PHYSIOLOGIC TOOTH MOVEMENT

ERUPTION

TEETHING
Objectives

To Describe phases of tooth eruption:
To explain the different types of tooth movements during eruption phases
To understand the mechanism of tooth eruption
To know normal events occurring during different eruption phases
To Describe the initial growth of the tooth and the compensational changes that occur in the surrounding, overlying and underlying tissues.
To discuss clinical considerations of tooth eruption
Definition
Phases of tooth movement
Direction and types of Tooth Movement
A. PRE-ERUPTIVE Tooth movement
Movements of the deciduous tooth germs
Movement of Permanent Teeth
B. PREFUNCTIONAL ERUPTIVE PHASE
Five major events take place during this phase:
1. Changes in tissues overlying the tooth:
   Gubernacular canals
   Gubernacular cord (Gubernaculum dentis)
2. Changes in the tissues around teeth
3. Changes in the tissues underlying the teeth
MECHANISM(S) OF TOOTH ERUPTION
1- ROOT FORMATION THEORY:
2- BONE REMODELING THEORY:
3- VASCULAR PRESSURE THEORY
4- PERIODONTAL LIGAMENT TRACTION THEORY
Sequence of eruption of Deciduous teeth
Sequence of eruption of permanent teeth
C. POST ERRUPTIVE PHASE (FUNCTIONAL ERUPTIVE PHASE)
Histology of Post eruptive tooth movement:
1- Movements to accommodate growth of the jaws.
2- Movements to accommodate for continued occlusal wear.
3- Movements to accommodate interproximal wear.
BOLE OF DENTAL FOEICLE WITH REDUCED ENAMEL EPITHELIUM TISSUE TENSION THEORIES:
CLINICAL CONSIDERATION
TOOTH ERUPTION
Physiological tooth Movement

Definition

is the axial or occlusal movement of the tooth within and from its developing site through the bone of the jaw and overlying mucosa to appear in the oral cavity and reach its functional position in the occlusal plane.

is a complex and multistep process, which includes different types of tooth growth and *movements* within the bony crypt in order for the tooth to erupt into the *genetically designated area* of the maxilla or mandible.

To accomplish eruption, bone remodeling by osteoclasts (resorption of bone) and osteoblasts (bone deposition) must take place in a coordinated manner. Most important is the removal of bone overlying the crypt, which forms the eruption pathway. In experimental studies, it has been shown that without eruption pathway formation, the tooth will not erupt.
Direction and types of Tooth Movement

1- **Axial (occlusal) movement:** It is an occlusal movement in the direction of the long axis of the tooth.

2- **Bodily movement:** Bodily movement is a shift of the entire tooth germ, which causes bone resorption in the direction of tooth movement and bone apposition behind it.

**Drifting movement:** Bodily movement in a distal, mesial, lingual or buccal directions.
3- **Tilting or tipping movement**: movements around a transverse axis.

4- **Rotatory movement**: movement around a longitudinal axis.

5- **Eccentric growth movement**: refers to relative growth in one part of the tooth while the rest of the tooth remains constant, the root elongates yet the crown does not increase in size. As a result, the center of the tooth changes.

Or Movement where one part remains fixed while the rest continues to grow leading to change in the center of the tooth germ.
Phases of Physiological tooth movement or Pattern of Eruption

- Pre-eruptive phase
- Eruptive prefuctional phase
- Post-eruptive Functional phase
A. PRE-ERUPTIVE TOOTH MOVEMENT

**Starts:**
- Early bell

**Ends:**
- Begin of root formation

**Type of movement**
- Bodily
- Eccentric

* It starts at the beginning of tooth development and ends when the crown formation is completed.

The movements of the developing and growing tooth germs within the alveolar process before root formation. During this phase, the growing teeth move in various directions to maintain their position in the expanding jaws. This is accomplished by both *bodily* movements and *eccentric* growth.

These movements relate to the adjustments that each crown must make in relation to its neighbor and to the jaw as they increase in width, height and length.
When Increase in jaw length
- Anterior deciduous teeth drift forward and second deciduous molar tooth germs drift backward.

Increase in jaw height
Tooth germs move in vestibular direction (upward or downward).

Increase in jaw width
Tooth germs move (outward) facially.
1- The permanent incisors and canine first develop lingual to the deciduous tooth germ at the level of their occlusal plain and in the same bony crypt.

2- As the deciduous predecessors erupt, the permanent tooth germs move to a more apical region of their deciduous predecessor and occupy their own bony crypts.
Premolars

1- The permanent premolars begin their development lingual to their predecessors at the level of their occlusal surface and in the same bony crypts.

2- Later, they are found between the divergent roots of the deciduous molars.

3- At the end of the pre-eruptive phase, the tooth germs of the permanent premolars are found below the roots of the deciduous molars in their own crypts.
Permanent Molars

Maxillary tuberosity

Base of the ramus
The permanent molars undergo considerable movements adjusting positions as the jaws grow:

1- The upper molars develop in the tuberosities of the maxilla, with their occlusal surfaces facing distally. They swing around only when the maxilla has grown sufficiently to provide the necessary space.
2- **The lower molars** develop in the base of the **mandibular rami** and their occlusal surfaces facing **mesially**. They only become upright as rooms for them become available.
B. PREFUNCTIONAL ERUPTIVE PHASE

It begins with the initiation of root formation and ends when the teeth reach the occlusal plane. (Emergence phase)
**Eruptive Phase**

**Starts:**
Onset of root formation

**Ends:**
Tooth reach occlusal plane

**Events:**
- Crown completed
- Root formation
- Development of PDL and supporting tissue
- Development of dentogingival junction.
- Clinical crown

**Type of movement:**
All types of movements
**FIVE MAJOR EVENTS TAKE PLACE DURING THIS PHASE:**

1- **Secretory stage** of amelogenesis (crown) is completed.
2- **Intra-osseous stage** at the beginning of root formation. Root is completed in this phase.
3- **Supra-osseous stage** when the erupting tooth moves occlusally through the bone of the crypt and the connective tissue of the oral mucosa, so that the reduced enamel epithelium covering the crown comes into contact with the oral epithelium.

As this occurs, the reduced enamel epithelium of the crown proliferates and forms firm attachment with the oral epithelium. A fused double epithelial layer over the erupting crown is thus formed.
4- **Emergence stage** (clinical crown appear) when the tip of the crown of the tooth appears in the oral cavity by breaking through the center of the double layered cells. The crown erupts further, and the lateral borders of the oral mucosa become the dentogingival junction. The reduced enamel epithelium, now surrounding the crown like a cuff, and known as the junctional or attachment epithelium. When the tip of the crown appears in the oral cavity, about one half to three quarters of the root is formed.

5- **The erupting stage** tooth continues to move occlusally at a maximum rate and there is gradual exposure to more of the clinical crown. Occlusal movements are the result of active eruption. As the tooth moves occlusally, gradual exposure of the clinical crown is accomplished through separation of the attachment epithelium from the crown and the resulting apical shift of the gingiva.
- **ACTIVE ERUPTION**: It is the actual movement of the tooth from its developmental site to its position in the dental arch.

- **PASSIVE ERUPTION**: Does not involve tooth movement but occurs due to apical recession of gingival tissue exposing more tooth structure into the oral cavity.

- **ANATOMICAL CROWN**: It is part of the tooth which is covered by enamel.

- **CLINICAL CROWN**: is the part of the tooth which is seen in the oral cavity.
The nature of the intrinsic forces involved in active tooth eruption is not fully understood.

Available experimental evidence seems to support factors related to tissue tension theories.

Experiments where an erupting tooth is wired to the lower border of the mandible show that, despite immobilizing the tooth, an eruptive path is formed by resorption of the overlying bone.

However, if the dental follicle associated with an erupting tooth is removed, no such pathway in bone is formed and tooth does not erupt.

This finding, coupled with the fact that human teeth erupt according to a specific chronology, implies the presence of a programmed mechanism that leads to tooth eruption. Such mechanism is probably a multifactorial one that includes control by specific gene(s), hormones as well as several growth factors.
Mechanism of eruption

Theories:
- Bone Remodeling theory
- Root formation theory
- Vascular pressure theory
- PDL traction theory

Role of the dental follicle with reduced enamel epithelium in tooth eruption.