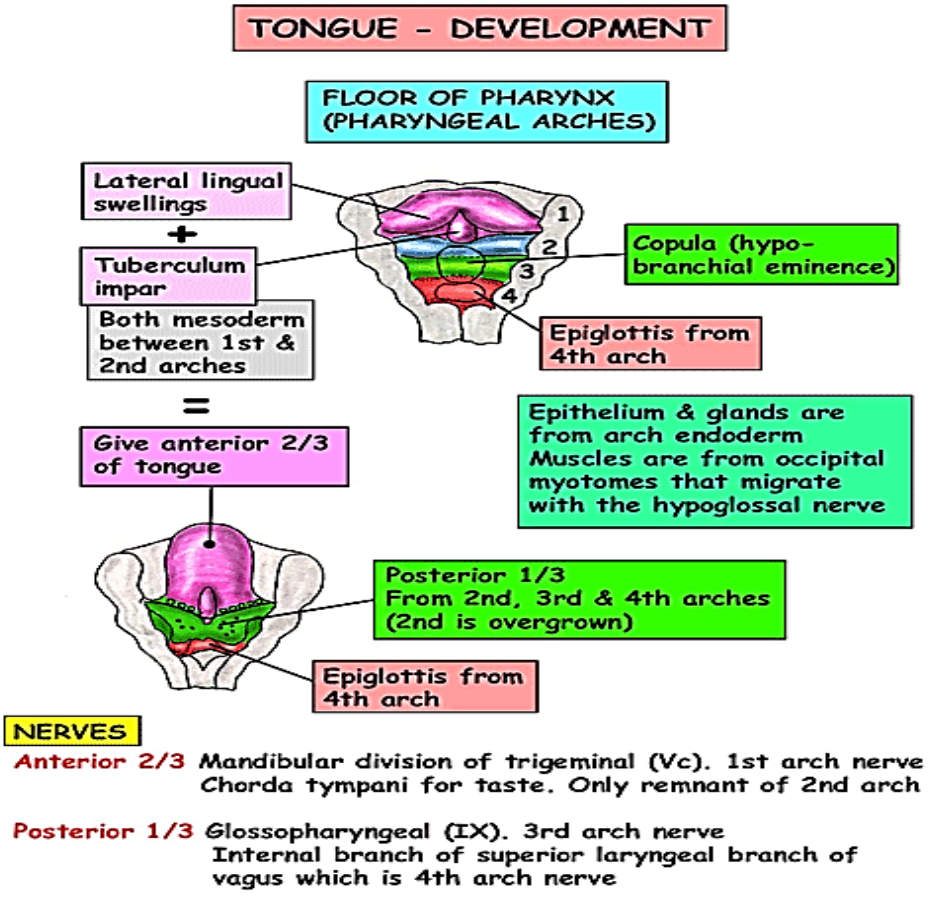
Development of the tongue

The tongue begins to develop during the 4th week of embryogenesis from a median swelling of the first pharyngeal arch known as *the tuberculum impar*. At 5th week a pair of lateral swellings(the lateral lingual swellings) appear ,which expand and cover the tuberculum impar and continue to develop forming the anterior 2/3rd of the tongue.

A swelling appears in the midline by fusion of the ventromedial part of the second pair of pharyngeal arches called *the copula* .During the 5th and 6th weeks the copula is overgrown by a swelling from the 3rd and 4th arches called *the hypopharyngeal eminence*, and this develops into the posterior part of the tongue. The boundary between the two parts of the tongue, is marked by the V-shaped terminal sulcus ,at the tip of the terminal sulcus is the foramen caecum.



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

-Sensory innervation of the mucosa is via the lingual branch of the trigeminal nerve

-Taste bud innervation is via the chorda tympani branch of the facial nerve,

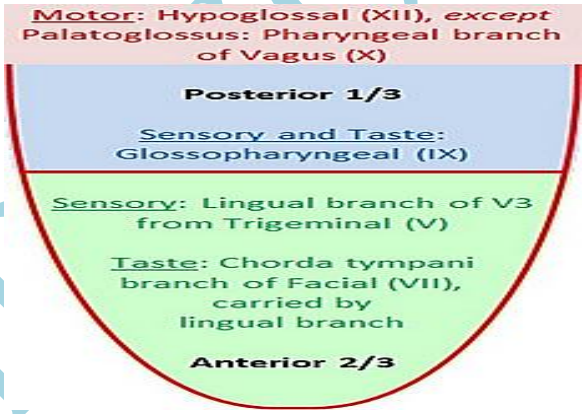
-The taste buds in the circumvallate papilla that present in the posterior most part of the anterior 2/3rdof the tongue are innervated by glossopharyngeal nerve.

Innervation of the posterior 1/3rd 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)

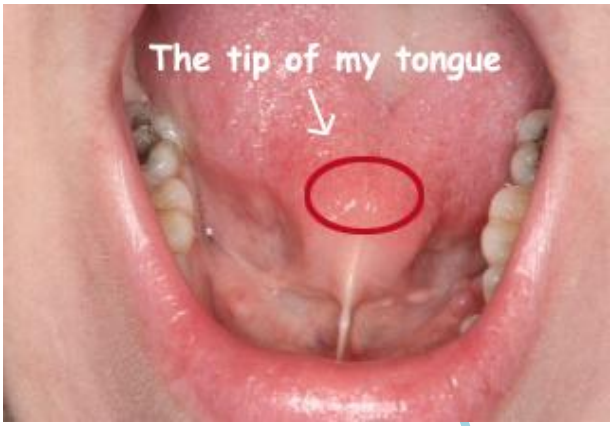
Motor innervation of the intrinsic skeletal muscles is via the hypoglossal nerve.



Abnormalities:

Ankyloglossia (Tongue-Tie)

Ankyloglossia (tongue-tie) is the general clinical term for the short lingual frenulum (less than 2 cm), that limits the range of movement of the tongue, This is associated with speech development and feeding disorders. In the most common form of ankyloglossia, the frenulum extends to the tip of the tongue.



Macroglossia

Macroglossia is the medical term for an unusually large tongue. Sever enlargement of the tongue can cause cosmetic and functional difficulties in speaking, eating, swallowing and sleeping. Macroglossia is uncommon, and usually occurs in children. There are many causes can be associated with a number of genetic abnormalities including: trisomy 21 (Down syndrome), acromegaly. Treatment is dependent upon the exact cause(A).

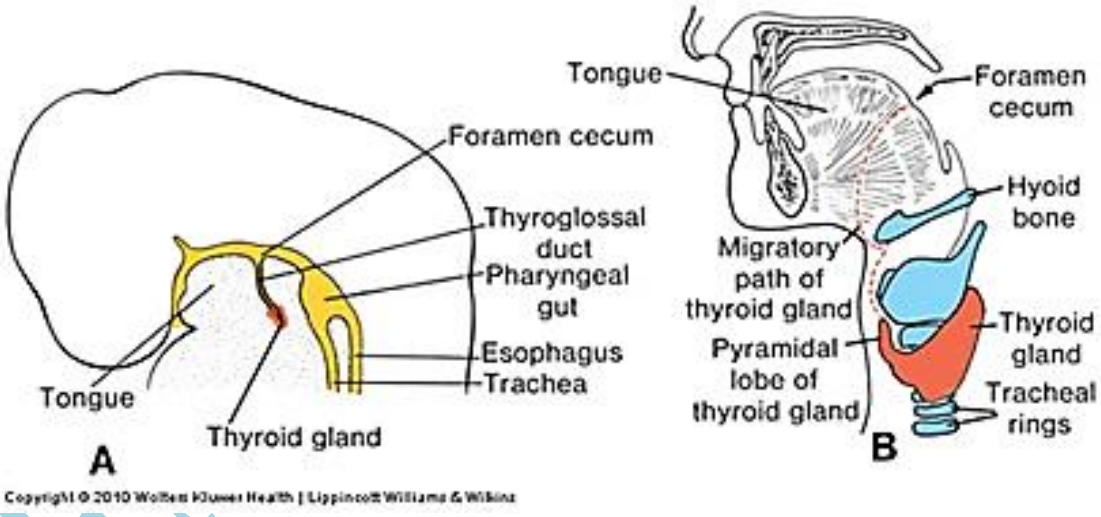
Microglossia

This is a rare condition where the size of the tongue is abnormally small. Cases of complete absence of the tongue have been reported. A tiny tongue will pose many difficulties related to speech and swallowing. There is no treatment for this condition, and the affected person will have to train their tongue to the best of their abilities(B).

Thyroid gland

The thyroid gland appears as an epithelial proliferation at a point indicated by the foramen ceacum . Subsequently, the thyroid descends in front of the pharyngeal gut as a bilobed diverticulum . During this migration, the thyroid remains connected to the tongue by the *thyroglossal duct* which later disappears.

With further development, the thyroid gland descends in front of the hyoid bone and the laryngeal cartilages. It reaches its final position in front of the trachea in the 7th week. The thyroid begins to function at approximately the end of the third month, at which time the first follicles containing colloid become visible. Follicular cells produce the colloid that serves as a source of **Triiodothyronine(T3) and Thyroxine (T4).** Parafollicular, or C, cells derived from the ultimobranchial body ,serve as a source of **calcitonin.**

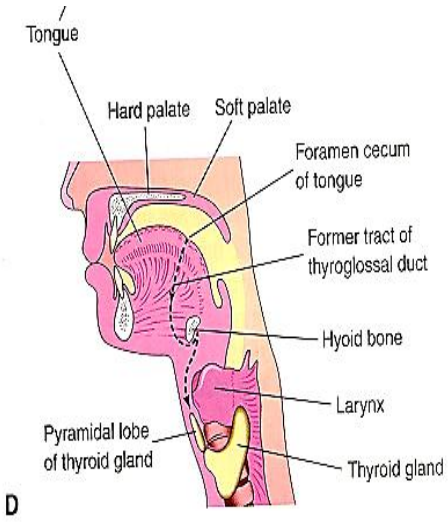


A. The thyroid primordium arises as an epithelial diverticulum in the midline of the pharynx
B. Position of the thyroid gland in the adult(Broken line, the path of migration).

Thyroglossal cyst

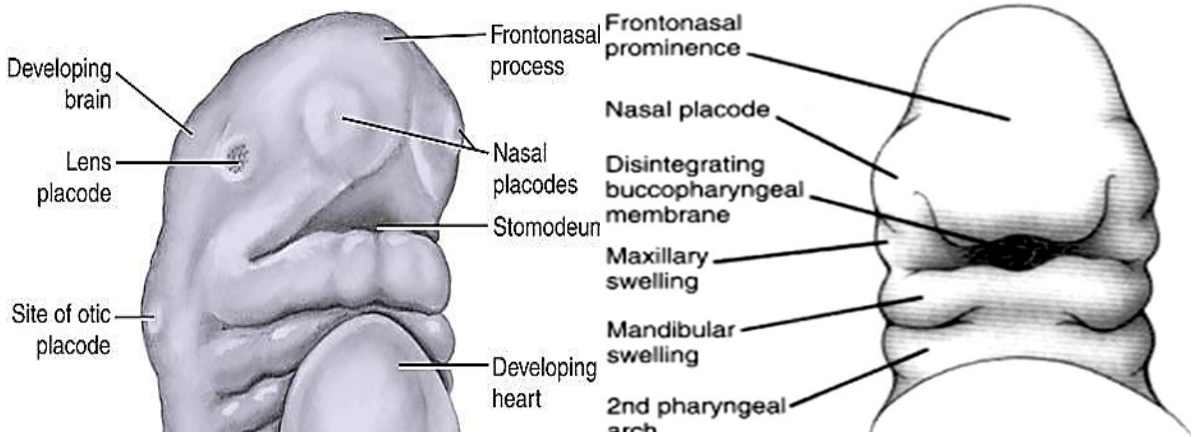
A thyroglossal cyst may lie at any poínt along the migratory pathway of the thyroid gland but is always near or in the midline of the neck. It is a cystic remnant of the thyroglossal duct,they may also be found at the base of the tongue or close to the thyroid cartilage.Sometimes, a thyroglossal cyst is

connected to the outside by a fistulous canal, a thyroglossal fístula. Such a fistula usually arises secondarily after rupture of a cyst but may be present at birth.



Facial, nasal and palatal development

The external human face develops between the 4th and 6th weeks of embryonic development. By the 6th week the external face is completed. Between the 6th and 8th weeks the development of the palate subdivides nasal and oral cavities. This development continues into the 12th week with completion of the soft palate.



The face develops from five primordia that appear in the fourth week: the frontonasal prominence, the two maxillary swellings, and the two mandibular swellings.

Frontonasal process (2 medial nasal and 2 lateral nasal processes)
First pharyngeal arch (2 mandibular and 2 maxillary processes).

Sequence of developmental events :

During the 3rd week of development an *oropharyngeal membrane (buccopharyngeal)* is first seen at the site of the future face, between the primordium of the heart and the rapidly enlarging primordium of the brain.

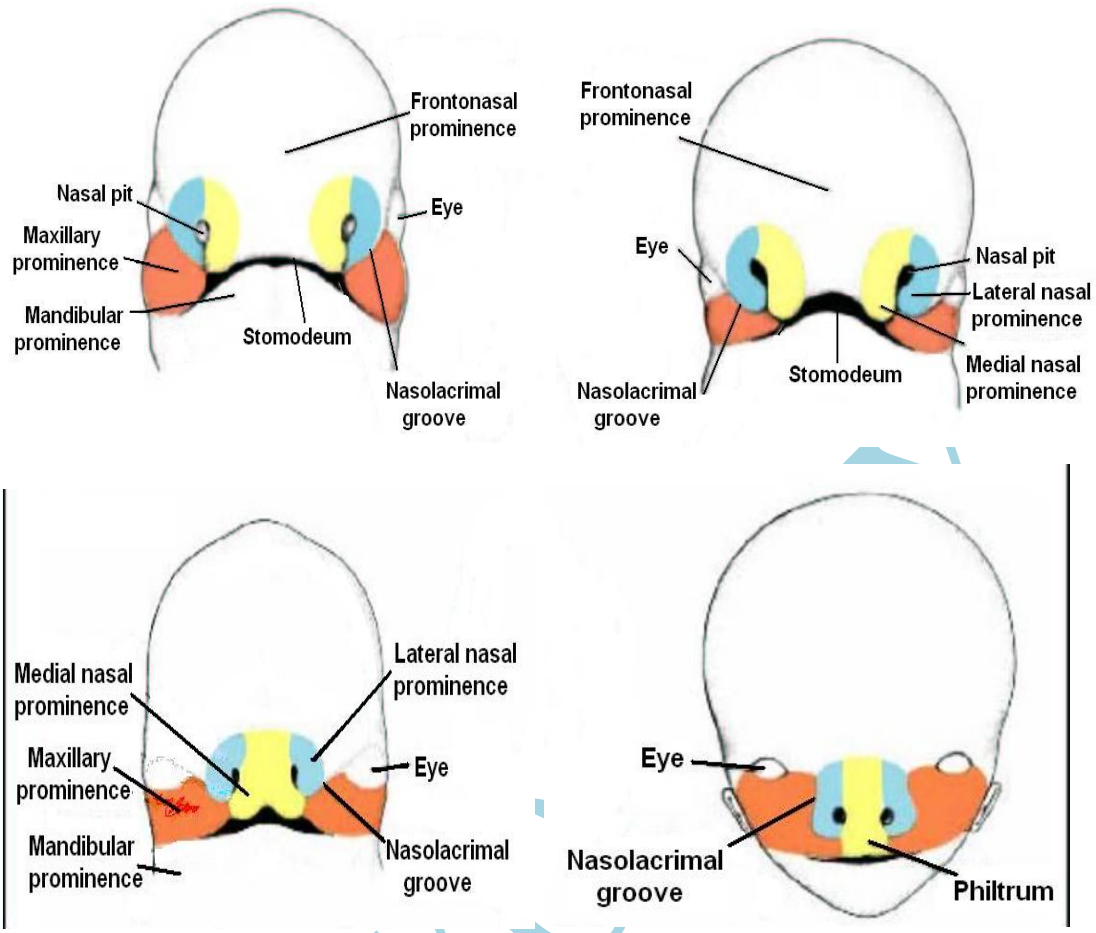
It is composed of ectoderm externally and endoderm internally. It lies at the beginning of the digestive tract and breaks down during the 4th week in order to form the opening between the future oral cavity (primitive mouth or stomodeum) and the foregut.

Face initially formed by 5 mesenchymal swellings (prominences):

- Two mandibular prominences
- Two maxillary prominences
- Frontonasal prominence (*midline structure is a single structure that is ventral to the forebrain).* These processes come together to form the continuous surfaces of the external face.

Nasal placodes

- at the end of the 4th week, two ectodermal thickenings: nasal placodes, appear on the frontonasal process.They thicken and sink in to form nasal pits.
- At the same time, mesodermal cells proliferate around the placodes, and the sides of these swellings form the medial and lateral nasal prominences. The lateral nasal prominence gives rise to the ala of the nose and fuses with the maxillary prominence, forming the nasolacrimal duct(*This duct is formed when the ectoderm thickens into a cord and sinks into the underlying mesenchyme).*



- The growth of maxillary prominences compresses the medial nasal prominences and causes them to fuse around the 10th week of development. This establishes the bridge of the nose and the intermaxillary segment.
- The intermaxillary segment yields:

a- the portion of the upper lip containing the philtrum

b-the upper jaw with 4 incisors

c-the primary palate.

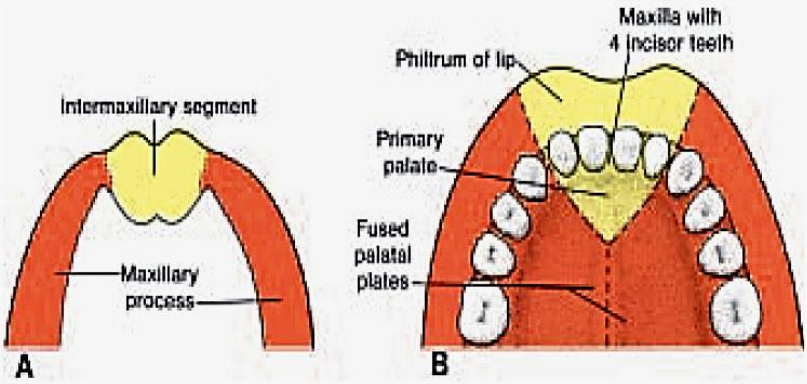
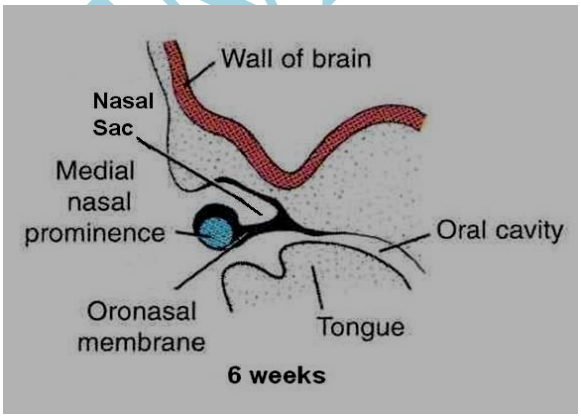


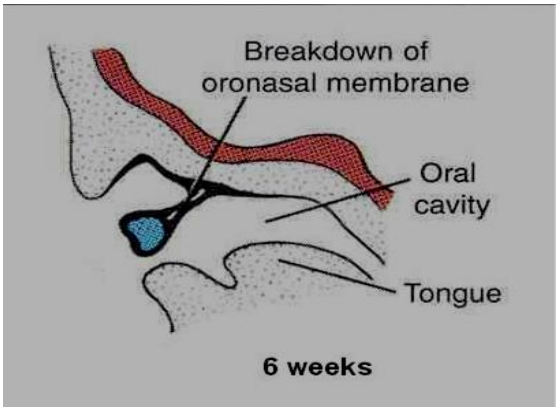
Figure 15.24 A. Intermaxillary segment and maxillary processes. **B.** The intermaxillary segment giving rise to the philtrum of the upper lip, the median part of the maxillary bone with its four incisor teeth, and the triangular primary palate.

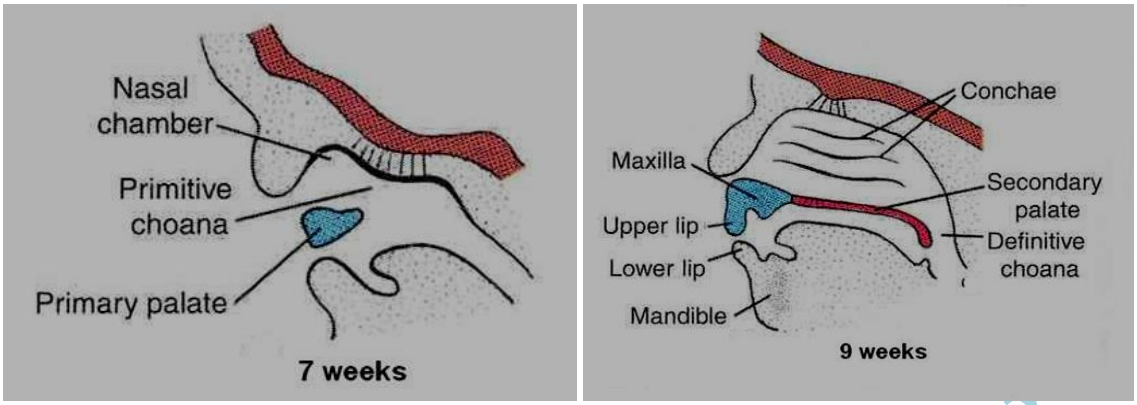
The nasal cavity

The formation of the lateral and medial nasal prominences makes the nasal placodes lie in the floor of the depression, called nasal pits.The nasal pits deepen and develop the nasal sacs in the 6th week.

These new structures grow dorsocaudally in front of the forming brain.In the beginning, the nasal sacs are separated from the oral cavity by the oronasal membrane which disappears in the 7th week leaving a connection between the nasal cavities and the oral cavity, called ***the primitive choanae***. Later, when the development of the secondary palate occurs, the choanae changes its position and locates at the junction of the nasal cavity and the pharynx(***Definitive choanae).***



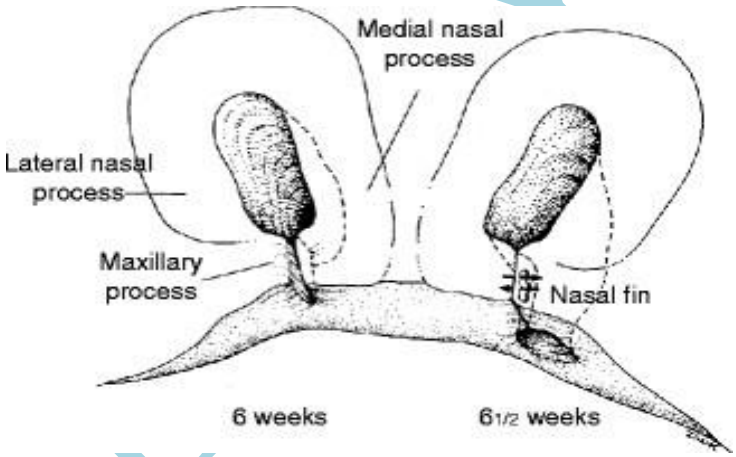




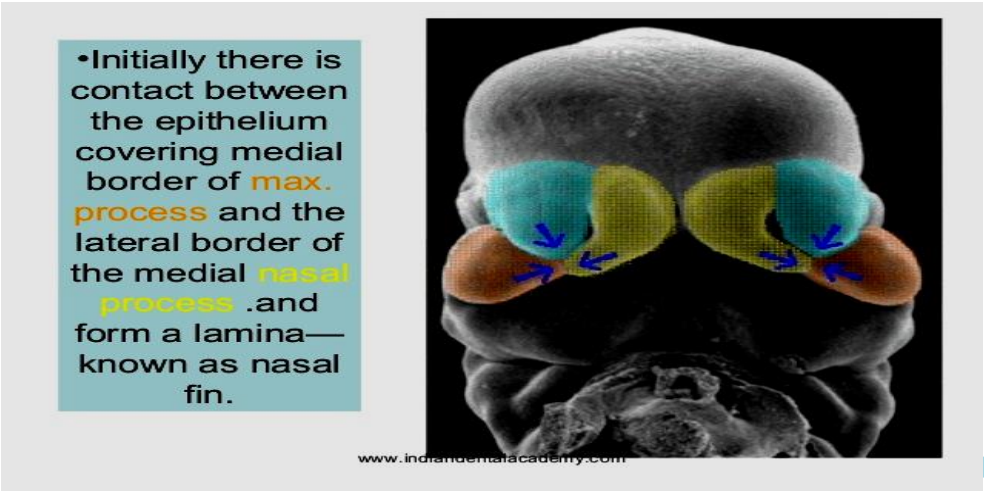
The nasal septum grows as a downgrowth from the merged nasal prominences and fuses with the palatine process. Finally, the superior, middle and inferior conchae develop the lateral wall of each nasal cavity.

Nasal fin

The epithelial covering of the medial nasal and maxillary processes normally contact and create a zone of fusion named nasal fin. This epithelial fin is soon presented by connective tissue growth, which binds together the two maxillary and medial nasal parts of the lip.



Breakdown of nasal fin and formation of nostrils. Arrows indicate disintegration of the nasal fin between the medial nasal and maxillary prominences



The cheeks

After formation of the upper and lower lips,the stomodium is very broad in it's lateral part,it is bounded above by the maxillary process & below by the mandibular process.These processes undergo progressive fusion with each other to form the cheeks.

The palate

The secondary palate is an anatomical structure that divides the nasal cavity from the oral cavity in many vertebrates ,it consists anteriorly of the bony hard palate and posteriorly of the muscular soft palate. The hard palate is crucial for normal feeding and speech, whereas the soft palate is movable and closes off the nasal airway during swallowing.

The development of the secondary palate commences in the 6th week of human embryological development, as paired outgrowths, which initially grow vertically flanking the developing tongue and subsequently reorient to the horizontal position above the dorsum of the tongue in a process known as palatal shelf elevation . With growth and expansion of the mandible the tongue moves down, allowing the palatine shelves to grow toward the midline where they meet and fuse with each other.The secondary palate fuses anteriorly with the primary palate with the incisive foramen being the landmark between the

primary palate and secondary palate,and anterodorsally with the nasal septum, to form the intact roof of the oral cavity.

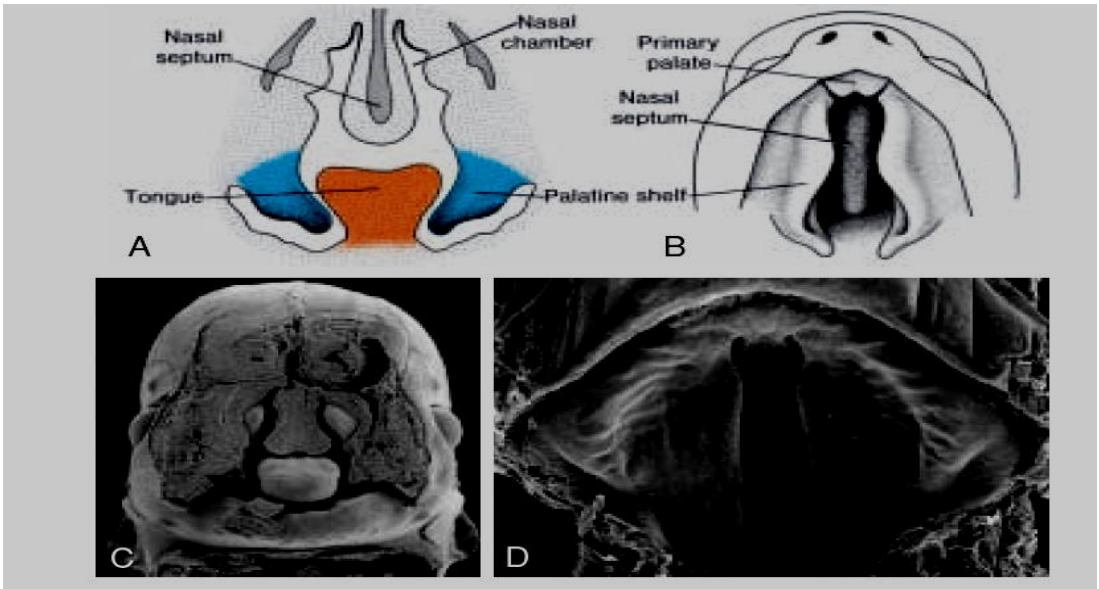


Figure 15.25 A. Frontal section through the head of a 6.5-week-old embryo. The palatine shelves are in the vertical position on each side of the tongue. **B.** Ventral view of the palatine shelves after removal of the lower jaw and the tongue. Note the clefts between the primary triangular palate and the palatine shelves, which are still vertical. **C.** Scanning electron micrograph of a mouse embryo at a stage similar to that of **A. D.** Palatal shelves at a stage slightly older than those in **B.** The shelves have elevated, but they are widely separated. The primary palate has fused with the secondary palatal shelves.

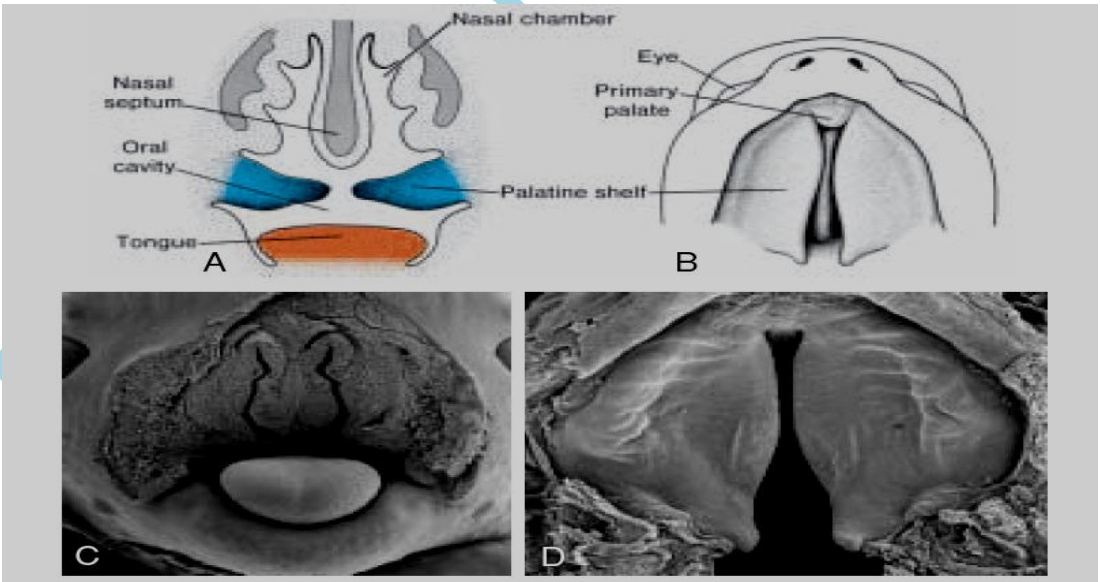


Figure 15.26 A. Frontal section through the head of a 7.5-week embryo. The tongue has moved downward, and the palatine shelves have reached a horizontal position. **B.** Ventral view of the palatine shelves after removal of the lower jaw and tongue. The shelves are horizontal. Note the nasal septum. **C.** Scanning electron micrograph of a mouse embryo at a stage similar to that of **A. D.** Palatal shelves at a stage similar to that of **B.**

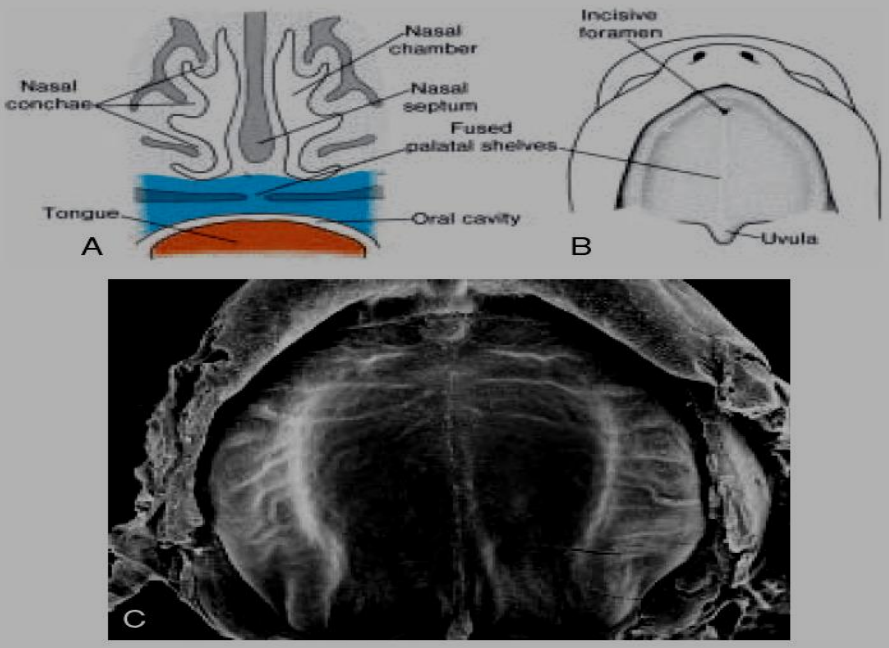


Figure 15.27 A. Frontal section through the head of a 10-week embryo. The two palatine shelves have fused with each other and with the nasal septum. **B.** Ventral view of the palate. The incisive foramen forms the midline between the primary and secondary palate. **C.** Scanning electron micrograph of the palatal shelves of a mouse embryo at a stage similar to that of **B.**

The palatine uvula: is a conic projection from the posterior edge of the middle of the soft palate, composed of connective tissue containing a number of racemose glands, and some muscular fibers. It also contains a large number of serous glands that produce a lot of thin saliva ,during swallowing, the soft palate and the uvula move together to close off the nasopharynx, and prevent food from entering the nasal cavity.

Abnormalities

Cleft lip is a physical split or separation of the two sides of the upper lip and appears as a narrow opening or gap in the skin of the upper lip. This separation often extends beyond the base of the nose and includes the bones of the upper jaw and/or upper gum.

Hare lip: A congenital cleft or fissure in the midline of the upper lip, resembling the cleft upper lip of a hare, often occurring with cleft palate .Result from bilateral failure of fusion of maxillary and medial nasal prominences to fuse.

Cleft palate is a split or opening in the roof of the mouth. A cleft palate can involve the hard palate, and/or the soft palate .Because the lip and the palate develop separately, it is possible to have a cleft lip without a cleft palate, a cleft palate without a cleft lip, or both a cleft lip and cleft palate together.

- 

Oblique facial cleft :unilateral failure of maxillary and lateral nasal prominences to fuse.

Macrostomia:incomplete lateral merging of maxillary and mandibular processes.

Frontonasal dysplasia: hyperplasia of inferior frontonasal prominence,thus preventing fusion of the medial nasal prominenses.

Hypertelorism associated with frontonasal dysplasia and encephalocele.

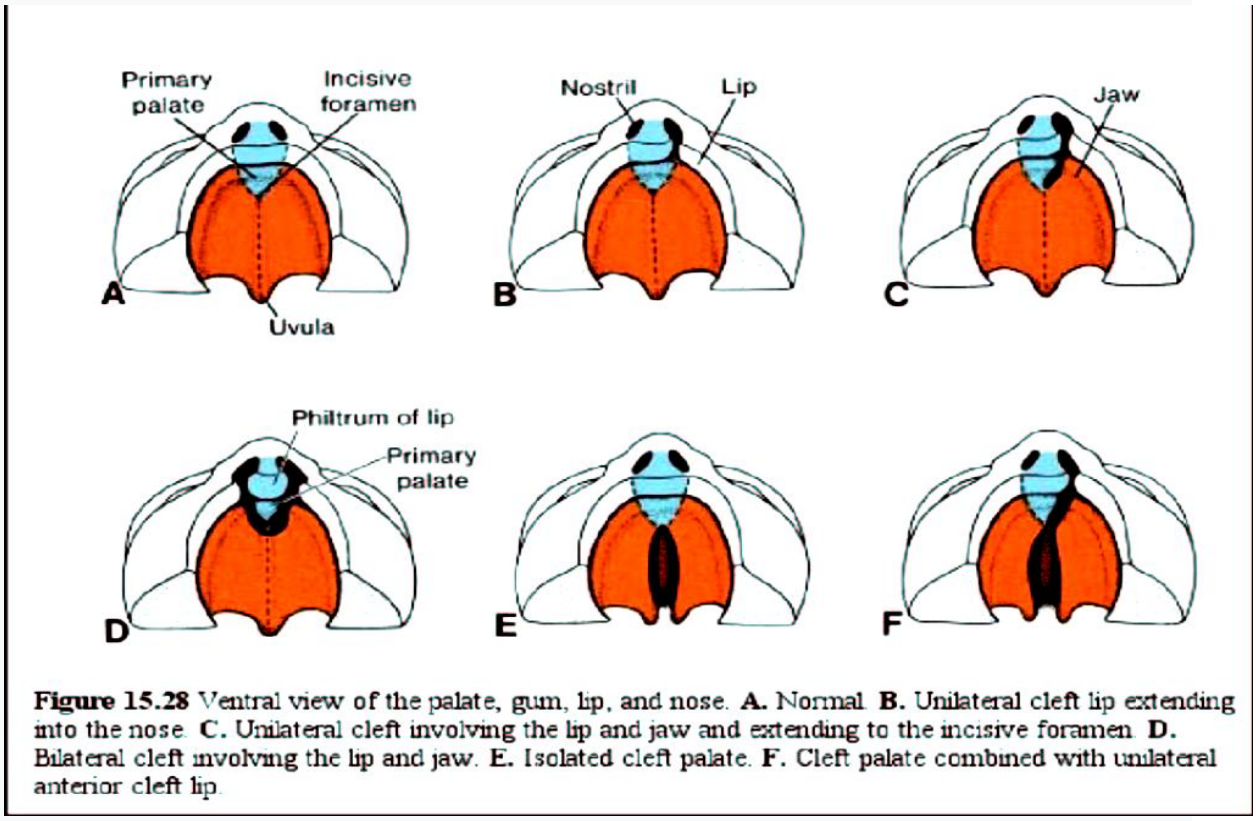


Figure 15.28 Ventral view of the palate, gum, lip, and nose. **A.** Normal. **B.** Unilateral cleft lip extending into the nose. **C.** Unilateral cleft involving the lip and jaw and extending to the incisive foramen. **D.** Bilateral cleft involving the lip and jaw. **E.** Isolated cleft palate. **F.** Cleft palate combined with unilateral anterior cleft lip.