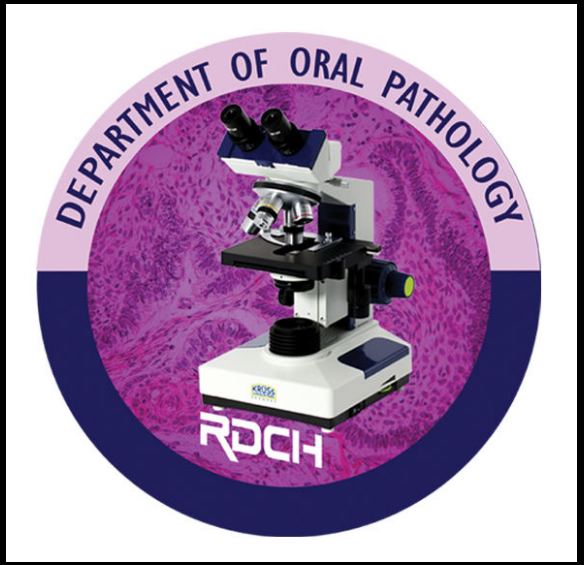


SALIVARY GLANDS

INTRODUCTION

- Salivary glands are ***compound, tubuloacinar,merocrine,exocrine*** glands whose ducts open into the oral cavity.
- Composed of parenchymal elements invested in & supported by connective tissue.

- Secretes saliva, which is a complex fluid & forms a thin film coating the teeth & mucosa, creating & regulating a healthy environment in the oral cavity.

CLASSIFICATION & STRUCTURE

- According to size:-

  1)Major salivary glands:-

  a) Parotid

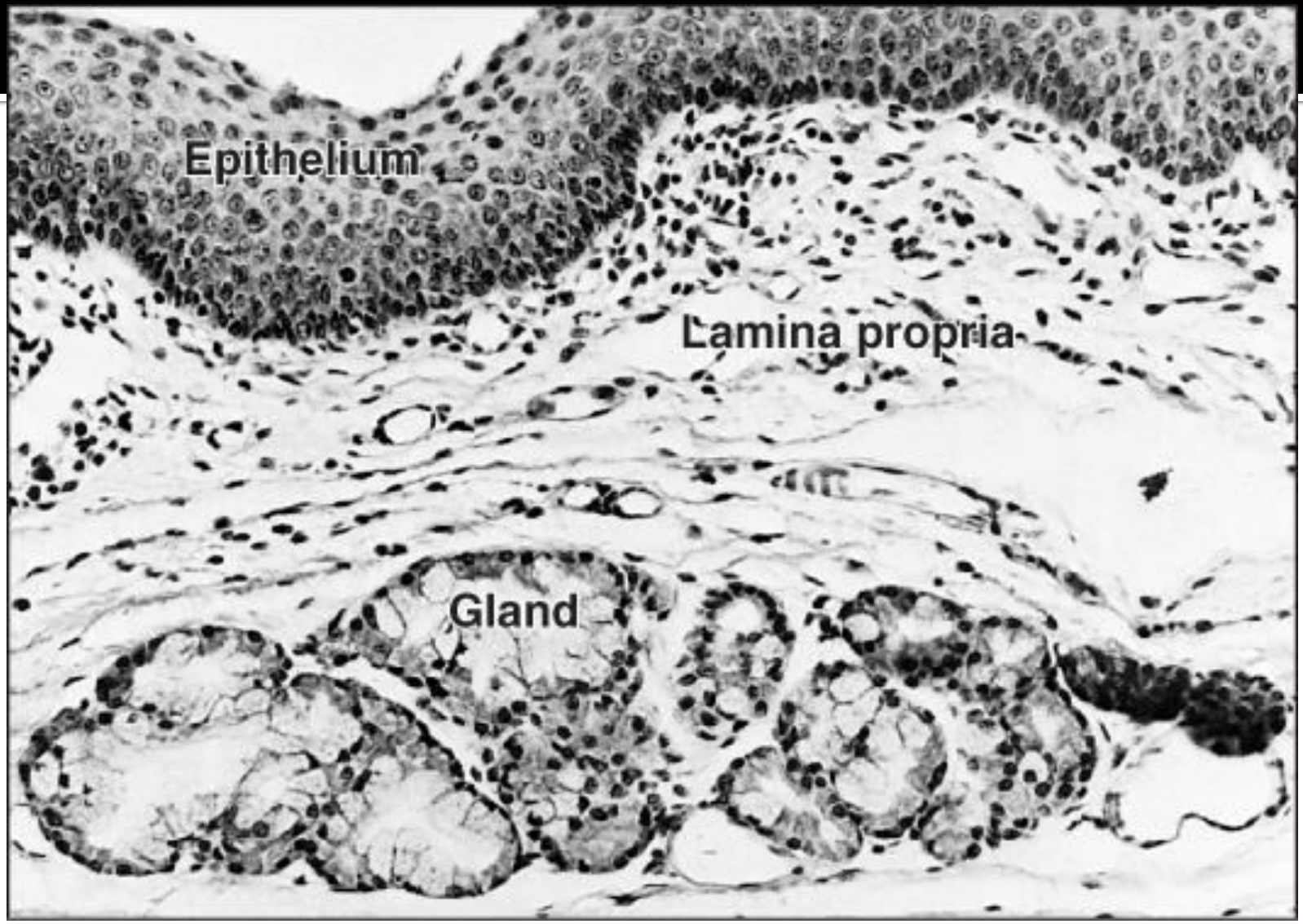
  b) Submandibular

  c) Sublingual

  2)Minor salivary glands:-

- According to location :- lip, cheek, floor of the mouth, tongue, palate.
- According to histochemical nature of secretory product :- serous or mucous

- Three pairs of major salivary glands located outside the oral cavity & through extended duct system secrete their secretion into the mouth.
- Parotid
- Submandibular
- Sublingual


Epithelium
Lamina propria
Gland

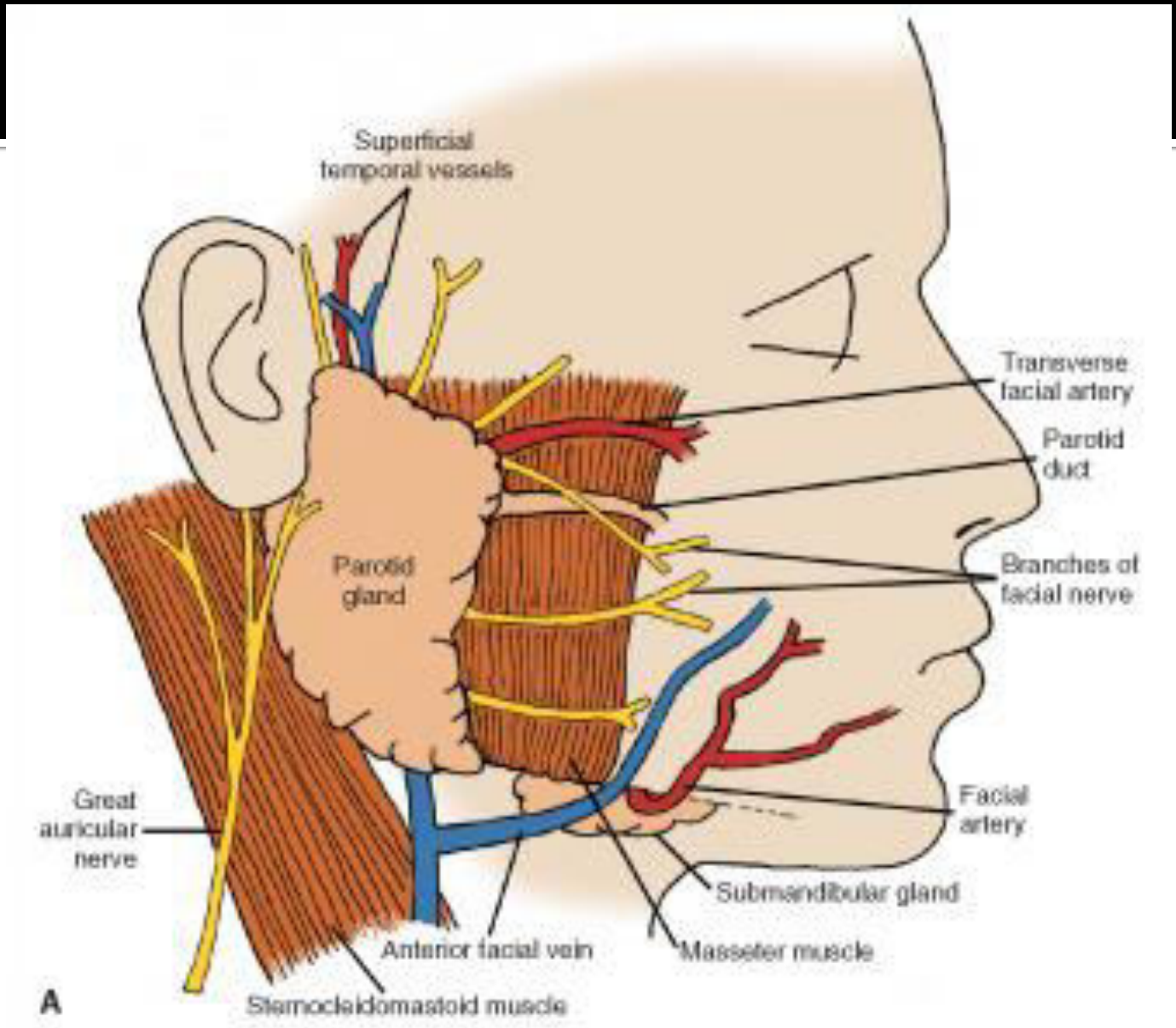
- These glands exist as small ,discrete aggregates of secretory tissue present in the submucosa throughout most of the oral cavity.
- These are estimated to number between 600-1000.

- Anterior lingual glands (glands of Blandin & Nuhn)
- These two irregular glandular groups lie on either side of the frenum on the under-surface of the tongue ,with several ducts piercing the overlying mucosa.

- Posterior lingual glands (glands of von Ebner)
- These are small glands whose ducts open into the sulci of the circumvallate papillae. (purely Serous)

- Lingual ,Buccal, Labial and Palatal glands
- These glandular aggregates are scattered over the tongue surface, inside of lips and cheeks, and palatal mucosa.

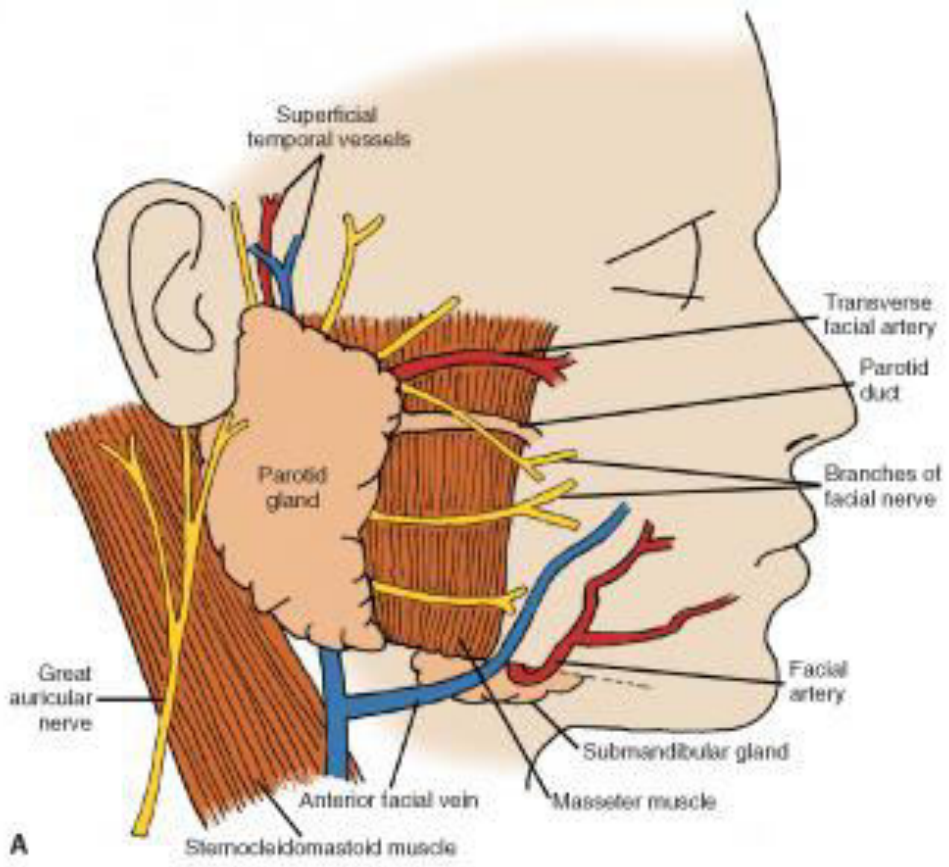
- Salivary glands are ***NOT*** present :
- Gingiva
- Anterior raphe region of hard palate
- Anterior 2/3 of dorsum of tongue


Superficial temporal vessels
Transverse facial artery
Parotid duct
Parotid gland
Branches of facial nerve
Great auricular nerve
Facial artery
Submandibular gland
Anterior facial vein
Masseter muscle
Sternocleidomastoid muscle
A

PAROTID GLAND

- Pyramidal in shape and engulfed by a dense fibrous capsule.
- The superficial surface of the gland is defined by the zygomatic arch, the external auditory meatus ,and just behind and below the angle of mandible .

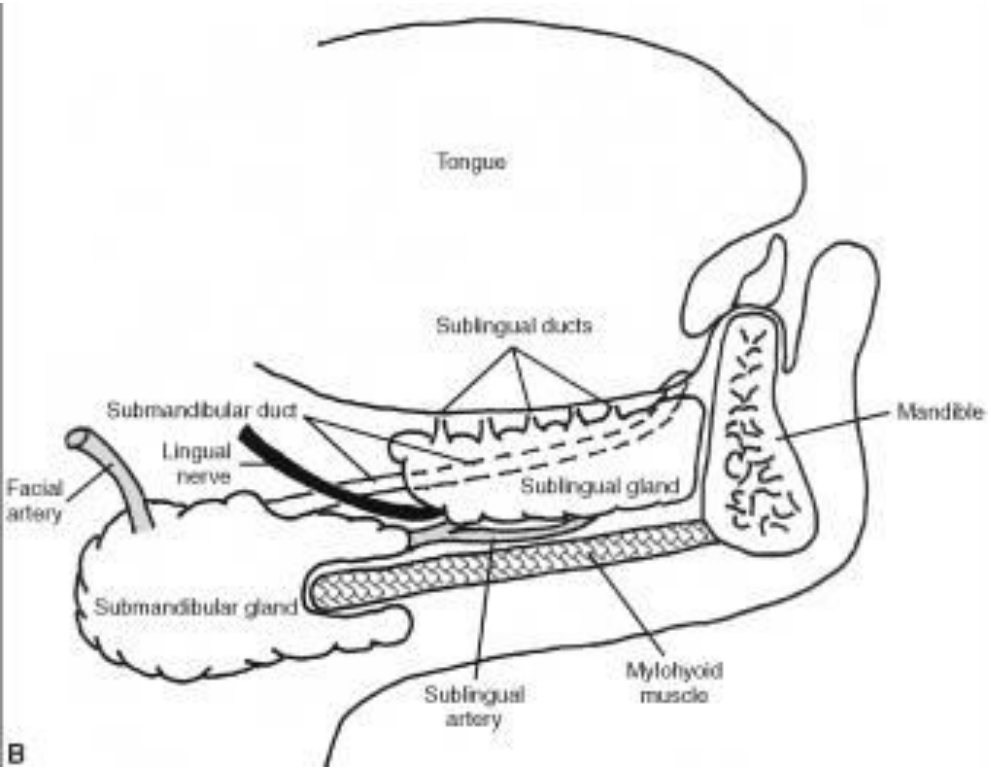
PAROTID GLAND



- Largest major salivary gland.
- Purely serous gland. (infants-few mucous)
- The secretion of this gland is 20-30% of the total salivary volume.

- The main excretory duct is Stenson's duct & it opens into the oral cavity on the buccal mucosa opposite the maxillary second molar.
- The duct is about 5cm long and 3mm in internal diameter.
- The opening is usually marked by small papilla.

SUBMANDIBULAR GLAND

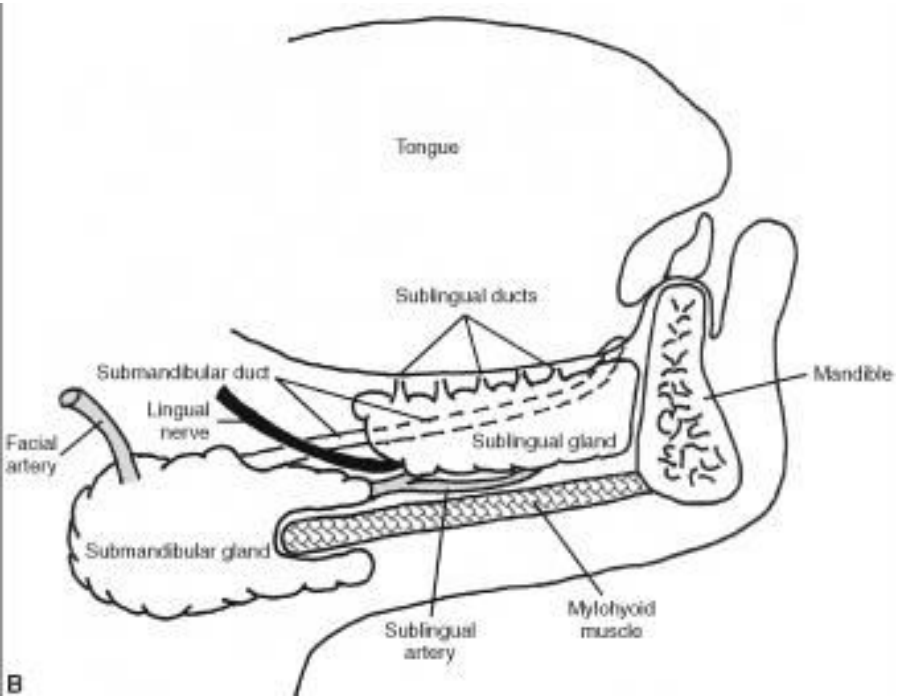


- The glands are irregular ,walnut in shape .
- The superficial inferior surface is in contact with the skin and platysma muscle .

- Laterally the gland is in contact with mandibular body and medially with the extrinsic muscle of tongue and mylohyoid muscle.

- Mixed gland but the serous units predominant.
- The submandibular duct (wharton's duct)open in the sublingual papilla at the side of lingual frenum.
- The duct is tortuous and approximately 5cm long.
- The secretion of this gland is 60-70% of the total salivary volume .

SUBLINGUAL GLAND



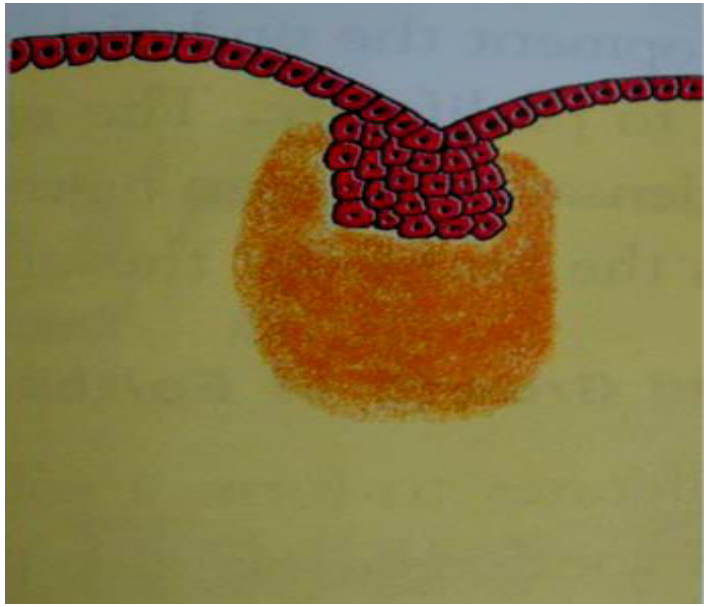
- The glands lie immediately beneath the oral mucosal lining of floor of mouth, raising a small fold on either side of tongue.
- The gland rest on mylohyoid muscle, with the mandible lateral and the genioglossus muscle medial to it.

- A series of small ducts (ducts of Rivinus) open on to the surface of the sublingual folds on either side of the tongue, often through a larger duct (Bartholin's duct) .
- The gland produce 2-5% of total salivary volume.

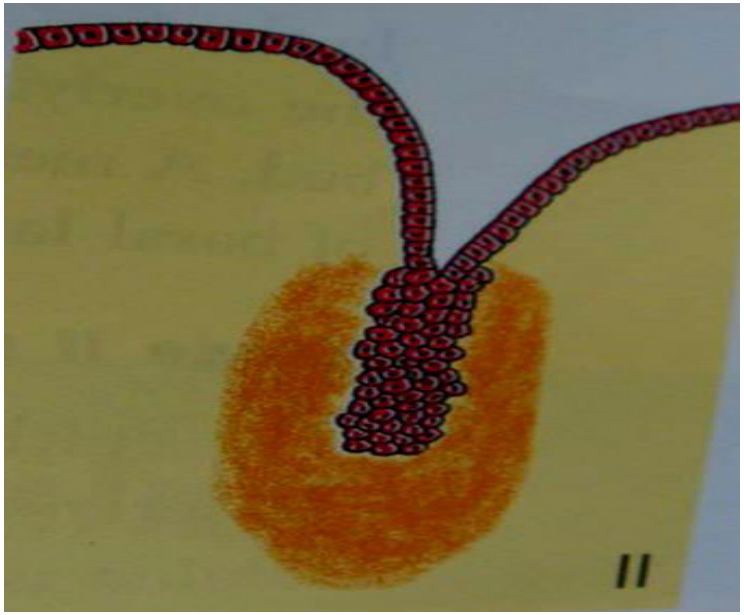
- Mixed type of gland ,Mucous secretory units predominate.
- The capsule & intercalated ducts are poorly developed.

DEVELOPMENT

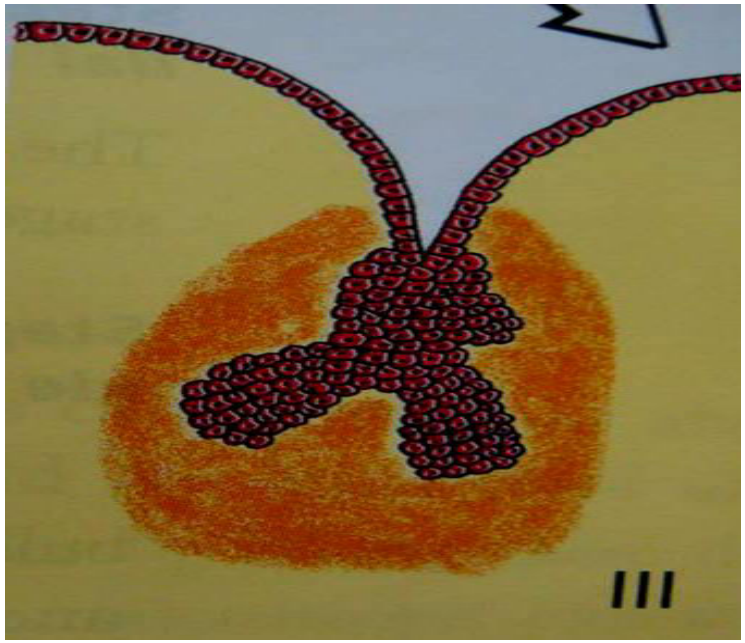
- Ectoderm of the oral cavity
- Growth of a bud of oral epithelium into underlying mesenchyme
- Primordia of parotid & submandibular glands- 6th week of fetal life
- Sublingual glands-7th-8th week of fetal life
- Minor salivary glands-3rd month

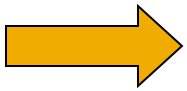


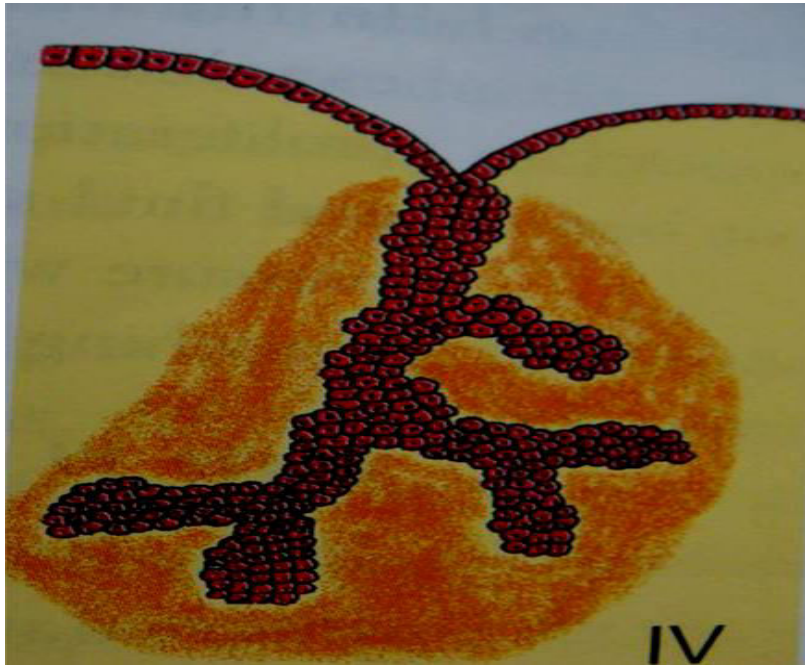
BUD FORMATION



CORD FORMATION

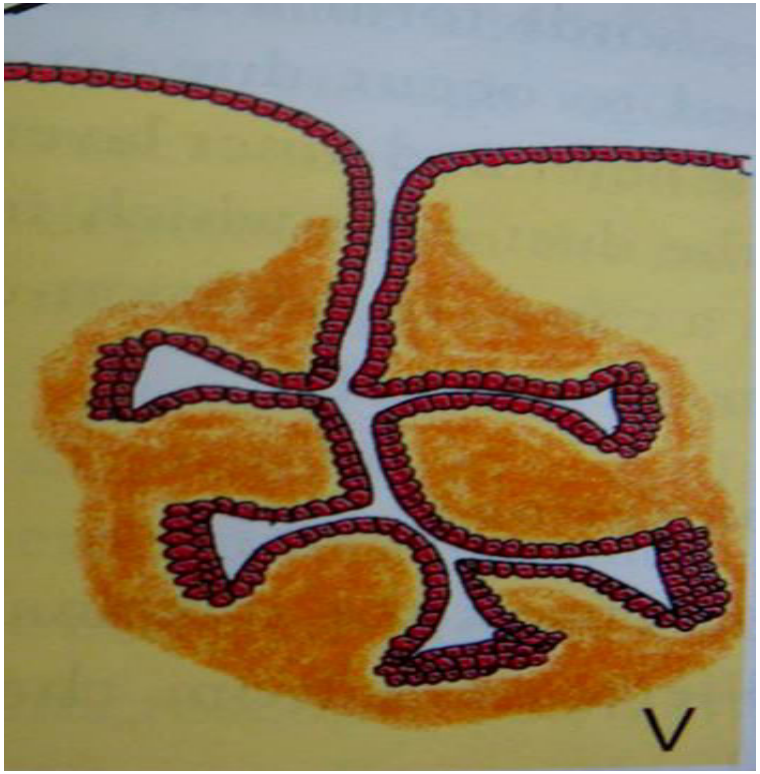


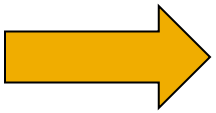


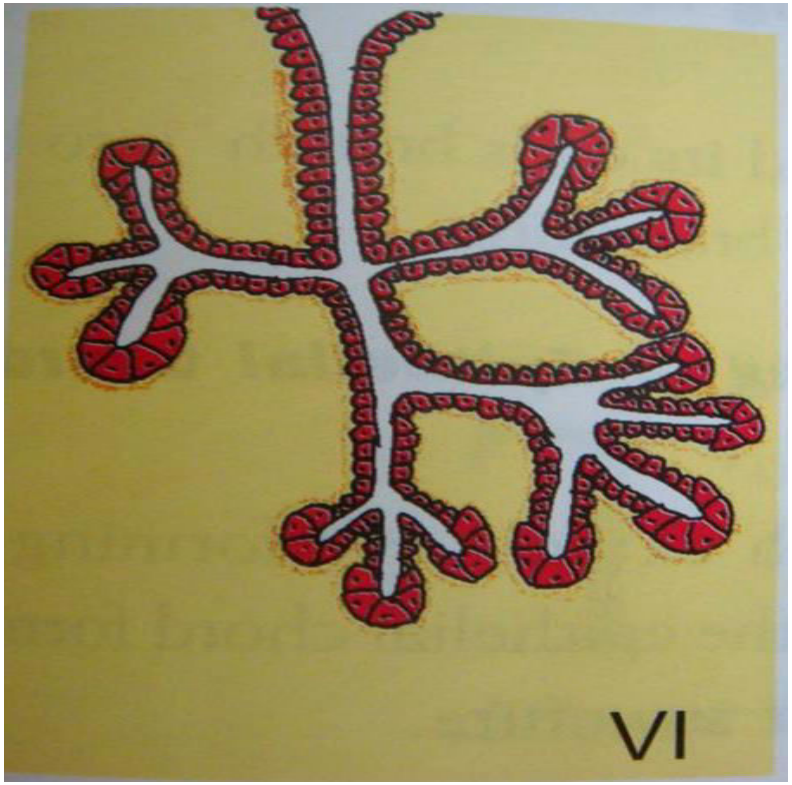


BRANCHING OF CORDS

LOBULE FORMATION

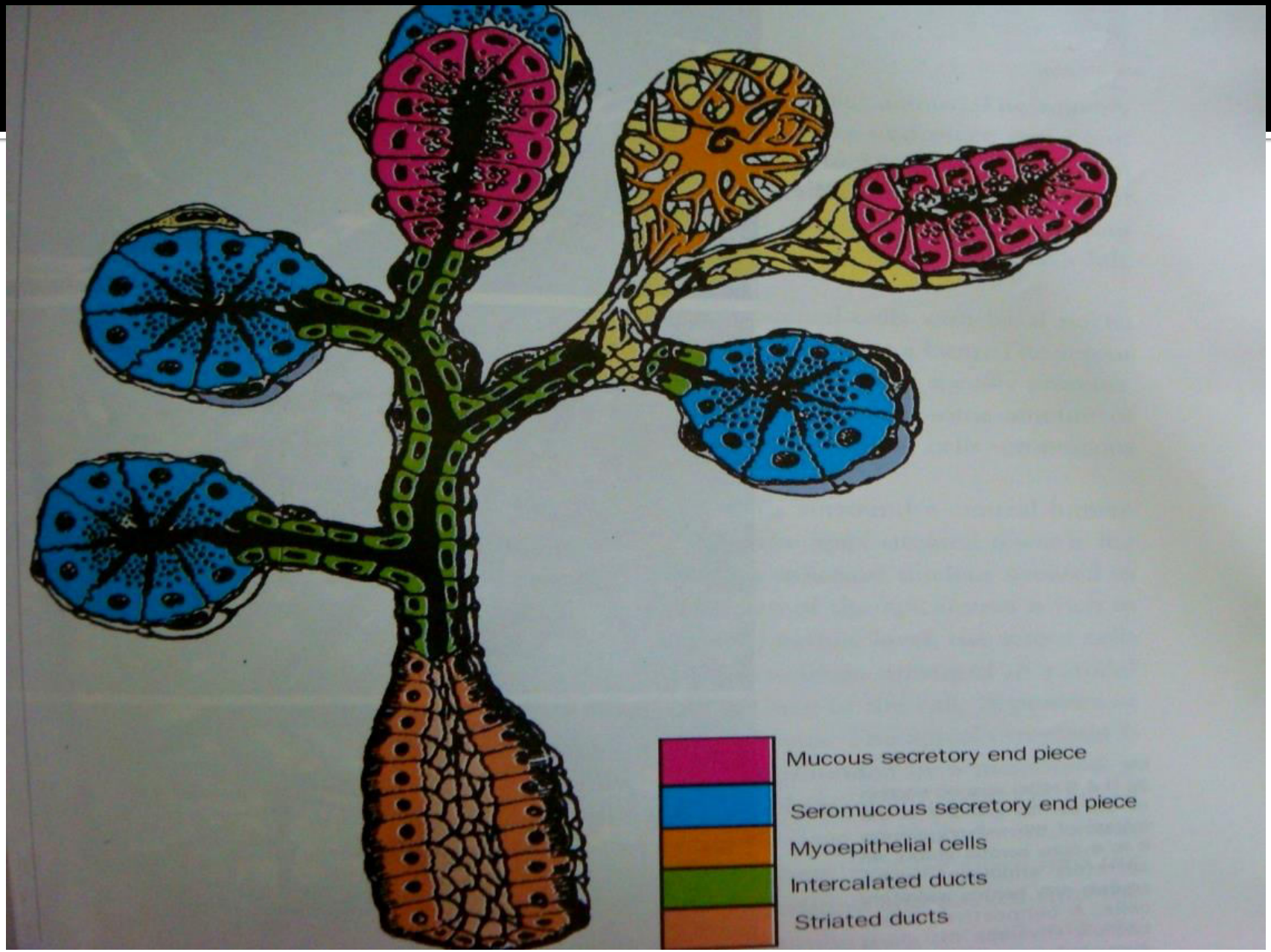




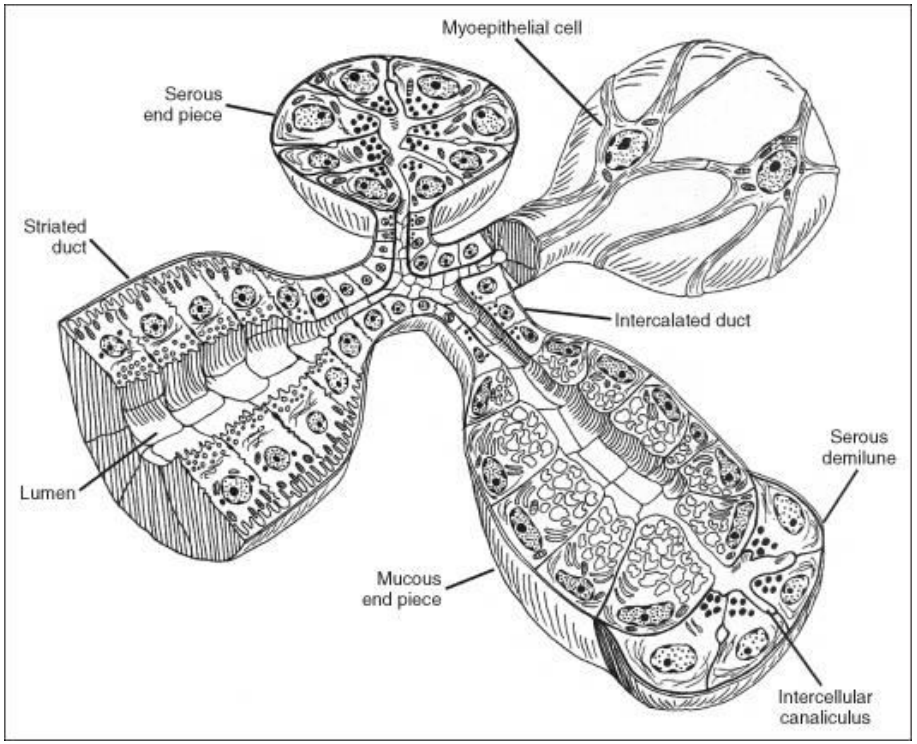


CANALIZATION OF CORDS

CYTODIFFERENTIATION


Mucous secretory end piece
Seromucous secretory end piece
Myoepithelial cells
Intercalated ducts
Striated ducts

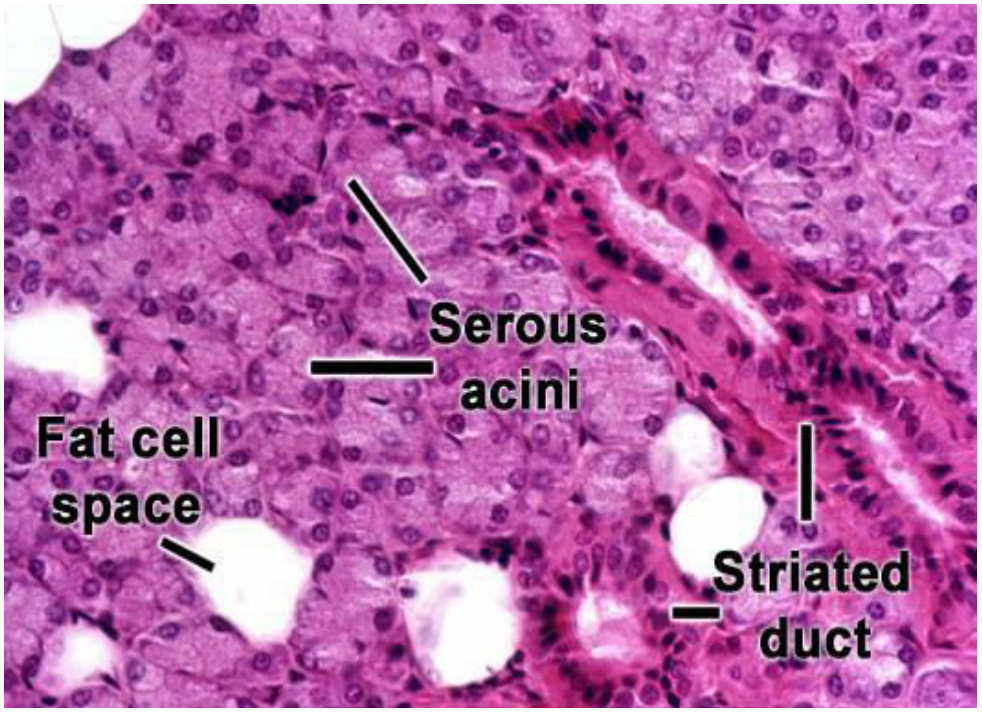
- The general structure of salivary glands is often compared to a bunch of grapes ,with the grapes representing the secretory acini while the stalks represents the ductal system.

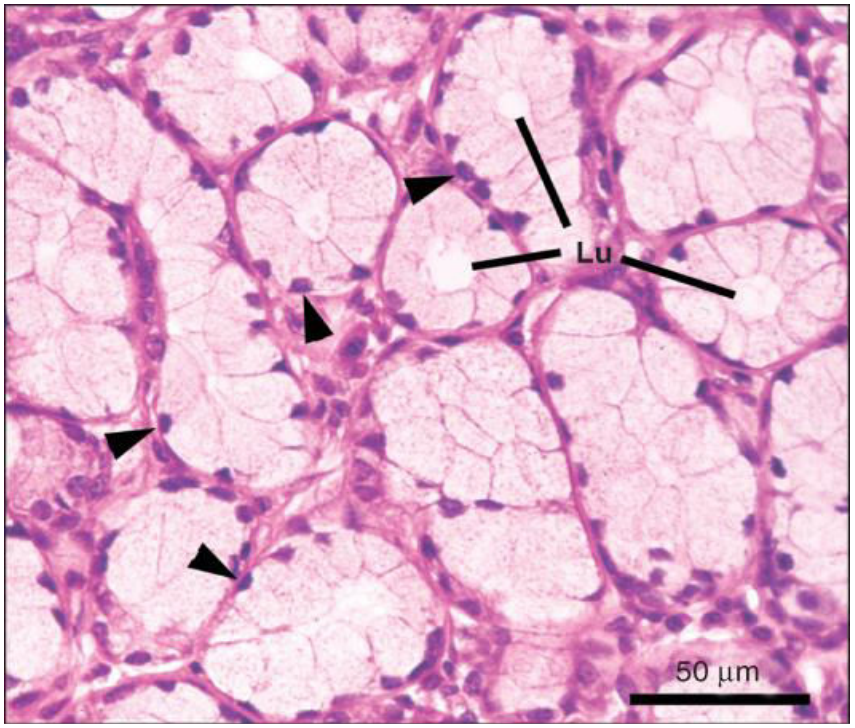


- The terminal secretory end piece is also called as acinus and it can be of three types-
- Serous,mucous and mixed .

- In the acini in addition to *serous* and *mucous* cells, another family of cells called as *myoepithelial* cells are also present.

- THE SECRETORY UNITS
  - -Serous cells
  - -Mucous cells
  - -Myoepithelial cells
- THE DUCT SYSTEM
  - -Intercalated ducts
  - -Striated ducts
  - -Terminal excretory ducts


Serous
acini
Fat cell
space
Striated
duct


Lu
50 µm

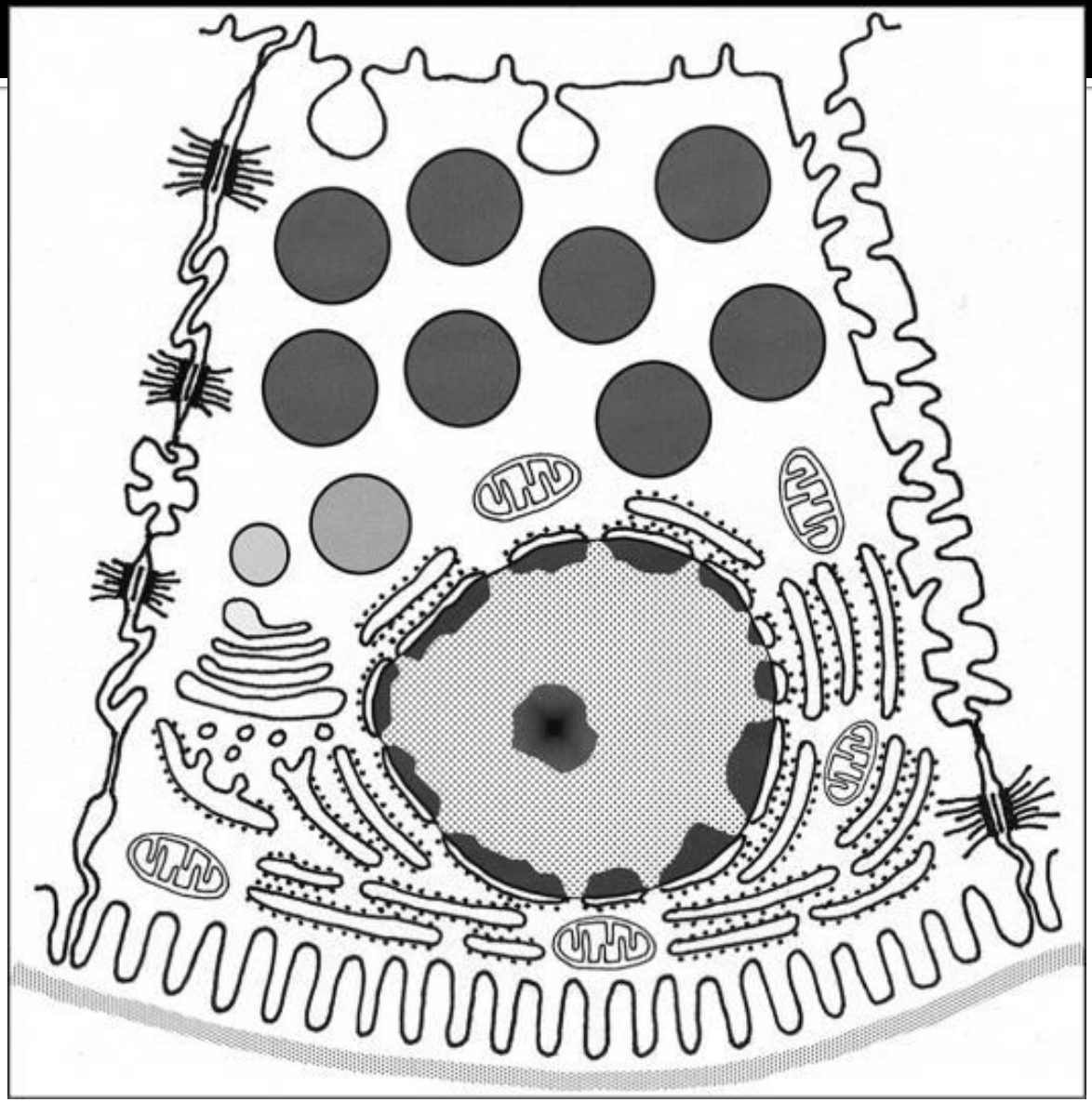
Serous acini /cell

- Roughly spherical
- Smaller lumen
- In H& E darkly stained (zymogen granules)
- Nucleus – spherical, basal in position

Mucous acini /cell

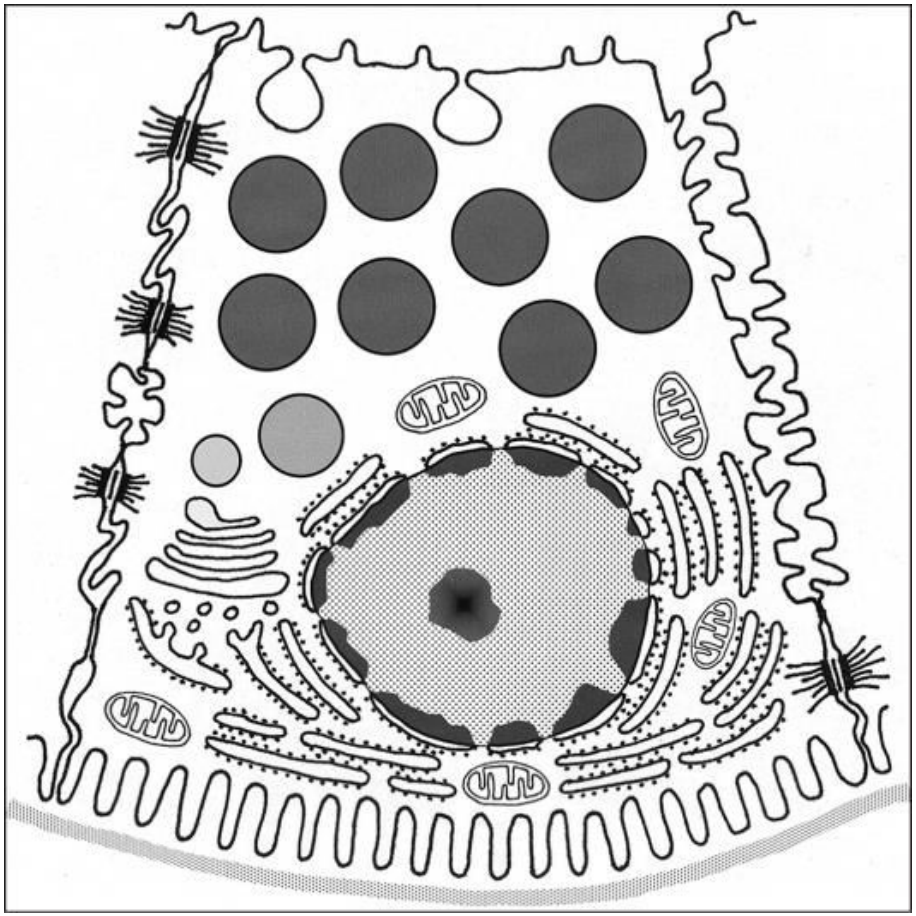
- Tubular shape
- Larger lumen
- In H & E lightly stained (secretory droplets)
- Nucleus – flattened, basal in position

Serous cell

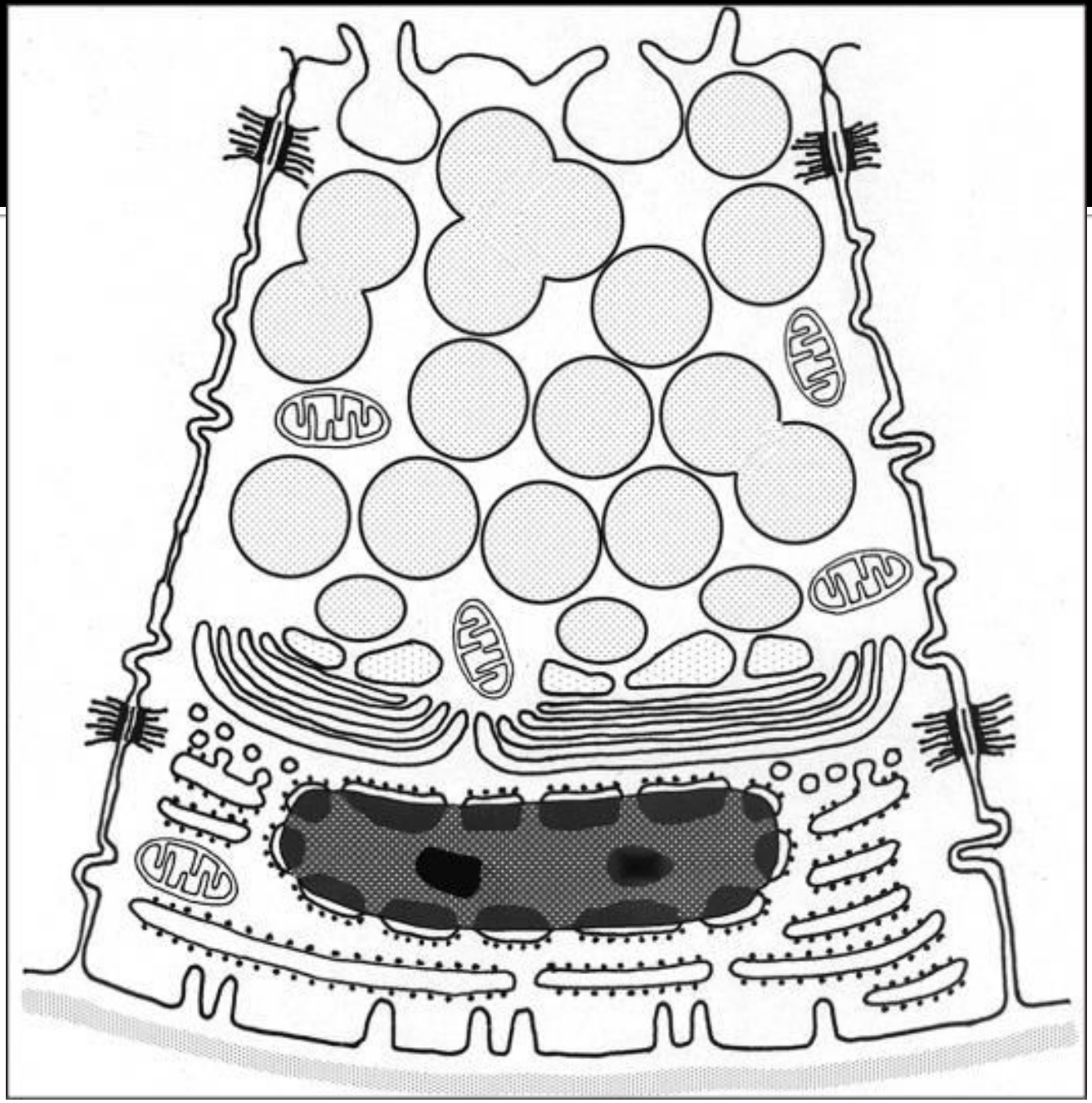


SEROUS CELLS

- Shape: pyramidal with broad base resting on a thin basal lamina & narrow apex bordering the lumen. Spherical nucleus in the basal region.
- Function-Synthesis, storage & secretion of proteins

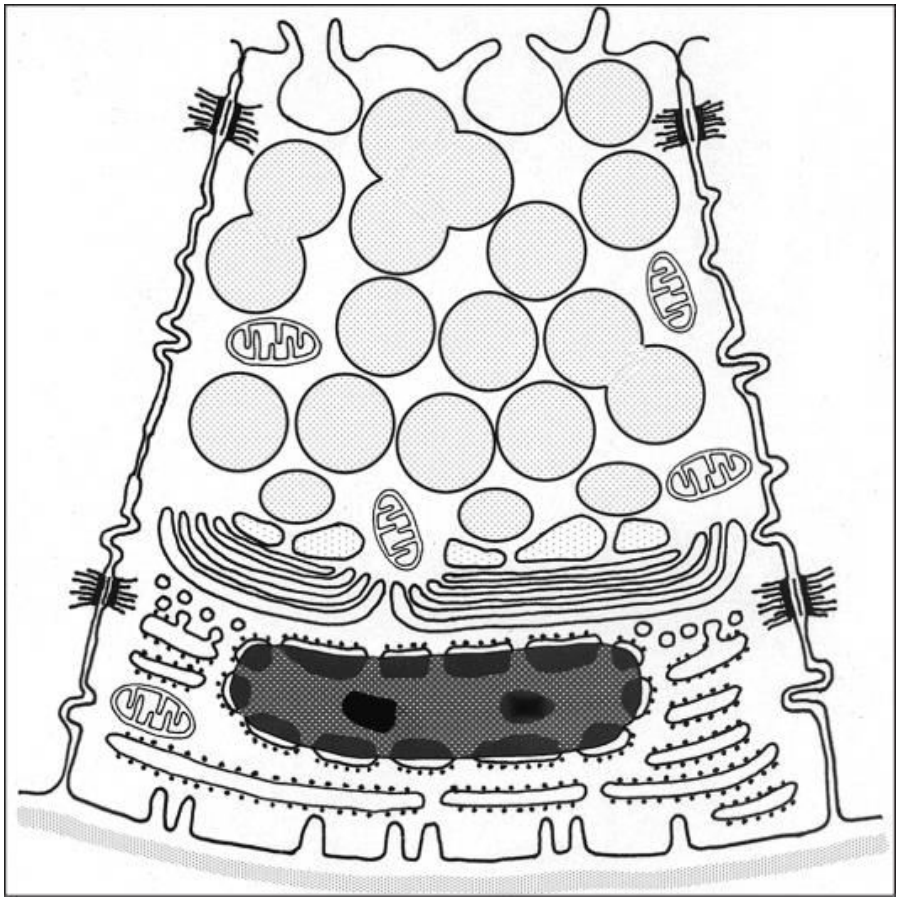


- Prominent feature: accumulation of the secretory granules (Zymogen granules) in the apical cytoplasm.
- The basal portion of the cytoplasm is filled with cell organelles in which ribosome is abundant & is basic unit for protein synthesis.

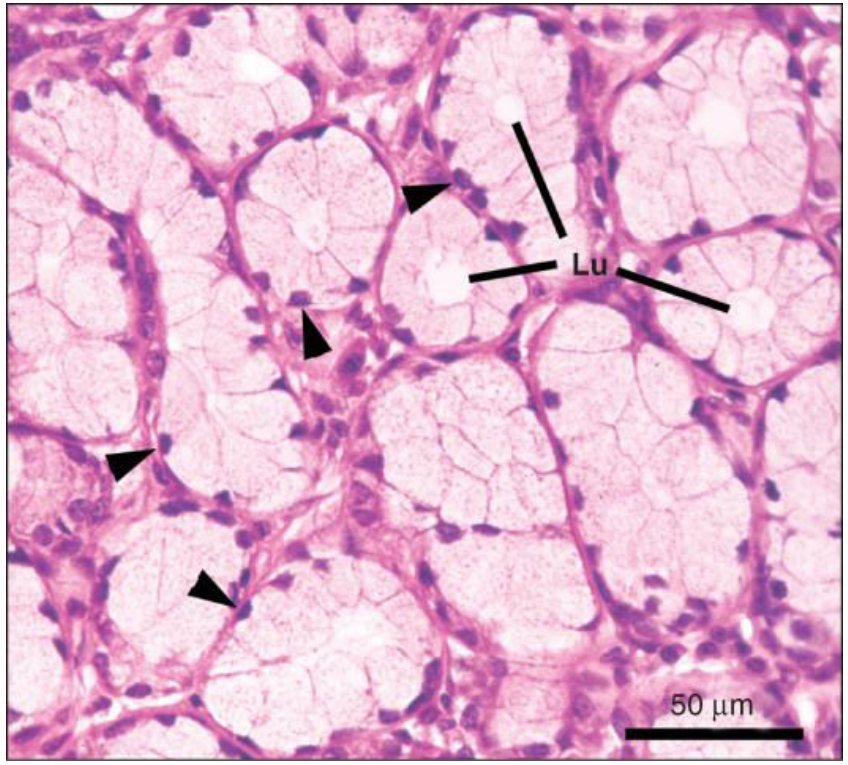


MUCOUS CELLS

- The structural difference is that the nucleus & a thin rim of cytoplasm are compressed against the base of the cell.
- Apex appears empty except for thin strands of cytoplasm forming a trabecular network
- Function- Synthesis, storage & secretion of secretory product (mucus) .

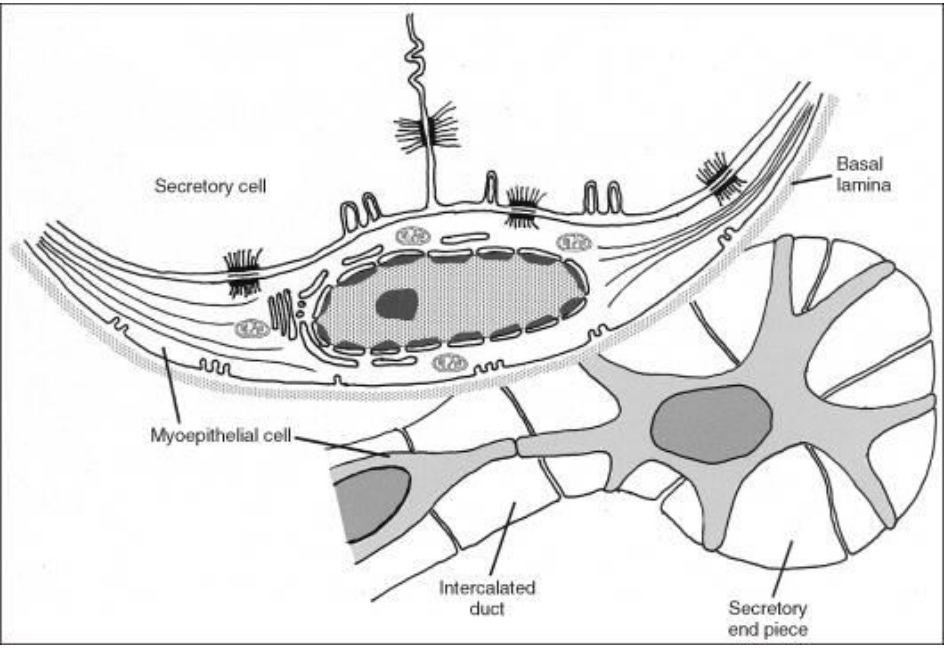


- EM: pale electron lucent secretory droplets containing scattered flocculent material
- Secretory products differ from those of serous cell:



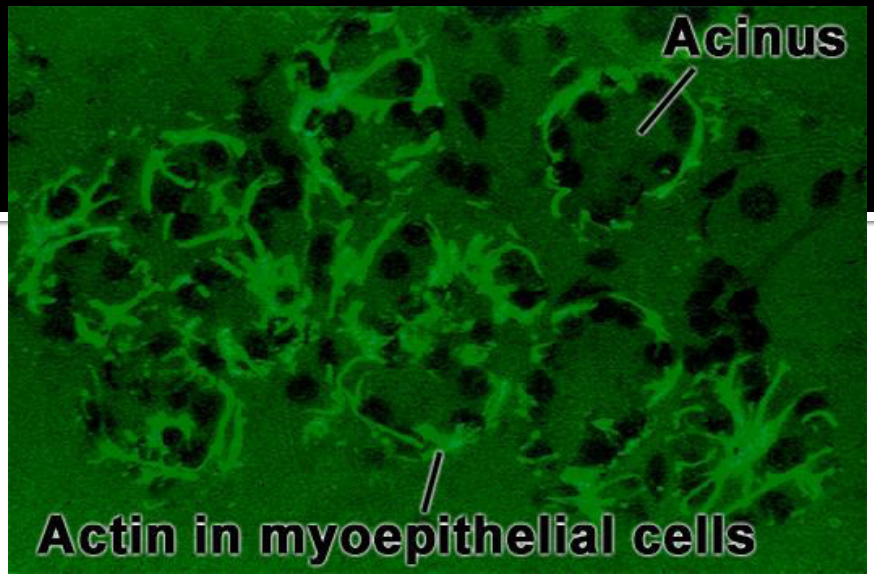
1. They have little or no enzymatic activity & probably serve mainly for lubrication & protection of oral tissues.
2. The ratio of carbohydrate to protein is greater, & larger amount of sialic acid & occasionally sulfated sugar residues are present.

MYOEPITHELIAL CELLS



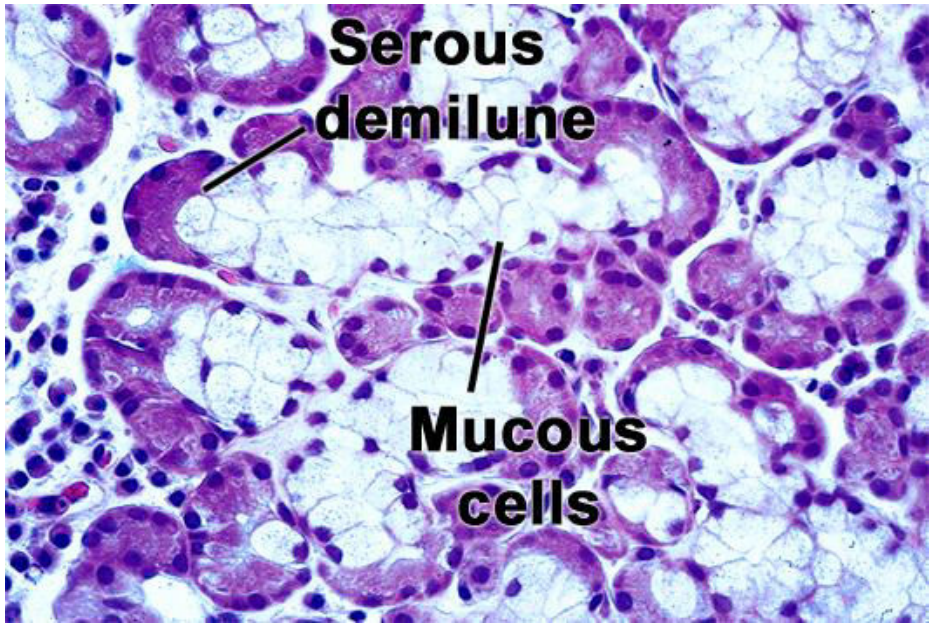
- Closely related to secretory & intercalated duct cells
- Present between basal lamina & the secretory or duct cells & joined to the cells by desmosomes.

- Stellate or spiderlike, with flattened nucleus, scanty perinuclear cytoplasm & numerous branching cytoplasmic processes that embrace the secretory & duct cells.



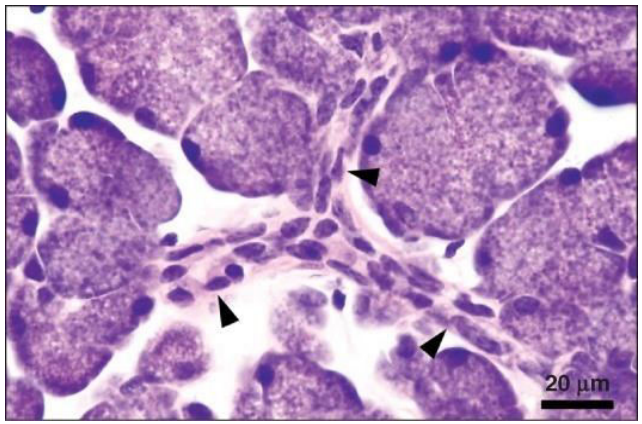
- Also called as ***Basket cell.***
- Considered to have a contractile function.
- Function-Help to expel secretions from the lumina of the secretory units & ducts.
- Origin – Epithelial or C.T. **?**

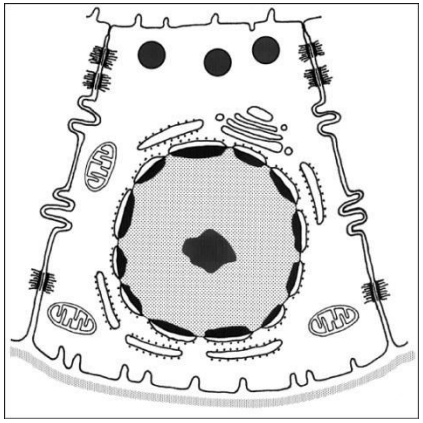
DEMILUNE



- ***Demilune*** -Some mucous end pieces have serous cells associated with them in the form of crescent shaped covering.

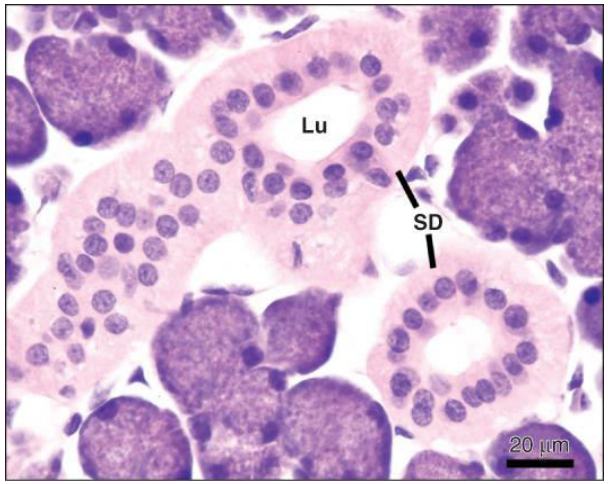
INTERCALATED DUCTS

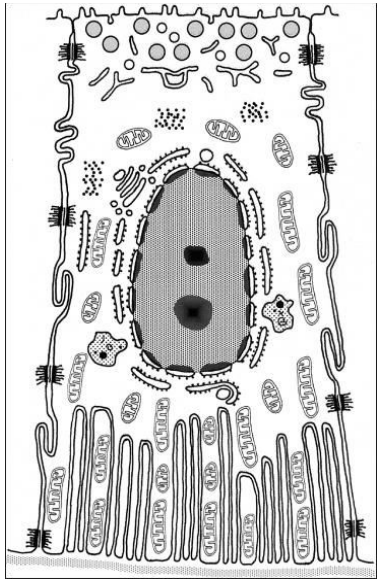




- Single layer of low cuboidal cells.
- E.M.- similar to serous cells, (RER,GC,SG).
- Junctional complexes & desmosomes present.

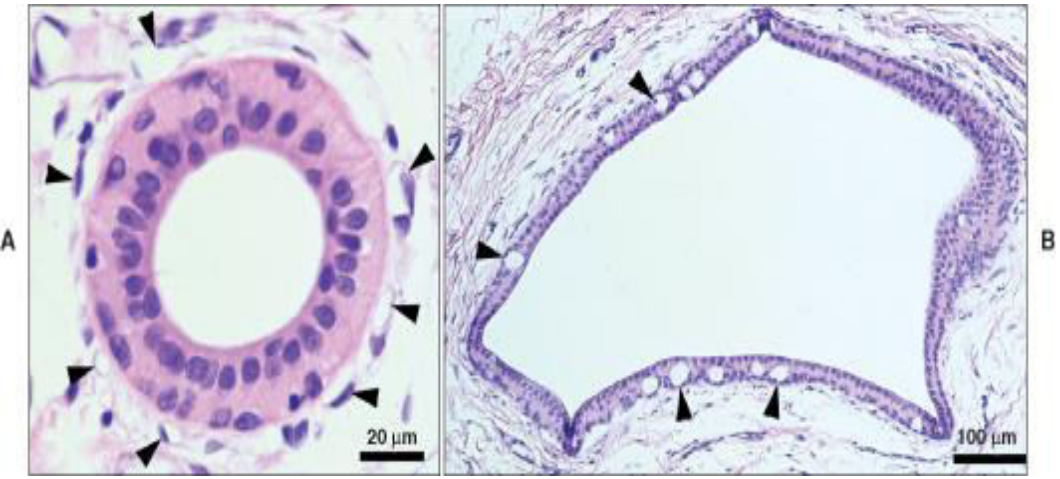
STRIATED DUCTS





- Intralobular in position.
- Single layer of columnar cells with centrally placed nucleus & pale acidophilic cytoplasm.
- E.M.-Basal striations due to presence of deep infoldings of plasma membrane & numerous elongated mitochondria

EXCRETORY DUCTS



- Interlobular in position.
- Transiton to stratified squamous epithelium.
- Other cell types also present – tuft or brush cells ,Lymphocytes, Macrophages, Dendritic cells .

FUNCTIONS OF DUCTS

1. To convey the primary saliva secreted by the terminal secretory units to the oral cavity.
2. To modify the primary saliva by secretion & reabsorption of electrolytes & secretion of proteins.

3.Presence of Undifferentiated cells (Salivary gland stem cell) & antibacterial proteins(lactoferrin & lysozyme) in the intercalated ducts.

4.Apical cytoplasm of striated ducts contains secretory granules consisting of kallikrein (salivary glycoprotein)

- In the intercalated ducts saliva is isotonic or slightly hypertonic to plasma, with Na+ & Cl- equal ,K+ low compared to Na+ .HCO_3 variable .
- The striated ducts actively reabsorb Na+ from primary secretion & secrete K+ & HCO_3 ,leaving the saliva hypotonic.

- In the excretory ducts saliva is hypotonic with Na+ & Cl- low ,K+ high .
- Conc. Of electrolytes varies with flow rate.
- At flow Na+ & Cl- & HCO_3 too & K+ leaving the saliva isotonic ,due to inefficient reabsorption of Na+ & Cl- by striated ducts.

- All of the water in the saliva enter at the level of secretory units .
- Striated & excretory ducts- relatively impermeable to water.

COMPOSITION OF SALIVA

- Electrolytes (Na+,K+,Cl+,HCO_3-,Ca, Mg, etc.)
- Secretory proteins (Amylase, Mucins, Lysozyme,Peroxidase,Lactoferrin,Defensins,etc.
- Immunoglobulins (sIgG)
- Organic (glucose, urea, amino acids etc.)
- Others (EGF,insulin etc.)

FUNCTIONS OF SALIVA

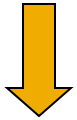
- Digestion
- Taste
- Lubrication
- Water balance
- Soft tissue repair
- Maintenance of ecological balance
- Direct antimicrobial
- Maintenance of ph
- Maintenance of tooth integrity
- Excretory function
- Maintenance of mucous membrane integrity

1)DIGESTION

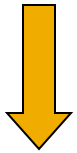
- Saliva contributes to the digestion of food.
- The solubilization of food substances and the actions of enzymes such as amylase and lipase, begin the digestive process.
- The moistening and lubricative properties of saliva also allow the formation and swallowing of a food bolus.

2)TASTE

- Solubilization of food



- Protein +nt in saliva bind to taste substance



- Present them to taste receptors

3)LUBRICATION

- The lubricating properties of saliva are mainly due to mucin glycoproteins and proline rich glycoproteins.
- The lubricating film reduces the friction ,allow ready phonation as well as food passage.

4) WATER BALANCE-

- Salivary glands are part of control system for maintaining a appropriate level of hydration. The need for fluid intake are usually originated by a dry mouth which activates receptors in oral cavity.
- The signals to salivary glands results from osmotic changes detected in the hypothalamus

5)SOFT TISSUE REPAIR-

- The presence of nerve growth factor and epidermal growth factors in saliva accelerate wound healing.

6)MAINTENANCE OF ECOLOGICAL BALANCE

- Colonization of tissue surface ,adherence to oral tissue is critical for many bacteria.
- Bacterial clearance by mechanical, immunological, non-immunological means is one of the main function of salivary defense mechanism.

- Saliva contain a spectrum of proteins with antimicrobial activity such as histatins, lysozyme, lactoferrin and peroxidase

7)DIRECT ANTIMICROBIAL-

- Lysozyme can cause lysis of bacterial cell, specially s.mutans.
- The histidine rich peptide of parotid saliva has growth inhibiting and bactericidal effect on oral bacteria and are effective antifungal agent at very low concentration.
- Lactoferrin is bactericidal to bacteria that require iron for their metabolic process.

8)MAINTENANCE OF pH-

- Saliva is effective in helping to maintain relatively neutral pH in the oral cavity as well as Oesophagus.
- Salivary bicarbonate is responsible for maintenance of pH.
- At rest histidine rich peptidine and to a lesser extent, phosphates contribute to buffering action.

9) MAINTENANCE OF TOOTH INTEGRITY-

- After the eruption, the crown of the tooth is fully formed morphologically but it is crystallographically incomplete.
- Interaction via diffusion of ions such as calcium, phosphorous, magnesium and fluoride into surface enamel increases surface hardness, decreases permeability and increases resistance to caries.

10)EXCRETORY FUNCTION-

- Many drugs as well as alcohol are excreted into saliva ,which could theoretically serve as a route of elimination.

11)MAINTENANCE OF MUCOUS MEMBRANE INTEGRITY-

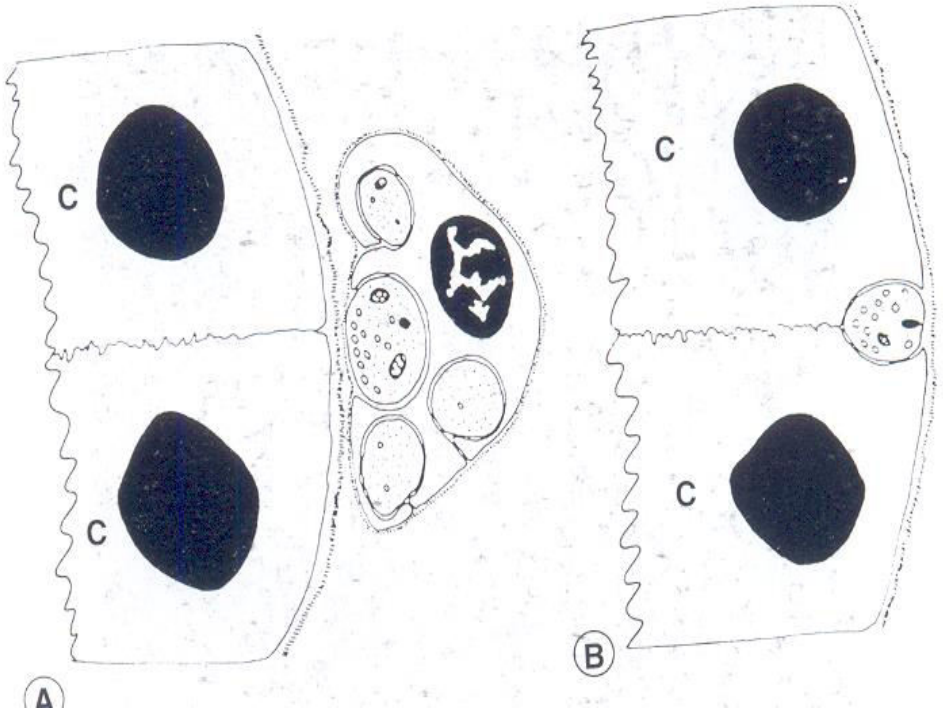
- The salivary mucin posses properties such as low solubility, high viscosity, elasticity and adhesiveness which enable them to concentrate on oral mucosal surface ,where they provide an effective barrier against dessication and environmental insults.

- The glycosylated mucin of saliva are resistant to proteolysis.

CONNECTIVE TISSUE

- Cells –fibroblasts, macrophages, mast cells,leukocytes,plasma cells,& fat cells.
- Collagen & reticular fibers.
- Ground substance.
- Vascular supply
- Nerve supply

Nerve supply



- The secretory cells receive their innervation by two patterns

1. Subepithelial
2. Intraepithelial

- Autonomic nervous system

1. Sympathetic (Adrenergic)
2. Parasympathetic (Cholinergic)

- Various neurotransmitters like substance –P, vasoactive intestinal polypeptide (VIP), release from the vesicles in the nerve terminals adjacent to the parenchymal cells stimulates them to discharge their secretory granules & secrete water & electrolytes.

- Norepinephrine ,the sympathetic transmitter ,interacts with both α- & β-adrenergic receptors , & acetylcholine interacts with the cholinergic receptors
- β-adrenergic receptors--Protein secretion .
- α-adrenergic & cholinergic receptors –mainly water & electrolyte secretion ,but also low levels of Protein secretion

CLINICAL CONSIDERATIONS

- Age changes
- Diseases
- Xerostomia (dry mouth)

Age changes

- Generalised loss of parenchymal tissues.
- Replacement with adipose tissue.
- Increase in fibrous connective tissue .
- Decrease production of saliva.

Diseases

- Inflammatory diseases ,Viral(mumps) , Bacterial infections .
- Autoimmune diseases such as Sjogren's syndrome.
- Genetic diseases such as cystic fibrosis.
- Sialoliths (salivary stone).
- Mucocele .
- Benign & malignant tumors.
- Various systemic & metabolic diseases

Xerostomia (dry mouth)

- Loss of salivary function /reduction in salivary volume .
- Causes -Sjogren's syndrome,effect of chemotherapy /radiation, medications (anticholinergic,antidepressants,antihypertensives, drugs used in parkinsonism etc.)