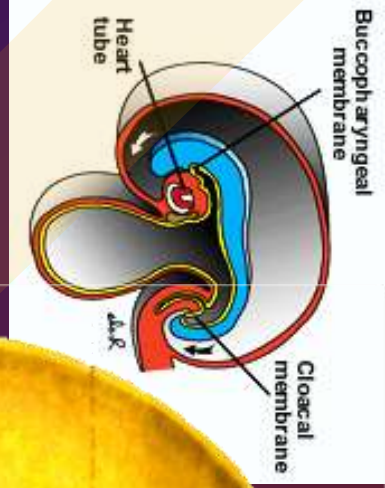
General Anatomy of Gastro-IntesTinal System

The teeth, Oral cavity, Tongue, Salivary glands, Pharynx.
Their vessels and innervation

Ivo Klepáček

Primordium of the alimentary canal (GastroInTestinal Canal)



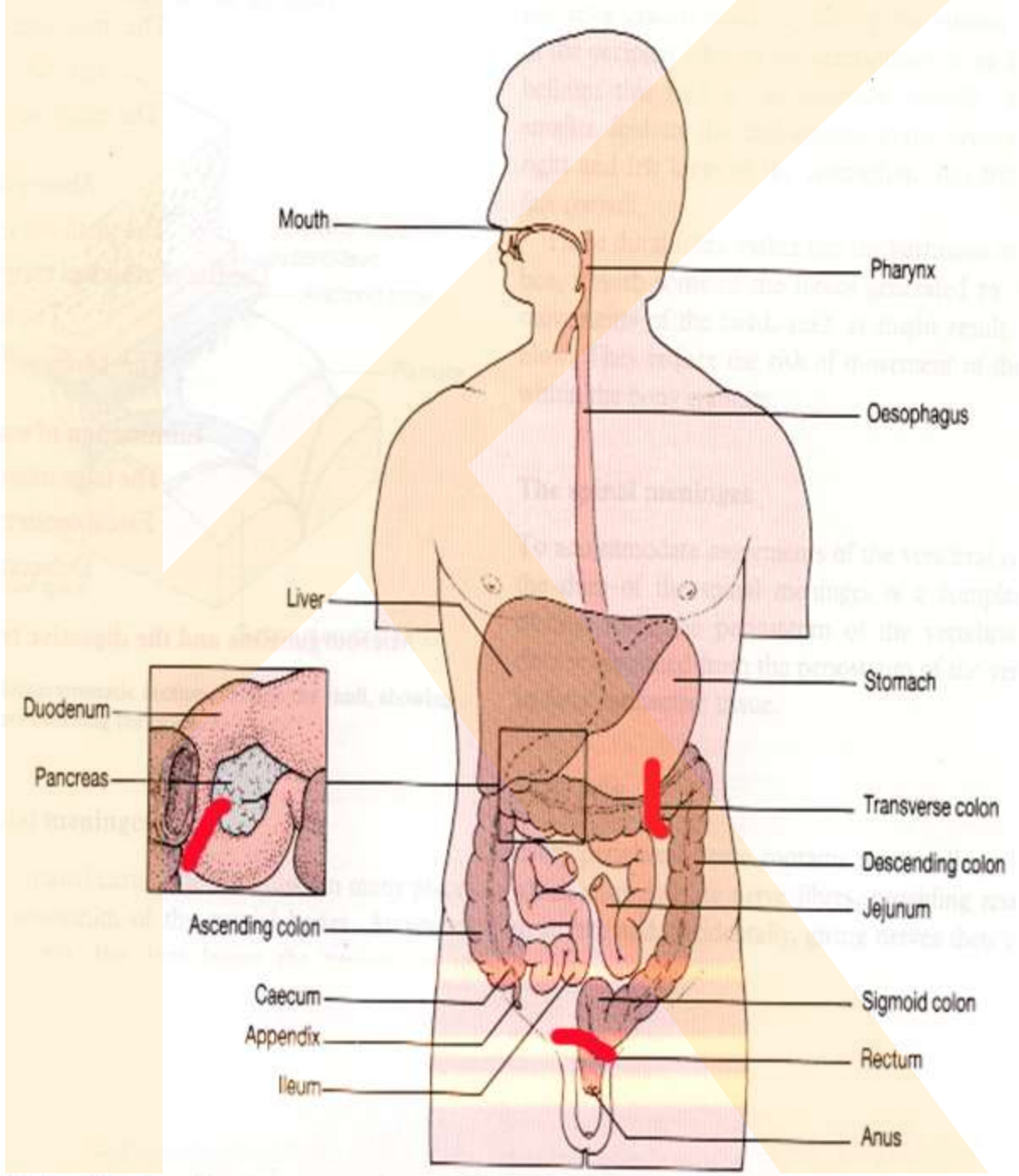
- GIT devel– *systema gastropulmonale* –
- *it develops from the embryonal intestine (entoderm) ; lower respiratory structurses are splitted from intewstine as a **tracheobronchial pouch***
- *Ventral (head) intestine part is added to ectodermal pouch called **stomodeum**, caudal part of the intestine is added to ectodermal pouch called **proctodeum***
- *Division of the alimentary tract:*
- 1) oral ectodermal segment
  2) main entodermal segment
  3) caudal ectodermal segment
- *děivision of the main segment:*
- ventral gut (foregut – to biliary duct opening)
  middle gut (midgut – to 2/3 colon)
  dorsal gut (hindgut – to upper part of the anal canal

Digestive System:

Oral cavity (***ectodermal origin***)

The gut and ist derivatives (***entodermal origin***) is devided in four sections:

1. Pharyngeal gut or pharynx
2. Foregut - esophagus, stomach, ¼ of duodenum, liver and gallblader, pancreas
3. Midgut – ¾ of duodenum, jejujnum, ilium, colon caecum, colon ascendens and 2/3 of colon transversum
4. Hindgut – 1/3 of colon transversum, colon descendens, colon sigmoideum, colon rectum, canalis analis

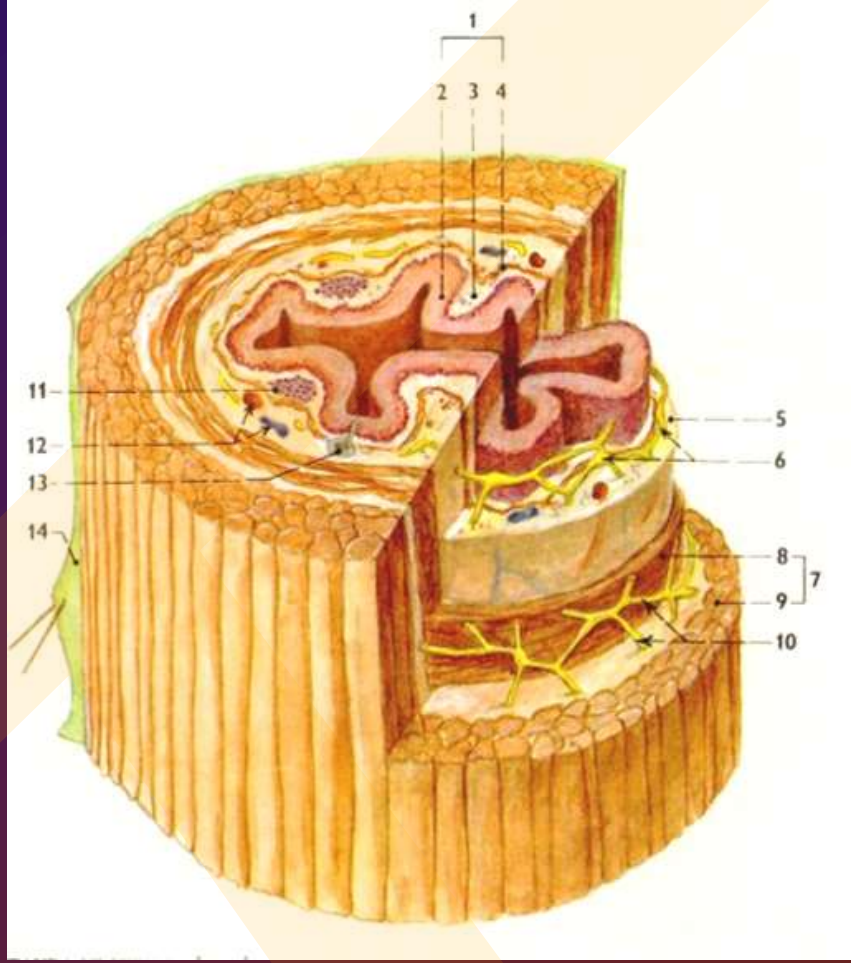


The digestive system. Inset shows structures deep to the transverse colon.

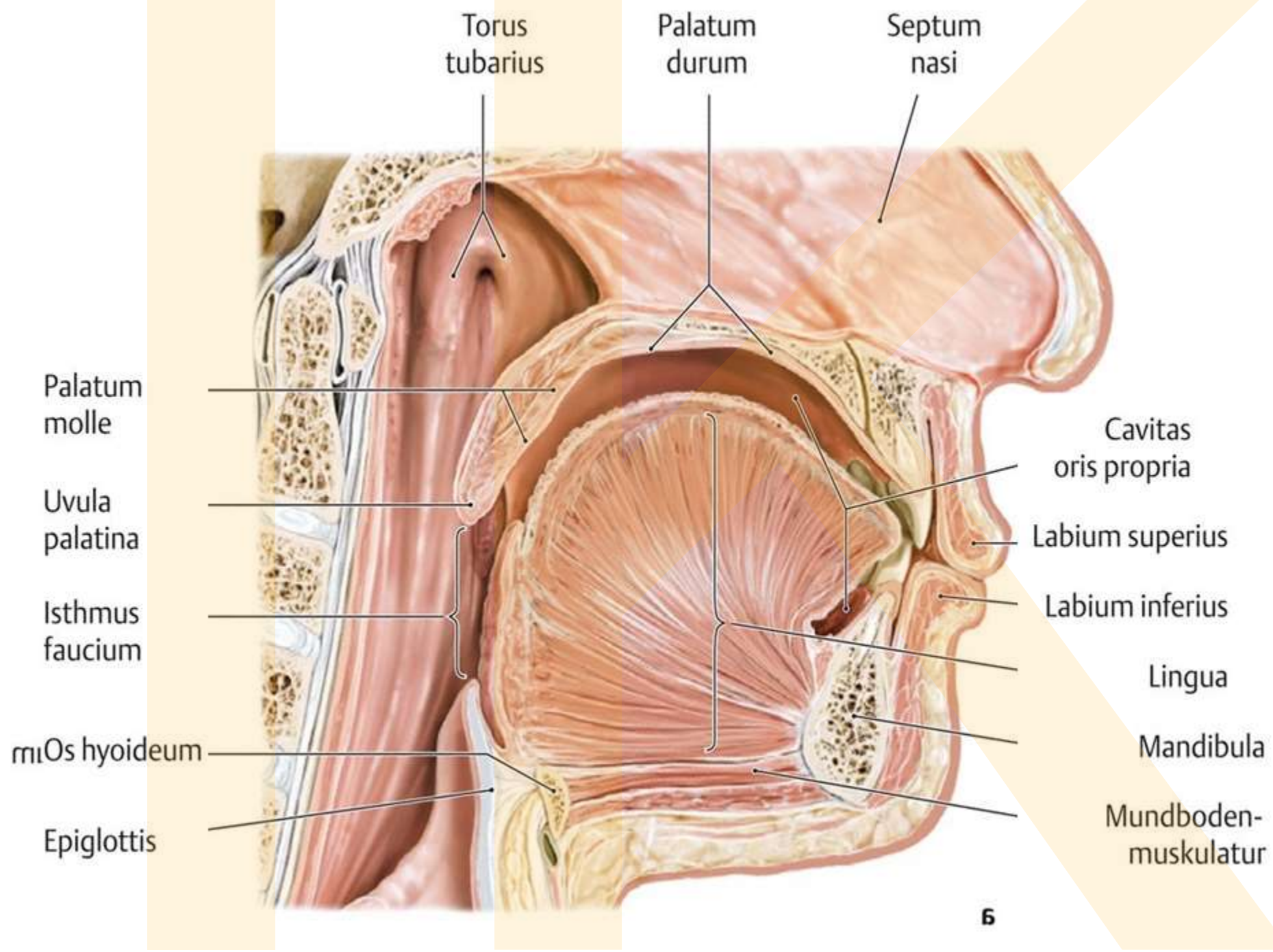
Principal function	Parts of tract	Associated glands
Digestion	Buccal cavity	Salivary glands
	Pharynx	
	Oesophagus	
	Stomach	
	Duodenum	Pancreas, Liver
Absorption	Duodenum	
	Jejunum	
	Ileum	
Elimination	Caecum	
	Appendix	
	Colon	
	Ascending	
	Transverse	
	Descending	
	Sigmoid	
	Rectum	
	Anal canal	

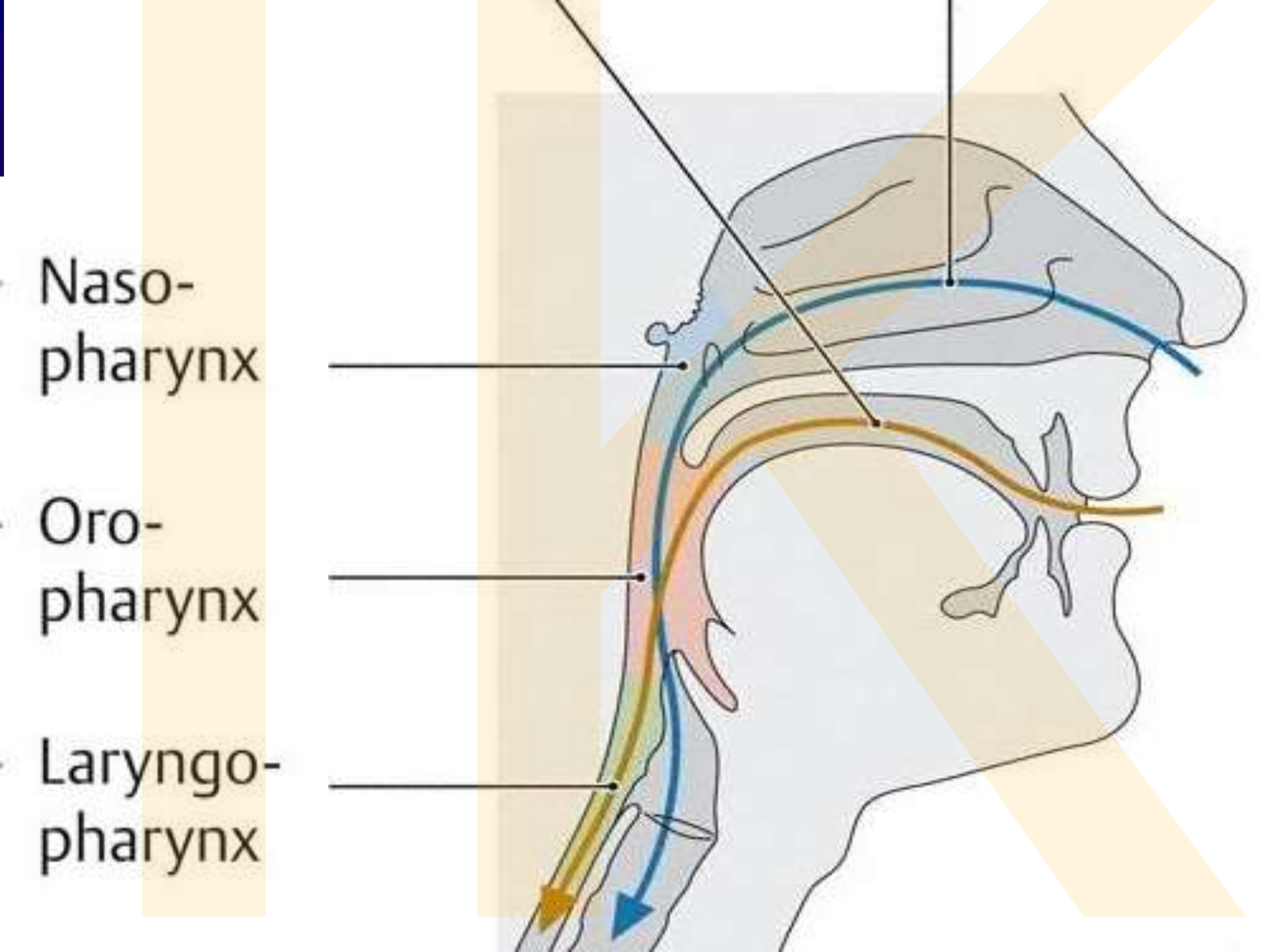
Alimentary tube (canal) - general structure

- tunica mucosa (mucous membrane 1
  - epithelium
  - lamina propria mucosae (lymph tissue)
  - lamina muscularis mucosae
- tunica submucosa (submucous layer) – vessels, erves (plexus submucosus Meissneri)
- tunica muscularis externa 7 (outer muscular layer) – longitudinal, circular even plexiform; vessels, nerves (plexus myentericus Auerbachi)
- tunica serosa (serous layer) *or* tunica adventitia (fibrous layer)



salivary glands (glandulae salivares)
pancreas
liver (hepar)
gall bladder and bile ducts (vesica fellea, ductus choledochus)


Torus tubarius
Palatum durum
Septum nasi
Palatum molle
Uvula palatina
Isthmus faucium
Os hyoideum
Epiglottis
Cavitas oris propria
Labium superius
Labium inferius
Lingua
Mandibula
Mundboden-muskulatur
6


Naso-
pharynx
Oro-
pharynx
Laryngo-
pharynx

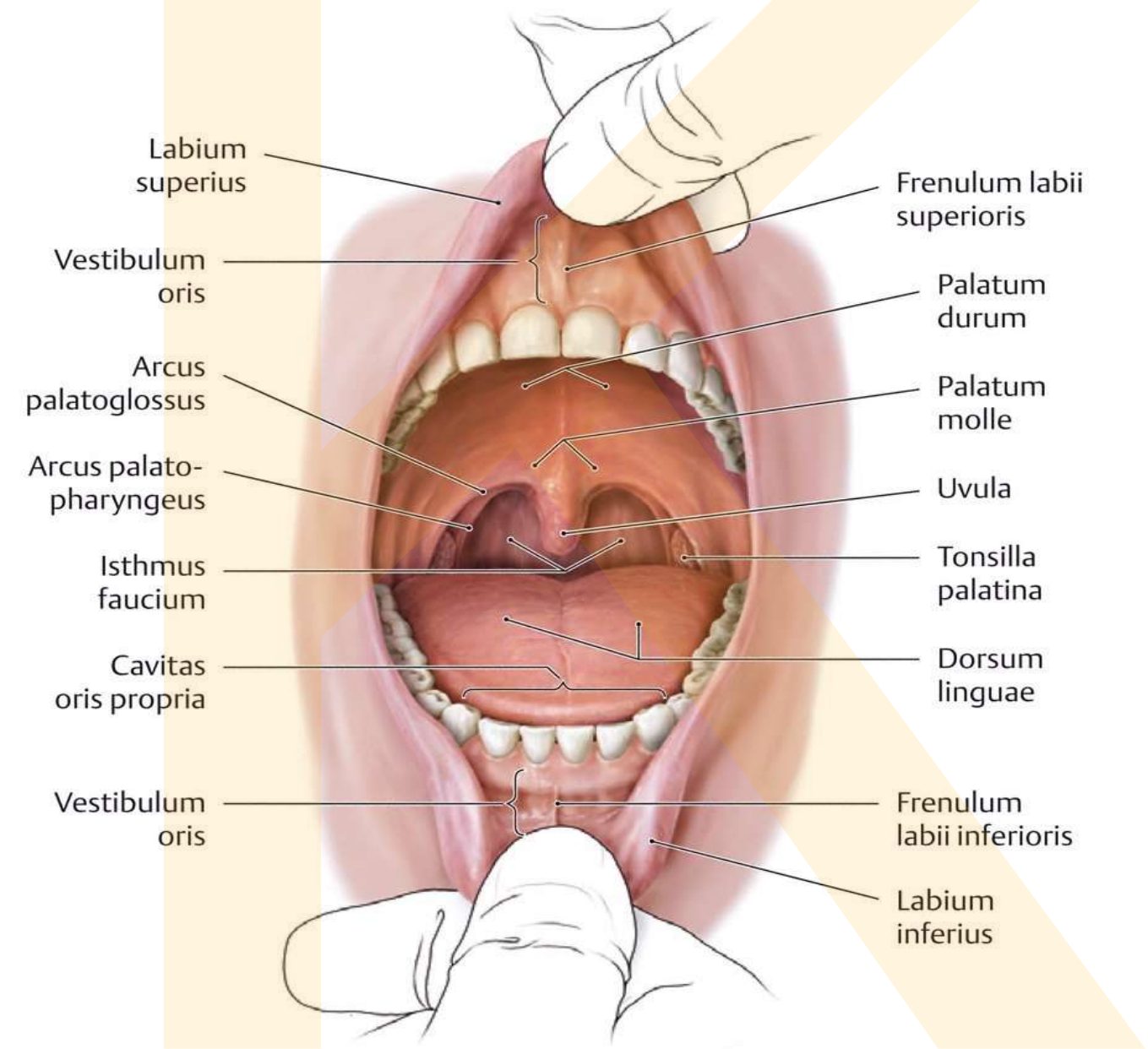
rima oris – isthmus faucium

Dental arches divide cavity:

vestibulum oris and **cavitas oris propria**

borders:
Ventrally: lips - labia oris
laterally: faces – buccae
roof: palatum
bottom: mylohyoid m. + geniohyoid m., tongue (lingua, glossa)

Masticatory mucosa - Hard palate + gum (keratinized)
Specialised mucosa - Tongue + papillary epithelium
Lining mucosa - Bucca, soft palate (non-keratinized)



Periodontium

Innervation:

free endings	pain
Ruffini bodies	traction
Vater-Paccini bodies	pressure, vibration

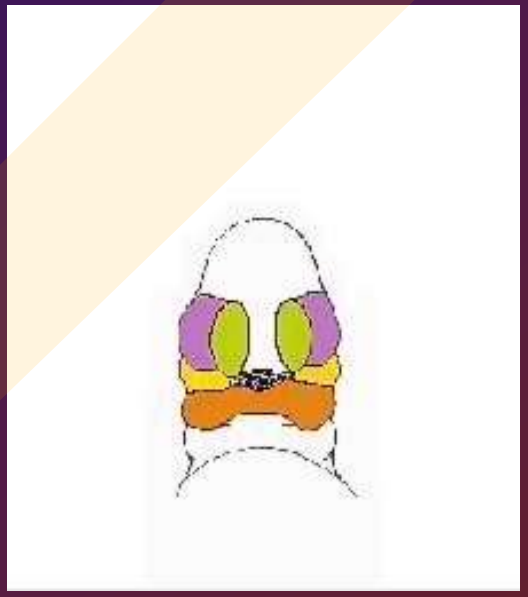
Mucosa

- masticatory
  specialised
  lining

Innervation:

free,	Paccini, Ruffini, Meissner	
pain, temperature,	*vibration, traction, pressure*	
free,	Paccini, Ruffini,	taste buds
pain, temperature,	*vibration, traction,*	*taste*
free,	Paccini, Meissner, Merkel	
temperature,	*vibration, pressure,*	*pressure*

Development of the facial skeleton, formation of the nasal and oral cavities



Primitive lips:

- week 6 - ectoderm ingrowth to mesenchyme in developing jaw – formation of the labiogingival lamina
  - lamina splits into two layers separated by groove
  - central part of upper lip (known as a philtrum develops from the intermaxillary segment

Primitive oral cavity - stomodeum

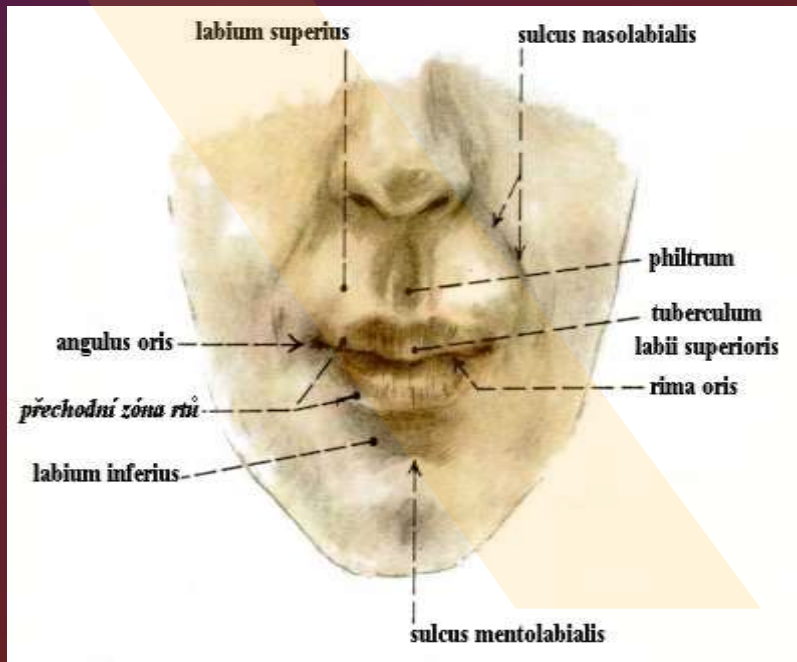
depression lined by ectoderm and oropharyngeal membrane

margines:

lower processes from the 1. pharyngeal arch - mandible

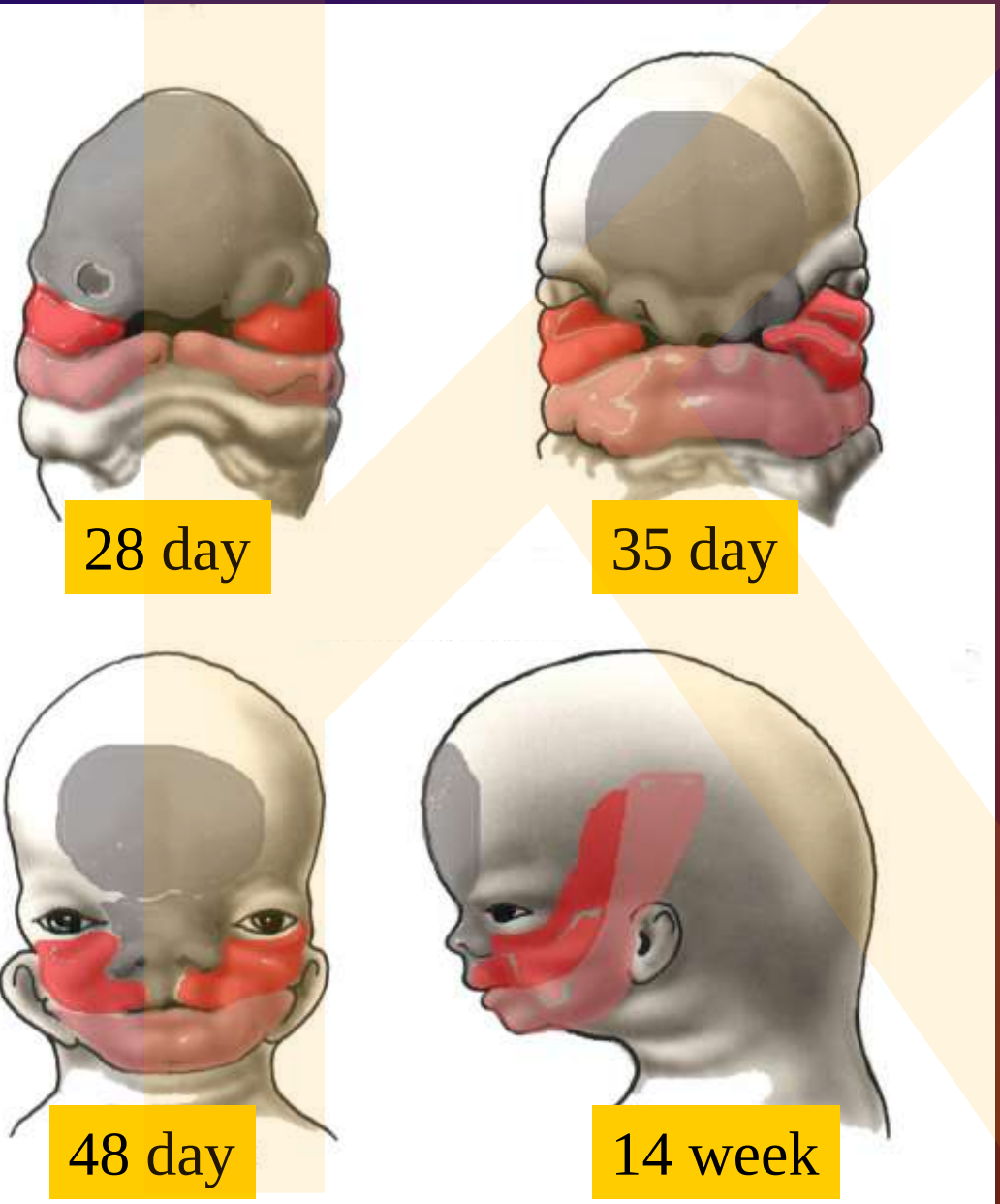
laterally of them upper processes of the 1. pharyngeal arch - maxilla

superiorly frontonasal process where nasal placodes appear(→pits, sacs and later are opened to primitive nasal cavity), medial and lateral nasal processes.

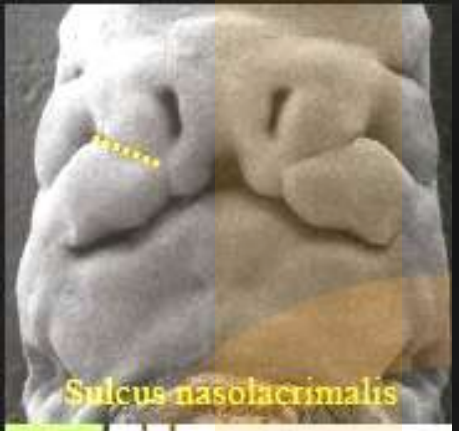


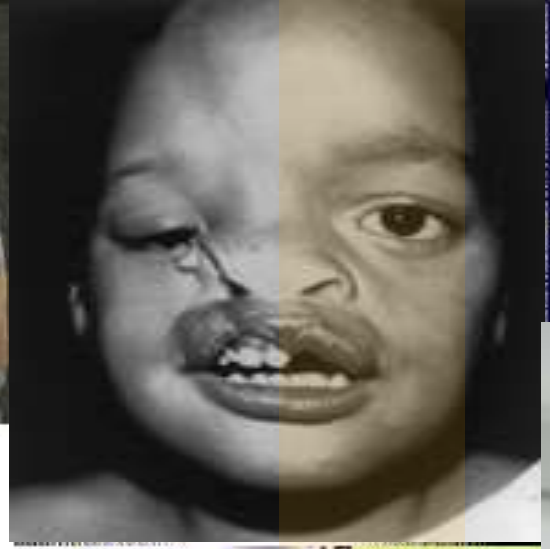
Face formation

- Frontonasal
- maxillary et
- mandibular processes

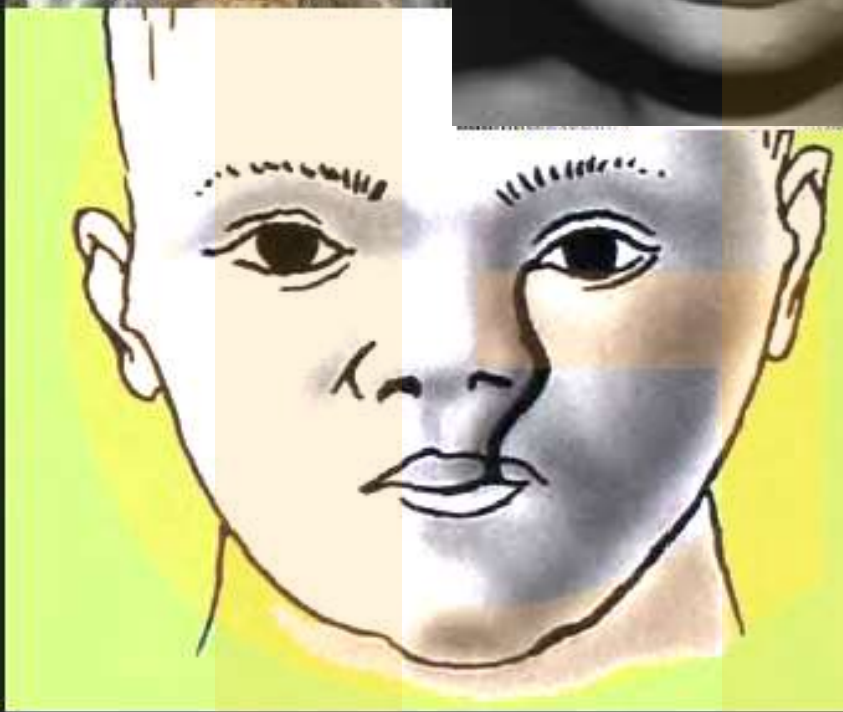


Philtrum, nasolacrimal groove, cheeks, maxillae, nose

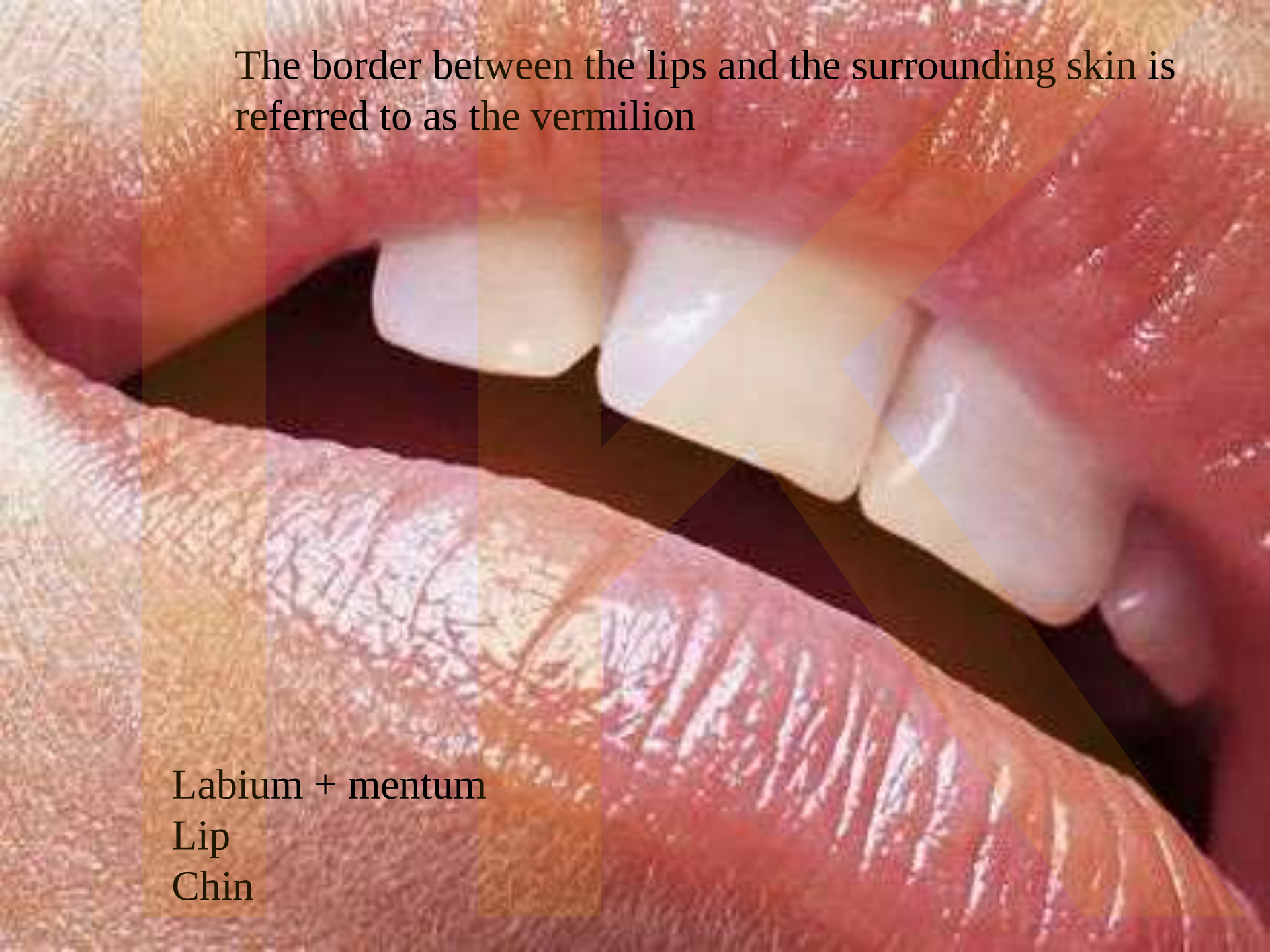




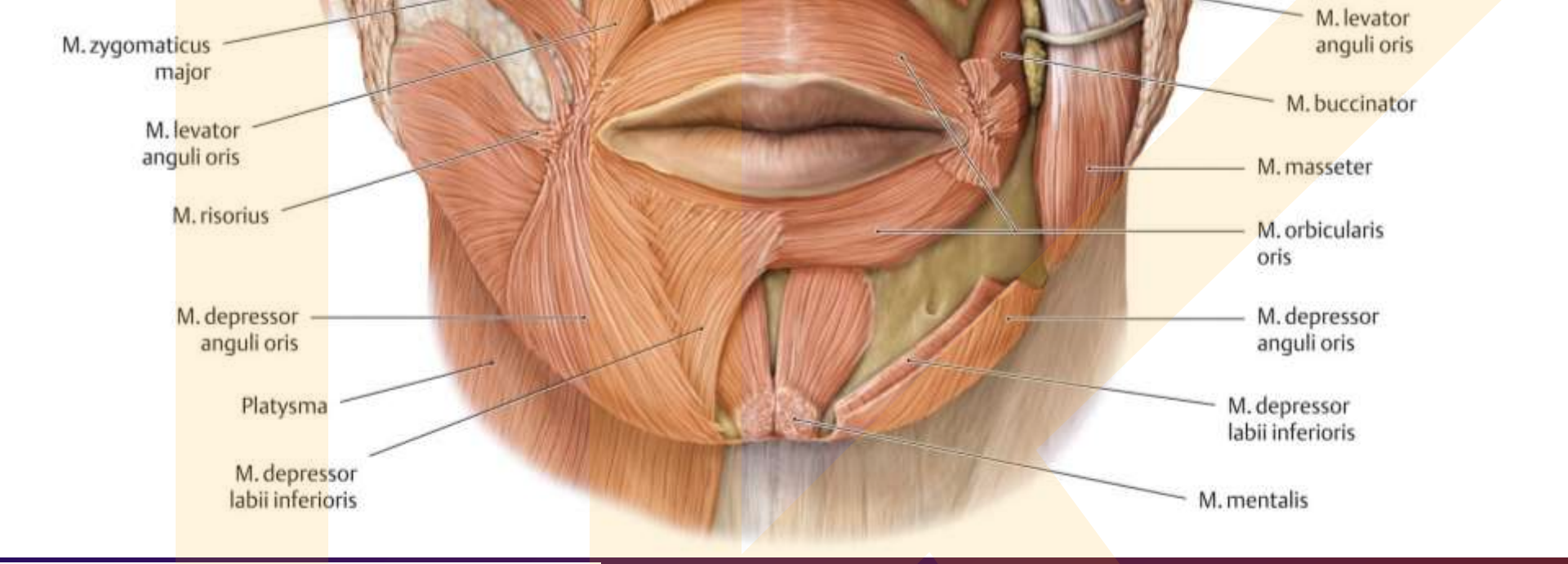
Šikmý rozštěp tváře
Oblique facial cleft

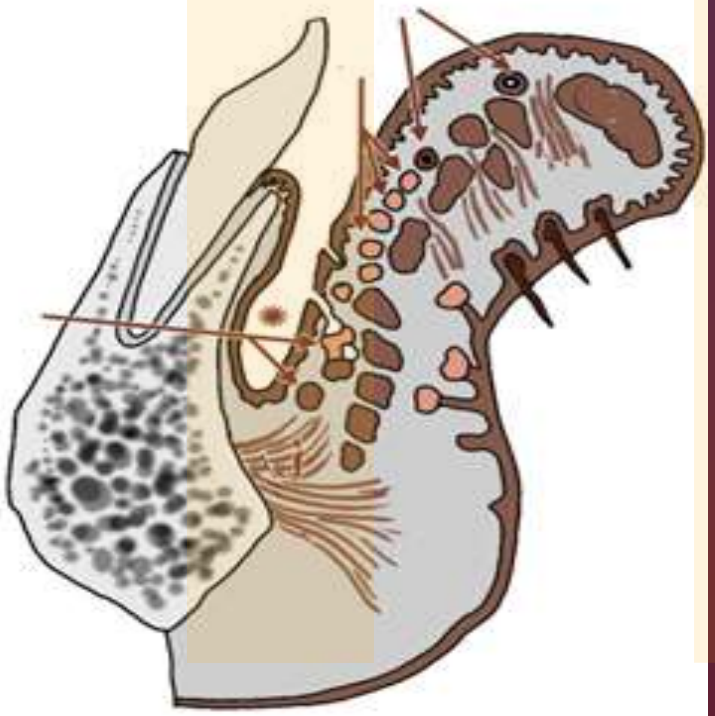


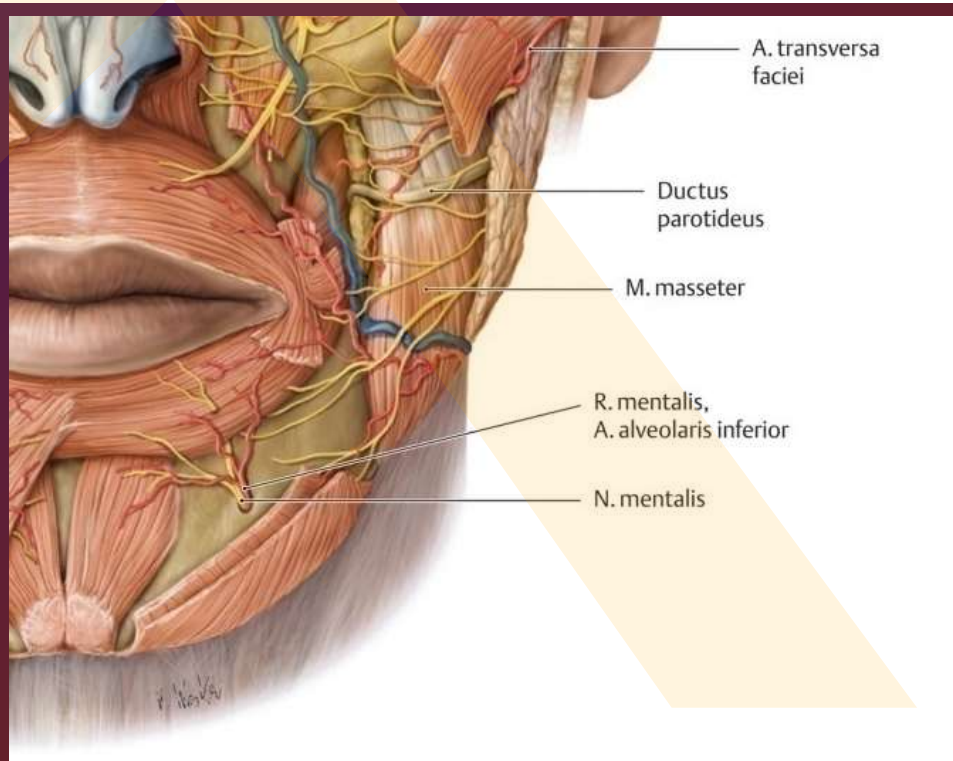
Příčný rozštěp tváře
Transverse facial cleft

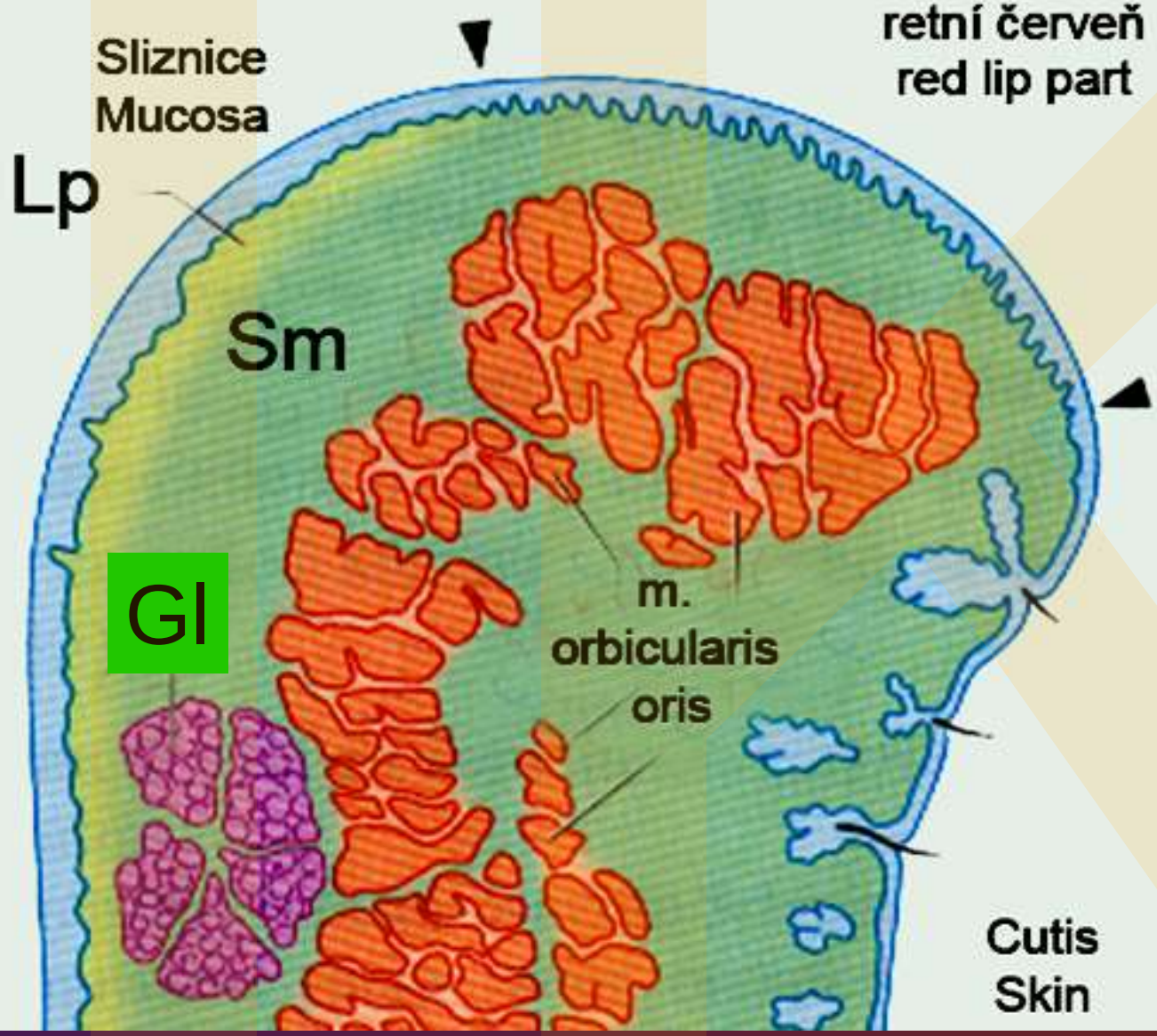

The border between the lips and the surrounding skin is referred to as the vermilion
Labium + mentum
Lip
Chin

The skin of the lip, with three to five cellular layers, is very thin compared to face skin, which has up to 16 layers. Lip skin contains fewer melanocytes (pigment cells). Because of this, the blood vessels appear through the skin of the lips, which leads to their notable red coloring. The lip skin is not hairy, and does not have sweat glands or sebaceous glands. Therefore it does not have the usual protection layer of sweat and body oils which keep the skin smooth, inhibit pathogens, and regulate warmth. For these reasons, the lips dry out faster and become chapped more easily.


M. zygomaticus major
M. levator anguli oris
M. risorius
M. depressor anguli oris
Platysma
M. depressor labii inferioris
M. levator anguli oris
M. buccinator
M. masseter
M. orbicularis oris
M. depressor anguli oris
M. depressor labii inferioris
M. mentalis




A. transversa faciei
Ductus parotideus
M. masseter
R. mentalis, A. alveolaris inferior
N. mentalis



Lp – lamina propria mucosae
Sm – submucosa
Gl – glandulae labiales

Keratinizing epithelial layer continues dorsally as a multilayered cuboid non-keratizing epithelial layer; **Lamina propria mucosae** continues as a submucous layer containing numerous small salivary or mucous glands (compare with soft palate)

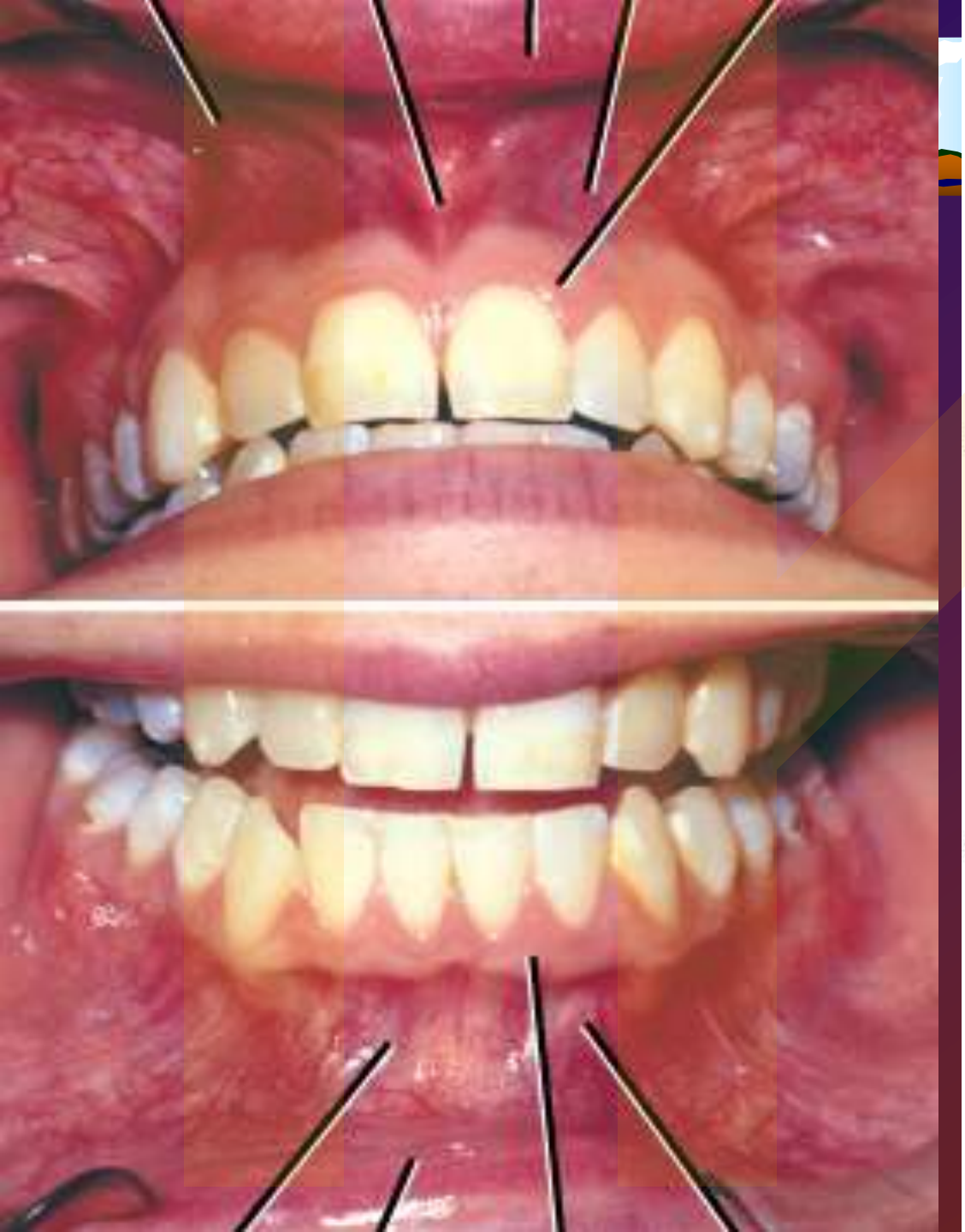
vascular and nervous suply of the face and lips

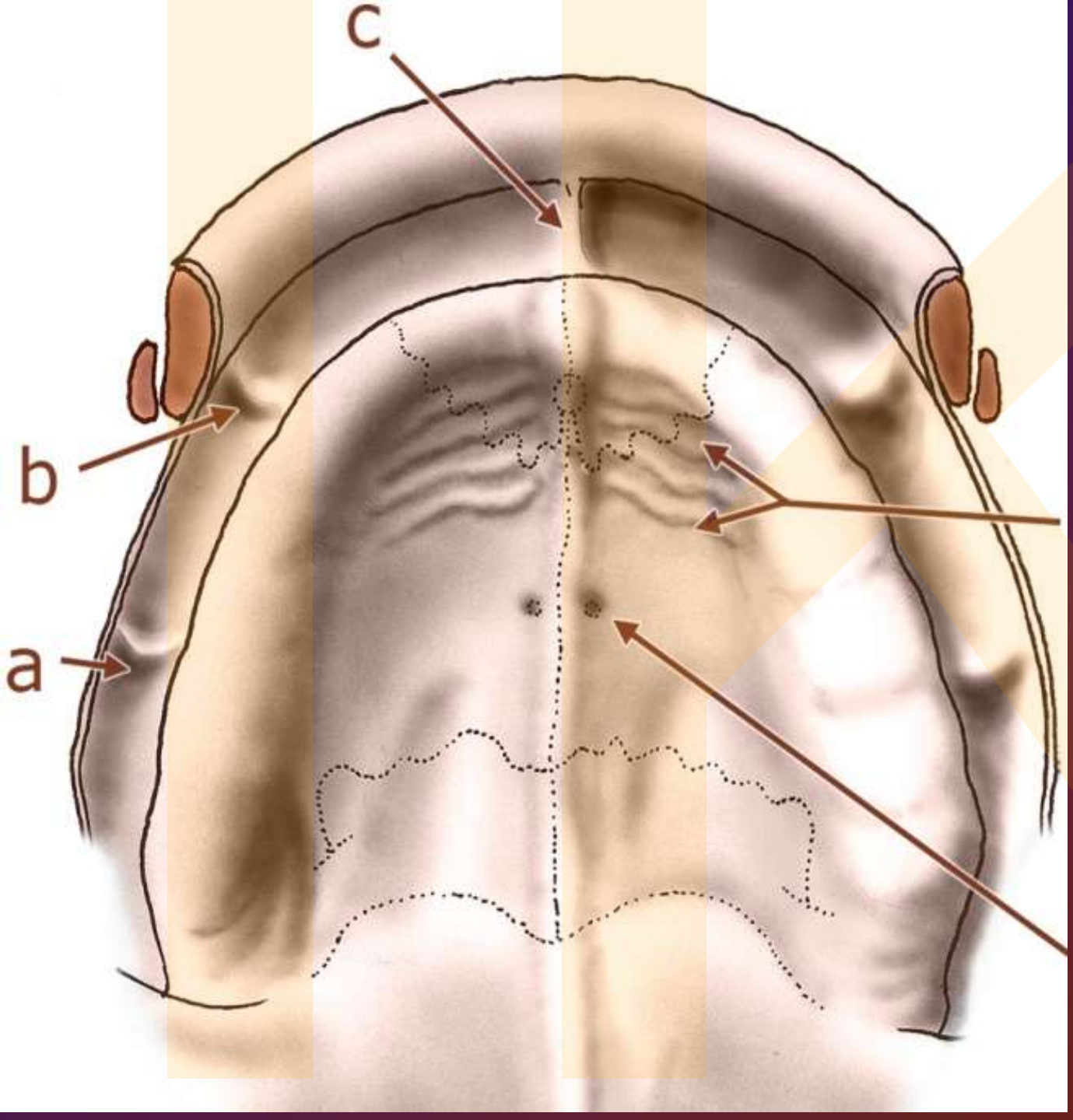
A. facialis → a. labialis sup.& inf.
A. temporalis superficialis → a. transversa faciei
A. maxillaris → a. buccalis

V. facialis →
V. transversa faciei → v. retromandibularis
v. faciei profunda → pl. pterygoideus

Ln. submentales, submandibulares

Inervation
sensitive: n.V/2 → n.infraorbitalis, zygomaticus
V/3 → n.mentalis, buccalis
motor: n.VII

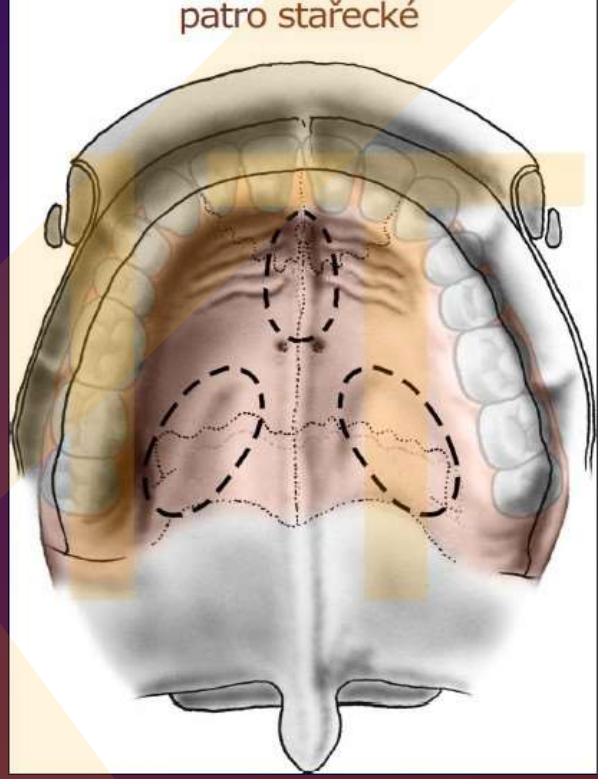

Labial frenulum
Labial mucosa
Alveolar mucosa
Vestibular (mucolabial) fold
Labial maxillary gingiva
A
B
Vestibular (mucolabial) fold
Alveolar mucosa
Labial mandibular gingiva
Labial mucosa



c - frenulum linguae sup.

b,a - plicae bucco-alveolares (buccales)

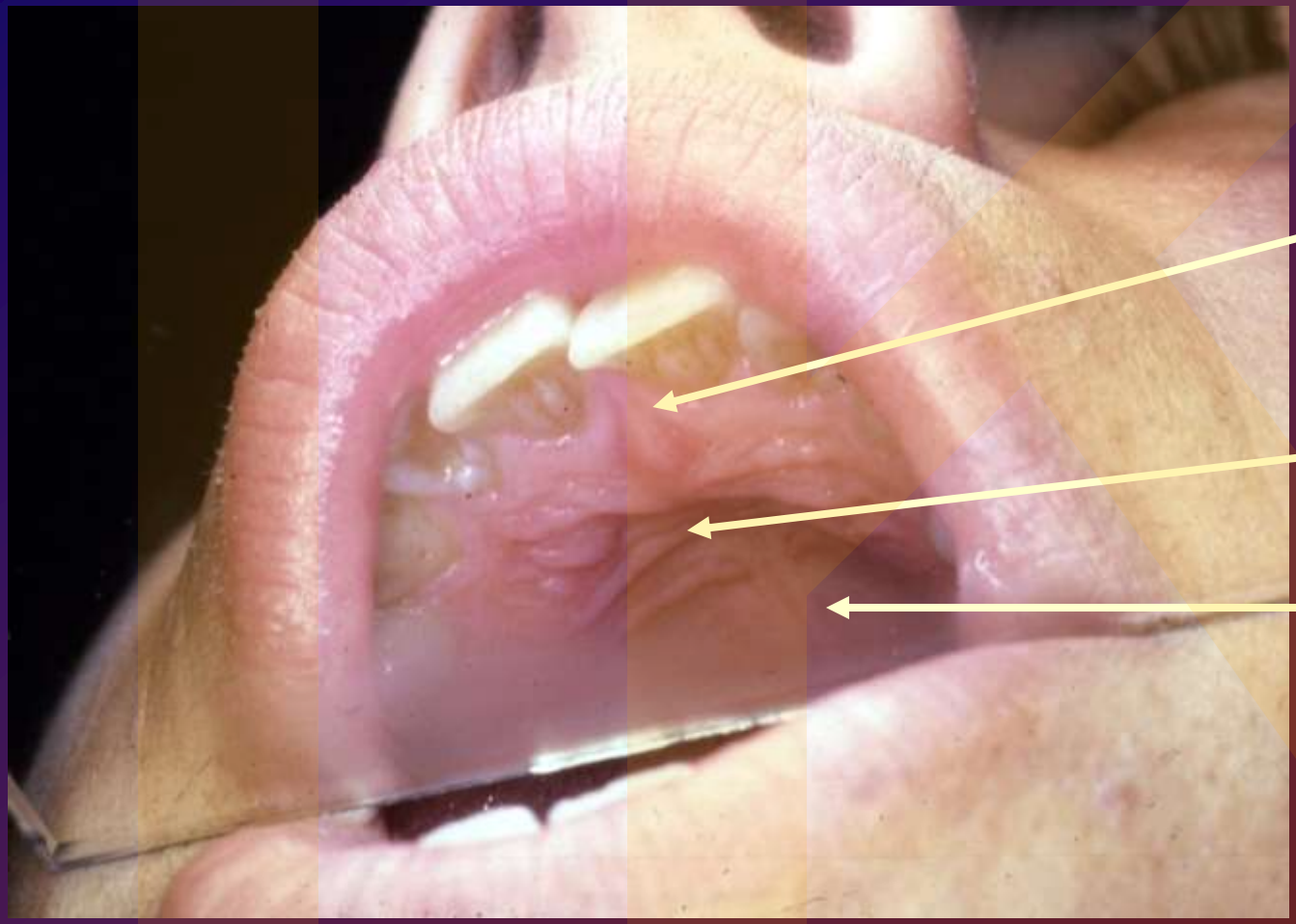
Palatum durum
Palatum molle
Hard palate
Soft palate



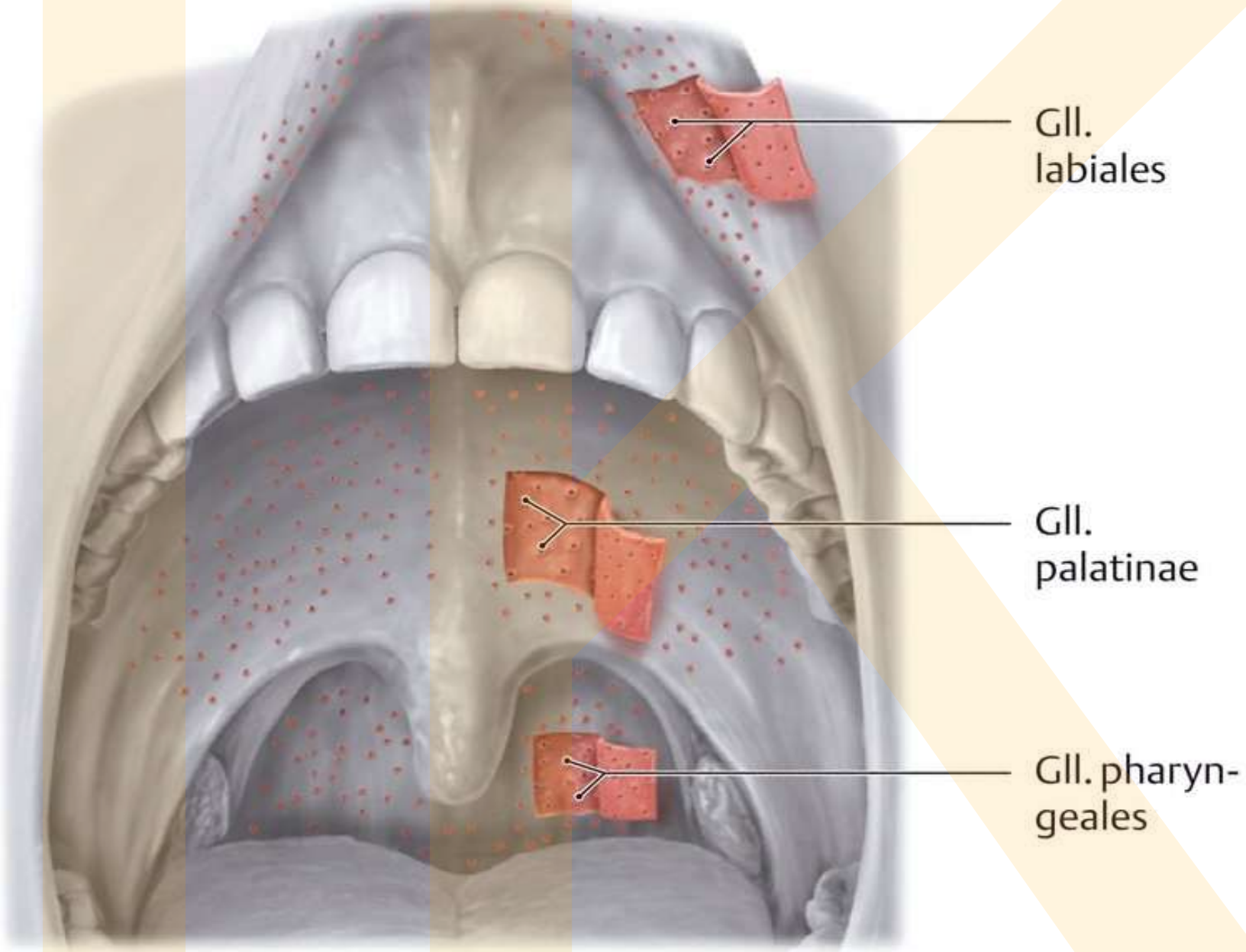
Premaxilla
Maxilla
Os palatinum

Papilla,
rugae (folds)
pits (foveolae)
Lines (crests)

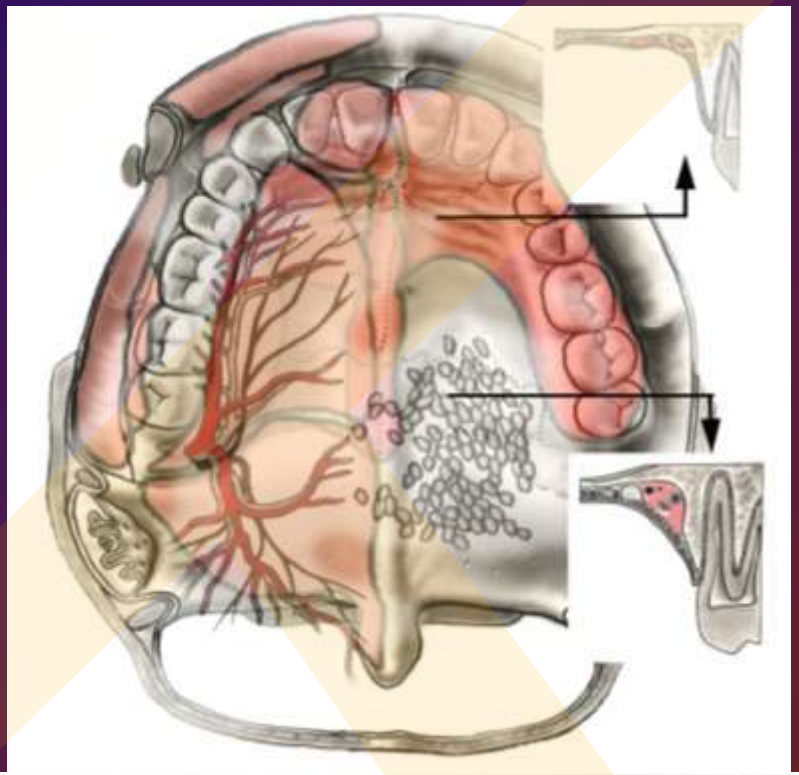
Palate – surface features

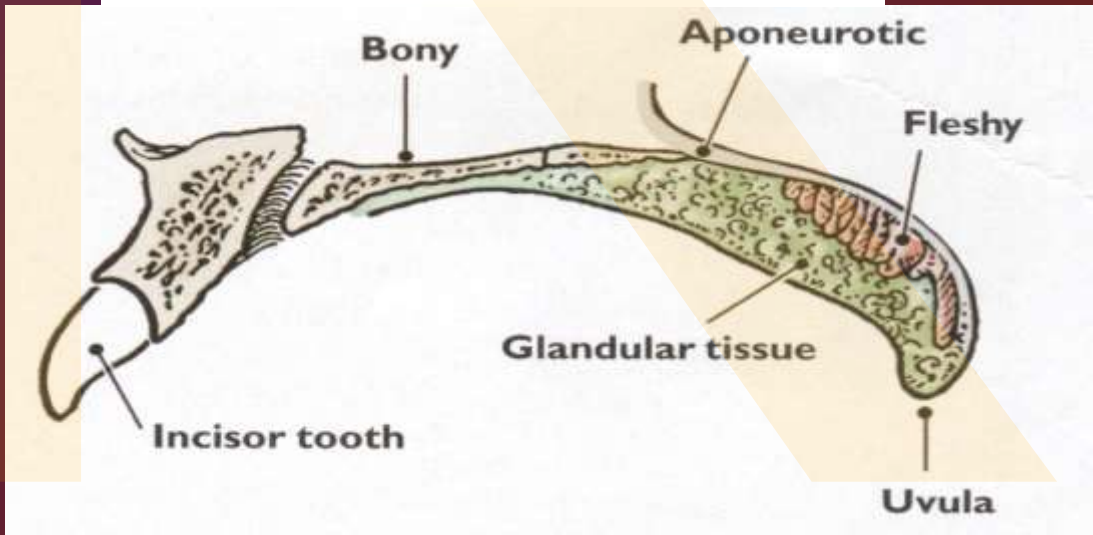


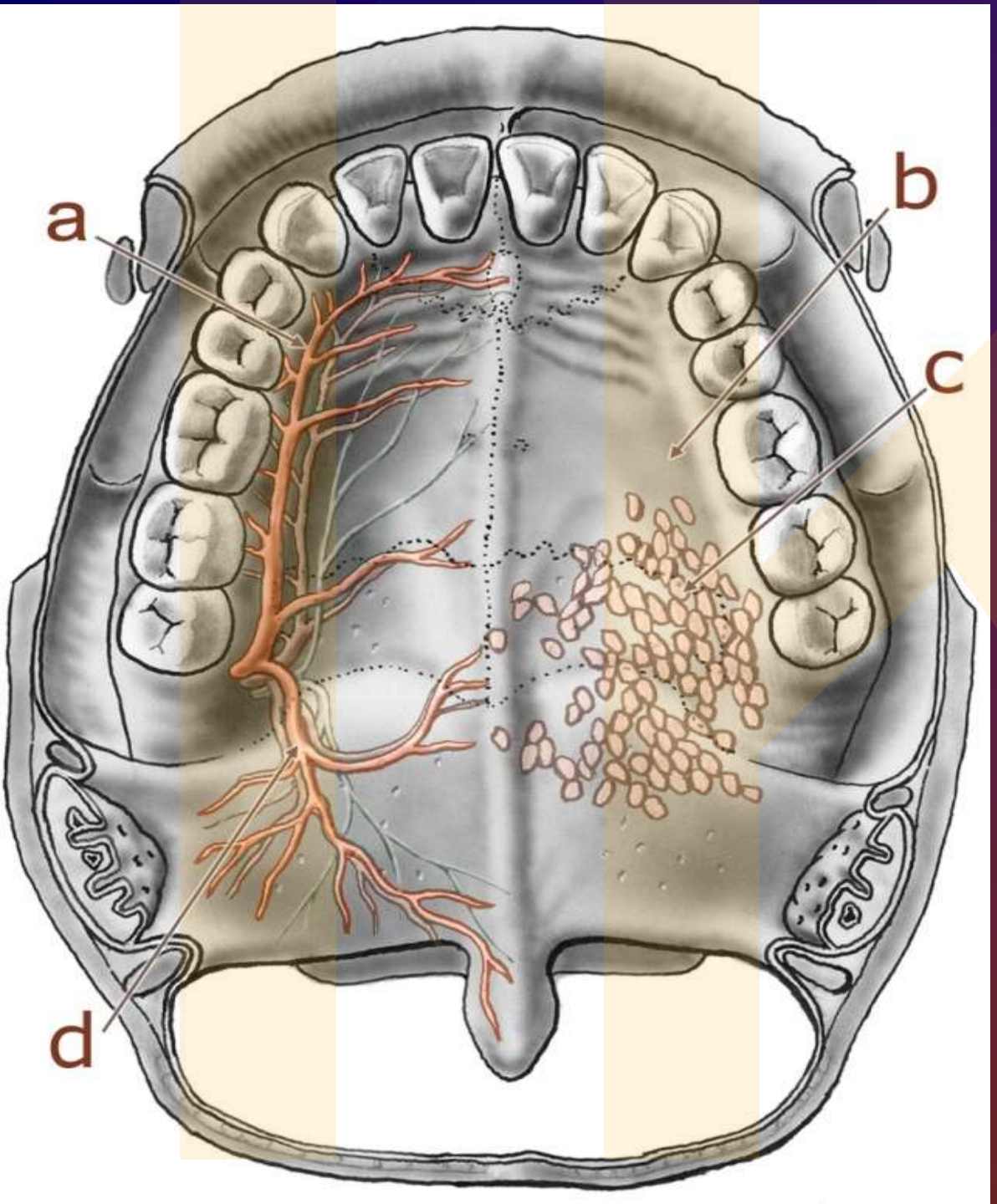
Lacey


Gll. labiales
Gll. palatinae
Gll. pharyn-geales

Palatal relief with rugae, foveolae and incisal papila





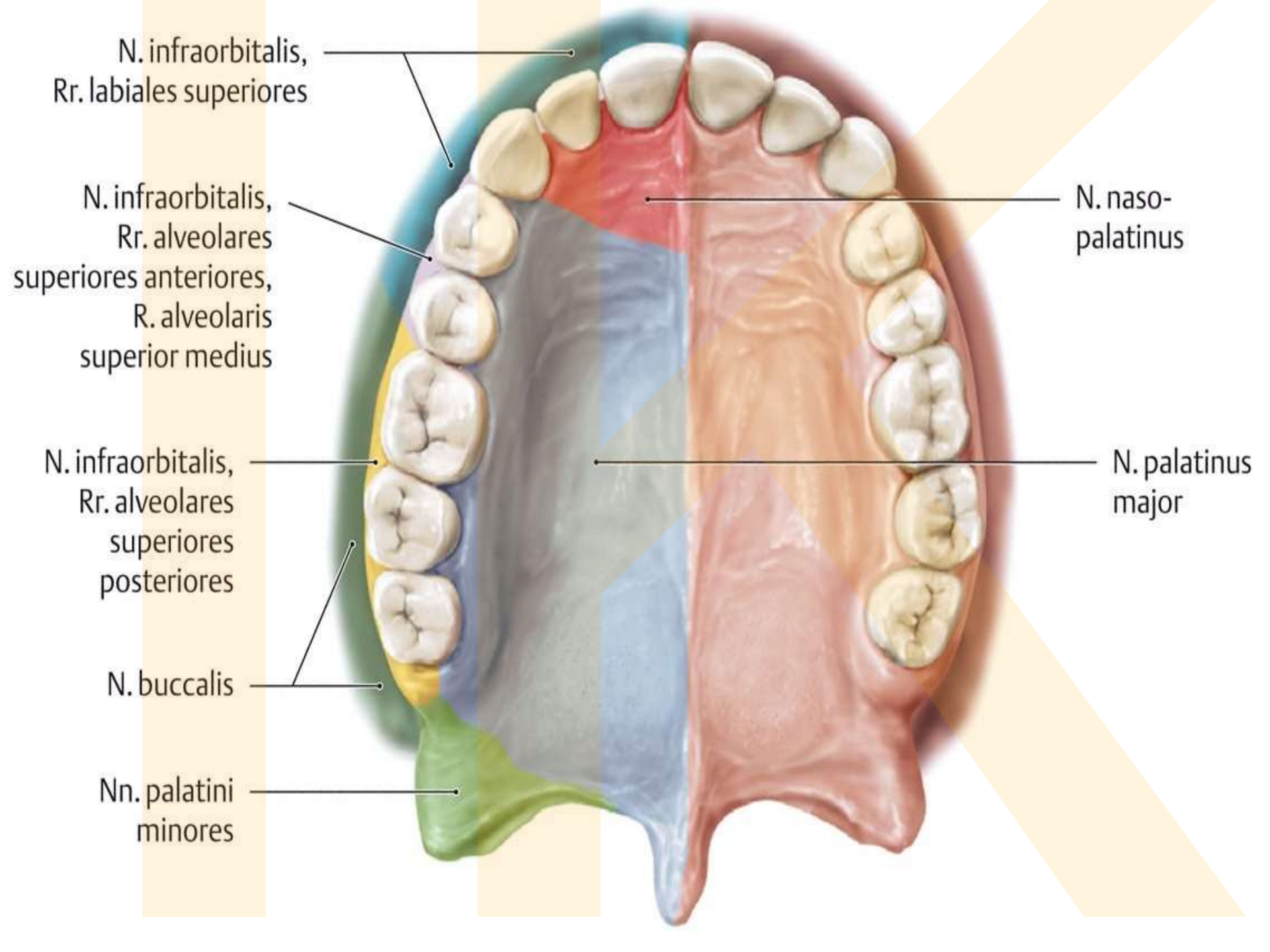


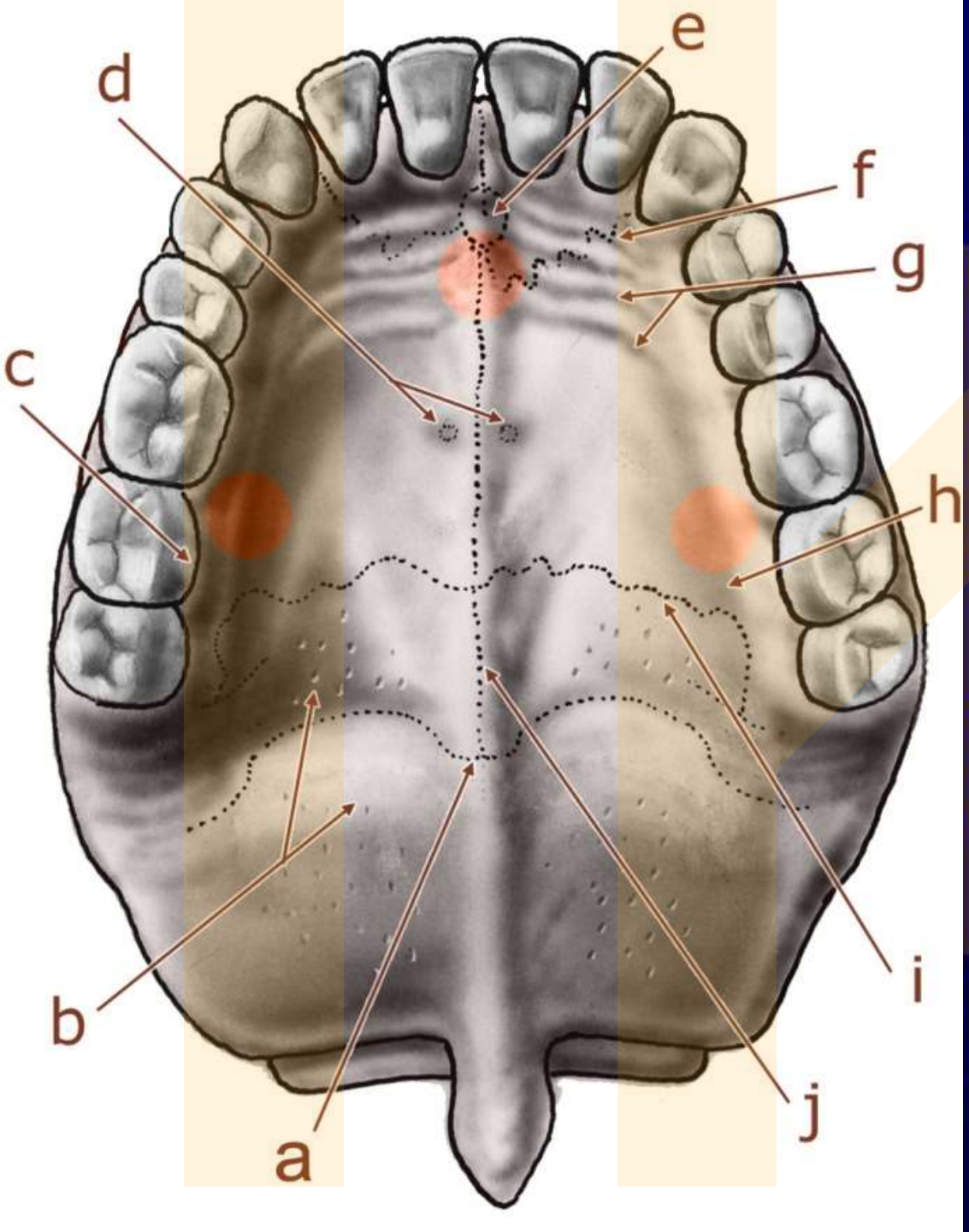
a –
a.+v. +n. palatinus major
greater palatine artery, vein, nerve

b –
sulcus palatinus major
greater palatine groove

c –
glandulae palatinae
palatal glands

d –
a.+v.+n. palatinus minor
lesser palatine artery, vein, nerve


N. infraorbitalis, Rr. labiales superiores
N. infraorbitalis, Rr. alveolares superiores anteriores, R. alveolaris superior medius
N. infraorbitalis, Rr. alveolares superiores posteriores
N. buccalis
Nn. palatini minores
N. naso-palatinus
N. palatinus major



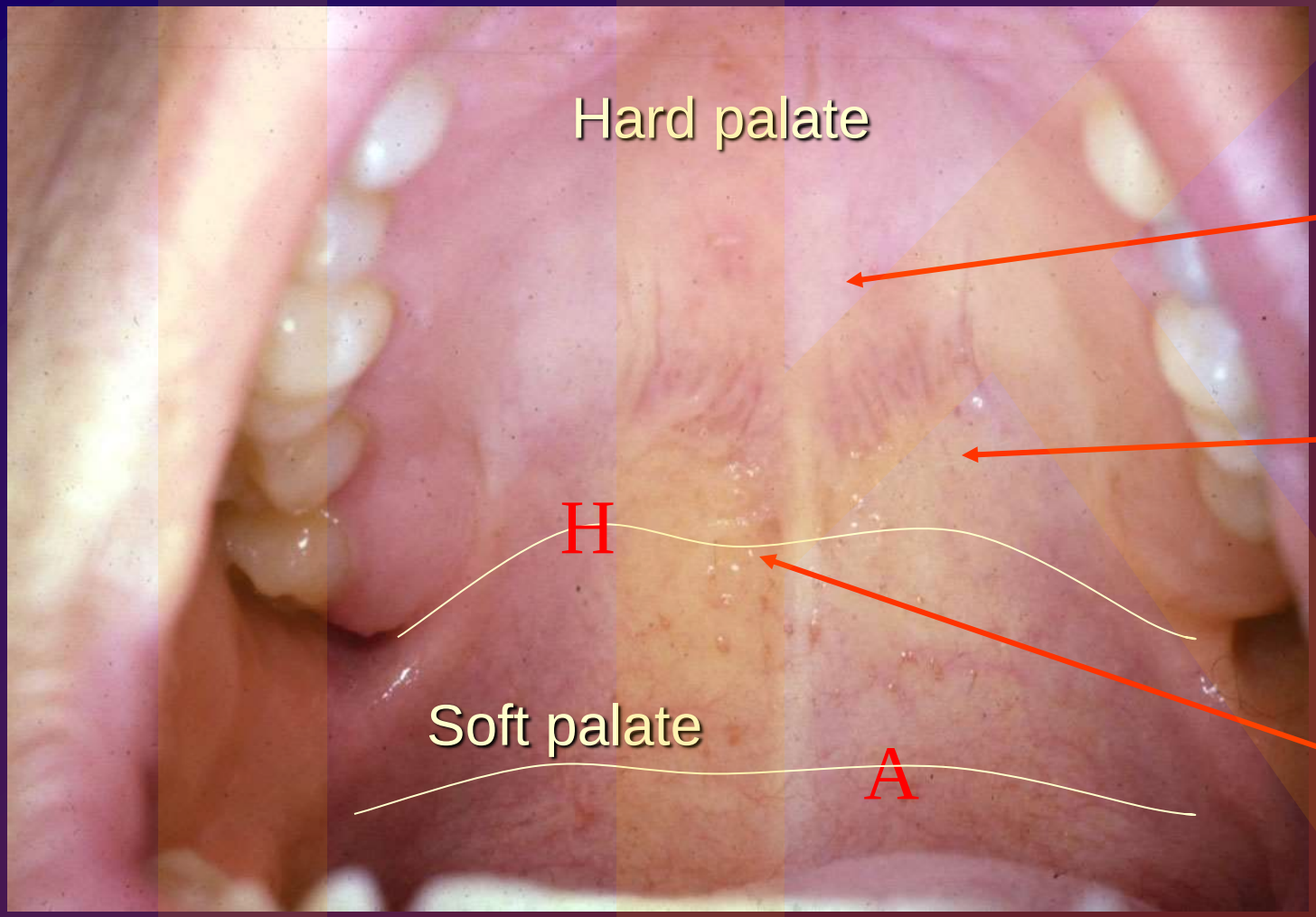
a –
a.+v. +n. palatinus major
greater palatine artery, vein, nerve

b –
sulcus palatinus major
greater palatine groove

c –
glandulae palatinae
palatal glands

d –
a.+v.+n. palatinus minor
lesser palatine artery, vein, nerve

Palate – surface features

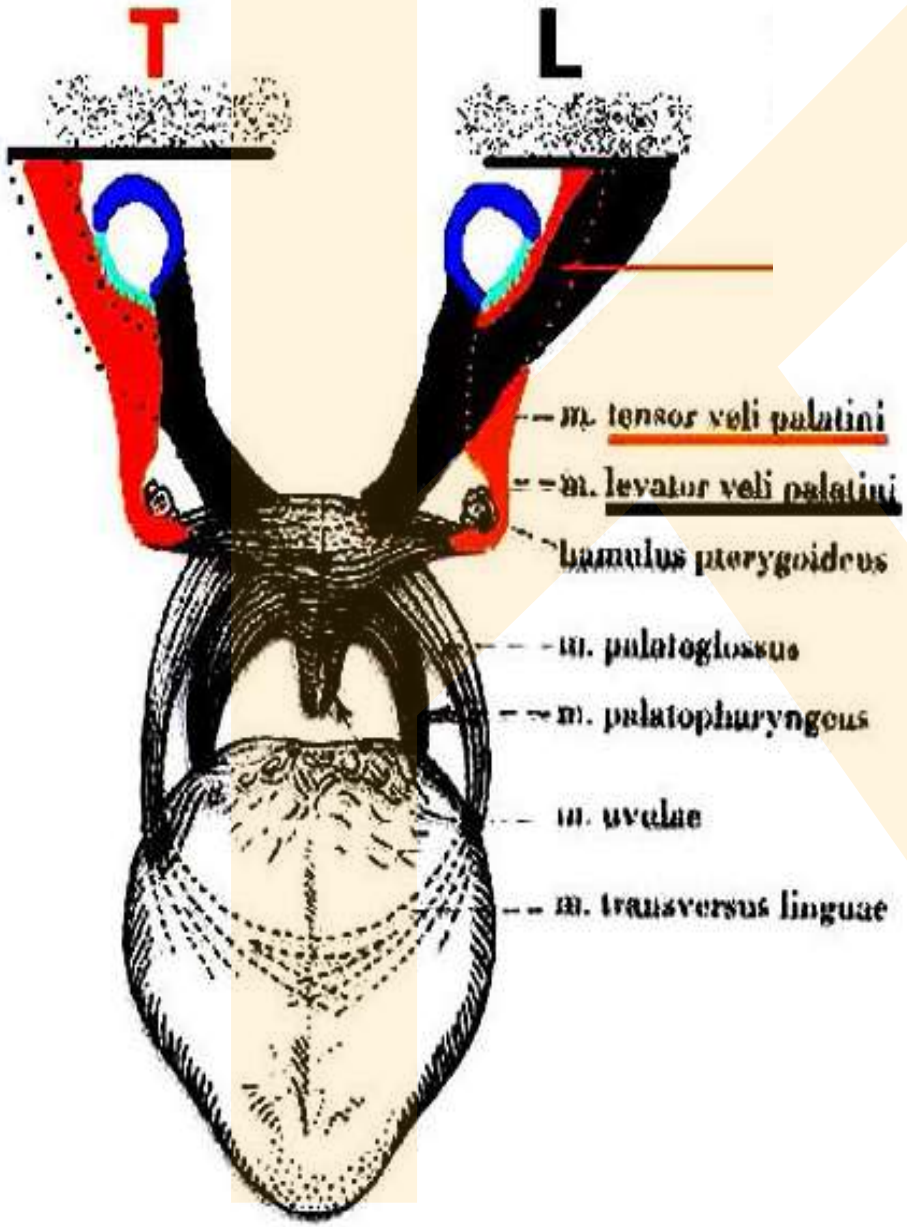


Lacey

Hauptmayer line - hard and soft palate connection

tensor - Dilates tube

levator - Opens tubal orifice

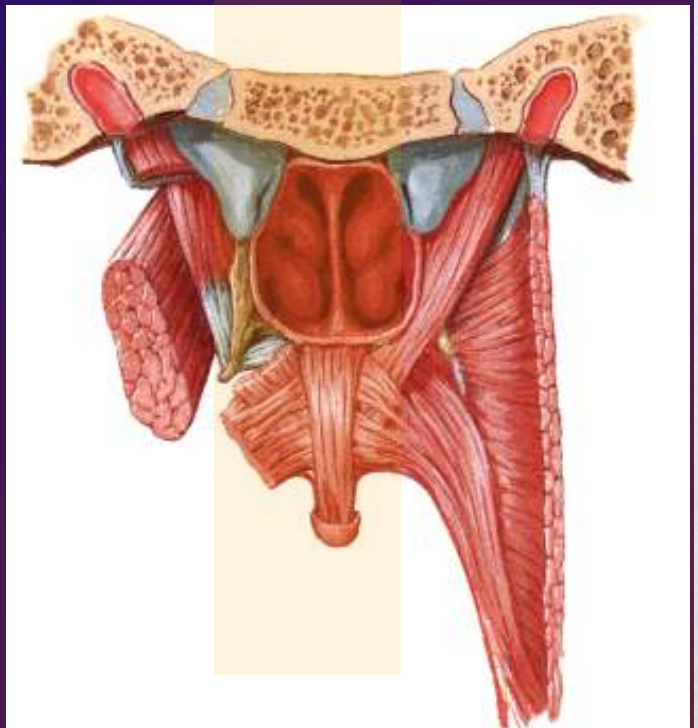


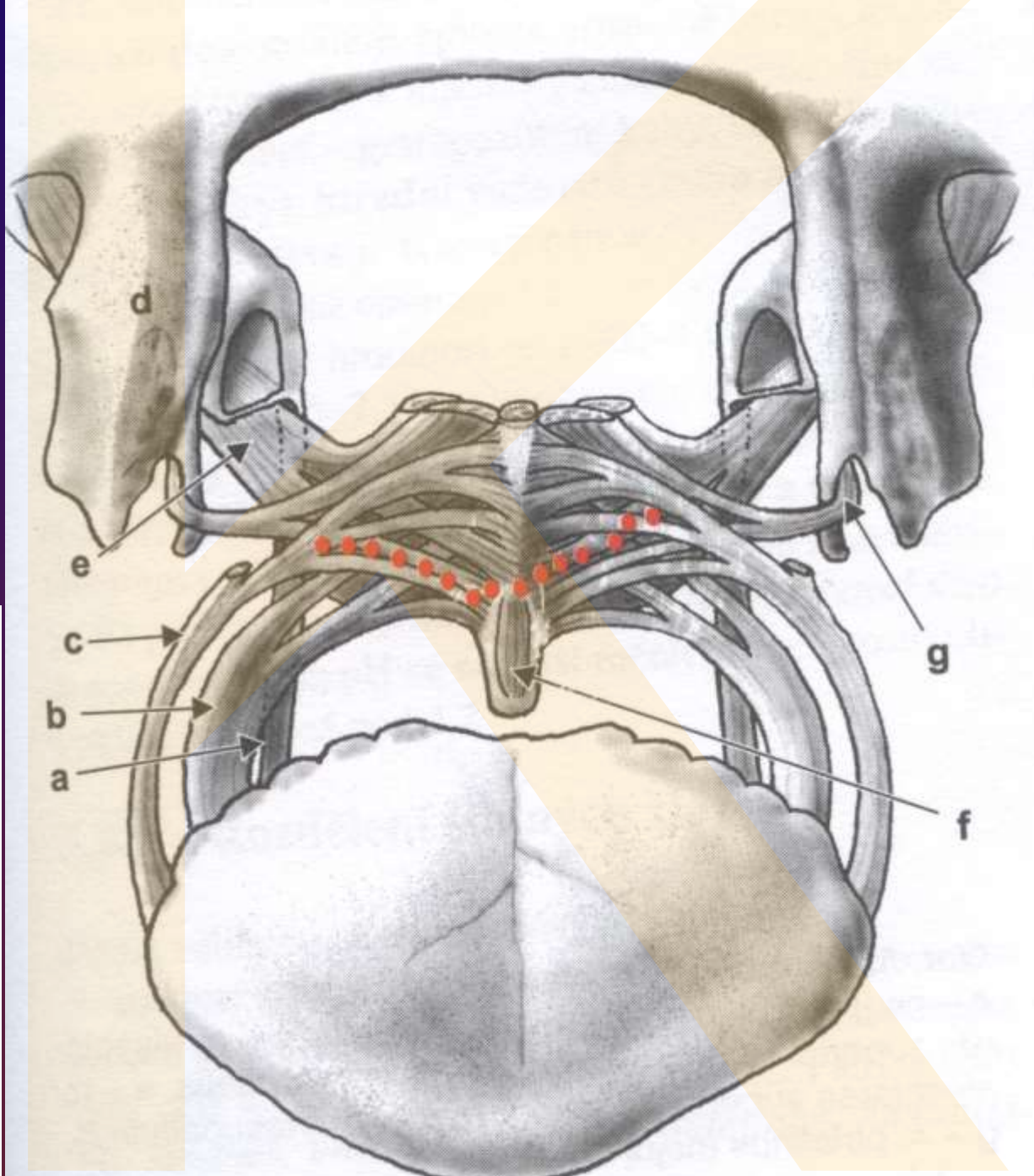
after Petrovicky 2002

Soft palate

– ventral view

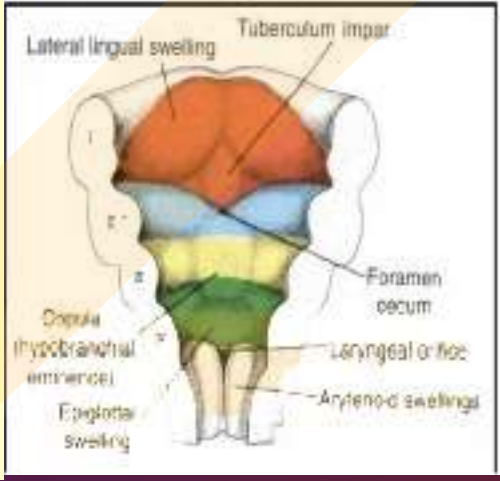
– dorsal view






Chrápání
Snoring

Lingua, tongue, glossa



Arcus palato-pharyngeus
Epiglottis
Tonsilla lingualis
Foramen caecum
Tonsilla palatina
Arcus palato-glossus
Sulcus terminalis
Ausschnitt s. **Ba**
Sulcus medianus
Radix linguae
Dorsum linguae
Corpus linguae
Apex linguae

Mobile musculoepithelial organ;

Located in the oral cavity and pharynx

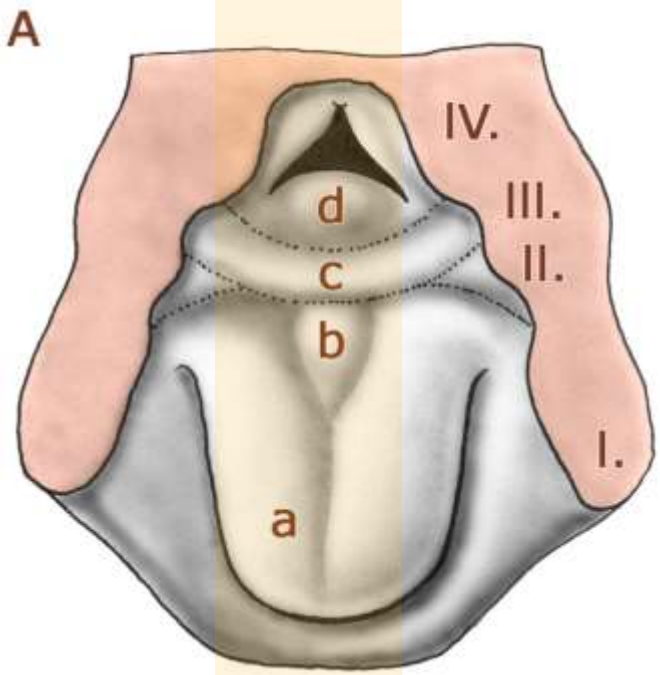
Mastication,

Deglutition,

Speech

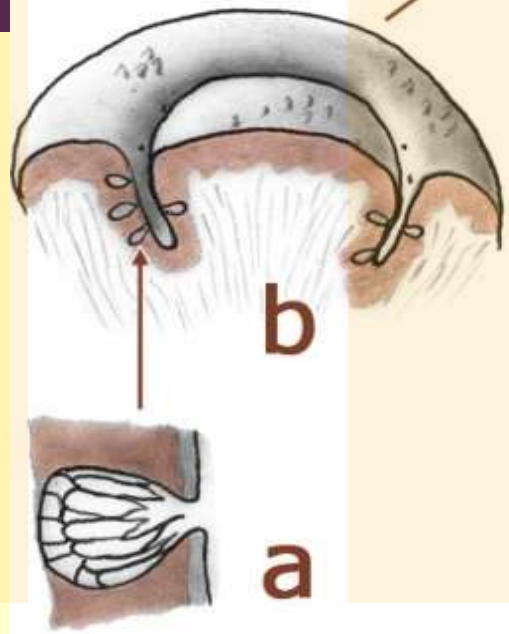
Squeezing food into pharynx during swallowing;

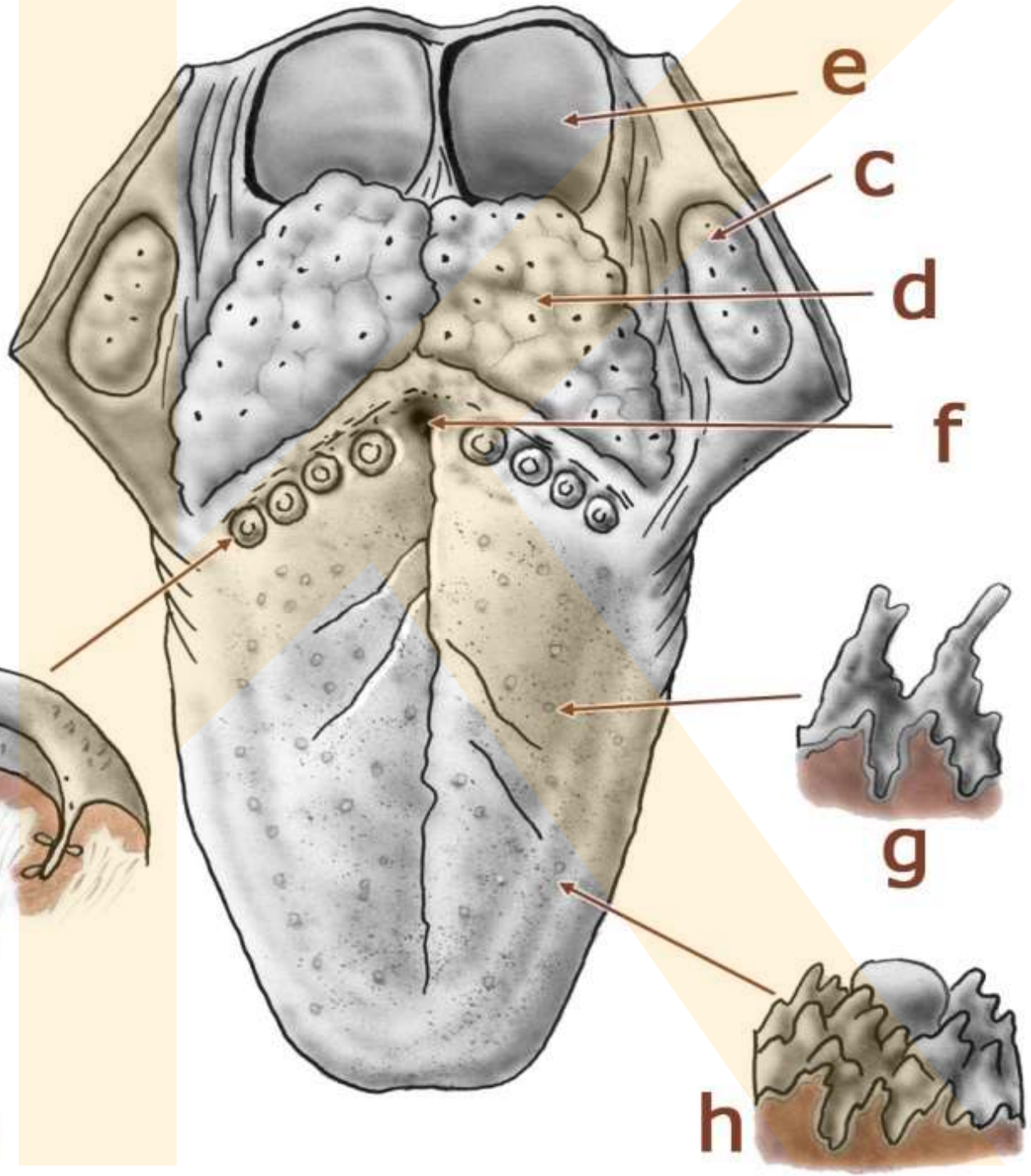
Forming words during speaking



Week 6 - 7

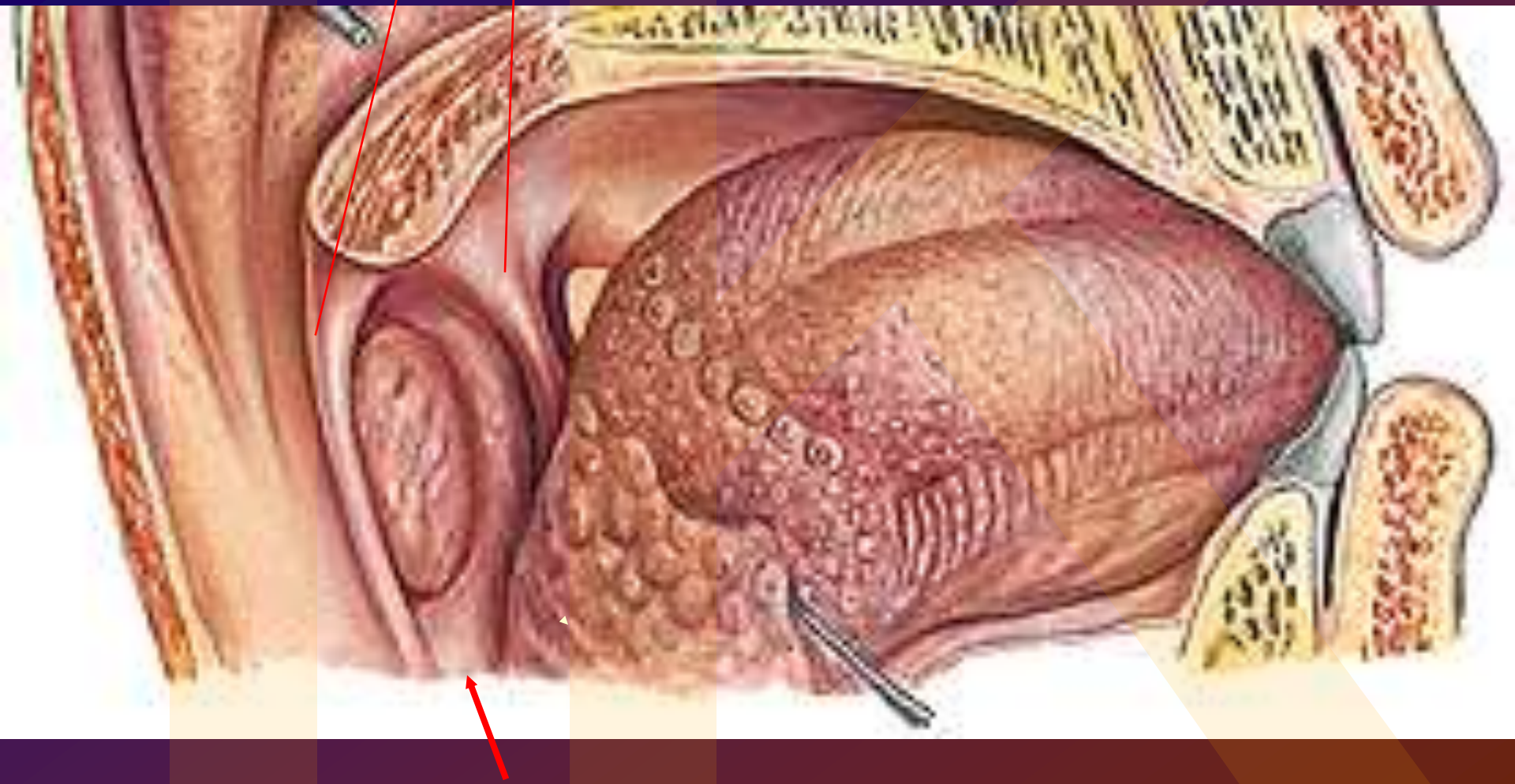
Papillae
filiformes
fungiformes
vallatae
Foliatae



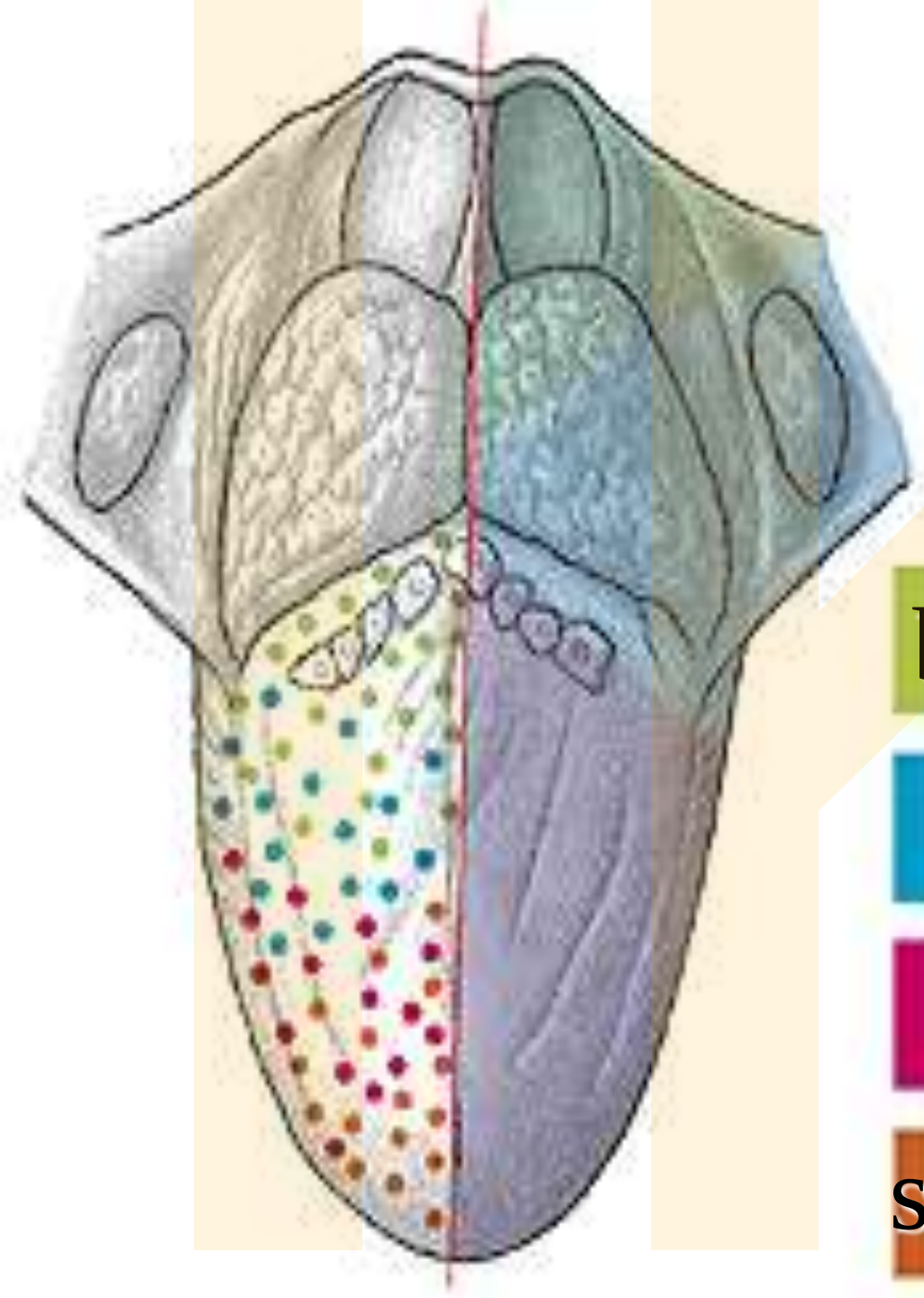


Palatoglossal arch

Palatopharyngeal arch



Triangular fold (plica) (there is r. tonsillaris)

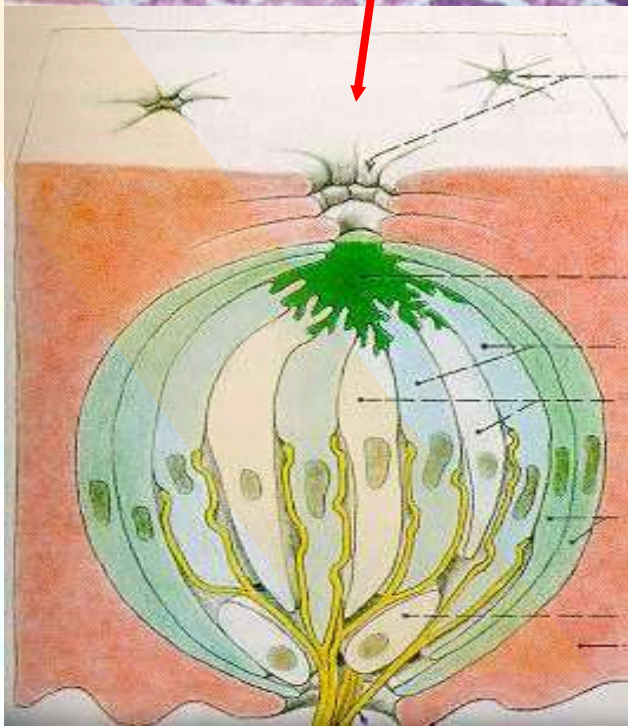


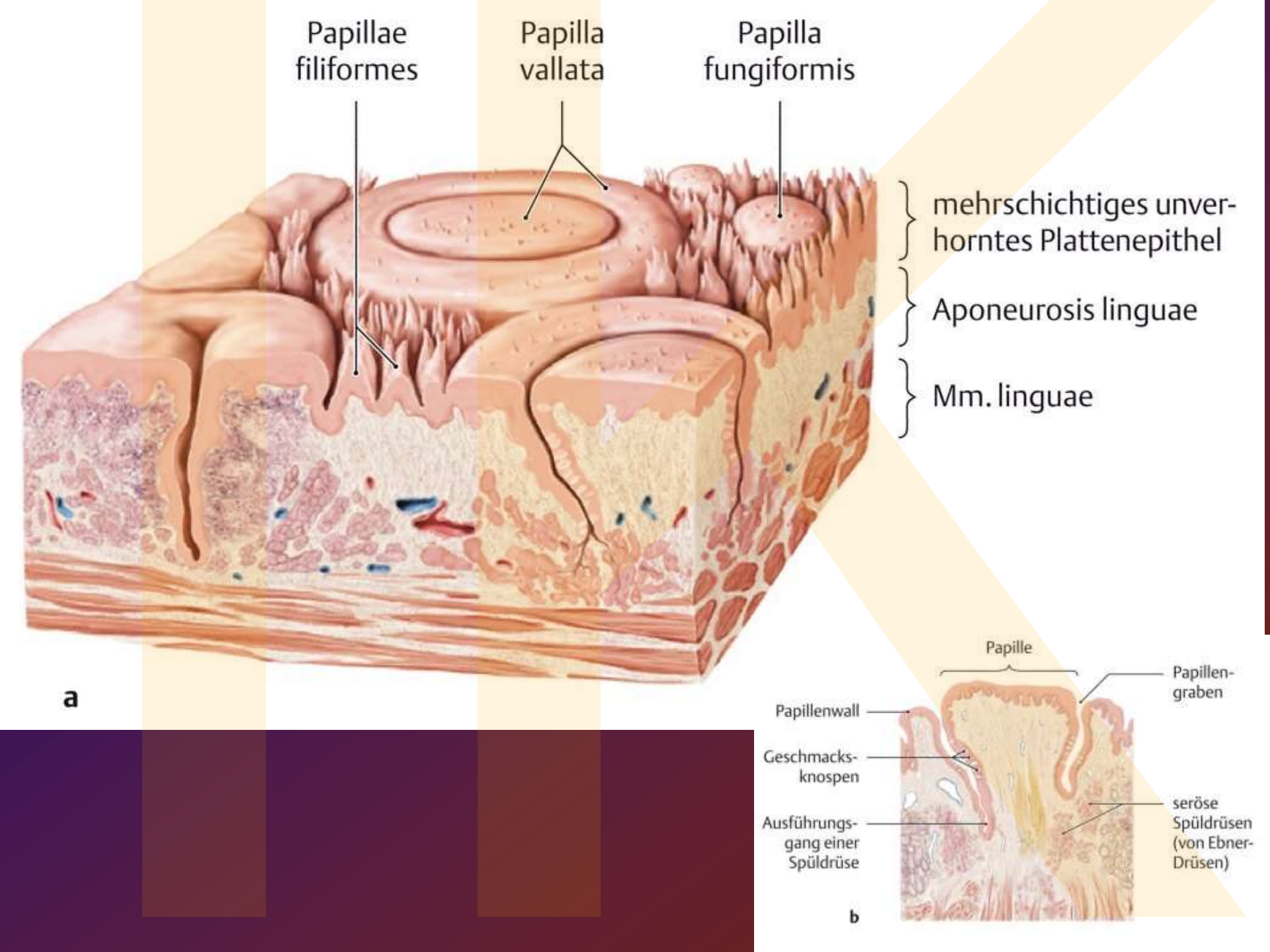
bitter

sour

salty

sweet




Papillae filiformes
Papilla vallata
Papilla fungiformis
mehrschichtiges unverhorntes Plattenepithel
Aponeurosis linguae
Mm. linguae
a
Papille
Papillenwall
Papillengraben
Geschmacksknospen
Ausführungsgang einer Spüldrüse
seröse Spüldrüsen (von Ebner-Drüsen)
b

Innervation

motor:

n. XII, (X m.palatoglossus)

sensitive

sensory

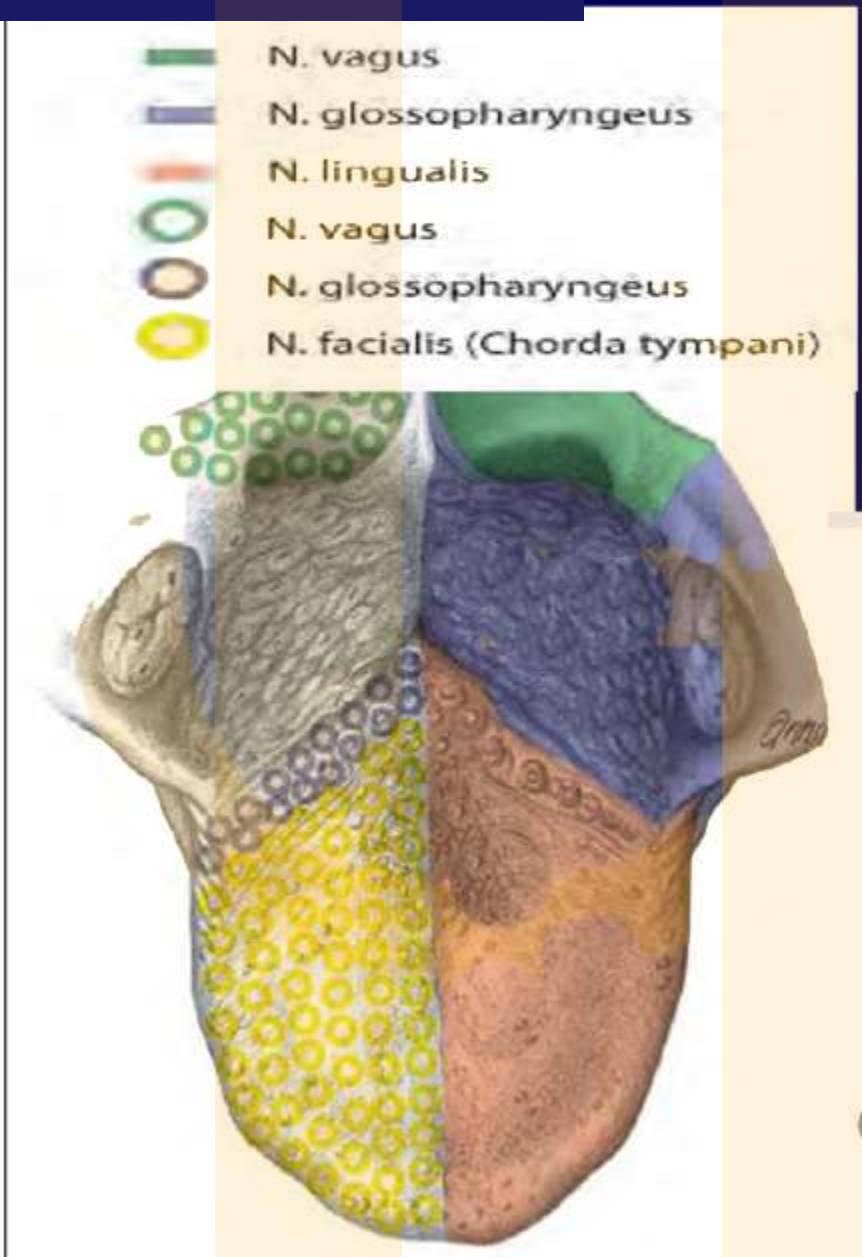
vegetative:

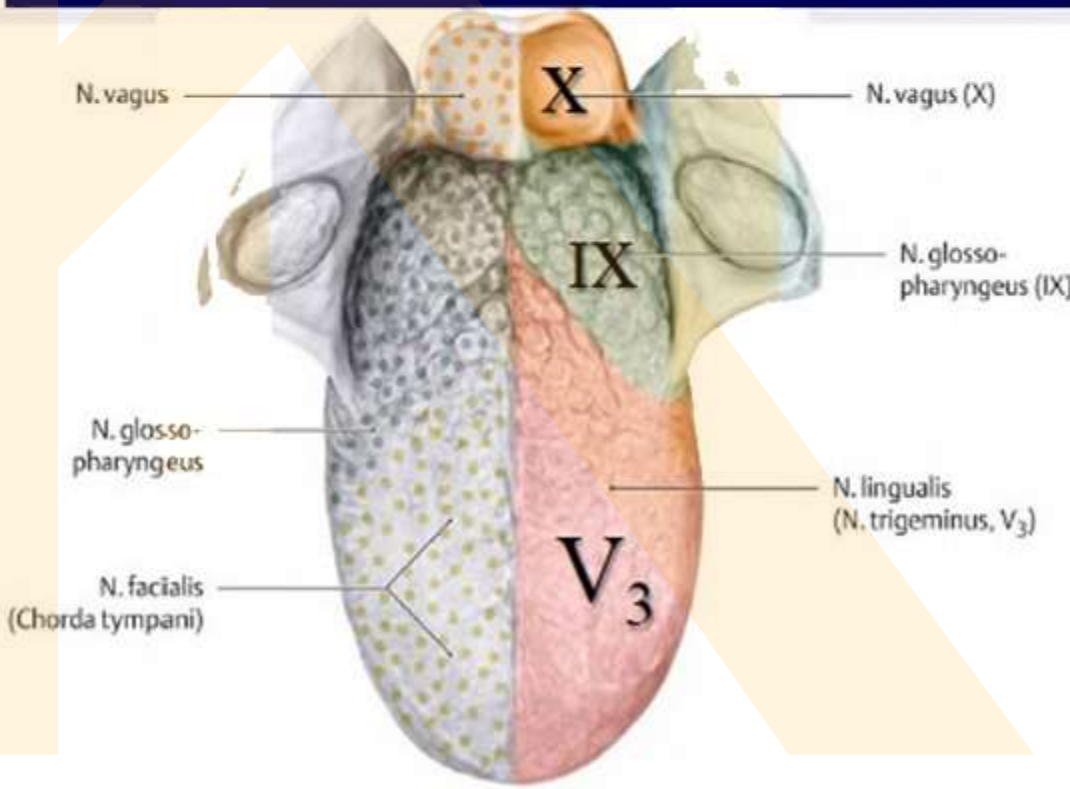
parasympathetic

ggl. submandibular

sympathetic

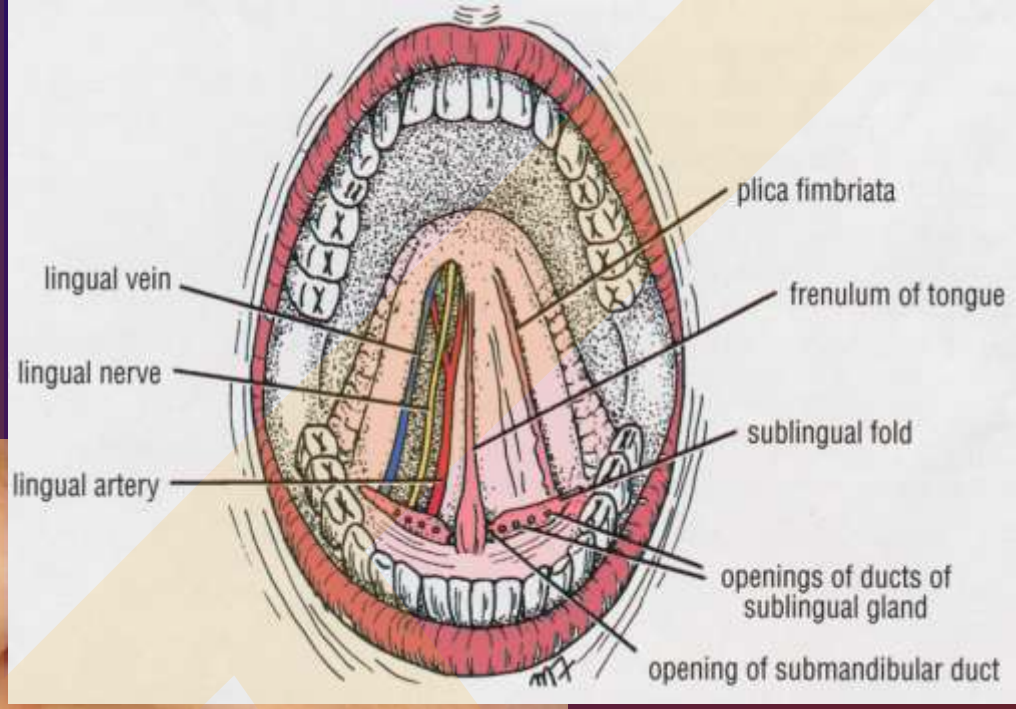
plexus lingualis

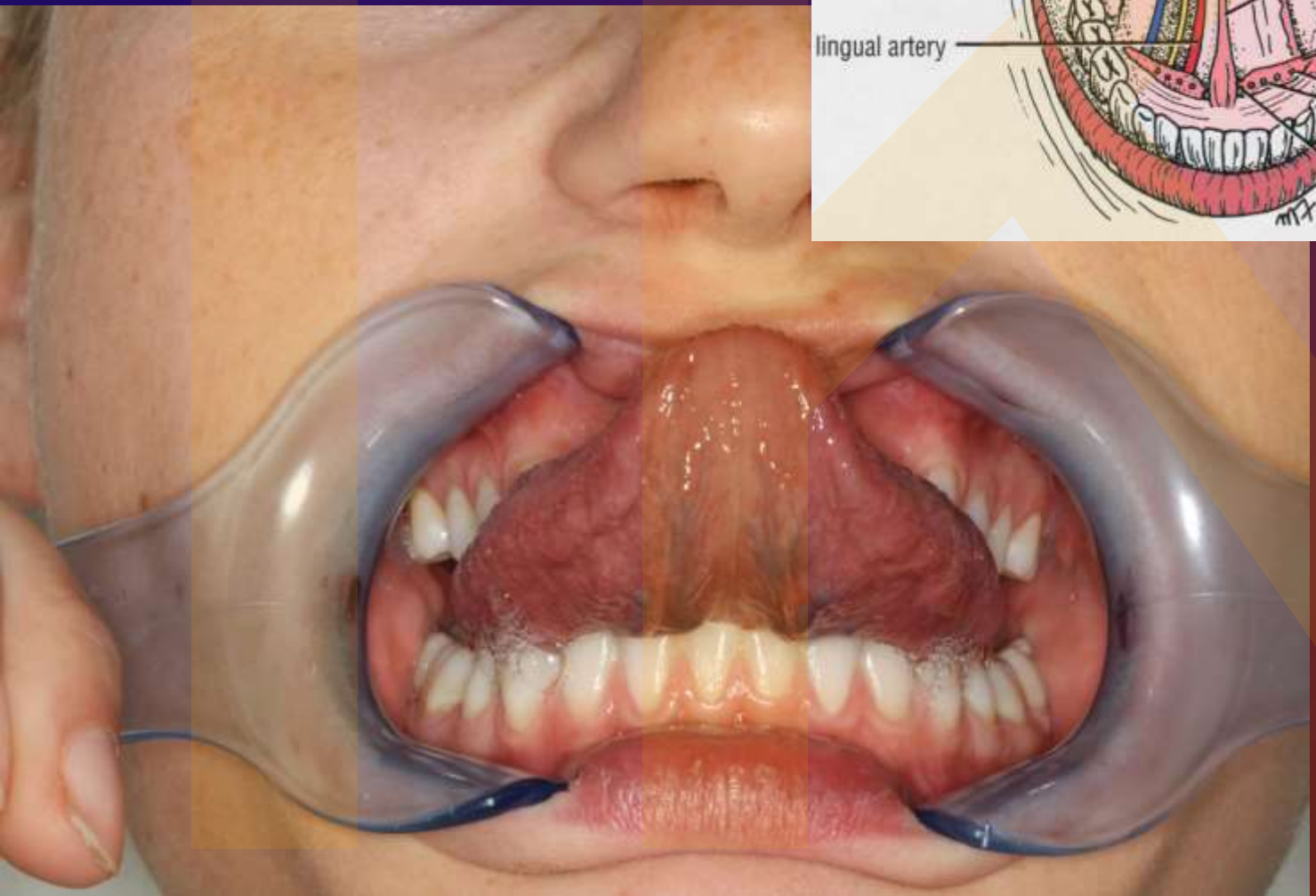




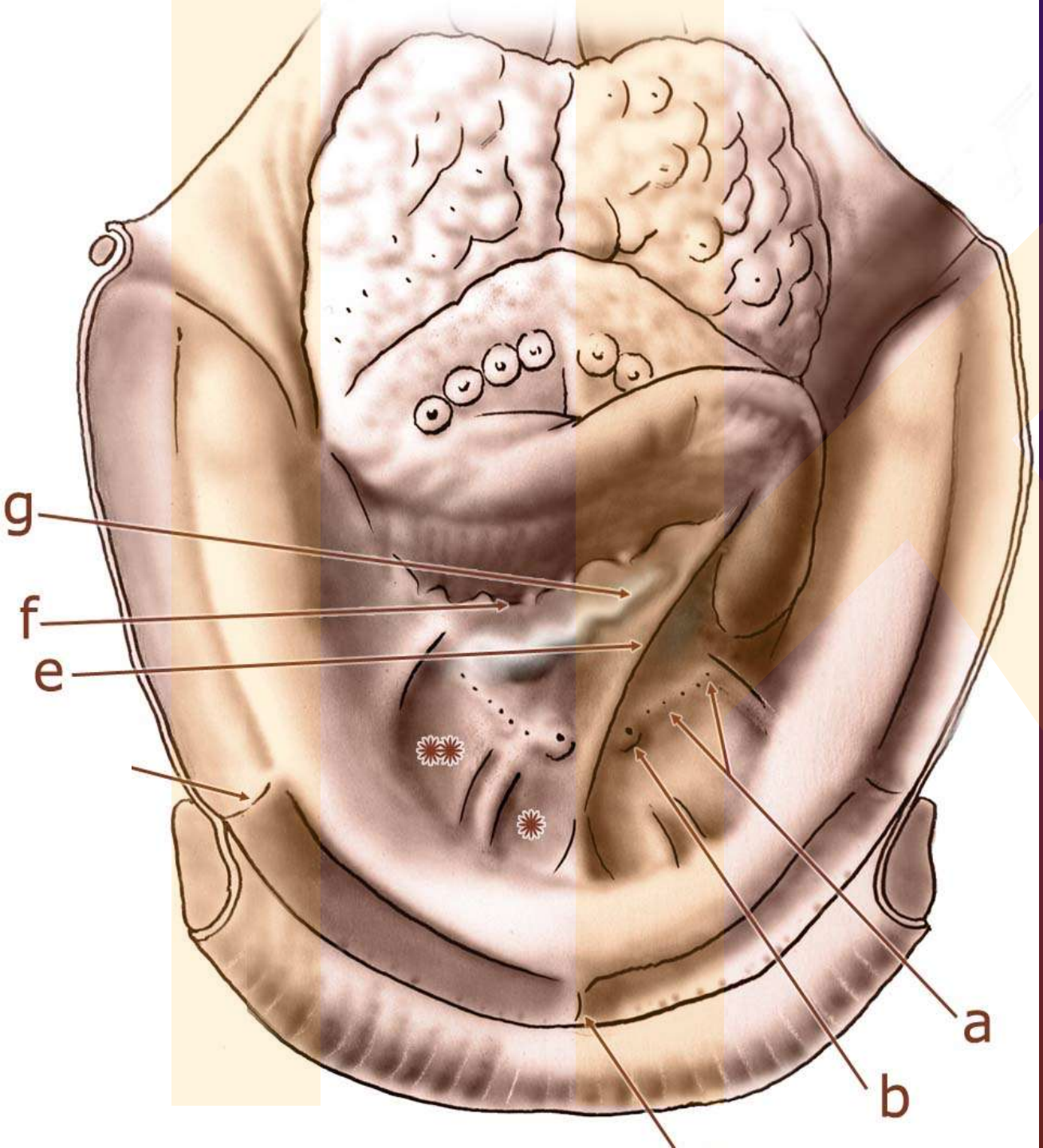
Floor of the oral cavity

lingual frenulum,
sublingual folds,
carunculae





Paralingual canal = between hyoglossus and genioglossus



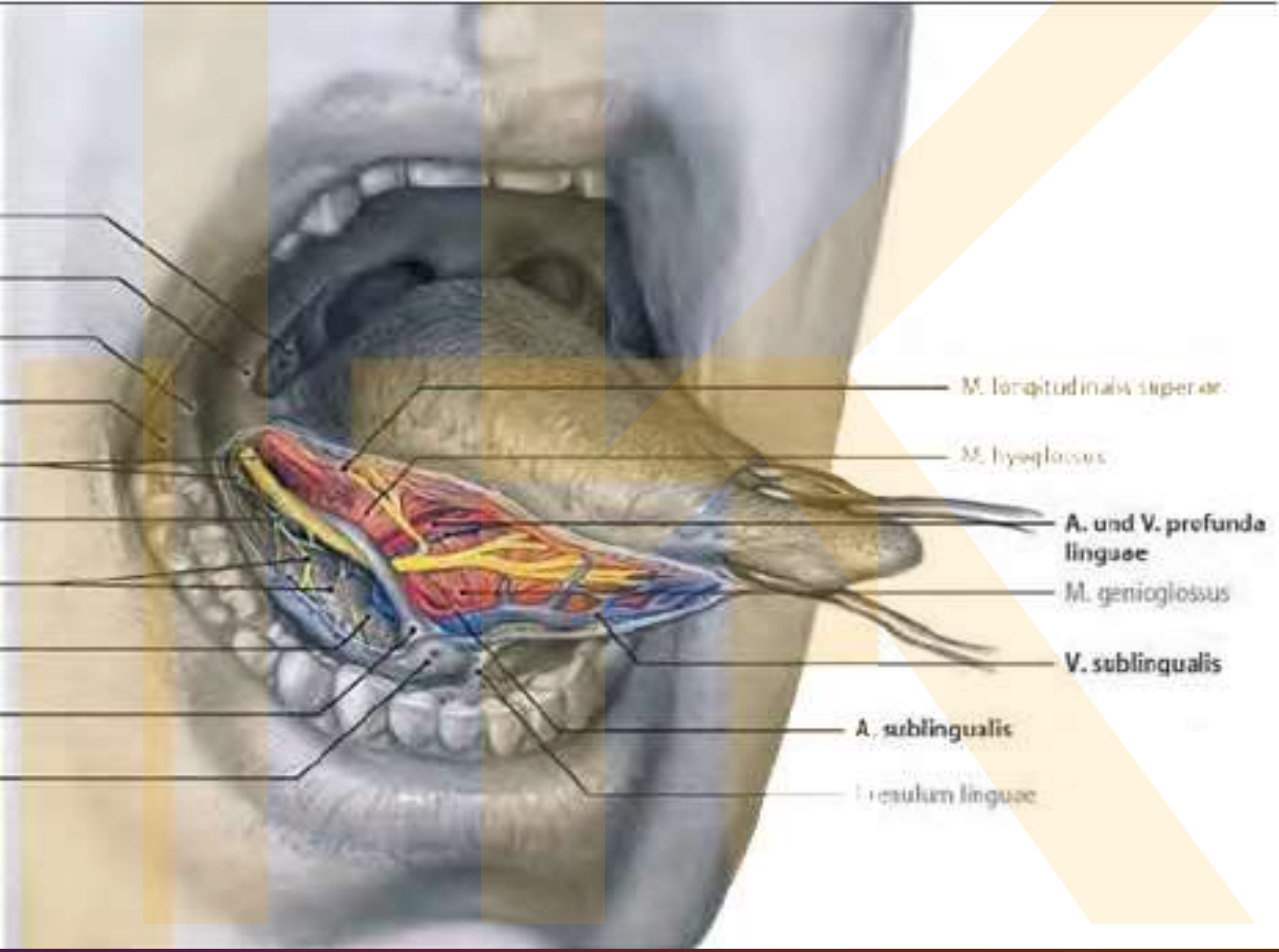
f – plica fimbriata

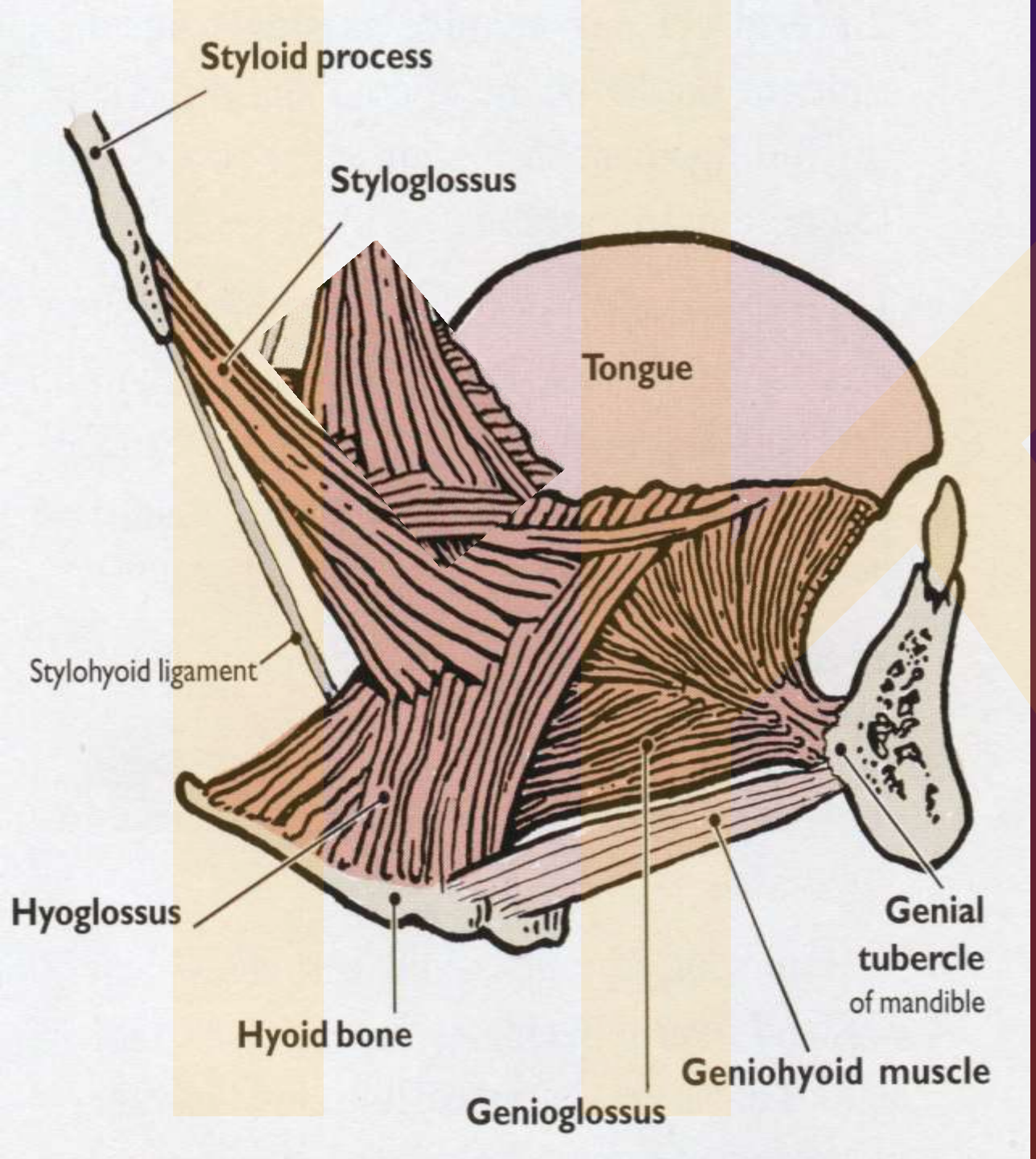
e – frenulum linguae

g – vena lingualis profunda

b – caruncula sublingualis

a – openings of the sublingual duct on plica sublingualis


M. longitudinalis superior
M. hyoglossus
A. und V. profunda linguae
M. genioglossus
V. sublingualis
A. sublingualis
Frenulum linguae



Extrinsic lingual muscles

alter the position of the tongue

Styloglossus
Palatoglossus

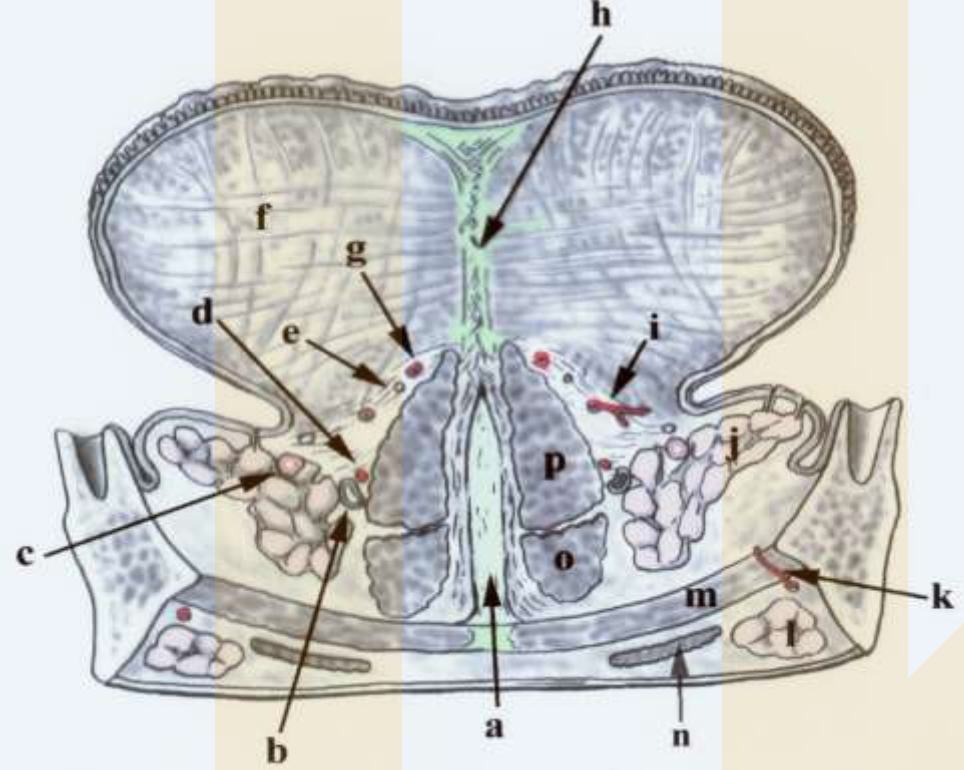
Hyoglossus
Genioglossus

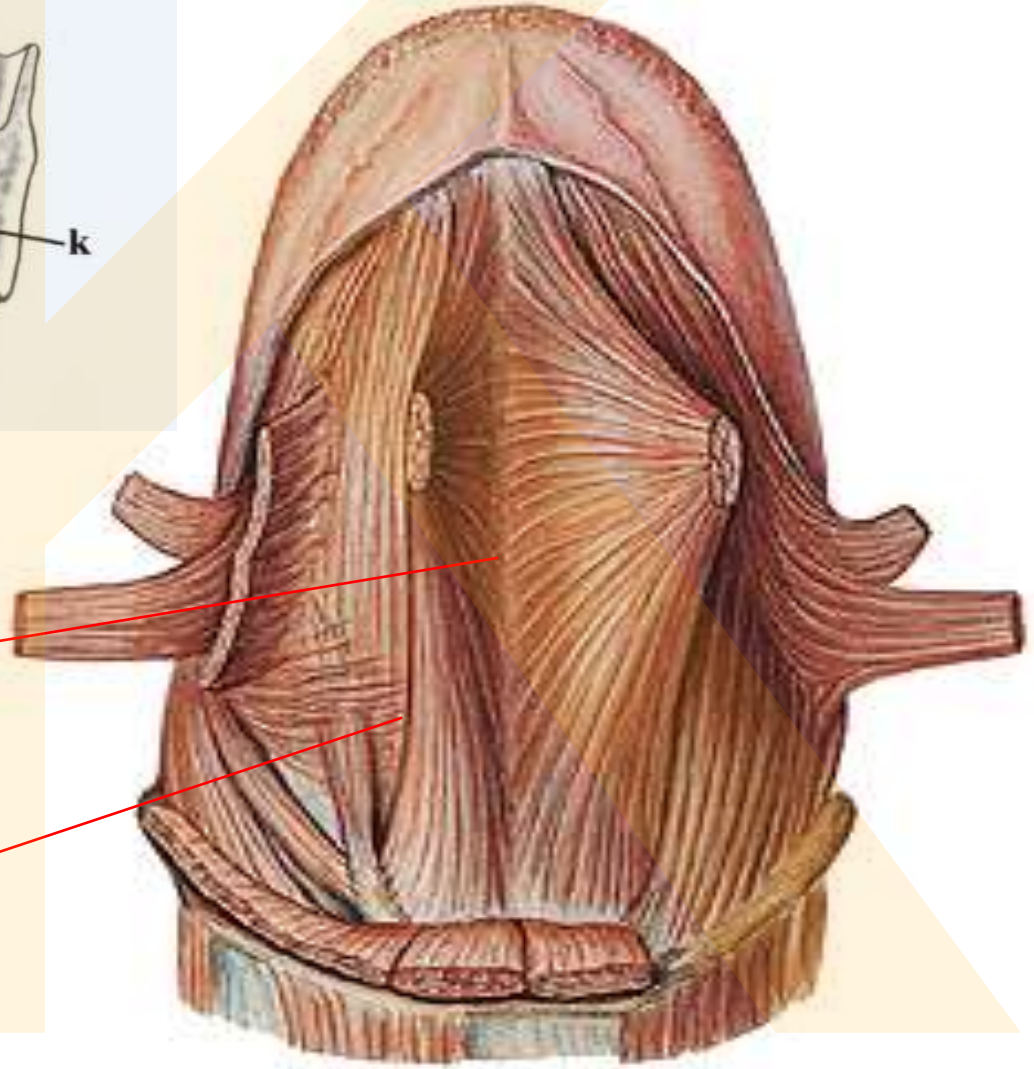
Intrinsic lingual muscles

alter lingual shape

Superior and inferior longitudinal, transverse, vertical muscles

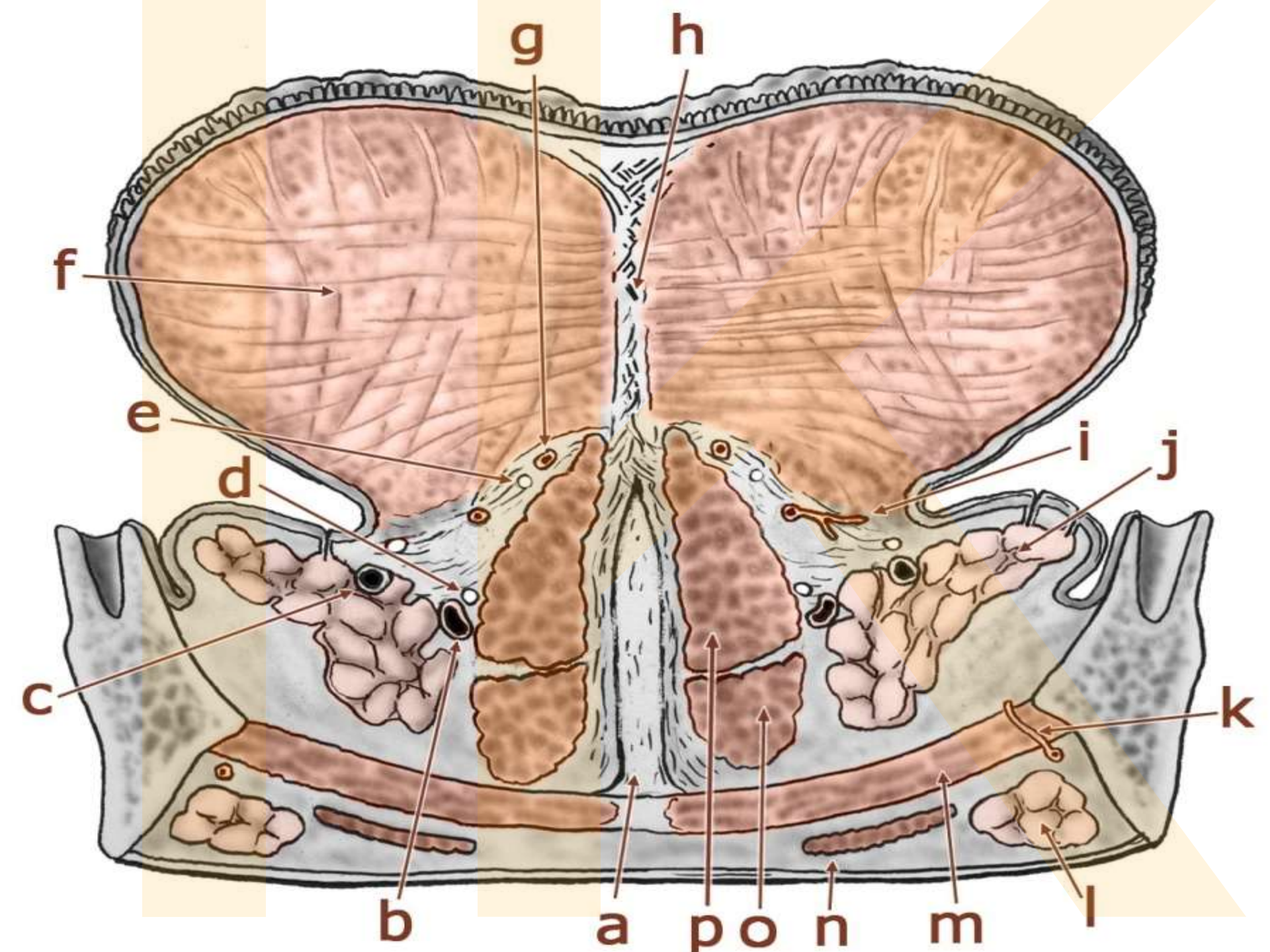
Lingual septum can be defibered;
after this abscess cavity appears





Musculi genioglossi are separated by the lingual septum

Between hyoglossus and genioglossus muscles there is lingual canal


g
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j
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m
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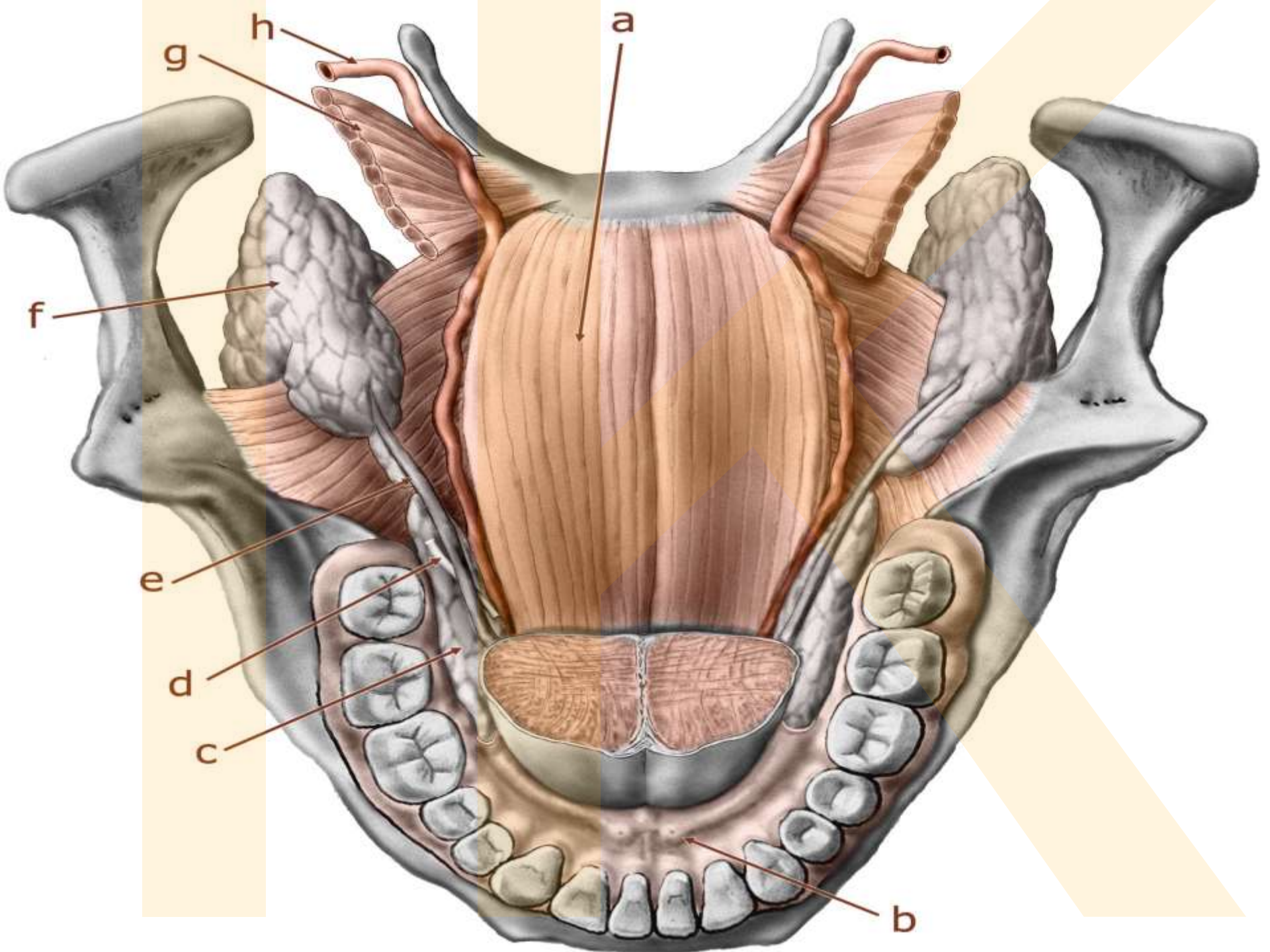
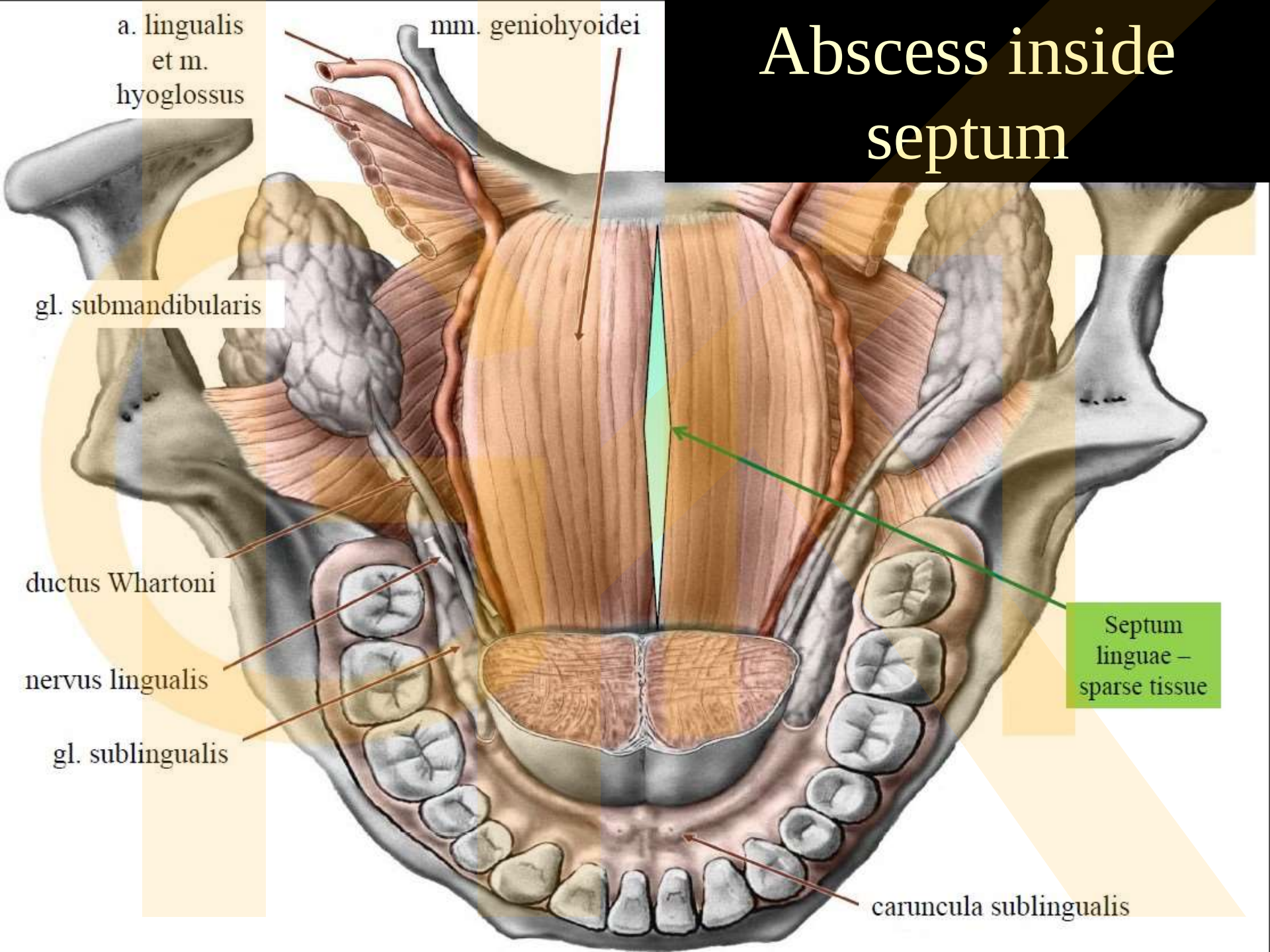
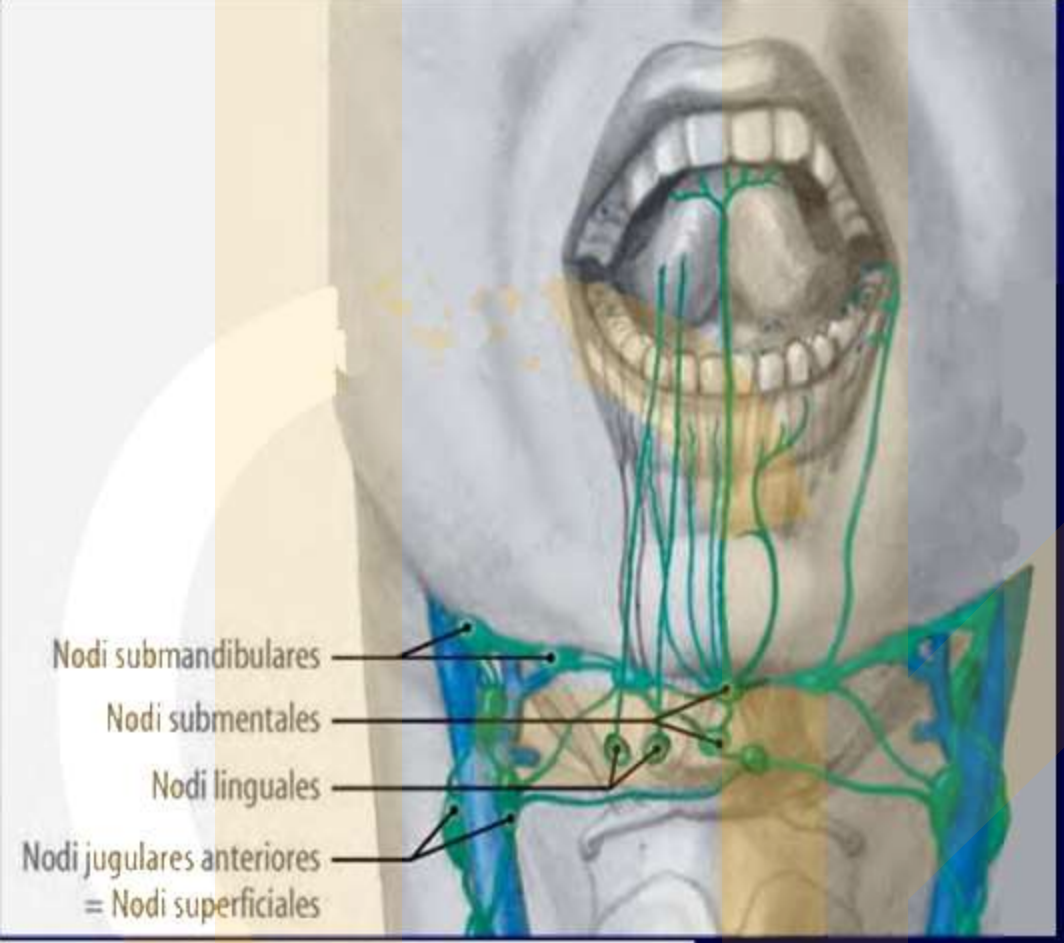
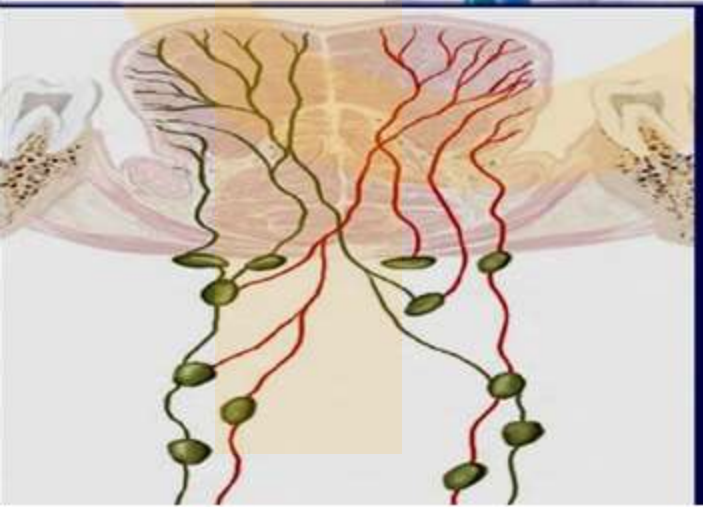

h
g
a
f
e
d
c
b

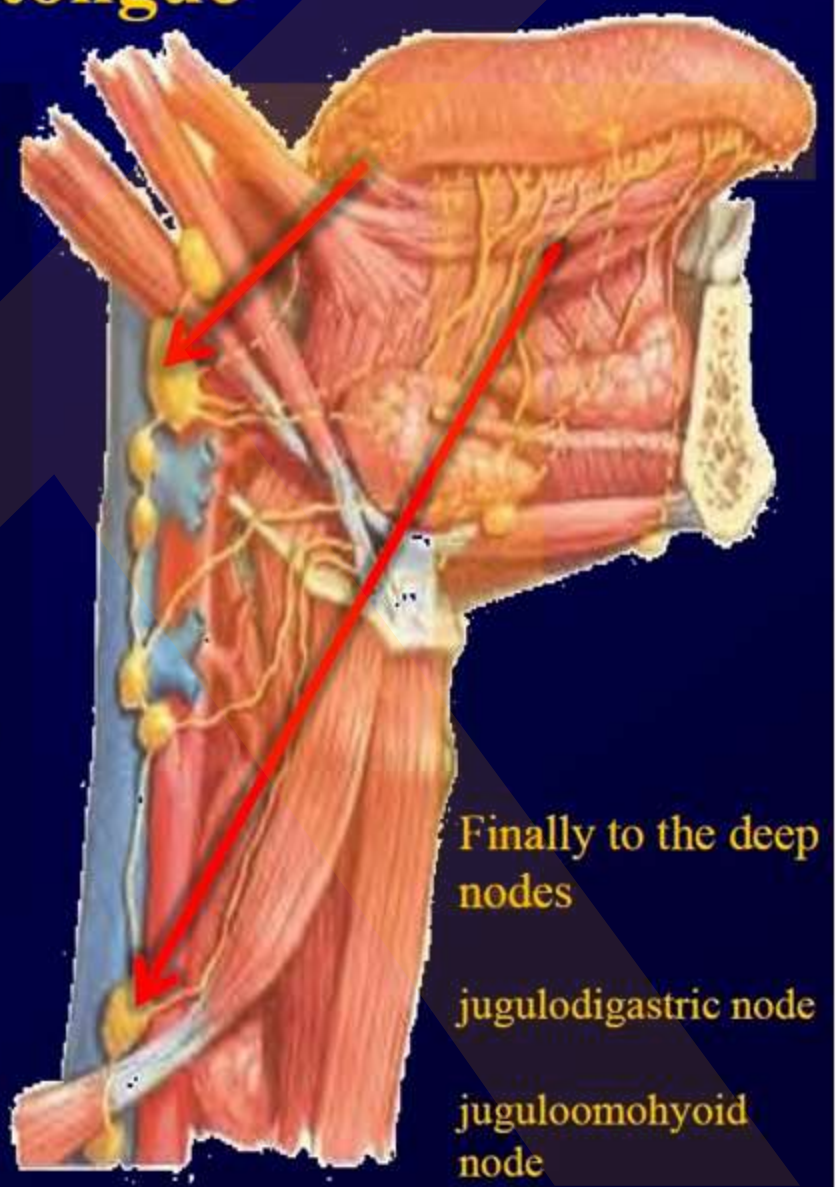
Abscess inside septum



Lymph outflow from tongue







Finally to the deep nodes

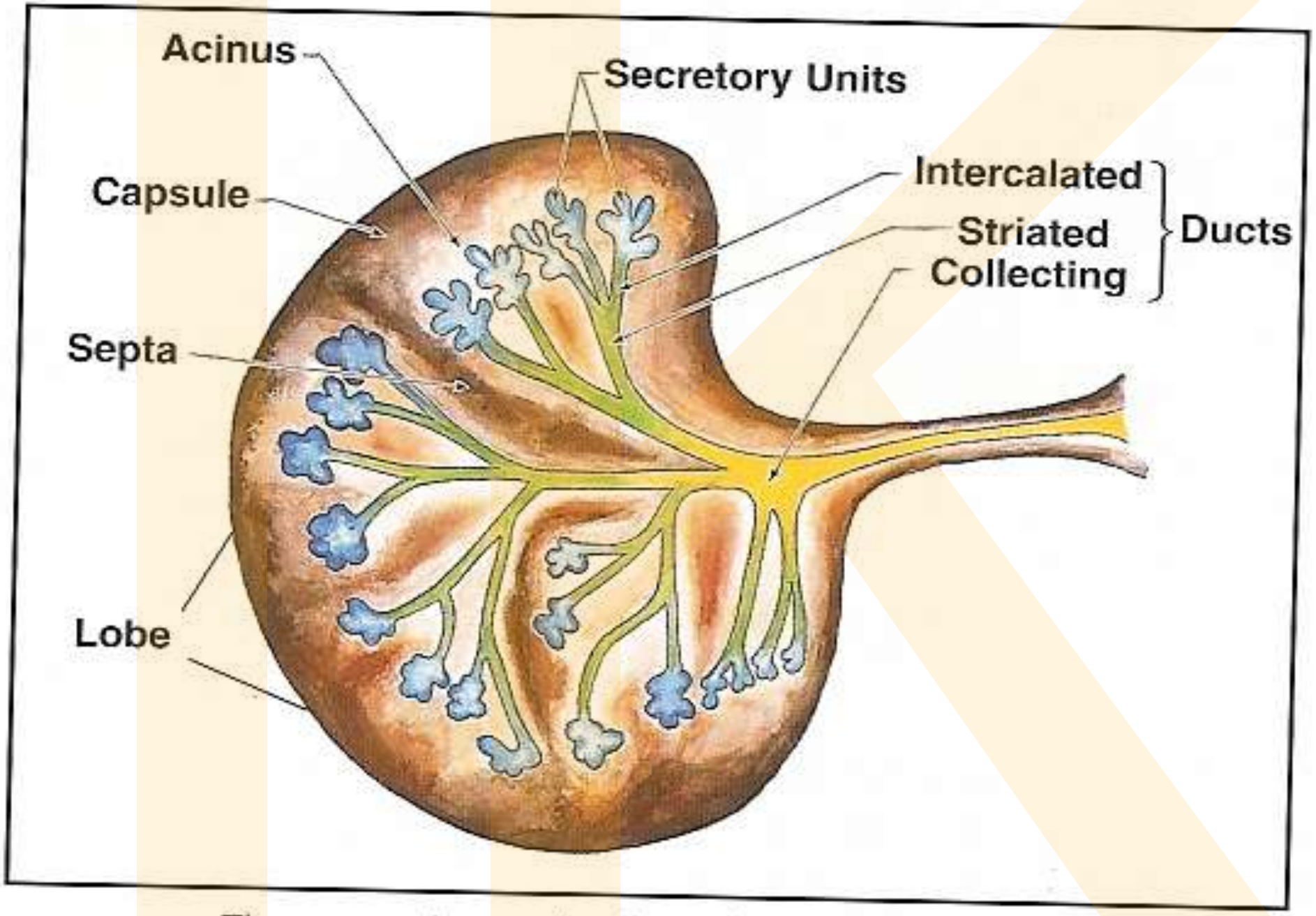
jugulodigastric node

juguloomohyoid node

Glandulae oris

- glandulae salivariae majores
  - **gl. parotis**
  - **gl. sublingualis**
  - **gl. submandibularis**
- glandulae salivariae minores - labiales, buccales, molares, palatinae, linguales */Nuhnil/*

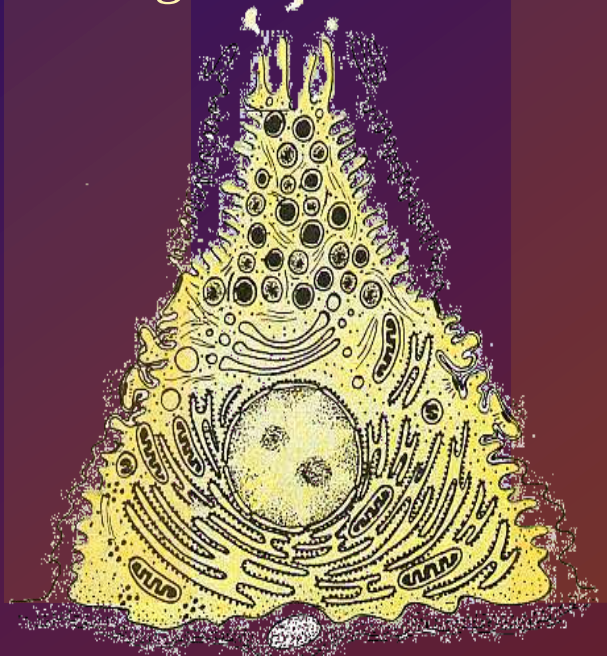
- Surrounded by capsules (dense connective tissue) → septae
  - Secretory part – serous and mucinous cells, myoepithelial (basket) cells
  - Glandular ducts



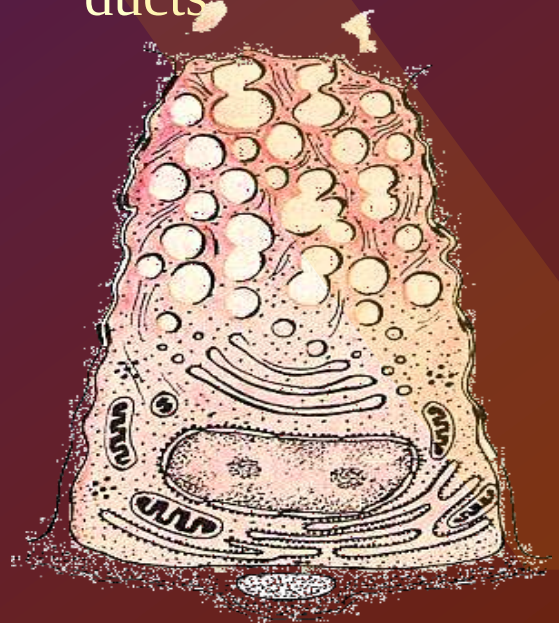
The general organisation of a salivary gland.

Salivary glands

- Serous cells
  - pyramidal, acinous,
  - Secerned proteins
  - bazofilic, ↑ER, GA
  - Apically have microvili, secretory granula

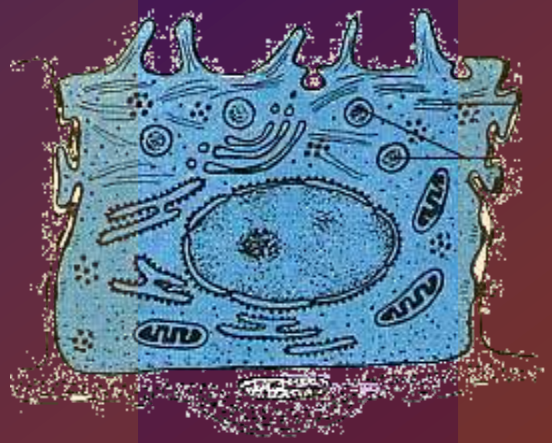


- Mucinous cells
  - Cuboidal, cylindric, form tubules
  - Secerned mucus → pale granula (fused)
  - Viscous secret ⇒ distally located inside ducts



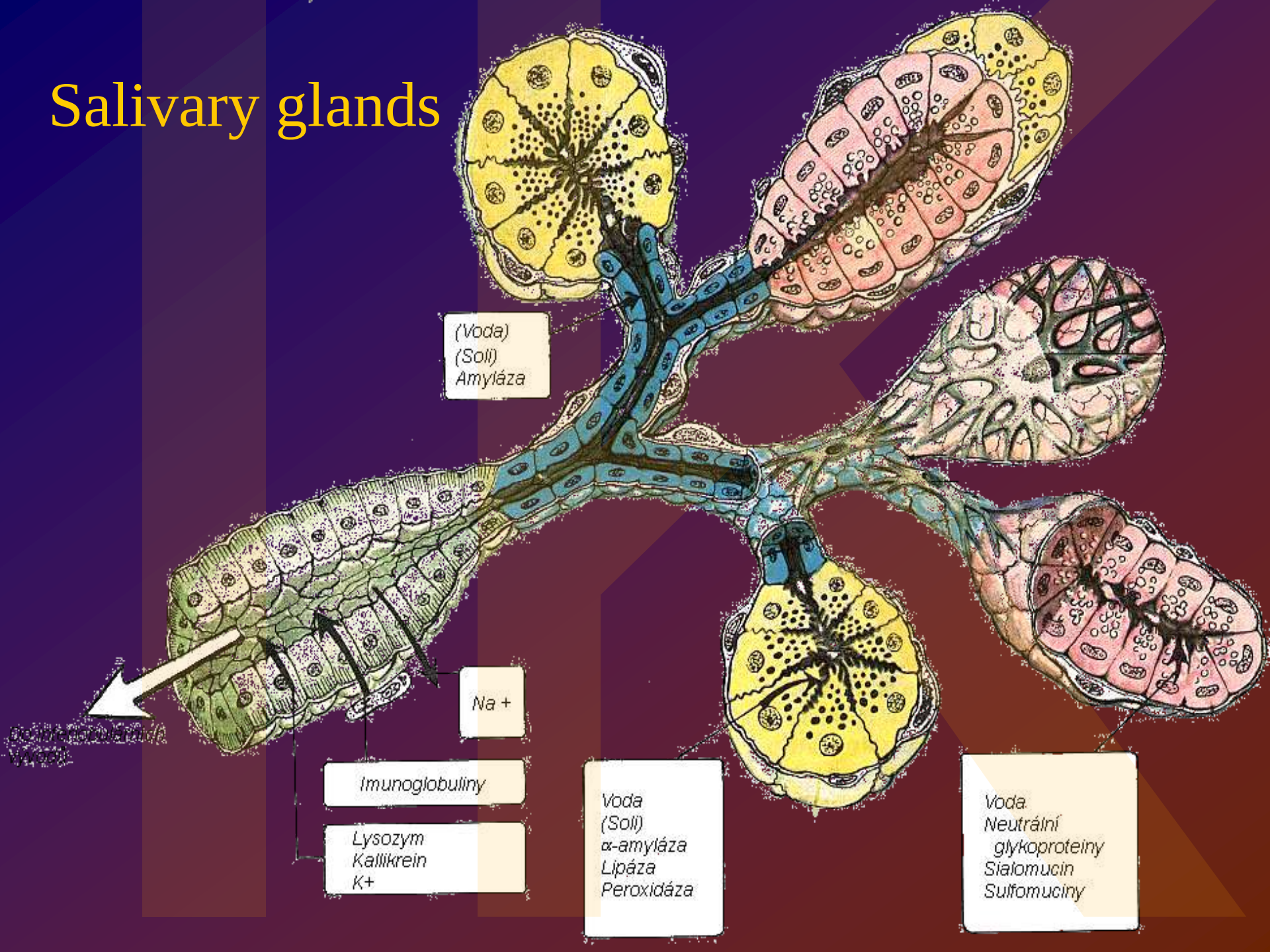
Salivary glands

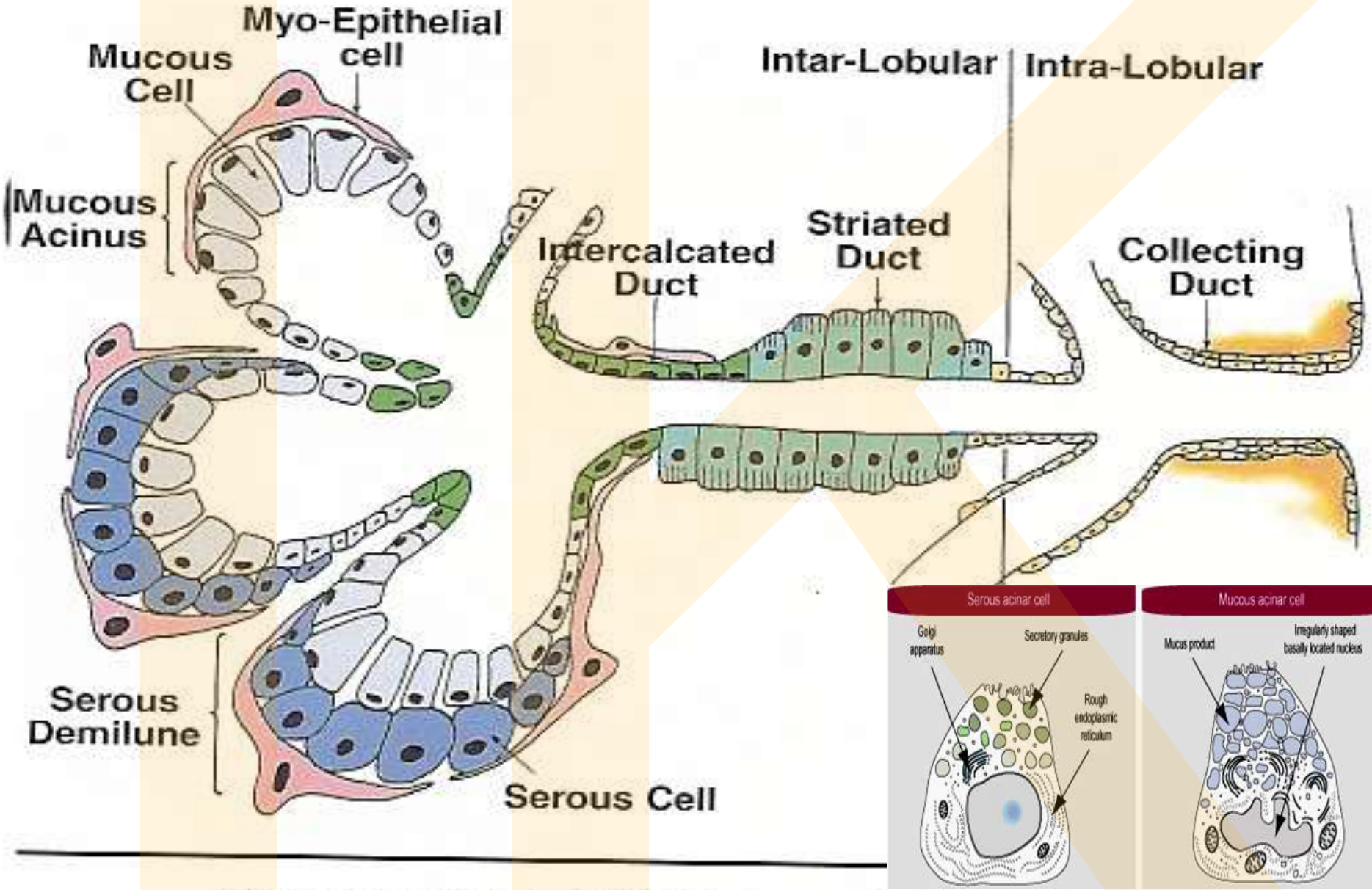
- Cells of intercalate ducts
  - One-layered epithelium (flat)
  - Lactoferin,, lysozymes
  - Intralobular ducts



- Cells of striateed ducts
  - Radially organised, waved, transport ionts and participate in formation of hypotonic saliva

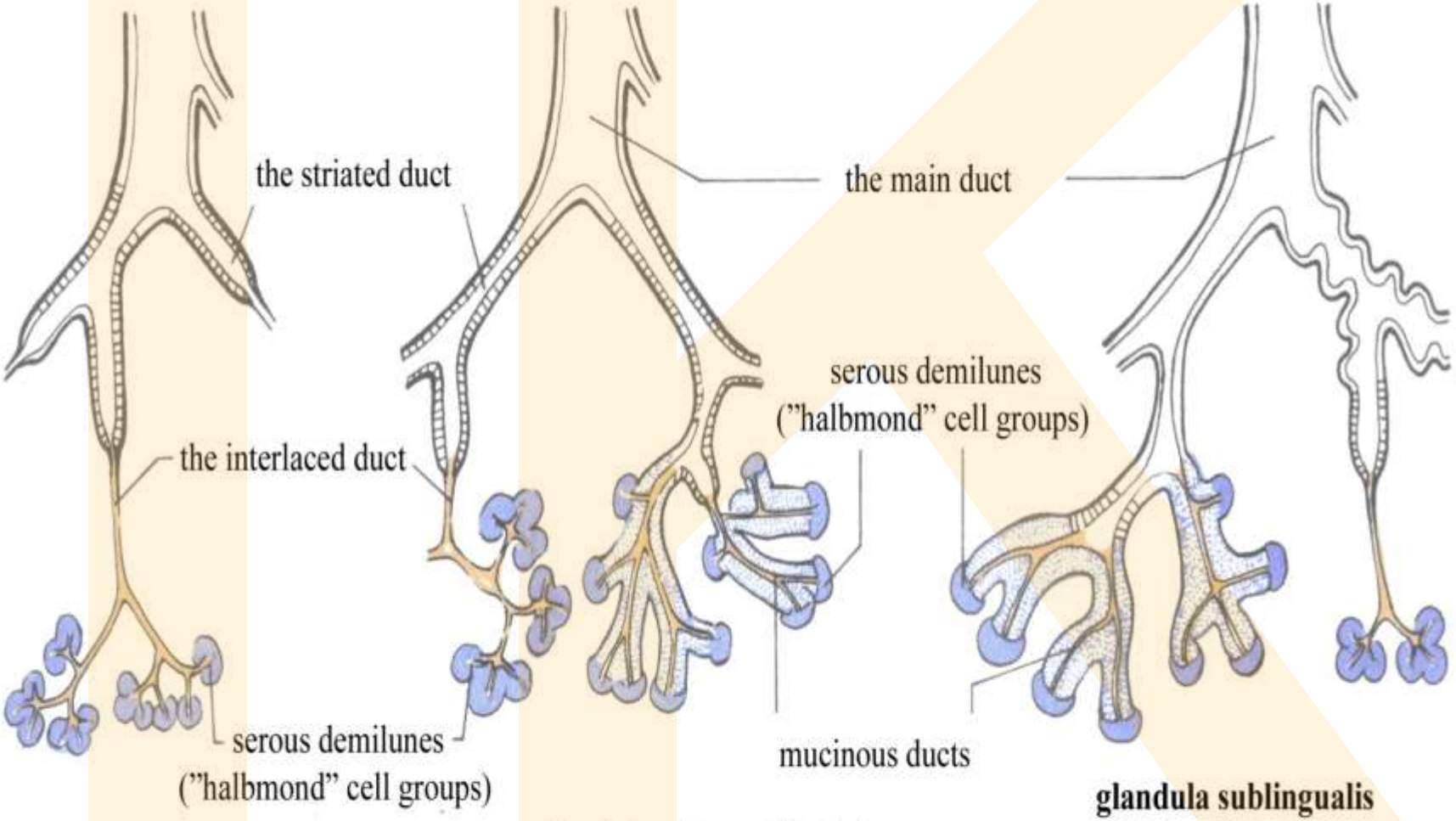
Salivary glands





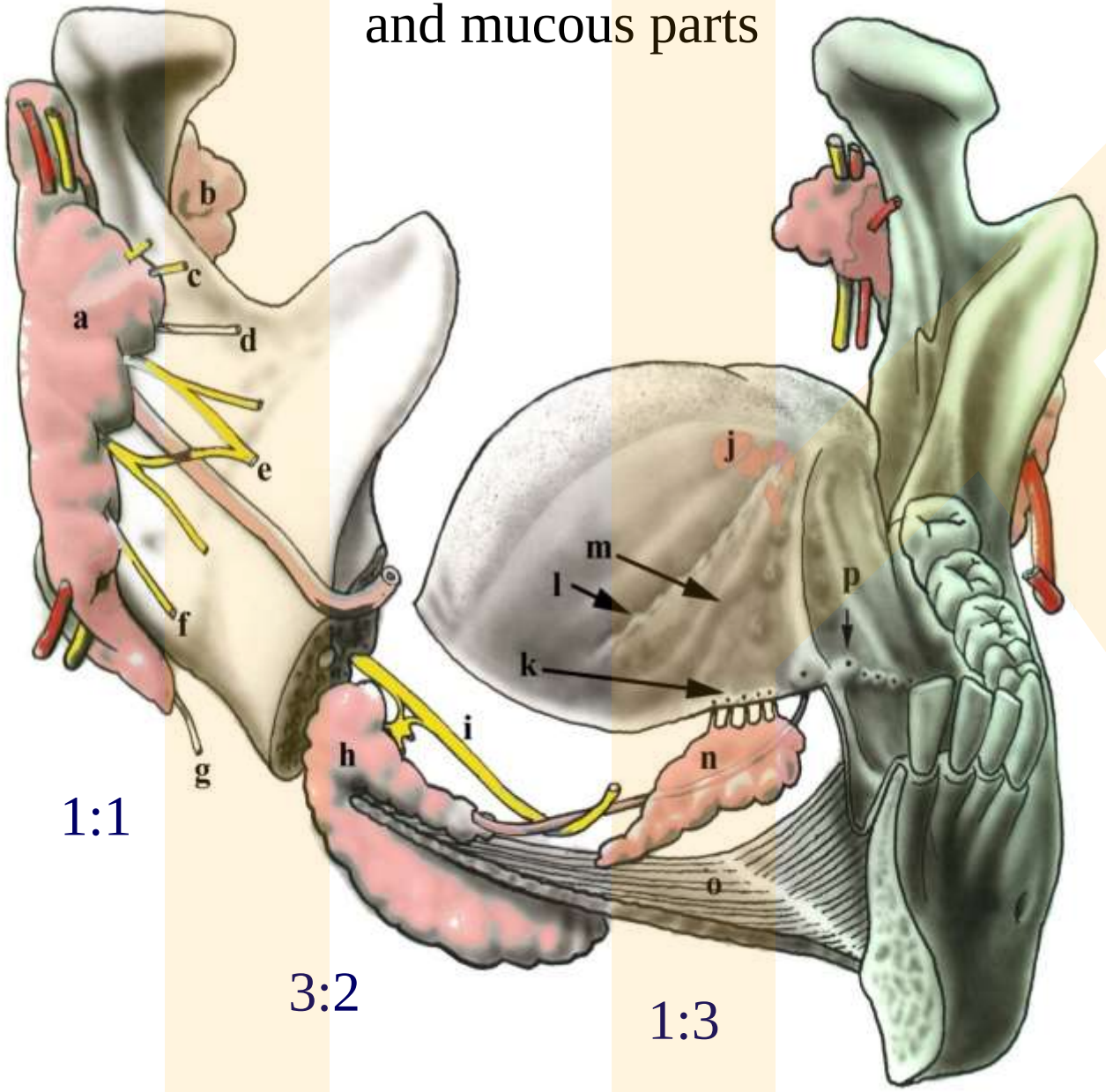
The secretory and ductal elements in a mixed salivary gland. However, as discussed later, the serous demilunes are artefacts of preparation.

Structure of the salivary glands - scheme



after Schumacher 2002

Relation between serous and mucous parts



1:1

3:2

1:3

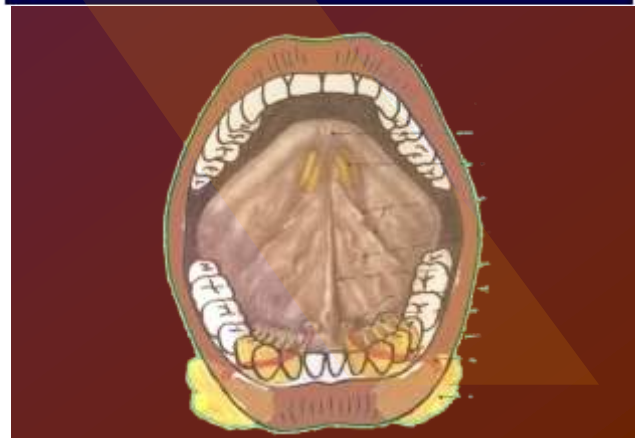
Glandula parotidea

Sublingualis

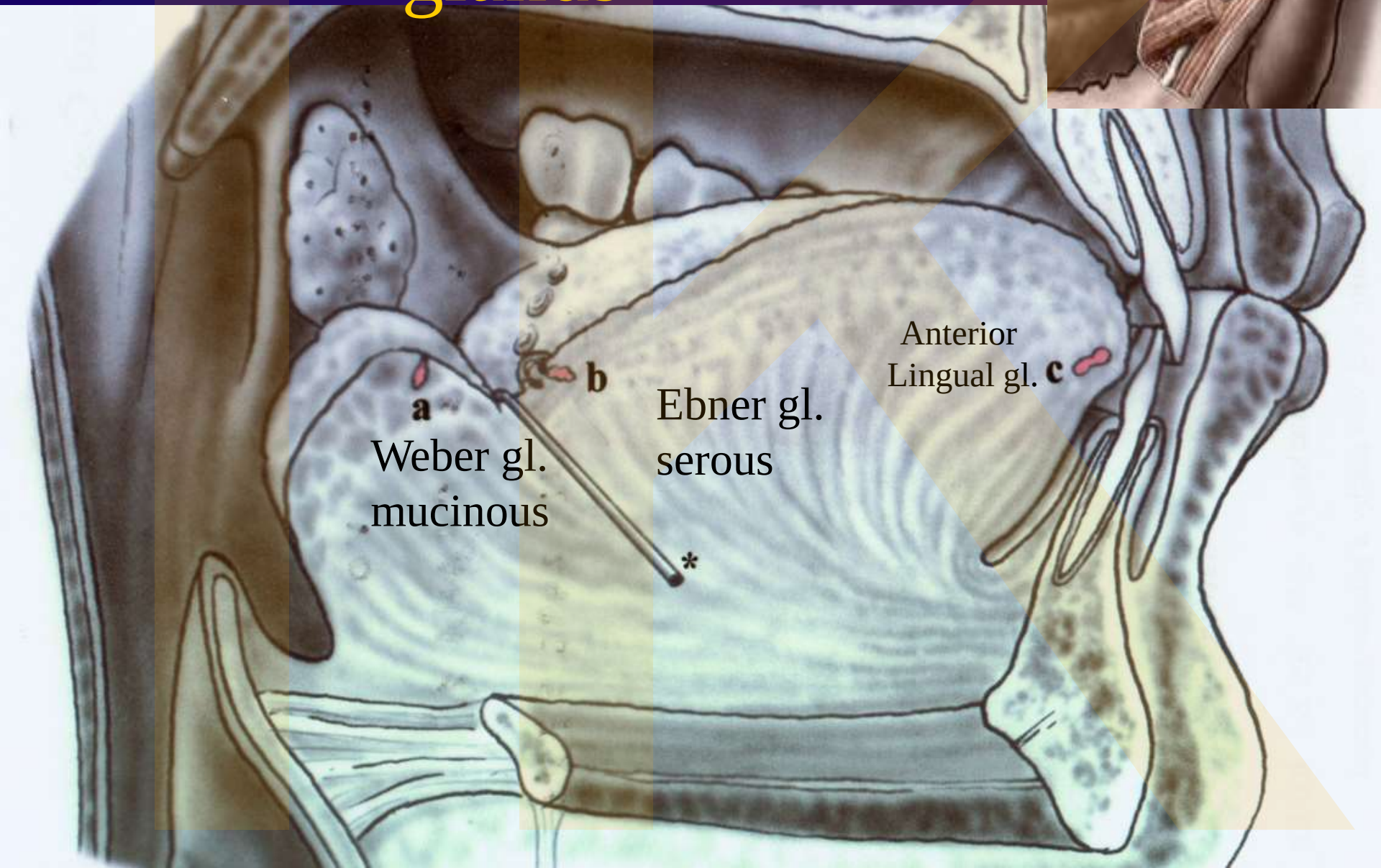
Sublingualis anterior

Submandibularis

Lingual nerve crosses submandibular duct in the level of dorsal margine of mylohyoid muscle



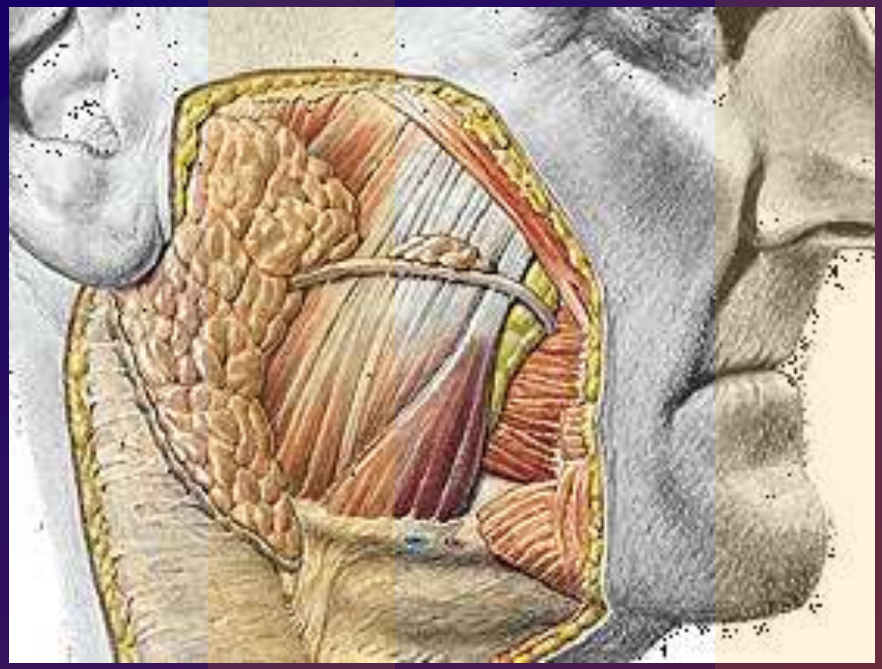
Mucous and serous small glands

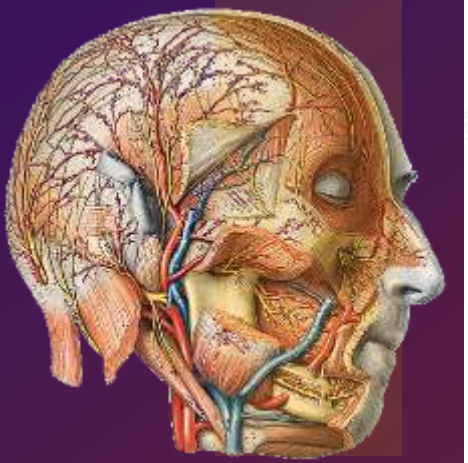


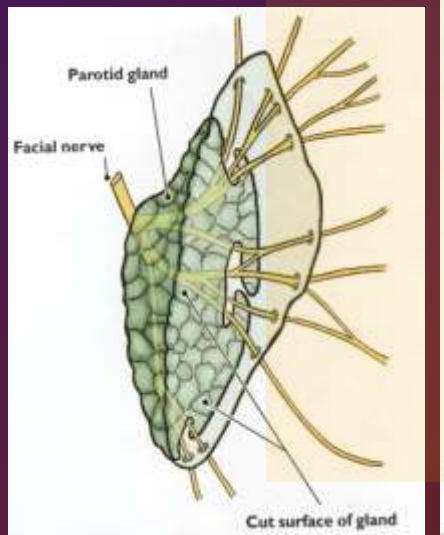
Glandula parotis

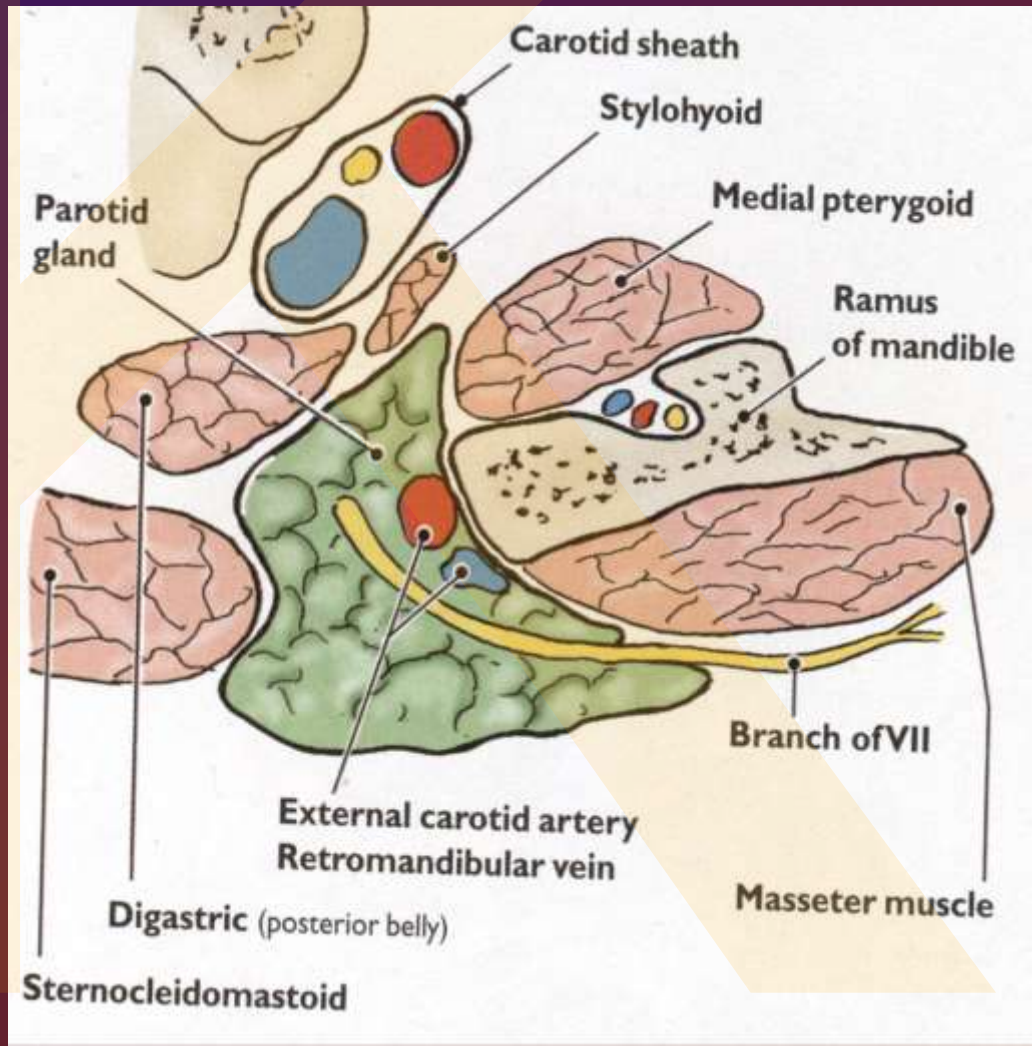
Superficial part
Deep part (processus pharyngeus

Serous tissue
Ductus parotideus (of Stensen)

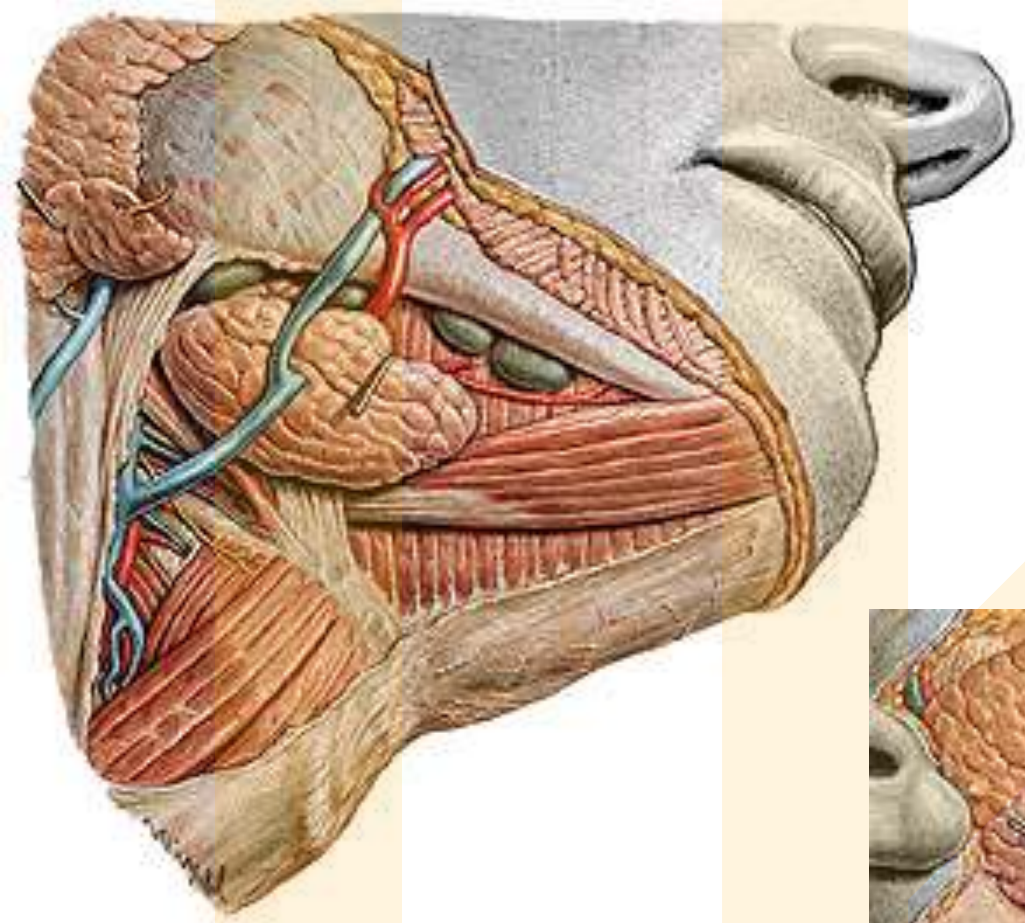


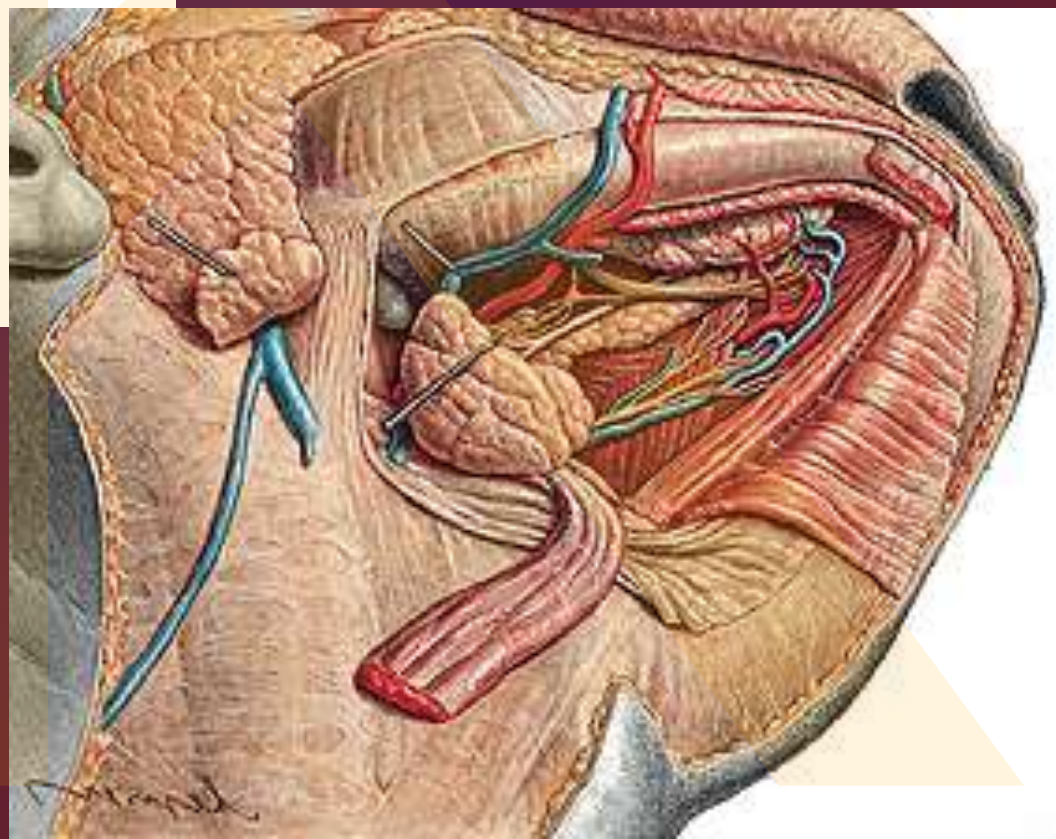






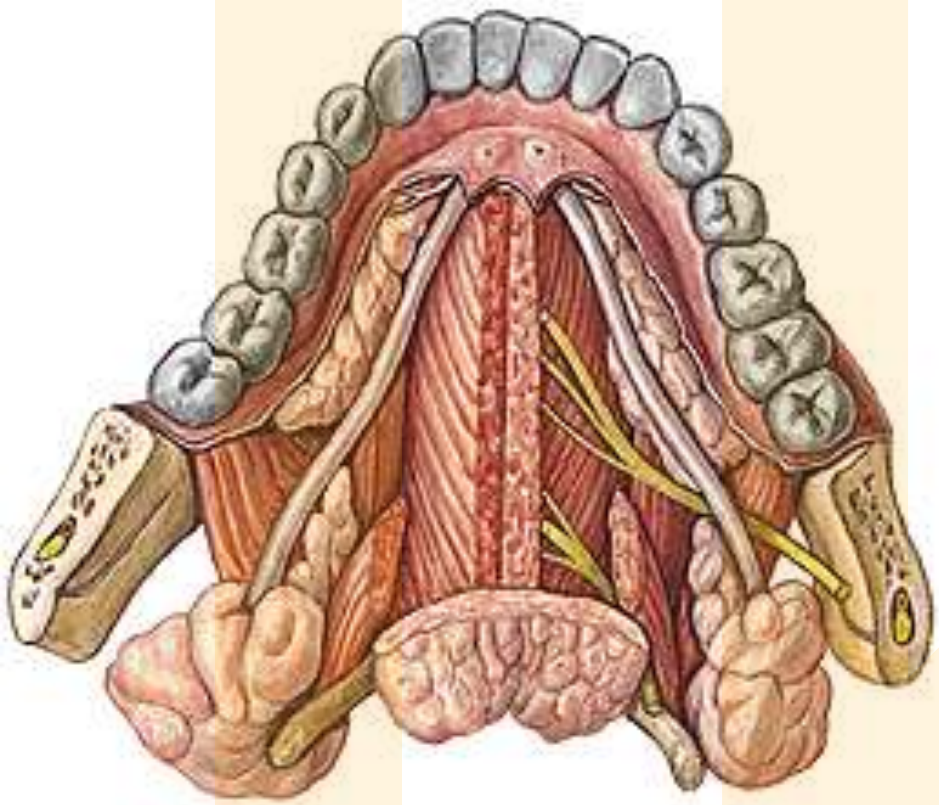
Glandula submandibularis

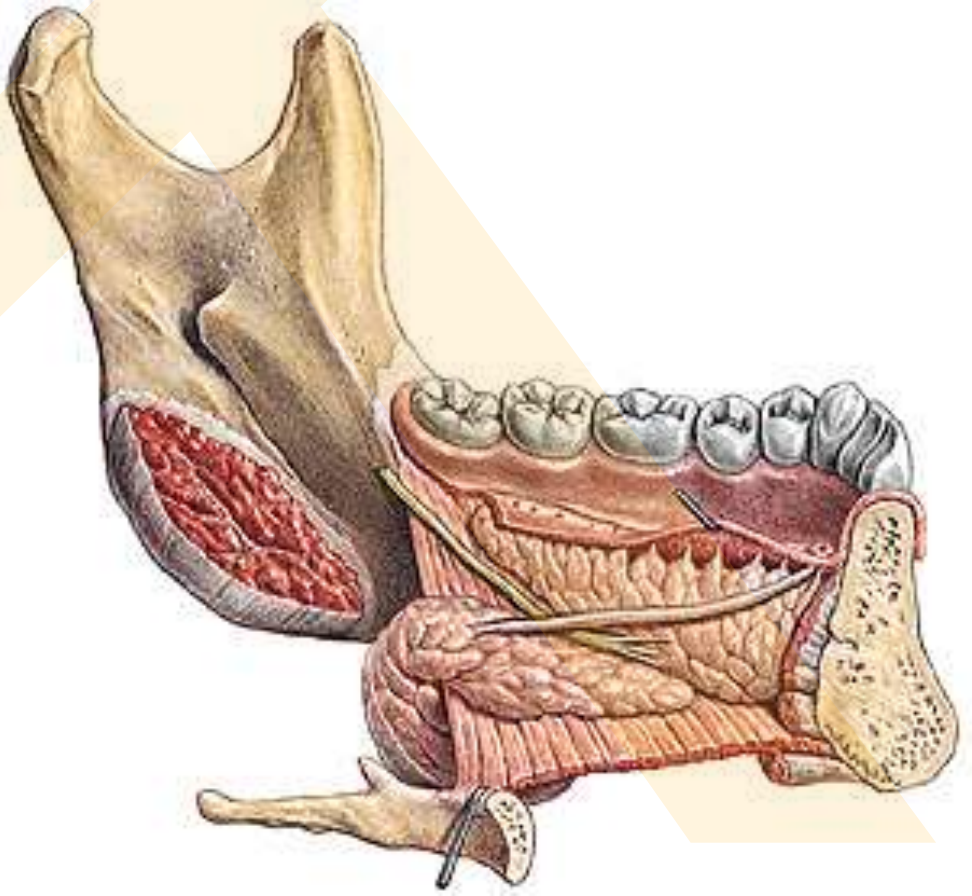




mucoserous tissue
Ductus submandibularis (of Wharton)

Glandula sublingualis

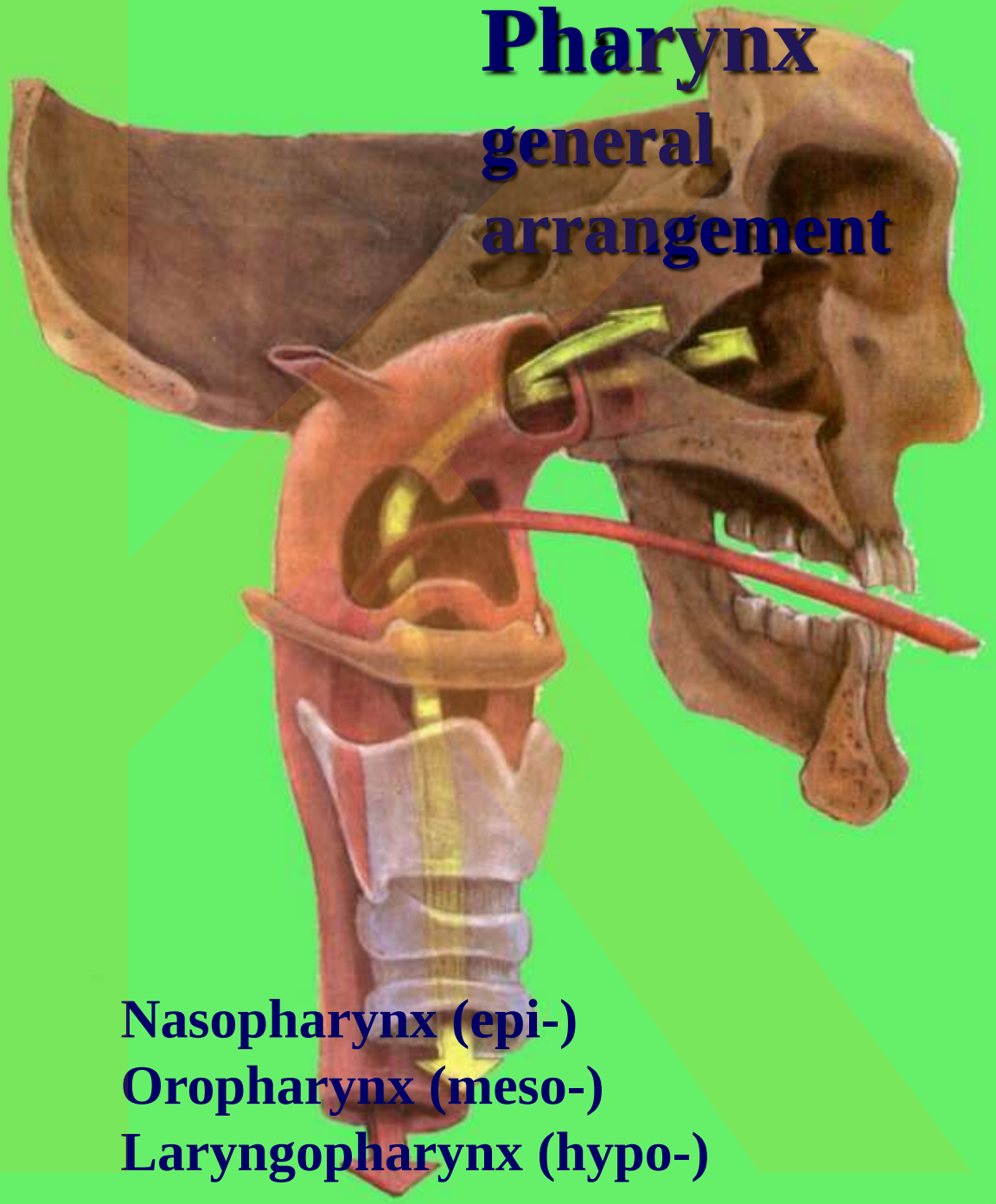




Seromucinous tissue
Ductus sublingualis major et minores (of Santorini)

Pharynx

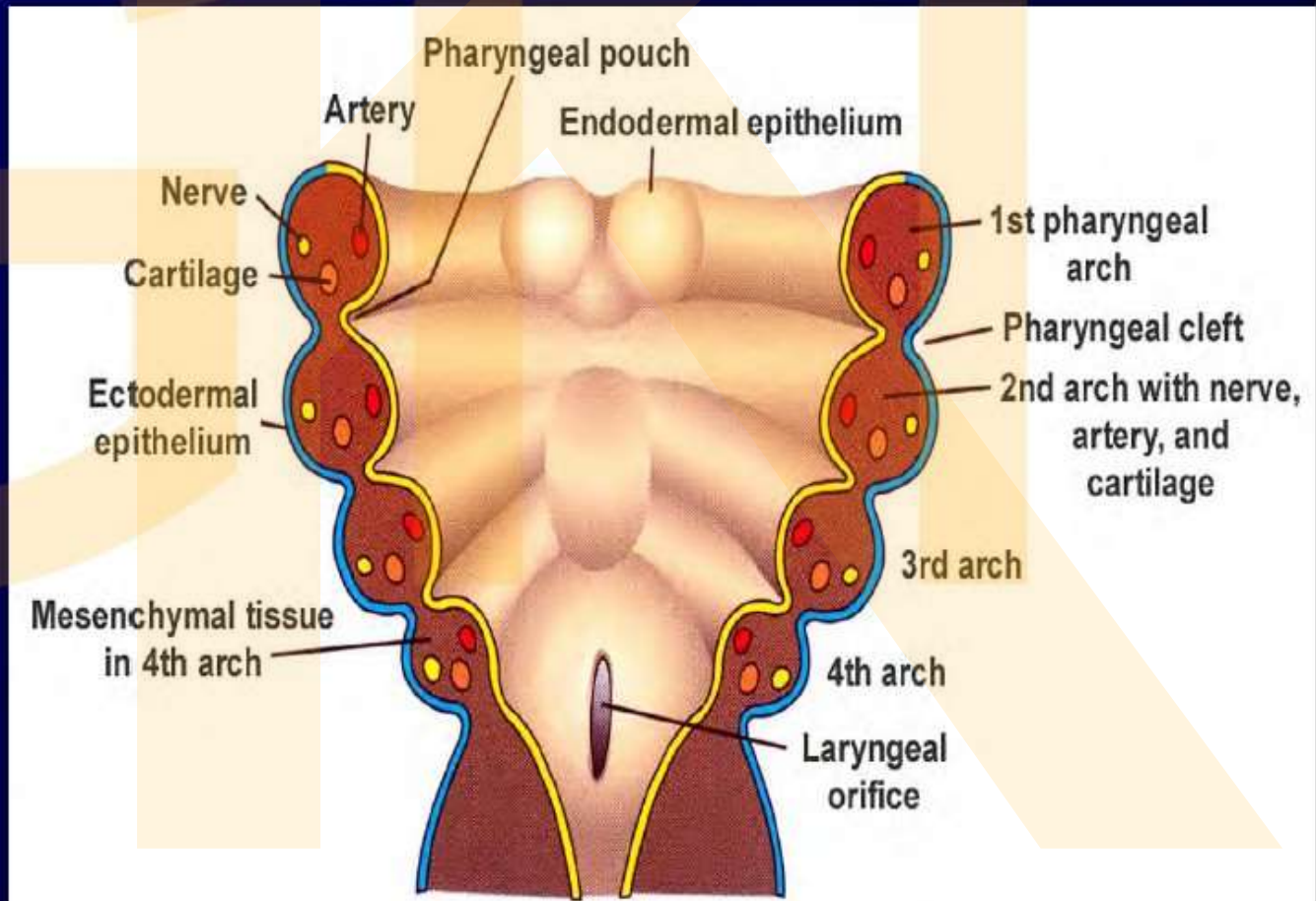
general arrangement

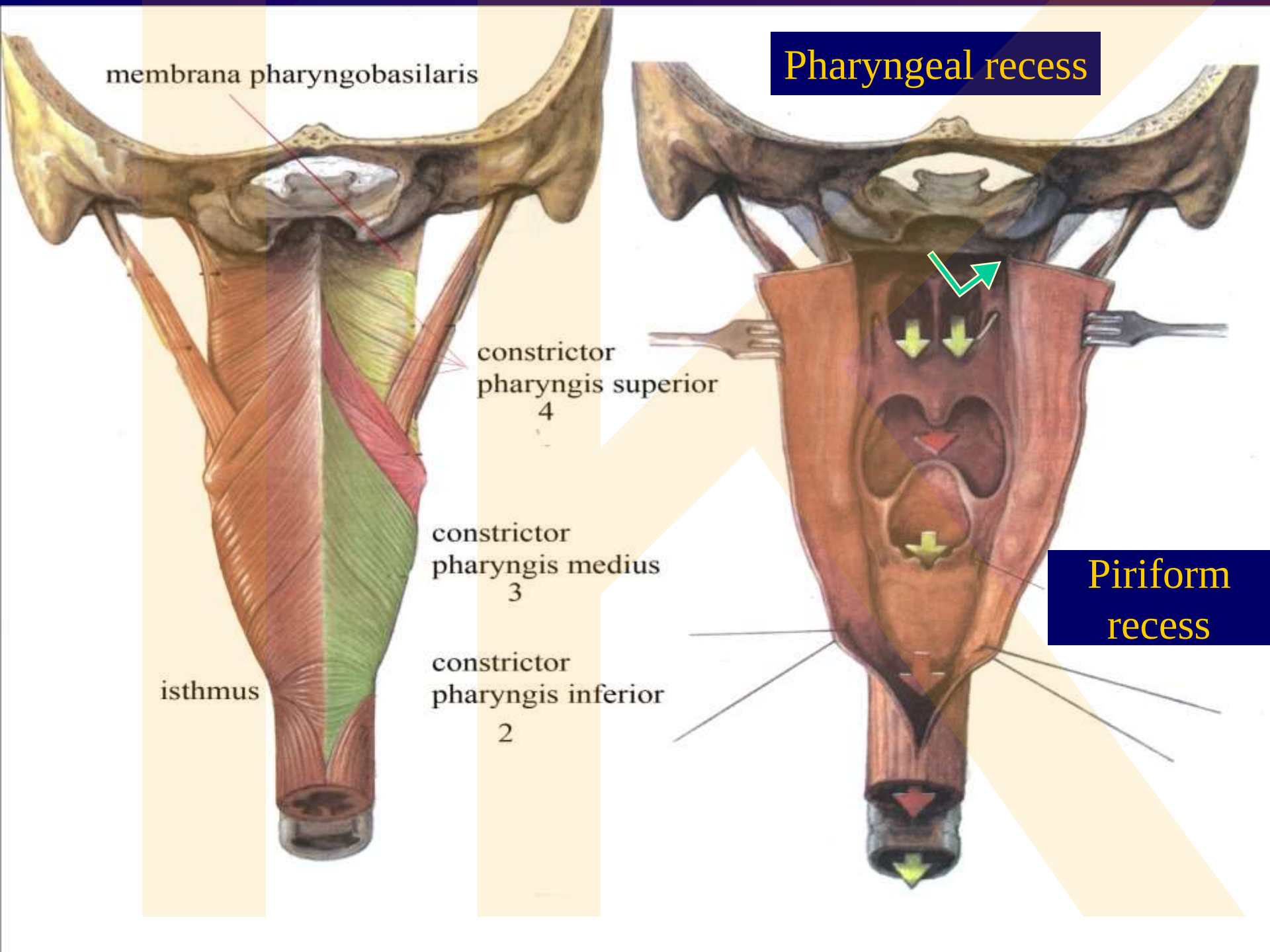


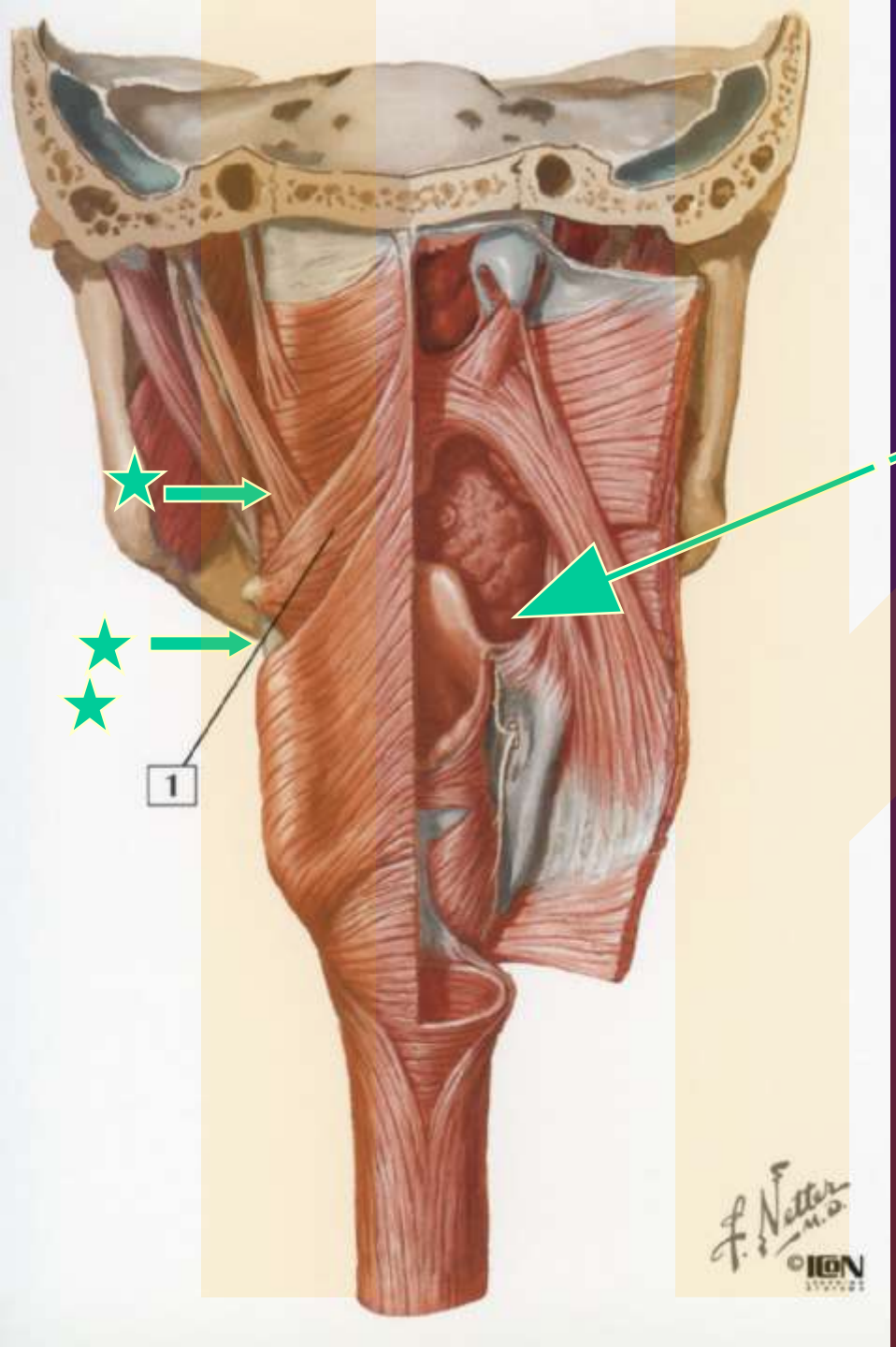
Nasopharynx (epi-)
Oropharynx (meso-)
Laryngopharynx (hypo-)

Development of pharynx

- Cranial part of the ventral gut
- 6 pharyngeal arches (gills, branchial arches)
- Pharyngeal pouches




membrana pharyngobasilaris
constrictor
pharyngis superior
4
constrictor
pharyngis medius
3
constrictor
pharyngis inferior
2
isthmus
Pharyngeal recess
Piriform
recess



Piriform recess
Recessus piriformis
(piriform recess, pouch)
is bordered by aryepiglottic fold
and pharyngoepiglottic fold

* m. stylopharyngeus

** Nervus et vasa laryngea superiora CN X

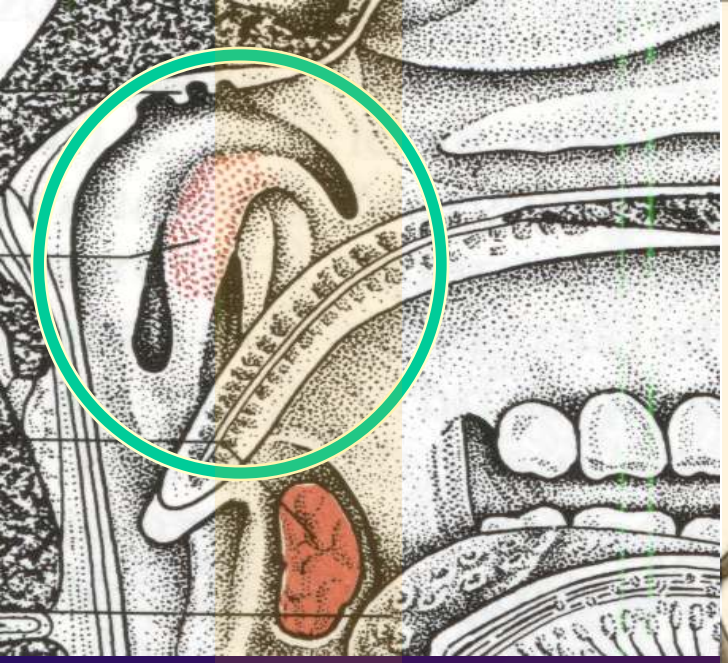
Nervus can be irritated through difficult swallowing or tumor growth

Superior constrictor SC
1 Pars pterygopharyngea
2 Pars buccopharyngea
3 Pars mylopharyngea
4 Pars glossopharyngea

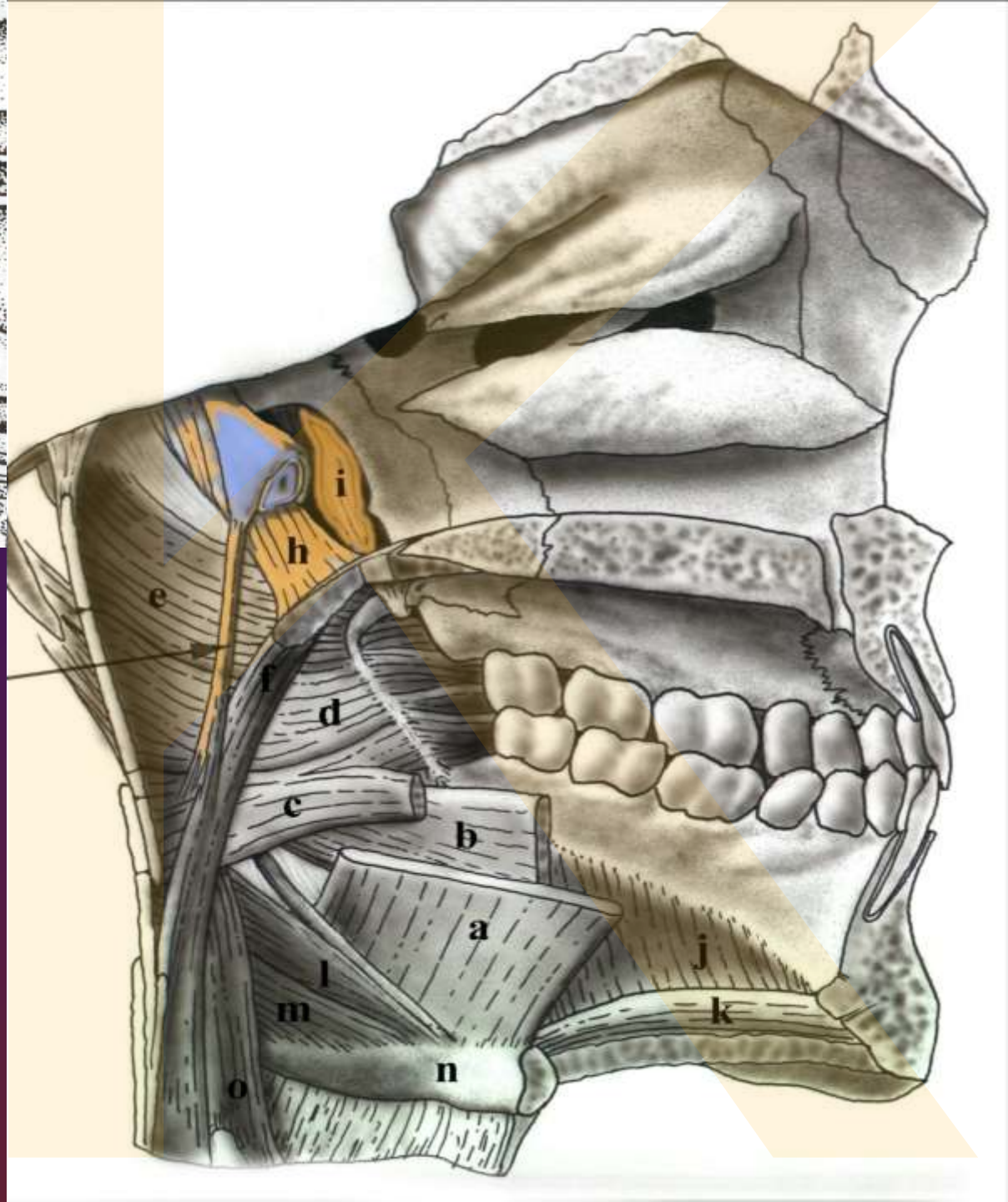
Medius constrictor MC
5 Pars chondropharyngea
6 Pars ceratopharyngea
7 Pars desmopharyngea

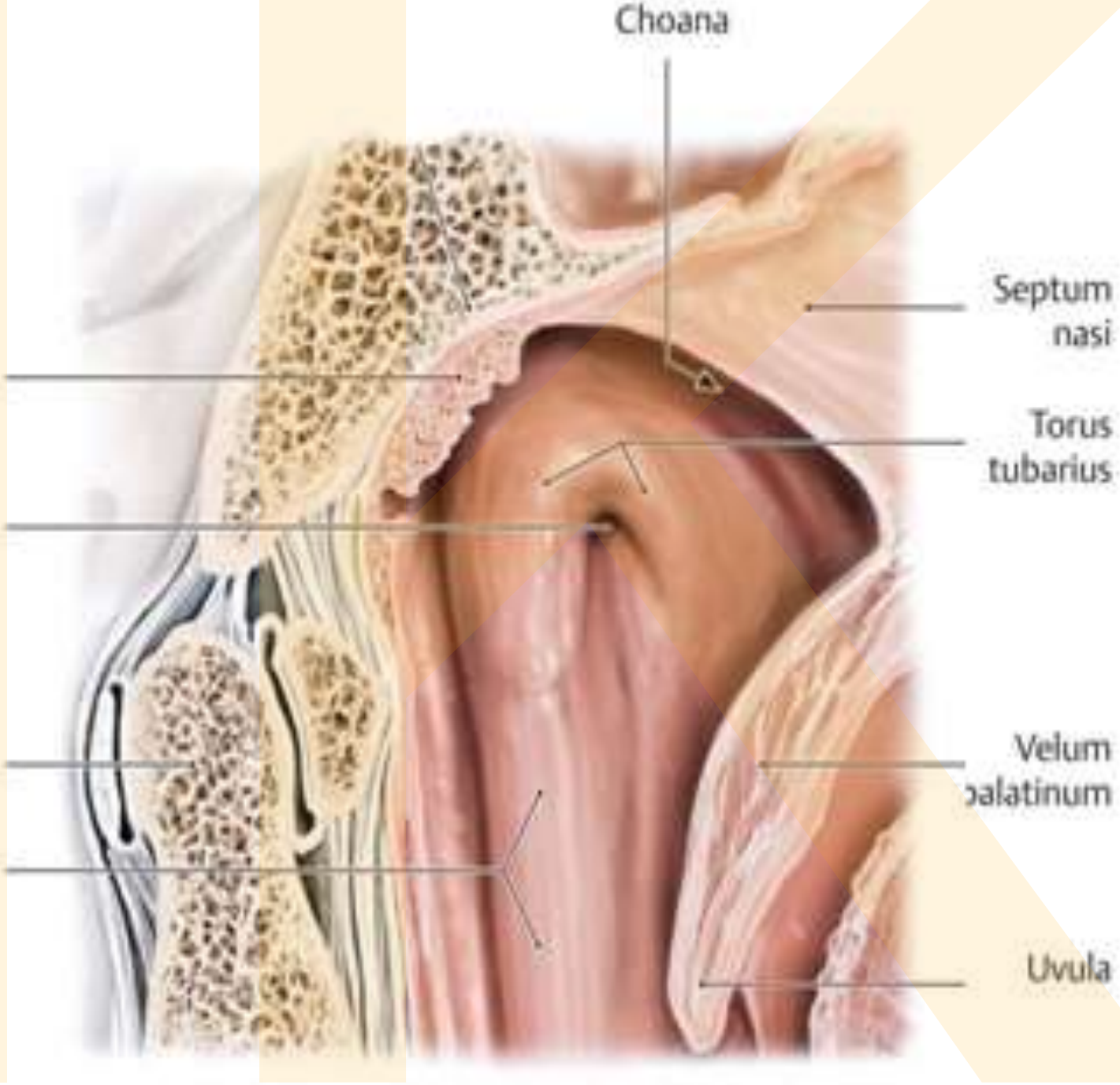
Inferior constrictor IC
8 Pars thyropharyngea
9 Pars cricopharyngea

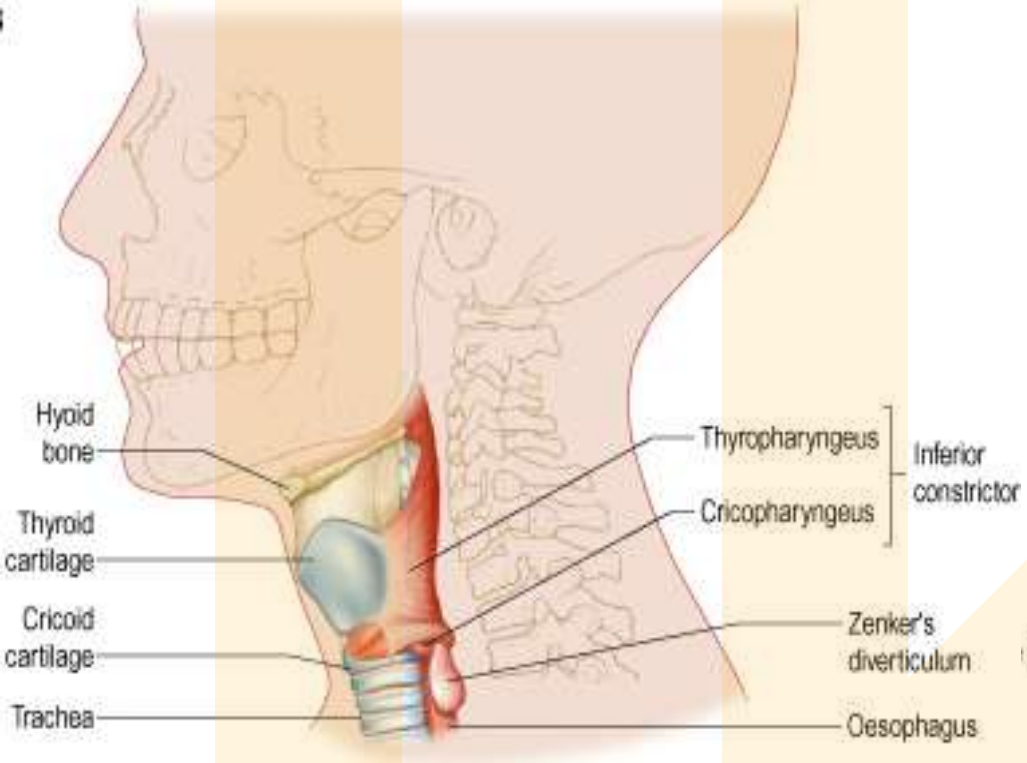
SC: raphe – mandible and hamulus
MC: raphe – hyoid bone and stylohyoid lig.
IC: raphe – cricoid and thyroid cartilages and cricothyroid lig.



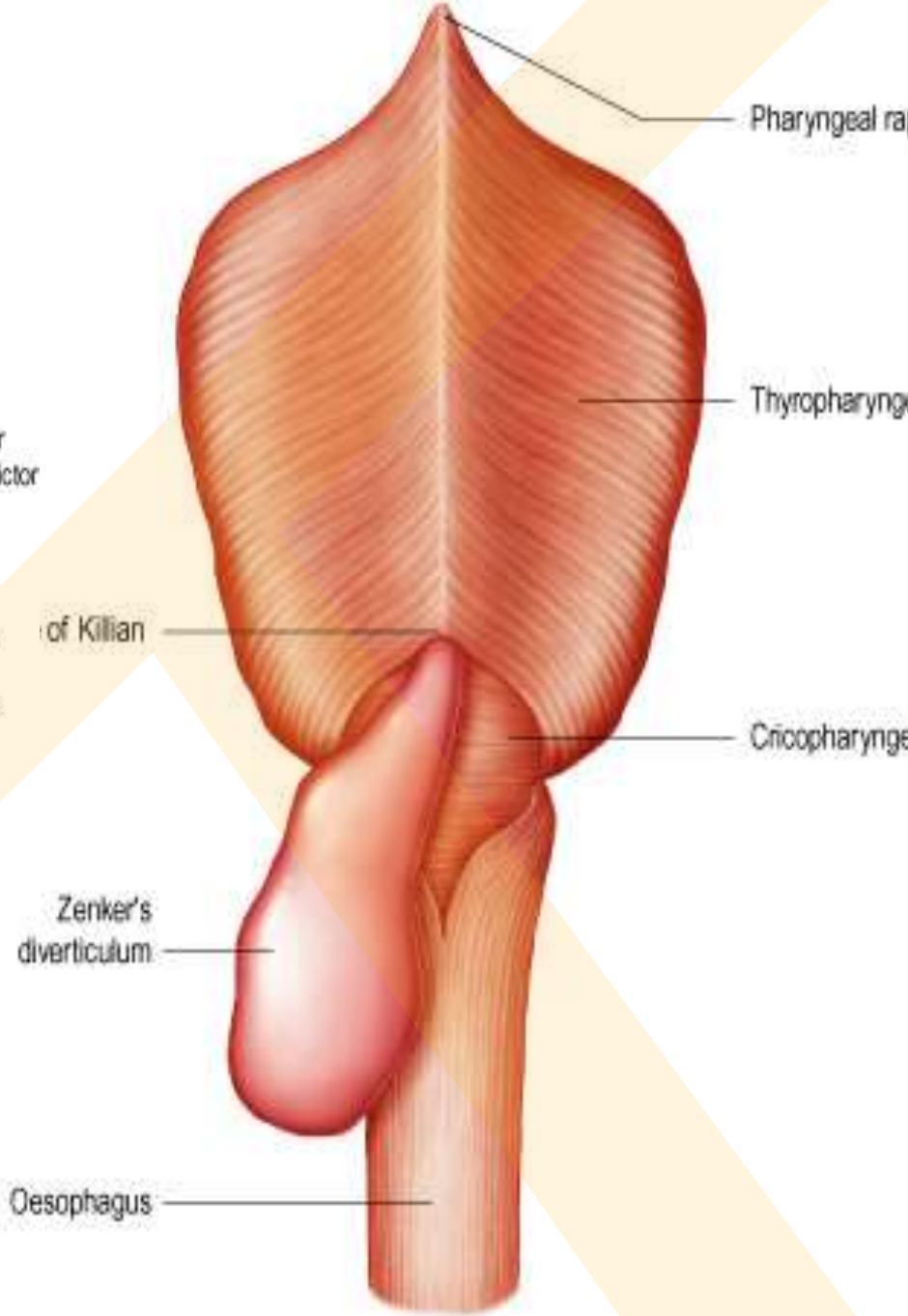
Eustachian tube
(auditive tube, salpinx)
relates to
tensor veli palatini (torus tubarius)
levator veli palatini (torus levatorius)
and salpingopharyngeus
(from palatopharyngeus)
muscles



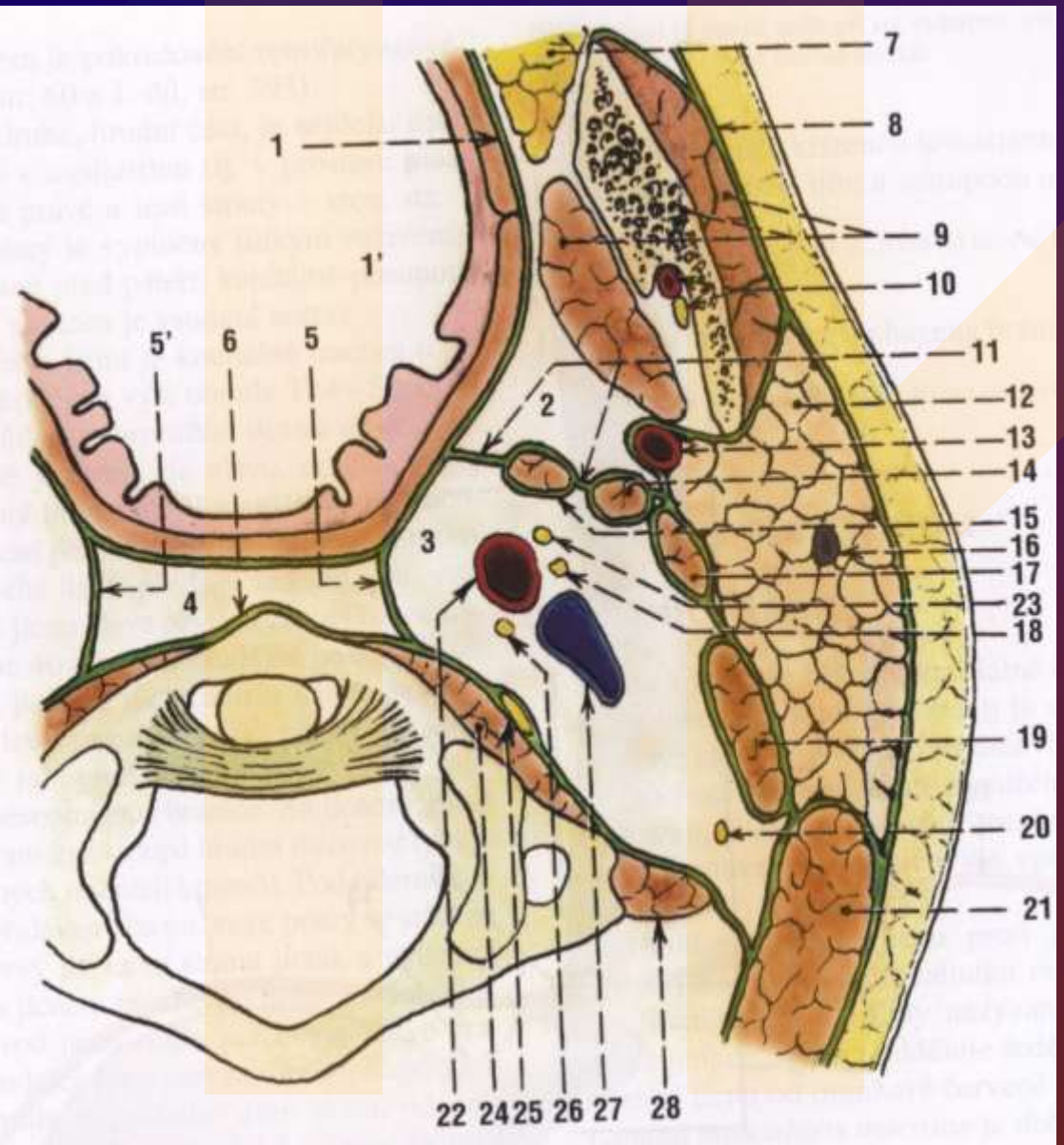

Choana
Septum nasi
Tonsilla pharyngealis
Torus tubarius
Tubenöffnung (Ostium pharyngeum tubae auditivae)
Dens axis
Velum palatinum
Plica salpingo-pharyngea
Uvula



Esophageal (Zenker´s) diverticle



Spatia around pharynx



- lamina prevertebralis fasciae cervicalis + septum styloideum
- spatium previscerale
- spatium retropharyngeum
- spatium parapharyngeum
  1. sp. prestyloideum
  2. sp. retrostyloideum
- spatium paraviscerale

Anulus lymphoideus pharyngis /*Waldeyeri/*

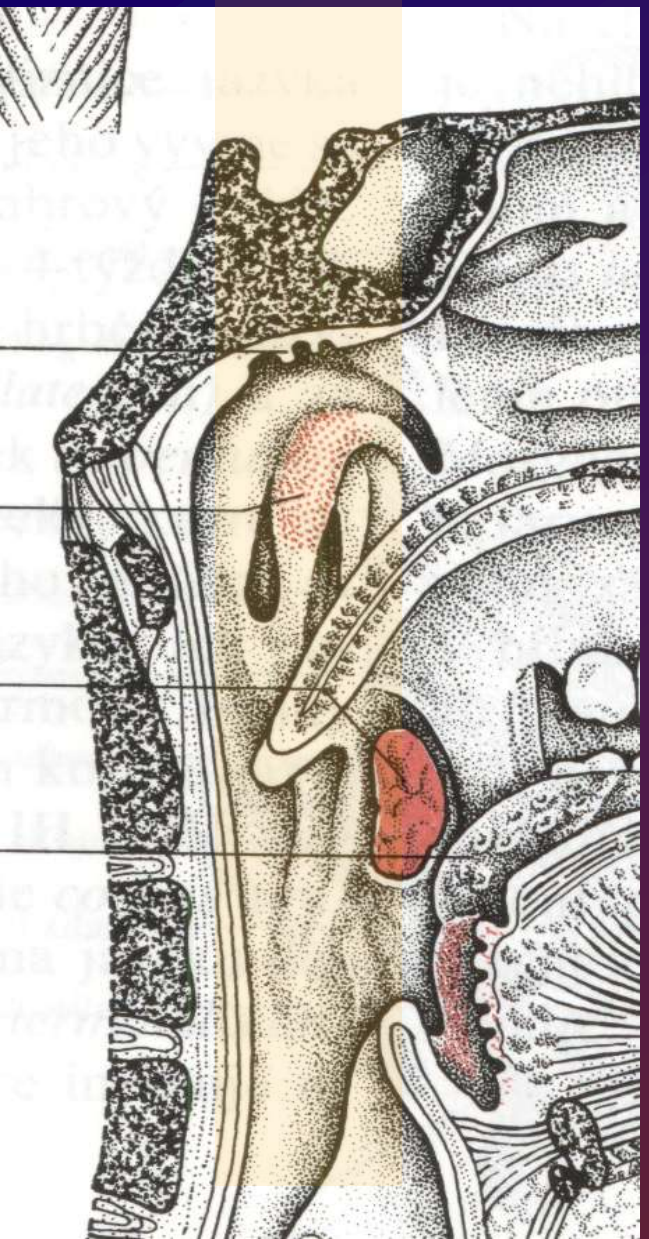
First barrier protecting body against antigens in food

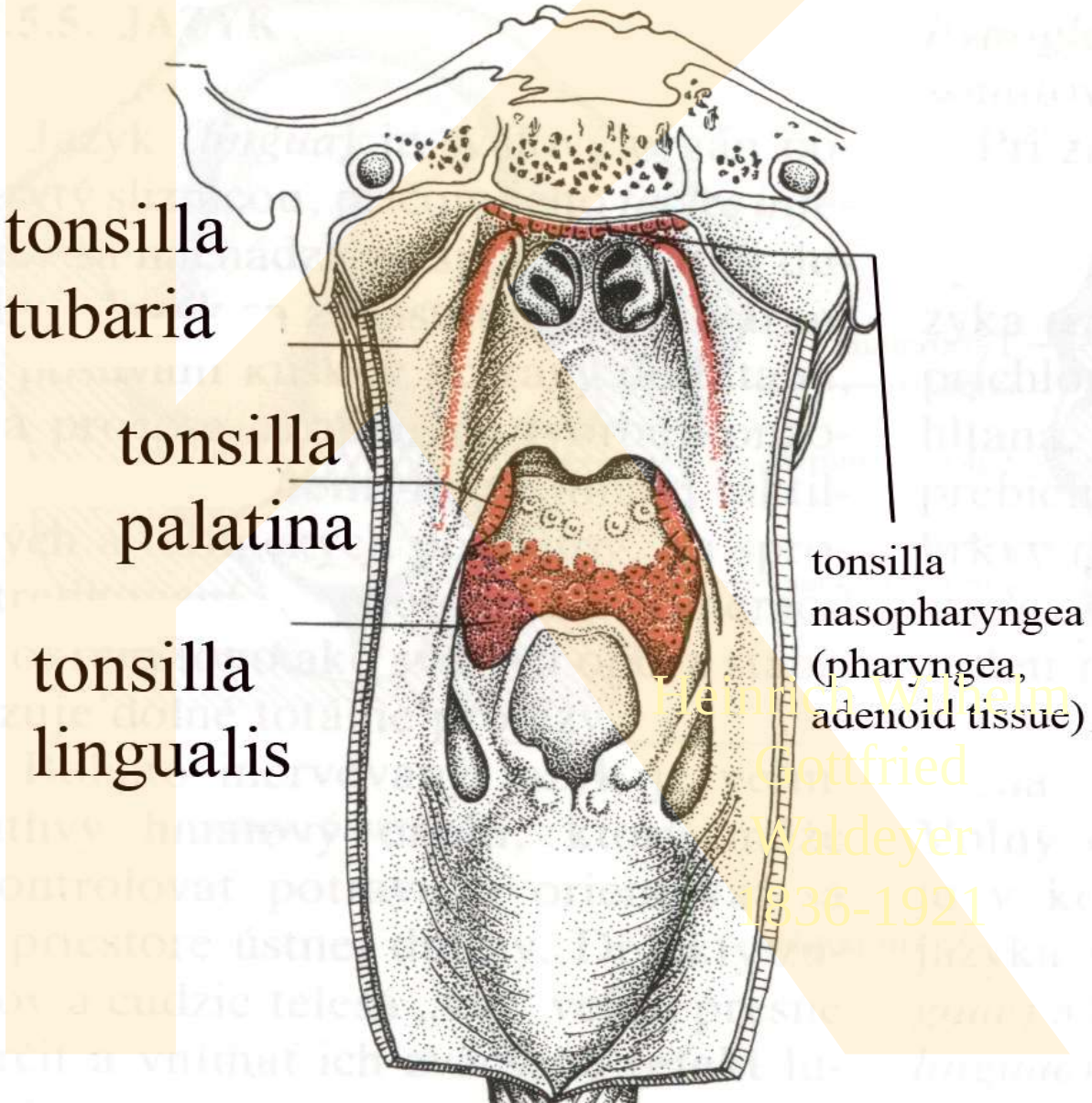
- Tonsilla pharyngea /1/
- Tonsilla tubaria /*Gerlachi/* /2/
- Tonsilla palatina /2/
- Tonsilla lingualis /1/

Wilhelm Gottfried von Waldeyer-Hartz

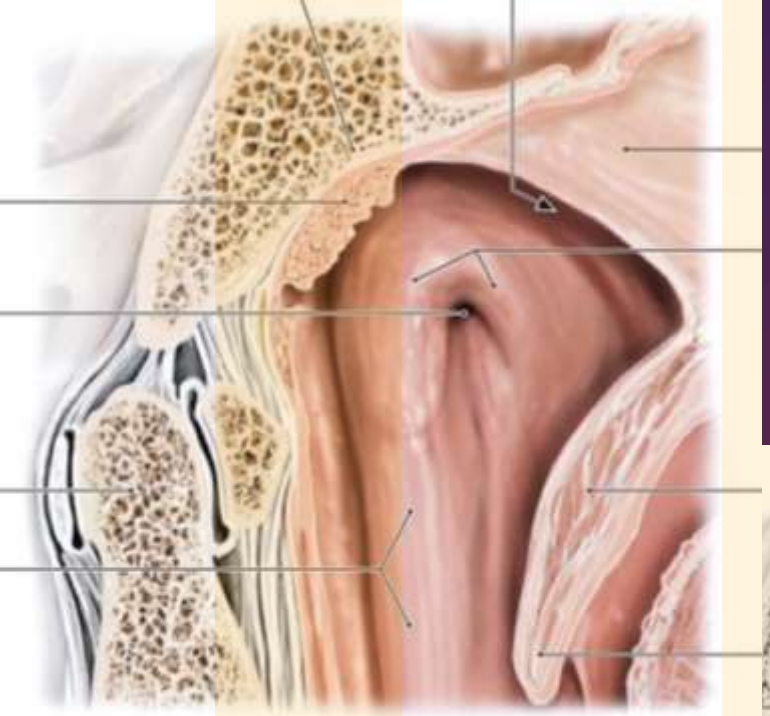
, German anatomist

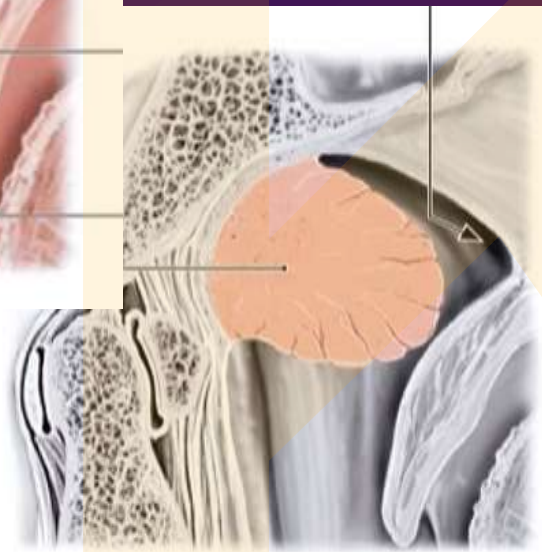
Tonsillar lymph circle of Waldeyer

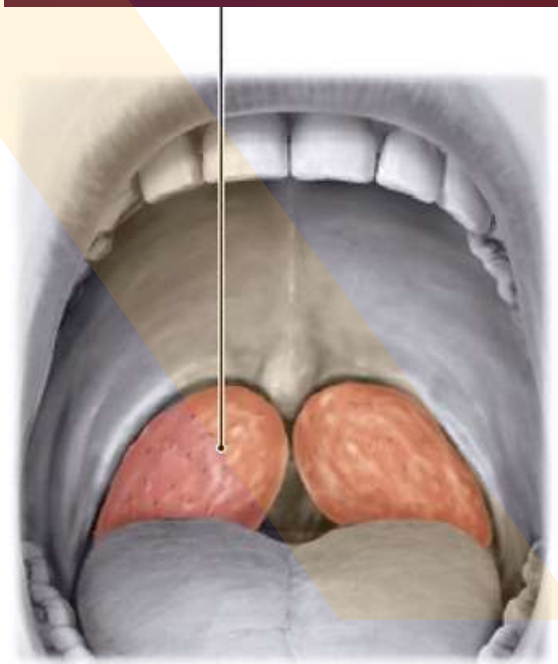




Heinrich Wilhelm Gottfried Waldeyer 1836-1921

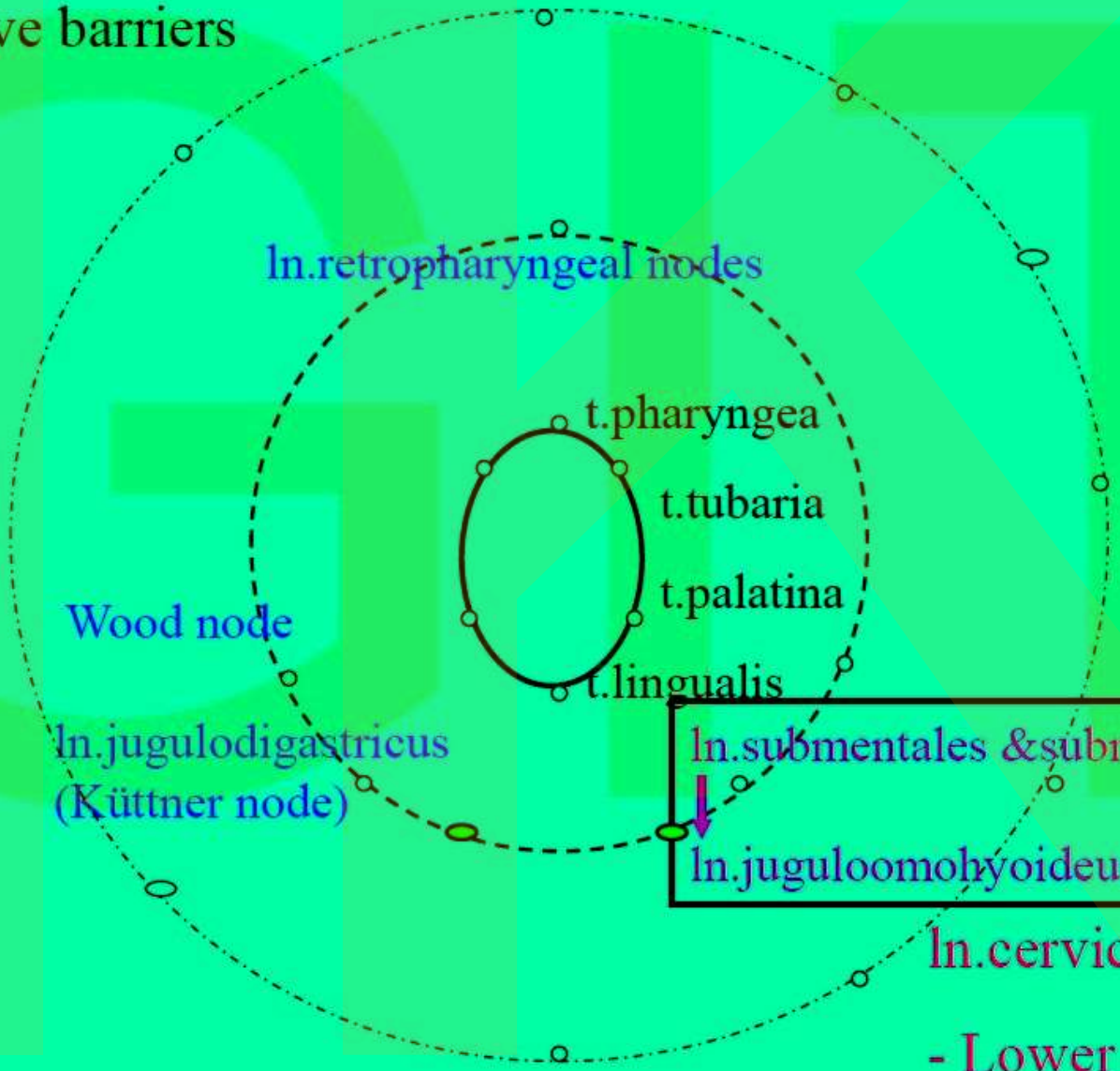


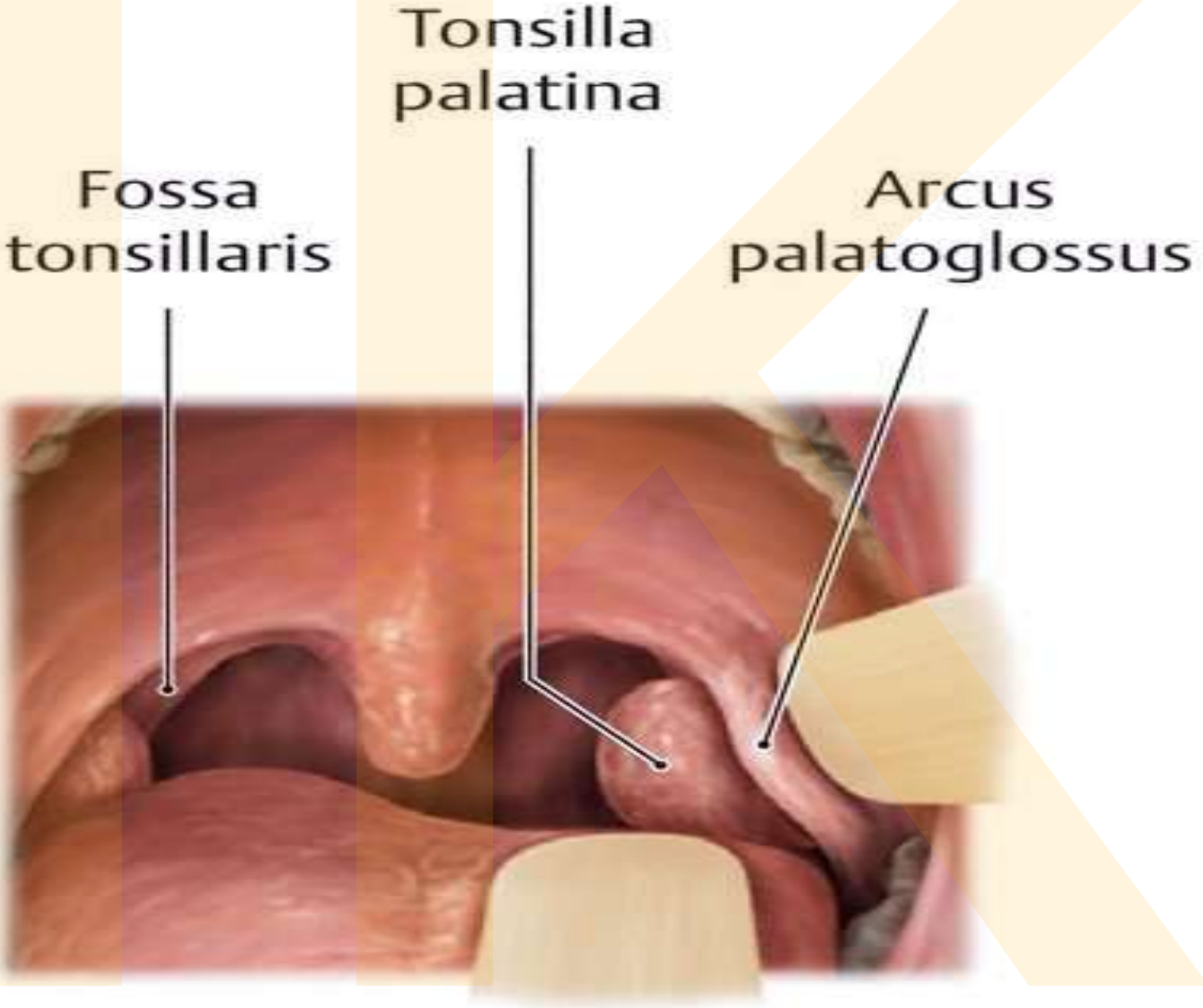


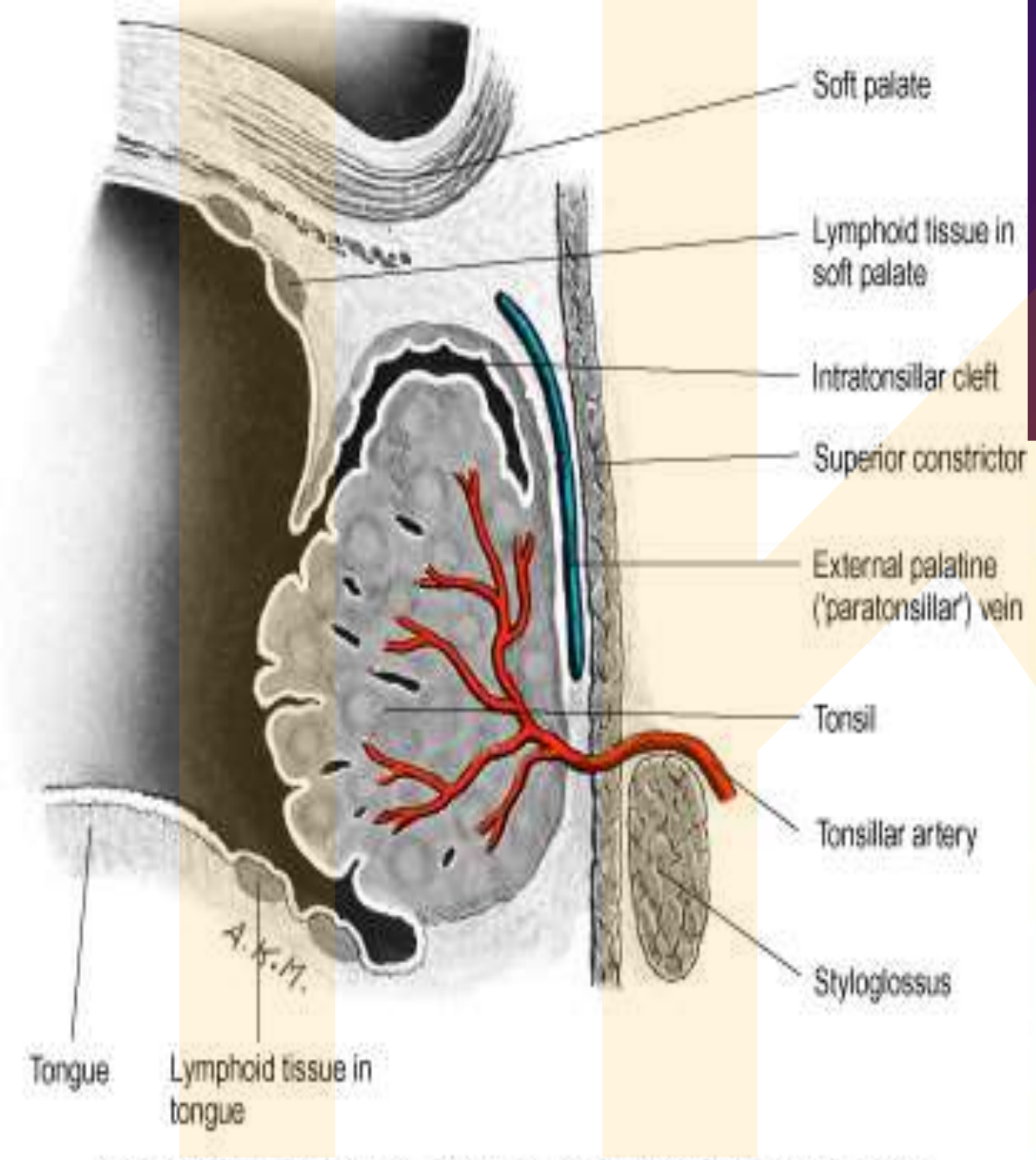


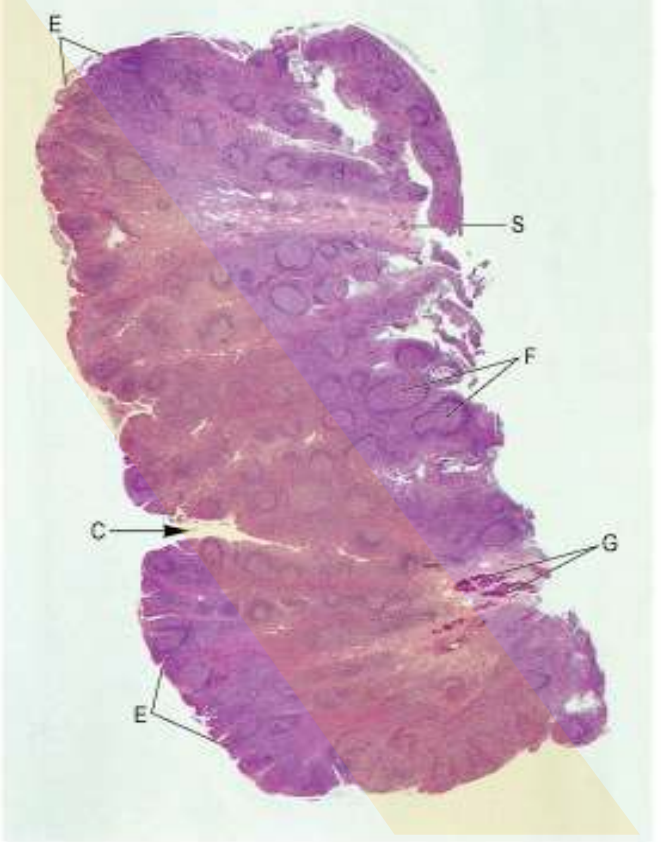
Waldeyer lymph circle

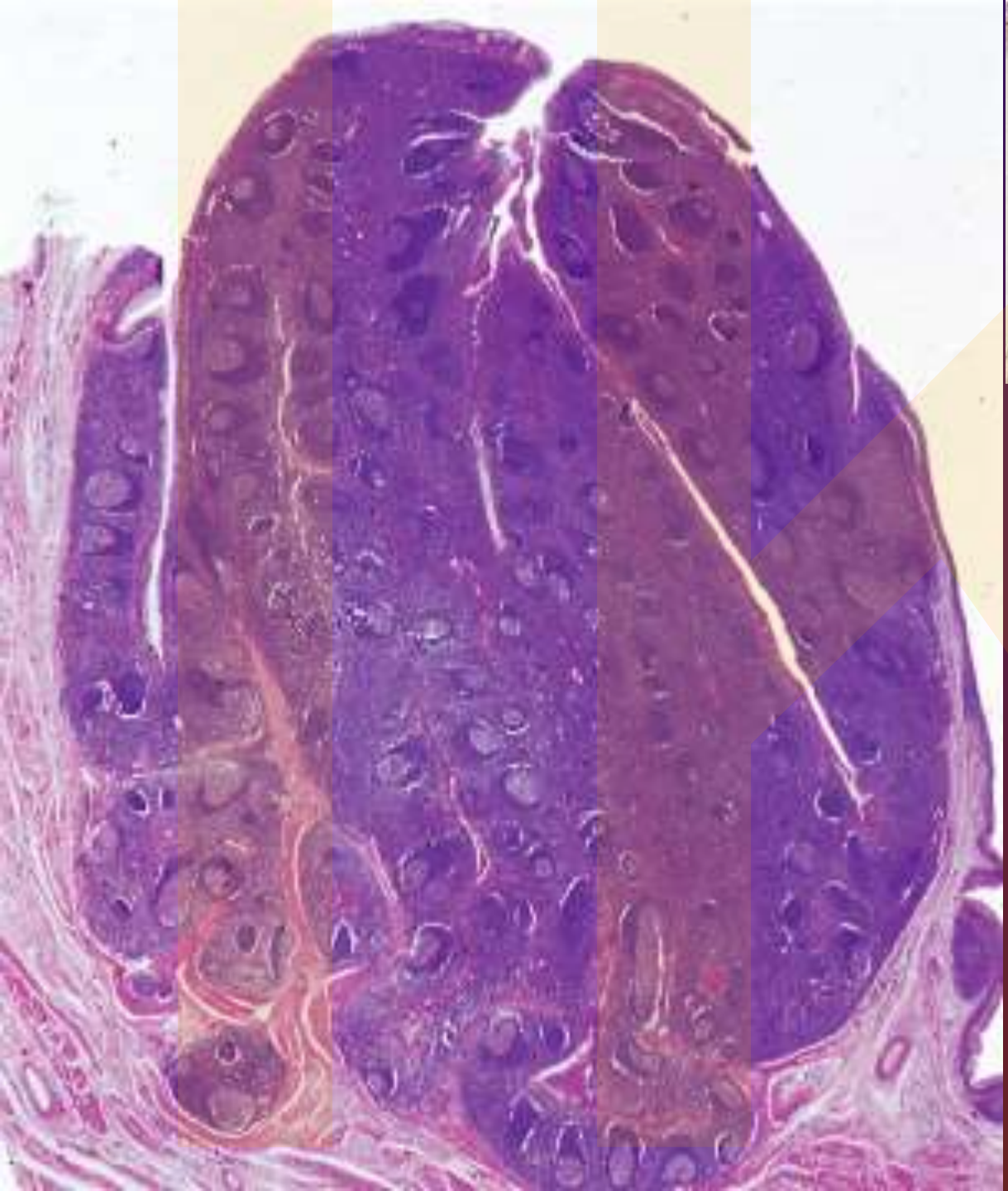
3 protective barriers

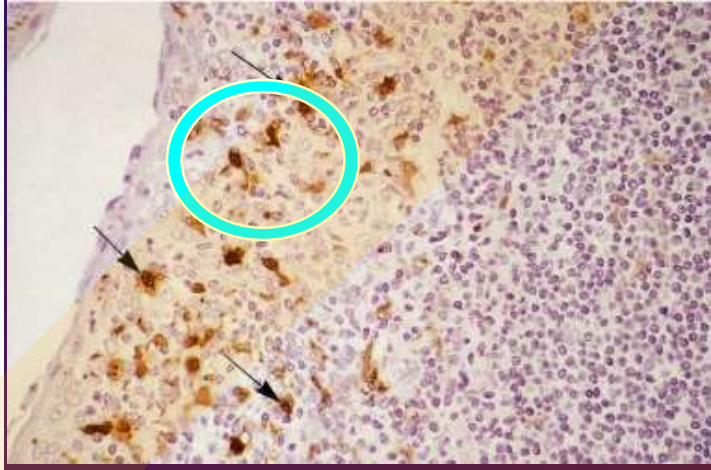



Tonsilla palatina
Fossa tonsillaris
Arcus palatoglossus





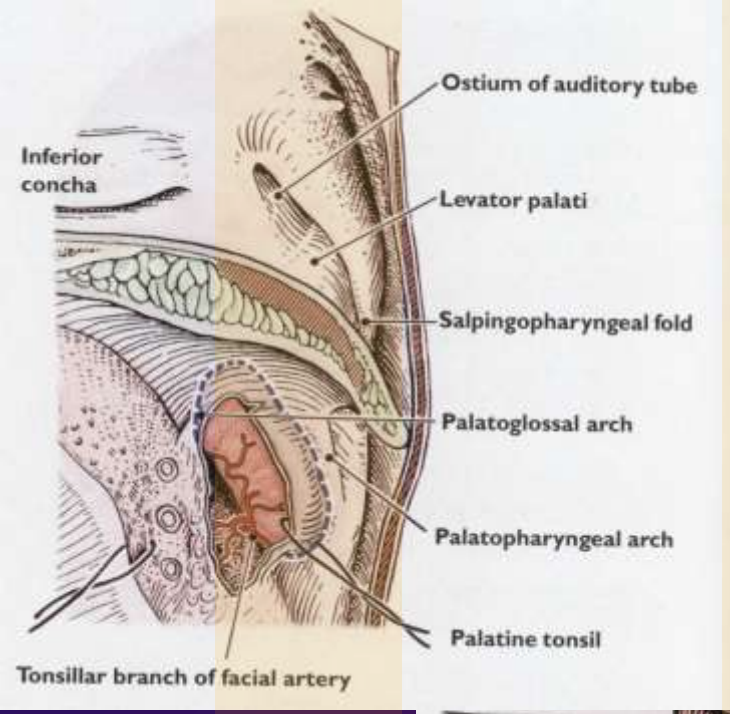


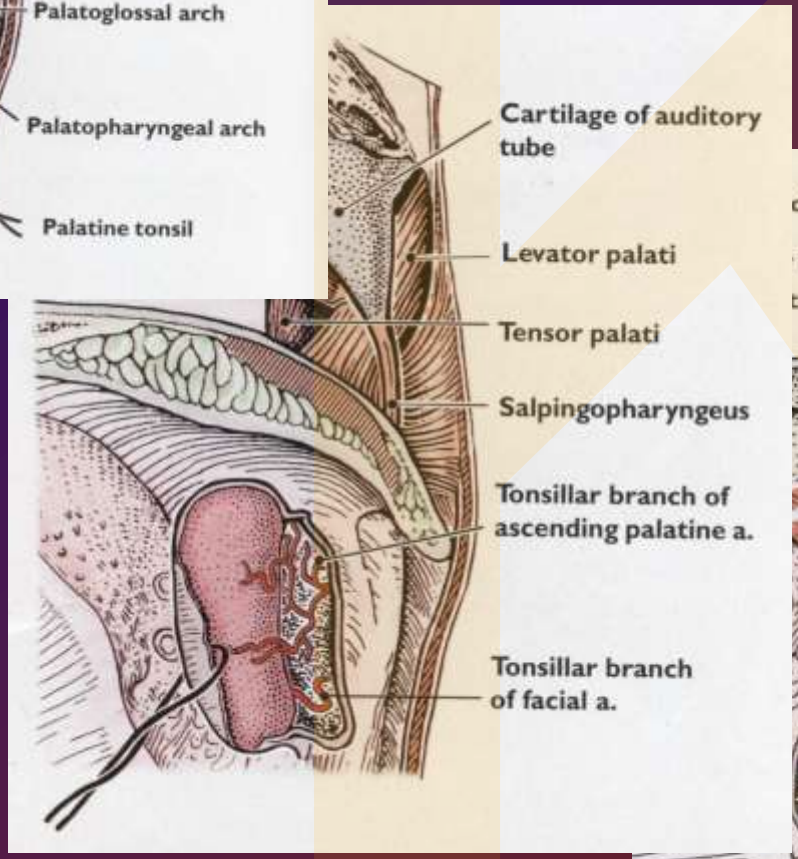


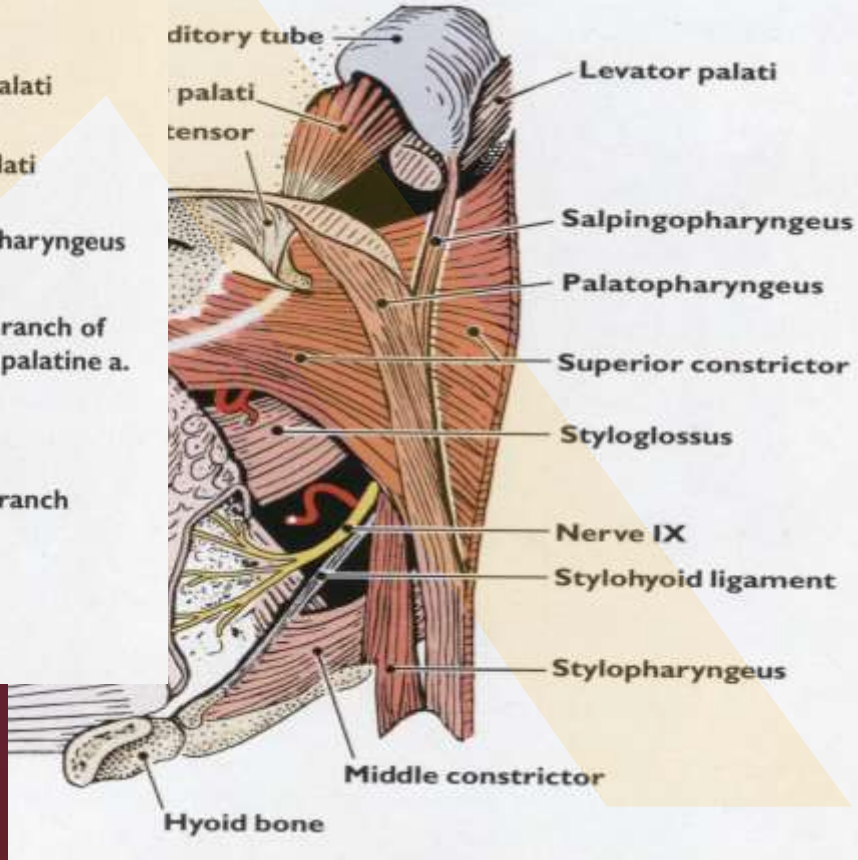
Incomplete capsule
Only efferent lymph vessels
Modified epithelium in crypts (lymphoepithel or FAE follicle-associated epithelium)
Intraepithelial vascularization

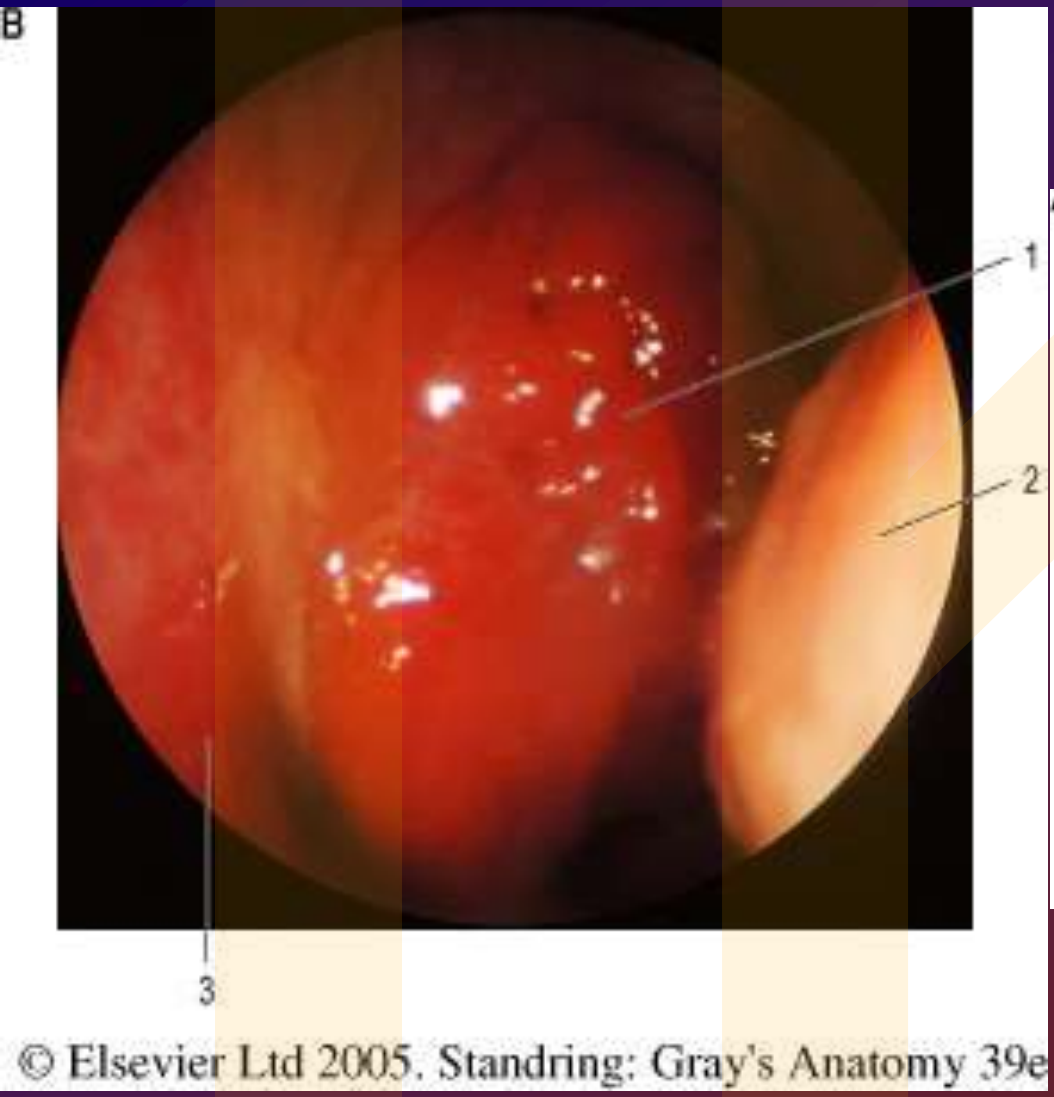
Free, T, B lymphocytes, active immunocompetitive cells, macrophages, Langerhans cells, fibrous stroma

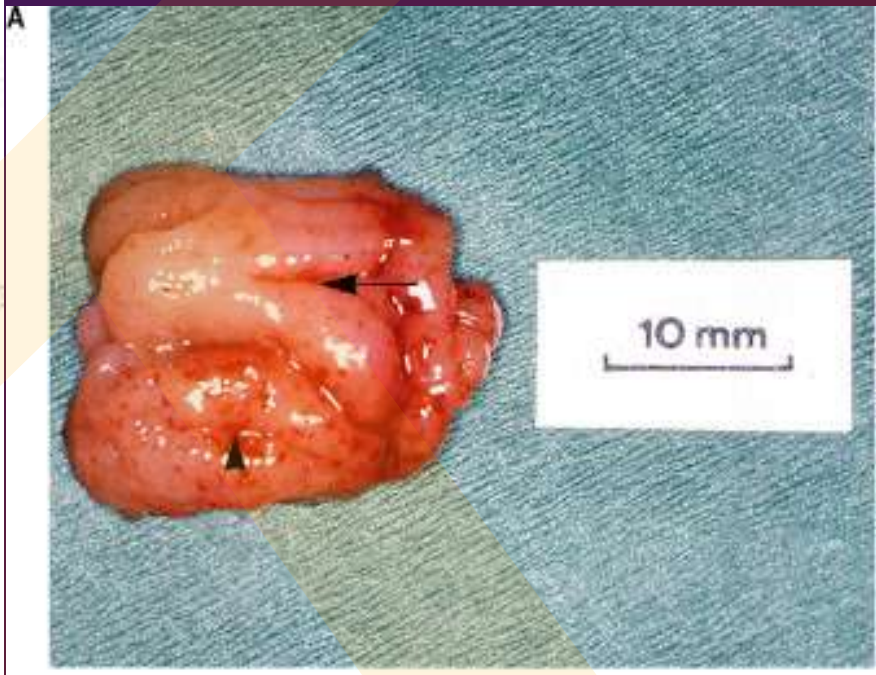
tonsillectomy











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