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RESEARCH ARTICLE

DEVELOPMENT OF DENTITION

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Abstract

Knowledge of the normal development of the dentition and an ability to detect deviation from the normal are essential prerequisites for orthodontic diagnosis and a treatment plan. Dentition means a set of teeth, teeth in the dental arch are used to designate the natural teeth in position in their alveoli.

Introduction:-

Knowledge of the normal development of the dentition and an ability to detect deviation from the normal are essential prerequisites for orthodontic diagnosis and a treatment plan.

Dentition means a set of teeth, teeth in the dental arch are used to designate the natural teeth in position in their alveoli.

Development of Tooth

The tooth development proceeds into 3 stages.

1. Bud stage,
2. Cap stage and
3. Bell stage.

Bud Stage

The epithelium of DL is separated from ectomesenchyme by a basement membrane. On differentiation of DL, round/ovoid swelling arise from the basement membrane, which are the primordia of tooth bud and enamel organ.

There are about 10 such round to ovoid swelling both in maxillary and mandibular arches. The enamel organ, the tooth buds consists of peripherally located low columnar cells and centrally located polygonal cells. These cells, which are surrounding the mesenchyme, undergo mitosis, due to increased mitotic activity and migration of neural crest cells into the area of the ectomesenchymal cells, condensation of the ectomesenchymal cells occur surrounding the tooth bud. This area of condensation, which is immediately subjacent of the enamel organ, is *'dental papilla'*. While the condensed ectomesenchymal cells surrounding tooth bud and dental papilla is *'dental sac'*.

The dental papilla forms tooth pulp and dentin whilst dental sac forms cementum and periodontal ligament.

Cap Stage

As tooth buds continue to proliferate, there is shallow invagination on deep surface that marks the onset of cap stage. The peripheral cells of the cap stage are cuboidal covering the convexity of cap and are called outer enamel epithelium. Whilst cells in the concavity, which are tall columnar are called inner enamel epithelium. The outer and inner enamel epitheliums are separated from dental sac and dental papilla respectively by basement membrane.

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Bell Stage
Continued growth of the tooth germ leads to the next stage of tooth development, the bell stage so called because the dental organ comes to resemble a bell as the undersurface of the epithelial cap deepens.
Four different types of epithelial cells can be distinguished in this stage,
1. the inner enamel epithelium,
2. the stellate reticulum,
3. the stratum intermedium, and
4. the outer enamel epithelium.

Dental Lamina
In all of the teeth, except the permanent molars, the dental lamina proliferates at its deep end to give rise to the enamel organs of the permanent teeth.

Dental Papilla
The dental papilla is enclosed in the invaginated portion of the enamel organ. Before the inner enamel epithelium begins to produce enamel, the peripheral cells of the mesenchymal dental papilla differentiate into odontoblasts under the organizing influence of the epithelium. First, they assume a cuboidal form; later they assume a columnar form and acquire the specific potential to produce dentin. The basement membrane that separates the enamel organ and the dental papilla just prior to dentin formation is called the membrana preformativa (which forms later CEJ).

Dental Sac
The dental sac shows a circular arrangement of its fibers and resembles a capsular structure. With the development of the root, the fibers of the dental sac differentiate into the periodontal fibers that become embedded in the developing cementum and alveolar bone.

Advanced Bell Stage
During the advanced bell stage, the boundary between inner enamel epithelium and odontoblasts outlines the future dentinoenamel junction. In addition, the cervical portion of the enamel organ gives rise to the epithelial root sheath of Hertwig.

Root Formation
The development of the roots begins after enamel and dentin formation has reached the future cementoenamel junction. The enamel organ plays an important part in root development by forming Hertwig's epithelial root sheath, which molds the shape of the roots and initiates radicular dentin formation. Hertwig's root sheath consists of the outer and inner enamel epithelium only.

Development of Occlusion
Development of occlusion is a genetically and environmentally conditioned process that 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 developmental process may lead to anomalies, or else may be compensated for by other developmental process.

The development of occlusion may be divided into 4 periods;
1. Period from birth to the complete eruption of the deciduous teeth (birth to 2 1/2 years),
2. Period from the completion of the deciduous dentition to the eruption of the 1st permanent molar (2 1/2 to 6 years),
3. Period from eruption of 1st permanent molar to the final shedding of the deciduous teeth (6 to 12 years) and
4. The period from the eruption of the second permanent molars at about 12 years onwards.

Period from Birth to the Complete Eruption of the Deciduous Teeth
At birth the alveolar arches, also called gum pads, are horseshoe shaped in the maxilla and U-shaped in the mandible. They are firm and pink in colour. These gum pads develop in two parts, Labio buccal portion- that differentiates first and grow more rapidly, Lingual portion- that differentiates later. The two portions of gum pads are separated from each other by a groove called the dental groove.

The gum pads are divided by 10 transverse grooves that represent the future deciduous teeth as their tooth sacs,

which are papillomatous at first. Of these grooves those between the canines and first molars segment are of importance as they help in assessing the relationship of the gum pads to each other; they are called lateral sulci, and these are the only ones to extend on the buccal side. Normally the mandibular arch is more distal to that of the maxillary arch.

The sequence of deciduous teeth eruption is A B D C E.
By two and a half years of age the deciduous dentition is usually complete and in full function.

Self-correcting malocclusion
Retrognathic mandible
Corrects with differential and forward growth of the mandible.

Anterior open bite
Eruption of primary incisors

Infantile swallowing pattern
During the first year of life with introduction of solid foods in diet.

Period from the completion of the deciduous dentition to the eruption of the 1st permanent molar
By three years of age the roots of all the deciduous teeth are complete. First permanent molar crowns are fully developed and the roots are starting to form. The crypts of the developing permanent second molars are now definite and can be seen in the space formerly occupied by the developing first permanent molars. Although calcification is proceeding in the developing permanent successors, little shift can be noted in the position of these teeth at this time with the exception of the first permanent molars.

Spacing
Spacing in the deciduous dentition occurs between all the teeth as they erupt or subsequently as they erupt.

Spaced dentition is supposed to be good as spaces in between the teeth can be utilized for adjustment of permanent successors, which are always larger in size compared to the deciduous teeth. These spaces present are of two types:
1. Physiologic/developmental spaces and
2. Primate/simian/anthropoid spaces

Physiologic/developmental spaces are present in between the primary teeth and play an important role in normal development of the permanent dentition. The total space present varies 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.

Primate/simian/anthropoid spaces are very prominent spaces present in the primate species and in human they exist between the upper lateral incisors and the canines (present mesial to maxillary deciduous canines) and lower canines and first deciduous molars (present distal to mandibular deciduous canines). Given by Buame in 1950.

Canine relationship: The relationship of the maxillary and mandibular deciduous canines is one of the most stable in primary dentition. It is classified as class I when mandibular canine interdigitates in embrasure between the maxillary lateral and canine and class II where mandibular canine interdigitates distal to embrasure.

Non-spaced dentitions in deciduous teeth are present without any spaces in between the teeth. This lack of space maybe due to the narrowness of the dental arches or teeth are wider than usual. This type of dentition usually indicates to crowding in developing permanent dentition, but it is not always the case. It may depend on the individual's growth of the jaws.

According to Leighton B.C (1971), the chances of crowding in permanent dentition is 100% when there is crowding in the deciduous dentition.

Primary molar relationship
The relationship of the distal surface of the maxillary and mandibular second primary molars is, one of the key factors that influence the future occlusion of the permanent dentition. The mandibular second molar being somewhat

wider mesiodistally, gives rise, typically, to a flush terminal plane at the end of the primary dentition. As the distal surface of the second primary molars guides the first permanent molars into occlusion, it is important to know how the upper and lower deciduous molars are related to each other. The mesio-distal relation between the distal surface of the upper and lower second primary molars usually can be classified into the three types:

1. Flush terminal or vertical plane type:
2. Mesial step type:
3. Distal step type:

Flush terminal or vertical plane type

The distal surfaces of the upper and lower teeth are in a straight plane (flush) and therefore situated on the same vertical plane. Usually it is a favourable relationship to guide the permanent molars.

Mesial step type

The distal surface of the lower molar is more mesial to that of the upper. Invariably it is favourable to guide the permanent molars into a class I relationship.

Distal step type

The distal surface of the lower molar is more distal to that of the upper. This relationship is prognostically unfavourable as it guides the permanent molars into distal occlusion.

Self correcting malocclusion

1. Anterior deep bite
2. Eruption of deciduous molars
3. Attrition of incisal edges
4. Forward and downward growth of mandible

Flush Terminal Plan

(Early shift) Eruption of the first permanent molar
(Late shift) Leeway space

Spacing

Eruption of first permanent molar

Period from eruption of 1st permanent molar to the final shedding of the deciduous teeth

This is the period during which both the primary and permanent teeth are in the mouth together, so also called period of mixed dentition. The permanent teeth erupting in place of previous deciduous teeth are the successional teeth, whereas those erupting posteriorly to the primary teeth are called the accessional teeth.

Nolla's Stages of Tooth Calcification

Nolla divided the development of each tooth into 10 stages, as
0 - absences of crypt,
1 - presences of crypt,
2 - initial calcification,
3 - 1/3rd of crown completed,
4 - 2/3rd of crown completed,
5 - crown almost completed.
6 - crown completed,
7 - 1/3rd root completed,
8 - 2/3rd root completed,
9 - root almost completed, open apex and
10 - apical end of the root completed.

Of these stages the important stages are:

1. Stage2 wherein there is initial calcification,
2. Stage 6 the time most teeth begin eruptive movements,
3. Stage 8 wherein the teeth pierce the alveolar crest.

The important aspects of the mixed dentition are utilization of the arch perimeter which is used for alignment of the permanent incisors and in the adaptive occlusal changes that occur during the transition from one dentition to the other.

Phases of Mixed Dentition can be Divided into Three Period
The first transitional period
1. emergence of the first permanent molars
2. incisors transition
3. establishment of occlusion

Inter-transitional period
1. containing both sets of dentition
2. four permanent incisors, left and right first permanent molars
3. deciduous canines and deciduous first and second molars

Second transitional period
1. Emergence of bicuspids, cuspids and the second permanent molars.
2. Establishment of occlusion

The First Transitional Period (fig. 3.15)
By the time of first permanent molars erupts any initial spaces between the deciduous molars and canines will generally have diminished or disappeared.

In both the jaws, the first permanent molars erupt more or less in a perpendicular orientation to the occlusal plane. They originate one above the other in the ramus and come downward with the maxillary permanent molars being accommodated by additions at the tuberosity.

Ideally, the eruption of the permanent molars into a class I relationship is desired, since the flush terminal relationship is more common in deciduous dentition, it is more common for the permanent molars to erupt into an end-to-end relationship.

The desired class I relationship is established by the following ways:

Early mesial shift
If the deciduous dentition is spaced dentition with flush terminal relationship of second deciduous molars, the eruptive force of the permanent molars causes a closing of any existing spaces between the primary molars or primate spaces effectively causing a decrease in arch length.

Late mesial shift
When no spaces exist, the erupting first permanent molar is not able to close spaces. In these cases when the primary molar exfoliates the permanent molar migrates mesially to use up the "Leeway space" (the difference between the mesiodistal width of the primary canine, first and second molars and their permanent successors). This averages 1.8 mm in the maxilla and 3.4 mm in the mandible.

Primary molar guidance of permanent dentition
The primary second molar relationship can give clues to the eventual permanent molar relationship. If the deciduous arches terminate in a mesial step, the permanent molars may erupt directly into a normal, angle class I occlusion (meaning that the mandibular first molar is half a cusp mesial to its antagonist), in few cases it may develop into class III relationship. A definite distal step guides the molars into distal relationship, which generally does not improves with age, instead deteriorates.

Favourable variations in the size ratio between the primary and permanent teeth
Labial Inclination
When the permanent incisors erupt, they assume a somewhat more anteriorly inclined position (labial inclination) than the deciduous incisors. This position of the incisors averages 2.3 mm and results in an increase in inter-canine arch length of approximately 3 mm without any change in inter-canine width. This makes another characteristic

difference in tooth axis. The interincisal angle between the maxillary and mandibular incisors is about 150^0 in primary dentition, whereas it is about 123^0 in permanent dentition which makes permanent dental arch circumference wider.

Incisal Liability
The permanent incisors are usually larger in total width than the primary incisors they replace this difference is called *'incisal liability'*. This is corrected by the utilization of the developmental spaces, apart from which the labial inclination also help to adjust the accommodation. At the time of eruption of lateral incisors the deciduous canines are pushed laterally, which help in accommodating of the permanent central and lateral incisors.

The sum of the mesio-distal width of the permanent lateral incisors is generally smaller than of the primary lateral incisors by about 1mm in the maxilla and 3mm in the mandible. This carries out the smooth exchange of the lateral incisors.

Leeway Space
Permanent canine, premolars are usually smaller in total width than primary canine and molar they replace this difference is called *'Leeway space'* by Nance. This averages 1.8 mm in the maxilla and 3.4 mm in the mandible.

The Leeway space, in addition to providing space for the permanent canine, also allows the permanent molars to move mesially when the deciduous molars are replaced with the mesio-distally smaller premolars. Moreover, the fact that the Leeway space is greater in the mandible than in the maxilla and facilitates a greater mesial movement of the lower permanent molars in relation to the upper ones, which consequently results in a change from a possible cusp-to cusp molar relationship to a normal molar interrelation.

'E' space
The deciduous 2nd molars are usually have larger total width than the successor, the permanent 2nd premolars, this space difference is called E space.

Ugly Duckling Stage
This is the stage occurs when there is a transitional mal-alignment during the exchange period of the upper anterior teeth. In the upper arch when the permanent incisors erupt, these appear much larger compared with the primary teeth with their longitudinal axes-flared out like as an inverse 'V'. This is because of the pressure of erupting permanent canines in the developing roots of lateral incisors, the crowns of erupting incisors flare more laterally producing diastema.

This is also called as Broadbent phenomenon, who gave about this in 1941. This phenomenon is self-correcting and normally, the incisors gradually straighten with the eruption of the lateral incisors and canines, as the pressure is transferred from the roots to the crown of the incisors.

Inter Transitional Period
In the inter-transitional period, which lasts about 1.5 years, asymmetry in emergence and associated differences in height levels and lengths of clinical crowns of the corresponding left and right teeth, are made up.

Under the influence of the tongue, the mandibular lateral incisors attain the proper sites within the dental arch and their initial lingual location is eliminated.

Small rotations are corrected by the pressure exerted by the tongue and lips if the spatial conditions in the dental arches permit these movements.

There is wearing of deciduous teeth with attrition of the cusp tips and occlusal morphology approaching that of a plane.

The antero-posterior relation between 2 jaws is not fixed in occlusion. A fixed intercusp relationship is absent. No interferences from the occlusal contacts are present so the mandibular teeth attain a slightly more mesial position.

Second Transitional Period
At around 9 to 10 years of age, the second transitional period starts with shedding of the primary posterior teeth. The alignment of the erupting permanent teeth depends a lot on the order of exchange of the lateral teeth which takes about 1 1/2 years to complete the exchange of all the lateral teeth.

In the permanent dentition, the overbite and overjet decrease throughout the second decade of life probably due to relatively greater forward growth of the mandible.

Self Correcting Malocclusion
Anterior Deep Bite
Proprioceptive response condition of patient with the eruption of first permanent molars and premature contact of the pad of tissue overlying them as natural bite opener).

Mandible Anterior Crowding
Tongue pressure, Increase in inter-canine width

Ugly Duckling Stage
Maxillary canine eruption

End-on relation
With eruption of first permanent molars, late mesial shift in non spaced dentition

The period from the eruption of the second permanent molars at about 12 years onwards:
The permanent dentition is considered when all the permanent teeth (all 28 teeth) are seen in the dental arches, often by the age of 12 to 14 years of age. The established interrelationship between permanent dental arches is by no means the final step in occlusal development. After the occlusion of the dentition has been established fairly minor changes related to teeth take place in sagittal, transverse and vertical interrelationship.

1. Horizontal overbite decreases
2. Dental arches become shorter due to proximal wear and often crowding develops in mandibular incisor region by 14 years of age.
3. Vertical overbite decreases upto the age of 18 years by 0.5 mm.
4. The alveolar process may grow in height beyond 16 years of age.
5. Overjet decreases by 0.7mm between 12 and 20years of age. Individual variations are considerable. The increase in the dental arches is generally not continuous.

Self correcting malocclusion
Overjet and overbite
Decreases with eruption of all permanent molars Differential growth of mandible.

Conclusion:-

The knowledge of development of teeth is essential rather basic for any orthodontist as such to start. As this helps in knowing the chronology of the dentition, various self correcting malocclusion, anomalies.

This helps not only come to proper diagnosis but also helps to plan out for the various other treatment modalities available.

References:-

1. Sillman J.H.,: A serial study on occlusion from birth to three years. AJO-DO; 207 - 227,1940.
2. Sillman J.H.,: dimensional changes of dental arches: longitudinal studies from birth to 25 years. AJO-DO; 50: 824-842,1964.
3. Sillman J.H.,: a serial study of good occlusion from birth to 12 years: longitudinal studies from birth to 12 years. AJO-DO., 37: 481,1951
3. Dent. Practnr dent. 1971 21: 359-372.] Leighton B. C.
4. Broadbent, B. H.: Ontogenetic Development of Occlusion, Angle Orthodontist, 11: 223-241, 1941
5. Moorrees , C. F. A., and Chadha, J.M.,: Available space for the incisors during dental development. Angle

orthodontist., 35;12-22, 1965.
6. Baume, L J : Physiological tooth migration and its significances for the development of occlusion. J Dent. Res. 29: 123, 331-338, 1950.