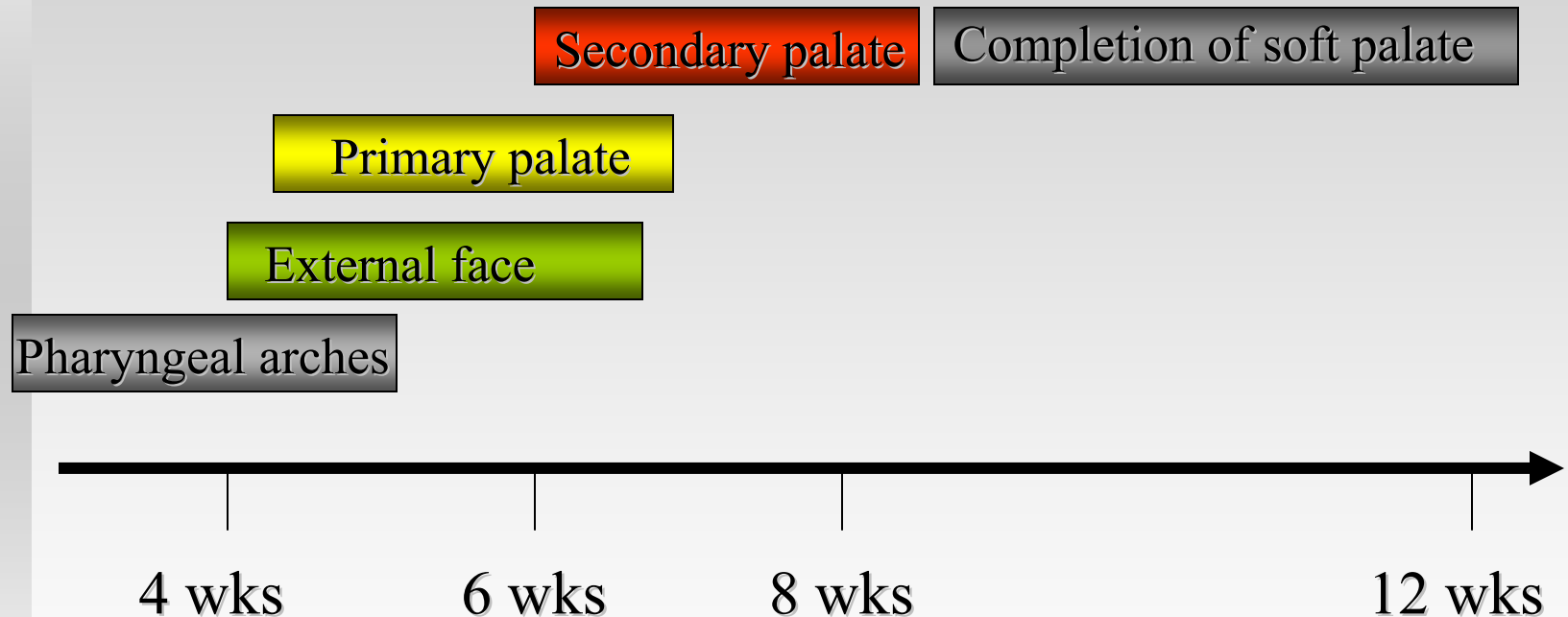


Facial and palatal development

L.Moss-Salentijn

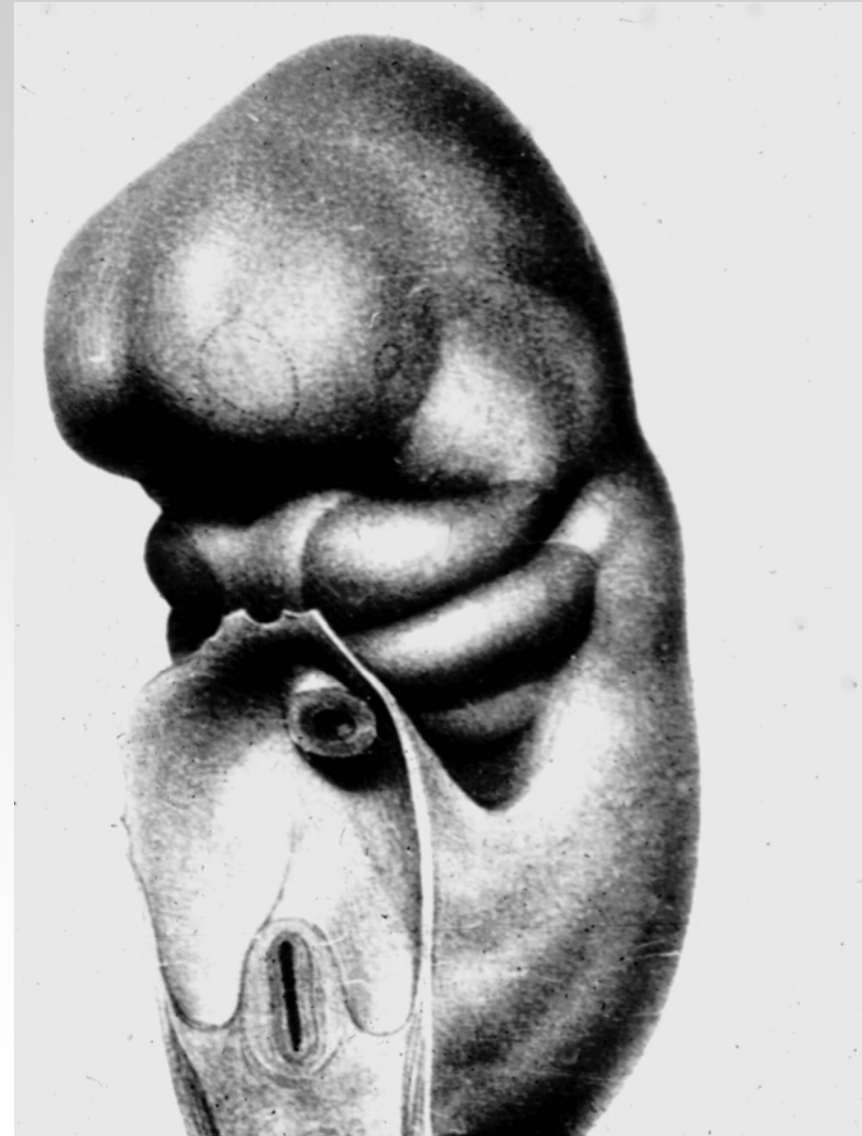
Timeline for development



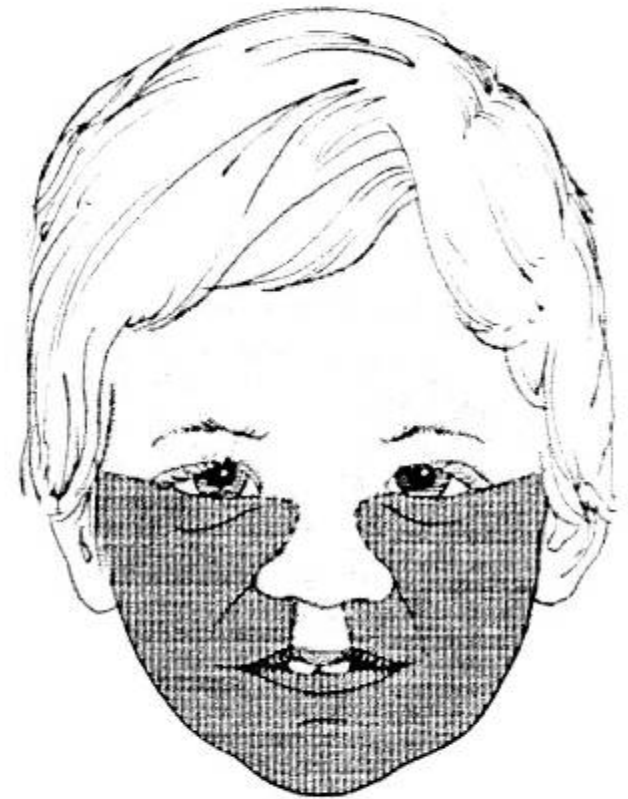
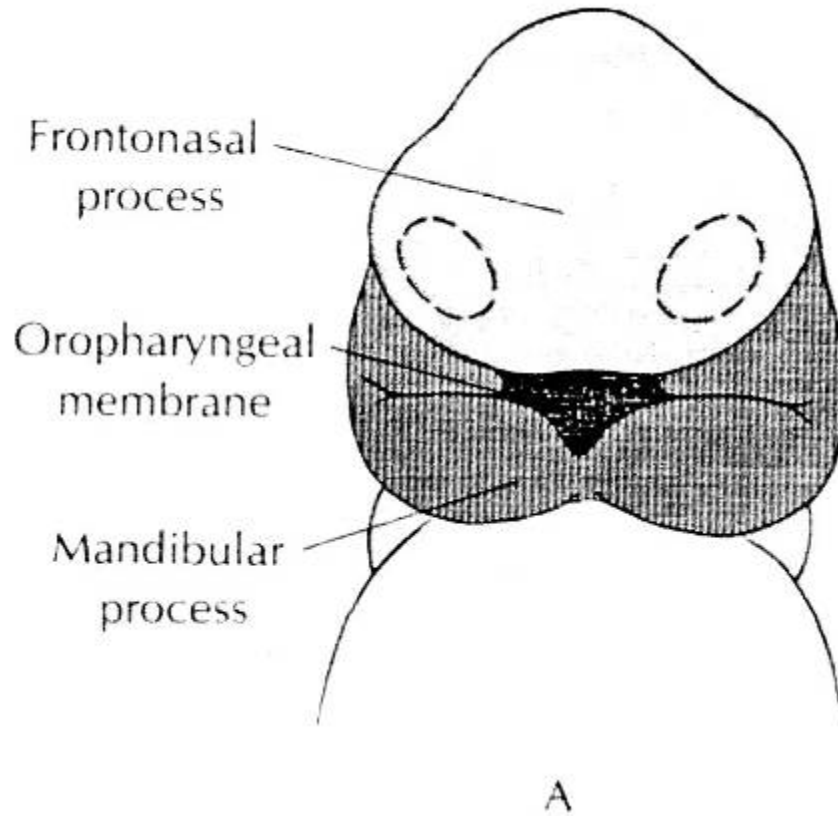
Decrease of severity of potential congenital malformations

Contributions to the external face

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



Contributions to external face

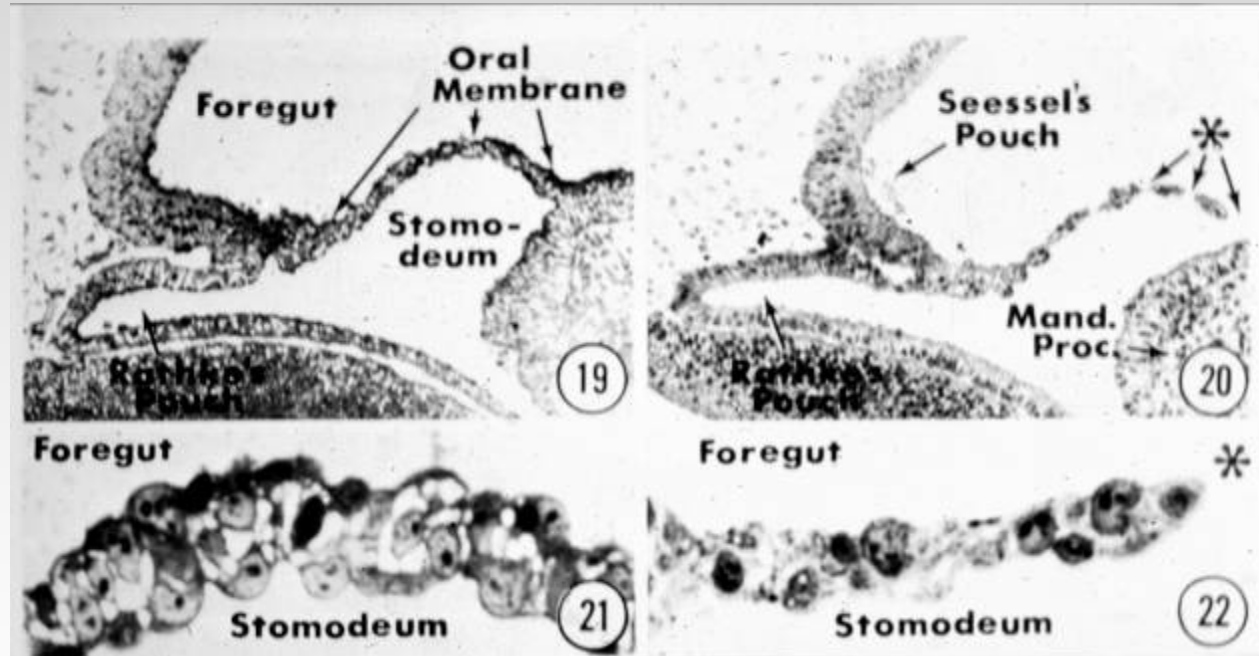
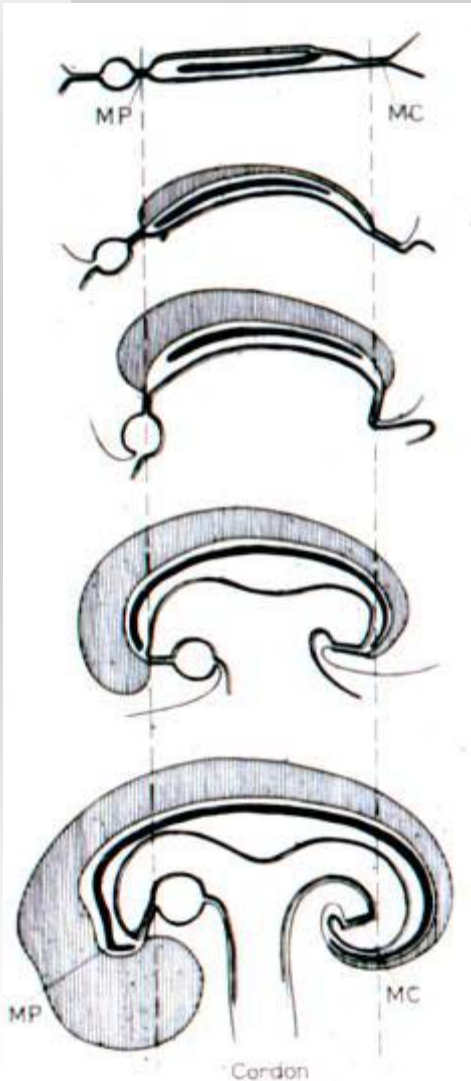


Moss-Salentijn L, Klyvert M (1990)

Oropharyngeal membrane (buccopharyngeal, oral)

Tuchmann-Duplessis H, David G, Haegel P (1975)

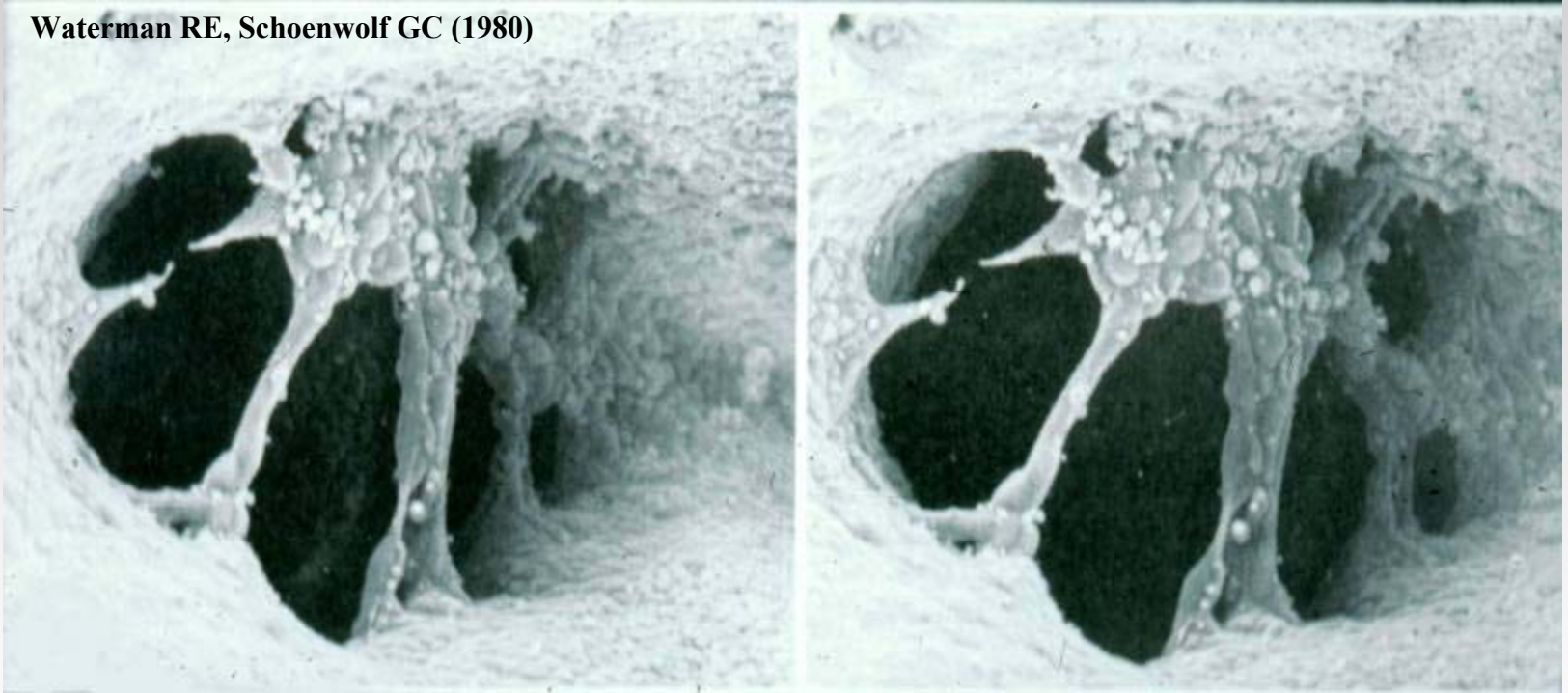
Waterman RE, Schoenwolf GC (1980)



**Membrane is composed of
ectoderm and endoderm**

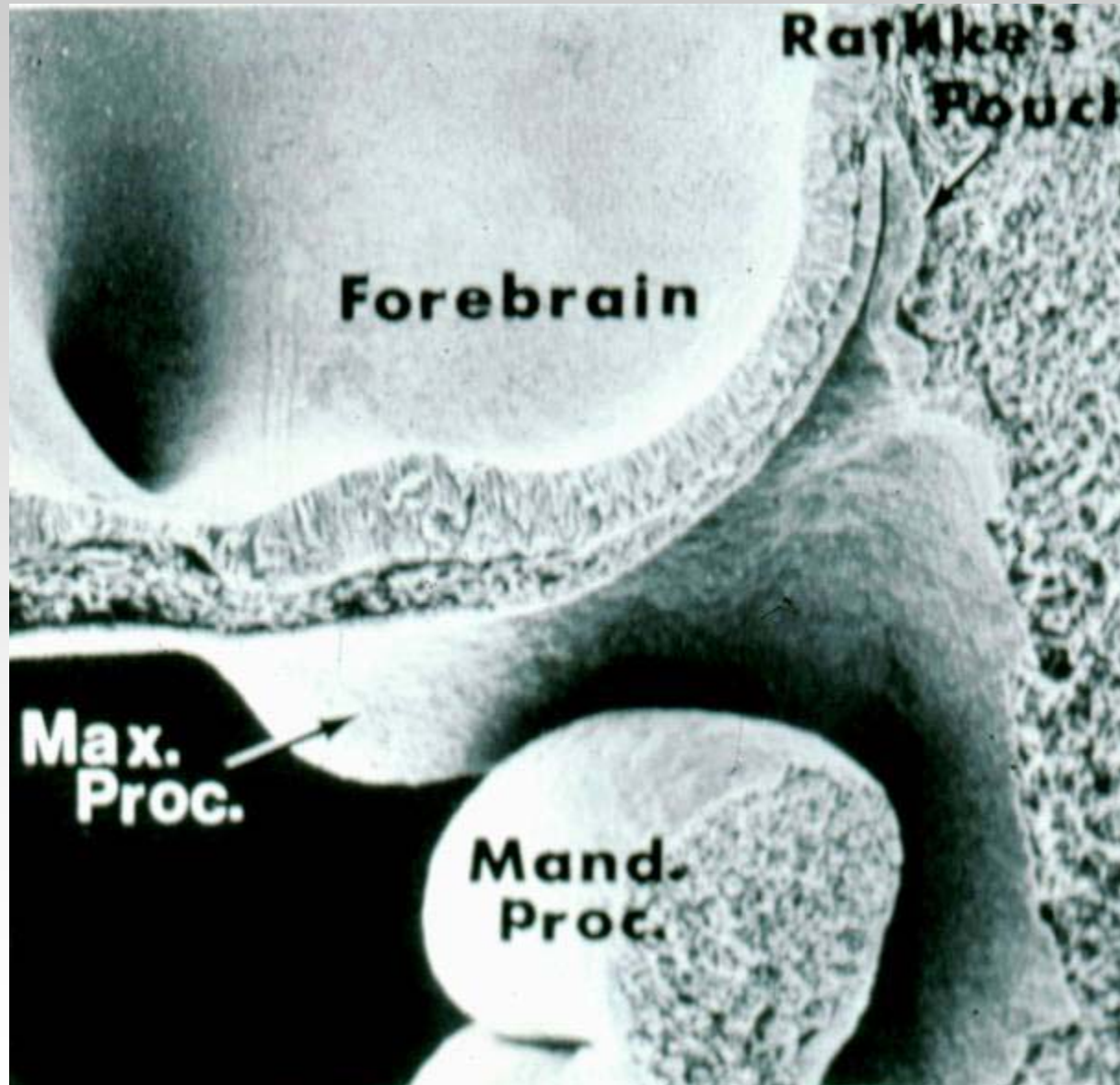
Disintegration of oropharyngeal membrane

Waterman RE, Schoenwolf GC (1980)



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

Stomodeum at 4 weeks



Waterman RE, Schoenwolf GC (1980)

Facial processes (prominences)



Bilaterally:

Lateral nasal

Medial nasal

Maxillary

Mandibular

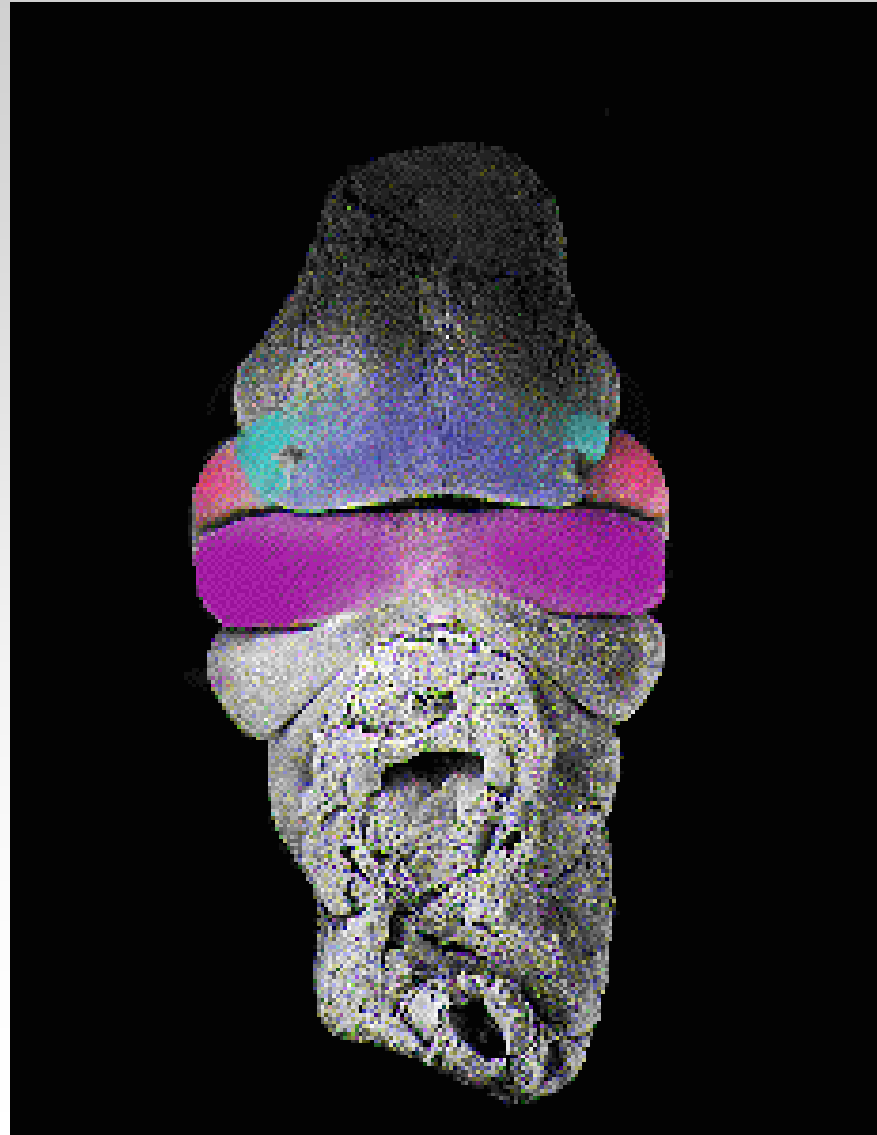
Face development animation 1



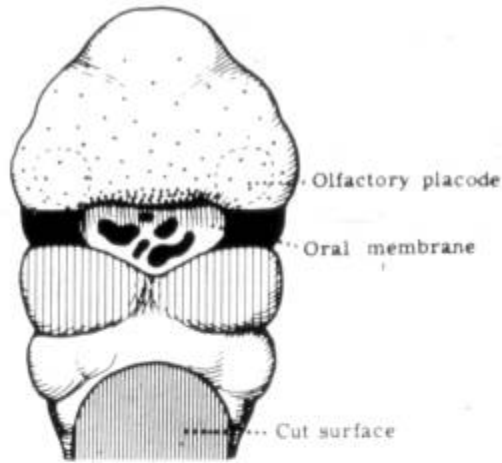
Watt, Marie A, and Sanders, Colin

Face development – animation 2

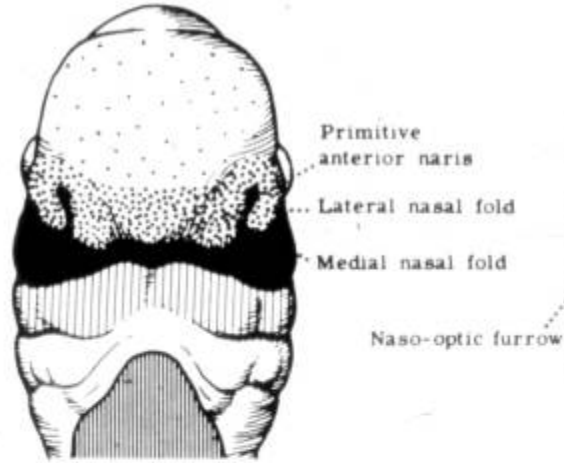
Watt, Marie A, and Sanders, Colin



Development external face (4-5 wks)



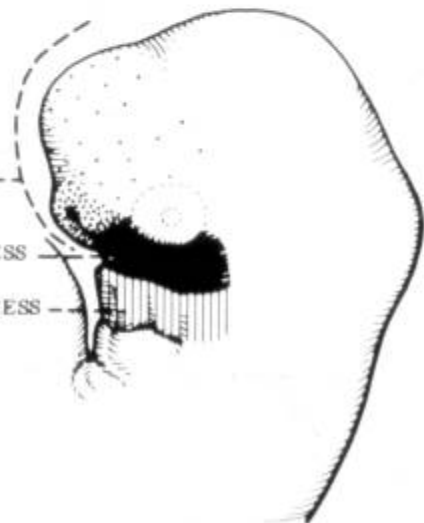
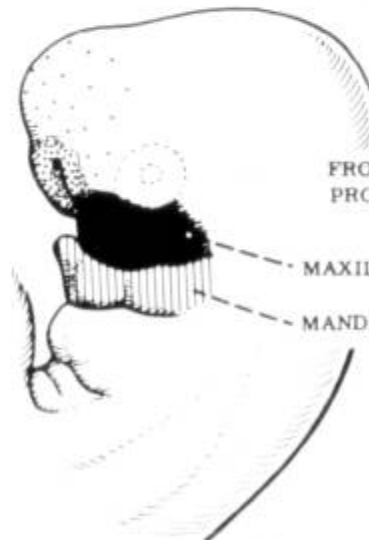
4 weeks (3½ mm)



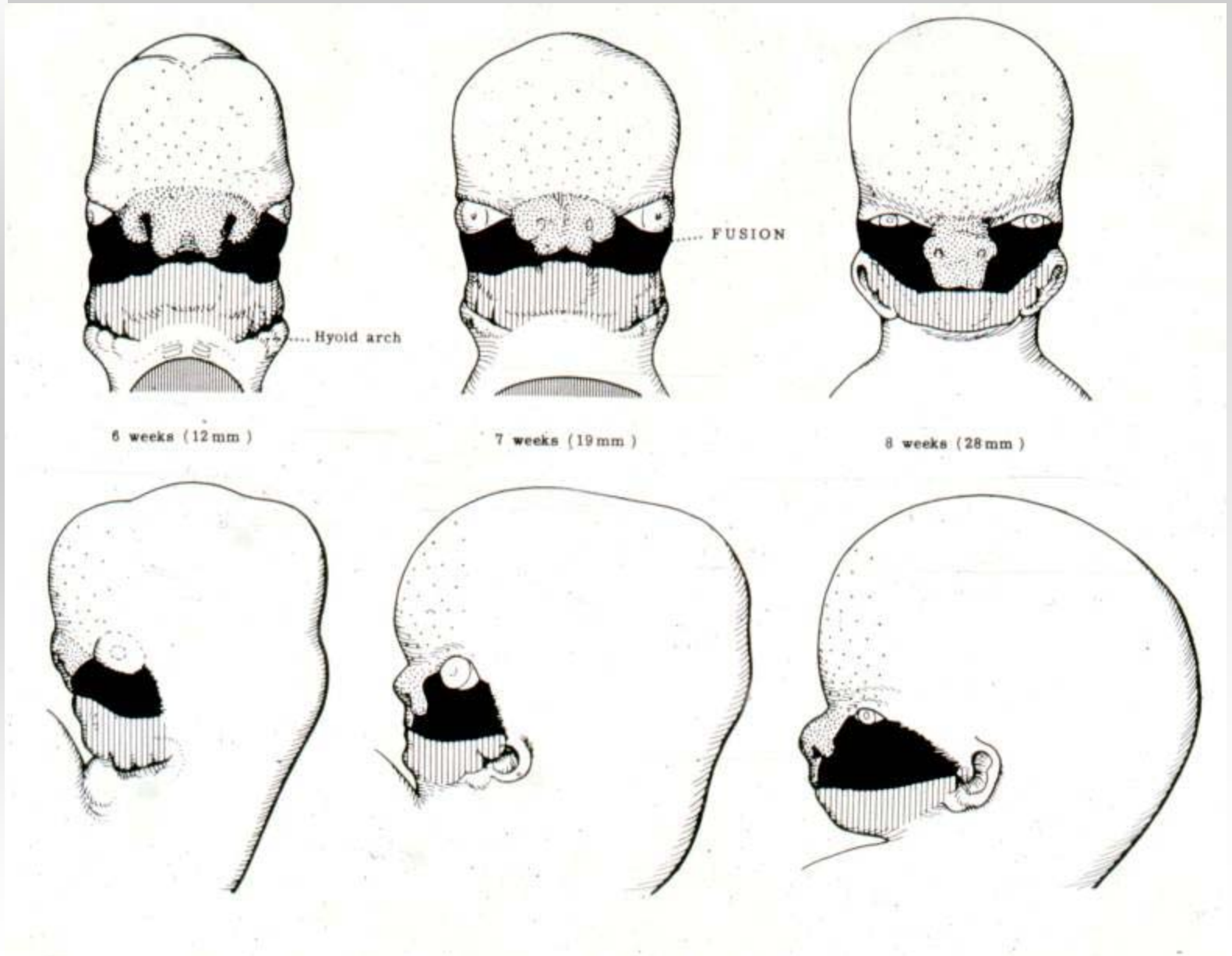
5 weeks (6½ mm)



5 weeks (9 mm)



Development external face (6-8 wks)





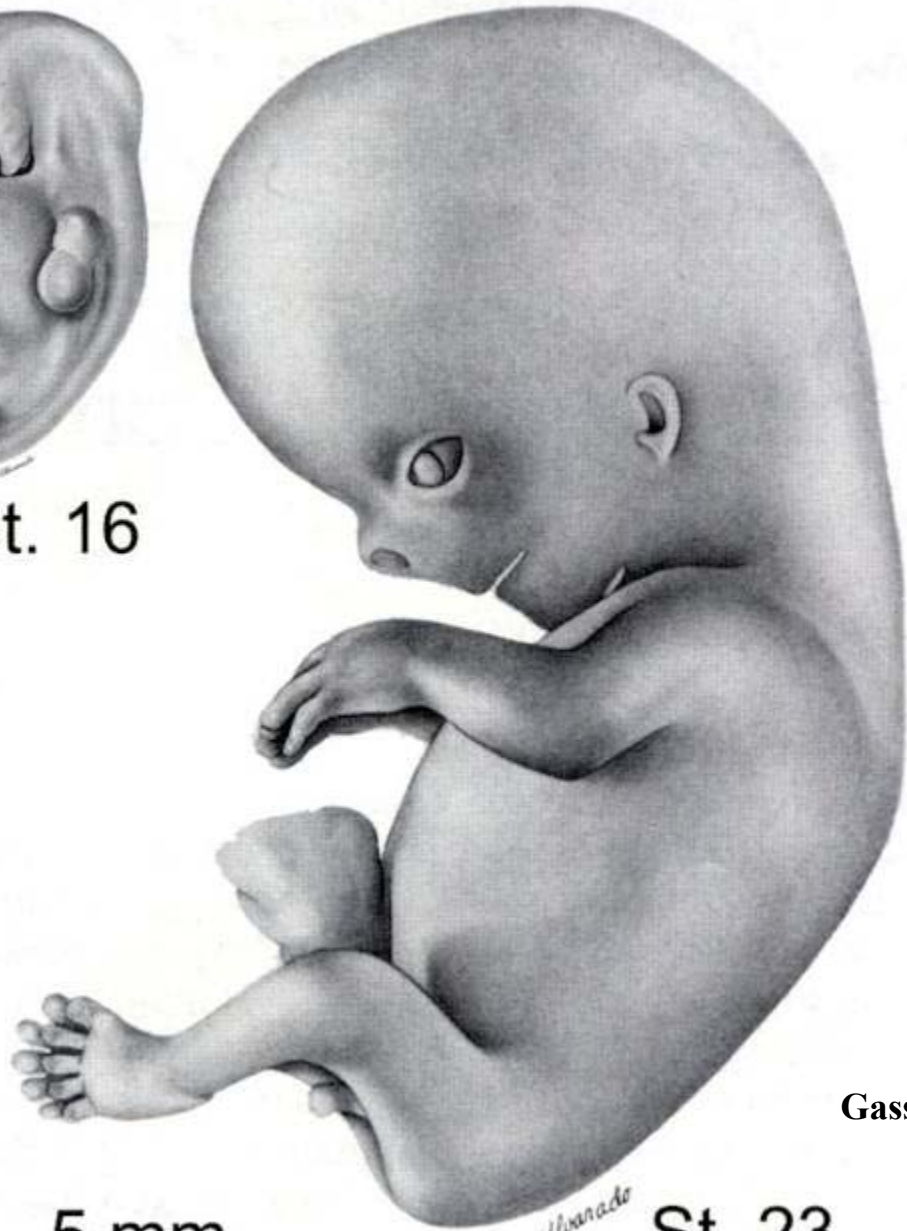
St. 13



St. 16



St. 19

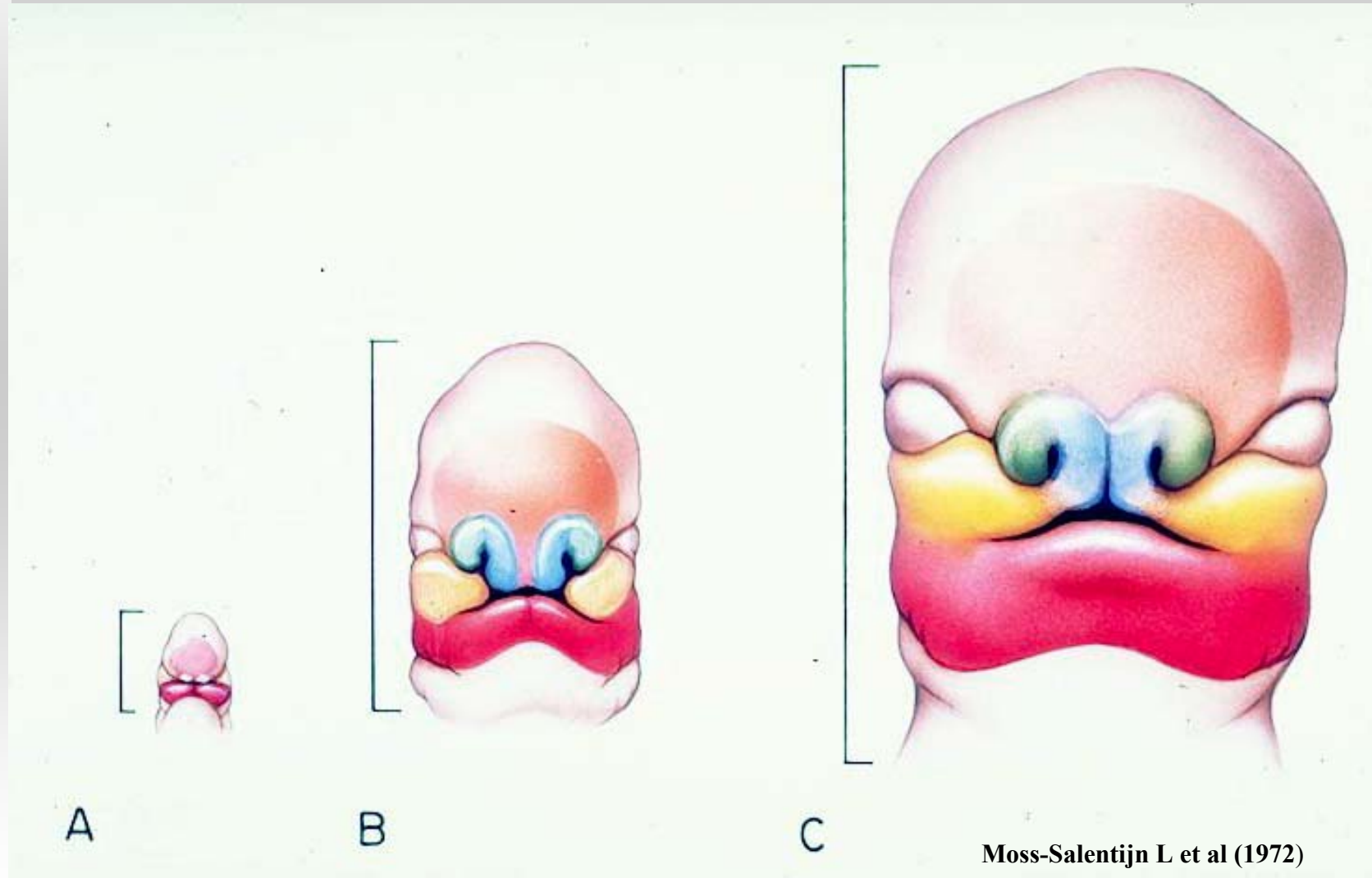


St. 23

5 mm

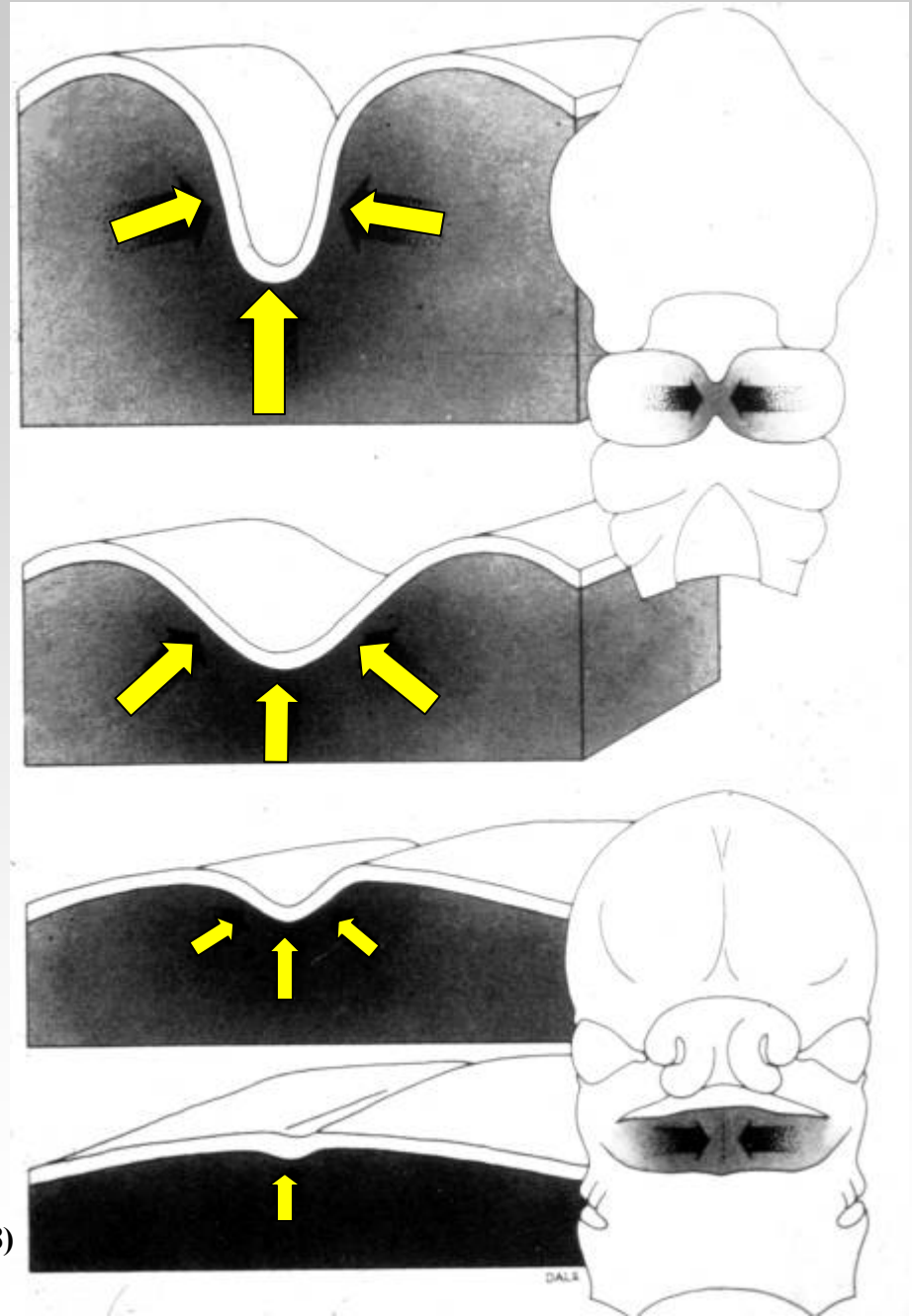
Gasser R (2006)

10-fold linear increase in size !



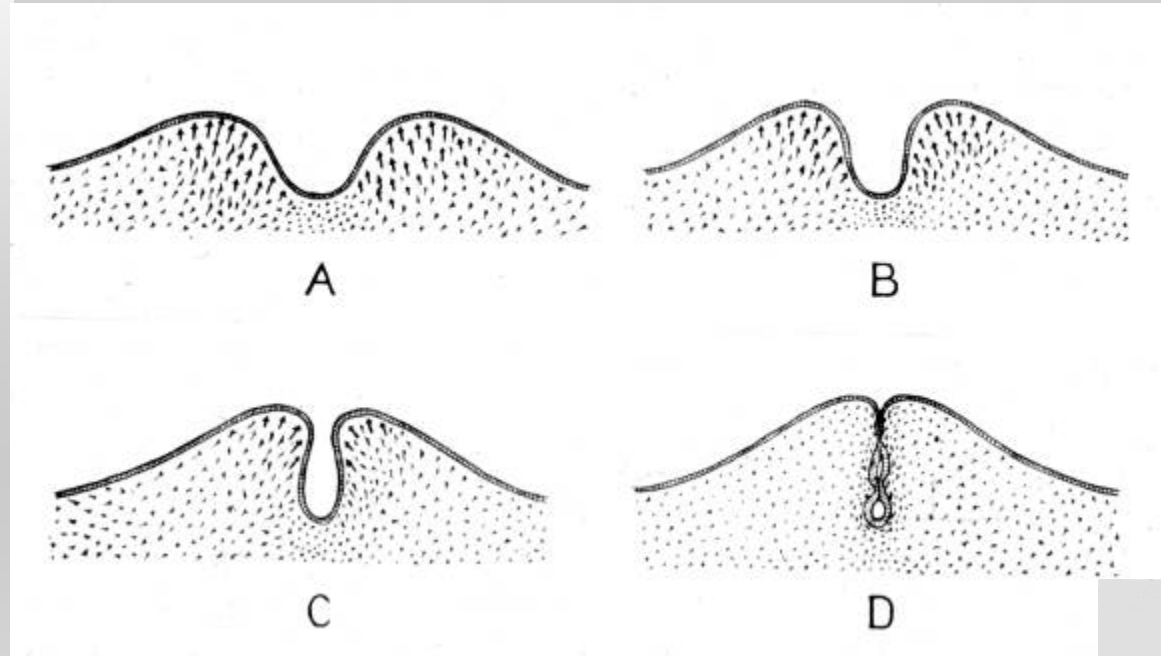
Merging

**Differential
mesenchymal
proliferation.
Elimination of
groove.**



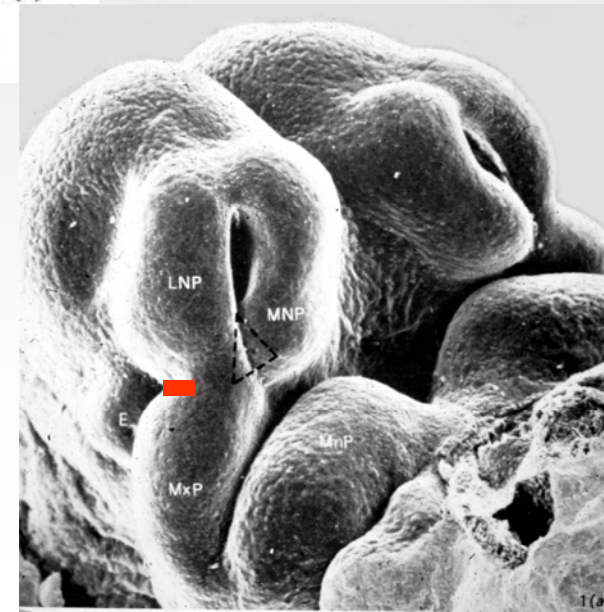
Ten Cate AR (1988)

Merging with epithelial inclusion

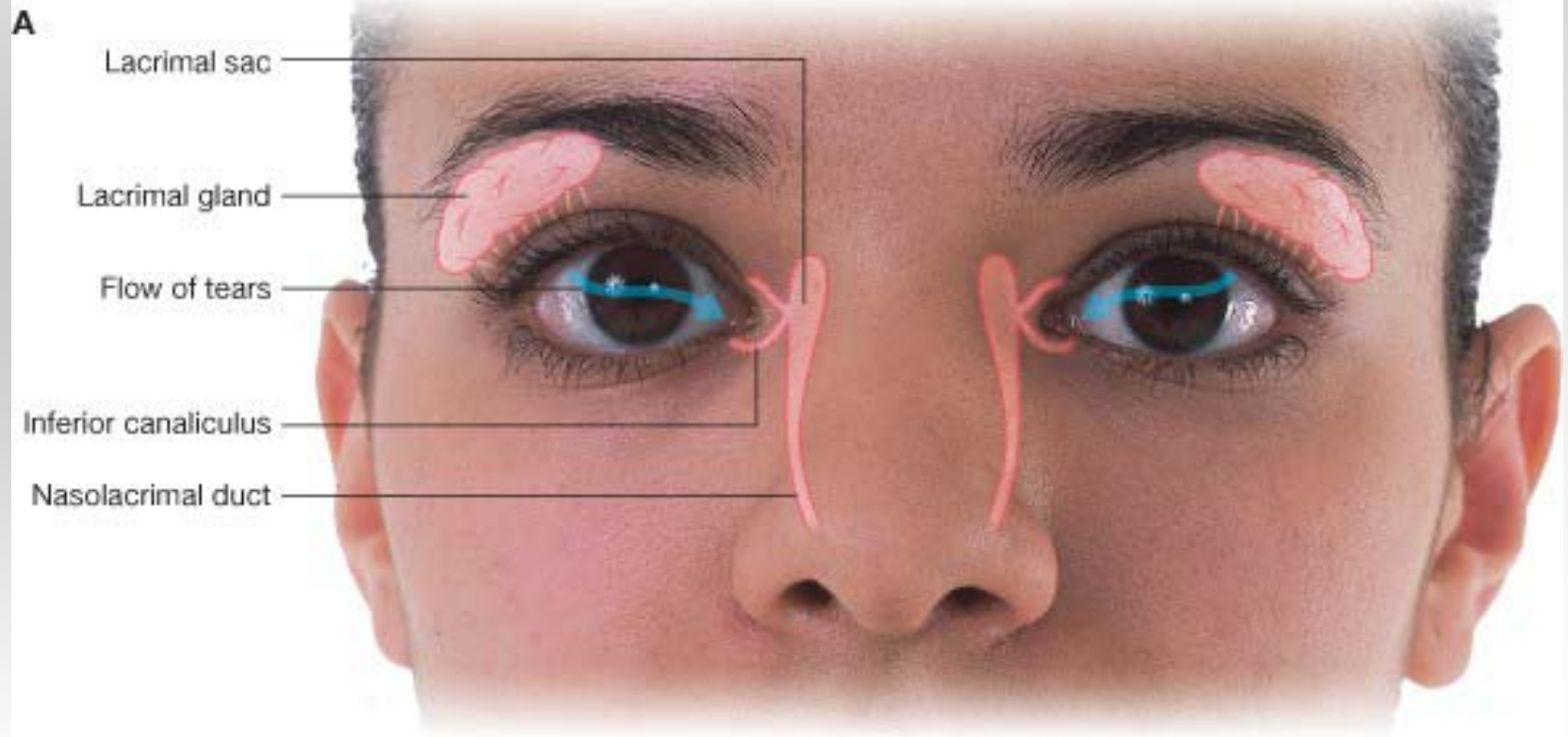


May result in facial cleft.

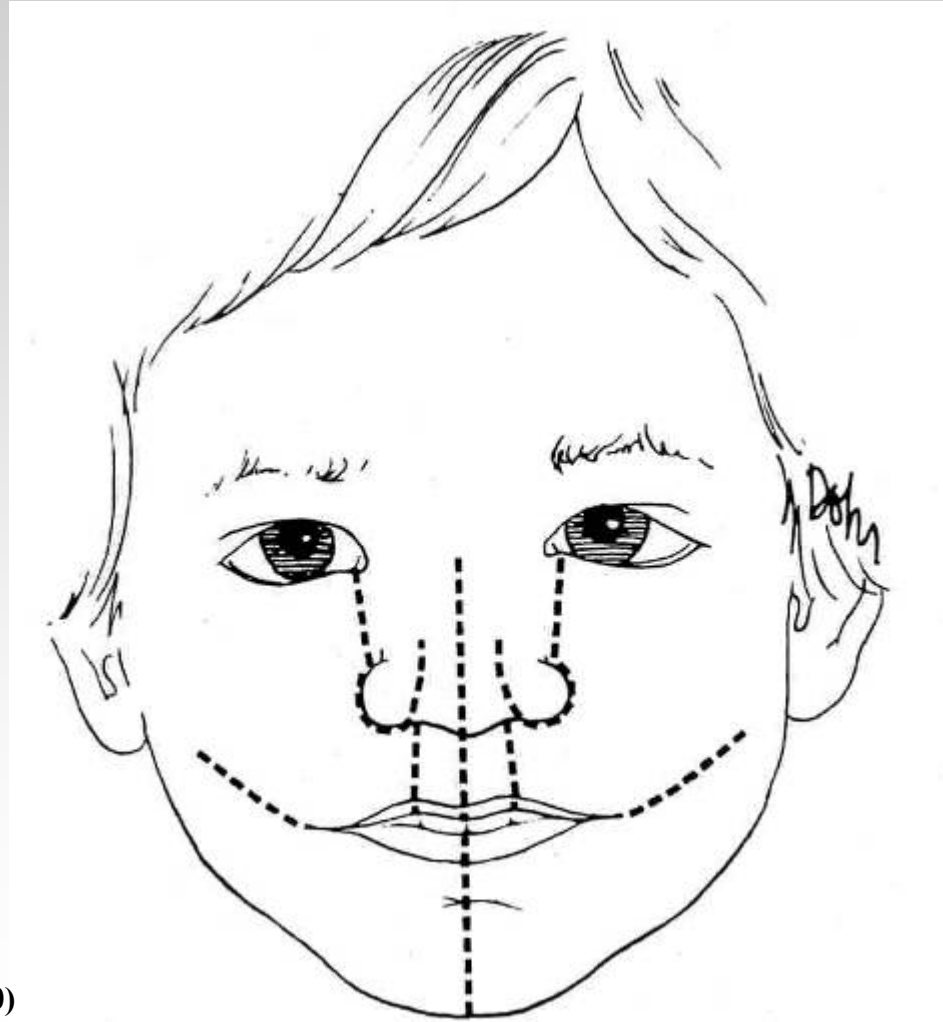
May be normal between LNP and maxillary process where enclosed epithelium gives rise to part of nasolacrimal duct epithelium.



Nasolacrimal duct between maxillary and lateral nasal processes



Sites of potential facial clefts

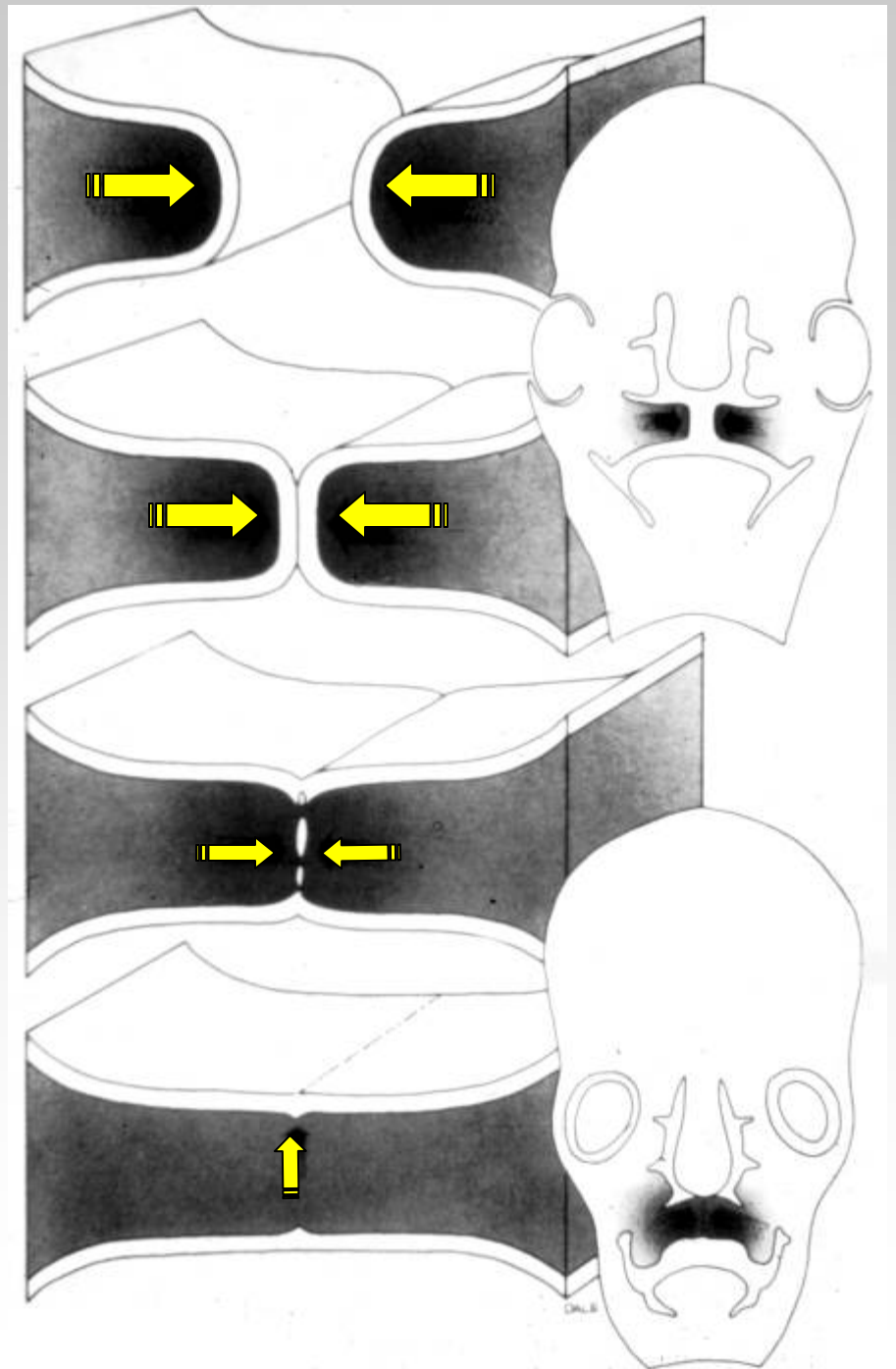


Moss-Salentijn L, Klyvert M (1990)

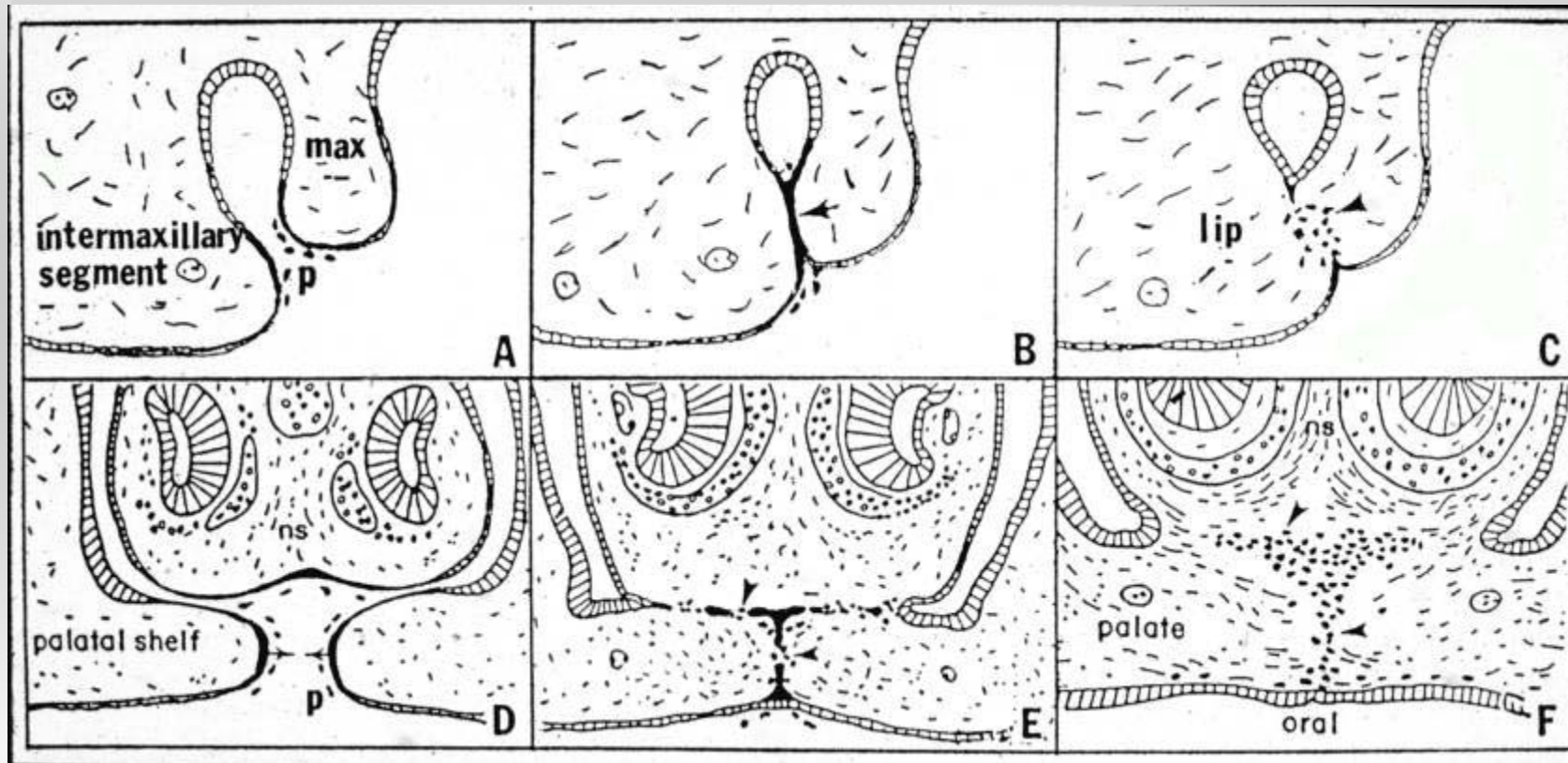
Fusion

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

Ten Cate AR (1988)



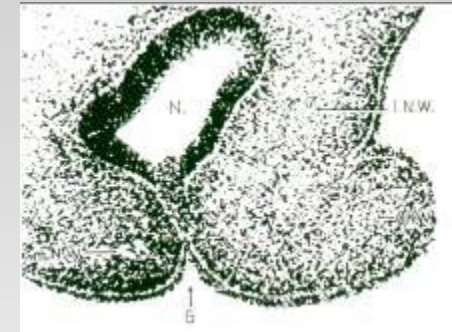
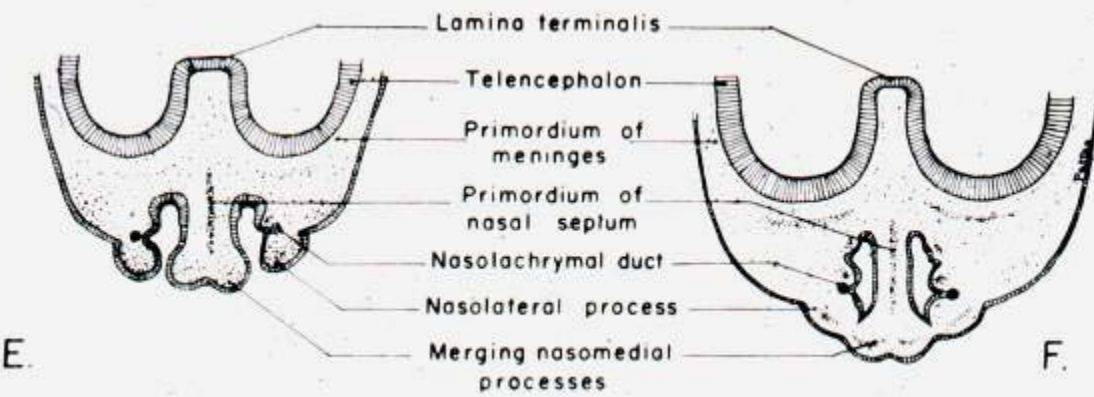
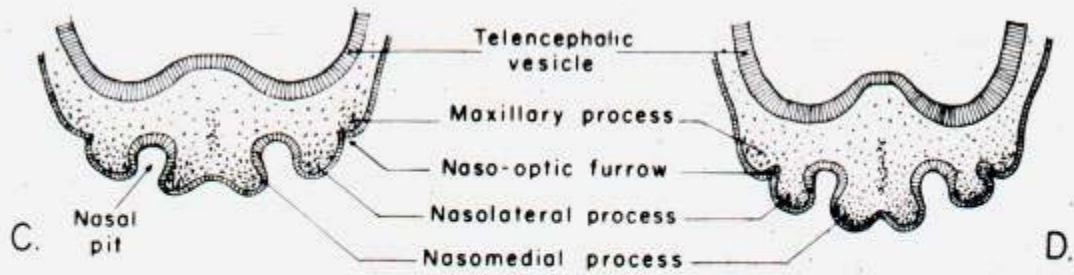
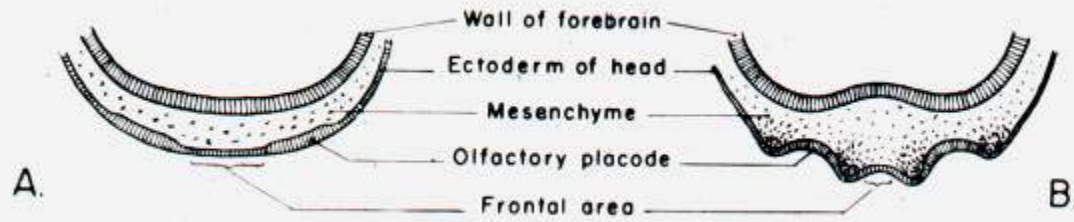
Fusion in primary and secondary palate development



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**

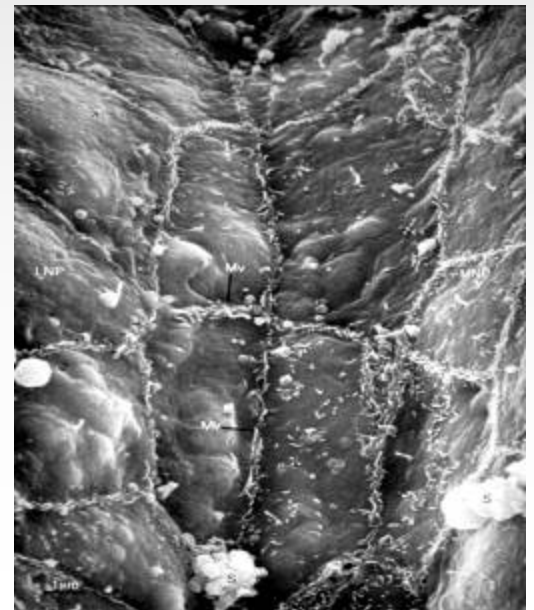
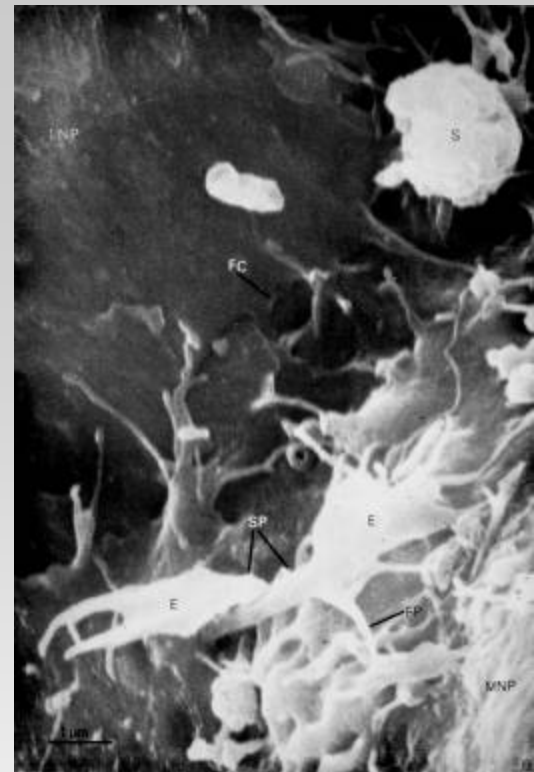
Development of nose

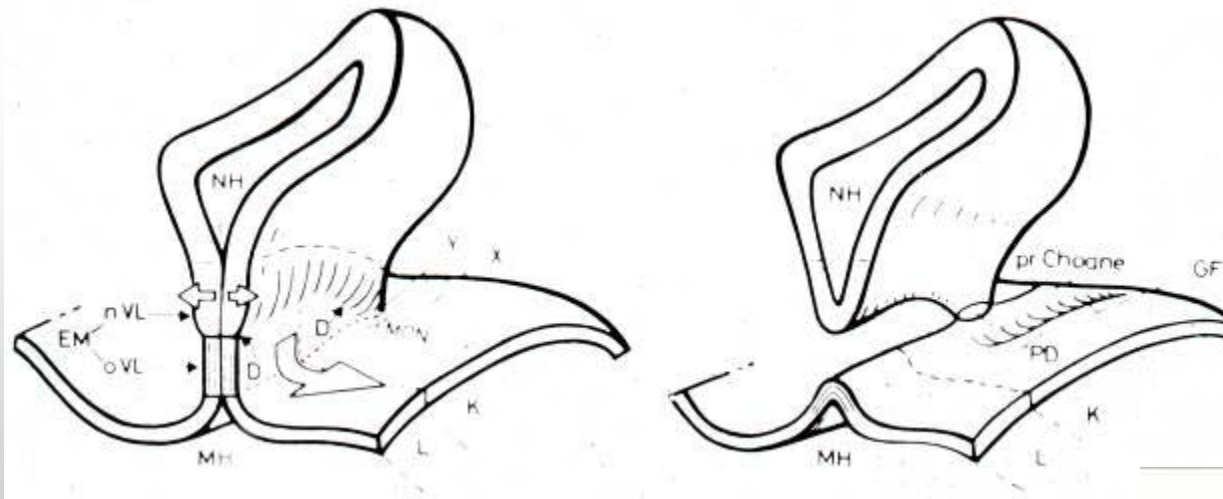




Initial fusion of medial and lateral nasal processes, and subsequently between medial nasal and maxillary processes.

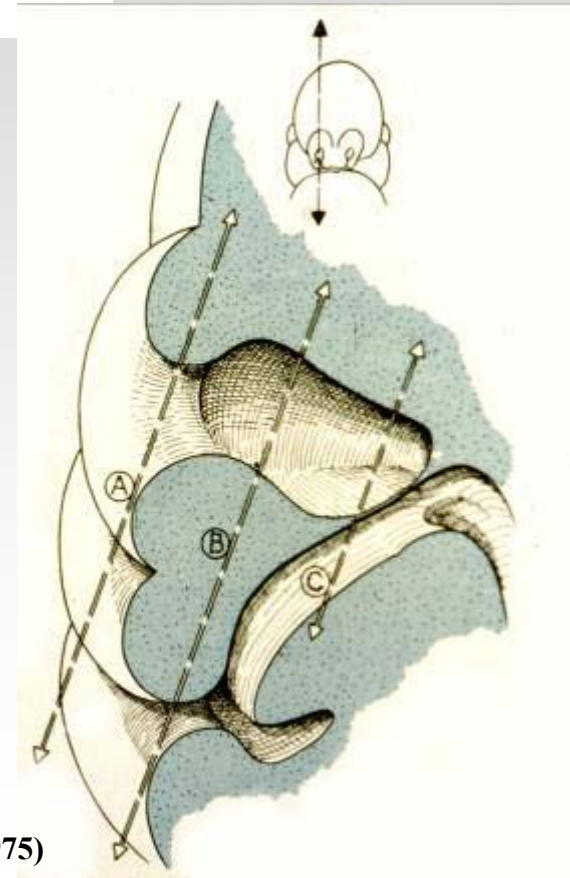
Millicovsky G, Johnston MC (1981)



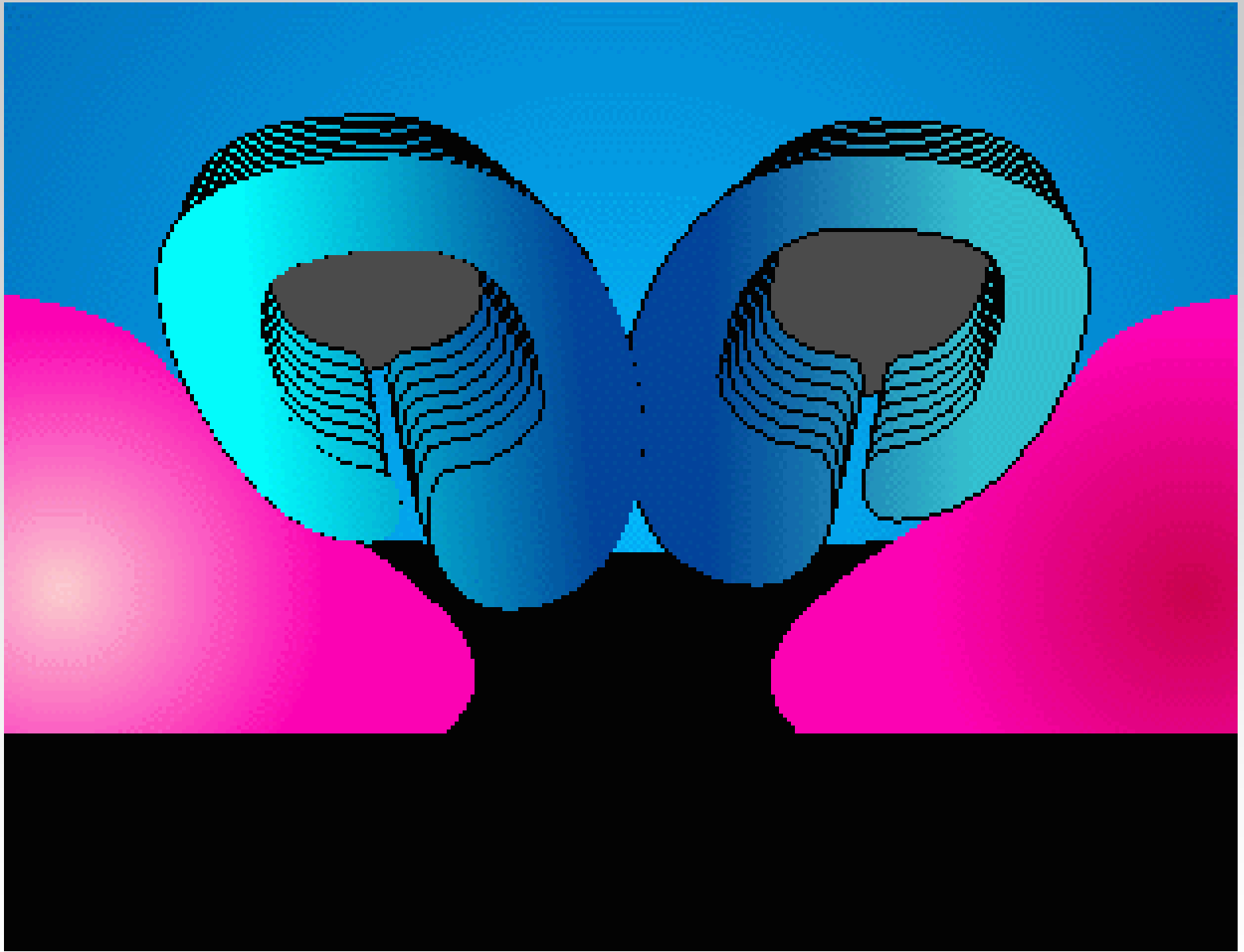


Otto H-D, Opitz Ch (1987)

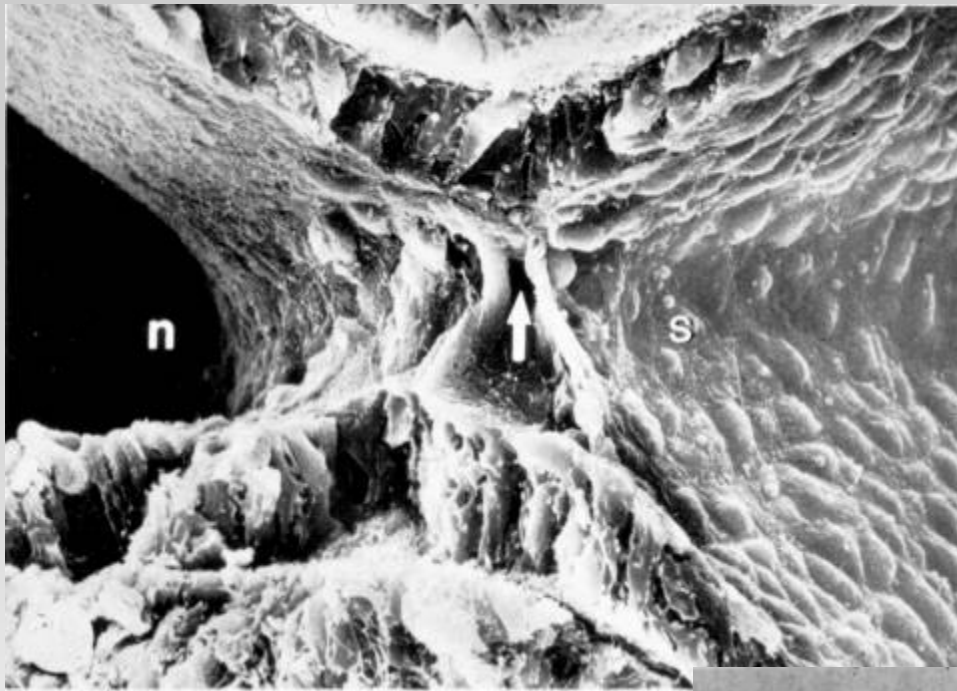
All epithelium in fusion line is removed except oronasal membrane (ectoderm-ectoderm)



Tuchmann-Duplessis H, Haegel P (1975)

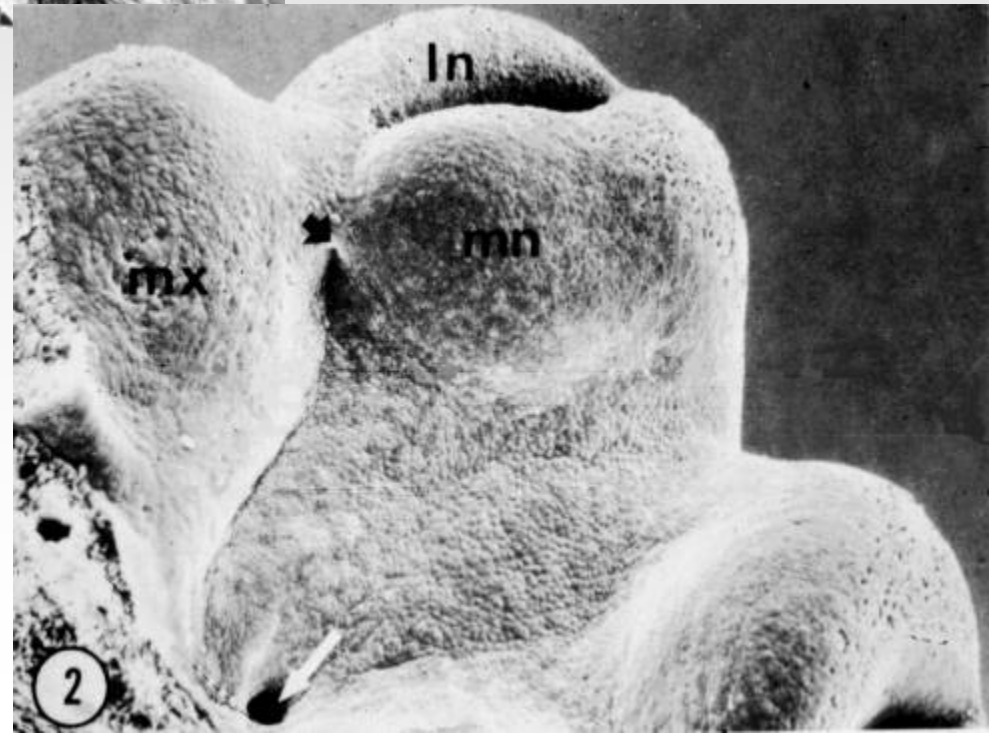


Watt, Marie A, and Sanders Colin, Univ Glasgow



Oronasal membrane

**Breaks down at
about 6 wks of
development.**



Tamarin A (1982)

Primary (primitive) palate

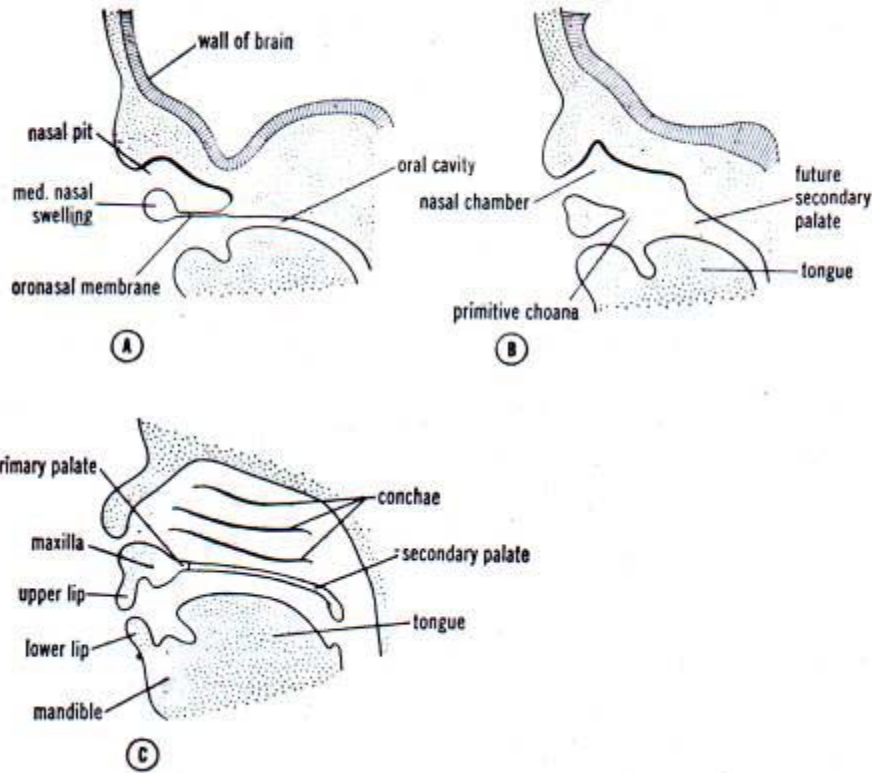


Tamarin A (1982)

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

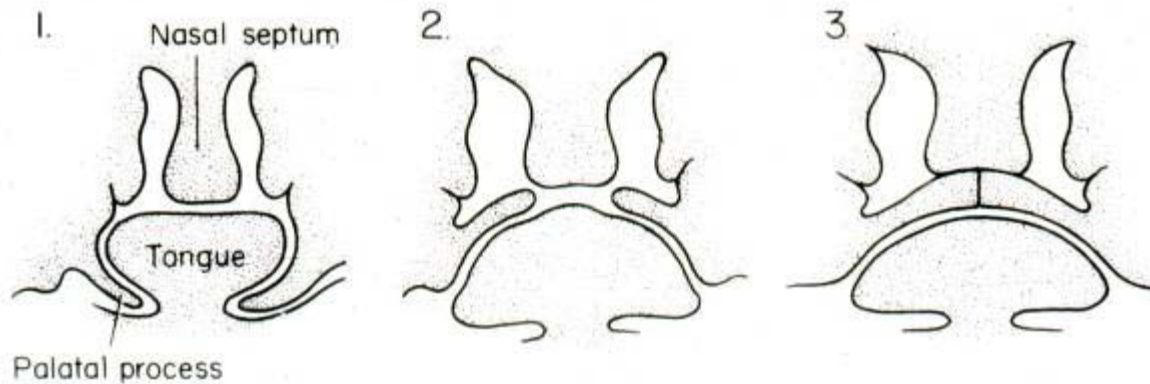
P: primary (primitive) choana permitting oro-nasal communication

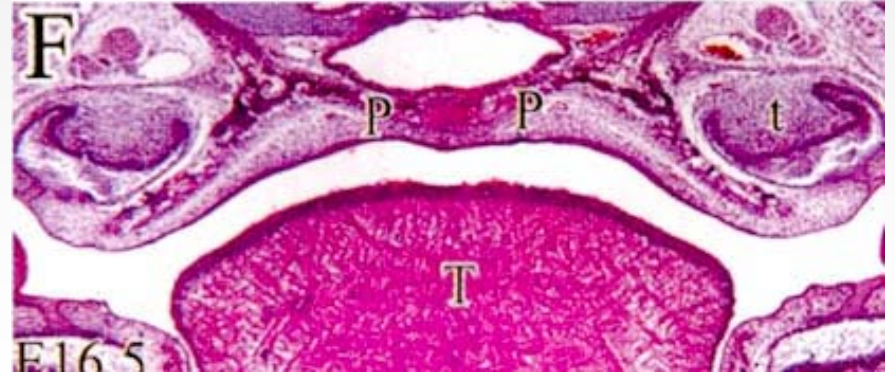
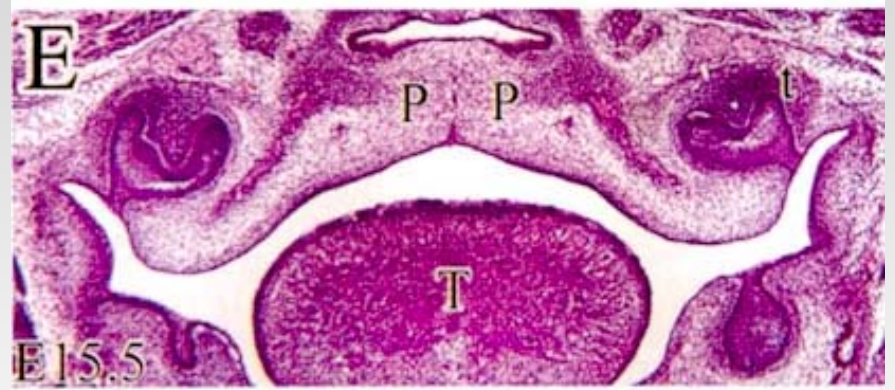
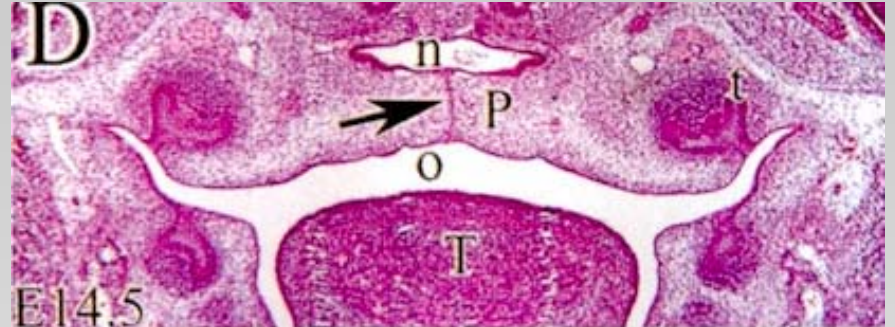
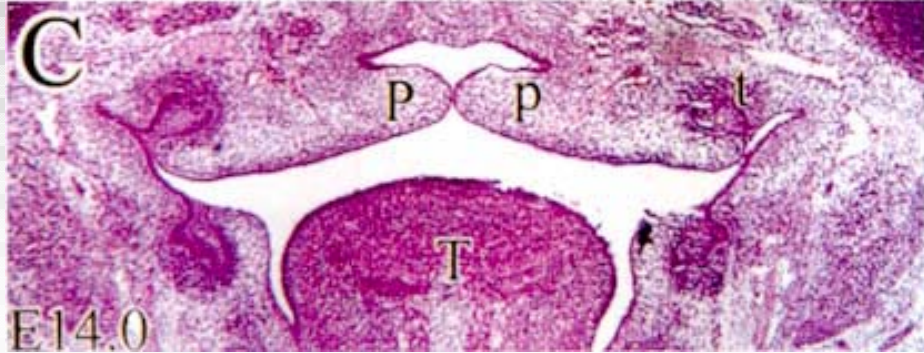
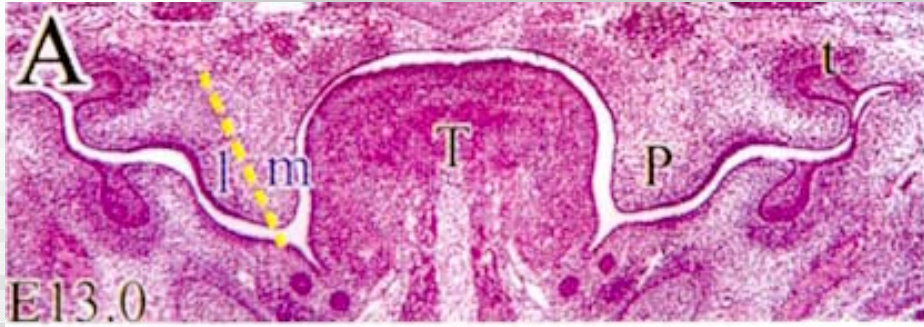
Development of primary and secondary palate



Langman J Medical Embryology

Secondary palate development



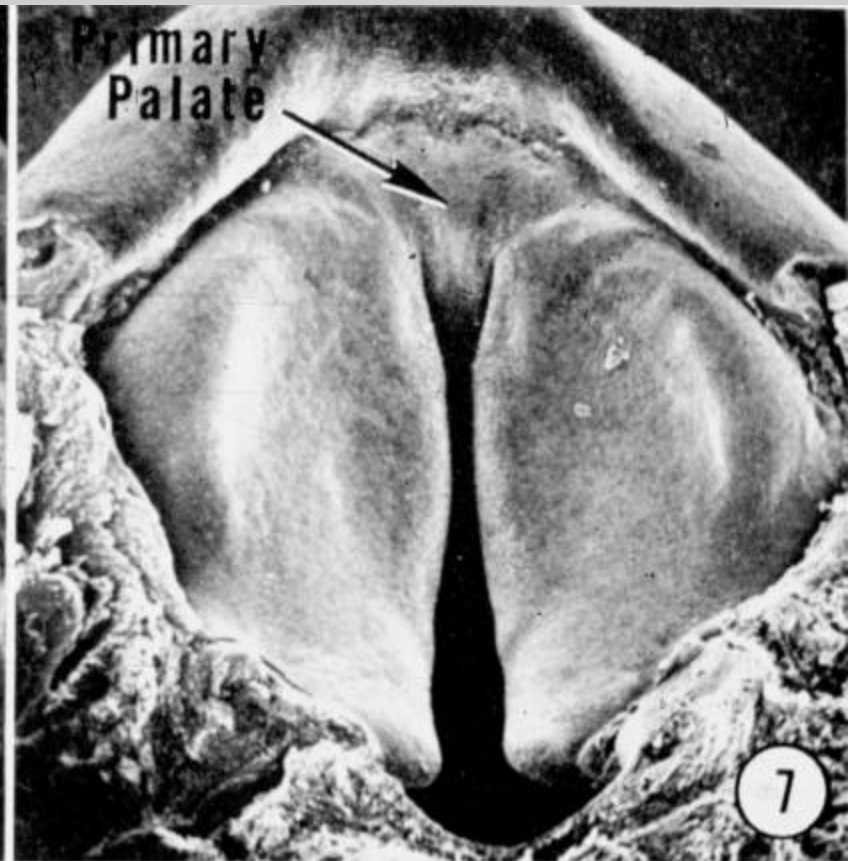
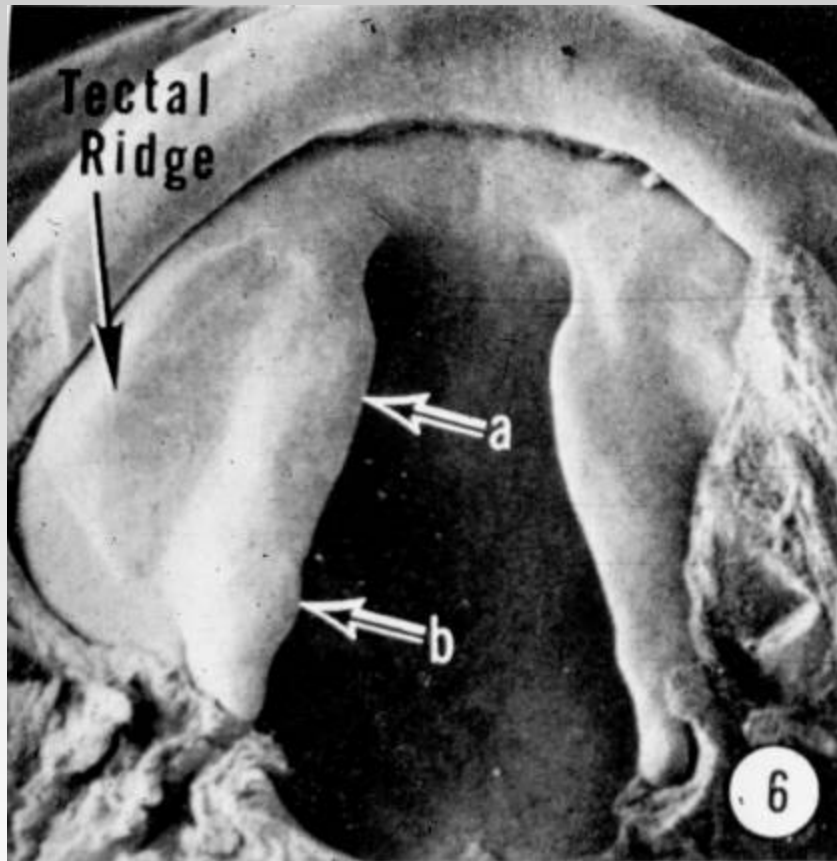


Chai Y, Maxson RE (2006)

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



Waterman RE, Meller SM (1974)

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

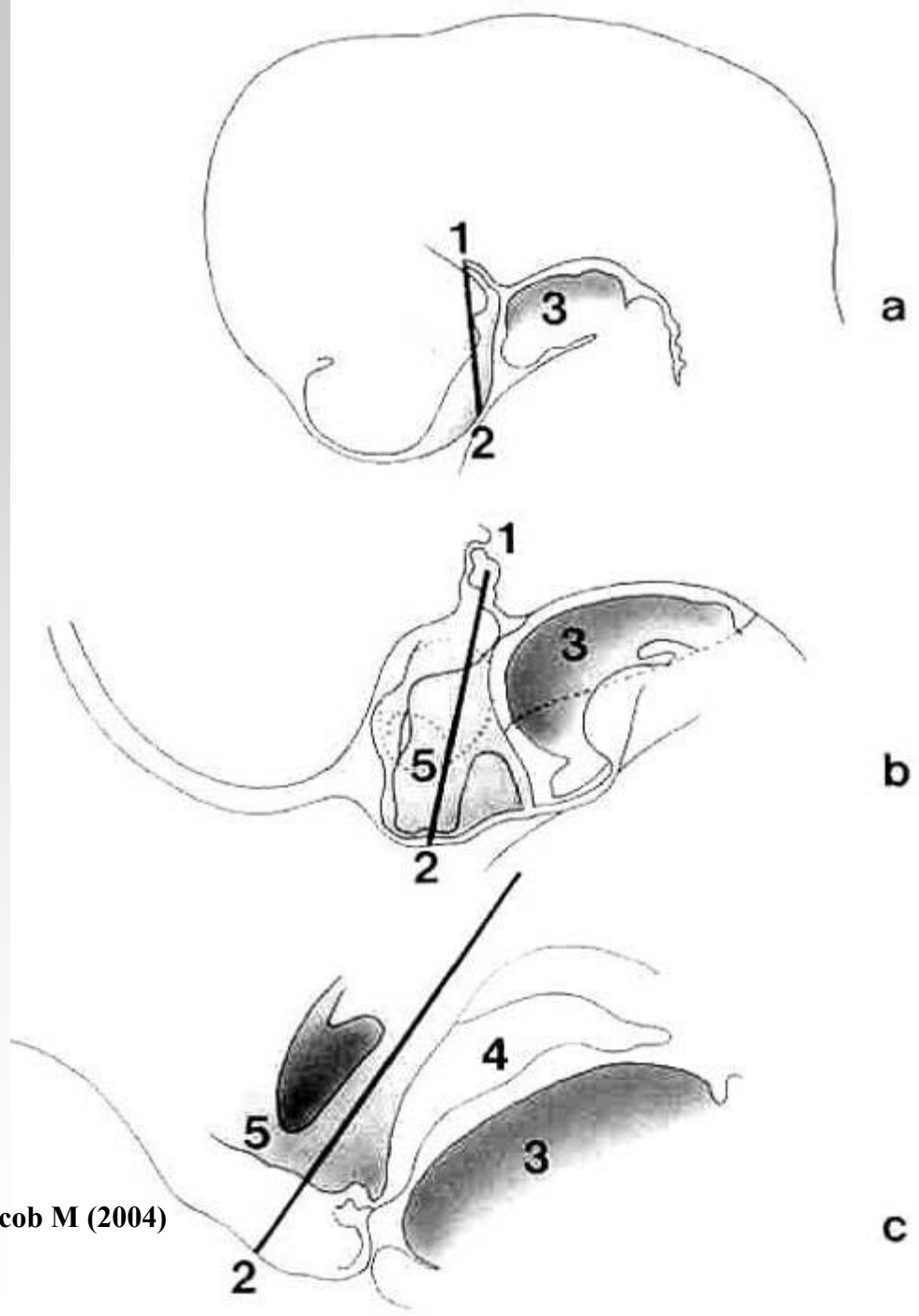
Horizontalization of palatal processes



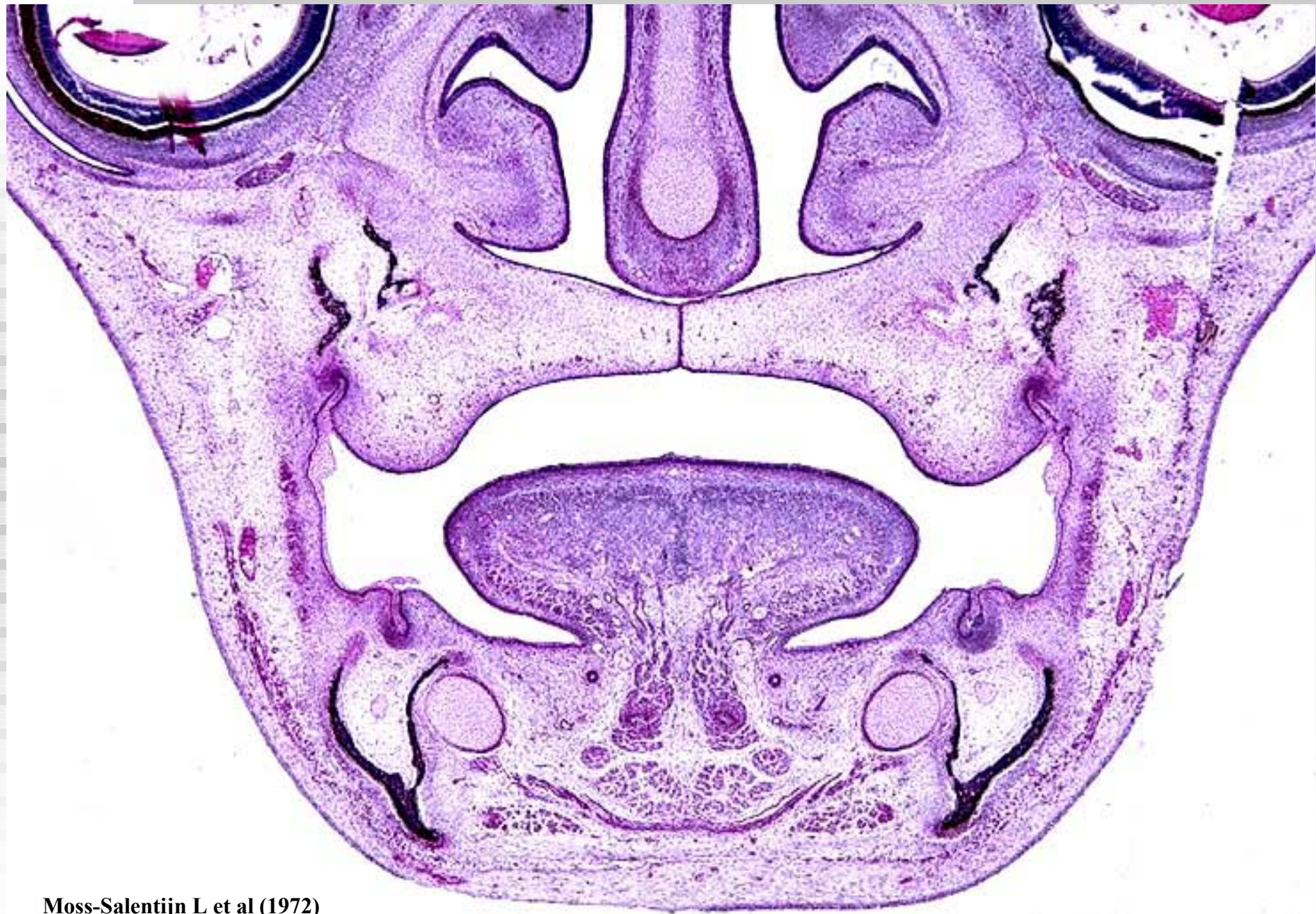
Watt, Marie A, and Sanders, Colin

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



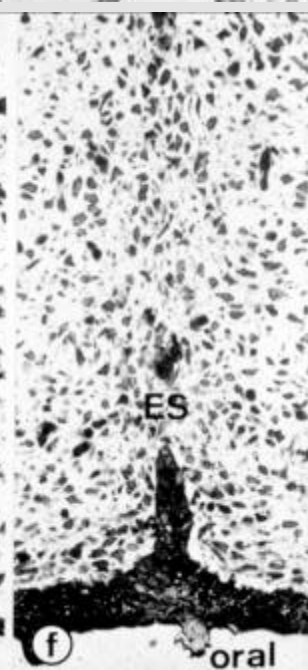
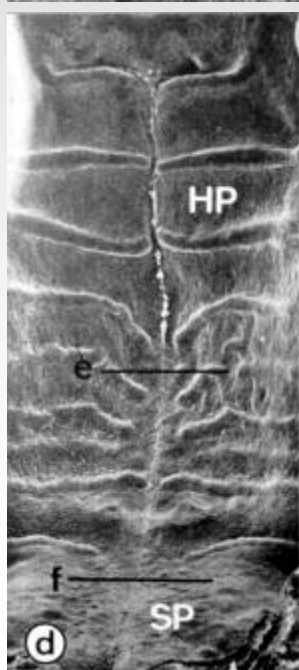
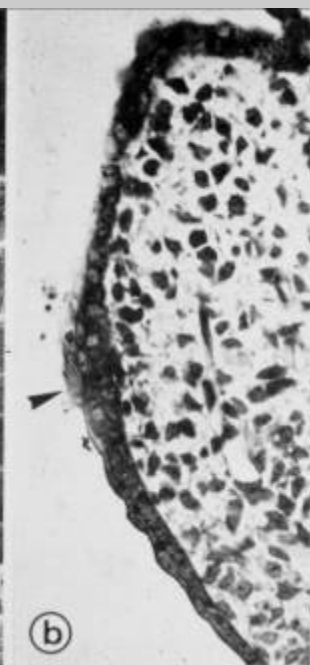
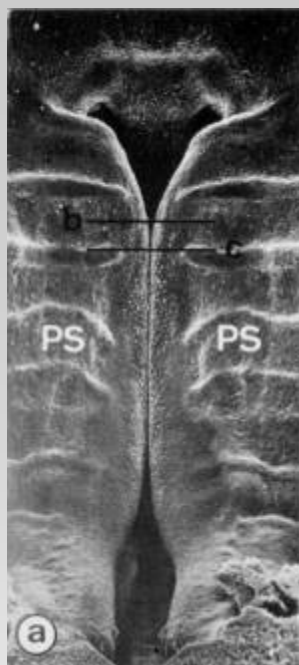
Barteczko K, Jacob M (2004)



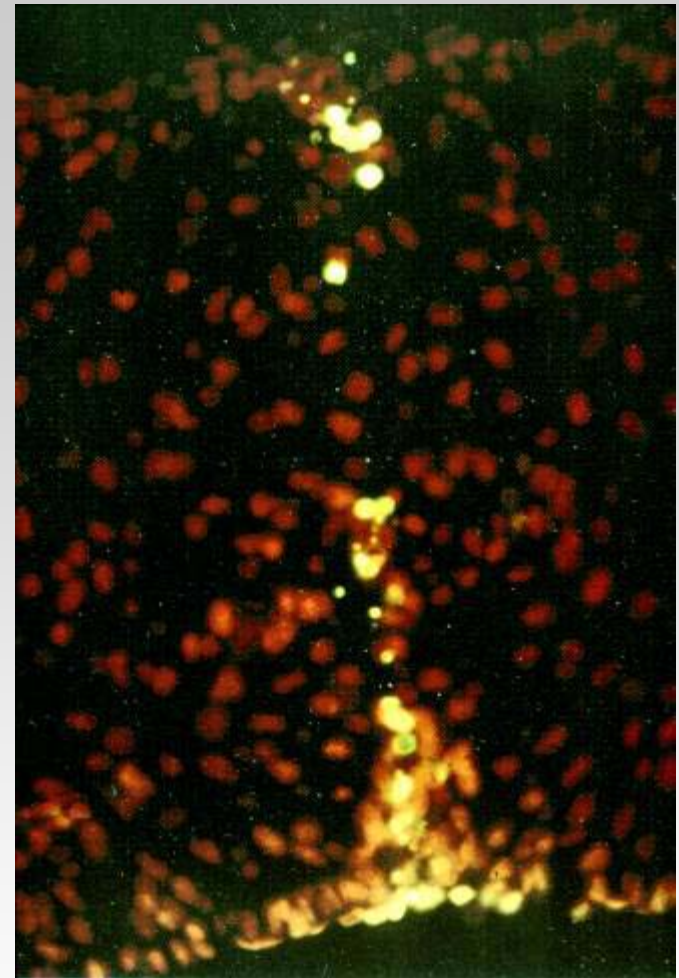
Moss-Salentijn L et al (1972)

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



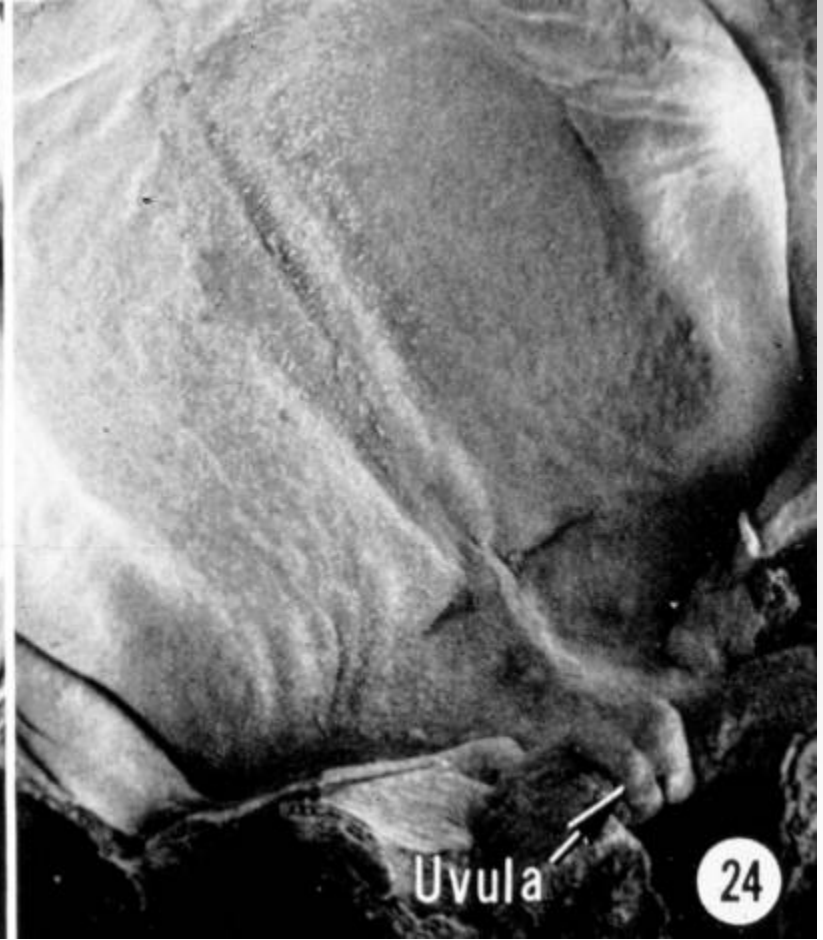
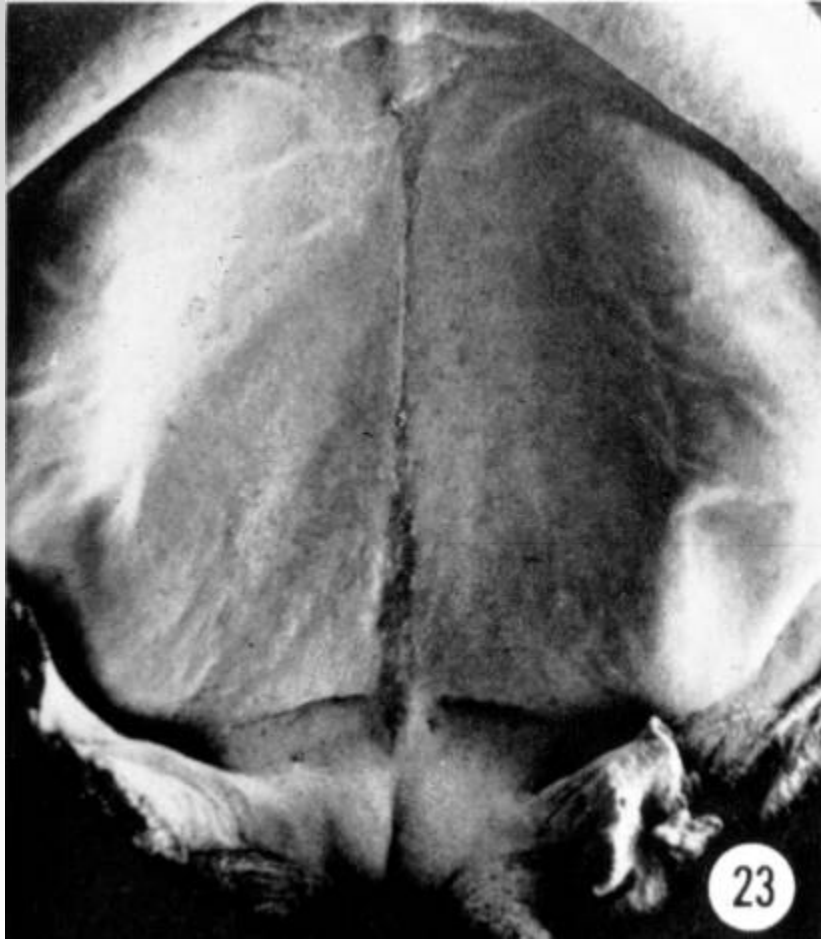
Mori C, et al. (1994)



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

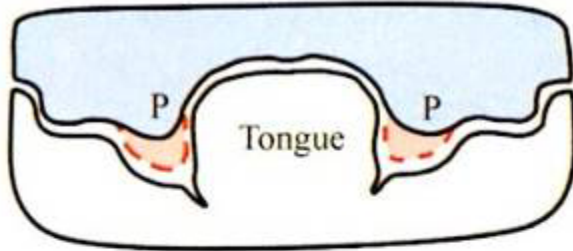
Schubach PM, Schroeder HE (1983)

Completion of palate formation

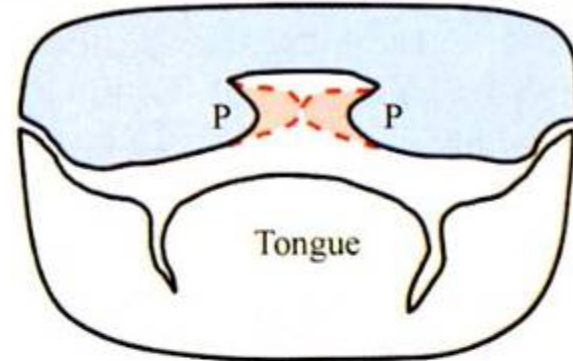


Waterman RE, Meller SM (1974)

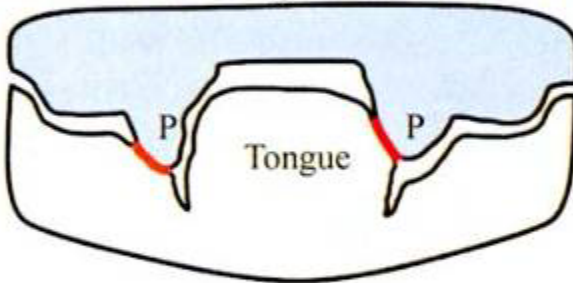
Failure of palatal shelf formation



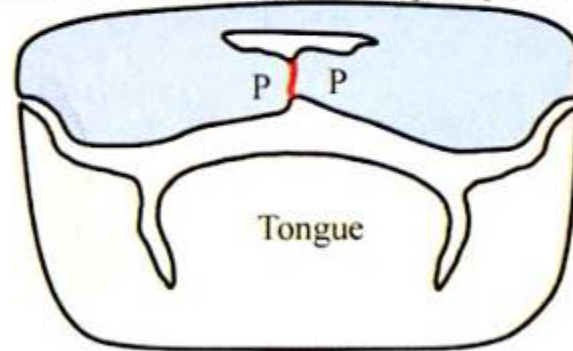
Failure of shelves to meet following elevation



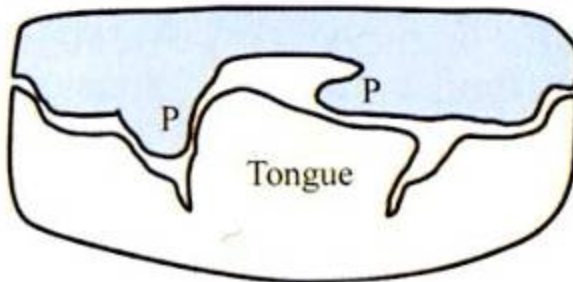
Fusion with the tongue or the mandible



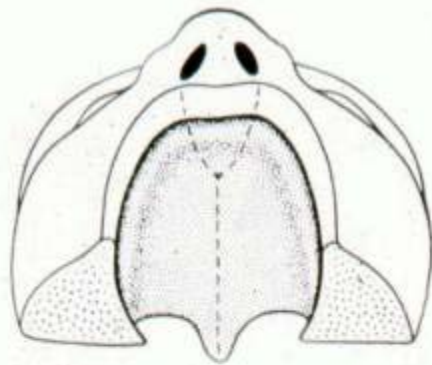
Persistence of medial edge epithelium



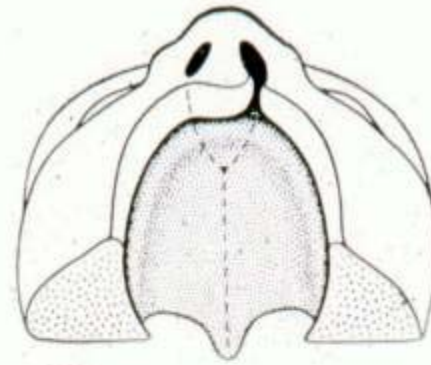
Failure of palatal shelf elevation



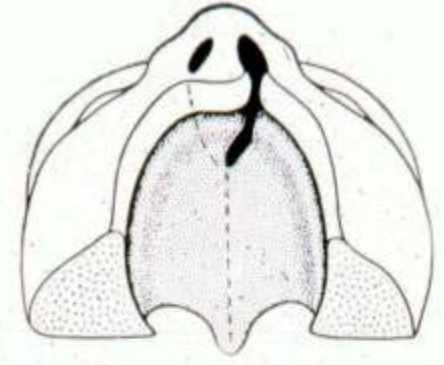
Sites of potential palatal clefts



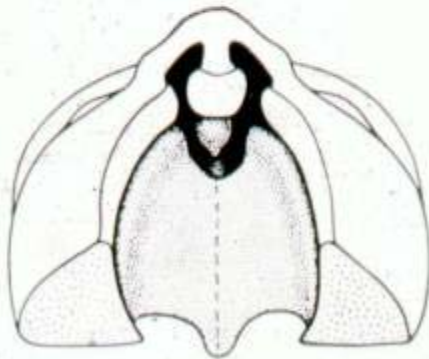
A



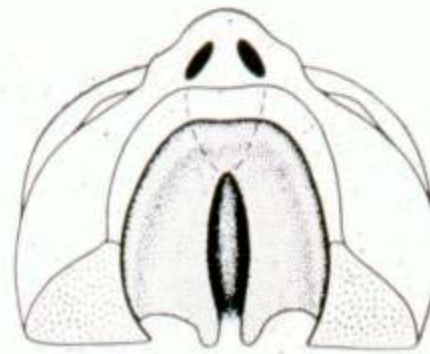
B



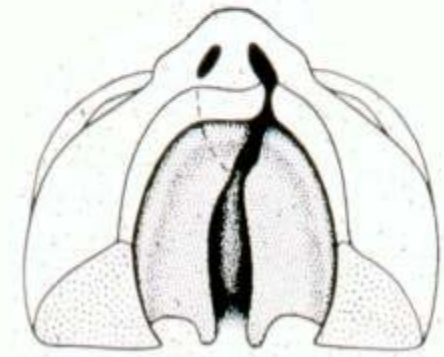
C



D



E



F