Embryological development & oral cavity

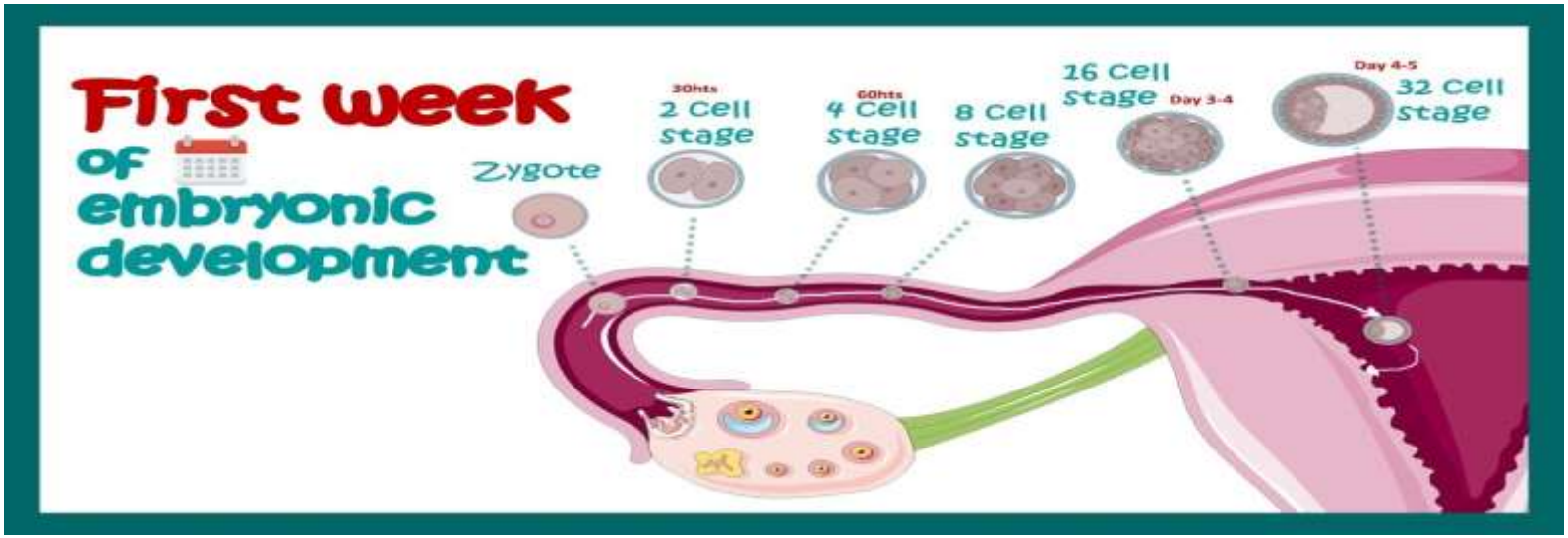
Senior lecturer
Dr sura talal kadhim
Department of prosthodontics technology
Lec 3

Major phases of intra-Uterine life

- The intra-Uterine development of human is divided into three major phase as follows:

Phase I: Formation of three germ layers

- Fertilization.....end of 2nd week



Phase II: The embryonic period. During this time all organ systems are developed

- 3rdweek .....8th week

Phase III : The fetal period. During this period there is a rapid increase in the overall size and maturation of the fetus.

- 8th week .....birth .

Development of the face

Fourth week:

Central nervous system (CNS) begins to develop in embryo, Neuroectoderm differentiates from ectoderm, localized to neural plate which is a band of cells that extends length of the embryo, from cephalic to caudal end.

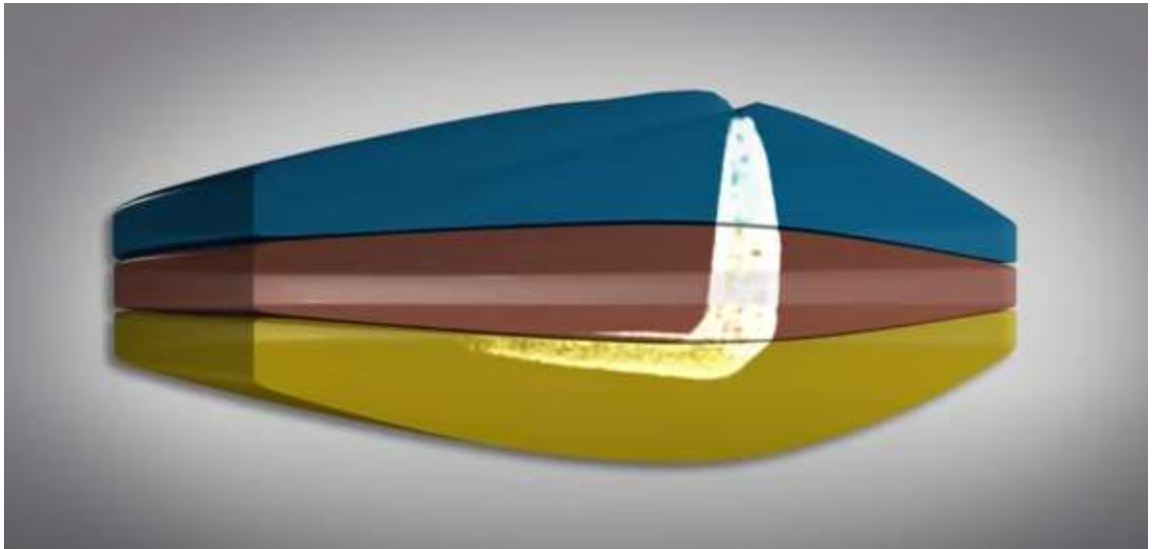
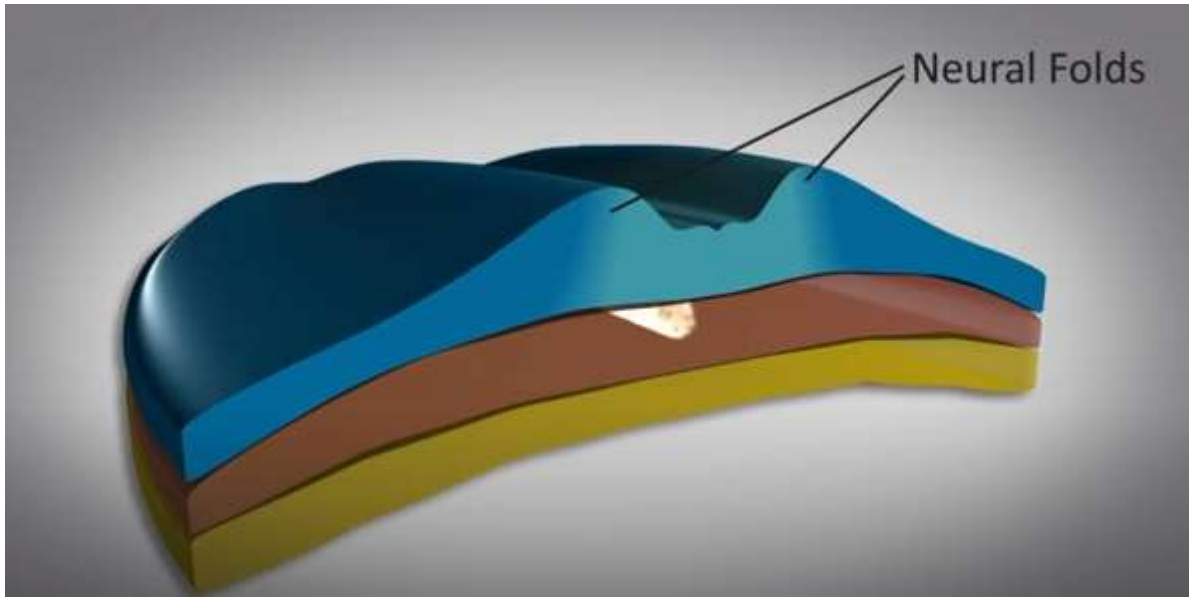
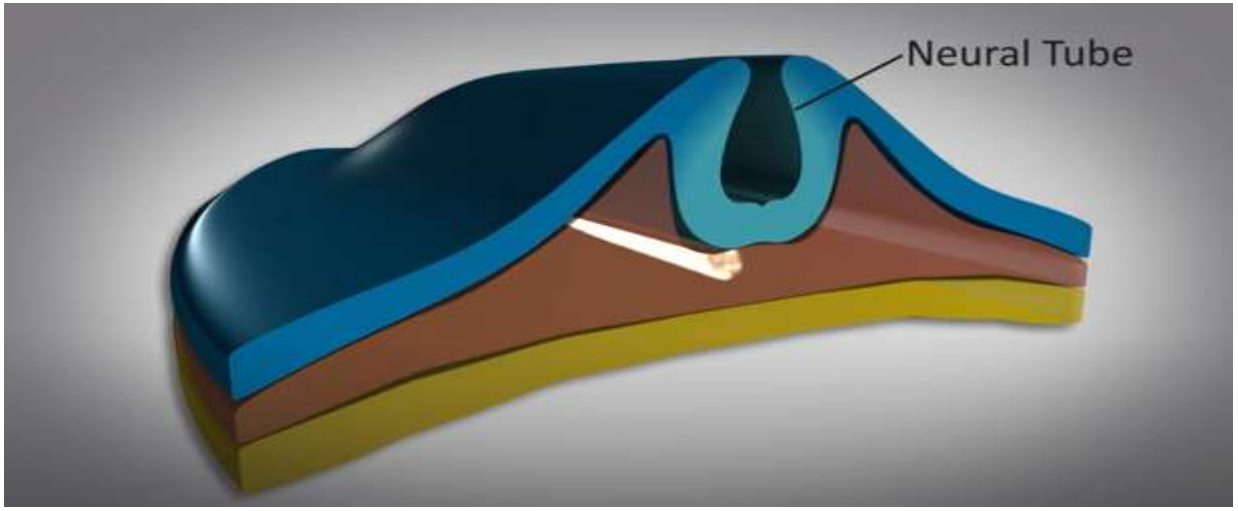


Plate undergoes further growth and thickening, which cause it to deepen and invaginate centrally, forming the neural groove.

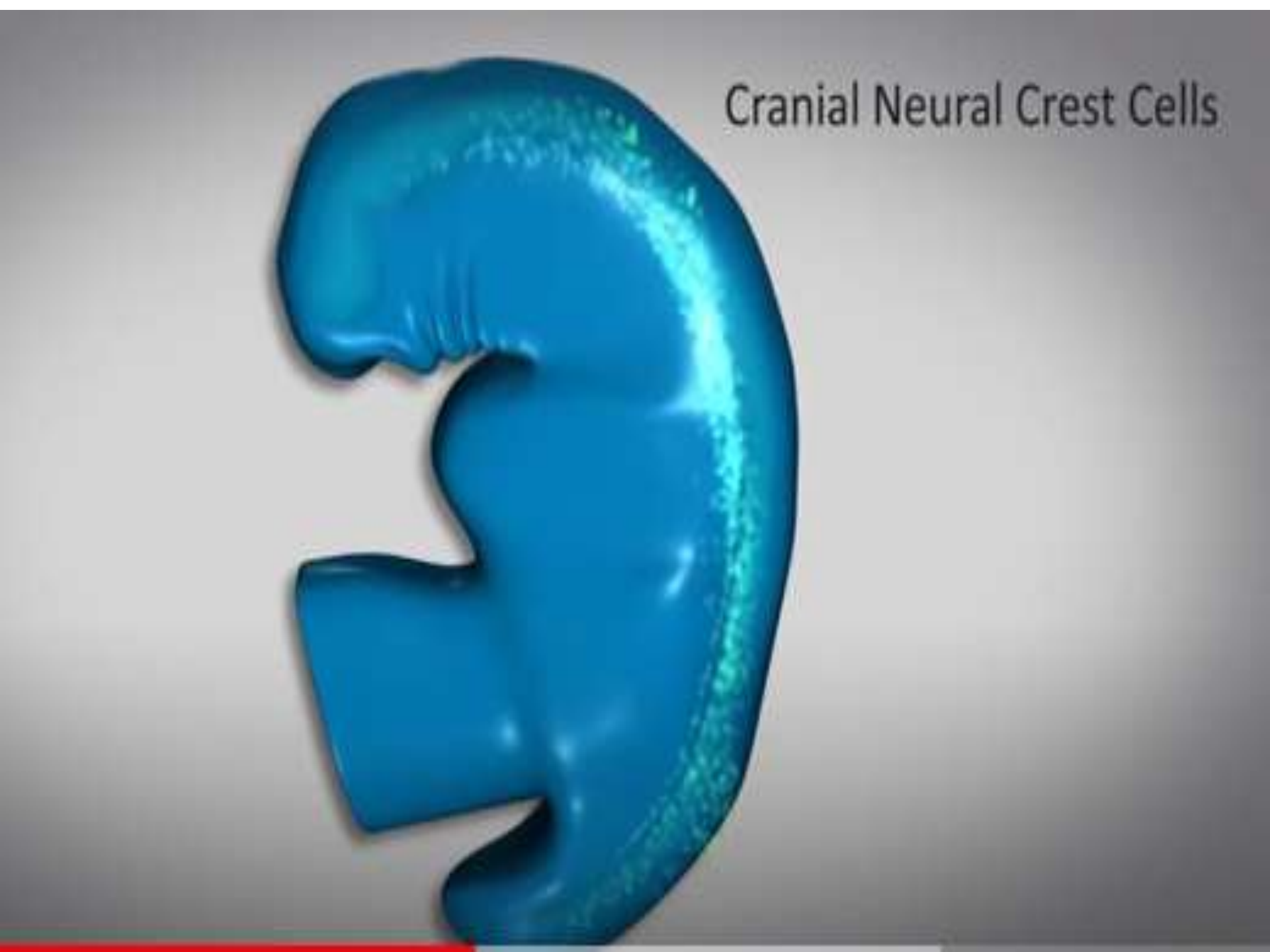


Neural groove deepens further and becomes surrounded by neural folds, which meet superior to neural groove, forming a neural tube which undergoes fusion at its most superior portion, future spinal cord .



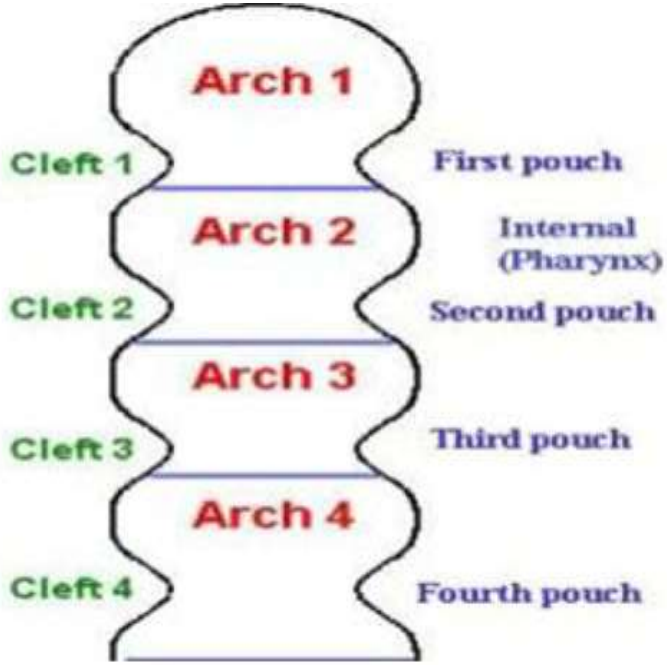
Disc now has a cephalic end (head) where oropharyngeal membrane (buccopharyngeal membrane, (future mouth forms) and caudal end (tail) where cloacal membrane forms (future anus).

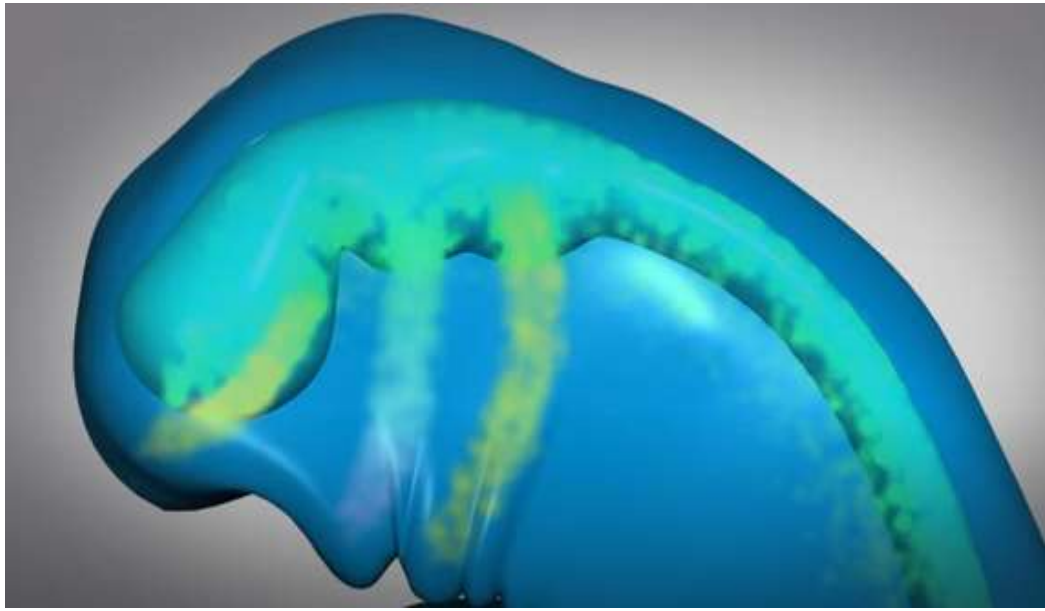
Cells of ectoderm along the back of the embryo grow more rapidly than the front, forming a curved shape.


Cranial Neural Crest Cells

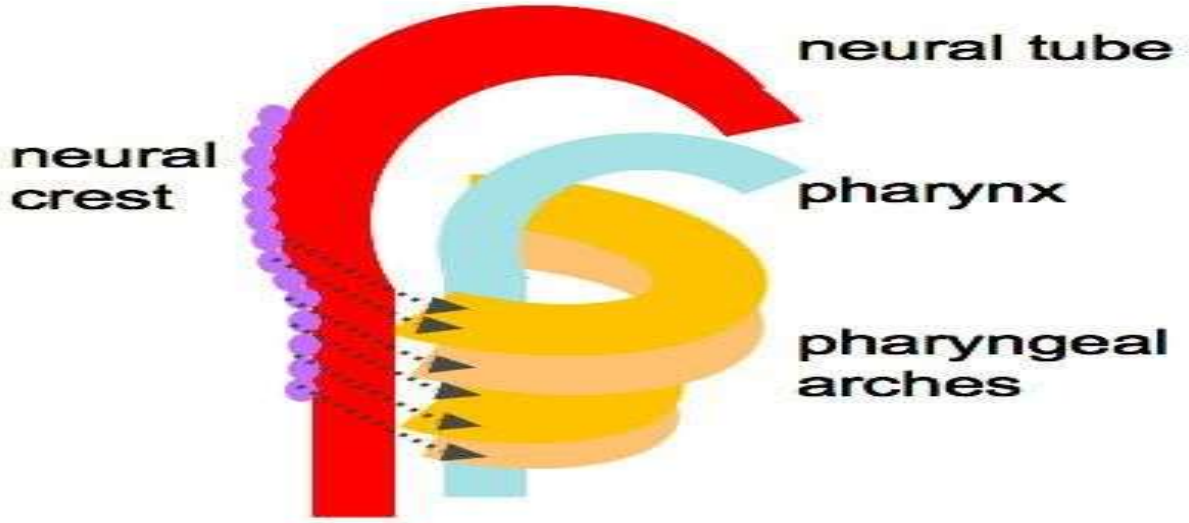
Branchial or pharyngeal arches

Neural crest cells develop from neuroectoderm, then migrate from neural folds and disperse within mesenchyme; they are IMPORTANT in development of head and neck structures such as branchial or pharyngeal arches.





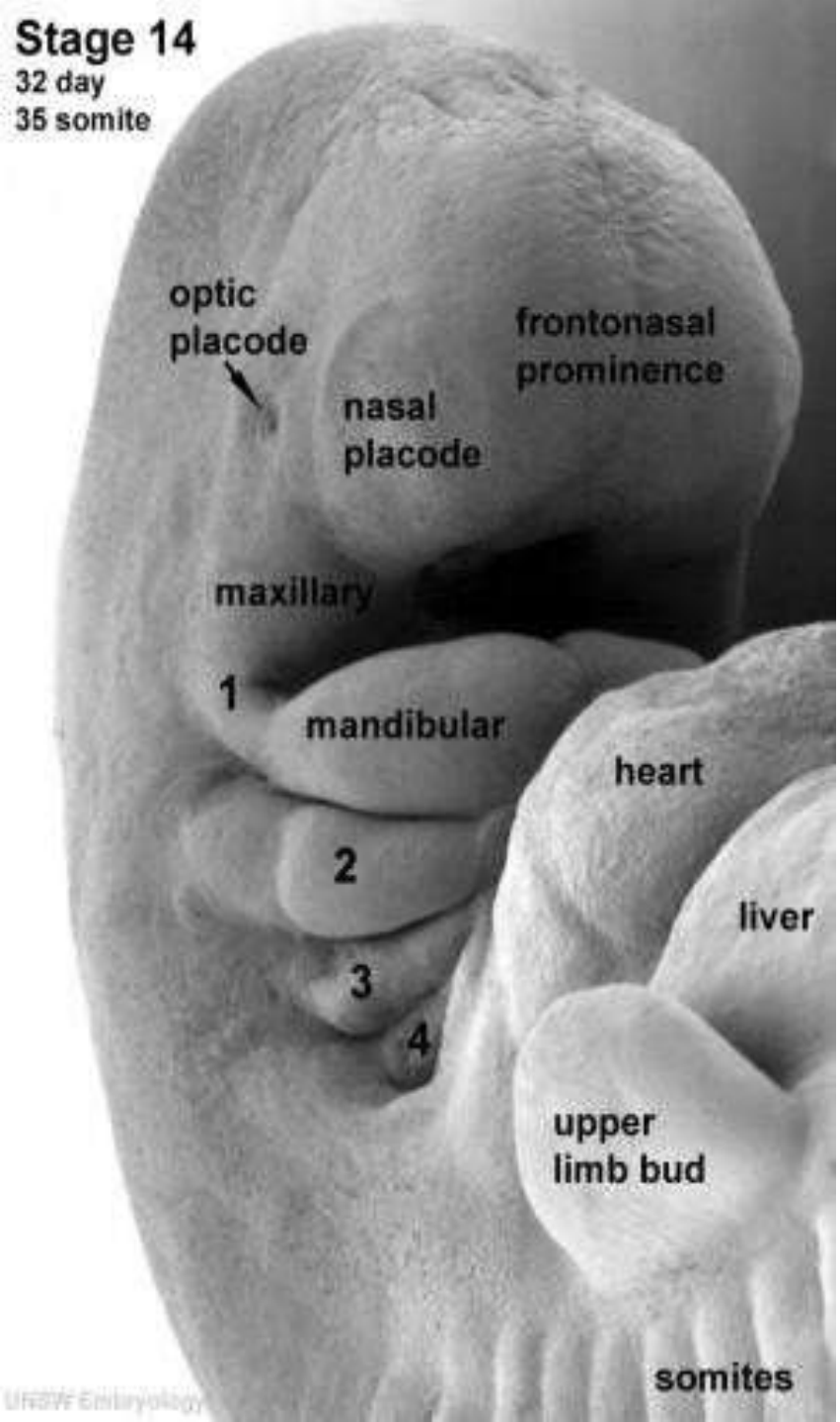
- The development of the pharyngeal arches is complex involving a number of embryonic cell types: ectoderm, endoderm, mesoderm and neural crest

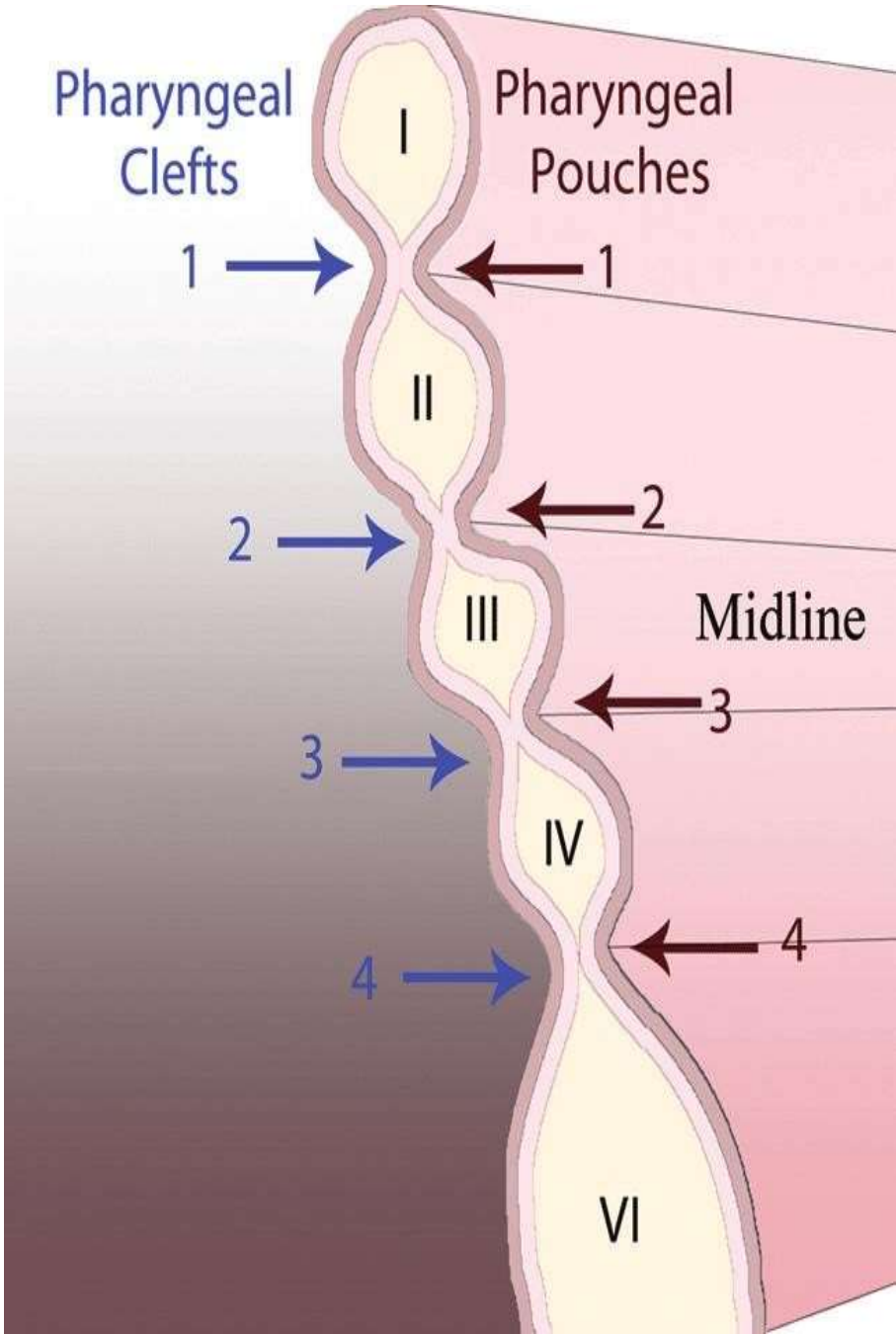


During human development, pharyngeal arch pairs project forward from the back of the embryo toward the front of the face and neck.

Each arch develops its own artery, nerve and cartilage that controls a distinct muscle group, and skeletal tissue. These arches grow and join in the ventral midline.

The first arch, as the first to form, separates the mouth pit .
The 1st pharyngeal arch appears at about the beginning of the 4th week and others are added more caudally later such that there are 5 arches by the end of the 4th week; the 5th arch fails to form, so the arches are numbered 1, 2, 3, 4, and 6.


Stage 14
32 day
35 somite
optic placode
frontonasal prominence
nasal placode
maxillary
1
mandibular
heart
2
liver
3
4
upper limb bud
somites


Pharyngeal Clefts
Pharyngeal Pouches
I
1
1
II
2
2
III
Midline
3
3
IV
4
4
VI

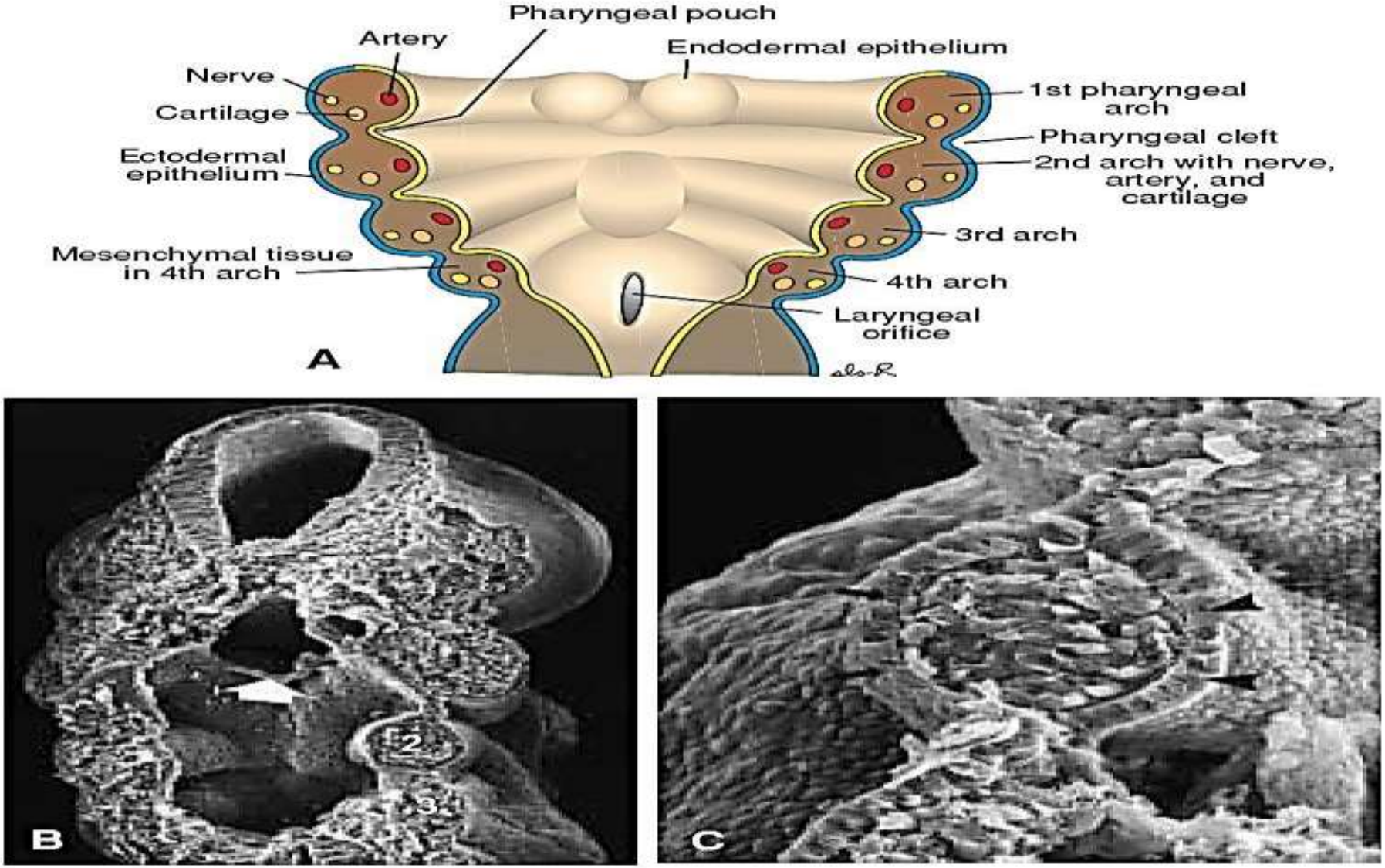
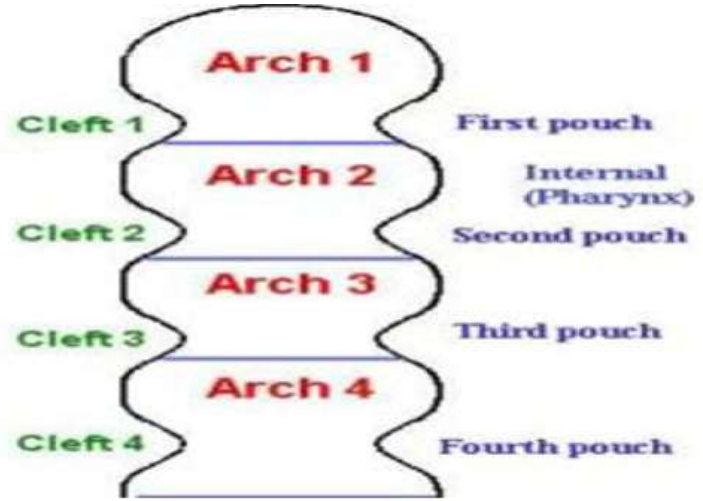


Figure 15.6 A. Pharyngeal arches. Each arch contains a cartilaginous component, a cranial nerve, an artery, and a muscular component. **B.** Scanning electron micrograph of the pharyngeal region of a mouse embryo, showing the pharyngeal arches, pouches, and clefts. The first three arches (I, II, and III) are visible. A remnant of the buccopharyngeal membrane (*arrow*) is present at the entrance to the oral cavity. **C.** Higher magnification of the pharyngeal arches of a mouse embryo. Pharyngeal arches consist of a core of mesoderm lined by endoderm internally (*arrowheads*) and ectoderm externally (*arrows*). Pouches and clefts occur between the arches, where endoderm and ectoderm appose each other.

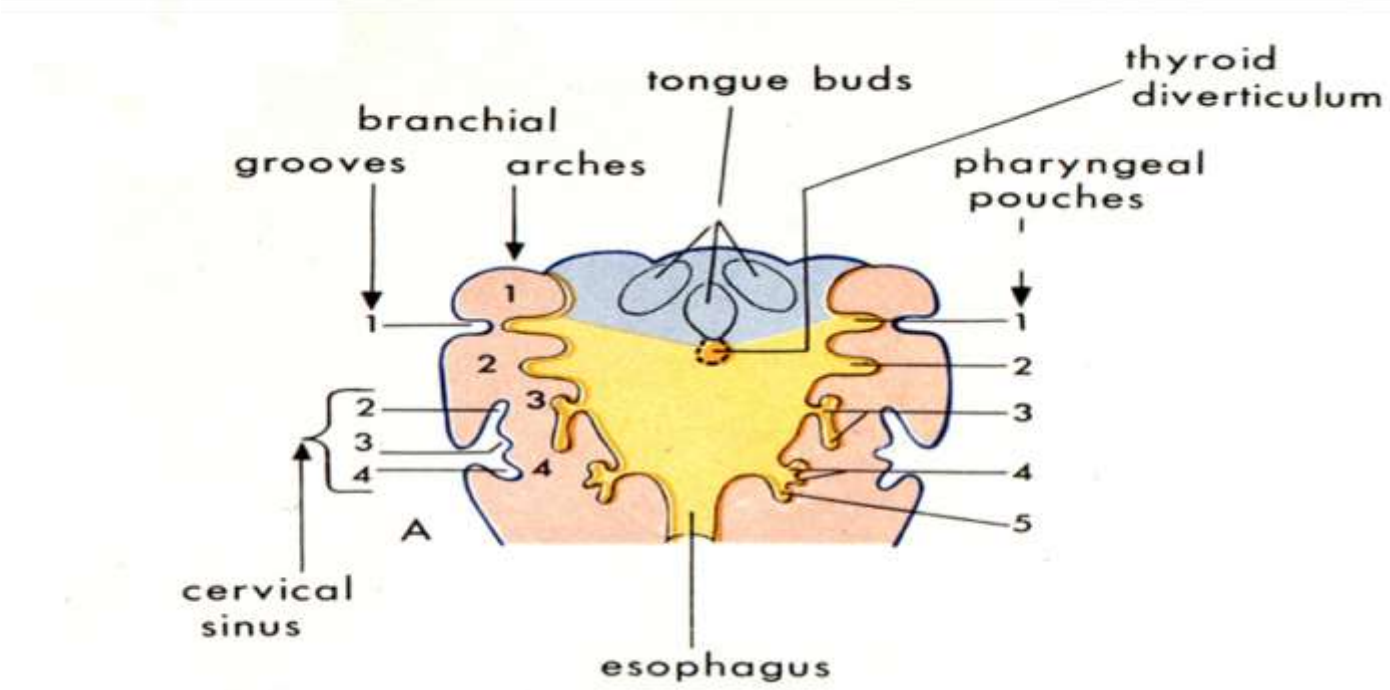
Branchial arches or pharyngeal arches

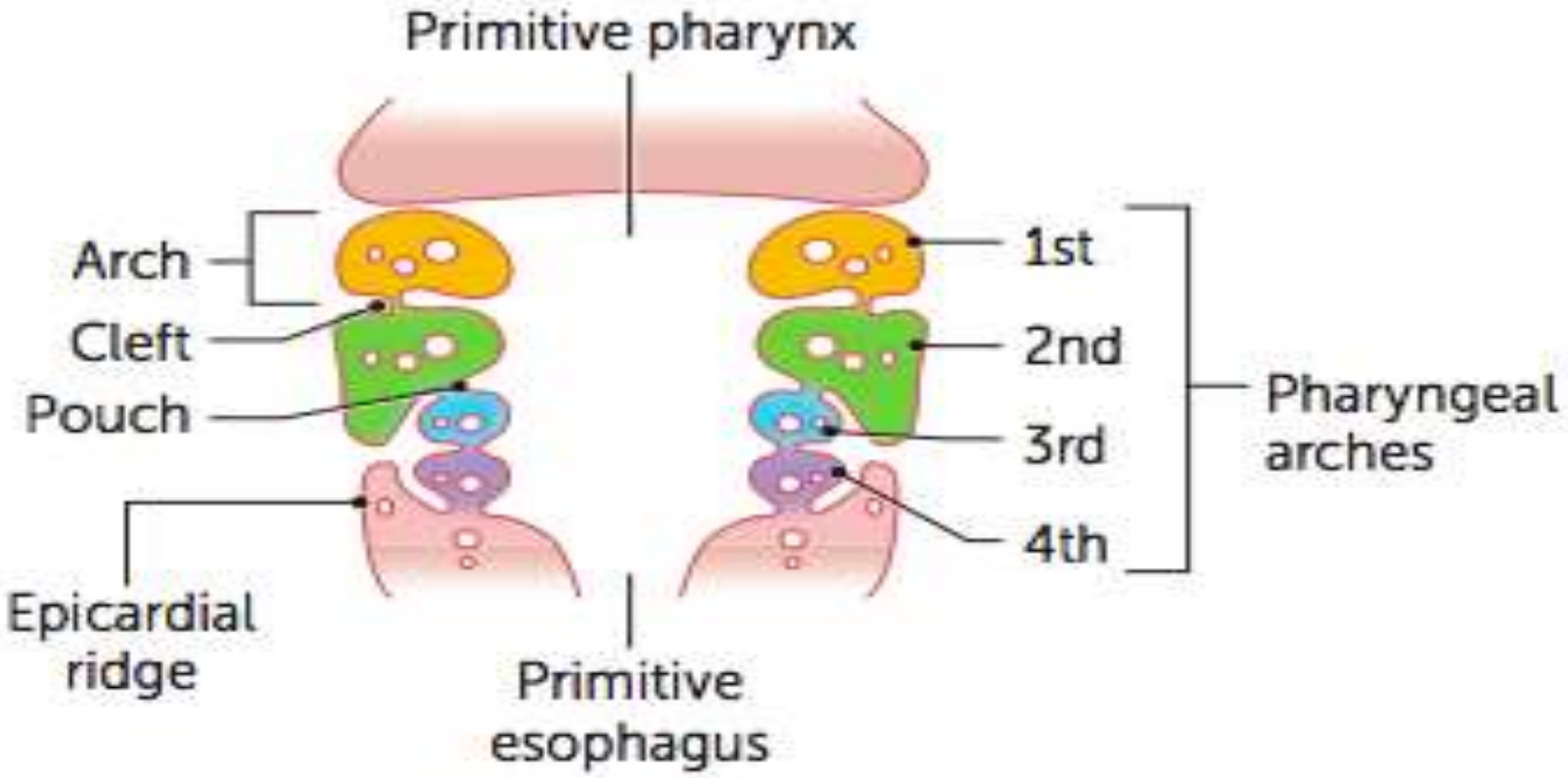
- The branchial arches appear in the fourth and fifth weeks of embryologic development.
- The branchial arches are formed within mesenchymal tissue from ectoderm and separated by deep clefts known as branchial clefts.



Branchial Apparatus Formation

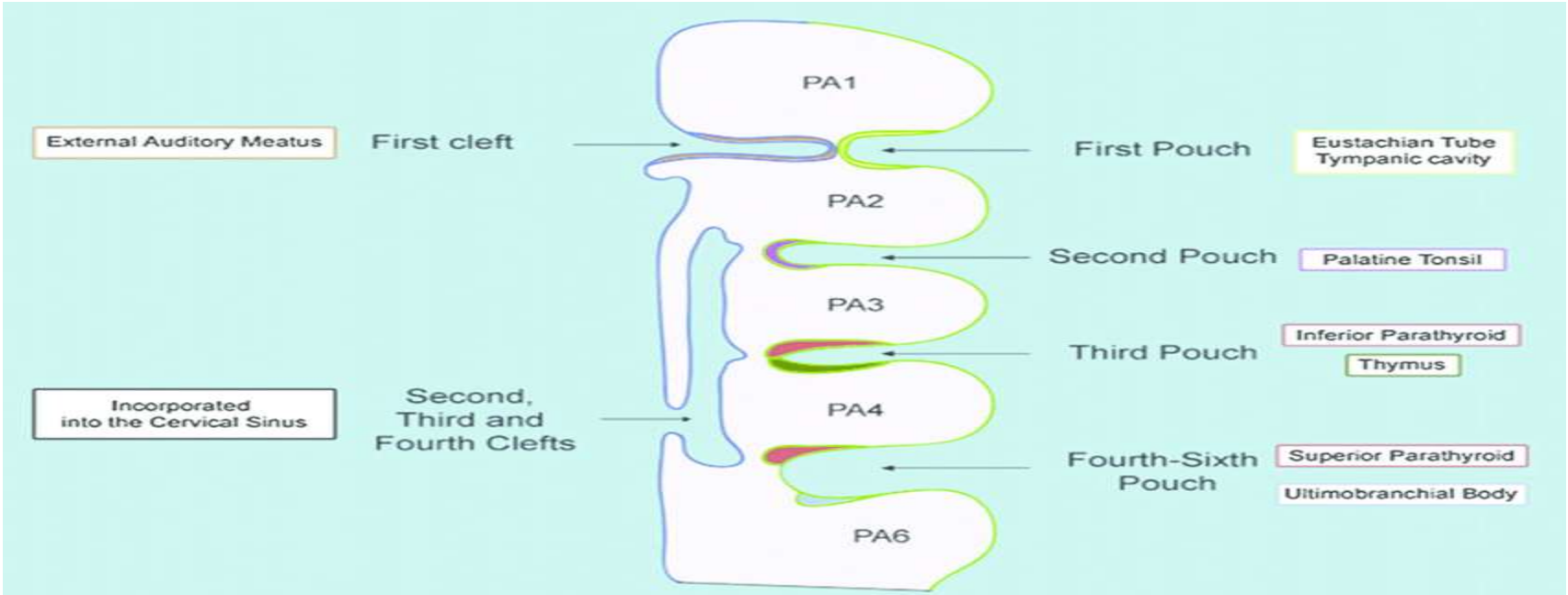
Branchial apparatus consists of the branchial arches, branchial grooves or clefts and pharyngeal pouches.




Primitive pharynx
Arch
Cleft
Pouch
Epicardial ridge
1st
2nd
3rd
4th
Pharyngeal arches
Primitive esophagus

pharyngeal pouches

Five well-defined pairs of pharyngeal pouches develop as endodermal envaginations form the lateral walls lining the pharynx and form different structures.

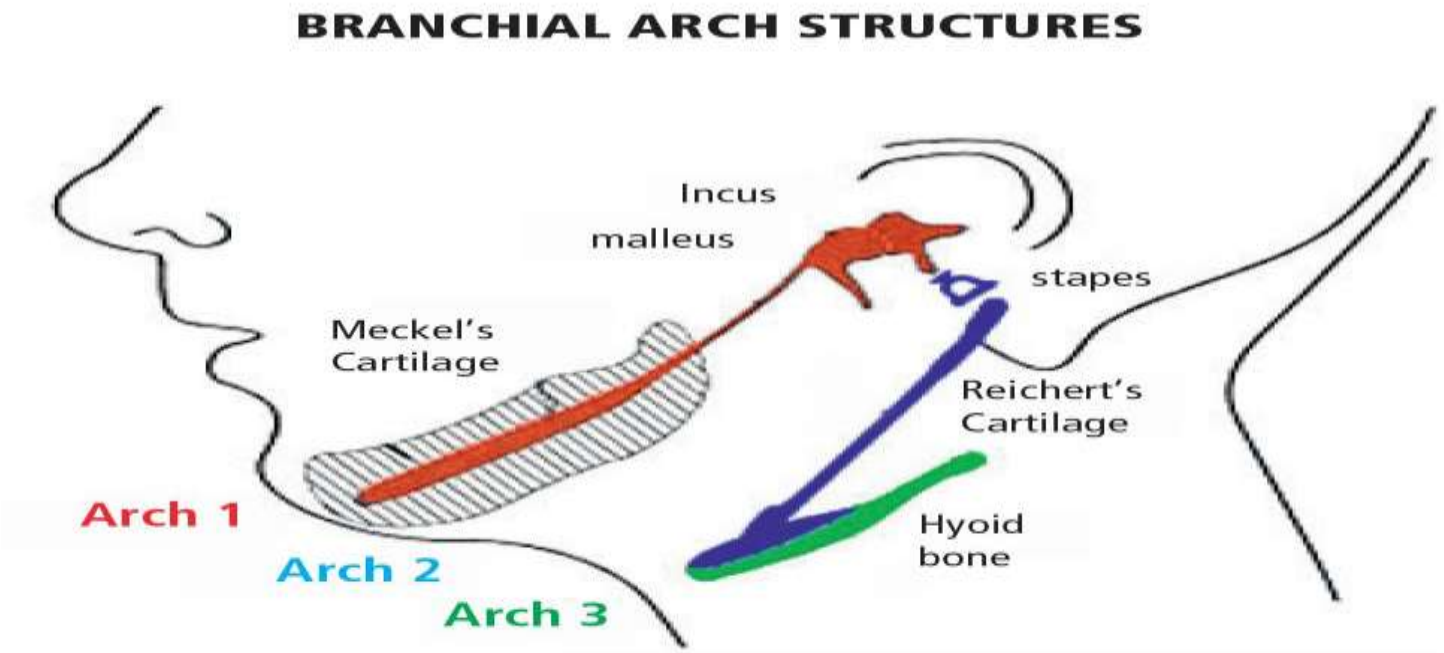


- There is no specific name for each branchial arch except the first and second .The first one is called as the Mandibular arch and the second one is the hyoid arch

Branchial arches

Arches are six pairs of U-shaped stacked bilateral swellings of tissue appearing inferior to the stomodeum and include the mandibular arch (FIRST branchial arch), which will form the lower face; each arch will form into different structures. Each arch contains cartilaginous core, aortic arch, definite cranial nerve; each cranial nerve will supply the structures that develop from the mesenchyme of the arch.

Second (hyoid) arch enlarges and grows so that by the sixth week it will overlap the third, fourth, and sixth arches and cover them.



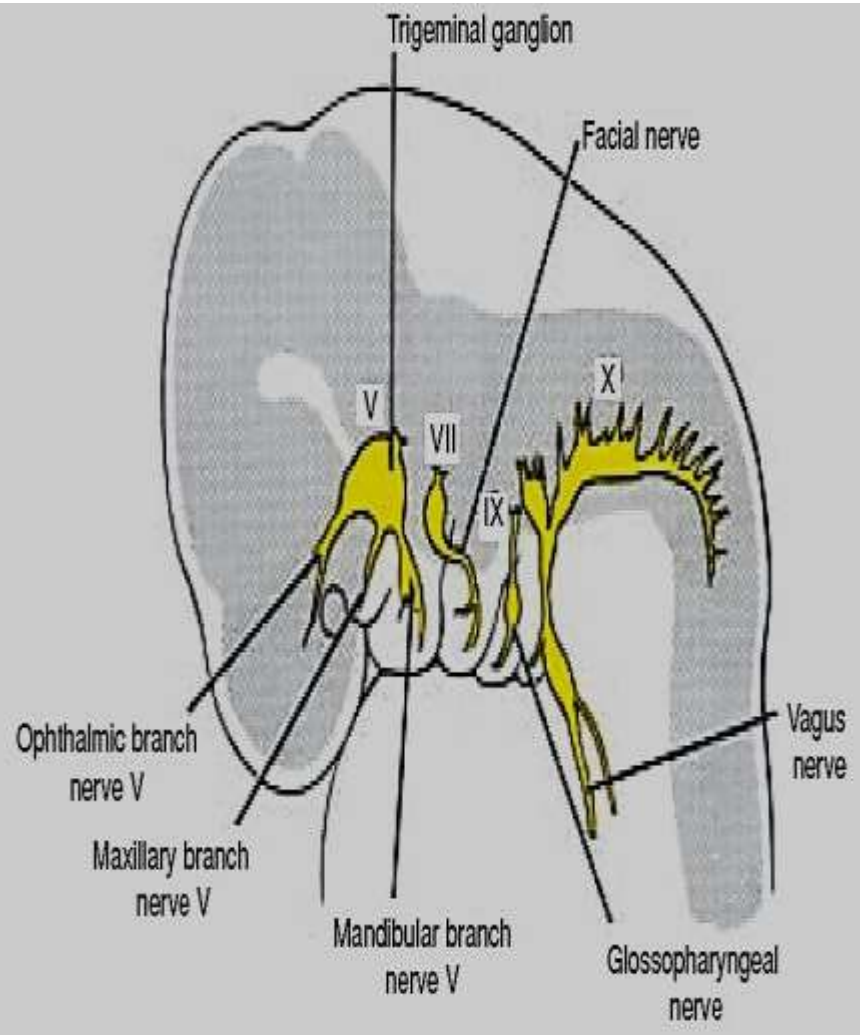


Figure 15.7 Each pharyngeal arch is supplied by its own cranial nerve. The trigeminal nerve supplying the first pharyngeal arch has three branches: the ophthalmic, maxillary, and mandibular. The nerve of the second arch is the facial nerve; that of the third, the glossopharyngeal nerve. The musculature of the fourth arch is supplied by the superior laryngeal branch of the vagus nerve, and that of the sixth arch, by the recurrent branch of the vagus nerve.

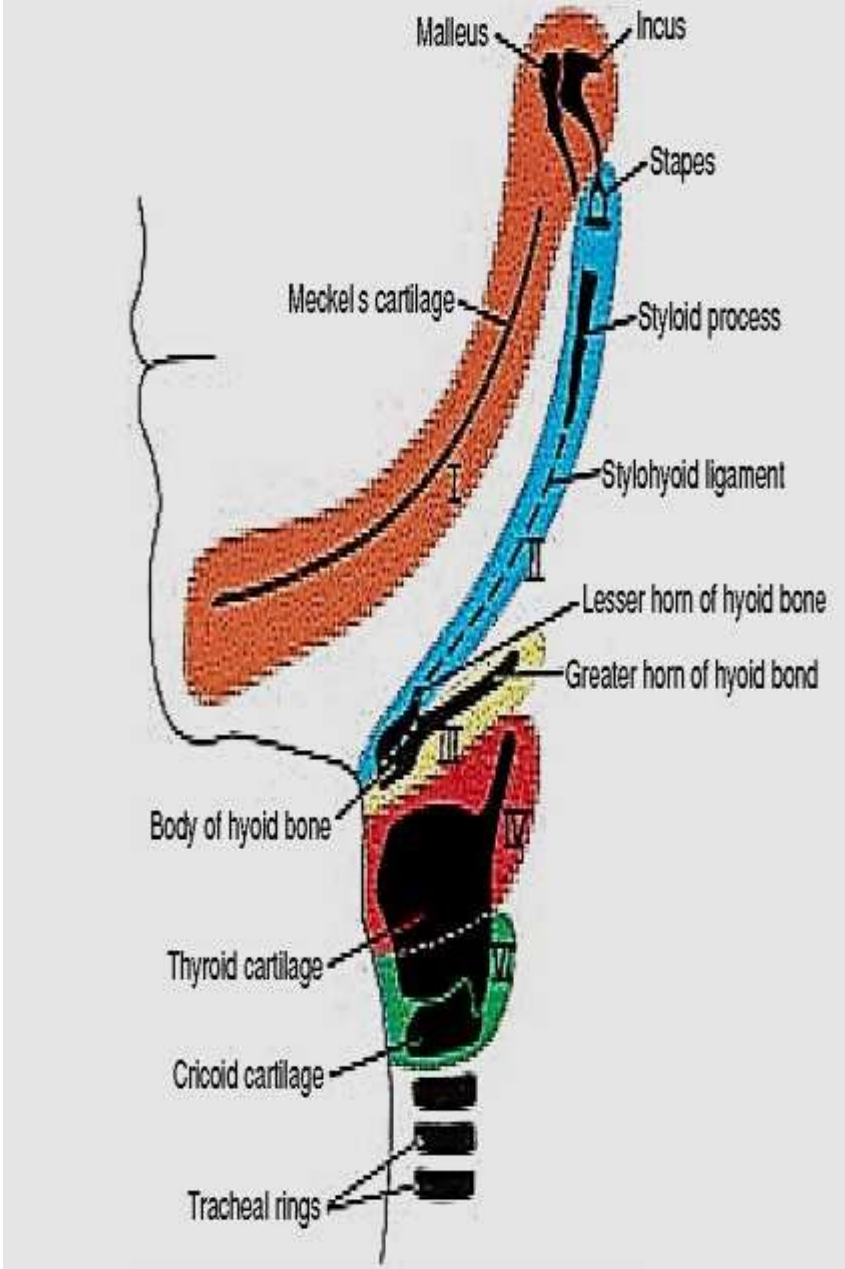
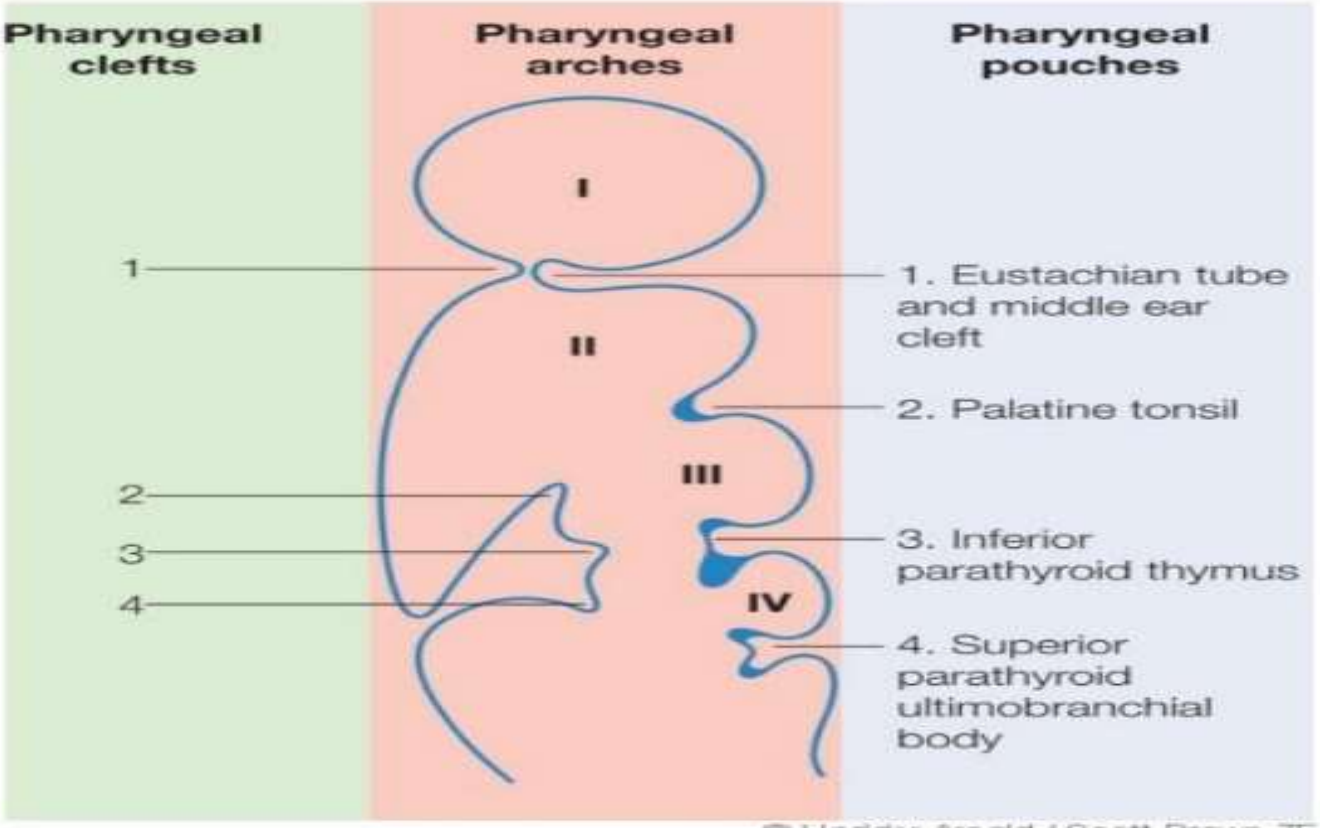


Figure 15.9 Definitive structures formed by the cartilaginous components of the various pharyngeal arches.

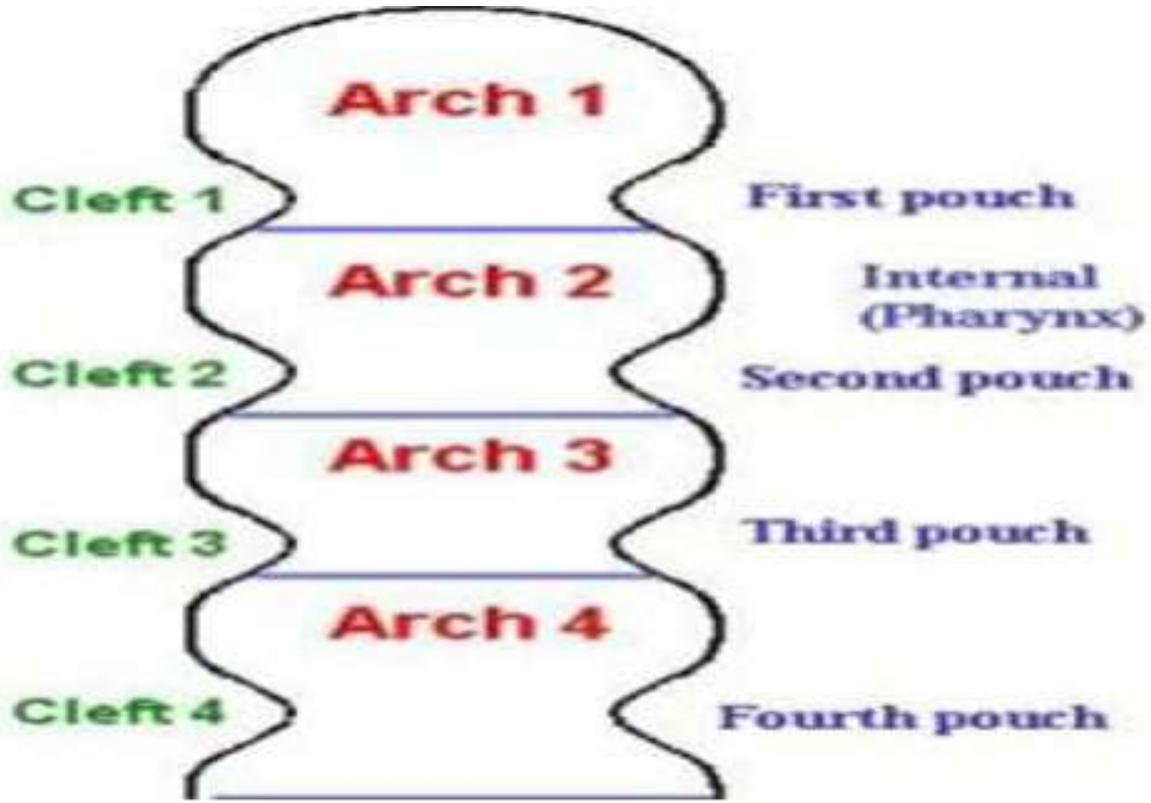
Derivatives of the pharyngeal pouches & clefts

- 1st pouch and cleft give external auditory meatus
- 2nd pouch : tonssilar fossa (palatine tonsills)
- 3rd pouch : inferior parathyroid and thymus
- 4th pouch : superior parathyroid .


Pharyngeal clefts
Pharyngeal arches
Pharyngeal pouches
I
II
III
IV
1
2
3
4
1. Eustachian tube and middle ear cleft
2. Palatine tonsil
3. Inferior parathyroid thymus
4. Superior parathyroid ultimobranchial body
© Hodder Arnold / Scott-Brown 7E

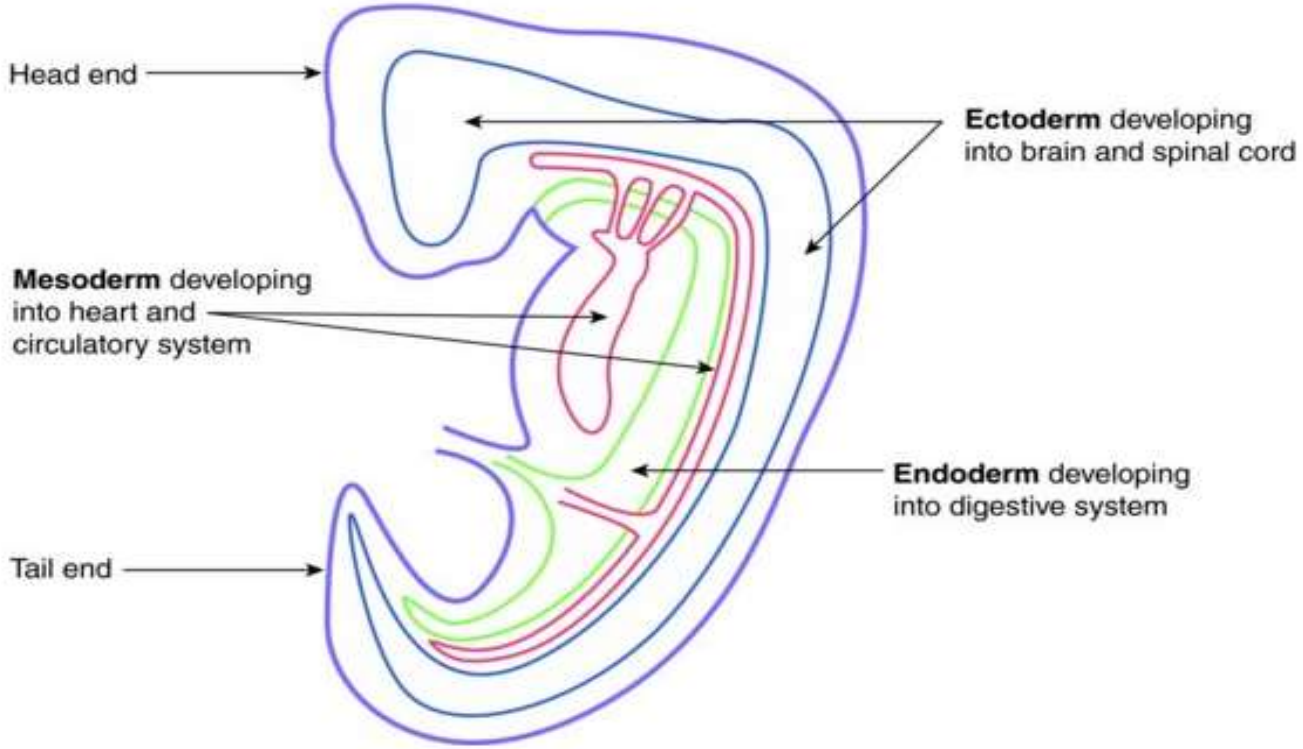
Derivatives of the first branchial arch :

- 1- The mandible and maxilla .
- 2- All the teeth
- 3- All muscles of mastication.
- 4- Anterior 2\3 of the tongue.
- 5- All the salivary glands.


Arch 1
Cleft 1
First pouch
Arch 2
Internal
(Pharynx)
Cleft 2
Second pouch
Arch 3
Cleft 3
Third pouch
Arch 4
Cleft 4
Fourth pouch

- **Endoderm tissue buds begin developing, and will later form the respiratory and digestive organs.**
- **Brain begins to develop, as do eye stalks and ear pits.**
- **Ectoderm tissue buds develop, and will later form the limbs.**
- **Ectoderm tissue folds develop as branchial arches, which will become the jaws and other neck structures.**

Heart begins developing on the front of the embryo, beneath the head, and is pushed down into the chest as the branchial arches develop



Fifth week

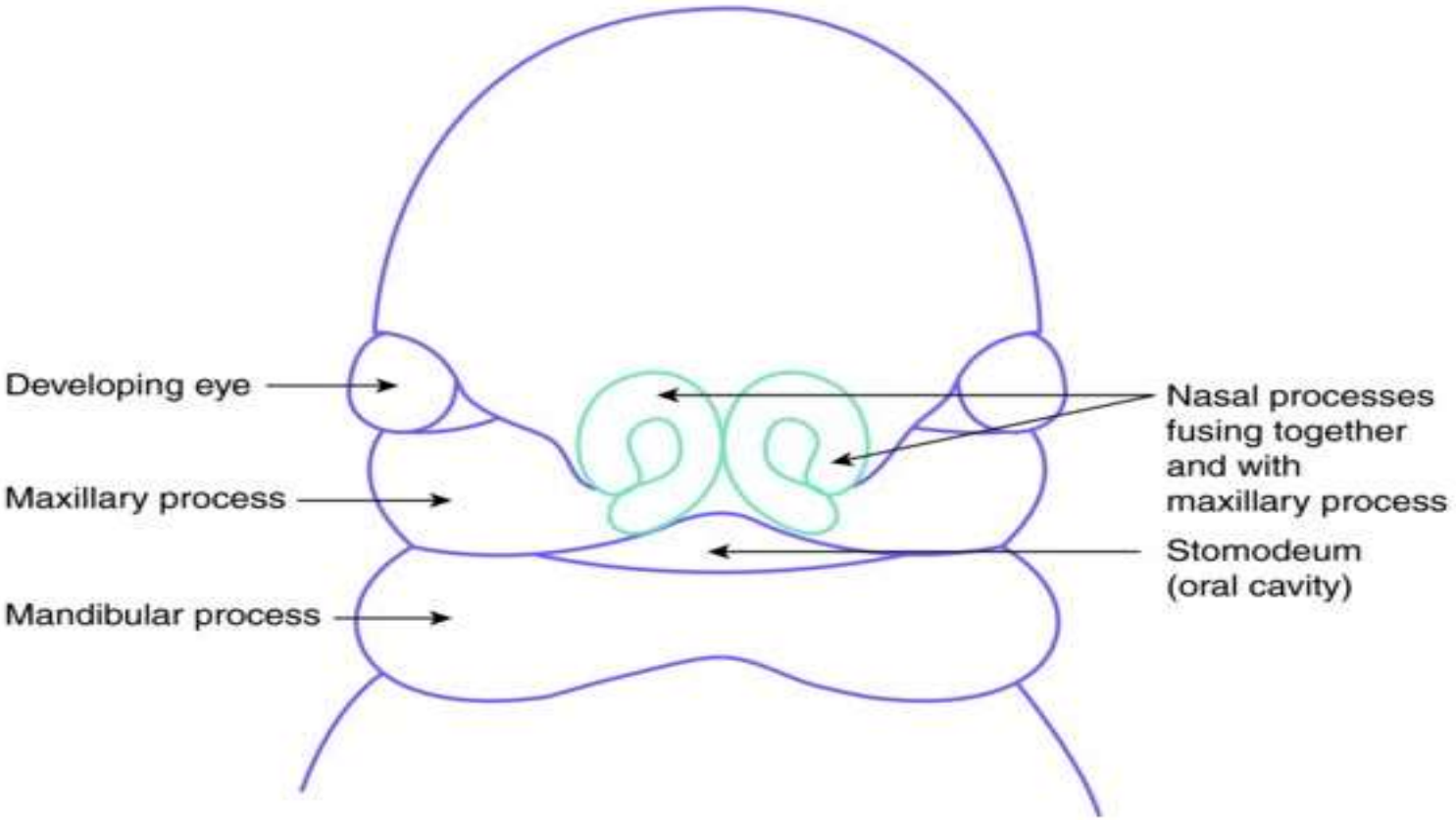
Nose begins developing as nasal pits.

Jaws and ears form.

Hands and feet begin developing.

All internal organs are developing.

Ectoderm tissue folds grow to join at the front and form the **chest and abdominal cavity walls.**

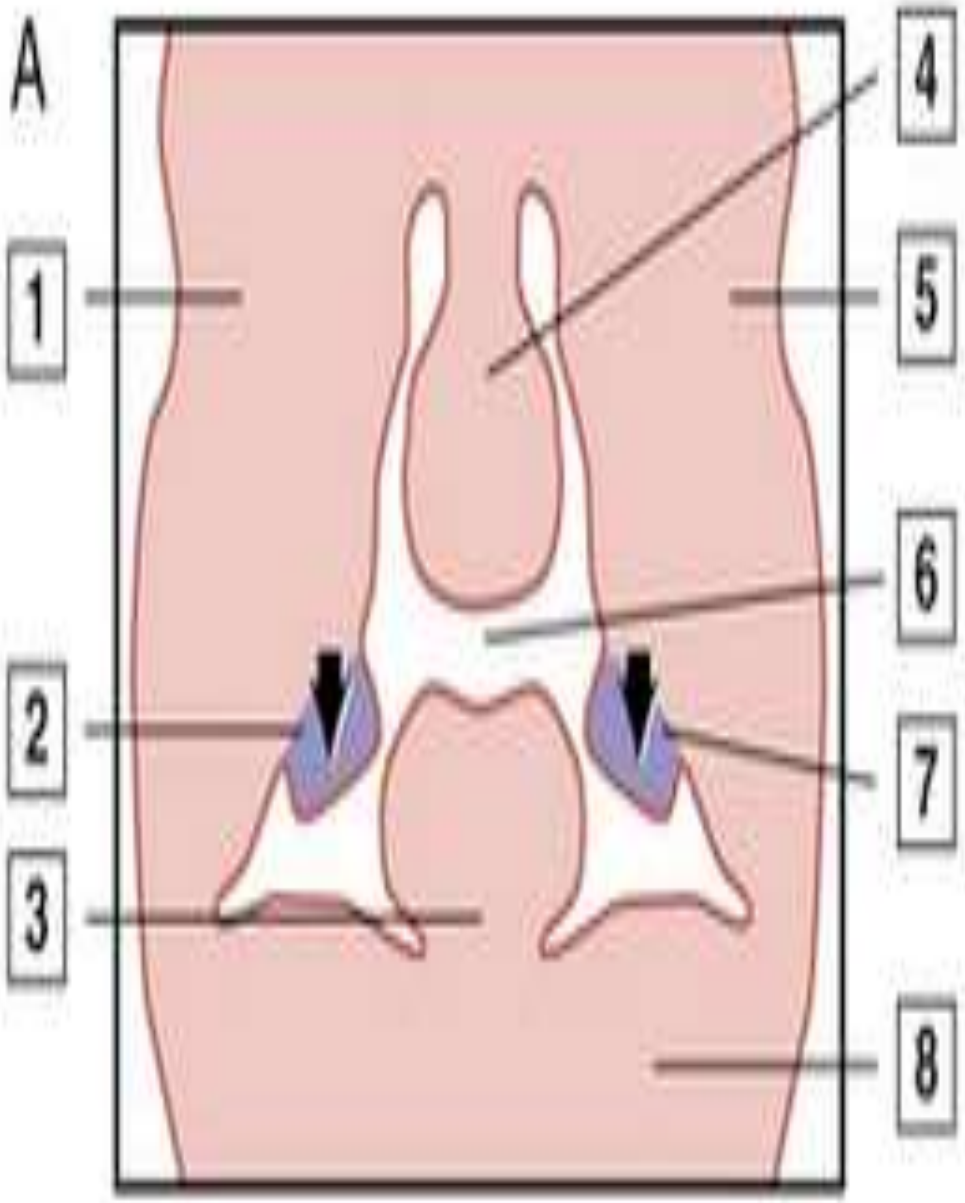

Developing eye
Maxillary process
Mandibular process
Nasal processes fusing together and with maxillary process
Stomodeum (oral cavity)

Head and neck embryology

- The head and neck are formed from mesenchyme derived from mesoderm (muscle & skeleton)
- neural crest cells, and ectodermal structures migrate to form the tissue structures of the mid facial.
- The embryologic development of the head and neck is marked by the formation of the branchial (or pharyngeal) arches.

Development of the palate

Formation of the palate starts in the embryo during fifth week, takes place during several weeks of prenatal development, and is completed in twelfth week in the fetus Formed from two separate embryonic structures, primary palate and secondary palate.



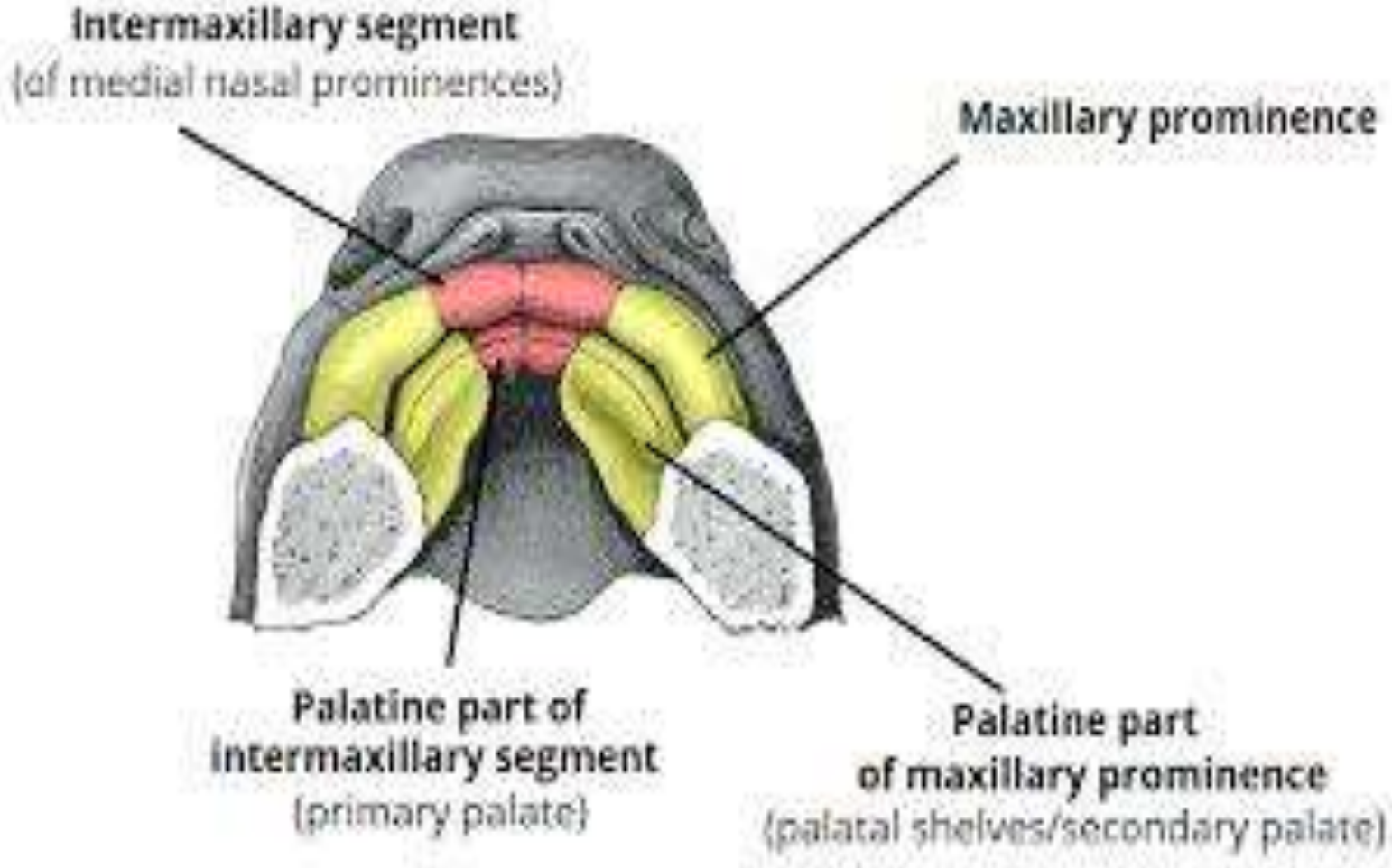
1 Maxillary process
2 Palatal shelf
3 Developing tongue
4 Developing nasal septum
5 Maxillary process
6 Stomodeum
7 Palatal shelf
8 Developing mandible

Palate is developed in three consecutive stages:

1. **Formation of primary palate.**
2. **Formation of secondary palate.**
3. **Completion of final (definitive) palate.**

1. Formation of primary palate.

Intermaxillary segment forms primary (primitive) palate, a triangular mass .In the future, primary palate will form premaxillary portion of the maxilla, anterior one third of final (definitive) palate .Consists of small portion of the hard palate, anterior to incisive foramen; contains maxillary incisor teeth.

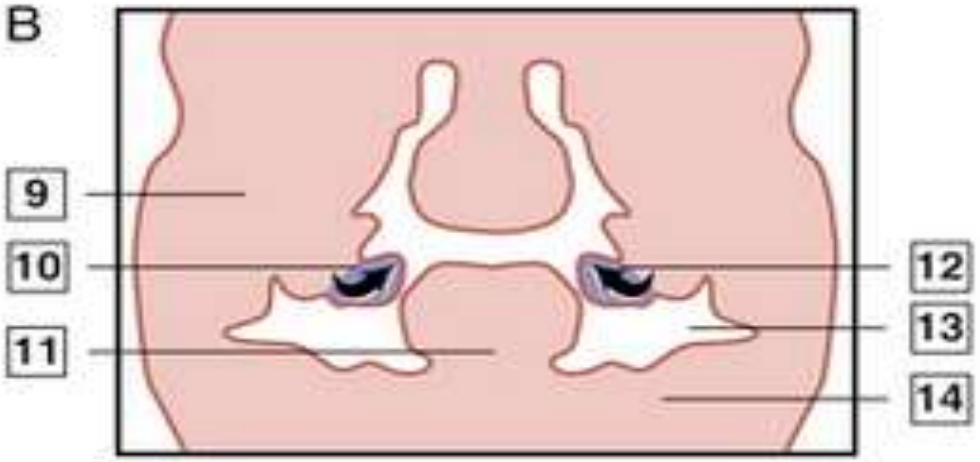

Intermaxillary segment
(of medial nasal prominences)
Maxillary prominence
Palatine part of
intermaxillary segment
(primary palate)
Palatine part
of maxillary prominence
(palatal shelves/secondary palate)

2. Formation of secondary palate.

New outgrowths from the medial edges of the maxillary prominences form the shelves of the secondary palate. These palatal shelves grow downward beside the tongue , at which time the tongue partially fills the nasal cavities.

3. Completion of final (definitive) palate.

- **At about the ninth gestational week, the shelves elevate, make contact, and fuse with each other above the tongue to form the final palate .**



9 Maxillary process

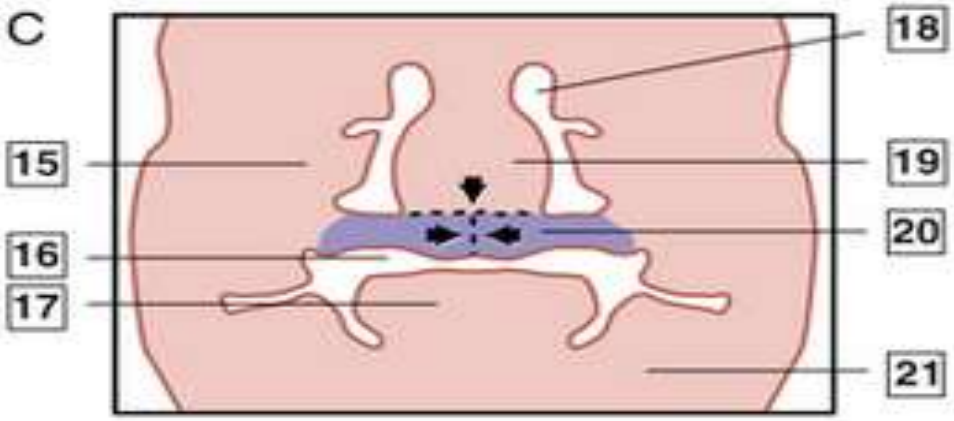
10 Palatal shelf

11 Developing tongue

12 Palatal shelf

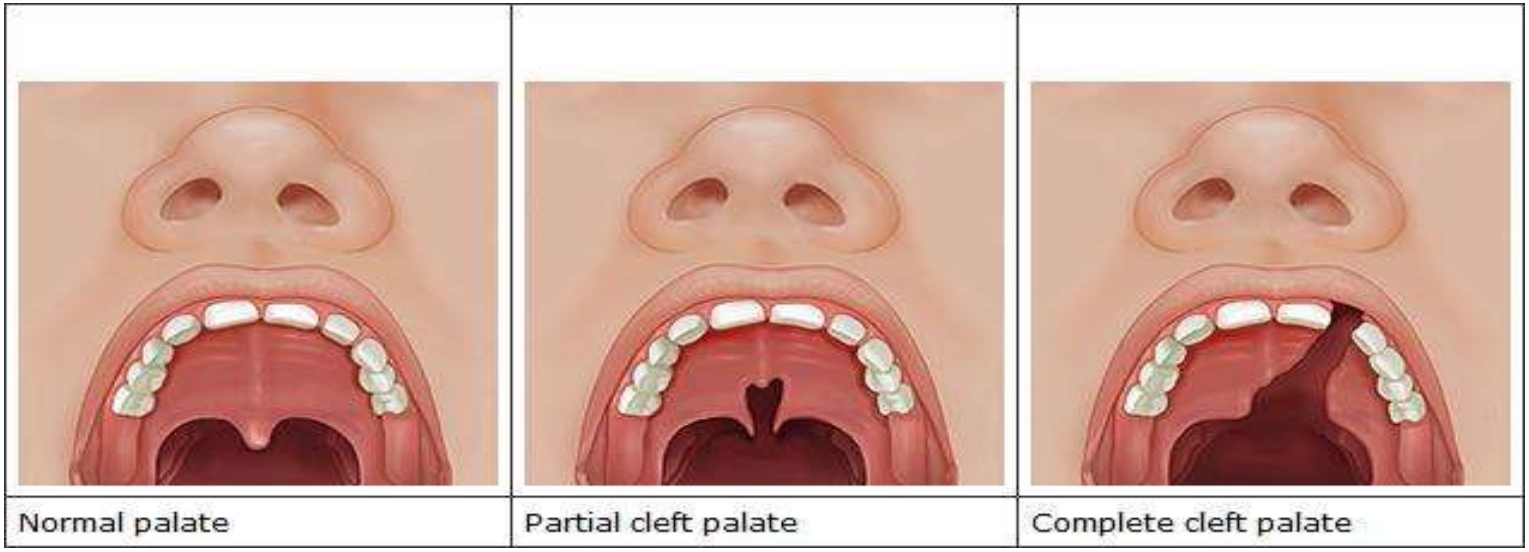
13 Stomodeum

14 Developing mandible



15 Maxillary process
16 Oral cavity
17 Tongue
18 Developing nasal cavity
19 Nasal septum
20 Fusing palate
21 Developing mandible

If the palatal shelves do NOT fuse with the primary palate (or with each other), cleft palate can result, with varying degrees of disability.



Thank you