Obligate Nose Breathing

Descent of the Epiglottis

SIDS

Presentation prepared by:

Brian Palmer, D.D.S.

Kansas City, Missouri, USA

December, 2001

"Knowledge is most meaningful when shared with others."

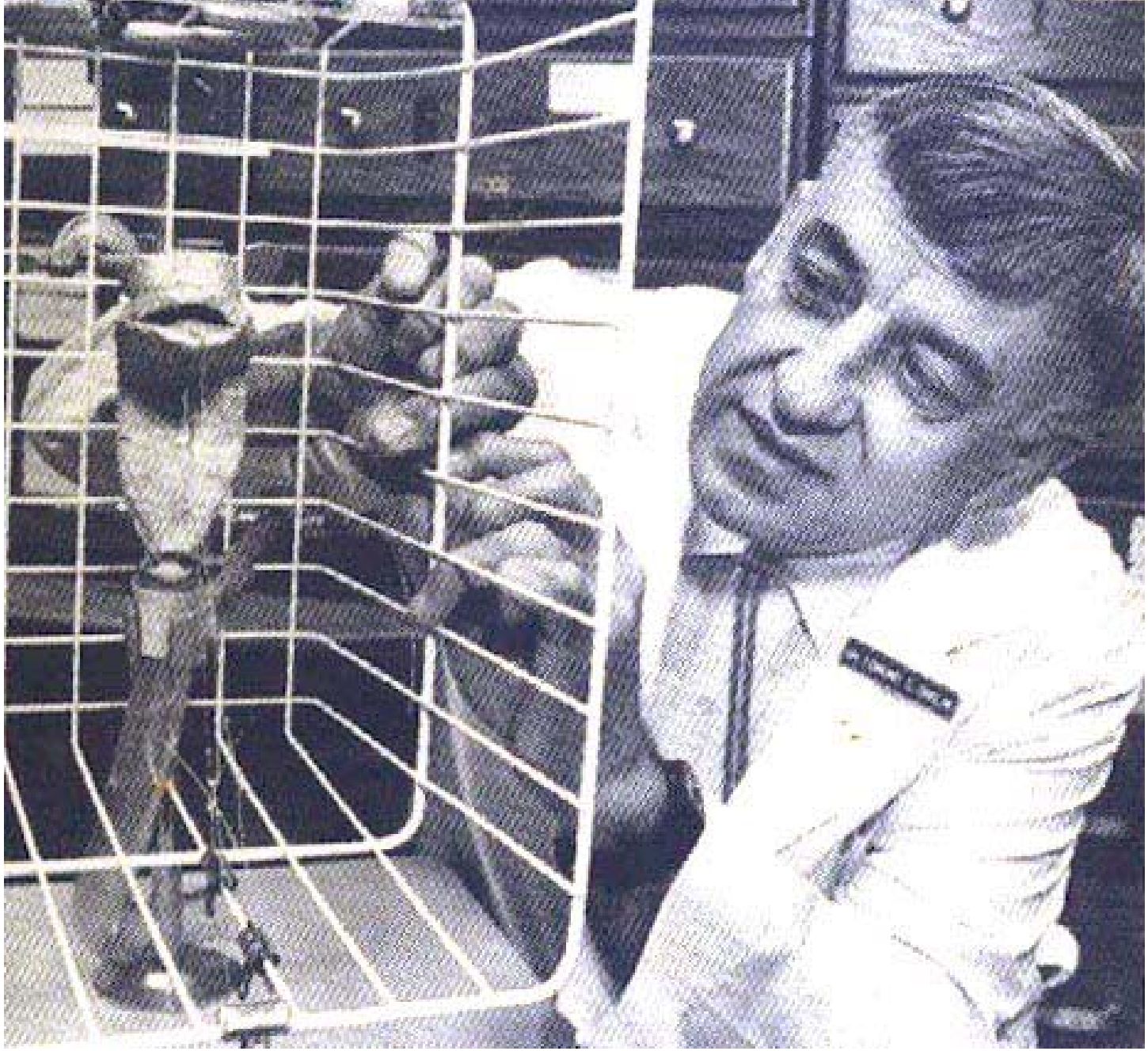
WARNING

Some of the pictures in this presentation are of dissections which are quite graphic. The pictures may not be suitable for all to view.

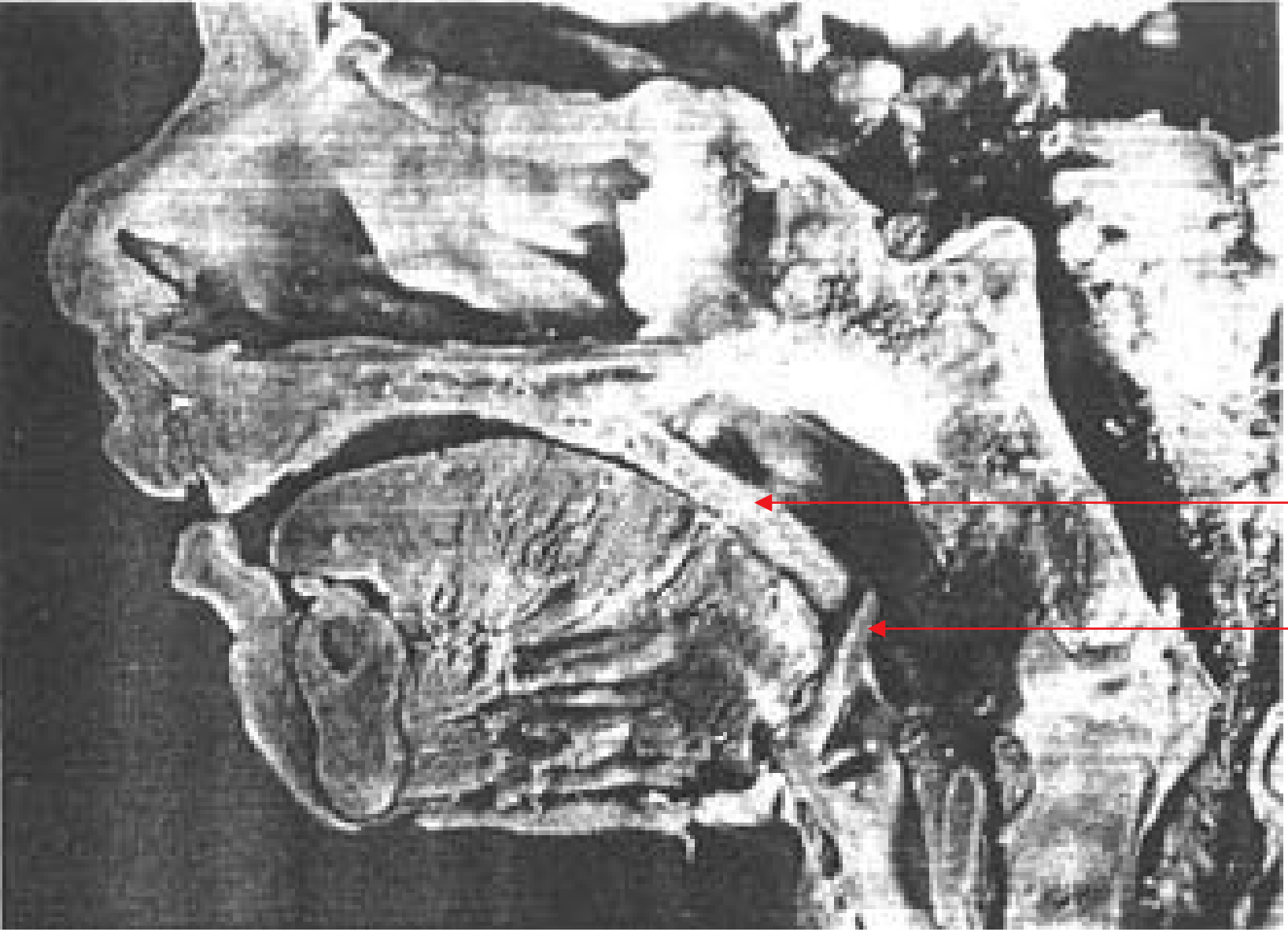
This presentation on SIDS is dedicated to:

Edmund S. Crelin, Ph.D., D.Sc.

- Faculty member at Yale, 1951-1988
- Professor of Anatomy, Dept. of Surgery.
- Chairman: Human Growth & Development.
- Author of 168 research articles
- Author of 3 books.
- Author of 5 CIBA Clinical Symposia.
- 3 awards at Yale as “outstanding teacher”.



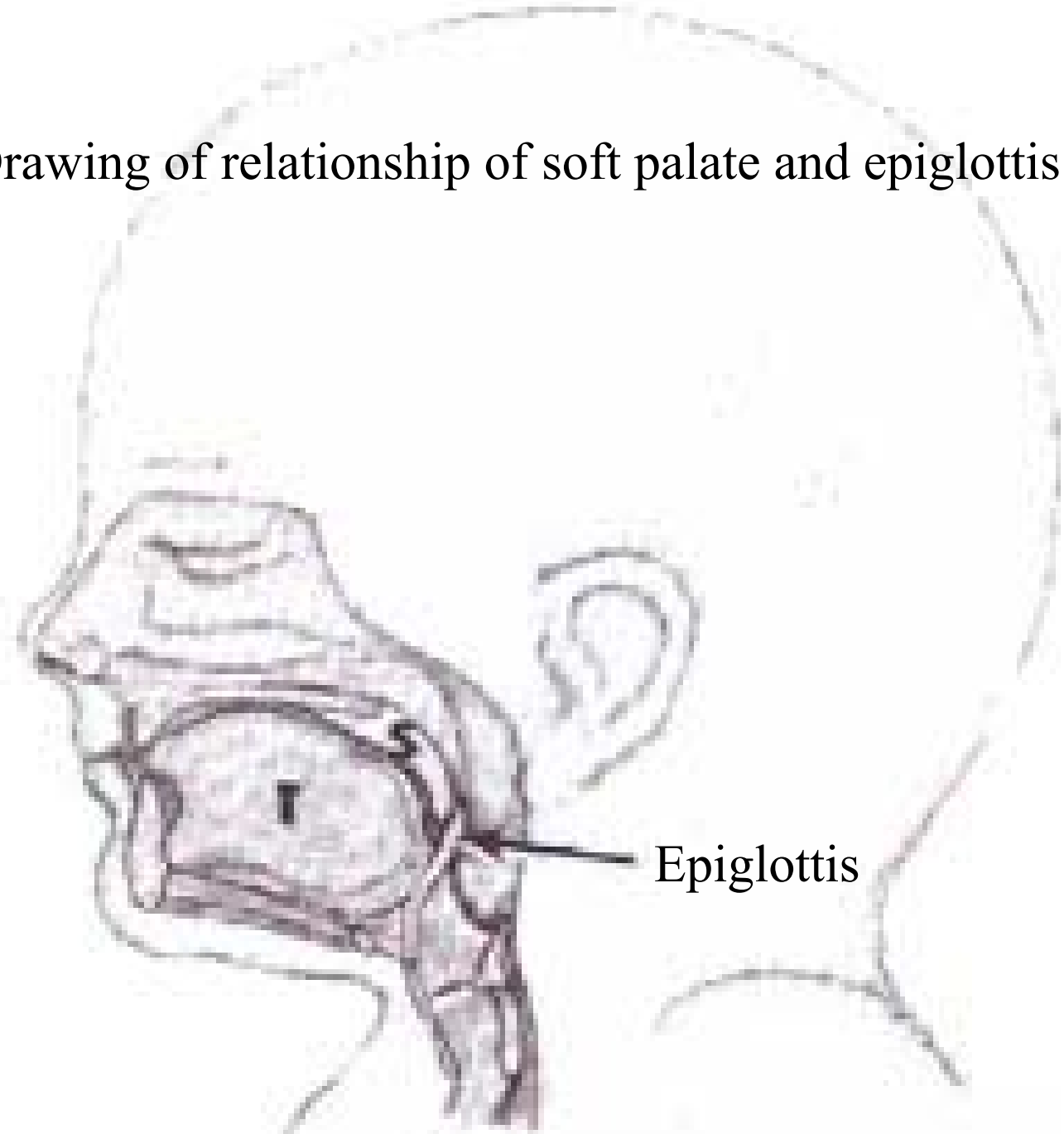
5 Dr. Crelin with his latex rubber model of a human vocal tract.

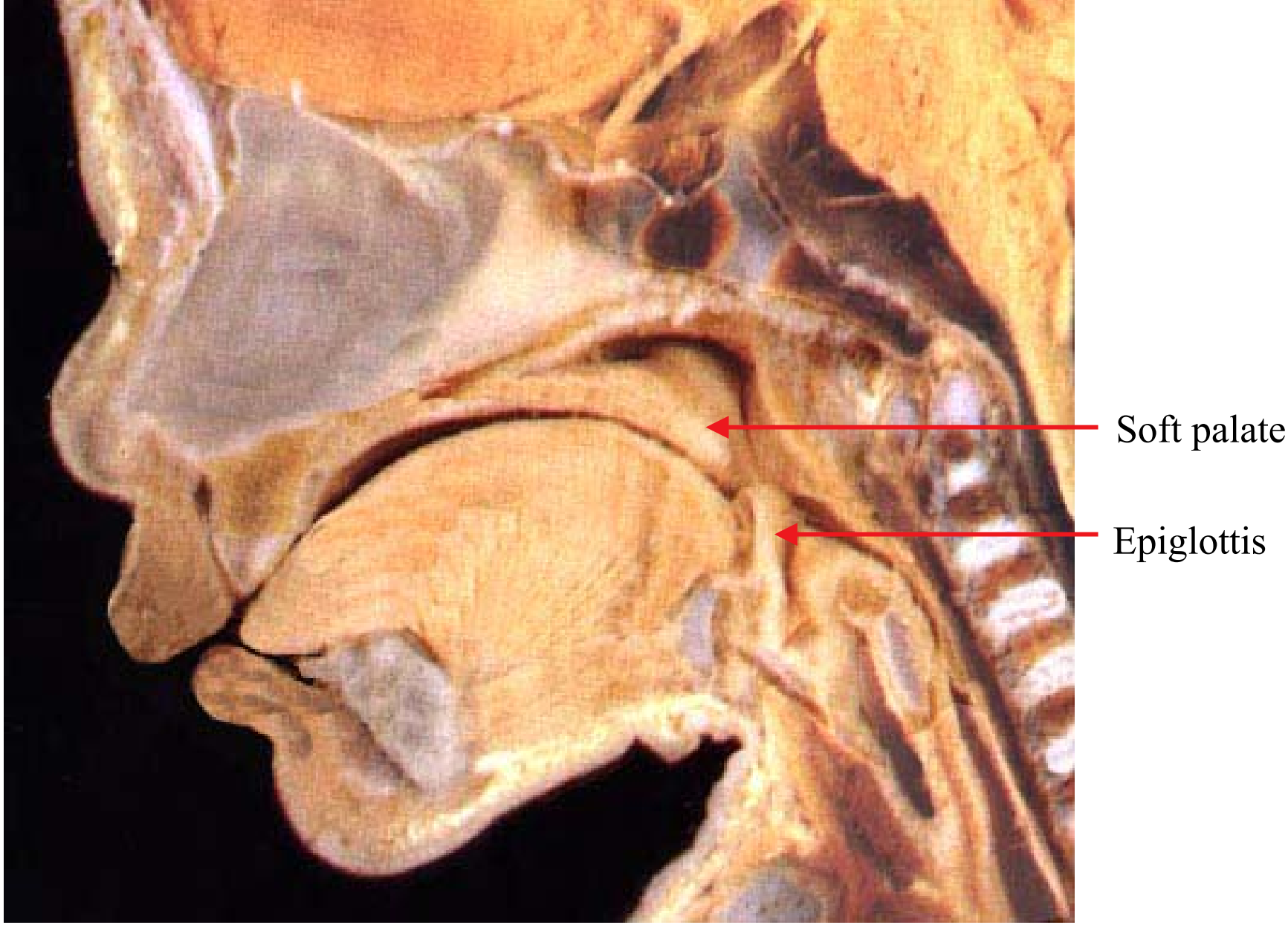


The epiglottis is in direct contact with the soft palate. The tongue is located entirely within the oral cavity. (Crelin)

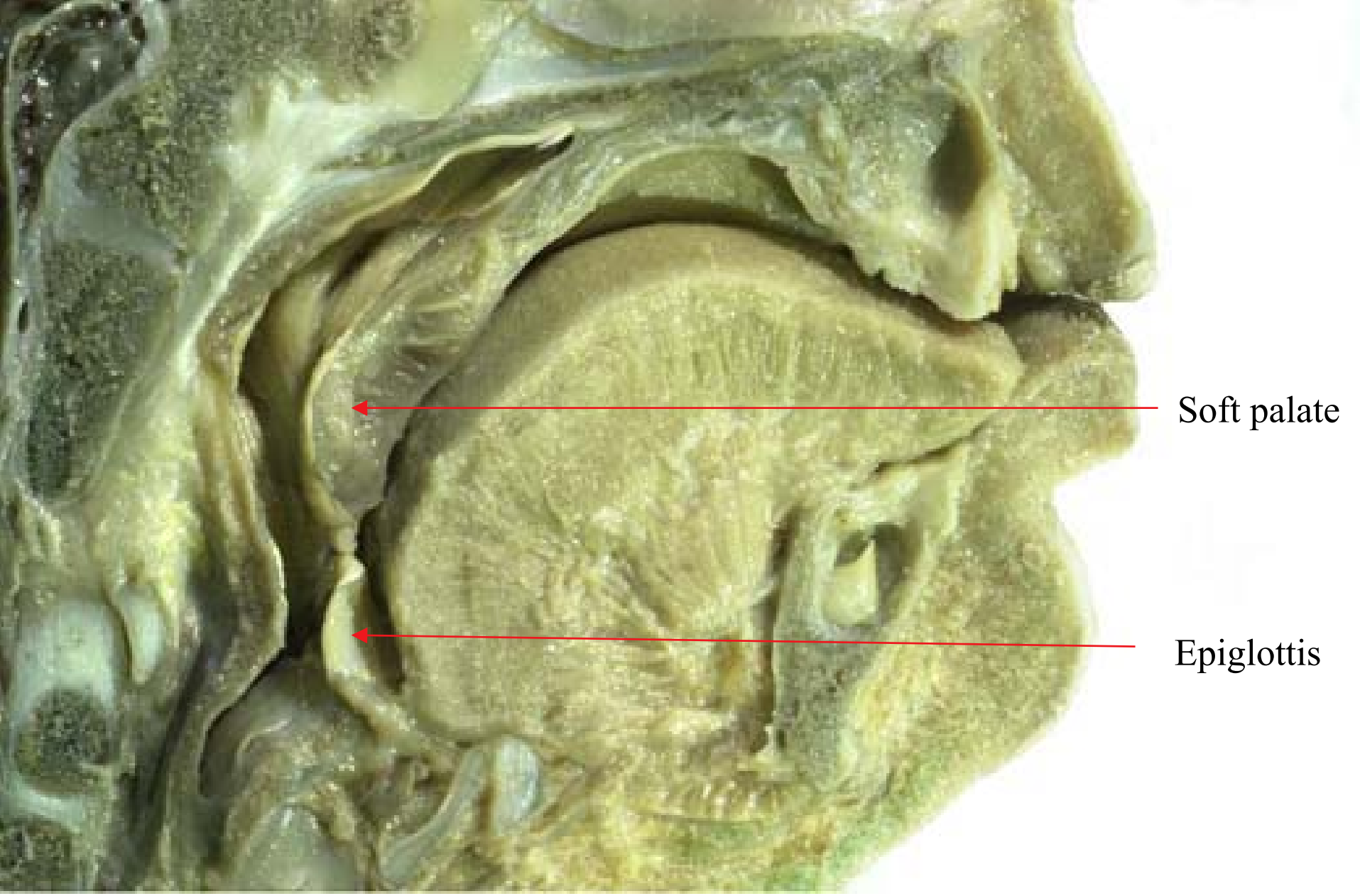
The epiglottis is in direct contact with the soft palate. The tongue is located entirely within the oral cavity. (Crelin)

Drawing of relationship of soft palate and epiglottis. (Crelin)



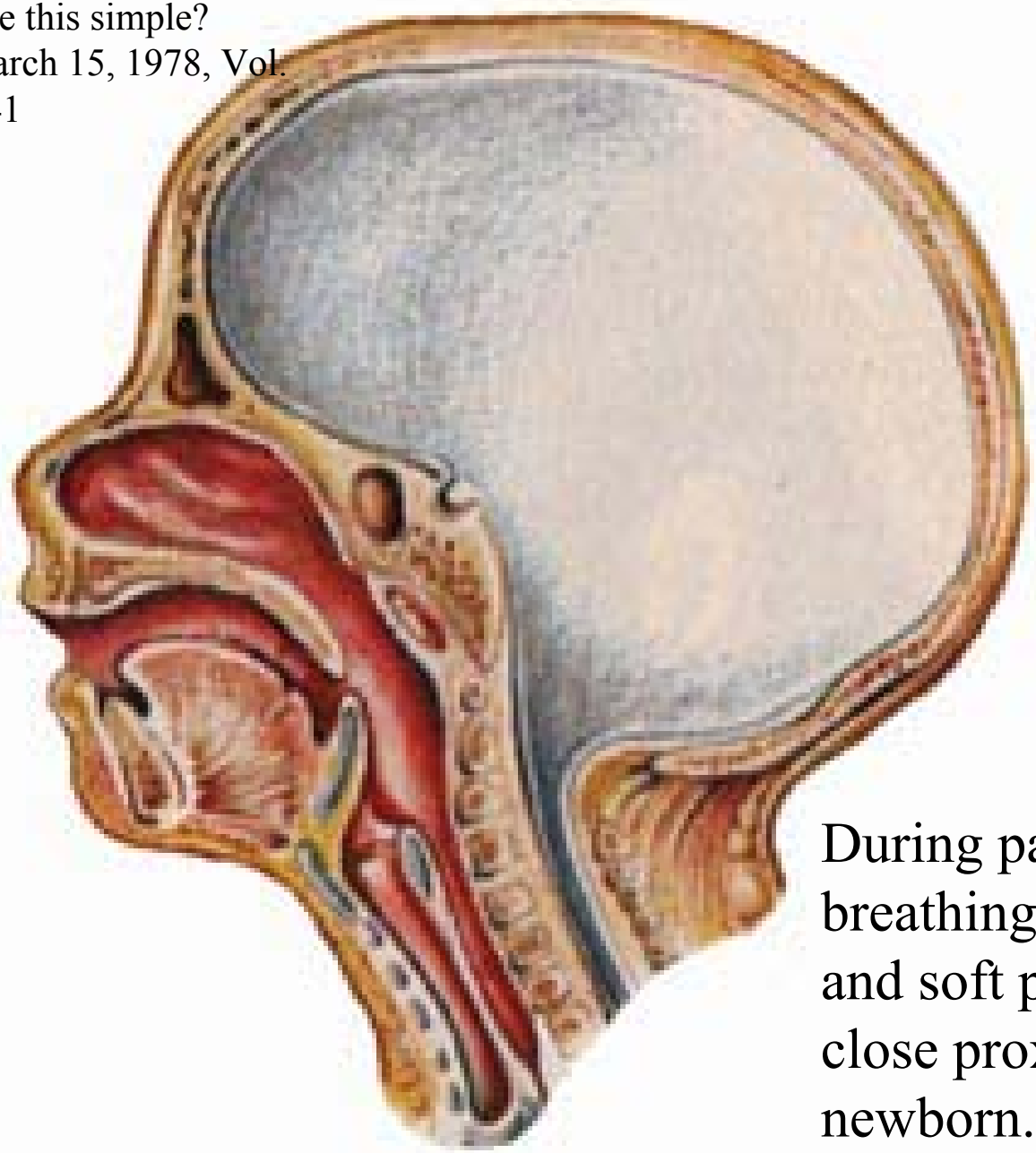


Atlas picture demonstrating similar relationship of epiglottis and soft palate. (Rohen/Yokocki)

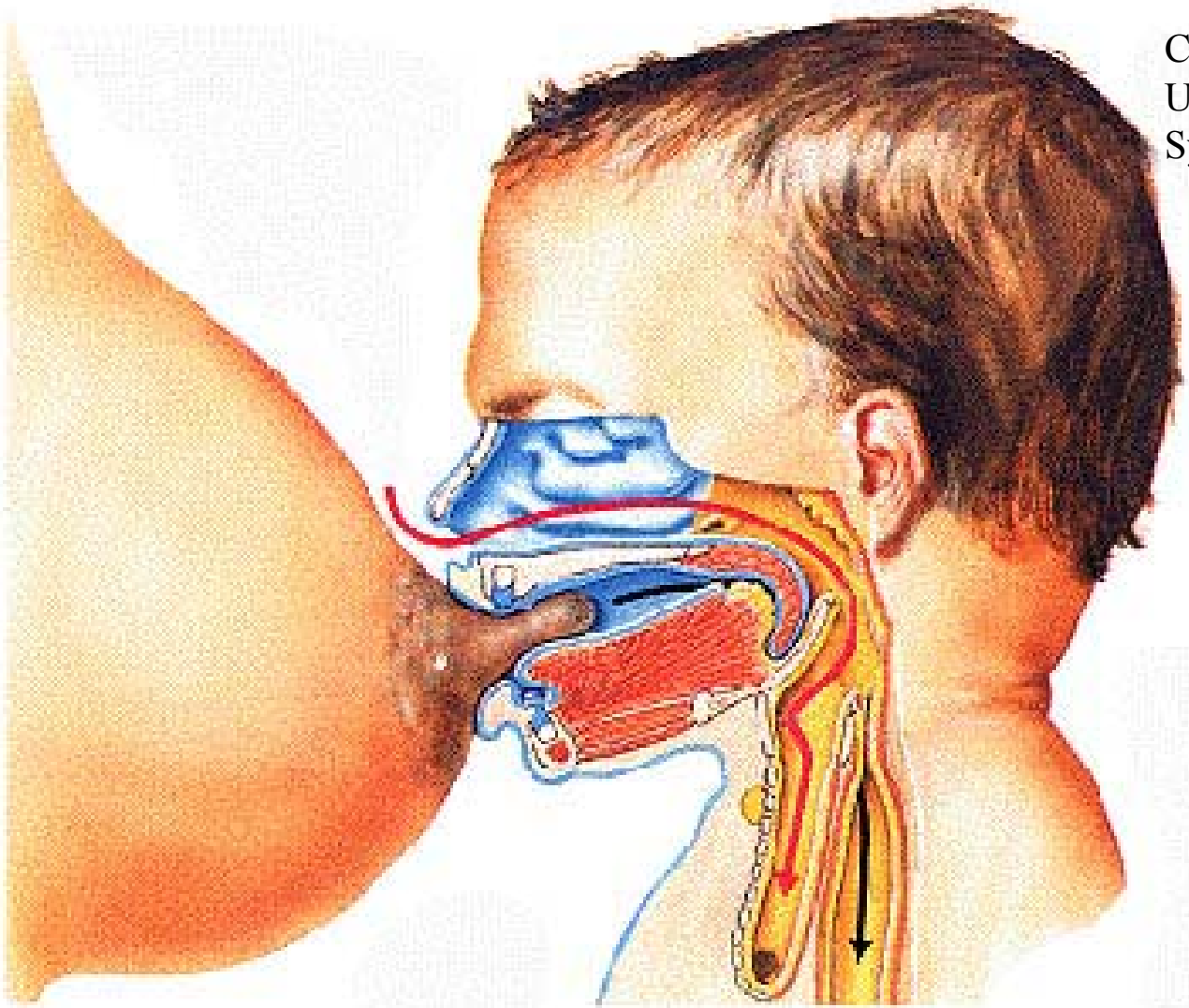


Cadaver dissection showing same relationship.

Crelin ES, Scherz RG, Can the cause of SIDS be this simple? Patient Care, March 15, 1978, Vol. 12, No 5:234-241



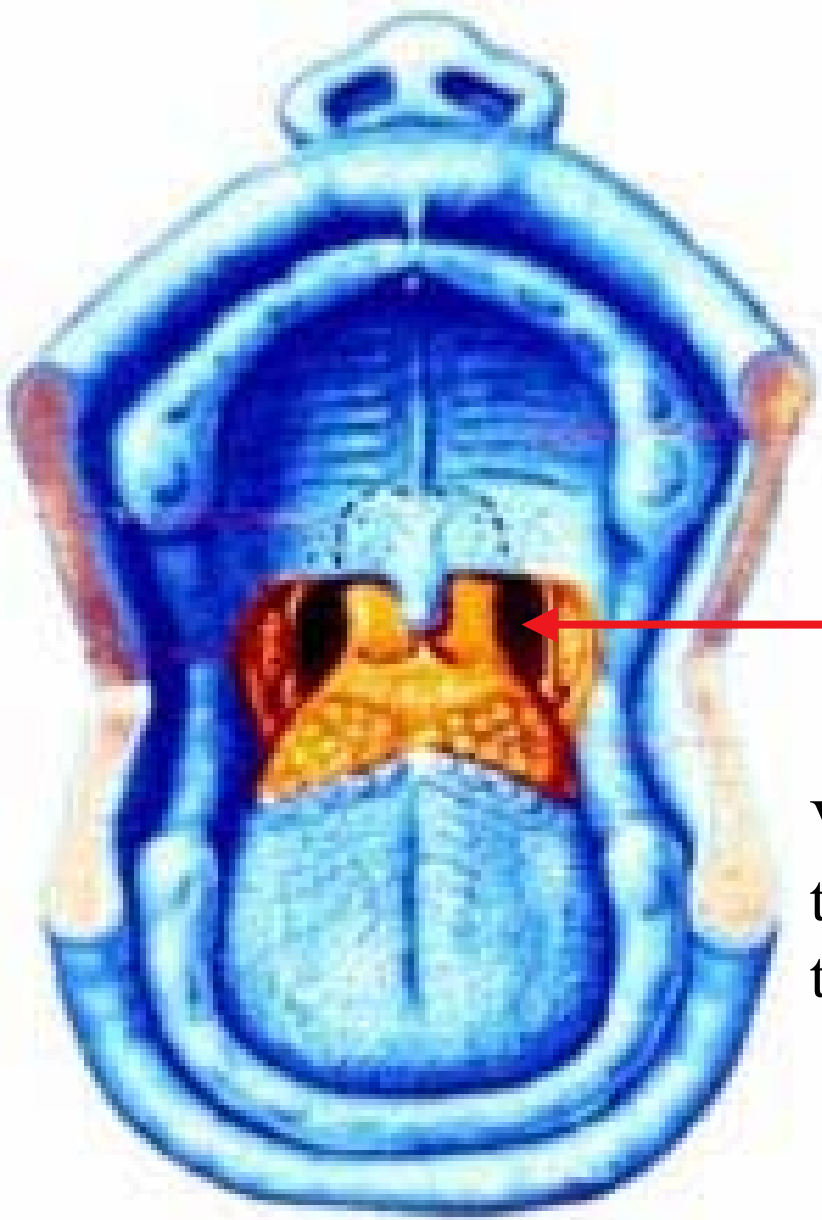
During passive breathing, the epiglottis and soft palate are in close proximity in a newborn.



Crelin ES. Development of the Upper Respiratory System, Clinical Symposia, Vol. 28, No. 3, 1976

During the act of breastfeeding, Dr. Crelin states the larynx can be elevated so that the epiglottis can slide up behind the soft palate to lock the larynx into the nasopharynx. This allows the infant to both swallow and breathe at the same time.

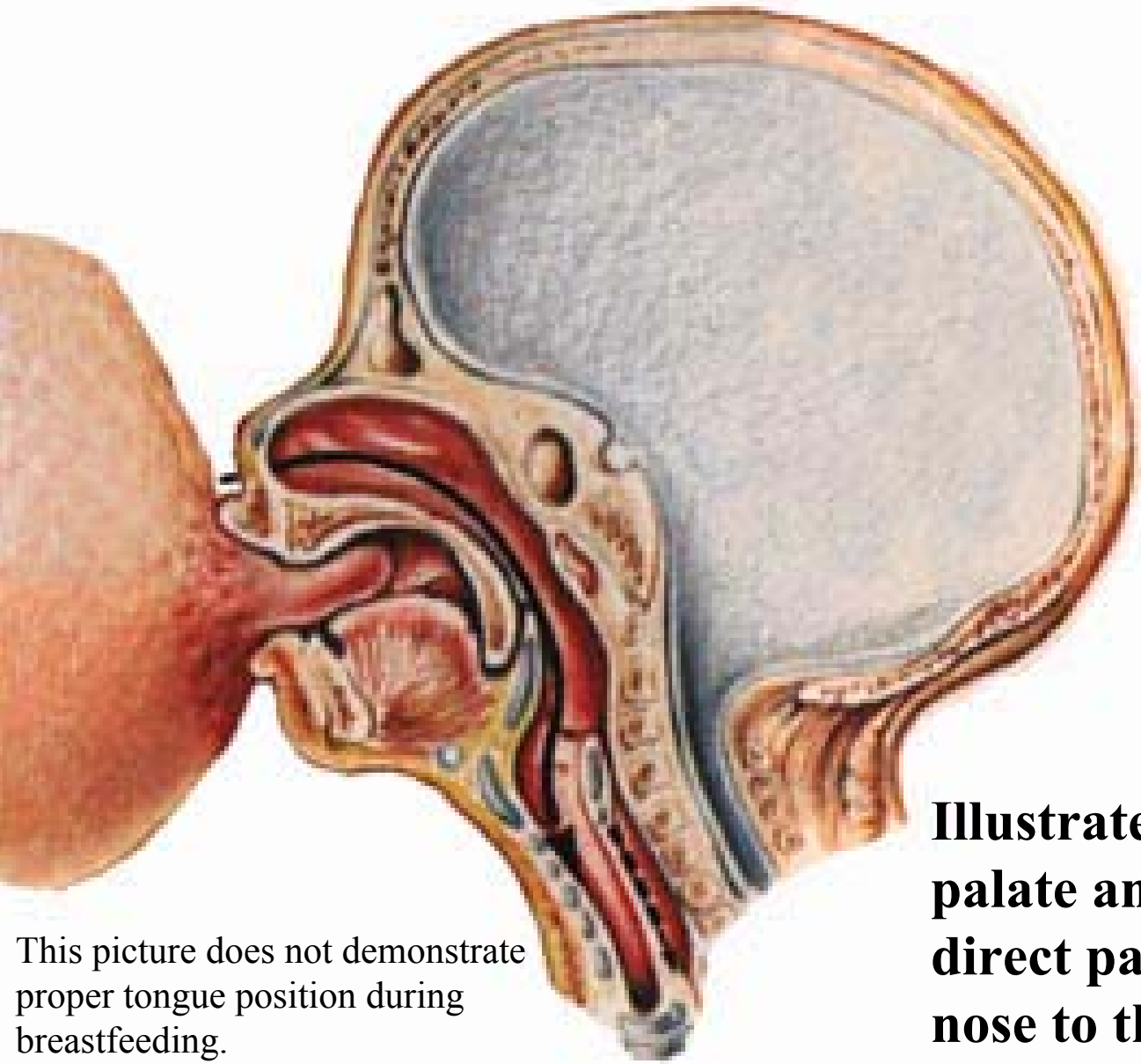
Crelin ES. Development of the Upper Respiratory System, Clinical Symposia, Vol. 28, No. 3, 1976



Faucium channel

View looking into the mouth to illustrate the interlocking of the soft palate and epiglottis.

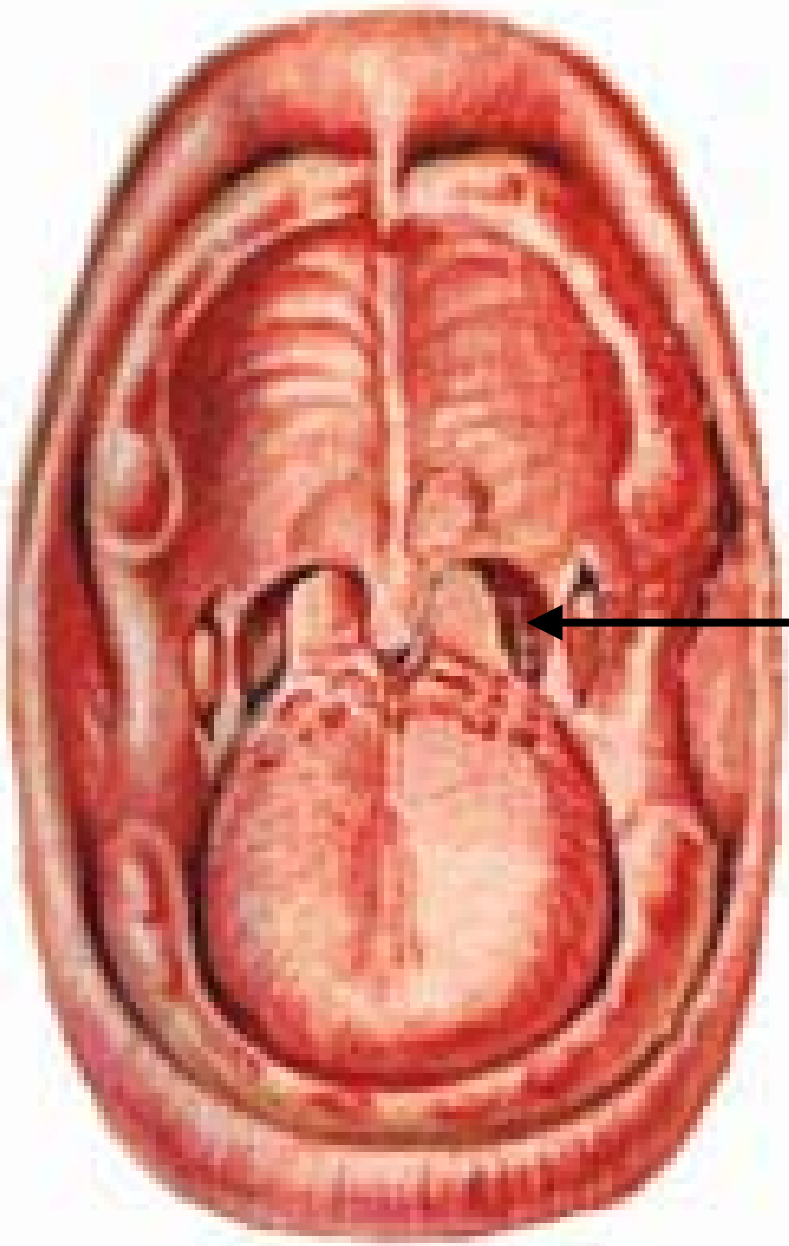
Crelin ES, Scherz RG, Can the cause of SIDS be this simple? Patient Care, March 15, 1978, Vol. 12, No 5:234-241



This picture does not demonstrate proper tongue position during breastfeeding.

Illustrates interlocking of soft palate and epiglottis and direct path air has through the nose to the lungs.

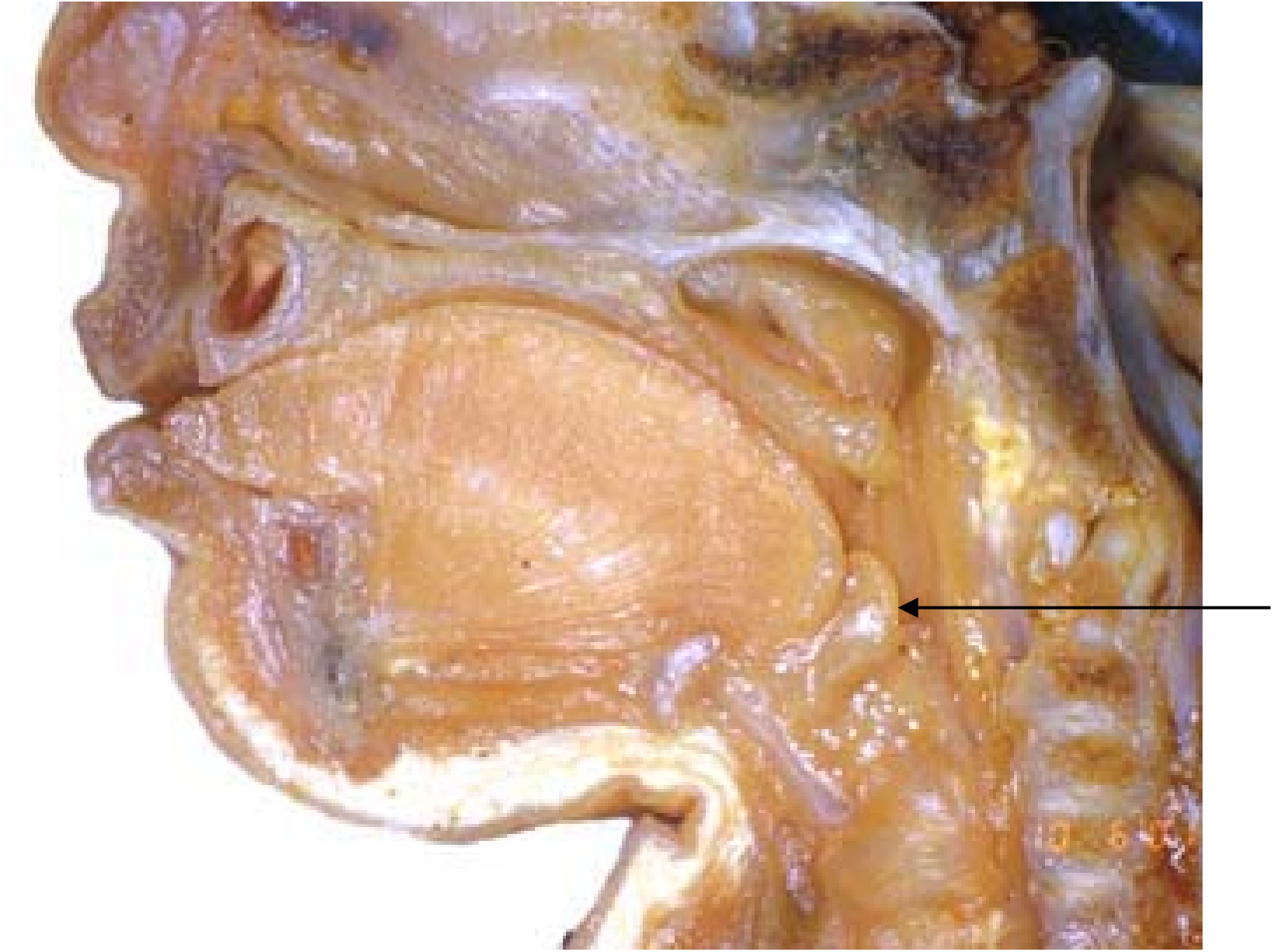
Crelin ES, Scherz RG, Can the cause of SIDS be this simple? Patient Care, March 15, 1978, Vol. 12, No 5:234-241



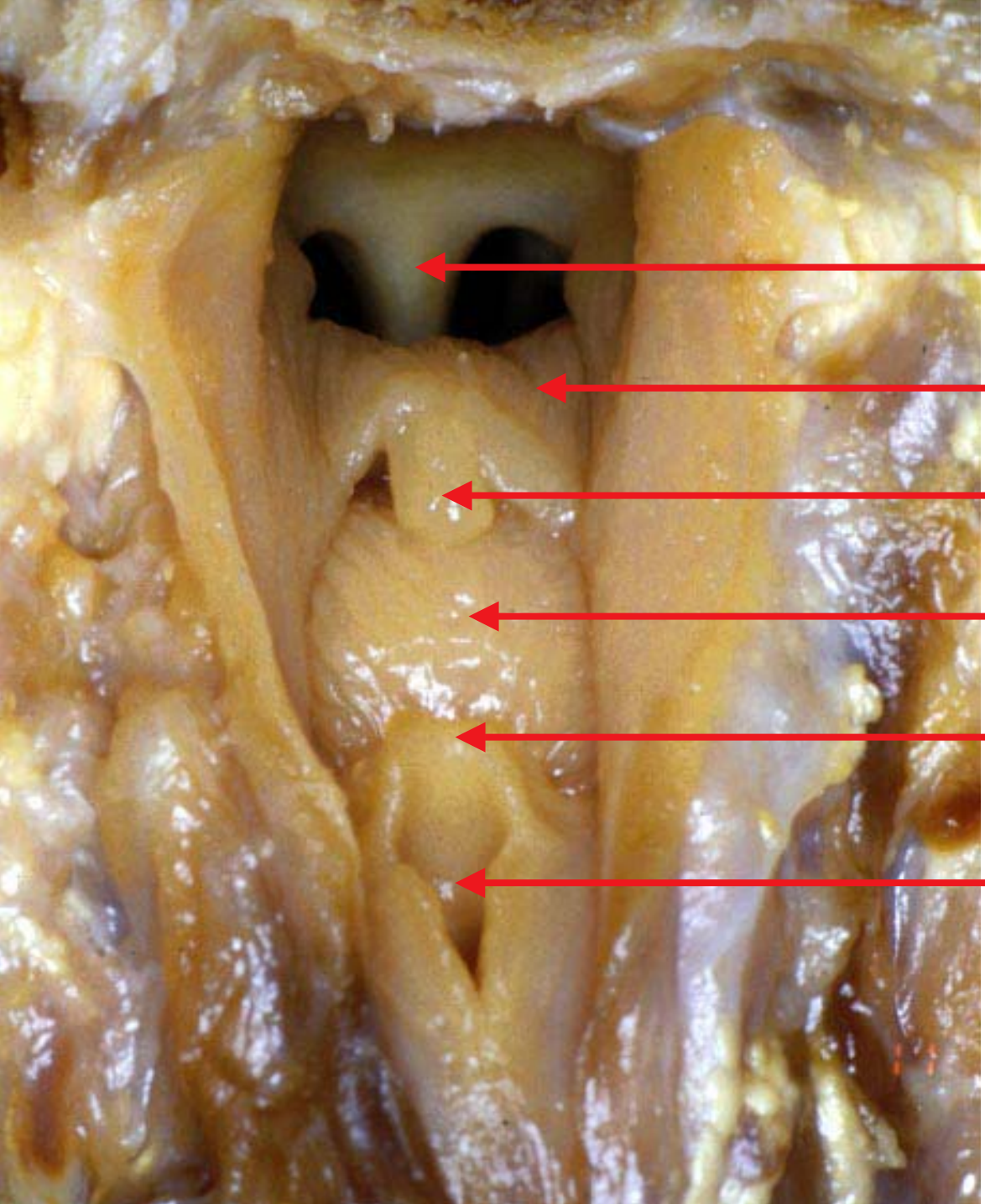
Faucium channel

Illustrates interlocking of soft palate with epiglottis and faucium channels through which the breastmilk flows.

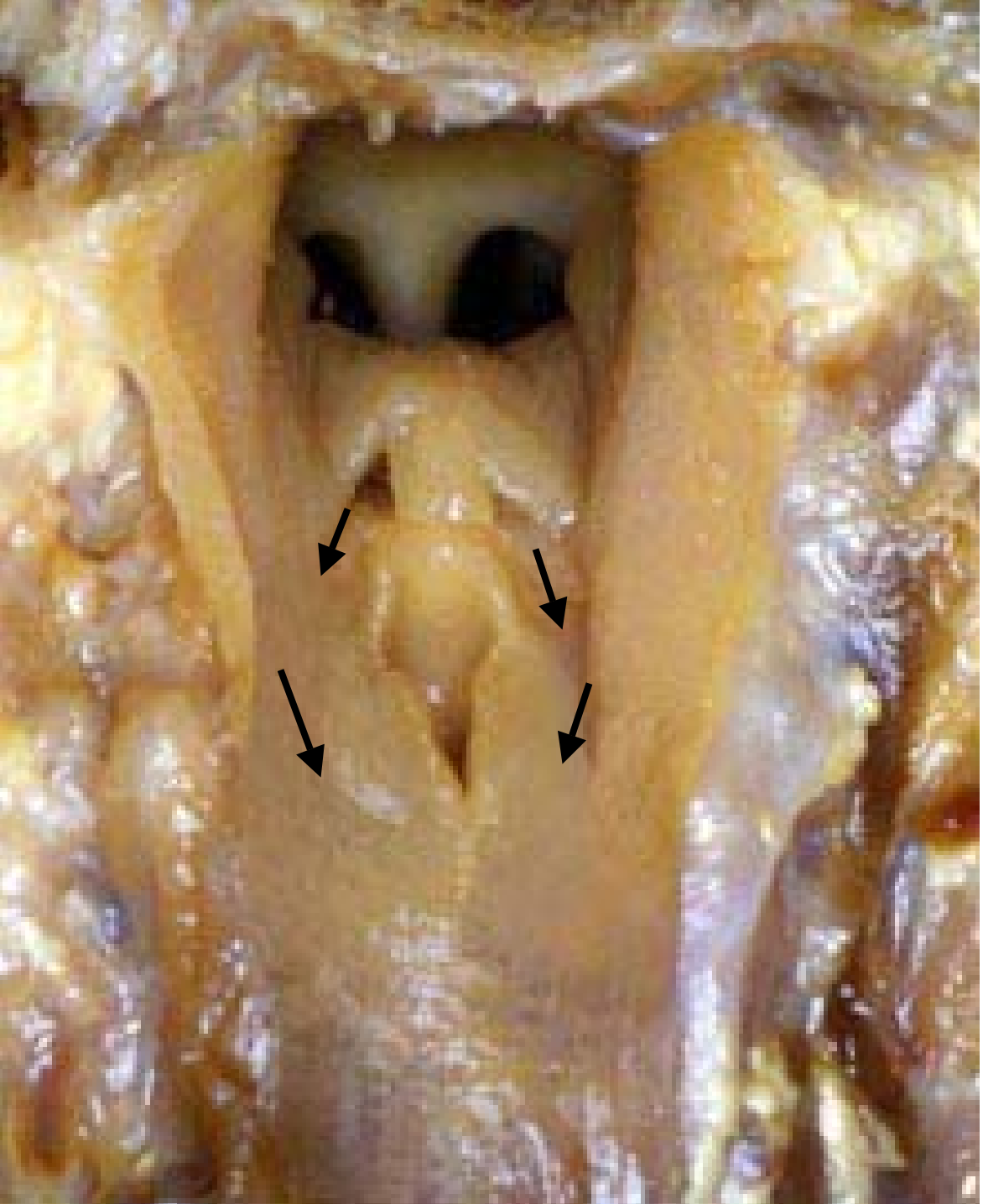
Demonstrates one of the functions of the uvula in adults - funneling of mouth secretions down the middle of the throat.



Illustrates epiglottis not fully developed

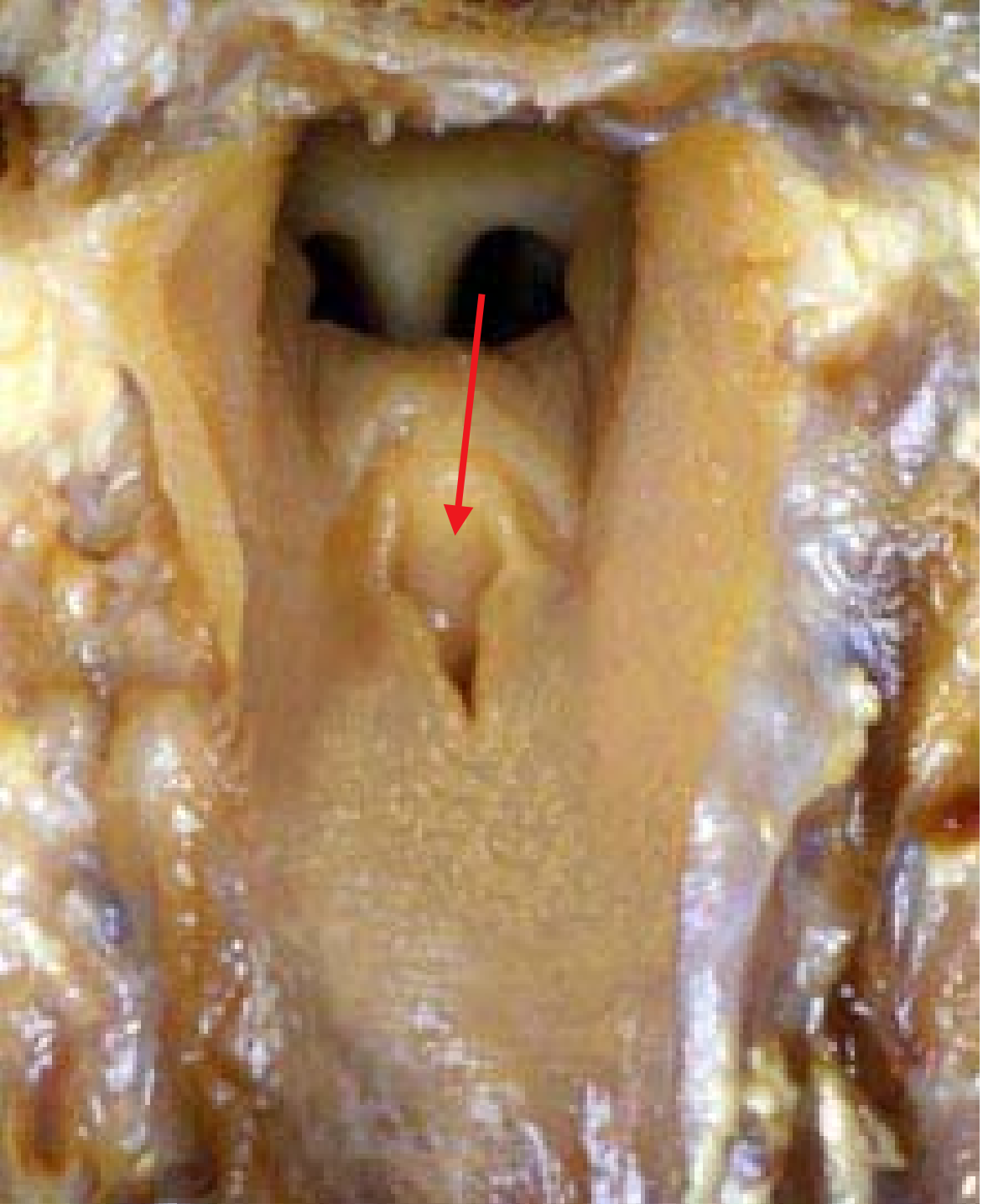


Interior dissection of the pharynx from behind.



This is the previous picture that has been altered to demonstrate how interlocking of soft palate and epiglottis would occur and how fluid passes though faucium channels and around the epiglottis.

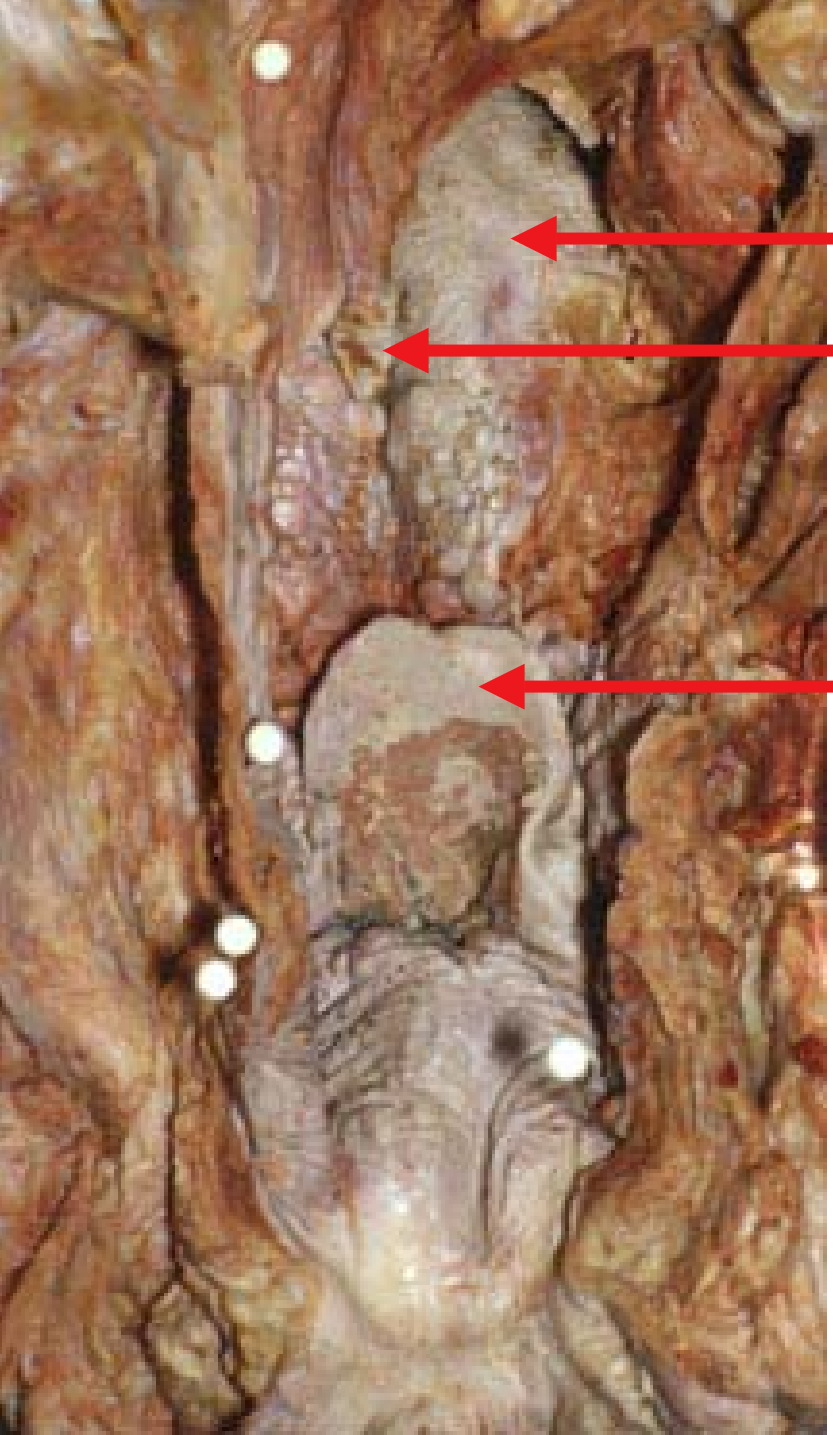
(Epiglottis was elevated using Photoshop)



This picture <u>was also altered</u> to demonstrate the direct connection from the nasal cavity chamber to the inlet of the larynx - allowing the newborn infant (and othe mammals) to be "obligate nose breathers."

(Epiglottis was elevated even higher using Photoshop)

Epiglottis in adult dissection

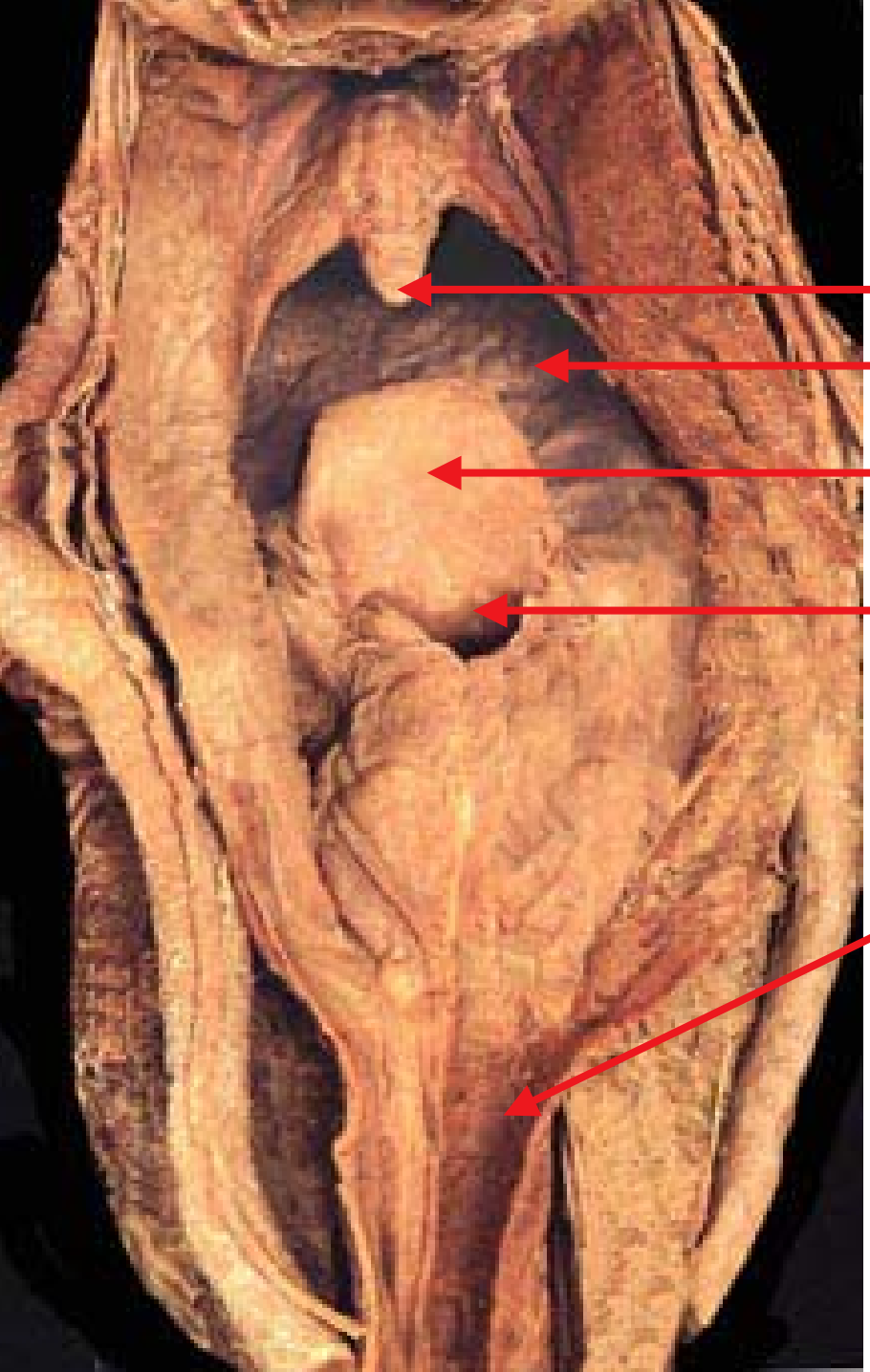


Tongue

Uvula

Epiglottis:

Note size of neck or collar that can deflect food or fluid around inlet to larynx.



Atlas picture showing view of adult pharynx from behind.
(Rohen/Yokocki)

Uvula

Tongue

Epiglottis

Inlet to larynx

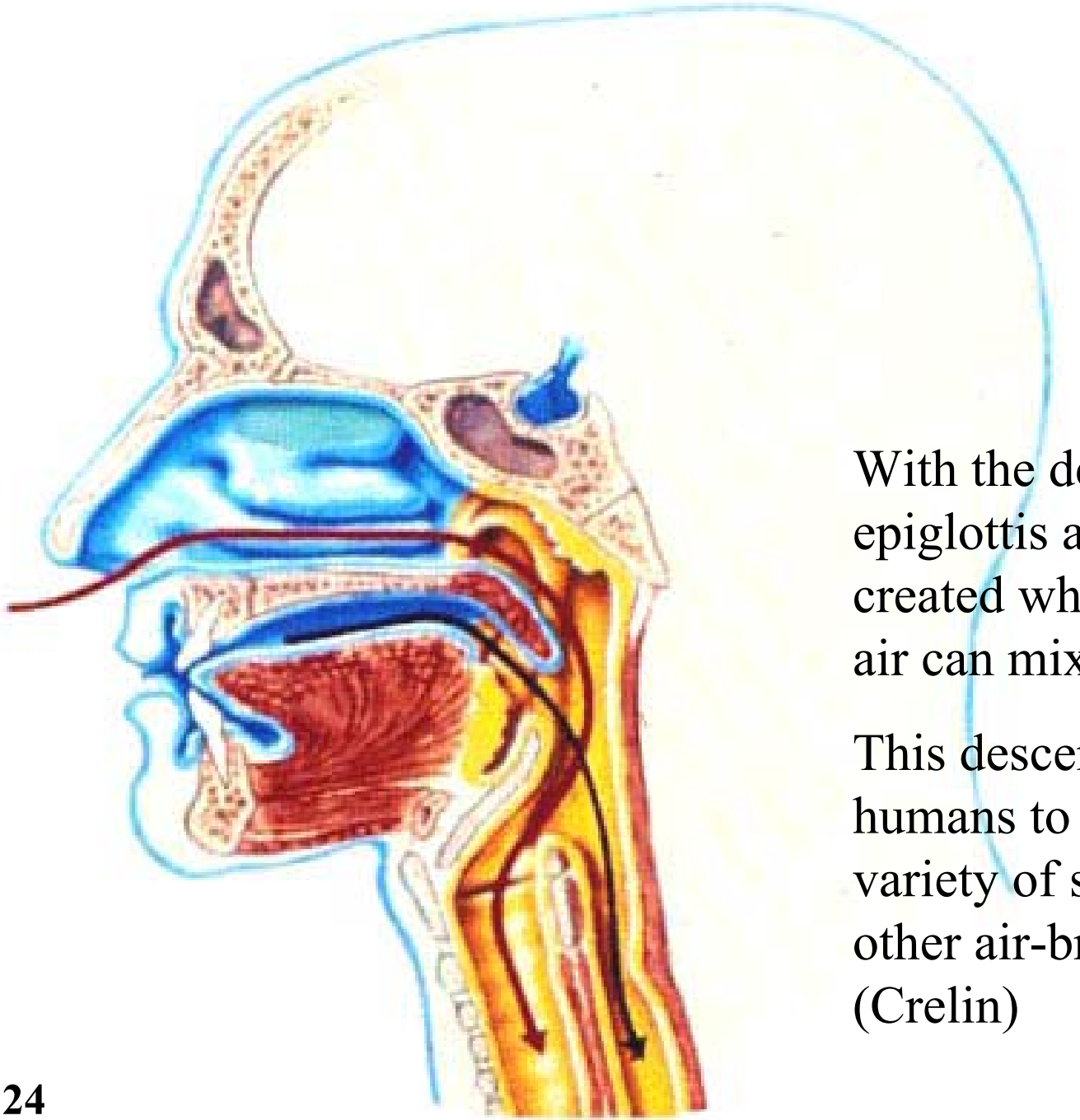
Esophagus

Note the size of the neck or collar of the epiglottis and how it blocks or protects the entrance to the larynx.

This is the previous picture that has been altered to demonstrate only how interlocking of soft palate and epiglottis could occur and how fluid passes though faucium channels and around the epiglottis. (Rohen/Yokocki)

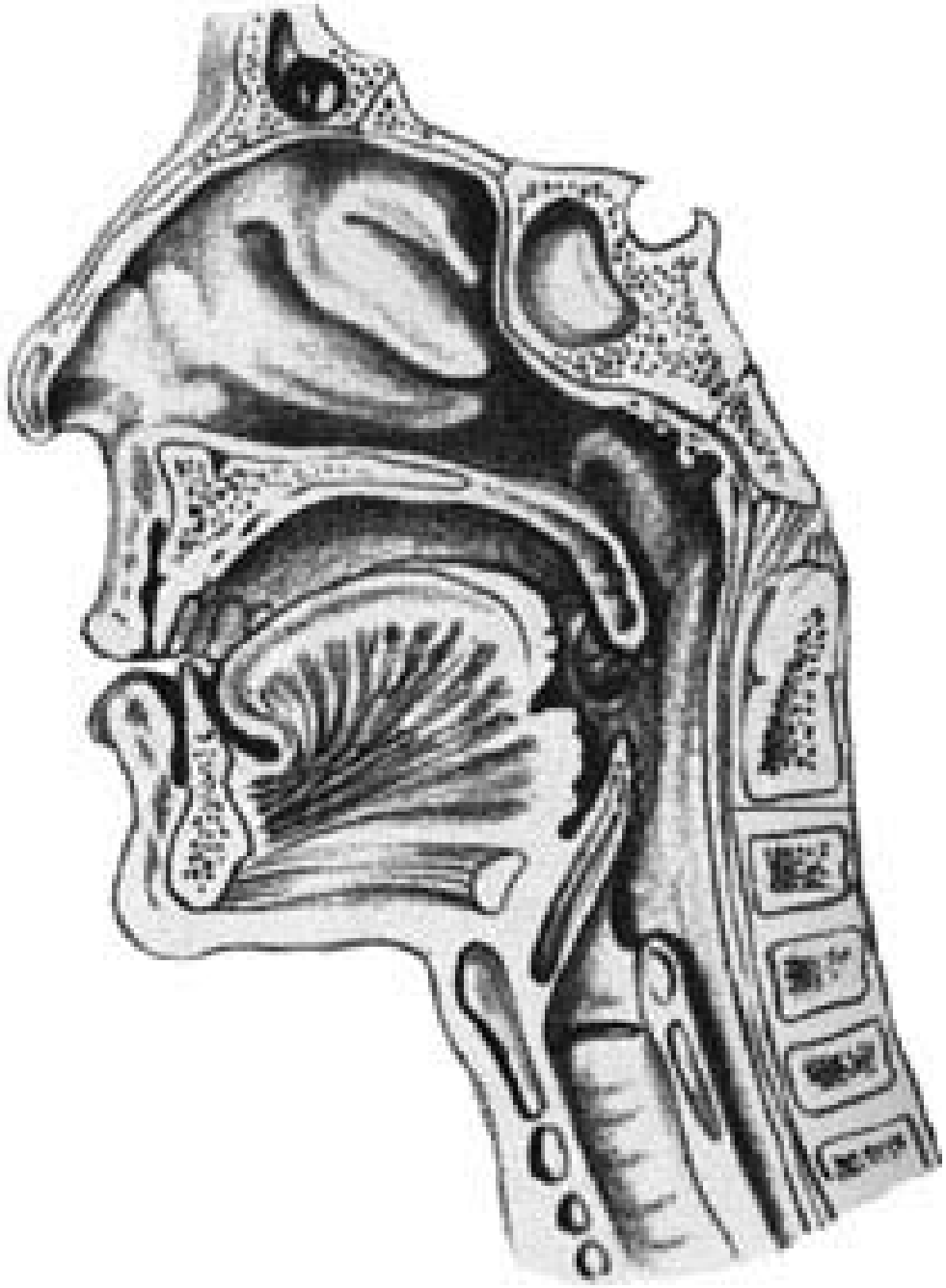
(This cannot occur in the adult human because the epiglottis cannot elevate this high.)

(Epiglottis was elevated using Photoshop)



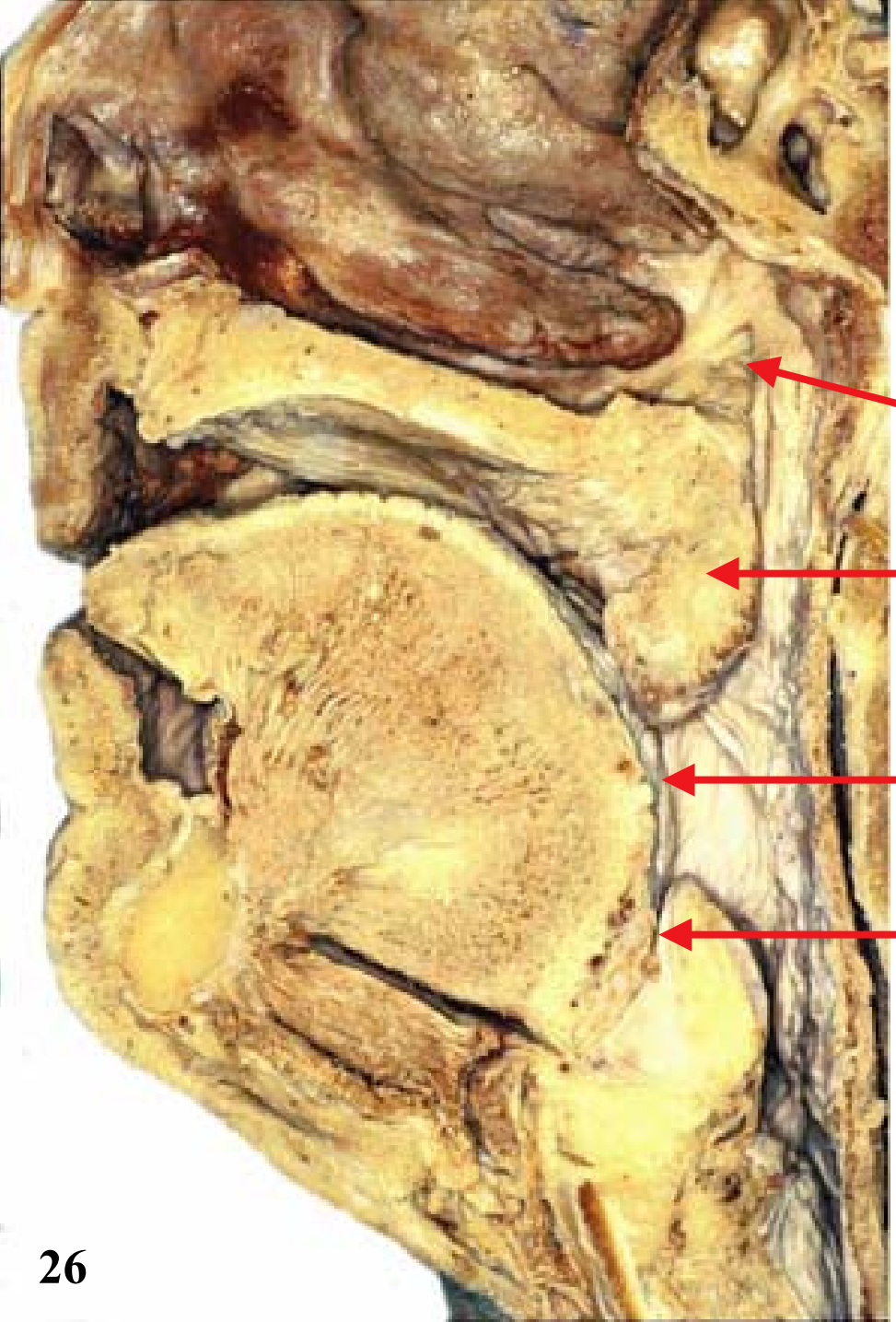
With the descent of the epiglottis a common area is created where both food and air can mix.

This descent also allows humans to produce a greater variety of sounds than all other air-breathing forms. (Crelin)



Crelin ES, Scherz RG, Can the cause of SIDS be this simple? Patient Care, March 15, 1978, Vol. 12, No 5:234-241.

In the adult, the soft palate and epiglottis can no longer touch. The tongue no longer extends out over the mandible. The tongue drops back into the mouth as the epiglottis descends. The posterior 1/3 of the tongue is now the anterior wall of the oropharynx.



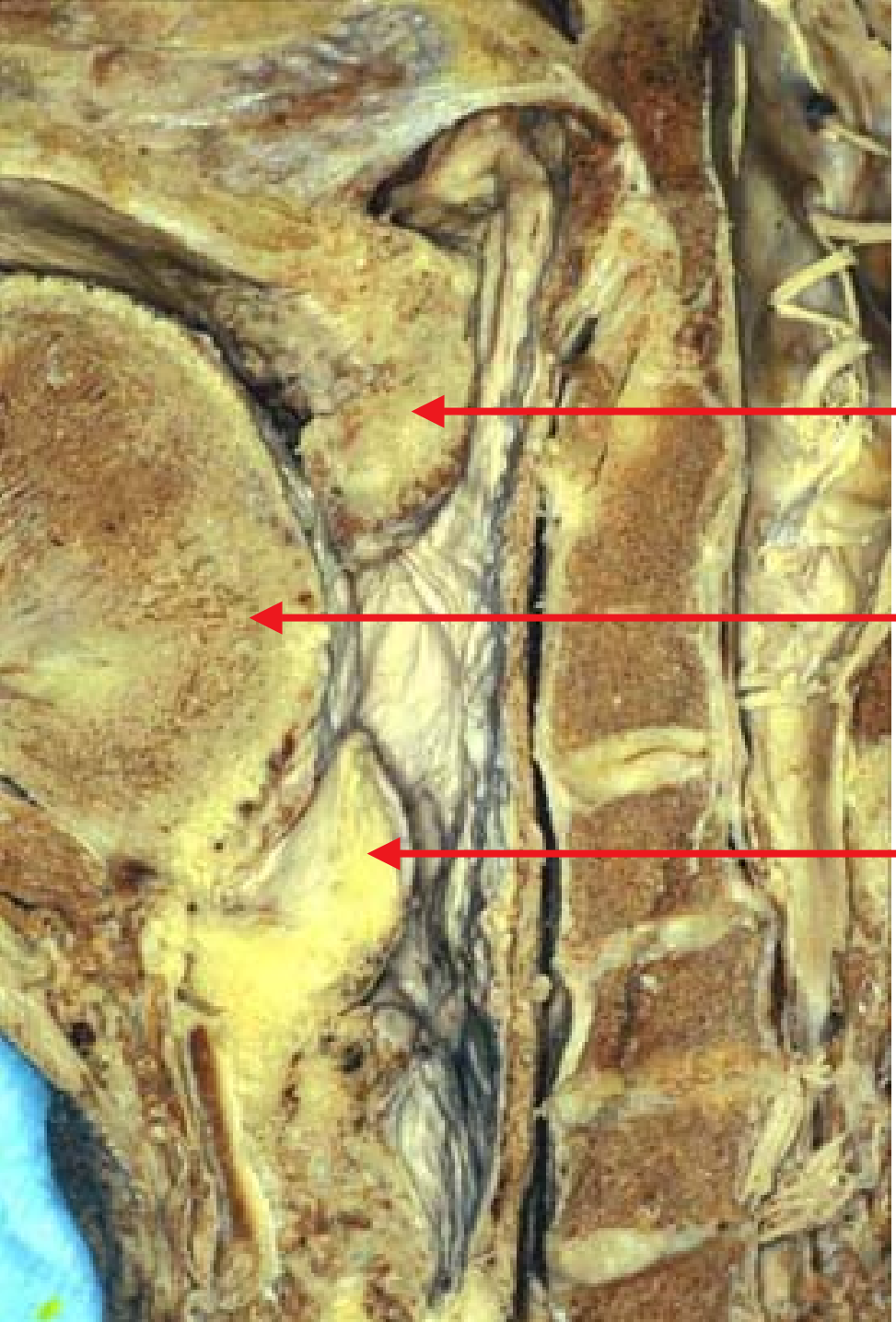
Note neck or collar shape of an adult epiglottis.

Auditory canal / Eustachian tube

Soft palate

Posterior 1/3 of tongue is now anterior wall of oropharynx

Neck of epiglottis



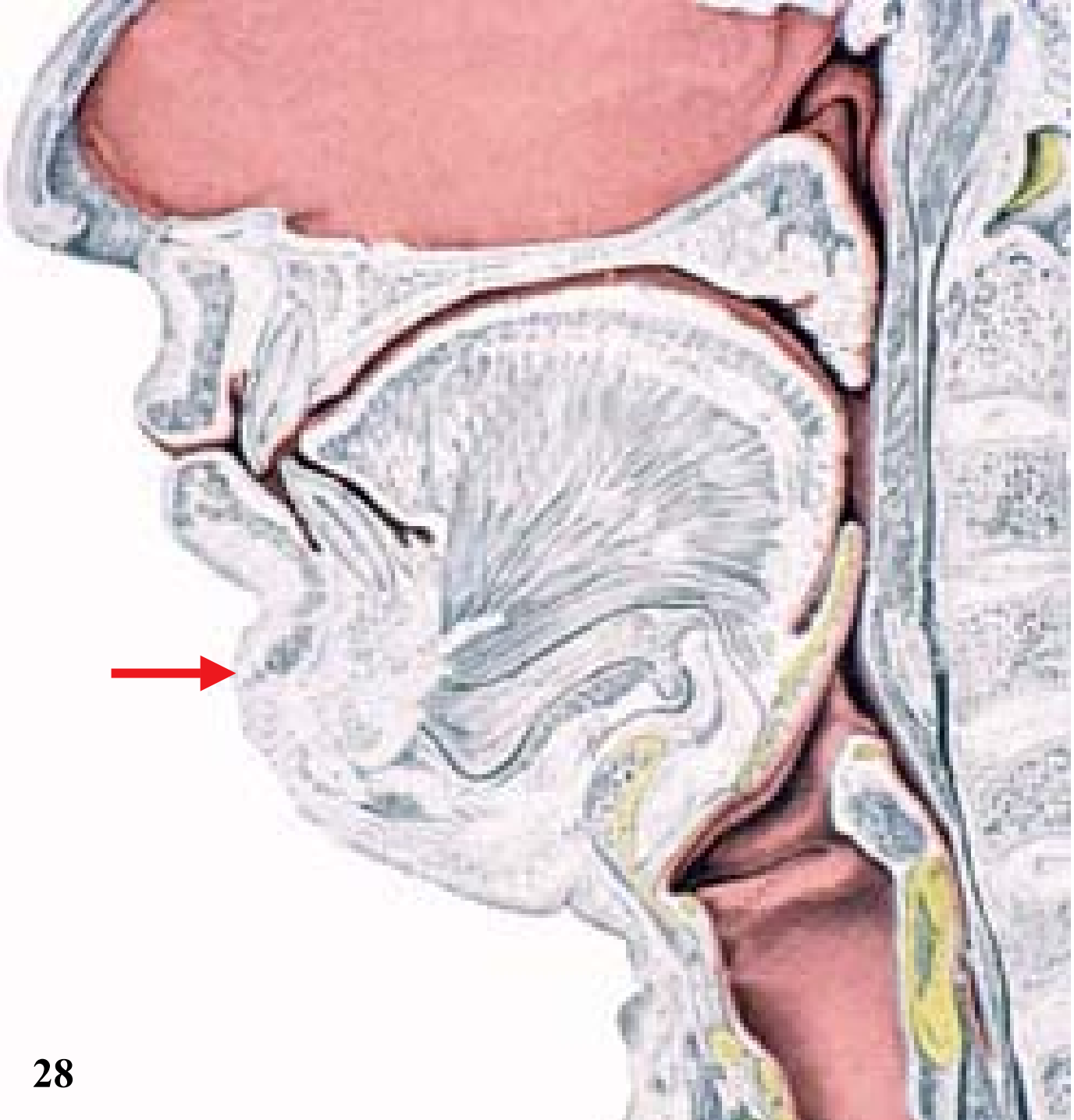
Closer view of separation between epiglottis and soft palate in an adult.

Soft palate

Tongue

Epiglottis

Also note that the posterior 1/3 of the tongue is now the anterior wall of the oropharynx.

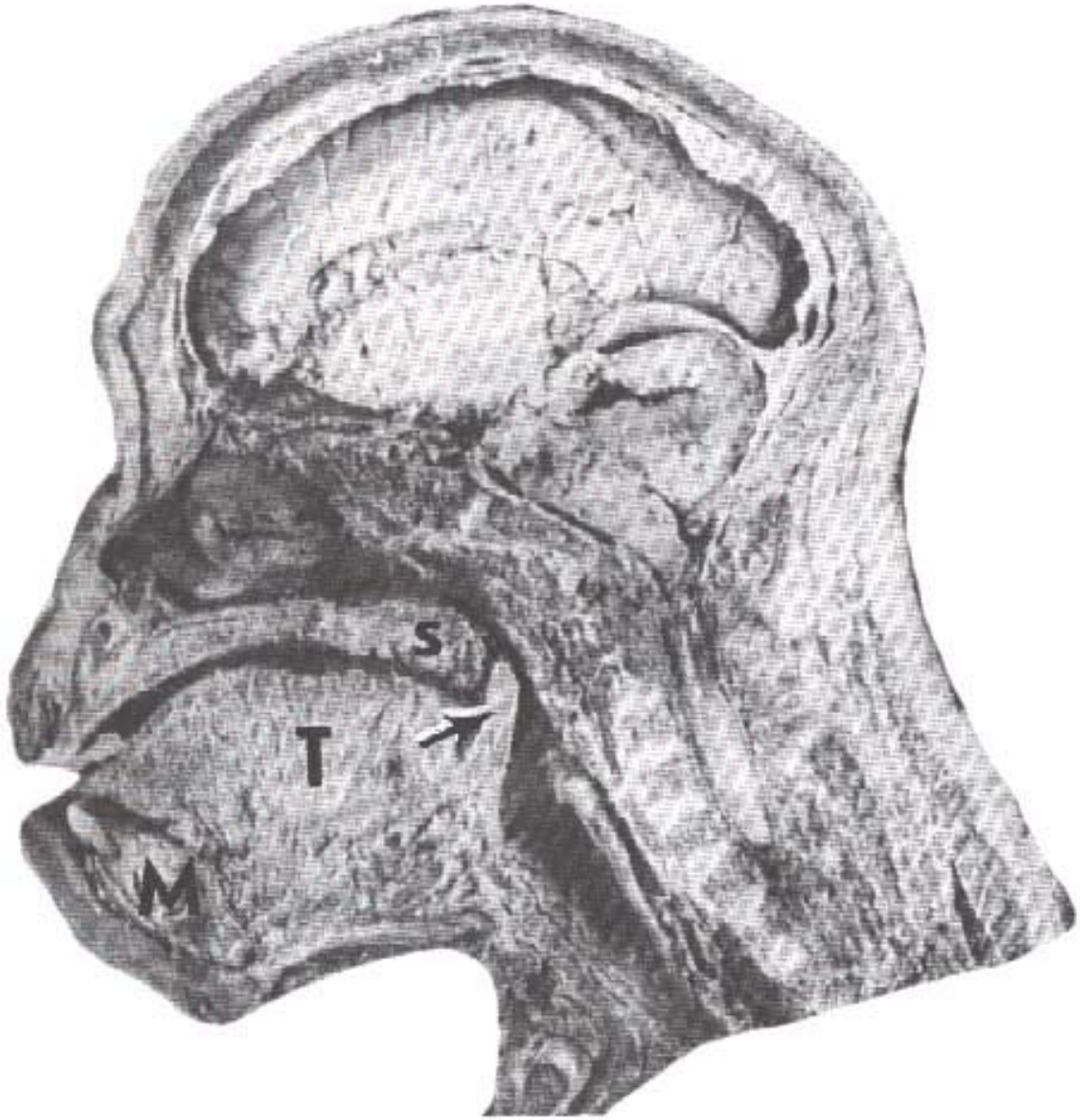


This adult individual may have died from OSA. Note blockage of airway by soft palate and base of tongue. Also note retruded (pushed back) Class II mandible (chin). (Grant's Atlas)

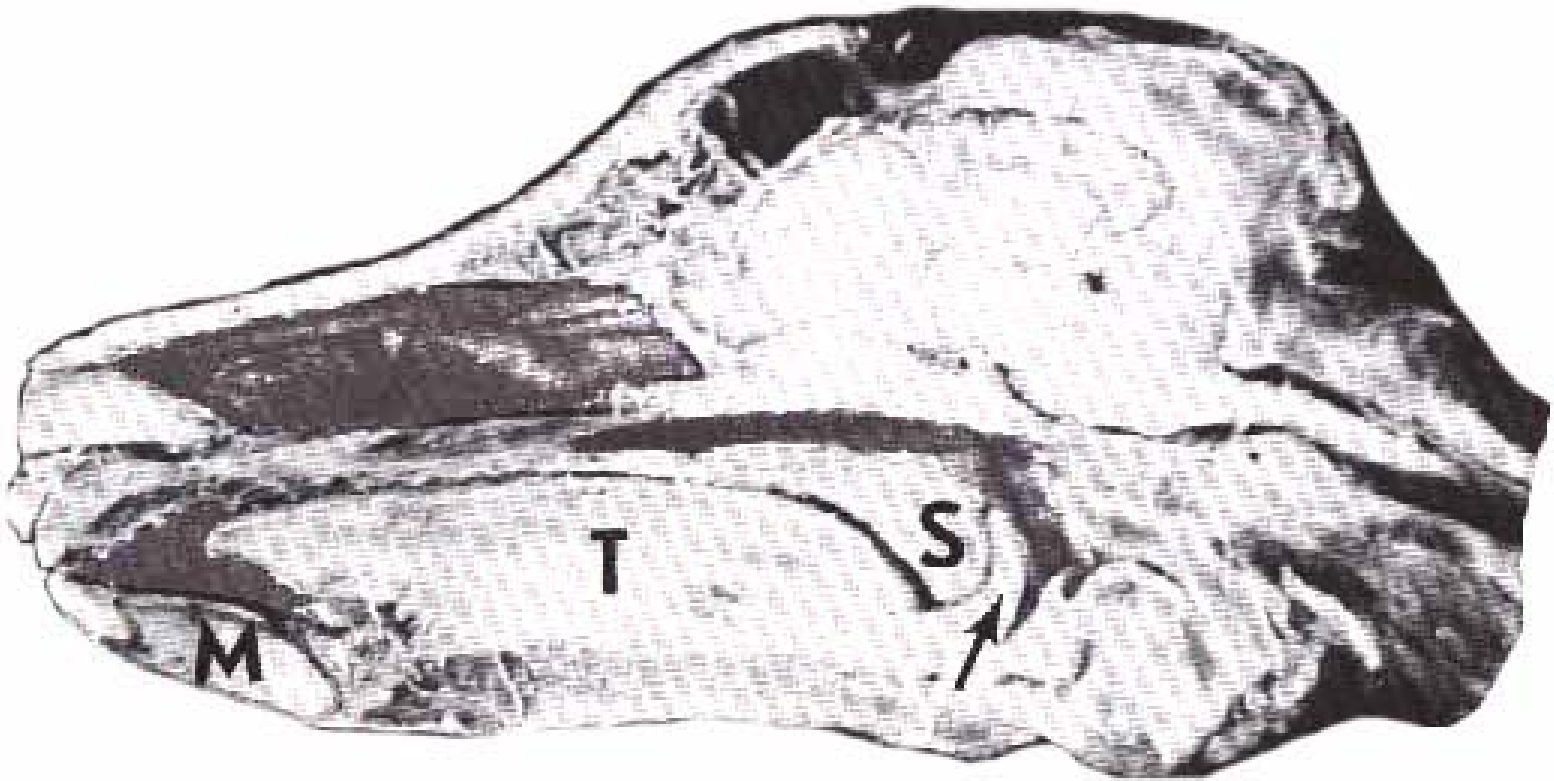
If this had been an illustration of an infant, he may have died from SIDS.

Mammals
as
obligate nose breathers

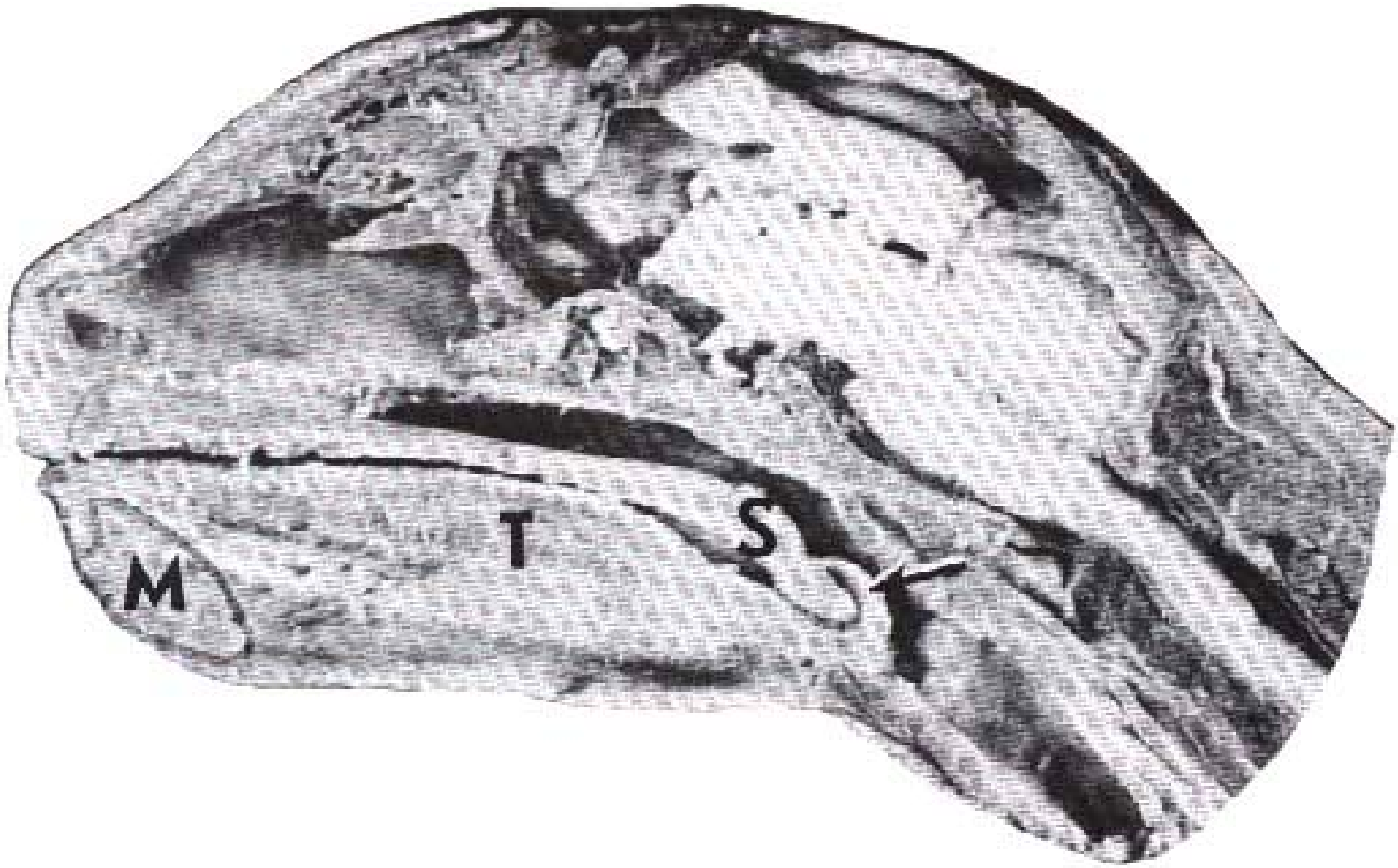
Note interlocking of soft palate and epiglottis in each illustration.



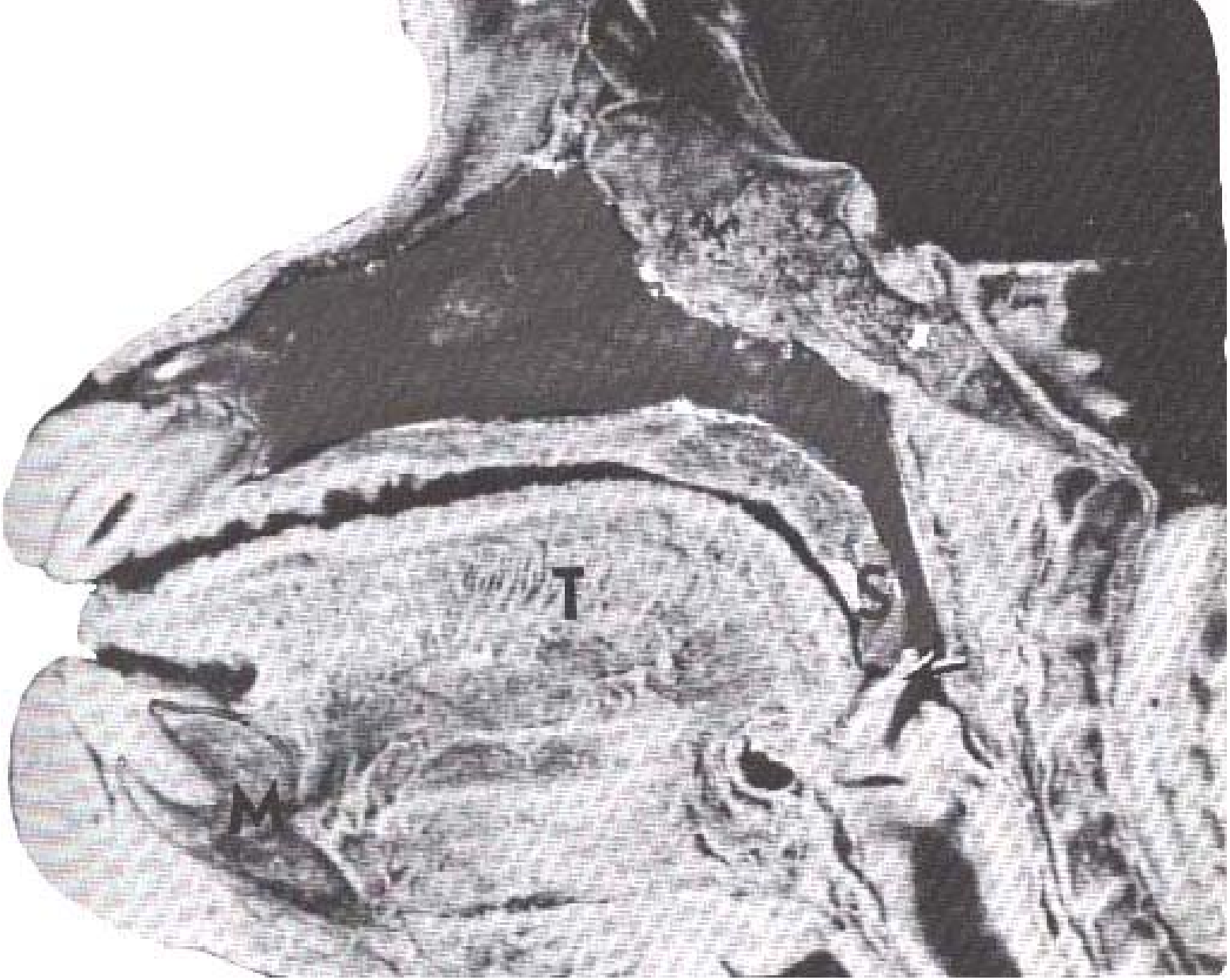
Adult chimpanzee (Crelin)



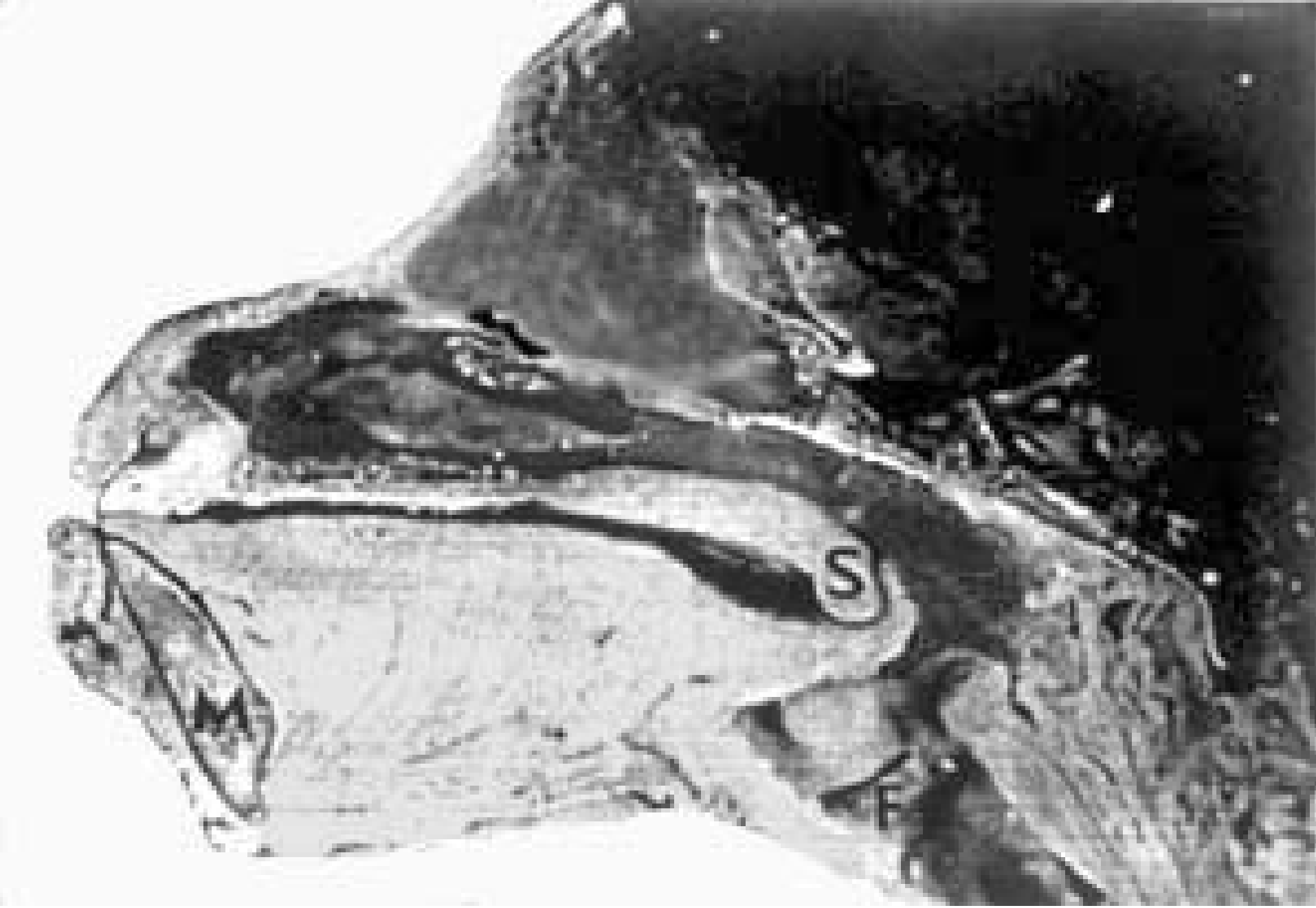
Adult dog. (Crelin)



Adult cat (Crelin)



Adult stumptail macaque (Crelin)



Adult spider monkey (Crelin)

Relationship of the tongue to breastfeeding, SIDS and Obstructive Sleep Apnea (OSA)

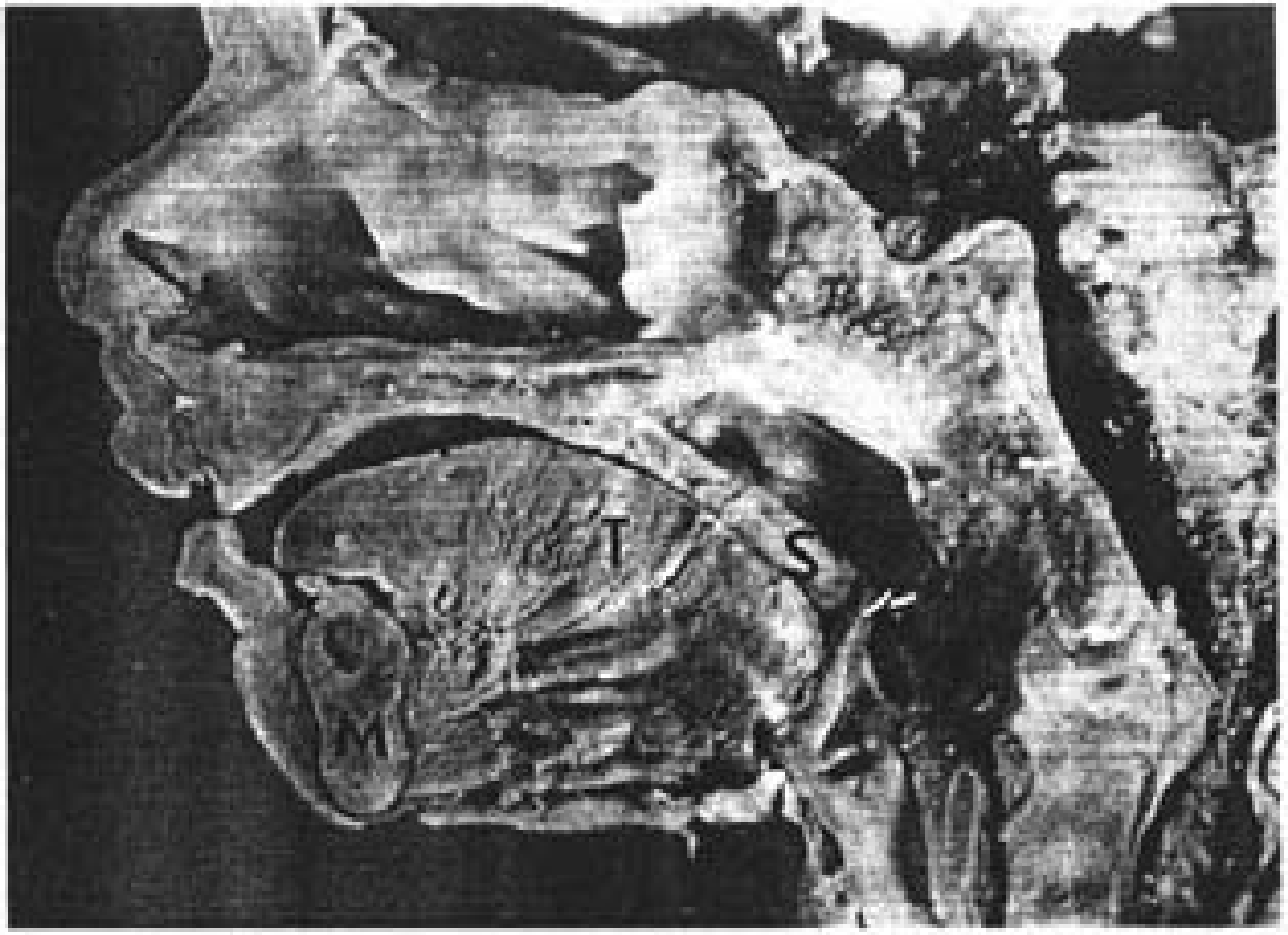
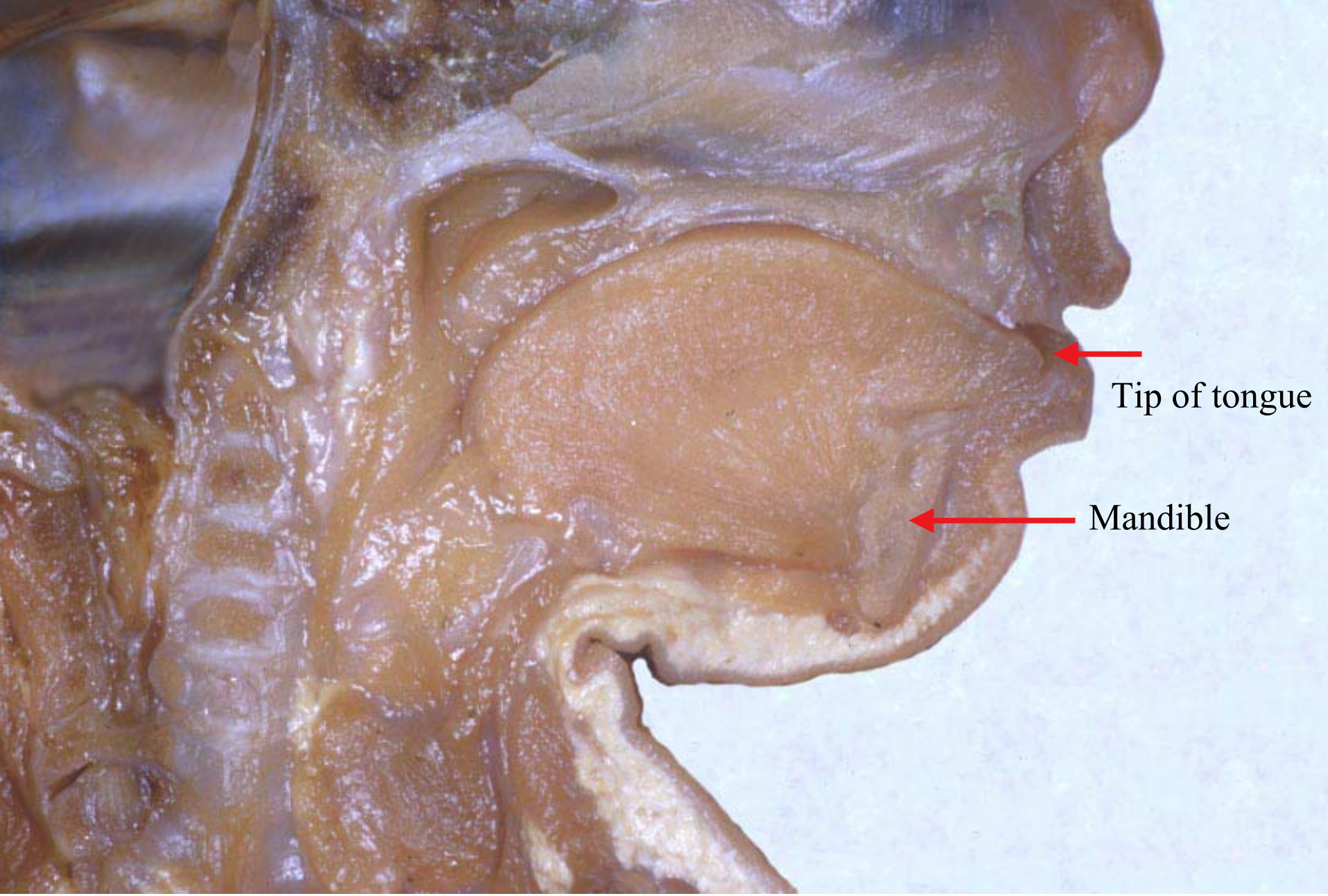
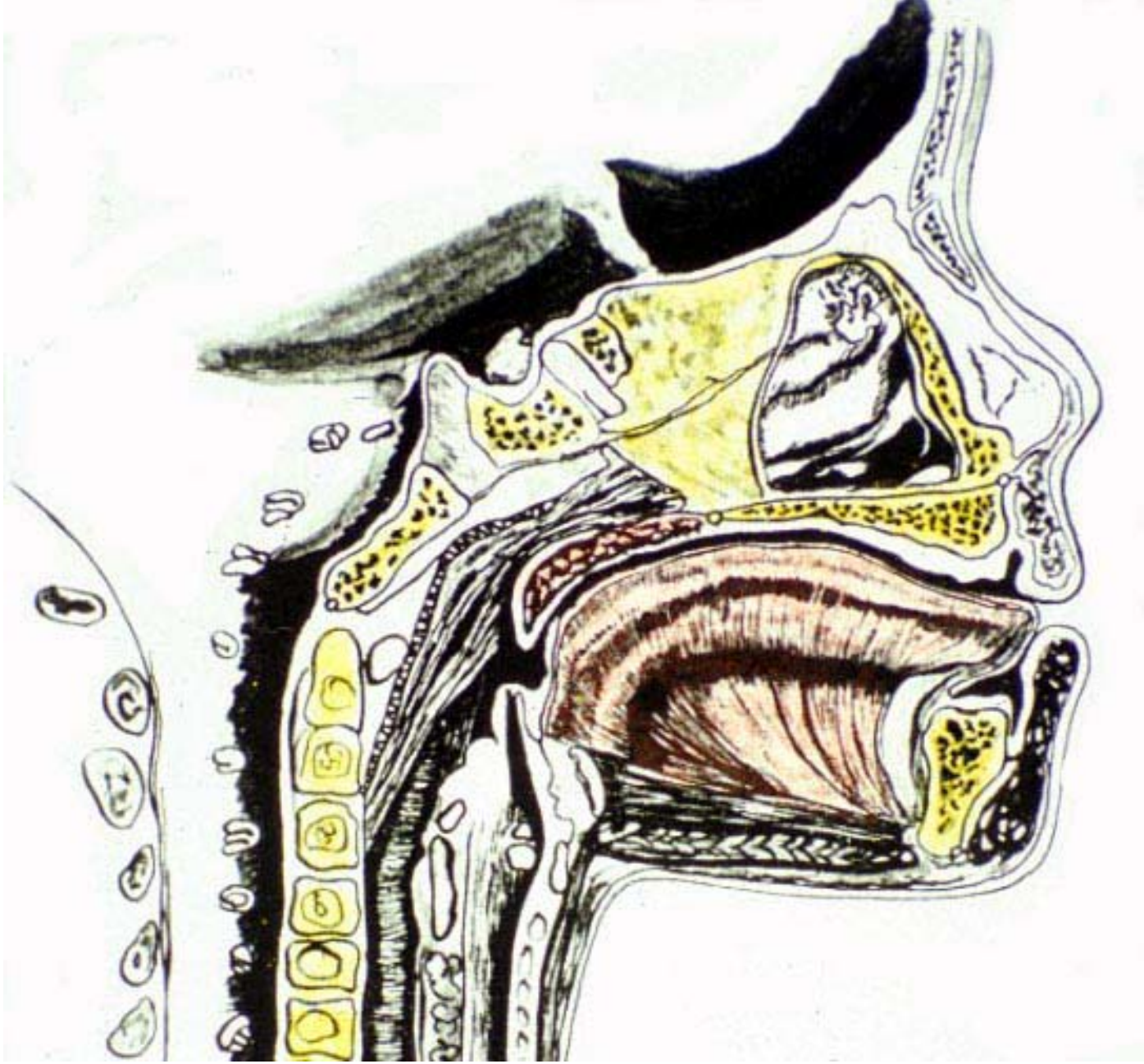


Figure 56. Right half of the head of a full-term human newborn male infant cut in the midplane. The epiglottis (arrow) is in direct contact with the soft palate (S) because the larynx is locked into the nasopharynx. The tongue (T) is located entirely within the oral cavity. Original symphysis of the mandible (M).

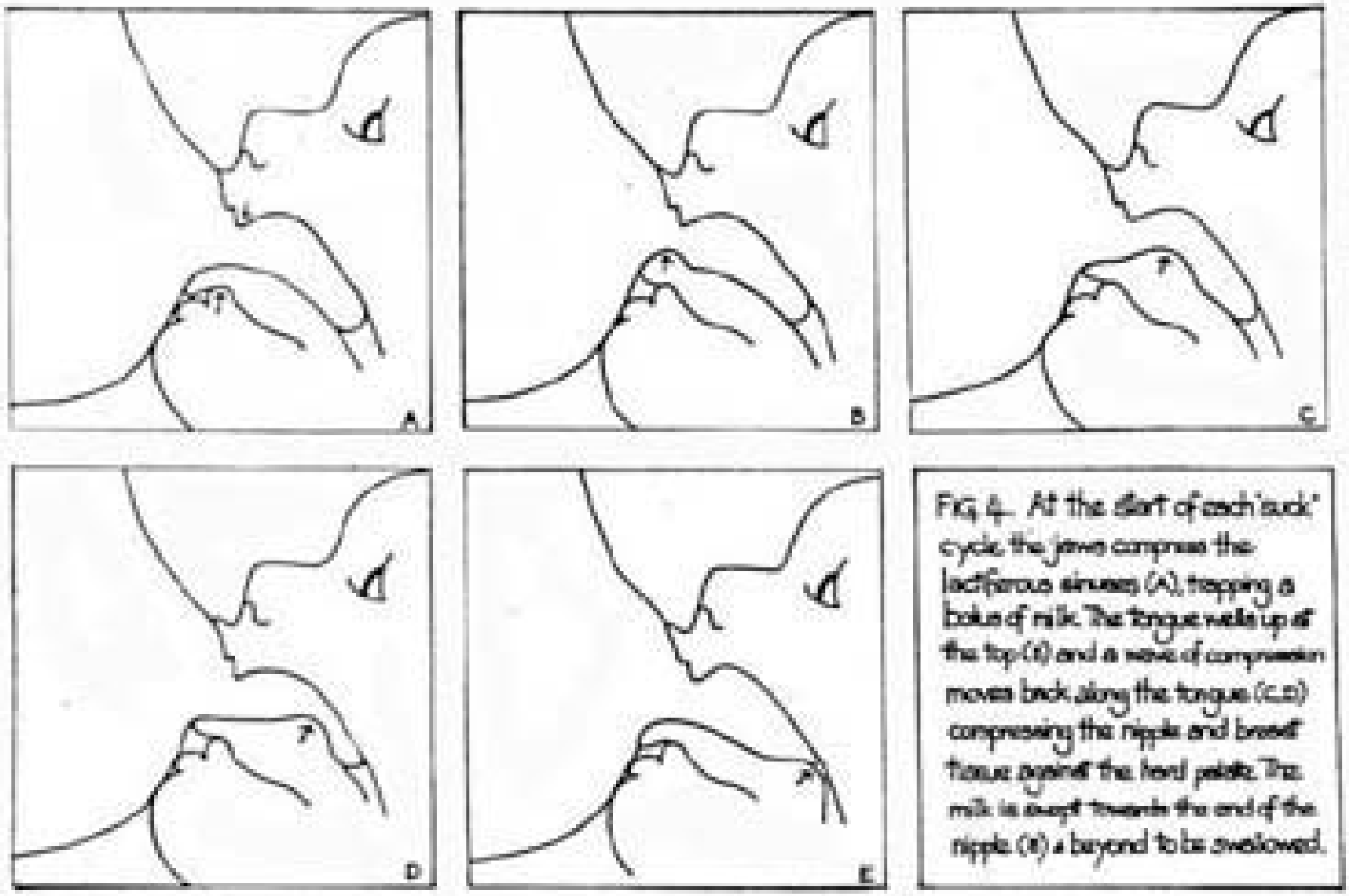
Key statement by Dr. Crelin: "The tongue (T) is located entirely within the oral cavity".



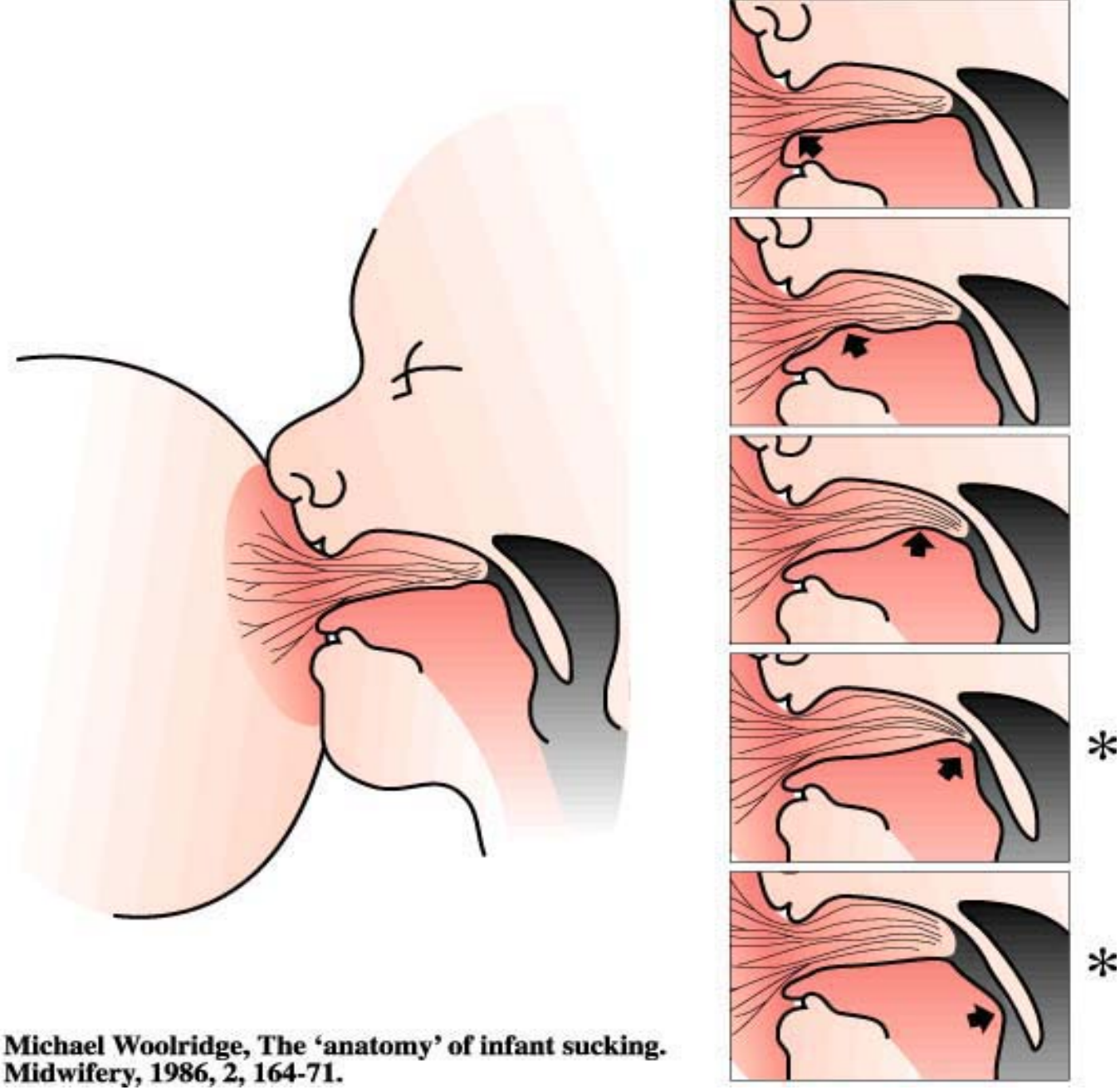
37 Normal / habitual tongue posture of infant - extends out over & past mandible.



38 Atlas picture demonstrating habitual tongue posture of infant.



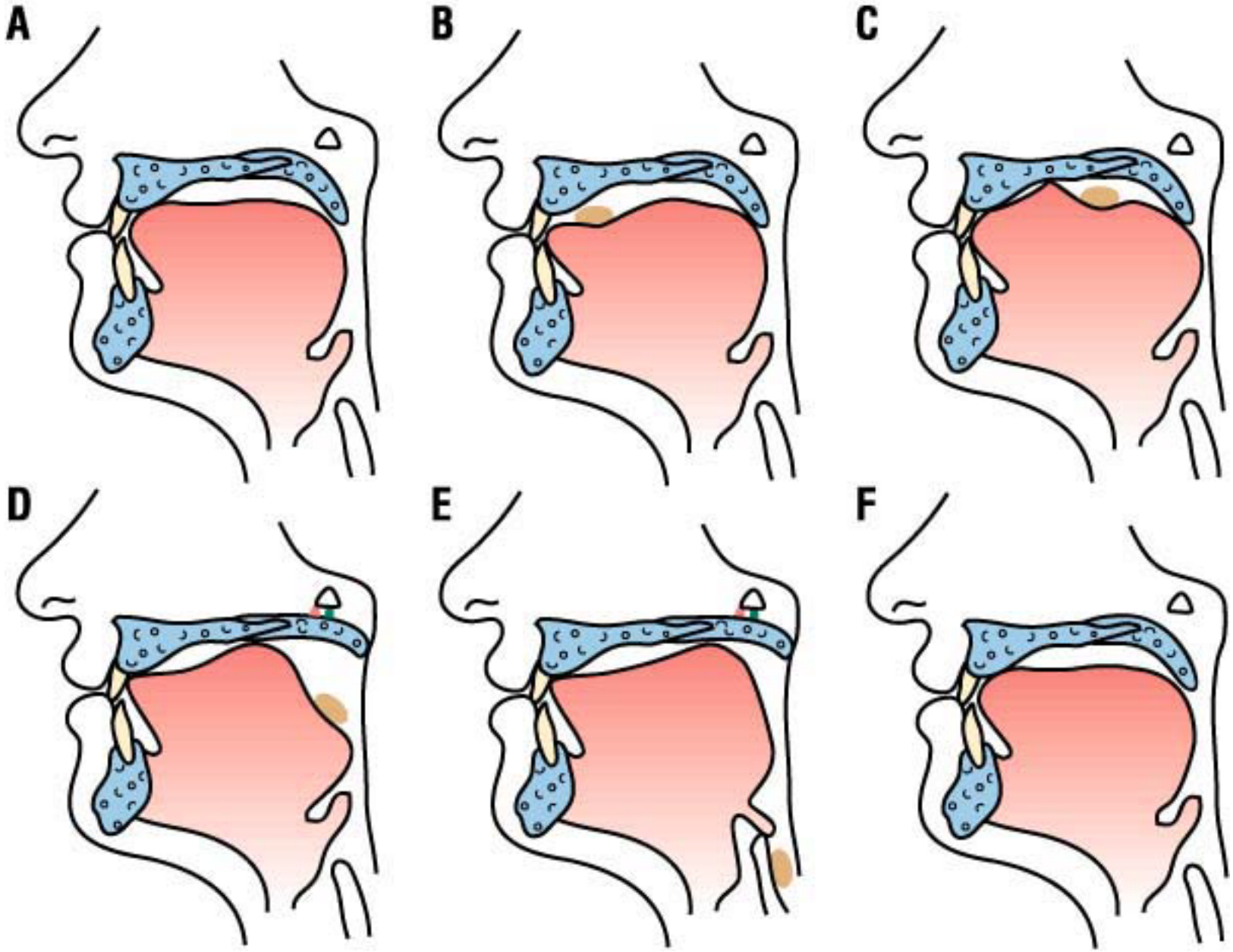
Demonstrates position and action of tongue during breastfeeding (Escott)

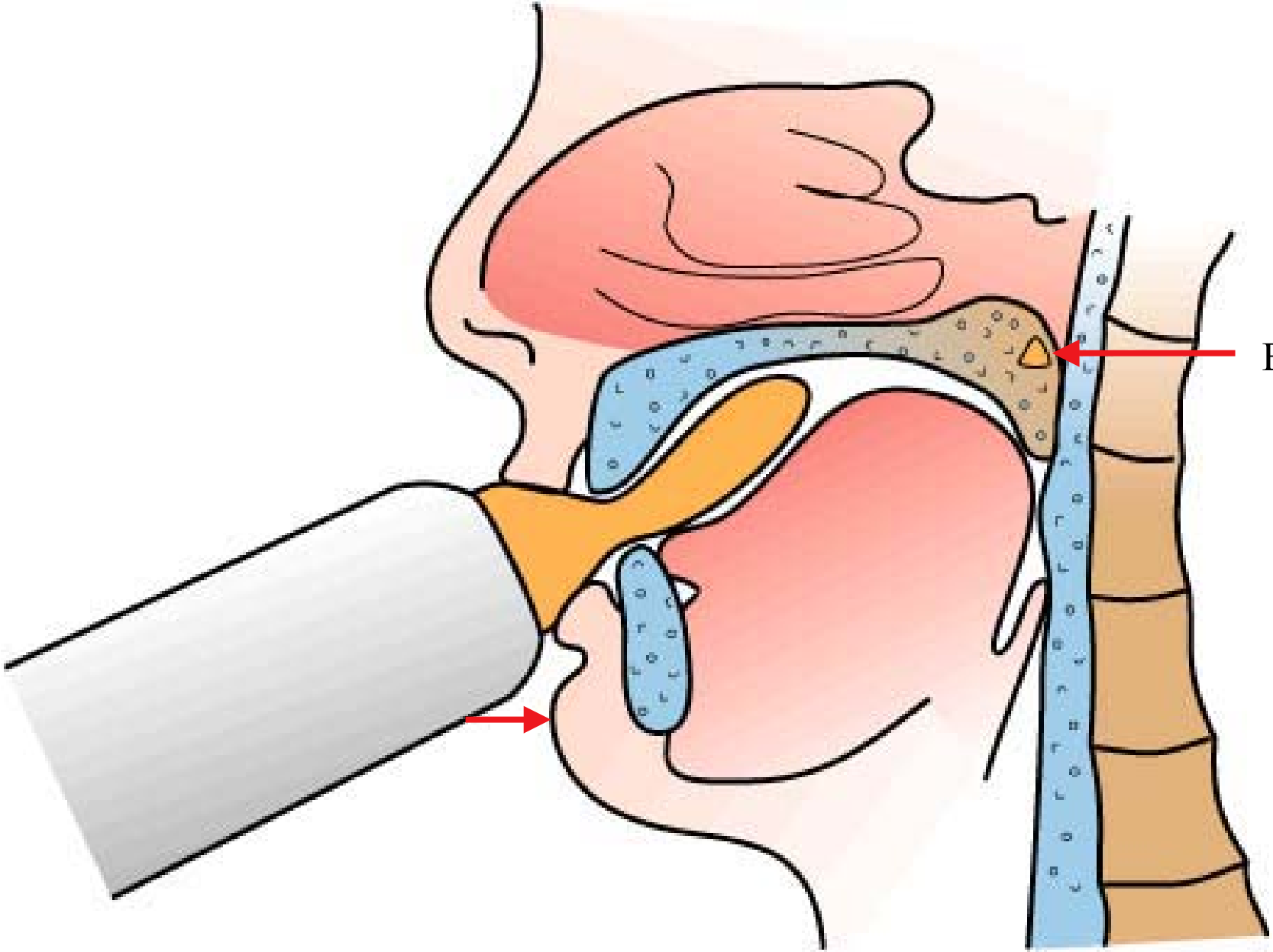


Michael Woolridge, The 'anatomy' of infant sucking. Midwifery, 1986, 2, 164-71.

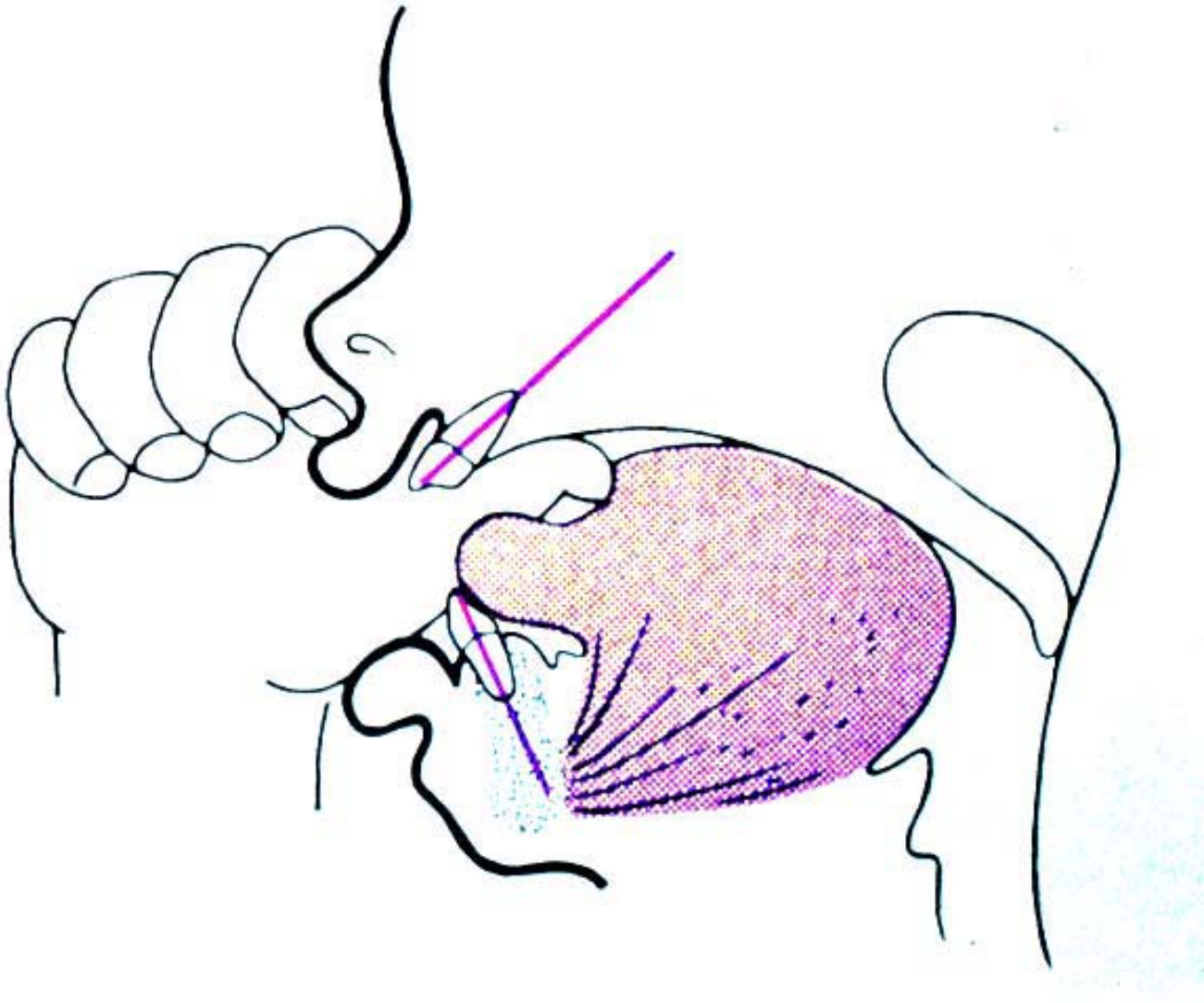
Demonstrates position and action of tongue during breastfeeding (Woolridge)

Adult Swallow



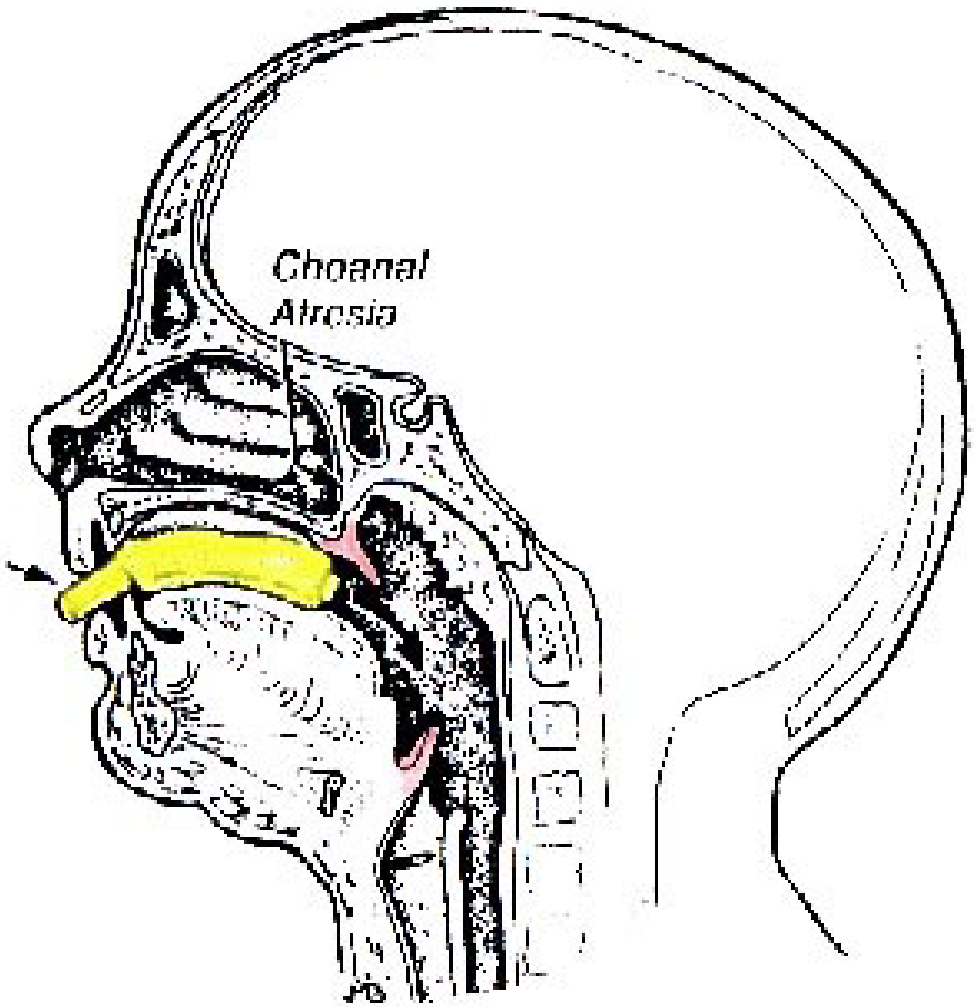


Bottle feeding can separate the epiglottis/soft palate connection, elevate the soft palate, drive the tongue back and alter the action of tongue.



EXCESSIVE thumb sucking can also have the same impact on the oral cavity as bottle feeding.

Atlas picture of adult demonstrates how a tongue that is driven back by some force can extend distance between soft palate and epiglottis as well as block off airway. (Rohen/Yokocki)



Prosthesis used by Drs. Hickey and Vergo to treat choanal atresia. Prosthesis creates downward displacement of mandible to keep oral airway open and to allow oral breathing. Driving mandible down and tongue back, however, separates soft palate and epiglottis union.

Incidence of SIDS

- Accounted for 2,529 deaths in 1998.
- SIDS is third leading cause of infant mortality (12%), after congenital anomalies (22%) and short gestatic low birth weight (14%) in the United States.
- Infections were the most frequent natural cause.

Hunt CE. Sudden Infant Death Syndrome and other causes of infant mortality. Am J Respir Crit Care Med 2001; Vol. 164:346-357.

Possible reasons for SIDS

- Infection.
- Malfunction of brain, heart or diaphragm.
- Infants may not respond to oxygen and carbon dioxide levels the same as adults do.
- Suffocation in bedding - nerve pathway not fully developed and infant does not have skills to reposition.
- Infanticide or intentional murder.
- Infant version of obstructive sleep apnea (OSA).

"Age group 4 to 6 months seemed to represent a transitional period from obligate nasal breathing to potential oral tidal respiration… this transition is important because it reflects a period of potential respiratory instability."

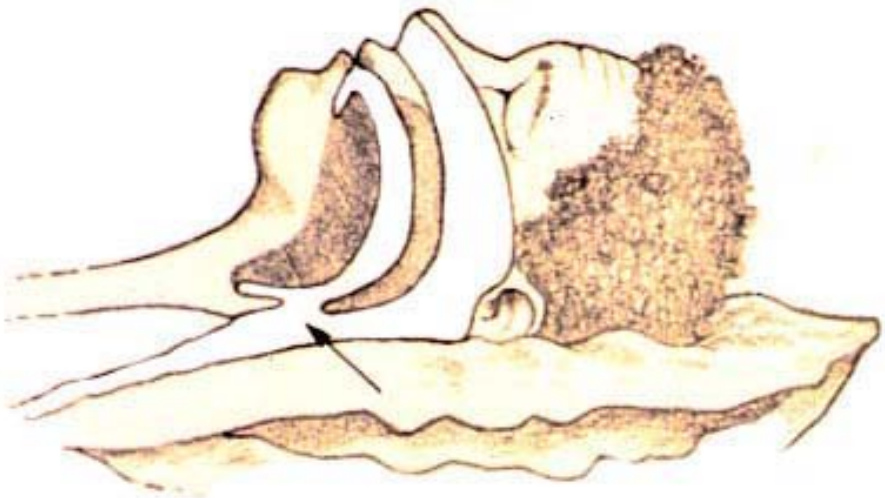
Sasaki CT, Crelin E,S et al. Postnatal Descent of the Epiglottis in Man, March 1977, Arch Otolaryngol, Vol. 103, 169-171

"Maturational descent of the epiglottis, found to occur between 4 and 6 months of age, is verified by cineradiography."

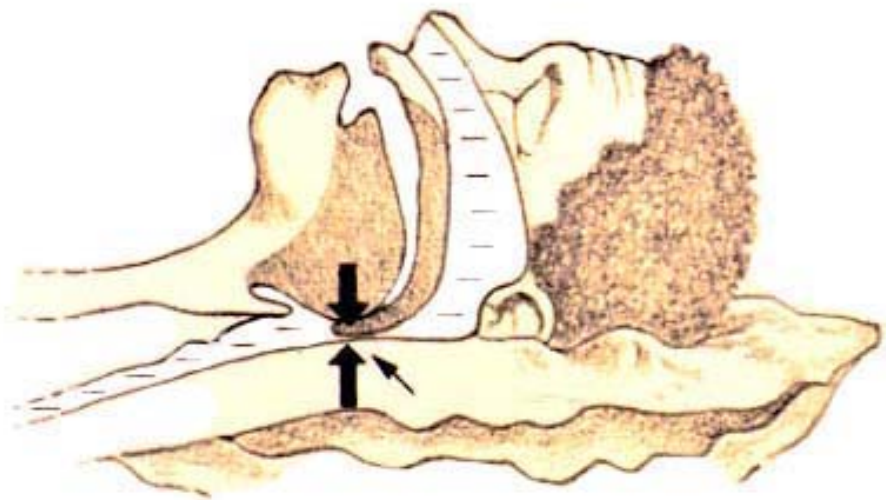
"This period, interestingly coincides with the peak incidence of SIDS, which similarly occurs at 3 to 5 months of age."

Sasaki CT, Crelin E,S et al. Postnatal Descent of the Epiglottis in Man, March 1977, Arch Otolaryngol, Vol. 103, 169-171

Gravity



Jaw and tongue are forward while awake.



While asleep, muscles relax and gravity can drop the tongue back and block off the airway.

NASA Research

Conclusion of research in space:

"This is the first direct demonstration that gravity plays a dominant role in the generation of apneas, hypopneas, and snoring in healthy subjects."

Elliott AR, Shea SA et al. Microgravity reduces sleep-disordered breathing in humans, 2001. Am J Respir Crit Care Med; Vol. 164:478-485.

Dr. Alfred Steinschneider

- Former president of the American SIDS Institute in Atlanta
- Former medical director for the SIDS Institute at the U of Maryland
- Credited with establishing the Apnea Theory of SIDS. The theory came under attack in the media due to the belief that this theory may not account for as many SIDS deaths as previously thought.

"A leading hypothesis for a large proportion of SIDS cases is that SIDS may reflect a delayed development of arousal or cardiorespiratory control ... When the physiologic stability of such infants becomes compromised during sleep, they may not arouse sufficiently to avoid the fatal noxious insult or condition."

AAP position on SIDS: Kattwinkel J, Brooks J, Keenan M, Mallory M, AAP,Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position, Pediatrics, Vol. 105, No. 3, March 2000, 650-656.

"Although several retrospective studies have demonstrated a protective effect of breastfeeding on SIDS …the Task Force believes that evidence is insufficient to recommend breastfeeding as a strategy to reduce SIDS" (Page 652)

AAP position on SIDS: Kattwinkel J, Brooks J, Keenan M, Mallory M, AAP,Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position, Pediatrics, Vol. 105, No. 3, March 2000, 650-656.

"Four recent studies have reported a substantially lower SIDS incidence among infants who used pacifiers than among infants who do not. Although this association has been strong and consistent, it does not prove that pacifier use prevents SIDS."

4 articles were referenced for this research - including that of L'Hoir." (See next slide)

AAP position on SIDS: Kattwinkel J, Brooks J, Keenan M, Mallory M, AAP,Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position, Pediatrics, Vol. 105, No. 3, March 2000, 650-656.

"The fear that dummy use might stand in the way of breastfeeding is irrelevant to cot death cases, because most cot death mothers do not breastfeed their infants …***only 10% of Dutch cot death mothers do so!***"

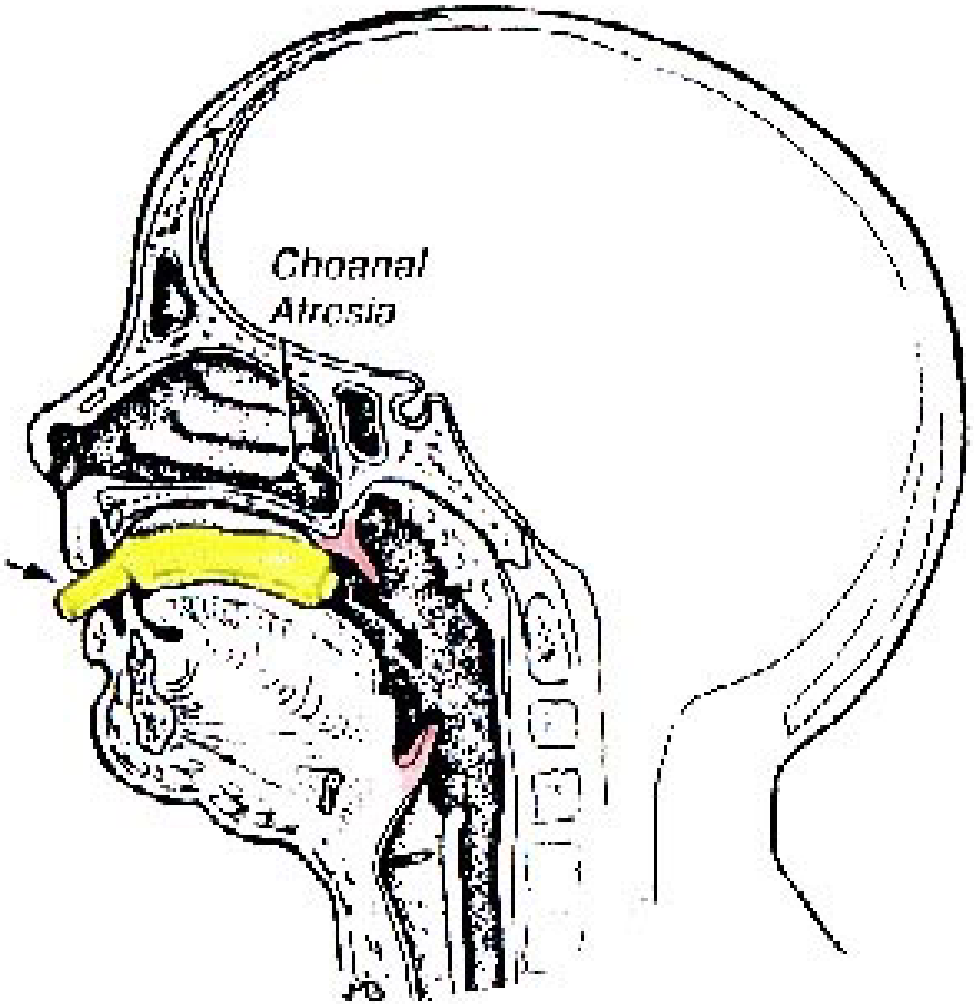
L'Hoir MP, Engleberts AC, vanWell, GTJ et al. Risk and preventive factors for cot death in the Netherlands. Eur J Pediatr. 1998;157:681-688

KEY QUESTIONS:

IF only 10% of Dutch cot death mothers breastfeed their infant:

WHY would bottles and pacifiers be recommended? By this report, 90% of SIDS cases happen to children who are bottle fed and/or use pacifiers!

WHY doesn't this demonstrate the importance of breastfeeding for reducing the incidence of SIDS?



How a “modified” version of a pacifier might reduce the incidence of SIDS - for infants who might be at high risk for SIDS.

Prosthesis used by Drs. Hickey and Vergo to treat choanal atresia. Prosthesis creates downward displacement of mandible to keep oral airway open and to allow oral breathing. Driving mandible down and tongue back, however, separates soft palate and epiglottis union.

Stanford Morphometric Model

$$P + (Mx - Mn) = 3 \times OJ + 3x (BMI - 25) \times (NC/BMI)$$

P = palatal height

Mx = maxillary intermolar distance

Mn = mandibular intermolar distance

OJ = overjet

NC = neck circumference

BMI = body mass index

"Model has clinical utility and predictive values for patients with suspected obstructive sleep apnea"

Facial structure and SIDS

- Tested hypothesis that backset maxillae and mandibles predispose infants to SIDS.
- Since facial structure is at least partly inherited, this may provide a familial link in SIDS.
- Results provided a further link between SIDS and sleep apnea / hypopnea syndrome.

Rees K, Wright A, et al. Facial structure in the sudden infant death syndrome: case-control study. BMJ 1998;317:178-189 (18 July)

Craniofacial Development

- Largest increase occurs within the first 4 years of life.
- Is 90% complete by 12 years of age.

Shepard, J. et al. Evaluation of the Upper Airway in Patients with OSA. *Sleep* 1991, 14(4):361-71. (Research done at Mayo)

AAPD Vision Statement - 1996

- "89% of youth, ages 12 - 17 years, have some occlusal disharmony."
- "16% of youth have a severe handicapping malocclusion that requires mandatory treatment."

Pediatr Dent, Spec Edition: Ref Manual 1995-96, 17(6).

Impact of infant sucking habits

- Digit and dummy sucking resulted in increased tendency to tongue thrust.
- Tongue thrust related to: open bites, overjet, and Class II malocclusion.
- Sucking habits influence the etiology of malocclusion.

Melsen B, et al., Sucking habits and their influence on swallowing pattern and prevalence of malocclusion; European J of Orthodont, 1979, 1(4):271-280.

Facial form and risk for sleep apnea

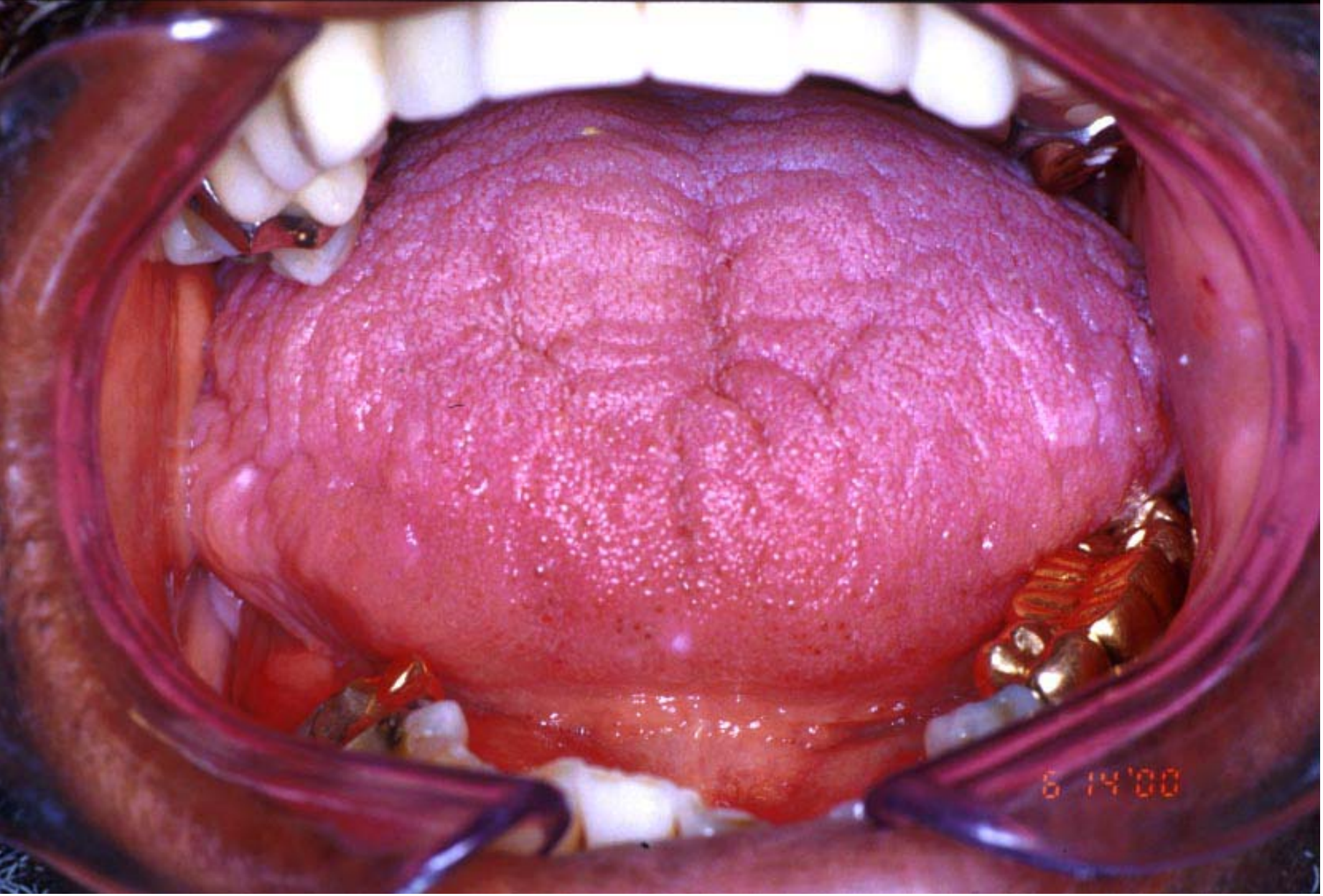
Craniofacial familial features can be a strong indicator of risk for the development of obstructive sleep apnea syndrome (OSAS).

Guilleminault C, Parinen M, Lollman K, Powell N, Stoohs R. Familial aggregates in obstructive sleep apnea syndrome, Chest 1995, 107:1545-1551.

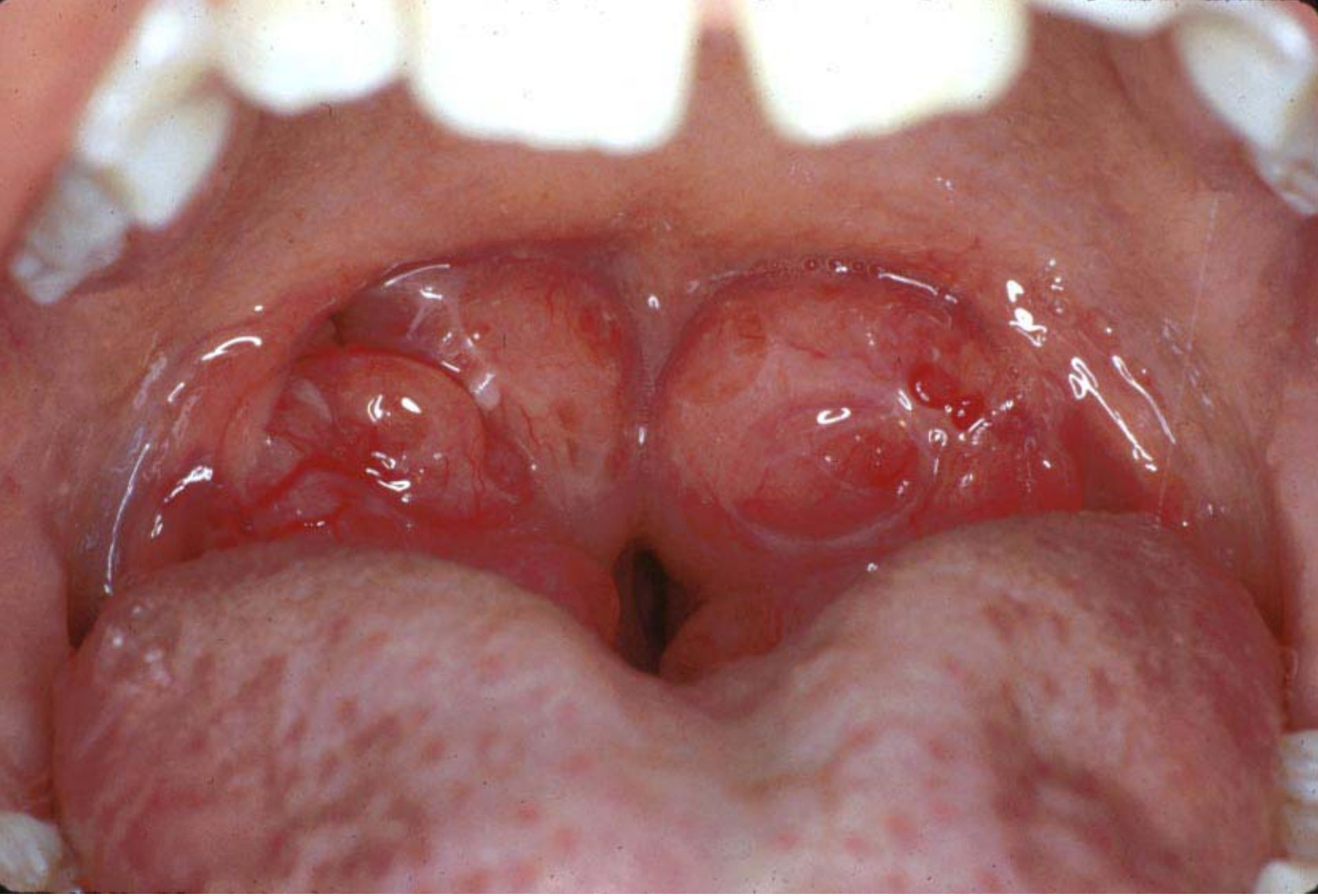
Anatomic features that contribute to OSA include:

- High palates
- Retruded chins / faces
- Large tongues
- ANYTHING that can interfere with or reduce the flow of air to the lungs.

At this point I recommend you view my presentation on sleep apnea. I strongly believe both SIDS and OSA are very similarly related as to cause.



A large tongue can obstruct the oropharynx



67 Massive tonsils can obstruct the airway.

Infant CPAP by Ackrad Co.

"If we are to know physiologic and pathologic changes we must know the normal."

Dr. Robert Getty, Preface in : Sisson and Grossman's

The Anatomy of the Domestic Animals, Saunders, 5th Ed., 1975.

"Knowledge is most meaningful when shared with others."

Brian Palmer, DDS

Presented by:

Brian Palmer, D.D.S.

Kansas City, Missouri, USA

December, 2001

Special thanks go to Dr. Edmund Crelin

for his outstanding research.