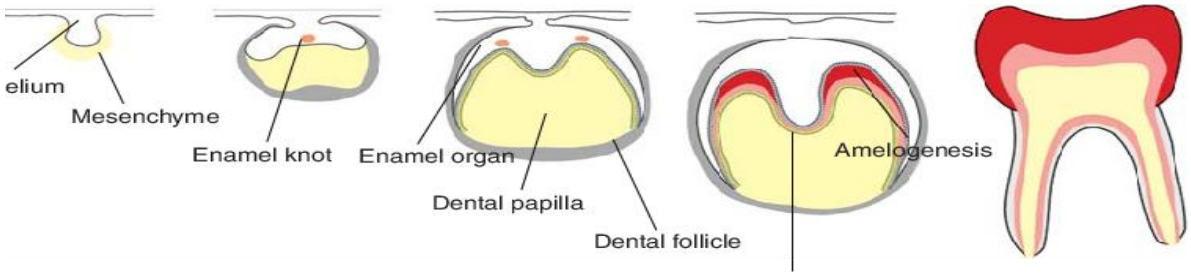
LECTURE
DEVELOPMENT OF TOOTH(ODONTOGENESIS)
PART-III



DR SAJDA GAJDHAR
COURSE COORDINATOR
ORAL CAVITY IN HEALTH

LECTURE LEARNING OUTCOMES

1. Explain early and advanced stage of development of tooth.
2. Describe different cells seen in bell stage
3. Discuss clinical consideration of tooth development

STAGES OF TOOTH DEVELOPMENT AND GROWTH

STAGES OF TOOTH DEVELOPMENT MAY BE DESCRIBED ACCORDING TO:

1- Changes in the morphology of the developing tooth (*MORPHOLOGICAL STAGES*)

2- Its physiological changes (*HISTOPHYSIOLOGICAL STAGES*)

DEVELOPMENTAL STAGES

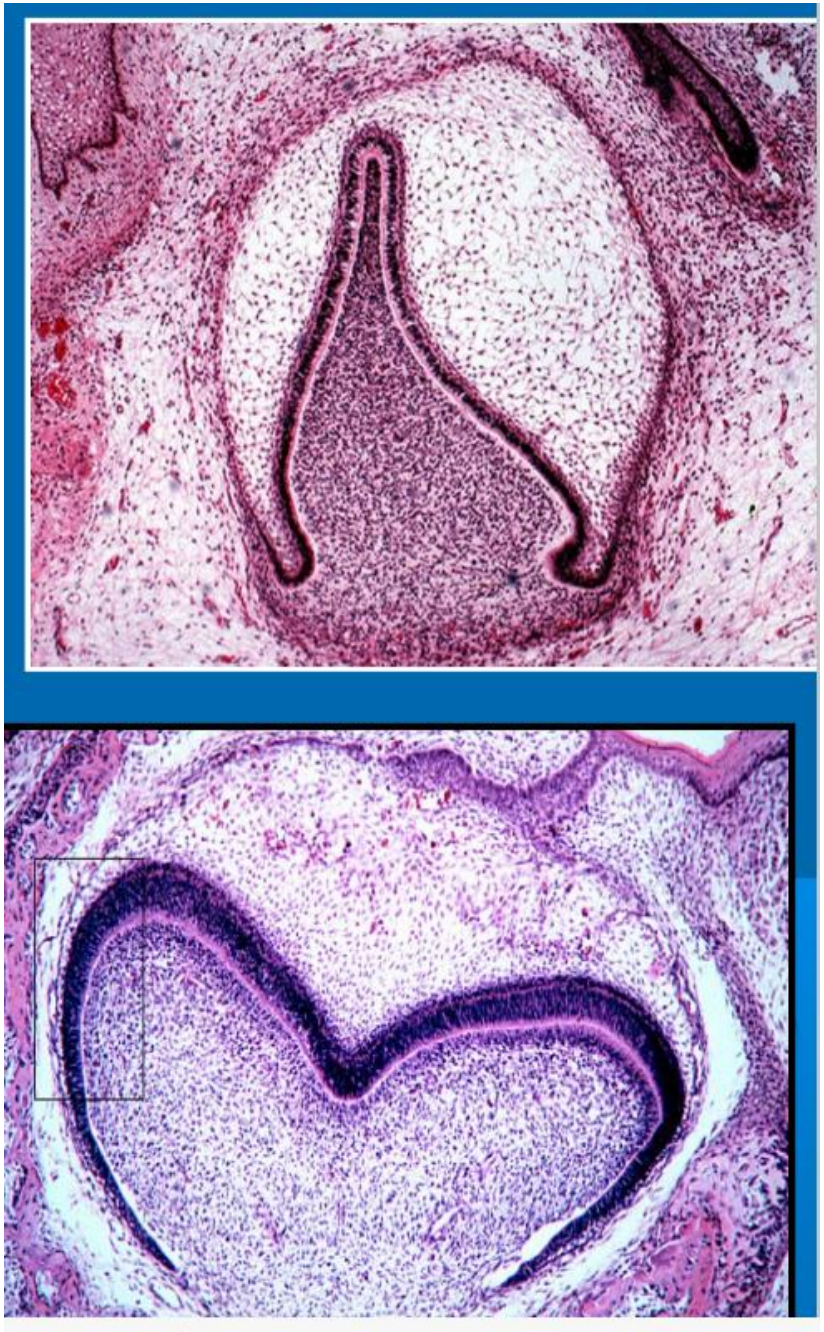
Morphological	Physiological
1. Dental lamina	• Initiation
2. Bud stage 3. Cap stage	• Proliferation
4. Early Bell stage	• Histodifferentiation
5. Advanced Bell stage	• Morphodifferentiation(shape and size of teeth determined)
6. Formation of enamel and dentin matrix	• Apposition

BELL STAGE جرس

Differential growth accompanied by Histodifferentiation & Morphodifferentiation (the tooth crown assumes its final shape) leads to increase in size & shape of the enamel organ to exhibit a **bell shape.**

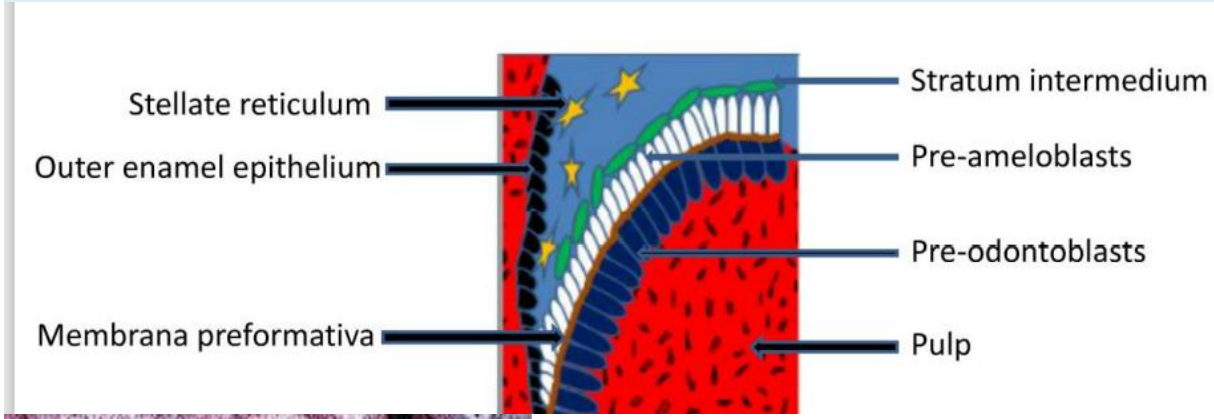
It is divided into:

1. Early bell stage: before any hard tissue formation
2. Advanced or late bell stage: which begins by formation of the first layer of mineralized tissue.



Early Bell stage

1. INNER ENAMEL EPITHELIUM
2. STRATUM INTERMEDIUM
3. STELLATE RETICULUM
4. OUTER ENAMEL EPITHELIUM



The junction between inner and outer enamel epithelium is called **cervical loop** and it is an area of intense mitotic activity.

Four cell layers are present in the Early Bell Stage

1. Outer Enamel Epithelium

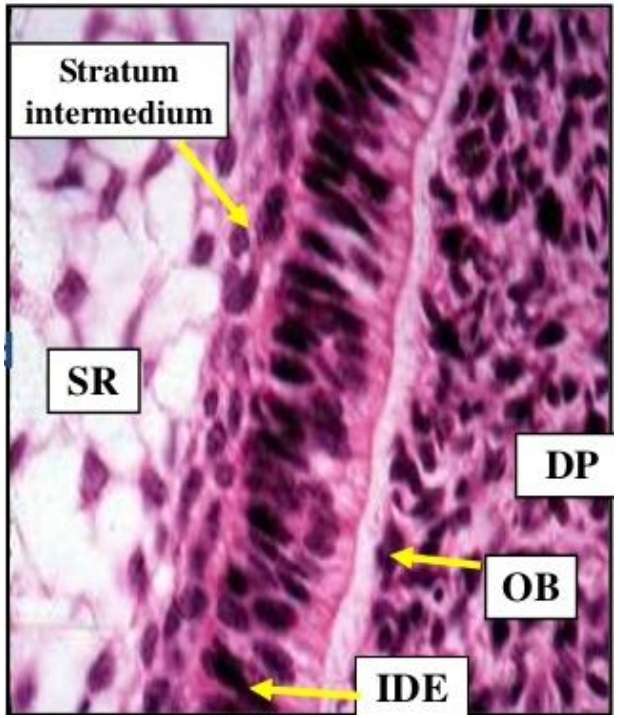
2. Inner Enamel Epithelium (also called Preameloblast b/c the cells become tall columnar)

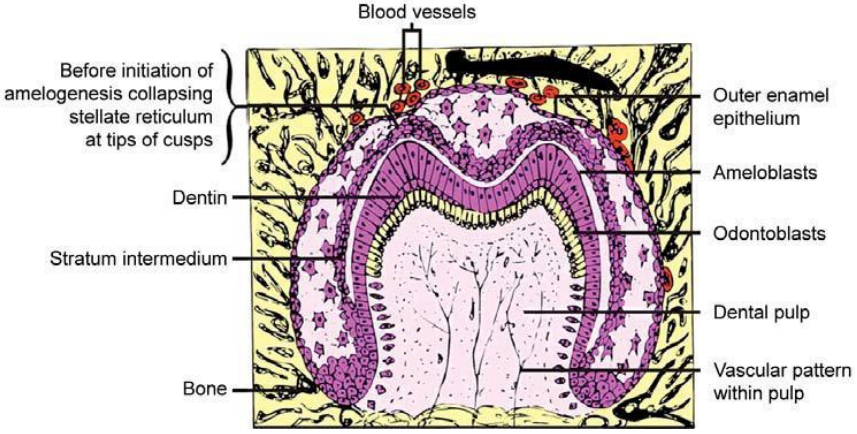
3. Stellate Reticulum

4. Stratum Intermedium: present b/w inner enamel epithelium & stellate reticulum. It acts as a single functional unit with inner enamel epithelium for the formation of enamel.

Stratum intermedium

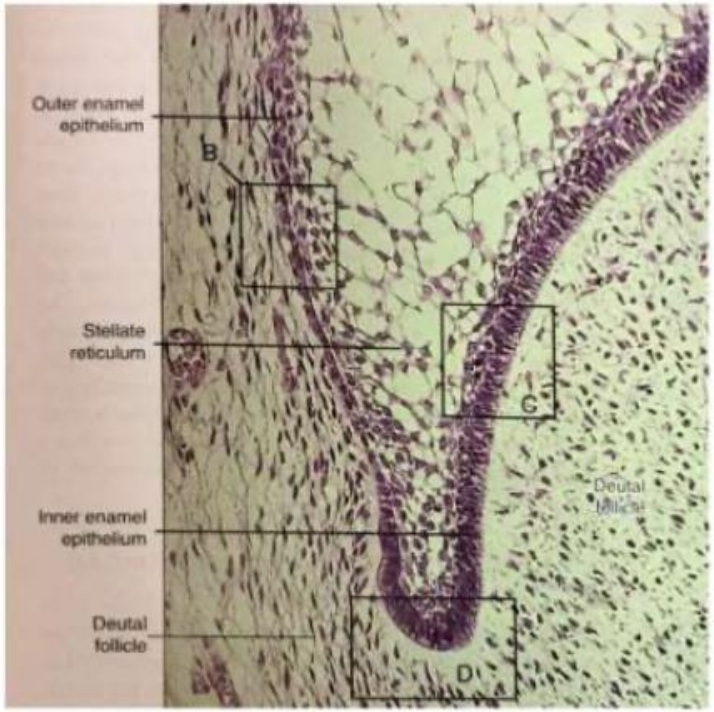
- 2-3 layers of flat cells or squamous cells between inner E.E. & the stellate reticulum & are connected to both of them by desmosomes
- They are rich in alkaline phosphatase enzyme essential for enamel mineralization.
- They are considered as a functional unit in enamel formation & mineralization.
- They control fluid diffusion into & out of the ameloblasts.

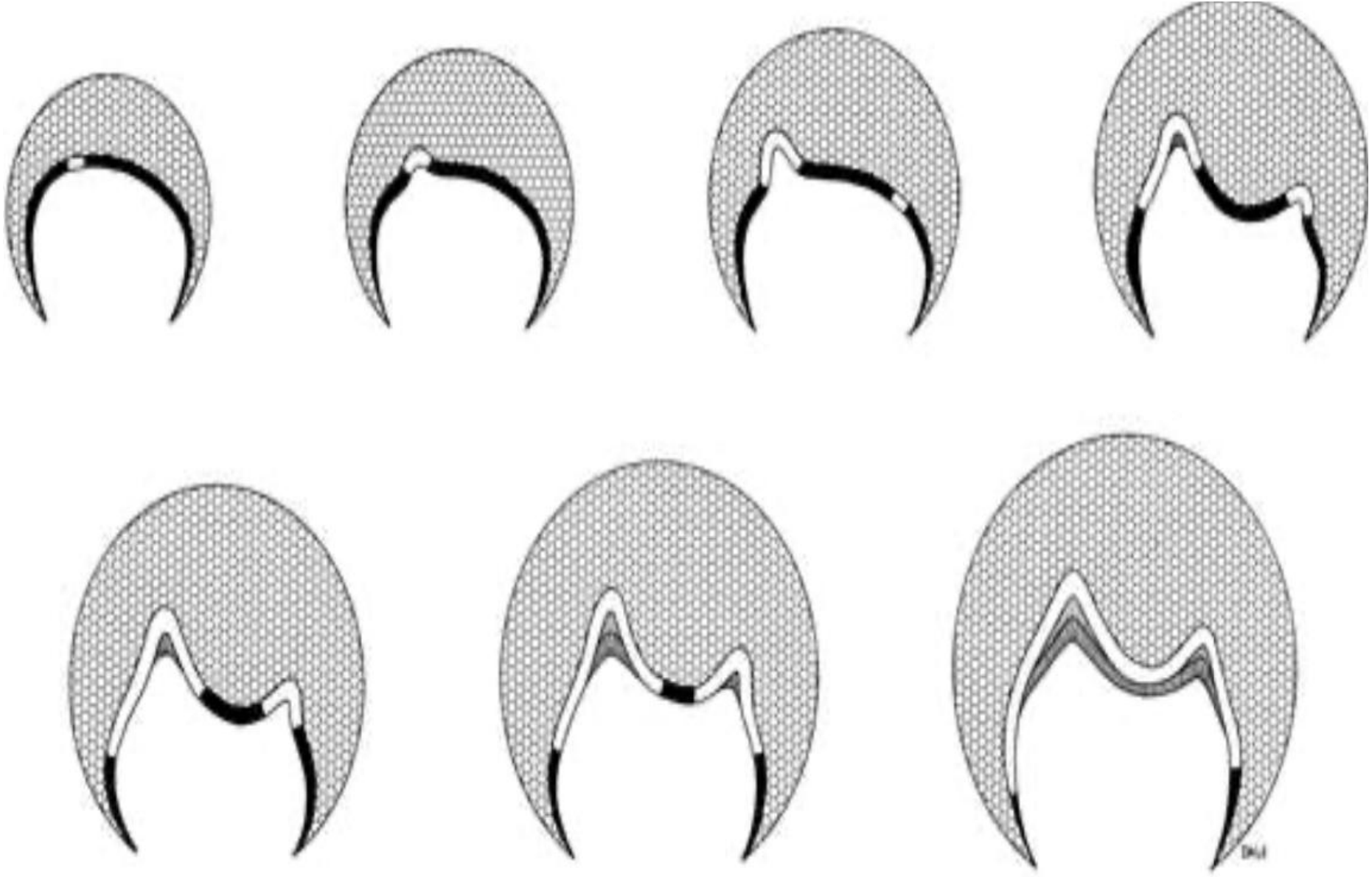




Stellate Reticulum

- The stellate reticulum expands further, mainly by an increase in the amount of intercellular fluid. Desmosome junctions are observed.
- Before enamel formation begins, the stellate reticulum collapses, reducing the distance between the centrally situated ameloblasts and the nutrient capillaries near the outer enamel epithelium.

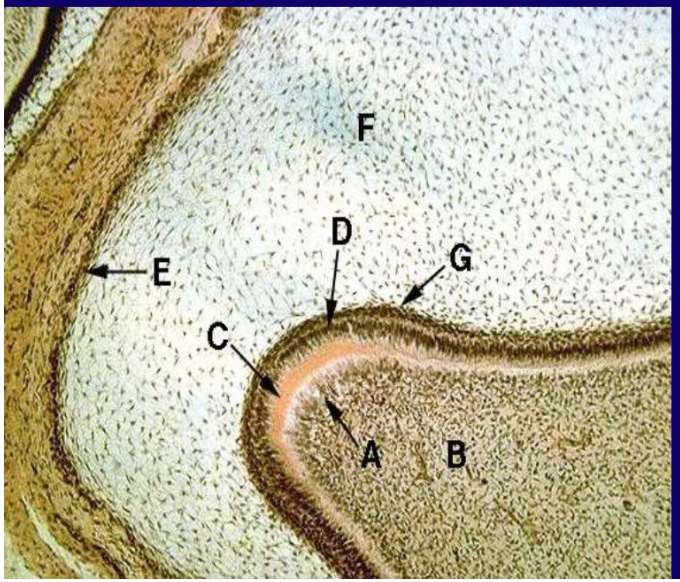




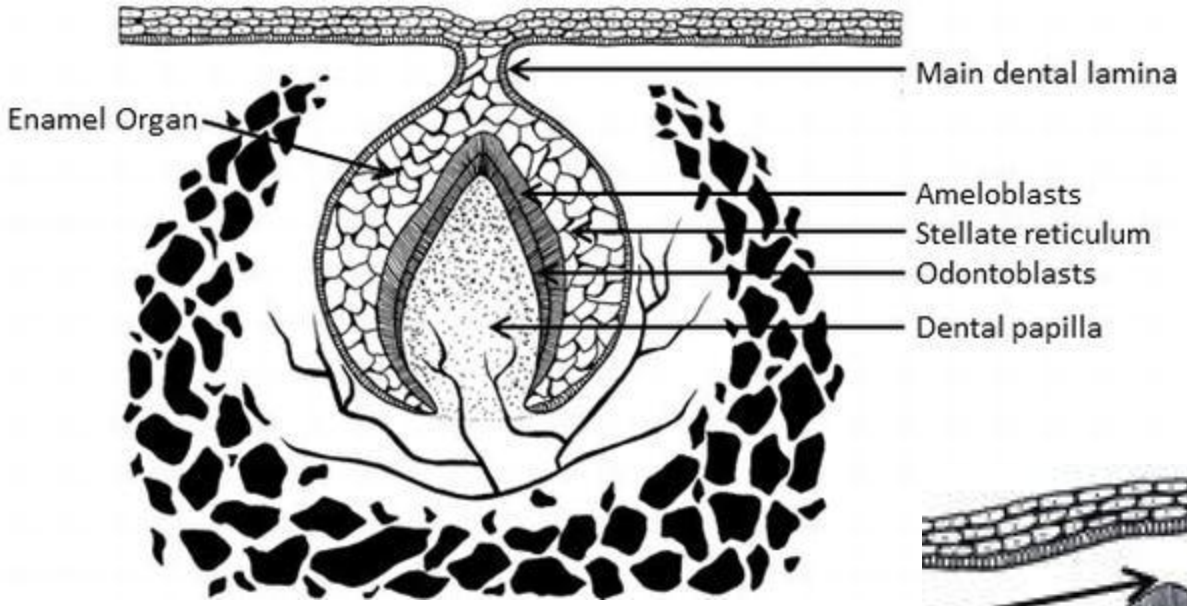
Future crown patterning occurs in the bell stage, by folding of the inner dental epithelium.

Advanced bell stage

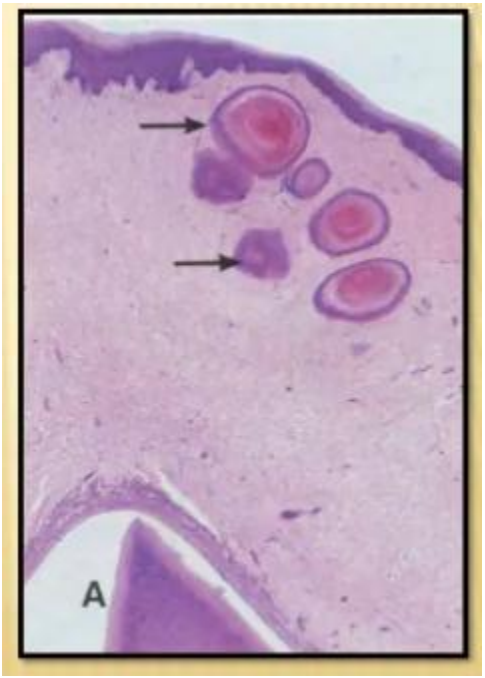
Advanced bell stage **Formation of hard tissue structure**

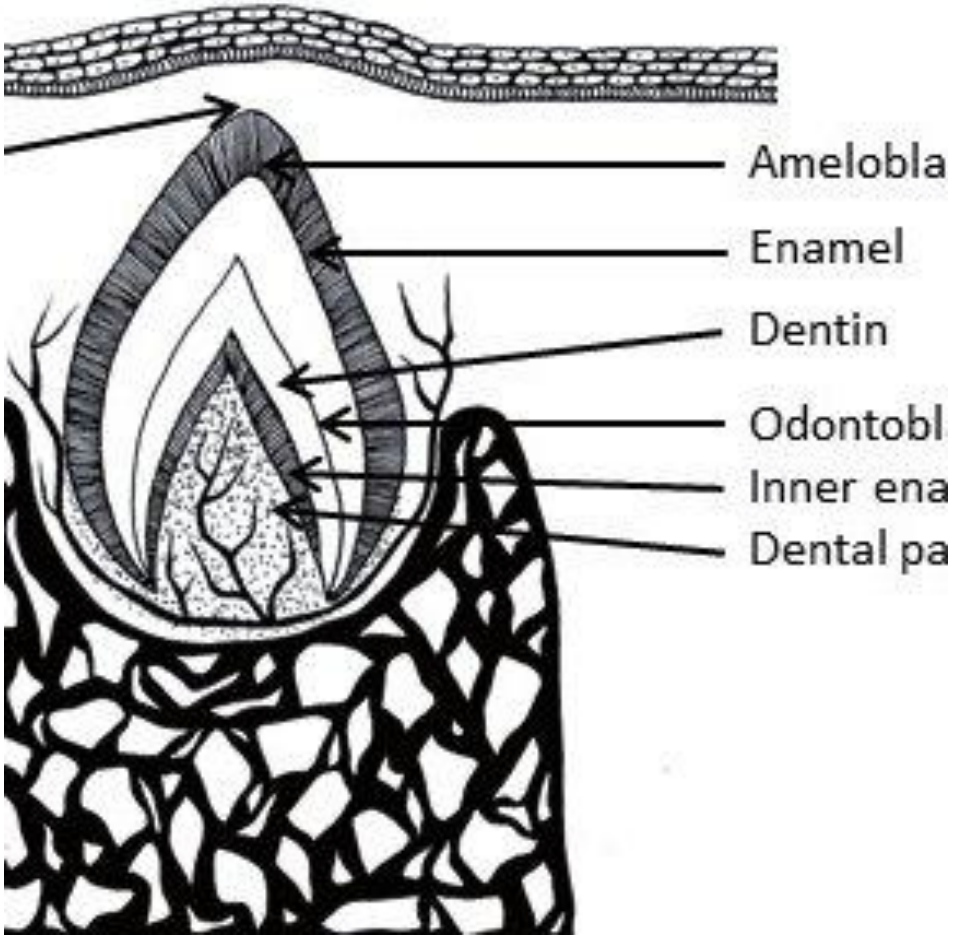


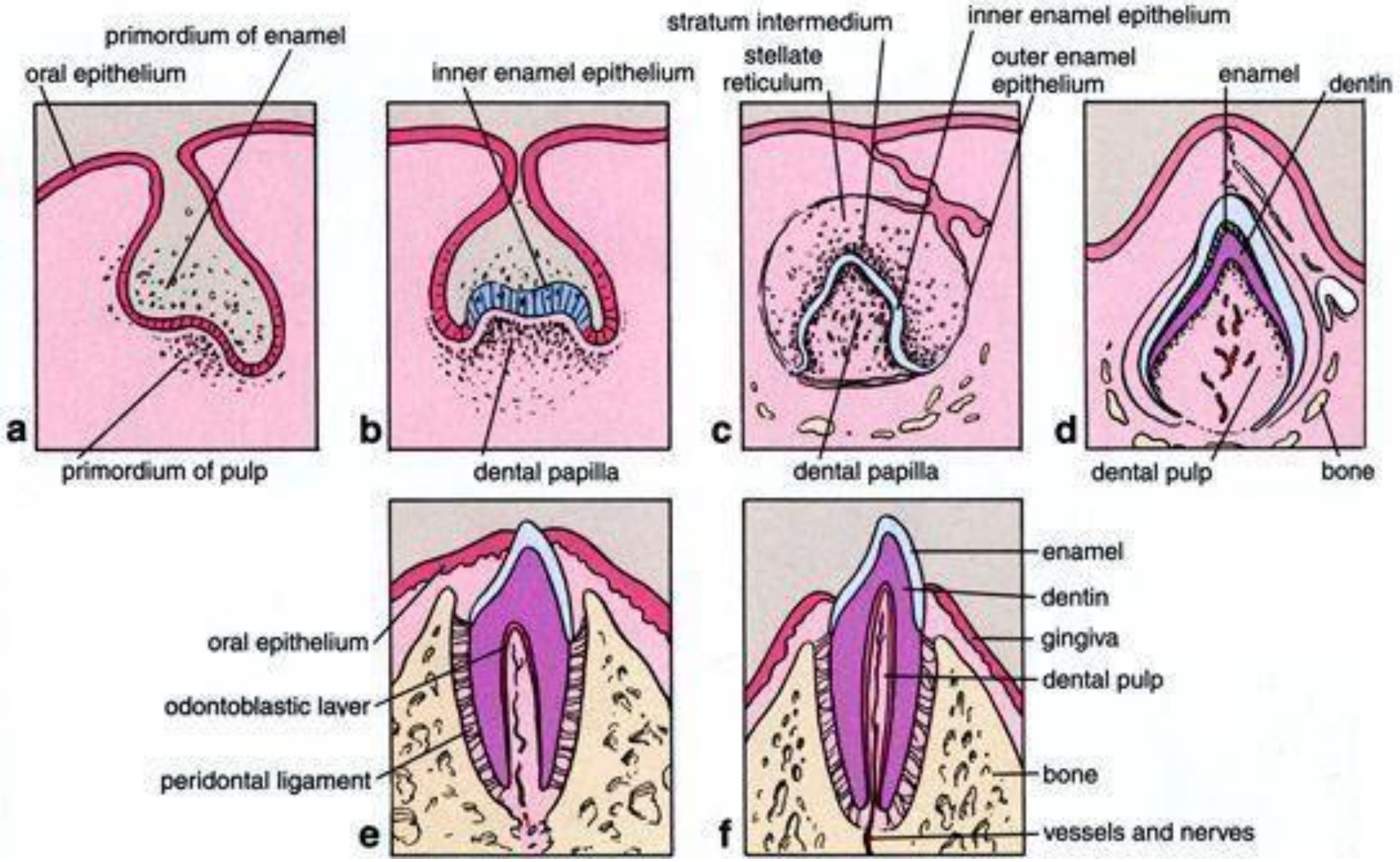
- A= odontoblasts
- B= dental papilla
- C= dentin
- D= organizing ameloblast layer of inner dental epithelium
- E= outer enamel epithelium
- F= stellate reticulum
- G = stratum intermedium



Rest cells of Serre






primordium of enamel
oral epithelium
a
primordium of pulp
inner enamel epithelium
b
dental papilla
stratum intermedium
inner enamel epithelium
stellate reticulum
outer enamel epithelium
c
dental papilla
enamel
dentin
d
dental pulp
bone
oral epithelium
odontoblastic layer
peridontal ligament
e
enamel
dentin
gingiva
dental pulp
bone
vessels and nerves
f

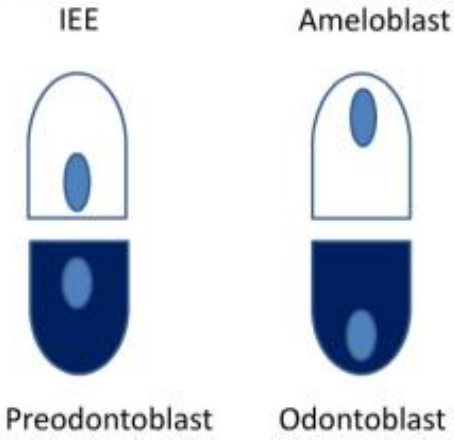
ADVANCED BELL STAGE

- It shows degeneration of dental lamina which leads to separation of the tooth germ form the oral epithelium
- Remnant of the Dental lamina are called as Cell Rests of Serre. It can be present in the jaws.
- Morphogenesis is completed in the Advanced Bell Stage

Histodifferentition

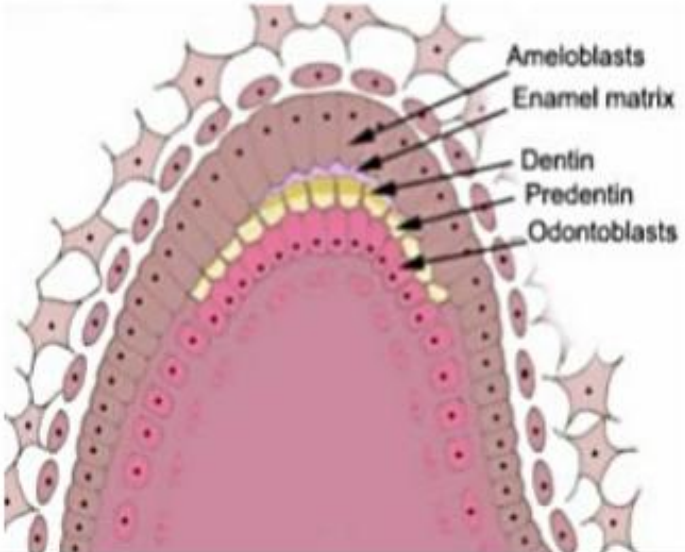
Is seen in the form of :

- Formation of Ameloblasts and Odontoblasts in the Ameloblasts and Odontoblasts are tall columnar in shape and both of them are characterized by Reverse Polarity (Nucleus away from the basement membrane)

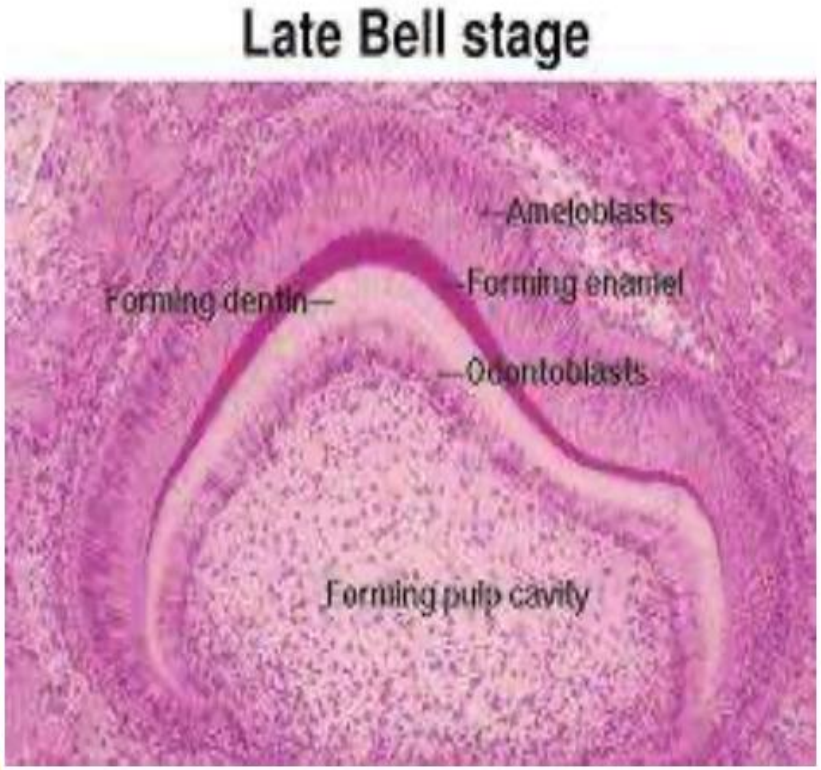


Apposition begins in this stage:

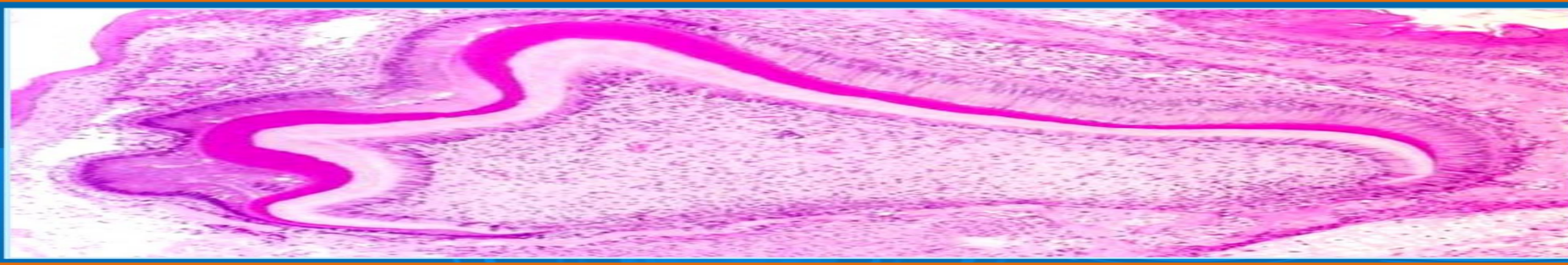
- It is the process of deposition of enamel and dentin matrix
- Deposition of enamel matrix by ameloblasts is called Amelogenesis
- Deposition of dentin matrix by Odontoblasts is called Dentinogenesis
- Dentin forms before the enamel
- Deposition of enamel and dentin always begins at the cusp tips
- Enamel can not regenerate since ameloblasts completely loose their activity after crown formation is complete. Dentin can regenerate because odontoblasts are present or can form continuously throughout life



ADVANCED BELL STAGE

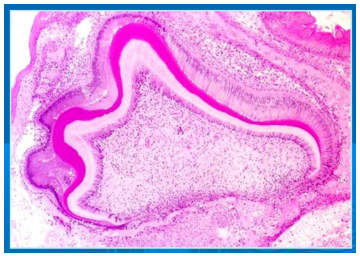


- During this stage the boundary between inner enamel epithelium and odontoblasts outlines the future dentino enamel junction.
- Here, histologically enamel and dental formation can be appreciated.
- As the hard tissue formation continue, the nutritional supply to the ameloblasts from dental papilla is cut off and they derive alternate source from dental sac.
- The outer enamel epithelium becomes more irregular and stellate reticulum collapses further to bring the blood vessels of dental sac closer.
- Deposition of enamel proceeds coronally and cervically in all regions from the dentino enamel junction.
- Once the enamel and dentine formation reach the cervical region of tooth, root formation begins.
- The cervical region of enamel organ gives rise to epithelial root sheath of Hertwig's



Outer enamel epithelium

- The cells of the outer enamel epithelium flatten to a low cuboidal form.
- At the end of the bell stage, preparatory to and during the formation of enamel, the formerly smooth surface of the outer enamel epithelium is laid in folds.
- Between the folds the adjacent mesenchyme of the dental sac forms papillae that contain capillary loops and thus provide a rich nutritional supply for the intense metabolic activity of the avascular enamel organ.
- This would adequately compensate the loss of nutritional supply from dental papilla owing to the formation of mineralized dentin.

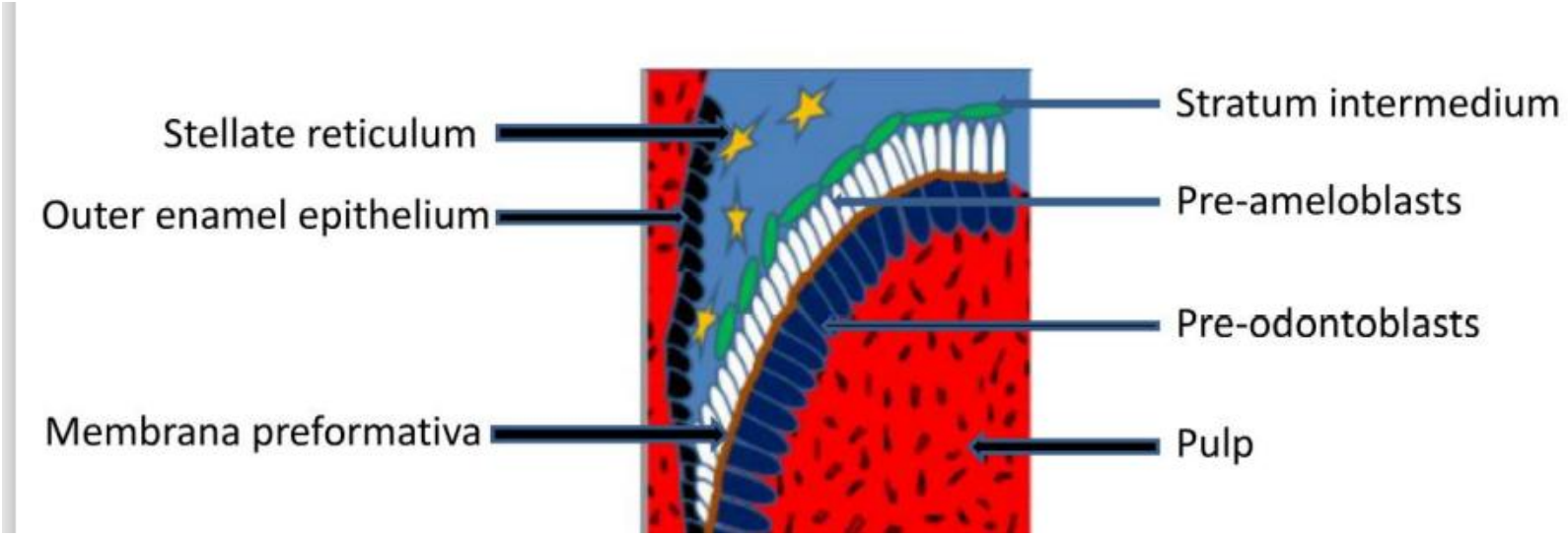


Dental papilla

- The dental papilla is enclosed in the invaginated portion of the enamel organ.
- Before the inner enamel epithelium begins to produce enamel, the peripheral cells of the mesenchymal dental papilla differentiate into odontoblasts under the organizing influence of the epithelium.
- First, they assume a cuboidal form; later they assume a columnar form and acquire the specific potential to produce dentin.
- The basement membrane that separates the enamel organ and the dental papilla just prior to dentin formation is called the **membrana preformativa**.
- Gives rise to dentin and dental pulp

Membrana Preformativa

- Structure that separates Preameloblasts & Preodontoblasts is called Membrana Preformativa.
- Future: Forms the Dentino-enamel Junction.



The basement membrane

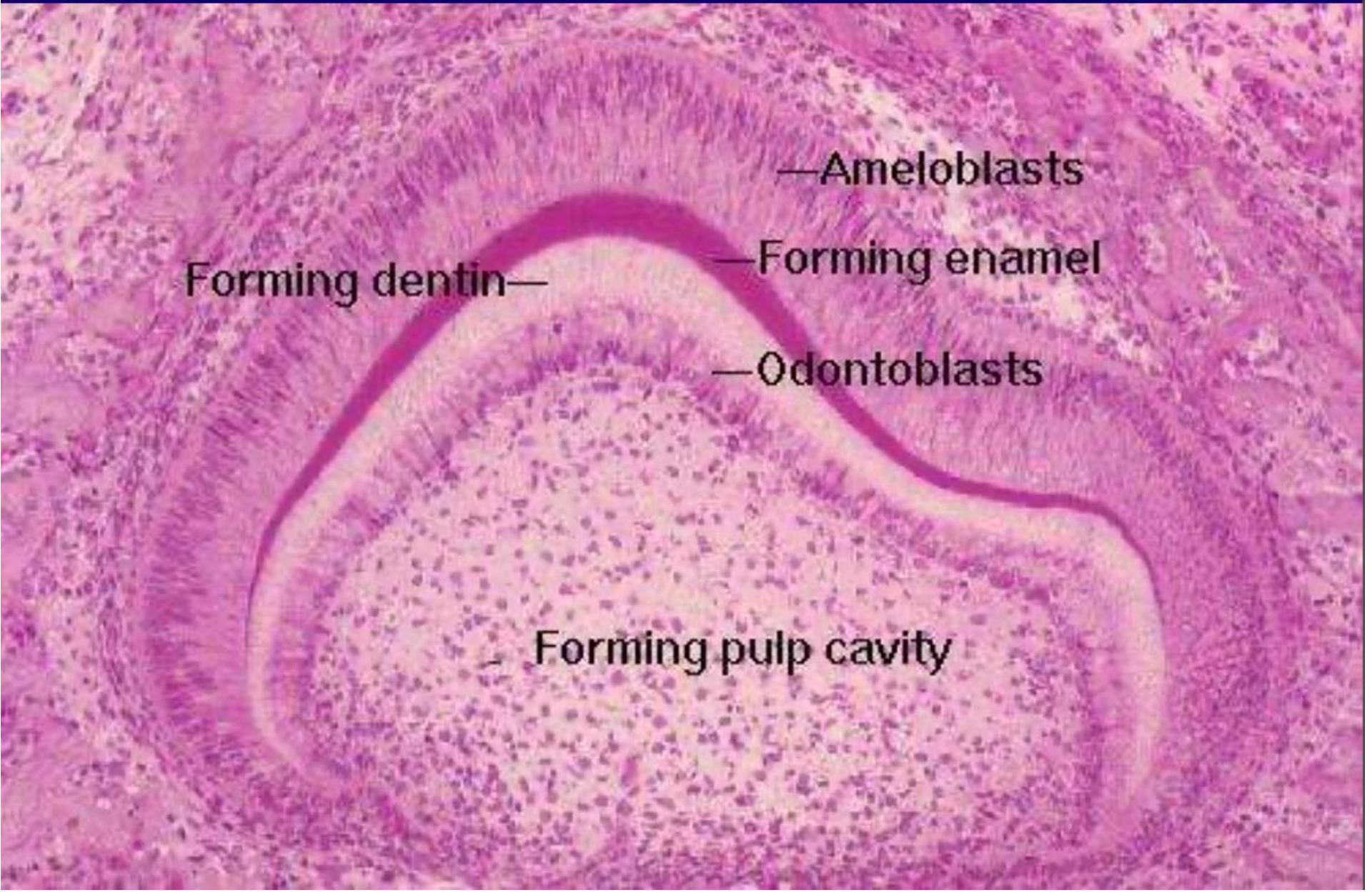
separates the

enamel organ and the dental papilla

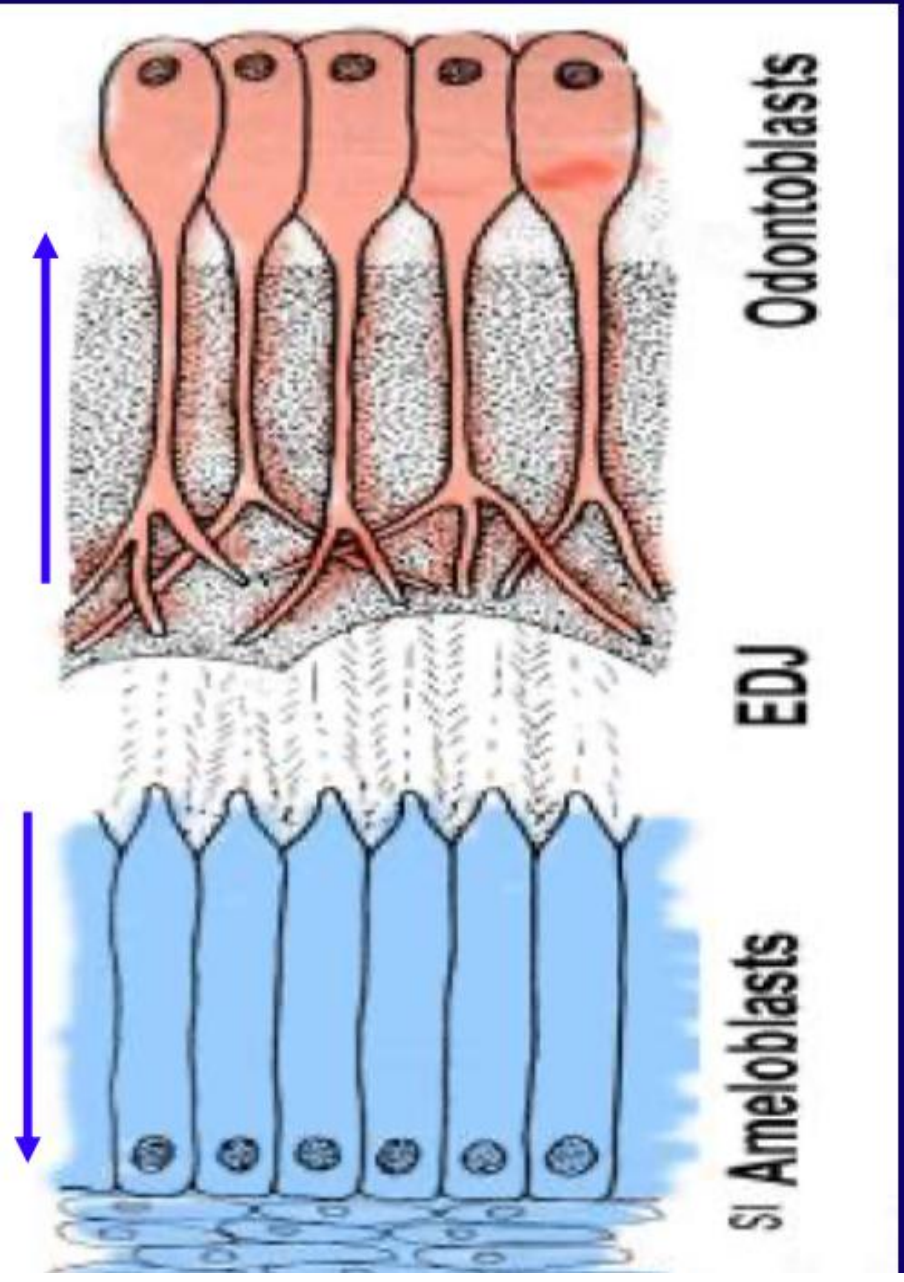
just prior to dentin formation

membrana preformativa

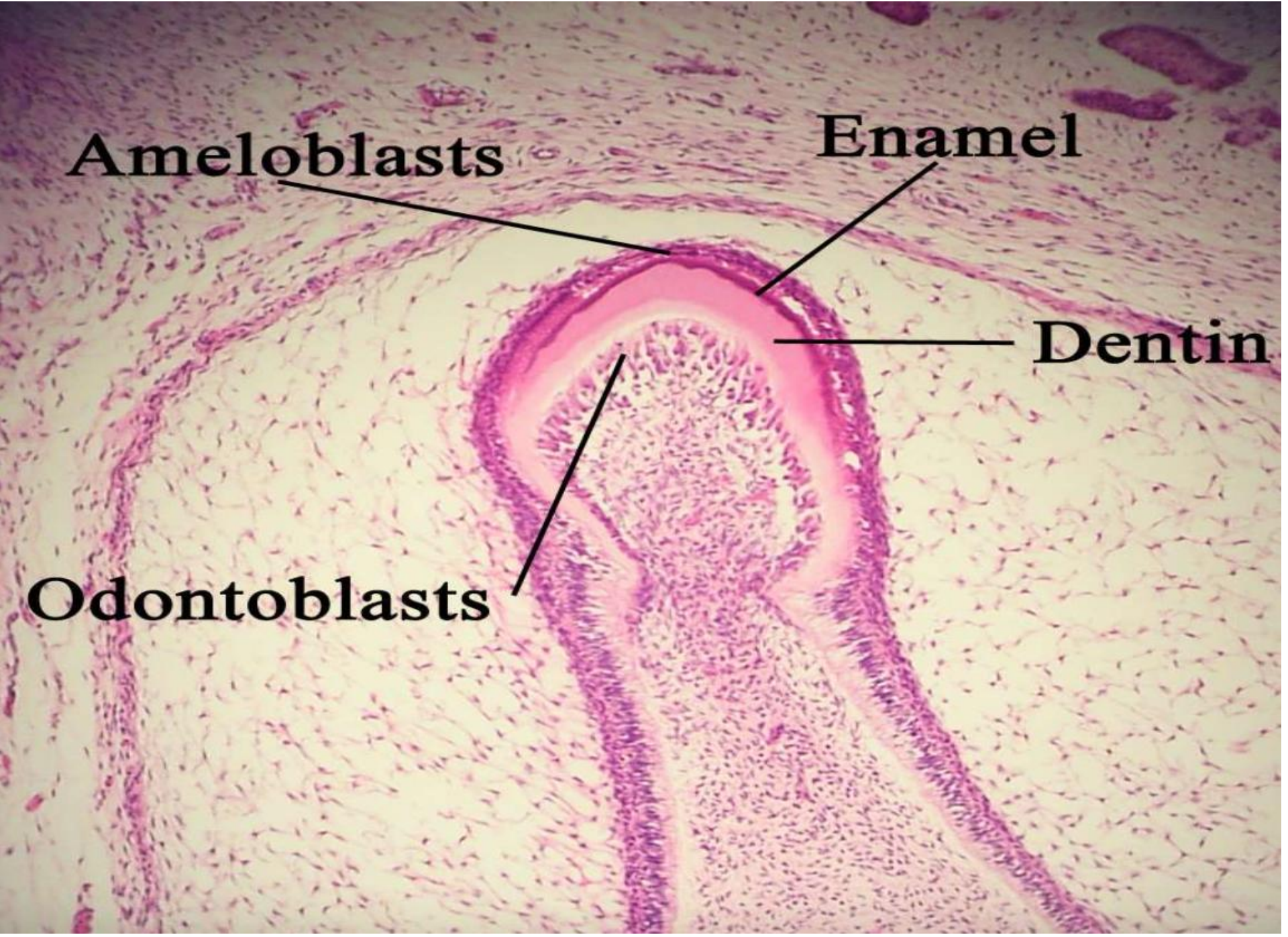
Advanced bell stage



Ameloblast & odontoblast

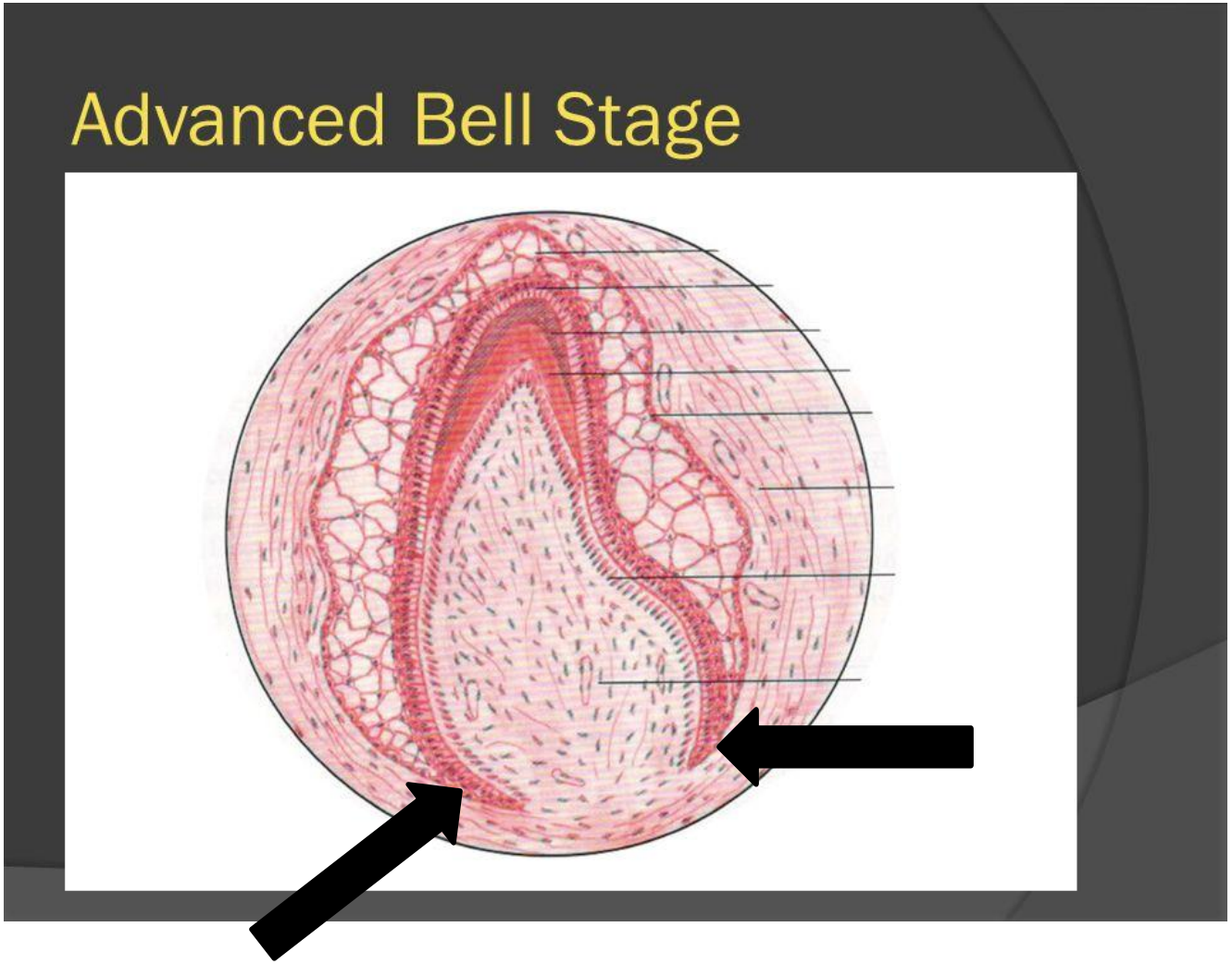


- **Ameloblast and Odontoblast layers move apart, leaving enamel and dentine between them**


Ameloblasts
Enamel
Dentin
Odontoblasts

CERVICAL LOOP (only outer and inner enamel epithelium)

epithelium cells located in cervical loop in adv. bell stage gives rise to Hertwig's epithelial root sheath



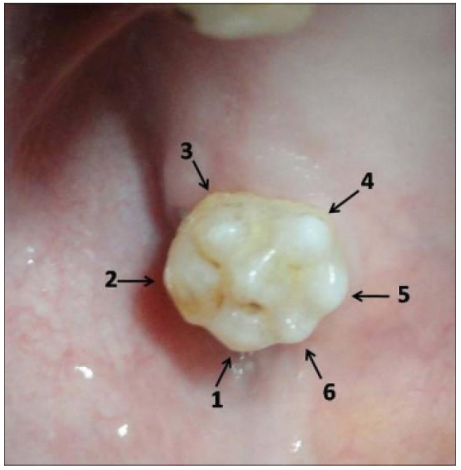
CLINICAL CONSIDERATIONS

Lack of initiation or abnormal initiation

Anodontia

Supernumerary teeth

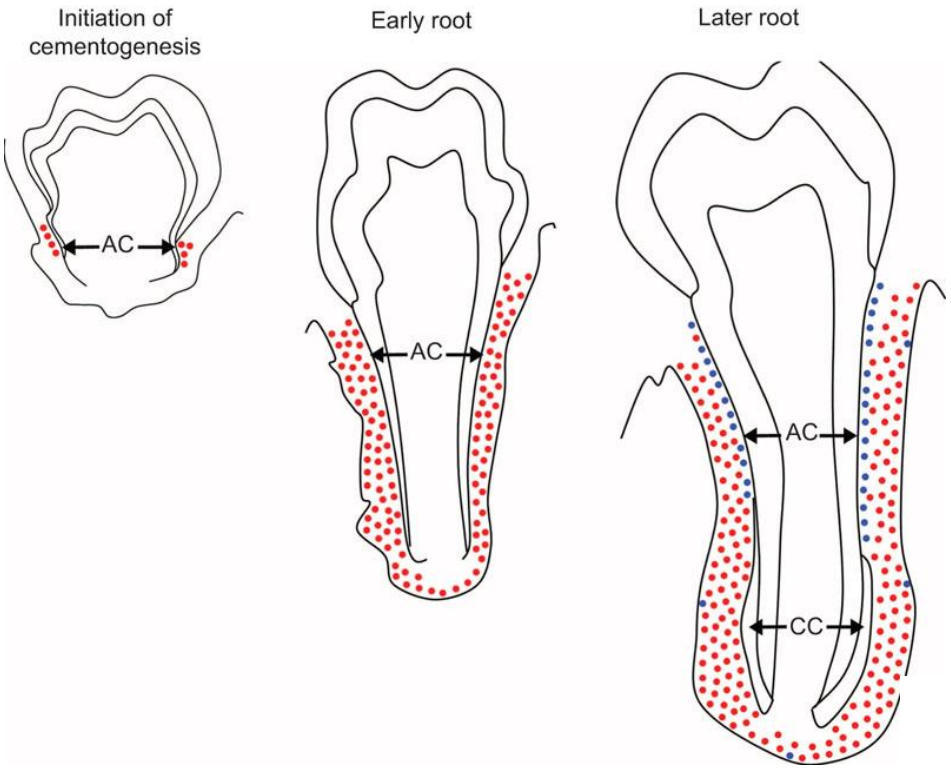
Defect in morpho differentiation

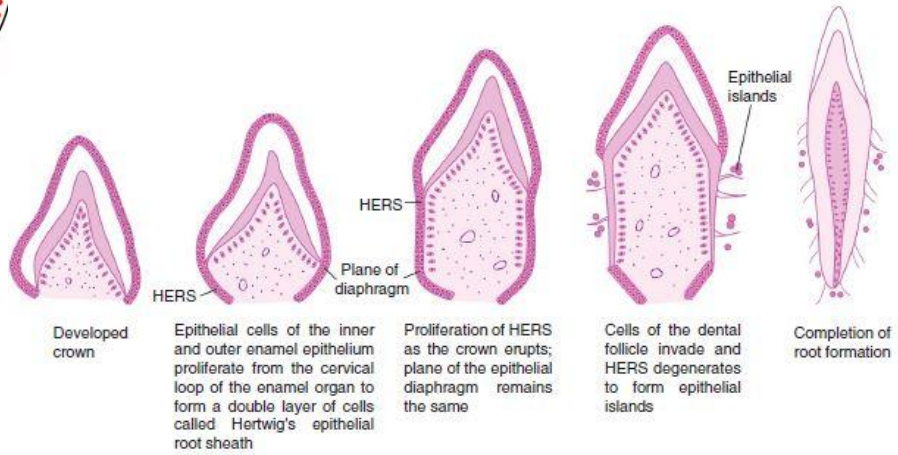


Defect in apposition

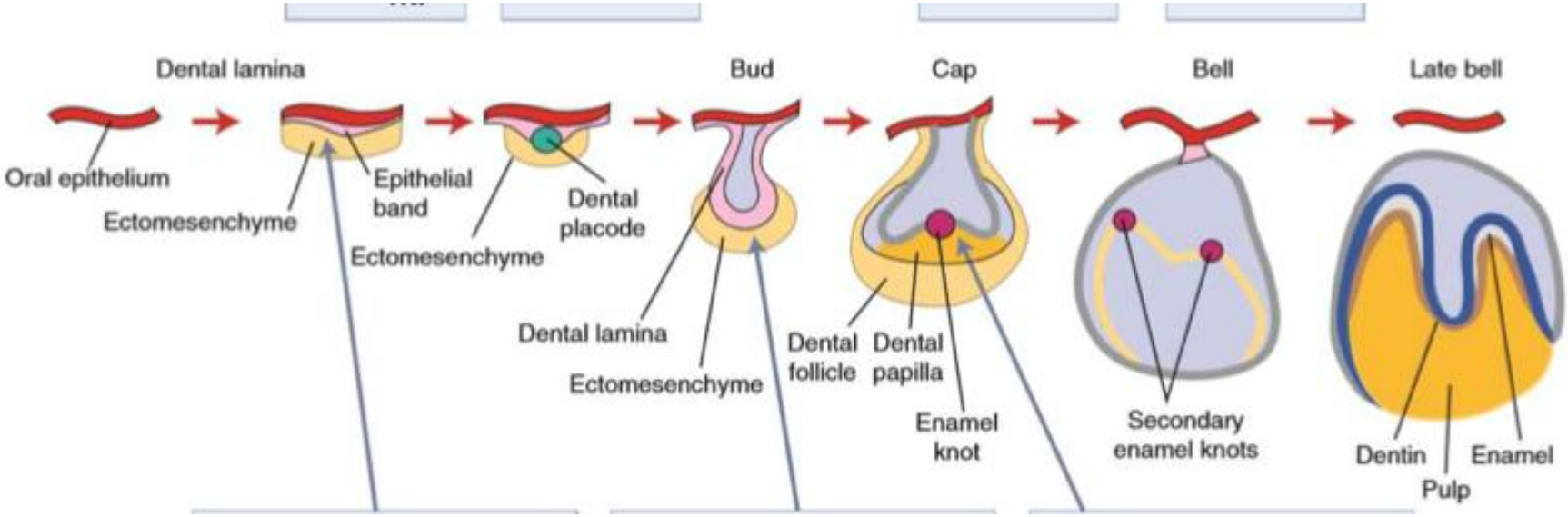
Hypocalcified teeth

ROOT FORMATION





SUMMERY


Dental lamina
Bud
Cap
Bell
Late bell
Oral epithelium
Ectomesenchyme
Epithelial band
Ectomesenchyme
Dental placode
Dental lamina
Ectomesenchyme
Dental follicle
Dental papilla
Enamel knot
Secondary enamel knots
Dentin
Pulp
Enamel

Identify A, B and C

A

B

C

REFERENCES

- ORBANS's Oral HISTOLOGY AND AND EMBRYOLOGY (page no 24-47)
- TEN CATE'S ORAL HISTOLOGY


THANK
YOU!