

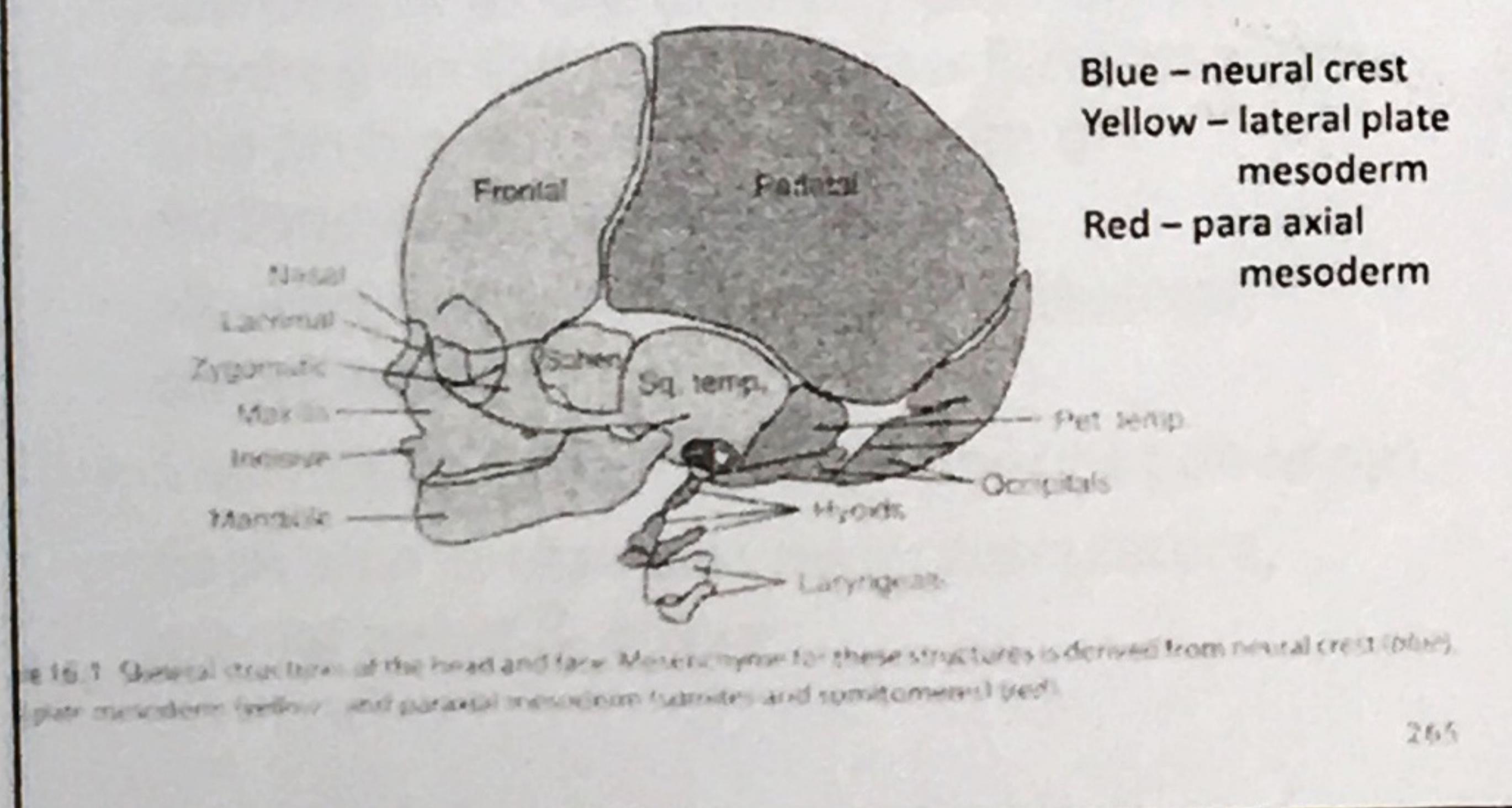
## DEVELOPMENT OF HEAD & NECK

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- Pharyngeal arches
- Pharyngeal pouches
- Pharyngeal clefts
- Development of tongue
- Development of thyroid

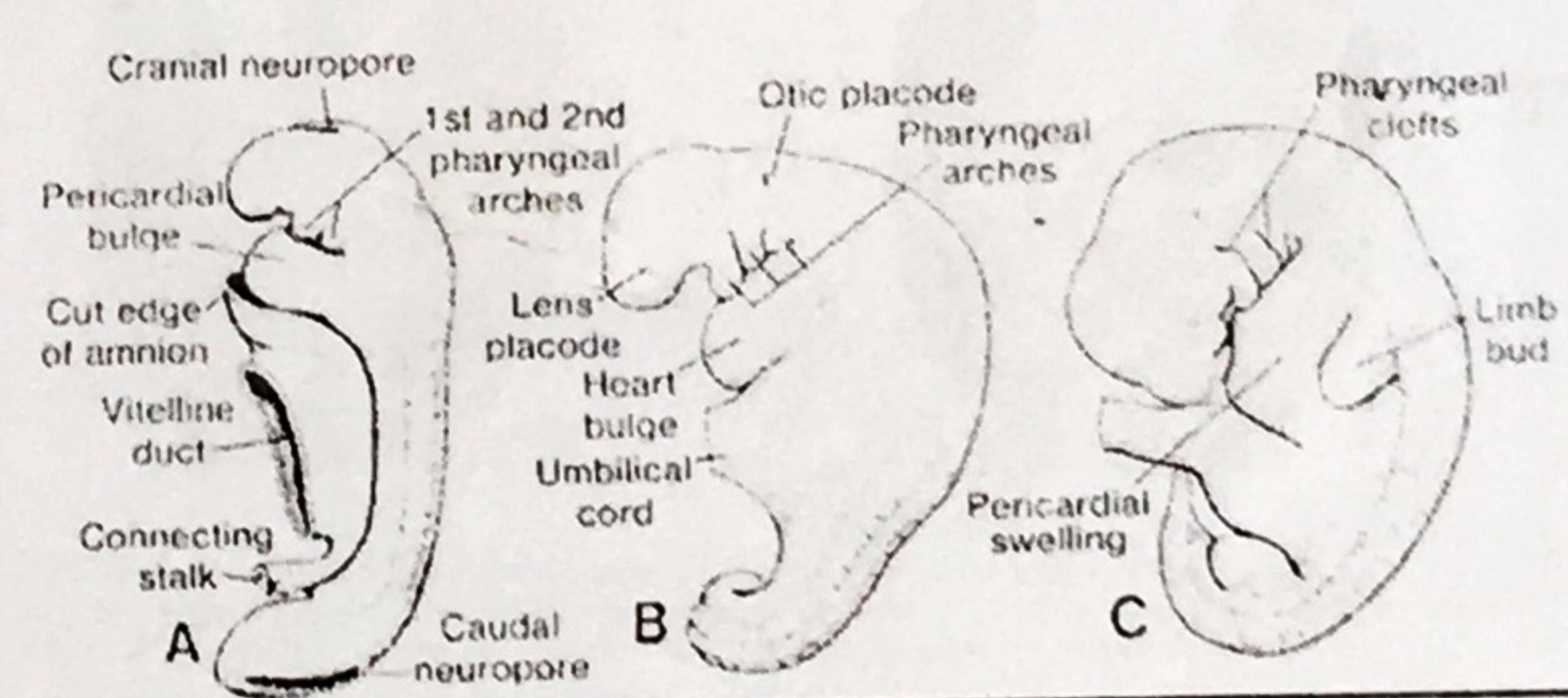
- lateral plate mesoderm
  - Laryngeal cartilages (arytenoid and cricoid)
  - Connective tissue in laryngeal region
- Neural crest
  - Front & midfacial and pharyngeal arch skeletal structures
- Ectoderm
  - all other tissues in these regions, including cartilage, bone, dentin, tendon, dermis, pia and arachnoid, sensory neurons, and glandular stroma
  - With neural crest it form neurons of the 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> cranial sensory ganglia

## DEVELOPMENT OF HEAD & NECK



## WHAT STRUCTURES FORM HEAD & NECK?

- Pharyngeal arches
- Pharyngeal pouches
- Pharyngeal clefts



### • WHAT GERM CELL LAYERS FORM HEAD & NECK?

- Head region develops from
  - Mesoderm – paraxial and lateral plate mesoderm
  - Neural crest
  - Ectoderm – ectodermal placodes (thickened regions)
- Paraxial mesoderm (somites and somitomeres)
  - Forms the floor of the skull & small portion of the occipital region
  - All voluntary muscles of the craniofacial region
  - Dermis and connective tissues in the post. region of the head
  - Meninges caudal to the prosencephalon

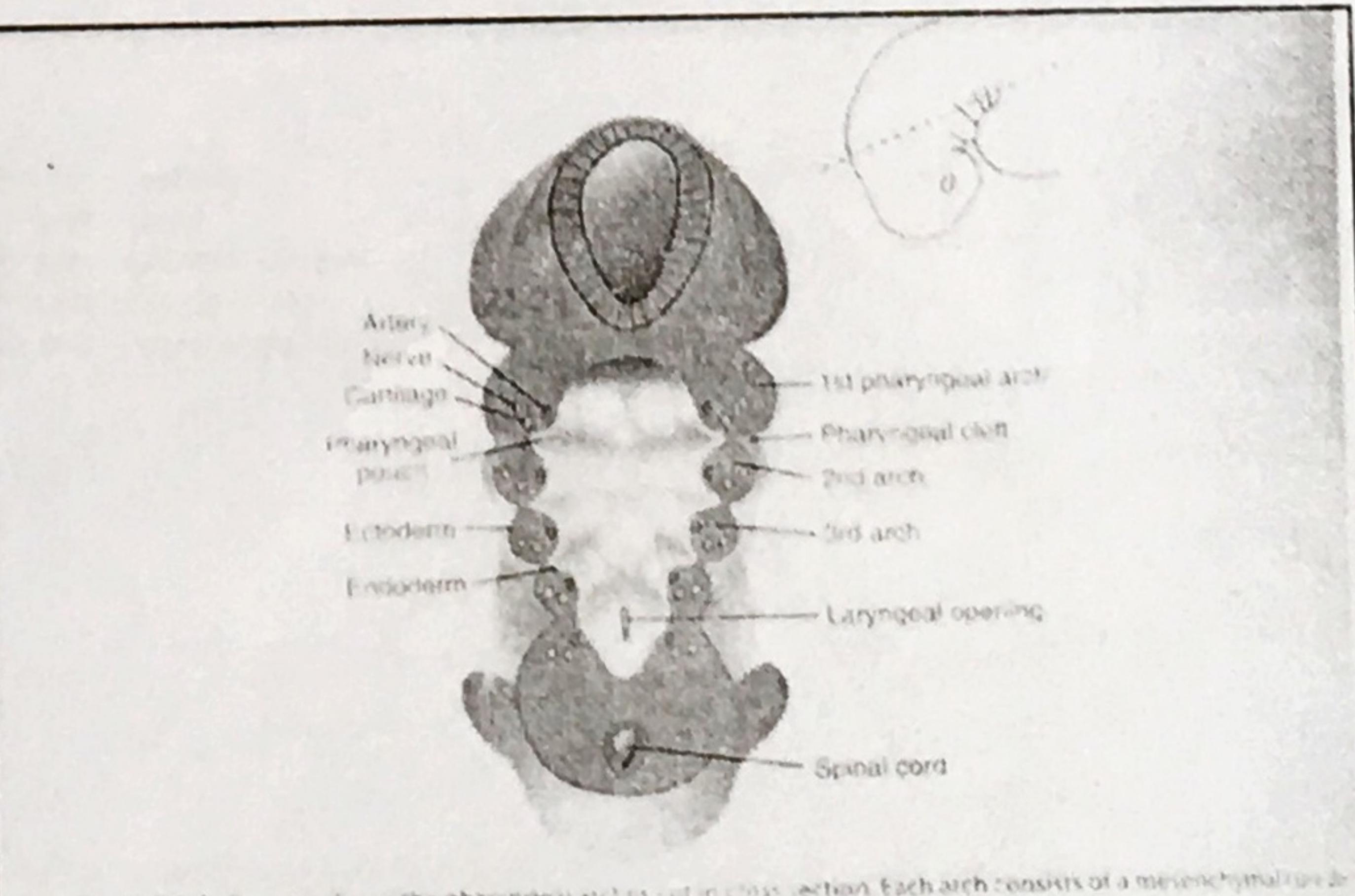


Figure 16.6 Drawing shows the pharyngeal arches cut in cross section. Each arch consists of a mesenchymal core derived from mesoderm and neural crest cells and is lined internally by endoderm and externally by ectoderm. Each arch also contains an artery (one of the aortic arches), and a cranial nerve and each will constitute specific skeletal muscular components to the head and neck. Between the arches are pouches on the inner surface and clefts externally.

### Pharyngeal arches, pouches & clefts

- These are comparable to the gills found in fish
- They form face & neck
- At the end of 4<sup>th</sup> week, stomodeum (future mouth) is surrounded by the first pair of pharyngeal arches
- At 42 days 5 prominences (some parts of pharyngeal arches) appear around stomodeum
  - 2 X mandibular prominences
  - 2 X maxillary prominences
  - Frontonasal prominence

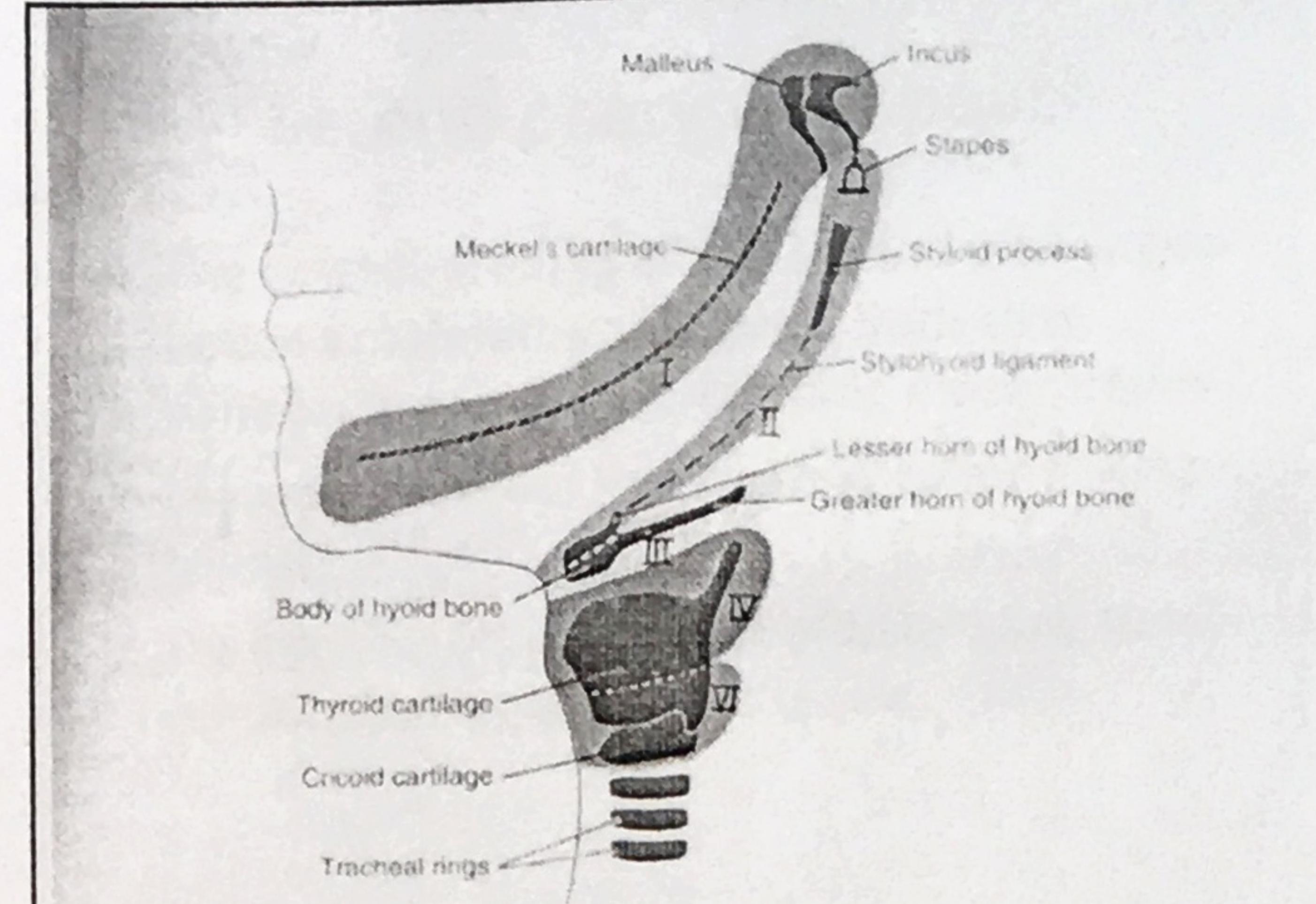


Figure 16.9 Definitive structures formed by the cartilaginous components of the various pharyngeal arches

### Pharyngeal arches

- Consists of a core of mesenchymal tissue covered on the outside by surface ectoderm and on the inside by epithelium of endodermal origin
- Neural crest cells contribute to skeletal components of the face
- 5 arches (1 – 6 but 5<sup>th</sup> arch does not develop)
- Each arch contains its own musculature, cranial nerve & artery

### Pharyngeal arches

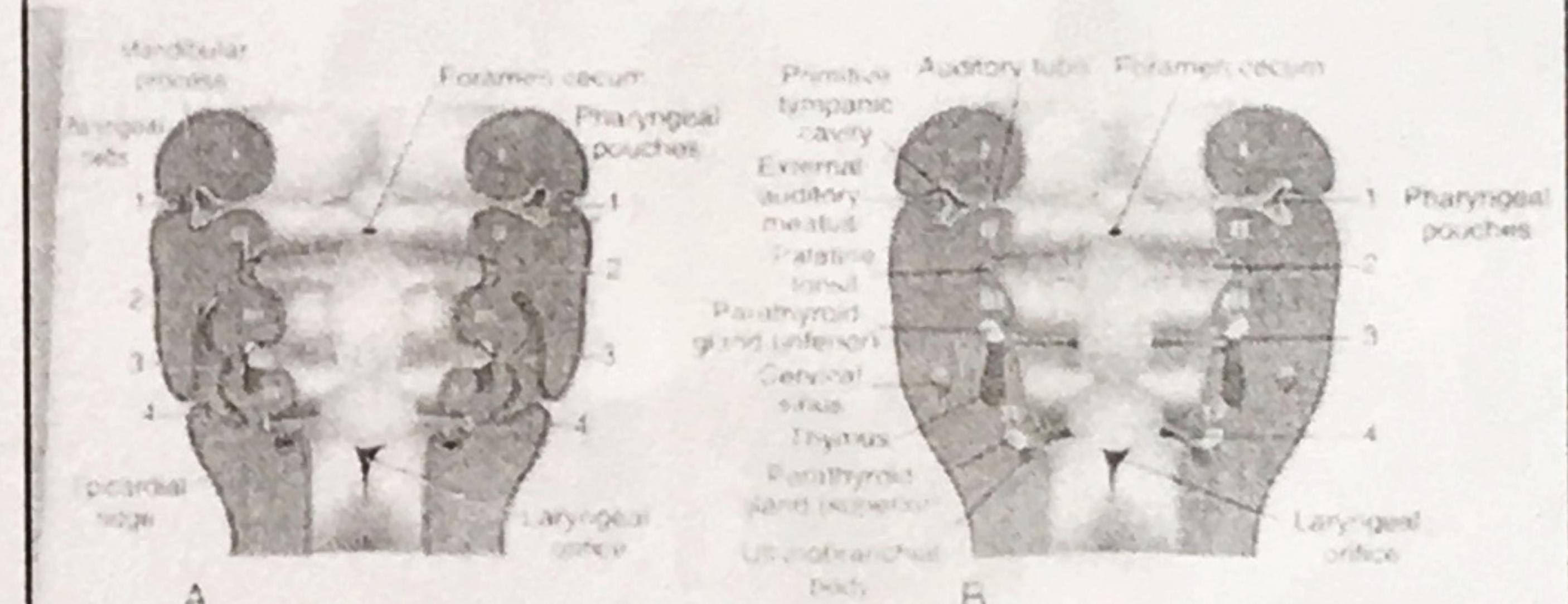


Figure 16.10 A. Development of the pharyngeal clefts and pouches. The second arch grows over the first and fourth arches, burying the second, third, and fourth pharyngeal clefts. B. Remnants of the second, third, and fourth pharyngeal pouches form the cervical sinus, which is normally obliterated. Note the structures formed by the various pharyngeal pouches.

### Pharyngeal arches

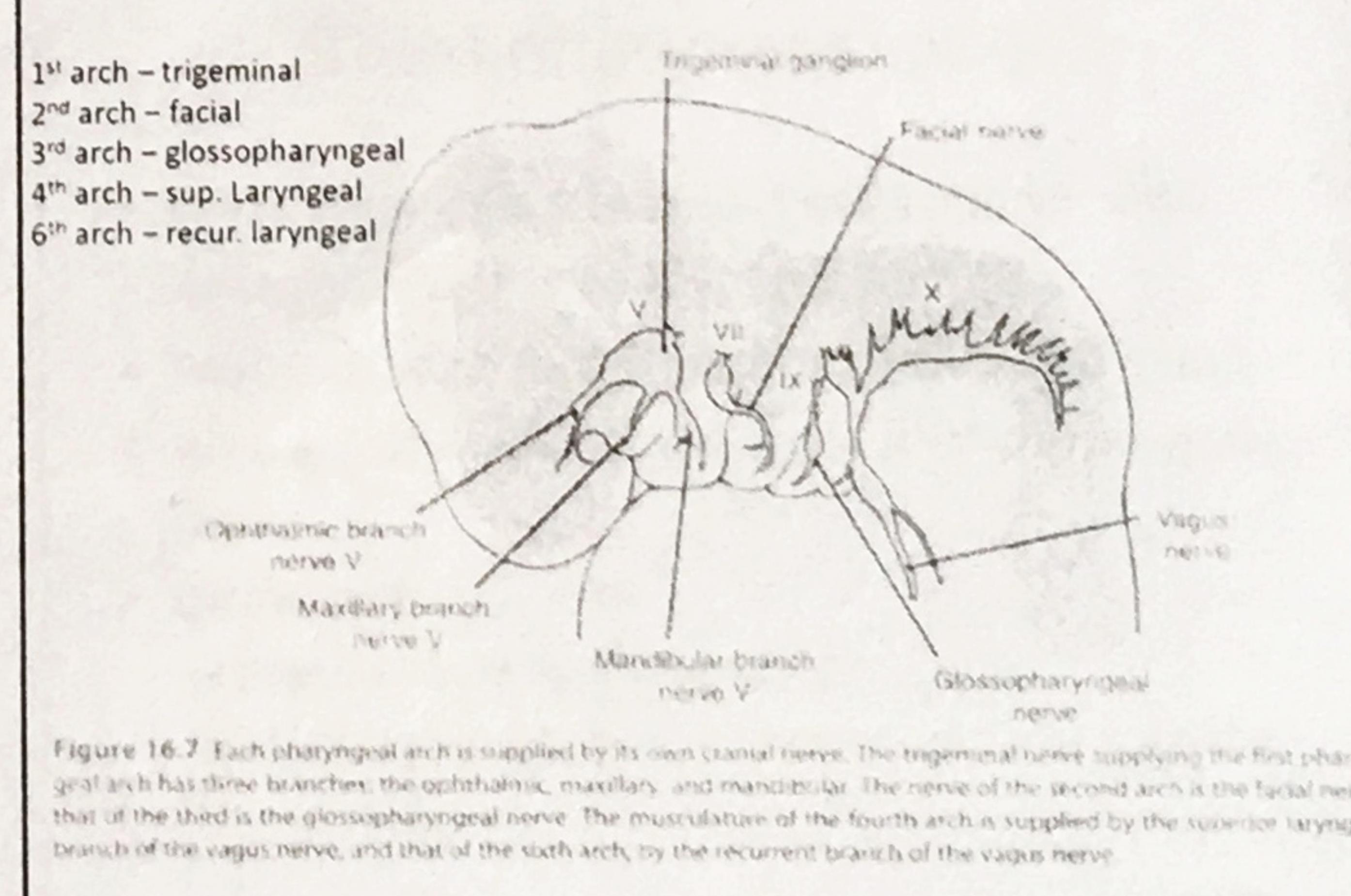
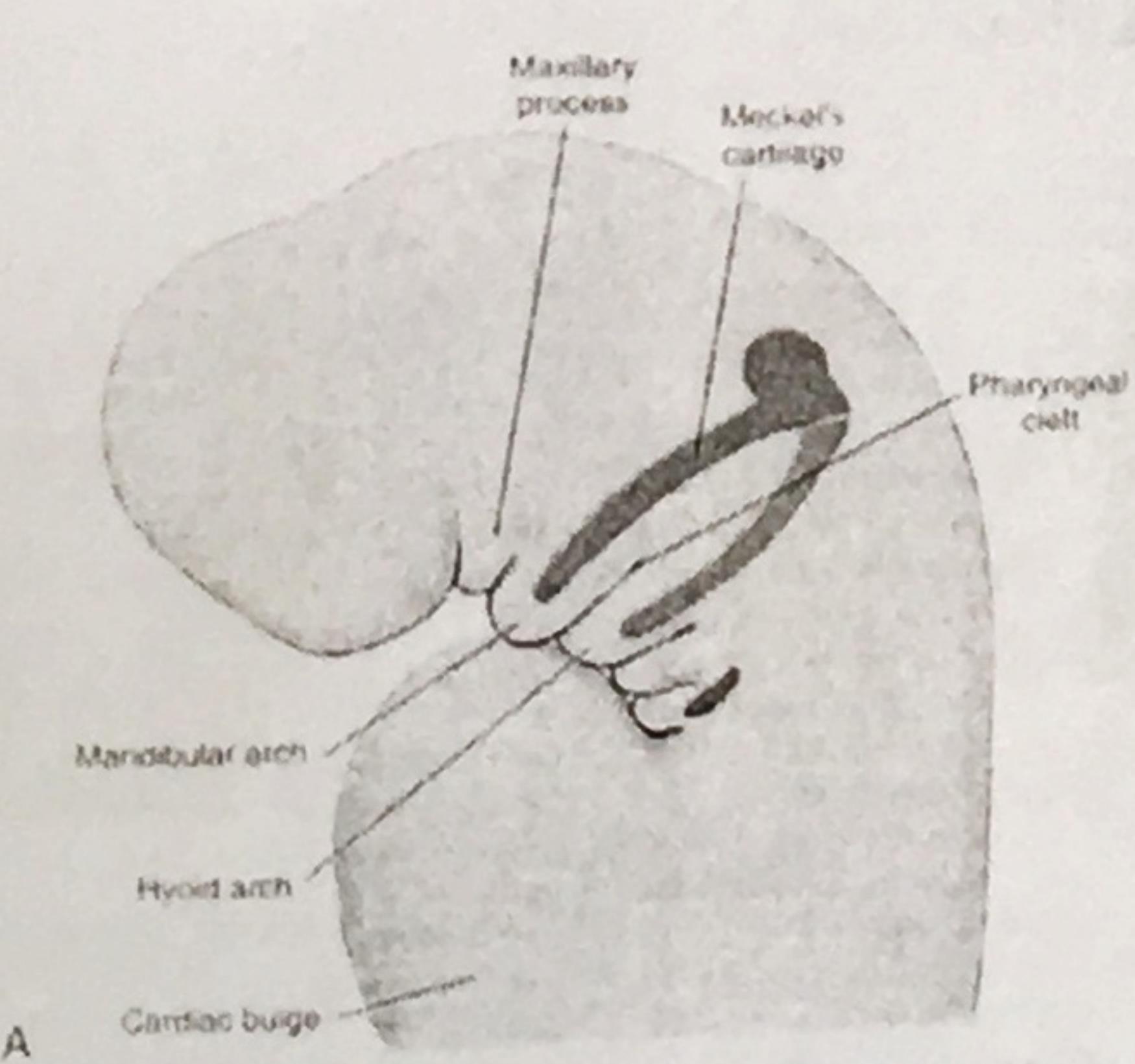


Figure 16.7 Each pharyngeal arch is supplied by its own cranial nerve. The trigeminal nerve supplying the first pharyngeal arch has three branches, the ophthalmic, maxillary, and mandibular. The nerve of the second arch is the facial nerve, that of the third is the glossopharyngeal nerve. The musculature 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.

## Pharyngeal pouches

- Pharyngeal pouch develops between two consecutive pharyngeal arches. Therefore 6 pharyngeal arches mean 5 pouches, but 5<sup>th</sup> is atypical & considered as part of 4<sup>th</sup> pouch. (4 pairs of pouches)

## Second pharyngeal pouch

- The epithelial lining of the second pharyngeal pouch proliferates and forms buds that penetrate into the surrounding mesenchyme
- Mesoderm enters into the bud to form platian tonsils
- During 3<sup>rd</sup> – 5<sup>th</sup> months, the developing tonsil is infiltrated by lymphatic tissue

## First pharyngeal pouch

- Forms the tubotympanic recess
- Comes to contact with the epithelial lining of the first pharyngeal cleft
- Distal part of the pouch expands & forms the developing middle ear cavity
- Proximal end of the pouch forms the pharyngo-tympanic tube (auditory tube)

## Second pharyngeal pouch

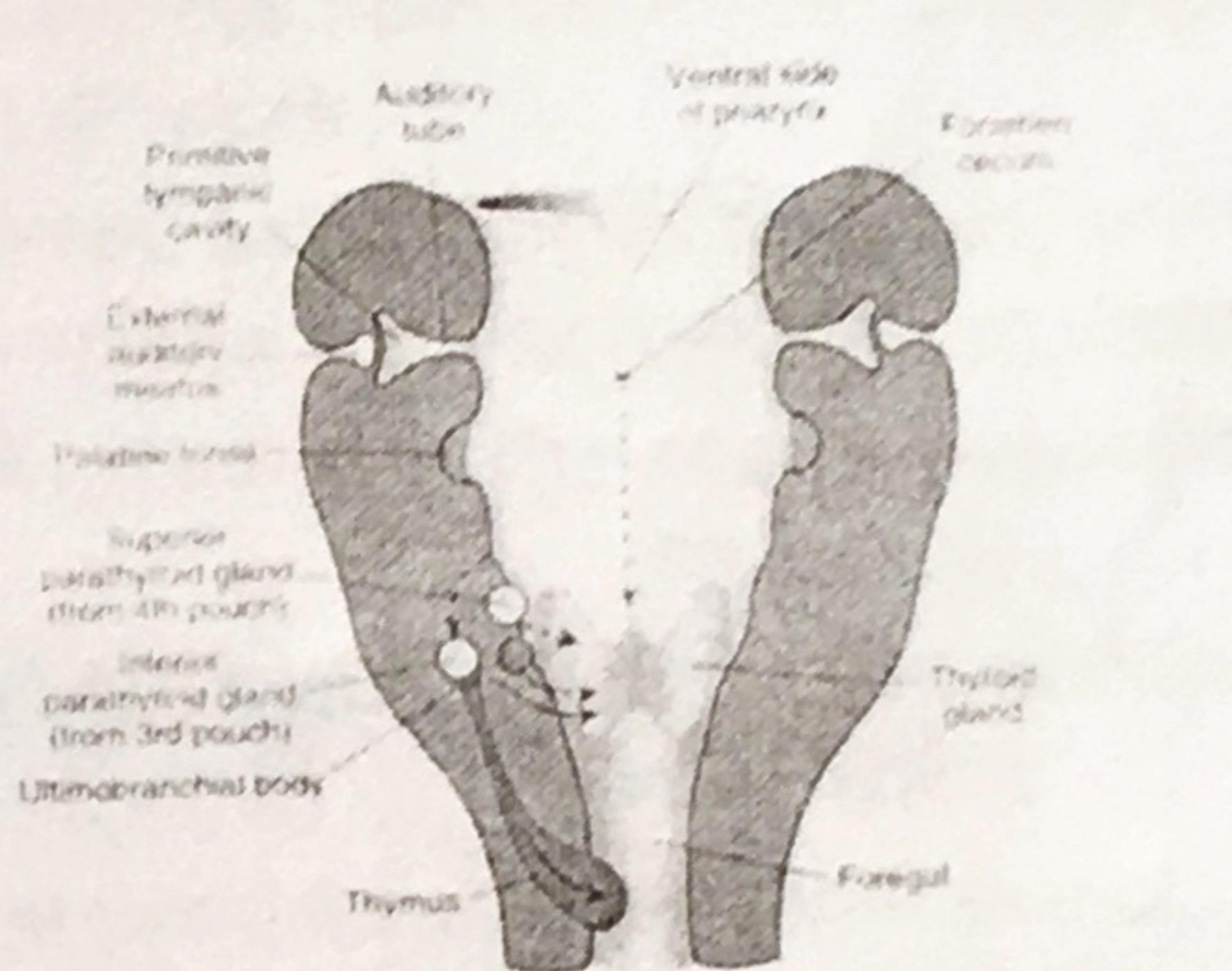


Figure 16.11 Migration of the thymus, parathyroid glands, and ultimobranchial body. The thymus gland originates in the migrate at the level of the foramen cecum and descends to the level of the first tracheal ring.

## Pharyngeal pouches

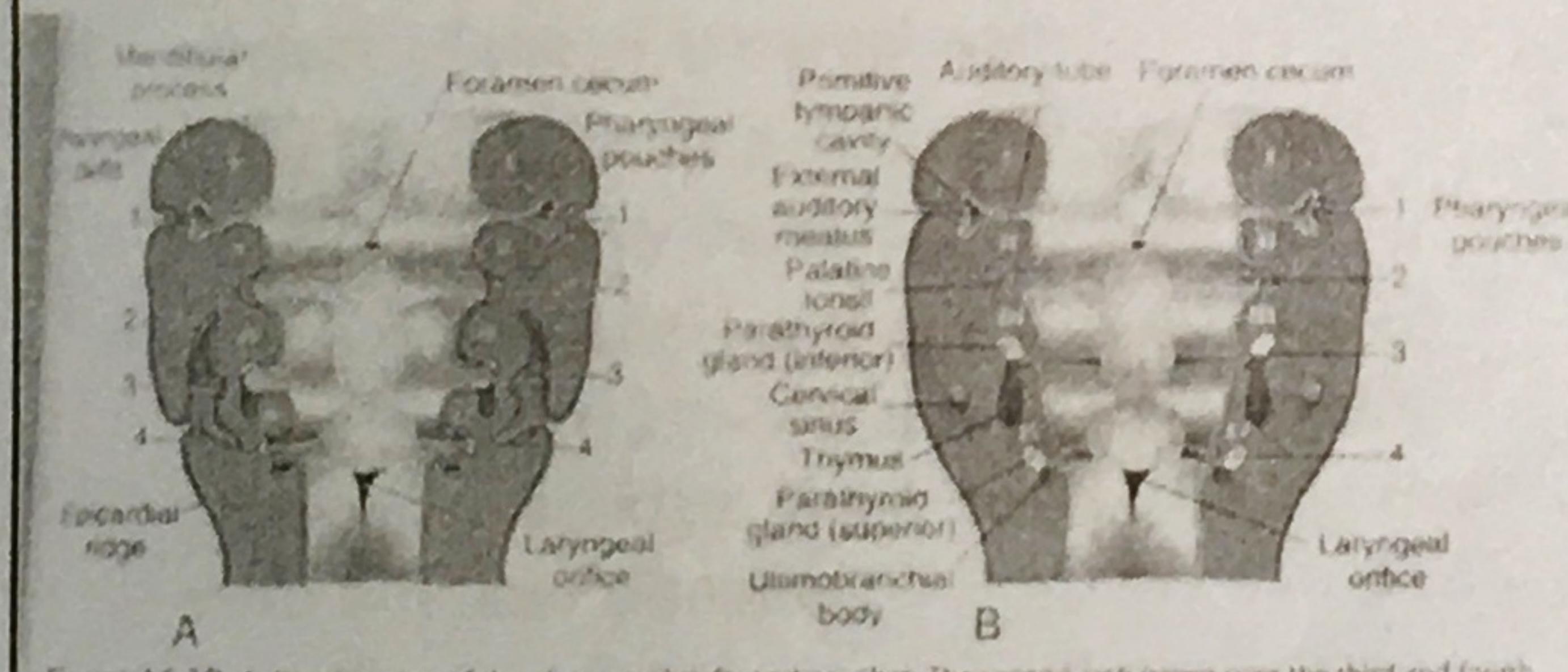


Figure 16.10 A: Development of the pharyngeal clefts and pouches. The second arch grows over the third and fourth arches, bypassing the second, third, and fourth pharyngeal clefts. B: Remnants of the second, third, and fourth pharyngeal clefts from the cervical sinus, which is normally obliterated. Note the structures formed by the various pharyngeal pouches.

## Third pharyngeal pouch

- It has anterior & posterior wings (expansions)
- Anterior wing forms thymus gland
- Posterior wing forms inferior parathyroid gland
- Both glands move downwards & thymus migrate faster
- Ultimately
  - Thymus lies in sup. Mediastinum
  - Inf. Para thyroid gland lies posterior to thyroid gland

**TABLE 16.2 Derivatives of the Pharyngeal Pouches**

Pharyngeal Pouch	Derivatives
1	Tympanic (middle ear) cavity Auditory (eustachian) tube
2	Palatine tonsils Tonsillar fossa
3	Inferior parathyroid gland Thymus
4	Ultimobranchial body (parafollicular [C] cells of the thyroid gland)

## Pharyngeal Clefts

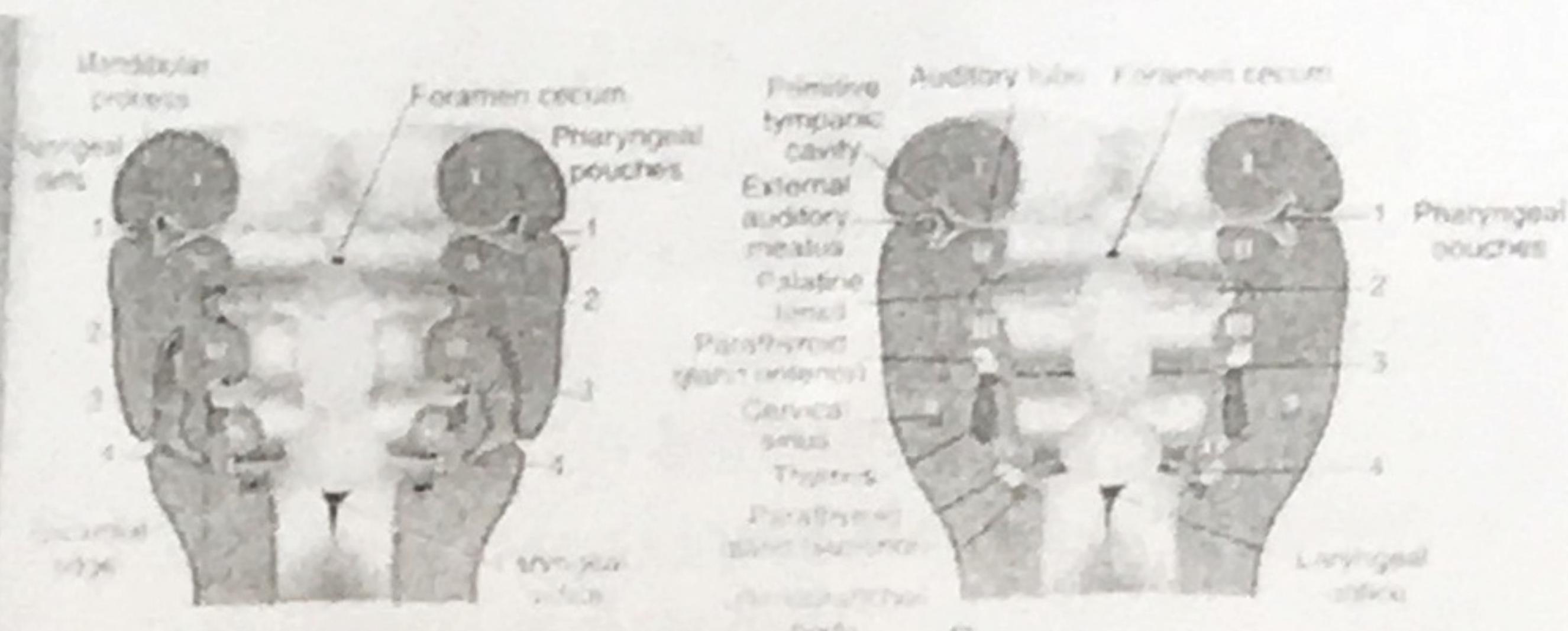


Figure 16.10 A. Development of the pharyngeal clefts and pouches. The second arch grows over the third and fourth pouches, burying the second, third, and fourth pharyngeal clefts. B. Remnants of the second, third, and fourth pharyngeal clefts form the cervical sinus, which is normally obliterated. Note the structures formed by the various pharyngeal pouches.

### Fourth pharyngeal pouch

- It has anterior & posterior wings (expansions)
- Anterior wing (5<sup>th</sup> pharyngeal pouch incorporated into 4<sup>th</sup> pouch) forms ultimobranchial body
- Posterior wing forms superior parathyroid gland
- Both structures move downwards
- Superior parathyroid gland lies embedded in upper posterior part of the thyroid gland
- Ultimobranchial body incorporated into the thyroid gland to form parafollicular cells (secrete calcitonin)

### Development of the tongue

- Tongue develops from the 1<sup>st</sup> – 4<sup>th</sup> pharyngeal arches at 4<sup>th</sup> week
- 1<sup>st</sup> arch – two lateral (lingual swellings) and one medial swelling (tuberculum impar)
- 2<sup>nd</sup>, 3<sup>rd</sup> & part of 4<sup>th</sup> arch – copula (hypobranchial eminence)
- Post. Part of 4<sup>th</sup> arch – third median swelling forms epiglottis
- Arytenoid swellings situated either side of laryngeal opening

### Pharyngeal Clefts

- At 5<sup>th</sup> week 4 clefts appear in the outer surface of the pharyngeal wall
- Only 1<sup>st</sup> cleft forms definitive structure – external auditory meatus
- Active proliferation of tissues from 2<sup>nd</sup> arch, grows over the 2<sup>nd</sup> – 4<sup>th</sup> clefts and joins with the epicardial ridge. These clefts from cervical sinus but later disappear

### Development of the tongue

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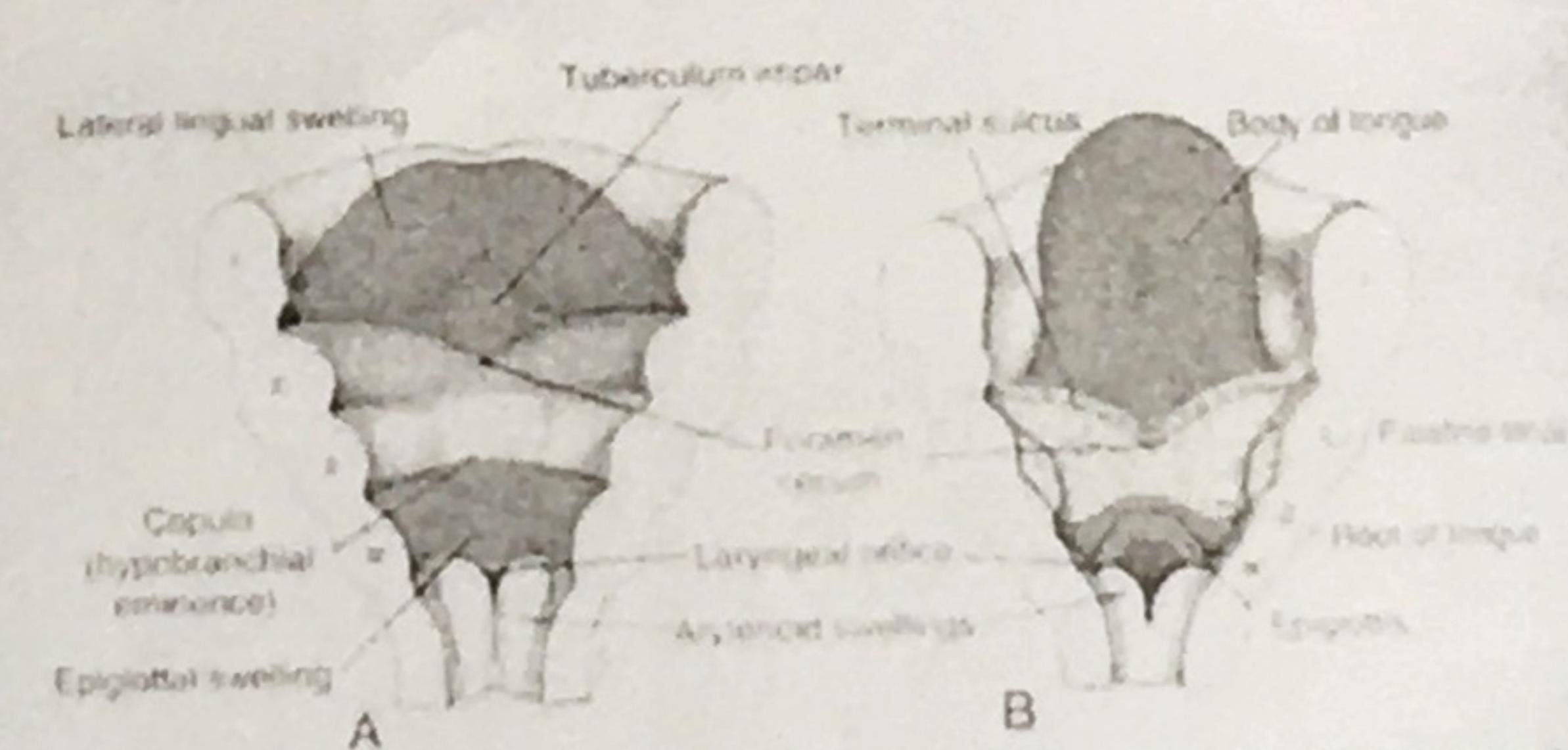


Figure 16.17 Ventral portion of the pharyngeal arches seen from above showing development of the tongue. A to B the cut pharyngeal arches. A. 5 weeks (6 mm). B. 5 months. Note the foramen cecum, site of origin of the thyroïd postero.

### Development of the tongue

- Two lateral lingual swellings increase in size, & overgrow the tuberculum impar to form the anterior two-thirds of the tongue
- The part that develop from 3<sup>rd</sup> arch overgrows 2<sup>nd</sup> & 4<sup>th</sup> arches to form posterior one-thirds
- Junction between ant. 2/3 & post. 1/3 is marked by terminal sulcus (sulcus terminalis)

### Development of thyroid gland

- Develops as an epithelial proliferation in the floor of the pharynx
- It develops between tuberculum impar and copula (later indicated by the foramen cecum)
- It descends in front of the pharyngeal gut as a diverticulum (as 2 lobes)
- Thyroid is connected to tongue by a narrow canal (thyroglossal duct)

### Innervation of the tongue

- General sensory
  - Ant. 2/3 of tongue - mandibular branch of the trigeminal nerve (1<sup>st</sup> arch nerve)
  - Post. 1/3 of tongue - glossopharyngeal nerve (3<sup>rd</sup> arch nerve)
  - epiglottis and extreme posterior part of the tongue – superior laryngeal nerve branch of vagus nerve (4<sup>th</sup> arch nerve)

### Development of thyroid gland

- Thyroid gland descends in front of the hyoid bone & laryngeal cartilages
- reaches its permanent position anterior to upper trachea by 7<sup>th</sup> week
- Secretes thyroid hormones by end of 3<sup>rd</sup> month
- Parafollicular (C cells) derived from ultimobranchial body (4<sup>th</sup> pharyngeal pouch)

### Innervation of the tongue

- Motor nerve supply
  - Some muscles develop in situ
  - Others migrate from occipital somites
  - So tongue muscles are supplied by hypoglossal nerve
- Taste sensation by
  - Ant. 2/3 by chorda tympani branch of facial nerve (2<sup>nd</sup> arch nerve)
  - Post. 1/3 by glossopharyngeal nerve (3<sup>rd</sup> arch nerve)

### Development of thyroid gland

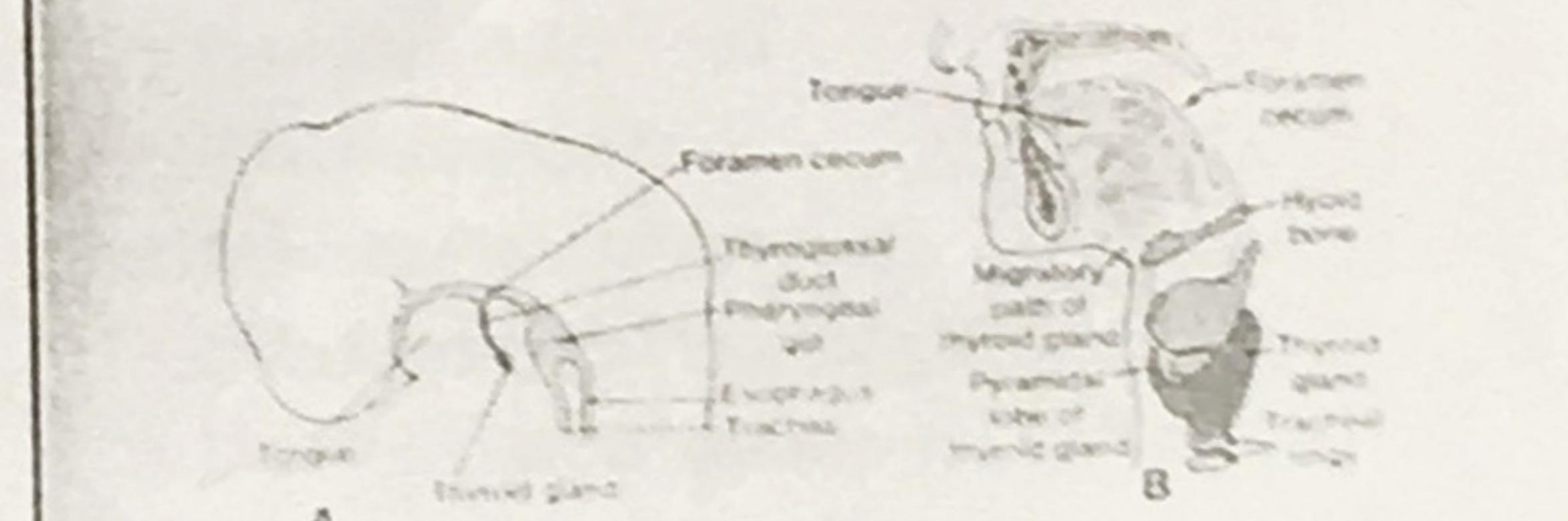


Figure 16.18 A. The thyroglossal diverticulum migrates an epithelial diverticulum to the median of the pharynx (intraoperatively) resulting in the tuberculum impar. B. Position of the thyroid gland in the adult. (From: Moore KL, Persaud TVN, Torchia ME, 2012)

### Development of thyroid gland

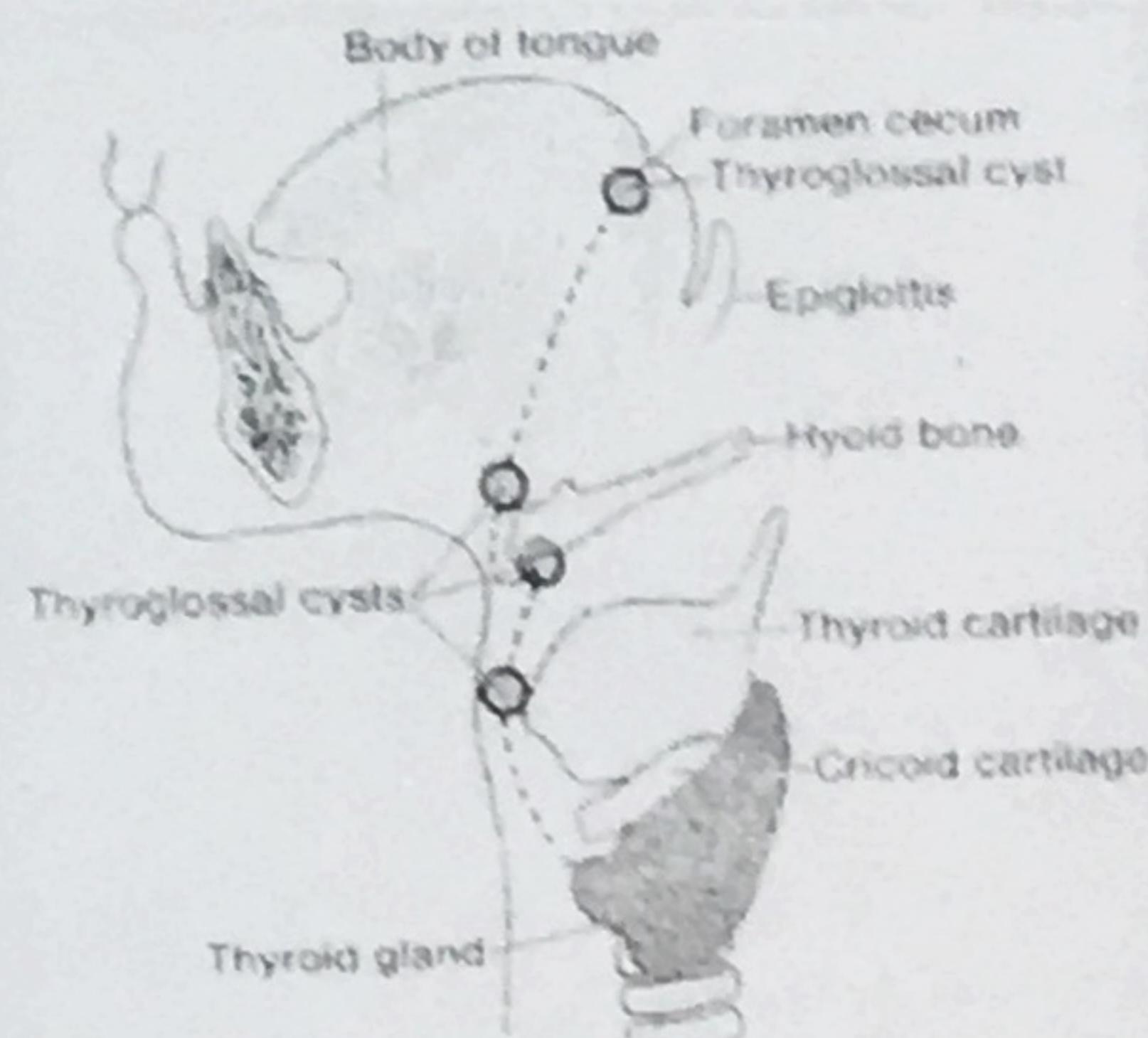


Figure 16.19 Thyroglossal cysts. These cysts, most frequently found in the hyoid region, are always close to the midline. (Continued)

### Clinical correlation

- Ectopic thymic & parathyroid tissue
- Branchial fistulas – failure of the 2<sup>nd</sup> pharyngeal arch to grow over 3<sup>rd</sup> & 4<sup>th</sup> pharyngeal clefts
- Facial mal-developments due to neural crest cells abnormalities
- Thyroglossal cyst
- Tongue tie

### Development of parathyroid gland

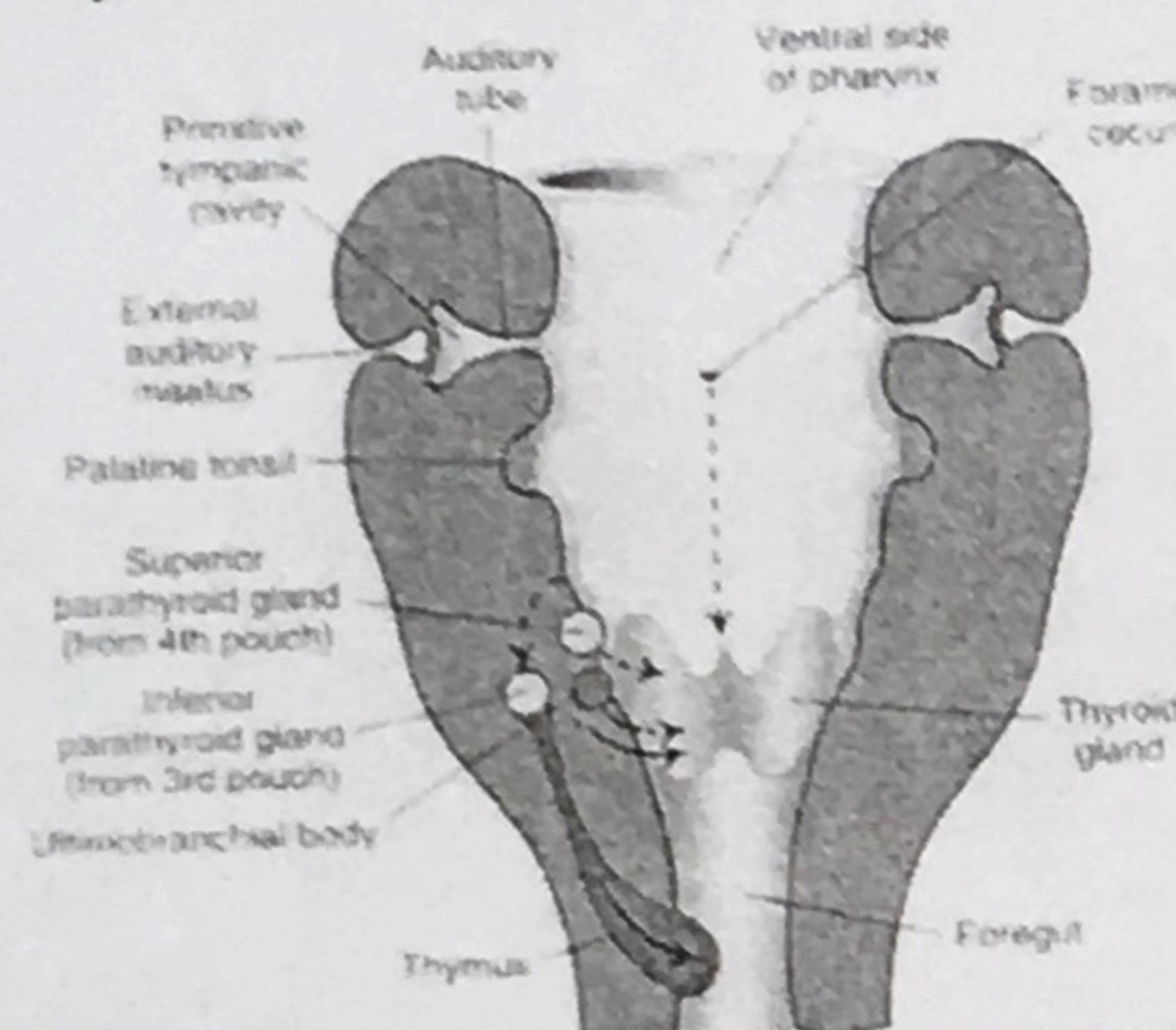


Figure 16.11 Migration of the thymus, parathyroid glands, and ultroabdominal body. The thyroid gland originates in the midline at the level of the foramen cecum and descends to the level of the first tracheal rings.

### Lateral cervical cyst

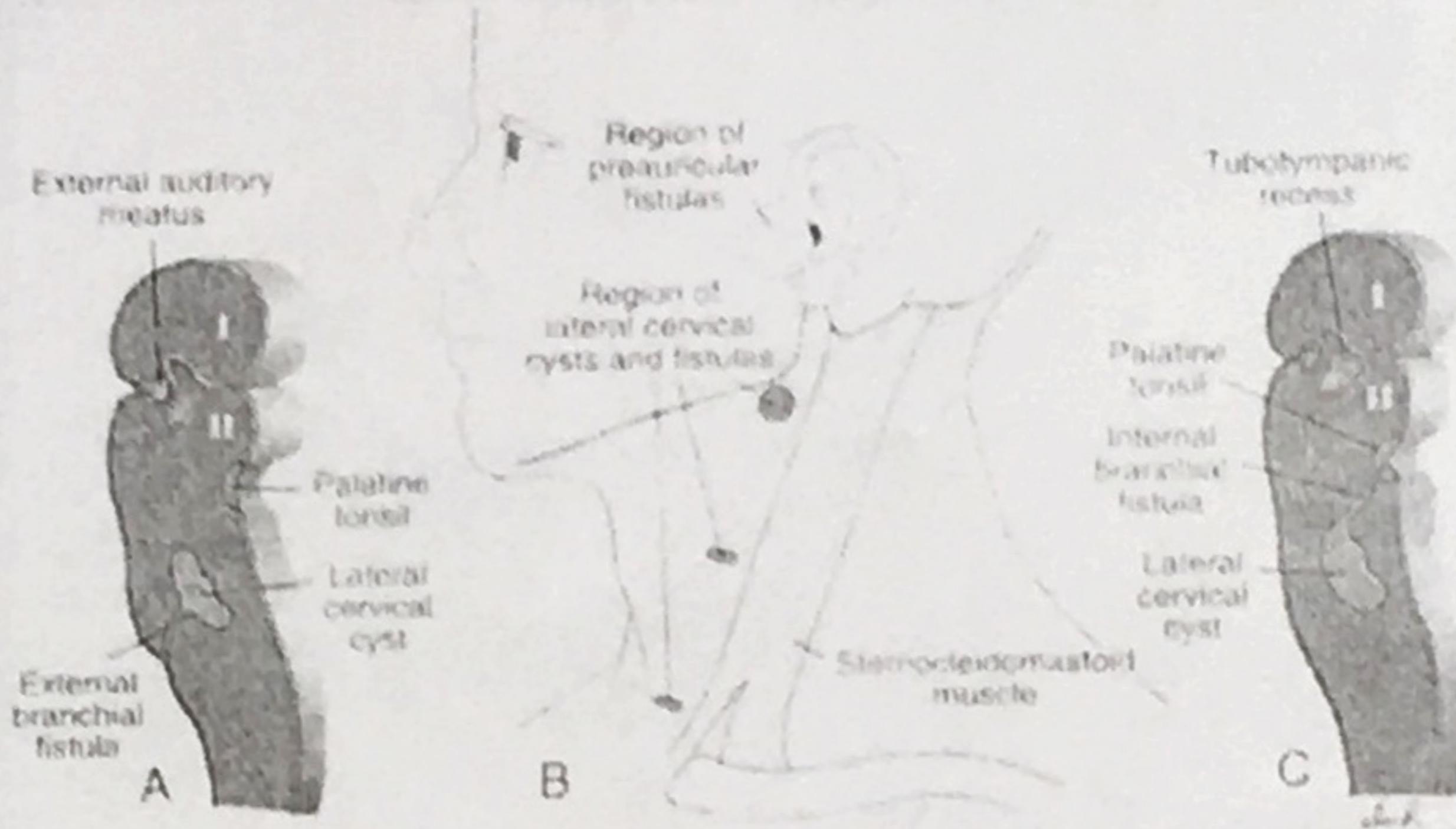


Figure 16.14 A. Lateral cervical cyst opening at the side of the neck by way of a fistula. B. Lateral cervical cysts and fistulas in front of the sternocleidomastoid muscle. Note also the region of preauricular fistulas. C. A lateral cervical cyst opening into the pharynx at the level of the palatine tonsil.

(Continued)

### Development of parathyroid gland

- Inferior parathyroid glands develop from 3<sup>rd</sup> pharyngeal pouch
- Inferior parathyroid glands develop with thymus & migrate downwards, to lie at posteroinferior position of thyroid gland
- Superior parathyroid glands develop from 4<sup>th</sup> pharyngeal pouch, to lie at posterosuperior position of thyroid gland

### Summary

- Pharyngeal arches
- Pharyngeal pouches
- Pharyngeal clefts
- Development of tongue
- Development of thyroid gland
- Development of parathyroid gland