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Oral cavity, development and microscopic structure

Sylabus for foreign students

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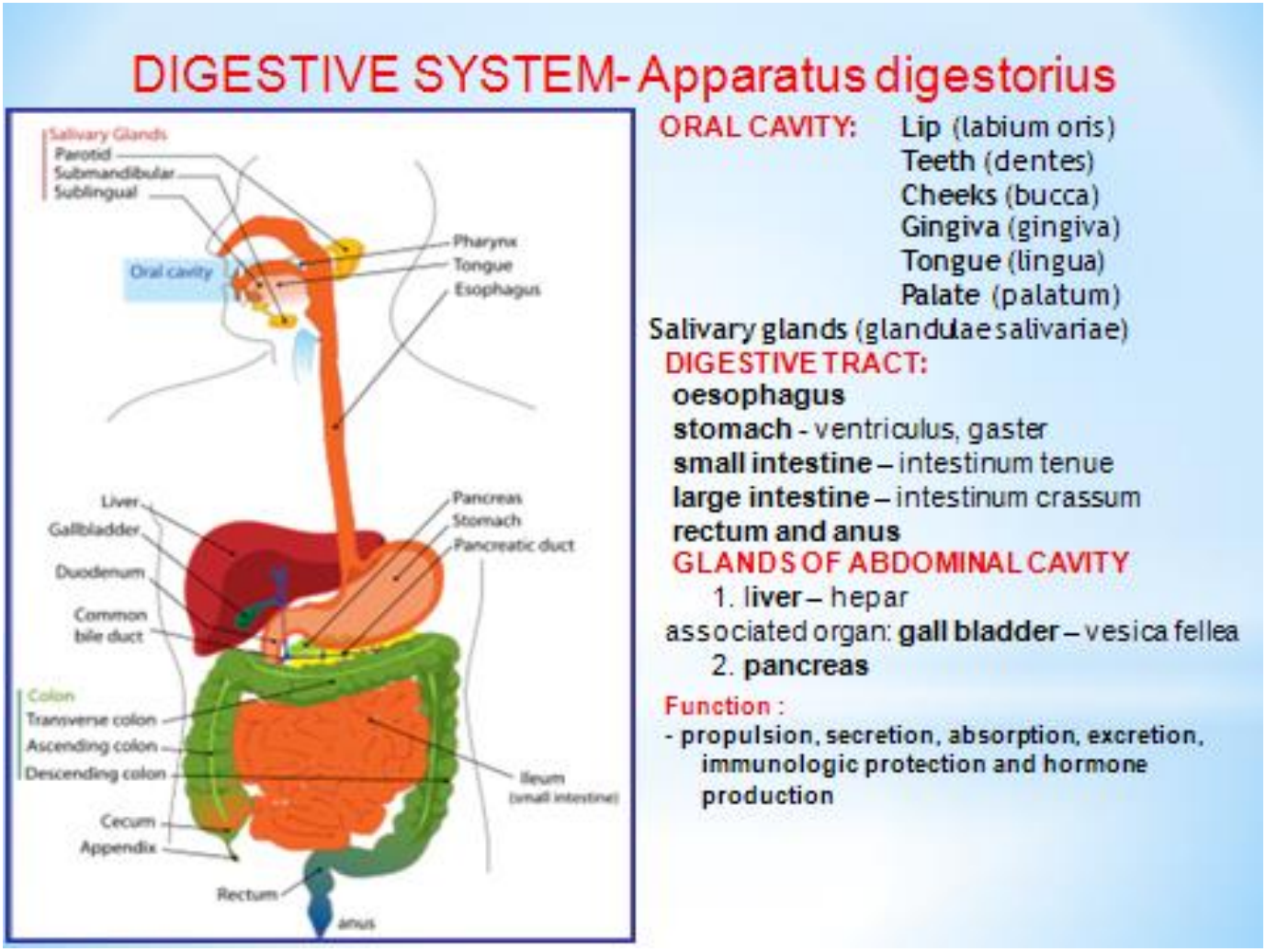


LIPS– *labium oris*

Guard the entrance to the digestive tract. The central core of the lips is made of skeletal muscle – orbicularis oris muscle- surrounded by fibroelastic connective tissue

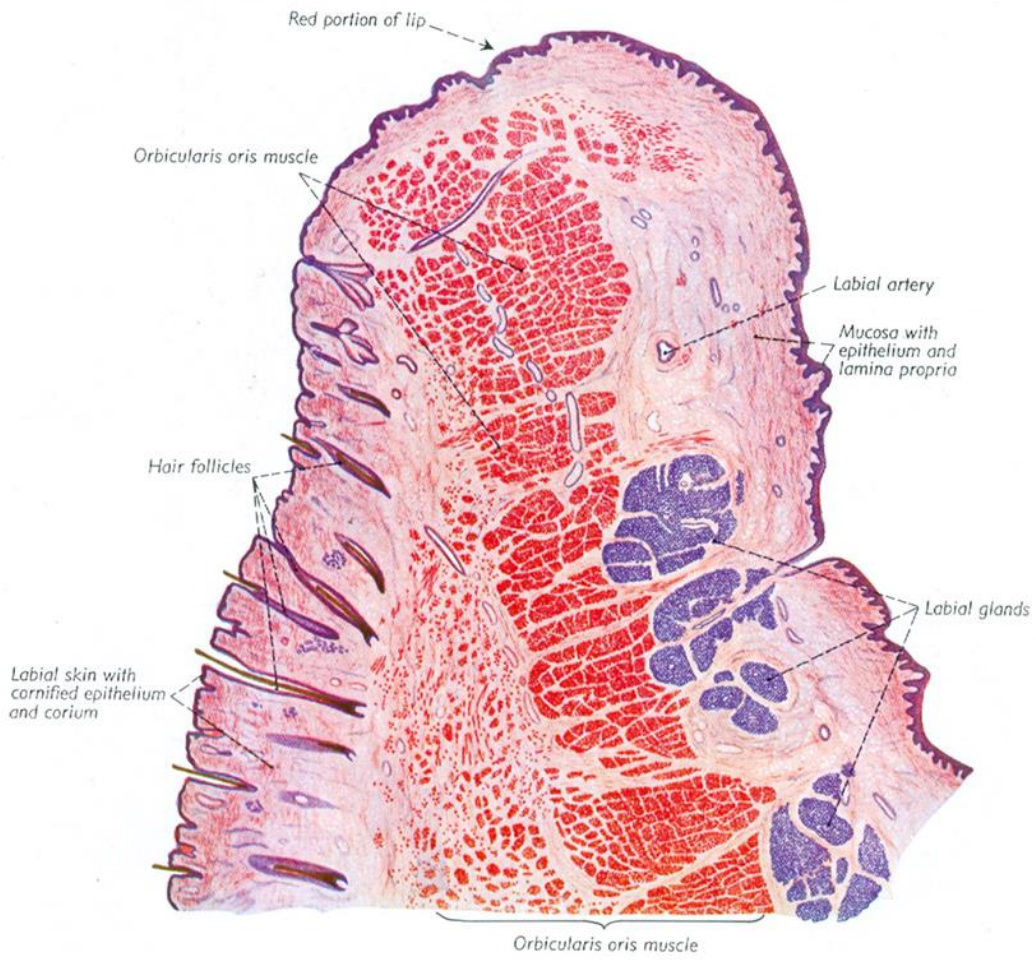
The Lip has three surfaces:

1. **Ventral surface** - skin - *pars cutanea labii* - consists of an epidermis and an underlying dermis with hair follicles, sebaceous glands and sweat glands

2. **Dorsal surface of the li**p - oral mucous membrane- *pars mucosa labii* - consists of thick nonkeratinized stratified squamous epithelium and underlying lamina propria of loose richly vascularized connective tissue forming delicate papillae.

The submucosa – deep layer, + small groups of minor salivary glands – *glandulae labiales*- mainly mucus – secreting glands providing the moisture and lubrication.

3. **Red (vermillion) border** – pinkish-red colour because of the relatively translucent epithelium and blood in capillaries in the papillae. Abundant sensory nerve fibres are present there.



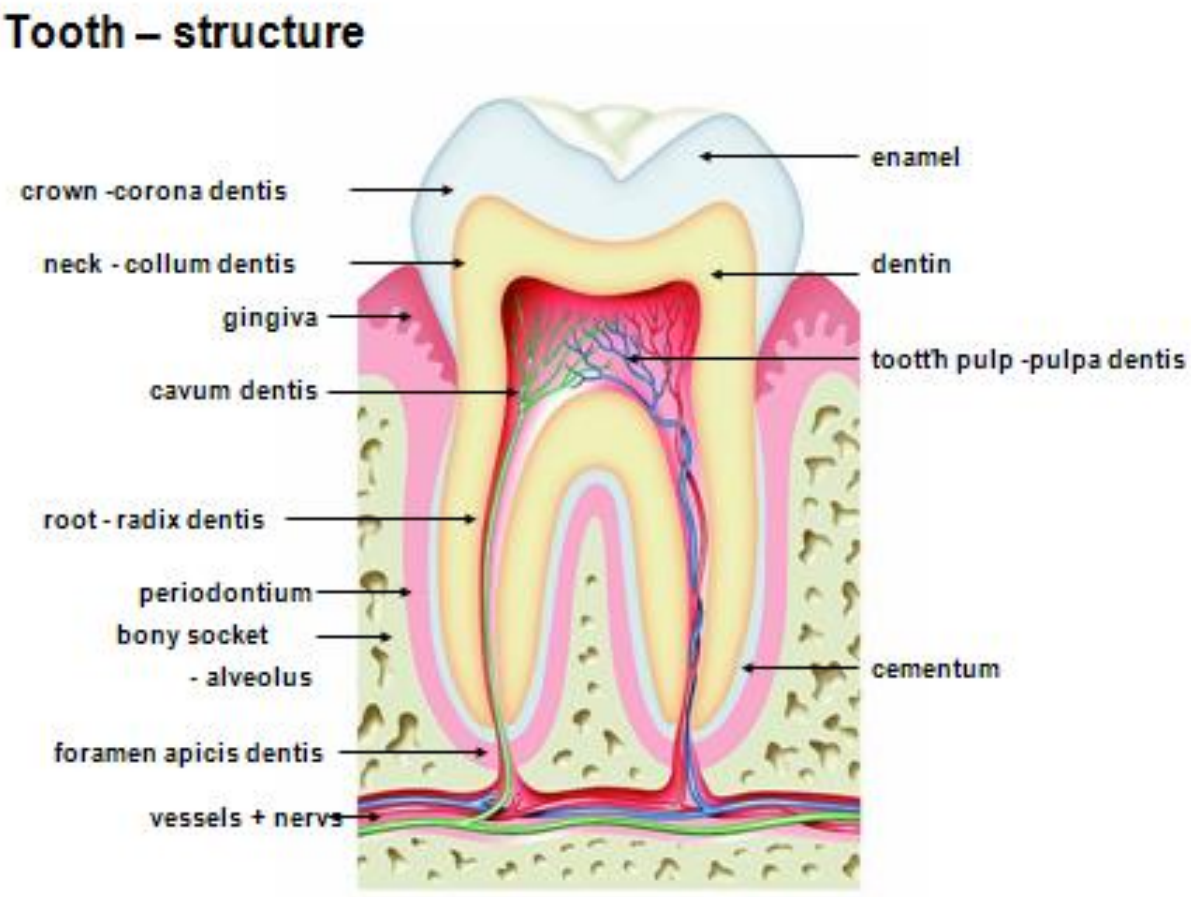
TEETH

Humans have two sets of teeth:
1. the primary – deciduous teeth (*dentes decidui seu lactei*)
2. permanent teeth (*dentes permanentes*)

● they play role in cutting, mastication and grinding of the food
● they are disposed in two bilaterally symmetric arches in the maxillary and mandibular bones

anatomy: 1. Crown – *corona dentis*
2. Neck – *cervix dentis*
3. Root – *radix dentis*

1. the crown (*corona dentis*) - the portion that projects above gingiva
3. one or more roots *(radix dentis*) hold the teeth in **bony sockets-** alveoli
the periodontal membrane –collagenous fibrous – structure that fix the tooth in its bone socket



Histologycal composition of the tooth –

I. <u>Hard tissues</u>: enamel *(enamelum)***, dentine** *(dentinum)***, cement** *(cementum)*
II. <u>Soft tissue</u>: tooth (dental) pulp *(pulpa dentis)*
III. <u>Supporting tissues</u>: periodontium (*periodontium*), **gingiva** (*gingiva*), **alveolar bone**

<u>Enamel – enamelum</u>

- covers the crown
- the hardest component of human body, consists of
  → 95% calcium salts – mainly hydroxyapatite
  → organc matrix – made of special glycoproteins : amelogenins and enamelins

- enamel consists of elongated columns of hydroxyapatite crystals enamel rods (prisms) that are bound together by mineralized interrod enamel
- the prisms extend through entire thickness of enamel layer
- enamel matrix is secreted by **<u>ameloblasts</u> (originate from ectoderm) - active only within development.** Each ameloblast has an apical enlargement **– Tomes process,** containing numerous secretory granules

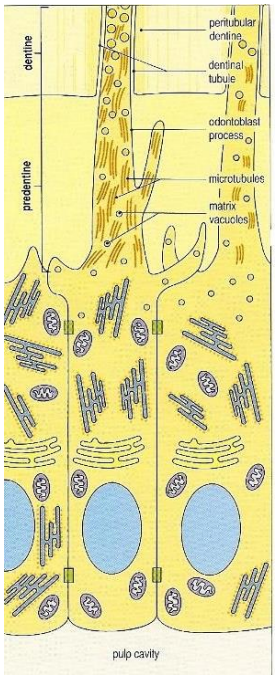
<u>Dentin - dentinum</u>

- calcified tissue harder than bone

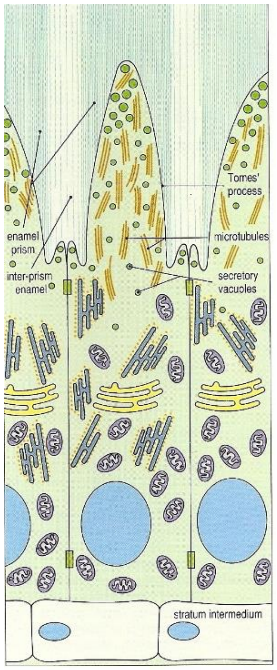
1. intertracellulkar matrix (amorphous ground substance and fibers)
→ 72% of inorganic material (hydroxyapatite crystals)
→ 28% of organic material – collagen type I fibrils, glykosaminoglycans, proteoglycans - chondroitin sulfate, keratansulfate.

2. the cells – **<u>odontoblasts</u> –(originate from mesenchyme)** polarized cells secreting proteins of intercellular matrix **predentin (unmineralised dentin)** at the dentinal surface
- active throughout the life
- they line internal surface of the tooth
- they have long cytoplasmic extensions that penetrate entire dentin layer **Tomes fibers** running in small canals called dentinal tubules

ODONTOBLASTS

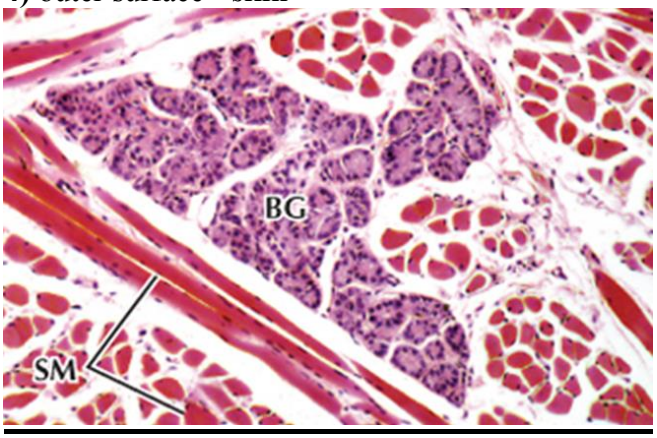


AMELOBLASTS



CHEEKS – *bucca*

Histologic features of cheek:
1) the cheek resembles the lip, inner surface is covered with **stratified squamous nonkeratinized epithelium**
2) LPM with short papillae and abundant elastic fibres attaches to underlying
3) skeletal muscle fibres ***(m.buccinator)***
- the fibres are arranged into fascicles, mixed with the **minor salivary *(buccal)* glands**
4) outer surface - **skin**



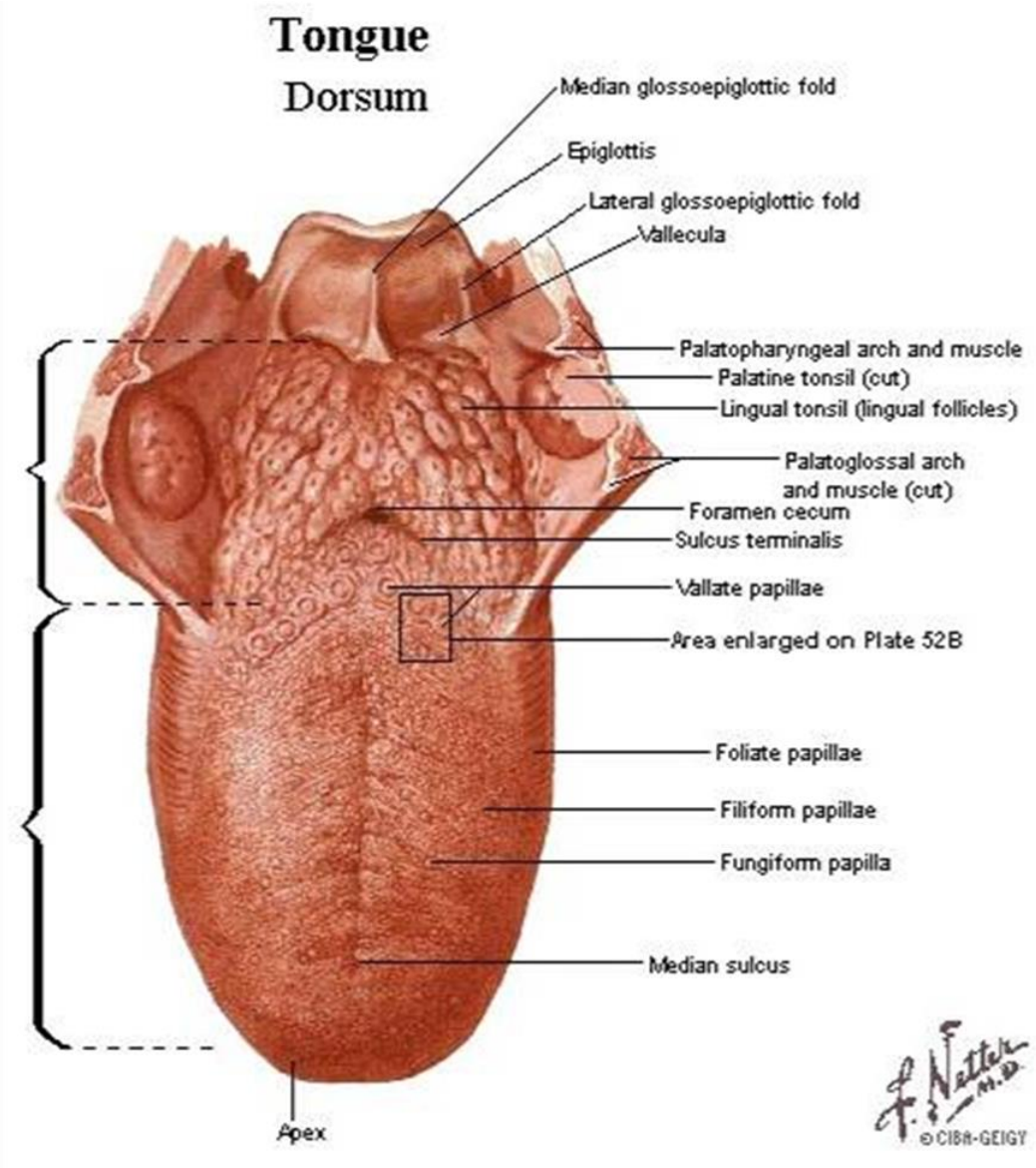
GUM - *gingiva*

- mucous membrane lacks glands, cover outer and inner surfaces of alveolar processes of the maxilla and mandibula and surrounds each tooth
-has **two** recognized regions: **attached gingiva**
free gingiva

Attached gingiva: is directly bound down to the underlying alveolar bone (periost) and tooth (supraalveolar cementum). It has masticatory mucosa.
Free gingiva: consist of narrow rim of mucosa that is not bound down to underlying hard tissue. The unattached region between the free gingiva and tooth **is gingival sulcus (*sulcus gingivalis*).** The region apical to this, where gingiva is bound to the underlying tooth, is **junctional epithelium (*stratum basale* - cuboidal cells and *suprabasale* - flattened cells, several layers) - non keratinized**

TONGUE - *lingua*

- muscular organ covered externally by mucous membrane - tunica mucosa
- engages in mastication, swallowing, speech and taste



Development of the tongue

- the beginning of the 5th week from ventromedial parts of pharyngeal arches

1)Anterior two thirds - *dorsum lingae*

– arise from mandibular part of 1st pharyngeal arch

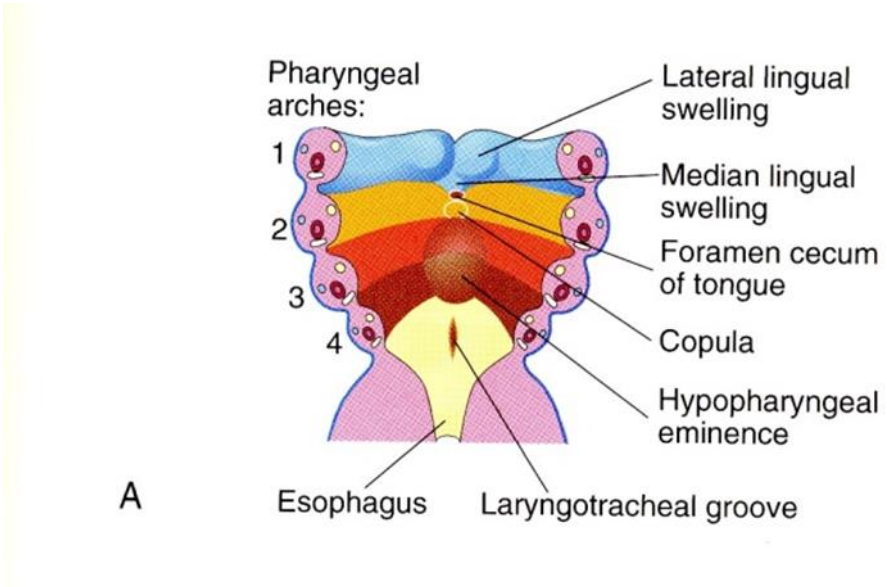
a) Median tongue bud – median lingual swelling
(*tuberculum impar*) – elevation in the floor of primitive pharynx rostral to the ***foramen caecum***
b) Pair of distal tongue buds – lateral lingual swellings (*tuberculum linguale laterale dextrum et sinistrum*)
on both sides, rapidly increase, overgrow median bud, fuse and formed by thickened mesenchyme covered with ectoderm.

2) Posterior third - *radix linguae*

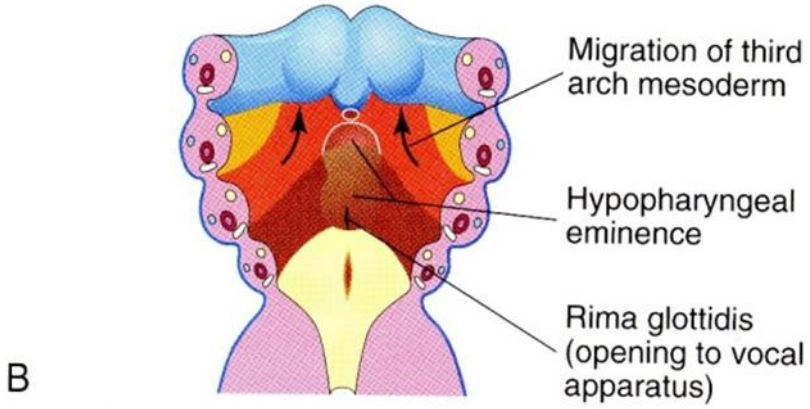
- arise from two elevations caudal to the ***foramen caecum*** –(endodermal)

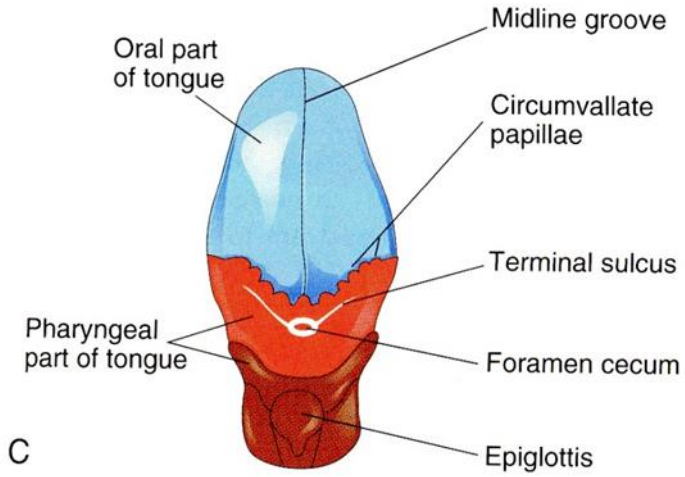
a) Copula (*copula*) – ventromedial part of 2nd pharyngeal arch

b) Hypopharyngeal eminence - *Eminentia hypobranchialis* - mesenchyme of ventromedial part of 3rd and 4th pharyngeal arches



The border between *dorsum* and *radix linguae* forms **V shaped groove - *sulcus terminalis*,** the point is made by *foramen caecum.*
Pharyngeal arch mesenchyme forms the connective tissue and vessels of the tongue.
Glands arise from the epithelium of the tongue most of the tongue muscles is derived from myoblasts that migrate from myotomes of occipital somites (2nd and 3rd somit)





Inervation of tongue

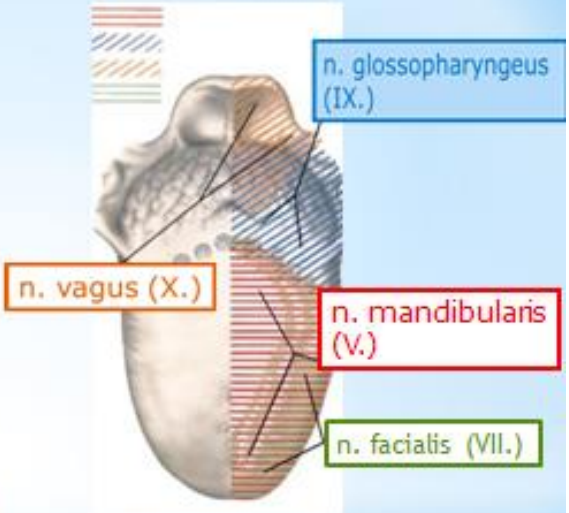
hypoglossal nerve- most of the tongue muscles derived from myoblasts, that migrate from myotomes of occipital somites

- anterior 2/3 derived from mandibular part of 1st branchial arch- mandibular nerve

- the mucosa of anterior part- chorda tympani of facial nerve (2nd pharyngeal arch)

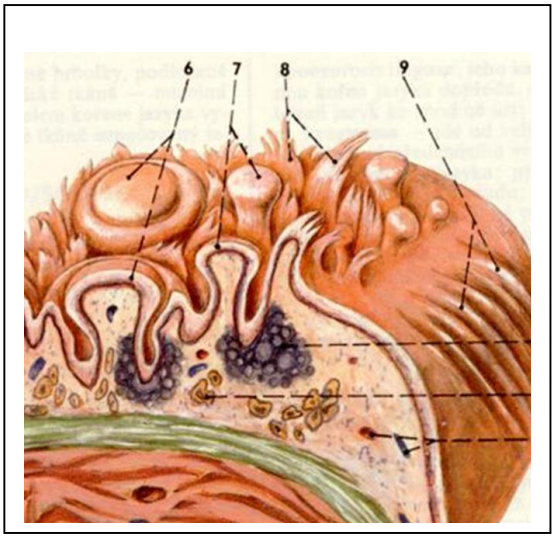
- the mucosa of posterior third derived from 3rd branchial arch- branches of glossopharyngeal nerve

- part of radix derived from 4th branchial arch- branch of vagus nerve



Tunica mucosa consist of
1, lamina epithelialis mucosae - nonkeratinized stratified squamous epithelium
2. lamina propria mucosa - loose connective tissue

The mucosa of the anterior two thirds is formed into papillae of three types:



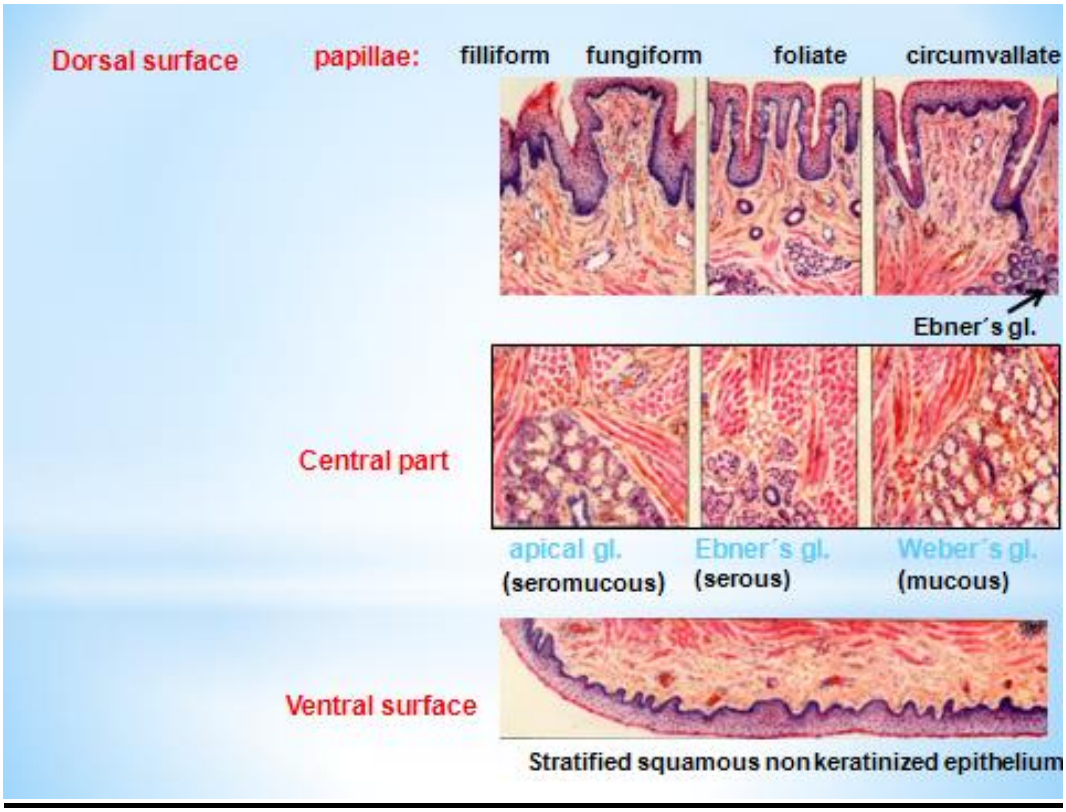
1. Filiform papillae - 8
- enlarged conical shape
- epithelium keratinized
- present over entire surface

2. Fungiform papillae - 7
- mushrooms -shaped
- narrow stalk and dilated upper part
- interspersed among filiform papillae

3. Foliate papillae - 9
- poorly developed in human
- present on lateral tongue borders

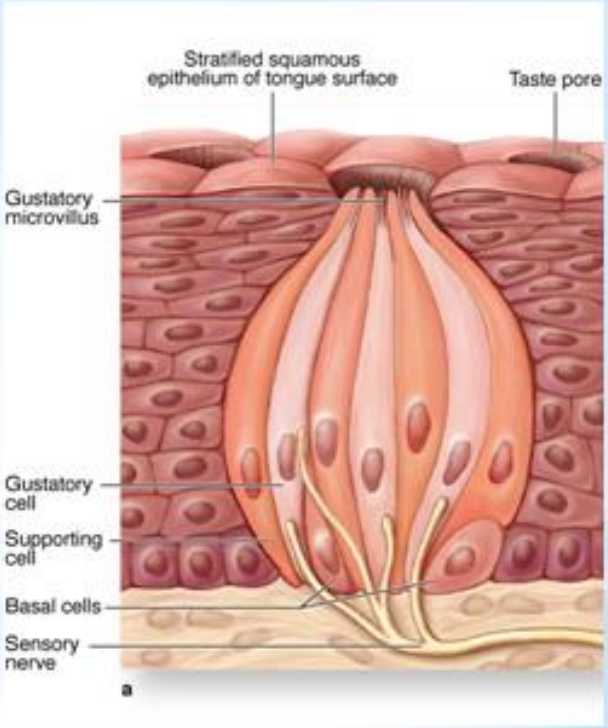
4. Circumvallate papillae - 6
- one row 7-12 papillae lies just anterior to the *sulcus terminalis*
- diameter of up to 3 mm ,countersunk beneath the surface
- surrounded by a circular furrow
- taste buds on lateral surface – gustatory sensations

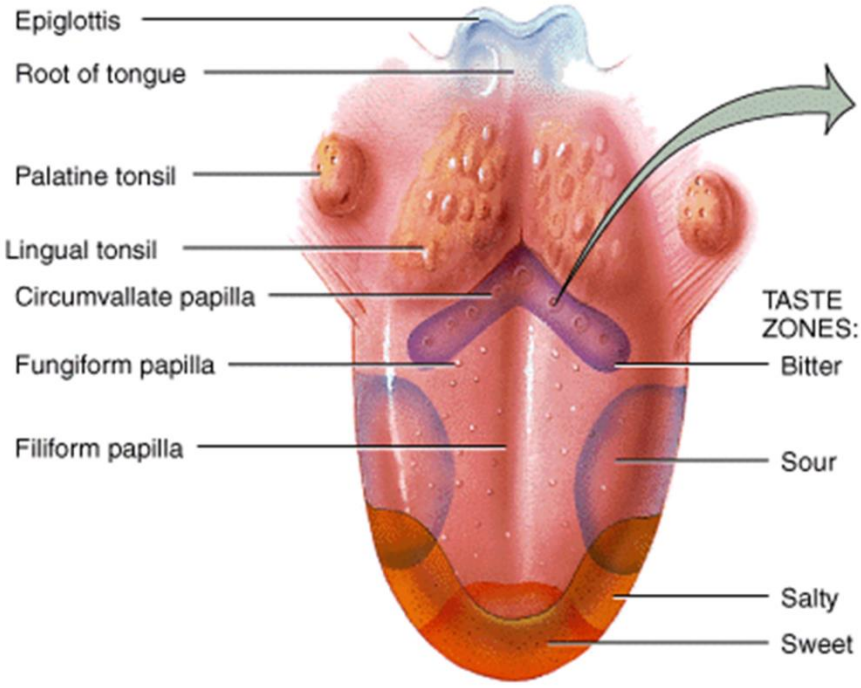
The basis of the tongue consists of striated skeletal muscle, formed by the bundles of muscle fibres oriented in three planes- longitudinal, vertical, and transversal.



Taste bud

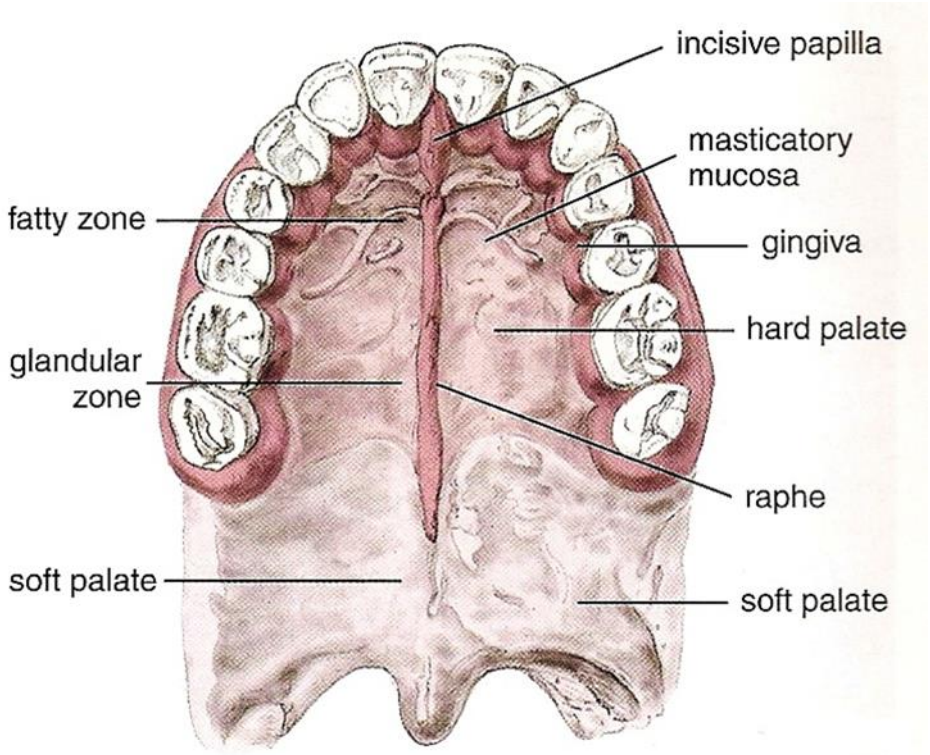
tongue- 5000
epiglottis- 900
soft palate- 2500
larynx, pharynx - 600





(a) Dorsum of tongue showing location of papillae and taste zones

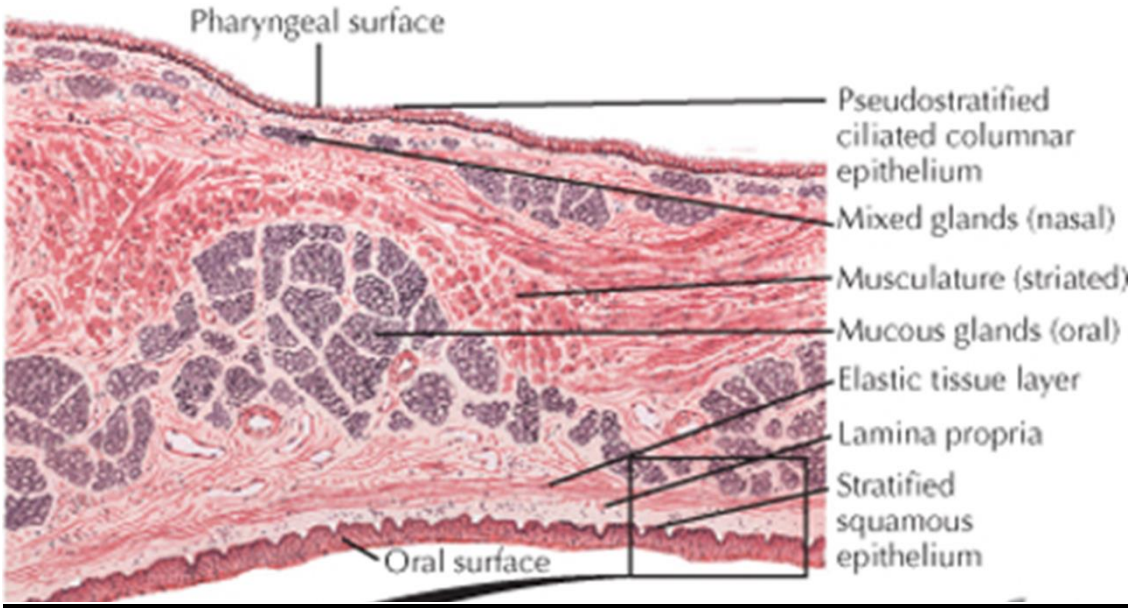
PALATE – *palatum*



Hard palate *(palatum durum):* tunica mucosa + tunica submucosa (with palatine gl. – mucous, posteriorly) + bone
Medially: *raphe palati* has no submucosa; mucosa is directly attached to periosteum
In this part epithelium is keratinized

Anterior part of the palate - the base is formed by the bone mucosa strongly connected with periosteum, immobile, **Lamina epithelialis** – lightly keratinized, **Lamina propria mucosae** – forms long connective tissue papillae.

Soft palate *(palatum molle)*: palatine aponeurosis (dense CT) serves for attachment of skeletal muscle



Glands Associated with the Digestive Tract

SALIVARY GLANDS – *glandulae salivariae*

Classification:

A. According the size:
1. Minor salivary glands
2. Major salivary glands

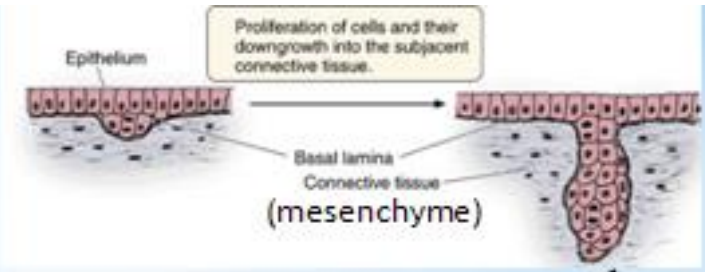
B. According the secretory material:
1**.** Serous glands
2. Mucous glands
3. Mixed– serous-mucous glands

C. According the shape of secretory part:
1. Acinar (alveolar) glands
2. Tubular glands
3. Mixed – tubuloacinar glands

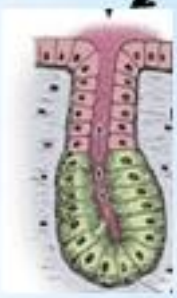
Salivary glands in oral cavity

	minor	major
Serous	Ebner's glands	parotid gland
Mucous	Weber's glands palatine gl.	
Mixed seromucous	labial gl. buccal gl. retromolar gl. lingual apical gl.	submandibular gland **(mostly serous)** sublingual gland **(mostly mucous)**

Development of salivary glands:



1) epithelial buds → grow into underlying mesenchyme, proliferate
2) epithelium proliferates and forms of solid epithelial cords (6 - 7th week)
- growing to the mesenchyme



3) development lumens in the cords
- forming of branched system of the ducts

4) terminal tubules - forming of secretory portion: acini + tubules - growing of terminal ends of the tubules is induced by mesenchyme

5) surrounding mesenchyme → forming of connective tissue parts (capsule + trabeculae) → separating of parenchyma into the lobules

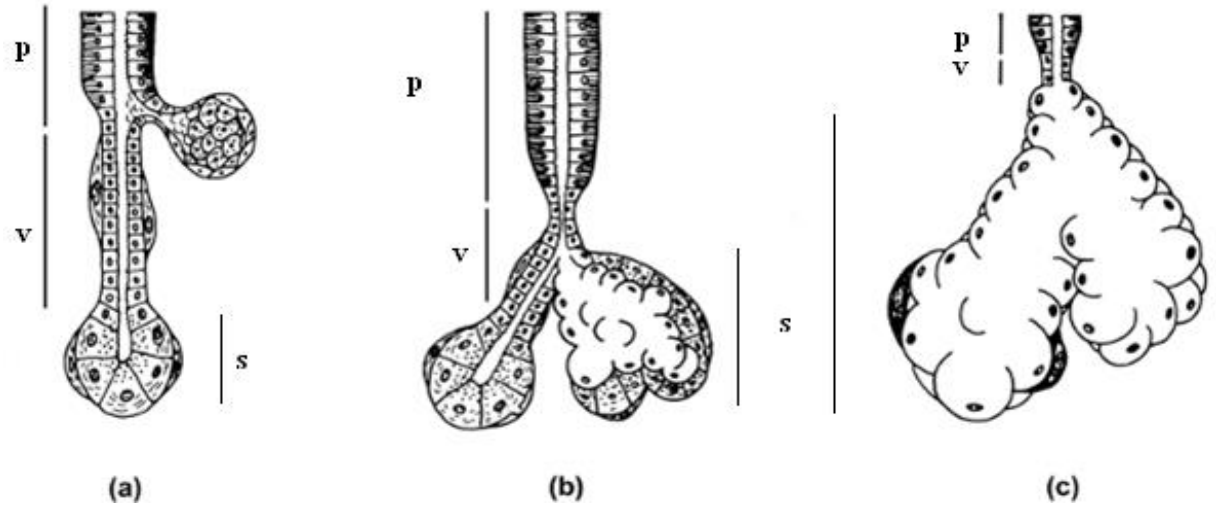
6) main duct is formed from epithelial cord connecting base of the gland with the site of its origin

Ectodermal origin:
parotid gl.
Endodermal origin:
submandibular gl.
sublingual gl.

Basic histological structure of salivary glands

exocrine glands – secretion of saliva
- connective tissue capsule + connective tissue septa dividing them into→ lobules
- vessels, nerve fibers enter the glands at the hilum

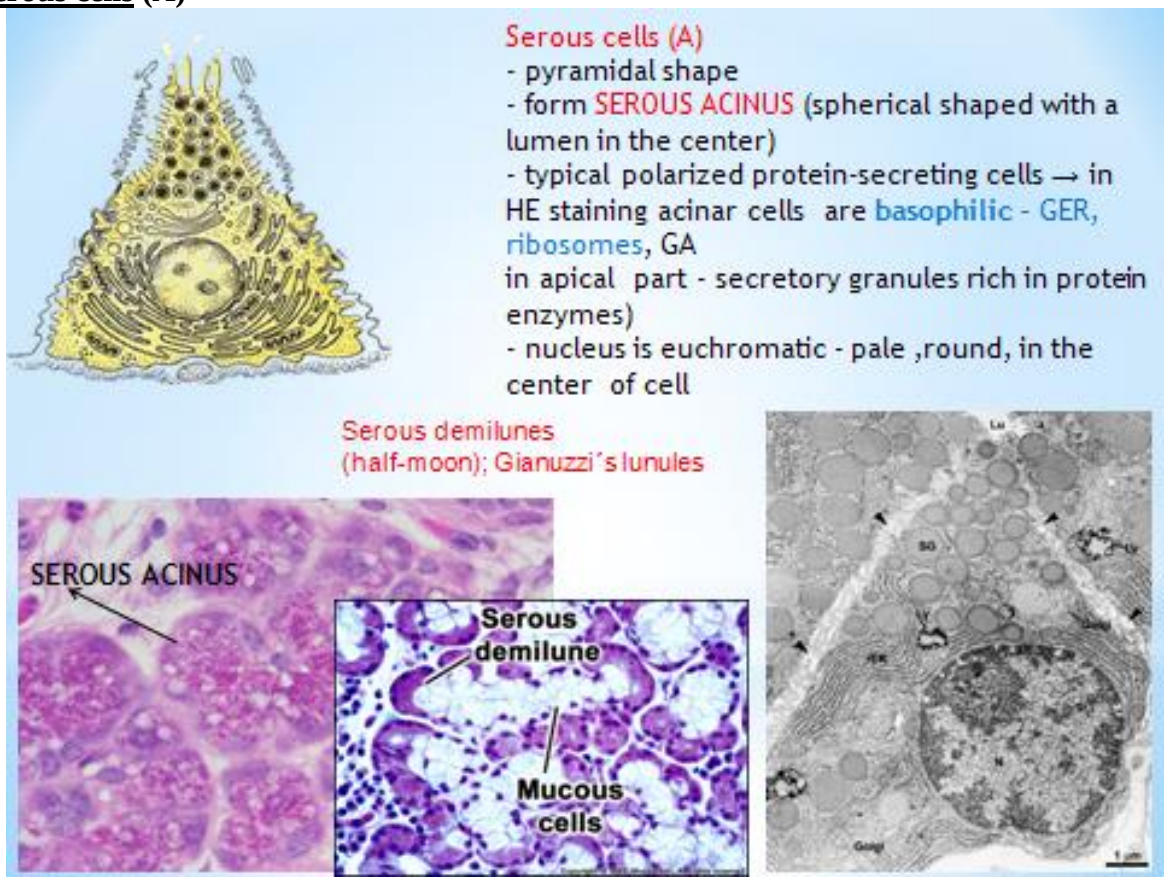
1. **secretory portion (s)** – secretory cells + myoepithelial cells
   A. serous cells → serous acinus
   B. mucous cells → mucous tubules
2. **duct system** (**p)**-striated ducts,**v**–intercalated ducts)-with 1 unbranched duct-**simple glands**
   - with many branched ducts- **compound glands**



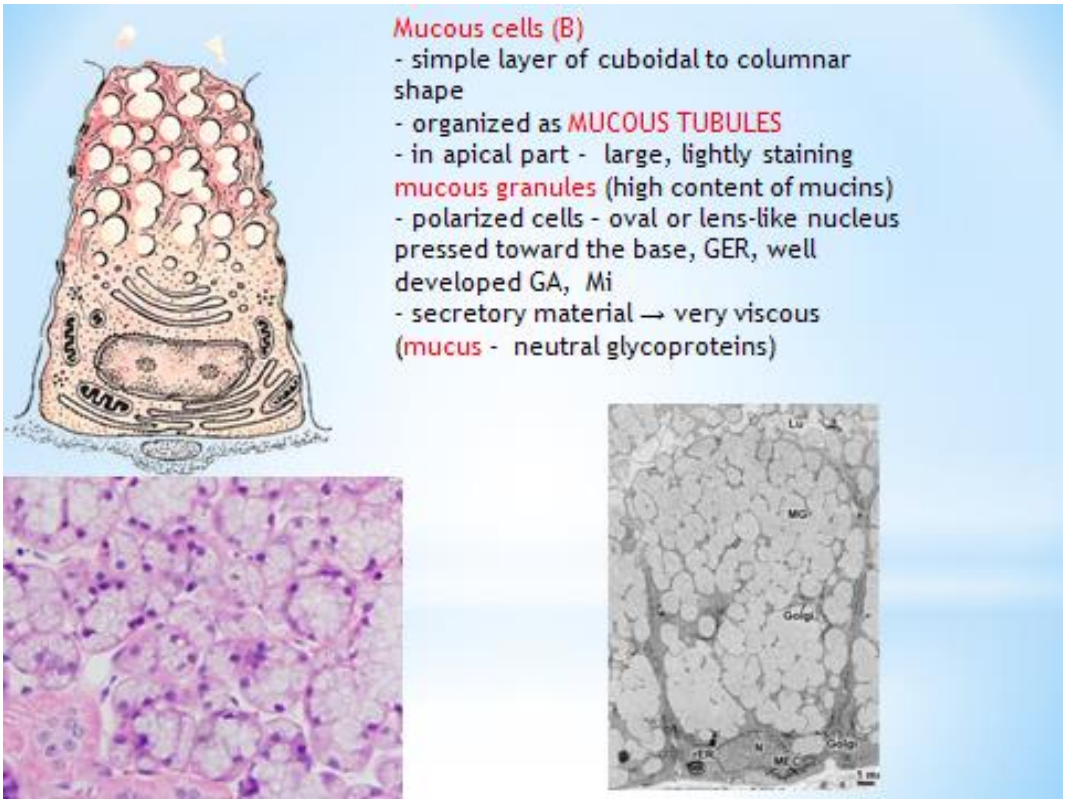
a – glandula parotis b – glandula submandibularis c – glandula sublingualis

Saliva function
- moistening → water &mucus (mucin - GPs)
- digestion → α-amylase + lipase
- immunologic function → IgA,
  lactoferrin
  lysozyme
- clearing of oral cavity
- remineralization of tooth enamel
- buffer function (HPO42-, HCO3-)

Serous cells (A)



Mucous cells (B)



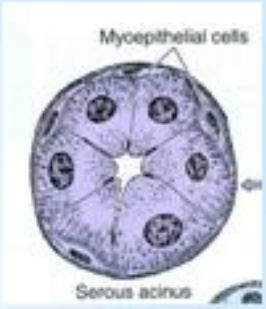
Myoepithelial cells

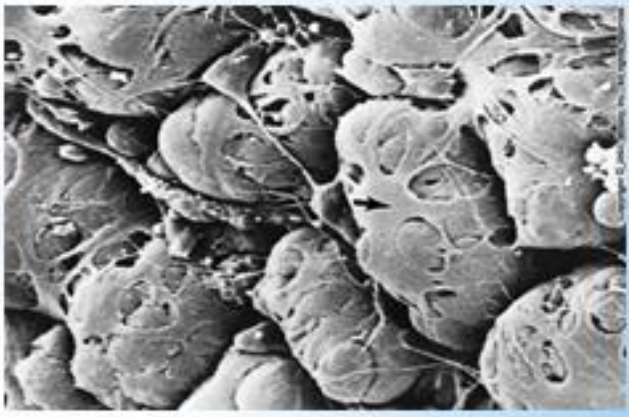
Myoepithelial cells - myoepitheliocytus

- found within basal lamina of glandular and ductal epithelia
- ultrastructure resembles smooth muscle cells
- around the serous acini - highly branched cells- star shaped cells
- around mucous tubuli and intercalated ducts - spindle shaped cells
- flattenned nucleus, in cytoplasm – actin myofilaments responsible for contraction and releasing of secretory material into duct system, intermediate cytokeratine filaments – epithelial origin, desmosomes

- Function:

1. supporting
2. releasing of secretory material





DUCT SYSTEM

Function of ducts – to change isotonic primary saliva to hypotonic

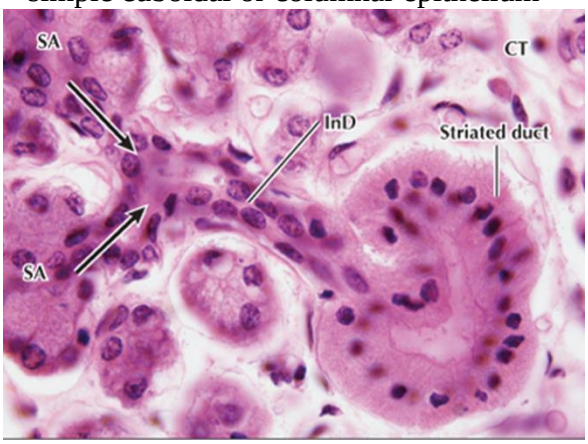
A. Intralobular ducts

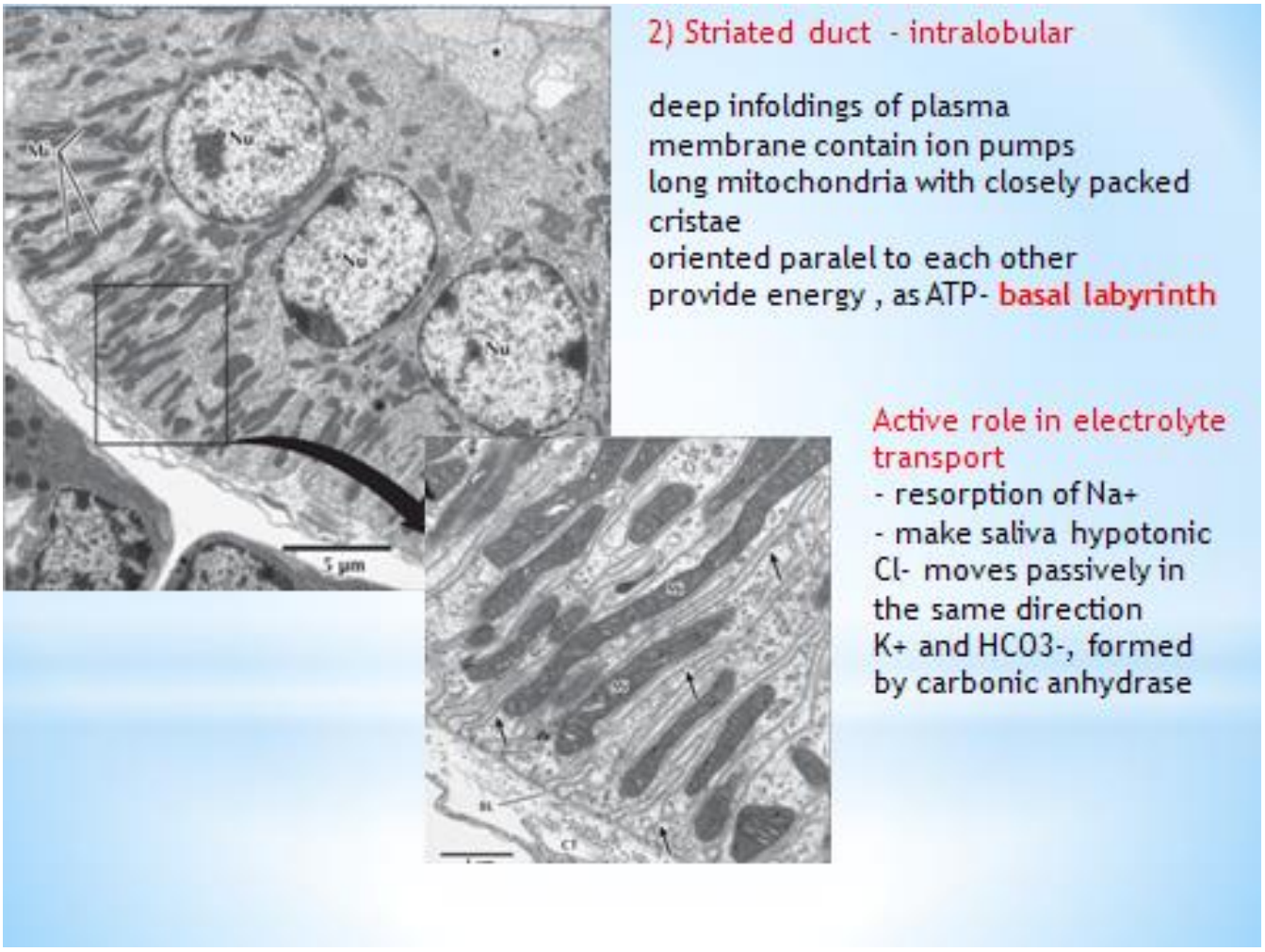
1. intercalated duct - start inside acini

***** simple squamous or cuboidal epithelium

2. striated duct-radial striations, that extend from the bases of the cells to the level of nuclei

* simple cuboidal or columnar epithelium

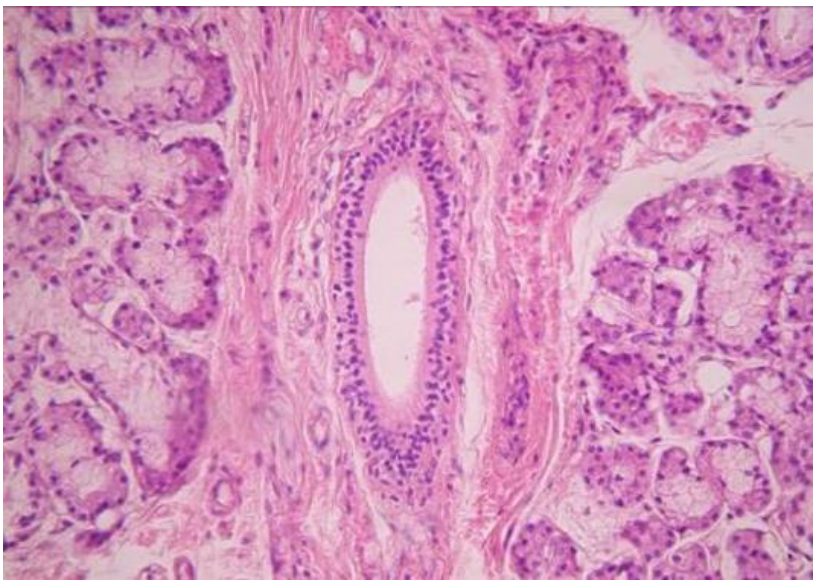




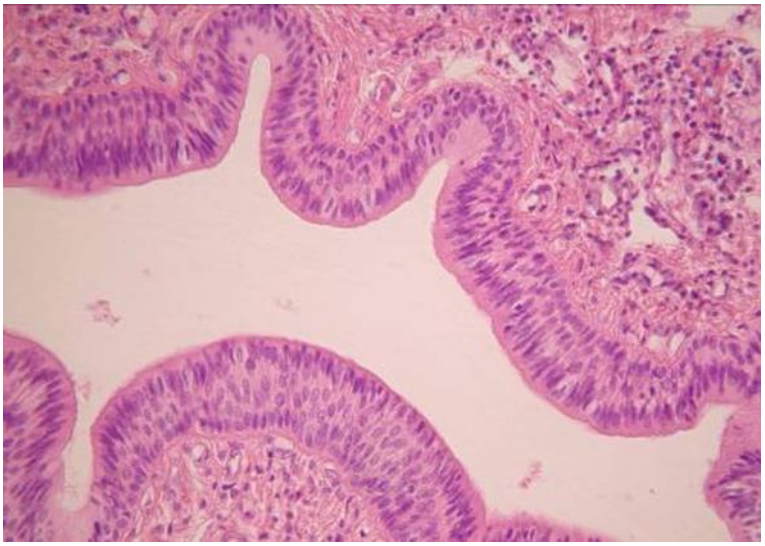
B. Interlobular ducts – between lobules in collagen tissue septa

1. interlobular duct -excretory

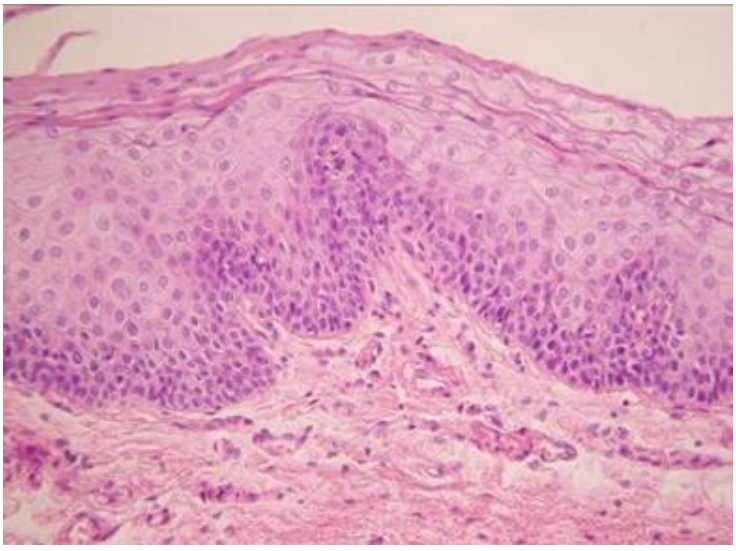
* simple → pseudostratified columnar epithelium

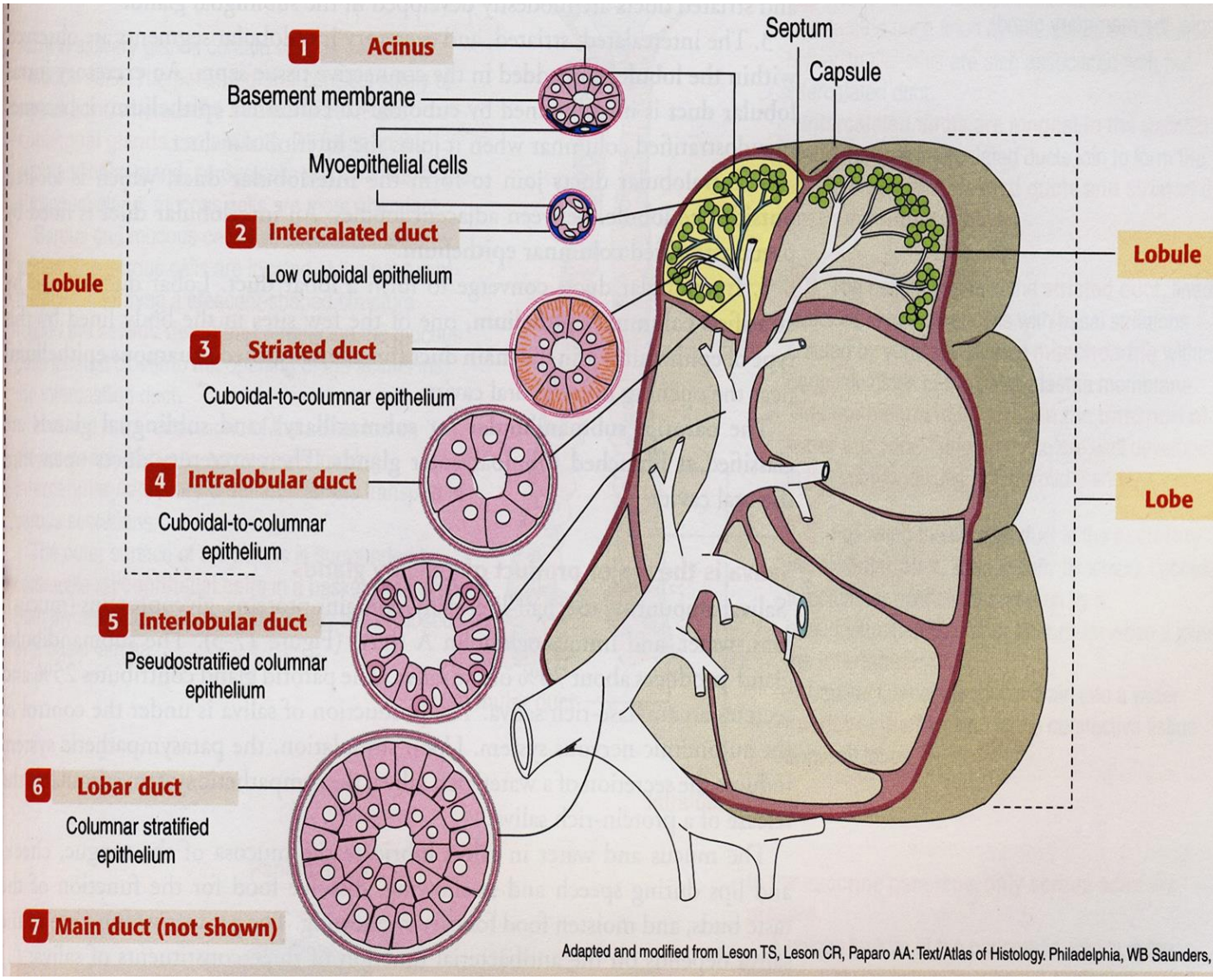


2. lobar duct
* pseudostratified → stratified columnar epithelium



3. the main duct
* stratified squamous nonkeratinized epithelium

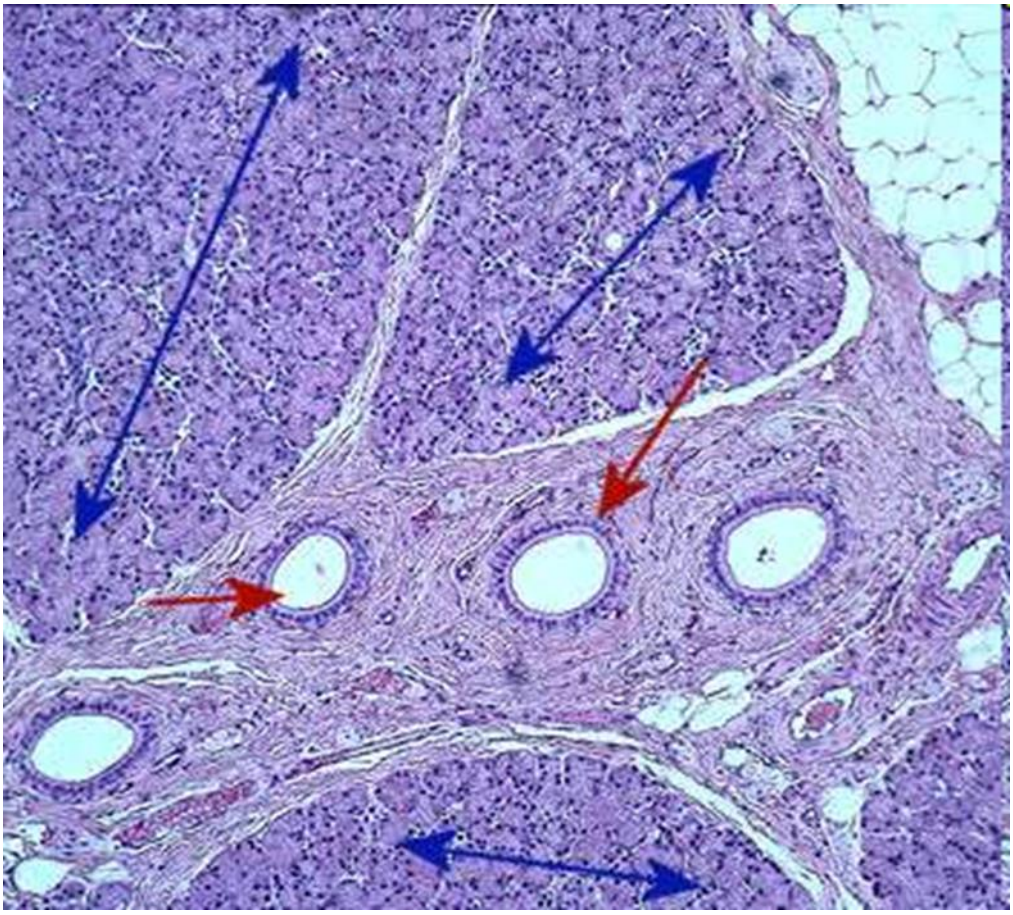



1 Acinus
Basement membrane
Myoepithelial cells
2 Intercalated duct
Low cuboidal epithelium
Lobule
3 Striated duct
Cuboidal-to-columnar epithelium
4 Intralobular duct
Cuboidal-to-columnar epithelium
5 Interlobular duct
Pseudostratified columnar epithelium
6 Lobar duct
Columnar stratified epithelium
7 Main duct (not shown)
Septum
Capsule
Lobule
Lobe
Adapted and modified from Leson TS, Leson CR, Paparo AA: Text/Atlas of Histology. Philadelphia, WB Saunders,

PAROTID GLANDS – *glandulae parotis*

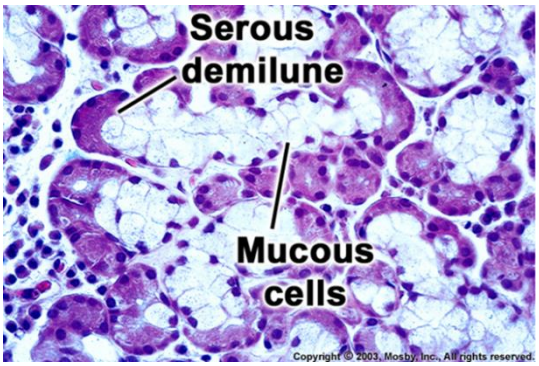
A branched serous acinar gland, secretory portion consists exclusively of serous cells.

- Connective tissue capsule + septa penetrate the glands – dividing them into lobules **- lobuli**
- Secretory portion (serous acini) → serous cells + myoepithelial cells
- Connective tissue septa (collagen fibers)
  → ducts, vessels, nerves and nerve ganglia
- Interstitial connective tissue:
  Numerous of adipocytes, B-lymphocytes, plasma cells
- completely formed duct system
- intercalated ducts – long and branched
- They produce 25% of total saliva.
- Secretory granules– α-amylase, lysozyme and lactoferin



SUBMANDIBULAR GLAND – *glandula submandibularis*

Encapsulated branched tubuloacinar salivary gland with predominant serous cells.
● Connective tissue capsule and septa - lobuli
● Secretory portion – mucous tubules
– serous acini 95% -
– mixed glandular units → the end of mucous tubules are capped by serous cells - serous **Giannuzi demilunes! – semiluna serosa**
● Connective tissue septa (dense connective tissue) , present → adipocytes, ducts, vessels and nerves
● They produce 70% of total saliva



SUBLINGUAL GLAND – glandula sublingualis

Encapsulated branched tubuloacinar salivary gland with predominant mucous cells.
● Connective tissue capsule and septa - lobuli
● Secretory portion – mucus tubuli – ↑↑ numerous (*)
– rare serous acini → mucous transformation!
– mixed glandular units → Giannuzi demilunes - semiluna serosa
● Connective tissue septa (dense CT) , present → adipocytes, ducts, vessels, nerves
● intercalated ducts – low number replaced by mucus tubule
● striated ducts – low number and relatively short
● They produce only 5% of total saliva.