



Development of head & neck.

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INTENDED LEARNING OBJECTIVES (ILO)

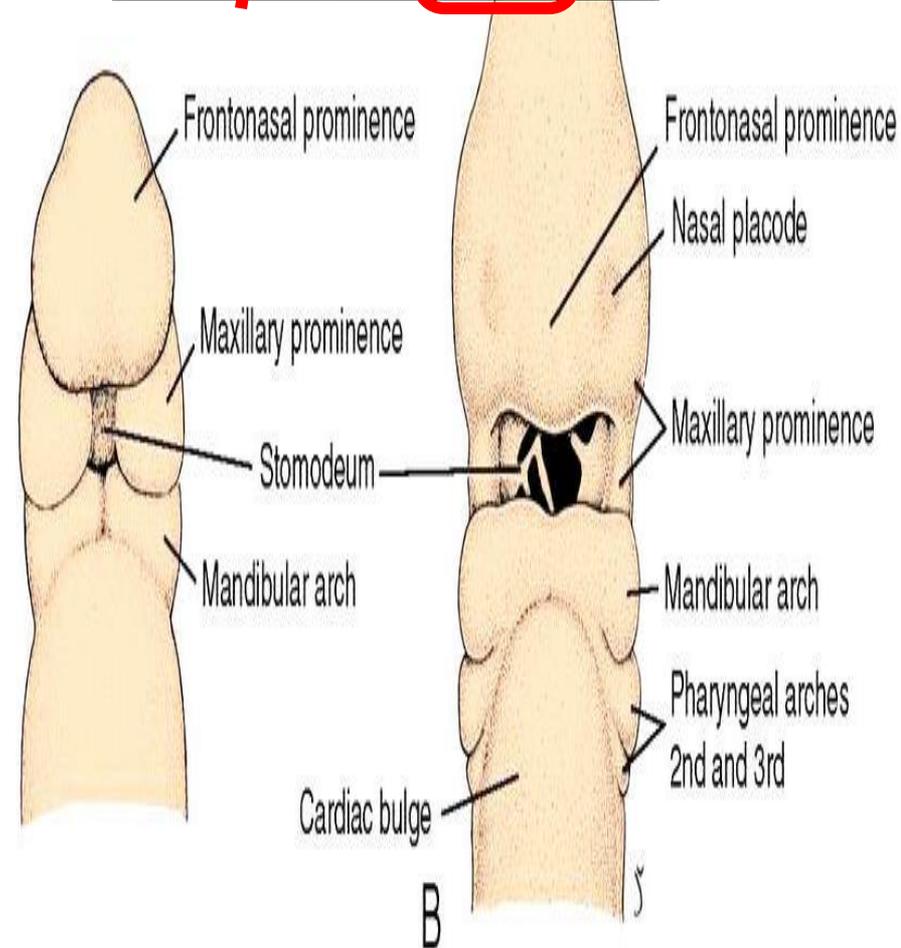
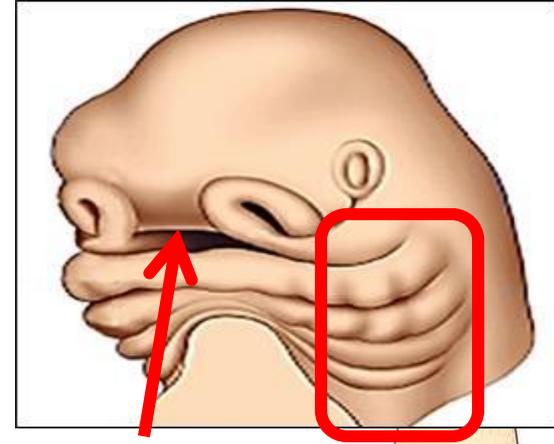
- 1 Define the following: Pharyngeal arches. Neural crest cells. Pharyngeal grooves. Pharyngeal pouches. Pharyngeal membranes.
- 2-Discuss the changes that will take place on the above structures leading to formation of various organs in the head and neck.
- 3-Make a list of these processes involved in the formation of each organ.
- 4-Define each process

After formation of the head fold, the buccopharyngeal membrane is buried at the bottom of an ectodermal depression called **stomodeum “primitive mouth”** in between the forebrain cranially and the primitive heart caudally.

In the 4th and 5th weeks, six elevated bars appear, on each side, in the region between the stomodeum and the primitive heart. They contribute in the development of the neck and face.

It surrounds the primitive pharynx so it is called Pharyngeal arches

They are also called “branchial arches” because they resemble the gills (branchia) of fishes however, the term pharyngeal is better.

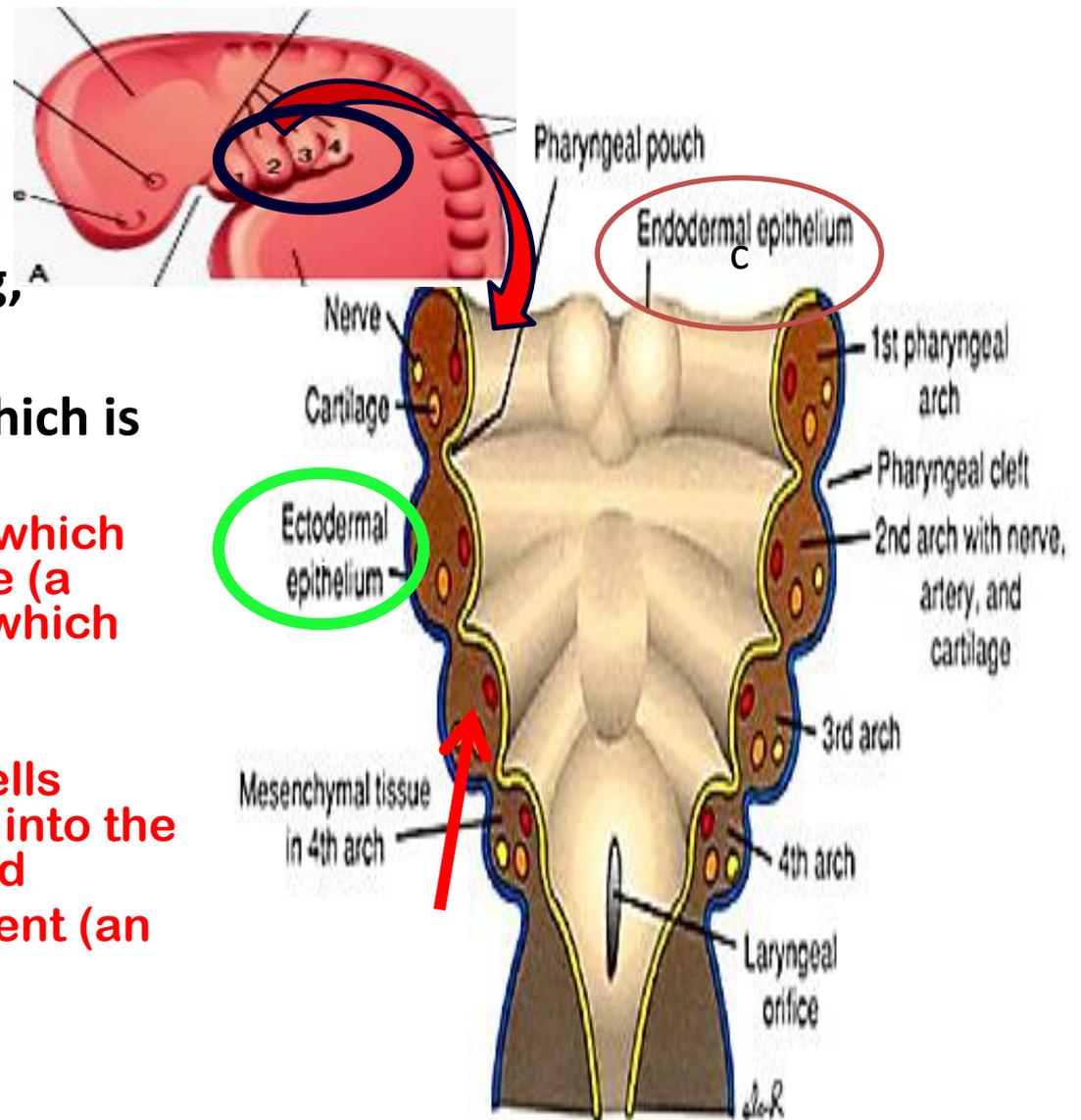


Each arch has 3 elements:

1. an ectodermal covering, ^A
2. an endodermal lining
3. a mesenchymal core which is derived from 2 sources:

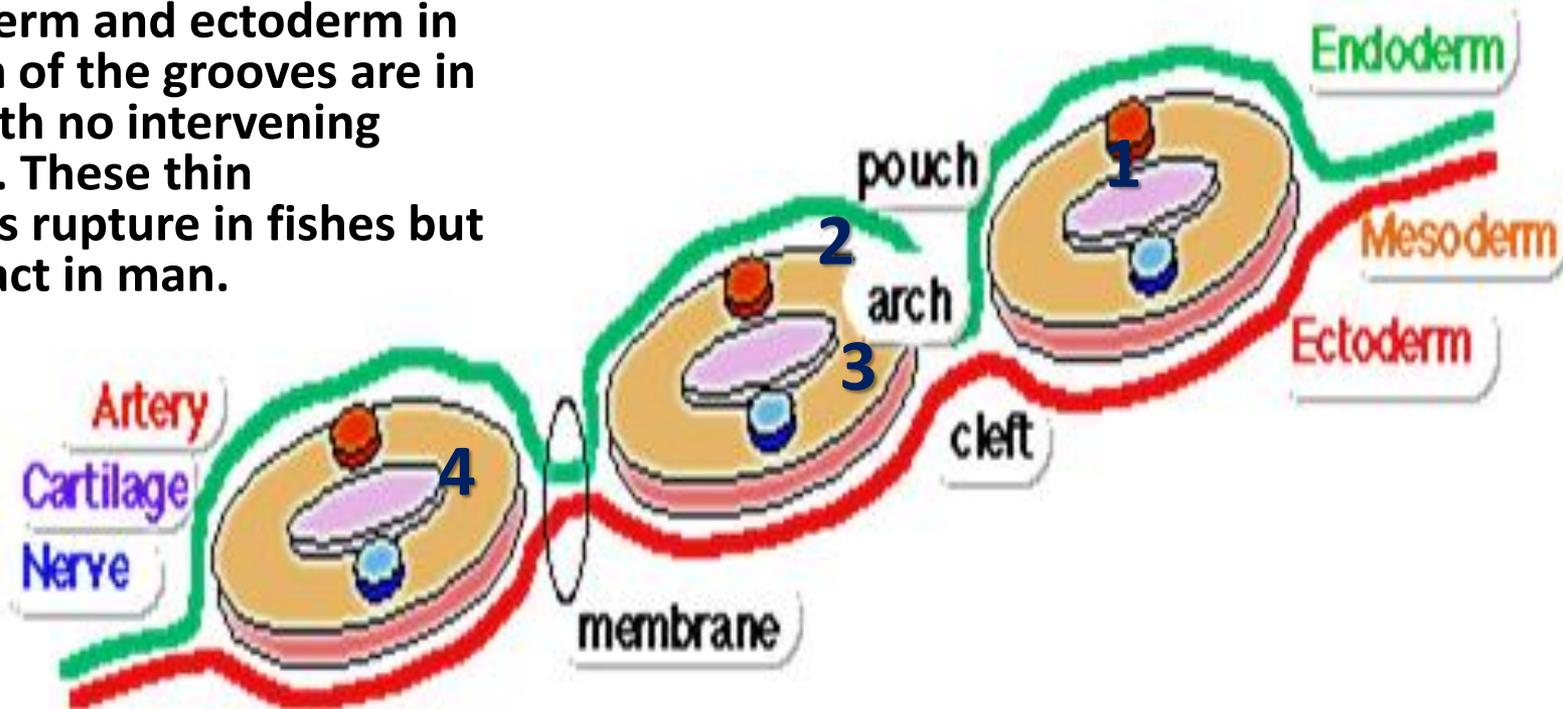
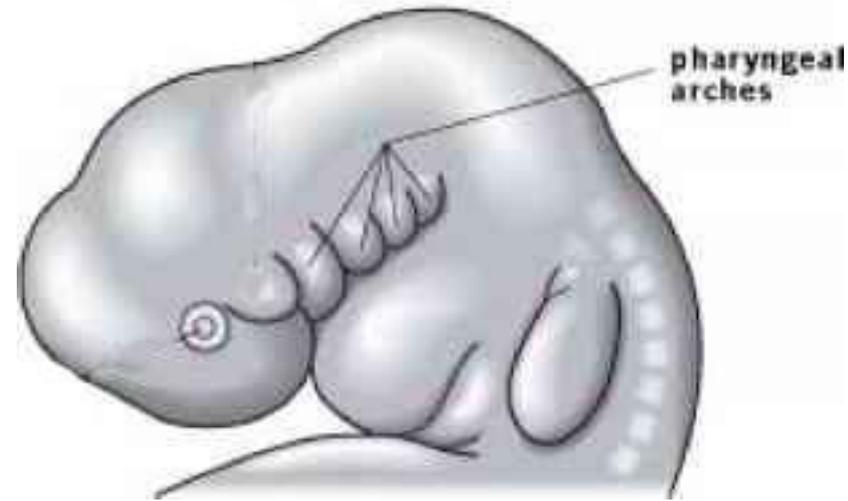
a. The paraxial mesoderm which forms the arch musculature (a group of striated muscles which may migrate)

b. Migrating neural crest cells migrate from the hindbrain into the mesenchyme of future head which form a skeletal element (an arch cartilage).



Branchial (pharyngeal) apparatus

- 5 grooves are seen internally and externally between the arches.
- The internal grooves, lined by endoderm, are called "*pharyngeal pouches*".
- The external grooves, lined by ectoderm, are called "*pharyngeal clefts*".
- The endoderm and ectoderm in the bottom of the grooves are in contact, with no intervening mesoderm. These thin membranes rupture in fishes but remain intact in man.

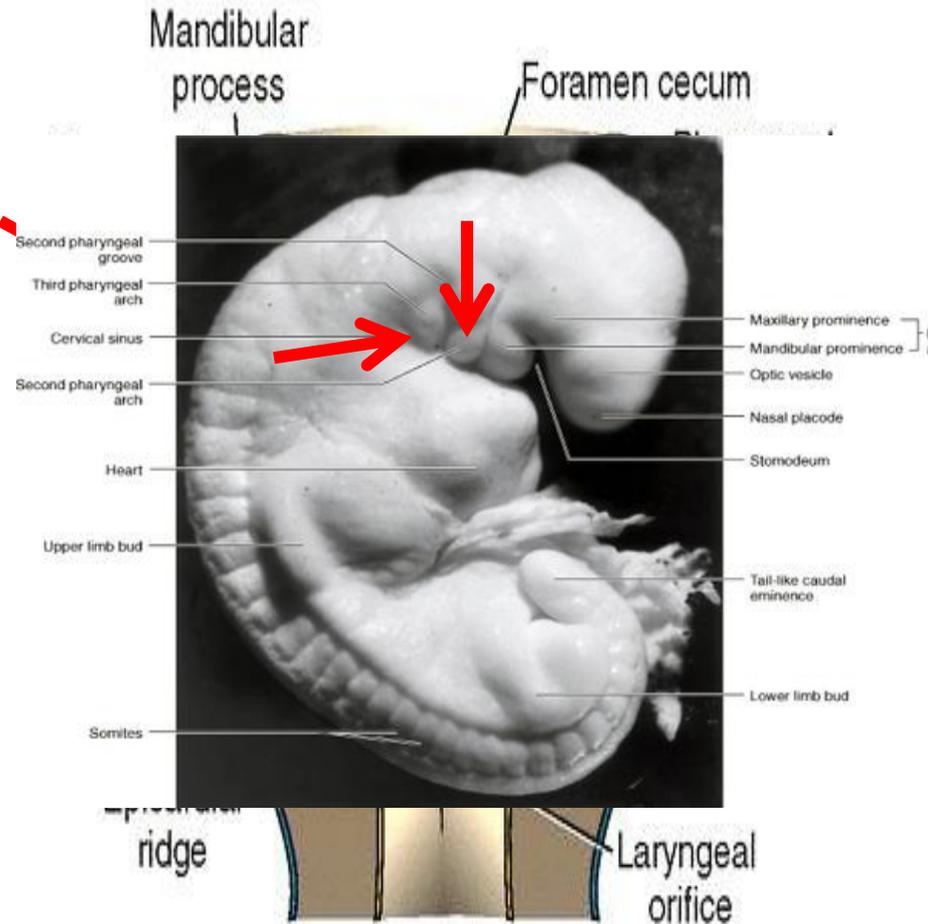


During 5th week of development, The mesoderm of the 2nd arch proliferates causing its surface overgrows 3rd & 4th arches,

cover the 2nd, 3rd & 4th clefts & finally it fuses with the ectodermal covering of the 6th arch. forming an ectodermal depression known as the **cervical sinus**.

A temporary cavity lined with ectoderm “the cervical sinus” is formed and buried beneath the surface ectoderm. It soon disappears.

The 1st cleft persists & gives the external auditory meatus + the outer surface of the tympanic membrane. The auricle develops from 6 hillocks (elevations) that appear around the external auditory meatus and later fuse together.



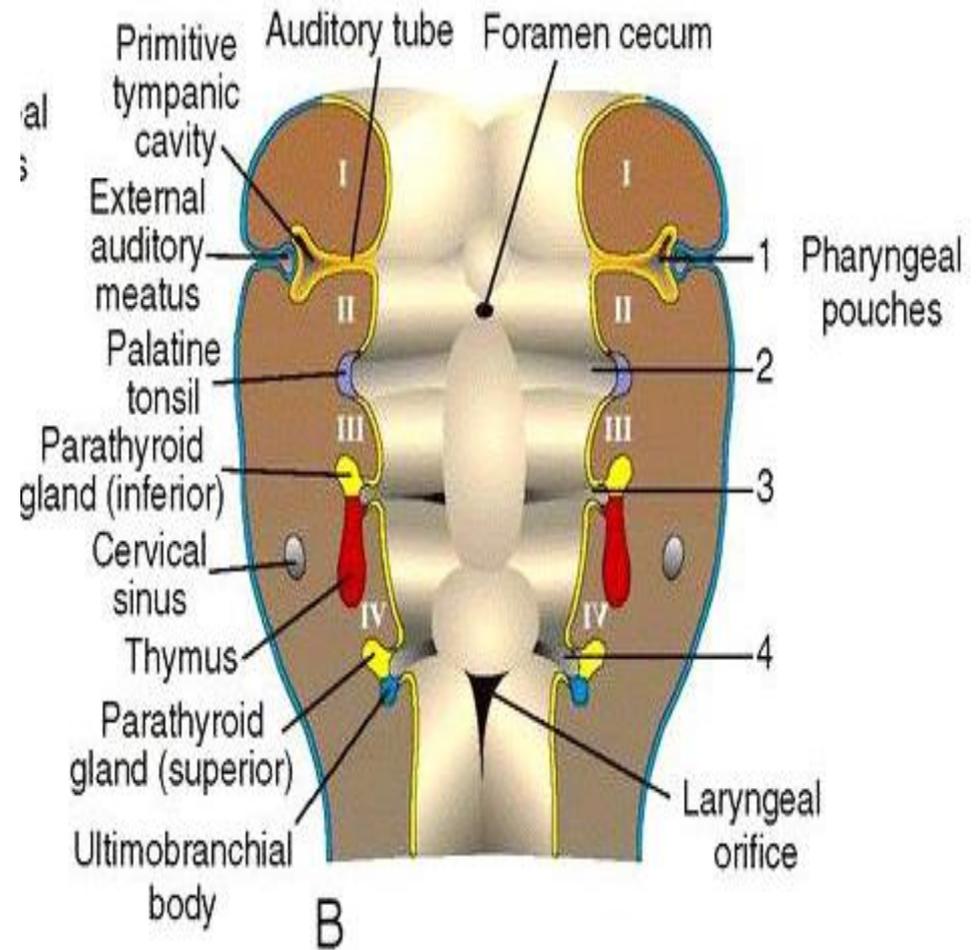
5th arch disappears early & 6th arch becomes very small

2nd – 4th pharyngeal clefts & cervical sinus disappear, giving the neck a smooth contour.

The 1st cleft persists



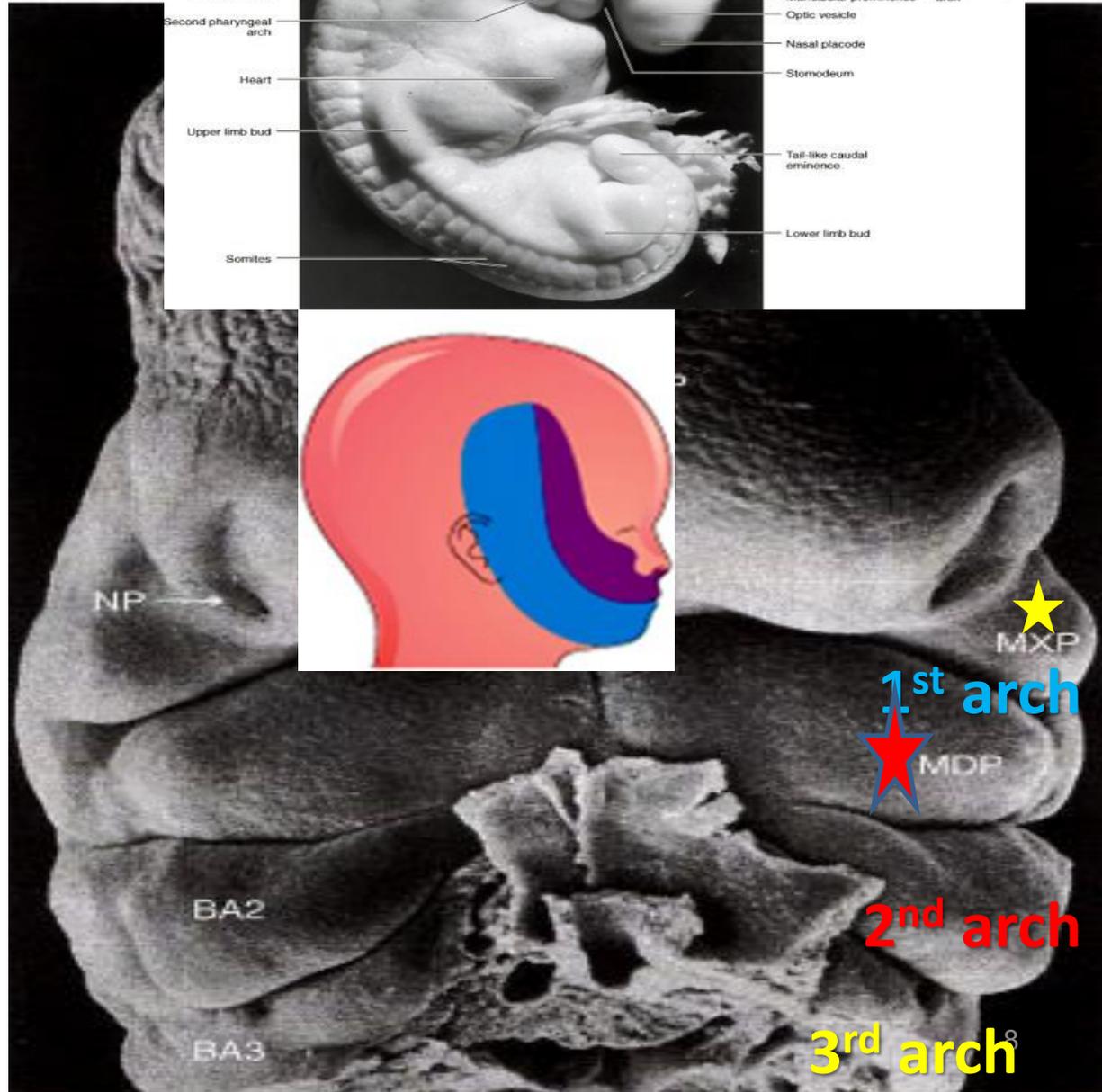
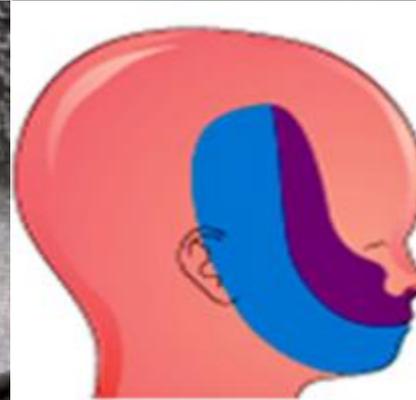
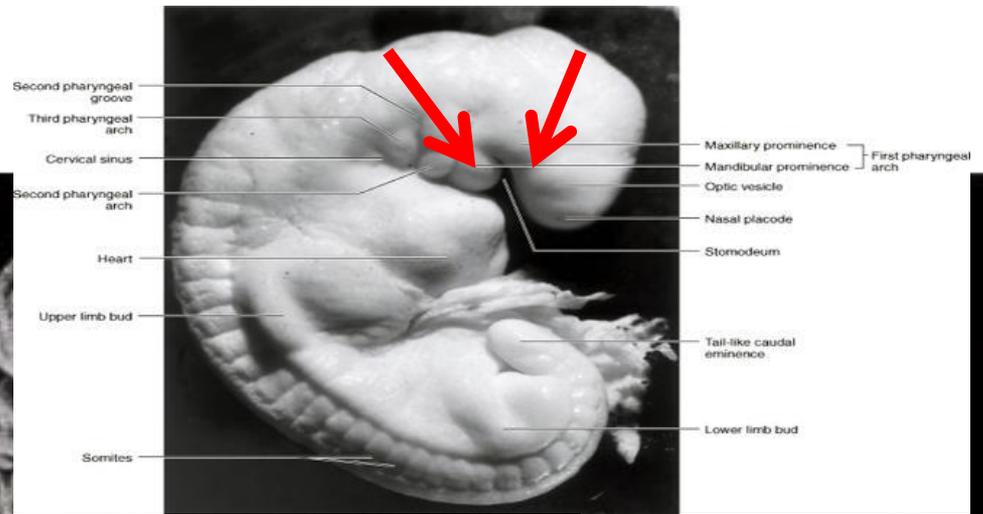
external auditory meatus + the outer surface of the tympanic membrane.



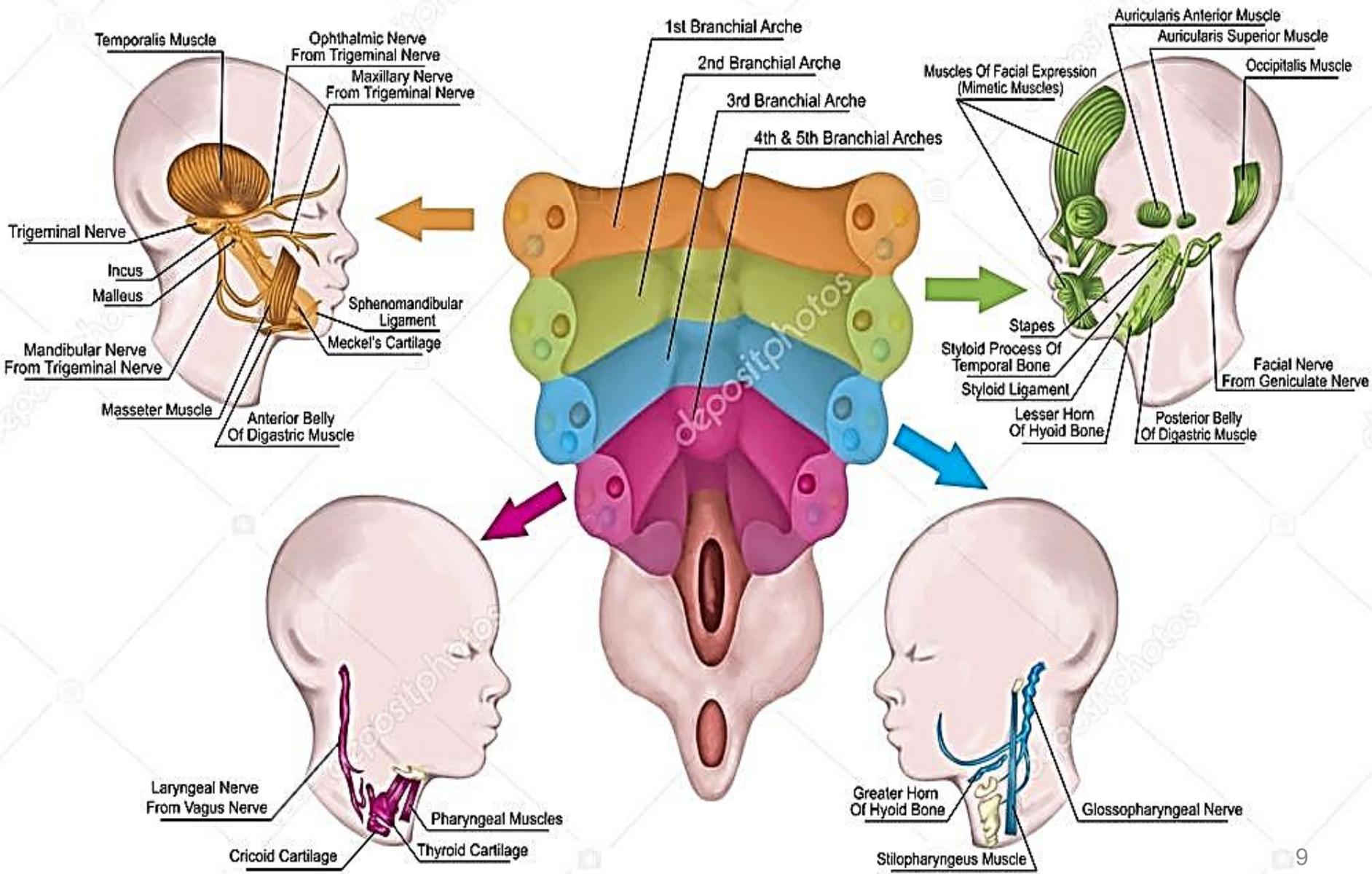
The 1st pharyngeal arch (primordium of the jaws) on each side, divides into 2 prominences:

Smaller upper **maxillary prominence** which gives rise to the maxilla (upper jaw), zygomatic, palatine & temporal bones. ★

Larger lower **mandibular prominence** which forms the mandible (lower jaw). ★



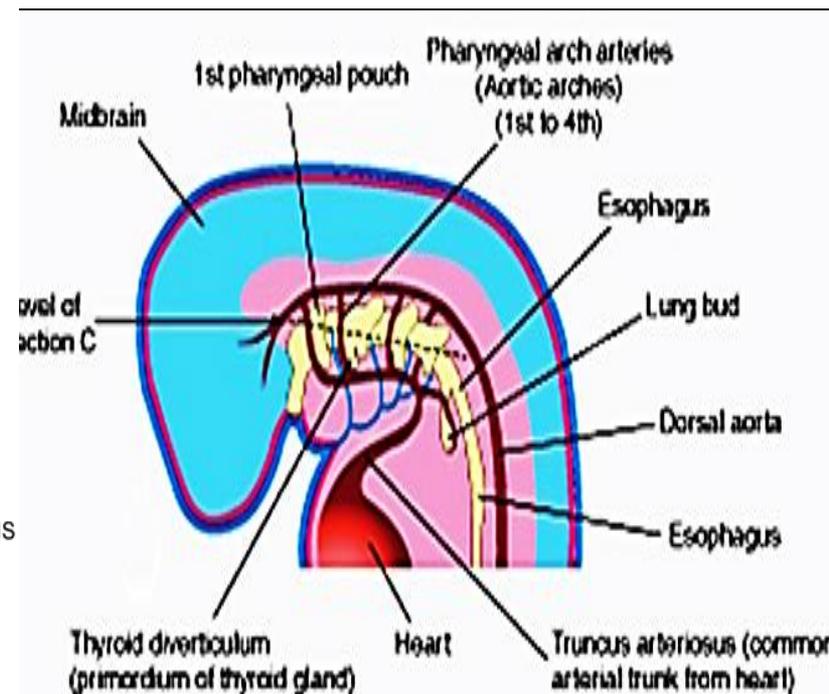
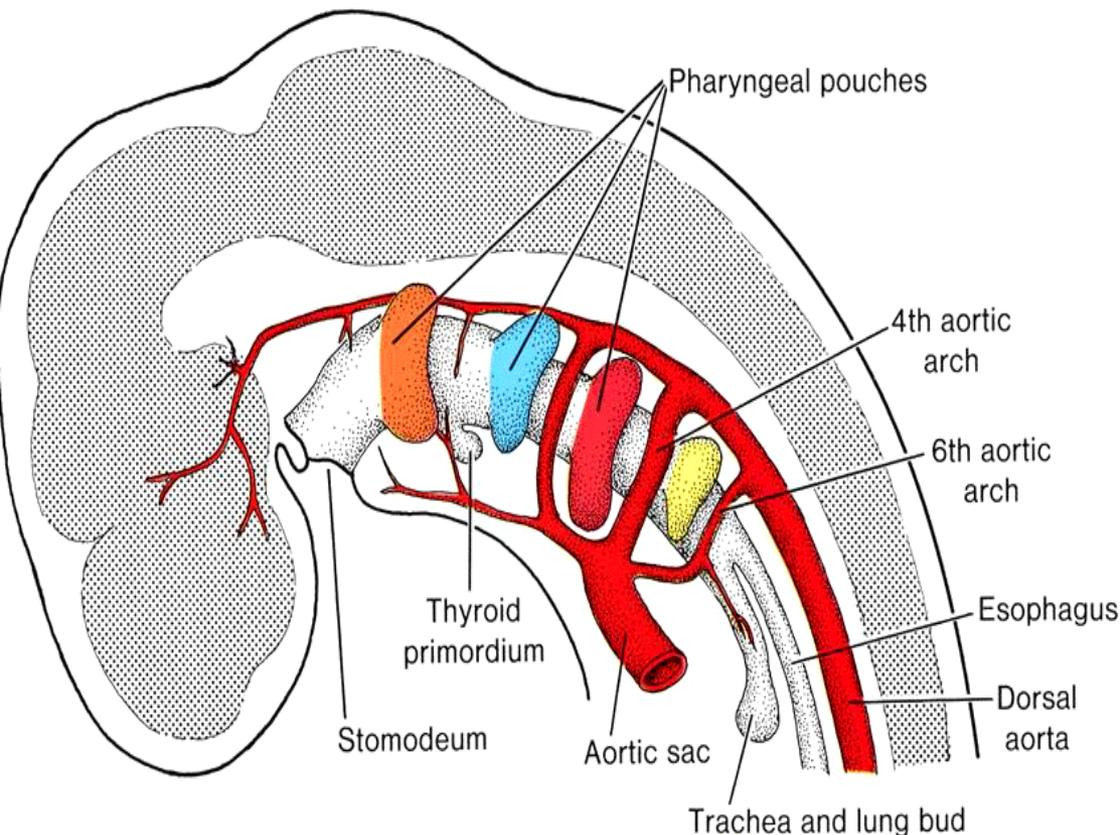
Branchial (pharyngeal) apparatus



The mesenchyme of each arch is invaded by:

1. An aortic arch which connects the aortic sac with the corresponding dorsal aorta.

2. A cranial nerve, derived from the adjacent hind brain.
The arches appear in a cranio-caudal sequence.



Components of pharyngeal arches:

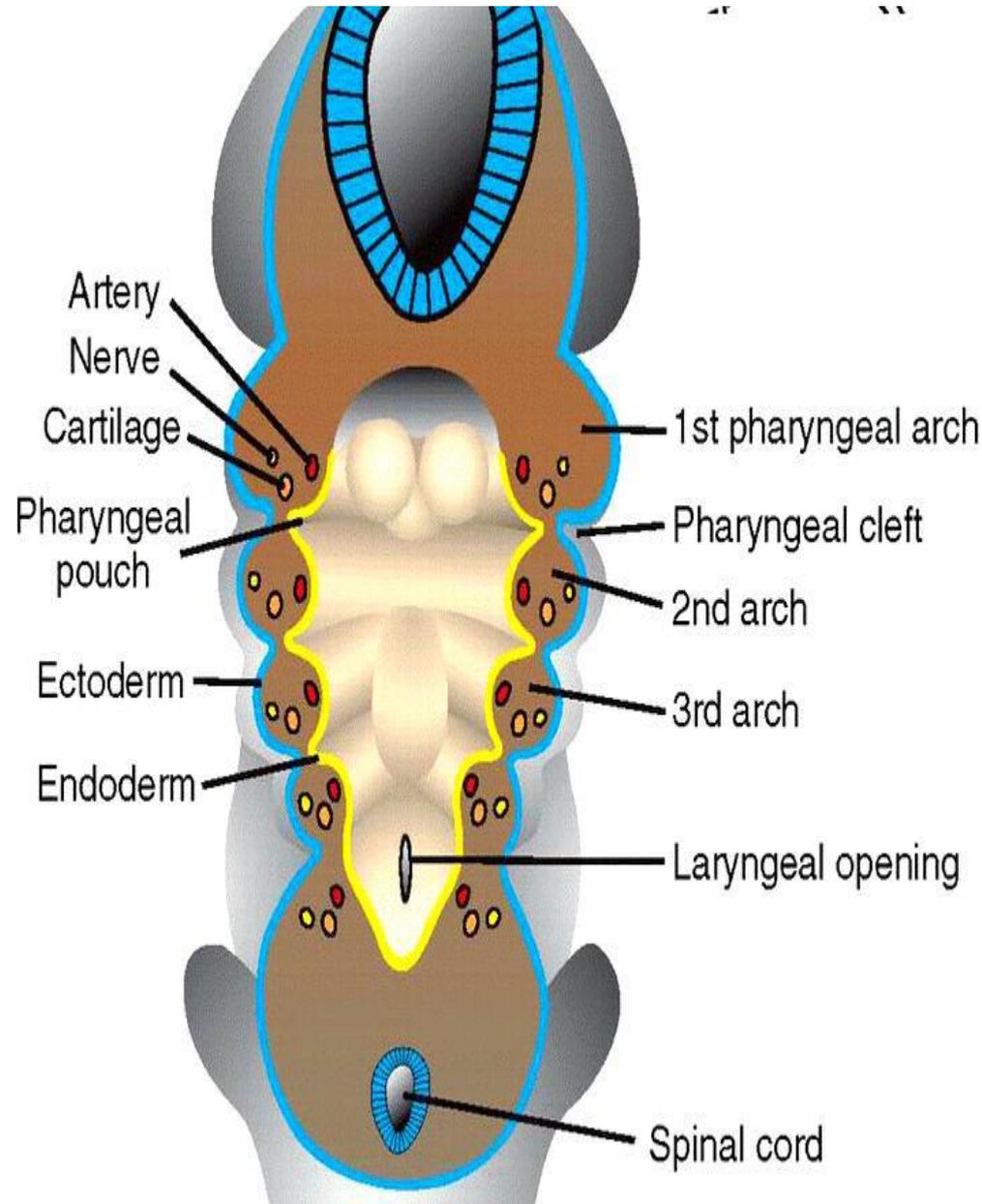
-Each pharyngeal arch has
4 components: **A C M N**

1. **Pharyngeal arch artery (aortic arch)** that arises from the truncus arteriosus of the primordial heart & runs around the primordial pharynx to enter the dorsal aorta.

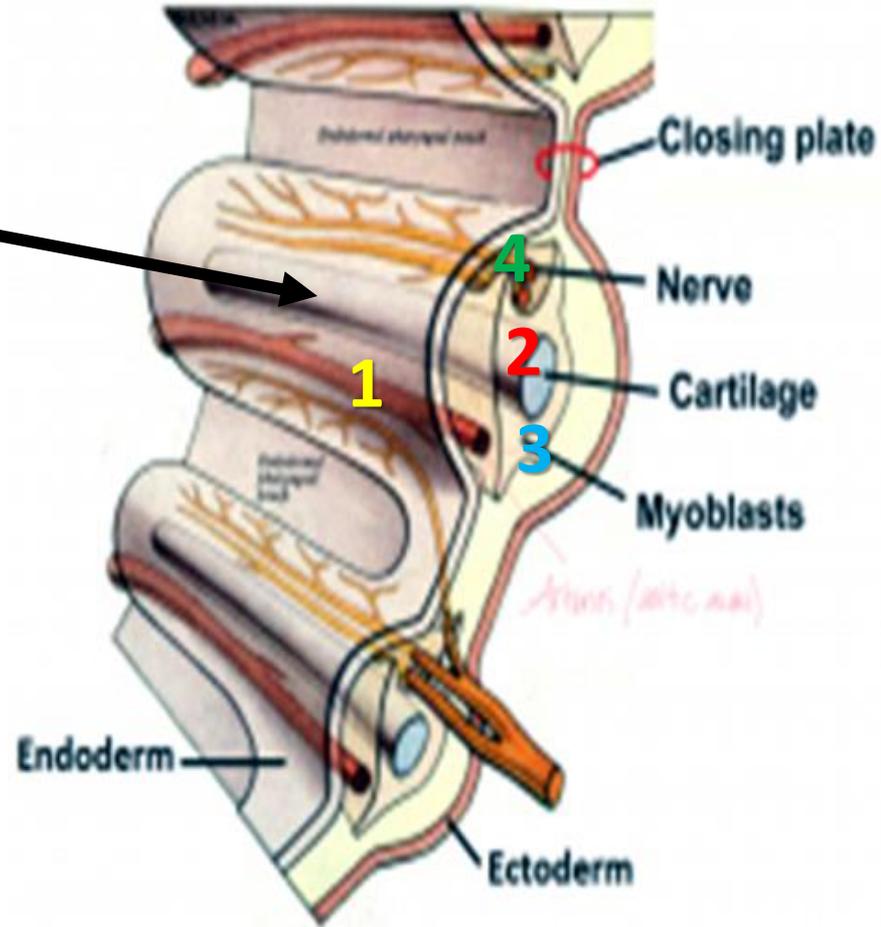
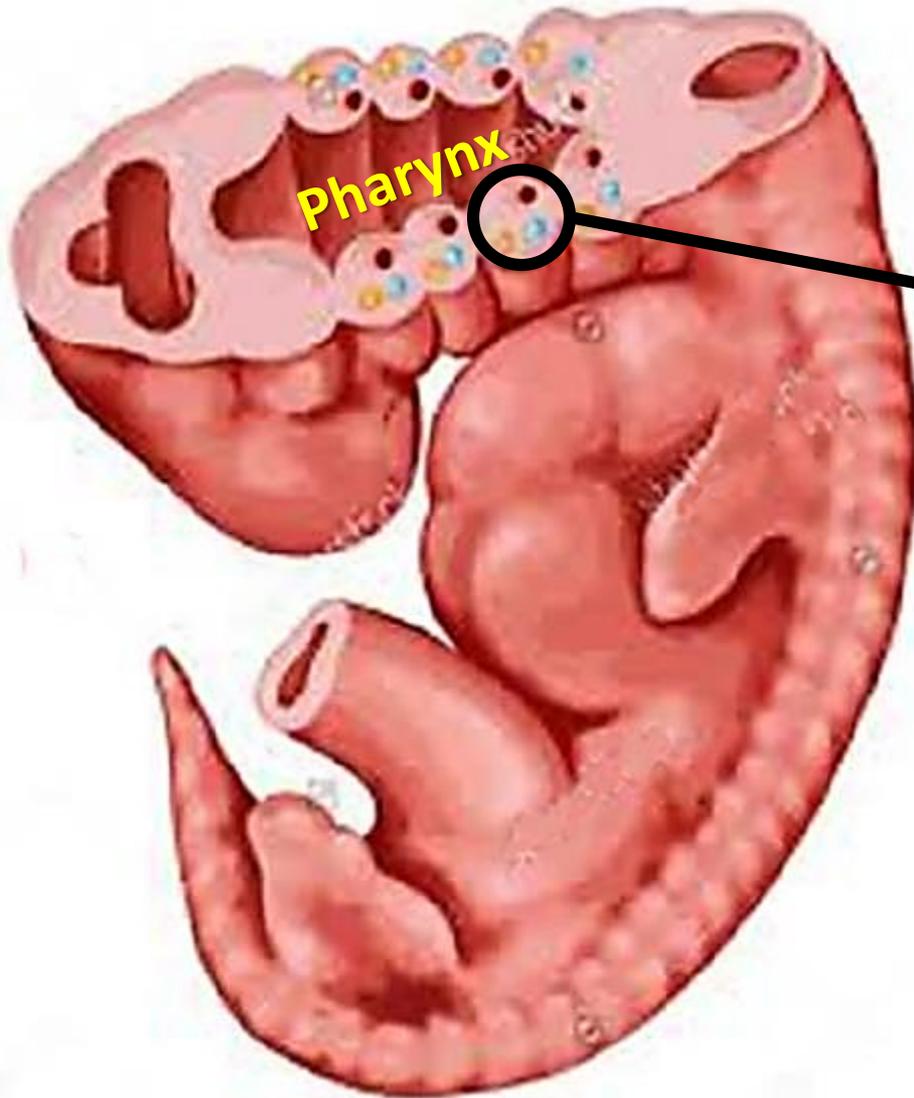
2. **Cartilage** that forms the skeleton of the arch.

3. **Muscular** component which gives rise to the muscles in head & neck.

4. **Nerve** that supplies the muscles derived from the arch



Components of pharyngeal arches



Derivatives of pharyngeal arch cartilages:

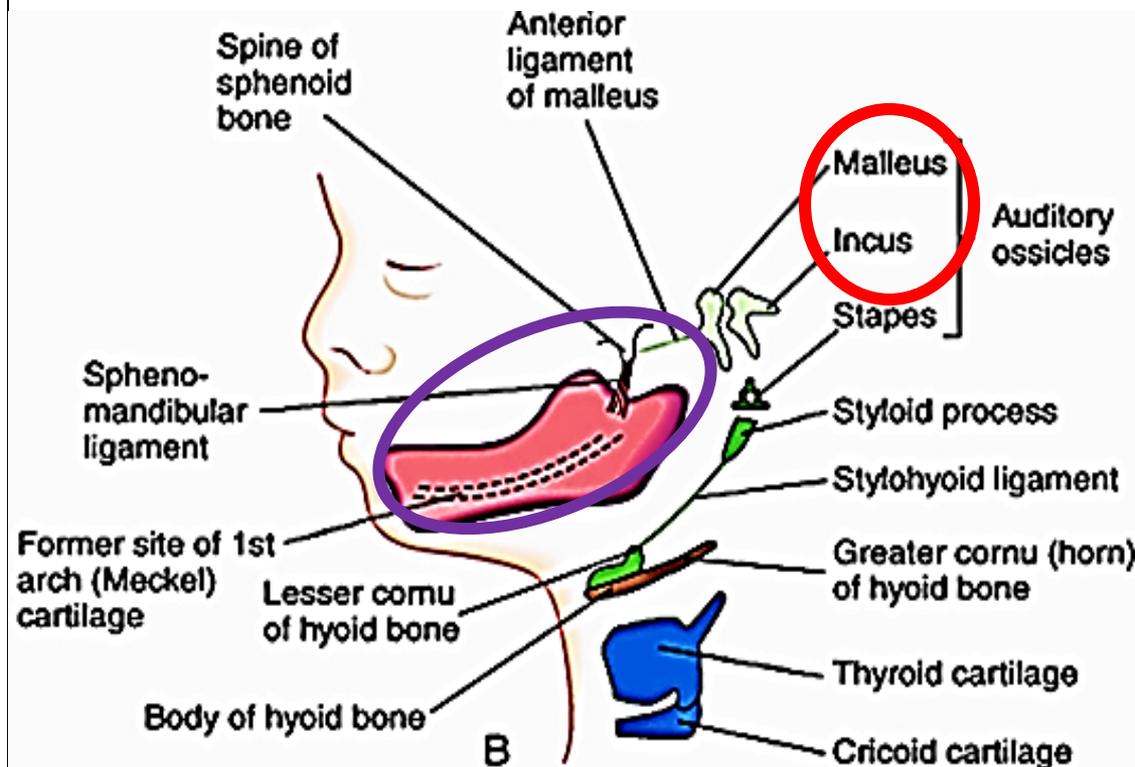
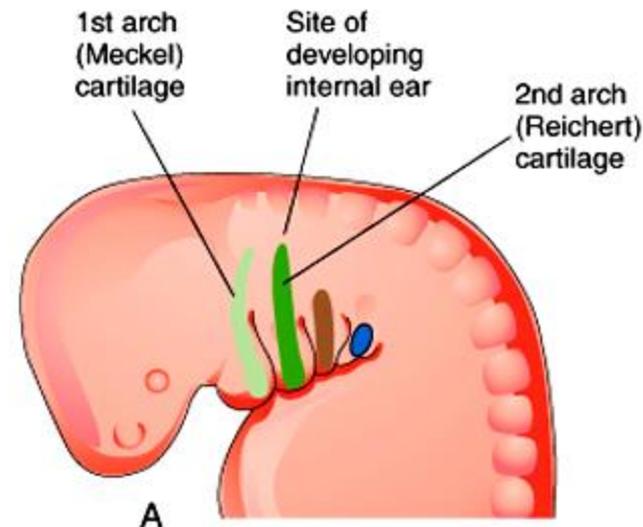
1st pharyngeal arch (**Mandibular arch**): Its cartilage is called Meckel's cartilage.

-It disappears leaving 2 remnants (**incus & malleus**) in middle ear.

-The mesenchyme around Meckel's cartilage gives: *Neural crest*

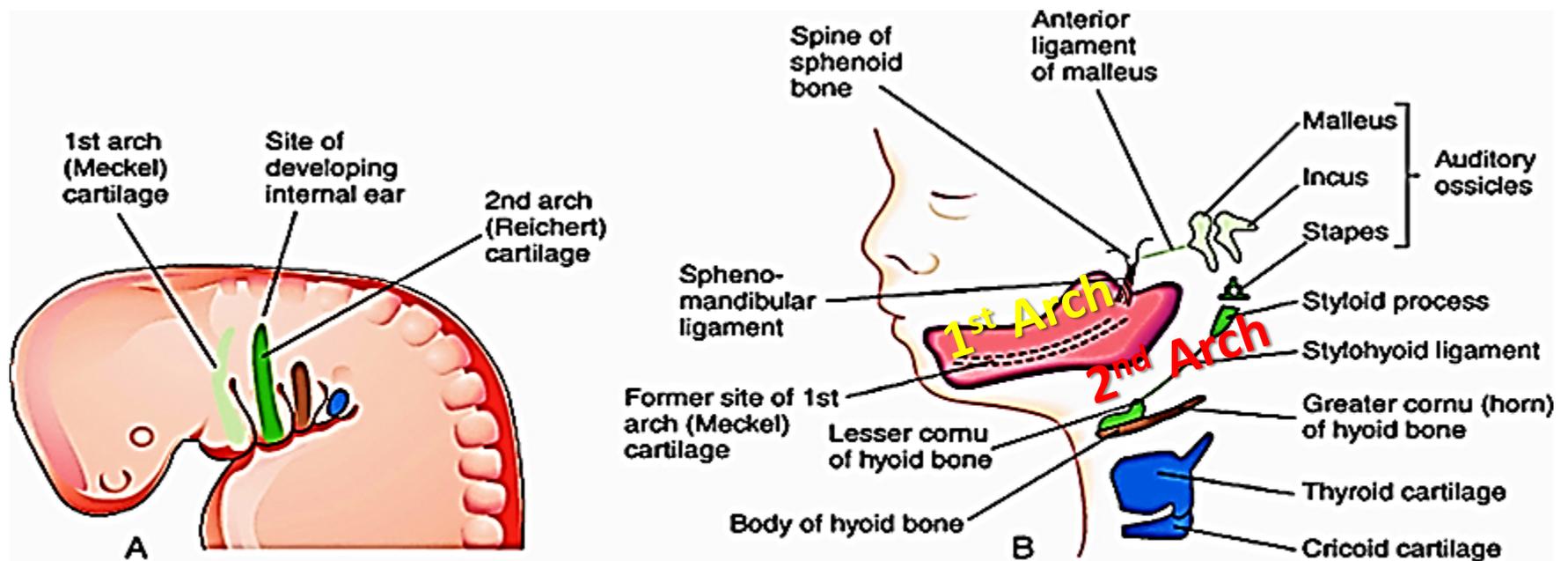
1. Mandible, by membranous ossification.
2. Sphenomandibular ligament.
3. Spine of sphenoid.
4. Anterior ligament of malleus.

-The mesenchyme in **maxillary process** ⇒ Maxilla, zygomatic, palatine & squamous temporal bones, by membranous ossification.



▪ **2nd** pharyngeal arch (**Hyoid arch**): Its **cartilage** is called **Reichert's cartilage**. It gives:

1. Stapes.
2. Styloid process.
3. Stylohyoid ligament.
4. Lesser cornu & upper part of the body of hyoid bone.



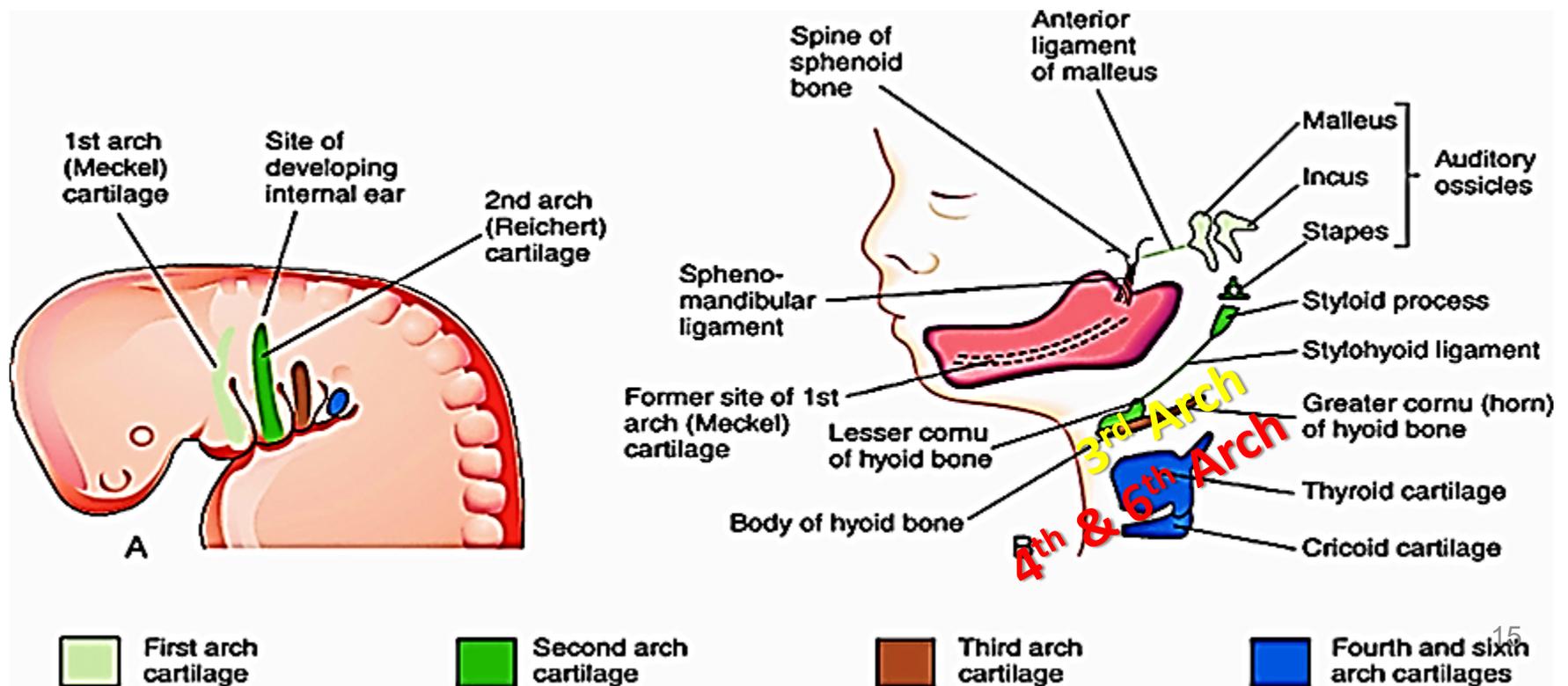
□ First arch cartilage

■ Second arch cartilage

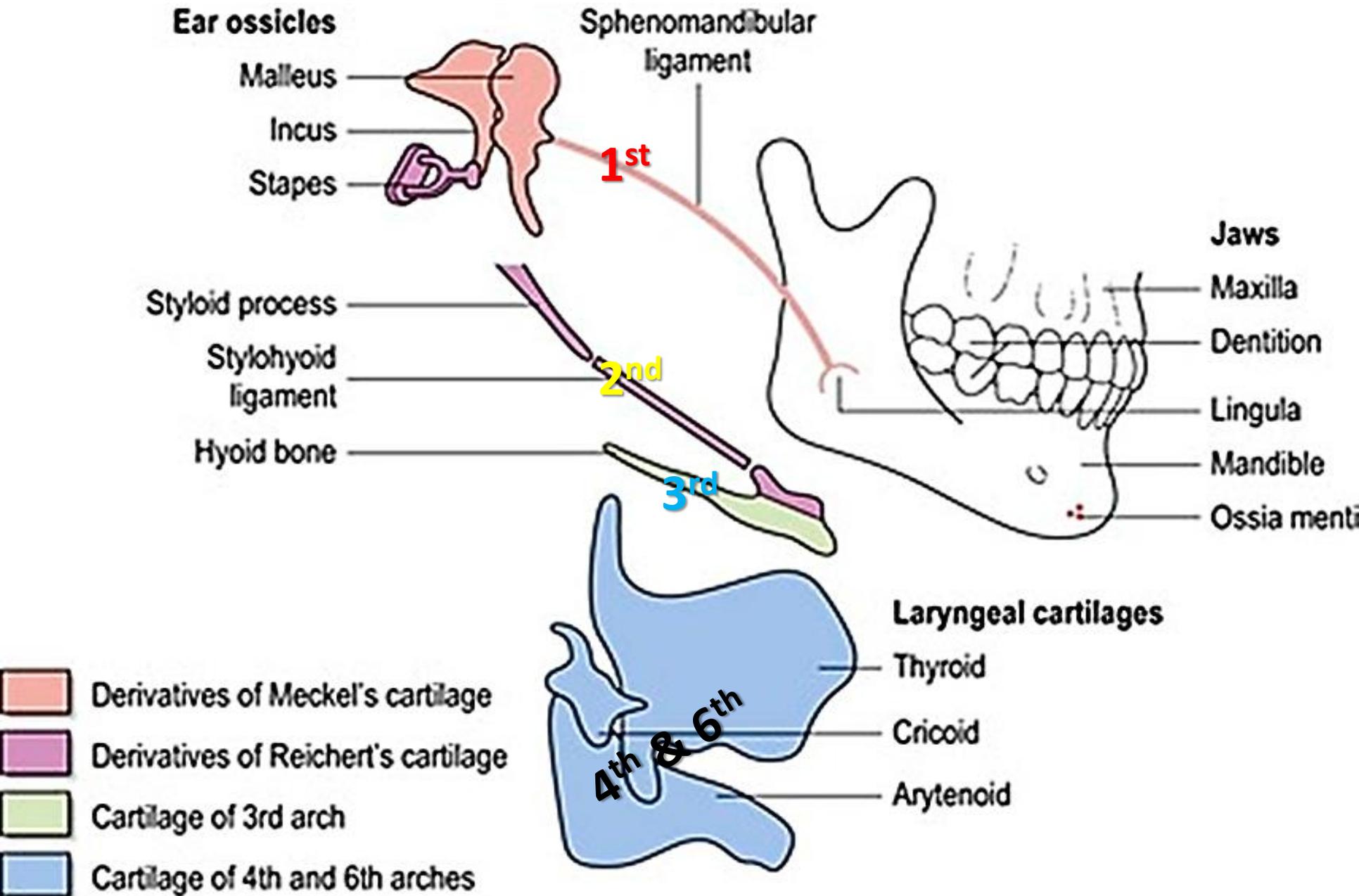
■ Third arch cartilage

■ Fourth and sixth arch cartilages

- **3rd** pharyngeal arch: Its cartilage ossifies to form the greater cornu & inferior part of the body of the hyoid bone. **2nd & 3rd**
- **4th & 6th** pharyngeal arch cartilages: They fuse (as the 5th arch disappears) to form all laryngeal cartilages (e.g. thyroid & cricoid cartilages), EXCEPT the epiglottis.



Derivatives of pharyngeal arch cartilages



● Derivatives of pharyngeal arch **muscles:**

-**1st** pharyngeal arch → Muscles of mastication (4) + 4 other muscles: 2 tensor (palati & tympani) and 2 adjacent muscles (mylohyoid & anterior belly of digastric).

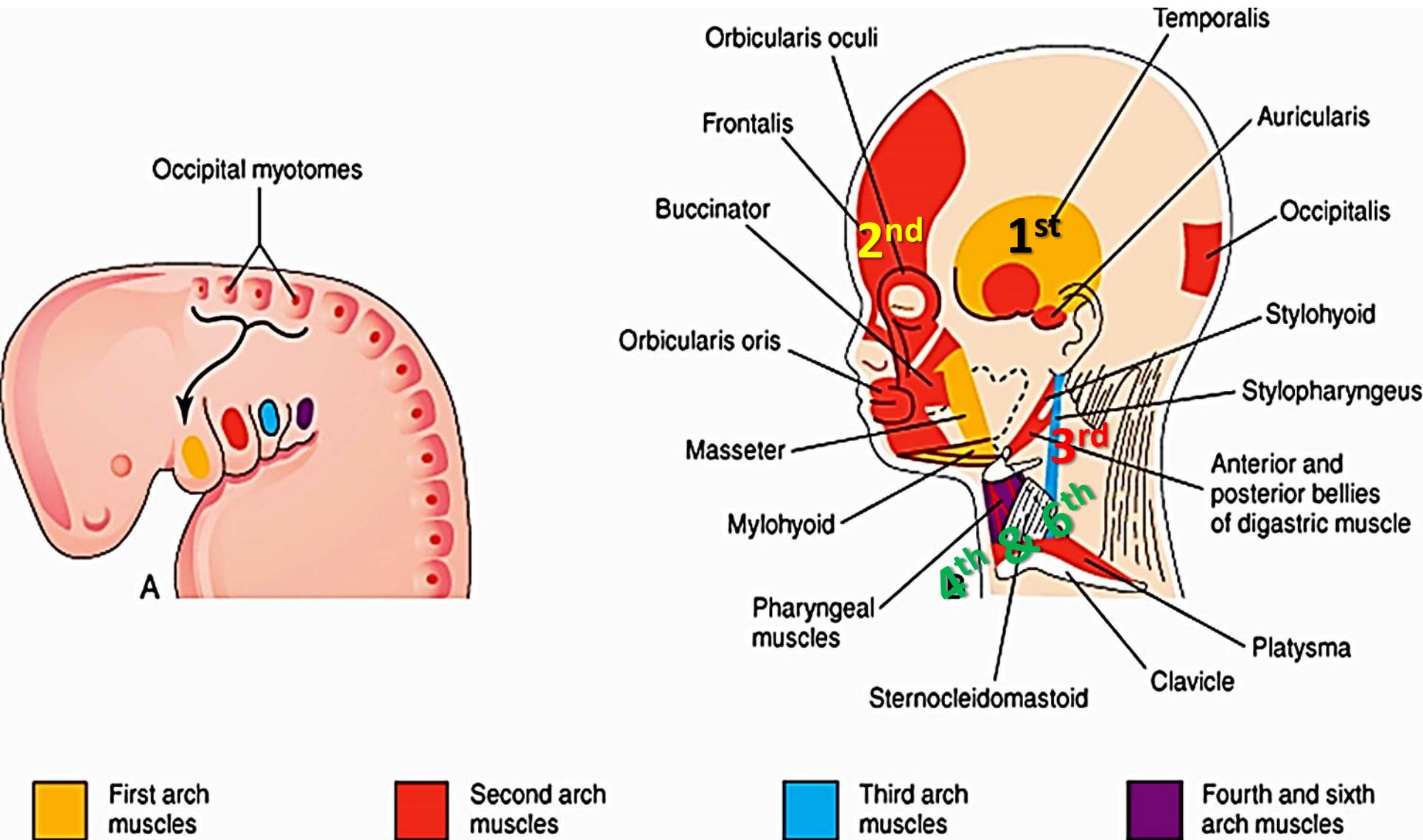
-**2nd** pharyngeal arch → Muscles of facial expression + 4 other muscles: Stapedius (in middle ear), platysma and 2 adjacent muscles (stylohyoid & posterior belly of digastric).

-**3rd** pharyngeal arch → Only one muscle (Stylopharyngeus muscle).

-**4th** pharyngeal arch → *Cricothyroid* - Pharyngeal constrictors – Levator palati.

-**6th** pharyngeal arch → All muscles of the larynx EXCEPT cricothyroid muscle.

Derivatives of pharyngeal arch muscles



Nerve supply of pharyngeal arches: 5 – 7 – 9 – 10 & 11 **[1975]**

.Each arch is supplied by a cranial nerve (CN) which supplies the muscles derived from this arch (*Motor*):

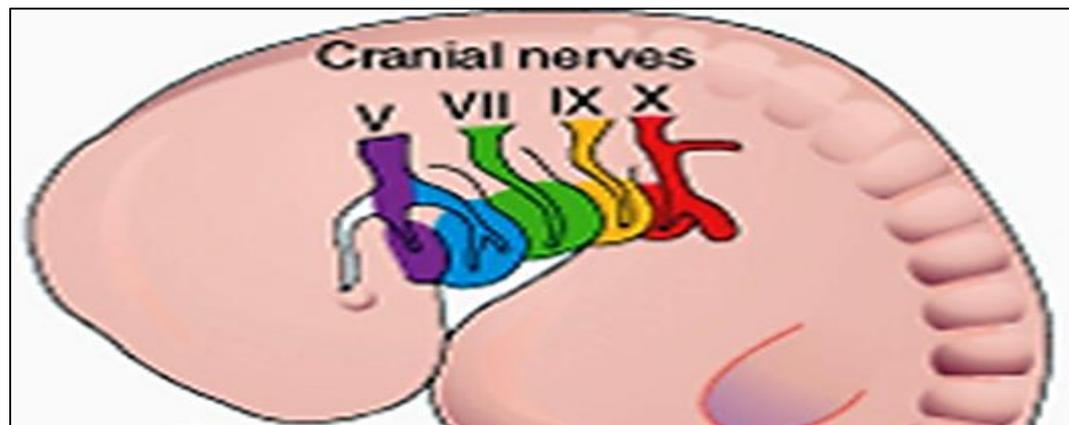
-**1st** pharyngeal arch → Mandibular division of trigeminal N. **5**

-**2nd** pharyngeal arch → Facial N. **7**

-**3rd** pharyngeal arch → Glossopharyngeal N. **9**

-**4th** pharyngeal arch → Superior laryngeal branch of vagus nerve. **10** (+ **11th CN**)

-**6th** pharyngeal arch → Recurrent laryngeal branch of vagus nerve. **10** (+ **11th CN**)





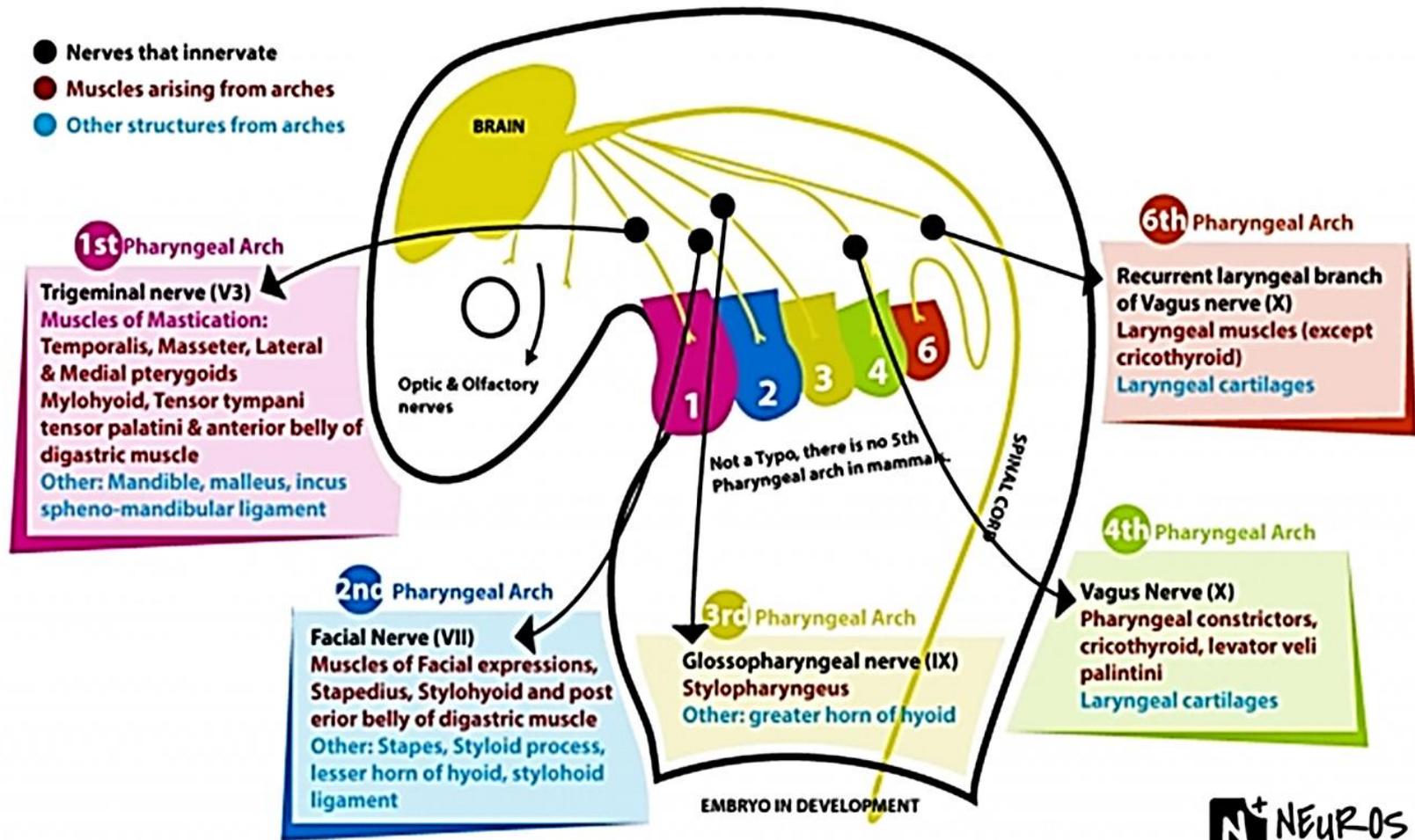
Note that

- The mesenchyme of 1st pharyngeal arch contributes widely to the dermis & the mucous membranes of the head & neck, thus, the trigeminal nerve (5th CN) [nerve of 1st arch] is the main sensory nerve of the head & neck.
- Nerves of 2nd – 6th arches have little sensory distribution.

For summary of pharyngeal arches see next slide please

STRUCTURES FROM THE PHARYNGEAL ARCHES

ALSO CALLED BRACHIAL ARCHES

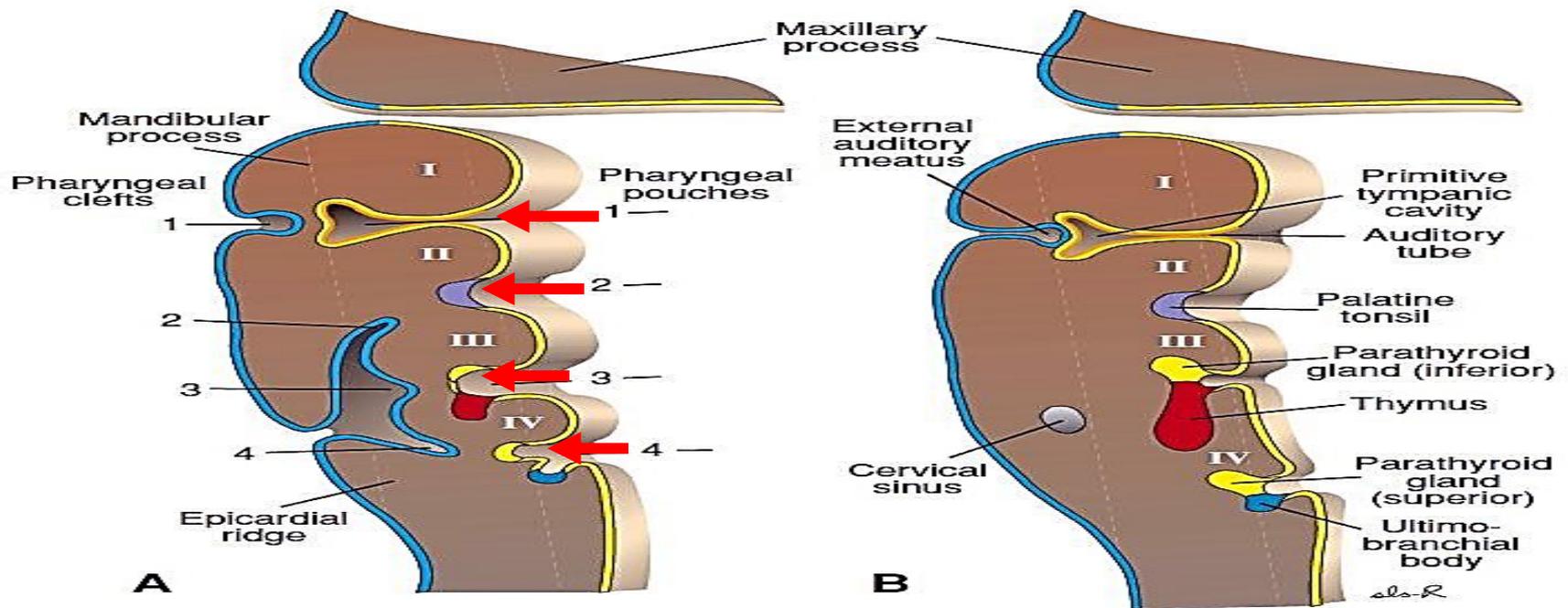


Pharyngeal pouches: 4

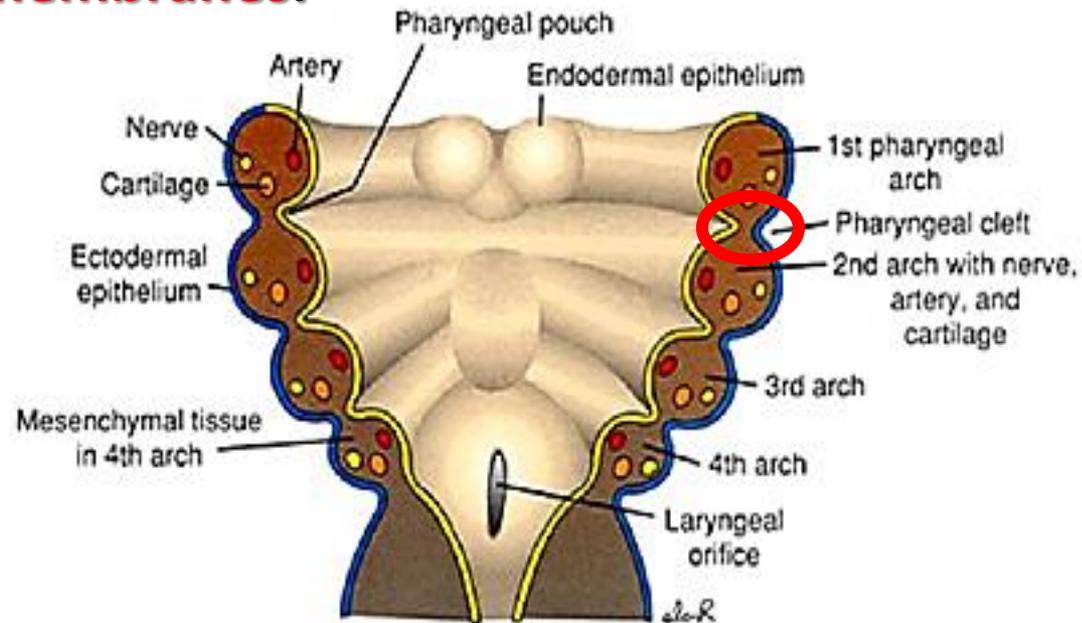
-The endoderm of primordial pharynx lines the inner aspect of the pharyngeal arches & passes into diverticula known as the pharyngeal pouches.

.The pharyngeal pouches lie in-between the pharyngeal arches (e.g. 1st pouch lie between 1st & 2nd arches).

.**4 pairs** of pharyngeal pouches are well defined & the 5th pair is absent or rudimentary.



.The endoderm of pharyngeal pouches contacts the ectoderm of pharyngeal clefts & together they form the double layered pharyngeal membranes.

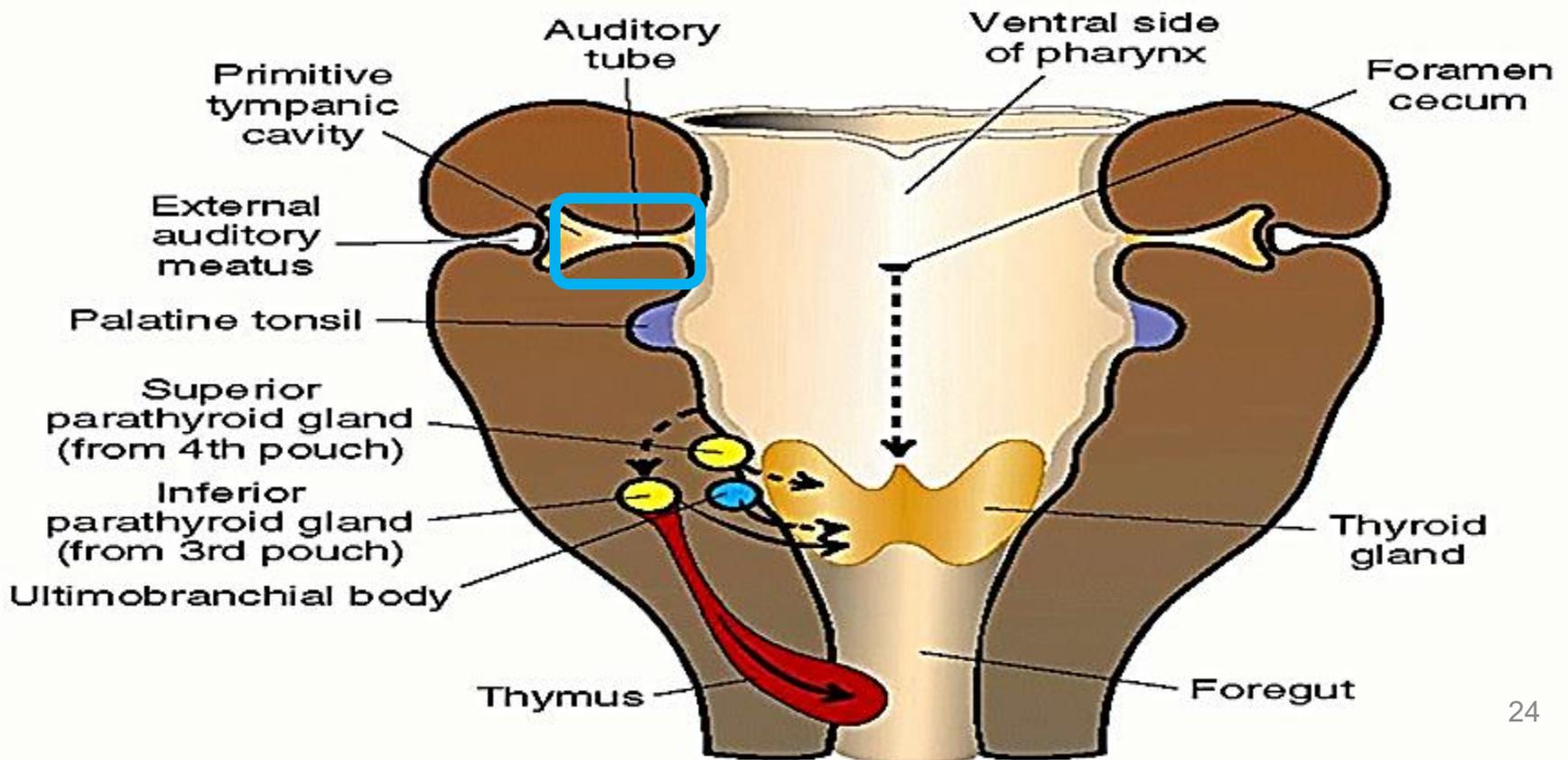


● Derivatives of pharyngeal pouches:

- **1st pouch** → Tympanic cavity (middle ear) & auditory tube.

.The 1st pharyngeal membrane forms the tympanic membrane (eardrum). *Thin layer of mesenchyme*

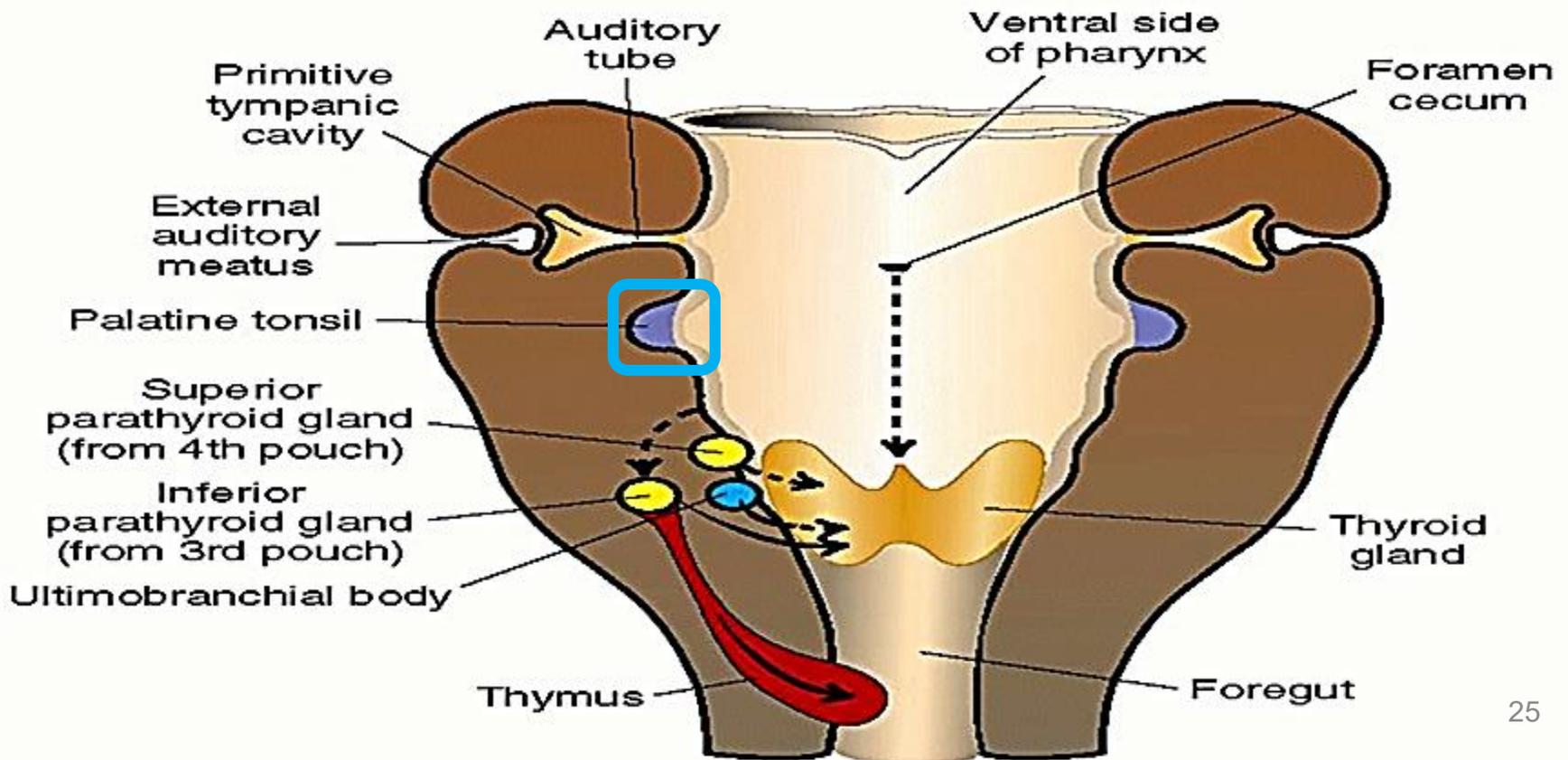
.1st pharyngeal cleft forms the external auditory meatus.



-2nd pouch → Palatine tonsil.

The endoderm gives tonsillar sinus & crypts while, surrounding mesenchyme forms the lymphoid tissue.

◆ Both 3rd & 4th pharyngeal pouches divide into dorsal & ventral parts.

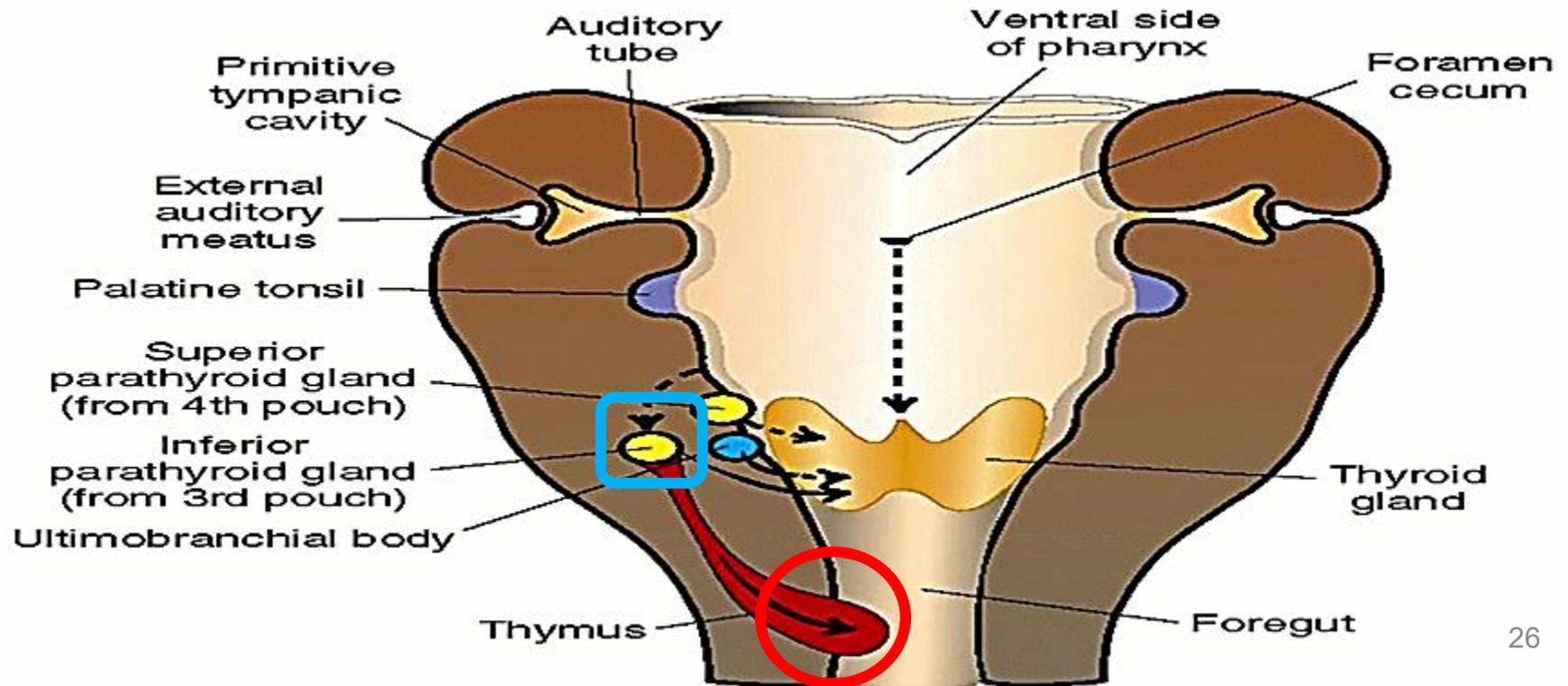


-3rd pouch:

.Dorsal part → Inferior parathyroid glands (parathyroid III)

.Ventral part → Thymus gland.

-Both lose their connections with the pharynx, separate from each other & migrate downwards to lower part of the neck & superior mediastinum respectively.

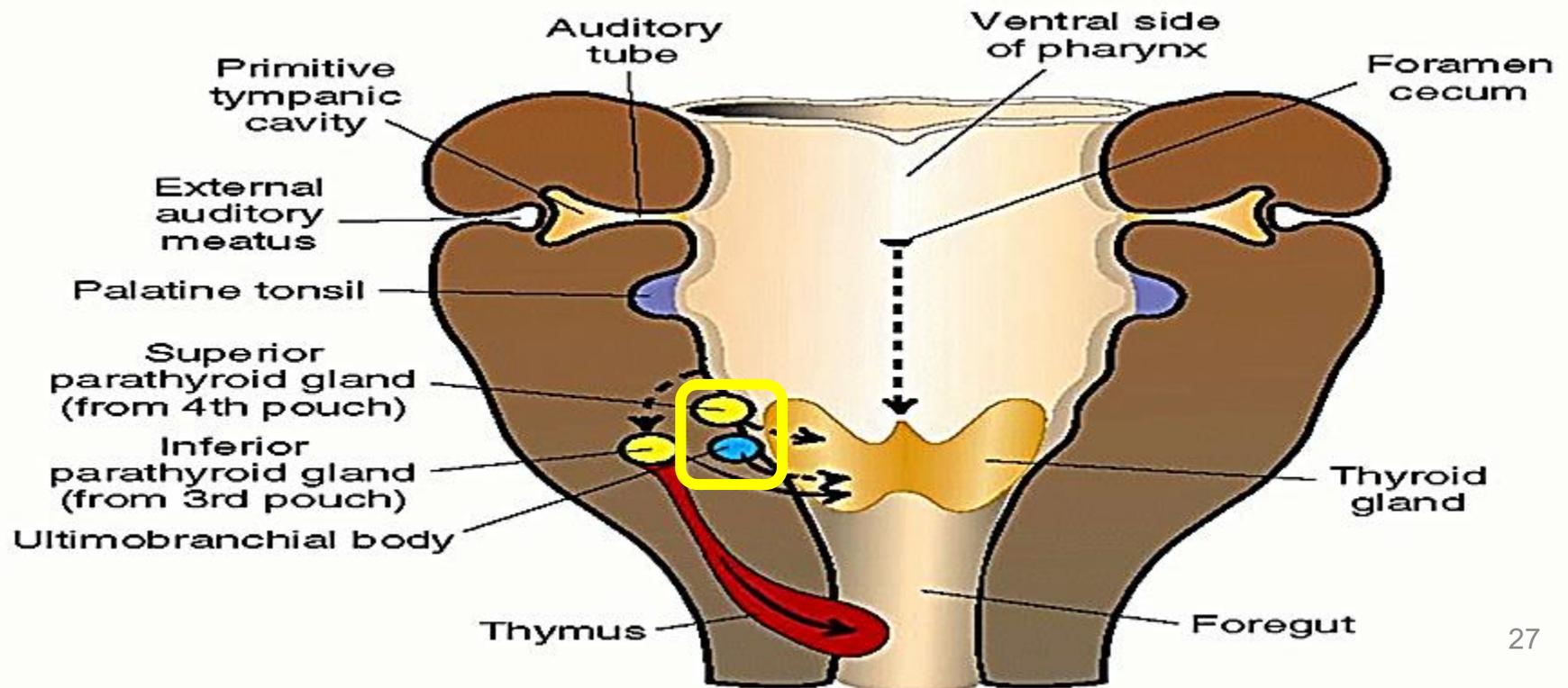


-4th pouch:

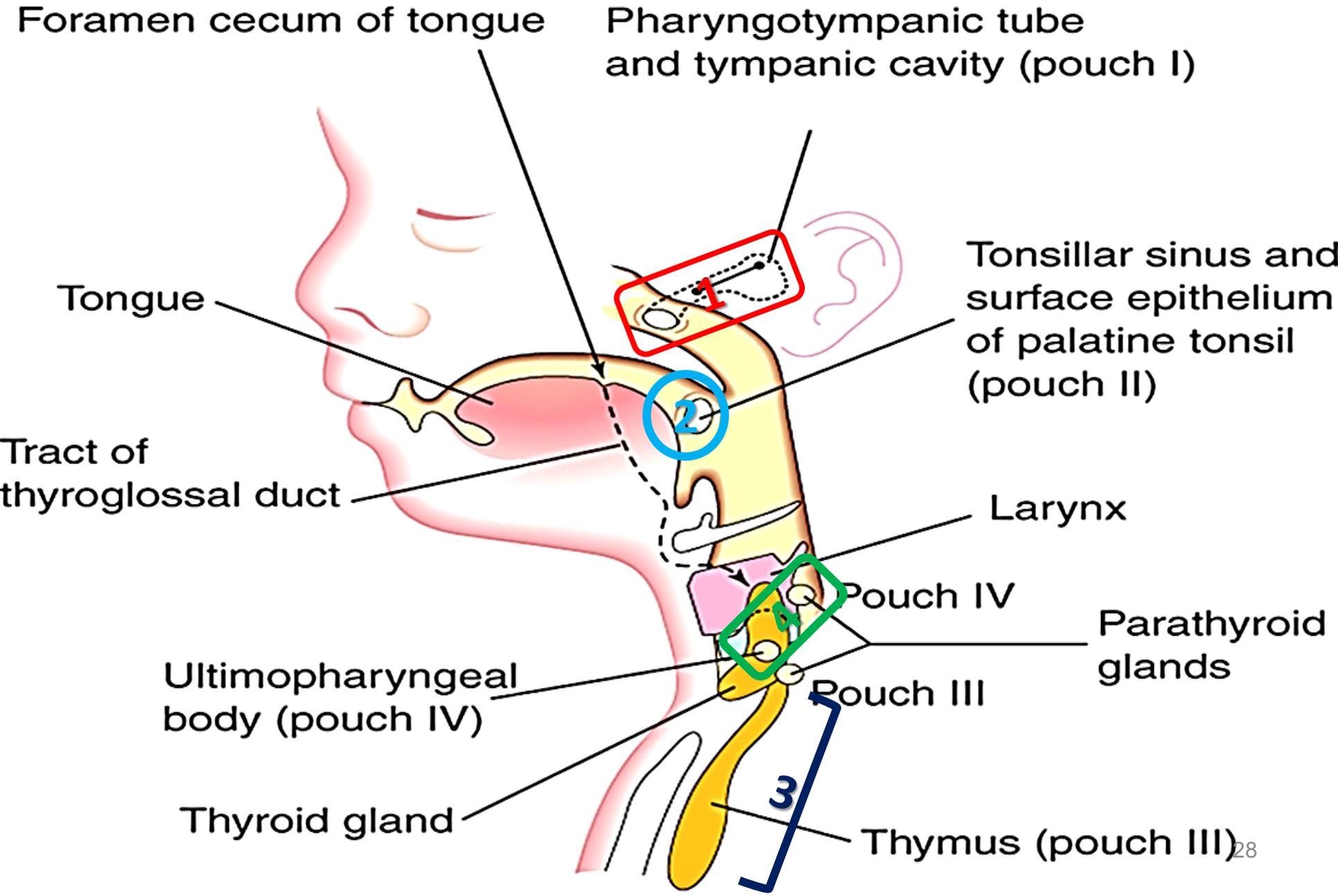
.Dorsal part → Superior parathyroid glands (parathyroid **IV**)

.Ventral part → Parafollicular C cells of thyroid gland.
(Ultimobranchial body)

-C cells secrete calcitonin to regulate blood Ca level. They are derived from migrating *neural crest cells*.



Derivatives of pharyngeal pouches



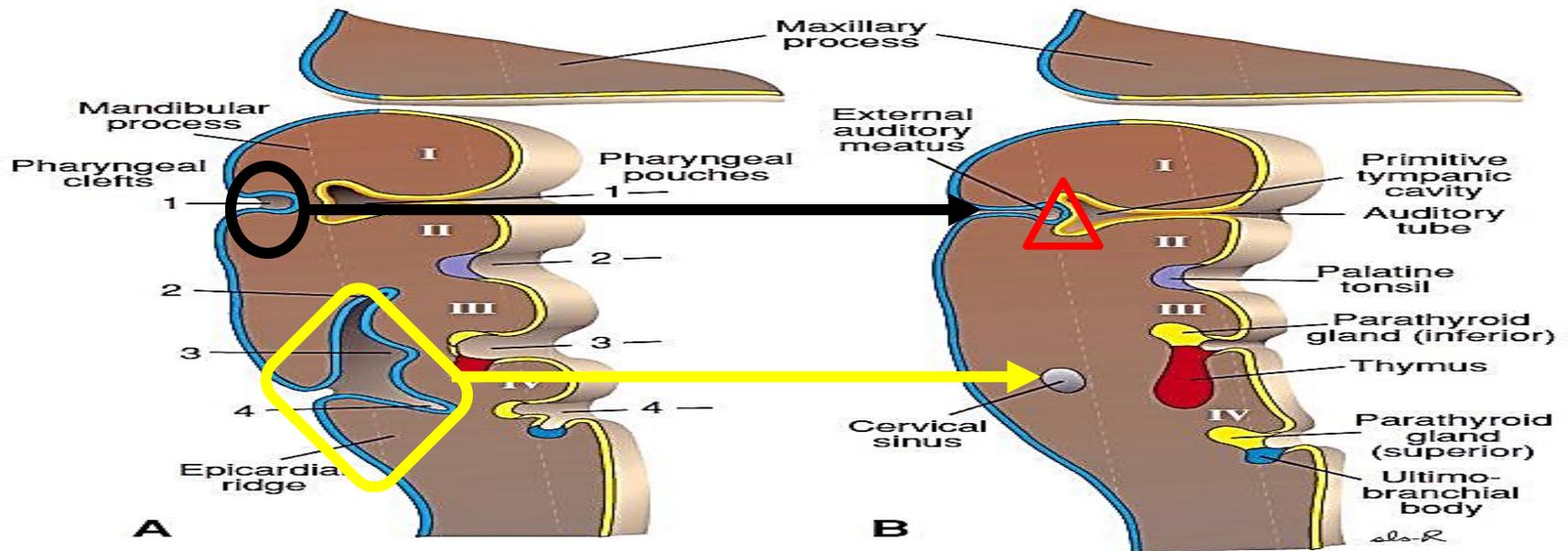
Pharyngeal grooves or clefts: 4

4 pairs of ectodermal grooves that separate the pharyngeal arches externally.

Only **1st cleft** persists to form the external acoustic meatus on each side.

Other clefts \Rightarrow Lie within **cervical sinus** which disappears at 7th week.

◆ Only 1st pharyngeal membrane persists \Rightarrow Tympanic membrane. Other membranes disappear.



Congenital anomalies of pharyngeal apparatus

1. **Auricular pits & cysts:** Anterior to the auricle.

These are remnants of the 1st pharyngeal groove.

2. Failure of the cervical sinus to obliterate results in:

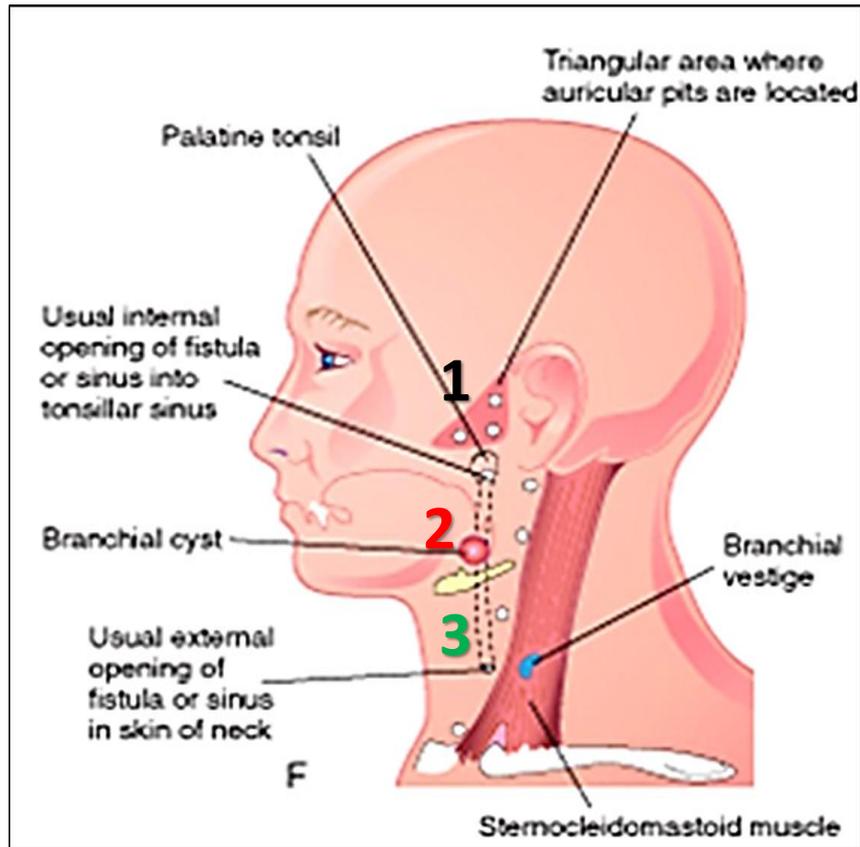
Branchial (lateral cervical) sinuses, cysts & fistula.

-They open on the side of the neck, along the anterior border of the sternocleidomastoid muscle in inferior 1/3 of the neck.

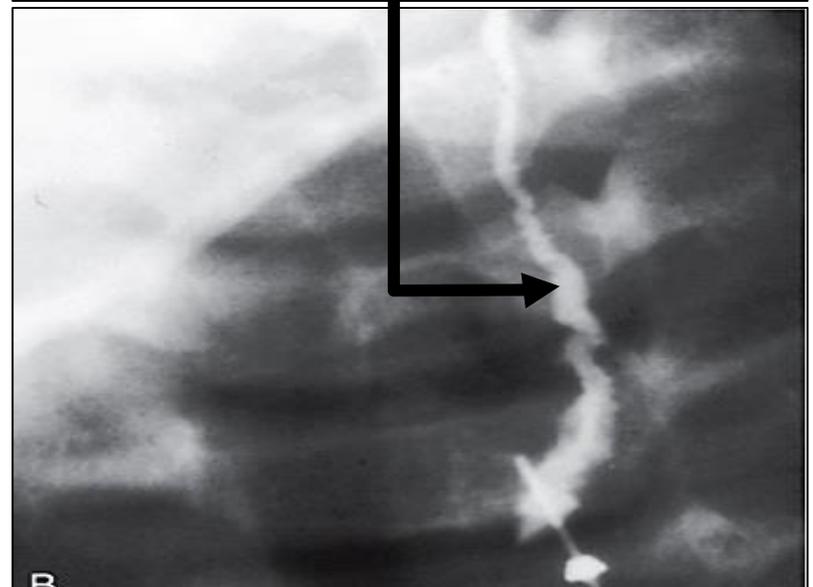
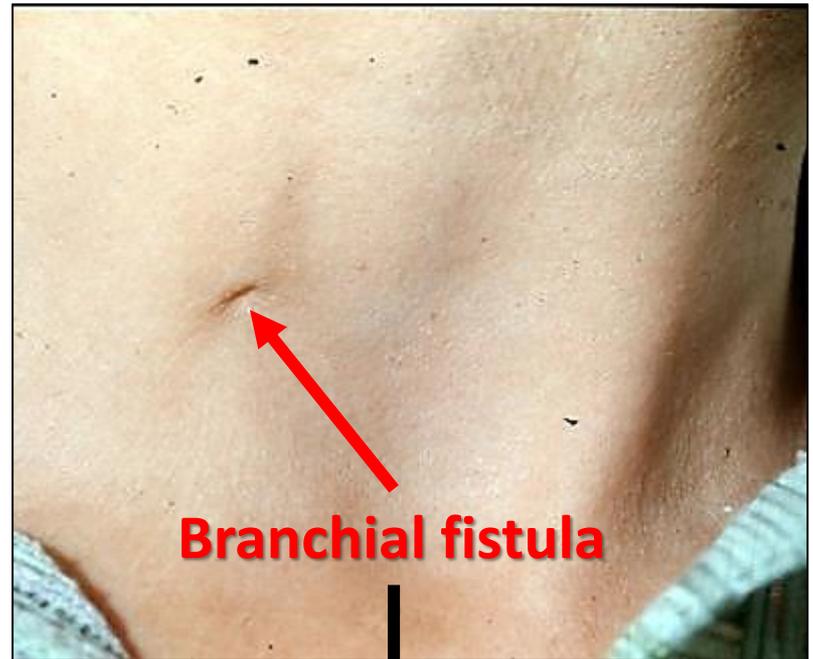
-Branchial or lateral cervical cysts are slowly enlarged, painless swelling on the side of the neck.

-Branchial fistula opens internally at tonsillar sinus. *2nd pharyngeal groove*

Anomalies of pharyngeal apparatus



Branchial (lateral cervical) cyst & fistula

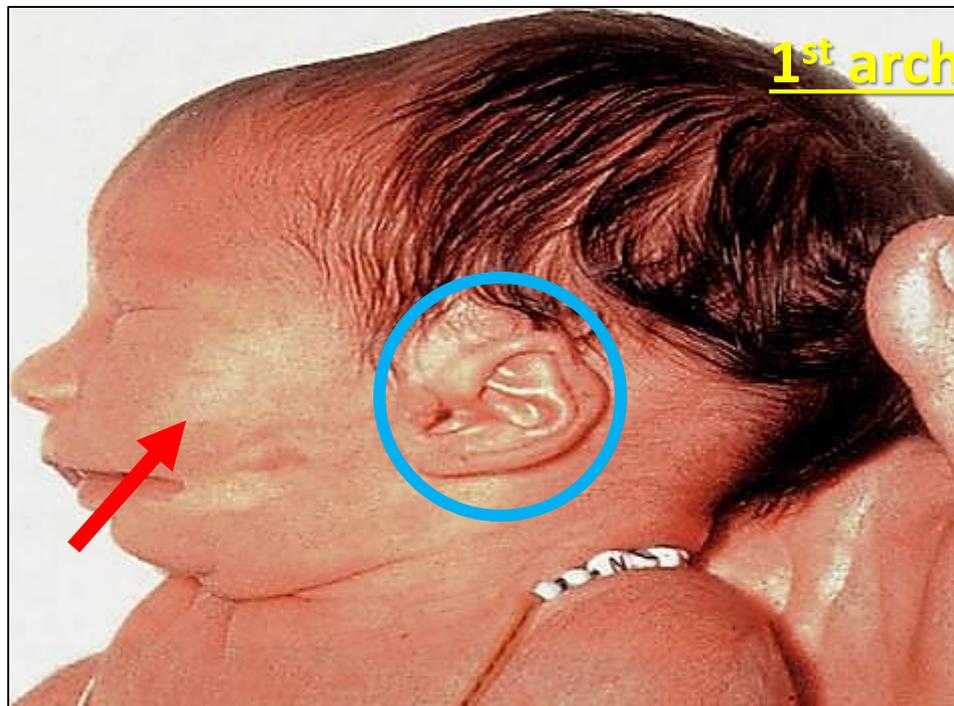


3. **Ectopic parathyroid:** Inferior parathyroid may descend into thorax with thymus.

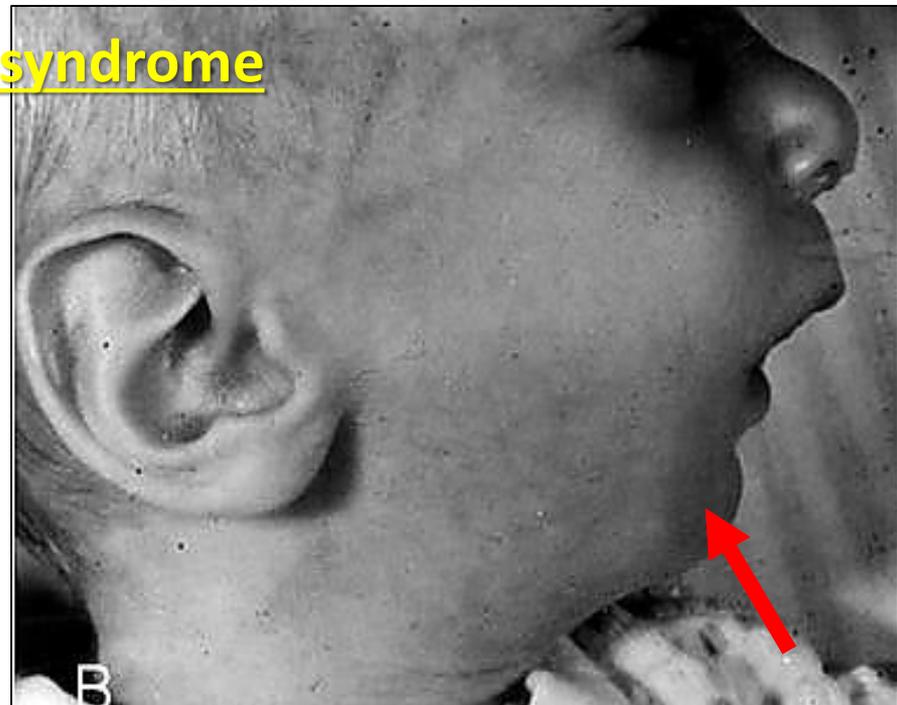
4. **1st arch syndromes:** These syndromes result from insufficient migration of neural crest cells into 1st arch.

. **Treacher Collins syndrome:** Malar hypoplasia (under development of zygomatic bone) & deformed external ears.

. **Pierre Robin syndrome:** Mandibular hypoplasia & cleft palate.



1st arch syndrome



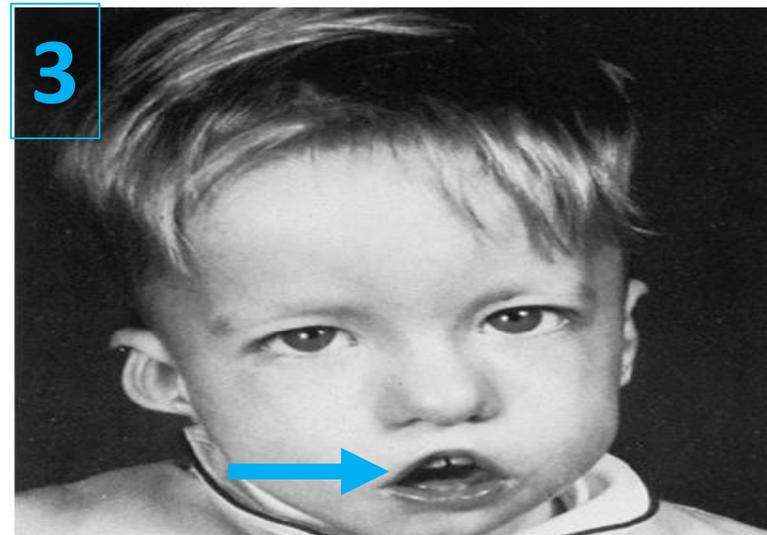
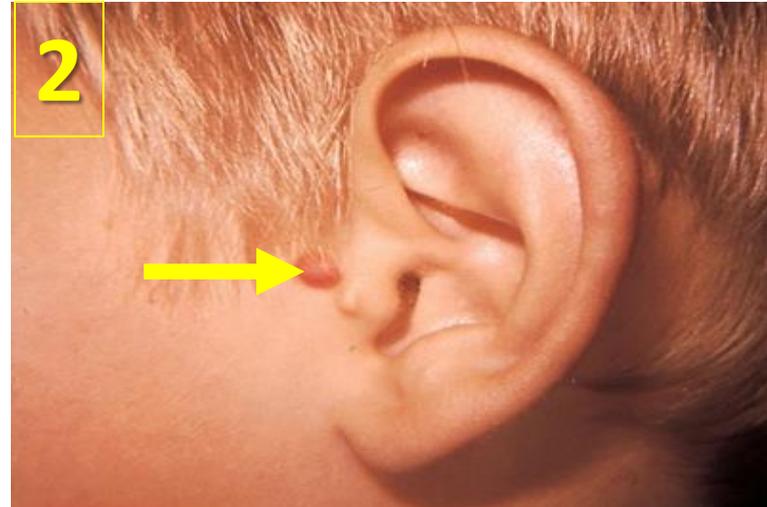
5. **DiGeorge syndrome** (3rd & 4th pharyngeal pouches syndrome):

- Absence of thymus & parathyroids. *Immune deficiency & \uparrow Ca*
- Anomalies of the heart.
- Facial defects as fish mouth & cleft lip.



DiGeorge syndrome

Identify the anomaly





GOOD LUCK