before the

dentine is formed it results in missing or abnormal

epithelial cells

When the epithelial cells are missing the Odontoblasts

do not differentiate and dentine doesn't form opposite the

defect that occurred in the root sheath

The result will be a small lateral canal. This lateral canal

is also called as supplemental canal or accessory canal

Accessory canals connect the main root canal with the periodontal ligament

If the epithelial root sheath does not degenerate at the proper time and remain stuck to the surface of the root dentine, then that area becomes devoid of cementum

 Areas of root without cementum can be a cause of sensitivity if the there is gingival recession

Fate of epithelial root sheath

After dentine formation in root takes place, the epithelial root sheath breaks down and its remnants migrate away from the dentinal surface

They lie in the periodontal ligament and are called epithelial rests of Malassez

The epithelial rests of Malassez are found the in the periodontal ligament through out the life

Sometimes when there is chronic inflammation the epithelial cell rest of Malassez proliferate into cysts and tumours

Root formation anomalies

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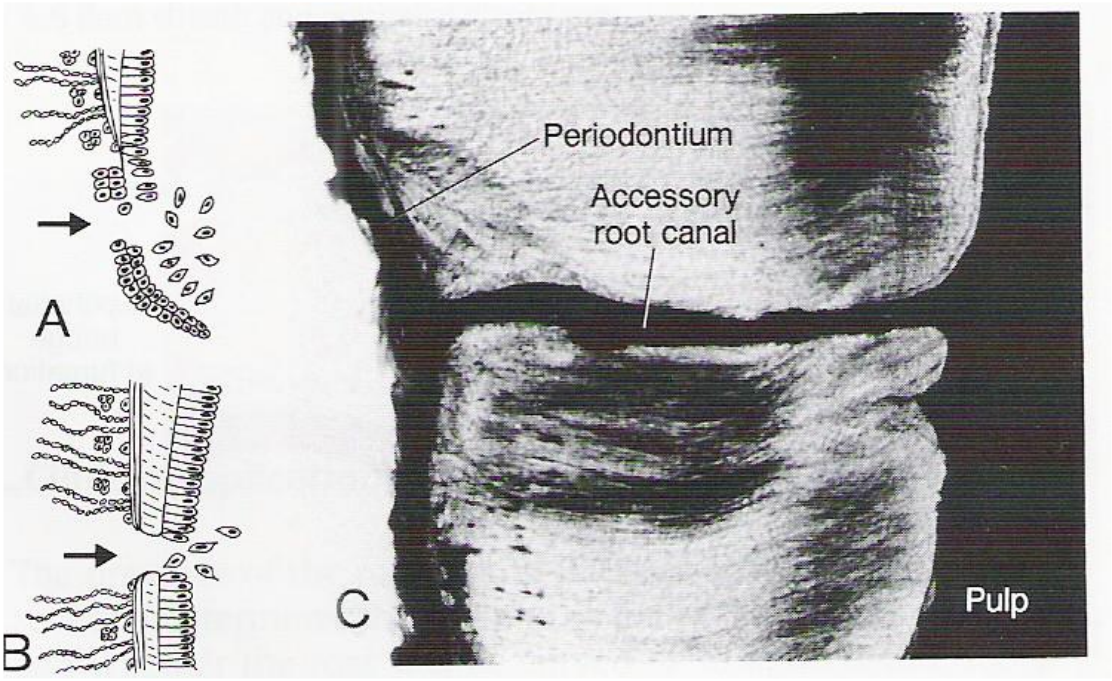
 When the epithelial cells are missing the Odontoblasts do not differentiate and dentine doesn't form opposite the defect that occurred in the root sheath

The result will be a small lateral canal. This lateral canal

is also called as supplemental canal or accessory canal
Accessory canals connect the main root canal with the periodontal ligament they contact each



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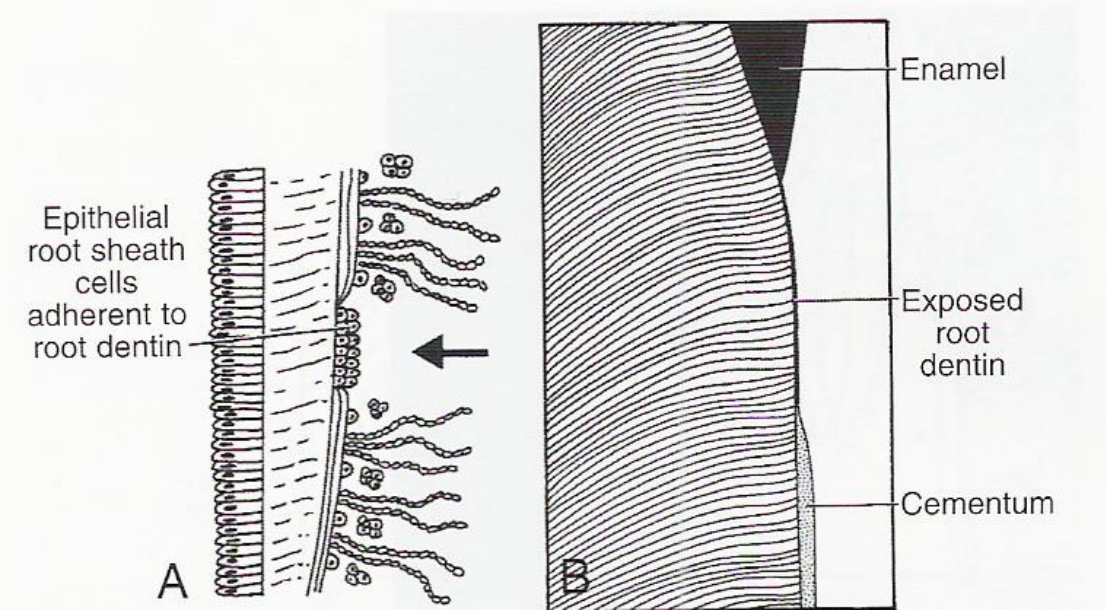
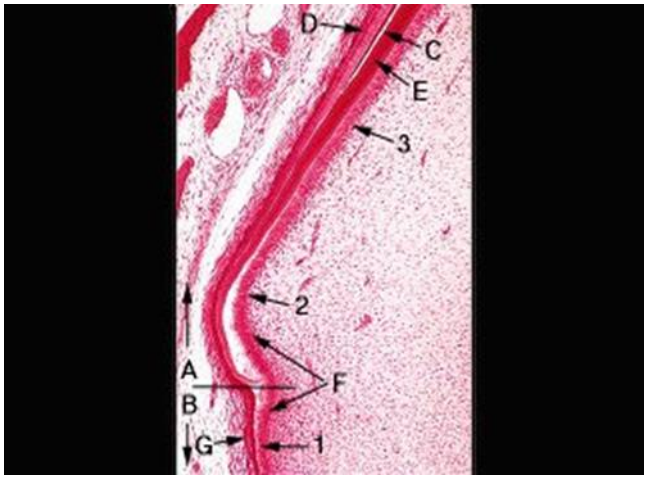
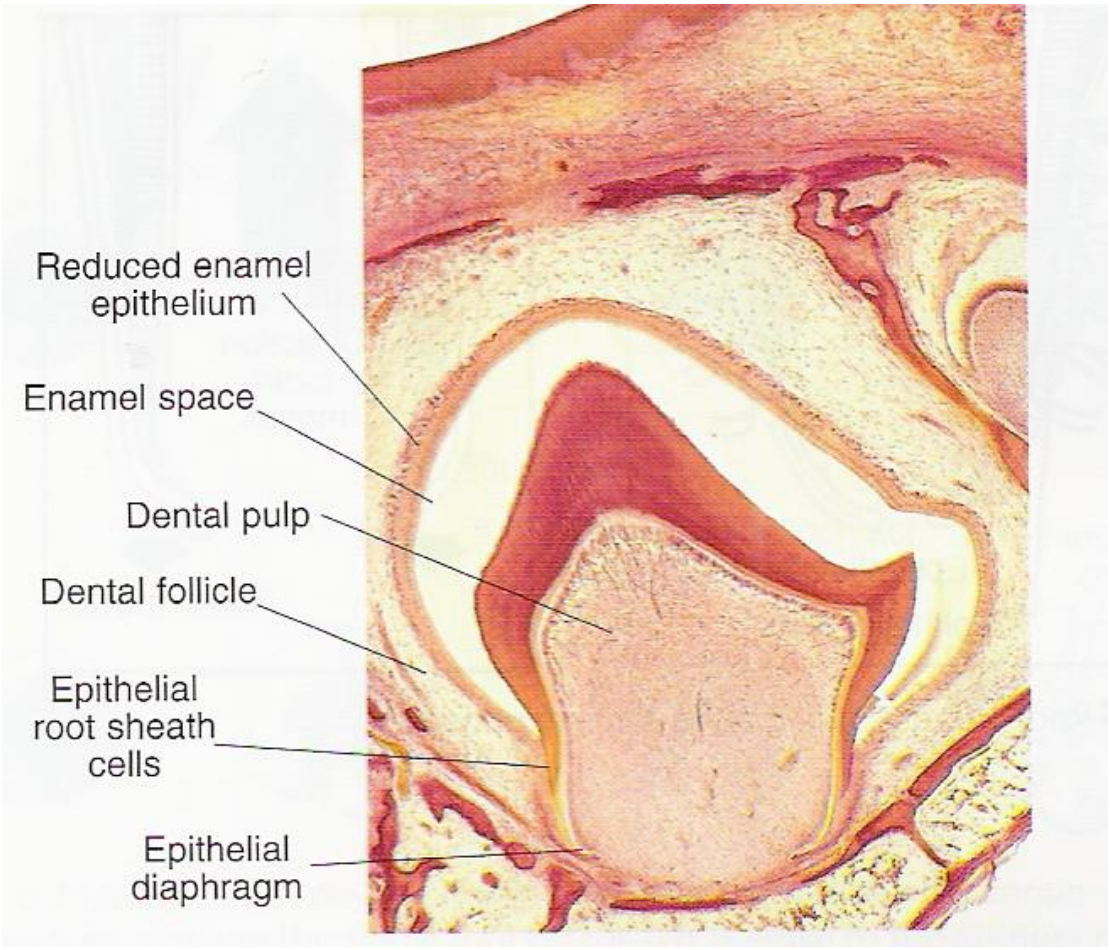
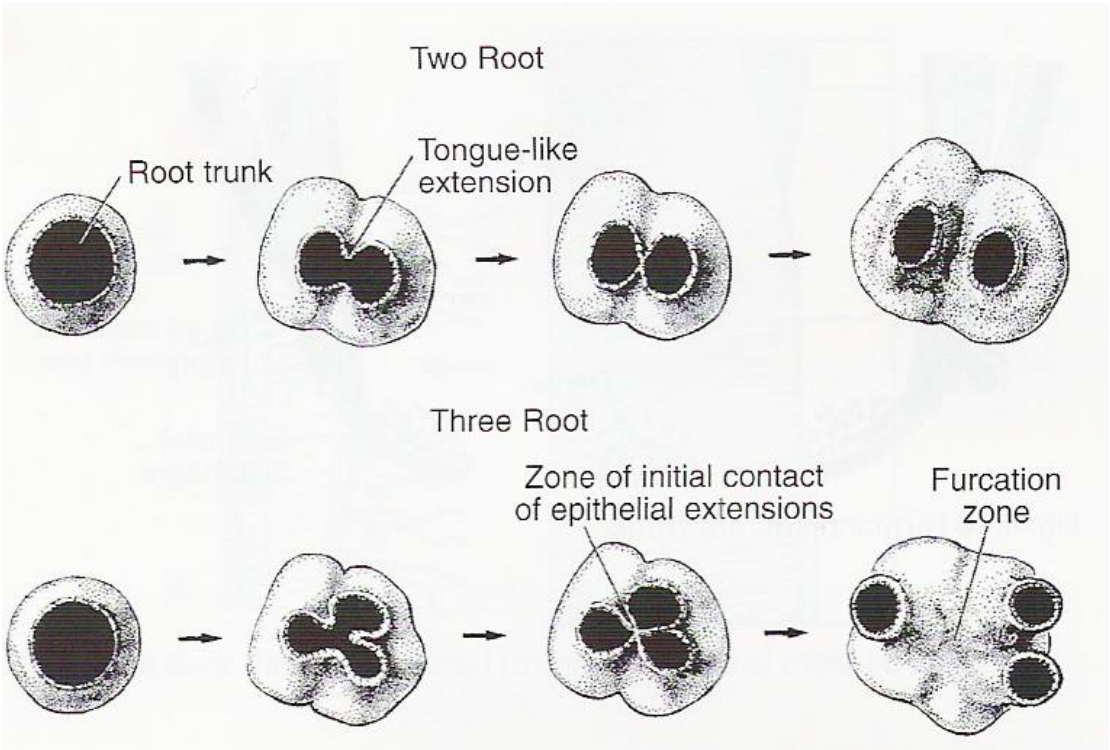




A - crown of tooth
B - root of tooth
C - enamel space
D - ameloblasts
E - dentin

F - odontoblasts
G - epithelial diaphragm
1 - morphogenic region
2 - organizing region
3 - secretory region


Reduced enamel epithelium
Enamel space
Dental pulp
Dental follicle
Epithelial root sheath cells
Epithelial diaphragm


Two Root
Root trunk
Tongue-like extension
Three Root
Zone of initial contact of epithelial extensions
Furcation zone

Cementogenesis

The 'formation of Cementum' is also known as "Cementogenesis", one of the three mineralized substances of a tooth. Cementum covers the roots of teeth and serves to anchor gingival and periodontal fibers of the periodontal ligament by the fibers to the alveolar bone (some types of cementum may also form on the surface of the enamel of the crown at the cementoenamel junction (CEJ)).

Process

For cementogenesis to begin, Hertwig epithelial root sheath (HERS) must fragment. HERS is a collar of epithelial cells derived from the apical prolongation of the enamel organ. Once the root sheath disintegrates, the newly formed surface of root dentin comes into contact with the undifferentiated cells of the dental sac (dental follicle). This then stimulates the activation of cementoblasts to begin cementogenesis. The external shape of each root is fully determined by the position of the surrounding Hertwig epithelial root sheath.

It is believed that either

1) HERS becomes interrupted;

2) infiltrating dental sac cells receive a reciprocal inductive signal from the dentin;

3) HERS cells transform into cementoblasts.

The cementoblasts then disperse to cover the root dentin area and undergo cementogenesis, laying down cementoid. During the later steps within the stage of apposition, many of the cementoblasts become entrapped by the cementum they produce, becoming cementocytes. When the cementoid reaches the full thickness needed, the cementoid

surrounding the cementocytes becomes mineralized, or matured, and is then considered cementum. Because of the apposition of cementum over the dentin, the dentinocemental junction (DCJ) is formed.

After the apposition of cementum in layers, the cementoblasts that do not become entrapped in cementum line up along the cemental surface along the length of the outer covering of the periodontal ligament. These cementoblasts can form subsequent layers of cementum if the tooth is injured. Cementum grows slowly, by surface apposition, throughout life.