

Physiologic tooth movement : Eruption & shedding

Tooth Eruption:

- The word eruption properly means “cutting of the tooth through the gum”
- Tooth eruption is defined as the physiologic process of the axial or occlusal movement of the tooth from its developmental position within the jaw to its functional position in the occlusal plane.
- The timely initiation and eruption of teeth into the oral cavity is very important for healthy dentition .
- Eruption rates of teeth are greatest at the time of crown emergence; rates also differ according to tooth type.

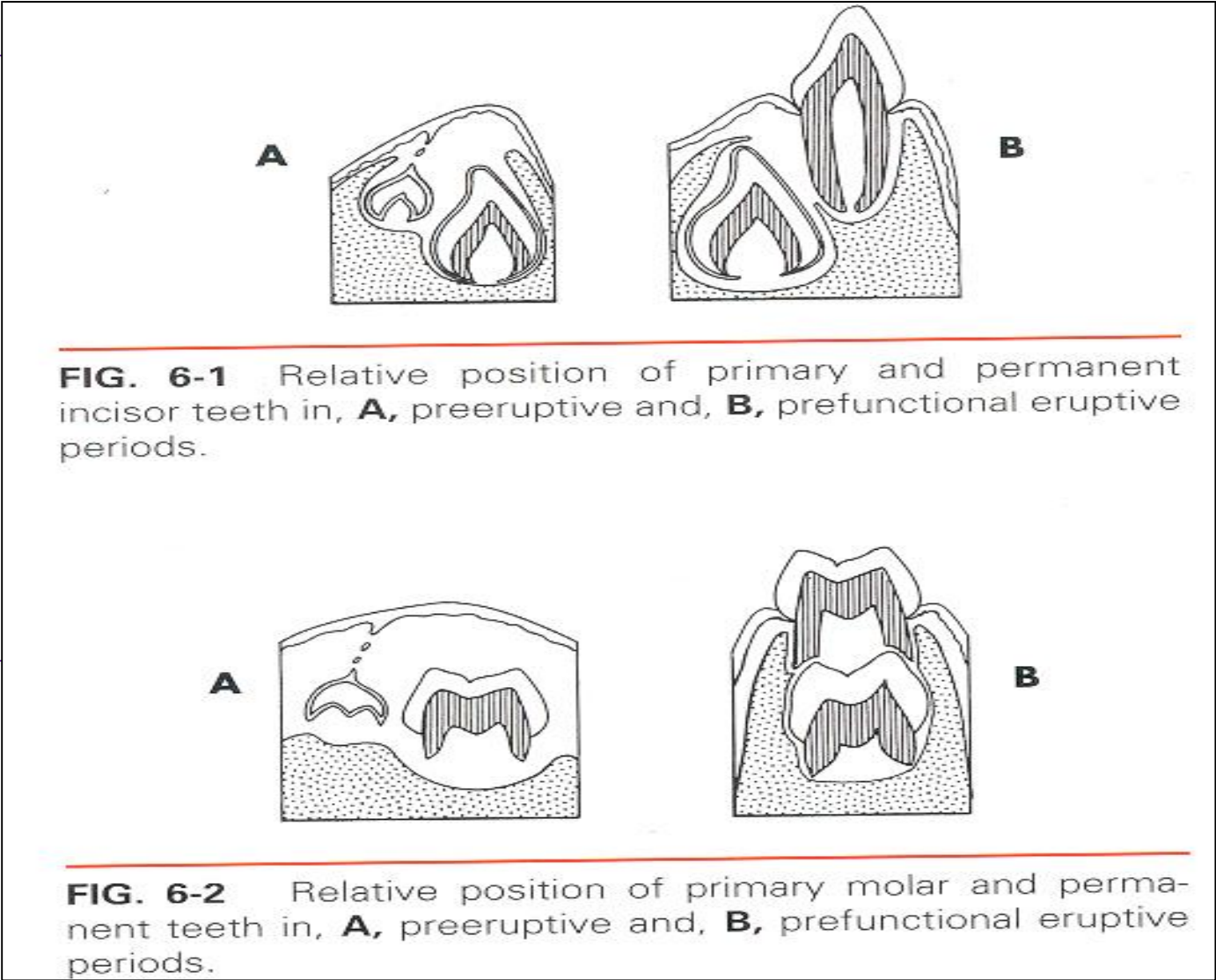
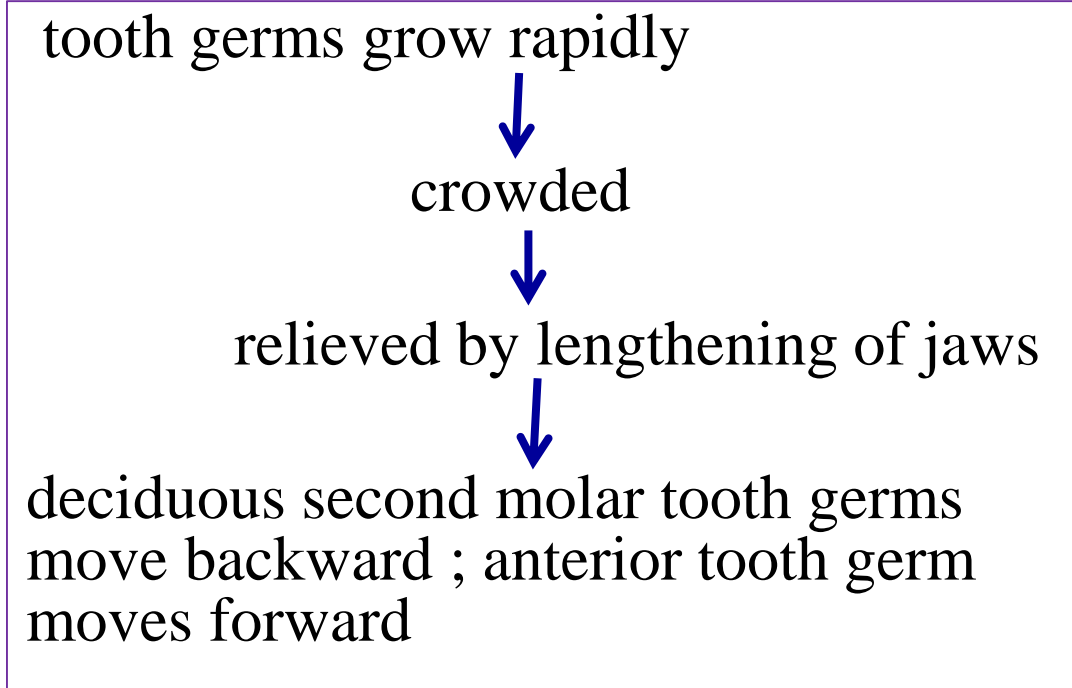
ACTIVE TOOTH ERUPTION

- The term active tooth eruption implies the emergence of crown into the oral cavity.
- This eruptive process physiologically is usually divided into 3 stages
 1. Pre eruptive stage : made by the deciduous & permanent tooth germs within tissue of the jaw before they begin to erupt.
 2. Eruptive stage: starts with initiation of root formation and made by teeth to move from it's position within bone of the jaw to it's functional position in occlusion.
 3. Posteruptive stage: takes place after the teeth are functioning to maintain the position of the erupted tooth in occlusion while the jaws are continuing to grow.

Preeruptive stage:

- This stage is made by both deciduous and permanent tooth germs within tissues of the jaw before they begin to erupt.
- It is also known as 'Follicular phase of eruption'
- Growing tooth moves in two directions to maintain its position in expanding jaws :
 - 1- Bodily movement** –which occurs continuously as jaw grows ,is a movement of entire tooth germ ;This causes bone resorption in direction of tooth movement and bone apposition.
 - 2- Eccentric growth** - growth in one part of tooth while rest of remains constant .
 - For example- root elongates ,yet crown does not increase in size , the crown maintains a constant relationship to surrounding alveolar bone while increase in alveolar height compensates for root growth.
 - Successional permanent teeth develop lingual & near to occlusal level of their primary precursor.

- This change occurs mainly due to eruption of primary teeth & increase in height of supporting tissues.



Preeruptive phase :

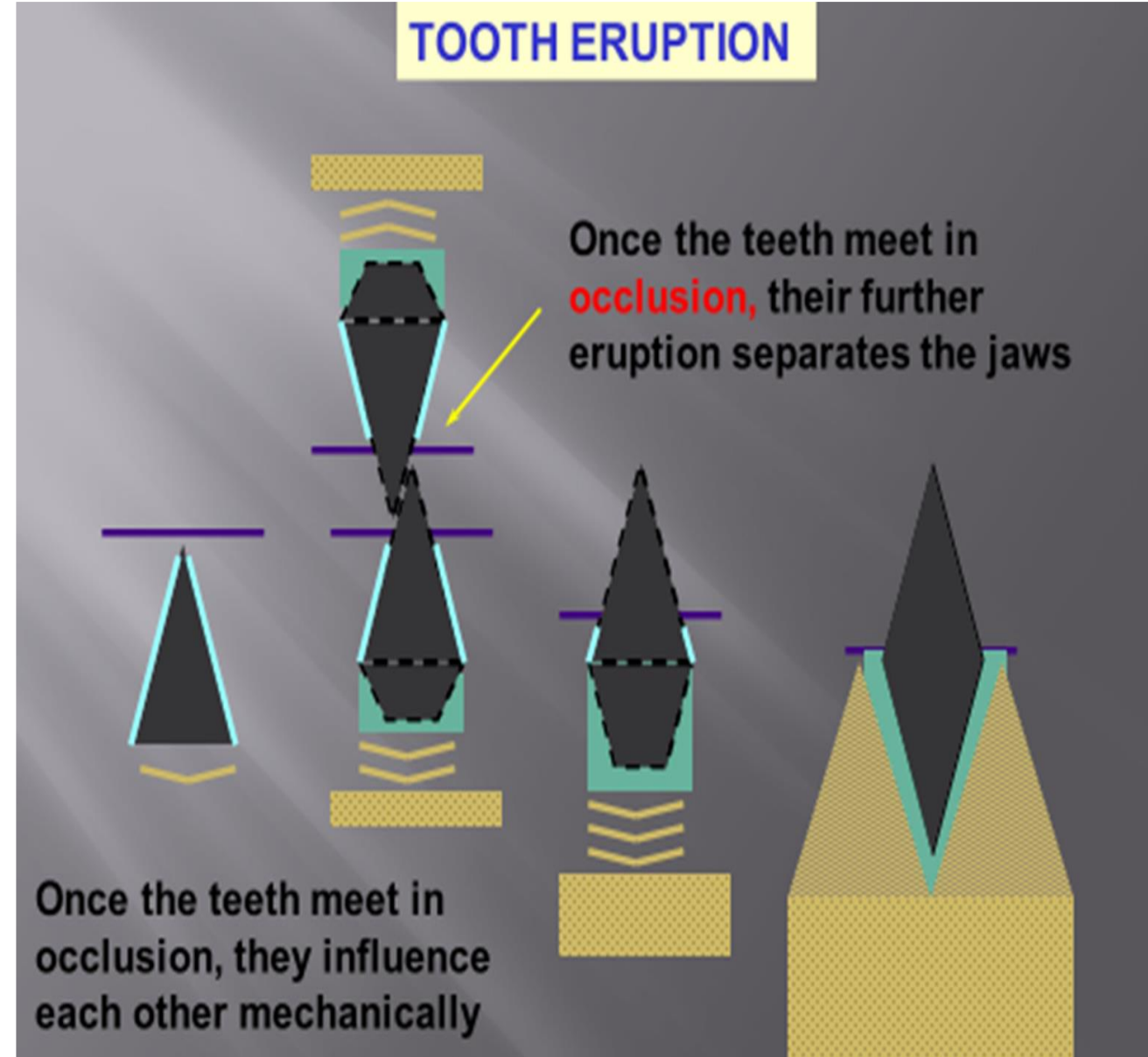
- Permanent anterior tooth germs develop lingual to the primary anterior teeth and later as primary teeth erupt, the permanent crowns lie at the apical 3rd of primary roots.
- Premolars tooth germs are finally positioned between the divergent roots of deciduous molars.

Histologic features

- Remodeling of the bony wall of crypt by selective deposition and resorption of bone by osteoblasts and osteoclasts.
- Normal skeletal morphogenesis might be involved in determining tooth position

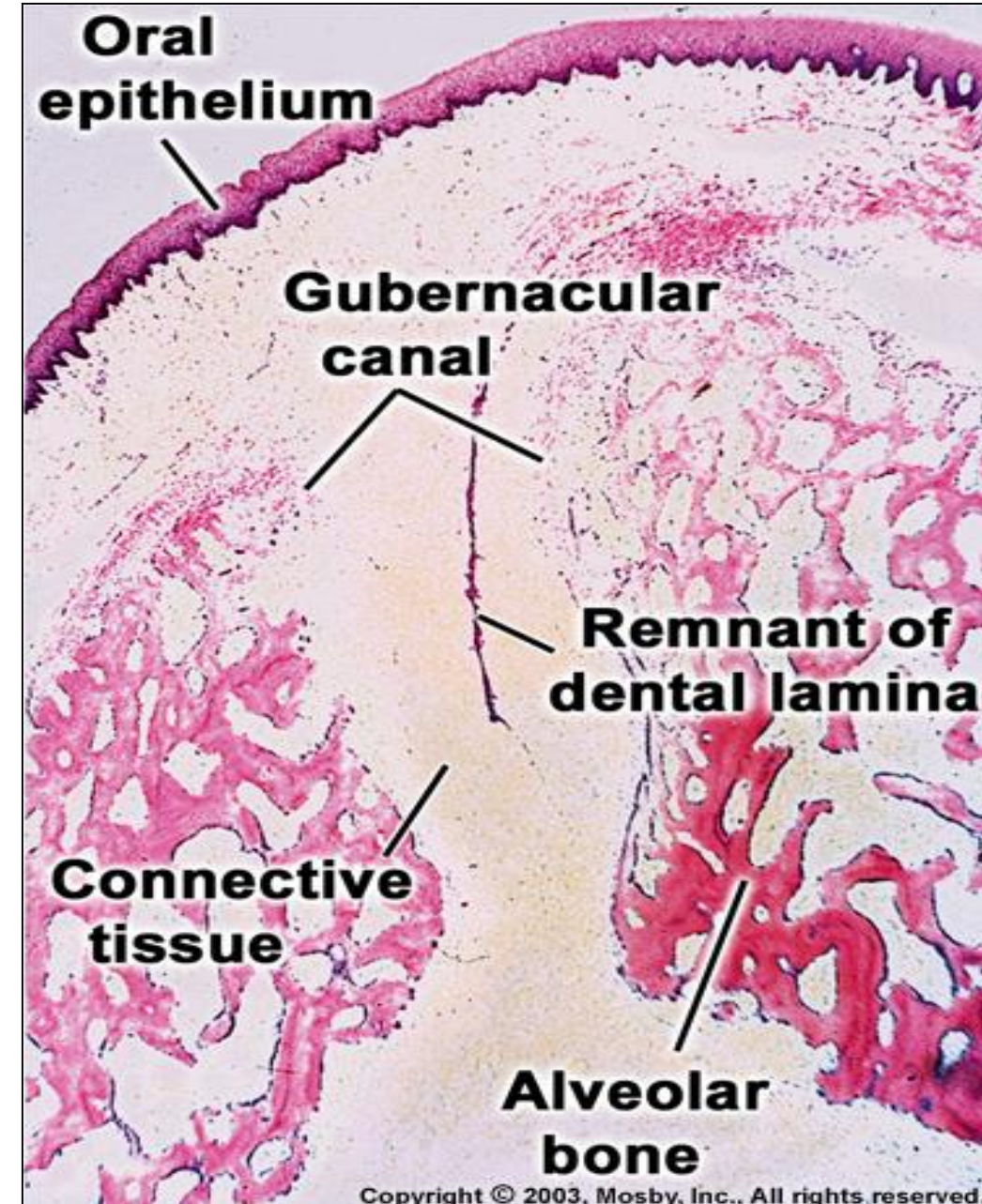
Eruptive phase / pre-functional eruptive phase:

- During this phase the tooth moves from its position within the bone of the jaw to its functional position in occlusion.
- The eruptive or prefunctional stage **begins with the development of root.**
- The principal direction of movement is occlusal or axial.
- During this phase of eruption, the movement of tooth takes place at the rate of 4mm in 14weeks
- This stage continues until the erupting teeth meet the opposing teeth.



Histology of tooth eruption:

- Degeneration of connective tissues immediately overlying the erupting teeth.
- Eruption pathway – altered tissue area overlying the teeth.
- Macrophages destroy cells and fibers with loss of blood vessels & nerves by secreting hydrolytic enzymes.
- Osteoclast are found along the borders of the resorptive bone overlying the teeth.
- **Gubernacular cord:** The connective tissue overlying a successional tooth that connects with the lamina propria of the oral mucosa by means of a strand of fibrous connective tissue that contains remnants of dental lamina.



Gubernacular canal: Holes noted in a dry skull; noted lingual to primary teeth in jaws that represent openings of gubernacular cord .

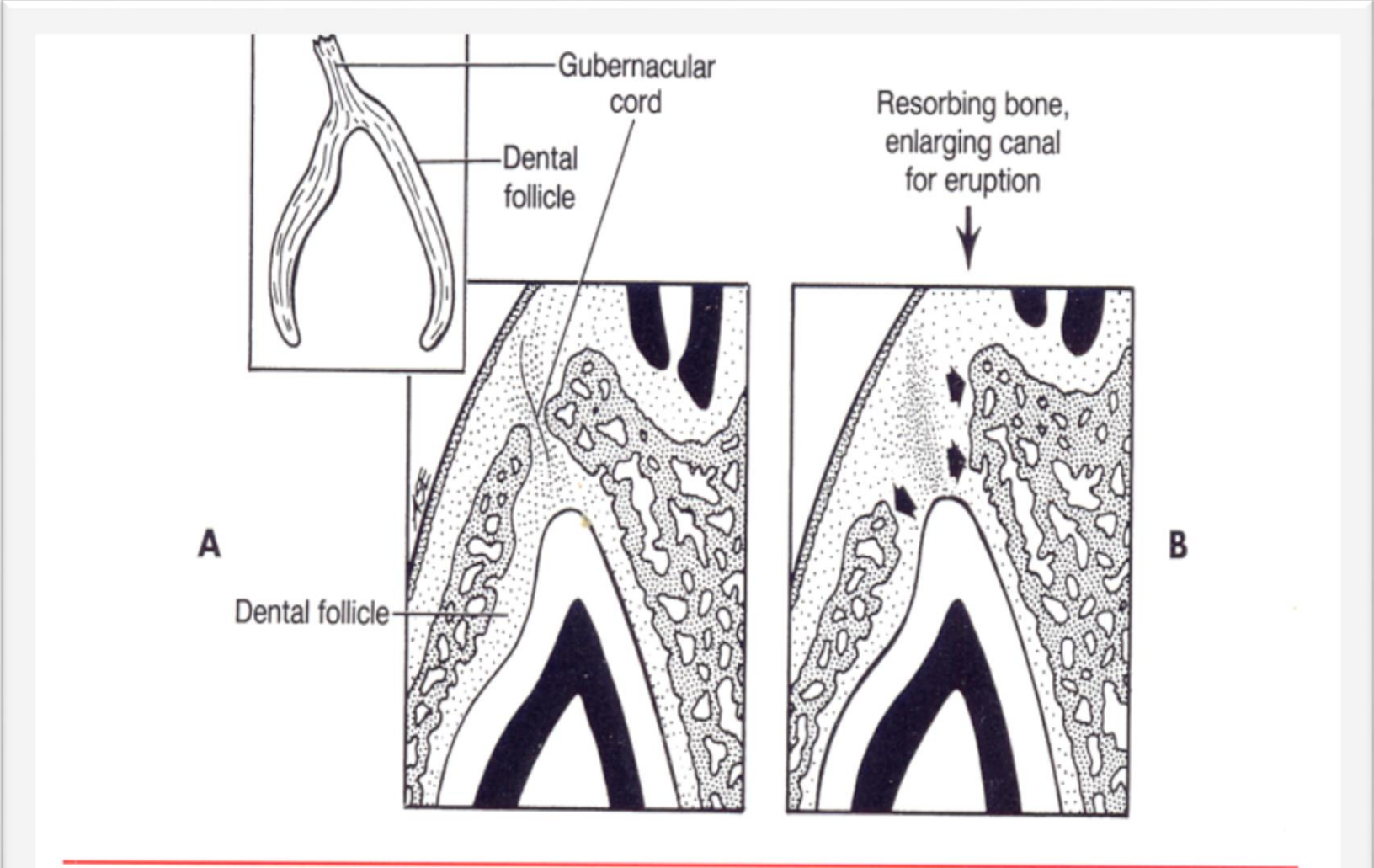
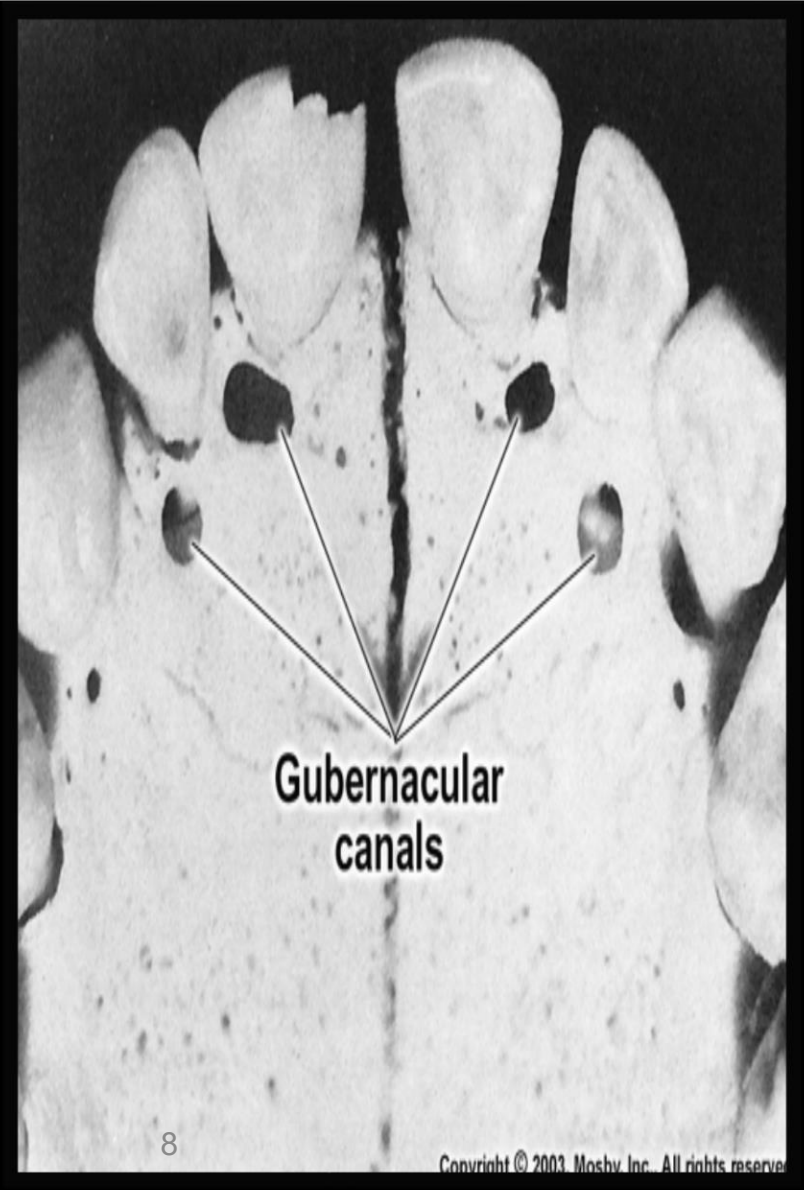


FIG. 6-10 Developing eruption pathway. **A**, Gubernaculum dentis. **B**, Bone resorption in eruption pathway.

Stages of tooth eruption

The rate of tooth eruption depends on the type of movement [3]

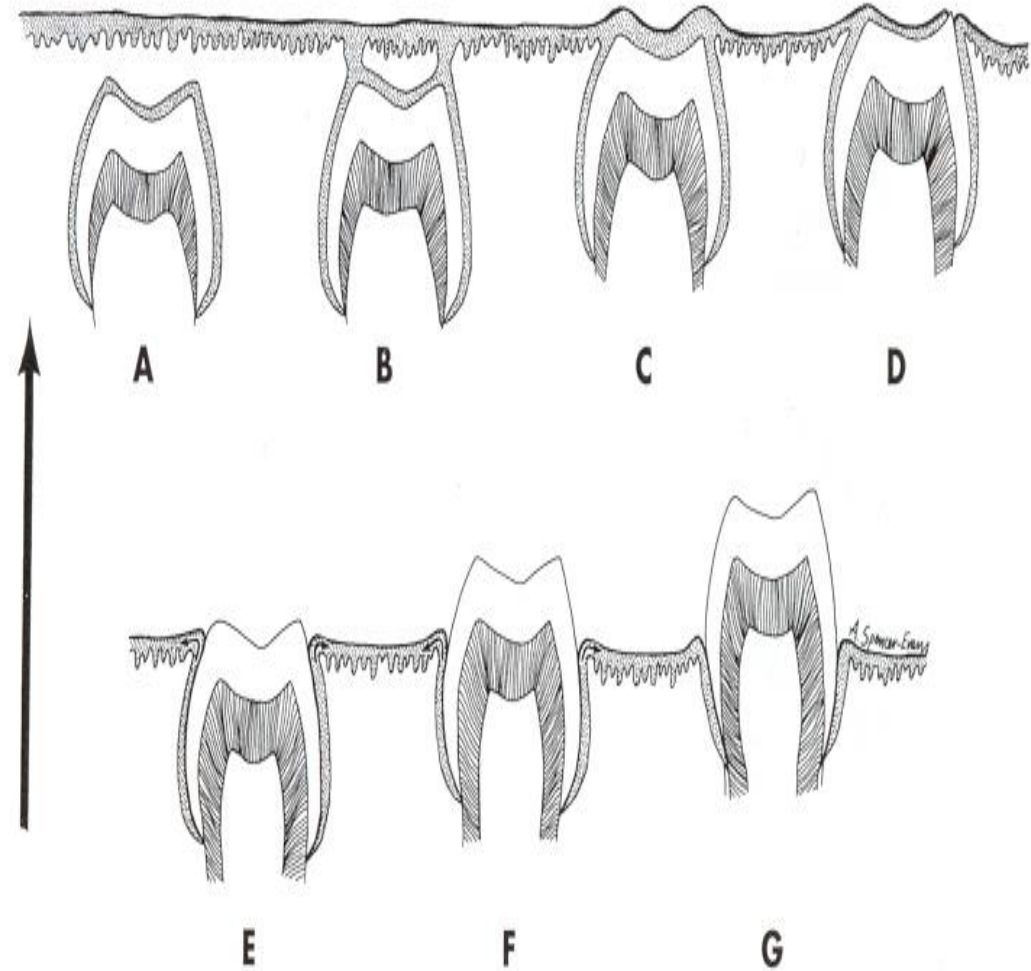
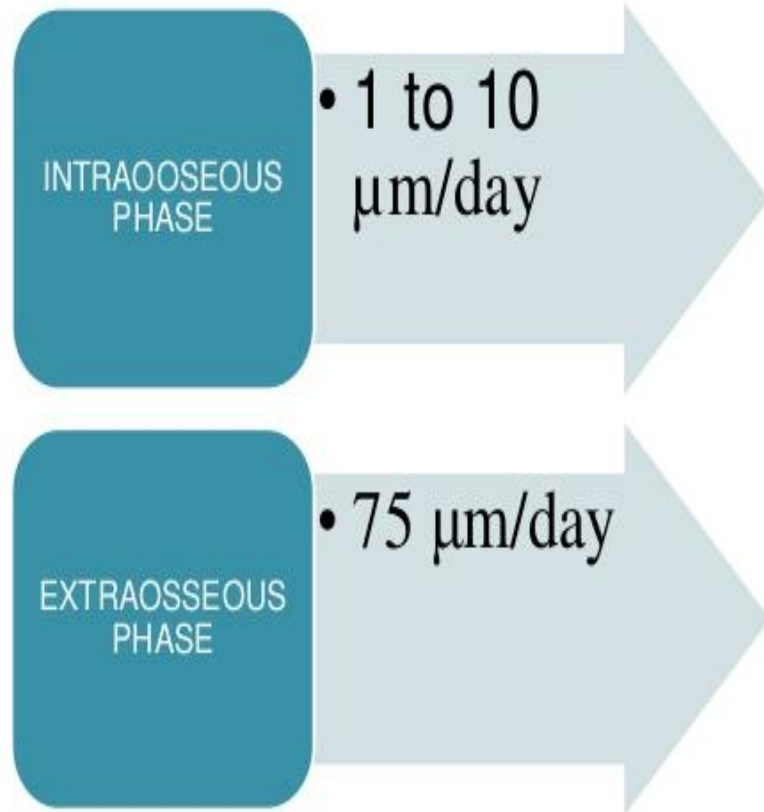


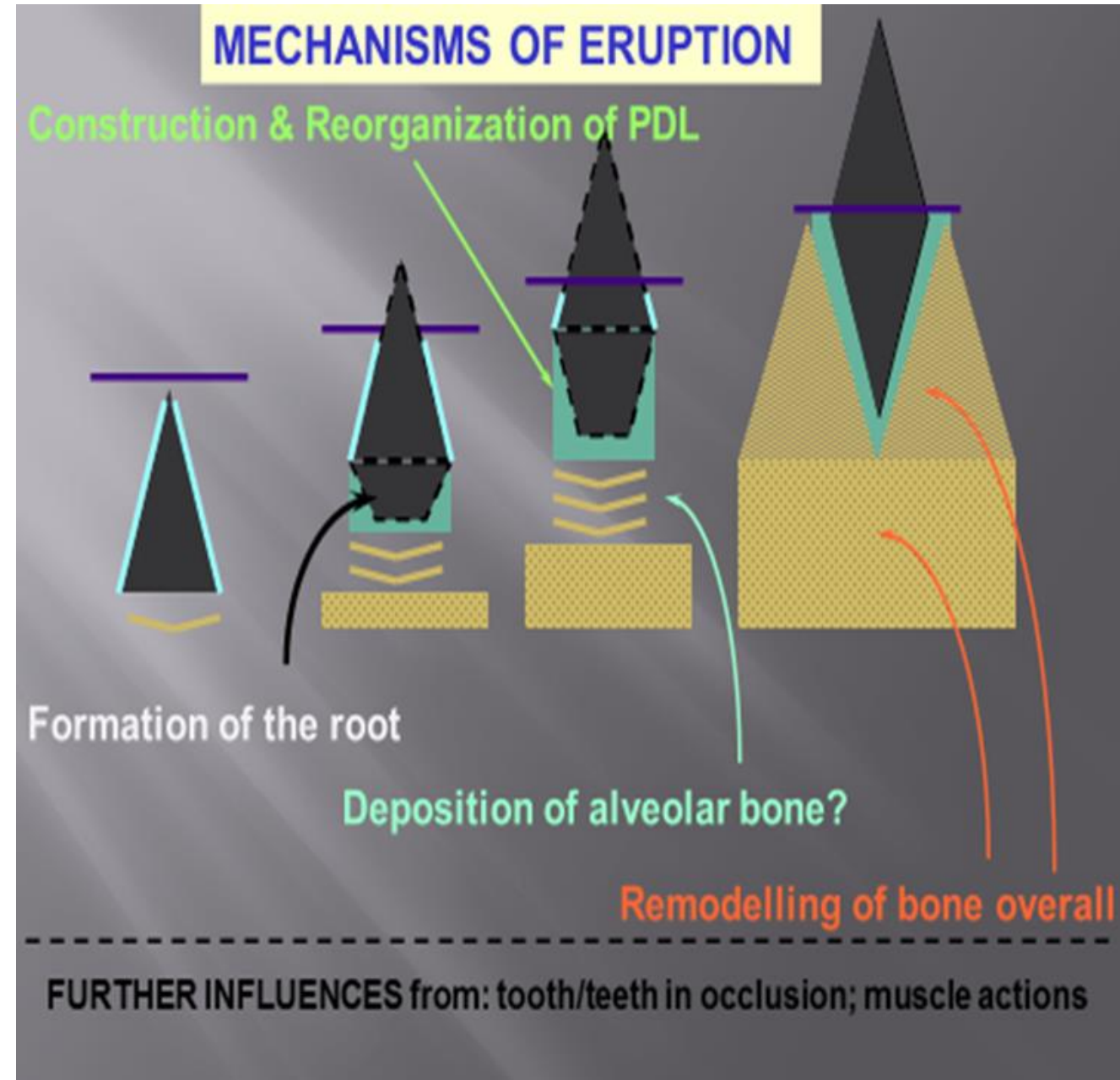
FIG. 6-19 Tooth eruption **A**, Crown penetrating bone and connective tissue. **B**, Contact of crown with oral epithelium. **C**, Fusion of epithelia. **D**, Thinning of epithelia. **E**, Rupture of epithelium. **F**, Crown emergence. **G**, Occlusal contact.

★“Why tooth eruption occurs without bleeding”

→The changes occurring in the connective tissues affect the epithelia it sustains and both the reduced enamel epithelium and the overlying oral epithelium begins to proliferate and migrate into disorganized connective tissue so that eventually a solid plug of epithelium forms in advance of the erupting tooth. The central cells of epithelium mass degenerate and form an epithelium-lined canal through which tooth erupts without any hemorrhage.

Mechanism of tooth eruption:

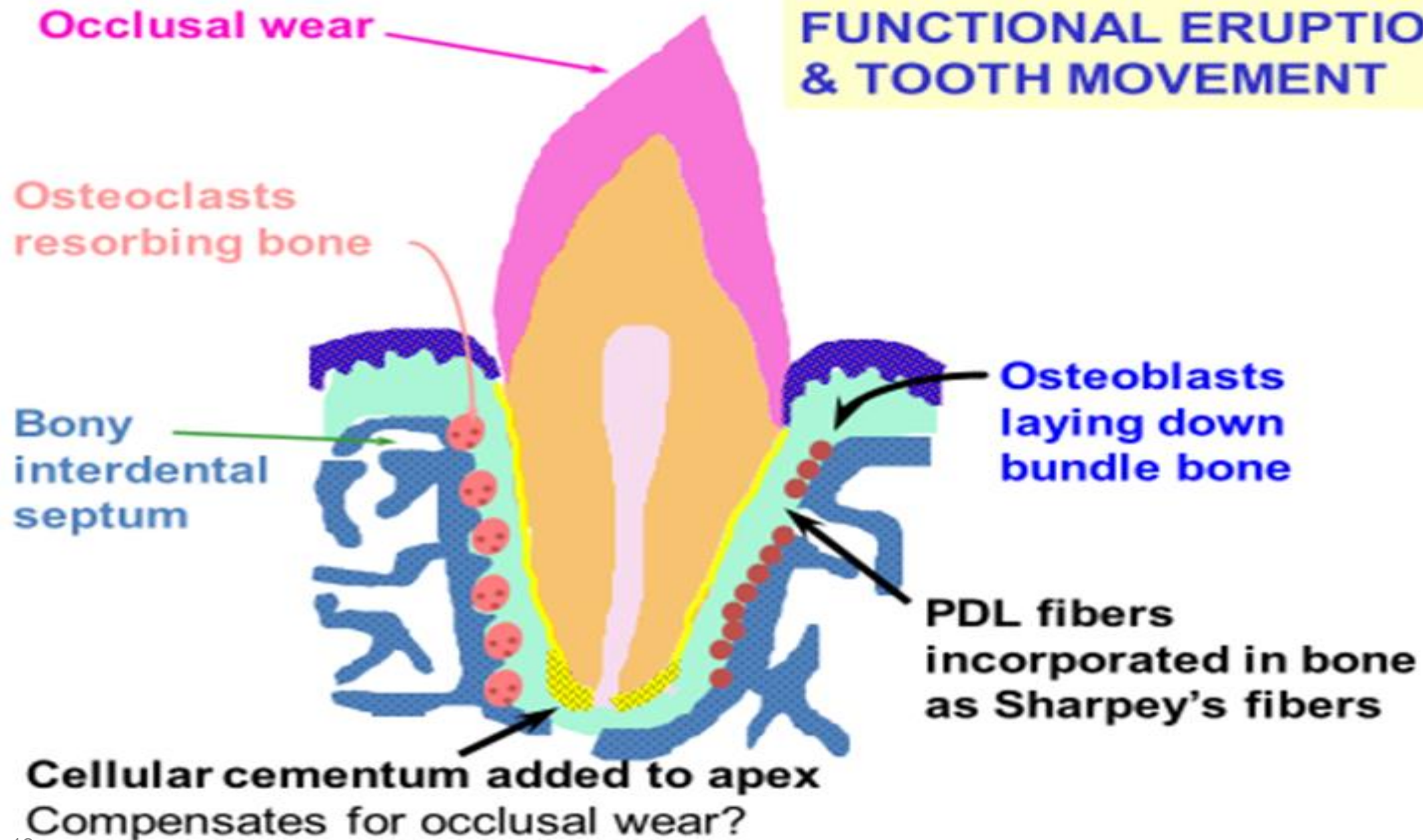
- ❑ As the tooth moves occlusally it creates space underneath the tooth to accommodate root formation
- ❑ Hydrostatic pressure within the periapical tissues pushing the tooth occlusally.
- ❑ Bony remodeling ; bone trabeculae fill in the space left behind as the tooth erupts in the pattern of a ladder which gets denser as the tooth erupts
- ❑ Pulling of the tooth in an occlusal direction by the cells and fibers of the periodontal ligament attach to the apical cementum and extend into the adjacent alveolar bone.



Post Eruptive Tooth Movements:

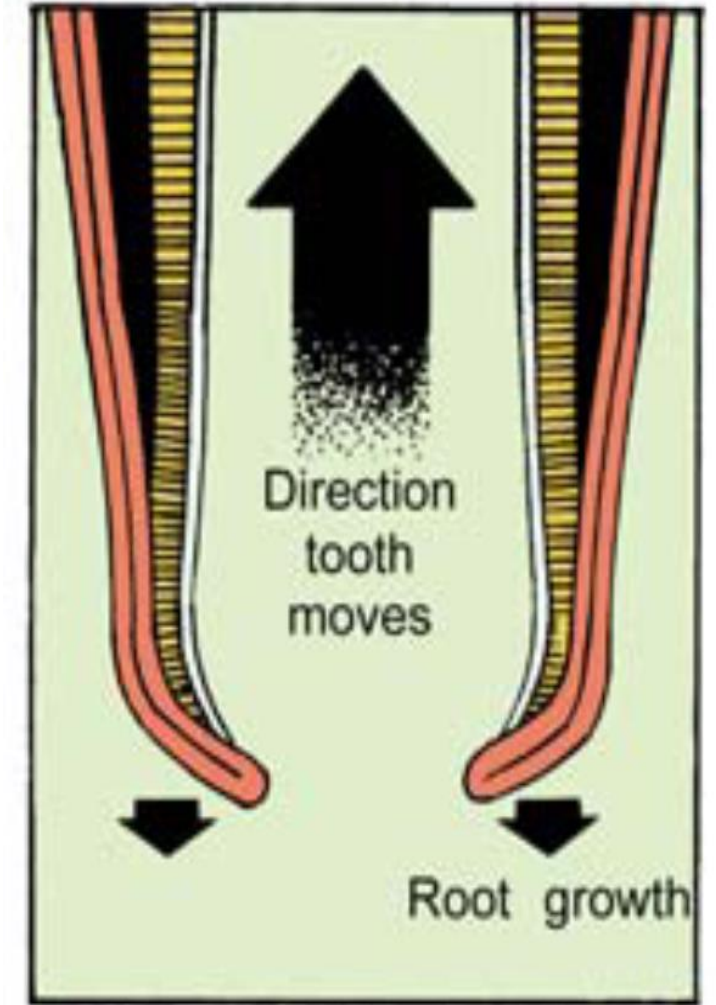
- These movements made by the tooth after it has reached its functional position in the occlusal plane.
- They may be divided in three categories:
 - **Accommodation for growth** - Mostly occurs between 14 and 18 years by formation of new bone at the alveolar crest and base of socket to keep space with increasing height of jaws.
 - **Compensation for occlusal growth** - Compensation primarily occurs by continuous deposition of cementum around the apex of the tooth. However, this deposition occurs only after tooth moves.
 - **Accommodation for interproximal wear** - Compensated by mesial or a proximal drift.
- **Mesial drift is the lateral bodily movement of the tooth on both sides of the mouth.**

FUNCTIONAL ERUPTION & TOOTH MOVEMENT



CAUSES OF ERUPTION (THEORIES.....)

- Root formation
- Bone remodeling
- Dental follicle
- Periodontal ligament
- Hydrostatic pressure
- Pulpal pressure
- Cellular theory
- Molecular theory
- Active eruption
- Passive eruption
- Genetic factors
- Local factors



- **Active eruption** : bodily movement of tooth from its site of development to its functional position in the oral cavity.
- **Passive eruption** : apparent lengthening of the crown due to loss of attachment or recession of gingiva.
- **Genetic and environmental factors** :The environment, prenatal and maternal factors, social factors, climate etc. may influence the timing of tooth eruption but the determinants of this timing are still thought to be more genetic than environmental
- **CONTROL OF ERUPTION:**

1- Hormonal control mechanisms

2- Physical control mechanisms

SHEDDING OF TEETH :

- The physiologic process resulting in the removal of the deciduous dentition is called shedding or exfoliation.
- The main factors which play role in shedding of teeth are the odontoclast and pressure from the successional tooth.
- External pressures generated by cheeks and tongue also play a minor role in shedding.

Pattern of shedding :

- Shedding or exfoliation occurs as a result of progressive resorption of roots of the teeth and their supporting tissue , the periodontal ligament.
- In general , the pressure generated by the growing and erupting permanent tooth dictates the pattern of deciduous tooth resorption.
- At first the pressure is directed against the vestibular direction, resorption of the roots of the deciduous incisors and canines begins on their lingual surfaces.
- Later, the developing tooth germs occupy a position directly apical to the deciduous tooth.
- The areas of early resorption are repaired by the deposition of a cementum-like tissue.

Factors that play an important role in shedding

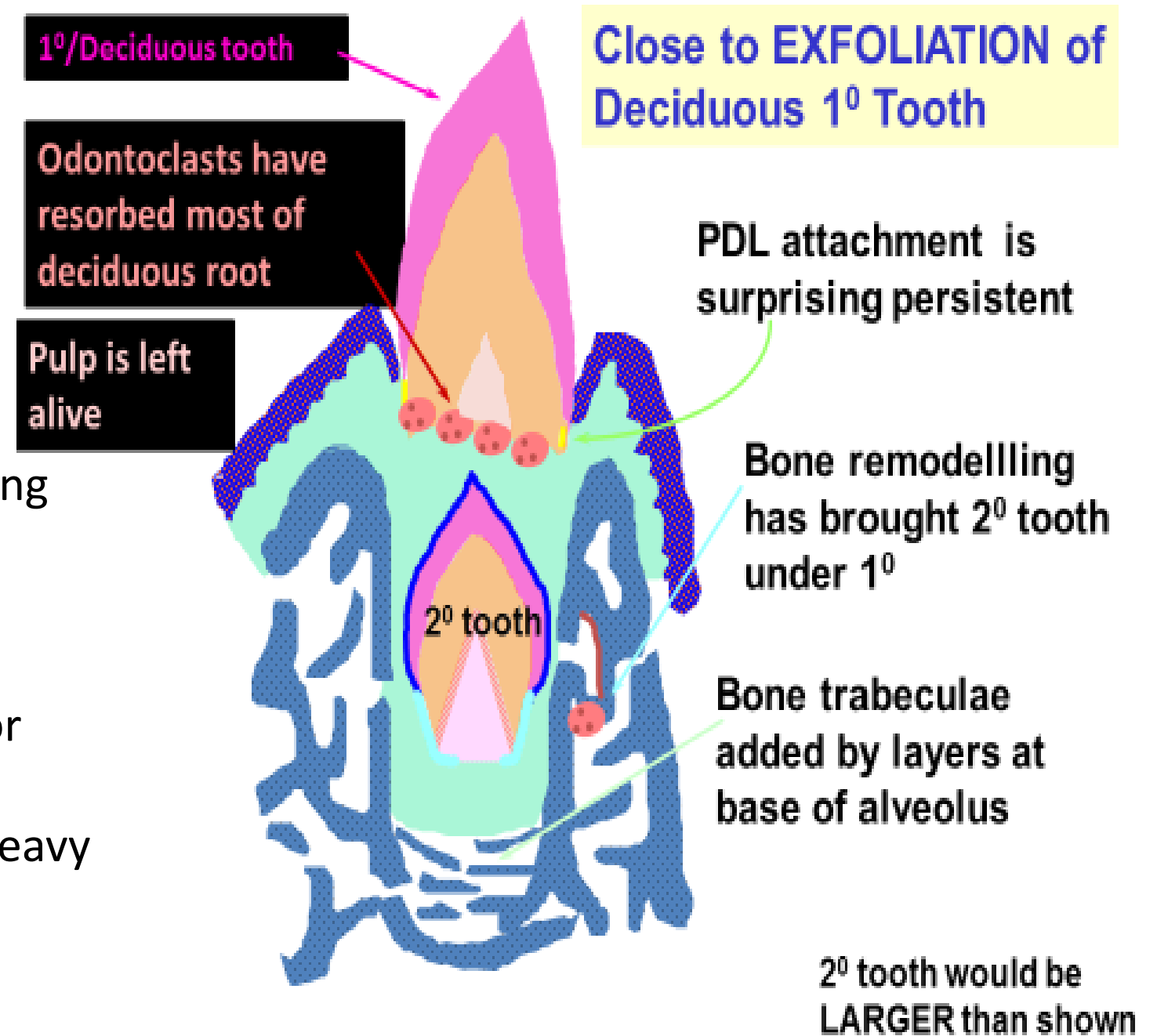
- 1.Odontoclast
- 2.Pressure.

1- Odontoclast :

- Derived from monocyte and migrates from pulpal B.V to the resorption sites , where they fuse to form multinucleated odontoclast with a clear ruffled (brush) border , are found in lacunae .
- Histologically , characteristic feature of this is a high level of activity of the enzyme acid phosphatase , which can be used as identifier ; occurred within vacuoles and these vacuoles are concentrated in the cytoplasm near the ruffled border ,

PRESSURE:

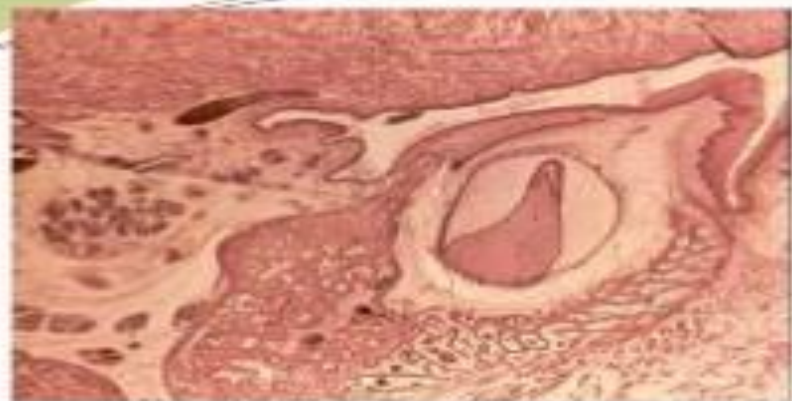
- The pressure exerted by the erupting permanent teeth seem to play an important role in resorption of deciduous teeth.
- The local pressure is responsible for initiation of resorption.
- In addition to this local pressure, heavy masticatory and muscular forces (external pressure) play a role in resorption.



Mechanism of resorption and shedding:

- Pressure from the erupting successional tooth and appearance of odontoclasts at the site of pressure.
- Membrane of ruffled borders act as proton pump → adding hydrogen ions to extracellular region → acidification → mineral dissolution.
- Increased forces of mastication with increase in jaw size leading to trauma to PDL → degeneration of PDL
- Resorb bone for the eruption pathway
- Dental follicle is interposed between the alveolar bone and tooth , it is an ideal location to regulate the cellular events of eruption and receive signals from the tooth

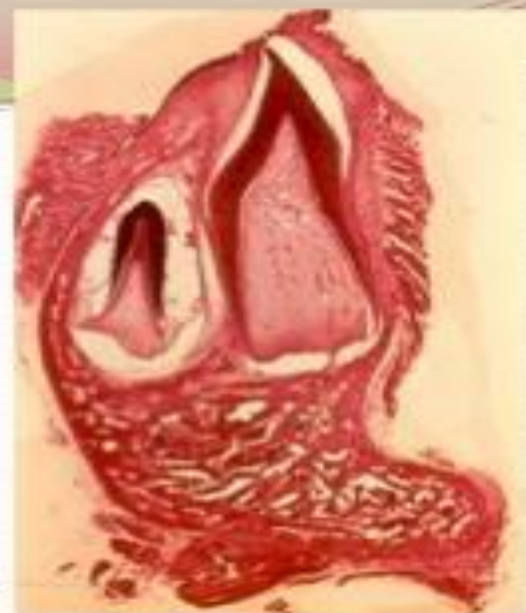
Shedding of mandibular incisor



5 months



At birth



1 year



2 years



3.5 years



4.5 years

Figure Source: Dr. Sandra Meyers

Histology of shedding:

- Odontoclasts are resorbing cells derived from monocytes & migrate from blood vessels to resorption site , where they form multinucleated odontoclast with a clear attachment zone & ruffled border.
- Giant multinuclear cells with 4-20 nuclei
- Resorption occurs at ruffled border which greatly increases surface area of odontoclast in contact with bone.
- **Distribution of odontoclast during tooth resorption-** found on surface of roots in relation to advancing permanent tooth.
- Single rooted tooth shed before root resorption is completed.
- Odontoclasts are not found in pulp chamber of these teeth.
- In molars, roots are completely resorbed & crown is partially resorbed.
- Odontoblasts layer is replaced by odontoclasts.
- Sometimes all dentine is removed & vascular tissue is seen beneath translucent cap of enamel.

The six/four rule for primary tooth emergence

Four teeth emerge for each 6 months of age

1. 6 months: 4 teeth (lower centrals & upper centrals)
2. 12 months: 8 teeth (1. + upper laterals & lower laterals)
3. 18 months: 12 teeth (2. + upper 1st molars & lower 1st molars)
4. 24 months: 16 teeth (3. + upper canines & lower canines)
5. 30 months: 20 teeth (4. + lower 2nd molars & upper 2nd molars)

1. By 5 months in utero, all crowns started calcification
2. By 1 year old, all crowns completed formation
3. By 2.5 years, all primary teeth erupted
4. By 4 years old, all primary teeth completed root formation

Clinical considerations :

- **Natal or neonatal teeth** : Eruption of teeth at birth called natal teeth or during first 30 days of life called neonatal teeth
 - They may be well formed & normal or represent horrified epithelial structures without roots.
 - Found on gingiva over crest of ridge
 - arise either from an accessory bud of dental lamina ahead of deciduous bud or from bud of an accessory dental lamina.
- **TEETHING**: is a term limited by common usage to eruption of primary teeth.
- Clinical features:
 1. Local signs
 2. Systemic signs
- Baby is teething when his or her first set of teeth, called primary teeth , break through the gums.
- Begins at around 6 months of age.

- Congenital hypothyroidism/ Cretinism

due to hypo function of thyroid gland

- primary tooth eruption is delayed till 2 years.
- large head, protruding tongue
- as soon as it is noticed, treated with thyroxin.

- Eruption cyst

- follicular enlargement occurring just before eruption.
- blue-black color due to presence of blood
- no specific treatment if uninfected.



- **INFRA OCCLUSION:**

- This is the preferred term for **submerged** or **ankylosed** teeth.

- It describes teeth that have failed to achieve or maintain their occlusal relationship to adjacent and opposing teeth.

- **ANKYLOSIS**

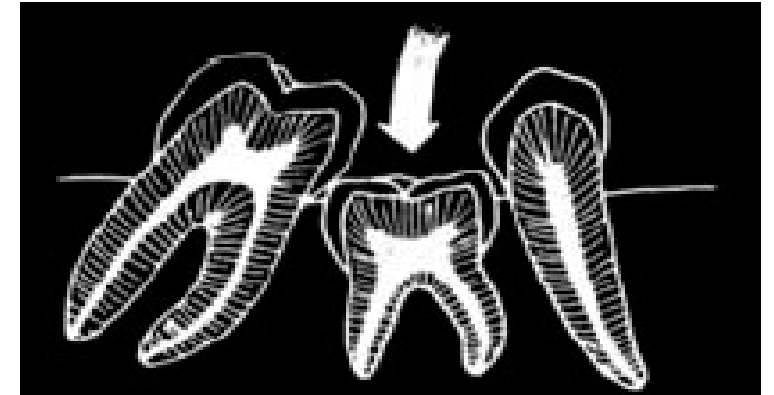
- Thought to be due to an imbalance in the normal pattern of resorption and repair in primary teeth.

- Trauma and infection have been suggested as precursors.

- Most likely cause here is congenitally absent lower permanent second premolars.

- If the teeth are ankylosed they will be more difficult to remove, and may require minor oral surgery

Ankylosed Teeth
Submerged Teeth



- **Embedded teeth:** These are teeth that fail to erupt in the oral cavity due to various local factors.
- **ECTOPIC ERUPTION:**
 - Term used to describe a tooth or teeth that erupt in an abnormal position.
 - The prevalence of ectopic eruption was significantly higher in the mandible.
 - It is believed that ectopic eruption is due to an abnormal change in position of the dental follicle, delayed loss of primary tooth, loss of space in the alveolar arch.
- But, not yet the true reason for this condition is concluded

