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Second stage - Al Ameed University

College of Dentistry 2024-2025

SALIVARY GLANDS

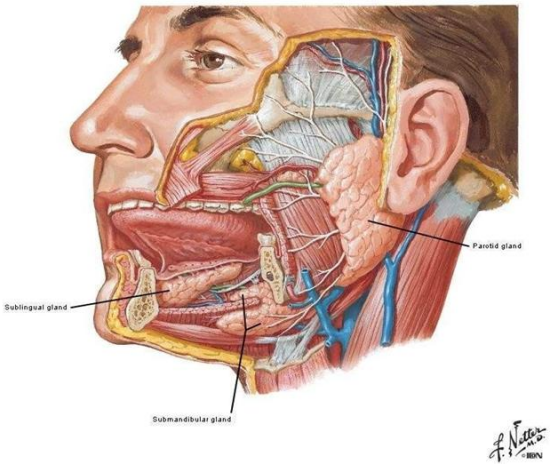
Salivary glands are exocrine glands, whose ducts open into the oral cavity.

Secretion of saliva is a reflex function starts from salivary centers brain. It is dependent on afferent stimulation (e.g. taste and mastication).
Saliva is drained to the oral cavity, to maintain lining well beings of the mouth. Patient with deficiency in salivary secretion experience difficulty in swallowing, eating and speaking and mouth become more prone to infection of mucosa and teeth.

The saliva in the mouth is derived from:

1. Three paired **major** salivary glands, i.e. the parotid, submandibular and sublingual glands (together accounting for about 90% of the fluid production).

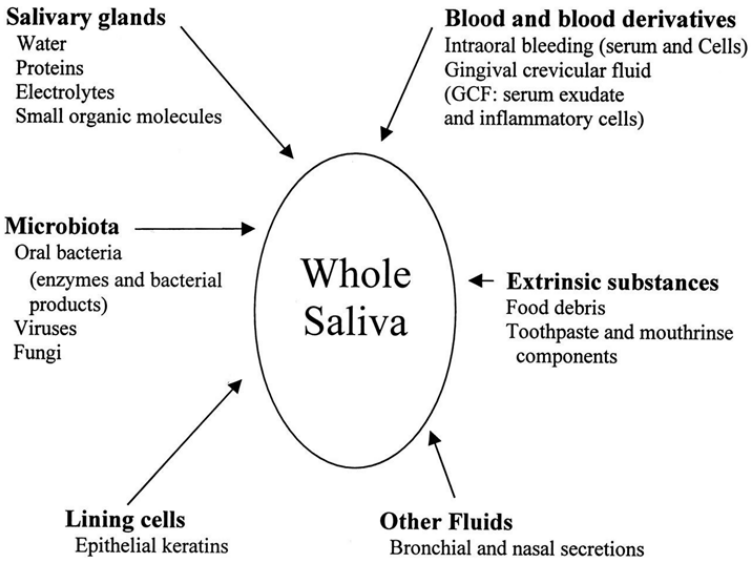
2. From the **minor** salivary glands in the oral mucosa. The minor salivary glands produce less than 10% of the total volume of the saliva. They play an important role in lubricating the mucosa, as even in the absence of local stimuli they produce saliva.



Whole saliva contains:

1. Glandular secretion from the salivary glands.
2. Gingival crevicular fluid.
3. Microorganisms from dental plaque.
4. and food debris.

In healthy individuals the daily production and swallowing of saliva normally ranges from 0.5 to 1.5L and it is composed of 99% water and 1% solids, mostly proteins and salts.



Structure of salivary glands:

Both groups of glands (major and minor) are composed of secretory units supported by connective tissue.

The secretory units are derived from oral epithelium and consists of secretory units that eventually open into duct. The connective tissue from capsule around the gland and extend into secretory units to separate it into lobes and lobules.

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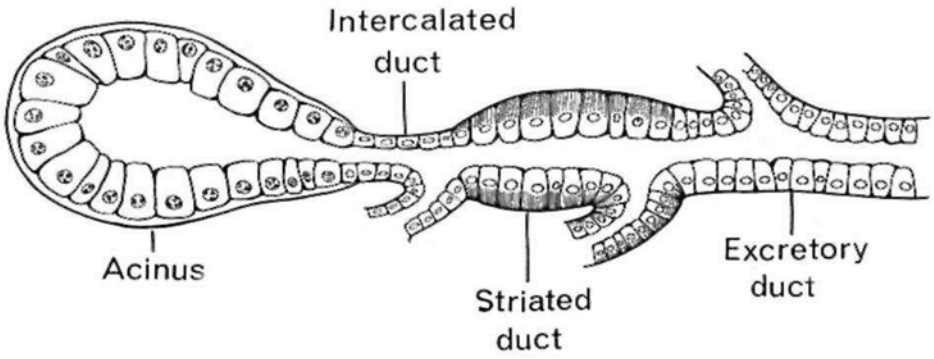
Secretory and duct system of salivary gland

Intercalated ducts and striated ducts are types of intralobular ducts (within lobule) while Excretory ducts are interlobular ducts (drain lobules and found between lobules)



Secretion of salivary glands:

The serous parotid glands produce a **thin watery**, and **amylase rich** fluid on stimulation which accounts for up to half of the mouth volume of saliva **under stimulated** conditions, whereas it contributes **much less** to the **unstimulated** saliva secretion, which is produced **predominantly by the submandibular glands** comprising both serous and mucous acinar cell types. The sublingual glands which contribute with 1-2% of the unstimulated volume of whole saliva mainly consist of mucous acinar cells and also produce viscous mucin-rich saliva.

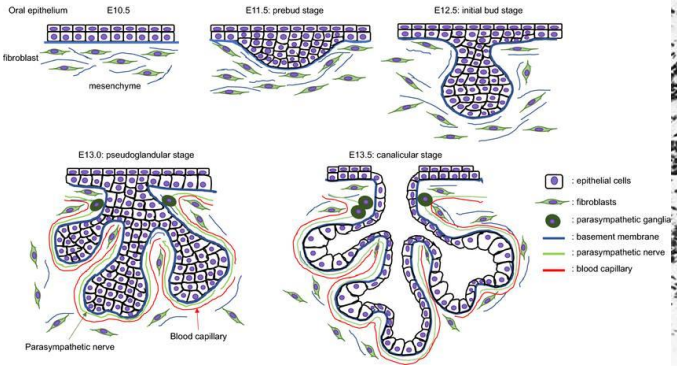
The minor glands produce less than 10% of the total volume of saliva. Nevertheless, they play an important role in the lubricating the mucosa, as even in the absence of local stimuli they produce saliva.

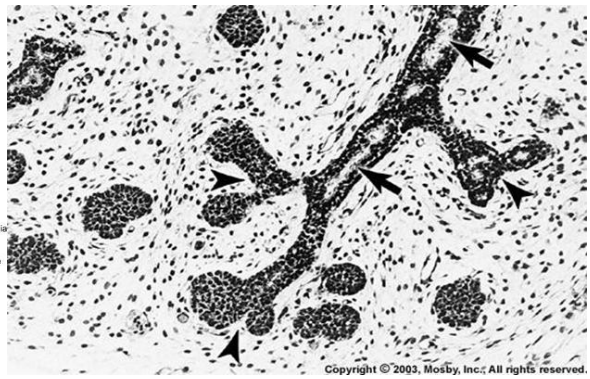
DEVELOPMENT:

1. Salivary gland arises embryologically as a focal thickening of oral epithelium that grows into underlying ectomesenchymal tissue and form a bud,
2. Parotid glands begin to develop at 4-6 weeks of embryonic life.

3.The submandibular gland at 6 weeks of embryonic life. The sublingual and minor salivary gland appears at 8-12 weeks.

4. The salivary glands continue to grow postnatally up to 2 years after birth.





CLASSIFICATION: -

1. According to site and location

a. Extra oral

1. parotid gland in parotid space.
2. Submandibular gland in submandibular space adjacent to the medial aspect of mandible.

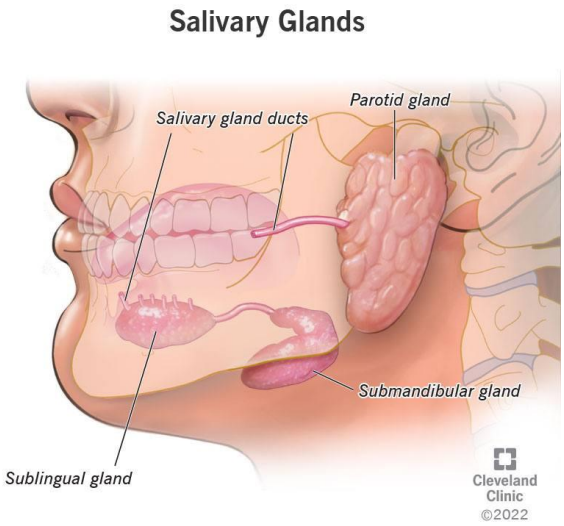
b. Oral: in mucosa and sub mucosa of oral cavity.

1. Sublingual gland lies between the mucosa of the floor of the mouth and the mylohyoid muscle.
2. Labial minor salivary glands (in the lip).
3. Lingual minor salivary glands (in the tongue).
4. Palatal minor salivary gland (in the submucosa of posteriolateral part of hard palate and submucosa of soft palate).
5. Buccal in the submucosa of cheek.
6. Alveolar mucosal gland
7. Glossopalatine glands in the glossopalatine folds

2- according to size: -

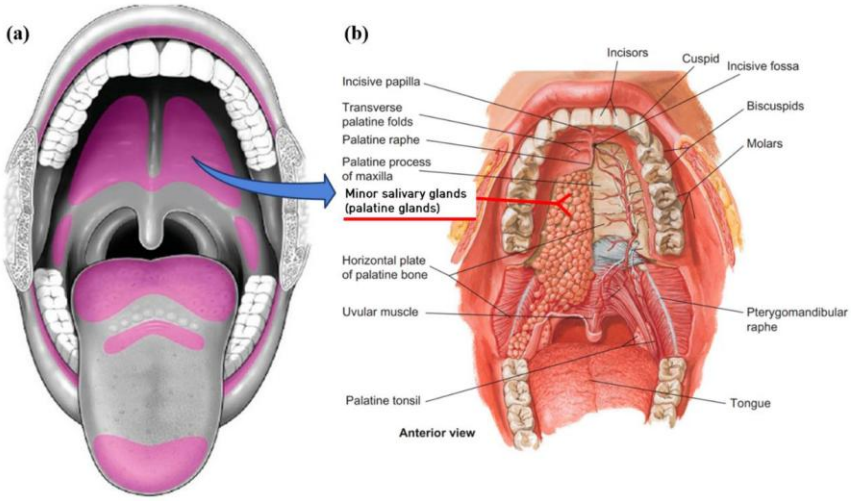
a: Major salivary gland

i. Parotid gland.
ii. Submandibular gland
iii. Sublingual gland



b. Minor salivary glands:

Estimated to number between 600 and 1000, exist as small, discrete aggregates of secretory tissue present in the submucosa through most of oral cavity. The only places they are not found are the gingiva and the anteriolateral part of hard palate.



3- According to the nature of secretory product:

i. **purely serous:** -parotid gland, and von Ebner gland.
ii. **Purely Mucous:** - glossopalatine, palatine, anterior group of lingual minor salivary gland and posterior lingual (Weber's glands of posterior one third of the tongue)
iii. **Mixed in secretion: -**
   a) Submandibular salivary gland mucous and serous but predominantly serous.
   b) Sublingual: it is predominantly mucous.
   c) Labial and buccal minor salivary gland mixed but predominantly mucous.

STRUCTURE OF SALIVARY GLAND: -

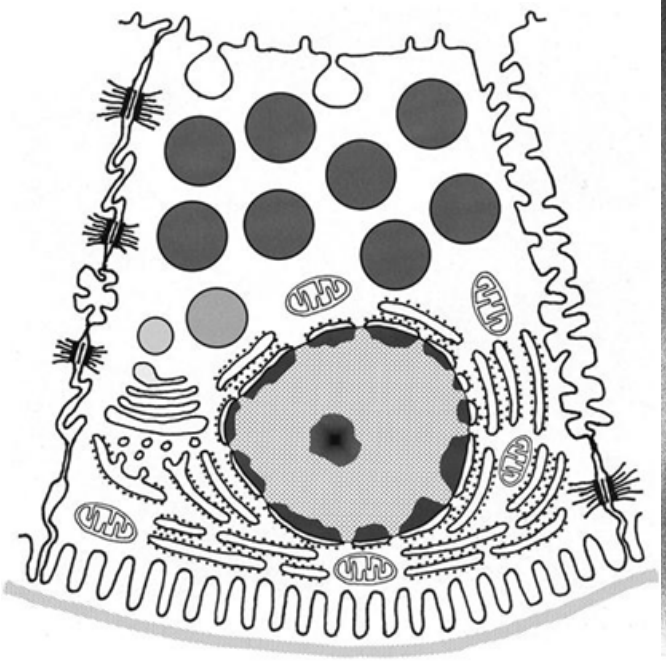
Salivary gland consists of a series of branched ducts, terminating in spherical or tubular secretory units or acini.
The terminal secretory units are **composed of**:

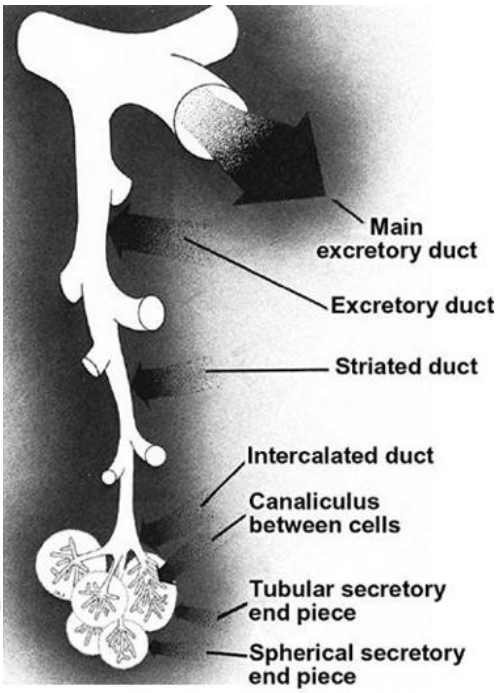
a. Serous
b. Mucous as a secretory cell
c. Myoepithelial cells as contractile cells.

a. Serous

These cells are arranged into secretory acini (in serous secreting gland) or secretory tubules (in mucous secreting glands).
The secretion of these units is collected by intercalated ducts which empty into striated ducts. Several striated ducts drain into interlobular excretory ducts.

99% of saliva is water coming mostly from the serous cells. Secretion of water is regulated by the parasympathetic stimulation.





b- Mucous cells: -

These cells are specialized for synthesis, storage and secretion of pertinacious material.

The secretory product of mucous cells **differs** from that of serous cells in: -

1- They have little or no enzymatic activity and serve probably for lubrication and protection of oral tissue.

2- The carbohydrate molecules are linked to protein to form mucin.

Mixed gland: -

Mucous secretory units in the major salivary glands and minor salivary glands have serous cells associated with them in the form of a demilune (serous demilune) at the end of the tubules. The secretions from these serous demilune reach the lumen of the secretory units through intercellular canaliculi extending between the mucous cells at the end of the tubules.

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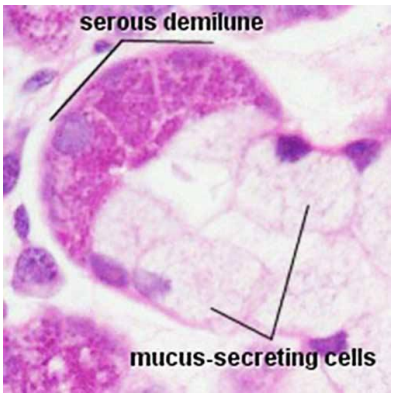
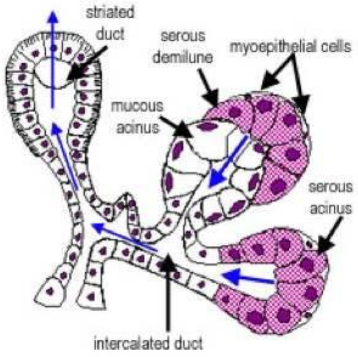




MYOEPITHELIAL CELLS: - (BASKET CELL):

These cells are closely related cells to the secretory units (cells) and the intercalated ducts.

They are lying between the basal lamina and the plasma membrane of the parenchymal cells.

The structure of myoepithelial cell is similar to that of smooth muscle cells.

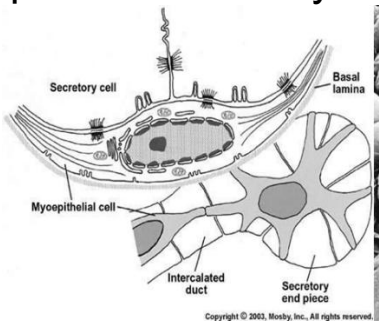
Myoepithelial cells around acini are dendritic cells. The body of the cell is small and filled mostly by flattened nucleus and numerous branching cytoplasmic processes radiated to embrace the secretory unit's cells (similar to the spider catching a prey). They have contractile protein like the smooth muscle.

The myoepithelial cells are considered to have a contractile function, helping the cells of secretory units to expel the secretion into the lumen.

The function of myoepithelial cells:

a. Accelerate the flow of saliva.

b. Provide support for secretory units.



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Major salivary gland: -

1- parotid gland: -

It opens into oral cavity via **Stinson's duct** which opens in buccal mucosa at the level of maxillary second molar. This gland is pure serous. All acini are similar, however, in infant and very aged person few mucous secretory units may be found. The intercalated ducts are large and branching. The pale-stained striated ducts are numerous. The connective tissue septa contain numerous fat cells, which increase in number with age.

2- submandibular gland: -

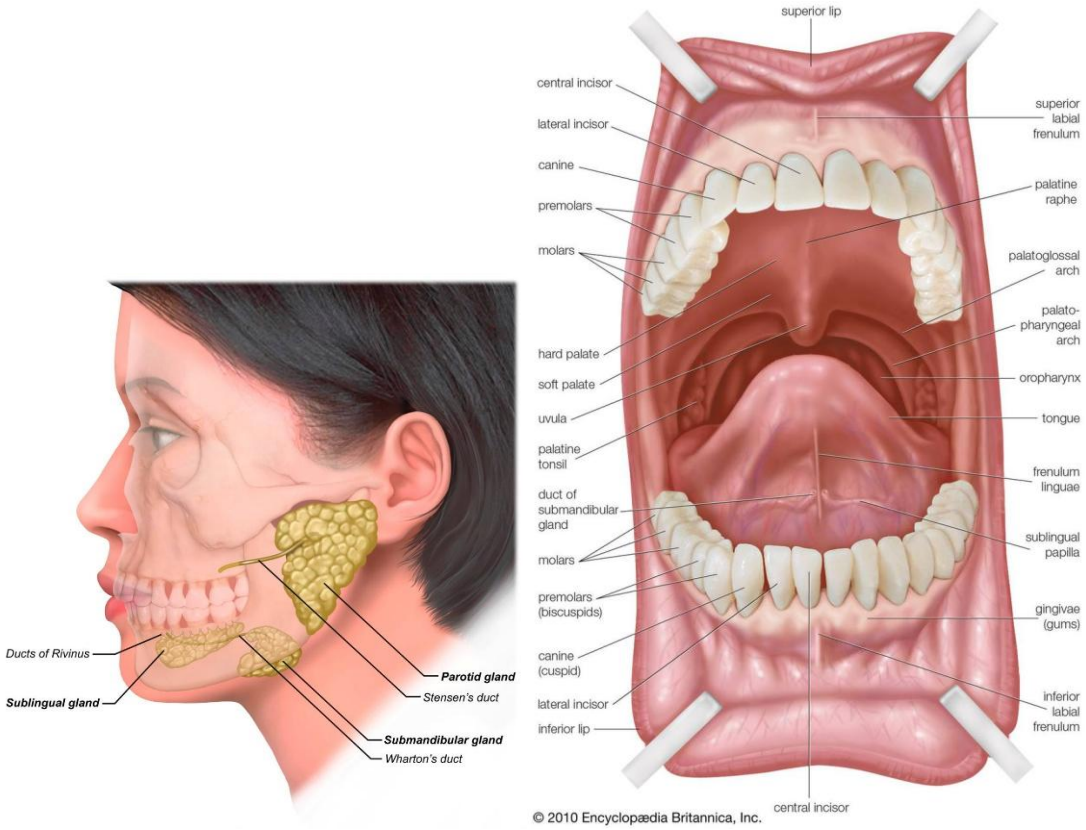
This gland is located in submandibular triangle behind and below the free border of mylohyoid muscle lying above mylohyoid muscle and its well capsulated open into oral cavity via **Wharton's ducts** that open at carnicula sublngualis (small papillae. it is mixed gland, with both serous and mucous secretory unit, the serous are predominate in about 70%. It either appear as a separated acini or the serous cell capped the mucous acini as a tubular fashion known as demilunes.

3- sub lingual gland: -

The gland is lying between the floor of the mouth and mylohyoid muscle. It is consisting of two groups. The major one is small almond shape gland drains into oral cavity via small duct called **Bartholin's duct** opens near submandibular duct. The other group is the small or **minor sublingual glands** open via smaller ducts independently along sublingual fold.

The gland is encapsulated by poorly developed capsule, but C.T septa are prominent within gland.

It is mixed gland predominately mucous the serous part seen as a demilune capping the mucous acini. The intercalated and striated ducts are poorly developed.



MINOR SALIVARY GLAND: -

These glands located in mucosa and submucosa of oral cavity. These glands have no capsule.

The minor salivary glands are small groups of secreting units that are distributed throughout the submucosa of the oral cavity. Their acinar cells are serous, mucous, or both, and their collecting ducts are short and convoluted. They are consisting of several short ducts that open directly into oral cavity.

The minor salivary glands were named according to their location:

1- labial and buccal group: -

In lip and cheek mixed gland, the mucous acini are capped with serous demilune. The intercellular canaliculi can observe between the cells.

2- Glossopalatine group: -

Are mucous glands located in the region of isthmus of glossopalatine fold.

3- palatine group: -

Pure mucous glands located in lamina propria and submucosa of posterior part of hard palate and extend into soft palate. The openings of ducts (about 200 openings) are large can easily identified.

4- Lingual glands: They are divided into the following groups:

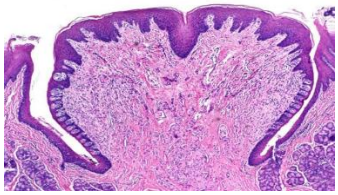
i. Anterior group (Blandin and Nuhn group): Located near the apex of tongue. The anterior regions of the glands are chiefly mucous, but its posterior portions are mixed.

ii. Posterior lingual group (Weber's glands): located lateral and posterior to circumvallate papillae. It is associated with lingual tonsils. They are purely mucous. Their ducts open at dorsum of tongue.

The Weber's glands together with the palatine glands and the glossopalatine glands, altogether, form the **mucous salivary ring**, at the entrance of oropharynx, which helps in swallowing of the bolus.

iii. von Ebner's glands: purely serous glands, located between muscle fibers of tongue below circumvallates papillae. Their ducts open by a series of small ducts into the base of the moat that surrounds each cicumvallate papillae, and into the clefts that constitute the foliate papillae.

Its function is serving to wash the surface of taste bud present on the circumvallate papillae and have protective and digestive function. During the infant period the glands secrete lipase enzyme which helps in digestion of lipid in infant.



DUCTS SYSTEM: -

The duct system if formed by confluence of small ducts into a larger caliber in the lobule.

1. Intralobular ducts:

a. Intercalated ducts
b. Striated ducts

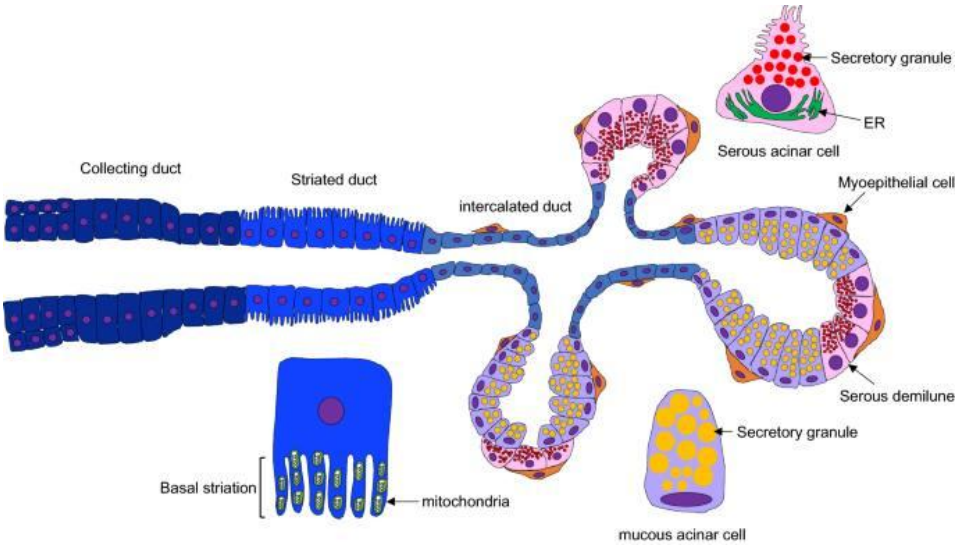
The smallest ducts are the intercalated ducts, this connects the terminal secretory unit to the next larger duct (striated ducts). Both of them are located inside the lobules. In the interlobular connective tissue, the duct continues to join each other, increasing in size to form main excretory duct.

a) Intercalated duct: -

The duct is lined by single layer of low cuboidal cells. The process of myoepithelial cell can by identified attached to with ductal cells.

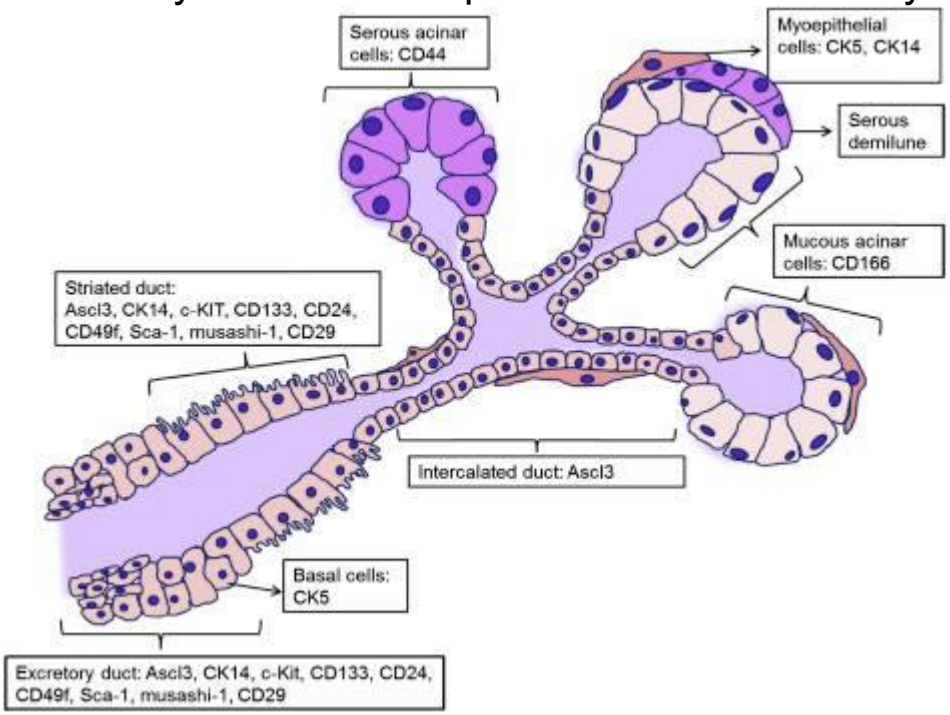
b) Striated ducts: -

Lined by a single layer of tall columnar cells with large centrally located nuclei, cytoplasm is abundant and eosinophilic. The ductal cells are characterized by basal enfolding with large number of mitochondria giving the cells an appearance of ion transporting cells.



2) Interlobular (excretory ducts): -

The epithelium here becomes pseudostratified with increasing number of smaller basal cells between tall columnar cells on longest duct. An occasional mucous goblet cell and ciliated cells can be found. The cells gradually become stratified squamous epithelium in the main excretory ducts which opens in the mouth cavity.



The connective tissue elements seen in the salivary glands include the fibers which constitute the capsule and the connective tissue septum which the glandular tissues into lobes and lobules.

The cells present in the connective tissue include fibroblast, macrophage, mast cells, lymphocytes and plasma cells. The plasma cells are the source of the antibodies, which are crossing the acini and becoming part of the composition of the saliva.

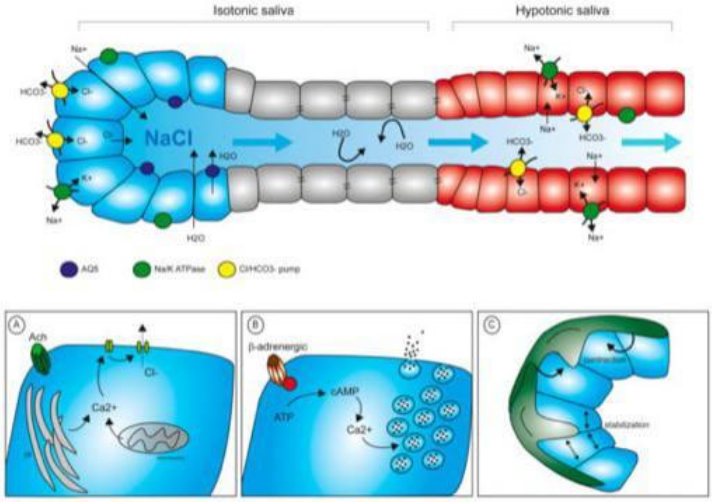
The vascular supply is embedded within the connective tissue. The ducts system is supplied with a close capillary network. Arterioles anastomoses around a larger interlobular duct.

FUNCTION OF SALIVARY DUCTS: -

1. To convey the primary saliva secreted by terminal secretory unit to the oral cavity.
2. Modify the primary saliva by secretion and reabsorption of electrolyte and secretion of protein.

The initial fluid is isotonic in nature and is derived from the local vasculature. While acinar cells are water-permeable, ductal cells are not. However, ductal cells actively absorb most of the Na^+ and Cl^- ions from the primary salivary secretion and secrete small amounts of K^+ and HCO_3^- and some proteins. The primary salivary secretion is thus modified while passing through the striated ducts, and the **final salivary secretion** as it enters the oral cavity is **hypotonic**. **That explains the importance of striated ducts in changing the nature of saliva from isotonic to hypotonic solution. The active transport nature of the cells of the striated ducts is the key role in modulating the nature of saliva.**

3. The cells of intercalated duct secret protein that contain two of antimicrobial agents, lysosomes and lactoferrin.



NERVE SUPPLY: -

The main branches of the nerves follow the vessels, breaking into a plexus adjacent to terminal portion of parenchyma.

Both division of autonomic nervous system may participate in innervations of secretory cell

- Sympathetic (adrenergic).
- Parasympathetic (cholinergic).

Sympathetic: -

a) Tend to modulate the composition of saliva by increasing exocytosis from certain cells.

b) Often do not cause much mobilization of fluid.

Parasympathetic: - (tend to be more prevalent)

a- Evoke most fluid secretion.

b- Cause variable degree of exocytosis.

c- Induce contraction of Myoepithelial cells.

d- Taste impulses are carried to the brain by parasympathetic nerves

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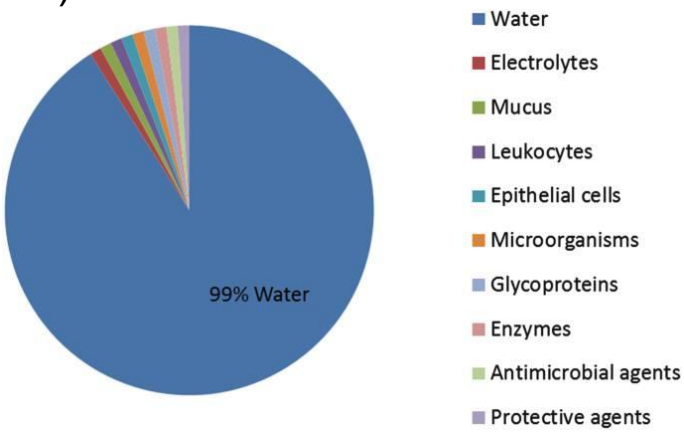
COMPOSITION OF SALIVA: -

The total salivary volume secreted daily by humans approximately 750 ml, 60% produced by submandibular gland, 30% by parotid, and 5% or less from sub lingual, and remainder 7% from the minor salivary gland.

The 99% of saliva is water, 1% of saliva include, inorganic ions, protein (including various enzymes like amylase), glycoprotein and certain serum content (albumin, blood clotting factors).



FUNCTIONS OF SALIVA: -

1. Saliva exerts several important actions in the maintenance of tooth integrity. Saliva dilutes and removes substances from the oral cavity (oral clearance). Elimination of sugars from the oral cavity is important because of the cariogenic potential of this substance.

Apart from clearing sugars, saliva also clears dietary acids and thereby protects the teeth against erosion

2. Buffer system: - Another important function of saliva is its ability to buffer acid, in order to prevent caries possibly

by reducing the tooth demineralization by the action of the acid on the tooth.

The buffering capacity is originating from:

a. content of bicarbonate
b. Phosphate ions.
c. Protein in saliva.

The concentration of bicarbonate is dependent on the salivary flow rate. The concentration of bicarbonate is very low in cases of reduced salivary flow. In stimulated salivary flow bicarbonate ions are responsible for approximately 90% of the buffer capacity. At a low flow rates and low salivary pH below 5, proteins constitute the major buffering capacity.

The buffering system is coming from secretion of the major salivary glands. Minor salivary glands do not have buffering capacity due little HCO3 ions secreted from these glands.

PH of whole saliva: 6.4 - 7.4

PH of saliva from parotid: 6.0 – 7.8

3. Saliva participates in digestion by providing fluid environment for solubilization of food substance and through active of digestive enzyme (amylase).

4. Protective function: By moistening of oral mucosa and facilitate swallowing and speaking.

5. Mucin in the saliva provides lubrication for movement of oral tissue on each other. Mucins also is hydrophilic, thereby resist mucosal hydration.

6. Salivary epidermal growth factor plays a role in the maintenance of oro-esophageal and gastric tissue integrity, include healing of ulcers.

7. The water in saliva moistens the food particles, whereas the salivary mucin binds masticated food into a coherent and slippery bolus.

8. Protection teeth from dental caries by cleansing action and buffering action of saliva.

9. Protein of saliva bind to tooth surface, forming acquired pellicle.

10. Antibacterial activity: -

a. Agglutination, promotion or inhibitions of bacterial adhesion are mediated by several salivary proteins.

b. Secretion of peroxides by acinar cells and thiocyanate by the duct cells has a bactericidal activity in saliva inhibit growth of microorganisms on oral tissue.

c. The lysosomes in saliva are hydrolyzing the polysaccharide of bacteria cell wall.

d. Lactoferrin: iron binding protein enhances inhibitory effect of antibody on microorganism.

e. Salivary amylase is considered to play a role in dental health, as it binds to streptococci, and is involved in modulating the adhesion of bacteria on oral surfaces

f. Defensive activity: -

The defensive substance in saliva is the immunoglobulin, the predominant one is IgA and a small amount of IgM and IgG and they act primary through inhibiting the adherence of microorganism on oral tissue.

11. Lingual lipase secreted from the vonEbner's glands is considered to be of limited significance in lipolysis of healthy individuals, whereas it may be of importance in patients with cystic fibrosis and pancreatic insufficiency who exhibited varying degree of steatorrhea because of lack of pancreatic lipase activity. Lingual lipase is compensating for developmental deficiency in pancreatic lipase in neonates.

12. Diagnostic application of saliva for systemic diseases. As a diagnostic fluid, saliva offers distinctive advantages over serum because it can be collected non-invasively by individuals with modest training.

13. Saliva also provides monitoring of levels of hormones and drugs like psychiatric medications anti-cancer drugs.

14. Saliva is essential for taste perception.

Factors that influence the salivary flow:

i. Factors decrease flow of the saliva:

- Dehydration, loss of body fluid
- Position of body, lying, sleep, saliva flow decreases during the sleeping time.
- Exposure to light, saliva decreases in darkness
- Side effects of drugs, certain drugs decrease the flow of saliva
- Fight /flight response
- Disease like the Sjogren’s syndrome
- Radiotherapy to the head and neck.

ii. Factors increase the flow of saliva:

- Smoking
- Sight and smell of food
- Vomiting
- Mastication
- Taste

AGE CHANGE: -

1. Fatty degeneration.
2. Fibrosis.
3. Progressive accumulates of lymphocyte in salivary gland.
4. Oncocyte epithelial cells can be identified by marked granularly and acidophilic cytoplasm. They can be found in acini and striated duct. They could give rise to neoplasm.

CLINICAL CONSIDERATION: -

1. There are several ways by which serum constituents that are not part of the normal salivary constituents (i.e., drugs and hormones) can reach saliva ultra filtration, which occurs through the tight junctions between the secretory cells, is the most common extracellular route.
2. Salivary gland may be subjected to a number of pathological conditions include inflammatory disease, viral, bacterial or allergic, benign and malignant tumors, autoimmune diseases e.g. Sjogren's syndrome and genetic disease as cystic fibrosis.

Mucocele to labial salivary glands causes vesicle elevation in mucosa.

3. Blockage of salivary duct by calcified mass (sialoliths); require surgical removed of stone.
4. Parotid gland might enlarge during starvation, protein deficiency, pregnancy, diabetic Mellitus and liver disease.
5. Xerostomia: deficiency in saliva caused by Sjogren's syndrome, radiation at neck region, therapeutic agents or due to age change where the glandular tissue is replaced by fatty tissue.