# Introduction to Orthodontic Appliances

المرحلة الرابعة

**Lec. 1** **أ.م.د .ليث محمد كريم**

## Orthodontic Appliances

**The appliance that apply mild pressure to a tooth or a group of teeth and their supporting tissue in a predetermined direction to achieve tooth movement within the bone and other tooth supporting tissues.**

### Classification of Orthodontic Appliances:

**The simplest classification is based on the patient's ability to remove the orthodontic appliance. Based on this the appliances can be classified as:**

### A. Removable appliance:

**An appliance which can be removed for cleaning by the patient or for adjustment by the Orthodontist. These appliances can be taken out of the mouth by patient when required.**

**According to their *mode of action*, removable orthodontic appliances are divided into three main groups:**

**1-*Active removable appliances:* These appliances are capable of exerting force (pressure) and perform tooth movement.**

***2-Passive removable appliances*:**

**These appliances remain passive in the mouth and exert no active force (pressure). Example as space maintainer, retainers, habit breaker.**

***3-Functional appliances*: These appliances work by transmitting or modifying muscle forces to the teeth and their supporting tissues.**

**Example as: Horizontal activator, Andersen appliance, Frankles functional regulators.**

### B. Combination of removable and fixed appliances:

**Here some part of appliances can be removed by the patient and other parts remain fixed on the teeth.**

### C. Fixed appliances:

**These appliances cannot be removed by the patient; it is consisting of:**


1. **Bands- cemented on teeth (occasionally cast metal caps).**
2. **Attachments or brackets of different types attached on the bands or on teeth directly with bonding materials.**
3. **Labial or lingual arch wires – These may themselves be active or passive and may carry auxiliary springs for movement of teeth.**

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# Removable orthodontic Appliances

The patient can insert and remove these appliances without the intervention of a dentist. They may be active or passive, depending upon their capability of exerting forces.

**Active removable orthodontic appliances**

designed to achieve tooth movement (mainly tipping), e.g. wire springs, screws etc.

***Advantages of removable appliances***

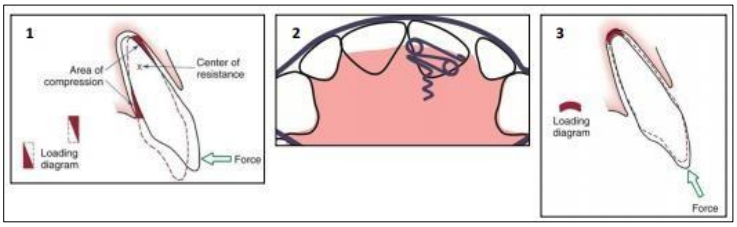
1. The patient can do the oral hygiene procedures without any hindrance (More hygienic than fixed appliances).
2. These appliances are less complicated than fixed appliances and generally more acceptable to the patients.
3. Most forms of tipping movement can be done successfully.
4. They can be delivered and monitored by the general dentist (because these are relatively simple appliances).
5. less chair time to deliver the appliance as compared to the fixed appliances because the appliance fabrication is done in specialized labs.
6. less chair time to activate the appliance as only few movements can be carried out simultaneously with these appliances.
7. These appliances are relatively cheap as compared to the fixed appliances.

***Disadvantages of removable orthodontic appliances***

1. Totally cooperation dependent (since it depends on the patient wearing).
2. These appliances are capable of doing limited types of teeth movements; they do not give three-dimensional control over the teeth to be moved.
3. Multiple movements are difficult or impossible to carryout.
4. The patient has to have a certain amount of dexterity and skill to be able to remove and replace the appliance for successful treatment to be possible.
5. The chance of appliance loss and/or breakage is more than fixed appliance.

## Types of tooth movement done by removable appliances:

1. Tipping movement
    a. Labio-lingual (bucco-palatal) direction
    b. Mesio-distal direction
2. Rotation of less than 90° (couple force system)
3. Intrusion and extrusion (combination appliance)




## Components of the removable orthodontic appliances:

According to their function:
1-Active components: which produce force for tooth movement, as springs, screw, elastics, active labial bows.
2-Retentive components: responsible for holding the appliance inside the mouth, as clasps.
3-Acrylic base plate: as a major connector connecting the components.
4-Anchorage: which is an imaginary component resisting unwanted tooth movement, while certain teeth are being moved by the active components.

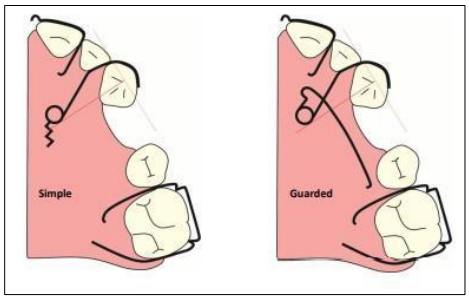
### Active components

responsible for producing the desired tooth movement. They can be categorized as springs, bows, screws and auxiliary elastics.

**Springs:**

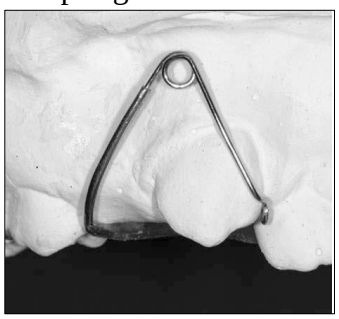
**- Palatal finger springs**

Palatal finger springs are constructed in 0.5- or 0.6-mm stainless steel wire and used to move teeth mesially or distally along the dental arch. The incorporation of a helix (coil) increases the length of the wire and allows the delivery of lighter forces whilst a guard wire will protect the spring from distortion. By convention, the helix is placed such that activation of the spring is done by opening of the coil as tooth movement occurs; the spring should be positioned at right angles to the planned tooth movement.



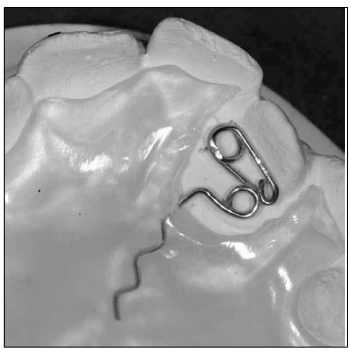

**- Buccal canine retractor**

Buccal canine retractors are constructed in 0.7-mm stainless steel, reduced to 0.5mm if sleeved. These springs can be used to retract buccally displaced maxillary canines.



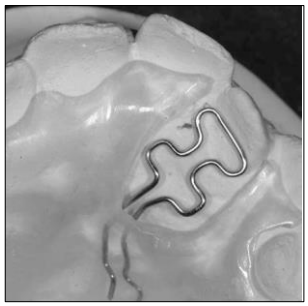
**Z-spring**

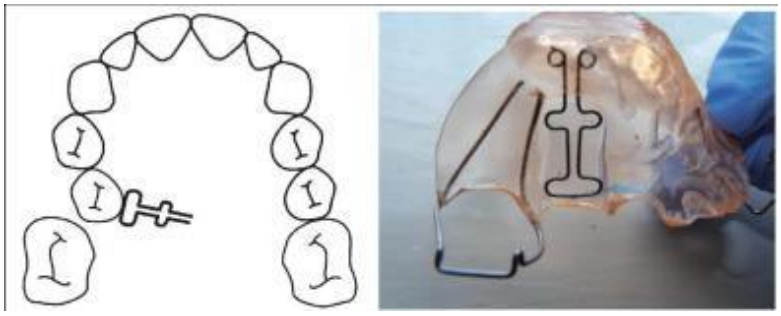
The Z-spring is constructed in 0.5-mm stainless steel wire and generally used to move one or two teeth (recurved or double) labially. Activation is achieved by pulling the spring away from the baseplate (opening the coils) at an angle of approximately 45° to the long axis of the tooth, which will tend to displace the appliance away from the palate; good anterior retention is therefore important.



**- T-spring**

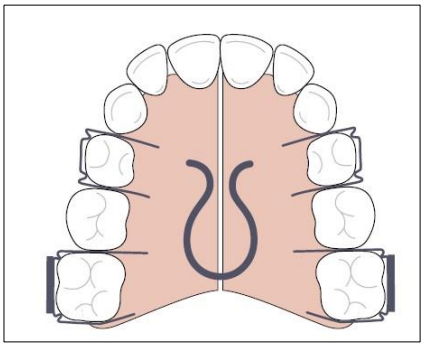
T-springs are constructed in 0.5-mm stainless steel wire and used to move individual teeth either labially or buccally. Activation is again produced by pulling the spring away from the baseplate and therefore retention also needs to be good.





**Coffin spring**

A coffin spring provides a useful alternative to a screw for expansion. This heavy spring is constructed in 1.25-mm wire and activated by pulling the two halves of the appliance apart manually or flattening the spring with pliers. Coffin springs deliver high forces that will tend to displace the appliance and good retention is important.



**<u>Active labial bows</u>**

An active labial bow can be used to reduce an increased overjet by tipping the teeth palatally if the upper labial segment is proclined and spaced. However, a normal labial bow will only allow a small range of activation and this can be improved either by increasing the amount of wire in the bow, as in a Mills bow, or by constructing it in a lighter wire, such as a Roberts retractor.

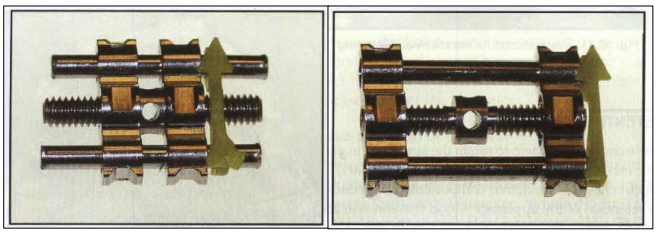
## Screws

■ Screws may be designed to move a single tooth or groups of teeth. The direction of tooth movement is determined by the position of the screw in the appliance.

■ Activation is achieved by turning the screw with a small wire key inserted into one of the holes of screw so that the two sections of the acrylic are moved a part, if the screw is over activated the appliance will not be fully seated.

■ There are basically two types of screws:

**a- Jack screw:** which is the most commonly used it consist of two halves threaded central cylinder, turned by means of a key which separates the two halves by a distance, usually about 0.2 mm each quarter turn.



**Screw before opening** **Screw after opening**


**b- Piston-screw (Landen screw)** activated by moving the screw assembly forward by screwdriver.

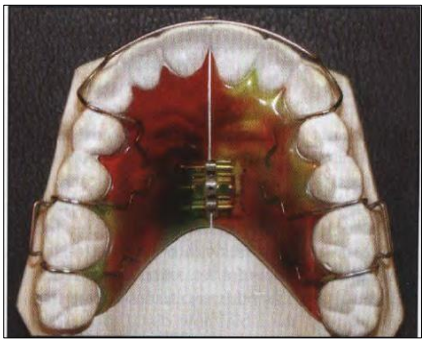
■ They are bulky, expensive and depends on patient's cooperation.

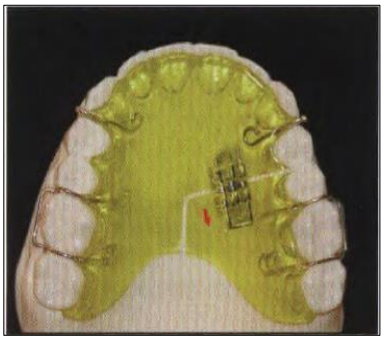
The screws is mainly used for (direction of tooth movement depend on the position of the screw in the appliance):

**a.** Arch expansion; screw placed in the center of the arch.

**b.** Labial/buccal movement of one or a group of teeth.

**c.** Mesial/ distal movement of one or more teeth.

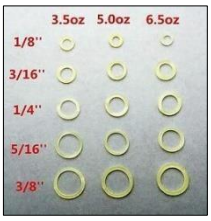




**Elastics:**

- Although elastic deteriorates rapidly in the mouth it is still used where no suitable spring is available.
- Commonly used for intermaxillary traction with fixed & removable appliances. Adams clasp can be used as attachment site. The hooks for the elastics may be incorporated in the clasps or may be separate.
  - They have the advantage of being almost invisible.

They are not commonly used as the active component of a removable appliance because they tend to ride up the teeth and damage the gingival tissues.

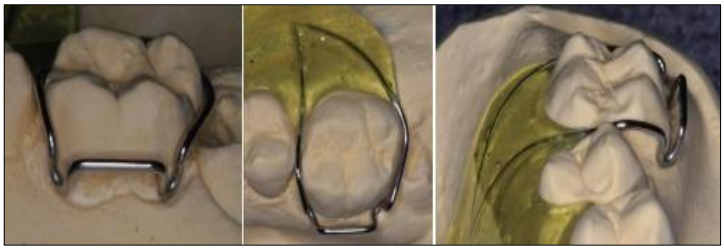


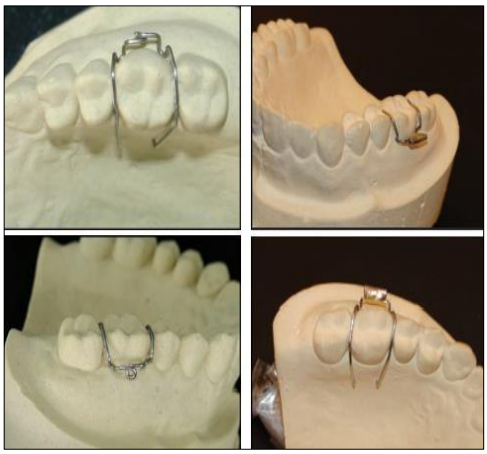

## Retentive components

The retentive components are responsible for holding the appliance inside the patient mouth in the correct position and prevent dislodgement, they can also contribute in anchorage.

### Adams clasp

Adams clasps are constructed in 0.7-mm stainless steel wire and most commonly used on the first molars, although they can be used on premolars and anterior teeth. The arrowheads of the clasp engage undercuts at the mesial and distal corners of the buccal tooth surface and can easily be adjusted at the chairside to increase retention. The bridge of an Adams clasp can also be used by the patient to remove the appliance from the mouth, whilst the orthodontist can use it to attach auxiliary springs or tubes for headgear.





**Southend clasp**

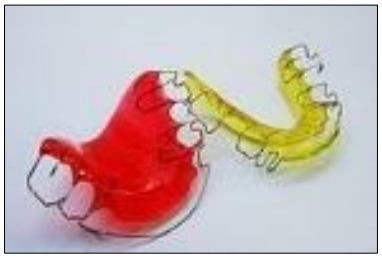
The Southend clasp is also constructed in 0.7-mm stainless steel wire, but is used for retention on the incisor teeth. This clasp is adjusted by bending the U-loop towards the baseplate, which carries the clasp back into the labial undercut of the tooth.

**Ball-ended clasp**

Ball-ended clasps engage into interproximal undercuts between the teeth and are adjusted by bending the ball towards the contact point.

**Labial bow**

A labial bow is constructed from 0.7-mm stainless steel wire and can provide retention from the labial surface of the incisor teeth, which can be increased by contouring the wire around these teeth in a fitted labial bow or by placing an acrylic facing on the wire of the bow. The labial bow has some flexibility by incorporating U-loops at each end, which allow adjustment by compressing the U-loop.



# Introduction to Orthodontic Appliances

**Lec. 2** **أ.م.د .ليث محمد كريم**

## Acrylic base plate

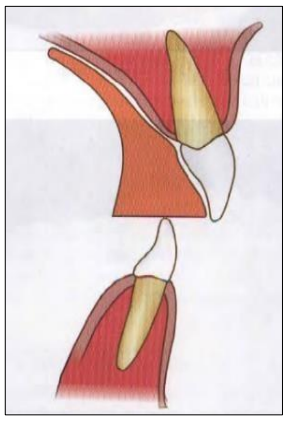
The material most often used for base plate is cold cure or heat cure acrylic. It forms a major part of the removable appliance. Base plate acts as a support for pressure sources and distributes the reaction of these forces to the anchorage areas. In the maxillary arch it should extend to the distal of the first molar and slightly cut off in the midline, while in the lower arch does not extend too deep to avoid trauma to the sulcus and any undercut area should be blocked.

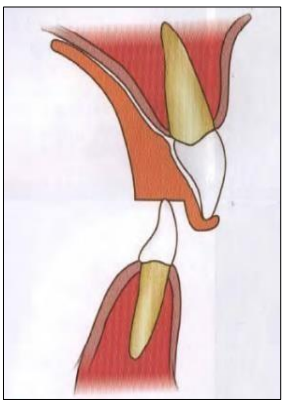
### Properties of base plate

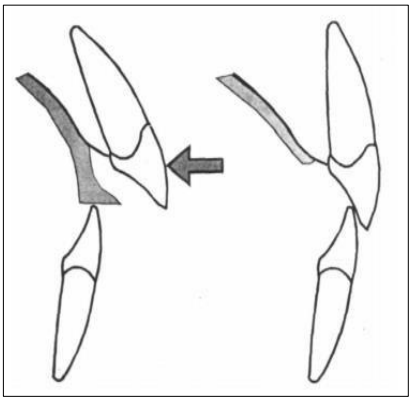
1. It incorporates both the retentive and active components into a single functional unit (act as major connector).
2. It helps in anchorage and retention of the appliance in the mouth by contact with the palate and with teeth intended not to move and distributes the forces from the active components over a large area.
3. It protects the palatal springs against distortion in the mouth.
4. Bite planes can be incorporated into the base plate and used to treat specific problems.
5. The baseplate should be as thin as possible to reduce bulk yet thick enough for strength. It should be closely adapted to all teeth except those which are to be moved.

## Modifications of acrylic base plate

*Bite plane* (anterior or posterior) can be added to acrylic base plate







**1. Flat anterior bite plane (FABP):**

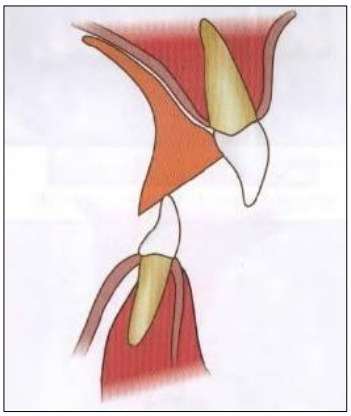
Action: the anterior bite plane is added to the maxillary plate to prevent the posterior teeth from occluding by contacting with lower incisors opening the bite posteriorly.

Properties: the bite plane should be wide enough that the patient cannot bite behind it. It should be flat, not inclined posteriorly, to avoid mandibular retrusion effect. This is particularly important in class II malocclusion.

Indication: it *corrects deep bite* by separating the molars allowing them to over-erupt & so decreasing the overbite. After opening the bite, the bite plane is cut lingually but not occlusally to allow for upper incisor retraction.

**2. Inclined anterior bite plane:**

It also corrects deep bite, added to the maxillary plate, but it corrects increased overjet as well by proclining lower incisors and acting as a myofunctional appliance enhancing mandibular growth & retarding maxillary growth.



**3. Posterior bite plane:**

Action: the posterior bite plane can be added to the maxillary or mandibular plate. It usually covers the occlusal surfaces of all the posterior teeth, so that when the teeth are brought together the mandibular canines, premolars & molars occlude on the bite plane, thus leaving the incisors out of contact & free to be moved without occlusal interferences.

**Indications:**

-It opens the bite anteriorly to allow, correction of anterior crossbite.

-Treatment of posterior crossbite by expansion screw. The bite plane is flat on both sides to allow for mandibular repositioning after crossbite correction.

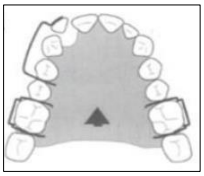
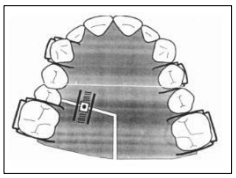
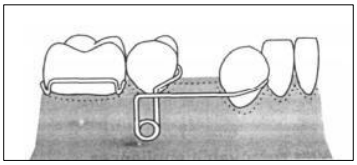
## Anchorage components:

It is an imaginary component of the removable appliance resisting unwanted tooth movement. In orthodontic treatment we apply force to move the teeth, and according to *Newton's third law* (for every action there is a reaction of equal magnitude and opposite direction), so this means that when we apply a force to move the teeth, the reaction force will be transmitted through the appliance and tends to move the anchor teeth in the opposite direction which is undesirable and should be avoided.

**Classification of anchorage:** According to the

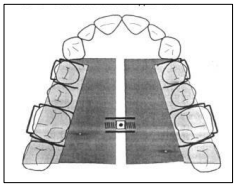
### A- Way of applying force:

**1-** *Simple* anchorage (resistance to tip) the anchor unit's resistance to the tip is used to move other teeth. Simple anchorage is an anchorage that uses teeth that have greater resistance as anchors to move teeth that have smaller resistance. It is used in removable appliance.

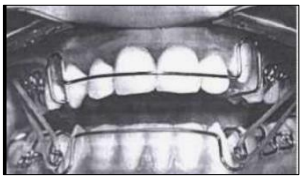
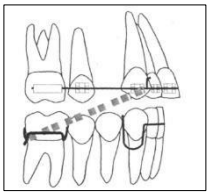
**2-** *Stationary* anchorage (resistance to bodily movements) means the anchor teeth do not move at all, cannot be used in removable appliance.

**3-** *Reciprocal* anchorage involves using two teeth or two groups of teeth that have the same anchor value to each other to produce reciprocal tooth movements for example: diastema closure, transverse expansion.

### B- The jaws involved

**1-** *intramaxillary*: anchorage is established in the same jaw.
**2-** *intermaxillary*: anchorage is distributed to both jaws.

### C- Anchorage location

**1)** *intraoral*: anchorage is obtained inside the mouth

**2)** *extraoral*: anchorage is obtained outside the mouth, for example a) cervix: e.g. neck strap, b) occipital: e.g. head, c) cranial: e.g. high pull headgear, and d) facials: e.g. face mask; and 3) muscular: anchorage comes from muscle action.

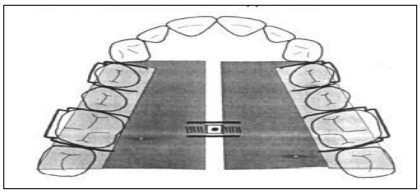
high pull headgear

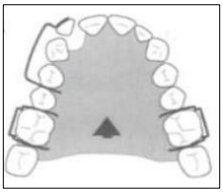
j- hook

face mask

## D- Number of anchorage units

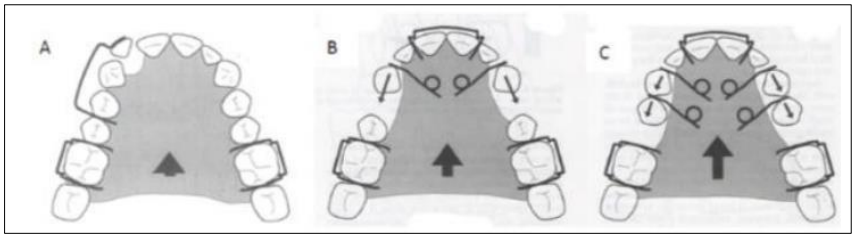
1) single or primary anchorage: anchorage only involves one tooth, 2) compound anchorage: anchorage involving two or more teeth, and 3) reinforced anchorage: adding a non-dental anchor location. For example, mucosa, muscles, head, etc.





Factors that affect anchorage

**1-** The root surface area the tooth root surface area in the anchor group should be larger than the teeth to be moved so that the movement of anchor teeth is as minimal as possible. This can be performed by only moving one tooth each quadrant and involving as many anchor teeth as possible.




**2-** if the force is too large, the anchor teeth will also move, so keep the force as low as possible.

**3-** Tendency of the teeth to shift to mesial. Therefore, it must be carefully considered if there is a mesial force acting on the anchor teeth. For example, in canine retraction there is an action to move the canine distally and there is a mesial force or retraction acting on the anchor teeth.

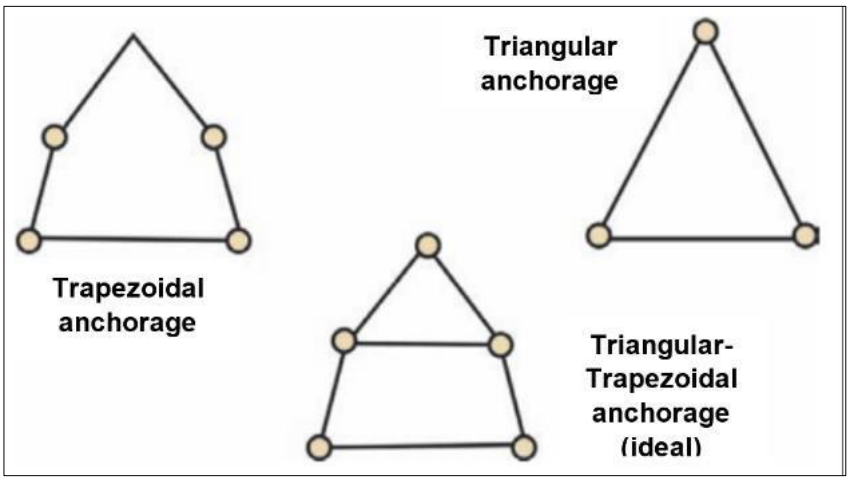
### Anchorage management:

**1-** keep the force used light enough to move the wanted teeth without affecting the anchor teeth.

**2-** increase anchoring resistance: a- increase the number of teeth in anchor unit (e.g., second molar) b- reduce the number of teeth to be moved c- teeth with large root surface area have greater anchorage value than teeth with small root surface area. d- base plate: covering teeth and mucosa e cuspal interlock with the teeth of opposing arch example: anterior and posterior bite planes with good occlusal contact with the cusps of the teeth of opposing arch.

**f-** reinforce the anchorage: Various other ways include, the use of palatal arch, Nance arch, lingual arch, lip bumper, extraoral device.

**g-** Distribution of the retentive units: Tammoscheit (1969) described three types of anchorage systems based on geometric designs for the placement of the retentive units to obtain the best anchorage value.

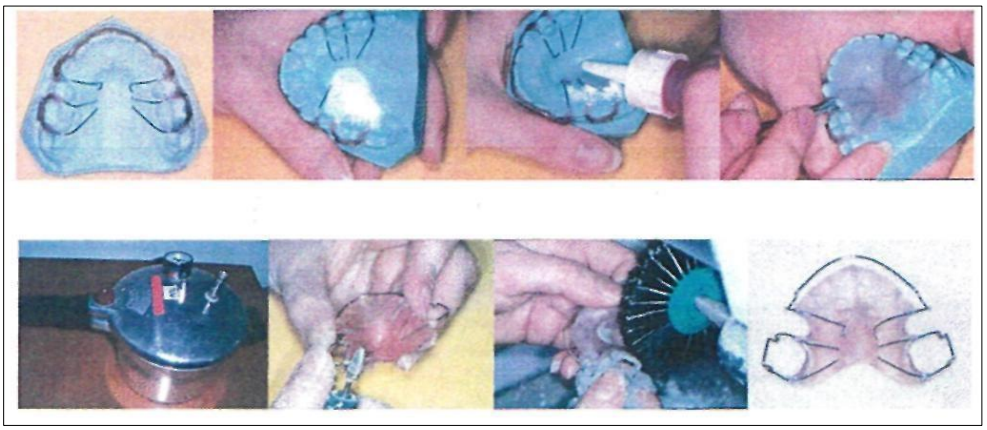



## Fabrication of a removable orthodontic appliance

The materials used in removable orthodontic appliance are: a- Stainless steel wires (springs, clasps and labial bow). b- Acrylic base plate (hot cure acrylic, cold cure acrylic or most commonly orthocryl).

*The steps are:*

1. Do the necessary wire bending (springs, labial bow and clasps).
2. Fix the springs and clasps to the cast by wax on the occlusal and labial surfaces of the teeth, so that they do not move during fabrication of the acrylic. Wax is applied on the coils and arms of Z-, recurved, T- and finger springs not to be embedded in the acrylic baseplate.
3. Soak the cast in water for about 5 minutes until no more air bubbles come out of the cast to prevent the monomer from entering inside the cast and fusing the acrylic with the stone of the cast.
4. Materials: either heat cure or cold cure acrylic which is preferred because it is easy to use and faster to fabricate but care must be taken to eliminate residual monomer to reduce the porosity in the appliance, so orthocryl (a type of cold cure acrylic that need to set under pressure in a hydroflask) was introduced and gave better properties, it can be prepared by the dough stage method or by the sprinkle method (salt and pepper) to construct the acrylic base-plate by successively applying polymer and then monomer.
5. Cure in a hydroflask under 2 bar pressure to eliminate porosity. The hydroflask contains water at 40°C to accelerate the curing reaction.
6. The wax is cleaned and the acrylic base plate is finished with a carbide bur and polished with pumice.



## Welding:

Welding is the union of two stainless steel wires by melting them onto each other by passing an electrical current through them. This is accomplished by a welder machine.

The two wires are put in firm contact under pressure of the jaws of the welder and then a low voltage high amperage electrical current is passed through the wires to melt the surfaces of the wires and make them fuse.

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1. Repair fractured clasps.
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An appliance should be ideally fitted as soon as possible after the impression has been taken and any delay in fitting an appliance allows forward movement of posterior teeth following orthodontic extraction or natural loss of deciduous molars and may interfere with fitting the appliance. Fitting the appliance

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1. Check that you have the correct appliance and design for the patient.
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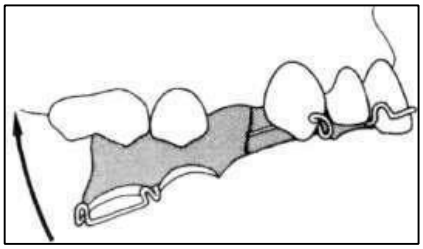
**b)** Inserting the appliance

1. The appliance should be inserted into the mouth with the anterior part lightly into position and then press the acrylic base upwards until the molar clasps engage. Removal of the appliance: Should be carried out in the reverse order. The finger tips are used to pull down on the bridges of the molar clasps until they disengage readily, make sure the patient can insert and remove the appliance.



2. Adjust the retentive components and check the retention.
3. Activate the springs and check the teeth if they are free to move (adjustment of retention comp., so that the appliance will be retention inside mouth).

c) Instruction to the patient and to the parents:

**1-** The patient should be shown in a mirror the insertion and removal of the appliance. Insist that the appliance be maneuvered by the bridges of the clasp and not the labial bow or springs. The correct method of insertion is to engage the anterior wire on the incisors and then press the acrylic palate upwards until the molar clasps engage. Removal is accomplished by pulling down on the molar clasps before disengaging the anterior teeth

**2-** You might face some discomfort during eating and speech in the first few days and in case of appliance damage report immediately to the dentist.

**3-** You should wear the appliance during day and night (24 hrs).

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**5-** Avoid all sticky or hard foods such as; boiled sweets, chewing gum etc. These precautions will minimize the chances of a breakage

## Monitoring progress during visits

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- Anchorage situation.
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## Common problems during treatment

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Normally tooth movement should proceed at approximately 1 mm per month in children, and slightly less in adults. If progress is slow, check the following:

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- Is tooth movement obstructed by the acrylic or wires of the appliance?
- Is tooth movement prevented by occlusion with the opposing arch? It may be necessary to increase the bite-plane or buccal capping to free the occlusion.

2. Frequent breakage of the appliance

- The appliance is not being worn full time.
- The patient has a habit of clicking the appliance in and out.
- The patient is eating inappropriate food while wearing the appliance.

3. Excessive tilting of tooth being moved

- The further that the spring is from the center of resistance of the tooth the greater is the degree of tilting. Therefore, a spring should be adjusted so that it is as near the gingival margin as possible without causing gingival trauma.
- Excessive force is being applied to the tooth.

4. Lack of overbite reduction

In children, the most common reason for lack of progress with overbite reduction is that the appliance is not being worn during meals. Patients should be advised that their treatment will be quicker and more successful if they wear their appliance for eating, and that adaptation will be enhanced if they start with softer foods.

5. Palatal inflammation

This can occur for two reasons:

- Poor oral hygiene.
- Entrapment of the gingivae between the acrylic and the tooth/teeth being moved.
- Trauma from active arm of the spring.

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This can be increased by the following:

- Part-time appliance wear, thus allowing the anchor teeth to drift forwards.
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**1-** How was the appliance broken? If a breakage has been caused by the patient failing to follow instructions, it is important to be sure any co-operation problems have been overcome before proceeding with the repair.

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Occasionally it is possible to adapt what remains of the spring or another component of the appliance to continue the desired movement.

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**Repairing a fractured Adam's clasp:**

The Adam's clasp is commonly fractured from the U-loop because it has an acute bend. The procedure of soldering is as follows:

1. Flux is added on the wire to prevent its oxidation under the flame.
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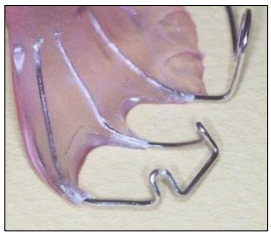

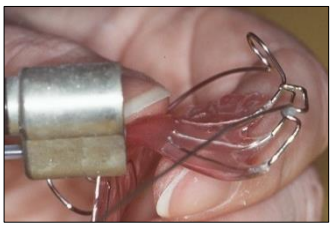


**Acrylic repair**

1. Make all active components passive
2. Reduce retention
3. Put it inside the mouth
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6. Re-inserted again

# Good luck …

# Introduction to Orthodontic Appliances

المرحلة الرابعة

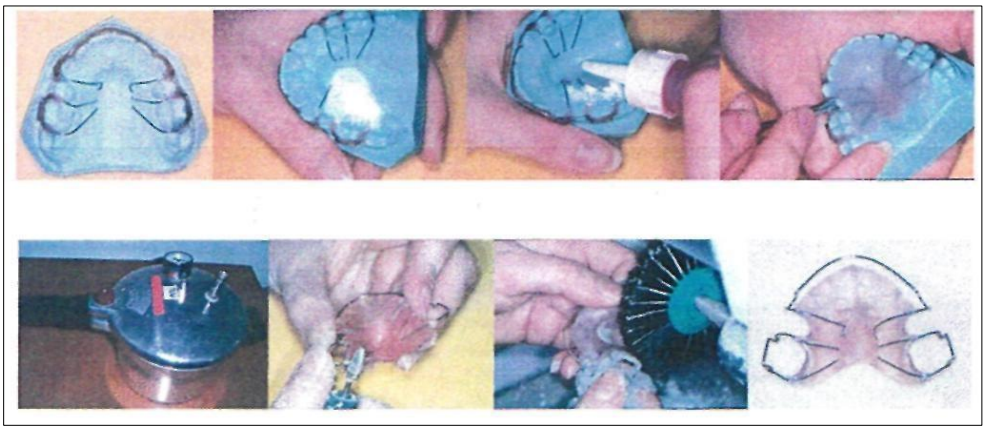
## Lec. 3

## Fabrication of a removable orthodontic appliance

The materials used in removable orthodontic appliance are: a- Stainless steel wires (springs, clasps and labial bow). b- Acrylic base plate (hot cure acrylic, cold cure acrylic or most commonly orthocryl).

*The steps are:*

1. Do the necessary wire bending (springs, labial bow and clasps).
2. Fix the springs and clasps to the cast by wax on the occlusal and labial surfaces of the teeth, so that they do not move during fabrication of the acrylic. Wax is applied on the coils and arms of Z-, recurved, T- and finger springs not to be embedded in the acrylic baseplate.
3. Soak the cast in water for about 5 minutes until no more air bubbles come out of the cast to prevent the monomer from entering inside the cast and fusing the acrylic with the stone of the cast.
4. Materials: either heat cure or cold cure acrylic which is preferred because it is easy to use and faster to fabricate but care must be taken to eliminate residual monomer to reduce the porosity in the appliance, so orthocryl (a type of cold cure acrylic that need to set under pressure in a hydroflask) was introduced and gave better properties, it can be prepared by the dough stage method or by the sprinkle method (salt and pepper) to construct the acrylic base-plate by successively applying polymer and then monomer.
5. Cure in a hydroflask under 2 bar pressure to eliminate porosity. The hydroflask contains water at 40°C to accelerate the curing reaction.
6. The wax is cleaned and the acrylic base plate is finished with a carbide bur and polished with pumice.



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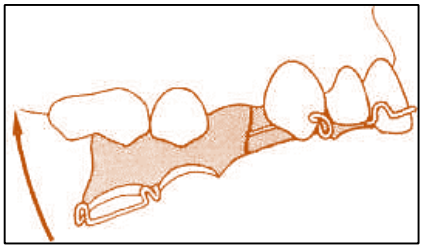

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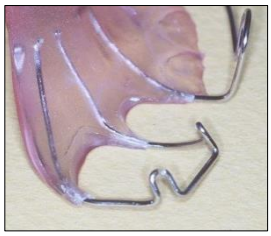

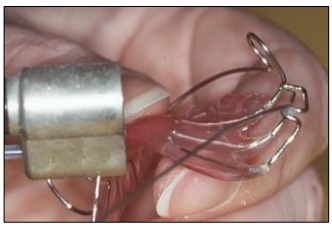


**Acrylic repair**

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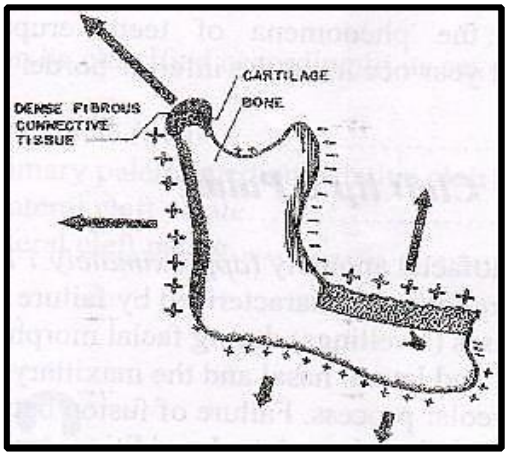
**Good luck …**

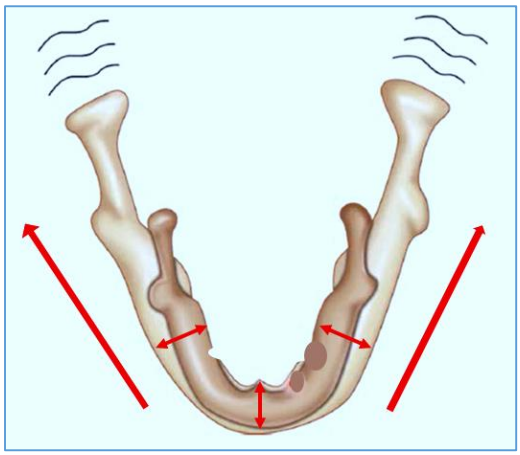
# ORTHODONTIC

## Lec. 4 د. حيدر فاضل سلوم

## *Mandibular growth*

The mandible is a bone of membranous origin but there are secondary cartilages that develop in it. At birth the mandible consists of two hemi-mandible separated by symphyseal suture. The condylar cartilage will persist for long time but the coronoid cartilage and the cartilage of the angle of the mandible will disappear early and play no role in the mandibular growth. The symphyseal suture will disappear at two years of age. The condylar cartilage will contribute in the vertical and anteroposterior growth. The increase in size is due to apposition and resorption phenomena.



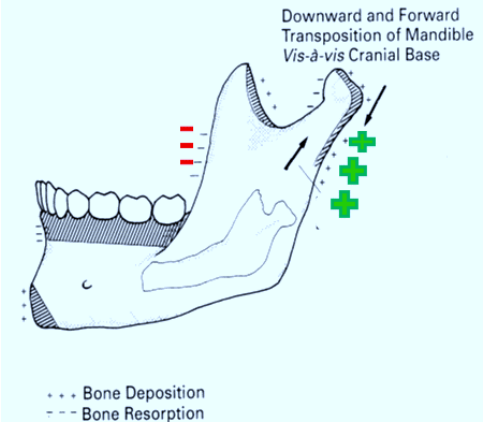



### *a- transversal growth:*

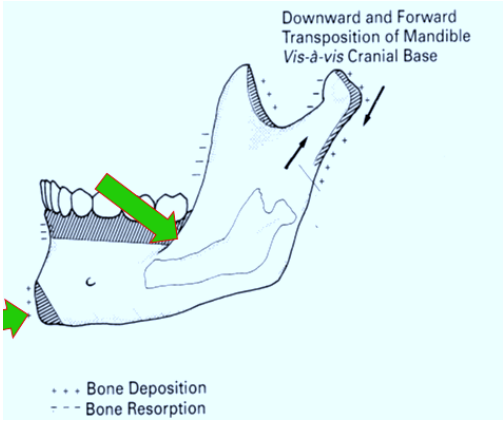
After the first year, the symphyseal cartilage does not play any more role in the growth, only the apposition and resorption phenomena continue to manifest but they stop early, only the alveolar borders show thickening which accommodate the roots of the permanent teeth, in fact the increase in transverse dimension of the mandible result from its vertical growth because of its divergence toward the posterior, the transversal growth is therefore sensitive in the posterior part, particularly at the condyles which are more away from each other following the transversal growth of the cranial base.

## *b- antero-posterior growth:*

1- ramus of the mandible: it results in important apposition on its posterior border and resorption on the anterior border but less rapid than the apposition in a way that the ramus will move backward and become more thick.




2- body of the mandible: the resorption of the anterior border of the ramus will increase the antero-posterior dimension of the body of the mandible. So the inferior part of the ramus is therefore incorporated progressively in the body also an osteal apposition occurs during the first year of life particularly at the mental symphysis.

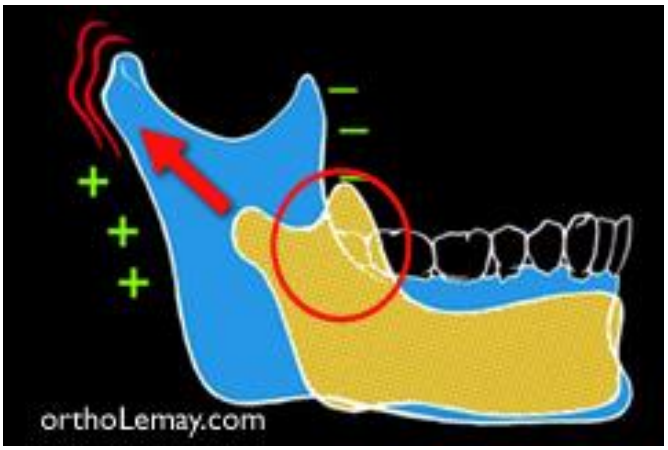



## *c- vertical growth:*

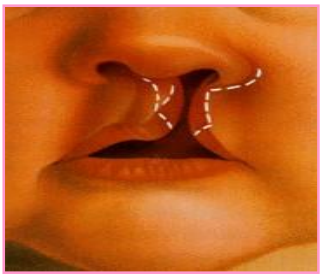
1- ramus of the mandible: at birth the ramus is very short, its size depending on the activity of the condylar cartilage that determines the vertical dimension in the same time as the total length of the mandible.

2- body of the mandible: the vertical growth of the ramus will move away the body of the mandible from the maxilla in the space that is liberated there through the development of the alveolar process by osteal apposition jointly

with the phenomena of teeth eruption. Little apposition during the first year occurs at the inferior border of the body of mandible.




## *Cleft lip and palate*



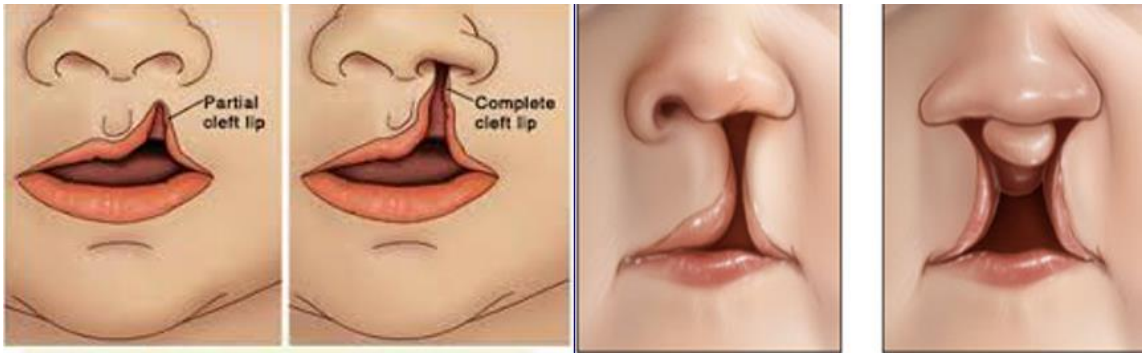
The most common craniofacial anomaly, caused by failure of fusion between certain embryological processes during facial morphogenesis. Failure of fusion between the medial and lateral nasal and the maxillary processes results in a cleft of the lip and/or alveolar process. Failure of fusion between the lateral palatine processes results in a cleft of the palate.

The etiology of cleft lip and palate is thought to be multifactorial. Genetic is implicated in 20%-30%of the patients. Environmental factors that have been shown in experimental animals to result in clefting include nutritional deficiencies, radiation, several drugs, hypoxia, viruses, and vitamin excesses or deficiencies. In complete or bilateral clefts of the lip, alveolus and palate, the maxillary arch typically is collapsed in the transverse direction, especially in the area of the cleft. The maxillary permanent lateral incisors may be congenitally missing or malformed, and many atypically shaped supernumerary teeth may be present in the area of the cleft.

**Classification:**

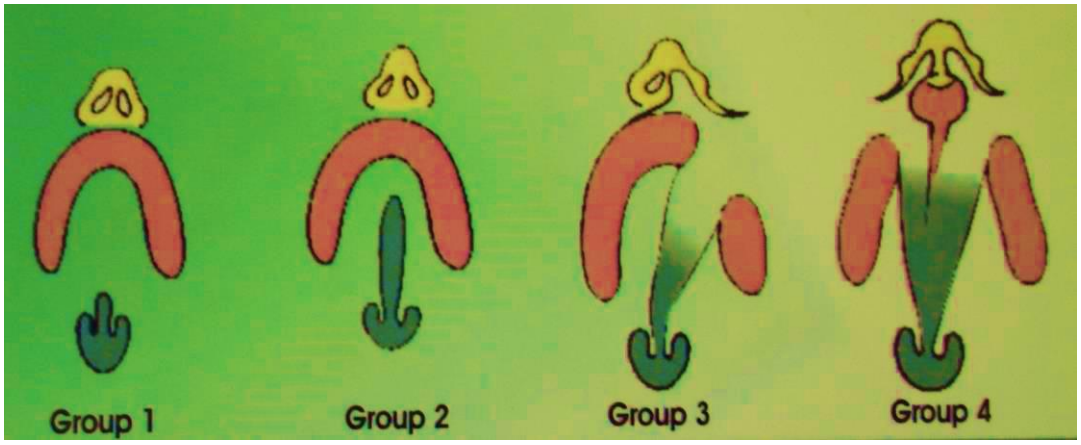
A cleft can be complete or incomplete, and it can occur unilaterally or bilaterally. A useful classification divides the anatomy into primary and secondary palates. An individual thus may have clefting of the primary palate, the secondary palate, or both.

**Cleft lip** is classified either unilateral or bilateral and it could be minor cleft of the lip ( small notch in the upper lip ) or increase in the severity to complete cleft of the upper lip or continue to reach the nostril or to the internal angle of the eye, mostly unilateral, sometimes cleft lip may include cleft of the alveolar ridge.




**Cleft palate:** the fusion of the palatal components that form the palate usually start from the anterior aspect and continue posteriorly so that cleft palate could happen at any site through this process of fusion. Cleft palate can be classified according to its severity as follows:

Class I : Cleft of soft palate (uvula)
Class II : Cleft of the secondary palate ( median palatine cleft )
Class III: Complete unilateral cleft palate
Class IV: Complete bilateral cleft palate

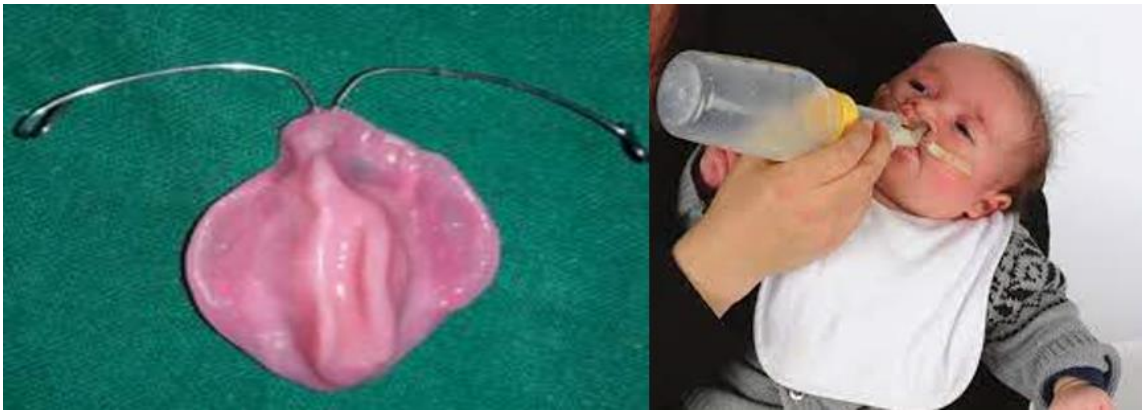


## Treatment

Treatment of cleft lip and palate must be started as soon as possible after birth because of its physiological effect on the infant since it interferes with the natural feeding process, and its psychological trauma to the parents, this treatment of patients with cleft lip and / or palate is along and involved process, requiring many stages of intervention by many different specialists, forming a cleft lip and palate team.

The involvement of the team, orthodontist starts a few days after the baby was born, with presurgical infant orthopedic treatment if applicable, ( construction of baby feeding plate which assists the infant to suck and swallow the milk properly ).

Baby feeding plate is a piece of acrylic that disconnect between the oral and nasal cavities which are opened to each other through the cleft palate. This plate has advantage to help the two pieces of the palate to approximate toward each other ( orthopedic movement ).



Repair of the lip usually is performed within the first three months after birth, and the palate subsequently is repaired within the first year. The scar tissue created from these and other surgical procedures is considered responsible for variable degrees of maxillary growth inhibition which is commonly seen during subsequent growth.

When the cleft involves the alveolar process, a bone graft may be necessary to restore the alveolar anatomy. Alveolar bone grafting usually is performed prior to the eruption of the permanent maxillary canine on the side of the cleft.

*Phase I* of orthodontic treatment, in preparation for the alveolar bone graft, may consist of expansion of the constricted maxilla and correction of any cross bites. Following alveolar bone grafting, and when the patient is in the permanent dentition, *phase II* of orthodontic treatment is performed to idealize the occlusion, or if a severe skeletal discrepancy is present, to prepare the arches for orthodontic surgery.

***GOOD LUCK …***

# *ORTHODONTIC*

**Lec. 2** **د. حيدر فاضل سلوم**

## The skulls and jaws at birth

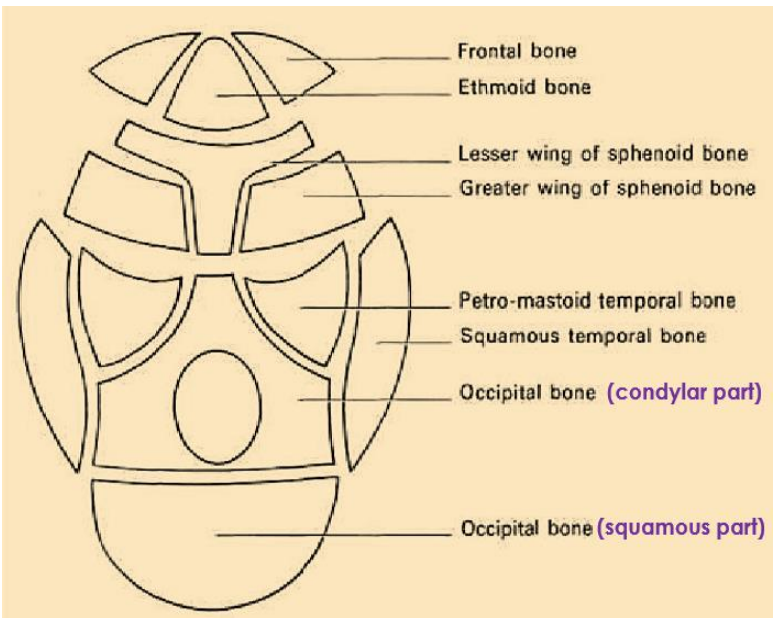
At birth the skull is far from merely a small version of the adult skull. There are difference in shape, in proportion of the face and the cranium and in the degree of development and fusion of the individual bones. Some bones, which in adult are single bones, are still in separate constituent parts at birth. Other bones, which in the adult are closely joined to their neighbours at sutures, are at birth, widely separated from neighbouring bones.

Bones which have developed from cartilage, mainly those at the base of skull, still have cartilaginous element activity growing. Bones which have developed from membrane, mainly those of calvarium and face, still have wide membranous areas at their margins actively forming bone. The main features of skull at birth can be summarized as follows:

**1- bones in separate component parts**

**A-** At the base of the skull the sphenoid bone is in three parts, the central body with its two lesser wings, and on each side the greater wing and its attached pterygoid process.

**B-** The occipital bone is in two parts, the condylar part which carries the occipital condyles, and the squamous part, much of which has developed from membrane and forms part of the calvarium.




**C-** The temporal bone on each side is in two parts, the petromastoid component which has developed from the cartilaginous neurocranium, and the squamous component which has developed from the membranous neurocranium

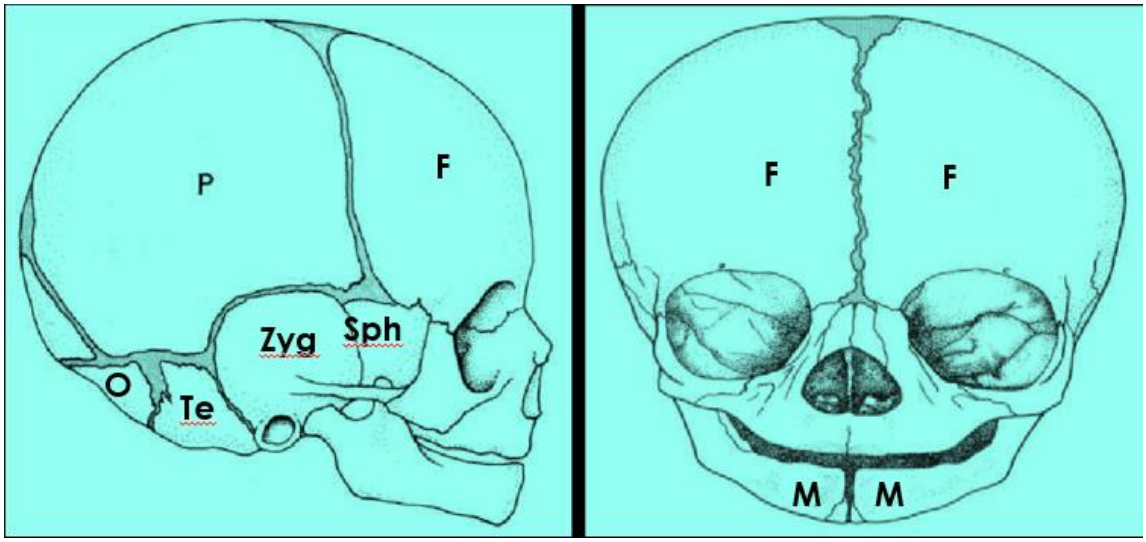
**D-** The frontal bone and the mandibule, which will eventually become single bones, are each in two parts at birth, the parts being separated in the mid-sagittal plane.

## 2- bones widely separated from neighbouring bones

Sutures and fontanelles are present during fetal and early neonatal life. Sutures also called synchondroses, are fibrous joints comprised of sheets of dense connective tissue that separate the bones of the calvaria and help to change the shape during birth by a process called modeling.

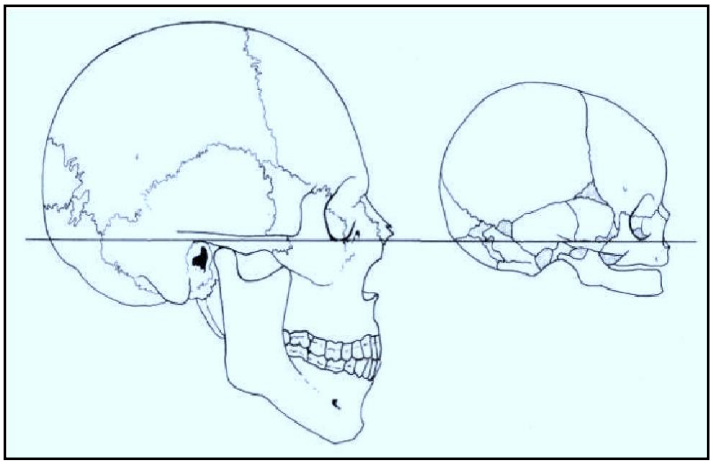
Fontanelles are regions of dense connective tissue where sutures come together. Sutures and fontanelles ossify at variable times after birth.

This separation is particularly noticeable at the four corners of the parietal bone, which are the anterior and posterior fontanelles in the midsagittal plane where the parietal bones meet the frontal bone anteriorly and occipital bone posteriorly, and the antero-lateral and postero-lateral fontanelles on each side, at the junction of parietal, sphenoid and frontal bones anteriorly and parietal, temporal and occipital bones posteriorly. At birth the sphenoid and occipital bones are still separated by a cartilaginous area, the spheno-occipital synchondroses, and eventually become fused at the base of skull.



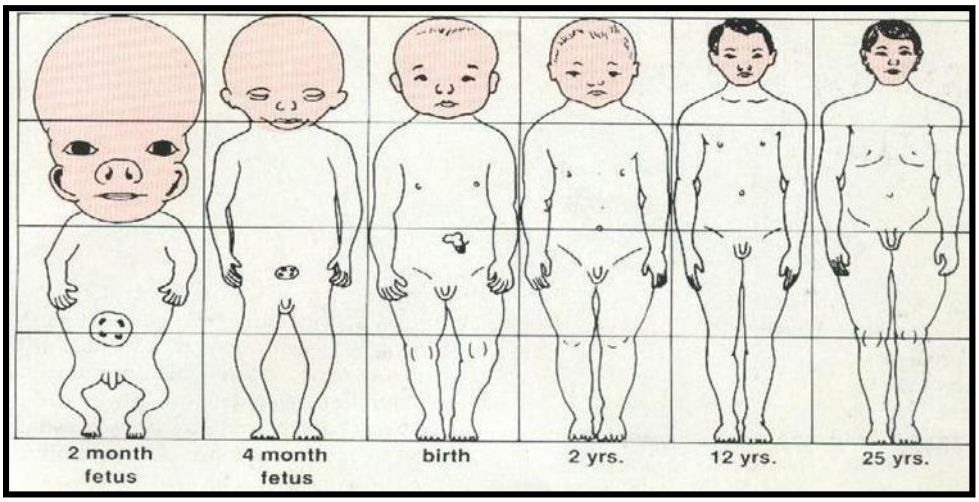

## 3- relative size of the face and the cranium

The relationship in size between the face and the cranium is noticeably different at birth from that in the adult. The cranium has grown rapidly in the pre-natal period, accommodating the rapidly developing brain. The face has developed less towards its adult size than has the cranium, with the result that at birth the face appears small in the vertical dimension in relation to the total size of the head when compared with the situation in the adult. The main reasons for this are the maxilla and the mandible, which form the main contribution to the vertical dimension of the face, are relatively small at birth. The maxillary antrum is little more than a flat space, compared with its much greater vertical depth in the adult. The mandible is relatively straight, with a more obtuse angle than in the adult. In both bones there are no erupted teeth and consequently little vertical development of alveolar bone.



***Rates of growth from birth to adult***

At birth the head forms about 1/4 of the total height of the body. In the adult the head forms about 1/8 of the total body height therefore, between birth and maturity the body must grow faster than the head.



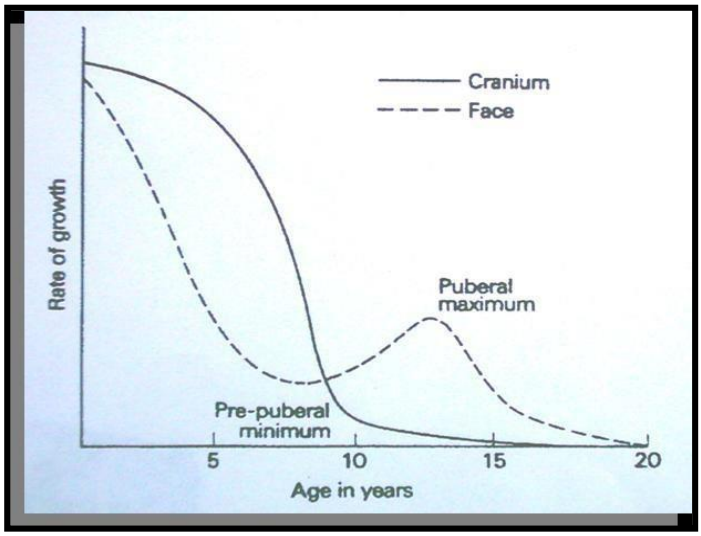

In infancy, growth proceeds at a relatively high rate, slowing progressively during childhood to reach a minimum rate in the prepuberal period. There is an increase in growth rate in puberty and finally a marked slowing in growth rate to maturity.
The age at which these phases of growth begin and end varies between individuals.

The two main components of the head are the cranium and face, they also differ in their relative proportion at birth and at maturity, and therefore they must grow at differing rates.

### *Growth rate of the cranium*

The cranium has grown rapidly before birth and continues to grow rapidly up to about one year of age, accommodating the rapidly developing brain, which at this stage is developing to provide an enormous increase in physical and mental activity. Thereafter the growth rate decreases, and by about 7 years of age the cranium has reached some 90% of its final volume. Then there is a slow increase in size to maturity.

The growth rate of eyes, and consequently of the eye sockets, follows a similar pattern. Thus the infant appears to have a small face with large eyes, large cranium and retrusive nose if compare with adult.

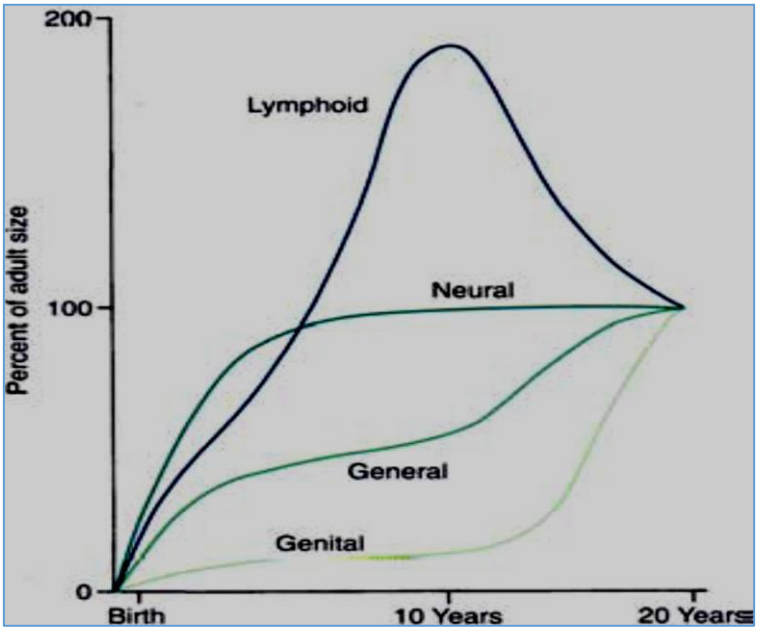



### *Growth rate of the face*

The growth rate of the face is highest at birth then it falls sharply and reaches a pre-puberal minimum level (it is earlier in female than in male) then it increases to a peak at puberty, declining again until growth stops in late teenage.

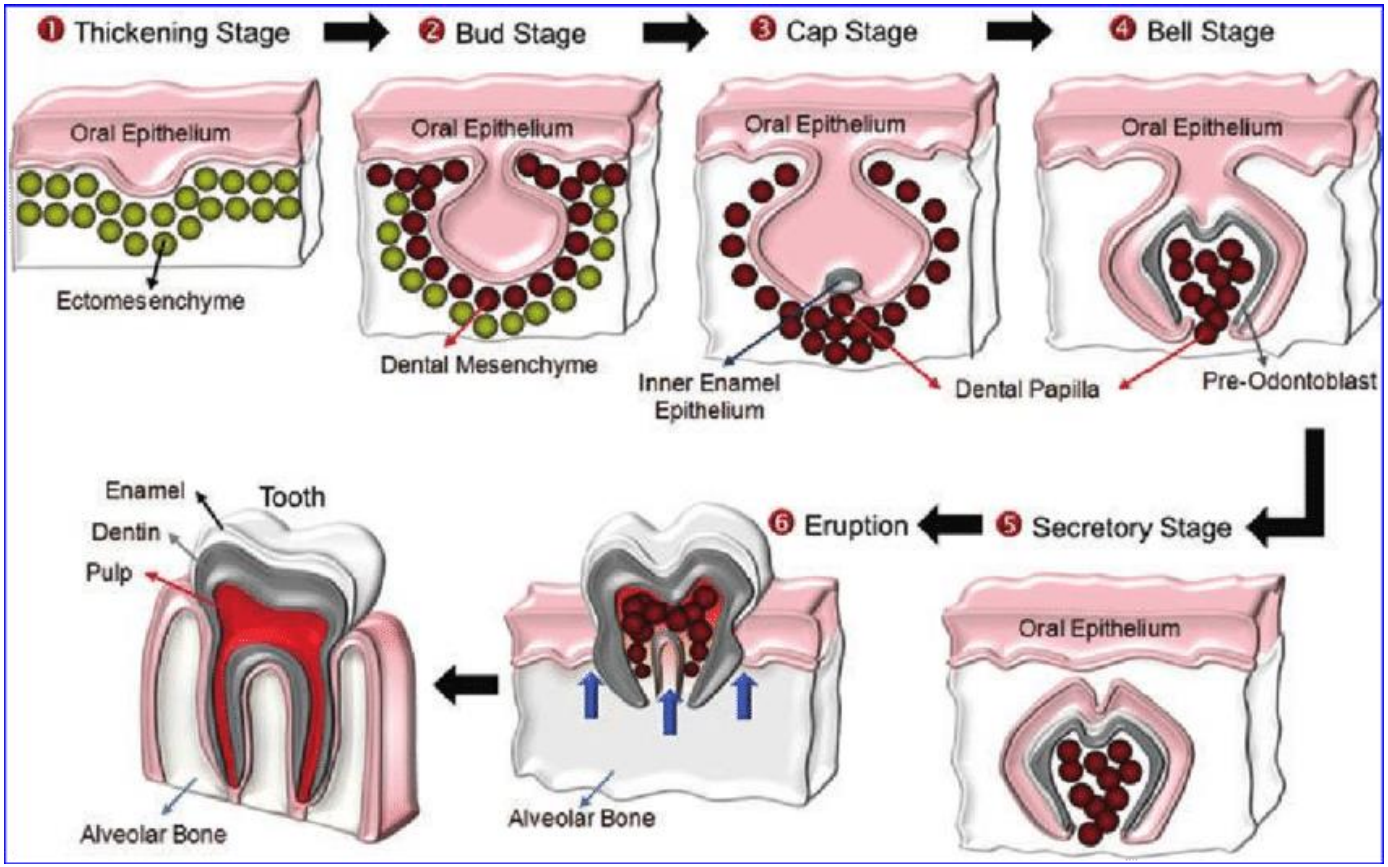
Facial growth is normally associated with eruption of the primary dentition between 1 and 3 years of age and of the permanent dentition between 6 and 14 years of age, when the erupting teeth and developing alveolar process add to the total size of the jaws.

Roughly the facial growth rate follows the same pattern as the rate of body growth, forward and downward growth of both maxilla and mandible follow this pattern, and the period of maximum puberal growth of the jaws is a few months later than that of body height. Also the mandibular growth continued for about 2 years longer than maxillary growth and this difference in growth between the two jaws may be important in orthodontic treatment planning.


200
100
0
Percent of adult size
Lymphoid
Neural
General
Genital
Birth
10 Years
20 Years

*GOOD LUCK*

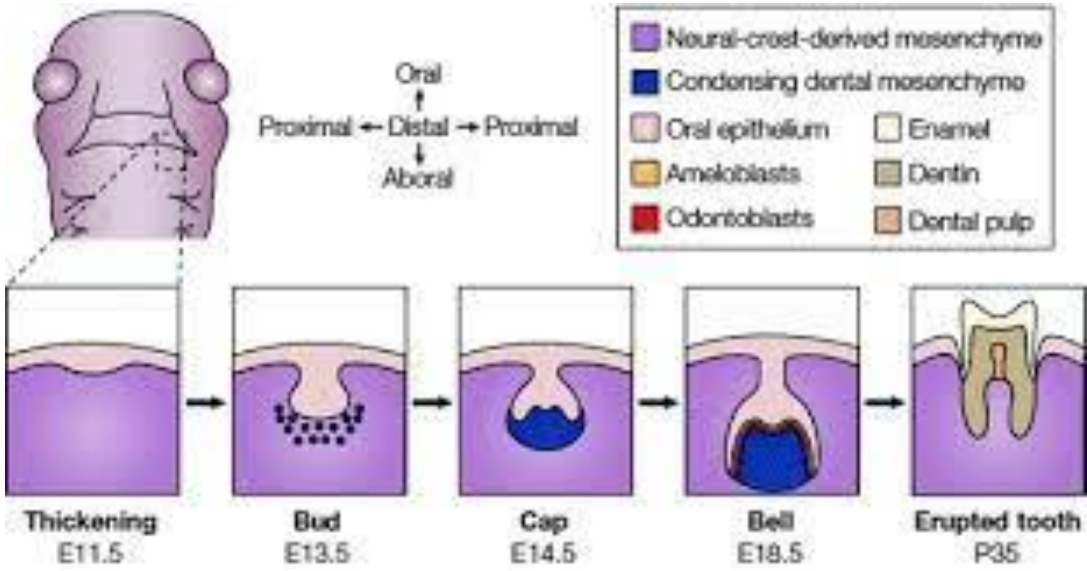
# Development of Dentition



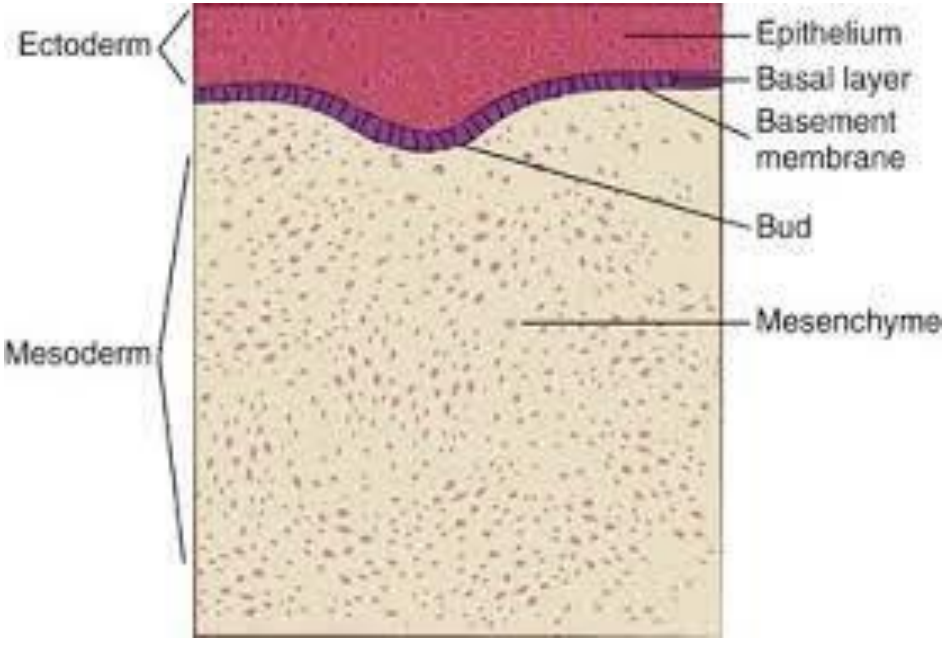
## Prenatal Development of Dentition

The embryonic oral cavity is lined by stratified squamous epithelium called the *oral ectoderm*, which is visible around 28-30 days of intrauterine life.

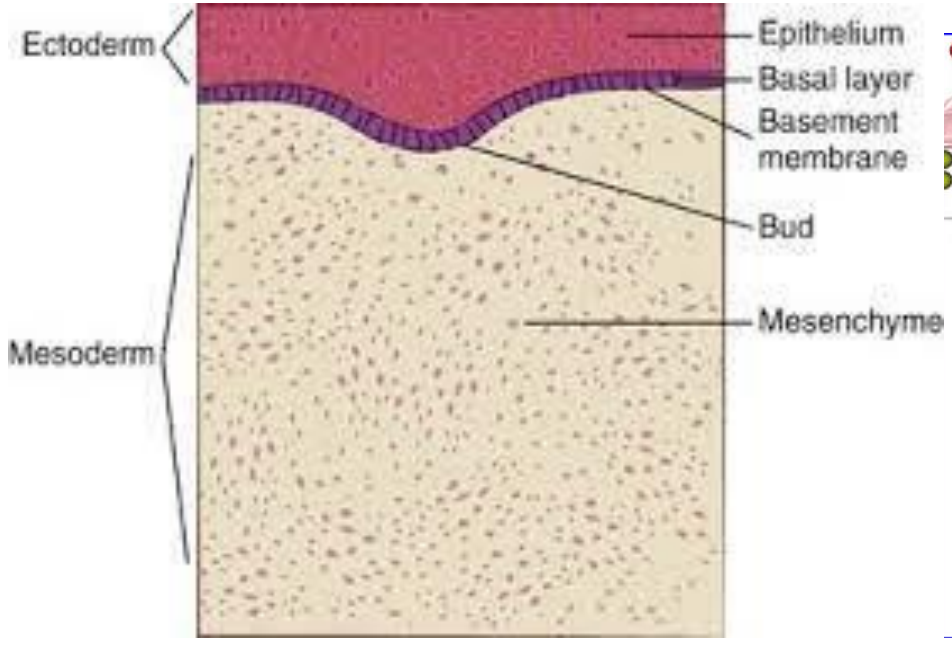
The first sign of tooth development appears late in the 3rd embryonic week when the epithelial lining begins to thicken on the inferior border of the maxillary process and the superior border of the mandibular process which join to form the lateral margins of the oral cavity.

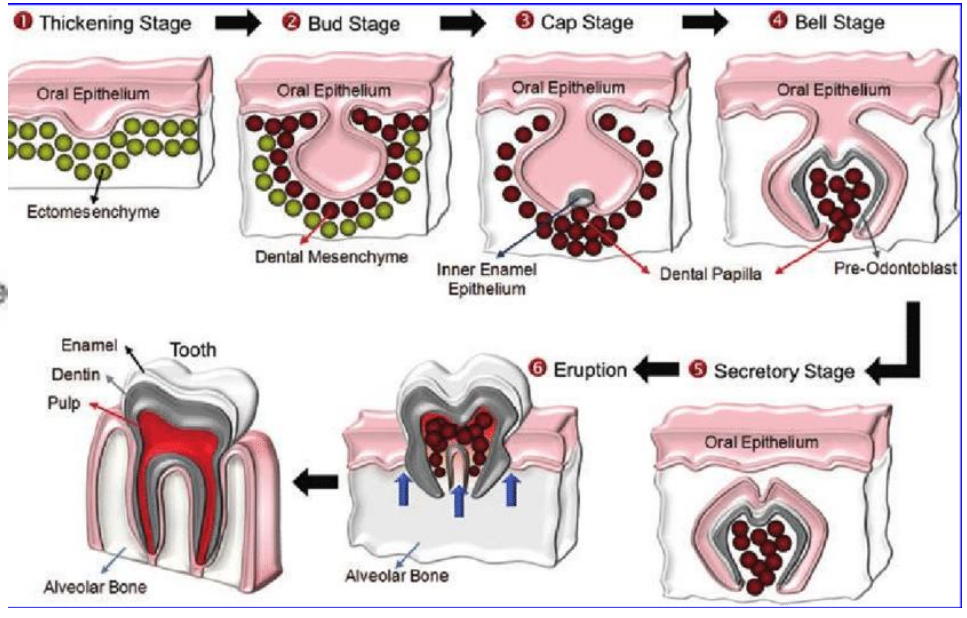


At 6 weeks, four maxillary odontogenic zones coalesce to form the dental lamina and the two mandibular zones fuse at the midline. The dental lamina is the foundation for the future dental arches. Tooth formation begins with invagination of the dental lamina epithelium into the underlying mesenchyme at specific locations. The dental lamina gets demarcated into ten knoblike structures namely the tooth bud/germ.



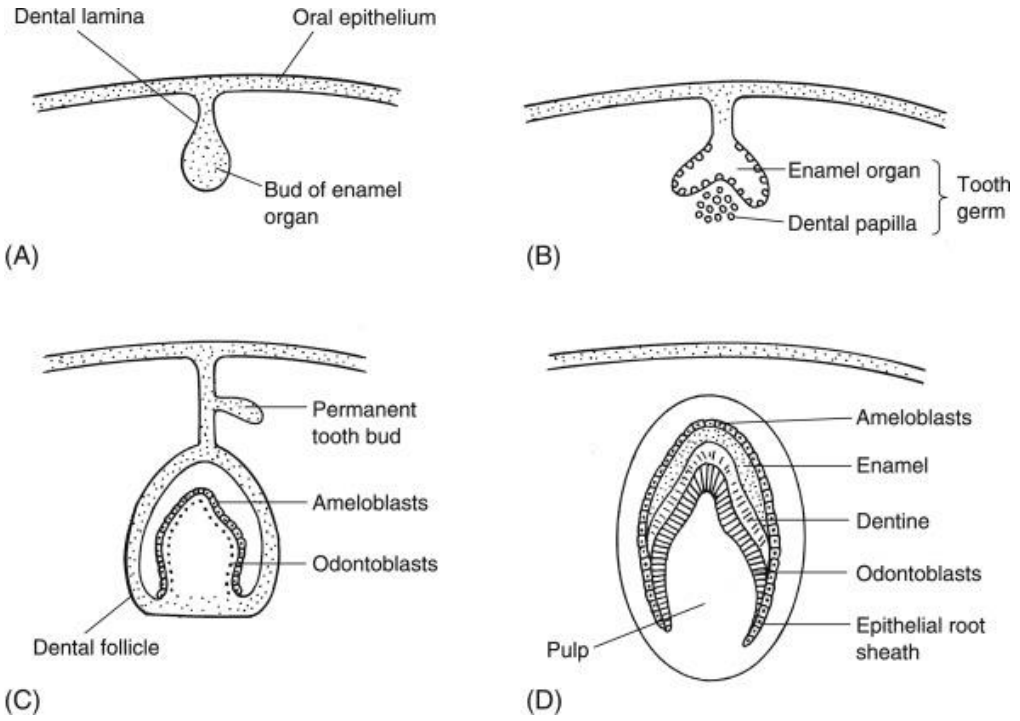
A tooth bud consists of an enamel organ, which is derived from the oral ectoderm, a dental papilla and a dental sac, both of which are derived from the mesenchyme. Each of these swellings of the lamina proliferates and differentiate, passing through various histological and morphological differentiation stages namely bud, cap and bell stages.



# Stages of Tooth Bud Development

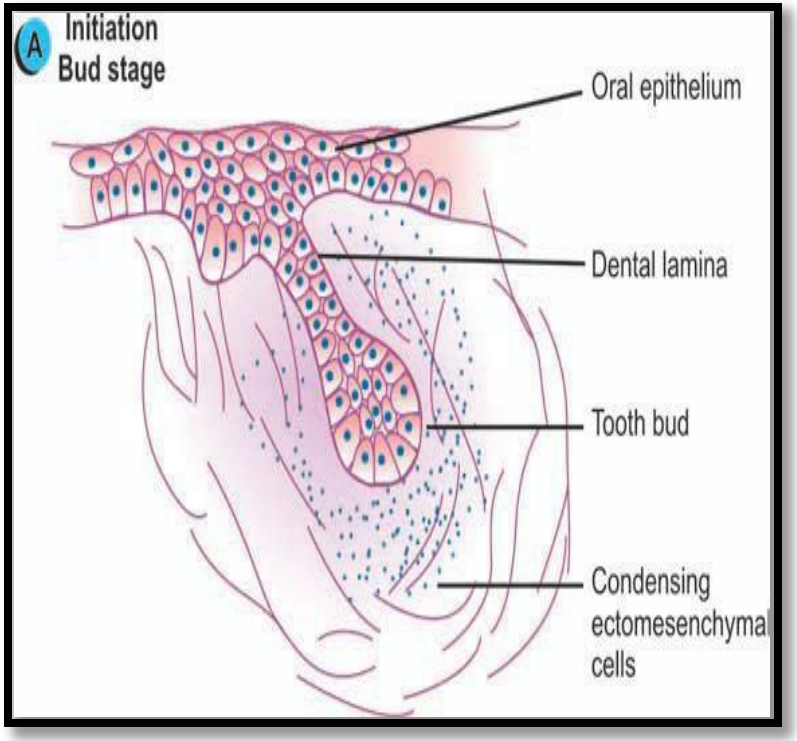
***Initiation***: This is the first epithelial incursion into the ectomesenchyme of the jaw. The tooth bud is the primordium of the enamel organ. Histologically it consists of peripheral low columnar cells and centrally located polygonal cells. The area of ectomesenchymal condensation subjacent to the bud is the dental papilla. The dental sac surrounds the tooth bud and the dental papilla. The dental papilla later on forms the dentin and pulp whereas the dental sac forms cementum and the periodontal ligament.



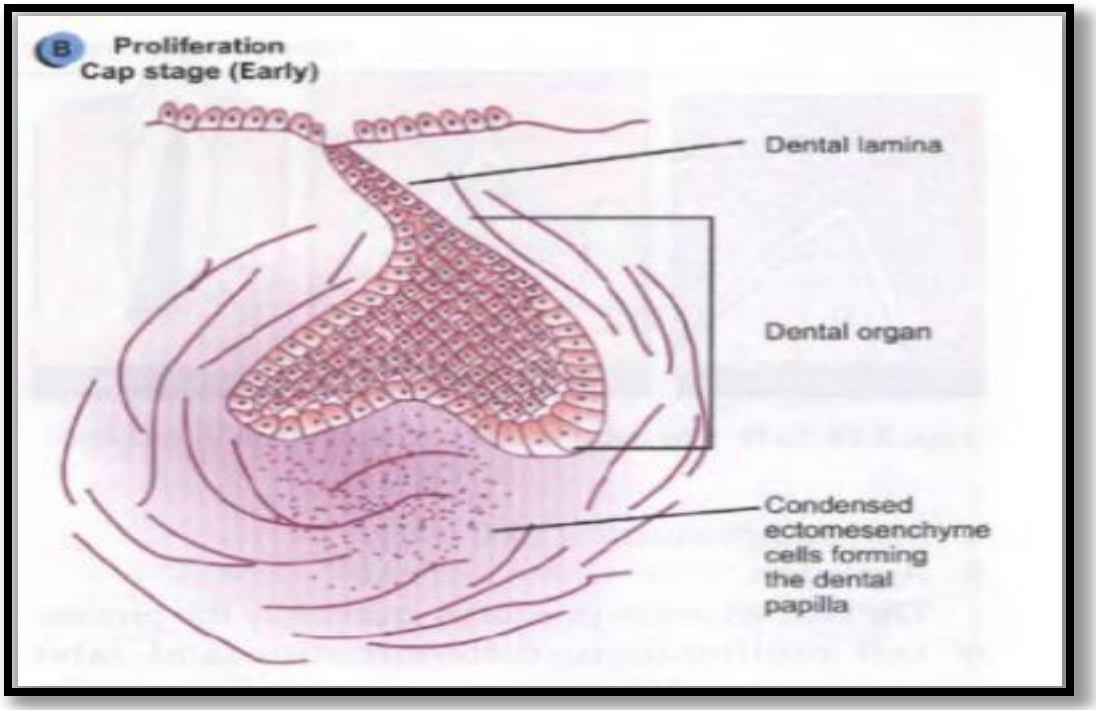
Initiation takes place as follows:•

1. Deciduous dentition: 2nd month *in utero*.
2. Permanent dentition: Growth of the free distal end of dental lamina gives rise to the successional lamina, which initiates the permanent dentition; starts from 5th month *in utero*.

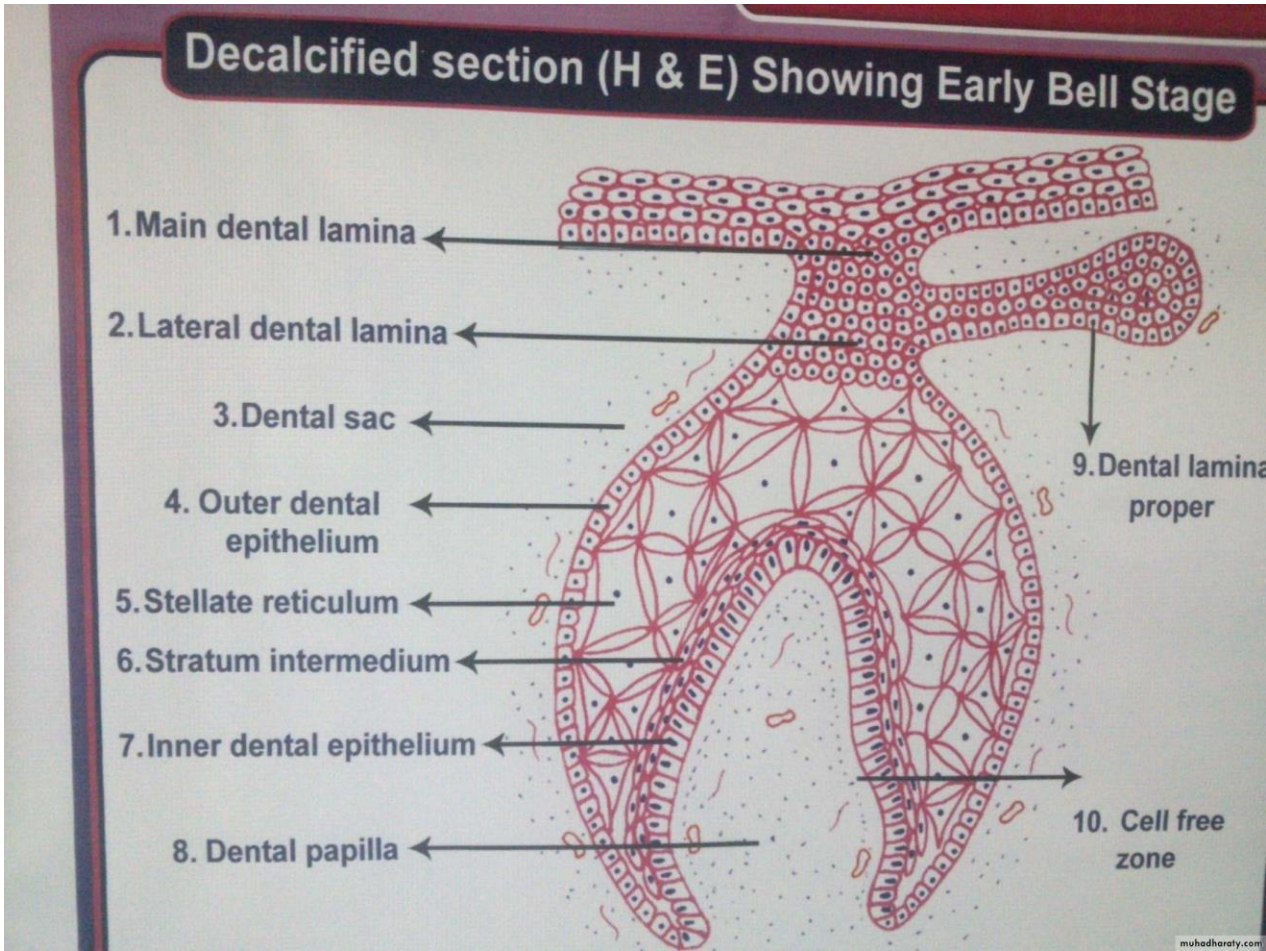
Dental lamina elongates distal to the second deciduous molar and gives rise to the permanent molar tooth germs .



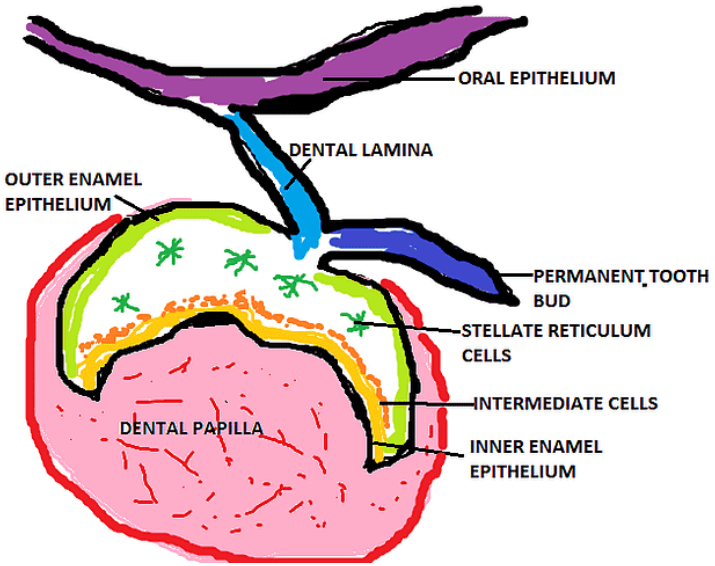
***Proliferation***: Unequal growth in different parts of the bud produces a shallow invagination on the deep surface of the bud to produce a cap shaped structure. Histologically it is made up of the outer enamel epithelium (cuboidal cells) at the convexity of the cap and the inner enamel epithelium (tall, columnar cells) at the concavity of the cap.

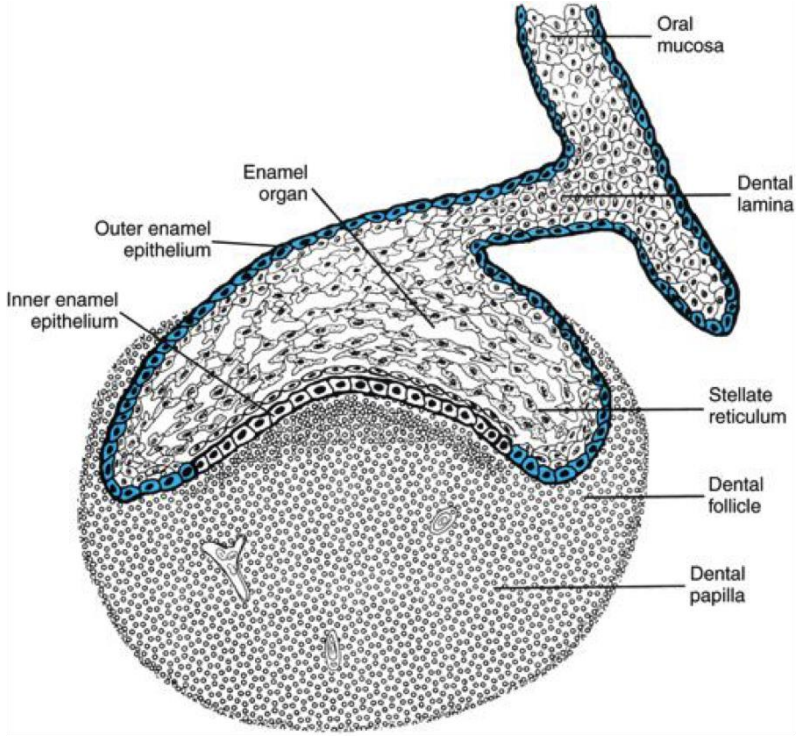


Between the above 2 layers
polygonal cells are located which is known as the stellate reticulum. These cells assume a branched reticular network as more intercellular fluid is produced.



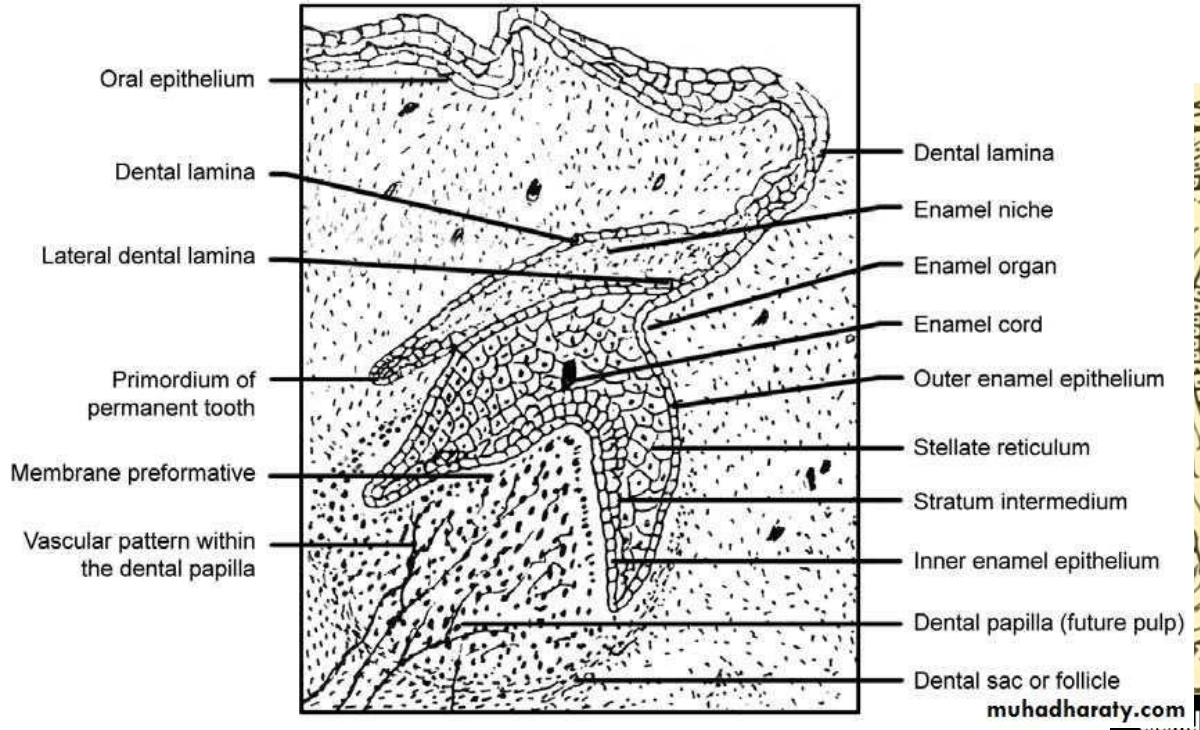
***Histo-differentiation***: The enamel organ now assumes a bell shape as the invagination of the cap continues and the margins grow longer. Four different layers are seen. The inner enamel epithelium (IEE) cells remain tall columnar cells. The outer enamel epithelium flatten to low cuboidal cells. The stellate reticulum expands further and the cells become star shaped. A new layer of cells known as Stratum Intermedium whose function is to provide nutrition to IEE cells appears between inner enamel epithelium and stellate reticulum.

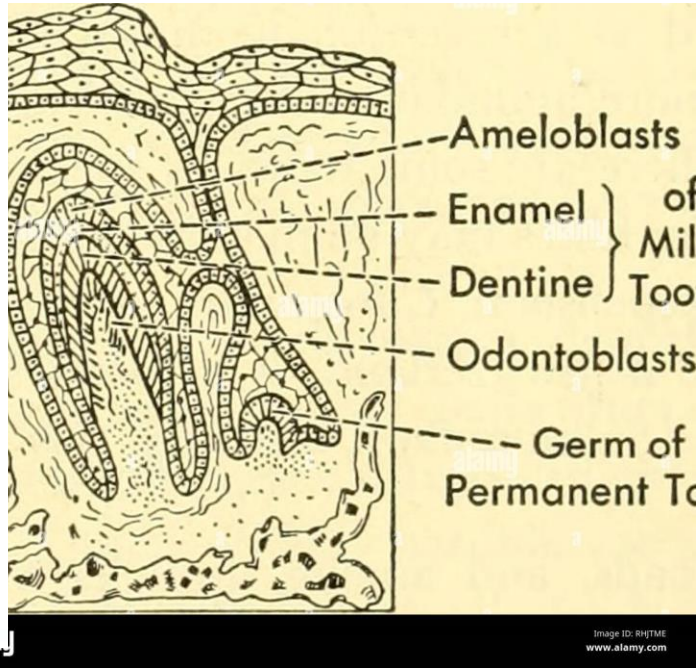


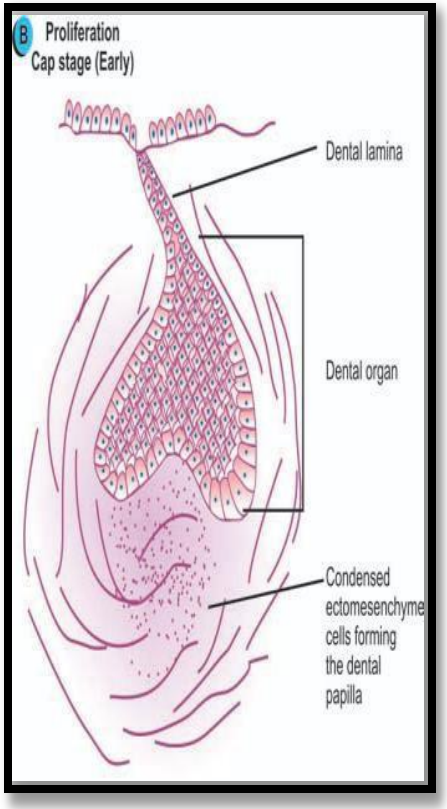



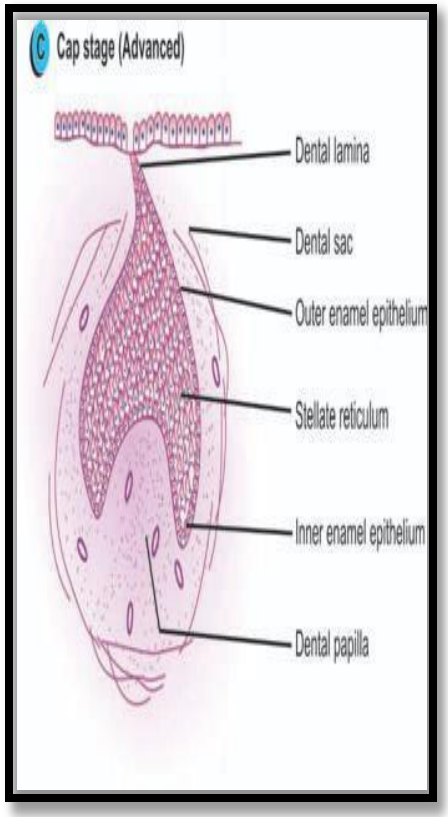
## *Morpho-differentiation (bell stage) Apposition*

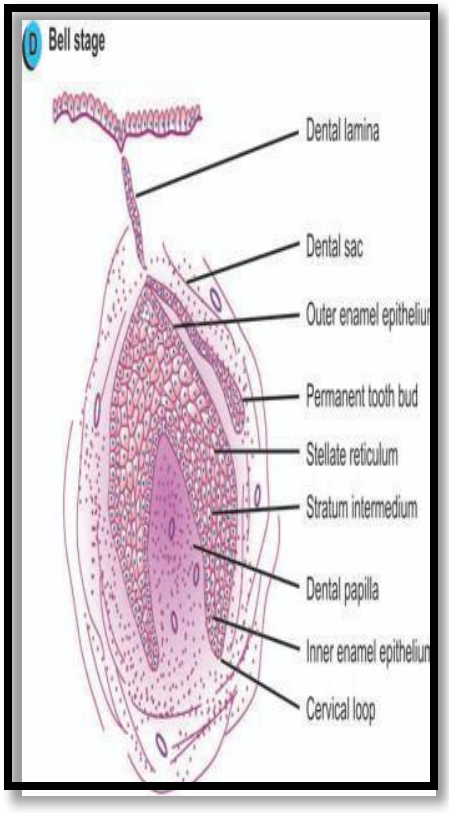
The enamel organ produces enamel by the process of cell proliferation, differentiation and later mineralization. Mineralization commences in the deciduous dentition around the 14th week of intrauterine life and occurs first in the central incisors. The permanent tooth buds appear around the fourth to fifth month of intrauterine life and their mineralization is initiated at birth, beginning with the first permanent molar.

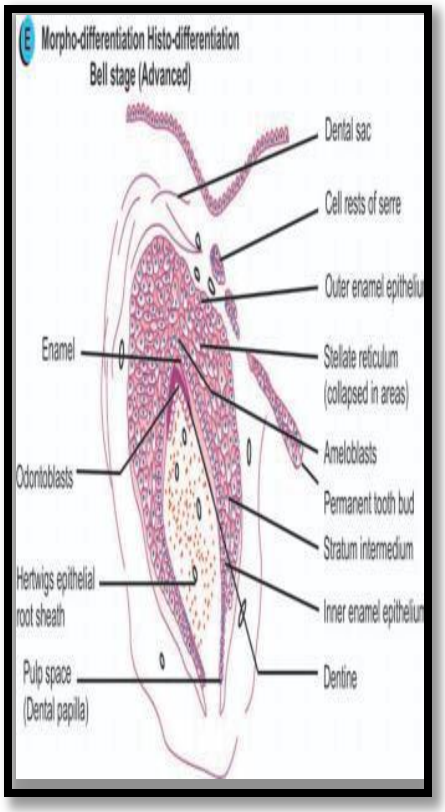


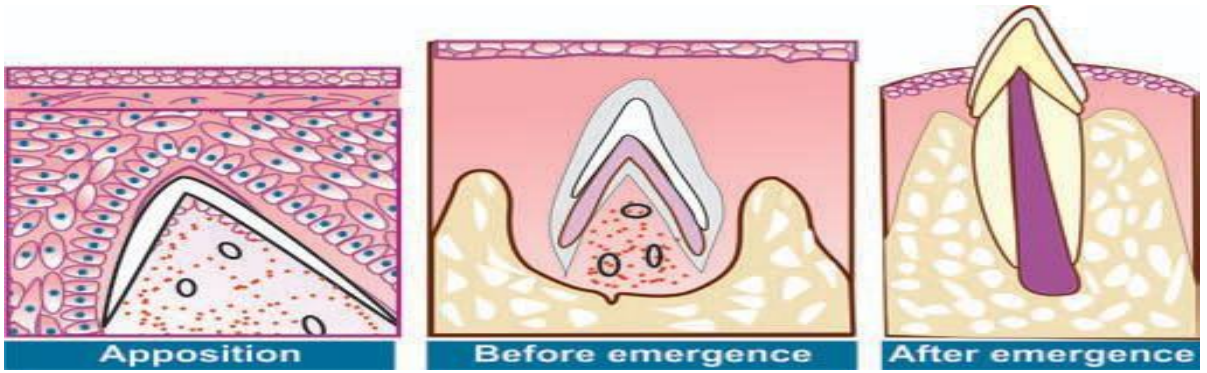




B
Proliferation
Cap stage (Early)
Dental lamina
Dental organ
Condensed ectomesenchyme cells forming the dental papilla


C
Cap stage (Advanced)
Dental lamina
Dental sac
Outer enamel epithelium
Stellate reticulum
Inner enamel epithelium
Dental papilla


D
Bell stage
Dental lamina
Dental sac
Outer enamel epithelium
Permanent tooth bud
Stellate reticulum
Stratum intermedium
Dental papilla
Inner enamel epithelium
Cervical loop


E
Morpho-differentiation Histo-differentiation
Bell stage (Advanced)
Dental sac
Cell rests of serre
Outer enamel epithelium
Enamel
Stellate reticulum (collapsed in areas)
Ameloblasts
Odontoblasts
Permanent tooth bud
Stratum intermedium
Hertwigs epithelial root sheath
Inner enamel epithelium
Pulp space (Dental papilla)
Dentine


Apposition
Before emergence
After emergence

# Eruption

Eruption is the developmental process that moves a tooth from its crypt position through the alveolar process into the oral cavity and to occlusion with its antagonist.

During eruption of succedaneous teeth:

1. Primary tooth resorbs
2. Roots of the permanent teeth lengthen
3. Increase in the alveolar process height
4. Permanent teeth move through the bone.

Teeth do not begin to move occlusally until crown formation is complete. It takes 2-5 years for posterior teeth to reach the alveolar crest following crown completion and 12-20 months to reach occlusion after reaching alveolar margin.

**Factors Determining Tooth Position During Eruption**

**Tooth passes** through four distinct stages of development:

*Pre-eruptive* Initially position of tooth germ is dependent on heredity

*Intra-alveolar* Tooth position is affected by:-

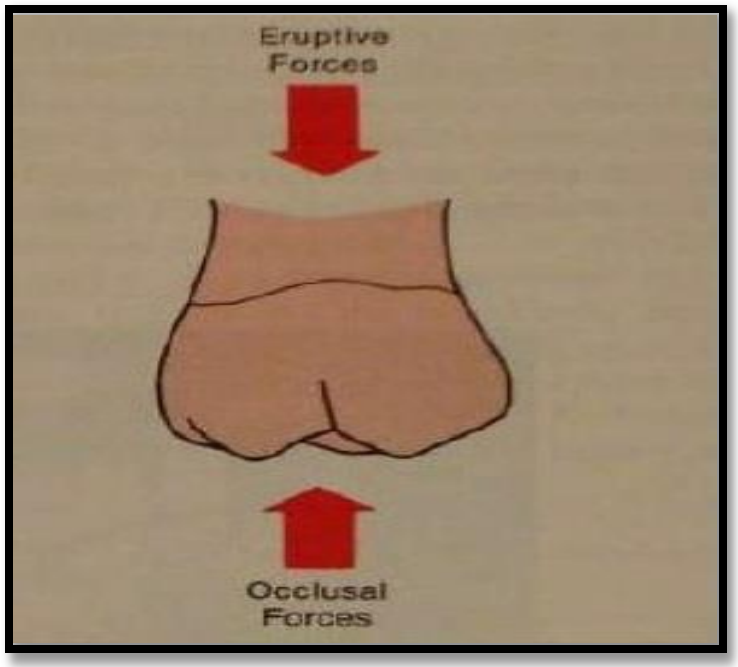
Presence or absence of adjacent teeth

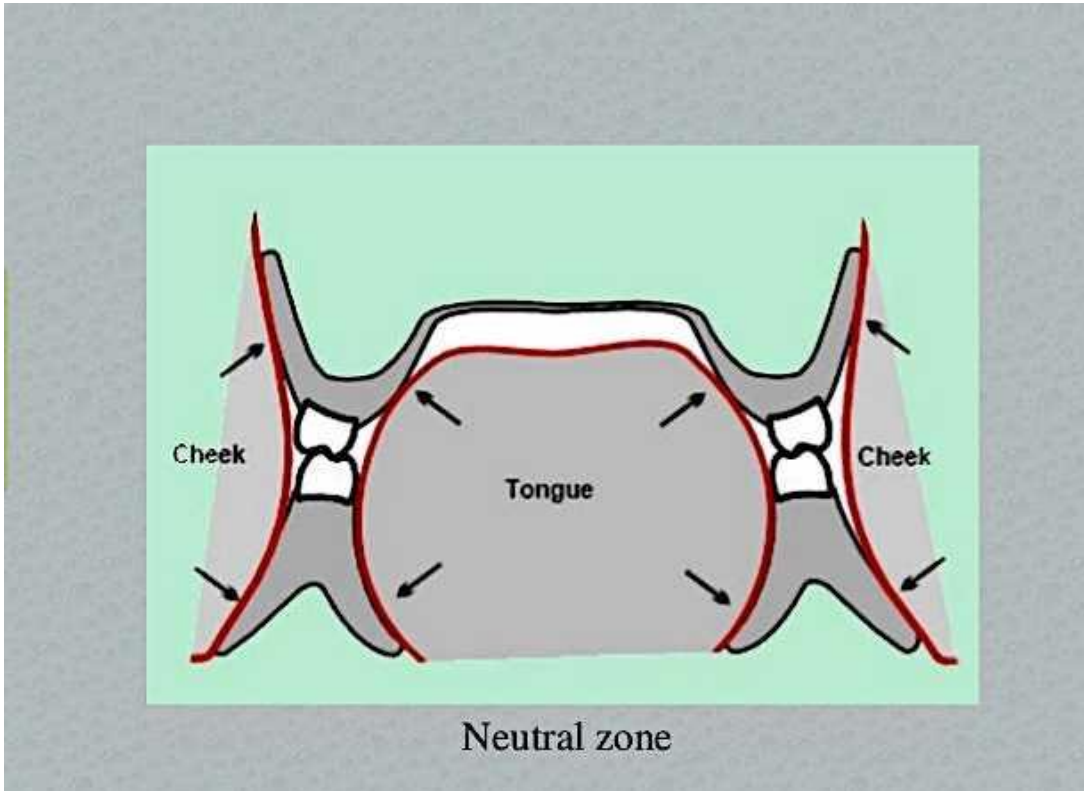
Rate of resorption of primary teeth

Early loss of primary teeth

Localized pathologic conditions.

*Intraoral stage* Tooth can be moved by lip, cheek, tongue muscles or external objects and drift into spaces.
*Occlusal stage* Muscles of mastication exert influence through interdigitation of cusps. The periodontal ligament disseminates the strong forces of chewing to the alveolar bone.



## Developmental Disturbances Affecting The Teeth

## Disturbances During Initiation Of Tooth Germs

*Ectodermal dysplasia* Complete or partial anodontia of both the dentitions along with the presence of malformed teeth.

*Anodontia* Absence of 1 or more teeth due to failure of tooth bud initiation. Most commonly missing teeth are third molars followed by mandibular second premolars, maxillary lateral incisor and maxillary second premolars.

Supernumerary and supplemental teeth: teeth in excess of the normal complement of teeth. The difference between the two is that supplemental teeth resemble normal teeth whereas supernumerary teeth do not, e.g. of supernumerary teeth:

1. ***Mesiodens :*** **between maxillary central incisors.**
2. ***Peridens :*** **located buccal to the arch**
3. ***Distomolar :*** **distal to the third molar.**
4. ***Paramolar:*** **located buccal or lingual to molars.**

*Natal and neonatal teeth :* These may be either supernumerary or deciduous teeth.

*Predeciduous dentition:* Aborted structures with caps of enamel and dentine.

*Post permanent dentition:* Teeth erupt after the loss of the permanent dentition, usually impacted accessory teeth.

# Disturbances During Morphodifferentiation of Tooth Germs

Hutchinson’s incisors: Screwdriver shaped notched incisors, e.g. in congenital syphilis.

Mulberry molars : Occlusal surface is narrower than the cervical margin and is made up of agglomerate mass of globules; seen in congenital syphilis.

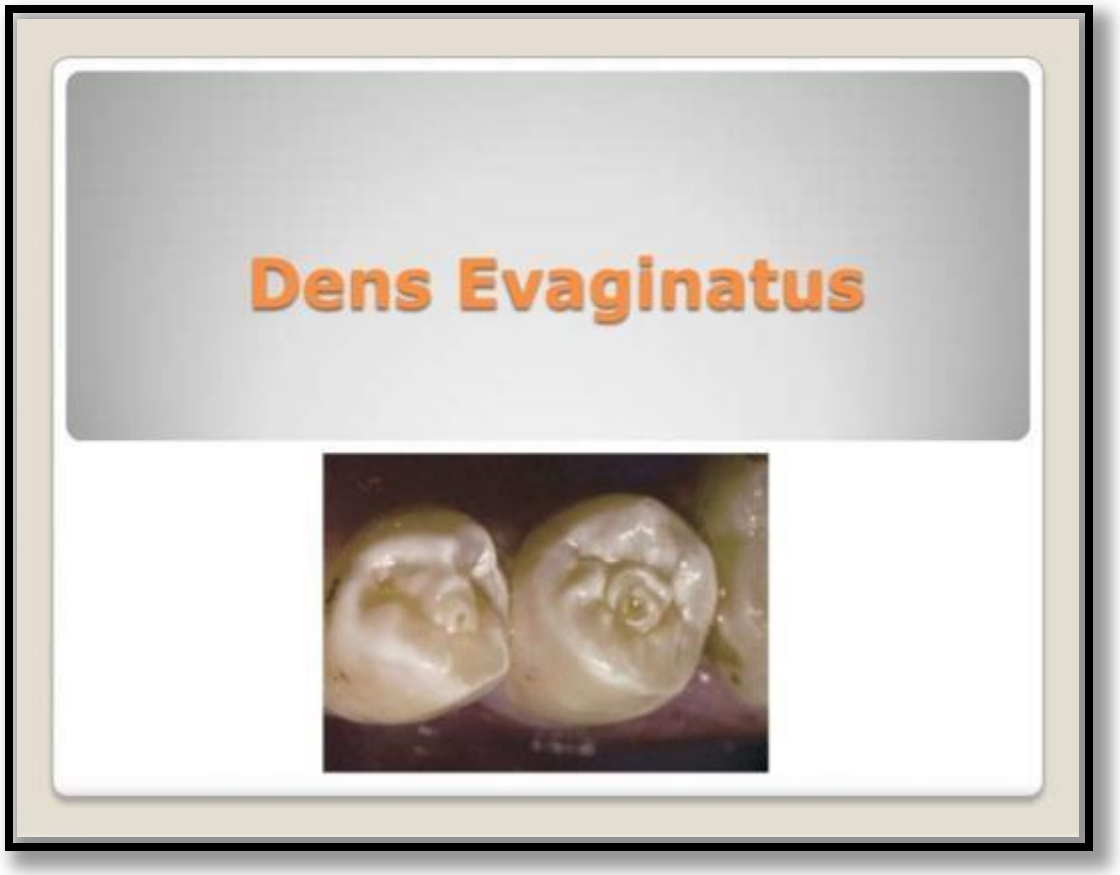
*Peg shaped laterals:* Proximal surfaces of the crown converge giving the tooth a conical shape.

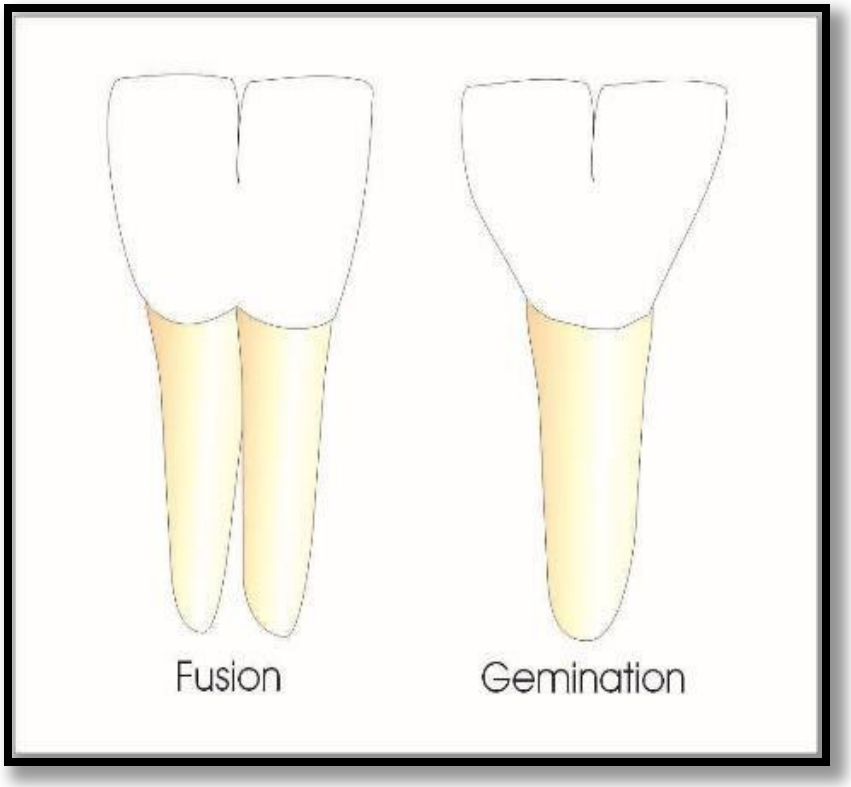
Macrodontia Teeth: larger than normal. It may be true or relative generalized.

*Microdontia*Teeth: smaller than normal. It may be true or relative generalized; most commonly the lateral incisor and third molars

*Dens in dente:* Tooth invaginates before calcification, e.g. permanent maxillary lateral incisor.

*Dens evaginatus:* A tubercle or protruberance from the involved surface of the affected tooth; occurs due to proliferation or evagination of part of the inner enamel epithelium into the stellate reticulum. Seen in premolars.






*Gemination :* Single tooth germ splits into partially or fully separated crowns but with a common root and root canal.
*Fusion* Two tooth germs unite to form a single large crown with two root canals; seen in incisors.

- *Dilaceration:* Twisting, bending or distortion of a root.

*Taurodontism:* Enlargement of the body and pulp chamber of a multi-rooted tooth with apical displacement of the pulpal floor and bifurcation of the root

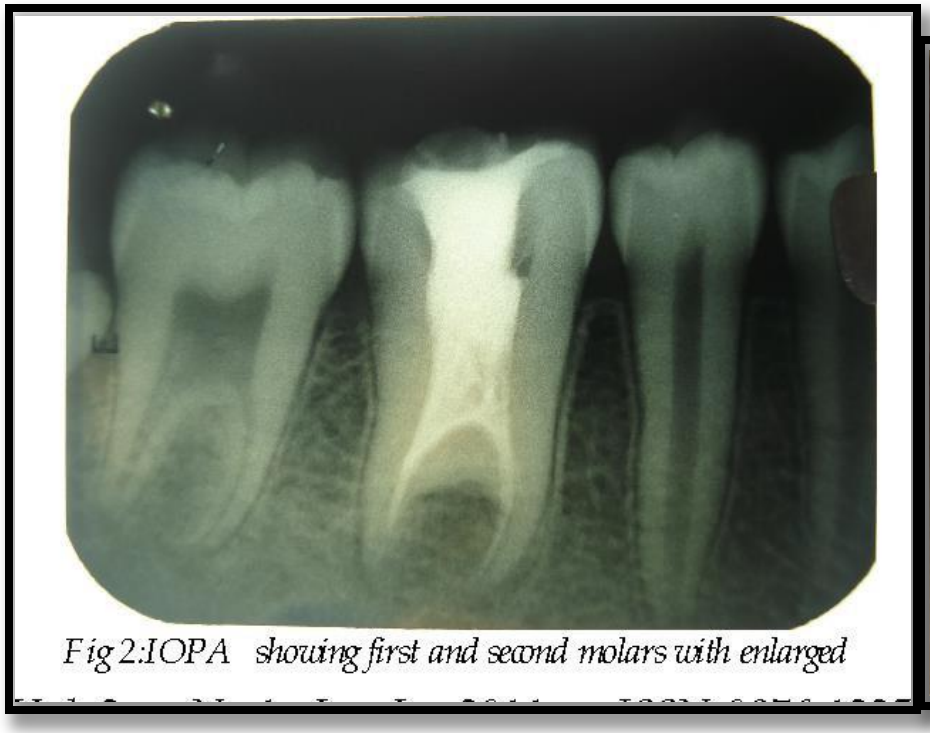


*Fig 2:IOPA showing first and second molars with enlarged*

## Disturbances During Apposition of Hard Tissues

•*Enamel hypoplasia:* Reduction in the amount of enamel formed.

Local enamel hypoplasia Periapical infection or trauma (Turner's tooth)

Systemic enamel hypoplasia Rickets, German measles, fluoride ingestion.

Hereditary enamel hypoplasia Tooth appears yellow due to reduced enamel thickness.

Amelogenesis imperfect: Hereditary disorder wherein the quality and quantity of enamel formed is altered. Three types:

Hypoplastic Defective matrix formation
Hypocalcification Defective mineralization of matrix.
Hypomaturation Immature enamel crystals.

*Dentinogenesis imperfect: Hereditary developmental disorder of the dentine. The dentine appears grey to brownish violet, enamel frequently separates from the defective dentine, roots become short, canals get obliterated, rapid attrition is seen.*

*Dentinal dysplasia* Premature loss of teeth, short roots.

*Shell teeth* Roots fail to form, pulp chambers are wide.

*Odontodysplasia (Ghost teeth)*Enamel and dentine is defective and very thin.

*Pigmentation of enamel and dentine*

Erythroblastosis fetalis: enamel is green/blue.

Porphyria: red to brownish

Tetracyclines: brownish

*Cemental hypoplasia* Reduced rate of cementum formation, e.g. hypophosphatasia.

*Enamel pearls* Attached to the furcation area of maxillary molars.

**Disturbances During Calcification Of Hard Tissue**

*Enamel hypocalcification* Calcification is subnormal. It may be local, systemic or hereditary.

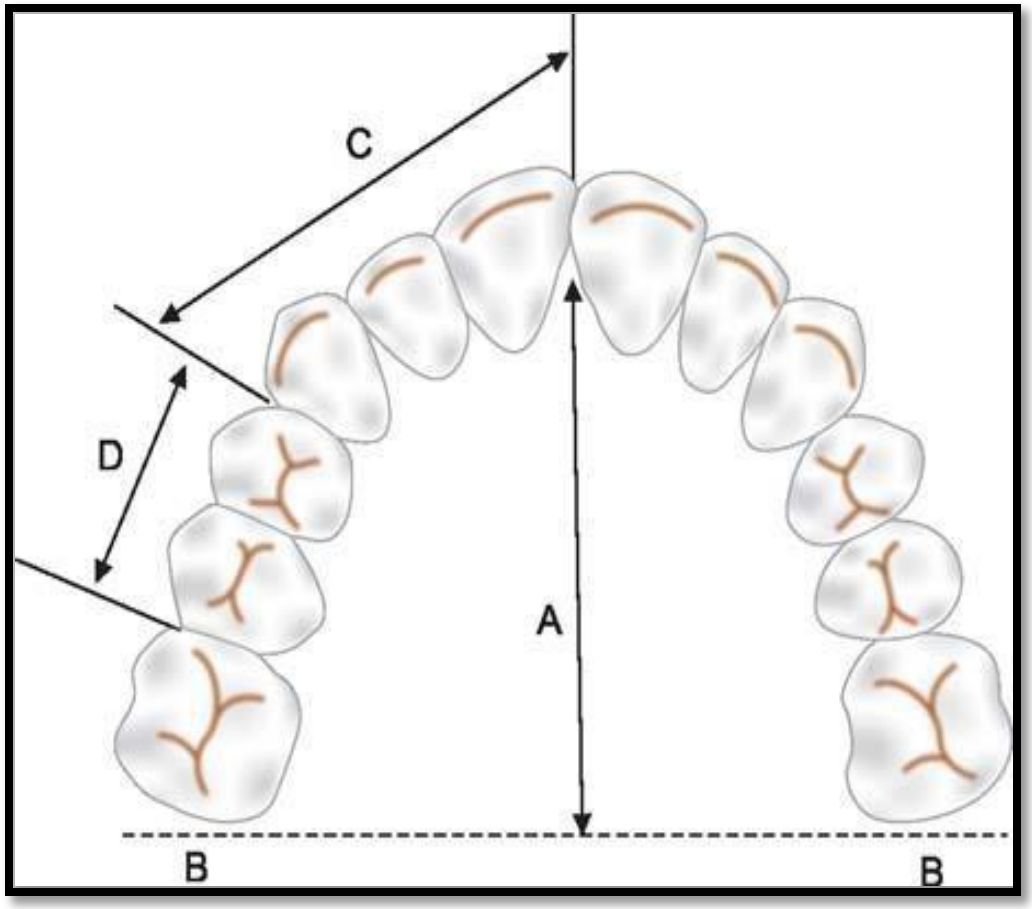
*Interglobular dentine* Areas of partially calcified dentine.

**Disturbances During Eruption of Teeth**

*Concrescence:* Cemental union of two teeth.

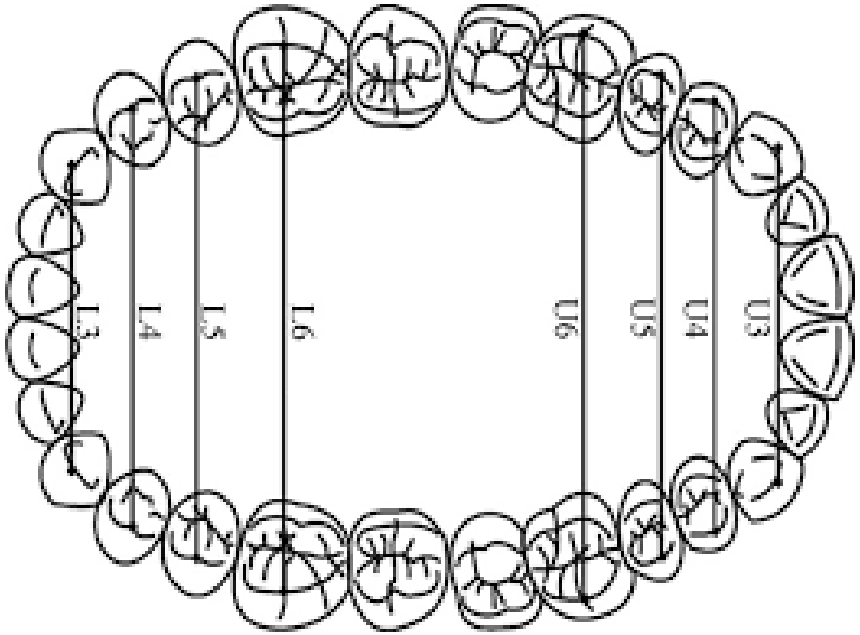
*Retarded eruption:* Due to endocrine disturbances, vitamin deficiencies, local causes.

*Ankylosed teeth:* Teeth fail to erupt to the occlusal level as they are fused to the bone.



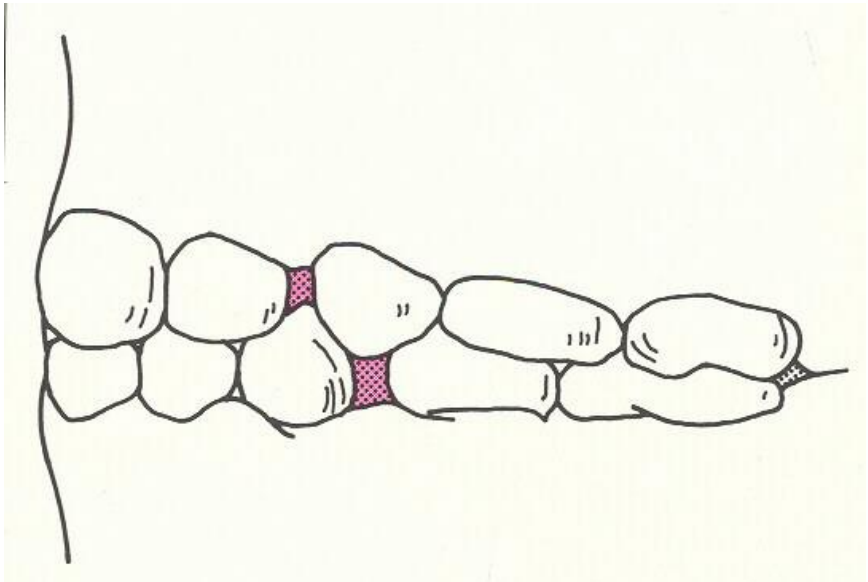

# Dimensional Changes In The Dental Arches

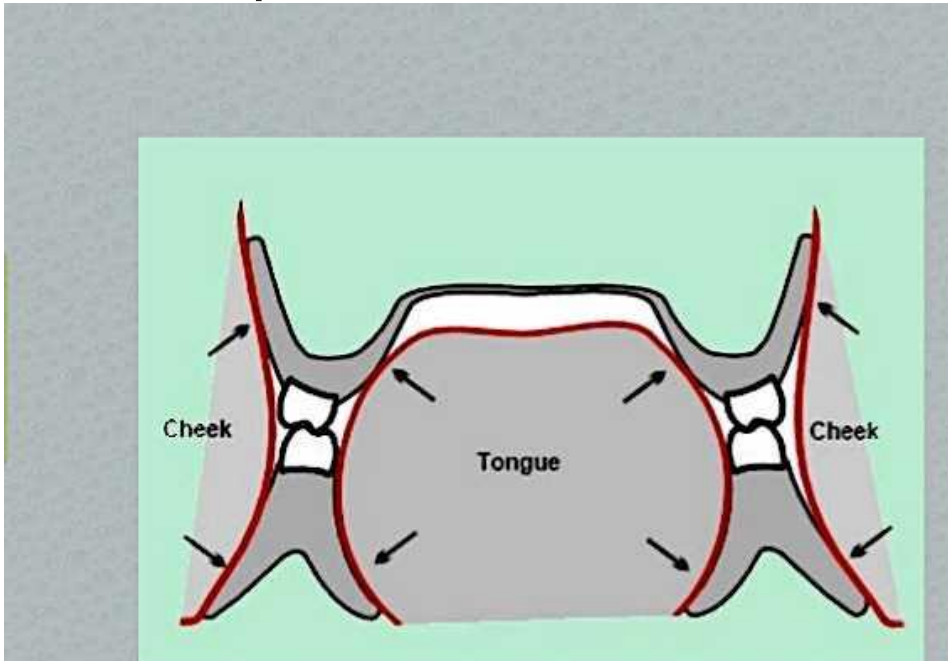
The usual arch dimensions measured are:
**Widths** of the canines, primary molars (premolars) and first permanent molars:
Dimensional increase in width involves alveolar process growth almost totally, since there is little skeletal width increase at this time.



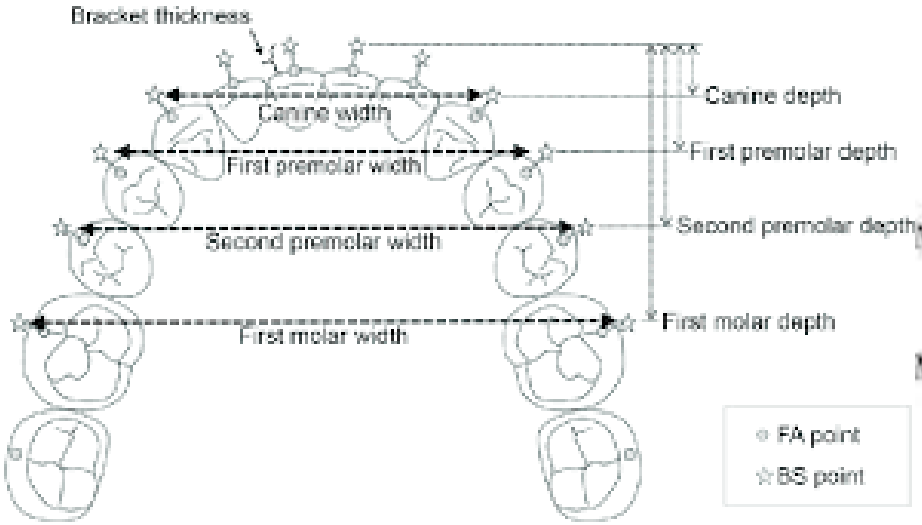
Clinically significant differences exist in the manner and magnitude of width changes in the maxilla and mandible. Width increase correlates highly with vertical alveolar process growth. Maxillary alveolar processes diverge while mandibular alveolar processes are more Parallel. Thus, maxillary width increases more and can be easily altered in treatment.

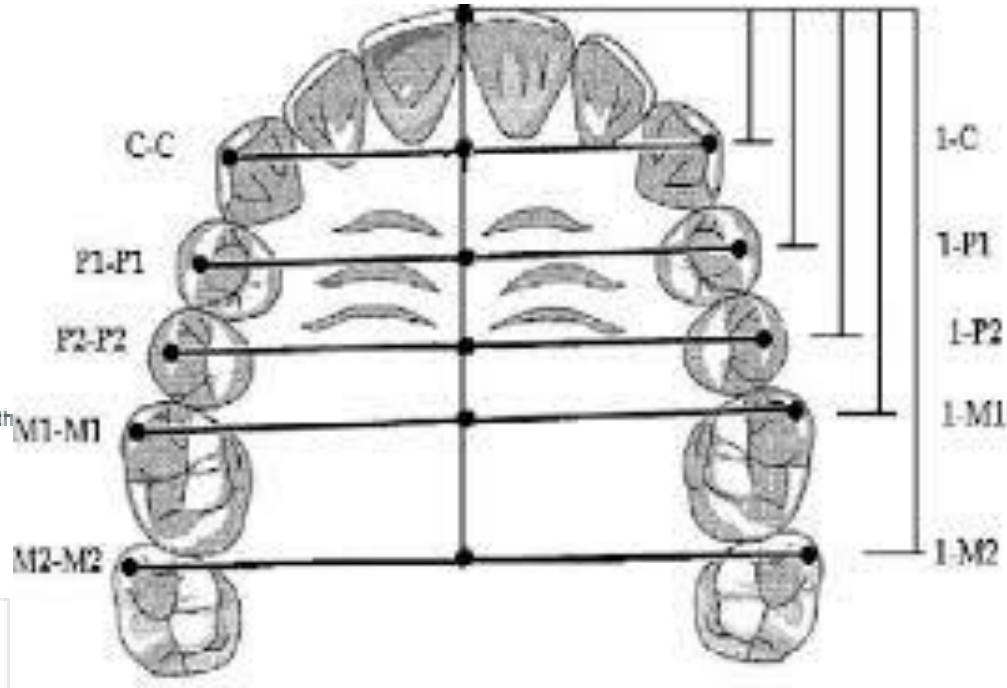
The only significant increase in mandibular inter-canine width occurs during eruption of Incisors when primary cuspids are moved distally into primate spaces and does not increase significantly thereafter.



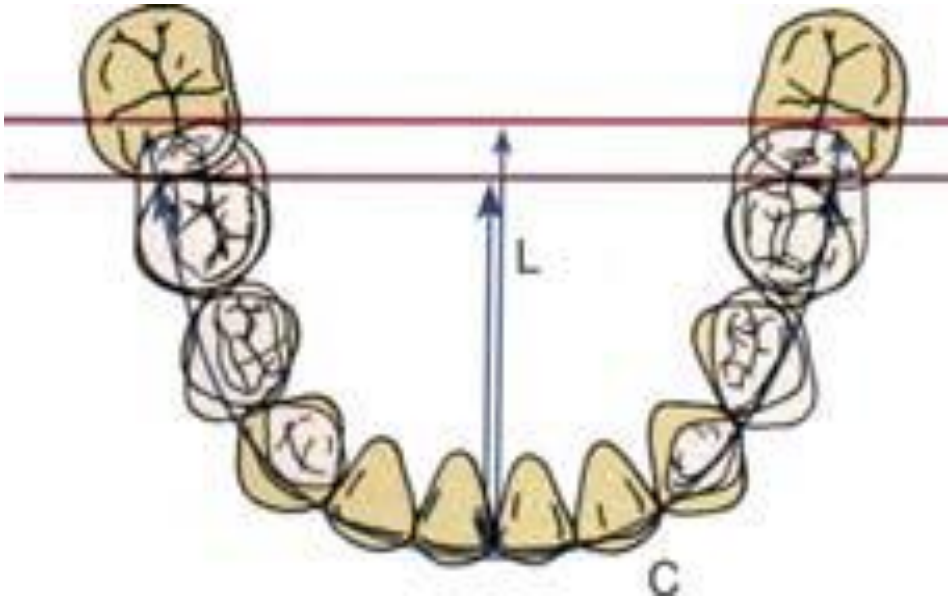


Maxillary arch width increase is timed with periods of active eruption of teeth. Eruption of maxillary permanent canines is an important factor in widening of the arch. Maxillary premolar width increase is coincidental with vertical growth whereas mandibular premolar width increase occurs because of further buccal placement of premolar crowns.

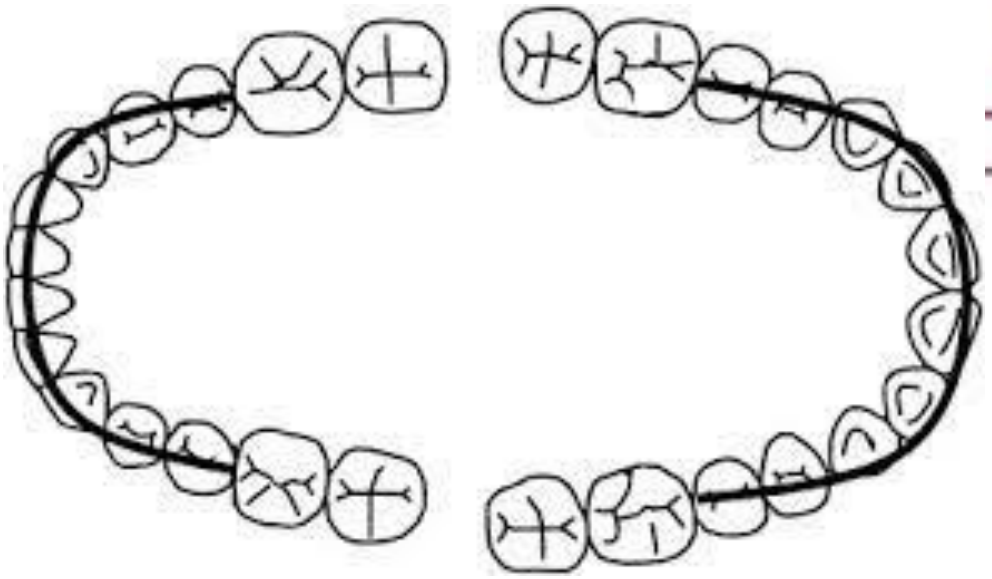


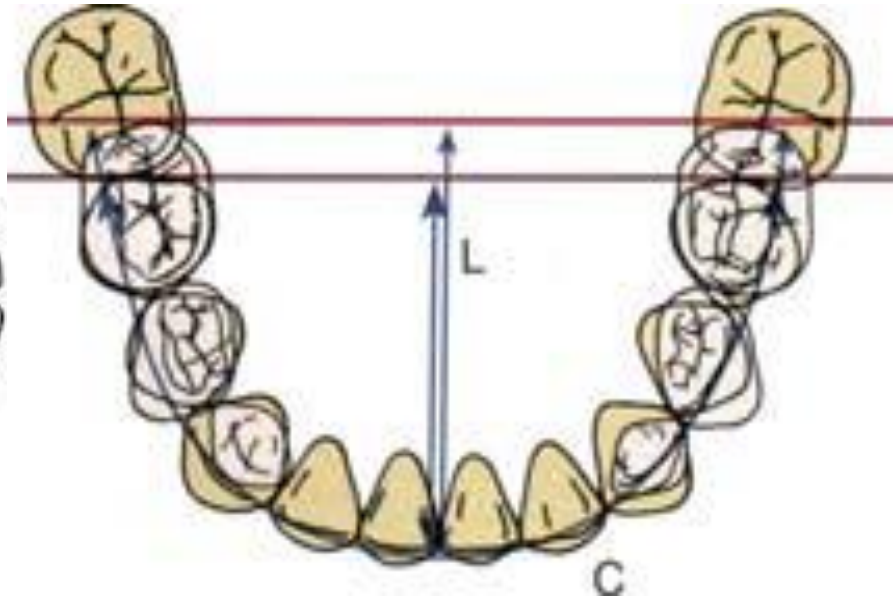



**Length or depth**: Arch length or depth is measured at the midline from a point midway between central incisors to a tangent touching distal surfaces of second primary molars or premolars. Any changes in arch length are coarse reflections of changes in perimeter.



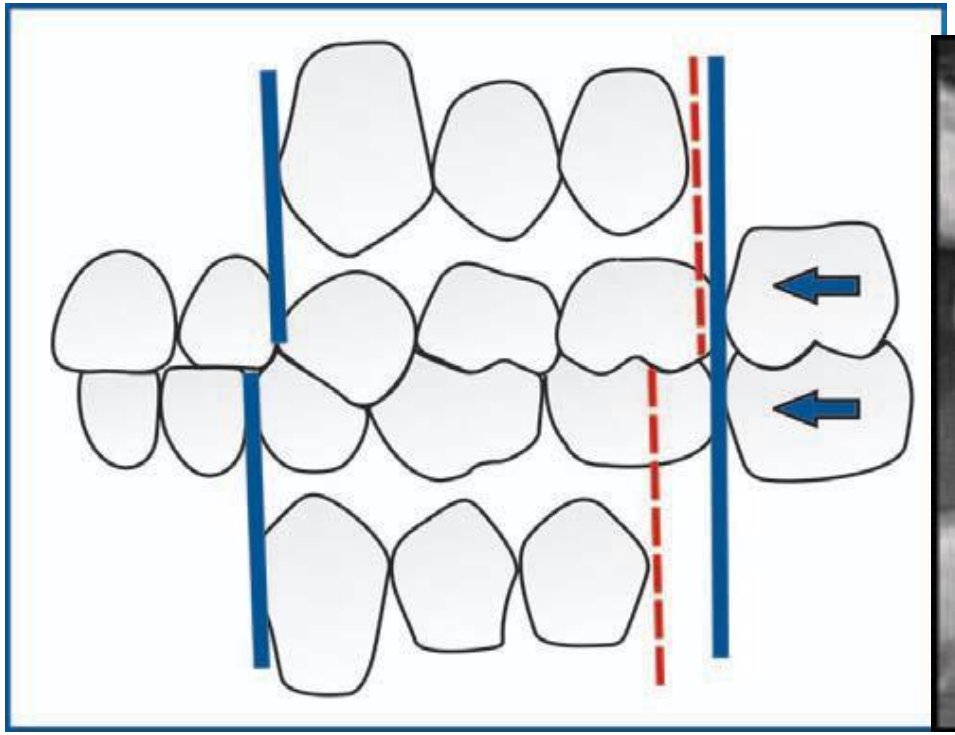
**Arch circumference or perimeter**: Measured from distal surface of second primary molar or mesial surface of first permanent molar around the arch over contact points and incisal edges in a smoothened curve to the distal of second primary molar or mesial surface of first permanent molar of the opposite side..

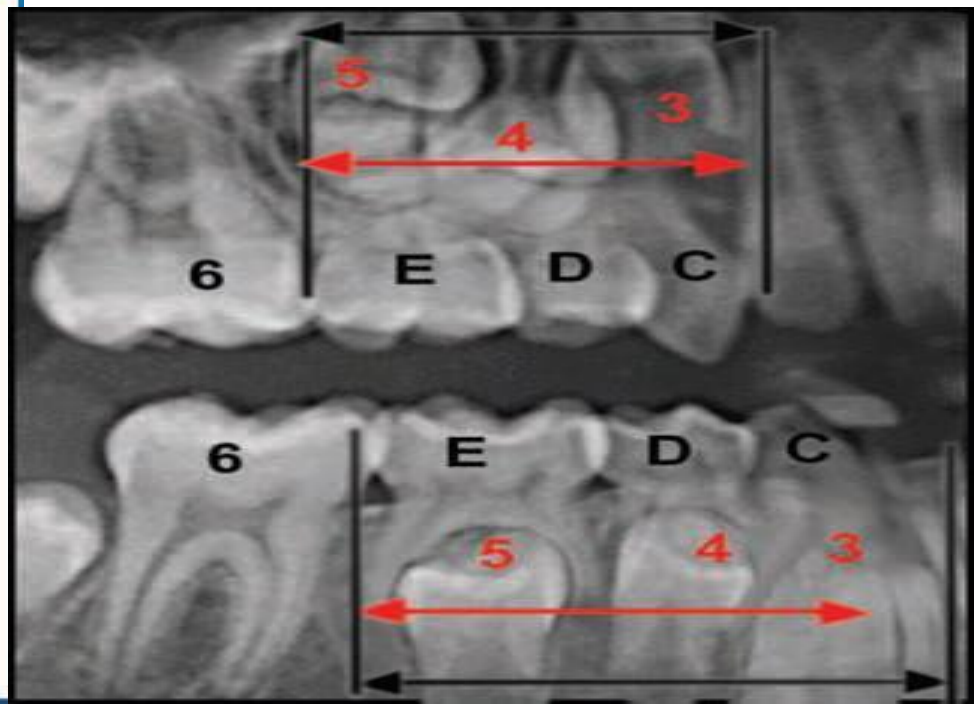




The reduction in mandibular arch circumference during transitional and early adolescent dentition is a result of:

- Late mesial shift of first permanent molar as “leeway space” is pre- erupted.
- Mesial drifting tendency of posterior teeth throughout life slight interproximal wear of teeth.
- Lingual positioning of incisors.
- Original tipped position of incisors and molars.





**Conclusion**

Development of dentition in humans is complex and depends on many variables. Development of dentition deviates markedly from that of other parts and structures of the body. Crowns of teeth are formed directly to adult size and housed within the jaws years Before they emerge. To determine an abnormal course of development, it is the responsibility of an orthodontist to have adequate knowledge on the subject to differentiate abnormal from normal before initiating therapy.

# Growth and Development

***Introduction:***

Growth can be defined as an increase in size while development is the increase in complexity.

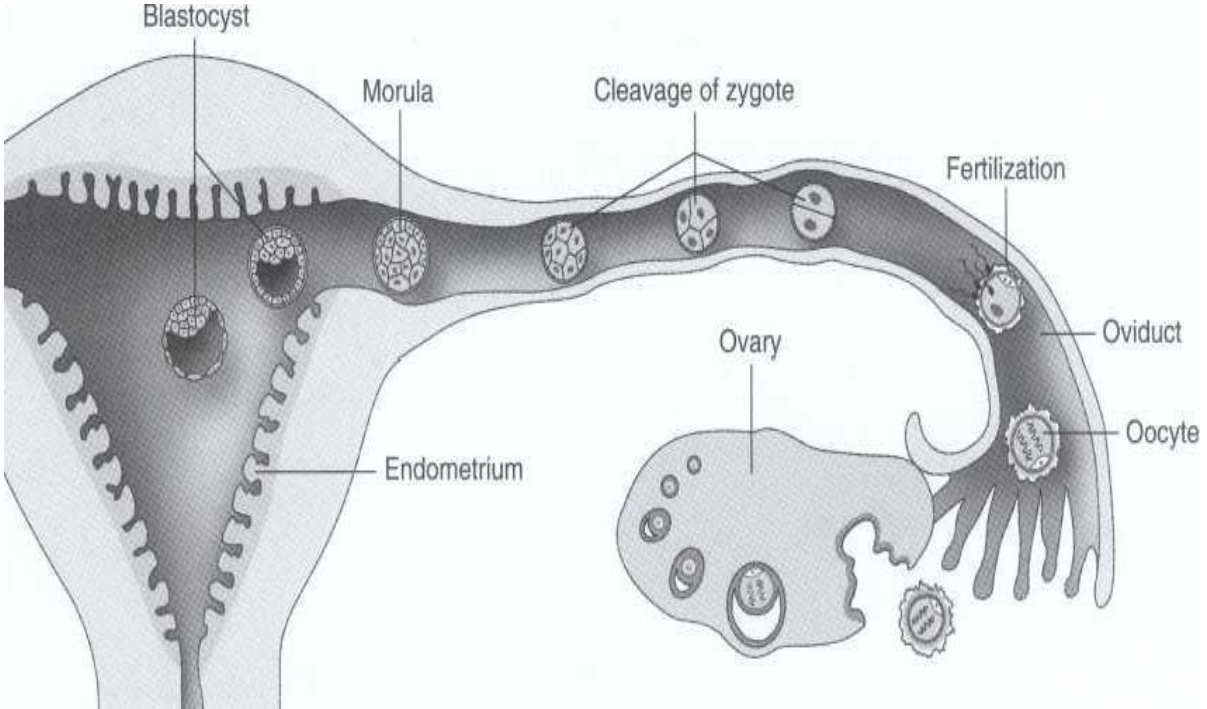
The knowledge about growth and development is very important for orthodontist since during this period any disturbances may give rise to certain congenital malformations, malocclusion and facial deformities …etc. although the etiology of malocclusion is mainly based on genetic factors.

This category can be divided into two periods: prenatal and postnatal.

*The prenatal (neonatal) period:*

It can be divided into three periods:

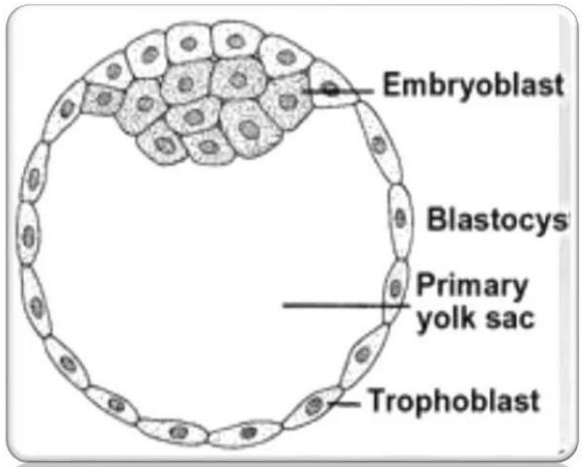
1. **period of ovum:** from the time of fertilization to the end of 2nd week: in this period human development begins when a sperm fertilize the ocyte resulting in the formation of a zygote. Fertilization occurs in the ampulla of the uterine tube ( oviduct ). The zygote undergo a series of mitotic divisions as it moves along the uterine tube toward the uterus. The cells resulting from this division are called blastomers they adhere to one another and form a ball of cells called a morula, which enters the uterus about three days after fertilization.

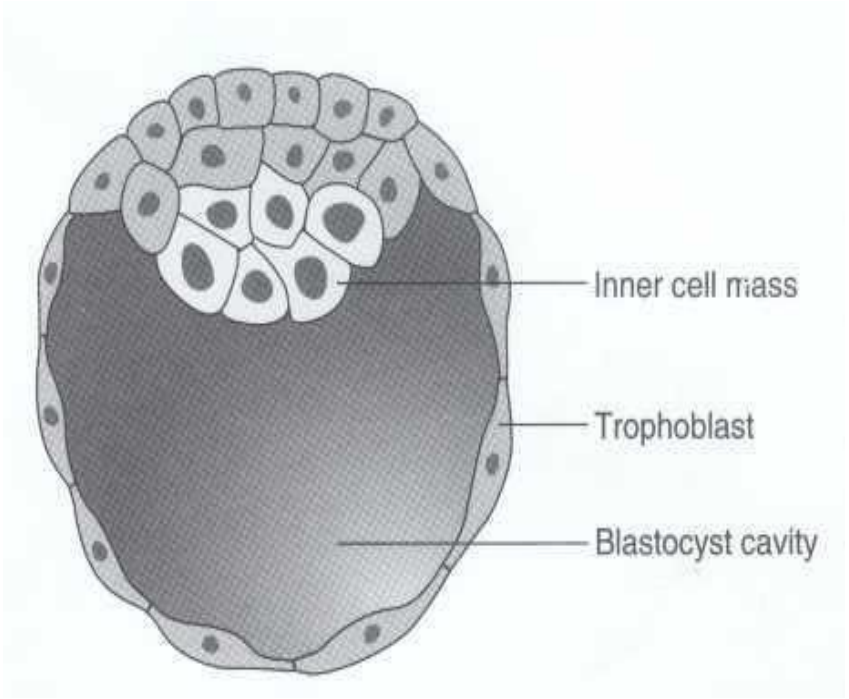


A fluid-filled space called the blastocyte cavity develops, within the morula, and the entire structure is called the blastocyst. Six days after fertilization, two distinct cell types comprise the blastocyst

*The trophoblast form a single layer of cells covering the outside of the blastocyst.

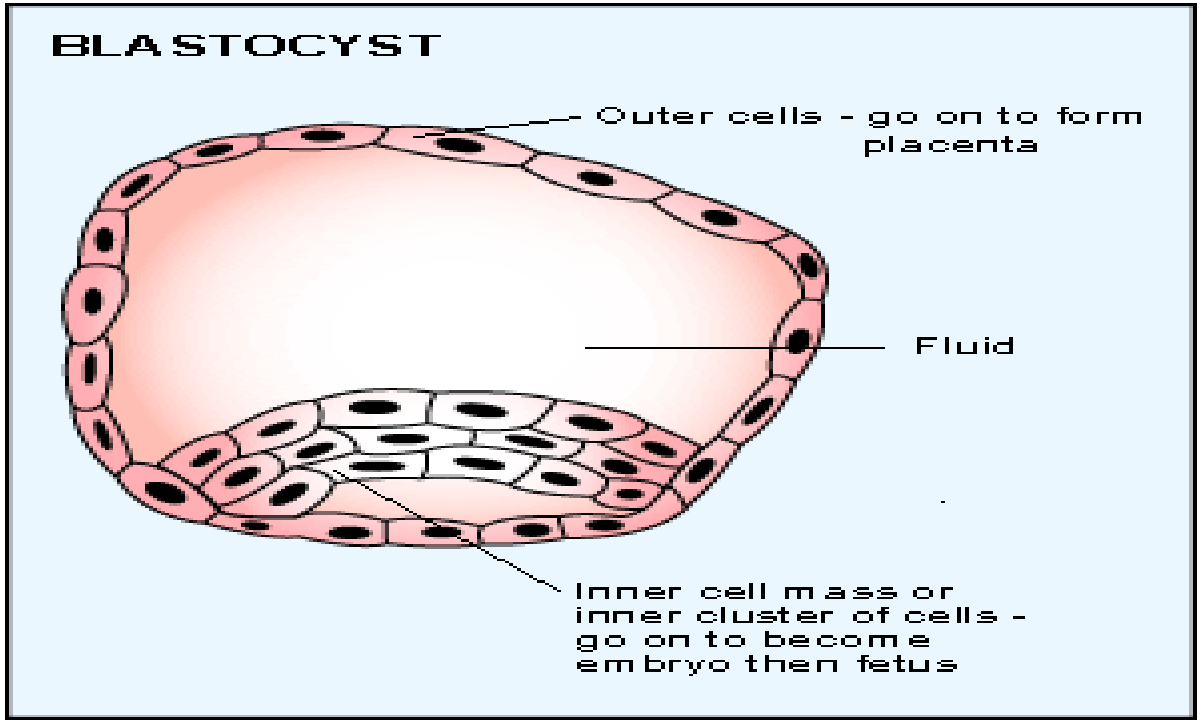
## structure

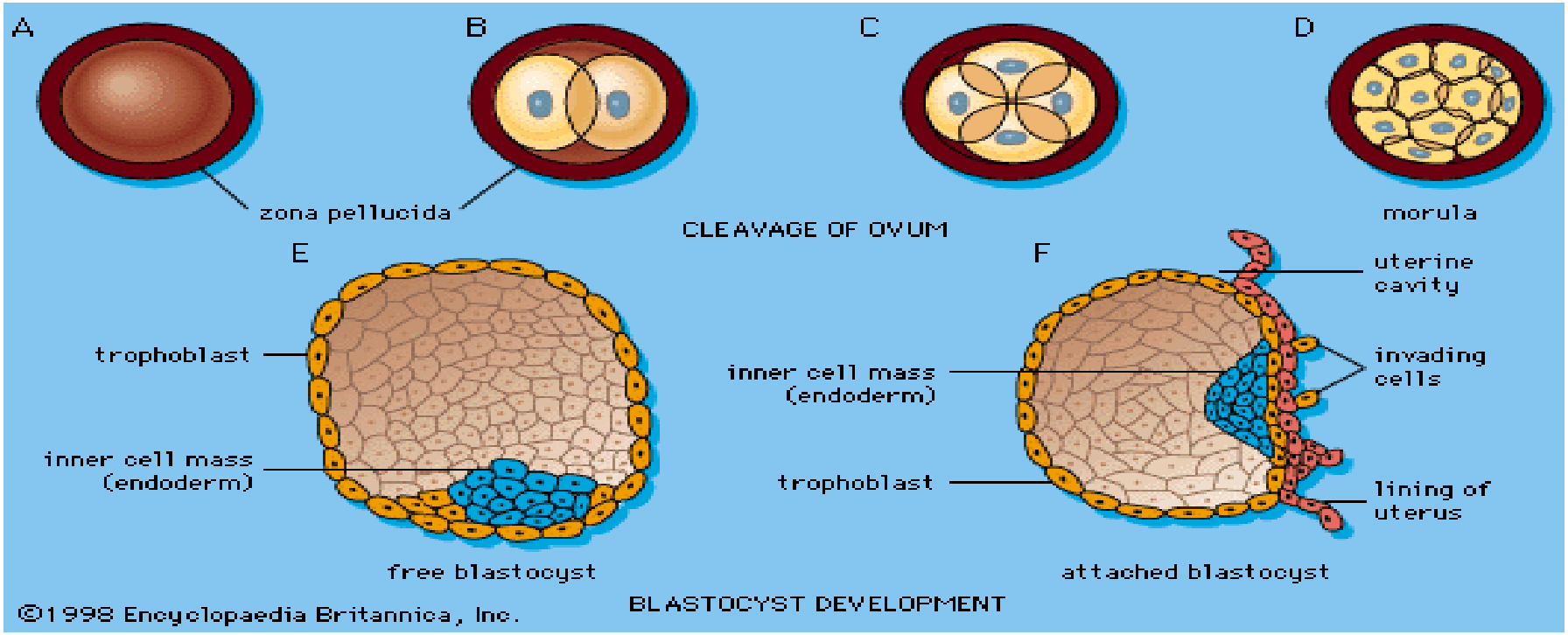


*the inner cell mass which is a cluster of cells located inside the trophoblast

The inner cell mass develops into embryo whereas the trophoblast forms the embryonic part of the placenta and other peripheral structures associated with the embryo.




A
B
C
D
zona pellucida
CLEAVAGE OF OVUM
morula
E
F
trophoblast
inner cell mass
(endoderm)
uterine
cavity
invading
cells
inner cell mass
(endoderm)
trophoblast
lining of
uterus
free blastocyst
attached blastocyst
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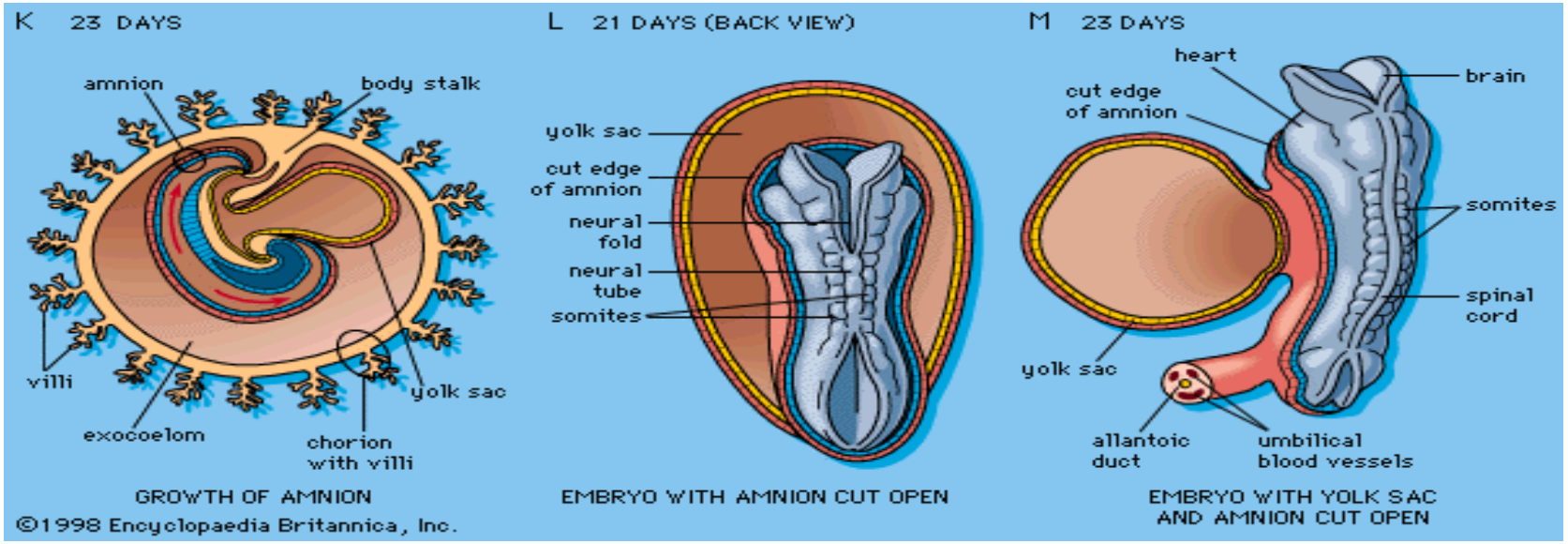
BLASTOCYST DEVELOPMENT

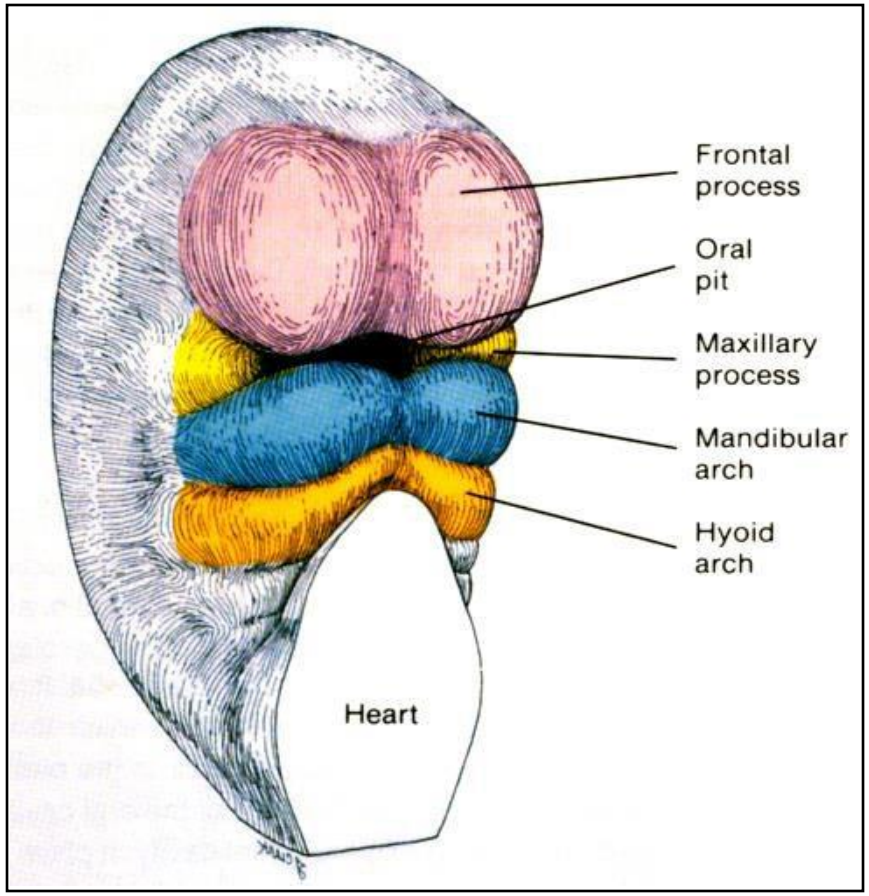
**2-period of embryo**: from the 2nd week to the 8th week : in this period most organs and organ systems are formed, it is the period of differentiation and most congenital malformations developed during this period. At the end of this period the developing individual has a recognizable human appearance.

**3- period of fetus:** from 8th week to 40 week.



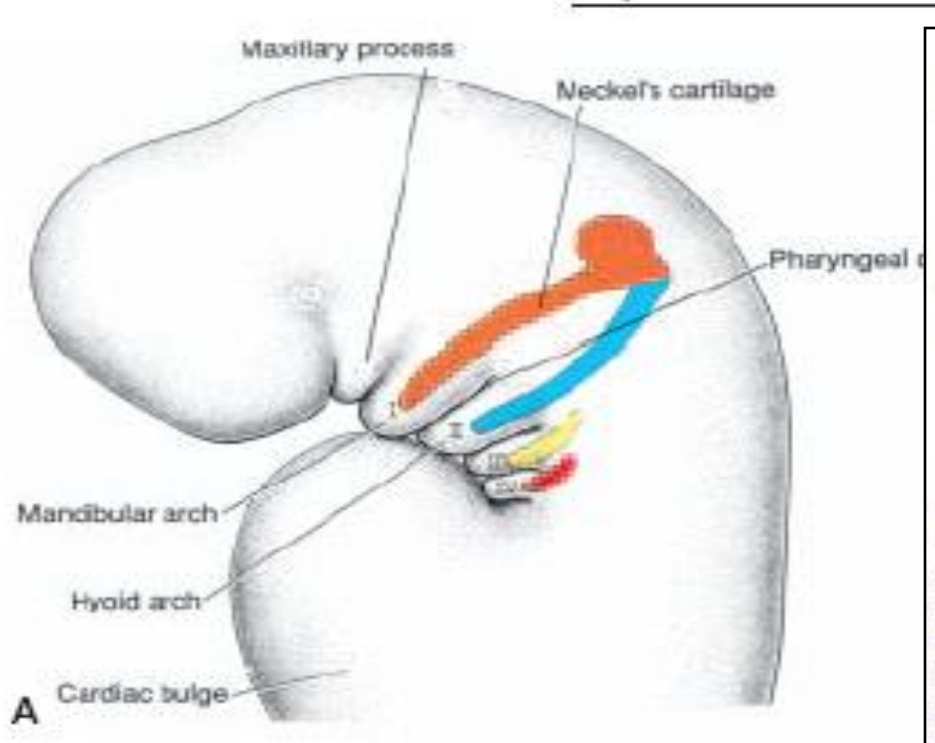
Most of the cranio facial structures are formed in the first trimester of pregnancy.

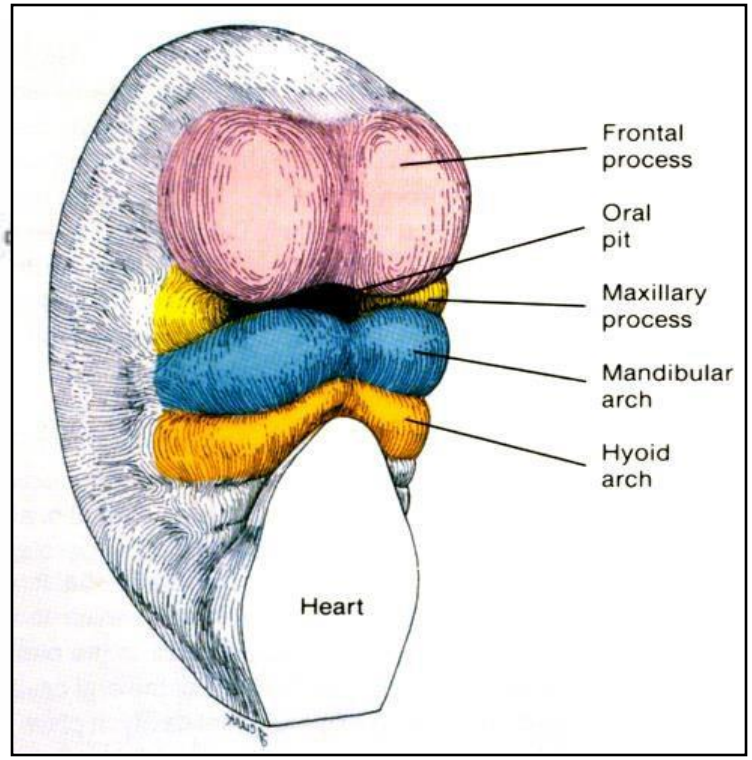
In the 3rd week the head is composed mainly of the pros-encephalon (frontal prominence) which represents the most caudal portion of the pros- encephalon, overhangs the developing oral groove.



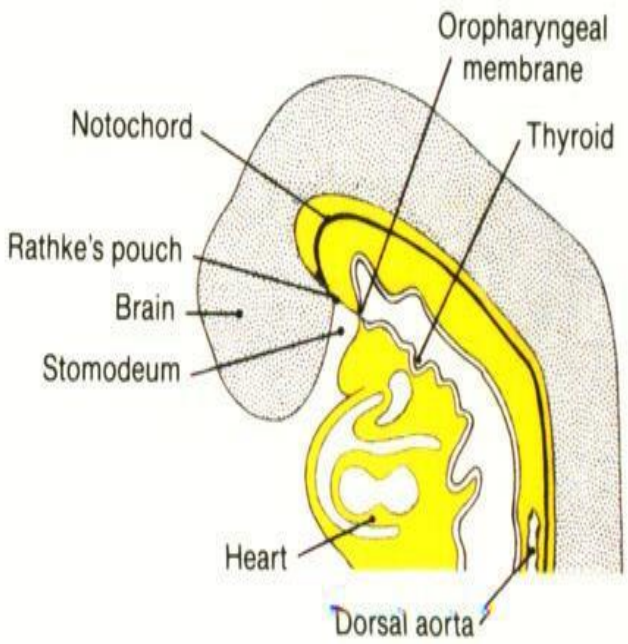
This oral groove is bounded on its lateral sides by the rudimentary maxillary processes, the mandibular arch is below the groove while the frontal process is above.

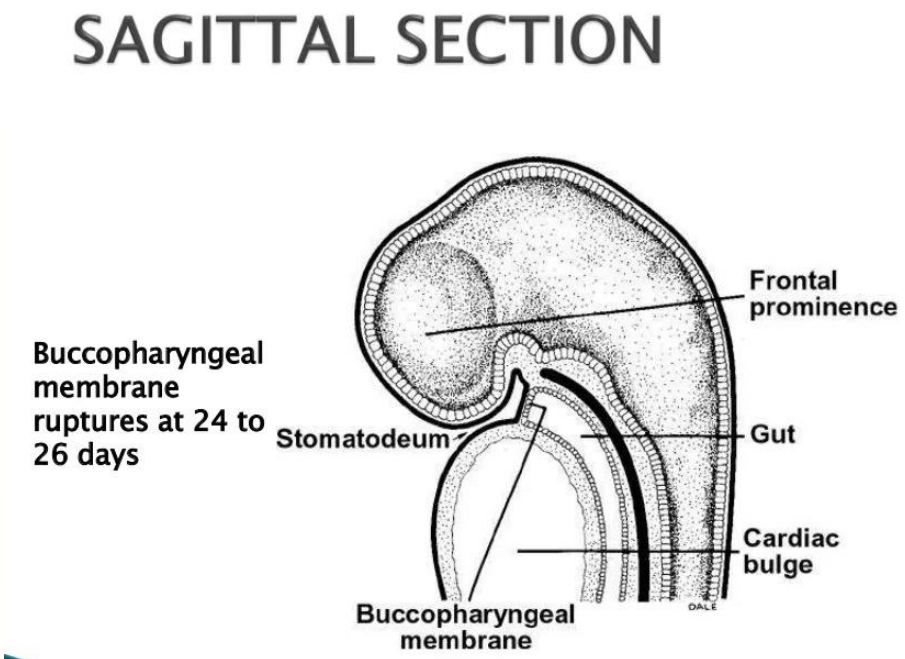
The frontal prominence, mandibular arch and the maxillary processes are called together the stomodeum.



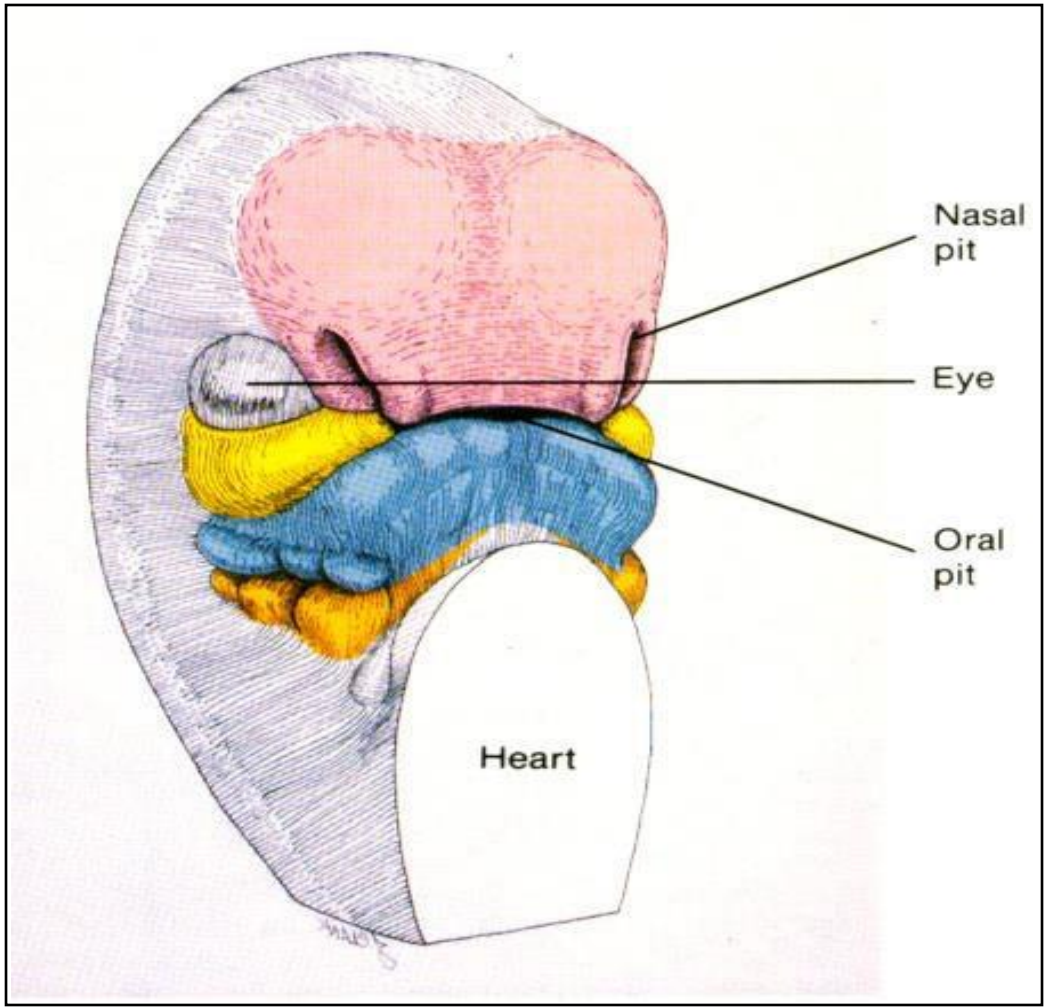



During the following few weeks the oral groove deepens and the oral plate ( bucco pharyngeal membrane ) which consists of an ectodermal floor of the stomodeum and endodermal lining of the foregut, ruptures to establish the oral opening.

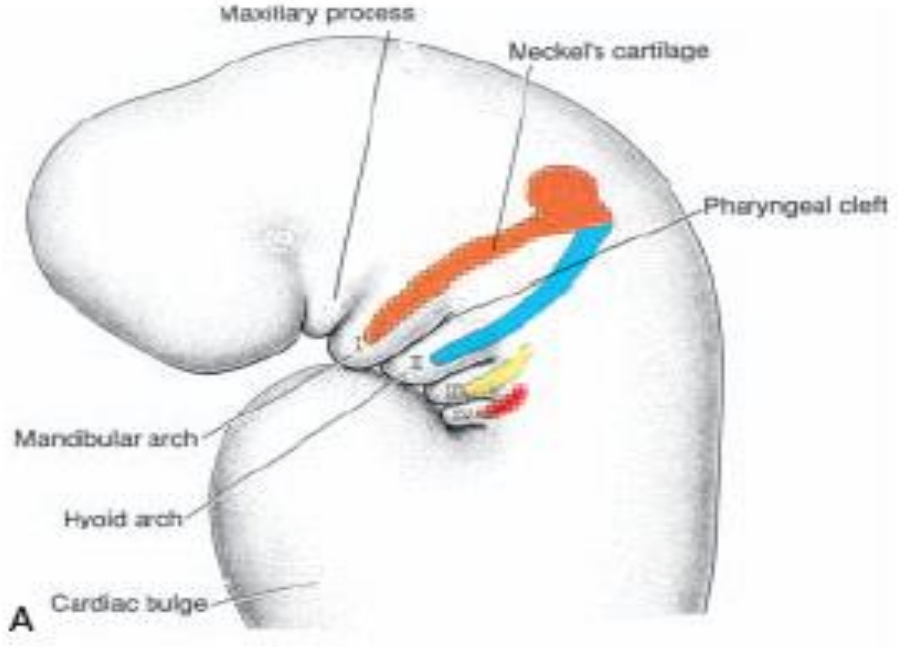


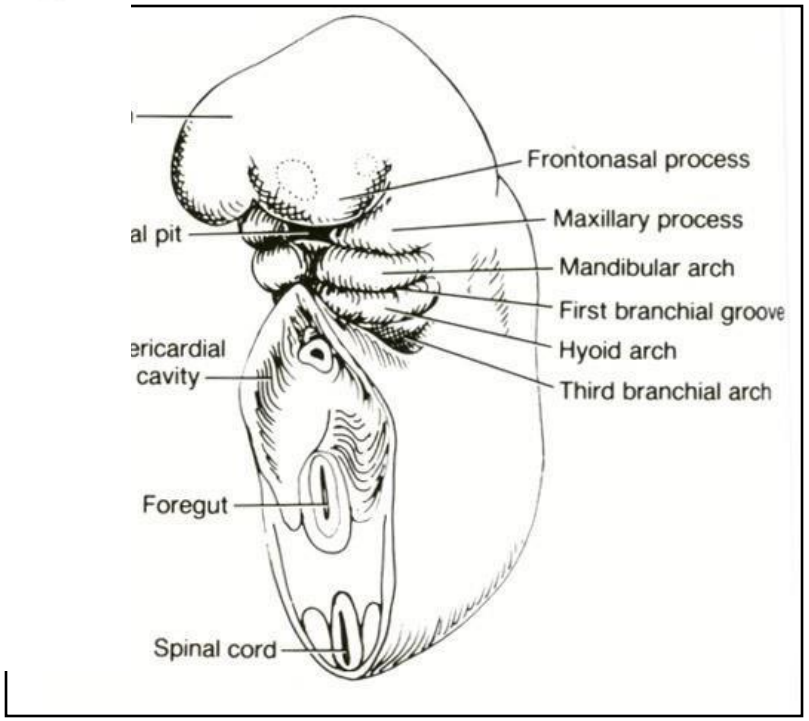



In the 4th week we can notice two ectodermal proliferations on either side of the frontal process. These later on will give rise to the nasal placodes, which develop to nasal pits and the olfactory epithelium.

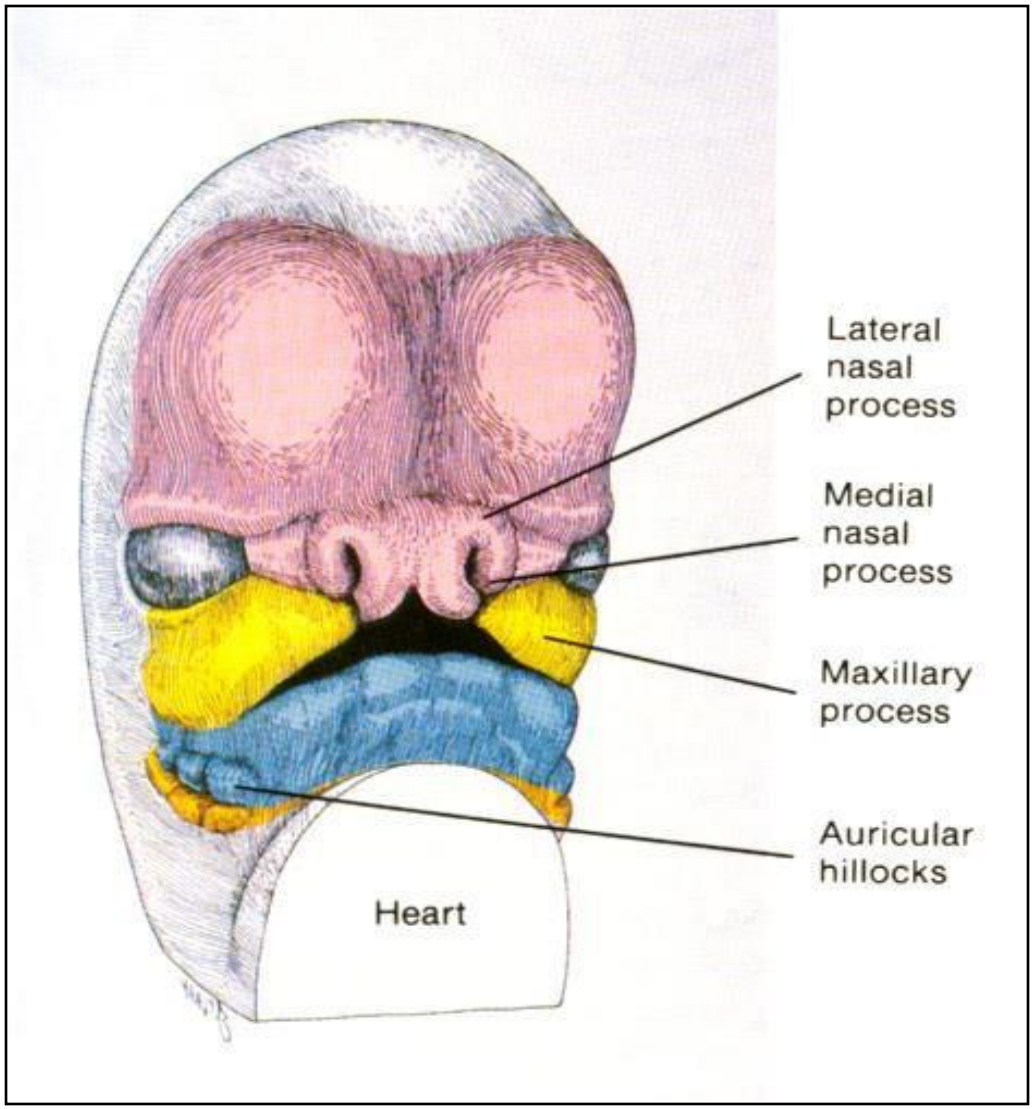


At this time we can also see the brachial arches, which are distinguished as four arches with a fifth transieitary brachial arch. The first arch is called the mandibular arch while the second is called the hyoid arch.

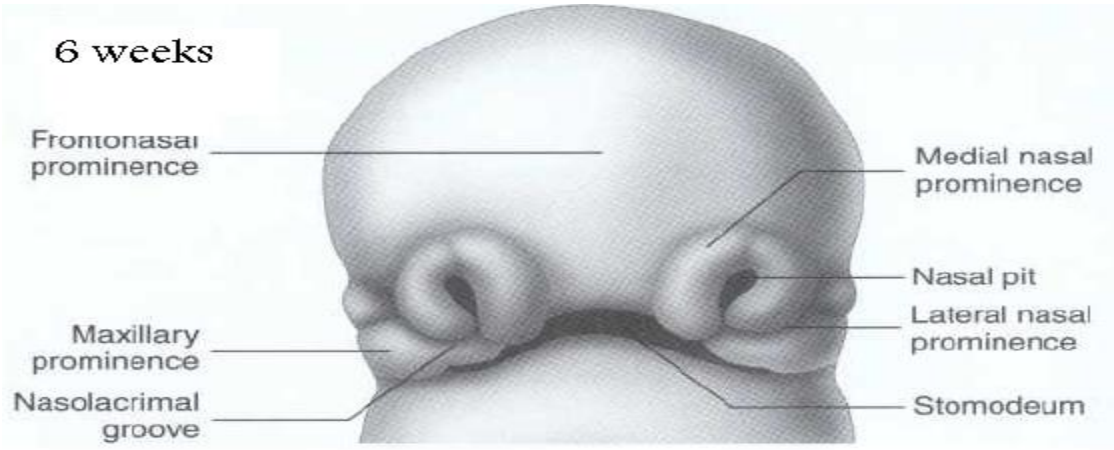


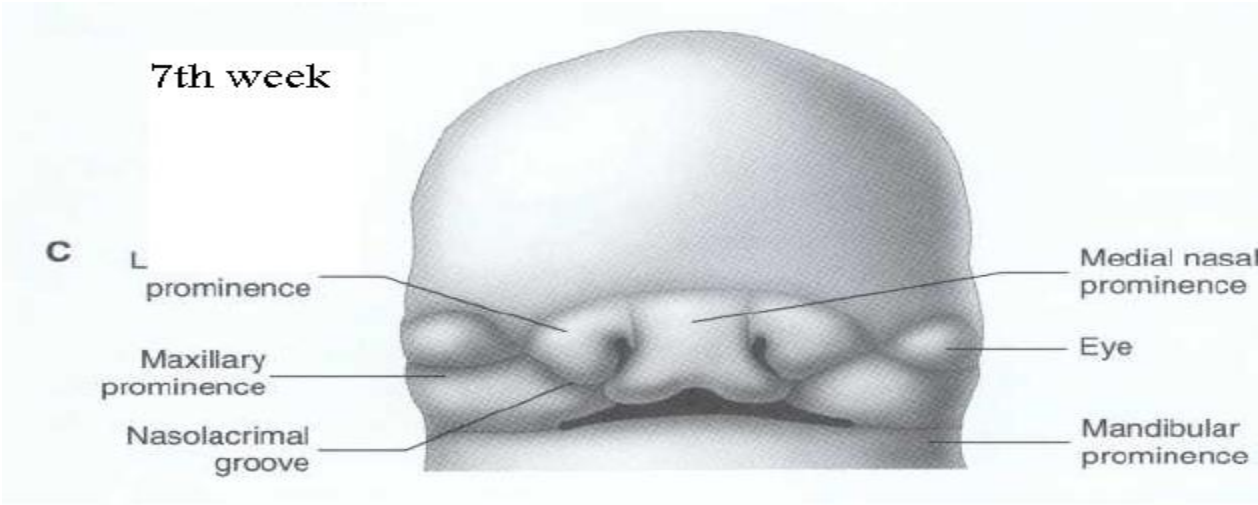



On the 5th week the nasal pits widen and the medial and lateral walls of the nasal pits start to proliferate and grows downward giving rise to the medial nasal and lateral nasal processes.

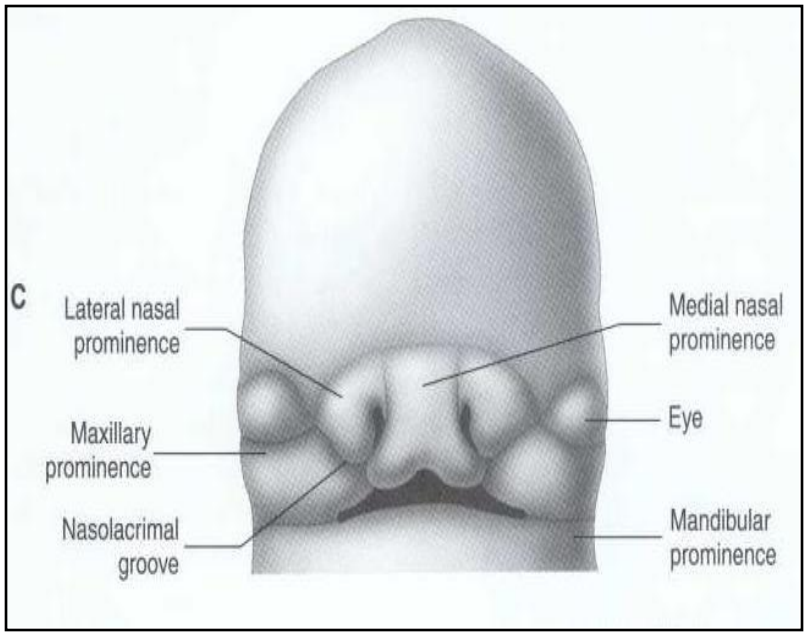


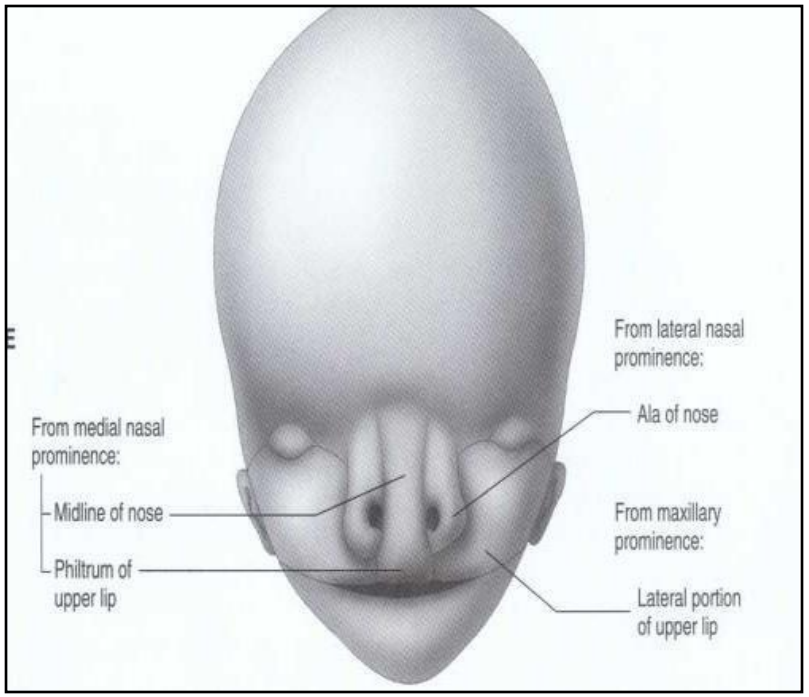
The maxillary processes on either side start to proliferate toward the medial nasal processes and the union between the medial nasal and the maxillary processes give rise to the maxilla, palate, upper lip and the lower central part of the nose.



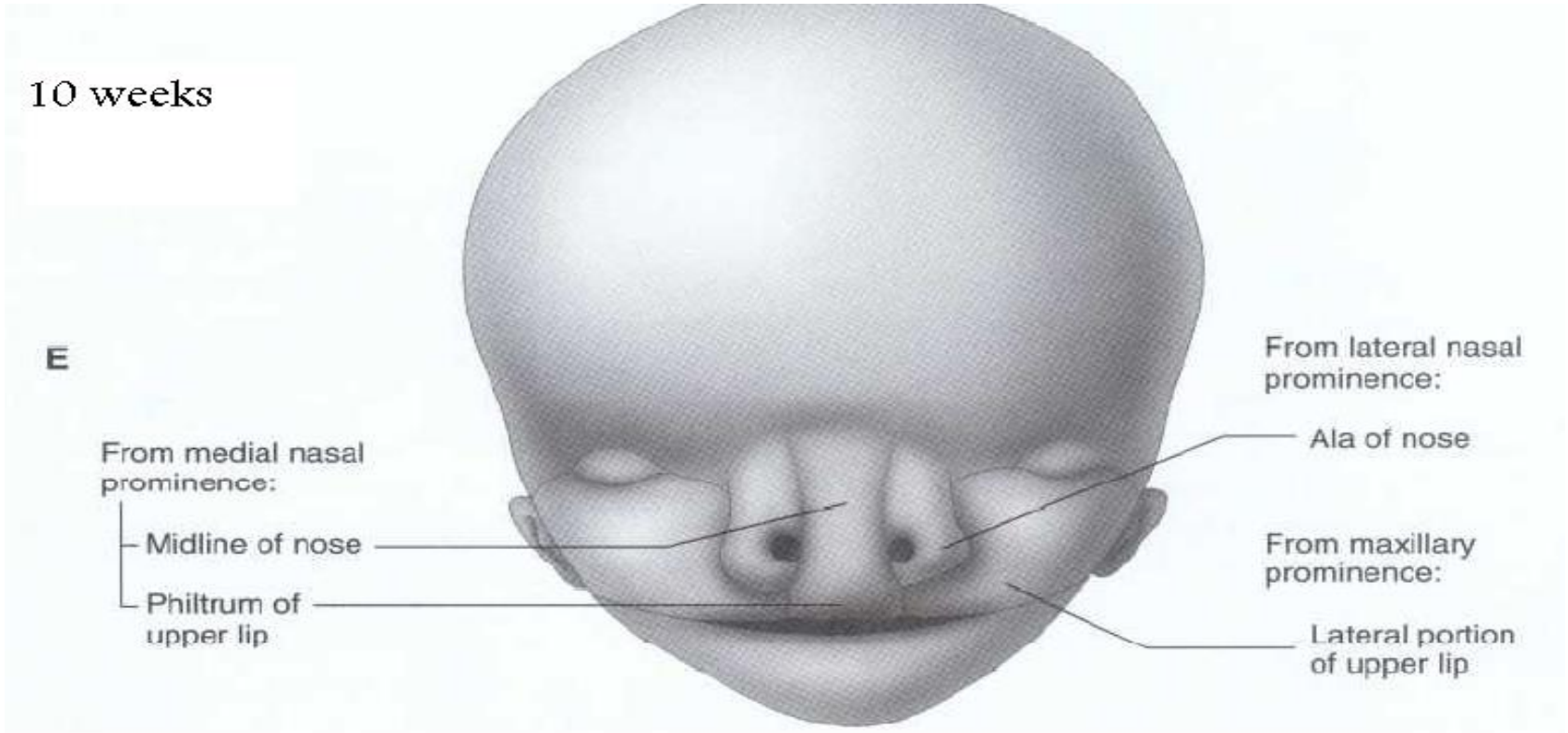



The line of fusion of the the two medial nasal processes is represented by a depression on the upper lip called the philtrum, the fusion of the medial nasal processes and the maxillary processes completes during the 7th week. Cleft lip develops if failure of fusion of these two processes takes place. This cleft may be a unilateral or a bilateral, it is also can be a complete or an incomplete one.



By the 8th week, the facial structures are apparent, the nose is more prominent and the nasal septum elongates and become more narrowed, the eyes migrate toward the midline and the ears begin to develop, the nostrils are formed by an opening in the nasal pit area which communicates with the upper part of the oral cavity.



The nasal septum is forming from the cells of the medial nasal process and of the frontal prominence, the demarcation between the lateral nasal process and the maxillary process creates a furrow, which is converted into the naso-lacrimal duct when it closes over.

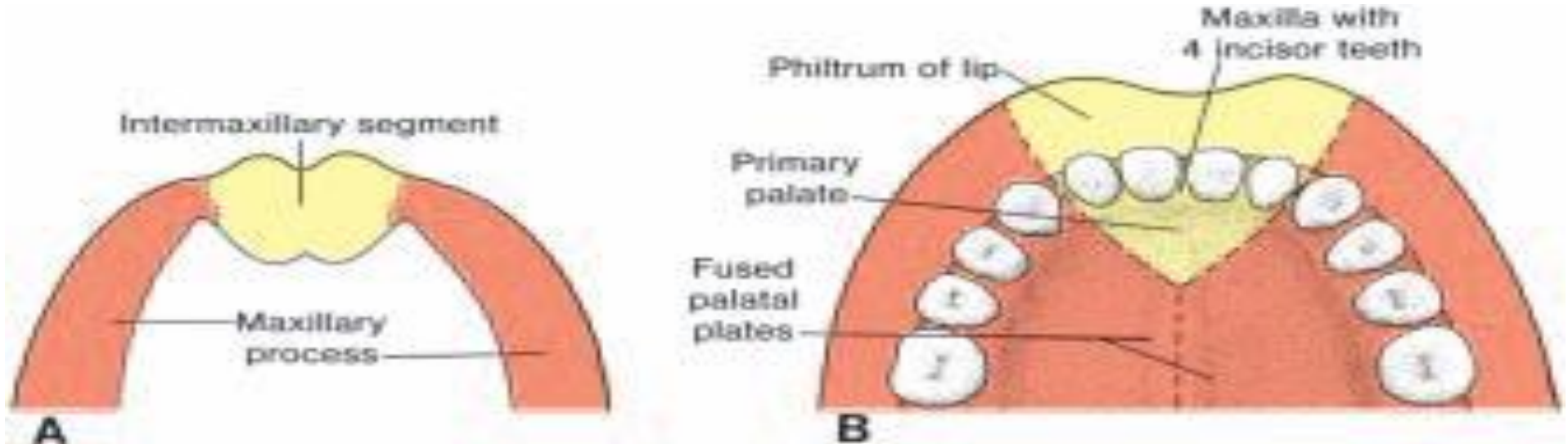
By the $12^{th}$ week the eyelids and nostrils have formed and subsequent intra-utrine changes lead to little further differentiation, these intrauterine changes involve increasing in size and changes in proportions.

## Development of palate

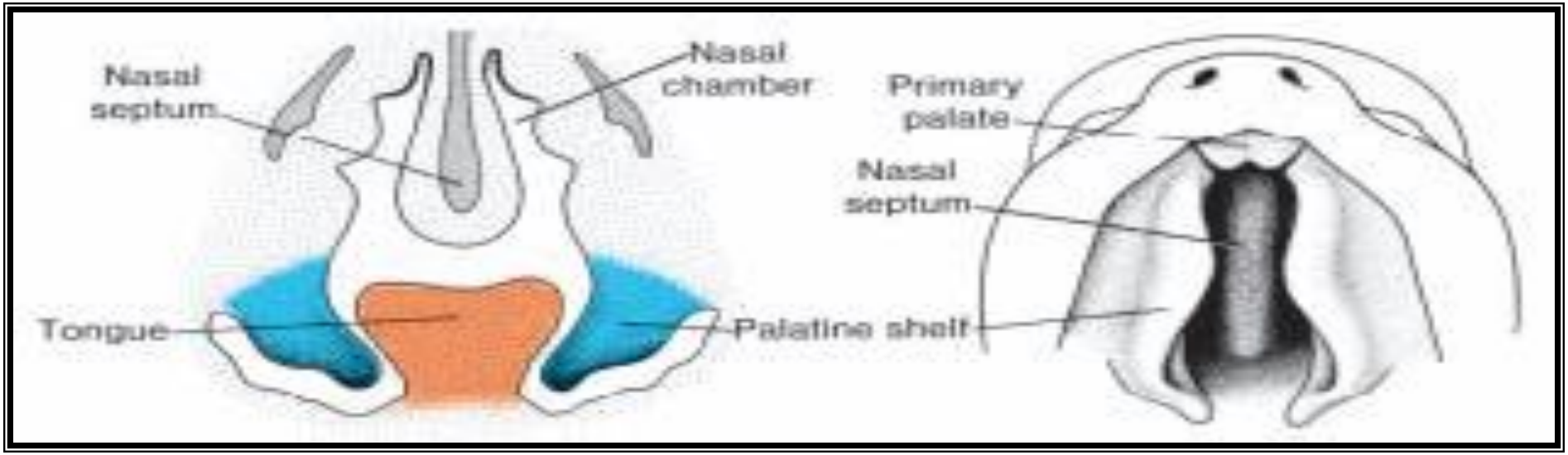
The palate begins to develop early in the 6th week, but the process is not completed until 12th week. The most critical period during palatal development is the end of the 6th week to the beginning of the 9th week.

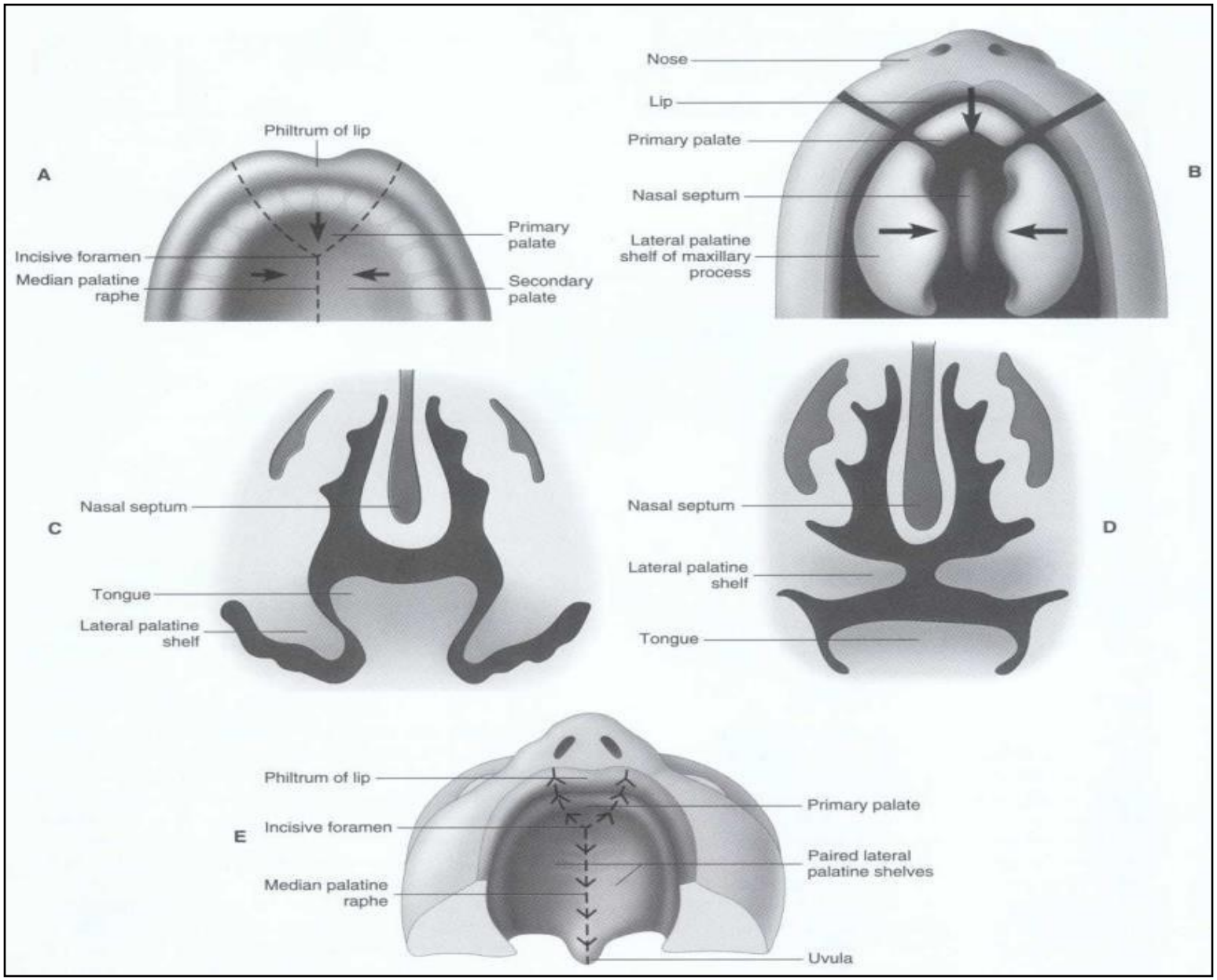
The entire palate develops from:

1. the primary palate (premaxilla): is the triangular-shaped part of the palate anterior to the incisive foramen. Its origin is the deep portion of the intermaxillary segment, which arises from the fusion of the two medial nasal prominences.



1. the secondary palate : give rises to the hard and soft palate posterior to the incisive foramen. It arises from paired lateral palatine shelves of the maxilla. These shelves are oriented in a superior-inferior plane with the tongue interposed. Later they become elongated and the tongue becomes smaller and moves inferiorly. This allows the shelves to orient horizontally, to approach one another, and to fuse in to midline. Later on these lateral palatal shelves fuse with the primary palate and nasal septum. Cleft palate results if the lateral palatal shelves failed to fuse with each other, with the nasal septum, or with the primary palate.



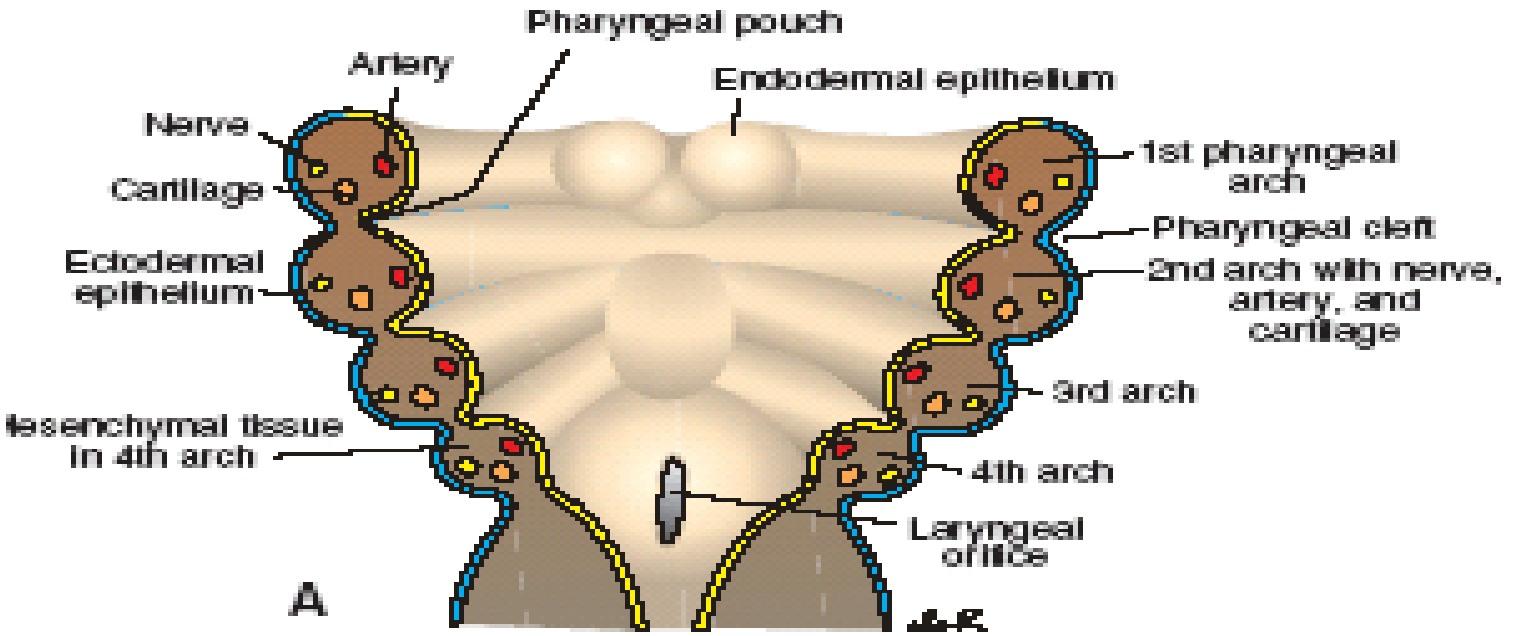

A
Philtrum of lip
Primary palate
Incisive foramen
Median palatine raphe
Secondary palate
B
Nose
Lip
Primary palate
Nasal septum
Lateral palatine shelf of maxillary process
C
Nasal septum
Tongue
Lateral palatine shelf
D
Nasal septum
Lateral palatine shelf
Tongue
E
Philtrum of lip
Primary palate
Incisive foramen
Paired lateral palatine shelves
Median palatine raphe
Uvula

**Development of the tongue**

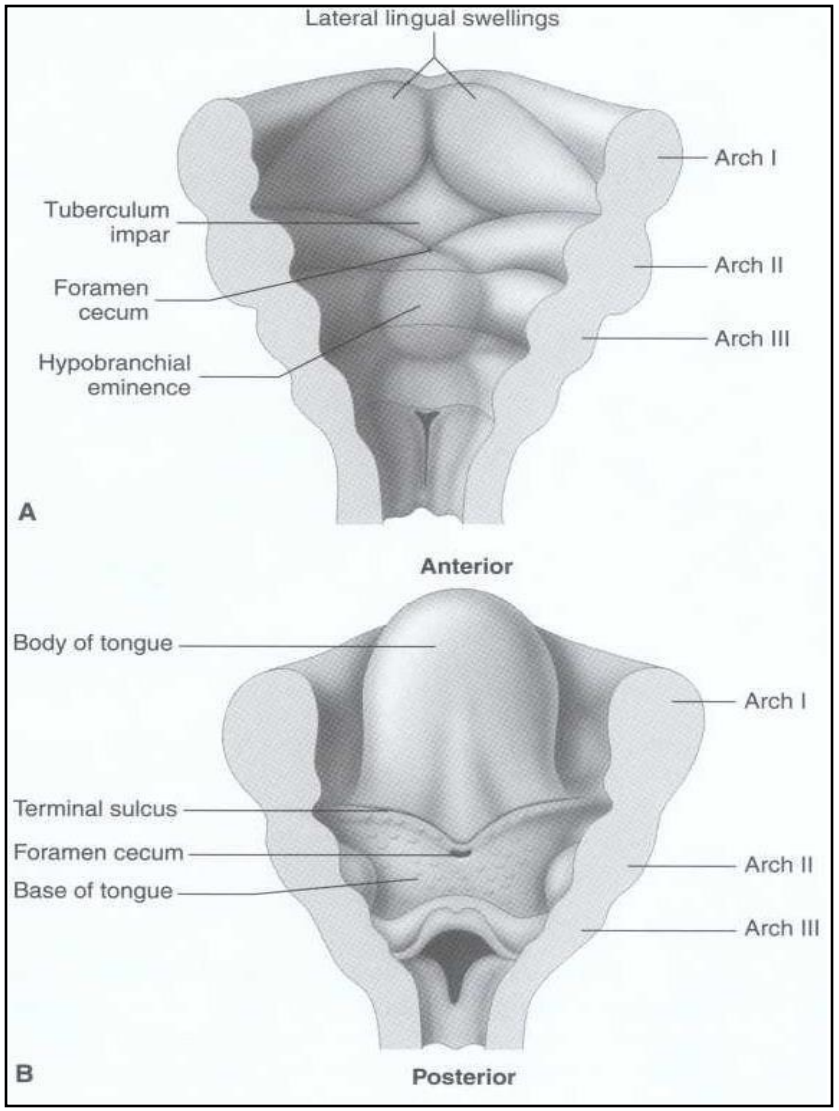
The tongue develops from several different sources. The body of the tongue or anterior two thirds develops from the first pharyngeal arch, Whereas the base of the tongue or posterior one third develops from the third arch.

The tongue begins its development near the end of the fourth week as a midline enlargement in the floor of the primitive pharynx cranial to the foramen cecum

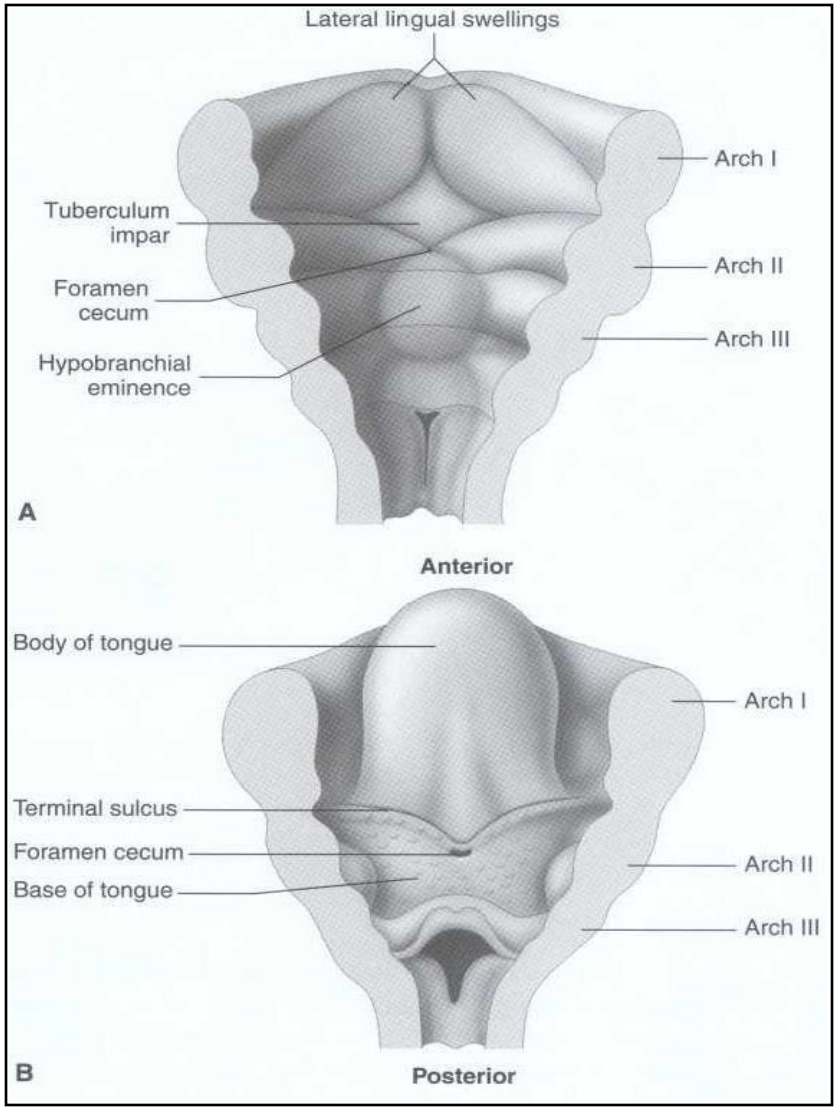




The enlargement is called the tuberculum impar. Two lateral lingual swellings form adjacent to the tuberculum impar. All three structures form as a result of proliferation of first arch mesenchyme. The lateral lingual swellings rapidly enlarge, fuse with one another, and overgrow the tuberculum impar. These three structures give rise to the body of the tongue.



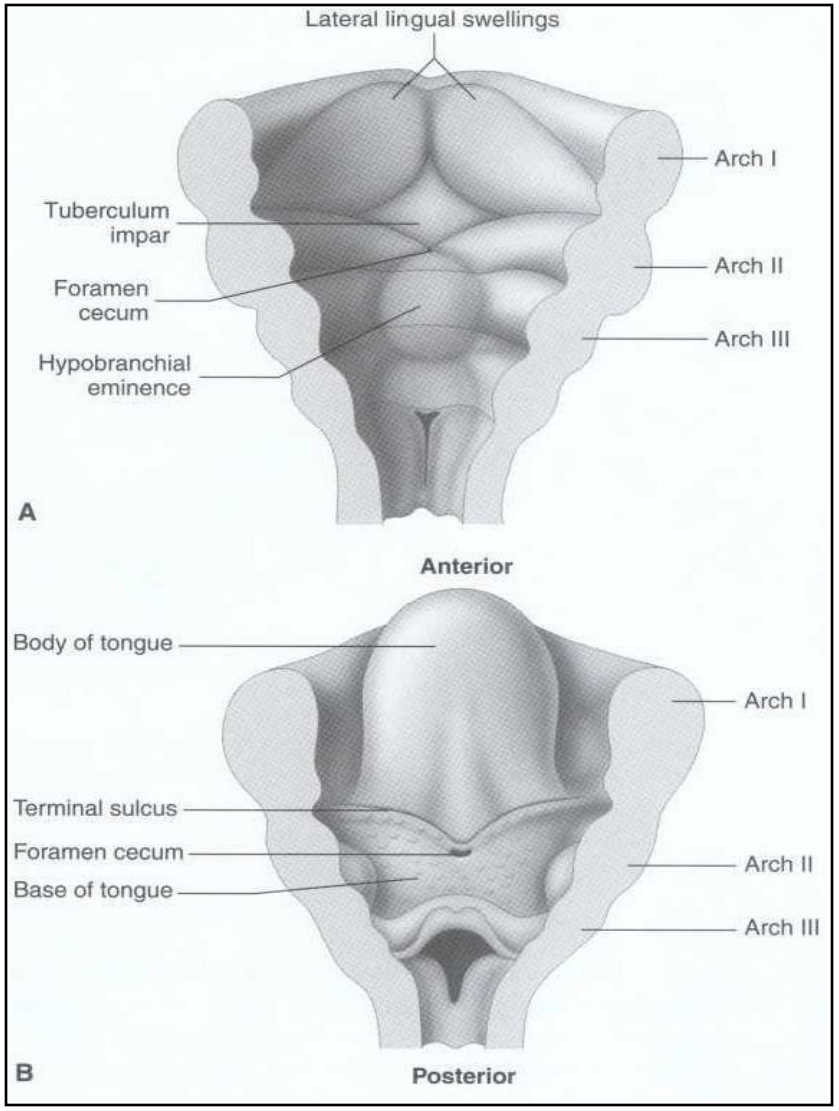
The posterior third, or base, of the tongue develops from the hypobrachial eminence, which is a midline swelling caudal to the foramen cecum. The hypobrachial eminence is composed primarily from third arch.



The *copula* is a midline enlargement derived from second arch.

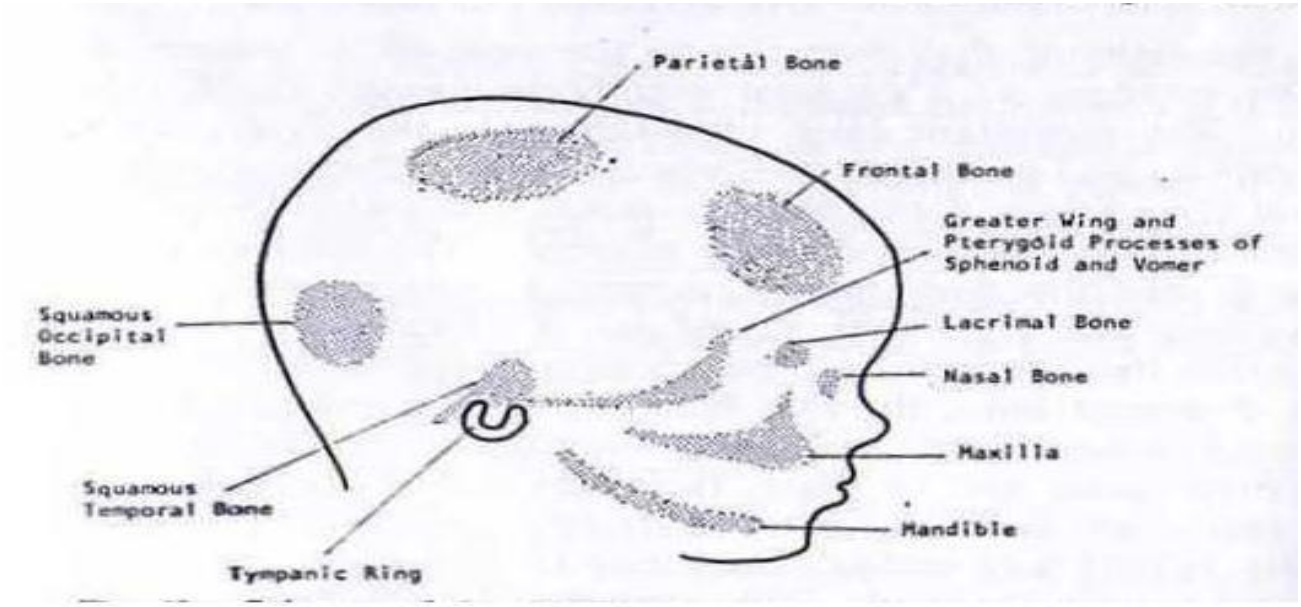
The hypobrachial eminence overgrows the copula and fuses with the tuberculum impar and lateral lingual swellings. The copula disappears without contributing to the formation of the tongue. Thus the base of the tongue is derived from the third pharyngeal arch.

The line of the demarcation between the body and the base is called *terminal sulcus*, and the foramen cecum is found in the midline of this structure.



**Development of the skull**

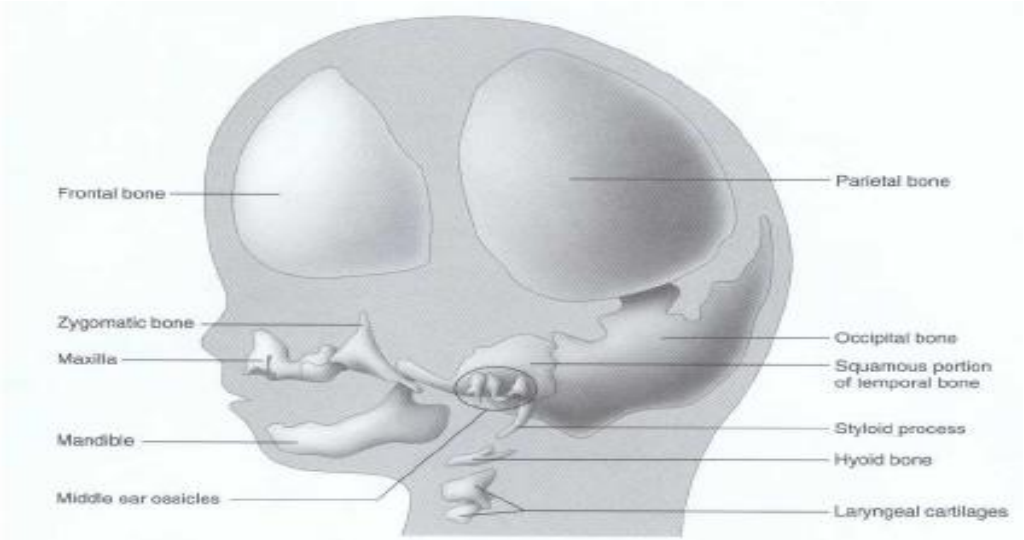
The skull forms from mesenchymal connective tissue around the developing brain. The development of the skull is considered in: 1st The development of the *neurocranium*, which is the calvaria and base of the skull and 2nd the development of the *viscerocranium* which includes the skeleton of the face and associated structures. Each component has some structures that form by endochondral ossification ( cartilaginous component ) and other structures that form by intramembranous ossification ( membranous component ).



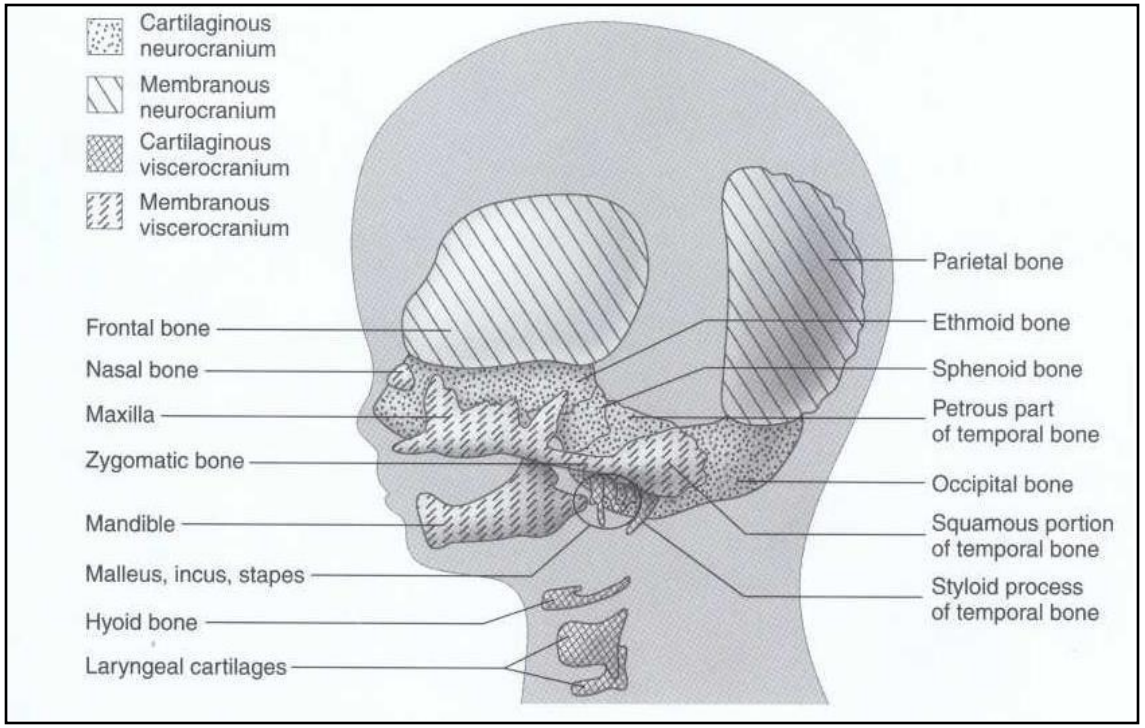
*Neurocranium* (calvaria and base of the skull)

*The cartilaginous neurocranium ( chondrocranium ) consist several cartilages that fuse and undergo endochondral ossification to give rise to the base of the skull. The cartilage junctions between two bones are called synchondroses. The occipital bone is formed first, followed by the body of the sphenoid bone and then the ethmoid bone. Also the vomer bone of the nasal septum and the petrous and mastoid parts of the temporal bone are formed by the cartilaginous neurocranium.

*The membranous neurocranium, give rise to the flat bones of the calvaria, including the superior portion of the frontal, parietal, and occipital bones.



*Viscerocranium* (the skeleton of the face and associated structures)
It arises from the pharyngeal arches. *The cartilaginous viscercranium includes the middle ear ossicles, the styloid process of the temporal bone, the hyoid bone, and the laryngeal cartilage.
*The membranoum viscerocranium includes the maxilla, zygomatic bones, the squamous temporal bones, and the mandible. These bones form by intramembranous ossification except for the mandibular condyle and the midline of the chin.



**The development of the mandibule**

In the mandibular brachial arch ( first brachial arch ) there is a cartilage called Meckels cartilage, which is during the 2nd month of intra- utrine life serve as a precursor of the mandibular mesenchyme, which forms around it and is responsible for mandibular growth activity. Bone begins to develop lateral to the Meckels cartilage during the 7th week and continues till the posterior aspect, which is covered with bone.

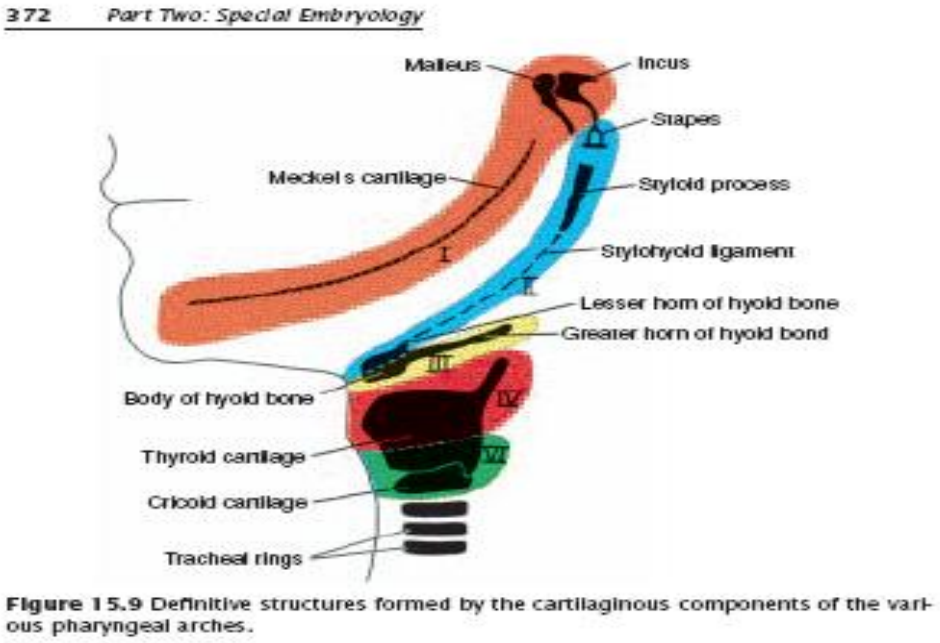
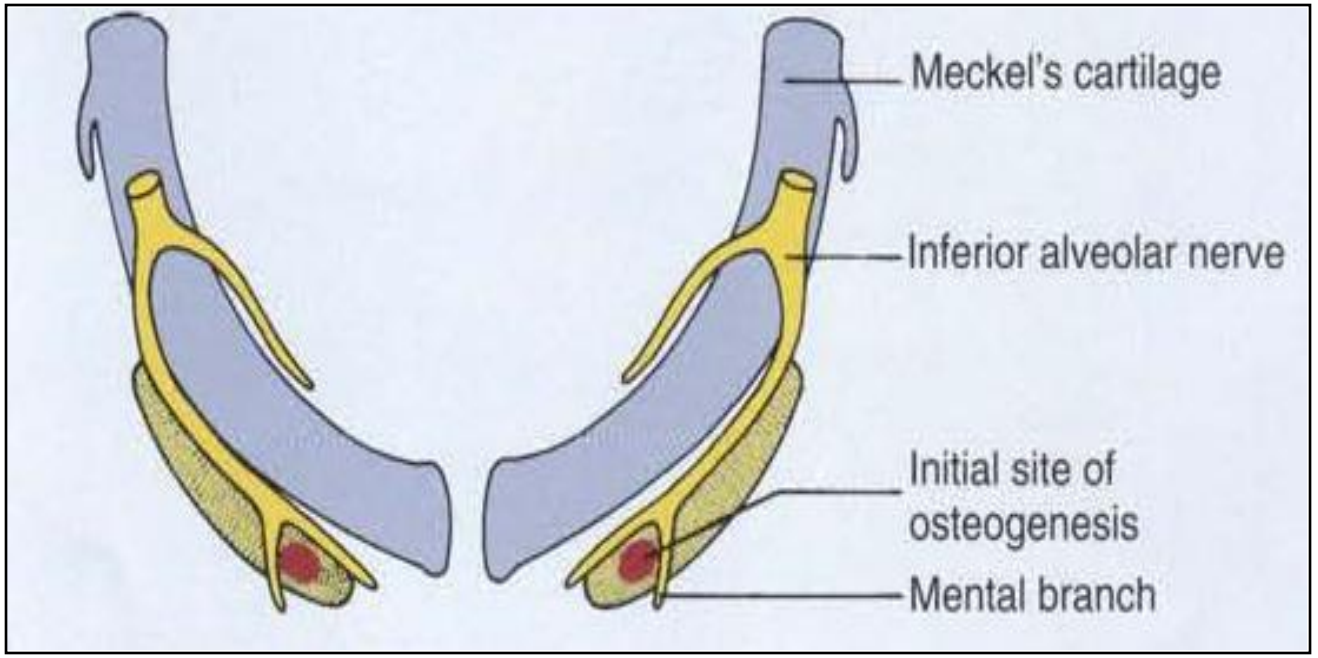



**Figure 15.9** Definitive structures formed by the cartilaginous components of the various pharyngeal arches.

The part of the Meckels cartilage that has been encapsulated, serving its purpose as a splint for the intramembranous ossification, then it will be largely deteriorates.

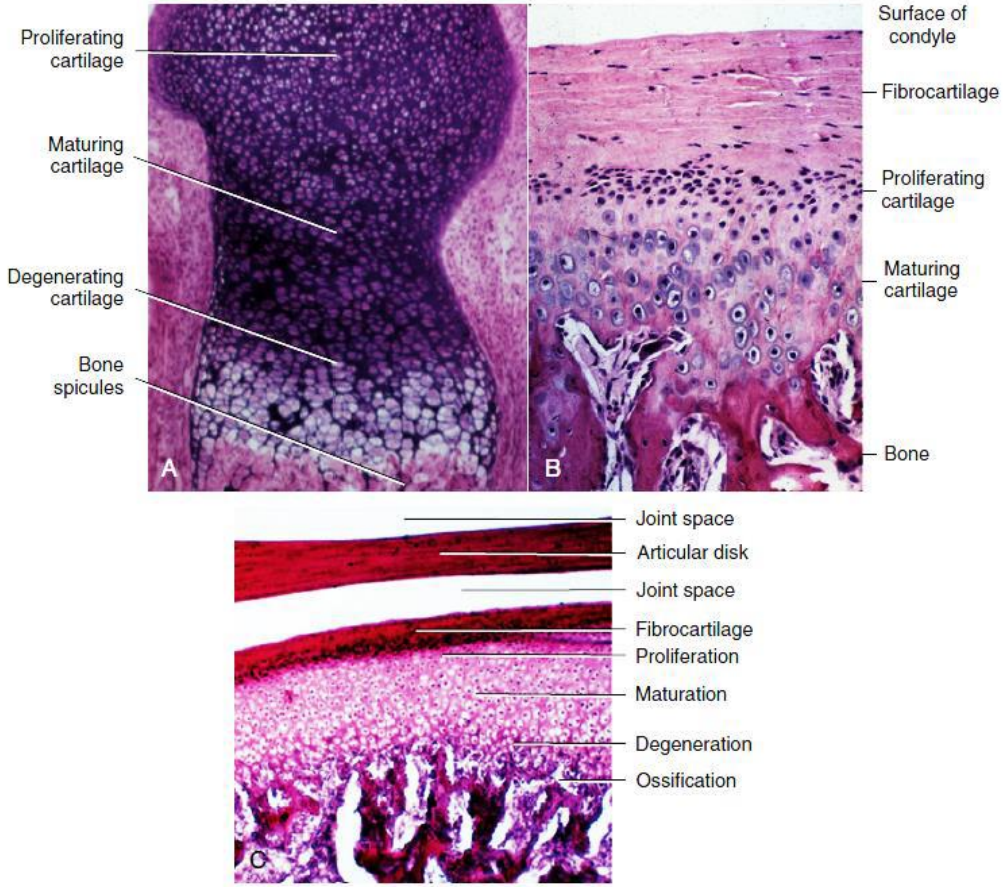
The activity of the condylar cartilage does not appear until the 4$^{th}$ or 5$^{th}$ month of postnatal life and continues until the age of 20 years so it has no role in the prenatal life.



# GROWTH

## *Mechanisms and areas of growth*

Bone unlike most other tissues, cannot grow simply by interstitial division of its living cells to give increasing size. There are three main mechanisms of bone growth, each of which plays its part in the growth of the skull and jaws:



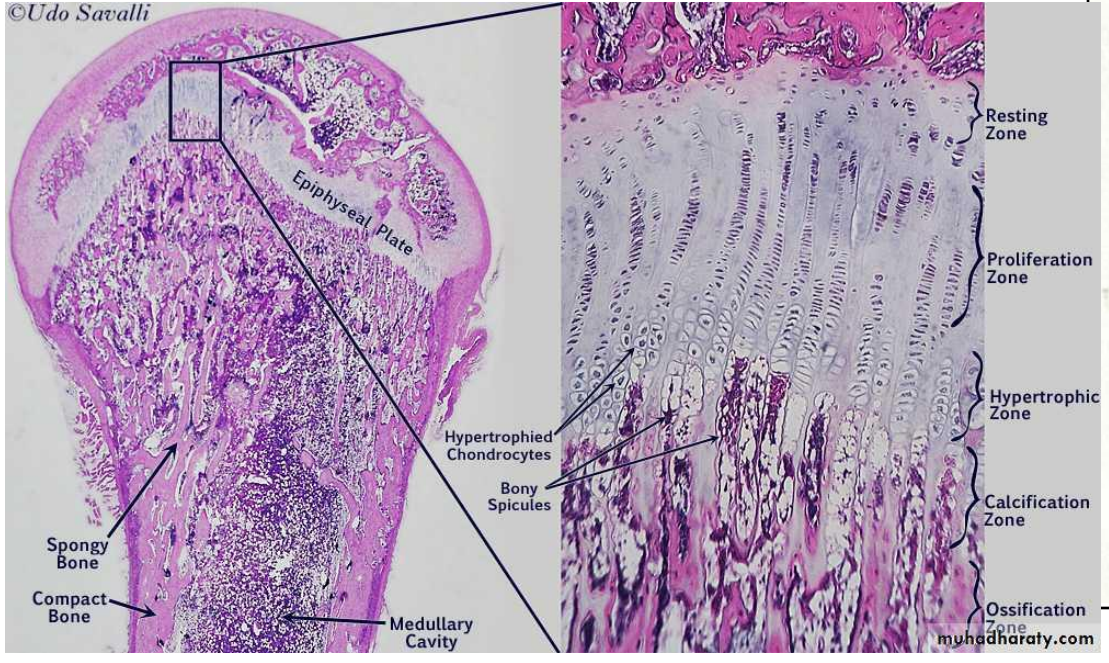
## cartilaginous growth: •

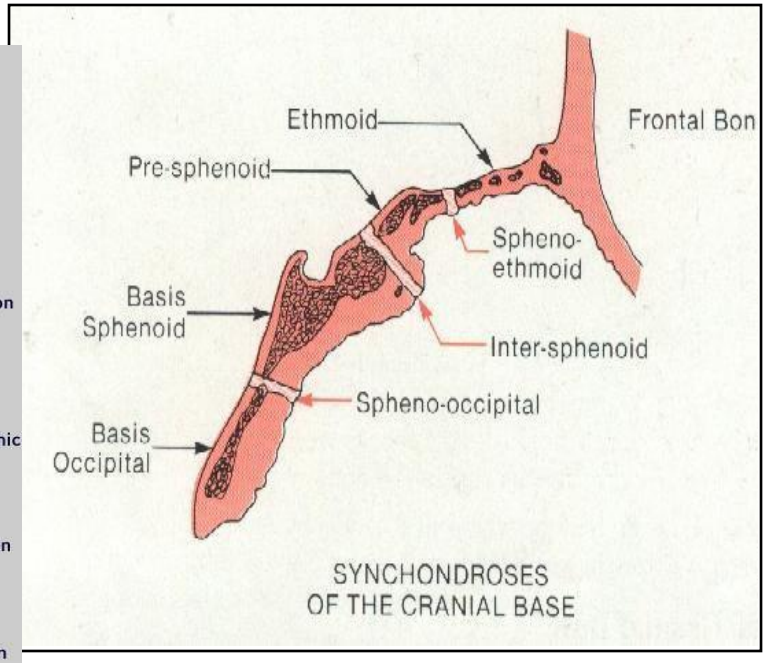
The growth of cartilage by cell division with progressive conversion to bone by ossification. This growth occurs mainly in:

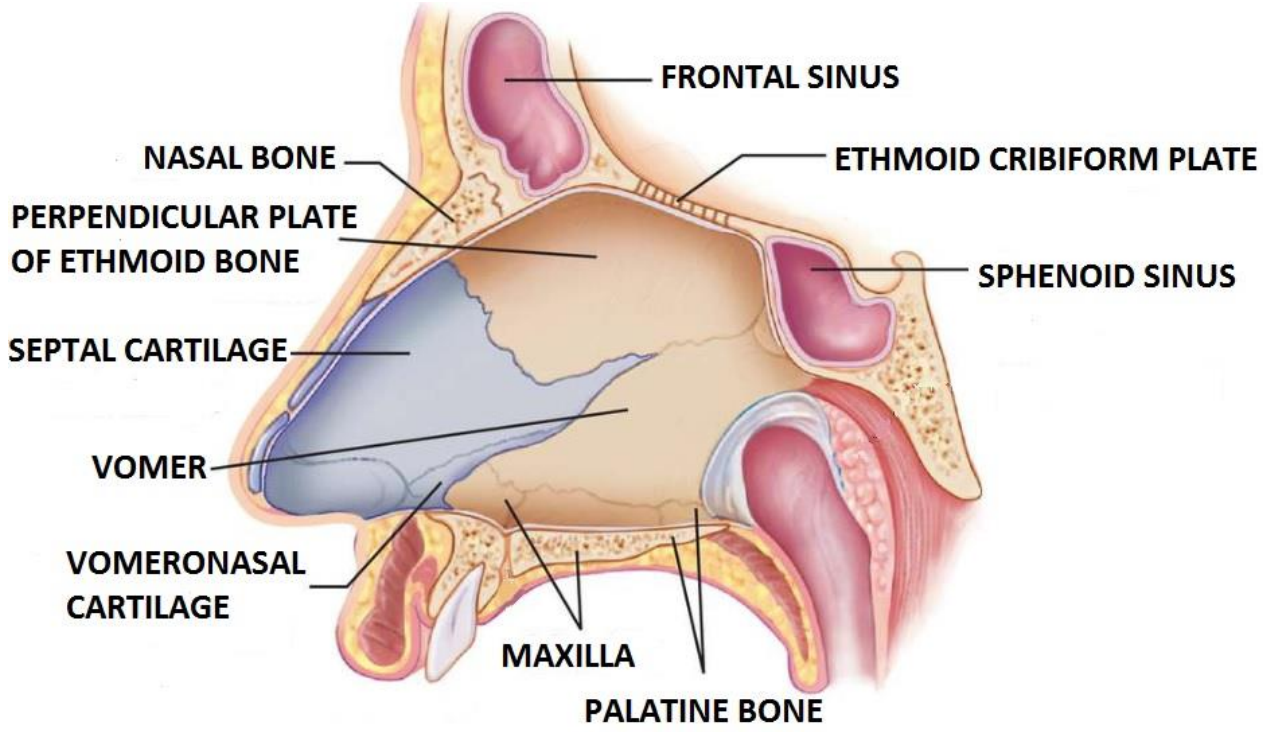
A- At the base of the skull (spheno-occipital synchondroses ) would increase the antero- posterior dimension of the skull base.

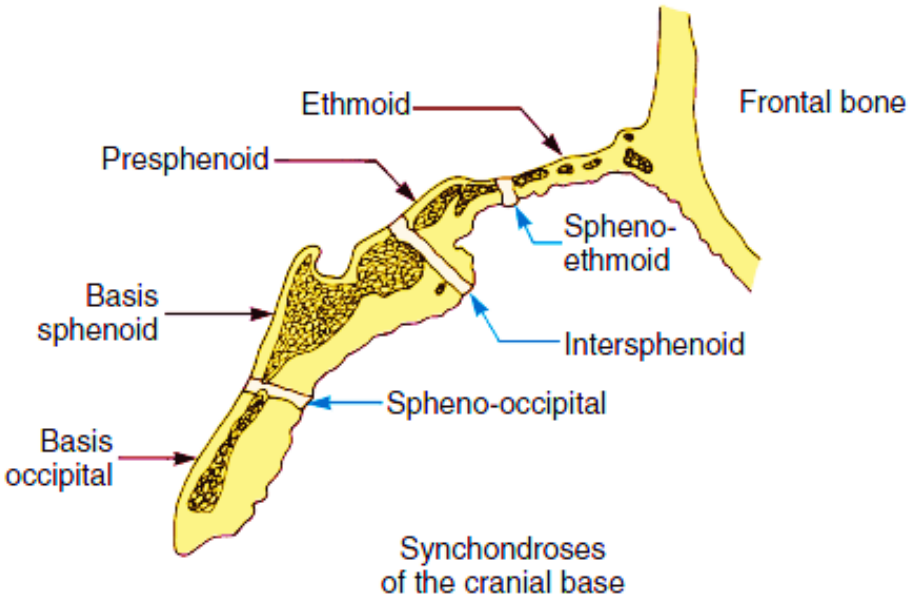
B- In the area of the nasal septum would bring the nose forward from its original position under the front of the cranium.

C- At the head of the mandibular condyle would increase the total length and height of the mandible.





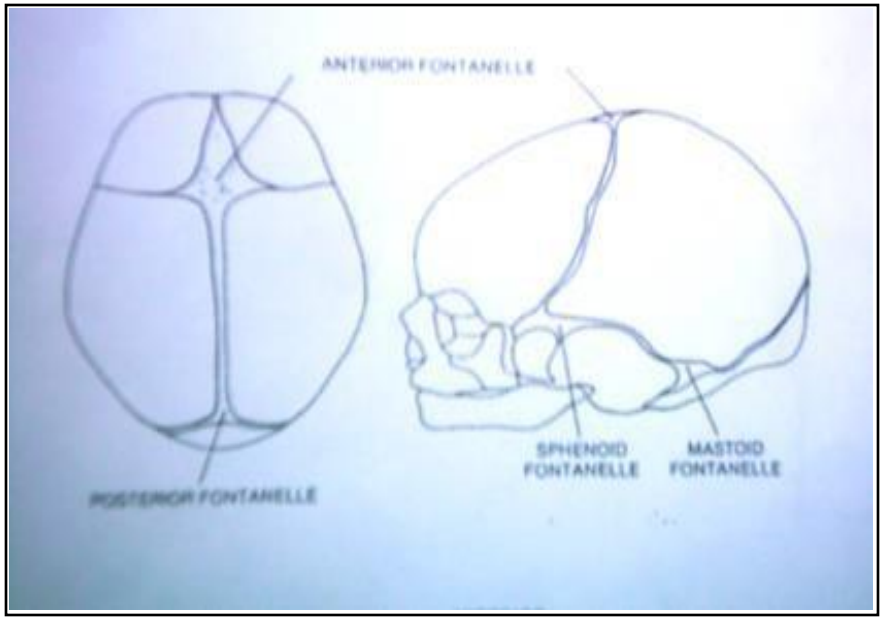



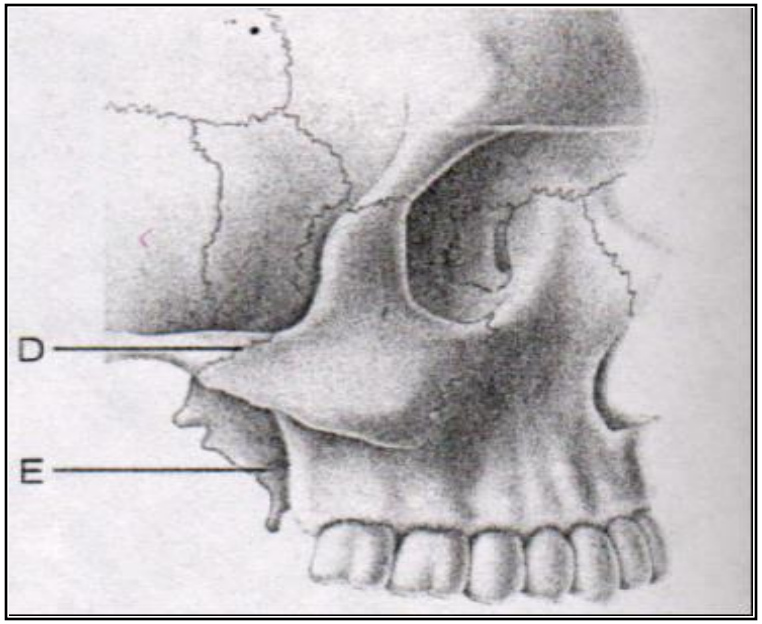

Synchondroses
of the cranial base

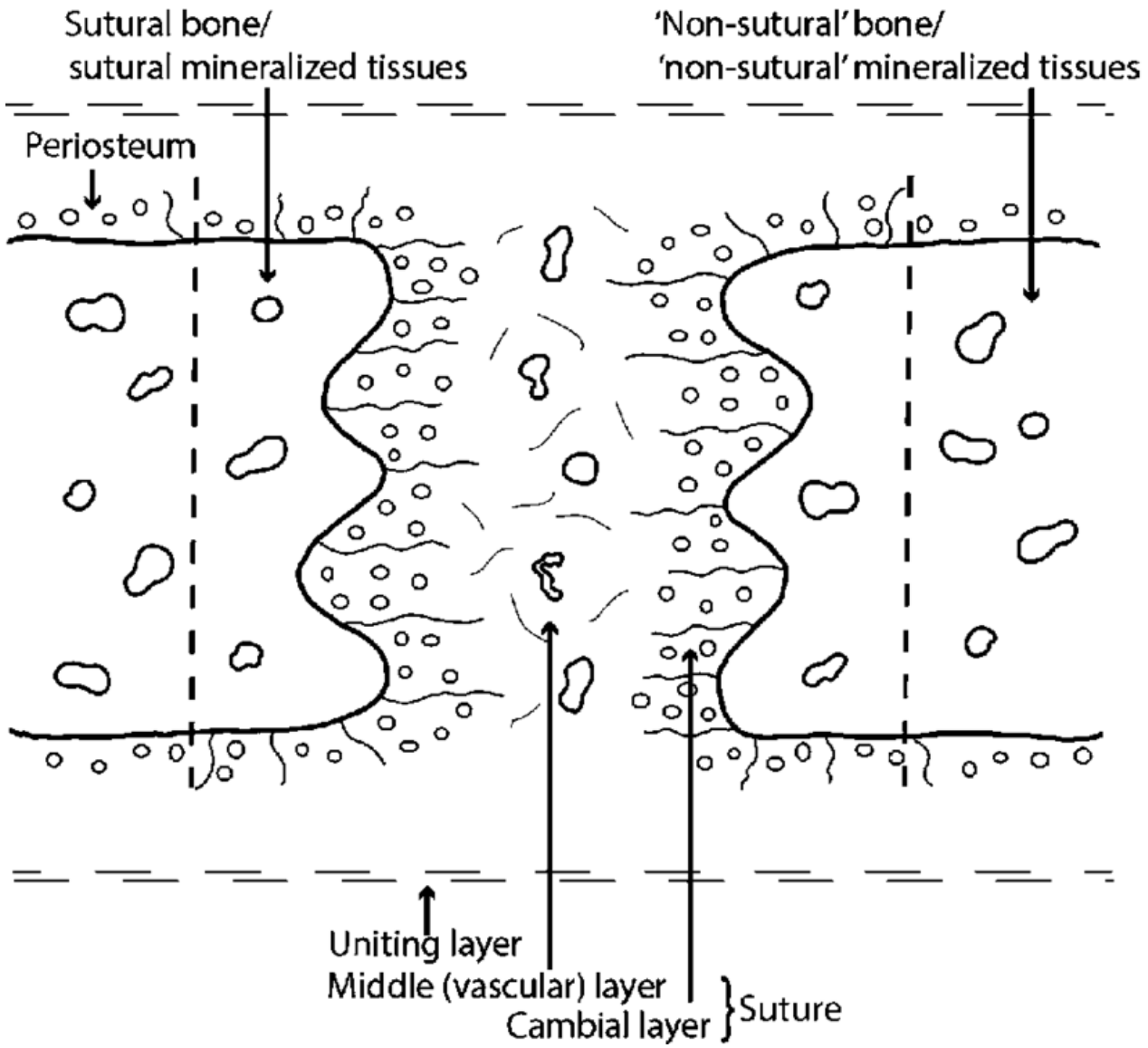
## sutural growth

The bony sutures of the head would be capable of increasing the size of the head in all dimensions. The sutures which separate the face from the cranium are aligned so that growth at these sutures would move the face in a forward and downward direction in relation to the cranium.

In the very early years when the bones of the skull are widely separated from each other, sutural growth is active in bringing the bones into close proximity. Some sutural growth take place at the same time with the enlargement of the bone, therefore sutural growth must be active at the same time of main enlargement of the cranium that is up to 6 or 7 years of age.

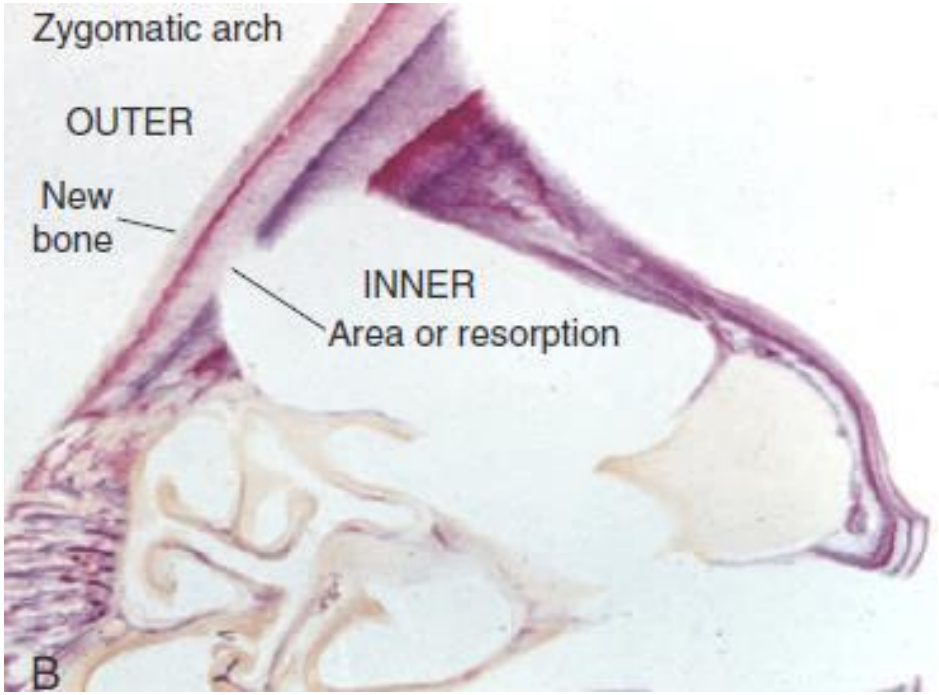


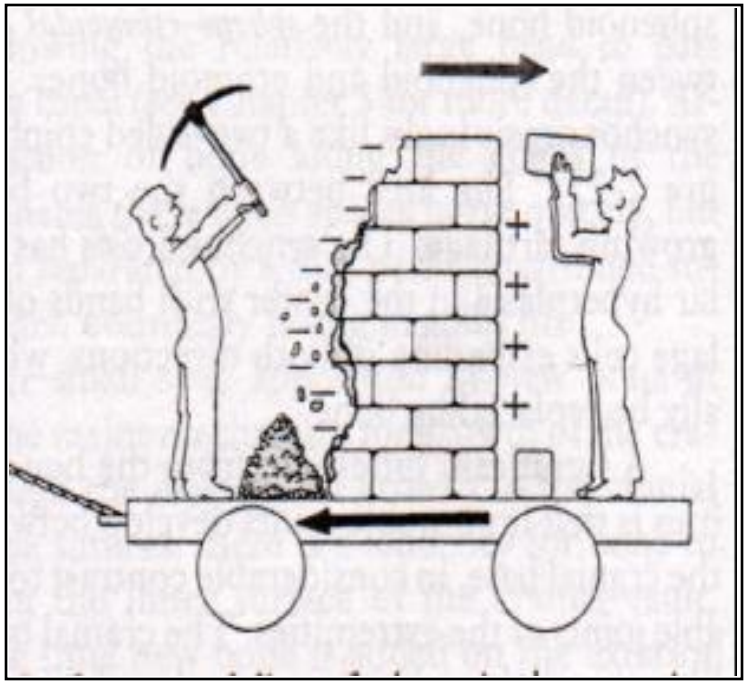

Sutural bone/
sutural mineralized tissues
'Non-sutural' bone/
'non-sutural' mineralized tissues
Periosteum
Uniting layer
Middle (vascular) layer
Cambial layer
Suture

- **periosteal and endosteal growth**
- The apposition of bone on the periosteal surfaces would obviously enlarge the head in all dimensions, but this will increase the thickness of bone therefore concomitant resorption of bone is necessary in order to obtain the appropriate thickness and strength.

However, periosteal growth is not simply a matter of addition of bone to the outer surface and resorption of bone from the inner surface. Extensive remodeling of bones takes place, which involve resorption of bone from the outer surface and apposition of bone on the inner surface.



Endosteal resorption and addition of bone from within the cancellous spaces is also necessary to maintain the appropriate thickness of the cortical layer of bone.
It is generally thought that this method of growth is the most active type of growth in the skull and jaws after the first few years of life, when cartilaginous and sutural growth slows.



***Moss theory (Functional matrix growth):***

This theory depend on the concept that each part of the skull will grow by the simulation of tissue matrix that mean the bones will grow to accommodate a growing vital organ, as:

the vault of the cranium will grow by the stimulation of growing brain to accommodate its increase in size.

the orbital cavity, this will grow by stimulation of growing orbit.

the growth of the mandible can also be stimulated by the growth of tongue.

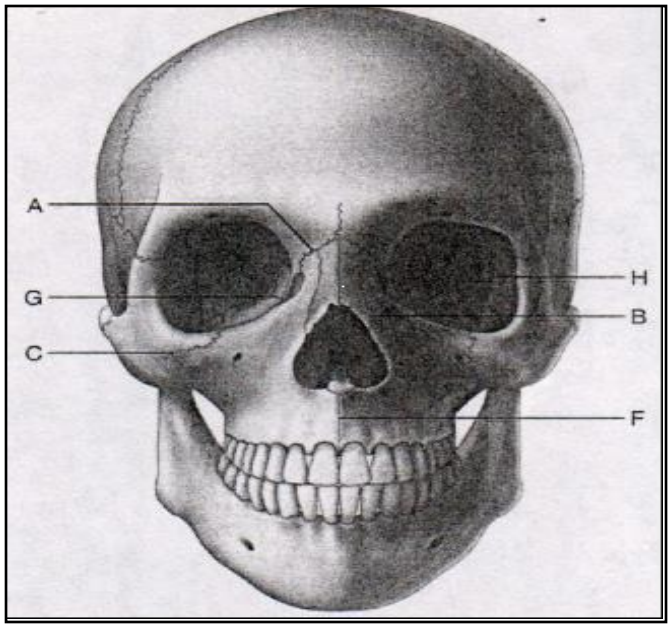
alveolar bone growth can also be stimulated by development and eruption of teeth.

## *Naso-maxillary growth*

### The maxilla:

The maxilla develops postnatally entirely by intra-membranous ossification. Since there is no cartilage replacement, growth occurs into two ways: *sutural growth* and *surface remodeling* which can be described as:

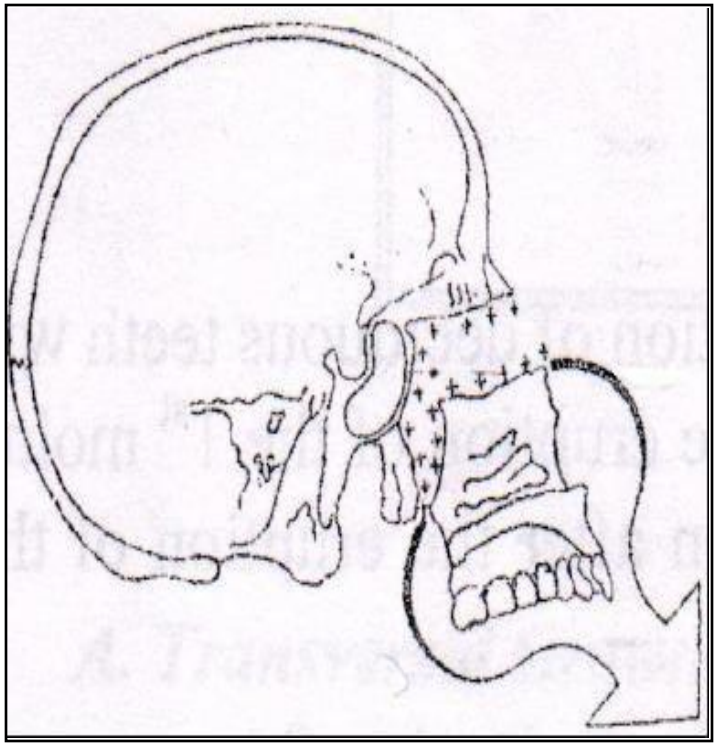
**A- Trasversal growth:** by appostion of bone at the sagittal sutures such as inter nasal suture, intermaxillary suture, interpalatine suture, their activity decrease at the end of the first year but they continue forming osteal tissue for a long period. Also appostion of bone at the external aspect of the maxilla on both sides at the premolar regions by surface remodeling.

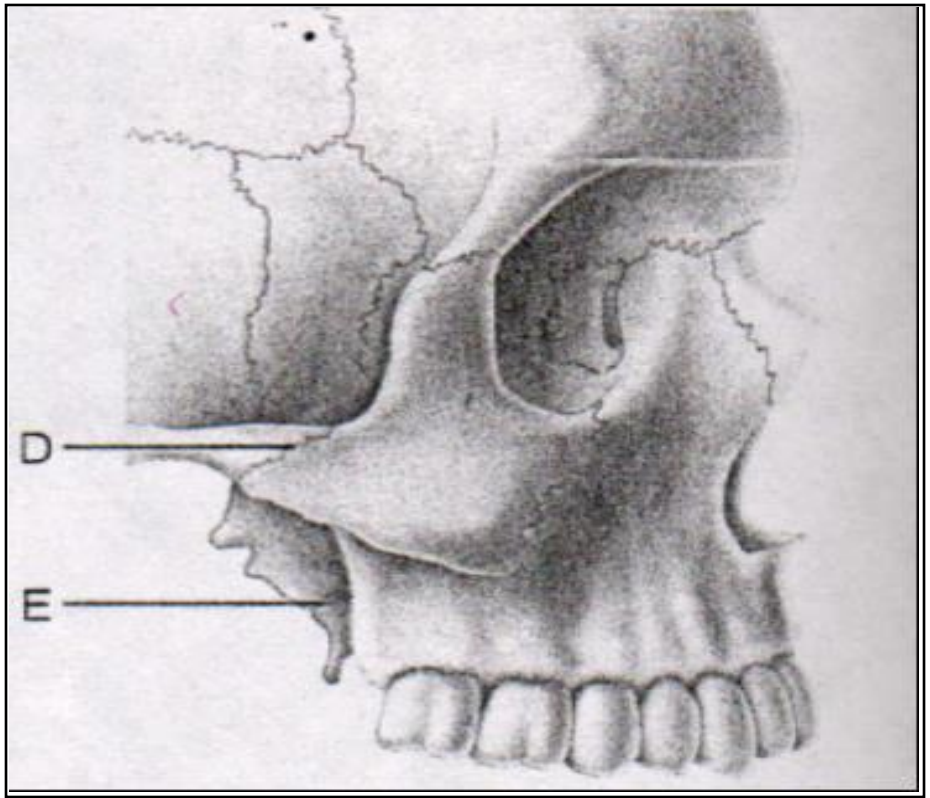


## B- Vertical and antero-posterior growth:

this is accomplished in two ways:

•Appostion of bone at the sutures that connect the maxilla to the cranium and cranial base such as tempro-zygomatic suture, maxillo-zygomatic suture, pterygo-palatine suture and fronto-maxillary suture, these are parallel to each other and they orient the direction of the facial growth downward and forward



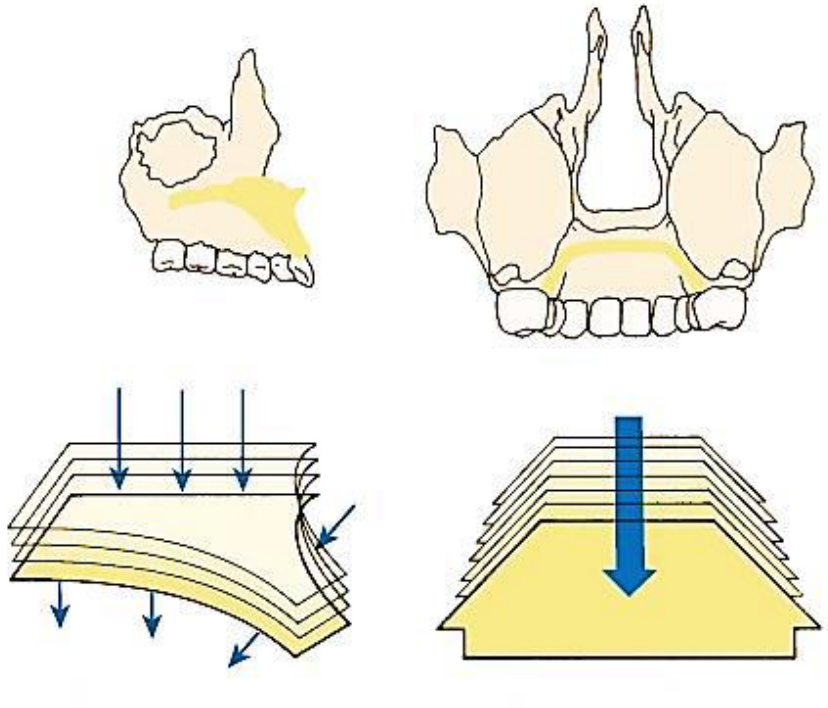


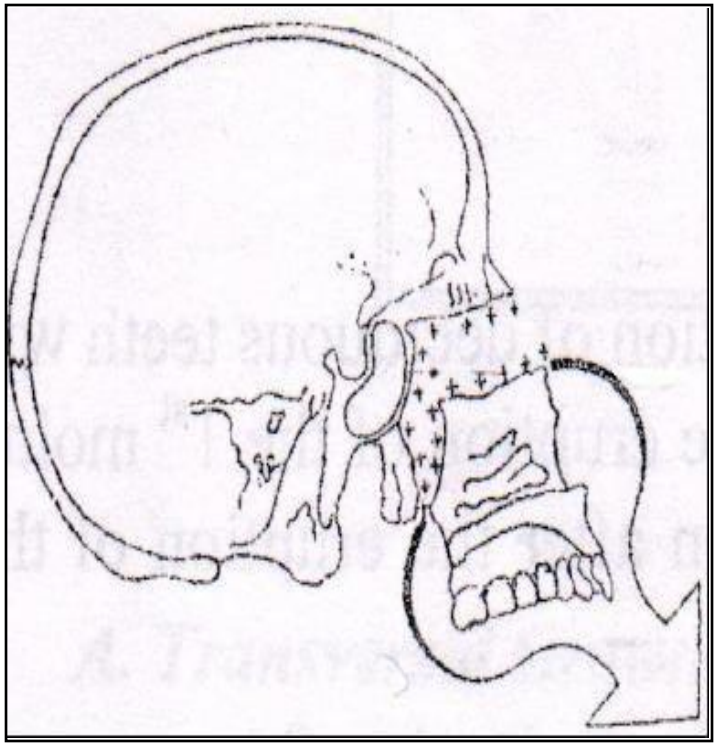
Surface remodeling which occurs by:•

*<u>*vertical growth*</u> include:

# alveolar process: the formation of alveolar process start about the 4th month of intrauterine life their growth is by apposition of bone on three aspects( inferior, internal, external ) in posterior region and on two aspect( internal, inferior ) in the anterior region.

# palate: there will be resorption on the superior aspect ( nasal ) and apposition on the inferior aspect ( oral ) which will bring the palate downward



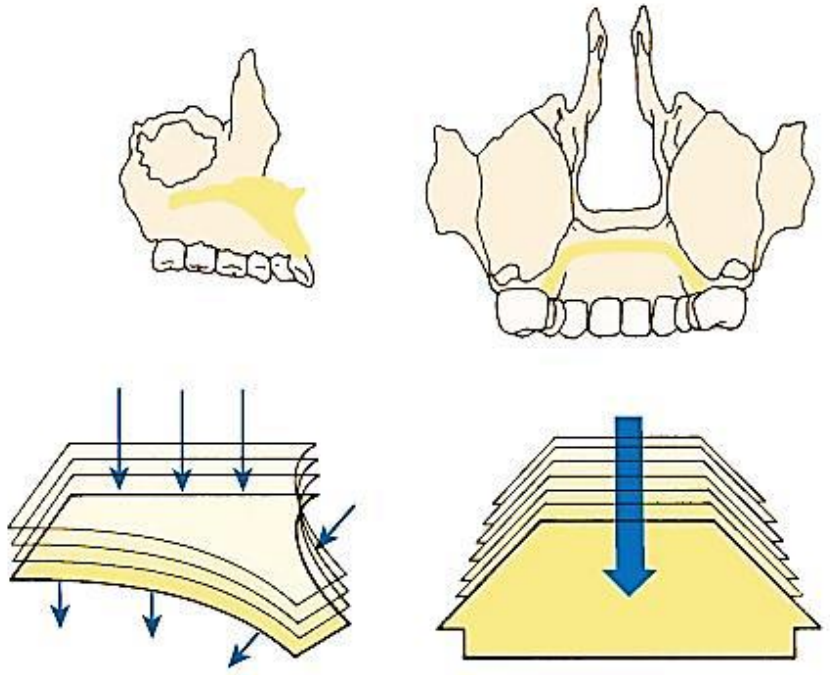


*antero-posterior growth* occurs by:

1- anterior alveolar growth, resorption in the vestibular part and appostion on the inferior and palatal part.

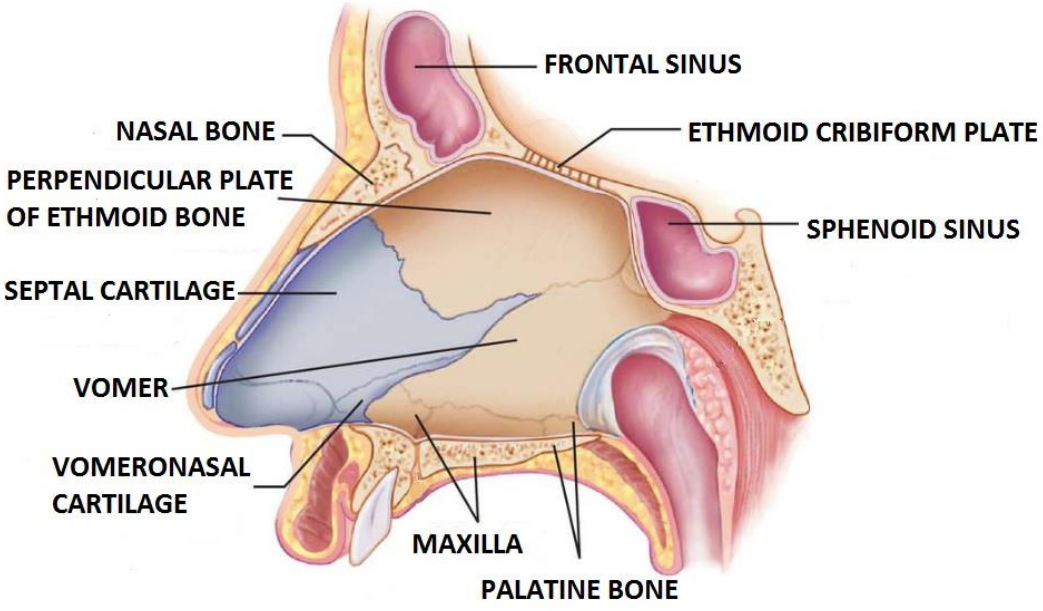
2- an apposition on the posterior aspect of the horizontal part of the palate.

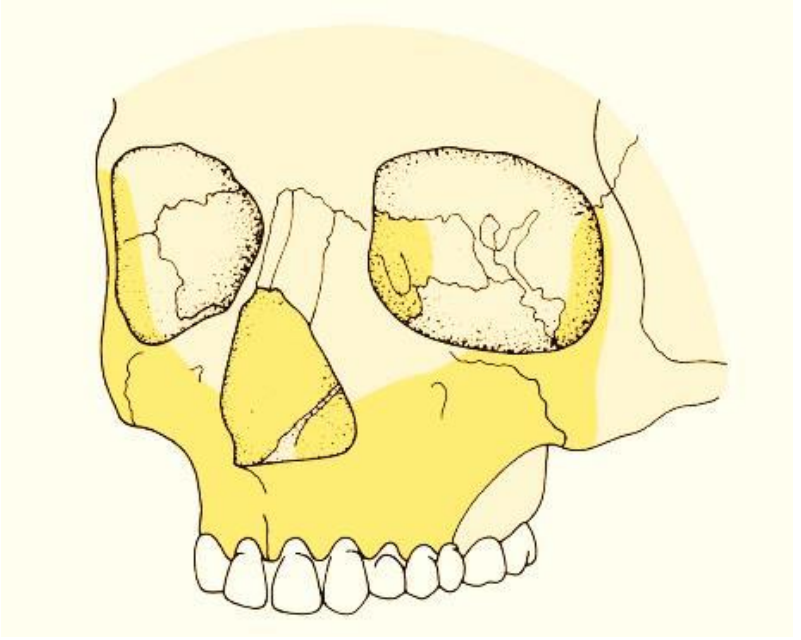
3- development of the tuberosity.



# Nasal region

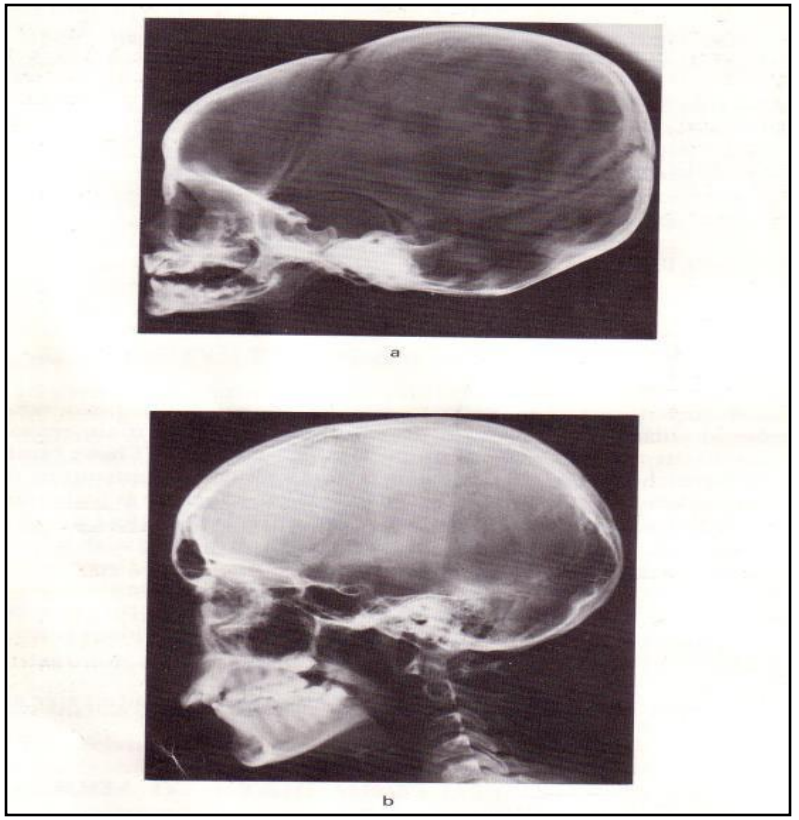
The superior part of the nose wedged between the orbits and the nasal cavity develops particularly on their inferior part from the 10 years of age and continue to develop in the vertical and transversal direction which is in relation with the descending palate.



## Maxillary sinus

As the sinus has the volume of small peas, the eruption of deciduous teeth will modify its volume and it increases in size with the eruption of the 1st molar, about 8 years it has a pyramidal form that will lengthen after the eruption of the canine and the last molar.



# Development of occlusion

The development of dentition is an important part of craniofacial growth as the formation, eruption, exfoliation and exchange of teeth take place during this period.

According to Angle occlusion is “ The normal relation of the occlusal inclined planes of the teeth when the jaws are closed"

According to Ash and Ramfjord occlusion is the " The contact relationship of the teeth in function and parafunction"

Periods of Occlusal development can be divided into the following development periods:

Neo-natal period (at birth).

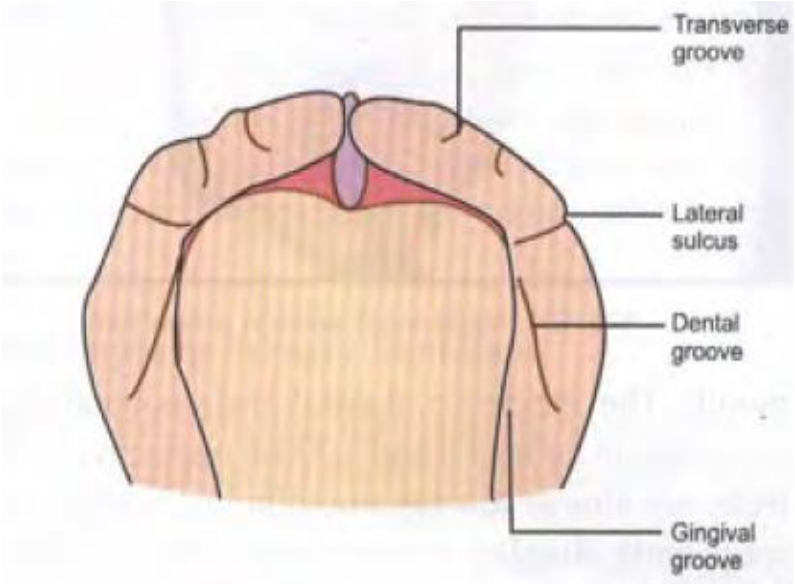
Primary dentition period.

Mixed dentition period.

Permanent dentition period

**Neonatal period**

Alveolar processes at the time of birth known as gum pads. Which is Pink in color, firm and are covered by a dense layer of fibrous periosteum , the pads get divided into ‘labio- buccal’ & ‘lingual portion’, by a dental groove , and gum pad soon gets segmented into 10 segment by a groove called transverse groove, & each segment is a developing tooth site . The groove between the canine and the 1st molar region is called the lateral sulcus which helps to judge the inter-arch relationship.

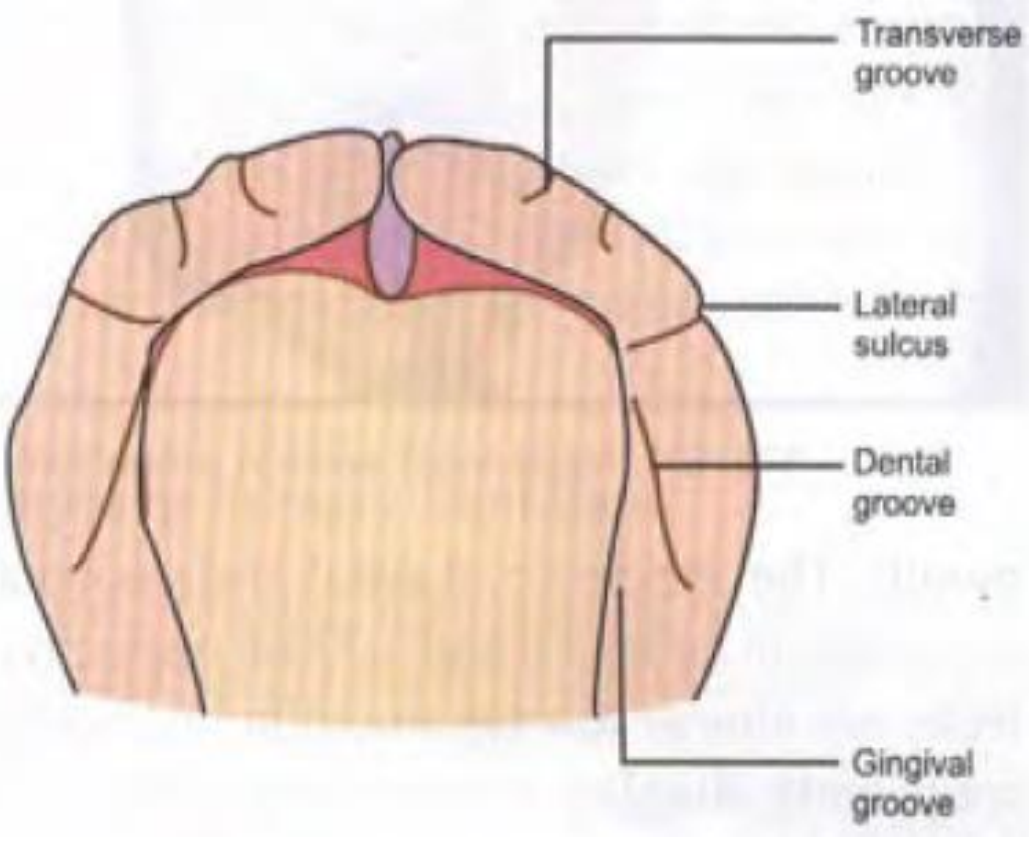


**The upper gum pad** is horse shoe shaped, **shows**

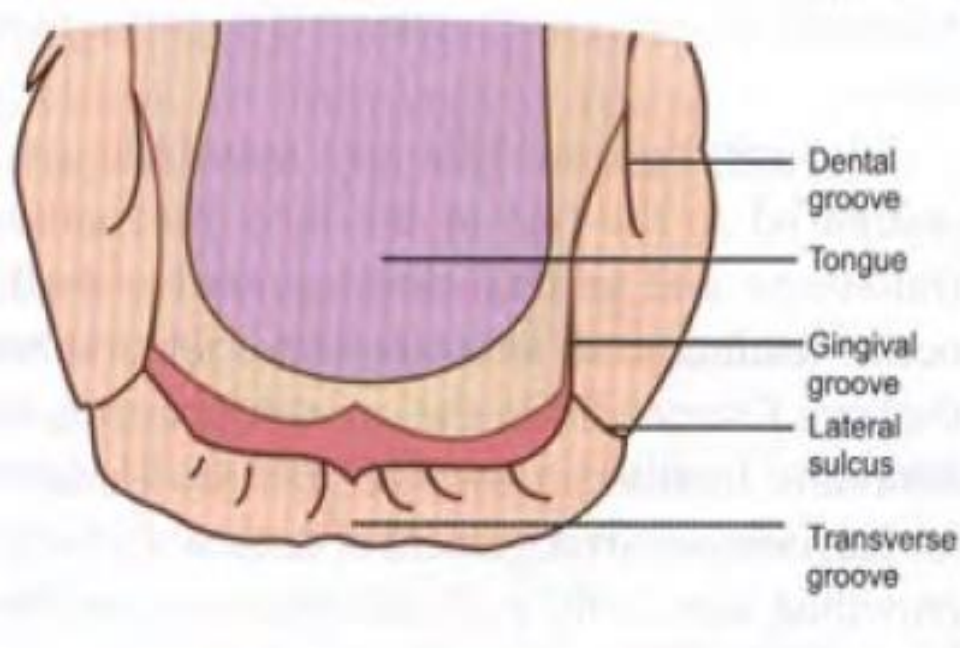
-Gingival groove separates gum pad from the palate

- Dental groove starts at the incisive papilla, extends backward to touch the gingival groove in the canine region & then moves laterally to end in the molar region

-Lateral sulcus.



**The lower gum pad** U shaped , characterized by
-Gingival groove lingual extension of the gum pads
-dental groove
- Lateral sulcus.



## Relationship of Gum Pads

- Anterior open bite is seen at rest with contact only at the molar region.
- Upper gum pad being more wider and longer than lower gum pads thus when approximated a complete over jet present all around.
- Class II pattern with the maxillary gum pad being more prominent.
- Mandible is distal to the maxilla and usually the upper jaw overlap the lower jaw in anterior posterior and transverse direction.
- Mandibular lateral sulci posterior to maxillary lateral sulci

The anterior opening of the mouth will facilitate the feeding process without discomfort to the mother,
at this stage the labial frenum is usually attached to the incisive papillary region and after the eruption of the deciduous teeth it will migrate in upward direction and gives the insicive papillary attachment is due to alveolaor bone formation in association with the development of deciduous teeth ,
the upper lip at this stage is usually short , and the anterior oral seal of the mouth occur due to the contact between lip and the tongue

**Neonatal Jaw Relationships**

Mandibular functional movements are mainly vertical and to a little extent anteroposterior. Lateral movements are absent , precise bite or jaw relationship is not yet seen , therefore neonatal jaw relationship can not be used as a diagnostic criterion for reliable prediction of subsequent occlusion in primary dentition.

The newly born child mouth is usually without teeth , sometimes Natal teeth that are present above the gumline (have already erupted) at birth. Neonatal teeth or Early Infansive teeth that erupt during the 1st month of life these teeth look like the deciduous teeth.

Pre-erupted teeth erupt during the second or third month.

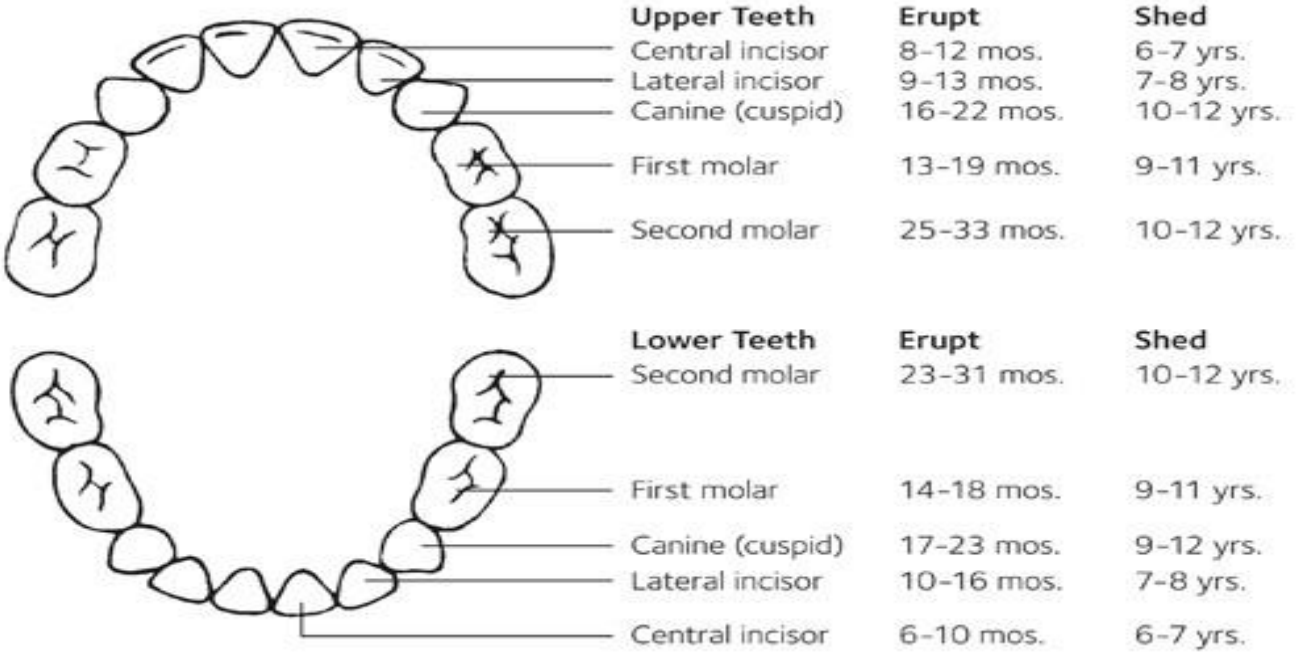
they are contained enamel , dentine and pulpal tissue and usually without roots or there is a very short root with them.

No intervention is usually recommended unless they are causing difficulty to the infant or mother . The incidence of natal and neonatal teeth is estimated to be l:1000and 1:30000respectively. These teeth are almost always mandibular incisors, which frequently display enamel hypoplasia. There are familial tendencies for such teeth. They should not be removed if normal but removed if supernumerary or mobile

At birth, both maxilla and mandible are small compared to the rest of the face. Extensive early transverse and ventral development of both jaws occurs leading to an anteroposterior relation between the jaws . overjet diminishes markedly during the 1st 6 month.
increase in jaw size provides enough space For harmonious arrangement of deciduous teeth. Thus crowding seen in the pads disappears when the teeth erupt.
Eruption of deciduous teeth commences at about 6 months of age.
Occlusion starts developing posteriorly when deciduous first molars attain contact.
By the time the first molars have settled, occlusion in the posterior region is established.

# Deciduous Dentition

Deciduous teeth or primary teeth, are the first set of teeth in the growth development of humans . They develop during the embryonic stage of development starts at the sixth week of tooth development as the dental lamina, there are ten buds on the upper and lower arches that will eventually become the primary (deciduous) dentition. These teeth will continue to form until they erupt and become visible in the mouth during infancy, there are a total of twenty teeth that is made up of central incisors, lateral incisors , canines, first molars , and secondary molars; there is one in each quadrant, making a total of four of each tooth: five per quadrant and ten per arch.

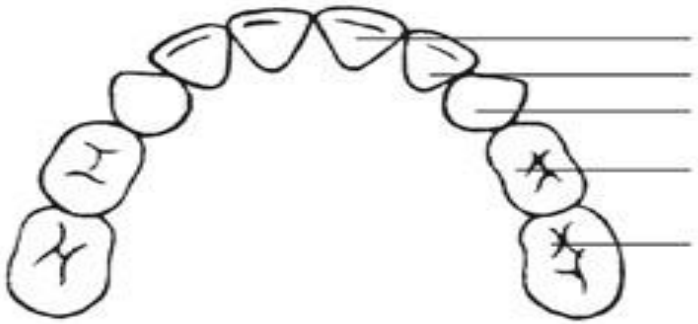


| Upper Teeth | Erupt | Shed |
|---|---|---|
| Central incisor | 8–12 mos. | 6–7 yrs. |
| Lateral incisor | 9–13 mos. | 7–8 yrs. |
| Canine (cuspid) | 16–22 mos. | 10–12 yrs. |
| First molar | 13–19 mos. | 9–11 yrs. |
| Second molar | 25–33 mos. | 10–12 yrs. |

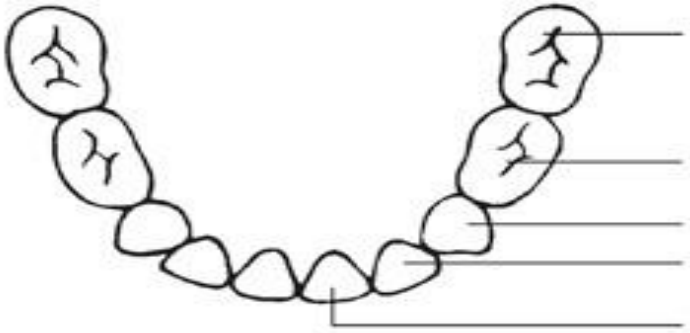
| Lower Teeth | Erupt | Shed |
|---|---|---|
| Second molar | 23–31 mos. | 10–12 yrs. |
| First molar | 14–18 mos. | 9–11 yrs. |
| Canine (cuspid) | 17–23 mos. | 9–12 yrs. |
| Lateral incisor | 10–16 mos. | 7–8 yrs. |
| Central incisor | 6–10 mos. | 6–7 yrs. |

The eruption of these teeth ( teething ) starts from the eruption of the first deciduous tooth, usually the deciduous mandibular central incisors and ends with the eruption of the first permanent molar, i.e. from 6 months to 6 years of postnatal life. By 2½ years of age, deciduous dentition is usually complete and in full function. Root formation of all deciduous teeth is complete by 3 years of age.

# The sequence of eruption and sheddind of deciduous teeth



| Upper Teeth | Erupt | Shed |
|---|---|---|
| Central incisor | 8–12 mos. | 6–7 yrs. |
| Lateral incisor | 9–13 mos. | 7–8 yrs. |
| Canine (cuspid) | 16–22 mos. | 10–12 yrs. |
| First molar | 13–19 mos. | 9–11 yrs. |
| Second molar | 25–33 mos. | 10–12 yrs. |



| Lower Teeth | Erupt | Shed |
|---|---|---|
| Second molar | 23–31 mos. | 10–12 yrs. |
| First molar | 14–18 mos. | 9–11 yrs. |
| Canine (cuspid) | 17–23 mos. | 9–12 yrs. |
| Lateral incisor | 10–16 mos. | 7–8 yrs. |
| Central incisor | 6–10 mos. | 6–7 yrs. |

**Normal Signs of Primary Dentition**

1. Ovoid arch form
2. Straight or vertical inclination of the incisors

Deep bite are present this could be duo to vertical inclination of primary incisors over a period of time these deep bite reduced duo to eruption of primary molars ,rapid attrition of incisors and forward movement of the mandible due to growth , and which change to edge to edge relationship

•Minimal overjet and absence of crowding.

Fig. 1 Unspaced primary dentition.

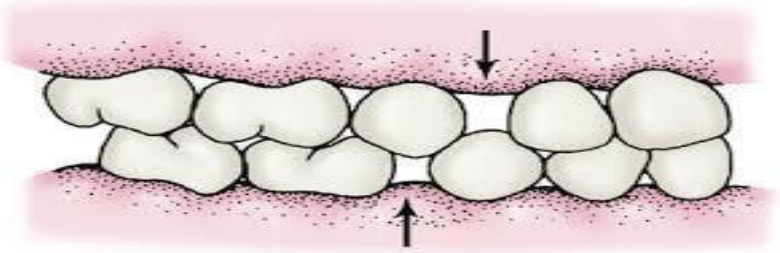
**Two types of primary dentitions seen**

A- **Closed primary dentition**: absence of spaces is an indication that crowding of teeth may occur when the larger permanent teeth erupt.

B- **Spaced or opened primary dentition**: in which interdental spaces are present called spaced dentition there are 2 types of spacing.

**1-Physiologic or generalized spaces** :usually seen in the deciduous dentition to accommodate the larger permanent teeth in the jaws, More prominent in the anterior region.

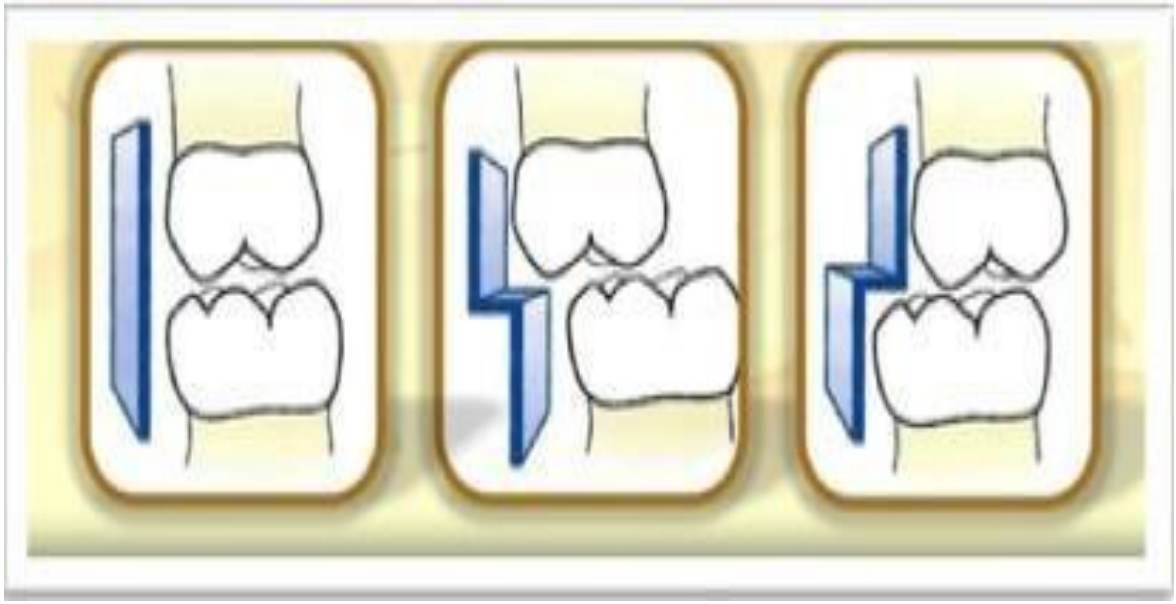
2- **Primate spaces** **or anthropoid spaces**gnirrucco yllarutan : spacing between the teeth of the primary dentition. In the maxillary arch, it is located between the lateral incisors and canines, where as in the mandibular arch the space is between the canines and first molars, This space is used for early mesial shift.

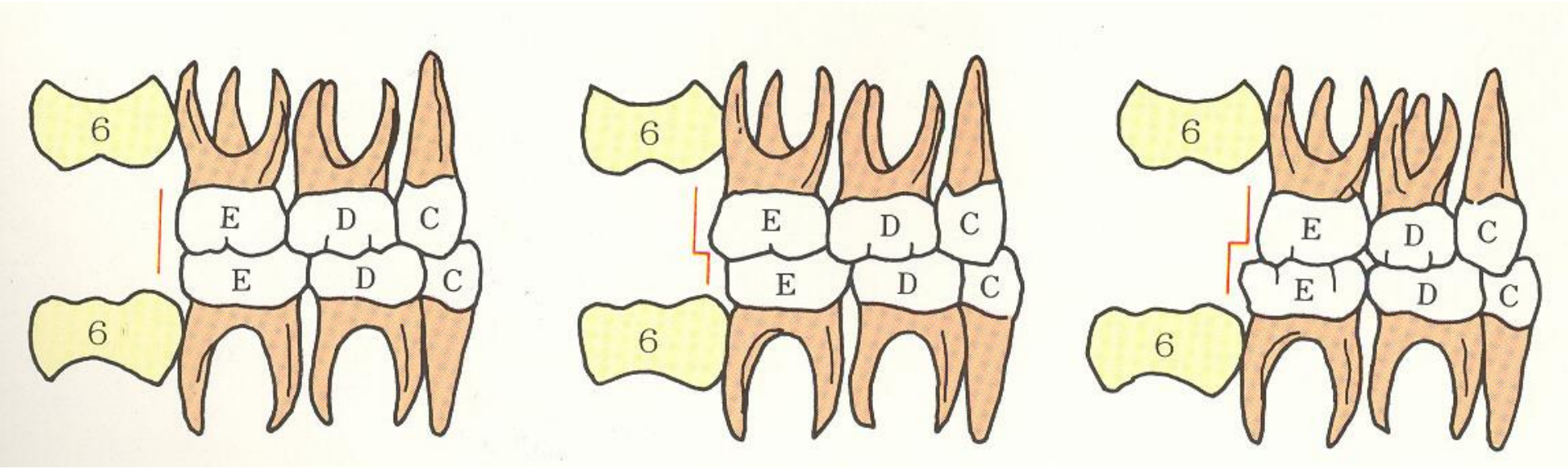


molar relation in primary dentition described in terms of terminal plans, terminal planes are the distal surfaces of the 2nd primary molars, these two planes can be related in **3** ways:

- **Flush terminal plane**:both maxillary and mandibular planes are at the same level anteroposteriorly, normal molar relationship in the primary dentition, because the mesiodistal width of the mandibular molar is greater than the mesiodistal width of the maxillary molar.
- **Mesial teminal plane**:maxillary terminal plane is relatively more posterior than the mandibular terminal plane forming a mesial step.

**Distal terminal plane**: the maxillary terminal plane is relatively more anterior to the mandibular.

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All of primary teeth are gradually replaced with a permanent, but in the absence of permanent replacements, they can remain functional for many years. The replacement of primary teeth begins around age six, when the permanent teeth start to appear in the mouth, resulting in mixed dentition. The erupting permanent teeth cause root resorption, where the permanent teeth push on the roots of the primary teeth, causing the roots to be dissolved by odontoclasts (as well as surrounding alveolar bone by osteoclasts) and become absorbed by the forming permanent teeth.

The process of shedding primary teeth and their replacement by permanent teeth is called **exfoliation**. This may last from age six to age thirteen. By age twelve there usually are only permanent teeth remaining. However, it is not extremely rare for one or more primary teeth to be retained beyond this age, sometimes well into adulthood, often because the permanent tooth fails to develop.

The spaces of the deciduous teeth try to increase with age due to growth of the jaws in anteroposterior , vertical , and transverse direction , and due to attrition, and these teeth subjected to large amount of attrition due to wear at the incisal edge, and proximal surfaces since the deciduous teeth mostly converted to edge to edge relationship at late stages, the occlusal forces with root resorption will increase the mobility of the deciduous teeth and if the closed case ( no spacing)this will produce attrition at the proximal surfaces due to friction produced by movement during mastication , so the mobility progress the spaces to increased and this will facilitated the normal shedding of the incisors.

**Mixed Dentition period**

(Around 6 years- 13 years) Most malocclusions make their appearance during this stage The mixed dentition period can be divided into:

First transitional period.

Inter-transitional period.

Second transitional period.

## First Transitional Period

Emergence of the first permanent molars and transition of incisors The following events take place during this period.

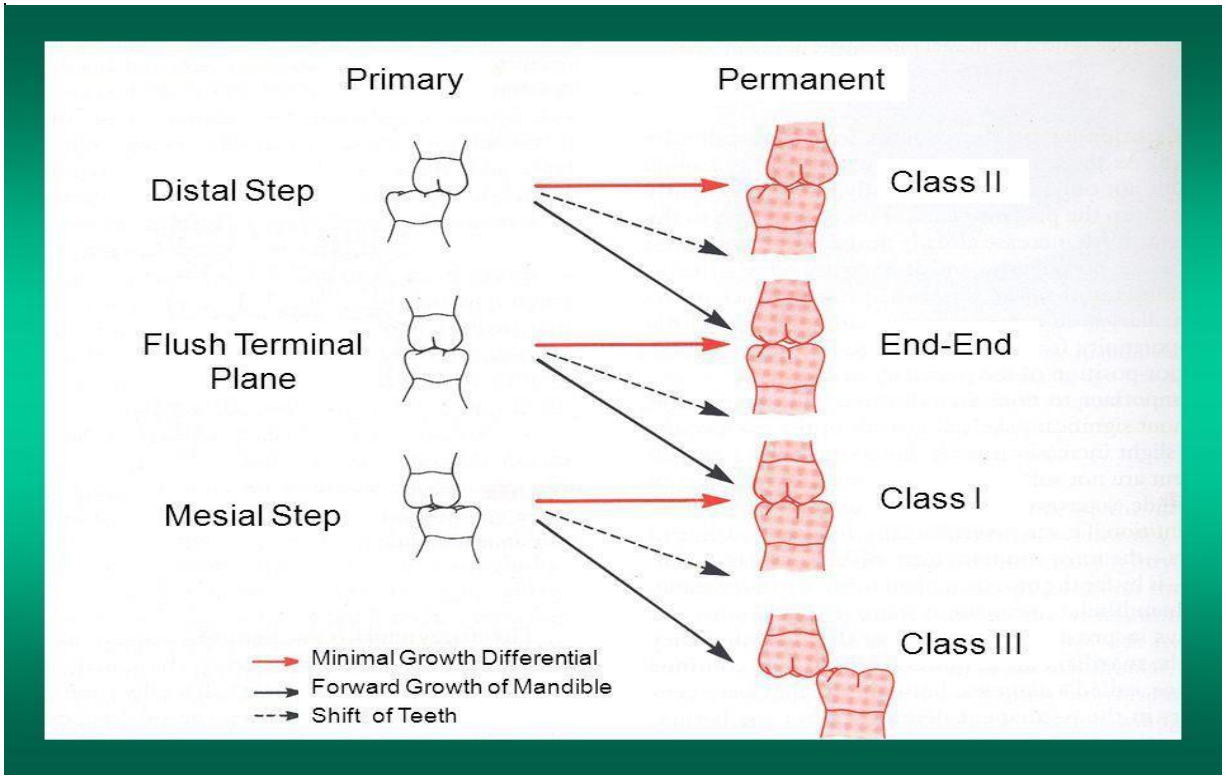
## Eruption of Permanent First Molars

The first permanent molars erupt at 6 years. They play an important role in the establishing and in the functioning of occlusion, in the permanent dentition.

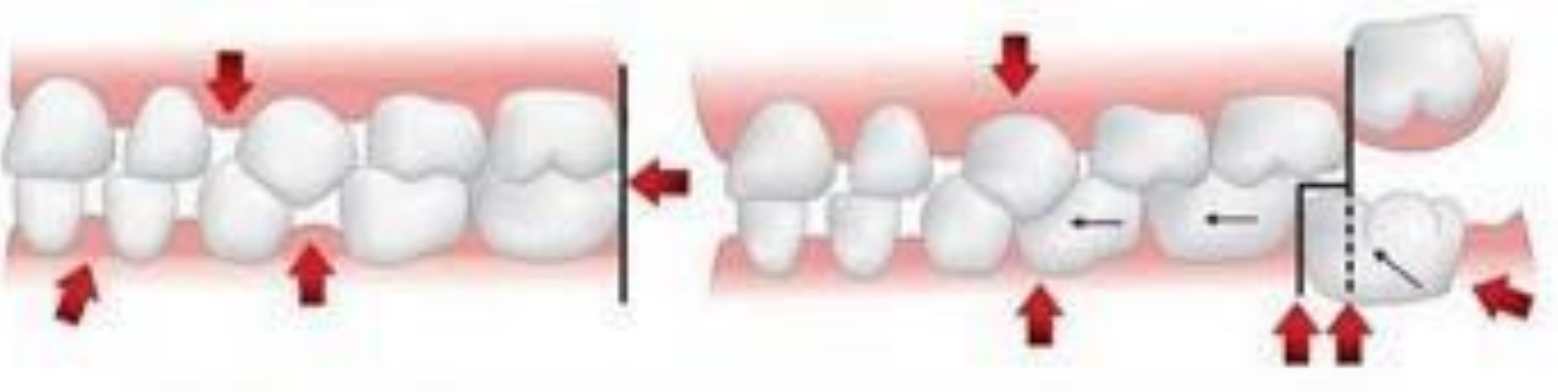
Anteroposterior positioning of the permanent molars is influenced by: Terminal plane relationship the distal surface of the upper & lower2nd deciduous molar• When the deciduous second molars are in a flush terminal plane, the permanent first molar erupts initially into a cusp-to-cusp relationship, which later transforms into a Class I molar relation using the primate spaces .Later, cusp-to-cusp relationship of the permanent first molar can be converted to a Class I relationship by the mesial shift of the permanent first molar following exfoliation of the primary molar and thus making use of the Leeway space (late mesial shift)

**Distal Step**: When the deciduous second molars are in a distal step, the permanent first molar will erupt into a class II relation. This molar configuration is not self correcting and will cause a class II malocclusion despite Leeway space and differential growth.

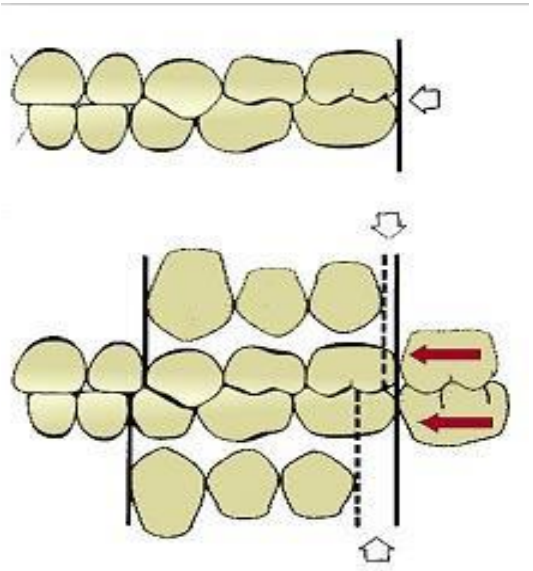
**Mesial Step**: Primary second molars in mesial step relationship lead to a class I molar relation in mixed dentition. This may remain or progress to a half or full cusp class III with continued mandibular growth

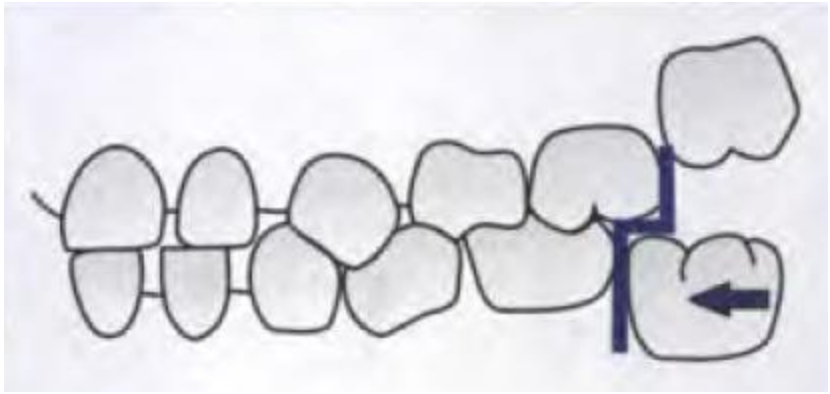


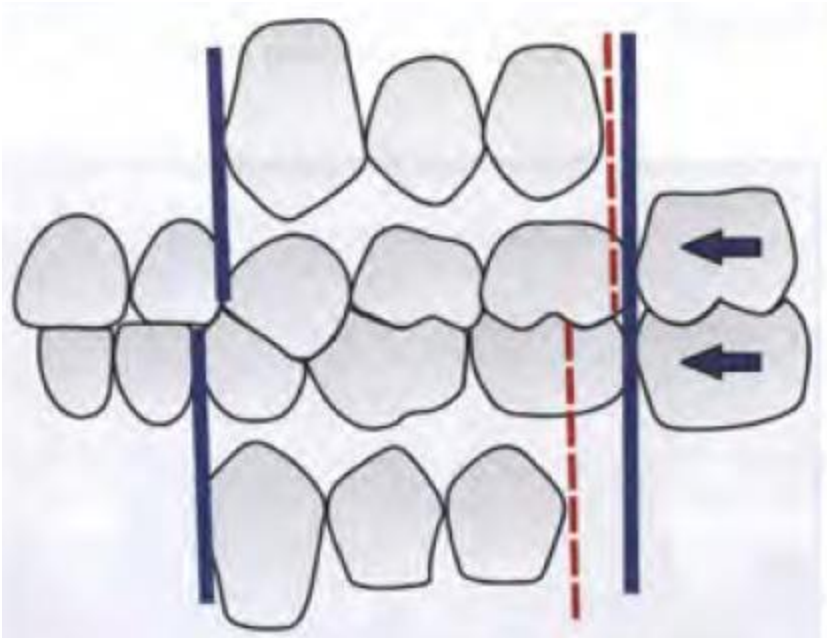
.**Early mesial Shift** : Early shift occurs during the early mixed dentition period. Since this occurs early in the mixed dentition, it is called early shift , the eruptive force of first permanent molar push the deciduous 1st & 2nd deciduous molar to close the primate space. In a spaced arch, eruptive force of the permanent molars causes closing of any spaces between the primary molars or primate spaces, thus allowing molars to shift mesially



**Late mesial Shift**: This occurs in the late mixed dentition period when the second deciduous molar exfoliate the first permanent molar drift mesialy & use leeway space and is thus called late shift. When the primary second molar are lost there is an adjustment in the occlusion of the first molar teeth , There is a decrease in arch length in both maxillary and mandibular arches as the first molar shift mesialy this shift is more in mandible which accounts for the establishment of full cusp molar class I relation from flash terminal plane relation ship in deciduous dentition this shift is called late mesial shift of molars.



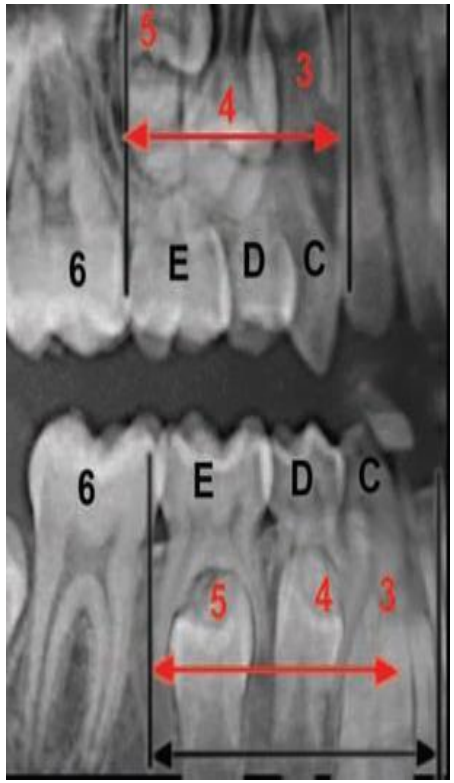


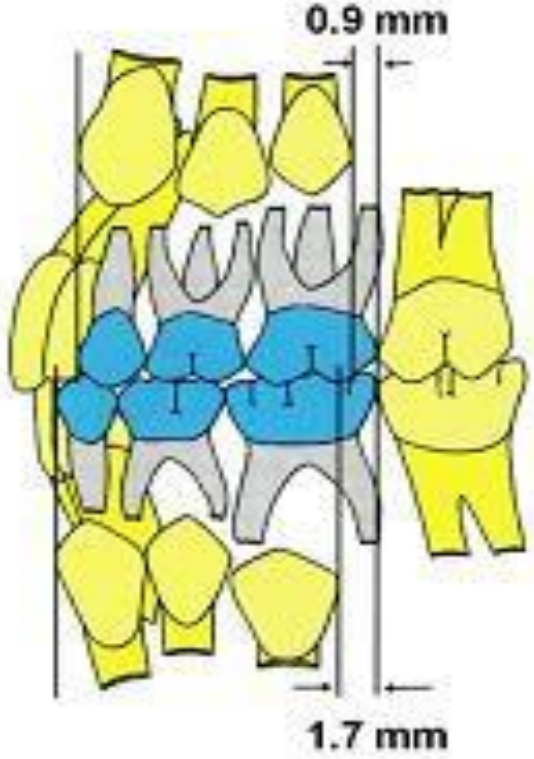


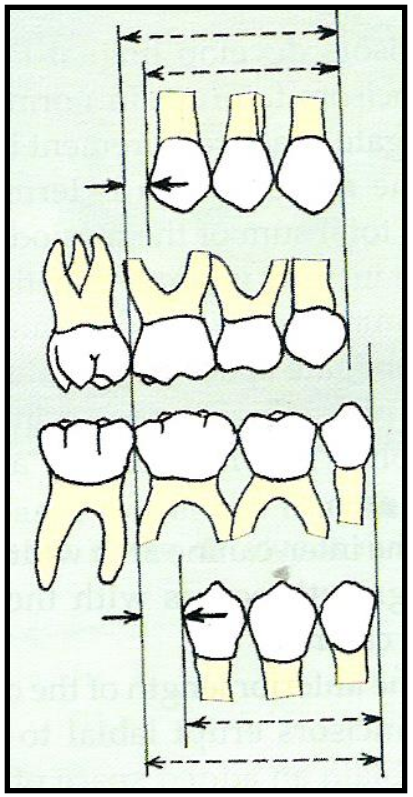
## Leeway Space of Nance

Described by Nance in 1947 (the combined mesiodistal width of the permenant canines and premolars 3,4 and 5 is usually less than of the deciduous canines and molars CD&E).

Maxilla: 0.9 mm/segment = 1.8 mm arch . Mandible: 1.7 mm/segment = 3.4mm arch

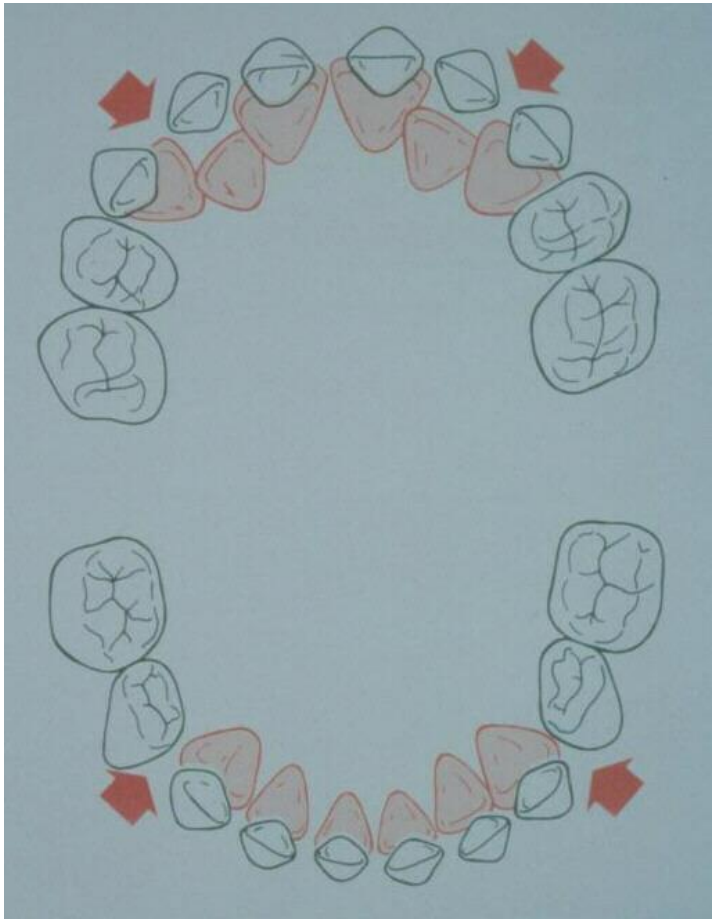


**Exchange of Incisors:**

Transition of Incisors Permanent incisors develop lingual to the primary incisors. For incisors to erupt in normal alignment , there is an obligate space requirement in the anterior part of both the arches which is termed as the incisal liability

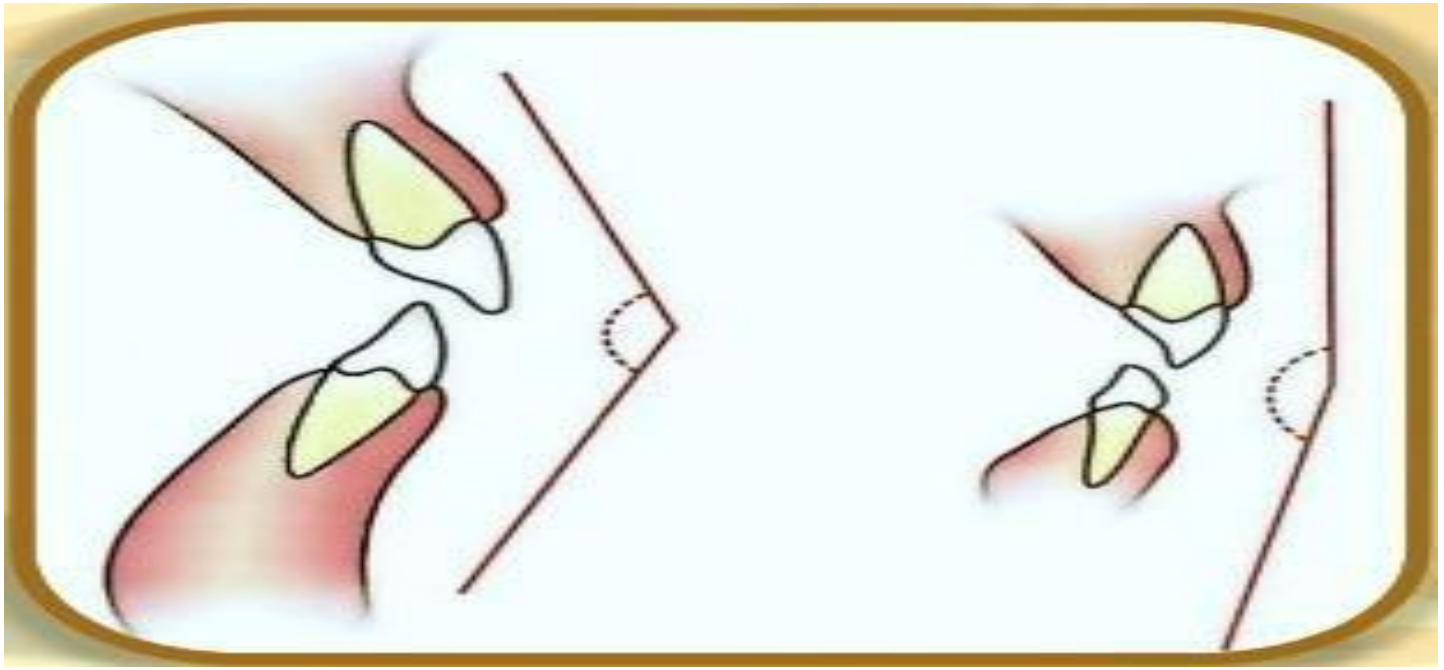


incisal liability( permenant incisors is larger than deciduous incisors the difference between the amount of space needed for the incisors and the amount available for them) is over come by the following factors:

1. Interdental physiological spacing in the primary incisor region. (4 mm in maxillary arch & 3 mm in mandibular arch)
2. Increase in inter-canine arch width: Significant amount of growth occurs with the eruption of incisors and canines
3. Increase in anterior length of the dental arches: Permanent incisors erupt labial to the primary incisors to obtain an added space of around 2-3 mm , change in inclination of permanent incisors, Primary teeth are upright but permanent teeth incline to the labial surface This increases the arch parameter .

**Change in inclination of permanent incisors:**

Primary teeth are upright but permanent teeth incline to the labial surface thus decreasing the inter-incisal angle from about 150° in the deciduous dentition to 123° in the permanent dentition This increases the arch perimeter



## Mixed Dentition period

(Around 6 years- 13 years) The mixed dentition period can be divided into:

First transitional period.

Inter-transitional period.

Second transitional period.

## Inter-Transitional Period

This is a stable phase where little changes take place in the dentition. The teeth present are the permanent incisors and first molar along with the deciduous canines and molars.

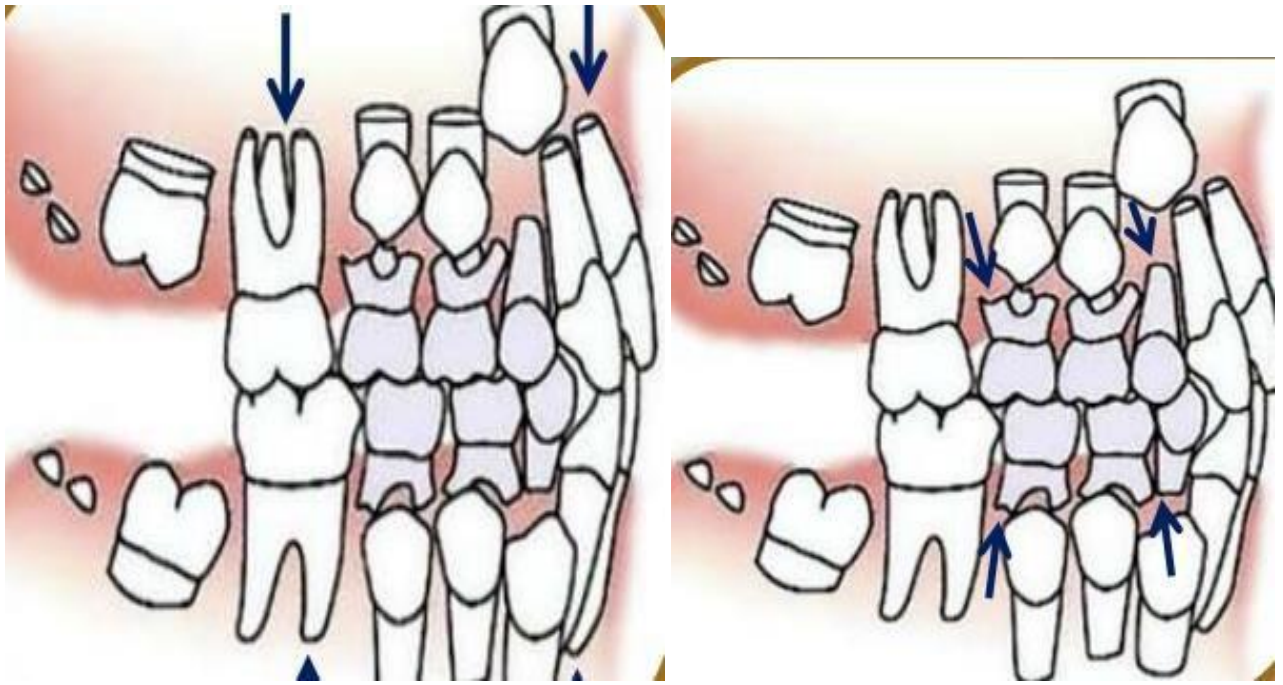
Some of the features of this stage are:

1. Any asymmetry in emergence and corresponding differences in height levels or crown lengths between the right and left side teeth are made up.
2. Occlusal and interproximal wear of deciduous teeth causes occlusal morphology to approach that of a plane.
3. Ugly duckling stage.
4. Root formation of emerged incisors, canines and molars continues, along with concomitant increase in alveolar process height.
5. Resorption of roots of deciduous molars.

it is a silent period extend from 8.5 years of age to IO years of age ,this period is called (Lull period) In this period ,the teeth present are

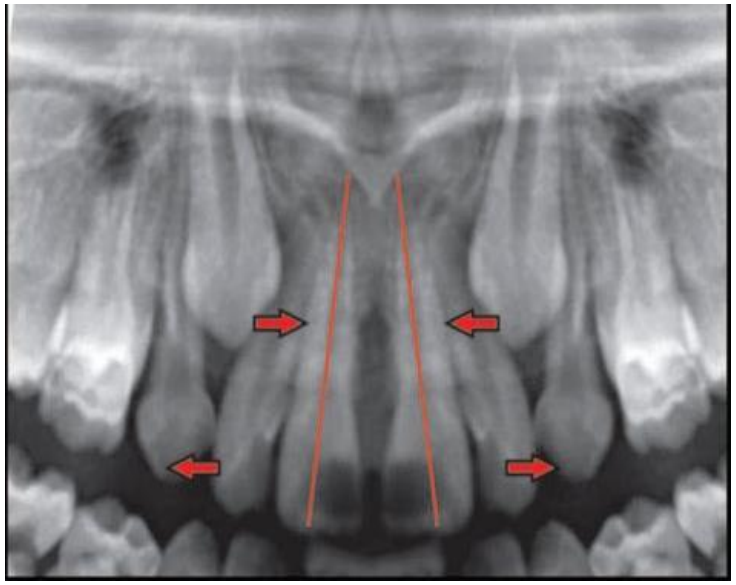
6EDC21 12CDE6

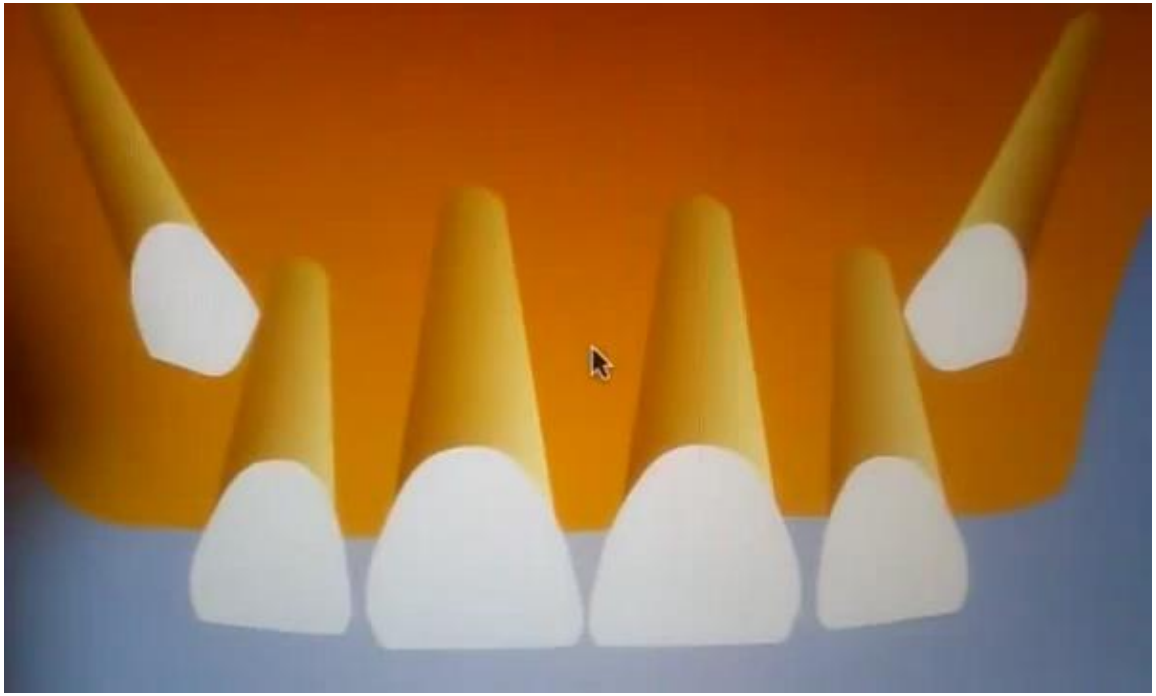
This phase prepares for the second transitional phase

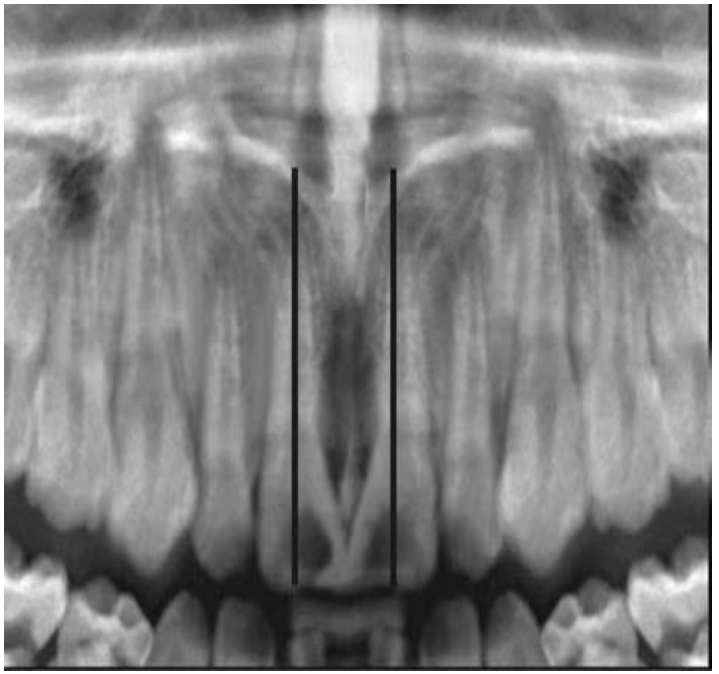


**Ugly Duckling Stage (Broadbent's phenomenon):**

Around the age of 8 - 9 years, a midline diastema is commonly seen in the upper arch, which is usually misinterpreted by the parents as a malocclusion. Its typical features are: Flaring of the lateral incisors. Maxillary midline diastema, crowns of canines on young jaws impinge on developing lateral incisor roots, thus driving the roots medially and causing the crowns to flare laterally, the roots of the central incisors are also forced together, thus causing maxillary midline diastema , With the eruption of the canines, the impingement from the roots shift incisally thus driving the incisor crowns medially, resulting in closure of the diastema as well as the correction of the flared lateral incisors







## Second Transitional Period

This period is marked by the eruption of the four permanent second molar , establishment of proper occlusion , replacement of deciduous canines and molars by premolars and permanent cuspid respectively

**The following events take place:**

***Exfoliation of primary molars and canines*** At around 10 years of age, the first deciduous tooth in the posterior region, usually the mandibular canine sheds and marks the beginning of the second transitional period.

Usually no crowding is seen before emergence except maybe between the maxillary first premolar and canine.

***Eruption of permanent canines and premolars*** These teeth erupt after a pause of 1-2 years following incisor eruption. The first posterior teeth to erupt are the mandibular canine and first premolar (9-10 years) followed by maxillary premolars and canine around 11-12 years.

common eruption sequence is 4-5-3 in the maxilla and 3-4-5 in the mandible. Favorable occlusion in this region is largely dependent on:

- Favorable eruption sequence.
- Satisfactory tooth size- available space ratio.
- Attainment of normal molar relation with minimum diminution of space available for bicuspids.

***Eruption of permanent second molars****:* the eruption of second permanent molars(upper & lower) at the age of 12 years old, it takes along path of eruption, but less than the path of eruption of canine , so ,they subjected to less amount of crowding, the malocclusion of second molars is very rare , and their impaction very rare , but sometimes the lower second molars may be impacted, Before emergence second molars are oriented in a mesial and lingual direction. These teeth are formed palatally and are guided into occlusion by the Cone Funnel mechanism (the upper palatal cusp/cone slides into the lower occlusal fossa/funnel). The arch length is reduced prior to second molar eruption by the mesial eruptive forces. Therefore, crowding if present is accentuated

**Mixed dentition problems**

**1**-*Premature loss of deciduous teeth*

The major effect of early loss of a primary tooth, whether due to caries, premature exfoliation, or planned extraction, is localization of preexisting crowding. In an uncrowded mouth this will not occur. However, where some crowding exists and a primary tooth is extracted, the adjacent teeth will drift or tilt around into the space provided. The extent to which this occurs depends upon the degree of crowding, the patients age, and the site.

**2**-*Retained deciduous teeth*

A difference of more than 6 months between the shedding of contralateral teeth should be regarded with suspicion. Provided that the permanent successor is present, retained primary teeth should be extracted, particularly if they are causing deflection of the permanent tooth.

**3** Infra-occluded (submerged) primary molars
term for describing the process where a tooth fails to achieve or maintain its occlusal relationship with adjacent or opposing teeth.
**4** Impacted first permanent molars

**5** Dilaceration

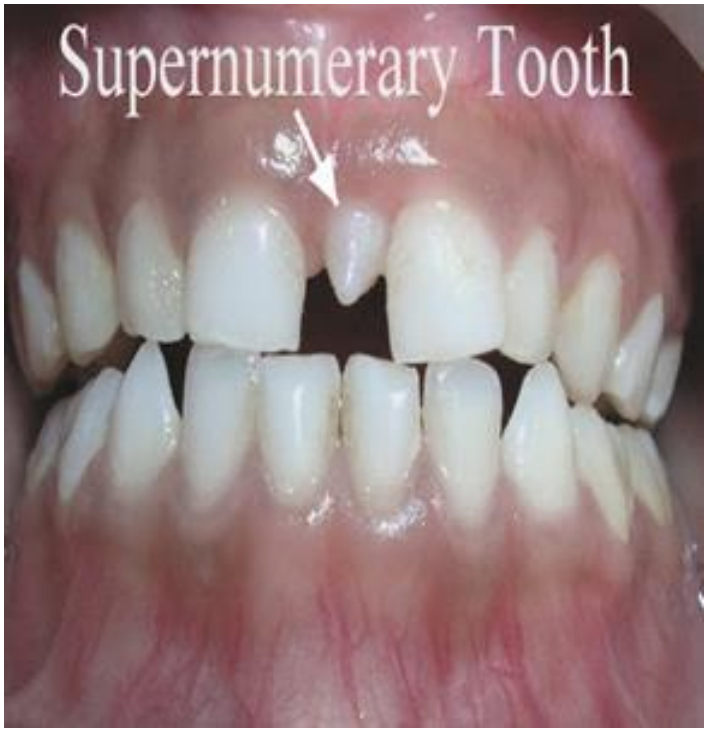
Dilaceration is a distortion or bend in the root of a tooth. It usually affects the upper central and/or lateral incisor

**6** Supernumerary teeth

**7** Habits

**8** First permanent molars of poor long-term prognosis

**9** Median diastema



## The Permanent Dentition

**Permanent teeth** or adult teeth are the second set of teeth formed in mammals. In humans, there are thirty-two permanent teeth, consisting of six maxillary and six mandibular molars, four maxillary and four mandibular premolars, two maxillary and two mandibular canines, four maxillary and four mandibular incisors.

The first permanent tooth usually appears in the mouth at around six years of age, and the mouth will then be in a transition time with both primary (or deciduous dentition) teeth and permanent teeth during the mixed dentition period until the last primary tooth is lost or shed.

The first of the permanent teeth to erupt are the permanent first molars, right behind the last 'milk' molars of the primary dentition.

These first permanent molars are important for the correct development of a permanent dentition. Up to the age of thirteen years, twenty-eight of the thirty-two permanent teeth will appear.

The full permanent dentition is completed much later during the permanent dentition period. The four last permanent teeth, the third molars, usually appear between the ages of 17 and 25 years; they are considered wisdom teeth.

Calcification of permanent begins at birth with the calcification of the cusps of the first permanent molar and extends as late as the 25th year of life. Complete calcification of incisor crowns take place by 4 – 5 years and of the other permanent teeth by 6 – 8 years except for third molars, at approximately 13 years of age all permanent teeth except third molars are fully erupted, The permanent incisors develop lingual to the deciduous incisors and move labially as they erupt. The premolars develop below the diverging roots of the deciduous molars.

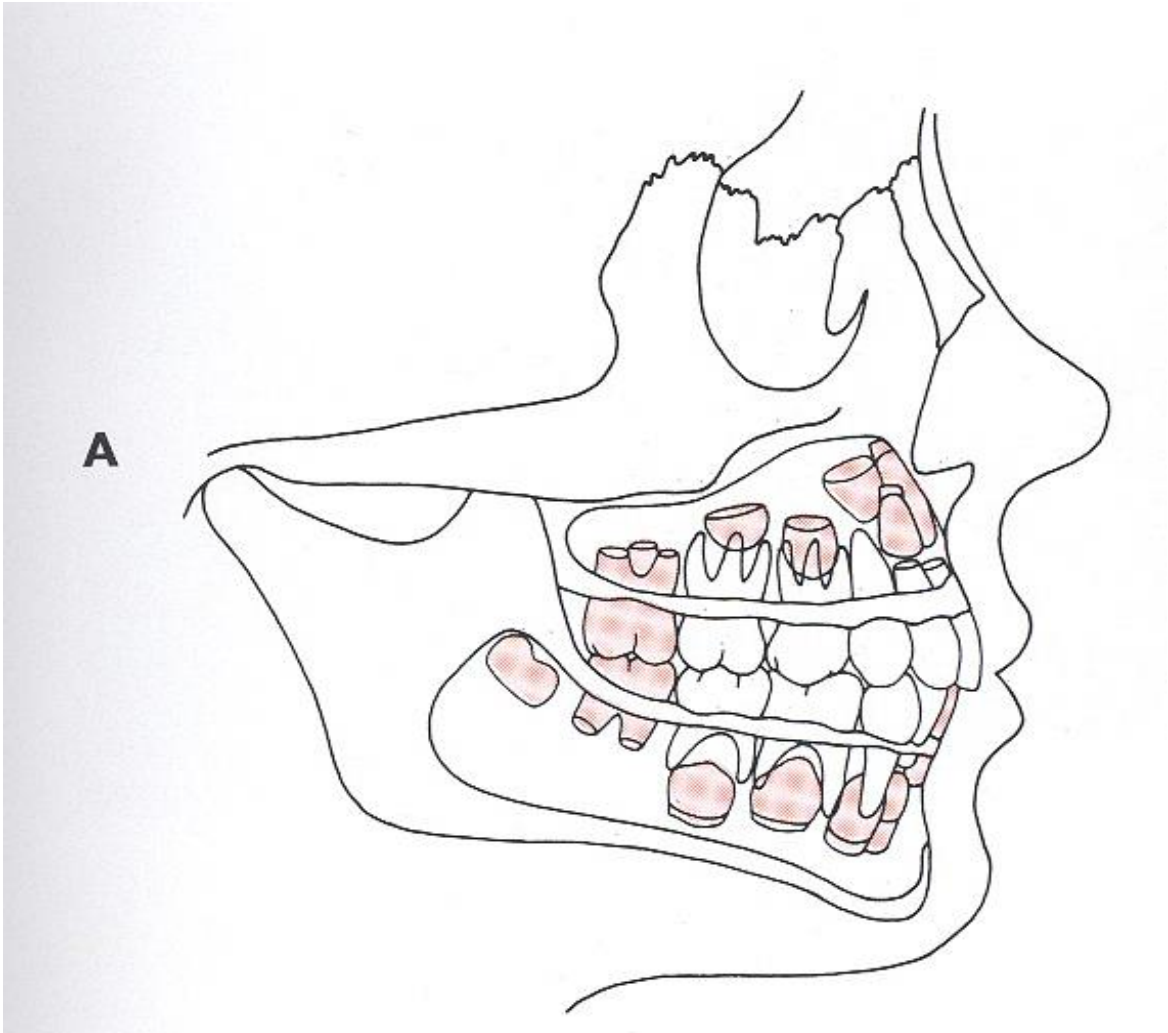
The third molars erupt at 18-24 years of age, Their path of eruption is nearly similar to the path of eruption of the second molars . the upper molars developed at the posteroinferior position of the maxillary tuberosity ,so , these teeth are subjected to a high amount of crowding in comparison with the first or second molars due to the lack of space available for them . the lower third molars may be subjected to impaction due to lack of space , these teeth may be absent or congenitally missing.

**Features of the permanent dentition**:

- Coinciding midline.
- Class I molar relationship of the permanent first molar.
- Vertical overbite of about one-third the clinical crown height of the mandibular central incisors

**The sequence of Permanent teeth emergence**:

There is wide variability in the sequence of arrival of teeth in the mouth.
*Maxilla* 6-1-2-4-3-5-7 or 6-1-2-4-5-3-7 (most common)
*Mandible* 6-1-2-4-5-3-7 or 6-1-2-3-4-5-7 (most common)



**Dental age 6: First stage of eruption**

•Eruption of mandibular central incisor and permanent first molar

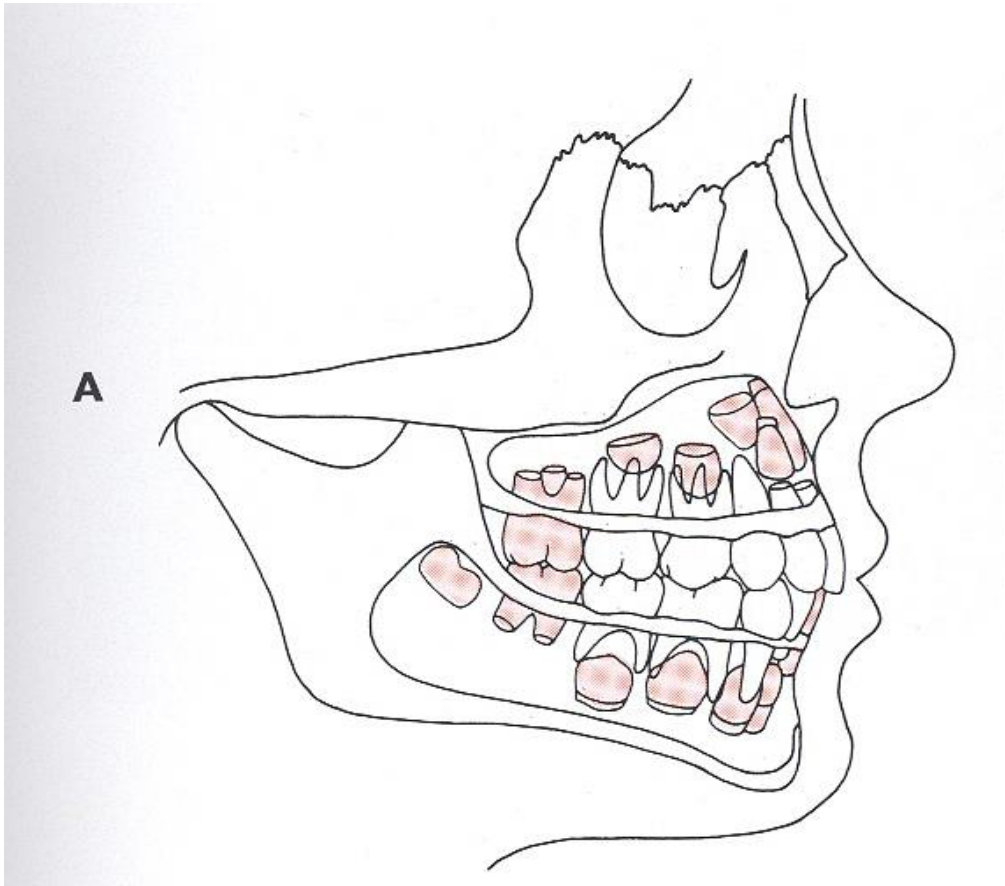
Mandibular molar eruption precedes maxillary molar.

**Dental age 7**

•Eruption of maxillary central and mandibular lateral incisor.

•Root formation of maxillary lateral incisor well advanced.

•Crown completion of canines and premolars.



**Dental age 8**

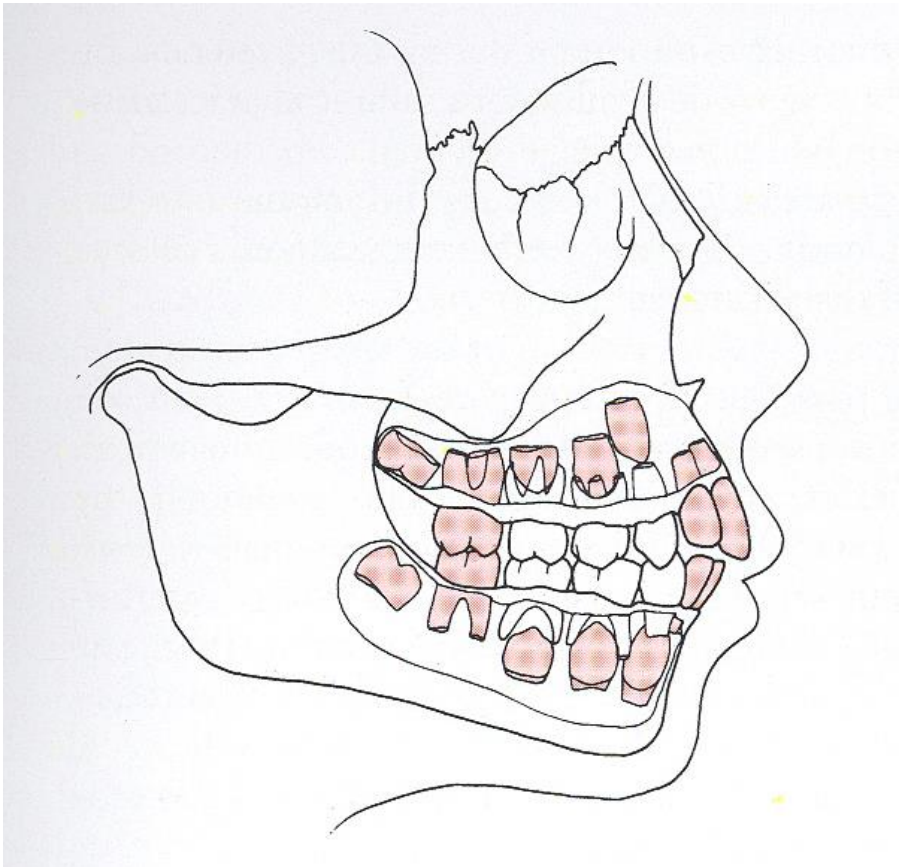
•Eruption of maxillary lateral incisor.

•Delay of 2-3 years before any further teeth erupt.

**Dental age 9**

•One-third root formation of mandibular canine and first premolar is complete.

•Root development of mandibular second premolar begins.

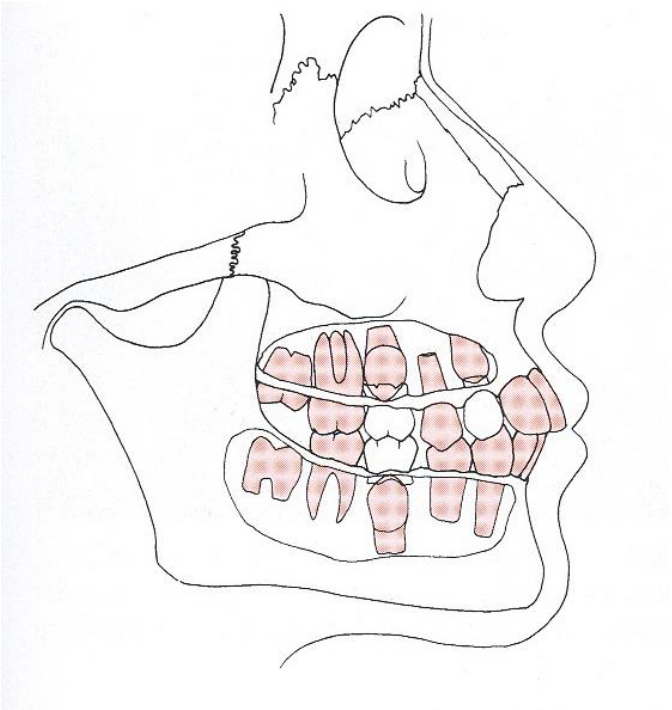


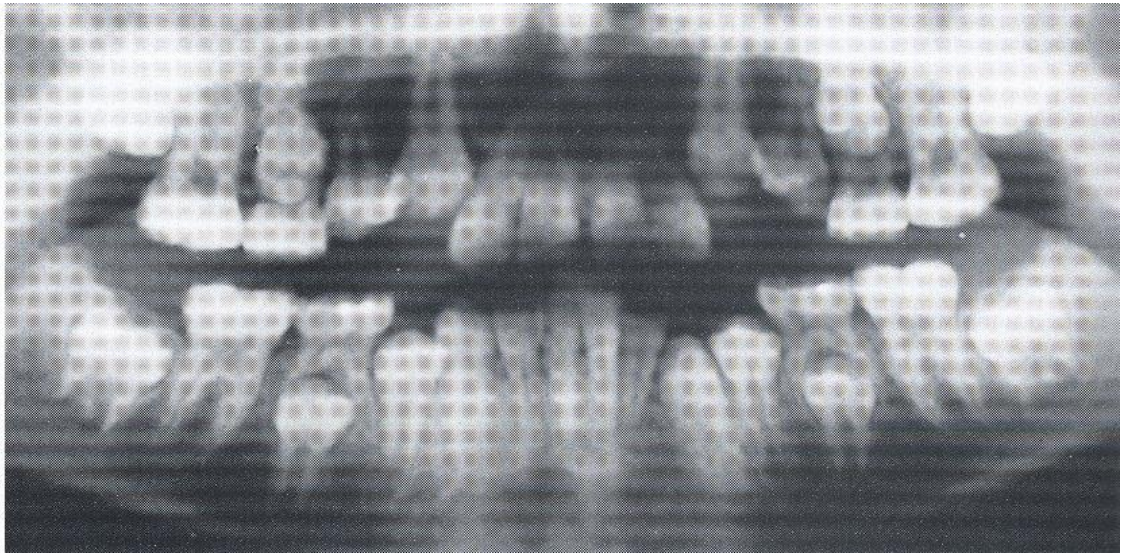
**Dental age 10**

- One-half root formation of mandibular canine and first premolar is complete.
- Significant root development of maxillary and mandibular second premolar as well as maxillary canine.
- Root completion of mandibular incisors and near completion of maxillary laterals.
- According to Moyers, mandibular canine erupts between 9 and 10 years.

**Dental age 11**

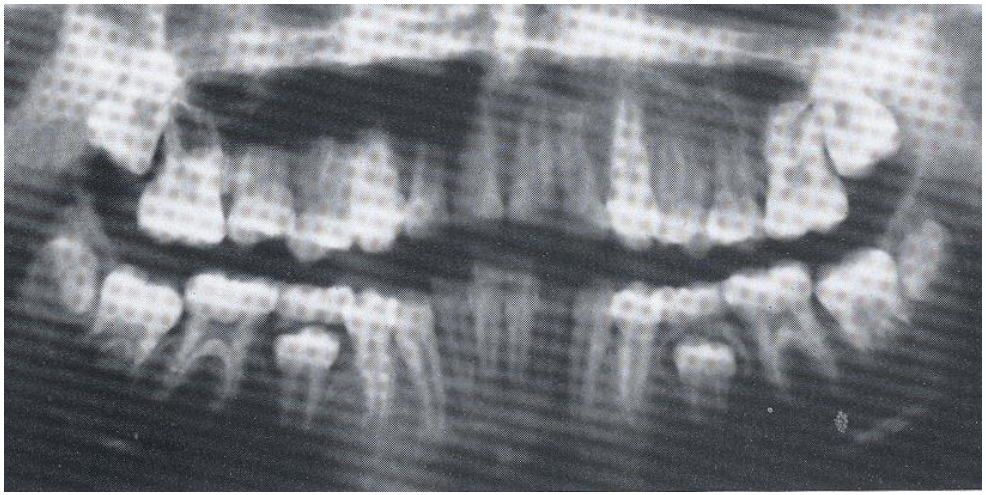
- Eruption of mandibular canine, mandibular first premolar and maxillary first premolar.
- Maxillary first premolar erupts ahead of canine and second premolar.

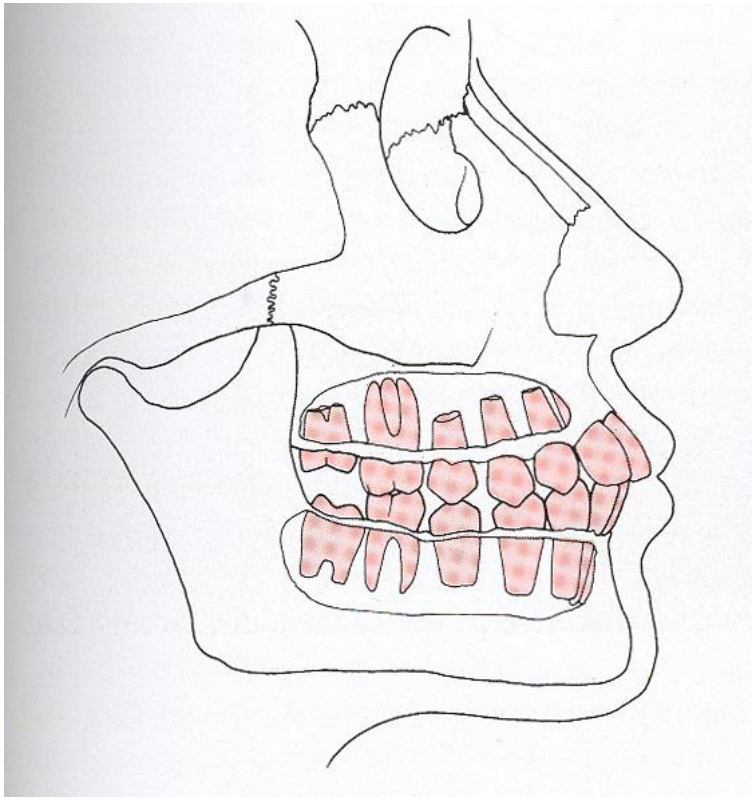




**Dental age 12**

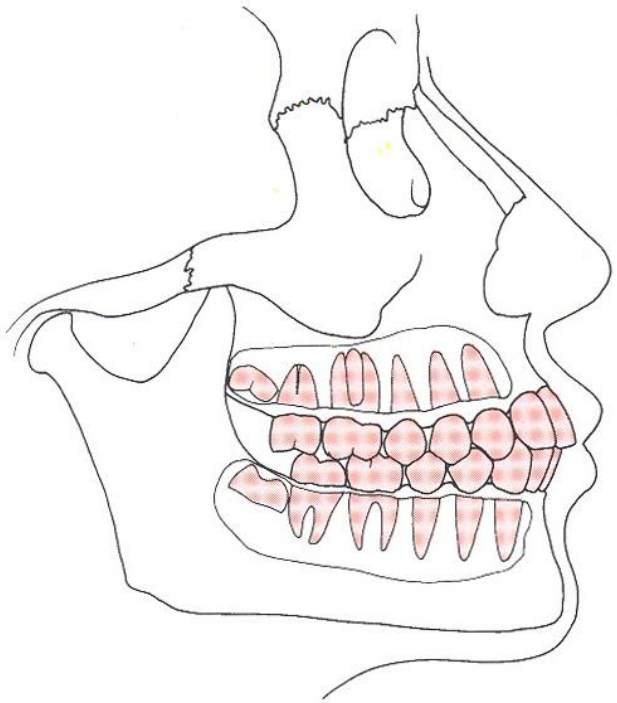
- Remaining succedaneous teeth erupt.
- Second permanent molars nearing eruption
- Early beginnings of third molar

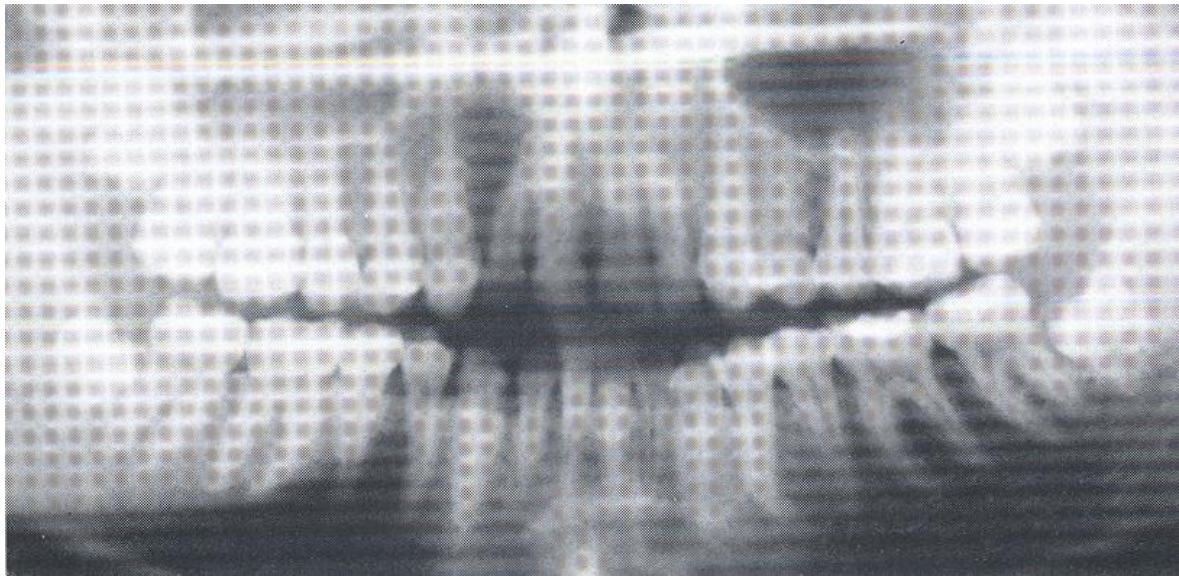




**Dental age 13,14,15**

- Completion of roots of permanent teeth
- Third molars apparent on the radiograph
- Change in eruption sequence is a reliable sign of disturbance in normal development of the dentition





| | Calsification(months) | Eruption(years) |
|---|---|---|
| Maxillary teeth | | |
| Central incisor | 3-4 | 7-8 |
| Lateral incisor | 10-12 | 8-9 |
| canine | 4-5 | 11-12 |
| First premolar | 18-21 | 10-11 |
| Secondpremolar | 24-27 | 10-12 |
| First molar | Around birth | 5-6 |
| Second molar | 30-36 | 12-13 |
| Third molar | 84-108 | 17-25 |
| | | |
| Mandibularteeth | | |
| Central incisor | 3-4 | 6-7 |
| Lateral incisor | 3-4 | 7-8 |
| canine | 4-5 | 9-10 |
| First premolar | 21-24 | 10-12 |
| Secondpremolar | 27-30 | 11-12 |
| First molar | Around birth | 5-6 |
| Second molar | 30-36 | 12-13 |
| Third molar | 96-120 | 17-25 |

Abnormalities of eruption and exfoliation

•Eruption cyst

An eruption cyst is caused by an accumulation of fluid or blood in the follicular space overlying the crown of an erupting tooth. They usually rupture spontaneously, but very occasionally marsupialization may be necessary.

Failure of/delayed eruption•

There is a wide individual variation in eruption times, Where there is a generalized tardiness in tooth eruption in an otherwise fit child, a period of observation is indicated. However, the following may be indicators of some abnormality and therefore warrant further investigation:

1-A disruption in the normal sequence of eruption.

2-An asymmetry in eruption pattern between contralateral teeth. If a tooth on one side of the arch has erupted and 6 months later there is still no sign of its equivalent on the other side, radiographic examination is indicated. Localized failure of eruption is usually due to mechanical obstruction this is advantageous as if the obstruction is removed then the affected tooth/teeth has the potential to erupt. More rarely, there is an abnormality of the eruption mechanism, which results in primary failure of eruption (the tooth does not erupt into the mouth) or arrest of eruption(the tooth erupts, but then fails to keep up with eruption/ development). This problem usually affects molar teeth and unfortunately for the individuals concerned, commonly affects more than one molar tooth in a quadrant. Extraction of the affected teeth is often necessary.

## FACTORS DETERMINING TOOTH POSITION DURING ERUPTION

Tooth passes through four distinct stages of development:

1. *Pre-eruptive* Initially position of tooth germ is dependent on heredity.
2. *Intra-alveolar* Tooth position is affected by-
   - Presence or absence of adjacent teeth
   - Rate of resorption of primary teeth
   - Early loss of primary teeth
   - Localized pathologic conditions.
3. *Intraoral stage* Tooth can be moved by lip, cheek, tongue muscles or external objects and drift into spaces.
4. *Occlusal stage* Muscles of mastication exert influence through interdigitation of cusps. The periodontal ligament disseminates the strong forces of chewing to the alveolar bone

## DISTURBANCES DURING ERUPTION OF TEETH

1. Concrescence Cemental union of two teeth.
2. Retarded eruption Due to endocrine disturbances, vitamin deficiencies, local causes
3. Ankylosed teeth Teeth fail to erupt to the occlusal level as they are fused to the bone.

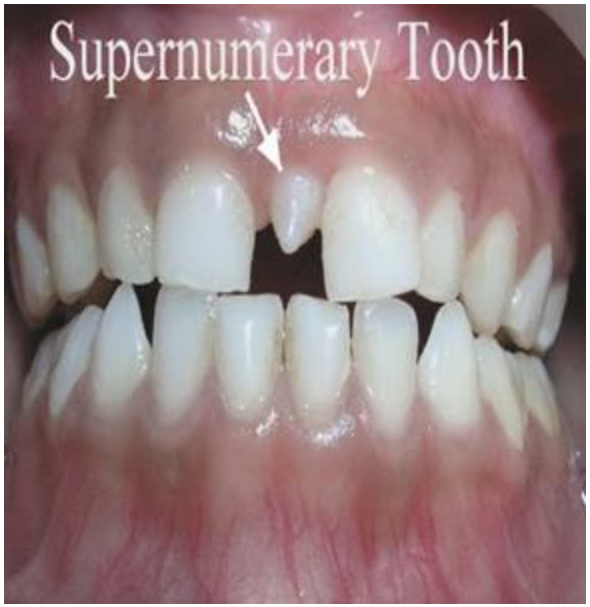
Causes of delayed eruption

**Generalized causes**

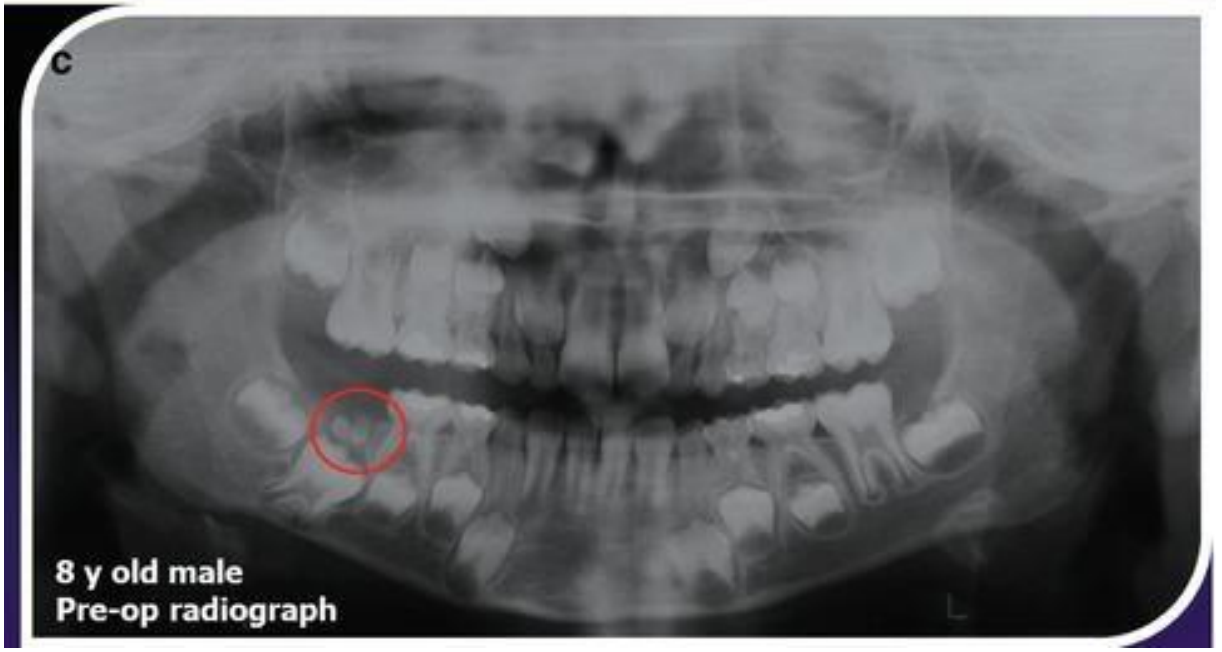
1. Hereditary gingival fibromatosis
2. Down syndrome
3. Cleidocranial dysostosis
4. Cleft lip and palate
5. Rickets

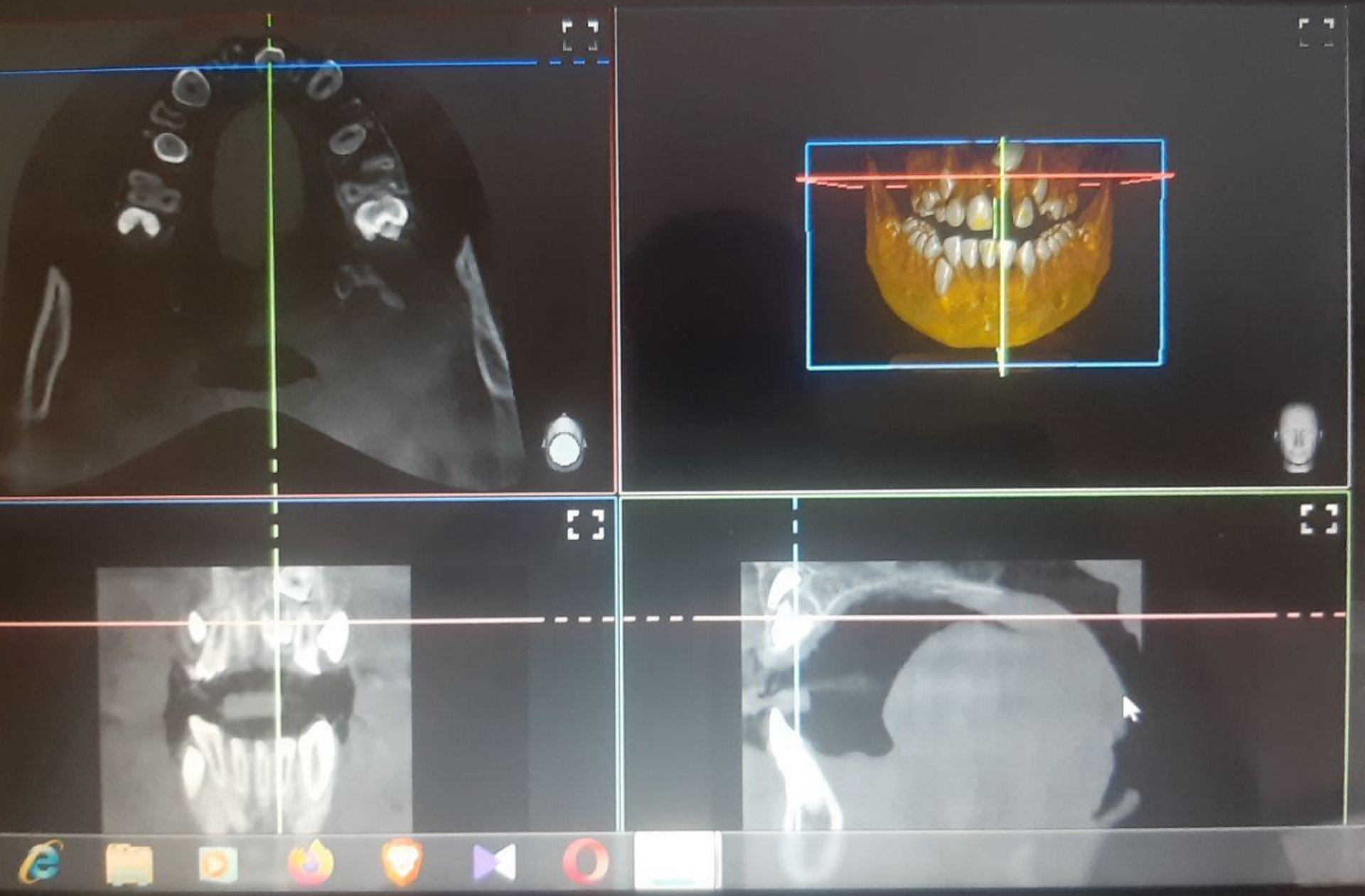
**Localized causes**

1. Congenital absence
2. Crowding
3. Delayed exfoliation of primary predecessor
4. Supernumerary tooth
5. Dilaceration
6. Abnormal position of crypt
7. Primary failure of eruption


Supernumerary Tooth


b
11 y old male


c
8 y old male
Pre-op radiograph



What to refer and when

**Deciduous dentition

- Cleft lip and/or palate (if patient not under the care of a cleft team)
- Other craniofacial anomalies

**Mixed dentition

- Severe Class III skeletal problems which would benefit from orthopaedic treatment
- Delayed eruption of the permanent incisors
- Impaction or failure of eruption First permanent molars of poor long-term prognosis where forced extraction is being considered
- Marked mandibular displacement on closure and/or anterior crossbites
- Ectopic maxillary canines
- Patients with medical problems where monitoring of the occlusion would be beneficial
- Pathology e.g. cysts on of the first permanent molars

# FIXED ORTHODONTIC APPLIANCES

# FIXED ORTHODONTIC APPLIANCES

They are devices which have attachments that are fixed onto the tooth surface, and forces are exerted via these attachments using archwires and /or other auxiliaries. The appliances cannot and should not be adjusted or removed by the patient.

# Advantages

1. Precise tooth control is possible.
2. Multiple tooth movements are possible.
3. Patient cooperation is reduced in comparison to removable appliance
4. All types of tooth movements are possible.

# Disadvantages

1. Oral hygiene requirement.
2. Esthetics.
3. Special training for operator.
4. Increased cost of treatment.
5. Increased chair side time.
6. Anchorage control is more difficult.
7. The possibility of producing adverse tooth movement.

## INDICATIONS FOR THE USE OF FIXED APPLIANCES

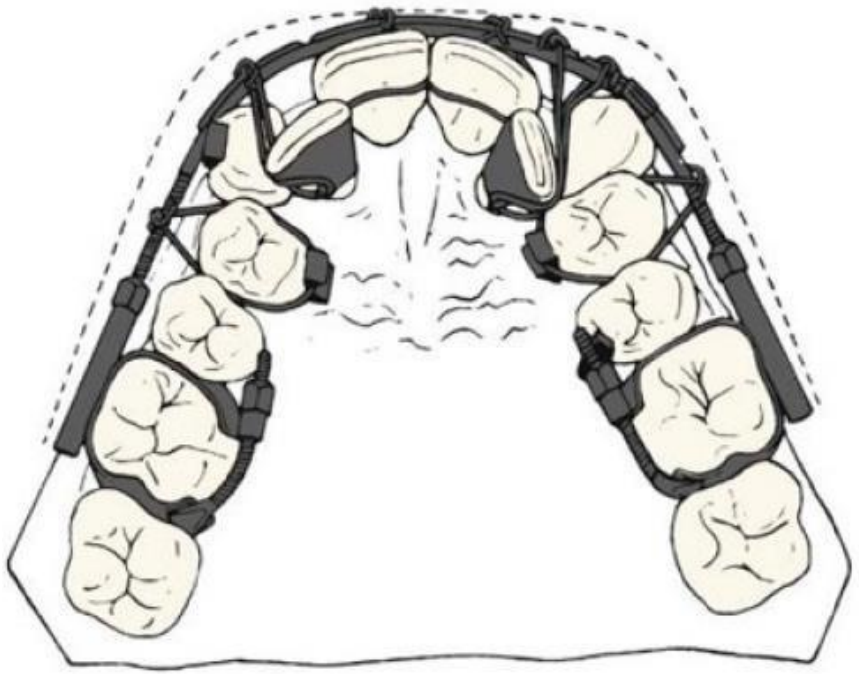
1. Correction of mild to moderate skeletal discrepancies. As fixed appliances can be used to achieve bodily movement it is possible, within limits, to compensate for skeletal discrepancies and treat a greater range of malocclusions.
2. Intrusion/extrusion of teeth.
3. Correction of rotations.
4. Overbite reduction by intrusion of incisors.
5. Multiple tooth movements required in one arch.
6. Active closure of extraction spaces, or spaces due to hypodontia.

# The development of contemporary Fixed Appliances

Edward Angle's position as the “father of modern orthodontics” is based not only on his contributions to classification and diagnosis but also on his creativity in developing new orthodontic appliances.

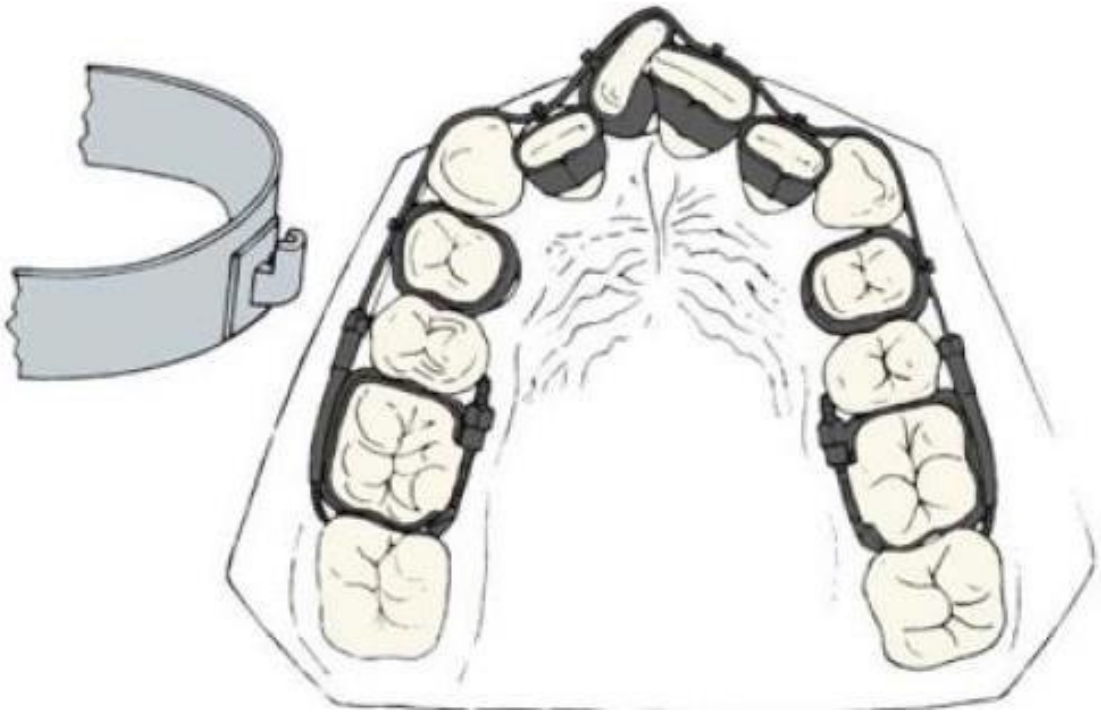
## E-Arch:

Edward Angle's E-arch from the early 1900s. Ligatures from a heavy labial arch were used to bring malposed teeth to the line of occlusion.



**Ribbon Arch**

Angle's ribbon arch appliance, introduced about 1910, was well-adapted to bring teeth into alignment but was too flexible to allow precise positioning of roots. It was the first introduction of brackets. Used a gold wire of 10x20.

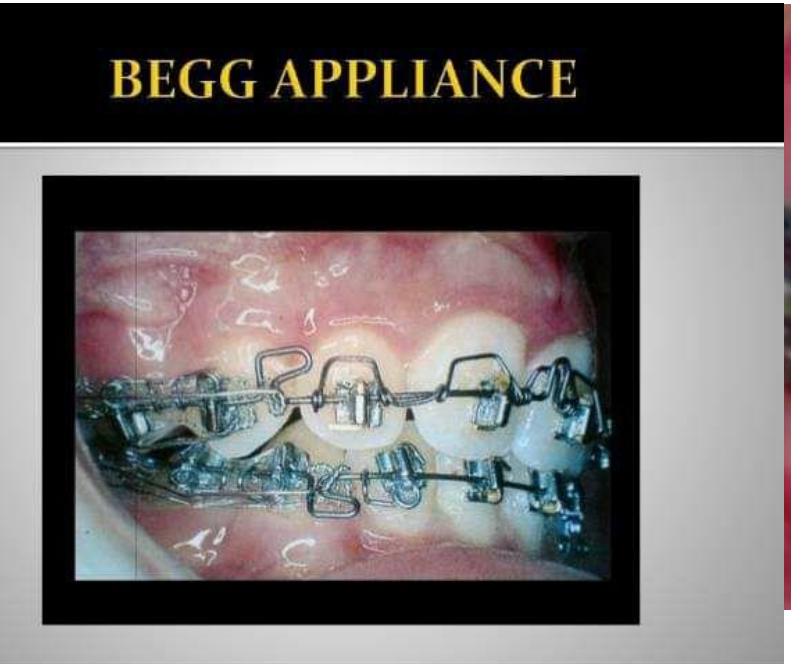


# Edgewise

To overcome the deficiencies of the ribbon arch, Angle reoriented the slot from vertical to horizontal and inserted a rectangular wire rotated at 90 degrees to the orientation it had with the
ribbon arch, thus the name “edgewise”

**Begg Appliance**

The Begg appliance used a modification of the ribbon arch attachment, into which round archwires were pinned. A variety of auxiliary archwires were used in this system to obtain control of root position.




**Contemporary Edgewise**

The Begg appliance became widely popular in the 1960s because it was more efficient than the edgewise appliance of that era, in the sense that equivalent results could be produced with less investment of the clinician's time. Developments since then have reversed the balance; the contemporary edgewise appliance has evolved far beyond the original design while retaining the basic principle of a rectangular wire in a rectangular slot, and now is more efficient than the Begg appliance, which is the reason for its almost universal use now, known as:

**Straight-Wire Appliance**

# Straight-Wire Appliance

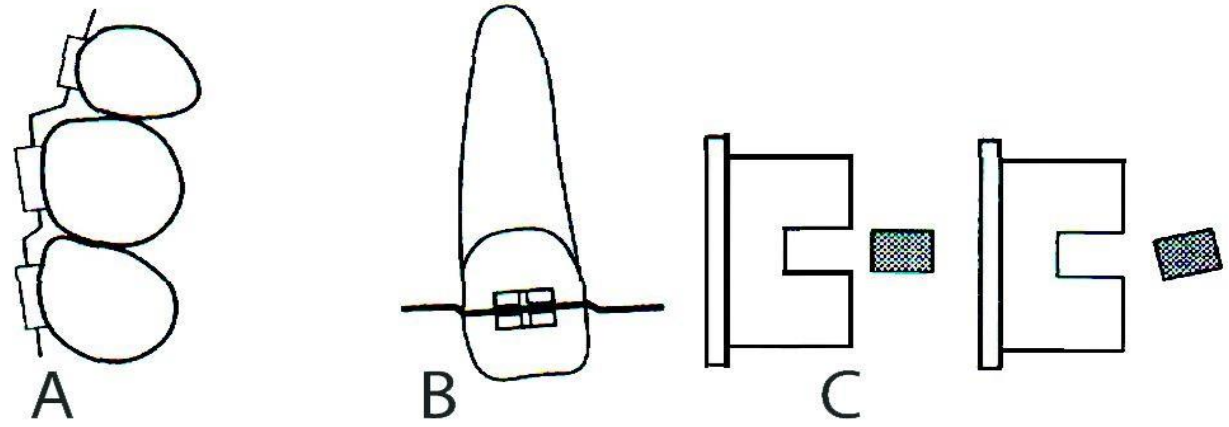
Angle used the same bracket on all teeth, as did the other appliance systems. In the 1980s, Andrews developed bracket modifications for specific teeth to eliminate the many repetitive bends (first, second and third order bends) in archwires that were necessary to compensate for differences in tooth anatomy, and bonding made it much easier to have different brackets for each tooth. The result was the “straight-wire” appliance. This was the key step in improving the efficiency of the edgewise appliance.

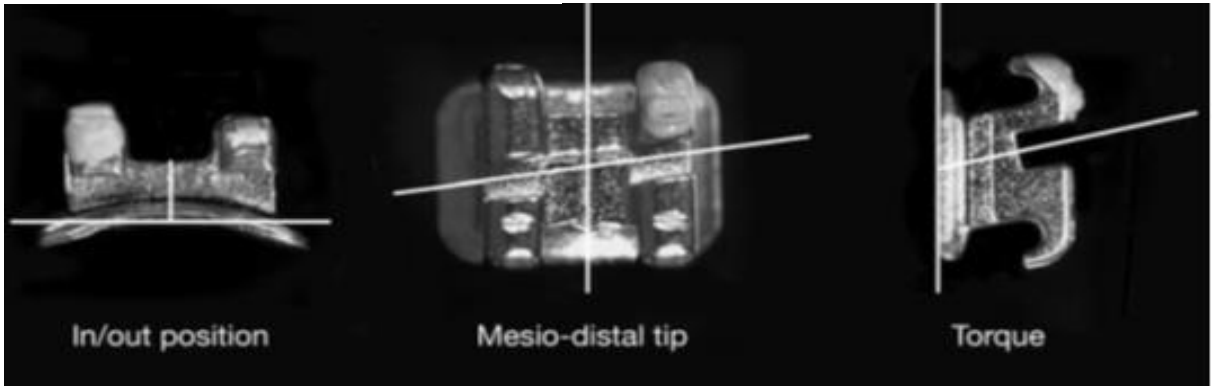
**Basic bends with standard edgewise appliance**

**A: First order bends:** made in the horizontal direction, and are required to make the wire conform anatomically to the labial & buccal contours of teeth.

**B: Second order bends:** made in the vertical plane, used for uprighting teeth and paralleling of the roots.

**C: Third order bends:** made for torque.



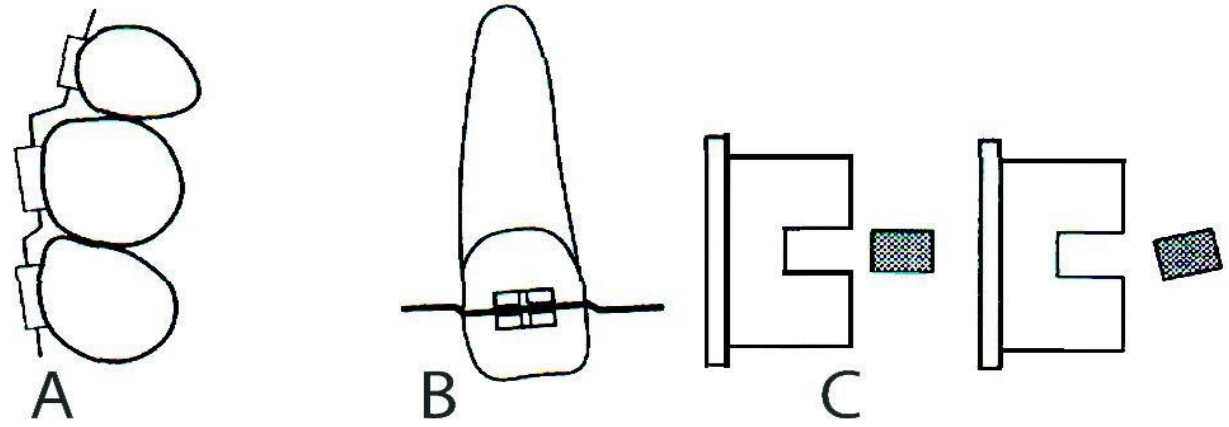



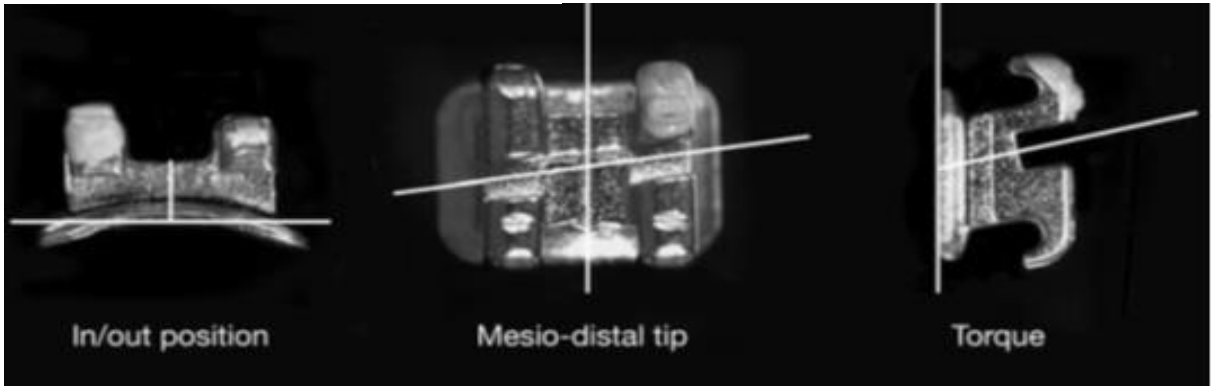
**Features of the brackets of straight wire appliance:**

Variable distance from base of slot to base of bracket for correct in/out position.

Pre-angulated slots for correct mesiodistal tooth angulation or tip;

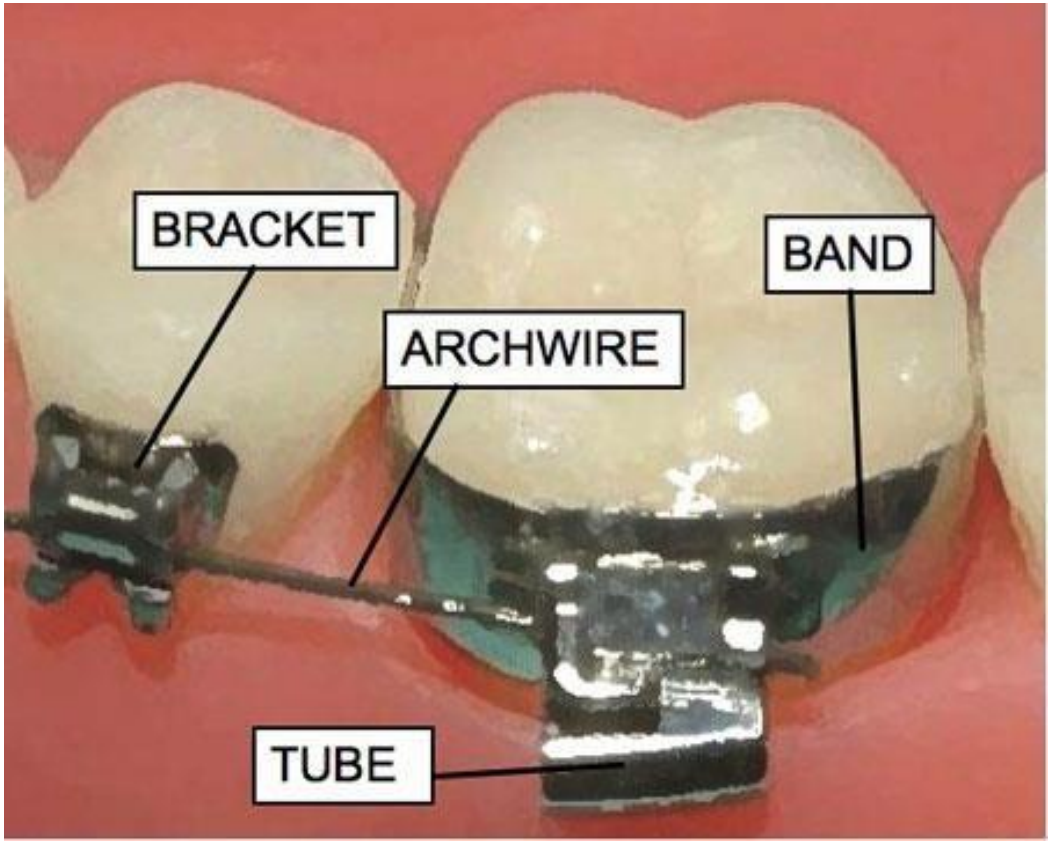
Bracket bases inclined for correct inclination or torque.



**Components of Fixed orthodontic Appliance: they can be broadly classified into:**

- **Attachments**
- **Archwire.** **.Auxiliaries.**



Attachments:•

- These include:
- Bands
- Brackets.
- Other attachments: Buccal tubes, Buttons, eyelet, sheath, cleat, ….etc.

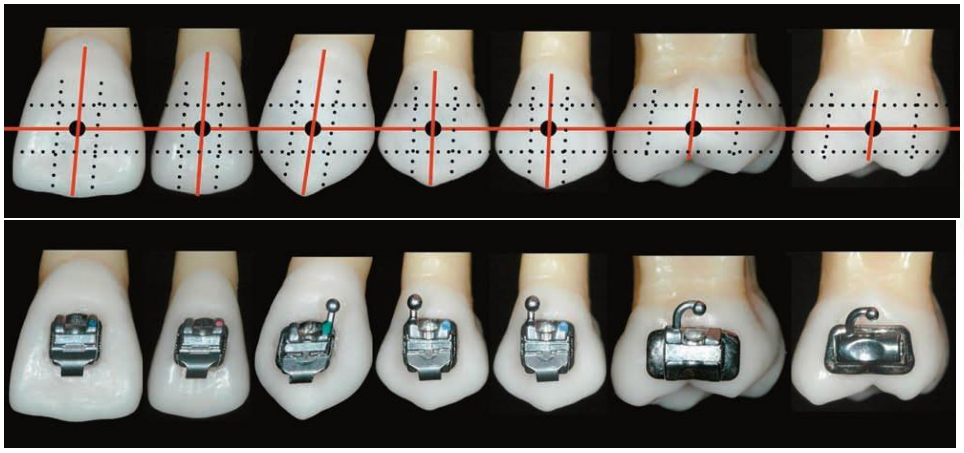
The attachments may be welded to bands, or directly placed on the tooth surface.

Bands:

These are rings encircling the tooth to which buccal, and as required, lingual attachments are soldered or welded. Until the 1980s, the only practical way to place a fixed attachment was to put it on a band that could be cemented to a tooth.


Brackets:

Each bracket is made up of a bracket base, stem with bracket slot, tie-wings to retain the ligature as it secures the arch wire into the slot, and some form of hook used for intramaxillary or intermaxillary attachment of elastics or coils.



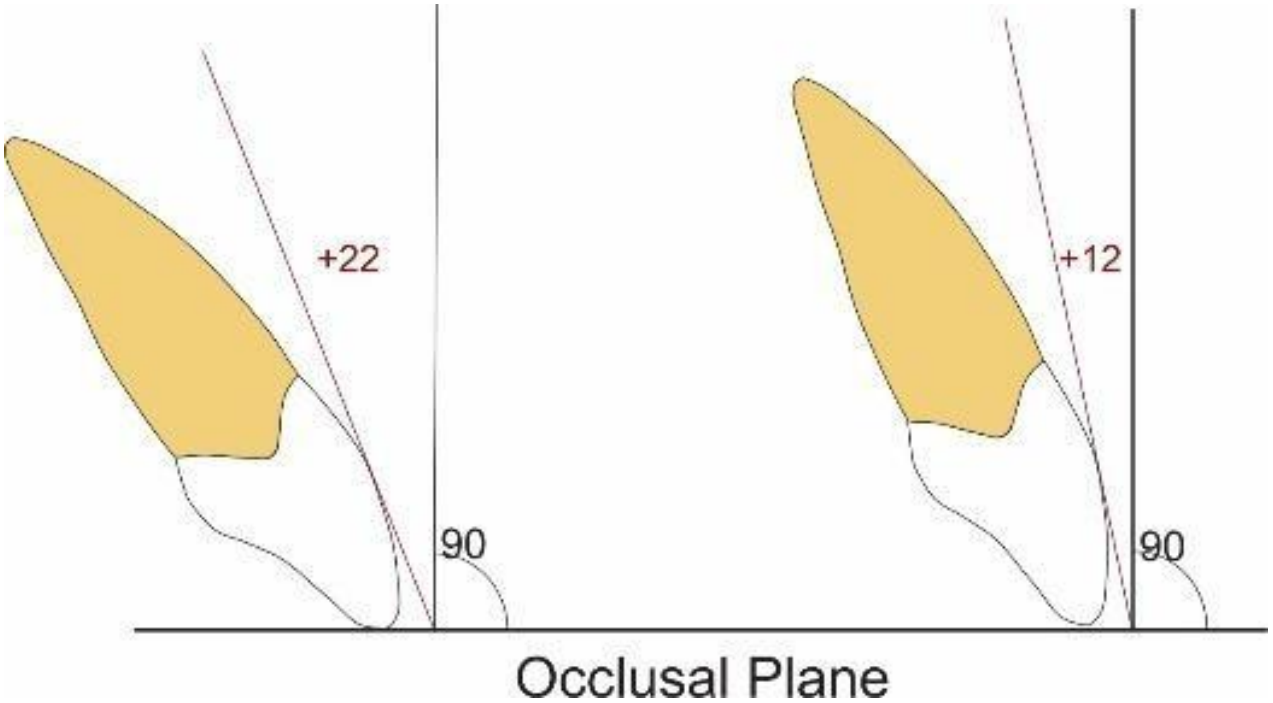
There are many bracket types, the basic ways to classify brackets are: 1- According to material:

A. Metallic: e.g. Stainless-steel.

B. Non-Metallic (Esthetic): Composite, Ceramic, Sapphire.

- According to prescription (the amount of built-in tip and torque):

  Standard edgewise (zero tip and torque).
  Roth prescription
  McLaughlin, Bennett, & Trevisi (MBT) prescription,
  ….etc.



According to slot size:

*18 mil (milli-inch) slot. (0.018 x 0.025 inch, where 0.018 is the width, and 0.025 is the slot depth)*

*22 mil slot (0.022 x 0.028 inch, where 0.022 is the width, and 0.028 is the slot depth)*

According to ligation method

Conventional ligating.

Self-ligating brackets (which utilize a permanently moveable component to installed, entrap the arch wire).

C. Other attachments: including but not limited to:

·Buccal Tubes: Used on molars.

Buttons:Small,mushroom-shaped orthodontic attachments that can be bonded directly onto a tooth or welded on a band. They are usually used on the palatal surface of the teeth (to provide a couple force), or on a partially erupted tooth. Also placed for attaching elastics to control rotation& cross bite.

- Eyelets: mostly on partially erupted teeth.

**Archwires:**

The amount and type of force applied to an individual tooth can be controlled by varying the cross-sectional dimension and form of the archwire, and/ or the material of its construction.

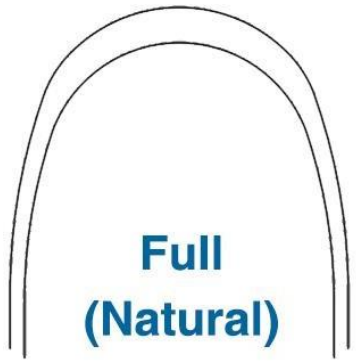
In the initial stages of treatment, a wire which is flexible with good resistance to permanent deformation is desirable (e.g. Nickel-titanium archwires), so that displaced teeth can be aligned without the application of excessive forces.

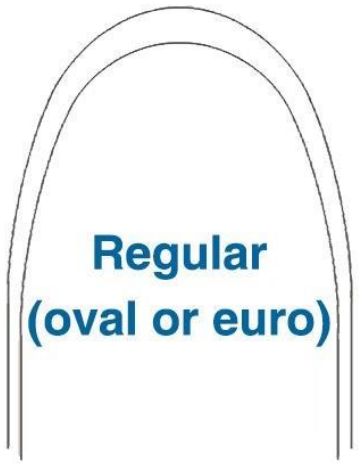
In contrast, in the later stages of treatment rigid arch wires are required to engage the archwire slot fully and to provide fine control over tooth position while resisting the unwanted effects of other forces, such as elastic traction (e.g. stainless-steel).

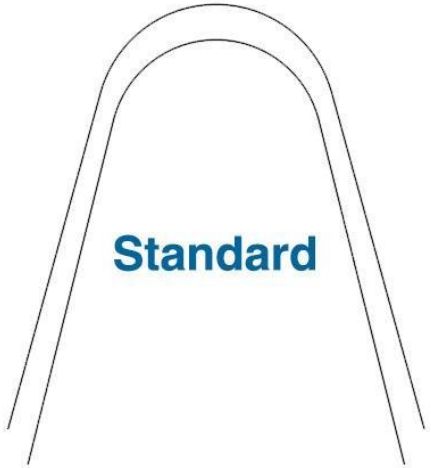
Archwires can be described according to their material, dimensions, and form.

**Material**: e.g. stainless-steel, Nickel titanium, Beta Titanium, Etc. **Dimensions**: Usually archwire dimension is expressed in milli-inches (= 0.025 mm). A 16 milli-inch (0.016") is a round 0.4 mm wire, and a 16x22 is a rectangular 0.4x0.55 mm wire.

**Form**: It may be a full form, regular (or oval) form, or standard form.



Auxiliaries•

There are many auxiliaries used with fixed orthodontic appliance, among them are:

***Ligatures***: these are used to secure the archwire into the bracket. They include elastomeric modules and ligature wires.

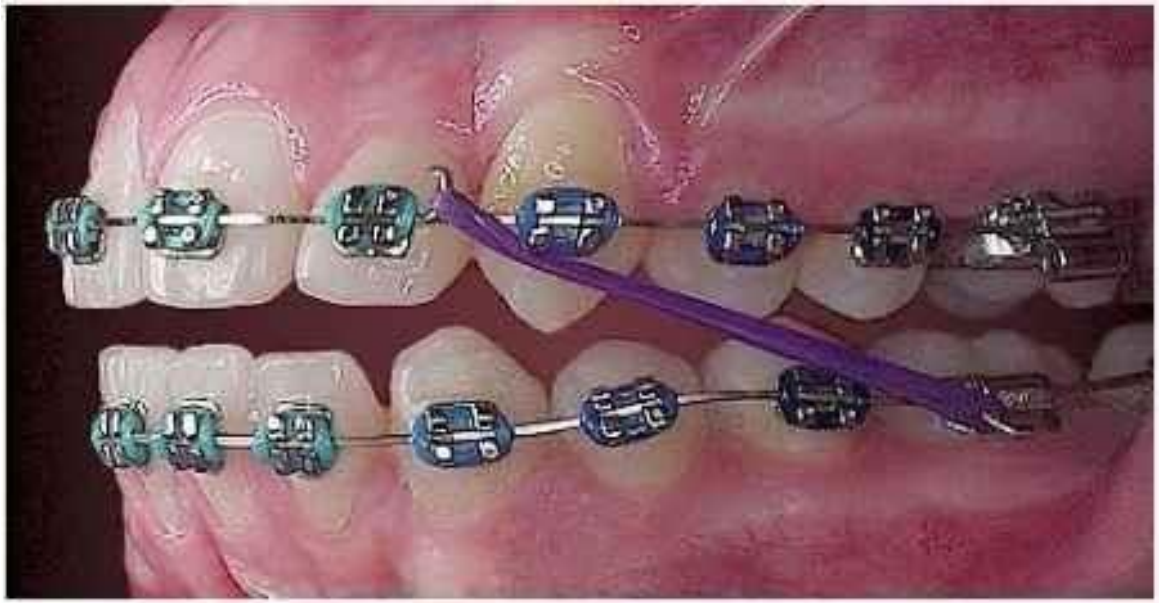
**ligature elastic**

**diff. colours mainly grey for SS bracket & white for esthetic one**

**ligature wire**

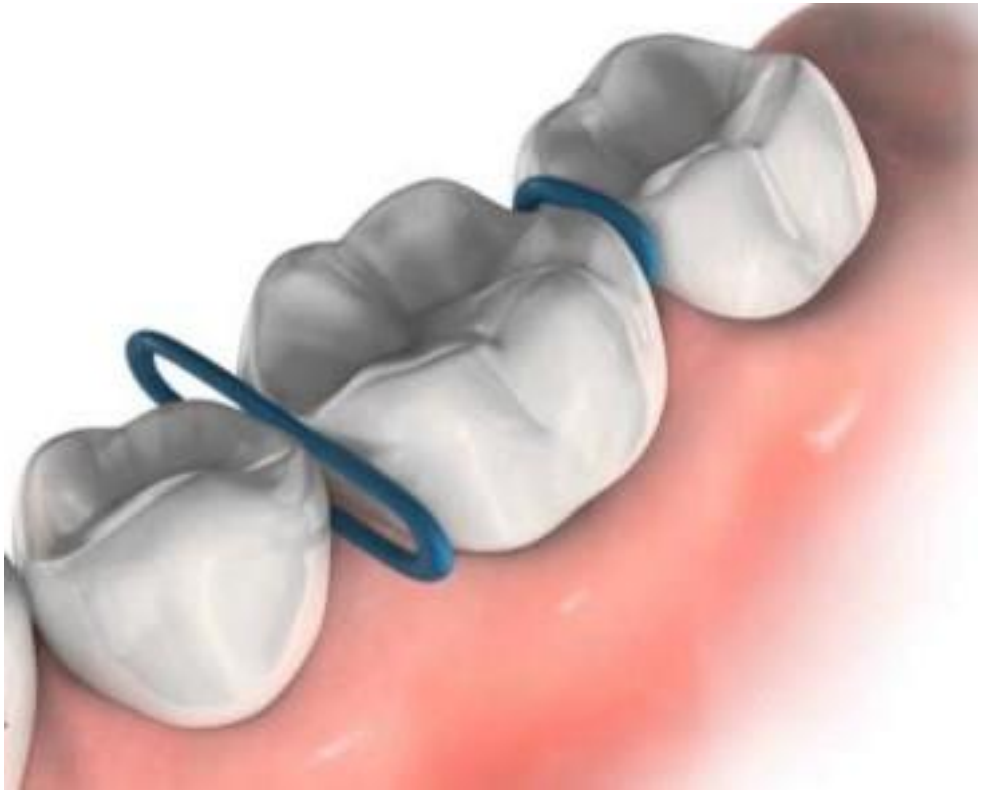
**Soft SS (009", .010", .012“)**

***Intra-oral elastics***: available in different sizes and strength to provide intra and interarch traction. For most purposes they must be changed daily. Class II and Class III elastics are ways to describe these elastics according to their use.



**Separators** (Elastic separator)

Elastomeric rings of varying thickness that are placed around the interproximal contact point to create the necessary separation over time.



## ***Elastomeric modules (Elastomeric chain, or Power chain)***

A chain of connected elastomeric rings used as a force-producing mechanism for orthodontic tooth movement. Elastomeric chains can be long, short, or closed, depending on whether or not there is a distance between the rings at its passive state.

# Lingual Appliances:

These are secured to the lingual surfaces of the teeth. There are some problems associated with them including some pronunciations difficulties that occur after insertion, the technique is difficult and time consuming, and the working position is awkward.

## Fixing attachments

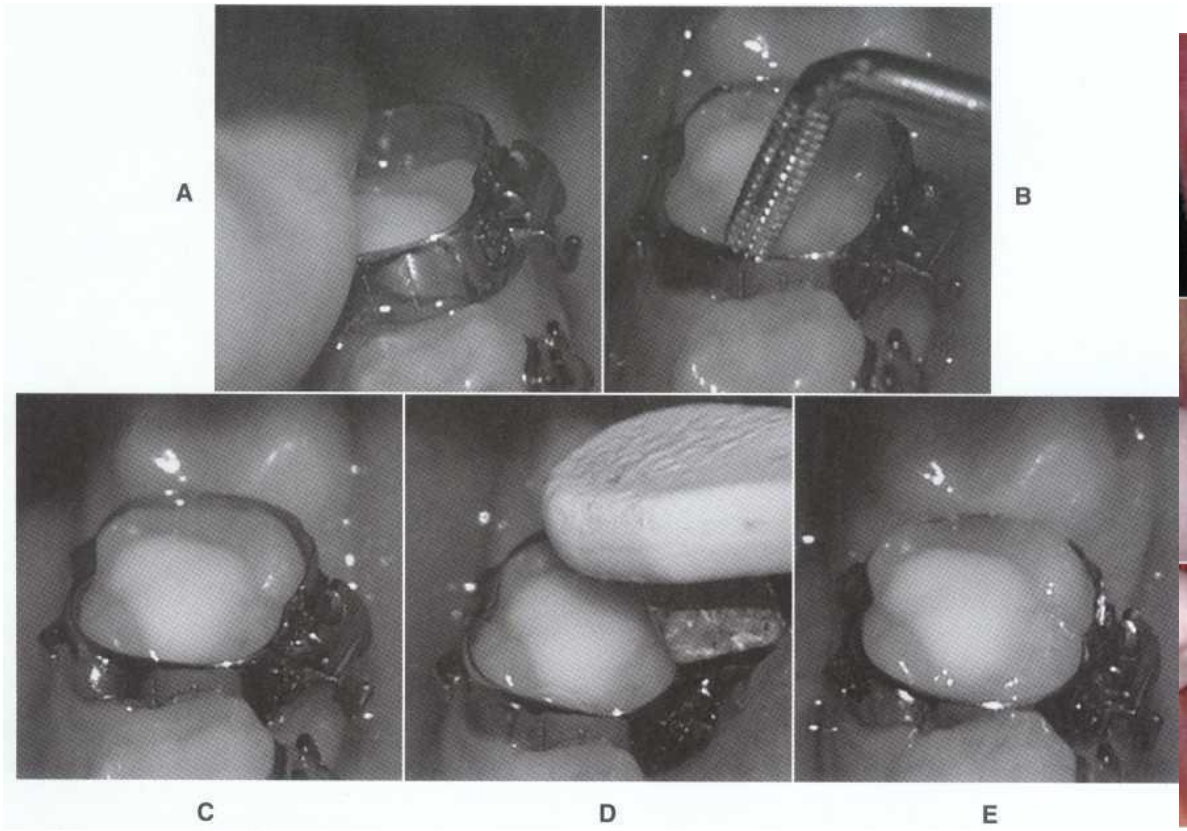
Attachments can be fixed to the teeth surfaces by either banding or bonding. The procedure of cementing a band to the tooth is called “banding". The method of fixing attachment directly to enamel using resins is called bonding. It greatly enhances esthetics, and maintenance of oral hygiene as compared to banding.

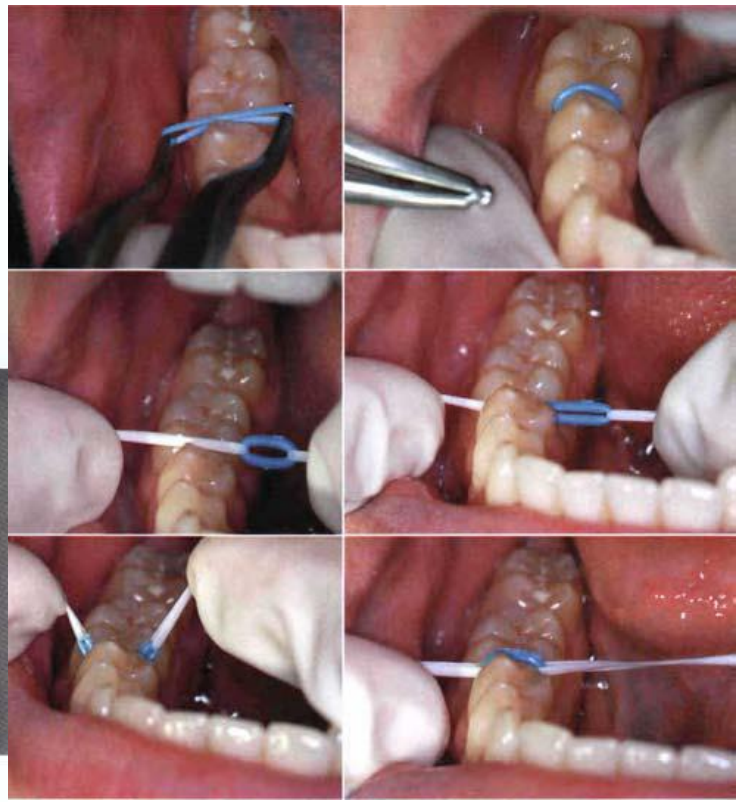
Banding involves:

a. Separation of teeth.

b. Selection of proper band size with close fit.

c. Cementation of the band preferably using glass ionomer cement.



A number of indications still exist for use of a band rather than a bonded attachment, including:

a. Teeth that will receive heavy intermittent forces against the attachments, e.g, an upper first molar against which extraoral force is placed via a headgear.

b. Teeth that will need both buccal and lingual attachments such as a molar with both headgear tube and transpalatal bar.

c. Teeth with short clinical crowns, so that bonded brackets are difficult to place correctly.

d. Teeth with extensive restorations.

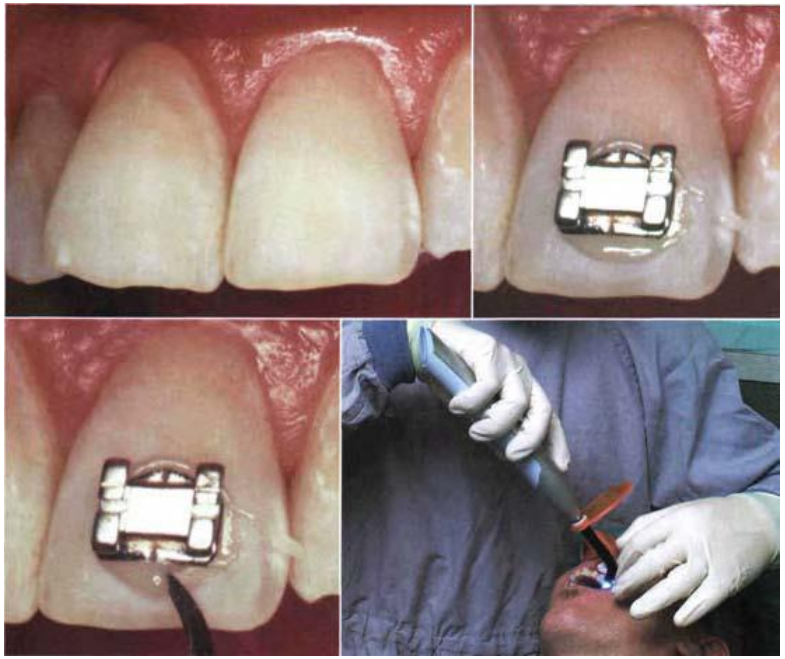
Bonding may be made directly in the office, or indirectly through a lab. Direct bonding involves:

Cleaning the tooth surface, to remove any pellicle using a slow hand piece and prophy brush or cup;

Acid-etching the enamel surface using 35-37% phosphoric acid for 15-30 seconds;

Washing and drying the tooth surface;

Placing unfilled primer on the etched area of the tooth;
Placing composite resin on the bracket base;
Positioning the bracket on the tooth crown;
Cleaning up excess composite from around the bracket base; and
Curing the composite,either chemically or with a blue light source. It is very important to clean up excess composite or 'flash' as this can create problems in maintaining high levels of oral hygiene and result in demineralization around the bracket, a major risk of fixed appliance therapy.



In indirect bonding, the brackets are glued with a temporary material to the teeth on the patient's models, transferred to the mouth with some sort of tray into which the brackets become incorporated, and then bonded simultaneously with adhesives.

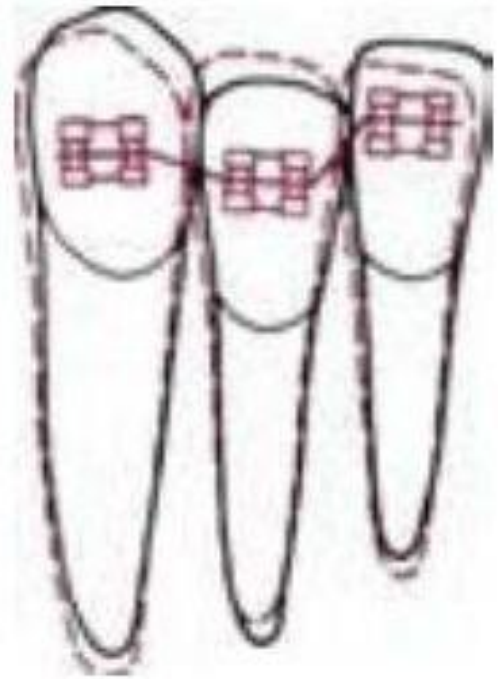
The main advantages of indirect compared to direct bonding are:
a.The brackets can be positioned more accurately in the laboratory.
b.The clinical chair time is decreased.

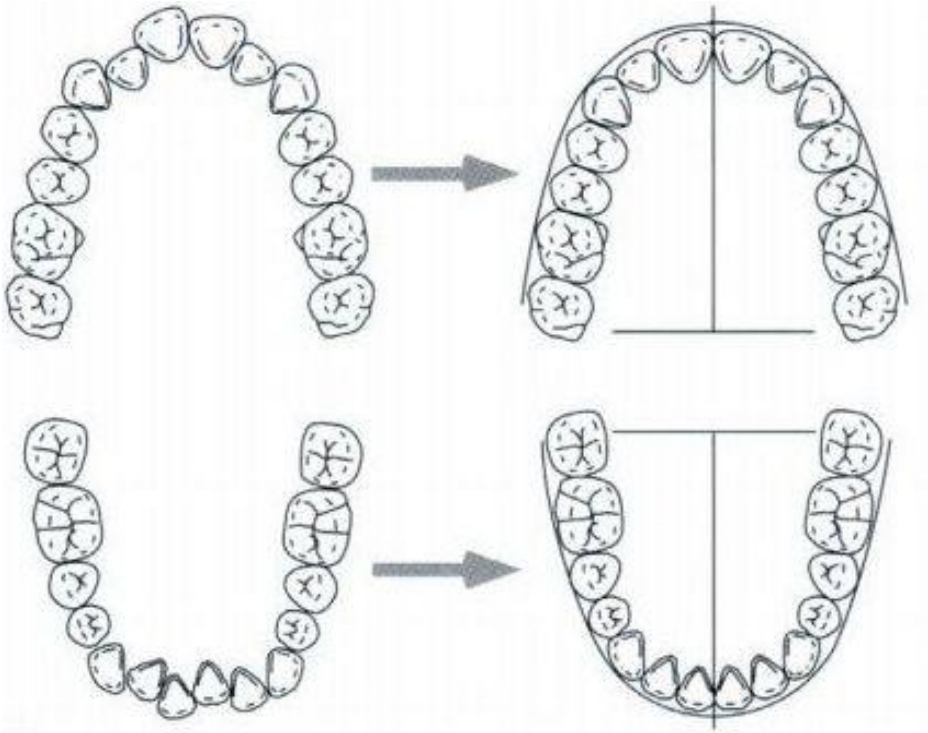
However,the method is:
1. Technique-sensitive.
2.The procedure requires greater experience.
3. Removal of excess adhesive can be more difficult and more time consuming with some techniques.
4.The risk for adhesive deficiencies under the brackets is greater.
5. The risk for adhesive leakage to interproximal gingival areas can disturb oral hygiene procedures.
6. The failure rates with some methods seem to be slightly higher.

The comprehensive orthodontic treatment with fixed appliance

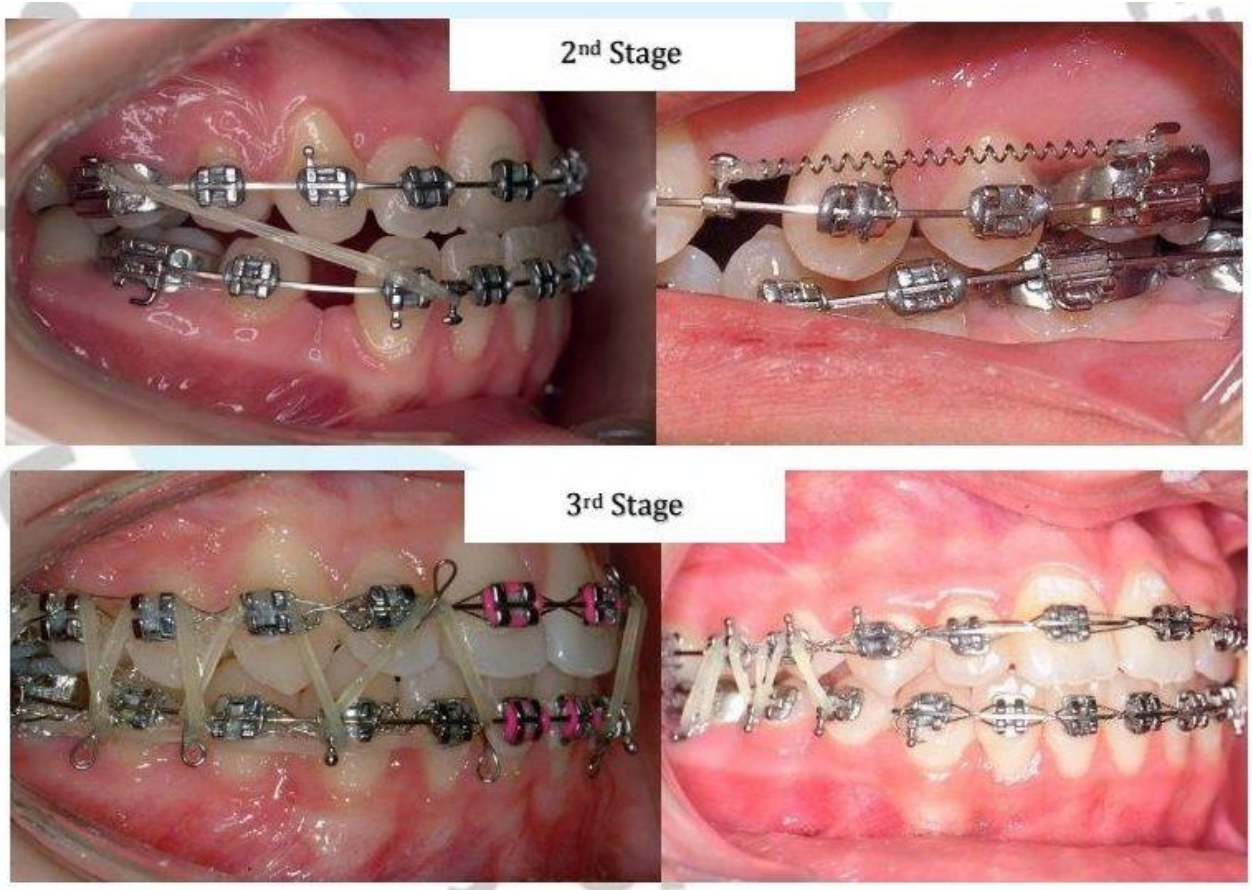
1st stage: Alignment and leveling: Eliminating rotations, bringing the teeth to one line buccolingually and one level occlusogingivally following the archwire shape.

It facilitates future treatment stages.





2nd stage: Correction of molar relationship and space closure (e.g. extraction space).
3rd stage: Finishing (settling): optimizing occlusal relationship between upper and lower dental arches.



## Visit frequency

Following insertion, the patient must be seen regularly to evaluate the progress of treatment and make the necessary adjustments. There is no agreement or evidence to support a specific timeframe. Most orthodontists see their patients every 4 weeks, others see them every 6,8, or 10 weeks intervals.

These visits are also necessary to avoid or prevent problems during orthodontic treatment. The problems encountered are caries and decalcification, debonded brackets, loose bands and soft tissue problems.

## Treatment duration

There is no specific way to estimate duration of treatment. It usually takes 12-30 months, depending on the complexity of the case. Missing appointments will lengthen treatment duration.

Pain with fixed orthodontic appliances

Some pain may be felt in the teeth for a period of 3-5 days following each adjustment visit, especially during eating. The pain level is usually mild to moderate. Analgesics like ibuprofen or paracetamol may be used to decrease pain.

Some pain may be felt with salty or sour food because of ulcers. Ulcers often develop as a result of rubbing the cheeks and lips with the appliance during normal function. This usually lasts for few days after insertion, and can be reduced by using orthodontic wax.

Trauma to the cheek may happen because of a protruding wire; it is better to go to the orthodontist to fix it, meanwhile orthodontic wax can be used to reduce irritation.

Instructions for patients wearing a fixed appliance:

1-Teeth cleaning:

A. It is necessary to clean the teeth with a toothbrush using fluoridated toothpaste for three minutes immediately after each time you eat, and before going to bed. It is preferable to have a traveler brush with you all the time to ensure cleaning the teeth after each time you eat.

B. You should clean all the surfaces of the teeth thoroughly including the area between the teeth and brackets.

C. Cleaning the teeth with a fixed orthodontic appliance in place is more difficult and takes more time than without an appliance.

D. Fluoridated alcohol-free mouthwash should be used at least once daily after toothbrushing. You should avoid eating or rinsing your mouth for at least 20 minutes after using the mouthwash.

E. Having snacks and drinks with a high sugar content without proper cleaning of your teeth will result in permanent damage to the teeth.

2-Food:

A.Avoid snacks and drinks with a high sugar content between meals and at bedtime.

B. Avoid sticky food, especially sweets and chewing gum, as they will stick to the teeth and theappliance, this will increase the accumulation of bacterial plaque around orthodontic brackets, leading to decay

C. Avoid hard food like nuts as it can damage the appliance,and requiring repair. Fruits and vegetables that are relatively hard, like apples or carrots should be cut into small pieces.

D. Avoid frizzy drinks and consuming large quantities of fruit juice.

E.Since it will be necessary to use a tooth brush after eating, most patients find it best to avoid snacks between main meals.

3- Appliance breakage:

A. In case of appliance breakage, you should contact your orthodontist immediately to schedule an emergency appointment. You should not wait for your regular appointment, as this may result in unfavorable tooth movement, or further damage to the appliance which will eventually increase treatment duration.

B. Repeated breakages of an appliance because of poor care may result in stopping treatment.

C. You should wear a protective shield while practicing contact sports, according to your orthodontist's instruction.

4- Maintain regular visits and follow your orthodontist's instructions.

# Oral Hygiene measures

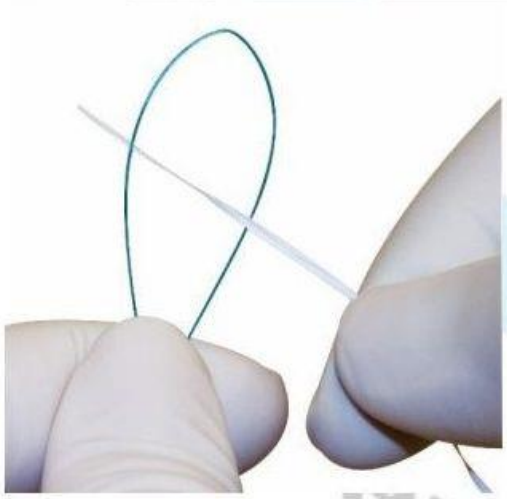
## for patients with fixed orthodontic appliance:

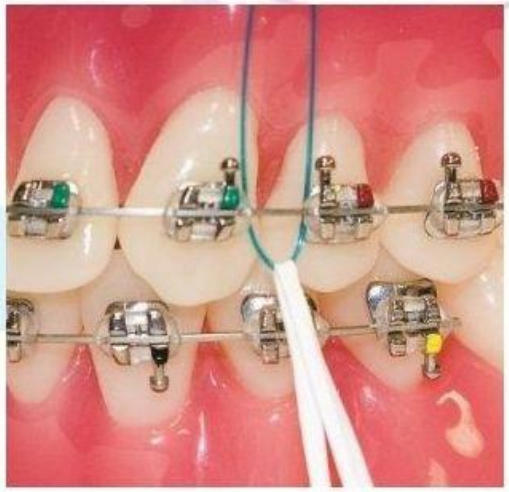
Tooth brushing: preferably using a V trim tooth brush to clean the appliance, and a regular brush to clean the occlusal and lingual/palatal surfaces of the teeth.

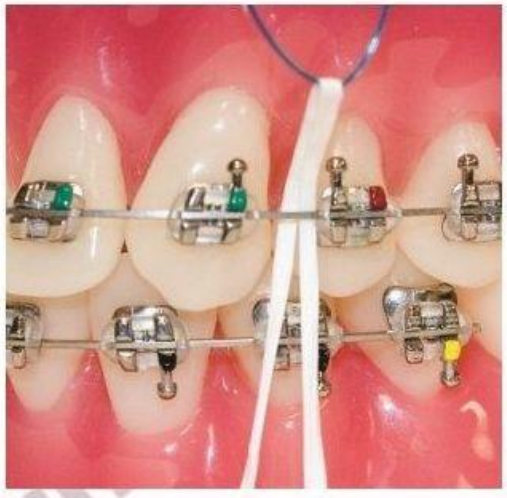
Using interdental brush for interproximal and detailed cleaning.

Flossing: The floss is passed between the archwire and the teeth using a floss threader.

Interdental brush







Using a floss and a floss threader to clean between the teeth.

A superfloss may also be used without the need for a floss threader. Alternatively, a water flosser may be used.
Mouth rinses: Fluoridated mouth rinses are usually used.

Superfloss parts: 1) plastic threader,
2) spongy part, 3) soft nylon floss.

Risks of orthodontic treatment

Orthodontic treatment is not without risk. These include:

1-Enamel demineralization

The incidence of demineralization during fixed appliance therapy is high and can result in the development of enamel opacities on the labial surfaces of the teeth. The main etiological factors are poor oral hygiene and a diet high in refined sugars. In combination and over the long-term, these factors will inevitably result in demineralization and permanent marking of the teeth.

2- Enamel fracture and abrasion

The removal of a fixed appliance bonded to enamel carries a small risk of fracture at the enamel-dentinal junction if the bracket bond strengths are too high. In reality, bond strengths used are considerably lower than this, and at debond failure usually occurs at the bracket base-adhesive junction. An exception to this proved to be some early ceramic bracket systems; manufacturers were concerned with failure of the bracket bond during treatment and enhanced the mechanical bonding chemically. This resulted in excessive bond strengths and a significant risk of enamel fracture on debonding. Modern ceramic bracket bases are designed with features that facilitate easier debonding, which reduces the risk of enamel fracture. Attrition of teeth occluding against ceramic brackets is the most important disadvantage of the ceramic brackets. The clinician must avoid bracket contact with opposing teeth.

3- Root resorption

External apical root resorption (EARR) is an almost universal finding following orthodontic treatment, but this is usually not clinically significant and has no influence on long-term health of the teeth. Severe root resorption, when more than one-third of the root length is lost, has been reported to occur in between 1% and 5% of orthodontically treated teeth.

4- Damage to the pulp

The use of excessive force or pushing the apex of teeth through the cortical plate can result in a loss of vitality. Teeth with a history of trauma are more susceptible to vitality loss during treatment, but in most cases, there is no obvious cause. Fortunately, loss of vitality is a rare complication of orthodontics.

5-Gingivitis

Gingival irritation is inevitable with the use of fixed appliances, especially when bands are used, and this is exacerbated by poor oral hygiene that can result in gingival hyperplasia.

Gingival health improves significantly following the removal of appliances, with a reduction in probing depths mainly due to shrinkage of hyperplastic tissues.

6- Alveolar bone loss

A small loss of alveolar bone height following orthodontic treatment has been reported in relation to teeth adjacent to extraction sites, but there appears to be no long-term effect on periodontal health from orthodontic treatment.

An exception to this is orthodontic treatment in patients with active periodontal disease because this can rapidly increase bone loss. Periodontal disease should be treated, stable and well maintained in these patients prior to commencing orthodontic treatment. Orthodontic treatment can also result in recession when teeth are moved excessively in a labial or buccal direction during treatment, resulting in a bonydehiscence and gingival recession.

7- Oral ulceration

Traumatic ulceration in susceptible individuals is common particularly during the early stages of treatment.

8-Allergic reaction

Orthodontic wires and brackets contain nickel and patients allergic to nickel could have non-specific intraoral signs including erythematous areas and severe gingivitis despite good oral hygiene.

Instruments commonly used with fixed orthodontic appliance

Separating pliers used for placement of elastic separators

Bracket holding tweezer or bracket positioning tweezer is used in orthodontics for holding and positioning the bracket

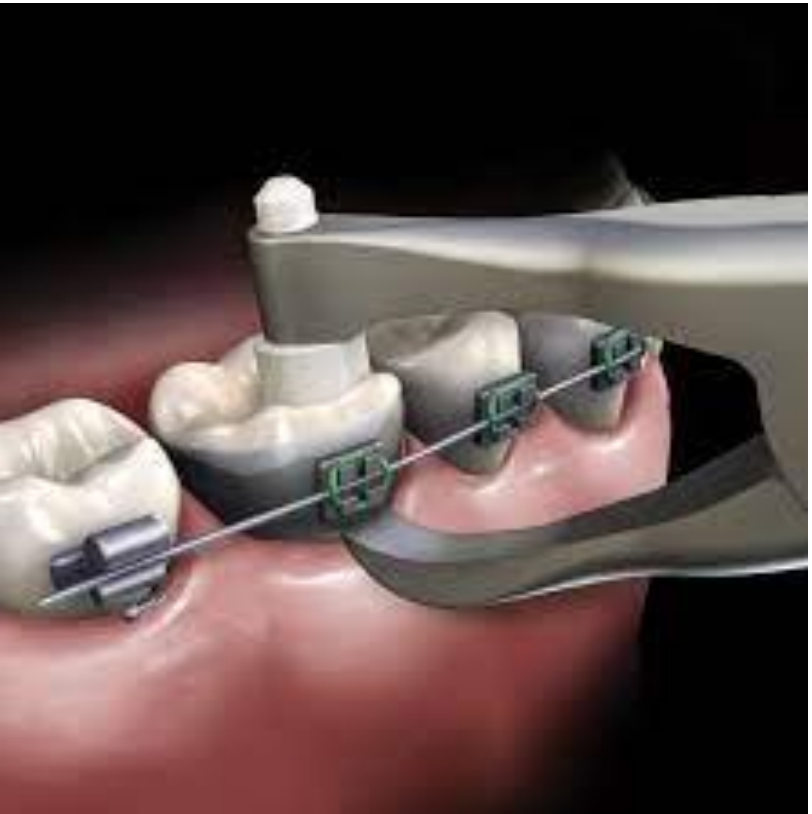
Mathieu hemostat a multipurpose instrument used to place elastic and steel ligatures on orthodontic brackets

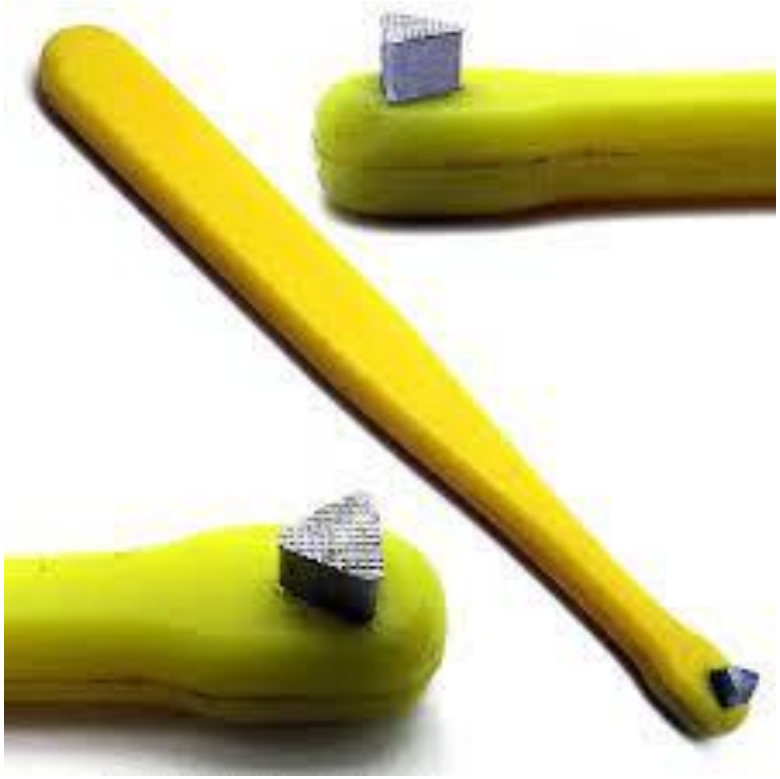

Howe pliers is a utility pliers which has serrated tips for gripping wires. It is useful for placement and removal of archwires as well as placement of pins and other auxiliaries

Cutter there are hard and ligature wires cutter
Distal end cutter it cuts and holds the wire distally to the buccal or bracket
Height gauge it is used to check the height of bracket placement from the incisal edge


Band seater is used to place and adjust orthodontic band

Band removing pliers as the name implies it helps removing band





Bracket debonding pliers: may be straight or angulated, used to remove bonded brackets.