Development of Occlusion

Development of occlusion :

Occlusion in the primary dentition plays a significant role in determining the space for and occlusion in the succeeding permanent dentition. The characteristic set of features of this dentition to a large extent lays the foundation for proper eruption and alignment of the succeeding dentition.

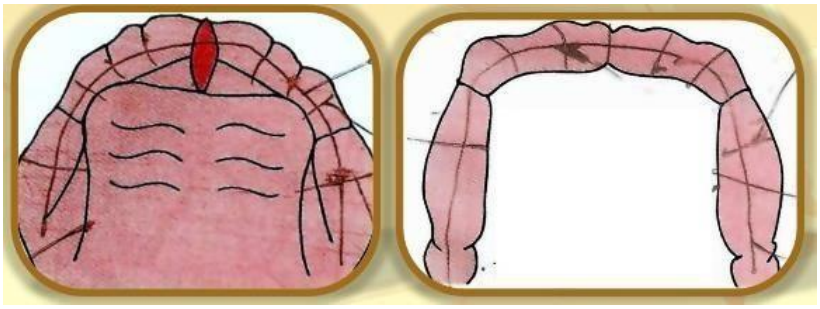
Can be divided into four stages :

1. **Predental stage, Gum pads stage (0-6 months).**
2. **Deciduous dentition.**
3. **Mixed dentition.**
4. **Permanent dentition.**

1. Predental stage, gum pads stage :

From birth until the eruption of the first primary tooth. at birth, neither the maxillary nor the mandibular alveolar process is well developed.

The newly born child's mouth usually contains 20 elevations (these elevation called gum pads) which are corresponding to the future 20 deciduous teeth. (10 of them in the upper jaw and 10 of them in the lower jaw). These elevations become segmented by transverse grooves and each segment is a developing tooth site.

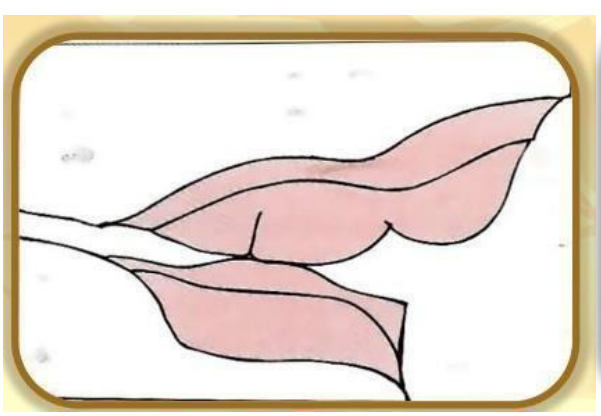


Indeed, at birth there is such a variability in the relationships of the upper and lower gum pads that the neonatal relationship cannot be used as a diagnostic criterion for reliable predictions of subsequent occlusion in the primary dentition.

But in general, The upper jaw is a horse shoe shape, while the lower is a U shape and usually the upper jaw overlaps the lower jaw in anteroposterior and in transverse direction, in other ward: the upper jaw is more wider than the lower jaw and at the same time the lower jaw is a retrognathic position in relation to the upper jaw.

At this age the anterior gum pads is averted anteriorly and usually the anterior segment of the upper and lower gum pads don’t approximate each other with a space

created between them, in this way the opposing surface of the pads provides an efficient way of squeezing milk during breast feeding, while the posterior segment occlude with each other at molar region. The tongue is positioned in this space between the upper and lower gum pads during suckling. This infantile open bite is transient and get self-corrected with the eruption of deciduous incisors.



The upper lip at this stage is usually short, and the anterior oral seal of the mouth occurs due to the contact between the lower lip and the tongue.
On the upper jaw we can see the lateral sulcus which express to the distal margin of the upper deciduous canine and the gum pads, which is separated from the masticatory mucosa by a long and continuous groove called gingival groove.
At this age usually the labial frenum is attached to the incisive papillary region and after the eruption of the deciduous it will migrate in upward direction and gives the incisive papillary attachment this is due to alveolar bone formation in association with the development of the deciduous teeth.

The size of the gum pads at birth might be determined by anyone of the following factors: (1) the state of maturity of the infant at birth; (2) the size at birth as expressed by birth weight; (3) the size of the developing primary teeth; and (4) purely genetic factors.

Precociously Erupted Primary Teeth :

Occasionally, a child will be born with teeth already present in the mouth.

- ✓ **Natal teeth:** (present at birth),
- ✓ **Neonatal teeth:** (erupted during the first month),
- ✓ **Pre-erupted:** (erupting during the 2^{nd} or 3^{rd} months) teeth are almost always mandibular incisors which frequently display enamel hypoplasia. There are familial tendencies for such teeth. Such teeth should not be removed, if they are near normal, even though they may cause the mother some discomfort during nursing, unless they are certainly supernumeraries.

Classification:

Hebling (1997) classified natal teeth into 4 clinical categories :

1. ***Shell- shaped crown poorly fixed to the alveolus by gingival tissue and absence of root.***
2. ***Solid crown poorly fixed to the alveolus by gingival tissue and little or no root.***
3. ***Eruption of the incisal margin of the crown through gingival tissue***
4. ***Edema of gingival tissue with un erupted but palpable tooth.***

Etiology:

It has been related to several factors, such as:

- Superficial position of the germ.
- Infection or malnutrition
- Eruption accelerated by fibrile incidente or hormonal stimulation.
- Hereditary transmission of a dominant autosomal gene
- Osteoblatic activity inside the germ area related to the remodelling phenomenon and hypovitaminosis

2. Primary Dentition stage (6 months- 6 years) :

Usually the deciduous teeth begin to erupt at the sixth months of age until 2.5 - 3 years of age. (All the deciduous teeth will be erupted, completely, at the age of third years).

Eruption Sequence of Deciduous Dentition :

Table (1): show the timing of calcification, eruption and root completion of deciduous dentition

Primary tooth	Calcification begins (IU weeks)		Eruption (months)		Root Completed		Exfoliation (yr.)	
	Max	Mand	Max	Mand	Max	Mand	Max	Mand
Central incisors	14wk.IU	14wk. IU	7-8 mo.	6-7 mo.	11/2 yr.	11/2yr.	7-8yr.	6-7yr.
Lateral incisors	16wk. IU	16wk. IU	8-10 mo.	8-10 mo.	2yr.	11/2yr.	8-9yr.	7-8yr.
Canine	17wk. IU	17wk. IU	19 mo.	20 mo.	31/4yr.	31/4yr.	11-12yr.	9-11yr.
1st Molar	15wk. IU	15wk. IU	16 mo.	16 mo.	21/2yr.	21/4yr.	9-11yr.	9-11yr.
2nd Molar	19wk. IU	18wk. IU	29 mo.	27 mo.	3yr.	3yr.	10-12yr.	10-12yr.

Characteristics features of Deciduous Dentition :

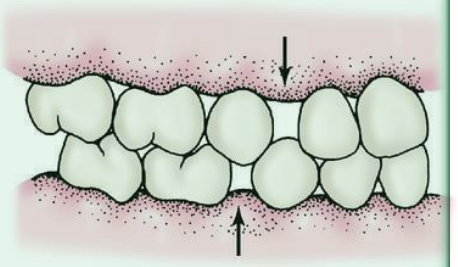
1. Interdental Spaces :

Spacing in the primary incisor region is normally distributed among all the incisors, not just in the "primate space" locations where permanent spaces exist in most mammalian Species. This arrangement of the primary incisor teeth with gaps between them may not be very pretty, but it is normal.

There are two types of spacing :

1. **Developmental - Generalized – physiologic spaces :** these are present throughout the primary dentition. The reason for developmental space is anterior posterior growth of the jaw. Generalized spacing between the teeth are seen in both the dental arches and helps in accommodation of larger successor teeth. Spaced dentition is preferable in a child because the chances for crowding in the permanent dentition are very minimal. Developmental space is on average 4mm in maxillary arch and 3mm in mandibular arch. Developmental spaces between the incisors are often present from the beginning, but become somewhat larger as the child grows and the alveolar processes expand.

2. **Primate space – anthropoid spaces :** In the maxillary arch, the primate space is located between the lateral incisors and canines (mesial to upper canine), whereas in the mandibular arch, the space is between the canines and first molars (distal to the lower canine).

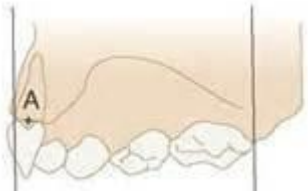


Closed dentition/ Nonspaced dentition : primary teeth without any spaces in between teeth are called closed dentition. Lake of space could be either due to wider primary teeth or reduced arch length. Closed dentition invariably leads to crowding in the permanent dentition.

2. Incisors relationship :

Deep bite : when the primary incisors erupt, the overbite is deep. This could be due to vertical inclination of the primary incisor. Over a period of time, this deep bite later gats self-corrected by:

1. Eruption of primary molars,
2. Rapid attrition of incisors,
3. Differential growth of the alveolar processes of the jaws.



At about six year of age, there may be an edge to edge relationship.

Overjet : Overjet is initially more in primary dentition. The overjet decreases with the forward growth of the mandible. The average overjet in primary dentition is 1-2mm.

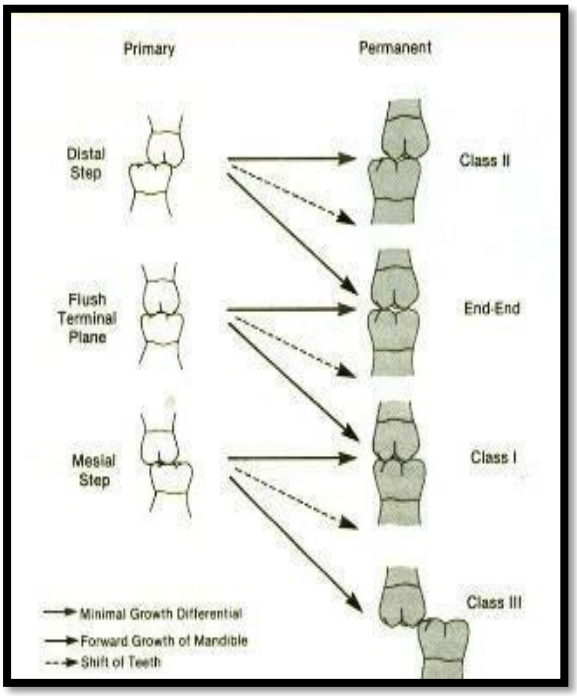
3. Molar relationship :

The anteroposterior molar relationship in deciduous dentition is described in term of the terminal planes. Terminal plan is alien drawn along the distal surfaces of the maxillary and mandibular second primary molars.

A. Flush terminal plane

In straight/flush terminal plane, the distal surfaces of the maxillary and mandibular second deciduous molars are in the same vertical plane.

It is of significant to note that the mandibular second primary molar has a greater mesiodistal diameter than the maxillary second molar. This difference in the dimensions make the distal surfaces of both maxillary and mandibular deciduous second molars to fall in same vertical plane in centric occlusion. Flush terminal plane is considered to be the ideal kind of molar relationship in the primary dentition.



B. Mesial step :

In this terminal plane relationship, the distal surface of the mandibular deciduous second molar is more mesial to the distal surface of the maxillary deciduous second molar.

Primary second molars in mesial step relationship lead to a class I molar relation in mixed dentition. This may remain or progress to a half cusp Class III with continued mandibular growth.

C. Distal step :

In this terminal plane relationship, the distal surface of the mandibular deciduous second molar is more distal to the distal surface of the maxillary deciduous second molar.

Determining the terminal plane relationship in the primary dentition stage is of great importance because the erupting first permanent molars are guided by the distal surfaces of the second primary molars as they erupt into occlusion.
Thus, the terminal plane relationship of primary dentition largely determines the type of molar relationship in the permanent dentition to be achieved later.
When the deciduous second molars are in a distal step, the permanent first molar will erupt into a class II relation.
This molar configuration is not self-correcting and will cause a class II malocclusion despite Leeway space and different growth.
When the deciduous second molars are in a fIush terminal plane, the permanent first molar erupts initially into a cusp-to-cusp relationship.

The following normal signs of a primary dentition should be noted:

A. Spaced anterior,
B. Primate spaces,
C. Deep bite is present initially which changes to edge to edge relationship, d) Straight terminal plain,
D. Class I molar and cuspid relationship,
E. Almost vertical inclination of anterior teeth,
F. Ovoid arch form.

Changes that is Happened in Deciduous Dentition :

Changes in Spaces :

*The spaces of the deciduous teeth try to increase with age due to **the growth of the jaws** in: anteroposterior, transverse and vertical direction, and due to : **attrition**; since the shape of the deciduous teeth is triangular and these teeth will be subjected to a great amount of attrition due to wear at the incisal edges; so, the spaces will be increased, especially anteriorly due to the attrition. This attrition will occur at the incisal edges and the proximal surfaces since the deciduous teeth mostly converted into edge to edge relationship at a later stage.*

At the age of 5.5 -6 years the permanent teeth begun to erupt, and these teeth contains an eruptive cyst, and this is filled with fluid, this fluid will exert a pressure on the roots of the deciduous teeth causing their resorption with the aid of special enzyme which is produced at this stage of age. The roots resorption of the deciduous teeth means decrease in the root length and since the occlusal forces at the age of 5-6 years are more than those of 3 years; so, these occlusal forces together with the root resorption will increase the mobility of the deciduous teeth and if the deciduous

teeth in closed case (without spacing), this will produce attrition of the proximal surfaces due to friction produced by movement during mastication, as the mobility progress the spaces will be increased and this will facilitate the process of normal shedding of the incisors. Usually, the permanent teeth when erupt ,they are located at the palatal or lingual aspect of the deciduous incisors, causing their resorption during eruption, but sometimes, the permanent teeth could be deflected from the roots of incisors; therefore, this process will not happen in the normal way, and the permanent erupt ,while the deciduous is stay in its space.

3. Mixed Dentition Stage :

From the eruption of 1st permanent tooth till the shedding of last deciduous tooth. Significant changes in occlusion are seen in mixed dentition period due to the loss of 20 primary teeth and eruption of their successor permanent teeth. Most malocclusions are developed at this stage. There is a close relationship between the moment of eruption of a tooth and its stage of root development. Just after emergence, three quarters of the roots of the tooth have normally been formed. In the case of lower first permanent molars and central incisors, half the roots have been formed by this time.

Eruption Sequence of permanent dentition:

In the maxillary arch, the most frequent sequence was (6-1-2-4-5-3-7-8). In the mandibular arch, the most common sequence was found to be (6-1-2-3-4-5-7-8). The sequence of eruption of the permanent teeth can play an important role when considering a serial extraction procedure.

A change in the sequence of eruption is a much more reliable sign of a disturbance in normal development than a generalized delay or acceleration.

Table (1): Timing of calcification, eruption and root completion of the permanent teeth.

Permanent tooth	Calcification begins		Eruption		Root Completed	
	Max	Mand	Max	Mand	Max	Mand
Central	3 mo.	3 mo.	7 yr.	6 yr.	10 ½ yr.	9 ½ yr.
Lateral	11 mo.	3 mo.	8 yr.	7 ½ yr.	11 yr.	10 yr.
Canine	4 mo.	4 mo.	11 yr.	10 yr.	13 ½ yr.	12 ¾ yr.
1st Premolar	20 mo.	22 mo.	10 yr.	10 yr.	13 ½ yr.	13 ½ yr.
2nd Premolar	27 mo.	28 mo.	11 yr.	11 yr.	14 ½ yr.	15 yr.
1st Molar	32 wk. IU	32 wk. IU	6 yr.	6 yr.	10 ½ yr.	10 ½ yr.
2nd Molar	27 mo.	27 mo.	12 yr.	12 yr.	15 ¾ yr.	16 yr.
3rd Molar	8 yr.	9 yr.	20 yr.	20 yr.	22 yr.	22 yr.

This stage can be divided into 3 phases :

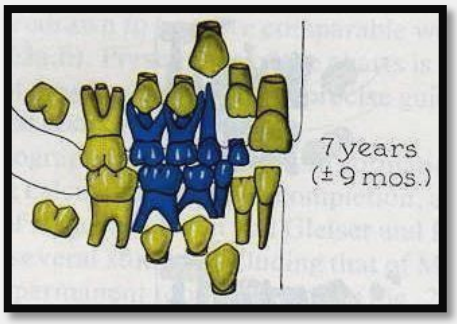
1. ***First transitional period about 6-8years of age.***
2. ***Inter-transitional period about 8-10 years of age.***
3. ***Second transitional period about 10-12 years of age.***

1. First Transitional Period :

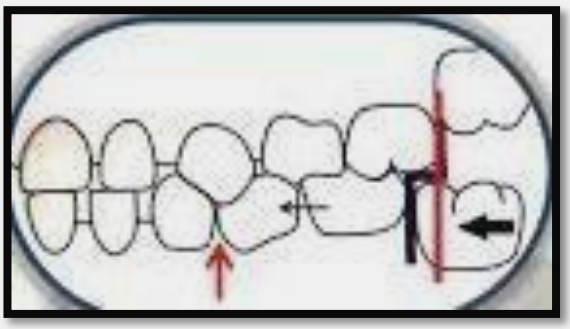
A. *The upper and lower first molars display different pathways of eruption. The lower molar buds are mesially and lingual inclined. Consequently, the lower first molar erupts in a mesial and lingual arc, while the upper first molar bud develops with a buccal and distal orientation and therefore erupt in distal and buccal arc. If these teeth are flush in the terminal plane then the first permanent molars assume a cusp-to-cusp relationship when they erupt. In order to establish a class I molar relationship, some mesial movement of the mandibular first permanent molar will be required and this is called early mesial shift.*

Early mesial shift :

In patient with spaced primary dentition, and flush terminal plane relationship the eruptive force of the permanent molars will move the primary molar mesially, so that close the space distal to the primary canines (primate spaces), thus allowing lower permanent molars to shift mesially into Class I relationship. In closed dentition, this is not possible.



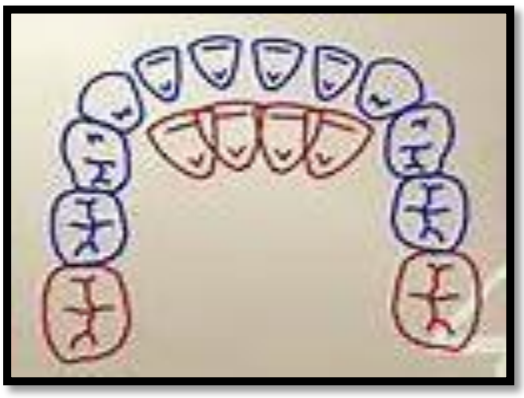
Eruption First molar

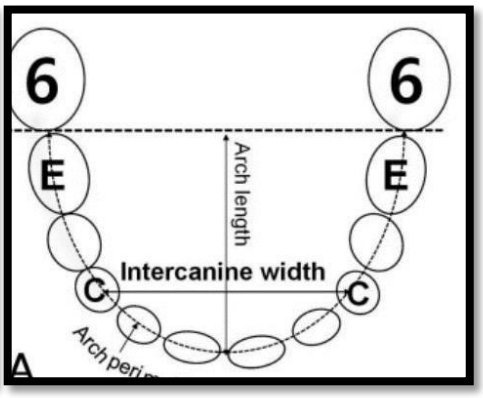


Early mesial shift

B. Replacement of incisors :

Permanent incisors develop lingual to the primary incisors. They are located in (zigzag) fashion and the lateral usually trapped by the centrals and canines. Since the upper lateral incisors situated palatal to the centrals, so they may be influenced by the malocclusion more than the centrals. If there is no enough space in dental arch for all the incisors, most of the available space is occupied at the eruption of centrals, when laterals erupt later, they may erupt in a rotated or in cross bite condition. The collective mesiodistal dimensions of the permanent incisor tooth crowns are larger than their deciduous predecessors by approximately (6 mm) in the mandible and (8 mm) in the maxilla. The difference between the amount of space needed for the incisors and the amount available for them is called the *Incisor Liability*.





Some degree of transient crowding may occur due to incisal liability at about 8-9 years of age. A favorable incisal liability exists when the primary dentition is an open dentition. Unfavorable situation exits in closed dentition. The space discrepancy is compensated by three mechanisms :

1- Increased intercanine width : significant increase in the inter-canine arch width by growth occurs with the eruption of incisors. It is about 3-4 mm.

2- Utilization of interdental spacing : physiological spaces in primary dentition.

Primary spaces : *that is present mesial to the upper deciduous canine this space will be utilized by the incisors during their eruption.*

Secondary spaces : *during the eruption of the lower incisor, the lower deciduous canine will be pushed in a distal and buccal direction due to the fact that: the collective mesiodistal width of the permanent incisors is more than the collective mesiodistal width of the deciduous incisors, and since there is a contact between the lower deciduous canine so, the upper deciduous canine will be pushed in a lateral and distal direction and this will produce an additional spaces named as: secondary spaces, which will be utilized by the permanent incisors. This will permit the permanent incisors of the adult face which is present in a small child face to erupt in a normal way.*

3- Due to proclination of the incisors during the eruption : the incisors erupt in a proclined situation and this will increase the available arch length present for the permanent incisors, and this proclination is mainly due to the increase in activity of the tongue at this period (8.5 years) due to the increased amount of the growth stimulation hormone at this period. This decrease the inter incisal angle in the permanent dentition and placing them in a wider arch to obtain 2-3mm space to the arch.

Variations (Changes) Exist During The Eruption of Incisors :

Ugly duckling stage:

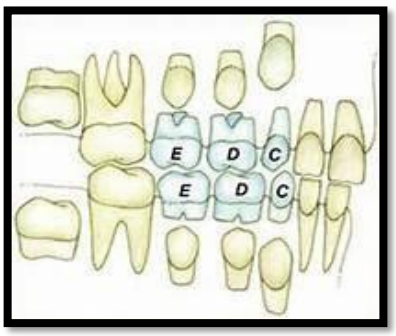
It takes place between the ages of 8- 12 years. It is a stage of dental development preceding the eruption of the permanent canine, in which the lateral incisor may be tipped laterally because of crowding by the un erupted canine crowns. It is called ugly duckling stage because dentition in children at this stage looks very ugly due to multiple spacing between their teeth. It is also known as transient or self-correcting malocclusion. It is also called physiological median diastema or Broadbent's phenomena.


Etiology :

The roots of the maxillary permanent lateral incisor serve as a guide for the erupting maxillary canine, during eruption of the canine, the cusps of the canine impinge on the roots of the lateral incisor causing a lateral flaring of the lateral incisors. Some of the leeway space is taken by the movement of the larger permanent canine falling into primate space. At 8-10 years as it moves downwards and forward towards occlusion, it comes to lie against the apices of the erupted permanent lateral and central incisors causing mesial pressure on their roots. The centrals clinically respond to that pressure by central diastema and distal crown flaring while laterals show labial tipping.

2. Inter Transitional Period :

Begins when all permanent incisors and permanent first molar are fully erupted, and ends when the replacement of the primary teeth starts in the buccal region. This period is a silent period extend from 8.5 to 10 years of age, during which there is no teeth eruption or exfoliation, except a little changes in occlusion. This period is called (Lull period).

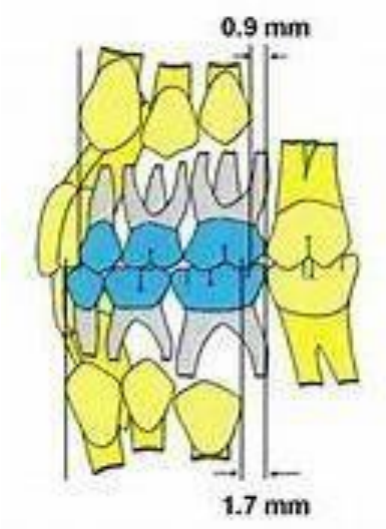


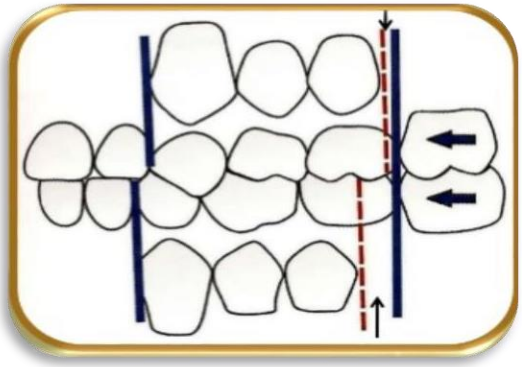
Dental age 10 is characterized by a greater amount of both root resorption of the primary canines and molars, and root development of their permanent successors. At dental age 10, approximately one half of the roots of the mandibular canine and mandibular first premolar have been completed; nearly half the root of the upper first premolar is complete; and there is significant root development of the mandibular second premolar, maxillary canine, and maxillary second premolar. Another indicator of dental age 10, therefore, would be completion of the roots of the mandibular incisor teeth and near completion of the roots of the maxillary laterals.

3. The Second Transitional Period :

This active stage of development involves replacement of primary molars and canines, and emergence of 2nd permanent molars. This exchange normally takes place between 10-12 years of age.

In contrast to the incisor dentition, the combined mesiodistal width of the deciduous of the canine and molar teeth is greater than that of the permanent canine and premolars, an excess space known **as the leeway space.** In maxillary arch It is about **0.9** mm on one side, an equal to 1.8 mm, while in mandibular arch about 1.7 mm on one side, an equal to 3.4 mm.The mesiodistal width of lower E is more than that of the upper E. and after the exfoliation of C, D and E the six tries to move in a forward direction to close this extra space and the movement of the sixes after the exfoliation of deciduous dentition is named as: **late mesial shift.**





late mesial shift

Eruption of the permanent canines and premolars normally as the following :

- ***In the mandible, the canine erupts ahead of the first premolar and this is followed by the second premolar.***
- ***In the maxilla, the first premolar usually erupts first, followed by the second premolar and then the canine.***

The consequences of these eruption patterns are that the mandibular second premolar and maxillary canine teeth are the most vulnerable for potential crowding. For the canines to develop normally, it should firstly directed mesially until it touch the apical part of the lateral incisor root, then it directs into a coronal and lateral direction till reaches the occlusal level.

Undoubtedly, the larger the leeway space present within each quadrant, the more potential space there will be for eruption of the permanent canine and premolar teeth. The crowding of canines is common particularly in the maxillary arch, so that

it could be erupted in buccal direction or be impacted if it directed palatally because the masticatory mucosa cannot be pierced by the canine due to the presence of high amount of collagen fibers. This usually occurs in maxilla where the permanent canine develops in a high position (under the orbit), so it has a long tortuous path of eruption. It often depends on the presence and shape of root of permanent lateral incisors as guide for normal eruption.

In addition, if substantial forward movement of the first permanent molar has occurred, particularly in the mandibular arch, during establishment of the molar relationship or following the early loss of deciduous second molars, there will be a less space for permanent canine and premolar teeth to erupt uncrowded.

The variation exist in this period includes :

Impaction of lower 5(s) due to lack of space for it due to or since it is the latter tooth which is erupted in the lower jaw mesial to the lower seven. While in the upper jaw the lack of space will influence the canine eruption, since it is the latter toot h that erupts prior to the upper seven in maxilla.

Eruption of the second permanent molars :

The final part of this phase of dental development occurs with eruption of the second permanent molars, usually at around 12 years of age. Eruption of these teeth is often associated with some reduction in arch length, which manifests as increased crowding, particularly of the lower incisors. If the second permanent molars erupt precociously before the premolar teeth, in the lower jaw especially, as their path of eruption is directed mesially and occlusally, this can result in a considerable arch length reduction and crowding of the second premolar tooth. Occasionally, there is a lack of space in the posterior regions of the maxillary and mandibular dental arches and the second molars can become impacted. The vertical dimension of the face increases which allows the heightening of the alveolar ridge. Space for maxillary and mandibular second molars is gained by bone remodeling in maxillary tuberosity and mandibular ramus.

4. Permanent dentition stage :

The permanent dentition stage of dental development starts after shedding of the last primary tooth and the eruption of all permanent teeth.

The permanent teeth tend to erupt in groups, and it is less important to know the most common eruption sequence than to know the expected timing of these eruption stages. The stages are used in the calculation of dental age, which is particularly important during the mixed dentition years. Dental age is determined from three characteristics. The first is which teeth have erupted. The second and third, which are closely related, are the amount of resorption of the roots of primary teeth and the amount of development of the permanent teeth.

Teeth usually emerge when three fourths of their roots are completed. Thus a signal that a tooth should be appearing in the mouth is root development approaching this level.

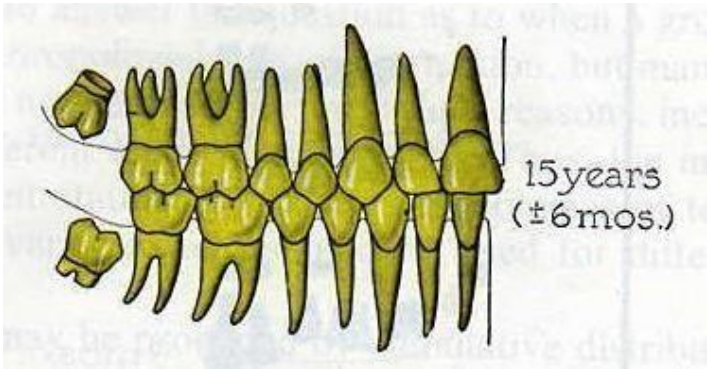
It takes 2 to 3 years for roots to be completed after a tooth has erupted into occlusion. Several reasonably normal variations in eruption sequence have clinical significance and should be recognized.

These are :

1. Eruption of second molars ahead of premolars in the mandibular arch,
2. Eruption of canines ahead of premolars in the maxillary arch, and
3. Asymmetries in eruption between the right and left sides.

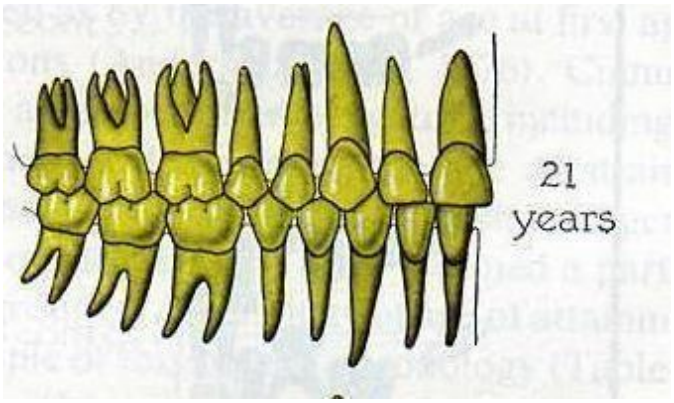
The Third Stage of Eruption

Dental ages 13, 14, and 15 are characterized by the extent of completion of the roots of permanent teeth. By dental age 15, if a third molar is going to form, it should be apparent on the radiographs, and the roots of all other permanent teeth should be complete.



Third Molar Eruption

Third molars show more variability in calcification and eruption than do any other teeth. The eight try to erupt between the age of 18- 24 years of age. The third molar shows high constancy with its own pattern of development; that is, early calcifying third molars erupt early and complete their roots early. The path of eruption of the 8s is nearly similar to the path of eruption of the 7s. The upper 8s developed at the postero-inferior position of the maxillary tuberosity, so, these teeth are subjected to a high amount of crowding in comparison with the 6s or 7s → due to the lack of space available for them. The lower third molar may be subjected to impaction due to lack of space, Impacted wisdom teeth are classified by the direction and depth of impaction, the amount of available space for tooth eruption and the amount soft tissue or bone (or both) that covers them. The classification structure allows clinicians to estimate the probabilities of impaction. These teeth may be absent congenitally due to etiological reasons since the human jaws tend to be reduced in size while, the size of teeth are remaining as it is.



Characteristics of Permanent Dentition :

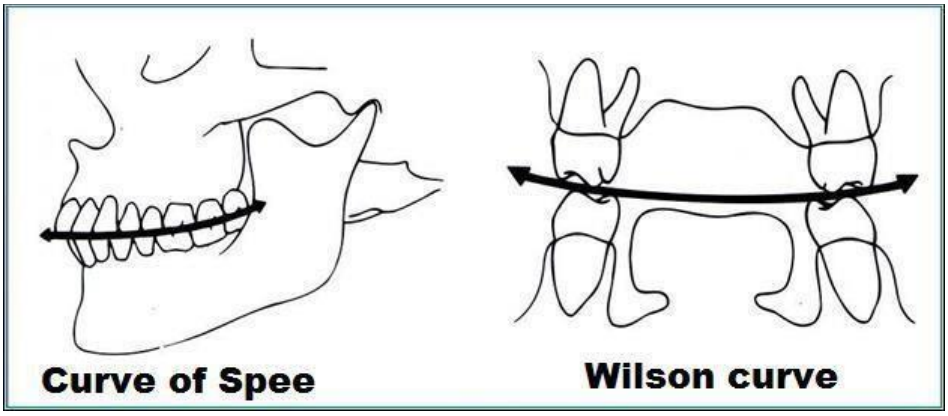
Some of the characteristics of the "normal" occlusion in the permanent dentition stage include the following:

1. **Overlap :** In a normally occluding dentition, the maxillary teeth are labial/buccal to the mandibular teeth.

2. **Angulations :** In the primary dentition stage the teeth are, in general, vertically positioned in the alveolar bone. On the other hand, in the permanent dentition stage the teeth have buccolingual inclination and mesiodistal angulations.

3. **Occlusion :** With the exception of the mandibular central incisors and the maxillary third molars, each permanent tooth occludes with two teeth from the opposite arch.

4. **Arch Curvatures :** The anteroposterior curvature in the mandibular arch is called the curve of Spee. The corresponding curve in the maxillary arch is called the compensating curve. The buccolingual curvature from the one side to the other is called the Wilson curve.



5. **Overbite and Overjet :** The normal Overbite & Overjet often ranges between 2.0 and 4.0 mm.

6. **Posterior Relationships :** The maxillary and mandibular molars are in a Class I occlusion (i.e., the mesiobuccal cusp of the maxillary first molar is in the buccal groove of the mandibular first molar).

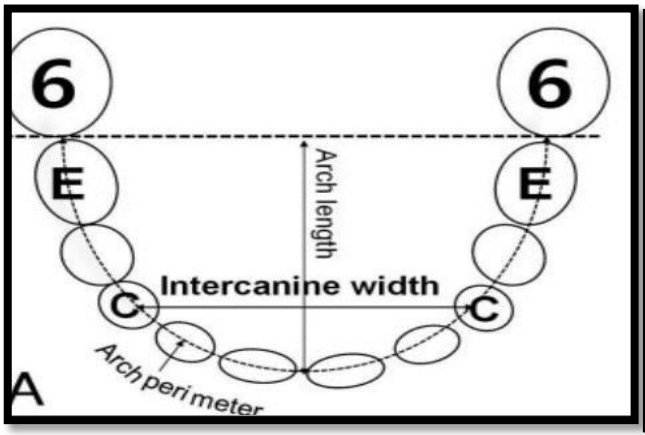
Development Of The Dental Arches :

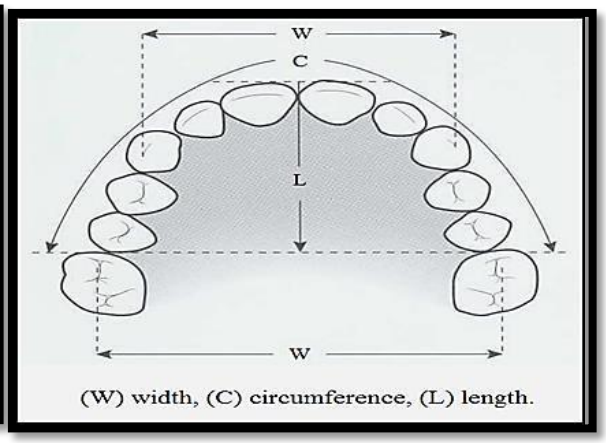
Inter-Canine Width : is measured across the cusps of the deciduous/ permanent canines and during the primary dentition an increase of around 1-2 mm is seen. In the mixed dentition an increase of about 3 mm occurs, but this growth is largely completed around a developmental stage of 9 years with some minimal increase up to age 13 years.

Arch Width : is measured across the arch between the buccal cusps of 1st molar posteriorly of one side to the same point on the opposite side. Between the ages of 3 and 18 years an increase of 2-3 mm occurs; however. For clinical purposes arch width is largely established in the mixed dentition.

Arch Length or Depth : is measured at the midline from a point midway between the central incisors to a tangent touching the distal surfaces of the second primary molars or second premolars.

Arch Circumference : is determined by measuring around the buccal cusps and incisal edges of the teeth to the distal aspect of the second deciduous molars or second premolars. On average, there is little change with age in the maxilla: however, in the mandible arch circumference decreases by about 4 mm because of the leeway space. In individuals with crowded mouths a greater reduction may be seen.





The reduction in mandibular arch circumference during the transitional and early adolescent dentition is the result of (1) the late mesial shift of the first permanent molars as the "leeway space" is pre-empted, (2) the mesial drifting tendency of the posterior teeth throughout all of life, (3) slight amounts of interproximal wear of the teeth, (4) the lingual positioning of the incisors as a result of the differential mandibulo-maxillary growth. I n summary, on the whole there is little change in the size of the arch anteriorly after the establishment of the primary dentition, except for an increase in intercanine width which results in a modification of arch shape. Growth posteriorly provides space for the permanent molars, and considerable appositional vertical growth occurs to maintain the relationship of the arches during vertical facial growth.