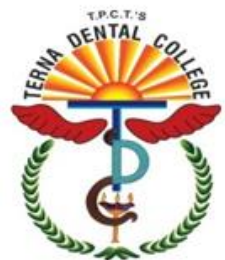
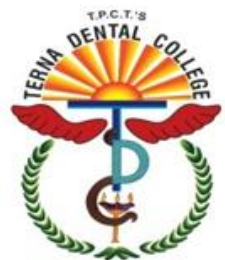


# Growth and Development of Nasomaxillary complex



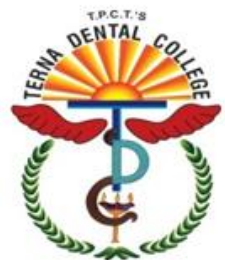
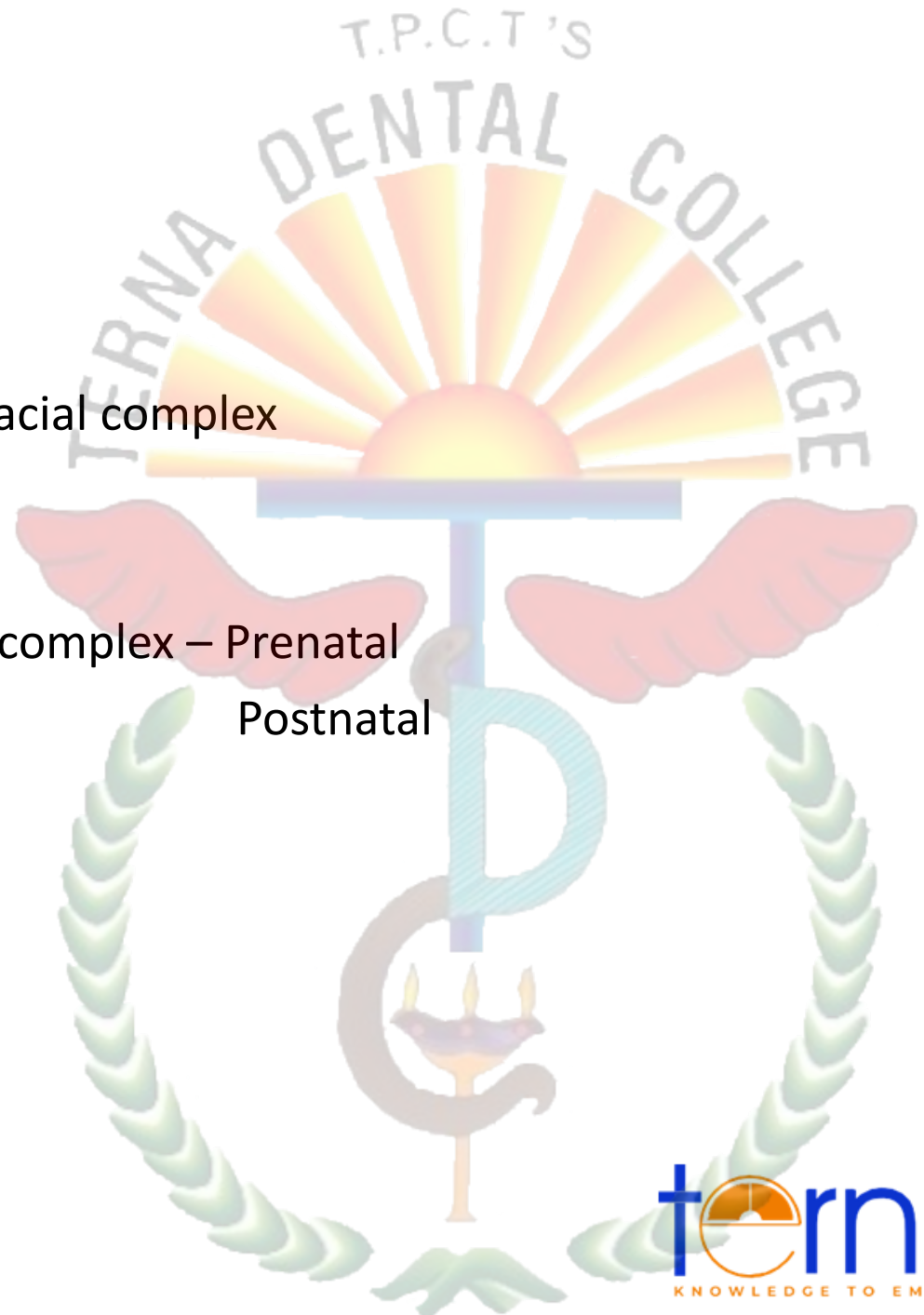
# Learning Objectives

- To understand the anatomy of the nasomaxillary complex
- To understand the concepts of growth associated with the growth of maxilla
- To understand different synchondrosis which lead to growth of maxilla.



# Contents

- Introduction
- Sites of growth in craniofacial complex
- Anatomy of maxilla
- Sites and type of growth
- Growth of nasomaxillary complex – Prenatal  
Postnatal

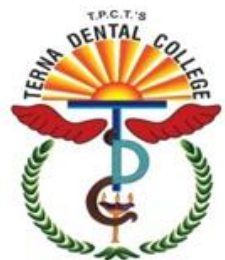


# Introduction

- The growth and development of the human face provides a fascinating interplay of form and function.

## **Growth:**

Increase in size ,change in proportion and progressive complexity



## Development:

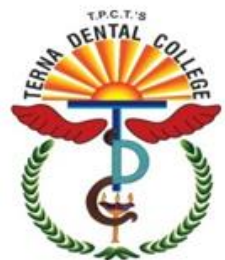
Refers to all the naturally occurring unidirectional changes in life of an individual from its existence as a single cell to its elaboration as a multifunctional unit terminating in death

- Moyers.



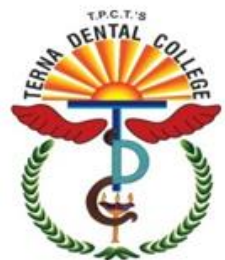
• To understand growth in any area of the body it is necessary to understand –

1. The site or location of growth
2. The type of growth occurring at that location
3. The mechanism of growth
4. The determinant or controlling factors in that growth

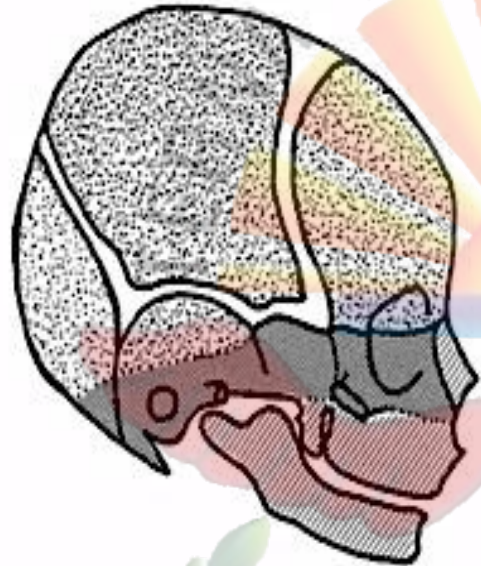


## Sites of growth in the craniofacial complex.

1. Cranial vault (Bones that cover outer surface of brain)
2. Cranial base (Bony floor under the brain)
3. Maxilla ( Nasomaxillary complex ) – Nose , Maxilla and associated small Bones
4. Mandible



### Embryonic origins of the skull



-  Desmocranium
-  Chondrocranium
-  Viscerocranium

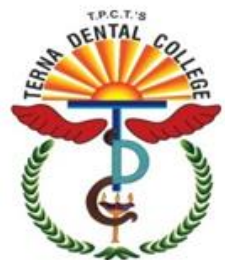
### Main developmental divisions of the skull





# Pre Natal Growth

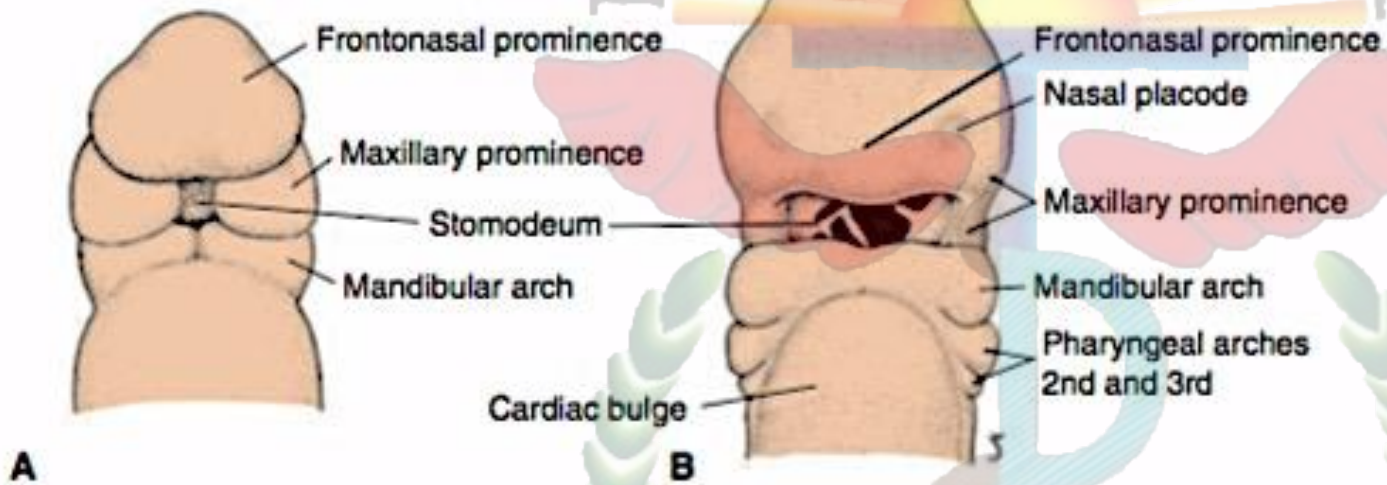
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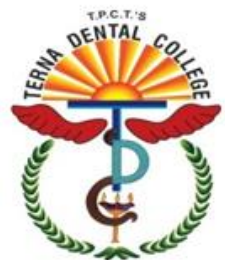
# Pre-natal development of maxilla

- Around the 4<sup>th</sup> week of intrauterine life, a prominent bulge appears on the ventral aspect of the embryo .
- Below the bulge a shallow depression which corresponds to primitive mouth is called **stomodeum**.

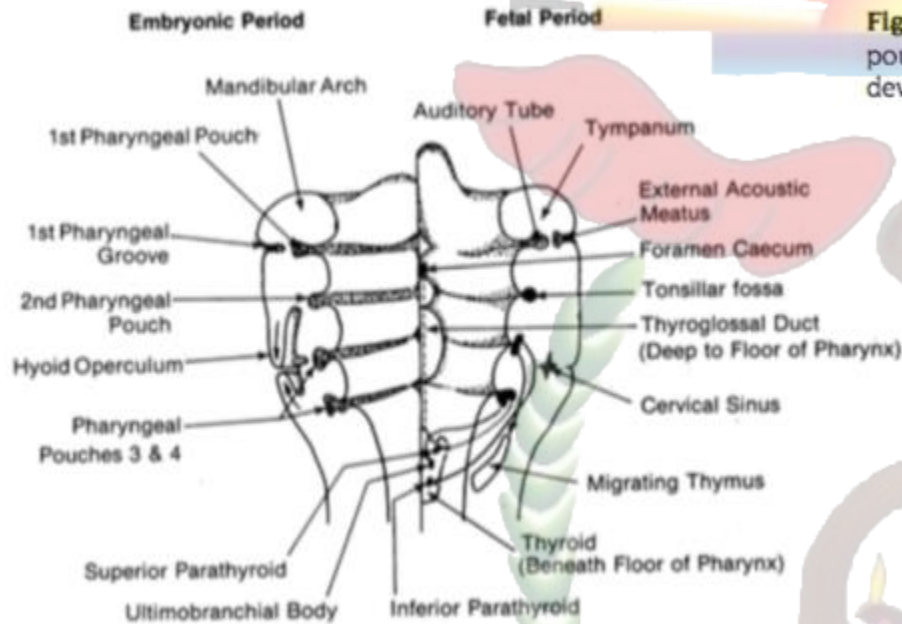




- The floor of the stomodeum is formed by the buccopharyngeal membrane that separates the stomodeum from the foregut.
- By around 4<sup>th</sup> week of intra uterine life ,five brachial arches form in the region of the future head and neck.
- The first brachial arch is called the mandibular arch plays an important role in the development of naso – maxillary region.



# Pharyngeal arches



**Figure 5-1** Schema of pharyngeal-pouch and pharyngeal-groove development.



# Brachial Arches

Sr no.	Arch	Skeleton	Muscle	Nerve
1.	Mandibular	<p><u>Meckels</u> cartilage ,incus, malleus, spine of sphenoid, anterior ligament of malleus, <u>sphenomandibular</u> ligament, maxilla ,mandible , secondary palate</p>	<p>Muscles of mastication, <u>mylohyoid</u>, anterior belly of <u>diaphragmatic</u>, tensor tympani, tensor <u>palatini</u></p>	<p>Mandibular division of trigeminal nerve</p>



Sr no.	Arch	Skeleton	Muscle	Nerve
2.	Hyoid	<u>Riechert's</u> Cartilage, <u>styloid</u> process, stapes , Lesser horn and superior part of hyoid bone , <u>stylohyoid</u> ligament	Muscles of facial expression, <u>stylohyoid</u> , <u>stapedius</u> , posterior belly of <u>diaphragm</u>	Facial nerve
3.	Third	Lesser horn and superior part of hyoid bone	<u>Stylopharyngeus</u>	Glossopharyngeal nerve



Sr no.	Arch	Skeleton	Muscle	Nerve
4.	Fourth	Thyroid cartilage, Laryngeal Cartilages	Constrictors of pharynx, <u>cricothyroid</u>	Superior Laryngeal nerve
5.	Sixth	Laryngeal cartilages	Laryngeal muscles except <u>cricothyroid</u>	Superior laryngeal nerve , pharyngeal plexus, Inferior laryngeal nerve





# Development of facial region

- The external face forms from two sources that surrounds the oropharyngeal membrane.



## Prominence

## Structures Formed

Frontonasal

Forehead, bridge of the nose, median and lateral nasal process

Maxillary

Cheeks, lateral portion of the upper lip

Median nasal

Philtrum of the upper lip, crest, and tip of the nose

Lateral nasal

Alae of the nose

Mandibular

Lower lip



Frontonasal process  
(Fifth Week)



Median nasal process

Lateral nasal process

Maxillary Process

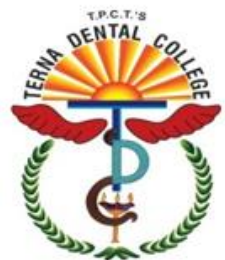
Mandibular Process

Sixth week

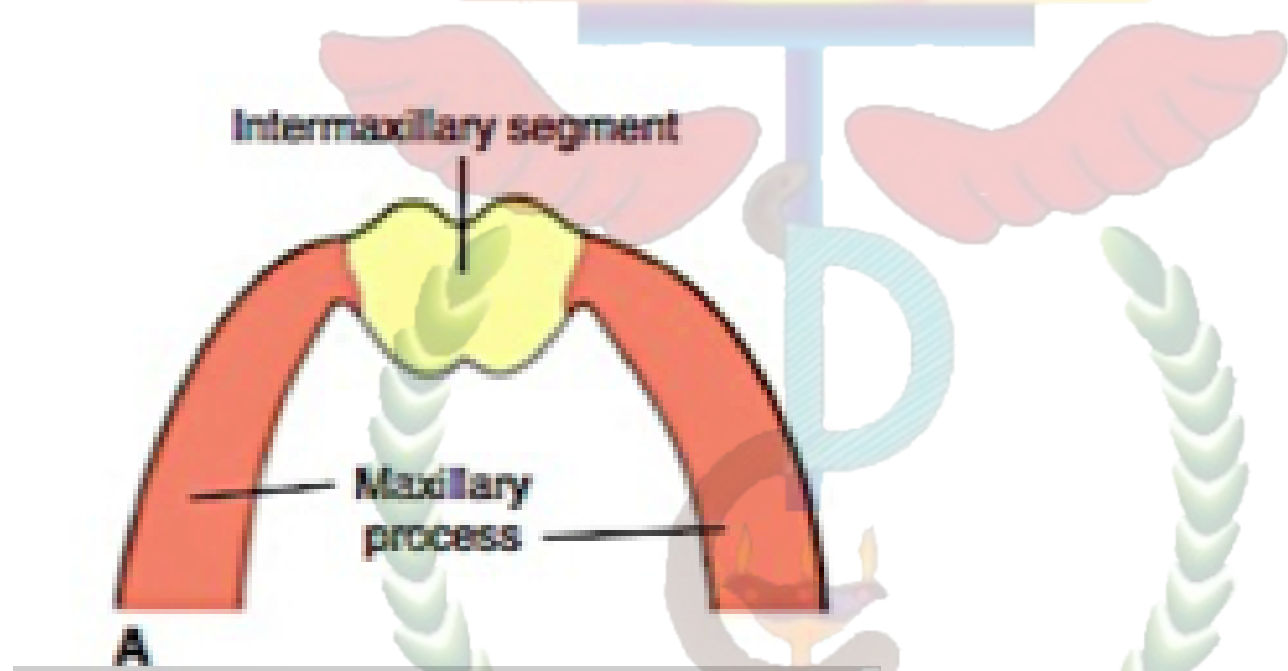
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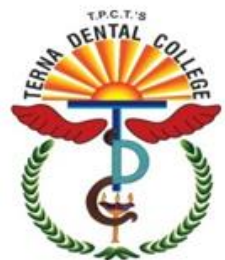
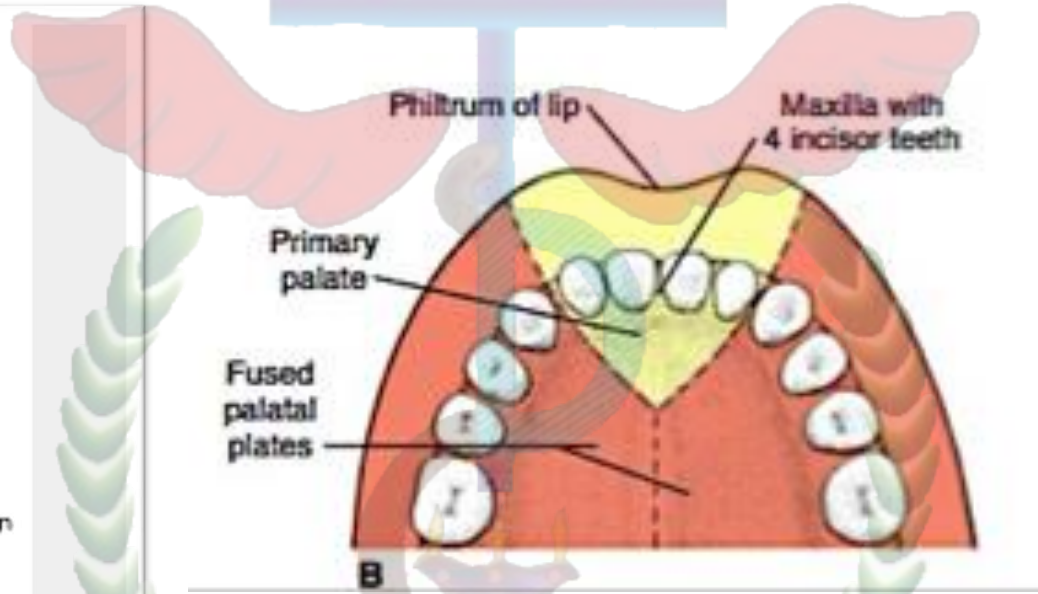
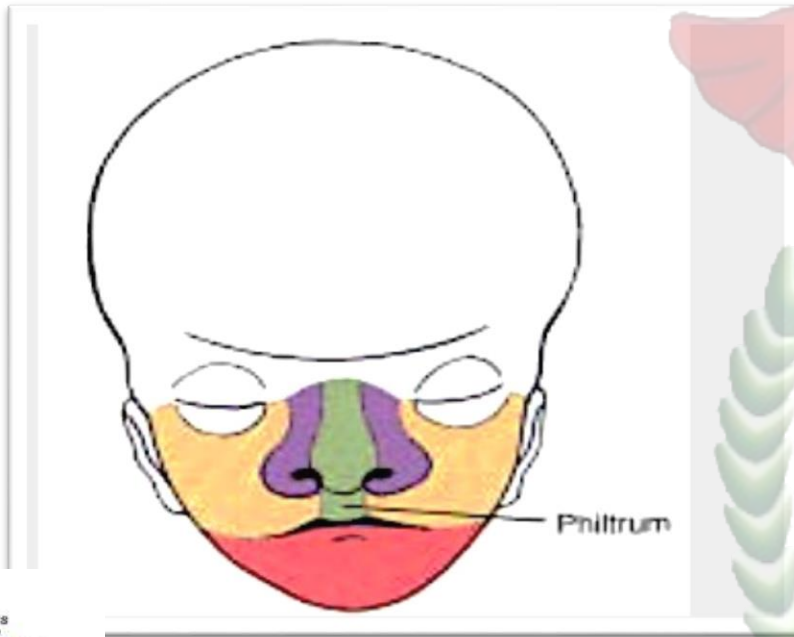
gives the impression that the nasal processes invaginate.



- The merged nasomedial processes form the intermaxillary segment, which is a precursor for :-

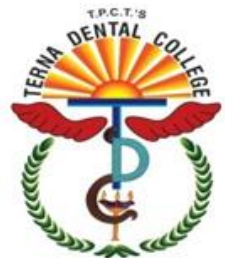


- Philtrum of the lip
- Premaxillary component of the upper jaw,
- Primary palate



# Palate

- The palate is derived from three primordia:
- Unpaired median palatine process
- Pair of lateral palatine processes

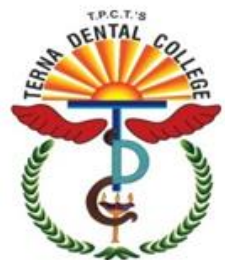


**AT 6 TH WEEK**

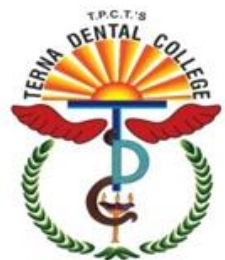
The *primary palate*, formed by the two maxillary and two medial nasal processes, separates the developing oral and nasal cavities.

**AT 6<sup>TH</sup>-8<sup>TH</sup> WEEK**

The *secondary palate* is formed from two palatal processes (outgrowths of the maxillary processes).



- Primary and secondary palates together form the definitive palate.
- The median palatine process forms a triangular bony structure called the **primary palate**.
- In postnatal life, the skeletal component of the primary palate is referred to as the **pre maxillary component of the maxilla**

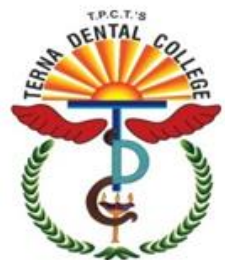




The primary palate is formed by

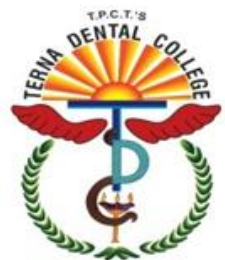
Firstly Coming into contact with the lateral nasal processes

Secondly with the globular process of the medial nasal processes



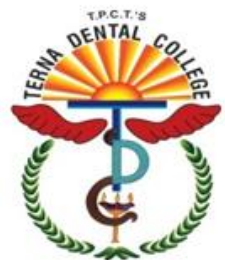
The secondary palate can also be divided into two anatomical parts:-

- Anterior hard palate - ossified (contributions from the maxilla and palatine bones)
- Posterior soft palate - muscular



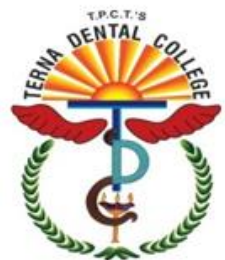
# Formation of the palate

- a. Growth of the palatal shelves
- b. Elevation
- c. Fusion
- d. Removal of the epithelial at the site of fusion.

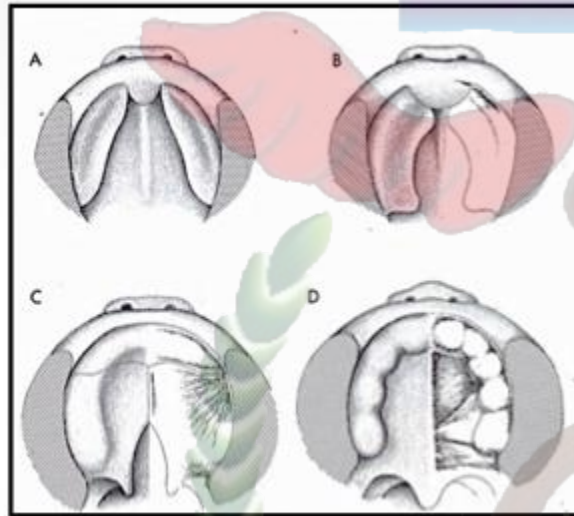


# Formation of secondary palate

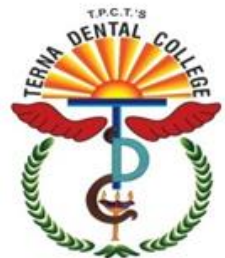
- The posterior border of the primary palate is located just posterior to the site of the future incisive foramen of the skull.
- As the face grows in an antero - posterior dimension, the primary palate soon is too short to provide adequate separation between the nasal cavities and the oral cavity .



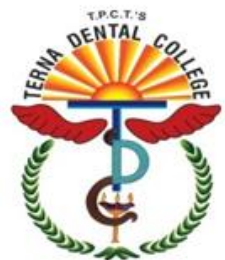
# Fusion of palatal shelves



Fusion of the palatal shelves



- The epithelium overlying the edges of the palatal shelves is especially thickened, and their fusion is crucial to intact palatal development.
- Fusion also occurs between the dorsal surfaces of the palatal shelves and lower edge of the midline nasal septum.
- The fusion initially forms anteriorly in the region of the hard palate, with subsequent merging in the region of the soft palate



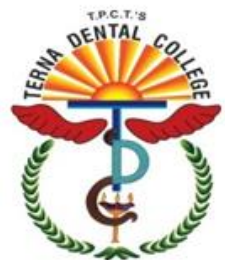
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# Post Natal Growth



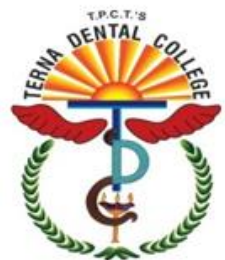
# Growth of maxilla

- The maxilla develops postnatally entirely by intramembranous ossification.
- As there is no cartilage replacement, growth occurs in two ways :
  1. Apposition of bone at the sutures that connect the maxilla to the cranium and cranial base.
  2. Surface remodeling.



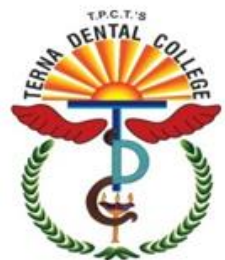
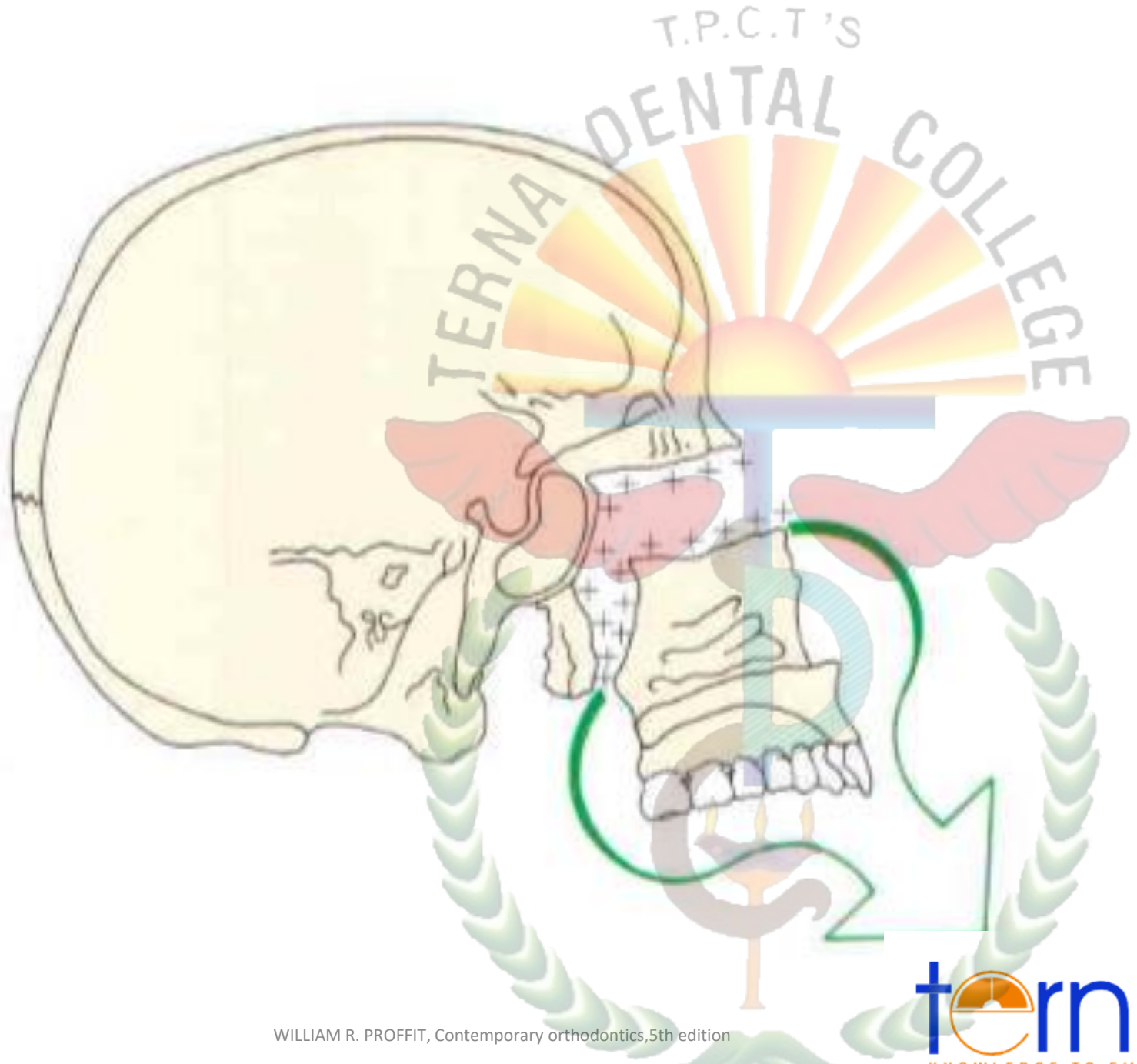


- The growth pattern of the face requires that it grow “out from under the cranium”
- This type of growth is accomplished in two ways :
  1. By a push from behind created by cranial base growth
  1. By growth at the sutures



- Upto 6 yrs of age, displacement from cranial base growth is an important part of maxilla's forward growth.
- Failure of the cranial base to lengthen normally creates a characteristic mid face deficiency. (eg: Achondroplasia).
- At about 7 yrs of age, cranial base growth stops and then the sutural growth is the only mechanism for bringing the maxilla forward.



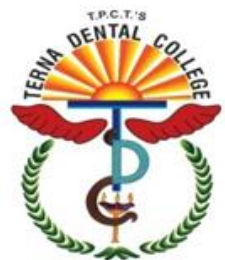


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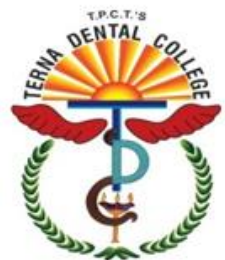
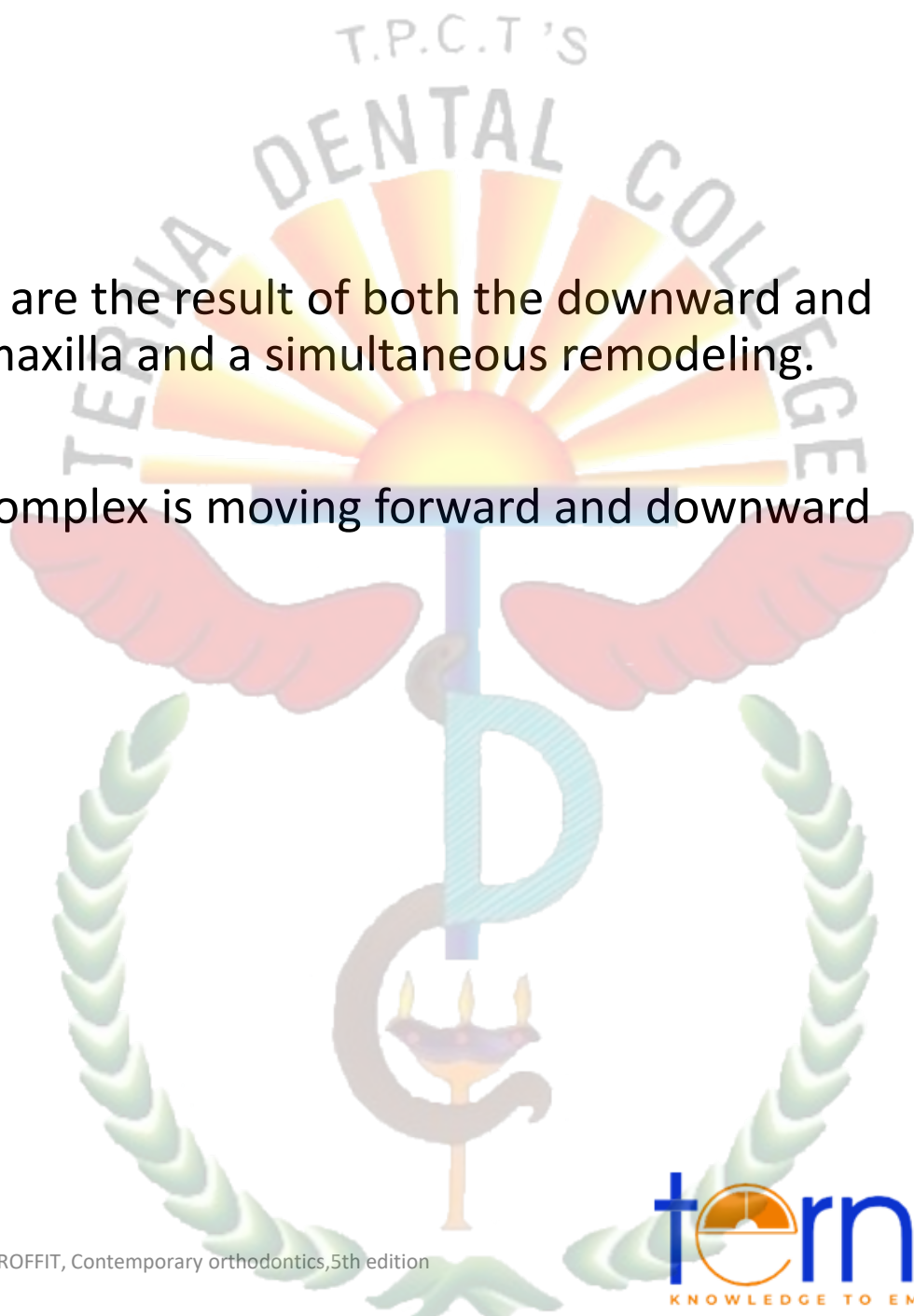


# Surface remodeling

- As the maxilla grows downward and forward, its front surfaces are remodeled, and the bone is removed from most anterior surface.

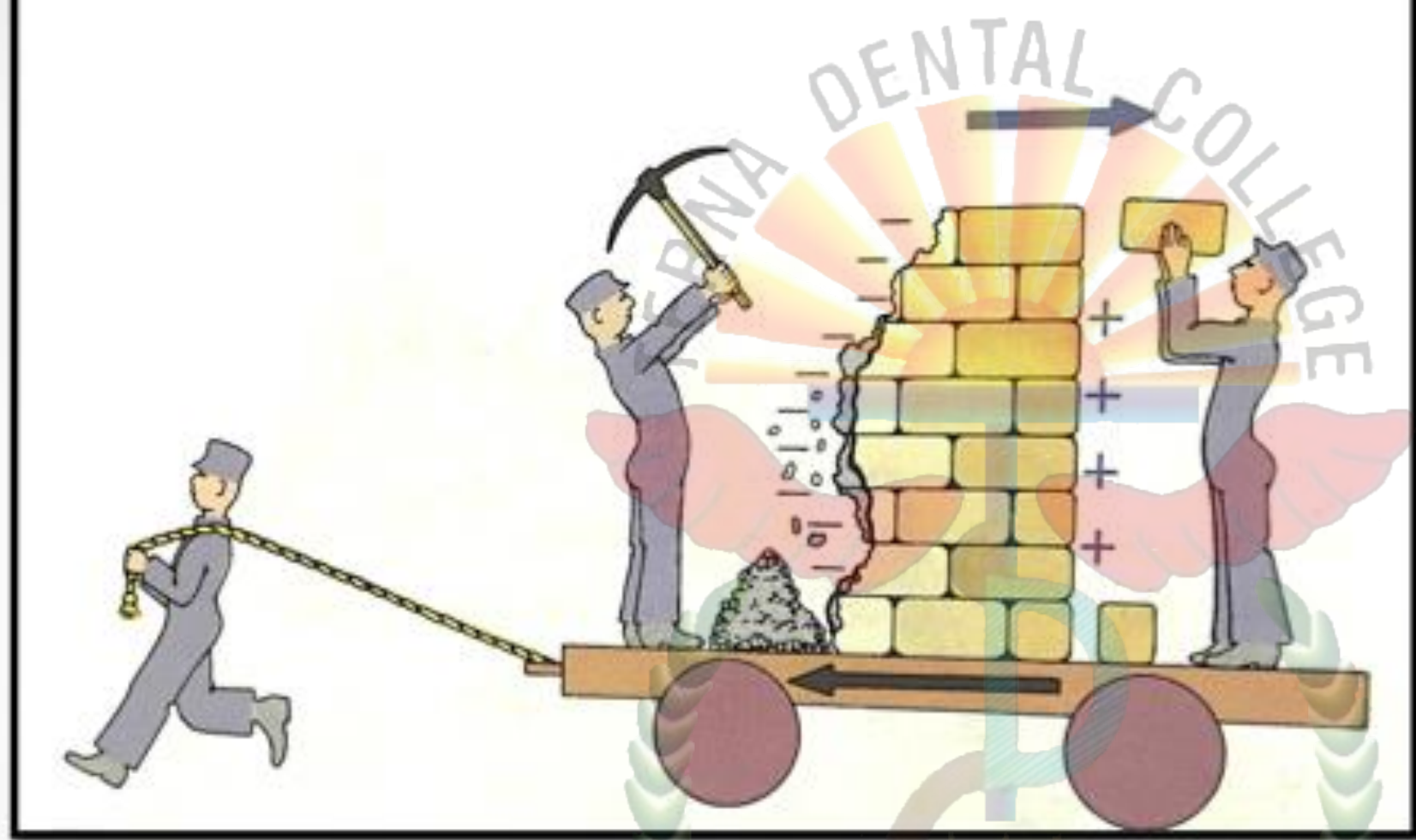


- The overall growth changes are the result of both the downward and forward translation of the maxilla and a simultaneous remodeling.
- The whole naso-maxillary complex is moving forward and downward relative to the cranium.

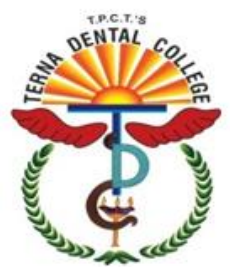


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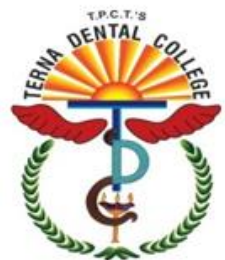
## Surface remodeling of bone



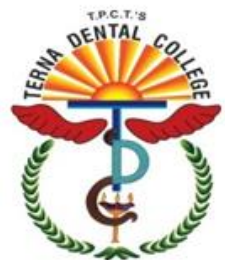
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- Different parts of the maxilla are growing and moving in a complex variety of directions.
- The overall plan of maxillary growth is much more complex than the simplified generalization stating that the maxilla grows downward and forward by a process of bone deposition on posterior and superior surfaces.



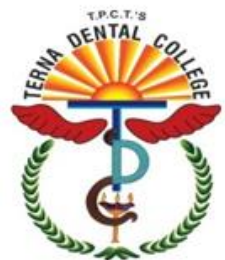
- Bone Growth at the maxillary sutures causes a **resultant thrust** of the whole maxilla anteriorly and inferiorly.
- The sutural connective tissue is **not adapted** to a pressure related growth process.
- The suture is essentially a **tension-adapted** tissue.



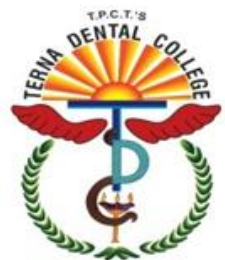


# Maxillary tuberosity

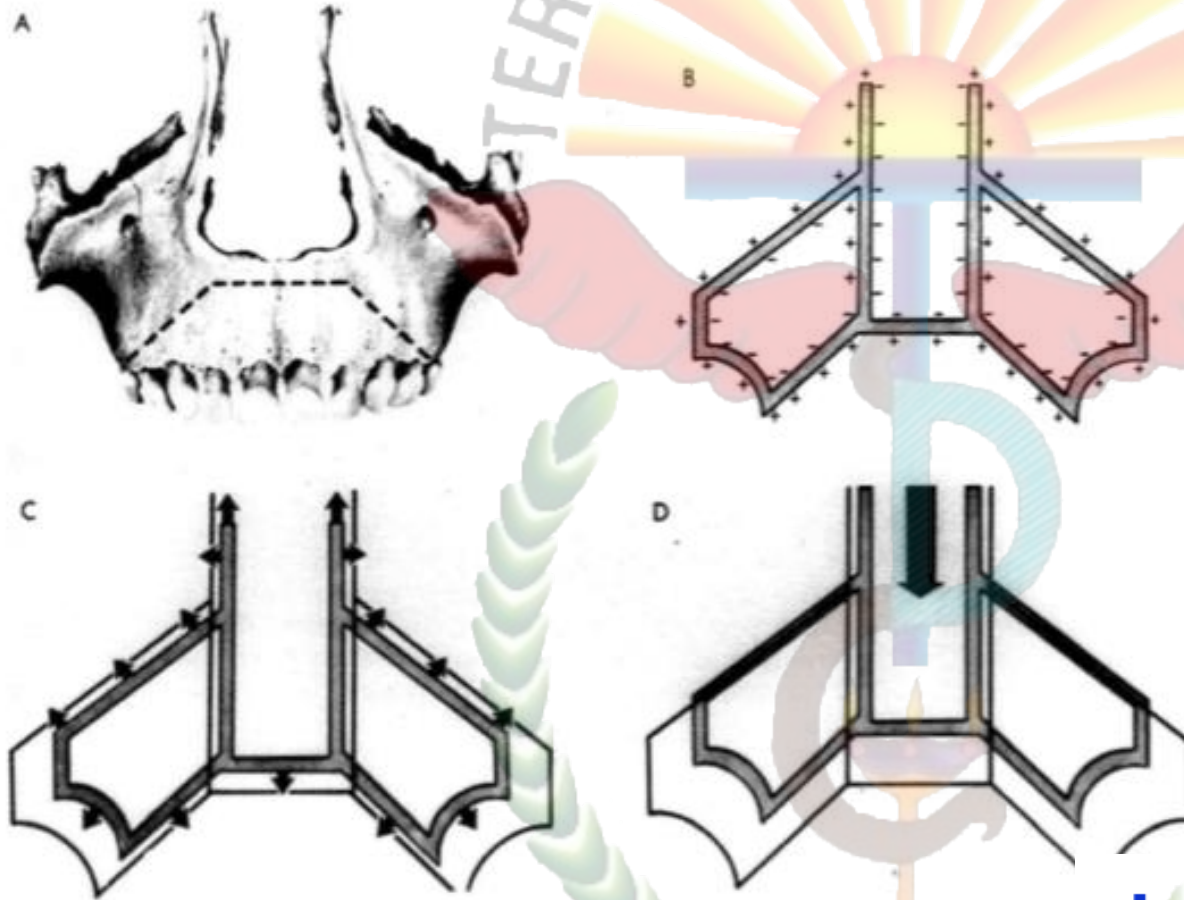
- The ***horizontal lengthening*** of the bony maxillary arch is produced by remodeling at the maxillary tuberosity.
- The maxillary tuberosity is a major "site" of maxillary growth.
- It does not, however, provide for the growth of the whole maxilla, but is associated with the lengthening of posterior part of the arch.



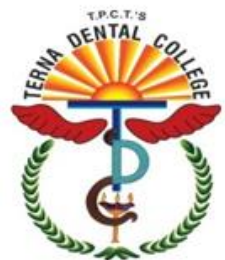
Depository fields – *It is* in which the backward-facing periosteal surface of the tuberosity receives continued deposits of new bone as long as growth in this part of the face continues.  
-It leads to widening of arch.



- **Resorptive fields** - Endosteal side of the cortex within the interior of the tuberosity (the maxillary sinus)



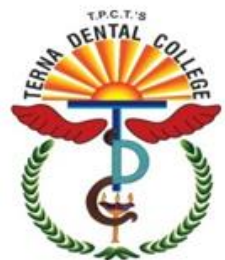
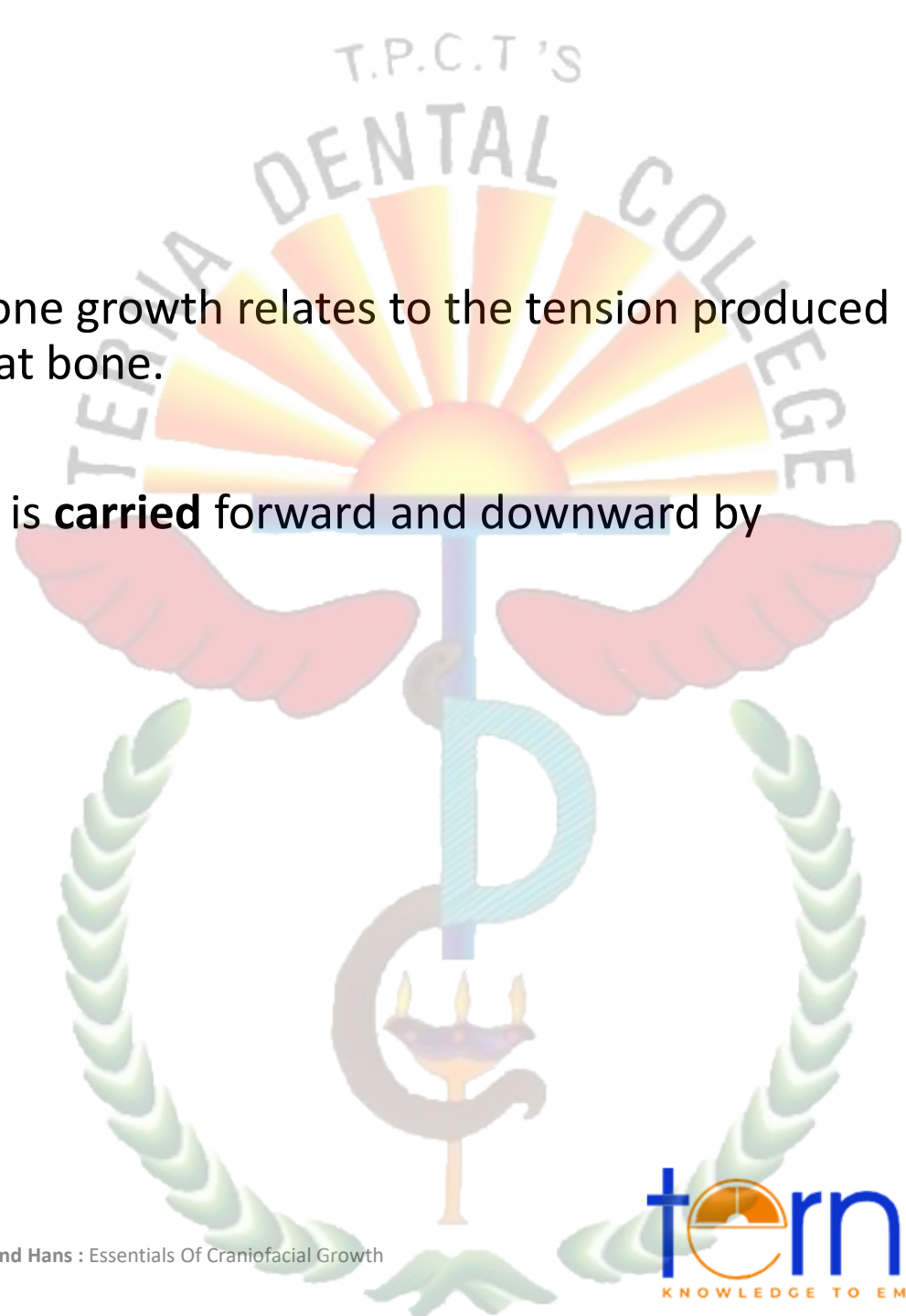
- The whole maxilla undergoes a simultaneous process of **primary displacement** in an anterior and inferior direction.
- Extensive remodeling occurs throughout the nasomaxillary complex as the entire region undergoes anterior displacement.



- One early theory suggested that additions of new bone on the posterior surface of the maxillary tuberosity "push" the maxilla against the adjacent muscle-supported pterygoid plates.
- Another theory held that bone growth within the various maxillary *sutures* produces a pushing-apart of the bones, with a resultant thrust of the whole maxilla anteriorly.

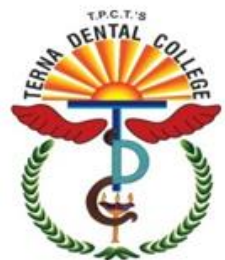


- The stimulus for sutural bone growth relates to the tension produced by the **displacement** of that bone.
- Thus, as the entire maxilla is **carried** forward and downward by displacement.

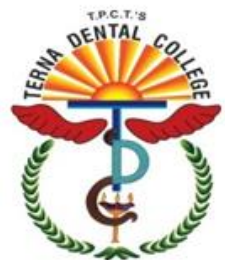


# Lacrimal suture :Key growth mediator

- The **sutural** system of the lacrimal bone provides for the "slippage" of the multiple bones with the pivotal lacrimal as they all enlarge differentially.
- The lacrimal sutures make it possible for the maxilla to "slide" downward along its orbital contacts.

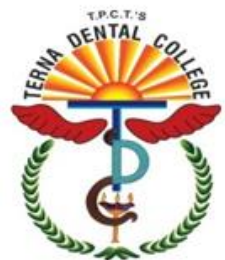


- This allows the whole maxilla to become displaced inferiorly.
- This is a key midfacial growth event

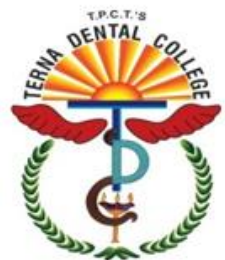




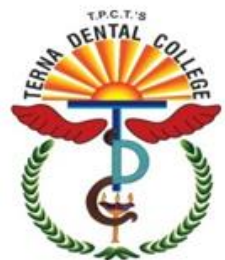
- The lacrimal bone itself undergoes a remodeling rotation
  1. *More medial **superior** part* remains with the lesser expanding nasal bridge
  1. *More lateral **inferior** part* moves markedly outward



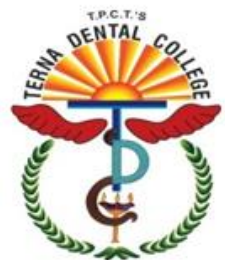
- Every function is completely carried out by a functional cranial component.
- Each such component is composed of two parts:
  - (1) A **functional unit** which actually carries out the function.
  - (2) A **skeletal unit** whose biomechanical role it is to protect and support its specific functional matrix.



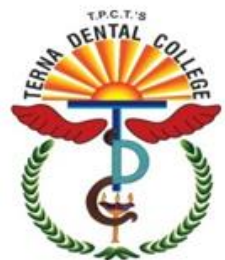
- The term functional matrix is by no means equivalent to what is commonly understood as only “soft tissues”.
- Although it includes muscles, glands, nerves, vessels, fat, etc. ,**Teeth are also a functional matrix**
- Indeed, most orthodontic therapy is based firmly on the fact that when this functional matrix grows or is moved, the related skeletal unit (the alveolar bone) responds appropriately to this morphogenetically primary demand.



- **Skeletal units** may be composed variably of bone, cartilage or tendinous tissues.
- When such a “bone” consists of a number of skeletal units, we call them micro- skeletal units.
- Eg :Both the maxilla and the mandible are formed of a number of such micro skeletal units.



- When adjoining portions of a number of neighboring “bones” are united to function as a single cranial component, we term this a macro skeletal unit;
- Eg : The endo cranial surface of the calvaria



## Take home message:

- Different tissues of the body grow at different rate at a different time
- The speno occipital synchondrosis is the last to fuse which plays a major role in the growth of maxilla
- The branchial arches are responsible for the growth of the craniofacial region

### Expected questions:

#### SAQ

1. Branchial arches
2. Synchondrosis
3. Speno – occipital synchondroses
4. Sutural theory

#### LAQ

1. Describe in detail pre and post natal growth of nasomaxillary complex.



Thank you

