Salivary glands
intro to teeth

Jan Krivanek

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Lecture 2

- Overview of the **salivary glands** of the oral cavity and their microscopic structure
- **Large salivary glands** - topography, structure and description.
- **Saliva**
- **TMJ**

Salivary glands - glandulae salivariae

Exocrine glands with watery, mucous or mixed secretions

Formed by proliferation of the ectoderm of the primitive oral cavity into the ectomezenchyme (composite organ)

Salivary glands classification

- According to the **type of secretory compartments** and the nature of the secretion:

  serous - acini

  mucinous - tubules

  mixed - acini, tubules + tubules with Gianuzzi lunules (tubuloacinary units)

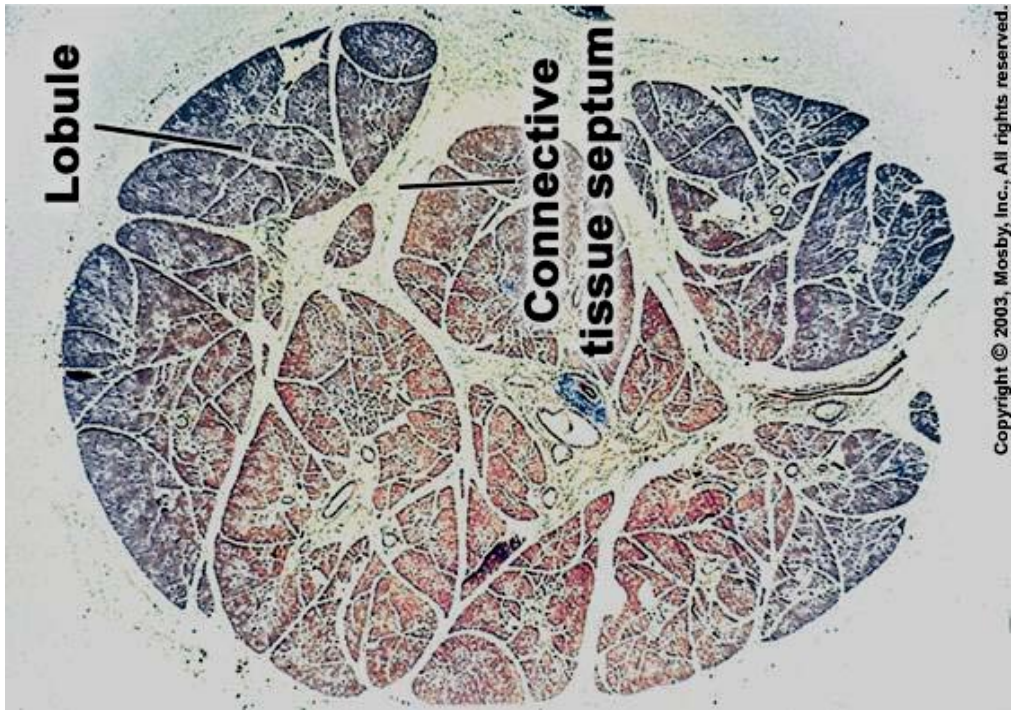
- According to size:

  large – gl. parotis, gl. submandibularis a **gl. sublingualis**

  small – in tela submucosa, the number of 800 - 1000

General structure of large salivary glands

- Ligament → capsula fibrosa
  → septa *(+ vessels, nerves, interlobular and larger ducts)*
- Parenchyma → lobes



→ **Glandular compartments**

(*serous acini, mucinous tubules, serous lunules*)

→ **Ducts**

(*intercalated, striated,*

interlobular, main)

Structural components of the salivary glands

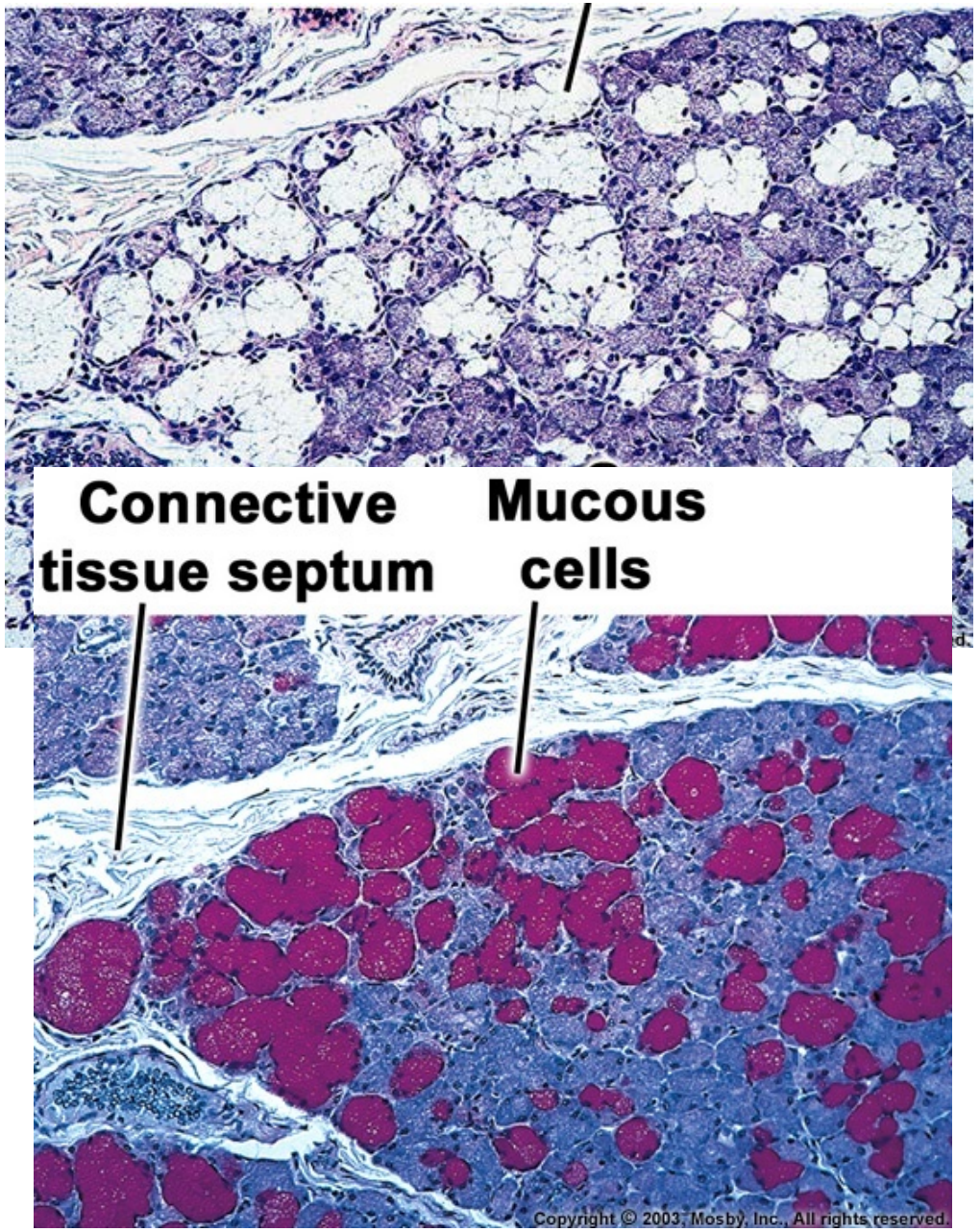
Ligament

gl. parotis and gl. submandibularis ligament forms
capsule
gl. sublingualis and gl. lingualis anterior capsule incomplete
septa

Glandular tissue (parenchyma)

The lobules contain:
secretory compartments: serous acins, mucinous tubules or tubules with Gianuzzi lunules +
2 parts of the duct system - intercalated and striated ducts

(interlobular and main - in septal ligament)

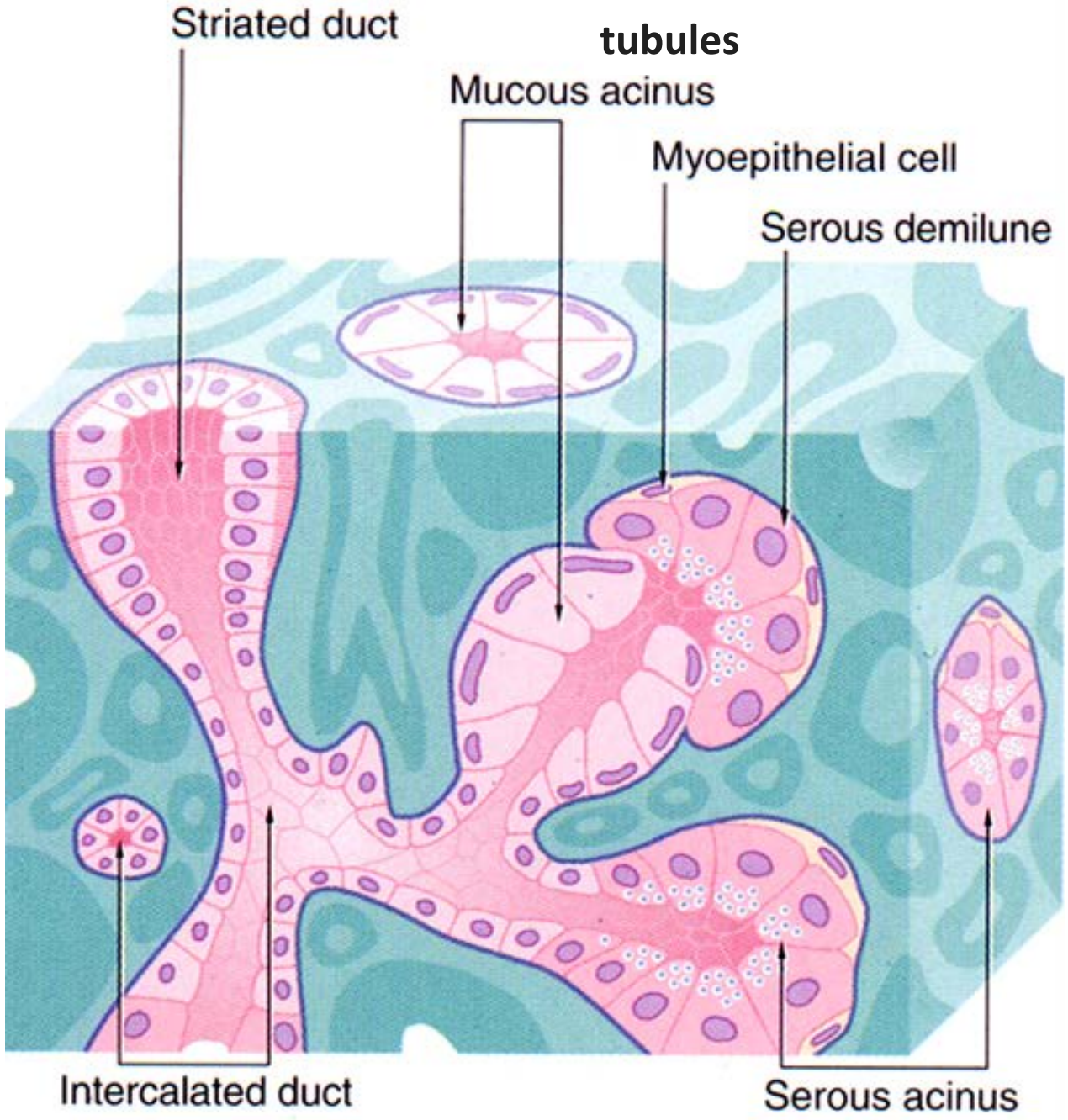


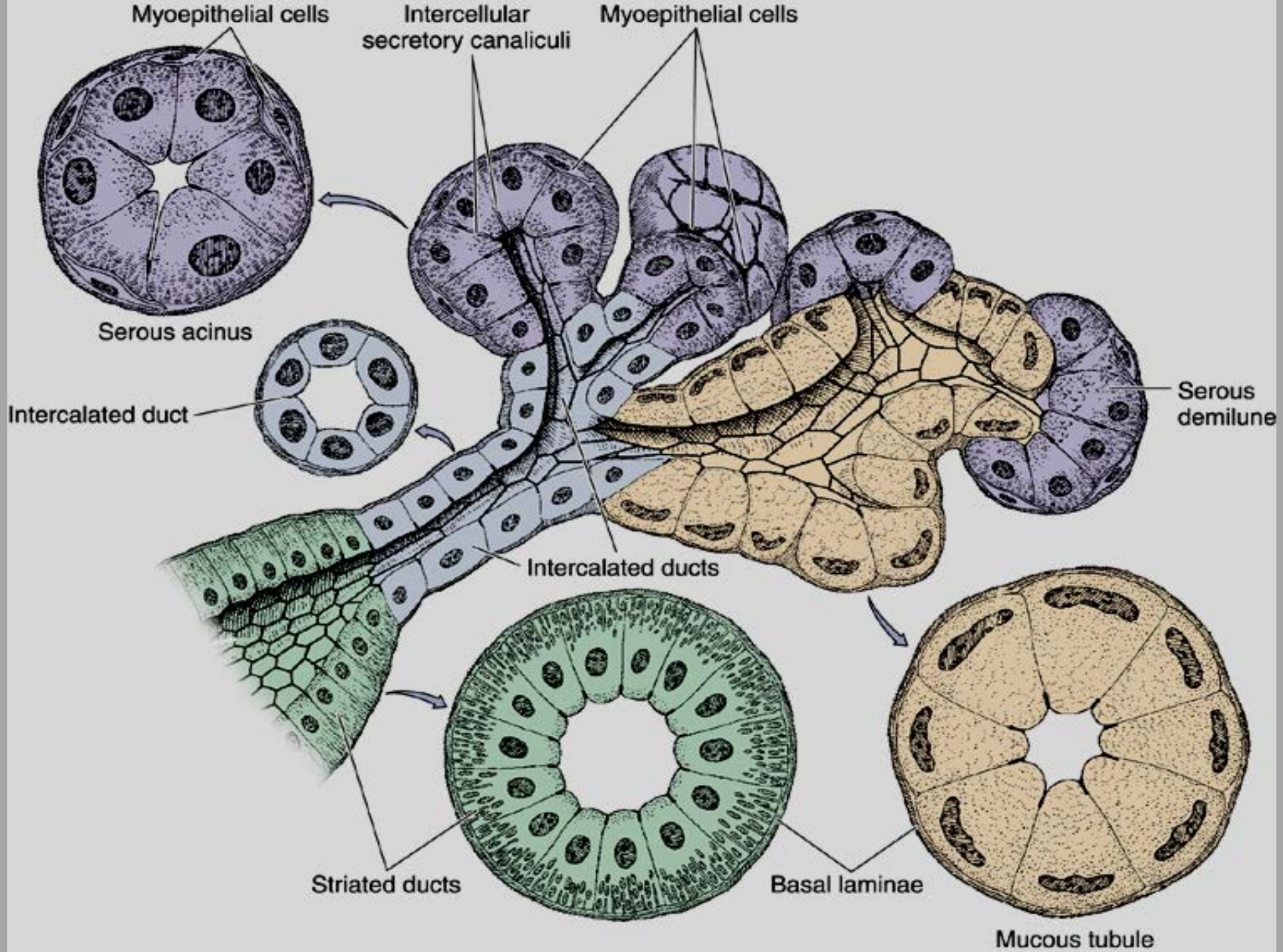
Wall of secretory compartments:

- basement membrane
- myoepithelial cells
- glandular cells

Wall of intecalated and striated ducts

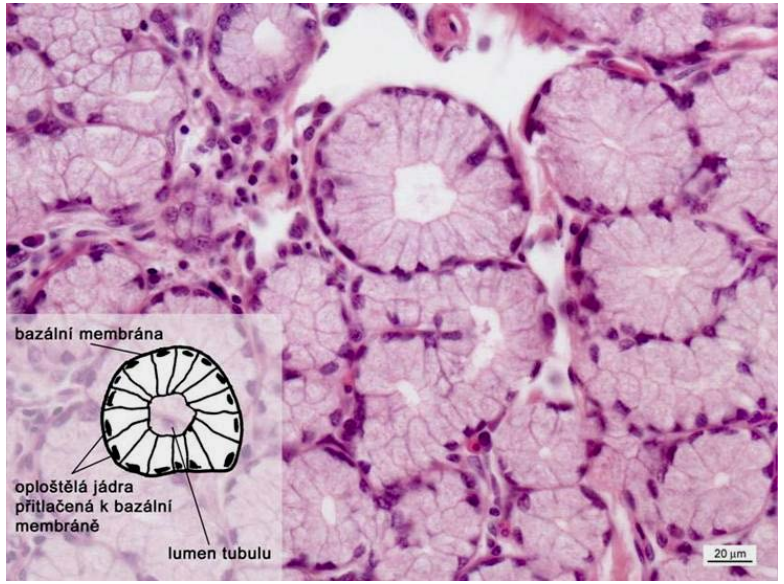
- basement membrane
- myoepithelial cells (interalated ducts only)
- Epithelial cells



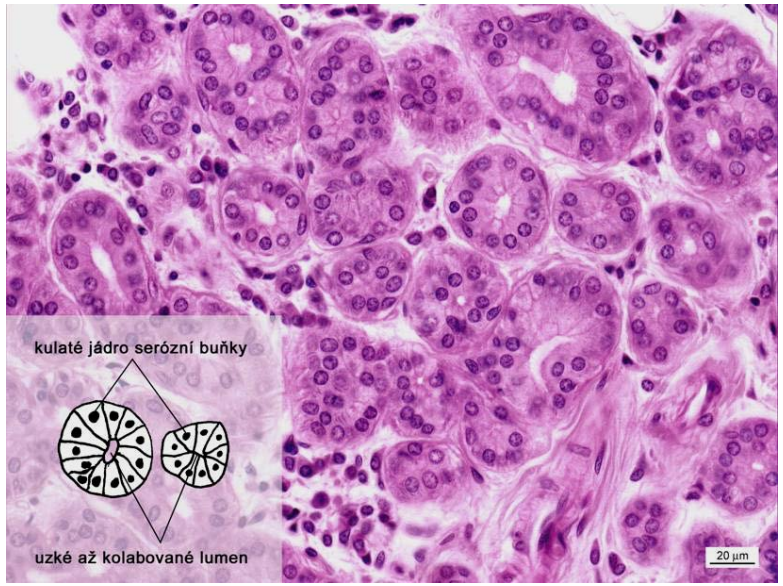

Myoepithelial cells
Intercellular secretory canaliculi
Myoepithelial cells
Serous acinus
Intercalated duct
Serous demilune
Intercalated ducts
Striated ducts
Basal laminae
Mucous tubule

Secretory compartments

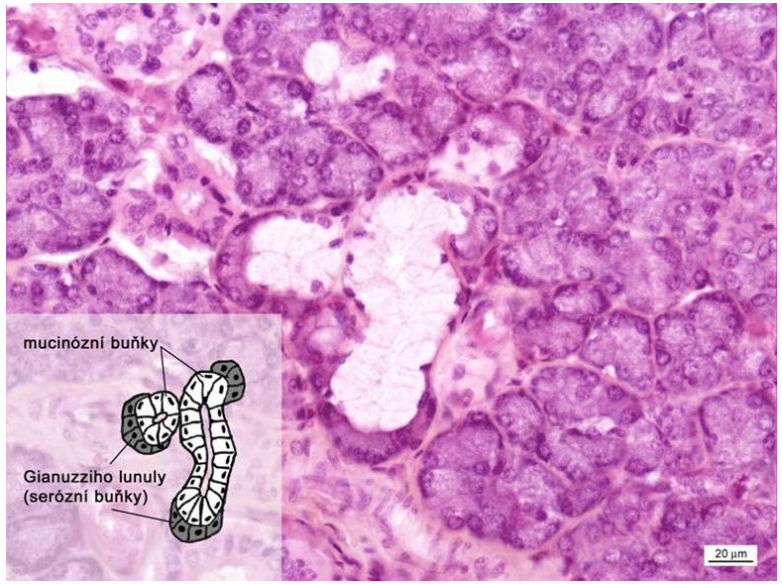
Mucinous tubules



Serous acini

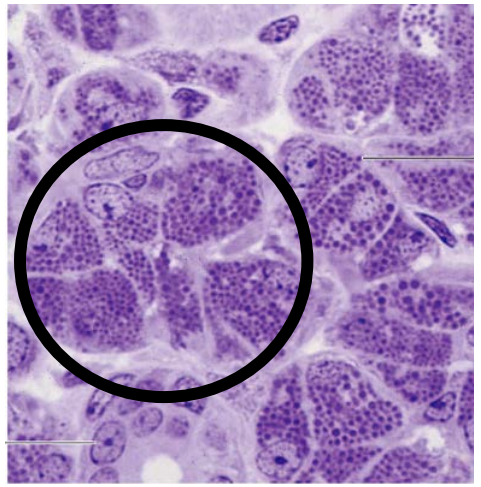


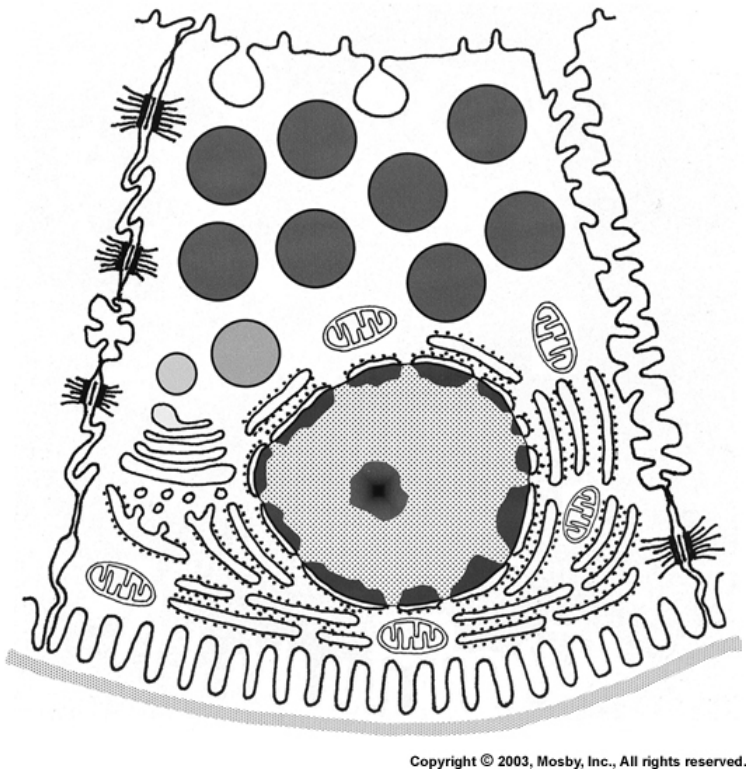
Tubules with lunules



Serous acini

spherical to ovoid sacs (60 - 150 µm) with a narrow lumen
wall: serous cells, myoepithelial cells, basement membrane

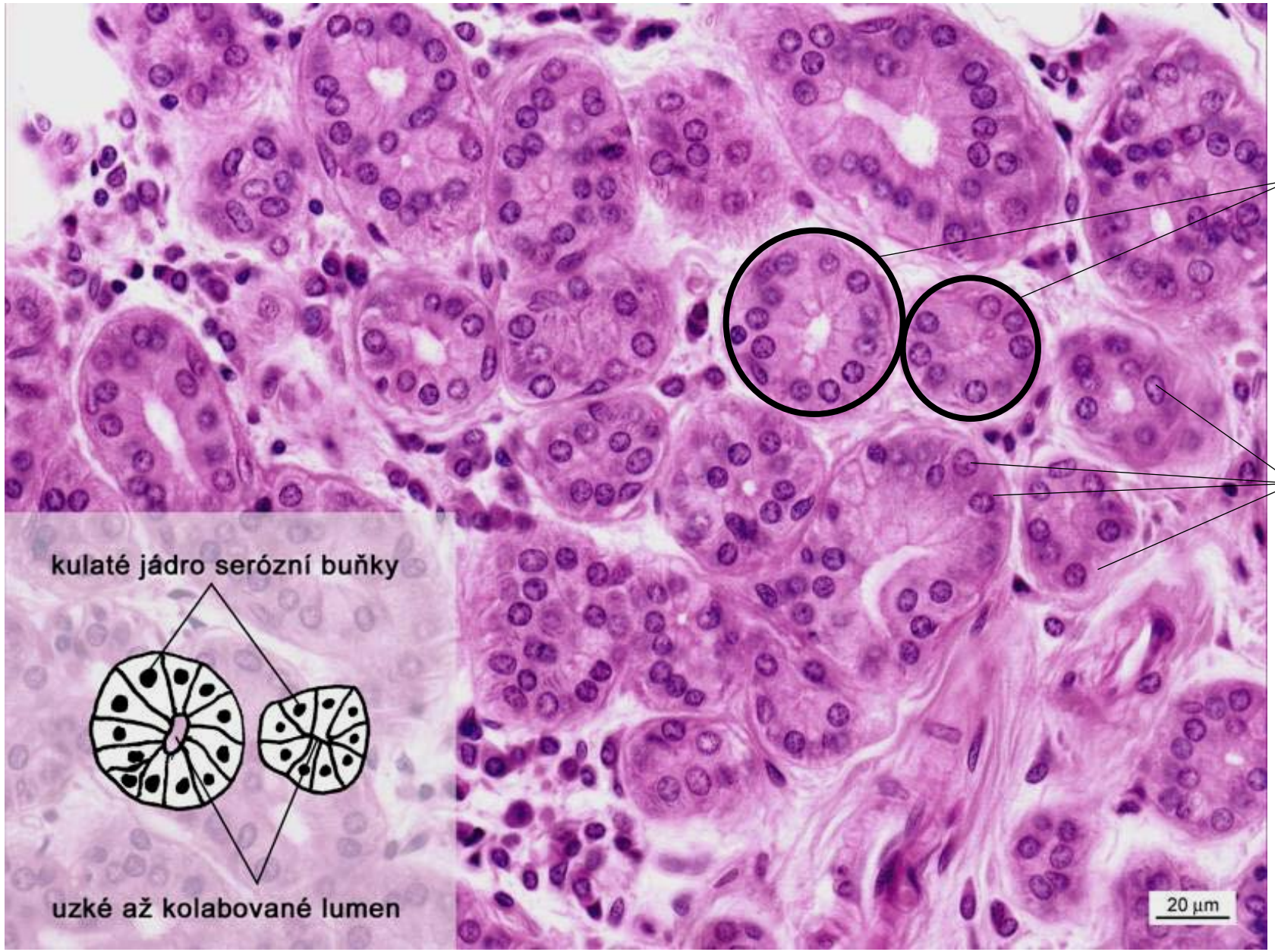




Serózní buňky

Cells

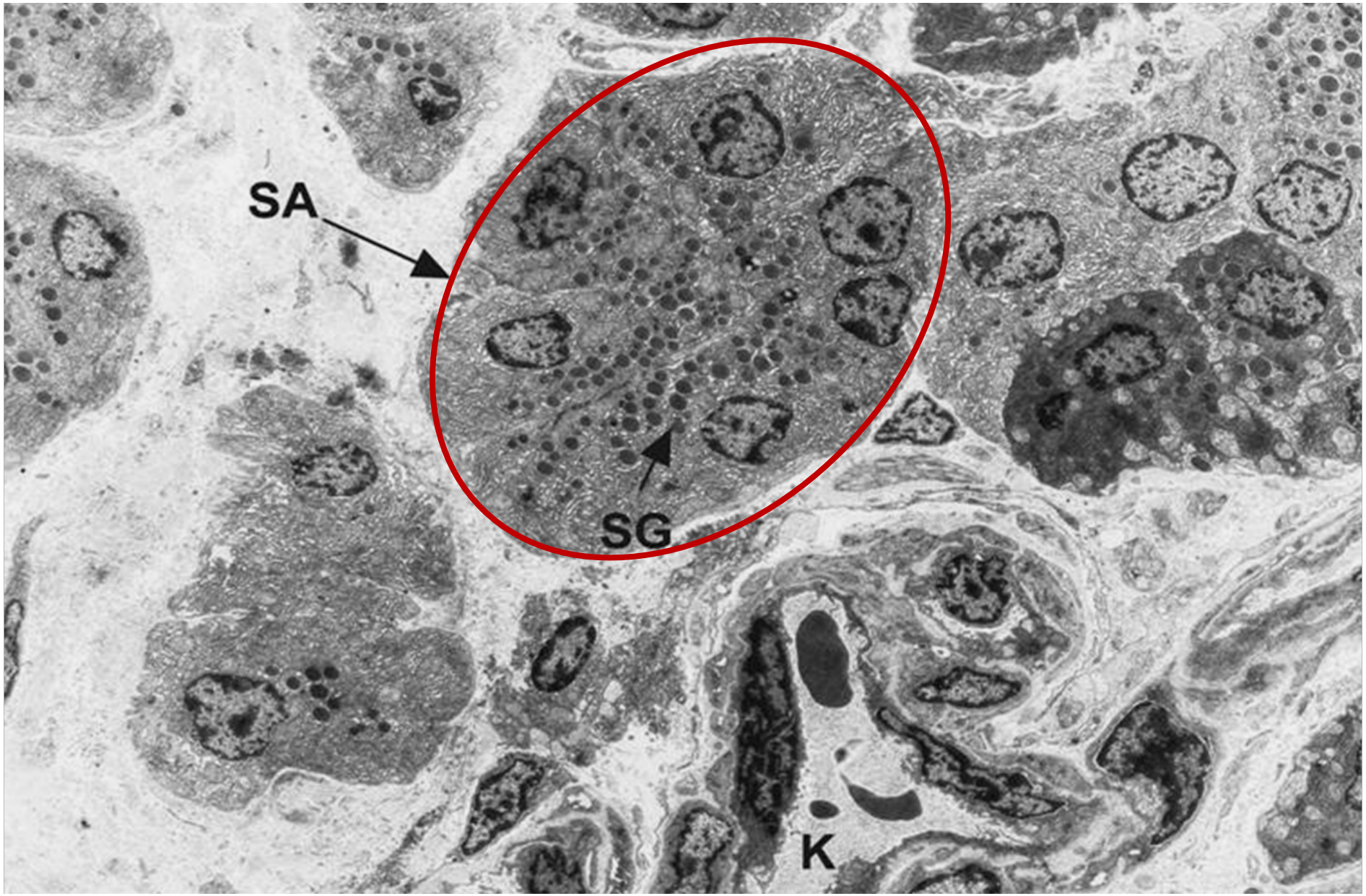
- pyramidal shape and spherical nucleus at the base
- below the nucleus is a basophilic cytoplasm (rER, mitochondria and ribosomes)
- supranuclear - eosinophilic secretory grains / zymogenic = proenzyme
  (zymogen = inactive enzyme precursor)



Serous acini

Serous cells

Aqueous secretion, rich in proteins and enzymes



Rat salivary gland parenchyma: SA – serous acinus, SG – secretory granule, K – capillary. TEM, primary magnification 1,500x

Mucinous tubules

Usually larger diameter than serous acins (about 200 µm), distinct lumen

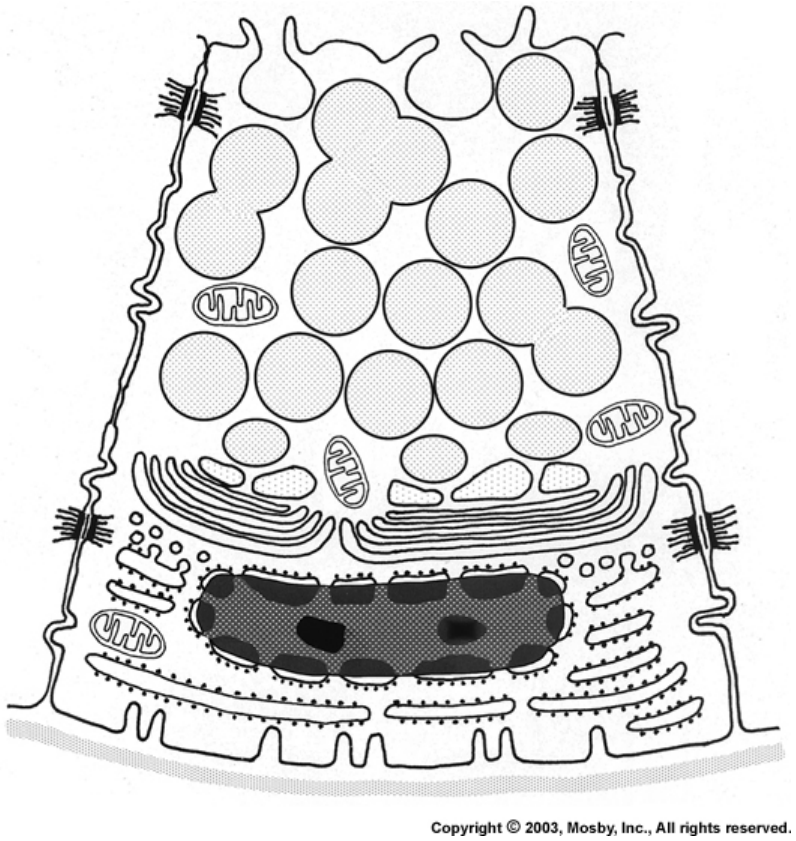
On sections: transversely or longitudinally sectioned

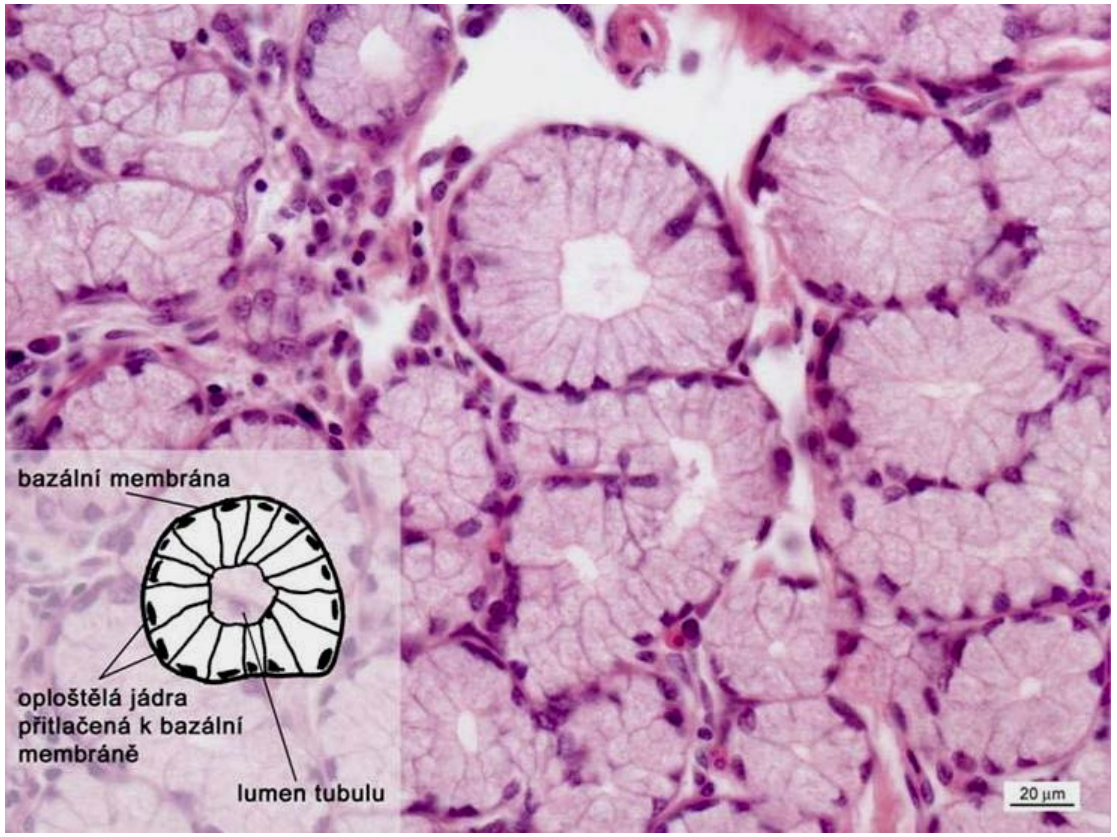
Wall: cylindrical mucinous cells, myopithelial cells and basement membrane

Flattened nuclei

Apexes - numerous grains of mucinogen

Viscous mucus secretion



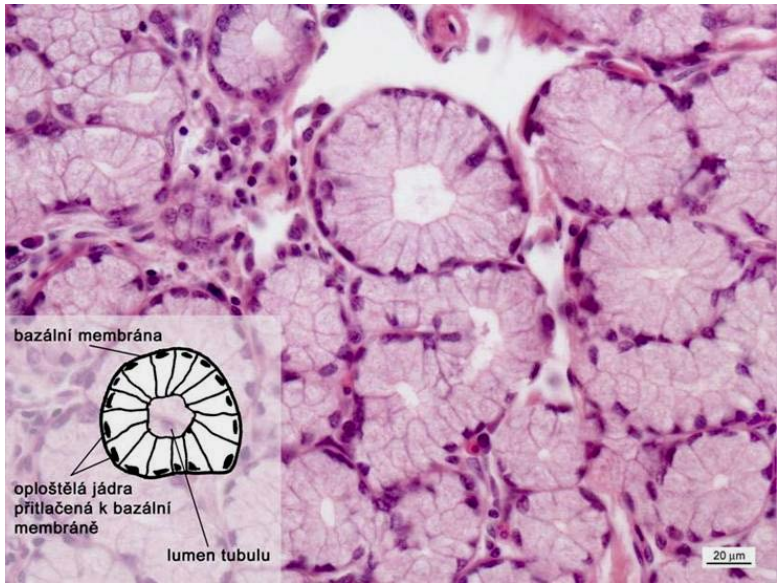


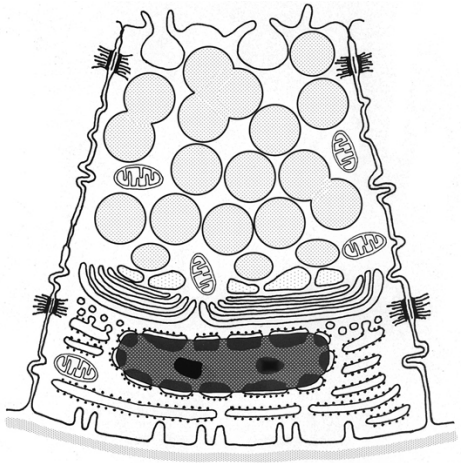
<u>Tubules with lunules</u> (Gianuzzi) - **tubuloacinary units**

Lunule (demilune) = aggregation of serous cells at one or both ends of a mucinous tube, similar to a demilunes

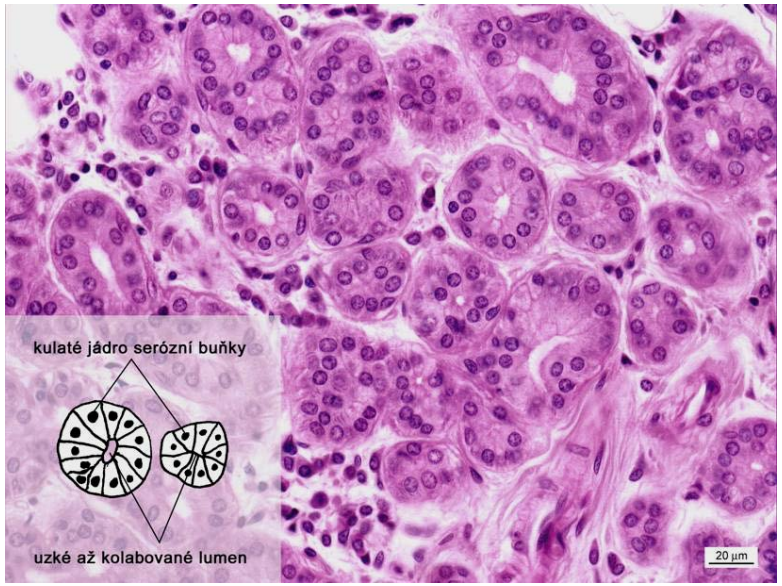
Secretory compartments

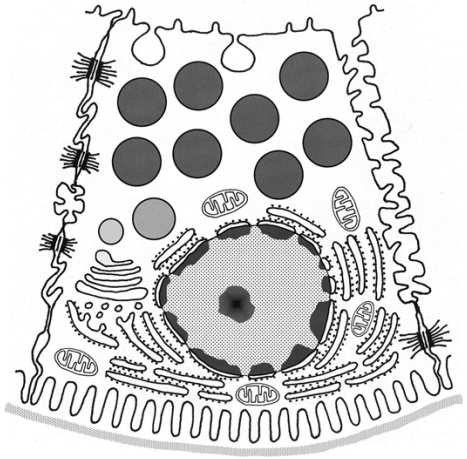
Mucinous tubules





Serous acini

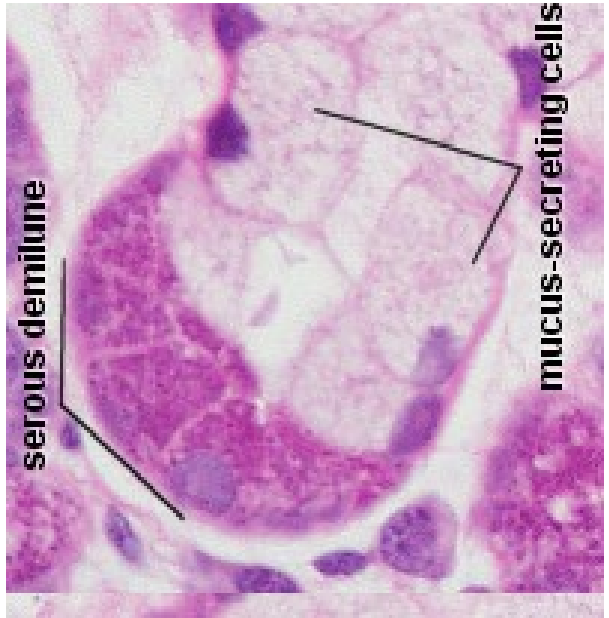


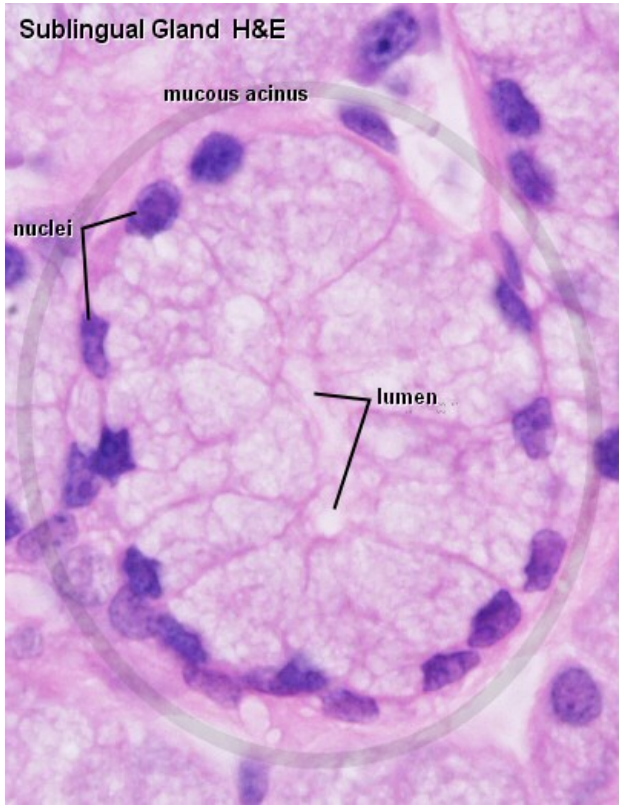


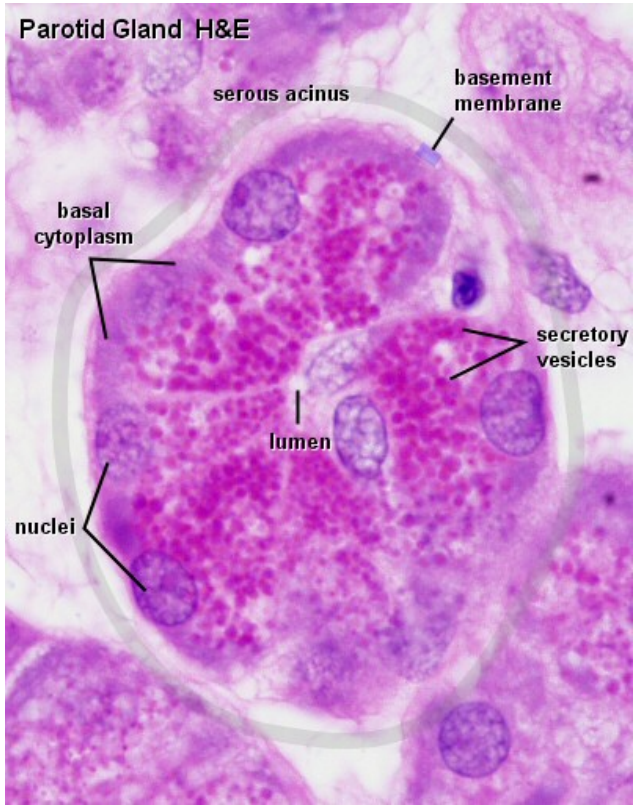
Tubules with lunules

Secretory compartments

- Serous acini
- Mucinous tubules
- Lunules (demilunes)







Myoepithelial cells

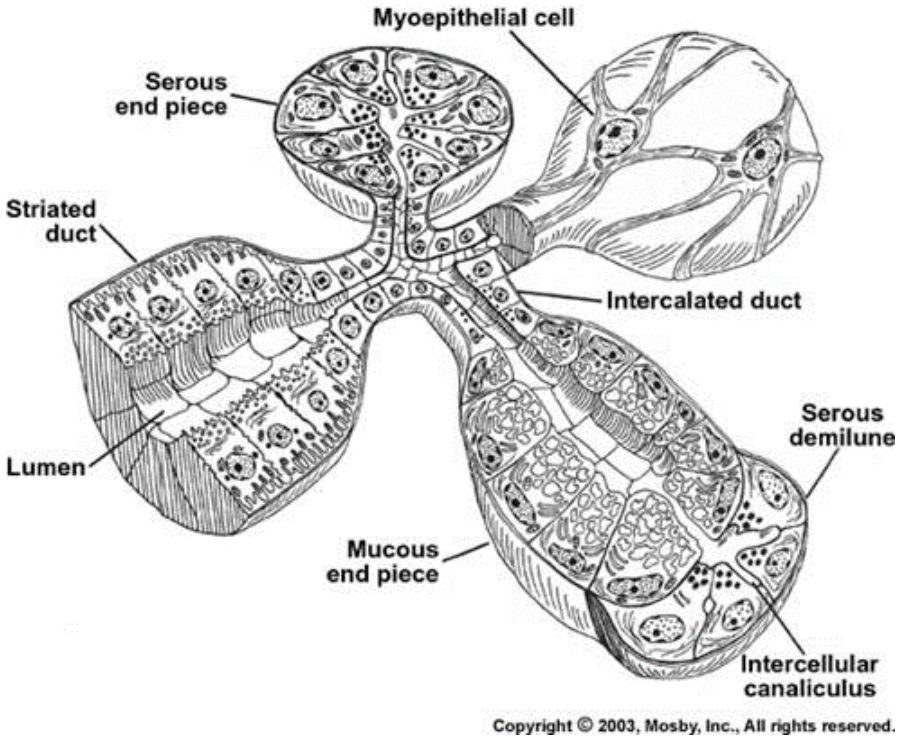
Capable **contractions**, **Vegetative** control

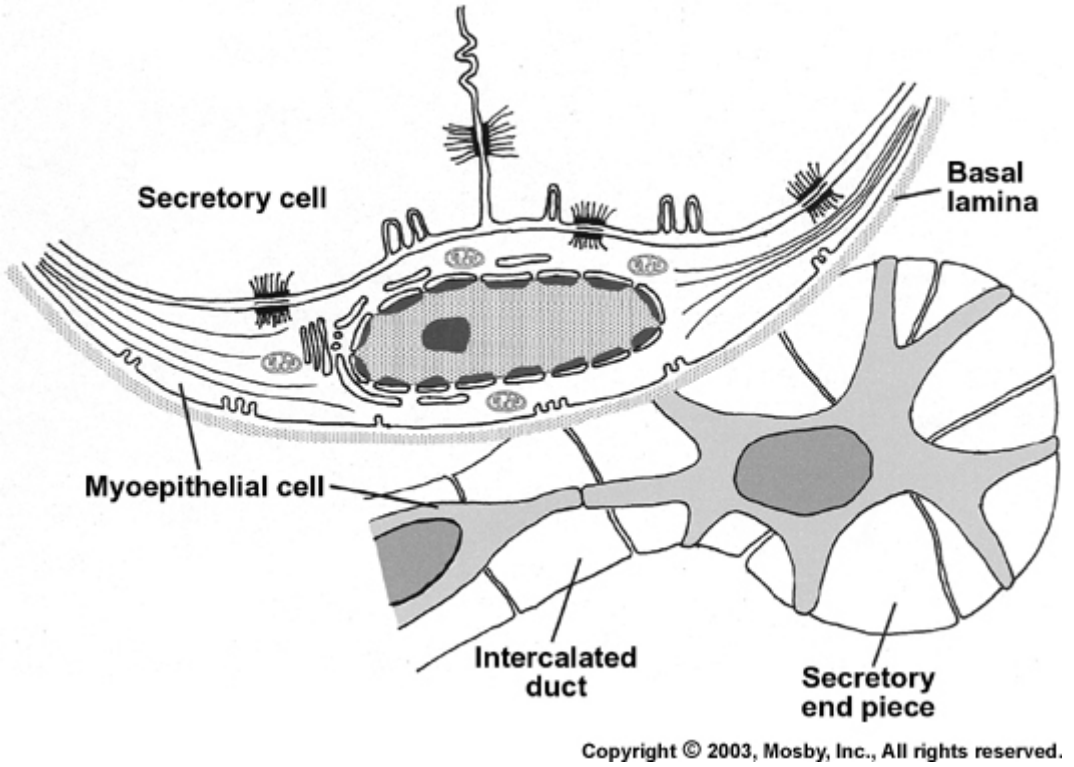
They **regulate secretion**, control nutrient supply and control electrolytes

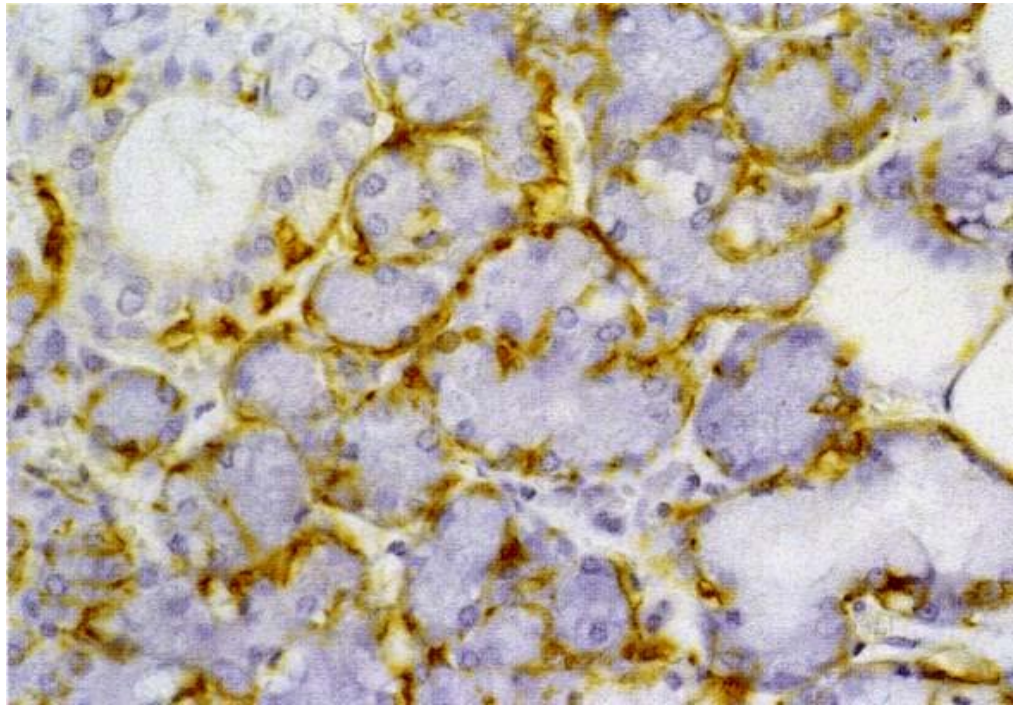
Inserted **between the bases of secretory cells** (acins and tubules) **and the basement membrane**

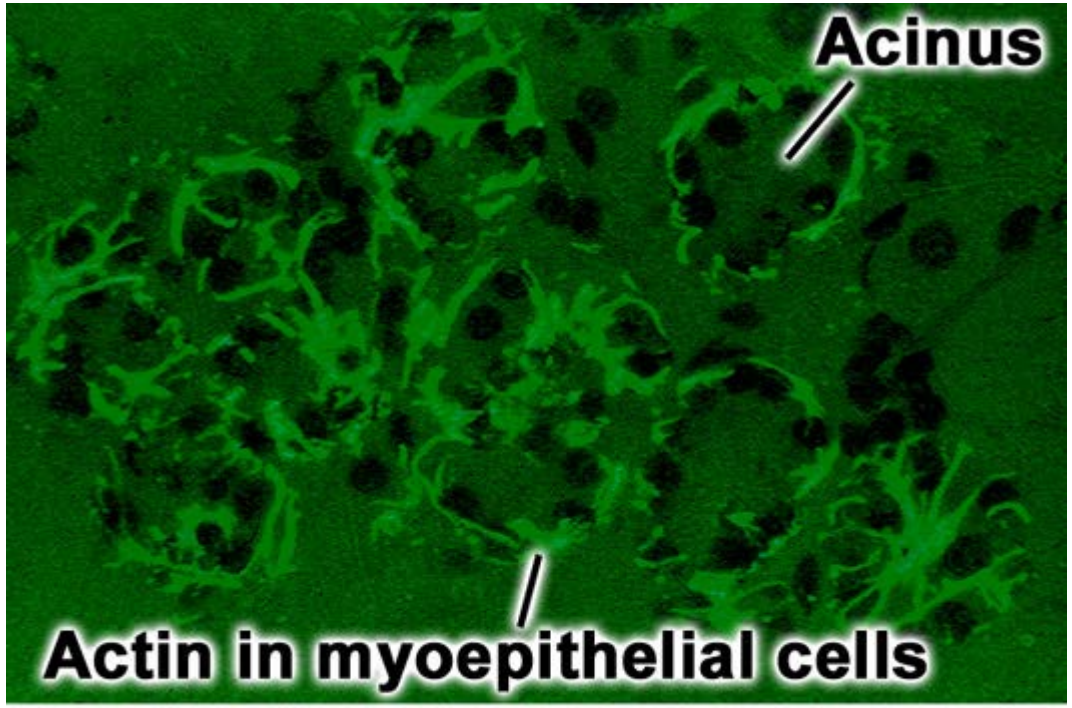
Flattened body, several protrusions, between secretory and myoepithelial cells numerous desmosomes or hemidesmosomes

In the **cytoplasm actin microfilaments** (bundles) + cytokeratin filaments







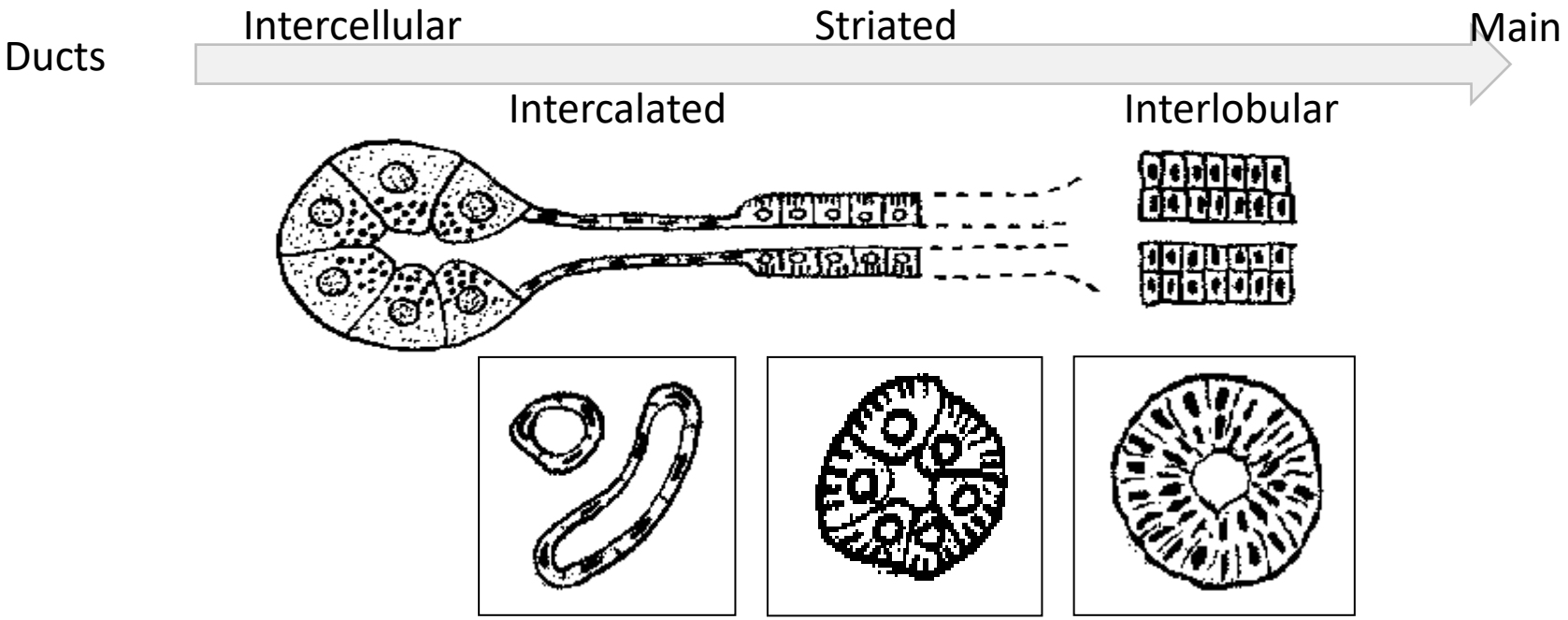


The cells help to release the secretion into the lumen of the secretory compartments and its further passaged through the inserted ducts (in the wall of which they are also present)

Origin: Neural crest, active from the 25th week of development

Salivary ducts types

- Intercelual *(they do not have their own wall, intercellular space)*
- Intercalated *(simple squamous ep., only serous and mixed glands)*
- Striated *(simple cuboidal/low columnar ep.; basal labyrinth ➔ striation)*
- Interlobular *(simple – stratified columnar ep., in septs)*
- Main *(stratified columnar ep.)*



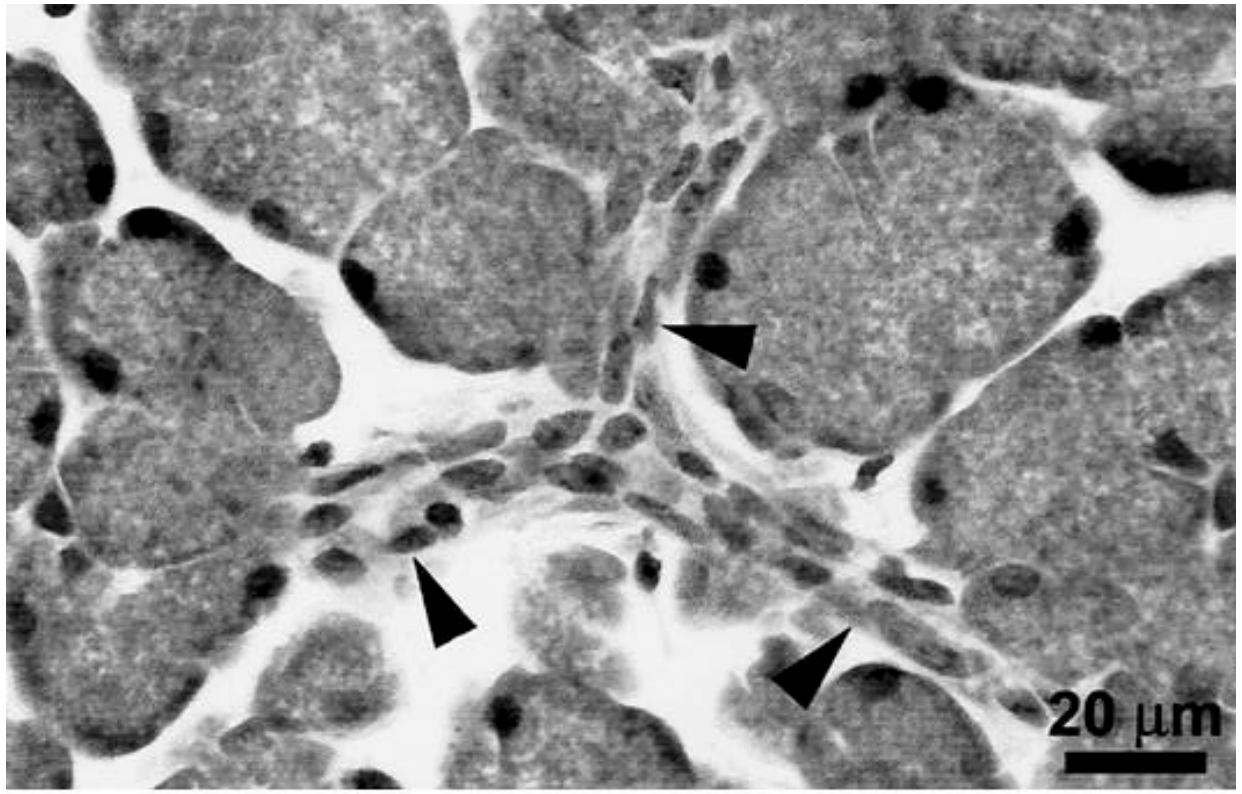
Intercalated ducts

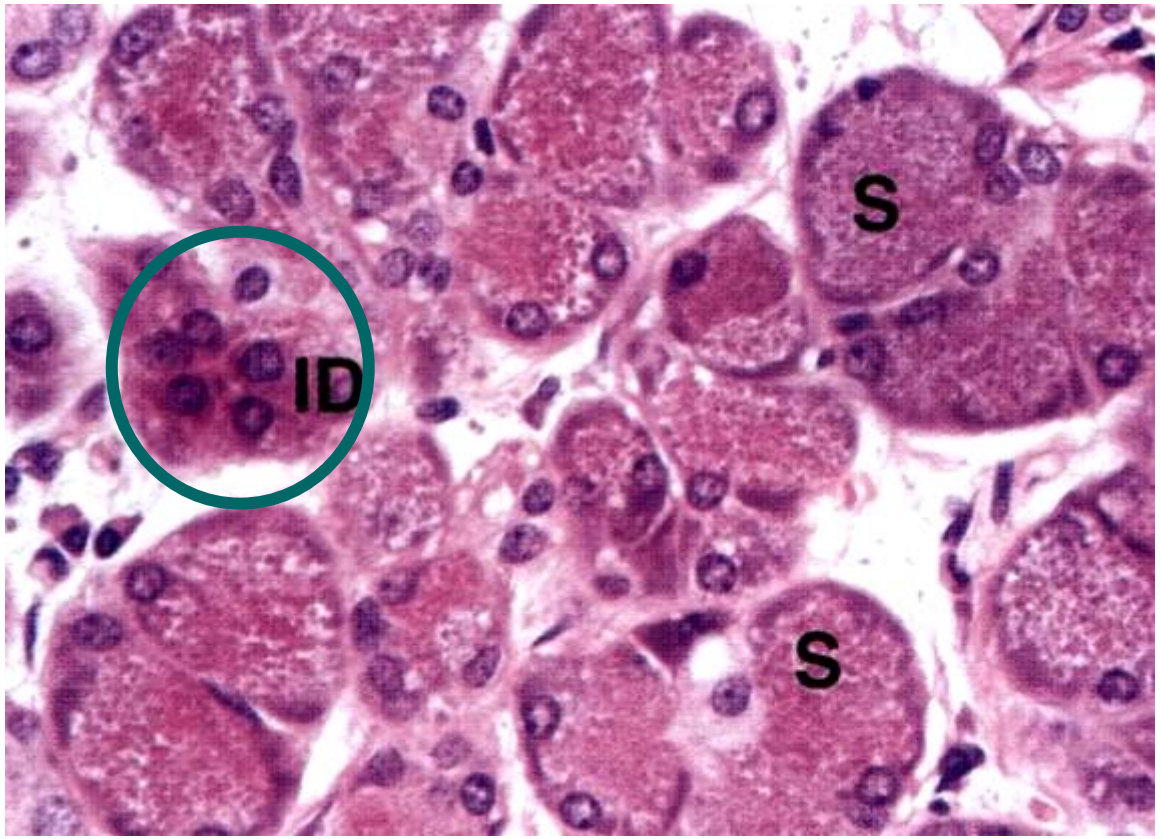
Narrow and thin-walled channel, collapsed on slides

Wall: basal membrame, myoepithelial cells and simple squamouse to low cubic ep.

Numerous in serous type of glands

(cells of intercalated ducts secrete to saliva macromolecular substances: lysozym + lactoferin)



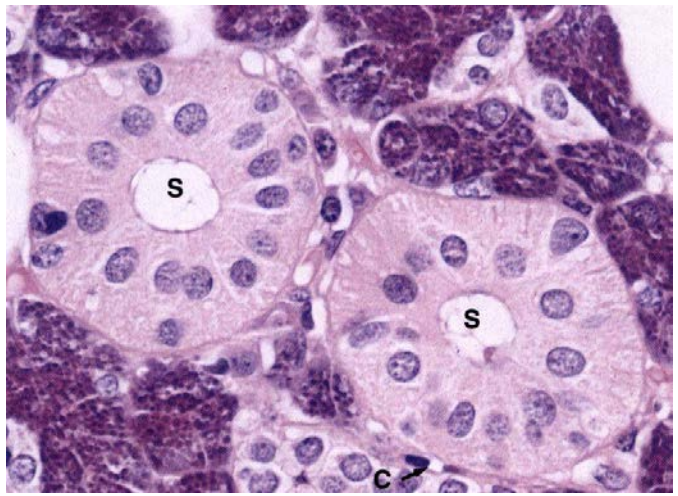


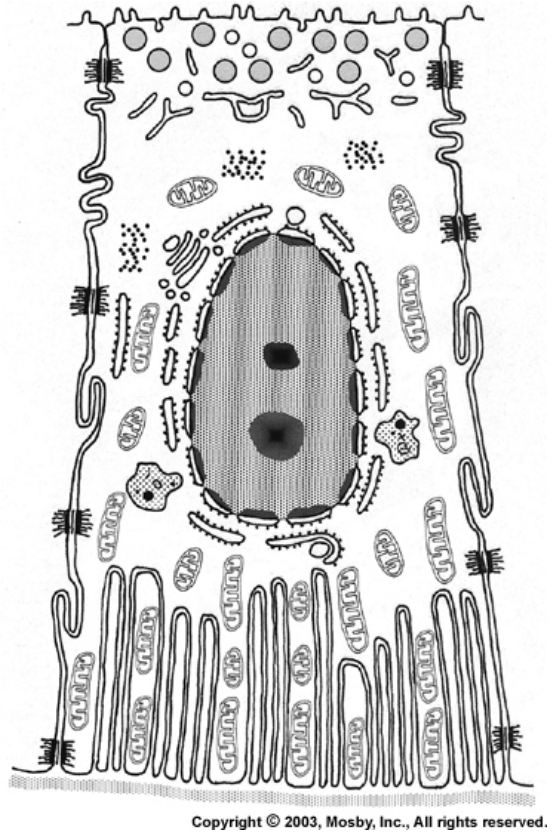
Striated ducts

Wider than the intercalated ducts (easy to find), usually in the middle of lobe
Wall: Basal membrane and simple cuboidal/low columnar ep.
Microvilli on apexes and an bases characteristic striation (basolateral labyrinth)
In the cytoplasm of cytokeratin filaments

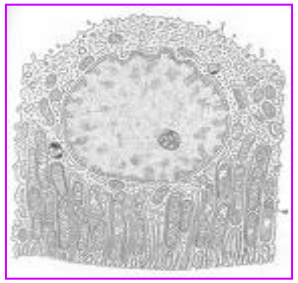
Glandula submandibularis

The cells of striated ducts regulate the content of water and electrolytes (Na+, K+, Cl-, Ca2+, Mg2+, HCO3-) in the secretion.
Resorption of Na+, and Cl-
Secretion of K+ and HCO3-
nerve control

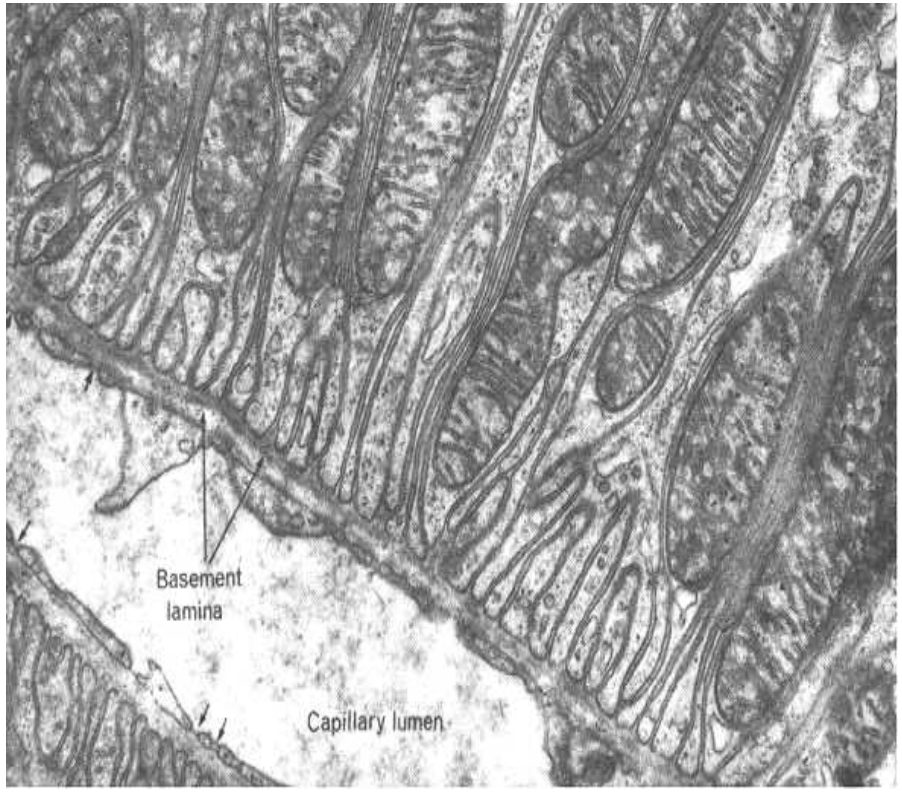


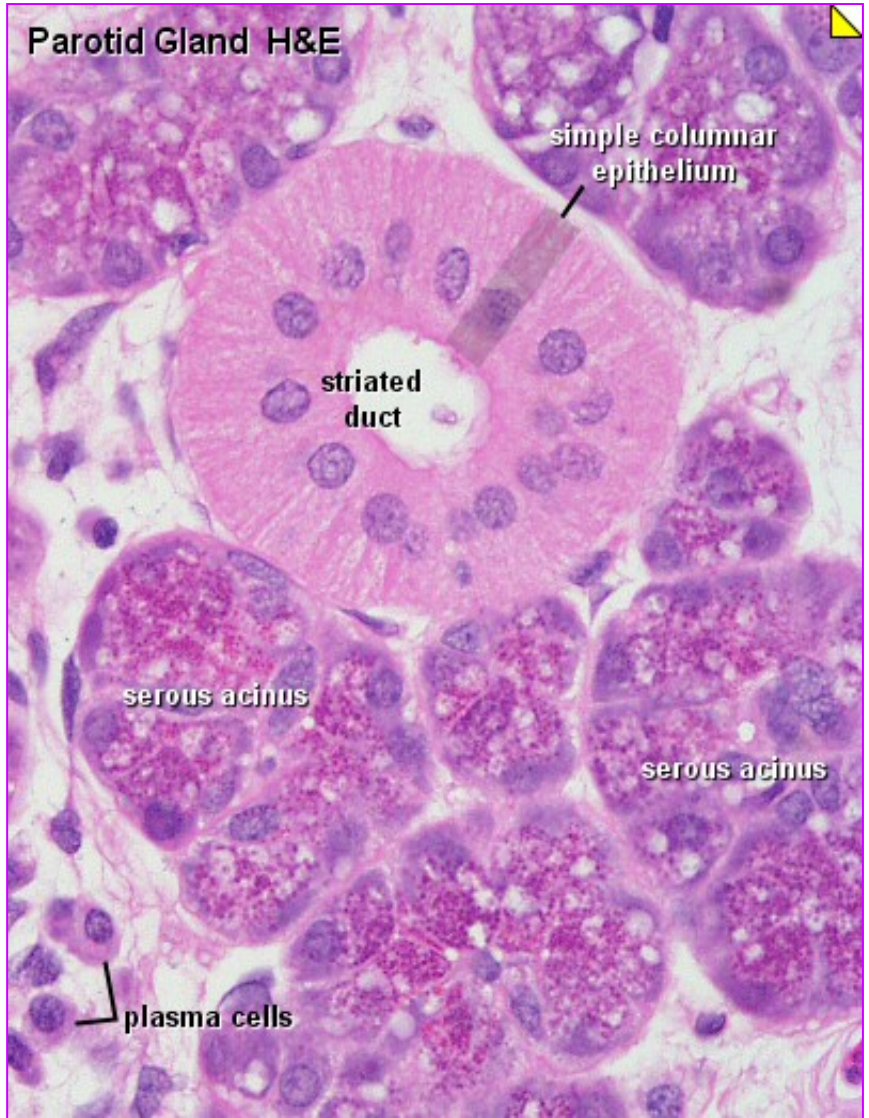


Striated duct – basal labyrinth



Epithelial cell





Base of epithelial cell:
Invagintion of cytoplasmic membrane, numerous mitochondria

Interlobular and main ducts

Interlobular ducts

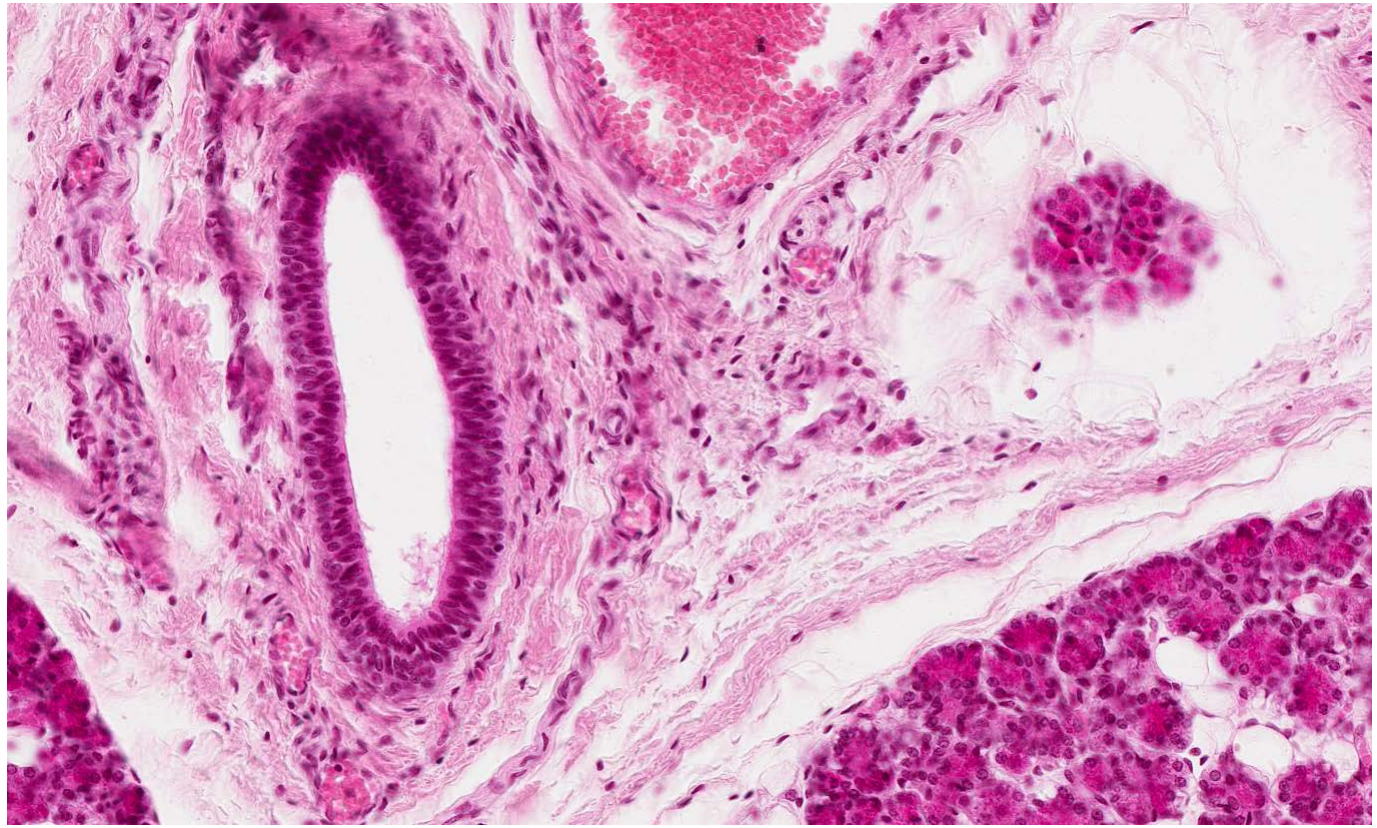
Located in fibrous septae between the lobes (columnar or stratified columnar epithelium)

They are formed by the **connection of several striated ducts**

Lined by a **high single-layer columnar** and in the terminal sections also a **stratified columnar** epithelium

Main ducts
Stratified columnar ep. with goblet cells

Ductus parotideus
Ductus submandibularis
Ductus sublinguales (major et minores)

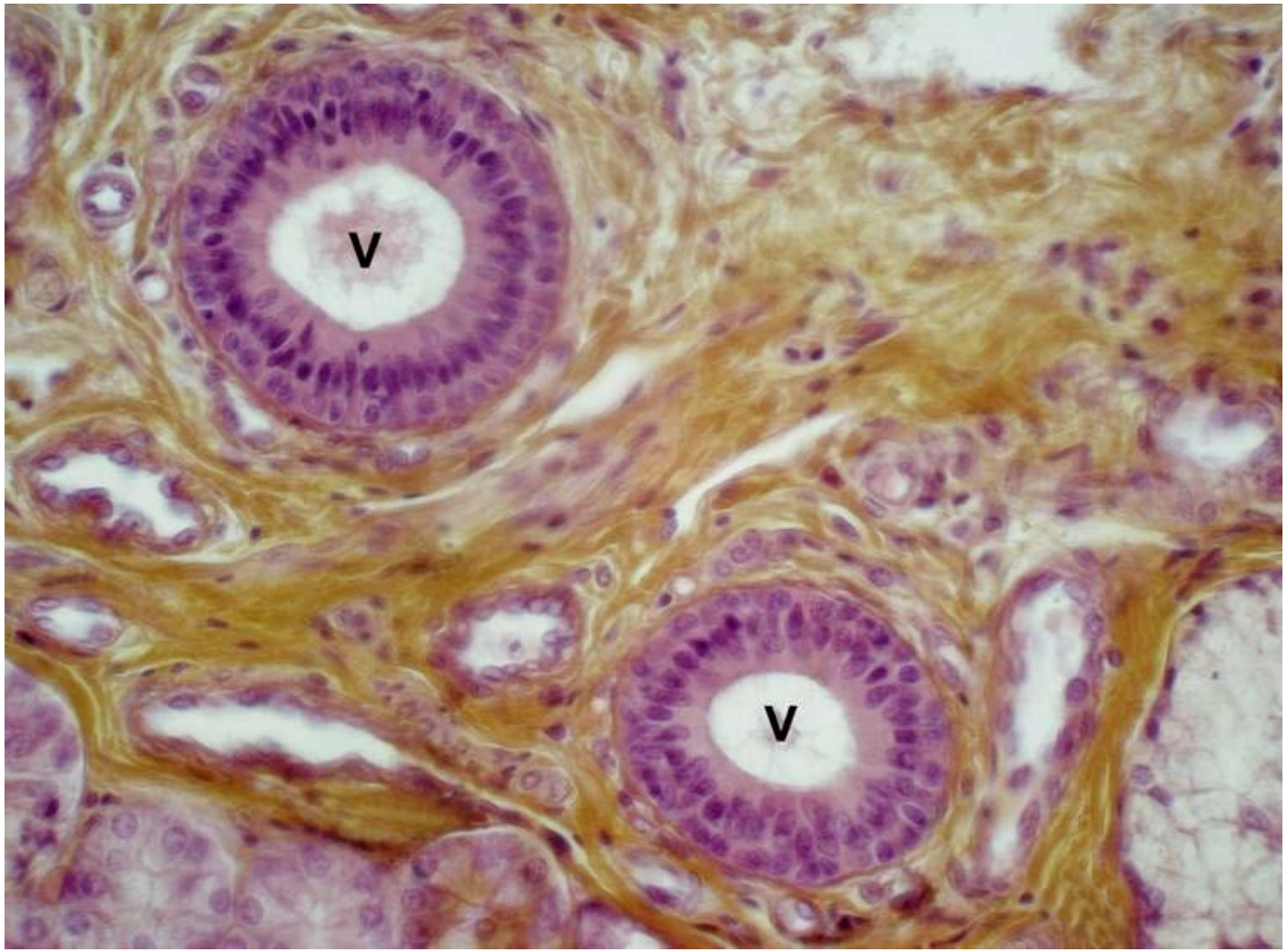


Main ducts

Stratified columnar ep.

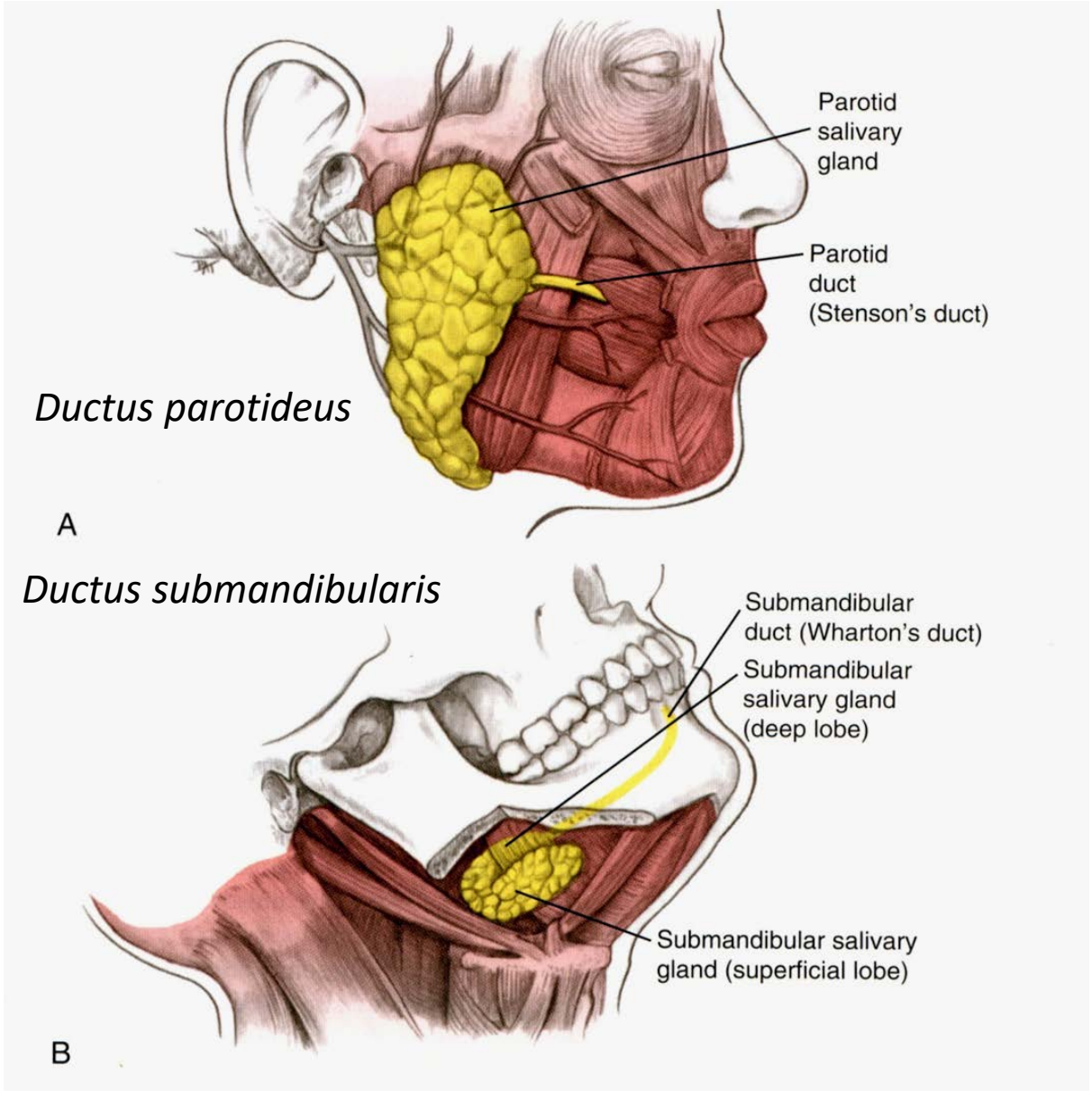
In epithelium **Goblet cells**

Wall supported by the dense collagenous connective tissue and smooth muscle cells



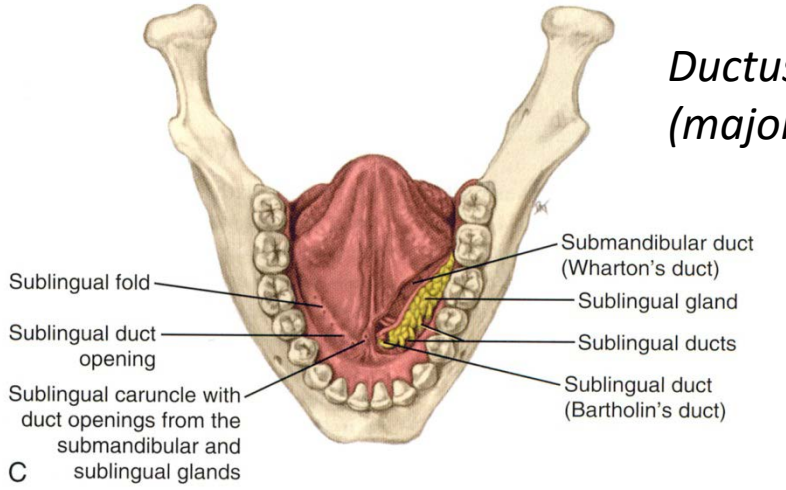
Ductus Rivini (V) – septum of *gl. sublingualis*.

Topography od large salivary glands

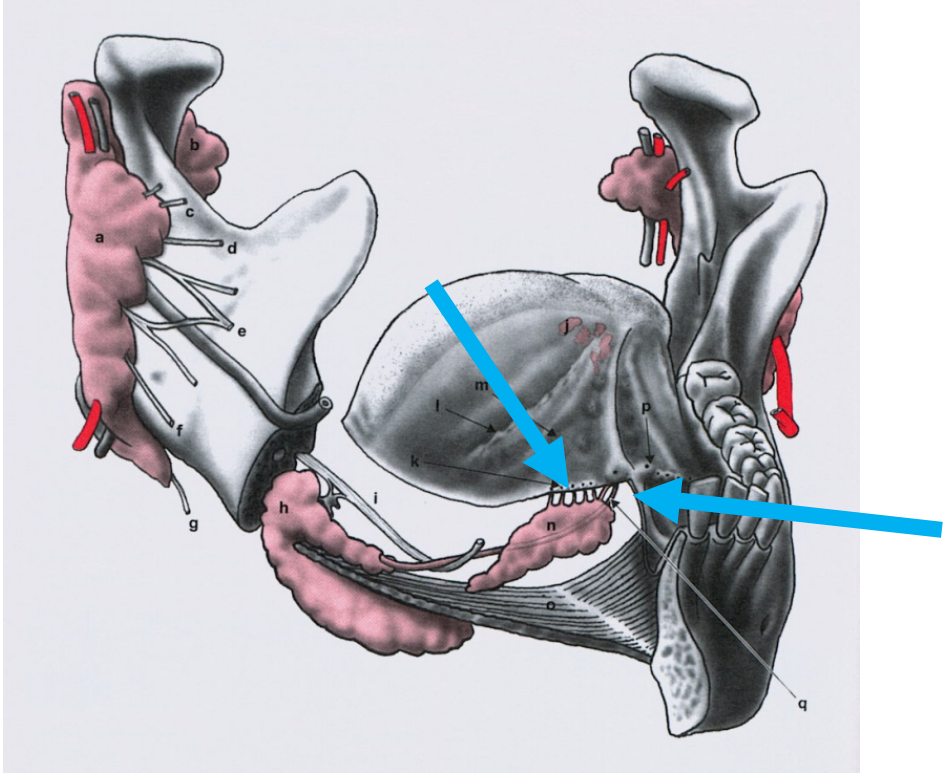


Ductus parotideus

Ductus submandibularis

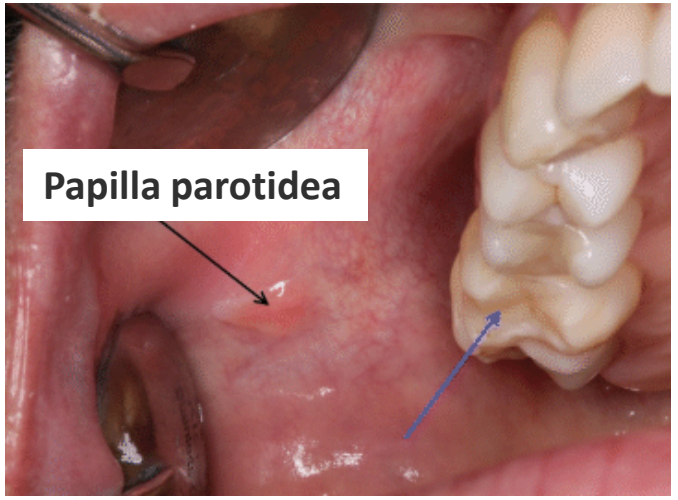


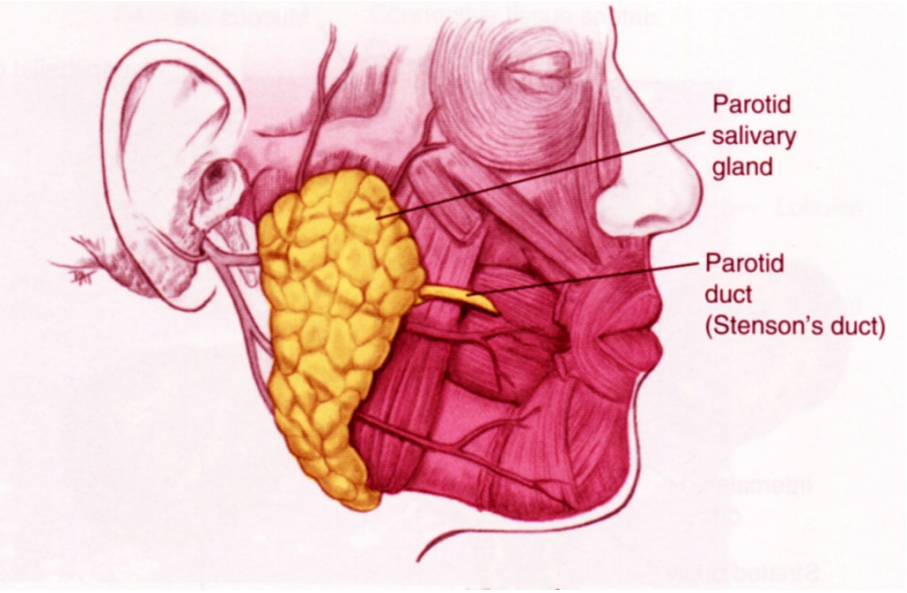
Ductus sublinguales (major et minores)

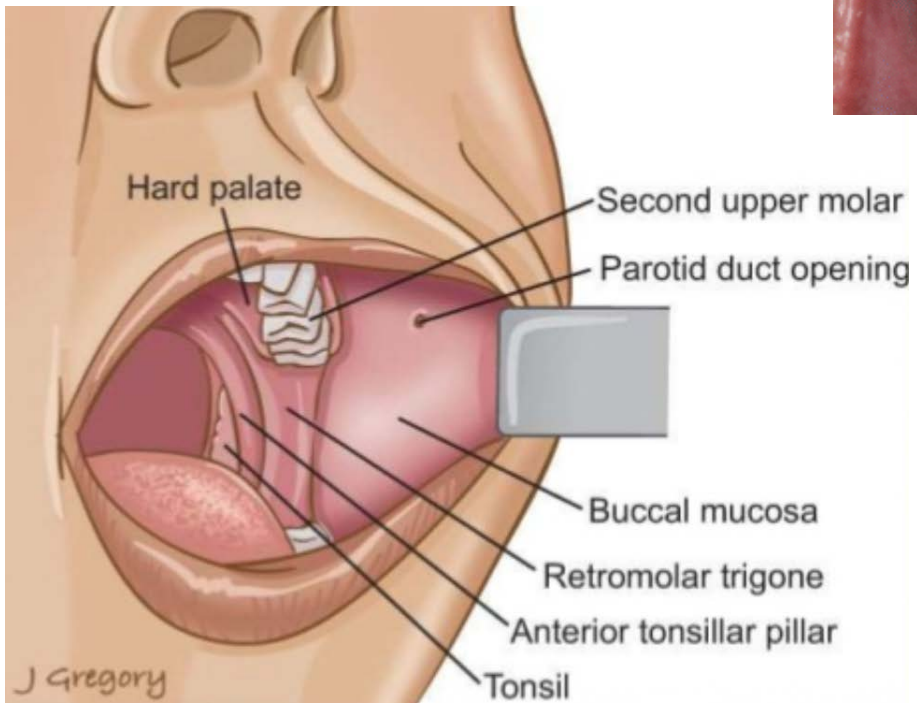


Glandula parotis

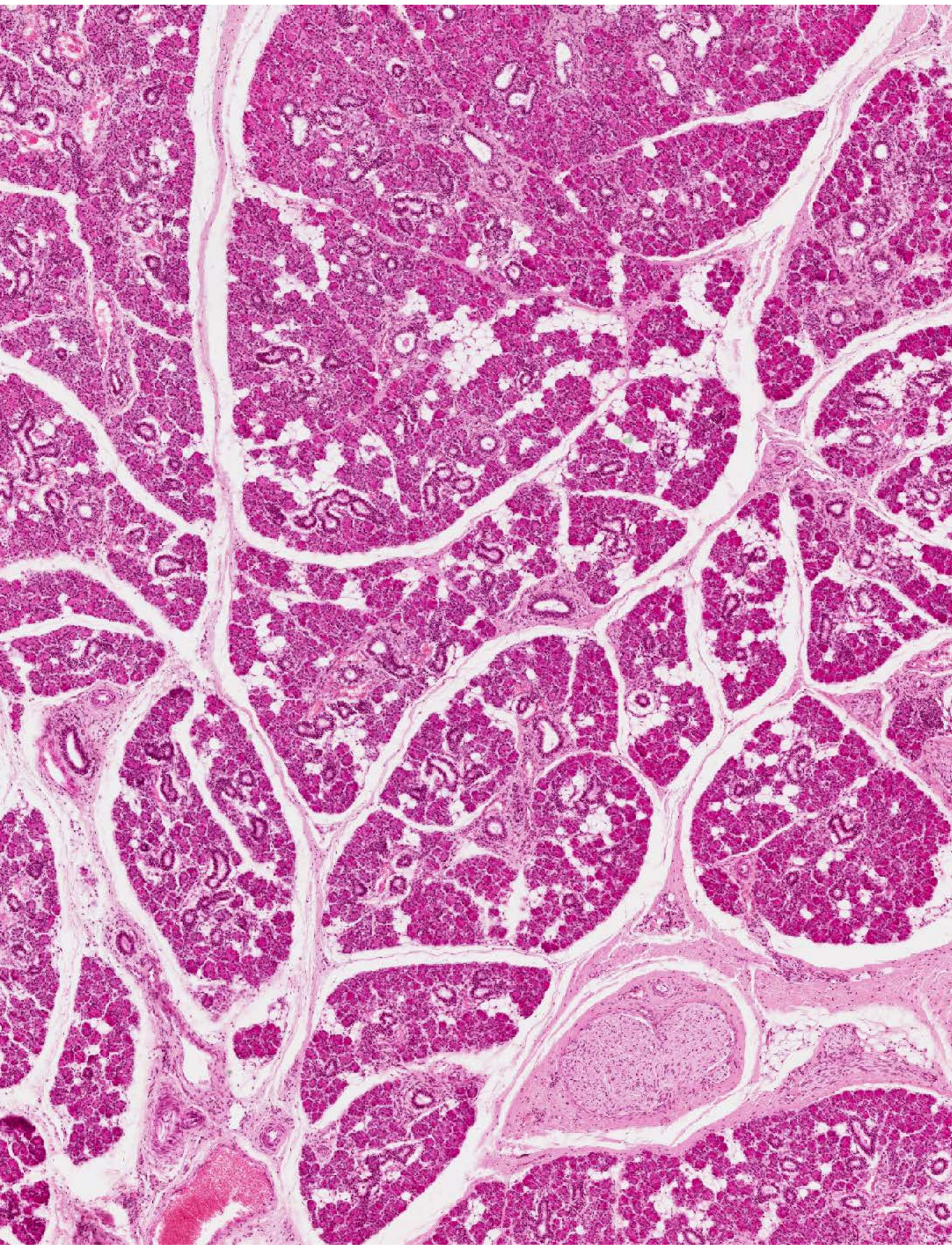
- **SEROUS gland**
- 14 - 28 g
- capsule, septs and lobules
- Serous acini, ducts: **long** intercalated ducts, **numerous** of striated ducts
- **ductus parotideus (Stenoni)** - 2. upper molar (Steno/Stensen, Niels)
- adipocytes

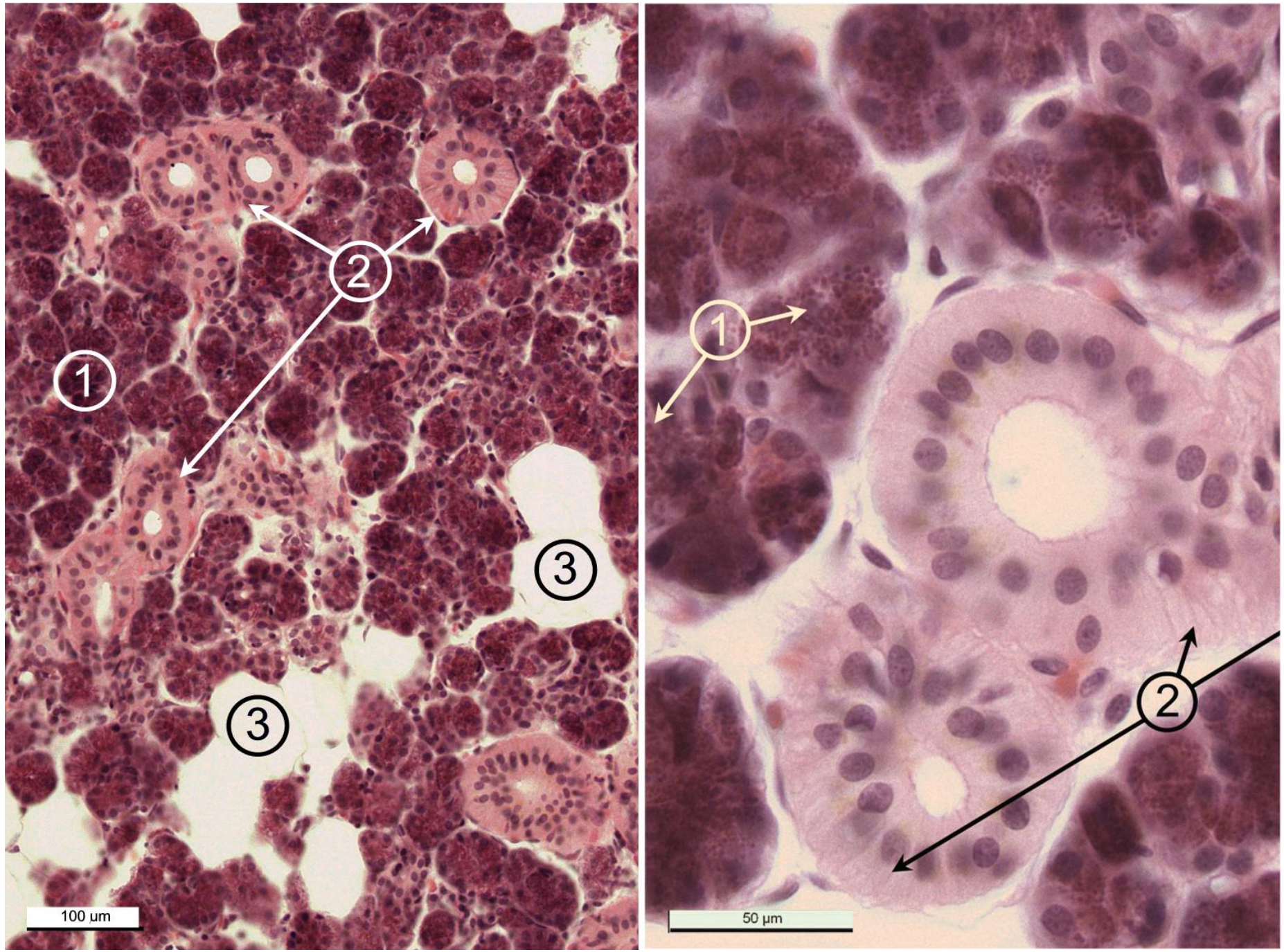






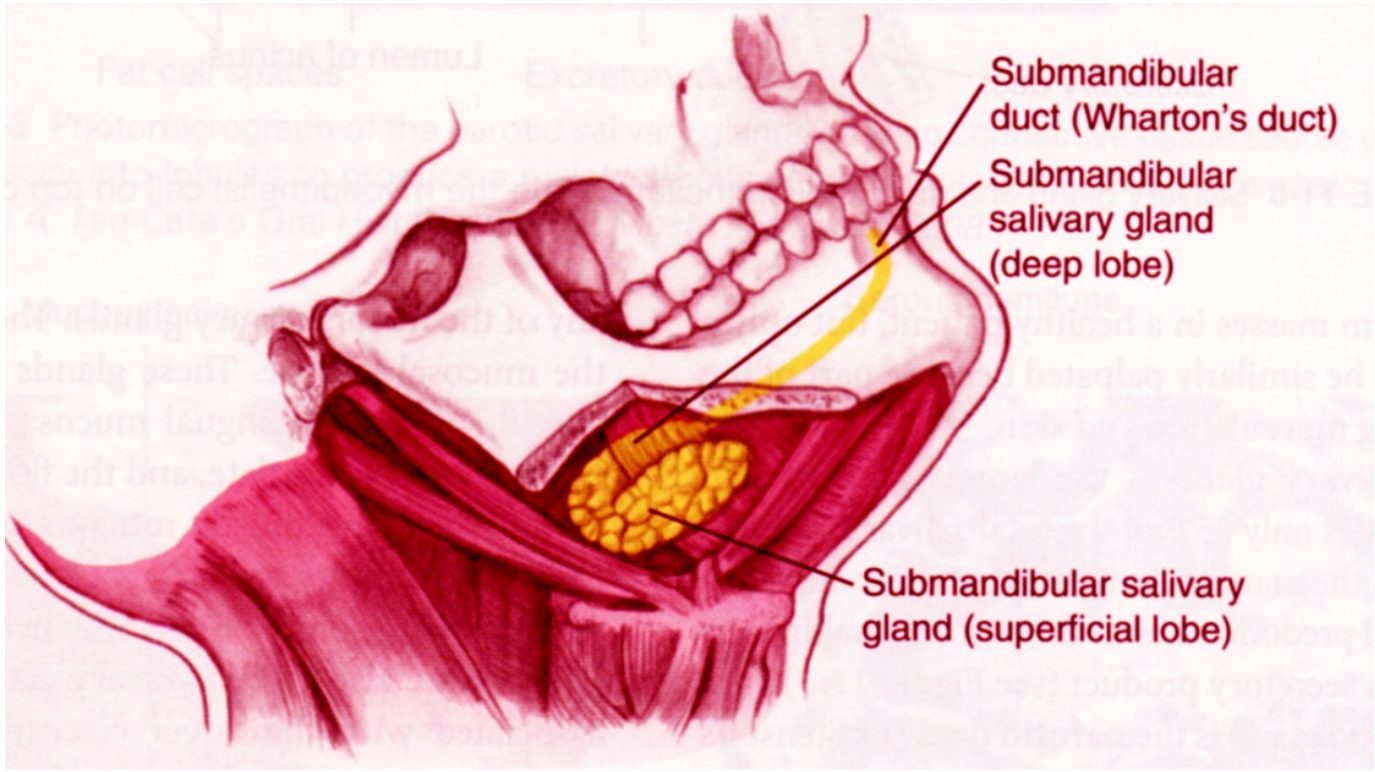
Glandula parotis

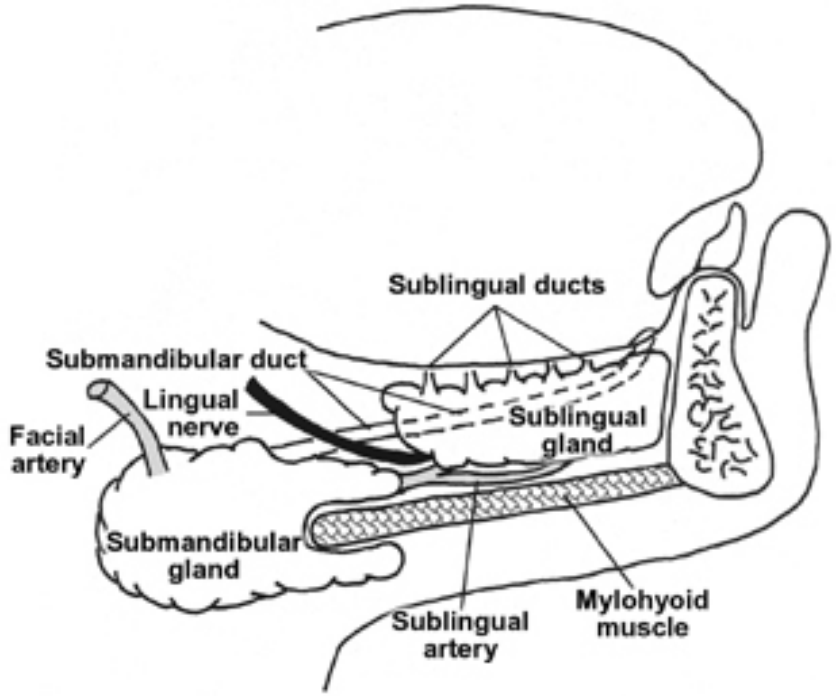



1
2
3
3
100 µm
1
2
50 µm

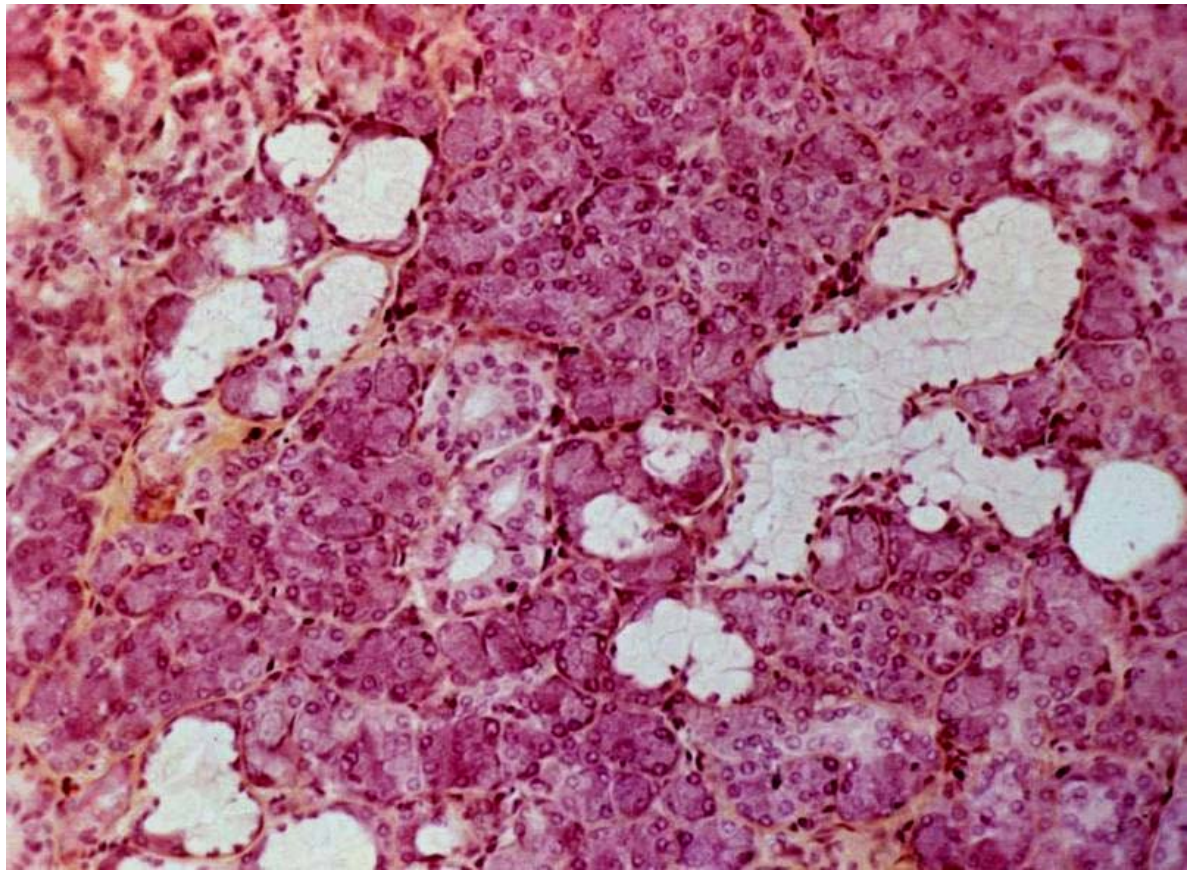
Glandula submandibularis

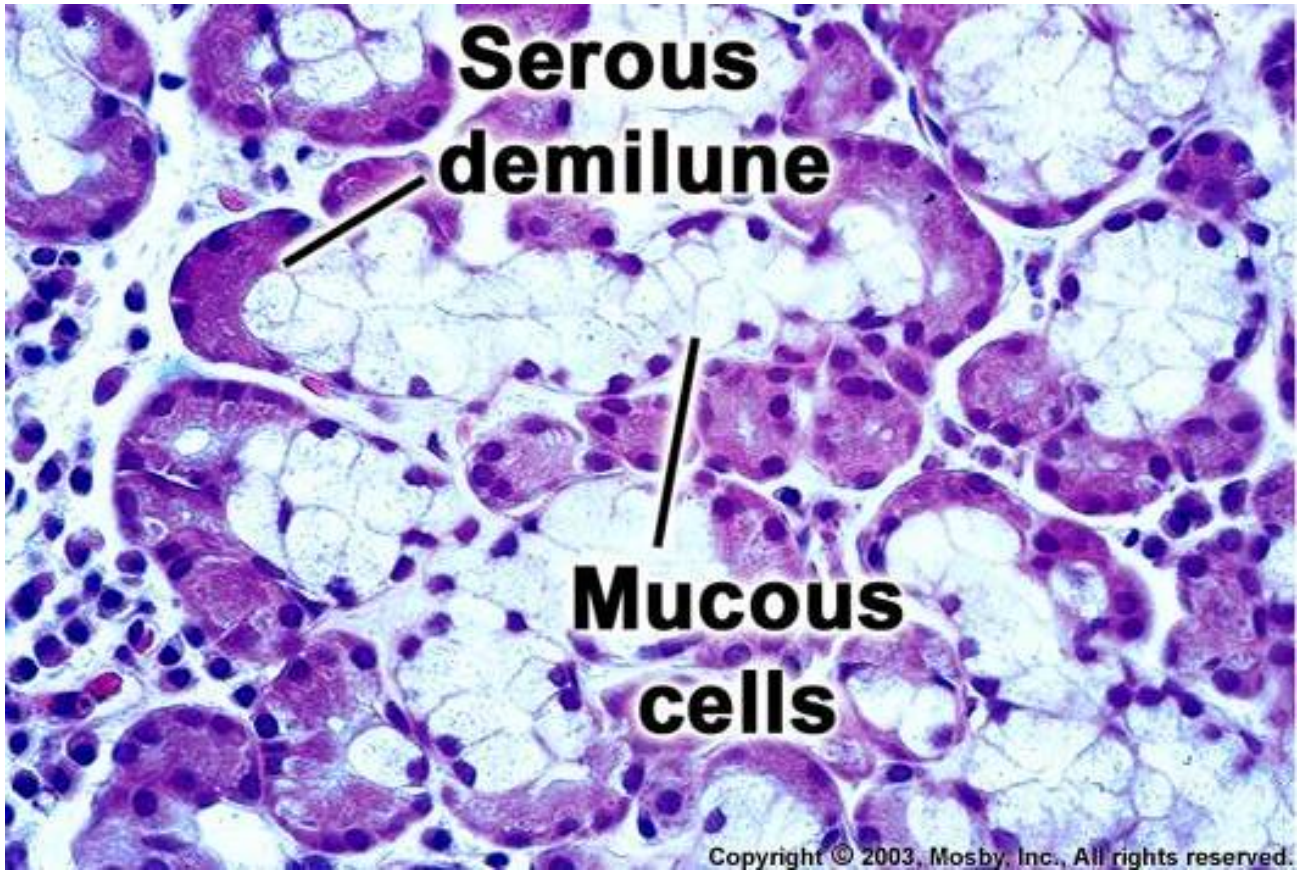
- **MIXED** tuboalveolar gland, predominantly **SEROUS**
- 10-15 g
- serous acini - 80 %, rest are mucinous tubules with **Gianuzzi demilunes**
- intercalated and striated ducts
- **ductus submandibularis (Whartoni) - frenulum linguae**





Glandula submandibularis



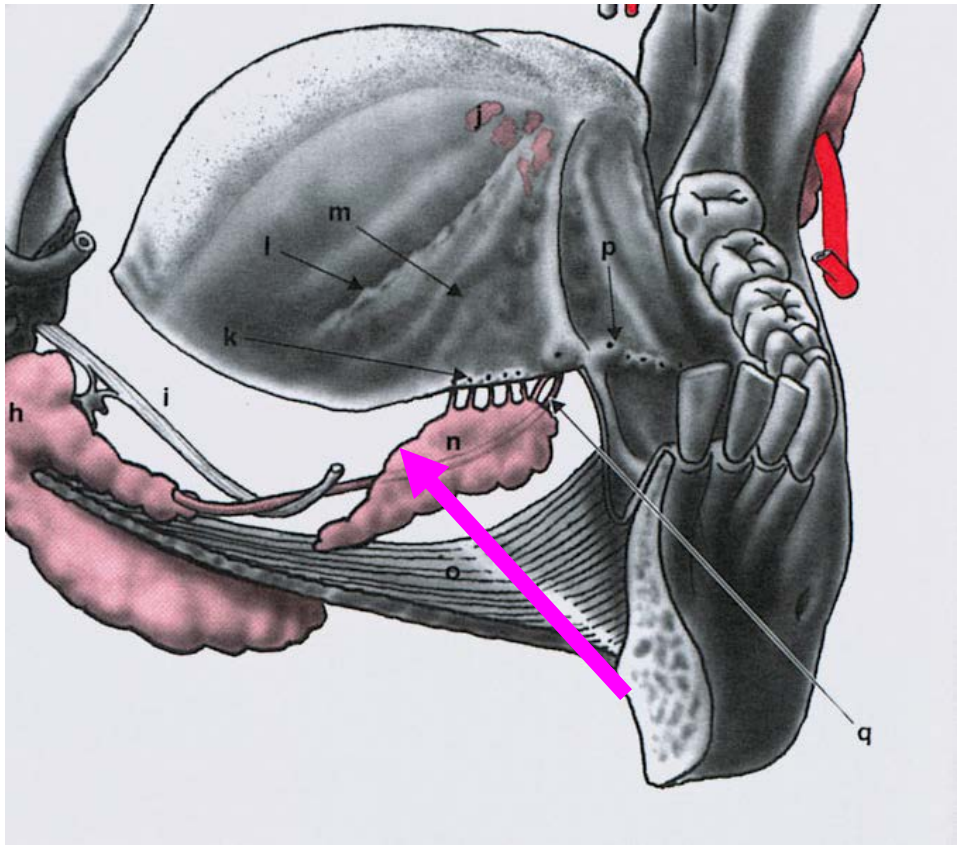


Glandula sublingualis

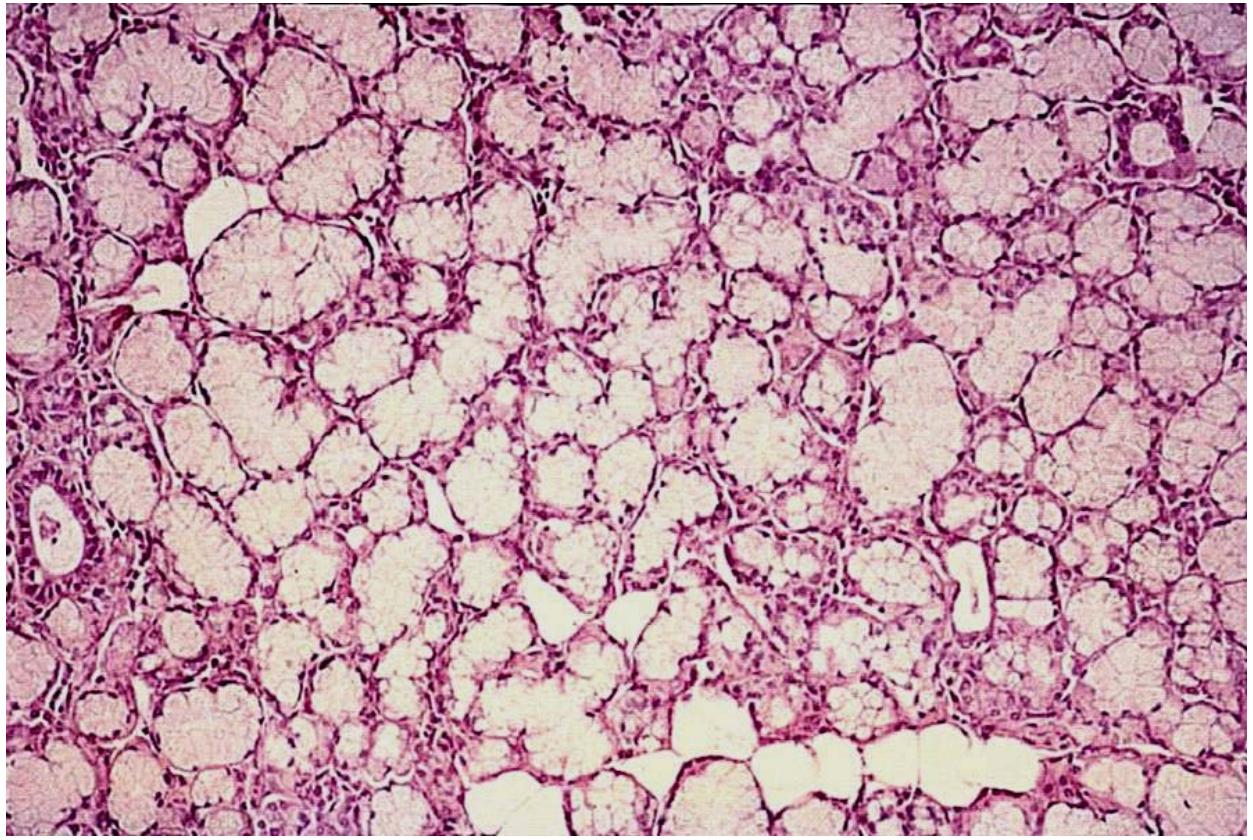
- **MIXED** tuboalveolar gland, predominantly **MUCOUS**
- 2g
- located on the floor of the mouth on mylohyoid muscle near the midline
- Mucinous tubules, **serous acini are rare**, instead of them: **Gianuzzi demilunes**
- Intercalated ducts are missing, striated ducta are present, but are reduced in number and short

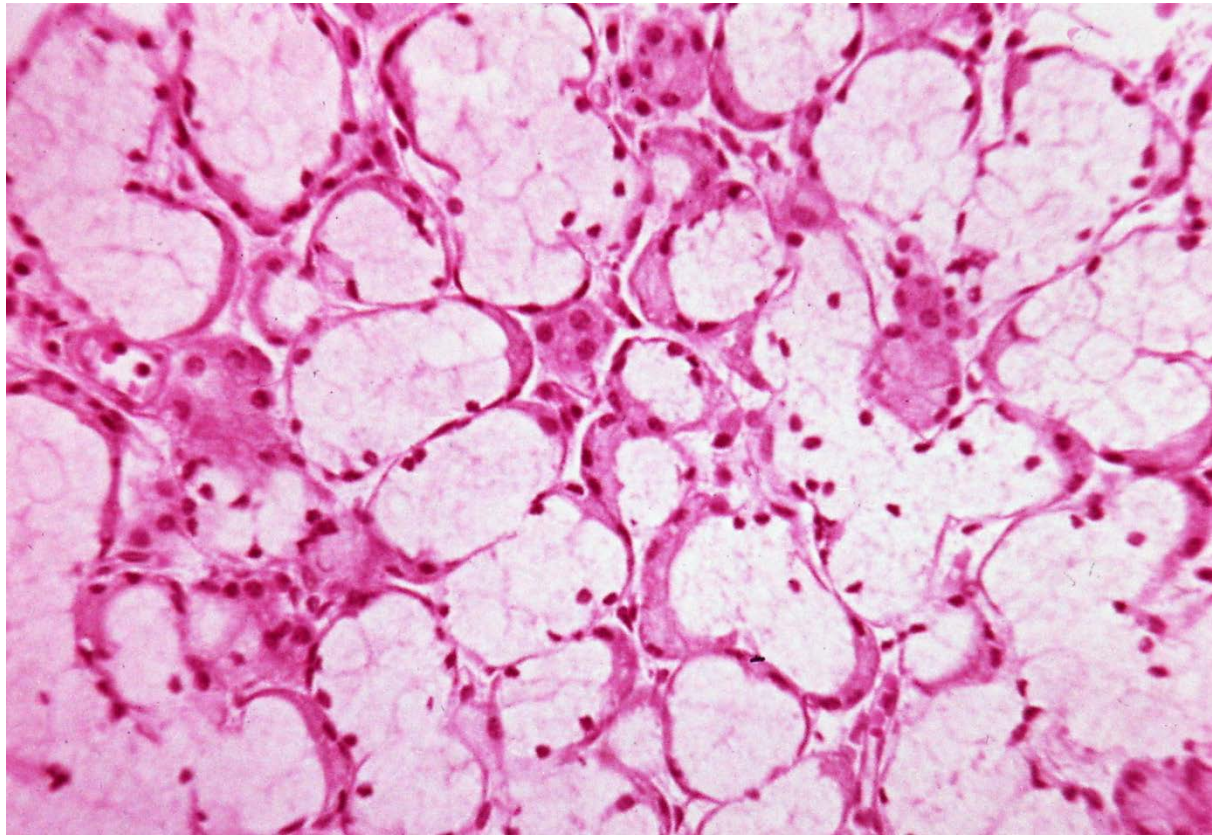
- **ductus sublingualis major** (Bartholini)
- **ductus sublinguales minores** (Rivini)

along the crest of the plica sublingualis



Glandula sublingualis





Saliva

Product of all salivary glands of the oral cavity

1.0-1.5 liters / day (0.3-0.6 ml / min)

Small glands 10 % / large glands 90 % (gl. Parotis 25 %, gl. Submand. 60-65 %, gl. Sublingualis 10 %)

Clear or slightly opalescent viscous liquid, **slightly acidic pH: 6.8 (**6.5 - 7.2)

It consists of a liquid and solid component:

Liquid: water (95%)

ions - Na +, K +, Cl-, Ca2 +, Mg2 +, HCO3-, etc.

proteins: amylase (ptyalin) and maltase, peroxidase, lysozyme, lactoferrin

glycoproteins - mucus (mucin)

immunoglobulins (Ig A, IgG and IgM)

small organic molecules (glucose, amino acids, urea, uric acid, etc.)

Formed: removed dead cells of the epithelium of the oral cavity,

salivary bodies (altered lymphocytes) and

non-pathogenic saprophytic bacteria

2 stages of saliva production: **primary saliva (isotonic**) – before passing through striated ducts and **definitive saliva (hypotonic)** - was modified by striated ducts

Saliva function

Protective:	forms a thin film on the surface of the mucosa and teeth - a salivary film
	stimulates repair processes in the oral cavity
	participates in remineralization and maintains tooth integrity
	ensures moisture and self-cleaning of the oral mucosa
	protects teeth from bacteria
Antimicrobial:	proteins with bacteriostatic effect - lysozyme, peroxidase, lactoferrin, etc.
Moisturizing:	moisturizes dry food and makes them easier to swallow
Digestive:	initiates cleavage of polysaccharides (salivary amylase)

saliva is a **sensitive indicator of oral health**
(changes during periodontal disease, caries, candidiasis, etc.)

Location		Name	Type	Size
Lips		gll. labiales sup. et inf.	mixed, pred. mucinous	minor
Cheeks		gll. buccales	mixed, pred. mucinous	minor
		gll. molares (retromolares)	mixed, pred. mucinous	minor
		GL. PAROTIS	serous	**MAJOR**
Palate	**hard**	gll. palatinae (glandular zone)	mucinous	minor
	soft	gll. palatinae	mucinous	minor
Tongue	**Apex**	gl. apicis lingue (Blandini-Nuhni)	mixed, pred. mucinous	**minor/ major**
	Terminal sulcus	gll. Ebner‘s (gll. papillae vallatae)	serous	minor
	Base	gll. Weber‘s (gll. linguales post.)	mucinous	minor
Floor of the mouth		**GL. SUBMANDIBULARIS**	mixed, pred. serous	**MAJOR**
		GL. SUBLINGUALIS	mixed, pred. mucinous	**MAJOR**

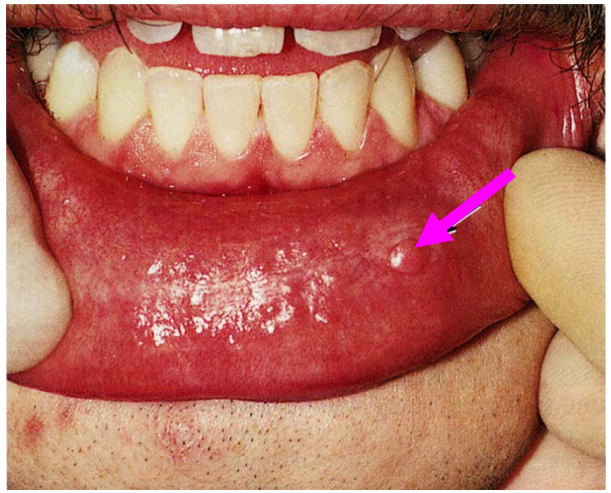
Pathology (diseases) of the salivary glands

Sialadenitis (sialoadenitis) – inflammation of the salivary glands, of bacterial or viral origin

Sialolithiasis - saliva in the ducts becomes a viscous to such an extent that the concentrated secretion can secondary calcify - prevents drainage - impermeability of the outlets

Sialolithiasis in small salivary glands - dilatation of secretory compartments (mucocele), and enlargement of glands

In case of obstruction of the ductus submandibularis - large retention cyst located at the base of the oral cavity - **ranula**



Control of salivary gland function

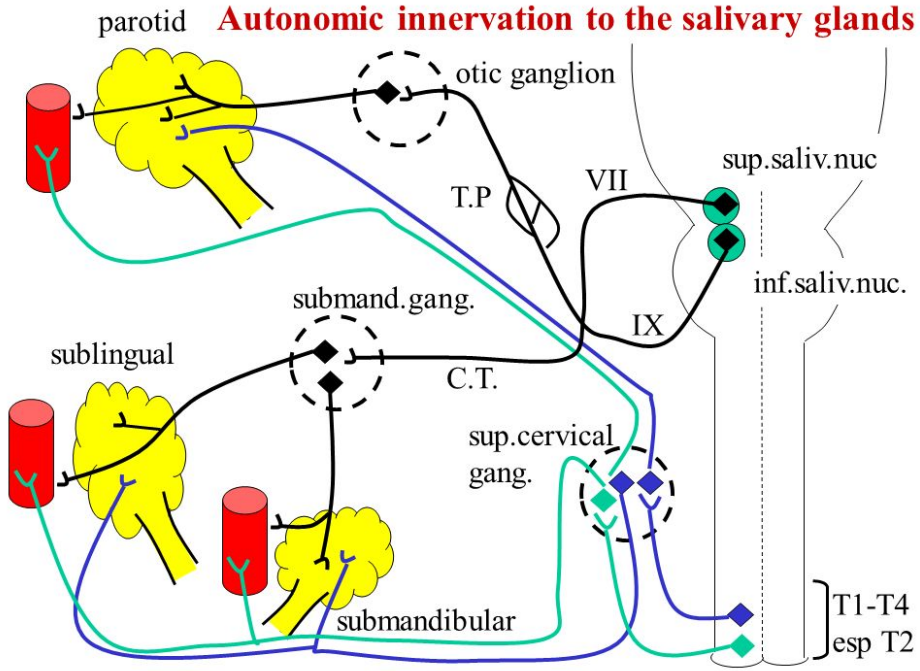
Autonomic nervous system: efferent fibers enter the glands from the parasympathetic and thoracic sympathetic fibers, forming dense network on the surface of the secretory compartments and ducts

Stimulation of sympathetic fibers **reduces saliva production**
Stimulation of parasympathetic fibers **increases saliva production**

small salivary glands secrete constantly
the large salivary glands secrete only on stimulus (eg chemical, mechanical, etc.).

Atrophy of the glandular parenchyma
atrophy accompanies some systemic diseases, drug-induced, irradiation

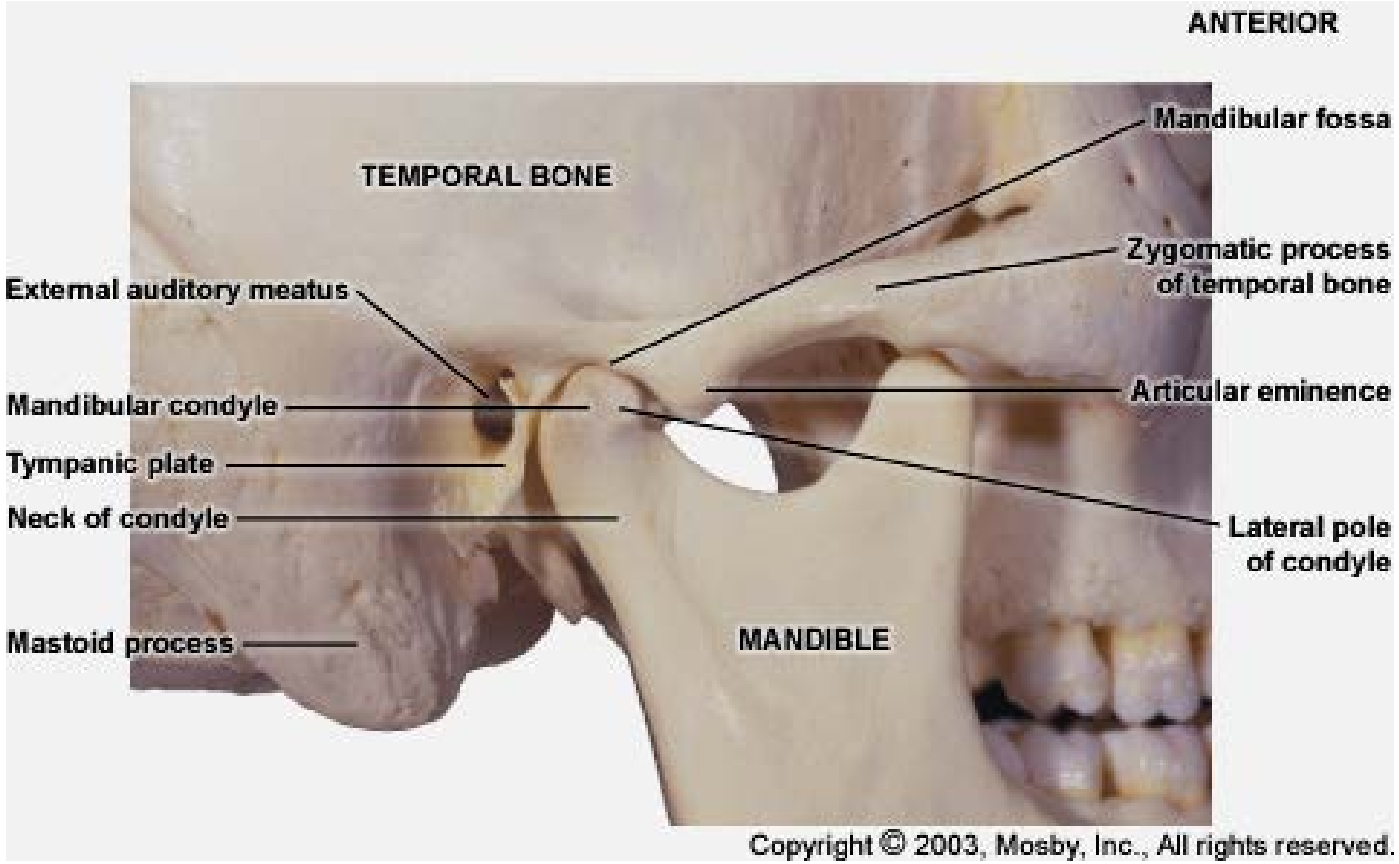
Consequence: **hyposalivation - xerostomia ("dry mouth")**

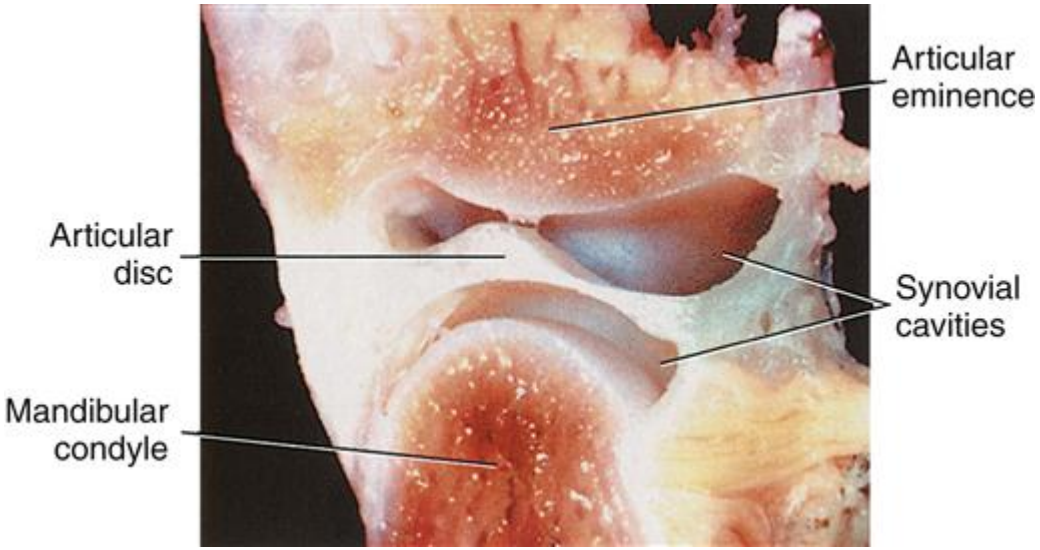


Temporomandibular joing (art. temporomandibularis, TMJ)

The connection between the mandible and the fixed temporal bone of the cranial base

Fossa mandibularis + **Tuberculum art**. of temporal bone
Caput mandibulae (condylus mandibulae)
Discus articularis – cartilage plate



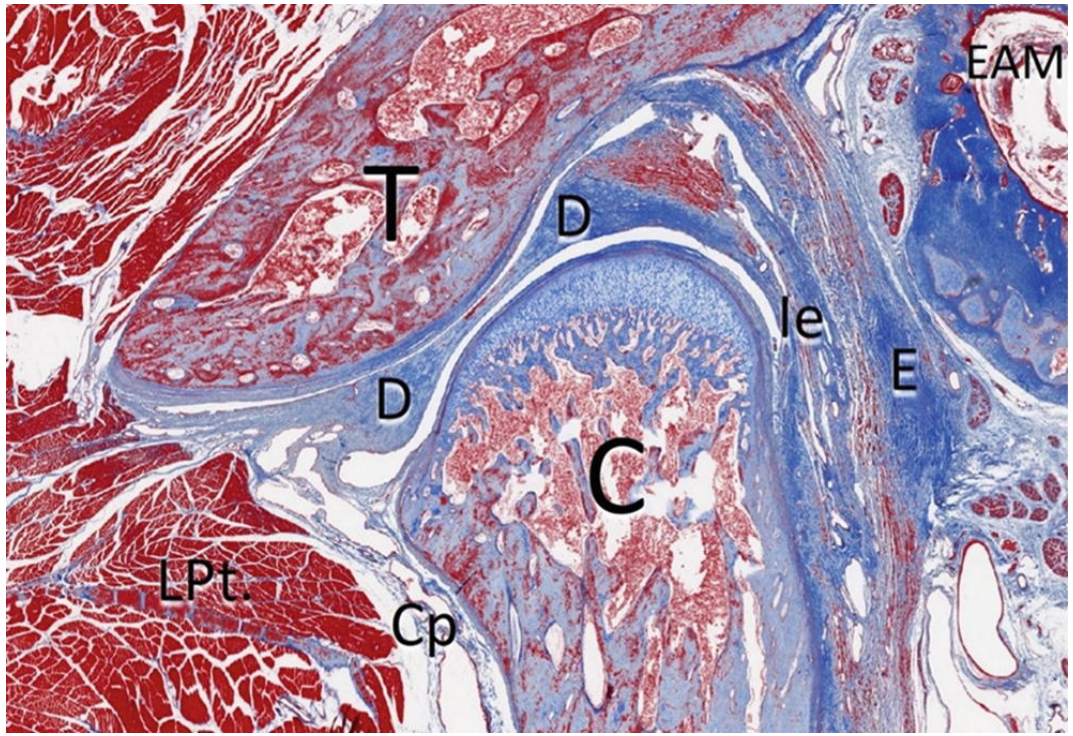


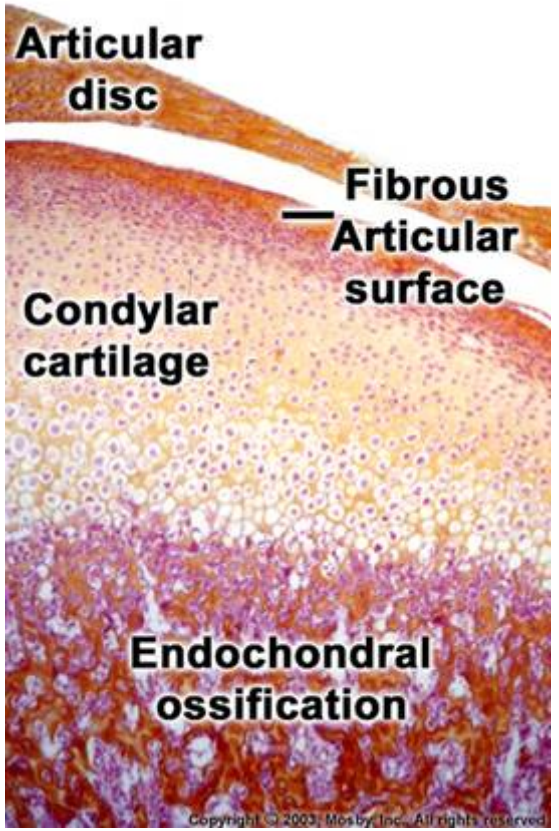
Microscopic structure of TMJ

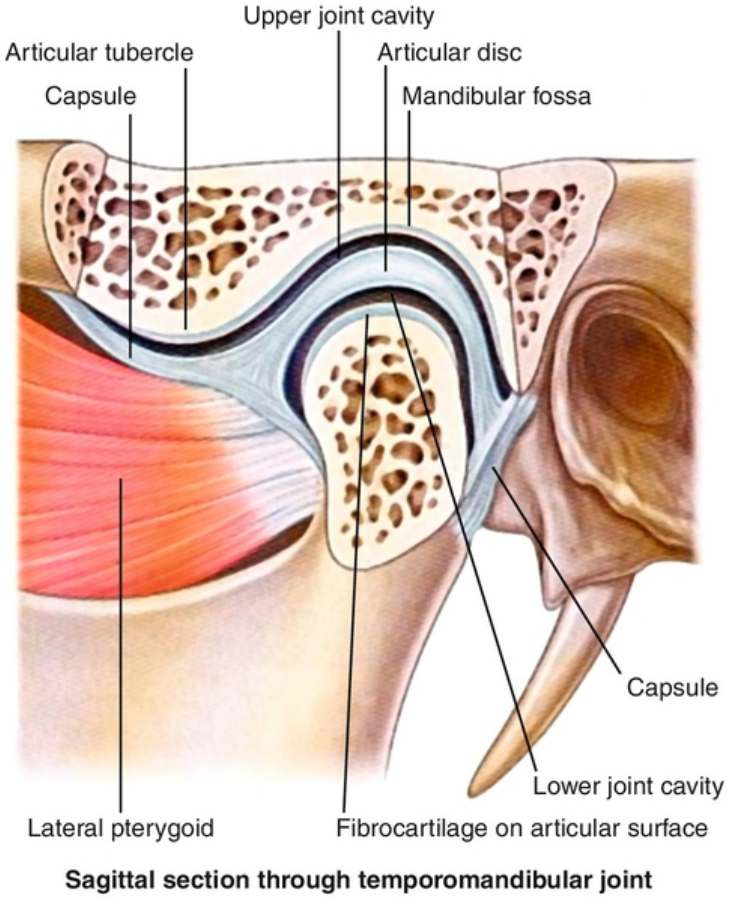
Caput mandibulae (condylus mandibulae) – elongated ellipsoidal shape, elongated axis oriented horizontally on the condyle surface - thin plate of compact

Inside is cancellous bone – trabeculles diverge from the center of the condyle radially to the surface

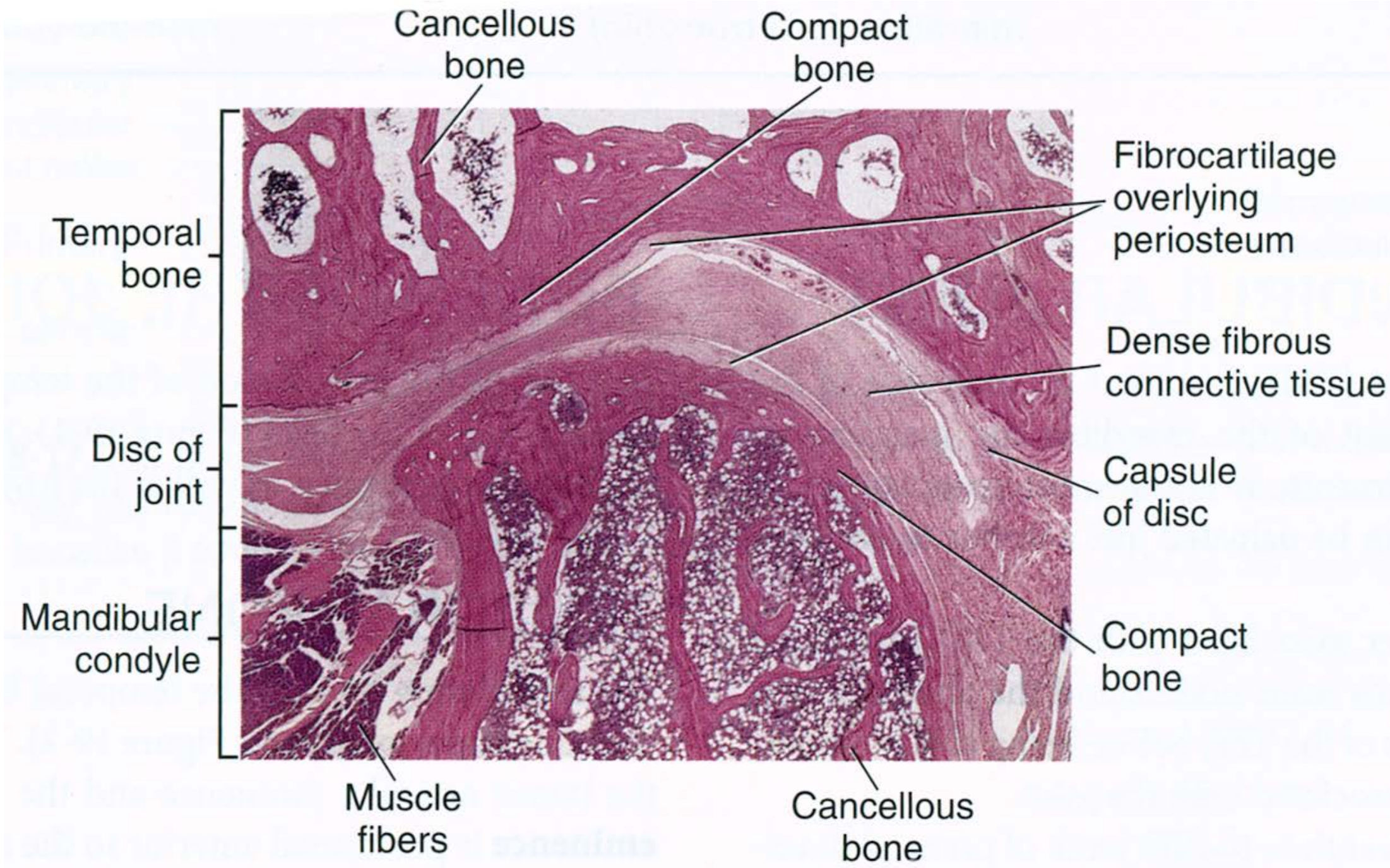
During childhood trabeculles can contain islands of hyaline cartilage







Sagittal section through temporomandibular joint

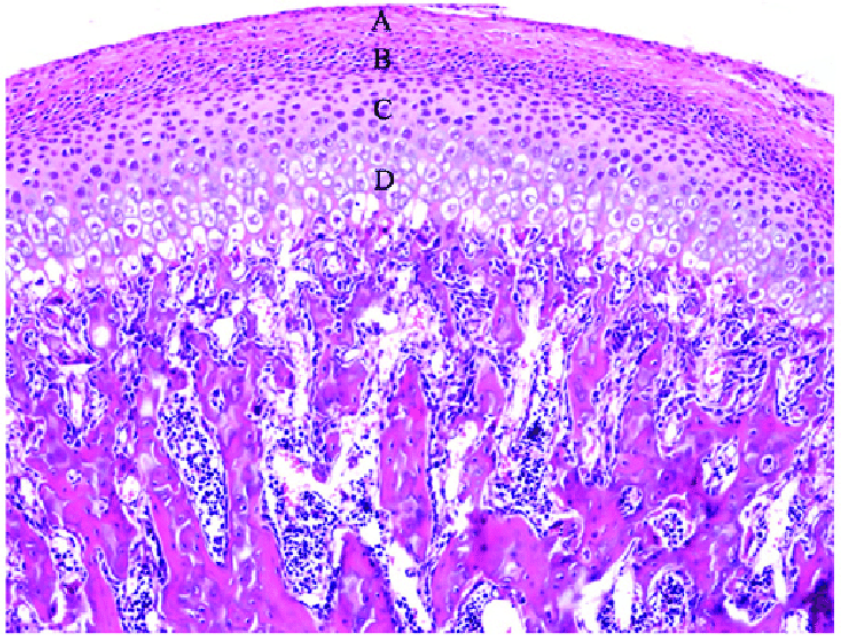

Cancellous bone
Compact bone
Fibrocartilage overlying periosteum
Temporal bone
Dense fibrous connective tissue
Disc of joint
Capsule of disc
Mandibular condyle
Compact bone
Muscle fibers
Cancellous bone

Fossa mandibularis

- Plate of compact bone
- The anterior border of mandibular fossa constitutes the **tuberculum articulare** - it has a similar structure to the caput mandibulae

TMJ surfaces - fibrous cartilage

- It is reinforced on the back of the tuberculum articulare
- Cartilage better resists degeneration and has a good ability to regenerate

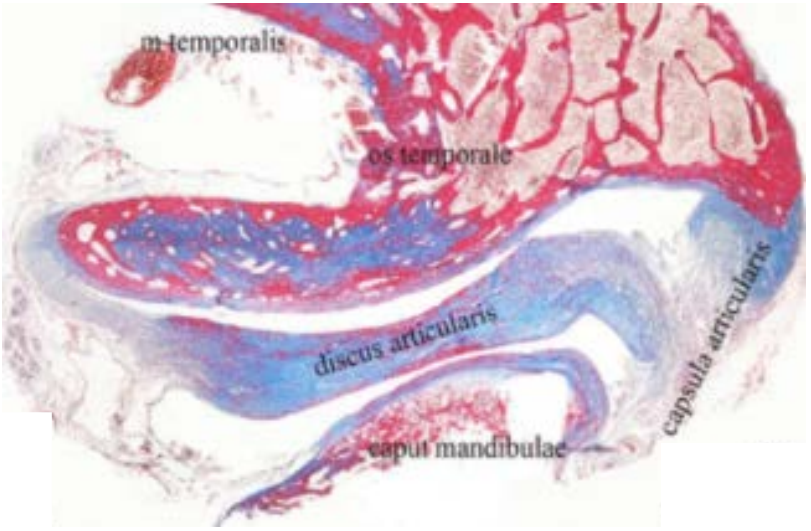


Mandibular condyle

A: Articular layer
B: Proliferative layer
C: Chondrogenic layer
D: Hypertrophic layer

Discus articularis

- Ligament plate 3 - 4 mm thick
- Its edges are fixed in a joint
- Thinner in the middle - intermediate zone (1 - 1.5 mm)
- **Dense collagen tissue of a irregular type**
- In adulthood, it may contain islets of hyaline cartilage
- Function: Stabilization and absorbtion of shocks and vibrations functions



Discus articularis

Complex inner structure

Dorsal section is divided in 2 lamellae:

Superior retrodiscal lamella of elastic fibers, which are inserted to dorsal edge of the fossa

Inferior retrodiscal lamela inserts to the rear edge of condyle

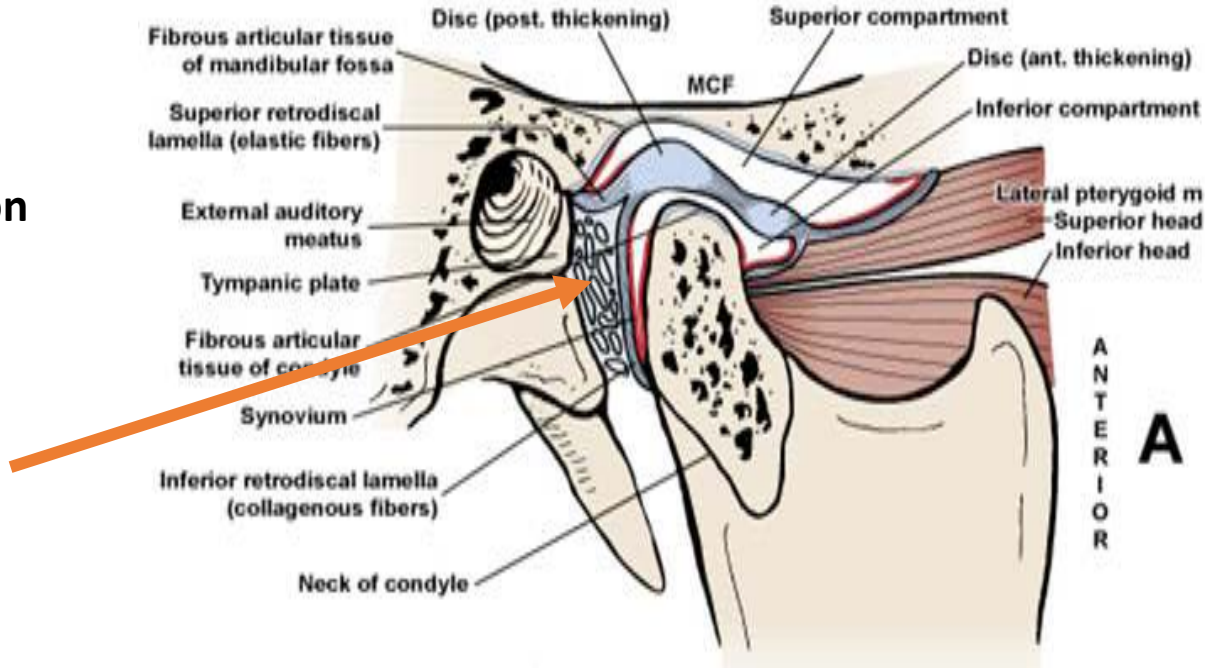
Between lamellae the **retroauricular pillow of Zenker** is present - areolar connective tissue with rich venous plexus (it is continuous by pterygoid plexus - plexus pterygoideus)

Ventral section is thickenned and ends in places of insertion of lateral pterygoid muscle

Thickened compartments act as stabilizing regions (wedges): stabilize condylus in the fossa

Dorsal section

Retroauricular pillow of Zenker



Ventral section

Temporomandibular joing (art. temporomandibularis, TMJ)

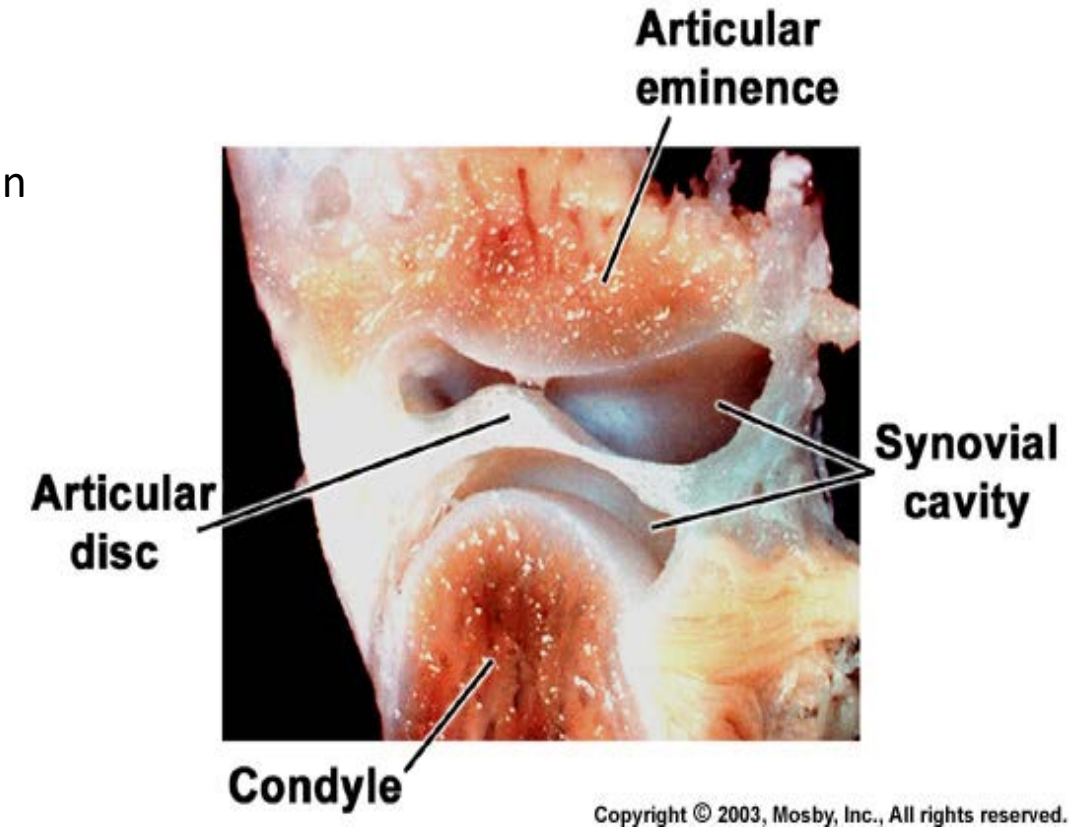
Joint capsule - free, especially on the medial side externally supported by the lateral and medial ligaments

2 layers: stratum fibrosum and stratum synoviale

Articular cavity contains synovial fluid and is divided in two section

upper - **discotemporal**

lower - **discomandibular**



Joint biomechanics:

TMJ (articular disc) movements:
https://www.youtube.com/watch?v=mB468Jh9aAY&ab_channel=AlilaMedicalMedia

MRI:
https://www.youtube.com/watch?v=ZnNgMnSfAws&ab_channel=SpringerVideos

Age changes in TMJ

Final form takes between 20 -25 years of age

Adaptability of TMJ – the ability to adapt to new functional requirements

Very good in cartigale

Poor in discur articularis

a) Degenerative changes in the discus articularis, rupture or disintegration

b) After the 5th decade perforation of the central disc part and connection of both sections of the articular cavity can occur

TMJ clicking:
https://www.youtube.com/watch?v=Opgz2EUyI0w&ab_channel=WellingtonVillageOrthodonticsOttawa