DEVELOPMENT OF DENTITION & OCCLUSION

DEPARTMENT OF ORTHODONTICS
SUBHARTI DENTAL COLLEGE

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

Presented By:
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Introduction

The development of dentition is an important part of craniofacial growth as the formation, eruption, exfoliation and exchange of teeth take place during this period. This is an assimilation of facts, predictions, studies, in both static and dynamic situations; the factors influencing them and their clinical implications.

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PRE-NATAL DEVELOPMENT OF TEETH

- **Initiation**
- **Bud stage**
- **Cap stage**
- **Bell stage**
Initiation

The very 1\textsuperscript{st} sign of tooth development appears \textit{late in the 3\textsuperscript{rd} embryonic week.}

At 6 weeks, the 4 maxillary odontogenenic zones coalesce to form the dental lamina.

Morphological changes in the dental lamina occurs in 3 main phases:

- Initiation of the entire deciduous dentition – during \textit{2\textsuperscript{nd} month in utero}
- Initiation of the entire permanent dentition – from \textit{5\textsuperscript{th} month in utero}
- Initiation of the 1\textsuperscript{st} permanent molar – \textit{7 months in utero}
- Initiation of the 2\textsuperscript{nd} permanent molar – \textit{1 yr}
- Initiation of the 3\textsuperscript{rd} permanent molar – \textit{4 to 5 yrs}
GROWTH

INITIATION  
PROLIFERATION  
HISTODIFFERENTIATION  
MORPHODIFFERENTIATION

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Bud Stage

Immediately after the formation of Dental lamina:

- *Division for cheek & lip from the Dental arches at the Vestibular furrow.*

- *Increased mitotic activity( knob-like ) corresponding to each deciduous tooth position.*

- *Between the 7th & 8th week both max. & mand. Deciduous tooth buds form.*

- *The 1st buds to form are the mand. Anterior teeth.*
Cap Stage

- The growth rate throughout the tooth bud is not uniform & is more active at the periphery.
- The Cap stage begins by the 8th week with the appearance of a concavity on the deep surface of the bud.
- The epithelium of the cap-shaped tooth organ enlarges & proliferates into deeper connective tissues (ectomesenchyme).
- Areas of increased cellular density give rise to non-enamel portions of the tooth & its periodontal matrix.
- The tooth germ, consisting of the Enamel organ, Dental papilla & Dental follicle can be identified.
Bell Stage

The Enamel organ differentiates into:

- Inner enamel epithelium
- Stellate cells
- Stratum intermedium
- Outer enamel epithelium
Dental papilla cells differentiate into Odontoblasts & Inner enamel epithelium cells into Ameloblasts. They deposit Dentin & Enamel respectively, and withdraw from each other & the DE junction.
- The OEE becomes discontinuous & allows entry of cells from the Dental sac, while the Stellate cells are withdrawn to make room for the Crown.
- When enamel formation is complete, the crown is fully formed.
Root Formation

- Just before the ameloblasts deposit their matrix, the Cervical loop lengthens due to a proliferation of cells & forms the Hertwigs epithelial root sheath (determines no., size & shape of roots).
- Dentin matrix is deposited against the root sheath & covered by cementum due to the invasion of cementoblasts, which eventually form the PDL.
THEORIES OF TOOTH ERUPTION

- Bone remodeling
- Root growth
- Vascular pressure
- Periodontal ligament traction
PERIODS OF OCCLUSAL DEVELOPMENT

- Pre dentition period
- Deciduous dentition period
- Mixed dentition period
- Permanent dentition period

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BIRTH TO COMPLETE PRIMARY DENTITION (Birth- 3yrs)

- The tooth buds of all primary teeth are present and in various stages of development at the time of birth.
- About 7 to 8 months after birth, all the teeth except the 7’s & 8’s are present in some stage of development.
- In a mandible which is less than 1yr of age, a line drawn along the occlusal surfaces passes through the condyle suggesting the lack of ramal growth.
- By the 1st year, a normal & desirable dentition will usually exhibit spacing.
• The 1st primary tooth to erupt is the lower central incisor between 6&8 months of age, followed by the U.Centrals, U.Laterals & L.Laterals.

• The 1st primary molar erupts by about the 14th month.

• The primary cuspids & 2nd primary molars erupt by about 2 1/2 yrs of age.

• The primary teeth are quite upright whereas the permanent incisors have a labial inclination & the permanent posteriors have a mesial tilt.

• There is evidence of vertical growth as signified by the superior positioning of the condyle to the occlusal plane.

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From birth to eruption of 1st deciduous teeth in oral cavity e.g. Lower central incisor at 6 month of age

At birth – Alveolar arches → Gum pads

- Pink
- Firm

- Horseshoe shaped in maxilla
- U—shaped in mandible.
Gum Pad is divided into grooves

Dental groove

- Gum pads develop in two parts.
  - Buccal and
  - Lingual portion

- Starts at incisive papilla

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Transverse groove

- Separates gum pad in ten segments.
- Gum pad in both arches show certain elevations and grooves that outline portion of various primary teeth, which are still developing in alveolar ridge.
Lateral Sulcus

- Prominent transverse groove separating canine and 1st deciduous molar region in both dental arches.

Gingival groove

- Separates maxillary and mandibular gum pad from palate and floor of mouth.
Characteristic features of Gum Pad stage

1) Complete overjet

- Maxillary gum pad wider & longer and overlap mandible gum pad both horizontally and vertically.

- In this way opposite surface of pads provide efficient way of squeezing milk during breastfeeding.

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2) Infantile open bite

- Contact occurs between upper & lower gum pads at 1st molar region & space exists between them in anterior region.

- Tongue is positioned in this space.

- This open bite is transient get corrected with eruption of deciduous incisors.

- This infantile open bite is normal & help in suckling
3) Precocious eruption of primary teeth: Natal & Neonatal teeth

Natal teeth

- Present at birth - e.g. Mandibular incisor.

Neonatal teeth

- Erupt during neonatal period, from birth to 30 days.

*Such premature eruption of teeth may cause problems during feeding.*
Etiology of neonatal and natal teeth

- Superficial position of tooth germ,
- Increased rate of eruption,
- Hormonal stimulation
- Heredity.

Incidence

Incidence of natal and neonatal teeth is 1:1000 and 1:30,000.

85% of natal or neonatal teeth are mandibular incisors.
11% are maxillary incisors.
3% mandibular cuspids or molars
3% maxillary cuspids or molars.

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DECIDUOUS DENTITION PERIOD
(6 months to 6 years)

- Spans from time of eruption of primary teeth until eruption of 1\textsuperscript{st} permanent teeth around 6 years of age.

- Primary teeth erupt -6 months of age (Mandibular Centrals)

- Primary dentition $\rightarrow$ established by age 2 &1/2 – 3 years

- Sequence of eruption of deciduous dentition $\rightarrow$ A-B-D-C-E
Spacing: Two types of dentition→ Spaced and non-spaced

1. Spaced dentition

Spaced dentition supposed to be good as spaces in between teeth utilized for adjustment of permanent successors.

Spaces present are of two types:

- Primate spaces
- Physiologic/ developmental spaces
Interdental spacing

- Interdental spacing when present in permanent dentition is considered abnormal.

BUT

- Presence of interdental spacing is normal feature of deciduous dentition, which is required for accommodation of larger permanent teeth at later stage.
Primate/Simian/Anthropoid spaces

- Spacing occurs mesial to maxillary canine & distal to mandibular canine.

Significance

- Following eruption of primary 1st molar when canine teeth erupt and reach occlusion the primate space facilitate proper interdigitation of opposing canine. This space is used for early mesial shift.
Physiologic/ Developmental space

- Total space present may vary 0 to 8 mm –

  Average

  4 mm in maxillary arch
  3 mm in mandibular arch.

- Include general spacing between teeth + Primate spaces
Non-spaced dentition

This lack of space may be due to

Narrowsness of dental arches

Teeth wider than usual.
2) Incisor relationship in deciduous dentition

- Increased overbite
- Increased overjet
Deep Bite

- An increased overbite seen in initial stages of development with deciduous mandibular incisors contacting cingulum area of deciduous maxillary incisors.

- Deep bite may be due to primary incisors more vertically placed than permanent incisors.
This deep bite later gets self corrected by:

- Attrition of incisors
- Eruption of deciduous molars
- Differential growth of alveolar process of jaws
Increased Overjet

- Excessive incisal overjet observed in deciduous dentition
- Get corrected later by forward growth of mandible.
Moyers described 3 kinds of Primary molar relationship

1. **Flush terminal/vertical plane/straight type**
2. **Mesial step type**
3. **Distal step type**
Flush Terminal

- Distal surface of upper and lower 2\textsuperscript{nd} deciduous molar teeth are in straight plane (flush) or on same vertical plane.

- Ideal kind of molar relation in primary dentition.
Significance of Terminal Plane Relationship

- Determining terminal plane relationship in primary dentition stage is importance because---

- Erupting 1st permanent molars guided by distal surface of 2nd primary molars as they erupts in occlusion.

- Thus terminal plane relationship of primary dentition determine type of molar relationship in permanent dentition to be achieved later.

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Mesial Step Terminal Plane

- Distal surface of deciduous mandibular 2\textsuperscript{nd} molar is more mesial to that of upper.
- It is favourable to guide permanent molar into a class I relationship in mixed dentition
- May progress to half or full cusp class III
Distal Step Terminal Plane

- Distal surface of 2nd deciduous mandibular molar is more distal to that of upper.
- This relationship is unfavourable as it guides permanent molars into distal occlusion or class II relationship.
MIXED DENTITION PERIOD (6 -12 years)

- Period during which both primary and permanent teeth are in mouth.
- Begins at 6yrs with eruption of permanent molar.
- Most malocclusion developed in this stage

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Phases of Mixed Dentition

- Early/1\textsuperscript{st} Transitional Period
- Intertransitional Period
- Late/2\textsuperscript{nd} Transitional Period

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1\textsuperscript{st} / EARLY TRANSITIONAL PERIOD (6-8 years)

- Concerned with replacement of primary incisors by their successors and addition of four 1\textsuperscript{st} permanent molars to dentition.

- 1\textsuperscript{st} permanent molars erupt at 6 years of age with mandibular molar preceding maxillary molar.

- Location and relationship of 1\textsuperscript{st} permanent molar influenced by presence of interdental spacing and terminal plane relationship of primary dentition.
Effect of Flush Terminal Plane

- Flush terminal plane develops into class 1 molar relationship in permanent dentition.
- Some cases of flush terminal plane also develop into class 11 molar relationship if forward mandibular growth is not sufficient.
Effect of Flush Terminal Plane

- In presence of flush terminal plane, 1st permanent molars initially assume a cusp to cusp or end on molar relationship, as they erupt distal to 2nd primary molars.

- Lower 1st permanent molar has to move 2-3 mm anteriorly in relation to upper 1st permanent molar in order to transform end on molar relation to class 1 molar relation and this transformation occur in 2 ways.
CLASS 1 molar relation achieved as

Early Mesial Shift

Late Mesial Shift
Early Mesial Shift

- Early mesial shift of lower permanent 1\textsuperscript{st} molar occur by utilization of physiologic spaces present between primary incisors and primate spaces.
- Eruptive force of permanent molar push deciduous molars forward in spaces, establishing class 1 molar relationship.
- As change occur in early mixed dentition shift is called

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Late Mesial Shift

- In absence of sufficient development spaces in primary dentition, erupting permanent 1st molars not able to establish class 1 relationship in early mixed dentition.
- In such case class 1 molar relationship established following exfoliation of primary 2nd molars, by utilizing Leeway space.

Averages

- 1.8 mm maxilla
- 3.4 mm in mandible.

- As this occur in late mixed dentition...
Significance of Leeway space of Nance

- Presence of excessive Leeway space provides for mesial movement of permanent molars.
- Leeway space in mandibular arch more than of maxillary arch.---because primary mandibular molars wider than primary maxillary molars.
- Leeway space differential between two arches cause mandibular 1st molar to move mesially more than maxillary 1st molar.
Such arrangement causes change in molar relationship from end on in early mixed dentition period (late mesial shift) to class I.

Leeway space deficiency seen in some individuals when size of unerupted premolars and permanent canine are larger than space available.
ERUPTION OF PERMANENT INCISORS

- Permanent incisors develop labially to primary incisors.
- Mandibular central incisor are 1st to erupt.

Incisor Liability

- Mesiodistal crown dimension of permanent incisors greater than of primary incisor.
- This difference in mesiodistal crown dimension termed as Incisal Liability.

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Incisor Liability

7.6 mm in maxilla

6 mm in mandible *(Wayne 1968)*

Anterior crowding of permanent dentition may develop in the absence of interdental spacing.
Some degree of transient crowding occur due to incisal liability at 8-9 years of age and persist until emergence of canine when space for teeth again become adequate. Incisal liability overcome by--

- Utilization of interdental spacing between primary anteriors
- Increase in intercanine arch width
- Change in incisor inclination
Increase in Intercanine Arch Width

- Continuing growth of jaw often result in increase in intercanine arch width during mixed dentition period.

- This contribute to accommodation of bigger permanent incisors in arches.
Change in Incisor Inclination

- Permanent incisors erupt labially to primary incisors.

- Interincisal angle between maxillary, mandibular incisors

- 150 degree in primary dentition

- 123° in permanent dentition which makes permanent dental arch circumference wider.

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BROADBENT PHENOMENON

- 8-9 years – Midline Diastema

- Because of pressure of erupting permanent canines in developing roots of lateral incisors.

- Crowns of erupting incisors flare more laterally producing diastema. “ugly duckling stage’ (Broadbent in 1937).
Broadbent described this stage of development as Ugly Duckling Stage as children appear ugly with crooked teeth during this stage of development.

This phenomenon is self correcting and normal.

Incisors gradually straighten with eruption of lateral incisors and canines.
- Upper canine develop palatally, migrate labially to lie slightly labial and distal to root apex of lateral incisors.

- Erupting canine apply pressure on apices of lateral incisors.

- Roots of lateral incisors get displaced mesially with resultant distal tilting their crown.
Mesially displaced roots of lateral incisor then apply pressure on roots of maxillary central incisors.

Roots of maxillary central incisors also get displaced mesially with resultant divergence of their crown.

Creation of midline diastema (ugly duckling stage)
After 1\textsuperscript{st} permanent molars and incisors establish occlusion, there is period of 1-2 years where little change in occlusion is seen.

- Mandibular lateral incisors attain proper sites within dental arch and their initially lingual location is eliminated.

- Small rotations corrected by pressure exerted by Tongue and Lips.

- Resorption of roots of Deciduous canines and molars continues
SECOND TRANSITIONAL PERIOD

- Involves replacement of deciduous molars and canine by premolars and permanent canines and emergence of 2nd permanent molars.
- Lower cuspid and first bicuspid erupt at 9-10 years
- Maxillary premolars and canines then erupt, at 11 to 12 years, and period terminated by appearance of 2nd molars at 12 years.
- Most common sequence of eruption of permanent lateral teeth in maxilla is 4-3-5 and in mandible 3-4-5.
Eruption of Premolars

- Important portion of dental arch in development of occlusion is premolar segment.

- This is because erupting premolar smaller in mesiodistal dimension than primary molars which they replace.

- Thus major change in occlusion observed during premolar emergence.
Eruption of permanent 2\textsuperscript{nd} molars

- Emergence of 2\textsuperscript{nd} permanent molars ideally should follow eruption of premolars.

- If 2\textsuperscript{nd} molars erupt before premolars then:
  - Shortening of arch perimeter occurs,
  - Malocclusion more likely to occur.
Permanent dentition stage of dental development starts after shedding of last primary teeth & eruption of all permanent teeth excluding third molars.

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<table>
<thead>
<tr>
<th>Tooth</th>
<th>Hard Tissue Formation Begins</th>
<th>Amount of Enamel Formed at Birth</th>
<th>Enamel Completed</th>
<th>Eruption</th>
<th>Root Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maxillary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central incisor</td>
<td>3 - 4 mos.</td>
<td>.........</td>
<td>4 -5 Yrs</td>
<td>7 - 8 Yrs</td>
<td>10 Yrs</td>
</tr>
<tr>
<td>Lateral incisor</td>
<td>10 - 12 mos.</td>
<td>.........</td>
<td>4 -5 Yrs</td>
<td>8 - 9 yrs</td>
<td>11 Yrs</td>
</tr>
<tr>
<td>Cuspid</td>
<td>4 -5 mos.</td>
<td>.........</td>
<td>6 - 7 Yrs</td>
<td>11 -12 Yrs</td>
<td>13 - 15 Yrs</td>
</tr>
<tr>
<td>First bicuspid</td>
<td>11/2 - 1 3/4 Yrs.</td>
<td>.........</td>
<td>5 - 6 Yrs</td>
<td>10 - 11 yrs</td>
<td>12 -13 Yrs</td>
</tr>
<tr>
<td>Second bicuspid</td>
<td>2 - 21/4 Yrs</td>
<td>.........</td>
<td>6 - 7 Yrs</td>
<td>10 - 12 yrs</td>
<td>12 - 14 Yrs</td>
</tr>
<tr>
<td>First molar</td>
<td>at birth</td>
<td>Some times a trace</td>
<td>21/2 - 3 Yrs</td>
<td>6 - 7 Yrs</td>
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</tr>
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<td>Second molar</td>
<td>21/2 - 3 Yrs</td>
<td>.........</td>
<td>7 -8 Yrs</td>
<td>12 -13 Yrs</td>
<td>14 - 16 Yrs</td>
</tr>
<tr>
<td><strong>Mandibular</strong></td>
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</tr>
<tr>
<td>First bicuspid</td>
<td>13/4 - 2 Yrs.</td>
<td>.........</td>
<td>5 - 6 Yrs</td>
<td>10 - 12 yrs</td>
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Differential Mandibular Growth

- During growing period, both maxilla and mandible grow downward and forward.

- However mandible grows more forward than maxilla during this development stage.

- Such differential mandibular growth thought to contribute to transition from end on to class 1 molar relationship.
THANK YOU