Deciduous and permanent dentition 1

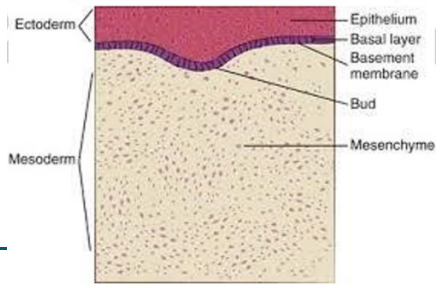
The development of dentition is an important part of craniofacial growth as the formation, eruption, exfoliation and exchange of teeth take place during this period.

Prenatal Development of Dentition

The embryonic oral cavity is lined by stratified squamous epithelium called the *oral ectoderm*, which is visible around 28-30 days of intrauterine life.

The first sign of tooth development appears late in the 3rd embryonic week when the epithelial lining begins to thicken on the inferior border of the maxillary process and the superior border of the mandibular process which join to form the lateral margins of the oral cavity.

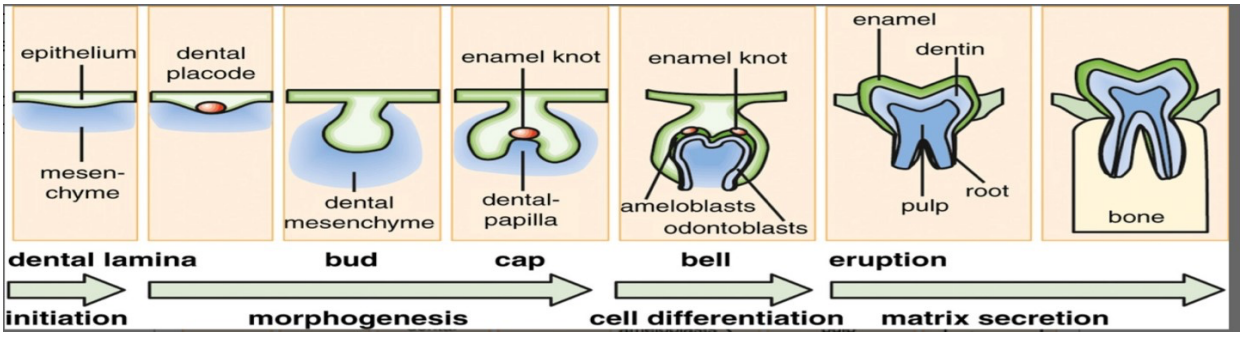
At 6 weeks, four maxillary odontogenic zones coalesce to form the dental lamina and the two mandibular zones fuse at the midline. The dental lamina is the foundation for the future dental arches. Tooth formation begins with invagination of the dental lamina epithelium into the underlying mesenchyme at specific locations. The dental lamina gets demarcated into ten knoblike structures namely the tooth bud/germ. A tooth bud consists of an enamel organ, which is derived from the oral ectoderm, a dental papilla and a dental sac, both of which are derived from the mesenchyme. Each of these swellings of the lamina proliferates and differentiate, passing through various histological and morphological differentiation stages namely bud, cap and bell stages.



Stages of Tooth Bud Development

1. ***Initiation***: This is the first epithelial incursion into the ectomesenchyme of the jaw. The tooth bud is the primordium of the enamel organ. Histologically it consists of peripheral low columnar cells and centrally located polygonal cells. The area of ectomesenchymal condensation subjacent to the bud is the dental papilla. The dental sac surrounds the tooth bud and the dental papilla. The dental papilla later on forms the dentin and pulp whereas the dental sac forms cementum and the periodontal ligament. Initiation takes place as follows:

- Deciduous dentition: 2nd month *in utero*.
- Permanent dentition: Growth of the free distal end of dental lamina gives rise to the successional lamina, which initiates the permanent dentition; starts from 5th month in utero.
- Dental lamina elongates distal to the second deciduous molar and gives rise to the permanent molar tooth germs.



2. Proliferation: Unequal growth in different parts of the bud produces a shallow invagination on the deep surface of the bud to produce a cap shaped structure. Histologically it is made up of the outer enamel epithelium (cuboidal cells) at the convexity of the cap and the inner enamel epithelium (tall, columnar cells) at the concavity of the cap. Between the above 2 layers polygonal cells are located which is known as the stellate reticulum. These cells assume a branched reticular network as more intercellular fluid is produced.

3. Histo-differentiation: The enamel organ now assumes a bell shape as the invagination of the cap continues and the margins grow longer. Four different layers are seen. The inner enamel epithelium (IEE) cells remain tall columnar cells. The outer enamel epithelium flattens to low cuboidal cells. The stellate reticulum expands further, and the cells become star shaped. A new layer of cells known as Stratum Intermedium whose function is to provide nutrition to IEE cells appears between inner enamel epithelium and stellate reticulum.

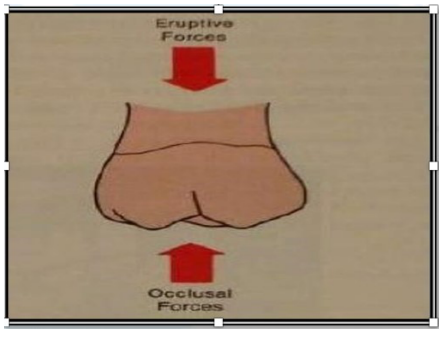
4. Morpho-differentiation (bell stage)

5. Apposition

The enamel organ produces enamel by the process of cell proliferation, differentiation and later mineralization. Mineralization commences in the deciduous dentition around the 14th week of intrauterine life and occurs first in the central incisors. The permanent tooth buds appear around the fourth to fifth month of intrauterine life and their mineralization is initiated at birth, beginning with the first permanent molar.

Eruption

Eruption is the developmental process that moves a tooth from its crypt position through the alveolar process into the oral cavity and to occlusion with its antagonist. During eruption of succedaneous teeth:



- Primary tooth resorbs.
- Roots of the permanent teeth lengthen.
- Increase in the alveolar process height.
- Permanent teeth move through the bone.

Teeth do not begin to move occlusally until crown formation is complete. It takes 2-5 years for posterior teeth to reach the alveolar crest following crown completion and 12-20 months to reach occlusion after reaching alveolar margin.

Factors Determining Tooth Position During Eruption

Tooth passes through four distinct stages of development:

1. Pre-eruptive Initially position of tooth germ is dependent on heredity.

2. Intra-alveolar Tooth position is affected by:

- Presence or absence of adjacent teeth
- Rate of resorption of primary teeth
- Early loss of primary teeth
- Localized pathologic conditions.

3- *Intraoral stage:* Tooth can be moved by lip, cheek, tongue muscles or external objects and drift into spaces.

4- *Occlusal stage:* Muscles of mastication exert influence through interdigitation of cusps. The periodontal ligament disseminates the strong forces of chewing to the alveolar bone.

Occlusal development:

According to Angle, occlusion is "The normal relation of the occlusal inclined planes of the teeth when the jaws are closed".

According to Ash and Ramfjord occlusion is the " The contact relationship of the teeth in function and parafunction".

Periods of Occlusal development can be divided into the following development periods:

1-Neo-natal period (at birth).

2- Primary dentition period.

3- Mixed dentition period.

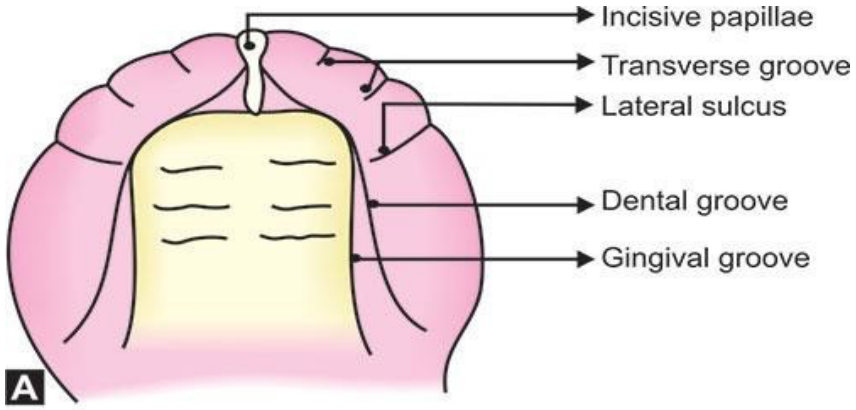
4- Permanent dentition period.

Neonatal period

Alveolar processes at the time of birth known as gum pads. Which is Pink in color, firm and are covered by a dense layer of fibrous periosteum, the pads get divided into 'labio- buccal' & 'lingual portion', by a dental groove. Gum pad soon gets segmented into 10 segment by a groove called transverse groove, & each segment is a developing tooth site. The groove between the canine and the 1st molar region is called the lateral sulcus which helps to judge the inter-arch relationship.

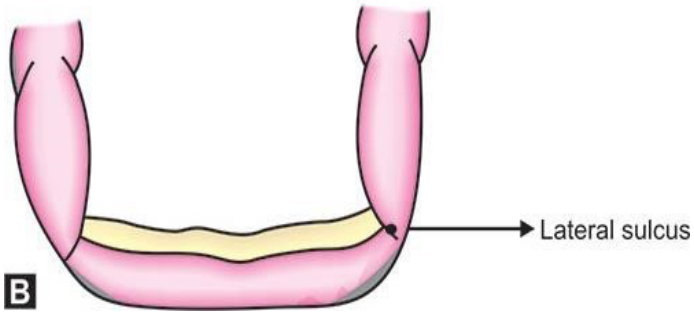
*** The upper gum pad** is horse shoe shaped, shows:

1. Gingival groove separates gum pad from the palate.
2. Dental groove starts at the incisive papilla, extends backward to touch the gingival groove in the canine region & then moves laterally to end in the molar region.
3. Lateral sulcus.



*** The lower gum pad** U shaped, characterized by

1. Gingival groove lingual extension of the gum pads
2. Dental groove
3. Lateral sulcus.



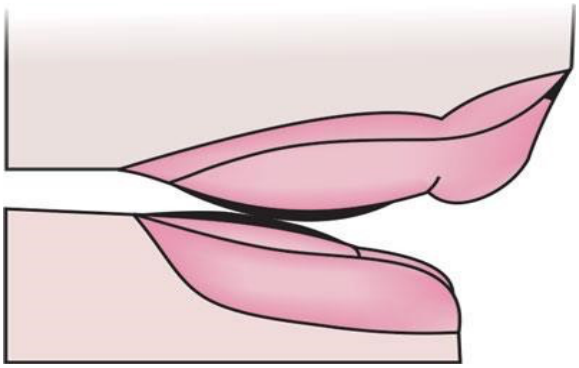
Relationship of Gum Pads

❖ Anterior open bite is seen at rest with contact only at the molar region.

❖ Upper gum pad being wider and longer than lower gum pads thus when approximated a complete over jet present all around.

❖ Class II pattern with the maxillary gum pad being more prominent Mandible is distal to the maxilla and usually the upper jaw overlaps the lower jaw in anterior posterior and transverse direction.

❖ Mandibular lateral sulci posterior to maxillary lateral sulci The anterior opening of the mouth will facilitate the feeding process without discomfort to the mother, at this stage the labial frenum is usually attached to the incisive papillary region and after the eruption of the deciduous teeth it will migrate in upward direction and gives the incisive papillary attachment is due to alveolar bone formation in association with the development of deciduous teeth ,the upper lip at this stage is usually short, and the anterior oral seal of the mouth occur due to the contact between lower lip and the tongue.



Neonatal Jaw Relationships

Mandibular functional movements are mainly vertical and to a little extent anteroposterior. Lateral movements are absent, precise bite or jaw relationship is not yet seen; therefore neonatal jaw relationship cannot be used as a diagnostic criterion for reliable prediction of subsequent occlusion in primary dentition.

The newly born child mouth is usually without teeth, sometimes Natal teeth that are present above the gumline (have already erupted) at birth. Neonatal teeth or Early Infantile teeth that erupt during the 1st month of life these teeth lookalike the deciduous teeth.

Pre-erupted teeth erupt during the second or third month. they consist from enamel, dentine and pulpal tissue and usually without roots or there is a very short root with them. No intervention is usually recommended unless they are causing difficulty to the infant or mother. The incidence of natal and neonatal teeth is estimated to be l:1000 and 1:30000 respectively. These teeth are almost always mandibular incisors, which frequently display enamel hypoplasia. There are familial tendencies for such teeth. They should not be removed if normal but removed if supernumerary or mobile.

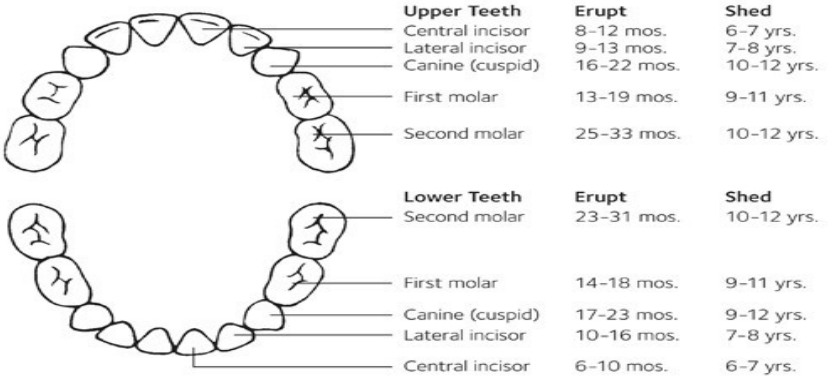
Deciduous Dentition

Deciduous teeth or primary teeth are the first set of teeth in the growth development of humans. They develop during the embryonic stage of development starts at the sixth week of tooth development as the dental lamina, there are ten buds on the upper and lower arches that will eventually become the primary (deciduous) dentition. These teeth will continue to form until they erupt and become visible in the mouth during infancy, there are a total of twenty teeth that is made up of central incisors, lateral incisors, canines, first molars, and secondary molars; there is one in each quadrant, making a total of four of each tooth: five per quadrant and ten per arch.

The eruption of these teeth (teething) starts from the eruption of the first deciduous tooth, usually the deciduous mandibular central incisors and ends with the eruption of the first permanent molar, i.e. from 6 months to 6

years of postnatal life. By 2½ years of age, deciduous dentition is usually complete and in full function. Root formation of all deciduous teeth is complete by 3 years of age.

The sequence of eruption and shedding of deciduous teeth



Normal Signs of Primary Dentition

1. Ovoid arch form
2. Straight or vertical inclination of the incisors
3. Deep bite present this could be due to vertical inclination of primary incisors over a period of time these deep bite reduced due to eruption of primary molars, rapid attrition of incisors and forward movement of the mandible due to growth, and which change to edge to edge relationship
4. Minimal overjet and absence of crowding.

Two types of primary dentitions seen:

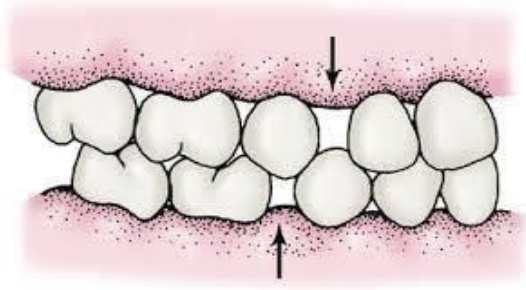
a) **Closed primary dentition**: absence of spaces is an indication that crowding of teeth may occur when the larger permanent teeth erupt.

b) **Spaced or opened primary dentition**: in which interdental spaces are present called spaced dentition there are 2 types of spacing:

1- **Physiologic or generalized spaces**: usually seen in the deciduous dentition to accommodate the larger permanent teeth in the jaws, More prominent in the anterior region.

2- **Primate spaces or anthropoid spaces**: naturally occurring spacing between the teeth of the primary dentition. In the maxillary arch, it is located between the lateral incisors and canines, where as in the

mandibular arch the space is between the canines and first molars, This space is used for early mesial shift.



All primary teeth are gradually replaced with a permanent, but in the absence of permanent replacements, they can remain functional for many years. The replacement of primary teeth begins around age six, when the permanent teeth start to appear in the mouth, resulting in mixed dentition. The erupting permanent teeth cause root resorption, where the permanent teeth push on the roots of the primary teeth, causing the roots to be dissolved by odontoclasts (as well as surrounding alveolar bone by osteoclasts) and become absorbed by the forming permanent teeth. The process of shedding primary teeth and their replacement by permanent teeth is called **exfoliation**. This may last from age six to age thirteen. By age twelve there usually are only permanent teeth remaining. However, it is not extremely rare for one or more primary teeth to be retained beyond this age, sometimes well into adulthood, often because the permanent tooth fails to develop.

The spaces of the deciduous teeth try to increase with age due to growth of the jaws in anteroposterior, vertical, and transverse direction, and due to attrition, and these teeth subjected to large amount of attrition due to wear at the incisal age, and proximal surfaces since the deciduous teeth mostly converted to edge to edge relationship at late stages, the occlusal forces with root resorption will increase the mobility of the deciduous teeth and in case the spaces are closed (no spacing) this will produce attrition at the proximal surfaces due to friction produced by movement during mastication, so the mobility progress the spaces to increased and this will facilitated the normal shedding of the incisors.

The End