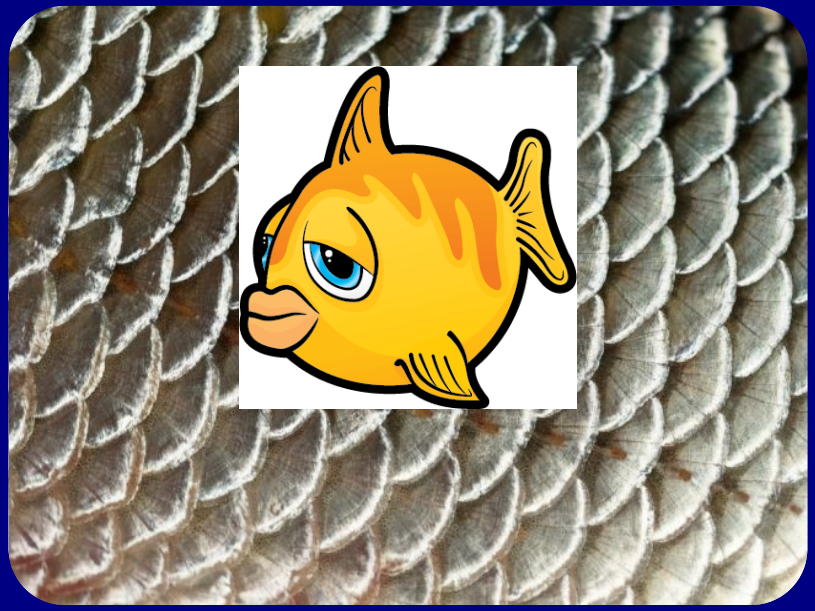
Pharyngeal arches

Pharyngeal pouches

Thieme

Sobotta

Multimedial Unit of Dept. of Anatomy Jagiellonian University



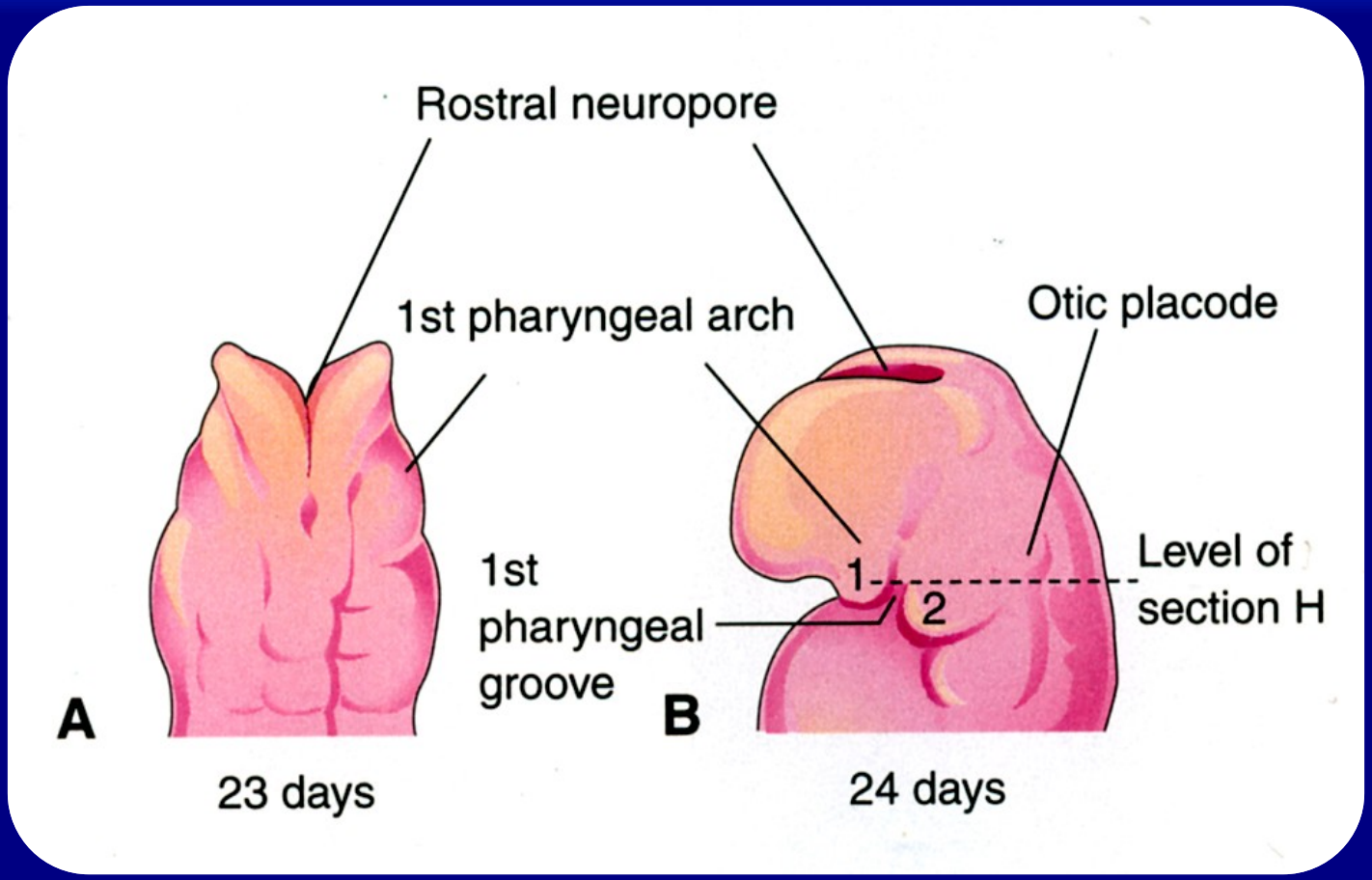
The head and neck regions of a 4-week human embryo somewhat resemble these regions of a fish embryo of a comparable stage of development.

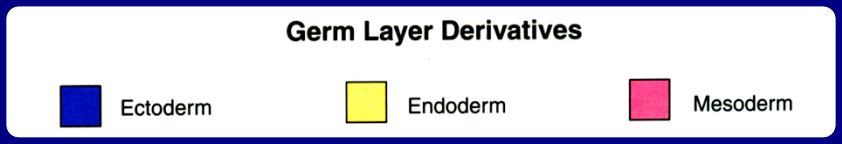
This explains the former use of the designation „branchial apparatus” – the adjective „branchial” is derived from the Greek word branchia – the gill.

The pharyngeal apparatus consists of:

- pharyngeal arches
- pharyngeal pouches
- pharyngeal grooves
- pharyngeal membranes

The pharyngeal arches begin to develop early in the fourth week as neural crest cells migrate into the future head and neck regions.

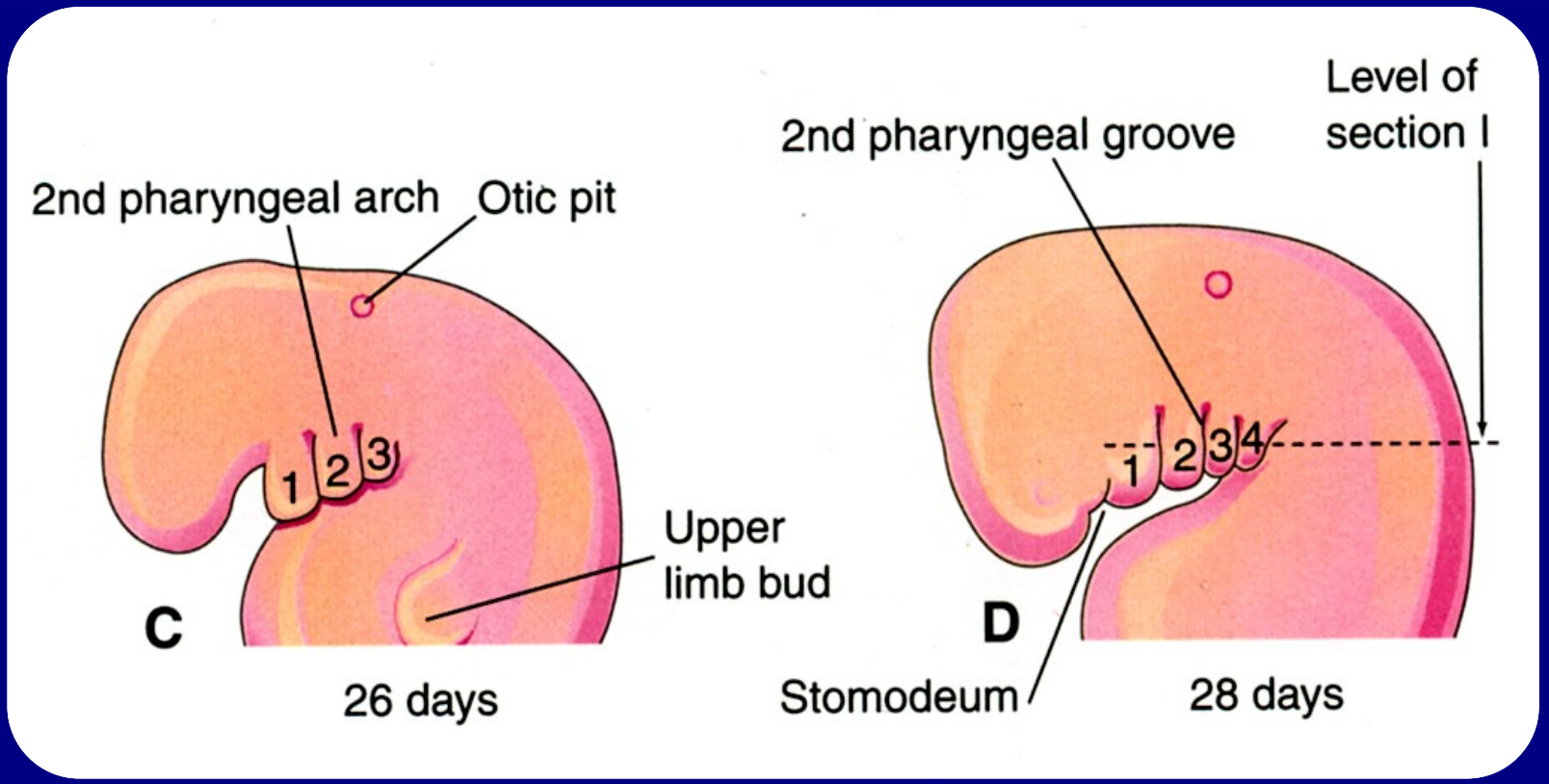


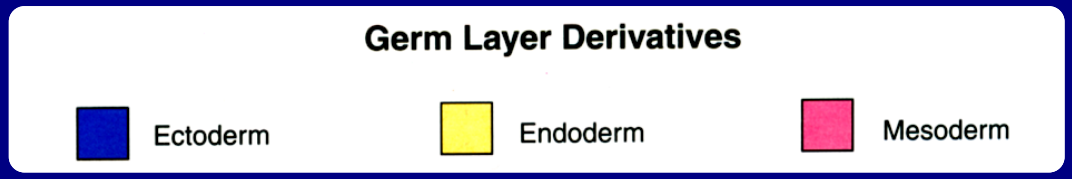


Drawings illustrating the human pharyngeal apparatus.

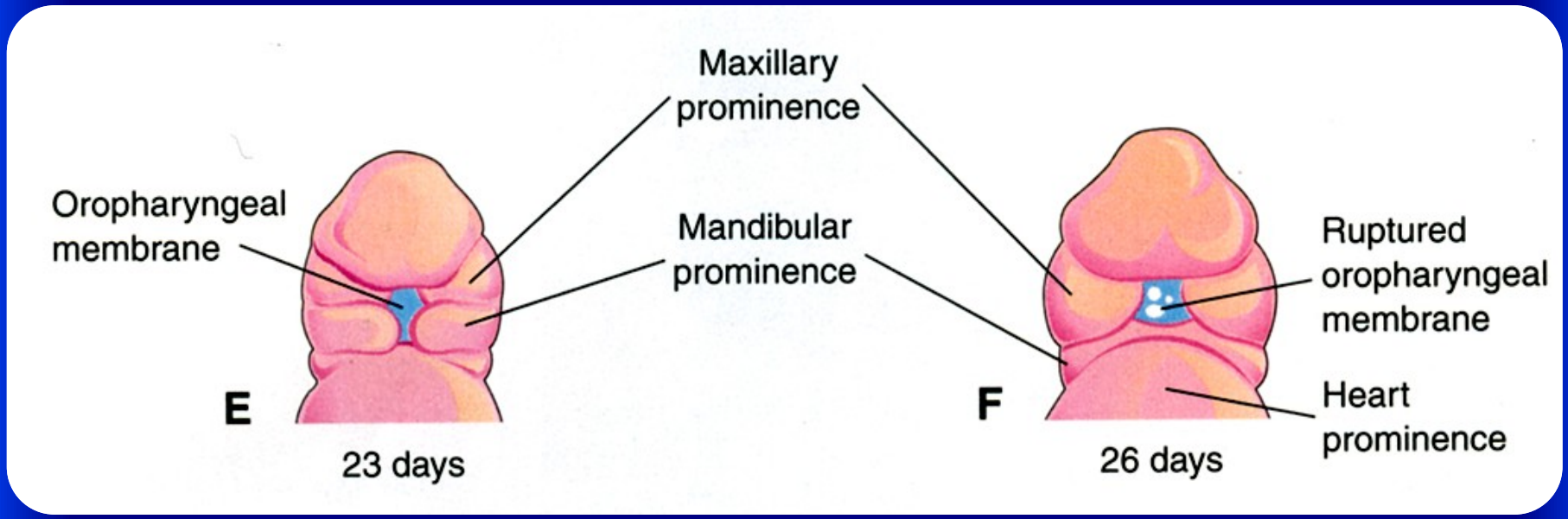
The first pharyngeal arch (mandibular arch) develops two prominences

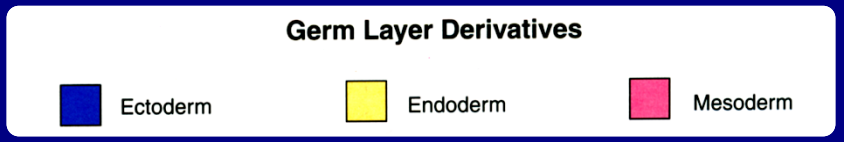
- the maxillary prominence (gives rise to maxilla, zygomatic bone, and squamous part of temporal bone)
- the mandibular prominence (forms the mandible)



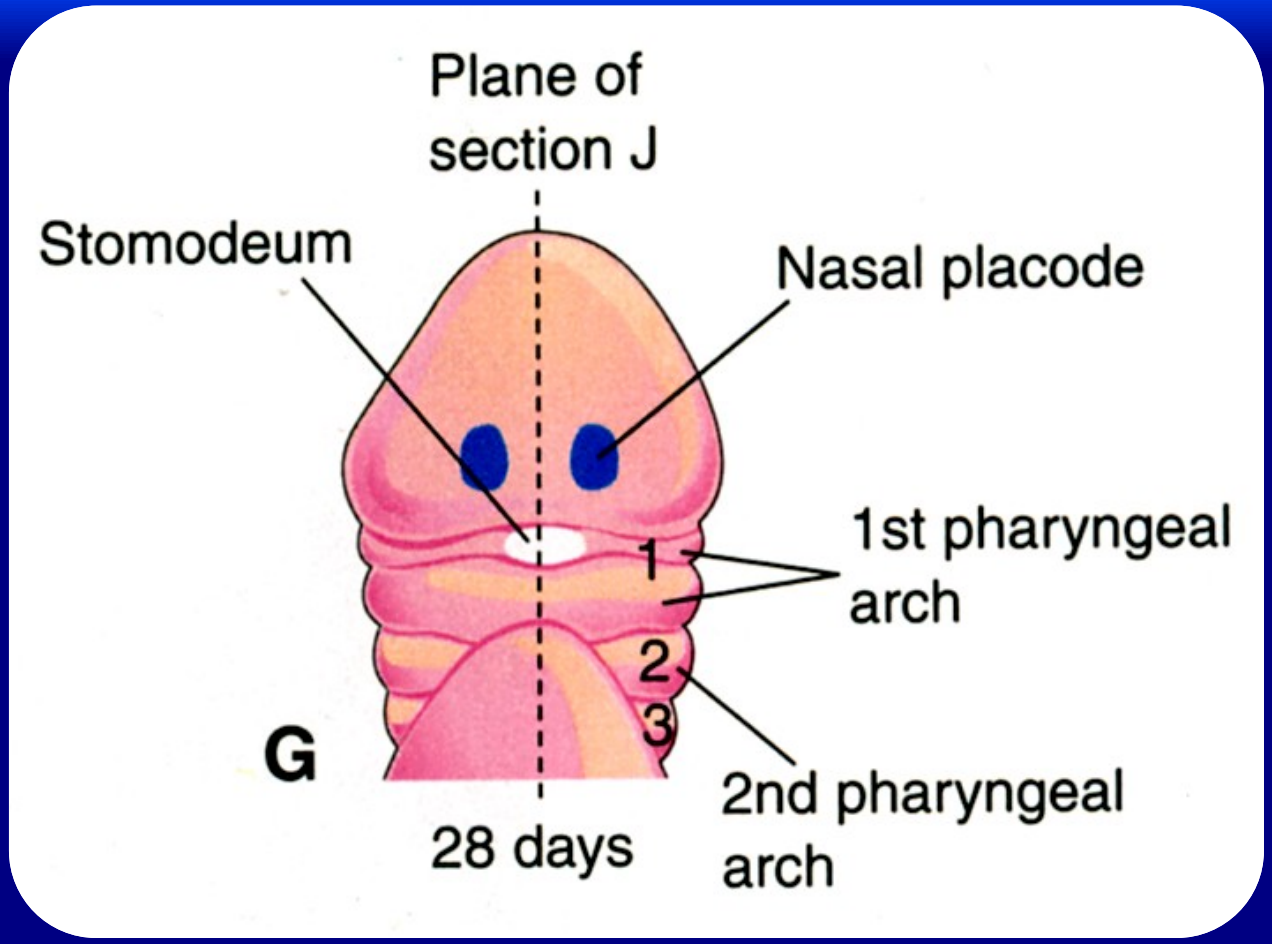


Drawings illustrating the human pharyngeal apparatus.

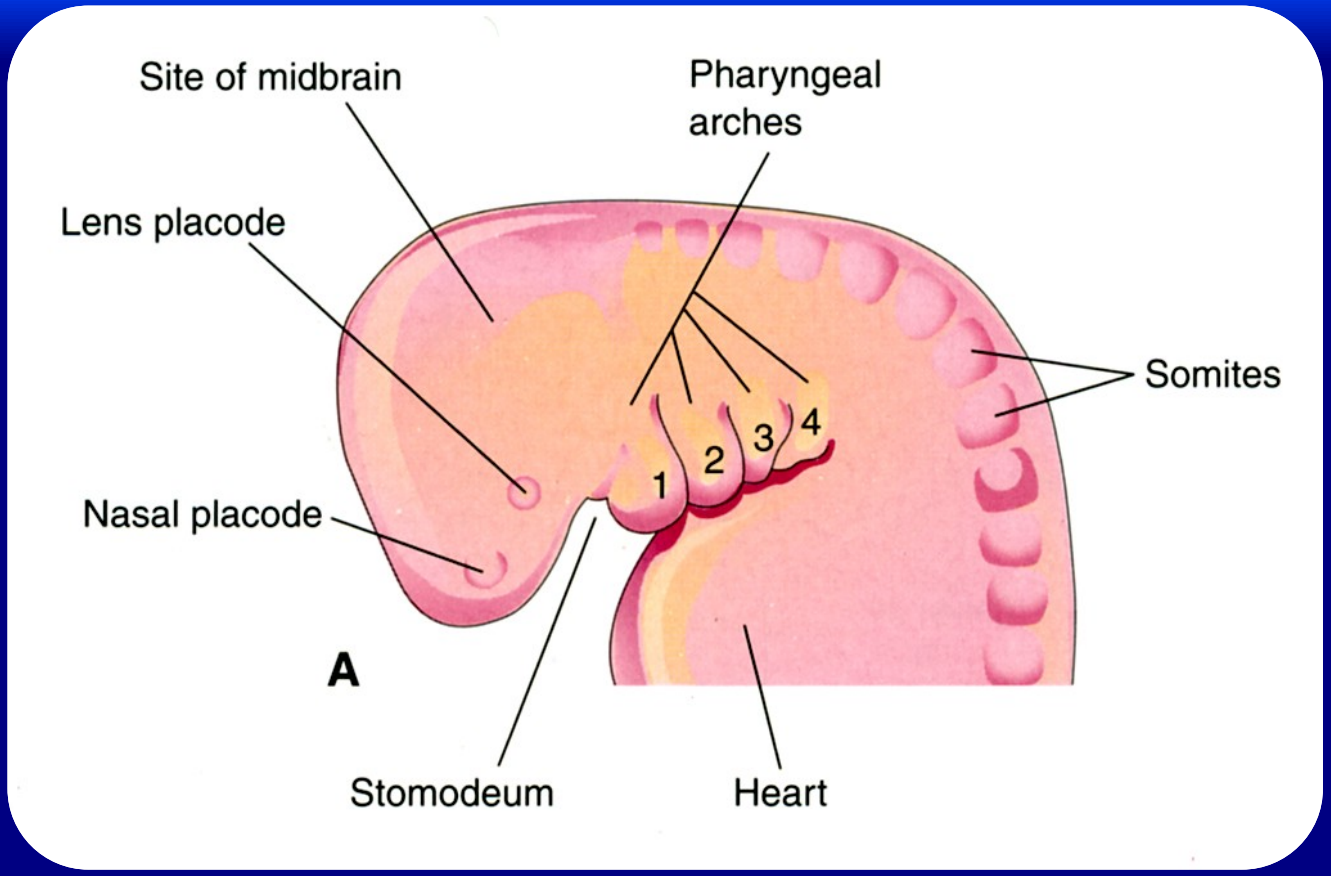




Drawings illustrating the human pharyngeal apparatus.

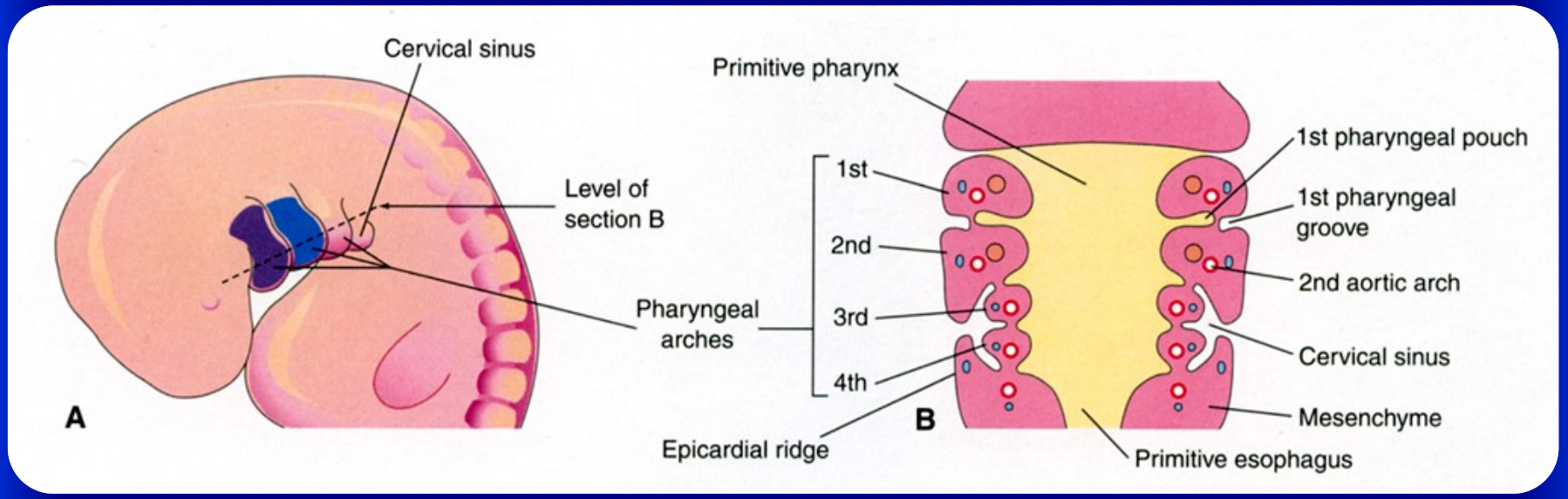


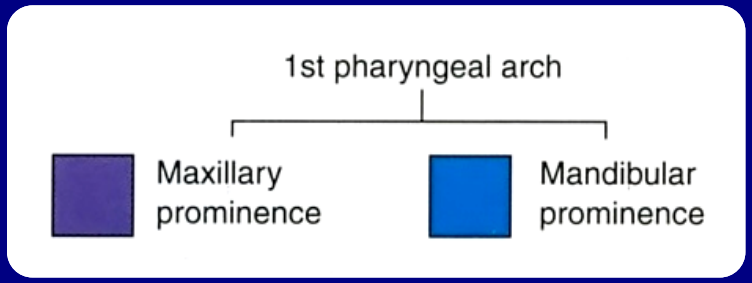
Drawings illustrating the human pharyngeal apparatus.



Drawing of the head, neck, and thoracic regions of a human embryo (about 28 days), illustrating the pharyngeal apparatus.

During the fifth week, the second pharyngeal arch enlarges and overgrows the third and fourth arches, forming an ectodermal depression – the cervical sinus.



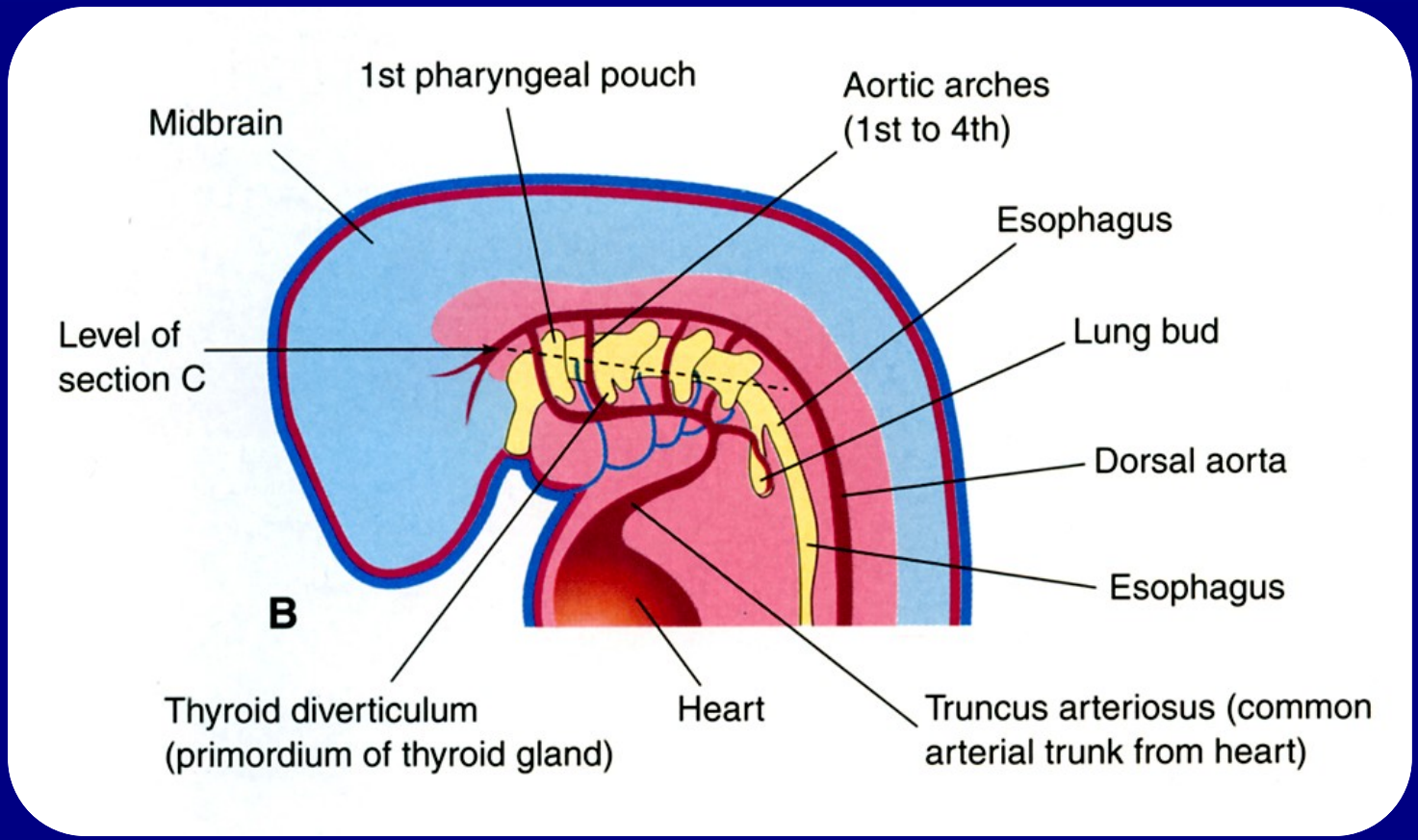


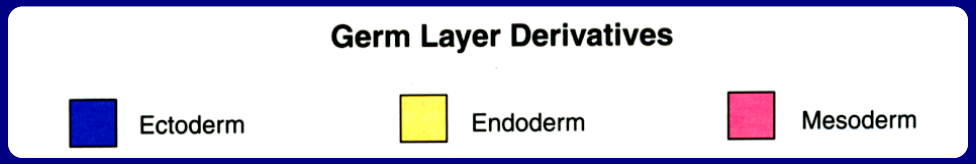
A - Lateral view of the head, neck, and thoracic regions of an embryo (about 32 days), showing the pharyngeal arches and cervical sinus.

B - Diagrammatic section through the embryo at the level shown in A, illustrating growth of the second arch over the third and fourth arches.

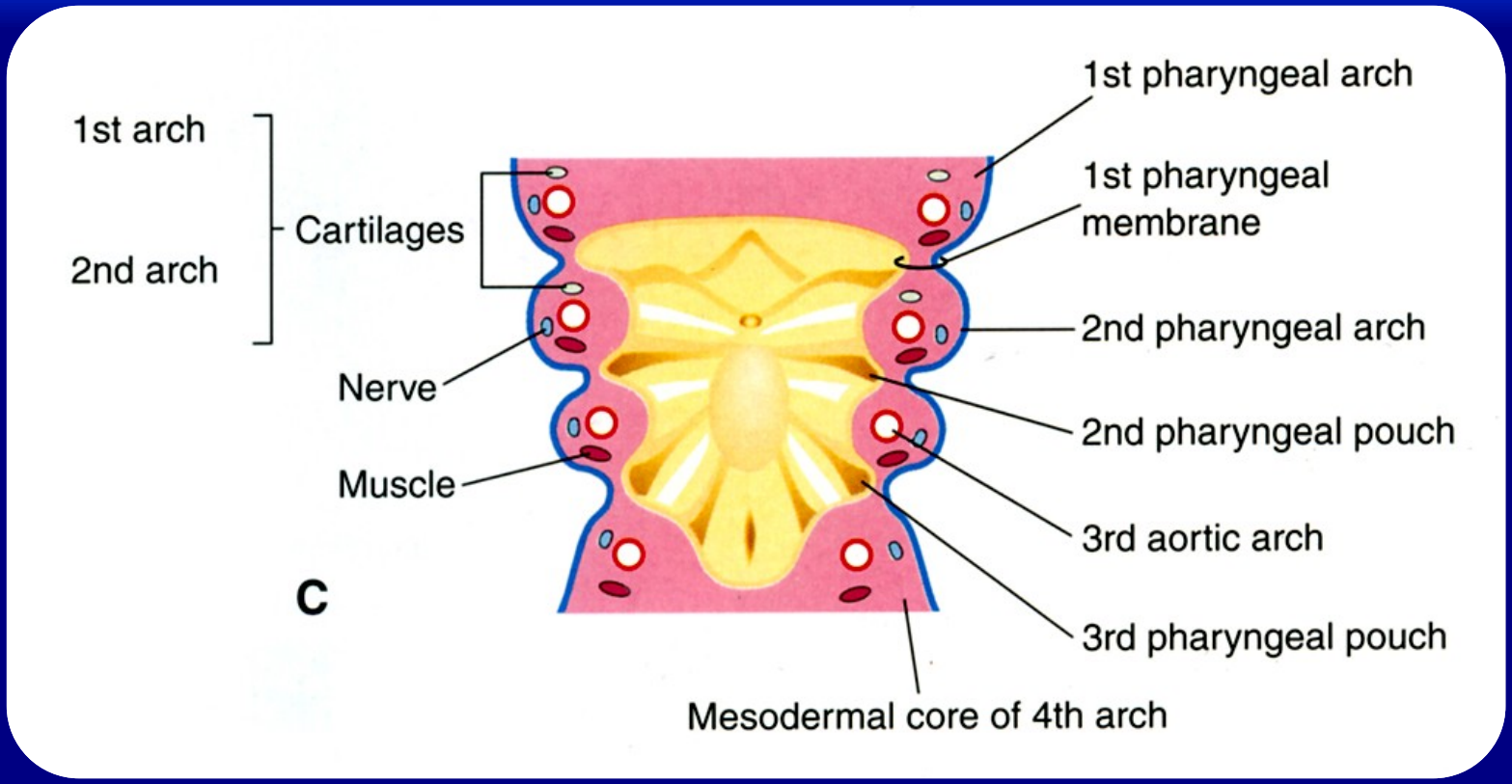
A typical pharyngeal arch contains:

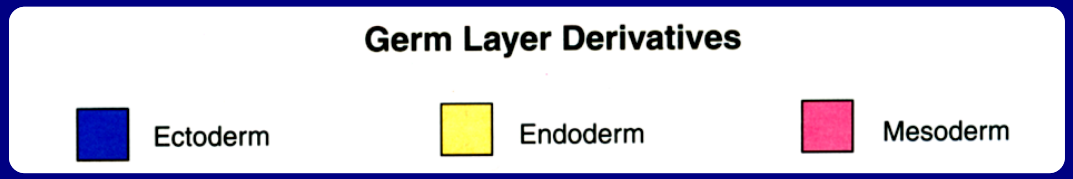
- an aortic arch (an artery that arises from the truncus arteriosus of the primordial heart and passes around the primordial pharynx to enter the dorsal aorta
- a cartilaginous rod that forms the skeleton of the arch
- a muscular component that differentiates into the muscles in the head and neck
- a nerve that supplies the mucosa and muscles derived from the arch (derived from the neuroectoderm of the primordial brain)



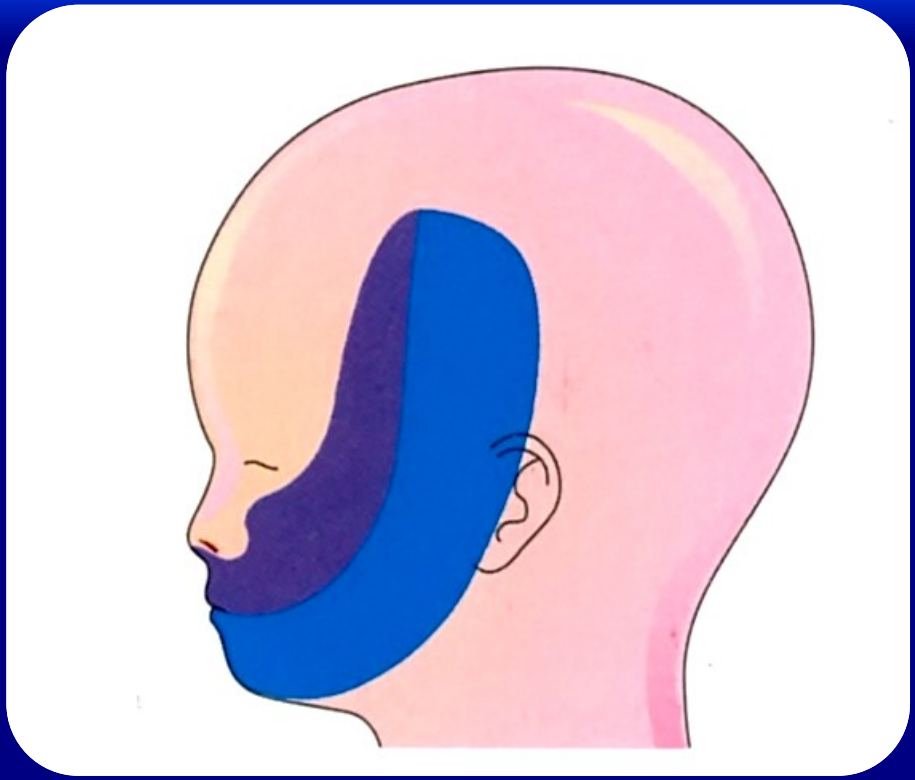


Schematic drawing showing the pharyngeal pouches and aortic arches.

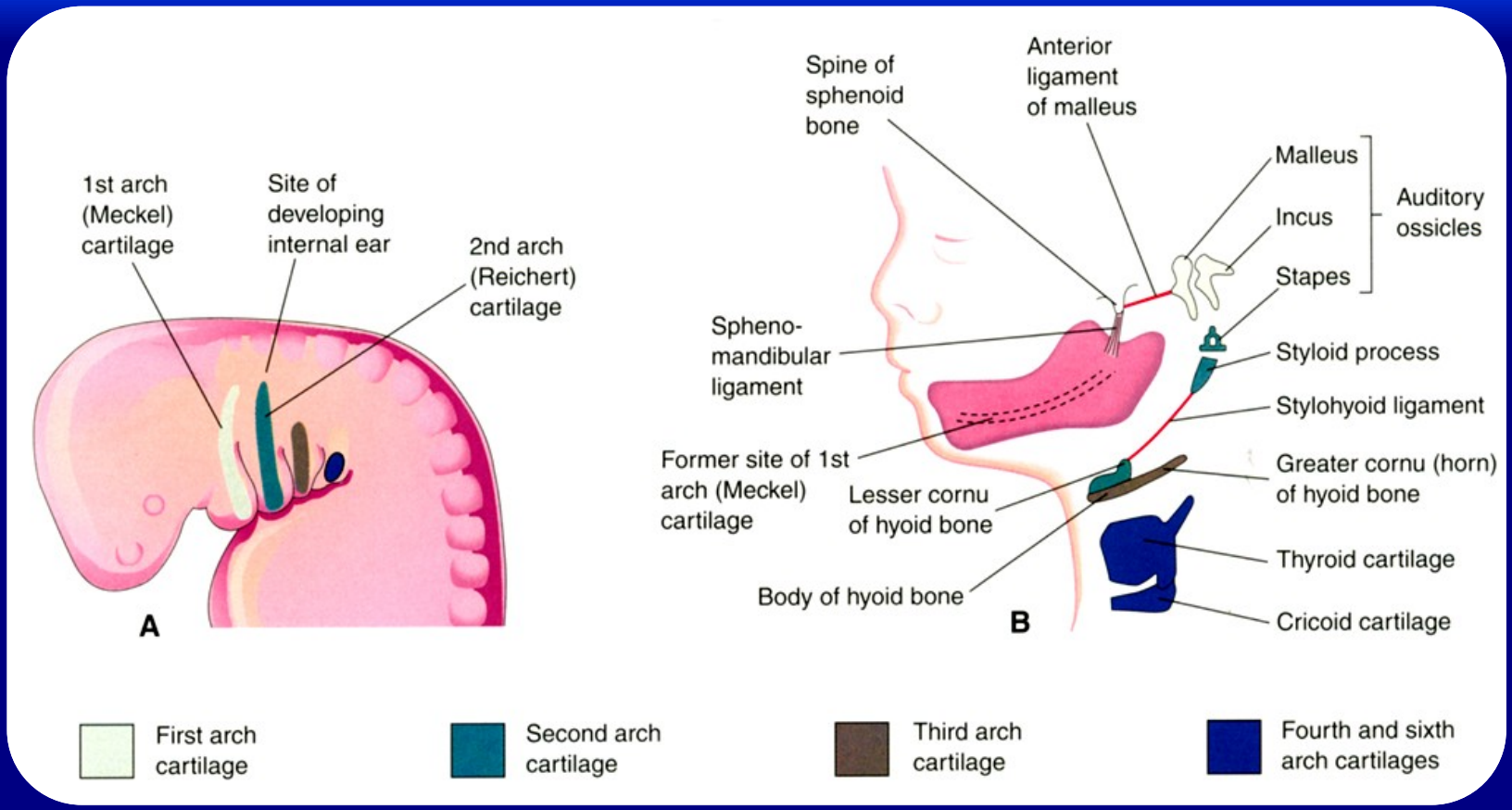




Horizontal section through the embryo showing the floor of the primordial pharynx and illustrating the germ layer of origin of the pharyngeal arch components.



Drawing of a 20-week fetus illustrating the area of the face derived from the first pair of pharyngeal arches.

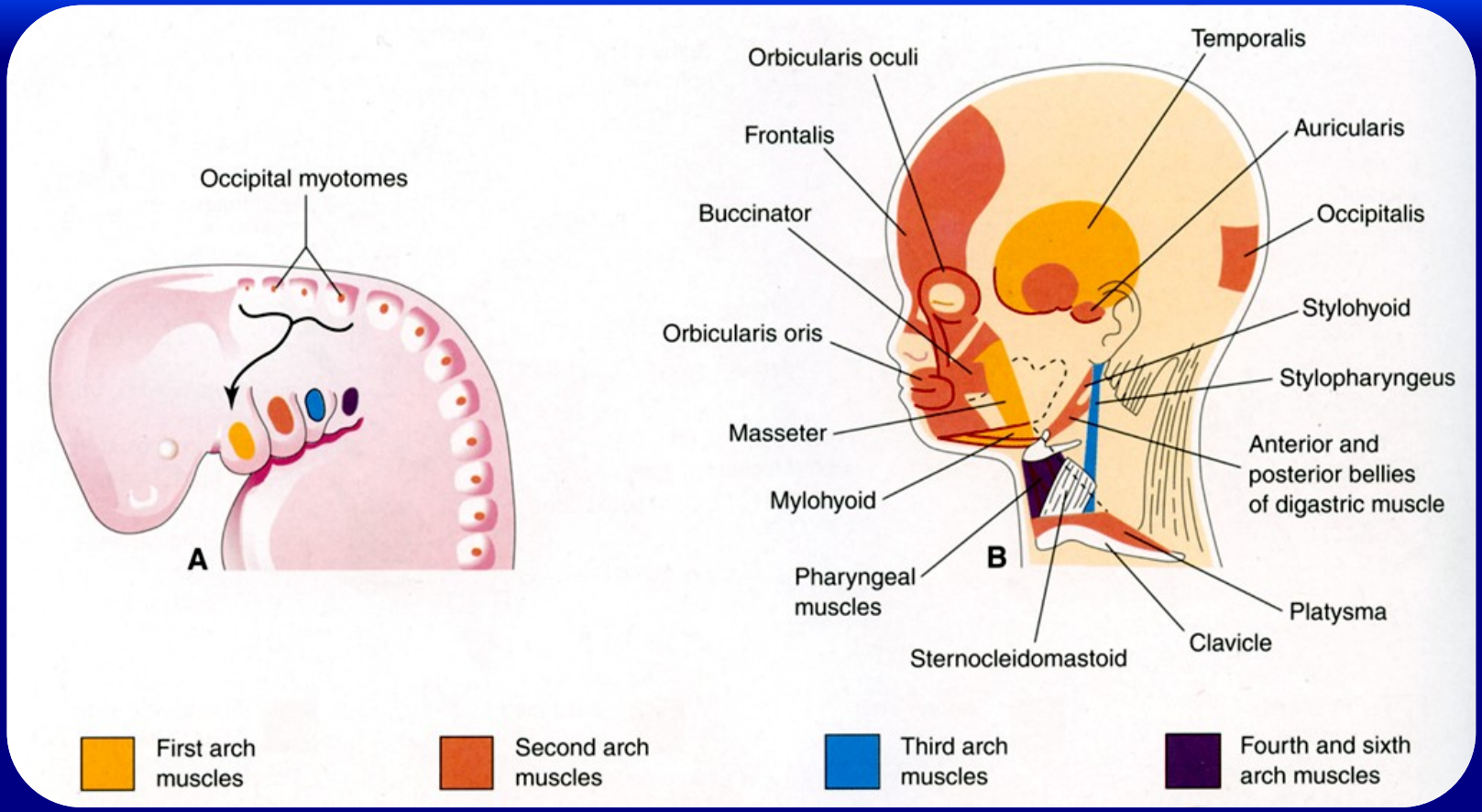


A, Schematic lateral view of the head, neck, and thoracic regions of a 4-week embryo, illustrating the location of the cartilages in the pharyngeal arches. B, Similar view of a 24-week fetus illustrating the adult derivatives of the arch cartilages. Note that the mandible is formed by intramembranous ossification of mesenchymal tissue surrounding the first arch cartilage. This cartilage acts as a template for development of the mandible, but does not contribute directly to the formation of it. Occasionally ossification of the second arch cartilage may extend from the styloid process along the stylohyoid ligament. When this occurs, it may cause pain in the region of the palatine tonsil.

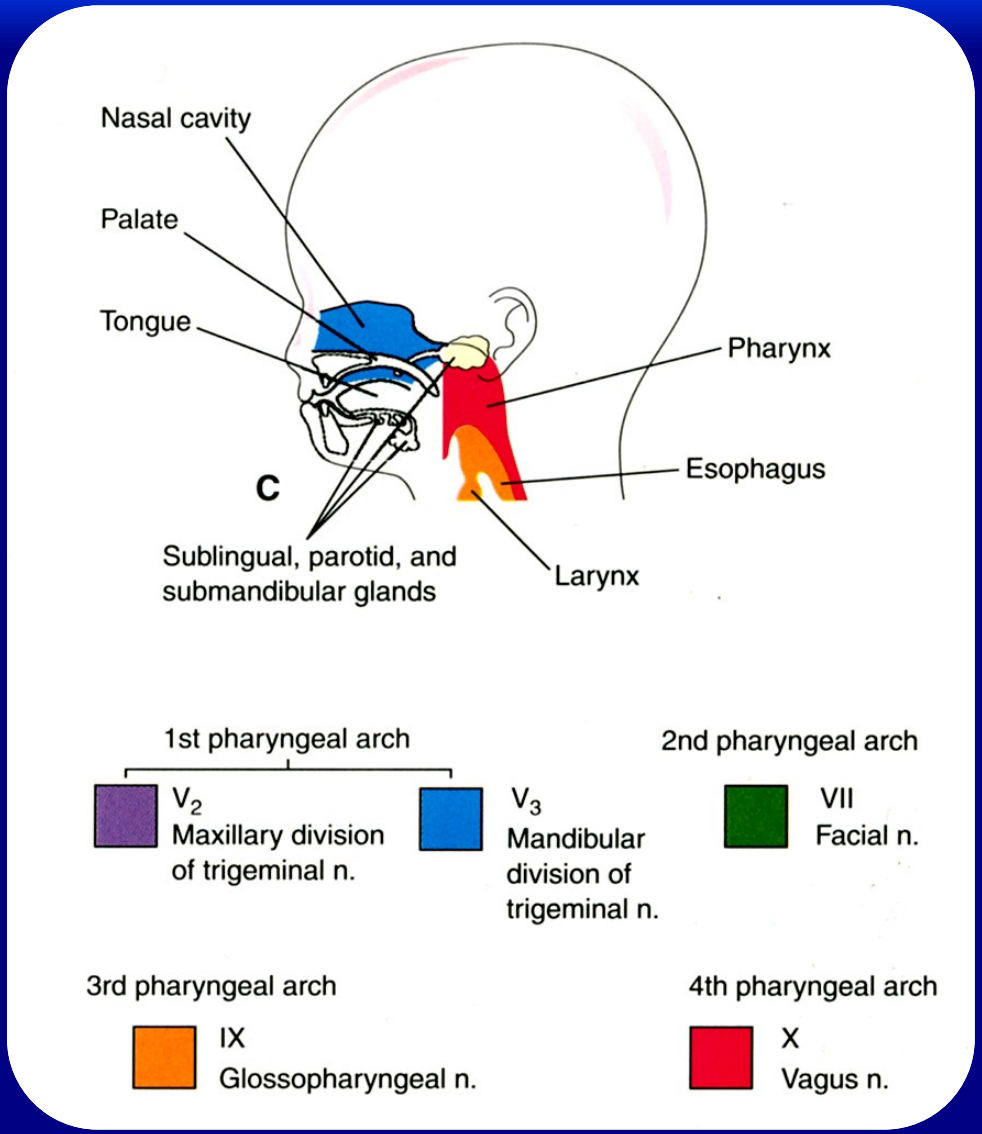
Structures Derived from Pharyngeal Arch Components*

Arch	Nerve	Muscles	Skeletal Structures	Ligaments
First (mandibular)	Trigeminal† (CN V)	Muscles of mastication‡ Mylohyoid and anterior belly of digastric Tensor tympani Tensor veli palatini	Malleus Incus	Anterior ligament of malleus Sphenomandibular ligament
Second (hyoid)	Facial (CN VII)	Muscles of facial expression§ Stapedius Stylohyoid Posterior belly of digastric	Stapes Styloid process Lesser cornu of hyoid Upper part of body of hyoid bone	Stylohyoid ligament
Third	Glossopharyngeal (CN IX)	Stylopharyngeus	Greater cornu of hyoid Lower part of body of hyoid bone	
Fourth and sixth‖	Superior laryngeal branch of vagus (CN X) Recurrent laryngeal branch of vagus (CN X)	Cricothyroid Levator veli palatini Constrictors of pharynx Intrinsic muscles of larynx Striated muscles of esophagus	Thyroid cartilage Cricoid cartilage Arytenoid cartilage Corniculate cartilage Cuneiform cartilage	

*The derivatives of the aortic arch arteries are described in Chapter 14.
†The ophthalmic division CNV does not supply any pharyngeal arch components.
‡Temporalis, masseter, medial and lateral pterygoids.
§Buccinator, auricularis, frontalis, platysma, orbicularis oris and orbicularis oculi.
‖The fifth pharyngeal arch is often absent. When present, it is rudimentary and usually has no recognizable cartilage bar. The cartilaginous components of the fourth and sixth arches fuse to form the cartilages of the larynx.



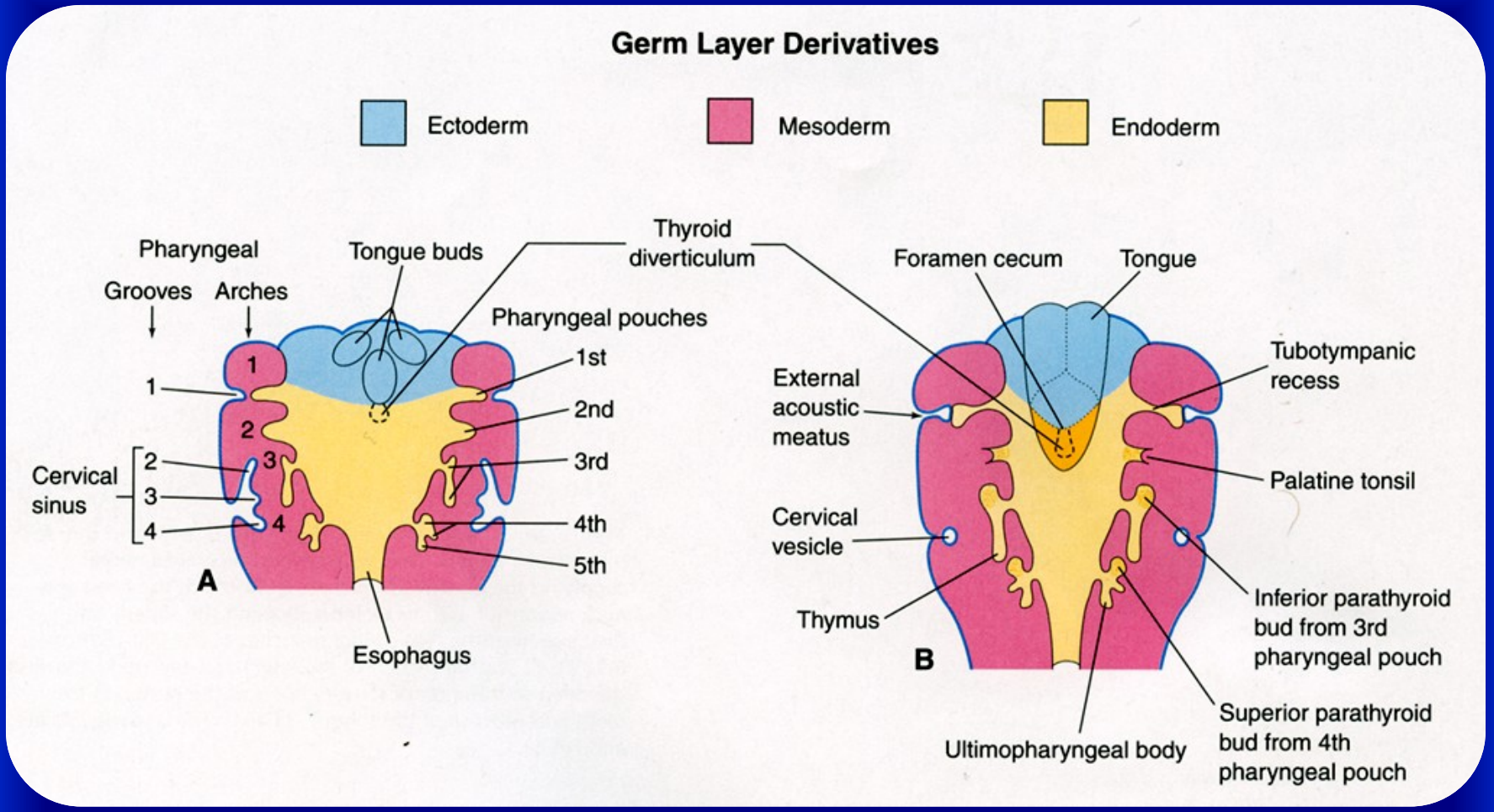
A, Lateral view of the head, neck, and thoracic regions of a 4-week embryo showing the muscles derived from the pharyngeal arches. The arrow shows the pathway taken by myoblasts from the occipital myotomes to form the tongue musculature. **B**, Sketch of the head and neck regions of a 20-week fetus, dissected to show the muscles derived from the pharyngeal arches. Parts of the platysma and sternocleidomastoid muscles have been removed to show the deeper muscles. Note that myoblasts from the second arch migrate from the neck to the head, where they give rise to the muscles of facial expression. These muscles are supplied by the facial nerve (CN VII), the nerve of the second pharyngeal arch.



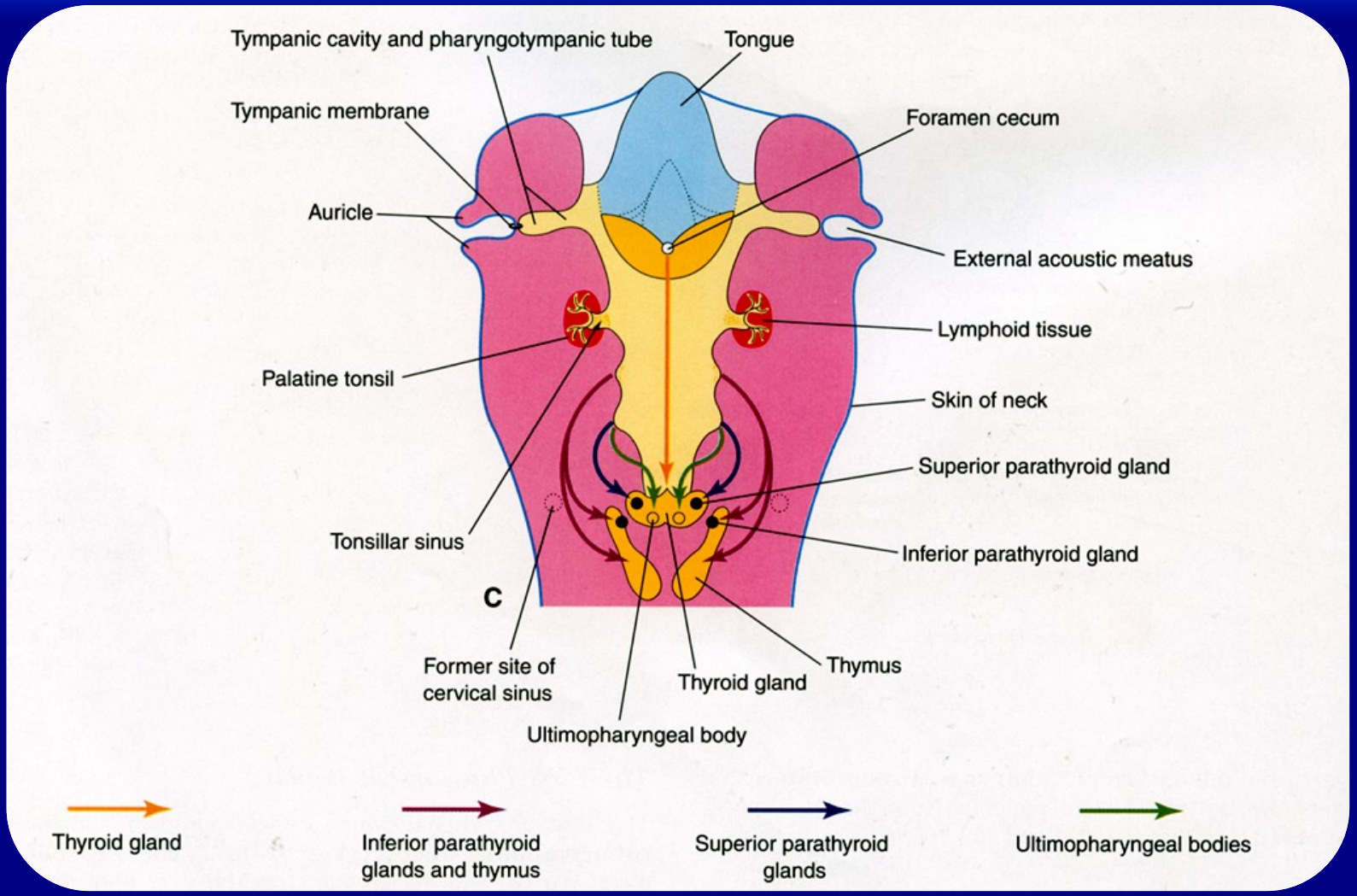
Sagittal section of the fetal head and neck, showing the deep distribution of sensory fibers of the nerves to the teeth and mucosa of the tongue, pharynx, nasal cavity, palate, and larynx.

Pharyngeal pouches

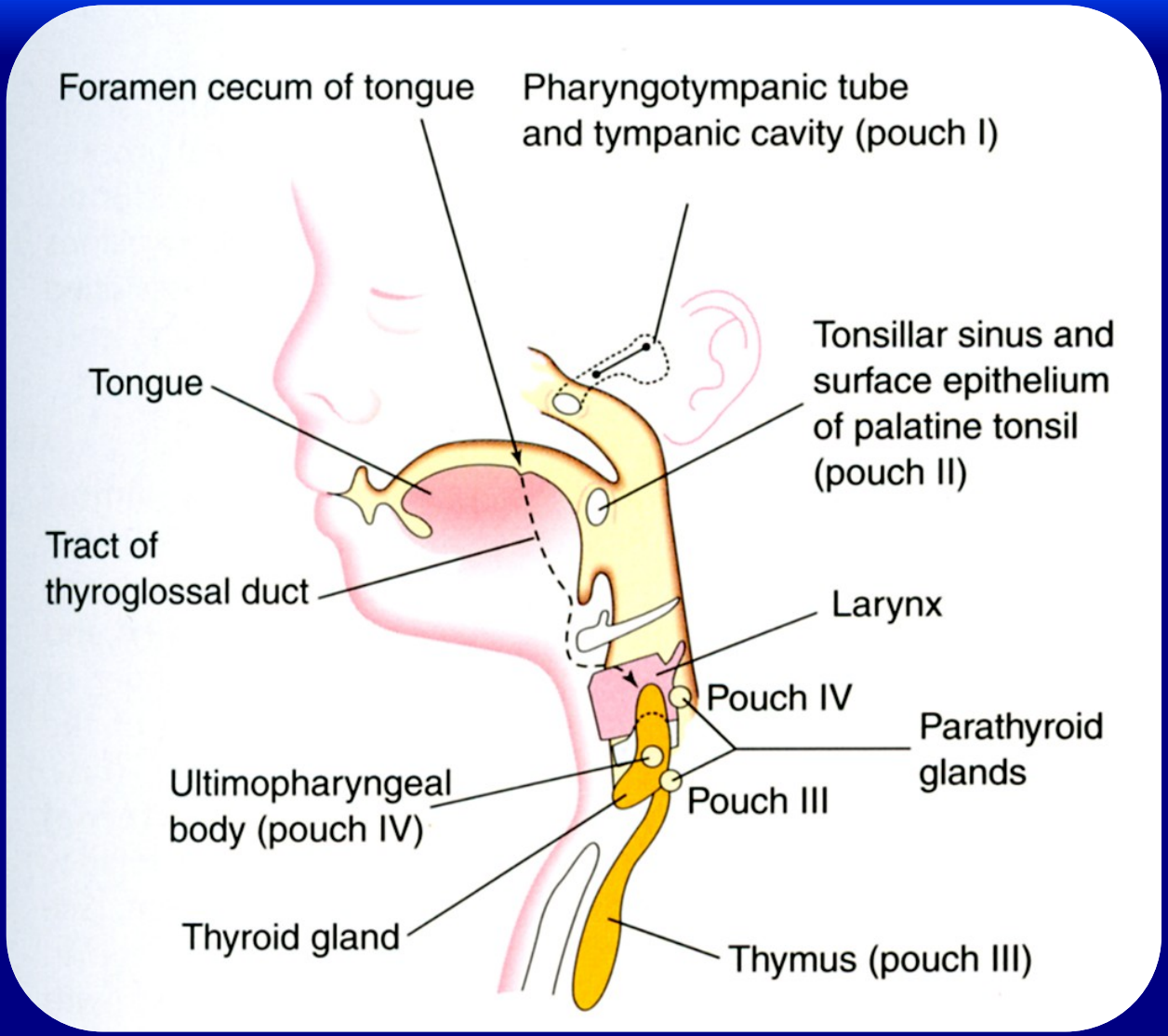
- first pharyngeal pouch – tubotympanic recess
- second pharyngeal pouch – palatine tonsil and tonsillar sinus
- third pharyngeal pouch – inferior parathyroid gland/thymus
- fourth pharyngeal pouch – inferior parathyroid gland
- first pharyngeal groove – external acoustic meatus
- first pharyngeal membrane – tympanic membrane



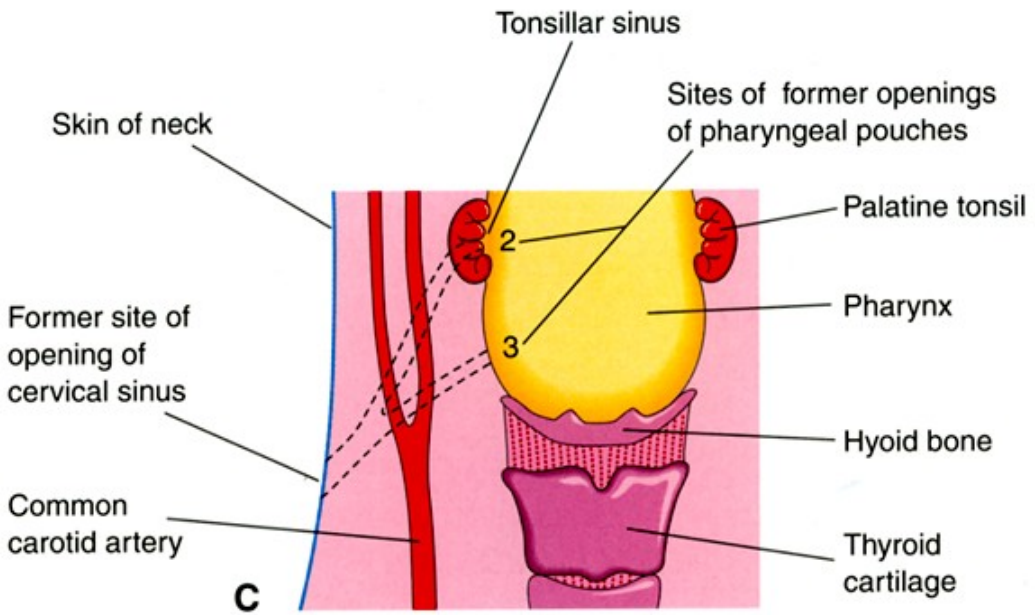
Schematic horizontal sections at the level shown in Figure 10-4/4, illustrating the adult derivatives of the pharyngeal pouches. **A**, 5 weeks. Note that the second pharyngeal arch grows over the third and fourth arches, burying the second to fourth pharyngeal grooves in the cervical sinus. **B**, 6 weeks.

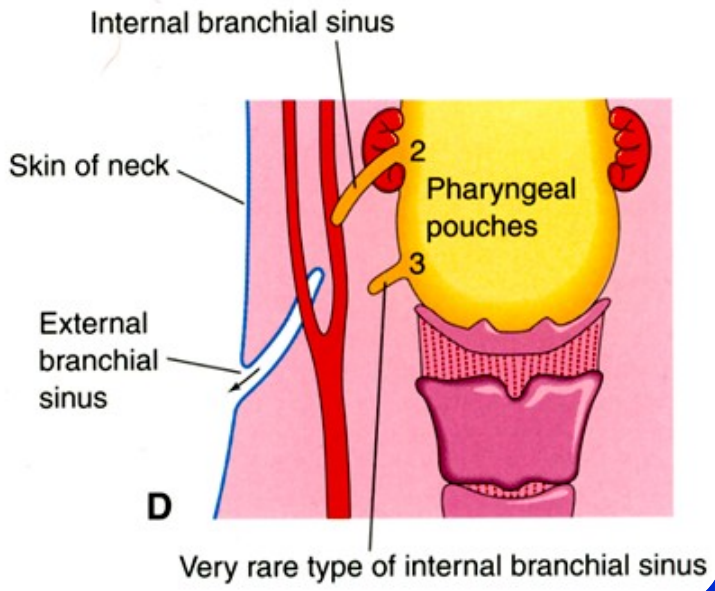


C, 7 weeks. Note the migration of the developing thymus, parathyroid, and thyroid glands into the neck.



Schematic sagittal section of the head, neck, and upper thoracic regions of a 20-week fetus, showing the adult derivatives of the pharyngeal pouches and the descent of the thyroid gland into the neck.

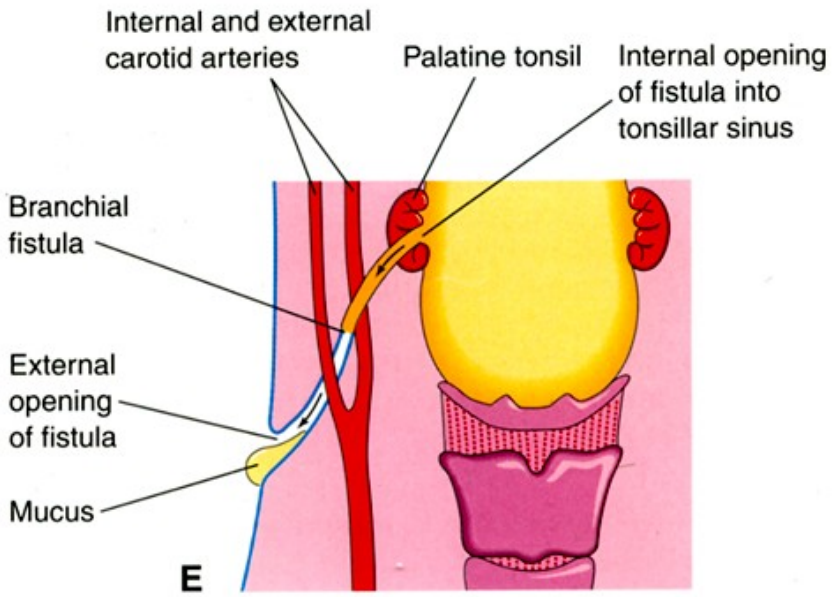


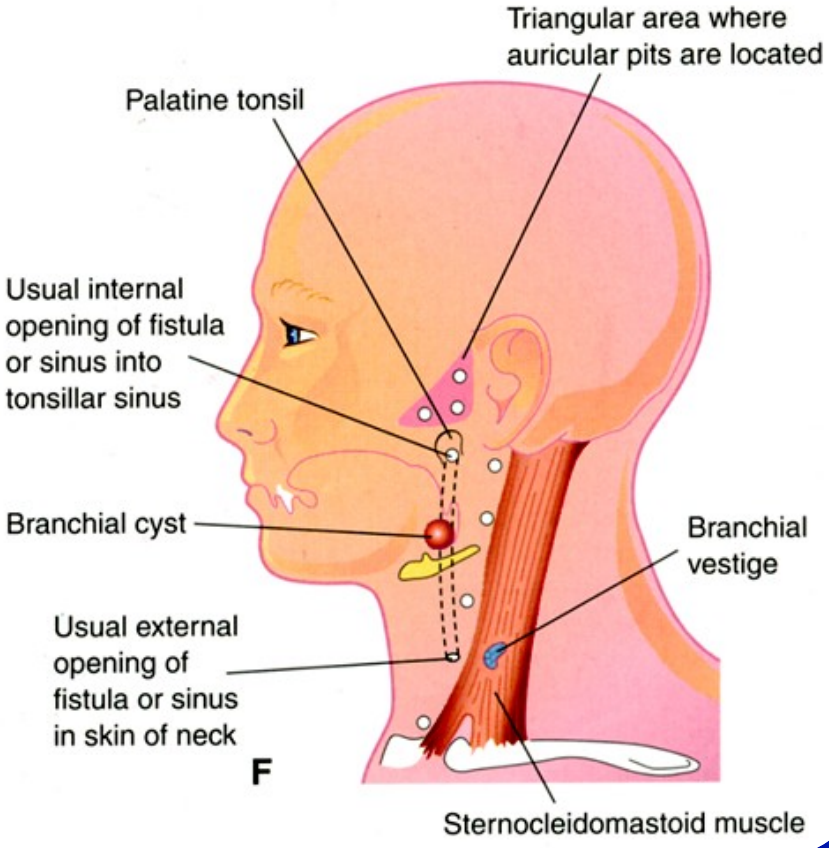


C, Diagrammatic sketch of the adult pharyngeal and neck regions, indicating the former sites of openings of the cervical sinus and pharyngeal pouches. The broken lines indicate possible courses of branchial fistulas.

D, Similar sketch showing the embryological basis of various types of branchial sinus.

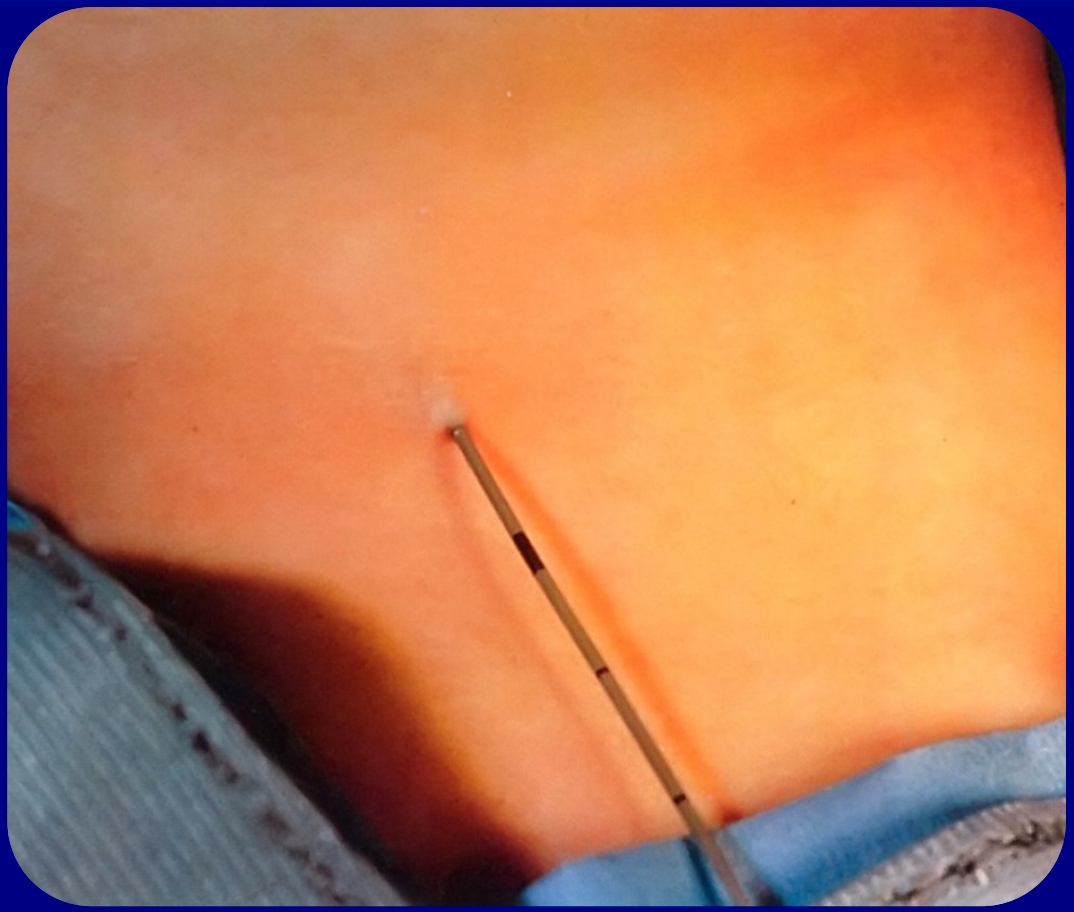
Cysts of the neck





E, Drawing of a branchial fistula resulting from persistence of parts of the second pharyngeal groove and second pharyngeal pouch.

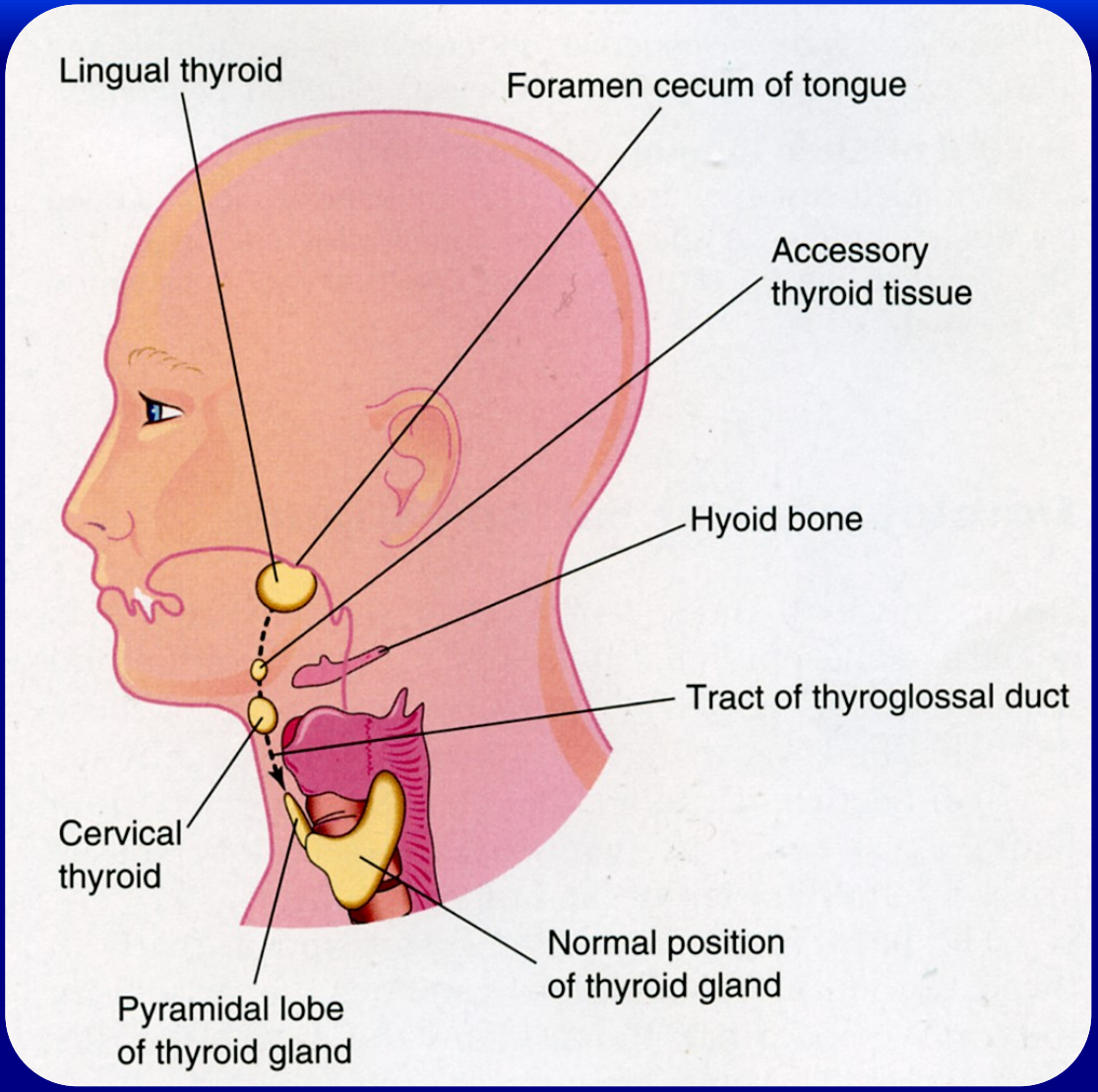
F, Sketch showing possible sites of branchial cysts and openings of branchial sinuses and fistulas. A branchial vestige is also illustrated.



Photograph of a child's neck showing a catheter inserted into the external opening of a branchial sinus. The catheter allows definition of the length of the tract, which facilitates surgical excision.

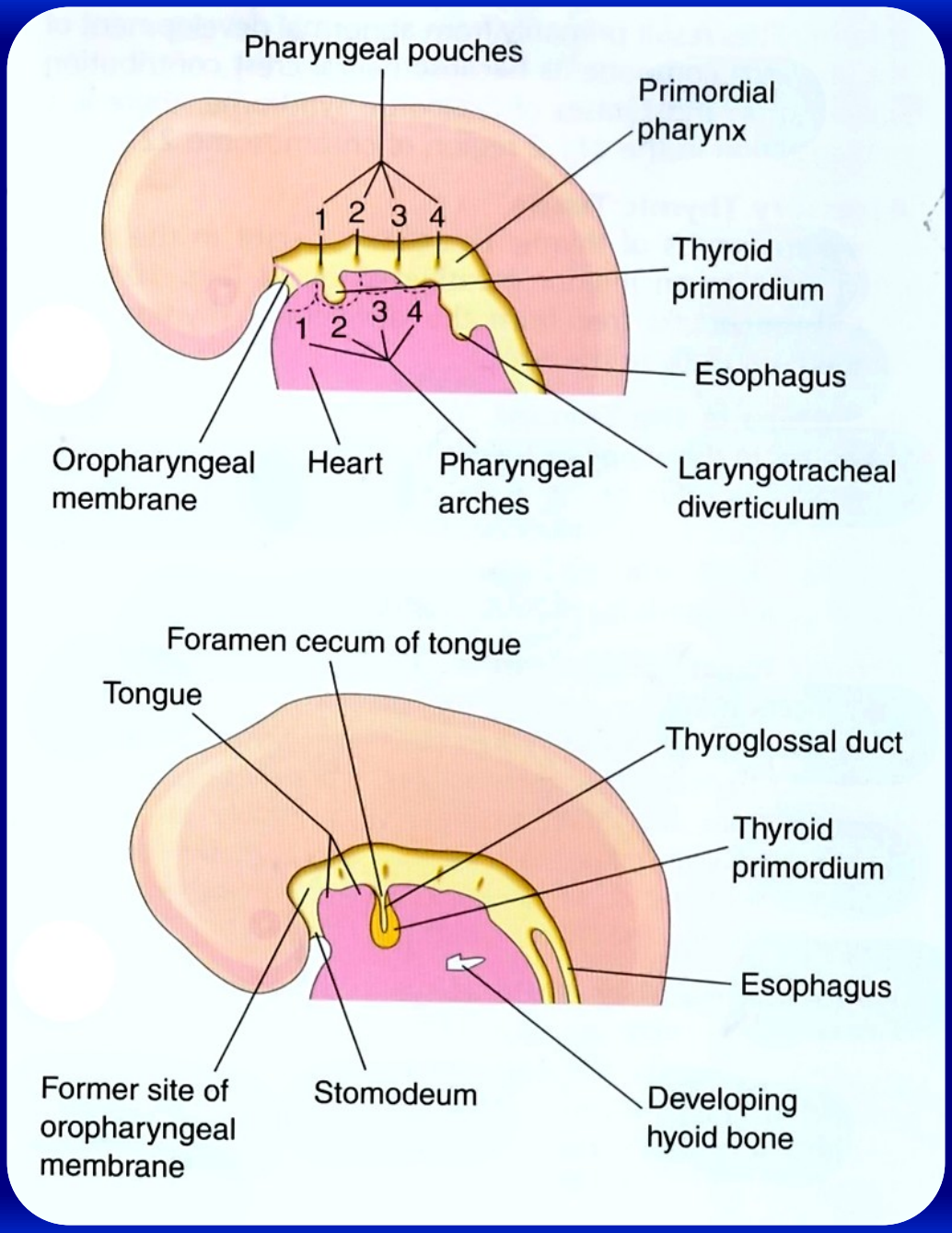
Photograph of a boy showing the swelling in the neck produced by a branchial cyst.

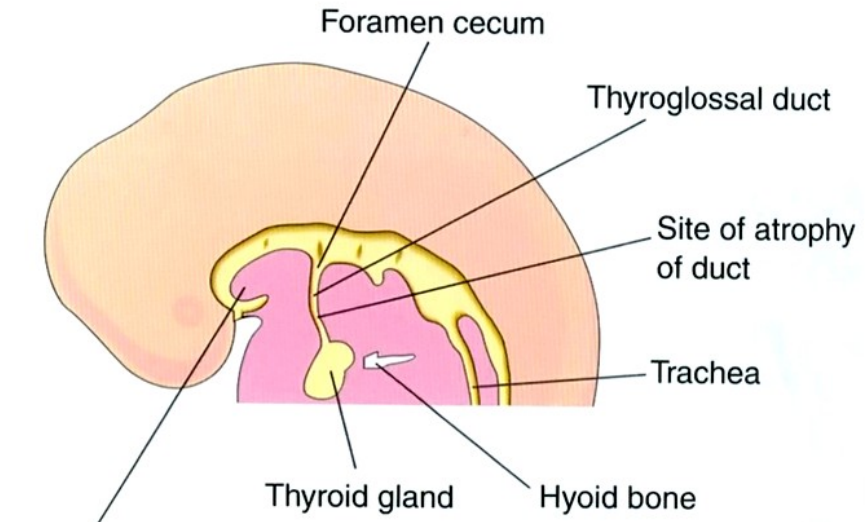
Photograph of an infant with the first arch syndrome, a pattern of anomalies resulting from insufficient migration of neural crest cells into the first pharyngeal arch. Note the following: deformed auricle, preauricular appendage, defect in cheek between the auricle and the mouth, hypoplasia of the mandible, and macrostomia (large mouth).

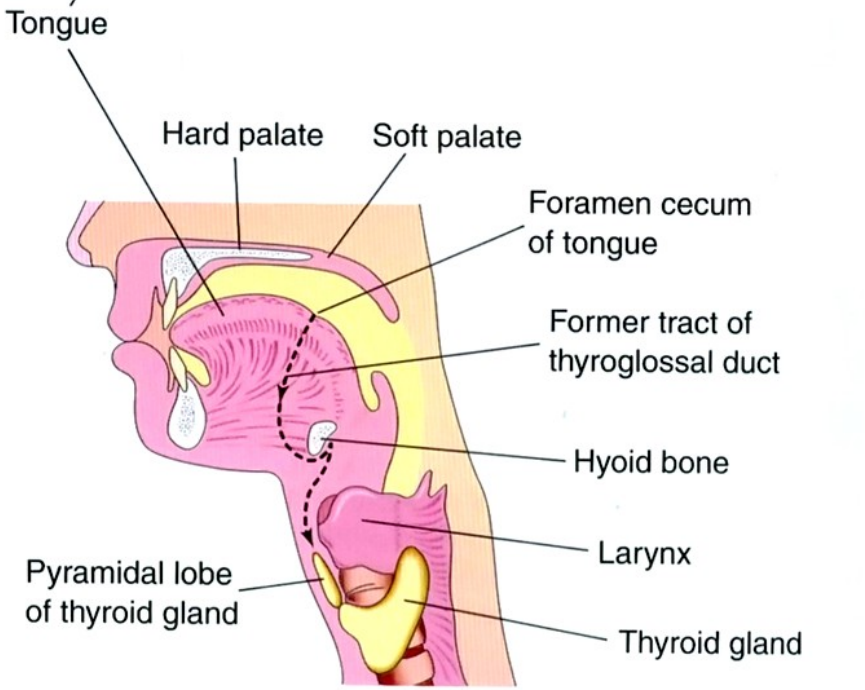


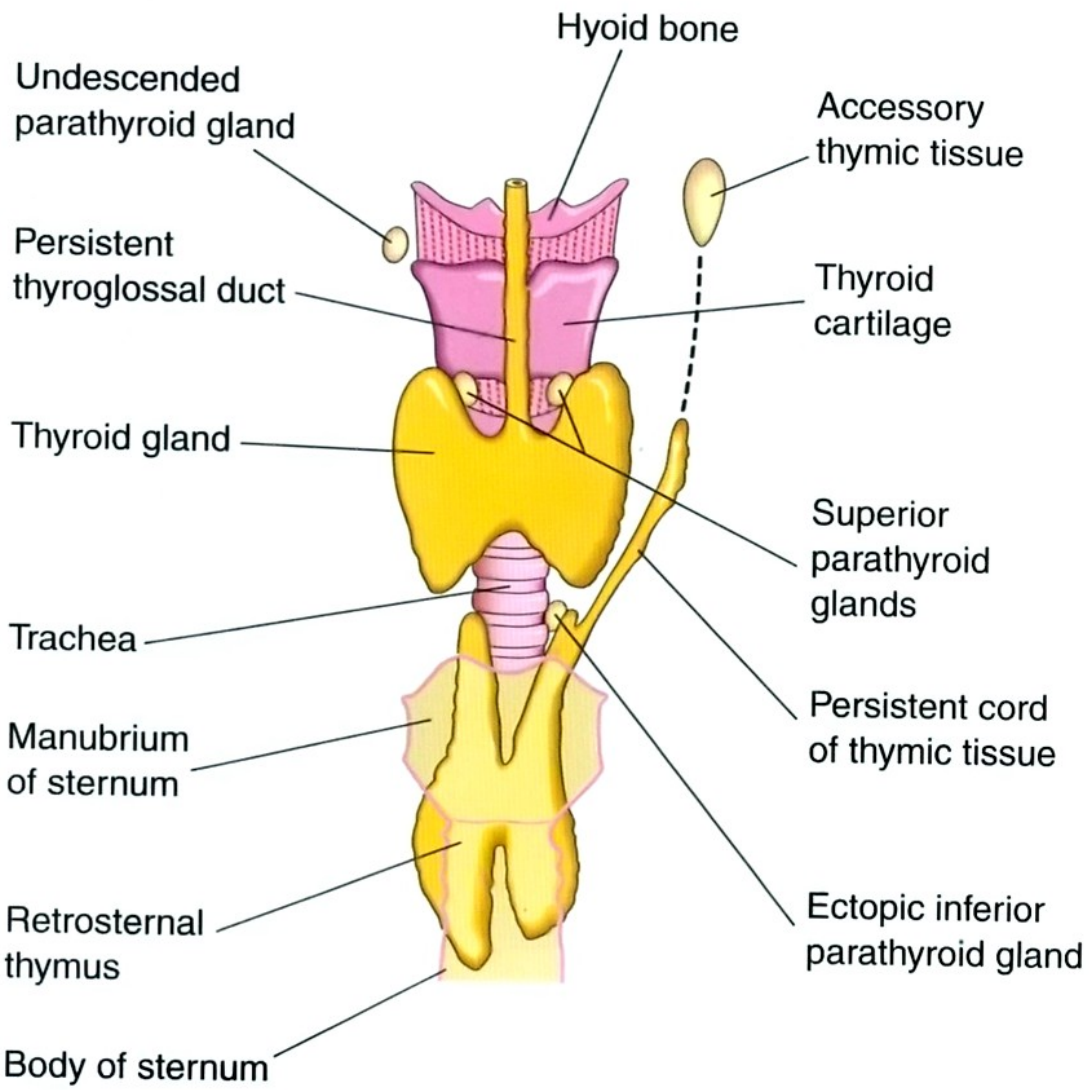
Sketch of the head and neck, showing the usual sites of ectopic thyroid tissue. The broken line indicates the path followed by the thyroid gland during its descent and the former tract of the thyroglossal duct.

Development of thyroid

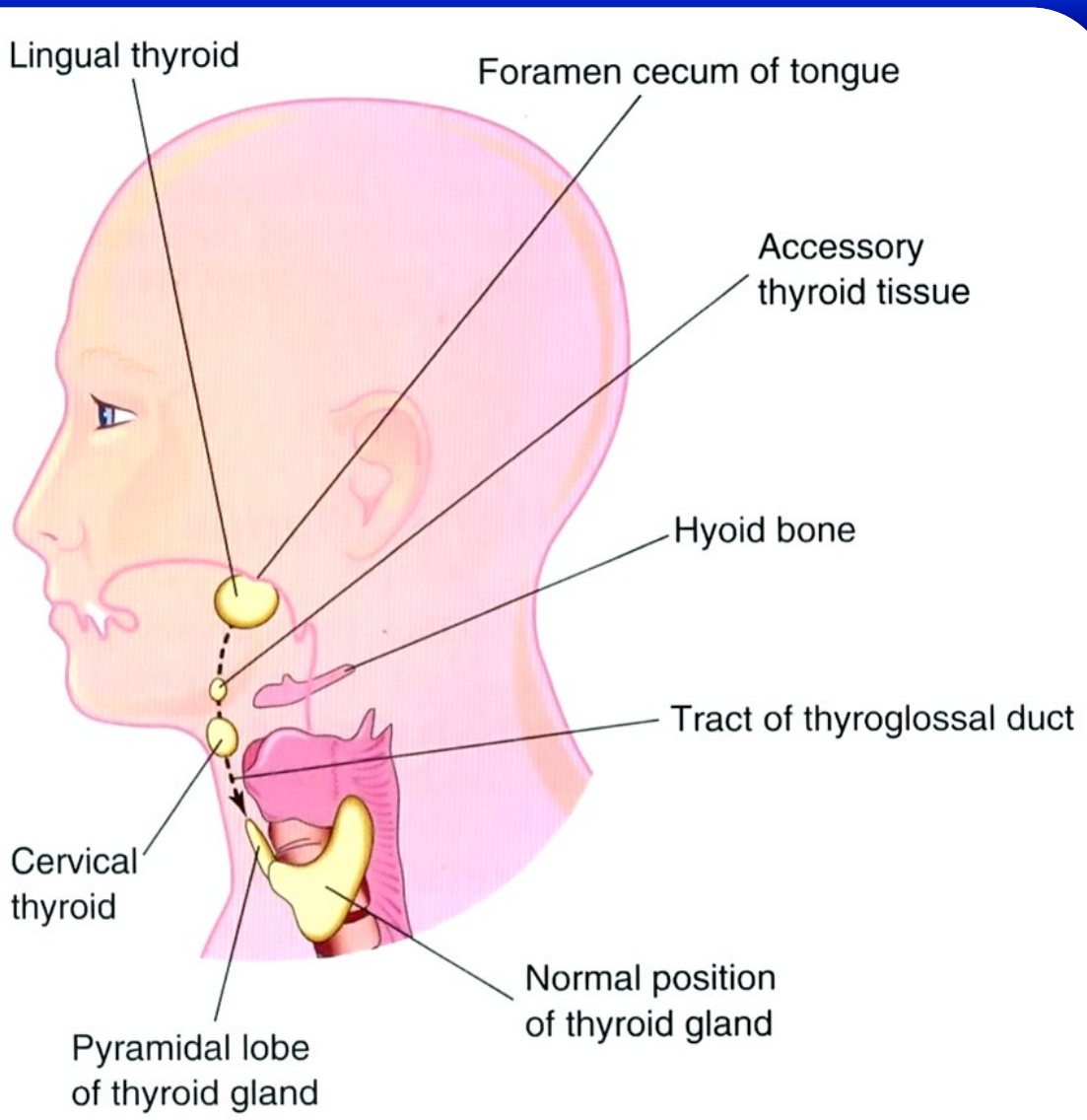

Pharyngeal pouches
Primordial pharynx
1 2 3 4
Thyroid primordium
1 2 3 4
Esophagus
Oropharyngeal membrane
Heart
Pharyngeal arches
Laryngotracheal diverticulum
Foramen cecum of tongue
Tongue
Thyroglossal duct
Thyroid primordium
Esophagus
Former site of oropharyngeal membrane
Stomodeum
Developing hyoid bone


Foramen cecum
Thyroglossal duct
Site of atrophy of duct
Trachea
Thyroid gland
Hyoid bone


Tongue
Hard palate
Soft palate
Foramen cecum of tongue
Former tract of thyroglossal duct
Hyoid bone
Larynx
Pyramidal lobe of thyroid gland
Thyroid gland

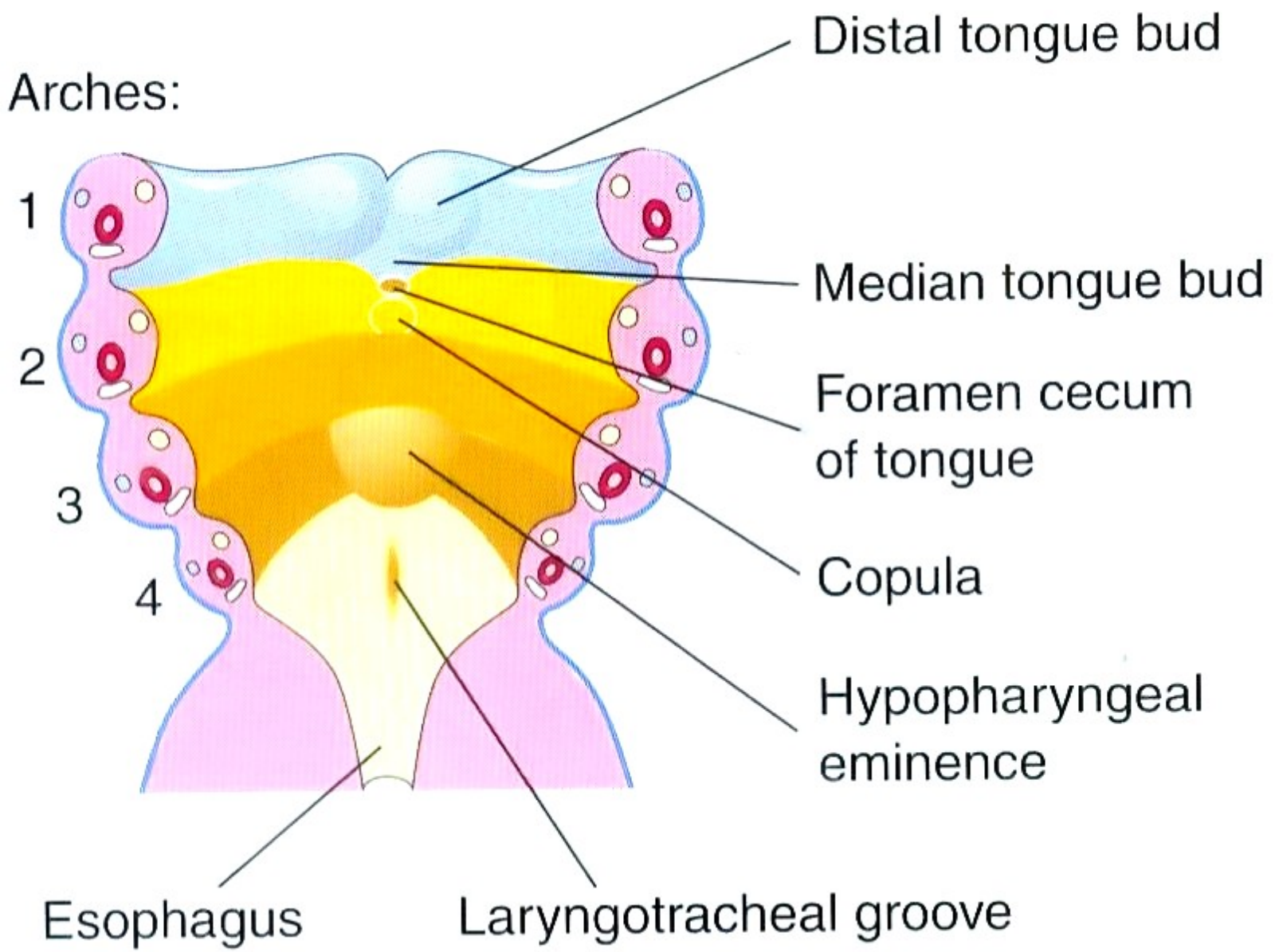


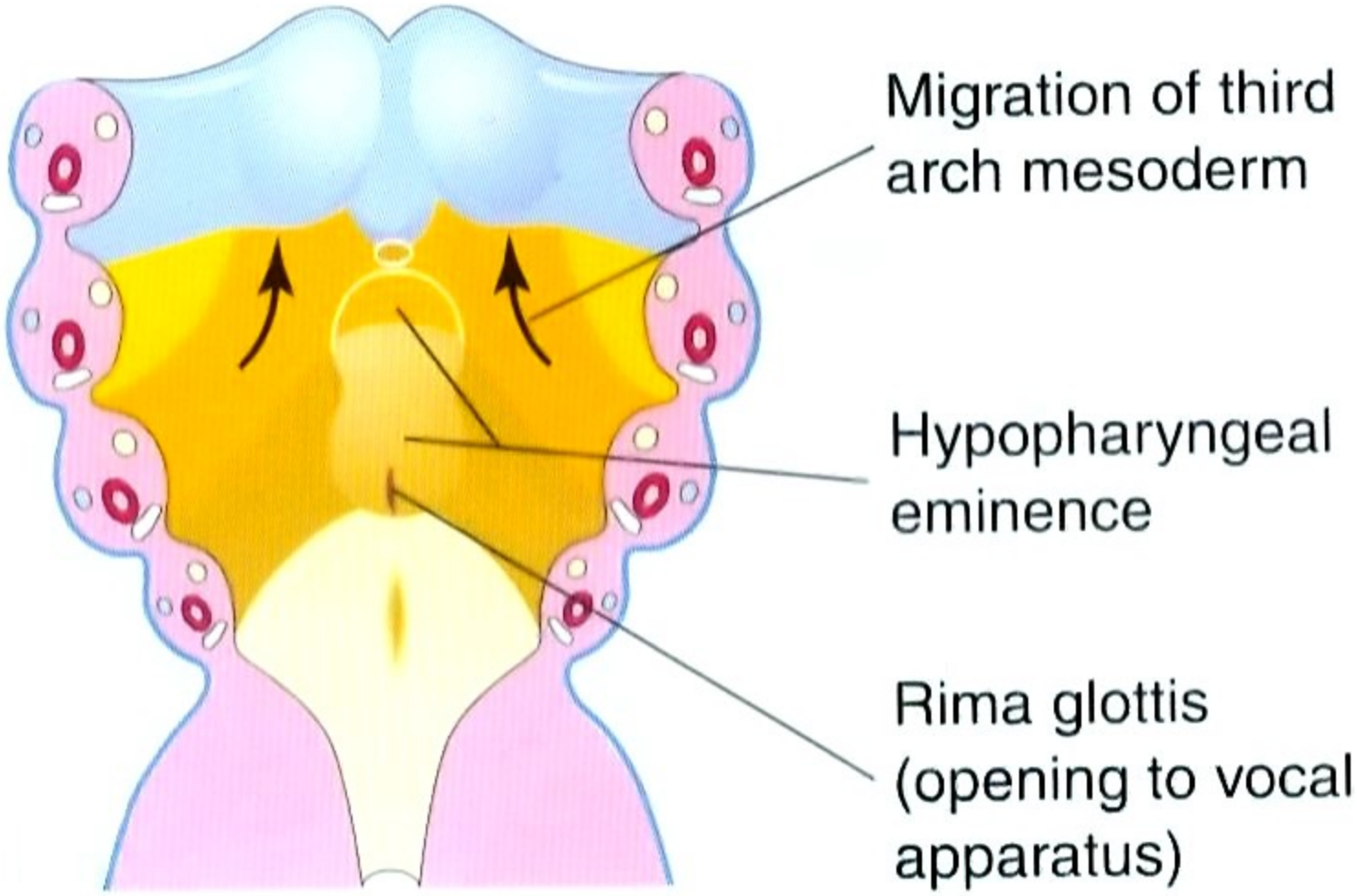
Anterior view of the thyroid gland, thymus, and parathyroid glands, illustrating various congenital anomalies that may occur.

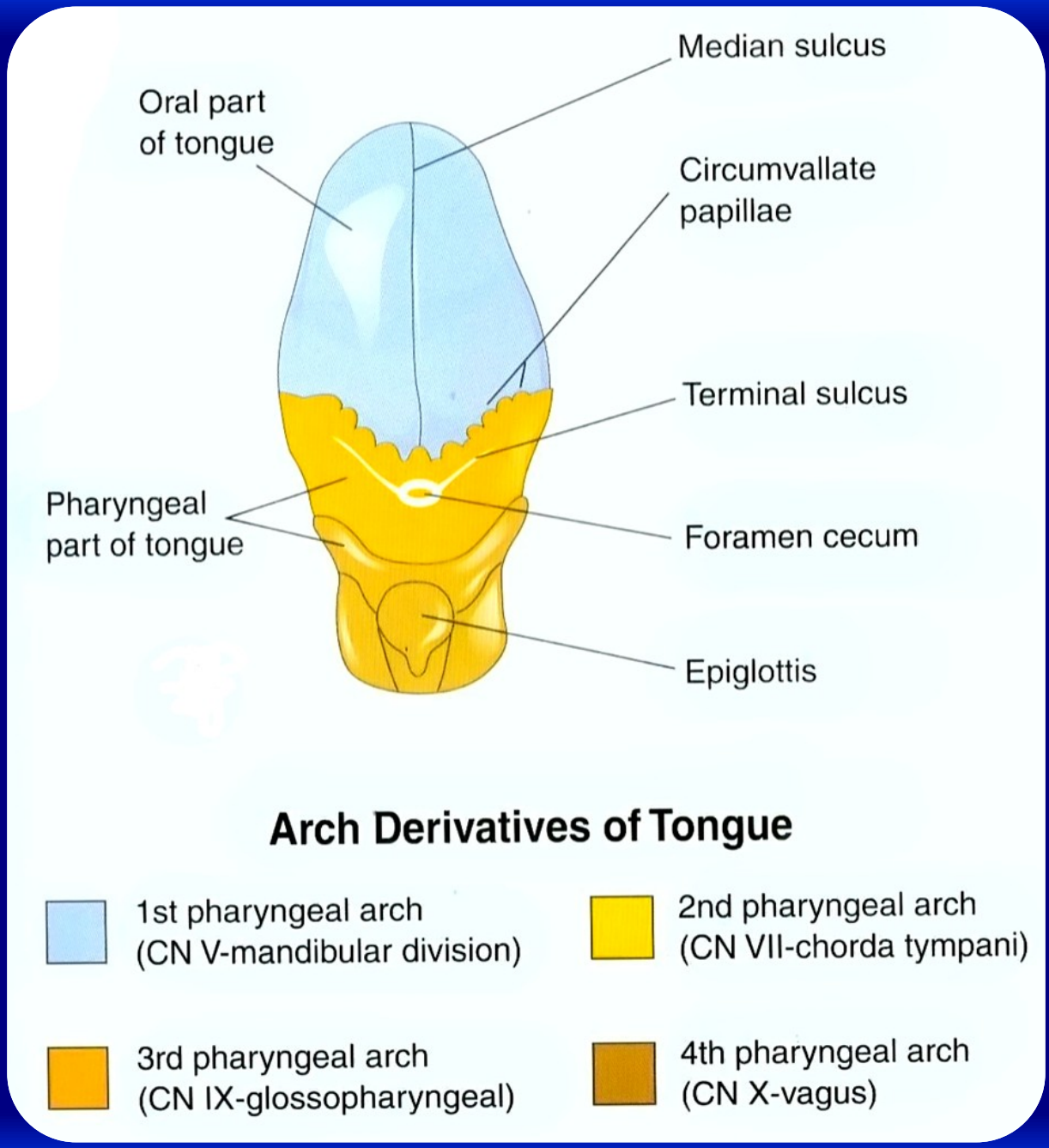


Sketch of the head and neck, showing the usual sites of ectopic thyroid tissue. The *broken line* indicates the path followed by the thyroid gland during its descent and the former tract of the thyroglossal duct.

- Near the end of the fourth week, a median tongue bud arises, soon accompanied by two distal tongue buds (mesenchyme of the first pair of pharyngeal arches).
- Formation of the posterior third of the tongue is indicated by two elevations: copula (from second pair of pharyngeal arches) and the hypobranchial eminence (from third and fourth pairs of arches)


Arches:
1
2
3
4
Distal tongue bud
Median tongue bud
Foramen cecum of tongue
Copula
Hypopharyngeal eminence
Esophagus
Laryngotracheal groove


Migration of third arch mesoderm
Hypopharyngeal eminence
Rima glottis (opening to vocal apparatus)


Median sulcus
Oral part of tongue
Circumvallate papillae
Terminal sulcus
Pharyngeal part of tongue
Foramen cecum
Epiglottis
Arch Derivatives of Tongue
1st pharyngeal arch (CN V-mandibular division)
2nd pharyngeal arch (CN VII-chorda tympani)
3rd pharyngeal arch (CN IX-glossopharyngeal)
4th pharyngeal arch (CN X-vagus)

Development of salivary glands

- parotid glands are first to appear (6th week) from oral endodermal linings near the angles of the stomodeum
- submandibular glands (late in the 6th week) from endodermal buds in the floor of stomodeum
- sublingual glands (8th week) from endodermal epithelial buds in the paralingual sulcus