Pharyngeal Arches and Stomodeum Closure

First Pharyngeal Arch

The first pharyngeal arch is crucial in the initial stages of facial development. It gives rise to a ventral end, which forms the mandibular process, and a dorsal end, which forms the maxillary process.

- Mandibular process (ventral)
- Maxillary process (dorsal)

Maxillary and Mandibular Processes

These two processes, originating from the first pharyngeal arch, exhibit forward growth, facilitating the closure of the stomodeum from lateral aspects. This growth contributes significantly to the early facial architecture.

Frontonasal Process

Simultaneously, the forebrain bulge extends downward, forming the frontonasal process. As growth continues, the stomodeum progressively narrows, initiating the discernible formation of the face.

Nasal Placodes and Facial Prominences

Nasal Placodes

Two local ectodermal thickenings, known as nasal placodes, emerge on the frontonasal process. These structures are distinct from the sites of eye formation and play a critical role in nasal cavity development.

Nasal Pit

Each nasal placode encompasses a central depression, referred to as the nasal pit, which marks the future nostril.

Medial and Lateral Nasal Prominences

The nasal pit is surrounded by two elevated areas: the medial nasal prominence and the lateral nasal prominence. These prominences contribute to the formation of the nasal septum and alae.

Nasolacrimal Groove

A groove, termed the nasolacrimal groove, develops at the junction between the frontonasal process and the maxillary process. The eyes develop laterally to the nasal placodes, on the sides of the head.

Merging of Facial Processes

Maxillary and Mandibular Fusion

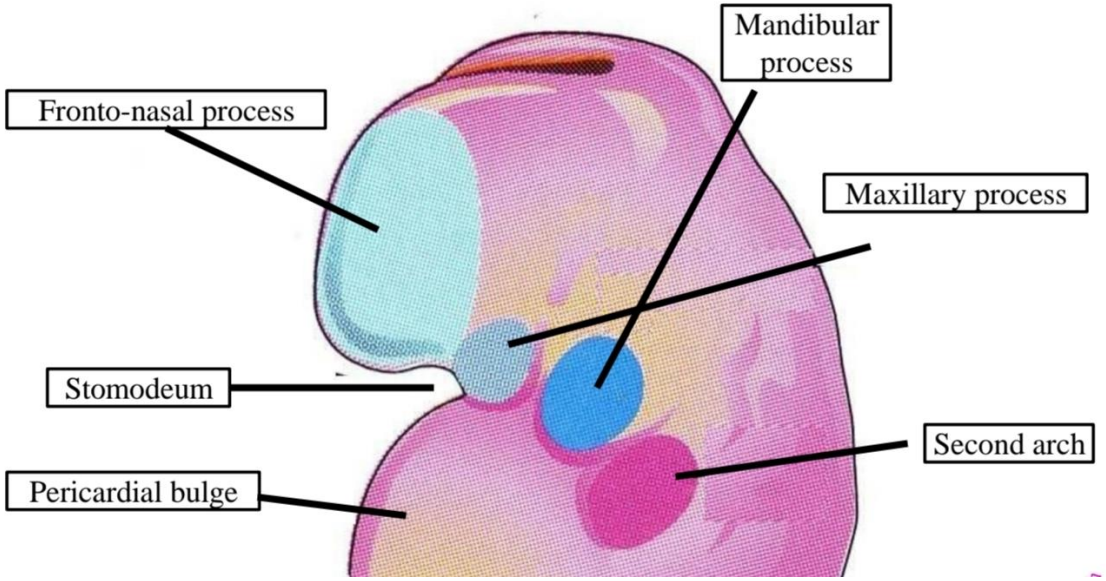
The maxillary process extends forward and fuses with the mandibular process, although this fusion is intentionally incomplete to allow separation between the upper and lower lips.

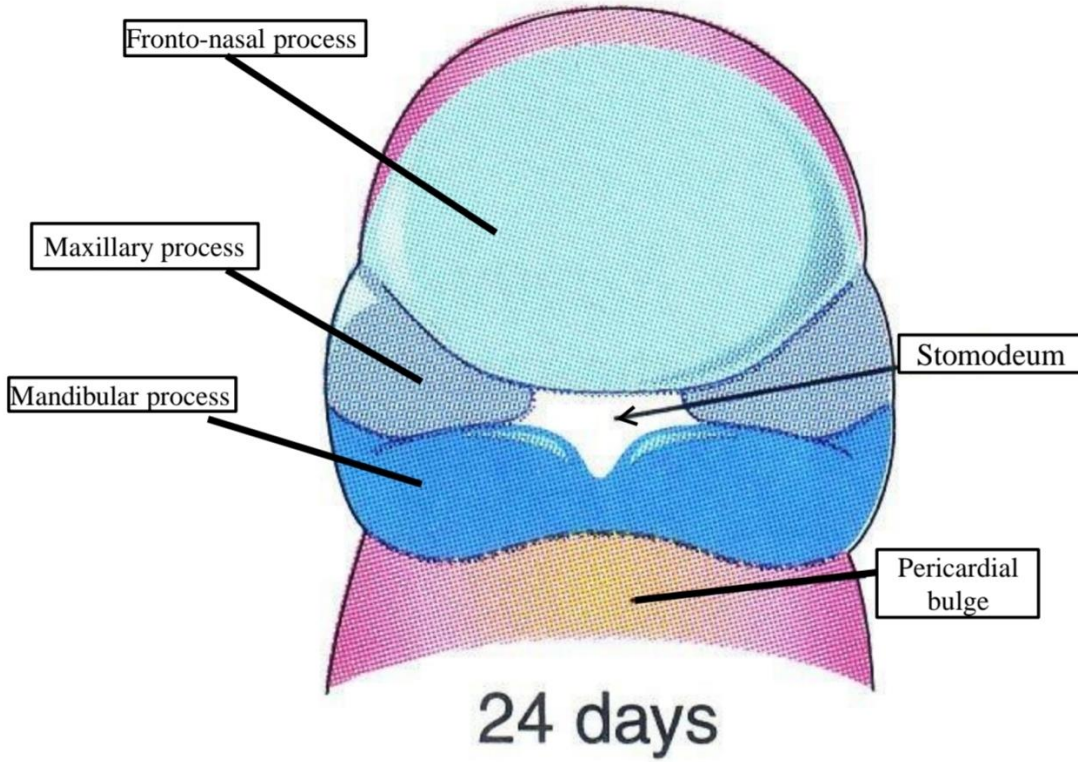
Mandibular Processes Merge

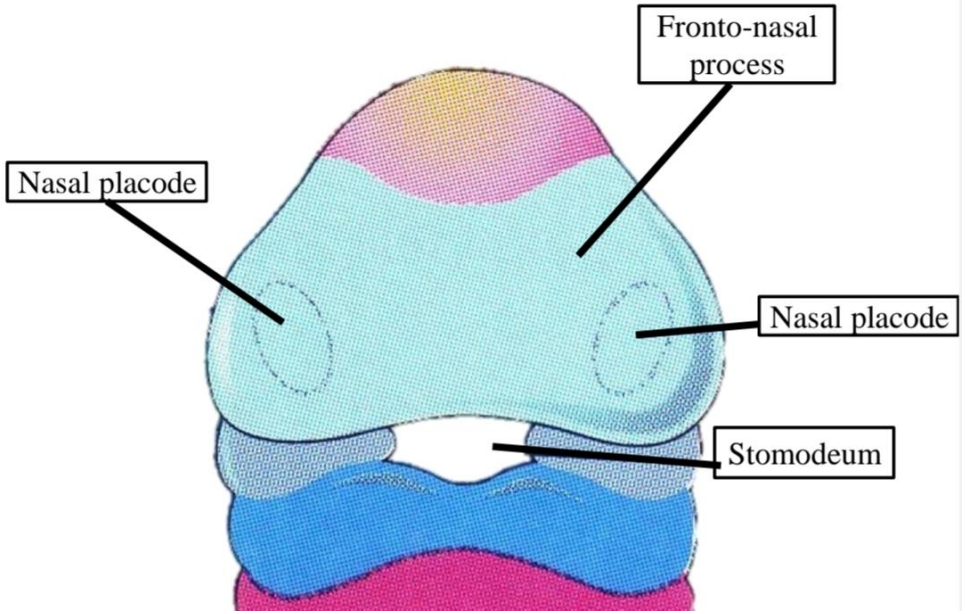
The mandibular processes unite at the midline to establish the mandible, completing the lower jaw structure.

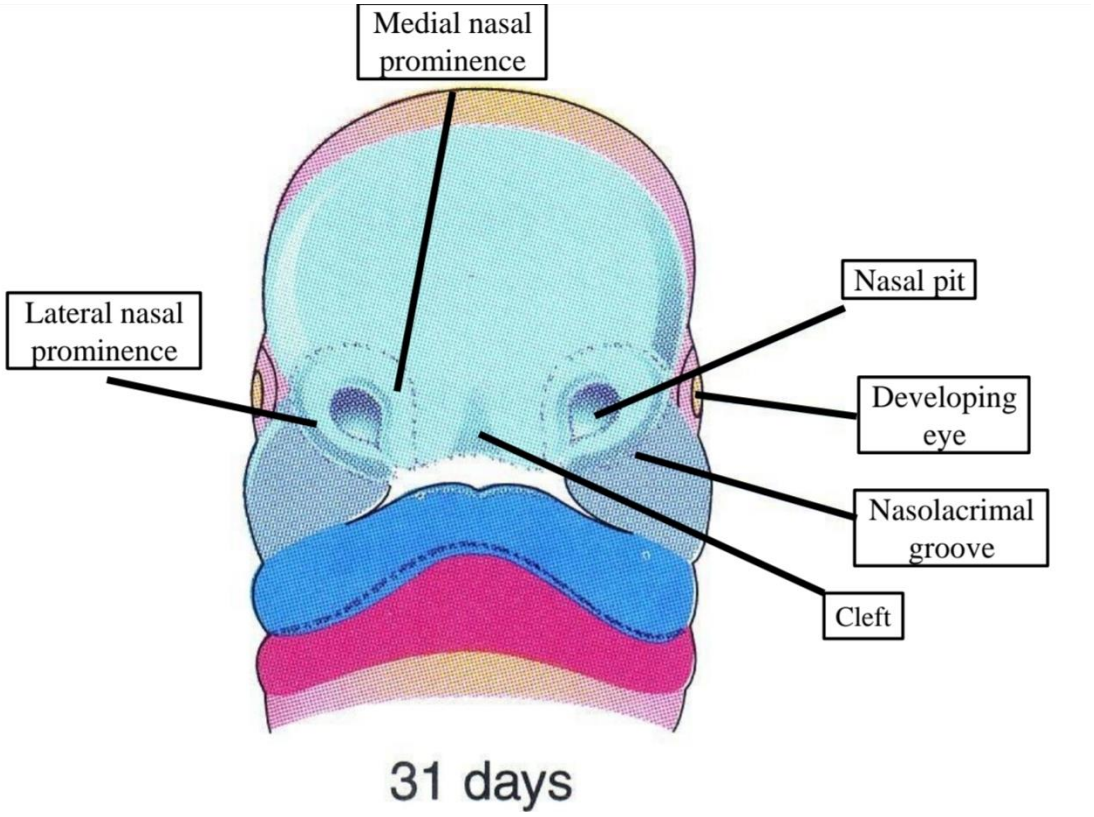
Medial Movement of Nasal Placodes

As the maxillary processes advance, they exert medial traction on the nasal placodes, narrowing the cleft between them and facilitating normal facial development.


Mandibular process
Fronto-nasal process
Maxillary process
Stomodeum
Second arch
Pericardial bulge


Fronto-nasal process
Maxillary process
Stomodeum
Mandibular process
Pericardial bulge
24 days


Fronto-nasal process
Nasal placode
Nasal placode
Stomodeum


Medial nasal prominence
Lateral nasal prominence
Nasal pit
Developing eye
Nasolacrimal groove
Cleft
31 days

Fusion of Nasal Prominences

Medial Nasal Folds

As development progresses, the nasal placodes move closer. The medial nasal folds approach each other until they fully fuse. This fusion leads to the disappearance of the nasal cleft.

Nasal Septum Formation

The fused medial nasal folds give rise to the nasal septum, which divides the nasal cavity into two separate nostrils.

Alae Formation

The lateral nasal folds contribute to the formation of the alae of the nose, which form the outer sides of the nostrils.

Intermaxillary Segment Formation and Fusion

Downward Growth

After fusion, the medial nasal folds grow downward, forming the intermaxillary segment.

Location

It lies between the two maxillary processes, preventing complete fusion between them.

Fusion with the Frontonasal Process

The maxillary processes fuse with the frontonasal process almost completely, except at the orbital region where the upper and lower eyelids will form.

Nasolacrimal Duct Formation

1

Nasolacrimal Groove

The nasolacrimal groove is at the junction between the maxillary process and the frontonasal process.

2

Ectodermal Cord

Ectodermal cells proliferate in this groove to form a solid cord of cells.

3

Canalization

This cord canalizes to form the nasolacrimal duct.

4

Lacrimal Sac

The upper end of this duct widens to form the lacrimal sac.

Medial Nasal Fold Fusion and Palate Development

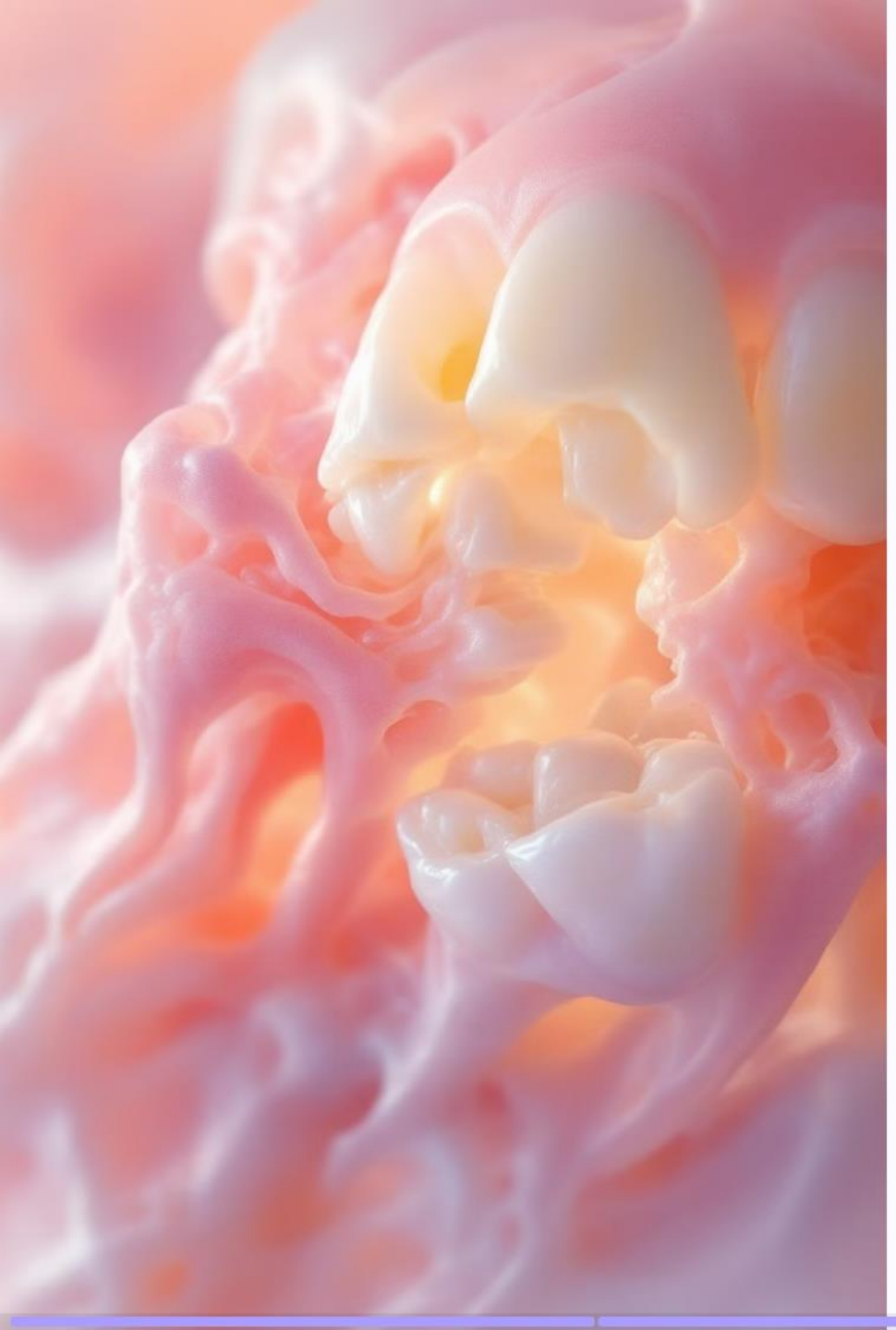
Fusion of Medial Nasal Folds

The medial nasal folds fuse in the midline, giving rise to the middle part of the nose and a downward extension known as the intermaxillary segment. This segment is responsible for forming the philtrum of the upper lip and the primary palate anterior to the incisor teeth.

- Middle part of the nose
- Intermaxillary segment

Palate Formation

The primary palate originates from the intermaxillary segment. The secondary palate forms through horizontal projections called palatine shelves from each maxillary process. These shelves fuse in the midline, eventually fusing with the intermaxillary segment to complete the hard palate.



Mandibular Processes and Fusion Anomalies

Mandibular Processes

The mandibular processes meet at the symphysis menti in the midline. They form the entire lower lip, the lower jaw, and the floor of the mouth, contributing significantly to the lower face structure.

Maxillary-Mandibular Fusion

Fusion between maxillary and mandibular processes determines the size of the mouth opening. Anomalies in this fusion can result in microstomia (abnormally small mouth) or macrostomia (abnormally large mouth).

Fronto-Nasal Process

The fronto-nasal process is characterized by nasal placodes, which are rounded thickenings of the surface ectoderm. These develop on the lower lateral parts of the fronto-nasal process. Invagination of these placodes leads to the formation of nasal pits. These nasal pits are subsequently surrounded by medial and lateral nasal prominences, or folds. These folds merge to form the intermaxillary segment, which gives rise to the philtrum, the part of the upper jaw that carries the upper four incisors, and the primary palate.

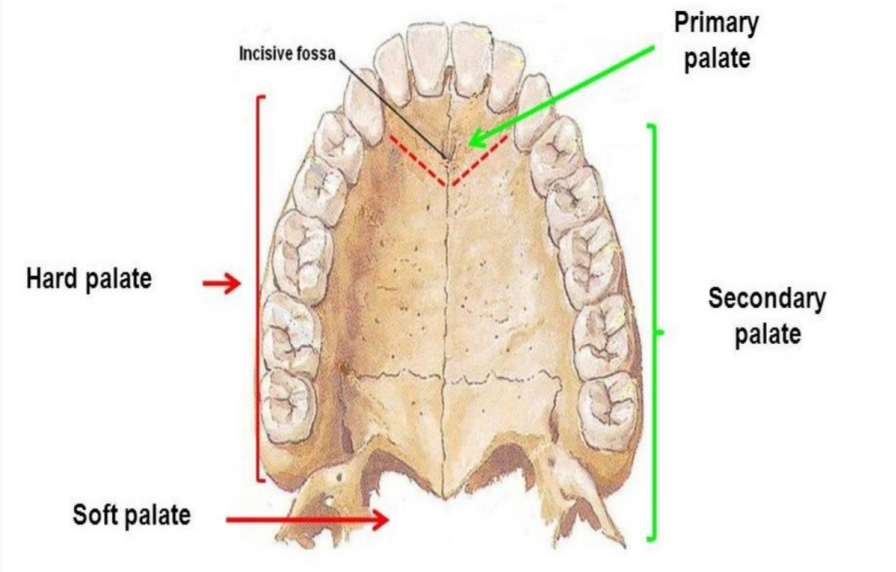
Maxillary Processes

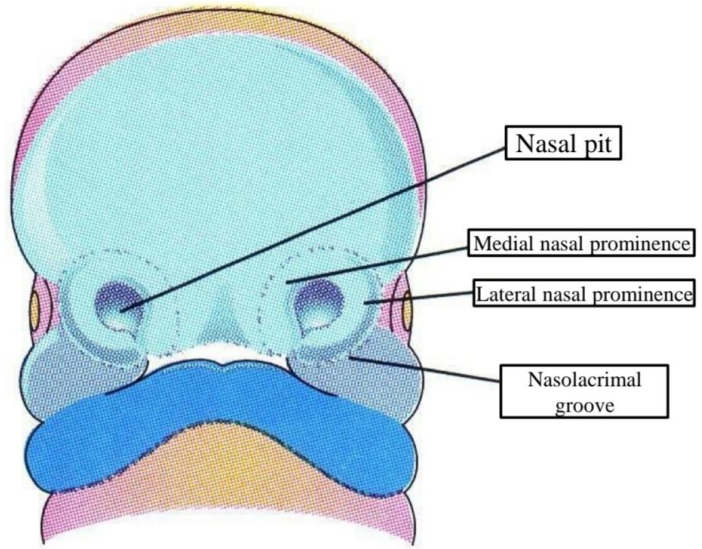
Lower eyelid	Upper part of cheek
Upper lip, except for the philtrum	Upper jaw, excluding the portion carrying the upper incisors
Most of the hard palate	

The maxillary processes originate as forward growths from the dorsal end of the first pharyngeal arch. Each maxillary process is separated from the intermaxillary segment. It also partially fuses with the mandibular process to form the cheek. Palatine processes, projections from the maxillary processes, extend inward to form the secondary palate. This divides the stomodeum into the upper nasal and lower oral cavities. The maxillary processes are responsible for forming several key facial structures, including:

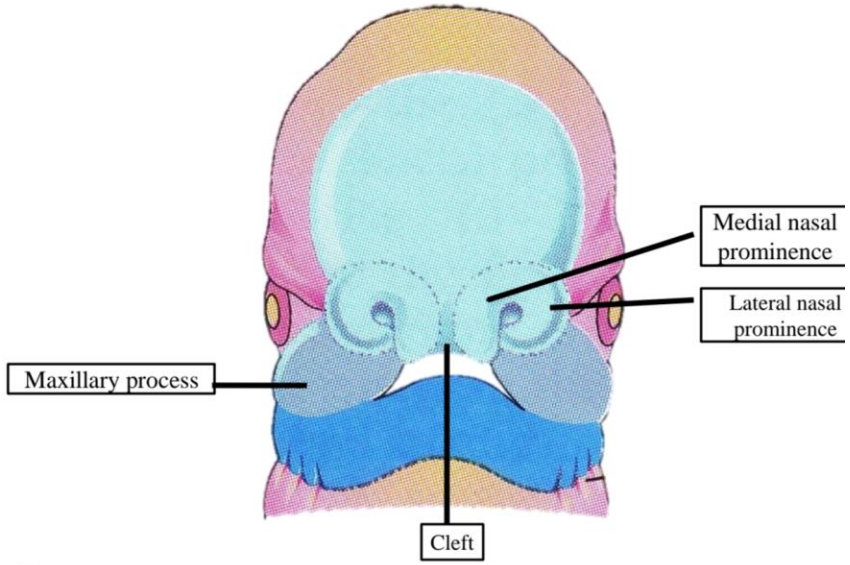
Mandibular Processes and Palate Development

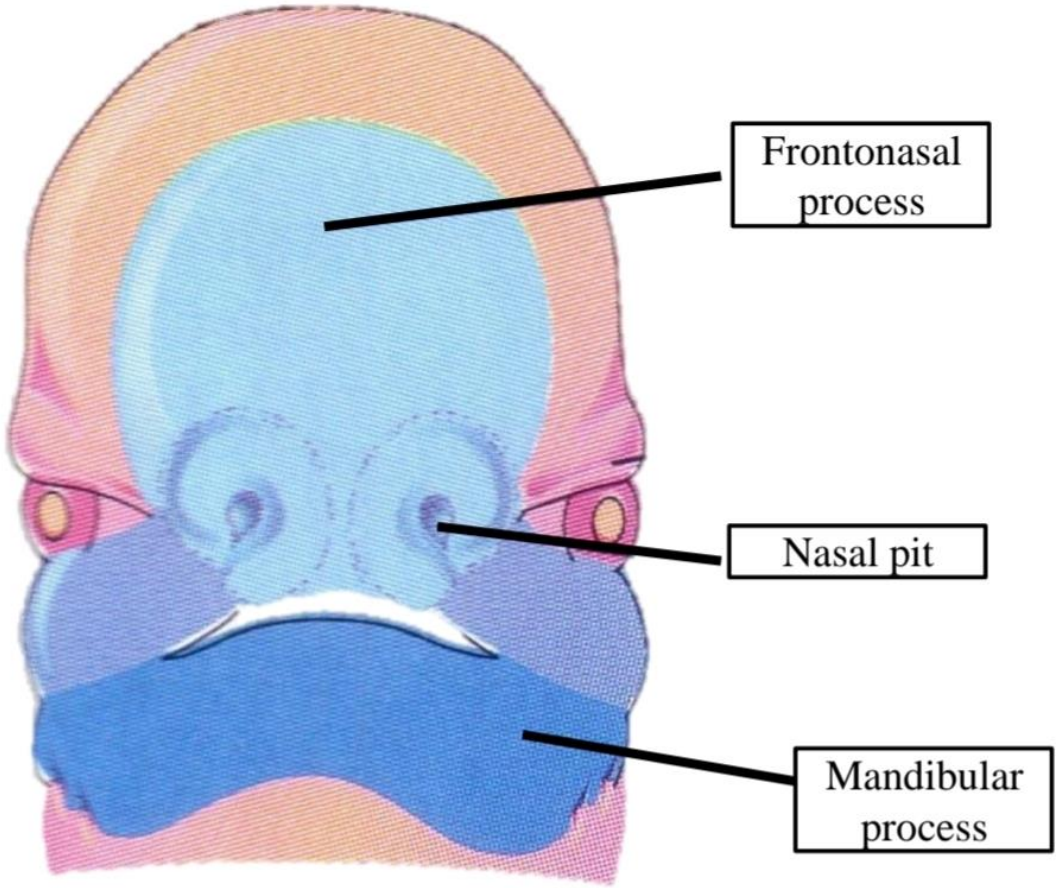
The mandibular processes arise as forward growths from the ventral end of the first pharyngeal arch. These processes contribute to the formation of the lower part of the cheek, the entire lower lip, the lower jaw, and the floor of the mouth. Palate development occurs in two stages. The **primary palate** develops from the intermaxillary segment of the fronto-nasal process. The **secondary palate** is formed by the palatine shelves of the maxillary processes, which contribute to most of the hard palate and the soft palate. The hard palate receives the downward growth of the nasal septum.




Nasal pit
Medial nasal prominence
Lateral nasal prominence
Nasolacrimal groove

33 days


Medial nasal prominence
Lateral nasal prominence
Maxillary process
Cleft


Frontonasal process
Nasal pit
Mandibular process

Formation and Pathogenesis of Dermoid Cysts

Embryonic Origin

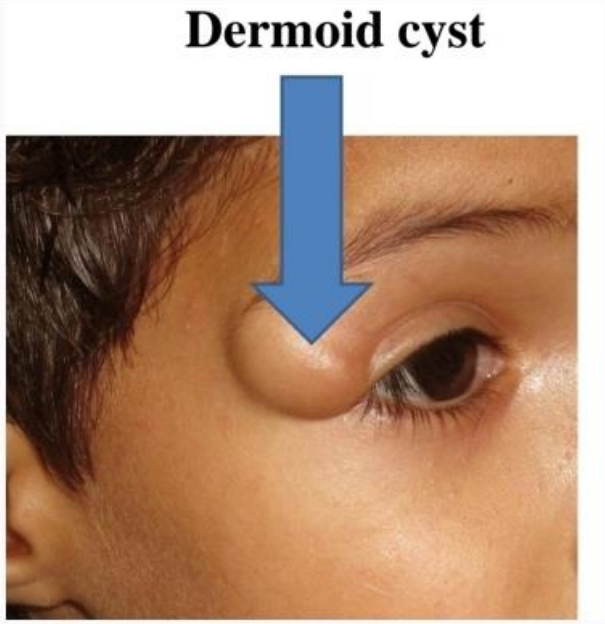
Dermoid cysts originate from ectodermal tissue becoming trapped during embryonic fusion of the frontonasal and maxillary processes.

Differentiation

The trapped ectoderm then differentiates into its derivatives, forming a cyst lined with skin-like structures.

Skin Appendages

The cyst may contain hair fibers, nerve tissue, teeth, sweat glands, and sebaceous glands. These are called skin appendages, hence the alternative name "epidermoid cyst."



Clinical Presentation and Management

Periorbital Dermoid Cyst

The most common location is the periorbital region, specifically on the lateral side of the eye along the junction between the upper and lower eyelids.

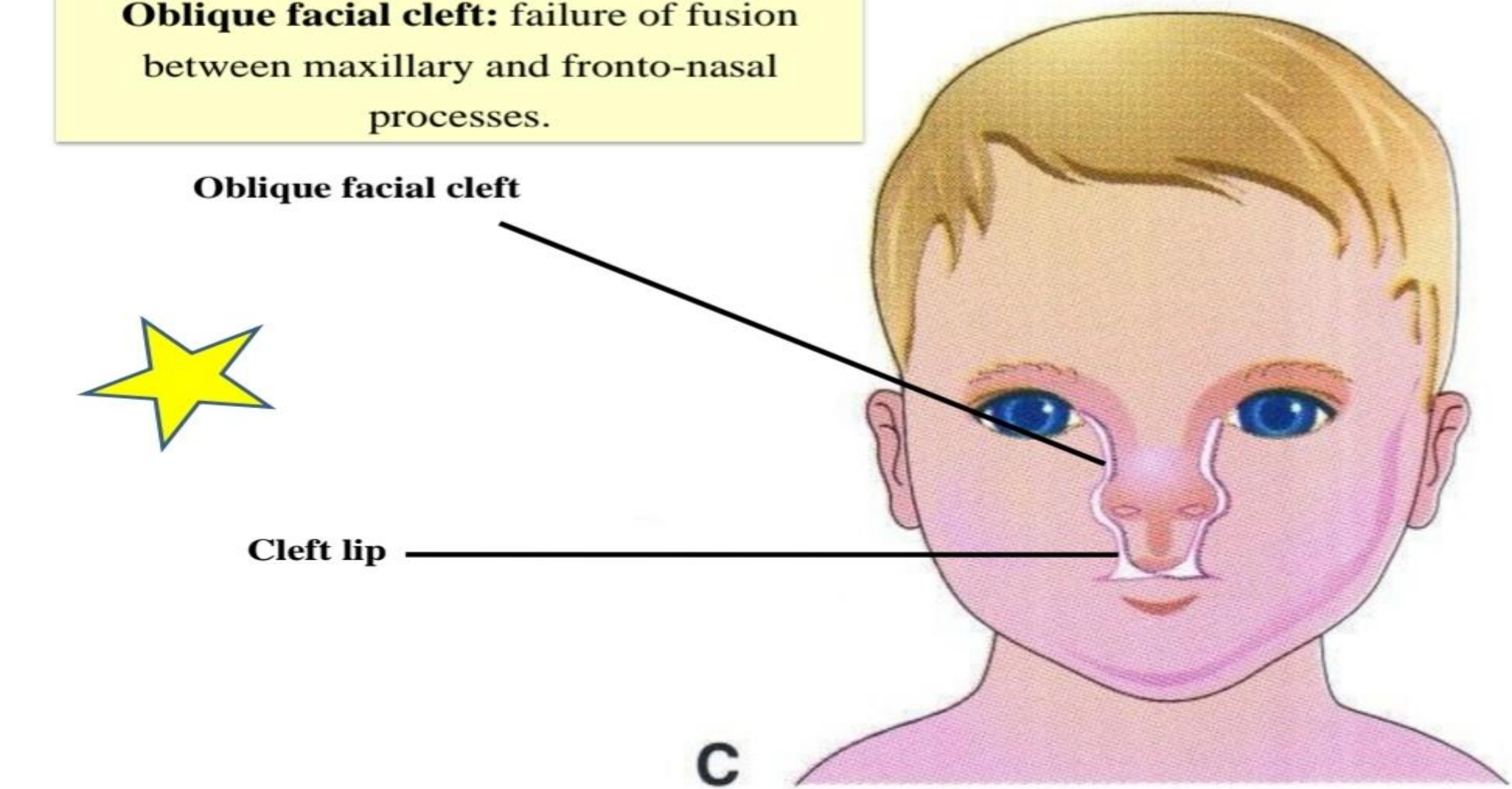
Clinical Significance

Usually, dermoid cysts have no significant clinical consequences.

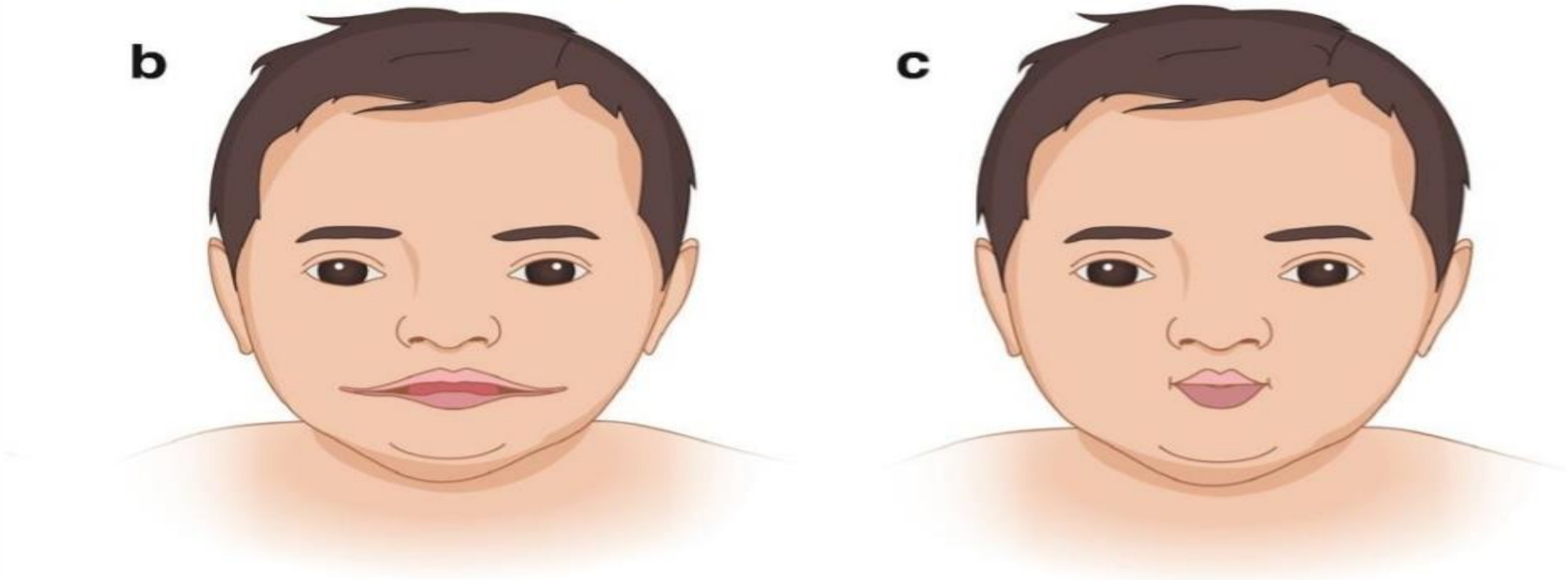
Treatment

Treatment primarily involves surgical removal

Oblique facial cleft: failure of fusion between maxillary and fronto-nasal processes.



Macrostomia or Microstomia: defective or marked fusion between maxillary and mandibular processes

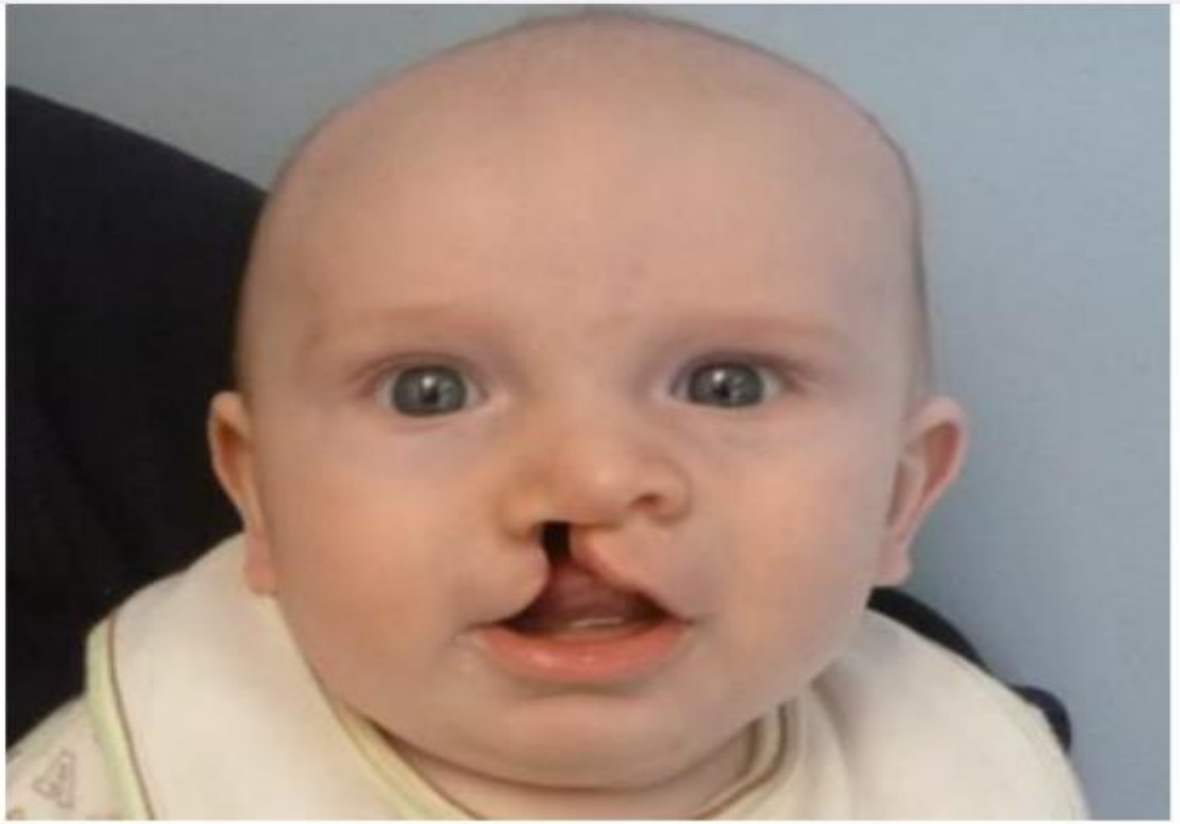


Macrostomia

Microstomia

Unilateral Cleft lip

Cleft (hare) lip: cleft lip due to failure of fusion between maxillary process and intermaxillary segment.



Bilateral Cleft lip

Median cleft lip:
Results from malfusion of the medial nasal prominences

Cleft Lower Lip
The cleft is exactly central and is caused by incomplete fusion of the mandibular processes

Cleft of the primary palate

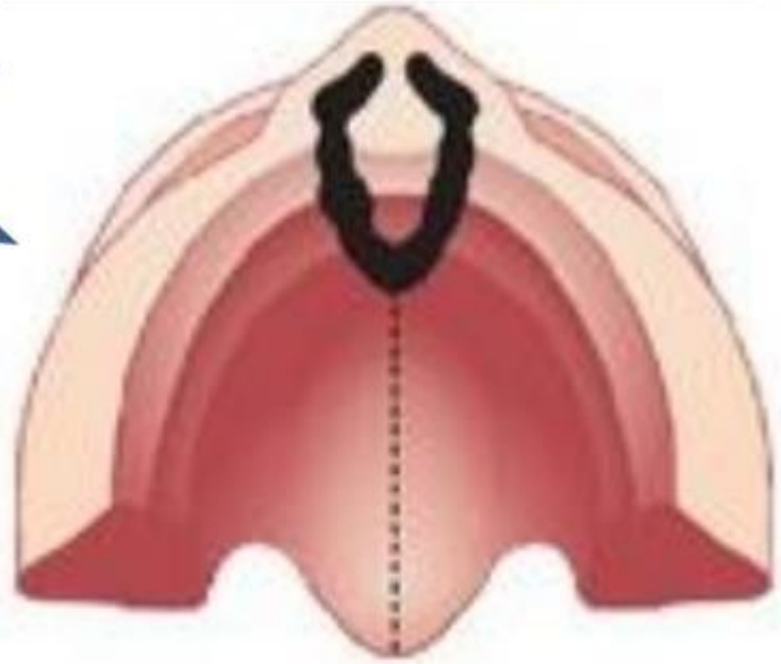
✓Results from failure of the maxillary process to fuse with the intermaxillary segment

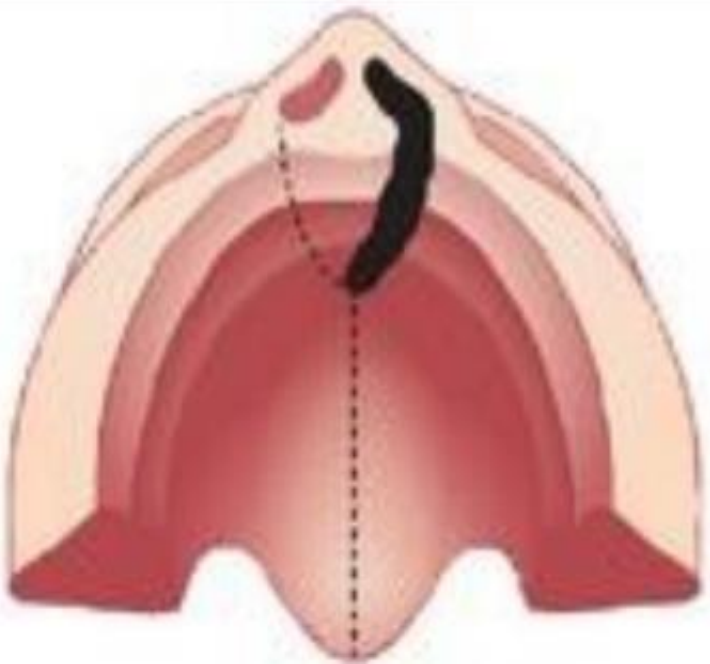
✓Takes place **anterior to the incisive foramen,** therefore this type is Anterior cleft palate

✓Note: that cleft of the primary palate is always **anterior**

✓Can be unilateral and bilateral

Primary Bilateral Cleft Palate (combined with bilateral cleft lip)	**Primary Unilateral Cleft Palate** (combined with unilateral cleft lip)





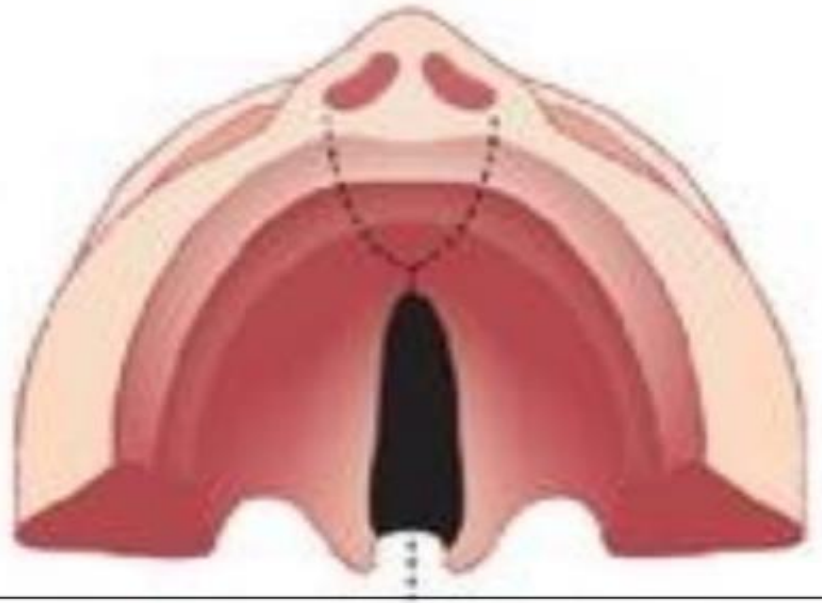
Cleft of the secondary palate

✓ Results from failure of the maxillary processes to fuse with each other

✓ Takes place **posterior to the incisive foramen,** therefore this type is Posterior cleft palate

✓Note that cleft of the secondary palate is always **posterior**

Secondary cleft palate

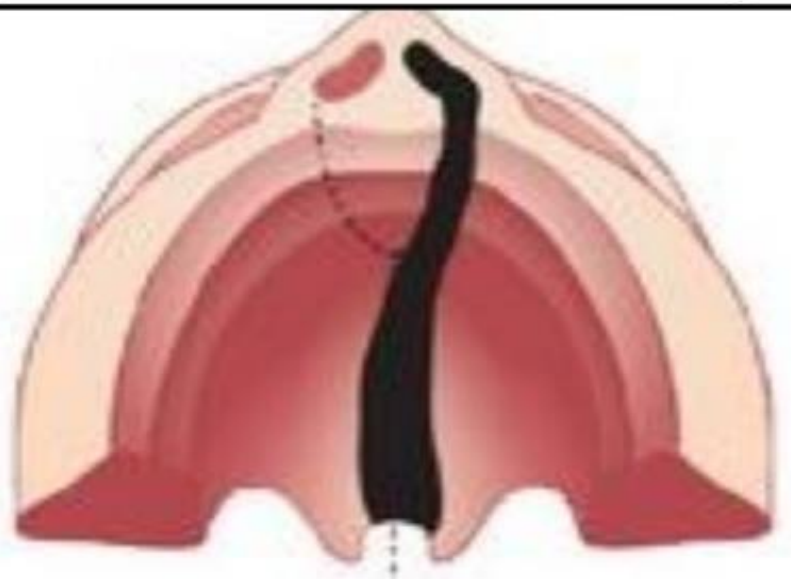


Cleft of the primary and secondary palate

✓Results from failure of the maxillary processes to fuse with each other and with the intermaxillary segment

✓ Takes place **anterior and posterior to the incisive foramen,** therefore this type is mixed anterior and posterior cleft palates

Primary and secondary Cleft palates
(combined with unilateral cleft lip)



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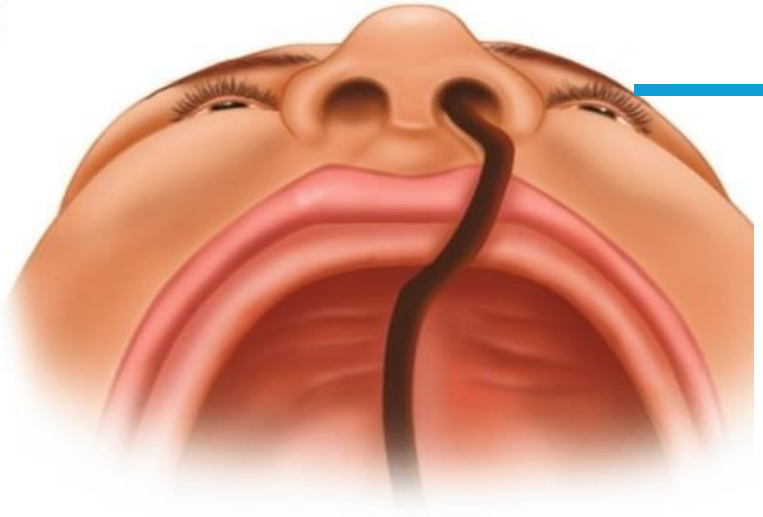
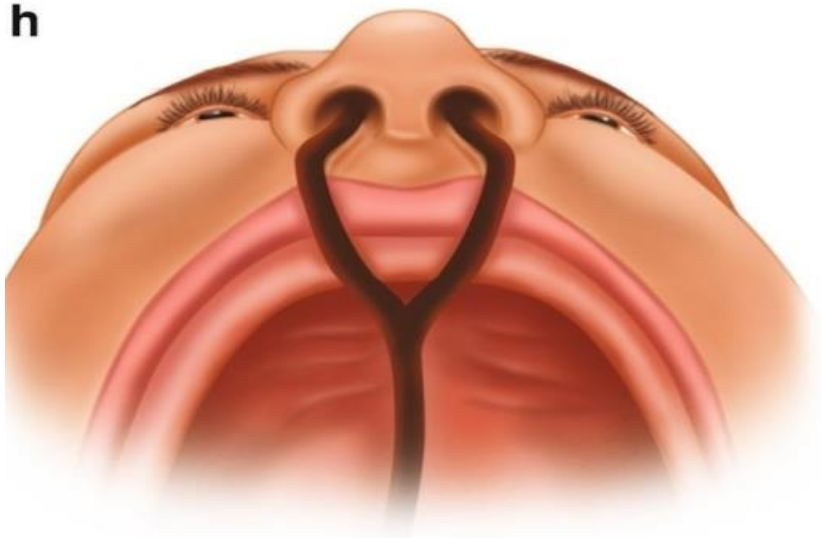


Unilateral complete cleft lip and palate

h



Bilateral Cleft Lip & Palate

Primary and secondary Cleft palates
(combined with unilateral cleft lip)

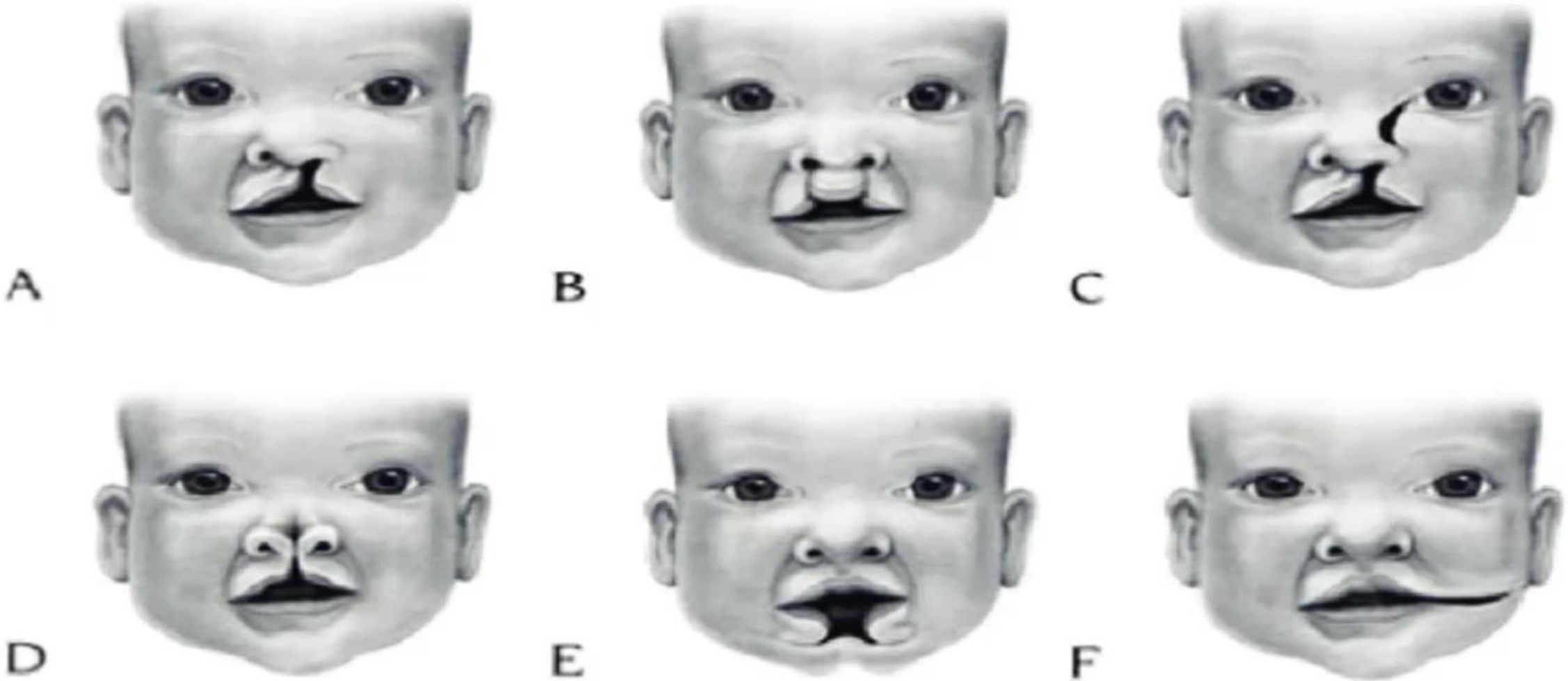
Secondary cleft palate

Cleft uvula

Some orofacial clefts—like cleft lip, cleft palate, oblique facial cleft, and macrostomia—can be unilateral or bilateral.

Cleft uvula:is a minor form of cleft palate resulting from incomplete fusion of the palatine shelves at the posterior end of the soft palate. It occurs despite complete fusion of the primary and secondary palates. It has no clinical consequences and is usually asymptomatic.

Try to figure out the embryonic rationale behind the following orofacial anomalies



(A) unilateral cleft lip; (B) bilateral cleft lip; (C) oblique facial cleft; (D) median cleft lip and nasal defect; (E) median mandibular cleft; (F) unilateral macrostomia.

For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			

رسالة من الكاتب:

﴿ وَإِنَّ السَّاعَةَ لَآتِيَةٌ ۖ فَاصْفَحِ الصَّفْحَ الْجَمِيلَ﴾إستحضارُ الرَّحِيل؛ يُعينُ على الصّفحِ الجَميل قال رسول الله-ﷺ- مَنْ كَانَتْ الْآخِرَةُ هَمَّهُ جَعَلَ اللَّهُ غِنَاهُ فِي قَلْبِهِ، وَجَمَعَ لَهُ شَمْلَهُ، وَأَتَتْهُ الدُّنْيَا وَهِيَ رَاغِمَةٌ. اللهمّ اجعلنا ممنْ سَلِمَت قُلُوبُهم، وَصَفَت سَرائِرُهُم؛فخَرَجَ مِن هذه الدُّنيا آمنًا مُطمَئنا.. 🤲