



GI HISTOLOGY

01



WRITER:
Doctor 020

Zoher alswaeer

CORRECTOR:
Zoher alswaeer

DOCTOR:
Name

WHY WE ARE EVEN STUDYING THIS?!

-To describe the cells of the GI tract then to know their function

(for instance, we have four types of cells in the mucosa of the stomach: Mucous cells which obviously secrete mucus, Parietal cells that secrete HCl, Chief cells that secrete pepsinogen, and the G cells that secrete Gastrin hormone).

-To describe the histological features of each part of the GI tract.(The lining epi.)from the oral cavity until the esophagus with the anal canal (alimentary tract): Stratified squamous NON keratinized. The stomach: Simple columnar epi. without goblet cells. The small intestine: Simple columnar ciliated epi. with goblet cells. The large intestine: Simple columnar ciliated epi. with numerous goblet cells.

-To differentiate between different parts of the GI tract.

-To be able to diagnose the pathology, if you don't know how the normal cells look like how would you know the abnormal ones!

The cell of liver is hepatocytes it changes to fat cell during the liver fat disease.

-GENERAL CONCEPTS:

- The digestive system consists of the digestive tract—oral cavity, esophagus, stomach, small and large intestines, rectum, and anus—and its associated glands—salivary glands, liver, and pancreas.
- Its function is to obtain the molecules necessary for the maintenance, growth, and energy needs of the body from ingested food.
- Large molecules such as proteins, fats, complex carbohydrates, and nucleic acids are broken down into small molecules that are easily absorbed through the lining of the digestive tract, mostly in the small intestine.
- Water, vitamins, and minerals are also absorbed from ingested food. In addition, the inner layer of the digestive tract is a protective barrier between the content of the tract's lumen and the internal milieu of the body.

-Then through portal vein, these molecules will leave the blood and go to the liver, for storage, formation of enzymes and hormones, detoxification, vitamins formation, metabolic pathway, so if the liver is damaged, that will be not functioning properly.

-Upper GI such as the stomach has a function to make the chyme (semi fluid material).

-Small intestines do secretion and absorption for the digested material. Large intestines (colon) do absorption of material and formation of stool or feces.

-GENERAL STRUCTURE OF THE DIGESTIVE TRACT:

- The entire gastrointestinal tract presents certain common structural characteristics

- is a hollow tube composed of a lumen whose diameter varies, surrounded by a wall made up of four principal layers: the mucosa, submucosa, muscularis(externus), and serosa or adventitia.

1-Mucosa (mucous membrane):it's divided into 3 sublayers:

A. epithelial lining: each part has its own type (ex: stomach has simple columnar epithelium without goblet cell, but from mouth to esophagus with the anal canal it's lined by stratified squamous nonkeratinized...).

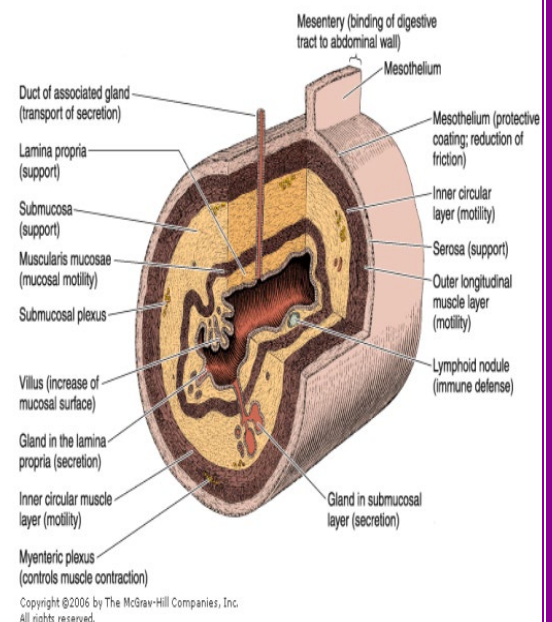
B. lamina propria: loose areolar connective tissue rich in blood and lymph vessels and smooth muscle cells, sometimes also it contains glands (important for secretion) and lymphoid tissue.

#intestinal glands are called Lieberkühn Crypts.

#chief cells secrete pepsinogen.

#parietal cells secrete HCl.

C. muscularis mucosa: usually made of a thin inner circular layer and an outer longitudinal layer of smooth muscle separating the mucosa from



the submucosa. It changes the shape of lumen (helps in peristaltic movement).

-In the stomach the most inner layer is OBLIQUE.

2-Submucosa: it's composed of dense connective tissue with many blood and lymph vessels and a submucosal (Meissner's) nerve plexus (which is located between the submucosa and the external muscle). It may also contain glands and lymphoid tissue.

There are glands in the submucosa of esophagus and duodenum (unlike the mucosa as it contains glands in all the organs), Meaning that both the esophagus and duodenum have glands in their submucosa as an EXCEPTION.

-The submucosal gland of duodenum is known as Brunner's gland, it secretes alkaline secretions to neutralize the acidic chyme of stomach when reaches duodenum (in addition to mucosal glands).

-Esophageal cardiac gland in submucosa (there are mucosal esophageal glands, too).

3-Muscularis (Muscularis externa): it is composed of smooth muscle cells that are spirally oriented and divided into two sublayers:

A. The internal sublayer (close to the lumen), the fiber orientation is generally circular.

B. The external sublayer it is longitudinal.

-Also, it contains the myenteric or (Auerbach's) nervous plexus, which lies between the two muscle sublayers. It's way bigger than the submucosal (Meissner's) nerve plexus. The vagus nerve gives the biggest parasympathetic preganglionic here, it's responsible for the secretion and the peristaltic movement.

-Blood and lymph vessels in the connective tissue between the muscle sublayers.

4-Serosa and adventitia: It's a thin layer of loose connective tissue rich in blood and lymph vessels, adipose tissue. If simple squamous covering epithelium (serosa or mesothelium), if the coverage is connective tissue, then it is (adventitia).

-In the abdominal cavity, the serosa is continuous with the mesenteries (a double fold of peritoneum that attaches the intestine to the posterior abdominal wall) and with the peritoneum.

-However, in places where the digestive organ is bound to other organs or structures the serosa is replaced by a thick adventitia, consisting of connective tissue containing vessels and nerves, without the mesothelium. -For example: The oral cavity, thoracic esophagus, ascending colon, descending colon and rectum.

-BASIC MUCOSAL FORMS IN THE GI TRACT:

- **Protective** : stratified squamous epithelium that is found in the oral cavity, pharynx, the esophagus and the anal canal. Rapid and excessive mitosis for the fast healing of the damaged tissue.
- **Seceretary** : the mucosa consists of a long closely packed tubular glands, found in the stomach. In the lamina propria or the submucosa.
- **Absorptive** ; the mucosa is arranged in a fingerlike projections called vili with intervening short glands called crypts, that is typical for the small intestine.
- In the duodenum some crypts extend from the muscularis mucosa to the submucosa (**Brunners Gland**) (for the neutralizing effect of stomach acidity to prevent peptic ulcers).
- **Absorptive/protective** ; the mucosa is arranged into closely packed tubular glands specialized for water absorption and mucus secreting goblet cellss (to produce mucous that protects the intestines from feces which may be a hard object).It lines the whole large intestine.

-THE ORAL CAVITY:

- The oral cavity is lined with stratified squamous epithelium, keratinized or nonkeratinized, depending on the region.

-It has the same layers as the 4 lined layers of the GI tract. because it is part of it, after the 4 layers there is a voluntary muscle which is the buccinator (supplied by buccal branch from facial).

- The keratin (Para keratinized) layer protects the oral mucosa from damage during masticatory function and is present mostly in the gingiva (gum) and hard palate.
- The lamina propria in these regions has several papillae and rests directly on bony tissue.
- Nonkeratinized squamous epithelium covers the soft palate, lips, cheeks, and the floor of the mouth and the cleft (groove) of the papilla.

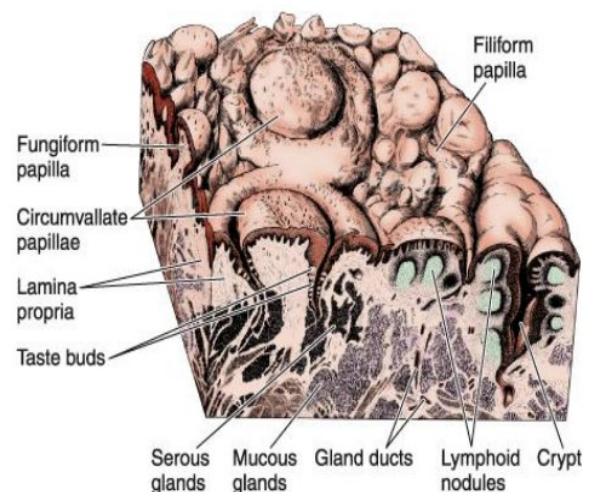
- The lamina propria has papillae, similar to those in the dermis of the skin, and is continuous with a submucosa containing diffuse small salivary glands.
- The soft palate has a core of skeletal muscle, numerous mucous glands, and lymphoid nodules in its submucosa.
- In the lips, a transition from the oral nonkeratinized epithelium to the keratinized epithelium of the skin can be observed.

-in the lips we can see

- Outer layer: skin (with sebaceous glands, hair follicles...).
- Internal mucous surface: has lining mucosa with a thick, nonkeratinized epithelium and many minor labial salivary gland.
- Voluntary Orbicularis oris muscle.
- Red region (vermillion/ transitional zone): modified skin with no hair follicles, no sebaceous glands, rich in blood vessels, and highly sensitive (nerve terminals), that is why it occupies large area in the brain, despite its small size.

-TONGUE:

- The tongue is a mass of striated muscle covered by a mucous membrane whose structure varies according to the region.
- The muscle fibers cross one another in three planes; they are grouped in bundles, usually separated by connective tissue.
- Because the connective tissue of the lamina propria penetrates the spaces between the muscular bundles, the mucous membrane is strongly adherent to the muscle.
- The mucous membrane is smooth on the lower (ventral) surface of the tongue.
- The tongue's dorsal surface is irregular, covered anteriorly by a great number of small eminences called papillae.



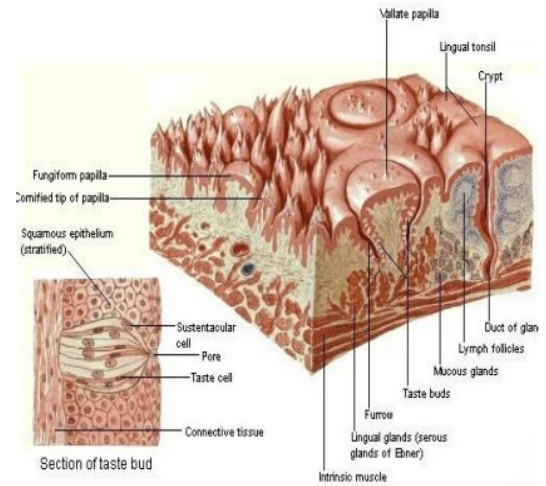
Copyright ©2006 by The McGraw-Hill Companies, Inc.
All rights reserved.

- The posterior one-third of the dorsal surface of the tongue is separated from the anterior two-thirds by a V shaped boundary (sulcus terminalis).

- Behind this boundary, the surface of the tongue shows small bulges composed mainly of two types of small lymphoid aggregations:

- small collections of lymphoid nodules
- and the lingual tonsils, where lymphoid nodules aggregate around invaginations (crypts) of the mucous membrane in the posterior 1/3.

Tongue - Schematic Stereogram



-PAPILLAE:

- Papillae are elevations of the oral epithelium and lamina propria that assume various forms and functions.

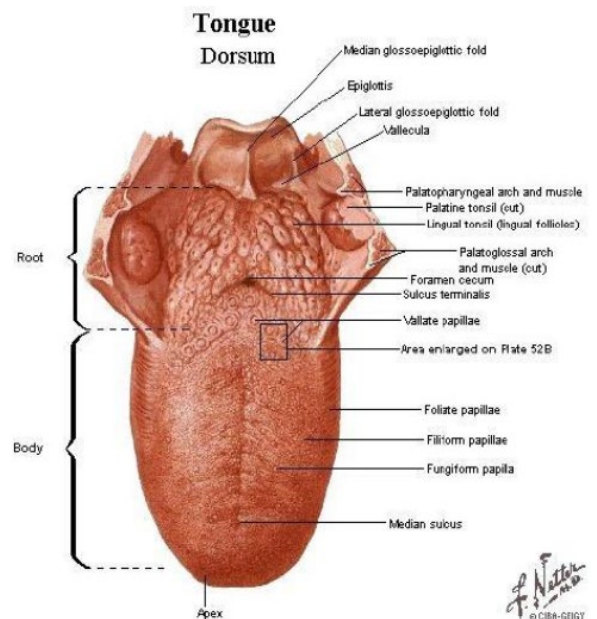
There are four types:

1- Filiform papillae have an elongated conical shape, they are quite numerous and are present over the entire surface of the tongue.

- Their epithelium is keratinized which DOESN'T contain taste buds.

2- Fungiform papillae resemble mushrooms; they have a narrow stalk and a smooth-surfaced, dilated upper part, these papillae, which contain scattered taste buds on their upper surfaces, are irregularly interspersed among the filiform papillae.

3- Foliate Papillae: poorly developed in humans, consist of two or more parallel ridges and furrows on the dorsolateral surface of the tongue and contain many taste buds.



4- Circumvallate papillae: (surrounded by circular groove, they are where we find taste buds at medial side of papilla) Circumvallate is circular, but you can see two clefts/ grooves/sulcuses in some sections, they have taste buds at both sides of papilla.

-the bitter taste.

-A common mistake that a lot of people do that when they take a medicine, they put the pill all the way in the back side of their tongues, which it makes them feel that EWW taste! (Instead you can advise them to put it in the apex of their tongues which will make them feel nth at all because it's for the sweet taste).

-All of them are innervated by chorda tympani except the circumvallate (by glossopharyngeal).

-In the photo, the arrow which says (vallate papilla) from both sides, you can find a groove (named here: circular sulcus), the part of the vallate which faces the groove is the medial wall of and it is made of para keratinized BUT the lateral wall of circumvallate (the arrow which says the circular wall) is made of nonkeratinized epithelium because it is deep, and not likely to be injured.

- **Circumvallate papillae are 7–12 extremely large circular papillae whose flattened surfaces extend above the other papillae.**

- **They are distributed in the V region in the posterior portion of the tongue.**

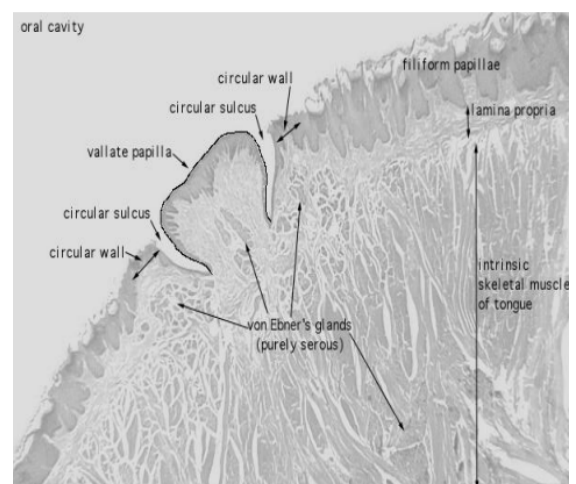
- **Numerous serous (von Ebner's) glands drain their contents into the deep groove that encircles the periphery of each papilla.**

- **This moatlike arrangement provides a continuous flow of fluid over the great number of taste buds present along the sides of these papillae.**

- **The glands also secrete a lipase that probably prevents the formation of a hydrophobic layer over the taste buds that would hinder their function.**

- **This flow of secretions is important in removing food particles from the vicinity of the taste buds so that they can receive and process new gustatory stimuli.**

- **Along with this local role, lingual lipase is active in the stomach and can digest up to 30% of dietary triglycerides.**

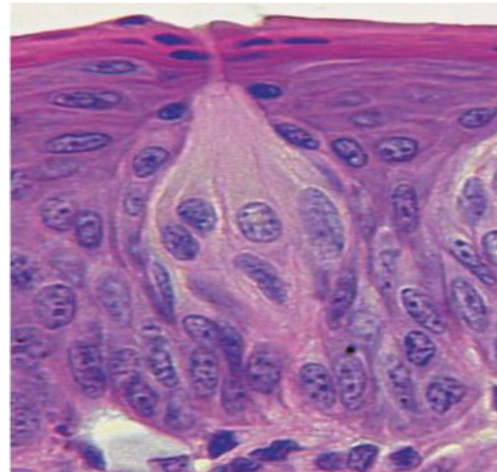
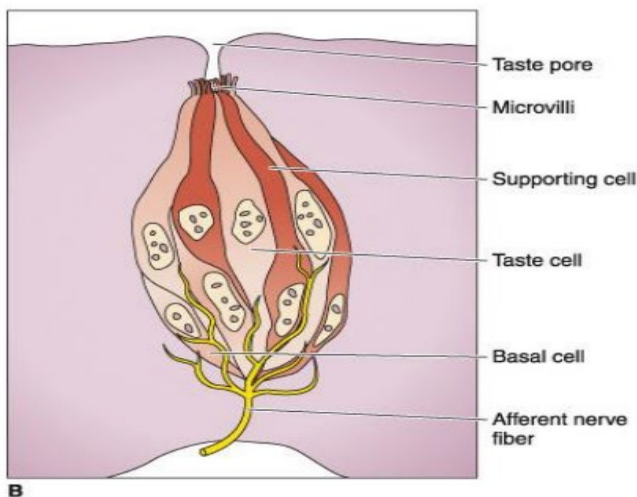


- Other small mucous salivary glands dispersed throughout the lining of the oral cavity act in the same way as the serous glands associated with this type of papilla to prepare the taste buds in other parts of the oral cavity, such as the anterior portion of the tongue, to respond to taste stimuli.

-Taste buds:

Types of Cells responsible for taste:

- o Bipolar cell/ Gustatory cell: It is known as gustatory microvillus; it's found in the center microvilli from each taste cell projects into the taste pore and here starts chorda tympani (branch of facial nerve).
- o Supporting cells (around the gustatory/ bipolar cells).
- o Basal cells (basal stem): active in mitosis to regenerate the two previous cells (gustatory and supporting).

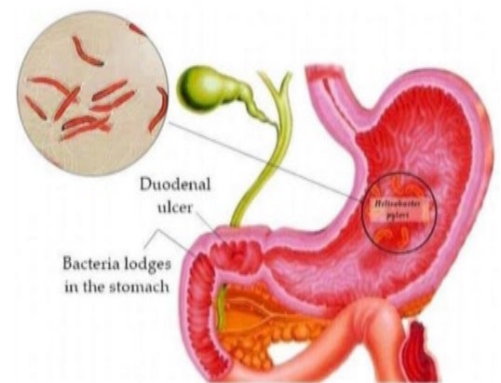


-SALIVARY GLANDS:

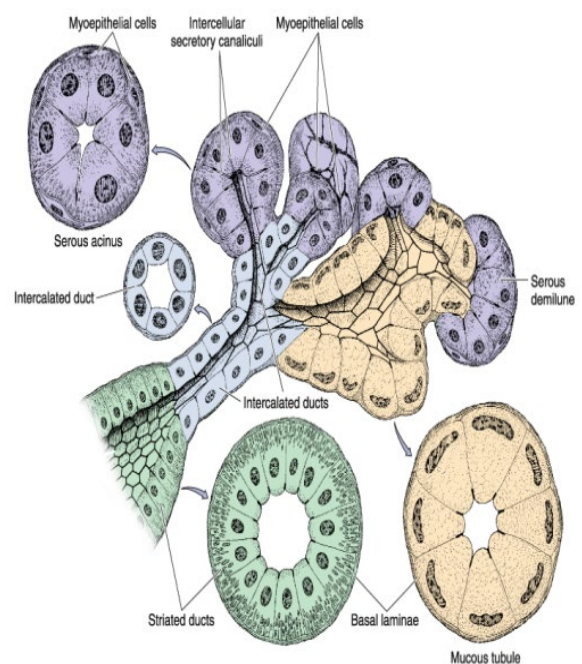
- Saliva is a complex fluid that has digestive, lubricating, and protective functions.
- In addition to the small salivary glands scattered throughout the oral cavity, there are three pairs of large salivary glands:
 - **Parotid gland:** serous secretion, its duct opens at the vestibule of mouth(at the level of upper second molar).
 - **Submandibular gland:** mixed, 70% serous and 30% mucous.
 - **Sublingual gland:** mucous mainly, 10% serous.

- In humans, the minor salivary glands secrete 10% of the total volume of saliva, but they account for approximately 70% of the mucus secreted.
- A capsule of connective tissue, rich in collagen fibers, surrounds the large salivary glands.
- The parenchyma of the glands consists of secretory end pieces and a branching duct system arranged in lobules, separated by septae of connective tissue originating from the capsule.
- The secretory end pieces present two types of secretory cells—serous and mucous.
- as well as the nonsecretory myoepithelial cells.
- This secretory portion is followed by a duct system whose components modify and conduct the saliva to the oral cavity.

-Dehydration leads to dryness which leads to growth of bacteria, especially when immunity weakens, we have bacteria everywhere in our body, they are opportunistic waiting for your immunity to weaken (*Helicobacter pylori* in stomach is normally NON-pathogenic unless in cases of immunosuppression, they are activated and may cause gastritis).



- Serous cells are usually pyramidal in shape, with a broad base resting on the basal lamina and a narrow apical surface with short, irregular microvilli facing the lumen with rounded nuclei.
- They exhibit characteristics of polarized protein-secreting cells.
- Adjacent secretory cells are joined together by junctional complexes and usually form a spherical mass of cells called acinus, with a small lumen in the center.
- This structure can be thought of as a grape attached to its stem; the stem corresponds to the duct system.



Copyright ©2006 by The McGraw-Hill Companies, Inc.
All rights reserved.

- Mucous cells are usually cuboidal to columnar in shape; their nuclei are oval and pressed toward the bases of the cells.
- They exhibit the characteristics of mucus-secreting cells containing glycoproteins important for the moistening and lubricating functions of the saliva
- Most of these glycoproteins are called mucins and contain 70–80% carbohydrate moieties in their structure
- Mucous cells are most often organized as tubules, consisting of cylindrical arrays of secretory cells surrounding a lumen.

-The mucous glands have a clear, vacuolated, foamy appearance compared to the much more dense, darkly-staining serous glands.

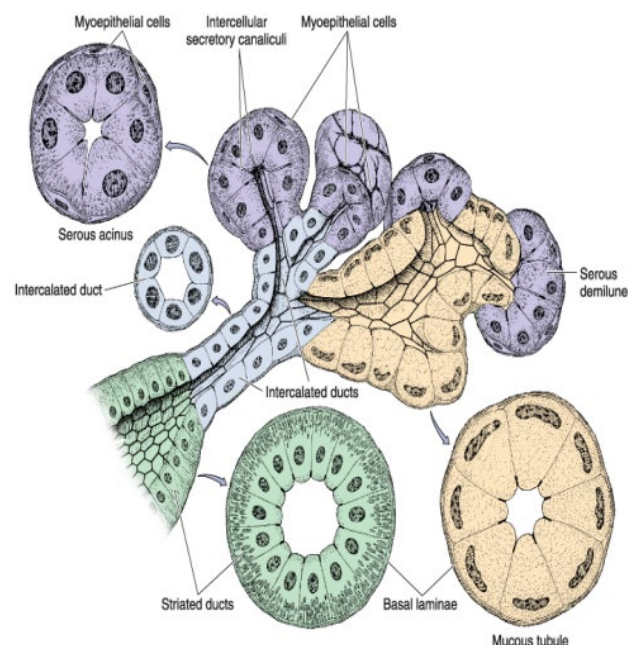
-MYOEPIHELIAL CELLS:

- are found between the basal lamina and the basal plasma membrane of the cells.
- forming secretory end pieces and intercalated ducts (to a lesser extent), which form the initial portion of the duct system.
- Myoepithelial cells surrounding each secretory portion, usually two to three cells per secretory unit, are well developed and branched (and are sometimes called basket cells).

- whereas those associated with intercalated ducts are spindle shaped and lie parallel to the length of the duct.

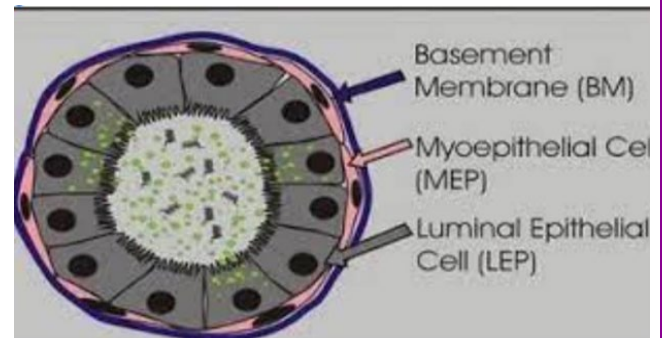
- These cells show several characteristics that resemble smooth muscle cells, including contractility.

- These cells show several characteristics that resemble smooth muscle cells, including contractility. However, they also establish intercellular junctions among themselves and with secretory cells, such as desmosomes.



Copyright © 2006 by The McGraw-Hill Companies, Inc.
All rights reserved.

- Although the contraction of myoepithelial cells accelerates the secretion of saliva, their main function seems to be the prevention of end piece distention during secretion due to the increase in intraluminal pressure.

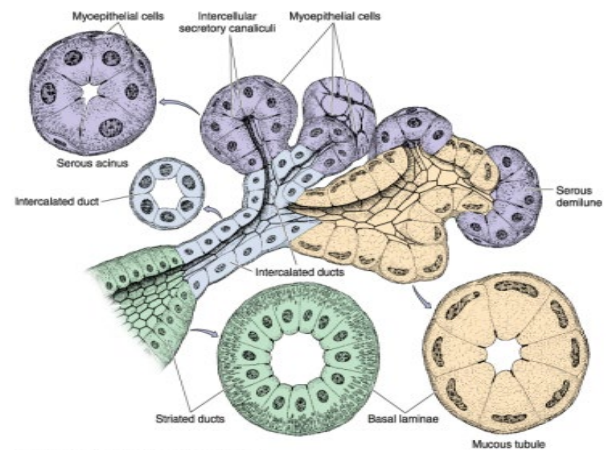


- In the duct system, secretory end pieces empty into the intercalated ducts, lined by cuboidal epithelial cells.

- These cells have the ability to divide and differentiate into secretory or ductal cells.

- Several of these short intercalated ducts join to form striated ducts.

- characterized by radial striations that extend from the bases of the cells to the level of the central nuclei.



Copyright © 2006 by The McGraw-Hill Companies, Inc. All rights reserved.

- Intercalated and striated ducts are also called intralobular ducts because of their location within the lobule.

- When viewed in the electron microscope, the striations are seen to consist of infoldings of the basal plasma membrane with numerous elongated mitochondria that are aligned parallel to the infolded membranes; this structure is characteristic of ion-transporting cells

- The striated ducts of each lobule converge and drain into ducts located in the connective tissue septae separating the lobules, where they become interlobular, or excretory, ducts

- They are initially lined with pseudostratified or stratified cuboidal epithelium, but more distal parts of the excretory ducts are lined with stratified columnar epithelium containing a few mucus-secreting cells

- The main duct of each major salivary gland ultimately empties into the oral cavity and is lined with nonkeratinized-stratified squamous epithelium.

- Vessels and nerves enter the large salivary glands at the hilum and gradually branch into the lobules.

- A rich vascular and nerve plexus surrounds the secretory and ductal components of each lobule.
- The capillaries surrounding the secretory end pieces are very important for the secretion of saliva, stimulated by the autonomic nervous system.
- Parasympathetic stimulation, usually through the smell or taste of food, promotes vasodilation and a copious watery secretion content. Sympathetic stimulation produces small amounts of viscous saliva, rich in organic material.

-PAROTID GLAND:

- The parotid gland is a branched acinar gland; its secretory portion is composed exclusively of serous cells.

- containing secretory granules that are rich in proteins and have a high amylase activity.

- This activity is responsible for most of the hydrolysis of ingested carbohydrates.

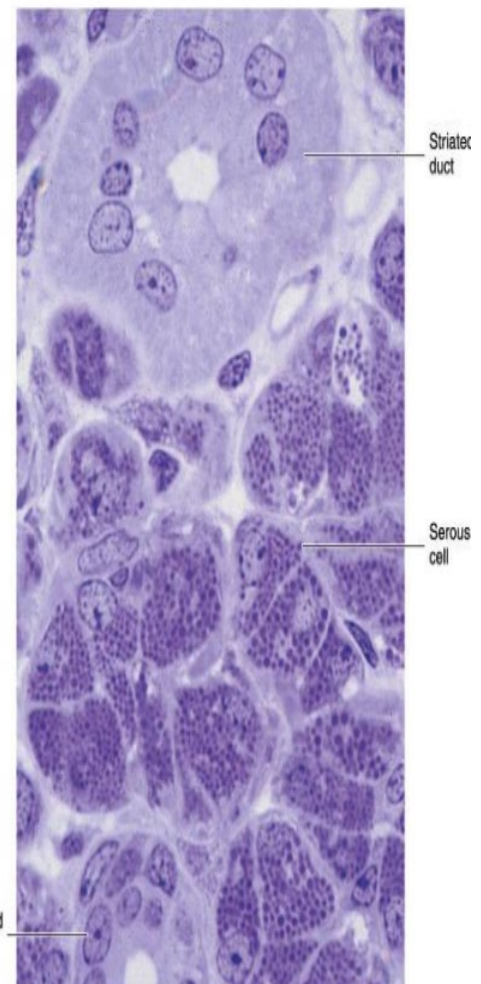
- The digestion begins in the mouth and continues for a short time in the stomach, before the gastric juice acidifies the food and thus decreases amylase activity considerably.

- Intercalated and striated ducts are easily observed within the lobules, due to their length.

- As in other large salivary glands, the connective tissue contains many plasma cells and lymphocytes.

- The plasma cells secrete IgA, which forms a complex with a secretory component synthesized by the serous acinar, intercalated duct, and striated duct cells.

- The IgA-rich secretory complex released into the saliva is resistant to enzymatic digestion and constitutes an immunological defense mechanism against pathogens in the oral cavity.

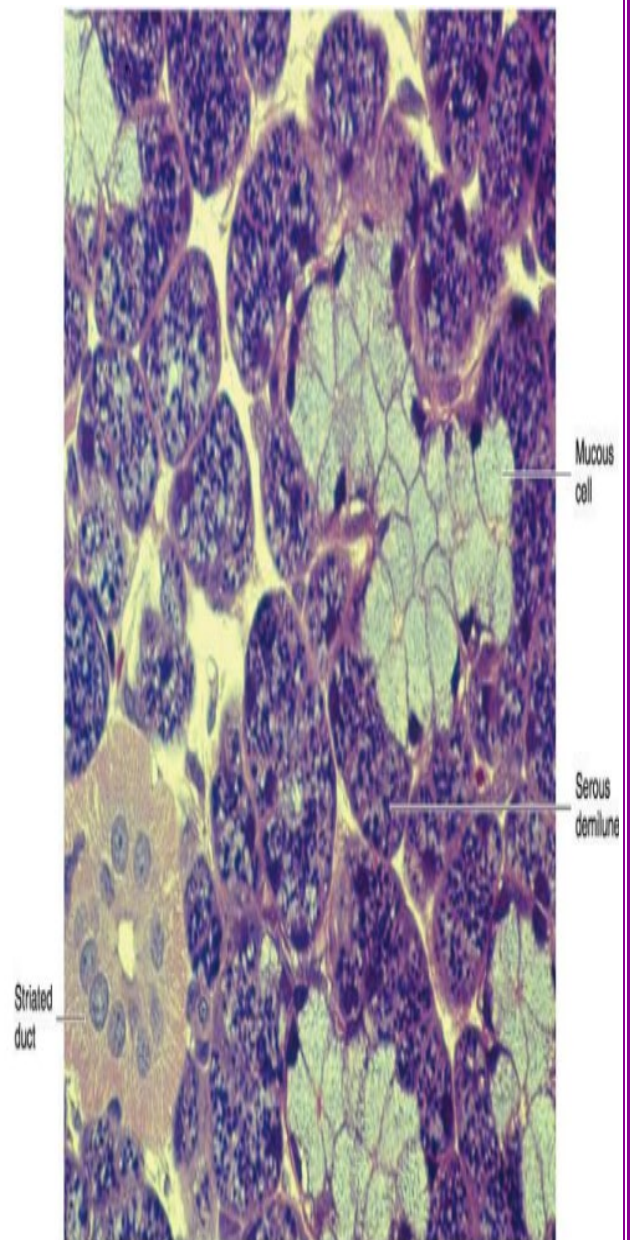


Intercalated duct

Copyright ©2006 by The McGraw-Hill Companies, Inc. All rights reserved.

-SUBMANDIBULAR (SUBMAXILLARY) GLAND:

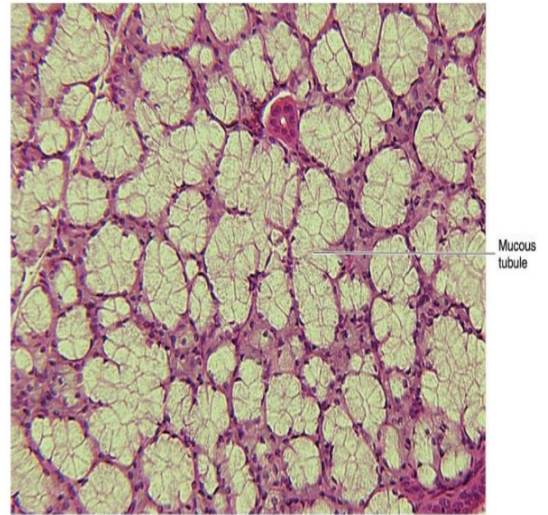
- The submandibular gland is a branched tubuloacinar gland.
- its secretory portion contains both mucous and serous cells.
- The serous cells are the main component of this gland and are easily distinguished from mucous cells by their rounded nuclei and basophilic cytoplasm.
- In humans, 90% of the end pieces of the submandibular gland are serous acinar, whereas 10% consist of mucous tubules with serous demilunes.
- Serous cells are responsible for the weak amylolytic activity present in this gland and its saliva.
- The cells that form the demilunes in the submandibular gland secrete the enzyme lysozyme, whose main activity is to hydrolyze the walls of certain bacteria.
- Some acinar and intercalated duct cells in large salivary glands also secrete lactoferrin, which binds iron, a nutrient necessary for bacterial growth.
- Striated ducts are easily observed in the human submandibular gland, but intercalated ducts are very short.



Copyright ©2006 by The McGraw-Hill Companies, Inc.
All rights reserved.

-SUBLINGUAL GLAND:

- The sublingual gland, like the submandibular gland, is a branched tubuloacinar gland formed of serous and mucous cells
- Mucous cells predominate in this gland; serous cells are present almost exclusively on demilunes of mucous tubules
- As in the submandibular gland, cells that form the demilunes in this gland secrete lysozyme.
- Intralobular ducts are not as well developed as in other major salivary glands.



Copyright ©2006 by The McGraw-Hill Companies, Inc.
All rights reserved.

-MINOR SALIVARY GLANDS:

- These nonencapsulated glands are distributed throughout the oral mucosa and submucosa.
- they are numerous, covering the whole oral cavity. They are mucous, and contributes a lot to the daily 8 salivary liters.
- Labial glands (related to lips).
 - Lingual glands (related to tongue).
 - Minor salivary glands of palate.
- Saliva is produced by small groups of secretory units and is conducted to the oral cavity by short ducts, with little modification of its content
 - Although variations exist, minor salivary glands are usually mucous
 - The small serous glands present in the posterior region of the tongue (von Ebner's glands) are the only exception
 - Lymphocyte aggregates are commonly observed within minor salivary glands, associated with IgA secretion.