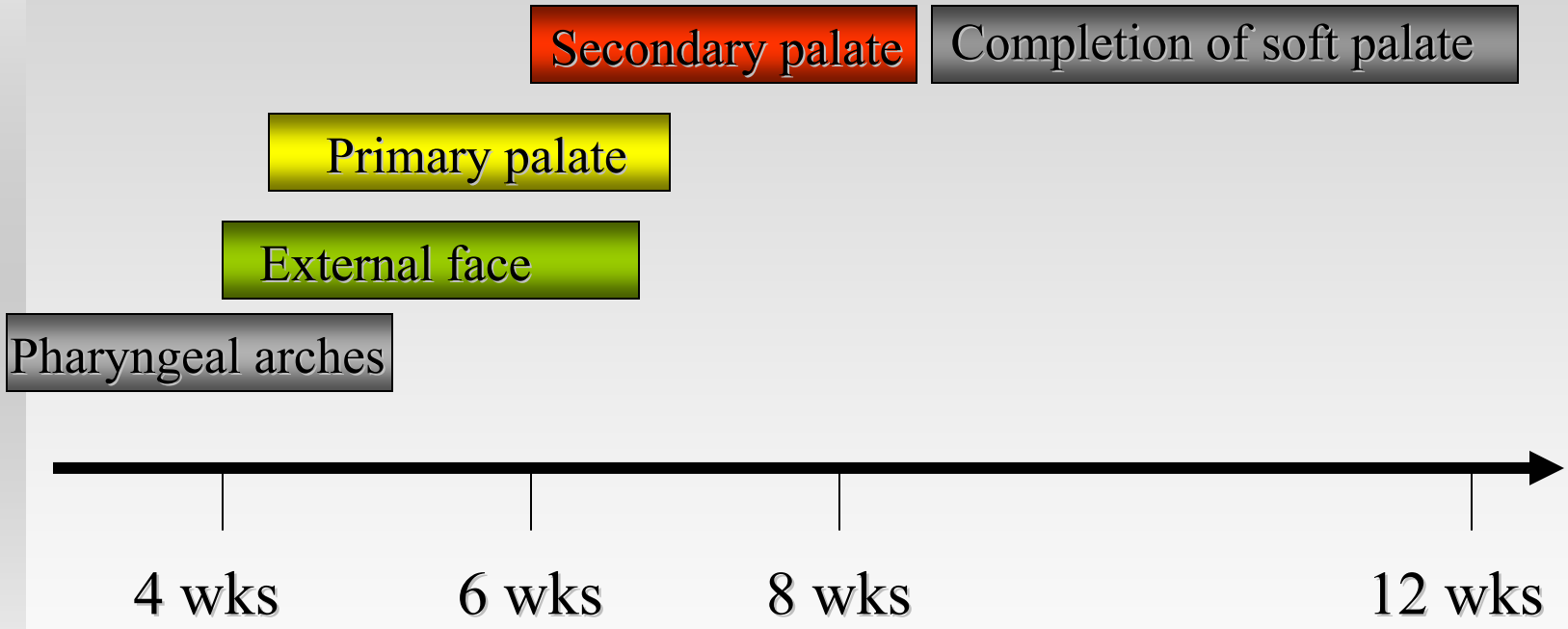
Facial and palatal development

L.Moss-Salentijn

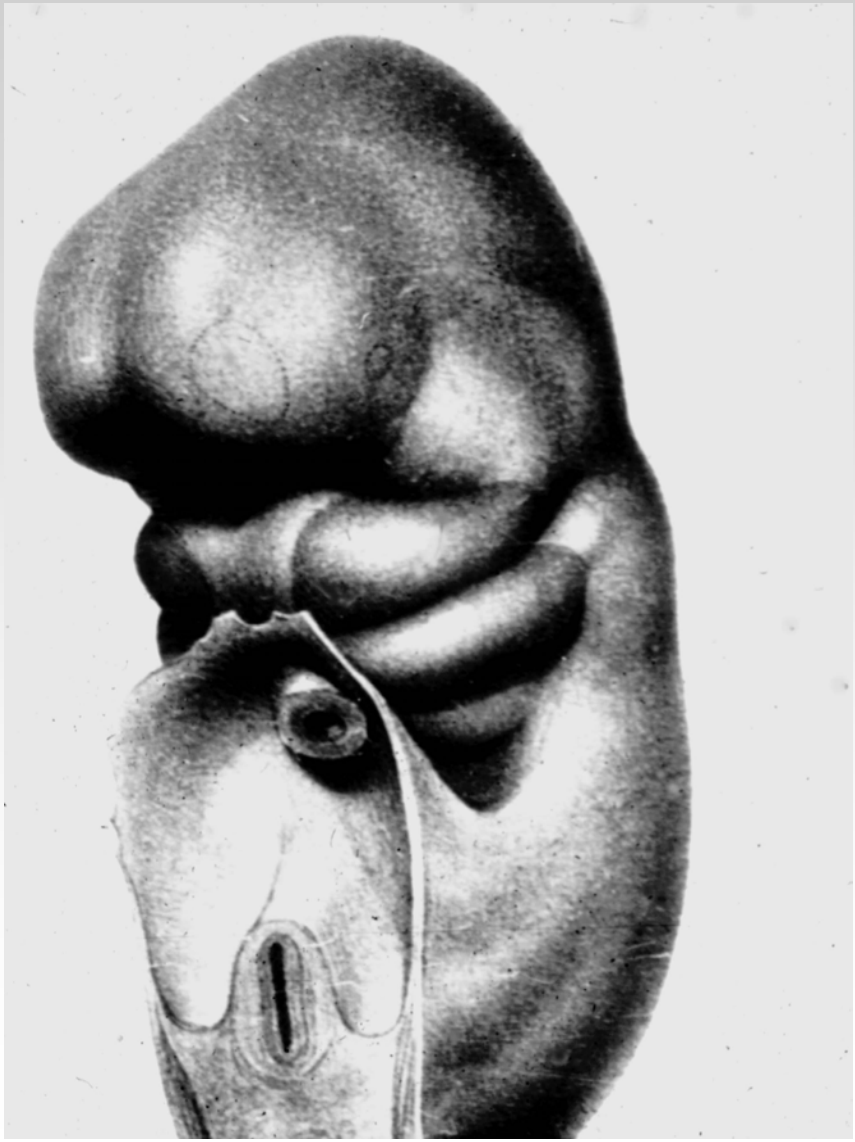
Timeline for development



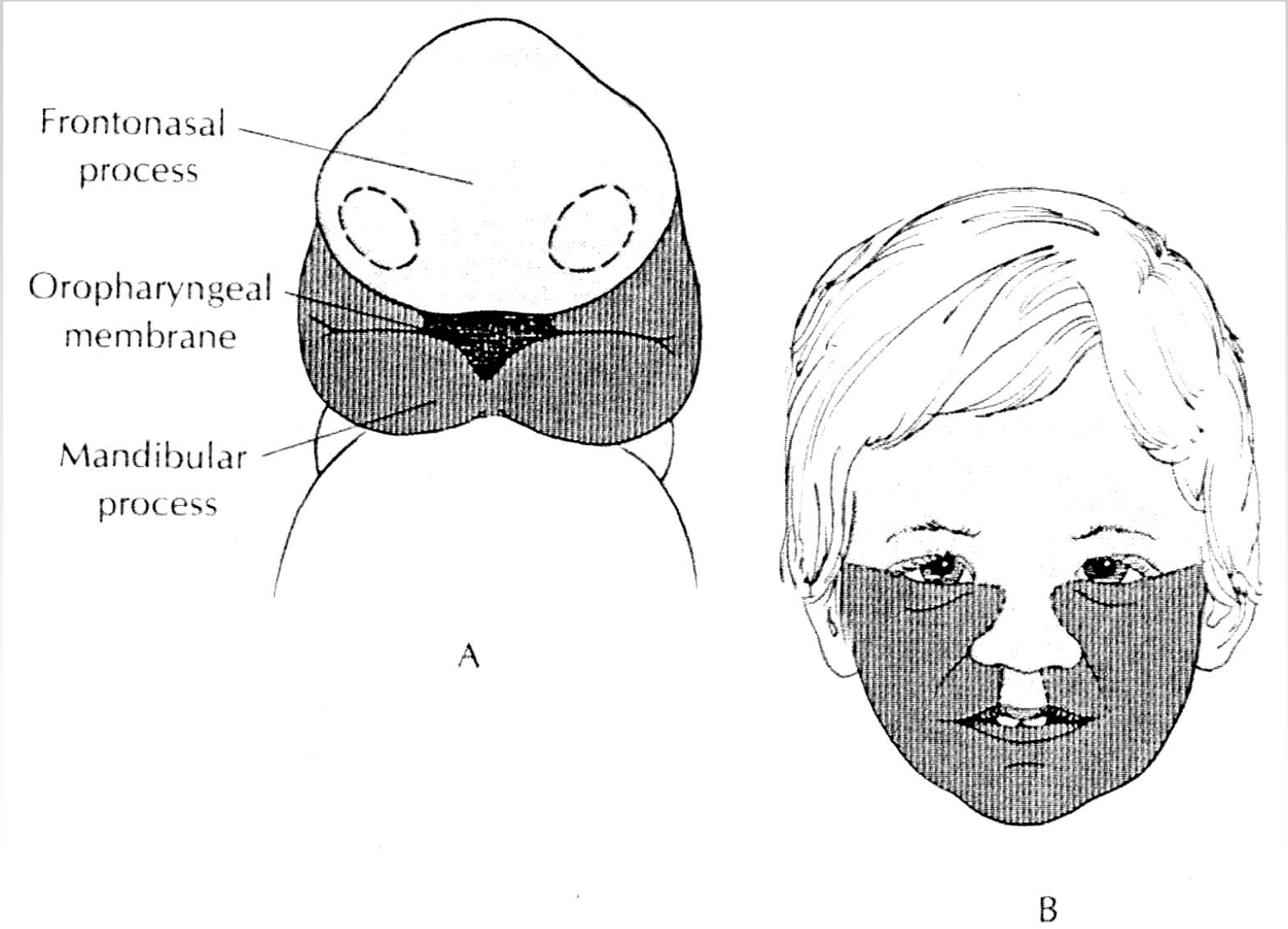
Decrease of severity of potential congenital malformations

Contributions to the external face

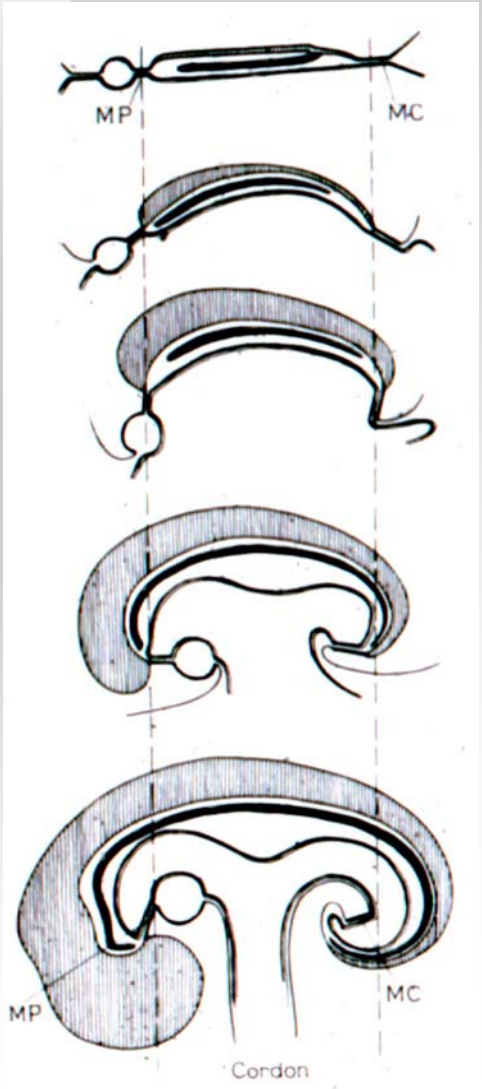
- Periprosencephalon: ectoderm and mostly nc-derived mesenchyme surrounding the forebrain. Frontonasal process.
- First pharyngeal (mandibular) arch. Mandibular and maxillary processes.

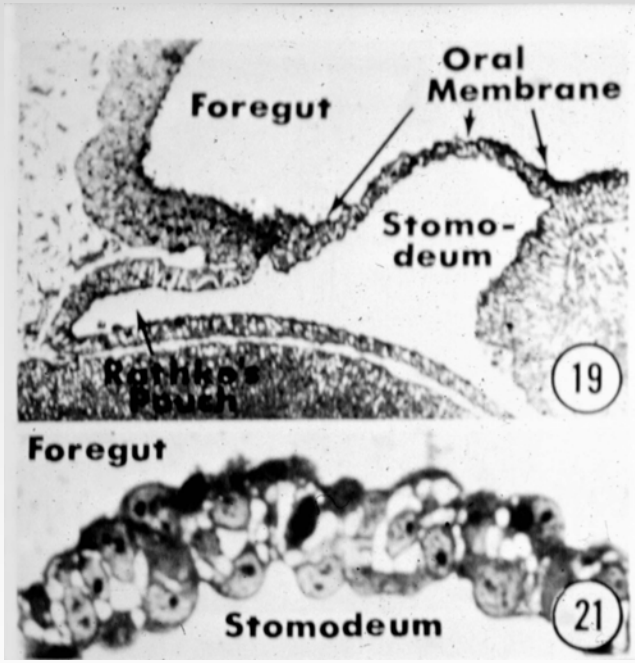


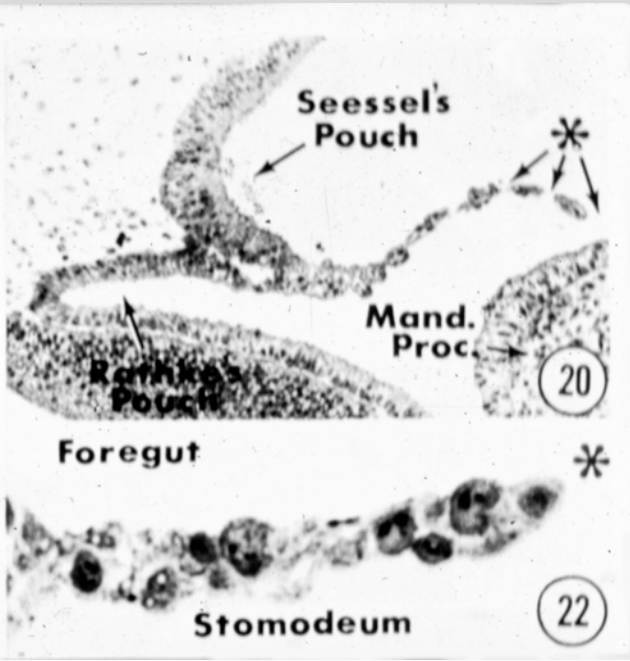
Contributions to external face



Oropharyngeal membrane (buccopharyngeal, oral)

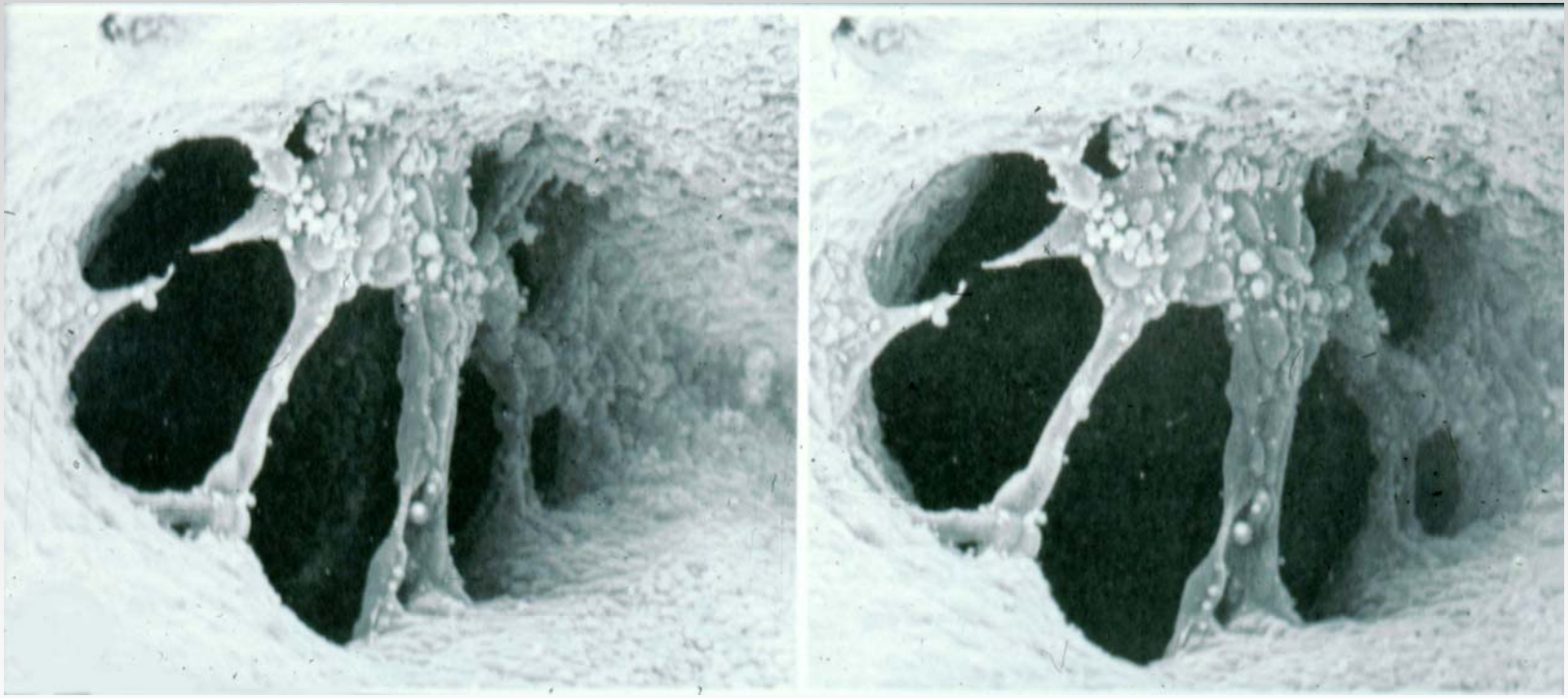






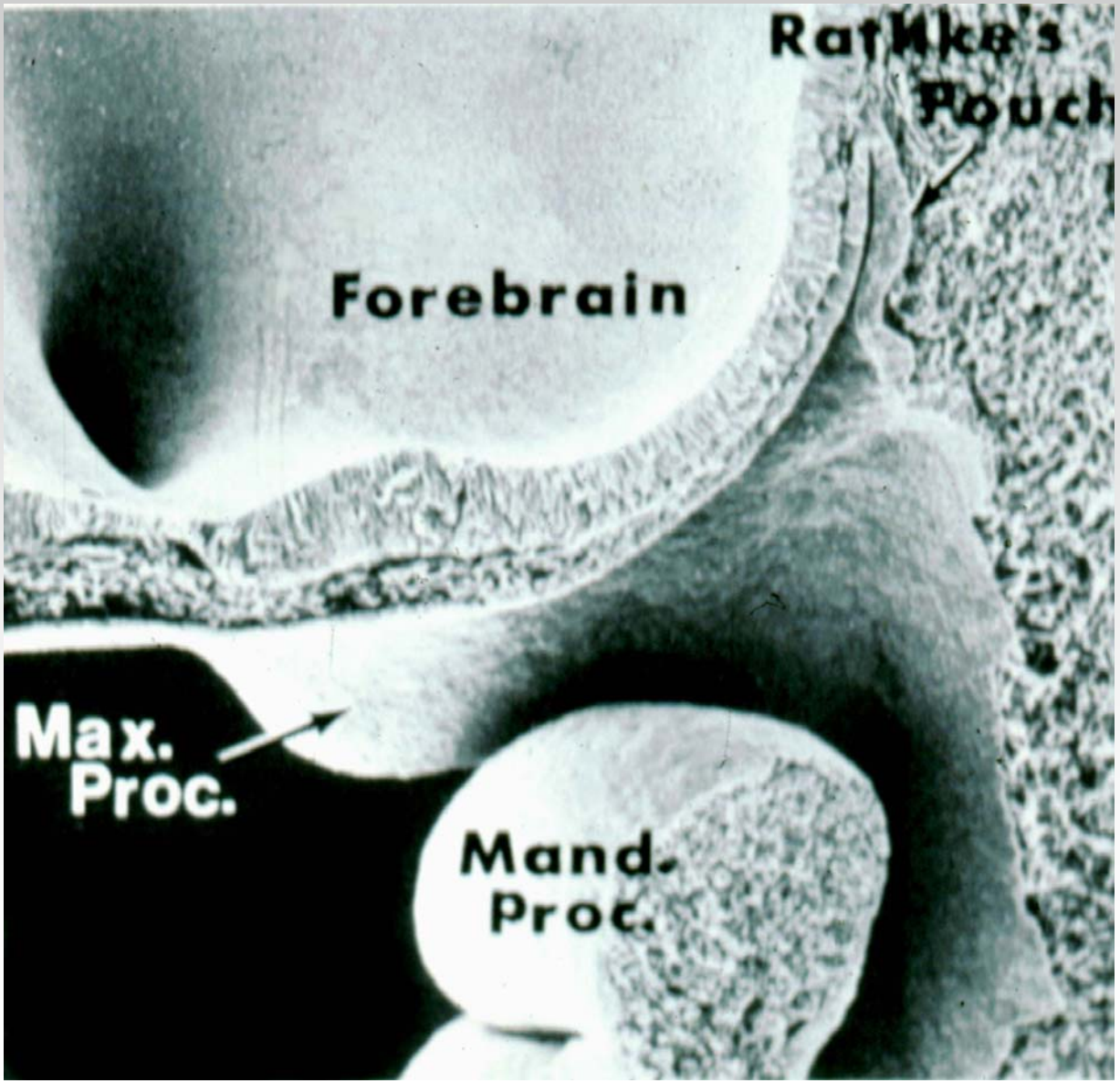
Membrane is composed of ectoderm and endoderm

Disintegration of oropharyngeal membrane

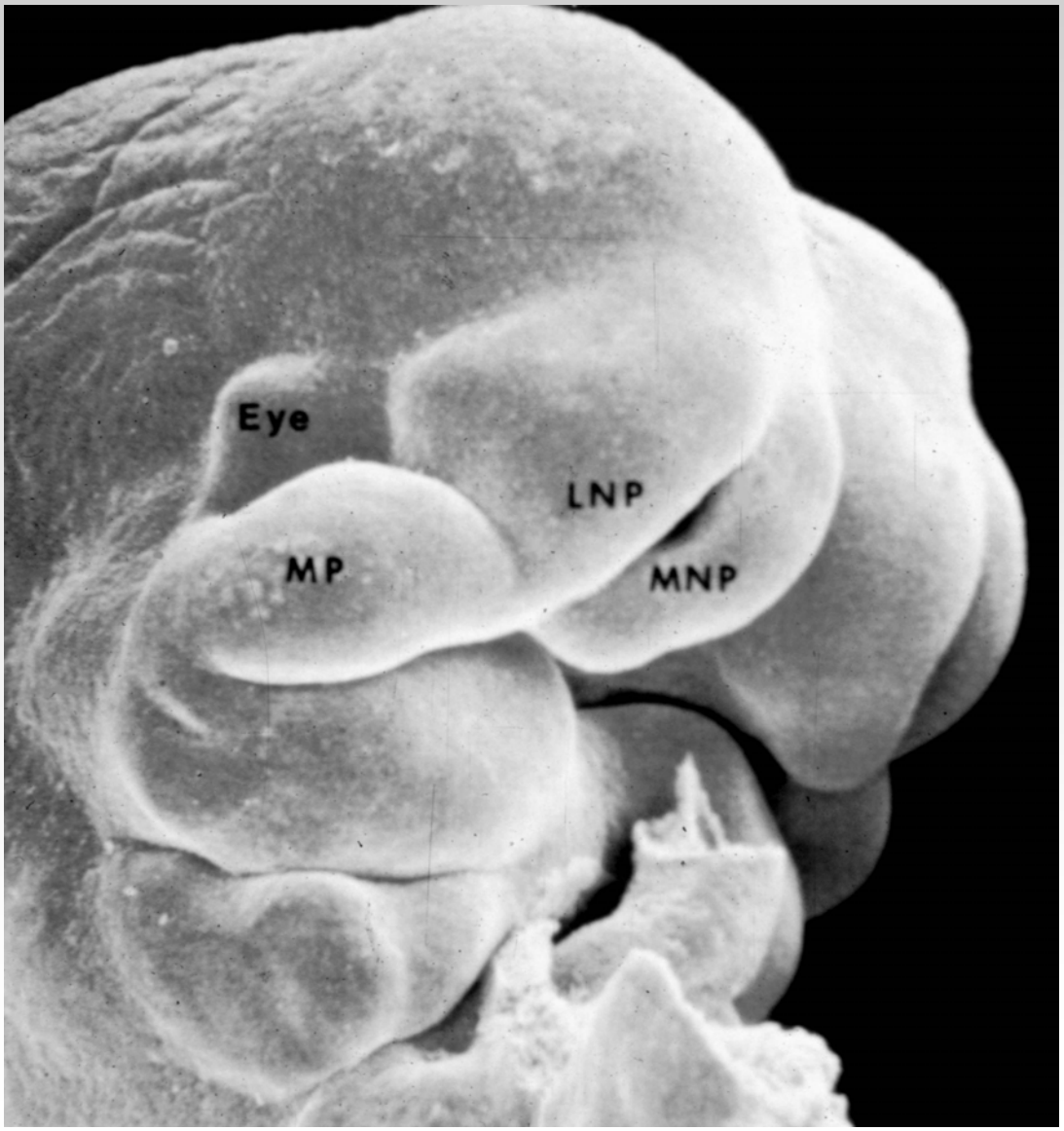


Communication between foregut and amniotic cavity at approximately 4 weeks of development

Stomodeum at 4 weeks



Facial processes (prominences)



Bilaterally:

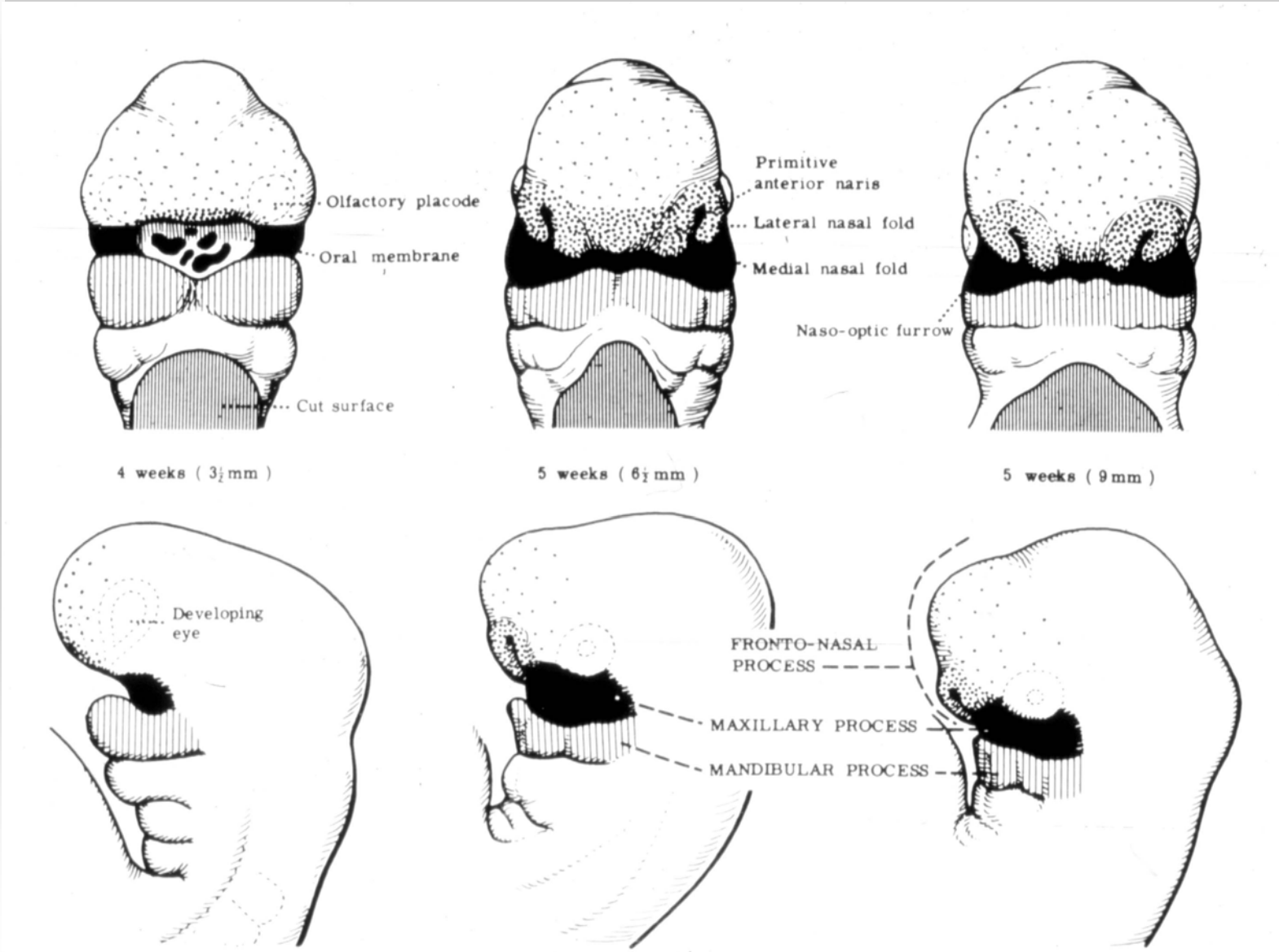
Lateral nasal

Medial nasal

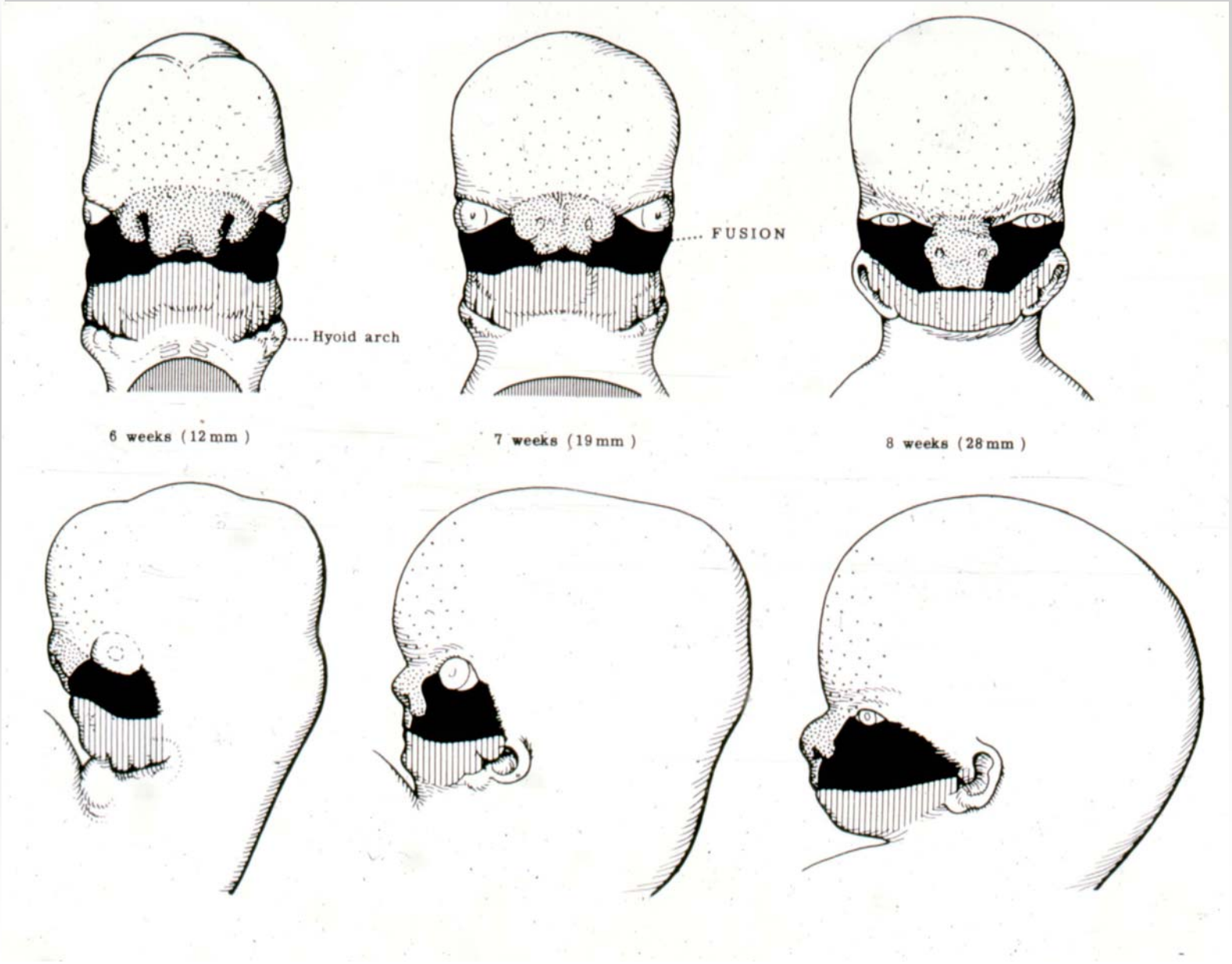
Maxillary

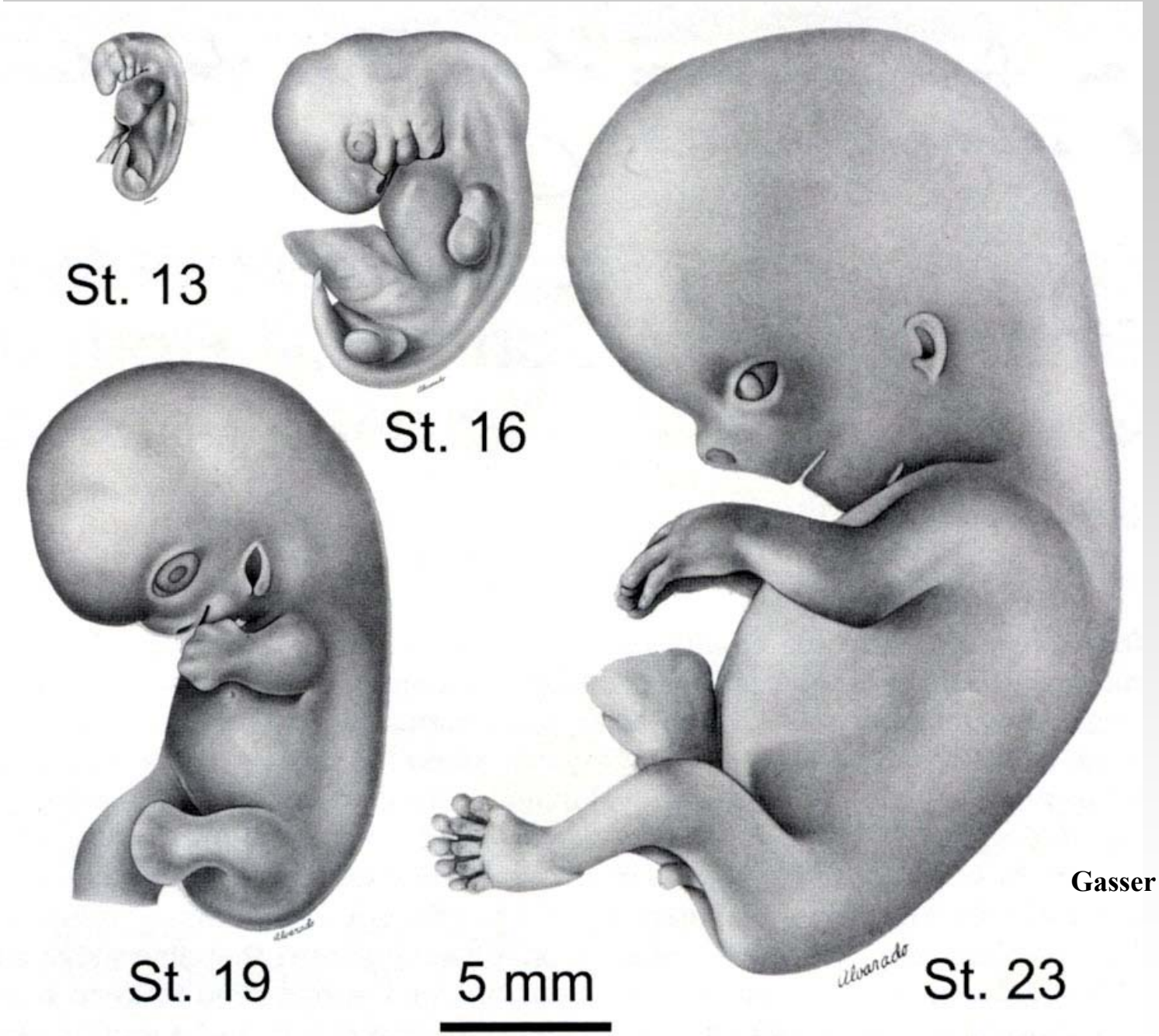
Mandibular

Development external face (4-5 wks)



Development external face (6-8 wks)

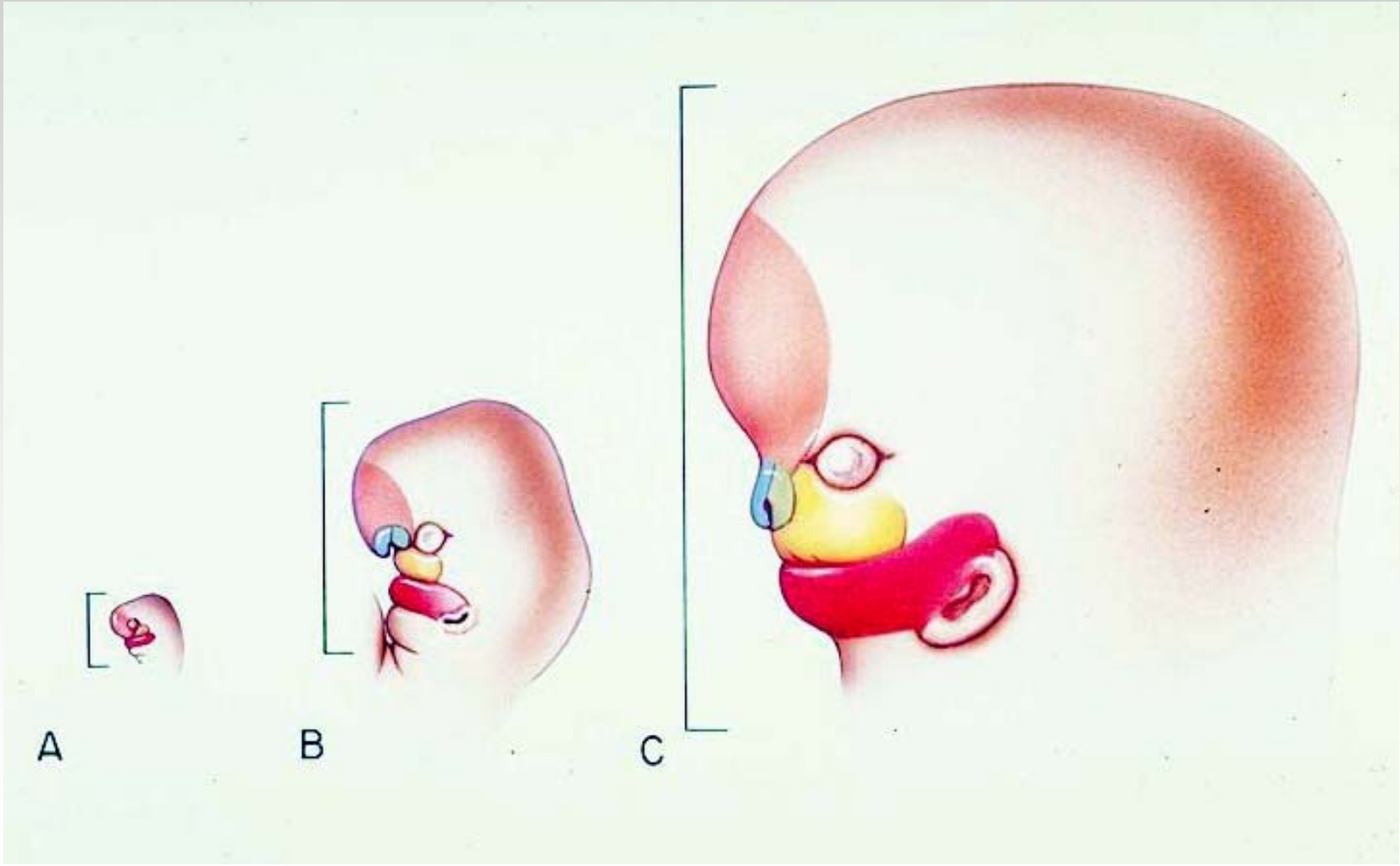




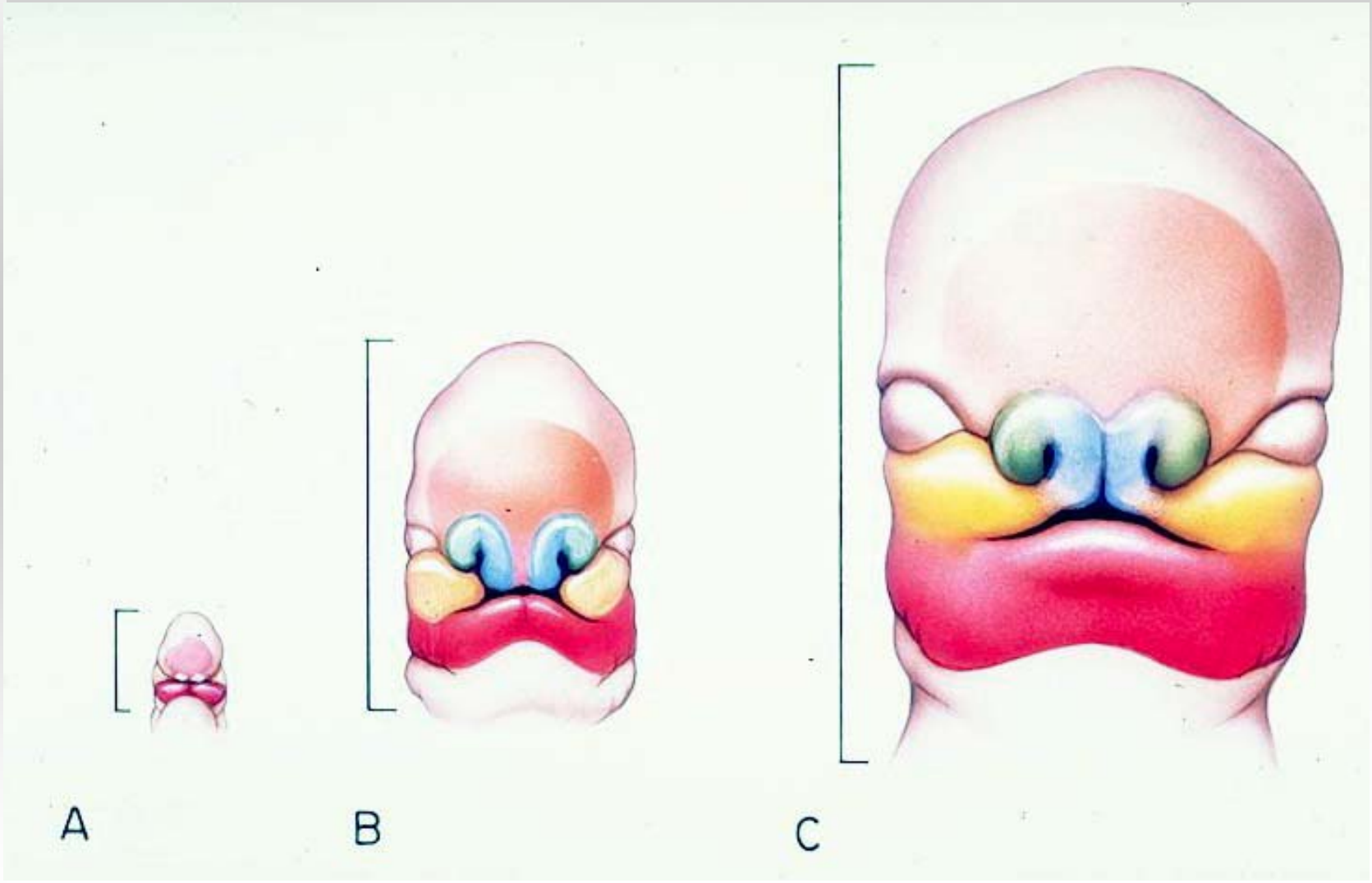
Gasser R (2006)

Face development animation 1

Dimensional changes (4-6 wks)



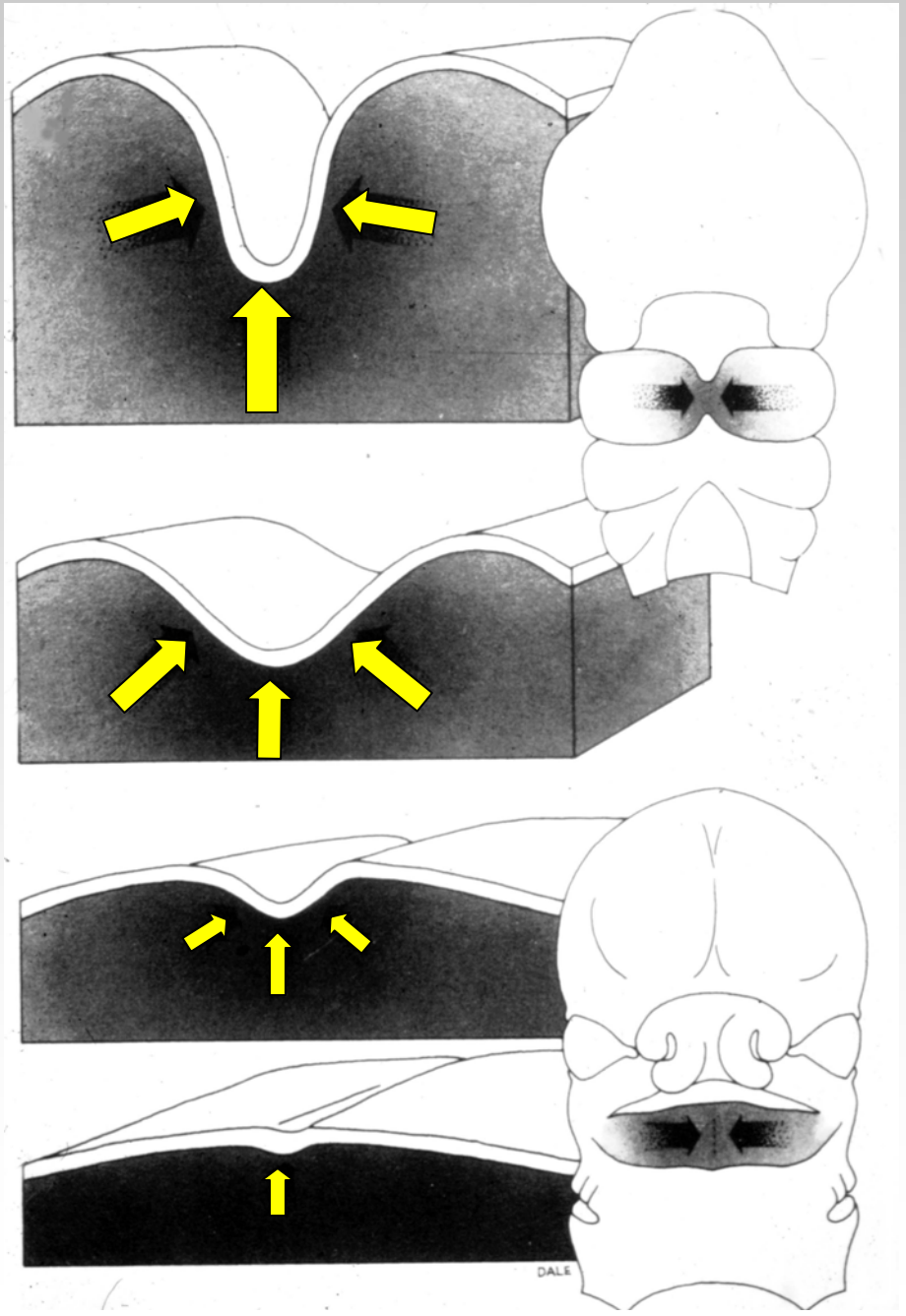
10-fold linear increase in size !



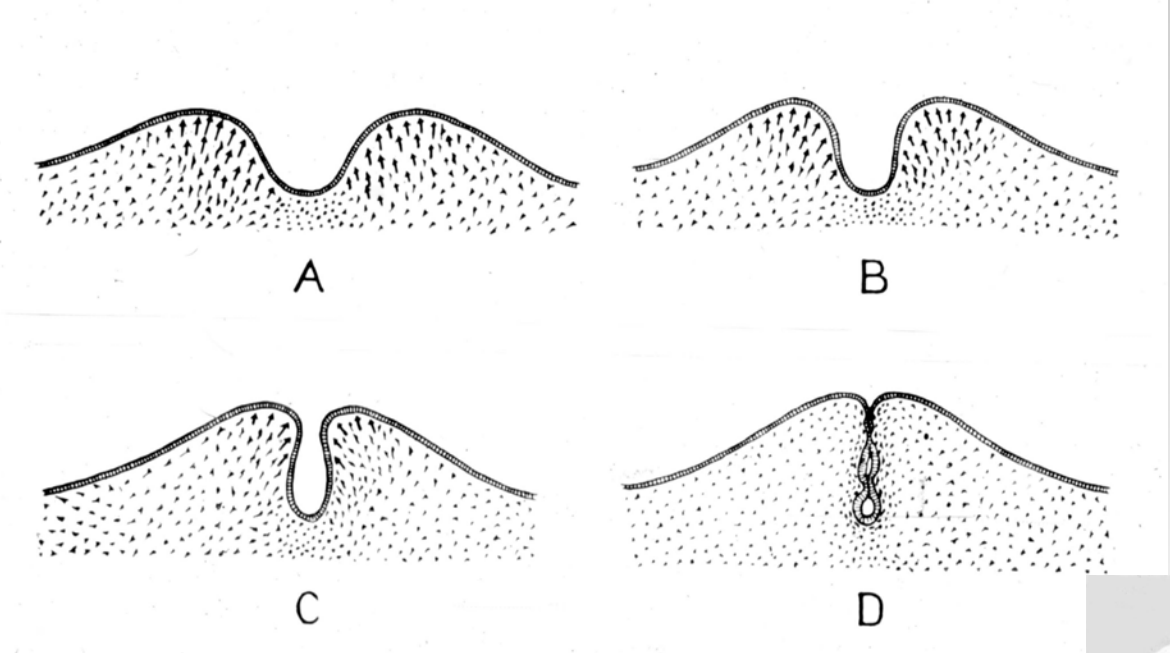
Face development – animation 2

Merging

Differential mesenchymal proliferation. Elimination of groove.

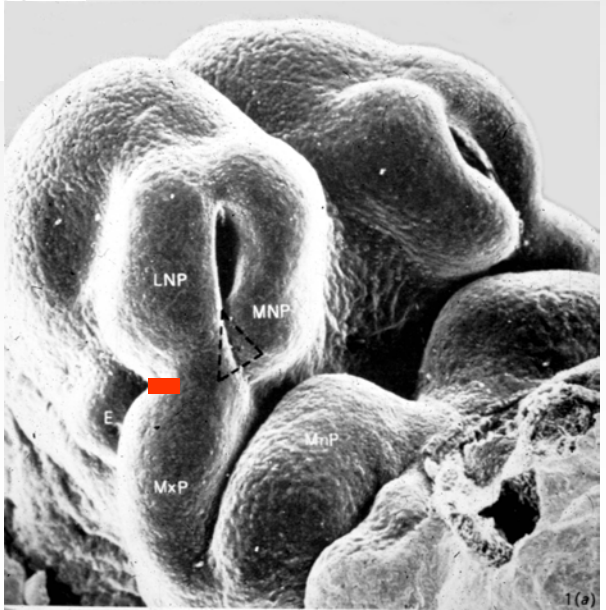


Merging with epithelial inclusion

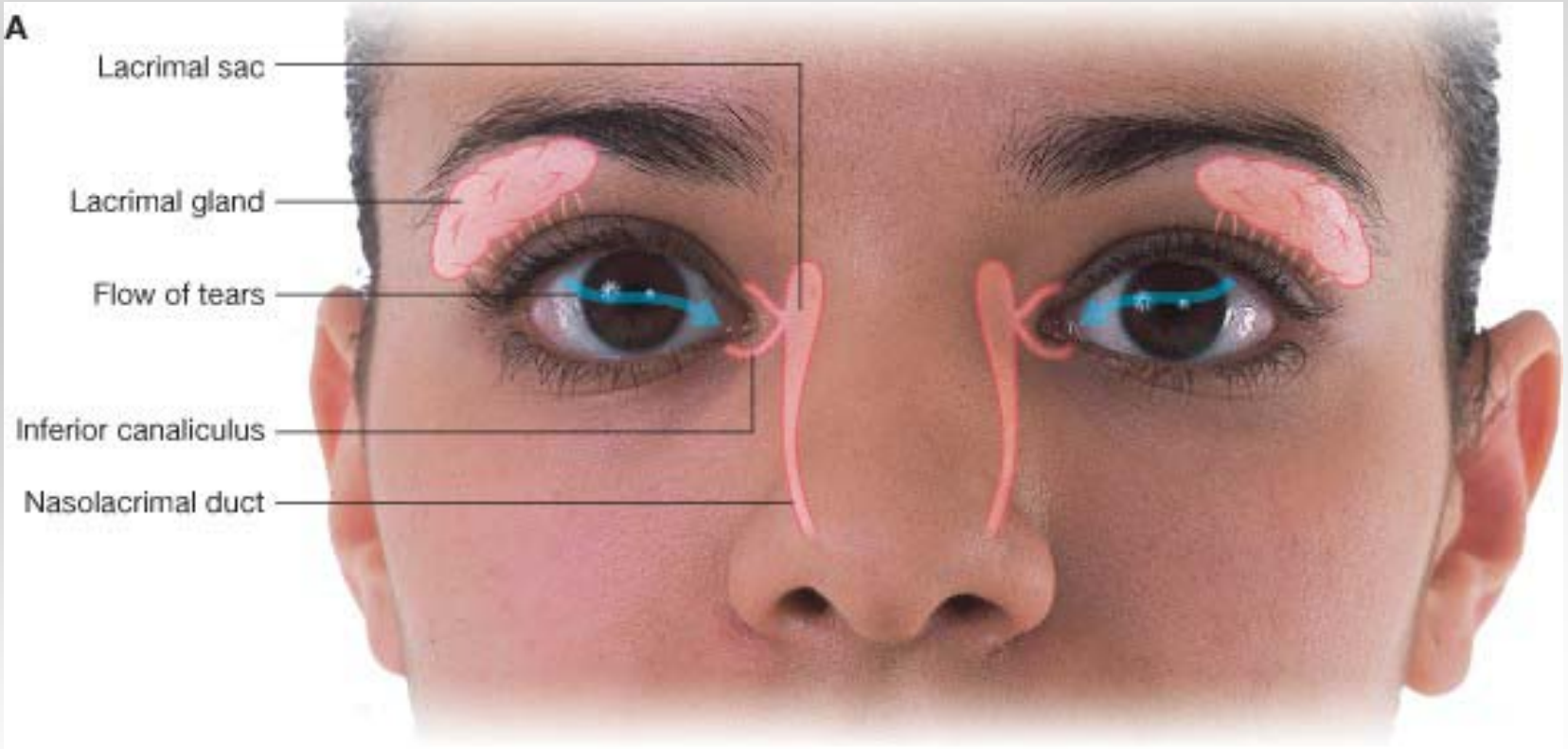


May result in facial cleft.

May be normal between LNP and maxillary process where enclosed epithelium gives rise to part of nasolacrimal duct epithelium.



Nasolacrimal duct between maxillary and lateral nasal processes



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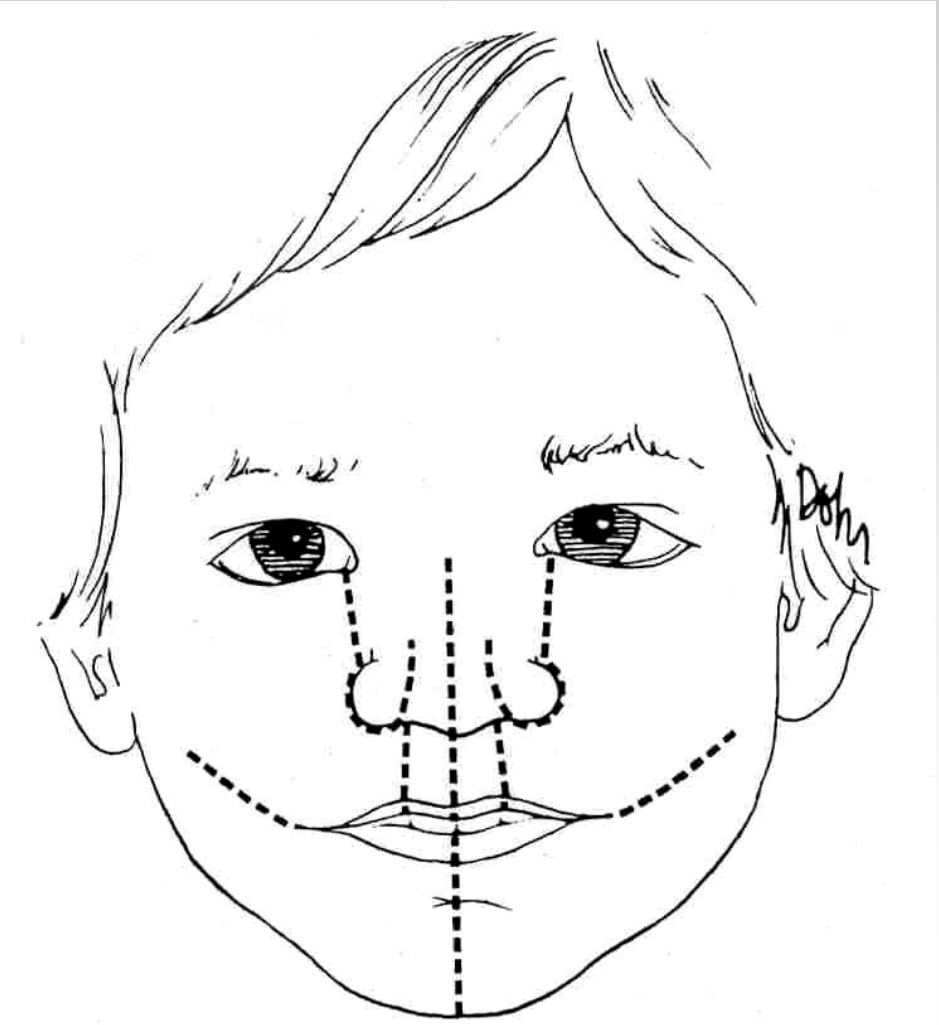
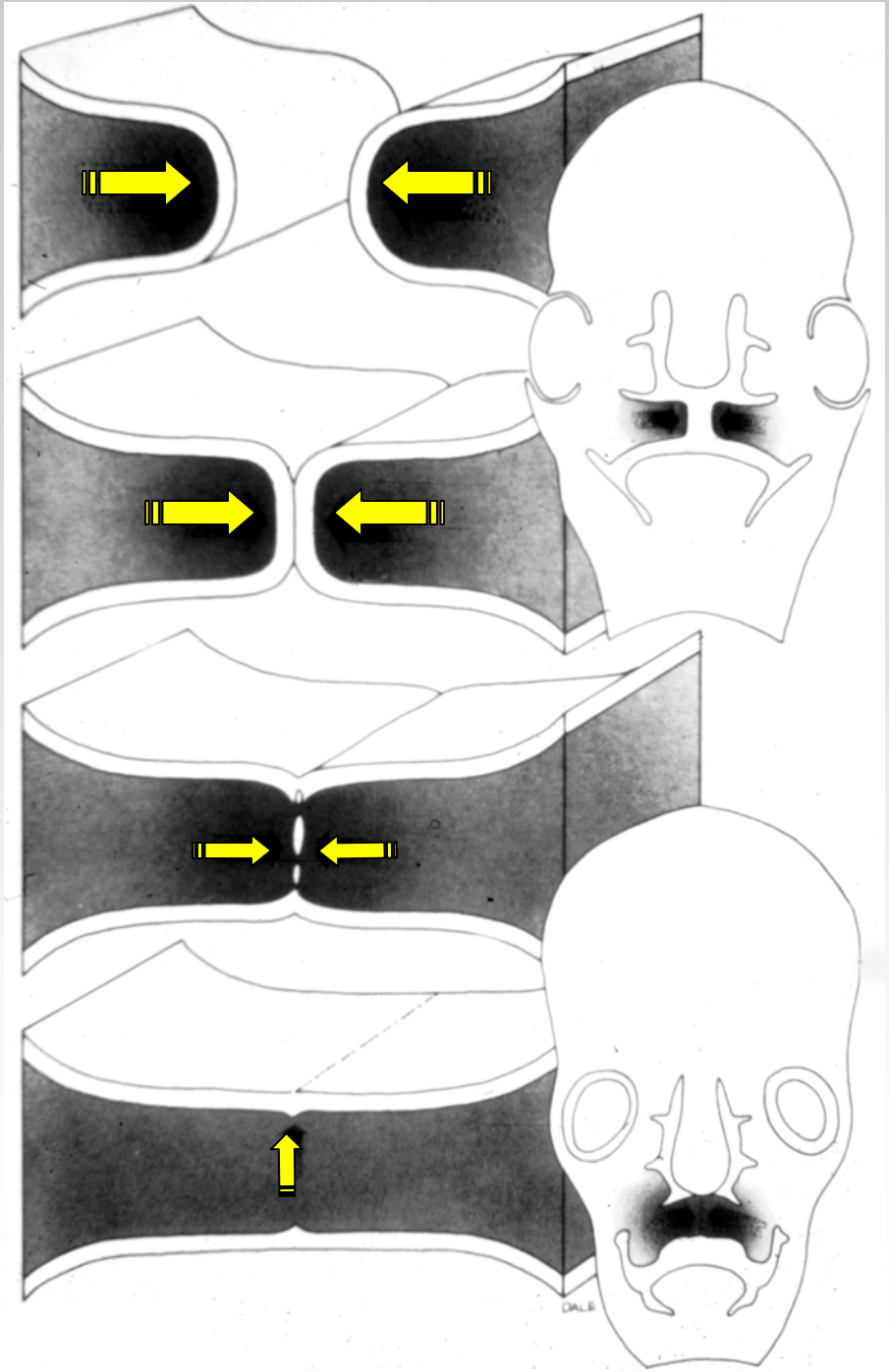
Sites of potential facial clefts

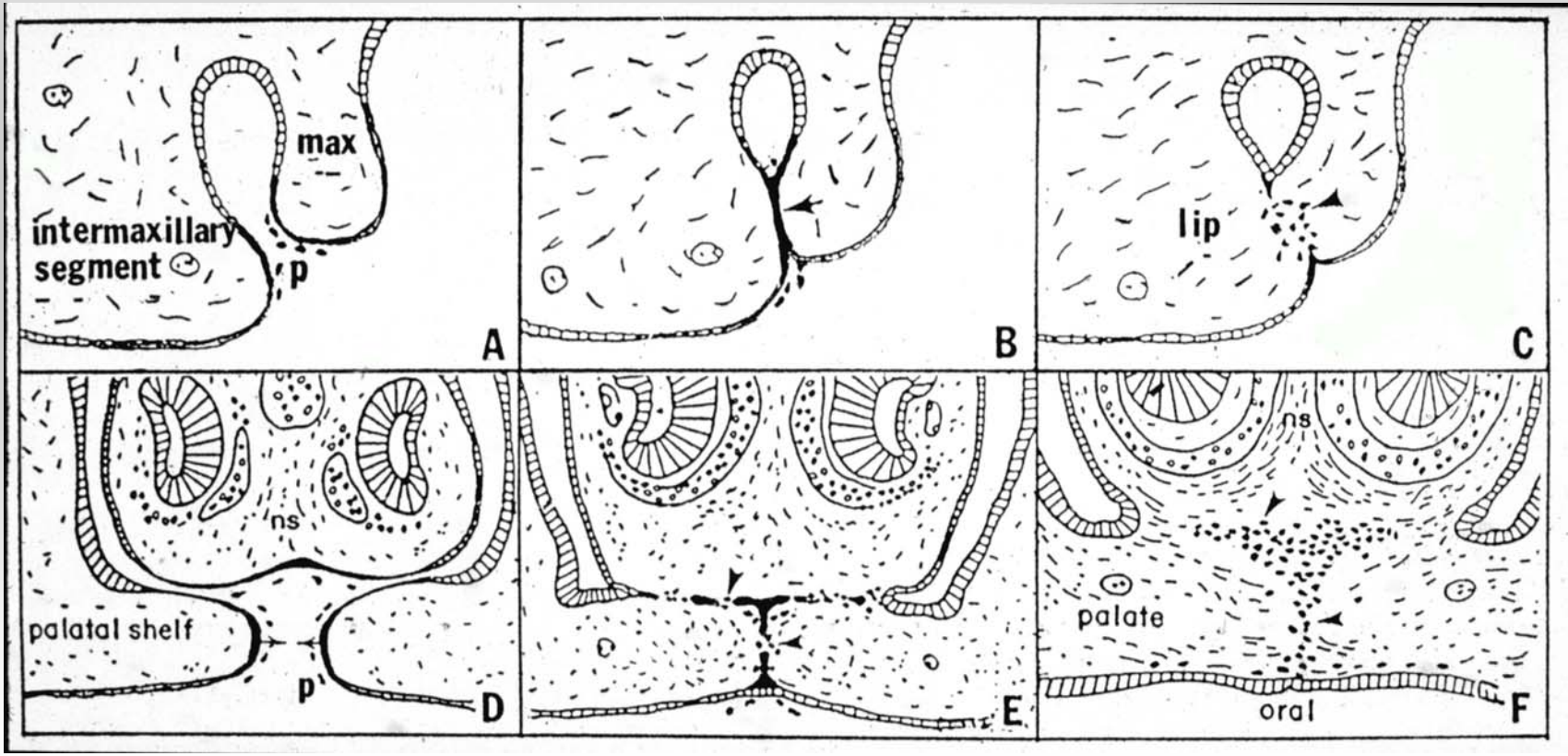


Fusion

Contact and fusion of epithelium-covered surfaces. Removal of epithelium



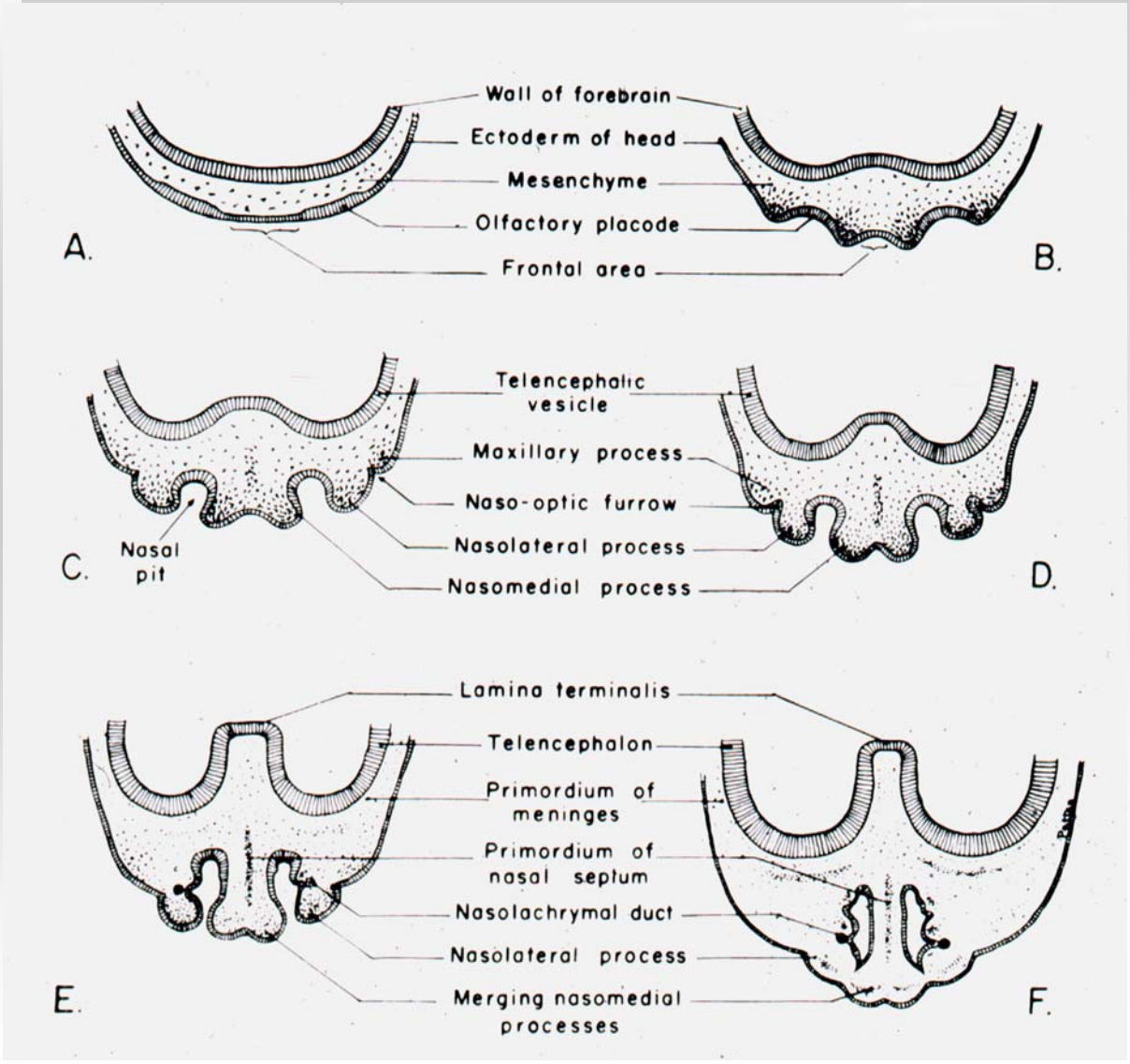
Fusion in primary and secondary palate development

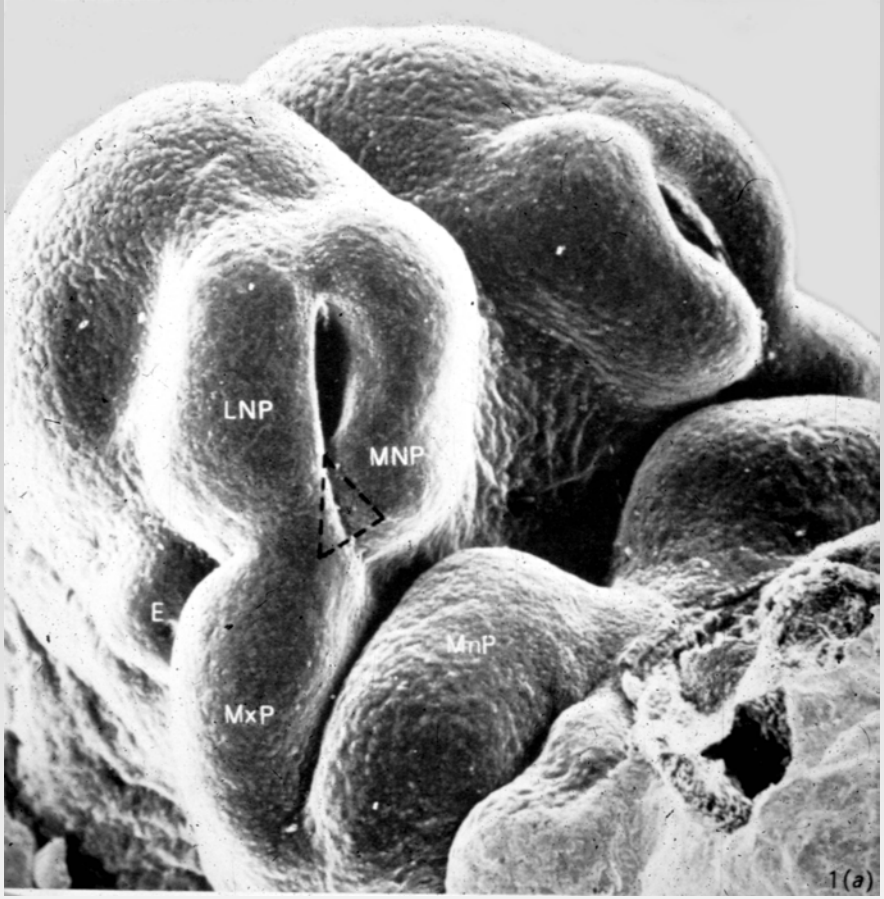


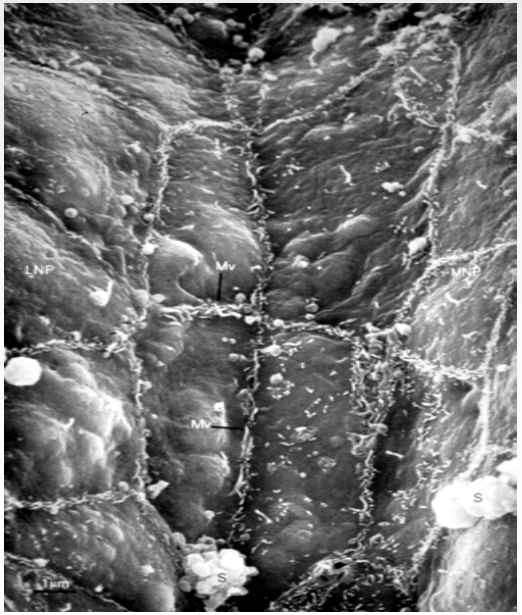
Fate of fused epithelium

- Non-proliferating epithelium in rapidly growing environment: passive stretch and incorporation in nearby surface epithelia
- Apoptosis and phagocytosis
- Epithelial-mesenchymal transformation

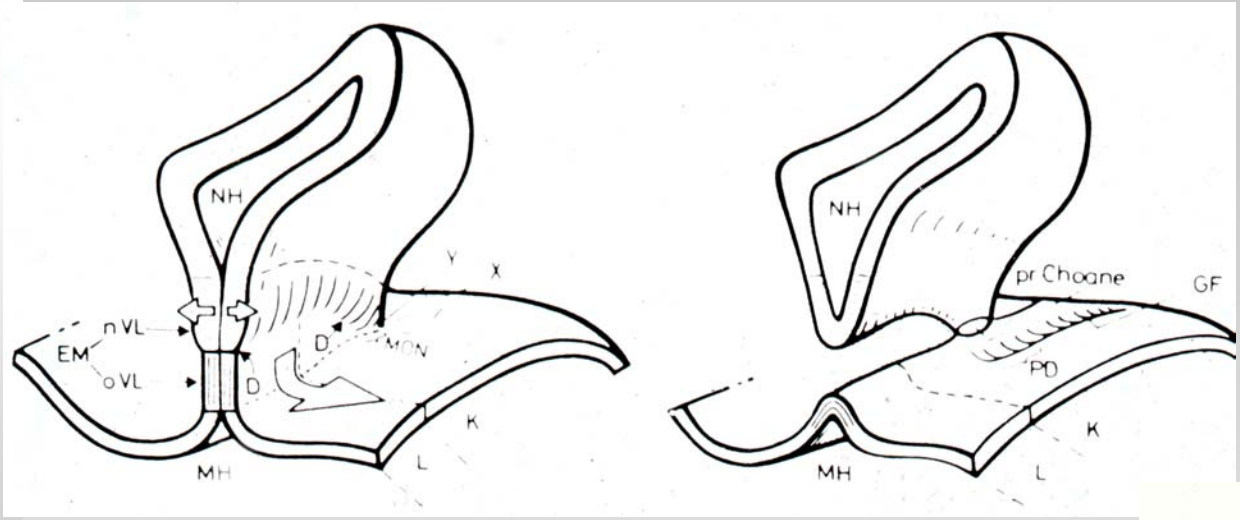
Development of nose



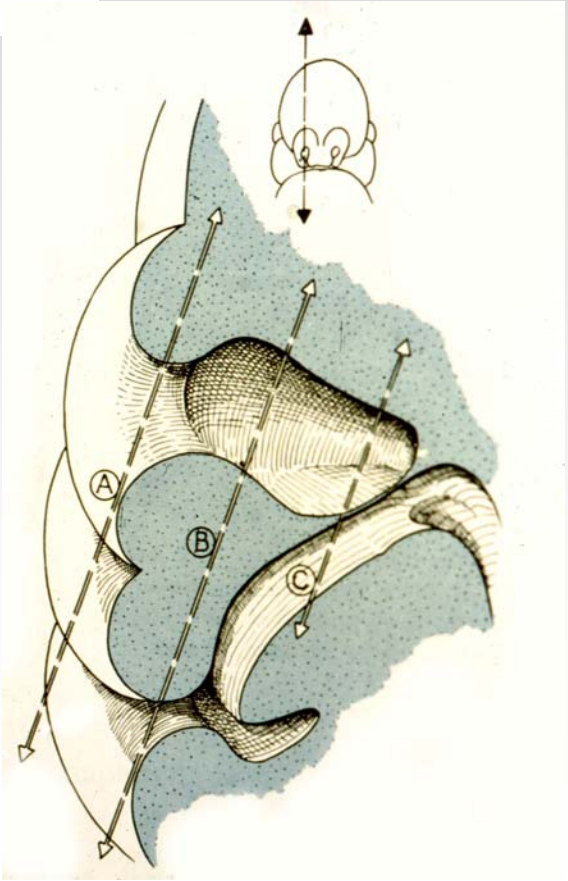


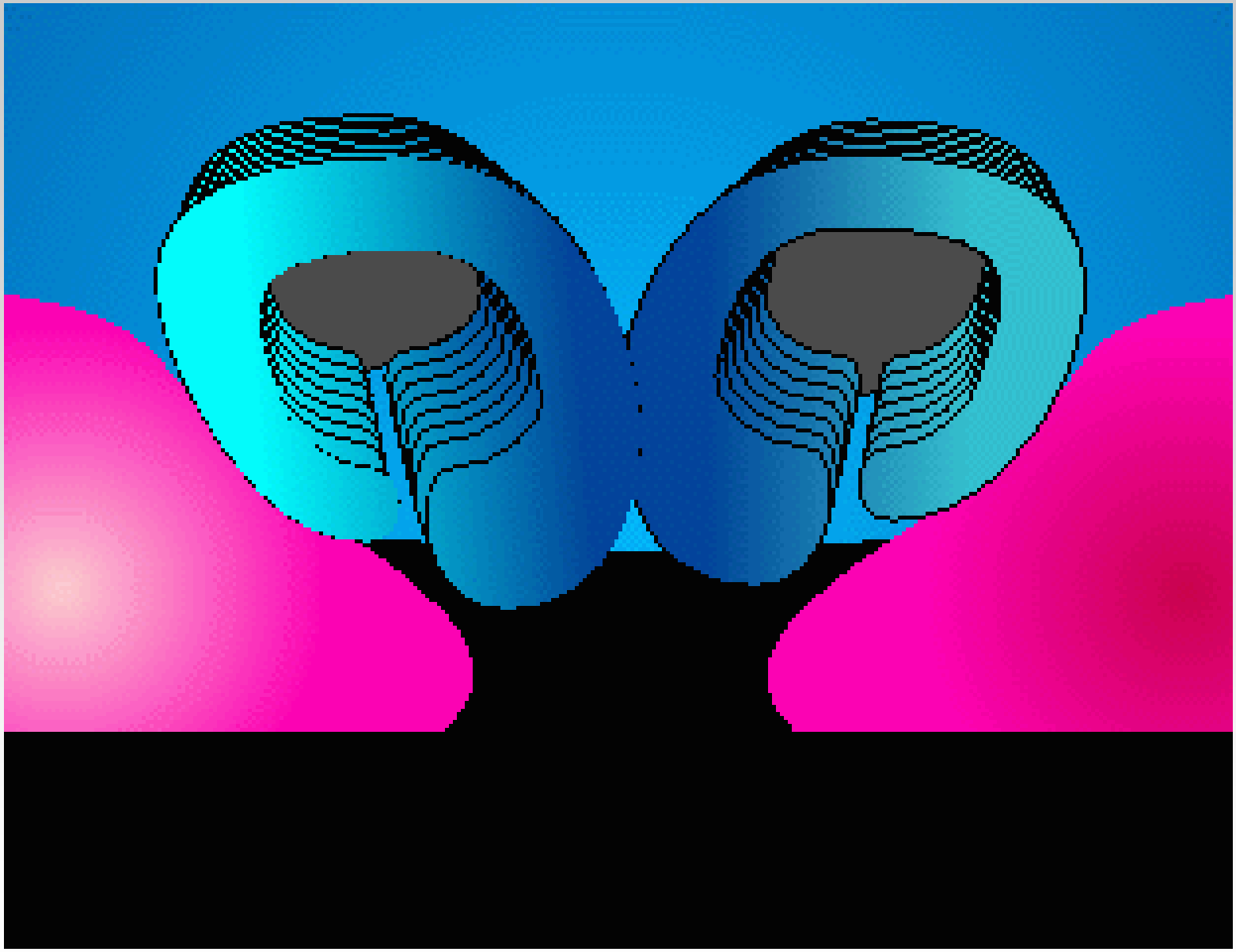


Initial fusion of medial and lateral nasal processes, and subsequently between medial nasal and maxillary processes.

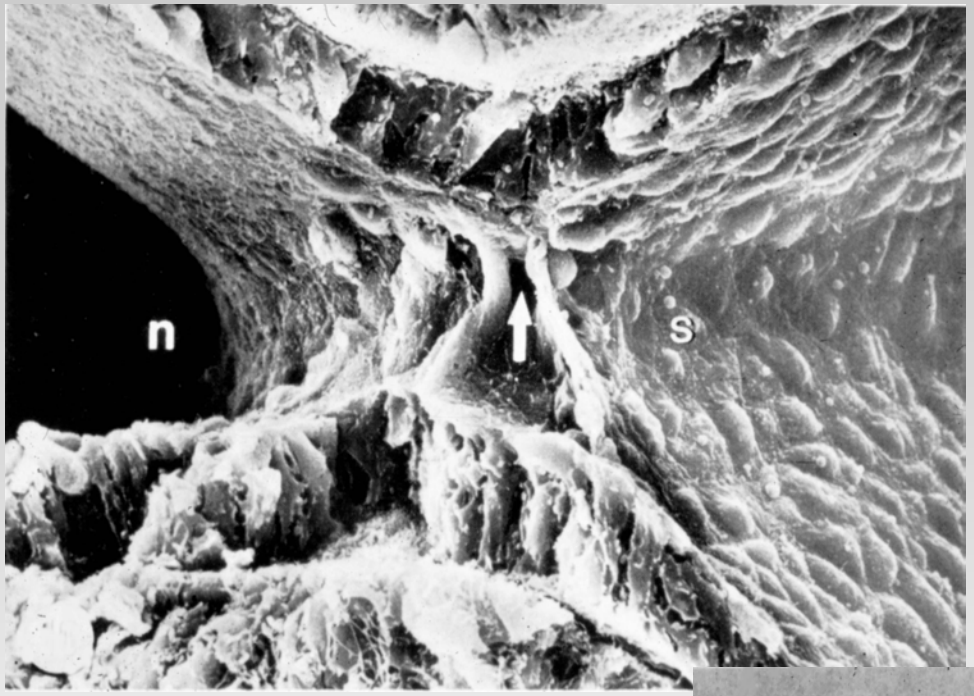


All epithelium in fusion line is removed except oronasal membrane (ectoderm-ectoderm)

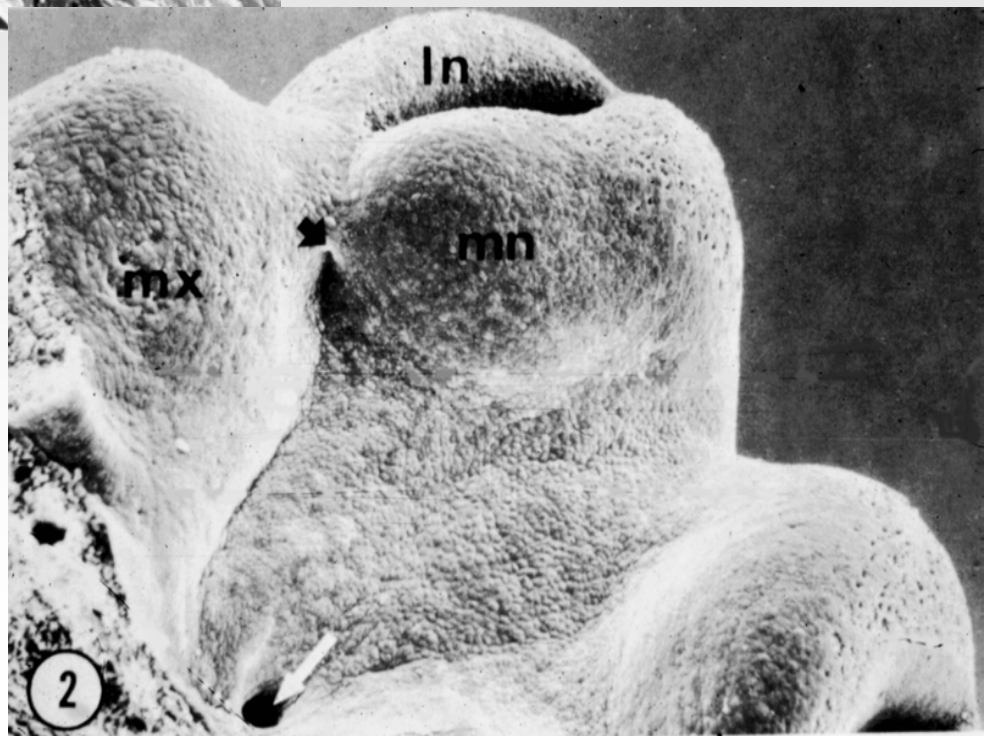




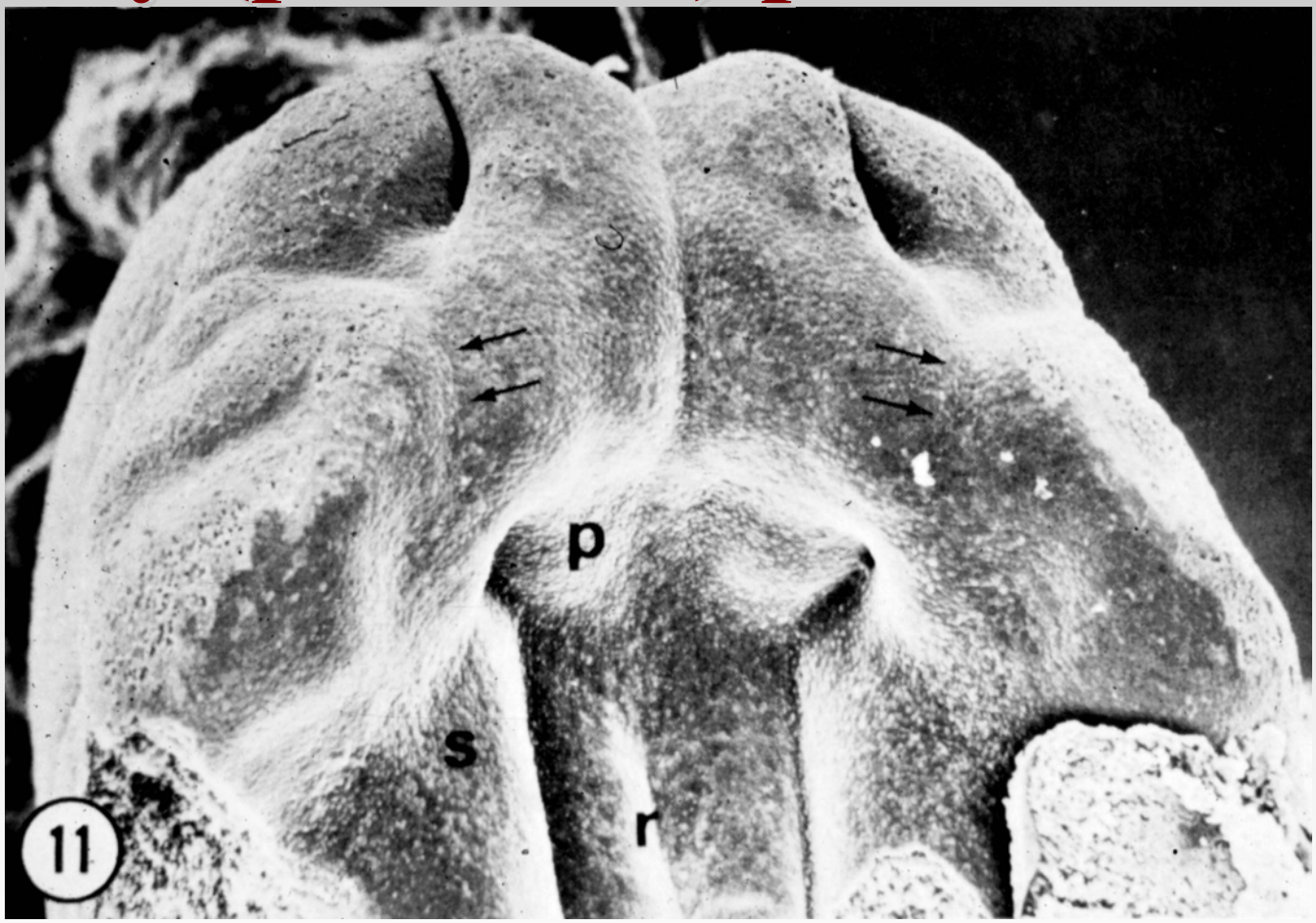
Oronasal membrane



Breaks down at about 6 wks of development.



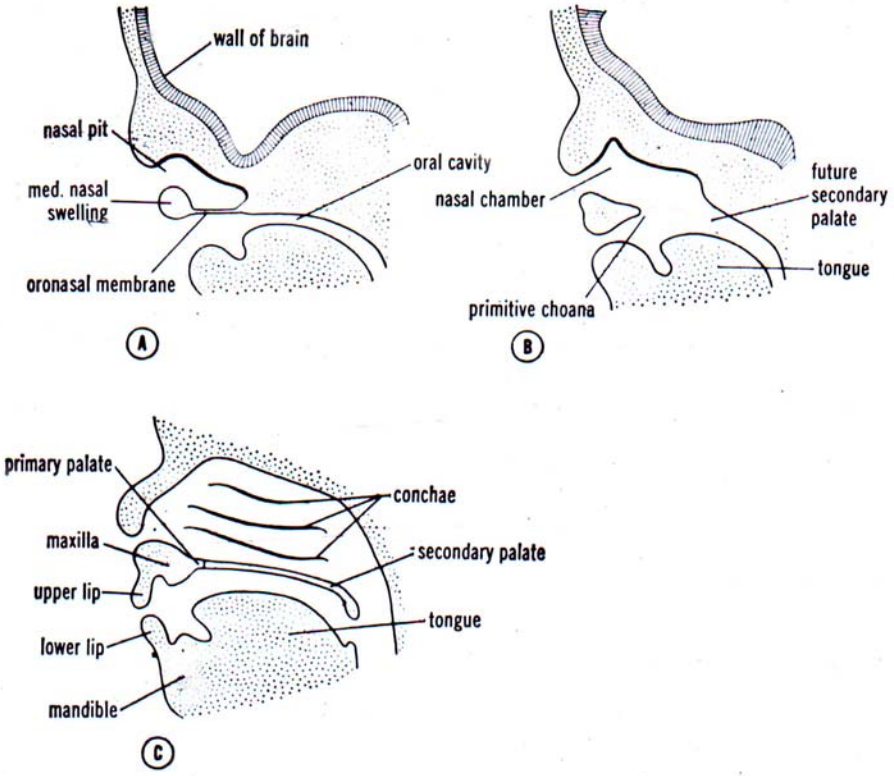
Primary (primitive) palate



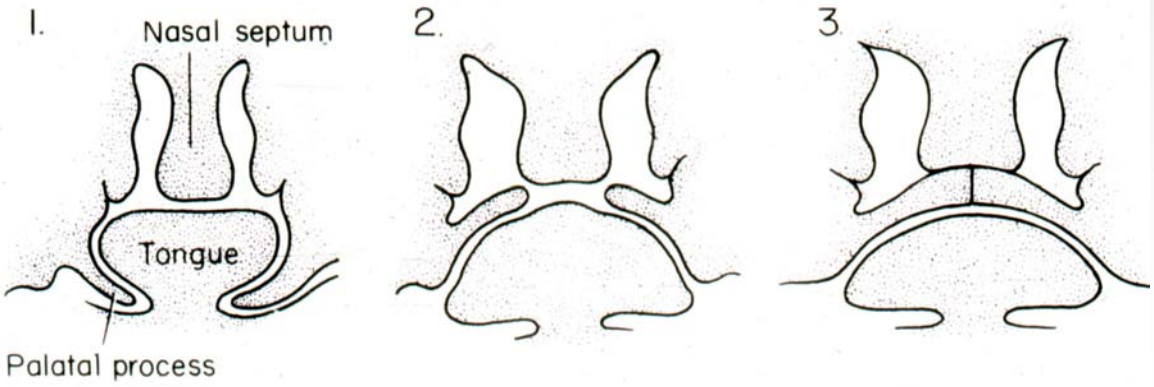
Primary palate composed of: intermaxillary segment of merged MNP's and the rostral tips of the maxillary processes.

P: primary (primitive) choana permitting oro-nasal communication

Development of primary and secondary palate



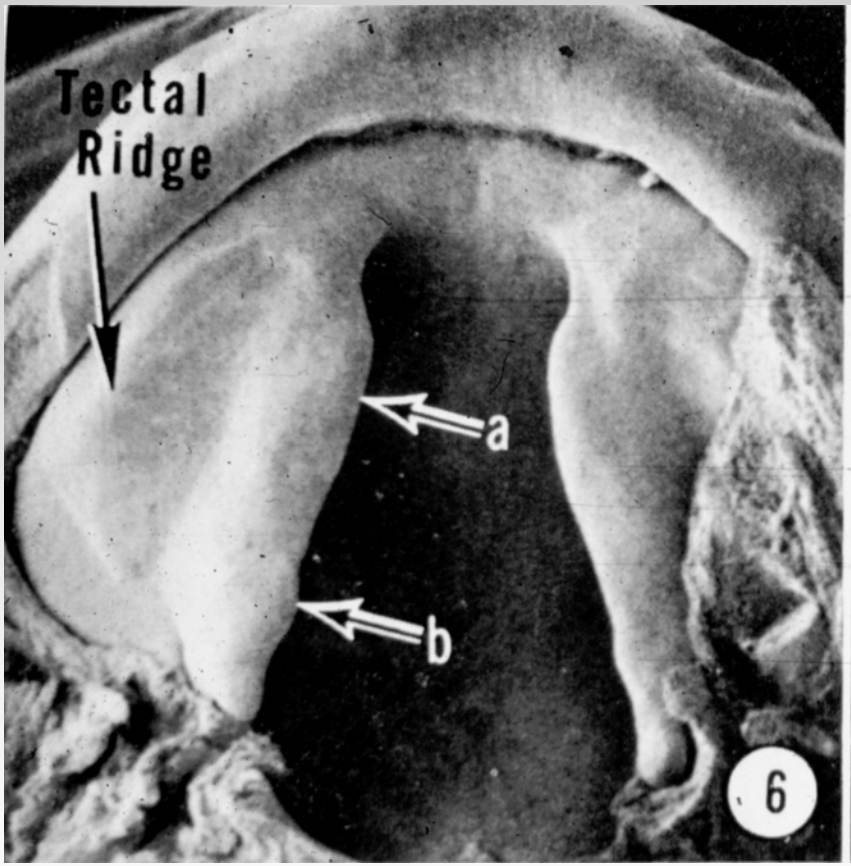
Secondary palate development

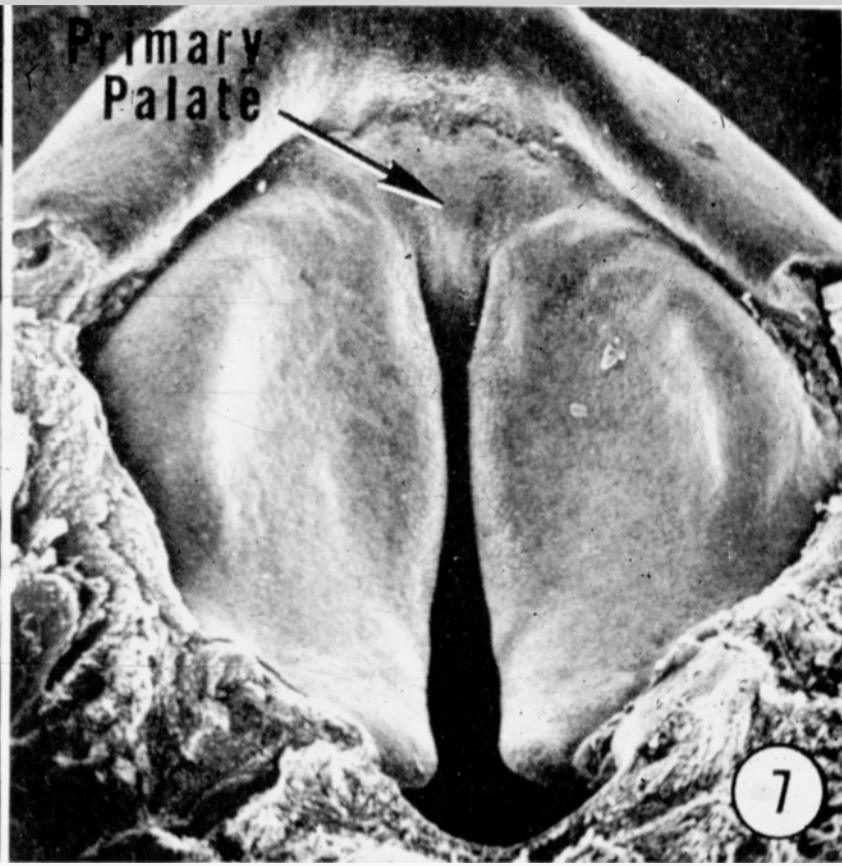


Intrinsic factors in the successful development of the secondary palate: increase in size of palatal processes

- Mesenchymal cell proliferation – ceases hours before palatal processes become horizontal
- ECM production increasing volume of palatal processes
- Hydration of ECM – major increase in volume and turgor just prior to horizontalization

Secondary palate development



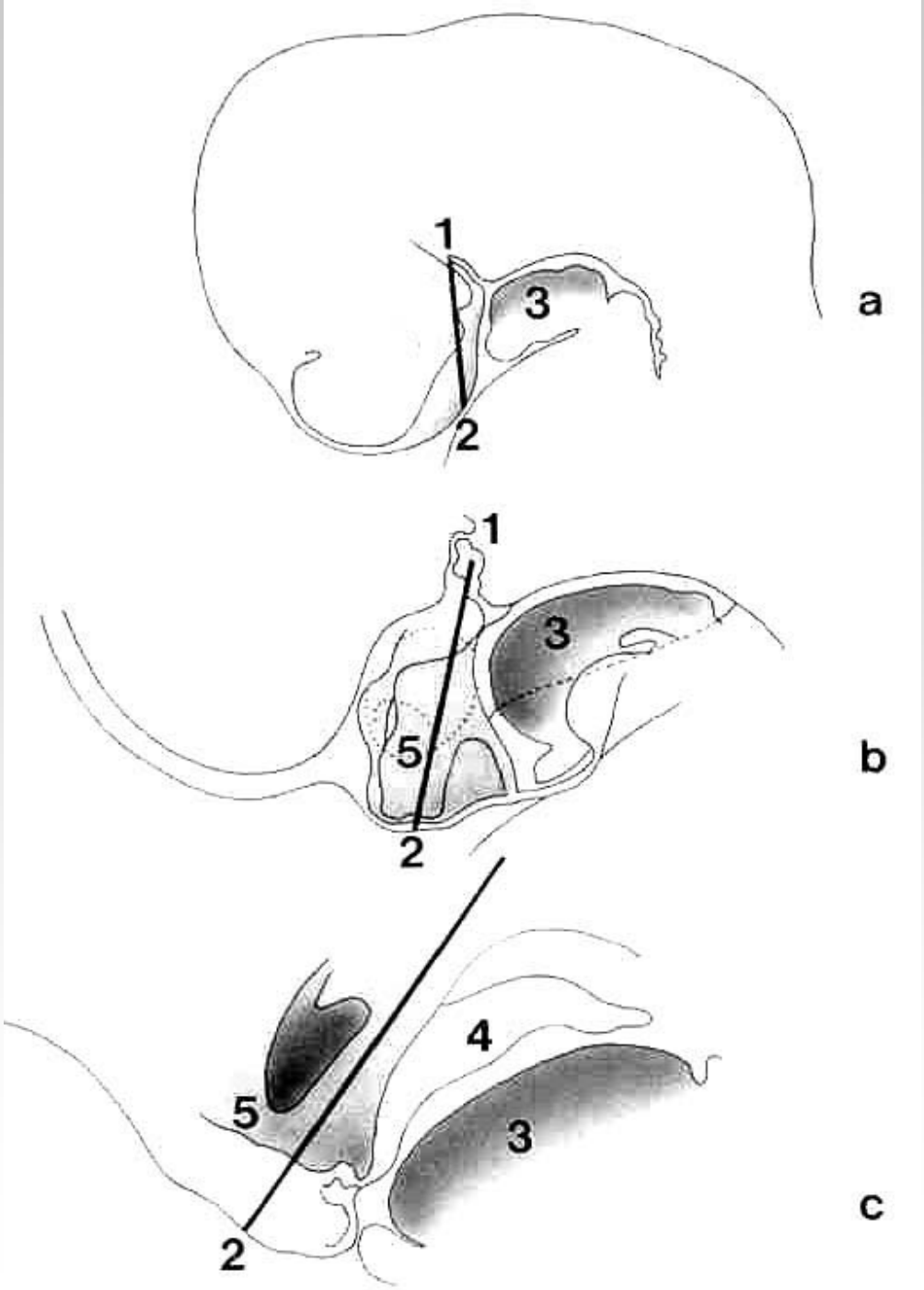


Palatal processes develop on the oral surfaces of the maxillary processes: initially vertically oriented, they assume horizontal orientation during eighth week of development.

Horizontalization of palatal processes

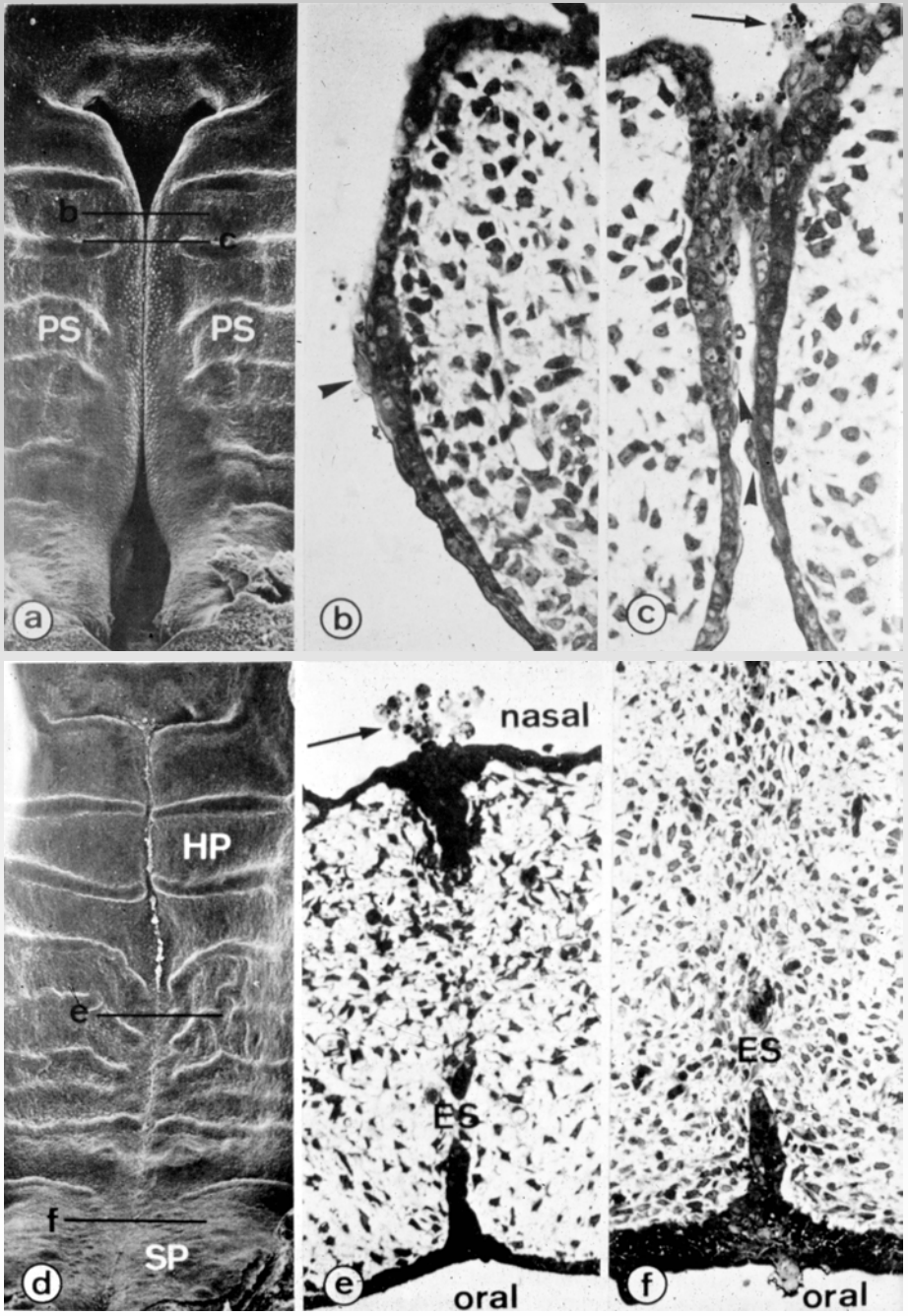
Factors contributing to the horizontalization of the palatal processes

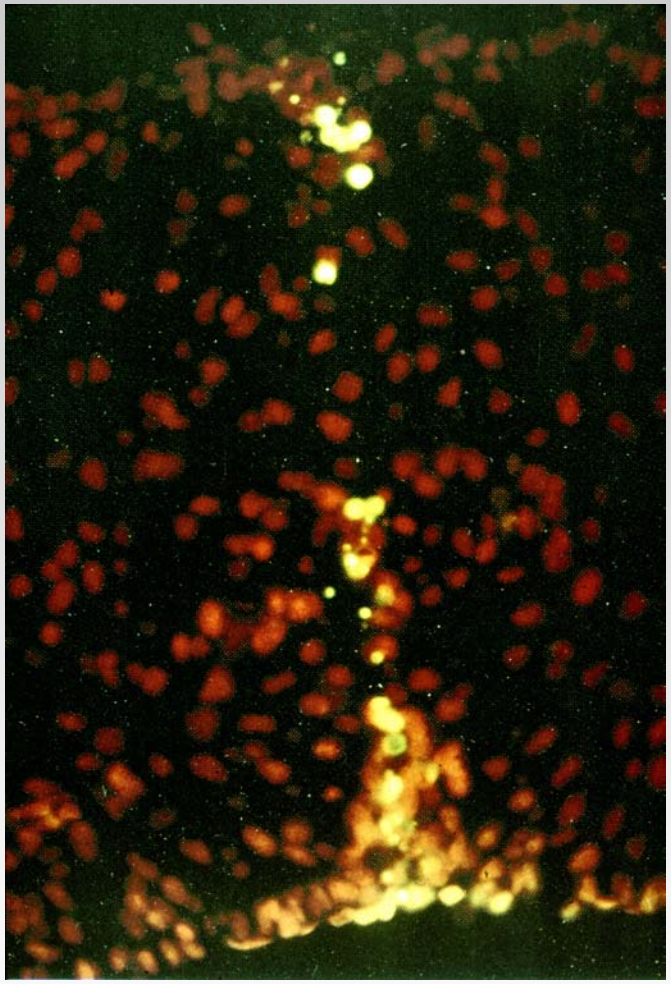
- Turgor in the palatal processes
- Movements of the tongue – primitive swallowing- allowing tongue to move out of the way
- Downward and forward growth of lower jaw complex – providing space for the secondary palate
- Straightening of the cranial base – providing mechanical conditions for horizontalization


1
3
2
a
1
3
5
2
b
4
5
3
2
c

Factors contributing to the successful fusion of the secondary palate: the medial edge epithelium (MEE)

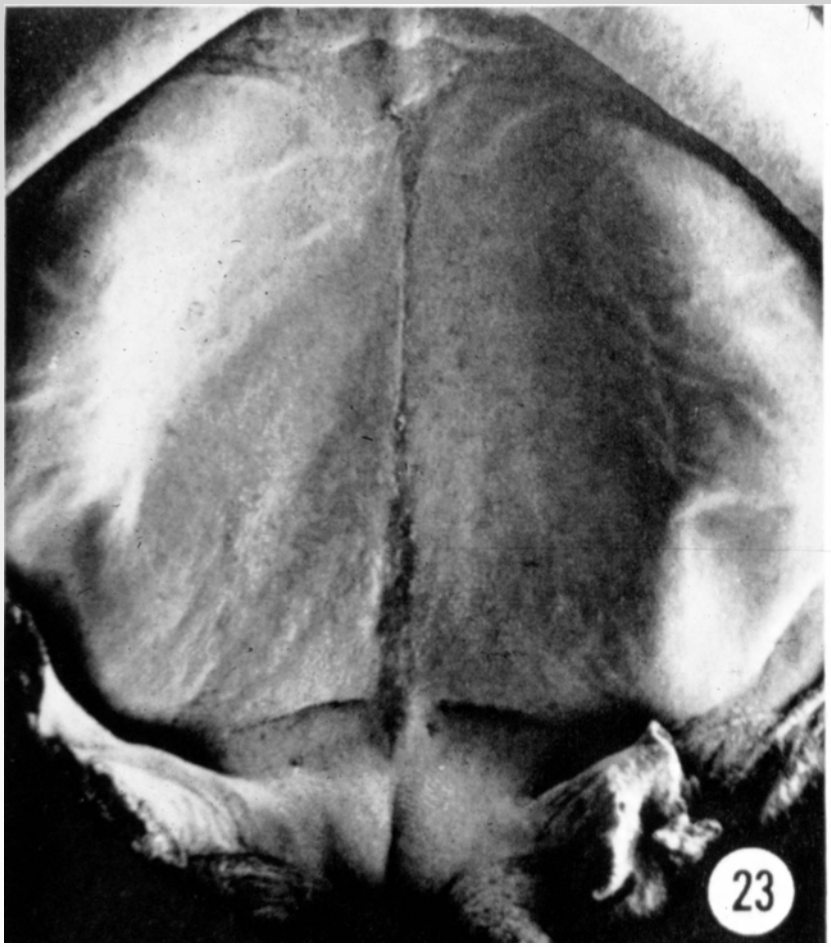
- Apoptosis of MEE surface cells immediately prior to fusion
- Development of temporary glycoprotein membrane coating, enabling adhesion between MEE cells of opposing palatal processes
- Successful removal of MEE from fusion line

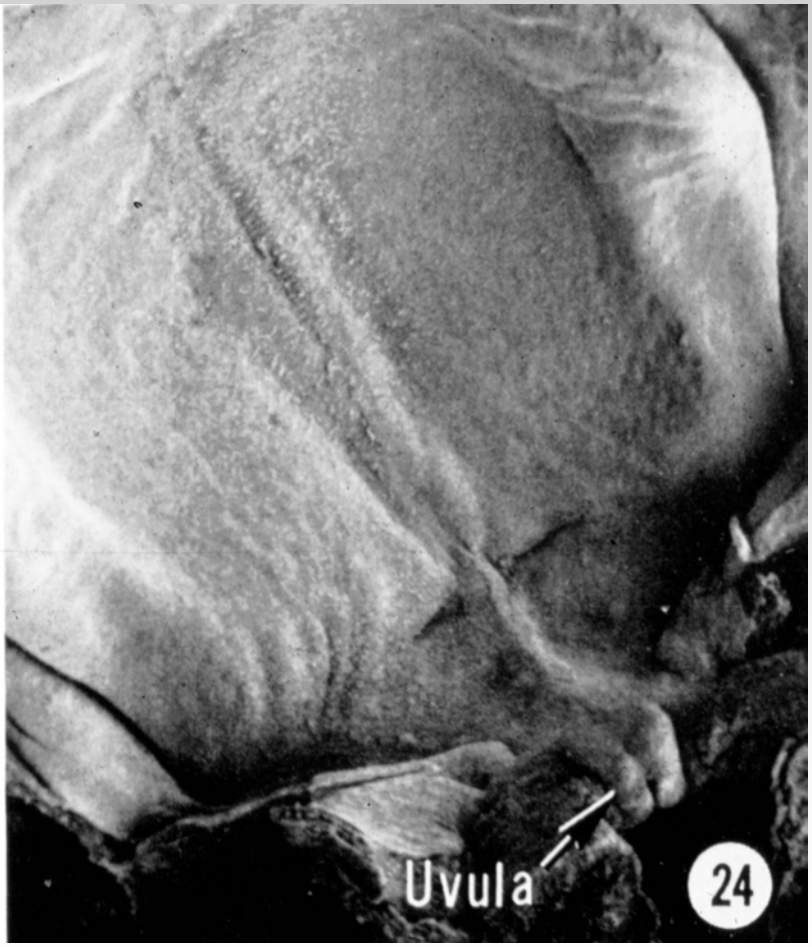




Fate of MEE cells: apoptosis (TUNEL reaction above) and phagocytosis

Completion of palate formation





Sites of potential palatal clefts