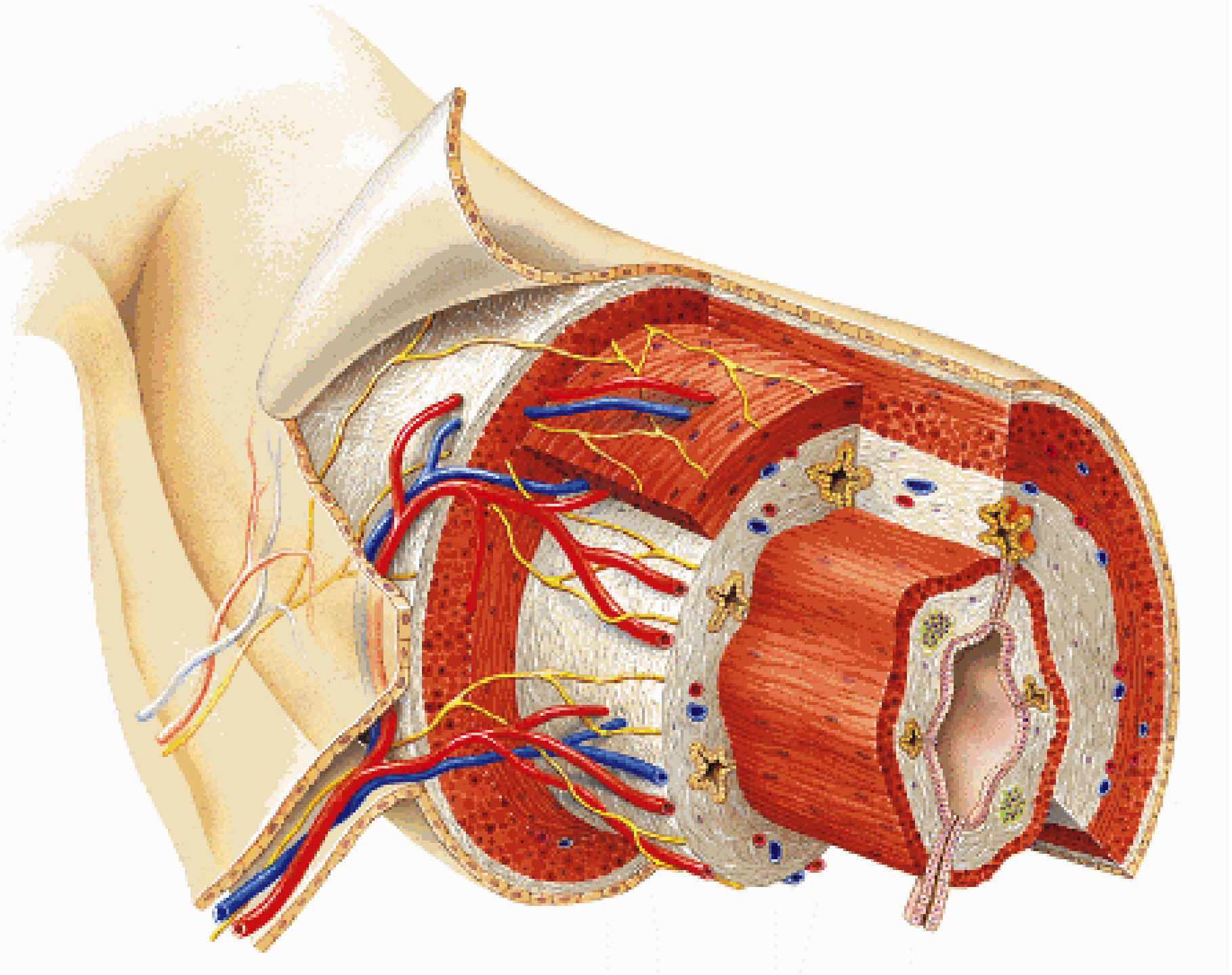
Histology of GIT 1

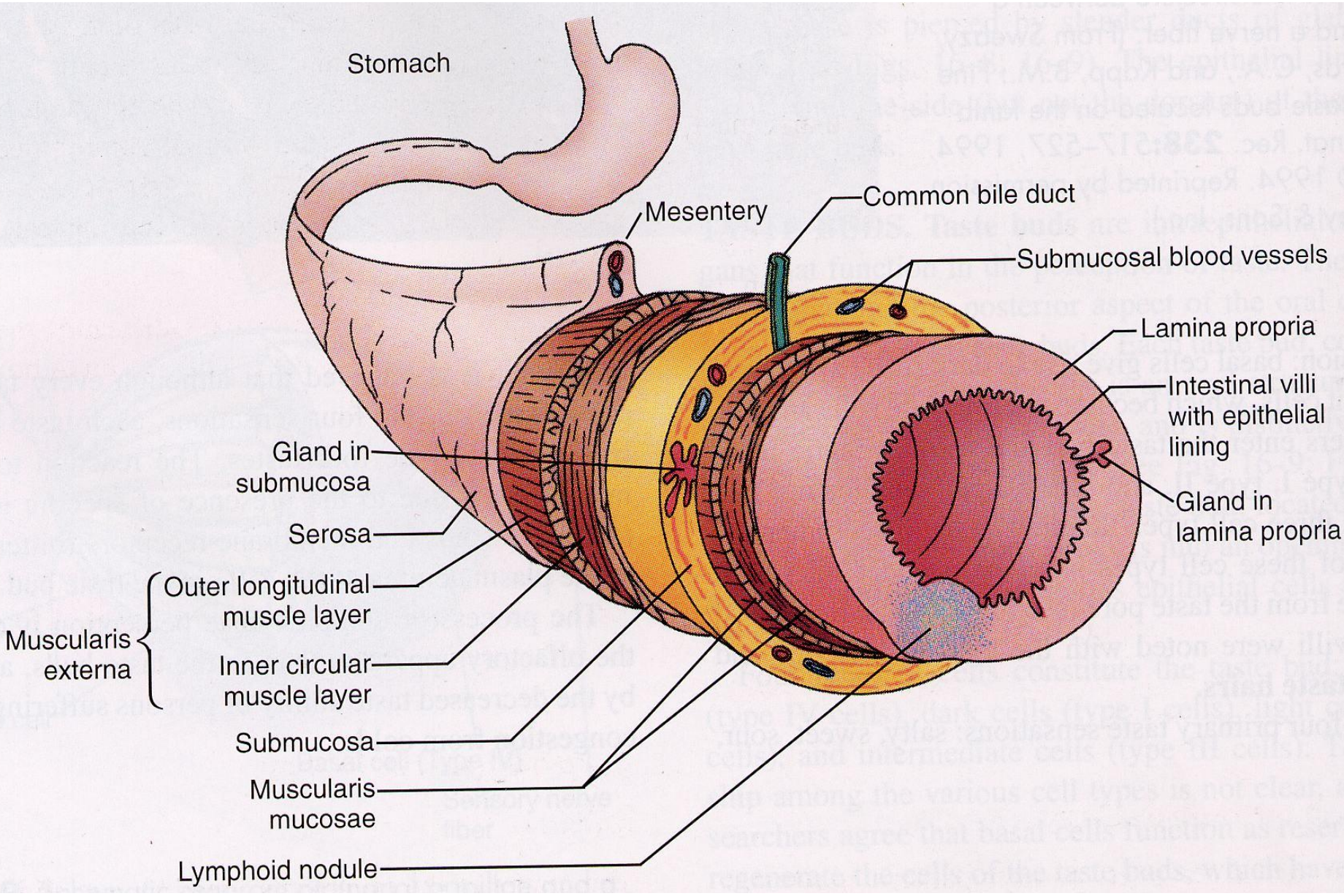
Bětka Blanková

alzbeta.blankova@nemlib.cz

General organization of GI tube

- Tunica mucosa
  - Lamina epithelialis
  - Lamina propria mucosae
  - Lamina muscularis mucosae
- Tela submucosa
- Tunica muscularis
  - Stratum circulare
  - Stratum longitudinale
- Tunica serosa/adventitia (+ tela subserosa)




Stomach
Mesentery
Common bile duct
Submucosal blood vessels
Lamina propria
Intestinal villi with epithelial lining
Gland in lamina propria
Gland in submucosa
Serosa
Muscularis externa
Outer longitudinal muscle layer
Inner circular muscle layer
Submucosa
Muscularis mucosae
Lymphoid nodule

Oral cavity

- Epithelium – stratified squamous keratinized and non-keratinized (parakeratinization)
- Lamina propria – immune cells (lymphocytes, macrophages)

Oral cavity - mucosa

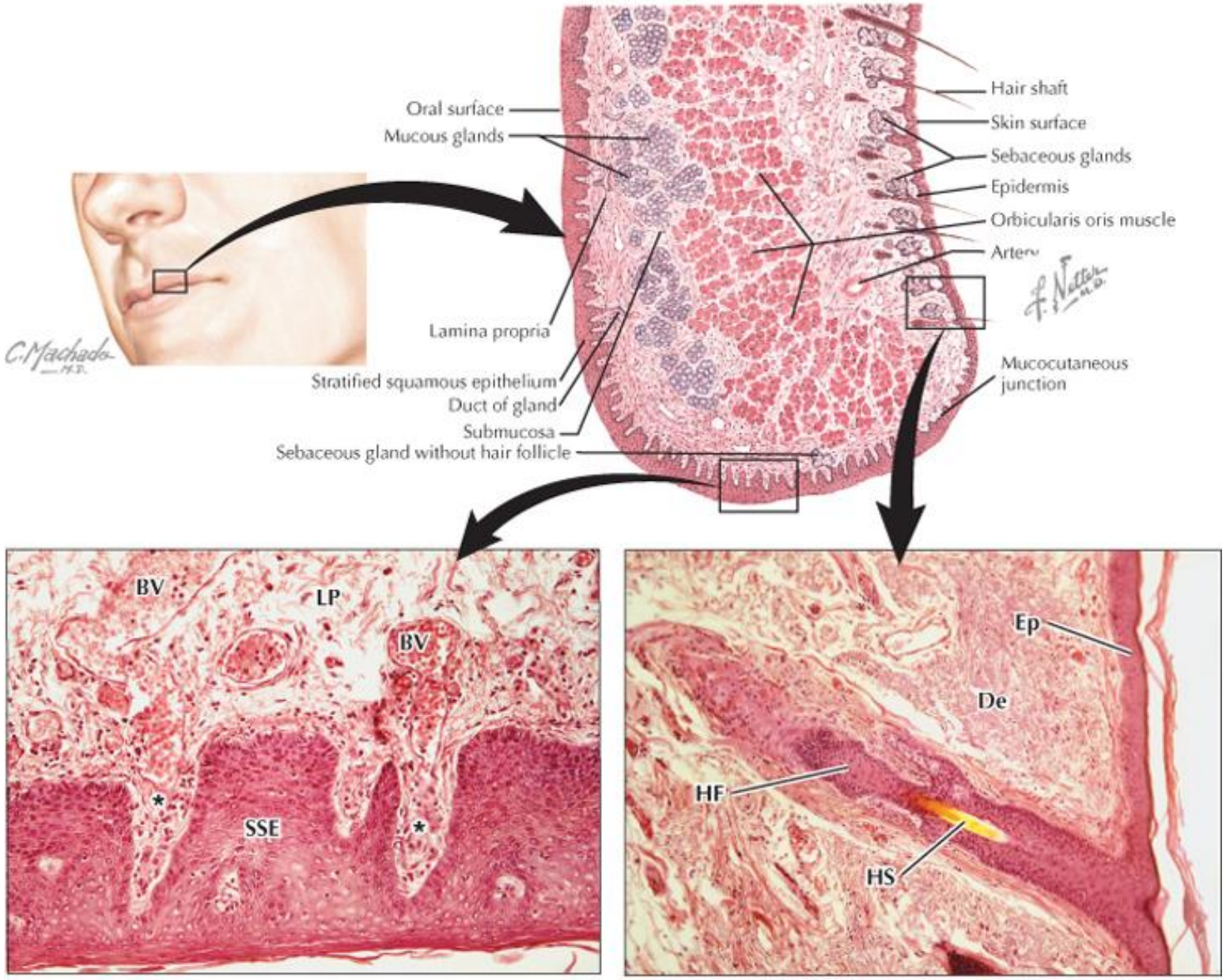
- Masticatory mucosa – mechanicky namáhaná,
  - Stratified squamous keratinized epithelium
  - Gingiva and hard palate – mucosa is hardly attached to hard palate
- Lining mucosa – covering soft parts of oral cavity
  - Stratified squamous non-keratinized epithelium
  - Cheeks, lips, soft palated, lower site of tongue
- Specialized mucosa – taste buds

Lips

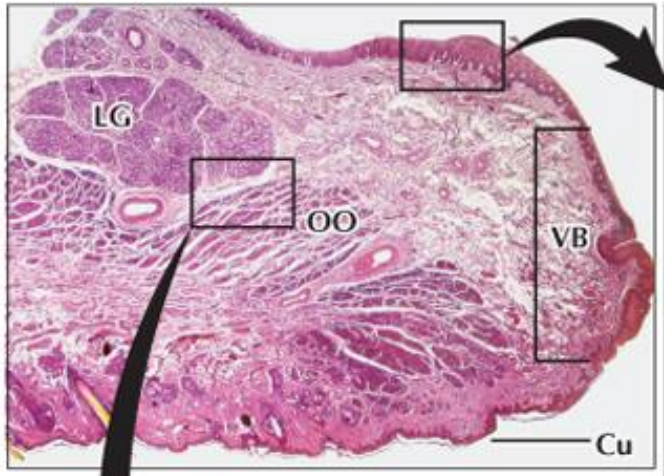
- 3 different surfaces
  - External skin surface – epidermis and dermis
  - Vermillion (red part) – stratified squamous with slite keratinization, thin – translucent
  - Internal vestibular surface – stratified sqauamous non-keratinized, salivary glands (gll.buccales et labiales)

- Muscular core = m. orbicularis oris

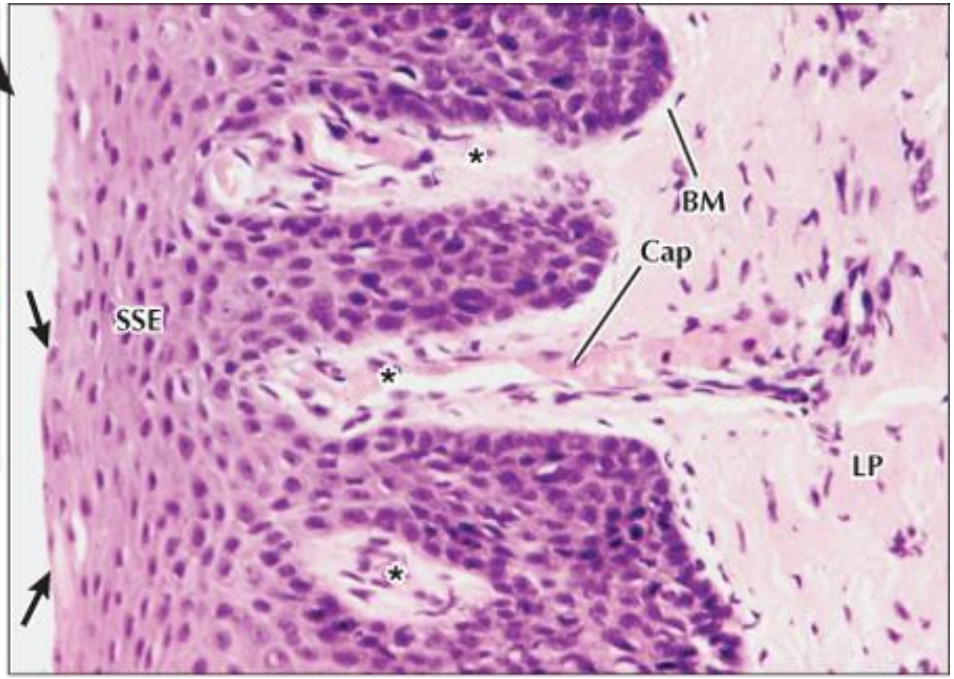
▼ Section through the upper lip.



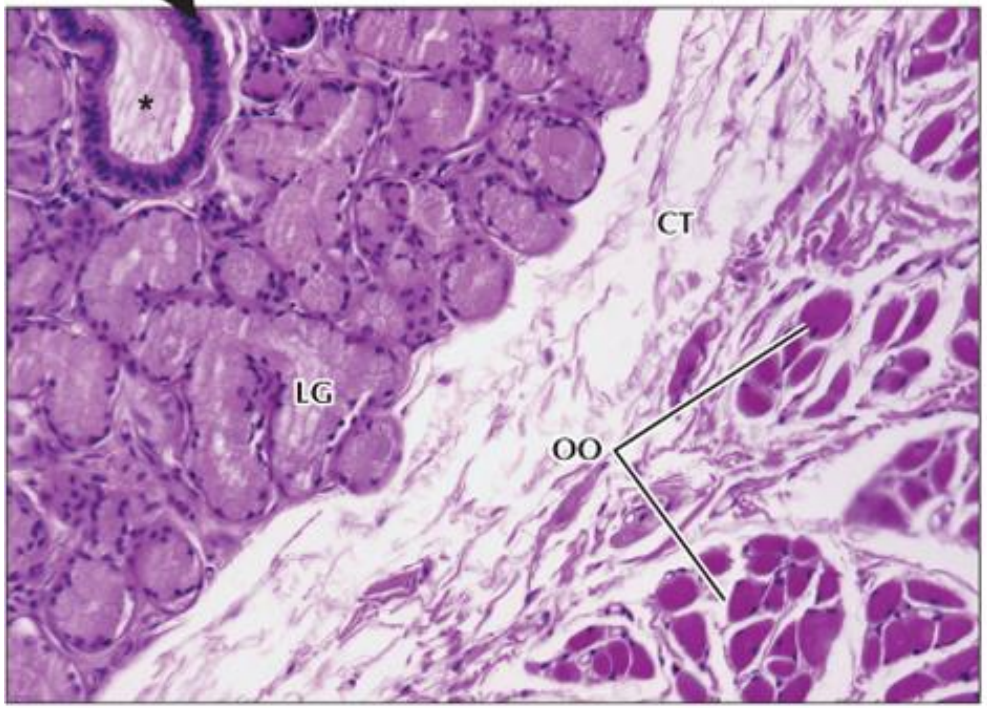
▲ **Light micrographs (LMs) of parts of the lip. Left**, The vermillion border is stratified squamous epithelium (**SSE**) with a thin layer of surface keratin, below. Underlying connective tissue—lamina propria (**LP**)—contains many blood vessels (**BV**). The highly corrugated interface between epithelium and connective tissue shows tall papillae (*) penetrating the epithelium to take capillaries close to the surface. **Right**, The external cutaneous surface, of typical thin skin, consists of epidermis (**Ep**) and underlying dermis (**De**). A hair follicle (**HF**) and associated hair shaft (**HS**) are seen. **Left**: 130×; **Right**: 85×. *H&E.*



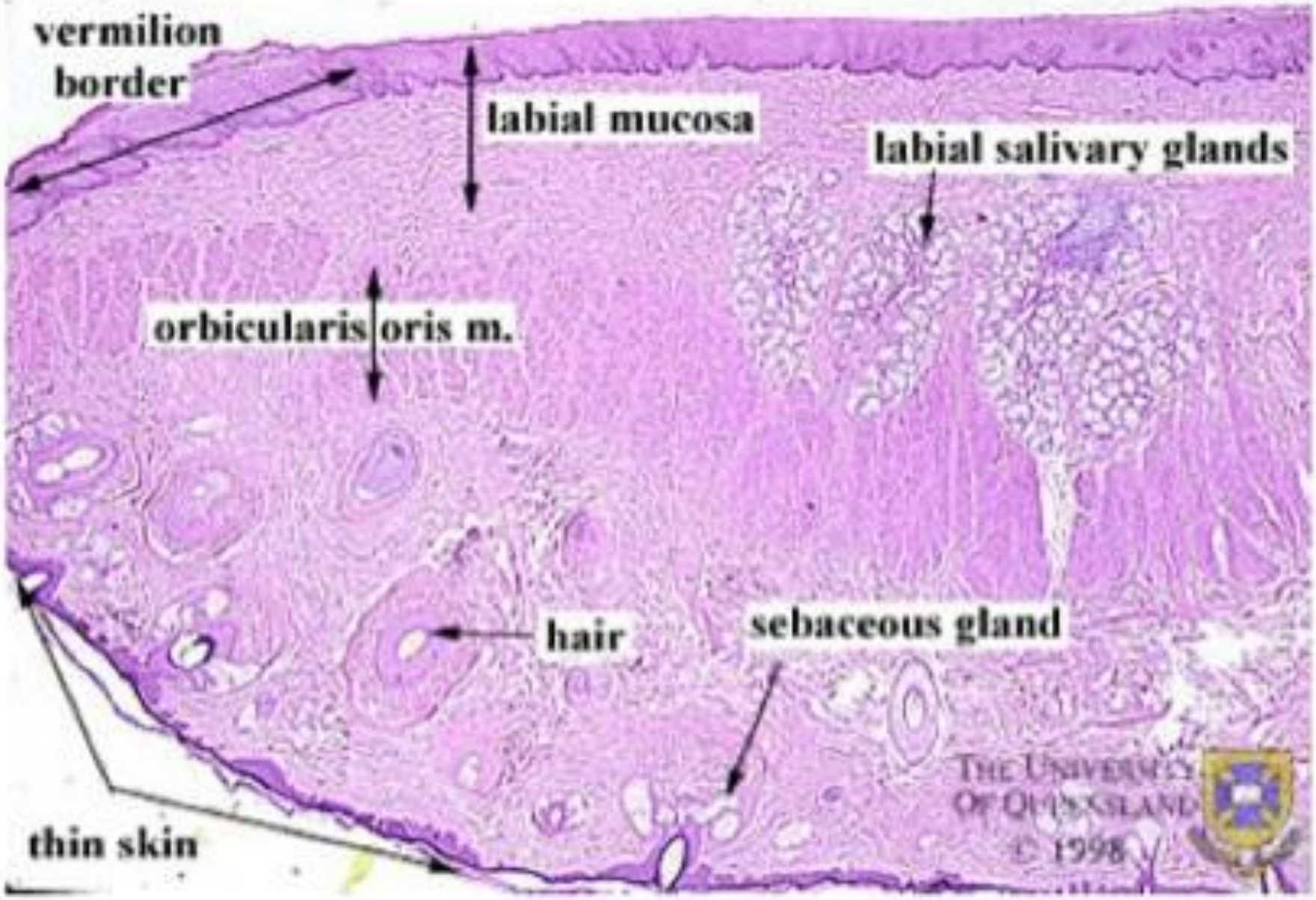
▲ **LM of the lip.** The cutaneous surface (**Cu**) and vermillion border (**VB**) are seen; the oral mucous membrane is at the top. The central core of the lip contains muscle fibers of the orbicularis oris (**OO**). Labial glands (**LG**) are close to the oral surface. 5×. *H&E.*



▲ **LM of part of the oral mucosa of the inner surface of the lip.** The nonkeratinized stratified squamous epithelium (**SSE**) is multilayered. Its flat surface cells (**arrows**) retain their nuclei; its cuboidal basal cells rest on an ill-defined basement membrane (**BM**). The lamina propria (**LP**) is loose, highly cellular connective tissue. Capillaries (**Cap**) extend into papillae (*). 280×. *H&E.*



◀ **LM of the central core of the lip.** Tightly packed mucous acini of a labial gland (**LG**)—a tubuloacinar minor salivary gland—surround a small duct (*). Low simple columnar epithelium lines the duct. The connection of the duct is not seen in the plane of section, but it opens onto the oral surface. Adjacent skeletal muscle fibers of the orbicularis oris (**OO**) are organized into fascicles. The pale area between the gland and muscle is fibroelastic connective tissue (**CT**). 125×. *H&E.*


vermilion
border
labial mucosa
labial salivary glands
orbicularis oris m.
hair
sebaceous gland
thin skin
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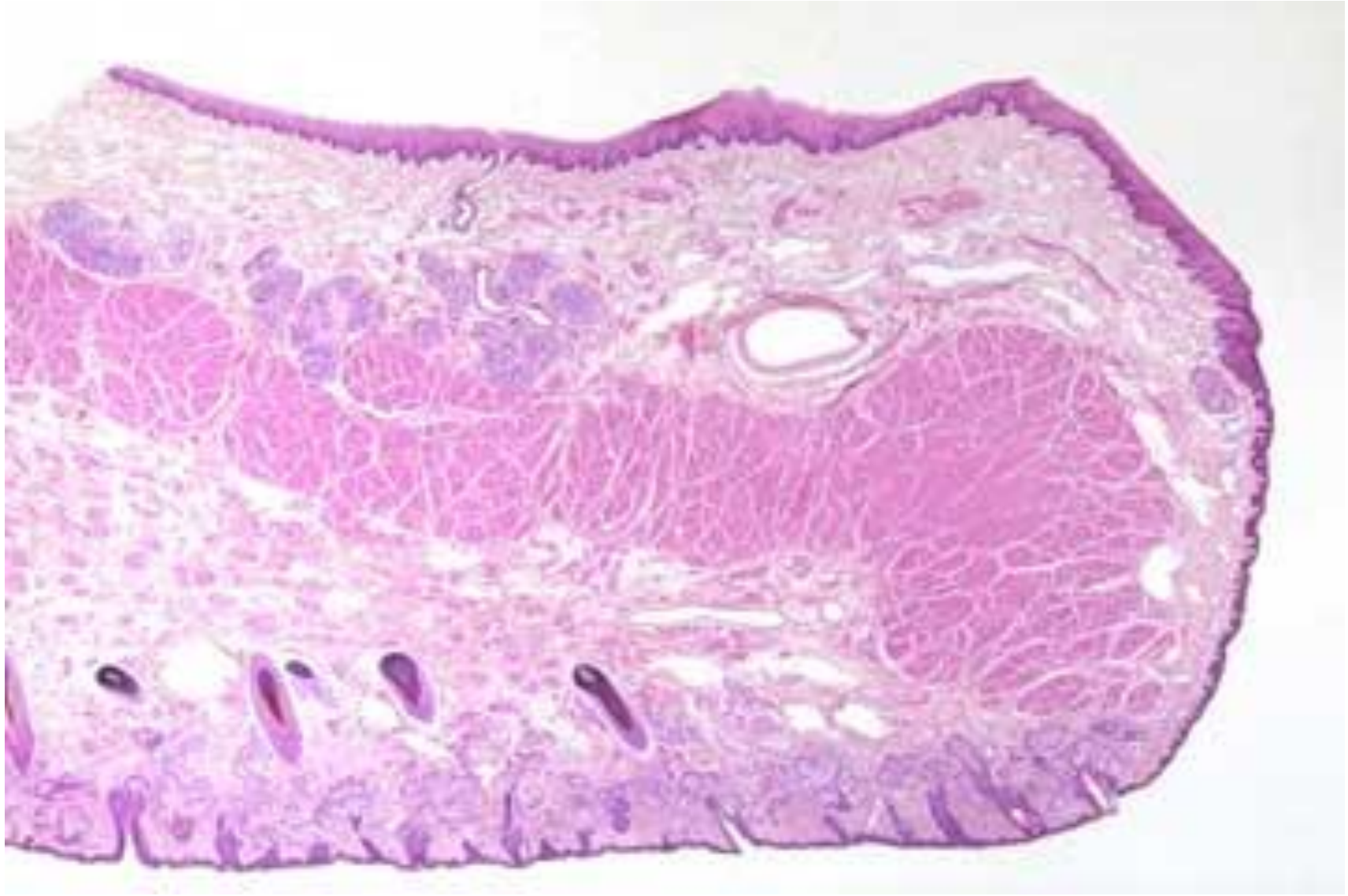
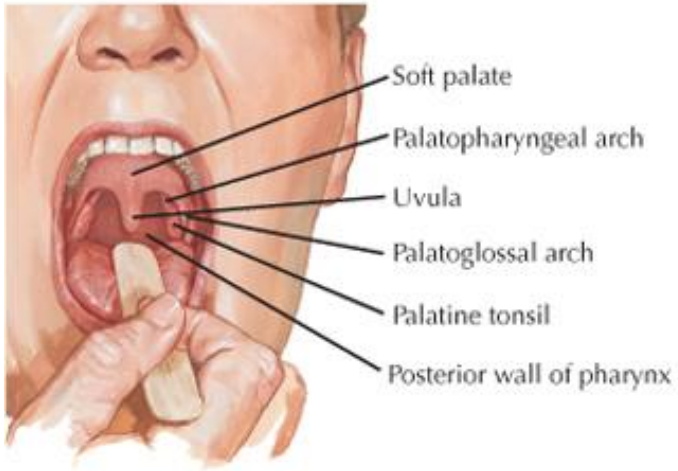
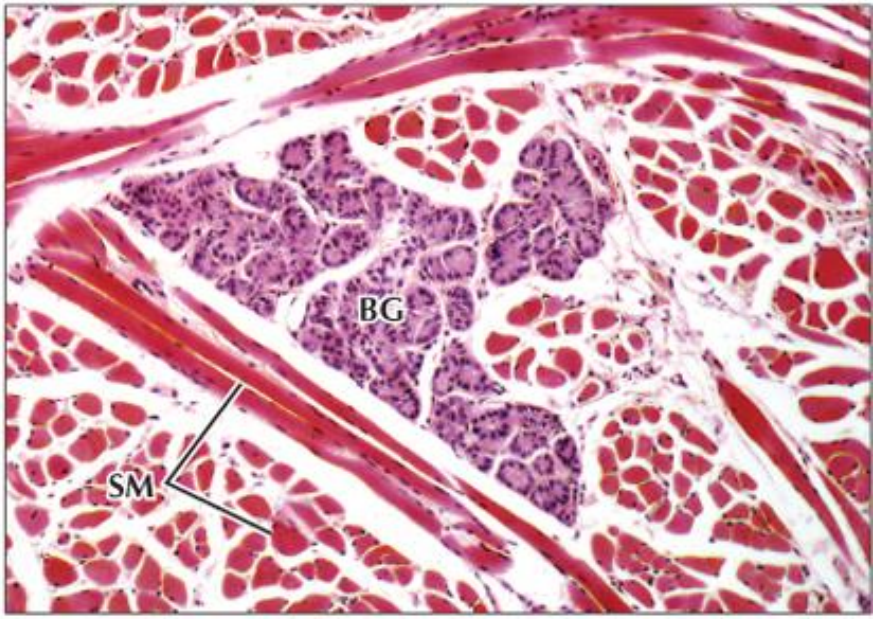


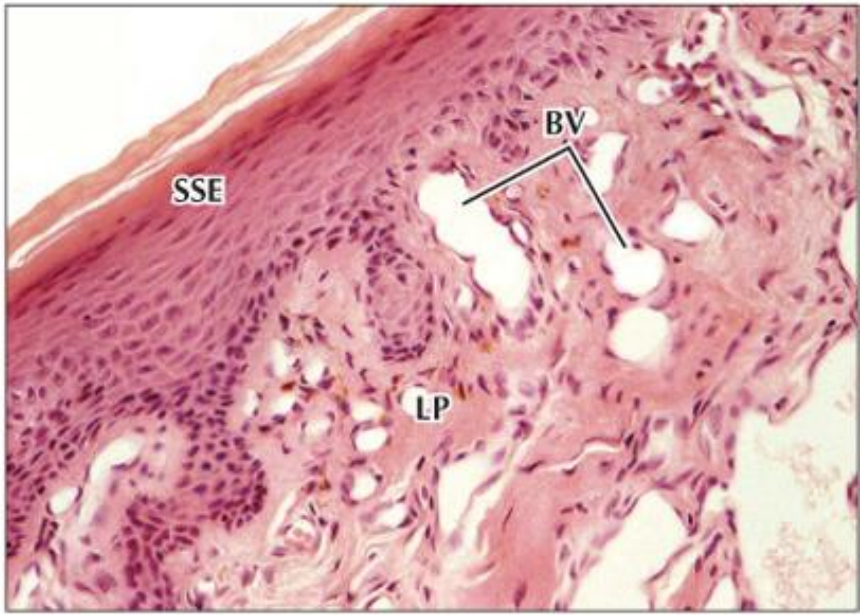
▼ **Oral cavity.**





▲ **LM of part of the cheek.** Skeletal muscle fibers (**SM**) of the buccinator are sectioned longitudinally and transversely. Parenchyma of a minor salivary (buccal) gland (**BG**) is in intervening connective tissue. 60×. *H&E.*

▼ **Marginal gingivitis.**



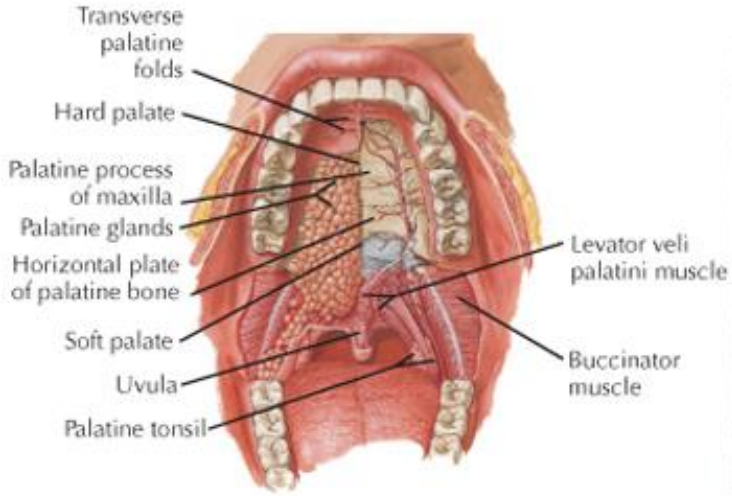
► **LM of the gingiva.** Lightly keratinized stratified squamous epithelium (**SSE**) and richly vascularized lamina propria (**LP**) form the masticatory oral mucosa on the surface Many small, thin-walled blood vessels (**BV**) are in the connective tissue. 250×. *H&E.*

Palate

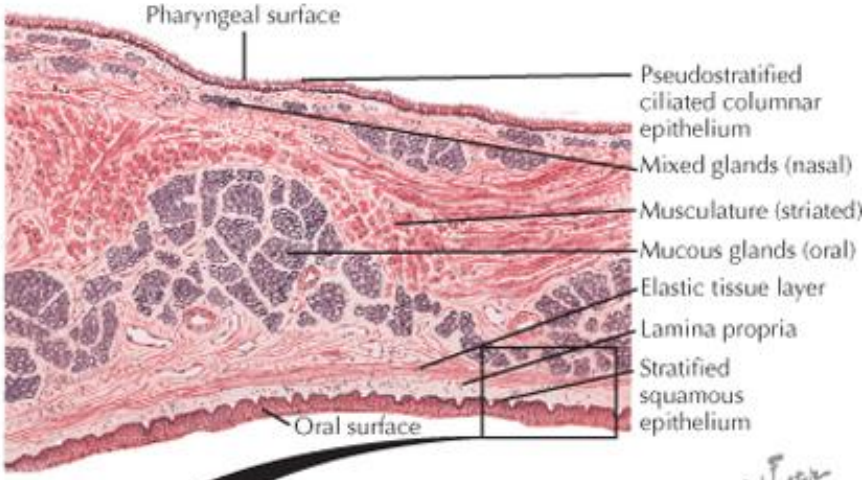
- Hard palate – bone plate covered by masticatory mucosa tightly attached to periost

- Soft palate
  - Oral surface – stratified squamous epithelium
  - Nasal surface – respiratory pathway epithelium
- Glandulae palatinae – salivary mucous glands

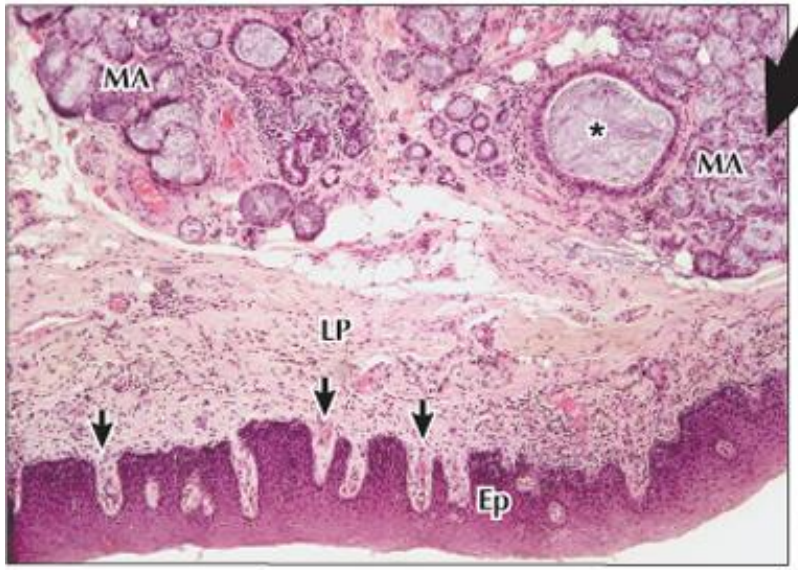
▼ Roof of mouth.



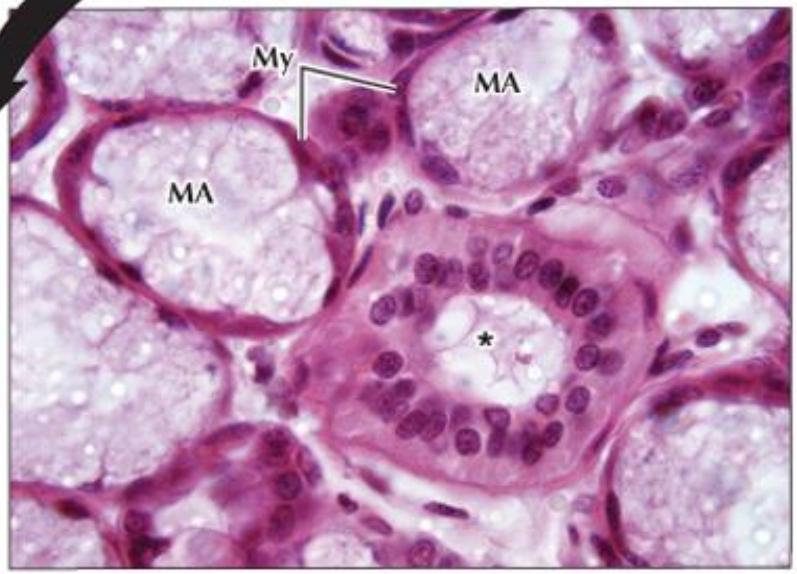
▼ Section through the soft palate.



F. Netter M.D.



▲ **LM of the oral surface of the hard palate.** Stratified squamous epithelium (**Ep**) of the mucosa is orthokeratinized. Lymphocytes infiltrate the richly vascularized lamina propria (**LP**). Conical connective tissue papillae (**arrows**) protrude into the epithelium. Part of a palatine gland—consisting of collections of pale mucous acini (**MA**) and a duct (*)—is in the submucosa. 60×. *H&E.*



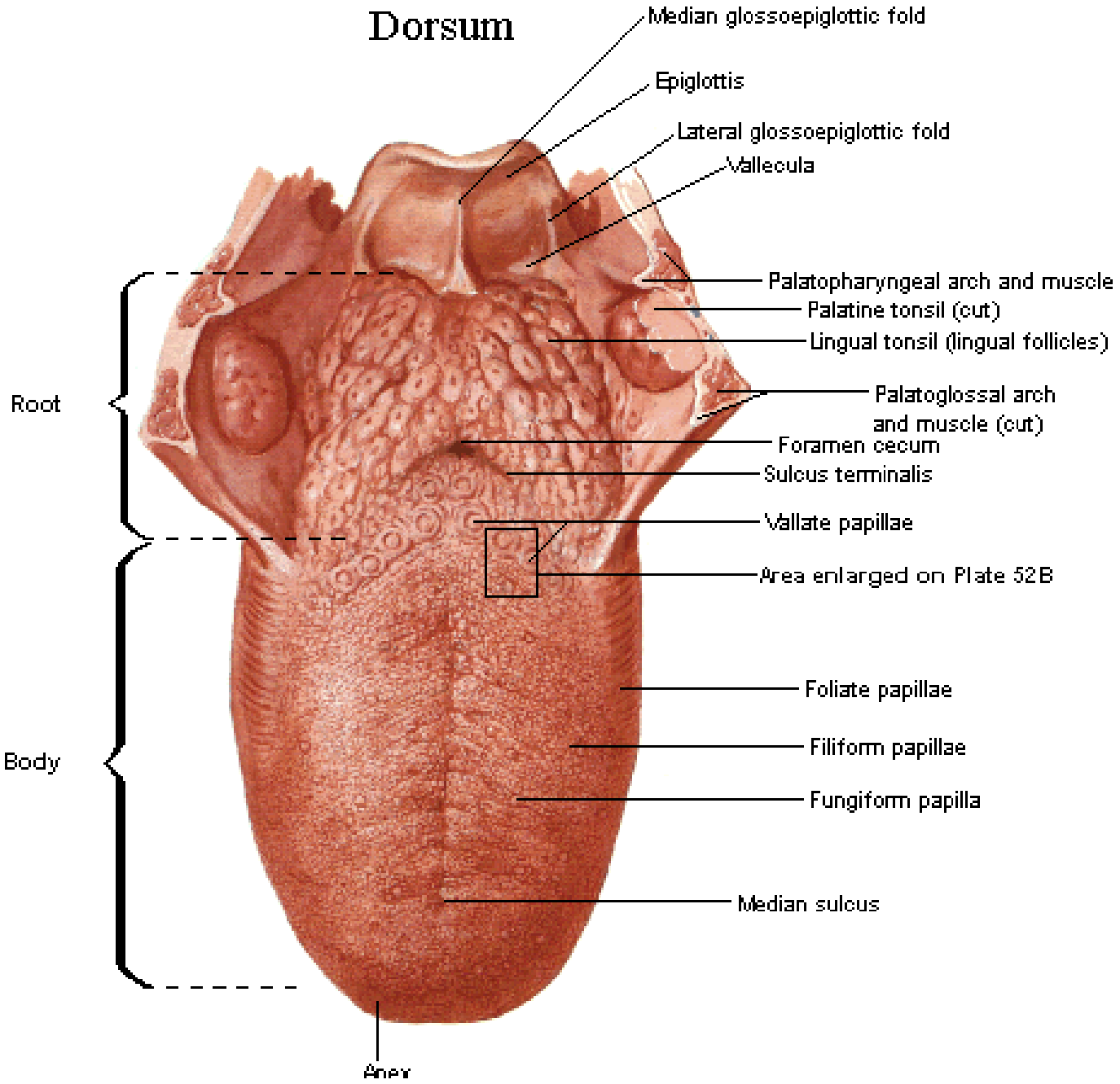
▲ **LM of part of a palatine gland.** Pale mucous cells make up each mucous acinus (**MA**). More deeply eosinophilic, flat myoepithelial cells (**My**) are associated with the base of each acinus. A duct (*), sectioned transversely, consists of one row of columnar epithelial cells around a central lumen. 560×. *H&E.*

Tongue

- Striated muscle (vertical, longitudinal and transverse)
- Slucus terminalis
  - Oral 2/3 – epithelium derived from oral ectoderm
  - pharyngeal 1/3 – epithelium derived from endoderm of primitive gut
- Parakeratinized stratified squamous epithelium

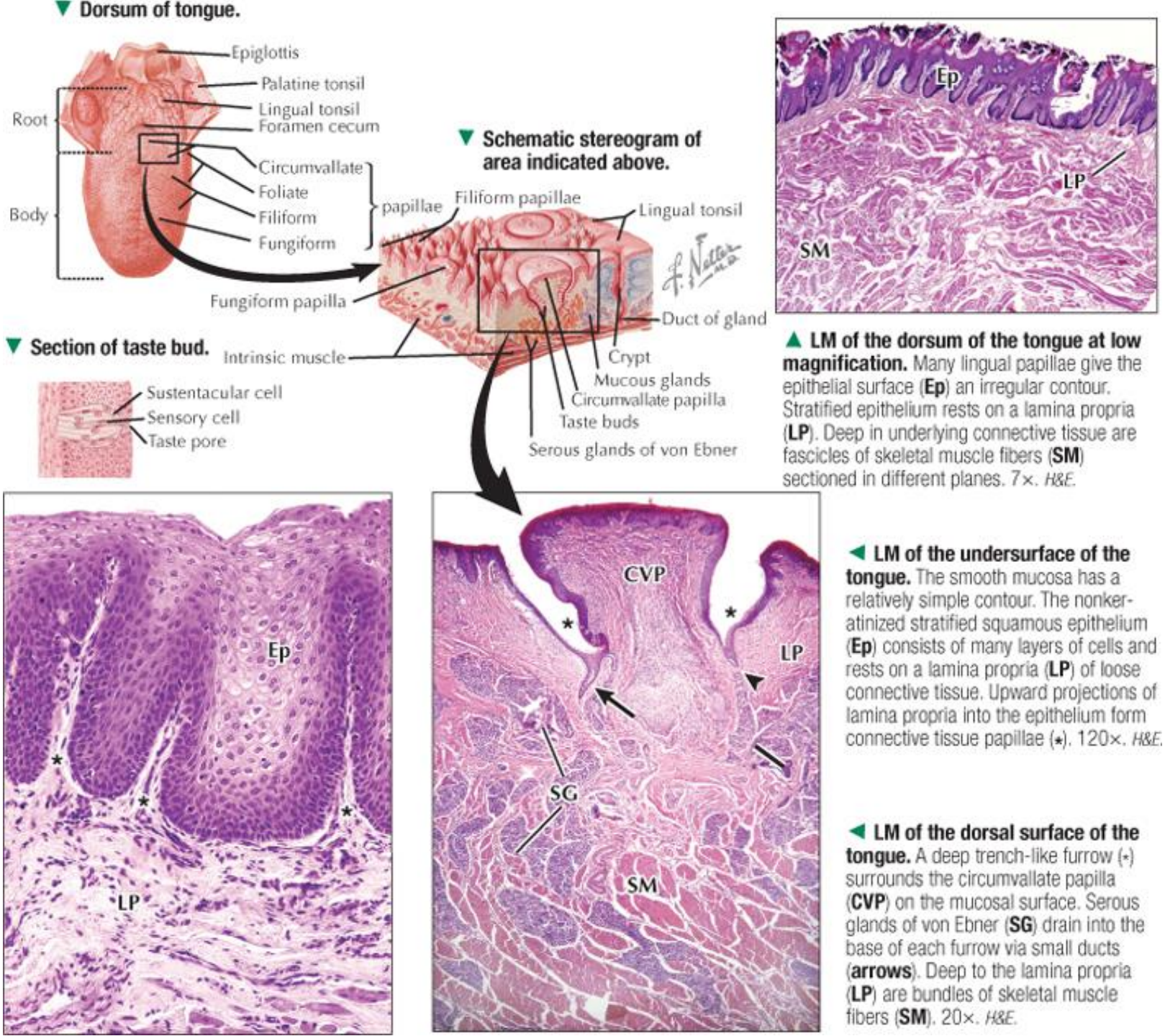
Tongue

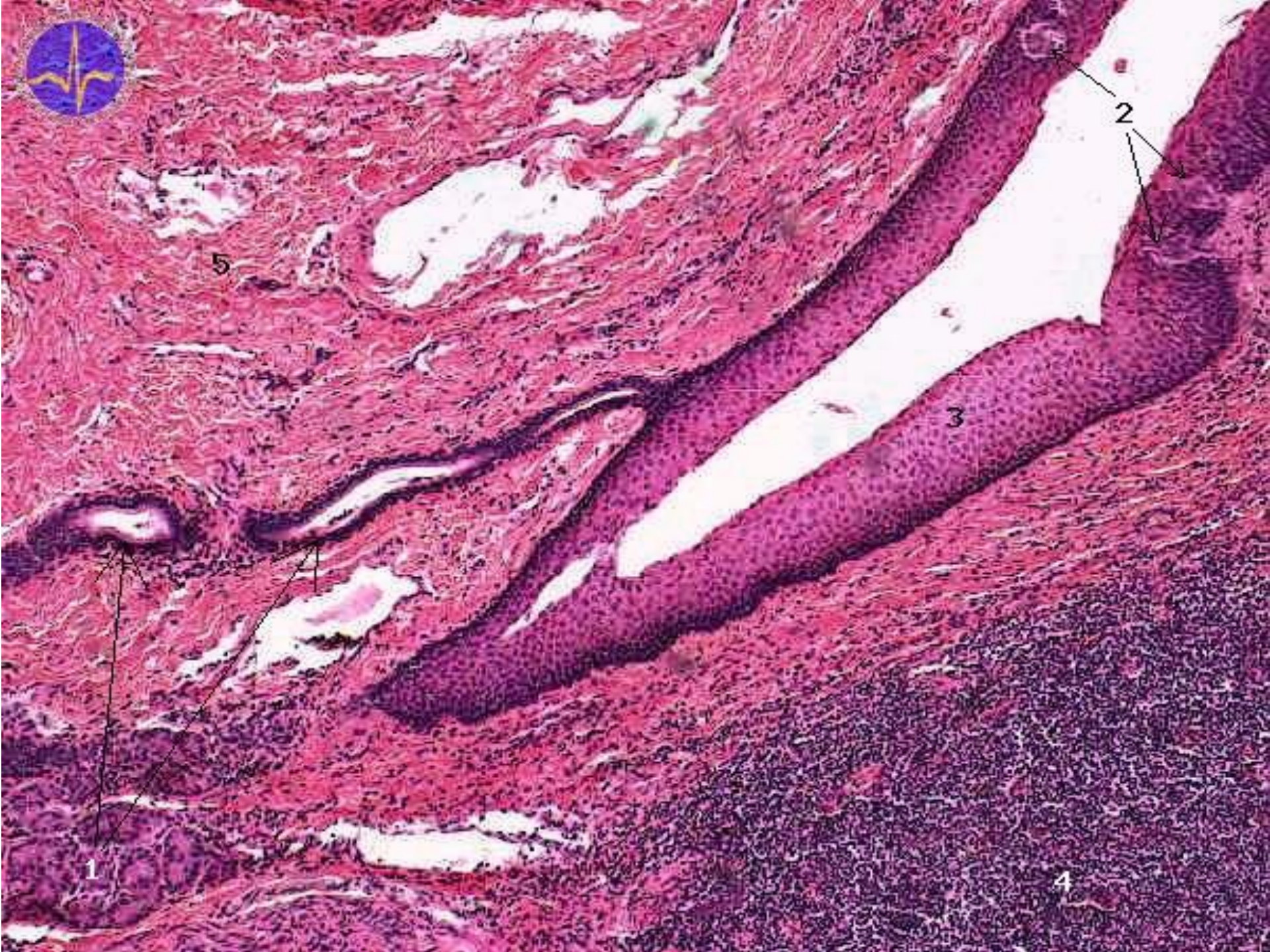
Dorsum



Tongue

- oral 2/3 – papillae
  - Papillae filiformes
  - Papillae fungiformes
  - Papillae foliatae
  - Papillae (circum)vallatae
- pharyngeal 1/3 – without papillae, 35-100 lymphatic lobules➡tonsilla lingualis


Dorsum of tongue.
Epiglottis
Palatine tonsil
Lingual tonsil
Foramen cecum
Root
Body
Circumvallate papillae
Foliate
Filiform
Fungiform
Fungiform papilla
Schematic stereogram of area indicated above.
Filiform papillae
Lingual tonsil
Duct of gland
Crypt
Mucous glands
Circumvallate papilla
Taste buds
Serous glands of von Ebner
Intrinsic muscle
Section of taste bud.
Sustentacular cell
Sensory cell
Taste pore
Ep
LP
SM
LM of the dorsum of the tongue at low magnification. Many lingual papillae give the epithelial surface (Ep) an irregular contour. Stratified epithelium rests on a lamina propria (LP). Deep in underlying connective tissue are fascicles of skeletal muscle fibers (SM) sectioned in different planes. 7×. H&E.
Ep
LP
LM of the undersurface of the tongue. The smooth mucosa has a relatively simple contour. The nonkeratinized stratified squamous epithelium (Ep) consists of many layers of cells and rests on a lamina propria (LP) of loose connective tissue. Upward projections of lamina propria into the epithelium form connective tissue papillae (*). 120×. H&E.
CVP
LP
SG
SM
LM of the dorsal surface of the tongue. A deep trench-like furrow (*) surrounds the circumvallate papilla (CVP) on the mucosal surface. Serous glands of von Ebner (SG) drain into the base of each furrow via small ducts (arrows). Deep to the lamina propria (LP) are bundles of skeletal muscle fibers (SM). 20×. H&E.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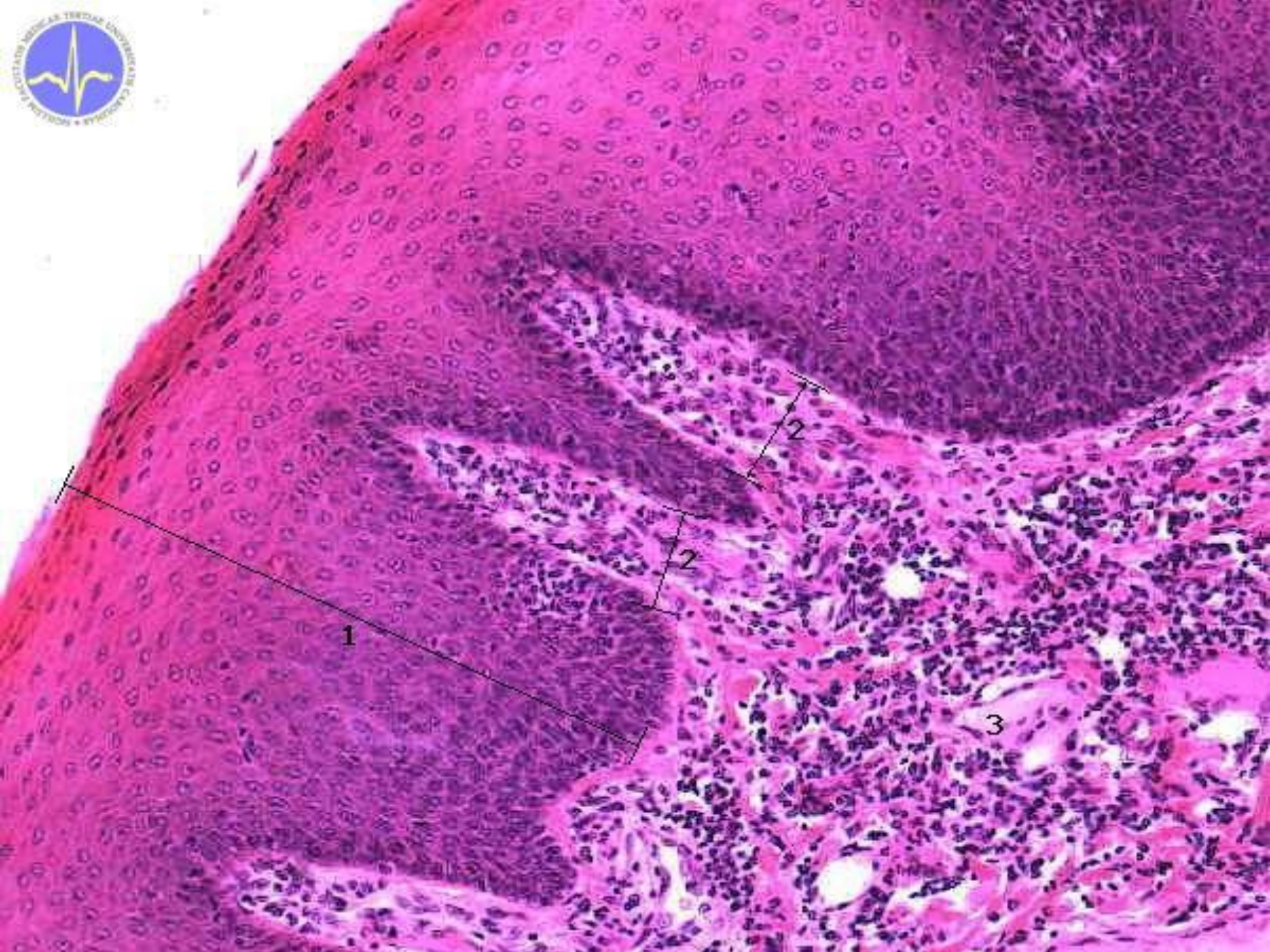
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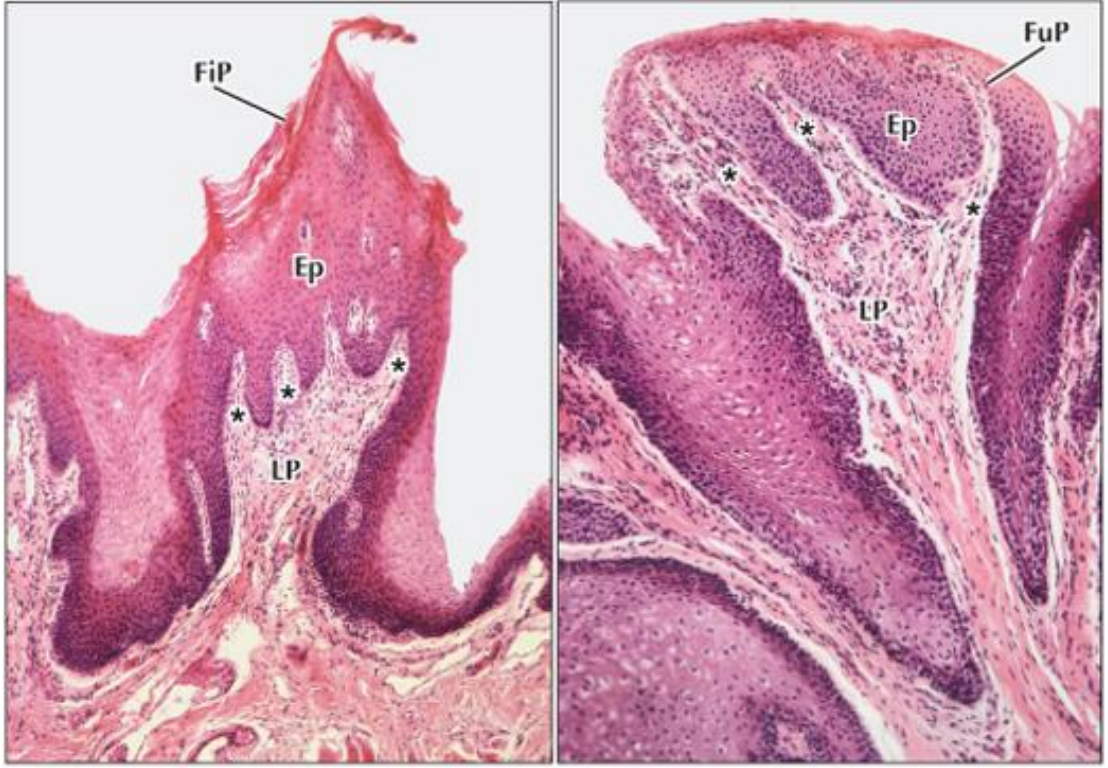
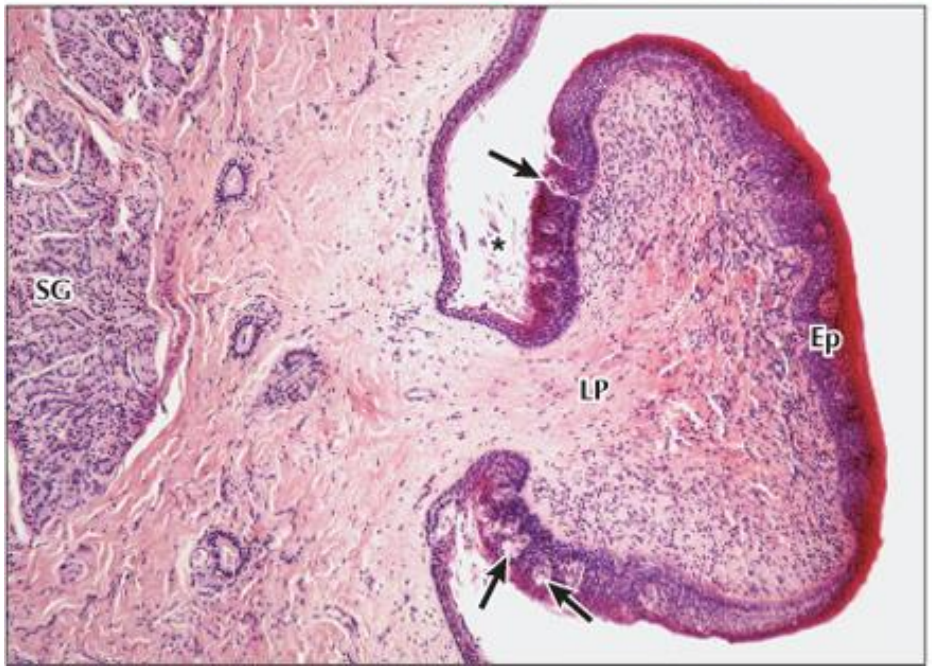


◀ **LMs of filiform (Left) and fungiform (Right) papillae. Left**, A layer of keratin covers the pointed end of the filiform papilla (**FiP**). Underlying stratified squamous epithelium (**Ep**) is a core of lamina propria (**LP**) with secondary connective tissue papillae (*). **Right**, The mushroom-shaped fungiform papilla (**FuP**) has parakeratinized epithelium (**Ep**). Small secondary connective tissue papillae (*) emanate from a central core of lamina propria (**LP**). **Left:** 75×; **Right:** 80×. *H&E.*



◀ **LM of a circumvallate papilla.** Nonkeratinized stratified squamous epithelium (**Ep**), which has several taste buds embedded in the lateral margins (**arrows**), covers the papilla, and a deep furrow (*) encircles it. Underlying lamina propria (**LP**) is loose, richly cellular connective tissue. Serous glands of von Ebner (**SG**) are in deeper areas of the connective tissue. Their watery secretions help flush cellular debris from the furrow, to better expose taste buds to gustatory stimuli. 70×. *H&E.*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1
2
3


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1
2
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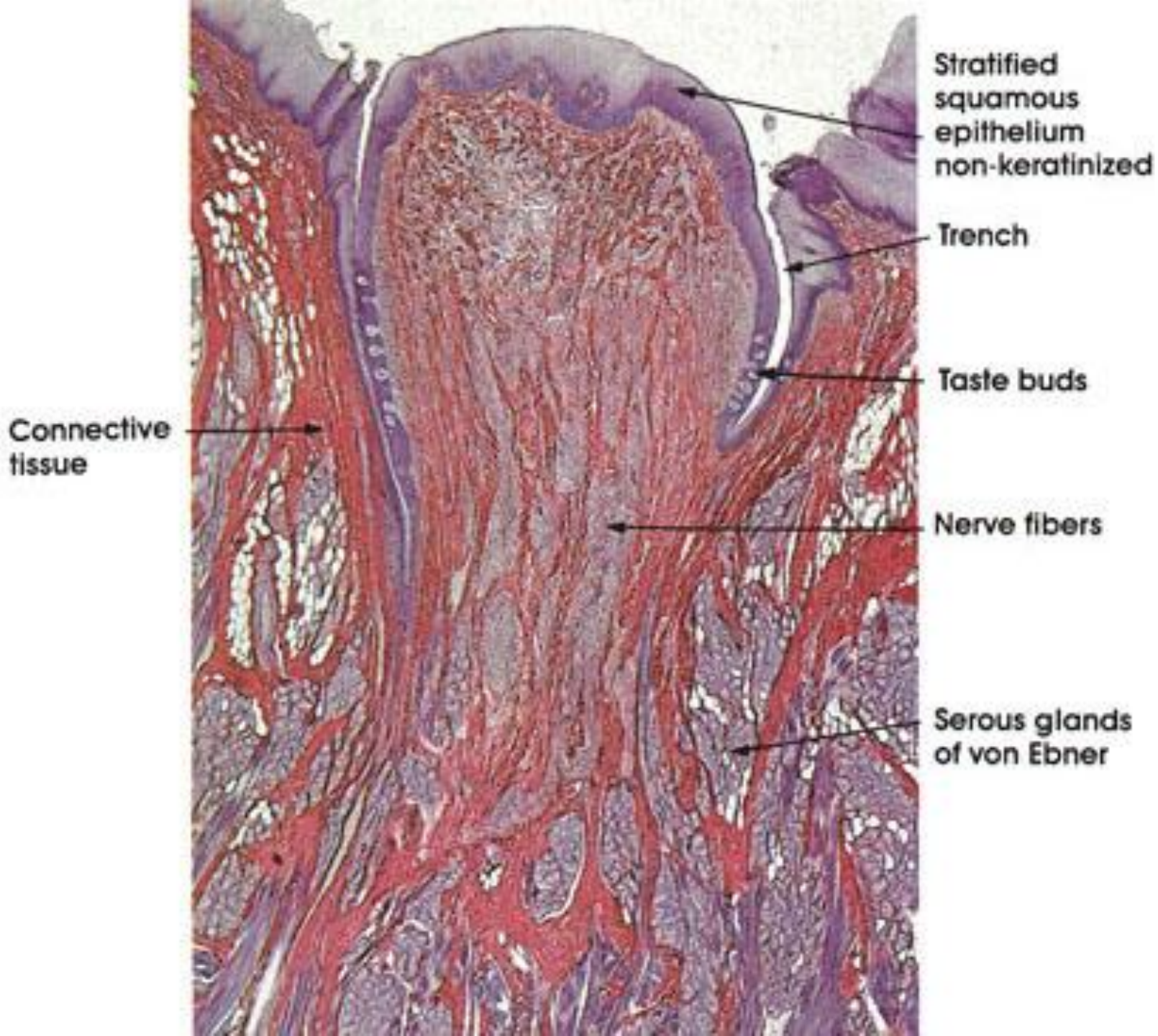
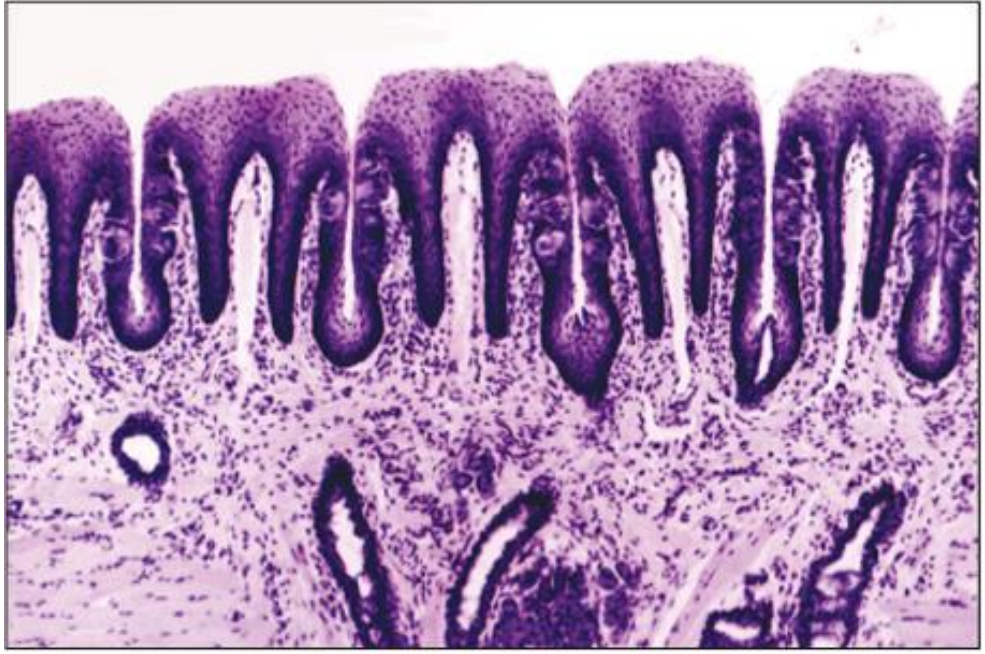
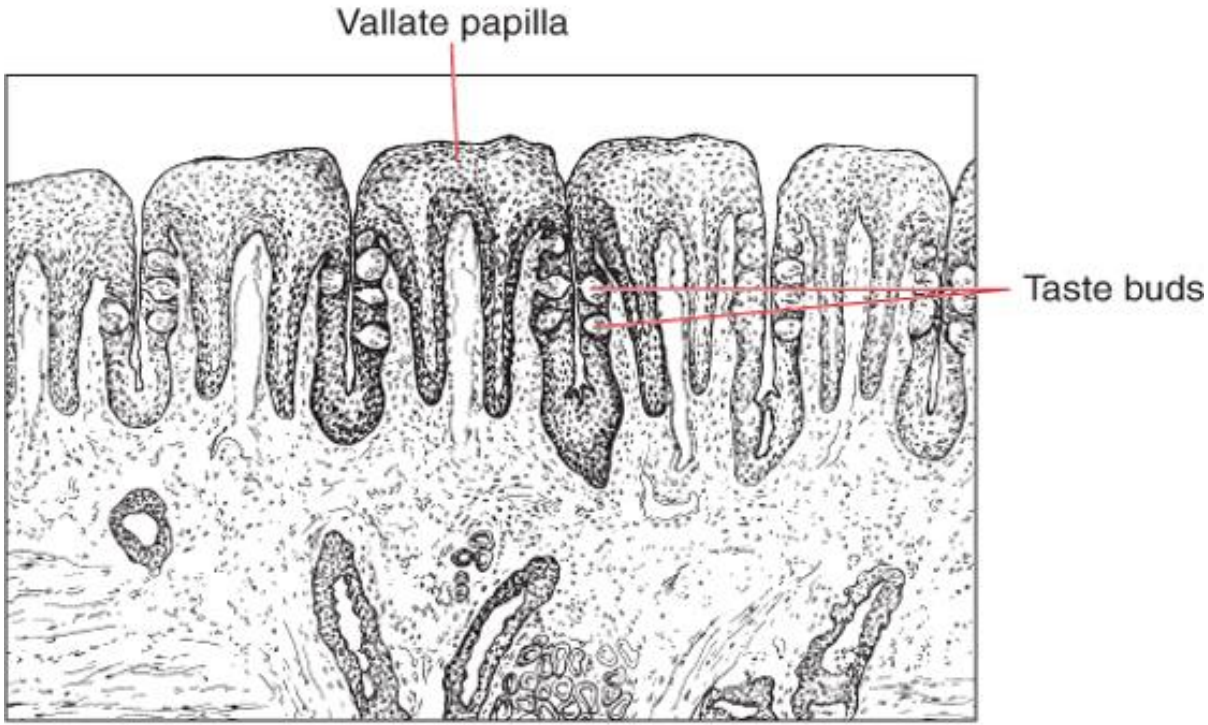
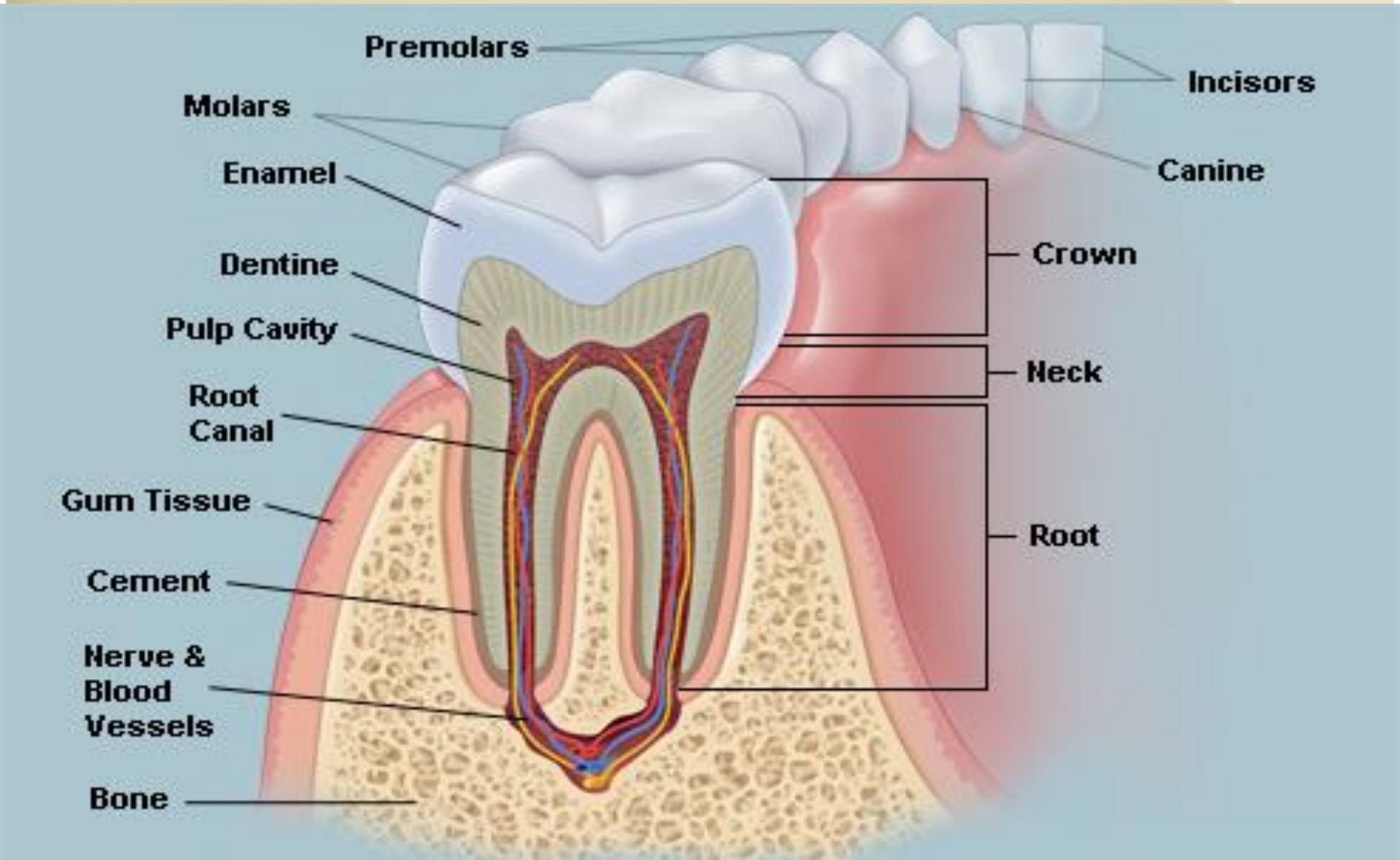
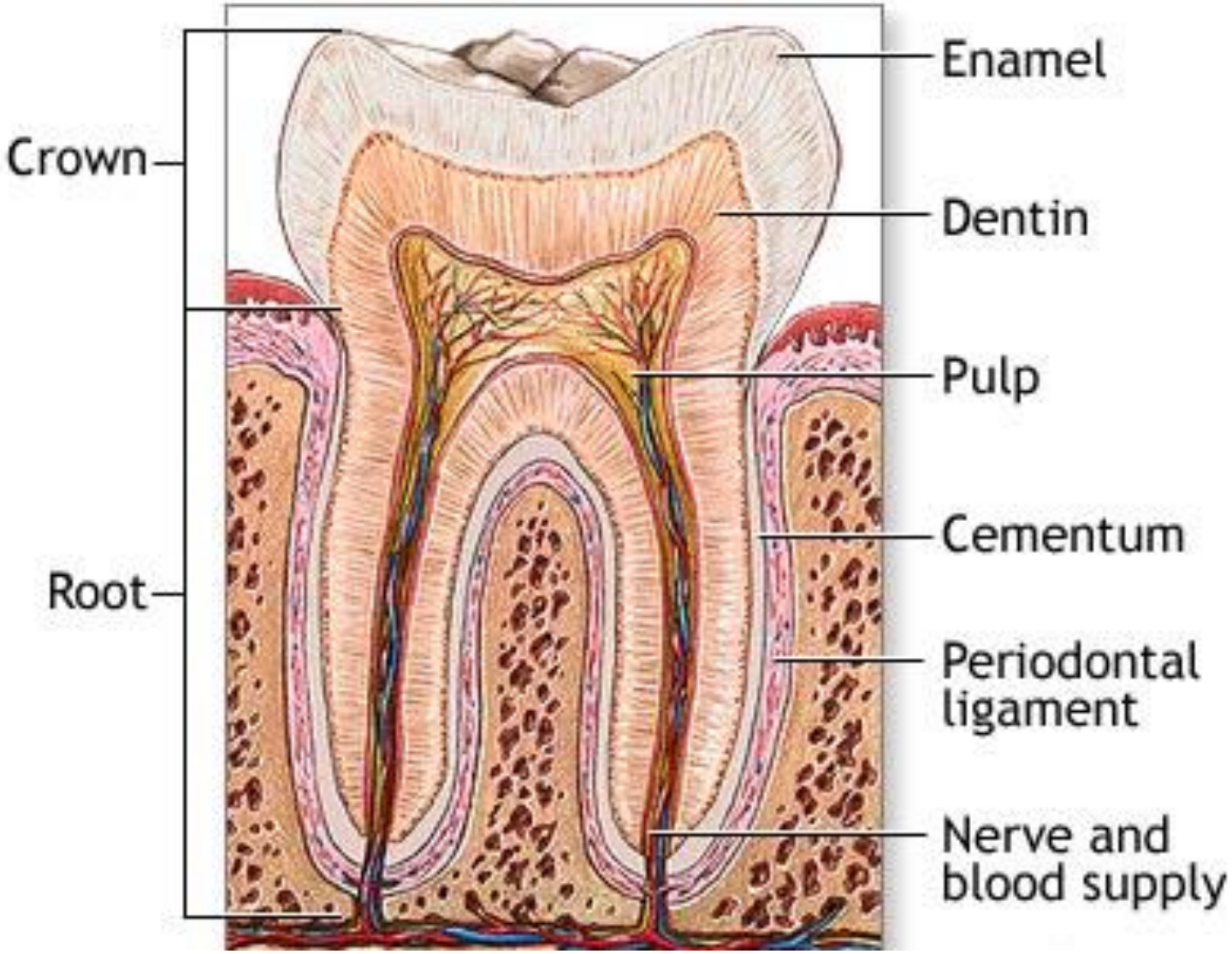

Stratified squamous epithelium non-keratinized
Trench
Taste buds
Connective tissue
Nerve fibers
Serous glands of von Ebner

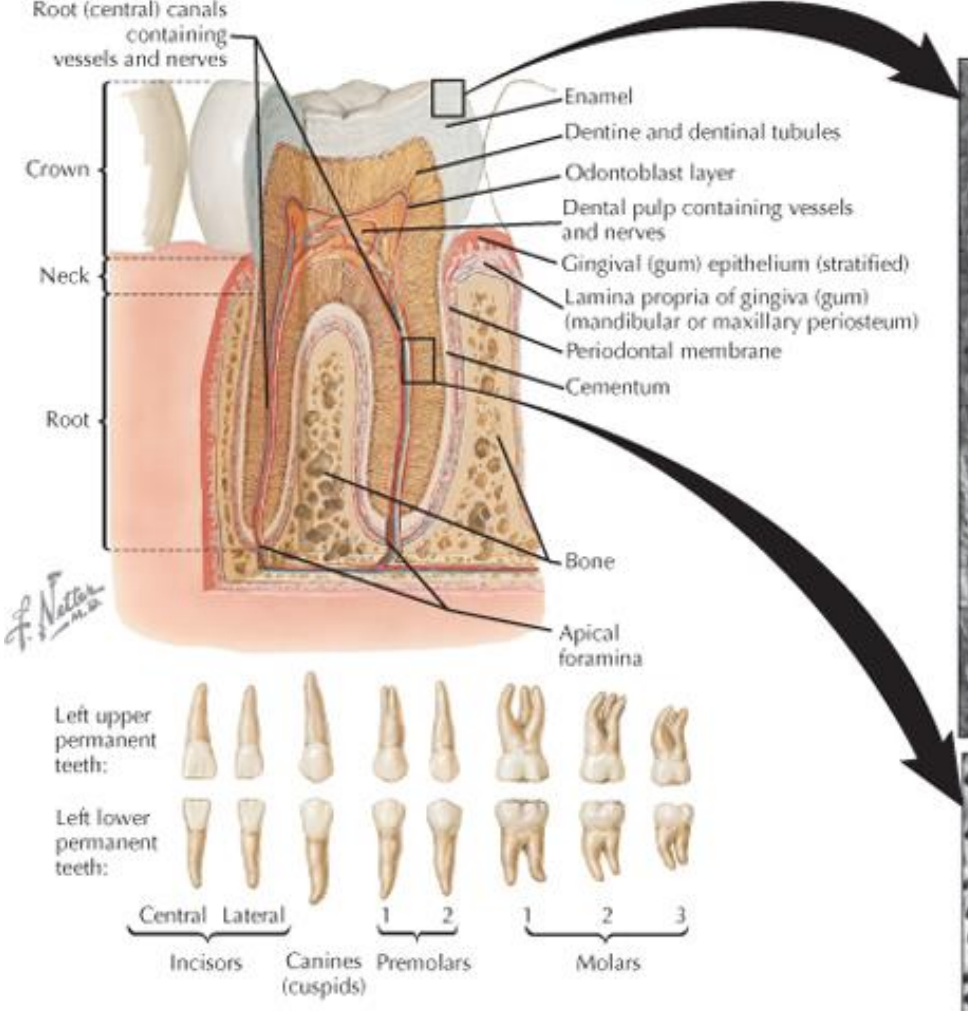


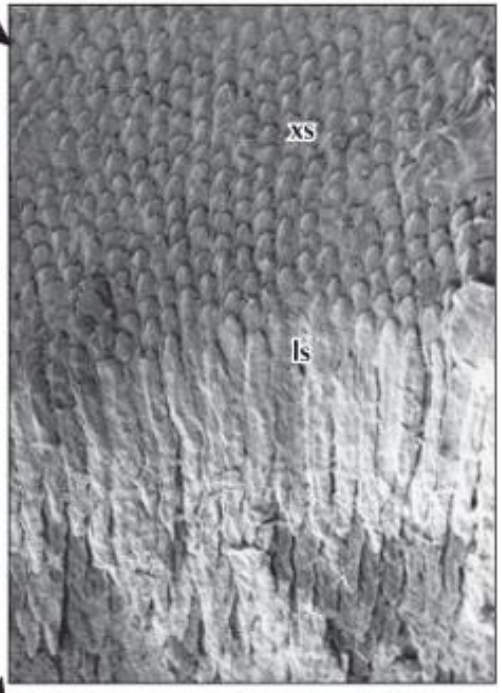

Vallate papilla
Taste buds

Tooth

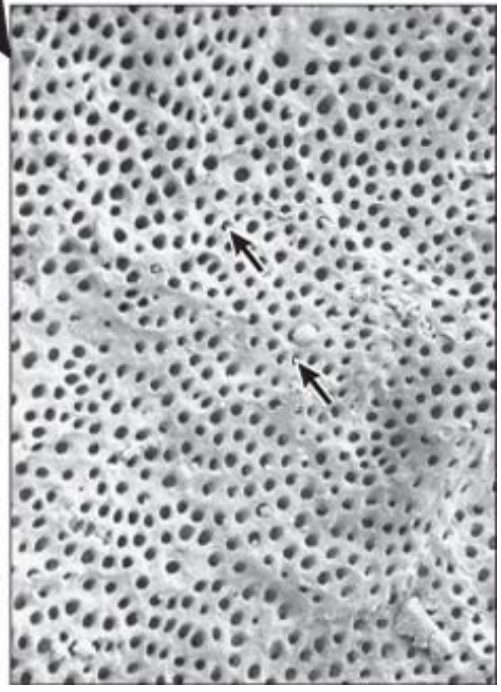

Premolars
Molars
Enamel
Dentine
Pulp Cavity
Root Canal
Gum Tissue
Cement
Nerve & Blood Vessels
Bone
Incisors
Canine
Crown
Neck
Root


Crown
Root
Enamel
Dentin
Pulp
Cementum
Periodontal ligament
Nerve and blood supply





◀ **Scanning electron micrograph (SEM) of enamel.** Tightly packed enamel rods are fractured transversely (**xs**) and longitudinally (**ls**). 950×. *(Courtesy of Dr. P. R. Dow)*

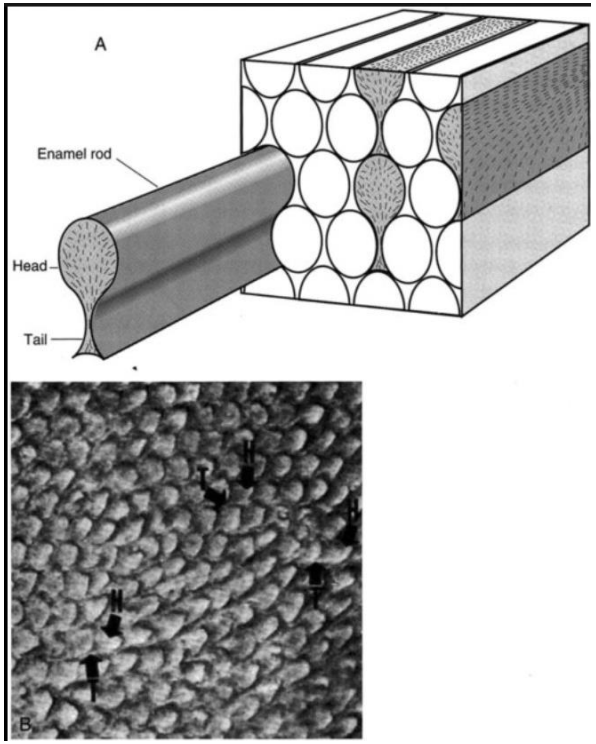


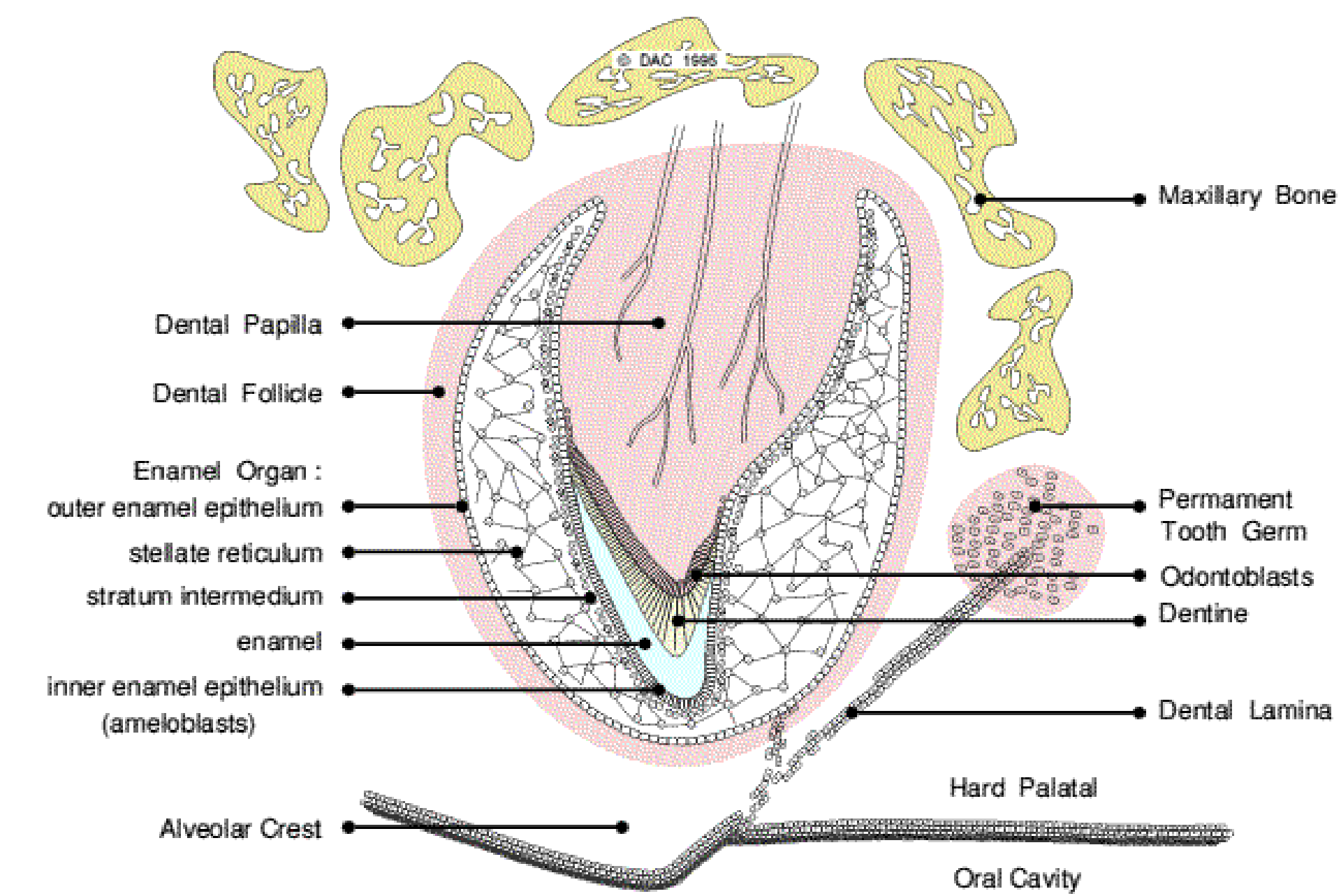
► **SEM of dentin.** Dentinal tubules (**arrows**) are seen in the transverse plane. 950×. (*Courtesy of Dr. P. R. Dow)*

Ameloblasts & Enamel

- Cylindric polarized cells present only during development
- 96 – 98 % of calcium hydroxyapatite
- Enamel is composed of enamel rods

- Matrix production – partialy mineralized enamel
- Matrix maturation – influx of calcium and phosphate ions

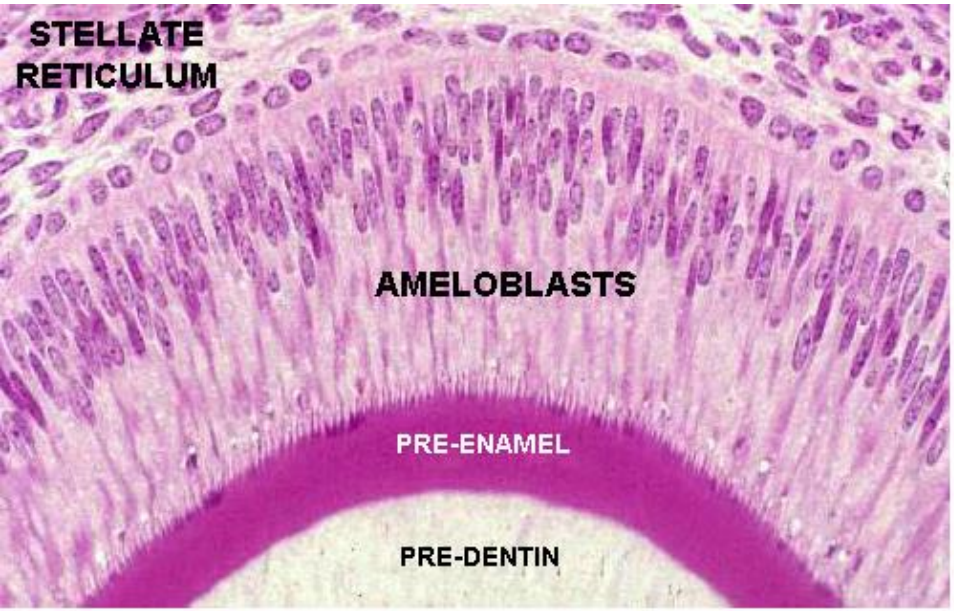


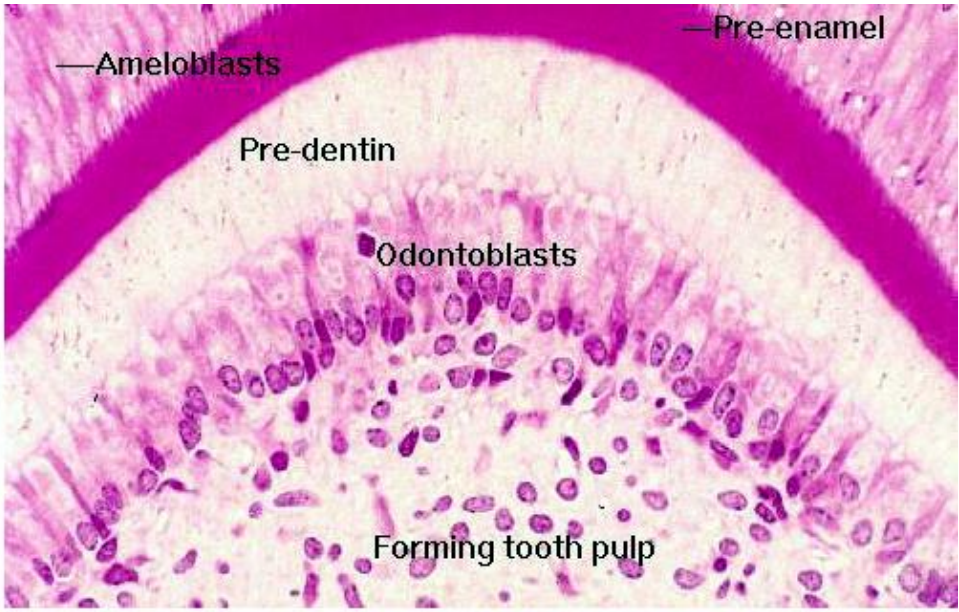


Enamel organ during development

Enamel

- 95 – 98 % calcium hydroxyapatite (HA)
- EC protein matrix 1 – 2 %
- water 2 %
- Enamel rods = parallely oriented HA crystals
- Interprismatic matter = HA crystals with different orientation





A close relationship between the ameloblasts and the overlying stellate reticulum is necessary for continued enamel to form. This is seen in the left panel in an un-erupted tooth. At right, the intimate contact between the odontoblasts and the forming dentin is shown. Both ameloblasts and odontoblasts are tall, coumnar cells with long processes; as they lay down and calcity their matrices, they retreat from the forming material and leave small channels in the hardened substances. These dentinal tubules and enamel tubules are fracture planes where injury to the tooth is likely to occur from trauma.

Odontoblasts & Dentin

- Columnar cells producing dentine – neural crest
- Calcified mineral material forming most of the tooth substance
- Containing about 70 % of HA
- Odontoblasts = epithelial layer over the inner surface of dentin
- Dentinal tubules = narrow channels projecting from odontoblasts through dentin layer

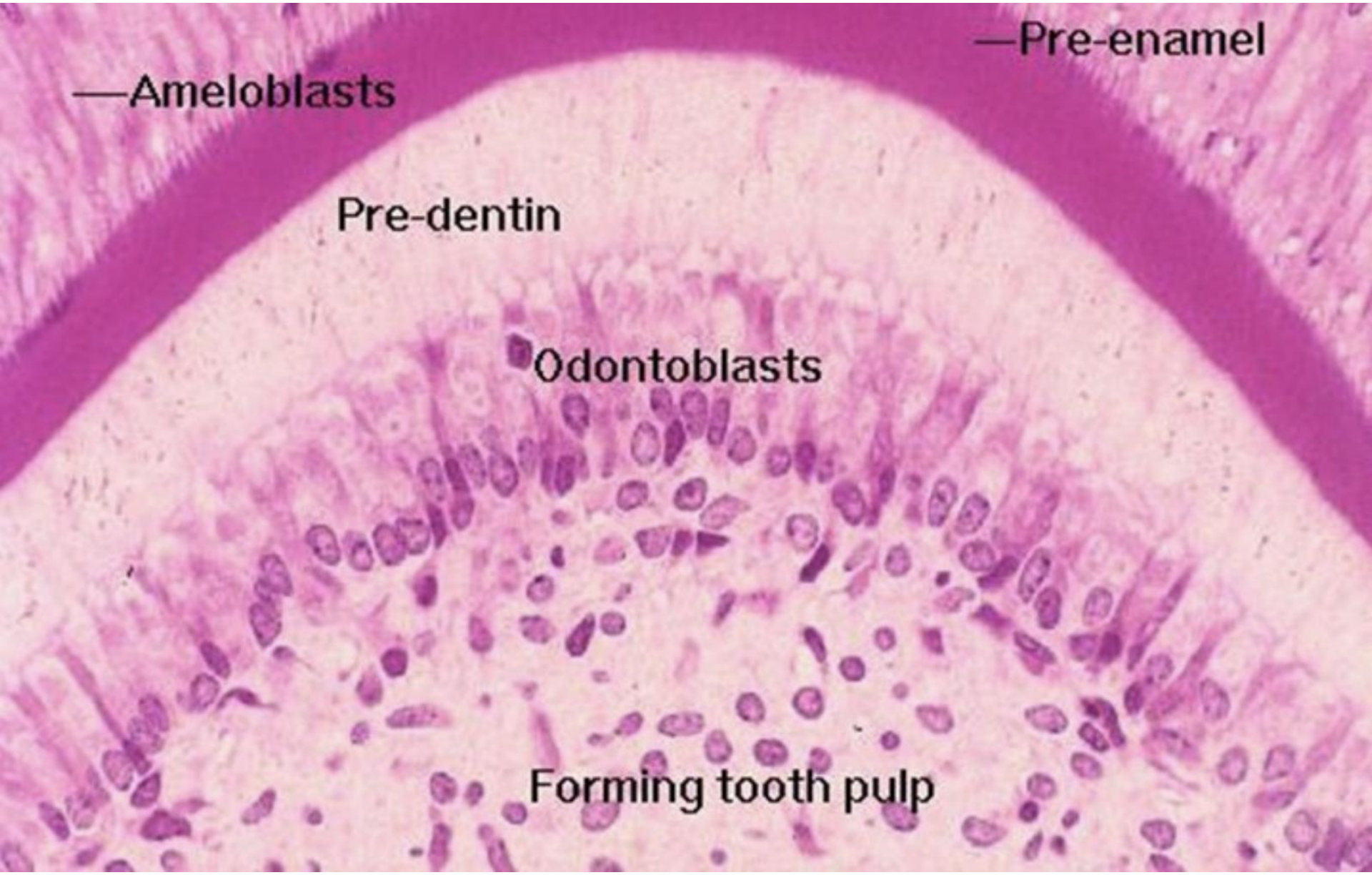


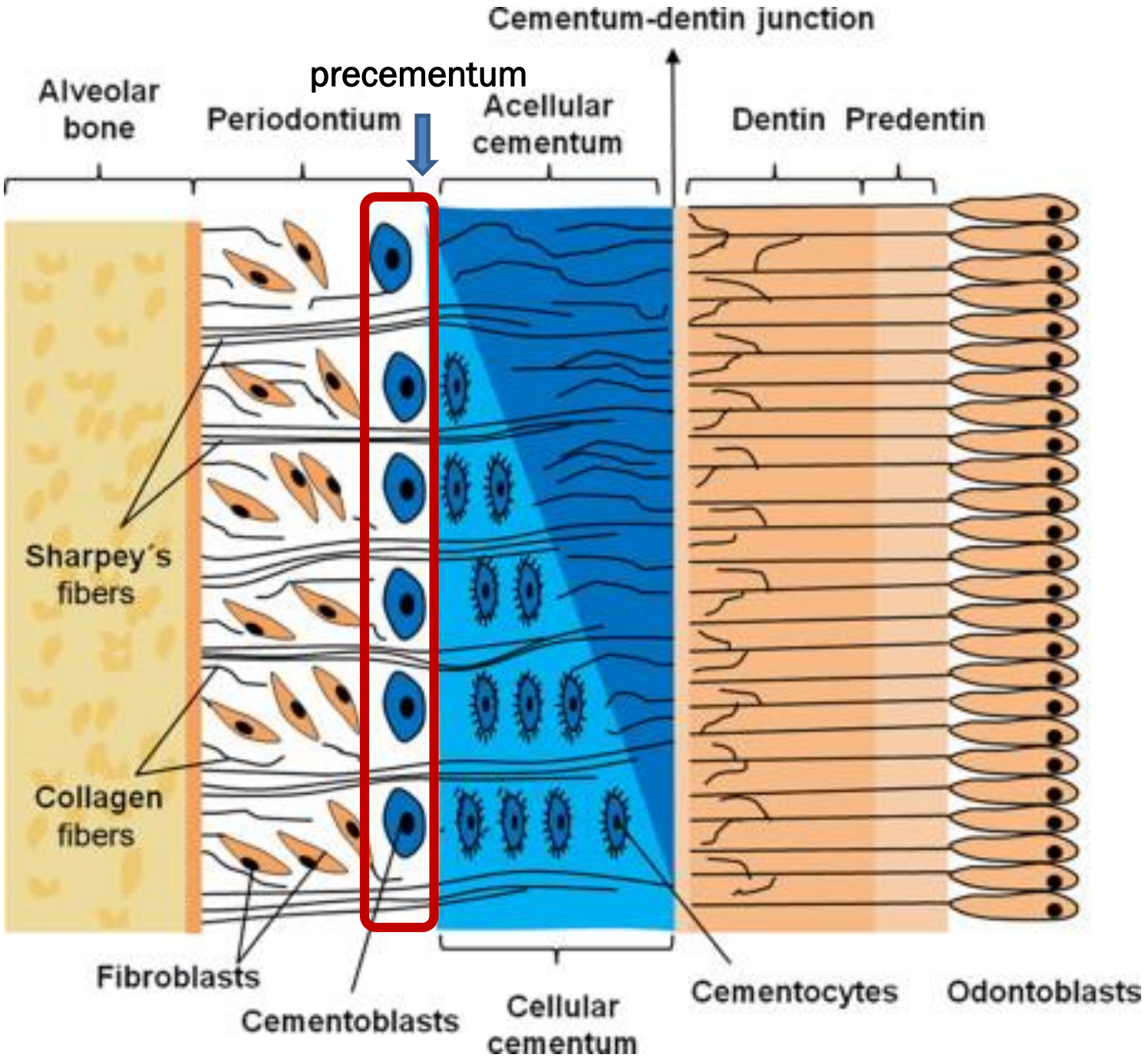
Illustration of polarized odontoblasts. Unique features of odontoblasts are shown, including the polarized cell morphology, cellular processes (including odotoblast process and primary cilium), organelles distribution (including the nucleus, Golgi apparatus, ER, centrosome and secretory vesicles), cytoskeleton arrangement, and cell-cell junctions.

Cementum

- Covers the root of the tooth
- Thin layer of bonelike material
- Secreted by cementocytes (resemble osteocytes)
- Avascular!

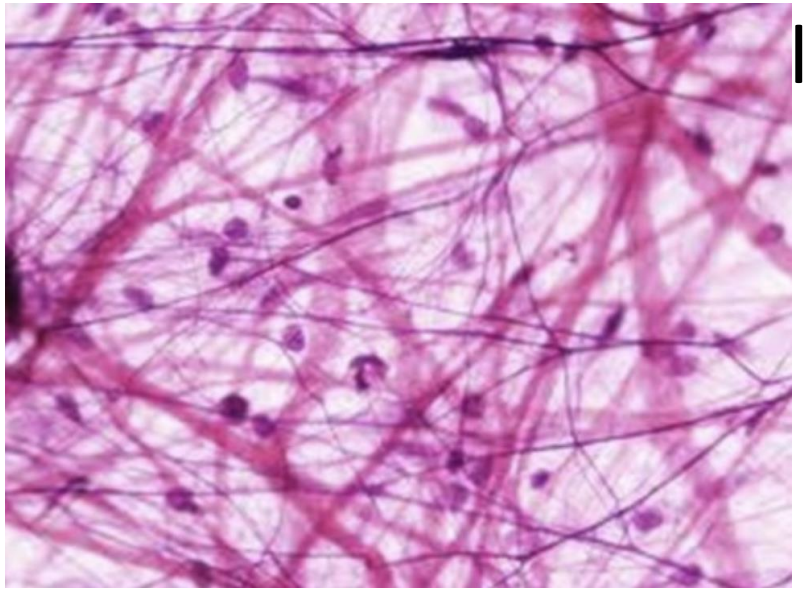
  - Minerals 60%
  - Organic matter 30% - collagen fibers (I)
  - water 10%

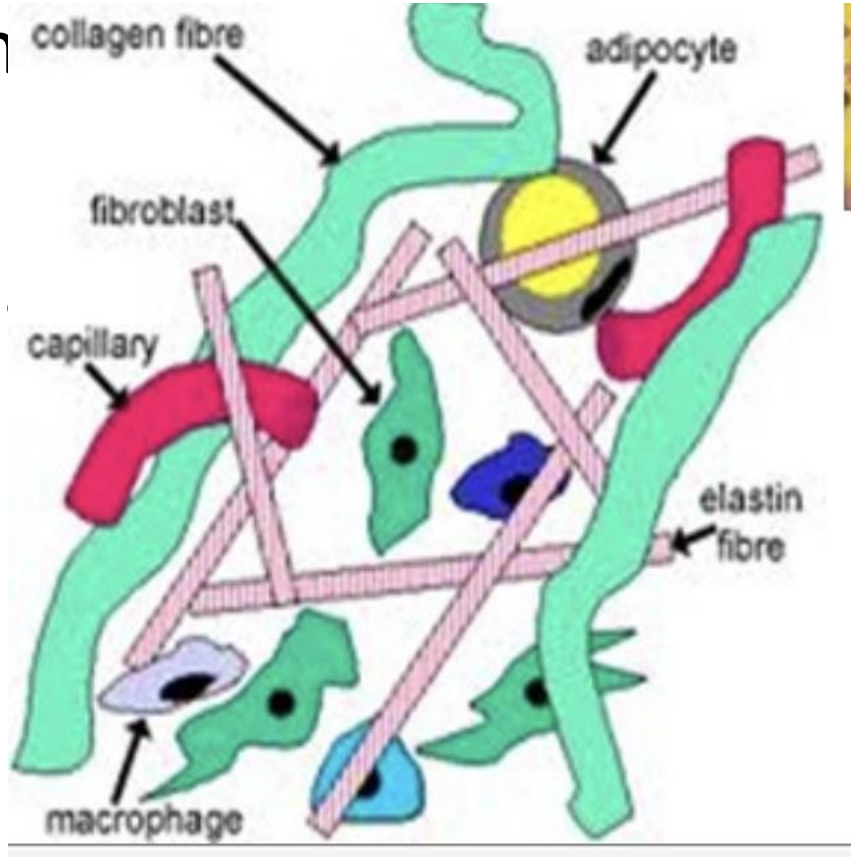
- Sharpey`s fibers – collagen fibers projecting out of the cementum, embed the tooth in bony matrix


Cementum-dentin junction
precementum
Alveolar bone
Periodontium
Acellular cementum
Dentin
Predentin
Sharpey´s fibers
Collagen fibers
Fibroblasts
Cementoblasts
Cellular cementum
Cementocytes
Odontoblasts

Pulp

- Specialized connective tissue in the pulp cavity
- Loose connective tissue richly vascularized and supply by abundan
- Apical foramen
-





Salivary glands

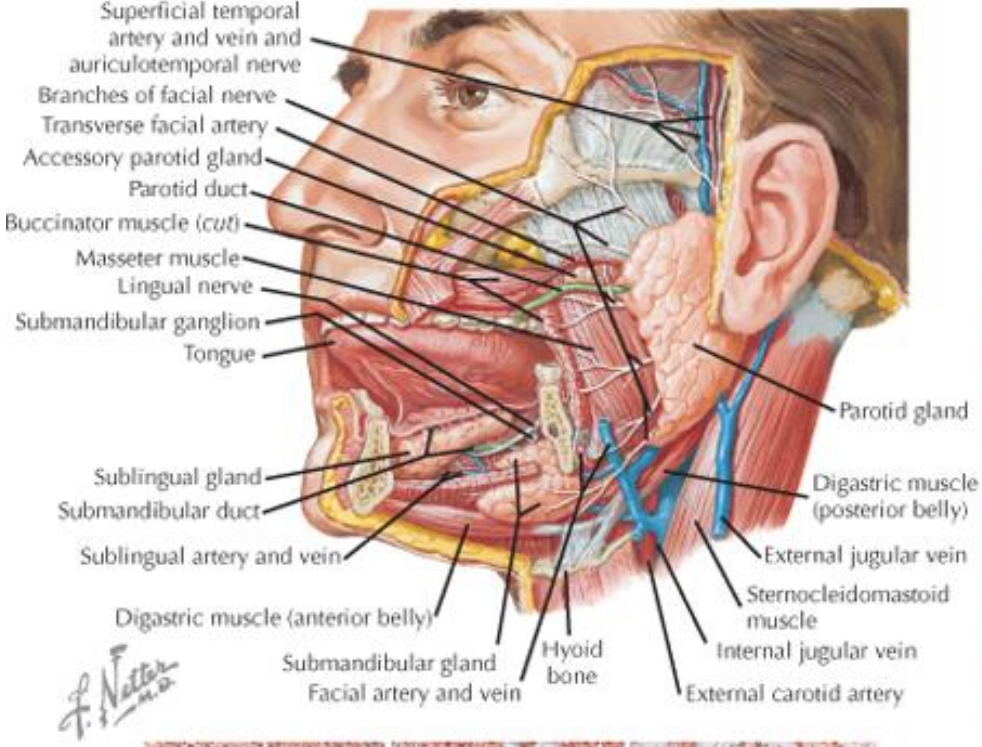
- 700-1500 ml/day
- Gll.salivariae majores et minores
- water, enzymes, ions, IgA (G,M), amylase, lysosyme, mucines, defensine…

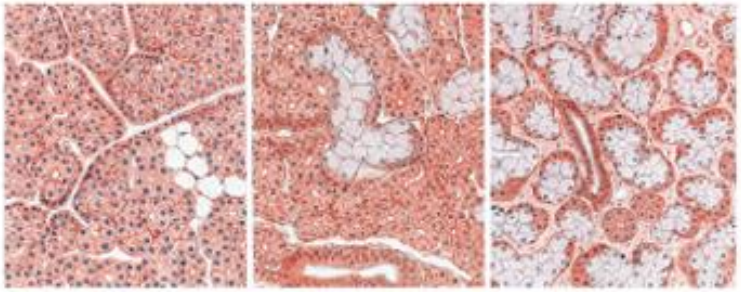
- Parenchyme and connective tissues
- Glandular epithelium – derivative of oral ectoderm (6.t.)
- Capsule – mesenchymal origin

Glandula parotis

- Acinar gland with serous secretion
- The biggest salivary gland (15-30 g)

- Pyramidal serous cells surrounding lumen

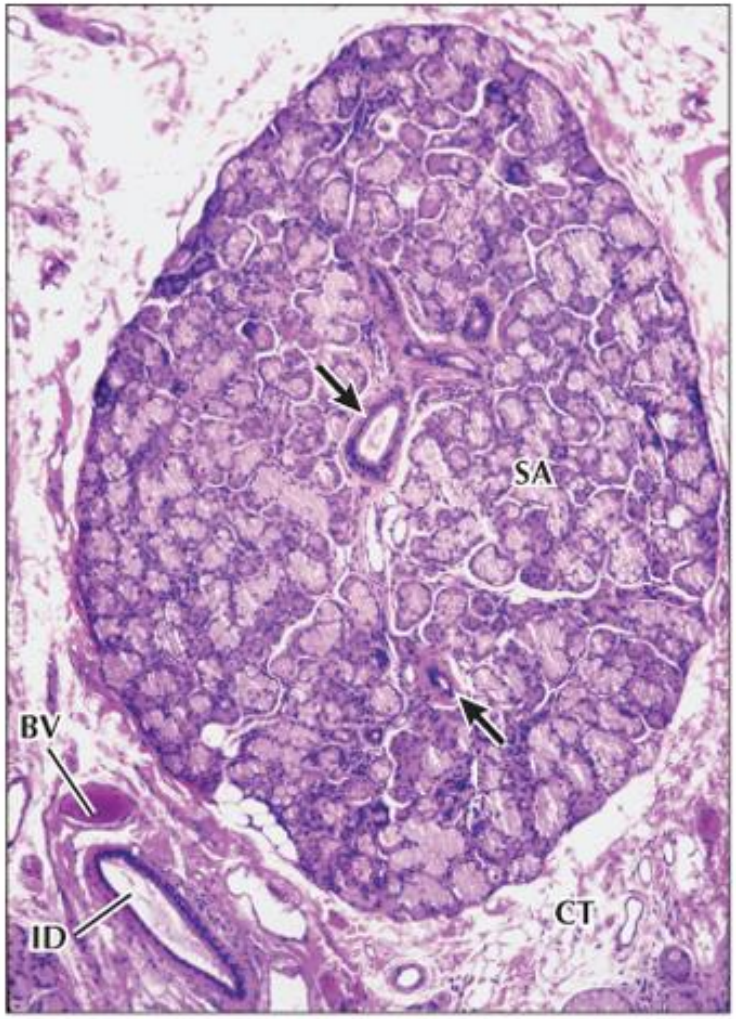




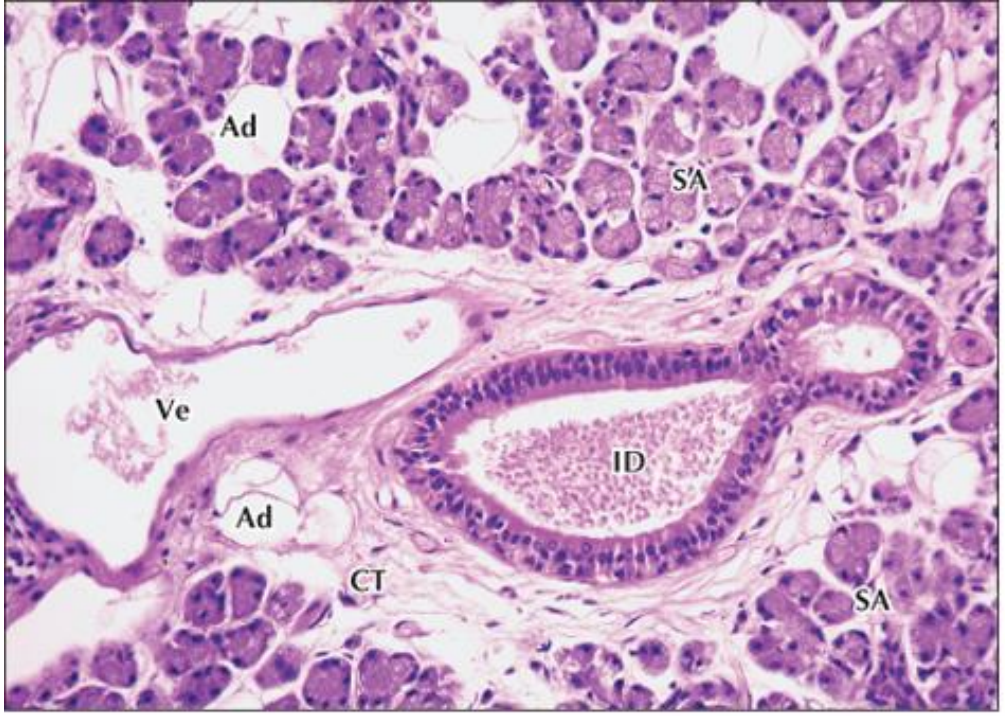
Parotid gland: totally serous

Submandibular gland: mostly serous, partially mucous

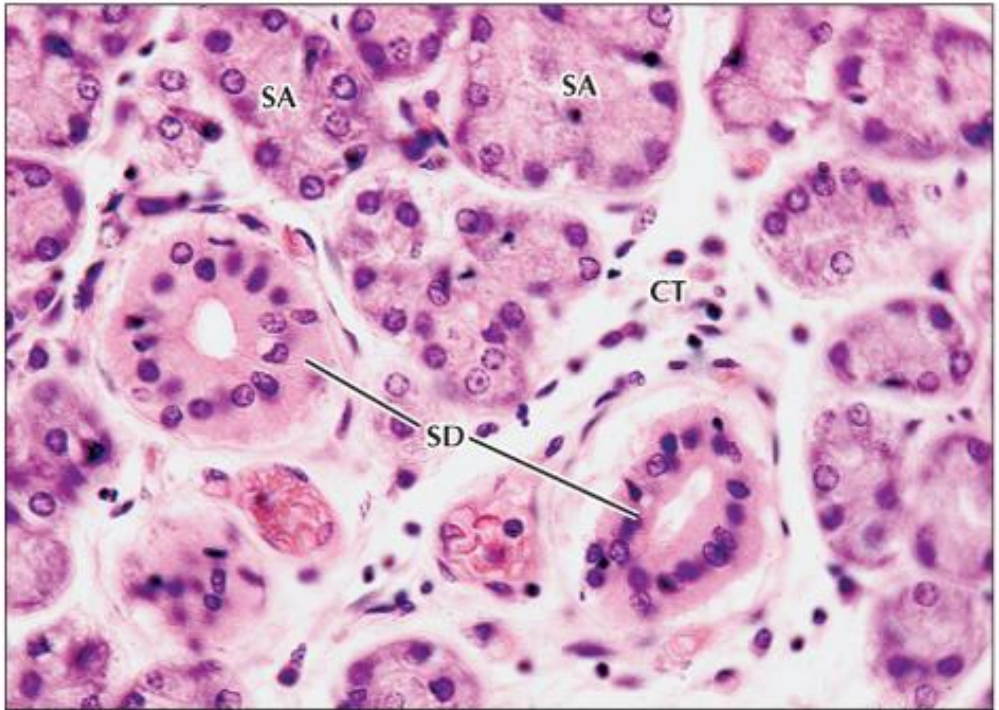
Sublingual gland: almost completely mucous



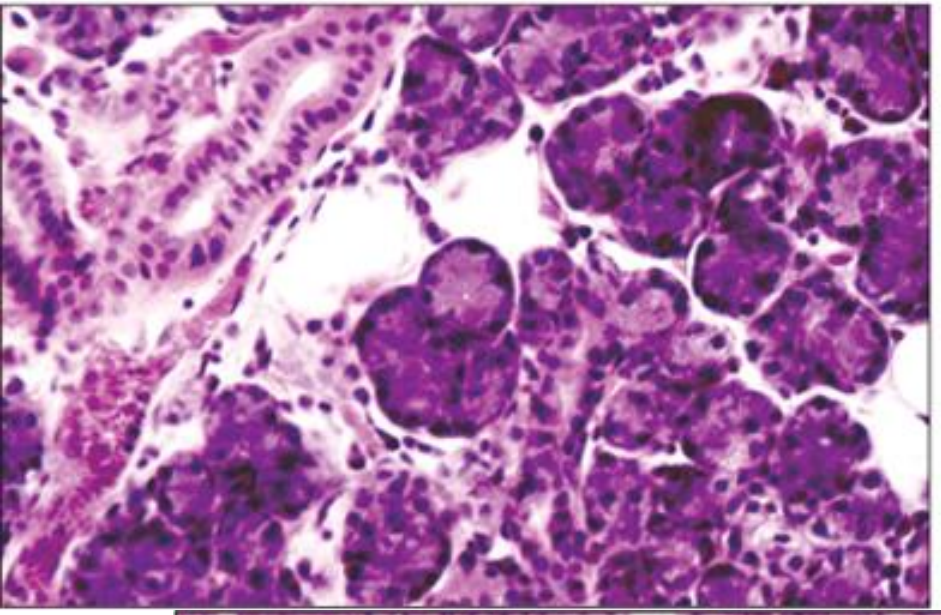
▲ **LM of a lobule of a sublingual gland.** All three major salivary glands are organized into lobules similar to this, with tightly packed parenchyma surrounded by loose connective tissue stroma (**CT**). Grape-like clusters of secretory acini (**SA**) and a few intralobular ducts (**arrows**) are in the lobule; larger interlobular ducts (**ID**) and blood vessels (**BV**) are in the stroma. 60×. *H&E.*

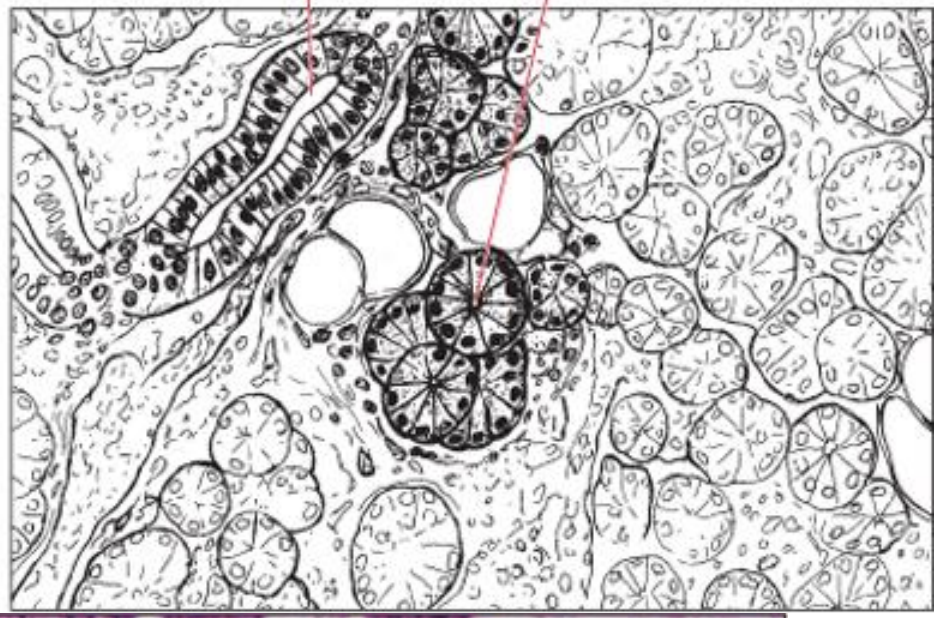


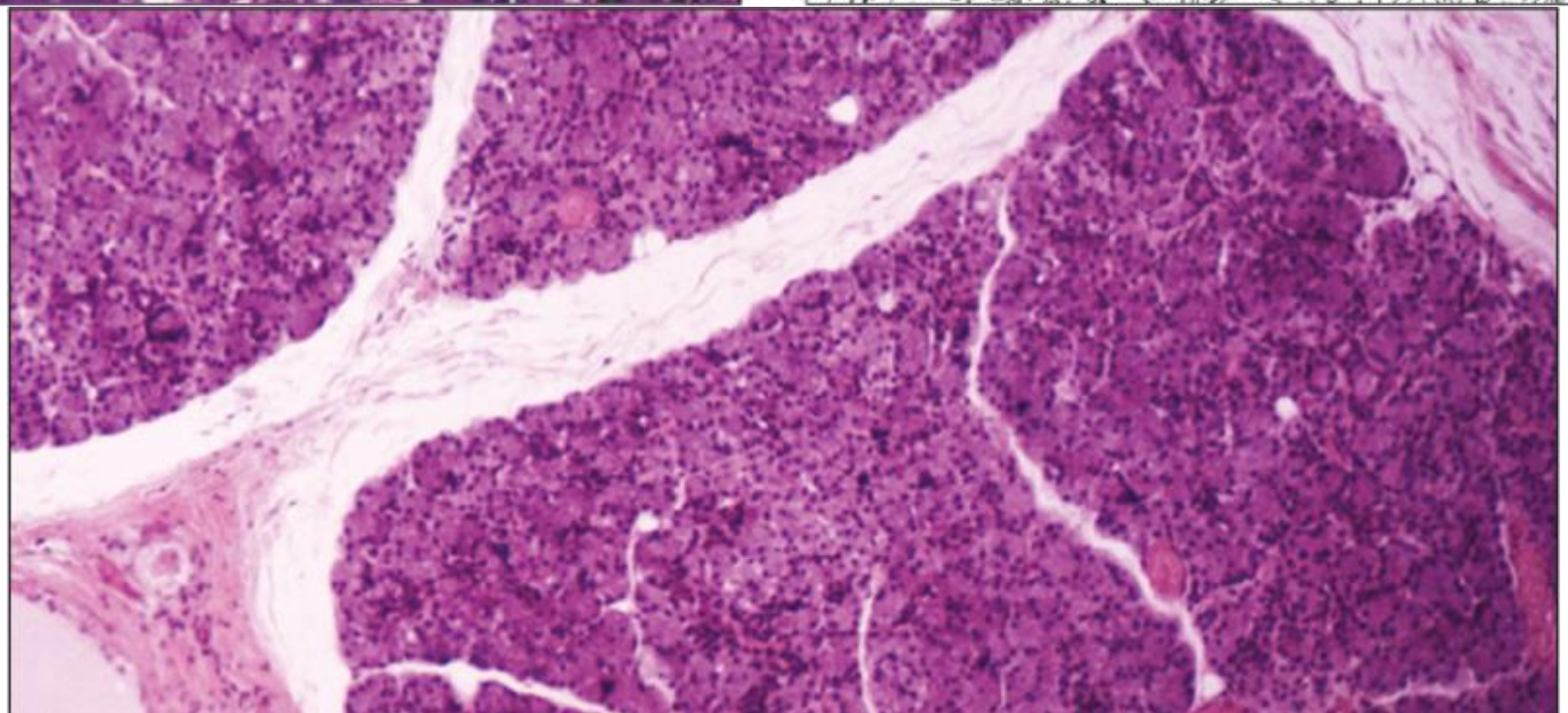
◀ **LM of a parotid gland.** Closely packed clusters of purely serous acini (**SA**) and a branching interlobular duct (**ID**) are visible. Pseudostratified epithelium lines the duct, which is between parts of two lobules, is surrounded by dense irregular connective tissue (**CT**), and accompanies a venule (**Ve**). Adipocytes (**Ad**) occur mainly in the parotid, not often seen in the two other major salivary glands. 175×. *H&E.*

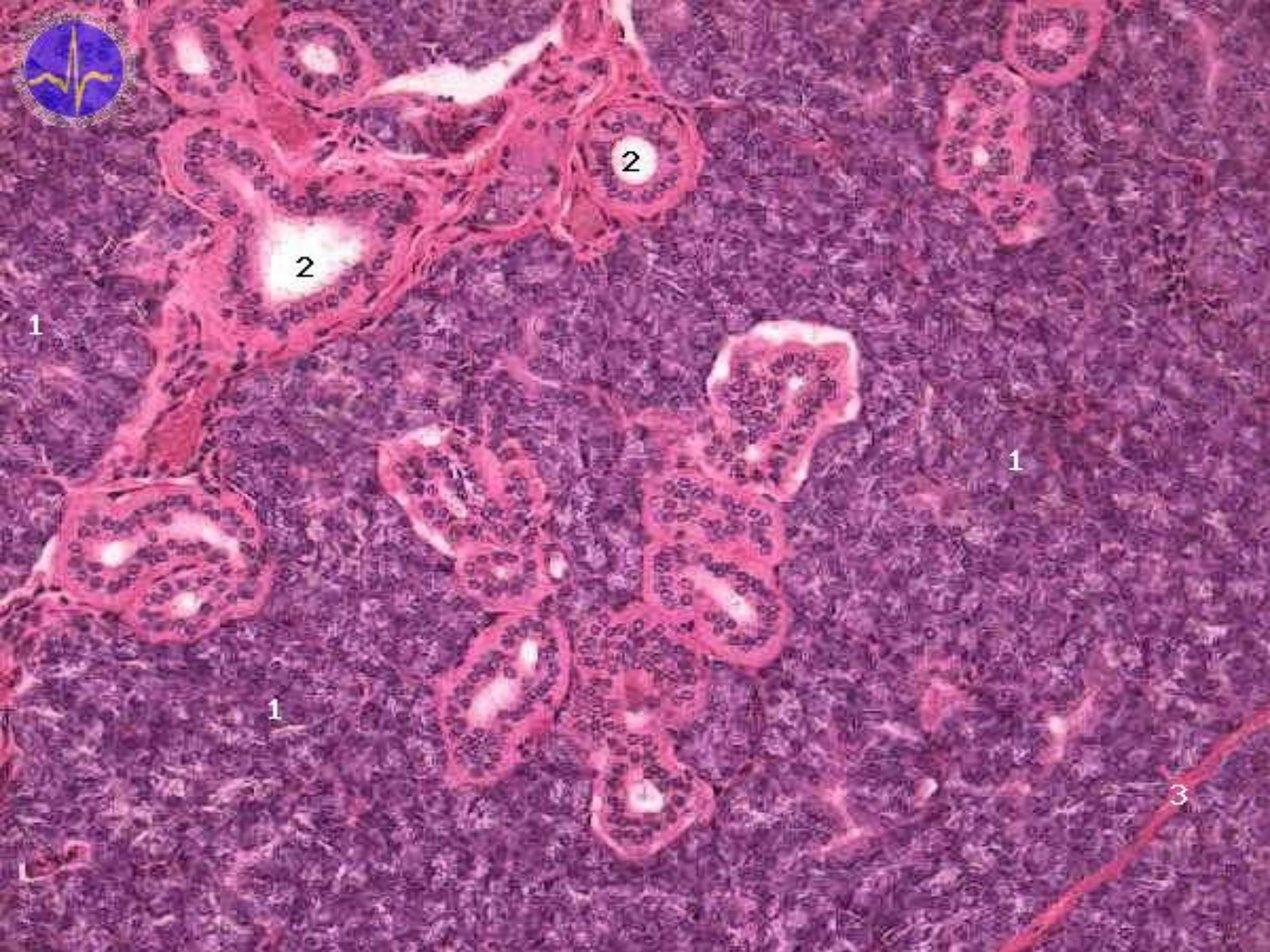


► **LM of a parotid at higher magnification.** Loose connective tissue (**CT**) of the stroma surrounds many secretory acini (**SA**) and two striated ducts (**SD**). Serous cells in each acinus have round basal nuclei and are arranged around a small central lumen. Simple columnar epithelium lines the larger lumina of striated ducts, so named because of striations in the basal cytoplasm of the lining cells. 340×. *H&E.*




Duct
Serous acinus

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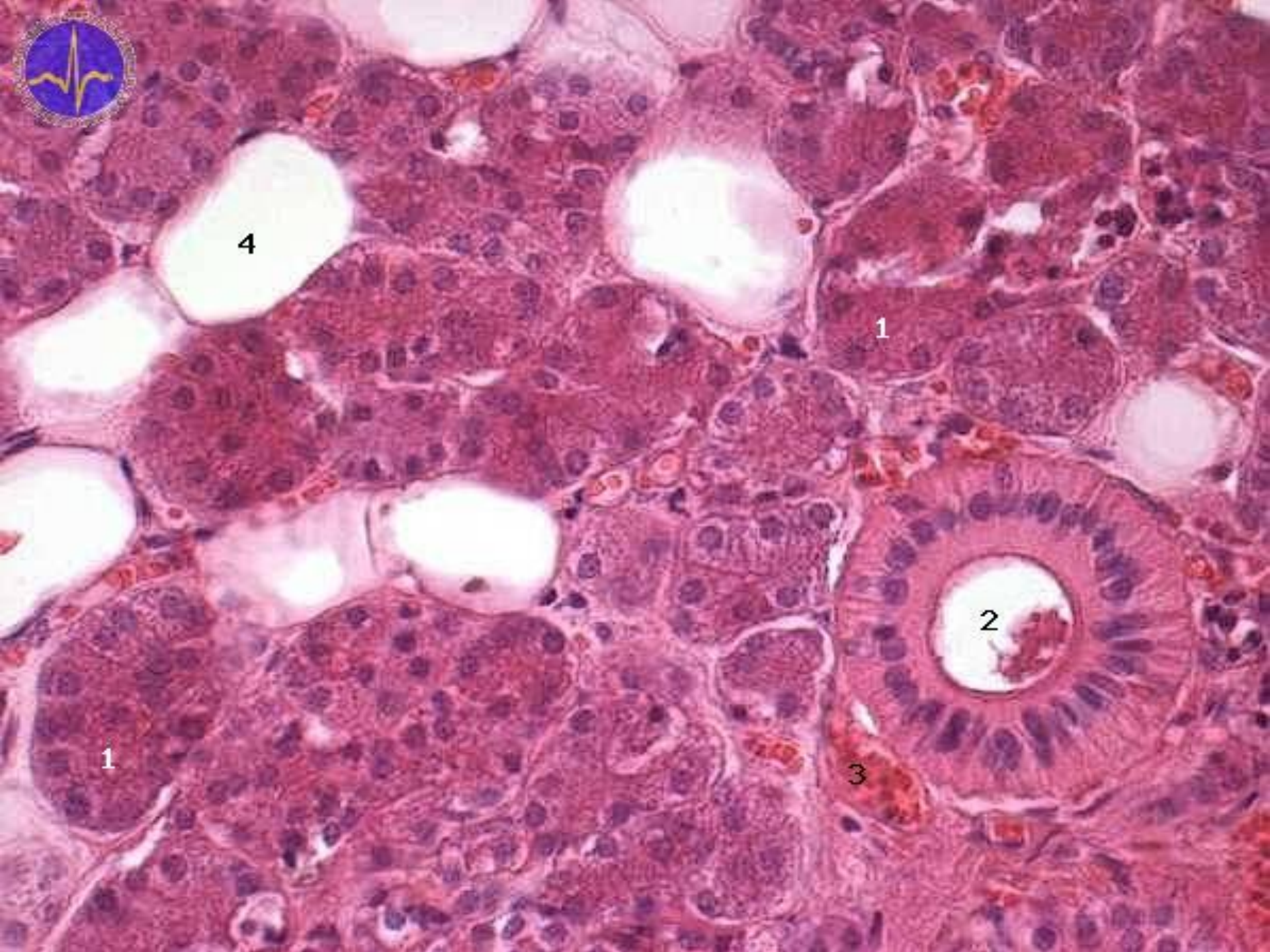
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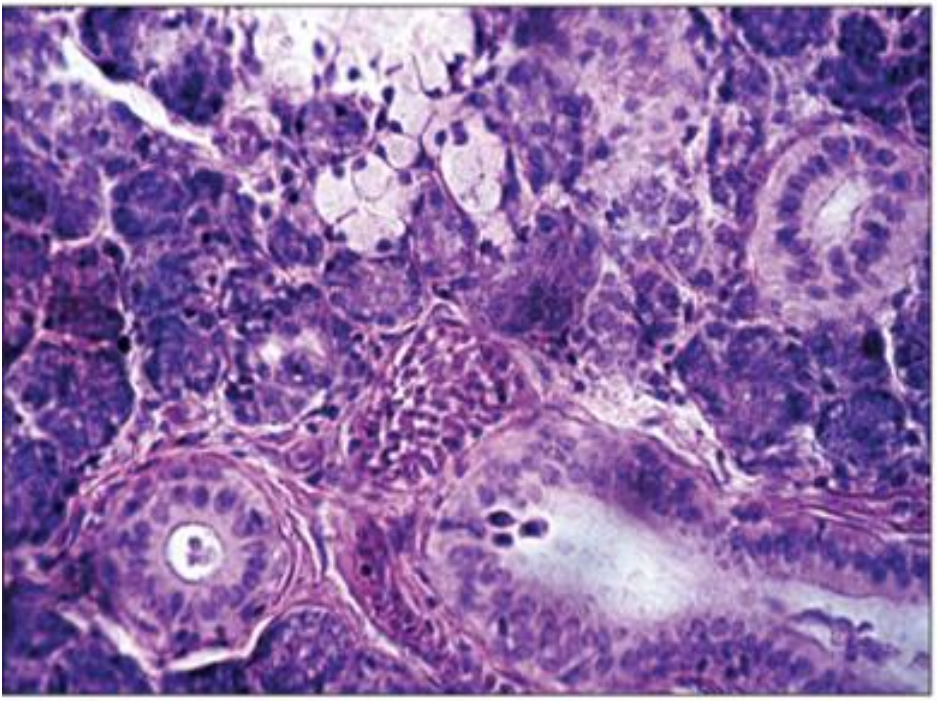
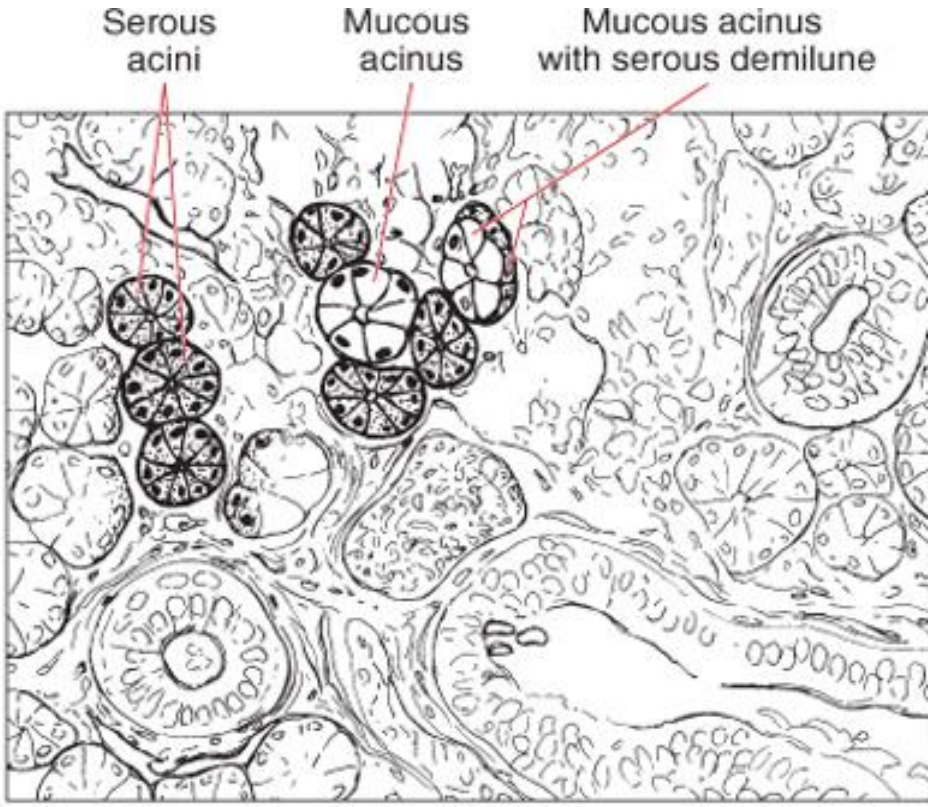
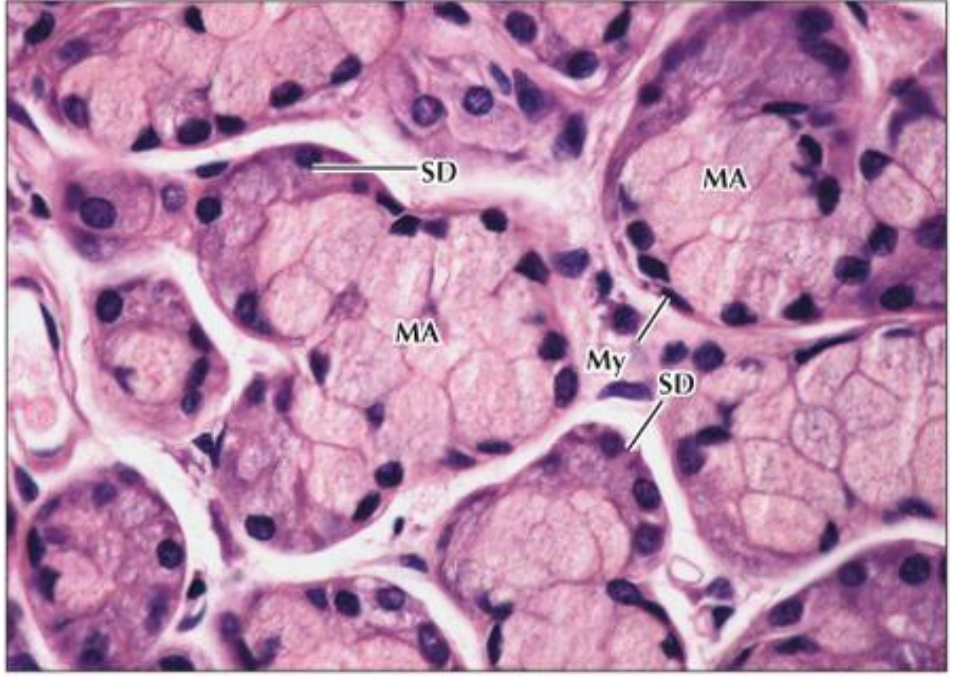
Glandula submandibularis

- Tuboacinar gland with mixed seromucous secretion

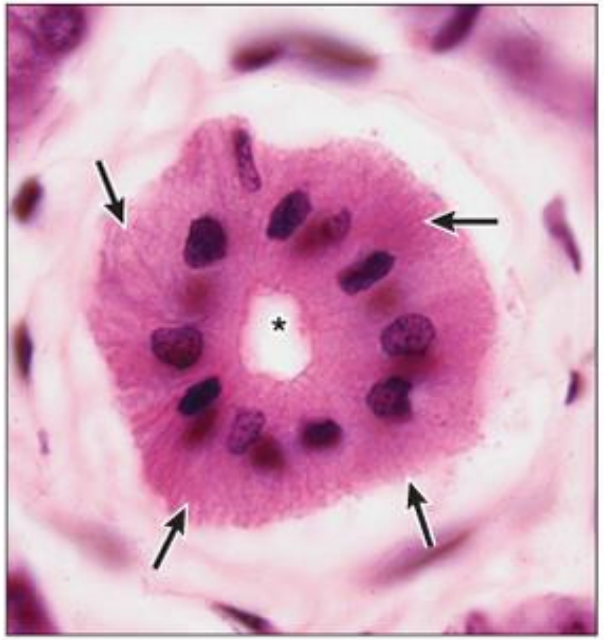


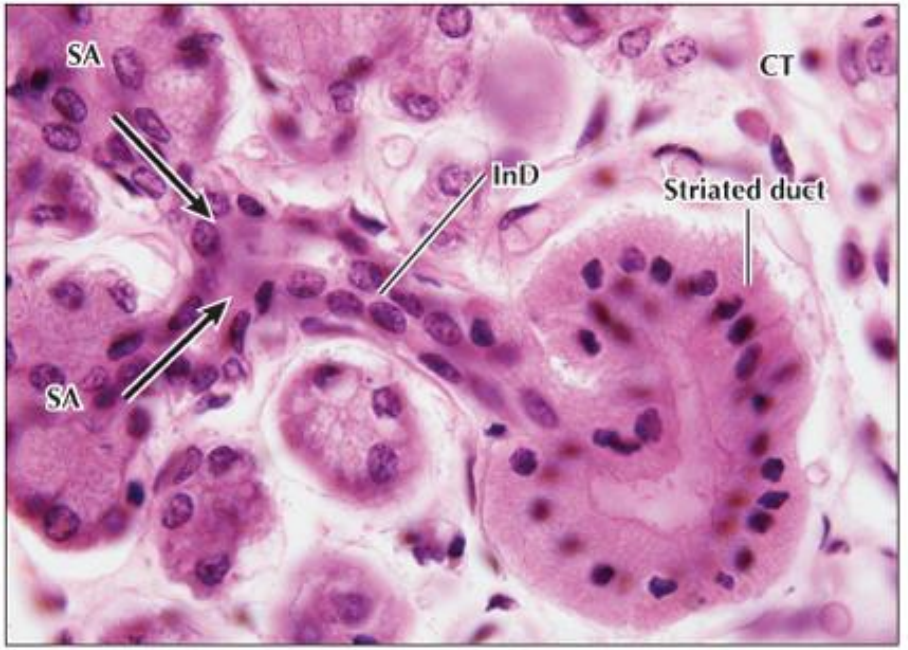

Serous acini
Mucous acinus
Mucous acinus with serous demilune



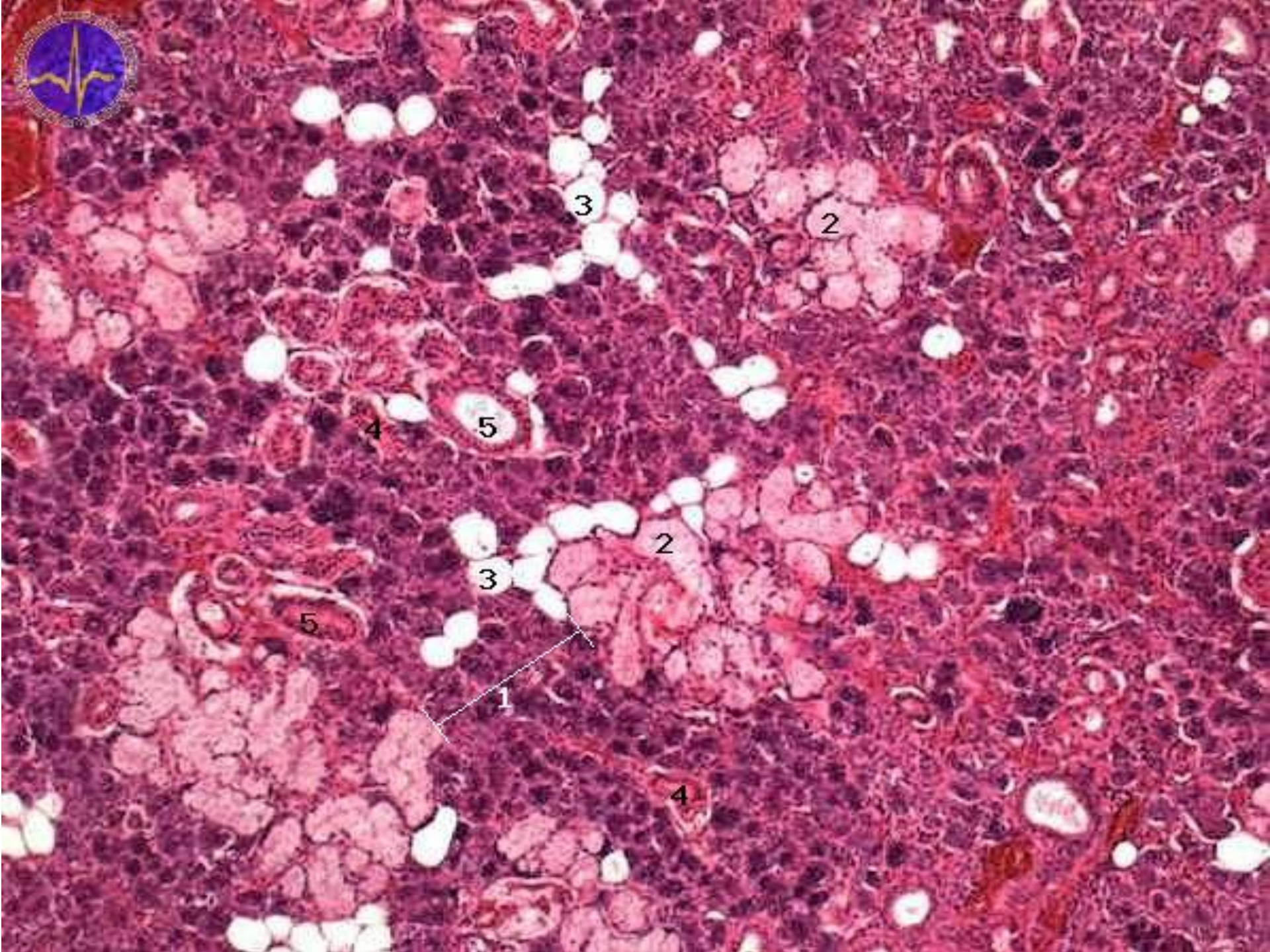
◀ **LM of part of a submandibular gland.** Mucous acini (**MA**) are made of pyramidal, pale-staining mucous cells with flattened basal nuclei. These cells surround small central lumina. Darker staining serous demilunes (**SD**) cap some acini. A few myoepithelial cells (**My**) are associated with acini and share a basement membrane with the mucous cells. 320×. *H&E.*

▼ **LM of part of a sublingual gland showing details of intralobular ducts.** An intercalated duct (**InD**) lined by simple squamous epithelium drains (**arrows**) two secretory acini (**SA**). The intercalated duct empties into a larger striated duct lined by tall columnar cells with basal striations. Surrounding stroma is loose, delicate connective tissue (**CT**). 800×. *H&E.*





▲ **LM of a striated duct at high magnification.** Lightly eosinophilic columnar cells with basal striations (**arrows**) line a central lumen (*). 1000×. *H&E.*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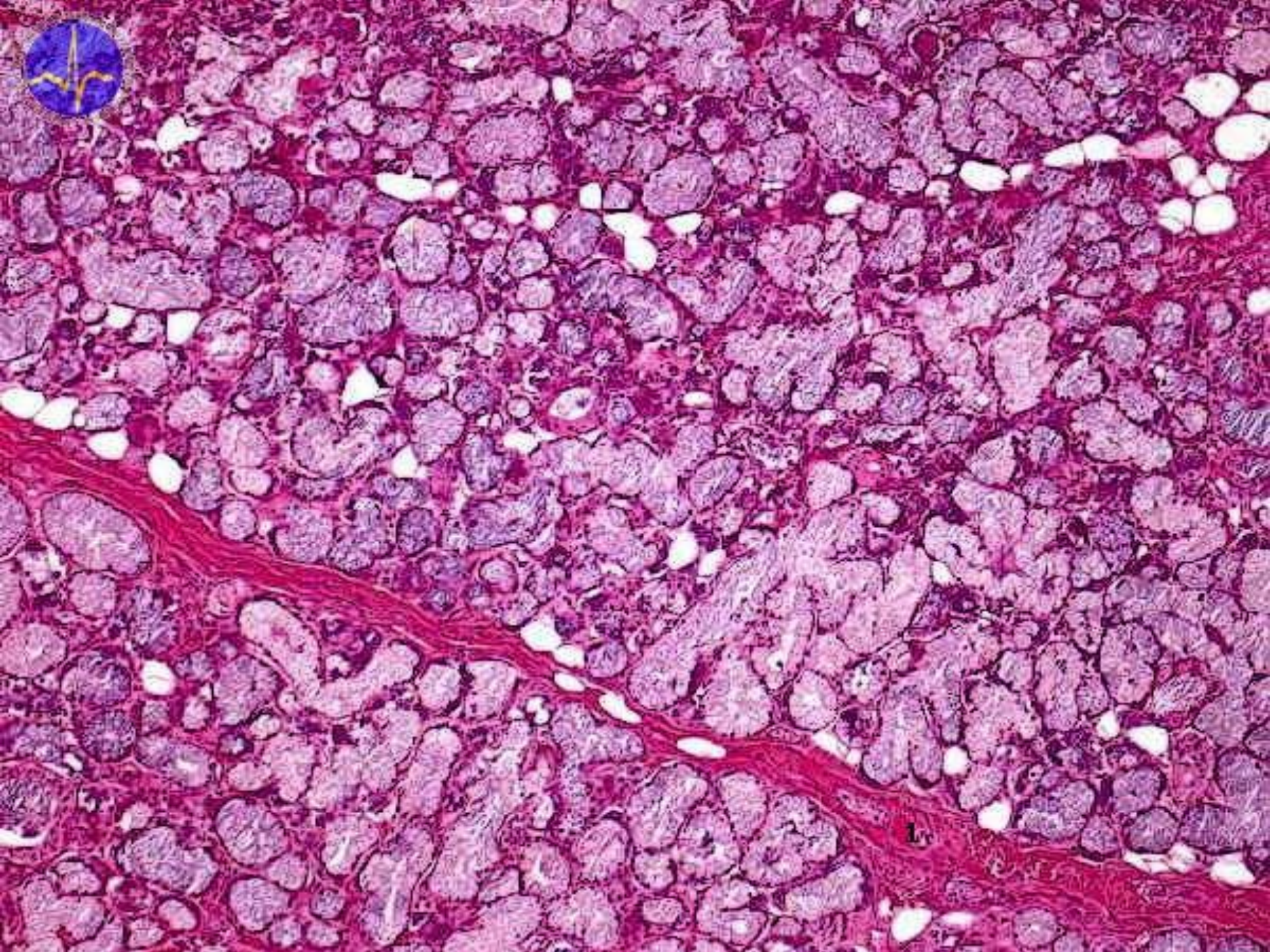
Glandula sublingualis

- Tuboacinar gland with mixed secretion, predominantly mucous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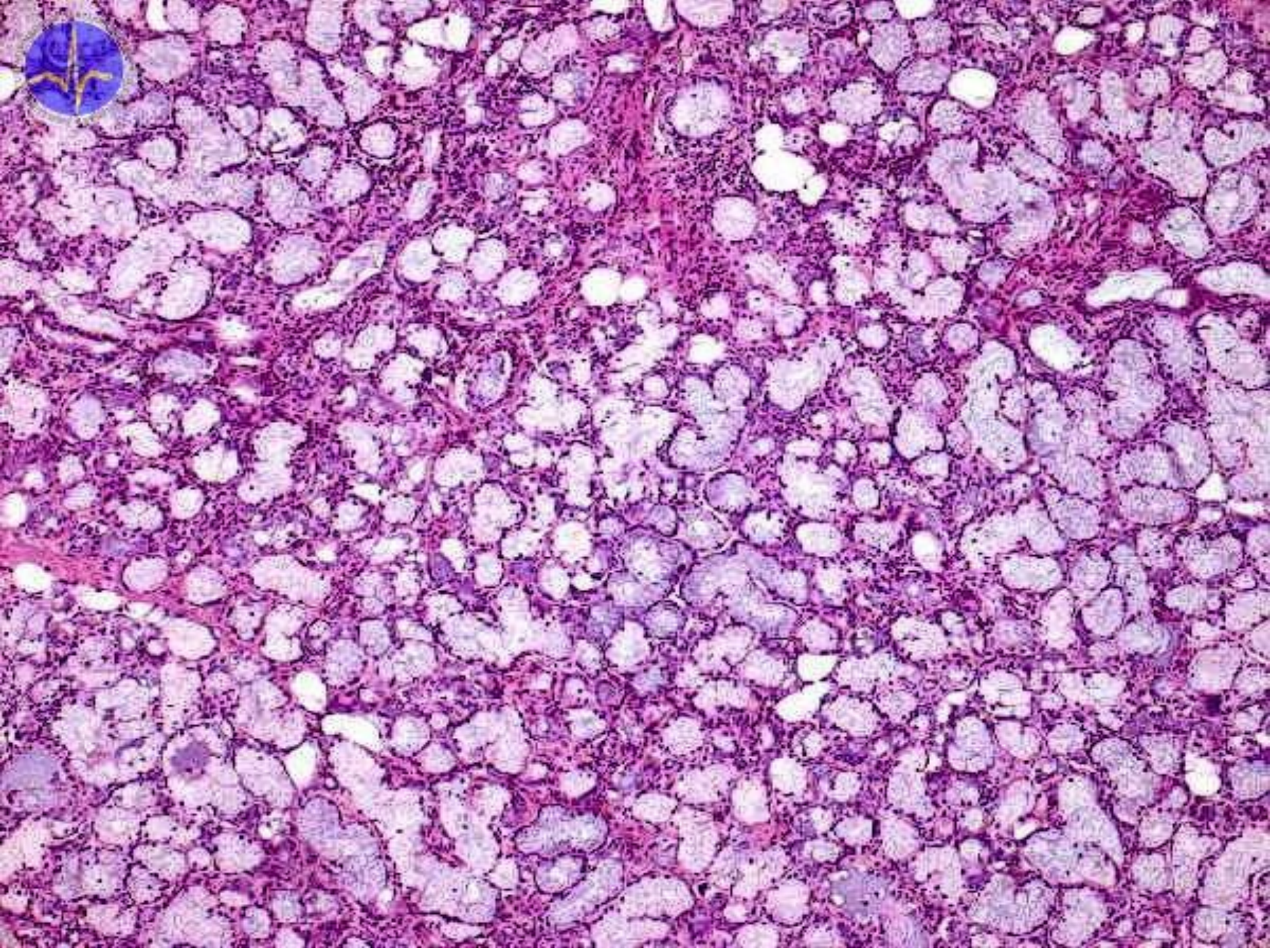
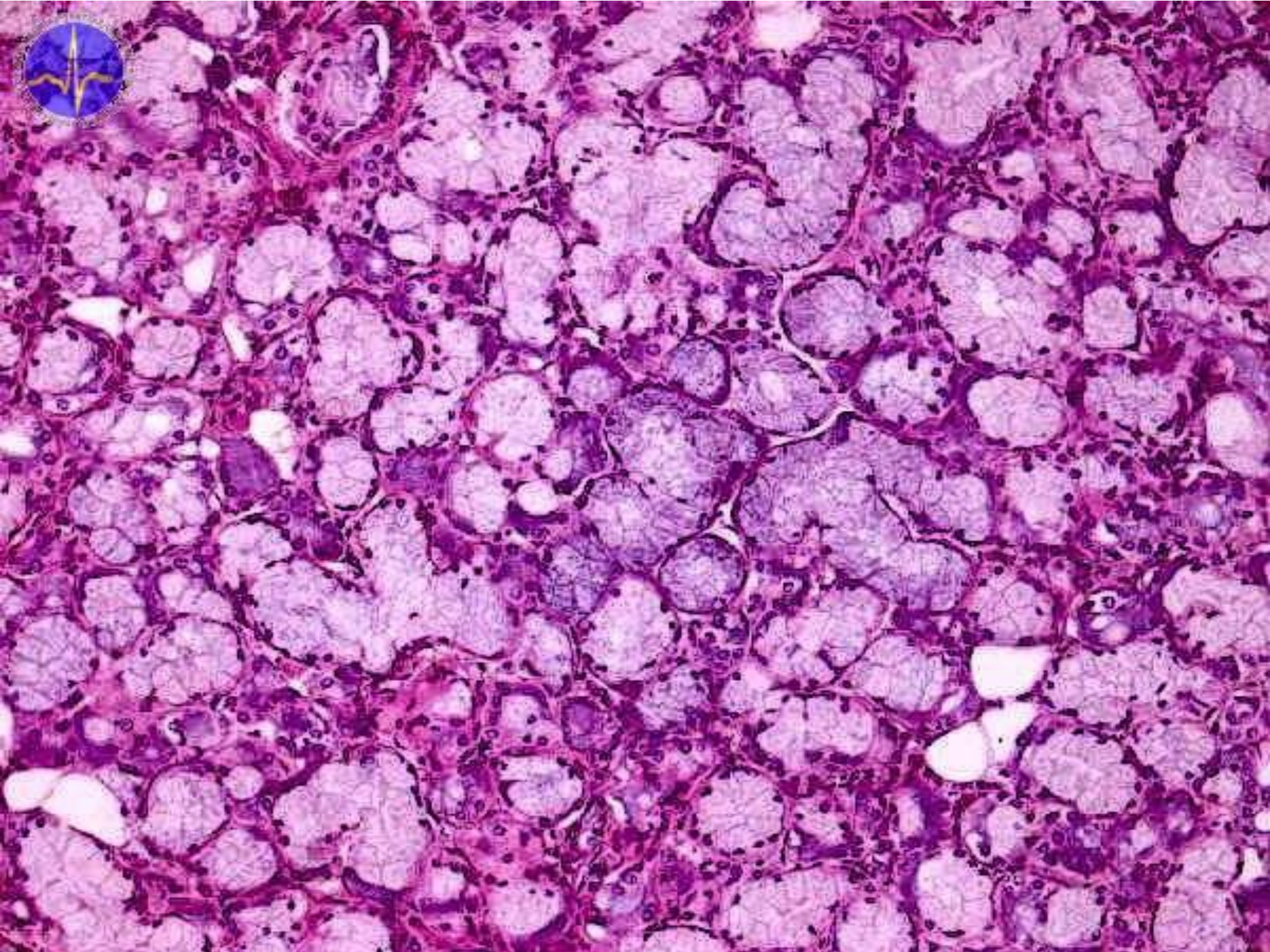




Esophagus

- Nonkeratinized stratified squamous epithelium
- Thick lamina muscularis mucosae - longitudinal
- Longitudinal folds of mucosa

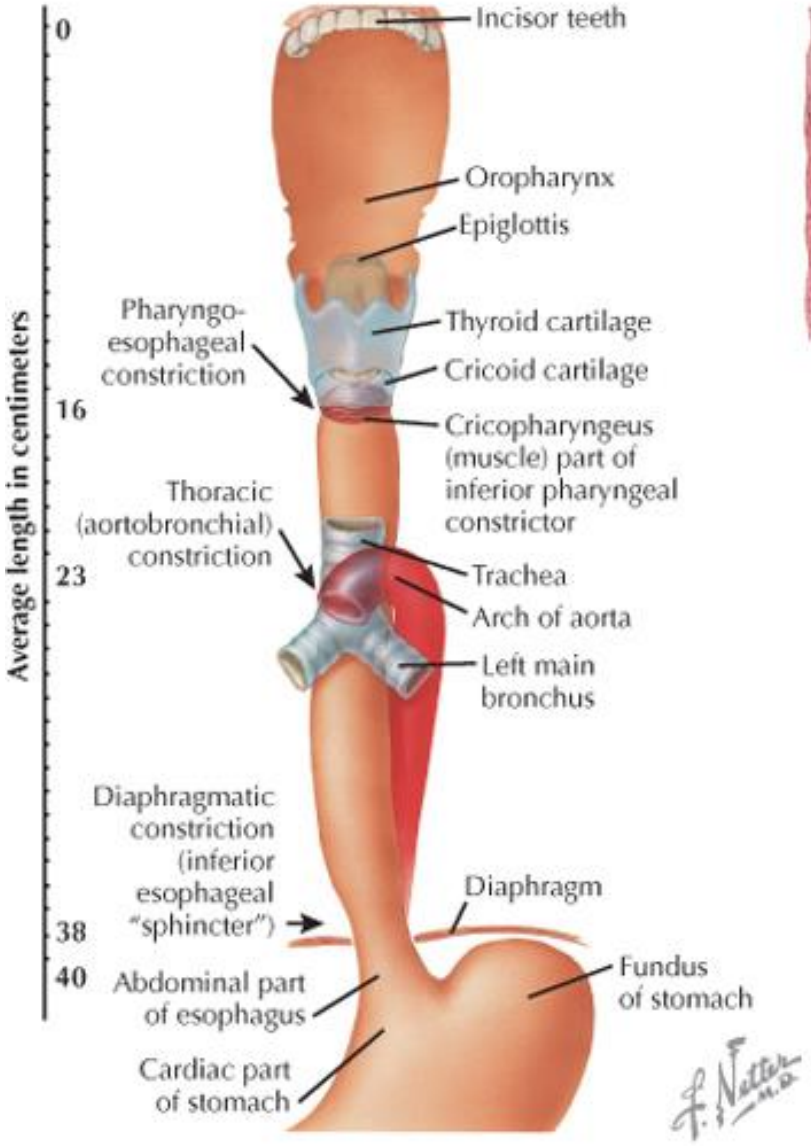
- Tunica muscularis – str. circulare et longitudinale
  - upper 1/3 striated muscle
  - middle 1/3 mixed muscle
  - lower 1/3 smooth muscle
- Tunica adventitia et serosa

Esophagus

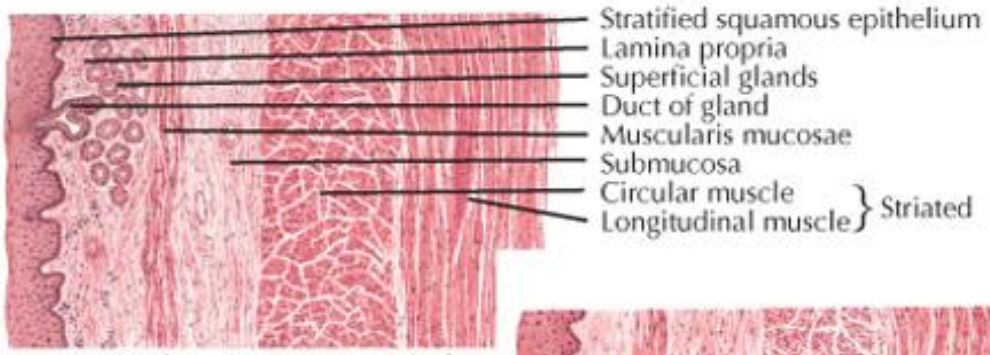
- Gll. oesophageales – mucous glands
  - 2 types – lubrication of wall
    - In lamina propria – only in terminal part
    - In tunica submucosa – small compound tuboalveolar glands, upper part

- Gastroesophageal reflux disease
- Barrett‘s esophagus

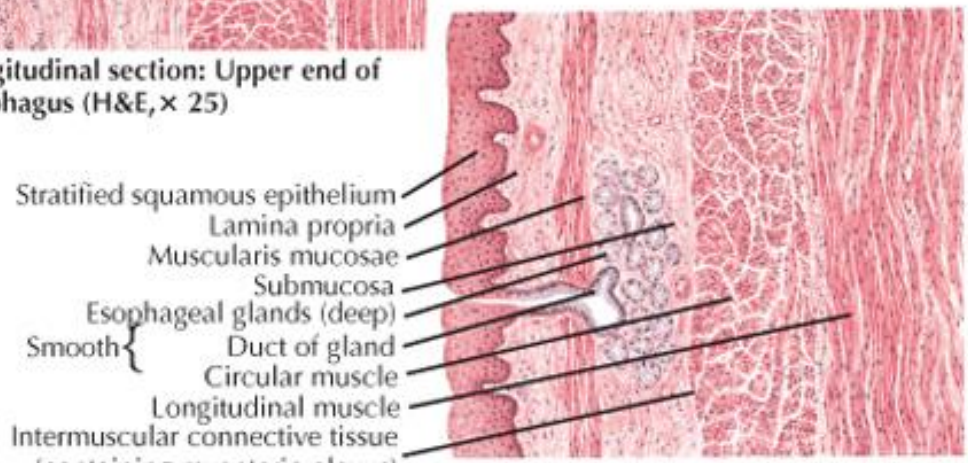
▼ Gross anatomy of the esophagus.



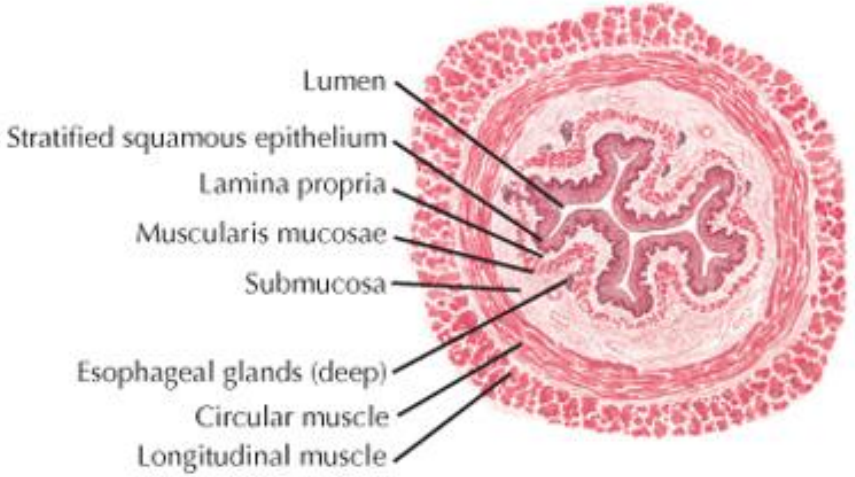
▼ Histology of the esophagus at different levels.

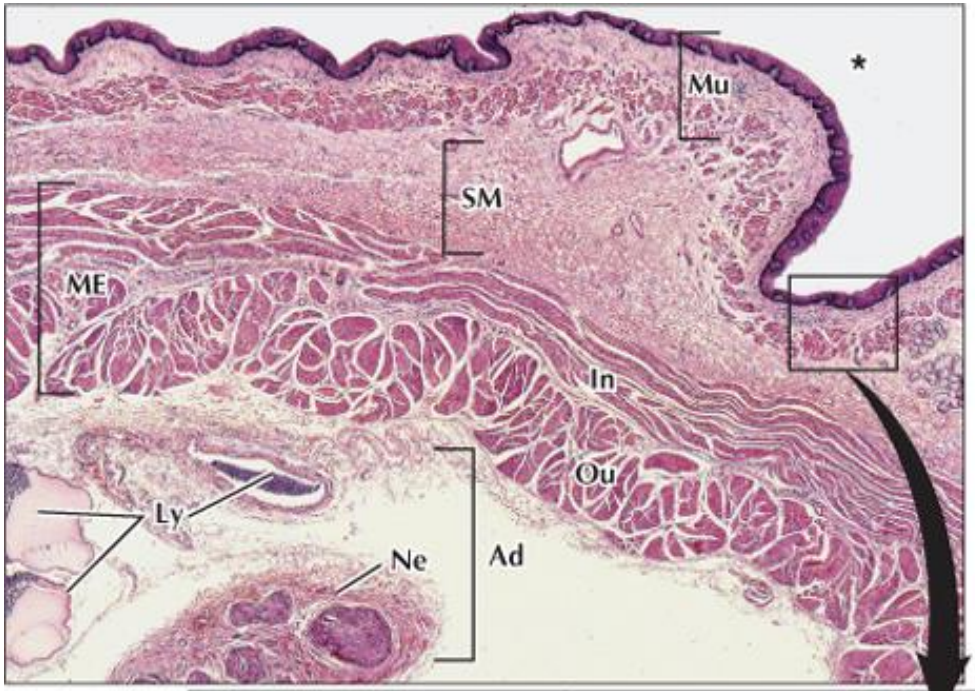


Longitudinal section: Upper end of esophagus (H&E, × 25)



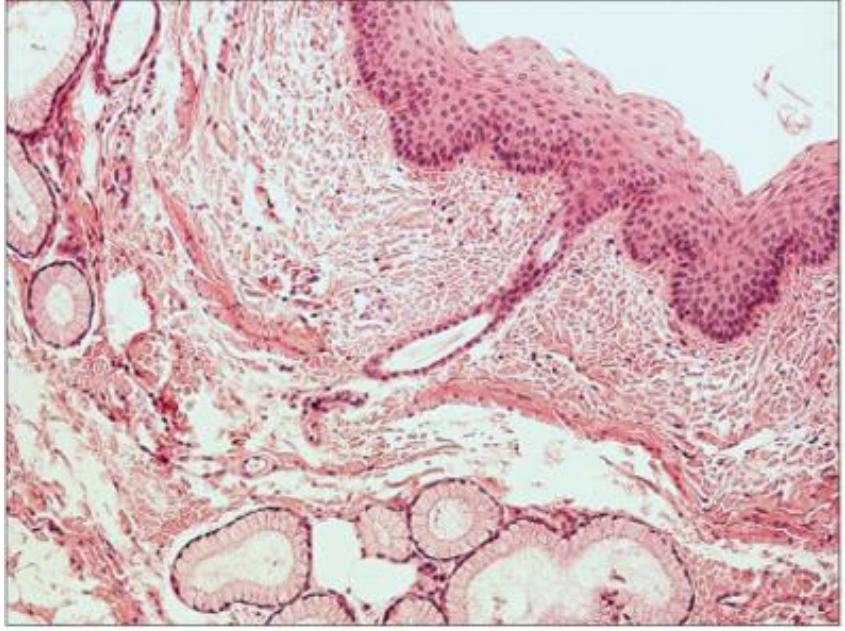
Longitudinal section: Lower third of esophagus (H&E, × 25)

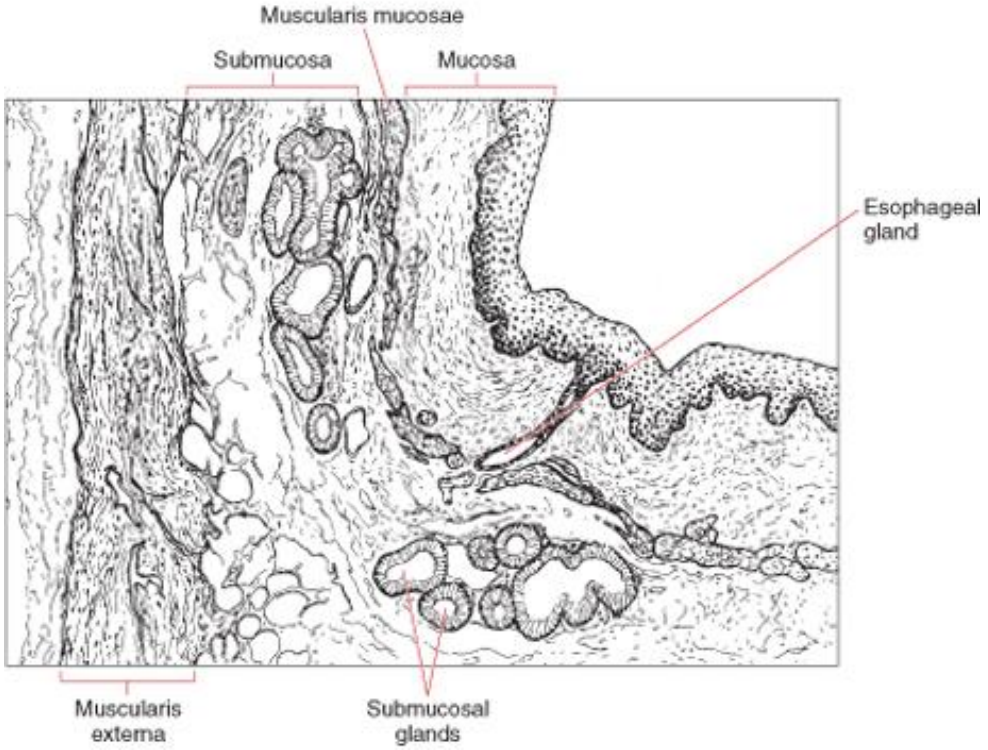


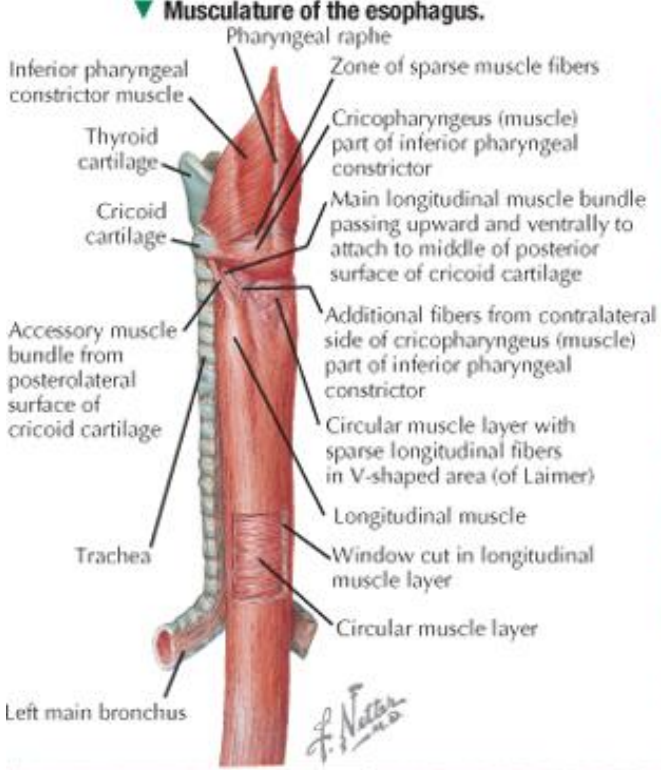


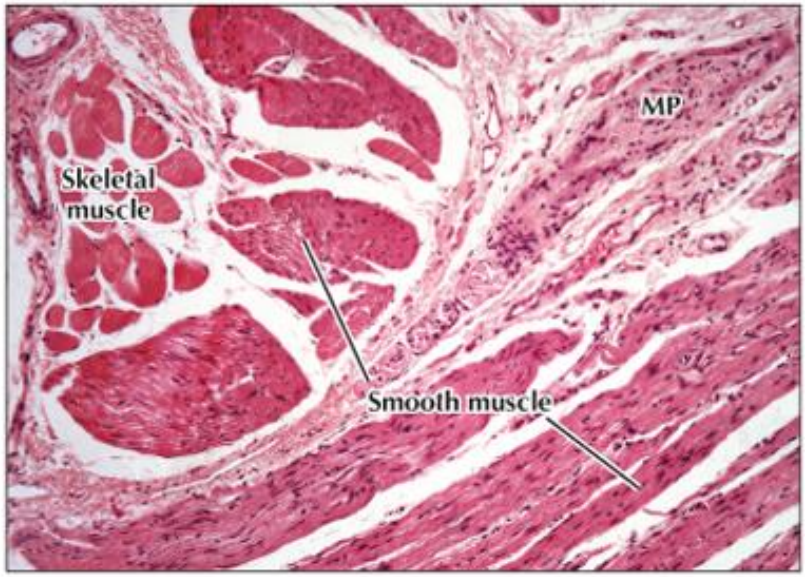
◀ **LM of the wall of the esophagus.** As in most other parts of the digestive tract, four tunics are seen: mucosa (**Mu**), next to the lumen (*); submucosa (**SM**); muscularis externa (**ME**); and adventitia (**Ad**). The muscularis externa has inner (**In**) and outer (**Ou**) smooth muscle layers; the adventitia, nerves (**Ne**) and lymphatic channels (**Ly**). 6.5×. *H&E.*

▼ **Higher magnification LM of esophageal mucosa.** The superficial layers of the nonkeratinized stratified squamous epithelium (**SSE**) have a basket-weave appearance. Highly vascularized lamina propria (**LP**) sends connective tissue papillae (**arrows**), which carry capillaries (**Cap**), close to the epithelium. The muscularis mucosae (**MM**) is thicker in the esophagus than in other parts of the digestive tract. 135×. *H&E.*

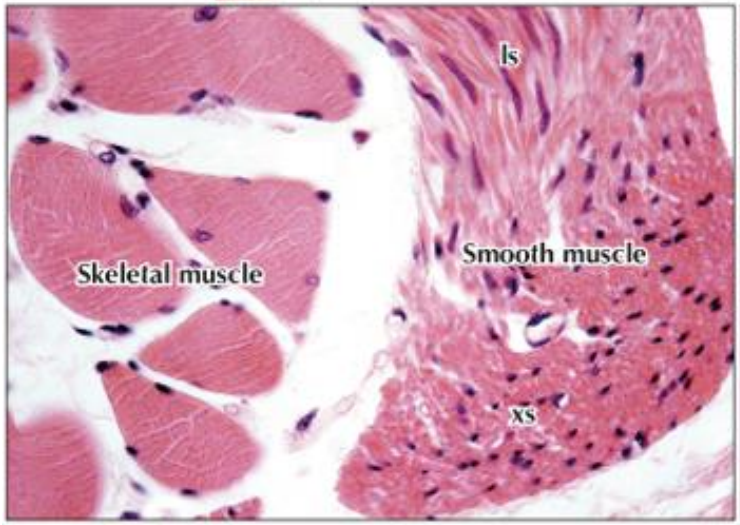



Muscularis mucosae
Submucosa
Mucosa
Esophageal gland
Muscularis externa
Submucosal glands

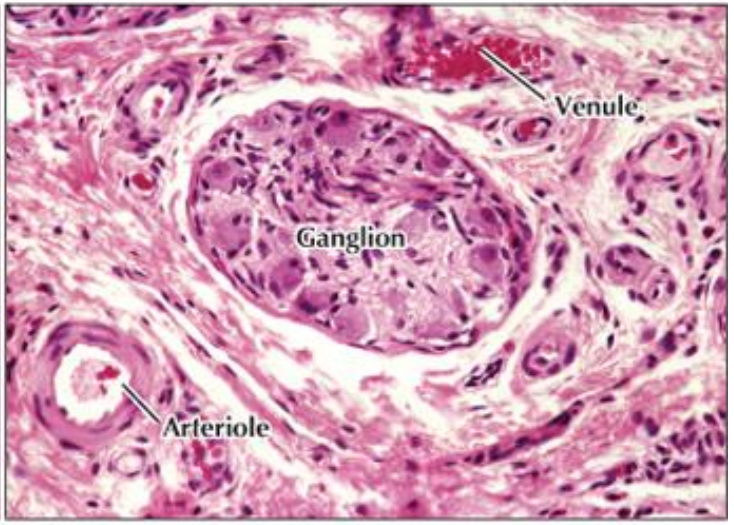




▲ **LM of the muscularis externa.** The middle third of the esophagus has a mixture of skeletal muscle fibers and smooth muscle cells. Part of a myenteric plexus (**MP**) is between the inner and outer muscle layers. 180×. *H&E.*

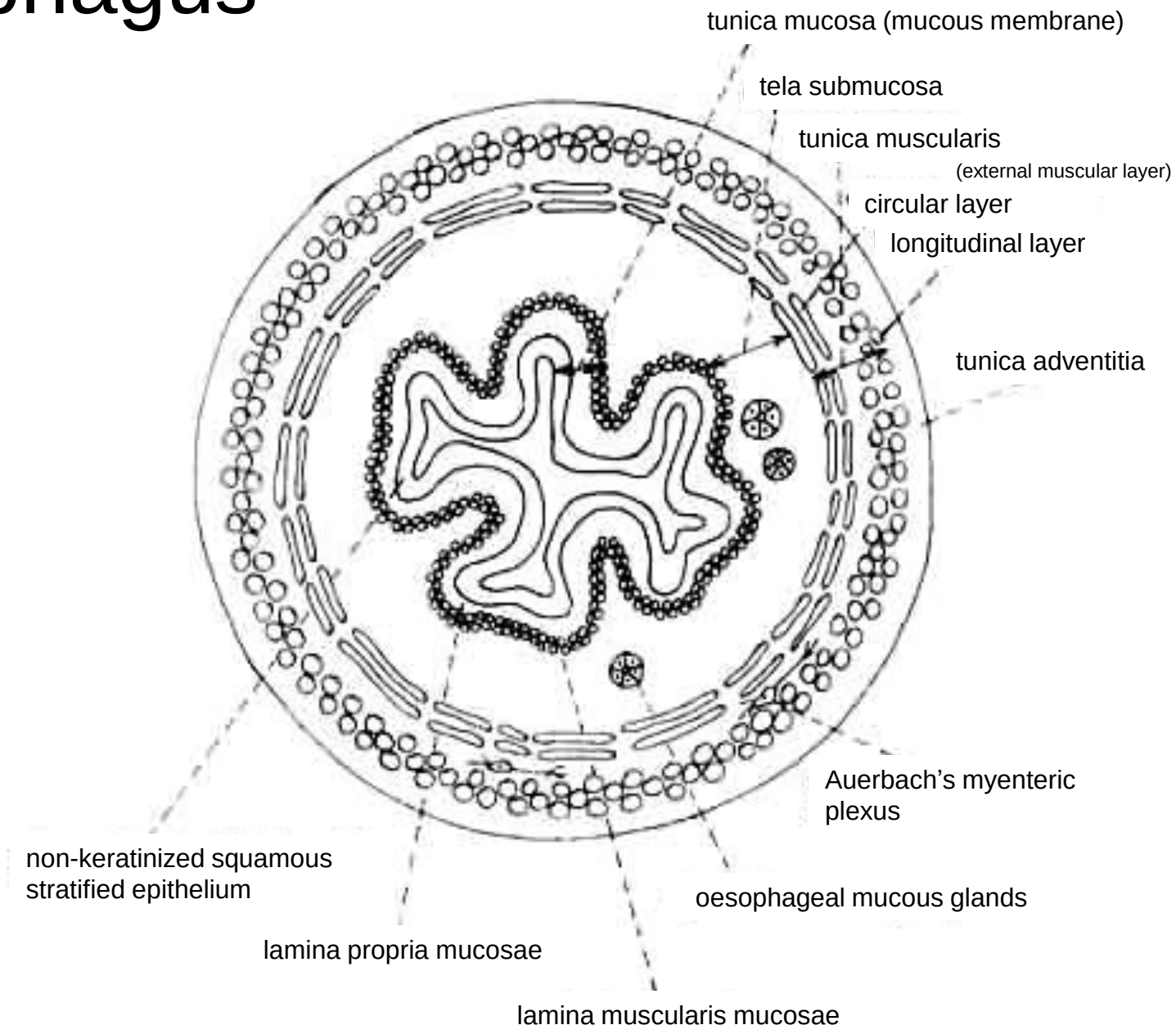


▲ **Higher magnification LM of two types of muscle tissue in the esophagus.** The larger skeletal muscle fibers are pleomorphic and have peripheral nuclei. The much smaller smooth muscle cells are sectioned transversely (**xs**) and longitudinally (**ls**). 280×. *H&E.*



▲ **LM of part of the adventitia of the esophagus.** This dense irregular connective tissue layer contains many blood vessels, nerves, and lymphatics that often travel together. An arteriole and venule are near a peripheral autonomic ganglion. 250×. *H&E.*

Esophagus


tunica mucosa (mucous membrane)
tela submucosa
tunica muscularis
(external muscular layer)
circular layer
longitudinal layer
tunica adventitia
Auerbach's myenteric plexus
non-keratinized squamous stratified epithelium
oesophageal mucous glands
lamina propria mucosae
lamina muscularis mucosae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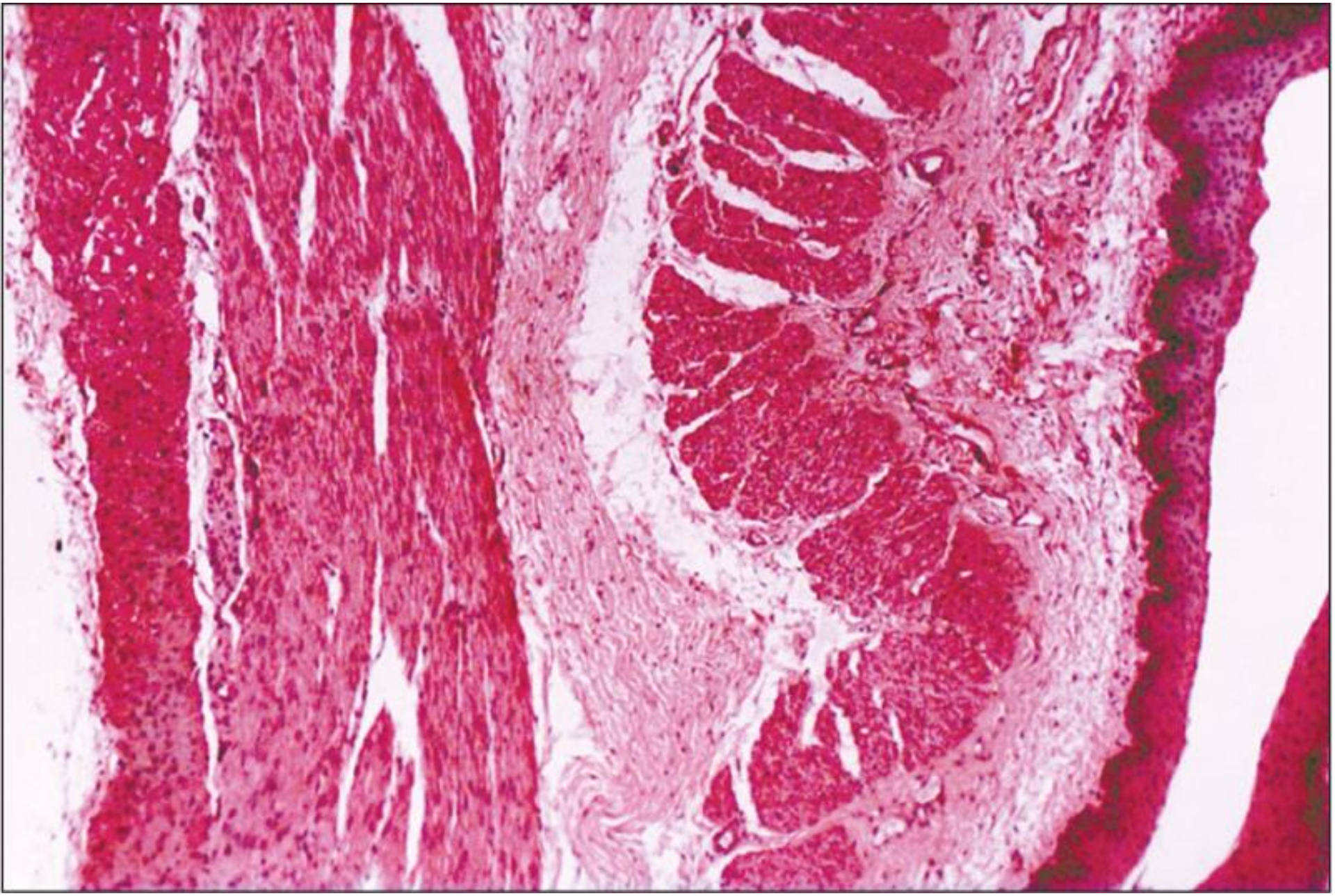

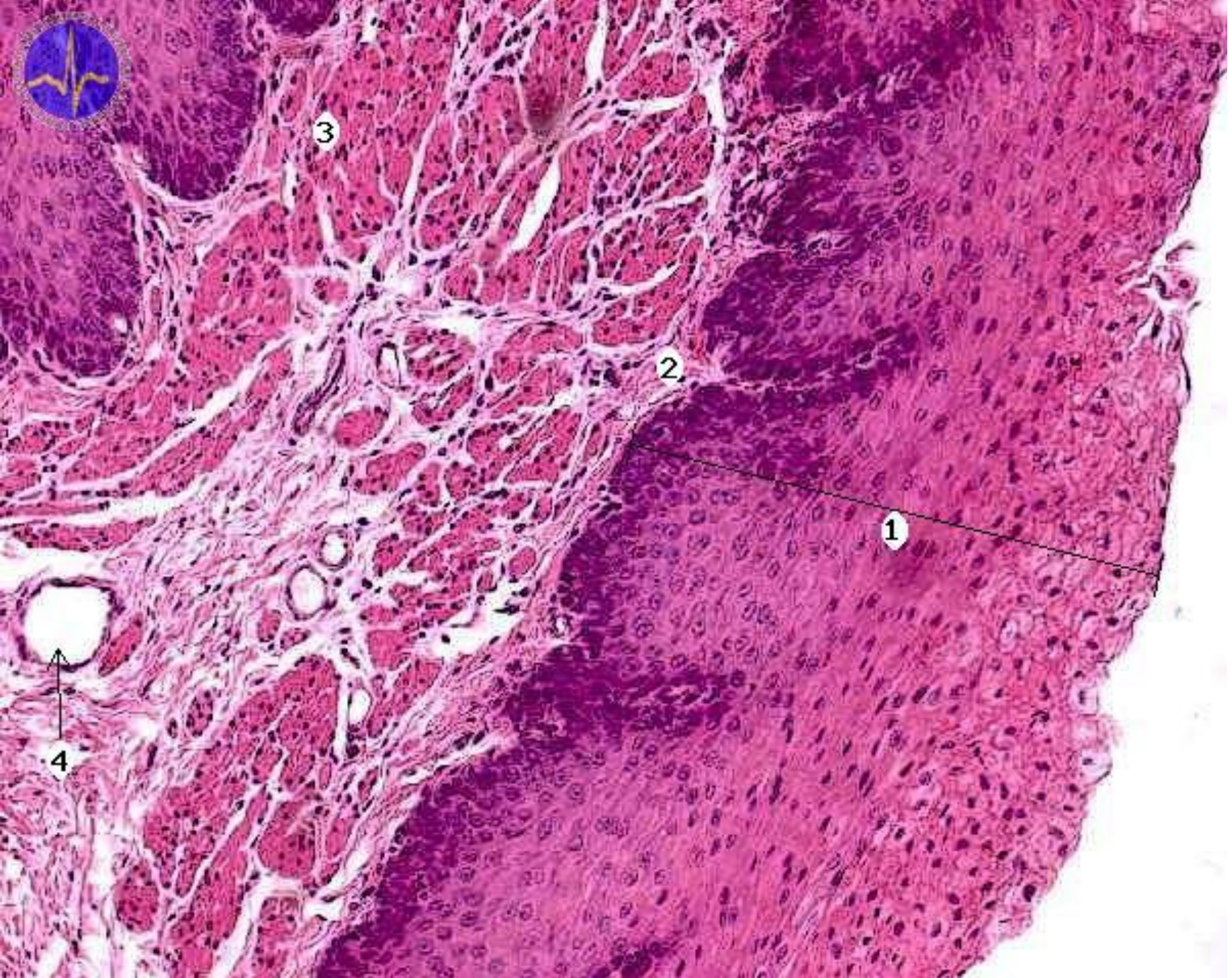
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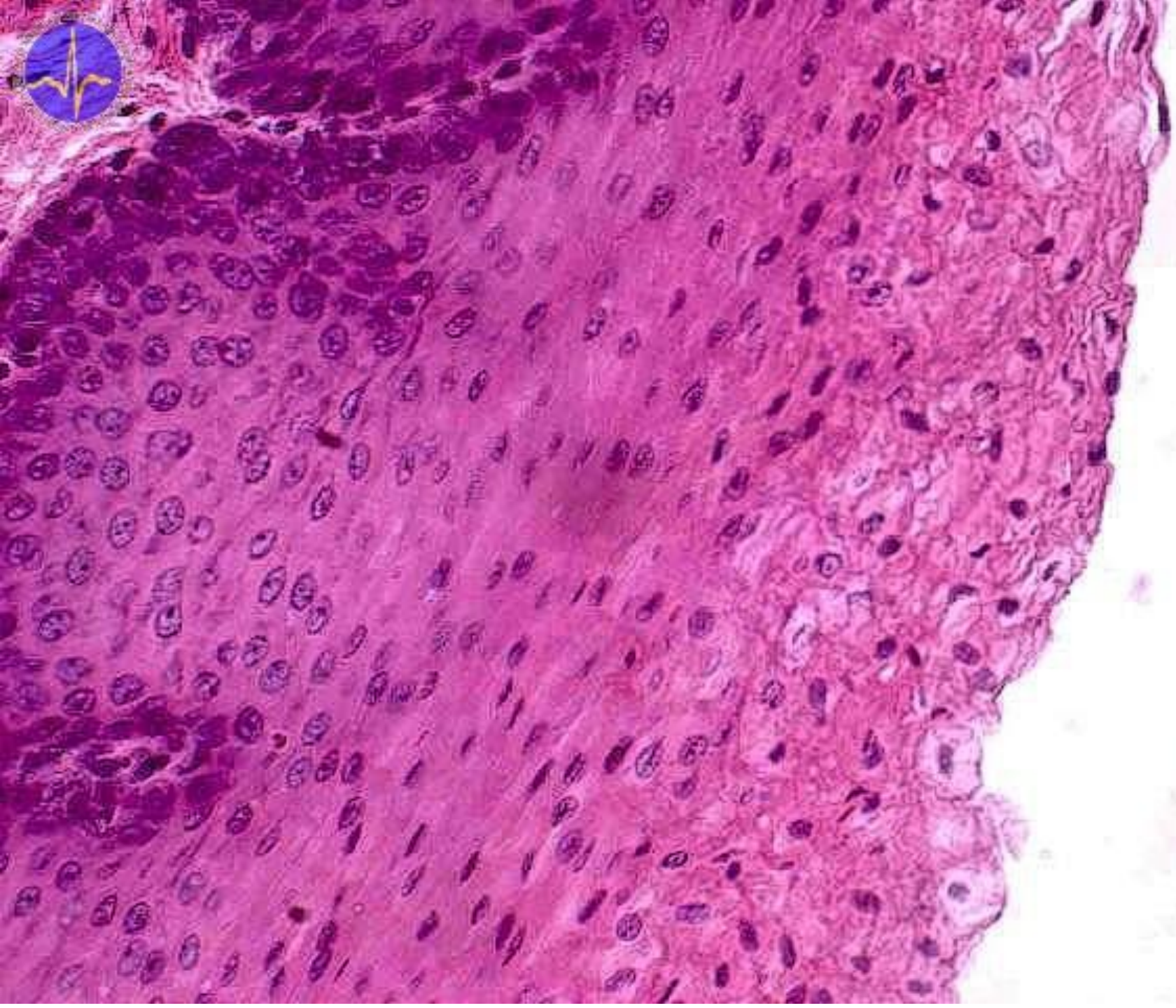
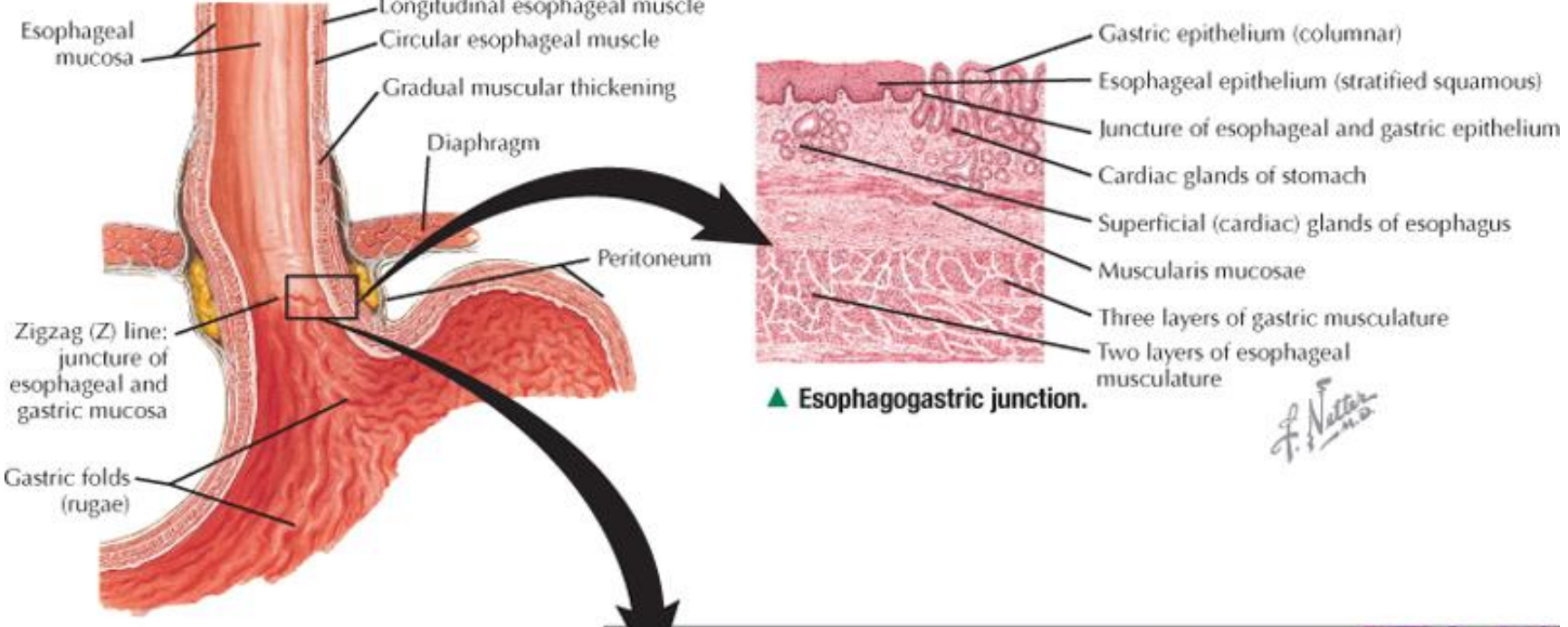


Enteric nerve system

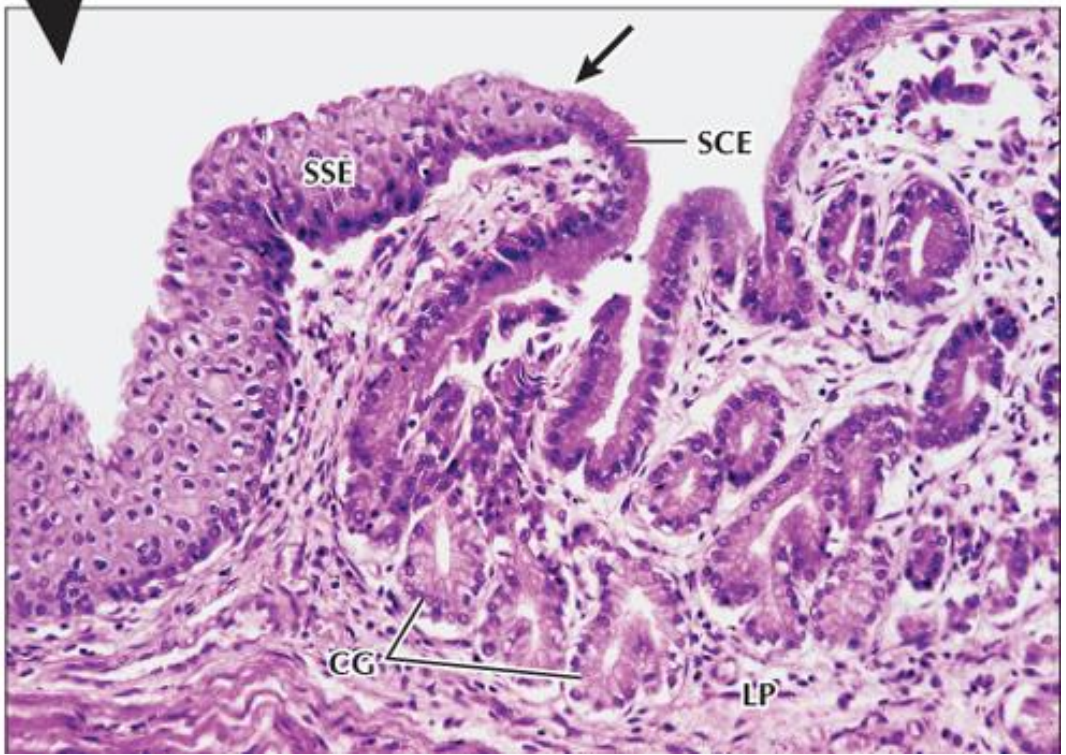
- 2 nerve plexus
  - Plexus submucosus Meissneri
    - Gland innervation
  - Plexus myentericus Auerbachi
    - between stratum circulare et longitudinale
    - Peristaltic activity
- Ganglion cells and nerve fibres, under controle of parasympathetic system

Gastroesophageal junction

- Z – line – transition of nonkeratinized stratified squamous epithelium of esophagus into simple columnar epithelium of stomach

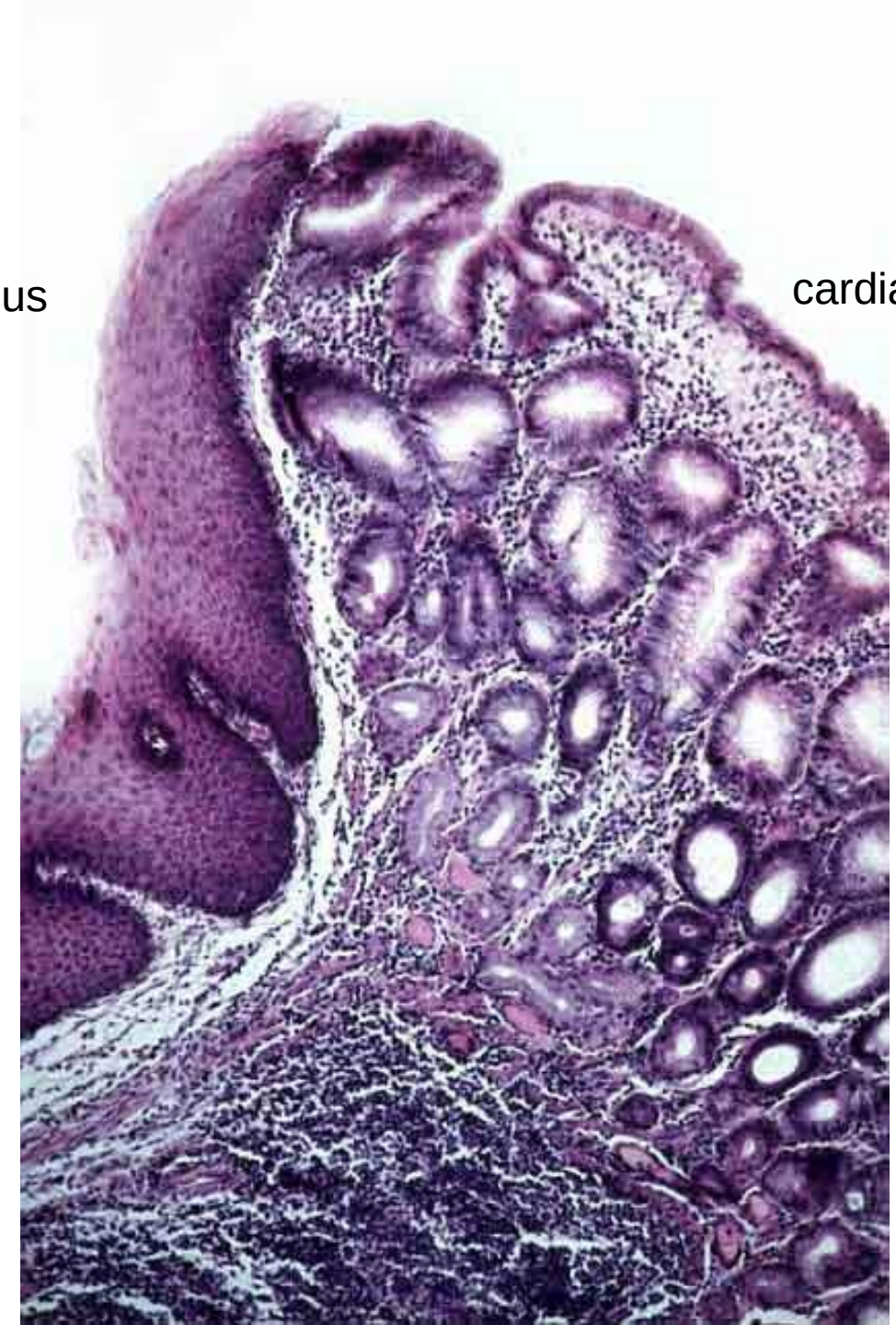


▲ **Esophagogastric junction.**

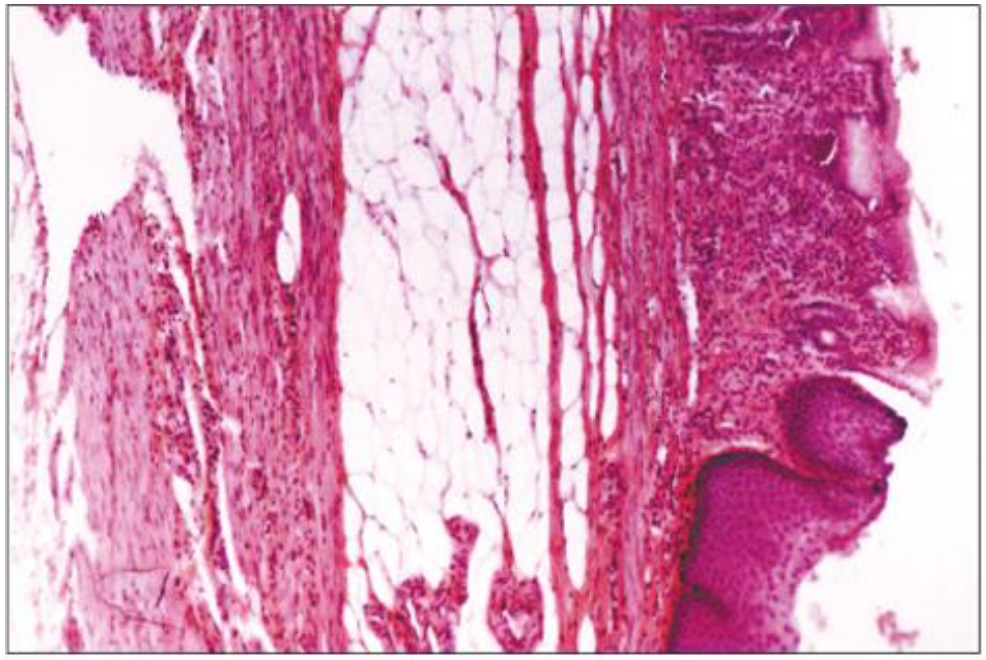


► **LM of the esophagogastric junction.** An abrupt transition occurs at this squamocolumnar junction (**arrow**). Nonkeratinized stratified squamous epithelium (**SSE**) of the esophagus changes to simple columnar epithelium (**SCE**) of the stomach. Gastric epithelium contains surface mucous cells. Small gastric glands—cardiac glands (**CG**)—are in underlying lamina propria (**LP**), are associated with gastric epithelium, and contain mucus-secreting cells. 240×. *H&E.*

esophagus



cardia




Stomach
Esophagus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