Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 1 / Dr. Suhair W. Abbood

- Eruption of Teeth :-

*** Paediatric Dentistry :-**

- An age-defined specialty that provides both primary and comprehensive preventive and therapeutic oral health care for infants and children through adolescence, including those with special health care needs.

Paedodontics *:-* is a branch of dentistry that is concerned with the dental care of children its origin came from a Greek wards (paedo - child + odous, odont - 'tooth').

*** Eruption of Teeth :-**

- This process can be defined as the movement of the tooth through the tissues of the jaw towards occlusion into the oral cavity. The formation and eruption of teeth are two essential processes which may be influenced by :-

1. Genetic factors 2. Environmental factors 3. Hormonal factors

Dentition :-

*** Primary**

E D C B A	A B C D E
E D C B A	A B C D E

*** Permanent**

8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8
8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8

* Each tooth starts to move toward occlusion at approximately the time of crown completion, and the interval from crown completion and the beginning of eruption until the tooth is in full occlusion is approximately 5years for permanent teeth.

**** Pattern of tooth movement :-***

- A considerable movements are required to bring the teeth to the occlusal plane and then into functional occlusion.

**** Types of tooth movements :-***

1. Pre- eruptive tooth movement :- includes all movements of the deciduous and permanent tooth germs within the tissues of the jaw, from the time of early initiation and formation to the time of crown completion and this phase terminates with the initiation of root development, during this phase the growing tooth moves in two directions to maintain its position in the expanding jaws (outward and upward in the mandible and outward and downward in the maxilla).

- Bodily movement :- it occurs continuously as the jaw grows by which the movement of the entire tooth germ cause bone resorption at the direction of tooth movement and bone apposition behind it.

- Eccentric movement :- one part of the tooth germ remains fixed while the rest continues to grow causing a shift in the center of the tooth germ.

***The root elongates when the crown does not increase in size.**

2. Eruptive tooth movement :- it is the axial movement of the tooth from its crypt within the bone of the jaw to its functional position in occlusion (to occlude with its antagonist).

3. Post eruptive tooth movement :- it occurs primarily to maintain the position of the erupted tooth while the jaw continues to grow and to compensate for the occlusal and proximal wear. This movement occur in axial direction.

**** Theories of tooth eruption :-***

1. Root formation :- It was believed that root formation is an obvious cause of tooth eruption because it causes an overall increase in length of the tooth that must be accommodated by the growth of the root into the bone, an increase in jaw height or by the occlusal movement of the crown (eruption). Root growth theory suggested the presence of the cushion hammock ligament at the base of the socket that transmits the force to cause eruption but the ligament was never found histologically.

2. Bone remodeling :- An inherent growth pattern of the maxilla and mandible supposedly moves teeth by selective deposition and resorption of bone. This theory is not accepted. Bone resorption and formation occurred because of eruptive forces applied by tooth over the bone (there are some animal studies showed that bony remodeling occurs around the dental follicle regardless of the presence of a tooth).

3. Vascular pressure :- The Vascular Pressure theory supposes that a local increase in tissue fluid or blood pressure in the periapical region is sufficient to move the tooth (States that ‘’ the tissue

pressure apical to the erupting tooth was greater that occlusally, theoretically generating an erupting force ‘’). It means that the hydrostatic pressure on top of the tooth is less than hydrostatic pressure underneath the tooth. This difference in pressure will push the tooth occlusally.
* However, since surgical excision of the growing root and associated tissues eliminates the periapical vasculature without stopping eruption, this means that the local vessels absolutely are not necessary for tooth eruption.

4. Periodontal ligament :- Eruptive force resides in the dental follicle-periodontal ligament complex. Formation and renewal of the PDL has been considered a factor in tooth eruption because of the traction power that fibroblasts have which may pull the tooth out during eruption.

‘’ The periodontal ligament, which is derived from the dental follicle provide the force required for eruption mainly by fibroblasts contraction’’

*****However**,** in vitro tissue studies have limitations concerning this theory.

5. Dental follicle theory :- It is clear that the dental follicle is essential to achieve the bony remodeling required to accommodate tooth movement, for it is from this tissue that the osteoblasts differentiate.

Note :- Studies have shown that the reduced dental epithelium initiates a cascade of intercellular signals that recruit osteoclasts to the follicle. By providing a signal and chemoattractant for osteoclasts, it is possible that the dental follicle can initiate bone remodeling which goes with tooth eruption. Teeth eruption is delayed or absent in animals models and human diseases that cause a defect in osteoclast differentiation

***Summery :-**

**** Root Formation Theory ;-***

- Depend on the idea that root elongation is the motive force behind tooth eruption. **But,**
- **Rootless teeth can erupt**
- **Teeth still erupt after completion of root formation**
- **Some teeth erupt a greater distance more than the total length of their root**

**** Bone Remodeling Theory :-***

- Depend on the idea that bone remodeling that achieved by osteoclast and osteoblast around an erupting tooth are the motive force behind tooth eruption. **But,**
- **Bone formation occurs after the tooth has been moved**
- **THUS it is a result, not a cause of this process**

**** PDL traction Theory :-***

- Depend on the idea that migration and traction of PDL fibroblasts are the motive force behind tooth eruption.

*** Tooth movement is brought about by :-**

1) Fibroblast contractile properties.

2) Connection with extracellular collagen fibers fibro-nexus (imp. in transmitting traction to the extracellular matrix)
3) Oblique alignment of PDL collagen fibers. **But,**

- **Rootless teeth can erupt**
- **Impacted teeth with a well-developed PDL cannot erupt**

**** Vascular Pressure Theory :-***

- Depend on the idea that vascular tissue hydrostatic pressure within the PDL is the motive force behind tooth eruption. **But,**

- Eruption can also occur independently of the vascular alteration

*** So** What actually happens when the tooth is erupting, there are certain genes codes certain proteins binds to certain cells of the dental follicle stimulating these follicle to differentiate into osteoclasts and osteoblasts where bone resorption and bone apposition occurs on both surfaces of the tooth occlusal and apical, this actually will cause the tooth to erupt. ***Therefore,*** the dental follicle is mainly responsible for the process of eruption.

*** Development of Teeth :-**

- Tooth development or odontogenesis is the complex process by which teeth form from embryonic cells, grow, and erupt into the mouth (starts as early as 28 days of IUL and continues to the end of eruption of permanent molars). For human teeth to have a healthy oral environment, all parts of the tooth must develop during appropriate stages of fetal development.
- Primary (baby) teeth start to form between the sixth and eighth week of prenatal development, and permanent teeth begin to form in the twentieth week. If teeth do not start to develop at or near these times, they will not develop at all, resulting in hypodontia or anodontia. Development of teeth passes through the following stages :-

A. Development in the prenatal period :- in this period three overlapping phases occur :-

1. Beginning of the deciduous dentition development :- The development of teeth starts at 3rd week of IUL, then the odontogenic epithelium proliferates in the 5th week to form the dental lamina which form invaginations that develop into tooth buds.

2. The formation of the successional lamina :- It is the lingual extension of the dental lamina develops in the 5th months of IUL (permanent central incisor) to 10th months of age (2nd premolar).

3. Initiation of the permanent dentition :- It is initiated in the 4th month of IUL.

B. Status of development at birth :- the teeth are in different stages of development at birth.

C. Development in the postnatal period :- it shows completion of the crowns of all primary teeth and initiation of root formation. The permanent teeth continue to develop in different stages till their root formation is completed.

**** Life cycle of the tooth :-***

* A number of physiological changes take place in the progressive development of teeth :-

1. Growth :-

a) Initiation (bud stage) :- first stage of tooth development occurs around 6-7 weeks IUL. One of the earliest signs in the formation of a tooth that can be seen microscopically is the distinction between the vestibular lamina and the dental lamina. The dental lamina connects the developing tooth bud to the epithelial layer of the mouth for a significant time.

- In this phase the location of teeth are established with the appearance of tooth germs (tooth buds) in both jaws (mandible and maxilla) to form primary teeth.

b) Proliferation (cup stage) :- second stage of development known as the cap stage. It results from cellular division and multiplication of cells. As a result of unequal growth in the different parts of the bud, a cap is formed. A shallow invagination appears on the deep surface of the bud. The peripheral cells of the cap later form the outer and inner enamel epithelium.

* As with a deficiency in initiation, a deficiency in proliferation results in failure of the tooth germ to develop and in less than the normal number of teeth. Excessive proliferation of cells may result in epithelial rests. If the cells become more fully differentiated or detached from the enamel organ, they produce enamel and dentin, which results in an odontoma or a supernumerary tooth. The degree of differentiation of the cells determines whether a cyst, an odontoma, or a supernumerary tooth develops.

c) Histodifferentiation :- The epithelium continues to invaginate and deepen until the enamel organ takes on the shape of a bell, during this stage there is a differentiation of the cells of the dental papilla into odontoblasts and of the cells of the inner enamel epithelium into ameloblasts. Histodifferentiation marks the end of the proliferative stage as the cells lose their capacity to multiply.

- This stage is the forerunner of appositional activity. Disturbances in the differentiation of the formative cells of the tooth germ result in abnormal structure of the dentin or enamel. One clinical example of the failure of ameloblasts to differentiate properly is amelogenesis imperfecta. The failure of the odontoblasts to differentiate properly, with the resultant abnormal dentin structure, results in the clinical entity dentinogenesis imperfecta.

d) Morphodifferentiation :- At this stage, the shape of the teeth is determined. The formative cells are arranged to outline the form and size of the tooth. This process occurs before matrix deposition. The morphologic pattern of the tooth becomes established when the inner enamel epithelium is arranged so that the boundary between it and the odontoblasts outlines the future dentinoenamel junction.

- Disturbances and aberrations in morphodifferentiation lead to abnormal forms and sizes of teeth. Resulting conditions include peg-shape laterals, microdontia, macrodontia, dens evaginatus, dens invaginatus), other types of microdontia, and macrodontia.

e) Apposition :- appositional growth is the result of a layer-like deposition of a nonvital extracellular secretion in the form of a tissue matrix. This matrix is deposited by the formative cells, ameloblasts, and odontoblasts, which line up along the future dentinoenamel and dentino-cemental junction at the stage of morphodifferentiation. These cells deposit the enamel and dentin matrix according to a definite pattern and at a definite rate.

- Any systemic disturbance or local trauma that injures the ameloblasts during enamel formation can cause an interruption or an arrest in matrix apposition, which results in enamel hypoplasia. Hypoplasia of the dentin is less common than enamel hypoplasia and occurs only after severe systemic disturbances.

f) Calcification :- This process starts between 14 and 16 weeks of intrauterine life for primary teeth. Calcification (mineralization) takes place following matrix deposition and involves the precipitation of inorganic calcium salts within the deposited matrix.

- The process begins with the precipitation of a small nidus, and further precipitation occurs around it. The original nidus increases in size by the addition of concentric laminations. There is an eventual approximation and fusion of these individual calcospherites into a homogeneously mineralized layer of tissue matrix.

* Notes :-

- It begins in cusp tips and incisal edges of teeth and continues cervically.
- Very sensitive process that takes place over a long period.
- If the calcification process is disturbed, there is a lack of fusion of the calcospherites. These deficiencies are not readily identified in the enamel, but in the dentin, they are evident microscopically and are referred to as interglobular dentin.
- Any disturbances during the period of pregnancy as early as 14 or 16 weeks in utero might results in disturbances or anomalies in child's teeth as soon as the primary teeth erupt.

2. Eruption :-

- Includes two processes intrabony phase and intra oral phase. They take 5 years to be completed. The tooth emerge when ¾ its root formation has occurred. The tooth usually reaches the occlusal plane before its root development is completed, the teeth of girls erupt earlier than that of boys. When the tooth is not fully formed its root shape is funnel shaped.

3. Attrition :-

A physiological process characterized by wearing of a tooth during tooth - to - tooth contact as in mastication. The surfaces involved are incisal, occlusal and proximal. Basically, attrition is an aging process and it continues throughout the life.

**** Influence of Premature Loss pf Primary Molars on Eruption Time of their Successors :-***

1. In children who lose primary molars at 4 or 5 years of age and before eruption of the premolar teeth will be delayed.

2. If extraction of the primary molars occurs after the age of 5 years, there is a decrease in the delay of premolar eruption.
3. At 8, 9, and 10 years of age, premolar eruption resulting from premature loss of primary teeth is greatly accelerated.
- Premature loss of teeth associated with systemic disease usually results from some change in the immune system or connective tissue. The most common of these conditions appears to be hypophosphatasia and early-onset periodontitis.

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- Eruption of Teeth :-

**** Tooth numbering system :-***

1. Zsigmondy- palmer system ;-

- The Hungarian dentist Adolf Zsigmondy discovered this system in 1861, using a Zsigmondy cross to record quadrants of tooth positions. Adult teeth were numbered 1 to 8, and the child primary dentition (also called deciduous, milk or baby teeth) were depicted with a quadrant grid using Roman numerals I, II, III, IV, V to number the teeth from the midline. Palmer changed this to A, B, C, D, E. This makes it less confusing and less prone to errors in interpretation.
- The Palmer notation consists of a symbol (┘ └ ┐ ┌) designating in which quadrant the tooth is found and a number indicating the position from the midline. Adult teeth are numbered 1 to 8, with deciduous (baby) teeth indicated by a letter A to E. Hence the left and right maxillary central incisor would have the same number, "1", but the right one would have the symbol, "┘ ", underneath it, while the left one would have, " └".

87654321 | 12345678
87654321 | 12345678

EDCBA | ABCDE
EDCBA | ABCDE

*** Advantages :-**

1) Easy to implement.

2) Easy of writing and communication.

3) Less mistakes in identifying the designated tooth.

*** Disadvantages :-**

1) Cannot be written by the computer**.**

2) Non-numeric symbolization.

2. Universal numbering system :-

- This tooth numbering system was proposed by German dentist Julius Parredidt in 1882. Although it is named the "universal numbering system", it is also called the "American system" as it is commonly used in the United States. The uppercase letters A through T are used for primary teeth and the numbers 1 - 32 are used for permanent teeth.
- The tooth designated "1" is the maxillary right third molar ("wisdom tooth") and the count continues along the upper teeth to the left side. Then the count begins at the mandibular left third molar, designated number 17, and continues along the bottom teeth to the right side. Each tooth has a unique number or letter, allowing for easier use on keyboards. As specific numbers are employed for each tooth, it reduces the risk of mistake. Data can also be easily entered in the computer.

*** Advantages :-**

1. Individual number for each tooth**.**
2. Simple

*** Disadvantages :-**

1. Difficult in remembering the tooth no.
2. Matching the specific teeth and quadrants can be confusing.

3. There is no anatomic reference in this system and so it is difficult to follow for the beginners, and needs extra training to practice.

Permanent Teeth															
Upper Right								Upper Left							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Lower Right								Lower Left							

Primary teeth									
Upper Right					Upper Left				
A	B	C	D	E	F	G	H	I	J
T	S	R	Q	P	O	N	M	L	K
Lower Right					Lower Left				

3. International numbering system

- The Federation Dentaire International (FDI) system is a two-digit system, the first digit indicates the quadrant (1 through 4 for permanent and 5 through 8 for deciduous teeth) and the second digit indicates the tooth type (1 through 8 or 1 through 5). It is very simple, accurate, it is easy to memorize in the visual and cognitive sense, it is user friendly, and prevents errors in differentiating left and right, upper and lower arches, and tooth type. However, in the case of

deciduous teeth, there can be confusion and it is difficult to memorize. For specialists other than paedodontists, it can be difficult to understand or to define teeth, as in the case for example of 64, 85.

Upper Right					Upper Left				
55	54	53	52	51	61	62	63	64	65
85	84	83	82	81	71	72	73	74	75
Lower Right					Lower Left				

- For primary teeth

Upper Right								Upper Left							
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Lower Right								Lower Left							

- For permanent teeth

*This system makes the visual, cognitive and computer sense.

*** Advantages :-**

- Easy to remember and understand
- Unique number for each tooth
- Verbal communication is possible
- Compatible with computer keyboard
- Hence most accepted.

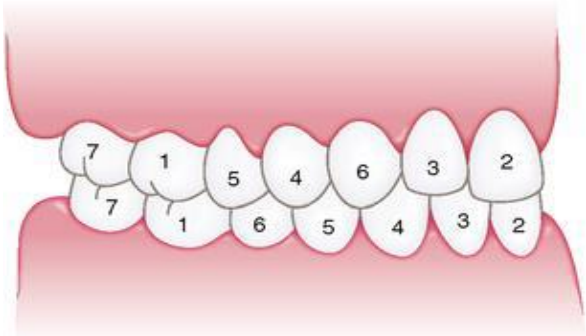
*** Sequence of eruption :-**

- For primary teeth :-

ABDCE
ABDCE

- For permanent teeth :-

61245378
61234578



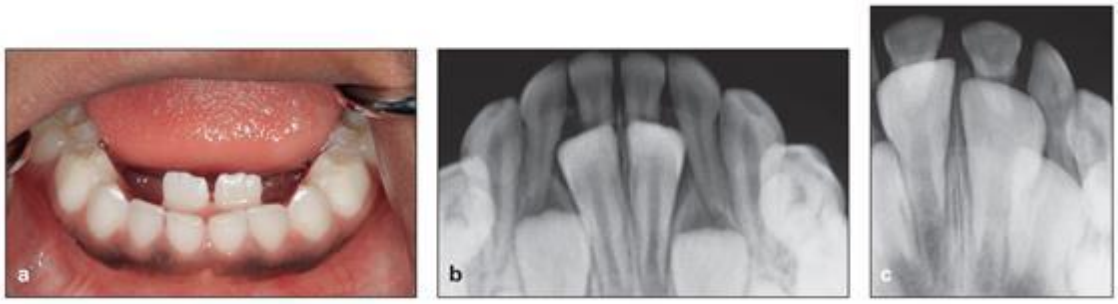
*** Variations in Sequence of Eruption :-**

- The mandibular first permanent molars are often the first permanent teeth to erupt. The mandibular central incisors quickly follow them. Then lateral incisor, canine, first premolar, second premolar, and second molar (the most common sequence of eruption of mandibular permanent teeth), while the most common sequence for the eruption of the maxillary permanent teeth is first molar, central incisor, lateral incisor, first premolar, second premolar, canine, and second molar.
- It is desirable that the mandibular canine erupt before the first and second premolars. This sequence aids in :- **1.** Maintaining adequate arch length and **2.** Preventing lingual tipping of the incisors, which not only causes a loss of arch length but also allows an increased overbite to develop.
- An abnormal lip musculature or an oral habit that causes a greater force on the mandibular incisors than can be compensated for by the tongue allows the anterior segment to collapse. For this reason, use of a passive lingual arch appliance is often indicated when the primary canines have been lost prematurely or when the sequence of eruption is undesirable.
- A deficiency in arch length can occur if the mandibular second permanent molar develops and erupts before the second premolar. Eruption of the second permanent molar first encourages mesial migration or tipping of the first permanent molar and encroachment on the space needed for the second premolar.
- In the maxillary arch, the first premolar ideally should erupt before the second premolar, and the canine should follow them. The untimely loss of primary molars in the maxillary arch, which allows the first permanent molar to drift and tip mesially, results in the permanent canine is being blocked out of the arch, usually to the labial side.
- The position of the developing second permanent molar in the maxillary arch and its relationship to the first permanent molar should be given special attention. Its eruption before the premolars and canine can cause a loss of arch length, just as in the mandibular arch. The eruption of the maxillary canine is often delayed because of an abnormal position or deviations in the eruption path.

*** Lingual Eruption of Mandibular Permanent Incisors :-**

- The primary teeth may have undergone extensive root resorption and may be held only by soft tissues. In other instances, the roots may not have undergone normal resorption and the teeth remain solidly in place. It is common for mandibular permanent incisors to erupt lingually, and this pattern should be considered essentially normal.
- The tongue and continued alveolar growth seem to play important roles in influencing the permanent incisors into a more normal position with time. Although there may be insufficient room in the arch for the newly erupted permanent tooth, its position will improve over several months. In some cases there is justification for removal of the corresponding primary tooth.

- Extraction of other primary teeth in the area is not recommended, however, because it will only temporarily relieve the crowding and may even contribute to the development of a more severe arch length inadequacy.
- Even when mandibular permanent incisors erupt uneventfully, they often appear rotated and staggered in position. The molding action of the tongue and the lips improves their relationship within a few months.



*** Teething and Difficult Eruption :-**

1) Increase in salivation, the child will want to put the hand and fingers into the mouth—these observations may be the only indication that the teeth will soon erupt.

2) The young child may become restless and fretful during the time of eruption of the primary teeth. He may loss his appetite.

3) In the past, many conditions, including croup, diarrhea, fever, convulsions, primary herpetic gingivostomatitis, and even death have been incorrectly attributed to eruption. Because the eruption of teeth is a normal physiologic process, the association with fever and systemic disturbances is not justified. A fever or respiratory tract infection during this time should be considered coincidental to the eruption process rather than related to it.

4) Inflammation of the gingival tissues before complete emergence of the crown may cause a temporary painful condition that subsides within a few days. The surgical removal of the tissue covering the tooth to facilitate eruption is not indicated.

* If the child is having extreme difficulty and to relief pain use :-

a) A nonirritating topical anesthetic may bring temporary relief. The parent can apply the anesthetic to the affected tissue over the erupting tooth three or four times a day.

b) Several low-dose products specifically formulated for infants are available without prescription. Caution must be exercised, however, when one is prescribing topical anesthetics, especially for infants, because systemic absorption of the anesthetic agent is rapid, and toxic doses can occur if the product is misused. The parent must clearly understand the importance of using the drug only as directed.

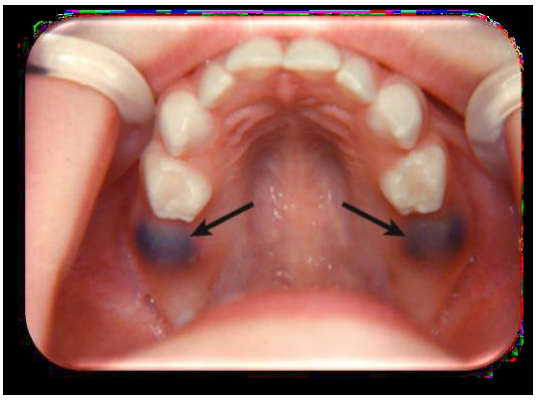
c) The eruption process may be hastened if the child is allowed to chew on a piece of toast or a clean teething object.

*** Interval of rest :-**

- It is the largest time between eruptions of two successive permanent teeth

2 | 2 and 4 | 4 1.5 year

*** Eruption Hematoma (Eruption Cyst) :-**



- An eruption hematoma is a bluish-purple elevated area of tissue occasionally develops a few weeks before the eruption of a primary or permanent tooth. It may result from trauma to the area during function and then hemorrhage in the follicle of an erupted tooth and it will subside after eruption after breakage of the soft tissue by the tooth.
- The blood-filled cyst is most frequently seen in the primary second molar or the first permanent molar region (6 and E). Because the condition is almost always self-limiting, treatment of an eruption hematoma is rarely necessary. However, surgical uncovering of the crown may occasionally be justified. When the parents discover an eruption hematoma, they may fear that the child has a serious disease such as a malignant tumor. The dentist must be understanding and sensitive to their anxiety while reassuring them that the lesion is not serious.

*** Eruption Sequestrum :-**

- The eruption sequestrum is occasionally seen in children at the time of the eruption of the first permanent molar (6). Clinically it is appear as a tiny spicule of nonviable bone overlying the crown of an erupting permanent molar just before or immediately after the emergence of the tips of the cusps through the oral mucosa.
- It is composed of dentin and cementum as well as a cementum-like material formed within the follicle. Eruption sequestra are usually of little or no clinical significance.

- It is probable that some of these sequestra spontaneously resolve without noticeable symptoms. However, after an eruption sequestrum has surfaced through the mucosa, it may easily be removed if it is causing local irritation. The base of the sequestrum is often still well embedded in gingival tissue when it is discovered, and application of a topical anesthetic or infiltration of a few drops of a local anesthetic may be necessary to avoid discomfort during removal.

*** Ectopic Eruption :-**

- A variety of local factors may influence a tooth to erupt or try to erupt in an abnormal position such as arch length inadequacy and tooth mass redundancy. Occasionally this condition may be so severe that actual transposition of teeth takes place.
- First permanent molars may be positioned too far mesially in their eruption path, with resultant ectopic resorption of the distal root of the second primary molar.

- There are two types of ectopic eruption - reversible and irreversible.

* In the reversible type, the molar frees itself from the ectopic position and erupts into normal alignment, with the second primary molar remaining in position **<u>while</u>**

* In the irreversible type, the maxillary first molar remains unerupted and in contact with the cervical root area of the second primary molar. By the ages of 7 and 8 years, any ectopic eruption of a permanent first molar should be considered irreversibly locked. The ectopic molar often occurred in more than one quadrant and was most often observed in the maxilla.

- Irreversible ectopic molars that remain locked, if untreated, can lead to premature loss of the primary second molar with a resultant decrease in quadrant arch length, asymmetric shifting of the upper first molar toward Class II positioning, and supra-eruption of the opposing molar with distortion of the lower curve of Spee and potential occlusal interference.
- Early assessment with intraoral or panoramic films approximating the timing of first permanent molar eruption is thus critical to identification of the problem and provides an opportunity to intercept potential sequelae.
- If the problem is detected at 5 to 6 years of age, an observation approach of “watchful waiting” with appropriate monitoring may be indicated, given the two-thirds potential for self-correction. With self-correction being unlikely as the child approaches 7 years of age, continued “locking” of the first molar with advanced resorption of the primary second molar usually warrants intervention. Another timing clue is that when the opposing molar reaches the level of the lower occlusal plane, intervention is indicated to establish proper vertical control and prevent supra-eruption.

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- Eruption of Teeth :-

*** Early Eruption :- (Natal and Neonatal Teeth)**

- Natal teeth are (teeth present at birth) and neonatal teeth (teeth that erupt during the first 30 days) prevalence is low. About 85% of natal or neonatal teeth are mandibular primary incisors, and only small percentages are supernumerary teeth. It is common for natal and neonatal teeth to occur in pairs. Natal and neonatal molars are rare. Most studies suggest that the etiology for the premature eruption or the appearance of natal and neonatal teeth is multifactorial. A possible factor involving the early eruption of primary teeth seems to be familial, due to inheritance as an autosomal-dominant trait.
- A radiograph should be made to determine the amount of root development and the relationship of a prematurely erupted tooth to its adjacent teeth. One of the parents can hold the x-ray film in the infant's mouth during the exposure.
- Most prematurely erupted teeth (immature type) are hypermobile because of limited root development. 1. If the tooth is extremely mobile to the extent that there is danger of displacement of the tooth and possible aspiration, so the treatment indicated in such a case is the removal of the tooth. 2. If the tooth has sharp incisal edge that may cause laceration of the lingual surface of the tongue, so treatment is the removal of the tooth.
- The preferable approach, however, is to leave the tooth in place and to explain to the parents the desirability of maintaining this tooth in the mouth because of its importance in the growth and uncomplicated eruption of the adjacent teeth. Within a relatively short time, the prematurely erupted tooth will become stabilized, and the other teeth in the arch will erupt.
- Eruption of teeth during the neonatal period presents less of a problem. These teeth can usually be maintained even though root development is limited.

- A retained natal or neonatal tooth may cause difficulty for a mother who wishes to breast-feed her infant. If breast-feeding is too painful for the mother initially, the use of a breast pump and bottling of the milk are recommended. However, the infant may be conditioned not to "bite" during suckling in a relatively short time if the mother persists with breast-feeding. It seems that the infant senses the mother's discomfort and learns to avoid causing it.

*** EPSTEIN PEARLS, BOHN NODULES, AND DENTAL LAMINA CYSTS :-**

- Small, white or grayish-white lesions on the alveolar mucosa of the newborn may be incorrectly diagnosed as natal teeth. The lesions are usually multiple but do not increase in size. No treatment is indicated because the lesions are spontaneously shed a few weeks after birth.

1. Epstein pearls :- are formed along the mid-palatine raphe. They are considered remnants of epithelial tissue trapped along the raphe as the fetus grew.

2. Bohn nodules :- are formed along the buccal and lingual aspects of the dental ridges and on the palate away from the raphe. The nodules are considered remnants of salivary gland tissue and are histologically different from Epstein pearls.

3. Dental lamina cysts :- are found on the crests of the maxillary and mandibular dental ridges. The cysts apparently originated from remnants of the dental lamina.

**** Shedding of the primary teeth :-***

- The human dentition like those of most mammals consists of two generations. The first generation is known as the deciduous or primary dentition and the second as the permanent dentition. The need and the necessity of two dentitions exists because :- **1.** Infant jaws are small and the size and number of teeth they can support is limited. **2.** Since the teeth, once formed, cannot increase in size, a second dentition, consisting of larger and more teeth, is required for the larger jaws of the adult. **The physiological process resulting in the elimination of the deciduous dentition is called shedding or exfoliation**.

**** Pattern of Shedding :-***

- The result of progressive resorption of the roots of teeth and their supporting tissues is the shedding of deciduous teeth. In general, the pressure generated by the growing and erupting permanent tooth dictates the pattern of deciduous tooth resorption.

- Resorption of Anterior teeth :-

- The permanent anterior tooth germ position is lingual to the apical third of the roots of the primary tooth hence the resorption is in the occluso-labial direction, which corresponds to the movements of the permanent tooth germ. - Later the resorption proceed horizontally because the crown of the permanent tooth lies directly apical to the root of primary tooth, and this horizontal resorption allows the permanent tooth to erupt into the position of the primary tooth.

- Resorption of Posterior teeth :-

- Initially, the growing crowns of the premolars are situated between the roots of the primary molars, so the root resorption of the posterior primary teeth will started at the inter-radicular bone area followed by resorption of the adjacent surfaces of the root. Meanwhile, the alveolar process is growing to compensate for the lengthening roots of the permanent tooth.
- As this occurs, the primary molars move occlusally, which allows the premolars crowns to be more apical. The premolars continue to erupt until the primary molars roots are entirely resorbed and the teeth exfoliate. The premolars then appear in place of the primary molars.

- Remnants of Deciduous teeth :-

- Sometimes parts of the deciduous teeth that are not in the path of eruption remain embedded in the jaw for a considerable time. They are most frequently associated with permanent premolars because the roots of the lower second deciduous molars are strongly curved or divergent. When they are close to the surface of the jaw, they may ultimately be exfoliated. Progressive resorption of the root remnants and replacement by bone may cause the disappearance of these remnants.

- Retained Deciduous Teeth :-

They may retained for a long period of time beyond their usual shedding schedule. Such teeth are usually without permanent successor, or their successors are impacted. Retained deciduous teeth are most often the upper lateral incisor, less frequently the mandibular second primary molars and rarely the lower central incisors. If permanent tooth is ankylosed or impacted, its deciduous predecessors may also be retained.

*** Factors causes differences in time of eruption :-**

1. **Race :-** Negro teeth erupted earlier than white people did.

2. **Environment :-** industrialized countries children erupt their teeth later than rural area because industrialized countries children eat ready food than the developing countries who eat raw food.

3. **Socioeconomic level :-** children from good socioeconomic level erupt their teeth earlier because of their good nourishment and health.

4. **Nutrition and growth :-** good nutrition lead to good growth, which lead to early eruption of teeth.

5. **Sex :-** girls erupt their teeth earlier than boys do.

6. **Disease :-** either systemic or local.

**** Local Factors influence time of eruption :-***

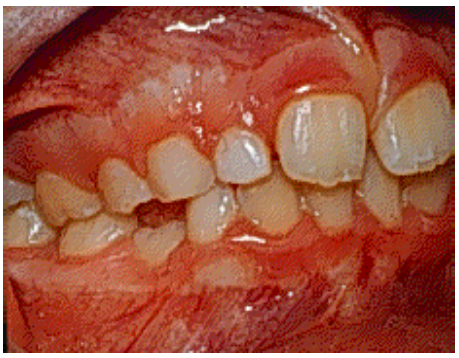
1) Infection around the tooth :- if it is :- **1.** near the eruption time it cause tearing of tissues and sometimes resorption in the area resulting in early eruption. **2.** If the infection occur before long period of time it will result in late eruption because infection for long period will healed with fibrosis in the area which aid in late eruption.

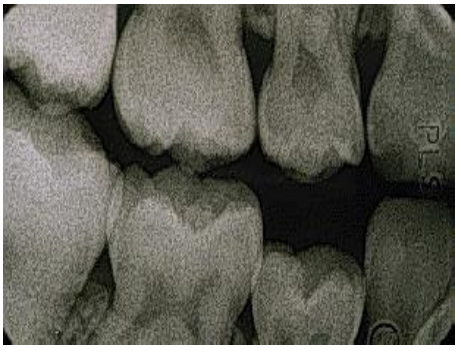
2) Supernumerary tooth :- may be of importance in late the eruption.

3) Trauma :- any trauma may cause early shedding of primary teeth, which lead to late eruption of permanent successor teeth.

4) Gingival fibromatosis :- Hereditary gingival fibromatosis (HGF) is characterized by a slow, progressive, benign enlargement of the gingivae, which is the most common genetic form of gingival enlargement, usually has an autosomal dominant mode of inheritance. It is also referred to as elephantiasis gingiva or hereditary hyperplasia of the gum. The dense fibrous tissue often causes displacement of the teeth and malocclusion, also it may prevent eruption of teeth and treatment usually is gingivectomy.

5) Ankylosed teeth :- Application of the term submerged molar to this condition is inaccurate, even though the tooth may appear to be submerging into the mandible or maxilla. This misconception results from the fact that the ankylosed tooth is in a state of static retention, whereas in the adjacent areas eruption and alveolar growth continue. Ankylosis should be considered an interruption in the rhythm of eruption and that a patient who has one or two ankylosed teeth is more likely to have other teeth become ankylosed.





- The mandibular primary molars are the teeth most often observed to be ankylosed. In unusual cases, all the primary molars may become firmly attached to the alveolar bone before their normal exfoliation time. Ankylosis of the anterior primary teeth does not occur unless there has been a trauma.
- The cause of ankylosis in the primary molar areas is unknown. It may follow a familial pattern. There is a relationship between the congenital absence of permanent teeth and ankylosed primary teeth. Normal resorption of the primary molar begins on the inner or lingual surfaces of the roots. The resorption process is not

continuous but is interrupted by periods of inactivity or rest. A reparative process follows periods of resorption. In the course of this reparative phase, a solid union often develops between the bone and the primary tooth. This intermittent resorption and repair may explain the various degrees of firmness of the primary teeth before their exfoliation.

- Extensive bony ankylosis of the primary tooth may prevent normal exfoliation and the eruption of the permanent successor. If ankylosis occurs early, eruption of the adjacent teeth may progress enough that the ankylosed tooth is far below the normal plane of occlusion and may even be partially covered with soft tissue. An epithelium- lined track, however, will extend from the oral cavity to the tooth.
- Ankylosis may occasionally occur even before the eruption and complete root formation of the primary tooth. Ankylosis can also occur late in the resorption of the primary roots and even then can interfere with the eruption of the underlying permanent tooth.

**** The diagnosis of an ankylosed tooth :-***

- It is not difficult to make, because :-

1. Eruption has not occurred and the alveolar process has not developed in normal occlusion, the opposing molars in the area seem to be out of occlusion.
2. The ankylosed tooth is not mobile, even in cases of advanced root resorption.
3. Ankylosis can be partially confirmed by tapping the suspected tooth and an adjacent normal tooth with a blunt instrument and comparing the sounds. The ankylosed tooth will have a solid sound, whereas the normal tooth will have a cushioned sound because it has an intact periodontal membrane that absorbs some of the shock of the blow.
4. The radiograph is often a valuable diagnostic aid. A break in the continuity of the periodontal membrane, indicating an area of ankylosis, is often evident radiographically.

**** The management of an ankylosed tooth :-***

- Early recognition and diagnosis are extremely important.

1) The eventual treatment may involve surgical removal. However, unless a caries problem is unusual or loss of arch length is evident, the dentist may choose to keep the tooth under observation.

2) A tooth that is definitely ankylosed may at some future time undergo root resorption and be normally exfoliated. When patient cooperation is good and recall periods are regular, a watchful waiting approach is best.

3) For primary teeth: In situations in which permanent successors of ankylosed primary molars are missing, attempts have been made to establish functional occlusion using stainless steel crowns, overlays, or bonded composite resins on the affected primary molars. This treatment is successful only if the eruption of permanent teeth are still in state of active eruption they will be seen by pass the ankylosed tooth.

4) For permanent teeth: The incomplete eruption of a permanent molar may be related to a small area of root ankylosis. The removal of soft tissue and bone covering the occlusal aspect of the crown should be attempted first, and the area should be packed with surgical cement to provide a pathway for the developing permanent tooth. Unerupted permanent teeth may become ankylosed by inostosis of enamel. This process follows the irritation of the follicular or periodontal tissue resulting from chronic infection.

- The close association of an infected apex with an unerupted tooth may give rise to the process. In the unerupted tooth, enamel is protected by enamel epithelium. The enamel epithelium may disintegrate because of infection (or trauma), the enamel may subsequently be resorbed, and bone or coronal cementum may be deposited in its place. The result is solid fixation of the tooth in its unerupted position.

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- Eruption of Teeth :-

**** Systemic (disease) Factors which cause late eruption :-***

1) Trisomy 21 Syndrome (Down Syndrome DS) :-

- Trisomy 21 syndrome (Down syndrome DS) - that is, the presence of three number 21 chromosomes rather than the normal two (diploid). It is one of the congenital anomalies, in which delayed eruption of the teeth frequently occurs. The first primary teeth may not appear until 2 years of age, and the dentition may not be complete until 5 years of age.
- The eruption often follows an abnormal sequence, and some of the primary teeth may be retained until 15 years of age. DS occurs very early in embryonic development, possibly during the first cell divisions. Anomalies of the eye and external ear are seen, and congenital heart defects are often present.
- The occurrence of DS is frequently related to maternal age. There is a relationship between female (mother) age and Down syndrome as follow :-

-The probability of Down syndrome at age 18-29 years about 1.5/1000.

-At age 30-40 years the probability is 29/1000.

-At age 44 years the probability about 91/1000.

*** The diagnosis of DS :-**

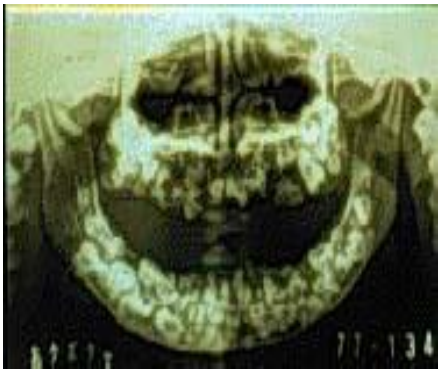
- In a child is not usually difficult to make because of the characteristic facial pattern :-

1. The orbits are small,
2. The eyes slope upward,
3. The bridge of the nose is more depressed than normal.

4. The formation of the external ear, characterized by outstanding “lap” ear with flat or absent helix.
5. Mental retardation is another characteristic finding, with most children in the mild to moderate range of disability
6. Retardation in the growth of the maxillae and mandible was evident in those with DS. Both the maxillae and mandible were positioned anteriorly under the cranial base.
7. The upper facial height was found to be significantly smaller.
8. The midface was also found to be small in the vertical and horizontal dimensions.
9. The smaller jaws contribute to a tendency for protrusion of the tongue and dental crowding, both of which may compromise the development of good occlusion.
10. The tongue also tends to be larger than normal.
11. Individuals with DS have a higher prevalence of periodontal disease mainly in the anterior region. However, susceptibility to dental caries is low for both primary and permanent teeth.
- Many children with DS have chronic inflammation of the conjunctiva and a history of repeated respiratory tract infections. The use of antibiotics has reduced the incidence of chronic infection and has resulted in fewer deaths from infection.

2) Cleidocranial Dysplasia :-

- A rare congenital syndrome that has dental significance is cleidocranial dysplasia (CCD), which has also been referred to as cleidocranial dysostosis,
1. The diagnosis is based on the finding of an absence of clavicles, although there may be remnants of the clavicles, as evidenced by the presence of the sternal and acromial ends.
2. The fontanels are large, and radiographs of the head show open sutures, even late in the child’s life.
3. The sinuses, particularly the frontal sinus, are usually small.
4. The development of the dentition is delayed. Complete primary dentition at 15 years of age, resulting from delayed resorption of the deciduous teeth and delayed eruption of the permanent teeth, is not uncommon.



5. One of the important distinguishing characteristics is the presence of supernumerary teeth. Some children may have only a few supernumerary teeth in the anterior region of the mouth; others may have a large number of extra teeth throughout the mouth.
- Even with removal of the primary and supernumerary teeth, eruption of the permanent dentition is often delayed and irregular.

Children who have only a few supernumerary teeth can be successfully **treated by :-**

1-Surgical removal of the extra teeth.

2-Complete uncovering of the crowns of the permanent teeth.

3-The construction of space-maintaining appliances to maintain the relationship of the teeth in the arch until the delayed teeth can erupt.

3) Hypothyrodism :-

- Hypothyroidism is another possible cause of delayed eruption. Patients in whom the function of the thyroid gland is extremely deficient have characteristic dental findings.

a- Congenital Hypothyroidism (Cretinism) :-

- Occurring at birth and during the period of most rapid growth, if undetected and untreated, causes mental deficiency and dwarfism. This condition was referred to as cretinism.

1. Congenital hypothyroidism is the result of an absence or underdevelopment of the thyroid gland and insufficient levels of thyroid hormone.
2. Child with congenital hypothyroidism is a small and disproportionate person, with abnormally short arms and legs.
3. The head is disproportionately large, although the trunk shows less deviation from the normal.
4. Obesity is common.
5. The dentition of the child with congenital hypothyroidism is delayed in all stages, including eruption of the primary teeth, exfoliation of the primary teeth, and eruption of the permanent teeth.
6. The teeth are normal in size but are crowded in jaws that are smaller than normal.
7. The tongue is large and may protrude from the mouth. The abnormal size of the tongue and its position often cause an anterior open bite and flaring of the anterior teeth.
8. Tooth crowding, malocclusion, and mouth breathing cause a chronic hyperplastic type of gingivitis.

b- Juvenile Hypothyroidism (Acquired Hypothyroidism) :-

- It results from a malfunction of the thyroid gland, usually between 6 and 12 years of age. Because the deficiency occurs after the period of rapid growth, the unusual facial and body patterns characteristic of a person with congenital hypothyroidism are not present. However, obesity is evident to a lesser degree.
- In untreated juvenile hypothyroidism, delayed exfoliation of the primary teeth and delayed eruption of the permanent teeth are characteristic. A child with a chronologic age of 14 years may have a dentition in a stage of development comparable with that of a child 9 or 10 years of age.

4) Hypopituitarism :-

1. A pronounced deceleration of the growth of the bones and soft tissues of the body will result from a deficiency in secretion of the growth hormone.

2. Pituitary dwarfism is the result of an early hypofunction of the pituitary gland. Again, early diagnosis is routine because of the mandatory blood screening of newborn infants for congenital hypothyroidism.
3. An individual with pituitary dwarfism is well proportioned, but he resembles a child of considerably younger chronologic age.
4. The dentition is essentially normal in size.
5. Delayed eruption of the dentition is characteristic. In severe cases the primary teeth do not undergo resorption but instead may be retained throughout the life of the person.
6. The underlying permanent teeth continue to develop but do not erupt. Extraction of the deciduous teeth is not indicated because eruption of the permanent teeth cannot be ensured.
7. Some degree of cognitive disability often occurs.

5) Achondroplastic Dwarfism :-

1. Easily diagnosed at birth, demonstrates a few characteristic dental findings.
2. Many children die during first year of life.
3. Growth of the extremities is limited because of a lack of calcification in the cartilage of the long bones. Stature improvements have been reported with surgical lengthening of the limbs and also with growth hormone therapy.
4. The head is disproportionately large, although the trunk is normal in size.
5. The fingers may be of almost equal length, and the hands are plump.
6. The fontanels are open at birth.
7. The upper face is underdeveloped, and the bridge of the nose is depressed.
8. The etiology of achondroplastic dwarfism is unknown, it is clearly an autosomal-dominant disorder. There is some evidence that the condition is more likely to occur when the ages of the parents differ significantly. In contrast to DS, the increased age of the father may be related to the occurrence of the condition.

**** Oral conditions :-***

1. Deficient growth in the cranial base is evident in many individuals with achondroplastic dwarfism.
2. The maxilla may be small, with resultant crowding of the teeth and a tendency for open bite.
3. Chronic gingivitis is usually present. However, this condition may be related to the malocclusion and crowding of the teeth.
4. The development of the dentition was slightly delayed.

6) Other Causes :-

- Delayed eruption of the teeth has been linked to other disorders, including fibromatosis gingivae, chondroectodermal dysplasia (Ellis-van Creveld syndrome), Gardner syndrome, and rickets.

*** Deciduous Dentition Period :-**

- The initiation of primary teeth occur during first 6 week of IUL and the first primary tooth erupts at the age of 6 months. It takes around 2 ½ to 3 ½ years for all the primary teeth to establish their occlusion.

*** Ugly Duckling Stage :-**

- Also called Broadbent phenomenon, a self-correcting malocclusion is seen around 9-11 years of age or during eruptions of canine. As the permanent canines erupt, they displace the roots of lateral incisors mesially. This force is transmitted to the central incisors and their roots are also displaced mesially. Thus, the resultant force causes the distal divergence of the crown in an opposite direction, leading to midline spacing (diastema in the incisor region).
- The term ugly duckling stage indicates the anesthetic appearance of the child during this stage. This condition corrects itself after the canines have erupted when it apply pressure on the crowns of the incisors thereby causing them to shift back to original positions. No orthodontic treatment should be attempted at this stage, as there is danger of deflecting the canine from its normal path of eruption.

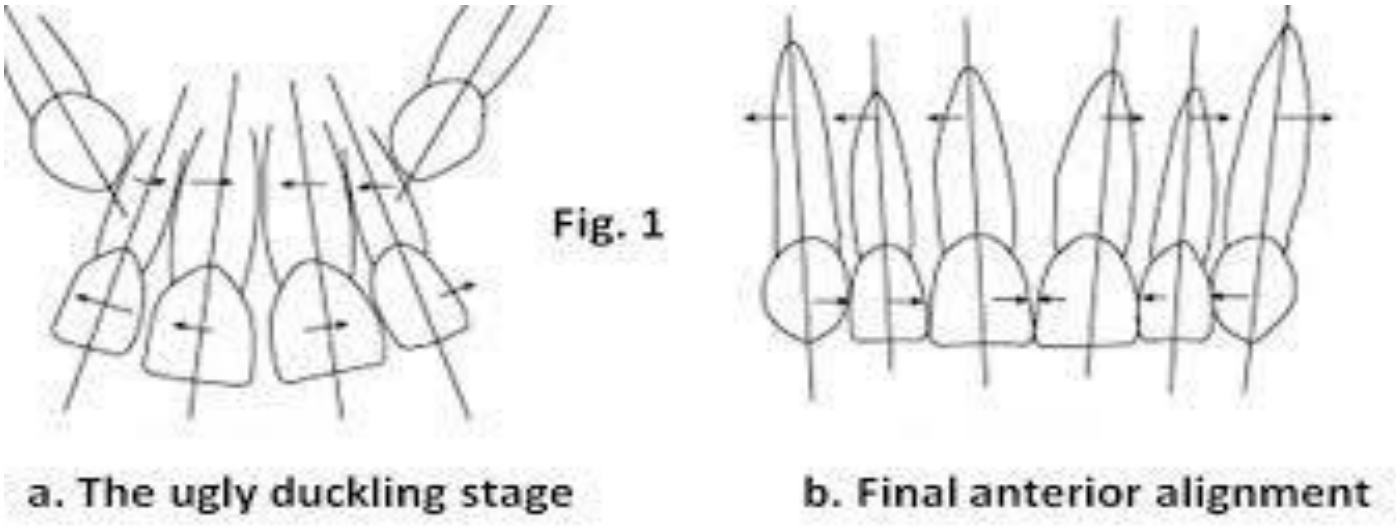


Fig. 1

a. The ugly duckling stage

b. Final anterior alignment

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*** Morphology of Individual Primary Teeth :-**

- Studying tooth morphology includes understanding the shape, configuration and parts of a tooth. It is very important for clinical application during performing various procedures. Cavity preparations must conform to the thickness of enamel and dentin, keeping in mind the location and size of the pulp. Restoration of natural contours and morphology of deciduous teeth is needed for function, which can be achieved only with a good knowledge of tooth morphology.
- An accurate chronology of primary tooth calcification is of clinical significance to the dentist. It is often necessary to explain to parents the time sequence of calcification in utero and during infancy. The common observations of tetracycline pigmentation, developmental enamel defects, and generalized hereditary anomalies can be explained if the calcification schedule is known. A brief discussion of the morphology of the primary teeth is also appropriate before restorative procedures are considered for children.

*** Maxillary Central Incisors :-**

- Labial aspect :-

1. The mesiodistal diameter of the crown is greater compared to the cervicoincisal height.
2. The incisal edge is straight with sharp mesioincisal and rounded distoincisal angle.
3. The labial surface is smooth without developmental grooves or depressions.
4. The mesial outline is straight whereas the distal outline is convex.
5. The mesial contact area is near the mesioincisal angle and the distal contact area is in the incisal third.
6. The root is conical with evenly tapered sides.

- Lingual aspect :- (Palatal aspect)

1. The cingulum and marginal ridges are well developed.
2. The lingual fossa is in the incisal third of the lingual surface.

- Mesial and Distal aspects :-

1. The crown is wide labiolingually in the cervical third because of prominent cingulum.
2. The labial outline shows prominent cervical ridge.

- Incisal aspect :-

1. The labial surface is smooth.
2. Lingual surface tapers towards cingulum.
3. The crown is wider mesiodistally than faciolingually.

*** Maxillary Lateral Incisors :-**

1. The maxillary lateral incisor is similar to maxillary central incisor except.
2. Crown is smaller than central incisor.
3. The distoincisal angle is more rounded.
4. The crown height is greater than mesiodistal width.
5. The root is longer in proportion to crown height.

*** Maxillary Canine :-**

- Labial aspect :-

1. The crown shows marked cervical constriction.
2. The mesial and distal outlines are convex.
3. Maxillary canine has a long sharp cusp with two cusp ridges meeting at an acute angle.
4. The mesial cusp slope is longer and straighter than distal cusp slope.
5. The mesial and distal contact areas are near the center of the crown cervico-occlusally.
6. The root is long, slender and tapering.
7. The root length is approximately more than twice the crown height.

- Lingual aspect :-

1. The lingual surface of canine shows a well-developed, prominent cingulum.
2. Well-developed mesial and distal marginal ridges.
3. The lingual ridge is somewhat distal to the midline of tooth.

- Mesial and Distal aspects :-

1. The crown appears triangular from mesial and distal aspects.
2. The cervical third of the crown is much thicker than that of the incisors.
3. The cusp tip is labial to long axis of the tooth.
4. The cervical ridge on the labial surface is prominent.
5. The root is bulky in its middle and cervical third and tapered in the apical third.

- Incisal aspect :-

1. The crown outline is somewhat angular and tapers considerably towards the cingulum.
2. The mesial outline is flat, tapered, angular and thicker faciolingually than in the distal half of the crown.
3. The cingulum is centered mesiodistally.

4. The crown is faciolingually broader than incisors

*** Mandibular Central and Lateral Incisors :-**

1. The crowns resemble the permanent mandibular incisor but are much smaller in size.
2. The crowns have prominent labial cervical bulge.
3. The roots are thin and nearly twice as long as the crowns.
4. Incisal edges are straight.
5. The distoincisal angle is rounded.
6. The mesial and distal sides taper evenly from contact areas.
7. The lingual surface shows cingulum, marginal ridges and lingual fossa.
8. The mesial aspect shows typical outline of an incisor.

*** Mandibular Canine :-**

1. There is very little difference in functional form between this tooth and maxillary canine.
2. The mesiodistal dimension of mandibular canine at root trunk is greater than mesiodistal width at contact area.
3. Mandibular canine is smaller mesiodistally than maxillary canine.
4. Mesial cusp slope is shorter than distal cusp slope.
5. Cervical ridge is less prominent than maxillary canine.

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*** Morphology of Individual Primary Teeth :-**

*** MAXILLARY FIRST MOLAR :-**

- Buccal aspect :-

1. The occlusal outline is scalloped with no definite cusp form.
2. The crown height is more mesially than distally.
3. The crown shows marked cervical constriction.
4. The mesial outline is straight and the distal outline is convex.
5. The contact area is in middle 1/3.
6. The buccal surface is smooth with little evidence of developmental grooves.
7. The cervical third of crown has prominent cervical ridge.
8. The three roots are thin and widely spread.
9. The root trunk is short.
10. The trifurcation of roots begins just below the cervical line.

- Lingual aspect :-

1. The crown is narrower on lingual aspect
2. The general outline of the crown is similar to the buccal aspect.
3. The mesiolingual cusp is the most prominent, largest and sharpest.
4. The distolingual cusp is poorly developed.
5. All three roots are seen from this aspect.
6. The palatal root is longer and larger than others.

- Mesial aspect :-

1. In the cervical third the crown is much wider buccolingually than the occlusal third.
2. The crown tapers occlusally.
3. The buccal outline shows prominent cervical ridge.

4. The buccal outline is straight from the ridge to the occlusal margin.
5. The lingual outline is convex in cervical and middle thirds and straight in the occlusal third.
6. The mesial marginal ridge may show a developmental groove.
7. The root trunk is short.
8. Only palatal and mesiobuccal roots are visible from this aspect.

- Distal aspect :-

1. The crown is narrower buccolingually and shorter cervico-occlusally than on the mesial side.
2. The cervical ridge is less prominent than from the mesial aspect.

- Occlusal aspect :-

1. The occlusal surface bears four cusps: mesiobuccal, distolingual, distobuccal and mesiolingual.
2. The crown is broader buccally more than lingually and mesially more than distally.
3. The crown shows lingual and distal convergence.
4. The occlusal surface is rectangular with the short sides represented by the marginal ridges.
5. The occlusal surface shows :-

a. Central fossa

b. Central groove that connects the mesial and distal fossae, which are present just inside the mesial and distal marginal ridges respectively.

c. Buccal developmental groove separates mesiobuccal and e distobuccal cusps.

d. A well-defined triangular ridge connects mesiolingual and distobuccal cusps called as oblique ridge.

e. Supplemental grooves radiating from the central groove are present.

*** MAXILLARY SECOND MOLAR :-**

- Buccal aspect :-

1. The primary maxillary second molar resemble the permanent maxillary first molar, but it is smaller in size
2. The buccal view show two well define buccal cusps with buccal developmental groove in between
3. The mesial and distal outlines converge cervically from contact areas
4. All three roots are longer, and thicker as compared to the maxillary first molar
5. The root trunk is very short

- Lingual aspect :-

1. The crowns shows three cusp: mesiolingual cusp, distolingual cusp and a supplemental cusp.
2. Cusp present on the lingual surface of mesiolingual cusp is called the 'tubercle of Carabelli' or fifth cusp.

- Mesial and Distal aspects :-

1. The buccolingual width is more as compared to crown height.
2. The mesiobuccal and lingual roots are seen from this aspect.

3. The mesiobuccal root extends far beyond the outline of the crown.
4. Buccal outline shows cervical ridge.
5. Both the buccal and lingual outlines show occlusal convergence.

- Occlusal aspect :-

1. The tooth resembles permanent first molar.
2. The occlusal surface is rhomboidal with 4 well developed cusps i.e. mesiobuccal, distobuccal, mesiolingual and distolingual.
3. The buccal outline is flat with a developmental groove in between the cusps.
4. The occlusal surface shows :-

a. Central fossa with central pit
b. Mesial triangular fossa, distal triangular fossa
c. Central groove is seen connecting mesial and distal pits.
d. The oblique ridge is prominent connecting the mesiolingual cusp with distobuccal cusp.
e. Distal to oblique ridge, distal fossa with distal groove is present.
f. The distal groove separates two lingual cusps and continues on the lingual surface as lingual developmental groove.

*** MANDIBULAR FIRST MOLAR :-**

- The anatomy of mandibular first molar does not resemble any tooth in permanent dentition

- Buccal aspect :-

1. The crown is wider mesiodistally
2. The mesiobuccal cusp is the largest and longest cusp.
3. The mesial outline is nearly straight whereas the distal outline is convex.
4. The mesial and distal roots are widely separated.
5. Roots are slender and the furcation is close to the cervical line.
6. Buccal surface shows a prominent cervical ridge.

- Lingual aspect :-

1. The crown and root converge lingually on the mesial side, part of mesial surface is visible from the lingual aspect.
2. The mesiolingual cusp is larger and longer than the distolingual cusp.
3. The lingual groove extends between two lingual cusps and ends in a depression in cervical third

- Mesial aspect :-

1. Buccal outline shows prominent cervical ridge.
2. The crown appears to lean towards lingual surface.
3. From cervical ridge the buccal outline is straight.
4. The mesial marginal ridge is concave is located more occlusally than distal marginal ridge.
5. The occlusal table is small buccolingually.
6. The cervical portion of the crown is quite wide in comparison (cervical convergence),

7. The mesial root is flat and squarish with a broad apex.
8. The mesial root has a depression along most of its length.

- Distal aspect :-

1. Buccal cervical ridge is less prominent from the distal side than from the mesial.
2. The distobuccal and distolingual cusps are nearly of the same height.
3. The distal marginal ridge is located more cervically than mesial marginal ridge.
4. The distal root is more rounded, less broad, thinner and shorter than the mesial root.

- Occlusal aspect :-

1. The general outline of this tooth from the occlusal aspect is rhomboidal.
2. Four cusps are present, they are mesiobuccal, mesiolingual, distobuccal and distolingual.
3. The mesiobuccal angle is acute and prominent.
4. The distobuccal angle is obtuse.
5. The crown shows lingual and distal convergence.
6. The mesiolingual cusp is the largest cusp.
7. The occlusal surface shows:
8. Transverse ridge is seen between the mesiobuccal and mesiolingual cusps.
9. Buccal developmental groove divides two buccal cusps and extends from between the buccal cusps to the central pit.
10. Central developmental groove separates the mesiobuccal and mesiolingual cusps.
11. Mesial and distal fossae contain mesial and distal pits respectively.

*** MANDIBULAR SECOND MOLAR :-**

- The primary mandibular second molar resembles the permanent mandibular first molar. It is the largest tooth in the deciduous dentition.

- Buccal aspect :-

1. The crown is wide mesiodistally.
2. The crown appears to be tilted distally on its root base.
3. There are 3 cusps of nearly equal size, namely mesiobuccal, distobuccal and distal.
4. These cusps are separated by mesiobuccal and distobuccal grooves.
5. The roots are widely separated.
6. Root trunk is short.

- Lingual aspect :-

1. Mesiolingual and distolingual cusps are about the same size and height.
2. Both the cusps are separated by lingual groove.
3. Root trunk is slightly longer.

- Mesial aspect :-

1. Buccal outline shows a prominent mesial cervical ridge giving the crown an appearance of lingual tilt.

2. The buccal and lingual outlines converge towards the occlusal surface.
3. The mesial marginal ridge is traversed by the mesial marginal groove.
4. The mesial surface is convex and flattens cervically.
5. The mesial root is broad and flat with a shallow depression.
6. Mesial root has two root canals.

- Distal aspect :-

1. Crown is narrower on the distal side than on mesial.
2. Distal root is broad and has less blunt apex.
3. Distal root may have I or 2 root canals.

- Occlusal aspect :-

- This tooth has 5 cusps with mesiobuccal cusp being the largest cusp.
- Occlusal surface shows :-

1. Central fossa
2. Mesial and distal triangular fossa
3. Central groove, mesiobuccal groove, distobuccal groove and lingual groove.

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**** Morphologic Differences between Primary and Permanent Teeth :-***

- The morphology of the primary dentition is different in many respects from that of the permanent dentition, and not only in the sizes of the crowns and roots. They have following morphologic difference :-

*** General differences :-**

1-No. of teeth present for primary is 20 and permanent is 28-32.

2- Bicuspids and third molars are absent in the primary teeth.

3- Primary teeth are smaller in size when compare to permanent teeth.

4- First tooth to erupt into the oral cavity is mandibular incisor whereas in permanent teeth it is the mandibular first molar.

*** Features of a deciduous crown :-**

1. The crown of the deciduous tooth is shorter than the permanent tooth.
2. The occlusal table of a deciduous tooth is narrower labiolingually than is the permanent tooth.
3. The deciduous tooth is constricted in the cervical portion of the crown.
4. The enamel and dentin layers are thinner in the deciduous tooth.
5. The enamel rods in the gingival third extend in a slightly occlusal direction from the dentino-enamel junction in deciduous teeth but extend slightly apically in the permanent dentition.
6. The contact areas between the deciduous molars are very broad and flat.
7. The color of the deciduous tooth is lighter than permanent teeth.

*** Features of a deciduous root :-**

1. The root of the deciduous anterior tooth is narrower mesiodistally than is that of the permanent anterior tooth.
2. The roots of the posterior deciduous tooth are longer and slenderer in relation to crown size than are those of the permanent tooth.

3. The roots of the deciduous molar flare more as they approach the apex (which affords the necessary room for the development of the permanent tooth buds) than do the permanent molar roots

*** Features of a deciduous pulp :-**

1. The pulp of the deciduous tooth is larger than that of the permanent tooth in relation to the crown size.
2. The pulp horns of the deciduous tooth (especially the mesial horns) are closer to the outer surface of the tooth than are those of the permanent tooth.
3. The mandibular molar has larger pulp chambers than does the maxillary molar in the deciduous tooth.
4. The form of the pulp chamber of the deciduous tooth follows the surface of the crown.
5. Usually there is a pulp horn under each cusp.
6. Thin and slender roots pulp canals.
7. Accessory canals extend from floor of the pulpal chamber to the furcation or interradicular area.
8. Increased blood supply, due to which the deciduous pulp exhibits typical inflammatory response.
9. Responds by inflammatory process, resulting in increased internal resorption.
10. Reduced sensitivity to pain-due to less number of nerve fibers.
11. Increased reparative dentin formation.
12. Poor localization of infection and inflammation.
13. Multiple ramifications, making complete debridement impossible.
14. Ribbon shaped root canal (hour glass appearance) that is narrower mesiodistally, discourages gross enlargement of the canal.

*** Size and morphology of the primary tooth pulp chamber :-**

- Considerable individual variation exists in the sizes of the pulp chambers and pulp canals of the primary teeth. Immediately after tooth eruption, the pulp chambers are large and generally follow the outline of the crown. They decrease in size as age increases, and under the influence of both function and abrasion of the occlusal and incisal surfaces of the teeth. Radiographs do not demonstrate completely the extent of the pulp horn into the cuspal area.
- In addition, the cemento-enamel junction of primary teeth presents three interesting morphologic relationships, in which the cementum is over enamel, the cementum and enamel are edge to edge, or there is a gap between the cementum and enamel with dentin exposure. This irregularity in the cemento-enamel junction may indicate the need for care during restorative and other procedures to avoid damage

*** Primary root canal anatomy :-**

- To treat the pulps of primary teeth successfully, the clinician must have a thorough knowledge of the anatomy of the primary root canal systems and the variations that normally exist in these

systems. To understand some of the variations in the primary root canal systems requires an understanding of root formation.

**** Root Formation :-***

- The roots begin after enamel and dentin formation has reached the future CEJ. The epithelial dental organ forms Hertwig's epithelial root sheath, which initiates formation and molds the shape of the roots. Hertwig's sheath takes the form of one or more epithelial tubes (depending on the number of roots of the tooth, one tube for each root).
- During root formation the apical foramen of each root has a wide opening. The dentinal walls diverge apically, and the shape of the pulp canal is like a wide open tube. Each root contains one canal at this time, and the number of canals is the same as the number of roots. When root length is established, the sheath disappears but dentin

deposition continues internally within the roots. As growth proceeds, the root canal is narrowed by continued deposition of dentin and the pulp tissue is compressed.

- Additional deposition of dentin and cementum closes the apex of the tooth and creates the apical convergence of the root canals common to the completely formed tooth. Root length is not completed until 1 to 4 years after a tooth erupts into the oral cavity. In the primary teeth the root length is completed in a shorter period of time than in the permanent tooth because of the shorter length of the primary roots. The primary tooth is unique in so far as resorption of the roots begins after a short period of complete root length formation.
- At this time the form and shape of the root canals roughly correspond to the form and shape of the external anatomy of the teeth. Root resorption or the deposition of additional dentin within the root canal system, however, significantly changes the number, size, and shape of the root canals within the primary tooth.

*** Root Completion of Primary Teeth :-**

- Primary tooth roots are completed between the ages of 18 months to 3 years. The complete primary dentition (with 20 teeth) is in the mouth from about 2 years of age to about 6 years, during which no permanent teeth are visible in the mouth, but permanent teeth are forming within the jaws.

*** Exfoliation (Shedding) of Primary Teeth :-**

- The roots of primary teeth are complete for only a short period of time. Only about 3 years after completion, primary tooth roots begin to resorb, usually at the apex or on one side near the apex. Resorption of a primary tooth root is the gradual dissolving away of the root due to the underlying eruption of the succedaneous tooth that will replace it.
- Root resorption continues as succedaneous teeth move closer to the surface until deciduous teeth eventually become loose and finally ‘’ fall off ‘’ (like leaves fall off deciduous trees). This process of shedding is called exfoliation. When a primary tooth is shed, the crown of the succedaneous tooth is close to the surface and ready to emerge.

*** Root canal anatomy of primary anterior teeth :-**

- The form and shape of the root canals of the primary anterior teeth resemble the form and shape of the roots of the teeth. The permanent tooth bud lies lingual and apical to the primary anterior tooth. Owing to the position of the permanent tooth bud, resorption of the primary incisors and canines is initiated on the lingual surface in the apical third of the roots.

*** Maxillary incisors :-**

- The root canals of the primary maxillary, central, and lateral incisors are almost round but somewhat compressed. Normally these teeth have one canal without bifurcations. Apical ramifications or accessory canals and lateral canals are rare, but they do occur.

*** Mandibular incisors :-**

- The root canals of the primary mandibular central and lateral incisors are flattened on the mesial and distal surfaces and sometimes grooved, pointing to an eventual division into two canals. The presence of two canals is seen less than 10% of the time. Occasionally lateral or accessory canals are observed.

*** Maxillary and mandibular canines :-**

- The root canals of the maxillary and mandibular canines correspond to the exterior root shape, a rounded, triangular shape with the base toward the facial surface. The canines have the simplest root canal systems of all the primary teeth and offer few problems when being treated endodontically. Bifurcation of the canal does not normally occur. Lateral canals and accessory canals are rare.

*** Root canal anatomy of primary molars :-**

- Normally the primary molars have the same number and position of roots as the corresponding permanent molars. The maxillary molars have three roots: two buccal and one palatal; the mandibular have two roots: mesial and distal. In the primary molars, resorption usually begins on the inner surfaces of the roots next to the inter-radicular septum. When full length of the roots of the primary molars has just been completed, only one root canal is present in each of the roots. The continued deposition of dentin internally may divide the root into two or more canals.
- During this process, communications exist between the canals and may remain in the fully developed primary tooth. Subsequent deposition of secondary dentin may produce a complete separation of the root canal into two or more individual canals. Many fine- connecting branches or lateral fibrils form a connecting network between the facial and lingual aspects of the root canals. Accessory canals, lateral canals, and apical ramifications of the pulp in primary molars occur in 10% to 20%.

*** Maxillary first primary molar :-**

- It has three to four canals that roughly correspond to the exterior root form with much variation. The palatal root is often rounded; it is often longer than the two facial roots. In most of these teeth three separate canals are present, with a very narrow isthmus connecting them especially between

the palatal and distal. Islands of dentin may exist between the canals, with many connecting branches and fibrils.

*** Maxillary second primary molar :-**

- It has three to five canals roughly corresponding to the exterior root shape. The mesiofacial root usually bifurcates or contains two distinct canals. This occurs in approximately 85% to 95% of maxillary second primary molars. Fusion of the palatal and distofacial roots may occur. These fused roots may have a common canal, two distinct canals, or two canals with a narrow connecting isthmus of dentin islands between them and many connecting branches or fibrils.

*** Mandibular first primary :-**

- It usually has two canals roughly corresponding to the external root anatomy, but it may have two to four canals. It is reported that approximately 75% of the mesial roots contain two canals, whereas only 25% of the distal roots contain more than one canal.

*** Mandibular second primary molar :-**

- It may have two to four canals, but it usually has three. The mesial root has two canals approximately 85% of the time, whereas the distal root contains more than one canal only 25% of the time

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**** Functions of primary teeth :-***

- Function of Primary teeth are essential in the development of the mouth. The primary teeth maintain the arch length within the jaw, the bone and the permanent teeth replacements develop from the same tooth germs as the primary teeth. The primary teeth provide guides for the eruption pathway of the permanent teeth.
- Well deciduous teeth are important and they are required to serve a number of functions above and beyond simply biting and chewing. This is why the children and parents need to take care of them and make sure they last until the permanent teeth are ready to come through.
- Many opinions have been expressed about the features that characterize a normal primary dentition, but three features are seen frequently enough for them to be considered normal :-

1. 'Straight' or 'mesial step second molar relationship' :-

- In most dentitions the maxillary and mandibular primary second molars are in cusp-to-cusp occlusion so that their distal surfaces are in the same distal plane. Frequently, however, there is a mesial step in this vertical plane. This can also be considered normal. Distal „step" indicate a class II arch relationship.

2. Incisor spacing :-

- Spacing among the primary incisors is normal, and indicates that the permanent successors will probably have adequate space into which to erupt. Lack of spacing or imbrication of primary incisors are signs that permanent incisors will probably be crowded when they erupt.

3. Anthropoid (primate space) :-

- The most common sites for spaces in the primary teeth are in the canine regions. The anthropoid spaces are mesial to the maxillary canines and distal to the mandibular canines.

*** The major functions of primary teeth :-**

1-Speech production and development :-

Learning to speak clearly is crucial for cognitive, social, and emotional development. The proper positioning of primary teeth facilitates correct syllable pronunciation and prevents the tongue from straying during speech formation.

2-Eating and nutrition :-

The ability to bite and chew also helps to break up food into more easily digestible pieces and allow for better digestion of food. As the food is being broken up by the teeth, it is also mixed with saliva containing enzymes that begin the digestive process. A child that swallows too rapidly without chewing the food adequately will prolong the digestive process.

- Children with malformed or severely decayed primary teeth are more likely to experience dietary deficiencies, malnourishment, and to be underweight. Proper chewing motions are acquired over time and with extensive practice. Healthy primary teeth promote good chewing habits and facilitate nutritious eating.

3-Self-confidence :-

Even very young children can be quick to point out ugly teeth and crooked smiles. Taking good care of primary teeth can make social interactions more pleasant, reduce the risk of bad breath, and promote confident smiles and positive social interactions.

4- Place Holder (space maintainer) :-

One of the major functions of primary teeth is to hold an appropriate amount of space for developing adult teeth. In addition, these spacers facilitate the proper alignment of adult teeth and also promote jaw development. Left untreated, missing primary teeth cause the remaining teeth to "shift" and fill spaces improperly. For this reason, pediatric dentists often recommend space-maintaining devices.

5-Excellent oral health :-

Badly decayed primary teeth can promote the onset of childhood periodontal disease. As a result of this condition, oral bacteria invade and erode gums, ligaments, and eventually bone. If left untreated, primary teeth can drop out completely – causing health and spacing problems for emerging permanent teeth. To avoid periodontal disease, children should practice an adult-guided oral care routine each day, and infant gums should be rubbed gently with a clean, damp cloth after meals.

6-Development of the Jaw Bones and Facial Muscles :-

The presence or absence of teeth will affect the way in which the jaw bones and facial muscles develop. The growth of the jaw bones is affected by the facial muscles. Teeth and the chewing function help to exercise the facial muscles and facilitate the development of the jaw bones.

**** Types and Function of Individual Primary Teeth :-***

*** Incisors :-**

- Incisors are the eight teeth in the front of the mouth (four on top and four on bottom). These are the teeth that are used to take bites of eaten food. Incisors are usually the first teeth to erupt - at around 6 months for the baby teeth, and between ages 6 and 8 for the adult.

**** Function of primary incisors :-***

1. Incisors cut and slice food when the child takes a bite. The incisors are the main teeth used for cutting pieces of food, for example when eating a whole apple, the incisors are the teeth that slice through the apple and help to get the piece of apple into the mouth to be fully chewed by other teeth.
2. Incisors support the lips and face. The sides of the lips are probably resting right up against the front teeth. Because of this, incisor teeth help to form the overall appearance of the face.
3. Help in speech. As in pronunciation of some sounds, the tongue touches the upper incisors. It touches near the top of the incisors for the “t” sound and near the bottom for the “th” sound. Many sounds need the incisor teeth to be pronounced. It’s also why denture wearers have to re-learn how to speak clearly when they get their dentures.
4. They can make the smile beautiful. The first thing that most people notice in the smile will be the teeth. Since the incisors are the front teeth, they have a tremendous effect on how the smile looks.
5. Incisors help to guide the jaw when closing the mouth.

**** Canines :-***

- The four canines are the next type of teeth to develop. These are the sharpest teeth and are used for tearing food apart. Primary canines generally appear with the upper canines coming in just ahead of the lower canines. In permanent teeth, the order is reversed.

*** Molars :-**

- Molars are used for chewing and grinding food. Primary molars are replaced by the first and second premolars. The permanent molars do not replace any primary teeth, but come in behind all of them, further back in the jaw.

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** Dental Caries Definition, Classification and Etiology :-*

- Definition :-

- The term dental caries is used to describe the signs and symptoms of a localized demineralization of the mineral portion of these tissues followed by the disintegration of their organic material, caused by metabolic events taking place in the biofilm (dental plaque) caused by the action of microorganisms on fermentable carbohydrates covering the affected area.
- The destruction can affect enamel, dentin and cementum. The disease can result in bacterial invasion and death of the pulp and the spread of infection into the periapical tissues, causing pain. In its early stages, however, the disease can be arrested since it is possible for remineralization to occur.

• Sequence of caries in primary dentition :-

- First to be attacked are the mandibular molars followed by maxillary molars, then the maxillary anterior teeth.
- Only rarely are mandibular anterior teeth affected or the lingual/buccal surfaces of the primary teeth generally, except in cases of rampant caries.
- First primary molars in both the mandibular and maxillary arches are less susceptible to caries than the second primary molars, though the first primary molars erupt earlier than the second. Difference is thought to be due to differences in morphology of occlusal surfaces as the pits and fissures in second primary molars are deeper, and less completely coalesced.
- Proximal caries progress more rapidly than occlusal caries and cause higher percentage of pulp exposure. Therefore, regular bitewing radiographs are essential for children once there are no spaces between the teeth or after proximal contact is established.

• Sequence of caries in permanent dentition :-

- Once the first permanent molars erupt, one should expect frequent occurrence of caries in the occlusal pits and fissures.
- The maxillary and mandibular permanent incisors are not highly susceptible to caries attack except in children with rampant caries (RC).
- The mandibular second permanent molars are more susceptible to caries than the maxillary second permanent molars.

**** The Caries Diagnosis :-***

1. Visual examination :- The clinical visual examination consisting of five stages form the basis of caries diagnosis.

a- Systematic :- Always start at the same place in the mouth – there is logic in making this the most distal surface in the upper right quadrant and working clockwise to the lower right, as these ties in with the FDI tooth notation. For every tooth, work round its surfaces in a systematic manner.

b- Clean :- Dental plaque is not translucent, so to diagnose even quite advanced lesions it must be removed. Polish the patient's teeth prior to attempting to diagnose caries.

c- Illumination :- The dentist requires a light source to make diagnosis possible. In addition to good illumination provided by a suitable positioned operating light, the use of a light source will facilitate trans-illumination.

d- Dry :- The detection of caries in its early stages relies on the differences in the porosity and therefore refractive index of caries versus sound dental hard tissue. When we dry the teeth we will have the ability to detect disease at its earliest visible stage (the white spot lesion).

- Drying the teeth helps with caries activity assessment :- A white spot enamel lesion has a matt enamel (acid-etched appearance) surface; this frequently indicates an active lesion. A lesion with a glossy surface is often arrested.

e- Put the sharp probe away :- For many years a visual-tactile examination rather than a purely visual examination was the mainstay of caries diagnosis. This should no longer be the case for a number of reasons :-

- The use of a probe does not improve the accuracy of caries diagnosis.
- Probing of a demineralized site (which has the potential to remineralise) will further destroy the enamel structure creating an iatrogenic cavity and preventing any possibility of remineralization.
- There is the possibility of inoculating other sites with cariogenic bacteria.

However, a blunt probe, such as a periodontal probe, can be used to remove plaque from fissures using a dredging motion. As it can be problematic determining if a brown spot lesion is cavitated or not, the side of a blunt probe may also be used to confirm if a surface has broken down.

2. Radiographs :- The views that are of value for caries diagnosis are :-

a- Bitewing :- is the 1st choice of caries diagnosis, provide information on both occlusal dentine caries and proximal enamel and dentine caries.

b- Orthopantomogram (OPG) :- can detect the presence of an occlusal dentine carious lesion with a high degree of accuracy. Proximal surface lesions can also be seen on OPG but with much lower accuracy than with bitewings.

c- Bimolar view :- Bimolars are not as useful a view as bitewings because there is often overlap of structures. However, they are of use in the pre-cooperative child who will not cope with bitewings or an OPG.

d- Periapical view :- are as accurate as bitewings for caries diagnosis, but obviously less information is available on any one film. The key role of the periapical view is in the diagnosis of periodontal disease, periapical disease and the diagnosis and monitoring of dental traumatic injuries.

3. Adjuncts Aids to Caries Diagnosis :-

a- Magnification :- During restorative treatment, dentists are increasingly using magnification to assist with the preparation of teeth. Magnification can also help with the detection and diagnosis of caries.

b- Fibre-Optic Trans-illumination (FOTI) :- FOTI helps with the detection of proximal enamel and dentinal lesions, and occlusal dentinal caries. Clinically, FOTI can be used in a number ways – for example, the dentist can use it routinely at every examination helping to decide if radiographs are indicated.

- It can also be used to provide further information when, despite a thorough clinical visual examination and radiographs, the clinician still remains unsure. One particular use of FOTI is to help differentiate between staining and caries on the occlusal surface.

c- Temporary Tooth Separation (TTS) :- The placement of an orthodontic separator for about three to four days to move the teeth apart allows direct visual access to a surface for diagnosis. The tooth returns to its original position following removal of the separator within hours.

- This approach has two significant **advantages** over bitewing radiography :-
- The avoidance of exposure to ionizing radiation.
- The ability to detect whether the surface is cavitated.

The **drawbacks** of TTS :- the patient may experience some discomfort while the separator is in place, and this discomfort is likely to be greater if all contacts are separated.

d- Laser Fluorescence :- The currently available commercial device (Diagnodent, KaVo Germany) measures the fluorescence of the porphyrins made by bacteria in the caries. This device is designed for the diagnosis of occlusal caries but it can be used on accessible smooth surfaces.

-It is not designed to be a screening tool, where it is likely to generate a number of false positive diagnoses, but to aid the dentist with equivocal lesions. In use, the dentist applies the probe tip to

the tooth surface under investigation and a digital reading indicates the status of the surface through sound to deep dentin caries.

e- Electric Caries Meter (ECM) :- Enamel is a very poor conductor of electricity. However, following carious attack the enamel becomes more porous and the ions present in the pores in the lesion will conduct electricity with much less resistance than sound enamel. This is the principle behind the working of the ECM (ECM Lode Netherlands).

- Like the laser fluorescence devices, the ECM is principally of use on occlusal surfaces. ECM is technique-sensitive. Of particular relevance to pediatric dentistry is that the ECM is not reliable on immature teeth.

- All of the above methods have both advantages and disadvantages, but they should be considered a toolkit from which the dentist selects to improve the accuracy of caries detection and diagnosis.

*** The Caries Classification :-**

- Carious lesions can be classified according to their anatomical site. There is nothing chemically special about these sites.

1. Lesions may commonly be found in pits and fissures or on smooth surfaces. Smooth surface lesions may start on enamel (enamel caries) or on the exposed root cementum and dentin (root caries).

2. Primary caries is used to differentiate lesions on natural, intact tooth surfaces from those that develop adjacent to a filling, which are commonly referred to as recurrent or secondary caries. As such, the etiology of both is similar

3. Residual caries, as the term implies, is demineralized tissue that has been left behind before a filling is placed.

- An important classification is whether a lesion is cavitated or noncavitated, as it impinges directly on the management of the lesion.

- Caries lesions may also be classified according to their activity. This is a very important concept and one that impinges directly on management, although it will be evident from the text that the clinical distinction between active and inactive (arrested) lesions is sometimes difficult.

- Clinically, if in doubt the dentist should always react as though he or she is dealing with an active lesion. A lesion considered to be progressing (the lesion would have developed further at a subsequent examination if not interfered with) would be described as an active carious lesion. In contrast to this is a lesion that may have formed years previously and then stopped further progression. Such lesions are referred to as arrested carious lesions or inactive carious lesions.

- The first sign of a carious lesion on enamel that can be detected with the naked eye is often called a white-spot lesion. This appearance has also been described as an early, initial or incipient lesion, but not all white-spot lesions are incipient! These terms are meant to say something about the ***stage of lesion development.***

- ***Rampant caries*** is the name given to multiple active carious lesions occurring in the same patient. This frequently involves surfaces of teeth that do not usually experience dental caries.
- These patients with rampant caries can be classified according to the assumed causality, e.g. bottle or nursing caries, early childhood caries, radiation caries or drug-induced caries.
- ***Hidden caries*** is a term used to describe lesions in dentin that are missed on a visual examination but are large enough and demineralized enough to be detected radiographically. It should be noted that whether a lesion is actually hidden from vision depends on how carefully the area has been cleaned and dried and whether an appropriate clinical examination has been performed.

*** The Caries Etiology :-**

• Dental caries is a multifactorial disease

–The primary factors are :-

1- The tooth
2- The microorganisms
3- Fermentable Carbohydrates
4- Time

–The secondary factors are :-

A. Local factors :-

1- Anatomy of the teeth in early eruption
2- Crowding or irregular teeth (makes cleaning difficult)
3- Presence of dental appliances, e.g. partial denture , space maintainer, orthodontic appliances

B. Systemic factors :- **Such as :-**

1. Childhood Fever and Caries Susceptibility :-

- Common childhood illnesses such as :- (chickenpox, measles, middle ear infections, fevers caused respiratory or urinary tract infections, and other fevers that cause skin rashes because enamel and skin share a common ectodermal origin) all can affect the coincidental dental hard-tissue formation. This can result in hypomineralization and discoloration, due to :-

a- Altered tooth morphology
b- Enamel porosity
c- Difficulties in maintaining good oral hygiene due to sensitivity.

- An example of this is molar incisor hypomineralization (MIH), in which the permanent incisors and first permanent molars are affected (and possibly also the tips of the canines). The affected teeth appear to be prone to posteruptive enamel loss.

2. Inherited defects :- Children with congenital enamel defects such as amelogenesis imperfecta or disease of the other dental hard tissues (e.g. dentinogenesis imperfecta) may be more susceptible to caries, but these conditions are rare.

3. “ Family ” caries :- Families do tend to pass on their dietary habits through generations. Therefore, granny losing her teeth early could be an indication of a “sweet tooth” being a family phenomenon.

- Furthermore; Streptococcus mutans, the main pathogen responsible for caries, is transmissible and there is very good evidence to show that it is passed from mother to baby.

4. Medicines :- in particular, elixirs, CAN cause caries BUT only if they contain sugar. Some medicines are sucrose-free, but may contain other sugars such as glucose syrup. “Sugars-free” means no sugar at all.

- Dentists and their teams should advise parents and medical and pharmacy colleagues to add the letters ‘’ SF ‘’ for sugars-free to written prescriptions – this is particularly important in cases in which repeated prescriptions are required.

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**** Rampant Dental Caries :-***

- Rampant caries has been defined by Massler as a "suddenly appearing, widespread, rapidly burrowing type of caries, resulting in early involvement of the pulp and affecting those teeth usually regarded as immune to ordinary decay."
- There is no evidence that the mechanism of the decay process is different in rampant caries or that it occurs only in teeth that are malformed or inferior in composition. On the contrary, rampant caries can occur suddenly in teeth that were previously sound for many years.
- The sudden onset of the disease suggests that an overwhelming imbalance of the oral environment has occurred, and some factors in the caries process seem to accelerate it so that it becomes uncontrollable; it is then referred to as rampant caries.
- Young teenagers seem to be particularly susceptible to rampant caries, although it has been observed in both children and adults of all ages.

- Etiology :-

1. It is usually due to poor oral hygiene and taking frequent cariogenic snacks and sweet drinks between meals.

2. Patient behavioral pattern and/ or parent overindulgence /parent ignorance.

3. There is considerable evidence that emotional disturbances may be a causative factor in some cases of rampant caries.

- Repressed emotions and fears, dissatisfaction with achievement, a traumatic school experience, and continuous general tension and anxiety have been observed in children and adults with rampant caries.
- An emotional disturbance may initiate an unusual craving for sweets or the habit of snacking, which in turn might influence the incidence of dental caries.

4. Additional Factors :-

A. SALIVA :- Any patient with a salivary deficiency, from any cause, is at a higher risk for caries activity. It is generally accepted that the dental caries process is controlled to a large extent by a natural protective mechanism inherent within the saliva.

- A reduction in the salivary flow may be temporary or permanent. A pronounced reduction or complete absence of saliva, however, results in an acidic environment with rampant caries.
- It has long been suggested that the viscosity of saliva is related to the rate of dental decay. Both thick, ropy saliva and thin, watery saliva have been blamed for rampant dental caries.

B. SOCIOECONOMIC STATUS :- Children and adolescents living in poverty suffer twice as much tooth decay as their more affluent peers, and that their disease is more likely to go untreated

C. ANATOMIC CHARACTERISTICS OF THE TEETH :- Certain teeth of many patients, particularly permanent teeth, seem vulnerable to dental caries as they emerge, and in caries-active mouths, they may show evidence of the attack almost coincident with their eruption into the oral cavity.

- Because enamel calcification is incomplete at the time of eruption of the teeth and an additional period of about 2 years is required for the calcification process to be completed by exposure to saliva, the teeth are especially susceptible to caries formation during the first 2 years after eruption.
- Permanent molars often have incompletely coalesced pits and fissures with or without hypoplasia that allows the dental plaque material to be retained at the base of the defect.
- In addition to occlusal surfaces, lingual pits on the maxillary permanent molars, buccal pits on the mandibular permanent molars, and lingual pits on the maxillary permanent lateral incisors are vulnerable areas in which the process of dental caries may proceed rapidly

**** CLINICAL FEATURES :-***

- Seen in primary and permanent dentition :-

• **In primary teeth** features are related to order of tooth eruption. Initial lesions appear on labial surface of maxillary incisors near the gingival margin as a white area/ pitting on enamel surface.

• **In permanent teeth**

–Related to the eruption of teeth.

–Buccal and lingual surface of premolar and molar are involved.

– Proximal and labial surface of maxillary incisors and proximal surface of mandibular incisors are involved.

**** COMPLICATIONS :-***

1- Affects maxillary anteriors which may lead to psychological problem

2- Minimal trauma can lead to fracture of teeth

3- Difficulty in speech.

4- Development of abnormal habits

5- Orthodontic problems
6- Multiple abscess formation
7- General health impaired and hospitalization may be required.

**** EARLY CHILDHOOD CARIES :-***

**** DEFINITION :-***

- The American Academy of Pediatric Dentistry (AAPD) defines early childhood caries (ECC) as the presence of one or more decayed (noncavitated or cavitated), missing (as a result of caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. **OR** it is the occurrence of any sign of dental caries on any tooth surface during the first 3 years of life.
- AAPD also specifies that, in children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (SECC).
- Caries affects the maxillary primary incisors and first primary molars in a way that reflects the pattern of eruption. The longer the tooth has been present and exposed to the caries challenge, the more it will be affected.
- The upper incisors are most vulnerable, while the mandibular incisors are protected by the tongue and saliva from submandibular and sublingual glands. Common terms for rampant caries in infants or preschool children have been „bottle caries" or „nursing caries", but the terms ECC, and S-ECC in severe cases, are now more commonly used.
- The lesions progress rapidly; they can be extensive and typically affect free smooth surfaces. Often the lesions cover many surfaces in each affected tooth. In severe cases front teeth break down during eruption and parents may associate this with developmental defects rather than caries. The pulp may be involved and thus a need for extraction in these very young children is the result.

**** "ECC": WHERE THE NAME CAME FROM AND WHY ?***

- Human breastfeeding in infants has many advantages and has not been epidemiologically associated with caries in the absence of other factors such as poor oral hygiene or a carbohydrate diet. Frequent nighttime bottle feeding with milk is associated with, but not consistently implicated in, SECC.
- Breastfeeding more than seven times daily after 12 months of age is associated with increased risk for ECC. Bovine milk, milk formulas and human breast milk have all been implicated in nursing caries because of their lactose content. Additional sweeteners in form of juice, honey dipped pacifiers can also cause this type of caries. Nursing bottle can effectively block the salivary access to the tooth surface, thereby increasing the cariogenicity of oral flora.
- Nighttime bottle feeding with juice, repeated use of a sippy or no-spill cup, and frequent between-meal consumption of sugar-containing snacks or drinks (e.g., juice, formula, soda) will increase the risk of caries.
- The child falls asleep, and the liquid becomes pooled around the teeth (the lower anterior teeth tend to be protected by the tongue). The carbo-hydrate-containing liquid provides an excellent

culture medium for acidogenic microorganisms. Salivary flow is also decreased during sleep, and clearance of the liquid from the oral cavity is slowed.

**** ETIOLOGY :-***

1- Exposure for long periods of time to cariogenic substrates (usually sugary drinks, sweetened or fruit-based drink) in nursing bottles and/or feeder cups given as pacifiers or dinky feeder.

2- Nursing bottle given at bedtime.

3- Low salivary rates at night.

4- Reduced buffering capacity.

5- Parental history of caries (especially mother).

6- Associated with low socio-economic status , low educational level of parents and ethnic minorities

7- Enamel defects and malnutrition may also play a role.

8- Overindulgence of parents, and crowded homes.

9- Malnutrition and low-birth weight infants (less than 2500 gm)

10- Recently, it has been seen that salivary gland function is impaired by iron deficiency, excess of lead exposure, which makes the oral environment more caries susceptible.

**** Some of the key biologic correlates of ECC :-***

1. Breast-feeding and bottle-feeding :-

- What is clear from the literature is that some children nurse in ways that either correlate with or lead directly to ECC, while the majority of breast-fed children do not experience ECC.
- Similarly, the majority of children who present with the nursing habit–associated pattern have a positive history of inappropriate bottle or sippy cup usage while the converse (that the majority of children who have a positive history of inappropriate bottle or sippy cup usage have ECC) is not true.

2. Diet :-

- Children in a "high-carbohydrate soft drink" group had higher caries experience than children in a high-juice group, high-water group, and high milk group, with the last having the least caries experience.
- Other indicators of poor diet and nutrition have also been correlated with cavities in young children. For example, not eating breakfast on a daily basis and not consuming the recommended five fruits and vegetables daily are associated with overall ECC experience.

3. Salivary mutans streptococci levels and visible plaque :-

- As with high-sugar diets, the associations between mutans streptococci, plaque, and caries are very well established. Multiple studies since the mid-1970s relate mutans levels in children to mutans levels in the mouths of their primary caregivers, suggesting that managing adult reservoirs and interfering with transmission may hold strong promise to reduce disease onset and experience.

**** PROGRESSION OF LESION :-***

1- Initially a demineralized dull, white area is seen along gum line on the labial aspect of maxillary incisors, which is undetected by parents.

2- These white lesions become cavities which involve the neck of tooth in a ring-like lesion.

3- Finally, the whole crown of incisors is destroyed leaving behind brown black root stumps.

- This unique pattern and unequal severity of the lesion is due to three factors :-

1- Chronology of primary tooth eruption

2- Duration of deleterious habits of feeding

3- Muscular pattern of infant sucking.

**** IMPLICATIONS (CONSEQUENCES) :-***

1- The child who has nursing caries has an increased risk of caries in permanent dentition

2- Children with caries are susceptible to other health hazards

3- The treatment of nursing caries may be a financial burden to some parents.

4- Loss of the upper primary incisors does not result in space loss.

5- Speech develops normally.

6- Loss of primary molars may lead to space loss and a space analysis should be performed to determine whether a space maintainer is needed. This is especially the case for the second primary molars whose early loss can lead to mesial positioning of the first permanent molars.

**** DIFFERENTIAL DIAGNOSIS :-***

1- Rampant caries

2- Radiation caries

3- Enamel hypoplasia.

**** MANAGEMENT :-***

- Aims :-

• Management of existing emergency

• Arrest and control of caries process

• Institution of preventive procedures

• Restoration and rehabilitation.

*** Factors Affecting Management :-**

• Extent of lesion

• Age of patient and its related behavioral problems of child

i. Prevention :-

1- The main strategies for prevention is to aware and alert the parents, prospective new parents about the condition and its cause

2- Information on nursing caries can be distributed to new parents through; obstetricians or gynecologists, pediatrics, paramedical staff, health workers, maternal and child health care centers

3- Sealing of all caries free pits and fissures

4- Topical fluoride application and antimicrobial therapy
5- Water fluoridation in suboptimal fluoride water level areas
6- Supervised home care should be taught
7- Broad committees at government level to address the issue of caries and risk factors in young children and how to recognize the early signs of the condition and promote early intervention.
8- Caries vaccine :- A vaccine to prevent the disease of dental caries has been an anticipated scientific breakthrough since at least the early 1940s.
- Research efforts assume that MS is the principal etiologic organism of dental caries, and the development of a method of immunization specifically targeted at neutralizing MS has been a major thrust of caries vaccine research.
- Bowen reported that monkeys remained caries-free for more than 6 years after the animals received intraoral injections of killed MS, even though the monkeys were fed highly cariogenic diets and had severe malocclusion that would predispose them to caries. The route of administration of the vaccine is usually mucosal absorption by intraoral or intranasal tissues.

ii. Proper treatment :- <u>Divided into 3 visits :-</u>

*** First Visit :-**

- This phase of treatment constitutes treatment of the lesion, identification of cause for counseling of parents.
- All lesions should be excavated and restored

1- Assess cooperation of child and decide on whether treatment will be conducted using local anaesthesia, sedation or general anaesthesia.
2- If abscess is present it is treated through drainage
3- Restoration of primary molars depending on extent of caries and cooperation of child with either composite, glass ionomer cement, pulpotomy, pulpectomy and preformed metal crowns (SSCs).
4- Antibiotics should be prescribed where acute soft tissue swelling or signs of systemic involvement (e.g. pyrexia) are present.
5- X-rays are advised to assess the condition of succedaneous teeth
6- Collection of saliva for determining salivary flow and viscosity

**** Parent Counseling :-***

1- The parents are questioned about the child's feeding habit, especially regarding the use of nocturnal bottles
2- The parent should be asked to try weaning the child from using the bottle as pacifier while in bed
3- In case, considerable emotional dependence on bottle, suggest the use of plain or fluoridated water
4- The parent should be instructed to clean child's teeth after every feed.

5- Parents are advised to maintain a diet record of the child for one week which include time, amount of food given, the type of food, number of sugar exposure.

*** Second Visit :-**

- It should be scheduled one week after the first visit.

1- Analysis of diet chart and explanation of disease process of child's teeth should be undertaken by simple equation

2- Isolate the sugar factors from diet charts and control sugar exposure by intelligent use

3- Reassess the restoration or redo if needed

4- Caries activity test can be started and repeated at monthly interval to monitor the success of treatment.

*** Third and Subsequent Visits :-**

1- Restoring all grossly decayed tooth and Endodontic treatment

2- Crowns can be done for grossly destructed teeth or endodontically treated teeth

3- Extraction of unrestorable teeth, followed by space maintainers are used

4- Review and recall after 3 months.

- Rampant caries vs. early childhood caries :-

	Rampant caries	Early childhood caries
1	*Acute, burrowing type of caries and showed early involvement of pulp. Involving those surfaces which are usually immune to decay.*	*It is a specific form of rampant caries*
2	*It occurs in all age group including adolescence*	*It occurs in infants toddler or preschoolers*
3	*It occurs in both primary and permanent dentition*	*Affect the primary dentition only*
4	*Mandibular incisors are Usually, affected*	*mandibular incisors are not affected*
5	*Multifactorial etiology like frequent snacking excessive sticky refined carbohydrate intake, decrease, salivary flow and genetic background.*	*Primarily associated to improper feeding practice such as bottle feeding or breast feeding or pacifier feeding during sleep.*
6	*If pulp is exposed, it requires pulp therapy or RCT*	*If diagnosed in early stage it can be managed by topical fluoride application and dental education.*

Department of P.O. P

Paediatric Dentistry / Fourth Stage

Lec. 11 / Dr. Suhair W. Abbood

Restorative Dentistry for Children

- Restorative Dentistry for Children :-

- Today the dentist devotes more time to preventive procedures and less time to the routine restoration of caries-affected teeth. Nevertheless, restoration of caries lesions in primary and young permanent teeth continues to be among the important services that pediatric dentists and general practitioners provide for the children in their practices.

- Guideline on Pediatric Restorative Dentistry :-

- Restorative treatment is based on the results of an appropriate clinical examination and is ideally part of a comprehensive treatment plan. The treatment plan should consider the following :-

1. The developmental status of the dentition
2. A caries-risk assessment
3. Patient's oral hygiene
4. Anticipated parental compliance and likelihood of timely recall
5. Patient's ability to cooperate for treatment

- The restorative treatment plan must be prepared in conjunction with an individually tailored preventive program.
- Restoration of primary teeth differs significantly from restoration of permanent teeth, due in part to the differences in tooth morphology.

- Maintenance of a Clean Field :-

- The maintenance of a clean operating field during cavity preparation and placement of the restorative material helps ensure efficient operation and development of a serviceable restoration that will maintain the tooth and the integrity of the developing occlusion.
- The rubber dam aids in the maintenance of a clean field. It is generally agreed that the use of the rubber dam offers the following advantages :-

1. Saves time :- The dentist who has not routinely used the rubber dam needs only to follow the routine or a modification of it for a reasonable period to be convinced that operating time can be appreciably reduced. The time spent in placing the rubber dam is negligible, as long as the dentist works out a definite routine and uses a chairside assistant.

2. Aids management :- It has been found through experience that apprehensive children can often be controlled more easily with a rubber dam in place. Because the rubber dam efficiently controls the patient's tongue and lips, the dentist has greater freedom to complete the operative procedures.

3. Controls saliva :- Control of saliva is an extremely important consideration when one is completing an ideal cavity preparation for primary teeth. The margin of error is appreciably reduced when a cavity is prepared in a primary tooth that has a large pulp and extensive caries involvement. Small pulp exposures may be more easily detected when the tooth is well isolated. It is equally important to observe the true extent of the exposure and the degree and type of hemorrhage from the pulp tissue. Thus the rubber dam aids the dentist in evaluating teeth that are being considered for vital pulp therapy.

4. Provides protection :- The use of the rubber dam prevents foreign objects from coming into contact with oral structures. When filling material, debris, or medicaments are dropped into the mouth, salivary flow is stimulated and interferes with the operative or restorative procedure. A rubber dam also prevents the small child in a reclining position from swallowing or aspirating foreign objects and materials.

5. Helps the dentist educate parents :- Parents are always interested in the treatment that has been accomplished for their child. While the rubber dam is in place, the dentist can conveniently show parents the completed work after an operative procedure. The rubber dam creates the feeling that the dentist has complete control of the situation and that a thorough effort has been made to provide the highest type of service.

- Armamentarium for Rubber Dam Placement :-

- The armamentarium consists of 5×5-inch sheets of medium latex, a rubber dam punch, clamp forceps, a selection of clamps, a flat-blade instrument, dental floss, and a rubber dam frame.
- If one visualizes an approximately 1¼ -inch square in the center of a sheet of rubber dam, each corner of the square indicates where the punch holes for the clamp-bearing tooth in each of the four quadrants of the mouth are to be made.
- As experience is gained in applying the dam, the dentist and assistant will soon learn the proper location for punching the holes.
- If the holes are punched too far apart, the dam will not readily fit between the contact areas. In addition, the greater bulk of material between the teeth will greatly increase the possibility that the rubber will become a barrier to proximal surface preparation.

- Conversely, if the holes are punched too close together, salivary leakage will contaminate the operating field. In general, the holes should be punched the same distance apart as the holes on the cutting table of the rubber dam punch.
- The large punch hole is used for the clamp-bearing tooth and for most permanent molars, the medium sized punch hole generally is used for the premolars and primary molars, the second smallest hole is used for maxillary permanent incisors, and the smallest hole is adequate for the primary incisors and lower permanent incisors.

- Selection of a Clamp :-

- Proper selection of a clamp is of utmost importance. It is recommended that the clamp be tried on the tooth before the rubber dam is placed, to ascertain that the clamp can be securely seated and will not be easily dislodged by the probing tongue, lip, or cheek musculature.
- An 18-inch length of dental floss should be doubled and securely fastened to the bow of the clamp. The floss will facilitate retrieval in the unlikely event that the clamp slips and falls toward the pharynx.

- Rubber Dam Application :-

- The dentist grasps the clamp forceps with the clamp engaged. The assistant, seated to the left of the patient (the dentist is right-handed in this example), grasps the upper corners of the dam with the right hand and the lower left corner between the left thumb and index finger.
- The dam is moved toward the patient's face as the dentist carries the clamp to the tooth while holding the lower right portion of the dam. If necessary, light finger pressure may seat the clamp securely by moving it cervically on the tooth. After securing the clamp on the tooth, the dentist then places the frame over the rubber dam.
- Together, the assistant and dentist attach the corners of the dam to the frame. If additional teeth are to be isolated, the rubber is stretched over them, and the excess rubber between the punched holes is placed between the contact areas with the aid of dental floss.
- The most anterior tooth and others, if necessary, are ligated to aid in the retention of the dam and prevention of cervical leakage. The free ends of the floss are allowed to remain because they may aid in further retraction of the gingival tissue or the patient's lip during the operative procedure.
- At the end of the operative procedure, the length of floss will also aid in removing the ligature. If the first or second permanent molar is the only tooth in the quadrant that exhibits caries and if it requires only an occlusal preparation, it is often desirable to punch only one hole in the dam and isolate the single tooth.
- This procedure will require only seconds and will save many minutes. Due to an increase in latex allergies, latex-free rubber dams are available and used in the same manner already described.

**** Recent Modifications :-***

- Quick Dam or Insta-Dam :-

1- These are new types of rubber dams that have pre-attached frame

2- Ease of application

3- Minimal time consumption in placement

4- Use of X-ray is more simplified with this type of dam

5- They can either have a rectangle or circle pattern.

- Optra Dam :-

- This is a type of quick dam for anterior segment where it can be fixed directly without use of any retainer clamps or for a posterior segment by the aid of clamp for retention.

- Its method of application is quiet simple by punching the holes corresponding to the size of the expected teeth. The rubber dam is stretched over the rubber dam clamps or the teeth. The exposed area between the teeth is then sealed with a caulking agent like Oraseal. This ensures that there is no leakage.

- Isolite System :-

- The Isolite system has also been recommended for achieving an isolated field. This dental isolation device is designed to function as a vacuum suction and to provide intraoral illumination. The system helps retract the tongue and has an integrated six-foot-long vacuum/power silicone hose that connects easily to most standard high volume ports.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 12 / Dr. Suhair W. Abbood

Morphological Considerations in Cavity Preparation of Primary Teeth :-

- The crowns of the primary teeth are smaller but more bulbous than those of the corresponding permanent teeth, and the molars are bell-shaped, with a definite constriction in the cervical region.
- The characteristic sharp lingual inclination occlusal to the facial surfaces results in the formation of a distinct facio-gingival ridge that ends abruptly at the cemento-enamel junction.
- The sharp constriction at the neck of the primary molar necessitates special care in the formation of the gingival floor during class II cavity preparation.
- The buccal and lingual surfaces of the molars, sharply converging occlusally, form a narrow occlusal surface or food table; this is especially true of the first primary molar.
- The pulpal outline of the primary teeth follows the dentino-enamel junction more closely than that of the permanent teeth.
- The pulpal horns are longer and more pointed than the cusps would indicate. The dentin also has less bulk or thickness, so the pulp is proportionately larger than that of the permanent teeth.
- The enamel of the primary teeth is thin but of uniform thickness. The enamel surface tends to be parallel to the dentino-enamel junction.

- Basic Principles in Cavity Preparation in Primary Teeth :-

- Traditional cavity preparations for class I and class II lesions include areas that have caries involvement and may be areas that retain food and plaque material and considered areas of potential caries involvement.
- A flat pulpal floor is generally advocated. However, a sharp angle between the pulpal floor and the axial wall of a two-surface preparation should be avoided.
- Rounded angles throughout the preparation will result in less concentration of stresses and will permit better adaptation of the restorative material into the extremities of the preparation.

- Although the traditional class I cavity preparation and restoration may occasionally be the most practical treatment for a tooth in certain circumstances, such treatment is currently obsolete for most class I lesions.
- The traditional treatment has been replaced, for the most part, by conservative caries excavation and restoration with a combination of bonding restorative and sealant materials.
- Likewise, the traditional class II cavity preparation and restoration, although not yet considered obsolete, are currently used less frequently as steadily improving restorative materials with therapeutic and bonding capability are developed.
- In the traditional class II cavity preparation for amalgam, the buccal and lingual extensions should be carried to self-cleansing areas. The cavity design should have greater buccal and lingual extension at the cervical area of the preparation to clear contact with the adjacent tooth. This divergent pattern is necessary because of the broad, flat contact areas of the primary molars and because of the distinct buccal bulge in the gingival third.
- Ideally the width of the preparation at the isthmus should be approximately one-third the inter-cuspal dimension. The axio-pulpal line angle should be beveled or grooved to reduce the concentration of stresses and to provide greater bulk of material in this area, which is vulnerable to fracture.

- Cavity Preparation in Primary Teeth :-

- The steps in cavity preparation in a primary tooth are not difficult, but they do require precise operator control. Many authorities advocate the use of small, round-ended carbide burs in the high-speed hand-piece which allow for conservative cavity preparations with rounded line angles and point angles.
- Alternatively, cavity preparations may be made with aluminum oxide air abrasion systems or with laser systems approved for hard-tissue procedures, when indications allow.

- Cavity Preparation in Primary Teeth :-

- For patients younger than 2 years with a small but definite carious lesion in the central fossa of first primary molars, A No. 329 or No. 330 bur is used to open the decayed area and extend the cavo-surface margin only to the extent of the caries lesion. If the patient is resistant (usually), completing the preparation with an air abrasion or laser system would be inconvenient.
- The preparation can be completed in just a few seconds. Restoring the tooth with amalgam or a resin-modified glass ionomer arrests the decay and at least temporarily prevents further tooth destruction without a lengthy or involved dental appointment for the child.

- Deep-Seated Class I Cavity :-

- If an **amalgam** restoration is planned, the first step in the preparation of an extensive class I cavity is to the enamel. The caries-affected dentin should next be removed with large, round burs or spoon excavators. If a caries exposure is not encountered, the cavity walls should be finished

first. With deep carious lesions and near pulp exposures, the depth of the cavity should be covered with a biocompatible base material to provide adequate thermal protection for the pulp.

- If a **resin-based composite** and/or **glass-ionomer restoration** is planned, any disease-free pits and grooves may be sealed as part of the bonded restoration. The restorative material also provides thermal insulation to the pulp.

- Class II Cavity :-

- Proximal lesions in a preschool child indicate excessive caries activity; a preventive and restorative program should be undertaken immediately.

- Small Lesions :-

- Very small incipient proximal lesions may be chemically restored with topical fluoride therapy provided by the dentist, along with the judicious use of fluoride products designed for topical application at home, improved diet and improved oral hygiene, and periodic examinations; some incipient proximal lesions may remineralise or remain in an arrested state indefinitely.
- As bonded restorations have improved, especially those restorations capable of fluoride release, more conservative cavity preparation designs have also been advocated. In otherwise sound teeth free of susceptible pits and fissures, accessing small class II caries lesions via small openings in the marginal ridges or in the facial surfaces of the teeth are becoming
popular techniques.
- Gaining access to the lesion with openings only large enough to allow caries excavation is the goal. Using resin-modified glass-ionomer materials result in excellent restorations for this conservative procedure.

- Lesions with Greater Dentin Involvement :-

- The first step in the traditional preparation of a class II cavity in a primary tooth involves opening the marginal ridge area. Extreme care must be taken to prevent damage to the adjacent proximal surface.

- Amalgam :-

- The gingival seat and proximal walls should break contact with the adjacent tooth.
- The angle formed by the axial wall and the buccal and lingual walls of the proximal box should approach a right angle.
- The buccal and lingual walls necessarily diverge toward the cervical region, following the general contour of the tooth.
- The occlusal extension of the preparation should include any caries susceptible pits and fissures. If the occlusal surface is sound and not caries-susceptible, then a minimal occlusal dovetail is still often needed to enhance the cavity retention form.
- If caries affected tooth structure remains after the preparation outline is established, it should be removed next.

- The appropriate liner or intermediate base, and a snug-fitting matrix should be placed before the amalgam is inserted.

- Aesthetic Materials :-

- The preparation and restoration may be similar to those for amalgam when significant caries exists on both the occlusal and proximal surfaces. However, little or no occlusal preparation may be required when the occlusal pits and fissures are caries-susceptible but sound or incipient.
- The proximal restoration may then be combined with the application of an occlusal sealant (with or without enameloplasty). Whenever composite restorative materials are used, enamel beveling, etching, and application of bonding agents are recommended.
- It has been demonstrated that the placement and finishing of posterior composite restorations are significantly more time consuming than those for comparable amalgam restorations. In addition to increasing the cost of care, the extra time required for treatment may complicate patient management for some young patients.

- Class III Cavity :-

- Carious lesions on the proximal surfaces of anterior primary teeth sometimes occur in children whose teeth are in contact and in children who have evidence of arch inadequacy or crowding. Caries involvement of the anterior primary teeth, however, may be interpreted as evidence of excessive caries activity requiring a comprehensive preventive program.
- If the carious lesion has not advanced appreciably into the dentin and if removal of the caries will not involve or weaken the incisal angle, a small conventional class III cavity may be prepared and the tooth may be restored with the dentist's choice of bonding materials.
- Primary incisors with small proximal carious lesions may not require conventional restorations at all. Enameloplasty of the affected proximal surface (usually described as "disking") to open the proximal contact and remove most, if not all, of the cavitation, followed by topical fluoride varnish, will often suffice until the teeth exfoliate naturally.
- Extraction is usually indicated when primary incisors have extensive caries. (Unrestorable by any type of treatment).

- Modified Class III Cavity Preparation :-

- The modified class III preparation uses a dovetail on the lingual or occasionally on the labial surfaces of the tooth. A lingual lock is normally considered for the maxillary canine, whereas a labial lock may be more conveniently prepared on the mandibular teeth, for which the aesthetic requirement is not as important.
- The preparation allows for the additional retention and access necessary for proper insertion of the restorative material. It is indicated for the distal surface of the primary canine in which

the position of the tooth in the arch, the characteristically broad contact between the distal surface of the canine and the mesial surface of the primary molar, and the height of the gingival tissue sometimes make it difficult to prepare a typical class III cavity and restore it adequately.

- Class IV Cavity Preparation :-

- One type of preparation used for the aesthetic restoration of primary incisors in which dental caries approximates or involves the incisal edge of the teeth. As with other operative procedures for the pediatric patient, the use of the rubber dam is helpful.
- The preparation includes a proximal reduction through the incisal angle and the caries lesion, and ends at the established cervical seat. Labial and lingual locks are then prepared in the cervical third of the tooth. The remaining caries is removed, the tooth is etched, and a bonding agent is applied.
- A properly placed matrix tightly wedged at the cervical seat aids the operator in placing, shaping, and holding the resin-based composite during the curing process. A good matrix also simplifies the finishing procedures.
- Beveling the enamel margins slightly before etching, to further improve the marginal bonding of the restoration had been recommended. Final polishing may be accomplished with the rubber cup and a fine, moist abrasive material or one of the composite polishing systems.

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Paediatric Dentistry / Fourth Stage

Lec. 13 / Dr. Suhair W. Abbood

** Restorative Materials Used in Paediatric Dentistry . . . . . (1)*

- Status of Common Restorative Materials :-

- Advances in the development of improved biomaterials for dental restorations have been rapid, and they continue to occur at a fast pace. The more common restorative materials used in pediatric dentistry are composite and other resin systems, glass ionomers, silver amalgam alloys, and stainless steel alloys.
- Porcelain, zirconia, and cast metal alloy materials are also used in pediatric restorative dentistry but less frequently. Resin-based composites, glass ionomers or some combination of the two are being used progressively more and silver amalgam progressively less in pediatric restorative dentistry; many pediatric dentistry practices do not use silver amalgam at all; instead, some form of resin-based composite or glass ionomer is used.
- It has been suggested that these materials and their combinations on a continuum, with glass ionomer on the left, resin-based composite on the right, and the combined materials somewhere in between, depending on the relative amounts of each material in the mix. Two major categories on the continuum are described as ‘’ resin-modified glass ionomer’’ and ‘’ compomers ‘’ . A fifth formulation has been added on the right side of the continuum in the form of ‘’ flowable resin-based composite ‘’.
- Knowing the particular strengths and weaknesses of each type of material will enhance the clinician’s ability to make the best choices for each individual restorative situation. Use of any of these restorative materials generally requires more effort and time than those needed for conventional amalgam restorations.

- Composite :-

- Composite (componere = to combine) is the universally used tooth-colored direct restorative material developed in 1962 by combining dimethacrylates (epoxy resin and methacrylic acid) with silanized quartz powder.

- Factors that influence the composite resin polymerization process :-

1- Curing time :- It depends on: resin shade, light intensity, box depth, resin thickness, curing through tooth structure.

2- Shade of resin :- Darker composite shades cure more slowly and less deeply than lighter shades (60 seconds at a maximum depth of 0.5 mm).

3- Temperature :- Composite at room temperature cures more completely and rapidly.

4- Thickness of resin :- Optimum thickness is 1 to 2 mm

5- Type of filler :- Microfine composites are more difficult to cure than heavily loaded composites.

6- Distance between light and resin :- Optimum distance < 1 mm, with the light positioned 90 degrees from the composite surface.

7- Light source quality :- Wavelength between 400 to 500 nm.

8- Polymerization shrinkage :- Depends on the amount of organic phase.

- Types of Composite :-

- Hybrid composite resins :-

– These composites are so called because they are made up of polymer groups (organic phase) reinforced by an inorganic phase.

– The characteristic properties of these materials are :- Availability of a wide range of colors and ability to mimic the dental structure, less curing shrinkage, low water absorption, excellent polishing and texturing properties, abrasion and wear very similar to that of tooth structures, similar thermal expansion coefficient to that of teeth, universal formulas for both the anterior and posterior sector, different degrees of opaqueness and translucency in different tones and fluorescence.

- Flowable composites :-

– These are low-viscosity composite resins, making them more fluid than conventional composite resins.

– The percentage of inorganic filler is lower.

– **Their main advantages** are :- High wettability of the tooth surface, ensuring penetration into every irregularity; ability to form layers of minimum thickness, so improving or eliminating air inclusion or entrapment; radiopaqueness and availability in different colors.

– **The drawbacks** are :- High curing shrinkage, due to lower filler load, and weaker mechanical properties.

– These are indicated in Class V restorations, cervical wear processes and minimal occlusal restorations or as liner materials in Class I or II cavities or areas of cavitated enamel.

- Condensable composites :-

– Condensable composites are composite resins with a high percentage of filler.

– **The advantages** are :- Condensability (like silver amalgam), greater ease in achieving a good contact point and better reproduction of occlusal anatomy.

– **Their disadvantages** are :- Difficulties in adaptation between one composite layer and another, difficult handling and poor esthetics in anterior teeth.

– Indication is Class II cavity restoration in order to achieve a better contact point.

- Compomer :-

– The word ‘’ Compomer ‘’ comes from composite and glass ionomer in an attempt to take advantage of the desirable qualities of both materials; the fluoride release and ease of use of the glass ionomers and the superior material qualities and esthetics of the composites.

– Compomer restorations have been shown to have insufficient retention without pretreatment of the dental hard tissue with an adhesive system.

– They are most suitable for restorations in the deciduous dentition due to their low abrasion resistance.

– In cervical restorations, compomer restorations performed better than resin-modified glass ionomers but not as well as hybrid composites.

- Indications of composite (in general) :-

1- Classes I, II, III, IV, V and VI restorations
2- Foundations or core build-ups
3- Sealants
4- Preventive resin restorations
5- Esthetic enhancement procedures integrity such as :-
– Partial veneers
– Full veneers
– Tooth contour modifications
– Diastema closures
6- Cements (for indirect restorations)
7- Temporary restorations
8- Splinting

- Contraindications :-

1- If the operating site cannot be isolated from contamination by oral fluids
2- If all of the occlusal load will be on the restorative material
3- Economics
4- Restorations that extend onto the root surface may result in less than ideal margins.

- Advantages :-

1- Esthetic
2- Conservative of tooth structure removal
3- Tooth preparation is simple
4- Have low thermal conductivity
5- Used almost universally
6- Bonded to tooth structure
7- Exhibit greater occlusal wear in areas of high occlusal stress
8- Repairable

- Disadvantages :-

1- May have a gap formation and marginal leakage
2- Time-consuming
3- Costly
4- Establishing proximal contacts, axial contours, embrasures may be more difficult
5- Technique sensitive

- Silver Amalgam :-

- Despite its declining use; silver amalgam remains one of the most durable and cost-effective restorative materials. Success in the use of this filling material depends on adherence to certain principles of cavity preparation.
- Classification :-

• Based on copper content

– High copper content: Copper content more than 12 percent
– Low copper content: Copper content less than 6 percent

• Based on zinc content

– Zinc containing alloy with more than 0.01 percent zinc
– Zinc free alloys with less than 0.01 percent zinc

• Based on particle shape and type

– Lathe-cut :- Irregularly shaped filings produced by cutting an ingot of alloy on a lathe.
– Spherical particle :- Produced by atomizing the alloy, whilst still liquid into a stream of inert gas.

- Indications of Amalgam :-

1- Moderate-to-large restorations
2- Restorations that are not in highly esthetic areas of the mouth
3- Restorations that have heavy occlusal contacts
4- Restorations that cannot be well isolated
5- Restorations that extend onto the root surface
6- Abutment teeth for a removable partial denture
7- Temporary or caries control restorations.

- Contraindications of Amalgam :-

1- Esthetically prominent areas of posterior teeth

2- Small-to-moderate classes I and II restorations that can be well isolated

3- Class VI restorations.

- Advantages of amalgam :-

1- Ease of use

2- High tensile strength

3- Excellent wear resistance

4- Favorable long-term clinical research results

5- Lower cost than for composite restorations

- Disadvantages of Amalgam :-

1- Non-insulating

2- Non-esthetic

3- Less conservative and weakens tooth structure

4- More difficult tooth preparation

5- Initial marginal leakage

- Operatory Prevention :-

1- The operatory should be well ventilated.

2- All excess mercury, including waste, disposable capsules, and amalgam removed during condensation should be collected and stored in well-sealed containers containing water.

3- Proper disposal through reputable dental vendors is mandatory to prevent environmental pollution.

4- Amalgam scrap and materials contaminated with mercury or amalgam should not be incinerated or subjected to heat sterilization.

5- If mercury comes in contact with the skin, the skin should be washed with soap and water.

6- Use of carpeting is limited as it may incorporate mercury vapors and waste.

- Bonded Amalgams :- Some renewed interest in silver amalgam has occurred because of the development of ‘’ bonded amalgams ‘’.

- They are silver amalgam restorations that have been condensed into etched cavity preparations lined with a dentin-bonding agent and some material on the glass-ionomer–composite resin continuum.

- Properties :-

- Bonded amalgam restorations have significant advantages over both conventional amalgam restorations and posterior composite resin restorations.

- Cavity design :- Conventional amalgam restorations are retained by mechanical retention like undercut cavity design but bonded amalgam incorporation technique reduces the need for removal of sound tooth tissue to create mechanical retention.

- The ability to bond to enamel and dentin by the acid-etch technique.
- No polymerization contraction.
- Marginal leakage and loss of marginal integrity around conventional amalgam restorations have been recognized as serious disadvantages. Bonded amalgam restorations, however, show significantly less marginal leakage than conventional amalgam restorations.
- The use of bonded restorations in posterior teeth has been shown to reduce cuspal flexure and increase the structural integrity of the tooth when compared to conventional restorations.
- Bonded amalgams require considerable extra effort and expense to place compared with conventional amalgam restorations.
- In general, the use of bonded amalgams seems difficult to justify for the routine restoration of primary teeth, because traditional silver amalgam should provide comparable quality more efficiently and cost-effectively in most situations.

- Clinical Technique :-

- Etchant :-

1- Apply Etchant to enamel and dentin—wait 15 seconds.
2- Rinse.
3- Remove excess water with an air syringe or by blotting.

- Activator / Primer :-

1- Mix one drop each of Activator and Primer.
2- Apply to etched enamel and dentin — wait 15 seconds.
3- Dry gently for 5 seconds.

- Adhesive Application :-

1- Mix one drop each of Adhesive and Catalyst.
2- Apply the mixed adhesive to the primed enamel and dentin.
3- Triturate amalgam

- Completing the Restoration :-

• Condense and burnish the amalgam.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 14 / Dr. Suhair W. Abbood

** Restorative Materials Used in Paediatric Dentistry . . . . . (2)*

- Glass Ionomer Cements :-

- Glass ionomer cements (GICs) were developed in an attempt to capitalize on the favorable properties of both silicate and polycarboxylate cements. Unfortunately, the first generation materials had severe limitations.

- Excessive opacity, limited shade selection, mixing and handling problems, quickly doused the enthusiasm surrounding this new product. As a result, it has struggled to gain popularity, even though continued research has produced clinically useful restorative materials.

- Properties of Glass Ionomer Cement :-

1- Low solubility
2- Coefficient of thermal expansion similar to dentin
3- Fluoride release and fluoride recharge
4- High compressive strengths
5- Bonds to tooth structure by primarily chemical, micromechanical way.
6- Low flexural strength and shear strength
7- Dimensional change (shrinks on setting, expands with water sorption)
8- Brittle
9- Lacks translucency
10- Rough surface texture
11- Biocompatible to tissues.

- Indications :-

1- Non-stress bearing areas
2- Teeth that are not expected to be long lasting
3- Class III and V restorations in adults

4- Class I and small cl II restorations in primary dentition
5- Temporary or “caries control” restorations
6- Crown margin repairs
7- Cement base under amalgam, resin, ceramics, direct and indirect gold
8- Core build-ups when at least 3 walls of tooth are remaining after crown preparation.

- Contraindications :-

1- High stress applications
2- Class IV and class II restorations
3- Cusp replacement
4- Core build-ups with less than 3 sound walls remaining.

- Advantages :-

1- Bonds to enamel and dentin
2- Significant fluoride release, can be recharged
3- Coefficient of thermal expansion similar to tooth structure
4- Tooth colored
5- Low thermal conductivity.

- Disadvantages :-

1- Opacity higher than resin
2- Less polish-ability than resin
3- Poor wear resistance
4- Brittle, poor tensile strength
5- Poor longevity in xerostomic patients.

- Recent Developments of Glass Ionomer Cement :-

• Modified powder — liquid system :-

– This system has improved wetting of the powder by the liquid rendering the mixing process much easier and faster.

• Capsules :-

– The glass ionomer cement in the form of capsule system is a modern application method, which simplifies and allows procedures to be performed with greater ease and efficiency.

– These capsules contain premeasured glass ionomer powder and liquid, which ensures correct ratio, consistency of mix and a predictable result.

– These capsules have angled nozzles that act as a syringe for accurate placement of the material into a cavity or a crown for cementation.

• Paste-paste dispensing system :-

– This is the latest development in the glass ionomer cement technology. This dispensing system was designed with the objectives of providing optimum ratio, easy mixing, easy placement, total reliability, using a specially designed cartridge and an easy-to-use material dispenser.

– In order to provide the material in a paste–paste consistency, an ultra-fine glass powder was designed specifically. The low particle size provides the mixed cement with a thixotropic creamy consistency.

- Modifications of Glass Ionomer Cement :-

• Metal modified glass ionomer :-

- Silver alloy admix (silver amalgam alloy particles mixed with glass particles). The addition of metal powders or fibers to glass ionomer cements can improve strength; however, their esthetics are poor and they do not burnish.
- Cermet (glass sintered with silver) Cermet–ionomer cements have greatly improved resistance to abrasion when compared with glass ionomer cements and their flexural strength is also higher; however, their strength is still insufficient to replace amalgam alloys and their use should be confined to low stress-bearing cavity preparations.

• Resin modified glass ionomer :-

- Resin modification of glass ionomer cement was designed to produce favorable physical properties similar to those of resin composites while maintaining the basic features of the conventional glass ionomer cement.
- In their simplest form, these are GICs with the addition of a small quantity of a resin in the liquid.

• "High strength," "packable," or "high viscosity" glass Ionomers :-

– These glass ionomers are particularly useful for atraumatic restorative treatment technique (ART). They were designed as an alternative to amalgam for posterior preventive restorations. These cements set only by a conventional neutralization reaction but have properties that exceed those of the resin modified systems. Setting is rapid, early moisture sensitivity is considerably reduced and solubility in oral fluids is very low.

- Calcium Hydroxide :-

- Calcium hydroxide was introduced in United States by Teuscher and Zander in 1938, and is since then being used as a pulpal medicament. Although the overall mechanisms of action of calcium hydroxide are not fully understood, many articles have been published describing its biological properties, role of the high pH and the ionic activity in the healing process, diffusion through dentinal tubules and influence on apical microleakage.

- Uses of Calcium Hydroxide :-

• Calcium hydroxide as an intracanal medicament :-

– It is the most commonly used dressing for treatment of the vital pulp.
– It also plays a major role as an inter-visit dressing in the disinfection of the root canal system.

• Calcium hydroxide as an endodontic sealer :-

– In the root canal obturation, sealer plays an important role, as it fills the gap between the walls of the prepared dentine and the gutta-percha. Examples of calcium hydroxide sealers :- Sealapex (Kerr), Apexkit (Vivadent).

• Calcium hydroxide as a pulp capping agent :-

– Calcium hydroxide is generally accepted as the material of choice for pulp capping.

– When calcium hydroxide is applied directly to pulp tissue there is necrosis of adjacent pulp tissue and an inflammation of contiguous tissue. Dentinal bridge formation occurs at the junction of necrotic tissue and vital inflamed tissue.

– Three main calcium hydroxide products for pulp capping are Pulpadent, Dycal, Hydrex (MPC).

• Calcium hydroxide in apexification :-

– Apexification technique is recommended in non-vital young permanent tooth with incomplete apices; it is cleaned and disinfected, then if tooth is free of signs and symptoms of infection, the canal is dried and filled with stiff mix of calcium hydroxide.

– Commercial paste of calcium hydroxide like Calasept, Pulpdent, Metapex may be used to fill the canals.

• Calcium hydroxide in pulpotomy :-

– It is the most recommended pulpotomy medicament for pulpally involved vital young permanent tooth with incomplete apices.

– It is acceptable because it promoted reparative dentin bridge formation and thus pulp vitality is maintained.

• Calcium hydroxide in weeping canals :-

– Sometimes a tooth undergoing root canal treatment shows constant clear or reddish exudate associated with periapical radiolucency. Tooth can be asymptomatic or tender on percussion, exudates stops but when opened in next appointment, it again reappears, this is known as “weeping canal”.

– In these cases tooth with exudates is not ready for obturation. Since culture reports normally show negative bacterial growth, so antibiotics are of no help. For such teeth, dry the canals with sterile absorbent paper points and place calcium hydroxide in canal which helps in controlling the exudates because pH of periapical tissues is acidic in weeping stage which gets converted into basic pH by calcium hydroxide.

- Advantages of calcium hydroxide :-

1- Initially bactericidal then bacteriostatic
2- Promotes healing and repair
3- High pH stimulates fibroblasts
4- Neutralizes low pH of acids
5- Stops internal resorption
6- Inexpensive and easy to use

- Disadvantages of calcium Hydroxide :-

1- Associated with primary tooth resorption
2- Dissolve after one year
3- May degrade during acid etching
4- Degrades upon tooth flexure
5- Marginal failure with amalgam condensation
6- Does not adhere to dentin or resin restoration

- Matrices :-

- Matricing is a procedure where by a temporary wall is created in the areas of tooth structure lost during preparation. The appliance used for building these walls is called matrix.

- Rationale for Using Matrix :-

1- Accurate reproduction of contour of teeth
2- To prevent interproximal excess
3- To establish tight contact areas
4- To maintain integrity of normal gingival papillae
5- To maintain arch dimensions in primary dentition.

- Functions of Matrix :-

1- To replace the missing wall
2- Close adaptation of restorative material
3- Retain restorative material during placement
4- Allows restoration of contact point and external crown contour
5- Isolation of cavity.

- Ideal Requirements of Matrix :-

1- Rigid to allow condensation
2- Promote desired contour
3- Should form positive contact with tooth
4- Should be of minimal thickness
5- Compatible with restorative material
6- Ease of application
7- Economic.

- Classification of Matrix :-

1- According to place of application :-

• Posterior – T- band, Toffelmire

• Anterior – Celluloid matrix

2- According to constituents :-

• Metallic – Ivory no.1, Ivory No. 8, Toffelmire

• Nonmetallic – Mylar strips

3- According to presence or absence of retainer :-

• With retainer - Ivory No. 1, Ivory No. 8

• Without retainer – S-band

4- According to form :-

• Anatomical – Celluloid crown form

• Non-anatomical – Ivory No. 1

5 According to patency :-

• Patent – Ivory No. 1

• Non-patent – Celluloid crown form

6 According to use :-

• Universal – Ivory No. 8, Toffelmire

• Unilateral – Ivory No. 1

- Recent Modifications in Matrix :-

• ***Sectional matrix :-*** This system is easy to place, gives a large preparation area thus reducing the working time. An added advantage of this system is that both mesial and distal proximal restorations can be accomplished by one matrix placement.

• ***Smart view matrix system :-*** The Smart View Matrix System also comes with Smart Bands Sectional Matrices and titanium instruments. The Smart Bands have a nonstick surface, are anatomically contoured, and integrate a reinforced placement tab while the instruments are made of high-grade, blue titanium. The specially designed titanium instruments are strong, durable, and lightweight. These are mostly used for composite restorations.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 15 / Dr. Suhair W. Abbood

Restorative Materials Used in Paediatric Dentistry . . . . . (3)

- Stainless Steel Crown (SSC) :-

- It is another commonly used pediatric restorative material. It is used extensively for full coronal coverage restorations of primary teeth. Stainless steel crowns undoubtedly preserve the function of primary teeth that otherwise would be unrestorable. They were originally developed to provide a 'restoration of last resort' for those teeth that were not salvageable by any other means.
- In addition, stainless steel crowns are often used to restore all posterior teeth in young patients with high risk for caries who exhibit multiple proximal lesions that could otherwise be restored with silver amalgam or esthetic materials. Crowns are used instead simply because they better protect all posterior tooth surfaces from developing additional caries and because the posterior crown restoration has proven to be the most durable and cost-effective in the primary dentition. Anterior and posterior stainless steel crowns may have labial and/or occlusal resin or porcelain veneers to enhance aesthetics.

- Indications :-

1- Extensive decay in primary teeth: Steel crown is indicated wherever one or more cusps are destroyed or weakened by caries. This commonly occurs in the first primary molars when the distal interproximal carious lesion is untreated.

2- After pulp therapy: In both primary and permanent teeth, after pulp therapy tooth become more brittle. So, it is recommended to prevent postoperative tooth fracture by placing a stainless steel crown.

3- As an alternative restoration of amalgam: Stainless steel crown is a preventive restoration because it helps to avoid amalgam failure or tooth fracture and to prevent caries from developing in other areas of the tooth.

- This application can be used in handicapped child who lack oral hygiene. Most of the practitioners no longer place MOD restorations in the first primary molars of preschool children rather they prefer to place a stainless steel crown.

4- To mask the developmental defects of tooth :- Linear hypoplastic defects can undermine the occlusal surface of primary molars if the systemic disturbances occur at natal and prenatal stage. Similarly, amelogenesis and dentinogenesis imperfects can alter tooth morphology and predispose the dentition to excessive wear and loss of cervico occlusal length.

5- The stainless steel crown on the first permanent molar is frequently used as a semi-permanent restoration for certain period in adolescent patient. When adequate secondary dentine has formed then it is replaced by more permanent restoration like, porcelain.

6- Stainless steel crown can be used for space maintainer. For example, crown and loop space maintainer.

7- Multiple rampant caries cases.

8- Fracture of permanent and primary incisors: It is useful restoration in cases where the fracture is close to the gingival margin and likely to be subjected to occlusal stresses the strength of the stainless steel crown is a great advantage.

9- Severe bruxism cases.

- The advantages :-

1- Single visit for placement.

2- Relatively quick and simple procedure.

3- Usually reduce sensitivity totally, because they cover the whole tooth.

4- Inexpensive compared with cast restorations.

5- Good retention rate.

- The disadvantages :-

1- Require more tooth preparation.

2- Once a tooth has been prepared for a stainless-steel crown, it will need a full coverage restoration eventually.

3- Sub-gingival margins.

- Operative technique :-

1- Obtain adequate anesthesia.

2- Isolate the tooth to be crowned.

3- Select the crown size.

4- Remove any carious dentine and enamel.

5- Replace tooth bulk with glass ionomer.

6- Reduce the occlusal surface minimally.

7- Reduce the mesial and distal surfaces; slicing with a fine tapered bur. Depending on the natural anatomy of the tooth it may be necessary to create a peripheral chamfer on the buccal and lingual surfaces.
8- Try the selected crown; adjust the shape cervically, such that the margins extend ~1 mm below the gingival crest evenly around the whole of the perimeter of the crown. Sharp Beebee scissors usually achieve this most easily, followed by crimping pliers to contour the edge.
9- After the contouring, smooth and polish the crown to ensure that it does not attract excessive amounts of plaque.
10- After test fitting of the crown remove the rubber dam to check the occlusion then re-apply for cementation.
11- Cement the crown usually with a glass ionomer based cement.
12- Remove excess cement carefully with an explorer and knotted floss.
13- Finally recheck the occlusion.

- Anterior teeth :-

- Most of the labial metal may be cut away, leaving a labial "window" that is then restored with resin-based composite. This restoration is called an open face stainless steel crown.
- Several brands of stainless steel crowns with esthetic facings pre-veneered to the labial surfaces are also available to restore primary anterior teeth. Such crowns are available for direct adaptation to the prepared teeth and have had a significant amount of success.

- Stainless steel crown modifications :-

<u>1- For the Undersized Tooth or the Oversized Stainless Steel Crown :-</u>

- Make a cut with the help of curved scissor on the buccal surface of the oversized crown from cervical margin to the occlusal table. The one free crown margins insert under the other free margins to achieve correct size then spot welded, soldered and polished and cemented to the reduced abutment.

<u>2- For the Oversized Tooth or the Undersized Crown :-</u>

- A vertical cut is made on the buccal surface of the crown. The margins are pulled apart and an additional piece of stainless steel band material is spot welded to the buccal surface to increase the dimensions of the crown. After contouring the crown, the cut surface is spot welded, soldered to fill any microscopic deficiency in seal. The crown is polished and cemented.

<u>3- For Deep Subgingival Caries :-</u>

- Use untrimmed rocky mountain crown to encompass the preparation along with deep carious part.

<u>4- For the Open Contact Problem :-</u>

- Select a larger crown or exaggerated interproximal contour can be obtained with 112 (ball and socket) pliers to establish a closed contact. Localized addition of solder can also build out the interproximal contour.

- Atraumatic Restorative Treatment (ART) :-

- The Atraumatic Restorative Treatment (ART) is a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material. Another terminology used for ART is Alternate Restorative Treatment. Usually carious lesions are left untreated in children of underprivileged communities of developing and underdeveloped countries mainly because of financial problems and lack of awareness.
- The treatment requires qualified personnel and expensive equipment. The absence of clean and pressurized water and irregular supply of electricity make it impossible for oral healthcare personnel to work efficiently. This method was presented for treating dental caries, which involved neither drill or water nor electricity at the headquarters of the WHO, Geneva, on World Health Day (April 7th, 1994).

- Advantages of ART :-

1- Easily available inexpensive hand instruments are used rather than the expensive electrically driven dental equipment.
2- As it is almost a painless procedure the need for local anesthesia is eliminated or minimized.
3- ART involves the removal of only decalcified tooth tissues, which results in relatively small cavities and conserves sound tooth tissue as much as possible.
4- Sound tooth tissue need not be cut for retention of filling material. The retention is obtained by the chemical adhesion of glass ionomer restorative material with cavity walls.
5- A practice of straightforward and simple infection control is used without the need to use autoclaved hand pieces.
6- The leaching of fluoride from glass ionomer probably remineralise the demineralized dentin and prevents development of secondary caries.
7- The combined preventive and curative treatment can be done in one appointment.
8- Repairing of defects in the restoration can be easily done.
9- It enables the oral health workers to reach people who otherwise never would have received any oral health service.

- Disadvantages of ART :-

1- ART restorations are not long lasting. The average life is two years depending upon the rate of caries activity of the individual oral cavity.
2- As fundamental principles of cavity preparation are not followed all oral health workers may not accept it.
3- Because of the low wear resistance and low strength of the existing glass ionomer materials their use is limited to small and medium sized one surface cavity only.
4- The continuous use of hand instruments over long period of time may result in hand fatigue

- Other Applications of ART :-

1- ART procedure helps in reducing dental anxiety: In patient especially popular in children and young dental patient.

2- Early childhood caries in toddlers.

3- Patient with contraindications for local anesthesia.

4- Those Patients who are with mentally or physical handicapped.

5- Children who present with behavior management problems, e.g. those who under normal situations cannot be treated except under sedation or general anesthetic agent. They have been found manageable with the use of ART.

- Patient Preparation and Armamentarium for ART :-

- The operator's work posture and positions :-

1- The work posture and position of the operator should provide the best view of the patient's mouth and both patient and operator should be comfortable.

2- The operator sits firmly on the stool, with straight back, thighs parallel to the floor and both feet flat on the floor. The height of the stool must then be adjusted so that the operator can see the patient's teeth clearly.

3- The head and neck should be still, the line between the eyes horizontal and the head bent slightly forward to look at the patient's mouth.

4- The distance from the operator's eye to patient's tooth is usually between 30 and 35 cm.

-The operator should be positioned behind the head of the patient. The exact position will depend on the area of the patient's mouth to be treated.

- Assistance :-

1- When treating patients, particularly children using ART, it is a great advantage if another person can mix the glass ionomer.

2- The assistant works at the left side of a right-handed operator and does not change position and should sit as close to the patient support as possible, facing the patient's mouth.

3- The assistant's head should be 10 to 15 cm higher than the operator, so that the assistant can also see the operating field and can pass the correct instruments when needed.

- Patient Position :-

- A patient lying on the back on a flat surface will provide safe and secure body support and comfortable and stable position for lengthy periods of time.

- Operating Light :-

- The light source can be the sun (natural) or artificial. The latter is more reliable and constant than natural light and can also be focused on a particular spot. Therefore, a portable light source is recommended, e.g. a headlamp or a light attached to the mouth mirror.

- Essential Instruments and Materials for ART Procedure :-

- The success of ART depends on the operator knowing the functions of the various instruments and using them properly and correctly. They must also be maintained in a good condition. The following instruments can be used in ART :-

1- Mouth mirror, tweezers and explorer.

2- Spoon excavator: used for removing soft carious dentine.

3- Dental hatchet :- used for widening the entrance of the carious lesions and for slicing away thin unsupported enamel.

4- Carver :- it has two functions; the blunt end is used for inserting the mixed GIC into the cavity as well as into pits and fissures. The sharp end is designed to remove excess restorative material and to shape the GIC restorations.

5- Mixing pad and spatula :- These are necessary for mixing GIC (disposable paper pad and the plastic spatula which is called agate spatula).

- Other Materials used in ART :-

1- Cotton rolls and pellets :- for isolation and cleaning and drying cavities.

2- Petroleum jelly :- used to keep moisture away from the glass ionomer restoration during setting.

3- Plastic strip and dental floss :- used for contouring the proximal surface and removal of excess material of multiple surface restorations.

4- Wedges :- used to hold the plastic strip close to the shape of the proximal surface of the tooth.

5- Restorative material :- GIC is the choice of filling material in ART.

- Technique :-

Tooth isolation ⟶ tooth cleaning ⟶ widening the entrance ⟶ remove the carious lesion ⟶ if necessary pulp protection by Ca(OH)2 ⟶ cleaning the cavity ⟶ acid etching ⟶ GIC is mixed according to manufacturer ⟶ fill the cavity ⟶ a gloved finger smeared with petroleum jelly is pressed on the occlusal surface with slight pressure ⟶ bite is checked ⟶ carving ⟶ cover the filling with petroleum jelly again or with varnish ⟶ instruct the patient not to bite on the tooth at least 30 min.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 16 / Dr. Suhair W. Abbood

Treatment of Deep Caries, Vital Pulp Exposure, Pulpless Teeth :-

- It is well recognizable that maintenance of the primary teeth has many of the same goals as the maintenance of the permanent dentition. Primary teeth aid in maintaining the integrity of the dental arch, thereby preventing malocclusion, allowing for proper speech and mastication, preventing aberrant tongue habits, and providing esthetics.
- Primary teeth have the additional goal of guiding the eruption of the permanent teeth. Therefore treating primary teeth that have been afflicted by disease or trauma is imperative. However, the treatment of the dental pulp exposed by the caries process, by accident during cavity preparation, or even because of injury and fracture of the tooth has long presented a challenge. Children and young adults who have not received early and adequate dental care and optimal systemic fluoride often have deep carious lesions with pulpal exposures.

- Notice that :-

- Experience, patience, skill and considerable clinical acumen are necessary to overcome the difficulty of pulp treatment in children.
- Pulp treatment in children is more challenging and difficult than in adult due to the following reasons :-
- Behavioral management problems in children.
- Limited opening of the mouth.
- Presence of complex root canal system in primary molars: fine and tortuous canals, accessory canals, lateral canals, anastomoses, etc...
- Danger of injuring the underlying permanent tooth bud.

- Objectives of Pulp Therapy :-

- The primary objective of pulp therapy is to maintain the integrity and health of the teeth and their supporting tissues. Other objectives of pulp therapy are :-
- Conservation of the tooth in a health state functioning as an integral component of dentition.
- Preservation of dental arch space and prevent consequent malocclusion due to premature tooth loss.
- Maintain esthetics, mastication.
- Prevent aberrant tongue habits
- Aid in speech.
- Prevent psychological effects associated with tooth loss.

- Notice that :-

- In certain restraints, pulpal therapy cannot saved the tooth such as :-

a- Medically compromised.
b- Non-restorable teeth.
c- Rate of root resorption
d- Life expectancy of a tooth.

- Diagnostic Aids in the Selection of Teeth for Vital Pulp Therapy :-

1- History of Pain :-

- The history of either the presence or the absence of pain may not be as reliable in the differential diagnosis of the condition of the exposed primary pulp as it is in permanent teeth. Degeneration of primary pulp even to the point of abscess formation without the child recalling pain or discomfort is common. Nevertheless, the history of a toothache should be the first consideration in the selection of teeth for vital pulp therapy.

- Momentary pain :- Immediate response to hot or cold that disappears on removal of the stimulus indicates that the pathosis is limited to the coronal pulp. A toothache coincident with or immediately after a meal may not indicate extensive pulpal inflammation; could be due to an accumulation of food within a caries lesion, by pressure, or by a chemical irritation to vital pulp protected by only a thin layer of intact dentin.

- A severe toothache at night usually signals extensive degeneration of the pulp and calls for more than conservative pulp therapy. This type of pain indicates pulpal damage-irreversible pulpitis.

- A spontaneous toothache of more than momentary duration occurring at any time usually means that pulpal disease has progressed too far for treatment, even with a pulpotomy.

- Persistent pain :- Pain from thermal stimuli would indicate wide spread inflammation of the pulp, extending into the radicular filaments.

2- Clinical Signs and Symptoms :-

a- A gingival abscess or draining fistula associated with a tooth with a deep caries lesion is an obvious clinical sign of an irreversibly diseased pulp. Successful endodontic therapy or extraction of the tooth can resolve such infections.

b- Abnormal tooth mobility is another clinical sign that may indicate a severely diseased pulp. If pain is absent or minimal during manipulation of the diseased mobile tooth, the pulp is probably in a more advanced and chronic degenerative condition. The dentist should distinguish pathologic mobility from normal mobility in primary teeth near exfoliation.

c- Sensitivity to percussion or pressure is a clinical symptom suggestive of at least some degree of pulpal disease, but the degenerative stage of the pulp is probably of the acute inflammatory type. Tooth mobility or sensitivity to percussion or pressure may be a clinical sign of other dental problems as well, such as a high restoration or advanced periodontal disease.

- However, when identification of this clinical information occur in a child and is associated with a tooth having a deep caries lesion, the problem is most likely to be caused by pulpal disease and possibly by inflammatory involvement of the periodontal ligament.

3- Radiographic Interpretation :-

- A recent x-ray film must be available to examine for evidence of periradicular or periapical changes, such as thickening of the periodontal ligament or rarefaction of the supporting bone. Radiographic interpretation is more difficult in children than in adults.
- The permanent teeth may have incompletely formed root ends, giving an impression of periapical radiolucency.
- The roots of the primary teeth undergoing even normal physiologic resorption often present a misleading picture or one suggestive of pathologic change.
- The proximity of caries lesions to the pulp cannot always be determined accurately in the x-ray film. What often appears to be an intact barrier of secondary dentin protecting the pulp may actually be a perforated mass of irregularly calcified and carious material. The pulp beneath this material may have extensive inflammation.

4- Pulp Testing :-

- Historically the value of the electric pulp test in determining the condition of the pulp of primary teeth is questionable. Although it will give an indication of whether the pulp is vital, the test does not provide reliable evidence of the degree of pulpal inflammation.
- A complicating factor is the occasional positive response to the test in a tooth with a necrotic pulp if the content of the canals is liquid. The child's apprehension associated with the pulp testing itself can affect the reliability of the pulp test for the young child.

-Types of pulp testing :-

1- **Thermal test**

- *Cold test :-* Applied in several different ways like stream of cold air, cold- water bath, ethyl chloride, dry ice etc...

- *Heat test :-* The mostly used way is by applying hot gutta - percha and hot compound.

2- **Electrical Pulp Testing**

5- Physical Condition of the Patient :-

- Although local observations are of extreme importance in the selection of cases for vital pulp therapy, the dentist must also consider the physical condition of the patient. In seriously ill children, extraction of the involved tooth after proper premedication with antibiotics, rather than pulp therapy, should be the treatment of choice.

- Children with conditions that render them susceptible to subacute bacterial endocarditis or those with nephritis, leukemia, solid tumors, idiopathic cyclic neutropenia, or any condition that causes cyclic or chronic depression of granulocyte and polymorphonuclear leukocyte counts should not be subjected to the possibility of an acute infection resulting from failed pulp therapy.

- Occasionally, pulp therapy for a tooth of a chronically ill child may be justified, but only after careful consideration is given to the prognosis of the child's general condition, the prognosis of the endodontic therapy, and the relative importance of retaining the involved tooth.

- Evaluation of Treatment Prognosis before Pulp Therapy :-

- The diagnostic process of selecting teeth that are good candidates for vital pulp therapy include :-

1- The dentist must decide that the tooth has a good chance of responding favorably to the pulp therapy procedure indicated.

2- The advisability of performing the pulp therapy and restoring the tooth must be weighed against extraction and space management.

3- The tooth is restorable or not.

4- The periodontal structures if they are irreversibly diseased.

5- The level of patient and parent cooperation and motivation in receiving the treatment.

6- The level of patient and parent desire and motivation in maintaining oral health and hygiene.

7- The caries activity of the patient and the overall prognosis of oral rehabilitation.

8- The stage of dental development of the patient.

9- Age of the patient.

10- The degree of difficulty anticipated in adequate performance of the pulp therapy (instrumentation) in the particular case.

11- Space management issues resulting from previous extractions, preexisting malocclusion, ankylosis, congenitally missing teeth, and space loss caused by the extensive carious destruction of teeth and subsequent drifting.
12- Excessive extrusion of the pulpally involved tooth resulting from the absence of opposing teeth.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

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- Treatment of Deep Carious Lesion :-

- The indications, objectives, and type of pulpal therapy depend on whether the pulp is vital or nonvital, based on the tooth's clinical diagnosis of normal pulp, reversible pulpitis, irreversible pulpitis, or necrotic pulp.

- Indirect Pulp Treatment (Gross Caries Removal or Indirect Pulp Therapy) :-

- The procedure in which only the removal of gross caries from the lesion and then sealed the cavity for a time with a biocompatible material is referred to as ***indirect pulp treatment.***

- Indirect pulp treatment is not a new procedure but it has attracted renewed interest. Teeth with deep caries that are free of symptoms of painful pulpitis are candidates for this procedure.

- ***Aim :-*** To remove the infected dentin and leaving intact the affected dentin, so that the affected dentin will remineralise and act as a barrier above the healthy pulp.

- Therefore, there will be :-

* Arresting to the carious process
* Promoting the dentin sclerosis
* Stimulating formation of tertiary dentin
* Remineralisation of carious dentin.

- Indications :-

- Deep caries in which the pulpal inflammation has been judged minimal and complete removal of caries would probably cause pulpal exposure.
- The tooth should have **NO :-**

* No history of spontaneous, unprovoked toothache (The tooth may have had a history of toothache associated with eating, as long as pain subsided immediately after removal of the stimulus).

* No tenderness to percussion.
* No abnormal mobility.
* No radiographic evidence of radicular disease.
* No radiographic evidence of abnormal internal or external root resorption.

- Contraindications :-

* When there is wide spread inflammation or evidence of periapical pathosis.

- The Clinical Procedure :-

- It involves removing the gross caries with large round bur or spoon excavators, but allowing sufficient caries to remain over the pulp horn to avoid exposure of the pulp. The procedure usually results in some discomfort to the child; therefore, it is advisable to use a local anesthetic.
- The walls of the cavity should be extended to sound tooth structure because the presence of carious enamel and dentin at the margins of the cavity will prevent the establishment of an adequate seal **(extremely important)** during the period of repair.
- A radiopaque biocompatible base mate1ial ($CaOH_2$) should be placed over the remaining thin layer of caries at the base of the cavity and then the cavity is sealed with a durable interim restoration. Some interim restorative materials may also serve as the base material. The treated teeth should not be reentered for at least 6 to 8 weeks.
- During this time, the caries process in the deeper layer will be arrested. The rate of regular dentin formation observed during the indirect pulp treatment technique was highest during the first month.
- If the decision is made to reenter the tooth after the minimum 6 to 8 week waiting period, the tooth is anesthetized and isolated with the rubber dam, and then removal of the temporary restorative material and calcium hydroxide dressing. Careful removal of the remaining carious material, sclerotic may reveal a sound base of dentin without an exposure of the pulp. If a second layer of dentin covers the pulp, a liner material containing calcium hydroxide is applied. The cavity preparation is completed, and then restoring the tooth in a conventional manner.

- Notice that :-

- If caries process does not already expose the pulp, it will have a chance to form protective layer of secondary dentine during the waiting period, but if the caries process has already invaded the pulp and caused inflammation, the Ca (OH_2) and the temporary filling will help in neutralizing the irritant and will reduce the pulpal inflammation.

- Treatment was judged successful if :-

* The restoration was intact.
* The tooth had no history of pain after treatment and during the waiting period. The tooth had normal mobility.
* The tooth was not sensitive to percussion.

* There was no radiographic evidence of abnormal root resorption nor a radicular disease.
* There was no clinical evidence of direct pulp exposure when the tooth was reentered.
- Its rationale is that carious dentin consists of two distinct layers. An outer layer irreversibly denatured that is infected, and not remineralisable which should be removed and an inner layer that is reversibly denatured, not infected (affected), remineralisable and which should be preserved.
- Removing the outer layers of the carious dentin, that contain the majority of the microorganisms thus reducing the continued demoralization of the deeper dentin layers from bacterial toxins, and sealing the lesion to allow the pulp to regenerate reparative dentin.

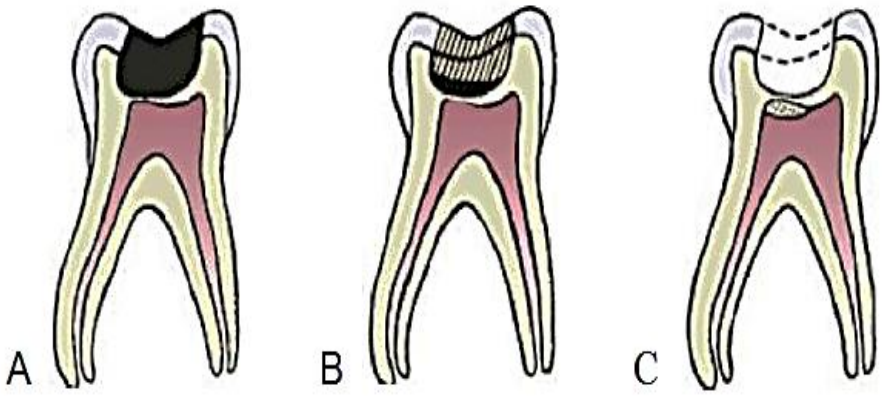
- Vital Pulp Exposure / Direct Pulp Capping :-

- The placement of a medicament or non-medicated material on an exposed pulp that is occurred in course of excavating the last portions of deep dentinal caries or because of trauma.

- Aim :- To create new dentin in the area of the exposure and subsequent healing of the pulp.

- Indications of Direct Pulp Capping :-

- Pulp-capping procedures should be limited to asymptomatic (absence of pain) vital primary teeth or young permanent teeth, with the possible exception of discomfort caused by the intake of food, the teeth should have :-
- True pinpoint exposure (small mechanical exposure less than 1 mm) surrounded by sound dentin produced accidentally by trauma during cavity preparation.
- Mechanical or carious exposures less than 1 mm, in an asymptomatic vital young permanent tooth.
- The exposure site should have bright red hemorrhage easily controlled by dry cotton pellet with minimal pressure.
- Lack of bleeding at the exposure site (the amount of bleeding considered normal in the absence of a hyperemic or an inflamed pulp.



A, A primary or permanent tooth with deep caries. B, The gross caries has been removed and the cavity sealed with durable biocompatible cement or restorative material. C, Six to eight weeks later, the cavity is reopened and the remaining caries excavated. A sound dentin barrier protects the pulp, and the tooth is ready for final restoration.

- Contraindications :-

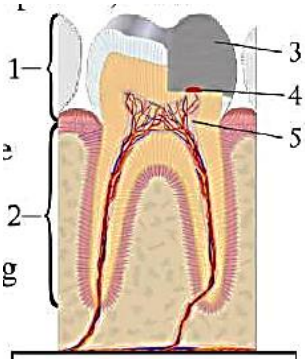
* Cariously exposed deciduous teeth * Spontaneous pain or severe toothache at night
* Swelling * Fistula * Tenderness to percussion * Pathologic mobility
* Root resorption-external/internal * Periapical/ interadicular radiolucency
* Pulp calcifications * Profuse hemorrhage from the exposure site
* Pus or exudate from exposure site.

- The clinical procedure :-

- All pulp treatment procedures should be carried out with sterile instruments in clean conditions. Use of the rubber dam will help keep the pulp free of external contamination.

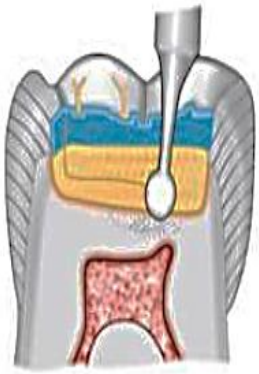
During caries removal if there is a pulpal exposure, necrotic and infected dentin chips could be pushed into the exposed pulp, and this can delay healing, causing further pulpal inflammation.

- Therefore while excavating caries from a deep cavity, it should be remembered that peripheral carious dentin from the walls should be removed first followed by removal from the floor of the cavity.
- Following a clinical exposure, use a nonirritating solution of normal saline (avoid the use of caustic solution because it may lead to pulpal injury) or anesthetic solution to cleanse the area and keep the pulp moist.

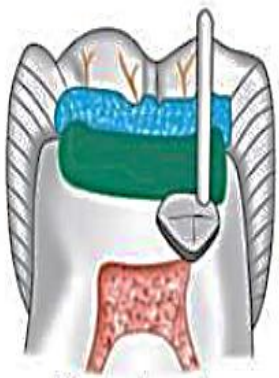


1) Crown 2) root 3) restoration 4) pulp cap 5) pulp chamber

- A blood clot formed after cessation of the bleeding, impedes the pulpal healing. Therefore, care must be taken not to allow clot formation. The clot formed does not allow the capping material to contact the pulp tissue directly, or the clot material itself could breakdown, producing degradation products that act as substrate to the bacteria.
- Then apply a pulp-capping agent over the exposure site and adequate seal following pulp capping is necessary to prevent bacterial contamination. Stainless steel crown restoration is the most preferred one.


Remove the caries with a slow-speed bur


Place calcium hydroxide over the exposed pulp


Direct pulp capping

- Notice that :-

- Calcium hydroxide is the material of choice for pulp capping of normal permanent teeth with vital pulp tissue due to its good ability in stimulating the repair reaction.
- All pulps capped with Dycal responded satisfactorily with complete bridging with no evidence of inflammation of the pulp or obliteration of the canal. The use of mineral trioxide aggregate (MTA) and Bio-dentin as a capping material have shown promise.

- The capping material should :-

* Stimulate reparative dentin formation
* Maintain pulpal vitality
* Be Bactericidal or bacteriostatic
* Adhere to dentin and to restorative material
* Resist forces during restoration placement and must resist forces under restoration during lifetime of restoration
* Able to be sterilized
* Radio-opaque
* Provide bacterial seal

Clinical success of direct pulp capping depends upon on the following salient features :-

* Maintenance of pulp vitality
* Lack of undue sensitivity or pain
* Minimum pulp inflammatory response
* Ability of the pulp to maintain itself without progressive degeneration.

******Direct pulp capping is less preferred in primary teeth.***

- Pulpotomy :-

- The procedure that involve the amputation of affected, infected coronal portion of the dental pulp leaving intact the vital tissue in the canals, followed by placement of a medicament or dressing over the remaining pulp stump in an attempt to promote healing and retention of this vital tissue (preserving the vitality and function of the remaining part of radicular pulp).

- Objectives :-

* Removal of inflamed and infected coronal pulp at the site of exposure thus preserving the vitality of the radicular pulp and allowing it to heal.
* The next main objective is to maintain the tooth in the dental arch.

- Indications of Pulpotomy :-

1* Mechanical pulp exposure in primary teeth.
2* Teeth showing a large carious lesion but free of radicular pulpitis
3* History of only spontaneous pain
4* Hemorrhage from exposure sites bright red and can be controlled
5* Absence of abscess or fistula
6* No interadicular bone loss

7* No interadicular radiolucency
8* At least 2/3rd of root length still present to ensure reasonable functional life
9* In young permanent tooth with vital exposed pulp and incompletely formed apices.

- Contraindications of Pulpotomy :-

1* Persistent toothache. 2* Tenderness on percussion
3* Root resorption more than I/3rd of root length
4* Large carious lesion with non-restorable crown
5* Highly viscous, sluggish hemorrhage from canal orifice, which is uncontrollable
6* Medical contradictions like health disease, immunocompromised patient
7* Swelling or fistula 8* External or internal resorption
9* Pathological mobility 10* Calcification of pulp.

- The clinical procedure :-

- The justification for this procedure is that the coronal pulp tissue, which is adjacent to the carious exposure, usually contains microorganisms and shows evidence of inflammation and degenerative change. The abnormal tissue can be removed, and the healing can be allowed to take place at the entrance of the pulp canal in an area of essentially normal pulp. Even the pulpotomy procedure, however, is likely to result in a high percentage of failures unless the teeth are carefully selected.

- In the pulpotomy procedure :-

1- At first, the tooth should be anesthetized and isolated with the rubber dam. A surgically clean technique should be used throughout the procedure. All remaining dental caries, as well as the overhanging enamel, should be removed to provide good access to the coronal pulp.

- Pain during caries removal and instrumentation may be an indication of faulty anesthetic technique. More often, however, it indicates pulpal hyperemia and inflammation, which makes the tooth a poor risk for vital pulpotomy. If the pulp at the exposure site bleeds excessively after complete removal of caries, the tooth is also a poor risk for vital pulpotomy.

2- Removal of the entire roof of the pulp chamber should be done. No overhanging dentin from the roof of the pulp chamber or pulp horns should remain. No attempt is made to control the hemorrhage until the coronal pulp has been amputated. Funnel-shaped access to the entrance of the root

canals should be created. A sharp discoid spoon excavator, large enough to extend across the entrance of the individual root canals, may be used to amputate the coronal pulp at its entrance into the canals.

- The pulp stumps should be excised cleanly, with no tissue tags extending across the floor of the pulp chamber. Then irrigation to the pulp chamber with a light flow of water from a water syringe and evacuated.

3- Placement of cotton pellets moistened with water in the pulp chamber and allowed to remain over the pulp stumps until a clot forms which is apparently essential for healing.

*** There are two specific pulpotomy techniques have evolved and are in general use :-**

- Pulpotomy Technique for Permanent Teeth :-

- The use of either calcium hydroxide or MTA can be recommended in the treatment of permanent teeth with carious pulp exposures when there is a pathologic change in the pulp at the exposure site.

- This procedure is particularly indicated for :-

* Exposure that occurred in young permanent teeth (where exposure of the pulp occurred by mechanical or bacterial means) and the remaining radicular tissue is judged vital by clinical and radiographic criteria whereas the root closure is not complete to preserve vitality of radicular pulp and allow for normal root closure.

* Permanent tooth with a pulp exposure resulting from crown fracture when the trauma has also produced a root fracture of the same tooth.

- Notice that :-

- The procedure of vital pulpotomy is completed during a single appointment. Only teeth free of symptoms of painful pulpitis are considered for treatment.

- If calcium hydroxide is used as a capping material, so it called as calcium hydroxide pulpotomy or young permanent partial pulpotomy or Cvek's Pulpotomy

- The clinical procedure :-

- The procedure involves the amputation of the coronal portion of the pulp as described, the control of hemorrhage, and the placement of the capping material over the pulp tissue remaining in the canals.

- A protective layer of hard-setting cement is placed over the calcium hydroxide (or the capping material being used such as MTA or Bio-dentin etc...) to provide an adequate seal. The tooth is subsequently prepared for full- coverage restoration.

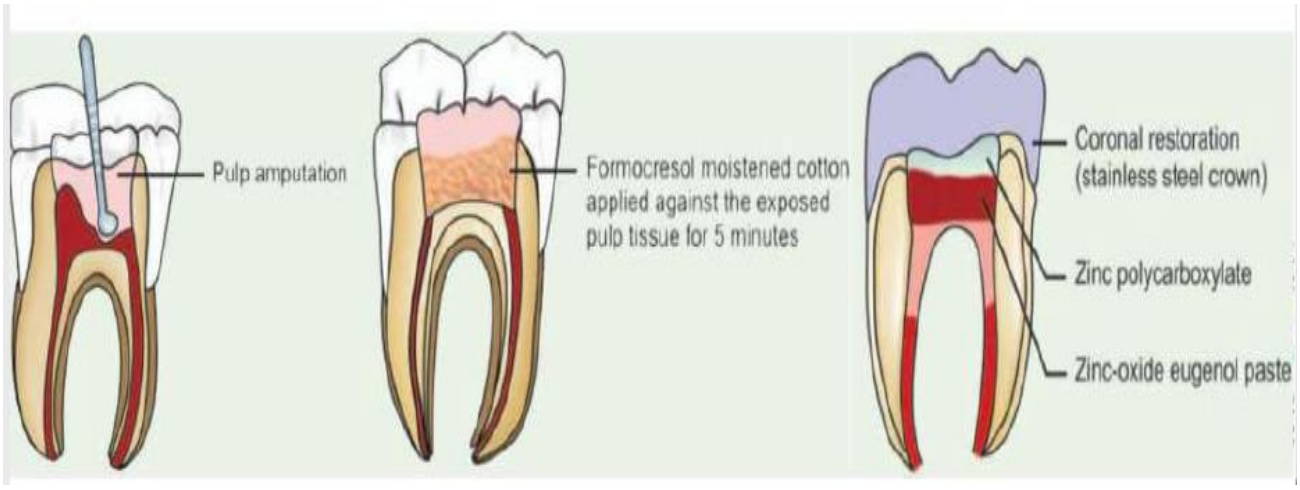
- However, if the tissue in the pulp canals appears hyperemic after the amputation of the coronal tissue, a pulpotomy should no longer be considered. Endodontic treatment is indicated if the tooth is to be saved.

- After 1 year, a tooth that has been treated successfully with a pulpotomy should have a normal periodontal ligament and lamina dura, radiographic evidence of a calcified bridge, and no radiographic evidence of internal resorption or pathologic resorption. The

treatment of permanent teeth by the pulpotomy method has resulted in a higher rate of success when the teeth are selected carefully based on existing knowledge of diagnostic techniques.

- Pulpotomy Technique for Primary Teeth :-

- The same diagnostic criteria recommended for the selection of permanent teeth for the pulpotomy procedure should be used in the selection of primary teeth for this procedure. The treatment is also completed during a single appointment.
- A surgically clean technique should be used. The coronal portion of the pulp should be amputated as described previously, the debris should be removed from the chamber, and the hemorrhage should be controlled.
- If there is evidence of hyperemia after the removal of the coronal pulp, which indicates that inflammation is present in the tissue beyond the coronal portion of the pulp, the technique should be abandoned in favor of pulpectomy or the removal of the tooth. If the hemorrhage is controlled readily and the pulp stumps appear normal, it may be assumed that the pulp tissue in the canals is normal, and it is possible to proceed with pulpotomy.
- The pulp chamber is dried with sterile cotton pellets. Next, a pellet of cotton moistened with a 1:5 concentration of Buckley's formocresol and blotted on sterile gauze to remove the excess is placed in contact with the pulp stumps and allowed to remain for 5 minutes. Because **formocresol is caustic,** care must be taken to avoid contact with the gingival tissues. The pellets then removed, and the pulp chamber is dried with new pellets. If the pulp stump become black instead of red, freshly prepared thick pulpotomy paste is prepared (by mixing of one drop of T.C.F. + one drop of eugenol+ zinc oxide powder) and placed over the pulp stumps. Then Cement base should applied on it and restored with filling material later on the tooth should restored with a stainless steel crown.



- Notice that :-

- Although the formocresol pulpotomy technique has been recommended for many years as the principal method for treating primary teeth with carious exposures, a substantial shift away from use of this medicament has occurred because of concerns about its toxic effects.
- Many alternatives, including MTA, sodium hypochlorite, ferric sulfate, electrosurgery, and lasers, have been investigated to replace formocresol as the medicament of choice for pulpotomy. Despite this, formocresol continues to be a very commonly used pulpotomy medicament.
- Buckley's original formula for formocresol calls for equal parts of formaldehyde and cresol. The 1:5 concentration of this formula is prepared by, first, thoroughly mixing three parts of glycerin with one part of distilled water, and then adding four parts of this diluent to one part of Buckley's formocresol, followed again by thorough mixing.

- Ca (OH) $_2$ in primary teeth induce osteoclastic activity.

- What do you Know about Pulpotec :-

*** Pulpotec** - is a radiopaque, non-resorbable dental paste for simple, rapid and long-term treatment by pulpotomy of vital molars, both permanent and deciduous.

- The addition of pharmacological constituents ensures an aseptic treatment, induces cicatrization of the pulpal stump at the chamber-canal interface, whilst maintaining the structure of the underlying pulp.
- The treatment of pulpitis with Pulpotec is considerably faster than by pulpectomy. It also avoids the numerous failures that have been noted with so-called «total» pulpectomy (over 50% worldwide in 1995).

- Composition :-

*** Powder** Iodoform, Polyoxymethylene, excipient

*** Liquid** Phenol, Guaiacol, Formaldehyde, Dexamethasone Acetate, excipient

- Direction for use as it is (as it appeared in the leaflet of the product) :-

- Perform pulpotomy in the usual way. Pulpotec being antiseptic, the use of a rubber dam is optional. Use high-speed rotary instruments in order to avoid tearing of the radicular endings and take care to eliminate all the cameral pulp. The use of after a pulpotomy performed with laser is also recommended.

- Two methods are recommended for inserting PULPOTEC into the pulp chamber :-

1* The traditional method Mix Pulpotec liquid with Pulpotec powder and blend to obtain required thick, creamy consistency of the paste. Insert the paste into the pulp-chamber with a large sized paste filler. The presence of small quantities of blood does not affect the efficiency of Pulpotec. Air-dry the cavity just prior to applying the paste. Seal with a temporary cement. Place a cotton roll between the 2 dental arches and request the patient to bite progressively but firmly, so that the Pulpotec paste clings to the walls of the pulp-cavity as well as to the root canal orifices.

2* Another efficient but simple method for inserting Pulpotec into the pulp-chamber mix the powder and the liquid on a glass slab and blend until the mix reaches the consistency of a small, supple ball of putty. Shape the ball into a cylinder and insert directly into the pulp-chamber. Press into place with a spatula and continue as indicated above with the temporary cement and the cotton roll.

*****Setting time of Pulpotec is approximately 7 hours.***

- The second session should take place once the initial Pulpotec insert has set. The treatment can then be completed by setting the final tight obturation with amalgam or any other suitable material. This can be directly placed on the, possibly leaving a thin intermediary layer of temporary cement to insulate Pulpotec from the final obturation material. Pulpotec being Eugenol free, any bonding application on the treated tooth is advisable. Though not totally necessary, a fixed prosthesis is recommended in order to ensure tight sealing, resistance and long-term results.

- Apexogenesis :-

- It is defined as the treatment of a vital pulp in the permanent teeth by capping or pulpotomy in order to permit continued growth of the root and closure of the open apex.

- Objectives :-

- Maintenance of integrity of the radicular pulp tissue to allow for continued root growth.

- Indications :-

* Indicated for traumatized or pulpally involved vital permanent tooth with incomplete formation of the root apex.
* No history of spontaneous pain
* No sensitivity on percussion.
* No hemorrhage.
* Normal radiographic appearance.

- Contraindications :-

* Evidence that radicular pulp has undergone degenerative changes
* Purulent drainage
* History of prolonged pain
* Necrotic debris in canal Periapical radiolucency.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

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- Non Vital Pulp Treatment with Irreversible Pulpitis or Necrotic Pulp :-

- Pulpectomy :-

-It involves the removal of the entire pulp and subsequent filling of the canals of the primary teeth with a suitable resorbable material.

- It is unwise to maintain untreated infected primary teeth in the mouth. They may be opened for drainage and often remain asymptomatic for an indefinite period. However, they are a source of infection and should be treated or removed. The morphology of the root canals in primary teeth makes endodontic treatment difficult and often impractical.

- Mature first primary molar canals are often so small that they are inaccessible even to the smallest barbed broach. If the canal cannot be properly cleansed of necrotic material, sterilized, and adequately filled, endodontic therapy is more likely to fail.

- Objectives of Pulpectomy :-

* Maintain the tooth free of infection
* Biomechanically cleanse and obturate the root canals
* Promote physiologic root resorption
* Hold the space for the erupting permanent tooth.

- Indications of Pulpectomy :-

* Patient should be in good general health with no serious disease. Maximum cooperation of patient and parents.
* A tooth previously planned for a pulpotomy that shows uncontrolled pulpal hemorrhage.
* Indicated for any primary tooth in absence of its permanent successor.

* Any deciduous tooth with severe pulpal necrosis provided there is no radiographic contraindication.
* Primary teeth with necrotic pulps and minimum of root resorption. Pulpless primary teeth with stomas (minute opening).
* Pulpless primary teeth in hemophiliacs.
* Pulpless primary anterior teeth when speech, esthetics are a factor. Pulpless primary molars holding orthodontic appliance.

- Notice that :-

- In addition to the previous indications, the tooth should have adequate periodontal and bony support.

- Contraindications of Pulpectomy :-

* *General Contraindications :-*
- Young patient with systemic illness such as congenital ischemic heart disease, leukemia.
- Children on long-term corticosteroids therapy.

* *Clinical Contraindications :-*
- Excessive tooth mobility.
- Communication between the roof of the pulp chamber, and the region of furcation.
- Insufficient tooth structure to allow

****** *Radiographical Contraindications* ***:-***
- External root resorption.
- Internal root resorption in the apical third of the root.
- Radicular cyst, dentigerous / follicular cyst in association with the primary tooth.
- Inter-radicular radiolucency that communicates with the gingival sulcus

- Partial Pulpectomy :-

- This procedure is indicated in primary teeth when :-

* Coronal pulp tissue and the tissue entering the pulp canals are vital but show clinical evidence of hyperemia.
* The tooth may or may not have a history of painful pulpits, but the contents of the root canals should be show evidence of necrosis (suppuration).
* There is no radiographic evidence of a thickened periodontal ligament or of radicular disease.
* If any of these conditions are not present, a complete pulpectomy or an extraction should be performed.

- The Clinical Procedure :-

- The partial pulpectomy technique may be completed in one appointment that involves the removal of the coronal pulp as for the pulpotomy technique. Removal of the pulp filaments from the root canals done with a fine barbed broach; there will be considerable

hemorrhage at this point. A Hedstrom file will be helpful in the removal of remnants of the pulp tissue. The file removes tissue only as it is withdrawn and penetrates readily with a minimum of resistance.

- Care should be taken to avoid penetrating the apex of the tooth. After removal of the pulp tissue from the canals, a syringe is used to irrigate them with 3% hydrogen peroxide followed by sodium hypochlorite. Then dryness of the canals should done with sterile paper points. Hemorrhage should control and the canals should be dry.
- Thin mix of zinc oxide-eugenol paste may be prepared, and paper points covered with the material can be used to coat the root canal walls. Small files may be used to file the paste into the walls. The excess thin paste may be removed with paper points and Hedstrom files.

- Notice that :-

- Zinc oxide-eugenol paste bas been viewed as the traditional root canal filling material for primary teeth.
- Results from multiple studies suggest that KRI paste (iodoform-containing paste) may be preferable. The primary components of **KRI** paste are zinc oxide and iodoform. The main advantages of KRI paste over zinc oxide-eugenol paste are that KRI paste resorbs in synchrony with primary roots and is less irritating to surrounding tissues if a root is inadvertently overfilled.
- Another popular root canal filling material for primary teeth is Vitapex. The primary components of Vitapex are calcium hydroxide and iodoform. Vitapex may be at least as effective as KRI paste.

- Complete Pulpectomy :-

- Clinical technique is similar to partial pulpectomy but not all the procedures are done on the first visit. On the first visit, the pulp is extirpated and all the contents of the pulp chamber and debris from the occlusal third of the canals should be removed, with care taken to avoid forcing any of the infected contents through the apical foramen.
- Then canals are irrigated, dried and a moistened pellet of camphorated monochlorophenol (CMCP) or 1:5 concentration of Buckley's formocresol, with excess moisture blotted, should be placed in the pulp chamber. The chamber may be sealed with zinc oxide-eugenol and the tooth is temporarily restored.
- On the second visit, several days later, the tooth should be isolated with a rubber dam and the treatment pellet removed. If the tooth has remained asymptomatic during the interval, the remaining contents of the canals should be removed and the canals are enlarged. If all the symptoms have subsided, the tooth is obturated and permanently restored.

- Notice that :-

- If the tooth has been painful and there is evidence of moisture in the canals after the removal of the treatment pellet, again mechanical cleaning of the canals should be done followed by irrigation then dryness and the treatment should be repeated.
- Obturation should postponed until the symptoms regresses.
- Systemic antibiotics are advised if cellulitis is present.
- The signs and symptoms at each visit will determined the number of appointments, timing and extent of instrumentation.

- Treatment of Immature Permanent Teeth with Pulpal Necrosis :-

- Apexification :-

- The conventional treatment of pulpless anterior teeth usually requires apical surgery. There is a less traumatic endodontic therapy called apexification, which has been found to be effective in the management of immature, necrotic permanent teeth. The apexification procedure should precede root canal therapy in the management of teeth with irreversibly diseased pulps and open apices.
- The procedure has been demonstrated to be successful in repeated clinical trials stimulating the process of root end development, which was interrupted by pulpal necrosis, so that it continues to the point of apical closure.
- Often a calcific bridge develops just coronal to the apex. When the closure occurs, or when the calcific "plug" is observed in the apical portion, routine endodontic procedures may be completed; the possibility of recurrent periapical pathosis is thus prevented.

a) A preoperative radiograph of maxillary left central incisor with an open apex (b) Radiographic evaluation of Mineral trioxide aggregate level (c) Follow-up after 6 months (d) Follow-up at 18 months

- Regenerative Endodontic Procedures (REPs) :-

- It is defined as biologically based procedures designed to replace damaged structures, which include dentin, root structures, and cells of the pulp-dentin complex. These procedures provide a biological alternative to induce continuous root development and reduce the risk of fracture associated with traditional treatments of immature teeth with necrotic pulps, such as calcium hydroxide or MTA or bio-dentin apexification, where the root remains thin and weak.

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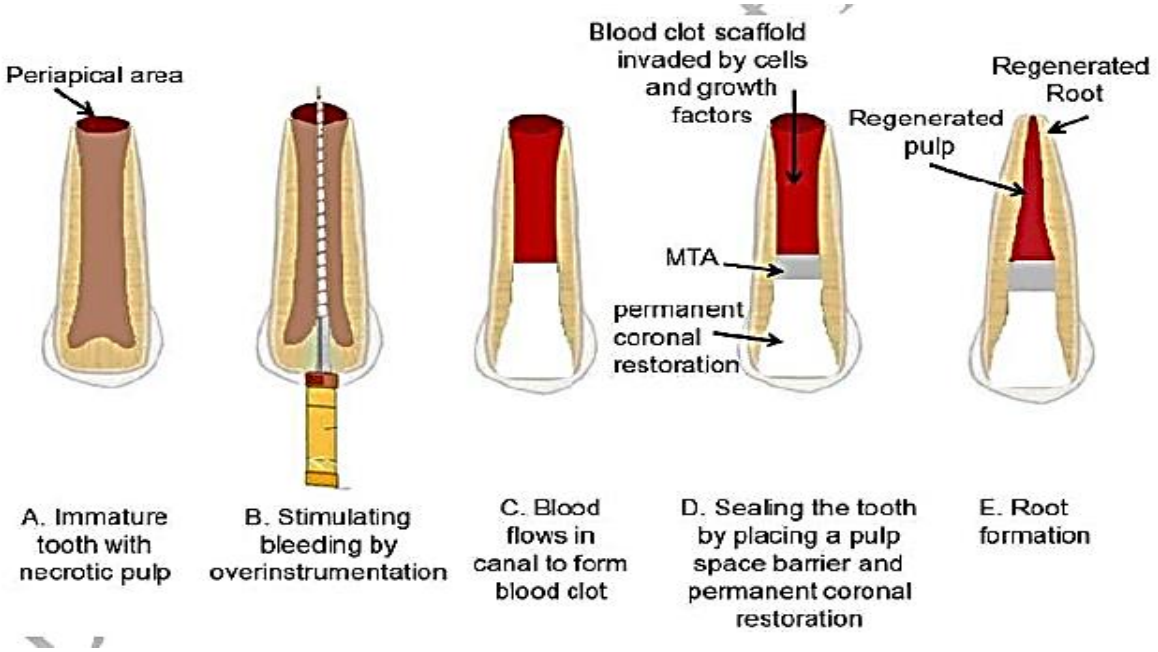


Failure after Pulp Therapy :-

- Factors that may lead to failure in the formation of a calcified bridge across the vital pulp may involve :-

1- The age of the patient

2- Degree of surgical trauma

3- Sealing pressure

4- Improper choice of capping material

5- Low threshold of host resistance

6- Presence of microorganisms with subsequent infection.

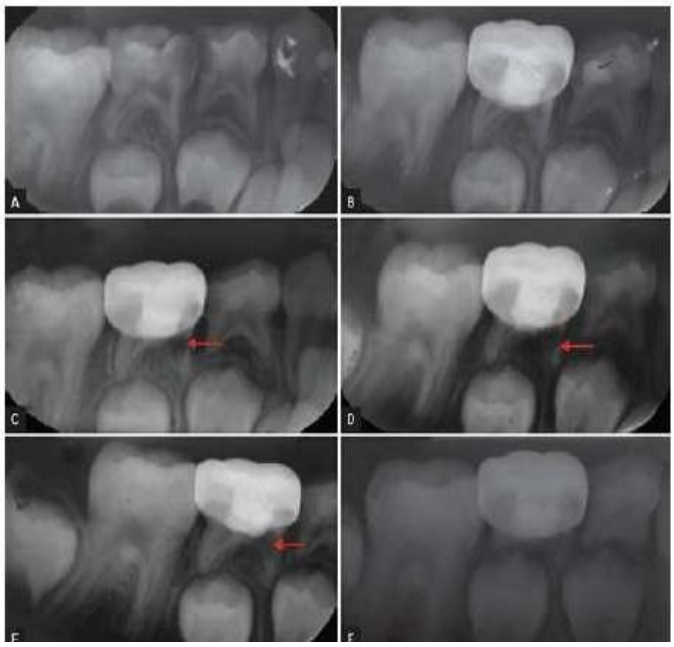
- This failure may appears as :-

1* Internal resorption

2* Alveolar abscess

3* Early exfoliation or over retention of primary teeth with pulp treatment

1* Internal Resorption :-



- One of the most frequently seen evidence of an abnormal response in primary teeth within the pulp canal several months after the pulpotomy procedure is the radiographic evidence of internal resorption. Internal resorption is a destructive process generally caused by odontoclastic activity, and it may progress slowly or rapidly. Occasionally, secondary repair of the resorbed dentinal area occurs.

- No satisfactory explanation for the post pulpotomy type of internal resorption has been given. However, that with a true carious exposure of the pulp, an inflammatory process will be present to some degree. The inflammation may be limited to the exposure site, or it may be diffused throughout the coronal portion of the pulp.

- Amputation of all pulp showing the inflammatory change may be difficult or impossible, and abnormal pulp tissue may be allowed to remain. If the inflammation

extended to the entrance of the pulp canal, odontoclasts may have been attracted to the area; if it were possible to examine the tooth histologically; small bays of resorption would be evident.

- This condition may exist at the time of pulp therapy, although there is no way to detect it. The only indication would be the clinical evidence of a hyperemic pulp.

- Inflammatory cells drawn to the area because of the placement of an irritating capping material might well attract odontoclastic cells and initiate internal resorption. This may explain the occurrence of internal resorption even though the pulp is normal at the time of treatment.

- Because the roots of primary teeth are undergoing normal physiologic resorption, vascularity of the apical region is increased. When an irritant in the form of a pulp-capping material is placed on the pulp, odontoclastic activity present in the area and may predispose the tooth to internal resorption

2* Alveolar Abscess :-

- Some months after pulp therapy has been completed, an alveolar abscess occasionally develops. The tooth usually remains asymptomatic, and the child is unaware of the infection, which may be present in the bone surrounding the root apices or in the area of the root bifurcation.
- A fistulous opening may be present, which indicates the chronic condition of the infection. Primary teeth that show evidence of an alveolar abscess should be removed.
- Endodontic treatment may be considered for permanent teeth that have previously been treated by pulp capping or by pulpotomy and later show evidence of pulpal necrosis and apical infection.

3* Early Exfoliation or over Retention of Primary Teeth with Pulp Treatments :-

- Occasionally a pulpally treated tooth previously believed to be successfully managed will loosen and exfoliate (or require extraction) prematurely for no apparent reason. It is believed that such a condition results from low-grade, chronic, asymptomatic, localized infection. Usually, abnormal and incomplete root resorption patterns of the affected teeth are also observed. When this occurs, space management must be considered.

- Another sequela requiring close observation is the tendency for primary teeth undergoing successful pulpotomies or pulpectomies to be over-retained. This situation may have the untoward result of interfering with the normal eruption of permanent teeth and adversely affecting the developing occlusion. Close periodic observation of pulpally treated teeth is necessary to intercept such a developing problem.
- Extraction of the primary tooth is usually sufficient. This phenomenon may occur when normal physiologic exfoliation is delayed by the bulky amount of cement contained in the pulp chamber. Even though the material is resorbable, its resorption is slowed significantly when large quantities are present.

- Reaction of the Pulp to Various Capping Materials :-

** Zinc Oxide Eugenol :-*

- Zinc oxide-eugenol was used more often than any other pulp capping material before calcium hydroxide came into common use. Although dentists have apparently had good clinical results with the use of zinc oxide-eugenol, it is not recommended as a direct pulp-capping material.

** Calcium Hydroxide :-*

- Calcium hydroxide used as a biological dressing. Because of its high alkalinity (pH 12), it is so caustic that when it is placed in contact with vital pulp tissue, the reaction produces a superficial necrosis of the pulp. The irritant qualities seem to be related to its ability to stimulate development of a calcified barrier.
- The superficial necrotic area in the pulp that develops beneath the calcium hydroxide is demarcated from the healthy pulp tissue below by a new, deeply staining zone comprised of basophilic elements of the calcium hydroxide dressing.
- The original proteinate zone is still present. However, against this zone is a new area of coarse fibrous tissue likened to a primitive type of bone. On the periphery of the new fibrous tissue,, cells resembling odontoblasts appear to be lining up.
- One month after the capping procedure, a calcified bridge is evident radiographically. This bridge continues to increase in thickness during the next 12 months. The pulp tissue beneath the calcified bridge remains vital and is essentially free of inflammatory cells.

** Preparation Contain Formalin :-*

- The clinical success experienced in the treatment of primary pulps with these materials is due to the drug's germicidal action and fixation qualities than to its ability to promote healing.
- Some studies have indicated that the formocresol pulpotomy technique may be applied to permanent teeth, but its use in permanent teeth remains an interim procedure, to be followed by conventional endodontic therapy.

- Notice that :-

- Recently, because of formocresol negative systemic properties, its use should be limited. Formaldehyde has a known carcinogenic, immunogenic, toxic, and mutagenic potential, which makes it questionable and unsuitable for use in paedodontic endodontics.
- Therefore, Bio-dentin and MTA can be used instead of it and other experimental capping materials alternative to formocresol are :-
- Laser Pulpotomy
- Electrosurgical Pulpotomy
- Bone morphogenic protein
- Calcium hydroxide dentin chips

** Ferric Sulfate :-*

- Ferric sulfate (15.5% Fe_2SO_4) has been used as pulpotomy agent as a substitute for formocresol for 15-20 years. Ferric sulfate in contact with blood forms a ferric ion-protein complex, which seals the cut blood vessels mechanically, producing hemostasis.
- The effect of ferric sulfate is hemostatic but not bactericidal or fixative. After application of ferric sulfate for 15 seconds, the pulp is covered with zinc oxide-eugenol and the cavity sealed.

** Glutaraldehyde :-*

- It has been widely tested, to replace formocresol. Studies have shown that application of 2-4% produces rapid surface fixation of the underlying pulp tissue.
- Attributes of glutaraldehyde over formocresol :-

* Forms strong intra- and intermolecular protein bonds leading to superior fixation by cross linkage.
* Diffuse ability is limited, thus reducing the apical extension of the material.
* Excellent antimicrobial property.
* Less dystrophic calcification.
* Produces initial zone of fixation that does not proceed apically.
* Readily excreted from the body. About 90% will be eliminated in 3 days.
* 15-20 times less toxic than formocresol and have little potential for chromosomal interference or mutagenicity.

** Mineral Trioxide Aggregate :-*

- MTA is emerging as a popular product for pulpotomies secondary to a variety of factors. Torabinejad described the physical and chemical properties of MTA in 1995.
- It is ash colored powder made primarily of fine hydrophilic particles of :-

1* Tricalcium silicate
2* Tricalcium aluminate
3* Tricalcium oxide

4* Silicate oxide and bismuth oxide is added for radio-opacity.

- MTA should mixed with sterile water or other sterile liquids in 3: 1 (powder /liquid) ratio to obtain a putty consistency or a thick grainy paste. If the paste is, too dry it will fall when one try to pick it up. Hydration of the powder results in a colloidal gel composed of calcium oxide crystals in an amorphous structure. This gel solidifies into a hard structure in less than three hours (2 hours and 45 minutes).

- MTA has an antibacterial effect on some facultative bacteria but no effect on strict anaerobic bacteria. This limited antibacterial effect is less than that demonstrated by calcium hydroxide pastes. The ability of MTA to resist the penetration of microorganisms appears to be high.

- The use of MTA as an agent for pulp capping or for providing apical seal is well documented. Recent studies have indicated that MTA can be used successfully as a pulpotomy agent also.

- Properties of MTA :-

* It is a biocompatible material and its sealing ability is better than that of amalgam or ZOE.
* Initial pH is 10.2 and set pH is 12.5.
* Antimicrobial activity.
* The setting time of cement is 4 hours
* The ability to set in the presence of moisture and blood.
* Low cytotoxicity
* It presents with minimal inflammation if extended beyond the apex.

- The Negative Attributes :-

* Difficulty of handling
* Exceptional cost.
* MTA can cause pulp canal obliteration.

- Mechanism of Action :-

- The successful usage of MTA in endodontic applications can be attributed to its biocompatibility, bioactivity and mechanism of action. The four actions of MTA after direct placement in contact with living tissues are :-

* Creation of an unfavorable environment for growth of bacteria due to its alkaline pH.
* Formation of hydroxyapatite like mineral structure on its surface and provide the biological seal.
* Formation of calcium hydroxide, which dissociates to release Ca ions, to promotes cellular attachment and proliferation.
* Modulation of cytokine production and encouragement of hard tissue forming cells to differentiate and migrate.

- Clinical Applications of MTA :-

1* Pulp capping :-

a- Direct Pulp Capping :-

- MTA is suitable as a pulp capping because it stimulates dental bridge formation and the bridge formed adjacent to MTA will be thick and continuous with regional dentin. No bacteria were observed on the cavity wall when MTA was used, due to sealing ability, biocompatibility, alkalinity, and ability of MTA to stimulate dentin bridge formation.

b- Pulpotomy of immature permanent teeth :-

- The pulp responds favorably to the protection provided by an MTA layer, and the reparative dentin is consistently uniform and thicker under MTA more than that with Ca $(OH)_2$.

c- Pulpotomy of primary teeth :-

- MTA seems to be a suitable replacement for T.C.F.

2* Root resorption

3* Apexification

4* Furcal repair

5* Perforation repair

6* Root ending filling

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 19 / Dr. Suhair W. Abbood

- Local Anesthesia and Pain Control for Children :-

- Local Anesthesia: Transient loss of sensation in a circumscribed area of the body caused by a depression of excitation in nerve endings or an inhibition of the conduction process in peripheral nerves

- Topical Anesthesia *Topical anesthetics* are effective to a depth of 2-3mm and are effective in reducing the discomfort of the initial penetration of the needle into the mucosa. Its disadvantages are the taste may be disagreeable to patient and the length of application time may increase apprehension of approaching procedure in the pediatric patient.

- Topical anesthetics are available in gel, liquid, ointment, patch and pressurized spray forms. When applying topical anesthetics to the soft tissue, use the smallest effective amount to avoid anesthetizing the pharyngeal tissues.

- Dental anesthetics fall into two groups: esters (procaine, benzocaine) and amides (lidocaine, mepivacaine, prilocaine and articaine).

- Esters are no longer used as injectable anesthetics; however, benzocaine is used as a topical anesthetic.

- Amides are the most commonly used injectable anesthetics with lidocaine also used as a topical anesthetic.

- Content of L.A. Solution :-

1- Local anesthetic agent.
2- Vasoconstrictors.
3- Reducing agents
4- Preservatives.
5- Fungicide.
6- Vehicle.

- Function of Vasoconstrictors :-

1- Delays absorption of LA from the site.

2- Provides blood less field.

3- Prolongs the action .

4- Reduces the systemic toxicity.

- Contraindication :- Thyrotoxicity, Asthma and hypertension.

- Administration of the Anesthetic :- There are two important goals one must accomplish during anesthetic administration;

* *control and limit movement* of the patient's head and body and

* *communicate with the patient* to draw their attention away from the minor discomfort that may be felt during the injection process.

- Most clinicians prefer to keep the uncapped needle out of the patient's line of sight. Do not ask the child to close his/her eyes as that is usually a sign to the child that something bad or painful is about to occur. Instead, the assistant passes the uncapped syringe behind the patient's head.

- Stabilization :- Before placement of the syringe in the mouth, the patient's head, hands and body should be stabilized. There are two basic positions for stabilizing the patient's head.

- Behind the patient position is assumed for injecting the contralateral quadrants to the clinician's favored hand and the anterior regions, i.e., right-handed clinicians injecting the left side, left-handed clinicians injecting the right side.

- The clinician stabilizes the patient's head by supporting the head against the clinician's body with the less favored hand and arm.

- The clinician stabilizes the jaw by resting the fingers against the mandible for support and retraction of lips and cheek.

- The clinician stabilizes the patient's head and retracts the soft tissues with the fingers of the weaker hand resting on the bones of the maxilla and mandible.

- To prevent unexpected movements of the child's hands during the injection, the assistant restrains the hands by asking the child to place them on their belly button and placing her hands over them.

- **Communication :-**

- The clinician initiates communication with the patient by speaking in a reassuring manner during anesthesia administration. The subject matter can range from describing the process in child friendly terminology, to praise, to storytelling, to singing, or, if the clinician is totally unimaginative, avoid words like shot, pain, hurt and injection and substitute words like cold, warm, and funny.

- Specific Injection Techniques :- The most common injection techniques used in pediatric dentistry are :-

**** Inferior Alveolar Nerve Block :-*** The inferior alveolar nerve block (IANB) is indicated when deep operative or surgical procedures are undertaken for mandibular primary and permanent teeth.

While a supra-periosteal injection (infiltration) may provide adequate anesthesia for the primary incisors and molars it is not as effective for providing complete anesthesia for the mandibular permanent molars.

- A major consideration for IANB in the pediatric patient is that the mandibular foramen is situated at a lower level (below the occlusal plane) than in an adult. Thus the injection is made slightly lower and more posteriorly than in an adult.

- The areas anesthetized are the: Mandibular teeth to the midline ,Body of the mandible, inferior portion of the ramus, Buccal muco-periosteum, mucous membrane anterior to the mandibular first molar, Anterior two thirds of the tongue and the floor of the oral cavity (lingual nerve), Lingual soft tissues and periosteum (lingual nerve)

- Technique :-

1-Depending on the age and size of the patient a 25 or 27 gauge long or short needle may be used.

2-Lay the thumb on the occlusal surface of the molars, with the tip of the thumb resting on the internal oblique ridge and the ball of the thumb resting on the retro-molar fossa. Support the mandible during the injection by resting the ball of the middle finger on the posterior border of the mandible.

3-The barrel of the syringe should be directed between the two primary molars on the opposite side of the arch. Inject a small amount of solution as the tissue is penetrated. Wait 5 seconds.

4-Advance the needle 4mm while injecting minute amounts (up to a ¼ cartridge).

5-The average depth of insertion is about 15mm (varies with the size of the mandible and the age of the patient). Deposit about 1 ml of solution around the inferior alveolar nerve.

6-If bone is not contacted, the needle tip is located too posteriorly. Withdraw it until approximately ¼ length of needle is left in the tissue, reposition the syringe distally so it is over the area of the permanent molar and repeat as above.

7-If bone is contacted too early (less than half the length of a long needle) the needle tip is located too anteriorly. Withdraw it until approximately ¼ length of needle is left in the tissue, reposition the syringe mesially over the area of the cuspid and repeat as above. The needle is withdrawn and recapped. Wait 3-5 minutes before commencing dental treatment.

**** Lingual Nerve Block :-*** Successful anesthesia of the inferior alveolar nerve will result in anesthesia of the lingual nerve with the injection of a small quantity of the solution as the needle is withdrawn. The clinician must not assume effective anesthesia is attained if the patient only exhibits tongue symptoms. The patient must also exhibit lip and mucosa symptoms.

**** Long Buccal Nerve Block :-*** The long buccal nerve provides innervation to the buccal soft tissues and periosteum adjacent to the mandibular molars. For the removal of mandibular permanent molars or for placement of a rubber dam clamp it is necessary to anesthetize the long buccal nerve. It is contraindicated in areas of acute infection.

- Technique :-

1-With the index finger, pull the buccal soft tissue in the area of the injection taut to improve visibility.

2-Direct the needle toward the injection site with the bevel facing bone and the syringe aligned parallel with the occlusal place and buccal to the teeth.

3-Penetrate the mucous membrane at the injection site distal and buccal to the last molar.

4-Advance the needle slowly until muco-periosteum is contacted.

5-The depth of penetration is 1-4mm.

6-Aspirate.

**** Supra-periosteal Injections :-*** (Local Infiltration) Supra-periosteal injection (commonly known as local infiltration) is indicated whenever dental procedures are confined to a localized area in either the maxilla or mandible. The terminal endings of the nerves innervating the region are anesthetized.

-The indications are pulpal anesthesia of all the maxillary teeth (permanent and primary), mandibular anterior teeth (primary and permanent) and mandibular primary molars when treatment is limited to one or two teeth. It also provides soft tissue anesthesia as a supplement to regional blocks.

- The contraindications are infection or acute inflammation in the injection area and in areas where dense bone covers the apices of the teeth, i.e., the permanent first molars in children. It is not recommended for large areas due to the need of multiple needle insertions and the necessity to administer larger total volumes of local anesthetic that may lead to toxicity.

**** Local Infiltration for Mandibular Molars :-*** A number of studies have reported on the effectiveness of injecting local anesthetic solution in the muco-buccal fold between the roots of the primary mandibular molars.

- Technique :-

1-Retract the cheek so the tissue of the muco-buccal fold is taut.

2-Apply topical anesthetic.

3-Orient the needle bevel toward the bone.

4-Penetrate the mucous membrane mesial to the primary molar to be anesthetized directing the needle to a position between the roots of the tooth. Slowly inject a small amount of anesthetic while advancing the needle to the desired position and injecting about a ½ cartridge of anesthetic.

5-If lingual tissue anesthesia is necessary (rubber dam clamp placement), then one can inject anesthetic solution directly into the lingual tissue at the free gingival margin or one can insert the needle inter-proximally from the buccal and deposit anesthesia as the needle is advanced lingually.

6-The needle is withdrawn and recapped.

**** Local Infiltration for Mandibular Incisors :-***

1-Retract the cheek so the tissue of the muco-buccal fold is taut.

2-Apply topical anesthetic.

3-Orient the needle bevel toward the bone.
4-Penetrate the mucosa labial to the tooth to be treated close to the bone at the muco-gingival margin. Advance the needle 2mm approximating the apex of the root. Inject a ¼-½ cartridge of anesthetic.
5-If it is necessary to anesthetize an adjacent tooth, partially withdraw the needle and turn the needle in the direction of the indicated tooth and advance the needle until it approximates the apex.
6-If lingual tissue anesthesia is necessary (extraction), then one can inject anesthetic solution directly into the lingual tissue at the free gingival margin or one can insert the needle inter-proximally from the buccal and deposit anesthesia as the needle is advanced lingually.
7-The needle is withdrawn and recapped.
8-Wait 3-5 minutes before commencing treatment.

**** Local Infiltration of the Maxillary Primary and Permanent Incisors and Canines :-***

- Technique :-

1-Retract the cheek so the tissue of the muco-buccal fold is taut.
2-Apply topical anesthetic.
3-Orient the needle bevel toward the bone.
4-Penetrate the mucosa labial to the tooth to be treated close to the bone at the muco-gingival margin with the syringe parallel to the long axis of the tooth. Advance the needle 2mm approximating the apex of the root.
5-Aspirate.
6-Inject a ¼-½ cartridge of anesthetic.

- If it is necessary to anesthetize an adjacent tooth, partially withdraw the needle and turn the needle in the direction of the indicated tooth in advance the needle until it approximates the apex.

7-Aspirate.

- If palatal tissue anesthesia is necessary (extraction or incomplete anesthesia of the tooth due to accessory innervation from the palatal nerves)

**** Anesthetization of the Maxillary Primary Molars and Premolars :-*** The areas anesthetized are the pulps of the maxillary first primary molars (primary and early mixed dentition) and the first and second premolars and mesio-buccal root of the first permanent molar in the permanent dentition, as well as the buccal periodontal tissues and bone over these teeth. The injection is contraindicated if infection or inflammation is present in the area of administration.

- Technique :-

1-The area of insertion for the first primary molar is in between the apices of the roots of the tooth at the height of the muco-buccal fold. The area of insertion for the premolars is in an area between the two teeth.
2-Retract the cheek so the tissue of the muco-buccal fold is taut.
3-Apply topical anesthetic.

4-Orient the needle bevel toward the bone.
5-Penetrate the mucous membrane and slowly advance the needle until its tip is above the area between the apices of the first molar or above the apex of the second premolar.
6-The needle is withdrawn and recapped.

**** Posterior Superior Alveolar Nerve Block*** *:-* For reasons already described, the posterior superior alveolar nerve block is used to anesthetize the second primary molar in the primary and mixed dentitions and the permanent molars in the mixed and permanent dentitions. The mesio-buccal root of the first permanent molar is not consistently innervated by the posterior superior alveolar nerve. Complete anesthesia of the tooth may need to be supplemented by a local infiltration injection.

- The injection is indicated when a supra-periosteal injection is contraindicated (infection or acute inflammation) or when supra-periosteal injection is ineffective. It is contraindicated in patients with blood clotting problems (hemophiliacs) because of the increased risk of hemorrhage in which case a supra-periosteal or PDL injection is recommended.

- Technique :-

1- A 25 or 27 gauge short needle is acceptable.
2- The area of insertion is the height of the muco-buccal fold above and distal to disto-buccal root of the last molar present in the arch.
3- Retract the cheek so the tissue of the muco-buccal fold is taut.
4- Apply topical anesthetic.
5- Orient the needle bevel toward the bone.
6- Insert the needle into the height of the muco-buccal fold over the last molar.
7- Advance the needle slowly in an :-
- Upward (superiorly at a 45 degree angle to the occlusal plane).
- Inward (medially toward the midline at a 45 degree angle to the occlusal plane).
- Backward (posteriorly at a 45 degree angle to the long axis of the molar) to a depth of 10-14mm.
8- Aspirate.
9- Slowly deposit ½-1 cartridge of solution (aspirate several times while injecting).
10- The needle is withdrawn and recapped.
11- Wait 3-5 minutes before commencing with dental treatment.
- If anesthesia is incomplete, supplement with a supra-periosteal or PDL injection.

**** Anesthetization of the Palatal Tissues :-***

• The steps in atraumatic administration of anesthesia in all palatal areas are :-
1-Provide adequate topical anesthesia (at least 2 minutes) in the injection area.
2-The applicator should be held in place by the clinician while applying sufficient pressure to cause blanching.
3-Use pressure anesthesia at the injection site before and during needle penetration and solution deposition.

4-The pressure is maintained with a cotton applicator with enough pressure to cause blanching.
5-Maintain control over the needle. The use of an ultra-short needle will result in less deflection and greater control.
6-A finger rest will aide in stabilizing the needle.
7-Inject the anesthetic solution slowly. Because of the density of the palatal soft tissues and their firm adherence to the hard palate there is little room to spread during solution deposition. Slow injection reduces tissue pressure and results in a less traumatic experience.

**** Nasopalatine Nerve Block*** *:-* The nasopalatine nerve innervates the palatal tissues of the six anterior teeth. If the needle is inserted into the nasopalatine foramen, it is possible to completely anesthetize the six anterior teeth. However, this technique is painful and not used routinely. The indications for a nasopalatine injection is when palatal soft tissue anesthesia is necessary for restorative therapy on more than two teeth (subgingival placement of matrix bands) and for periodontal and surgical procedures involving the hard palate. Local infiltration is indicated for treatment of one or two teeth. It is contraindicated when there is infection or inflammation in the area of the injection site.

- Technique :- (single penetration)

**** Greater Palatine Nerve Block*** *:-* The greater palatine nerve block is useful for anesthetizing the palatal soft tissues distal to the canine. It is less traumatic than the nasopalatine nerve block because the palatal tissue in the area of the injection site is not as anchored to the underlying bone.

- Technique :-

1-Locate the greater palatine foramen.
2-Place a cotton swab at the junction of the hard palate and the maxillary alveolar process.
3-Starting in the region of the maxillary first molar (or second primary molar in the primary dentition) apply pressure with the cotton swab while moving posteriorly.
4-The swab will fall into the depression created by the greater palatine foramen.
5-Prepare the tissue at the injection site, 1–2mm anterior to the greater palatine foramen.
6-Clean and dry the area with a sterile gauze.
7-Apply topical anesthetic with a cotton applicator for two minutes.
8-Move the cotton applicator posteriorly so it is directly over the greater palatine foramen and apply sufficient -pressure to blanch the tissue for 30 seconds.
9-Direct the syringe into the mouth from the opposite side of the mouth from the injection site at a right angle to the -target area with orientation of the needle bevel toward the palatal soft tissue.
10-Place the bevel of needle gently against the blanched tissue and apply enough pressure to slightly bow the needle.
11-Deposit a small volume of anesthetic.
12-Wait 2-3 minutes before commencing treatment.

- Palatal anesthesia in the area of the first premolar may be inadequate due to overlapping fibers from the nasopalatine nerve. To correct this it may be necessary to supplement the anesthesia with local infiltration.

*** Supplemental Injection Techniques**

- Periodontal Ligament Injection :- (Intra-ligamentary Injection) The periodontal ligament injection has been used for a number of years as either a method of obtaining primary anesthesia for one or two teeth or as a supplement to infiltration or block techniques. The needle is placed in the gingival sulcus, and advanced along the root surface until resistance is met. Then approximately 0.2 mL of anesthetic is deposited into the periodontal ligament.

- Pressure is necessary (by the injection) to express the anesthetic solution. periodontal injection should be avoided in primary teeth with a developing permanent tooth bud as there have been reports of enamel hypoplasia in permanent teeth following PDL injection. Because it is injected in a site with limited blood circulation it can be used in patients with bleeding disorders.

- Computer-Controlled Anesthetic Delivery System :- "The Wand" (Milestone Scientific, Livingston , NJ) is a computer-controlled local anesthetic delivery system. The system consists of a conventional local anesthetic needle inserted into a disposable pen-like syringe. A foot-controlled microprocessor controls the delivery of the anesthetic solution through the syringe at a constant flow rate, volume and pressure. It has been reported that block, infiltration, palatal and periodontal injections are more comfortable with the Wand than with conventional injection techniques

- Complications of Local Anesthesia :-

**** Anesthetic toxicity (overdose) :-*** While rare in adults, young children are more likely to experience toxic reactions because of their lower weight. Most adverse drug reactions occur within 5-10 minutes of injection.

- Overdose of local anesthetics are caused by high blood levels of anesthetic as a result of an inadvertent intravascular injection or repeated injections.

- Local anesthetic overdose results in excitation followed by depression of the central nervous system and to a lesser extent of the cardiovascular system. Early subjective symptoms of the central nervous system include dizziness, anxiety and confusion and may be followed by diplopia, tinnitus, drowsiness and circumoral numbness or tingling.

- Objective signs include muscle twitching, tremors, talkativeness, slowed speech and shivering followed by overt seizure activity. Unconsciousness and respiratory arrest may occur. The initial cardiovascular system response to local anesthetic toxicity is an increase in heart rate and blood pressure.

- As blood plasma levels of the anesthetic increase, vasodilatation occurs followed by depression of the myocardium with subsequent fall in blood pressure. Bradycardia and cardiac arrest may follow. Local anesthetic toxicity is preventable by following proper injection technique, i.e., aspiration during slow injection.

- Clinicians should be knowledgeable of maximum dosages based on weight. If lidocaine topical anesthetic is used it should according to the total administered dose as it can infiltrate into the vascular system. After injection the patient should be observed for any possible toxic response as early recognition and intervention are the keys to a successful outcome.

*** Allergic reactions :-** Although allergic reactions to injectable amide local anesthetics are rare, patients may exhibit a reaction to the bisulfite preservative added to anesthetics containing epinephrine. Patients with a sulfa allergy should not receive articaine. Patients may also exhibit allergic reactions to benzocaine topical anesthetics.

- Allergies can manifest in a variety of ways including urticaria, dermatitis, angioedema, fever, photosensitivity and anaphylaxis.

*** Postoperative soft tissue injury :-** Accidental biting or chewing of the lip, tongue or cheek is a problem seen in very young pediatric mentally or physically disabled patients. Soft tissue anesthesia lasts longer than pulpal anesthesia and may be present for up 4 hours after local anesthesia administration.

- The most common area of trauma is the lower lip and to a lesser extent the tongue, followed by the upper lip.

- Several preventive measures can be followed to avoid soft tissue injury:-

- Select a local anesthetic with a duration of action that is appropriate for the length of the planned procedure.
- Advise the patient and accompanying adult about the possibility of injury if the patient bites, sucks or chews on the lips, tongue and cheek. They should delay eating and avoid hot drinks until the effects of the anesthesia are totally dissipated.
- Reinforce the warning with patient stickers and by placing a cotton roll or rolled up gauze (“Bite on the ghost”) in the muco-buccal fold if anesthesia symptoms persist.
- The management of soft tissue trauma involves reassuring the patient and parent (it’s okay if the tissue turns white), allowing up to a week for the injury to heal, and lubricating the area with petroleum jelly or antibiotic ointment to prevent drying, cracking and pain.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 20 / Dr. Suhair W. Abbood

- Oral Surgery for Children, Indication and Contraindications for Extraction of Primary Teeth :-

- The basic principles used in the management of pediatric oral surgical procedures include :-

* The initial step is a diagnosis, which is developed through a process involving history taking, physical examination, and imaging.

* The pediatric patient's ability to cooperate must be considered. Depending on the patient's age and systemic health.

* The clean technique (a sterile technique) which is depending on preventing any organism from the surgical staff, other patient, instruments, or equipment from contaminating the patient. Also requires that the dentist scrubs his or her hands with an antiseptic soap then gloved and to wear the gown covering his or her arms, mask, and eye protection which protect the dentist as they are for the protection of the patient. Sterilized instruments, or equipment should be used.

* Adequate visibility, this entails adequate access, adequate light, and a good suction to create a debris free surgical field. Adequate access requires appropriate mouth-opening. Opening the patient's mouth can be facilitated with a bite block or a molt mouth prop.

- Indications for extraction of primary teeth :-

- Indications for extractions for children are much the same as those for adult patients :-

* non-restorable caries, * apical disease, * fractures of crowns or roots, * prolonged retention of primary teeth because of improper root resorption or ankylosis, * impacted teeth, and

* supernumerary teeth.

- The dentist must have an understanding of the growth and development of the pediatric patient, to assess and diagnose the situations that will be encountered. For example, the dentist should

know the eruption patterns of the primary and permanent teeth. Delayed eruption, especially when asymmetry, is frequently an indication of an abnormality.

- Contraindications for extraction of primary teeth :-

* Presence of acute oral infections such as, necrotizing ulcerative gingivitis or herpetic gingival stomatitis.
* Pericoronitis (difficult surgical procedure involving bone removal is anticipated).
* Extraction of teeth in previously irradiated areas (at least 1 year should be allowed for maximal recovery of circulation to the bone).
* Systemic contraindications to the tooth extraction.

- Indications for extraction of 1st permanent molars :-

- Treatment planning decision and management of extractions should be ideally made following input from both pediatric dentist and orthodontist general aim :-

1. For space closure created by loss of the 1st. permanent molar
2. To guide the eruption of the 2nd. Permanent molar to its proper position
3. To prevent crowding and other malocclusion

- We should keep in mind the following points before decision :-

* Child's age and social background
* Occlusion and developing dentition
* Oral hygiene practice and dietary habits
* Cooperation with treatment options
* Degree of molar-incisal hypomineralization
* Restorability of the 1st permanent molar
* Expected long term treatment cost

- The ideal timing for extracting the lower 1st permanent molar is when the furcation of the lower 2nd permanent molar begin to calcify usually 8.5-9.5 years

- ***Radiographic Survey*** :-

- Radiographic surveys of teeth to be extracted are of prime importance. The dentist should observe the size and contour of the primary roots, the amount and type of resorption, the relation of the roots to the succedaneous teeth, and the extent of disease.
- Simple exodontia in the pediatric patient requires minimal modification from that used in the adult. Concepts that may dictate slight modification include the following :-

1- The dentist must be cognizant of the proximity of the deciduous tooth to the succedaneous tooth.
2- The roots on primary teeth with non-resorbed roots will be long, slender, and potentially divergent.

- Technique for Extraction Primary Teeth :-

- Extraction technique :-

- Extracting a tooth is an exercise in administering a controlled force in a slow and deliberate fashion to expand the alveolus and disrupt the periodontal ligaments, such that the tooth can be a traumatically removed from the jaw.

-Rotational forces may be applied for selected roots that are conical (anterior teeth, cuspids, mandibular premolars, maxillary second premolars).

-In general, deciduous anterior teeth should be luxated to the labial aspect during the extraction procedure because of the lingual position of the permanent teeth and posterior teeth should be luxated with buccal and lingual pressures.

- Finally, once the alveolus is sufficiently expanded and the periodontal ligament disrupted, a slight coronal tractional forces are applied and the tooth is removed.

- The dentist's opposite hand may be placed such that the index finger or thumb is positioned on either the buccal and/or lingual/palatal aspect of the alveolus which provides :-

* feeling the expansion of the alveolus
* retraction of soft tissues to allow visibility and access
* protection the tissues if the instrument slips.
* resistance to the extraction force on the mandible to prevent dislocation.

<u>* Upper Anterior teeth :-</u>

- Apply the forceps beaks to the root and then using clockwise and anticlockwise rotations about the long axis (the action one would employ when using a screwdriver). In older children some additional buccal expansion may be required for the removal of the upper canine.

<u>* Upper Molars :-</u>

- The initial movement after application of the forceps is palatal, to expand the socket in this direction. The tooth is then subjected to a buccally directed force, which results in delivery.

<u>* Lower anterior teeth :-</u>

- These teeth are extracted in the same manner as their upper counterparts, in that, rotation about the long axis using lower primary anterior or root forceps.

<u>* Lower molars :-</u>

- These teeth are removed by Bucco-lingual expansion of the socket. They can be extracted using either lower primary molar or lower primary root forceps. After application of the forceps a small lingual movement is followed by a continuous buccal force, which delivers the tooth.

- The dentist and the patient position during surgical procedure :-

*** For the extraction of a maxillary tooth :-**

-The patient is positioned in the dental chair such that the maxillary occlusal plane is at an angle between 60°and 90°to the floor.

-The dentist stands in front of the patient, with a straight back.

*** For the extraction of a mandibular tooth :-**

-The patient is positioned in the dental chair such that the mandibular occlusal plane is parallel to the floor.

-A right-handed dentist during extraction the lower left teeth stands in front of the patient; the patient's mouth is at a height just below the dentist's elbow. While when extracting teeth from the lower right side, the dentist stands behind the patient with the chair as low as possible to allow good vision.

- The steps in teeth extracting :-

-***The first step*** in extracting a tooth is to separate the soft-tissue attachment from the cervical aspect of the tooth. This is most commonly achieved with a #9 Molt elevator which is a dual-ended instrument with one end sharply pointed used to separate the soft-tissue attachment from the tooth.

-***The second step*** is to use a straight elevator to luxate the tooth, it has a concave blade that is placed toward the tooth being luxated. The blades are available in various sizes, and their edges may be serrated to better grasp the tooth, the elevator must rest on the alveolus. The elevator is initially inserted so that the blade of the elevator angled toward the alveolar crest up to 45°from the alveolar crest in the coronal plane.

- The elevator is then turned such that the portion of the blade resting on the alveolus acts as a fulcrum and the coronal portion of the blade rotates toward the tooth being extracted. This action expands the alveolus, disrupts the periodontal ligament, and establishes initial mobility of the root.

-***The last step*** is to remove the tooth with forceps, which must be appropriately selected, several forceps are available in smaller sizes for the pediatric patient.

- The basic principles in selecting forceps are as follows :-

1- The beaks of the forceps should adapt to the root surface of the tooth.

2- The beaks of the forceps, when positioned and engaging the tooth, should be parallel to the long axis of the tooth.

3- The size of the beaks of the forceps should be small enough not to engage the adjacent teeth during luxation and removal of the tooth.

- The beaks of the forceps should be placed under the separated and reflected soft tissue and the tooth firmly engaged. The first force applied by the dentist when using forceps is apically directed.

- The apically directed force positions the center of rotation as close to the root apex of the tooth, the less likely an apical third root fracture will occur, the apically directed force also disrupts the periodontal ligaments as possible.

- Difficulties in extraction :-

1-Root fracture :- A root tip from a primary tooth may fracture during the procedure; if the tooth root is clearly visible and can be removed easily with an elevator, the root should be removed.

However, if removing the root tip poses a significant risk to the adjacent or succedaneous tooth, then the residual root tip should be left in the bone.

- Usually these root tips do not cause adverse sequelae. They may eventually resorb or migrate toward the gingiva and become exposed with the eruption of the permanent tooth. A post treatment radiograph should be obtained, and the child's parent should be informed.

2-Although they are rare :- the dentist must know when the roots of the deciduous molars are configured such that they could engage the succedaneous tooth and possibly cause the succedaneous tooth to be extracted with the deciduous tooth. If this is recognized radiographically or during the extraction, then sectioning the deciduous tooth with a surgical handpiece may be indicated.

3-Submerged or ankylosed primary tooth :- A primary tooth may be submerged or ankylosed. Ankylosed teeth may be slightly out of occlusion or they may be completely within the alveolar process. A submerged tooth may have non resorbed divergent roots or may have all or nearly all the root resorbed.

- Despite having the root significantly resorbed, the tooth may show no signs of mobility when pressure or leverage is applied and exhibit a solid sound on percussion. These teeth may be welded to the surrounding bone. The basic principles pertaining to extraction are followed. A tooth with non-resorbed divergent roots in which the potential for a root fracture is high, may be best extracted if the tooth is sectioned.

- If luxation is not accomplished with reasonable forceps pressure when the ankylosed tooth is extracted, a surgical approach is required. An intraoperative or postoperative radiograph may be indicated to assess the situation.

- Impacted teeth :-

- An impacted tooth is one that fails to erupt. Rare is the impaction of a deciduous tooth. The latter is commonly associated with pathology, such as an odontoma or supernumerary tooth.

- An impacted tooth also may be secondary to insufficient space in the dental arch or may be associated with genetic abnormalities.

- The most commonly impacted tooth is the third molar, other commonly impacted teeth include the maxillary canine, second premolar, mandibular second molar, and maxillary incisors. The frequency of impaction of the maxillary incisors is most likely secondary to injury, infection, or loss of the deciduous incisors.

- If the deciduous incisors are lost prematurely, a dense, hyperplastic, fibrous tissue may form over the alveolus, which impedes eruption and contributes to the impaction of the permanent maxillary incisors.

- Once an altered eruption pattern is recognized, the dentist must perform a clinical and radiographic examination. Palpation of the buccal, lingual, or palatal aspect may reveal a bulge,

suggesting the location of the impacted tooth. When the tooth is not palpable, radiographic imaging is indicated to determine the location of the impacted tooth.

- Extraction Complications :-

- The most frequent complications are :-

* Fracture of the tooth * Injuries to adjacent teeth * Fracture of the alveolar bone
* Fracture of the tuberosity * Extraction of the wrong tooth * Maxillary sinus perforation
* Root displaced in the sinus * Root displaced in the submandibular space
* Gingival and mucosal lacerations * Injury to the inferior alveolar nerve
* Hemorrhage and hematoma * TMJ trauma
* Damage to permanent successor. * Dry socket

- After Extraction :-

- Post-extraction care :-

* The socket should be inspected and any loose fragment of bone is removed or necessary socket irrigation is performed.
* The alveolar processes should be pressed together in order to reduce any distortion of the supporting tissues; suturing should always be done after multiple extractions.
* After extraction, a gauze pack is placed over the socket and patient is directed to bite on the pack for ½ hour, exerting firm, even pressure. This will prevent bleeding while the patient returns home and it allows a blood clot to form.

- Some Post-extraction instructions are :-

* The patient should be warned that sucking the wound, investigating the socket with tongue and rinsing during the first day disturbs the blood clot and may cause dry socket.
* Patient should be directed to remain quiet for several hours, preferably sitting in a chair or if lying down, keeping the head elevated.
* Only liquids and soft solids should be advice on the first day. They may be warm or cold but not extremely hot.
* The teeth should be brushed as usual and on the day after surgery rinsing of the mouth should begin. A warm saline solution is best for this purpose.
* Some degree of postoperative pain accompanies many exodontia procedures and begins after the effects of the anesthetic have left. So, it is better to take some analgesic before the effect of anesthetic wears off.
* Prevention of swelling after extensive or difficult operation. The degree of swelling is generally in direct proportion to the degree of surgical trauma.
* The application of cold to the operated site is beneficial in reducing the amount of postoperative swelling. Pressure dressings are also beneficial in limiting the postoperative swelling.

- Additional advisory in case of children :-

* Parent is instructed to keep a check on the status of cotton so that the child does not swallow it inadvertently.
* Patient is instructed to keep the cotton for 30 minutes to 1 hour and avoid spitting out.
* It is best to give cold food stuff like ice-cream to children to aid in clot formation.
* Explain the effect of anesthesia will keep the area numb for a specific time so as to avoid lip or cheek biting, especially in children.
* It is best to allow the child to be seated in the dental chair for at least 10 minutes before discharging him so as to avoid any shock symptoms.
* Advise parents to keep children under close supervision that particular day and avoid sports of heavy nature.
* Parents should use alternate methods to distract the child so as to avoid his attention towards the wound.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 21 / Dr. Suhair W. Abbood

- Space Maintainer, Indication and Contraindication :-

- The primary dentition plays a very important role in the child's growth and development, not only in terms of speech, chewing, appearance and the prevention of bad habits but also in the guidance and eruption of permanent teeth

- Maintaining Space in Developing Dentition Space management and space supervision represents one of the most critical aspects of orthodontic treatment for children.

- Space Maintenance :- It is defined as the process of maintaining a space in a given arch previously occupied by a tooth or a group of teeth.

- Space maintenance techniques may be employed from the early mixed dentition to the early permanent dentition. Maintenance of arch circumference will eliminate many developing crowding situations.

- Space maintainers :- an appliance designed to maintain a given area or space generally in the mixed or primary dentition

Or it is a fixed or removable appliance designed to preserve the space created by the premature loss of a primary tooth or a group of teeth

- Objectives of space maintenance :-

* Preservation of primate space.
* Preservation of the integrity of the dental arches.
* Preservation of normal occlusal planes.
* In case of anterior space maintenance, it should aid in esthetics and phonetics.

- Requirement of a space maintainer :-

* Should maintain the desired proximal dimensions of the space created by the loss of tooth.
* Preferred to be functional.
* Should not interfere with eruption of occluding teeth.
* Should not interfere with the eruption of the replacing permanent teeth.
* Should not interfere with speech, mastication or functional movement of mandible.
* Should be simple and strong.
* Should not impose excessive stress on adjacent tooth, that means it's passive in not imposing pressures on remaining teeth that might affect orthodontic movements
* Easily cleansable without enhancing dental caries or soft-tissue pathology.
* Should not restrict the normal growth and function.

- Indications for Space Maintenance :-

- A space maintainer appliance may be indicated as follows :-

1- When a deciduous first or second molar is lost prior to the eruption of the permanent first molar
2- To preserve leeway space when all of the posterior primary teeth are present but the dentition is slightly crowded

- Contraindications for Space Maintenance :-

- A space maintainer may not be indicated under the following situations :-

• The premolars are due to erupt within 6 months.
- The dental age of the patient should be evaluated. The following may serve as a guide :-
1-Root length 3/4 formed indicates eruption in approximately 6 months.
2-With 1/2 root formation present, it takes 4 to 5 months for the succedaneous tooth to move through 1 mm of overlying bone (as measured on a bite-wing radiograph).
3-There is poor compliance, poor oral hygiene, or uncontrolled rampant caries.
4-Space has already been lost.
5-Severe crowding already exists.
6-There is no recall program available

- Factors Affecting Planning for Space Maintainers :-

1- Time Elapsed Since Tooth Loss :-

- If space closure is going to occur, it will usually take place within six months after the loss of tooth. Therefore, the appliance must be placed as soon as possible, following the extraction of tooth.

2- Amount of Space Loss :-

* Loss of maxillary second primary molars results in the greatest amount of closure, up to 8 mm of space loss in a quadrant.

* Loss of mandibular second primary molars shows the next greatest amount, up to 4 mm in a quadrant.
* Loss of upper or lower first primary molars shows almost equal amounts of space closure when compared with one another; the amount is most affected by timing of the first primary molar loss.
* Space loss potential is particularly high if the primary molar loss occurs in approximation to first permanent molar eruption, irrespective of which primary molar is lost and in which arch the loss occurs.
* After first permanent molars have erupted into occlusion, loss of second primary molars may still result in significant space closure.
* Loss of a first primary molar with retention of the second primary molar shows minimal amounts of space closure because the second primary molar serves to buttress first permanent molar positions after occlusion is established.

3- Rate of Space Closure :-

* The younger the patient, more is the space loss.
* Maximum space is lost during first 6 months of extraction and most immediate loss is within 76 hours.

4- Direction of Space Closure :-

- Maxillary posterior spaces close predominantly by mesial bodily movement and mesio-lingual rotation around the palatal root of the first permanent molars. Only minimal mesial crown tipping of the first molar is usually noted. In contrast, mandibular spaces close primarily by mesial tipping of the first permanent molars, along with distal movement and retroclination of teeth anterior to the space. Bodily movement of first molars is not typically notable in the lower arch as seen in the upper arch. Lower molars also tend to roll lingually in conjunction with their mesial crown-tipping during space loss movements.

5- Eruption Status of the Adjacent Teeth :-

- It helps us ascertain (determine) mesial shift for molars and distal tipping for canines. For example, if the first primary molar is lost during the time of active eruption of the first permanent molar, a strong forward force will be exerted on the second primary molar, causing it to tip into the space required for the eruption of the first premolar. In addition, if the loss of the second primary molar occurs after the first permanent molars have fully erupted and normal cuspal interdigitation has been established, the degree of space loss should be less dramatic than earlier during molar transition

6- Amount of Bone Coverage Over the Tooth :-

- Predictions of tooth emergence based on root development and the influence of the time of the primary tooth loss are not reliable if the bone covering the developing permanent tooth has

been destroyed by infection. In such a situation the emergence of the permanent tooth is usually accelerated. If there is bone covering the crowns, it can be readily predicted that eruption will not occur for many months; insertion of a space maintaining appliance is indicated. A guideline for predicting emergence is that erupting premolars usually require 4 to 5 months to move through 1 mm of bone as measured on a bite-wing radiograph.

7- Eruption Status of the Succedaneous Tooth :-

- It is estimated by the amount of root completion (tooth erupts in oral cavity after 2/3rd root formation). Teeth normally erupt when three fourths of the root is developed, regardless of the child's chronologic age. However, the eruption timing of a permanent successor may be delayed or accelerated after premature loss of a primary tooth, depending on the developmental status, bone density of the area, and nature of the primary tooth loss. Very early loss before significant root formation of the permanent successor usually results in delayed eruption timing.

8- Dental Age of Patient :-

* It is the age calculated according to the last tooth erupted in oral cavity in normal eruption sequence. This involves recognizing the teeth clinically present in the oral cavity in comparison to dental eruption charts.

* The chronologic age of the patient is not as important as the developmental age. Delayed eruption timing may alter normal transitional adjustments in arch length, arch width, and arch circumference.

9- Sequence of Eruption :-

- Knowledge of usual eruption sequence is important. For example, if the mandibular primary 2nd molar is prematurely lost and mandibular 2nd permanent molar is erupting before the 2nd premolar, arch length loss secondary to mesial forces generated on 1st permanent molar as the 2nd permanent molar erupts can occur with subsequent space loss.

10- Delayed Eruption of Permanent Teeth :-

- Over-retained or ankylosed primary teeth, or impacted permanent teeth, can result in a delay of the eruption process. With the removal of these types of primary teeth an appliance may be needed to hold the space until the permanent tooth erupts into a normal position.

11- Available Space :-

- An evaluation of the available space should be performed to determine whether the deficiency is developmental or a result of the pre-existing condition. A space analysis conducted in the mixed dentition, will aid the practitioner in a prediction of the amount of available space for the unerupted permanent teeth. A decision may be made at this point on the type of appliance (space maintainer or space regainer) that is appropriate.

12- Congenital absence of the permanent tooth :-

- Before space maintenance, the presence of a normal successor must be ensured through radiographic evaluation. If permanent teeth are congenitally absent, the dentist must decide whether to hold the space for many years until a fixed replacement can be provided or to allow the space to close.

13- Abnormal oral musculature (Abnormal Oral Habits) :-

- They will exert abnormal pressure on dental arches and so may influence the type and planning of space maintainer. Strong mentalis muscle patterns may have a pronounced negative effect after loss of mandibular primary molars or canines, with collapse of the arch and the distal drifting of the anterior segment that is often exhibited. Thumb or finger habits may similarly produce abnormal forces in initiating collapse of the dental arches after untimely loss of primary teeth.

14- Arch Length Adequacy :-

- This will be estimated by position of incisors, Leeway space and incisor liability :-

* If analysis indicates a positive arch length or deficiency of less than l to 2 mm per quadrant, a space maintainer may be beneficial in holding tooth position. If the space is not held, the total arch length may be further decreased and lead to possible premolar extraction requirements. Holding the space may allow the permanent premolars and canines to erupt and utilize leeway space to alleviate anterior crowding.

* If the arch length deficiency is 2 to 3 mm or more per quadrant, a significant discrepancy exists where space regaining, serial extraction, and/or comprehensive orthodontic treatment may be indicated.

* If there is no question that permanent teeth will have to be removed to obtain a favorable occlusion, space maintenance may not be desirable because the space would need to be closed during orthodontic treatment anyway. In less obvious extraction cases, holding the space to allow teeth to erupt and prevent impactions can be a valuable service.

15- Miscellaneous Factors :-

- These factors influence planning because they may be associated with either space gain or space loss. Some of these factors are growth of jaws, proximal caries, wear and attrition.

16- Presentation of problems to parents-

- Take sufficient time to explain existing conditions & discuss the possibility of the development of a future malocclusion if steps are not taken to maintain the space or to guide the development of the occlusion. Also explain that the space- maintaining appliance will not correct an existing malocclusion but will only prevent an undesirable condition from becoming worse or more complicated.

- Types of Space Maintainers :-

1- Removable Space Maintainers :-

- They are space maintainers that can be removed and reinserted into the oral cavity by the patient. It can be functional or nonfunctional, and are bilateral most of the time.

- Removable appliance is typically used when more than one tooth has been lost in a quadrant. It is often the only alternative because there are no suitable abutment teeth and because the cantilever design of the distal shoe or the band and loop is too weak to with stand occlusal forces over a two-tooth span.it also can replace occlusal function.

- Advantages :-

1. Easy to clean and permit maintenance of proper oral hygiene.
2. Maintain or restore the vertical dimension.
3. Can be worn part time allowing circulation of the blood to the soft tissues.
4. Room can be made for permanent teeth to erupt without changing the appliance.
5. Stimulate eruption of permanent teeth.
6. Help in preventing development of tongue thrust habit into the extraction space.

- Disadvantages :-

1. May be lost or broken by the patient.
2. Un-co-operative patients may not wear the appliance.
3. Lateral jaw growth may be restricted, if clasps are incorporated.
4. May cause irritation of the underlying soft tissues.

- Indication :-

1. When aesthetics is of importance.
2. In case the abutment teeth cannot support a fixed appliance.
3. In cleft palate patients who require obturation of the palatal defect.
4. In case the radiograph reveals that the unerupted permanent tooth is not going to erupt in less than five months' time.
5. If the permanent teeth have not fully erupted it may be difficult to adapt bands.
6. Multiple loss of deciduous teeth which may require functional replacement in the form of either partial or complete dentures.

- Contraindications :-

1. Lack of patient co-operation.
2. Patients who are allergic to acrylic material.
3. Epileptic patients.

<u>- Types of removable space maintainers are :-</u>

a* Acrylic partial denture.

b* Complete denture; given when there is loss of all the teeth as in rampant caries or

ectodermal dysplasia.

c* Removable distal shoe space maintainer; acts as acrylic immediate partial denture with distal shoe extension into the alveolus. It is used when fixed distal shoe cannot be placed due to many missing teeth.

2- Fixed Space Maintainers :-

- They can be unilateral or bilateral, functional or nonfunctional, active or passive space maintainers that are designed to be cemented on to the tooth and thus cannot be removed by the patient.

- Types of fixed space maintainers are :-

a* Band and loop, crown and loop space maintainer

b* Passive lingual arch space maintainer

c* Transpalatal-bar space maintainer

d* Nance palatal arch space maintainer

e* Distal shoe space maintainers

a* Band and Loop Space Maintainers :-

They are unilateral, fixed, nonfunctional and passive space maintainers.

- Indications of band and loop space maintainer :-

* Used when single tooth is missing in the posterior segment.

* It can also be given in bilateral posterior tooth loss, before the eruption of permanent anterior incisors in the mandible, where two band and loop space maintainer can be given instead of passive lingual arch space maintainer.

- Contraindications of band and loop space maintainer :-

* High caries activity * Marked space loss

* More than one adjoining teeth missing.

- Disadvantages of band and loop space maintainer :-

* Nonfunctional

* Does not prevent continued supra-eruption of opposing tooth

* Caries check is difficult

* Oral hygiene maintenance is difficult

* The loop may slip from the position and impinge on the gingiva. Occlusal rests given to the loop that rests on the occlusal surface of the mesial abutment tooth prevents this disadvantage.

- Technique :-

* A stainless steel band is fitted on the tooth.

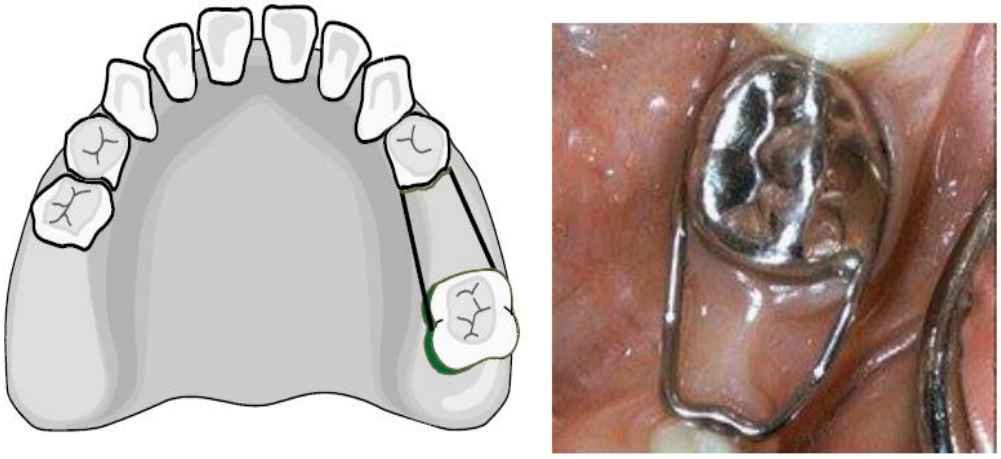
* Impression of dentition and band, the band is removed from the tooth and seated in the impression.

* On the stone model of the impression, a piece of 0.036-inch steel wire is used to prepare the

loop and soldered to the band.
* Band and loop appliance is cemented intraorally
- **The stainless steel crown and loop maintainer** is a modification of the band and loop space maintainer. It may be used
* if the posterior abutment tooth has extensive caries and requires a crown restoration or
* if the abutment tooth has had vital pulp therapy, in which case it is desirable to protect the crown with full coverage.

- The technique :-

* The steel crown should be prepared
* Before cementation, a compound impression is made
* The crown is removed from the tooth and seated in the impression,
* The stone model is prepared from the impression.
* A piece of 0.036-inch steel wire is used to prepare the loop.
- Because it is difficult to remove the crown to make adjustments in the loop, some dentists prefer to adapt a band over a cemented appliance.



Band and Loop Appliance

b* Passive Lingual Arch Space Maintainer :-

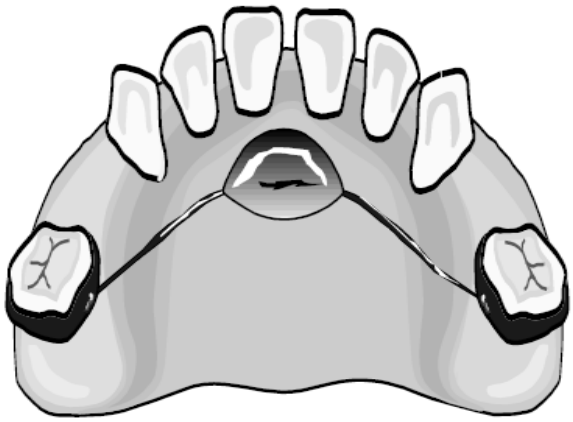
- It is a bilateral, fixed or semi-fixed, nonfunctional, passive space maintainer for the mandibular arch.
- Indicated when there is bilateral loss of molars after the eruption of the permanent incisors in the lower arch.
- If the lingual arch is given before the eruption of the permanent lower incisors it may interfere with the eruption of the permanent incisors.
- The right and left first permanent molars are banded in the lower segment.

Lower Lingual Arch (LLA)

- A 'U' shaped arch wire extends from the lingual surface of the molar bands to the lingual surface of the anterior teeth. They are placed above the cingulum of the lower incisors.
- It prevents the mesial movement of the posterior teeth and collapse of the anterior segment.

c* Nance Palatal Arch Space Maintainer :-

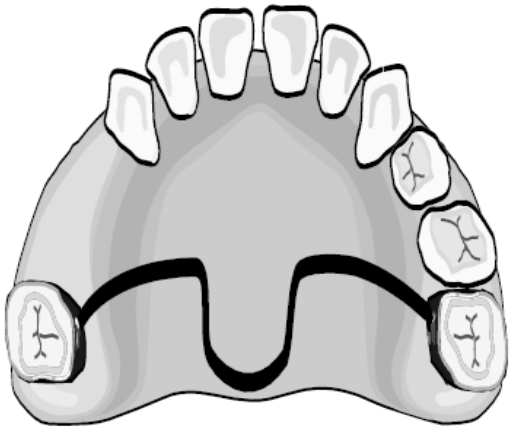
- It is a bilateral, fixed, passive and nonfunctional space maintainer for the maxillary arch.
- The first permanent molars are banded
- The arched wire extends from the palatal surface of one molar band to the other. Anteriorly it extends up to the rugae area and is embedded in an acrylic button. The acrylic button that is firmly placed on the rugae provides good anchorage
- Indicated when there is bilateral missing deciduous molars in the upper arch.
- It can be made active by incorporating 'U' loop to the wire. Opening the loop causes distalization of the first permanent molar.
- The acrylic button may irritate the soft tissues and this appliance may not be suitable for patients allergic to acrylic.



Nance Appliance

d* Transpalatal-bar Space Maintainer :-

- It is indicated for the maxillary teeth when one side of the arch is intact and several primary teeth are missing on the other side. In this case, the rigid attachment to the intact side usually provides enough stability for space maintenance. However, when primary molars have been lost bilaterally, both permanent molars may tip mesially with a transpalatal-bar arch. A Nance appliance is preferred in this situation



Transpalatal Arch (TPA)

e* Distal Shoe Space Maintainers :-

- It is a unilateral, fixed, nonfunctional and passive space maintainer. It is an intra-alveolar appliance, in which a portion of the appliance is extending into the alveolus.

- Indications of distal shoe space maintainer :-

* It is indicated when there is premature loss of second deciduous molar before the eruption of the first permanent molar.
* Used only when one tooth is lost on one quadrant as the strength of the appliance is limited. So when both the first and second deciduous molars are missing in the same quadrant, removable distal shoe is preferred.

- Contraindication of distal shoe space maintainer :-

* Inadequate abutments due to multiple loss of teeth
* Poor oral hygiene
* Missing permanent first molar
* Lack of patient and parent cooperation
* Presence of medical conditions such as blood dyscrasias, congenital cardiac defect predisposing to subacute bacterial endocarditis, history of rheumatic fever, diabetes, general debilitation.

Department of P. O. P

Paediatric Dentistry / Fourth Stage

Lec. 22 / Dr. Suhair W. Abbood

- Infections Manifestations and Management :-

- Lesions of the oral soft tissues :-

- Conditions affecting the oral mucosa and associated soft tissues can be classified as follows: infections, ulcers, vesiculo-bullous lesions, white lesions, cysts, and tumors.

- Infections :-

- Viruses, bacteria, fungi, or protozoa may cause infections of the oral mucosa, and also it may be affected by odontogenic infections.

- Viral Infections :-

**** Herpetic infections :-***

- Primary herpes simplex infection :- This condition usually occurs in children between the ages of 6 months and 5 years. Circulating maternal antibodies usually protect young babies.

- Prevention and Precautions :-

1. Care should be taken to prevent autoinoculation of the child's eyes, genitalia and finger nails beds, as further Herpes Simplex Virus infection could result.

2. The child should be isolated from other children.

- Treatment :-

1. Tell the parent that disease is self-limiting.

2. Recommend soft, cold diet rather than hot, spicy and hard food and advice high fluid intake.

- Although, no treatment is required but following methods may be used to treat the case.

* Systemic :- Acyclovir: 15 mg / kg / day for 5 days.

* Topical :-

1. Carboxy-methyl-cellulose gelatin paste that adheres to mucous membrane and by covering mucous membrane and provides some relief from pain.

2. Mucopain ointment provides relief from pain.

* Mouthwashes :- Recommend chlorhexidine mouthwash 3 to 4 times\day. In infants or young children who are unable to rinse with chlorhexidine mouthwash, parents swabbed the child's oral lesion with chlorhexidine saturated cotton pellet for several times.

- Secondary herpes simplex infection :- usually occurs at the labial mucocutaneous junction and presents as a vesicular lesion that ruptures and produces crusting.

- Treatment :-

1. Apply acyclovir cream in severe form of herpetic lesion.

2. Sunscreen is recommended to prevent recurrence of herpetic lesions.

- Herpes varicella-zoster Shingles :- which is caused by the varicella-zoster virus, is much more common in adults than in children. The vesicular lesion develops within the peripheral distribution of a branch of the trigeminal nerve. **Chickenpox,** a more common presentation of varicella-zoster in children, produces a vesicular rash on the skin. The intra-oral lesions of chickenpox resemble those of primary herpetic infection. The condition is highly contagious.

**** Mumps :-***

- Mumps produces a painful enlargement of the parotid glands. It is usually bilateral. The causative agent is a myxovirus. Associated complaints include headache, vomiting, and fever. Symptoms last for about a week and the condition is contagious.

- Treatment :-

1. Analgesic should be prescribed.

2. Advice hot saline gargles to open any obstruction in Stenson's duct.

3. Mouthwash like chlorhexidine should be recommended 3 times/day.

4. Vaccine may be useful as a prophylactic measure in susceptible individuals.

*** Measles :-**

- The intra-oral manifestation of measles occurs on the buccal mucosa. The lesions appear as white speckling surrounded by a red margin. The oral signs usually precede the skin lesions and disappear early in the course of the disease. The skin rash of measles normally appears as a red maculopapular lesion. Fever is present and the disease is contagious.

*** Rubella :-**

- Rubella (German measles) does not usually produce signs in the oral mucosa; however, the tonsils may be affected. Protection against the diseases of mumps, measles, and rubella can be achieved by vaccinating children with MMR vaccine in their early years.

- Treatment :-

* Symptomatic treatment may be given.

*** Herpangina :-**

- This is a Coxsackie virus A infection. It can be differentiated from primary herpetic infection by the different location of the vesicles, which are found in the tonsillar or pharyngeal region. Herpangina lesions do not coalesce to form large areas of ulceration. The condition is short-lived.

- Treatment :-

• No treatment is necessary.

• Mouthwashes, analgesic and antipyretic may be prescribed as symptomatic treatment.

*** Hand, foot, and mouth disease :-**

- This Coxsackie virus A infection produces a maculopapular rash on the hands and feet. The intra-oral vesicles rupture to produce painful ulceration. The condition lasts for 10-14 days.

- Treatment :-

- Symptomatic treatment may be used :-

1. Mucopain ointment for local application.

2. Oral rinse (Chlorhexidine mouthwash).

3. Recommended soft fluid diet.

4. Avoid spicy food during disease.

*** Infectious mononucleosis :-**

- The Epstein Barr virus causes this condition. It is not uncommon amongst teenagers. The usual form of transmission is by kissing. Oral ulceration and petechial haemorrhage at the hard soft palate junction may occur. There is lymph node enlargement and associated fever.

- There is no specific treatment. It should be noted that prescription of ampicillin and amoxicillin can cause a rash in those suffering from infectious mononucleosis. These antibiotics should be avoided during the course of the disease.

- Treatment is symptomatic and relies on analgesia and maintenance of fluid intake. It must be remembered that aspirin should be avoided in children under 12 years of age.

*** Corona viral infection :-**

- Coronaviruses are a large family of viruses which may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as **Middle East Respiratory Syndrome (MERS)** and **Severe Acute Respiratory Syndrome (SARS)**. The most recently discovered coronavirus is **Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)** which causes coronavirus disease COVID-19

- Research indicates that children and adolescents are just as likely to become infected as any other age group and can spread the disease.

- Evidence to date suggests that children and young adults are less likely to get severe disease, but severe cases can still happen in these age groups.

- Symptoms :-

- The most common symptoms of COVID-19 are fever, dry cough, and tiredness. Other symptoms that are less common and may affect some patients include aches and pains, nasal congestion, headache, conjunctivitis, sore throat, diarrhea, loss of taste or smell or a rash on skin or discoloration of fingers or toes.

- These symptoms are usually mild and begin gradually. Some people become infected but only have very mild symptoms. However, anyone can catch COVID-19 and become seriously ill.

- Oral manifestations :-

- Oral lesions have not been yet described with a proven Covid-19 infection. Some described irregular ulcer occurred after a short time of macular erythematous lesion, which could be explained by vasculitis.
- While others observed multiple orange-colored ulcers with an erythematous halo and symmetric distribution on the hard palate of the patient. Some noticed multiple pinpoint yellowish ulcers with an erythematous halo on the hard palate of the patient.
- Another case was presented with multiple blisters on the inner lip mucosa. The patient reported that the lesions were more pruritic than painful.

- Prevention :-

* Clean the hands frequently and thoroughly
* Avoid touching the eyes, mouth and nose
* Cover when cough with the bend of elbow or tissue. If a tissue is used, discard it immediately and wash the hands.
* Maintain a distance of at least 1 meter from others.

- Management :-

While some western, traditional or home remedies may provide comfort and alleviate symptoms of mild COVID-19, there are some medicines that have been shown to cure the disease. Self-medication with any medicines, including antibiotics are not recommended, as prevention or cure for COVID-19. Coordinating efforts to develop vaccines and medicines to prevent and treat COVID-19.

- Bacterial Infection :-

**** Staphylococcal infections :-***

- Staphylococci and streptococci may cause impetigo. This can affect the angles of the mouth and the lips. It presents as crusting vesiculo-bullous lesions. The vesicles coalesce to produce ulceration over a wide area.
- Pigmentation may occur during healing. Staphylococcal organisms can cause osteomyelitis of the jaws in children. The condition is self-limiting, although antibiotics may be prescribed in some cases.

- Streptococcal infection :-

- Streptococcal infections in childhood vary from a mucopurulent nasal discharge to tonsillitis, pharyngitis, and gingivitis. Scarlet fever is a hemolytic streptococcal infection consisting of a skin rash with maculopapular lesions of the oral mucosa.

- It is associated with tonsillitis and pharyngitis. The tongue shows characteristic changes from a strawberry appearance in the early stages to a raspberry-like form in the later stages. Topical or systemic antibiotic should be prescribed.

- Acute Necrotizing Ulcerative Gingivitis (Vincent Infection) or ANUG :-

- The etiologies are Fusobacterium nucleatum and Borellia Vincentii. This disease is rare in children under the age of 16 years, except in undeveloped countries. It is characterized by rapid destruction of inter- dental papilla and formation of punched out ulcers and presence of pseudo membranous necrotic tissues of the marginal gingiva.
- The ANUG may be localized or generalized. In extensive case both free and attached gingival may be affected and patient showed severe halitosis, which is characteristic of ANUG. Clinical manifestations of disease include poor appetite, fever and general malaise.

- Treatment :-

1. Remove gross calculus and debris from the gingival margins by scaling and irrigation with 20 vol. Hydrogen peroxide.

2. Prescribe metronidazole and penicillin group or cephalosporin group of drug or erythromycin for 7 days.

3. Recommend 3 % hydrogen peroxide with equal amount of warm water gargles every 2 hours and chlorhexidine mouth wash three times a day (2 to 3 weeks).

4. Give detailed oral hygiene instruction with avoidance of spicy food.

- Congenital syphilis :-

- Congenital syphilis is transmitted from an infected mother to the fetus. Oral mucosal changes such as rhagades, which is a pattern of scarring at the angle of the mouth, may occur. In addition, this disease may cause characteristic dental changes in the dentition.
- These include Hutchinson incisors (the teeth taper towards the incisal edge rather than the cervical margin) and mulberry molars (globular masses of enamel over the occlusal surface).

- Management :-

1. Aqueous crystalline penicillin G is recommended if congenital syphilis is proved or is highly suspected. Procaine penicillin G has been recommended as an alternative.

2. Surgical correction of facial defects gives good esthetic results.

3. Correction of dental defects using veneers or partial or full coverage crowns may be done.

- Diphtheria :-

- It is an acute, life-threatening, contagious bacterial infection caused by gram-positive bacillus, Corynebacterium diphtheria.
- Humans being the sole reservoirs, the infection mainly spreads via droplet inhalation.

- Clinical features :-

* Occurrence in children is most common, especially during winter season
* Clinical manifestations of fever, malaise, chills, headache, anorexia and vomiting are seen

* Enlargement of regional lymph nodes, especially cervical lymph nodes
* A patchy, yellowish-white thin film covered by grayish adherent membrane is seen known as "diphtheritic membrane"
* Raw bleeding surface is seen left when this membrane is stripped off
* Due to involvement of soft palate, uvula, larynx and trachea, there occurs sore throat and respiratory difficulties
* In severe cases, paralysis of soft palate can be seen.

- Management :-

1. Prophylactic active immunization with diphtheria toxoid.

2. Use of antitoxin in combination with antibiotics.

- Actinomycosis :-

- Actinomycosis can occur in children. It may follow intra-oral trauma including dental extractions. The organisms spread through the tissues and can cause dysphagia if the submandibular region is involved. Abscesses may rupture onto the skin and long-term antibiotic therapy is required.
- Penicillin should be prescribed and maintained for at least 2 weeks following clinical cure.

- Fungal Infection :-

- Neonatal acute candidiasis (thrush) contracted during birth is not uncommon. Young children may develop the condition when resistance is lowered or after antibiotic therapy. Easily removed white patches on an erythematous or bleeding base are found.
- Treatment with nystatin or miconazole is effective (those under 2 years of age should receive 2.5 ml of a miconazole gel (24mg/ml) twice daily; 5 ml twice daily is prescribed for those under 6 years of age, and 5 ml four times daily for those over 6 years of age).

- Protozoal Infection :-

- Infection by Toxoplasma gondii may occasionally occur in children, with the principal reservoir of infection being cats. There may be a granulomatous reaction in the oral mucosa and there can be parotid gland enlargement.
- The disease is self-limiting, although an antiprotozoal such as pyrimethamine may be used in cases of severe infection.

- Odontogenic Infection :-

- The major cause of this condition is dental in origin. The minor oral surgical treatments may all be employed to definitively treat the source of an orofacial infection. Alternatively, conservative treatments such as endodontic therapy may be appropriate.
- However, a rapidly spreading extra-oral infection is a surgical emergency that merits immediate treatment and may require admission for inpatient management.
- Two areas of extra-oral spread are of special importance. These are the submandibular region and the angle between the eye and the nose.

- Swelling in the submandibular region :-

- Arising from posterior mandibular teeth can result in the floor of the mouth being raised. This can cause a physical obstruction to breathing, and spread from this region to the para-pharyngeal spaces may further obstruct the airway.
- The advance from dysphagia to dyspnea can be rapid. A submandibular swelling should be decompressed as a matter of urgency in children. A child with rising of the floor of the mouth requires immediate admission to hospital.

- Infection involving the angle between the eye and the nose :-

- Has the potential to spread intra-cranially and produce a cavernous sinus thrombosis. This is a potentially life-threatening complication.
- The angular veins of the orbit (which have no valves) connect the cavernous sinus to the face, and if the normal extracranial flow is obstructed as a result of pressure from the extra-oral infection, infected material can enter the sinus by reverse flow.
- To prevent this complication, infection in this area (which arises from upper anterior teeth, especially the canines) must be treated at once.

<u>- The principles of the treatment of acute infection are :-</u>

* Removal of the cause is essential to cure an orofacial infection arising from a dental source. This usually means extraction or endodontic therapy.
* Institution of drainage and prevention of spread are supportive treatments they are not definitive cures.

- Drainage may be obtained during the removal of the cause (e.g. a dental extraction) or may precede definitive treatment if this makes management easier (e.g. incision and drainage of a submandibular abscess). Drainage may be intra- or extra-oral.

* Prevention of spread can be achieved surgically or by the use of antibiotics. In severe cases intravenous antibiotics will be used. The antibiotic of choice in children is a penicillin such as amoxicillin.
* It is important to remember that acute infections are painful and that analgesics, should be prescribed. The use of paracetamol elixir is usually sufficient. Similarly, it is important that a child suffering from an acute infection is adequately hydrated. If the infection has restricted the intake of oral fluids because of dysphagia, admission to hospital for intravenous fluid replacement is required.