# TOOTH ERUPTION AND SHEDDING

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# Eruption:

- Latin word “erumpere” , meaning “to break out”
- **Maury Massler and Schour (1941)** :Eruption is a process whereby the forming tooth migrates from its intraosseous location in the jaw to its functional position within the oral cavity.
- **Osborne:** Eruptive movement is defined as the axial movement of the tooth which brings the crown of the tooth from its developmental position within the bone of the jaw to its functional position in the occlusal plane.
- **James K Avery:** Eruption as the movement of the teeth through the bone of the jaws and the overlying mucosa to appear and function in the oral cavity.

# PATTERN OF TOOTH MOVEMENT

- Movements leading to eruption of tooth can be divided into 3 phases:

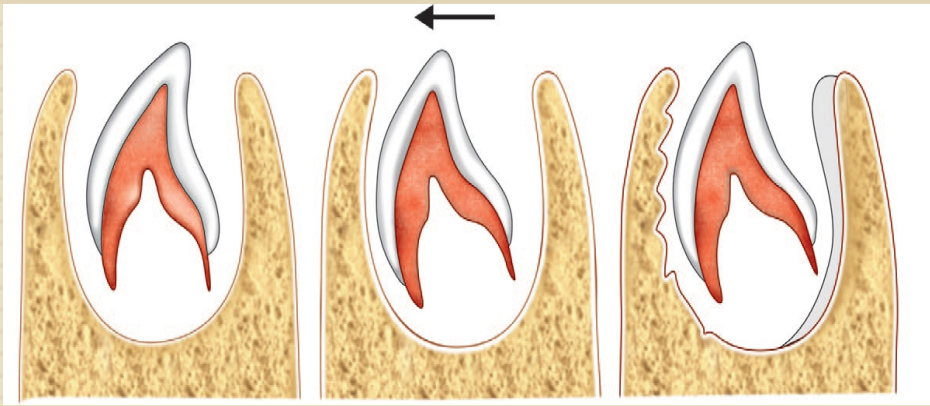
- Phase 1: The pre-eruptive phase.
- Phase 2: The prefunctional eruptive or eruptive phase.
- Phase 3: The functional eruptive or posteruptive phase.

# Pre-eruptive Phase:

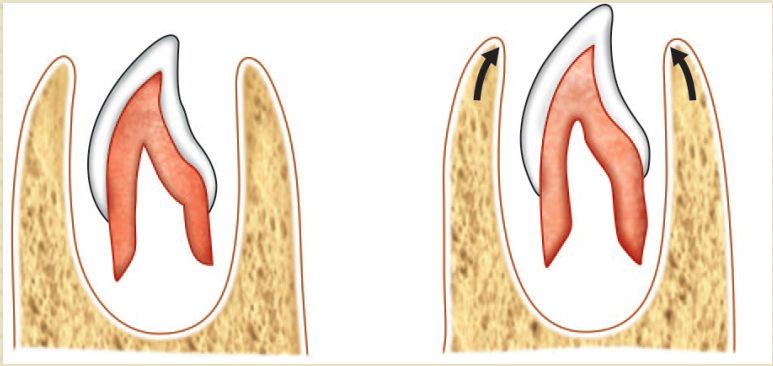
- The movement of the developing tooth germs within the alveolar processes prior to root formation.
- The growing tooth moves in two directions : 1) bodily movement
  2) eccentric movement

**Bodily movement:** Movement of the entire tooth germ.

- occurs continuously as the jaw grows.
- causes bone resorption in the direction of tooth movement and bone apposition behind it.



- **Eccentric growth:** Relative growth in one part of the tooth while the rest of the tooth remains constant.



Eccentric movement of crown during eruption

- During the **early** pre-eruptive phase, the successional permanent teeth : **lingual** and **near to occlusal level** of their primary predecessor.
- At the **end** of this phase, the teeth are positioned **lingually** and **near the apical third** of the primary anterior teeth.
- changes mainly **due to the eruption of the primary teeth** and **the coincident increase in the height of the supporting tissues.**

# Eruptive Phase:

- begins with the initiation of the root formation and ends when the teeth reach occlusal contact.
- Anatomic stages of tooth eruption: by **Noyes and Schour**

**Stage I**: Preparatory stage (opening of the bone crypt)

**Stage II**: Migration of the tooth toward the oral epithelium.

**Stage III**: Emergence of crown tip into the oral cavity.

(Beginning of clinical eruption)

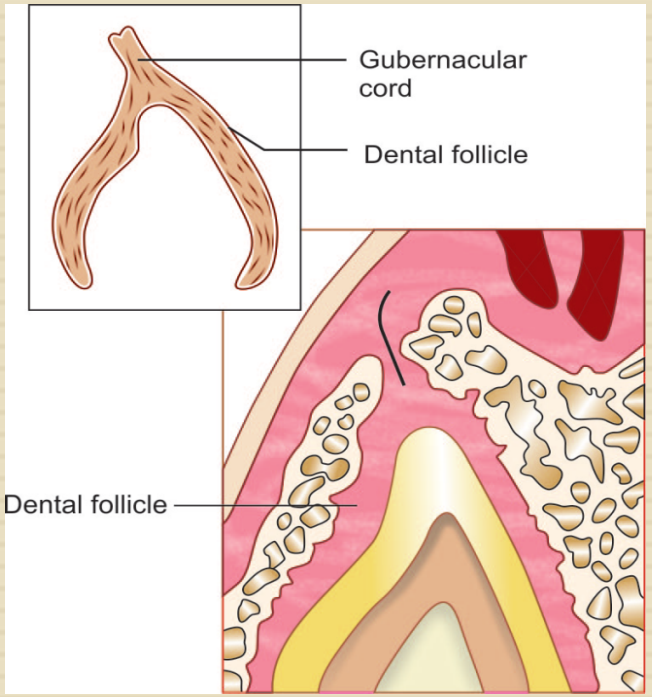
**Stage IV**: First occlusal contact.

**Stage V**: Full occlusal contact.

**Stage VI**: Continuous eruption.

# 1) Changes in Tissues Overlying Teeth

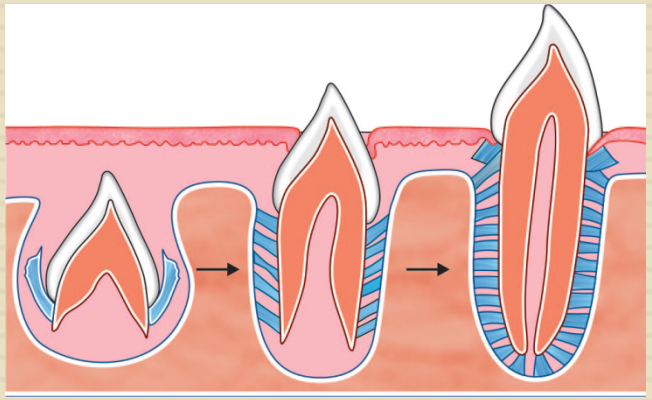
- Alteration of the connective tissue of the dental follicle to form pathway for the erupting teeth.
- Histologically, appears as a zone with **decreased and degenerated connective tissue** fibers, cells, blood vessels and terminal nerves.
- probably due to the **loss of blood supply** to this area and release of **enzymes** that aid in degradation of these tissues.
- An altered tissue space overlying the tooth becomes visible as an **inverted funnel** shaped area with the **follicle fibers directed towards the mucosa.**
- This is called the **gubernacular cord,** which guides the tooth in its eruptive movements.



- Osteoclasts resorb a portion of the bony crypt overlying the erupting tooth. So eruption pathway increases in dimension.
- When the tooth nears the oral mucosa, the reduced enamel epithelium comes into contact with the overlying mucosa. Simultaneously, the oral epithelial cells proliferate and fuse into one membrane.
- Further movement of the tooth stretches and thins the membrane over the crown tip.
- The tooth that will erupt slightly remain stationary for few days and then again erupt. In this manner, the supporting tissues are able to make adjustment to the eruptive movement.
- Each eruption movement result in more of the crown appearing in the cavity and further separation of the attachment epithelium from the enamel surface.

# 2)Changes in Tissues around the Teeth

- Initially follicle is composed of delicate connective tissue. gradually as eruptive movement commences, collagen fibers become prominent.
- The **first periodontal fiber bundles** appear at the **cervical area** of the root and extend at an angle coronally to the alveolar process.
- At the same time, the alveolar bone of the crypt is remodeled and the bone fills in to conform the smaller root diameter.



- As the eruption proceeds, other collagen fibers bundles become visible along the forming root. These are then populated with fibroblasts and myo-fibroblasts, with contractile capabilities.

- periodontal fibers attach on the root surface and in the alveolar bone as cementogenesis proceeds.
- Some fibers release as the tooth moves, and then reattach to stabilize the tooth. In this manner the tooth stabilizing process is performed by the same group of fibers throughout tooth eruption.
- Alveolar bone remodeling continues during eruption, as the tooth moves occlusally, the alveolar bone increases in height and changes shape to accommodate the crown.
- These actions are co-ordinated during the entire eruption process as well as they are throughout the life.

# 3)Changes in Tissues Underlying Teeth

- soft tissue and fundic bone,largely compensatory
- The tooth moves rapidly in the socket during prefunctional eruption than at any other period.
- Fine bony trabeculae appear in the fundic area.They compensate for tooth eruption, and provide some support at the apical tissues ,described as a **bony ladder**.
- The ladder becomes denser as alternate layers of bone plates and connective tissue are laid down.
- When the tooth comes into occlusion,root is incomplete. bony ladder is gradually resorbed and one plate at a time, to make space for the developing root tip.
- Root completion continues and takes1 to 1.5 years in deciduous teeth and from 2 to 3 years in permanent teeth.

# Posteruptive Phase

- begins when the teeth reach occlusion, and continues for long as each tooth remains in the oral cavity.
- the teeth continue to move occlusally, which accommodates the jaw and allows for root elongation.
- Alveolar bone density increases and the principal fibers of the periodontal ligament establish themselves into separate groups.
- This phase is characterized by movements of the tooth after it has reached its functional position in the occlusal plane.
- These movements include those to accommodate the growing jaws, to compensate for continued occlusal wear, to accommodate interproximal wear.

# THEORIES OF TOOTH ERUPTION

**1)Root elongation theory:**

- crowns of the teeth are pushed into the oral cavity by virtue of growth and elongation of the roots.
- Supporting: normal erupting tooth
- Against: Rootless teeth, Submrged teeth

**2) Pulpal constriction theory:**

- growth of the root dentin and the subsequent constriction of the pulp may cause sufficient pressure to move the tooth occlusally.
- Supporting:pulp is progressively constricted by growth of root dentine
- Against: Pulpless teeth

**3) Growth of periodontal tissues**

- Pull by surrounding connective tissue
- Alveolar bone growth

**4) Pressure from muscular action**

- Against: unilateral facial paralysis

**5) Resorption of the alveolar crest**

- Resorption of the alveolar crest would serve to expose the crown of the tooth into the oral cavity.
- Against: the alveolar crest is the site of the most rapid and continuous growth of bone

**6) Hormonal theory:**

- the hormones secreted by the thyroids and pituitary glands might govern the eruption of the teeth.

**7) Foreign body theory:**

- a calcified body such as the tooth tends to be exfoliated by the tissues just as does any foreign body

**8)Cellular proliferation theory:**

- the osmotic pressure and forces resulting from cellular proliferation in the pulp and surrounding tissues may account for the eruption of the teeth.

**9) Vascularity theory:**

- Tissues between the developing tooth and its bony surrounding possess a very rich vascular supply.The blood pressure exerted in the vascular tissue is the active mechanical factor in eruption of teeth.
- Evidence for the theory: Submerged teeth often erupt under the influence of hyperemia,
- the hyperemia in periodontitis causes a supraeruption of teeth.

**10) Blood vessel thrust theory:**

- The blood generates the force by hydrodynamic and hydrostatic forces within the blood vessels.

**11) Periodontal ligament contraction theory:**

- contractile element within the periodontal ligament, collagen constriction and constriction due to fibroblasts are responsible. Actual force required to move the tooth is linked to the contractility of fibroblasts.

**12) Dental follicle theory:**

- the dental follicle is essential to achieve the bony remodeling required to accommodate tooth movement, for it is from this tissue that the osteoblasts differentiate.

**13)Bony remodeling theory:**

- the inherent growth pattern of the mandible or maxilla supposedly moves teeth by the selective deposition and resorption of the bone in the immediate surroundings of the tooth.
- When the **developing premolar** is removed without disturbing the dental follicle, an **eruptive pathway still forms** overlying the enucleated tooth.
- if the **dental follicle** is removed **no eruptive pathway** is formed.
- if the tooth germ is replaced by a metal or silicone replica, and the dental follicle is retained the replica will erupt, with the formation of an eruptive pathway.
- These observations demonstrate that "programed" bony remodeling can and does occur, i.e. an eruptive pathway forms in bone without a developing and growing tooth.
- Second, they show that the dental follicle is involved but perhaps only indirectly.

# CLINICAL CONSIDERATIONS

- Since the teeth follow somewhat a strict time schedule in eruption, the presence of recently erupted permanent teeth along with erupted deciduous teeth (mixed dentition period) help in assessment of dental age and this along with skeletal age is an index of maturity in development of the individual.
- **Premature eruption:** Natal and neonatal teeth
- ***delayed or retarded eruption:****by* either local or systemic factors.
- **Systemic factors :**
- nutritional
- genetic
- endocrine deficiencies like decreased secretion of hormones influencing eruption-growth hormone, thyroid hormones
- bone diseases like osteopetrosis.

**Local factors:**

- loss of a deciduous tooth and **drifting of opposing tee**th to block the eruptive pathway.
- **Severe trauma** may eliminate the dental follicle, and hence periodontal ligament formation is prevented. When this happens, the bone of the jaw fuses with tooth, a condition known as ankylosis, and eruption is not possible.
- Eruption may be delayed by an **increased density of fibrous tissue** over the erupting tooth
- the development of an **eruption cyst** from remnants of the dental lamina

- **Primary failure of eruption :**wherein permanent teeth, especially molars fail to erupt. The failure of eruption has no identifiable systemic or local causes.. Orthodontic treatment to force eruption is unsuccessful.
- Family history of eruption problems and hypodontia (reduction in number of teeth) were identified in many cases. It is suggested that defects in genes like CSF-1, NF $\alpha$ B, c-fos may be responsible for this condition
- **overerupted or supraerupted teeth :**Teeth which have erupted beyond the occlusal plane.
- Lack of opposing teeth makes the tooth to overerupt. The periodontal ligament and the bone develop together and therefore the gingival margin follows the tooth
- In other cases the gingival margin stays at the original level and the root gets exposed due to supraeruption

- **submerged teeth** :teeth which are directly attached to the bone (tooth ankylosis) do not undergo posteruptive movement and lie below the occlusal level.

# shedding

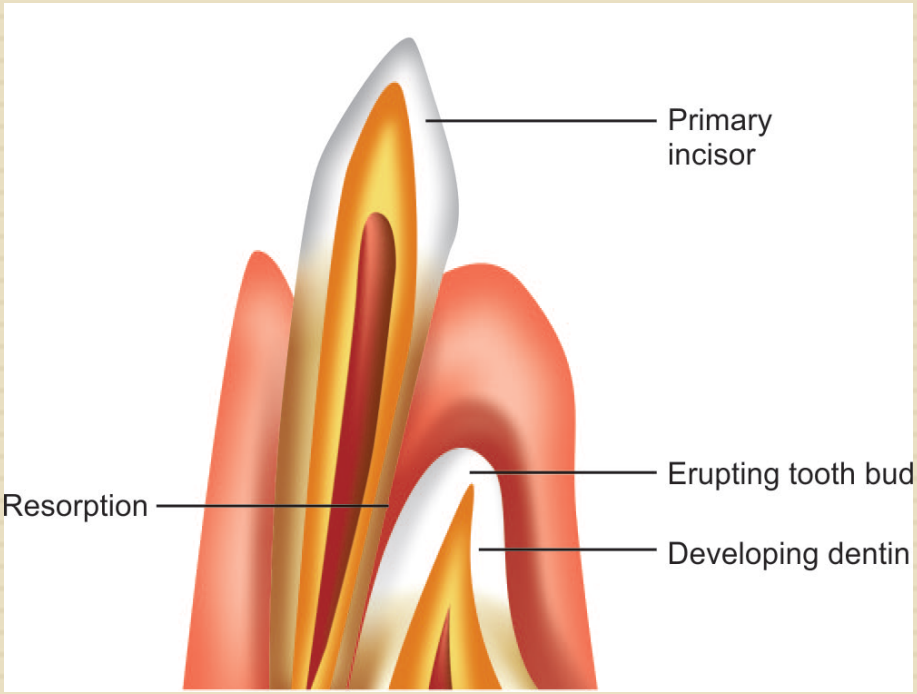
- The physiologic process resulting in the elimination of the deciduous dentition is called shedding or exfoliation.
- ***Pattern of Shedding:***
- the pressure generated by the growing and erupting permanent tooth dictates the pattern of deciduous tooth resorption.

1)Resorption of Anterior Teeth:

position of the permanent anterior tooth germ -lingual to the apical third of the roots of primary tooth

resorption-occluso-labial direction,which corresponds to the movements of the permanent tooth germ

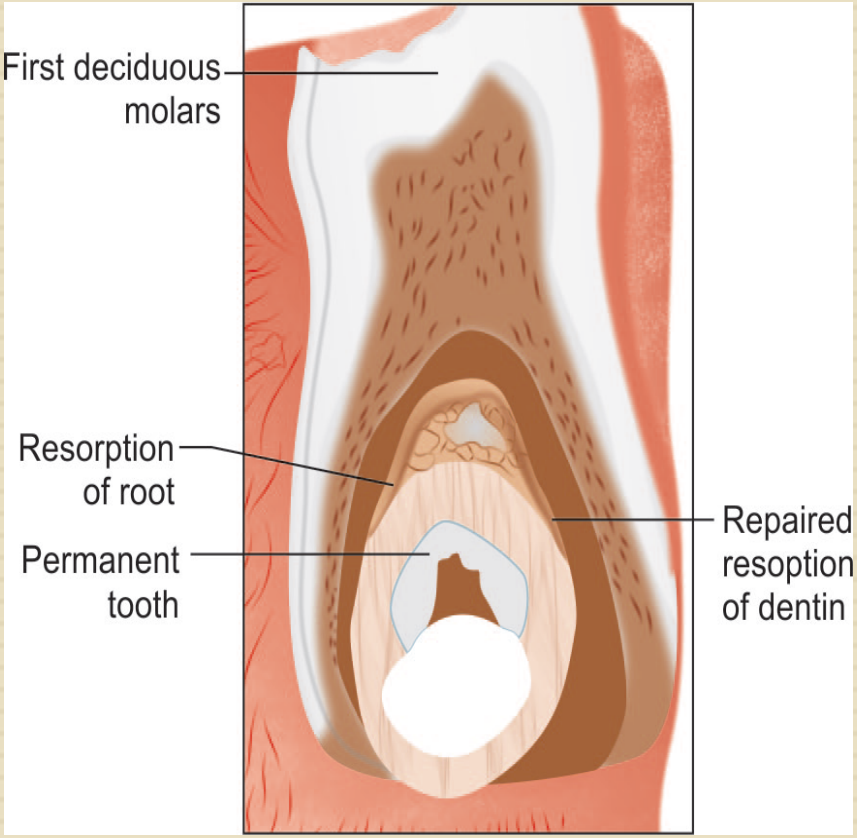
- Later the crown of the permanent tooth lies directly apical to the root of primary tooth, which causes resorption to proceed horizontally
- This horizontal resorption allows the permanent tooth to erupt into the position of the primary tooth.



2)Resorption of Posterior Teeth

-premolars ;initially between the roots of the primary molars

-initiation is by the resorption of the inter-radicular bone followed by resorption of the adjacent surfaces of the root of primary tooth



The alveolar process is growing to compensate for lengthening roots of the permanent tooth.

As this occurs, the primary molars move occlusally, this allows the premolar crowns to be more apical.

- The premolars continue to erupt until the primary molars roots are entirely resorbed and the teeth exfoliate. The premolars then appear in place of the primary molars.

# Mechanism of Resorption and Shedding

- 3 main reasons: loss of root, loss of bone and increased force.
- As permanent teeth grow they exert pressure to induce differentiation of osteoclasts and odontoclasts, which causes resorption of hard tissues and supporting structures of root.
- During the process of resorption the pressure form tooth is first directed to the bone followed by primary tooth.
- resorption of teeth is multifactorial but the pressure from the erupting successional tooth plays a key role because the odontoclasts differentiate at predicted sites of pressure.
- Presence of succedaneous teeth is a contributor in resorption not prerequisite

- Forces of mastication -synergistically involved in shedding.
- Due to growth and increased loading of jaws these forces far exceed the limit that the deciduous tooth periodontal ligament can withstand,causing trauma to the ligament and the initiation of resorption.

**Remnants of Deciduous Teeth**

- parts of the roots of the deciduous teeth that are not in the path of eruption remain embedded in the jaw for a considerable time

- most frequently found in association with the permanent premolars
- **Retained Deciduous Teeth**

- Deciduous teeth may be retained for a long time beyond their usual shedding schedule. Such teeth are usually without permanent successor, or their successors are impacted.

-most often upper lateral> mandibular second primary molars > lower central incisors

# CHRONOLOGY OF HUMAN DENTITION

- The regular sequence of eruption suggests that it is under genetic control while the same is an event highly subject to nutritional, hormonal and disease states.
- At **birth** jaws contain the partly calcified crowns of 20 deciduous teeth and beginning of calcification of the 1st permanent molars
- Eruption of deciduous dentition begins at an average of 7½ months of age and terminates at about 29 months.
- then quiescent for nearly 4 years
- At 6 years, the jaws contain 48 teeth