Oral Histo Lect. 3

Development of the face

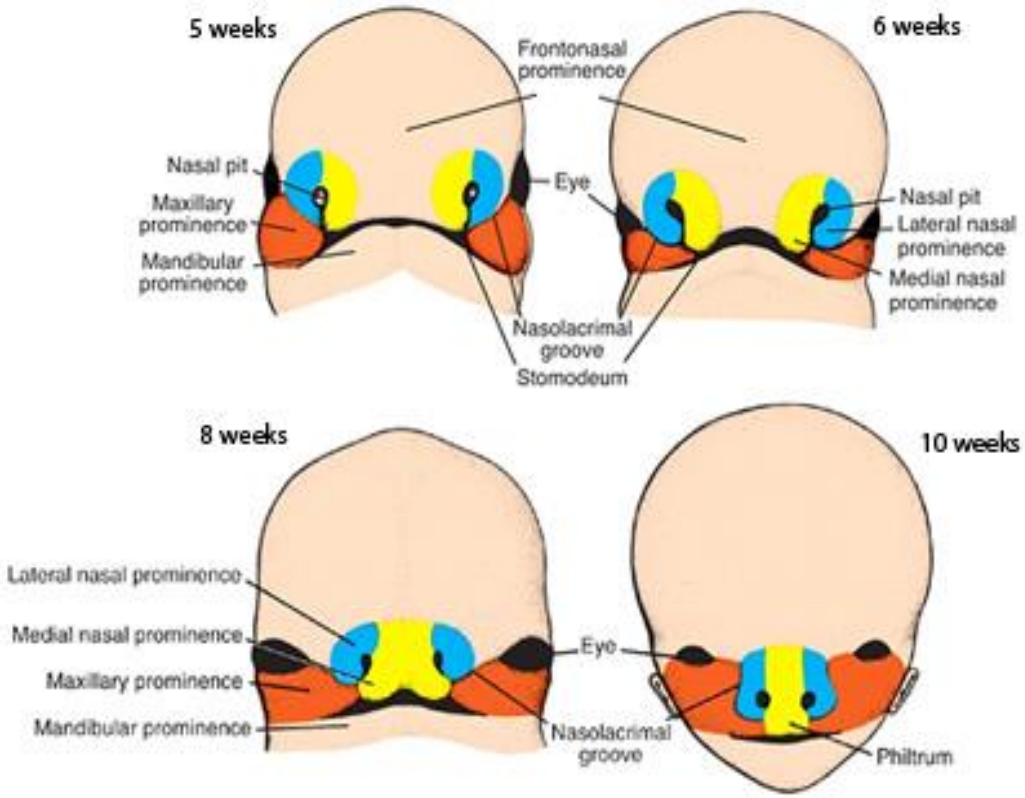
- initially formed by 5 mesenchymal swellings (aka processes or prominences):
    - **2 mandibular prominences** (right and left, from 1st arch neural crest mesenchyme)
    - **2 maxillary prominences** (right and left, from 1st arch neural crest mesenchyme)
    - **frontonasal prominence** (midline structure, from cranial neural crest mesenchyme)

- two nasal pits develop in the ventrolateral aspects of the frontonasal prominences, thereby forming 2 **lateral and medial nasal prominences**

- development of the face occurs via the growth and fusion of these prominences:
    - the **mandibular prominences** grow together to form a single **mandible**

    - The **maxillary prominences** (shown in **orange** below) grow toward the midline and fuse with the **lateral nasal prominences (blue)**. A deep groove called the **nasolacrimal groove** forms between the maxillary and lateral nasal prominences on either side of the developing nose. Most of the groove is obliterated with fusion of the maxillary and lateral nasal prominences, but a small portion persists as the **nasolacrimal duct** and **lacrimal sac**.

- Inward growth of the **maxillary prominences** also causes them to fuse with the **medial nasal prominences (yellow)**. Continued growth of the maxillary prominences combined with **regression of the frontonasal prominence** pushes the two medial nasal prominences together such the medial prominences eventually fuse to form the midline of the nose and **philtrum** of the upper lip –the superior portion of the frontonasal prominence grows and extends to form the forehead whereas the inferior portion does not grow very much, thus allowing the medial nasal processes to fuse in the midline.

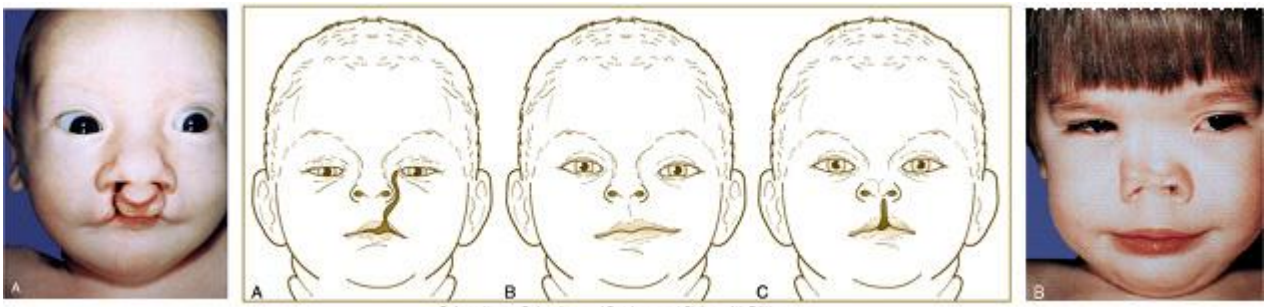


Below is a summary of the contributions of the prominences to the adult face:

Embryonic structure	Adult structure
frontonasal prominence	forehead, bridge of nose
medial nasal prominence	midline of nose, philtrum of upper lip
lateral nasal prominence	alae of nose
nasolacrimal groove	nasolacrimal duct, lacrimal sac
maxillary prominence	cheeks, lateral upper lip
mandibular prominence	lower lip, jaw

Disruption of the development of any of the facial prominences can result in a variety of facial anomalies, such as (from left to right in figures below):

- *hare lip (bilateral failure of maxillary and medial nasal prominences to fuse)*
- *oblique facial cleft (unilateral failure of maxillary, medial, and lateral nasal prominences to fuse)*
- *macrostoma (incomplete lateral merging of maxillary and mandibular processes)*
- *median cleft lip (incomplete fusion of medial nasal prominences)*
- *frontonasal dysplasia (hyperplasia of inferior frontonasal prominence, thus preventing fusion of the medial nasal prominences)*



Development of the tongue

A. Anterior 2/3 of the tongue:

1. Formation: the anterior 2/3 of the tongue is derived from median and lateral tongue buds that arise from the floor of the **1st pharyngeal arch** and then grow rostrally. The tongue buds are then invaded by occipital myoblasts that form the intrinsic muscles of the tongue.

2. Innervation of the anterior 2/3 of the tongue:

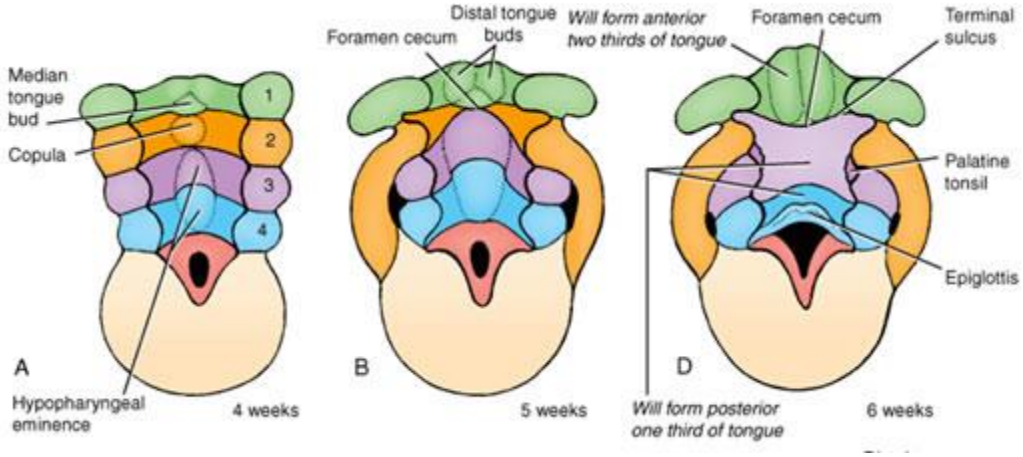
- **sensory innervation of the mucosa** is via the **lingual branch of the trigeminal nerve**
- **taste innervation** is via the **chorda tympani branch of the facial nerve**, except for the taste buds in any circumvallate papilla that may be present in the posteriormost part of the anterior 2/3 of the tongue –these are innervated by the glossopharyngeal nerve.
- **motor innervation of the intrinsic skeletal muscles** is via the **hypoglossal nerve(XII CN)**

B. Posterior 1/3 of the tongue:

1. Formation: swellings from the floor of the 3rd and 4th pharyngeal arches overgrow the 2nd arch and fuse with the anterior 2/3 of the tongue. Thus, the **posterior 1/3 of the tongue is derived from the 3rd and 4th arches** and there is NO contribution of the 2nd pharyngeal arch in the adult tongue. Intrinsic musculature is also derived from occipital myoblasts. The line of fusion of the anterior 2/3 and posterior 1/3 of the tongue is indicated by the **terminal sulcus**.

2. Innervation of the posterior 1/3 of the tongue:

- **sensory innervation of the mucosa** is mostly via the **glossopharyngeal nerve** (and some vagus)
- **taste innervation** is mostly via the **glossopharyngeal nerve** (and some vagus)
- **motor innervation of the intrinsic skeletal muscles** is via the **hypoglossal nerve**



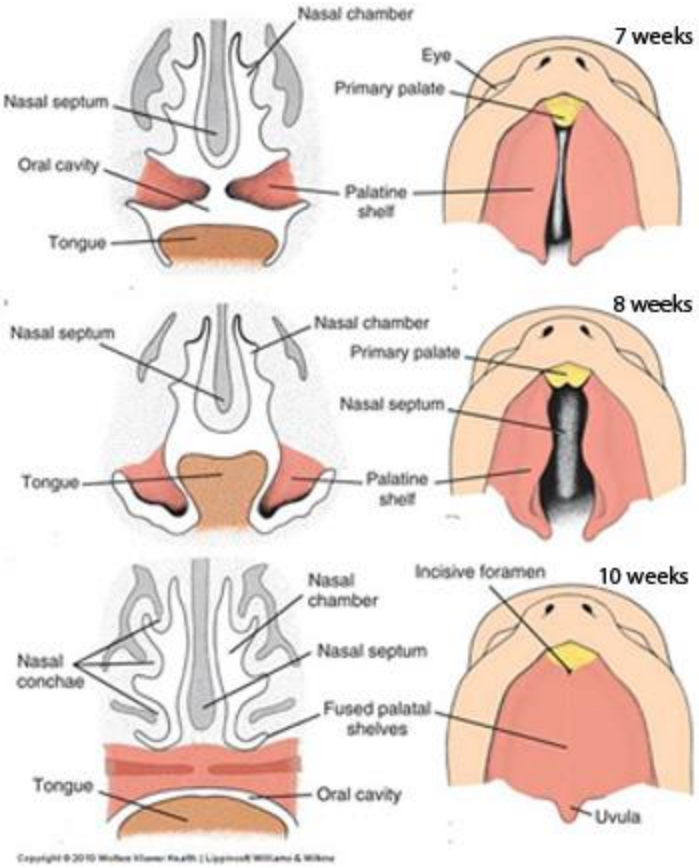
Development of the palate

A. Primary palate

- forms via the fusion of the two medial nasal prominences in the midline (of course, this midline fusion is driven via growth of the maxillary prominences which pushes the nasal prominences toward to the middle)
- consists of the premaxillary segment of the maxilla, which contains the four incisors and the incisive canal

B. Secondary palate

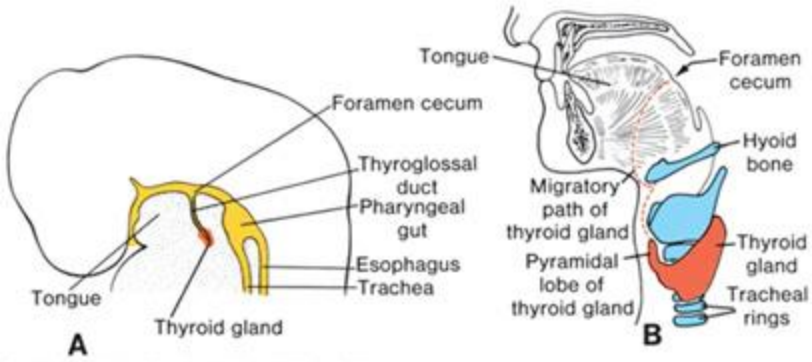
- forms via outgrowths of the maxillary prominences called the **palatine shelves**
- initially, the palatine shelves project on either side of the tongue. With growth and expansion of the mandible the tongue moves down, allowing the palatine shelves to grow toward the midline and fuse to form the secondary palate, which consists of the palatine segment of the maxilla and palatine bone. ***Disruption of growth of the tongue and/or mandible can therefore secondarily cause a cleft secondary palate.***

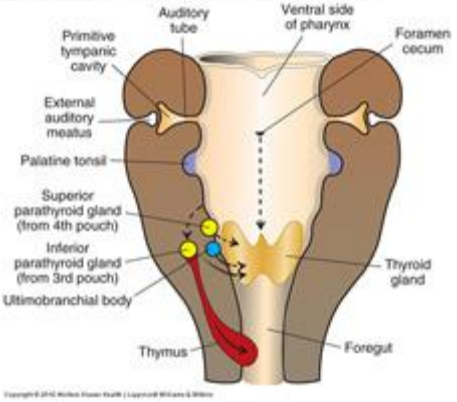


Complete fusion of the primary and secondary palate is a complex process involving growth of the component tissues, epithelial to mesenchymal transformation, cell migration, and programmed cell death at fusion sites –disruption of any part of this process can result in cleft palate. Given the involvement of the maxillary and nasal prominences, cleft palate is often (but NOT always) accompanied by cleft lip.

Development of the thyroid gland

- is **NOT** derived from any of the pharyngeal pouches
- arises from a **midline thyroid diverticulum** that forms from the **endoderm** in the floor of the pharynx just caudal to the 1st pharyngeal arch; these endoderm cells differentiate into the **follicular cells of the thyroid gland**.
- **neural crest cells** of the **ultimobranchial body** migrate into the gland and give rise to the **parafollicular cells** (aka C-cells) of the thyroid.
- with differential growth of the embryo, the diverticulum elongates, but remains connected to the forming tongue by a **thyroglossal duct** that later is obliterated; the site of the opening of the thyroglossal duct is the **foramen cecum** found in the midline at the terminal sulcus of the tongue.





*Anomalies in thyroid development can result in **ectopic thyroid tissue** and/or **cysts** present along the course of the thyroglossal duct, which is a **midline structure** (as opposed to **cervical cysts**, which are remnants of pharyngeal clefts 2-4 and are found **lateral** to the sternocleidomastoid muscles)*.