Growth and Development

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Development • It is refer to an increase in complexity and specialization ,is qualitative measure .

Growth

- According to KROGMAN , growth is an

“Increase in size, change in proportion and

progressive complexity” is quantitively measured

GROWTH

PRENATAL
Before birth

POSTNATAL
After birth

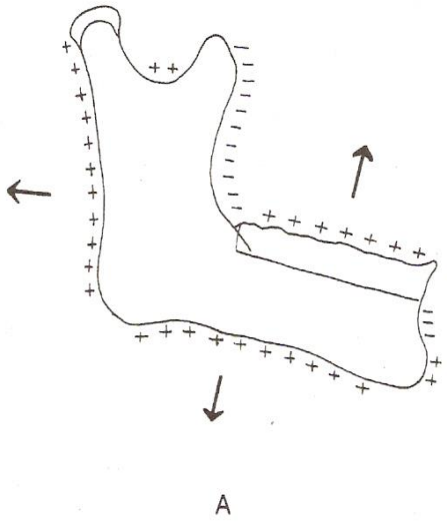
Mechanisms Of Bone Growth are:

- Remodeling

-Cortical drift

-Displacement

REMODELING



BONE DEPOSITION & RESORPTION:

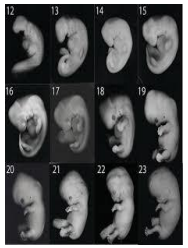
- Bone changes in shape & size by two basic mechanisms,bone deposition & bone resorption. The bone deposition & resorption together is called " BONE REMODELING".The changes that bone deposition & resorption can produce are:
- Change in size
- Change in shape
- Change in proportion
- Change in relationship of the bone with adjacent structures

CRITICAL DRIFT

- Most bones grow by interplay of bone deposition & resorption .A combination of bone deposition & resorption resulting in a growth movement towards the deposition surface is called “Cortical Drift”.
- If bone deposition & resorption on either side of a bone are equal, the thickness of the bone remains constant.
- If in case more bone is deposited on one side & less bone resorbed on the opposite side The thickness of the bone increases.

DISPLACEMENT

- Displacement: Growth which causes the mass of a bone to be moved relative to its neighbours. Displacement can be of two types.
- Primary displacement: If a bone gets displaced as a result of its own growth, it is called “Primary displacement”. e.g.. Growth of the maxilla at the tuberosity region results in pushing of the maxilla against the cranial base in a forward & downward direction.



Secondary displacement: If the bone gets displaced as a result of growth &enlargement of an adjacent bone, it is called “Secondary displacement.”e.g.. The growth of the cranial base causes the forward &downward displacement of the maxilla

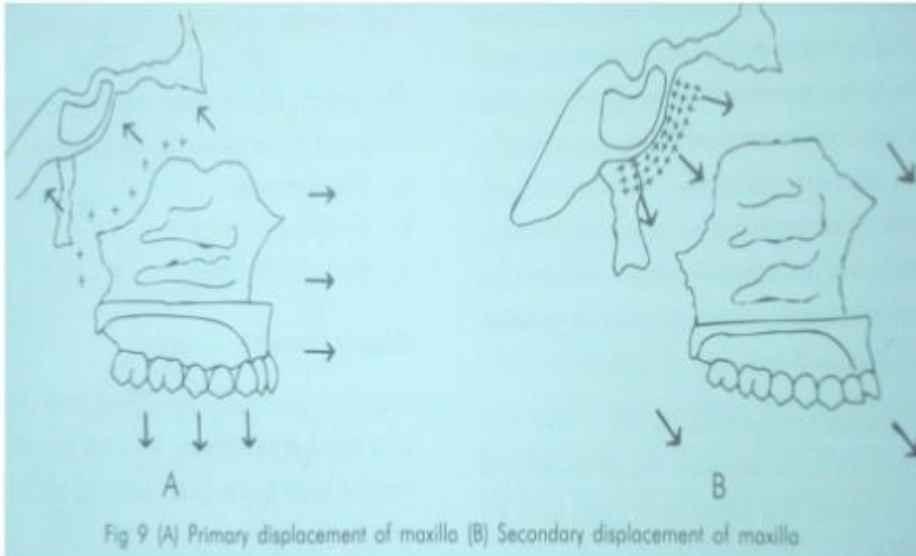
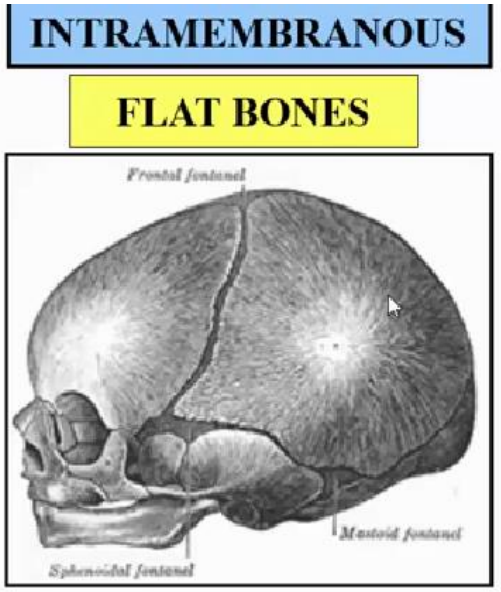


Fig 9 (A) Primary displacement of maxilla (B) Secondary displacement of maxilla

Bone formation occurs by 2 methods of differentiation of mesenchymal tissues. Accordingly 2 types of bone growth is normally seen.

- 1) Intra-membranous ossification : The transformation of mesenchymal connective tissue usually in membranous sheets, into osseous tissues. E.g. Cranial vault, face (Mx & body of Md) and the clavicles



2. Endochondral ossification: The conversion of hyaline cartilage into bone. E.g. Cranial base, condyle and Epiphyseal plate Proliferating cartilage.

GROWTH SPURTS

Growth doesn't take place uniformly at all times. There seem periods when a sudden acceleration of growth occurs. This sudden increase in growth is called growth spurt.

• The physiologic alteration in hormonal screation is believed to be the cause for such accentuated growth. The timing of growth spurt differs in boys and girls.

"Wow! That's some growth spurt!"

- The following are the timings of growth spurt

a. Just before the birth

b. 1 year after the birth

c. Mixed dentition growth spurt

Boys 8- 11

Girls 7-9

d. Pubertal growth spurt

Boys 14-16

Girls 11-13

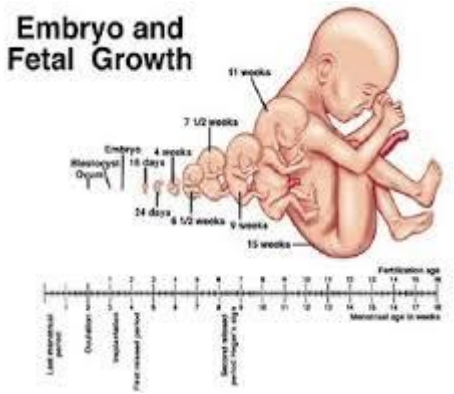
- Growth modification by the means of functional and orthodontic appliances elicit better response during growth spurt . surgical corrections of maxilla and mandible should be carried out only after cessation of growth spurt

Growth patterns

• Different tissues have different growth patterns (curves) in terms of rate and timing, and four main types are recognized: neural, somatic, genital, and lymphoid. The first two are the most relevant in terms of craniofacial growth.

Neural grow

• this essentially that which is determined by growth of the brain, with the calvarium following this pattern. There is rapid growth in the early years of life, but this slows until by about the age of 7 years growth is almost complete. The orbits also follow a neural growth pattern.



Somatic growth

- Is that which is followed by most structures. It is seen in the long bones, amongst others, and is the pattern followed by increase in body height. Growth is fairly rapid in the early years, but slows in the prepubertal period. The pubertal growth spurt is a time of very rapid growth, which is followed by further slower growth.
- Traditionally, the pubertal growth spurt has been reported to occur on average at 12 years in girls, but there is evidence that the age of puberty is decreasing in girls. In boys the age of puberty is later at about 14 years.

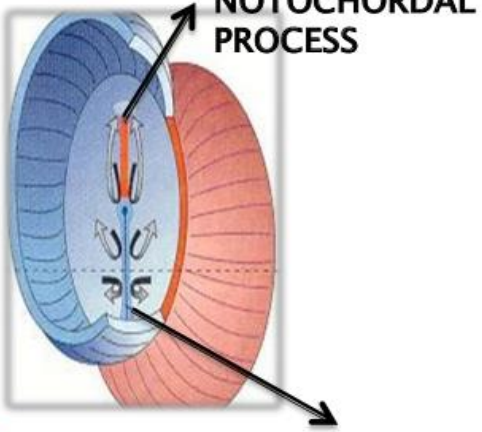
- PRIMARY GERM LAYERS

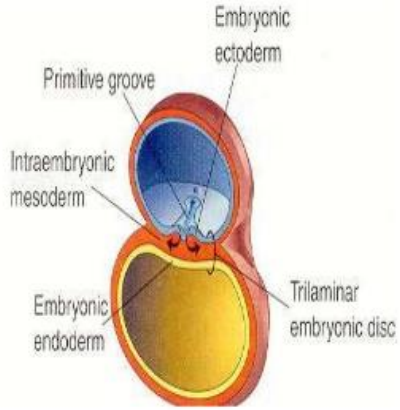
- ECTODERM ⟶ epithelium covering the outside of the body
  ⟶ epithelial lining of oral cavity, nasal cavity & sinuses.

- MESODERM ⟶ Skeletal system ,
  ⟶ muscles,
  ⟶ blood,
  ⟶ lymph cells,
  ⟶ vessels,
  ⟶ kidneys
  ⟶ internal organs

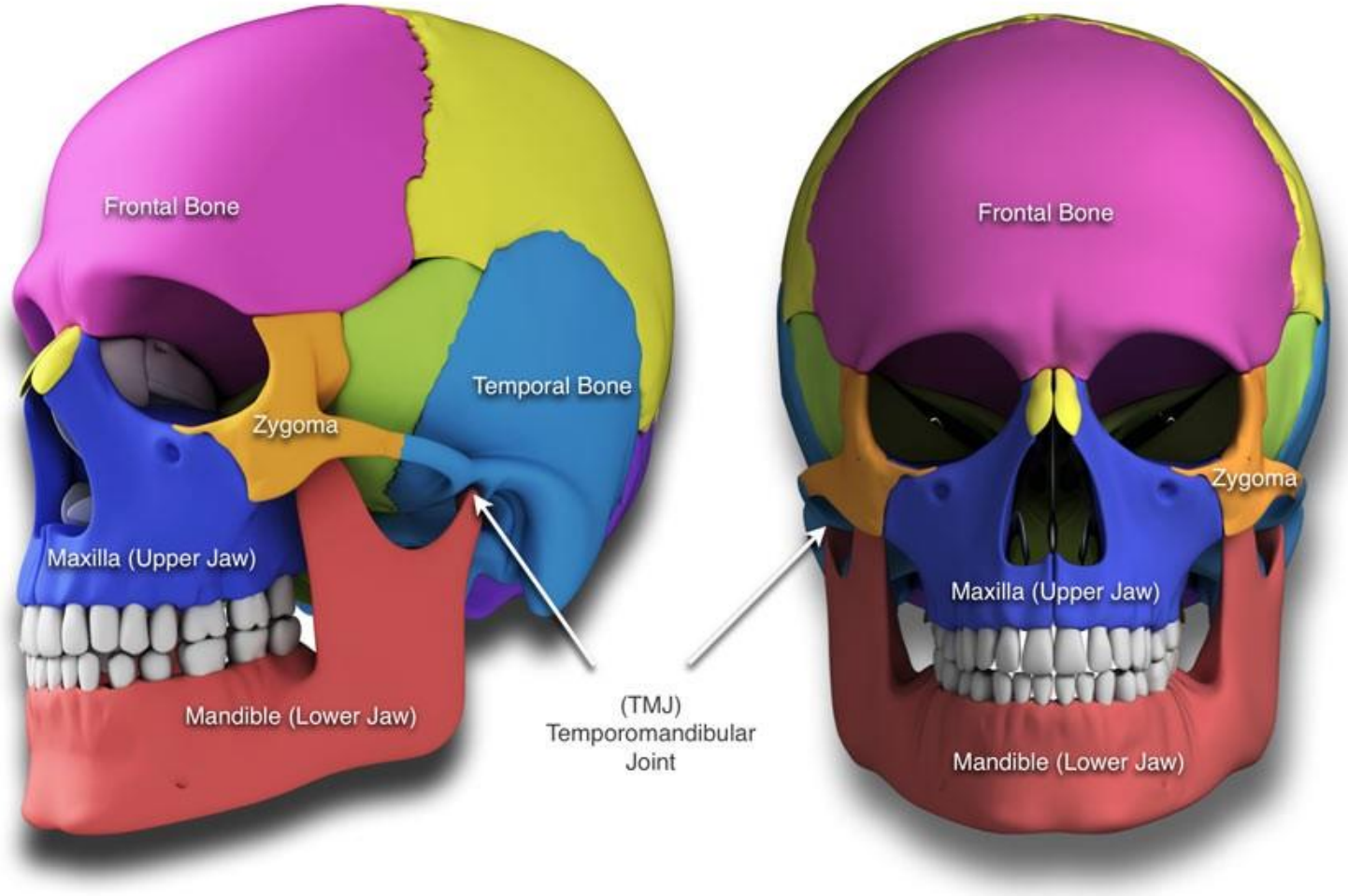
- ENDODERM Epithelial lining of the
  - → pharynx,
  - → stomach,
  - → lungs,

FORMATION OF THREE LAYERED EMBRYO:GASTRULATION(3RD WEEK)

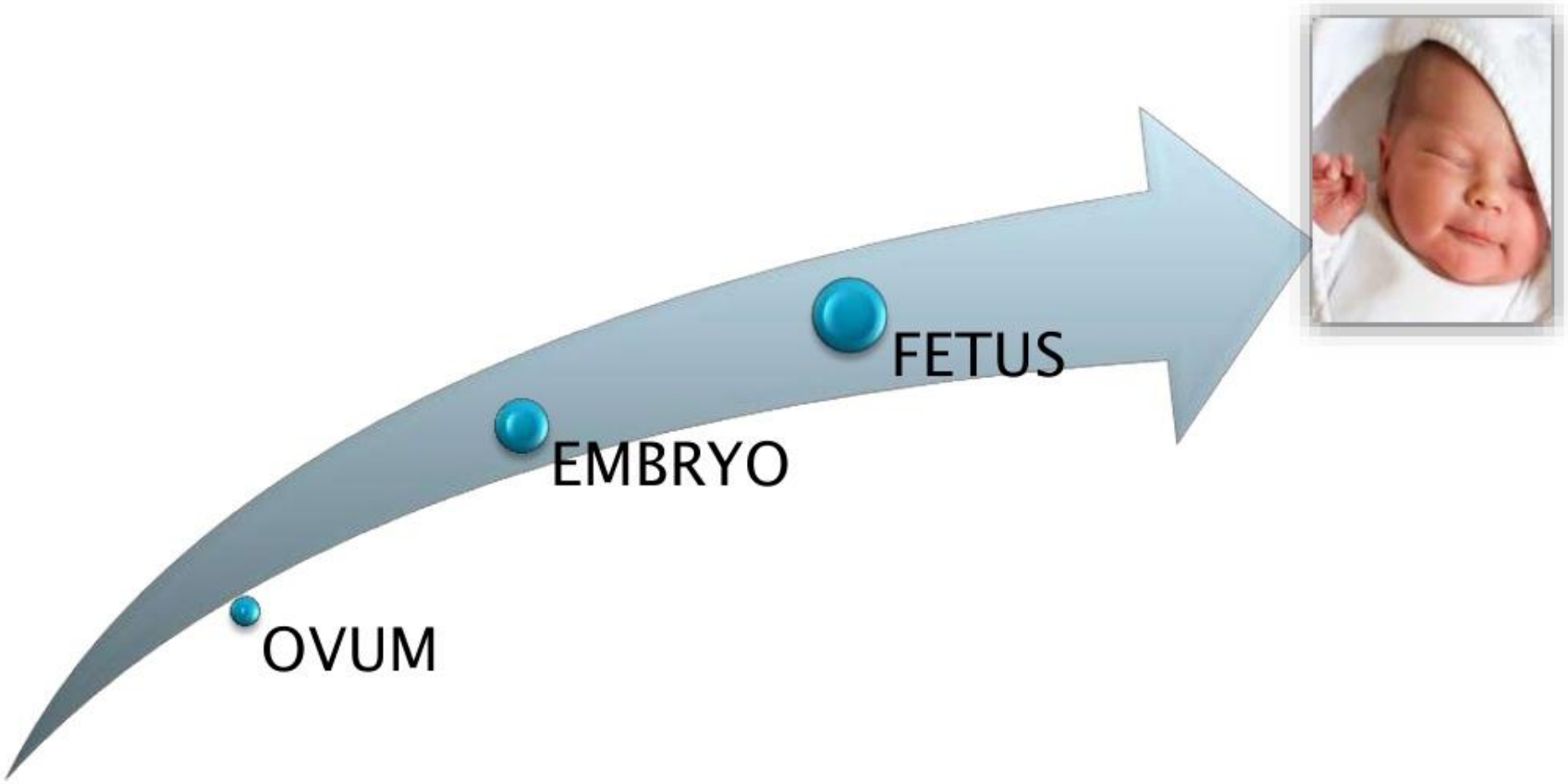




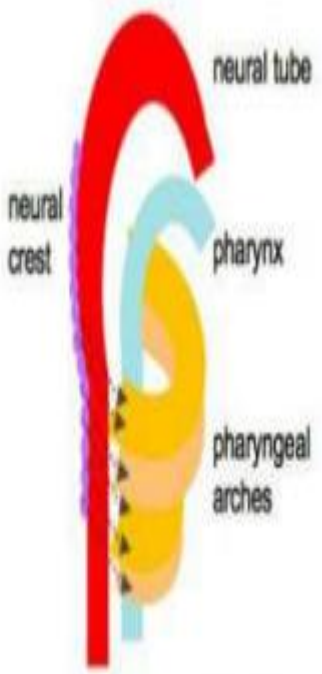
Development and growth of the jaws

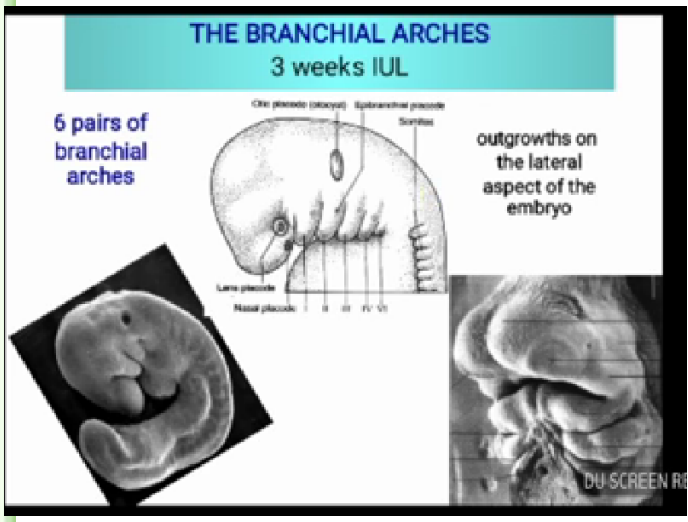


PRENATAL GROWTH



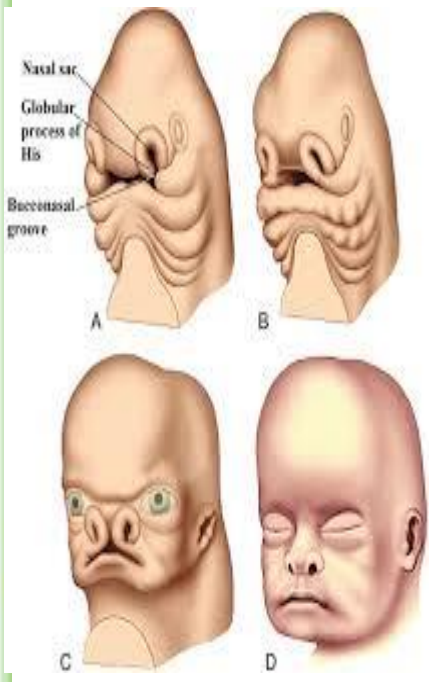
- Initially, there are 6 pharyngeal arches, but the 5th one usually disappears as soon as it is formed leaving only five.





- They are seperated by 4 branchial grooves.

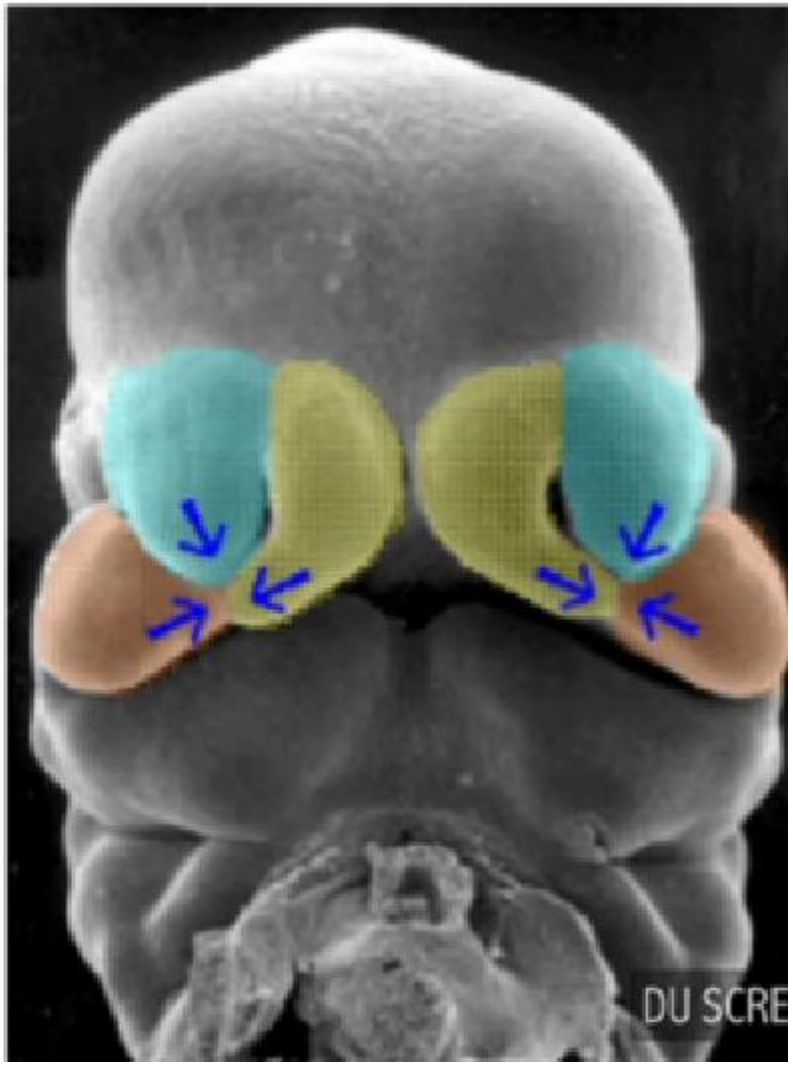
- The first arch is called MANDIBULAR ARCH and second arch is called HYOID ARCH.

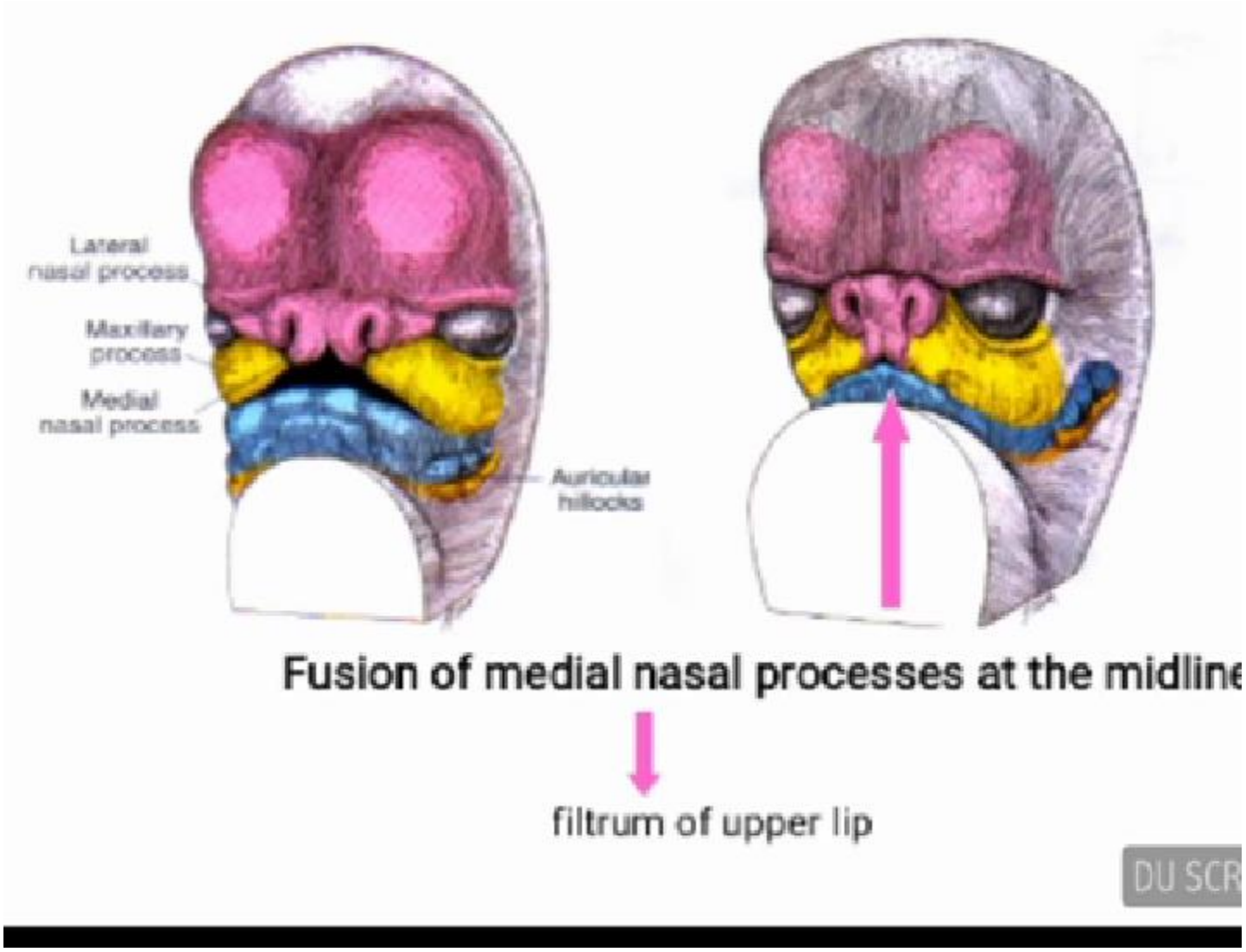


Derivatives of the first arch:

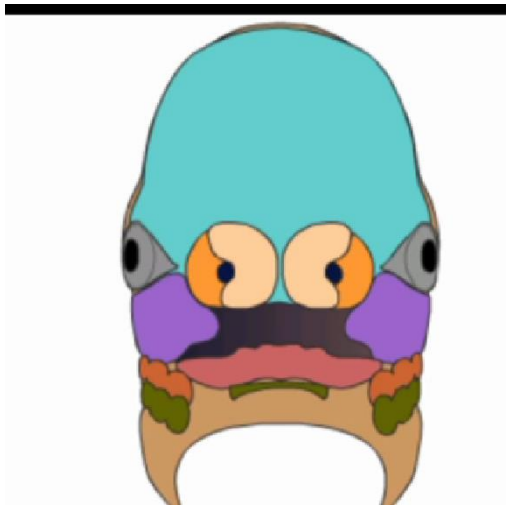
- 1-The mandible and maxilla
- 2-The lower lip, part of the upper lip and cheek
- 3-All the teeth
- 4-All salivary glands
- 5-All muscles of mastication
- 6-The anterior two thirds of the tongue

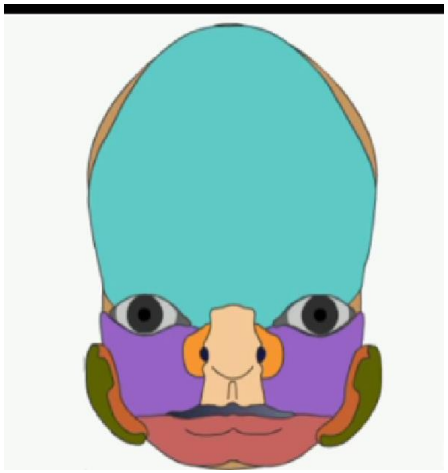
- Medial N. P.
- Lateral N.P.
- Maxillary P.
- Mandibular P.

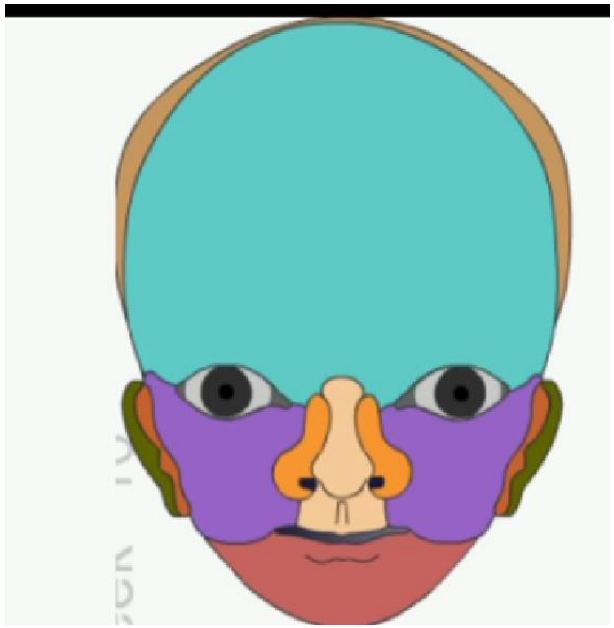



Lateral
nasal process
Maxillary
process
Medial
nasal process
Auricular
hillocks
Fusion of medial nasal processes at the midline
filtrum of upper lip

PALATE DEVELOPMENT







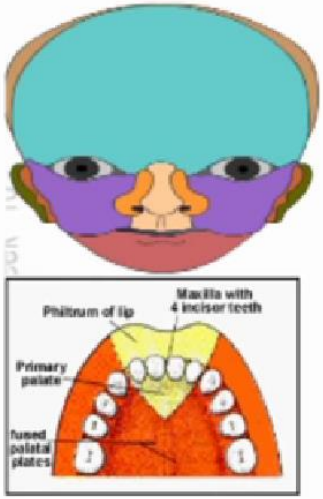
So the Face is developed from 7 processes

7 processes	Origin	structure formed
Two mandibular processes	Mandibular arch.	lower lip
Two Maxillary processes	Mandibular arch.	cheek and lateral parts of the upper lip.
Two lateral nasal processes	Frontonasal process.	lateral part of the nose (Ala of nose)
One medial nasal process	Frontonasal process.	middle portion of nose & filtrum of the upper lip and 1 ry palate

Primary Palate

5 – 6 w i u

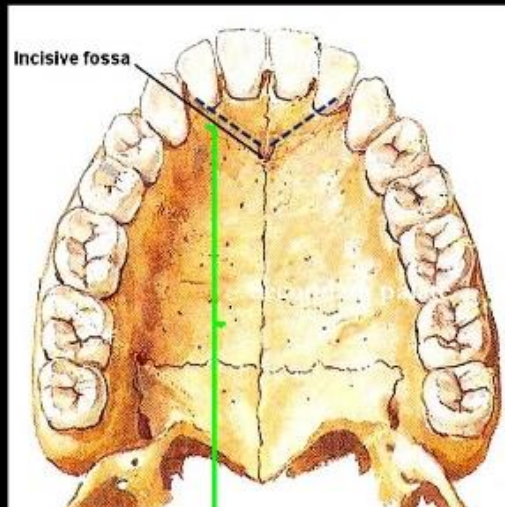
Inward extension of the medial nasal process



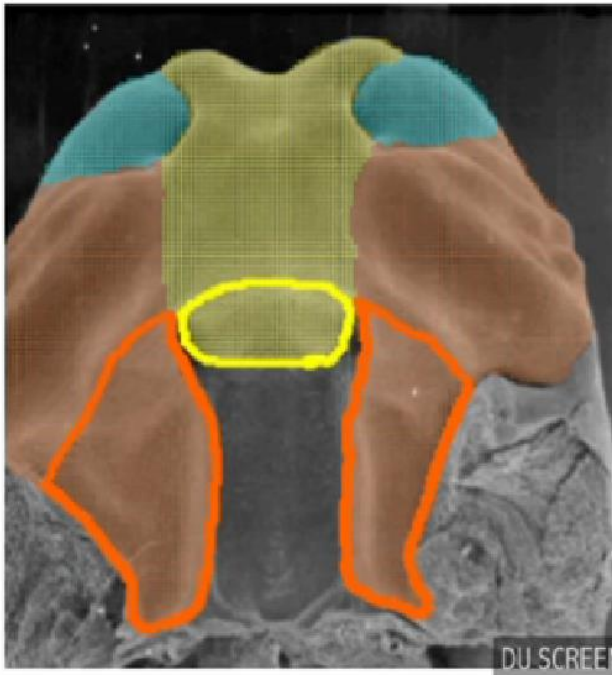
The primary palate represents only a small part lying anterior to the incisive fossa, of the adult hard palate

Hard palate

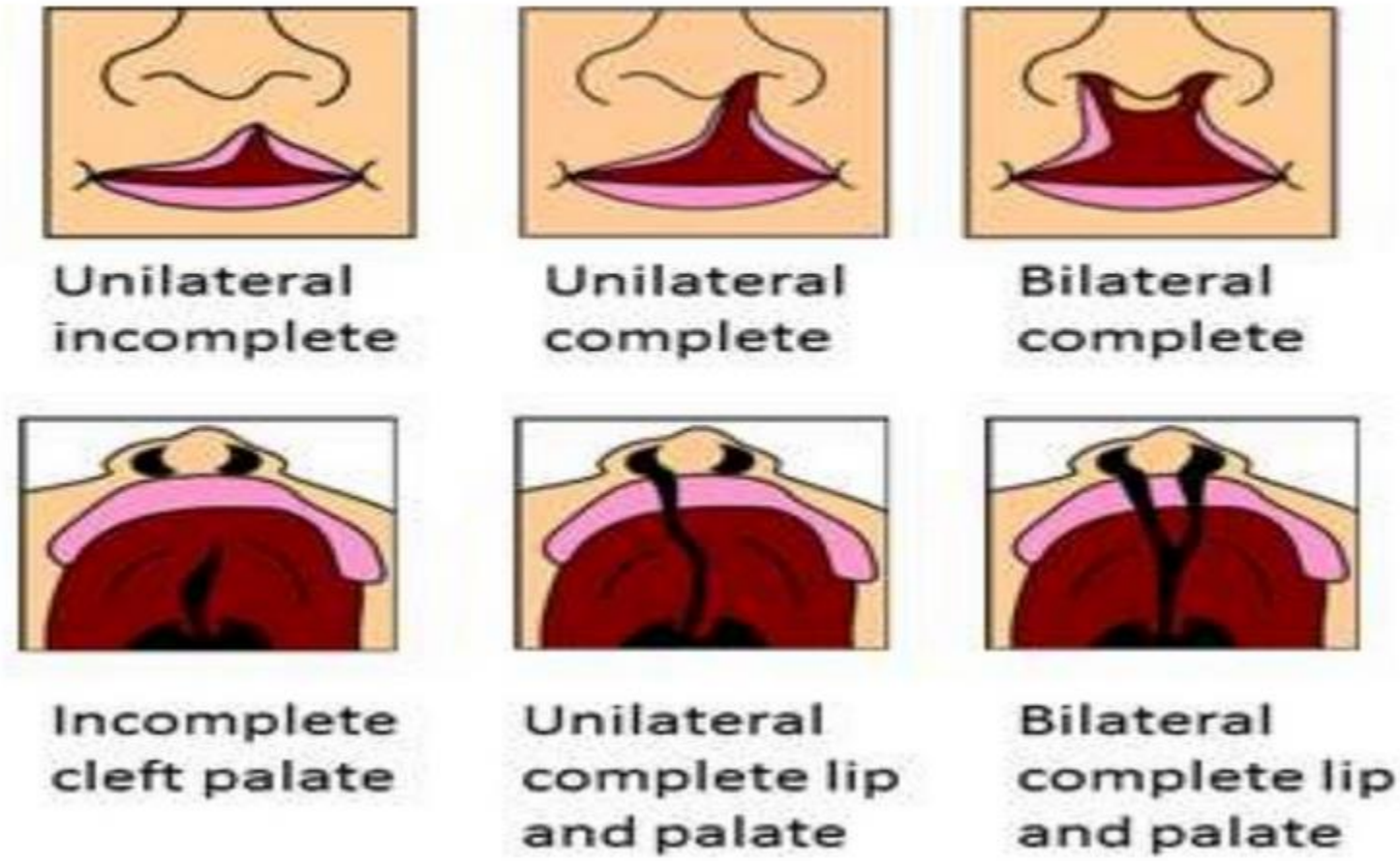
Soft palate



- Medial n.p.
- Lateral n p
- Maxillary p
- Primary palate
- Palatin process (shelvs)



Cleft lip and cleft Palate



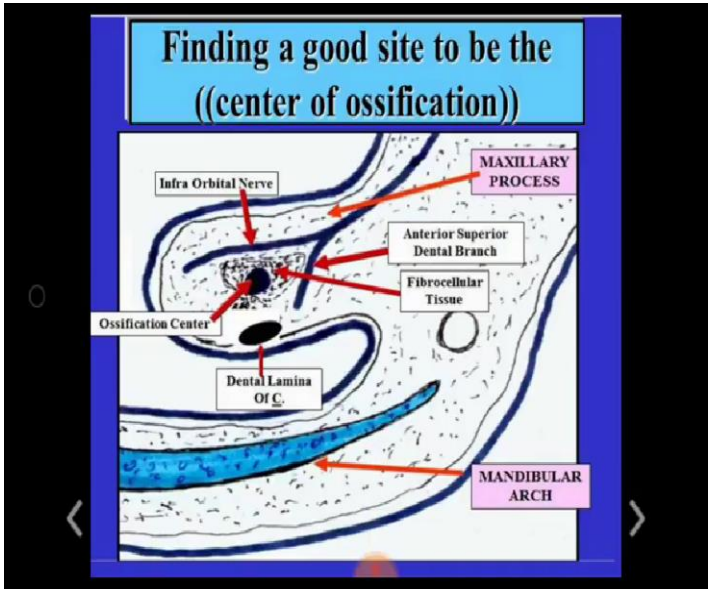
MAXILLA

Nasomaxillary complex

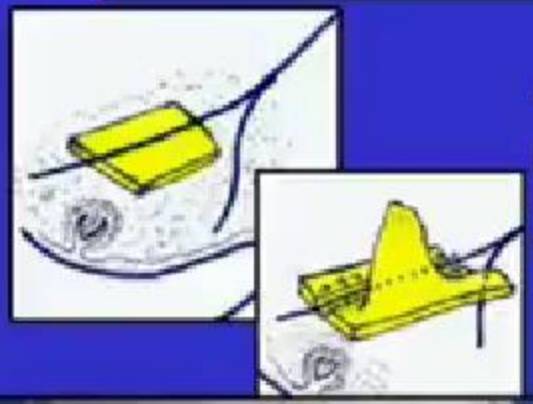
• The maxilla derives from the first pharyngeal arch and ossification of the maxillary complex is intramembranous, beginning in the 6th week i.u.

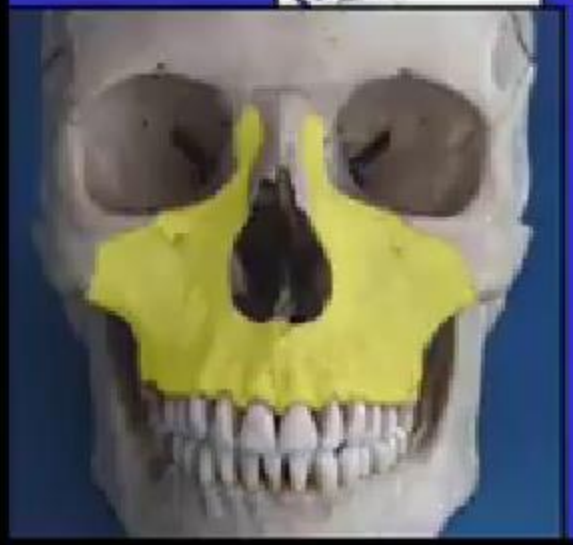
• The maxilla is the third bone to ossify after the clavicle and the mandible.

• The main ossification centres appear bilaterally above the future deciduous canine close to where the infraorbital nerve gives off the anterior superior alveolar nerve. Ossification proceeds in several directions to produce the various maxillary processes



SPREAD OF OSSIFICATION



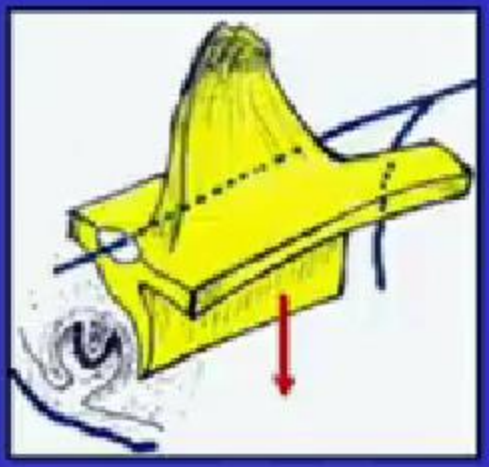


At first , ossification occurs below and around the **infra orbital nerve** , then From the center of ossification, bone formation spreads:

1- Backwards below the orbit to form the zygomatic bone,

2- Forward towards the incisor region.

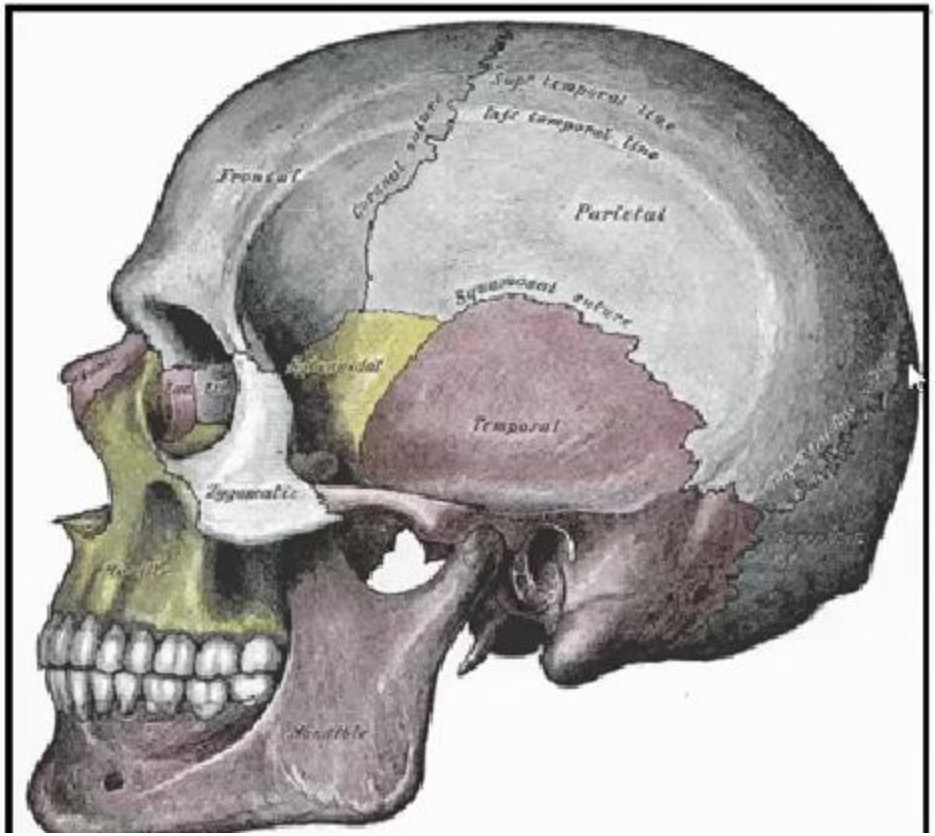
3- Upwards to form the frontal process.

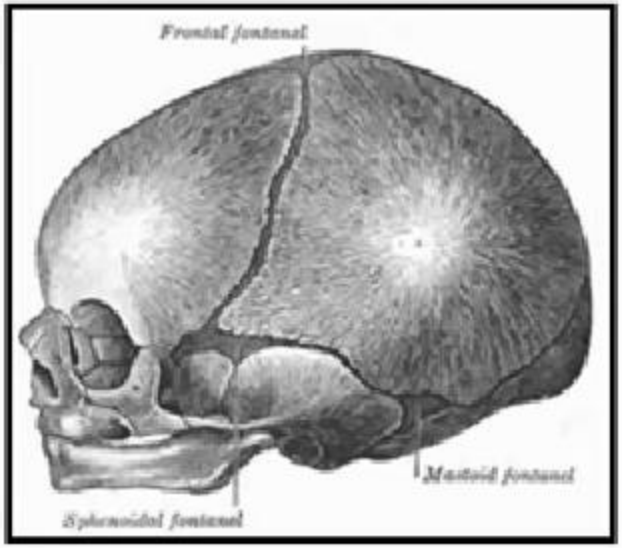


4- Downwards to form the outer alveolar bone (crypt)

5- Inwards into the palatine process to form the hard palate.

GROWTH OF THE MAXILLA





GROWTH AT SUTURES

Maxilla is attached to the cranium by

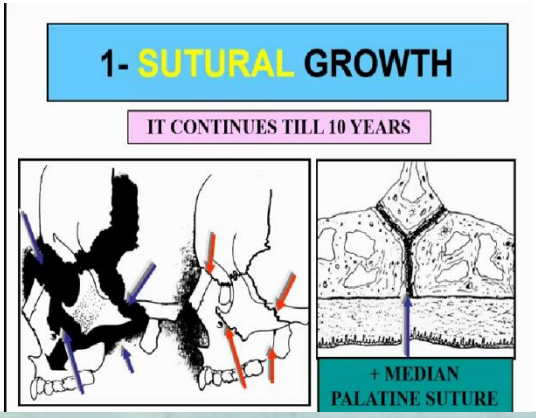
1- Fronto-nasal suture

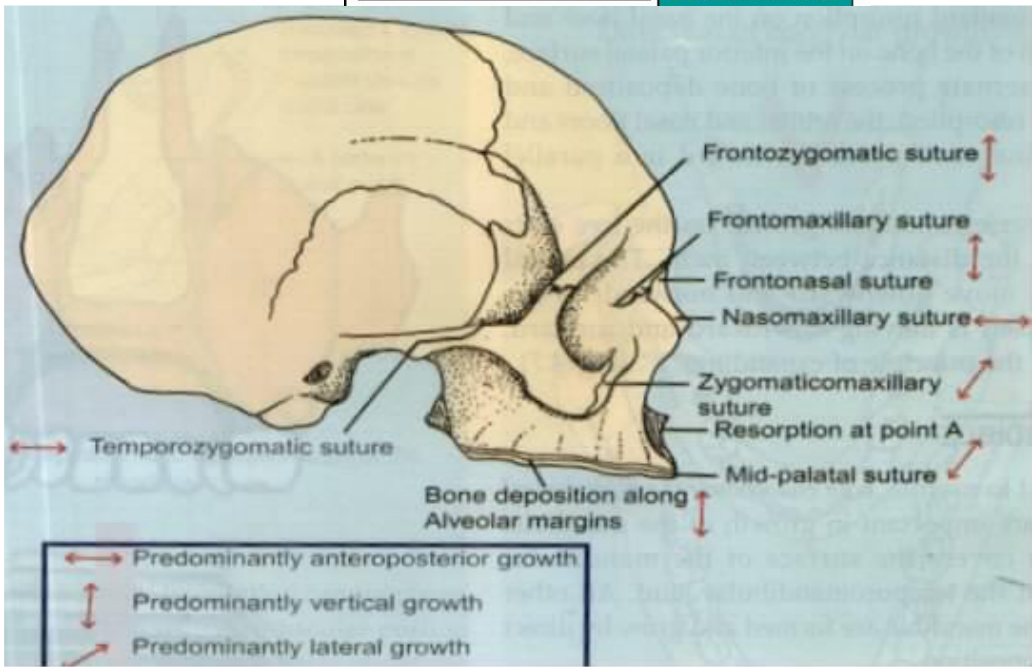
2- frontomaxillary,

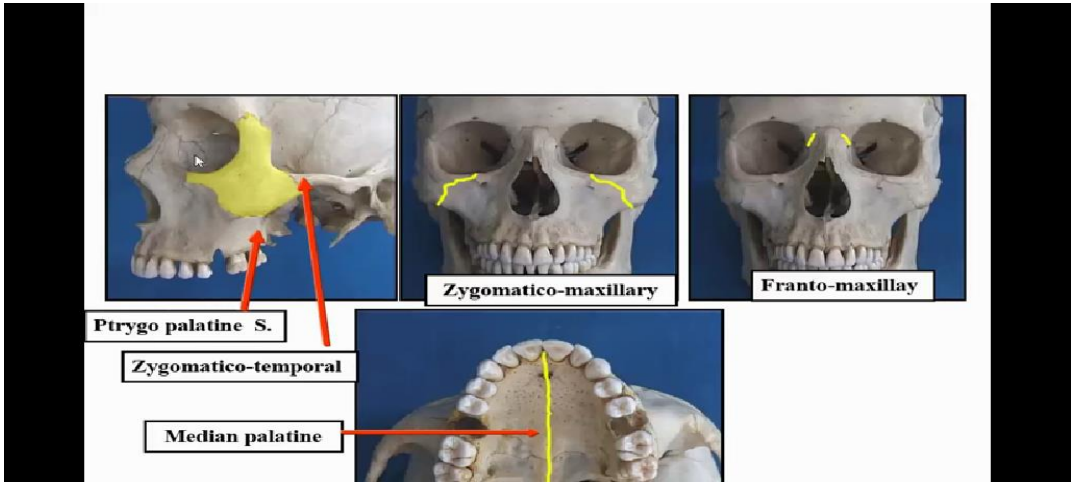
3- zygomaticomaxillary

4- zygomaticotemporal

5- pterygopalatine suture







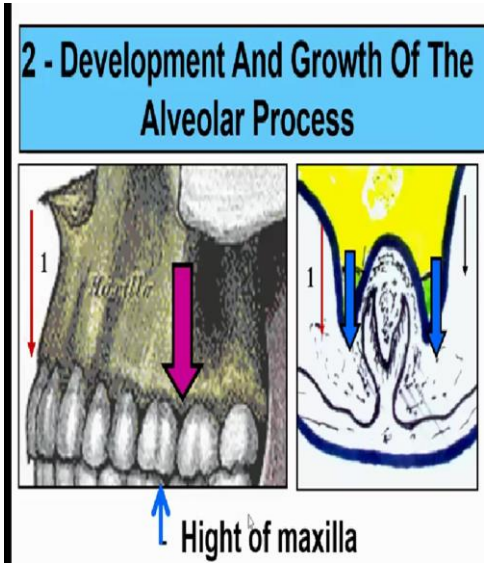
Sutures are oblique and parallel to each other. This allows the downward and forward repositioning of maxilla as growth occurs at these sutures. As growth of surrounding soft tissue occurs, the maxilla is carried downwards and forward. This leads to opening up of space at the sutural attachments. New bone is formed on either side of the suture. Thus the overall size of the bones on either side increases.

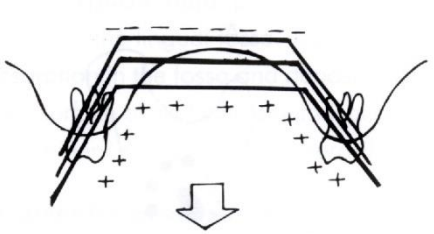
• Downward growth occurs by

1- vertical development of the alveolar process and eruption of the teeth.

2- also by inferior drift of the hard palate, i.e. the palate remodels downwards by deposition of bone on its inferior surface (the palatal vault) and resorption on its superior surface (the floor of the nose and maxillary sinuses).

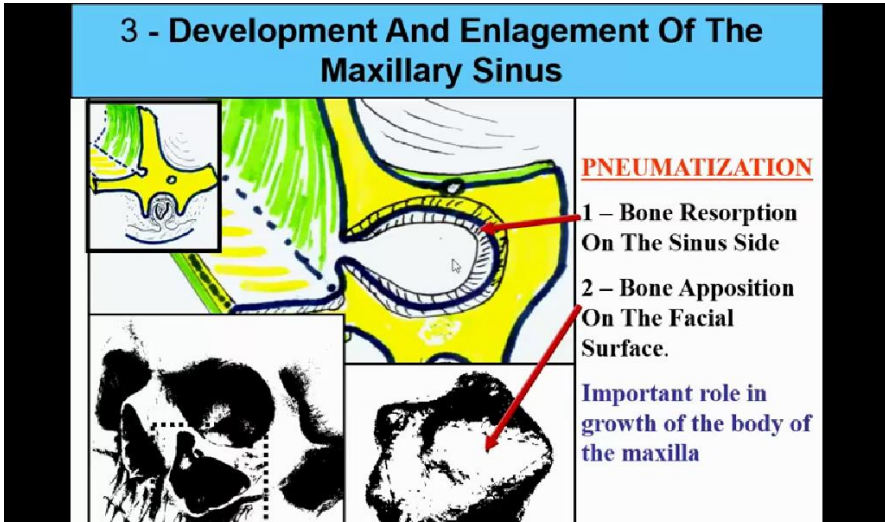
3- These changes are also associated with some downward displacement of the bones as they enlarge.





• Lateral growth in the mid-face occurs by displacement of the two halves of the maxilla, with deposition of bone at the midline suture.

• Internal remodelling leads to enlargement of the air sinuses and nasal cavity as the bones of the mid-face increase in size.



AGE CHANGES IN MAXILLA

AT BIRTH:

- The transverse and anteroposterior diameters are more than the vertical diameter.

Inferior surface of maxilla at birth

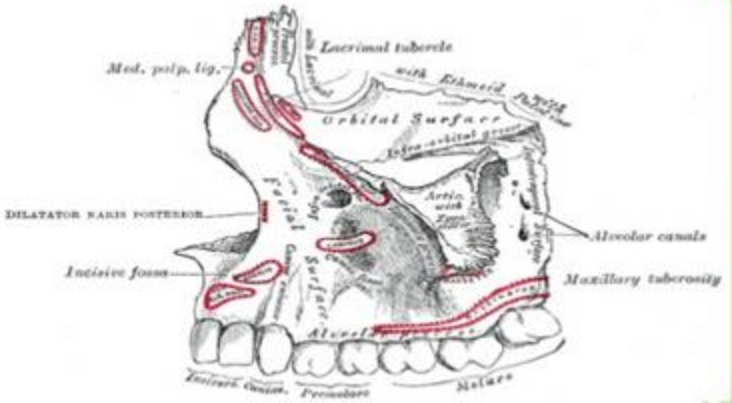
- Frontal process is well marked
- Body consists of a little more than the alveolar process

Anterior surface of maxilla at birth

- The tooth sockets reaching to the floor of orbit
- Maxillary sinus is a mere furrow on the lateral wall of the nose.

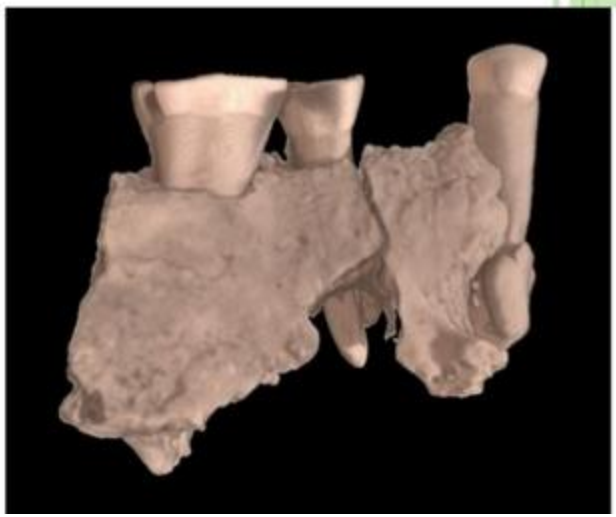
IN ADULT:

- Vertical diameter is greatest due to the development of the alveolar process and increase in the size of the sinus.



IN THE OLD:

- The bone reverts to infantile condition.
- Its height is a result of absorption of the alveolar process.



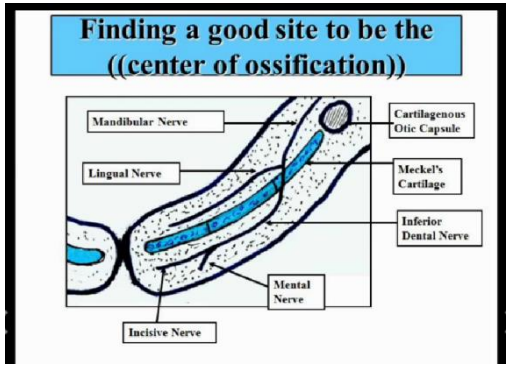
• Maxillary growth slows to adult levels on average at about 15 years in girls and rather later, at about 17 years, in boys.

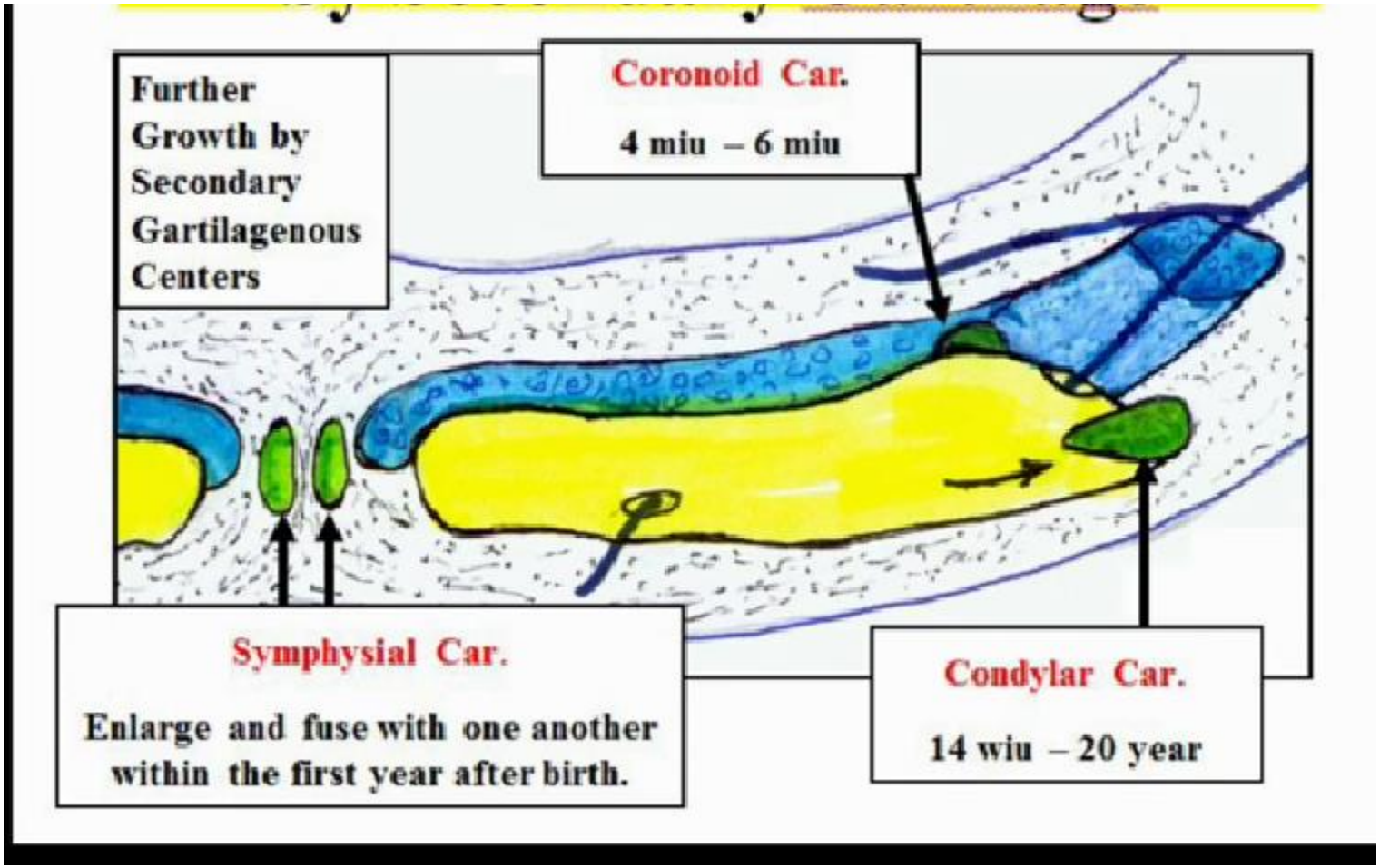
DEVELOPMENT AND GROWTH OF MANDIBULE

• The mandible derives from the first pharyngeal arch and ossifies intramembranously, beginning in the 6th week i.u. It is the second bone to ossify after the clavicle.

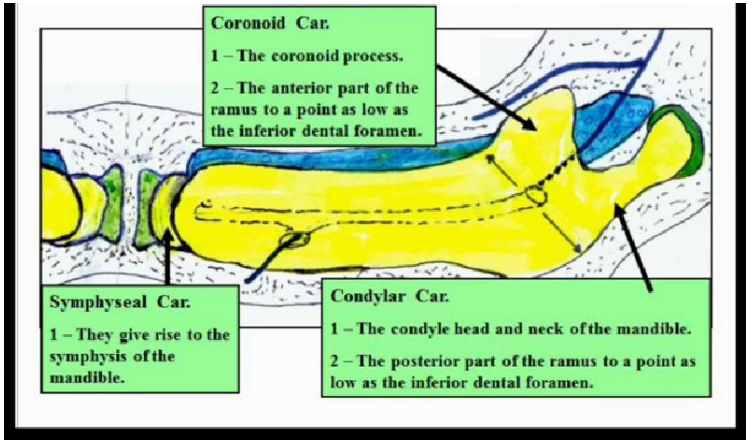
• It ossifies laterally to Meckel's cartilage with the ossification centres appearing bilaterally at the bifurcation of the inferior alveolar nerve into the mental and incisive branches.

• Ossification extends forwards, backwards and upwards to form the body, alveolar processes and ramus.




Further Growth by Secondary Gartilagenous Centers
Coronoid Car.
4 miu – 6 miu
Symphysial Car.
Enlarge and fuse with one another within the first year after birth.
Condylar Car.
14 wiu – 20 year

• Secondary cartilages appear, including the condylar cartilage during the 10th week i.u. Endochondral bone appears in the condylar cartilage by the 14th week i.u.



POST-NATAL GROWTH OF MANDIBLE

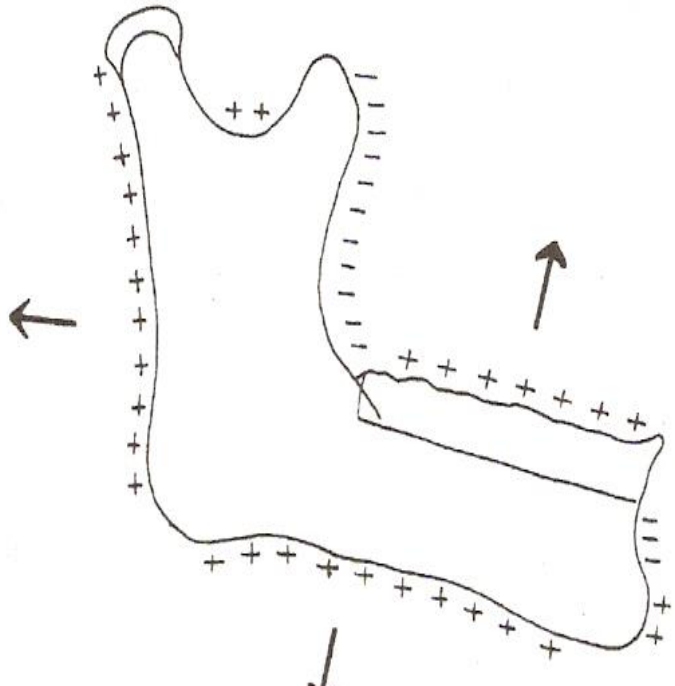
- While the mandible appears in the adult as single bone, it is developmentally and functionally divisible into a several skeletal sub-unit.
- Basal bone forms one unit, to which is attached the alveolar process, coronoid process, condylar process, angular process, the ramus and the chin.

RAMUS:

- It moves progressively posterior by a combination of deposition and resorption.

Resorption occurs on anterior part of ramus while bone deposition occur on the posterior region.

- This result in a “drift” in posterior direction.
- Function of the remodeling of ramus is to facilitate the lengthening of the mandibular body, which in turn accommodates the erupting molars.



THE BODY OF THE MANDIBLE

- Displacement of the ramus

results in the conversion of the

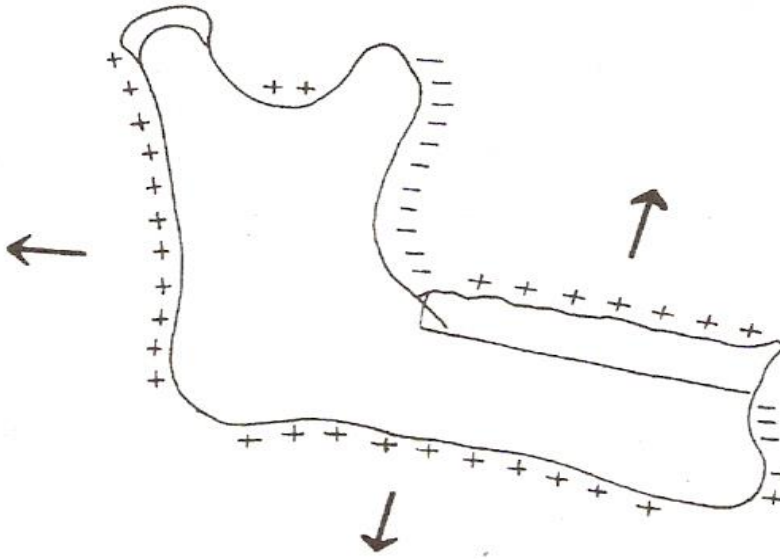
ramus bone into the posterior

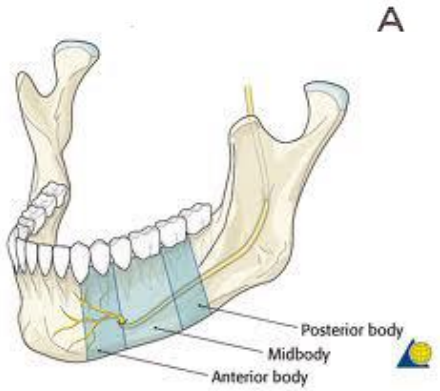
part of the body of the

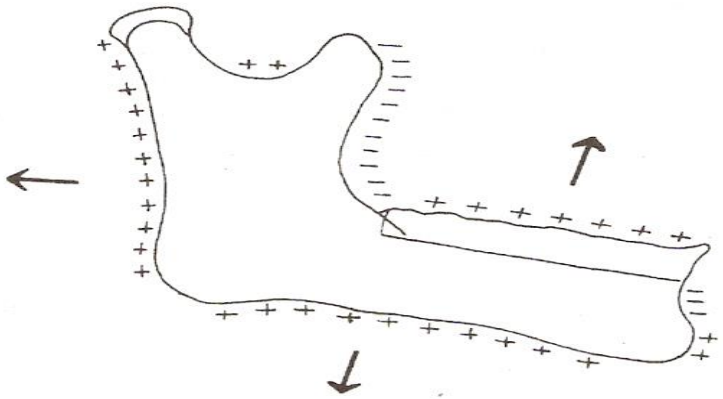
Mandible

Appositional growth occurs along the lower

border of mandible and on its lateral surface.







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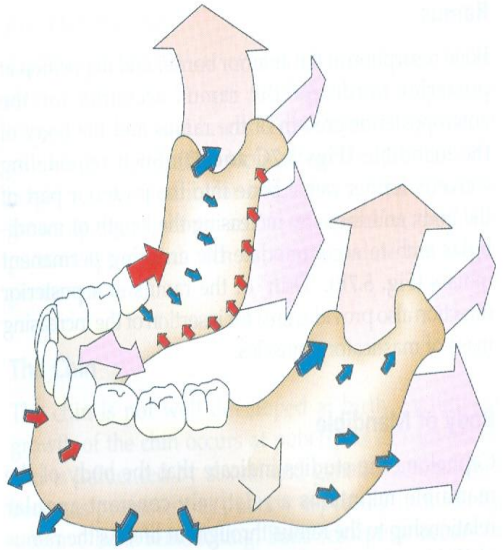


Fig. 5.7A: Overall growth occurring at various areas of mandible. Red arrows bone resorption, blue arrows bone deposition

ANGLE OF THE MANDIBLE:

• On the lingual side of the angle of the mandible, resorption take place on the posterio-inferior aspect while deposition on the anterio-superior aspect.

• On the buccal side, resorption occur on the anterio-superior part while deposition takes place on posterio-superior part.

• This results in flaring of the angle of mandible as age advances.

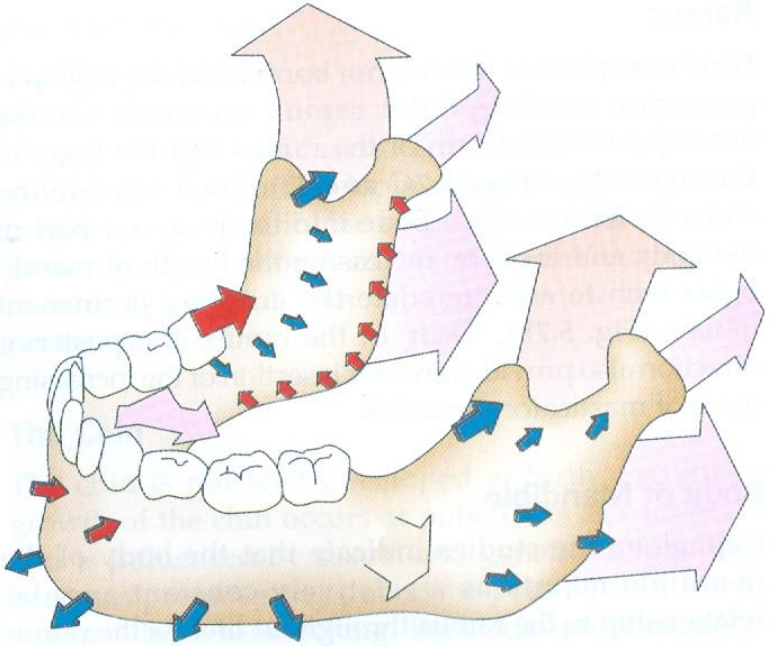


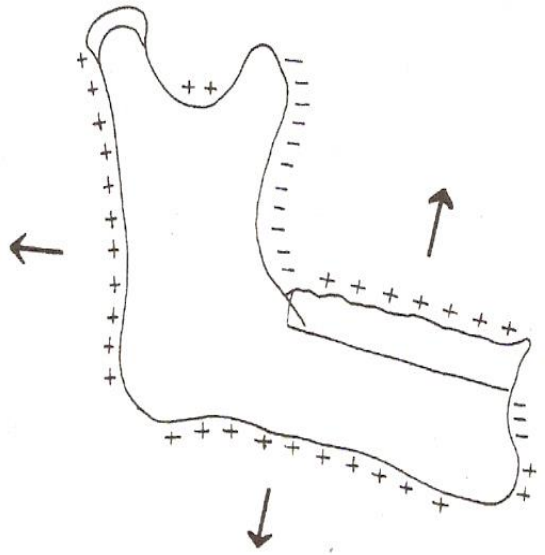
Fig. 5.7A: Overall growth occurring at various areas of mandible. Red arrows bone resorption, blue arrows bone deposition

III. Subperiosteal bone apposition and bone resorption:

Bone deposition	Bone resorption	Result in
External surface of the mandible	Inner surface of the mandible	Increase the transeverse dimension
Posterior border of the remus	Anterior border of the ramus	Adjust the thickness of the ramus
Anterior border of the coronoid process	Posterior border of the coronoid process	Displacement of the coronoid process
Chin region	———	Modeling of the lower face

ALVEOLAR PROCESS:

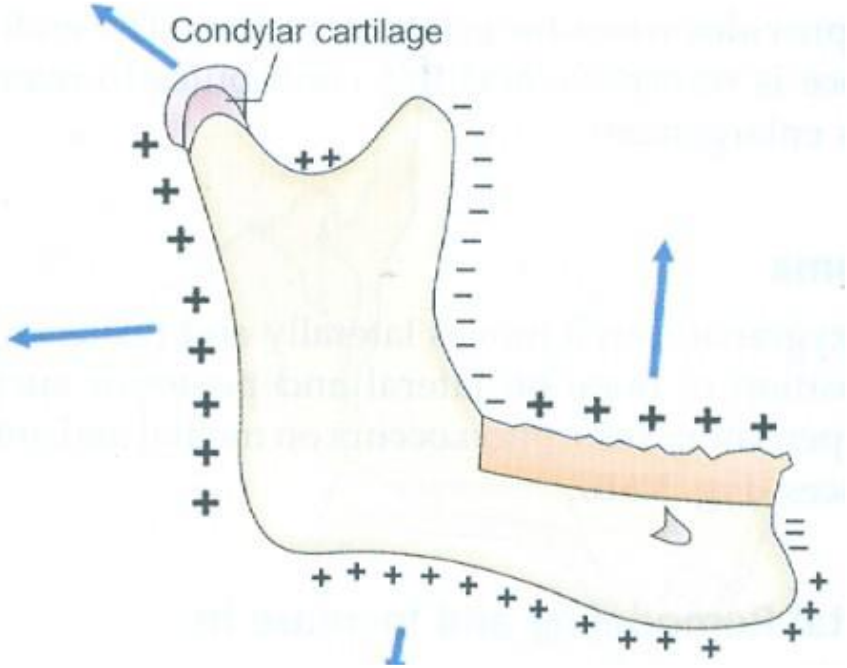
- It develops in response to the presence of tooth buds.
- As the teeth erupt, it develops and increases in height by bone deposition at the margins



A

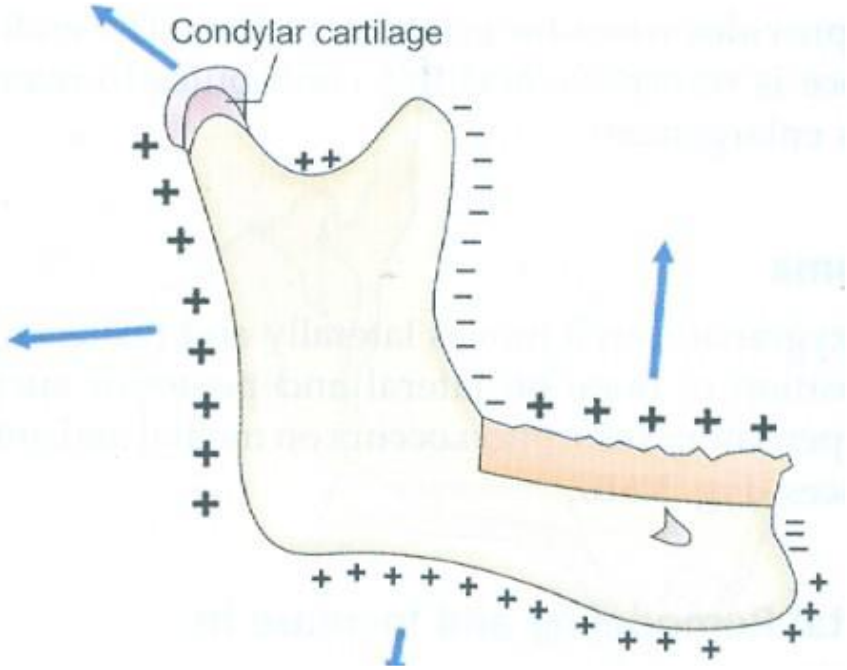
THE CHIN:

- As the age advances the growth of chin becomes significant.
- Usually males are seen to have prominent chin as compared to females.
- Bone deposition on mental protuberance.
- Bone resorption on alveolar region above the prominence, creating a concavity.



THE CONDYLE:

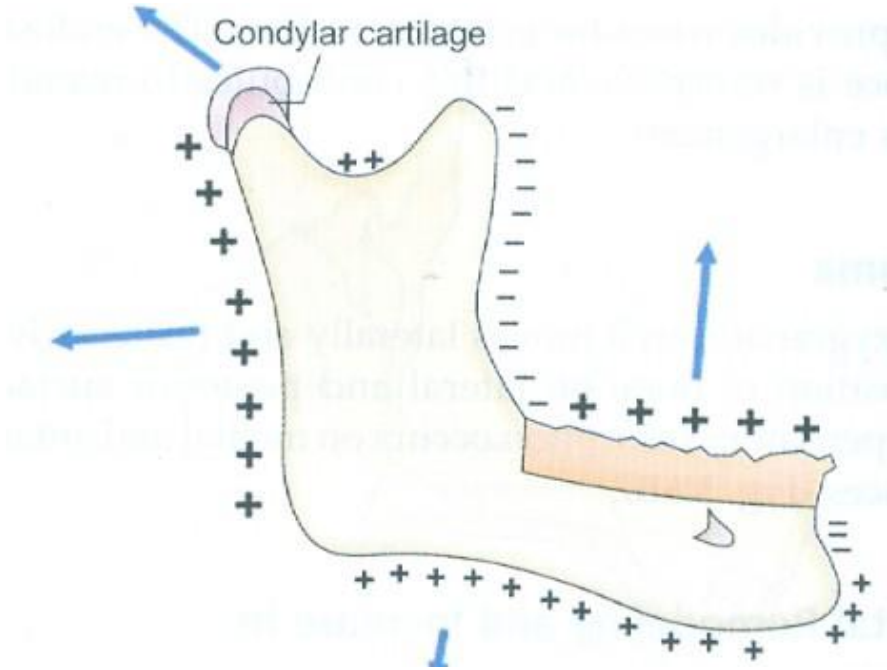
- The head of the condyle is covered by the thin layer of cartilage called the condylar cartilage.
- The presence of conylar cartilage is an adaptation to withstand the compression that occurs at the joint.



THE CONDYLE:

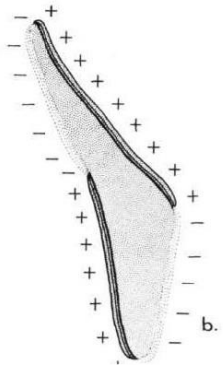
• It is believed that the growth of the soft tissues including the muscles and the connective tissues carries the mandible forward away from cranial base. Bone growth follows secondary at the condyle to maintain constant contact with cranial base.

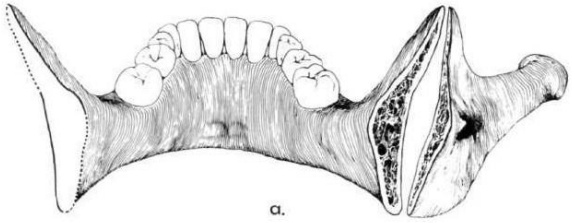
• The condylar growth rate increases at puberty reaching a peak between 12-14 years. The growth ceases around 20 years of age.



THE CORONOID PROCESS

- The growth follows the enlarging ‘V’ principle.
- Viewing, the longitudinal section of coronoid process from posterior aspect, it can be seen that deposition occurs on the lingual (medial) surfaces of the left and right coronoid process .
- Although additions take places on the lingual side, the vertical dimension of the coronoid process also increases. This follows the ‘V’ principle.
- Viewing from the occusal aspect, the deposition on lingual of coronoid process brings about posterior growth movement in ‘V’ pattern





SIGMOID NOTCH

- Bone deposition -

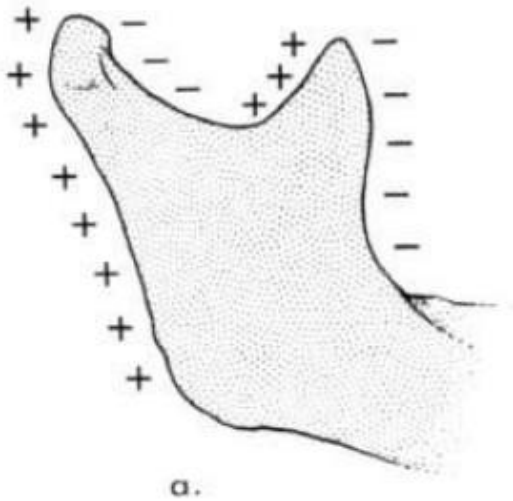
posterior border of

coronoid process

- Bone resorption -

anterior Face of neck of

condyle.



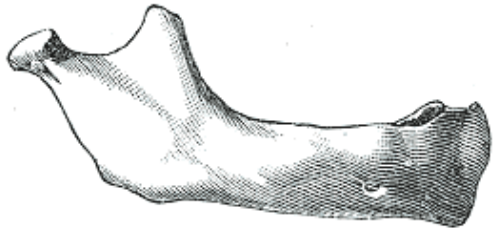
Age changes in mandible

- **INFANTS –**

Mental foramen - near lower border

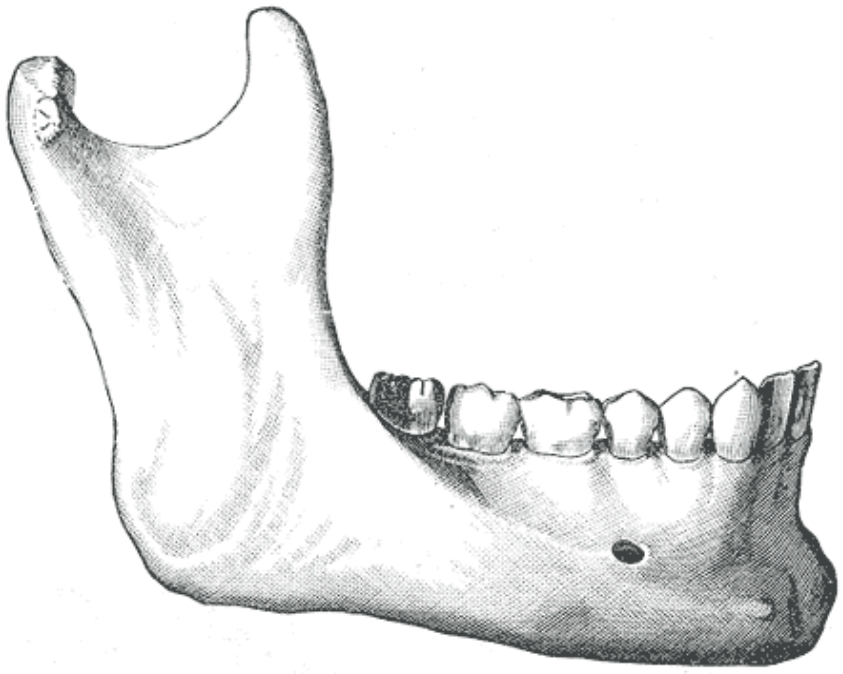
Mandibular canal - lower border of body of mandible

Angle of mandible - obtuse around 140* or more



ADULTS

- Mandibular canal - runs parallel with mylohyoid line.
- Angle of mandible - 110* - *١٢٠
- Mental foramen - midway of upper & lower border.



- **OLD AGE**

Mandibular foramen - near alv. Bone

Mandibular canal - near alv. Bone

Angle of mandible - obtuse 140*

Before puberty growth occurs at steady rate with an increase of 1–2 mm per year in ramus height and 2–3 mm per year in body length.

- However, growth rates can double during puberty and the associated growth spurt.
- Mandibular growth slows to adult levels rather later than maxillary growth, on average at about 17 years in girls and 19 years in boys, although it may continue for longer.

Agnathia

-Hypoplasia or absence of mandible

-The entire mandible or one side may be missing or only the condyle or the entire ramus.

Courtesy:Google

Micrognathia

- Means small jaw
- Maxilla or mandible may be affected
- Can be due to small jaw or to an abnormal positioning or abnormal relation of one jaw to another.

Courtesy:Google

Macrognathia

-abnormally large jaws

Factors that favor mandibular prognathism:

- Increased height of ramus
- Increased mandibular body length
- Increased gonial angle

Courtesy:Google

Abnormalities of dental arch relations

- Class I
- Class II
- Class III