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RESEARCH ARTICLE

DEVELOPMENT OF OCCLUSION

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Abstract

There are several reasons why pediatric dentist should understand the development of dental occlusion. One of the major objectives of orthodontic treatment is to correct occlusal problems. Much of the need for this treatment could be avoided if children received the proper dental care at earlier ages. Development of occlusion is a genetically and environmentally conditioned process, which shows a great deal of individual variations, and consequently, for the development of an acceptable occlusion, quite a remarkable co-ordination of different events is necessary. The development of occlusion depends on a number of conditions, like muscular pressure, habits, availability of space, etc. This development is coincident with the growth of all tissues associated with the dental apparatus, including the nose, maxillary sinuses, facial bones and muscles. Failure in one part of the development process may lead to anomalies, or else may be compensated for by other developmental processes. Thus Proper care of the developing deciduous and permanent teeth, both at the dental office and at home, is important for the appropriate development of occlusion. and timely diagnosis followed by appropriate interception can prevent any developing malocclusion. This article is an overview which depicts (1) periods of development of occlusion, (2) outline the development of normal occlusion in the pediatric patient and (3) explain what occlusion of the teeth is and why it is important.

Introduction:-

The term occlusion is derived from the Latin word ‘occluso’ which is the relationship between all the components of the masticator system in normal function, dysfunction and parafunction.[1] An occlusion is the perfect interdigitation of the upper and lower teeth, which is a result of developmental process consisting of the three main events, jaw growth, tooth formation and eruption.

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An ideal occlusion is a hypothetical or theoretical concept based on the anatomy of the teeth and rarely found in nature. The concept is applied to a condition when the skeletal bases of maxilla and mandible are of the correct size relative to each other and the teeth should be in correct relationship in all three plane of space at rest.[2]

The interrelation between the teeth essentially becomes established in childhood, it continues to change to some extent throughout life. Thus, the occlusion is regarded as a dynamic rather than a static interrelation between the facial structures.

Development of occlusion is a genetically and environmentally conditioned process, which shows a great deal of individual variations, and consequently, for the development of an acceptable occlusion, quite a remarkable co-ordination of different events is necessary. Failure in one part of the development process may lead to anomalies, or else may be compensated for by other developmental processes.[3]

The development of occlusion depends on a number of conditions, like muscular pressure, habits, availability of space,etc. There are a number of factors which may interfere with a normal balance of muscular pressure on the dental apparatus. Among these are, excessive pressure in a particular area or direction by the tongue; abnormal respiration; sucking habits involving the tongue, cheeks, lip,thumb or fingers, pacifier, blanket, etc.

This development is coincident with the growth of all tissues associated with the dental apparatus, including the nose, maxillary sinuses, facial bones and muscles. If the development of the occlusion of the teeth is normal, we may confidently expect that the development of the entire lower half of the face will be normal. If malocclusion of the teeth exists, normal development of the associated tissues will be interfered with and the degree of the resulting deformity will be in direct relation to the type and severity of the malocclusion.[2]

Thus Proper care of the developing deciduous and permanent teeth, both at the dental office and at home, is important for the appropriate development of occlusion. and timely diagnosis followed by appropriate interception can prevent any developing malocclusion.

Keeping this in mind this library dissertation is a humble effort to review and illustrate various aspects of development of occlusion.

History

Much like Charles Darwin found out about the beaks of finches, different types of teeth have an evolutionary history as well, Just like all other anatomical features of human species. The teeth and jaws of humans are smaller that todays great apes. Investigations on fossils have also shown the evidence of a decrease in the size of the masticatory system in the hominins which are accepted to be the ancestors of Homo Sapiens over the past 2.5 to 5 million years. It was stated that this decrease was mostly due to the changes in the dietary habits of the species.[4] (figure 1)

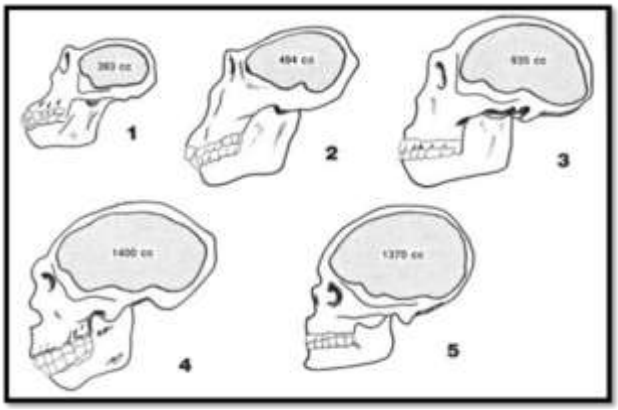

Figure 1:- Evolution of Hominds Jaw.

Incisors were probably procumbent at the time of eruption in the earliest and archaic hominins. However, the incisor teeth were relatively small and more vertical in the archaic megadont hominins and the genus Homo. This reduction

in the incisal size was combined with the enlargement of the premolars and molars.[4] Canine teeth are believed to be small in the earliest hominins and this reduction in size continues during the early period. Megadont archaic hominins present the greatest size reduction of the canines and the premolars are abnormally large in these taxa as reported by Wood and Stack. Hominin males generally have small canines, it is stated that, the higher the jaw joint, the smaller the canines are in males and generally, temporomandibular joint is high in the hominoids.

In the modern humans, the first molar teeth are the largest among the molars and the overall tooth size is reduced In the earliest hominins and archaic hominins, second molars were generally the largest of the molar teeth and the third molars were closer in size to the second molar. It is generally believed that the early hominins and archaic megadonts were small object feeders. Second premolars contribute more to the tooth row when the first molar/ third molar ratio is high and this is correlated to the canine tooth size. This might be due to the larger premolars extending the cheeks anteriorly reducing the size of the mouth slith.[5]

The occlusal plane in humans is often not horizontal. A helicoidal occlusal plane is an inclination of the teeth where the anterior cheek teeth show a plane sloping upward palatally while the more posterior teeth have a plane sloping upward buccally forming a twisted occlusal plane.

When the evolution of the mandibular condyle is evaluated, it was shown that the early hominins inherited a low and anteriorly placed joint from some ramamorph ancestor with a similarly placed joint point. In the ausralopitecine line, the joint remained forward but was raised. In the H.erectus group it was raised less and displaced backward. Neanderthals had a high ramus width, but they had widely different values of ramus height. In Homo sapiens the joint has moved forward, but it has maintained the same distribution of elevations as that for the Neanderthals. The mandibular condyles of hominoids occupy a restricted position in relation to the occlusal plane.[6](Figure 2)

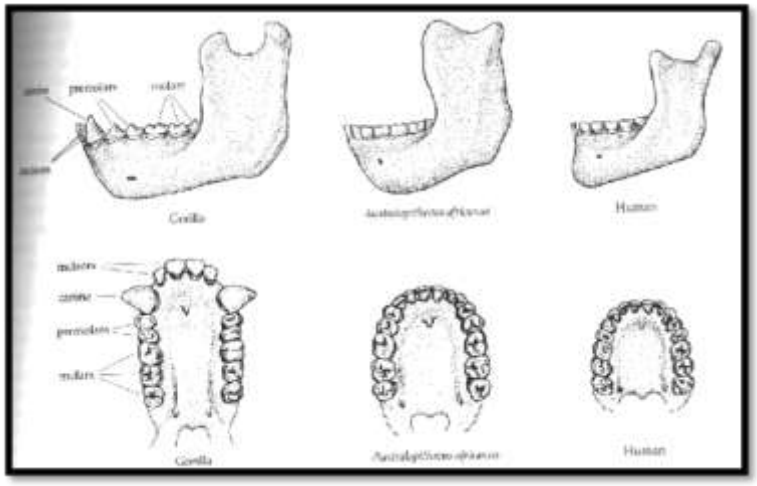

Figure 2:- Evolution of Human Jaw and Teeth.

19th-century orthodontists, who sought to decipher nature's grand plan for the arrangement of the dentition. "At a meeting of the Philadelphia Academy of Stomatology in 1898, Edward H. Angle proposed that orthodontics be based on the science of dental occlusion and offered a definition of normal occlusion as the ideal to be attained in the treatment of malocclusion.

The term malocclusion was coined by Edward Angle, the "father of modern orthodontics". as a derivative of occlusion. This refers to the manner in which opposing teeth meet (mal- + occlusion = "incorrect occlusion").

1n 1950 Massler and Savara have divided these teeth into two groups according to the time of eruption. They termed all teeth that are present at birth as natal teeth and those that erupt during the neonatal period (first 30 days of life) as neonatal teeth. And Hebbling in 1997 classified natal teeth into 4 types based on the time of eruption.
In 1950 Baume classified occlusion in primary dentition based on the relation of terminal plane into 3 types viz flush terminal plane, distal step, mesial step.

The terms Leeway space of Nance and Incisal Liability in mixed dentition are described by Nance in 1947 and by Warren Mayne in 1969 respectively.

The transient malocclusion termed Ugly Duckling stage (Broadbent phenomenon) described by Broadbent in 1957. In 1960 Nolla classified the stages of eruption of teeth known as "Nolla's stages of eruption".

In 1972 Lawrence F Andrews introduced six keys of normal occlusion. He had done 5 years of clinical trial from 1960-1964 for this.[7]

Development of occlusion was described under four periods. Pre dentate period, primary dentition, mixed dentition and permanent dentition.

I.Gum Pads Stage / Pre-Dental Period

This stage extends from birth until the eruption of the first primary tooth, around 6-7 months of age. The newly born baby mouth is usually devoid of teeth. The alveolar arches at this time period is called gum pads. Initially, these are smooth and firm but later get segmented corresponding to the sites of developing teeth (figure 3A and 3B). The basic form of the arches is determined in intrauterine life.[8]

Figure 3 :-Maxillary Gum Pad.

Figure 3 B:- Mandibular Gum Pad.

Maxillary Gum Pad (Figure 4A)

1. Shape of the arch: Horseshoe shaped
2. Extension of gum pads: Extend labially and buccally beyond those in the mandible.
3. Parts: a. Labiobuccal portion

Labio-Buccal Portion

1. Differentiates first and grows more rapidly.
2. Divided into 10 segments by grooves called *TRANSVERSE GROOVES.*
3. Each segment consist of one developing tooth sac.
4. The transverse groove between canine and 1st deciduous molar is called the *LATERAL SULCUS*. The labiobuccal and lingual parts are demarcated by the *DENTAL GROOVE*.

Lingual Portion

1. Differentiates later.
2. Remains relatively smooth.
3. The upper and lower gum pads are separated from the palate and the floor of the mouth respectively by a groove called *GINGIVAL GROOVE*

B. Mandibular gum pad (figure 4b).

1. Shape of the arch: U shaped
2. Anteriorly, the lower gum pad is everted.
3. The gum pad is divided into 10 segments by transverse grooves, which correspond to the deciduous tooth sac. The segments are less defined when compared to the maxillary gum pad.

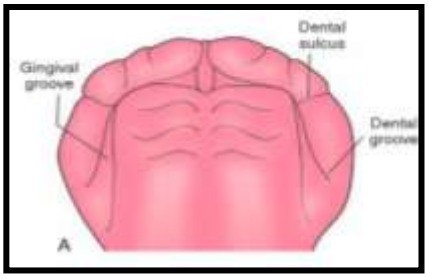

Figure 4 A:- Maxilla

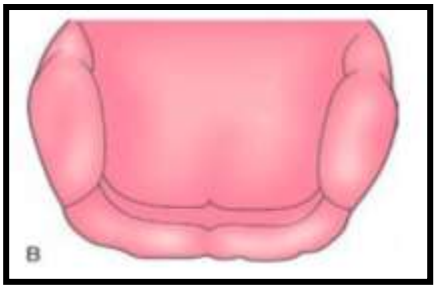

Figure 4 B:- Mandible

Relationship Between Upper And Lower Gum Pads (Figure 5)

The face and jaws in a newborn are positioned distally when compared to the adult position. With the initiation of function, a change in relationship occurs. Face and jaws grow forward, downward and laterally. The upper lip appears short and the tongue is interposed between the lips.[8]

Gum pad's relationship is arbitrary. They do not have a definite relationship.

1. The maxillary gum pad is wider than the mandibular gum pad, and there is total overlapping of maxillary gum pads anteriorly and posteriorly.
2. The lower lateral sulcus is usually distal to the upper lateral sulcus.
3. A vertical gap exists in between the upper and lower lip pads in the anterior region.
4. The gum pads grow rapidly during the first year of life, and the amount of growth is more in the transverse direction.
5. The length of the gum pad also increases, mostly posteriorly to accommodate the deciduous first and second molar.

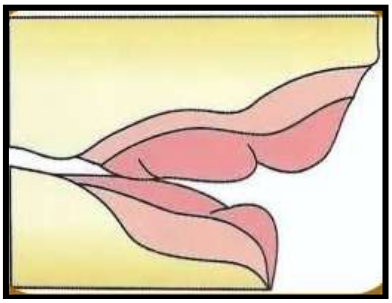

Fig. 5:- Relation between upper and lower gum pads at birth.

An infantile anterior open bite is seen at this time. The tongue is positioned in this space during suckling. This is called infantile swallowing. In this manner, the opposing surfaces of the pads provide for a more efficient way of squeezing milk during breastfeeding. This infantile open bite is transient and gets self-corrected with eruption of primary incisors.

Clinical Significance

Natal and Neonatal Teeth

Natal teeth are teeth present at birth, and "neonatal teeth" are teeth erupted within the first month of life. Premature eruption of a tooth at the time of birth or too early is combined with many misconceptions.

Terminology and Synonyms

Dentitia praecox, dens connatalis, congenital teeth, fetal teeth, infancy teeth, predeciduous teeth, and precocious dentition.

Incidence and Prevalence

The incidence of natal and neonatal teeth ranges from 1: 2000 to 1: 3500. More than 90% of natal and neonatal teeth are prematurely erupted deciduous series of teeth, whereas less than 10% are supernumerary.They most commonly occurs in the mandibularcentral incisors, followed by maxillary incisors, mandibular cuspids or molars, and maxillary cuspids or molars in descending order.

Multifactorial Etiology
Exact etiology of natal and neonatal teeth is not known. In the past, neonatal teeth were merely considered cysts of the dental lamina of the newborn.

Syndromes Associated
Few syndromes are reported to be associated with natal teeth and neonatal teeth. These syndromes include Ellis-Van Creveld, Rubinstein-Taybi, Steatocystoma Multiplex, Pierre-Robin, Cyclopia, Pallister-Hall, Short Rib-Polydactyly (type II), Wiedemann-Rautenstrauch (Neonatal Progeria), Cleft Lip and Palate, Pfeiffer, Ectodermal Dysplasia, Craniofacial Dysostosis, Multiple Steatocystoma, Sotos, Adrenogenital, Epidermolysis-Bullosa Simplex including Van der Woude, Down's Syndrome, and Walker-Warburg Syndromes.

Clinical Presentation
The natal teeth or neonatal teeth manifest usually with variable shape and size ranging from small, conical and may also resemble normal teeth. The appearance of these teeth is dependent on the degree of maturity, but most of the time they are loose, small, discoloured, and hypoplastic as in the cases presented here. They may show enamel hypoplasia/hypomineralization and a small root formation suggestive of an immature nature. The majority of natal teeth may exhibit a brown-yellowish-/whitish-opaque colour (Figure 6).

Figure 6:- Natal Teeth.

Complications
A major complication from natal/neonatal teeth is ulceration on the ventral surface of the tongue caused by the tooth's sharp incisal edge. This condition is also known as Riga-Fede disease or syndrome.

Eruption Cyst
An eruption cyst, or eruption hematoma, is a bluish swelling that occurs on the soft tissue over an erupting tooth. It is usually found in children and associated with both primary and permanent teeth. The fluid in the cyst is sometimes clear creating a pale-coloured cyst although often they are blue. An eruption cyst (eruption hematoma) is a developmental soft-tissue cyst of odontogenic origin that forms over an erupting tooth.[9](figure 7)

Figure 7:- Eruption cyst.

Histopathological features
The epithelial lining of eruption cyst is similar to that of the dentigerous cyst (non-keratinized stratified squamous epithelium), so the eruption cyst is considered a superficial dentigerous cyst.

Management
The cyst roof may be drained with its fluid to allow the tooth to erupt although most of them burst spontaneously.

Candida Albicans
Candidiasis is a yeast infection of the tongue and mouth. This common infection can be passed between a mother and baby during breastfeeding.[10](Figure 8)

Causes
1. Thrush occurs when too much of a yeast called **Candida albicans** grows in a baby's mouth.
2. Babies can also get a yeast infection on the diaper area at the same time. The yeast gets in the baby's stool and can cause a diaper rash.

Symptoms
Symptoms of thrush in the baby include:
1. White, velvety sores in the mouth and on the tongue
2. Wiping the sores may cause bleeding
3. Redness in the mouth
4. Diaper rash
5. Refusing to nurse because of soreness

Figure 8:- Candidiasis in newborn.

Symptoms of thrush in the mother include
1. Deep-pink, cracked, and sore nipples.
2. Tenderness and pain during and after nursing .

Treatment
1. Your baby might not need any treatment. Thrush often goes away on its own in a few days.
2. Your provider may prescribe antifungal medicine to treat thrush.
3. If you have a yeast infection on your nipples, your provider may recommend an over-the-counter or prescription antifungal cream.

Prognosis
Thrush in babies is very common and can easily be treated. But, let your provider know if thrush keeps coming back. It may be a sign of another health issue.

Prevention
1. If you bottle feed your baby, clean and sterilize all equipment, including nipples.
2. Clean and sterilize pacifiers and other toys that go in baby's mouth.
3. Change diapers often to help prevent yeast from causing diaper rash.

Primary Dentition Period

The primary dentition stage extends from the time of eruption of the primary teeth until the eruption of the first permanent tooth around 6 years of age. Initiation of primary tooth buds occurs during the first 6 weeks of intra-uterine life. The first tooth which erupts in oral cavity is usually mandibular central incisor and it erupts around 6 months after birth and by 3 years of age the eruption of deciduous teeth is usually completed. From 3 to 4 years of age, the dental arch is relatively stable and changes very slightly but from 5 to 6 years of age, there will be alteration of size of the dental arch due to the eruptive force of the first permanent molar.

The factors that control primary teeth calcification include genetic factors, developmental variability and sexual dimorphism. Eruption of primary tooth starts after the beginning of formation of roots. The normal sequence of eruption of primary teeth as follows: central incisors, lateral incisors, first molars, canines and second molars.

Characteristics Of Primary Dentition Stage

Spaces In Primary Dentition

Spacing in the upper and lower anterior segments is usual and desirable to accommodate the larger permanent teeth. Baume divided the primary dentition into two parts, i.e. spaced and non-spaced. He also concluded that primary spacing occurs around 70% in maxilla and 63% in mandible.[11]

Joshi and Makhija found out that more amounts of primary teeth spacing in males than in females.[12]

Primate Spaces

They are the most common space present in primary dentition in both maxillary and mandibular arches. It is also called simian space or anthropoid spacebecause it is seen in monkeys. Primate space is present between the mesial to the primary canine in the maxilla and distal to the primary canine in the mandible (Figure 9).[8] Primate space are used in the early mesial shift.

Figure 9:- Primate Spaces.

Physiologic Space

The other spaces in primary dentition are called developmental spaces, which are also known as physiological spaces and is present in between all the primary teeth and play an important role in normal development of the permanent dentition (Figure 10). The total space may vary from 0 to 8 mm with the average 4 mm in the maxillary arch and 1 to 7 mm with the average of 3 mm in the mandibular arch. All these spaces are important for the normal development of the permanent dentition.[13]

Figure 10:- Physiologic Space.

Non Spaced Dentition

it is also called closed dentition. Primary teeth without any spaces in between teeth are called closed dentition. Closed dentition invariably leads to crowding in the permanent dentition.(Figure 11)

Figure 23:- Non-spaced Dentition.

Occlusal Relationship Of The Second Primary Molars

The primary dentition is complete after the eruption of 2nd primary molars which indicates the location for eruption of future permanent dentition has been already determine at this stage. The relation of the distal surface of maxillary and mandibular second primary molar is one of the most important factor that influence the future occlusion of the permanent dentition.[13] The terminal plane can be classified into three types (figure 12);

Flush terminal plane
Mesial step
Distal step

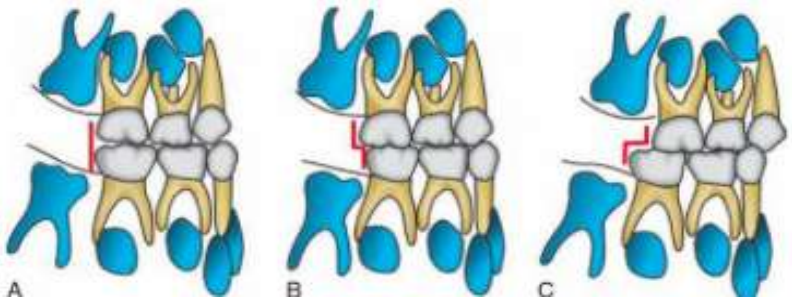

Figure 12:- Types of terminal planes.

Flush or vertical plane

In this plane the distal surfaces of the upper and lower teeth are flush i.e. they are situated on the same vertical plane. It is usually most favourable relationship to guide the permanent molars into class I relationship (Figure 13).

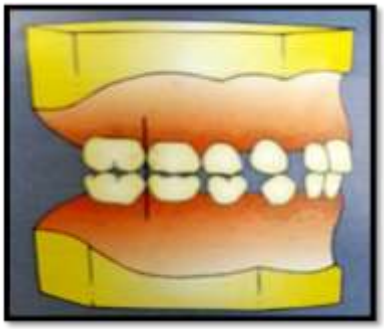

Figure 13:- Flush Terminal Plane.

Mesial step

The distal surface of the deciduous lower 2nd molar is more mesial to that of the upper 2nd molar (Figure 14). Invariably, this guides the permanent molars into a class I relationship. However, a few can proceed into half cusp class III during molar transition and further into full class III relationship with continued mandibular growth.

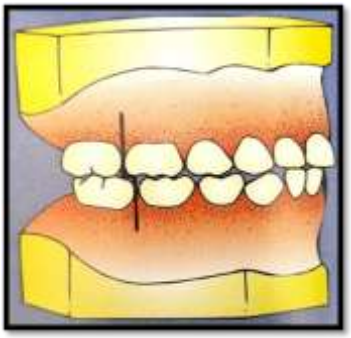

Figure 14:- Mesial Step.

Distal step

The distal surface of the lower primary 2nd molar is more distal to that of the upper 2nd molar (Figure 15). This relationship is unfavourable as it guides the permanent molars into distal occlusion or class II relationship.

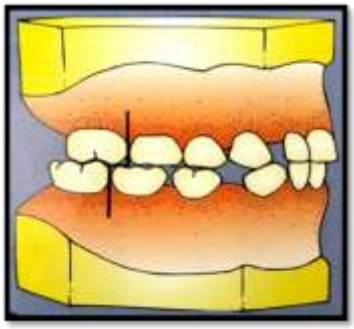

Figure 15:- Distal Step.

Among Indian children, the flush or vertical plane is most common type. This classification resembles the Angle's Class I for the inter-occlusal relation between the upper and lower first permanent molars. This relationship is used to forecast the inter-occlusal relation of the erupting first permanent molars in the future.

Mixed Dentition Period

This stage begins at approximately 6 years of age with the eruption of the 1st permanent molar. During the mixed dentition period, the deciduous teeth along with some permanent teeth are present in the oral cavity.

The mixed dentition period can be classified into three phases;

1. First transitional period
2. Inter-transition period
3. The second transition period

First Transition Stage

First permanent molar is the key to the permanent occlusion of the teeth as it plays important role in the establishment and function of the occlusion of the permanent dentition.

1. Pathway of eruption of the first molars
2. Establishment of occlusion of the first permanent molars
3. The exchange of incisors

Pathway Of Eruption Of The First Molars (Figure 16)

The tooth germ of the maxillary first permanent molar develops in the maxillary tuberosity and its occlusal surface is usually oriented downwards and backwards. The tooth germ of the mandibular first permanent molar is usually located at the corner of the mandibular gonian with its occlusal surface facing upwards and forwards. As soon as first permanent molar erupts into the oral cavity, it comes in contact with the distal surface of the second primary

molar. However, its location during this period is not stable until the final interocclusal relation has been established.[8]

Figure 16:- Pathway of eruption of first molar.

Mandibular molars position and relation is dependent on the relation of 2nd deciduous molars. If the 2nd deciduous molar is in flush terminal plane, then the erupting permanent molar will also be in the same relation. For this, to change into class I relation the molar has to move 2 to 3 mm in a forward direction[8], this is accomplished by;

Early Mesial Shift

the eruptive forces of 1st permanent molars are strong enough to push the deciduous molars forward in the arch thereby utilizing the primates spaces and thus establishing class I relationship (Figure 17).

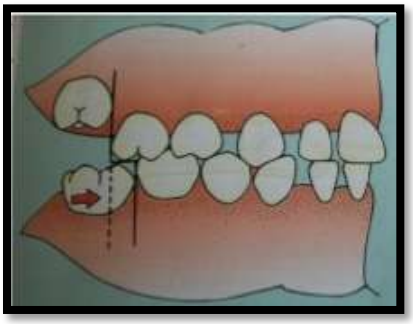

Figure 17:- Early mesial shift.

Late mesial shift

many children lack primate spaces and have a nonspaced dentition and thus erupting permanent molars are not able to establish class I relation even as they erupt (Figure 18). In these cases, the molars establish class I relation by drifting mesially and utilizing the leeway space after exfoliation of deciduous molars and this is called late mesial shift.

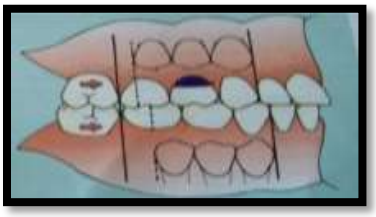

Figure 18:- Late mesial shift.

Establishment Of Occlusion Of The First Permanent Molars (Figure 19)

The way of occluding of first molars may be predicted to some extent at the primary dentition stage. The relationship between the types of terminal plane and the early occlusion of the first molar when they just erupted are as follows;[13]

Vertical plane type
If the dental spaces existed in the primary dental arch, the first molars will erupt into Class I occlusion. If not, then they will erupt into a cusp-to-cusp occlusion.

Mesial step type
The first molars erupt directly into Angle's Class I occlusion.

Distal step type:
The first molars erupt directly and definitively into Angle's Class II occlusion.

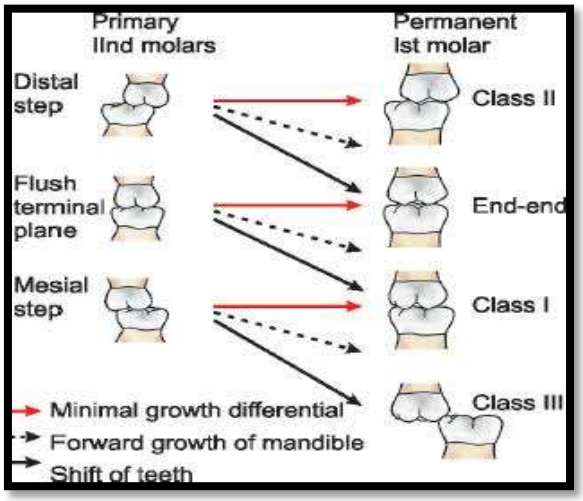

Figure 19:- Establishment of occlusion of the first permanent molars.

According to Nance (1947) the extra space obtained at the exchange of the lateral teeth, known as the leeway space, is the factor which determines whether the molars move into Class I after the adjustment of cusp-to-cusp occlusion by the first molars.

The Exchange Of Incisors
Before and after the eruption of 1st molars, the primary incisors begin to exchange with the permanent incisors (Figure 20).The total sum of the mesio-distal width of the four permanent incisors is larger than that of the primary incisors. This difference between the amount of space needed for accommodation of the incisors and the amount of space available is called incisal liability, which is about 7mm for maxilla and 5mm for mandible.[8]

Figure 20:- Exchange of incisors.

Arrangement of incisors will also influence whether or not the canines and premolars are arranged normally in the next stage i.e. 2nd transitional stage. The regulatory factors controlling the arrangement of the four permanent incisors can be summarized according to the following five stages.

1. Interdental spaces in the primary incisor region,
2. Increase of inter-canine width,

3. Increase of anterior length in the dental arch,
4. Change of tooth axis of incisors,
5. Ugly duckling stage

Inter- Transitional Period

In this period the maxillary and mandibular arches consist of sets of deciduous and permanent teeth. Between the permanent incisors and the first permanent molars are the deciduous molars and canines (Figure 21). This phase during the mixed dentition period is relatively stable and no change occurs.

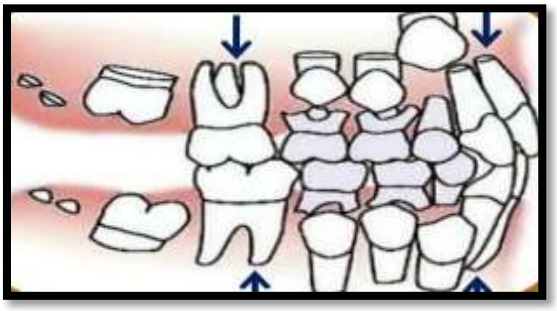

Figure 21:- Inter transitional period.

The Second Transitional Period

The second transitional period is characterized by the replacement of the deciduous molars and canines by the premolars and permanent cuspids respectively(figure 22).

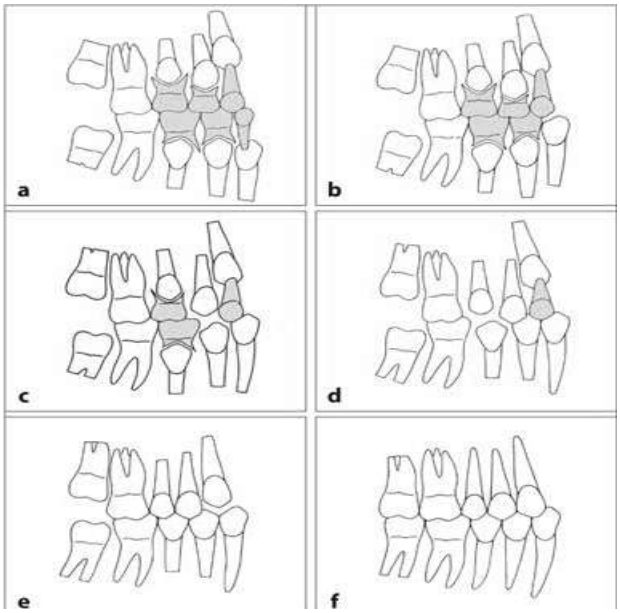

Figure 22:- Second transition period.

Exchange Of Canines And Premolars

For smooth exchange of lateral teeth the following conditions are important.

Leeway space

The sum of the mesio-distal widths of the permanent lateral teeth is generally smaller than that of the primary lateral teeth by about 1.8mm in maxilla and about 3.4mm in the mandible(Figure 23). This difference is called leeway space which is one of the important factors for smooth exchange of lateral teeth.

E- space : the dimension of deciduous 2nd molars is more than that of 2nd premolars, this excess space is called as E-space.

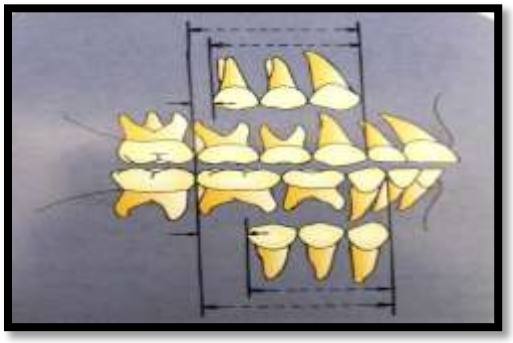

Figure 23:- Leeway Space of Nance.

Order of exchange of the lateral teeth

It takes about one and a half years to complete the exchange of all the lateral teeth. The most common sequence of eruption in the maxilla is 4-3-5 and in case of mandible the most common sequence is 3-4-5. As mentioned earlier, because the permanent canine is larger than the primary canine, crowding is very common immediately after the exchange of canines.[28]

Eruption Of The 2nd Permanent Molar

After completion of the lateral teeth and the dental arch is up to the establishment of 1st molar, the 2nd permanent molars will start erupting. With the eruption of the 2nd permanent molar the arch circumference may become shorter than that of the primary dental arch by the utilization of leeway space with the exchange of 2nd primary molar to the 2nd premolar. Proximal carious lesions or the early extraction of the 2nd primary molar will cause further loss of dental arch space. Sufficient surveillance will be needed during the eruption 2nd molar. If this is neglected, malocclusion will result in the permanent dentition.[13]

The Permanent Dentition Period

The permanent dentition forms within jaws soon after birth, except for the cusps of the 1st permanent molars, which form before birth. The permanent incisors develop lingual or palatal to the deciduous incisors and move labially as they erupt. The premolars develop below the diverging roots of the deciduous molars. The eruption sequence of the permanent dentition may exhibit variation. The frequently seen sequences in the maxillary arch are 6-1-2-4-3-5-7 or 6-1-2-3-4-5-7 and for mandible arch the sequence are 6-1-2-3-4-5-7 or 6-1-2-4-3-5-7[13.15].

Local factors affecting the exchange of teeth

Dental caries of the primary teeth

A reduction in the mesio-distal width of the tooth crown by dental caries, retained primary tooth roots and premature exfoliation or extraction of primary teeth can cause mesial movement of the adjacent tooth. In general, the amount of space lost tends to be larger at an earlier age. The most conspicuous space loss usually occurs in the first 6 months of the loss of primary teeth[14].

A periapical lesion of the primary tooth can cause abnormality in the direction of eruption and timing of eruption of a succedaneous tooth.

Factors related to dental abnormalies.[8]

1. Eruption of the permanent tooth is easily affected by the existence of a supernumerary tooth and odontoma.
2. Congenital missing teeth,will cause a reduction in the circumference of the primary dental arch.
3. Morphological abnormalities of the teeth, e.g. fused teeth, may cause abnormalities in the size and shape of the dental arch as well as in occlusal relationships.

Factors related to the permanent teeth

1. The impaction of a permanent tooth which can be induced by abnormality in location or tooth axis of the tooth germ may be associated with the prolonged retention of the primary tooth, resulting in adverse changes in the developing dental arch.

2. An ectopic eruption of the first molar may cause an unusual resorption of the roots of a second primary molar and quite commonly early exfoliation of that tooth.
3. The early loss of permanent tooth, e.g. the loss of first permanent molar due to dental caries or the loss of the permanent incisor(s) by traumatic injury may result in the reduction of the dental arch circumference.

Occlusal Curvatures And Axial Positions

1. Curve of spee
2. Curve of wilson
3. Sphere of monson
4. CURVE OF SPEE(Figure 24)

The curve of Spee (COS) was first described by Spee in 1890.[13]

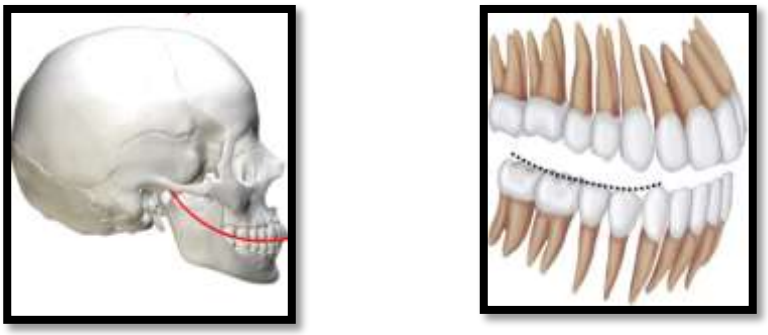

Figure 24:- Curve of Spee.

According to the glossary of prosthodontic terms, 1994 curve of spee, was defined as the anatomical curve established by the occlusal alignment of the teeth, as projected onto the median plane, beginning with the cusp tip of the mandibular canine and following the buccal cusp tips of the premolar and molar teeth, continuing through the anterior border of the mandibular ramus and ending at the anterior aspect of the mandibular condyle.[16] The curvature of the arc would relate, on average, to part of a circle with a 4-inch radius.

Development of curve of spee

Factors affecting the development of curve of Spee.[17]

Dental factors

Dental eruption timing, craniofacial variation, and neuromuscular factors.

Dentition stage

The occlusal plane is flat in the complete deciduous dentition. During the transition into mixed dentition, increases largely with the eruption of the central incisors and first permanent molars, and finally reaches a maximum with the eruption of the permanent second molars where it remains stable throughout adolescence and into adulthood.

Malocclusion

Curve of Spee is the most severe in Class II division 2 subjects, followed by Class II division 1 subjects, then Class I subjects, with the least amount of depth is detected in Class III subject.[18]

Curve of Wilson

The curve, viewed from the front, that contacts the buccal and lingual cusps of the molars, being lower in the middle due to the lingual inclination of the long axes of the mandibular molars.[19] (Figure 25). Named after Dr. George H. Wilson, who first described the curve in 1911.[20]

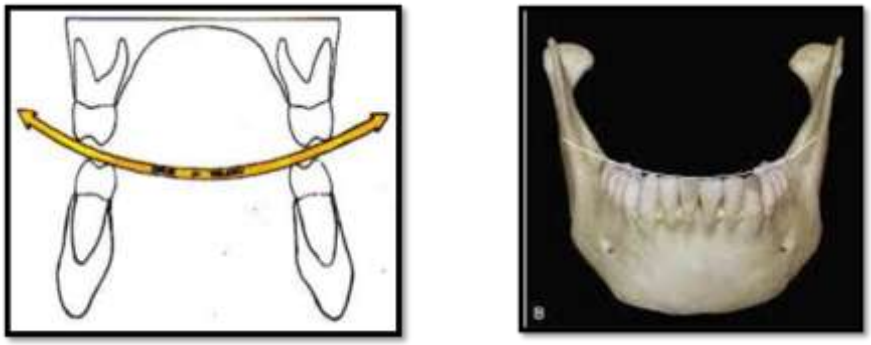

Figure 25:- Curve of Wilson.

Purpose of this arc in occlusal curvature is to complement paths of condyles during movements of mandible.

Sphere of Monson

An ideal curve of occlusion in which each cusp and incisal edge touches the surface of an imaginary sphere 8 inches in diameter (Figure 26). Proposed by Dr. George S. Monson in 1920.[13]

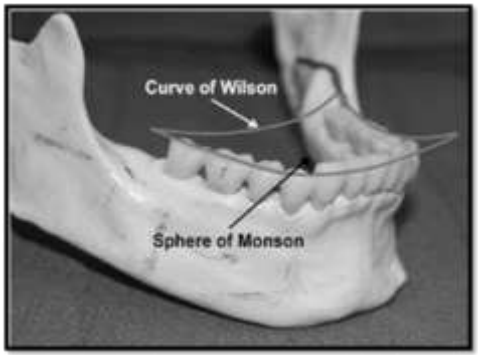

Figure 26:- Sphere of Monson.

Sphere of monsoon is a three dimensional curvature of the occlusal plane, which is the combination of the Curve of Spee and the Curve of Wilson. This curvature is in form of a portion of a ball, or sphere and is concave for mandibular arch & convex for the maxillary arch.

Conclusion:-

An ideal occlusion is the perfect interdigitation of the upper and lower teeth, which is a result of developmental process consisting of the three main events, jaw growth, tooth formation and eruption.To develop a functional occlusion it became necessary for the teeth and bones to develop synchronously.

Occlusal development can be divided into the following development periods: Neo-natal period, Primary dentition period, Mixed dentition period and Permanent dentition period.

The primary dentition will start to erupt in the first year of life and will be established by the end of the third. The permanent dentition is heralded by eruption of the first molars at around 6 years of age and is completed in most cases, by the appearance of the third molars in the late teenage years.

At birth, the maxillary dental arch is characteristically horseshoe-shaped whereas the mandibular arch assumes a wider U-shape. The mucous membrane of both the maxilla and mandible is thickened in the newborn infant to produce gum pads, which cover the alveolar processes containing the developing primary teeth. Occasionally a child is born with teeth already present or that undergo precocious eruption within the oral cavity like Natal teeth are present at birth, Neonatal teeth erupt within the first month of life and Pre-erupted teeth appear within the second and third months of life.

Mixed dentition stage starts when the first permanent tooth appears in the mouth, usually at five or six years with the first permanent molar, and lasts until the last primary tooth is lost, usually at ten, eleven, or twelve years. Since there are no premolars in the primary dentition, the primary molars are replaced by permanent premolars. if any primary teeth are shed or lost before permanent teeth are ready to replace them, some posterior teeth may drift forward and cause space to be lost in the mouth. This may cause crowding and/or misplacement once the permanent teeth erupt, which is usually referred to as malocclusion. Orthodontics may be required in such circumstances for an individual to achieve a functioning and aesthetic dentition.

The permanent dentition begins when the last primary tooth is lost, usually at 11 to 12 years, and lasts for the rest of a person's life or until all of the teeth are lost (Edentulism). Occlusion involves the relationship of the teeth in centric occlusion, in centric relation, and even during function, and because all this, requires neuromuscular coordination, occlusion should also involve an understanding of the neuromuscular systems, it is the responsibility of we 'pedodontists' to have an adequate knowledge on these subjects, to help us differentiate abnormal from normal, before initiating therapy.

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