Psychosexual/psychoanalytical theory by Sigmund Freud

PSYCHOLOGY

- It is the science dealing with the human nature and function and phenomenon of his soul in the main.

- **Child psychology**

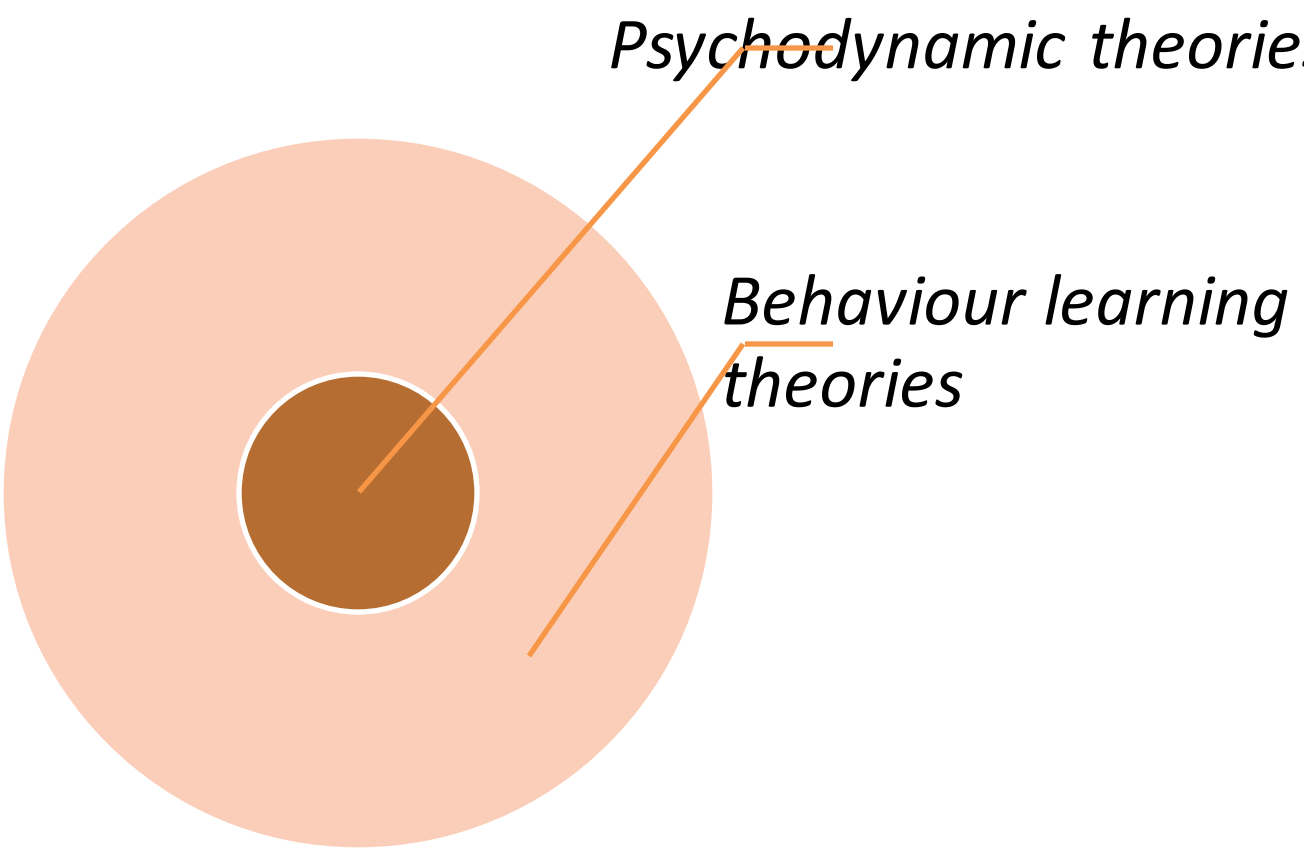
It is the science that deals with the mental power or an interaction through the conscious and sub conscious element in the child.

Significance in Dentistry:-

- *Oral habit development,fear and anxiety formation and oral hygiene habits are some aspects of personality,of interest to a dental professional.*
- *The development of these aspects of personality can be explain science of psychology.*



THEORIES OF CHILD PSYCHOLOGY



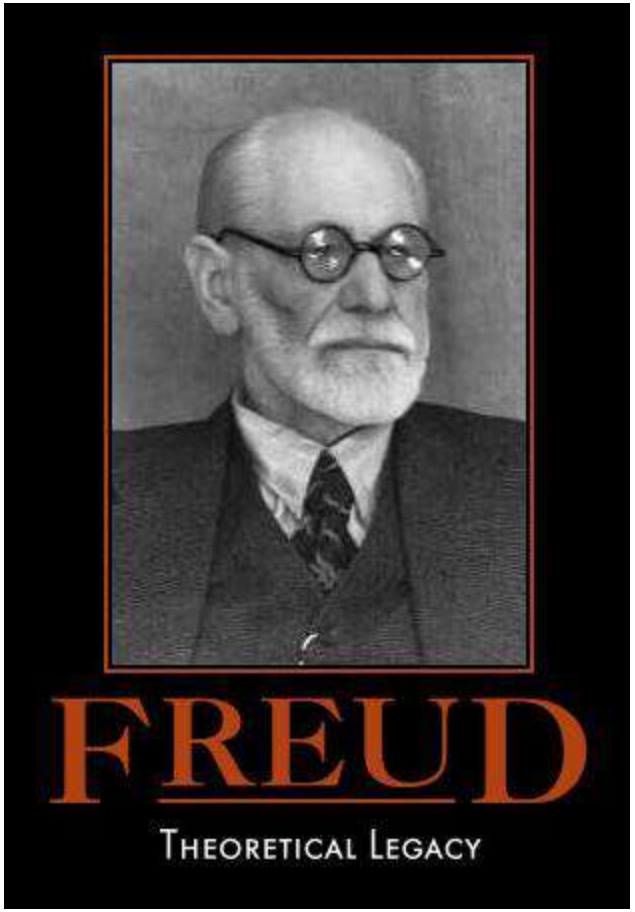
PSYCHODYNAMIC THEORIES:-

- *Classical psychoanalytical theory by Sigmund Freud (1905)*
- *The psychosexual theory by Sigmund Freud*
- *The psychosocial theory by Erik Erikson(1963)*
- *Cognitive development theory*

BEHAVIOUR LEARNING THEORIES:-

- Classical conditioning theory by Ivan Pavlov(1927)
- Operant conditioning theory by B.F. Skinner(1938)
- Theory of hierarchy of needs
- Social learning theory by Albert Bandura(1963)

Psychoanalytical theory/psychosexual theory



1.PSYCHOANALYTICAL THEORY:

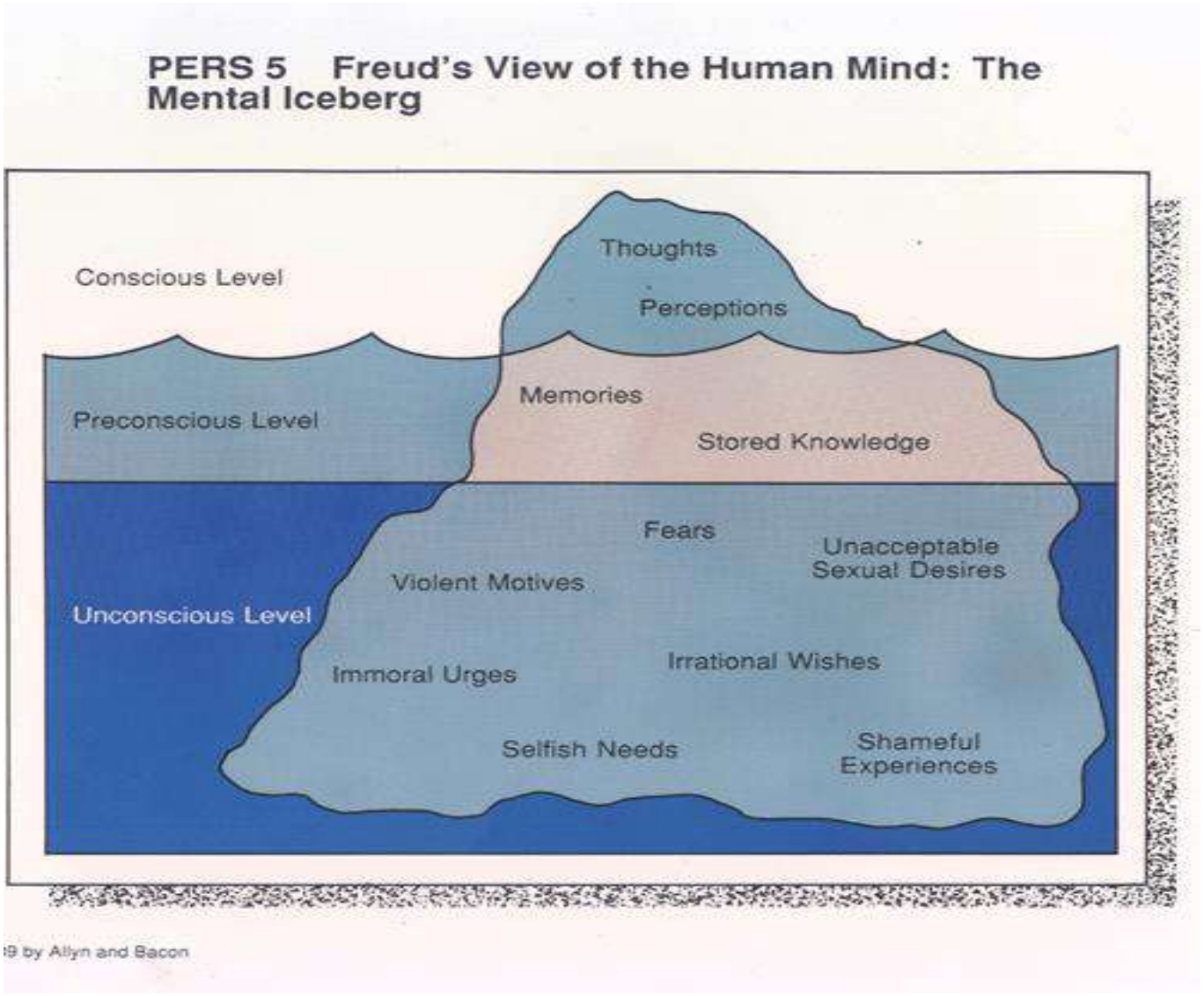
- *By Sigmund Freud(1905)*
- *He derived his ideas by working on patients with psychological problems.*

According to him a body has two types of neurons.

Phi neuron:-concerned with condition of emotion and psi neuron :- concerned with storage of emotion.

When emotions reach a certain level,a discharge is sparked off and this over display of emotions is called archaic discharge.

MENTAL ICEBERG



Human mind – an ice berg

- Small part visible above the surface of water is the conscious experience.
- Larger base below the surface of water is unconscious store house of impulses, passions and inaccessible memories which affects thoughts and behaviors.
- Conscious means being aware of a particular moment : present perceptions, memories , thoughts and fantasies

- Between conscious and unconscious mind is a preconscious mind.
- Preconscious mind works closely with conscious mind . These are those memories which can be readily brought to mind even if one is not thinking about that at that particular moment.

- Unconsciousness is the source of our motivations . They may be simple desires of food or sex , neurotic compulsions ,motive of any artist or scientist.
- But human beings are either driven to deny or resist becoming conscious of these motives.
- These motives are however available to human beings only in disguised form.

- *PSYCHIC TRIAD:-Psychic structure proposed by Freud consists of-*

  i)Id

  ii)Ego

  iii)Super ego

Psychic triad

- Id –most primitive part and sort of store house of biologically based urges : the urge to eat, drink, eliminate and especially to be sexually stimulated.
- Id can be defined as ,”inherent reservoir of unorganized desires.”
- It is the source of all gratification and pleasure ; represents the unconscious ,instinctive urges that motivate the behaviour.
- It operates on pleasure principle and is satisfied by seeking immediate gratification for instinctual needs which are immoral, illogical and lacks unity of purpose.

EGO

EGO:-develops out of id when child begins to distinguish between itself and outside world.

Ability to understand that their impulses cannot

always be gratified.

Obeys the REALITY PRINCIPLE.

Ego distinguishes things in mind and things in the external world.

It is the ego which makes the necessary interaction with the social world possible and permits the need of the Id to be satisfied.

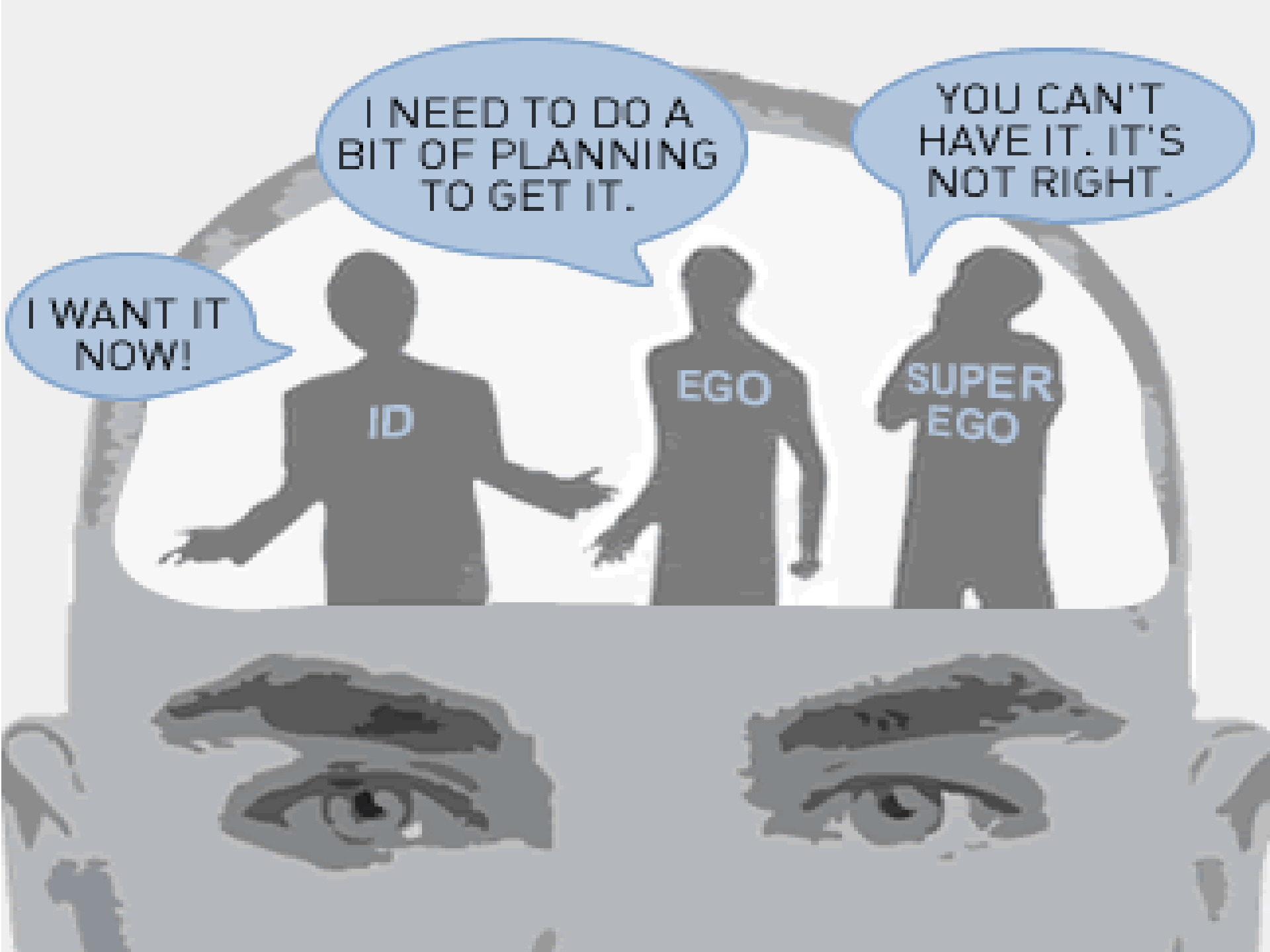
Ego can be defined as ," the integrating or mediating part of personality , which develops out of interaction of Id and environment .it has the perception of internal and external world.

SUPER EGO

- Superego acts as a conscience ; it is the internal part of individual that makes value judgements.
- Superego is idealistic and consists mainly of prohibitions learned from parents and other authorities
- Superego may condemn certain things as ”wrong” ,which the ego would otherwise do to satisfy the Id.

- The child is born without a superego . This element develops under the training and influence of the environment.
- Superego can be defined as the latest development of mind embodying the code of society ,including the concepts of right and wrong, value system and ideals.
- According to Freud ,Id , Ego and superego are related to unconscious , preconscious and conscious levels

- Entire Id resides in unconscious ; which is a large area , if the mind is an iceberg ; most of it [unconscious]remains hidden.
- With increasing age , preconscious and conscious occupy more and more of mental territory but unconscious has the largest area.
- So entire ID is unconscious ;EGO and SUPEREGO include material at all three levels of consciousness.
- Conflict between EGO and SUPEREGO may result in PERSONALITY DISORDERS.


I WANT IT NOW!
I NEED TO DO A BIT OF PLANNING TO GET IT.
YOU CAN'T HAVE IT. IT'S NOT RIGHT.
ID
EGO
SUPER EGO

THE PSYCHOSEXUAL THEORY:-

- *Oral stage*
- *Anal stage*
- *Phallic stage*
- *Latency stage*
- *Genital stage*

1.*ORAL STAGE:-*

- ✓ From birth to 18 months.
- ✓ Infant obtains sensual pleasure first by sucking and later by biting.
- ✓ Feeding and contact with the mother , mouthing new objects and relief of teething pain by biting – all help to make the mouth the focus of pleasure during the first year.
- ✓ ORAL REGION:Primary zone of pleasure.

- This is characterized by infants concern for his mouth and gratification he feels from oral stimuli.
- Since child`s personality is controlled by ID, therefore demands immediate gratification and responsive nurturing
- Both insufficient and forceful feeding can result in fixation in this stage.





- DENTAL IMPLICATIONS-
- Oral stimulation is also produced by engaging in activities such as sucking ,biting, swallowing and manipulating various parts of the mouth .Satisfaction of oral desires help in development of TRUST
- Oral stage fixations are manifested as smoking , alcoholism , nail biting , thumb sucking etc.

2.ANAL STAGE:-



- ✓Occurs between 18 months and 3 years.
- ✓Ego-centric and self-centered behaviour.
- ✓ANAL REGION:-Primary erogenous zone
- ✓Gratification derived from expelling or withholding faeces.
- ✓Child learns to walk,talk and control his/her toilet habits.
- ✓By exercising control over the retention or expulsion of feces , a child either grant or refuse parent`s wishes.

Symptoms and fixation of Anal stage

- Anal expulsive personality :
- Too lenient parents fail to instill the society`s rules about bowel movement control , child starts deriving pleasure and success from expulsion. These type of children are excessively sloppy , disorganized, reckless, careless , defiant.

- Anal retentive personality
- Children who receive excessive pressure and punishment from parents during toilet training, he will experience anxiety during bowel movements and hence will withhold such functions . Such children are clean, orderly and intolerant to those who are not clean.

Anal stage

- ✓ Over-emphasis on toilet training leads to compulsive and perfectionist behaviour.
- ✓ Under-emphasis results in impulsive personality.

Urethral stage

- Age 3 to 4 years
- Transitional zone having characteristics of both anal and phallic stages.
- Seeks pleasure in urination.
- Urethral erotism refer to pleasure in urination and urethral retention analogs to anal retention.
- Predominant urethral trait is of competitiveness and ambition which is related to compensation for shame due to loss of urethral control.

- Urethral competitiveness provides a sense of pride and self competence as a small boy can imitate and match his father`s adult performance.

PHALLIC STAGE



- 4-5 years
- Sex identification.
- Children begin to direct their awakened sexual impulses towards the parent of opposite sex (OEDIPUS complex in males and ELECTRA complex in females)
- 'Castration anxiety' in boys.
- As the child grows older,the male identifies himself with his father.
- Emergence of jealousy between peers and siblings.
- Unsatisfactory resolution manifest as inability to form sexual relationship,homosexuality and fear of a specific object or situation.

Oedipus complex

- Named after a young man in Greek mythology who killed his father and married his mother unaware of their true identities.
- Boys in the midst of Oedipus complex often experience castration anxiety which come from the fear of punishment from the father for their desire for the mothers.
- In the process of identifying with his father, the boy not only takes on his father behaviour patterns but also his fathers ideas of right and wrong.
- Thus its the rough identification in this stage that the boys superego begins to form.

ELECTRA COMPLEX

- In girls this type of attraction is called Electra complex after Agamemnon s daughter , who arranged for her mother to be murdered.
- For the girl , the sequence begins with a focus on the father.
- The girl notices that she does not have the sexual organs of her father and she experiences “Penis envy”
- She suspects she may have been castrated by her mother that makes her angry and she comes to resent and devalue her mother.

- She eventually identifies with her mother partly as she knows if she takes on her mother`s charateristics ,she will stand a better chance in her own relationship with her father.
- The girl eventually starts to identify with her mother behave like her and incorporates her values.

Symptoms of Phallic fixation

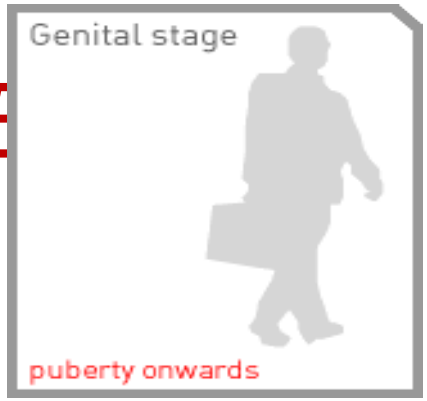
- Men :Anxiety and guilty feelings about sex, fear of castration and narcissistic personality.
- Women :women never progress past this stage fully and will always maintain a sense of envy and inferiority but there are no possible fixations which results from this stage.

4.*LATENCY STAGE:-*

- 5 years to puberty.
- Period of consolidation.
- This is the period during which sexual feelings are suppressed to allow the children to focus their energy on other aspects of life.
- This is a time of adjusting to the social environment outside home absorbing the culture forming beliefs and values , devloping same sex friendships , engaging in sports etc.

- Childs energy is channelized into developing new skills and acquiring new knowledge, and play becomes largely confined to other children of same gender
- Importance of peer group on character formation.

5.GENITAL STAGE



- 12-18 years.
- Begins with puberty.
- Endocrinal and physiological changes.
- This stage is marked by renewed sexual interest and desire and the pursuit of relationships.
- Three major sources of sexual arousal during this period are:
- Memories and sensations from early childhood period
- Physical manipulation of genitals and other erogenous zones
- Hormonal secretions.

- Many of themes and anxieties of earlier stages resurfaced but in new and more mature forms.
- The targets of sexual arousal now lie outside tiny circle of self and family.

Symptoms of fixation

- This stage itself does not cause any fixations
- If people experience difficulties in this stage,the damage was done in earlier stages.
- People come into this stage with fixations from previous stages.
- Attraction to opposite sex can be source of anxiety at this stage if the person has not successfully resolved the Oedipus and Electra conflict

Analysis of Freud`s Theory

- Basic Assumptions of Theory
- Major cause of behavior has its origin in unconscious.
- There is a reason for all type of behavior
- Different parts of unconscious mind are in constant struggle.
- Our behavior and feelings as adult are rooted in our childhood experiences.

Strengths

- Made the case study method popular in psychology.
- Defense mechanisms
- Highlighted the importance of childhood.
- Highlights the importance of unconscious mind.

FLAWS OF THE PSYCHOSEXUAL THEORY:-

- Inadequate methodology.
- Uncertain testability.
- Over-emphasis on childhood sexuality.
- Role of society in development of behaviour has been totally neglected.

GOOD MORNING



CONTENTS

- Introduction
- Indications
- Classification
- SSC with facing
- Resin crowns/ composite crowns
  - composite strip crowns
  - Composite shell crowns
  - New millennium crowns
  - Glass ionomer crowns
  - Polycarbonate crowns
  - Kudos crowns
- Pedonatural crowns
- Pedo jacket crowns
- ARTglass crowns/ Glasstech Crowns

- **Preveneered S.S crowns**
  - NuSmile crowns
  - Flex crowns
  - Pedo pearls
  - Cheng crowns
  - Whiter Biter crowns
  - Pedo compu crowns
  - High density polyethylene veneered crowns for children
  - Dura crowns
- **Ceramic (Zirconia) crown**
  - ZIRKIZ crown
  - EZ-crown
  - Kinder Krown
  - CEREC crown
  - Ceramo basemetal crown.
- **Biologic crowns**

Introduction

Esthetics

Esthetics can be defined as, the theory and philosophy that deal with beauty and the beautiful, especially with respect to the appearance of a dental restoration, as achieved through its from and / or color.



- Dental caries is the most common chronic disease of childhood.

- Early loss of primary anterior teeth may

  - ✓ Reduce **masticatory** efficiency
  - ✓ Loss of **vertical dimension**
  - ✓ Development of **parafunctional** habits (tongue thrust, speech problems)
  - ✓ **Malocclusion**
  - ✓ **Space loss**
  - ✓ **Psychological** problems

- Early restorations consisted of placement of stainless steel bands or crowns on severely decayed teeth.

- They were **unaesthetic** and their use was limited to **posterior teeth.**

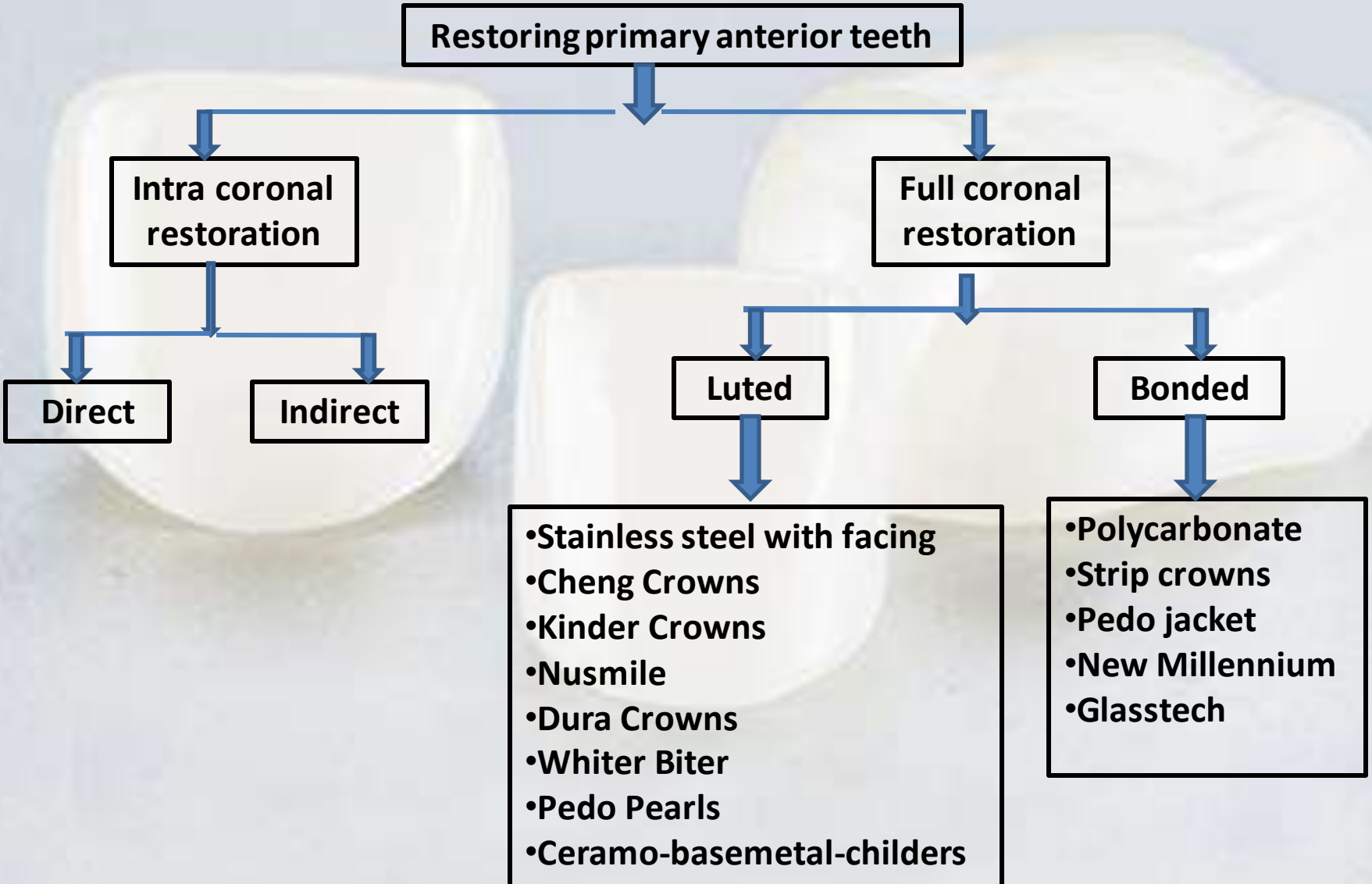
- Higher esthetic standard is expected by parents for restoration of their children's carious teeth.

- Thus the choice of **full coverage restorations** for primary teeth must provide an aesthetic appearance in addition to restoring function and durability.

Indications for Full Coverage Crowns

- Tooth with large **interproximal lesions**
- Tooth with **hypoplastic** defects
- **Unaesthetic** tooth due to discoloration
- Tooth that have undergone **pulp therapy** with significant loss of tooth structure
- Tooth with significant tooth structure loss due to **trauma or caries**
- Tooth with **small carious lesions** and with large areas of **cervical discoloration**

Different Materials And Various Means Of Approach In Restoring Anterior Teeth



CLASSIFICATIONS OF CROWNS

Based on Material Used

- **All metallic crown**

– Stainless steel crown (SSC)
– Aluminum crown

- **Stainless steel crowns (SSC) with facing**

- **Resinous/composite crown**

– Strip crown
– Composite shell crown
– New millennium crown
– Glass ionomer crown
– Polycarbonate crown
– Kudo crown
– PedoNatural crown
– Pedo jacket crown
– Artglass crown.

- **Preveneered stainless steel crown(PVSSC):**
  - **NuSmile crown**
  - **Flex crown**
  - **Pedo pearls**
  - **Cheng crown**
  - **Whiter Biter crown**
  - **Pedo compu-crown**
  - **High density polyethylene (HDPE) crown**
  - **Dura crown.**

- **Ceramic (Zirconia) crown**
  - **ZIRKIZ crown**
  - **EZ-crown**
  - **Kinder Krown**
  - **CEREC crown**
  - **Ceramo basemetal crown.**

- **Biologic crowns**

SSC WITH FACING/OPEN FACED STAINLESS STEEL CROWN/ CHAIRSIDE VENEERED SSC

(HARTMANN, 1983)

Tooth Preparation

- **Anesthetize** the tooth before the operative procedure.
- **Mesial, distal and facial surfaces** are reduced with a **No. 699 bur**, maintaining the walls **parallel** to the long axis of the tooth.
- The reduction is **extended 0.5 mm** into the gingival sulcus, in order to remove enough of the bulbous portion of the tooth
- The incisal edge is then **reduced 1.5 mm.**
- Finally, any **remaining caries** is removed with a **No. 4 round bur** in a slow-speed handpiece,
- Any **pulp treatment** indicated is performed.

Adaptation of the Crowns

- A stainless steel crown is selected and fitted in the customary fashion.
- The gingival margin on the facial surfaces is extended as deep as the sulcus will allow.
- Trim the excess crown margin so that gingival extension of crown should be **1 mm beneath gingiva** without blanching.
- After final crimping and polishing, the crown is cemented with **carboxylate cement.**
- Excess cement - removed.

Window Preparation

- A window is now placed in the **facial surface** of the crown.

- A **No. 330 or No. 245 bur** is used to cut the rough window.

- The window is refined incisally with a **No. 35 diamond disk** in a slow speed handpiece.

- The incisal portion of the window is reduced in order to allow a **0.5 mm undercut**, while keeping the margin as straight as possible.

- The esthetics of the finished crown is improved with a **straight incisal surface**, which is parallel to the incisal surfaces of the adjoining teeth.

- The window is opened mesiodistally with **a No. 330 or No. 245 bur** so that very little stainless steel is showing.
- Little retention is expected to be gained proximally.
- The same bur is used to shape **the gingival margin of the window** to the level of the **gingival crest.**
- A No. 699 bur is then used to prepare a retention **channel 1 mm in depth**, gingivally.
- With this accomplished, all remaining cement is removed from the incisal undercut and proximally to **within 1 mm of the margins of the window.**

Insertion of Composite

- After etching, cleaning and drying the prepared window, apply bonding agent, cure it.

- Then selected composite resin is inserted with a syringe. The injection begins by filling the gingival channel and continues up to proximal surface.

- The incisal undercut is then filled, followed by the other proximal surface.

- This method will ensure that the entire retention area has been filled with composite.

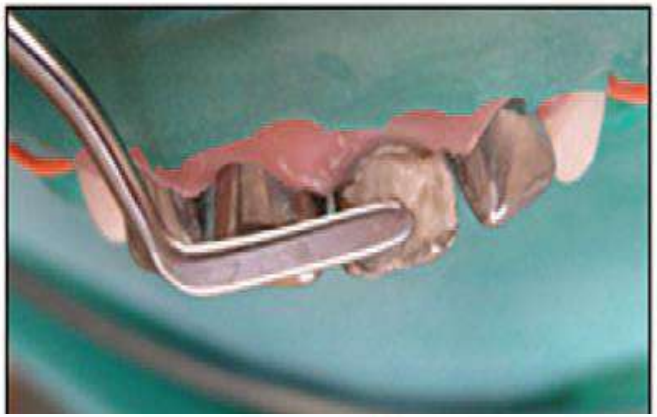
Polishing and Finishing

- After the composite is polymerized, the matrix is removed and the excess composite is trimmed from the margins using a No. 699 bur.

- No other polishing or finishing is necessary.










Advantages

- Inexpensive
- Durable
- Easy to do
- Well adapted to tooth
- Esthetically pleasing.

Disadvantages

- Difficulty to avoid blood and saliva contamination since composite facing is done
- Requires extra chair side time
- Less than optimal esthetic
- Metals may appear at the gingival edge of the crown.

Studies

1. **Weidenfeld *et al. (1995) - chairside veneering technique is successful*** for restoring severely damaged primary anteriors and the resulting veneer maintain the adaptability, strength and gingival contour with cosmetic effect.

2. **Hartman (1983)** evaluated new composite resin that is bonded to stainless steel crowns.

- **100 patients** were treated with a stainless steel crown on a primary tooth, **coverup (parkell)** was used to veneer the buccal or labial surfaces with a white shaded resin.

- This veneering technique has too many variables to hold forth any firm promises of success.

- Within one year, ***only a third of the composite cases were totally intact.***

- ***Shade stability decreased over a short period of time.*** Patient brushing habits profoundly affected veneer surface removal.

3. Widenfeld *et al. (1994)* *evaluated an esthetic* technique for veneering anterior stainless steel crowns with composite resin.

- The esthetic surfaces of crowns were **sand blasted with 50 µm aluminum oxide particles for 2 to 4 sec,** followed by application of adhesive resin cement (Panavia) to the sandblasted surfaces in a thin layer.
- A thin coat of opaque **light cured pit and fissure sealant** (Delton) was applied by rolling the panavia bonded surfaces in a drop of sealant and was cured for 20 sec
- followed by the application of **light cured composite** resin to the sealant surface and cured for 40 sec.
- It was concluded that, this technique yielded **excellent esthetics** and a **very high bond strength** of the veneered stainless steel crowns.

RESIN CROWNS/COMPOSITE CROWNS

COMPOSITE STRIP CROWNS

- Esthetic results of open faced crowns are somewhat compromised.
- Strip crown is very **esthetic** when prepared correctly.
- Installing these crowns demands **skillful technique** and often requires more time to perform.
- Because of the time required, these crowns can be ***difficult to place on young, uncooperative children.***
- Composite strip crowns are composite filled celluloid crowns forms.



- This is the first choice of many clinicians due to the superior esthetics and the **ease of repair** if the crowns chips or fracture frequently.
- most **technique sensitive**.
- lack of tooth structure, the presence of moisture or hemorrhage contributes to **compromised retention.**
- There is need of **sufficient tooth structure** after caries removal to ensure sufficient surface area for bonding.
- They are **less resistant to wear and fracture** more readily than other anterior full coverage restorations.

Commercial Products

3M™ ESPE™ Pediatric Strip Crowns



- Strip crown forms simplify composite work for pediatric anterior restorations.
- Trimmed and filled with restorative materials, they automatically contour the restorative material to match natural dentition.
- They strip off easily, leaving a smooth surface.
- They are ideal for both chemical and photo curing composites**.**

Features of Strip Crown

- **Thin interproximal walls.**
- **Anatomically shaped construction to match natural contours.**
- **Palmar notation on each crown tab for easy identification.**
- **Sufficient strength for easy handling.**



Availability

- There are **16 crown sizes** available in the 3M ESPE pediatric strip crown range.
- Features of commercial strip crowns and sizes.

TABLE 3.7 Strip crowns

Anterior and posterior pediatric strip crowns	
Color/Shades	Clear
Anterior/Posterior	Anterior and posterior
Quantity	120
Product brief	Crowns
Special features	Ideal for ankylosed tooth build-ups, crystal clear and very thin

TABLE 3.8 Anterior strip crown sizes

Crown shape	Number of sizes	Width range available in mm
Upper central incisors	8	6.0–8.1
Upper lateral incisors	8	4.3–6.7



3M™ Strip Crowns Forms

Dentition
Primary

Selection
Anterior

Key Traits
- Automatically contours restorative material to match the natural dentition
- Strips off easily leaving a smooth surface
- Thin interproximal walls
- Sufficient strength for easy handling
- Ideal for chemical or light–cured composites

3M™ Pediatric Strip Crown Forms–915100 Kit

Crown drawer only: PS-000

UPPER CENTRALS

Right					*Left*
UR 1 814011	UR 2 814012	UR 2 814012	UL 1 814001	UL 2 814002	UL 2 814002
UR 3 814013	UR 3 814013	UR 4 814014	UL 3 814003	UL 3 814003	UL 4 814004

UPPER LATERALS

Right					*Left*
UR 1 814031	UR 2 814032	UR 2 814032	UL 1 814021	UL 2 814022	UL 2 814022
UR 3 814033	UR 3 814033	UR 4 814034	UL 3 814023	UL 3 814023	UL 4 814024

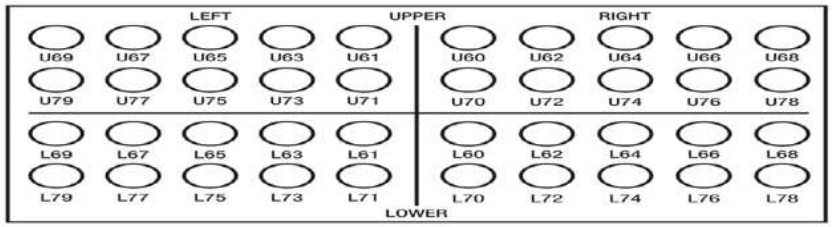
3M™ Pediatric Strip Crown Forms

MANUAL DENTAL WIDTH 00 MM	LEFT	RIGHT
CENTRALS		
6.0	UL1	UR1
6.7	UL2	UR2
7.4	UL3	UR3
8.1	UL4	UR4
LATERALS		
4.3	UL1	UR1
5.1	UL2	UR2
5.9	UL3	UR3
6.7	UL4	UR4

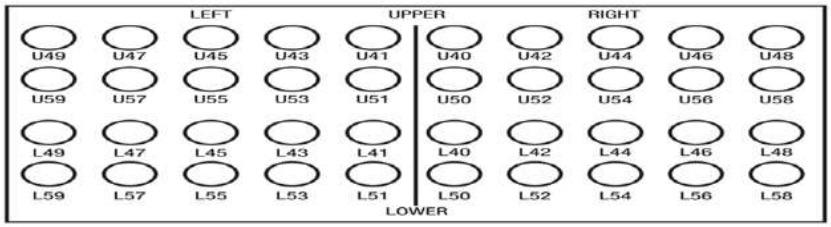
3M ESPE Prefabricated Crown Order Form

NOTE: If there are two sizes in a space, circle the number you wish to order.

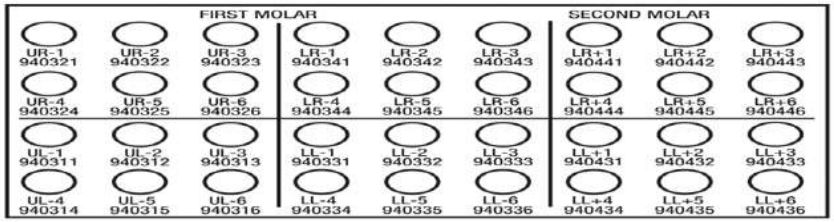
3M™ ESPE™ Iso-Form™ Molar Crowns
_____ Kit MC-64



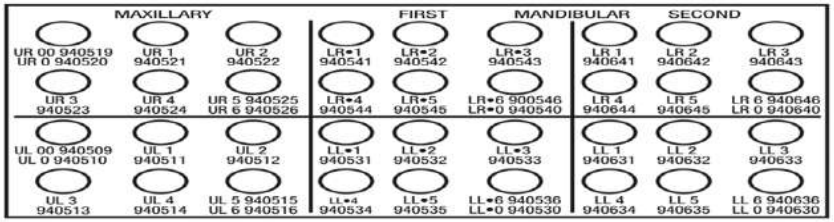
3M™ ESPE™ Iso-Form™ Bicuspid Crowns
_____ Kit BC-64



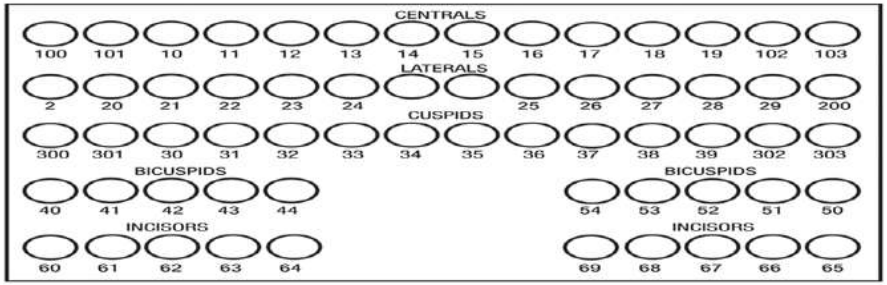
3M™ ESPE™ Gold Anodized Molar Crowns
_____ Kit 942301



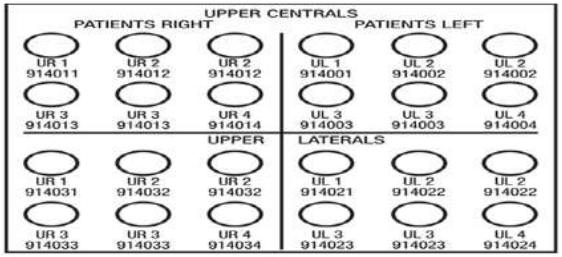
3M™ ESPE™ Gold Anodized Bicuspid Crowns
_____ Kit 942501



3M™ ESPE™ Polycarbonate Crowns
_____ Kit C-180



3M™ ESPE™ Pediatric Strip Crown Forms
_____ Kit 915100**



3M ESPE Customer Care Center U.S.A.: 1-800-634-2249
Canada: 1-888-363-3685

3M ESPE
Dental Products
2510 Conway Avenue
St. Paul, MN 55144-1000 USA

3M Deutschland GmbH
Dental Products
Carl-Schurz-Straße 1
41453 Neuss — Germany

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Indications

- Interproximal caries, excess or multisurface **caries on primary anterior teeth.**
- Following **pulp therapy** to primary anterior teeth.
- Restoration **of fractured anterior teeth.**
- Incisors with **hypoplastic defects, amelogenesis imperfecta.**
- **Discolored incisors.**
- **Congenitally malformed primary incisor.**

Contraindications

- Insufficient tooth structure for retention.
- Deep overbite
- Bruxism
- Periodontal diseases

Benefits

- ✓ Parent/patient pleasing
- ✓ Ideal for ankylosed tooth build–ups
- ✓ Simple to fit and trim
- ✓ Removal is fast and easy
- ✓ Easily matches natural dentition
- ✓ Leaves smooth shiny surface
- ✓ Easy shade control with composite
- ✓ Superior esthetic quality
- ✓ Ideal for photo cure
- ✓ Crystal clear and thin celluloid crowns

- ✓ Crowns are cost-effective
- ✓ Esthetic but more fragile than SSC
- ✓ Better retention than poly carbonate crown
- ✓ Functionally, allows occlusal wear
- ✓ Require removal of small amount of tooth structure
- ✓ Automatically contours restorative material to match natural dentition
- ✓ Strips off easily leaving a smooth surface
- ✓ Thin interproximal walls
- ✓ Sufficient strength for easy handling
- ✓ Ideal for chemical or light-cured composites

Disadvantages

- **Moisture or blood contamination** affects resin bonding.
- **Time consuming** procedure in young and uncooperative child—adequate tooth structure required.
- It is extremely **technique sensitive.**
- It **is not as durable or retentive** as stainless steel/open faced crowns, pre-veneered crown or polycarbonate crown
- It is not recommended on patients with **a bruxism habit or a deep bite.**

- Adequate moisture control might be difficult on an **uncooperative patient**
- Chances of **fracture or debond** of crown.
- It is direct restoratie method with bulk pack technique which can lead to **postoperative sensitivity.**
- The bulk packing - **incomplete polymerization**
- **Occlusion** cannot be checked until the strip crowns have been removed

Armamentarium

- Burs- taper fissure, inverted cone shaped bur
- Curved crown and bridge scissor
- Explorer
- Dental floss
- Rubber dam kit
- Composite kit.

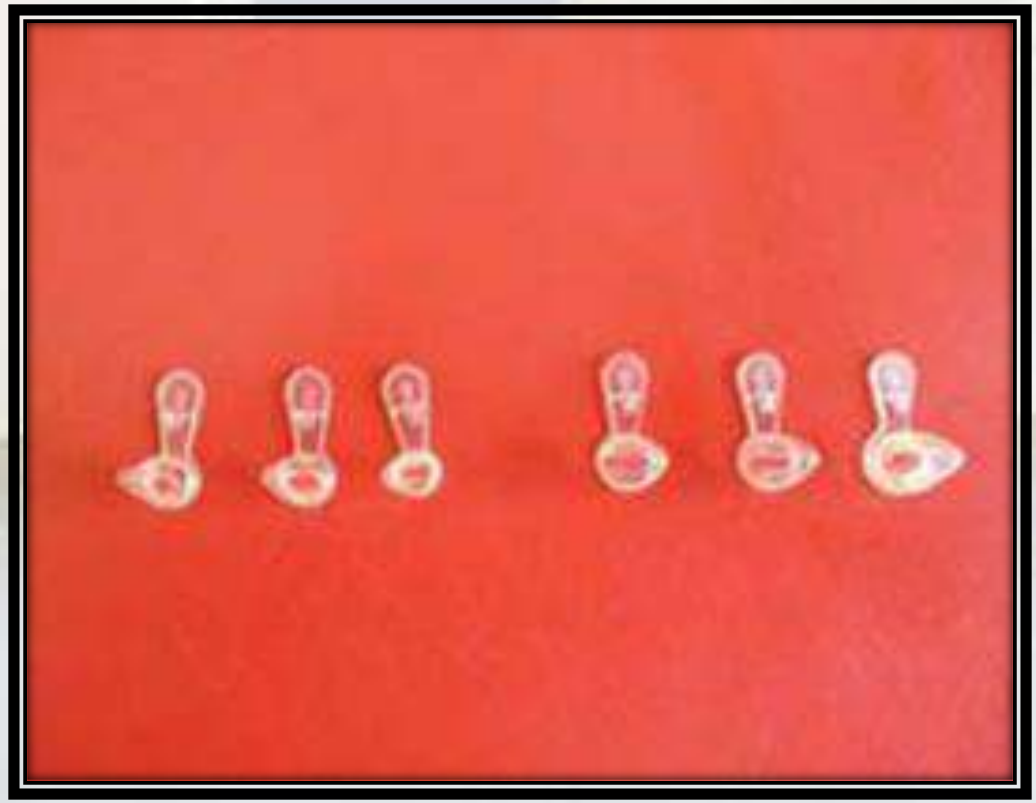
Preoperative Assessment

- Check for incisor relation
- Presence of remaining tooth structure
- less tooth structure - post and core followed by strip crown
- Cooperativeness of child—if child is uncooperative then crown placement should be performed under conscious sedation or GA

Procedure for crown placement

Selection of Crown Form

- Strip crowns are available in **6 sizes** 1 to 6





Crown selection, caries excavation, facial reduction

Select a primary celluloid crown form with a M-D incisal width equal to the tooth to be restored

by placing the ***incisal edge of the crown*** against the ***incisal edge of the tooth***

by measuring the ***MD dimension of the tooth to be restored with caliper and matching it with required crown form.***

Shade Selection

- Select the composite shade using **shade guide** under natural light.

- Pedo shade can be selected for better esthetic.

Rubber Dam Placement

- Place and ligate the rubber dam.

- The two most popular techniques for isolating anterior teeth are

❖ ***individual tooth isolation and***

❖ ***the split dam technique.***

Tooth preparation

- **Administer appropriate anesthesia**

- **Reduce the interproximal surfaces by 0.5 to 1** mm with a tapered diamond bur to produce **knife edge cervical margin**.



- **The interproximal walls should be parallel**. Proximal reduction should allow a crown to slip over the tooth **that is there should be snap fit of crown.**

- **Reduce incisal edge approximately 1 to 1.5 mm using fine tapered diamond (169 L) bur**



- Reduce the **facial surface** by at least **1 mm** and **lingual surface** by at least **0.5 mm.**
- Create **knife edge gingival margin**.
- Round all line angle.



- Create small cervical undercut **with *inverted cone bur (No. 35) or No. 330 bur*** **on *labial gingival margin*** for retention of composite restoration as it acts as mechanical lock to aid in retention.



- **Further tooth reduction** can be done to allow placement of selected crown form over the tooth if **the previous reduction was inadequate.**

- **Minimal enamel reduction** is desirable since retention of the restoration is based on the **quality and quantity of enamel surface area** exposed to acid etching procedure.

- Remove existing carious lesions with a **spoon excavator or round bur.**

- Removal of carious lesion will leave **additional undercuts** which will aid in the **retention of the restoration**.

- Removal of caries can be done **either before tooth preparation (pikham) or after (Mathewson)**



- Do **pulp therapy** if required.

- In cases of black colored arrested carie a **masking agent (Paint-On-Color, wh opaque, Coltene whaledent, NJ)** may used.

- Otherwise due **to transference nature of resin composites**, the dark color of the excavated lesion will be seen through the restoration

CROWN PLACEMENT

- Trim the selected crown form to remove excess crown form material cervically with crown and bridge **scissors**.



- check fitting of crown on prepared tooth. Trimmed crown form should fit **1 mm below gingival margin** with comparable height to adjacent teeth



- Consider the maxillary lateral incisors length of **0.5 to 1 mm** shorter than that of central incisors during crown form placement.

- **Punch a small hole** with sharp explorer at incisal edge or at **palatal surface of trimmed crown** form to create **vent for flow of excess composite material**.



- Place an appropriate **pulp liner** to all exposed dentin under dry field before etching.

- Etch the prepared tooth with **acid etchant for 15 to 20 sec.** Rinse and dry the tooth followed **bonding agent** application and **curing**



- Composite materials used to fill crown form are hybrid composite,
- ✓ **compomers (sparingly),**
- ✓ **flowable composites, or**
- ✓ **combination of an anterior/posterior composite** for strength perspective.

- Fill the crown forms with selected composite shade material to approximately **two-thirds of length** and seat on to tooth and check for correct position



- Excess material should flow from gingival margin and vent hole.

- Remove the excess - explorer



- Light cure the celluloid crowns to polymerize the composite material.

- Curing should be done both labially and lingually.



- After proper curing remove the celluloid crown form by using a composite finishing bur or curved scalpel blade to cut the material on the lingual surface and then peel the form from the tooth or use explorer to remove.

- Crown form removal should began from palatal side to avoid scratches on labial surface.



- Remove the rubber dam and **check for occlusion**



- Abrasive disc are used for final polishing of required areas.

Studies

Tate *et al.* *(2002)* *found that* composite strip crowns had a failure rate of 51 %, compared to an 8 % failure rate of stainless steel crowns.

- Resin crowns are much weaker than stainless steel crowns and there is an increased chance that a piece or corner of the crown may fracture off .

Morgolis FS (2002) - strip crown are relatively easy technique that produces a beautiful outcome in a comparatively short time after using strip crown procedure on hundreds of children for more than 20 years.

Ram and Fuks (2006) - observed high success rate of resin bonded composite strip crowns with a 2-yr follow-up and suggests that, retention rate is lower in teeth with decay in three or more surfaces, particularly in children with a high caries risk.

Kupietzky *et al. (2003)* *evaluated efficacy* of strip crown performance concluded that strip crowns performed esthetically well. They found parental satisfaction with strip crowns was excellent.

Kupietzky and Waggoner (2004) assessed parental satisfaction with 112 bonded resin composite strip crowns for primary incisors compared with their clinical evaluation and success. concluded that parental satisfaction is most affected by durability, even more so than appearance or color match.

Composite Shell Crowns

- **Composite shell crowns are crowns prepared with composite material by indirect method.**

Advantages

i. **Requires less chair side time**

ii. **No need of trimming or crimping during clinical procedure**

iii. **No need of postoperative adjustment of crowns since adjustments are made in lab**

iv. **Less technique/moisture sensitive as compared to strip crowns**

v. **Less postoperative sensitivity.**

Disadvantages

- **Two visit procedure.**
- **Needs lab procedures.**

Procedure of Composite Shell Crown Preparation and Placement

- **Remove all caries with spoon excavator**



- **Select composite shade** for preparation of shell crown with the help of vita shade guide under natural light.

- Take **full arch impression** of maxilla and mandible and pore the cast. After cast sets, apply double coating of the **separating media**, which acts as spacer for luting agent during crown cementation.

- **Composite buildup** done on the maxillary cast in harmonious with mandibular anteriors to form composite shell crown followed by light curing.

- After completion of shell crowns **check the occlusion** with mandibular cast and crown should be **finished and polished.**

- Before separation of shell crowns***, a silicone based positioner is fabricated*** which helps in holding the crowns in the mouth during cementation.

- Silicone positioner is prepared by ***extending the positioner bilaterally to cover at least one tooth distal to the last tooth being restored, palatally it should cover rugae area and half of the palatal slope, labially covers only the incisal third of labial surface.***



- Once positioner is prepared, **shell crown are carefully detached from cast**. The silicone positioner checked intraorally for proper fit without crowns



- ***Then teeth are cleaned and dried, etched followed by application of bonding agent and light curing.***

- Shell crowns filled with **dual cure luting resin** and placed in silicone positioner and which is transferred intraorally.

- Curing of luting agent done from **labially and lingually.**

- After curing positioner removed and **check for occlusion and teeth position.**

- There is **no need of post cementation adjustment** of crown since it has been done in laboratory stage.



Fabrication of composite shell crown
Murthy et al. (2013 JAOR)



NEW MILLENNIUM CROWN



- Similar to **Pedo Jacket and strip crown** except that these crowns are made up of **lab enhanced composite resin material and bonded to tooth**.
- The crown form is filled with **resin material** & bonded to the tooth.
- Crowns are very **brittle,** can **crack or fractured** if forced down onto a preparation that has not been adequately reduced.

For clinical success it requires

- **adequate bonding area,**
- **excellent moisture control**
- **absence of hemorrhage**.



- No long-term studies are available regarding these crowns

Manufacturers

- Success, essentials, space maintainers lab.

Availability

- Starter kit- **24 crowns (anterior)**
  12 crowns (posterior)

Advantages

- ✓ Very esthetic crowns
- ✓ Can be trimmed and reshaped with high speed finishing burs.



Disadvantages

- ✓ Very expensive compared to strip crown & Pedo Jacket crowns
- ✓ brittle
- ✓ Needs adequate moisture control.

GLASS IONOMER CROWN

- Crowns are fabricated using **GIC in conjunction with celluloid strips crown.**
- Distinct advantage of GIC over composite is its ability to **release fluoride for extended period**.
- Tooth preparation and crown adaptation is similar to that for strip crown except**, crown forms are filled with GIC (light cure or dual cured) instead of composite.**

Advantages

- ✓ Anticariogenic property due to fluoride release
- ✓ Better adaptation to tooth structure due to chemical adhesive nature of GIC
- ✓ Restoration can be done in single visit
- ✓ Advantages in primary teeth.

Disadvantage

- ✓ Lack of strength.

Session II

- Polycarbonate crowns
- Kudos crowns
- Pedonatural crowns
- Pedo jacket crowns
- ARTglass crowns/ Glasstech Crowns

Preveneered S.S crowns

- NuSmile crowns
- Flex crowns
- Pedo pearls

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THANK YOU !!



GOOD MORNING



Last Session

- Introduction
- Indications
- Classification
- SSC with facing
- Resin crowns/ composite crowns
  - Composite strip crowns
  - Composite shell crowns
  - New millennium crowns
  - Glass ionomer crowns

Todays Session

- Polycarbonate crowns
- Kudos crowns
- Pedonatural crowns
- Pedo jacket crowns
- ARTglass crowns/ Glasstech Crowns

Preveneered S.S crowns

- NuSmile crowns
- Flex crowns
- Pedo pearls

POLYCARBONATE CROWN

- Polycarbonate crowns **are hollow, tooth-shaped with walls about 0.3 mm thick.**
- Polycarbonate crowns are usually available in **two tooth colored shades** (dark and light).
- These crowns do not resists strong abrasive forces, leading to ***occlusal wear, fracture or dislodgement.***
- With the advent of composite strip crowns they lost their popularity.
- In the 1990s new manufacturing techniques made them **thinner and more flexible** resulting in stronger restoration.

Kits

Intro kit-180 crowns



Manufacturers of Polycarbonate Crowns

a. 3M ESPE
b. Direct dental products
c. Sweedish dental supplies Lab (SWEDEN)
d. PedoNatural crowns, Valencia CA
e. Crest, Oral-B.



3M™ ESPE™ Polycarbonate Crowns

- There are **60 crown sizes** available
- Different sizes for incisors, cuspids and bicuspids.
- Polycarbonate crowns for posterior teeth are packaged separately. They are generally more difficult to use due to **variations in tooth size and shape**

TABLE 3.9 Polycarbonate crowns

Crown type	Sizes	Available in mm
Upper central incisors	7	7.7–10.1
Upper lateral incisors	6	5.8–7.6
Lower incisors	10	4.9–6.3
Cuspids	7	7.5–9.0
Bicuspids	10	6.2–7.5

Polycarbonate crown is widely used for **temporary crowns** for several reasons:

i. It is **strong yet flexible** enough to contour easily.

ii. It **bonds chemically** to a self-curing acrylic resin material used to fill the shell.

iii. They have almost **perfect bonding properties.**

iv. Any area of a plastic crown, including the incisal edge, can be **extended** by adding layers of acrylic

Advantages

- ✓ **Crowns are made up of polycarbonate resin with microglass fibers which permit crown adjustment with pliers**
- ✓ **good durability and strength.**
- ✓ **Contours and crimps similar to metal crowns.**
- ✓ **Esthetic**
- ✓ **Good anatomic form.**
- ✓ **crowns have smooth surface to minimize plaque accumulation.**
- ✓ **Available in wide range of sizes for incisor, canine and premolars.**

Indications

- Primary maxillary incisors with extensive caries
- Malformed teeth
- Fractured teeth
- Discolored teeth
- Endodontically treated teeth.

Contraindications

- Bruxism
- Inadequate spacing
- Anterior crowding
- Deep overbite
- Evidence of abrasion in anterior teeth.

Placement Procedure

Crown Selection:

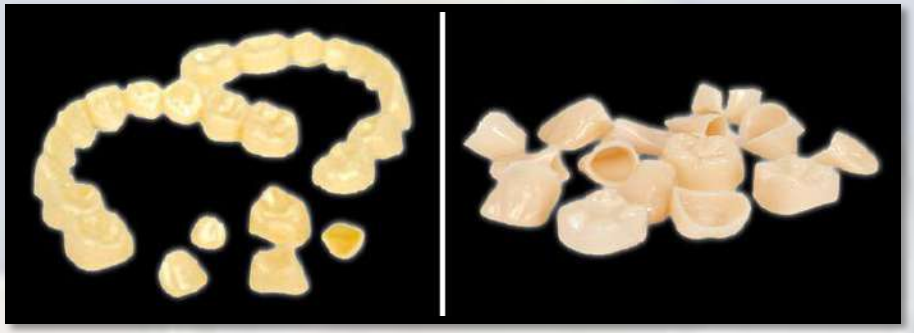
Crown Adjustment:

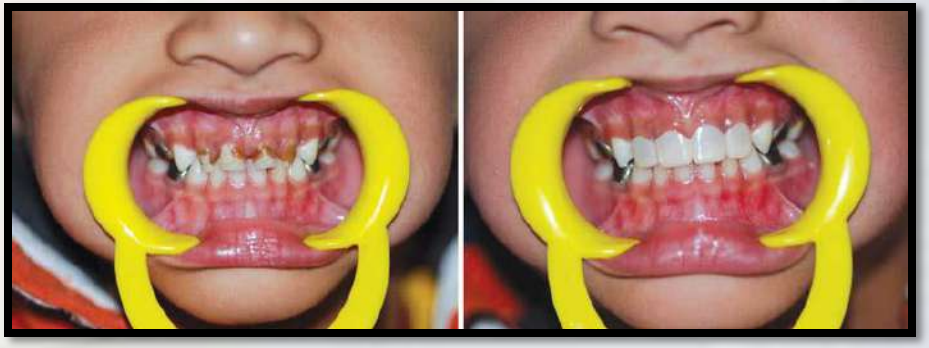
- gingival trimming
- gingival contouring- acrylic bur, greenstone or white stone
- adjust the internal surfaces - crown seat fully on the preparation.
- Reseat periodically – check contour of margins.
- Trim until occlusal surface is close to that of the adjacent teeth.
- If the proximal contacts are not closed, acrylic may be added to these areas later in the procedure.
- margins of the crown- cover the finish line of prepared tooth.
- While adjusting the crown, it is helpful to keep the "handle" attached . This will aid in trying the crown on and off. Removed once adjustments are made.

Crown Cementation: *acrylic resin*

KUDOS CROWNS

- Kudos crowns -newer generation polycarbonate crowns.
- It is easy to use and handle, reducing the chairside time
- It is more user friendly and esthetically acceptable.





Advantages	Disadvantages
• Esthetically acceptable • Less chairside time • Improved retention • Flexible • Better adaptability.	• Chances of breakage • Dislodgement • Discoloration.

Availability

- Kudos crowns are produced from **Hong Kong based company- Kudos International Holdings Ltd.**

Package includes:

- 1 F/F Regular Size Tmp C and B
- 1 F/F Large Size Tmp C and B
- 5ea × 20 regular size single crowns
- 5ea × 20 large size single crowns
- A2, A3, C3 shades are available
- 200ea pediatric crowns + 4ea C and B perpack.

Technique of Crown Placement

- After initial examination select proper size of the crown which snugly fits M-D

- After a trial fit the crown is checked for
  1. proper fit,
  2. marginal adaptability,
  3. overall coverage
  4. M-D width.

- crown is **relined using a cold cure acrylic material**

- After complete setting of the material, the margins are trimmed and finished and the **crown is cemented using a luting cement or composites.**

PEDONATURAL CROWN

- These are not composite restoration and **is never used with composites.**
- All components of these Crowns are **hydrophilic (moisture tolerant).**
- These are ultra thin crown form that is:
  - ✓ anatomically correct,
  - ✓ flexible,
  - ✓ easy to fit,
  - ✓ extremely strong,
  - ✓ durable.
- **superior esthetic** alternative to the composite strip crown or composite veneered S.S crown.

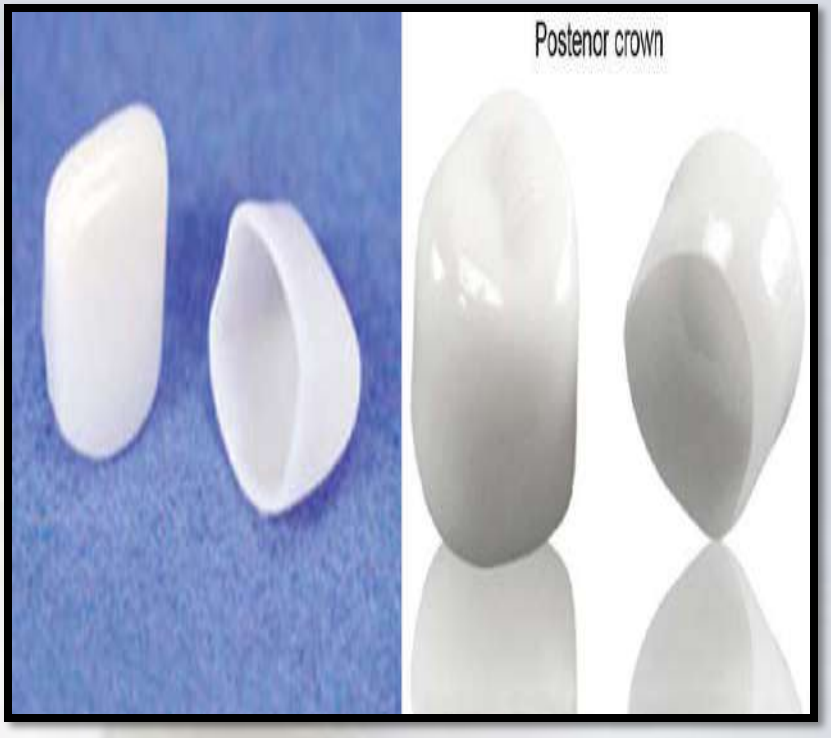
- Easily used in ***crowded situations as well as Class III occlusions.***

- Self-adhesive resin cements are available in several shades.
  - **anterior Crowns-** ***translucent shade*** .
  - **posterior crowns-** the translucent shade will also look great but in addition **shade A-1** gives an excellent result.

- **The PedoNatural Crown Consists of Three Component**
  1. Ultra-thin polycarbonate crown form
  2. Hybrid acrylic fill materia
  3. Glass ionomer cement.

Availability of Crown

- Available for both anterior and posterior primary teeth.
- The PedoNatural Crown is anatomically correct for each primary tooth.
- There are
  - ❖ 5 sizes for each posterior tooth,
  - ❖ 3 sizes for the maxillary central incisors and
  - ❖ 2 sizes each for the maxillary lateral incisors and cuspids.



Advantages

- Greater durability than composite strip crowns.
- Preveneered crowns.
- No need to use composite strip crowns & have hassle of moisture contamination with etching and bonding.
- Ease of application
- No need to use bulky and unsightly resin veneered S.S crowns which are difficult to place and usually chip.
- Not technique sensitive.
- Take about the same amount of time to place as S.S crowns, composite strip crowns and preveneered crowns

- Cost-effective.
- Superior marginal integrity.
- Excellent retention.
- High tensile strength.
- Trimmable.
- Crimpable.
- Anatomically correct shape and size.
- Flexible.
- Excellent retention.
- High tensile strength.

Disadvantages:

- They are not recommended in patients with heavy bruxism.
- Greater tooth reduction is required.

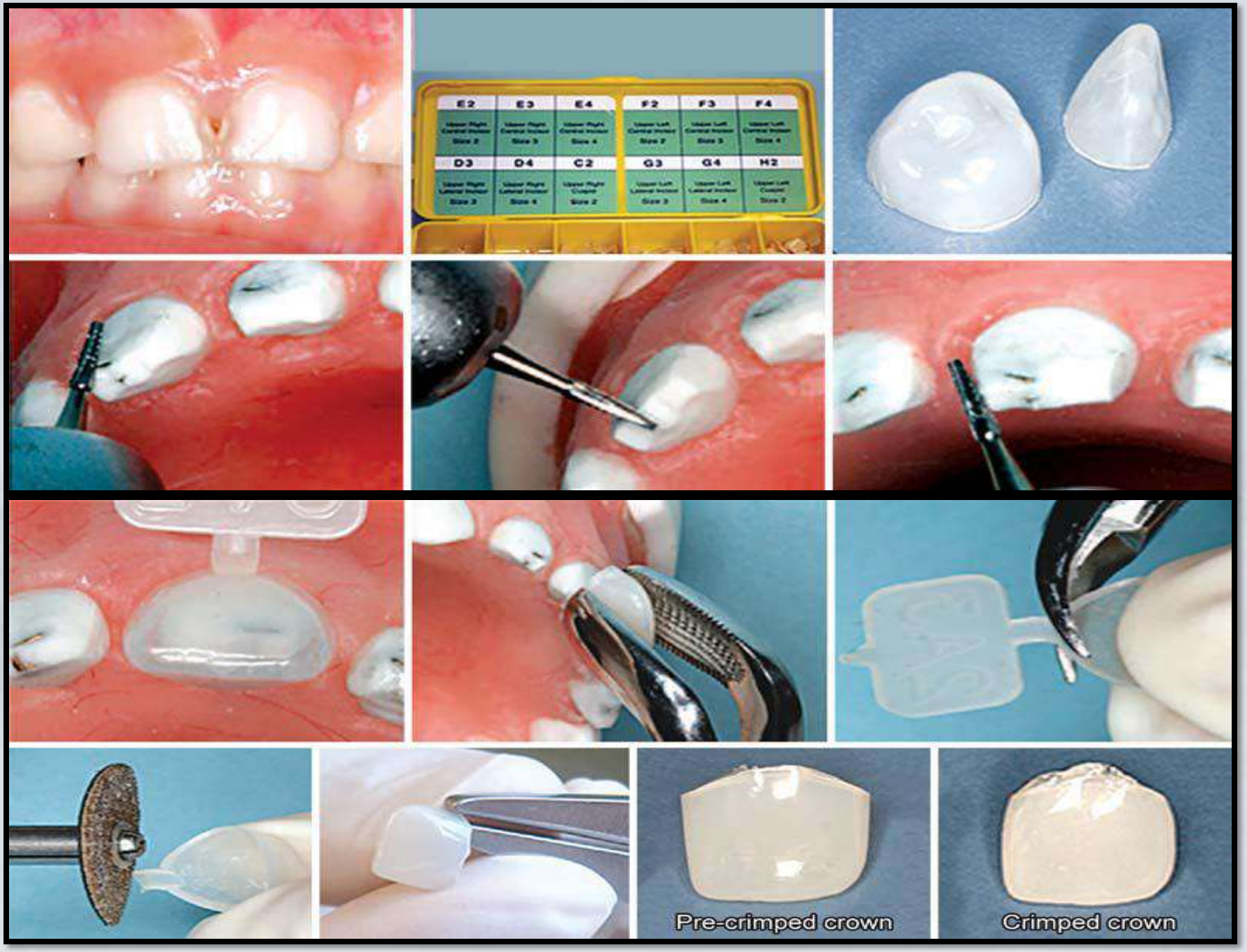
Tooth Preparation

- Differs from SSC - require **more tooth reduction** including buccal and lingual reduction.

- **Anesthetize** the tooth
- Isolation
- Select appropriate **crown size**
- Incisal or occlusal reduction- **2 mm.**
- Proximal reduction - break the contact point to create adequate clearance for crown placement.
- Remove all remaining decay and perform any necessary pulp tissue treatment.
- Reduce the **labial surface a minimum of 2 mm** and place all the margins subgingivally.

Crown Adaptation

- **Selection of crown**
- Place the crown over tooth and mark and trim the excess
- Later **crimp all the gingival margin** of the crown using crimping pliers and check for final fit of crown.
- Check for **snug fit** of crown.
- The fully seated crown should ***be below the occlusal plane for posteriors.***
- For **anteriors , finger pressure** is sufficient to seat the crown.


E2
E3
E4
F2
F3
F4
D3
D4
C2
G3
G4
H2
Pre-crimped crown
Crimped crown

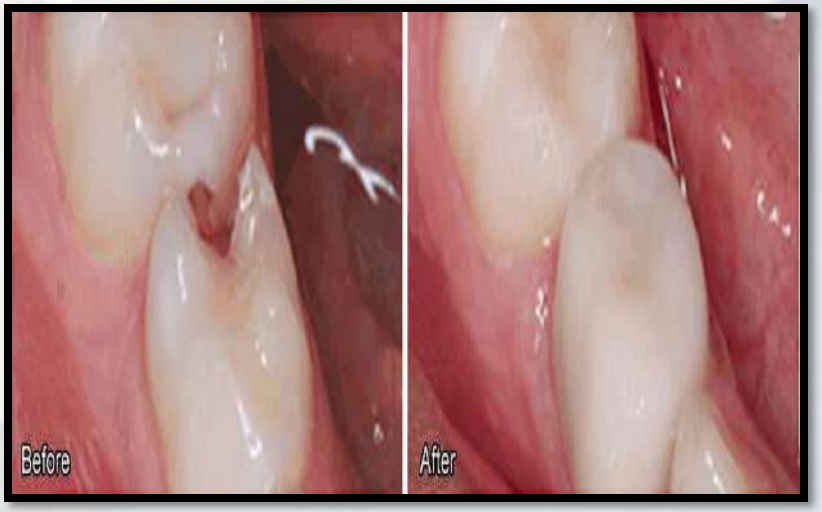
- Before cementation of crown **clean and dry the tooth surface** and selected crown.

- Apply **varnish adhesive agent** to internal surface of the crown using brush, followed by light curing.



- Fill the crown with **self adhesive resin**

- **Seat the crown** in position over tooth and hold it for few minutes, **remove excess** material from gingival surface and light cure the material



Procedure

The PedoNatural Crown is fabricate chair-side by filling he crown form with a especially formulated hybrid acrylic material

↓

That seamlessly unites with the crown form during curing.

↓

The finished crown is cemented with a glass ionomer cement

↓

Resulting in a full crown restoration that is truly esthetic, strong, long lasting and durable

PEDO JACKET CROWN



- Pedo Jacket crown is **like a strip crown** & is handled similar to a celluloid crown form.
- It is made up of **tooth-colored polyester material** which can be filled with resin and left on the tooth after polymerization.
- It comes only in a **single shade .**

- **trimmed with scissors,** adaptable over irregular teeth.

- It cannot be trimmed or reshaped with a high speed finishing bur otherwise **the material will melt to the bur**

- **Cementation is easy.**

- they can either bonded into place with **composite resin** or cemented with a **glass ionomer cement.**

- Pedo Jackets are ideal for both the **upper and lower dentition** & are available as anterior and posterior crowns

Advantages

- Crown placement can be done in one sitting
- Cost-effective
- Multiple adjacent restorations can be done with minimal tooth reduction
- Crown will not split, not stain or crack
- Crowns can be trimmed with scissors.

Disadvantages

- Available in single color hence color matching is difficult.
- Cannot be trimmed or reshaped with high speed finishing bur as the material melt to bur.

Manufacturers

Success essential, Space maintainers laboratory.

Availability

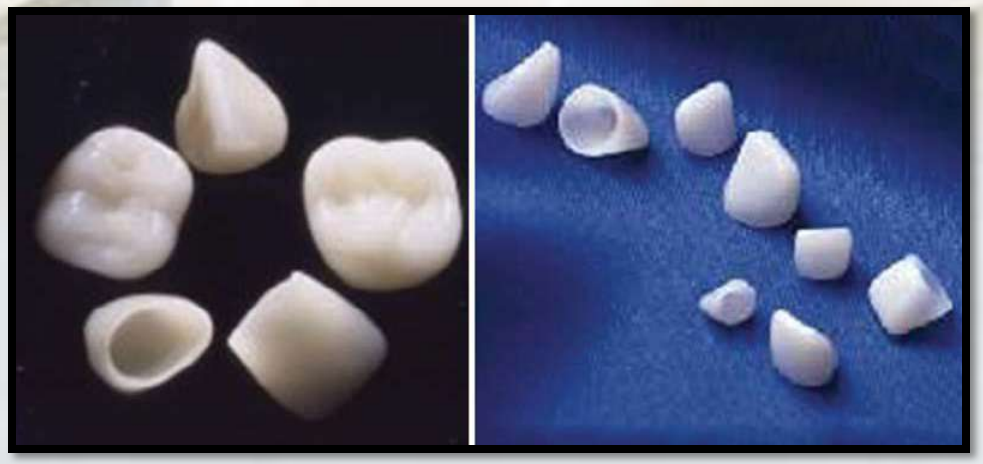
- Anterior crown sizes-D, E, F, G, L, U as 1-6 numbers.

- Replacement crowns: 5 per box.

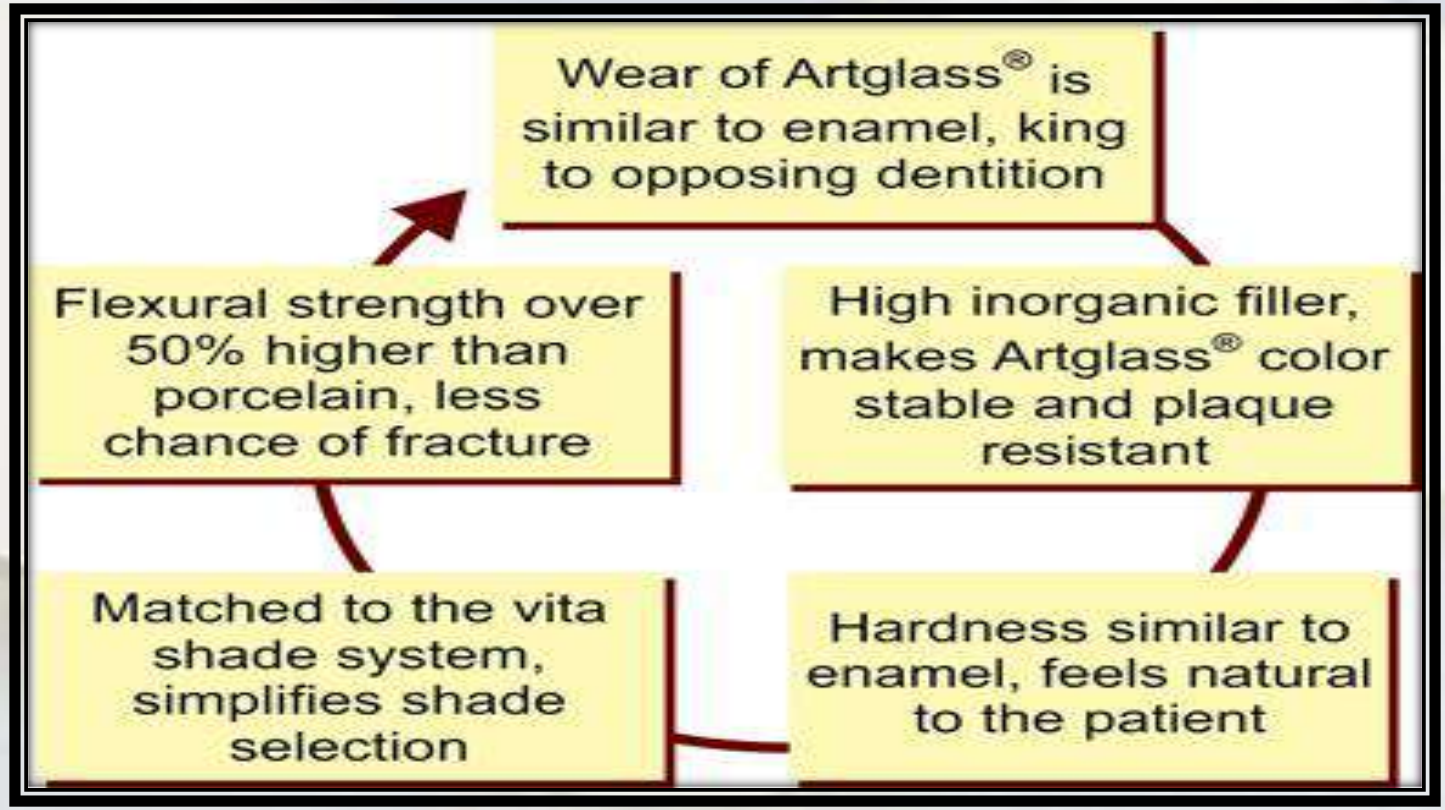
ARTGLASS CROWNS/GLASTECH CROWNS

- These are forms of ***full coronal restorations with esthetic value*** for the deciduous dentition.

- Artglass is a polymer glass, which provides the natural feel**, bond ability associated with composite** but the **esthetics and longevity of porcelain.**

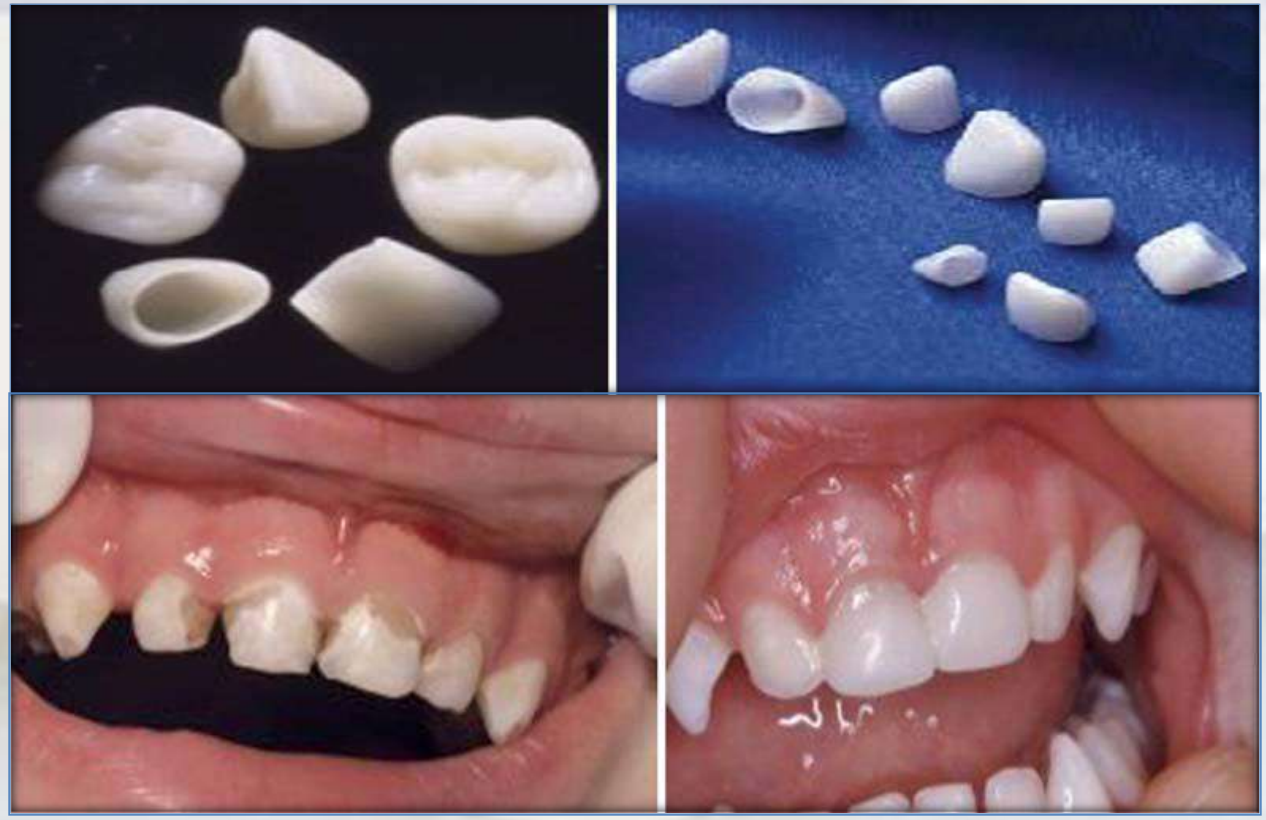


- Artglass is made up of **bifunctional and new multifunctional methacrylates.**



Availability

- Artglass crowns are available in a **single shade** with **six sizes** for the each anterior teeth.



Features

- **Esthetics** is comparable to the natural dentition
- They are **durable**
- No metal-composite interface to fail, **crack or craze**
- Its wear is similar to enamel, kind to opposing dentition
- The unique filler materials of **microglass and silica** are proposed to provide greater **durability and esthetics than strip crowns**
- High inorganic filler, makes Artglass **color stable and plaque resistant.**
- Flexural strength over 50 % higher than porcelain, **less chance of fracture.**
- Easily **adjusted or repaired** intraorally

- Offers the ease and bondability of a composite
- Requires minimum chairside work
- No impression required
- No metal to interfere with patient’s natural smile.

Disadvantage

Crown failure is usually due to result of bond failure

Preveneered Stainless Steel Crown

- PVSSCs are S.S /nickel chrome crowns that has an esthetic facing, mechanically and/or chemically bonded.

- PVSSC were introduced in the early 1990s.

- They were initially developed for **anterior teeth**, but later developed for **primary molars**.

- PVSSC for primary molars on the market are
  - ✓ Nusmile Primary Crowns (Houston TX),
  - ✓ Kinder Krowns (St Louis Park, MN),
  - ✓ Cheng Crowns (Exton PA).

Recommendations

- Children at high-risk caries may be treated to protect the remaining at-risk tooth surfaces.

- Children with extensive decay, large lesions, or multiple-surface lesions in primary molars.

For example:

1. NuSmile primary crown
2. Cheng crowns
3. Whiter Biter crown
4. Dura crown.

ADVANTAGES

- Esthetically pleasing
- Less moisture sensitive
- Durable
- Less chairside time
- Easy to place
- Full coronal coverage
- Parent satisfaction.

DISADVANTAGES

- Wide mesiodistally
- There is limited choice on the resin shade
- The labial section of the margin cannot be crimped
- Cannot be sterilized under heat pressure (heat would destroy the resin)
- Difficult to fit
- Chances of fractures
- Difficult to repair
- Excess tooth reduction to be done
- Occasionally part of veneer may chip off by putting excusive pressure
- Proper marginal seal is not obtained
- Expensive (3 times than SSC)

General Steps of Preveneered Crown Placement

- Tooth preparation for PVSSC is similar to that of SSC preparation.
- But they require little excess tooth reduction and no crimping or contouring of crown.
- The shape of the PVSSC is not alterable and in cases in which there is a loss of space, usually due to caries, the crown cannot be “squeezed” mesiodistally.
- Hence, careful case selection is necessary to avoid difficulties.
- Steam technique of sterilization - crowns

- The first step is to estimate the crown size needed. This is done prior to tooth preparation.
- occlusal reduction- Minimum of 2 mm.
- Circumferential reduction - tapered fissure bur.
- Margins - feather edge and extend slightly subgingivally.
- Upon try-in, the crown should fit passively with no resistance to the fully seated position.
- Snap fit of these crowns should not be achieved since forcing can produce micro fractures of the veneer and ultimately loss of veneer.
- Prepare and ***adjust the tooth*** rather than adjusting the crown to fit the tooth.
- Check for the occlusion.
- Cementation of crown - glass ionomer cement.

NuSMILE CROWNS

- These are S. S crowns with the most natural looking facing.
- These are anatomically correct, are less technique sensitive and offer excellent durability and color stability.
- These crowns are having facing on labial surface and metal portion on lingual side for crimping to achieve better seal.
- NuSmile® crowns available as anterior and posterior crowns.
- MacLean *et al. (2007) and Jeanetterr et al. (2007) concluded that NuSmile anterior* preveneered crowns are a clinically successful restoration for primary incisors with ECC.

Advantages

- Eliminates extra steps
- Ensures successful results
- Autoclavable
- Designed for optimum zirconia-cement retention
- Esthetically acceptable
- Long lasting
- Patient–parent's satisfaction
- Less chairside time
- Compatible to natural tooth color and translucency will not discolor with age
- Superior performance of composite bonding to the stainless steel crown.

Disadvantages

- May resulted in poor gingival health
- Very expensive
- Bulky
- Crimping may cause fracture.

NuSmile Crown is Available in Two Forms

1. NuSmile signature.

2. NuSmile ZR.

NuSmile Signature Crowns

- ✓ They are ***anatomically correct*** S.S crowns
- ✓ with a ***natural looking***, tooth color coating.
- ✓ These are ***widely used***,
- ✓ ***easy restorative*** option to traditional S.S & composite strip crowns.



NuSmile ZR Crowns

- ✓ Houston, Texas–NuSmile pediatric crowns has introduced NuSmile ZR.
- ✓ Superior esthetic
- ✓ durability
- ✓ easy to place compared to composite restoration and strip crown.



It is made from **monolithic zirconia**, similar to ceramic steel while **mimicking the anatomical contours of natural primary teeth** to achieve a natural clinical outcome.

- NuSmile ZR launched in US as ***NuSmile pediatric crowns.***

- Its high-strength formula **is nine times stronger than dentin and enamel** to provide a superior result to composite strip crowns."

- Available in **two shades** and **numerous sizes.**

- **Queis H *et al. (2010)*** *done a study to assess* the use of anterior esthetic S.S crown (PVSSC) among pediatric dentist by questionnaire survey on **2600** AAPD members.

- It was found that **NuSmile crown** used more among PVSSC that is

✓ 61 % NuSmile,
✓ 28 % Cheng crown,
✓ 35 % Kinder krowns.

Procedure for placing NuSmile crown

Case selection/precautionary measures-

- Avoid **anterior cross-bite, Class II malocclusion and severe crowding**
- Select tooth with **restorable crown structure**

Procedure-

Extra preparation required on lingual, mesial and distally compared to SSC.

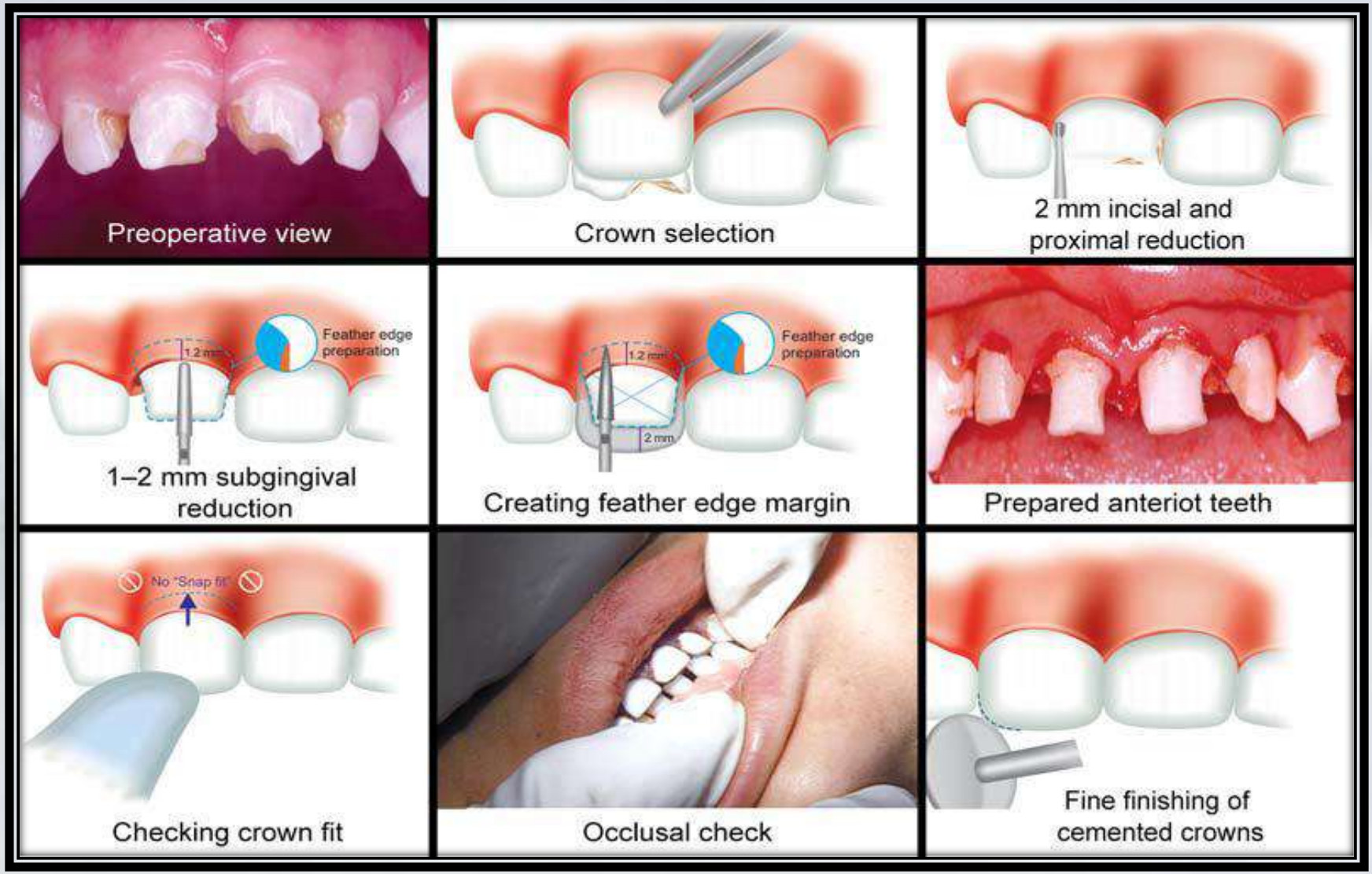
Select shorter crown to fit.

To avoid crown fracture do only snap fit.

Do not cement crown with noticeable craze line.

Be careful while crimping.

NuSmile crown placement procedure for anterior primary teeth.



Primary canine and molar NuSmile crown placement.





FLEX WHITE FACED PEDIATRIC CROWN

Flex white-faced stainless steel pediatric crowns are made of new material that *can be crimped on facial and lingual, and can also be squeezed on the mesial and distal* to allow for better adaptation without the fear of compromising the bond strength.



TABLE 3.10 Features of flex crown	
Sizes	1–6
Color/Shades	White-faced
Quantity	24
Product brief	Pediatric crowns
Special features	Available in upper right and left centrals and laterals, sizes 1–6. Kit includes 1 of each size

Manufacturer

❖Success essential space maintainer laboratory.

❖Available for incisor and primary molars.

❖Available as left, right, upper and lower

❖size 1 to 6.

❖ Kit includes 1 of each size = 24 crowns

Features and Benefits

1. **Squeeze-able on the mesial and distal**
2. **Crimpable on the facial and lingual**
3. **May be trimmed with scissors or green stone**
4. **1 mm shorter than standard SSC crowns**
5. **Matches natural dentition**
6. **Pediatric white shade**
7. **Saves chair time**
8. **No changes in bond strength after crimping or squeezing.**

Procedure of Crown Placement

Tooth preparation and crown placement is similar to that of SSC

PEDO PEARLS (ALUMINUM CROWNS WITH FACING)

- This technology developed in 1980.
- Pedo pearl crown is similar to the S. S crown but is completely coated with tooth colored epoxy paint.
- The crowns are made from ***aluminum*** instead of stainless steel because the epoxy coating adapt better to aluminum.



- These crowns are constructed of heavy gauge aluminum and coated with an organic enamel that is both flexible and durable.
- The color coating will not chip or peel.
- They reduce time and cost for selection.
- cementation - glass ionomer and self-curing composites enhance their performance and durability.
- These crowns are easy to cut and crimp which adjusts to the perfect fit without chipping or peeling.
- Durable coating with excellent adhesion and high performance enamel coating bonds exceptionally well with the heavy gauge aluminum crowns.
- If cosmetic touch-up is ever needed, a light cured composite may be used.

ADVANTAGES

- **Cost:** The price is much less than any other esthetical metal crown on the market and have an infinite shelf life.
- **Inventory:** The anterior pedo pearl crowns have universal anatomy, can be used on either side.
- **Crown coating:** coating will not chip or peel. The dentist can cut and crimp the crown without damaging the coating.
- **Natural look:** crowns are not bulky and fit easily to the tooth.
- **Flexible packaging:** crowns come in 3 kits for the dentist; the anterior kit, the posterior kit, and the complete arch kit. Refill packages - 3 crowns for all of sizes.
- **Maintenance:** can be touched-up or repaired easily.

DISADVANTAGES

1. They are relatively soft thus creating a problem for long-term durability.

2. In areas of heavy occlusion, the white coating will wear off .

Availability of Crowns

Complete arch kit contains: 72 crowns

Anterior-36

posterior kit-36

Anterior Kit

- 36 maxillary anterior crowns
- Centrals (sizes 1 to 4)
- Laterals (sizes 1 to 5)
- Cuspids (sizes 1 to 4)

All with universal anatomy.

Posterior Kit

- 36 maxillary posterior crowns
- 1st molars (sizes 3 to 5, R-L)
- 2nd molars (sizes 3 to 5, R-L)

Both left and right anatomies.



Session III

- Cheng crowns
- Whiter Biter crowns
- Pedo compu crowns
- High density polyethylene veneered crowns for children
- Dura crowns
- **Ceramic (Zirconia) crown**
  - ZIRKIZ crown
  - EZ-crown
  - Kinder Krown
  - CEREC crown
  - Ceramo basemetal crown.

- **Biologic crowns**

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THANK YOU !!



GOOD MORNING




Esthetic Crowns in Pediatric Dentistry
Session III
Presenter:
Dr Astha Soni

Last Session

- Polycarbonate crowns
- Kudos crowns
- Pedonatural crowns
- Pedo jacket crowns
- ARTglass crowns/ Glasstech Crowns

Preveneered S.S crowns

- NuSmile crowns
- Flex crowns
- Pedo pearls

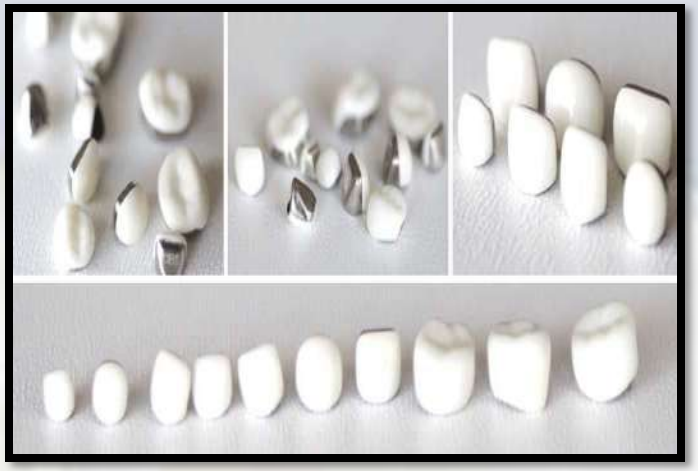
Todays Session

- Cheng crowns
- Whiter Biter crowns
- Pedo compu crowns
- High density polyethylene veneered crowns for children
- Dura crowns
- **Ceramic (Zirconia) crown**
  - ZIRKIZ crown
  - EZ-crown
  - Kinder Krown
  - CEREC crown
  - Ceramo basemetal crown.

- **Biologic crowns**

Cheng crown

- Cheng Crowns from Peter Cheng Orthodontic Laboratories, Inc. made its public debut in **1987**.
- named after the president of the company **'Mr Peter Cheng'.**
- These are stainless steel pediatric anterior crowns faced with a high quality **composite,** mesh-based with a light cured composite.





Commercial Company

- Peter Cheng Orthodontic Laboratories, Inc.

Availability

- It is available for the right and left central and lateral as well as cuspids with 6 sizes.

Crown Sizes

- **Anterior Crowns-** *Sizes (1 to 6)*

  Master primary anterior starter kit: 96 crowns,

  Basic primary anterior starter kit: 16 crowns

- **Posterior Crowns**

  starter kit: 12 crowns, sizes 3 to 5 (one of each size)

  Primary molar crowns available as sizes 2 to 7.

Benefits / Advantages

- Single visit procedure
- Less technique sensitive
- Natural-looking
- They can undergo heat sterilization without significant effect on their bond strength and color.
- Stain resistant
- durable, color stable, and matches pedoshade
- It does not cause wear of opposing teeth
- Less patient discomfort.

Disadvantages

- Fracture of veneers during crimping
- They are expensive

Fitting Instructions to Determine the Correct Size of Cheng Crown to use

- Tooth preparation & crown placement - similar to SSC
- First check the crown size on patient with a plain 3M Unitek SS crown
- When a correct size crown has been found, replace with corresponding size Cheng Crown to fit the patient
- This will eliminate the need for sterilization.

WHITER BITER CROWN

- It is preveneered SSC. Includes a SS shell sized to cover a tooth portion and a polymeric coating including a polyester/epoxy hybrid composition.
- The coating can be a very thin layer
- Coating does not peel or chip under normal use and mastication.

These crowns are no longer used now.

Roberts *et al*. (2001) found 32 % of the crown loosing some of the esthetic white facing.

Manufacturer- Whiter Biter Inc.

PEDO COMPU-CROWN

- These are stainless steel pediatric anterior crowns faced with a high quality composite, mesh-based with a light cured composite crowns.

- These crowns are
  - color stable,
  - plaque resistant,
  - match natural pediatric shades
  - Available as white colored crowns



Available as Sizes

- Available for the right and left **central** and **lateral** as well as **cuspids**.

- **Kit includes:**

Centrals sizes 2,3,4 (2 of each) - Right and left

laterals sizes 2,3,4 (2 of each) - Right and left

Cuspids 1 to 6

BENEFITS

1. Does not wears opposing dentition
2. Easy to adjust
3. Color stable
4. Feels natural
5. Shade matches to natural dentition

HIGH DENSITY POLYETHYLENE VENEERED CROWNS FOR CHILDREN

The veneer is comprised of ***high density polyethylene, which is thermoformed over a preformed stainless steel*** crown to obtain the desired appearance



PROPERTIES AND USES

1. **High elastic limit.**

2. **Greater flexural strength.**

3. **Withstand great shearing force when mechanically bonded to a preformed crown.**

4. **Natural appearance of a vital tooth.**

5. **High density polyethylene (HDPE) once engaged by the mechanical retention, does not separate unless the mechanical retention is broken from its weld points.**

6. **HDPE is compatible with the base metal.**

7. **Chipping, crazing, and splitting not occurs at human mouth temperatures.**

8. **Greater bond strength than other facing material currently used on children's esthetic stainless steel crowns.**

DURA CROWNS

- These crowns can be crimped **labially and lingually**, can be easily trimmed with crown scissors, easily festooned and has got a full knife edge margin.

- If the facing chips or breaks after placement, esthetic repair is difficult and usually requires replacement of the crown.

TABLE 3.12 Features of dura crown

Shades available	White-faced crowns
Crown sizes	Available for the upper, right and left centrals and laterals with 6 sizes for each tooth
Anterior/Posterior available	Anterior and posterior (Figs 3.62 A and B)
Quantity	Starter kit includes: 24 crowns Centrals, left and right sizes 2,3,4 (2 of each) Laterals, left and right sizes 3,4,5 (2 of each)
Adjustable	Facial and lingual may be crimped Facial and lingual surface easily trimmed with crowned scissors Easily festooned
Product number	470–300





ADVANTAGES

- Facial and lingual margins can be crimped
- Easily trimmed with crown scissors
- Easily festooned
- Full knife edge margin capabilities
- These preveneered crowns are esthetic and can be placed with poor moisture or hemorrhage control.

Ceramic (Zirconia) crown

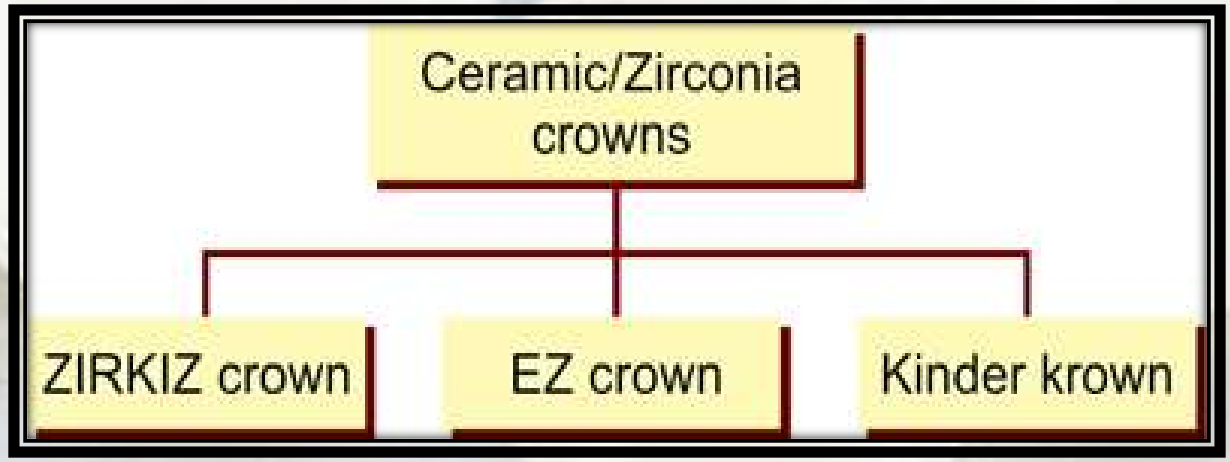
INTRODUCTION

- Zirconia crowns offer numerous advantages
  - They contain no metal.
  - Esthetic qualities

- **Zirconia crown** is the ultimate restoration for a root canal treated or fractured **permanent incisor.**
- **In vital teeth,** it should be **delayed** until the child is at least **18 years old**

- It has limited use in children before age of 18 years because:
  a. It is expensive
  b. Can fracture easily
  c. Use is limited to the permanent dentition

Commercial Pediatric Zirconia Crowns



ZIRKIZ CROWNS

- New approach in restoring the natural appearance of a child's smile with a **minimally invasive technique.**

- Zirconia crowns have
  - ✓ Superior esthetics & natural appearance
  - ✓ With short chair time.

- Zirconia is a crystalline **dioxide of zirconium.**

- In particular, **yttrium-oxide partially stabilized zirconia** (3Y-TZP) has mechanical properties similar to **metals,** yet it has a ***color similar to that of teeth***.

- mechanical properties - similar to stainless steel

Manufacturer

ZIRKIZ, HASS Corp; Korea.



- **Clinical Technique in Crown Placement**

1. Crown selection: Select the appropriate crown size prior to tooth preparation
2. Occlusal check
3. Anesthetizing the tooth
4. Isolation with rubber dam

5. Tooth preparation:

- ✓ caries should be removed with **stainless steel round burs.**
- ✓ Reduce incisal surface - **1 mm.**
- ✓ Facial & lingual surface - **0.5 - 1.0 mm**
- ✓ Check Occlusion - clearance from opposing dentition.
- ✓ Interproximal reduction involves

  creating **parallel** mesial and distal wall extending from **1 to 2 mm subgingivally** to the incisal edge of the preparation.
- ✓ After preparation - crown should fit passively.

- Zirconia crowns are ceramic and ***cannot be trimmed with scissors***
- ***Glass ionomer cement*** should be used to fill the crown completely. .
- "***Light-cure resin cement***" can also be used for cementation of ZIRKIZ crowns to eliminate any internal voids .
- No clinical studies of anterior crowns on primary teeth were identified that met all or even a majority of criteria
- More recently, a new type of ceramic material, based on zirconium dioxide, has been developed. ***Yttria-stabilized tetragonal. Zirconia polycrystal, Y-TZP,*** has a unique ability to ***resist crack propagation***
- This material has the potential to be used for larger restorations and in the molar area.

EZ- CROWNS

- EZ-pedo company first developed monolithic zirconia pedo crowns as anterior and posterior crowns





- EZ-pedo is the first company worldwide to offer fully "***white," prefabricated, ceramic*** crowns especially designed for children.
- Made of solid zirconia- **biocompatible material.**
- They look extremely ***esthetic.***
- Each crown is glazed with a hint of natural color, making them
  - ❖ **very smooth,**
  - ❖ **shiny**
  - ❖ **impermeable to staining.**
- They are exceptionally **strong**
- Their esthetics allows them to ***blend in seamlessly*** with surrounding natural teeth
- Tooth preparation for EZ-crown is similar to that of SSC.

Development of EZ-Crown

- **Jeff P Fisher and John P Hansen** did years of research with local dentists before founding all ceramic crown; EZ-Pedo Inc., in Loomis, California, in 2010.

- Today they produce thousands of ceramic dental crowns for children.



John P Hansen and Jeffrey P Fisher

- EZ-crowns got clearance from ***US Food and Drug Administration*** and clearance from ***FDA*** for use in 2009.

- The company states that, it had about 10% of the US nation's pediatric crown market

<u>Manufacturing of EZ-Crowns</u>

The zirconia crowns are first milled in an custom-made machine

About 35-50 crowns placed in a disc can be shaped simultaneously.



- From there, the crowns will be
  - smoothed,
  - polished,
  - put through a staining solution
  - hardened in a 4,000 degree chamber
  - microblasted
  - glazed.



- Every crown gets a label, which can be scratched off by a dentist before placement

- There are **96 shapes**
- and up to **six sizes** for each specific tooth.
- Zirlock technology has been implemented within the EZ-pedo crown to improve retention



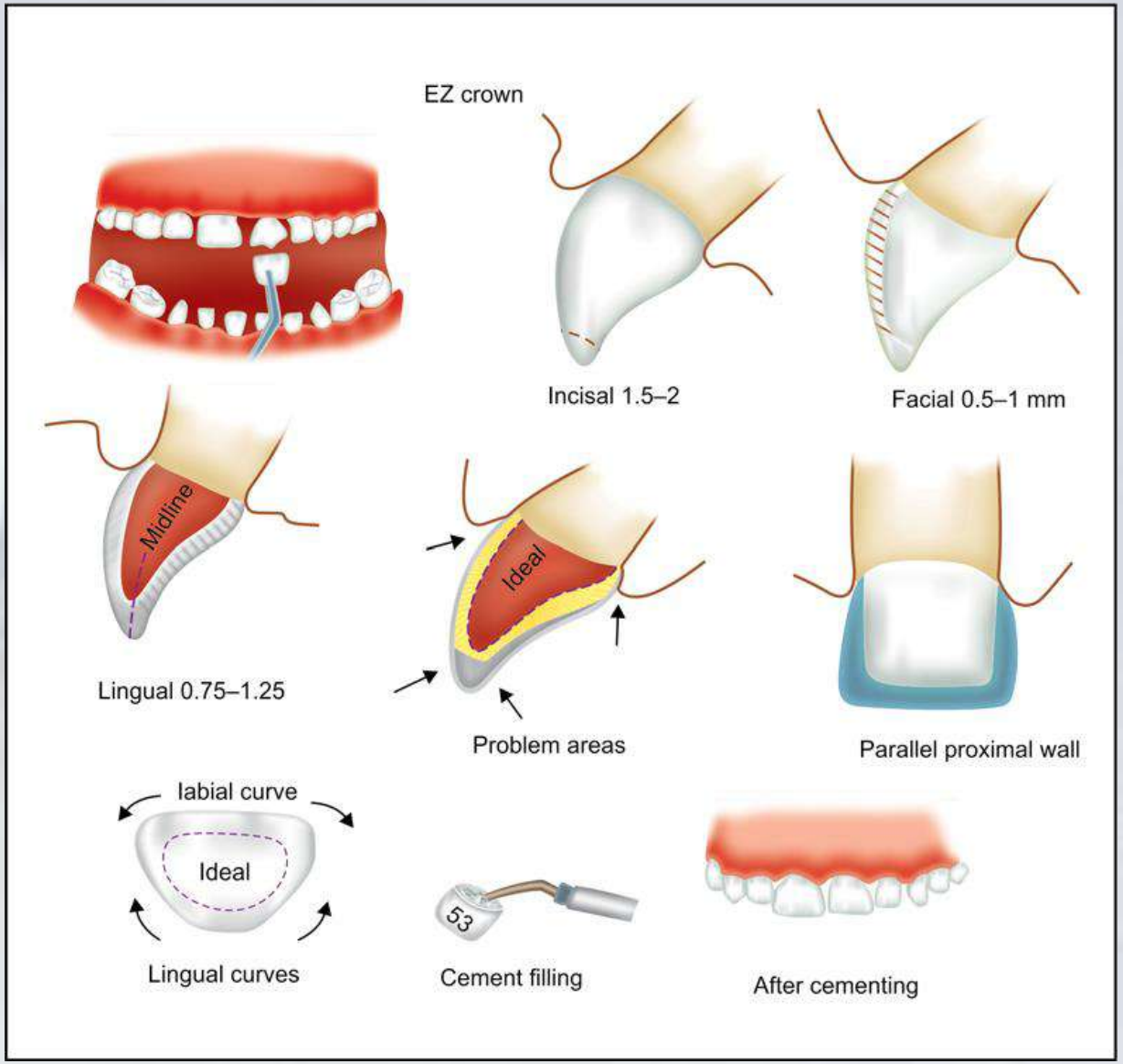
ADVANTAGES

1. Zirlock technology increases the internal surface area for long lasting clinical success
2. Provides glazed facial surface for better esthetic
3. Ultra low wear
4. Avoids chances of chipping, or fractured facing
5. Biocompatible
6. Provides better strength
7. Autoclavable.

Procedure for EZ-Crown Placement for Primary Teeth

The tooth preparation and crown placement are similar to that for SSC, i.e.

1. Crown selection
2. Tooth preparation-on lingual , incisal, facial, proximal surfaces
3. Checking for crown fit and crown cementation.



KINDER KROWNS

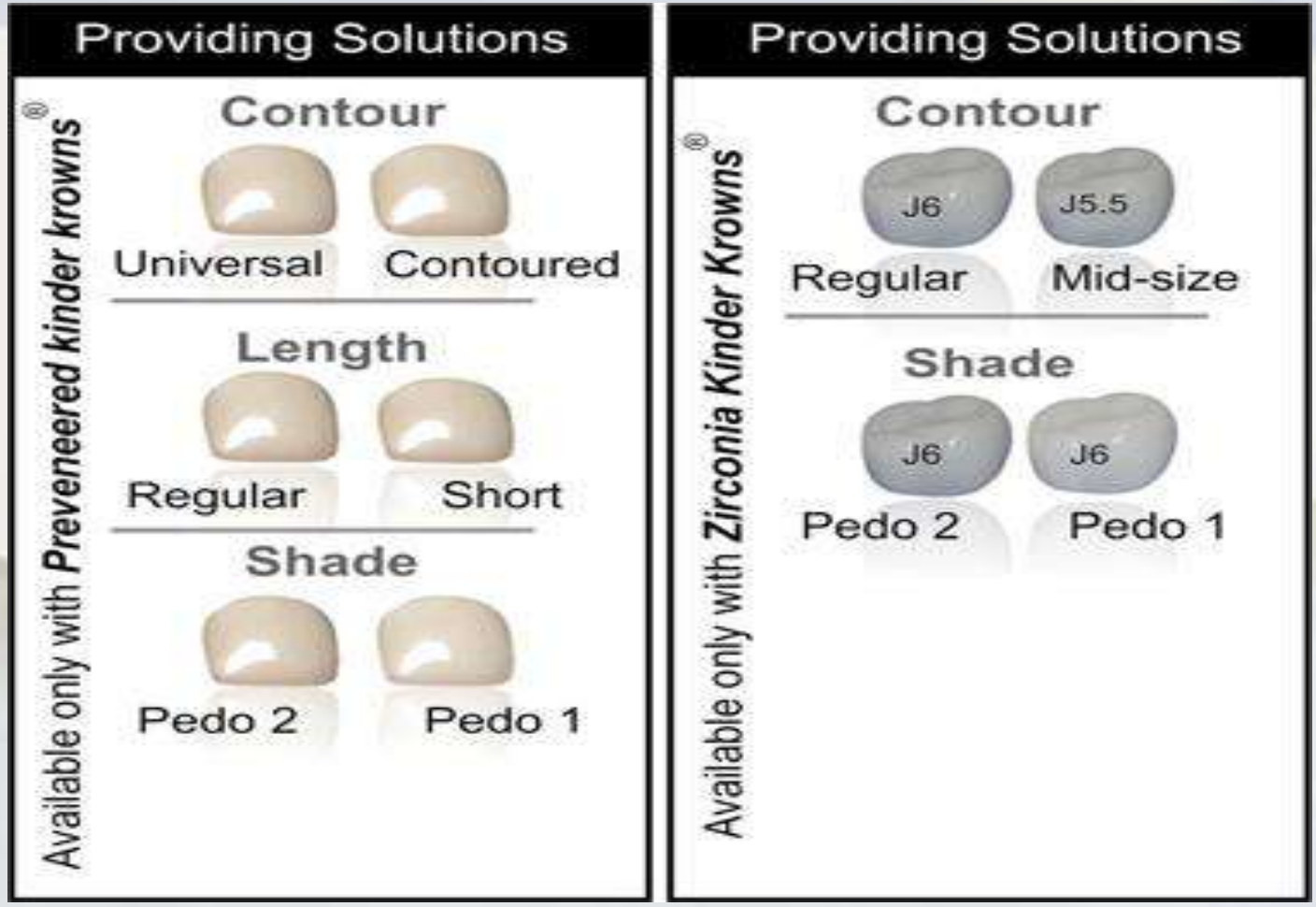
- Kinder Krowns offer the most natural shades and contour available for the pediatric patient.



- The great depth and vitality from the lifelike composite reveal a natural smile without the **bulky "Chiclet" look** of other restorations.

- Kinder Krowns available - anterior & posterior

Kinder Krowns (anterior and posterior)



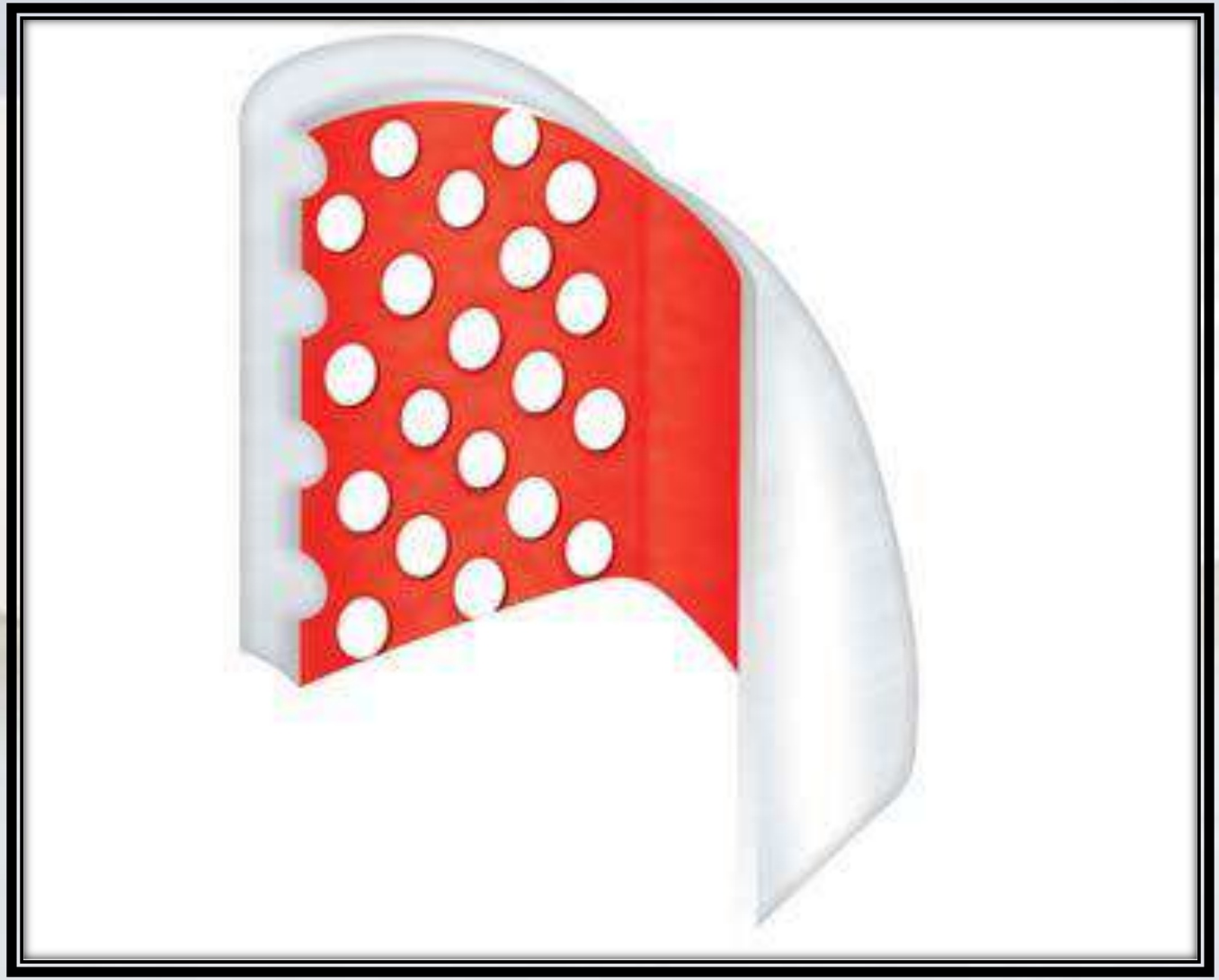
- The original Kinder Krowns® were introduced to the market in **1989.**

- The introduction of **IncisaLock in 1997** revolutionized esthetic pediatric dentistry.

- Kinder Krowns are designed with IncisaLock™—the optimal **union of state-of the- art** bonding procedures and mechanical retention

- **By adding mechanical retention** and more composite, Kinder Krowns **become strong** without sacrificing form or function.

IncisaLock for mechanical retention



- **Dr John Burgess**, examined the wear of enamel in both polished and glazed in the comparison to a commonly used porcelain and nature enamel.

- In his study, the polished zirconia demonstrated **8 times less wear** on enamel than glazed zirconia.

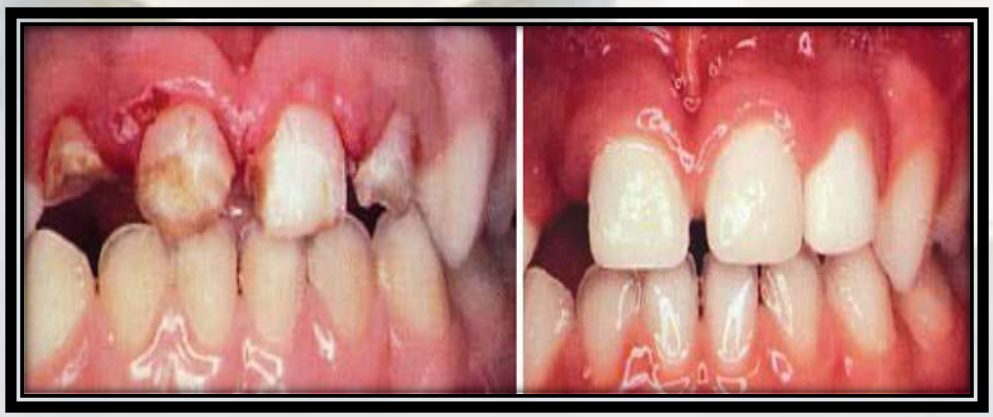
- These crowns are
  1. **consistent,**
  2. **easy to use,**
  3. **beautiful restorations every time.**

- The teeth in pedo bridges are constructed completely **out of composite**, making them more **durable** than acrylic teeth and they are repairable at chairside.

- They match any bioform or **vita shade for shade selection.**

- **Custom pedo bridges** are even made available from company.

- Kinder krowns can also be used in **fixed bridge farication for replacing lost primary incisors**





Features

- Esthetic
- **Durability: Crowns are faced with a special** bonding agent and a durable, high-flexural strength dental composite.
- **Ease of seating: Anterior crowns are a time saving,** less technique sensitive alternative to other esthetic crowns (open-faced window crowns and strip crowns.)
- To better meet seating needs and preference, Kinder Krowns are available in regular or **1 mm short length**.

Benefits

1. **Autoclavable**, easy to identify outer label
2. Precisely manufactured to ensure **proper fit**
3. **Rough external surface** for easy handling
4. **No contamination** provides better retention.

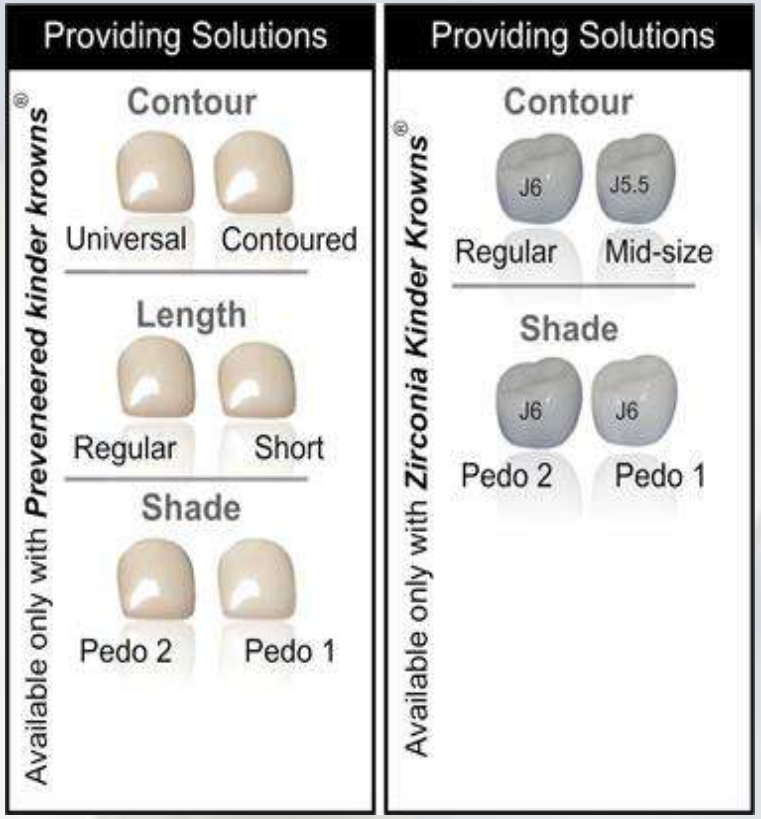
Available

- Available for anterior and posterior primary teeth
- Sizes D/E 1-6, in Pedo 1 or Pedo 2
- Pedo 2 shade is the most **natural shade**, while Pedo 1 shade is for those cases when **the bleached white shade is wanted**.



Anterior crowns are available

- ✓ Left and right
- ✓ Universal and contoured types
- ✓ Length—regular and short
- ✓ Shade-Pedo 1 and Pedo 2.

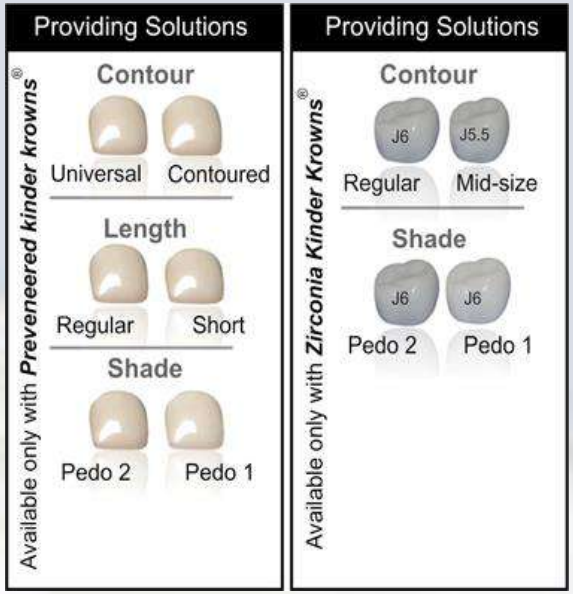


Posterior Crowns :

Shade: Available in two shades**,**

Pedo 1 and Pedo 2.

- Pedo 1 is a lighter bleached shade
- Pedo 2 is a natural A1/B1 blended shade which will matches natural dentition.



Midsizes: Midsizes designed for first and second primary molars to alleviate seating issues in situations for placing crowns back to back or significant space loss.

- The midsized crowns retain their buccal-lingual width, while the mesial-distal has been reduced to allow for easier placement.

Product Description

36 CROWNS

- CENTRALS 2, 3, 4 (4 OF EACH)
- LATERALS 3, 4, 5 (4 OF EACH)
- CENTRALS 1, 5, 6 (2 OF EACH)
- LATERALS 1, 2, 6 (2 OF EACH).

128 Crowns

Sizes: 1.5, 2.5, 2.5, 4.5, 5.5, 6, 6.5, 7 (1 of each B, I, S, L, A, J, T, K).

Sizes: 2, 3, 4, 5 (2 of each B, I, S, L, A, J, T, K).

Manufacturer

Orthodontic technologies-Kinder Krown

CEREC CROWNS-ALL CERAMIC CROWNS—CAD/CAM SYSTEM

- CAD/CAM restorations is clinically superior to man-made restorations in terms of fit and accuracy.

- ***Chairside economical restoration of esthetic ceramics (CEREC)*** crowns are all ceramic crowns prepared by CAD/CAM technology.

- CEREC crowns are made up of

1. enamel-like feldspar
2. glass ceramics,
3. cementable lithium disilicate
4. high-performance polymers.

CEREC One-visit Crown Placement Procedure (CAD/CAM Method)

- CEREC crown placement - single visit.
- The crown is made by a **CAD/CAM technology** thus eliminating the second appointment and the temporary crown.
- Tooth preparation procedure is similar to that for SSC crowns



- A digital image of the prepared tooth will be taken using a special camera.

- This image is then converted into a ***3D computerized model of tooth***, which is used as a guide to design new restoration .





- This newly designed tooth data is sent to an onsite **milling machine**, which ***fabricates new tooth*** from a high-quality ceramic block. The milling process can take anywhere from as little as **6 min to 30 min** depending on the exact technology and complexity of the tooth



The latest CEREC MCXL machine can mill a crown in as little as 6 min.

The ceramic blocks come in a wide variety of shades and colors, and tooth will be selected to match surrounding teeth



- Once the crown or veneer has been milled, then it may characterize it and stain it to match surrounding teeth, before either polishing it or glazing it in a furnace.



Advantages

1. Single visit appointment for crown preparation and placement
2. Time saving
3. No need of temporary crown
4. Esthetically acceptable
5. Durable.

Disadvantages

1. They look greater on posterior teeth, but do not have the esthetic quality of laboratary made crowns.
2. Unique CEREC technology requires extra training on the part of the dentist.

CERAMO BASE METAL CROWN

- Ceramo-metal alloys are those used to create the substructure of a bridge or crown which will have cosmetic porcelain fused to its visible surfaces.

- The ADA has 3 classes of Crown and Bridge Alloys. They are as follows:

High noble alloys:

- High noble ceramometal alloys are usually the color of white gold (silver color), due to addition of metals such as platinum and palladium.

- These metals improve the strength and rigidity of the prosthesis, making it better suited to support the cosmetic layer of porcelain that is applied to its outer surface

Noble alloys:

- Noble alloys have little or no gold.

- The gold was replaced by other precious metals such as silver and palladium.

- This originally resulted in an alloy that was significantly cheaper than high noble alloys.

- Recently, the price of palladium has escalated and the price differential is no longer significant.

Base metal alloys:

- Base metal alloys contain no noble metals.
- Cheaper
- They are generally an alloy of nickel and chrome, which results in their being very rigid.
- The microscopic surface roughness of this alloy after it has been etched with acid makes it the alloy of choice in the fabrication of Bonded (Maryland) Bridges.
- Base metal alloys still remain less expensive.

Clinical Evaluation between Zirconia Crowns and Stainless Steel Crowns in Primary Molars Teeth

Abdulhadi BS, Abdullah MM, Alaki SM, Alamoudi NM, Attar MH. J Pediatr Dent 2017;5:21-27

Aim:- To compared the clinical outcomes of two full-coronal restorations (stainless steel crowns [SSCs] and zirconia crowns Nu/ZR) in carious primary molars teeth.

Method:- 120 teeth are recruited - 60 teeth for SSC restorations
60 for Nu/ZR restorations.

Split mouth technique was used to ensure equalizing variables for both groups.

Result:-While looking at the improvements in gingival health relative to interventions, both Zirconia and SSC have significant changes through all time points.

- Zirconia performed better at the 3rd month with 80% compared to SSC with only 13.3% improvement with $P < 0.001$. and 0.005, respectively.
- At 6th month, all samples under group zirconia already improved whereas only 73.3% from SSC show improvement.

Conclusion:- Zirconia crowns performed better regarding gingival response to the material of restoration and plaque retention despite its high cost.

Effect of Crown Preparation Height on Retention of a Prefabricated Primary Posterior Zirconia Crown

Jing L, Chen JW, Kamp CR, Suprono MS. Pediatr Dent 20l9;41(3):229-33

Aim:-Evaluate the remaining crown preparation's occluso-cervical height, its impact on zirconia crown retention, and the cement failure pattern.

Method:-Seventy-five (75) extracted human noncarious teeth (permanent third molars)

Group 1: 4 mm OCH;

Group2: 3 mm OCH;

Group 3: 4 mm OCH;

Group 4:1 mm OCH with thermocycling;

Group5: 3 mm OCH without thermocycling (the control group)

Result:-

There were significantly lower MPa between the: one-mm group and two-mm group ($p<0.001$); one-mm and three-mm group ($p<0.001$); and one-mm and four-mm group ($p<0.001$). However, there was no significant difference in MPa among the two-mm, three-mm, and four-mm groups ($p>0.05$).

Conclusion:-

- **Two millimeters** of occluso-cervical height exhibited comparable retention strength to that of the three-mm and four-mm groups.
- Increased retention of prefabricated zirconia crowns is **directly related to the increase in crown preparation heights**.
- Most ZC **cementation failures** in this study occurred due to **adhesive failure** between the tooth and cement.

Fracture resistance of different primary anterior esthetic crowns
Shobber MZA , Alkhadra TA. The Saudi Dental Journal,
http://dx.doi.org/10.1016/j.sdentj.2017.07.006

Aim:- Investigate and compare fracture resistance of four commercially available esthetic crowns.

Method:-Sixty-four anterior crowns were used.

NuSmile Primary crowns -16

Preveneered Cheng Crowns-16

NuSmile ZR -16

Cheng Crowns zirconia-16

Crowns were mounted and cemented on a negative replica and placed under servo hydraulic mechanical universal testing machine. Force was applied at 90 degree with crosshead speed of 1 mm/min until they fractured.

Result:-

Mean maximum loads were as follows:

NuSmile ZR crowns (937.36 + 131.68 N),

Cheng Zirconia Crowns (751.43 + 102.103 N),

NuSmile Primary crowns (482.37 + 76.92), and

Preveneered Cheng Crowns (415.57 +12.28).

Zirconia crowns the had highest fracture resistance compared to preveneered crowns ($p < 0.05$).

Conclusion:-

Zirconia crowns showed the highest fracture resistance with NuSmile zirconia crowns to being able to resist fracture even under intense pressure of load compared to Cheng

Crowns zirconia.

BIOLOGIC CROWN

- In 1964 Chosak and Eildeman published the first case report on reattachment of a fractured incisor fragment.
- Fragment reattachment using natural teeth is a technique known as biologic restoration.
- Meets the esthetic and standard of natural teeth.
- alternative treatment for primary teeth.
- They are made from tooth fragments selected from natural extracted teeth or from a bank of tooth tissues and bonded with dual cure composite cement to prepared teeth.

- Biologic restoration using natural post and core can provide natural esthetics.

- Biologic post and core, crown and veneer restoration are comparatively cheaper to other esthetic materials.

- These restorations are performed easily without need of sophisticated equipment.

- There are 2 methods of restoring tooth with biologic restorations

1. **Autogenous biological restoration-** done when fractured fragment is available in satisfactory condition. Tooth fragment obtained from the patient itself.

2. From donated extracted teeth -

- Tooth fragment obtained from **donor or tooth bank**.
- Teeth were kept at 40ºC in HBSS with donor identification like tooth parameters such as dimensions, color, shape, size and age.
- The combination of tooth fragment, adhesive and restorative material provides good functional and esthetic result.
- In case of severe loss of tooth structure, intra canal post of natural tooth can be done.
- Use of biologic restoration as a post and core has shown promising results. It is cost-effective alternative.

LIMITATIONS

- Lack of patient acceptance
- Lack of availability of teeth with similar structure and color
- Fabrication of post needs technically sound system
- Adaptation of natural post to root canal may be less accurate
- Longevity affected by many factors like, design, length, diameter of root, ferrule effect cementation, quality and quantity of remaining tooth structure.
- A biochemical property of biologic restorations needs to be determined for long term clinical use

Tooth Preparation



FABRICATION OF CROWN PORTION

- Select the biologic crown by measuring M-D dimension.
- Autoclave the selected biologic tooth at 121° C for 15 minute.
- Coronal portion of selected sterilized tooth should be cut-off at CEJ and biologic crown prepared by hollowing both internally as well on the cervical portion, leaving approximately 1 mm dentin with enamel
- Place biological crown on prepared tooth and adjust biologic crown to fit on the prepared tooth

RADIOGRAPHIC EVALUATION

Confirm the fitting of biologic crown on prepared tooth with radiograph

CEMENTATION OF BIOLOGIC CROWN

- The coronal portion of tooth to be fitted and inner surface of biologic crown are conditioned with 37 % phosphoric acid, followed by application of adhesive and light curing.

- Later apply dual cure resin cement and position the biologic crown in place until polymerization completes.

- Clinically, evaluate the crown after cementation

- Take radiograph after cementation again to confirm proper adaptation and cementation

Benefits

1. Retention comfortable
2. Esthetic as natural tooth
3. Natural enamel has physiologic wear
4. Superficial smoothness and cervical adaptation compatible with those of the surrounding teeth.
5. Avoids long clinical appointments
6. No lab procedure
7. Inexpensive
8. Preservation of natural tooth structure.

Disadvantages

1. The difficulty in obtaining teeth with the required coronal dimensions and characteristics.

2. Problems in matching fragment color with tooth remnant color.

3. Having fragments from other people's teeth in their mouth is not a pleasant idea for some patients.

4. Possible chances of crown fracture.

5. Degradation between the margins of the fragment and the tooth surface.

CONCLUSION

Several modifications and newer esthetic crowns have been presented to overcome the disadvantages of stainless steel crowns. These crowns were introduced to meet the increasing esthetic demands of patient as well as their parents.

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Shobber MZA , Alkhadra TA. Fracture resistance of different primary anterior esthetic crowns. The Saudi Dental Journal, http://dx.doi.org/10.1016/j.sdentj.2017.07.006

THANK YOU !!



CLEFT LIP AND PALATE



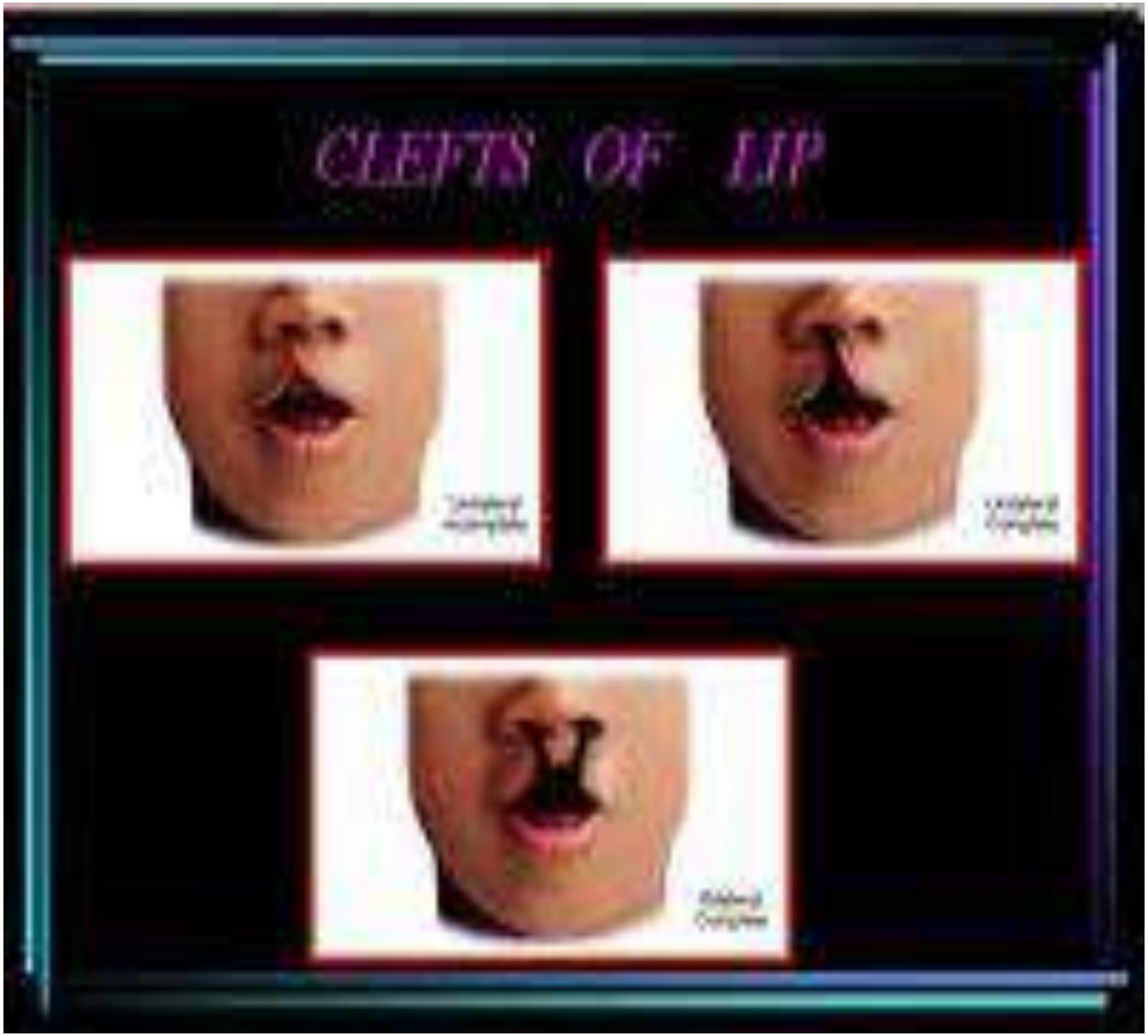
INTRODUCTION

A CLEFT

- A cleft is defined as an abnormal opening/a fissure in an anatomical structure that is normally closed.
- The palate is the roof of the mouth.
- A cleft lip/palate then is a split in the oral structure.

DEFINITION

- A cleft is a birth defect that occurs when the tissues of the lip &/or palate of the fetus do not fuse very early in pregnancy.
- A cleft lip, sometimes referred as a harelip, is an opening in the upper lip that can extend into the base of the nostril.
- A cleft palate is an opening in the roof of the mouth.


CLEFTS OF LIP

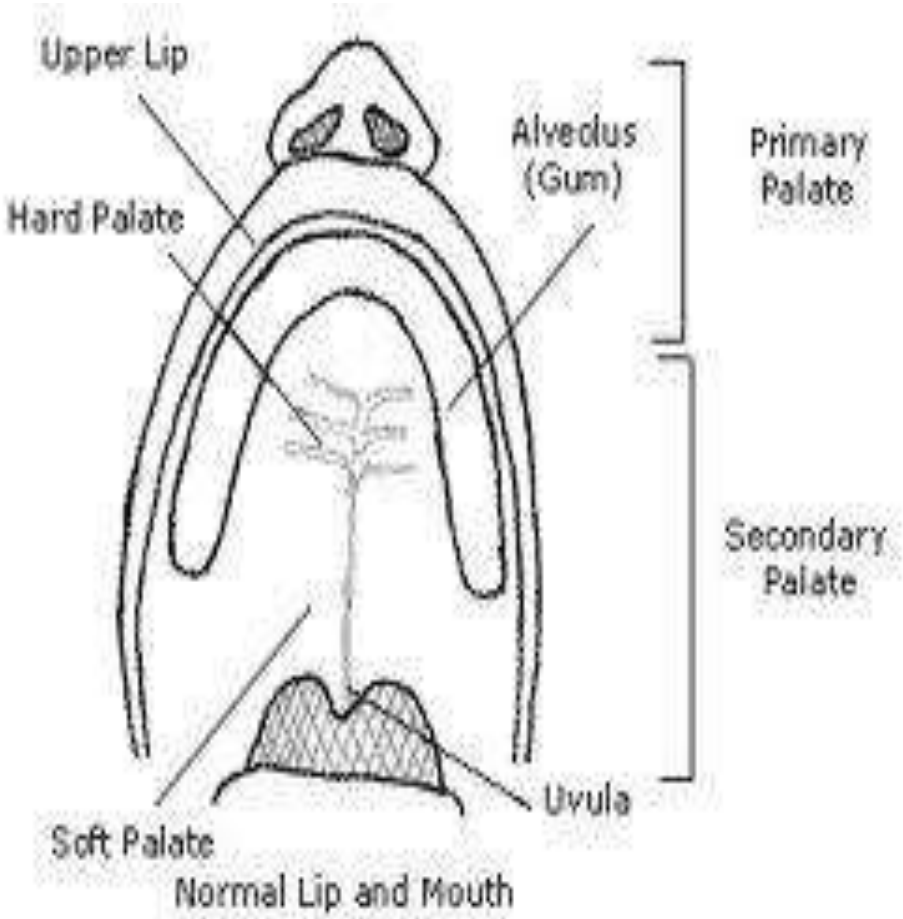

A
B
C
D

EMBRYOLOGY

- PRIMARY PALATE:
  includes the central portion of the upper lip, alveolus bearing four incisors and the palate anterior to the incisive foramen.
- Develops from median nasal process and fuses with maxillary process between 4-7 weeks of intrauterine life.

EMBRYOLOGY

- SECONDARY PALATE:
  includes the palate behind the incisive foramen.
  Develops by a positional change of the palatal shelves of the maxillary process from a vertical to horizontal position and then fusion starting from the incisive foramen progressing towards uvula (7-12 weeks of intrauterine life).


Upper Lip
Hard Palate
Alveolus
(Gum)
Primary
Palate
Secondary
Palate
Uvula
Soft Palate
Normal Lip and Mouth

DEVELOPMENT OF CLEFT

CLEFT LIP :

- Failure of fusion between median nasal process and maxillary process.
- Rupture of a cyst formed at the site of fusion.

DEVELOPMENT OF CLEFT

CLEFT PALATE :

- Alteration of intrinsic palatal shelf force.
- Non fusion of the shelves.
- Failure of the tongue to drop down.
- Rupture of inclusion cyst formed at the site of fusion.
- Fusion of the shelves with a subsequent break down due to inadequate mesodermal migration.

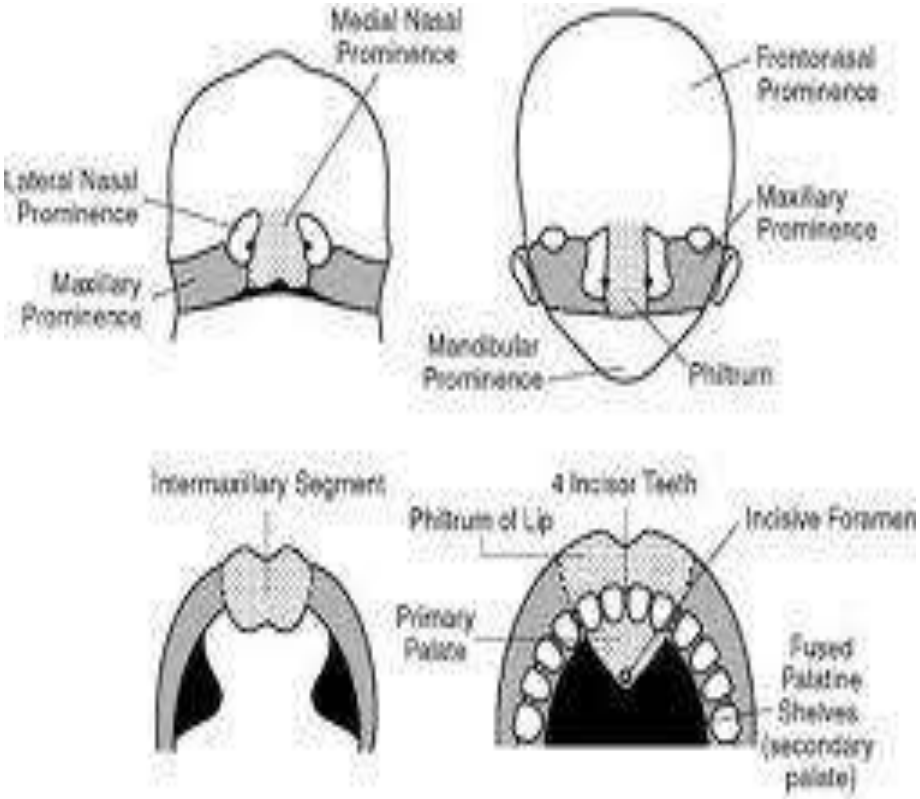


Figure III-G-9. Palate and Face Development

INCIDENCE OF CLEFT

- Overall incidence varies from 0.3 to 6.5 per 1000 live births.
- Negroid race has least incidence while Mongoloid have the maximum.
- Cleft lip is more common in males.
- Cleft palate is more in females.
- Unilateral clefts are more common than bilateral clefts.
- Left side has more predisposition for clefts.
- More chances of cleft in patients with family history of the same.

ETIOLOGY

- GENETIC FACTORS: positive family history in 20% of cases. Genes involved are : TGFB2, TGFA, TGFB3, MSX2.

- ENVIRONMENTAL FACTORS
- Fever with rashes
- Exposure to radiation
- Drugs: thalidomide, anti epileptic drugs, hormonal pills, quinine.
- Trauma
- Complications of pregnancy : attack of rubella during first trimester.
- Alcohol, smoking, hypoxic condition.

ETIOLOGY

- GENE ENVIRONMENT INTERACTIONS
- Interaction between multiple genes with small defects and environmental factors result in the defect.
- Most clefts in human beings appear due to multifactorial causes ie. due to combined effect of genetic influence and various environmental factors.

PREDISPOSING FACTORS

- Increased maternal age predisposes to cleft lip babies.
- Increased paternal age predisposes to cleft palate babies.
- Racial : mongoloids show the greatest percentage of incidence.
- Blood supply : any factor that reduces blood supply to the nasomaxillary area during embryological development predisposes to clefts.

ASSOCIATED SYNDROMES

- Down's syndrome (Trisomy 21)
- Vander Woude's syndrome (lip pits)
- Treacher Collins syndrome (hypoplastic zygoma, micrognathia, external and middle ear defects)

- Pierre Robin syndrome (micrognathia, glossoptosis, with respiratory obstruction)
- Orofacial digital syndrome (bilateral accessory toes)
- Wardenburg's syndrome(abnormal pigmentation of hair, iris and skin & deafness)
- Klippel- Feil syndrome (short neck with missing cervical vertebra)

CLASSIFICATION

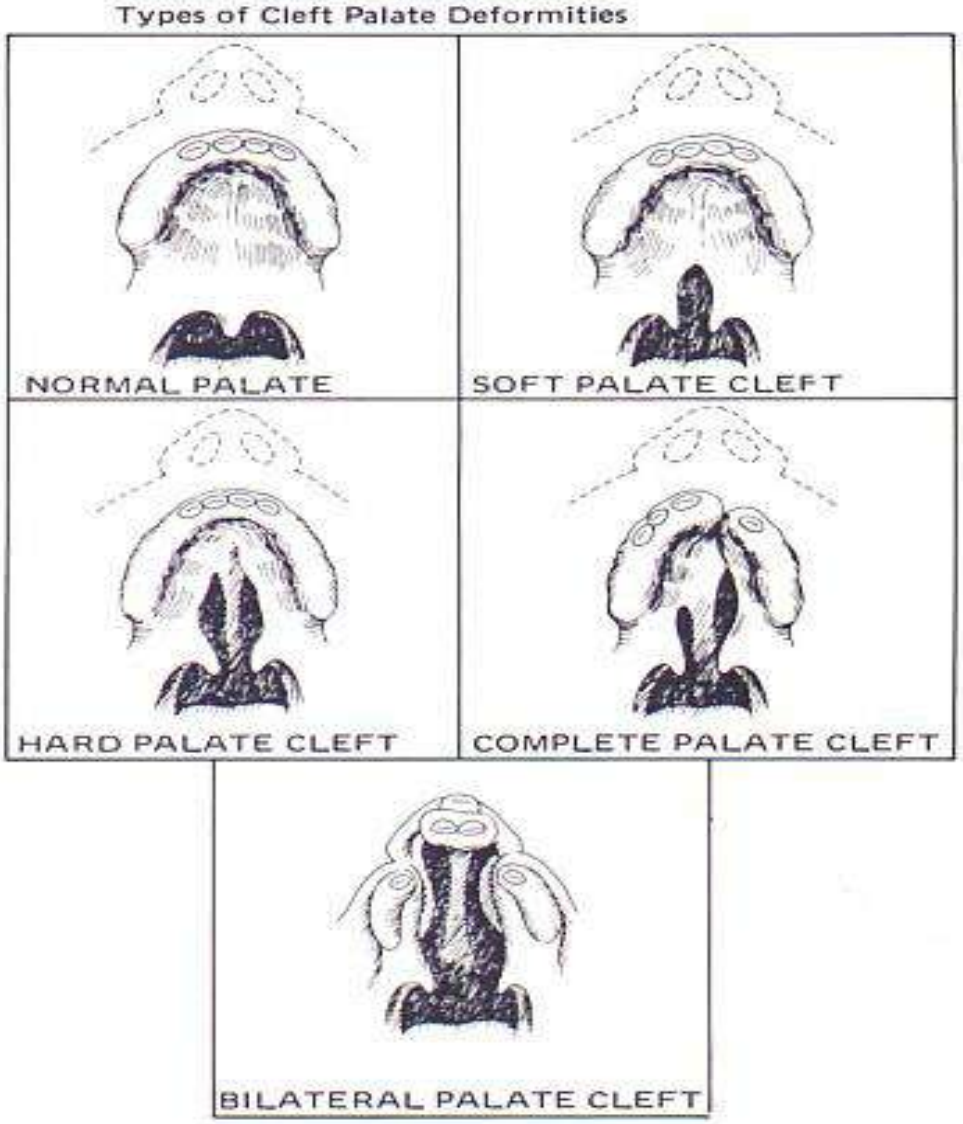
MORPHOLOGICAL CLASSIFICATION

DAVIES & RITCHIE (1922) AND VEAU (1931)

- Pre-alveolar clefts
- Post-alveolar clefts
- Alveolar clefts

VEAU CLASSIFICATION

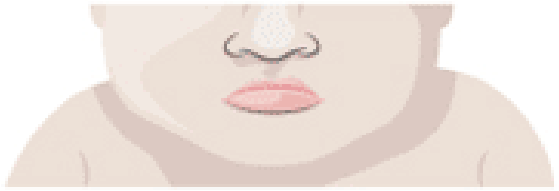
- Group I: cleft of soft palate only.
- Group II: cleft of hard and soft palate till the incisive foramen.
- Group III: complete unilateral cleft of the soft palate, hard palate ,the alveolar ridge and the lip on one side.
- Group IV: complete bilateral alveolar clefts.


Types of Cleft Palate Deformities
NORMAL PALATE
SOFT PALATE CLEFT
HARD PALATE CLEFT
COMPLETE PALATE CLEFT
BILATERAL PALATE CLEFT

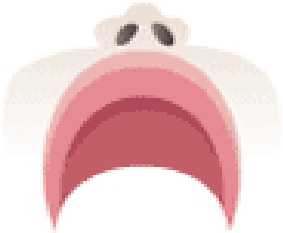
EMBRYOLOGICAL CLASSIFICATION

KERNAHAN AND STARK (1958)

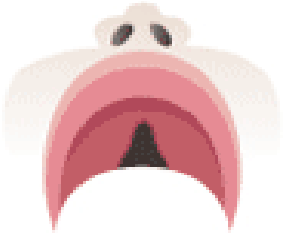
- Group I: cleft of the primary palate only.
  Unilateral
  Bilateral
- Group II: cleft of the secondary palate only.
  Total
  Subtotal
  Submucous
- Group III: Cleft of both primary and secondary palate.
  Unilateral
  Median
  Bilateral



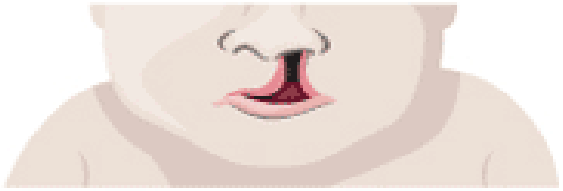
normal lip



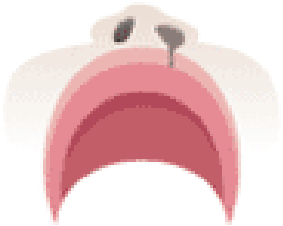
normal palate



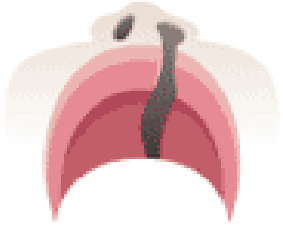
cleft palate



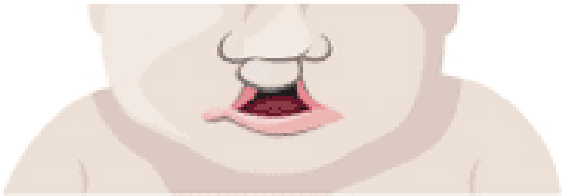
left unilateral cleft lip



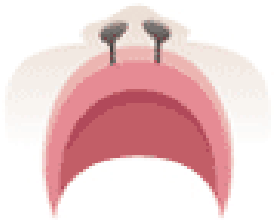
left cleft lip



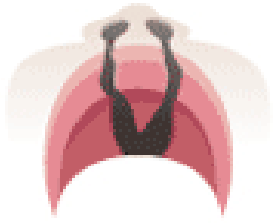
left unilateral cleft lip and palate



bilateral cleft lip and palate

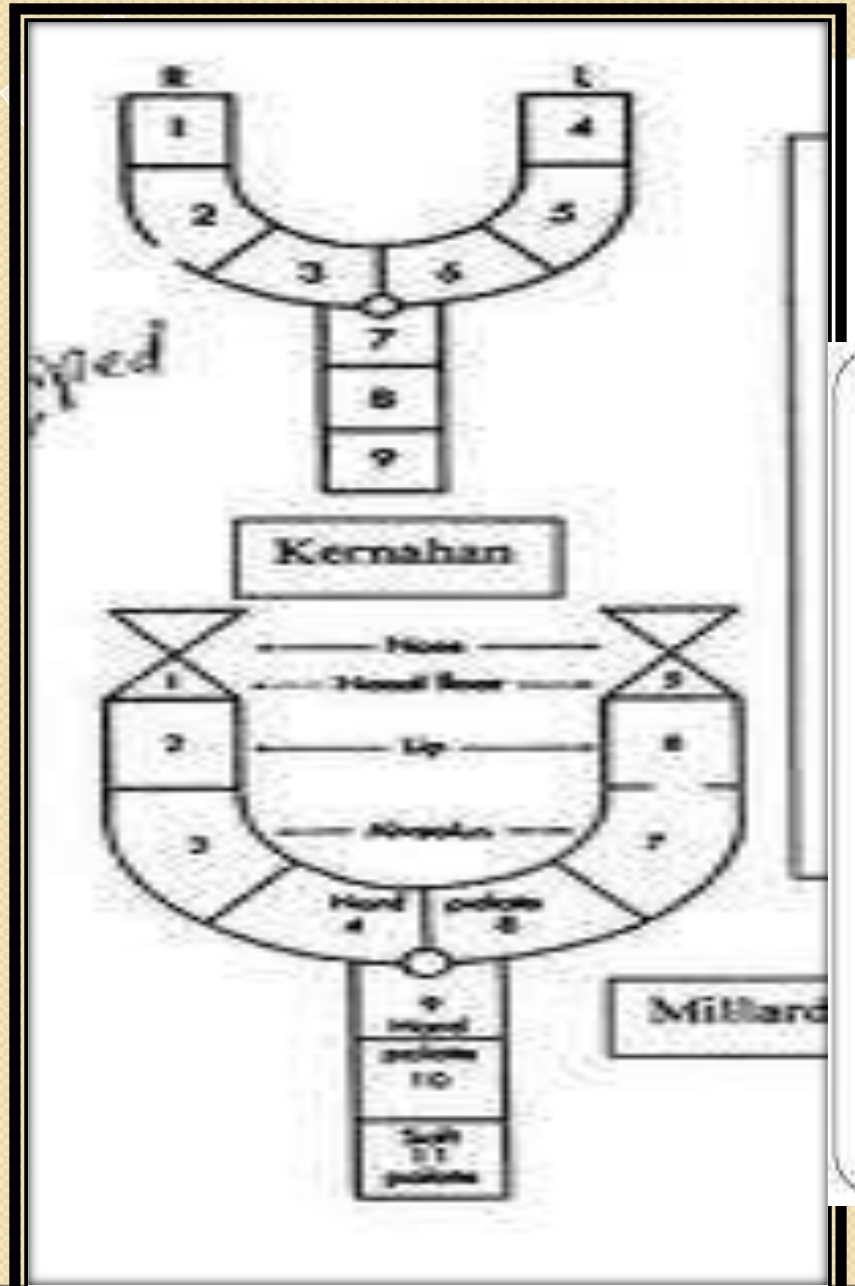


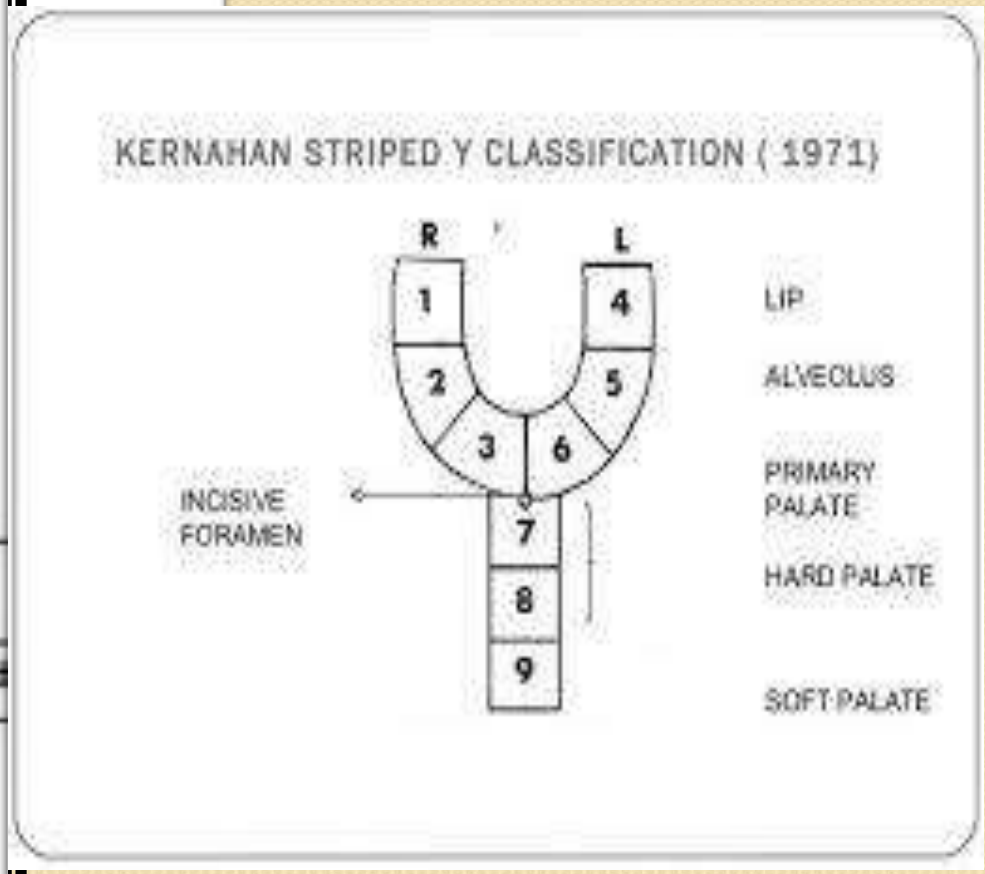
bilateral cleft lip



bilateral cleft lip with full palate

SYMBOLIC AND COMPUTERGRAPHIC PRESENTATION





PROBLEMS ASSOCIATED WITH CLEFTS

- Dental
- Esthetic
- Speech and hearing
- Psychological

DENTAL PROBLEMS

- Division, displacement & deficiency of oral soft tissues.
- Congenitally missing teeth (upper laterals)
- Presence of natal and neonatal teeth
- Presence of supernumerary teeth
- Ectopically erupting teeth
- Anomalies of tooth morphology
- Enamel hypoplasia
- Microdontia

DENTAL PROBLEMS

- Fused teeth
- Aberrations in crown shape, gemination & dilaceration
- Macrodontia
- Mobile and early shedding of teeth due to poor periodontal support
- Tendency toward a class III skeletal pattern. Posterior and anterior crossbite.
- Protruding premaxilla
- Deep bite
- Spacing / crowding

ESTHETIC PROBLEMS

- Facial disfigurement varying from mild to severe.
- Malformation of oro-facial structures.
- Congenitally missing oro-facial structures.
- Nose deformities: tip deviated to normal side, ala on cleft side flared, nostril horizontally oriented).
- Lip deformity
- Malpositioned or rotated incisors.
- Thus esthetics is greatly affected.





HEARING AND SPEECH DEFECTS

- Disorders of middle ear that may affect hearing.
- Presence of hearing problems can cause difficulties in language uptake and speech.
- Palatal dysfuntion and midfacial hypoplasia contribute to speech difficulties.
- Retardation of consonant sounds (p,b,t,k,g,d)
- Both the anatomical defects and the functional muscle imbalance requires ongoing help from speech therapy.

PSYCHOLOGICAL PROBLEMS

- Patients are under lot of psychological stress.
- Due to their abnormal facial appearance they have to put up with staring, curiosity, pity .
- Problems in obtaining jobs and making friends.
- Poor academic result due to hearing impairment, speech problems and frequent absence from school.

MANAGEMENT OF CLEFT LIP AND PALATE PATIENTS

CLEFT LIP AND PALATE TEAM

- The complexity of the problem requires that a number of health care practitioners co-operate to ensure comprehensive care of the patient.
- Concept of MULTIDISCIPLINARY CLEFT PALATE TEAM. This team has been described as a close, co-operative, democratic, multi-professional union devoted to the single cause of patient well being.

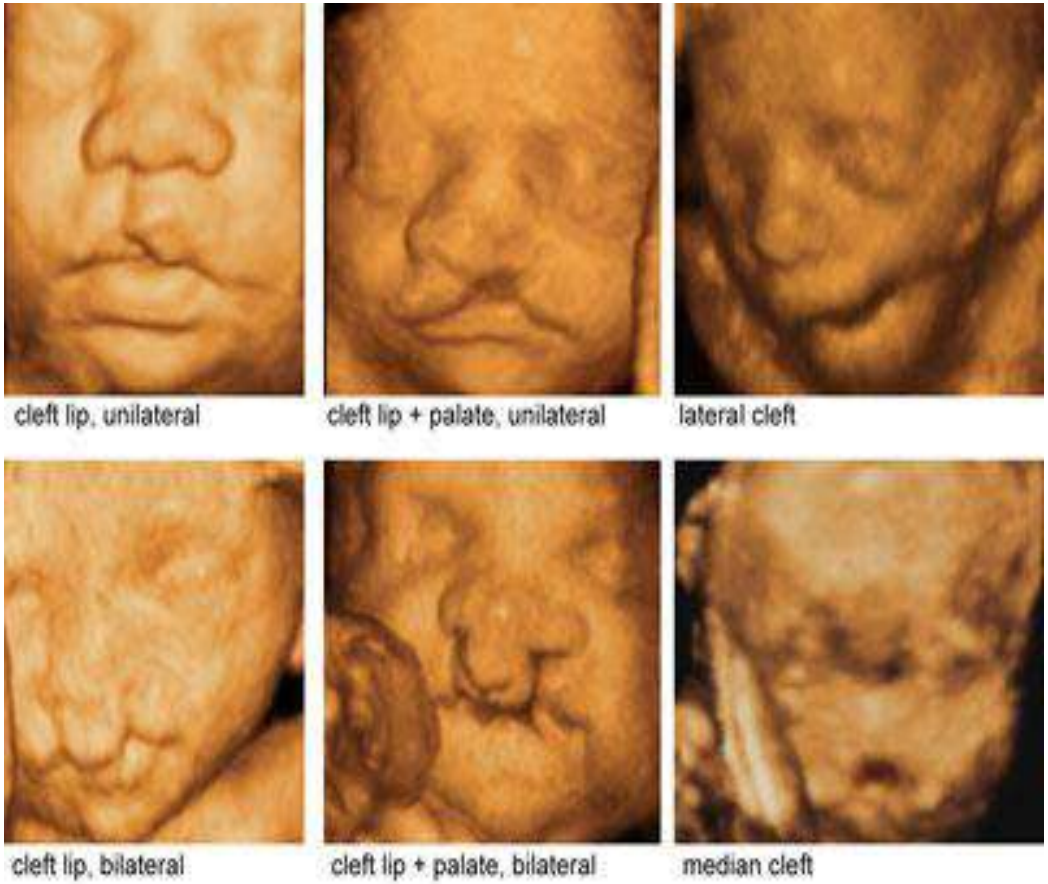
MULTIDISCIPLINARY CLEFT PALATE TEAM

- Pediatrician
- Pedodontist
- Orthodontist
- Oral and maxillofacial surgeon
- Prosthodontist
- Social worker
- ENT surgeon
- Plastic surgeon
- Psychiatrist
- Speech pathologist



PRENATAL DIAGNOSIS





PARENT COUNSELLING AT BIRTH

- Parents not prepared to face the problem.
- Feeling of guilt that they had something wrong during pregnancy.
- They should be clearly informed that there is nothing known which definitely results in cleft and there is nothing known which they could have done earlier to prevent its occurrence.
- They are informed how they can help in the outcome by co-operating during the course of treatment.

MULTIDISCIPLINARY SEQUENCING OF TREATMENT IN CLEFTS

- Treatment is divided into four stages which generally correspond to stages in the child's dental development.
- Stage I : Maxillary orthopedic stage, birth to 18 months.
- Stage II: Primary dentition stage, 18 months to 5 years of age.
- Stage III: Late primary or mixed dentition stage, 6 to 10 or 11years of age.
- Stage IV: Permanent dentition stage, 12 to 18 years of age.

STAGE I

- Management of feeding problems.
- Fabrication of feeding obturators.
- Pre surgical orthopaedics.
- Surgical management of cleft lip.
- Surgical management of cleft palate.

FEEDING ADVICE



- Babies with cleft palate are unable to suck mother's milk as intraoral negative pressure is not possible.
- To tackle this problem, expressed mother's milk is given with the help of a spoon. Spoon feeding is easily learnt by the parents and maintaining hygiene is much easier.
- Feeding by a large nipple with a large hole, catheter or syringe, nasogastric tube has been described but these methods are difficult for the parents. Difficult to maintain good hygiene.

FEEDING ADVICE

- Make sure child is eating in an upright position. Gravity will help to prevent milk from coming through the baby's nose.
- Use a cleft palate bottle or other squeezable bottle.
- Most infants can complete a feeding in 18-30 minutes. If more than 45 minutes are required the infant may be working too hard.

FEEDING ADVICE

Raising the head end of the baby while feeding by approximately 45 degrees to solve the problem of nasal regurgitation of milk.



SPECIAL BOTTLES

- CLEFT PALATE NURSER: soft sided bottle that is squeezed in coordination with the infants sucking efforts, thus milk is delivered into mouth.
- HABERMAN FEEDER: it consists of large compressible nipple with a oneway valve at its base that keeps nipple full of milk. The infants effort to compress the soft nipple is often sufficient to deliver the milk into infants mouth, but this can also be carried out by squeezing the nipple to increase the flow.



MANAGEMENT OF NATAL AND NEONATAL TEETH

- Natal teeth must be approached individually, with sound clinical judgement guiding appropriate therapy.
- The erupted teeth in most cases represent the deciduous dentition, & removal should not be performed hastily.
- If the teeth are mobile & at risk for aspiration, then removal is indicated.
- If mobility is not a problem & the teeth are stable, then they should be retained.





- Traumatic ulcerations of the adjacent soft tissue (Riga-Fede disease) may occur during breast feeding but often can be resolved with appropriate measures.
- Although extraction of the anterior primary teeth is not recommended, this procedure has resolved the ulcerations.
- The teeth should be retained if they are stable.
- Grinding the incisal mamelons, coverage of the teeth with a light cured composite or cellulose film, construction of a protective shield have been tried with variable success.

MAXILLARY OBTURATOR

- It is an intra oral prosthetic device that fills the palatal cleft and thus provides a false roofing against which the child can suck.

- It reduces the incidence of feeding difficulties such as insufficient suction, excessive air intake and choking.

- It also provides maxillary cross arch stability preventing the arch from collapsing.

MAXILLARY OBTURATOR

- It is fabricated using cold cure acrylic after selective blocking of all undesirable undercuts. Clasp can aid in retention.
- In case of insufficient retention, wings made of thick wire may be embedded in the acrylic and made to follow the cheek contour extraorally.
- These wings can be stabilized against the cheeks using adhesive tapes.

OBTURATOR FABRICATION

- Primary impression was made with molding the low fusing impression compound with hand adaptation to the palate of the patient.



- Infant was held upright by mother to prevent aspiration of any extra material. Primary cast was fabricated with dental stone.



- Customized special tray was fabricated with autopolymerising acrylic resin.



- Final impression was made with rubber base impression material to record the precise details of the supporting structure and defect.



- Master cast was fabricated and excessive undercuts were blocked out with modelling wax.



- The wax pattern of the feeding plate was adapted on the master cast. Flasking, dewaxing was done and feeding plate was fabricated with heat activated clear acrylic for obturating the defect in the soft palate involving uvula.



- Approximately 10 inch silk suture was passed through and tied to the eyelet of the feeding plate so as to facilitate easy insertion and removal of the prosthesis & also it acted as a safety measure to prevent swallowing of appliance.



- After proper trimming, finishing, polishing the feeding plate was tried in the patient's oral cavity, & minor adjustments were made & final polishing of the feeding plate was done.
- Mother was instructed about method of usage, function, cleaning & maintenance of feeding plate.
- A new obturator should be constructed every 3 months to accommodate the enlarged craniofacial sutures at growth.



MAXILLARY OBTURATOR

NEONATAL RESPIRATORY DIFFICULTY

- Infants with airway obstruction secondary to Pierre Robin sequence may require intervention to aid breathing. An obturator with a posterior palatal extension should be used in an attempt to reposition the tongue downward and forward out of the cleft site.

PRE SURGICAL ORTHOPAEDICS

- Aim is to achieve an upper arch form that conforms to lower arch.
- In some cases of bilateral cleft lip & palate, the infant has a premaxillary segment positioned severely anterior to the maxillary arch segments or deviated laterally to one side of the cleft defect.
- If lip surgery is undertaken with the premaxilla in such an abnormal position, the chances of lip dehiscence (lip separation caused by increased pressure at the suture lines) are increased.

- The orthodontist should try to correct these displacements by extra oral strapping across the premaxilla, attached directly to the face or to some form of head cap.
- In case of narrow collapsed maxillary arch the expansion can be achieved by a suitable appliance incorporating expansion screws or springs.

PREMAXILLARY RETRACTION

- BONNET RETRACTION SYSTEM: a baby bonnet is made to provide headgear anchorage for a premaxillary retraction strap. An elastic strap is placed over the protruding maxilla & anchored to the infant's head using the bonnet. By the application of sequentially increasing equal forces, the premaxilla is retropositioned into a more normal position relative to maxillary segments.

- MICROFOAM TAPE (SOFT ELASTIC TAPE): Used to retract the premaxillary segment in a simple manner. The advantage is its ease of fabrication.
- EXTERNAL ACRYLIC BULB PROSTHESIS: indicated in case of a laterally deviated premaxilla in an infant with a bilateral cleft lip and palate to position the premaxilla in the midline before retraction. By application of sequentially increasing differential forces to the premaxilla with elastic straps attached to the bulb prosthesis, the premaxilla is brought into the facial midline.







Presurgical Nasoalveolar Molding (NAM)

• Presurgical Nasoalveolar Molding (NAM) was introduced to reshape the alveolar and nasal segments prior to surgical repair.

•The first presurgical nasoalveolar molding (PNAM) appliance was designed by Grayson et al. (1999).

The objectives of PNAM are:

- Decrease the severity of the primary cleft deformity
- Provide symmetry to distorted nasal cartilage.
- Nonsurgical lengthening of the columella.
- Approximation of lip segments to decrease tension in the tissues after lip repair and thus reduce scarring.
- To produce additional favorable bone formation by decreasing the size of the cleft and improving nasal tip projection, decreasing the width of nasal alar base and nasal tip
- Reduce the need for secondary alveolar bone grafts.

PHASES OF UTILIZATION OF NAM IN UNILATERAL CLEFT LIP DEFORMITIES

AGE	WORK TO BE DONE
0-1 week	Impression
	Phase 1: Molding of alveolus
	Phase 2: Nasal molding
	Elevation of collapsed lower lateral cartilage
	Tenting of nostril apex
	Uprighting and centering of columella
	Approximation of alveolar segments
1-2 week	Plate insertion
12-16 week	NAM adjustments

PNAM is a non surgical method of reshaping the gums, lips and nostrils before cleft lip and palate surgery, thus lessening the severity of the cleft.

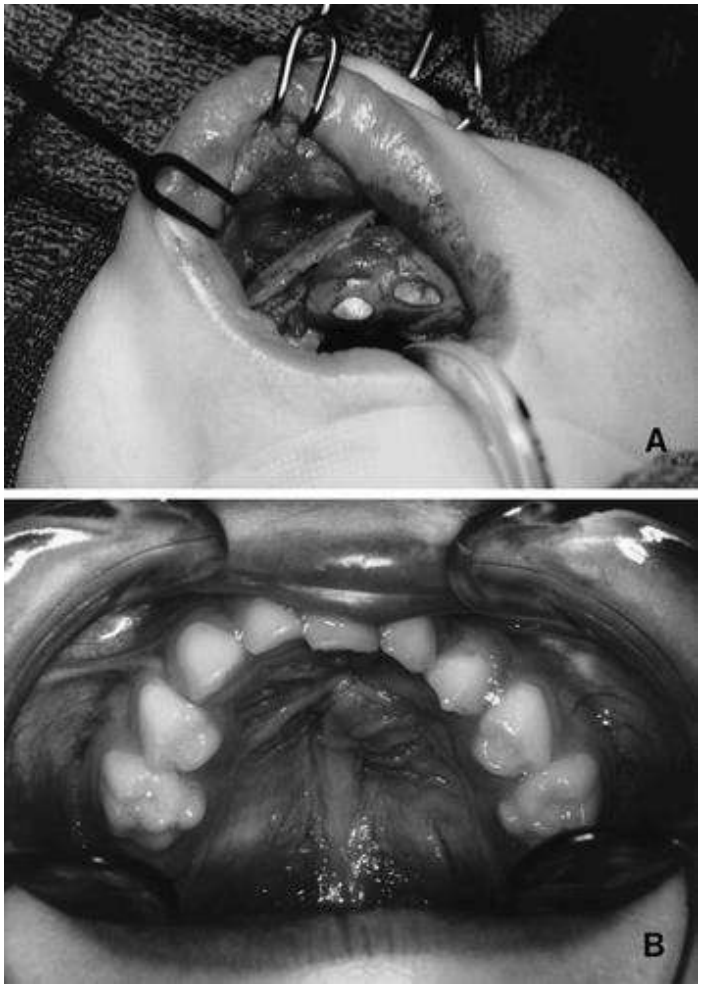
• Before the concept of nasoalveolar molding, repair of a large cleft required multiple surgeries between birth and 18 years of age.

• With advent of PNAM, the dentist can reduce the size of the cleft and mould the alveolar and nasal tissues in the correct anatomic position.

BONE GRAFTING OF ALVEOLAR CLEFT DEFECTS

- PRIMARY BONE GRAFTNG refers to bone grafting procedures involving alveolar cleft defects in children younger than 2 years of age.
- EARLY SECONDARY BONE GRAFTING refers to bone grafting procedures performed between 2 & 4 years of age.
- SECONDARY BONE GRAFTING is done between 4 & 15 years of age.
- LATE SECONDARY BONE GRAFTING refers to reconstruction of residual alveolar cleft defects in the adult.

PRIMARY ALVEOLAR BONE GRAFTING



- Rib inlay grafting to the labial surface of the maxilla, which spans the cleft defect site.
- Maxillary arch stability & good alignment can be obtained without affecting midfacial growth.

SURGICAL MANAGEMENT OF CLEFT LIP

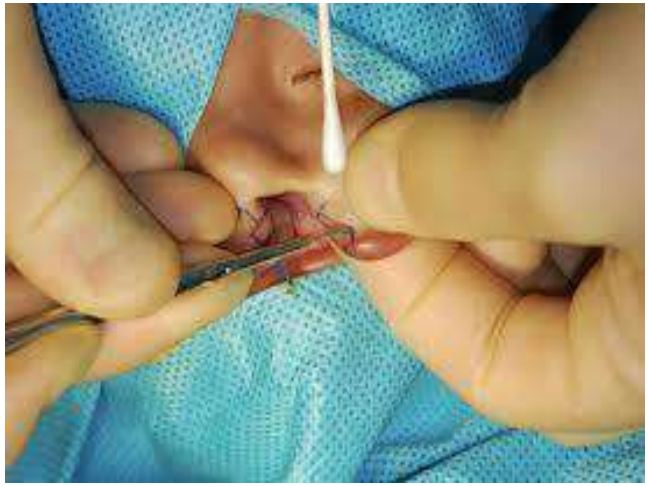
- TIMING: Majority of surgeons follow the "Rule of 10" as a guide for timing of lip and anterior palate repair.

- At the time of operation the haemoglobin should be 10gm%, age approximately 10 weeks, weight 10 lb (4.54kg) and total leukocyte count less than 10000 per cubic mm (ie. no infection).

TYPES OF CLEFT LIP SURGERY

Most commonly used operations for unilateral cleft lip

- Millard's repair
- Tennison-Randall repair
- Veau's repair.
- Rose Thompson repair.



BASIC STEPS IN CLEFT LIP REPAIR

- Ultimate aim of the repair is to achieve
- Equal length of philtral ridges on either side
- Horizontal cupid's bow
- Accurate repair of muscle, skin, mucosa without vermillion deformity
- Symmetrical nostril floor
- An esthetically acceptable scar

SURGICAL MANAGEMENT OF CLEFT PALATE

- TIMING: Early repair leads to a better speech development but severe mid facial growth retardation and dental malocclusion.
- If repair is done after full growth of maxilla, midfacial growth retardation and dental malocclusion problems will be less, but speech development will become very severe.
- The repair of palate between 1-1(1/2) year of age gives the best balanced results.

TYPES OF CLEFT PALATE REPAIR

- SINGLE STAGE REPAIR (By Von Langenback repair & Veau Wardill Kilner V-Y pushback palatoplasty) –
- Done at the age of 1(1/2) years.
- Produces normal speech in 50-70% of cases but midface growth retardation problem is not solved.

TWO STAGE REPAIR:

- First stage repair – soft palate repair before 18 months followed by obturation of the hard palate till the second stage repair.
- Second stage – hard palate repair at 4-5 year. This allows better midfacial growth, but the speech results have been unacceptably poor.

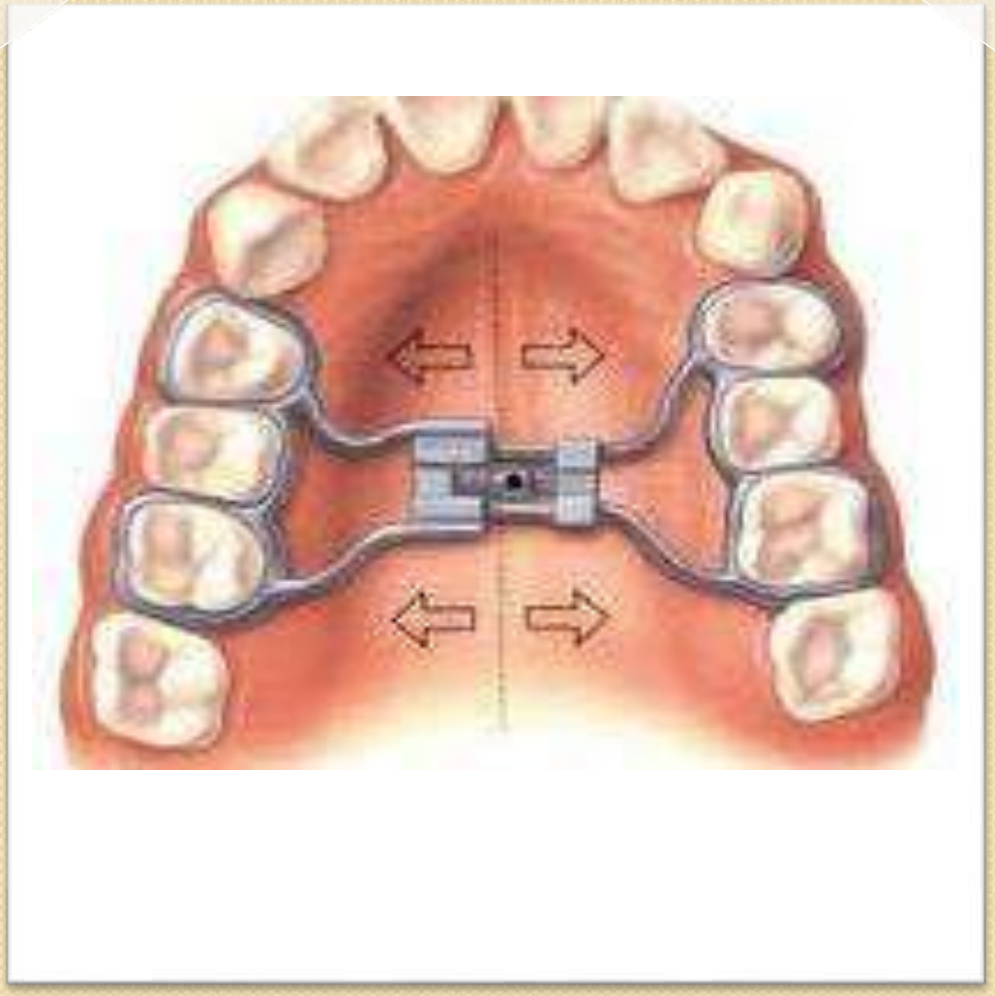
STAGE II: DECIDUOUS DENTITION TREATMENT

- Proper alignment &/or expansion of the primary dentition can be done more easily.
- Adjustments in the intra oral obturator to accommodate the erupting deciduous teeth.
- To maintain a check on eruption pattern & timing.
- Oral hygiene instructions.
- Restoration of decayed teeth.
- Simple form of fixed maxillary lingual appliance are preferred over the removable split palatal type of appliance because of occasional co-operation problems & a high relapse rate with a removable appliance.

STAGE III: MIXED DENTITION TREATMENT

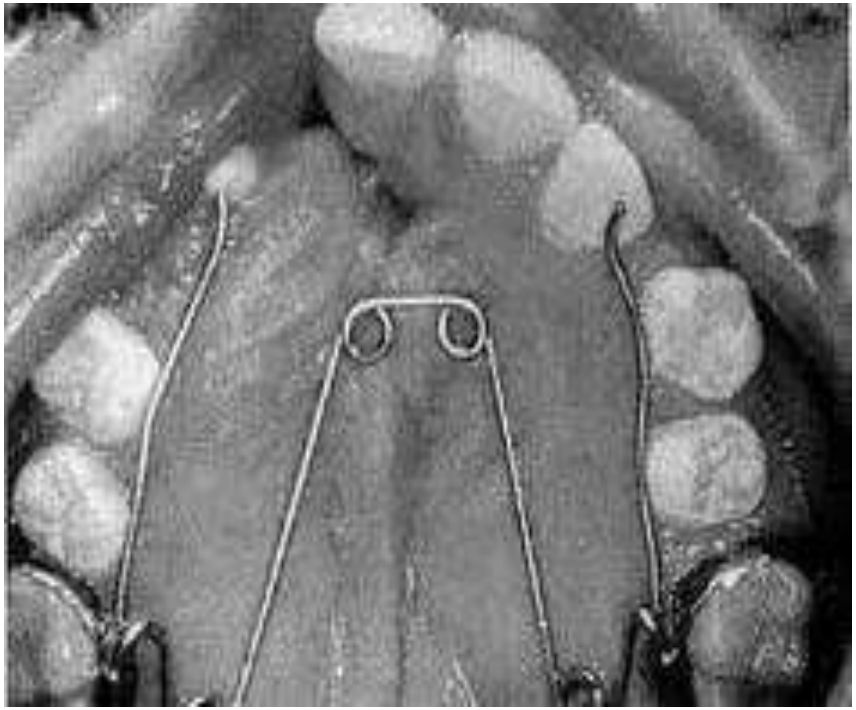
VARIOUS PROBLEMS REQUIRING ATTENTION AT THIS STAGE ARE:

- Retro inclination of permanent incisors and anterior crossbite: lead to esthetic, speech & psychological problems. Anterior crossbite should be corrected to avoid functional mandibular displacements & retardation of maxillary growth. Removable appliance incorporating Z spring can be used to treat anterior crossbite.
- Buccal segment crossbite can be treated by quad helix or expansion screws.



PALATAL EXPANDER

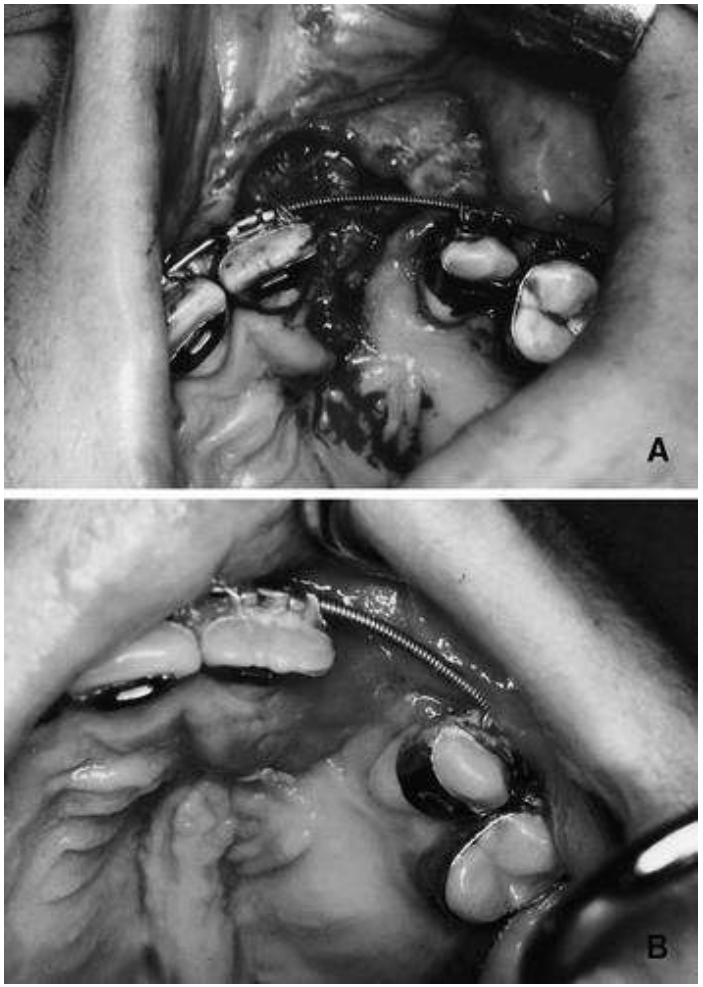
QUAD HELIX



- Crowded dentition: may require serial extraction whereby primary cuspids are removed to treat incisor crowding & the primary molars may be removed to hasten the eruption of the first bicuspids.

- Alveolar bone grafting: accepted as a means of uniting & stabilizing maxillary segments in cleft lip and palate patients. The procedure is carried out early enough (9-12years) to allow eruption of permanent canine in the cleft area through the grafted bone.

SECONDARY ALVEOLAR BONE GRAFTING



- Exposure & iliac cortico cancellous grafting of the alveolar defect during the transitional dental period.
- Consistent elimination of the oronasal fistula & rest of good alveolar height can be obtained provided good soft tissue is available.

STAGE IV: PERMANENT DENTITION PERIOD

- Problems at this stage are posterior crossbite & malpositioned permanent incisors.
- If orthognathic surgery is done to correct the underlying skeletal imbalance, preoperative & postoperative orthodontic treatment is needed to achieve proper alignment, position and inclination of the teeth.
- The possibility of opening of oronasal fistula due to arch expansion resulting in increased hypernasality and nasal regurgitation must be discussed before starting orthodontic treatment.

STAGE IV: PERMANENT DENTITION PERIOD

- Patient is treated using a fixed orthodontic appliance. All local irregularities like crowding, spacing, crossbites and overjet/overbite problems are corrected.
- Patients with hypoplastic maxilla maybe given facemask to advance the maxilla.
- Prosthesis can be given in case of missing teeth after completion of orthodontic therapy.
- Following the orthodontic treatment procedures, the patient should be put on a retention phase to maintain the orthodontic corrections.
- Cosmetic repair is also carried out at this stage but is probably the last treatment to be undertaken.

ROLE OF ENT SPECIALIST

- Due to abnormal function of eustachian tube there is an increased risk of otitis media.
- The parents are counseled for a possible hearing loss.
- ENT specialist, audiologist & speech specialist work together to note the middle ear problems and progress in speech.

ROLE OF SPEECH PATHOLOGISTS AND SPEECH THERAPY

- Speech therapy is started from 6 months of age &, if needed, continued till adulthood.
- Speech problems could be due to oronasal fistula, severe anterior or posterior crossbite or faulty habits of the patients.
- A proper orthodontics procedure or surgery in consultation with the speech pathologist may be required to correct these problems.

THANK YOU

PRINCIPLES, ASSESSMENT AND FACTORS INFLUENCING GROWTH

Presented by :-
Anu
MDS 1st year
Department of pediatric and preventive dentistry.

CONTENTS

- Introduction
- Factors affecting growth and development
- Growth- pattern, variability and timing concept
- Differential growth
- Methods for studying physical growth
- Growth spurts
- Growth trends
- Growth assessment parameters
- References

GROWTH

- "Increase in size, change in proportion and progressive complexity." – **by Krogman.**
- "An increase in size." **– by Todd.**
- "Quantitative aspect of biologic development per unit of time." **– by Moyers.**

DEVELOPMENT

- "Development is progress towards maturity."

  - Acc. to Todd.

- "It refers to all the naturally occurring unidirectional changes in the life of an individual from its existence as a single cell to its elaboration as a multifunctional unit terminating in death."

  - Acc. to Moyers.

FACTORS AFFECTING GROWTH AND DEVELOPMENT

1. **Genetic factors**

- Genetic control influences the size of the organism to a great extent and the rate of onset of growth event.
- **Polani** indicated that size at birth relates about :-

-18% to genome of fetus.

-20% to maternal genome.

-30% to unknown factors.

- After birth the infant's growth rate is no longer determined by maternal factors but increasingly related to his own genetic makeup.

2. Extracranial and intracranial pressure

- Any factor affecting physical growth is associated with affect on size and shape of cranial vault.
- For eg:-
- Raised intracranial pressure during infancy

↓

results in increased cranial circumference.

- If pressure is long standing, sutural margins develop interdigitation with spiky appearance
- When sutures are closed, it leads to excessive resorption of inner table of cranial vault.

3. **Maternal factors**

- Size of full-term infant correlates well with size of mother.

4. **Socioeconomic factors**

- Children living in favourable socioeconomic conditions tend to be larger, display different types of growth and show variations in timing of growth.
- **Leachtig A et al.** Concluded that lower the socioeconomic status, shorter the children.

4. **Nutrition**

- Lack of nutrition delays growth, affects size of body part.
- For eg:- iodine deficient diet retards craniofacial growth.

Hormones responsible for growth

Group 1	Group 2	Group 3	Group 4
Hormones influencing skeletal bone growth	Hormones responsible for ossification of long bones	Hormones responsible for pubertal growth spurt	Miscellaneous
▪ Growth hormone ▪ Insulin ▪ Thyrotropic hormone.	▪ Parathormone	▪ Androgens ▪ Progesterone ▪ Estrogen	Prolactin
• Stimulates production of proteins. • Excess or deficiency cause-dwarfism, cretinism, acromegaly, or gigantism.	• Increases bone resorption. • Facilitates conversion of vitamin D. • Facilitates calcium absorption.	• Development of secondary sexual characteristics • Sex differentiation • Behavioural changes in brain on puberty • Growth of female genital tract and breast.	Synthesis of milk.

6. **Muscular function**

- Muscles influence the growth both as tissue affecting vascular supply and as a force element.
- Increased loading of jaws leads to increased sutural growth and bone apposition resulting in transverse growth of maxilla and broader base of dental arches.

7. **Growth factors**

- Peptides that transmit signals within and between cells and play a role in modulation of tissue growth and development.
- These factors regulate a number of mechanisms like gene regulations, migration and differentiation

8. **Race**

- Various factors like nutrition and environment that may lead to difference in growth in different races.
- For eg- calcification and eruption of teeth occurs around 1 year faster in blacks as compared to their white.

9. **Illness**

- Any systemic disease or a prolonged debilitating disease has a profound effect on the growth process of a child.

10. **Climate and seasonal effect**

- Effect the growth rate and weight of newborn.
- Those living in old climates tend to have more of adipose tissue, whereas those living hot climate are thinner.
- Growth varies according to seasons like it is faster in springs and summers and slower in winters.

11. **Adult physique**

- Exists a definite relation between physique and development according to somatotypes.
- Tall women mature at later age as compared to other women of their age groups.

13. **Exercise**

- Useful for fitness and increase in muscle mass but has no relation with linear growth.

14. **Family size and birth order**

- Exist a difference between various members of family with respect to their individual sizes, maturation level and intelligence.
- Firstborns usually weigh less at birth, have less stature and higher IQ

15. Secular trend:-

- Size and maturational changes in a large population can be shown to occur with time.
- For eg:-
- 15 year old boys are 5 inches taller than 15 year old boys 50 years back.

16. Psychological disturbance

- Can lead to inhibition of growth
- Due to the fact that in stressful conditions children will display inhibition of growth hormone.

GROWTH – PATTERN, VARIABILITY, AND TIMING CONCEPT

- **Pattern** reflects proportionality usually of a complex Set of proportions.
- Arrangement of the body at any one time is a pattern of spatially proportioned parts.
- Changes in these Spatial Proportional Parts of Body is called pattern of growth.

Differential Growth

- Human body does not grow at the same rate throughout life.
- Different organs grow at different rates at a different amount and at different times.

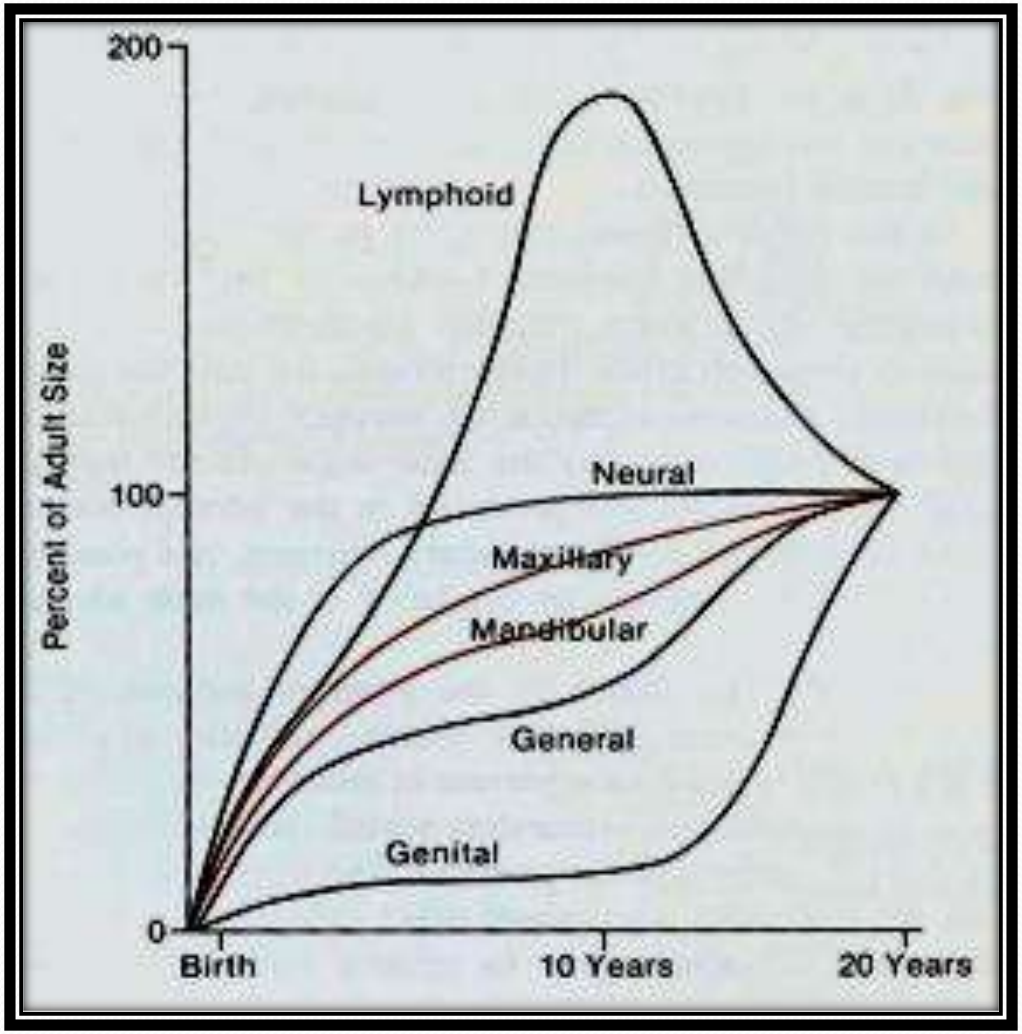
Two important aspects of growth are:-

- **Scammon's curve of growth**
- **Cephalo- caudal gradient of growth**

Scammon's curve of growth

- Body tissues classified into 4 types:-

- Lymphoid
- General
- Genital
- Neural



Lymphoid tissue:-

- Curve describes the growth of lymph glands, thymus glands, tonsils, appendix and lymphoid patches of tissue in the intestine.
- Tissues are involved with the child's developing immuonological capacities, including resistance to infectious diseases.
- Proliferates rapidly in late childhood and reaches almost 200% of adult size.
- This is an adaptation to protect children from infection.
- By about 18 years of age, lymphoid tissue undergoes involution to reach adult size.

Neural tissue:-

- Grows very rapidly
- Almost reaches adult size by 6-7 years of age.

General tissue:-

- Consists of muscles, bones and other organs.
- Tissues exhibit an 'S' shaped curve with rapid growth upto 2-3 years of age
- Followed by slow phase of growth between 3-10 years of age
- Rapid phase of growth occurs terminating by 18^{th} -20^{th} year.

Genital tissue:-

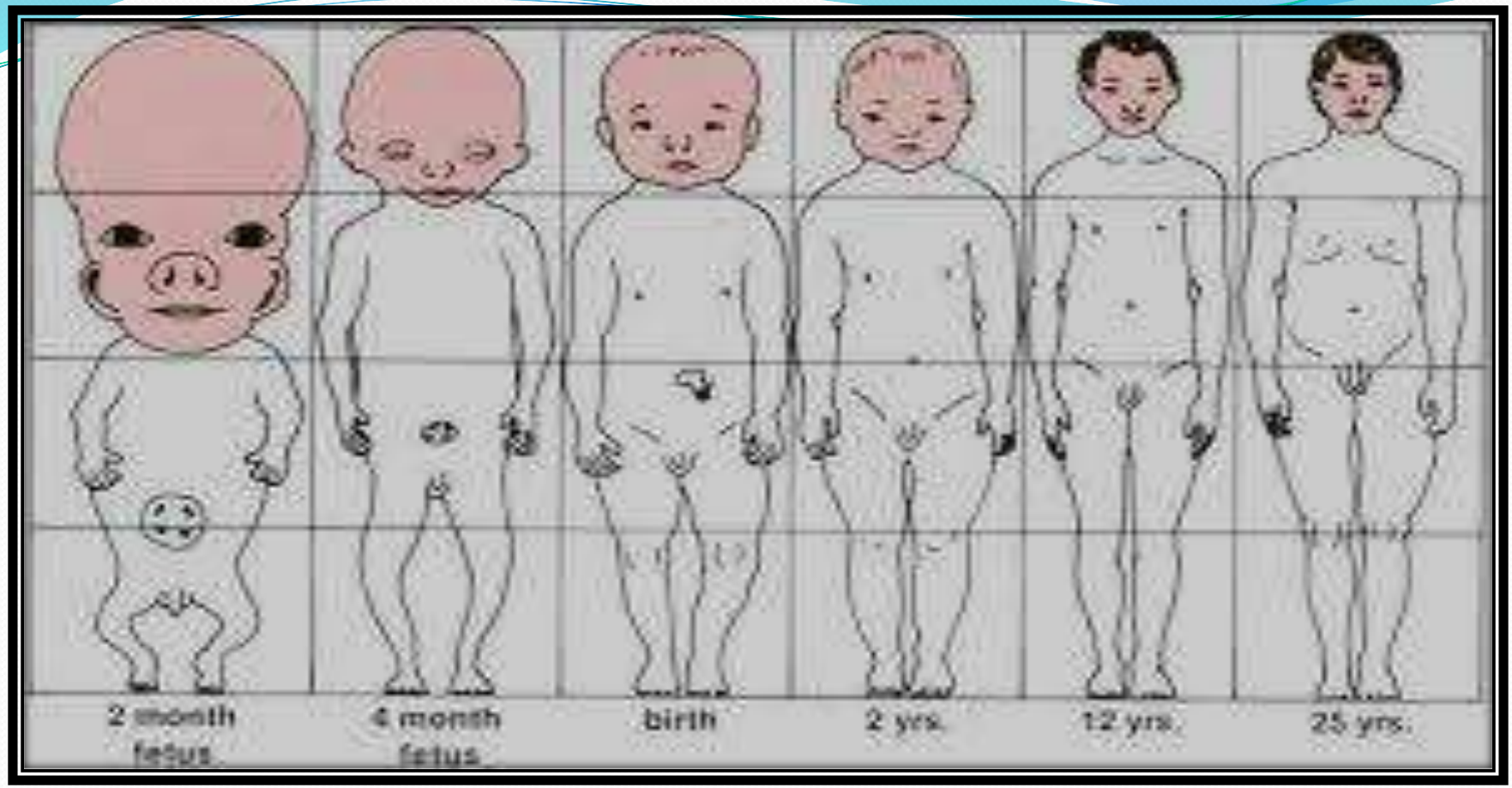
- Consists of reproductive organs
- Shows negligible growth until puberty.
- Grows rapidly at puberty reaching adult size after which growth ceases.

CEPHALOCAUDAL GRADIENT OF GROWTH

Axis of increased growth extending from the head toward the feet.

- **In fetal life**, at about the **third** month of intrauterine development, the head takes up almost 50% of the total body length.
- Cranium is large relative to the face and represents more than half the total head.

- Limbs are still rudimentary and the trunk is underdeveloped.
- By **the time of birth**, the trunk and limbs have grown faster than the head and face and the head has decreased to approximately 30% of total body length.
- Progressive reduction of the relative size of the head to about 12% of the adult.
- **At birth**, legs represent about one-third of total body length while in adult they represent one- half of total body length.



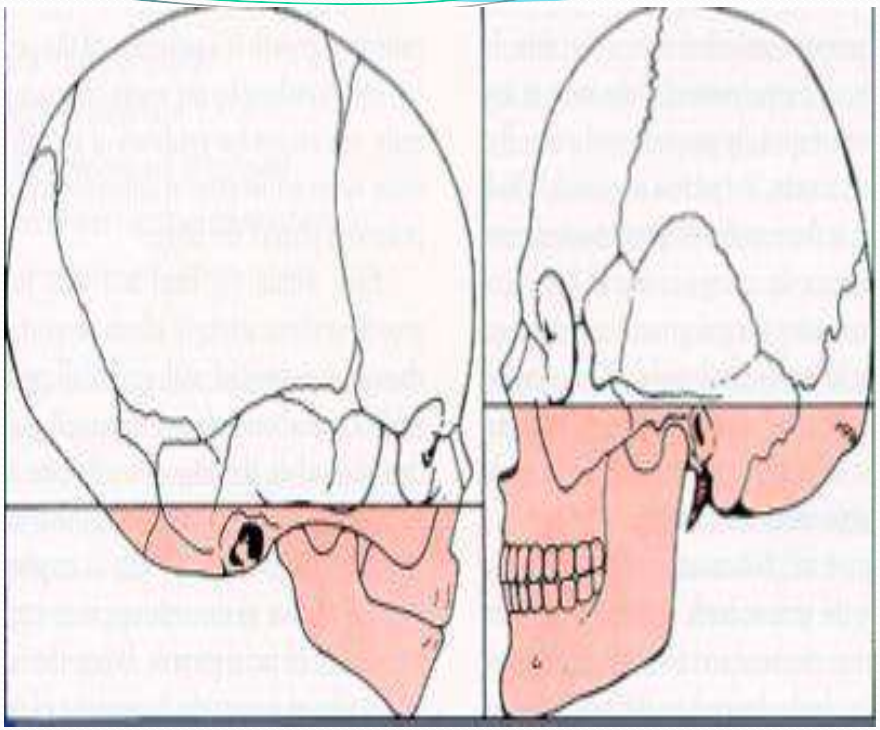
- Schematic representation of the changes in overall body proportions during normal growth and development. After the third month of fetal life, the proportion of total body size contributed by the head and face steadily declines.

GROWTH OF HEAD AND FACE

- Change in proportionality, with an emphasis on growth of the face relative to the cranium, is an important aspect of the pattern of facial growth.

- Within the head and face, the cephalocaudal growth gradient strongly affects proportions and leads to changes in proportion with growth .

- Infant has a relatively much larger cranium and a much smaller face.



- Changes in proportions of the head and face during growth. At birth, the face and jaws are relatively underdeveloped compared with their extent in the adult. As a result, there is much more growth of facial than cranial structures postnatally.

VARIABILITY.

- A **second** important concept in the study of growth and development is **variability.**
- Can be difficult, but clinically important, to decide whether an individual is merely at the extreme of the normal variation or falls outside the normal range.
- Categorizing people as normal or abnormal, it is more useful to think in terms of deviations from the usual pattern and to express variability quantitatively.

TIMING

- Variation in **timing** arises because the same event happens for different individuals at different times.

  For eg:-

- Some children grow rapidly and mature early, completing their growth quickly and thereby appearing on the high side of developmental charts until their growth ceases.
- If a girl reaches her menarche at the age of 10-11 years she will mature faster as compared to the girl who has menarche at 13-15 years.

METHODS FOR STUDYING PHYSICAL GROWTH

- Two basic approaches to studying physical growth:-

  Measurement approach

  Experimental approach

Measurement approach

- Carried out on living individuals.
- These methods don't harm the animal.
- Done by:-

By acquiring measurement data:-

•Craniometry
•Anthropometry
• Cephalometric radiology
• Three-dimensional imaging.

Analysis of measurement data

Experimental approach

- Destructive techniques.
- Animal that is studied is sacrificed.
- Not carried out on humans.
- Vital staning
- Radioisotopes
- Implants

By acquiring measurement data:-

CRANIOMETRY

- First measurement approach for studying growth.
- Based on measurements of skulls found among human skeletal remains.
- Originally used to study the Neanderthal and CroMagnon peoples whose skulls were found in European caves in the eighteenth and nineteenth centuries.

Advantages –

- That precise measurements can be made on dry skull.

Disadvantages-

- All the growth data must be cross- sectional.

Anthropometry.

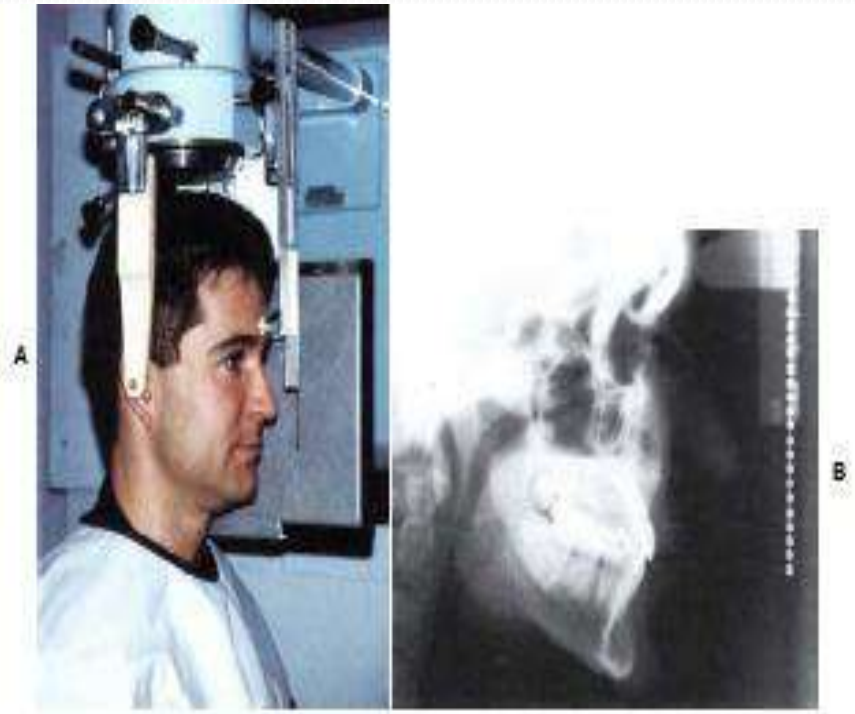
- Measurement can be made on either a dried skull or a living individual.
- By using soft tissue points overlying these bony landmarks.
- For example, it is possible to measure the length of the cranium from a point at the bridge of the nose to a point at the greatest convexity of the rear of the skull
- Follow the growth of an individual directly, making the same measurements repeatedly at different times.
- Produces longitudinal data:- repeated measures of the same individual.
- **Farkas'** anthropometric studies have provided valuable new data for human facial proportions and their changes over time.

CEPHALOMETRIC RADIOGRAPHY

- Combine the advantages of craniometry and anthropometry
- Direct measurement - bony skeletal dimensions follow up same individual over time .

Disadvantages

- Precise orientation of head , precise control of magnification.
- It produces a 2D representation of 3D structure.
- Can be overcome by making more than one radiograph at different orientations and using triangulation to calculate oblique distances.



A, A cephalometric radiograph merits this name because of the use of a head positioning device to provide precise orientation of the head. This means that valid comparisons can be made between external and internal dimensions in members of the same population group, or that the same individual can be measured at two points in time, because the head orientation is reproducible. B, This radiograph was taken in natural head position (NHP)

Three-Dimensional Imaging

Computed axial tomography (CAT or just CT)

- Allows 3-D reconstructions of the cranium and face.

Cone beam computed tomography (CBCT)

- Cone beam rather than spiral CT has been applied to facial scans.
- Reducing the radiation dose and allowing scans of patients with radiation exposure that is much closer to the dose from cephalograms.

Magnetic resonance imaging (MRI)

- Provides 3-D images that can be useful in studies of growth.
- No radiation exposure with this technique.

Analysis of Measurement Data

- Both anthropometric and cephalometric data can be expressed cross-sectionally rather than longitudinally.
- It would be much easier and quicker to do a crosssectional study
- Gathering data once for any individual and including subjects of different ages, rather than spending many years on a study in which the same individuals are measured repeatedly.

Experimental approaches

Vital staining.

- Method was originated by the great English anatomist **John Hunter** in the eighteenth century.
- Reported by **Belchier** in 1936.
- Dyes that stain mineralizing tissues (or occasionally, soft tissues) are injected into an animal.
- These dyes remain in the bones and teeth and can be detected later after sacrifice of the animal.
- **Belchier** noted that bones of animals that had eaten madder plants were stained red.
- Dye called **alizarin**, which still is used for vital staining studies.

- Alizarin reacts strongly with calcium at sites where bone calcification is occurring.
- Dye marks the locations at which active growth was occurring when it was injected.
- Manner in which bone is laid down, site of bone growth
- Direction, duration and amount of growth at different sites in the bone.

Various dyes are:-

- Alizarin Red 5
- Acid Alizarin Blue
- Trypon blue
- Lead acetate

RADIOISOTOPES

- When injected into tissue get incorporated in the developing bone and act as in vivo markers.
- Can later be detected by tracking down the radioactivity they emit.

Radioiotopes include:-

- Technetium- 33
- Calcium-45
- Potassium -32

Implants

- First introduced by **Bjork in 1960.**
- Involves the implanting of small bits of biologically inert alloys into growing bone.
- Serve as radiographic reference points.
- Metallic implants used for studying growth are very tiny.
- Around 1.5mm in length and 0.5mm in diameter
- Made up of tantalum metal.
- Embedded in certain areas of maxilla and mandible to study growth of skull.

- **Areas where implants are placed in maxilla:-**

1. Hard palate behind the deciduous canines.
2. Below the anterior nasal spine.
3. Two implants on either side of zygomatic process of maxilla.
4. Border between hard palate and alveolar process medial to first molar.

- **Areas where implants are placed in mandible:-**

1. Anterior aspect of symphysis, in the midline below the root tips.
2. Two pins on the right side of the mandibular body.
3. One pin on the external aspect of the right ramus at the level of occlusal surface of molars.

GROWTH SPURTS

- Growth does not take place uniformly at all times. There seem to be periods when a sudden acceleration of growth occurs. This sudden increase in growth is called as **growth spurt.**

- Physiological alteration in hormonal secretion is the cause for accentuated growth.

- Timing of growth spurts differs in boys and girls.

a. Just before birth
b. One year after birth
c. Mixed dentition growth spurt

    Boys: 8-11years

    Girls: 7-9 years

d. Pre pubertal growth spurt

    Boys: 14-16 years

    Girls: 11-13 years

Prediction and Clinical Application of Growth Spurts

- Orthodontic treatment must be done earlier in girls as their growth spurt is early.
- Girls mature earlier , also finish their growth sooner and that leads to the difference in adult size of men and women.
- Growth spurts are also affected by environmental variations.
- Malocclusion requiring surgical correction should only be undertaken after the growth spurt is completed.

- Arch expansion can be done during growth spurts.
- Class III tendency with mandibular prognathism should be treated before prepubertal growth spurt.
- Class II, III malocclusion should be treated during growth spurt.
- If the jaw growth has to be accelerated, it has to be done before adolescent growth spurt in girls.

Growth trends

Tweed discerned a pattern of growth and termed it as growth trends.

Type A

- The maxilla and mandible grow together and thus ANB angle remains same.
- Should this be accompanied by class I relationship and ANB does not exceed 4.5°, no treatment is indicated.
- Seen in more than 25 percent.

Type A Subdivision

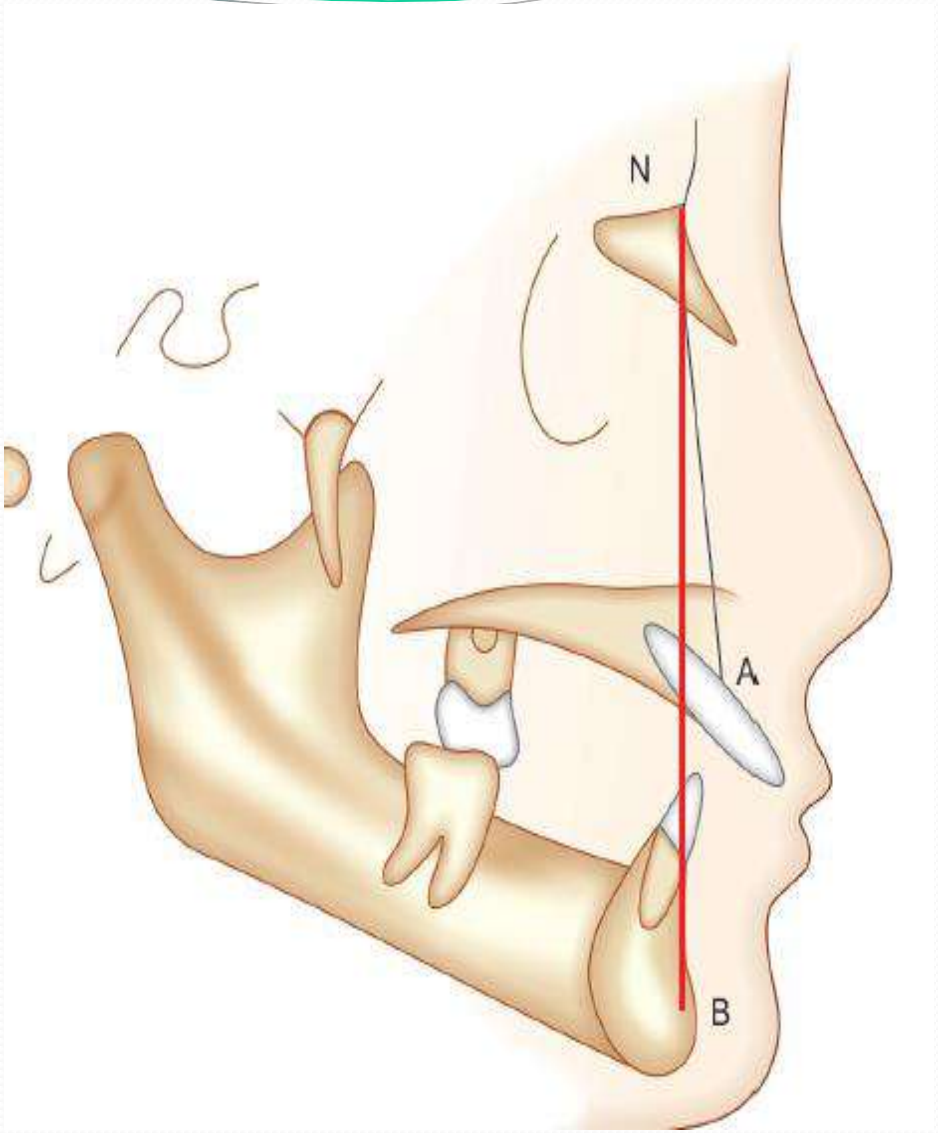
- Maxilla is protruding with ANB angle more than 4.5°.
- Treatment is to restrict the growth of maxilla while allowing mandible to catch up.
- Prognosis is good, but may sometimes require extraction of premolars.

•ANB angle:-

According to Sterner,

It is the angle between point A on maxilla and point B on mandible.

- The normal value of ANB angle is 2°.
- If it is less than 2° then it is indicative of class II and if it is more than 2° then indicative of class III malocclusion



Type B

- Mandible and maxilla grow forwards and downwards with the growth of maxilla exceeding that of mandible.
- Poor prognosis and indicates that point B will not catch up with point A.
- Growth of middle and lower face is predominantly in vertical direction.

Type B Subdivision

- The ANB angle is large and continues to grow indicating unfavorable growth trend.

Type C

- Maxilla and mandible grow forwards and downwards with mandible growing forward more rapidly.
- ANB angle is seen to be decreasing with mandible catching up with maxilla.
- Indicates favorable trend and no treatment is required until eruption of canine.

Type C subdivison

- Mandible is found to be growing more forward when compared to maxilla.
- Mandibular incisors are tipped lingually and maxillary incisors are tipped labially.

GROWTH ASSESSMENT PARAMETERS

1. Somatotypic Age
2. Chronologic Age
3. Height and Weight Age
4. Facial Age
5. Skeletal Age
6. Dental age

Somatotypic Age

- **Sheldon** defined somatotype by a series of 17 anthropometric measurements.

- **Endomorph**:- Stocky abundant subcutaneous fat, digestive viscera that are highly developed.
- **Mesomorph**:- Upright, sturdy, athletic, muscle bone and connective tisssue is predominant.
- **Ectomorph**:- Tall ,thin, and fragile with minimal subcutaneous fat and muscle tissue.



Chronologic Age

- Figured from child's date of birth.
- Difference in children of same chronologic age due to difference in thing of maturation, diseases and various environmental factors.
- Not an accurate indicator of development nor it is a good predictor of growth.

Height and Weight Age

- Employed as a deteminant of development age.
- Standard growth curve commonly employed to characterize a child's height compared, to that of children of same chronologic age is used to assess development age.

- Weight age alone is a poor indicator.

Facial age

- Aim is to identify whether they are on their own facial growth curve and to use this as a predictor of future growth.
- Various methods used for measurement of facial age and prediction of craniofacial growth are:-
- Anthropometric measurement.
- Facial growth velocity curve.
- Cephalometric radiograph.

Skeletal age

- Skeletal age is very important aspect of assesing the developmental age.
- Each endochondral bone begins with a primary center of ossification which then changes shape, size and contour till its fusion.
- Skeletal growth centers can be used for skeletal age assessment but hand and wrist have been most commonly used for assessment of pubertal maturation.

Advantages

- Readily recognizable stage of ossification.
- Regular sequence of developmental changes occuring from birth to childhood.
- Characteristic pattern of progression of ossification of epiphyseal centers can be identified.

Hand and Wrist Radiographs

- Hand-wrist region is made up of numerous small bones which show a predictable and scheduled pattern of appearance, ossification and union from birth to maturity.
- By comparing a patients' radiograph with the standards that represent different skeletal ages, we find out the skeletal maturation status of that individual.

Anatomy of hand-wrist region:

This region is made up of four groups of bones namely:-

- Forearm
- Carpals
- Metacarpals
- Phalanges.

Distal ends of long bones of forearm:

- The distal ends of radius and ulna form the first group of bones.
- Give rise to distal projections on their respective sides called radial and ulna styloid.

Carpals:

- Consist of eight small Irregularly shaped bones arranged in two rows.
- Proximal row:- Scaphoid, lunate, triquetral, pisiform
- Distal row: Trapezium, trapezoid, capitate, hamate

Metacarpals:- Five miniature long bones forming the skeletal framework of palm of hand.

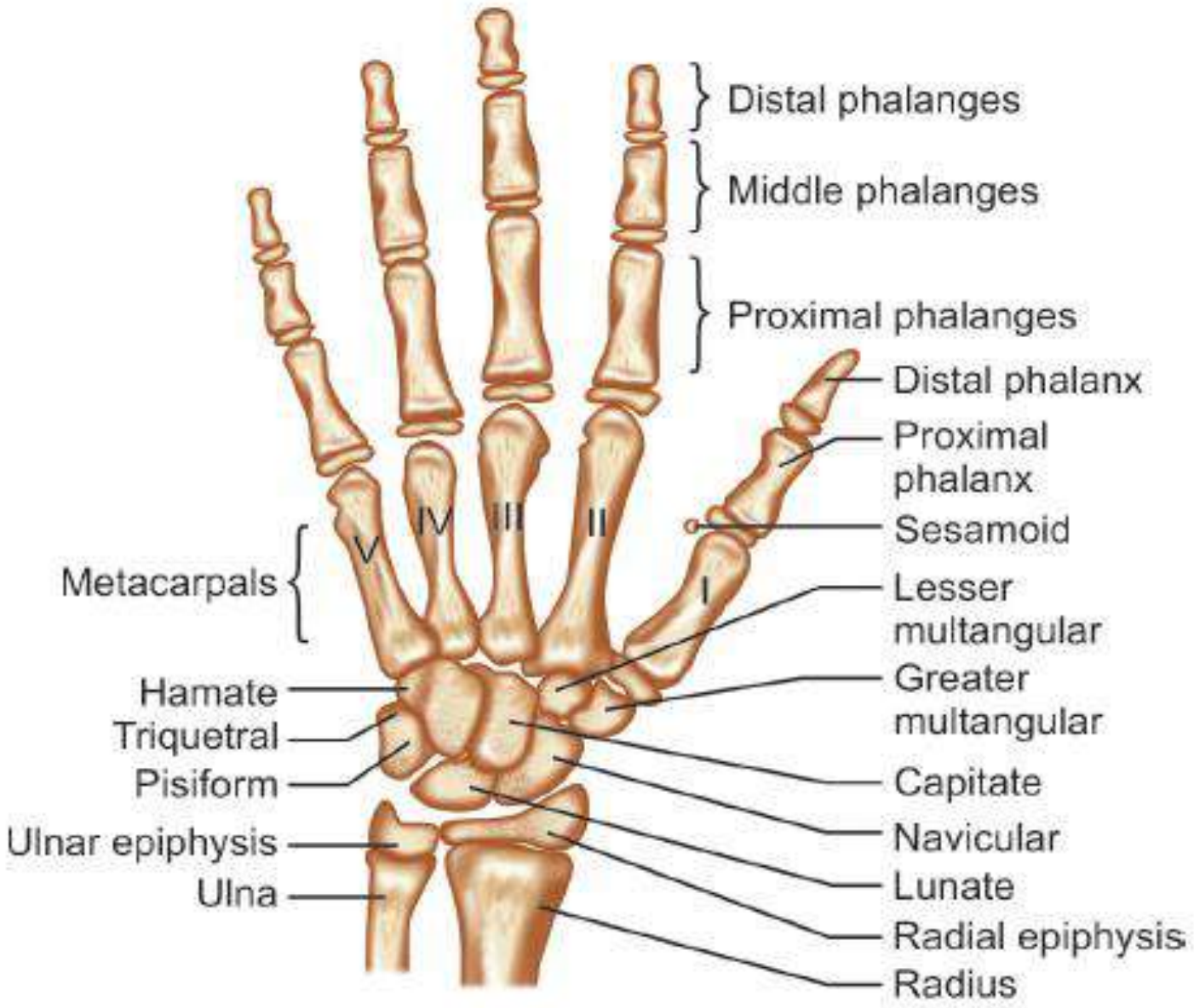
- Each metacarpal ossifies from one primary and one secondary center.

Phalanges:- Small bones forming the fingers.

- Three in number except for thumb which has two.
- Three bones are called as proximal, middle and distal.

Sesamoid bone: Small nodular bone often present embedded in the tendonous region of thumb.

Anatomy of hand- wrist radiograph

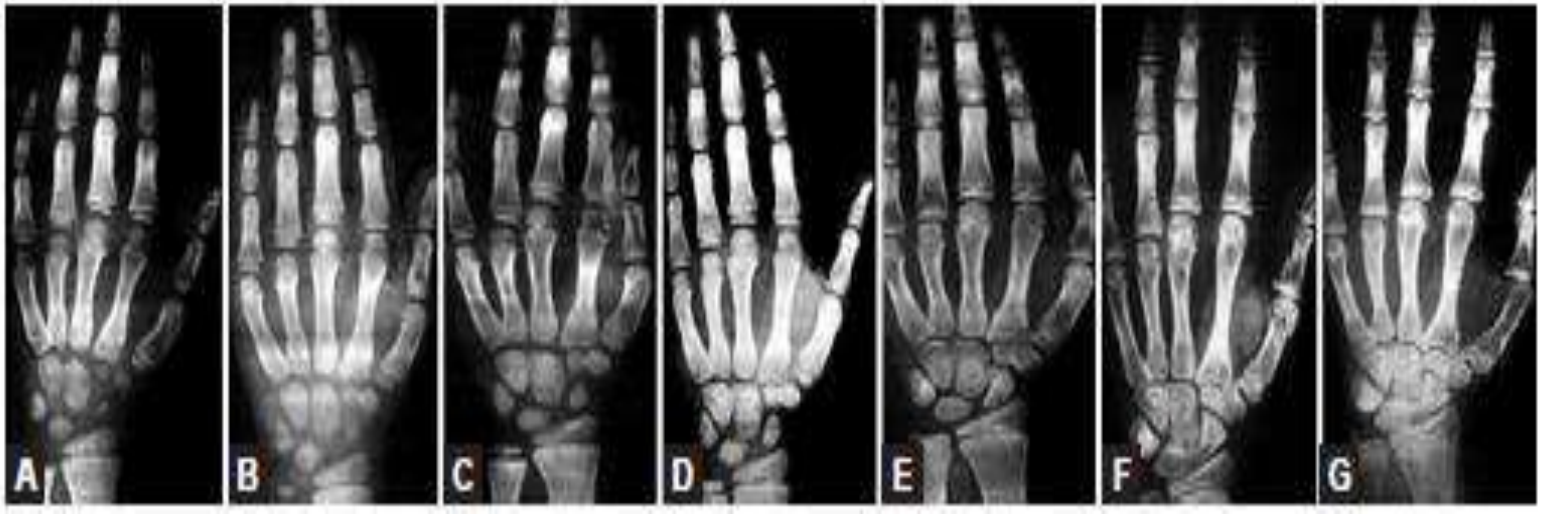


Indications of hand – wrist radiographs

- In patients who exhibit major difference between chronological and dental age.
- Determination of skeletal maturity prior to treatment of skeletal malocclusion.
- To assess skeletal age in patients whose growth is affected by neoplastic, infectious conditions.
- Helps predict future skeletal maturation rate and status.
- To predict pubertal growth spurt.
- Studying role of heredity, environment, nutrition on the skeletal maturational pattern.
- In patients with skeletal malocclusion needing orthognathic surgery to assess growth status.

Determination of skeletal growth

- APA view radiograph of left hand and wrist are considered to be standard for determining skeletal age.
- Methods for skeletal age assessment:-
- **Greulich and Pyle** published an atlas of standard handwrist radiogratphs for males and females at various ages.

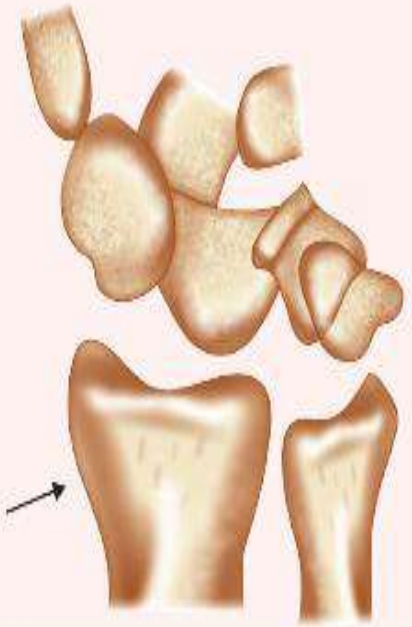


- For determination of skeletal age, one compares the radiograph of left hand-wrist region of the child with the atlas standards beginning with same sex and nearest chronological date.
- Hand-wrist standard that superficially resembles the child's radiograph is chosen for more detailed comparison.
- All the bones are assessed and each center is given a skeletal age of the standard.
- An overall age is then determined.
- **Tanner and Whitehouse**:- Suggested three methods of scoring maturity of individual bones to determine skeletal age:-
- Radius, ulna, short bone (RUS) score,
- Carpal bone method,
- TW2 method (Scores all the growth centers).

- **Grave and Brown**: Included more ossification centers.
- Divided skeletal development into nine stages, each representing a level of skeletal maturity.
- **Schopf** in 1978 gave specific chronological ages to each of these stage.

Stage 1	*Stage 2*	*Stage 3*
• Epiphysis and diaphysis of proximal phalanx of index finger are equal • 3 years before peak velocity of pubertal growth spurt • Males – 10.6 years; Females – 8.1 years	• Epiphysis and diaphysis of middle phalanx of middle finger are equal • Males – 12.0 years; Females – 8.1 years	• Characterized by areas of ossification viz. hamular process of hammate, ossification of pisiform • Males – 12.6 years; Females – 9.6 years
		

Stage 4	*Stage 5*	*Stage 6*
• Marks the beginning of pubertal growth spurt • Increase mineralization of ulnar sesamoid in thumb • Increased ossification of hamular process of hammate • Males – 13.0 years; Females – 10.6 years	• Peak of pubertal growth spurt • Epiphysis caps diaphysis in middle phalanx of 3rd finger, proximal phalanx of thumb and radius • Males – 14.0 years; Females – 11.0 years	• End of pubertal growth spurt • Union of epiphysis and diaphysis of distal phalanx of middle finger • Males – 15.0 years; Females – 13.0 years
		

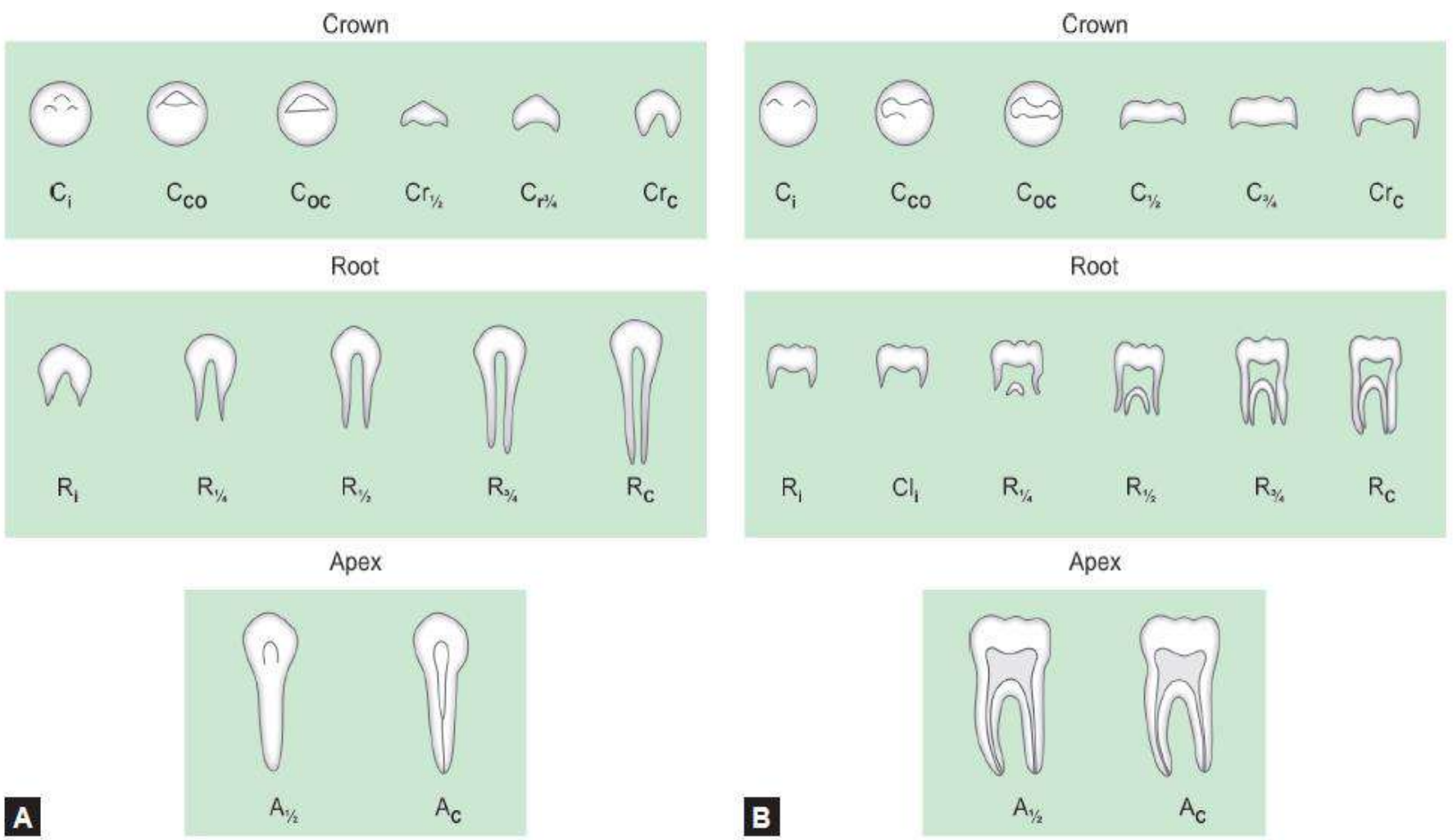
Stage 7	*Stage 8*	*Stage 9*
• Union of epiphysis and diaphysis of • proximal phalanx of middle finger Males – 15.9 years; Females – 13.3 years 	• Fusion between epiphysis and diaphysis of middle phalanx of middle finger • Males – 16.9 years; Females – 13.9 years 	• Signifies end of skeletal growth • Fusion of epiphysis and diaphysis of radius • Males – 18.5 years; Females – 16.0 years 

Dental age

- Dental age is estimated according to the last tooth erupted in oral cavity in normal sequence.
- Simplest but, the least accurate method.
- Atlas approach where we see the distinct stages of mineralization of tooth on radiographs and identify the age. e.g. Massler's method, **Moorrees method**, Andersons method.
- Scoring approach where each development is divided into stages and each stage given a score. e.g**. Demirjian method, Nolla's classification**, Jhonson's method.

Gron and Moorrees Method

- Most commonly used method of determining dental age.
- Method involved scoring of ten permanent teeth according to crown and root formation using standard dental film.
- Teeth which were scored were maxillary and mandibular incisor, mandibular canine, premolars and molars.



Tooth formation: (A) Single-rooted; (B) Multirooted. Coding symbols: Initial cusp formation, Ci, cusp coalescence, Cco; cusp outlime complete Coc; crown half complete Cr½; crown three quarters complete; Cr¾Cr crown complete Crc; initial root formation, Rc initial cleft formation, Clr root length one quarter, R¼; root length one half, R½; root length three quarters, R¾; root length complete Rc; apex half closed A½; apex completely closed, Ac

Nolla Stages

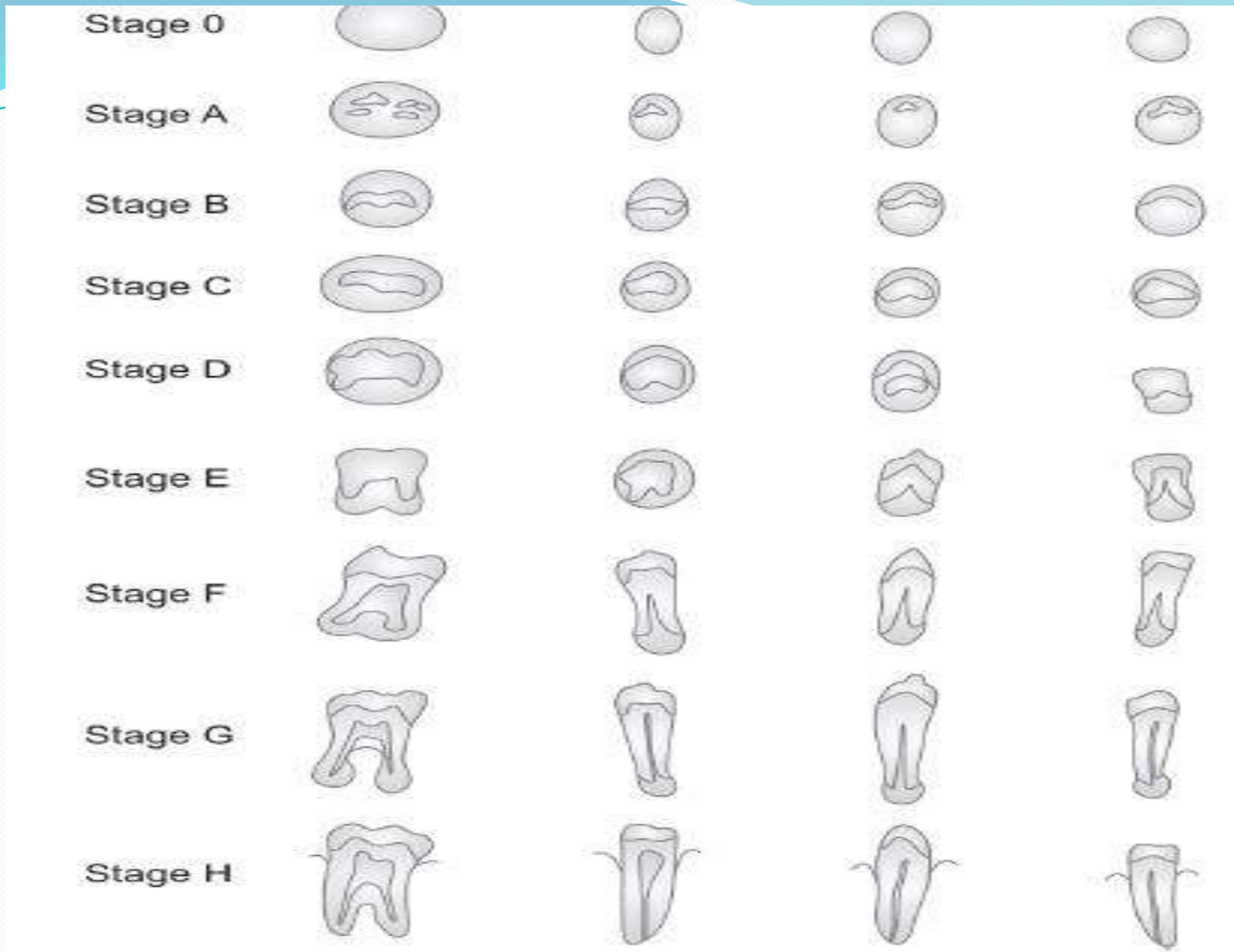
Classified the developing tooth according to its radiographic status



Diagram of tooth maturation showing the progression from initial appearance of crypt through the last stage of apical root closure for the developing tooth.

Demirjian Method

- **Demirjian and Goldstein** devised a new method for assessment of development of dental age.



Demirjian method for dental age assessment

Demirjian scale

Stage	*Description*
O	No sign of calcification
A	Beginning of calcification seen at superior level of crypt
B	Fusion of calcification points in the cuspal area to form occlusal surface
C	• Enamel formation is complete with convergence towards cervical region • Beginning of dentinal deposit • Outline of pulp chamber has a curved shape at the occlusal border
D	• Crown formation is completed till CEJ • Superior border of pulp chamber in uniradicular teeth is curved and in molars is in trapezoidal form • Projection of pulp horn starts • Beginning of root formation in form of a spicule
E	• In uniradicular teeth pulp chamber forms straight line whose continuity is broken by pulp horns • Initial formation of bifurcation is seen in molars • Root length is less than crown height
F	• Walls of pulp chamber form a triangle and apex ends in funnel shape in uniradicular teeth • Calcified region of bifurcation in molars is more developed thus giving roots of the teeth a more distinctive outline • The root length is equal to or greater than crown height
G	• Walls of root canal are parallel and apical end is still open in molars
H	• Apical end of distal root in molars is closed • Periodontal membrane has uniform width around the root and apex

- Each tooth having a stage was converted into a score using conversion table.
- The scores of all the teeth were then added to give the total maturity score.
- This score was then converted to dental age by a table given by Demirjian in 1973.

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- Textbook of pediatric dentistry- Nikhil Marwah (4th edition).
- Orthodontics – The Art and Science- S.I. Bhalajhi.
- Contemporary orthodontics- William R. Proffit (4th edition.)

THANK YOU!!!

PREVENTIVE RESIN RESTORATION

DEFINITION

- It is conservative treatment that involves limited excavation to remove carious tissue, restoration of the excavated area with composite resin, and application of a sealent over the surface of the restoration and remaining , sound, contagious pits and fissures (Ripa et al, 1992)

- This technique is employed after caries has formed and caries is judged to be deeper into dentin.

- First reported by *Simonsen and Stallard (1978)*

TREATMENT PHILOSOPHY

- Painless
- Preventive
- Preservations

INDICATIONS

- For small pit or fissures cavities in posterior teeth in non stress bearing areas.
- Deep pit and fissures in primary and permanent teeth that contain questionable caries area
- Well confined carious lesion
- Enamel defects

CONTRAINDICATIONS

- for stress bearing posterior restorations
- When moisture control is poor
- Large single or multisurface carious lesion

ADVANTAGES

- Esthetic
- Direct placement
- Easy to repair
- Bonded resin may enhance toothy strength
- Conservative preparation technique
- Less tooth structure is removed , leaving much stronger tooth when extension for prevention is necessary

DISADVANTAGES

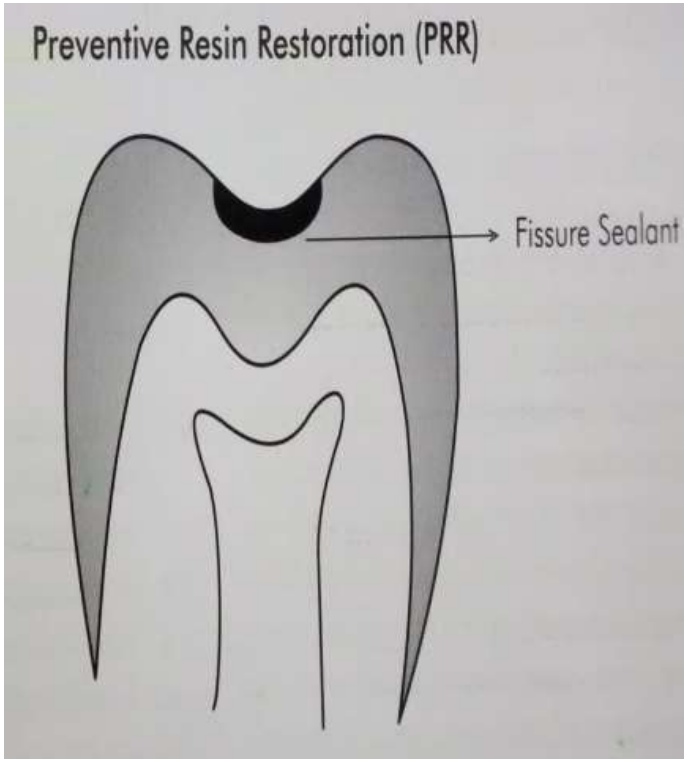
- No self sealing quality
- Excessive wear under stress
- Low fracture strength
- High technique senstivity

TYPES OF PRR

Based on the extent and depth of the carious lesions:

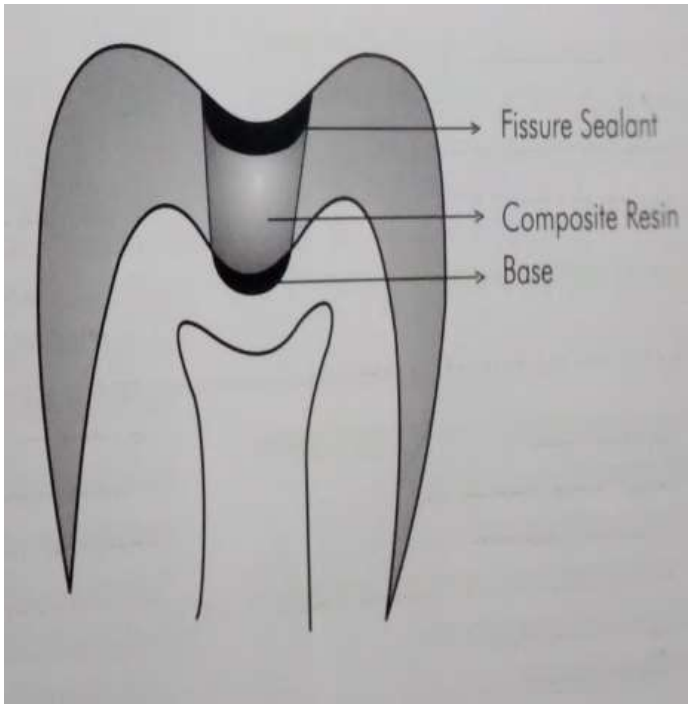
Type A –

- Suspicious pits and fissures where caries removal is limited to enamel.
- Unfilled resin or sealant is used to restore the preparation of carious lesions involving round bur of size ½ or less



Type B –

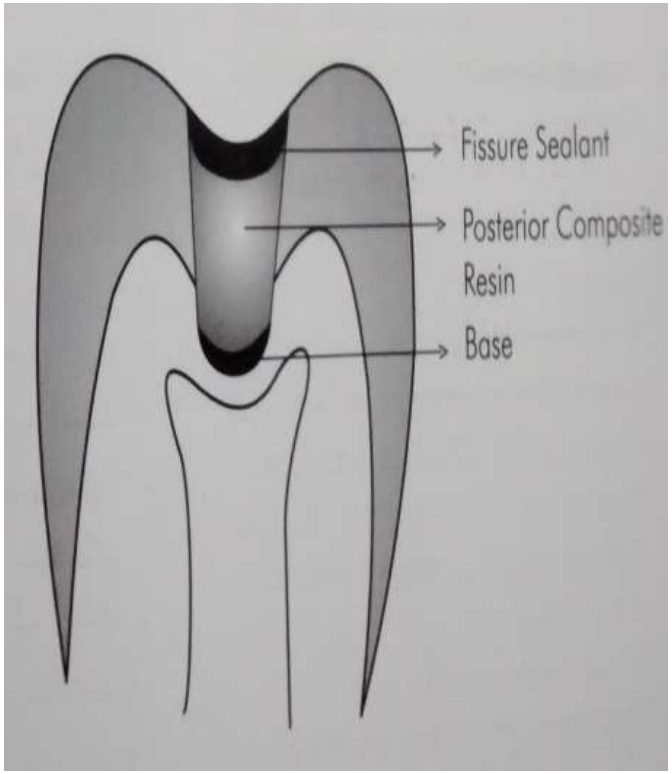
- Incipient lesion in dentin that is small and confined
- The restoration requires some filler to be added to the unfilled resin.



Type C –

- Characterized by the need for greater exploratory preparation in dentin

- Larger size bur is used following which a small bevel is placed at cavosurface margin.



TECHNIQUE

- Place a rubber dam to prevent saliva contamination during tooth preparation
- Clean surface of tooth with flour of pumice and a bristle brush
- Remove only carious lesion with small round bur, while maintaining the contour of the occlusal surface

- Etch the surface of the tooth with a 37% phosphoric acid solution for 20 SECONDS
- Rinse with copious amounts of water to remove etchant for 30-40 sec and completely dried
- Place dentin bonding agent over entire etched surface using a brush

- Fill the cavity with a light-curing composite and cured.
- A light-curing sealant is placed over the remaining susceptible areas and brushed into the pits and grooves.
- The materials are polymerized in accord with the manufacturer's instructions.
- Check the occlusion with articulating paper and adjust as necessary.

Management of Space in Pediatric Dentistry



Preventive orthodontics

- Graber [1966] has defined preventive orthodontics as the action taken to preserve the integrity of what appears to normal occlusion at a specific time.

Etiology of Early Primary Tooth Loss

- Extraction or destruction:
  - Extensive caries or traumatic injury

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

- Premature exfoliation:
  - Abnormal root resorption (e.G. Ectopic eruption)
  - Systemic disorders or hereditary syndromes

Hypophosphatasia	Rickets	Acrodynia
Histiocytosis X triad	Leukemia	Cherubism
Juvenile Periodontitis	Dentinal dysplasia	
Cyclic neutropenia	Papillon-Lefevre syndrome	

Space maintainers

- Space maintainers can be defined as appliances used to maintain space created by the early loss of deciduous teeth and to guide the unerupted tooth into a proper position in the arch.

Objectives of space maintenance

- Preservation of primate space.
- Preservation of integrity of dental arch.
- Preservation of normal occlusal planes.
- In case of anterior space maintenance, it should aid in aesthetics and phonetics.

Functions of a Space Maintainer

- **Function:**
  - prevent undesirable tooth movement following the premature loss of a primary tooth
    - i.e. Mesial migration of posterior segments and lingual collapse of anterior segments

Functions of a Space Maintainer

1. Maintain space
2. Prevent movement adjacent teeth
3. Provide masticatory function
4. Prevent over eruption of opposing teeth
5. Improve esthetics
6. Assist in speech (anterior segments)
7. Aid in control of deleterious oral habits

Note: appliance must neither inhibit nor deflect normal growth changes

Ideal Prerequisites of a Space Maintainer

1. Simple to construct and maintain
2. Durable, strong, stable
3. Passive
4. Easily cleanable and not enhance dental caries or soft tissue pathology
5. Readily adjustable for flexible application

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Factors to consider when planning a space maintainer:

- Question:

  "When should a space maintainer be placed?"

- General Rule:

  "Whenever the clinical situation will allow space loss to ***encroach on the arch length, space maintainer*** needed for the unerupted permanent teeth, giving due ***consideration*** to the patients dental health, motivation, and occlusion status".

Factors to consider when planning a space maintainer:

1. Dental and periodontal condition
2. Arch length
3. Presence/absence of permanent successor
4. Time elapsed since loss of primary tooth
5. Status of first permanent molar eruption
6. Status of permanent successor's development and eruption potential
7. Cooperation level of child and parents
8. Which tooth is lost, in which arch, at what time?



A space maintainer may not be required if there is:

1. Existence of cuspal interference.
2. Widely spaced primary dentition.
3. If present space is not adequate for the succeeding tooth.
4. The possibility of future orthodontic work.
5. Where the opposing 6's are locked into a desirable and stable relationship



Suggested that succeeding tooth will most likely erupt:

1. 75% of the root is present on the succeeding tooth.
2. Less than 1 mm of alveolar bone is covering succeeding tooth.
3. Destruction of the alveolar bone occurred when the primary tooth was lost.
4. Mixed-dentition is in its later stages.



Adverse Effects

1. Dislodged, broken, and lost appliances
2. Plaque accumulation
3. Caries
4. Interference with successor eruption
5. Undesirable tooth movement
6. Inhibition of alveolar growth
7. Soft tissue impingement
8. Pain

Prior to obtaining the consent, parents should be informed that:



1. Space maintainer requires monitoring.
2. Patient must maintain adequate oral hygiene..
3. Appliance may break, requiring repair or replacement.
4. Broken appliances are hazardous to the child and will be ineffective.
5. Even properly maintained appliances may fail to preserve the space.

It is necessary to obtain parental awareness and understanding related to space maintenance.

Classification and Types of Space Maintainer Appliances

According to Hitchcock –

- 1. Removable or Fixed or Semi fixed
- 2. With bands or without bands
- 3. Functional or Non Functional
- 4. Active or Passive
- 5. Certain combinations of the above

Classification and Types of Space Maintainer Appliances

According to Raymond C Thurow

- 1. Removable
- 2. Complete arch
  - a. Lingual arch
  - b. Extraoral Anchorage
- 3. Individual tooth

Classification and Types of Space Maintainer Appliances

According to Hinrichsen

1. Fixed space maintainers
    a. Class I
        i) Non Functional types
        ii) Functional type

    b. Class II
        i) Cantilever type e.g distal shoe, band and loop
2. Removable space maintainers e.g. acrylic partial denture.

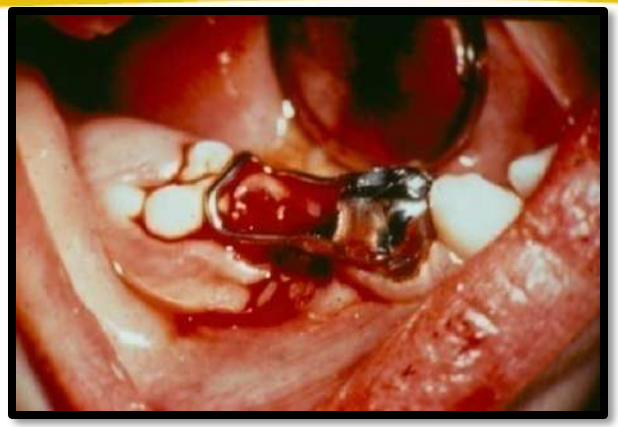
BAND AND LOOP SPACE MAINTAINER

- It is a unilateral,non functional,passive fixed appliance indicayed for space maintenance in the posterior segments when single tooth is lost.

SM: Band and Loop

Indications

1. Used when single tooth is missing in posterior segment.



2. Can be given in bilateral tooth loss before the eruption of permanent anteriors.



SM: Band and Loop
contraindications

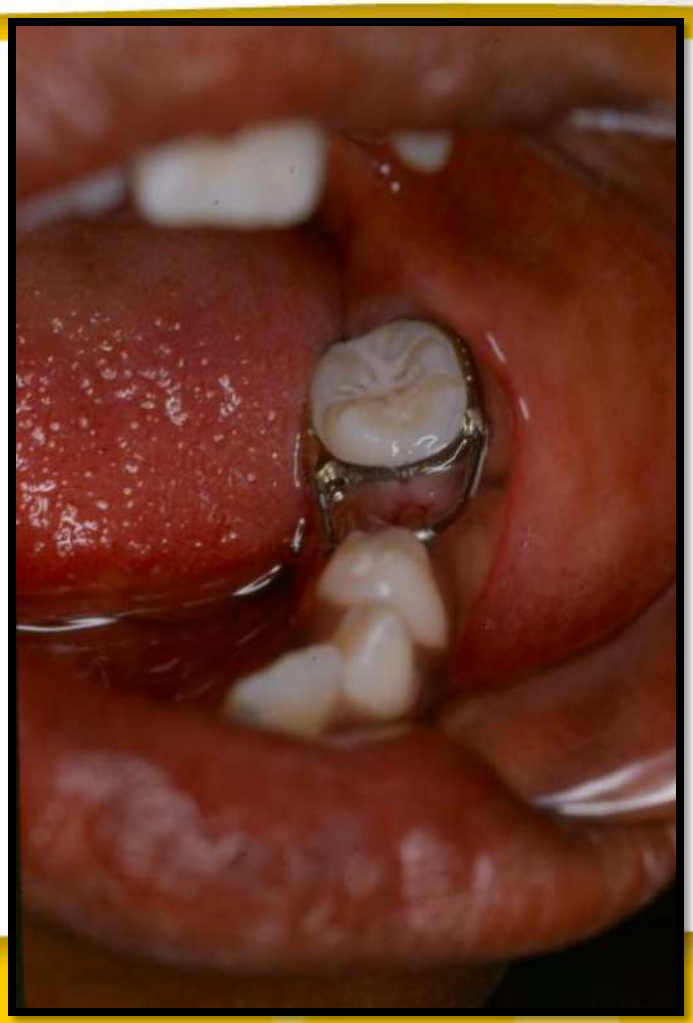
1. High caries activity.
2. Marked space loss
3. More than one adjoining teeth missing.



SM: Band and Loop

Advantages

1. Easy to construct.
2. Inexpensive.
3. Easily adjusted.
4. Allows eruption of permanent tooth.
5. Non invasive.
6. Painless.



SM: Band and Loop
Disadvantages



1. **Masticatory function.**
   - Not restored

2. **Extrusion of opposing dentition.**
   - Not prevented

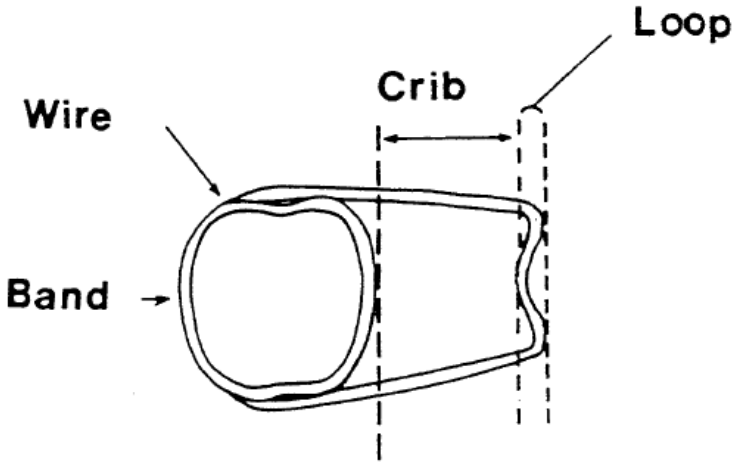
3. **Normal distal movment of primary cuspids during eruption of perm lateral incisor**

Disadvantages

- Cannot stabilize the arch.
- Slippage of loop by masticatory forces.
- Cannot be used for multiple loss of teeth.

SM: Band and Loop Construction

- **Band:** stainless steel material 0.005 inches in thickness for primary molars.
- **Crib:** portion of the wire spanning the edentulous space
- **Loop:** portion of the wire contacting the abutting tooth ,made of round stainless steel wire.





Modifications

- **Crown and loop**



Modifications

- **Crown band and loop**





Modifications

- **Mayne space maintainer** – Loop is halved with buccal loop eliminated and only the lingual extension given.





Modifications

Reverse band and loop

- when there is premature loss of primary second molar and permanent molars have not erupted fully to support a band.



Modifications

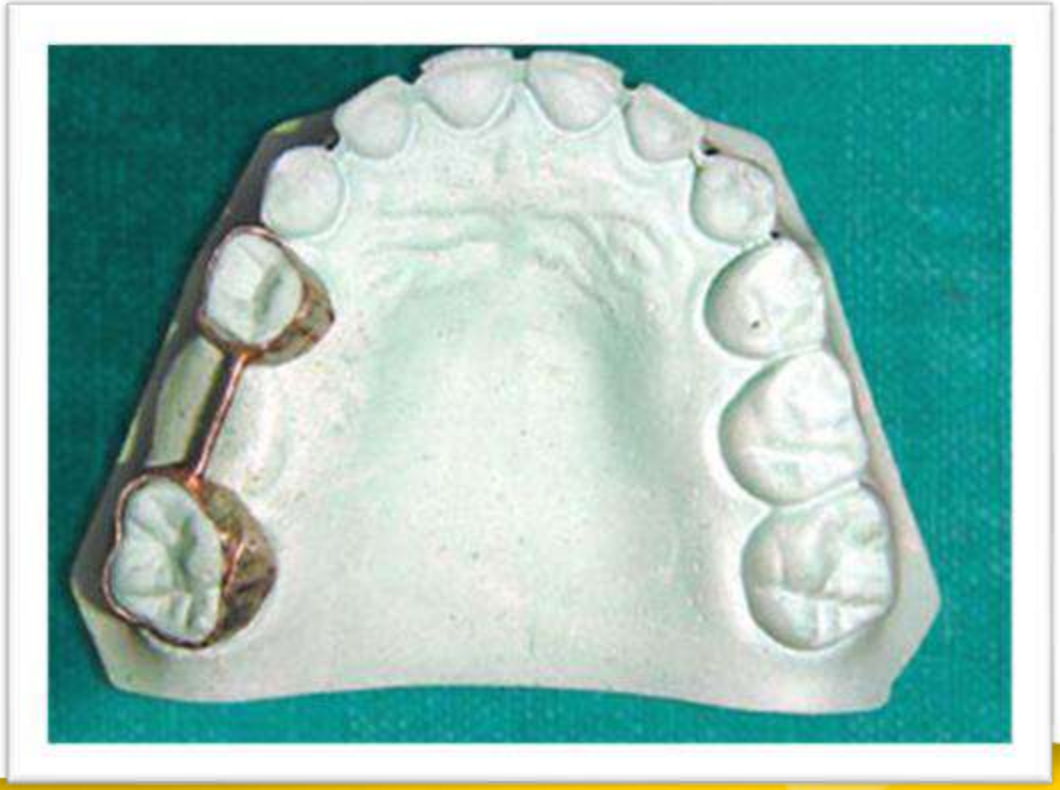
Reverse band and loop

- Primary first molar is banded and a loop is made that touches just below the marginal ridge of permanent molars.



Modifications

- **Band and bar**



Modifications

- **Long band and loop**:



Modifications

- **Long band and loop**: given when multiple tooth loss is there in one segment and we cannot give arch stabilizing space maintainer like lingual arch due to eruption status or in cases when removable appliance is contraindicated.

Modifications

Bonded band and loop space maintainer:



Modifications

Bonded band and loop space maintainer:

- simple space maintainers which are readily made with composite systems.
- can be easily adhered to dental contours, fast technique of application, has good strength.

LINGUAL ARCH SPACE MAINTAINER

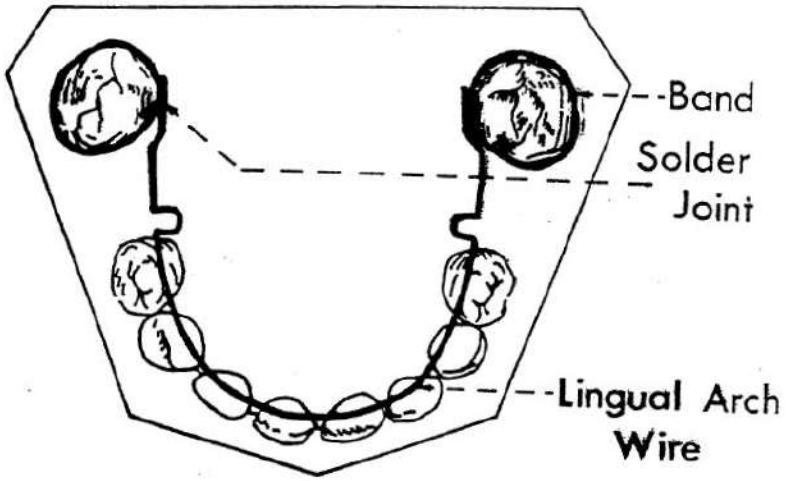
- Bilateral,nonfunctional,passive/active, mandibular fixed appliance.

SM: Lingual Arch
Indications

1. Unilateral Premature loss of primary posterior teeth after the eruption of incisors. .

2. Bilateral loss of primary molars after eruption of incisors.

3. Minor space regaining.



Contraindications

- Not used before eruption of permanent incisors as permanent tooth buds develop and erupt somewhat lingual to their primary precursors and the design of conventional mandibular lingual arch might interfere with their eruption.

SM: Lingual Arch

Advantages

1. Maintains esthetic. arch form.
2. Allows eruption of permanent teeth w/o interference.
3. Not easily displaced.
4. Arch holding space maintainer.
5. Can be modified easily to serve in many situations.
6. Can also be used to regain space.

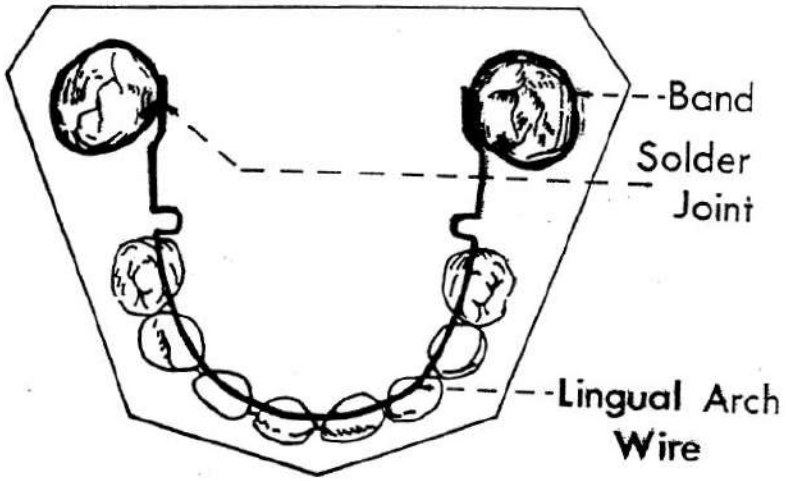
Disadvantages

1. Does not prevent extrusion of opposing teeth.
2. Not advisable to band teeth which are:
   - Hypoplastic
   - Hypocalcified
   - Highly prone to caries.
3. Can promote decay in non-compliant patients.
4. **More chances of distortion of appliance by tongue pressure**

SM: Fixed Lingual Arch Construction

- **Band:** Stainless steel material 0.005 inches in thickness (ortho bands)

- **Lingual arch wire:** Stainless steel round wire



Design of the wire

- Arch wire should contact the erupted permanent incisors at the cingulum.
- Arch wire should be located 2mm below the gingival margin or edentulous ridge in the posterior region to prevent distortion under process of mastication and should be located1 to 2mm lingual to the posterior teeth to permit satisfactory eruption of bicuspids in a buccolingual plane.

- Arch wire should meet the band at the mesiolingual cusp and at the same time place the soldered joint in the middle third of band to avoid occlusal interference.

Modifications

- Hotz Lingual Arch-when U loop is incorporated for space regaining.
- Removable lingual Arch

Distal shoe space maintainer



1.Also known as intra alveolar or eruption guidance appl.

2. First reported by Willet's in 1932.

3. Indicated when there is premature loss of second primary molar prior to the eruption of first permanent molar.

4. Willet's appliance was a cast gold appliance.

Distal shoe space maintainer

- Willet`s appliance is rarely used these days because of increased cost of materials and complicated fabrication procedures.

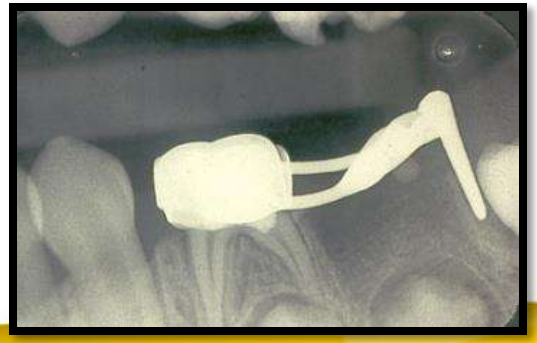
Distal shoe space maintainer



This appliance was modified by **Roche** in 1942.

Also known as Crown or Band and Bar D S appliance.

1. Difference between the two is gingival extension.
2. Roche has “V” shaped gingival extension Willet has bar shaped.



Distal shoe space maintainer

- V-shaped end offers a broader surface and helps prevent rotations.
- Distal surface of second primary molar provides a guide for unerupted first permanent molar.

Distal shoe space maintainer

- When the second primary molar is removed prior to the eruption of first permanent molar,this appliance provides greater control of path of eruption of unerupted tooth.

Distal shoe space maintainer

- **Contraindications-**
- Inadequate abutments due to multiple loss of teeth.
- Poor oral hygiene.
- Medically compromised patients.
- Congenitally missing first permanent molar.

Distal shoe space maintainer

- **Advantages-**
- Only space maintainer which can be used if there is premature loss of primary second molar before eruption of permanent molars.

Distal shoe space maintainer

- **Disadvantages-**
- Can cause deviation of permanent tooth bud.
- May cause tipping if not placed properly.
- Interfere with epithelization of socket.
- Can cause infection.

Distal shoe space maintainer

- Gingival extension –
- Depth of gingival extension should be 1mm below the mesial marginal ridge of erupting first permanent molar.

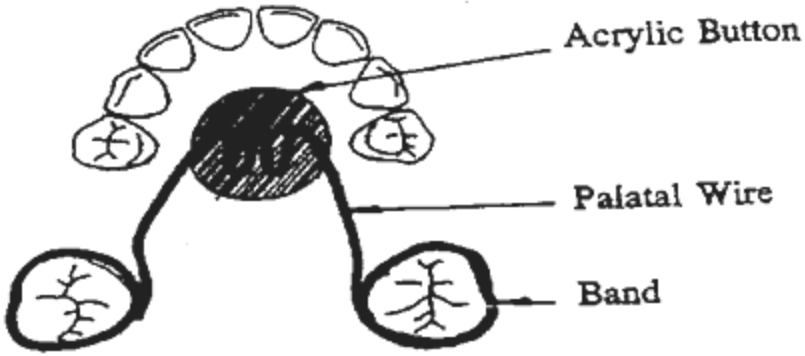
REMOVABLE DISTAL SHOE SPACE MAINTAINER

- An immediate acrylic partial denture with an acrylic distal shoe extension has been used successfully to guide the first permanent molar into position when deciduous second molar is lost shortly before the eruption of the first permanent molar.
- Extension can be removed after eruption of permanent tooth.

SM: Nance Appliance
Maxillary arch: multiple tooth loss

- Bilateral,non functional,maxillary fixed appliance that does not contact anterior teeth but approximates anterior palate via an acrylic button that contacts palatal tissue .



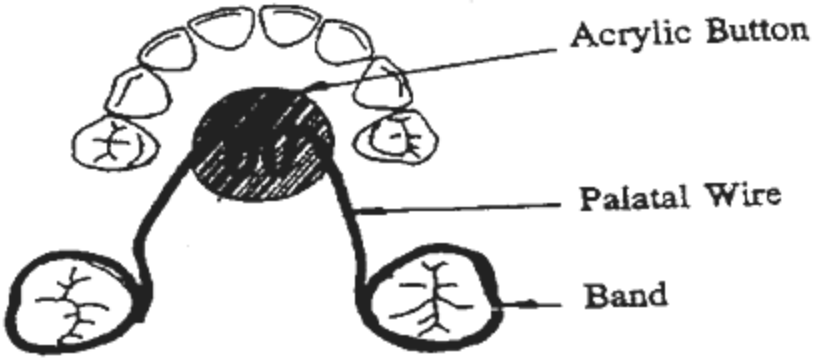


SM: Nance Appliance
Maxillary arch: multiple tooth loss

Indications:

Used in maintaining the maxillary first permanent molar positioning when there is bilateral premature loss of primary teeth with no loss of space in arch and a favourable mixed dentition analysis.

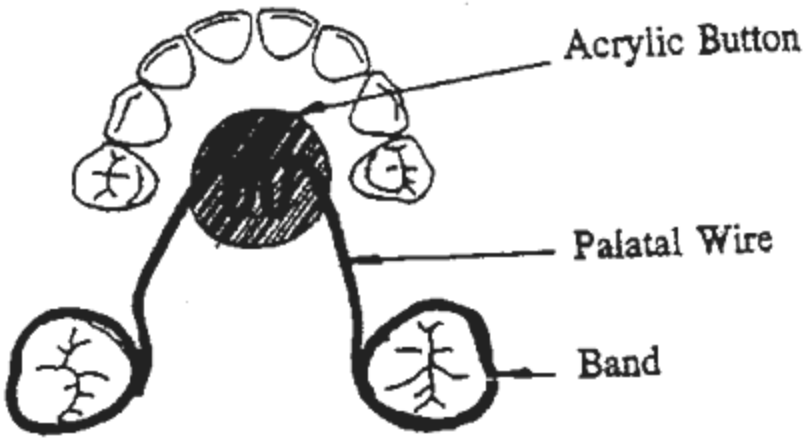




SM: Nance Appliance
Maxillary arch: multiple tooth loss

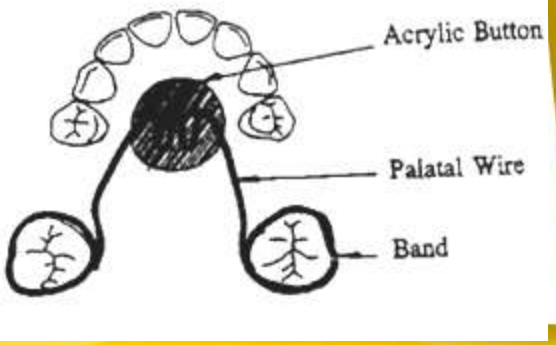
- ADVANTAGES-
- Arch stabilization.





SM: Nance Appliance
Maxillary arch: multiple tooth loss

- **DISADVANTAGES-**
- May cause tissue hyperplasia.
- Irritation to palatal tissues.
- Pressure effects
- Can`t be used in allergic patients.



Design of wire loop

- The arch wire extends anteriorly without touching against the surface of the primary molars as the successor bicuspids usually are broader buccolingually and the wire could deflect them from their natural position.

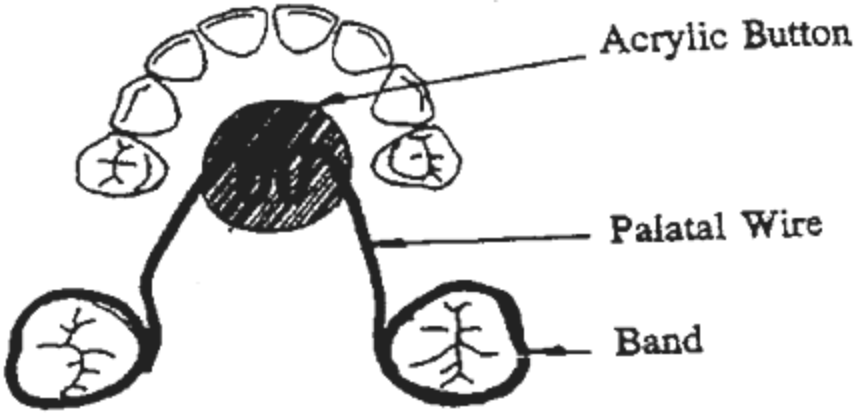
- At the rugae area,a small u shaped bend should be incorporated in the wire,which is approximately 1 to 2 mm away from soft tissue .
- The bend will enhance the retention of acrylic to the wire.

- The acrylic button ,0.5 inch in diameter is placed usually on the descending portion of palatal vault 1 to 2 mm below the incisive papilla.

SM: Nance Appliance
Maxillary arch: multiple tooth loss

Acrylic button provides resistance to the anterior movement of posterior teeth in a horizontal direction.





Modifications

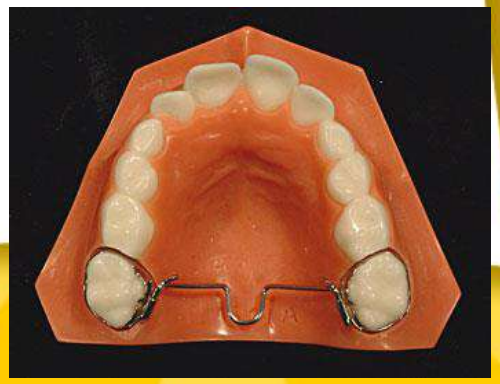
- Esthetic Nance Palatal Arch: teeth are attached in anterior region to serve as space maintainer and also for anterior esthetics.

Trans Palatal Arch Space Maintainer



1.Unilateral Fixed non functional passive appliance used in maxillary arch.

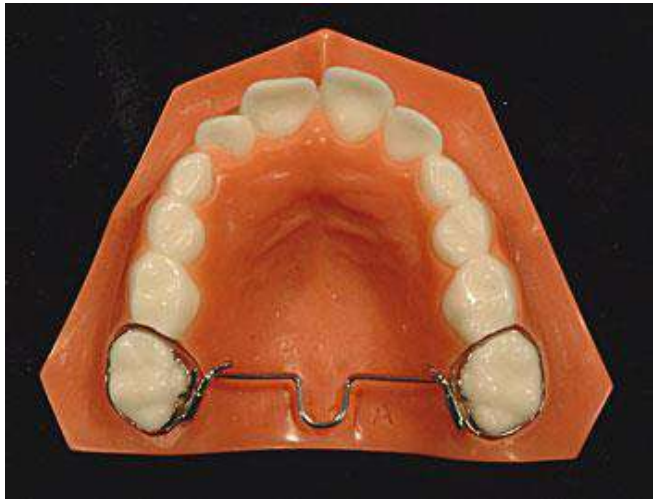
2. Used for stabilizing maxillary first permanent molar when primary molars require extraction.



Trans Palatal Arch Space Maintainer

Indication –

When one side of the arch is intact and several primary teeth are missing on the other side.



- This appliance is designed to prevent molars from rotation.
- In arch expansion.

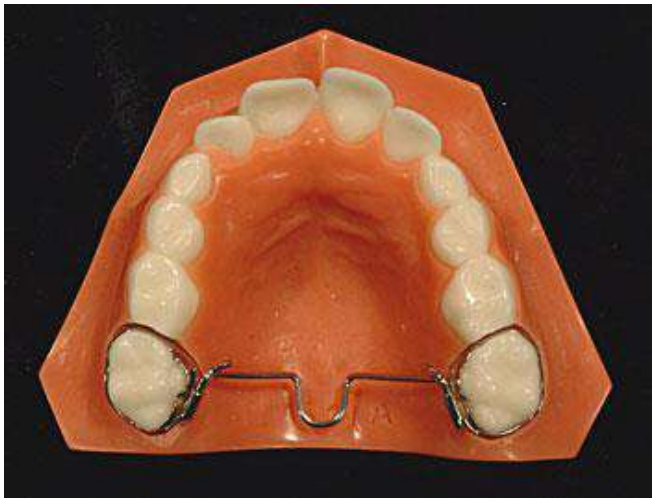
Trans Palatal Arch Space Maintainer



ADVANTAGES-

Used in Unilateral multiple tooth loss.

Can be used for expansion.



DISADVANTAGES-

May cause rotation of molars.

Both molars may tip together.

REMOVABLE SPACE MAINTAINERS

DEFINITION

They are space maintainers which can be removed and reinserted into the oral cavity by the patients.

INDICATIONS

- Aesthetics is of importance.
- The abutment teeth cannot support a fixed appliances, because of
  - Expected early loss, due to normal root resorption,
  - Previous injury or extended caries which has involved the pulp.
- A cleft palate is to be closed with a denture.

- The child has reached a mental age of 2 ½ years.
- All the primary teeth have erupted.
- The permanent teeth are not fully erupted for the adaptation of bands.
- Multiple losses of deciduous teeth

CONTRAINDICATIONS

- Lack of patient-parent cooperation
- If the child has not attained a mental age of 2 ½ years.
- If the patients are allergic to acrylic materials.
- Epileptic patients.
- Children with high caries activity.

Classification

- Removable appliances may be:
- Functional – Nonfunctional
- With clasps – Without clasps
- Functional space maintainers will incorporate teeth to aid in mastication, speech and esthetics whereas in nonfunctional appliances will have only an acrylic extension over the edentulous area to prevent space closure.

Brauer et al classified removable dentures for children as follows:

- Class 1: Unilateral maxillary posterior
- Class 2: Unilateral mandibular posterior
- **Class 3: Bilateral maxillary posterior**
- **Class 4: Bilateral mandibular posterior**
- **Class 5: Bilateral maxillary anterior posterior**
- **Class 6: Bilateral mandibular anterior posterior**
- **Class 7: One or more primary or permanent anteriors**
- **Class 8: Complete primary**

Advantages

- They are easy to clean and permit maintainance of proper oral hygiene.
- They maintain or restore the vertical dimension.
- They can be worn part time allowing circulation of the blood to the soft tissues.

1. They serve other important functions like mastication,
2. esthetics
3. and phonetics.

- Dental check up for caries detection can be undertaken easily

- Room can be made for permanent teeth to erupt without changing the appliance.
- They stimulate eruption of permanent teeth.
- Band construction is not necessary.
- They help in preventing development of tongue thrust habit into the extraction space.

Disadvantages

- They may be lost or broken by patient.
- Uncooperative patients may not wear the appliance.
- Lateral jaw growth maybe restricted , if clasps are incorporated.
- They may cause irritation of the underlying soft tissues.

REMOVABLE APPLIANCES FOR PRIMARY INCISOR AREA

- Acrylic partial dentures can be used successfully in primary incisor area, usually in maxillary arch.

- Requires degree of cooperation and interest in the children.

REMOVABLE OF TEETH: APPLIANCES FOR MULTIPLE LOSSES

Acrylic Partial Denture:

- The acrylic partial denture has been used successfully after the multiple losses of teeth in the mandible or the maxillary arch.
- Readily adjusted to allow for the eruption of teeth.

- If artificial teeth are included in the denture mastication function can be restored.

- To minimize the breakage of the appliance it is reinforced by the use of a stainless steel lingual bar











Thank You




STAINLESS STEEL
CROWNS

CONTENTS

- Introduction
- History
- Composition
- Classification
- Indications
- Contraindication
- Armamentarium used for placement

- Clinical procedure
- Clinical considerations
- Modifications
- Causes of SSC Failures
- Recent literature
- Conclusion

REFERENCES

- Dentistry for child and adolscence
  - Mc Donald & Avery
- Pediatric Dentistry infancy through Adolscence
  - Pinkham
- Pediatric Dentistry Infancy through Adolscence
  - casamassino , Fields , Metique Nowak
- Fundamentals of Pediatric Dentistry – 3rd edition
  - Mathewson
- PEDIATRIC DENTISTRY: TOTAL PATIENT CARE
  - Stephen H.Y Wei

INTRODUCTION



•It’s a semi-permanent restoration

Used in primary and permanent teeth.

- Also called as pre-formed metal crowns.

- The distinctive anatomical characteristics of primary teeth , petite life span of primary teeth in the oral cavity ,short attention span of the child ,prolonged duration and intricate treatment planning involved in preparation of willets inlay/cast crown restorations favors SSCs as an alternative in Pediatric dentistry.

HISTORY

- Stainless steel crowns(PMCs), for primary molar teeth were first described in 1950 by **Dr. William Humphrey (1950).**
- The initial crown preparation suggested by Mink and Bennet is still being used.



Composition

Stainless steel crowns

1. Iron : 67%
2. Chromium : 17-19%
3. Nickel : 10-13%
4. Minor elements : 4%



Nickel base crowns

1. Nickel – 76%
2. Chromium -15%
3. Iron -8%
4. Carbon – 0.08%
5. Manganese – 0.35%
6. Silicon – 0.2%

Classification



I. According to trimming

Untrimmed crowns

These crowns are neither trimmed nor contoured and require lot of adaptation , thus are time consuming.

Eg ; the rocky mountains

Pretrimmed crowns

They have straight , non-contoured sides but are festooned to follow at line parallel to the gingival crest.

They require contouring and some trimming .

Eg unitek , 3M CO, Denovo crowns



Precontoured crowns

These crowns are festooned and are also precontoured through a minimal amount of festooning and trimming may be necessary .

Eg : Unitek stainless steel crown

Ni-Chro ion crowns



Pre veneered

- Resin based composite bonded to buccal and occlusal surfaces
- Aesthetic
- Allows minimal crimping.



- According to composition

I. Stainless steel crown

II. Nickel – chromium crown

Indications(Mc Donald, AAPD guidelines)

- Restorations for primary or young permanent teeth with extensive & or multiple carious lesions.
- Restorations for hypoplastic primary or permanent teeth that cannot be adequately restored with bonded restorations
- Cervical decalcifications.
- Restorations for teeth with hereditary anomalies such as dentinogenesis imperfecta or amelogenesis imperfecta.

Dentinogenesis imperfecta

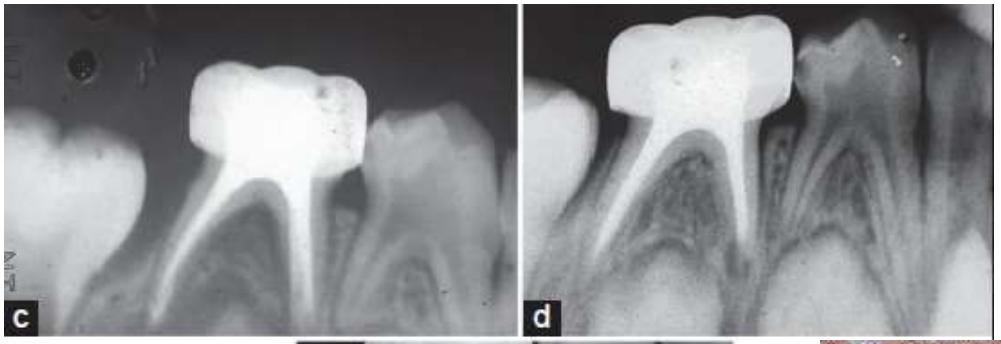






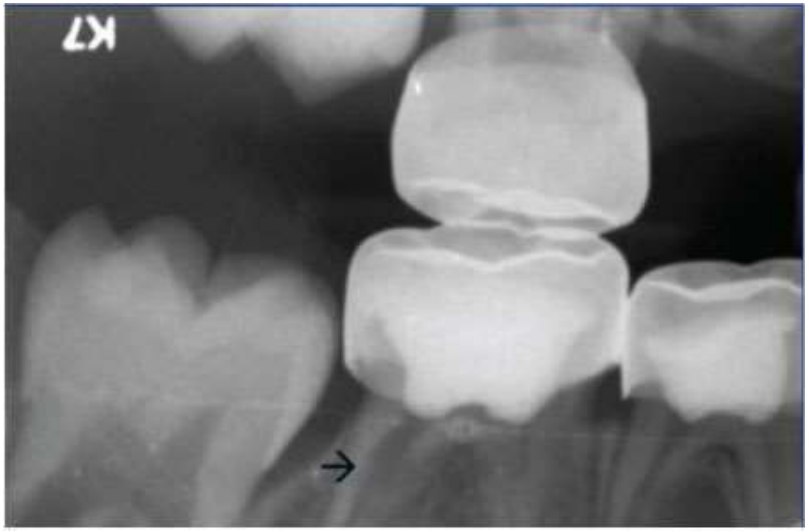


- Restorations for pulpotomized or pulpectomized primary or young permanent teeth.
- For fractured teeth.
- As abutments for appliances.
- Attachment for habit-breaking appliances.
- Patient with some special needs.
- Strong consideration should be given to the use of ssc's in children who require GA for dental treatment.


c
d


e




K7

- failure of other available restorative materials.
- high caries-risk children
- Extensive tooth surface loss eg attrition,bruxism,abrasion/erosion.





Contraindications

No absolute CI but relative contraindications include:

- Primary teeth in which conservative amalgam restoration can be placed.
- Teeth expected to exfoliate in a brief period.
- Excessive mobility
- Partially erupted

Armamentarium

BURS

1. No 69L ,169L pear shaped
2. Tapered diamond burs



Pliers

1. 114 johnson's ball & socket plier
2. 800-108 crimping plier
3. Gordon pliers contouring pliers
4. 114 johnson contouring pliers







- Scissors

1. Crown & bridge scissors

Finishing & polishing

1. Abrasive wheel
2. Rubber wheel
3. Chamois wheel





Clinical procedure

Tooth preparation

1. Evalua[illegible] preoperative occlusion
2. Admi[illegible]
3. Reduc[illegible] 169L taper fissur[illegible]



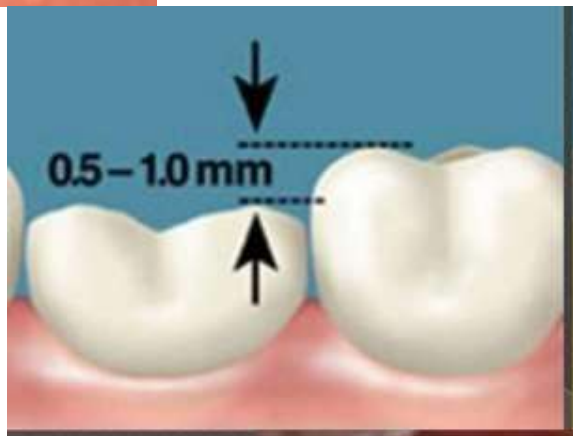
Depth cuts [illegible] maintain cuspal incl[illegible]

Rapp 196[illegible] [illegible]n from gingival m[illegible]

Humphrey [illegible] [illegible]cture

Pediatric Dentistry infancy through Adolscence - Pinkham




0.5 – 1.0 mm



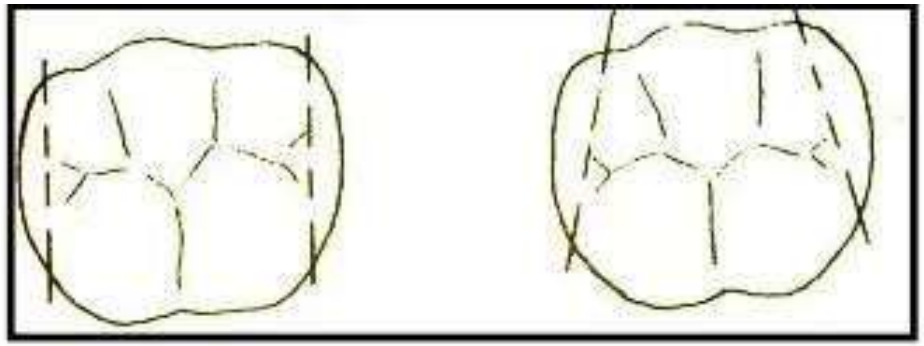


Occlusal anatomy preservation

- Increases Crown retentive potential
- Less chances of pulp exposure
- Preservation of tooth structure

Proximal reduction

- thin tapered diamond bur.
- Contacts should be broken with walls having slight occlusal convergence.



Proper slice Improper slice

Bucco – lingual reduction

- Natural undercute : retention
- Mathewson 1974 , Andlow and rock 1984 , Mink and Bennet 1968:
- Large buccal bulge : buccal reduction required.

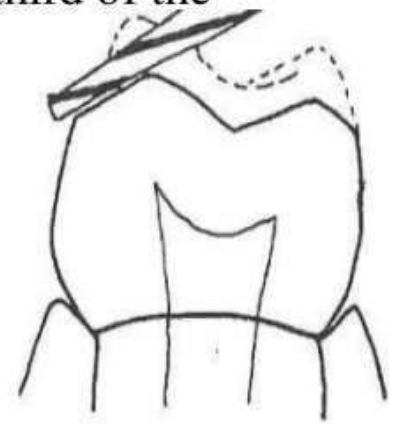
- Pinkham :
- Large mesiobuccal bulge : both buccal an lingual
- Using pre veneered crown : both buccal an lingual

Cervical finish line

- Gingival proximal margin should have **feather edge finish** line.
- Ledge – obstruct crown placement,popping of crown, stress.

Beveling

- A bevel at an angle of 30-45 degrees removes the sharp cusp tips and creates a gentle slope in the occlusal third of the lingual and buccal surfaces



Evaluation of tooth preparation

- Preliminary occlusal relationship is established by comparing adjacent marginal ridge heights.

- If crown does'nt seat to the same level then:
  - Occlusal reduction is inadequate.
  - Crown may be too long.
  - Contact not broken
- **Round all line angles**. Buccolingual beveling done is confined to occlusal 1/3rd of the crown.

- Excessive gingival blanching - too long/grossly overcontoured (it should just go 1mm into gingival sulcus)

Selection of crown

- Selection of crown begins as a trial and error procedure.
- Can be done before or after the procedure.
- Its first seated in the lingual and then in buccal direction – mandibular arch and vice versa in maxillary arch.

Considerations

1. Adequate M-D width
2. Light resistance to seating
3. Proper occlusal height
4. Too large crown will rotate the tooth preparation

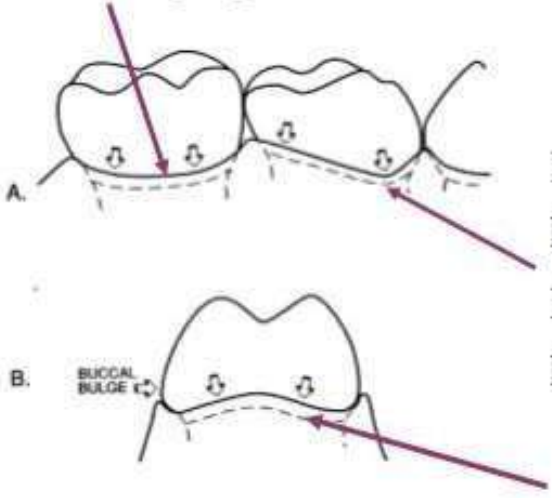
Crown contouring

- Contouring involves bending the gingival 1/3rd of the crown's margin inward to restore anatomic feature of the natural crown – no 137 gordon pliers



Gingival Contours

Buccal gingival contour of second primary molar-- ***smile***



Buccal gingival contour of first primary molar-- ***stretched-out S***

Proximal gingival contour of primary molars -- ***frown***



Crown crimping





Crown crimping

Evaluation

- Check with explorer
- If margins open : recrimp
- If over extended : start again
- Bitewing radiograph : More & Pink 1973



- A tight marginal fit aids in :

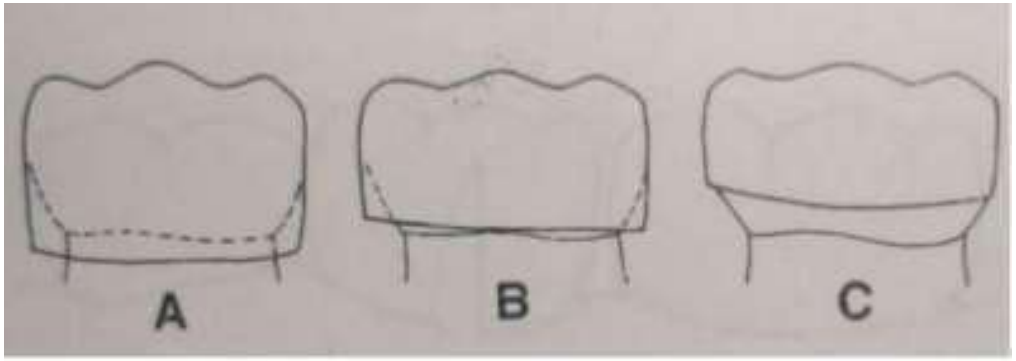
I. Mechanical retention

II. Protection of cement from exposure to oral fluids.

III. Maintainance of gingival health.

Crown fit

- View from proximal surface : B-L surfaces converge occlusally.
- Any point above greatest diameter : visible
- Any point below greatest diameter : not visible clinically
- Correct bucaal & lingual gingival margins



- Final smoothing and polishing of the crown margin should be done.
- GIC , ZnP , polycarboxylate or self curing resin ionomer cement

Crown finishing and polishing

- If unpolished : plaque accumulation & gingivitis
- Large green stone : Knife edge finish cervically
- Rubber wheel : to smoothen margins





Crown cementation

- The crown should be one half to two third filled with cement.
- Dry the tooth and seat the crown completely.
- Initially bite slowly with increasing pressure



- A tongue depressor or wooden stick will help to seat the crown without distorting it.
- Cement should express from all margins. Excess cement can be removed using spoon excavator
- Dental floss is tied to finger and slowly passed through interproximally.

--*PEDIATRIC DENTISTRY: TOTAL PATIENT CARE*

- Stephen H.Y Wei

- Sidhanth pathak et al reported that retentive strength of dual-polymerized self adhesive resin cement was better then RMGIC.(IJCPD 2016)





Mathewson : retention of ssc is due to cementing medium than due to mechanical adaptation.

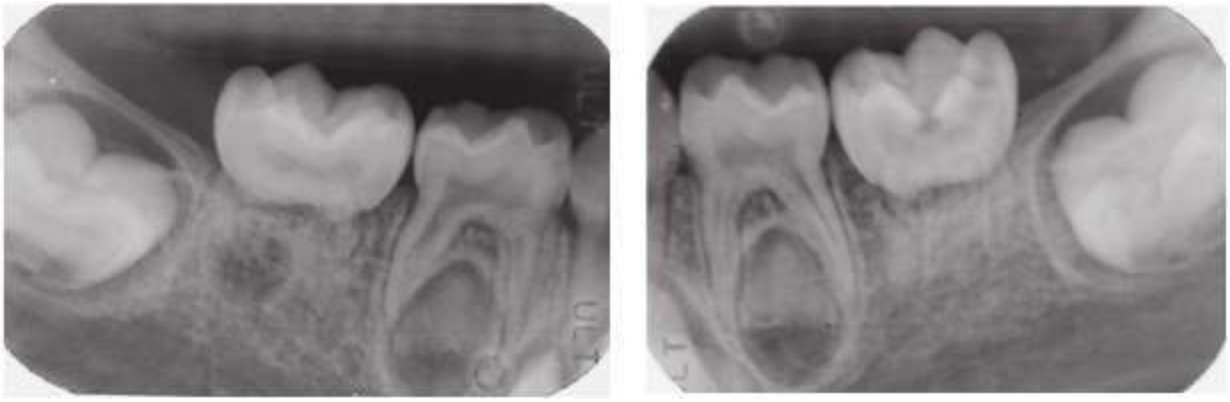

LE 2

Clinical guidelines for SSC's

Tooth preparation

- occlusal reduction –follow the contours of tooth
- smooth feather edge cervically
- no sharp line angles.
- Where a primary molar has no adjacent tooth either mesially or distally it is still important to carry out approximal reduction to avoid producing an excessive marginal overhang.

(distal surface of second primary molars - overhangs can impede the eruption of the first permanent molar.)



International Journal of Paediatric Dentistry, 2015

Crown selection

- measuring the mesio-distal dimension of the tooth, cast or contralateral tooth, with dividers or a graduated periodontal probe.
- tight snap fit





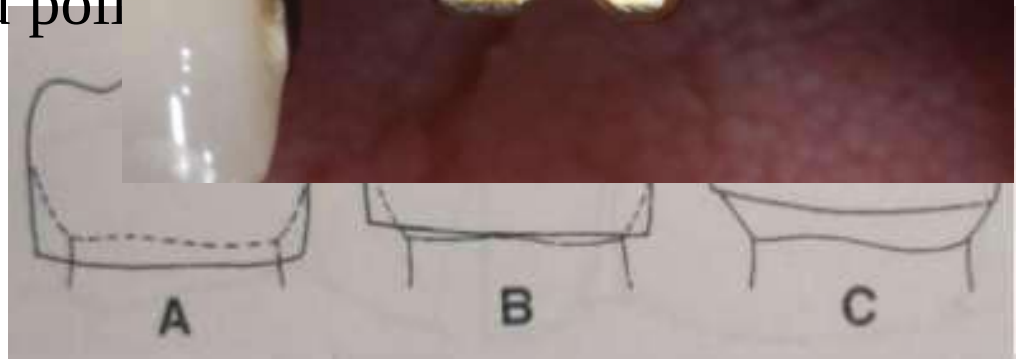
International Journal of Paediatric Dentistry, 2015

SSC Modifications

(International Journal of Paediatric Dentistry, 2015)

- 3M™ ESPE™ are a d cervically and in many instan .
- Over trimming of t d, as this may affect retention and
- Special attention sh distal margin on second primary is unerupted.
- crown is excessivel val blanching – trimmed and poli





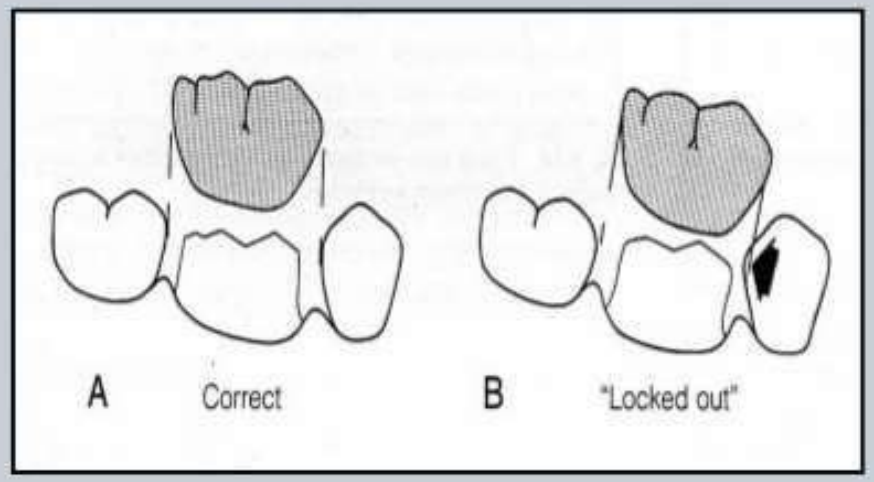
Arch length loss – caries/mesial drift

- flattening of the mesial and distal contact areas of the crown with Adam's pattern pliers.
- Where mesial drift has occurred in the lower arch it may be possible to use a SSC form for the contralateral upper tooth (e.g. ULE crown form for LRE) as these SSC forms have a shorter mesiodistal dimension.
- vertically slicing one aspect of the crown and spot-welding additional segments of stainless steel band to increase the perimeter.

International Journal of Paediatric Dentistry, 2015

Path of insertion of SSC

- The mesiodistal inclination of the path must parallel the contact areas of adjacent teeth.
- So if path is inclined mesially or distally, the restoration will be held up at the proximal contact areas & be "locked out".

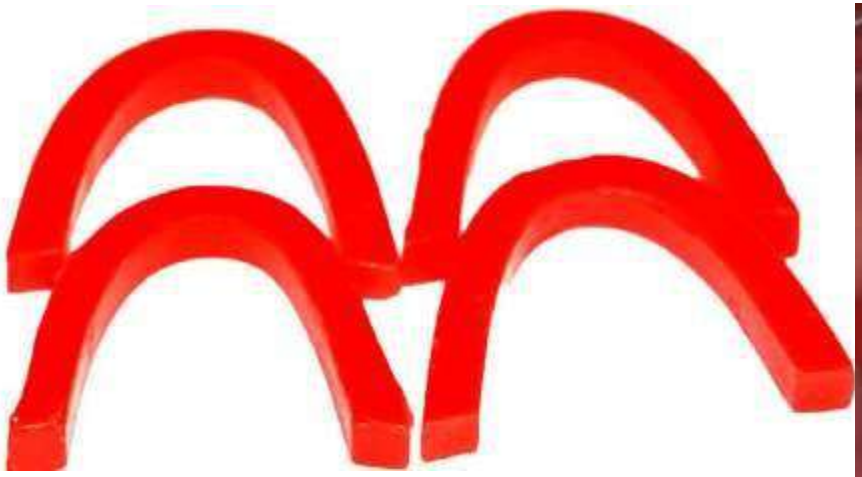


www.indiandentalacademy.com

International Journal of Paediatric Dentistry,2015

- Excessive occlusal interference should be avoided (greater than 1.0–1.5 mm), but a slightly premature up to about 1.0 mm is normally well tolerated in children.

- Wax Bite registration- Forrester 1981





How to check the occlusion during the placement of stainless steel crowns under general anesthesia ??????

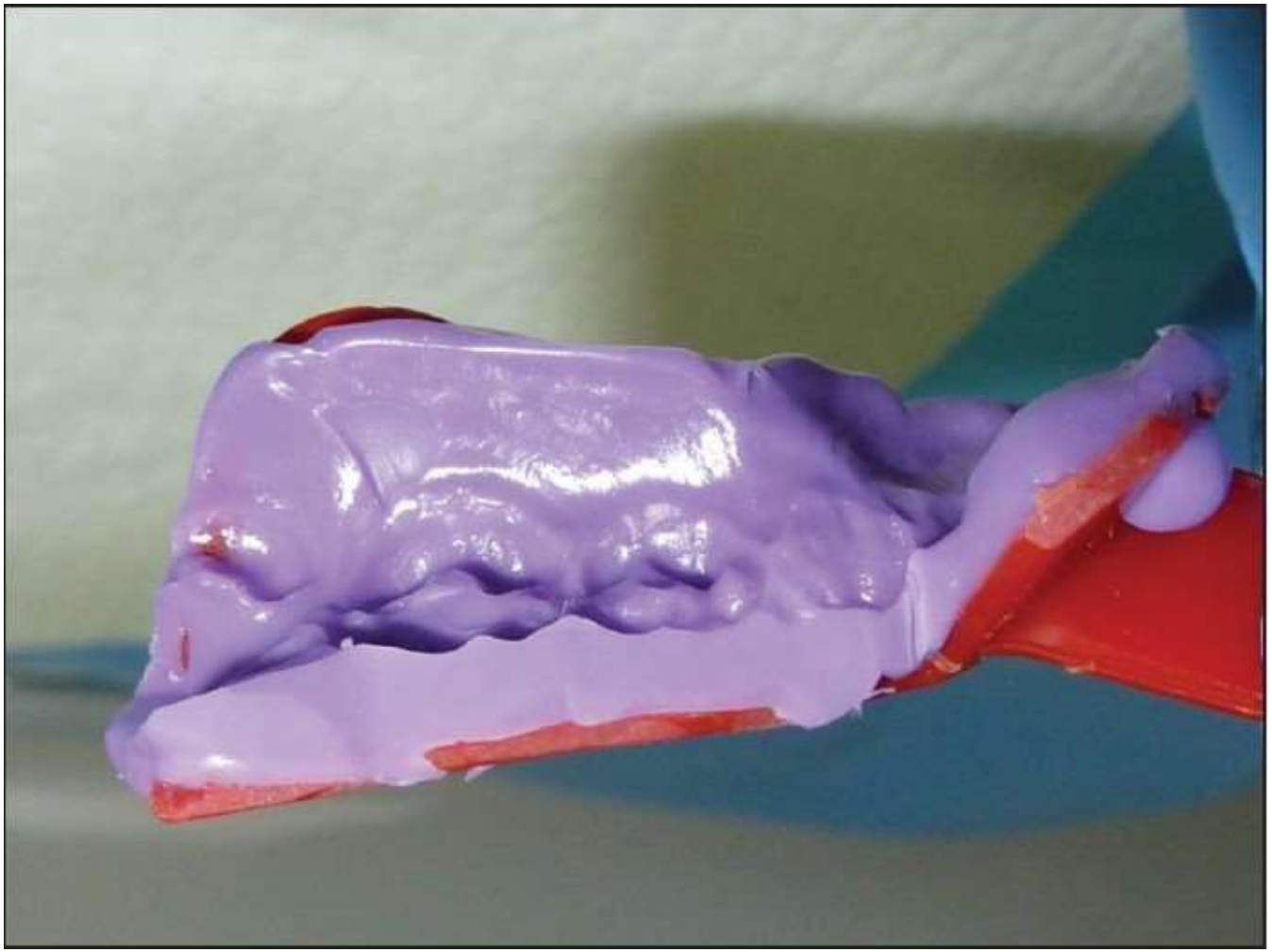
Sectional tray – cut the buccal flange

- This tray facilitates the carrying of the bite registration material into the patient's mouth and allows for accurate placement of the material in a patient who is devoid of any voluntary or involuntary control of muscle tone.



Dimashkieh M, Pani SC. A novel technique to check the occlusion during the placement of stainless steel crowns under general anesthesia. Saudi Journal of Oral Sciences. 2015 Jan 1;2(1):49.

Impressions are made separately for each quadrant, using a fast setting polyvinyl siloxane bite registration material



Dimashkieh M, Pani SC. A novel technique to check the occlusion during the placement of stainless steel crowns under general anesthesia. Saudi Journal of Oral Sciences. 2015 Jan 1;2(1):49.

The crowns are placed on the prepared teeth, and the template is placed on the crown to detect occlusal discrepancies and once these are corrected the template is used again to confirm the correct occlusion.



Dimashkieh M, Pani SC. A novel technique to check the occlusion during the placement of stainless steel crowns under general anesthesia. Saudi Journal of Oral Sciences. 2015 Jan 1;2(1):49.

- When cementing orthodontic bands to stainless steel crowns roughening of the internal surface of the band and external surface of the crown prior to cementation has been shown to improve retention.



Modifications

Mink & Hill 1971

1. *Undersized tooth or the oversized crown*

Crown is cut vertically along the buccal wall and the free ends are approximated and spot welded to reduce crown dimensions. After contouring the cut and relocated area is soldered and polished.

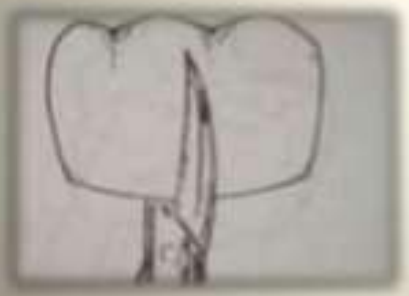
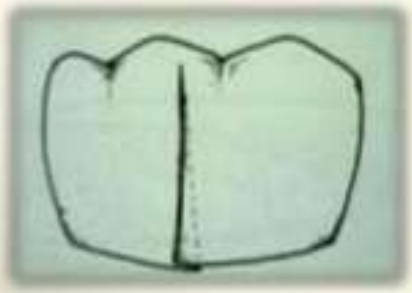
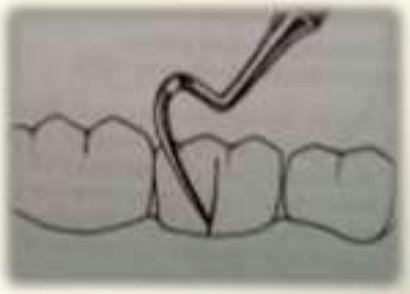
CLINICAL MODIFICATIONS

- **Undersized tooth and oversized crown.**

'V' cut made on the buccal surface of crown from gingiva to occlusal

→ Edges of 'V' reapproximated to overlap → Crown tried on tooth

And amount of overlap needed is marked → Overlapped edges welded


Oversized tooth & undersized crown

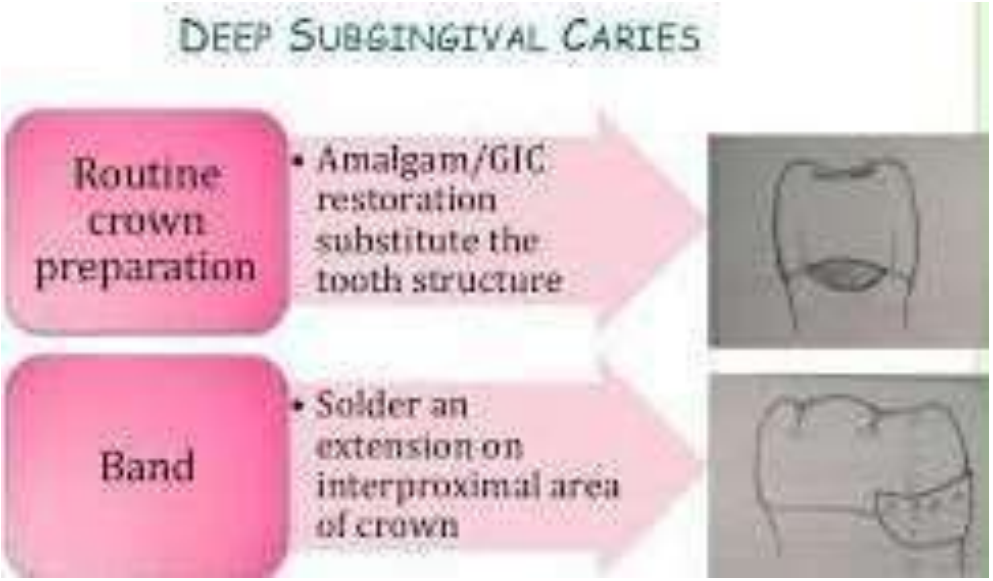
- A vertical cut is made on the buccal surface of the crown. The margins are pulled apart and an additional piece of band material is spot welded to the buccal surface

Deep subgingival caries

- It can be done by lengthening the crown with a spot welded and soldered piece of band material.

Open contact

- Selection of large size of crown



Microleakage of stainless steel crowns placed on intact and extensively destroyed primary first molars: an in vitro study.

The purpose of this investigation was to evaluate the effect of residual tooth structure on the microleakage of stainless steel crowns cemented with glass ionomer on primary maxillary and mandibular first molars.

Conclusion: There was no significant difference in the microleakage of sound or extensively carious teeth and primary maxillary or mandibular first molars.

Seraj, Bahman, et al. "Microleakage of stainless steel crowns placed on intact and extensively destroyed primary first molars: an in vitro study." Pediatric dentistry 33.7 (2011): 525-528.

Open faced stainless steel crown

- Roberts(1983) reported this
- In anterior teeth SSC's can be modified by this method.
- Labial surface trimmed away to leave a crown perimeter which is then restored with a resin veneering .
- Still some amount of metal being visible but esthetically more acceptable to patients & parents as compared to conventional ssc's.

Advantages:

Esthetics is improved.

Tooth structure is accesible for pulp testing.



Veneered stainless steel crowns

- available with variety of facing materials such as composite resin or thermoplastic resin bonded by a variety of mechanical & chemical bonding approaches to SSC's.

Advantages

- Enhanced esthetics
- Retention that is similar to traditional SSC's



Disadvantages

- Problems with contouring/crimping of the crown could cause fracture or loss of veneer .
- Substantially more expensive
- Cannot be heat sterilized
- Eg : cheng crown

- have resin composite facing

-Welded metal meshwork for mechanical retention.



Whiter biter crowns II

- Flexible thermoplastic veneer
- Nusmile primary crowns
- Have composite resin facing .

Kinder crowns

- Have composite resin facing
- Veneered directly to steel surface

In vitro anti-caries effect of fluoridated hydroxyapatite-coated preformed metal crowns.

- **AIM:** To synthesize fluoridated hydroxyapatite (FA) crystals directly on preformed metal crowns (PMCs) and evaluate the anti-cariogenic properties in an in vitro model.
- **METHODS:** FA crystals were grown on etched PMCs and stainless steel discs and characterised by SEM. FA-coated discs allowed fluoride release to be assessed from a known surface area of FA crystals. Discs were divided into four groups (n = 6/group) and exposed to solutions at pH 4-7. Fluoride levels in solution were measured after each exposure.
- Twelve FA-coated and 12 non-coated PMCs were cemented onto human molars using glass ionomer (GI) or unfilled resin, making four groups of six teeth; FA-coated + GI, FA-coated + resin; non-coated + GI and non-coated + resin. Teeth were exposed to acidified gelatin (pH = 4.3) for 9 weeks.

Clark, D. R., et al. "In vitro anti-caries effect of fluoridated hydroxyapatite-coated preformed metal crowns." European Archives of Paediatric Dentistry14.4 (2013): 253-258.

- **RESULTS:**
- SEM showed FA crystal growth on interior and exterior of the crowns. Average fluoride release from FA-coated discs was 0.16 mg/L/cm² at pH < 5.0. Teeth were sectioned through the lesion. Polarised microscopic examination revealed significantly smaller lesions in FA-coated crown groups compared to non-coated crown groups.

- **CONCLUSION:** FA-coated PMCs demonstrated carious lesion preventing effects, i.e. fluoride release and reduction of demineralization at crown/tooth interface.
- FA-coated crowns could be an aesthetic, inexpensive and caries preventive alternative in clinical dentistry.

SSC's HALL TECHNIQUE

- Hall technique is a conservative alternative treatment for carious primary molars developed by Dr Norna Hall in 1980's

- It involves the use of ssc's to seal over caries lesions on primary molars using GIC , no caries removal involved no crown preparation, no administration of LA.

Advantages

- Non invasive
- Patient acceptance is good
- Good rate of longevity

- A retrospective study by Kevin ludwig et al evaluated the clinical & radiographic success of ssc's used to restore primary molars with caries lesions by both traditional technique and hall technique. Results showed a similar success rate for SSC's placed with traditional technique/Hall technique.

N.P.T Innes et al – hall technique restoration placed on primary molars with decay clinically to dentine by a single operator in general dental practice have similar success rate to other conventional restorative techniques.

Causes of SSC's failures

- Improper cementation methods with lost crown or open margins
- Poor crown adaptation and subsequently poor retention.
- Failure to pulp treatment.
- Recurrent caries especially in the interproximal areas.

Risks(review article by Ros C Randall JOCPD)

Periodontal concerns

- Goto reported the incidence of gingivitis in primary teeth restored with nickel chromium crowns. He found the percentage of gingivitis associated with crowns to be higher in posterior part of the mouth than anterior and to be more strongly associated with poor fitting crowns .

- Henderson reported that plaque accumulation index for ssc teeth was generally lower than that for the entire mouth.

- Webber found no adverse change in the health of gingiva after placement of PMC's

Nickel allergy

- Nickel hypersensitivity is more prevalent in females than males
- A study says its difficult to evaluate nickel release into oral cavity & salivary protiens may have a protective effect by acting as corrosion inhibitors on the surface of alby.
- Adjustments of crown by cutting or crimping the margin will leave a roughened surface. So to decrease corrosion its important to smoothen to high glass.

Longetivity of preformed metal crowns

- A study done by Braff compared PMC with multisurface amalgam in primary molar teeth. Braff suggested that for patients near 4 years of age, PMC's were more economical than multisurface amalgams.

- Dawson et al suggested for patients under 8 years of age, PMC were the treatment of choice for primary molars, particularly for multisurface lesions in the 1st primary molar.

A retrospective study by Louise B Messer drawn following conclusions(AAPD)

1. The success of crowns placed on primary molars increases with age of the child at initial placement.
2. Crowns placed over formocresol pulpotomies show a grater relative risk of failure than those placed over vital coronal pulps.
3. Crowns placed in children younger than 4 years are predicted to show a success rate approx twice that of class II amalgams for each year up to 10 years of service.

LITERATURE

- Einwag J Dunminger P
- compared 2 methods of restoring primary teeth that had multisurface lesion. (longitudinal study)
- SSC's proved far superior to multisurface amalgam restoration wrt lifespan and replacement rate. SSC's are not only acceptable but also more cost effective.

- Champagne C, Waggoner w et al reported in their study that parental satisfaction with preveneered SSC was more than only SSC

  - Ped Dent 2008

- A khatri b nandlal – Nano composite resin used along with sandblasted SSC had more shear bond strength than conventional composite resins

- Lopez-loverich AM et al conducted a study to evaluate retention of ant preveneered SSC(Nusmile) & conventional ssc’s on primary anterior teeth. There is good crown retention rates for both crown types with no statistical significance

- Queis H in 2010 reported that anterior veneered ssc is a common restoration to treat primary anterior teeth among pediatric dentists.

Conclusion

- Primary teeth play an important role in growth and development of children.
- Attempts to maintain primary teeth until the eruption of the successors have resulted in the introduction of many restorative technique and materials.
- SSC are modified in number of ways such that it can accurately duplicate the anatomy of primary molar teeth.

- Children with extensive decay, large lesions or multiple surface lesion in primary molars are treated using ssc’s as they provide protection from future decay by providing full covering to the tooth .


THANK YOU!
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SYSTEMIC FLUORIDES

Fluoride content in some commonly used foods (Mean value of F in ppm by Dilnawaz et al (1973)

Cereals	Pulses and legumes	Vegetables
1. Whole Wheat -2.920	**Bengal gram flour -8.06**	**Amaranth leaves -6.154**
2. Wheat flour milled-5.4	Green gram whole -5.88	Carrots - 3.425
3. **Rice - 7.720**	Bengal whole gram -4.21	Chowli leaves – 4.04
4. Bajra - 1.885	Green gram dal -2.96	Tomato – 1.366
	Red gram dal – 3.590	**Betel leaves - 8.808**

Fruits	Animal foods	Beverages
1. Sweet lime – 1.835	Beef – 4.416	**Tea, dry leaves – 56.640**
2. Oranges – 1.745	**Fowl – 6.066**	Tea (1 g boiled in 125 gm water, 5 min)- 40.649
3. Apple – 1.744	Pork – 3.533	Sugar cane juice – 1.198
4. Grapes – 1.360	Mutton – 3.083	Tap water – 0.083
5. Banana – 1.096	**Bombay duck dry –6.149**	Coconut water – 0.508

Fluoride distribution

- The latest estimates suggest that around 200 million people, from among 25 nations the world over, are under the dreadful fate of fluorosis.
- India and China, the two most populous countries of the world, are the worst affected.
- India is plagued with numerous water quality problems due to prolific contaminants mainly of geogenic origin and fluoride stands first among them.

Fluoride distribution

- The unfettered ground water tapping exacerbates the failure of drinking water sources and accelerates the entry of fluoride into groundwater.
- Most of the scientific literature substantiates the benefits of low fluoride concentrations in preventing **dental decay.**
- However, as a surprising paradox, incidence of dental, skeletal and crippling skeletal fluorosis was reported in India with average fluoride concentrations as low as 0.5, 0.7 and 2.8 ppm respectively.

The Indian Scenario

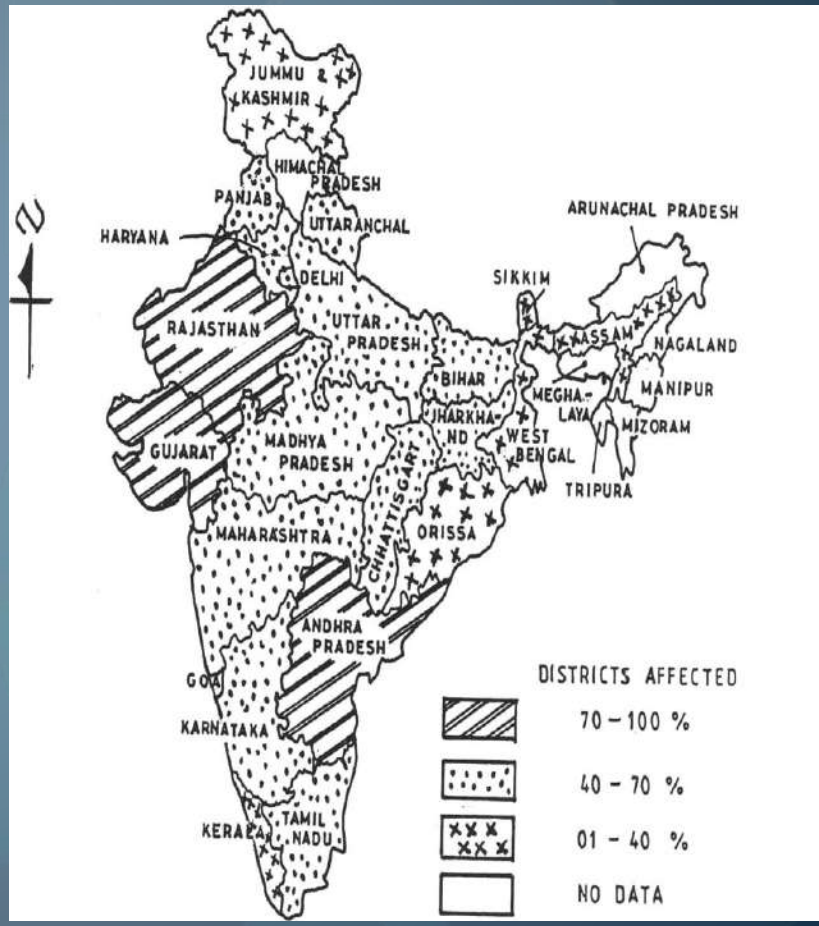
- Today India is the seventh largest, second most populous country in the world with a landmass of 3.29 million square km (slightly larger than a third of US) with more than 1.04 billion people, home to a-sixth of humanity.

- India possesses 16% of the world's population but with just 4% of its water resources. Though the surface water in India is scarce and groundwater is deep and difficult to reach, almost 90% of the drinking water needs are met from groundwater only.

The Indian Scenario

- In early 1930s fluorosis was reported only in 4 states of India, in 1986 it was 13, in 1992 it was 15, in 2002 it was 17 and now it is 20, indicating that endemic fluorosis has emerged as one of the most alarming public health problem of the country.

- Among the affected states, Rajasthan, Andhra Pradesh and Gujarat are most endemic. People in several districts of Rajasthan and Assam are forced to consume water with fluoride concentration up to 44 ppm and 23 ppm, respectively.
- The Mega City of Delhi is endemic for fluorosis with natural maximum fluoride concentration of 32 ppm.



History of fluoride



- **1717-** Fluorine discovered by chemist Scheele.
- **1846** – First reference of fluoride in water in Britain made by Wilson. (calcium fluoride in well of Edinburgh)

- **1859** - Dental treatments were also performed for a long time by so-called "craftsmen", the latter organized the American Dental Association. The new profession approached a certain scientific status with research on "mottled teeth"

- **1878**- Earliest reference relating fluoride to dental caries by Magitot.
- **1892**- Sir James Crichton Browne was inspired about the importance of fluoride in diet.

- **1901**- Dr. Fredick Mckay was the first person to notice the stains on teeth "Colorado stain"

History of fluoride



- **1902** – Dr. J M Eager reported high proportion of brown stains of Italian residents of Napels. “denti di chiae”
- **1916**- First large survey by Mckay & GV Black to know the cause of mottling.
- **1931**- Churchill developed a method for determining conc. of fluoride in drinking water.(Finaly it was known that F is the actual culprit behind the ugly condition of the teeth.)
- **1931** – Mr A W Petrey of ALCOA lab noted F present in water at 13.7 ppm
- **1931** - Shoe Leather Survey by Dr Tredley Dean
- **1934** – Mottling index by Tredley Dean
- **1939**–McKay and TrendlyDean concluded that the incidence of mottled enamel were halted by reducing the level of fluoride in water to 1ppm.

History of fluoride

- **1942** – Dean found relation between increasing fluoride and decrease in caries and maximum reduction in caries with 1 ppm Fluoride

- **1945** – NaF added to Grand Rapids water supply

  This proved the inverse relation of F and dental caries

  To support this fluoridation studies
  - Newburgh – Kingston study
  - Evanston – Oak Park study

History of fluoride

- **1946** – Klein observed
  - Teeth in process of eruption received maximum benefits
  - Teeth exposed shortly after eruption protected to a lesser degree

- This led to water fluoridation for communities and topical fluorides for individuals.
- **1964** – WHO and pan American health organization endorsed the practice of water fluoridation.

The shoe leather survey

- Collection of epidemiological and other pertinent data relevant to an epidemiological investigation by painstaking direct inquiry among all or a representative sample of the affected people, **for example by walking door to door (wearing out shoe leather in the process, hence the term) to ask direct questions**.

John Snow used this method in his investigations of cholera in the 1850s, and it was refined in the United States by the field officers of the ***Epidemic Intelligence Service*** **(EIS).**

The shoe leather survey



- Dr. Clinton T. Messner assigned a young dental officer Dr. Henry Trendly Dean (1931) to pursue a fulltime research on mottled enamel.
- He sent questionnaire to every state and local dental society in the country and asked weather mottling existed or not. If yes then the source of water was enquired.
- 632 replies out of 1197 questionnaires were received it was observed that 97 localities in US were effected by mottling.
- *Observation on 5,824 white children in 22 cities of ten states revealed that where water concentration was 3 ppm or more, mottling was widespread.*
- His aim was to find the minimal threshold of fluoride.

The shoe leather survey

- He gave the following observations

Water concentration of F	Signs
4 ppm or more	Discrete pitting
3 ppm or more	Wide spread mottling.
2-3 ppm	Dull chalky appearance.
1 ppm	No mottling
Less than 1 ppm	Incidence of caries was less as compared to non fluoridated areas.

Natural Fluoride areas – Dental Caries

- Ainsworth's report (1933) stated that caries in high fluoride areas was markedly lower than other areas.
- Dean reports inverse relationship between level of mottling and prevalence of caries in community.
- Dean in his survey of 9 year old 114 children in 1938 concluded that:

"In as much as it appears that the mineral composition of the drinking water may have an important bearing on the incidence of dental caries in a community, the possibility of partially controlling dental caries through the domestic water supply warrants thorough epidemiological- chemical study"

Natural Fluoride areas – Dental Caries

- Dean et al 1939 surveyed four cities in Illinois.

Galesburg & Monmouth (water supply- 1.8 & 1.7 ppm F)

Macomb & Quincy (water supply – 0.2ppm F)

885 children,12-14 years were examined. It was found that caries experience in **Macomb & Quincy** was more than twice as caries in **Galesburg & Monmouth**.

This prompted him to take up a extensive survey across US.

At last he concluded that maximal reduction in caries occurred with concentration of 1ppm F in drinking water,

Artificially Fluoridated Areas

Dr. Dean and department of state health and university of Michigan conducted the study (1944) :

Grand Rapids - Muskegon Study.

Grand rapids – experimental town.

Muskegon – Control group.

Base line score was almost similar in children aged between 4-16 years in 1944.

1945 NaF added to water supply in grand rapids.

Artificially Fluoridated Areas

- The effects were reported after 6 1/2 years by Arnold, Dean and Knuston in 1953.
- Results showed that caries experience of 6 year old Grand rapid children was almost half that of a 6 year old Muskegon children.



New burgh-Kingston study

- Study directed by David B. Ast, chief of Dental bureau, NY.
- 2nd May 1945, NaF – Drinking water Newburgh.
- Control group 35 miles – Kingston town.
- Clinical examination after 10 years 1955 reveled -

  Newburgh- DMF decreased from 23.5%- 13.9%

  Kingston – 23.1% caries teeth raised to 26.3% caries.

Evanston - Oak Park Study

- Conducted by-J R Blayney, I N Hill, S O Zimmerman (1946-1960)
- In Evanston, Illinois- water Fluoridated 1ppm.
- Oak Park – Control Group.
- In Evanston after 14 yrs. drop in caries by49% (DMF 11.66-5.95)
- No change in DMF of Oak Park

Here three American studies, carried out by different investigators in different parts of the country reached similar conclusions: 1ppm of Fluoride in drinking water reduced caries experience by 50%.

Canadian studies (Brantford, Sarina & Stratford)

- By – Hutton, Linscott and Williams 1951; Brown 1965.
- Brantford-Fluoride added in water supply- 1945.
- Sarina – Control town.
- Stratford – Fluoride naturally occurring.

- After 17 years- Brantford & Stratford caries experience reduced by 55% lower than that of Sarina.

Dutch Study (Tiel- Culemborg)

Tiel- 1953-march drinking water Fluoridated at 1.1ppm
Culemborg – Control group
1953-1969 the 15 year old children born in 1954 onwards
Kwant et al 1973.

	No. children	Pit & fissure	Approximal	Free smooth surface	total
Culemborg	135	12	10.1	3.6	25.8
Tiel	147	8.3	2.5	0.5	11.3
Difference %		31	75	86	

New Zealand study (Hasting)

- Base examination in 1954. further examination in 1964 (10 years)
- Ludwig 1965, 1971 reported that mean DMFT of 15 year old fell from 16.8 in 1954 to 8.5 in 1970, reduction of 49%.
- In these as the Dutch study-

  SSC reduced by 87%

  Approximal caries reduced by 73%

  Occlusal surface caries reduced by 39%

British studies Naturally occurring Fluoride Areas.

- South Shields (F content in water 1.4ppm) caries experience 50% lower than North Shields (F content 0.25)- observed by Weaver.(1944)

- West Hartlepool reported less than 1 DMFT because F content in water was 2ppm.- Weaver(1950)

- Forrest (1956)- compared caries prevalence between fluorinated and non fluorinated areas, and observed markedly lower caries in high fluoride areas in Britain.

British studies Artificially created Fluoride Areas.

- Watford, Kilmarnock and part of Anglesey- Fluoride was added to drinking water (1955-56).
- Sutton, Ary and remaining part of Anglesey- control group.
- After 5years a reduction of 50% in caries was reported in fluoridated areas.(In spite of this fluoridation was discontinues in Kilmarnock 1962 on instructions of the local council)
- 1969 the report confirmed that water fluoridation is a highly effective method to reduce dental decay.

  (reduction of 31%-43%)

Legal aspects of water fluoridation

- After the study in Kilmarnock 1962 and subsequently report on water fluoridation 1969 the govt. announced to give unlimited indemnity to any local authority in respect of actions for damages based on alleged harm to health resulting from fluoridation.

- Justice Kenny 1964, in the Irish High court held for the first time that fluoride ingested at a concentration of 1ppm in drinking water was safe and adding fluoride to public water supplies was not a violation of constitutional rights.

Legal aspects of water fluoridation

- By 1971 only 5% of the total population in UK was under water fluoridation which increased to 10% by 1980.

- 1977 Strathclyde Regional health Authority introduced water fluoridation in Scotland but was taken to court by Mrs. McColl.

- 1983 Judge Lord Jauncey ruled that water fluoridation in Scotland was *ultra vires*.

  This led to end of water fluoridation in Scotland.

  However 1985 law was changed in UK by means of water fluoridation bill to ensure that the fluoridation schemes could continue.

WHO guidelines

- The 1984 WHO guidelines suggested that in areas with a warm climate, the optimal fluoride concentration in drinking water should remain below 1 mg/litre (1ppm or part per million).

- While in cooler climates it could go up to 1.2 mg/litre. The differentiation derives from the fact that we perspire more in hot weather and consequently drink more water.

- The guideline value (permissible upper limit) for fluoride in drinking water was set at 1.5 mg/litre, considered a threshold where the benefit of resistance to tooth decay did not yet shade into a significant risk of dental fluorosis.

Classification

SYSTEMIC INCLUDES

Dietary fluoride

Fluoride in sugar

Salt fluoride

Dietary fluoride supplements

- Fluoride drops
- Fluoride drops with vitamins
- Fluoride tablets/lozenges
- Fluoride tablets with vitamins
- Fluoride sustained release
- Fluoride devices
- Fluoride rinse fluoride solution

Water fluoridation

School water fluoridation

Milk fluoridation

Systemic fluoride

- Fluoride after ingestion can get absorbed and incorporated into the developing enamel and can benefit teeth before eruption

- It also benefits the teeth after their eruption, when it returns to the mouth in saliva and gingival exudate.

Average reduction of dental caries through different methods of fluoridation

METHODS	% OF REDUCTION
Community water fluoridation	50-60%
School water fluoridation	40%
Diet	50-60%
Professionally applied	30-40%
Self applied	20-30%

Water Fluoridation

- Defined as an upward adjustment of the concentration of fluoride ion in public water supply in such a way that the conc. of fluoride ion in water may be consistently maintained as 1 ppm. by weight.

- As discussed earlier -Studies have shown that the adjustment of fluoride concentration in drinking water to the optimal level of 1ppm is associated with a marked decrease in dental caries

- Recommended daily dosage of fluoride for children above 3yrs of age is 1mg.
- This can be obtained by drinking 1lt of water with concentration of 1ppm fluoride ion.

- Amount of water consumed will vary with temp. The fluoride ion concentration that is considered optimal for a particular locality is predicted by the average of the maximum daily temperature.

Galagan and Vermillion's empiric formula -

- In 1957- To estimate the amount of daily fluid intake based on body weight and climatic conditions, using the mean annual max. daily air temperature:

Ppm F= 0.34/E

E=-0.038 +0.0062 x Temperature of area in Fahrenheit.

For colder climatic areas fluoride concentrations as high as 1.3ppm is considered safe.

Fluoride compounds in community water

- Sodium fluoride: First compound used in a controlled fluoridation program
- Sodium Silico Fluoride: replaced sodium fluoride owing to its low cost
- Hydro Fluorosilisic Acids: there has been an increased use
- Ammonium Silicofluoride.
- Fluorspar

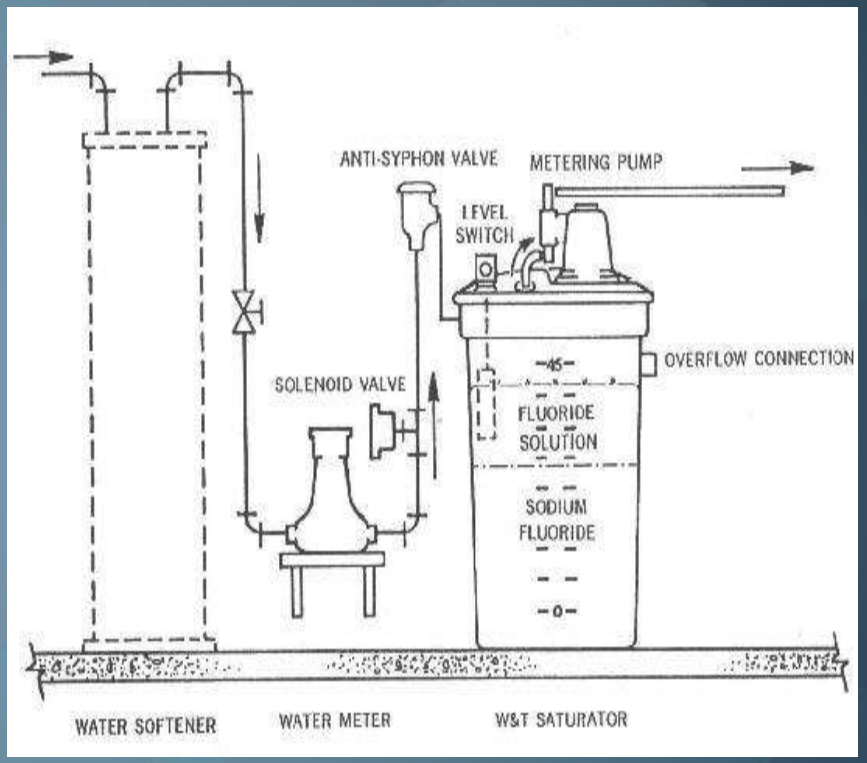
Equipments for water fluoridation

- Saturator system
- Dry feeder
- Solution feeder

Procedure	*Factors limiting usage*	*Recommendation*
4% saturated solution of NaF is produced and injected at the desired concentration in the water distribution source with aid of a pump.	Need to clean gravel bed used for filtration	Suitable for medium sized towns requiring less than 3.8 million lit/day.
NaF or silicofluoride in the form of powder is introduced into a dissolving basin	Care in handling fluoride, obstruction of pipes and compacting of fluoride while storage	Suitable for medium sized towns requiring 3.8 million lit/day to 19 million lit/day.
Volumetric pump permitting the addition of a given quantity of hydrofluosilicic acid in proportion to the amount of water treate	The equipment must be resistant to attack by hydrofluosilicic acid, necessitating construction in polyvinyl chlorides or another plastic.	Suitable for medium sized and large towns with a capacity of more than 7.6 million lit/day.

Fluoride Saturator

- In a fluoride saturator, the incoming water becomes saturated with sodium fluoride as it percolates up through the granulated sodium fluoride bed.
- This provides a four-percent sodium fluoride solution.
- This solution is injected into the water supply at a rate calculated to maintain a fluoride concentration of 1.2 ppm.

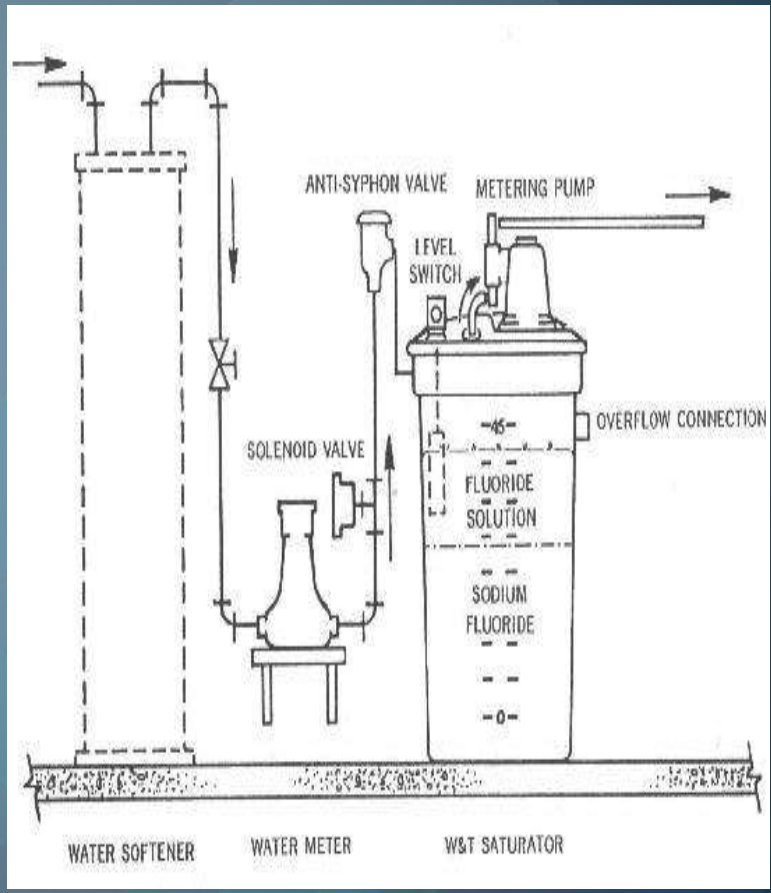


To prevent scale formation, a softener should be used to soften the makeup water for the saturator when the hardness exceeds 75 ppm as calcium carbonate or 4.4 grains.

This softened incoming water should then go through a water meter, a solenoid valve, or a flow control valve and a backflow preventer. The water is piped into the saturator through a diffuser system.

A constant water level is maintained inside the saturator by means of a float connected to a liquid level switch.

The upward flow rate should not exceed 2 gpm. The tank should be filled manually each day while recording the amount used so that the level remains constant.

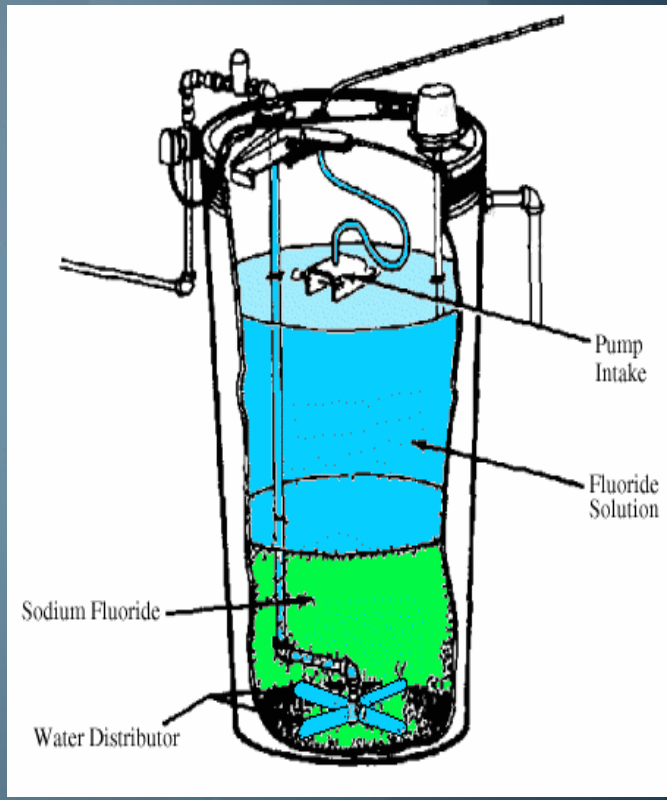


Operation

To operate the saturator, the following steps should be taken:

1. Mark the outside of the saturation tank at the five-inch level. This is the minimum depth of sodium fluoride needed in the tank to maintain a four-percent solution.
2. Turn on the power source for the valves to allow the water to fill the tank and begin to dissolve the sodium fluoride.

   The flow of water should shut off automatically when the proper level is reached in the saturator. There should be a minimum of 1 foot of water above the sodium fluoride bed.
3. Submerge the chemical feed pump suction line just below the water surface and start the pump. Set the pump at the desired feed rate (which will have to be calculated).



Maintenance

The saturator should be cleaned periodically according to the following procedures:

1. Allow the system to operate without adding chemical until the fluoride bed is depleted to a point that the diffuser is exposed.
2. Disconnect the power to the level control. Allow the chemical pump to run until only about one foot or less of solution remains above the fluoride bed.
3. Remove the cover from the saturator.
4. Remove the drain plug and allow the tank to drain. Agitation or stirring may be necessary to loosen the hardened material. Be careful not to damage the diffuser. The diffuser assembly can be removed if it is not embedded in the fluoride bed.
5. Rinse the inside of the tank to remove any built up deposits.

Acid Feed System

- Despite the name, solution feeders can be used for either liquid or dry chemicals.
- If the fluoride source is a liquid, then the fluoride can be fed directly into the water main using an **acid feed system**.
- If the fluoride source is a solid, a saturated solution can be produced using a saturator and the solution can then be fed into the water main.
- In either case, positive displacement pumps are used to pump the appropriate quantity of the fluoride solution into the water being treated.

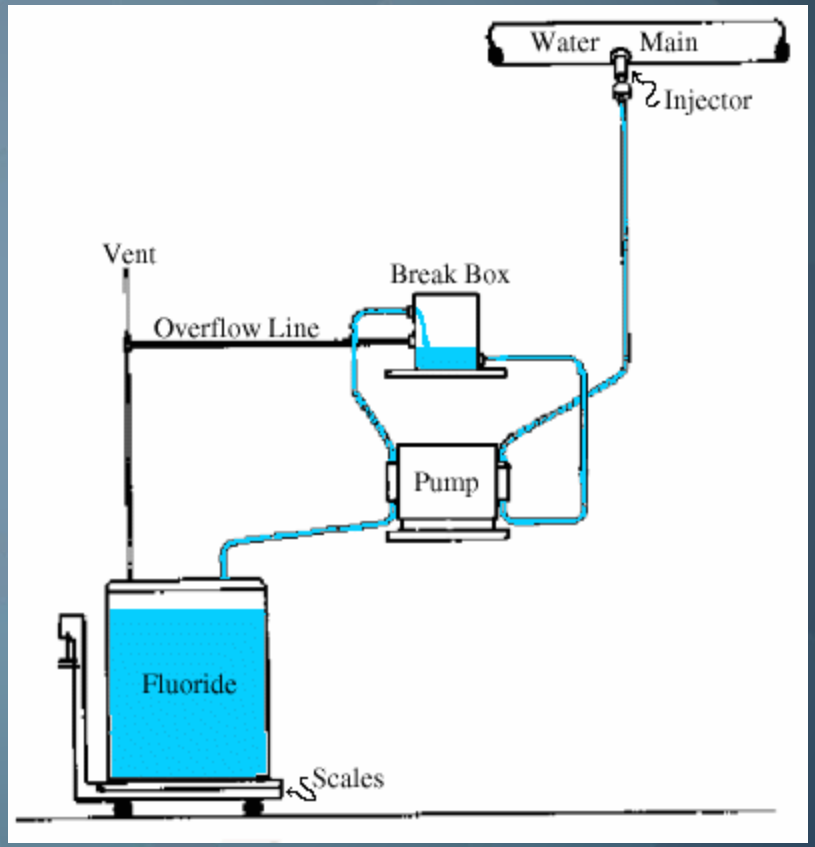
Acid feed systems

- The acid feed systems, which are usually used for pumping hydrofluosilicic acid into water.

- The setup is known as an acid feed system since hydrofluosilicic acid is pumped into the water in the same state in which it was delivered.

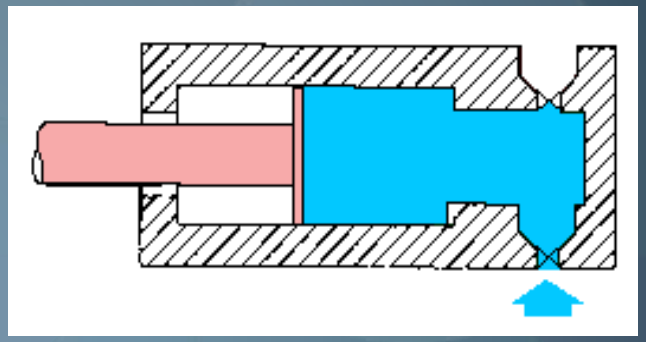
Acid feed systems

- The hydrofluosilicic acid begins in the shipping container, which is placed on a scales to measure the remaining liquid in the container (just as was done for chlorine cylinders.)
- A pump pulls acid from the shipping container into a **physical break box**, the purpose of which is to prevent a major overfeed of acid into the main flow of water.
- From the break box, the fluoride flows to the other side of the pump and is pumped to the water line.

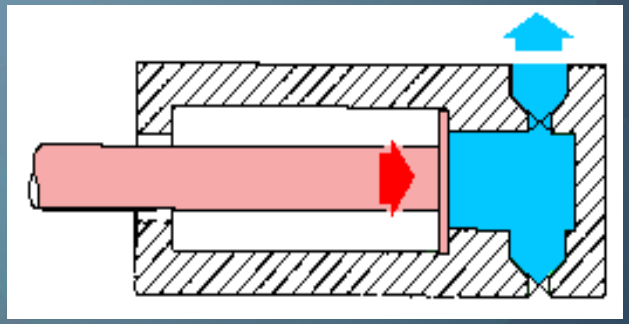


Positive Displacement Pumps

- In the acid feed setup shown in the previous section, the amount of fluoride solution added to water is measured by a pump.



- **Positive displacement pumps** are used in solution feeders to feed a measured volume of a liquid chemical during a specific time period.



- They have several advantages over other types of pumps, being accurate and capable of feeding a solution against pressure into a pipe or tank of water as well as into open tanks of water.

TESTING FOR FLUORIDE CONCENTRATION

This can be done in one of two ways:

1. By the SPADNS method, which measures the change of colour intensity in the SPADNS reagent when a sample containing fluoride is added.

   The change can be measured by comparison with colour standards provided with a SPADNS test kit or by photometric measurements using a colour meter.

TESTING FOR FLUORIDE CONCENTRATION

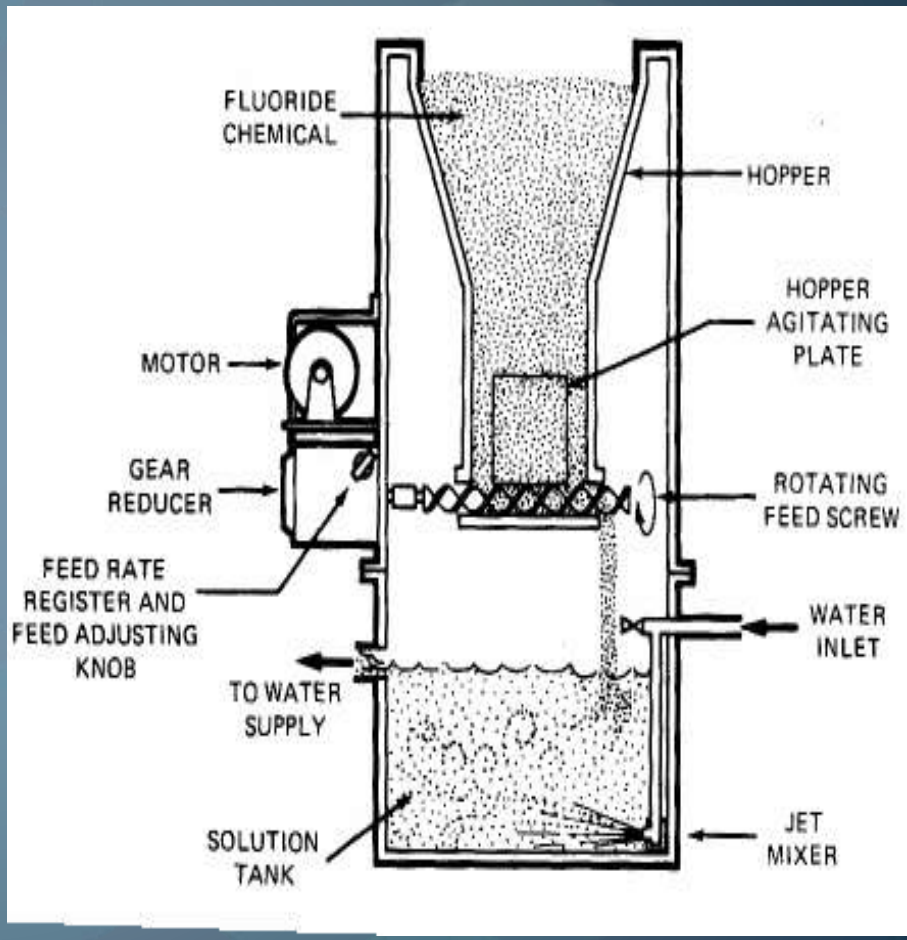
Some chemicals other than fluoride may interfere with the SPADNS test result and cause faulty readings.

Polyphosphate is the most common chemical used in drinking water that will give you a false high reading.

2. By use of a fluoride electrode and a meter that indicates the fluoride concentration. Other chemicals usually do not interfere with this test method.

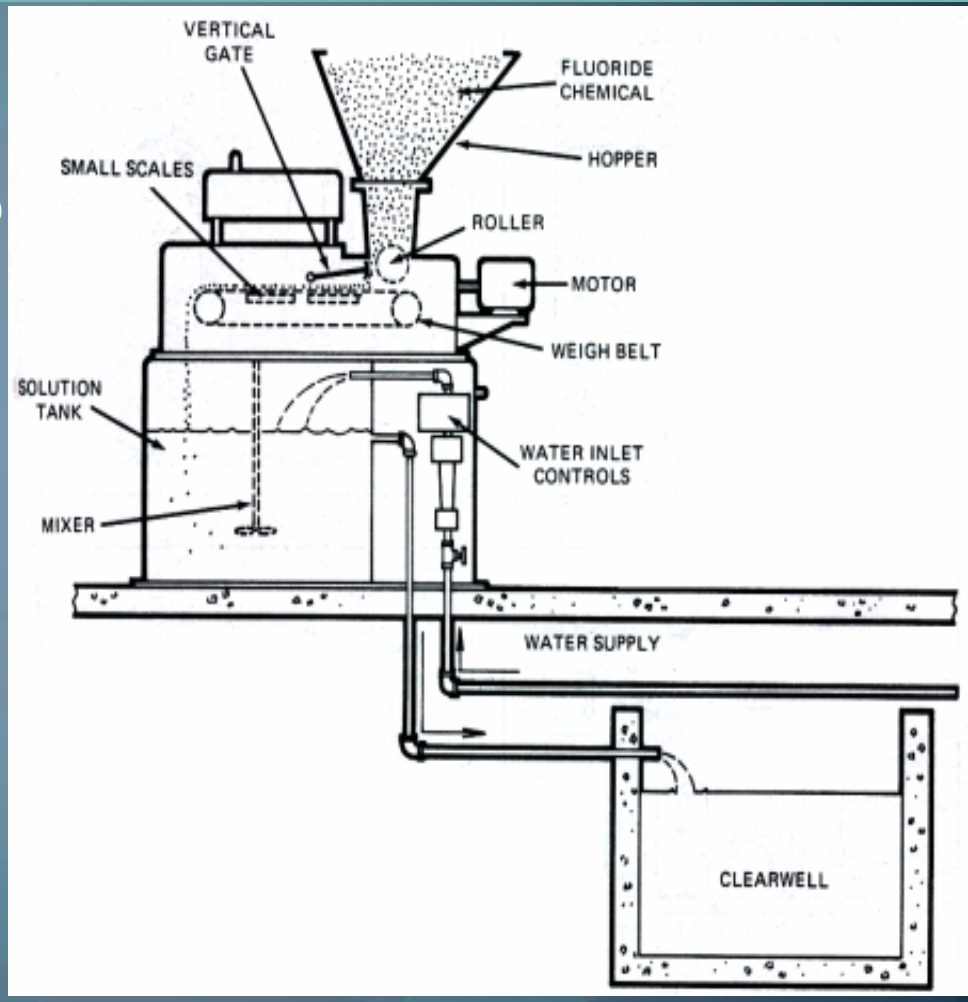
Volumetric Feeders

- **Volumetric feeders** feed a measured volume of dry chemical within a given time interval.
- The picture shows one type of volumetric feeder, in which the chemical begins in the hopper and is measured by a rotating screw.
- The dry chemical is then dropped into a solution tank where it is mixed with water to produce a fluoride solution.
- The solution can then be pumped to the water supply.



Volumetric feeders

- Volumetric feeders can also measure chemicals using rotating disks, oscillating pans, vibratory pans, rotating rollers, or star wheels.



Benefits of water fluoridation

- Cariostatic effects of water fluoridation in children are not limited to permanent dentition but also extented to primary dentition as well.

- This method is preferred since some tooth surfaces receive greater protection against caries than other eg- smooth surfaces of teeth, esp proximal surface derive maximum protection than do pit and fissures on the occlusal surfaces

Benefits of water fluoridation

- Water fluoridation has both pre-eruptive and post-eruptive effects

- Fluoridated drinking water not only acts systemically during tooth formation to make dental enamel more resistant to dental decay, but also has topical effect through the release in saliva after ingestion.

Benefits of water fluoridation

- Fluoride in saliva through systemic mode remains elevated for an extended period, provides protection against demineralization and facilitates remineralization.
- It changes the morphology of occlusal surfaces by making pit and fissures more shallow and self-cleansing
- Most effective and least expensive way to provide fluoride to large group of people.

- Beverages bottled in fluoridated areas or other such products may pass on the beneficial effects to fluoride deficient/deprived population.

  This is termed '**Diffusion**' or '***Halo' effect***.

Limitations of community water fluoridation

- The crucial requirement for community water fluoridation is a well-established, centralized piped water distribution system. Unfortunately, in most developing countries, where dental caries is increasing sharply, centralized water distribution system is often lacking even in densely populated urban areas and they are rarely found in rural areas.
- Interfere with Human rights.
- Other modes are not considered.

School water fluoridation

- 1947 - BOSTON - The Massachusetts Department of Public Health put *fluoride* in the *water* at two state *schools* for the mentally retarded in *1947*, four years before it was legal and considered beneficial to *fluoridate*.

- May 3, 1949 - *Fluoridation* of the *water* supply at the Soulhbury Training *School* for the last four years prevented a large measure of dental decay among children there.

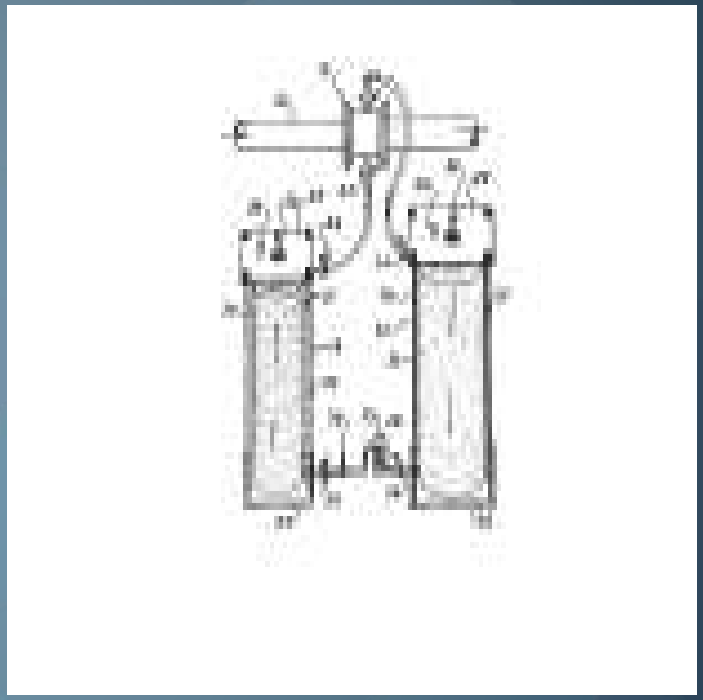
- Mar 14, 1963 - Tooth decay in Philadelphia *school* children was reduced by 75 per cent after seven years of *water fluoridation*.

- Dental exams show- “Definite and conclusive evidence that fluoridated *water* is the greatest instrument today in preventive dentistry," said Dr. Abram 1963.

- School water fluoridation is a suitable alternative where **community water fluoridation is not feasible**.
- The amount of fluoride added to school drinking water should be **grater than normal** because children have to stay in school for a short time and to compensate for holidays and vacations.

- The current recommended regime is to **add 4.5 times** the original F content.
- 25-40% decrease in dental caries with this programme.

Simple fluoridators which employ Venturi system are most suitable as they require no maintaince and can be utilize in small installations in medium or small school as well.



Advantages of School water fluoridation

- Good results in reducing caries
- Minimal equipment.
- Not expensive.



Disadvantages of school fluoridation

- Children do not receive the benefit until they go to school.
- Not all children go to school in underdeveloped countries.
- Amount of water drunk can't be regulated.

Effect of school water fluoridation on dental caries:

Results in Seagrove, after eight years

SB Heifetz, HS Horowitz, and WS Driscoll

In 1968 at Seagrove, NC, fluoride was added to the water supply of a rural school (grades 1 - 12) at a level of **6.3 ppm**, seven times the optimum level recommended for community water fluoridation in the area.

Findings after eight years showed that children in grades 1 to 8 had approximately **40% fewer** DMF surfaces than did their counterparts on the baseline.

A comparison of these findings with those of another school fluoridation study, in which a **level of 4.5 times** the optimum concentration had been tested, showed only a **slight advantage** to the children at Seagrove.

However, the full potential of school water fluoridation at seven times the optimum level cannot be determined until children in all grades will have been exposed since entering the first grade.

Journal of the American Dental Association, Vol 97, Issue 2, 193-196
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MILK FLUORIDATION



- First suggested by Zielger in 1956.(250mg milk contained 0.625mg of fluoride)

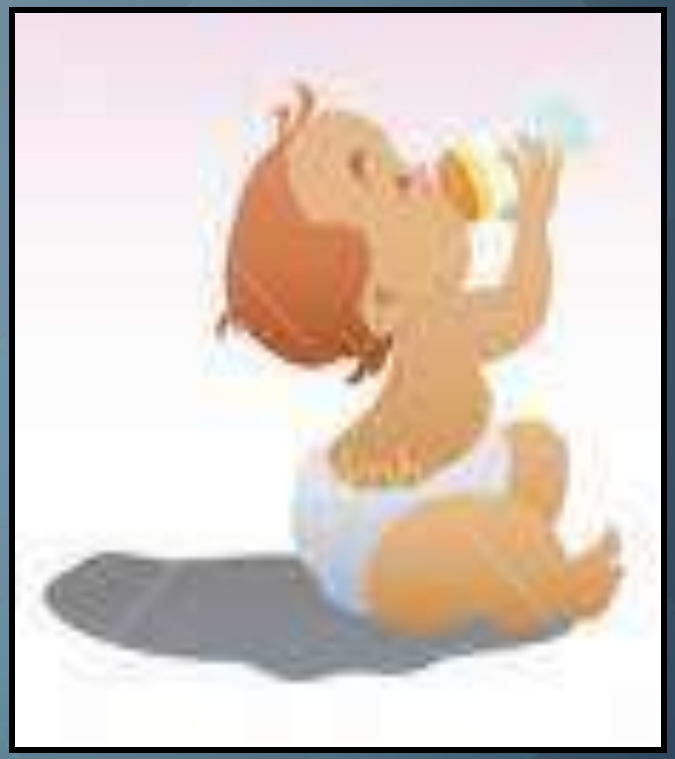
- Since milk is vital in our diet, it was considered a suitable vehicle for fluoride supplementation for children residing in areas with fluoride deficient water supplies.



HISTORICAL BACKGROUND

- Inamura (1959) from Japan reported a 36.3% caries reduction when 2. 5 mg NaF was added to milk and served daily in school meals.

- Rusoff et al. from U. S. A. (1962) reported a 35 % caries reduction with 3.5 ppm of fluoride in milk.



- ***Fluoride in milk can be in the form of sodium fluoride, disodium monofluorophosphate, calcium fluoride and disodium silicofluoride.***

- When **pasteurized milk** is prepared, fluoride can be added before or after pasteurization, provided the solution to be added is sterilized

Inspite of controversy concerning the binding and complexing of fluoride with calcium and protein of the milk and thus making it unavaible for its anticarioogenic action.

Ericsson (1985) using radio isotopic technique proved the availability of fluoride from milk is the same as from water 4 hours after consumption.

- **UHT (Ultra High Temperature) milk** is long life liquid milk, which is preserved by means of high temperature processing to eradicate all microorganisms.
- This temperature is usually 140°C for four seconds.
- Due to this temperature, the milk often loses its flavor. Hence addition of sweeteners or flavoring agents is frequently required.
- Fluoride is added before the heat treatment.

- **Powdered milk**: The removal of water from milk gives us powdered milk. Sodium fluoride solution is added to the evaporated milk before it is spray dried.

- The above-mentioned products have been shown to be stable with high fluoride availability.

Bioavailability of fluoride from milk

Fluoride bioavailability from milk that is ingested has been shown to vary with the gastric pH, sequence of consumption of milk, fluorides and other foods if any.

- Also, breast fed infants are supposed to receive very low amounts of fluorides from maternal milk.

- Fluoridated milk when consumed, has been shown to increase the fluoride content of dental plaque significantly.

- It has a dual effect i.e. both systemic when taken during tooth development and topical after tooth eruption.

Advantages of milk fluoridation are

- Wide consumption especially in younger age group
- Good absorption
- Little alteration in taste
- Cariostatic effect of fats and Proteins could occur as an added benefit.

Disadvantages

- In India, Majority of the children population living in rural areas.
- There does not exist a central milk supply system in these areas.
- Variation of intake and quantity of milk is another factor which cannot be controlled since it depends upon the socioeconomic, religious and ethnic factors.
- It requires parental or school efforts.
- High cost

Borrow Dental Milk Foundation (UK)

The Borrow Dental Milk Foundation was **established in 1971** with the primary objective to promote and support research into the use of fluoridated milk as a **measure to improve oral health and nutritional well** being of children worldwide.

The Trustees of the Foundation considered applications for assistance to develop:

Community level demonstration projects which evaluate the efficiency and organisational pattern of milk fluoridation for the prevention of dental caries as alternative to other systemic uses of fluoride.

The International Milk Fluoridation Programme

In 1986 an agreement was reached between WHO and BDMF (Borrow Dental Milk Foundation) which constitute d the International Programme on Milk Fluoridation aimed at close collaboration on various milk fluoridation projects for dental caries prevention in children.

Dr Gennady N. Pakhomov, Responsible Officer, WHO Oral Health Programme,

Based on Laboratory studies in the UK resulting in the discovery that fluoride availability can remain high in various forms of milk (pasteurised, sterilised, ultra heat treated and powdered) using only a simple production technique.

Promising Results

- A research project implemented in Italy found that consumption of fluoridated milk by pregnant women resulted in fluoride levels in amniotic fluid being sufficient to benefit the oral health of their offspring to the same *degree as* that achieved by taking NaF tablets.

- Animal experiments into fluoride bioavailability in fluoridated milk carried out by measuring fluoride incorporation in the incisor teeth of sheep was recently completed in New Zealand.

- Results revealed that the mean fluoride concentration in the tooth tissues were similar in respective milk and water groups indicating a similar bioavailability of fluoride from both media.

Ivanova K et al, J Public Health Dent 1995 55 (4):234-237.

Fluoridated sugar:

- Adding fluorides to sugar is not presently used, but has been proposed as a possibility.

- A study group was formed at the Oral Health Programme in Geneva (1989) to consider the possibility of reducing caries by addition of Fluoride to sugar.

- It was found that concentrations of **2 to 5 ppm** in sucrose solutions reduced caries experience by 43 - 44%.

- This effect is largely attributed to a re-precipitation of fluoride rich apatite on the tooth surface.

- The information obtained is however too scarce to recommend field trials.

Dent Res 9:3-5, February, 1995
Adding Fluoride to Sugar—a New Avenue to Reduce Dental Caries, or a "Dead End"?- D. Bratthall et al

SALT FLUORIDATION

- The introduction for using fluoridated salt was started in Switzerland in 1955 (Wespi) after it was substantiated that iodization of salt brought about prevention of goiter.

- Since then studies have been conducted throughout the world with concentration of fluoride in salt ranging from 90 mg. fluoride/kg salt initially in Switzerland to 200-350 mg/kg salt in Columbia, Spain and Hungary.

SALT FLUORIDATION

- In Switzerland and Hungary, fluoride is added to salt by spraying concentrated solutions of Sodium fluoride or Potassium fluoride on salt on a conveyer belt.

- In U.S.A., NaF and CaF_2 are first mixed with suitable PO_4 carrier salts and these premixed granules are added to the salt.
- Usually 200-350 mg fluoride /kg salt is adequate

FEASIBILITY IN INDIA

- Its distribution can be easily monitored as the supply can be effectively controlled especially for those areas which do not need supplemental fluoride i.e. endemic fluoride belts.

- Individual monitoring is not required as the levels are so adjusted so as to provide optimum levels of fluoride keeping in view the fact that on an average an individual consumes **5-8 gms** of salt per day.

- Also salt is freely available and is used on a large scale all over the country by majority of the population of various ethnic and regional groups.
- Moreover the cariostatic effectiveness equals that provided by fluoride in water when fluoride content of the salt is so adjusted (250 mg per kg salt)
- Regarding the acceptability of the population it shall be readily accepted as the addition of fluoride to salt does not alter its color as in the case of salt iodization.

- Enamel fluorosis is not expected with fluoridated salt. It has special advantages:-

1)Low cost

2)Negligible waste of fluorides

3)Ease of implementation

4)Can be easily used in individual households

DISADVANTAGES

1. In early age low consumption of salt.
2. Hypertension



Flour fluoridation:

- It has been suggested as another modality keeping in mind the extent of and the pattern of total flour consumption.
- However, sufficient data to support this is not available.

FLUORIDE SUPPLEMENTS

Fluoride tablets, drops, lozenges:

These are termed as dietary fluoride supplements introduced in 1940 & available with or without vitamins.



FLUORIDE TABLETS

- Prichard (1969) showed a 40% caries reduction after ingestion of fluoride tablets since birth.

- **Tablets:** In dosage of 0.125, 0.25, 0.5 mg F-,

  2.2 mg tablets = 1 mg of fluoride.

- Results suggested that use of fluoride supplements during development of dentitions results in caries reduction that even far exceeds benefits of water fluoridation.

- Tablets usually contain sodium fluoride, calcium fluoride or acidulated phosphate fluoride.

DISADVANTAGES OF FLUORIDE TABLETS

If taken in higher doses it can cause fluorosis.

Children who reported combined use of fluoride tablets and dentifrice had the highest odd ratios for very mild to severe fluorosis.

- The British Society of Paediatric Dentistry (BSPD) made the following recommendations with respect to fluoride supplements in a recent policy document:

- Dietary fluoride supplements are not generally a public health measure. They should be recommended only for individual children who are at risk and who live in areas with less than optimal water fluoride levels.

Dietary fluoride supplement schedule

Age	<0.3ppmF	0.3-0.6ppmF	>0.6ppmF
Birth-6mos	0	0	0
6mo-3yr	0.25mg	0	0
3-6yrs	0.50mg	0.25mg	0
6-16yr	1.00mg	0.50mg	0

Tablets are to be chewed first to ensure topical effect and then swallowed for the systemic effect.

Fluoride Prescription

- The child should not consume more than 1mg of F per day from fluoride supplements and water.

  (ADA council on dental therapeutics' recommended prescribing fluoride supplements on a sliding scale to accommodate the suboptimal level of fluoride in water etc.)

- Example: If fluoride in drinking water is 0.2ppm, the dose prescribed should not exceed 0.6mg/day.
- **1974 Ripa** : Appropriate marketed dosage forms may be given in full strength and half strength, and depending of age, and water content of the area the dosage should be given.

  (American Academy of pediatrics had accepted this approach)

FLUORIDE DROPS

Below 2 years of age fluoride drops can be an effective way of administering fluoride as it is difficult for a child to swallow tablets at such a young age.



For fluoride drops: -

1 drop= 0.1mg of fluoride

DISADVANTAGES OF FLUORIDE DROPS

1) Complexity of dosage schedules for children.

2) Poor compliance especially in small children.

FLUORIDE LOZENGES



The release of fluoride from a fluoride tablet and a chewable sodium fluoride lozenge to 0.5 M acid, water, and saliva was compared.

In acid, all the fluoride was released from the tablet (0.25 mg F), while there was a poor release in water and saliva (2-10 %).

The release from the sodium fluoride lozenge (0.25 mg F) was essentially complete in water and saliva as well as in acid.

Following sucking and chewing on a sodium fluoride lozenge, the mean salivary fluoride concentration increased in 5 min after intake.

Lorentzen B, Birkeland, JM Lokken-A comparison between the release of fluoride from sodium fluoride lozenges and bone meal tablets.

Comm.Dent Oral Epi,1976 Jul;4(4):140-1

- Lozi-Flur was introduced in April of 1998 by Dr. Robert E. Reed of Bakersfield, CA.
- Lozi-Flur has eliminated the barriers to patient compliance.
- Patients love the taste and convenience, and compliance, as reported by the dental offices prescribing Lozi-Flur.



DEFLUORIDATION

Defluoridation is removal of excess fluoride from water. Several methods have been suggested for removing excessive fluoride in water.

The defluoridation methods are divided into three basic types depending upon the mode of action :

1. Based on some kind of chemical reaction with fluoride
2. Based on adsorption process
3. Based on ion-exchange process

METHODS OF DEFLUORIDATION

Adsorption and ion Exchange method-

Some substances adsorb fluoride ion by the surface, and it can exchange its negative ions such as OH group for fluoride ions.

Thus the concentration of fluoride in water decreases. These are:
Activated Alumina, Fluidized Activated Alumina, Activated Bauxite Zeolite , Tricalcium phosphate, Super phosphate, Activated bone char.

Magnesite Activated Carbon, Palan Carbon, Charcoal, Clay and Soil, Bricks.

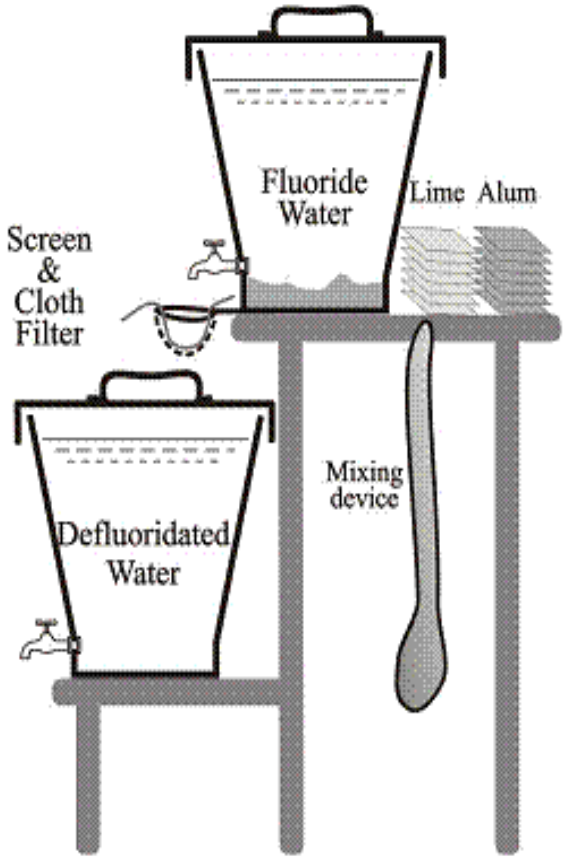
- Precipitation Method
  In a high pH condition, co precipitation of several elements in water with fluoride ions forms fluoride salts. Sometimes, it may cause flocculation if the substance used is Aluminium ions. Thus, the fluoride concentration in water decreases. These substances include:
  Alum ,Alum and lime, Calcium chloride

- Membrane separation
  Based on reverse osmosis All elements in water get diminished after filtration. This method is claimed to be the best water purification process available. This method seems to be expensive for developing countries as 30% of raw water is lost in the process.

NALGONDA TECHNIQUE

- This technique first developed in India in 1974.
- First community plant for removal of fluoride from drinking water was constructed in the district of Nalgonda in Andhra Pradesh, in the town of Kathri, thus the name of the technology.
- PROCEDURE: Raw water is mixed with adequate lime and Alum solution is added after the addition of lime, stirred gently for 10 minutes and the flocculations formed are allowed to settle.
- This process of flocculation formation, and setting requires an hour

- A co-precipitation process is often carried out in batch containers, where the precipitating chemicals are totally mixed with the raw water.
- This process requires filling of water and chemicals, mixing and settling and subsequent withdrawal of the treated water and the produced sludge.
- In the so-called **Nalgonda technique** high dosage of **alum** and **lime** are used in a coagulation/sedimentation process, where the precipitation of **aluminium hydroxide** instantly binds a part of the water fluoride.



The Nalgonda process as optimised for use in the Rift Valley.

The reaction occurs through the following equations -

- $2\ Al_2(SO_4)_3 . 18H_2O + NaF + 9Na_2CO_3 \rightarrow [5Al(OH)_3.Al(OH)_2F] + 9Na_2SO_4 + NaHCO_3 + 8\ CO_2 + 45\ H_2O$

- $3\ Al_2(SO_4)_3 . 18H_2O + NaF + 17NaHCO_3 \rightarrow [5Al(OH)_3.Al(OH)_2F] + 9Na_2SO_4 + 17\ CO_2 + 18\ H_2O$

ADVANTAGE

- This method can be used both at domestic an community levels.
- The chemicals are same as those used in a municipal urban water supply.
- It is cost effective.
- Designs are flexible to use at different locations
- Defluoridation meets with standard laid down by the Bureau of Indian Standard (fluoride content less than lmglL).

- Local skills could be readily employed
- Highly efficient removal of fluorides from 1.5 to 20 mg/L to desirable levels
- Simultaneous removal of colour, odour, turbidity, bacteria and organic contaminants
- Sludge generated is convertible to alum for use elsewhere
- Little wastage of water and least disposal problem
- Needs minimum of mechanical and electrical equipment
- No energy except muscle power for domestic equipment

- Economical - Annual cost of defluoridation (1991 basis) of water at 40 lpcd works out to Rs.20/- for domestic treatment and Rs.85/- for community treatment using fill and draw system based on 5000 population for water with 5 mg/L and 400 mg/l alkalinity which requires 600 mg/L alum dose.

- Provides defluoridated water of uniform acceptable quality.

DEFLUORIDATION PROCESSES

G.Karthikeyan and A. Shunmuga sundarraj

Department of Chemistry, Gandhigram Rural Institute - Deemed University

Gandhigram - 624 302, Tamil Nadu

Combined Nalgonda and Calcined Magnesite Techniqe

In this plant the Nalgonda technique was passed through a filter bed of calcined magnesite granules. Fluoride was absorbed by the calcined magnesite granules, there was a rise in pH over 10.0, this method is found impractical for rural regions.

PARASANTI TECHNOLOGY:

In Indian villages this method of utilizing Activated Alumina is found to be most popular and cost effective material for defluoridation.

Drumstick plant (Moringa Cleifera)

- Was also used as an alternative to defluoridate drinking water as it is easily accessible and it has been widely used to reduce water turbidity because of its excellent coagulating and clarifying properties.

Alkali - extract mycetial biomass

- Ability of this material from Aspergillus riger to bind fluoride from fluoride containing water but the mechanism is still not clear.

- Clay Minerals

  Two fluoride sorption Clay materials :

  Montmosllonite, Kaolin and a Silty Clay Sediment Series were tried for defluoridation.

- Tricalcium Phosphate (TCP)

  The TCP may be able to produce a complex chemical reacting mechanism in defluoridation

Aluminium-based Methods

Nalgonda technique

Implementation: India, Ethiopia etc.

Co-precipitation of fluoride on aluminium-hydroxide



Photo: Water Resources Bureau of Oromia in collaboration with UNICEF (Ethiopia)

Filtration with activated alumina

Implementation: US, Ethiopia, India etc.

Activated alumina used as a filter medium



Photo: Wonji/Shoa sugar cane plantation (Ethiopia)

Clay minerals

Implementation: Sri Lanka etc.

Clay compounds used as a sorption medium

Filtration with bone char

Implementation: Kenya, Tanzania, Thailand, Argentina etc.

Bone char used as a filter medium



Photo: Catholic Diocese of Nakuru, Water Quality (Kenya)

Apatite-based Methods

Contact precipitation

Implementation: Kenya

Precipitation of fluoride on bone char by adding calcium and phosphate



Photo: Catholic Diocese of Nakuru, Water Quality (Kenya)

Additional research is being carried out

FLUORIDE TOXICITY



FLUORIDE TOXICITY

- It is said "Good things should be taken…..in proper doses".
- This applies to the wonder element of dentistry too i.e. fluoride.

- If taken in quantities that exceed the normal doses, fluoride can prove to be dangerous. Hence, it is called "a double edged sword", and it should be remembered that a large dose can kill within minutes.

ACUTE TOXICITY OF FLUORIDES:

- Acute fluoride toxicity results from rapid excessive ingestion of fluoride at one time.
- The speed and severity of the response are dependent on the amount of fluoride ingested and the weight and age of the individual.
- The most frequent encountered adverse effect of topical fluoride therapy is nausea. This is caused by fluoride combining with hydrogen in the gastric juices to form hydrofluoric acid a stomach irritant.

Initial symptoms

- Fluoride toxicity include nausea, abdominal cramps, vomiting, diarrhoea, increased salivation, dehydration and thirst.
- In acute poisoning fluoride causes death by blocking normal cellular metabolism.
- Death usually results from cardiac failure or respiratory paralysis.

Table VI : The signs and symptoms of acute fluoride toxicity are as follows

Gastrointestinal	:	Nausea, vomiting diarrhea, abdominal pain and cramps.
Neurological	:	Paresthesia, paresis, tetany, central nervous system depression and coma.
Cardiovascular system	:	Weak pulse, hypotension, pallor, shock, cardiac irregularities and ultimately failure.
Blood chemistry	:	Acidosis, hypocalcemia and hypomagnesemia.

Table VII : Effect of fluoride through various media. Smith and Hodge(1959)

Concentration or dose of fluoride	Medium	Effect
2 ppm	Air	Injury to vegetation
1 ppm	Water	Dental caries reduction
2 ppm or more	Water	Mottled enamel
5 ppm	Urine	No osteosclerosis
8 ppm	Water	10% osteosclerosis
20-80mg/day or more	Water or air	Crippling fluorosis
50 ppm	Food or water	Thyroid changes
100 ppm	Food or water	Growth retardation
More than 125 ppm	Food or water	Kidney changes
2.5 - 5.0 gm F (Note : 5-10gm of NaF)	Acute dose	Death

Table IX : The commonly recognized effects of fluoride ingestion through fluoridated water at various levels:

Fluoride level	Fluoride in drinking water	Effects
0.7 - 1.2 ppm	Depending upon the temperature of the area	Prevents dental caries; No dental/skeletal fluorosis. (Considered the optimum level of fluoride that brings maximum caries reduction.)
1.5 - 3.0 ppm	Consumption of water for a period of 5 - 10 years or more	Milder forms of Dental fluorosis.
3.0 - 8.0 ppm	Consumption of water for a period over 15 - 20 years.	Severe form of Dental fluorosis and a milder form of skeletal fluorosis .
8.0 ppm or more	Consumption of water for a period of 5-10 years or more	Severe form of dental and skeletal fluorosis

CHRONIC FLUORIDE TOXICITY

- Dental fluorosis is a hypoplasia or hypomaturation of tooth enamel or dentine produced by the chronic ingestion of excessive amounts of fluoride during the period when teeth are developing .

- The major cause of dental fluorosis is the consumption of water, containing high levels of fluoride, by infants and children during the first six years of life.

- Although both primary and permanent teeth may be affected by fluorosis, under uniform conditions of fluoride availability fluorosis tends to be greater in permanent teeth than primary teeth.

- This disparity may be due to the fact that much of the mineralization of primary teeth occurs before birth and the placenta serves as a barrier to the transfer of high concentrations of plasma fluoride from a pregnant mother to her developing foetus thus controlling to a certain extent the delivery of fluoride to the developing primary dentition.

- Other reasons may be that the period of enamel formation for primary teeth is shorter than for permanent teeth and that the enamel of primary teeth is thinner than that of permanent teeth.

Dental fluorosis

Dental Fluorsis is a health condition caused by a child receiving too much fluoride during tooth development.

The critical period of exposure is between 1 and 4 years old; children over age 8 are not at risk.

In its mild form, which is the most common, fluorosis appears as tiny white streaks or specks that are often unnoticeable.

In its severe form it is characterized by black and brown stains, as well as cracking and pitting of the teeth.

Dental fluorosis

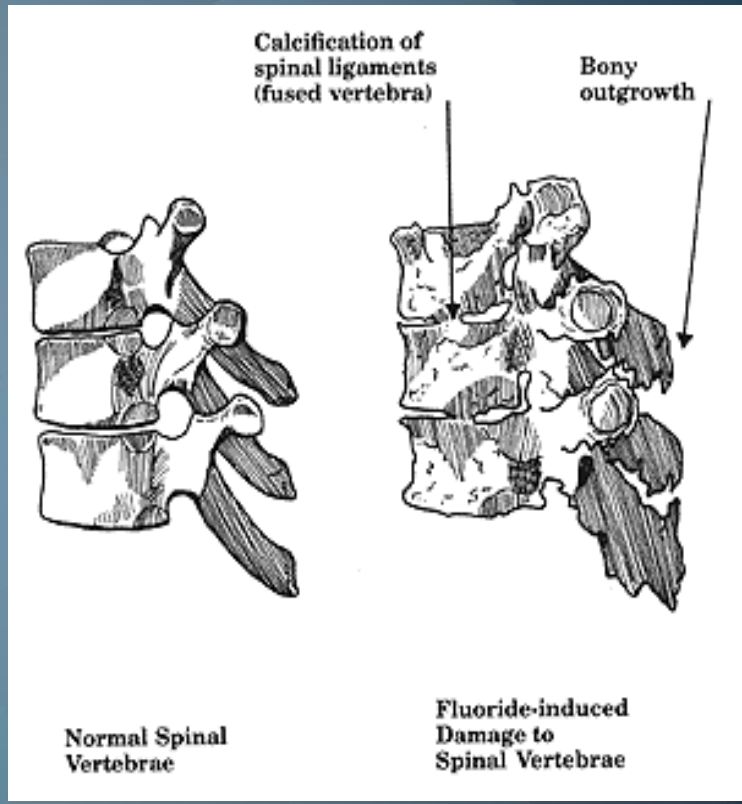
- The damage in tooth development occurs between the ages of 3 months to 8 years, from the overexposure to fluoride.
- Teeth are generally composed of hydroxyapatite and carbonated hydroxyapatite; when fluoride is present, fluorapatite is created.
- Excessive fluoride can cause white spots, and in severe cases, brown stains or pitting or mottling of enamel.

- Fluorosis cannot occur once the tooth has erupted into the oral cavity.
- At this point, fluorapatite is beneficial because it is more resistant to dissolution by acids (demineralization).
- Although it is usually the permanent teeth which are affected, occasionally the primary teeth may be involved.

- The basic structural material of the body, collagen, is also disrupted by fluoride, causing tissues such as muscles, tendons, and ligaments to be excessively mineralized.

- Others such as bones and teeth may be deficient.

  – Breseis Gatto, Book Review: *Fluoride the Aging Factor*, by John Yiamouyiannis



Fluoride ingestion and the risk of fluorosis.

Fluoride toothpastes are very widely used.

The potential for inappropriate use to result in fluorosis was emphasized in a study, where it was reported that 71 per cent of a series of cases diagnosed as fluorosis were explicable in terms of a history of having brushed more than once per day with more than **a pea sized** amount of toothpaste throughout the first eight years of life (Pendrys, 1995).

From these reports it may he concluded that risk factors for dental fluorosis may be ranked in the following order:

Risk factors for dental fluorosis

- Inappropriate fluoride supplements.
- Age of child when tooth brushing started.
- Frequency of brushing/swallowing toothpaste.
- Residence in an optimum fluoride area.

Dean's Index

- H.T. Dean's fluorosis index was developed in 1942 and is currently the most universally accepted classification system

Classification	Criteria – description of enamel
Normal	Smooth, glossy, pale creamy-white translucent surface
Questionable	A few white flecks or white spots
Very Mild	Small opaque, paper white areas covering less than 25% of the tooth surface
Mild	Opaque white areas covering less than 50% of the tooth surface
Moderate	All tooth surfaces affected; marked wear on biting surfaces; brown stain may be present
Severe	All tooth surfaces affected; discrete or confluent pitting; brown stain present

Table VIII : Criteria for diagnosis of Enamel Fluorosis [Fluorosis Index]

Dean Score	Criteria
0	Normal enamel
0.5	Questionable mottling : Normal translucency is varied by a few white flecks or white spots.
1.0	Very mild mottling: Small, opaque paper-white areas are scattered over the teeth; involving less than 25% of the surfaces.
2.0	Mild mottling: The white opaque areas are more extensive but do not involve more than 50% of the surface.
3.0	Moderate mottling : All enamel surfaces are affected and those subject to attrition show marked wear. Brown stain is a frequent disfiguring feature.
4.0	Severe mottling : All enamel surfaces are affected and hypolasia is so marked that tooth form may be altered. A major diagnostic sign is discrete or confluent pitting. Brown stains are widespread and the teeth often present a corroded appearance.

Prevalence

- As of 2005 surveys conducted by the National Institute of Dental Research in the USA between 1986 and 1987 and by the Center of Disease Control between 1999 and 2002 are the only national sources of data concerning the prevalence of dental fluorosis.

Deans Index	1987	2002
Questionable fluorosis	17%	11.8%
Very mild fluorosis		19%
Mild fluorosis	4%	5.83%
Moderate fluorosis	1%	0.59%
Severe fluorosis	0.3%	
Total	22.3%	37.2%

The survey provides further evidence that African Americans suffer from higher rates of fluorosis than Caucasian Americans.

- In November 2006, the ADA began recommending to Parents that infants from 0 through 12 months of age should have their formula prepared with water that is **fluoride-free**, or contains low levels of fluoride to reduce the risk of fluorosis.

Treatment

- Tooth bleaching, microabrasion, and conservative composite restorations or porcelain veneers are commonly used treatment modalities.

Bleaching and microabrasion are used for superficial staining, whereas the conservative restorations are used for more unaesthetic situations.



THEORIES OF GROWTH

CONTENTS :

- ✓ Introduction
- ✓ Need for understanding theories of growth
- ✓ History and evolution
- ✓ Major theories of growth control
- ✓ Conclusion
- ✓ References

GROWTH

- "An increase in size". *Todd*
- "Growth usually refers to an increase in size and number". *Profitt*
- "Change in any morphological parameter which is measurable". *Moss*

BASIS FOR DEVELOPMENT OF THEORIES

- Theories are the attempts from various scientists to explain the control mechanism involved in craniofacial growth process.

- Necessary to learn how skeletal growth is influenced and controlled to understand the etiologic process of malocclusion and dentofacial deformity.

- Craniofacial biology has no shortage of theories and there exists a continuum ranging from complete emphasis on ***INTRINSIC GENETIC CONTROL*** to a complete denial of genetic factor and total reliance on so called **FUNCTIONAL DETERMINANT**.

HISTORY AND EVOLUTION OF THEORIES OF GROWTH

Till 1940's ,

- Research was basically oriented towards study of structure of craniofacial skeleton, with little or no consideration for function.

- Growth process is controlled by heredity.

- The approach was more statistical than biological.

- Genetic paradigm.

THE GENETIC PARADIGM

- BRODIE assumed facial configuration under genetic control
- Focus on growth sites for this control: the sutures, craniofacial cartilages and periosteum
- Assumptions were made that cartilages and facial sutures are under genetic control and that the brain determined the vault dimensions.

In 1950's ,

- Craniofacial biology saw an increased emphasis on experimental animal research.
- This led directly to specific technologic developments like :
  - Radio-opaque implants
  - Vital stains
  - Autoradiography

- The concept of function, and adaptation to the altered function was introduced.

In 1960's ,

- The functional matrix hypothesis was first articulated by MOSS and YOUNG in an article in 1960 published in the American Journal of Physical Anthropology.

- In second major paper by Moss (1962), he introduced the FUNCTIONAL MATRIX HYPOTHESIS, that the real revolution within the subject began.

- The Functional Paradigm focused attention on the relative plasticity on those features of craniofacial/facial growth that could be altered clinically, given the appropriate treatment.

FUNCTIONAL PARADIGM

- Moss suggested skeletal tissues were passive under the direct control of functional components to which craniofacial skeleton is adapted.
- It emphasized the epigenetic interactions of intrinsic and extrinsic factors that result in variations in the craniofacial form.
- It also placed emphasis on the potential of modification of craniofacial growth and form.

GENOMIC PARADIGM	FUNCTIONAL PARADIGM
•Growth control lies in the bone	•Growth control lies in the soft tissue
•Single factor approach	•Multifactorial approach
•It is rigid : no consideration for adaptations.	•It is a continuous process which adapts to the continuous changing conditions around.

MAJOR THEORIES OF GROWTH CONTROL

- **Genetic theory** by BRODIE , 1941
- **Cartilaginous theory by SCOTT, 1953**
- **Sutural dominance theory** by SICHER, 1955
- **Functional matrix hypothesis** by MELVIN MOSS, 1962
- **Functional matrix Revisited, 1997**
- **VAN LIMBORG'S multifactorial theory,** 1970
- HUNTER & ENLOW's growth equivalent concept
- PETROVIC's cybernetics theory, 1947

THE GENETIC THEORY

It is the oldest theory given by ***Dr. Alan G. Brodie***

- Basic control of growth, both in magnitude & timing is located in genes.
- 1950's - head & face grew from growth centres - under strict genetic control
- Brodie -- Genetic factors - major significance in development of malocclusion
- Occlusal similarities running in families

- More assumed than proven

- LIMITATIONS:

1. If the face were under rigid genetic control, it would be possible to predict features of children from cephalograms of parents.

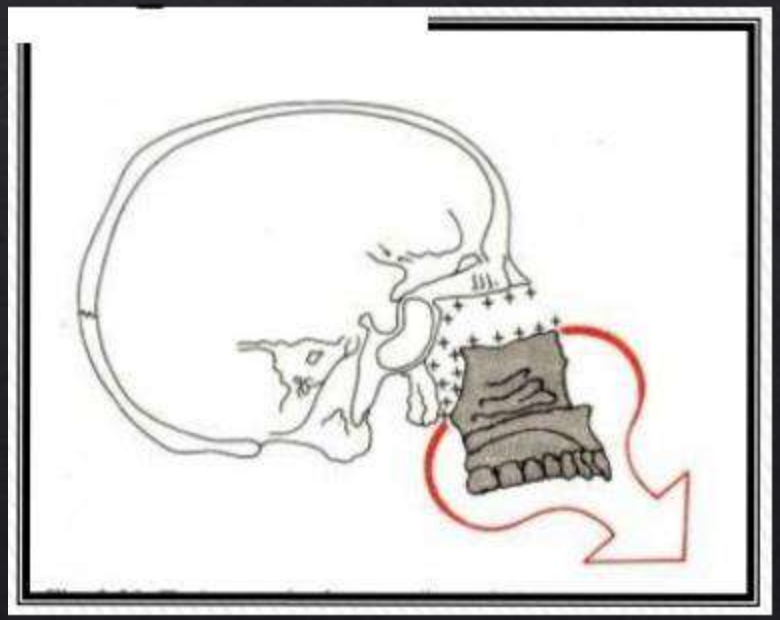
2. Doesn’t explain the role of environmental & epigenetic factors

3. Primary genetic control determines only certain features and doesn't have complete influence on growth

SICHER'S SUTURAL DOMINANCE THEORY (1955)

- According to *Sicher*, craniofacial growth occurs at the sutures. (using vital dyes)
- The primary event in sutural growth is the proliferation of the connective tissue between the two bones.
- The sutural connective tissue proliferates and creates space for appositional growth at the borders of the two bones.
- In Sicher's view, all bone- forming elements, cartilage, sutures and periosteum are growth centers, which are responsible for facial growth and assumed all were under tight intrinsic genetic control.

- Sicher and Weinmann explained that growth of the nasomaxillary complex in a downward and forward direction is due to the growth at sutures which attach the complex to the cranium which are parallel and oblique.



SHORTCOMINGS

Sutures are not the primary determinants of growth.

1. Sutures and periosteal tissues lack innate growth potential, proved by *transplanting* a suture.

Transplantational studies:

When the suture was transplanted into a different tissue, it did not continue to grow as assumed earlier (that it has innate growth potential).

Microcephaly and hydrocephaly raised doubts on intrinsic genetic stimulus of sutures.

SHORTCOMINGS

2. Growth at sutures respond to outside influences as compression & tension.

For eg. If cranial or facial bones are *pulled apart* at sutures, *new bone fills in* and if suture is *compressed*, the growth will be *impeded*.

3. Growth takes place in untreated cases of cleft palate even in absence of sutures.

Thus, sutures are the areas that react; not the primary determinants i.e. they are growth sites and not growth centers.

- Growth site:

  All surfaces of bones are covered by irregularly arranged growth fields. These can be either resorptive or depository. Growth fields that have a special role in the growth of particular bones are growth sites (e.g. mandibular condyle).

- Growth center:

  Growth centers are locations where growth takes place independently (mostly genetically controlled).

  They grow even when transplanted to other areas.

  They produce a tissue separating force, that facilitates bone deposition until the tension created on the adjacent bones is relieved. (e.g. synchondrosis & nasal septal cartilage).

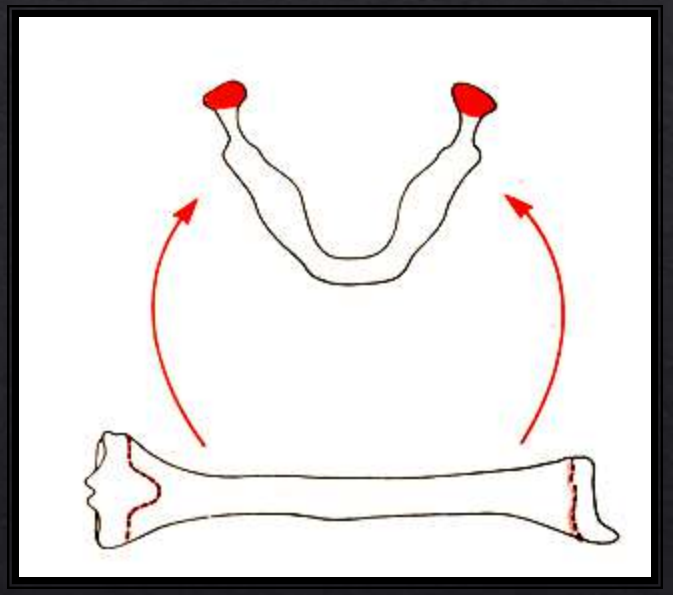
THE CARTILAGENOUS THEORY (1953)

- Given by JAMES SCOTT, a well known Irish Anatomist.
- According to him, primary controlling factors in craniofacial growth are found only in the cartilage and periosteum & the sutures are secondary and passive.

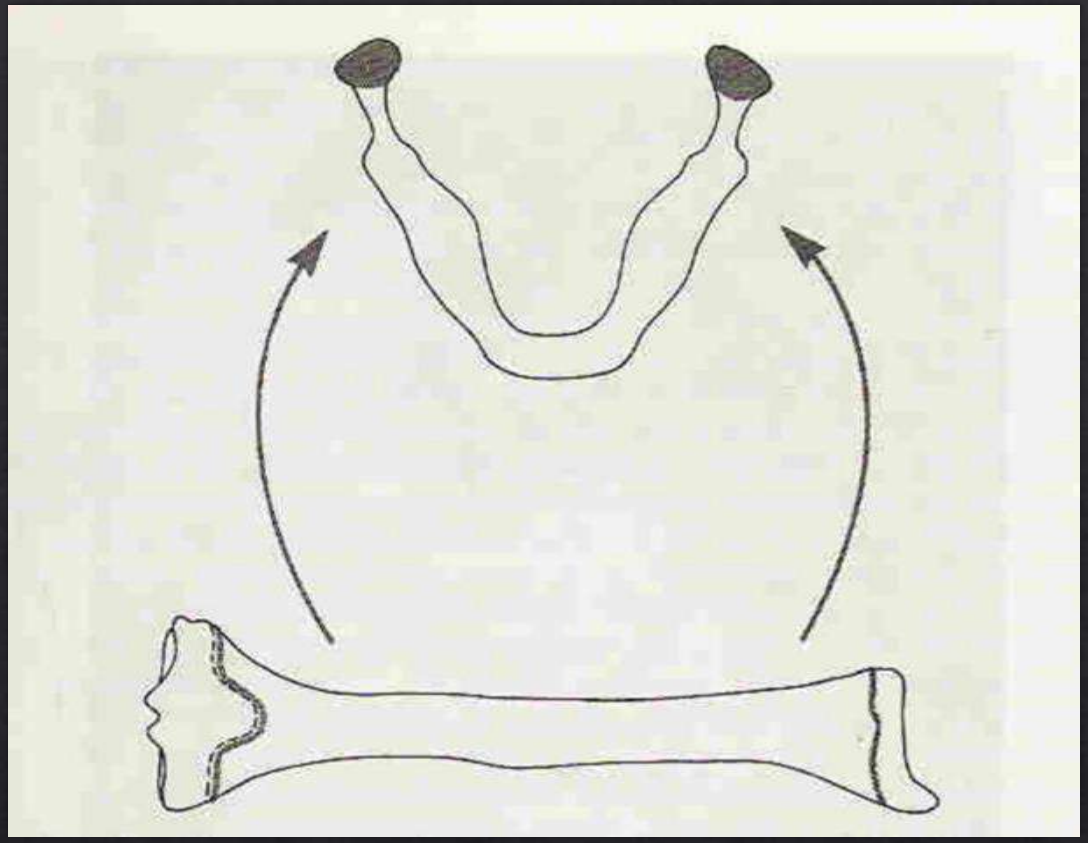
Spheno-occipital synchondrosis cartilage	Responsible for the growth of the cranial base
Nasal septal cartilage	Responsible for the growth of maxilla
Condylar cartilage	Responsible for the growth of mandible

- In case of the mandible, this can be explained by visualizing it as the diaphysis of a long bone bent into a horse shoe shape with the epiphysis removed, so that there is cartilage representing half an epiphyseal plate at the ends representing the mandibular condyles.

- Since a long time, it is being hypothesized that condylar cartilage is the growth center for the growth of mandible.



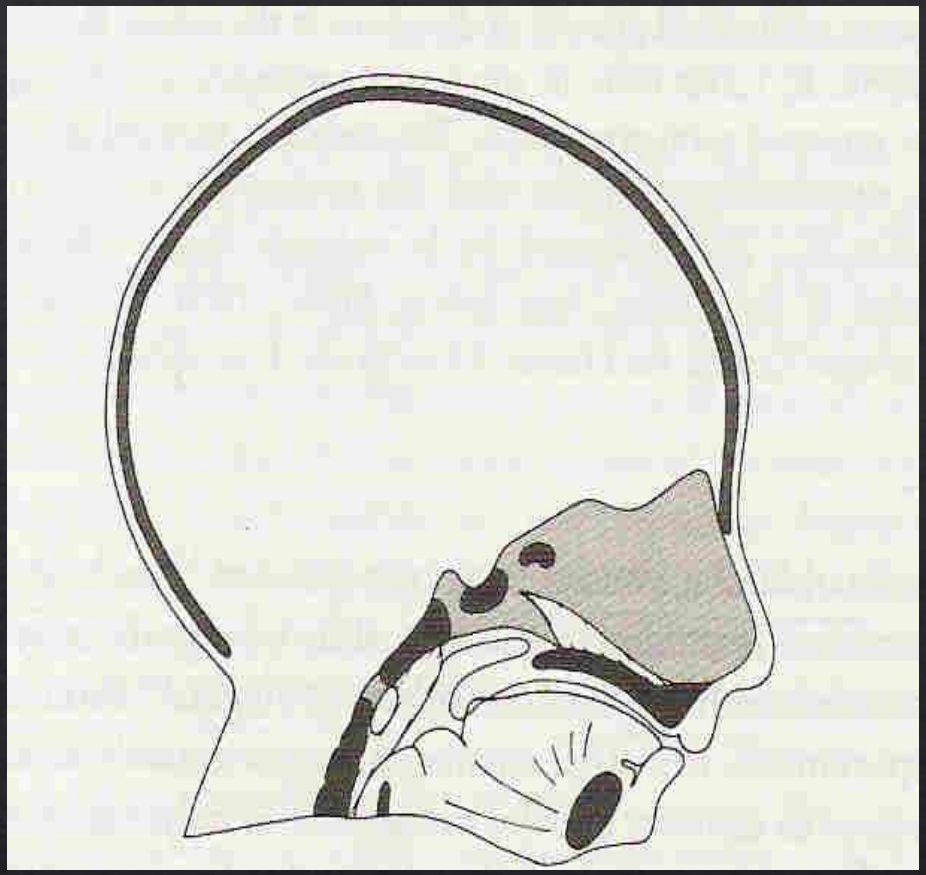
- *Experiments of transplanting condylar cartilage showed little or no growth potential.*



CONDYLAR CARTILAGE AS GROWTH DETERMINANT

Growth of maxilla on basis of Scott's theory

- Nasomaxillary complex grows as unit
- Cartilaginous nasal septum serves as a pacemaker for maxillary growth
- Cartilage growth leads to forward and downward translation of maxilla.
- Sutures which serve as reactive areas respond by new bone formation leading to growth.



Growth at nasal septum causes downward & forward translation of maxilla

LATHAM'S HYPOTHESIS

- Septo-premaxillary ligament:

  later part of fetal life

  Nasal septum together with septo-premaxillary ligament b/w nasal septum and premaxilla exerts an operative force during prenatal and early post natal period which causes forward and downward growth of premaxilla.

- Experimental research on rats by *Ohyama* :

  Even the most atraumatic removal of cartilage produces significant effect on growth.

Experiments to verify Scott's hypothesis

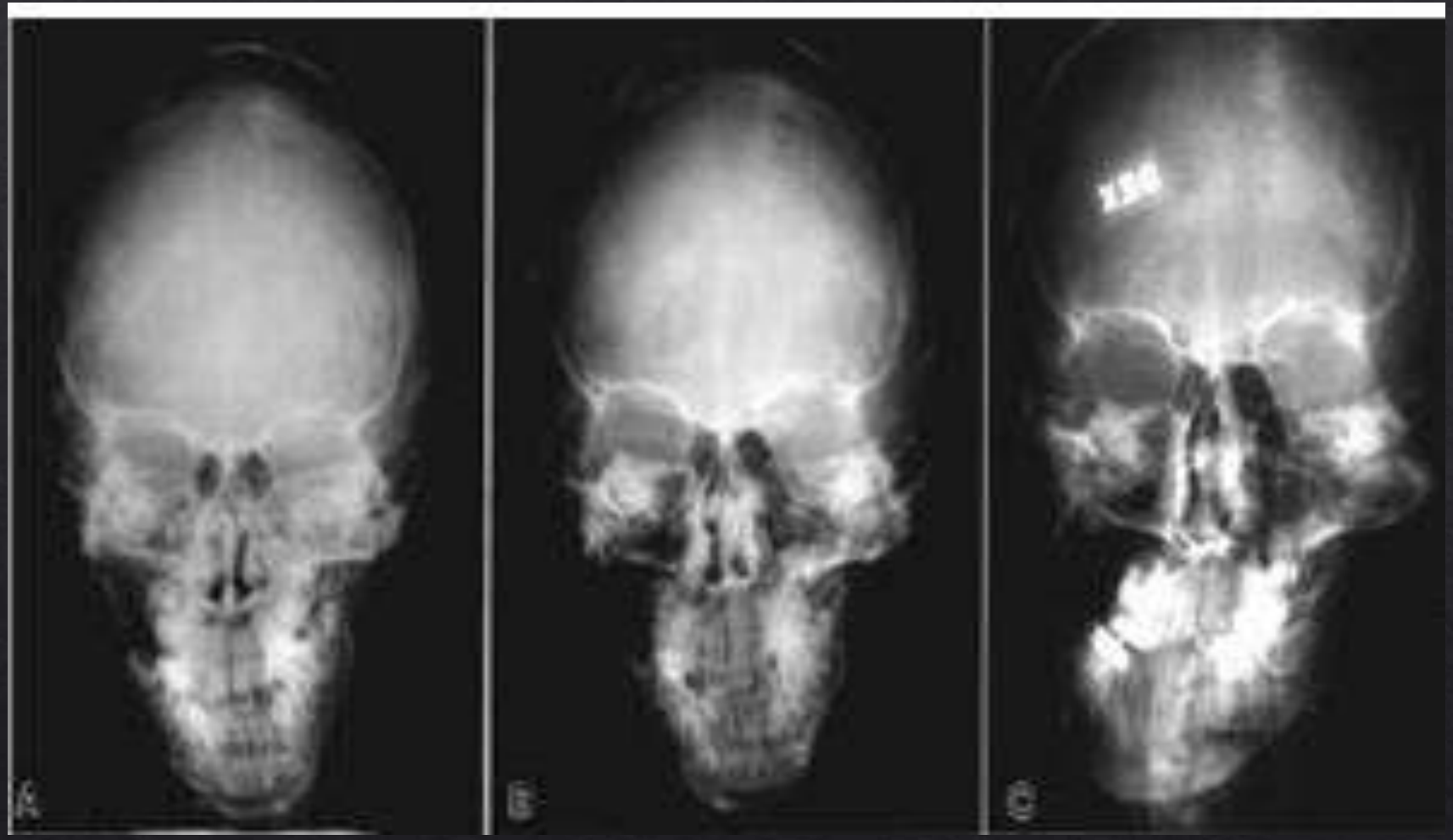
- Two kinds of experiments have been carried out to test the idea that cartilage can serve as a true growth center.

- **Transplantation Experiments**

- **Cartilage Removal Experiments**

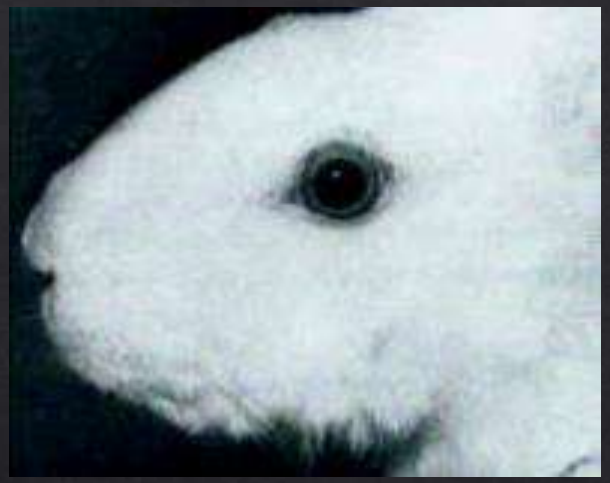


Transplantation Experiments



Progressively deteriorating asymmetry of the face associated with ankylosis of the TMJ in a 13-year-old boy (A). The condition was corrected by replacing the affected left condylar process with a costochondral graft. The chin still deviates to the left 1 year after the operation (B). Excessive growth of the mandible on the side with the graft then led to asymmetry opposed to the initial condition, 6 years post-operatively

Cartilage Removal Experiments





Experimental study

Extirpating/ Eliminating a young rabbit's septum causes a considerable deficit in growth of the snout (midface).

Clinical Study



- In one individual the entire septum was removed at the age of 8 after an injury.
- The obvious deficiency developed after the septum was removed.

Profitt William. Contemporary Othodontics. 5th edition.

- It can be argued that the arrest of growth occurring after surgical removal of nasal cartilage may be due to the surgery itself and the accompanying interference with the blood supply to the area, not the loss of cartilage causes the change of growth.

- The loss of growth in experimental animals when this cartilage is removed concluded that septal cartilage does have some innate growth potential, whose loss makes a difference in maxillary growth

Support :

- Pressure and tension have little effect on cartilaginous growth.
- *Hunter and Enlow* - relatively lesser response of the endochondral cranial base to external influences.
- Experimental research on rats by *Ohyama* -removal of cartilage produces significant effect on the growth of the mid-face.
- The theory was supported by research of *Sarnat, Burdi, Baume and Petrovic et al.*

Against :

- Two studies were carried out by **Gilhus-Moe** and **Lund** in Scandinavia in 1960's showed that

  - There are excellent chances that condylar process would regenerate to approximately its original size after trauma
  - In a few there was even a overgrowth of condyle.
  - In a few children there is a reduction in growth after injury maybe due to the trauma to the soft tissues / scarring

Therefore Scott's hypothesis does not hold true completely.

FUNCTIONAL MATRIX THEORY OF GROWTH (1960)

- Given by Melvin L Moss in 1960 and reviewed and updated by him in 1990s.
- His idea of functional matrix is based on the original concept of functional cranial component by Vander Klaaus
- Osteogenesis is mostly influenced by local functional demands .
- In his conceptual view, the soft tissue grow and both bone & cartilage react.



- *It says that the origin, form, position, growth and maintenance of all skeletal tissues and organs are always secondary, compensatory & necessary response, to chronologically and morphologically prior events that occur in specifically related non-skeletal tissues, organs and functional spaces.*

- The functional matrix theory attempts to establish relationship between form and function. i.e. function defines form and form defines function.

- Head is a region with in which certain functions occur and each function is carried out by a *functional cranial component*.

- Each component of a functional matrix performs vital functions such as respiration, balance, digestion, vision, mastication, olfaction, speech etc.

FUNCTIONAL CRANIAL COMPONENT

FUNCTIONAL MATRIX

All soft tissues and spaces that perform a given function

- Periosteal Matrix
- Capsular Matrix

SKELETAL UNIT

Bony structures that protect the functional matrix and are necessary for that function.

- Macroskeletal
- Microskeletal

Macroskeletal unit

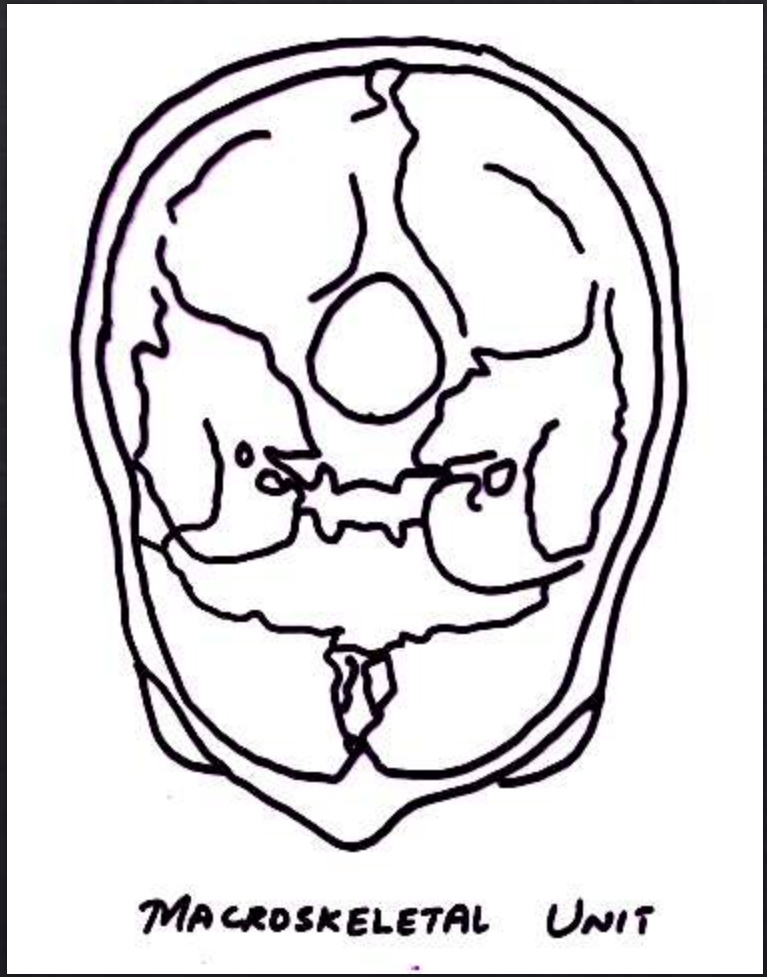
- When adjoining portions of a number of neighboring skeletal units are united to function as a single cranial component e.g endocranial surface of calvarium.

Microskeletal unit

- When a bone consists of a number of skeletal units , these skeletal units are termed microskeletal units e.g coronoid and condylar processes of mandible

MACROSKELETAL UNIT

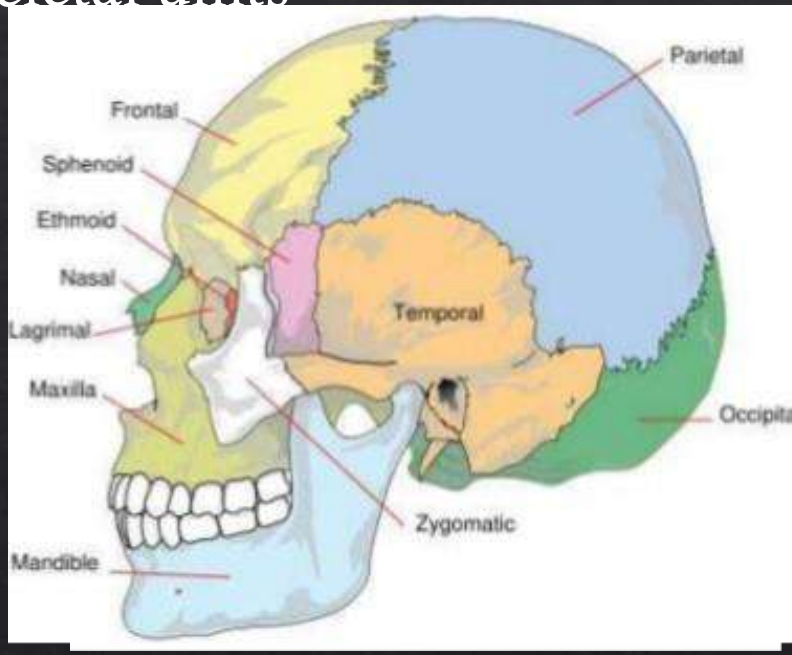
Adjoining portions of a number of neighbouring bones carrying out a single function e.g. endocrainal surface of calvaria .



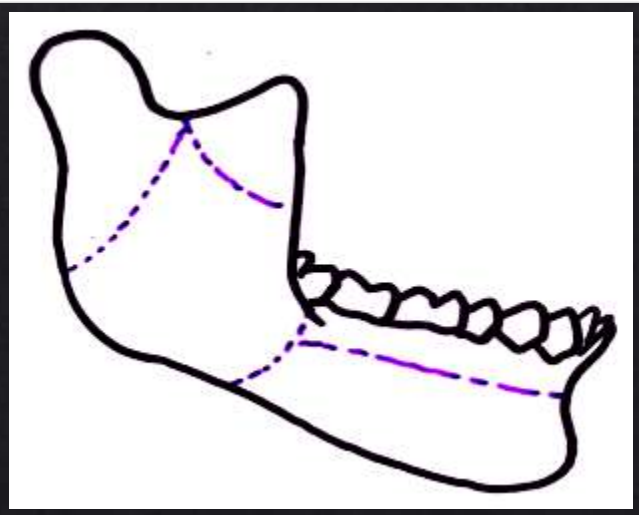
MICROSKELETAL UNIT

Bone consisting of number of small skeletal units

MAXILLA : 2 bones of the cranium
i.e. frontal and ethmoid.
7 bones of the face i.e.
nasal, zygomatic, lacrimal,
inferior nasal concha,
palatine, vomer and
adjacent fused maxilla.



MANDIBLE: -Coronoid
-Condylar
-Angular
-Alveolar
-Basal



FUNCTIONAL MATRIX :

- The term soft tissues cannot be used since teeth are also a kind of functional matrix. It consists of tissues, muscle, gland, nerve, vessels, fat, teeth and functional spaces.

TWO TYPES :

- Periosteal matrix
- Capsular matrix

PERIOSTEAL MATRIX :

- All non skeletal functional units adjacent to skeletal units form the periosteal matrices.
- They act directly by bringing transformation of the related skeletal units.
- They do so by processes of osseous deposition and resorption or by affecting perichondral or endochondral accretionary growth processes.

- Example – coronoid process and temporalis muscle
- Coronoid process does not grow itself first and thus provides a platform upon which the temporalis muscle can alter its function but it is the opposite which is true

CAPSULAR MATRIX :

- Since this type of matrix is protected by capsule it is known as capsular matrix.
- Four capsules are present :

i. NEURO CRANIAL

ii. ORO FACIAL

iii. OTIC

iv. ORBITAL

- Each of these capsules is an envelope containing functional cranial component sandwiched between two covering layers.
- It acts indirectly or passively and not by resorption or deposition
- Capsules expands due to volumetric increase of capsular matrix.
- This results in the translative movement of the embedded bones.

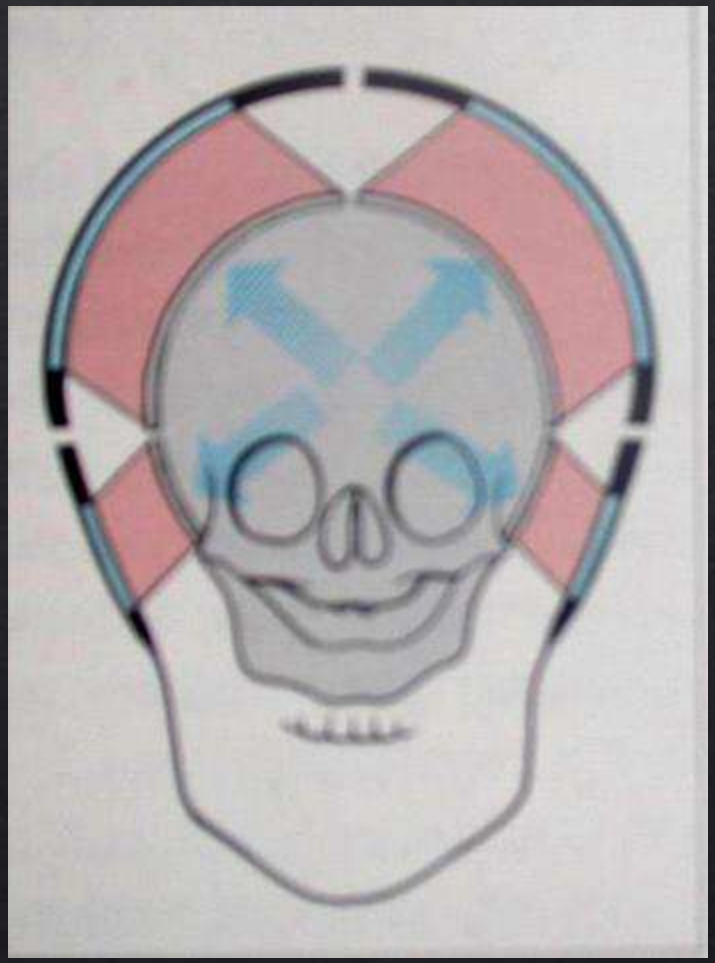
NEUROCRANIAL CAPSULE:

- Capsule's covering layers are made up of skin and dura matter.
- Acts to surround and protect neurocranial capsular matrix (brain, meninges, csf)
- It consists of:

-5 layers of scalp

-2 layered dura matter.

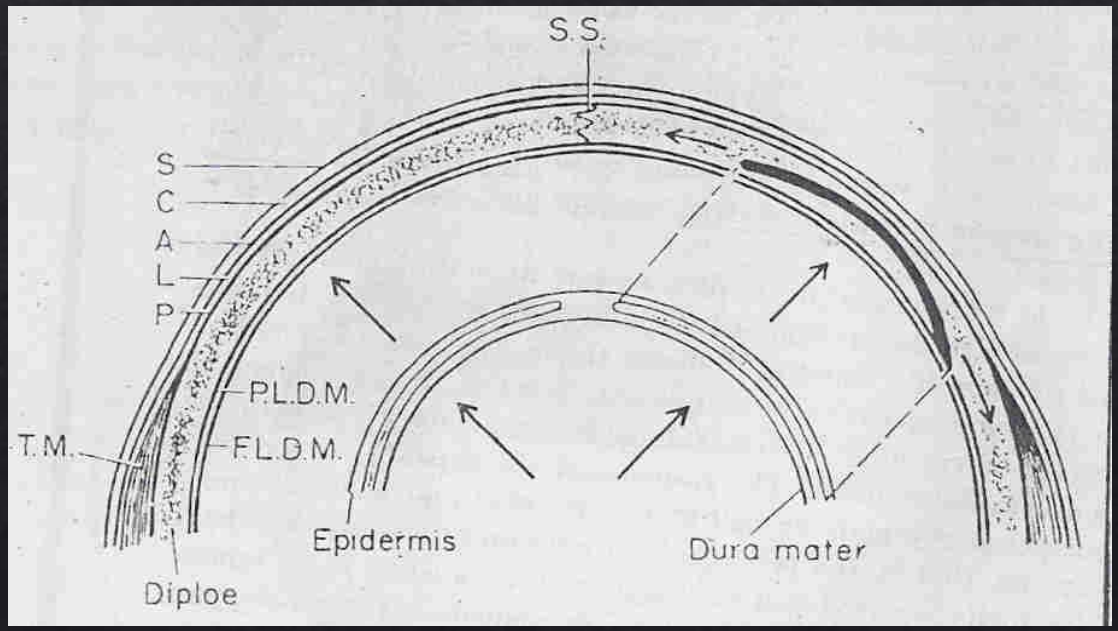
- Expansion of the brain i.e closed capsular matrix volume is primary event in expansion of the capsule.
- The volumetric increase causes compensatory expansion of surrounding capsule which is brought about by mitotic activity.



- The expansion of the neuro-cranial capsule is proportional to the increase in neural mass.
- This suggests that the neural skull does not grow first, rather the growth of neural mass is primary and causes secondary compensatory growth of the skull.

- Later the calvarial functional cranial component as a whole is passively and secondarily translated.

- Such translations occur without necessity of involving the processes of selective periosteal apposition and resorption.



NEUROCRANIAL CAPSULE

GRABER 5th EDITION

OROFACIAL CAPSULE :

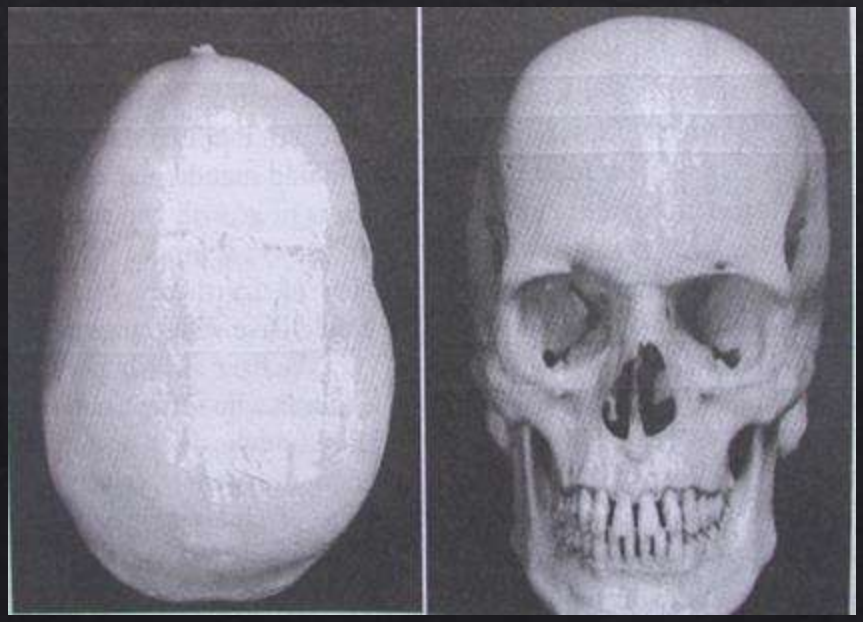
- Orofacial capsule surrounds and protects 3 functioning spaces:

  Oral, nasal & pharyngeal.

- Skin and mucous membrane form the limiting layers.

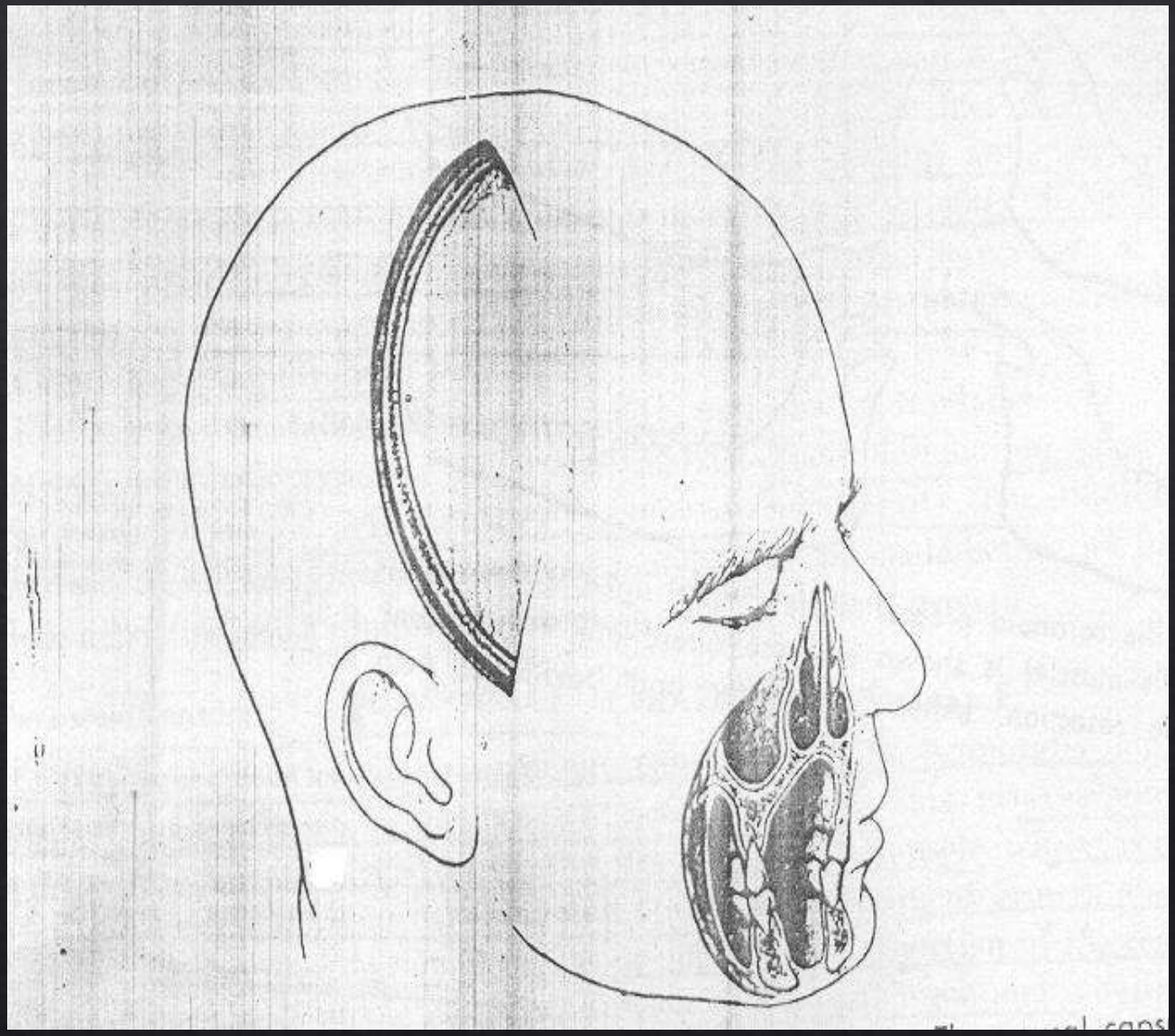
- Volumetric expansion of these spaces serves as the primary morphogenetic event in facial skull growth.
- Growth of functional spaces causes increase in the size of capsule.
- Followed by passive movement of functional cranial component.





Support :

- Anacephaly
- Hydrocephaly
- Microcephaly



OROFACIAL CAPSULE

FUNCTIONING SPACES :

- The combined oral, nasal & pharyngeal cavities is the capsular matrix.
- The capsular matrices of orofacial region differ from those of neurocranial and orbital regions. It is known as **functioning spaces.**
- These spaces are not volumes that are somehow left over after bones, muscles, epithelium or glands have finished growing.
- These are brought into being in the **embyronic period** , by the process of enclosure , as the embryonic facial processes develop.

Impaired function – Impaired growth



- Mandibular ankylosis causes restriction of mandibular movements.
  Impairment of normal function produces very small mandible.

- **It is seen in animal studies that**

  After removal of both the condyles the condylar complex still undergoes translation , this is because the amputation does not inhibit other micro skeletal units which are regulated by their individual matrices.

  The translation of mandible is in response to the morphogenetically prior volumetric expansion of the functioning spaces in this region.

LIMITATIONS OF F.M.H.

- Methodological constraint
- Hierarchical constraint

1. **Methodological constraint :** Macroscopic measurements, permitted only method specific description that cannot be structurally detailed. Experimental bases of FMH were cephalometric follow up of individuals

2. Hierarchical constraint :

- F.M.H couldn't describe the downward (i.e. cellular, sub cellular) or upward processes(i.e., multicellular) taking place during growth.

- How extrinsic, epigenetic functional matrix stimuli are transduced into regulatory signals by individual bone cells or how individual cells communicate to produce coordinated multicellular response.

Also, the FMH could not explain many of the medical conditions such as:

1. Mandibular tori
2. Polydactily
3. Franceschtti syndrome
4. Leontiasis ossea/ Lion Face Syndrome

FUNCTIONAL MATRIX HYPOTHESIS WAS CRITICISED FOR

Proffit- It does not make clear how the functional needs are transmitted to the tissues around the mouth and nose.

Enlow- FMH describes what happens during growth and there is no account of how it happens.

Johnston- Unnecessary ambiguous terminology and over simplistic assumptions about ‘ function’ and very extreme positions taken by Moss.

FUNCTIONAL MATRIX HYPOTHESIS - REVISITED

- Several new concepts of cellular mechanotransduction, biologic cellular network, macromolecular levers have originated since the inception of FMH.

- Recent advances allow more comprehensive revisions of FMH as of how functional matrix is involved in its own growth and how it is controlled.

- This new version deals only with the responses to periosteal matrices.
- It includes the molecular and cellular processes.

- Underlying triad of skeletal growth processes :

a. Deposition

b. Resorption

c. Maintenance

Revised statement:1997(Melvin Moss)

The developmental origin of all cranial skeletal elements (e.g., skeletal units) and all their subsequent changes in size and shape (e.g., form) and location, as well as their maintenance in being, are always, without exception, secondary, compensatory, and mechanically obligatory responses to the temporally and operationally prior demands of their related cephalic non-skeletal cells, tissues, organs, and operational volumes (e.g., the functional matrices).

Newest F.M.H version includes two complementary concepts :

- *Mechanotransduction* that occurs in a single bone cell.
- The bone cells are computational elements that function multicellularly as a *connected cellular network [C.C.N]*

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED
1. ROLE OF MECHANOTRANSDUCTION

- **MECHANOTRANSDUCTION :**

All vitals cells respond to alternations in their external environment by the processes :

a. Mechanoreception :

Transmit an extra cellular physical stimulus into a "receptor cells"

b. Mechanotransduction :

Transform the stimulus "informational content" into an intracellular signal.

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED
1. ROLE OF MECHANOTRANSDUCTION

OSSEOUS MECHANOTRANSDUCTION

- Static & dynamic loading continuously applied on bone
- Deformation of ECM & bone cells
- Stimulus exceeds threshold value
- Loaded tissue responds (by triad of bone adaptation process)
- Osteoblasts(regulate deposition & maintainance)
- Osteoclasts(regulate resorption)

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED
1. ROLE OF MECHANOTRANSDUCTION

OSSEOUS MECHANOTRANSDUCTION

- This process translates the information content of a periosteal functional matrix *stimulus* into a skeletal unit cell *signal*
- There are two skeletal cellular mechanotransductive processes:

1. Ionic
2. Mechanical

IONIC- involves transport of ions through plasma membrane resulting in creation of electrical signal.

Stretch activated channels – structure found in bone cells, esp fibroblasts

In Strained osteocyte → S-A get activated → passage of certain sized ions

Electrical processes

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED
1. ROLE OF MECHANOTRANSDUCTION

OSSEOUS MECHANOTRANSDUCTION

- This process translates the information content of a periosteal functional matrix *stimulus* into a skeletal unit cell *signal*
- There are two skeletal cellular mechanotransductive processes:

1. Ionic
2. Mechanical

MECHANICAL PROCESS

- The basis of this mechanism →physical continuity of the transmembrane molecule integrin →connected extracellularly with collagen and intracellularly with cytoskeletal actin → in turn, are connected to the nuclear membrane → at this site, activation of regulatory genomic activity.

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED. 2. THE ROLE OF AN OSSEOUS CONNECTED CELLULAR NETWORK

- **BONE AS AN OSSEOUS CONNECTED CELLULAR NETWORK [CCN]**

- Intercellular gap permits bone cells to intercellularly transmit and process periosteal functional matrix information.

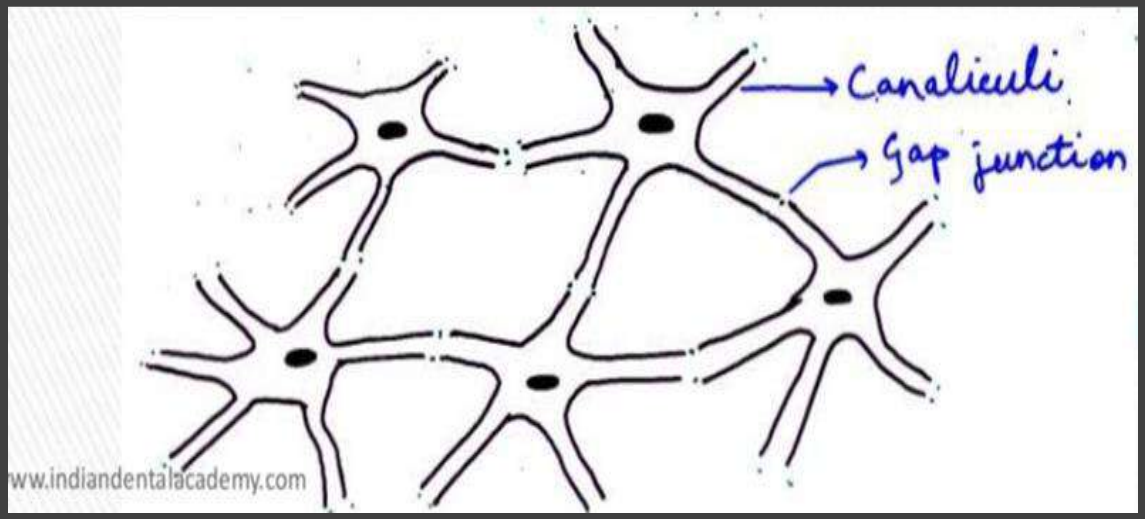
- This updating explains the extension of epigenetic event of muscle contraction hierarchically downward to the regulation of bone cell genome .

Bone as CCN

"The output determines the site, rate, direction, magnitude and duration of specific adaptive response i.e deposition, resorption or maintenance of the skeletal tissue".

Bone as CCN

- All bone cells are interconnected – ***Gap Junctions***
- Exception - osteoclasts



Connexin 43

Plasma membrane of canalicular processes meet

Gap junctions connect -

1. Osteons to interstitial regions
2. Superficial osteocytes – periosteal & endosteal osteoblasts
3. Laterally connected
4. Periosteal osteoblasts – pre-osteoblastic cells(interconnected)

Important points :

1. Information is not stored discretely in CCN; distributed across all/part of the network
2. CCN shows oscillations i.e. reciprocal signaling (feedback) between layers : enables to self-organize
3. Phenotypically similar osteoblasts are interconnected by open gap junctions
4. Variation in organization permit discrete processing of different signals

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED.
3. THE GENOMIC THESIS

THE GENOMIC THESIS says :

- "All phenotypic features are ultimately determined by the DNA sequence of the genome".

- The genomic thesis is denied because it is both reductionist and Molecular. It passes directly from the molecules to morphogenesis, ignoring the role of epigenetic processes, bypassing the structurally complex development stage.

Biologic bases for genomic thesis

- Only 10% of genome is related to ontogenesis



•Regulate metabolic and respiratory activity of all cells

•Regulate specific activity of special cell (neurons, osteoblasts)

Orthodontic implication of genomic thesis

- Defect in the regulatory activity of genes or gene expression governing the size of the teeth and jaws

↓

Malocclusion and dentofacial deformities

THE FUNCTIONAL MATRIX HYPOTHESIS REVISITED. 4. THE EPIGENETIC ANTITHESIS AND THE RESOLVING SYNTHESIS

EPIGENETIC ANTI THESIS :

- This antithesis is integrative.
- It clarifies the causal chain between genome and phenotype. It is applicable at each Hierarchical level of increasing structural and operation complexity.

GENOMIC THESIS

- Morphogenesis is predetermined reading out of an inherited genomic blueprint.

EPIGENETIC ANTITHESIS

- Many different extrinsic stimuli are capable of modifying DNA. Mechanical loading is known to influence gene expression.

RESOLVING SYNTHESIS

Fundamental argument is –

- Morphogenesis is regulated by activity of both genomic and epigenetic processes.
- Neither alone is sufficient and only integrated activity provides the necessary and sufficient causes of growth.
- Genomic factors are considered INTRINSIC and prior causes while epigenetic factors as EXTRINSIC and proximate causes.

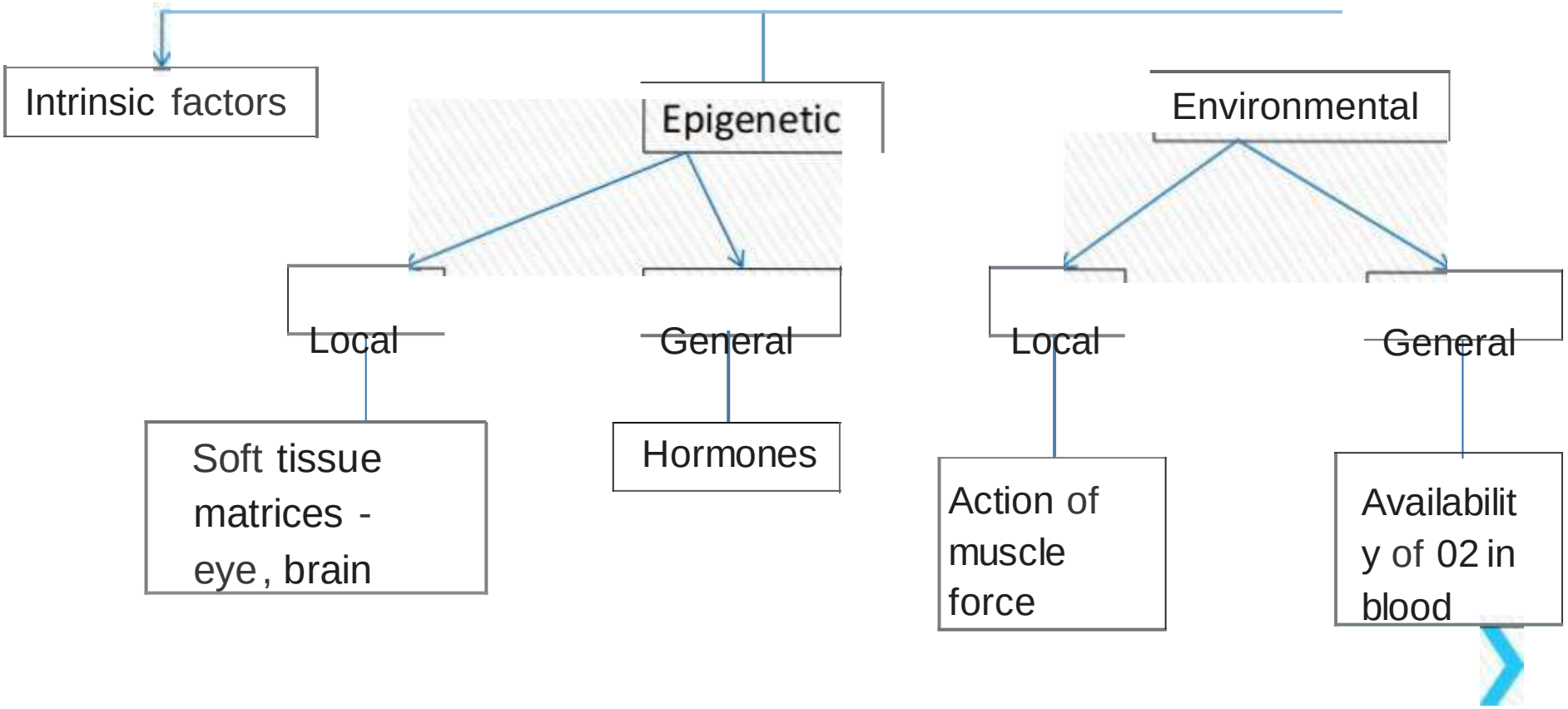
VAN LIMBORG'S MULTIFACTORIAL THEORY (1970)

- The genetic theory, sutural theory and cartilage theory were not satisfactory, yet each contains elements of significance that cannot be denied.
- Limborg explains the growth and development in a view that combines all the existing theories.
- According to him, craniofacial morphogenesis is controlled by five different factors.

- Van Limborgh suggested the following five factors that he believed control growth:

1. Intrinsic genetic factor
2. Local epigenetic factor
3. General epigenetic factor
4. Local environmental factor
5. General environmental factor

Factors influencing growth



- ***Intrinsic genetic factors***: they are the genetic factors inherent to the skull tissues.

They exert their influence within the cells and determine the characters of cells and tissues.

- ***Local epigenetic factors***: genetically determined influence originating from adjacent structures and spaces (brain, eyes, etc.)

- ***General epigenetic factors***: genetically determined influences originating from distant structures (sex hormones, growth hormone etc.)

- ***Local environmental factors***: local non-genetic influences originating from the external environment. (local external pressure, habits, muscle force, etc.)

- ***General environmental factors***: general non-genetic influences originating from the external environment (food and oxygen supply etc.)

REF: T.M. GRABER 3RD EDITION

Views expressed by Van Limborgh can be summarized in the following essentials of craniofacial growth:

1. Chondrocranial growth is controlled by intrinsic genetic factors.

2. The desmocranial (primordia of skull) growth is controlled mainly by many epigenetic factors that originate from skull cartilages and other head tissues.

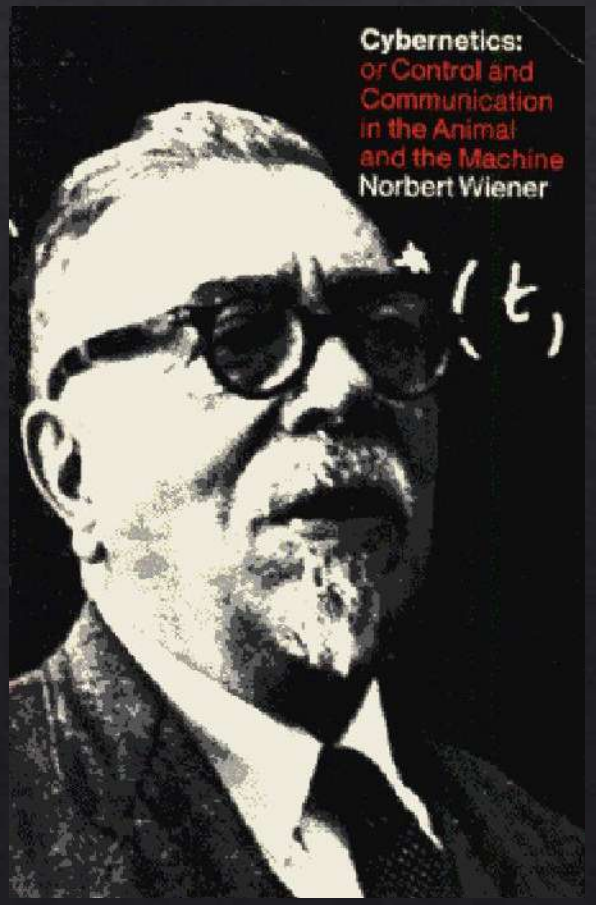
3. The growth of the desmocranium is influenced by local environmental factors occurring in the form of tension forces and pressures.

4. General epigenetic and general environmental factors are of minor importance.

SERVOSYSTEM THEORY (1970)

- Was introduced by Petrovic using the language of cybernetics

- Cybernetics is the science of control and communication in the animal and the machine.

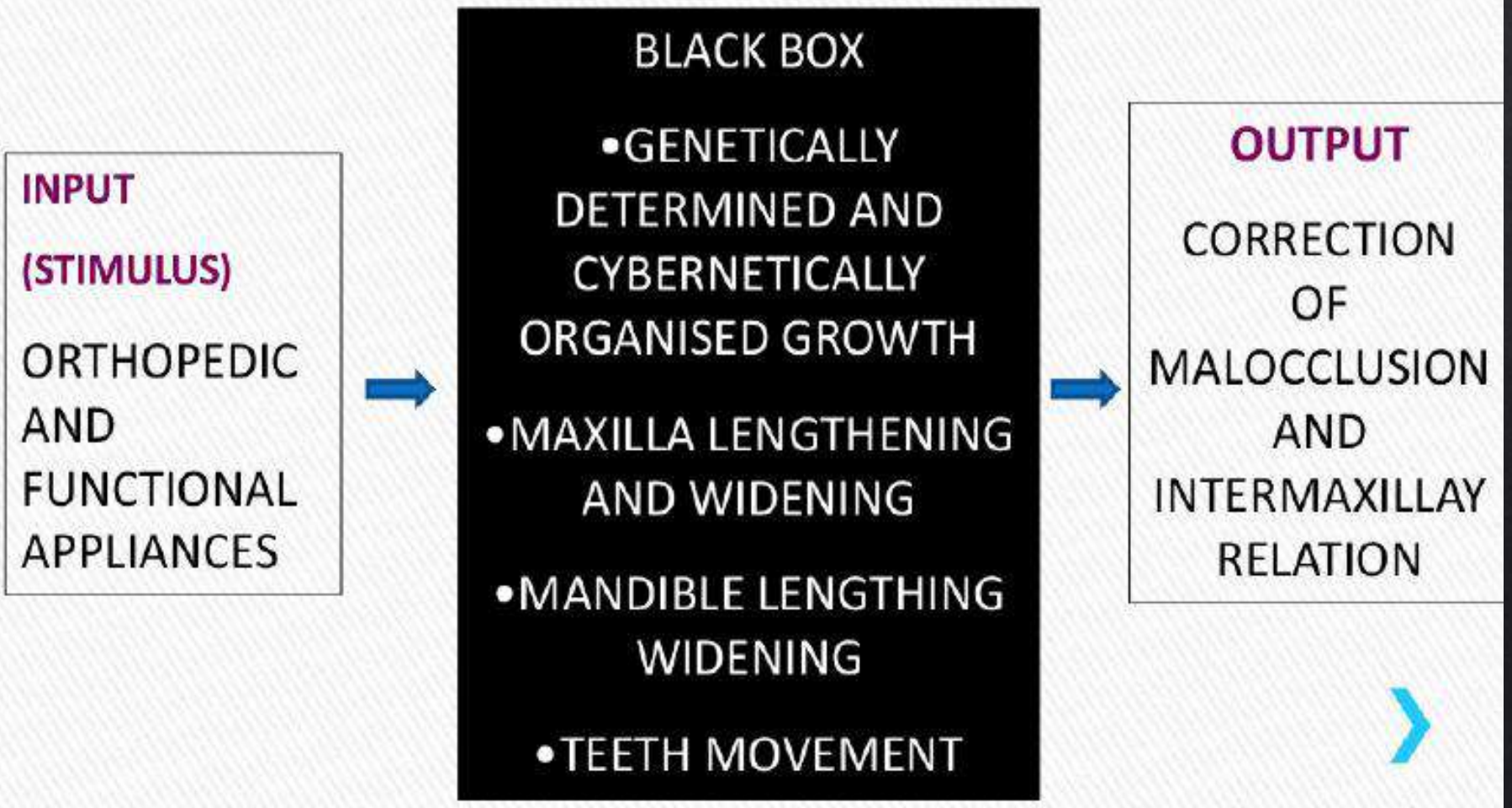


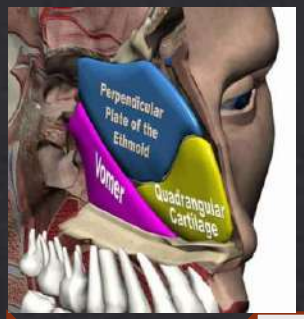
CYBERNETIC APPROACH

- System operates through signals that transmit information.
- Signal may be of physical, chemical or electromagnetic nature, of very low energy.
- Cybernetic system, when provided an input (or stimulus) produces an output. The output is related to the input by a **transfer function.**

- This is similar to feeding numbers into a computer, and obtaining the sum or product of the numbers.
- The calculations performed by the computer, correspond to the "TRANSFER FUNCTION"
- Advantages: not static, sophisticated.

CYBERNETIC ORGANISATION OF CRANIOFACIAL GROWTH





In case of Maxilla

- Growth Hormones, Somatomedin, Testosterone and Estrogen.
- (Command)

- Septal cartilage, Septopremaxillary frenum,Maxillary bones
- (Reference input elements)

- Growth of Maxilla in saggital and vertical direction

In case of Mandible

- Growth Hormones, Somatomedin, Testosterone and Estrogen.
- (Command)

- Lateral pterygoid, Medial pterygoid ,Temporalis muscles
- (Reference input elements)

- Growth of Mandible

SUPPORT :

- The Servosystem theory gives us an insight into the complex process of Craniofacial growth.
- Though the experiments conducted by Petrovic and coworkers were conducted on rats the biochemical and cellular response is the same.
- It is the only theory which can explain the role of intrinsic and extrinsic factors in growth.

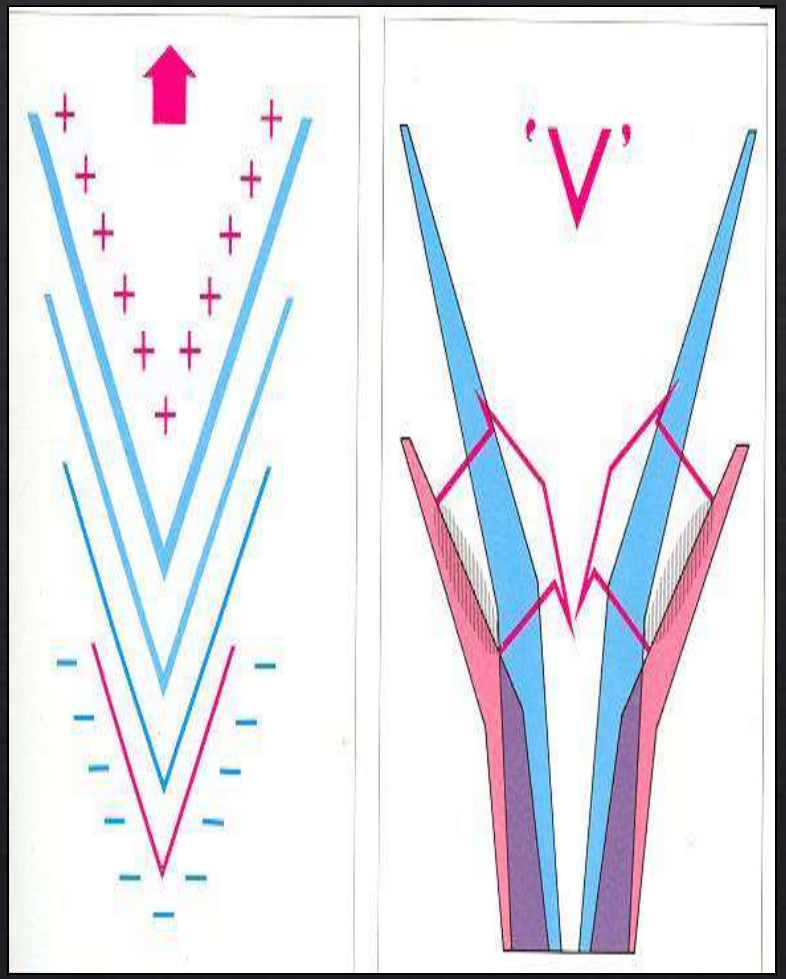
AGAINST :

- The theory places a lot of importance on the condyle as the growth centre. Hence if condylar cartilage is lost subsequent to a fracture, growth should seize. But studies done in Scandinavia show that this does not happen.
- Lot of importance on the role of hormones in controlling growth has been given. In all probability, they do not have such a large role to play.
- According to the theory, an end on relation is a repeller. Still, end on relation of the molars and other teeth are often seen
- The theory does not explain the action of the reverse pull headgear.

ENLOW'S "V" PRINCIPLE

- ENLOW'S -1970

- Most useful and basic concept in the facial growth.
- Deposition occurs on the inner side and resorption on the outerside of the bones causing enlargement and displacement.
- The displacement is towards wide end of 'V'
- Examples
  - Neck of the condyle
  - Palatal process of maxilla



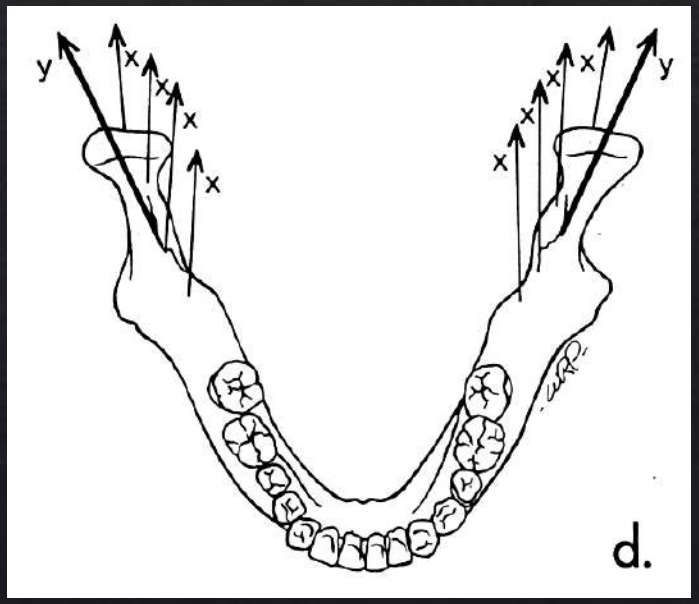
The outcome of these growth processes is

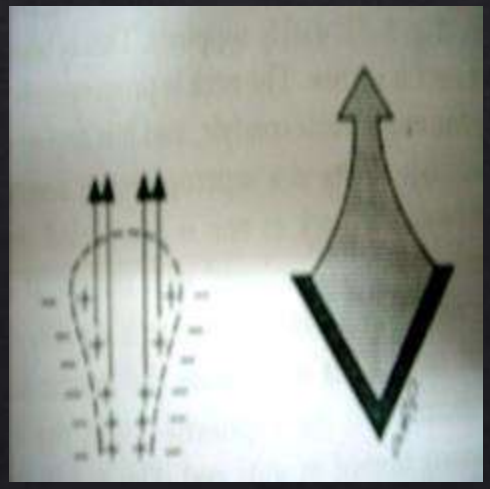
- Enlargement in overall size of the 'V' -shaped area.
- Movement of the entire 'V' structure toward its own wide end
- Continuous relocation

“V” PRINCIPLE IN CONDYLAR NECK

- The posterior edge of the condylar neck is depository and grows posteriorly.

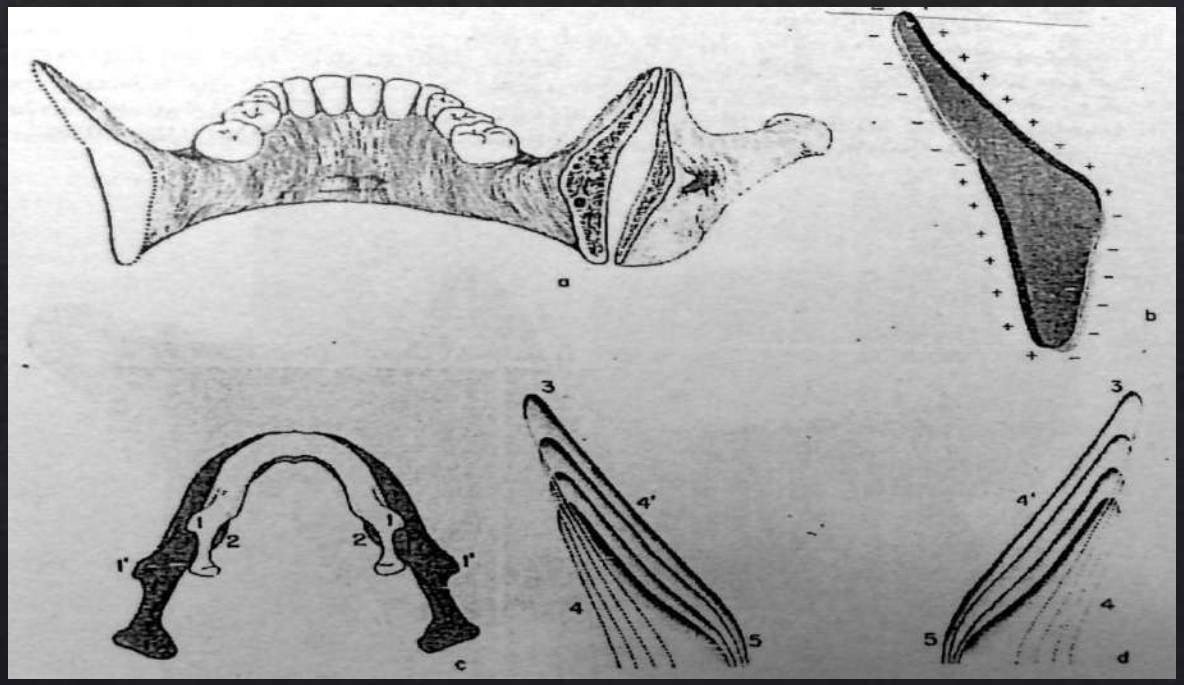
- The neck is relocated into the areas previously held by condyle by periosteal resorption and the endosteal deposition.





"V" PRINCIPLE IN CORONOID PROCESS

- When bone is added on the lingual side of the coronoid process, its growth thereby proceeds superiorly.

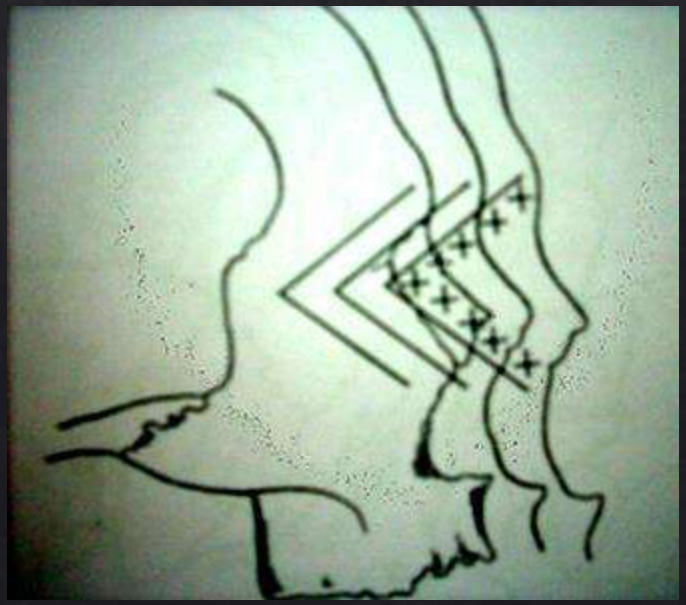


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“V” PRINCIPLE IN THE ORBIT

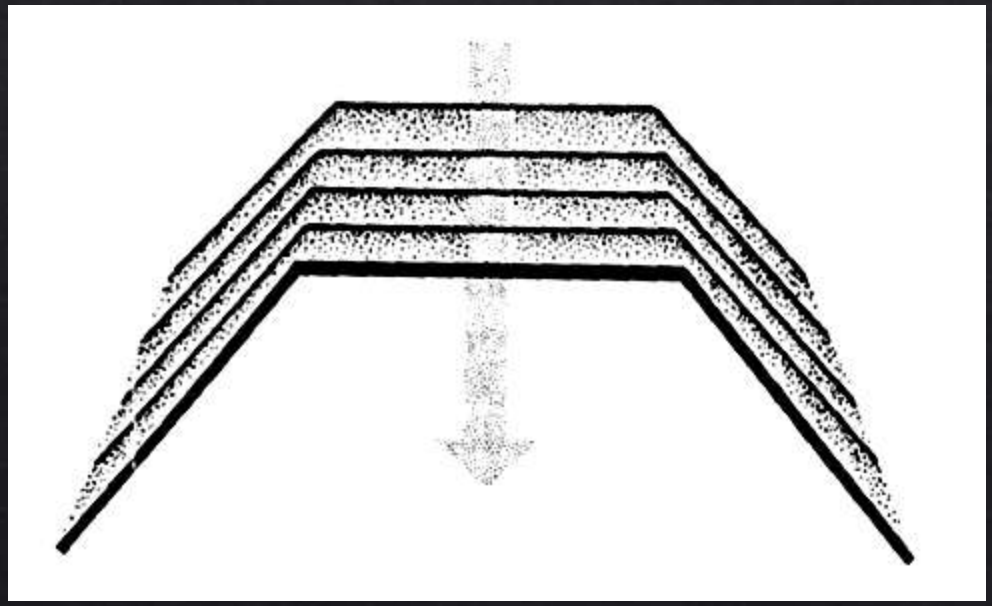
- The cone shaped orbital cavity grows and moves in a direction towards its wide opening.

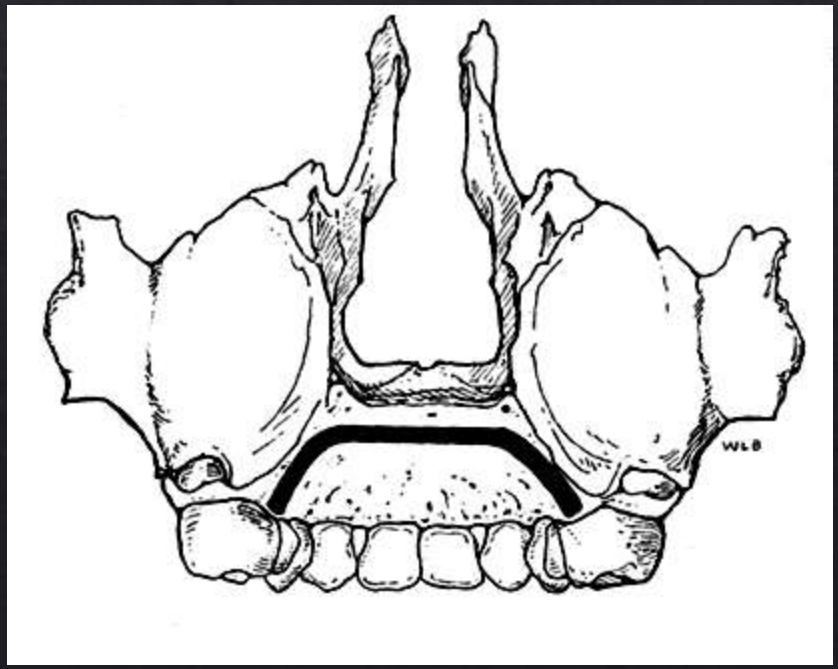
- Bone deposition on the inside surface.



"V" PRINCIPLE IN THE PALATE

- In the maxillary arch, bone being added on the inside of the arch, the arch increases in width and the palate becomes wider.





GRABER T.M. 3RD EDITION

ENLOW'S COUNTERPART PRINCIPLE

- This principle states that the growth of any given facial or cranial part relates specifically to its counterparts in the face and cranium in relation to proportions, shapes, relative sizes & angles.
- If each regional part & its counterpart enlarge at the same time, then balanced growth occurs.
- No face has yet been encountered that has perfect Anatomic and Geometric "Balance".

Different parts & their counterparts :

1. Nasomaxillary complex - Anterior cranial fossa
2. Horizontal dimension of the pharyngeal space – Middle cranial fossa.
3. Middle cranial fossa – Breadth of Ramus.
4. Maxillary & mandibular arches are mutual counterparts.

CONCLUSION

- *There is no single theory of craniofacial growth.*
- *It is important to understand various factors influencing the morphogenesis and growth of craniofacial complex.*
- *All factors should be taken care into account while planning the treatment at proper time & in appropriate measure to achieve the predictable and clinically efficacious results*

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THANK YOU



TOPICAL FLUORIDES



CONTENTS

- INTRODUCTION
- DEFINITION
- HISTORY
- RATIONALE FOR TOPICAL FLUORIDES
- PROFESSIONALLY APPLIED TOPICAL FLUORIDES
- *Solutions(NaF, Sn_2F, APF)*
- *Gels*
- *Varnishes*
- *Foam*
- *Slow release fluoride devices*
- SELF APPLIED TOPICAL FLUORIDES
- *Dentrifices*
- *Mouth rinses*
- *Fluoridated floss & tape*
- CONCLUSION

INTRODUCTION

- Fluoride is still the cornerstone of modern non-invasive dental caries management. It is also known as pivot of preventive dentistry.

- Today it is well accepted that long-term exposure to topical fluorides mediates a reduction in caries prevalence similar to that obtained through fluoride supplementation.

- Clinical findings are supported by in vitro and in vivo studies demonstrating that the mode of action of fluoride can be mainly attributed to its influence on the de- and remineralization kinetics of dental hard tissues [Fejerskov et al.,1981; Ten Cate and Featherstone, 1991; Ten Cate, 1999].

- The results of more recent epidemiological and laboratory studies summarizes that the posteruptive (topical) application of fluoride plays the dominant role in caries prevention.

TOPICAL FLUORIDES

DEFINITION

Topically applied fluoride is used to describe those delivery systems which provide fluoride for local chemical reaction to exposed surfaces of erupted dentition.

The delivery systems include measures designed for professional application in dental offices, such as fluoride containing prophylactic pastes, solutions, gels and varnishes, as well as systems designed for unsupervised home use, such as fluoride dentifrices and rinses.

History

Volker in 1939 demonstrated that exposure of enamel to a solution of sodium fluoride reduced the rate of dissolution of enamel in acid.

History.....

Concept of topical fluorides started with the classical study by Dean (1941).....

History.....

- Era of topical fluorides begin with the first clinical study by Bibby using 0.1% NaF solution.(1941)

- Subsequently over the years other topical fluoride agents have been evolved which in sequential order are :

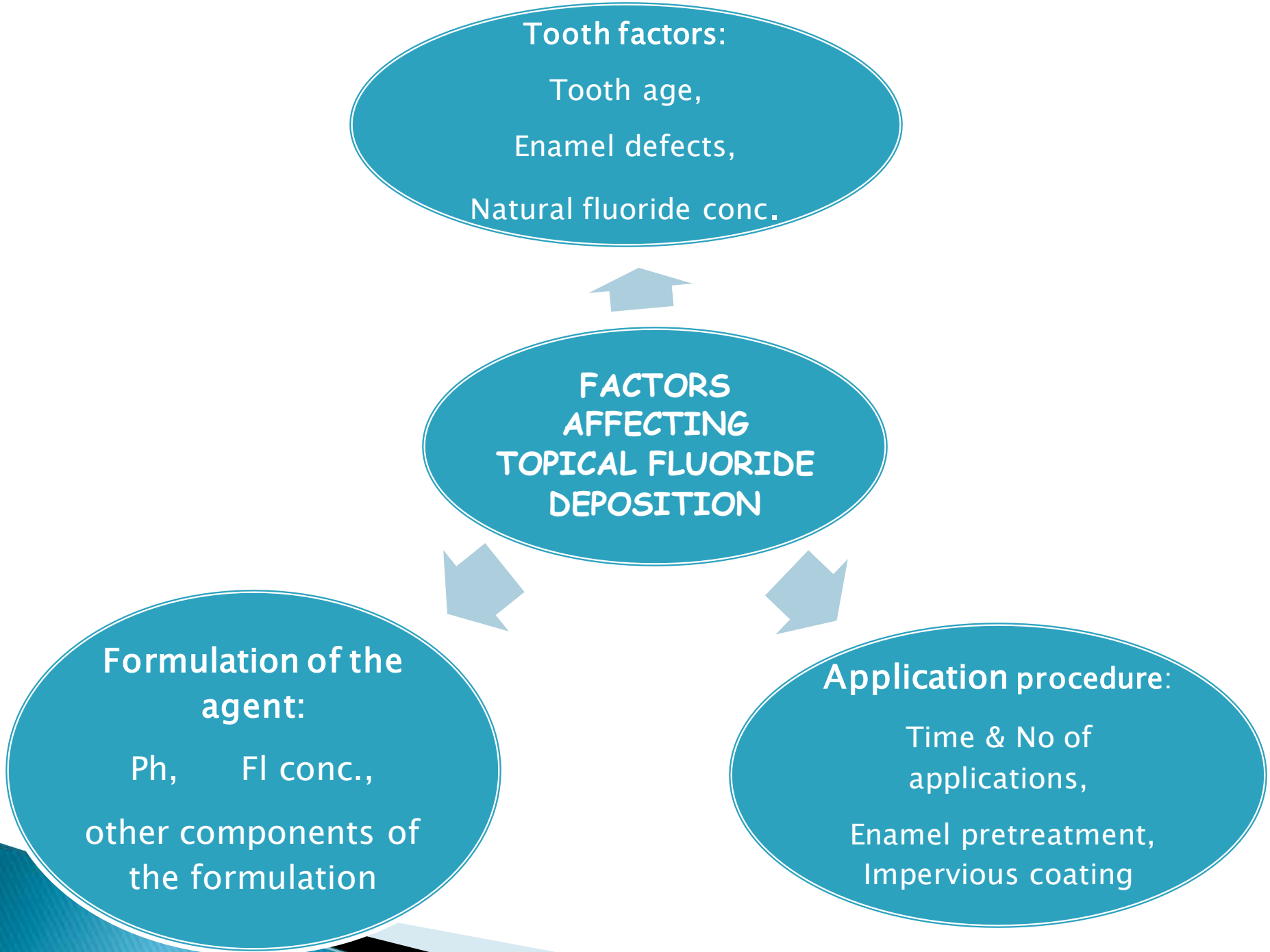
- Sn_2F 1947
- APF 1963
- NaMFP 1963
- Fluoride varnish 1964
- Amine fluoride 1967

RATIONALE FOR USING TOPICAL FLUORIDE

- To speed the rate and increase the concentration of fluoride aquisition above the level which occurs naturally.
- If an individual is exposed only to fluoride in drinking water it may take years before surface enamel acquires effective Concentration.
- Topical fluoride hastens this process

- Immature and porous enamel aquires fluoride rapidly, so best time to apply topical fluorides is soon after eruption.

- Initial carious lesion is porous and accumulates fluoride at a much higher concentration, so white spot can be remineralised.


Tooth factors:
Tooth age,
Enamel defects,
Natural fluoride conc.
FACTORS AFFECTING TOPICAL FLUORIDE DEPOSITION
Formulation of the agent:
Ph, Fl conc.,
other components of the formulation
Application procedure:
Time & No of applications,
Enamel pretreatment,
Impervious coating

METHODS OF ENHANCING FLUORIDE FIXATION IN ENAMEL

Increase in frequency of application and time exposure.

Pretreatment of enamel surfaces - By 0.05 M Phosphoric Acid.

By Acidified, saturated solution of Dicalcium phosphate dihydrate.

Use of Complexing Agents -
eg. 0.05 and 0.1 M Aluminium nitrate.

TYPES

Professionally applied- High fluoride concentration i.e. 5000-19000ppm or 5-19 mgF/ml.

Self applied- Low fluoride concentration i.e. 200-1000ppm or 0.2-1mgF/ml..

PROFESSIONALLY APPLIED FLUORIDES



METHODS OF APPLICATION

1. ***Paint on technique:***

   Applied using a brush and solution is painted on tooth surfaces first on lower arch than on upper



2. ***Tray technique:***

   Applied using custom or prefabricated trays where material is loaded and applied to all the teeth.



SODIUM FLUORIDE

- In 1942,Bibby conducted a trial in which 0.1% NaF was applied (7-8 min) 3 times a year at 4 month interval

  45% caries reduction was seen after one year,

  33% after two years

  36% at the end of 3rd year.

- In 1942 Knutson started series of clinical trials

(2% NaF 3-4 min) regarding the number of applications in a year.

- 1942 Knutson & Armstrong (8-15 applications)
- 1947 Knutson & Galgan (2,4,6 applications per year in three groups)
- In 1948,Knutson & Feldmen described a technique in which 2% NaF was applied 4 times at intervals of 1 week in a year & recommended 7,10,13 years as specific age groups.

Knutson's Technique

The 4 visit was recommended at the ages of 3,7,10,13 years of age.

- Teeth were to be cleaned and isolated.
- 2% NaF is applied with cotton applicators and is dried for 4 minutes.
- The patient is instructed to avoid eating, drinking or rinsing for 30 minutes so as to prolong availability of fluoride ion to react with tooth surfaces.
- Second, third and fourth visits are given at weekly intervals



Advantages

- Chemically stable
- Nonirritating
- Acceptable taste
- No discoloration

One disadvantage of the use of Knutson's technique is that the patient must make 4 visits to the dentist within a relatively short time.

Method of preparation of 2 per cent sodium fluoride

- Dissolve 20 gms of NaF powder in 1 litre of distilled water in a plastic bottle.

- Store fluoride in plastic bottles:

  because if *it* stored in glass containers, the fluoride ion of solution can react with silica of glass forming SiF2 thus reducing the availability of free active fluoride for anticaries action



Mechanism of Action of Sodium Fluoride

NaF is applied topically, it reacts with hydroxyapatite crystals to form CaF2

$$Ca_{10}(PO_4)_6(OH)_2 + 20F- = 10CaF_2 + 6(PO_4)-3 + 2(OH)-$$

This is due to high concentration of fluoride (9,000 ppm) in 2 % NaF due to which the solubility product of CaF 2 get exceeded fast and this initial rapid reaction is followed by drastic reduction in its rate and the phenomenon is called choking off.

Choking off:-

Once a thick layer of CaF_2 gets formed *it* interferes with the further diffusion of fluoride from the topical fluoride solution to react with hydroxyapatite

(*It is because of this reason that NaF is once applied and is left to dry for 4 minutes).*

$$CaF_2 + Ca_5(PO_4)_3(OH) = 2Ca_5(PO_4)_3F + Ca(OH)_2$$

CaF_2 reacts with HA (hydroxyapatite) to form fluoridated hydroxyapatite, making tooth structure more stable, less suceptible to dissolution by acids- showing anticaries effect

STANNOUS FLUORIDE

- Stannous fluoride in early 1950s occupied a central role in the saga of preventive dentistry.

- Muhler & Van Huysen (1947) carried out an in vitro study on various fluoride agents (K, Pb, Si, Tin, Zirconia).They found that SnF2 yielded most efficient cariostatic effect.

- Muhler *et al.* (1947) observed that enamel powders treated with stannous fluoride solution greatly reduced the rate of acid dissolution.

- Muhler & Huysen in 1950 popularized stannous fluoride solution in the concentration of 8% applied semiannually (six monthly). It was purported to be 3 times effective than sodium fluoride.

- Muhler (1950) in an experimental investigations in rats given 10 ppm SnF2 & 10ppm NaF in drinking water & found that SnF2 was better that NaF .

- These experimental studies paved the path for studying the clinical usage of SnF2 in topical form.

- Ist clinical study – Howel & Muhler (1950) 4 applications of 2%SnF2 & 2% NaF reported 83% & 23.6% decrease in caries rate.

- Gish & Muhler 1957, Jordan et al 1957- tried single annual application of 8% SnF2 & found to be better as compared with Knutsons technique.

4 clinical trials showed very low DMFS reduction:

- Wellock et al 1965- 0%
- Horowitz 1967- 0%
- Torell & Ericcson 1965- 3%
- Cons et al 1970 – 8%

- Whereas Muhler et al 1972 continued to show higher efficacy- 69% in 2year study

METHOD OF PREPRATION

0.8 gm of stannous fluoride to be dissolved in 10 ml distilled water.

IT IS FRESHLY PREPARED ,BECAUSE OF LIMITED SHELF LIFE

8% stannous fluoride contains 19360ppm Fl-

Technique of application:

- Thorough oral prophylaxis
- Isolation
- Application of a freshly prepared 8% stannous fluoride solution for four minutes, teeth are kept moist with reapplication of solution after 15-30 sec.
- Recommended once a year



The **Advantages** are:

- Highly soluble tin fluro phosphate complex forms on enamel that is more resistant to decay than enamel.

The **Disadvantages** are:

- Disagreeable taste
- Tissue irritation
- Discoloration (Tin Sulphide)
- The solution is not stable & it undergoes rapid hydrolysis and oxidation.
- Every time a fresh solution has to prepared.

MECHANISM OF ACTION OF SNF2

$Ca_5(PO_4)_3(OH) + 2SnF2 = 2CaF_2 + Sn_2(OH)PO_4 + Ca_3(PO_4)_2$ – At low conc.

$Ca_5(PO_4)_3(OH) + 16SnF2 = CaF_2 + Sn_3F_3PO_4 + Sn_2(OH)PO_4 + 4Ca(SnF_3)_2$

- Muhler 1968 reported that tin of SnF2 reacts with enamel & forms a new crystalline compound TTFP
- Jordan (1971) described that TTFP is more resistant to decay than enamel.
- Babock et al 1978 reported that calcium trifluorostannate has also got similar anticaries effect

- $Sn2OH(PO_4)$ **TIN HYDROXY PHOSPHATE**- METALLIC TASTE
- $Sn_3F_3PO_4$ (TTFP) **TIN TRIFLUORO PHOSPHATE**- STABLIZES THE TOOTH STRUCTURE MAKING IT LESS SUCEPTIBLE TO DECAY
- $Ca(SnF_3)_2$ **CALCIUM TRIFLUOROSTANNATE** -ALSO SHOWS ANTI CARIES EFFECT

SnF2 has a specific effect against streptococcus mutans, which is essential for initiation of caries

ACIDULATED PHOSPHATE FLUORIDE:

- Idea of APF as topical agent emerged with an in vitro study of Bibby (1947), who reported that as the pH of NaF solution is lowered , fluoride was absorbed more efficiently onto tooth surface and that slightly demineralized enamel acquires more fluoride than unaffected enamel.

- Hence, Brudevold developed a solution, which was acidulated with orthophosphoric acid and buffered to a pH of 3.

- 1963- Wellock & Brudevold reported 66% fewer carious surface in 2 year study using APF solution.

- 1963 Pameijer & Brudevold found APF 50% more effective than neutral NaF.

METHOD OF PREPARATION

- 20 gm NaF in 1 lit of 0.1M phosphoric acid
- To this add 50% HF to adjust the pH at 3 & Fl- concentration at 1.23%
- 1.23% APF contains 123000 ppm fluoride
- The solution is applied twice a year after oral prophylaxis and isolation.



Technique of application:

BRUDEVOLD TECHNIQUE

A) Prophylaxis to be done.

B) Isolate a quadrant with cotton rolls.

C) APF solution applied with cotton applicator.

D) Keep the teeth moist for 4 minutes.

E) Repeat procedure for remaining quadrant.

F) Instruct patient not to eat, drink or rinse for 30 minutes.

- **Advantages:**
  Cheap & easy to prepare

- **Disadvantages:**

  - Practical difficulties like teeth will be wet for 4mins.
  - Increases chair side time.
  - Acidic and sour and bitter in taste.
  - Cannot be stored in glass containers.
  - Damage to porcelain,composite restoration.

MECHANISM OF ACTION

$Ca_5(PO_4)_3(OH) + 4H^+ = 5Ca^{++} + HPO4^{--} + H2O$

- when APF is applied on the teeth it initially leads to dehydration & shrinkage in HAP crystals which further on hydrolysis forms intermediate compound (Dicalcium Phosphate Dihydrate DCPD)

$Ca^{++} + HPO4^{--} = Ca.HPO4.2H2O$

- DCPD Is highly reactive to fluoride & fluoride moves deeply through the openings produced by shrinkage & leads to the formation of FAP

$$Ca.HPO4.2H2O \xrightarrow{Fl^-} Ca_5(PO_4)_3F + 2HPO4^{--}$$

- Fluoride is continuously required for the conversion of DCPD to FAP so APF has to be continuously applied to tooth surface for 4 minutes.

GELS



- Gel products are essentially same as the aqueous solution but with the addition of gelling agent (methyl celulose)
- APFgel is most commonly used. It Contains 1.23%(12300ppm)fluoride
- Other agents are neutral sodium fluoride & stannous fluoride

Advantages Of Gel:



- Gel adheres to teeth for considerable time and eliminates continous wetting of enamel surfaces.
- When trays are used,it is possible to treat 2 or 4 quadrants simultaneously.
- Since each application may be loaded by coating it with a thin layer of gel, hazard of accidental ingestion of fluoride is minimized.
- Acceptable to child due to flavored taste

THIXOTROPIC SOLUTION

- Have high viscosity under storage condition but become fluid under condition of high stress or shearing force

CLINICAL IMPORTANCE: Gel thins out under biting force to penetrate the teeth ,but when not under strees, it remains in the tray does not run down the patients throat

FOAM

- Developed to minimize the risk of fluoride over dosage and to maintain the efficacy of topical fluoride treatment.

Advantages:

- Much lighter than gel, so small amount needed for application.
- Surfactant in foaming agent has a cleansing action.
- Does not require suctioning, so allows for home use as well as for treatment of young and disabled persons.

FLUORIDE VARNISH

- Topical fluoride solutions (Naf , SnF2, APF) have major disadvantage that they remain in contact in contact with teeth for a very short time i.e. 5-10 minutes & get diluted into saliva with a very superficial effect on enamel.

- Baud & Bang (1970) in their in vitro investigation showed fluoride penetration to an average depth of 50 µm after 4 min application of APF(1.23%) however prolonging the application time to 72 hours, increased the penetration to about 170 µm.

- Prolonging the application time results in a more bound form of fluoride

- A second drawback with topical fluoride solutions is that after application much of the aquired fluoride , probably representing unreacting fluoride & CaF2 leaches away (Brudevold 1967, Mellberg 1966)

- According to Brudevold most of the loss may occur within first 24 hours.

- So, to achieve prolonged fluoride action in mouth Schmith in 1964 developed a new coating method in which teeth were coated with laquer containing higher conc. of fluoride.

FLUORIDE VARNISH

Duraphat the first commercial varnish, was introduced in Europe in 1964



Fluoroprotector (1975)

Bifluorid-12 has been introduced more recently





DURAPHAT

- It is NaF varnish with 22.6mg fluoride per ml suspended in alcohol solution of natural organic varnish
- Active fluoride = 22600ppm
- Ist clinical trial 1968- Heuser & Schmidt



MECHANISM OF ACTION OF DURAPHAT

$$Ca_5(PO_4)_3(OH) + 10F^- = 2CaF_2 + Ca_5(PO_4)_3F + 6Ca_3(PO_4)_2 + 10(OH)^-$$

- Continuos reaction of HAP with slowly releasing fluoride leading to formation of FAP

$$CaF_2 + Ca_5(PO_4)_3(OH) = 2Ca_5(PO_4)_3F + Ca(OH)_2$$

- Part of CaF2 reacts with HAP to form FAP

FLUORPROTECTOR

- It is a colorless polyurethane lacquer.
- Fluoride compound is Difluorosilane (3-methoxy-4 hydroxy- cyclohexyl – ethyl - difluorohydroxy silane, MW-238) in conc of 2% wt.
- Fluoride content is .7% wt.
- Active fluoride available = 7000ppm



MECHANISM OF ACTION OF FLUOROPROTECTOR

- Arens & Schuthof (1975) showed that silane Fl of fluorprotector reacts with water to produce considerable amount of HF , which penetrates into enamel more readily than fluoride ions.

- The probable reaction being

  $$R\text{-}SiF_2OH + H_2O = R\text{-}Si(OH)_3 + 2HF$$

- Koritzer & levi (1979) suggested that fluorosilanes enhance retention and penetration of fl in enamel by utilising enamel network as a conduit.

- Duke & forward (1978) suggested that the strongly acid conditions produce by reaction b/w silane fluoride & oral fluids enhances the formation of CaF2 & forms an adherent precipitate on and within the enamel which leads to slow release of fluoride to the deeper layers.

$$R\text{-}SiF_2OH + H_2O = R\text{-}Si(OH)_3 + 2HF$$

Duraphat versus Fluoroprotector

- Inspite lower Fl content in fluorprotector as compared to duraphat the Fl deposited in enamel is twice as more & on the contrary its ability to inhibit caries is far less than duraphat.

- According to Arends et al 1980 fluoprotector, a high viscosity varnish penetrates the porosities of enamel forming tags 0.5-1.0µm long which act as a fluoride reservoir accounting for more fluoride deposition in enamel.

- On the other hand these tags further block the pathways for fluoride & do not let remineralisation of initial lesions occur, explaining the less caries inhibition.

- The fact that Ca dissolution is reduced more with Duraphat than Fluorprotector suggest that part of Fl deposited after tratment with FP may be in some form other than the bound form i.e, fluorapatite (Seppa- 1983)

BIFLUORID 12

- It is clear varnish containing 6% CaF & 6%NaF
- Size of particles = .5-2.0 μm, which allows them to penetrate & block the dentinal tubules and fill small gaps & spaces around the margins of restorations ensuring formation of CaF2 deposits.
- 1gm of preparation contains 56.3mg of fluoride
- Varnish base contains collodian & an organic solvent



- Hellwig & Attin (1994) showed that one application of Bifluorid 12 resulted in three times more structurally bound fluoride (CaF_2) as compared to Fluorprotector.

- Tweetman (1999) showed that fluoride conc. in whole saliva was higher upto 6 hours after single application of Bifluorid 12 as compared to Duraphat & Fluorprotector.

SLOW RELEASE FLUORIDE AGENTS

- EPOXYLITE: It is a polyurethane based semipermanent fissure sealant material with high conc. of fluoride.

- Indicated in fissures on newly erupting teeth, it is retained for few months providing continuous release of fluoride.

INTRAORAL SLOW RELEASING DEVICES

Device that can deliver a constant supply of fluoride over a period of at least 2 years

2 types

Copolymer membrane device

- Developed by Cowsar et al 1976
- Membrane controlled reservoir consist of inner core of hydroxyethyl methacrylate - methyl methacrylate copolymer (50:50) containing NaF
- Inner core is surronded by hydroxyethyl methacrylate-methyl methacrylate copolymer membrane that controls rate of fluoride release.
- 0.02-1.00 mg fluoride/day
- Duration 30-180 days

Fluoride glass device

- Releases elements over a period of 1 year
- 4mm in diameter attached to buccal aspects of Mx. permanent molar with an acid etch resin composite.
- When moist with saliva it releases fluoride

FLUORIDATED PROPHYLACTIC PASTES

- Concentration of fluoride= 0.1%-1.0%
- Most common agent NaF (SnF2,AmF & SMFP can also be used)
- Provide both the cleaning and fluoride application in one step.
- High temp. due to friction b/w prophylactic cup & teeth enhances uptake of fluoride
- Prophylaxis removes a fluoride rich layer and prophylactic paste replenishes the lost fluoride with a net gain in fluoride concentration.
- Offer less benefit than solution or gels.
- Not a substitute for regular topical application



DENTAL MATERIALS CONTANING FLUORIDE

GIC
FLUORIDE in AMALGAM
PIT & FISSURE SEALANTS
RMGIC
GIOMER
COMPOSITES
COMPOMERS

SELF APPLIED TOPICAL FLUORIDES

TO BE CONTINUED……

DENTRIFICES

Dens- tooth
fricare- to rub

Function:

A) Therapeutic functions-Physicomechanical functions- Reduces the cariogenicity of remaining plaque by flushing or rinsing action.

B) Chemical function- Based on anticaries mechanism of fluoride

FLUORIDE COMPOUNDS IN DENTRIFICES

- Sodium Fluoride
- Monofluorophosphate
- Amine Fluoride
- USUAL CONC. OF FLUORIDE IN DENTRIFICE: 1000-1500ppm

HISTORICAL EVOLUTION OF DENTRIFICES

- NaF was the first fluoride compound to be added as an active ingredient.

- Most of the earlier studies (Bibby 1945, Muhler et al 1955) evaluated 0.22% NaF dentrifices , but were found to be ineffective in reducing the incidence of dental caries.

- In 1955 another milestone development in history of dentrifices was the introduction of 0.4% SnF2 along with calcium pyrophosphate abrasive system, but initial studies fail to show any reduction in incidence of dental caries.

Negative results of initial studies were due to:

Basic incompatibility with calcium containing abrasives rendering the fluoride compound inactivated by forming insoluble CaF_2

Basic inadequacies in design & conduction of clinical trials

Child age	Recommendation for fluoride paste
<4yr	Not recomended
4-6yr	Brushing once with fluoride toothpaste
6-12yr	Twice aday
>12yr	Thrice a day

Recommendations for dentifrices

(Steven Adaire,Pediatric Dentistry,2006)

- <2yrs based on caries risk assessment
- Young children by adult, supervised for older children
- Pea sized dab
- Brush with F toothpaste twice daily

Dentifrices containing Amine Fluoride

- Amine fluoride were first tested for their cariostatic potential in Zurich, Switzerland .

- It showed organic fluorides have antibacterial and anti solubility properties which were superior to inorganic fluorides.

- It is available in the form of pastes ,gels,powders etc.
- Fluoridated dentifrices should be used with supervised brushing under the age of 6 years.



- Usually fluoridated dentifrices contain 1000ppmF but dentifrices with 220,1500,2500ppmF are also available.

- The certainly lethal dose (CLD)for 70 kg adult is 5000-10,000mg of sodium fluoride or 32-64mg F/kg body weight and safety tolerated dose is (STD)is approximately one -fourth of certainly lethal dose.

RECOMMENDATION FOR FLUORIDE TOOTHPASTE

- 1) Below 2 yrs-Fluoridated Toothpaste is not recommended.
- 2) 4-6 yrs-Brushing daily with fluoride toothpaste
  ¼ strip.
- 3) 6-10yrs -Brushing twice daily with fluoridated toothpaste-1/4-3/4 strip.
- 4) Above 10yrs-Brushing 3 times daily with fluoride toothpaste.

(McDonalds-8th Edition)



SEQUENTIAL FLUORIDE RINSES

- Patient rinses with a 0.31% APF solution followed by 0.4% SnF_2 solution.
- User is offered a choice of :

  A) Three rinse sequence - Two 1 minute rinses with APF solution followed by two

  1 rinse with SnF_2.

  B) Two 1 minute rinses with a combined solution of APF and SnF_2..

- ***Mechanism Of Action:***

Caries is prevented or arrested by an efficient delivery of ionic fluoride to the site in adequate concentration and duration.









FLUORIDE MOUTHRINSES

- A comprehensive multigroup trial observed that daily mouthrinsing for 2 years with 0.05% NaF led to 50% decline in caries increment.
- Daily rinsinsing was found to be more beneficial than forthnightly rinsing.

  Torrel,Erricson(1965)
- Koch(1967) reported 23%caries reduction using 0.5% NaF mouth rinse bi-weekly.

MOUTHRINSES

SODIUM FLUORIDE

- Home use:-
  0.05% daily
- Schools:-
  0.2% weekly/fortnight
- Fluoridated Areas:-
  0.25% weekly/fortnigh
- Non-Fluoridated Areas:-
  0.05% daily



Fluoride mouthrinses are not advocated below age of 6 years.

Mouth rinse made at home

- Dissolve 200mg NaF tablet in 5 table spoons of fresh clear water which is sufficient for daily mouth rinse of a family of 4 members.

- RECOMMENDED SCHEDULES FOR TOPICAL FLUORIDATION
- LOW RISK:no new carious lesions within one month-twice daily use of fluoride tooth paste&spot aplication of topical fluoride to new erupting molars
- MODERATE RISK:one/two new lesions per year or cervical white spots--.05%NaF mouth rinse daily.spot application of varnish to susceptible areas,proffesional topical application every three months
- HIGH RISK;more than two new lesions--.2%NaF mouth wash daily,professional topical application & fluoride varnsh to suceptible areas

BENEFITS OF TOPICAL FLUORIDES

- Prevention of dental caries
- Promotion of gingival health
- Arrest and reversal of incipient lesions.

INSTRUCTIONS TO PT.:
DO NOT RINSE/EAT SOLID FOOD THAT DAY
NOT TO BRUSH THAT DAY

NO OF APPLICATIONS PER YEAR:semiannualy

ADVANTAGE:remains in place for several days

SEQUENTIAL FLUORIDE RINSES

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- User is offered a choice of :

  A) Three rinse sequence - Two 1 minute rinses with APF solution followed by two

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Sodium benzoate		stabilizer	0.20

Topical fluorides – toothpaste

- In Britain – toothpaste containing 0.619% (2800ppmF) for
  - Rampant caries
  - Elderly patients
  - For compromised oral health

FLUORIDE MOUTHRINSES

- SODIUM FLUORIDE MOUTHRINSES:
- formulated at concentration of either 0.2% sodium fluoride (900ppmF) for weekly use
- .05% sodium fluoride (225 ppm F) for daily use- for high risk patients.

(John Featherstone, journal of public health dentistry,vol.24; 2004)

- used by swishing 10 ml of the liquid around the mouth for 60 seconds before expectorating.

- STANNOUS FLUORIDE MOUTHRINSES
- the anticaries effect of stannous fluoride rinses is roughly the same as that of sodium fluoride rinse

RECOMMENDATIONS FOR FLUORIDE MOUTHRINSES (Steven Adaire,Pediatric Dentistry,2006)

- Children with high caries risk
- Children who have mastered swallowing reflex
- Recommend alcohol free preparations

References

- J.J.Murray, Rugg-Gunn and Jenkins. Fluorides in caries prevention. Third edition
- Soben Peter. Preventive and community dentistry. Third edition
- Dr. Amrit Tewari. Fluorides and dental caries. Compendium.
- Murray , Nunn and Steele. Prevention of oral disease. Fourth edition
- Shobha Tandon. Textbook of pedodontics

- A.G Dijkman et al 1982 in an in vitro study found that amount of acquired fluoride in enemel in a 30 mic m thick layer was almost the same in duraphat & FP treated teeth(9& 10 mic gm/cm2 respectively)

- but the amount of fl deposited on enemel (maily in form of caf2) was fond to be more than twice with FP (20.4 & 53 mic gn/cm2 respectively)

- The same authors in 1983 in an invivo study studied the amount of fl present on & in human enamel for 3 months longitudnally – concluded that caf2 in duraphat specimens was lost within 1 week but in FP was noticable upto 1 month. The amount of acquired fl in fp specimens was found to increase with time(15mic gm/cm2 after 3 months)





INSTRUCTIONS TO PT.:

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TOPICAL FLUORIDE ENAMEL REACTIONS

$Ca_{10}(PO_4)_6(OH)_2 + 20F^- = 10CaF_2 + 6(PO_4)^{-3} + 2(OH)^-$

Reaction of high conc. Fluoride(>100ppm) & enamel

$Ca_{10}(PO_4)_6(OH)_2 = 6CaH(PO_4) + 4Ca^{2+} + 2H2O$

At low ph dissolution of surface enamel resulting in formation of DCP & CaF_2

IONTOPHORESIS

Small electric current helps fluoride ion to drive into enamel resulting in

-Reduced enamel solubility
-Increase fluroapetite formation
-Reduced dentin senstivity

Classification

Systemic

- Dietary F
- Water F
- Salt F
- Milk F
- F in sugar
- F supplements
  - Drops
  - Tablets

Topical

Professional

- F solutions
- Foam
- Varnish
- Gels

self

- Dentifrices
- Rinses