Shedding of Deciduous Teeth

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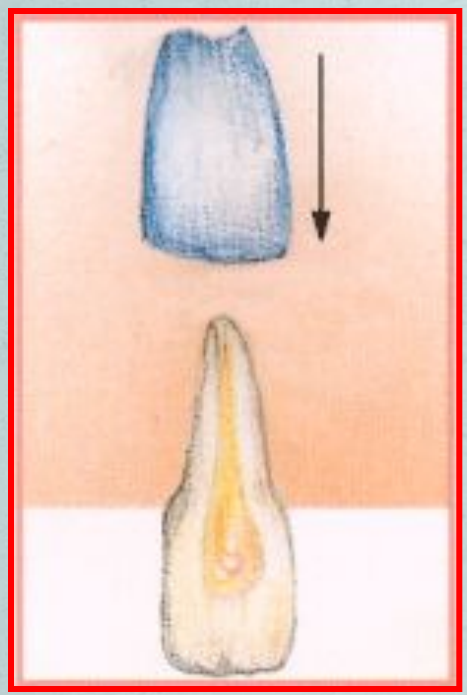
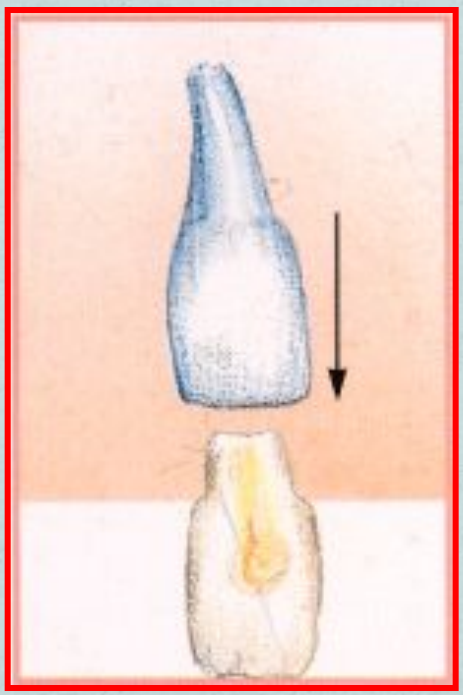
Definition

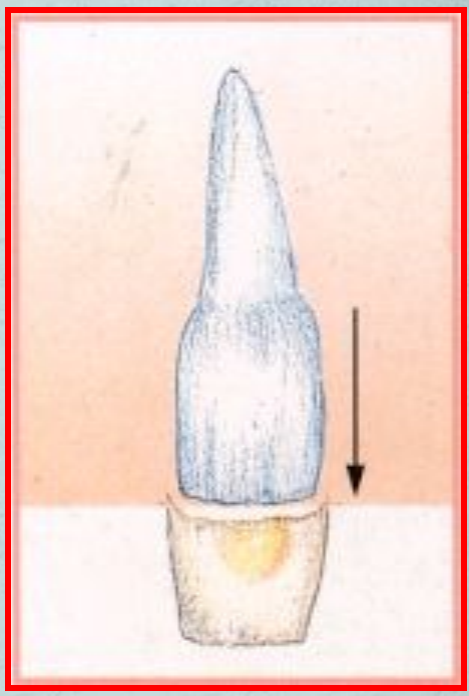
- Humans & most mammals have 2 sets of dentition
  - Deciduous/primary dentition
  - Permanent /secondary dentition
- Why 2 sets of dentition?
  - Infant jaws are small can only support few small teeth
  - Teeth, once formed, cannot increase in size
  - Adults need dentition, consisting of larger & more number of teeth
- **The physiologic process of elimination of the deciduous dentition is called shedding / exfoliation**

Shedding

Increased pressure Loss of root surface Loss of bone support







Cause for shedding

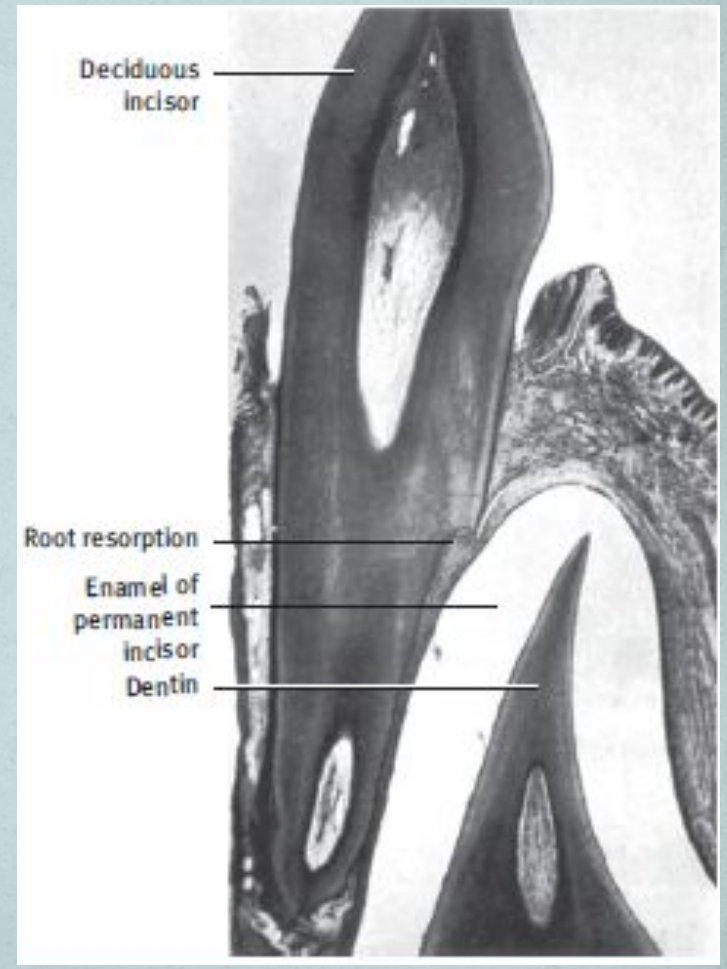
- Progressive resorption of the roots of deciduous teeth and their supporting tissue (PDL)
- Resorption involves:
  - Resorption of hard tissues (Cementum & Dentin)
  - Resorption of soft tissues (PDL & Pulp)
- Resorption of hard tissues is accomplished by multinuclear cells similar to osteoclasts called Odontoclasts

Pattern of Shedding

- Pressure generated by the growing & erupting permanent tooth dictates the pattern of deciduous tooth resorption
- Initially this pressure is directed towards the root surface of the deciduous tooth itself

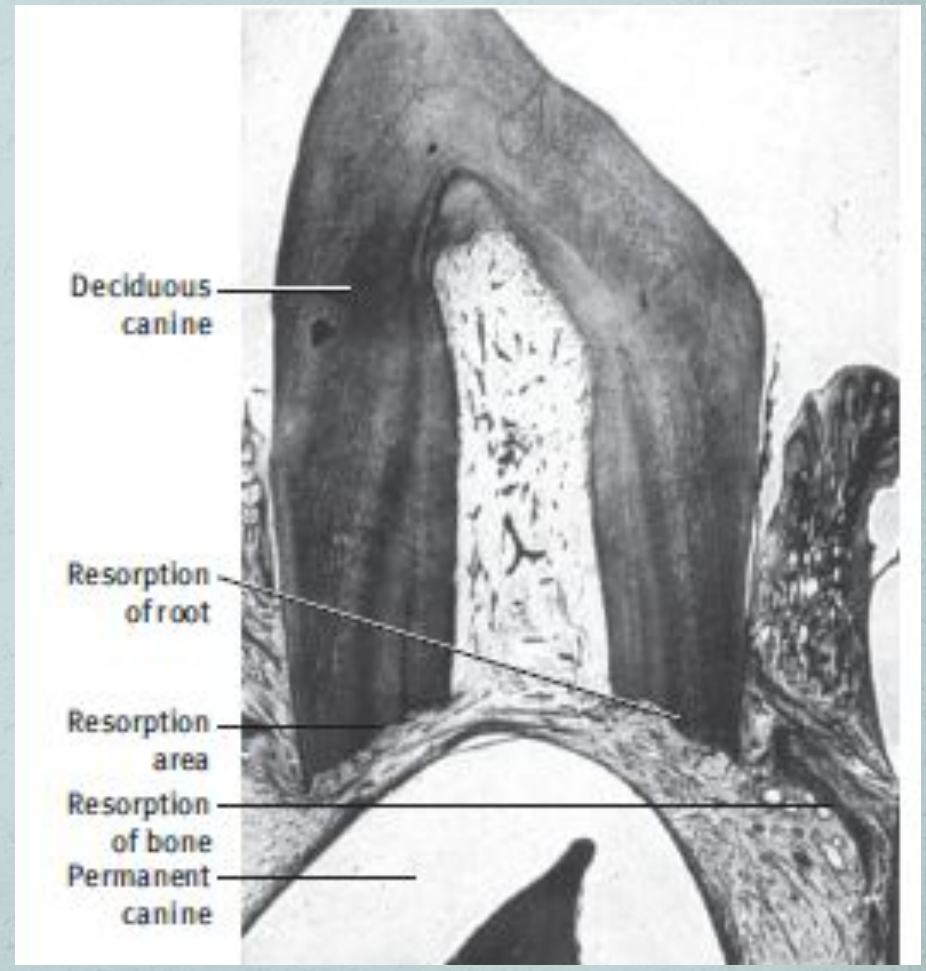
Pattern of Shedding

- Permanent incisor & canine tooth germs are located lingual to deciduous tooth apices
- They move in an occlusal & vestibular direction
- Hence resorption of deciduous incisors & canines roots of begins on their lingual surfaces



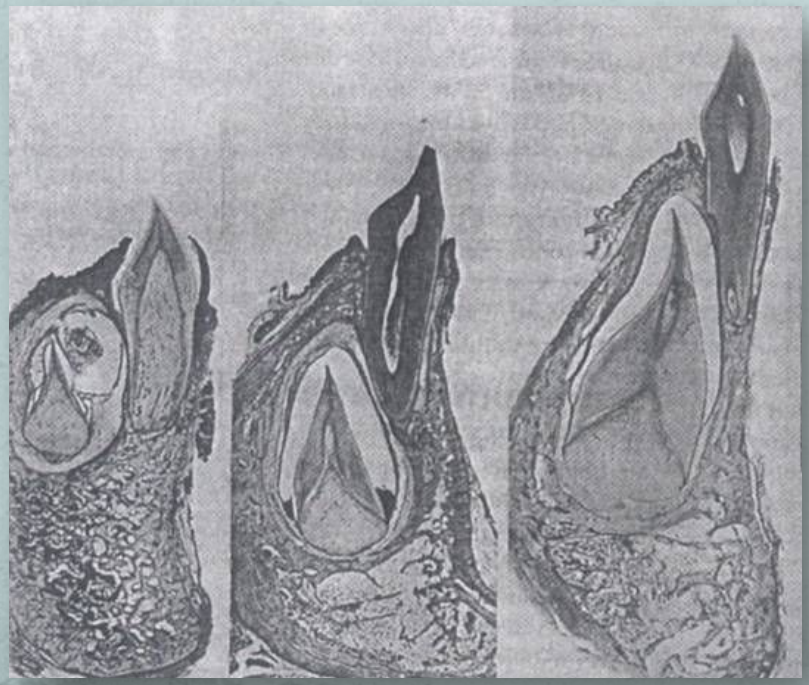
Pattern of Shedding

- Later, these tooth germs occupy a position directly apical to the deciduous tooth
- This permits them to erupt in the position formerly occupied by the deciduous tooth



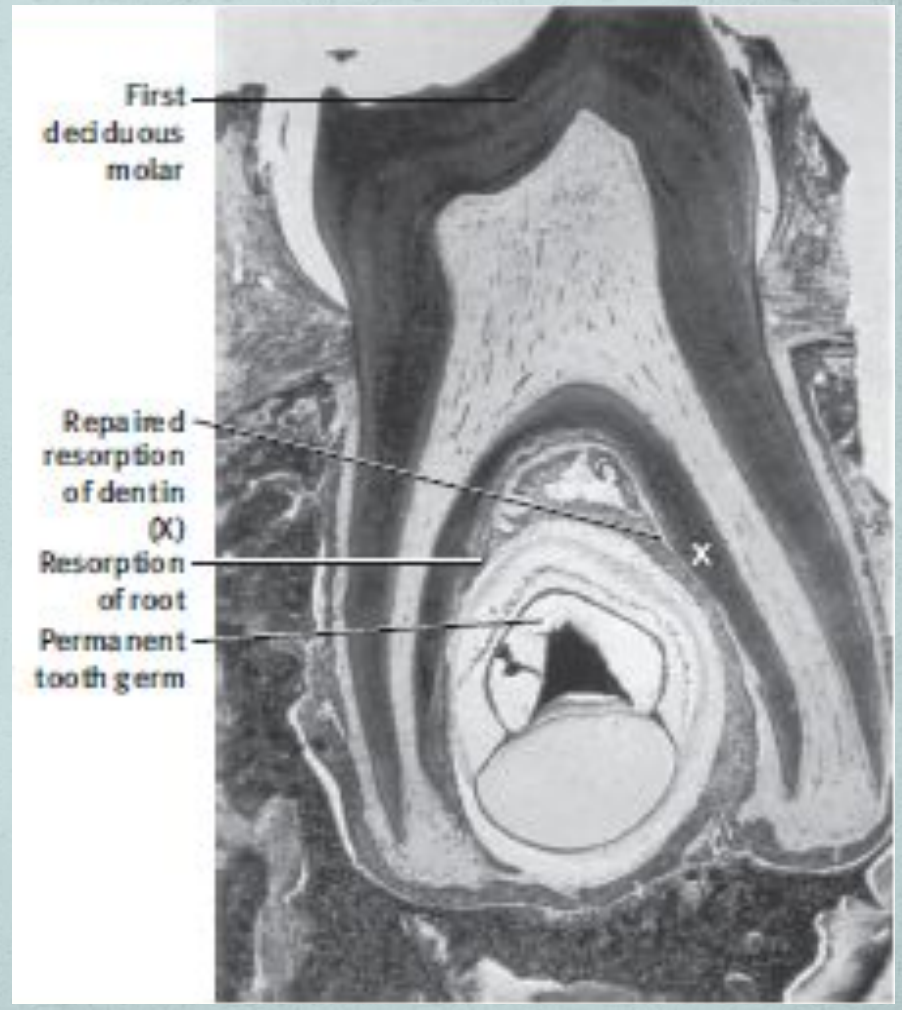
Pattern of Shedding

- But this apical positioning of the tooth germs does not occur in permanent mandibular incisors & they erupt lingual to deciduous tooth



Pattern of Shedding

- Developing premolars are found b/w roots of deciduous molars
- Resorption of deciduous molars begins on inner surfaces

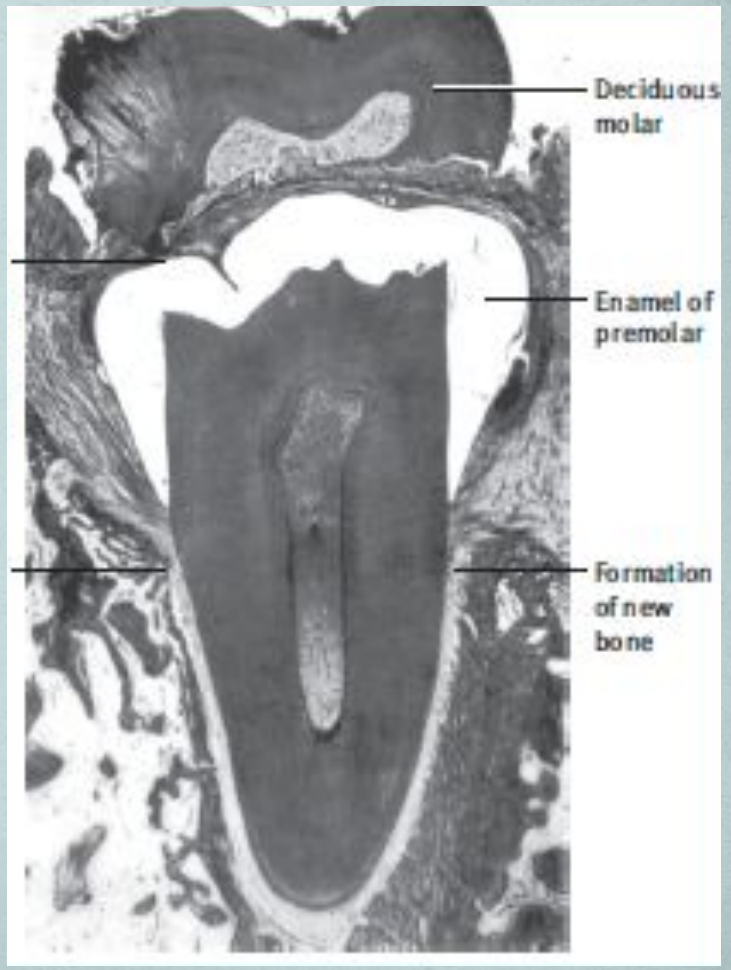


Pattern of Shedding

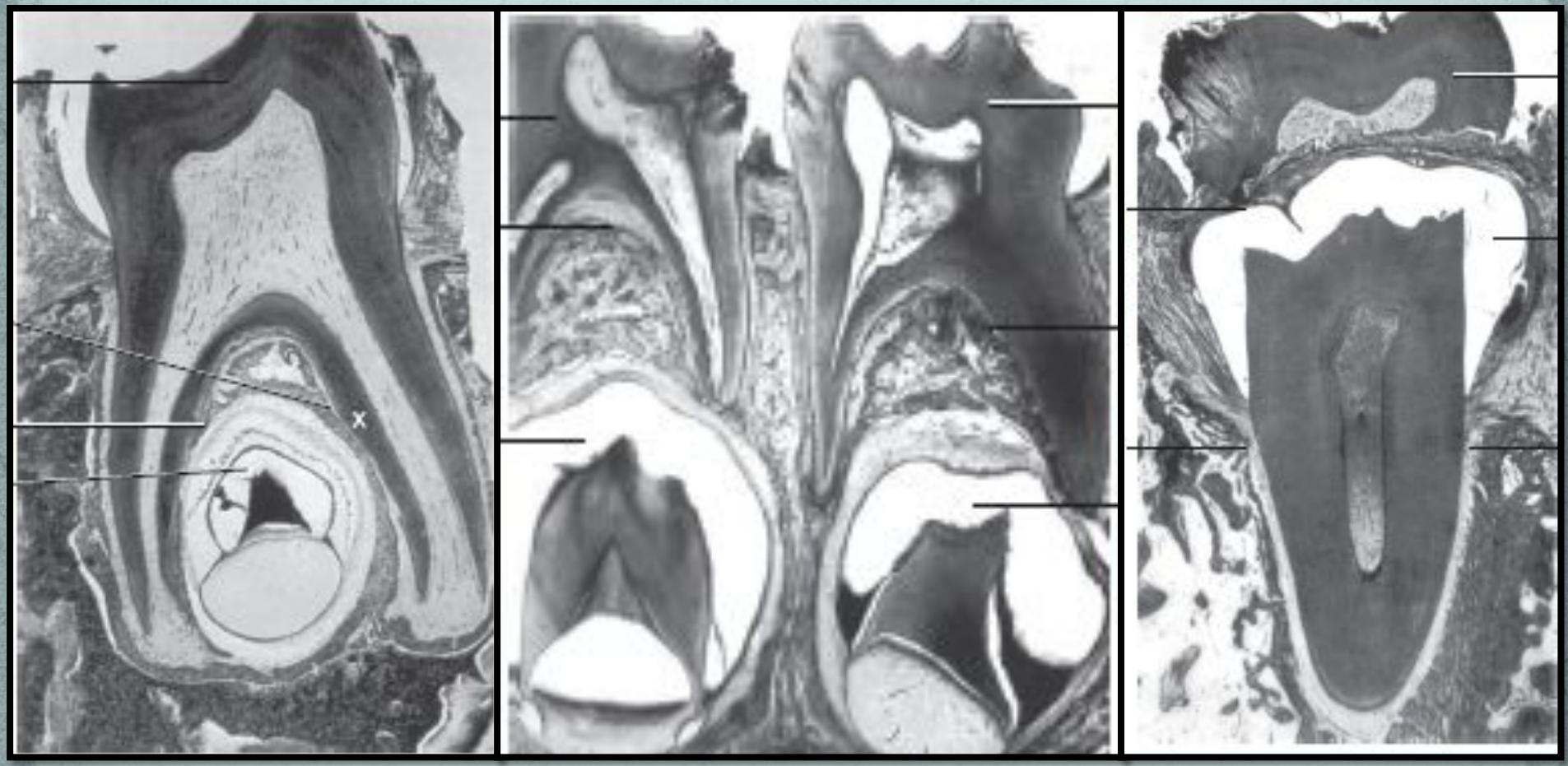
- Growth of jaws & occlusal movement of deciduous molars permanent tooth germs move apical to deciduous molars
- Growing bicuspids have adequate space for their development and relieves pressure on the roots of the deciduous molars
- Areas of early resorption are repaired by the deposition of cementum-like tissue

Pattern of Shedding

- When the premolars begin to erupt, resorption of the deciduous molars is again initiated
- Resorption continues until the roots are completely lost & the tooth is shed
- Premolars erupt in the position of deciduous molars



Pattern of Shedding



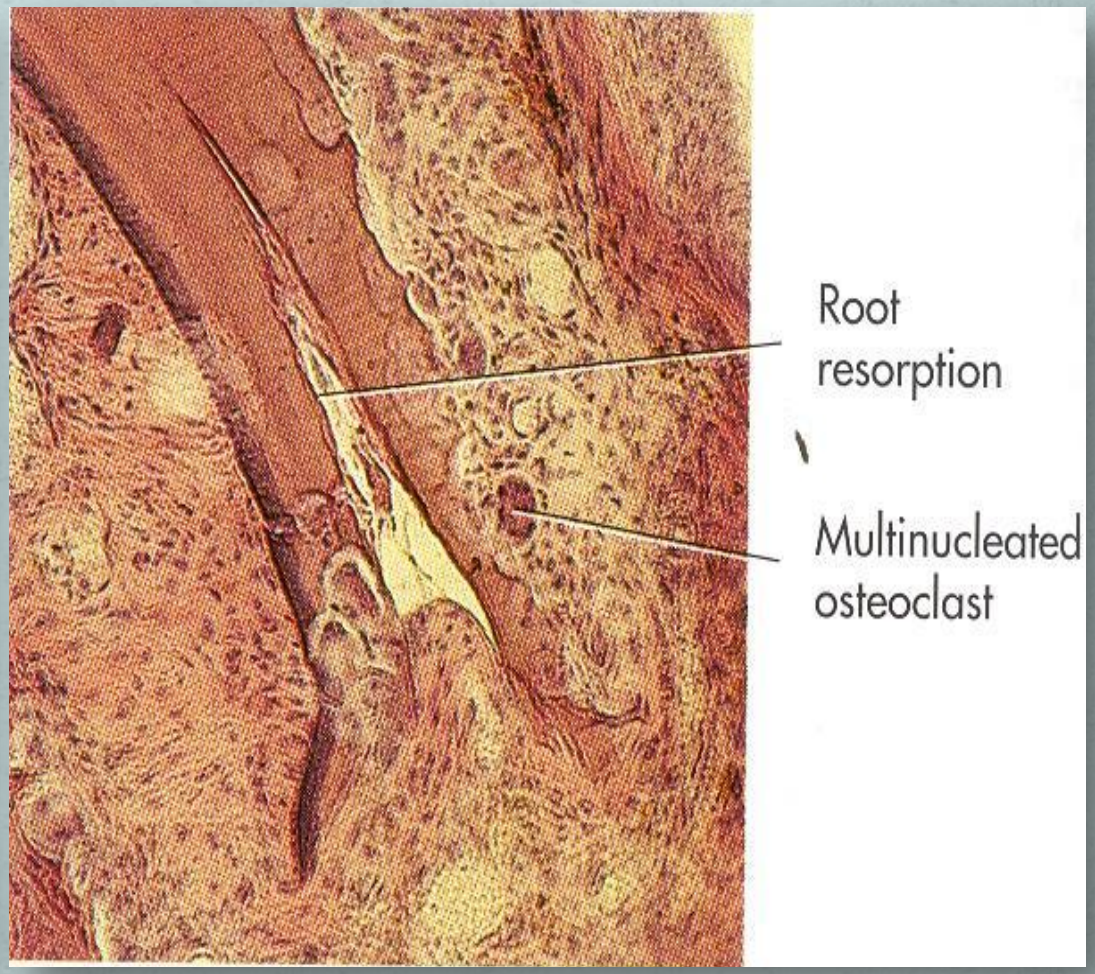
Histology of Shedding

- **Odontoclasts** are cells responsible for the removal of dental hard tissue
- Large, multinucleated cells present in resorption bays on the surface of dentin or cementum
- They are similar to osteoclasts but are smaller
- Contain fewer nuclei & produce smaller resorption lacunae
- Cytoplasm is vacuolated

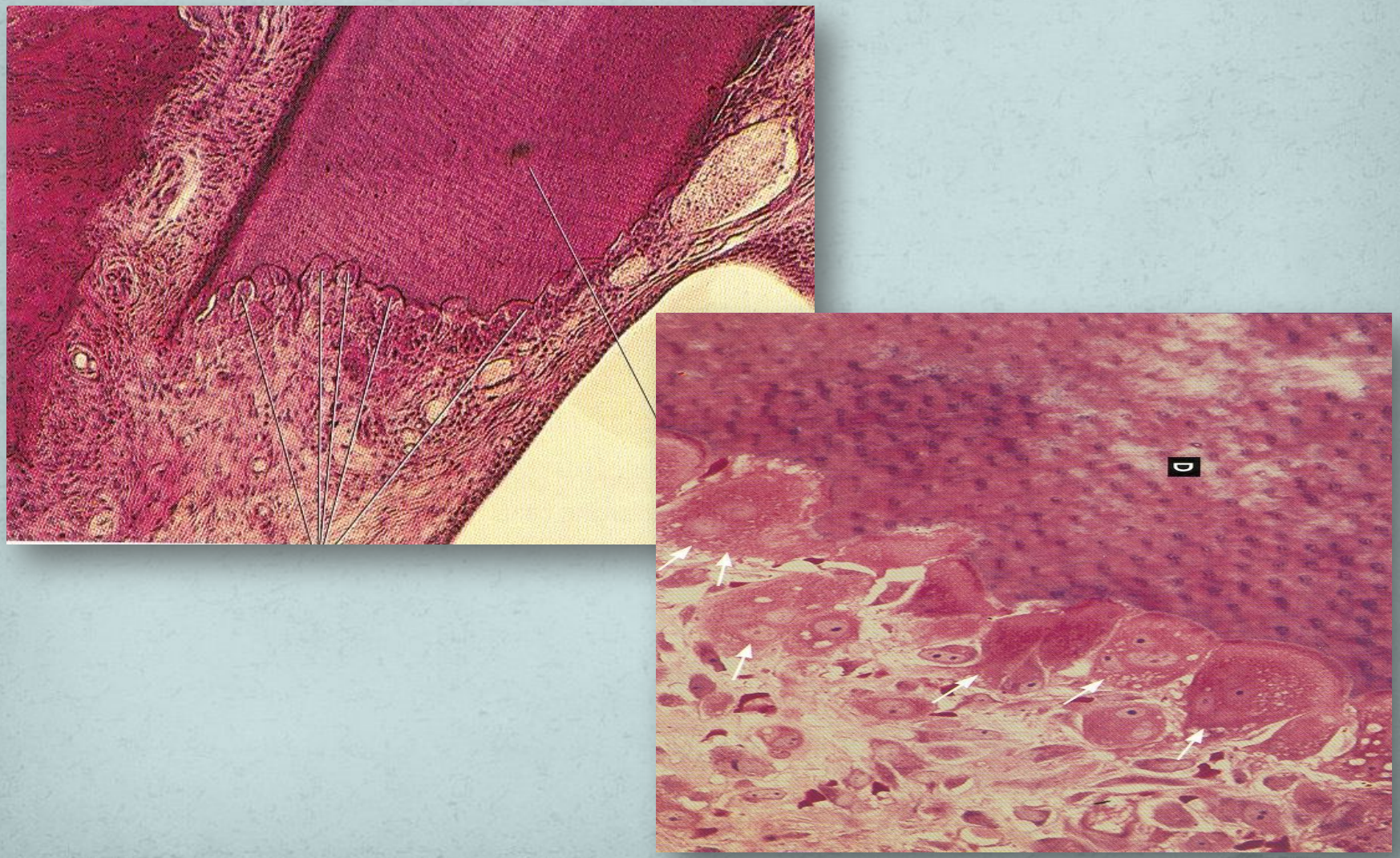
Histology of Shedding

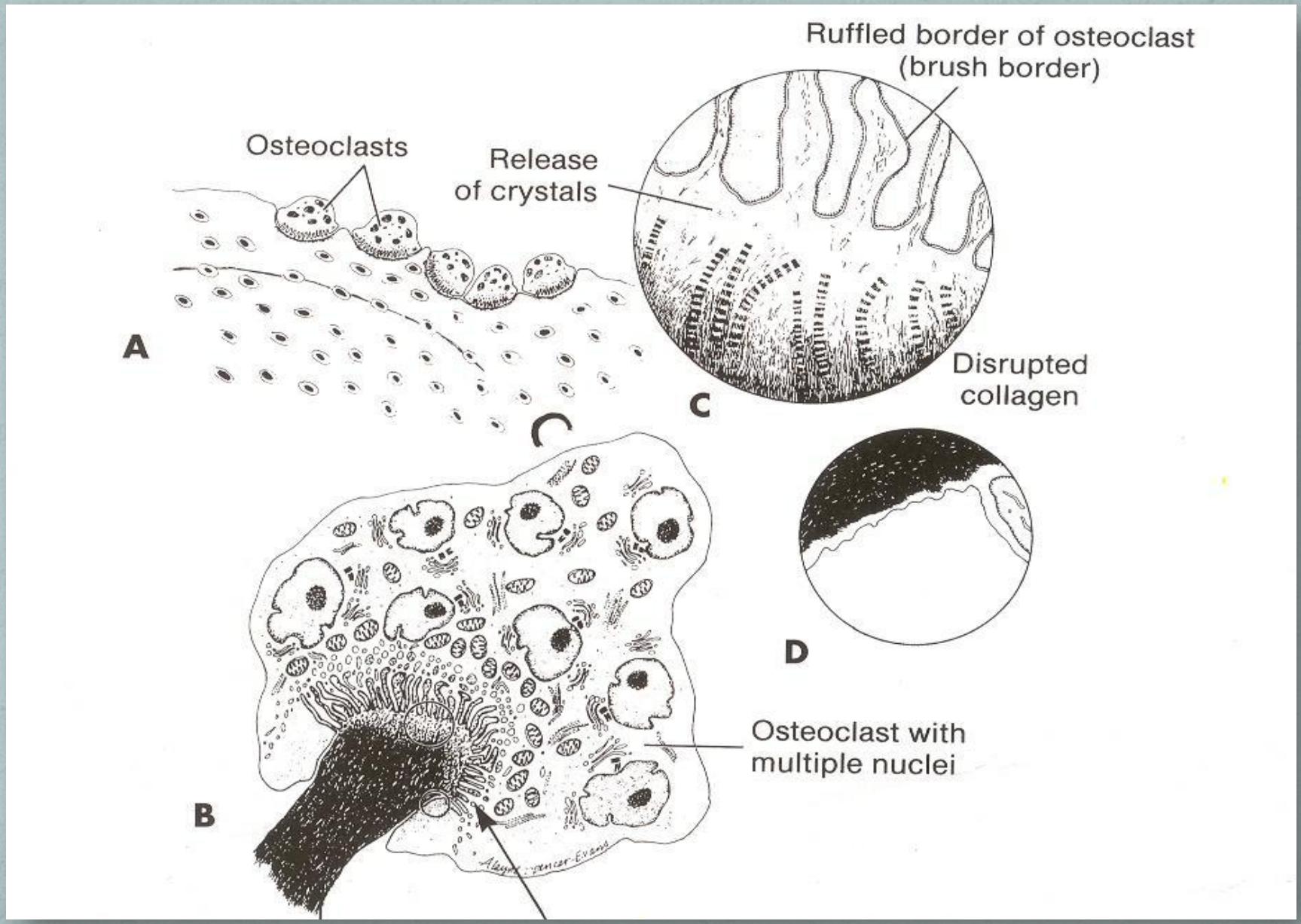
- Surface of the cell adjacent to the resorbing hard tissue forms a "ruffled" border
- Ruffled border: extensive folding of the cell membrane into a series of invaginations 2-3 μm deep
- Mineral crystallites are seen in the depths of the invaginations
- Adjacent to the ruffled border is a clear zone in which the cytoplasm is devoid of organelles but rich in filaments consisting of contractile proteins actin & myosin

Odontoclasts



Resorption Lacunae




Ruffled border of osteoclast
(brush border)
Osteoclasts
Release
of crystals
A
C
Disrupted
collagen
C
D
Osteoclast with
multiple nuclei
B

Histology of Shedding

- Cytoplasm of the odontoclast shows numerous mitochondria & many vacuoles, which are concentrated adjacent to the ruffled border
- Acid phosphatase activity occurs within these vacuoles
- Osteoclats develop ruffled border & clear zone after they contact the resorbing surface
- The odontoclasts fuse with each other to form a multinucleated giant cell only after they get attached to the resorbing surface

Histology of Shedding

- Odontoclasts can resorb all the dental hard tissues (including enamel)
- Resorption of dental hard tissues is similar to resorption of bone by oseoclasts
- When dentin is being resorbed, the presence of the tubules provides a pathway for the easy extension of odontoclast process
- Odontoclasts probably have the same origin as osteoclasts.
- Monocytes give rise to all tissue macrophages, including the osteoclast

Histology of Shedding

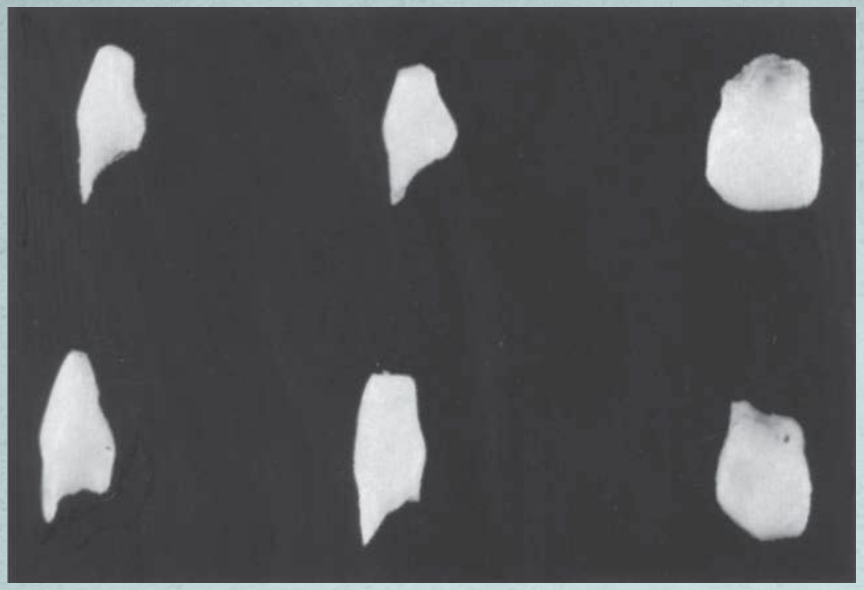
- It is not certain if osteoclasts are formed from resident tissue macrophages or from circulating monocytes
- Odontoclasts, are probably derived from tartrate-resistant acid phosphatase (TRAP)-positive circulating monocytes
- Suggested: HLA-DR positive cells are involved in the differentiation, migration & activation of odontoclast and cementoblast like cells during resorption of deciduous teeth

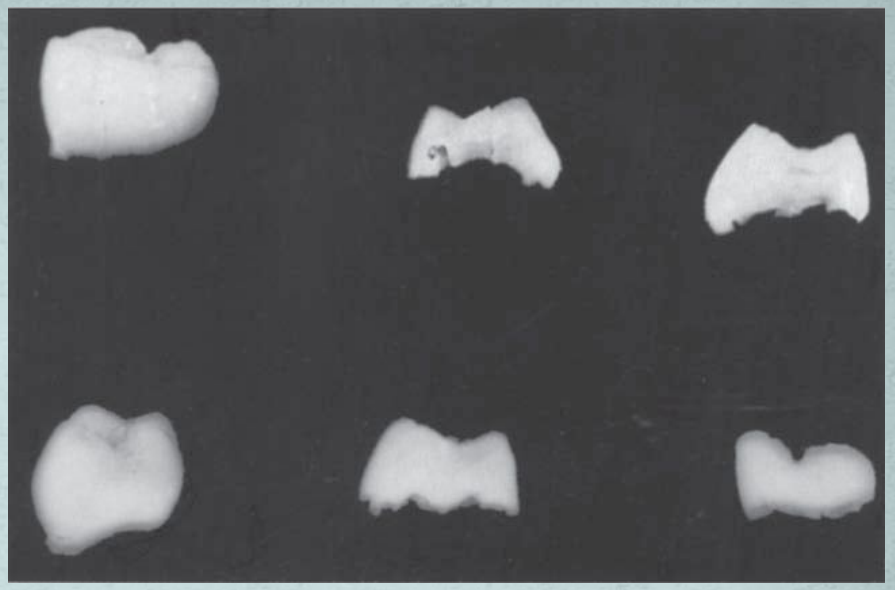
Histology of Shedding

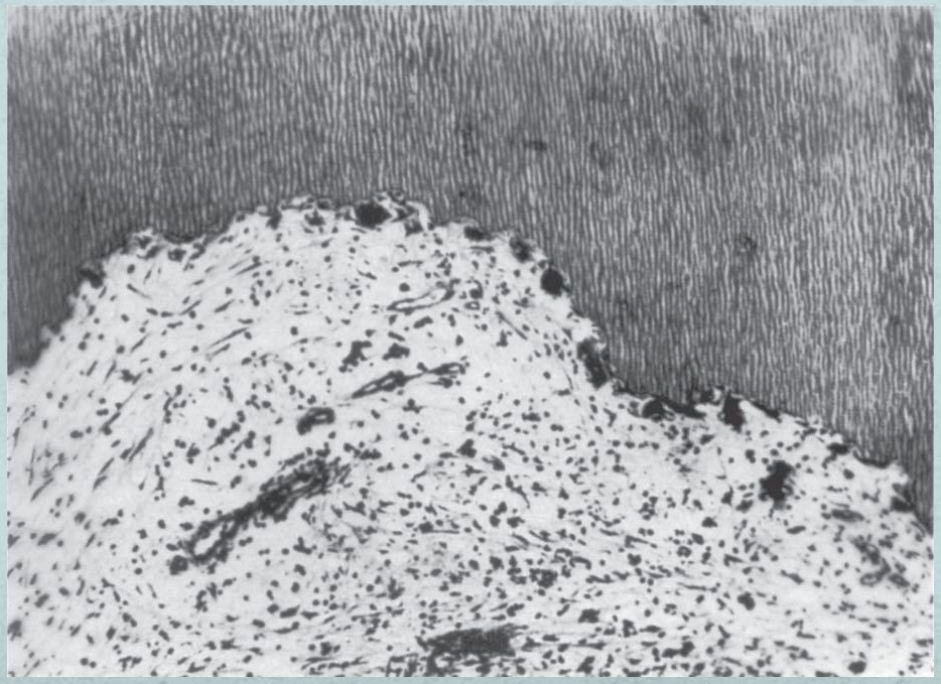
- Cells of PDL in teeth undergoing shedding express **RANKL (Receptor Activator of Nuclear factor Kappa B Ligand)**
- RANKL and its receptor, RANK are expressed on Odontoclasts derived from resorbing deciduous teeth
- Osteoprotegerin (OPG) prevents RANKL from binding to RANK
- Less in the periodontal ligament cells of resorbing teeth
- RANKL promotes odontoclast differentiation
- OPG inhibits osteoclast differentiation

Histology of Shedding

- Odontoclasts are most commonly found on surfaces of the roots
- However, they have also been described in the root canals & pulp chambers of resorbing teeth
- Single-rooted teeth are usually shed before root resorption is complete hence odontoclasts are not found within the pulp chambers & the odontoblast layer remains intact
- In molars, roots are completely resorbed followed by partial resorption of crown hence odontoblast layer is replaced by odontoclasts







Histology of Shedding

- Tooth resorption is not continuous, it has periods of rest & repair
- Cells resembling cementoblasts lay down a dense collagenous matrix □spotty mineralization occurs
- Resorbed enamel & dentinal surface becomes coated with cellular cementum like tissue
- This may help in retention of deciduous teeth until shedding
- Gingival epithelium holds the tooth in the cervical region just prior to shedding & the final part of shedding occurs by tearing this attachment

Mechanism of Resorption & Shedding

- Attachment of Odontoclasts to the mineralized surface of tooth
- Creation of a sealed acidic environment through action of the proton pump
- Demineralizes tooth & exposes the organic matrix
- Degradation of the exposed organic matrix by the action of released lytic enzymes such as Acid phosphatase and Cathepsin B
- Uptake of mineral ions and amino acids by the cells

Mechanism of Resorption & Shedding

- Pressure from erupting permanent tooth
- Reduced enamel epithelium of the erupting permanent teeth releases some substances
- Cementoblastic layer is damaged probably by inflammatory processes
- Expression of RANKL
- Odontoclasts differentiate & attach to the hard-tissue surface through the clear zone
- Sealed space lined by the ruffled border of the cell is created

Mechanism of Resorption & Shedding

- The membrane of the ruffled border acts as a proton pump, adding hydrogen ions to the extracellular environment
- Acidifyication mineral dissolution
- Primary lysosomes secrete their enzymes
- extracellular dissolution of organic matrix to smaller molecules
- Taken by odontoclasts and degraded further

Dissolution of PDL

- Cell death without inflammation
- Occurs in 2 ways
  - Accumulation of collagen intra cellularly: interference in normal collagen secretory mechanism
  - Apoptosis – programmed cell death

Sequence of shedding

- Symmetric on both sides
- Mand. Teeth shed before max. except second molars – simultaneous
- Girls teeth exfoliate before boys teeth
- Mand: ABCDE
- Max: ABDCE

Clinical Considerations

- Remnants of deciduous teeth
- Retained deciduous teeth
- Submerged deciduous tooth

Remnants of deciduous teeth

- Parts of deciduous teeth which have escaped resorption
- Composed of dentine & cementum
- In association with premolars – well separated roots of deciduous molars
- Covered by bone or cellular cementum
- Ultimately exfoliated or resorbed with bone replacement

Retained deciduous teeth

- Retained beyond their usual shedding schedule
- Seen when
- Permanent successors missing or impacted
  - Most commonly: Max. lateral incisors, Mand Second molar , Mand Central incisor
- If a permanent tooth is ankylosed or impacted, its deciduous predecessor may also be retained
  - Canines

Submerged deciduous teeth

Trauma

↓

Damage to PDL or dental follicle

↓

Eruption ceases

↓

Akylosis of tooth to bone

↓

Eruption of neighboring teeth,

↓

Submerged

↓

Prevents eruption of permanent tooth

Submerged deciduous teeth

Thank you