Growth of Mandible

Department of Orthodontics

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KNOWLEDGE TO EMPOWER

Learning Objectives

- To understand the anatomy and morphology of the human mandible
- To understand the growth and development of mandible
- To understand the different growth processes involved associated with the growth of the mandible

GROWTH AND DEVELOPMENT OF THE MANDIBLE

- **INTRODUCTION**
- **EMBRYOLOGY**
- **PRE NATAL GROWTH**
- **POST NATAL GROWTH**
- **ANOMALIES OF DEVELOPMENT**

INTRODUCTION

- It is the largest, strongest & lowest bone in the face.

- The adult mandible is a horse-shoe shaped / 'U'-shaped bone composed of bilaterally symmetrical (or roughly symmetrical) entities which are fused in the midline at the symphyseal area.

The mandible can be divided into :

A horizontal body portion &
A vertically oriented ramal section.

The two parts meet approximately at right angles in the posterior aspects of the mandible.

EMBRYOLOGY OF MANDIBLE

- 4th week of I.U. life : Developing brain & pericardium form 2 prominent bulges on the ventral aspect of the embryo

↓

- Bulges seperated by primitive oral cavity / stomodeum

↓

- Floor of oral cavity separated from foregut by bucco-pharangeal membrane

↓

- Pharyngeal arches are laid down on the lateral & ventral aspect of the cranial most part of the foregut in approximation of the oral cavity

Prenatal growth of the mandible

PRE-NATAL EMBRYOLOGY

Prenatal life can be divided into 3 periods:

- Period of Ovum – fertilization to end of 14^{th} day
- Period of Embryo– 14^{th} to 56^{th} day
- Period of Fetus – 56^{th} day to birth

Meckel's cartilage

- First appears around 41st to 45th day of I.U.L. extends from the cartilaginous otic capsule to the symphysis and provided a tempelate for guiding the growth of mandible.

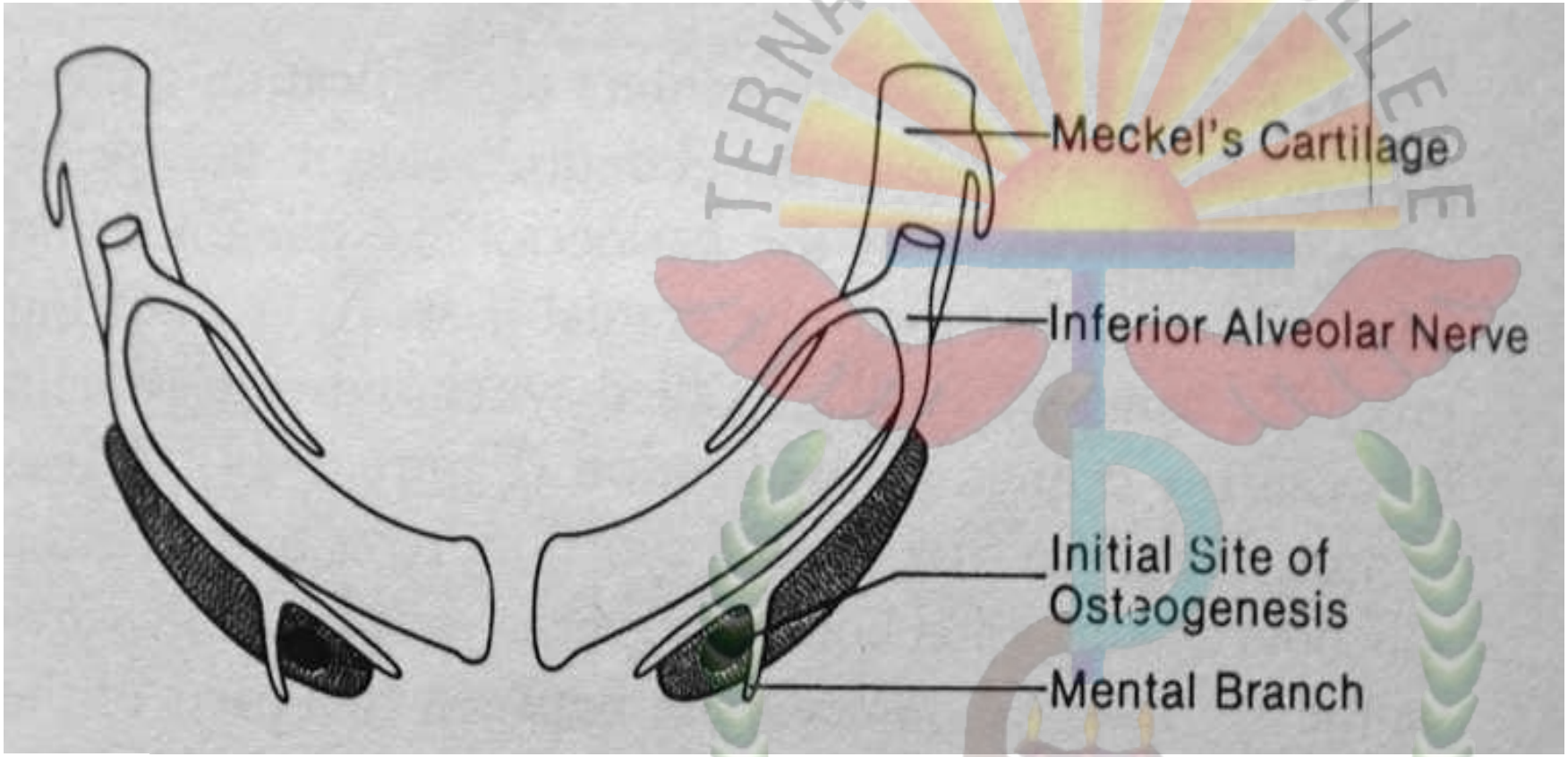
- Bony mandible develops independently from embryonic connective tissue .
- A major portion of the meckels cartilage disappears during growth and remaining part develops into following structures:

  1.mental ossicles

  2.incus and malleus

  3.spine of sphenoid

  4.sphenomandibular ligament



Condylar Cartilage

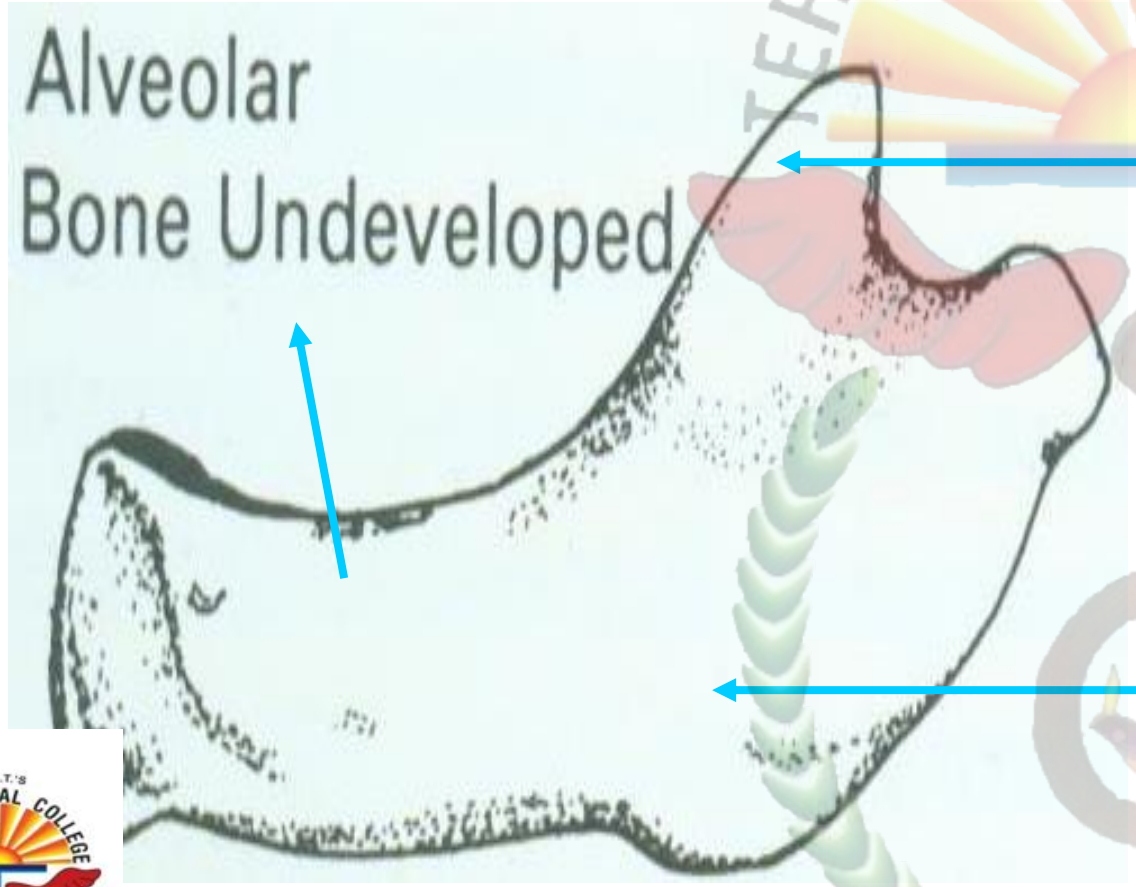
- Serves as a growth site
- Brings changes in the mandibular position and form
- Growth increases during puberty
- Peak 12 – 14 years
- Ceases by 20 years

Fetal period

Endochondral bone formation seen only in 3 areas

- Condylar process
- Coronoid process
- Mental region

Features of neonatal mandible



High Coronoid process

Wide Ramus

Differential growth

During fetal life

- 8 weeks - mandible > maxilla
- 11 weeks - mandible = maxilla
- 13 – 20 weeks maxilla > mandible

At birth

- Mandible tends to be retrognathic
- Early post natal life → orthognathic

- Ingham (1932) summarized the prenatal changes of mandible as :
  - The alveolar plate (ridge) lengthen is more rapidly than does the ramus.
  - The ratio of alveolar plate length to total mandibular length is reasonably constant.
  - The width of the alveolar plate shows a more rapid increase than does total width.

Post natal development

- Mandible at birth
- Mandibular growth during first year
- Growth progression after first year (mechanisms and sites of growth)

Main sites of post natal growth in the Mandible

- Condylar cartilage → **Height**
- Posterior border of the Rami → **Width**
- Alveolar ridges → **length**

Mandible at birth

- At birth, the two rami of mandible are quite short and the condyles are poorly developed
- The alveolar process not yet formed
- The body of mandible is like a shell of bone
- Ascending ramus is low and wide
- Coronoid process is larger and projects above the condyle

The angle of the mandible is about 130 with condyle nearly in line with the body

Mandibular growth during 1st year

Appositional growth especially active at

- Alveolar border
- Distal and superior surface of ramus
- Condyle
- Lower border of mandible
- Lateral surface of mandible

After first year growth becomes selective, remodeling and simultaneous displacement in a forward and downward direction proceeds from TMJ

MANDIBULAR GROWTH AFTER 1ST YEAR OF LIFE

Mandibular growth becomes more selective.

Growth of mandible is completed in a definitive sequence –

Growth in width is completed first

↓

Then, growth in length and

↓

finally growth in height completed.

Mechanisms Of Bone Growth

Growth Of The Mandible Primarily Involve

1. ***Bone remodelling***

Process Of Bone Deposition And Resorption

2. ***Cortical drift***

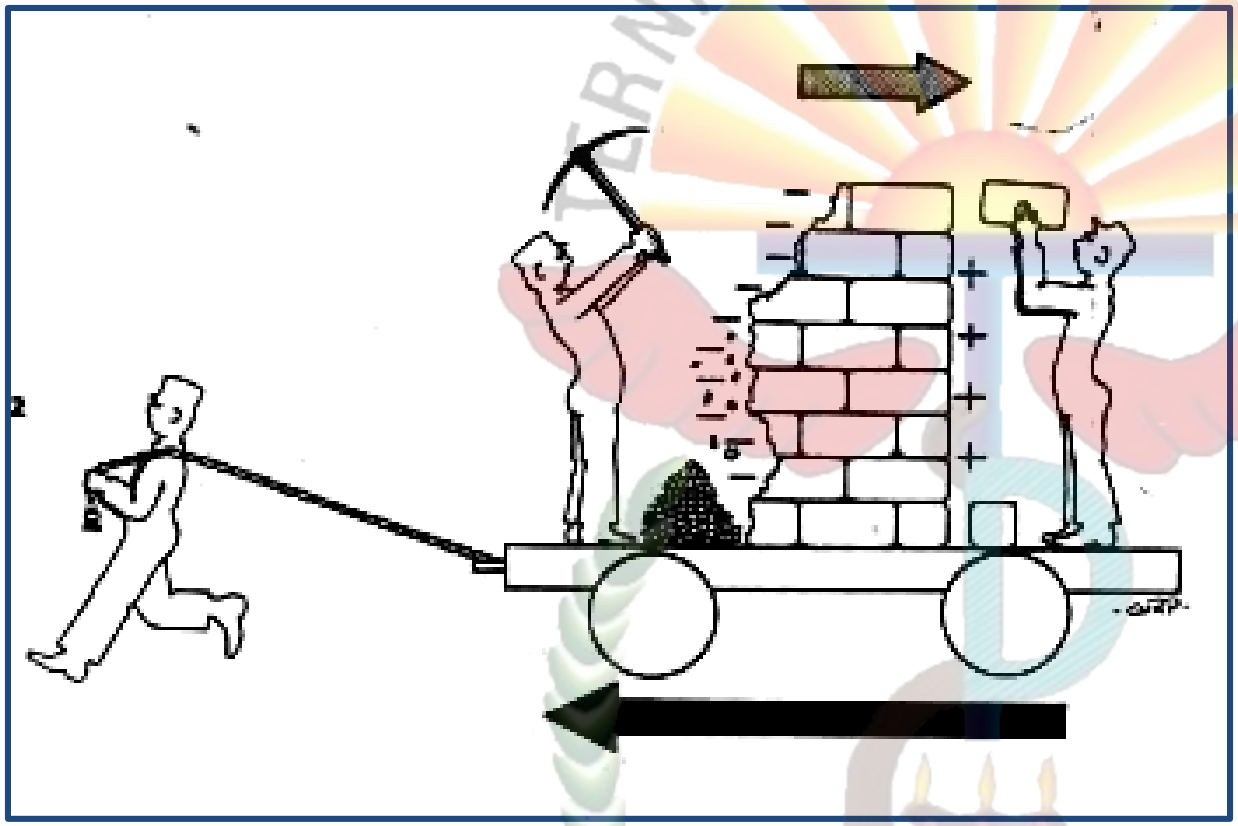
Combination of bone deposition and resorption resulting in growth movement towards deposition surface

3. ***Displacement***

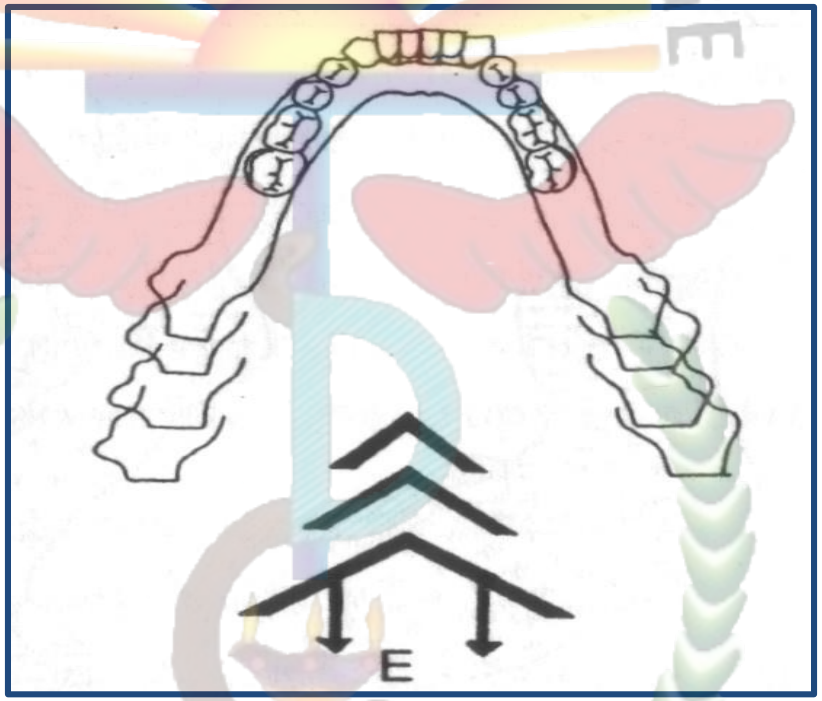
Movement of whole bone as a unit

I) Primary displacement

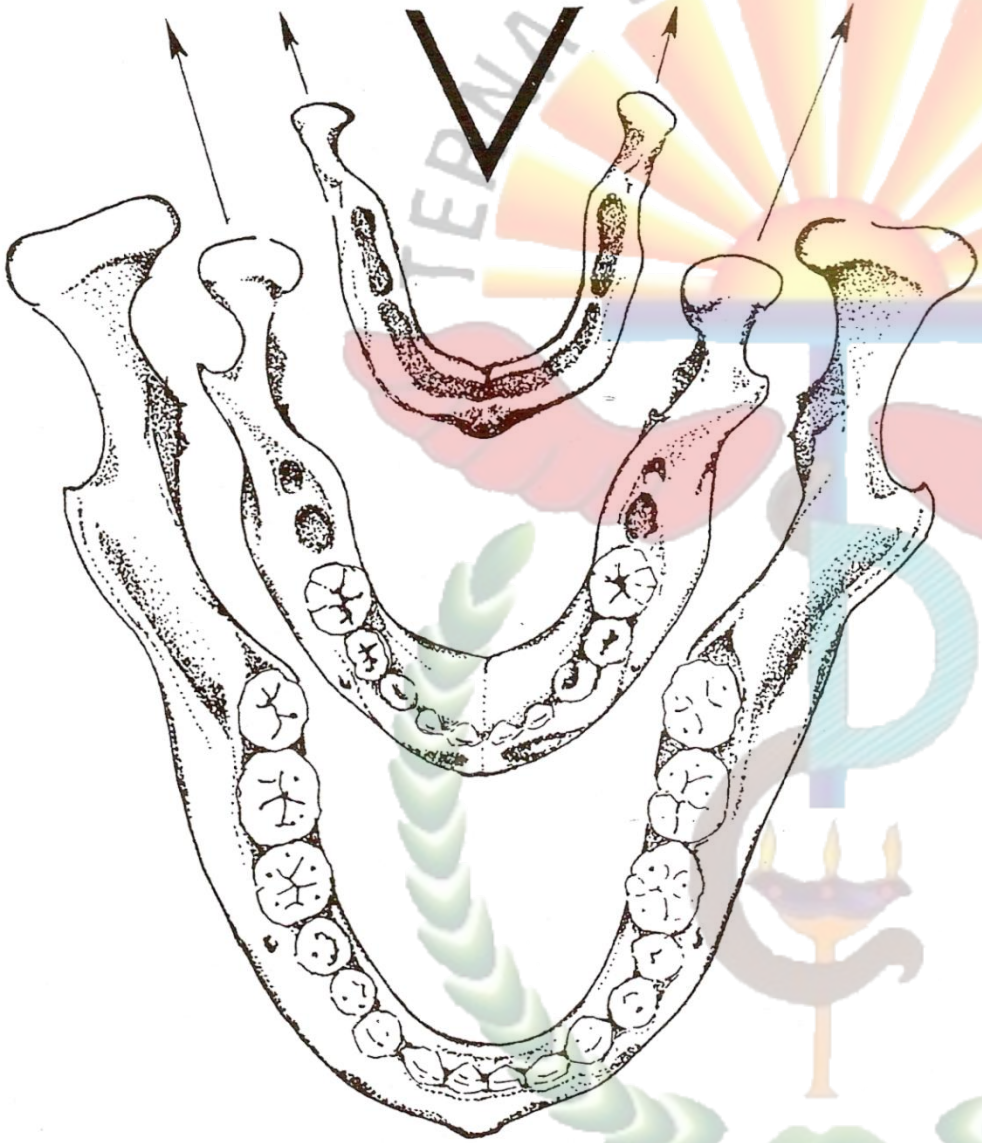
Secondary displacement



- ***ENLOW'S "V" PRINCIPLE***
- **The growth and enlargement of bones occur towards wide end of 'v' due to differential deposition and resorption**



Direction of Condylar Growth



Enlow's Counterpart Principle

Maxillary arch is counter part of mandibular arch.

Regional part

counter part

Balanced growth

Post Natal Growth And Development

GROWTH TIMING

Growth of *width* of mandible is completed *first*, then growth in *length* and finally growth in *height*

Post Natal Growth And Development

WIDTH OF MANDIBLE

- Growth in width is completed before adolescent growth spurt
- Both molar and bicondylar width shows small increase until growth in length ends

Post Natal Growth And Development

GROWTH IN LENGTH

- Growth in length continues through puberty
- Girls—14-15 years
- boys---18-19 years

Post Natal Growth And Development

- **Main sites of post natal growth in the Mandible**
- Condylar cartilage
- Posterior border of the Rami
- Alveolar ridges

Condylar cartilage

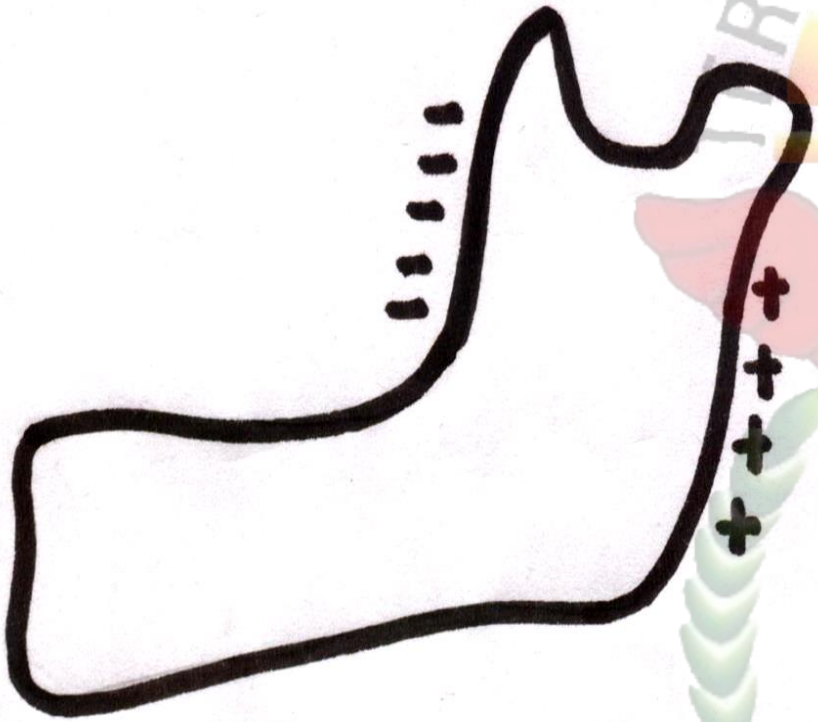
- Secondary cartilage
- Dual function:

  Articular

  growth

- Current concept

RAMUS



- Posterior border
  - deposition
- Anterior border
  - resorption

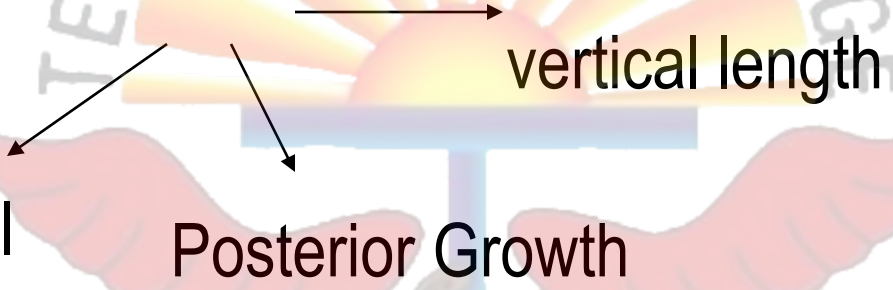
Ramus

- Superior part of ramus below sigmoid notch
  - LINGUAL - DEPOSITION
  - BUCCAL - RESORPTION
- Lower part of ramus below the Coronoid process
  - BUCCAL - DEPOSITION
  - LINGUAL - RESORPTION

Ramus

Coronoid process

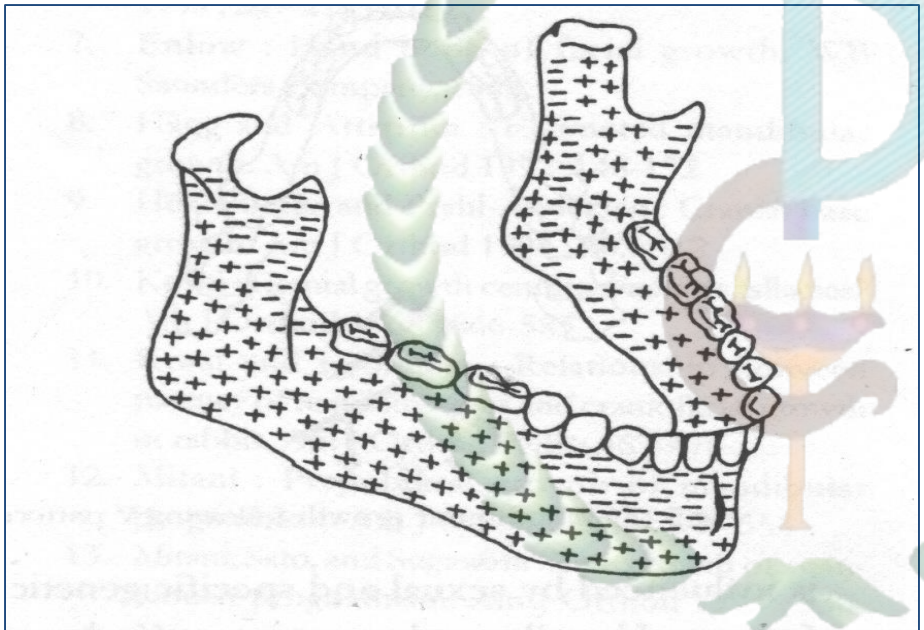
- Deposition on lingual side

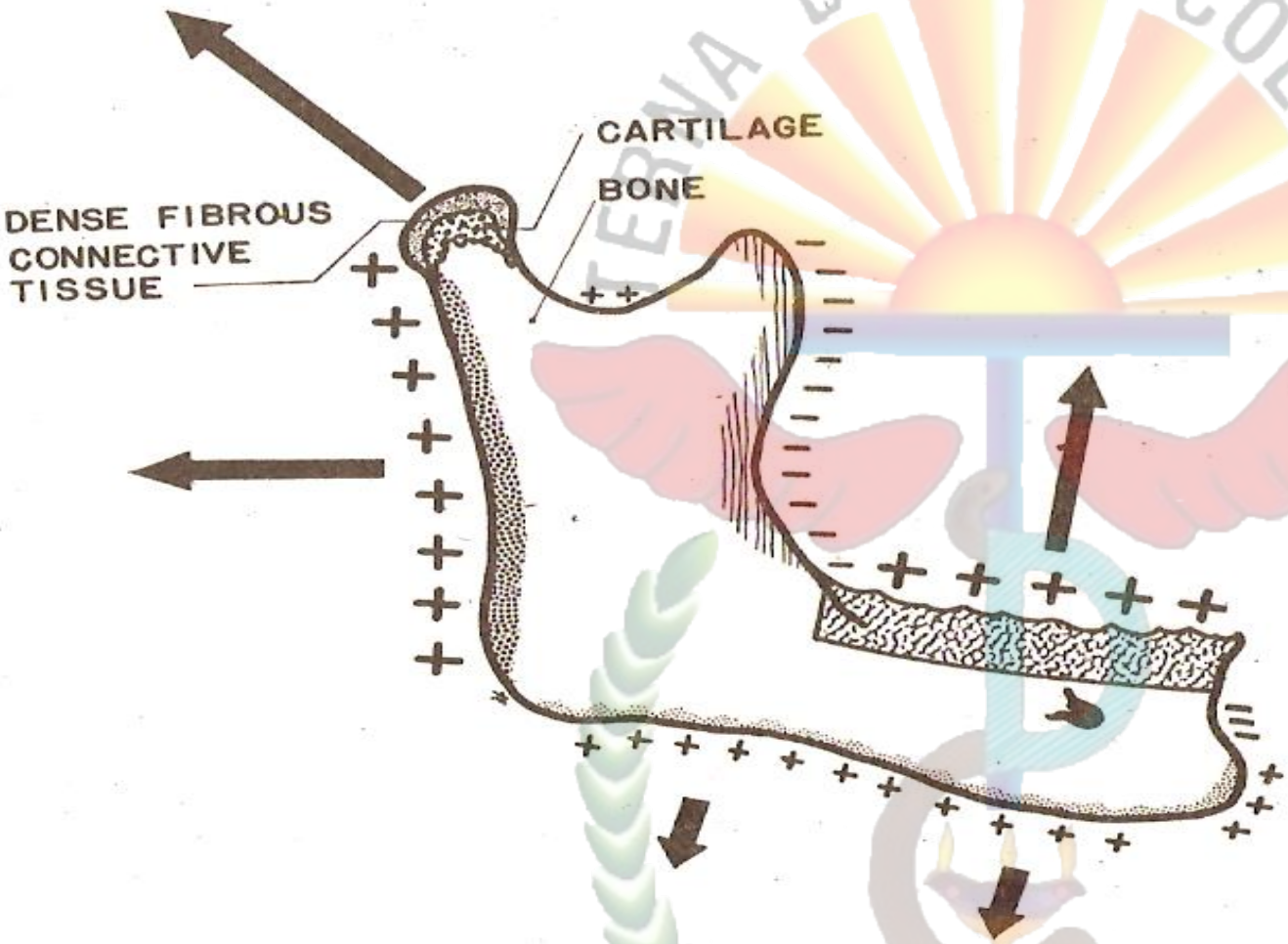


- Resorption - buccal surface

Body of mandible

- The increase in width of the mandible occurs primarily due to resorption on the inside and deposition on the outside
- Increase in length occurs due to drift of the ramus posteriorly
- Increase in height occurs due to eruption of the teeth





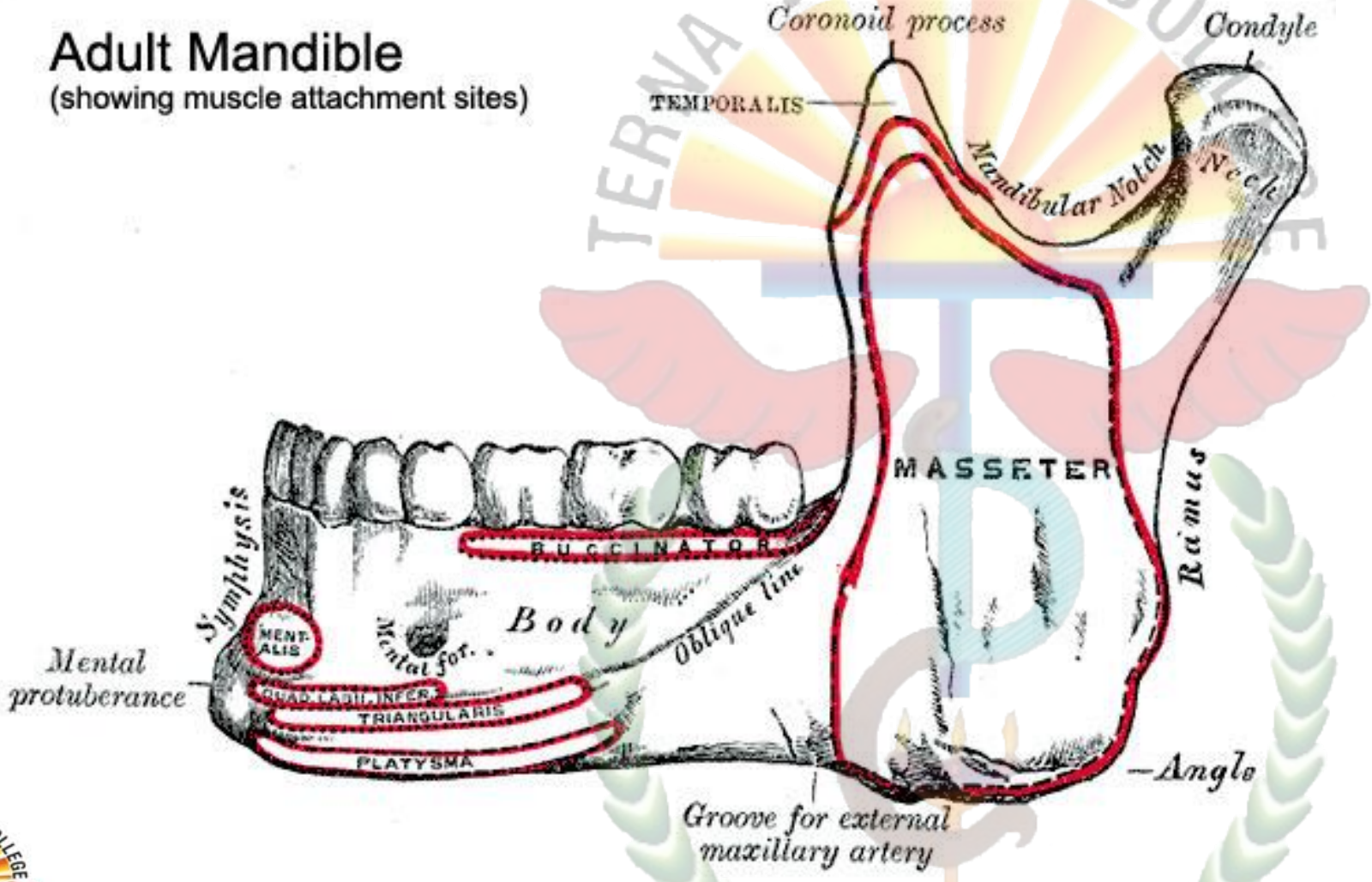
Role of Functional Matrix Theory in Mandibular Growth (Moss, 1969)

- Based on the functional cranial component, concept of **Van der Klaauw**, Moss supported the concept defining the role of functionl matrix.

- Mandible is not a unitary biological object but rather a composite of several relatively independent functional cranial components / functional matrix (periosteal and capsular matrices) and skeletal unit.

Adult Mandible

(showing muscle attachment sites)

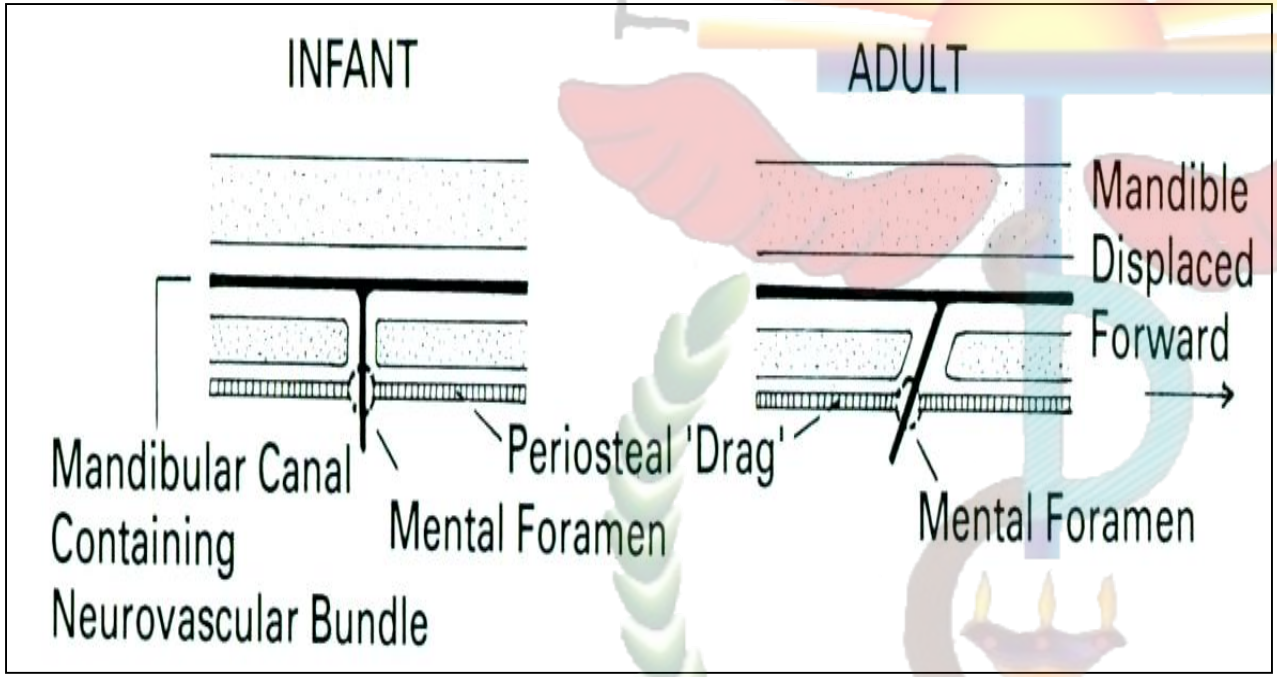


FUNCTIONAL MATRIX HYPOTHESIS

MOSS

SKELETAL UNITS	***FUNCTIONAL MATRIX***
• Coronoid	Temporalis
• Condyle	Lateral Pterygoid
• Angle	Masseter
• Alveolar bone	Teeth

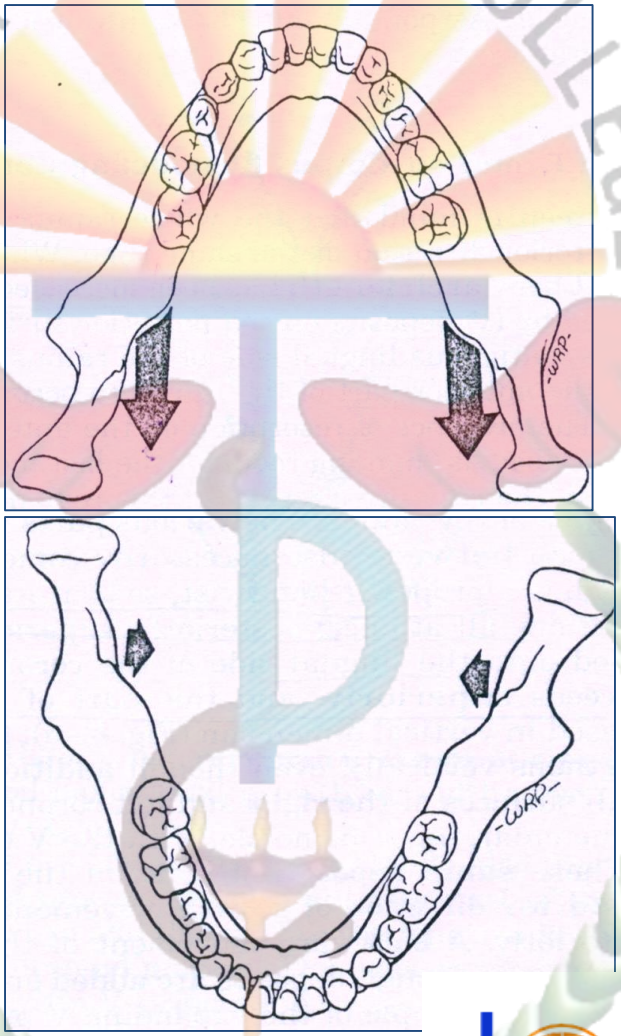
Mental foramen



Lingual Tuberosity

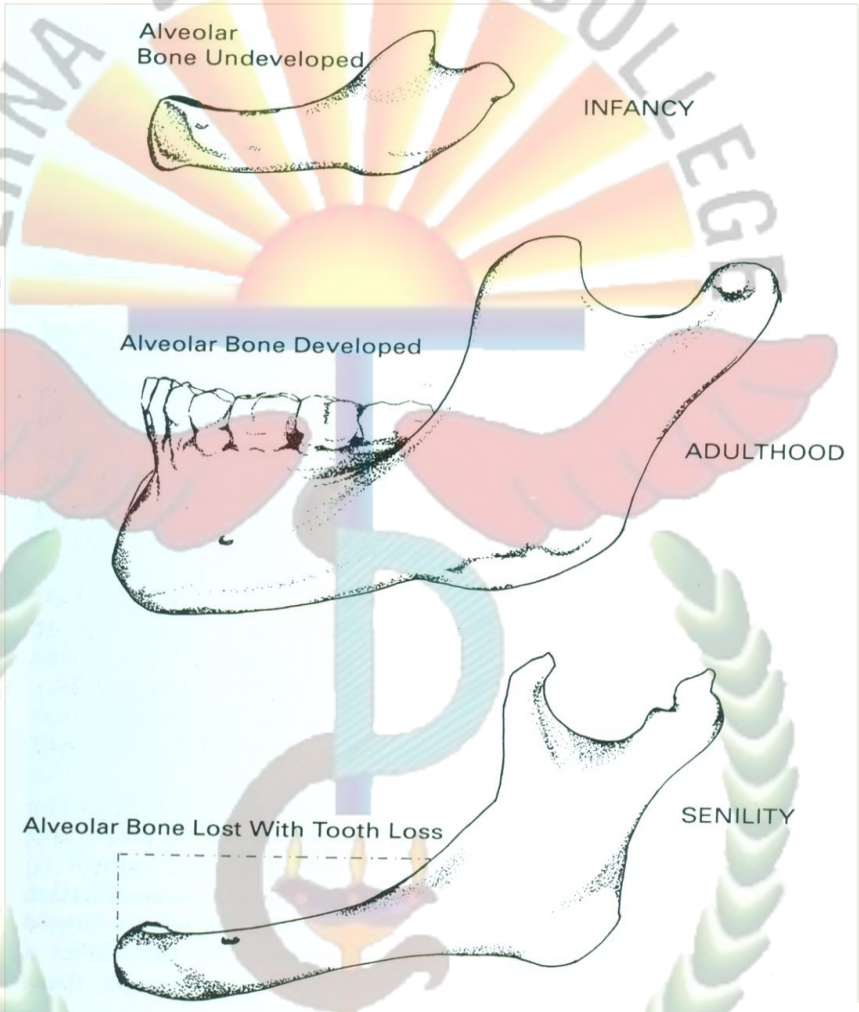
- Grows posterior and medial by deposition

- Resorptive field below- Lingual fossa



Alveolar Process

- Adds to the height and thickness of the mandibular body
- Teeth absent fails to develop
- Teeth extracted resorbs



Alveolar Process

- Maintain occlusal relationship during differential mandibular & midfacial growth.
- Maintains vertical height
- Adaptive remodeling makes orthodontic tooth movement possible

Mental Protuberance

- Formed by mental ossicles from accessory cartilage and ventral end of Meckel's cartilage

- Poorly developed in infants

Chin

- Protrusive chin is unique human trait
- More prominent in male
- Less prominent in female
- Underdevelopment of chin: microgenia

Weidenreich claimed that the presence of chin in human is due to the expansion of the brain case and reduction of the facial and dental skeleton.

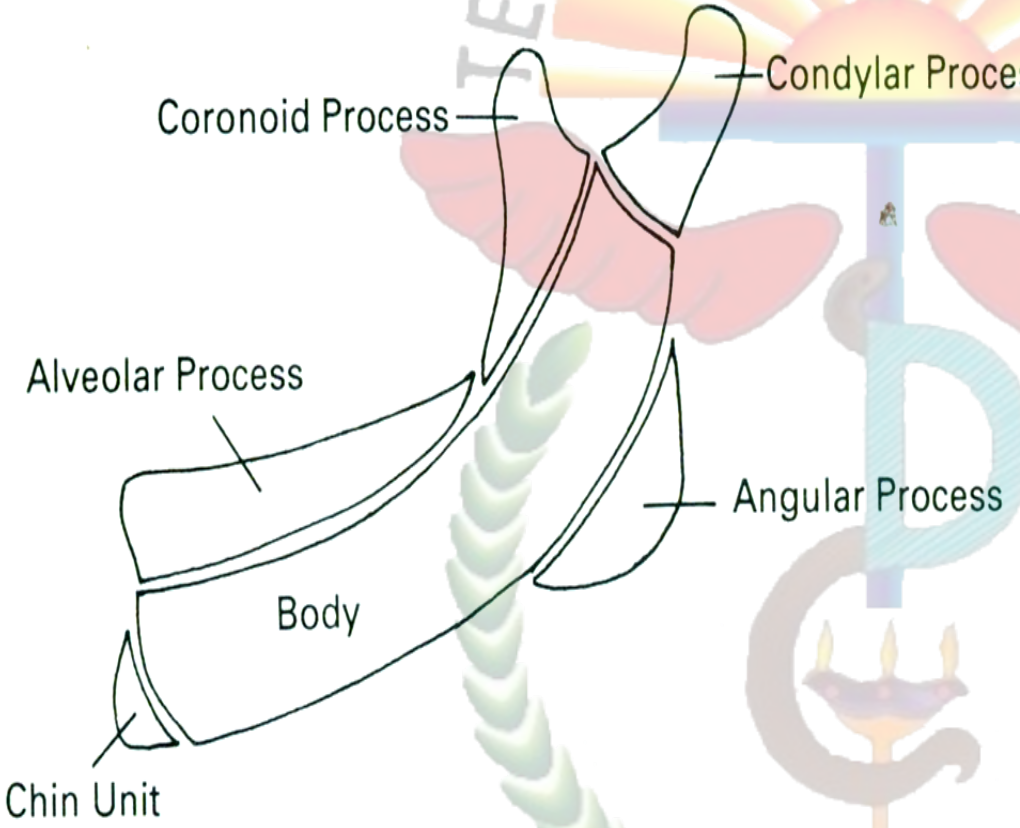
Witsky (1961) stated that it is relatively the most stable area within the outline of the mandible

Garn (1963) the postnatal growth increase in anteroposterior depth of the symphysis occurs due to an excess of lingual apposition over labial resorption, and it is largely independent of facial and body size.

Symphysis Menti

- Limited growth till fusion
- No widening after fusion

Skeletal units of mandible



Role of muscles in Mandibular growth

- Decrease muscle activity

Flattening of Gonial angle

Reduction of Coronoid process

Anomalies of mandible

- *Some of the syndromes associated with mandibular abnormality*

i) Down's syndrome

i) Marfan's syndrome

ii) Turners syndrome

iii) Kleinfelter's syndrome

iv) Pierre-robin syndrome

v) Treacher- collin syndrome

Congenital

- Agnathia
- Micrognathia
- Macrognathia
- Bifid / double condyle

Age Changes In Mandible

- Angle between ramus alveolar ridge

In infants 135°

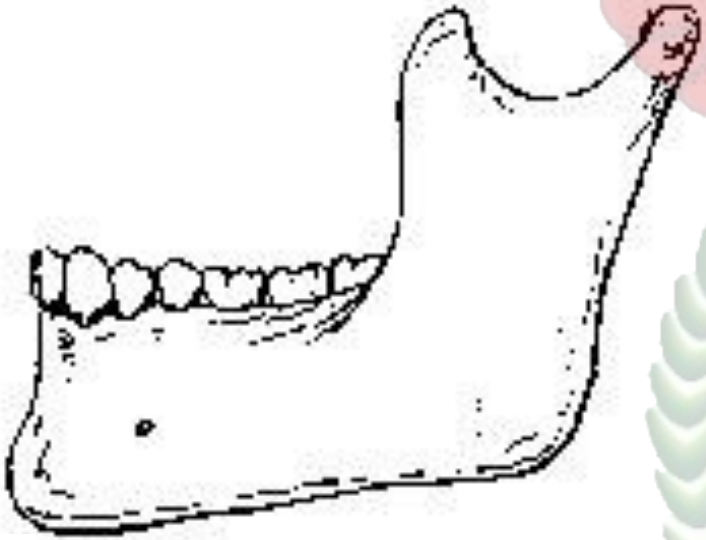
adults 100-110°

old age 140°

- Position of mental foramen
- Neck of condyle

Infancy

Childhood



Adulthood

Old Age

CLINICAL

IMPLICATIONS

In case of downward and backward rotation, opening of the bite is difficult to prevent, therefore, it is the policy to postpone treatment until the pubertal growth spurt is nearly over.

In case of pronounced upward and forward rotation of mandible there is a major risk of deep bite developing.

This can be prevented by means of a stabilizing appliance, such as bite plane, introduced before puberty.

A

B

Fig 2 Skeletal anterior open bite (A) Intraoral photograph (B) Lateral cephalogram

- Majority of children with **Class II malocclusion** have mandibular deficiency. Efforts to accelerate mandibular growth led to the development of a family of functional appliance (*e.g.* Activator).

➢In cases of **Class III malocclusion** due to mandibular prognathism, extra-oral force via a chin cup therapy orients the line of force application below the mandibular condyle so that chin is deliberately rotated downward and backward. This results in extension of teeth and the force aimed at the top of condyle might restrain growth there.

Take home message:

- Ossification of condylar cartilage leads to growth of mandible
- To understand the growth of mandible you need to understand the Enlows principle

Expected questions:

SAQ

1. Post natal growth of mandible
2.Enlows V principle
3.Counterpart principle
4.Growth rotations

LAQ

1. Describe in detail the pre and post natal growth of mandible

THANK YOU

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