LECTURE

PHYSIOLOGIC TOOTH MOVEMENT

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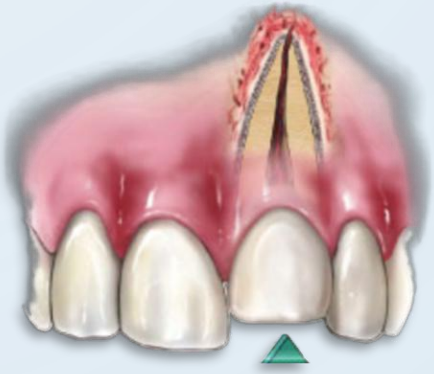
Mutah Edition

TYPES OF TOOTH MOVEMENT

Pathologic tooth movement

Physiologic tooth movement

Orthodontics tooth movement



Traumatic tooth movement

Physiologic tooth movement

Definition

Physiologic tooth movements is the movement of tooth germ from its original site until appear into the oral cavity, and come to occlusion , and still to move throughout live.

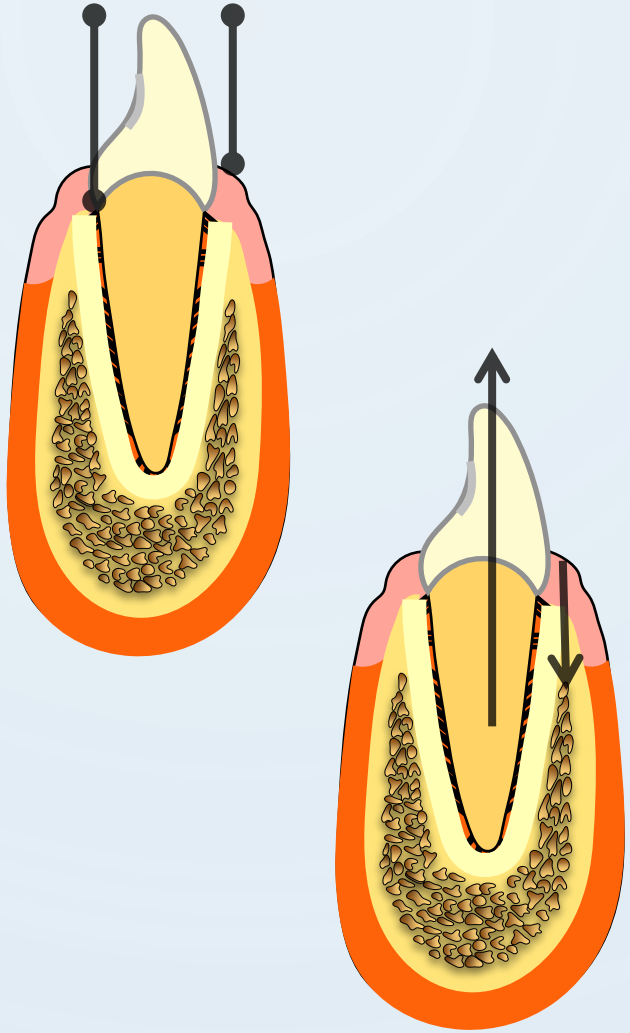
Terminology

Anatomical crown

Anatomical crown is the part of the tooth that covered by enamel from cervical line to the incisal edge or cusp tip.

Clinical crown

Clinical crown is the part of the tooth that noticed in the oral cavity begin from gingival margin to the incisal edge or cusp tip.



Active eruption

It is the actual movement of the tooth from its site of development to its position in the dental arch.

Passive eruption

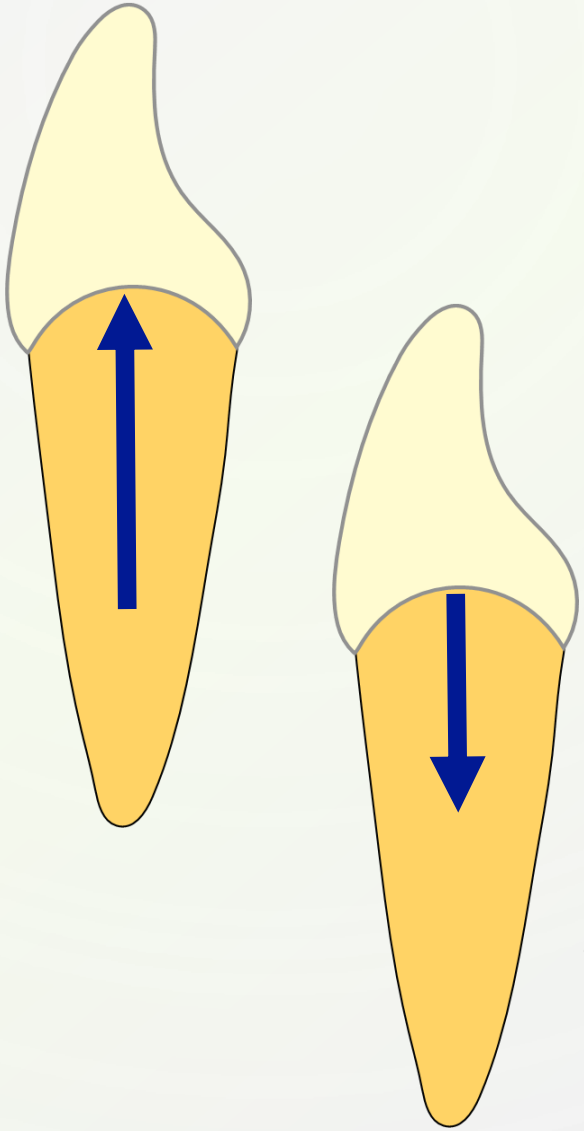
Occurs due to apical move of gingival tissue exposing more tooth structure into the oral cavity without active tooth movement.

Tooth movement nomenclature

Tooth movement nomenclature

Axial movement

- Movements of the tooth to incisal or occlusal direction.
- Also, termed extrusion



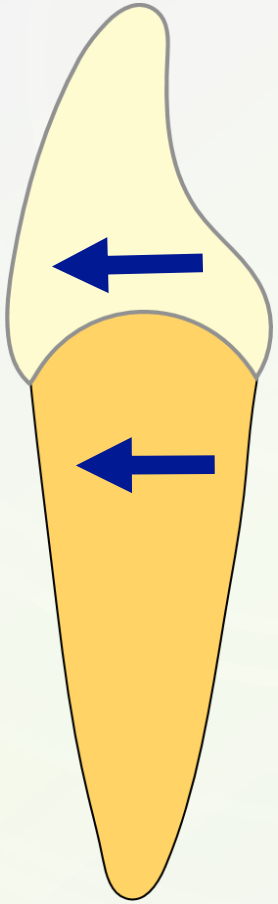
Intrusion

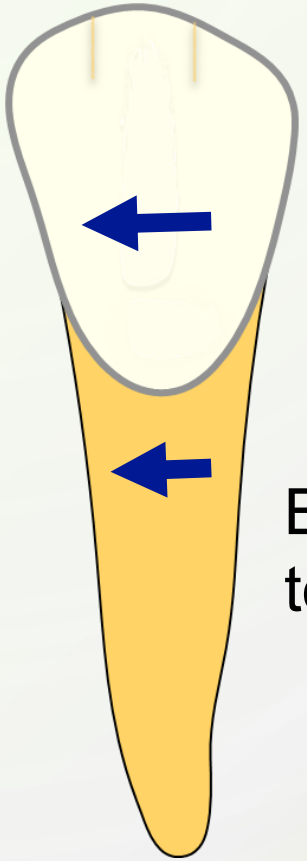
Movements of the tooth to apical direction.

Tooth movement nomenclature

Bodily movement

- Movements of the tooth as all into any direction.
- Both crown and root move toward the same side.





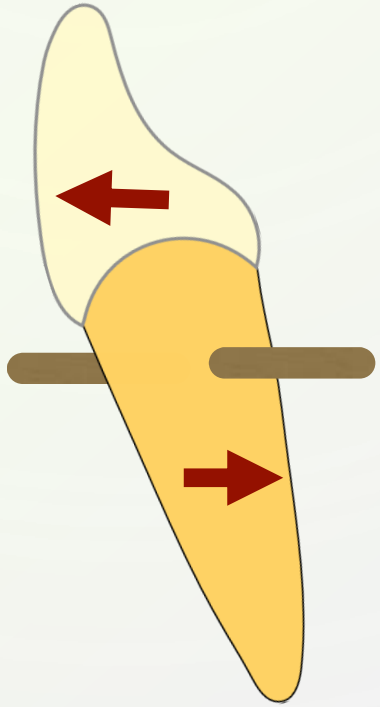
Mesial drift

Bodily movement of the tooth into mesial direction.

Tooth movement nomenclature

Rotation

- Movement of the tooth around longitudinal axis.



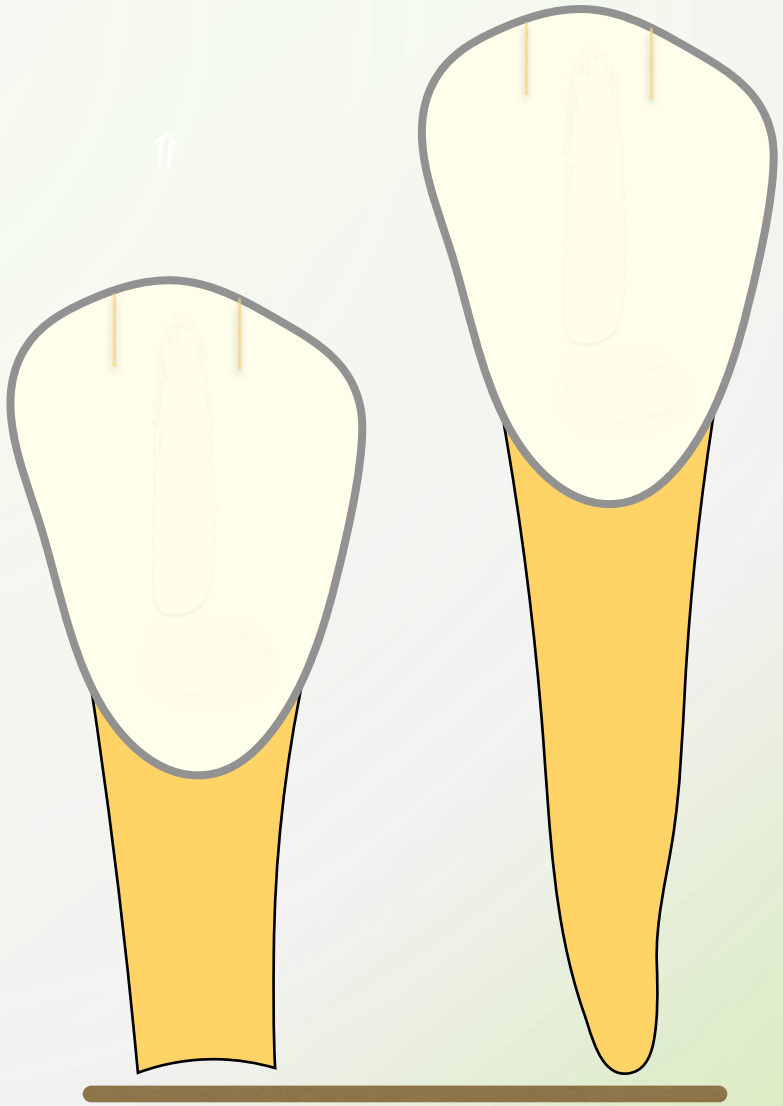
Tilting or tipping

- Movement of the tooth around horizontal axis.
- The crown move into one direction.
- Whereas the root move to the opposite.

Tooth movement nomenclature

Eccentric growth

- The crown moves in an axial direction, whereas the root elongates during growth and remains fixed at the same level.



Stages of Physiologic Tooth Movement

1. Pre-eruptive movement
2. Eruptive pre-functional movement
3. Eruptive functional movement

1. Pre-eruptive movement of deciduous teeth

Definition:

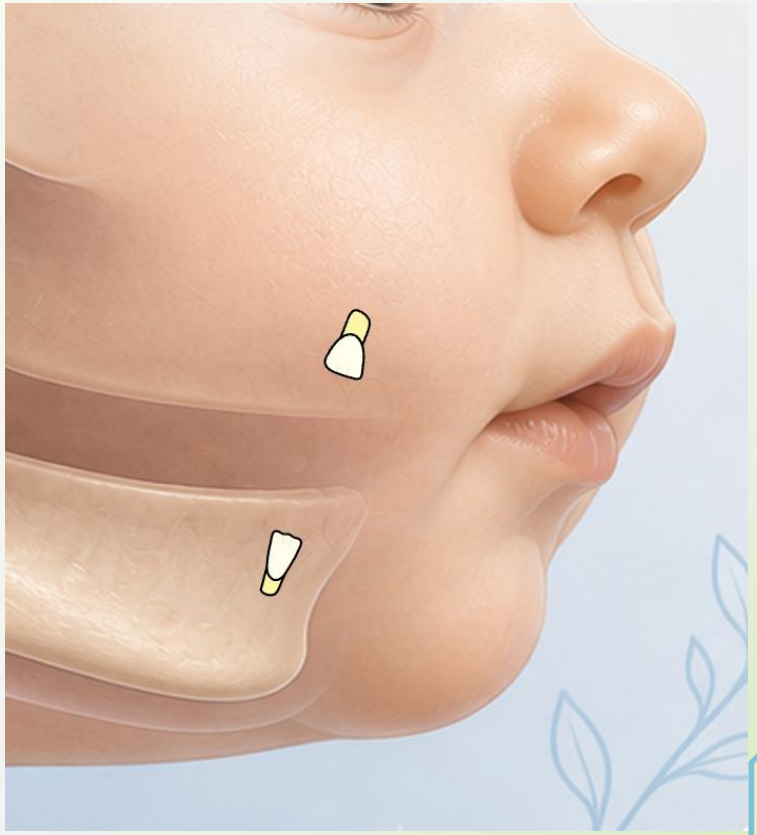
- Movements of the tooth from its origin within the jaw.

Time:

- **Begin from early bell stage till the appearance into the oral cavity.**

Function

- **This stage bring the tooth into the exact position to erupt normally.**



a) Scenario of deciduous teeth movement

1. **Growth of deciduous teeth germs firstly:**

- The five deciduous tooth germs grow more rapidly than the jaws, resulting in crowding.

2. **Growth of jaw later:**

A. Growth in length at midline allows:

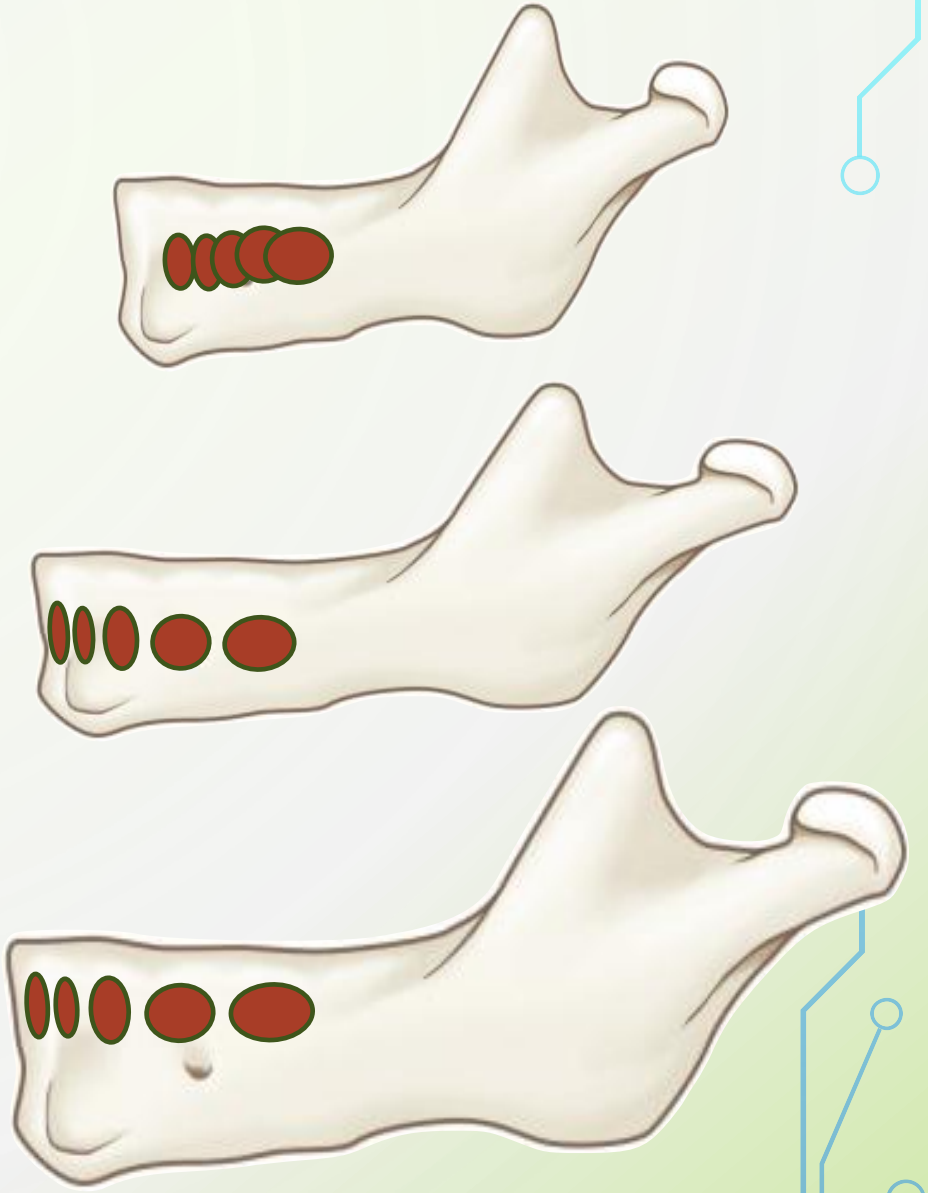
- Deciduous incisors move toward the midline.

B. Growth in length at ramus allows:

- Deciduous molars move distally.

C. Growth of the jaw in hieght allow:

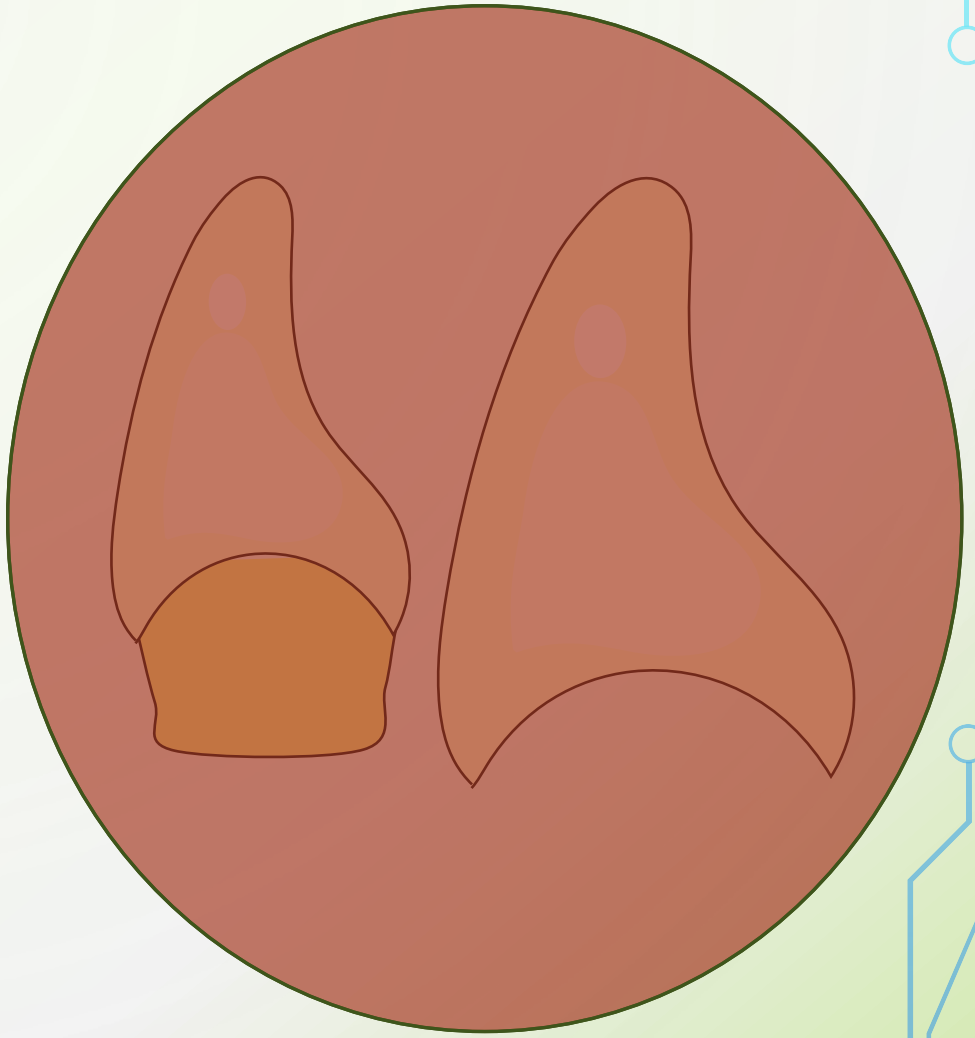
- Axial movement of the teeth to keep its superficial position to erupt easily.



b) Scenario of permanent anterior teeth movement

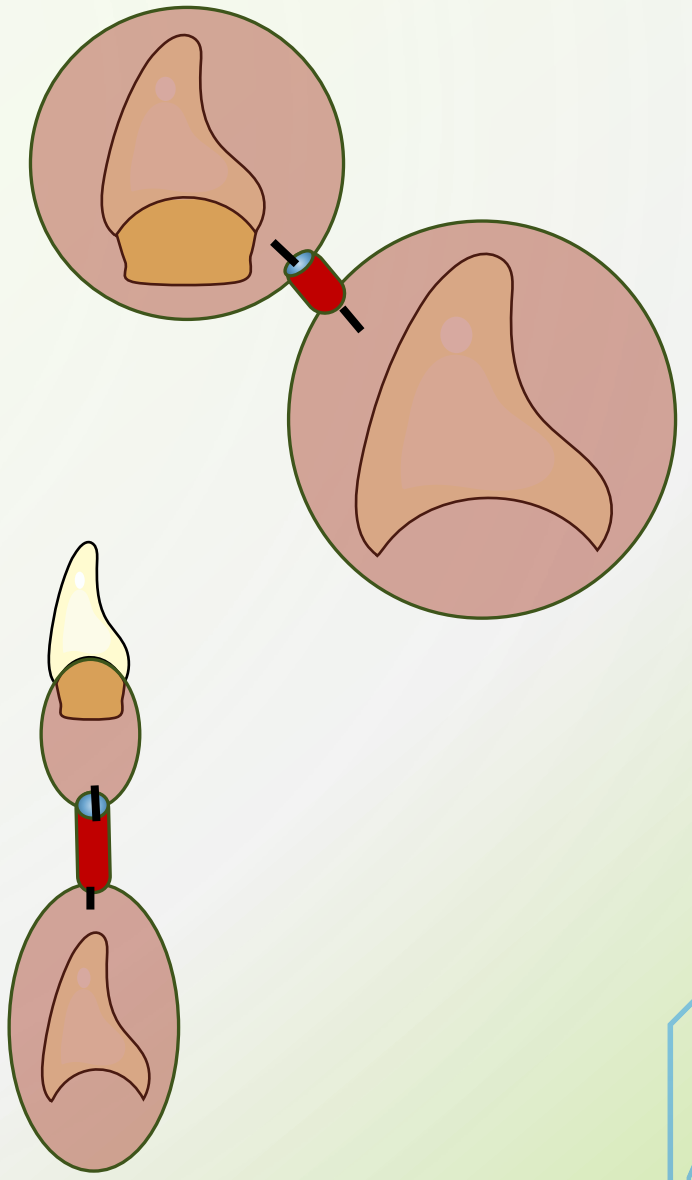
1. Firstly:

- The permanent anterior tooth germs develop at the same level of deciduous.
- The permanent and deciduous lie within the same crypt.
- The permanent located lingual to the deciduous one.



2. Then:

- The deciduous move in an axial direction.
- Both permanent and deciduous tooth germs become located in two separate crypts.



- Both permanent and deciduous are still connect each other through a canal termed **Gubernacular canal**.
- The gubernacular canals contain the **gubernacular cord** which is a part of successional lamina.
- The permanent anterior teeth become located in an apico-lingual position.
- The deciduous tooth root begin to resorb and the permanent become located apical to the deciduous until erupt

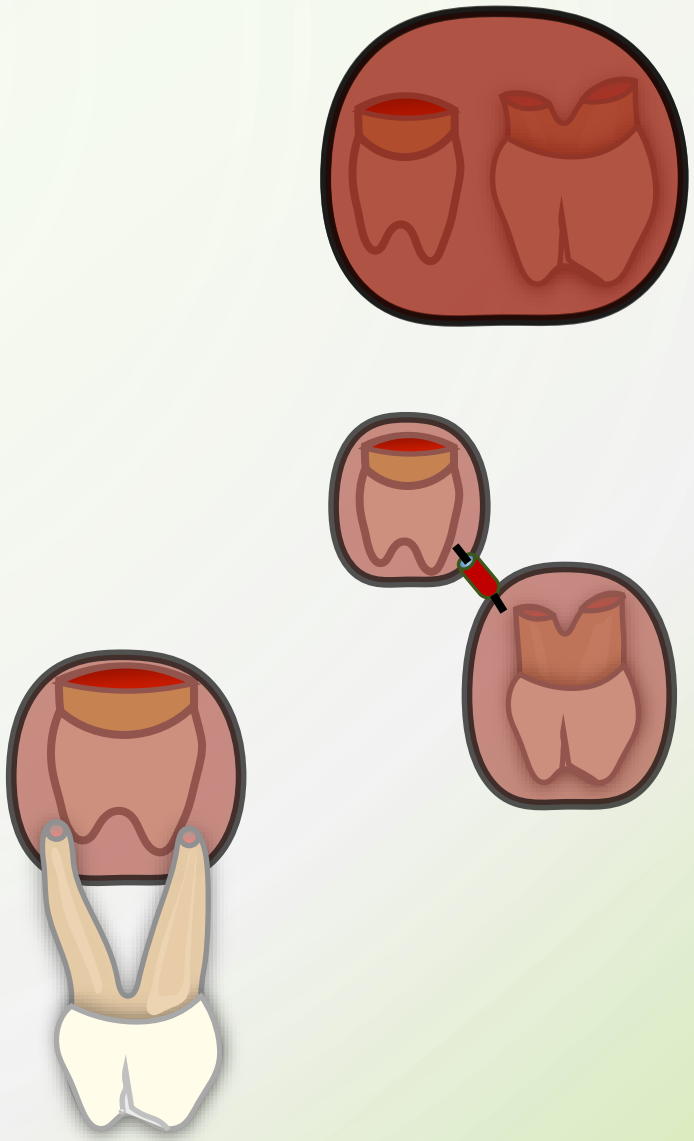
c) Scenario of Premolars movement

1. Firstly,

Both deciduous and permanent tooth germs are at the same level in the same bony crypt, while premolar tooth germs are located lingual to the deciduous one..

2. Then

By axial movement of deciduous teeth for eruption, Premolar germs move to become situated within the deciduous roots.



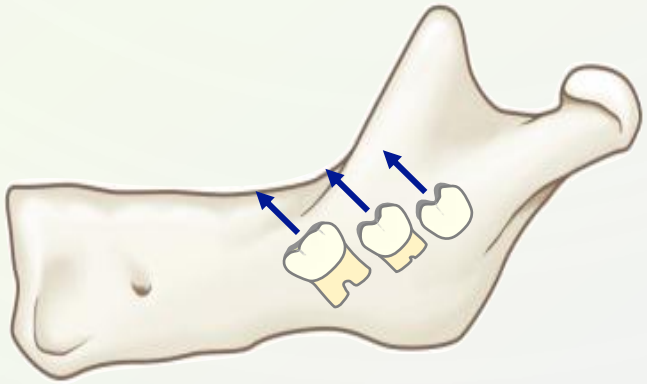
d) Scenario of permanent molars movement

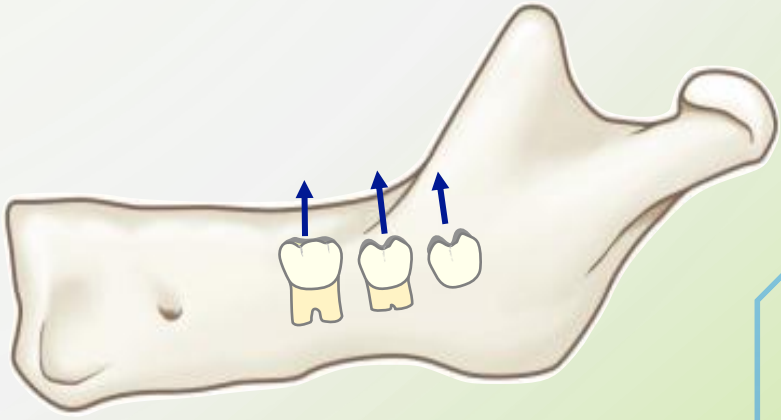
1. Maxillary molars:

- Maxillary molars are found in the maxillary tuberosity facing distally.
- Posterior growth of maxilla leads to tilting of the maxillary molars to become downward.

2. Mandibular molars:

- Mandibular molars are found in the ramus of mandible facing mesially.
- Distal growth of mandible leading to tilting to the mandibular molars to become upward.





Histology of Pre-eruptive Movement

Types of movements in pre-eruptive stage:

Bodily movement:

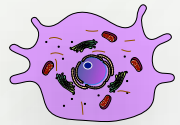
- Bone resorption occurs in the surface toward which tooth moves.
- Bone deposition occurs on the crypt wall behind it.

Eccentric growth:

- One end (crown) of the developing tooth move toward eruption indicating bone resorption.
- The other end (growing root) remain stable.

Cells:

- Osteoclasts, Osteoblasts, Cementoblasts, Fibroblasts.



Gobernacular canal and cord:

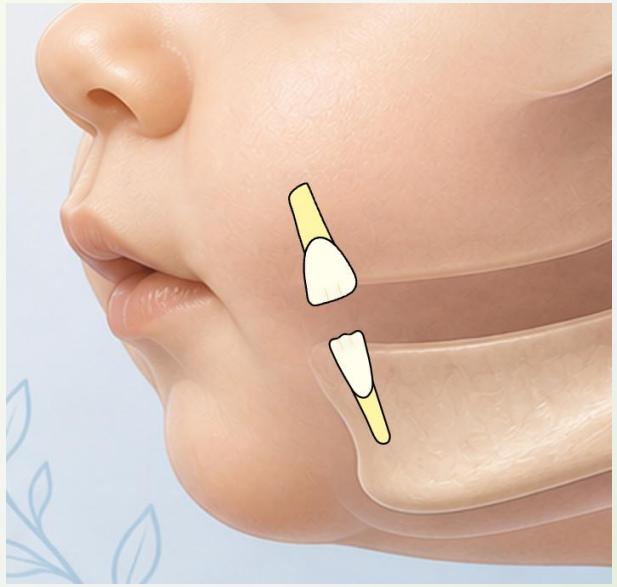
- The crypts of both deciduous and permanent successor are connected together by a canal termed: Gubernacular canal.
- This canal may act as a key for eruption of permanent successor into its proper position.
- Gubernacular canal contain a cord that connect between deciduous and permanent successor termed Gubernacular cord.

2. Eruptive Pre-functional Tooth Movement

Movement of the tooth from the appearance in the oral cavity until reaches the occlusion.

Time:

Begin from appearance of tooth in the oral cavity until reach to occlusion with the opposite teeth.



Function

Arrange the teeth into normal occlusion and begin to function.

Tooth eruption may be accompanied clinically by:

1. Discomfort or pain.
2. Irritability.
3. Mild fever.
4. Increased salivation.
5. **No bleeding.**

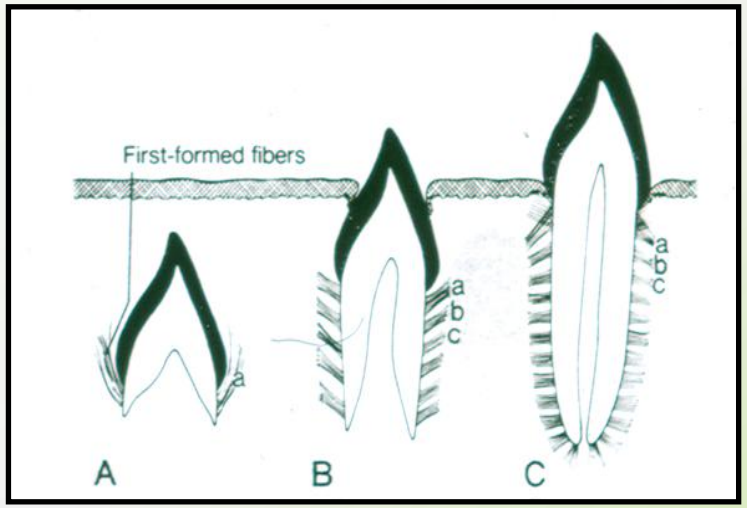
Histology Of Pre-functional Tooth Movement

Types of movements in eruptive pre-function stage:

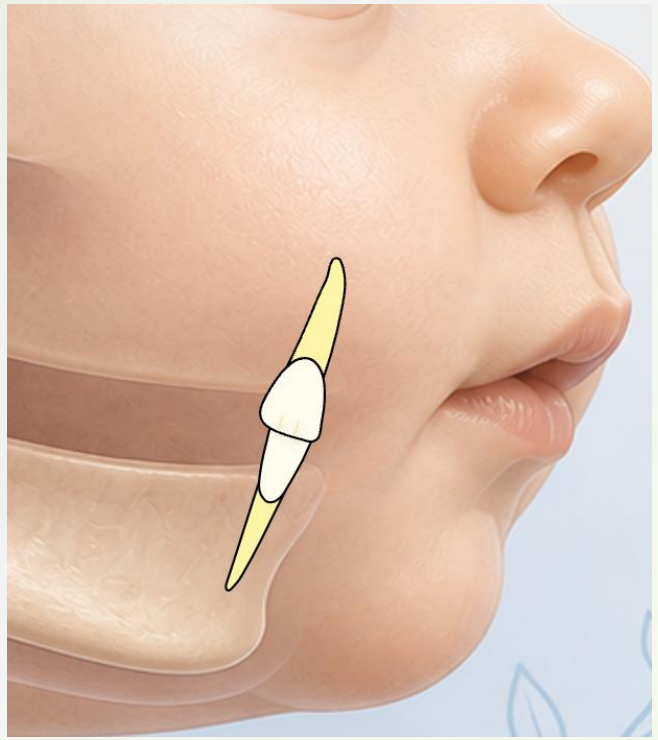
- **Axial occlusal or incisal:** in the direction of the long axis.
- **Bodily movement:** in distal, mesial, lingual or buccal direction.
- **Tilting movement:** around the horizontal axis as in case of molars.
- **Rotation movement:** as in case of lower central incisors or canine.

Characterized by:

1. Active eruption.
2. Formation of the root.
3. Formation of alveolar bone.
4. Formation of periodontal ligament.



3. Eruptive Functional Tooth Movement



The tooth has been reached to the occlusion and still move throughout life.

Time:

- Tooth movement that occurs after the tooth has reached occlusion.
- This movement persists throughout the entire life of the tooth.

Function

1. Adjustments that accommodate the growth of the jaws.
2. Movements that compensate for occlusal wear (attrition).
3. Movements that compensate for proximal wear.

1. Adjustments that accommodate the growth of the jaws.

This process is completed by the end of the second decade of life, when jaw growth ceases (at the end of 2nd decade of life).

It is accomplished through continuous bone remodeling, involving new bone formation at both the alveolar crest and the apical region.

This movement completed earlier in females than in males, due to earlier skeletal maturation.

These changes help teeth maintain their position relative to the increasing vertical height of the jaws.

2. Compensation for occlusal wear:

- Attrition of the occlusal surfaces creates space within the occlusion.
- Axial post-eruptive tooth movements occur to compensate for this loss.
- This adaptation takes place through continuous deposition of cementum at the apical region of the tooth.

3. Compensation for proximal wear.

- Proximal wear occurs at the contact areas between adjacent teeth.
- This wear leads to a gradual spacing in the dental arch.
- Compensation occurs mainly through mesial drift of teeth, which helps maintain proximal contact and arch continuity.
- This movement is a type of physiological tooth movement and is influenced by:
  1. Contraction of transseptal fibers of the periodontal ligament
  2. Continuous bone remodeling accompanies this movement:
     - Bone resorption on the mesial side
     - Bone deposition on the distal side
- As a result, contact between adjacent teeth is preserved, preventing food impaction.

Root formation theory

The root formation theory proposes that tooth eruption force is primarily derived by the growth and elongation of the root.

Limitations:

- Eruption can still occur even after root formation is completed.
- Teeth with incomplete or arrested root formation may still erupt.
- It does not explain pre-eruptive and post-eruptive phases of tooth movement.

Bone remodeling theory

Tooth eruption occurs through coordinated bone resorption in the eruption pathway and bone deposition periapical to the tooth, allowing the tooth movement.

Limitations:

- Bone remodeling alone cannot fully account for the eruptive force that initiates tooth movement.
- Bone remodeling may occur as a secondary response influenced by tooth eruption rather than acting as the main driving force of the process.
- It does not clarify how the precise direction of tooth eruption is regulated.
- It does not explain pre-eruptive phases of tooth movement.

Vascular Pressure Theory

- The eruption force is derived from the hydrostatic (vascular) pressure within the periapical tissues.
- Increased blood flow and vascular congestion in the apical region generate upward pressure.
- The resulting force contributes to the coronal movement of the developing tooth.

Limitations:

- The force derived from the blood supply is very weak to elaborate pressure.
- Does not fully explain eruption in situations where vascular pressure changes are minimal or inconsistent.
- Fails to account for the precise directional control of tooth eruption.
- Tooth eruption can still occur despite experimental alteration of local blood supply.

Periodontal Ligament Traction Theory

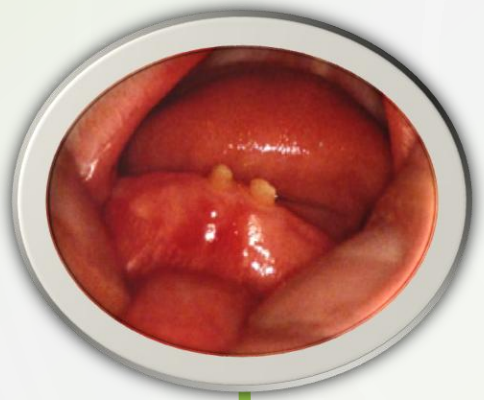
(Most accepted theory)

- The tooth eruption force is derived from traction generated within the PDL.
- **Source of traction:**
  1. Fibroblasts and connection between them (fibronexus).
  2. Fibroblasts, collagen fibers and connection between them (fibronectin).
- The contractile activity of fibroblasts, together with the coordinated behavior of collagen fibers, acts as both the initiator and the maintainer of the eruptive force.
- Continuous remodeling and reorientation of collagen fibers help generate eruptive forces.

Limitations

Despite its opponents, this theory remains the most widely accepted.

Clinical Cases of Eruption Problems



Natal teeth

Eruption cyst

Impaction