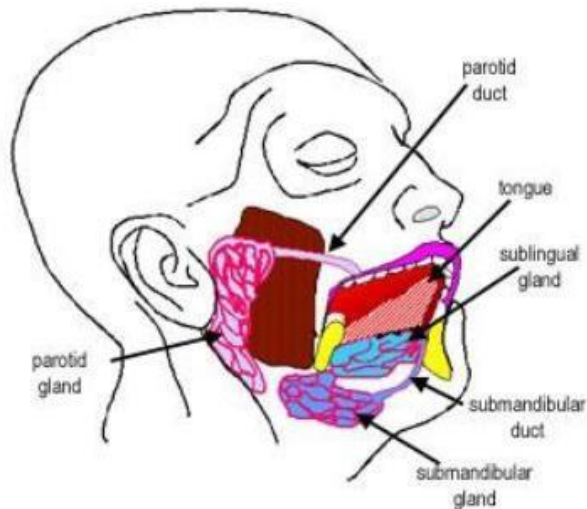


Oral Histology

Salivary glands



The **salivary glands** are exocrine glands that produce saliva through a system of ducts. Humans have three paired major salivary glands (parotid, submandibular, and sublingual), as well as hundreds of minor salivary glands. Salivary glands can be classified as serous, mucous, or seromucous (mixed).

In serous secretions, the main type of protein secreted is alpha-amylase, an enzyme that breaks down starch into maltose and glucose, whereas in mucous secretions, the main protein secreted is mucin, which acts as a lubricant.

In humans, between 0.5 and 1.5 l of saliva are produced every day. The secretion of saliva (salivation) is mediated by parasympathetic stimulation; acetylcholine is the active neurotransmitter and binds to muscarinic receptors in the glands, leading to increased salivation.

Saliva

is an extracellular fluid produced and secreted by salivary glands in the mouth.

Composition

Produced in salivary glands, human saliva comprises 99.5% water, but also contains many important substances, including electrolytes, mucus, antibacterial compounds and various enzymes.

Electrolytes: sodium (lower than blood plasma) potassium (higher than plasma), calcium (similar to plasma) magnesium and others.

Mucus (mucus in saliva mainly consists of mucopolysaccharides and glycoproteins)

- secretory immunoglobulin A)
- Epidermal growth factor (EGF)
- Various enzymes; most notably:
 - α -amylase (Lingual lipase, which is secreted by the acinar cells of the sublingual gland; has a pH optimum around 4.0 so it is not activated until entering the acidic environment of the stomach)
 - Antimicrobial enzymes that kill bacteria:
 - Lysozyme
 - Salivary lactoperoxidase
 - Lactoferrin
 - Proline-rich proteins (function in enamel formation, Ca^{2+} -binding, microbe killing and lubrication)

Development

1. The epithelium invaginates into the underlying connective tissue, bringing the epithelial basal lamina with it.
 2. The invagination develops a lumen that communicates to the original surface.
 3. The invagination differentiates into a secretory unit at its furthest part and a duct that connects the secretory unit to the epithelium.
- The primordia or buds of different glands appear at different period .

Buds of parotid and submandibular glands appear at 5- 6 weeks of I.U.L., primordium of sublingual glands appears after 7-8 weeks of I.U.L. minor salivary glands start developing at the third month of I.U.L.

Histology of Salivary glands

Both major and minor S.G. composed of parenchymal elements are derived from oral epith. consists of secretory end piece or acini either serous or mucous or a combination of the two called serous demilunes and these secretory units leading into ducts that open into oral cavity. The connective tissue (C.T.) forms a capsule around the gland and extends into it, dividing groups of secretory units and ducts into lobes and lobules, the blood and lymph vessels and nerves that supply the gland are contained within Capsule.

The major salivary glands are

1-Parotid gland

The two parotid glands are major salivary glands wrapped around the mandibular ramus in humans. These are largest of the salivary glands, secreting saliva to facilitate mastication and swallowing, and amylase to begin the digestion of starches. It is the serous type of gland which secretes alphaamylase. It enters the oral cavity via the parotid duct. They produce 20% of the total salivary content in the oral cavity. Mumps is a viral infection, caused by infection in the parotid gland.

2-Submandibular glands

The submandibular glands (previously known as submaxillary glands) are a pair of major salivary glands located beneath the lower jaws, superior to the digastric muscles. The secretion produced is a mixture of both serous fluid and mucus, and enters the oral cavity via the submandibular duct or Wharton duct. Around 70% of saliva in the oral cavity is produced by the submandibular glands, though they are much smaller than the parotid glands.

3-Sublingual glands

The sublingual glands are a pair of major salivary glands located inferior to the tongue, anterior to the submandibular glands. The secretion produced is mainly mucous in nature, but it is categorized as a mixed gland. Unlike the other two major glands, the ductal system of the sublingual glands does not have intercalated ducts and usually does not have striated ducts, either, so saliva exits directly from 8-20 excretory ducts known as the Rivinus ducts. About 5% of saliva entering the oral cavity comes from these glands.

Minor salivary glands

Around 800 to 1,000 minor salivary glands are located throughout the oral cavity within the submucosa of the oral mucosa in the tissue of the buccal, labial, and lingual mucosa, the soft palate, the lateral parts of the hard palate, and the floor of the mouth or between muscle fibers of the tongue. They are 1 to 2 mm in diameter and unlike the major glands, they are not encapsulated by connective tissue, only surrounded by it. The gland has usually a number of acini connected in a tiny lobule. A minor salivary gland may have a common excretory duct with another gland, or may have its own excretory duct. Their secretion is mainly mucous in nature and have many functions such as coating the oral cavity with saliva. Problems with dentures are sometimes associated with minor salivary glands if dry mouth is present. The minor salivary glands are innervated by the seventh cranial or facial nerve.

Ducts

The ductal system of salivary glands is a varied network of tubules that progressively increase in diameter, beginning at the secretory end pieces and extending to the oral cavity. The three classes of ducts are intercalated, striated, and excretory, each with differing structure and function. The ductal system is more than just a simple conduit for the passage of saliva; it actively participates in the production and modification of saliva.

1. Intercalated Ducts The primary saliva produced by the secretory end pieces passes first through the intercalated ducts. The first cells of the intercalated

duct are directly adjacent to the secretory cells of the end piece, and the lumen of the end piece is continuous with the lumen of the intercalated duct. The intercalated ducts are lined by a simple cuboidal epithelium, and myoepithelial cell bodies and their processes typically are located along the basal surface of the duct. The overall diameter of the intercalated ducts is smaller than that of the end pieces, and their lumina are larger than those of the end pieces. The apical cell surface has a few short microvilli projecting into the lumen.

2. Striated Ducts The striated ducts, which receive the primary saliva from the intercalated ducts, constitute the largest portion of the duct system. Striated duct cells are columnar, with a centrally placed nucleus and pale, acidophilic cytoplasm

The overall diameter of the duct is greater than that of the secretory end pieces, and the lumen is larger than those of the secretory end pieces and intercalated ducts.

Excretory Ducts The excretory ducts are located in the connective tissue septa between the lobules of the gland. These ducts are larger in diameter than striated ducts and typically have a pseudostratified epithelium with columnar cells extending from the basal lamina to the ductal lumen and small basal cells that sit on the basal lamina but do not reach the lumen. As the smaller ducts join to form larger excretory ducts, the number of basal cells increases, and scattered mucous (goblet) cells may be present. The epithelium of the main

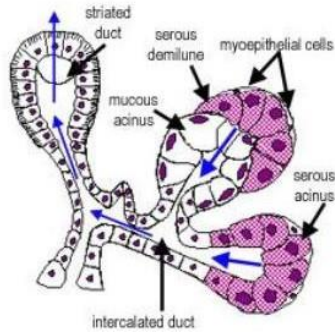
excretory duct may become stratified near the oral opening.

End piece of salivary gland

The functional unit of the salivary glands is the terminal secretory piece called **acini** with a roughly spherical or tubular shape. It also consists of branched ducts for the passage of the saliva and also plays an important role in the production and modification of saliva.

Myoepithelial cells:

They are contractile cells (contain the contractile filaments actin and myosin) associated with secretory acini and intercalated ducts of S.G. These cells are present around the secretory acini and have stellate shape, numerous branching processes extend from the cell body to surround and embrace the acinar. These cells are difficult to identify in routine histologic preparation, but their typical stellate shape can be observed in special histochemical technique. Their appearance resembles the basket cradling the secretory units. Contraction of these cells is thought to provide support for the acini and intercalated ducts during active secretion of saliva.



A diagram of part of a salivary gland showing a serous acinus and mixed serous-mucous acinus.

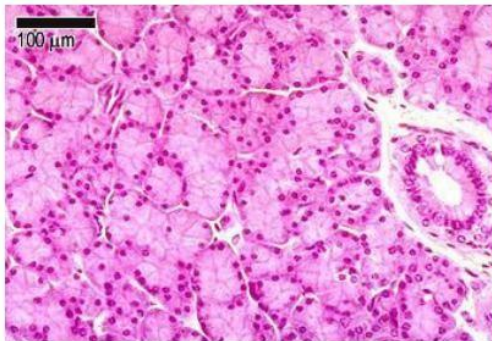
Salivary glands are made up of secretory **acini** (acini - means a rounded secretory unit) and ducts. There are two types of secretions - **serous** and **mucous**. The **acini** can either be **serous**, **mucous**, or a mixture of serous and mucous.

A **serous acinus** secretes proteins in an isotonic watery fluid.

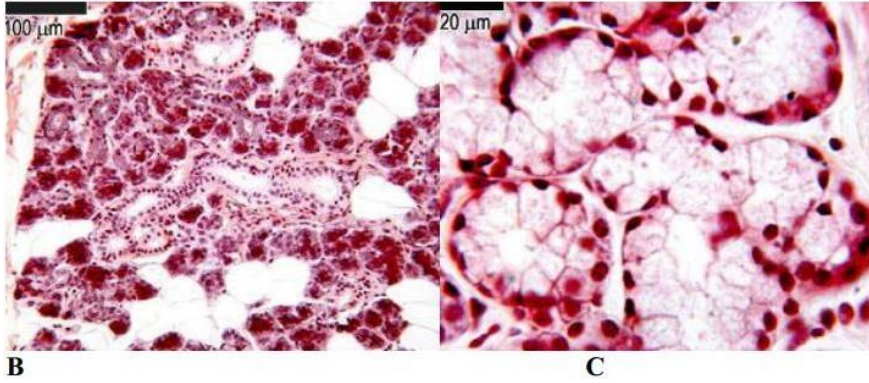
A **mucous acinus** secretes mucin - lubricant

In a mixed serous-mucous acinus, the **serous** acinus forms a serous **demilune** around **mucous** acinus, as shown in the diagram.

The secretory units merge into **intercalated** ducts, which are lined by simple low cuboidal epithelium, and surrounded by myoepithelial cells.



A



Images A, B, and C are of three different salivary glands. In image A you can see both secretory acini, and a duct.

- Sublingual glands have mainly mucous acini.
- Parotid glands have mainly serous acini.
- Submandibular glands have a mixture of mucous and serous acini.
- **Mucous acini** stain **more weakly** than serous acini, because of the techniques used to produce the sections.

Function

Salivary glands secrete saliva, which has many benefits for the oral cavity and health in general. These benefits include:

- **Protection:** Saliva consists of proteins (for example; mucins) that lubricate and protect both the soft and hard tissues of the oral cavity. Mucins are the principal organic constituents of mucus, the slimy viscoelastic material that coats all mucosal surfaces.
- **Buffering:** In general, the higher the saliva flow rate, the faster the clearance and the higher the buffer capacity, hence better protection from dental caries. Therefore, people with a slower rate of saliva secretion, combined with a low buffer capacity, have lessened salivary protection against microbes.
- **Pellicle formation:** Saliva forms a pellicle on the surface of the tooth to prevent wearing. The film contains mucins and proline-rich glycoprotein from the saliva.

The proteins (statherin and proline-rich proteins) within the salivary pellicle

inhibit demineralisation and promote remineralisation by attracting calcium ions.

- **Maintenance of tooth integrity:** Demineralization occurs when enamel disintegrates due to the presence of acid. When this occurs, the buffering capacity effect of saliva (increases saliva flow rate) inhibits demineralisation. Saliva can then begin to promote the remineralisation of the tooth by strengthening the enamel with calcium and phosphate minerals.
- **Antimicrobial action:** Saliva can prevent microbial growth based on the elements it contains. For example, lactoferrin in saliva binds naturally with iron. Since iron is a major component of bacterial cell walls, removal of iron breaks down the cell wall, which in turn breaks down the bacterium. Antimicrobial peptides such as histatins inhibit the growth of *Candida albicans* and *Streptococcus mutans*. Salivary immunoglobulin A serves to aggregate oral bacteria such as *S. mutans* and prevent the formation of dental plaque.
- **Tissue repair:** Saliva can encourage soft-tissue repair by decreasing clotting time and increasing wound contraction.
- **Digestion:** Saliva contains amylase, which hydrolyses starch into glucose, maltose, and dextrin. As a result, saliva allows some digestion to occur before the food reaches the stomach.
- **Taste:** Saliva acts as a solvent in which solid particles can dissolve and enter the taste buds through oral mucosa located on the tongue. These taste buds are found within foliate and circumvallate papillae, where minor salivary glands secrete saliva.