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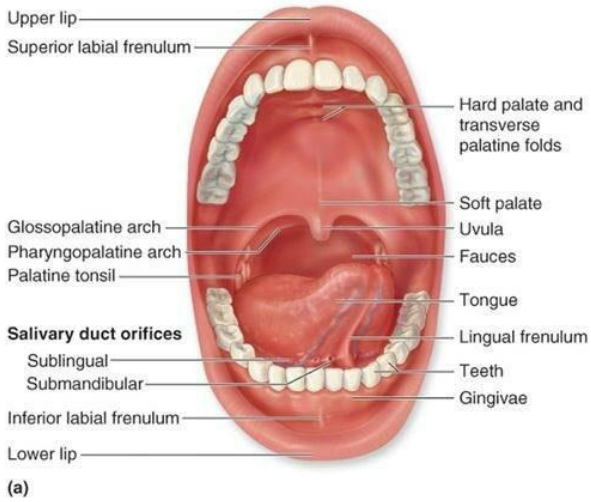
Oral Mucosa

The term mucosa is used to describe the moist lining of the GI tract.
In the oral cavity this lining is called **the oral mucosa**. The structure of oral mucosa reflects a variety of functional adaptations.
The oral cavity has sometimes been described as a mirror that reflects the health of the individual.
Changes indicative of diseases is seen as alterations in the oral mucosa lining the mouth, which can reveal systemic conditions.



Embryonic origin of oral mucosa: The oral cavity is lined by epithelium derived from both the ectoderm and endoderm.

i. **The ectoderm gives origin** for mucosa of: Lips, cheek, gingiva, soft palate hard part, alveolar mucosa, and the mucosa of the anterior two third of the tongue.
ii. **The structure derived from endoderm include:** Posterior one third of tongue and the floor of the mouth cavity.

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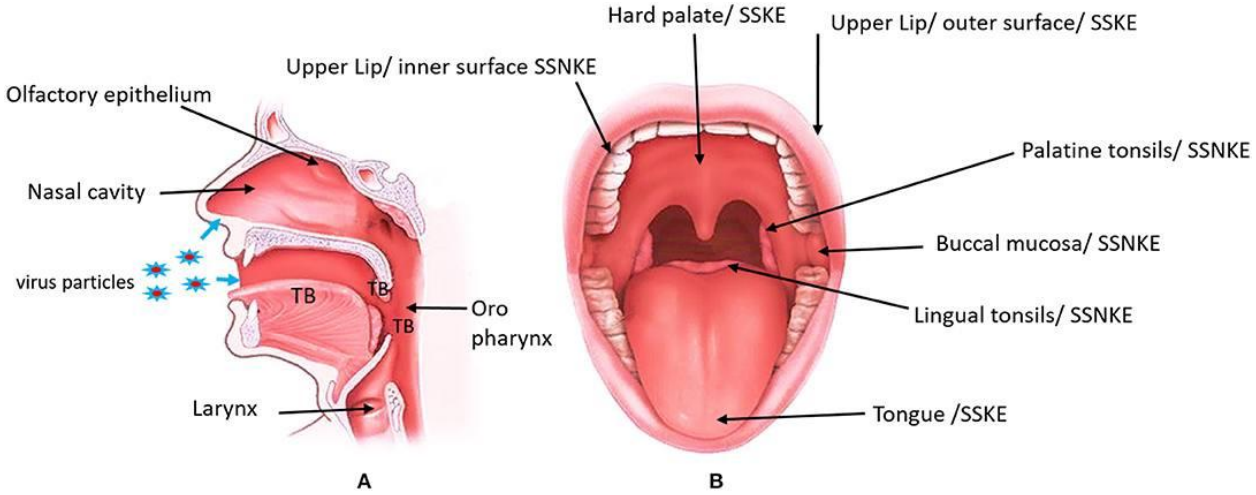
Differences between skin and oral mucosa:

1. **Color:** The oral mucosa is more deeply colored than skin. Normal healthy oral mucosa is pale pink; whereas inflamed mucosa is red, because of dilatation of the blood vessels.
2. The oral mucosa is **moist** surface due to the presence of saliva.
3. The oral mucosa is **devoid** of skin appendages like hair follicles, sebaceous gland and sweat glands

   Note: Due to the ectodermal origin of the epithelium of the upper lip and the buccal mucosa; sebaceous glands are seen in these places, they appear as yellow spots called **Fordyce's spots.**
4. The surface of the oral mucosa tends to be **smoother and have fewer folds** than the skin.
5. The Cornified layer of the oral mucosa is **thicker** than that of epidermis (except for the palm and sole).
6. Presence of **minor salivary glands** in oral mucosa
7. **Firmness:** Oral mucosa varies in its firmness. For example, buccal mucosa and lips are loose and pliable whereas the gingiva and hard palate are firm so critical clinically while giving injections.



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General Features of Oral Mucosa

1. Separated from the skin by vermillion zone of the lips which is more deeply colored than the rest of oral mucosa.
2. **Factors affecting color of the oral mucosa**:
   i. Concentration and state of dilation of the blood vessels in underlying connective tissue.
   ii. Thickness of the epithelium.
   iii. Degree of keratinization.
   iv. Amount of melanin pigment.

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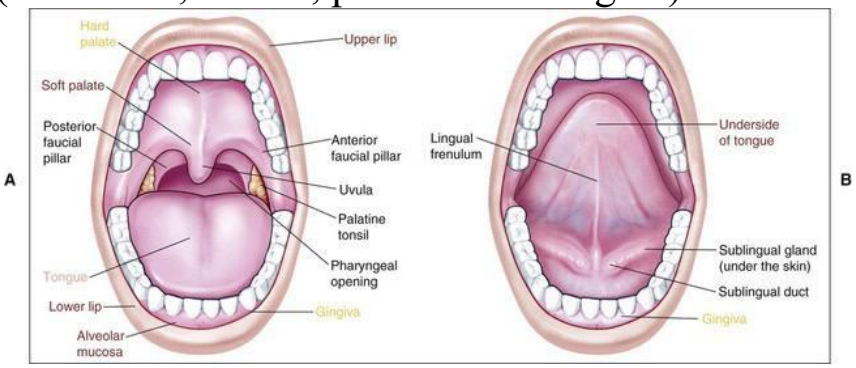
Functions of oral mucosa:

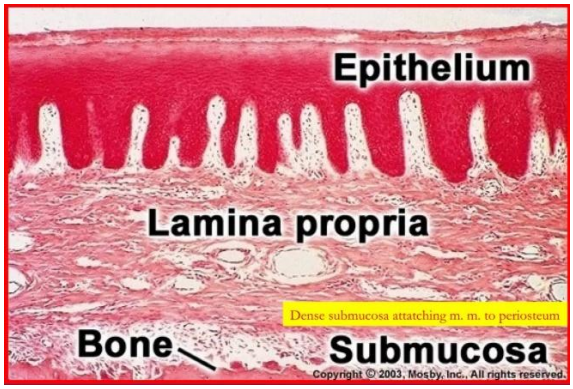
1. **Protection:** Protects the tissue and organs involved in the mastication of food such as gingiva and hard palate. Also, the epithelium of the oral mucosa acts as a major barrier against microorganisms that have toxic effect on the oral tissue.
2. **Sensation:**
   i. Certain receptors such as touch, pain and taste are found in the oral mucosa.
   ii. Certain receptors in the oral mucosa probably respond to the (taste) of water and signal the satisfaction of thirst.
3. **Secretion:** Many minor salivary glands are associated with oral mucosa (like labial, buccal, palatine and lingual).



Structure of oral mucosa

There are two main components of the oral mucosa:

1-Oral epithelium
2-Lamina propria (Connective tissue) Separating the two layers is a thin basement membrane.



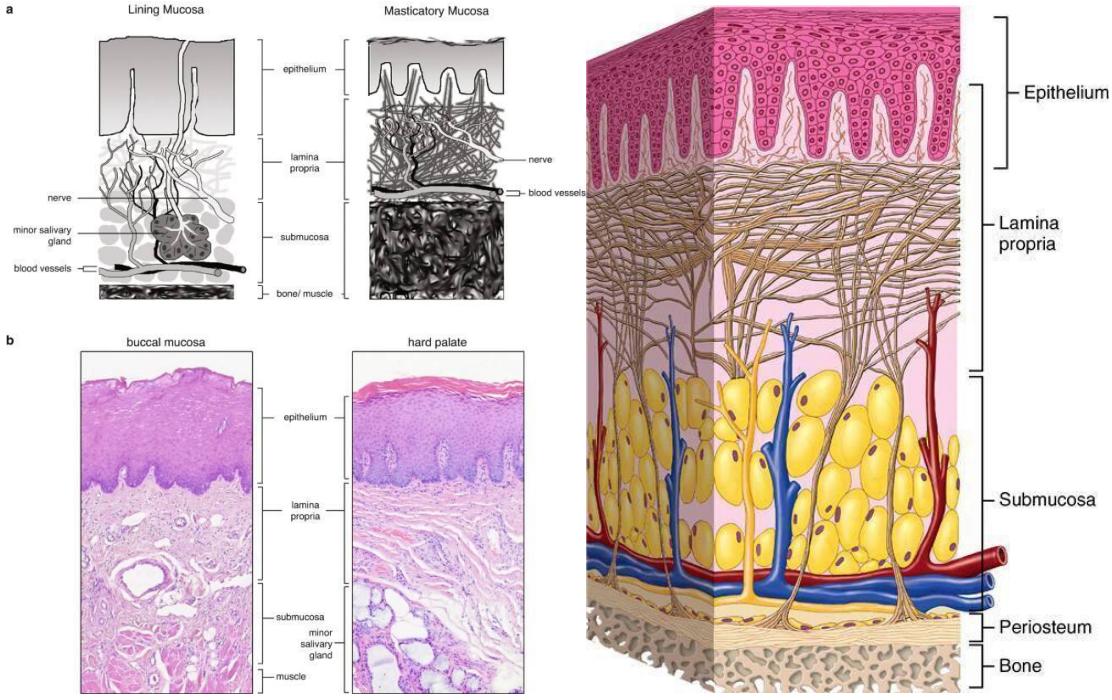
Interface between the oral epithelium and lamina propria is usually irregular, it is an upward projection of C.T called C.T papilla that interdigitate with epithelial ridges or pegs.

Although it is easy to differentiate between the two layers or oral mucosa it is usually difficult to separate between the oral mucosa and the underlying submucosa, represented by a loose fatty layer containing blood vessels and nerves that supply the mucosa. This layer determines the flexibility of the attachment of the oral mucosa to the underlying structures.

In some regions like the gingiva and hard palate the oral mucosa is attached directly to the periosteum of the underlying bone with no sub mucosa in between this is called mucoperiosteum and it provides a firm inelastic attachment.

Minor salivary glands are situated in or just beneath the lamina propria. Sebaceous glands lie in the lamina propria but are less frequent than the salivary glands. They produce a fatty secretion which has an unclear function, but it is thought that it may lubricate the surface of the mucosa so that it slides perfectly against teeth.

In other places like the cheek and lip the lamina propria is overlying the submucosa. The submucosa is composed of loose fatty and glandular tissue containing blood vessels, lymph vessels and nerves.



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The Oral Epithelium

The oral epithelium maintains its structural integrity by continuous cell renewal in which cells produced by mitotic division in the deepest layer which will then migrate to the surface to replace those that are shed.

Epithelium may be keratinized (Orthokeratinized), Parakeratinized or nonkeratinized, depending on the location; gingiva and hard palate are parakeratinized and sometimes keratinized; cheek and labial and sublingual epithelium are nonkeratinized.

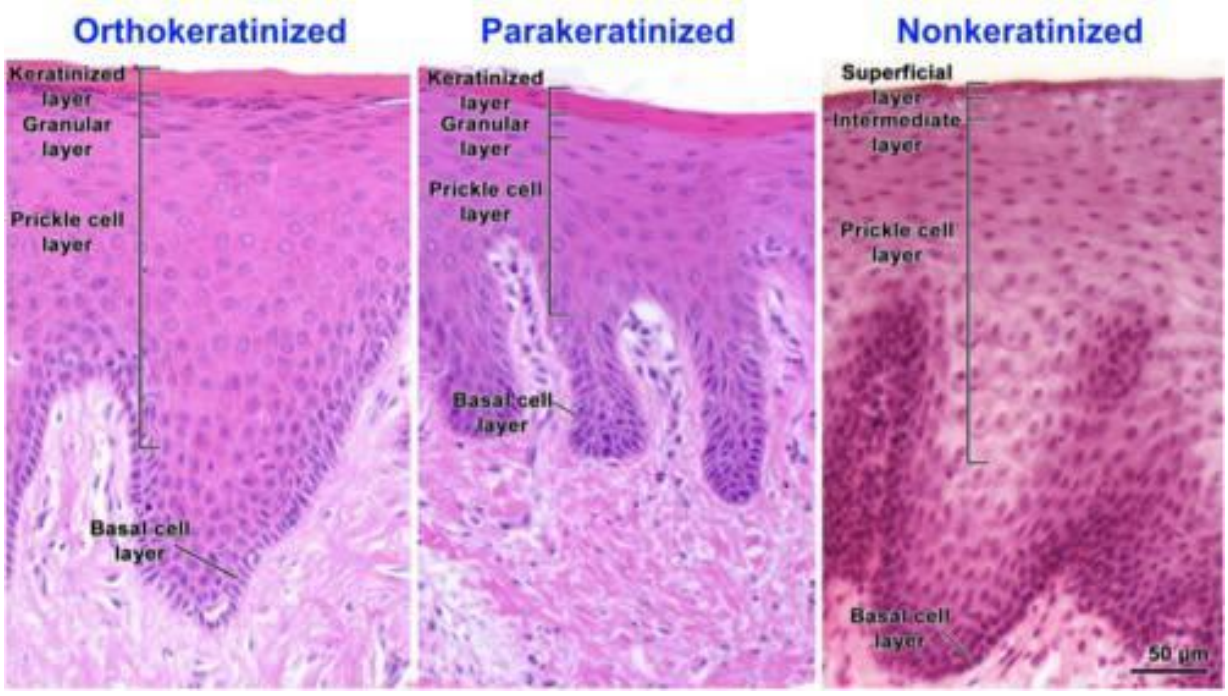
Oral epithelium has four layers:

1- Basel layer

2-Spinous layer

3-granular layer

4-cornified layer



Basel layer: Basel layer cells are attached to the connective tissue by hemidesmosoms present in the basal membrane of the cells. These can undergo mitosis to provide cells that will later migrate to replace other layers.

Spinous layer (Prickle layer): They are irregular polyhedral cells that provide tensile support for the epithelium.

Granular layer: This layer contributes to the resistance of the keratinized layer to chemical solvents. There is a similar thickening in the nonkeratinized epithelium and probably serves for the same function.

The cells of this layer have **two types of granules**:

i. Keratohyaline granules which form the precursor for the keratin found in the superficial Cornified layer.

ii. The granular layer is producing another type of granules called lamellar granules (also called Odland's bodies). The contents of these granules are discharged into the intercellular space, which acts as a barrier to limit the passage of material through the epithelium from the outside.

Cornified layer: This layer is made of keratinized squamous cells, larger and flatter than the granular cells. It is the most superficial layer. In this layer all cell organelles have disappeared and the cell is composed of densely packed keratin substance.

The superficial cells of this layer are continuously shed (desquamated) as part of continuous process of the renewal process of epithelial tissue. The replacement is coming from the underlying layer due to mitosis of cells of the basal layer.

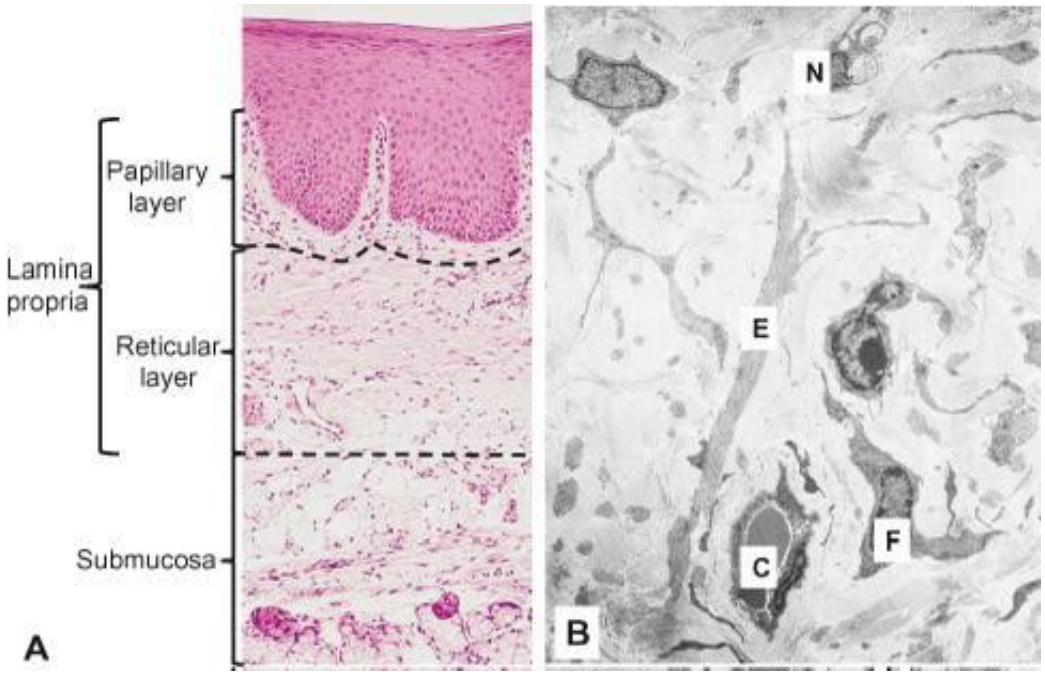
Clinical Note: Rapid clearance of the surface layer is important in limiting the colonization and invasion of epithelial surfaces by pathogenic microorganism.

Lamina propria:

It is the connective supporting the oral epithelium; it is divided into two layers (but only for descriptive purposes):

Like any other connective tissue, the lamina propria has

- **Cells** like fibroblasts, macrophages, mast cells and inflammatory cells (plasma cells and different leukocytes).
- **Fibers**: collagen, reticular and elastic.
- **And ground substance**



Functional classification of oral mucosa:

Three main types of oral mucosa are found in the oral cavity:

1.The lining mucosa: Represents nearly 60% of oral mucosa. It is either:

i. **firmly attached** lining mucosa, it covers the lip, cheek, soft palate and ventral surface of tongue.

ii. **Loosely attached,** it covers the floor of mouth cavity, and alveolar mucosa.

2.Masticatory mucosa: Seen in the hard palate and gingiva. Represents 25% of total oral mucosa. It is seen in gingiva (free, attached and interdental) and hard palate.

Masticatory mucosa is the primary mucosa to be in contact with food during mastication.

Masticatory mucosa is usually keratinized.

3.Specialized mucosa: Represents 15% of the oral mucosa. It covers the dorsal surface of tongue.

Lining Mucosa:

- Lining mucosa is a type of mucosa noted for its softer surface texture, moist surface, and ability to stretch and be compressed, acting as a cushion for the underlying structures.
- Lining mucosa includes the buccal (cheek) mucosa, the labial mucosa, the alveolar mucosa, and the mucosa lining the floor of the mouth, the ventral surface of the tongue, and the soft palate. Lining mucosa is associated with nonkeratinized stratified squamous epithelium.
- In many areas of lining mucosa, especially the labial and buccal mucosa, are **Fordyce's spots or granules**. These spots are a normal variant, visible as small, yellowish elevations on the surface of the mucosa.

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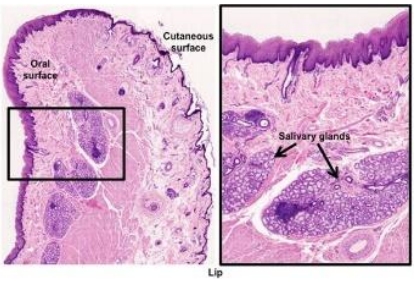
Histology of Lip

In the human lip three areas can be identified

1. **Skin side (external side)**: Covered by thin skin with keratinized stratified squamous epithelium and with adnexal skin structures like sweat glands hair follicles, and sebaceous glands.
2. **Vermillion zone (red margin)**: It is the transitional zone between the skin and lining of the lip. It has very thin keratinized epithelium that contains no adnexal skin structures (can contain sebaceous glands). The red appearance of the vermillion zone is due to:
   - **i.** Epithelium is thin
   - **ii.** Epithelium contains eleidin, which is transparent.
   - **iii.** Blood vessels are present near the surface Eleidin is a semi-fluid clear substance present in the stratum lucidum of the skin epithelium
3. **Oral mucosa (lining of the lip):** Has moist-surface, covered by nonkeratinized stratified squamous epithelium associated with small round seromucous glands of the lamina propria. In the submucosa fibers of orbicularis oris muscle is noted. **What makes the lining mucosa firmly fixed to the underlying structure in the lip?**
   - **i.** The epimysium of the orbicularis oris muscle is connected to the dense irregular connective tissue of the lamina propria of the lip mucosa.
   - **ii.** Lip mucosa is having highly elastic lamina propria.

     These two features permit the mucosa to maintain smooth surface during muscular movements and prevent formation of folds which lead to injury during chewing.

   The mixed labial minor salivary glands are situated in the submucosa.



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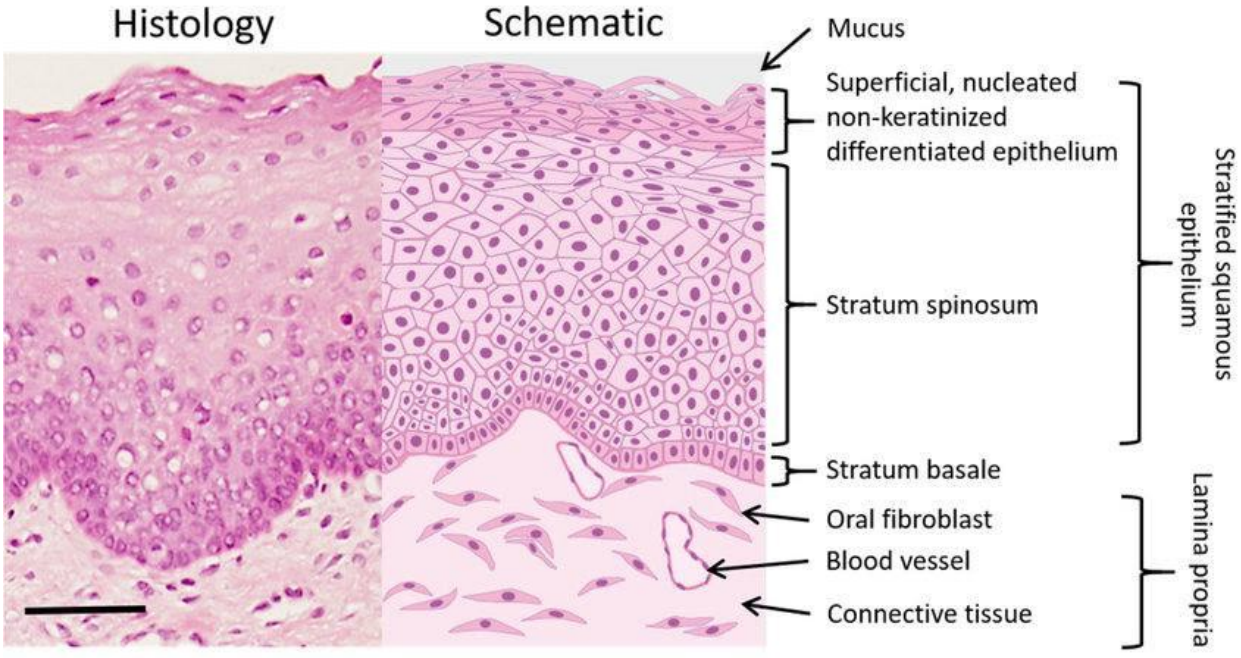
Histology of cheek mucosa

The Cheek is covered by thin skin. Its lining mucosa is **firmly attached mucosa**. The mucosa is having very **thick nonkeratinized epithelium of about 500 µm thickness**. The lamina propria contains dense connective tissue with short irregular papillae. The epimysium of the buccinators muscle is connected to the lamina propria of the mucosa, thus the mobility of the mucosa is limited preventing formation of folds which might be lodged between biting surfaces of teeth during mastication.

In the submucosa there is a loose connective tissue contains fat and group of minor mixed salivary glands called buccal glands.

The cheek lateral to the corner of the mouth may contain isolated sebaceous glands called Fordyce's spots. Also, area of melanin pigmentation may be seen.



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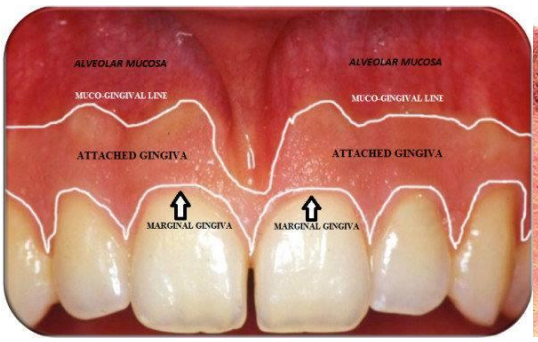
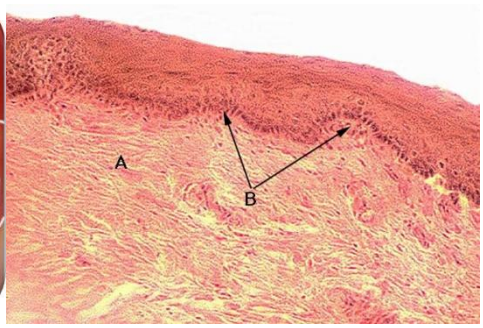
Alveolar mucosa

The mucosa of the lip and cheek reflects into mucosa covering the bone. This mucosa is called alveolar mucosa.
It is thin **loosely attached lining mucosa**. Being loosely attached mucosa that would be useful for easy movement of the lip and cheek.
The alveolar mucosa is separated from the gingiva by a line called **mucogingival** junction.
The epithelium is **thin** stratified nonkeratinized with low ridges. The lamina propria is thin with interwoven bundles of collagen fibers and numerous elastic fibers. The alveolar mucosa is **red in color** showing numerous small vessels close to the surface of thin epithelium.





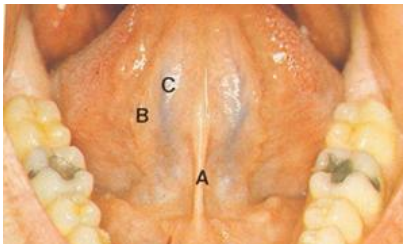
Mucosa of the floor of mouth cavity:

The mucosa is thin and loosely attached to the underlying structures to allow for free mobility of the tongue.

The epithelium is thin stratified squamous nonkeratinized, 100µm thickness. The lamina propria is thin, while the submucosa contains adipose tissue. The sublingual glands lie close to the covering mucosa in the sublingual fold.

Mucosa of the inferior surface of the tongue:

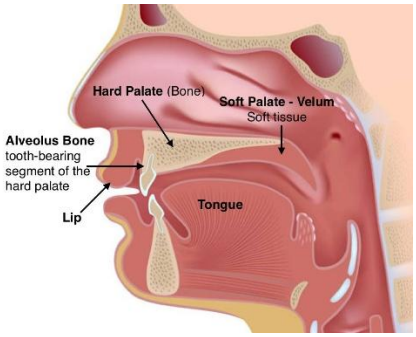
The mucosa is thin firmly attached lining mucosa with thin nonkeratinized epithelium



Soft palate:

The mucosa of the soft palate is highly vascularized and reddish in color, differing from the pale color of the hard palate.

The soft palate has two surfaces. The nasal surface is lined with respiratory mucosa, while the oral surface is lined with firmly attached lining mucosa. The lamina propria has a layer of elastic fibers separating it from submucosa which contains loose connective tissue containing a layer of mucous palatine glands.



Masticatory mucosa

It is the mucosa which covers the gingiva and hard palate.

Gingiva

The gingiva is that portion of the oral mucosa located around the neck of the teeth extending apically over the alveolar bone, and ending at the mucogingival junction. It is a masticatory mucosa with **no submucosa**. Traction bands are connecting the mucosa with the underlying bone, making the arrangement called **mucoperiosteum**.

The color of the gingiva is normally pink but sometimes have grayish white tint. Masticatory mucosa is associated with keratinized stratified squamous epithelium thicker than the nonkeratinized epithelium.

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Types of epitheliums:

There are three types of epithelial surface layers in the gingiva:

i. **Orthokeratinized** (stratified squamous keratinized) epithelium occurs in 15% of cases.

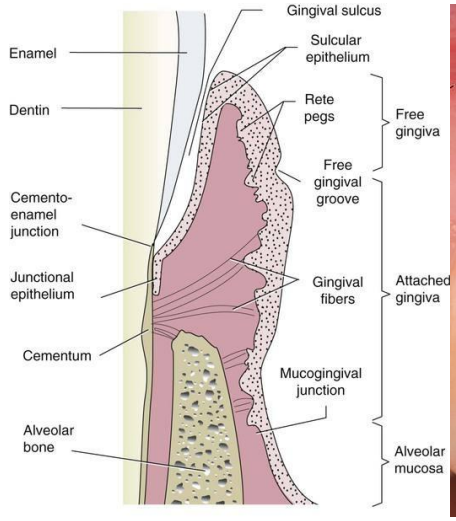
ii. **Parakeratinized epithelium** occurs in 75% of cases.

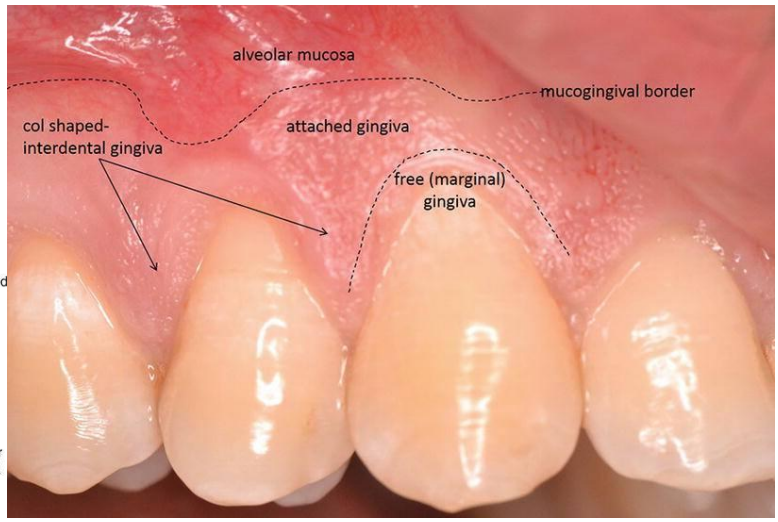
The parakeratinized is stratified squamous epithelium is considered as immature form of orthokeratinized epithelium, characterized by absence of granular layer and Cornified layer seen in the keratinized epithelium. The superficial layer of this epithelium is retaining pyknotic nuclei in their cells.

iii. **Nonkeratinized epithelium** occurs in 10% of the cases.

Parts of the gingiva

- Free gingiva
- Attached gingiva
- Interdental papilla





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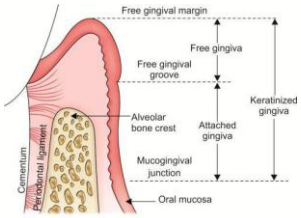
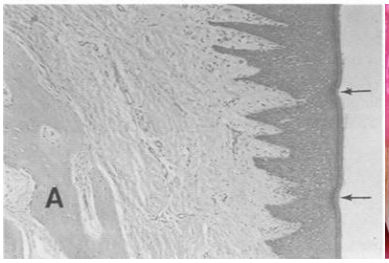


1. Free gingiva

Surrounds the cervical region of tooth.

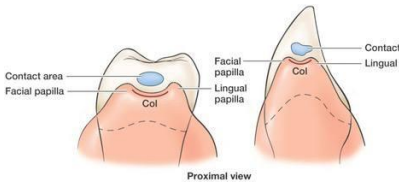
2. Attached gingiva:

It lies between free gingival groove and the alveolar mucosa where it separated from it by mucogingival junction. The attached gingiva is characterized by surface that appears stippled with orange peel appearance. In healthy attached gingiva "**stippling** "is seen which appears as **small pits in the epithelium and are due to deep rete pegs**. The Stippling is more in male than female. Also, the Stippling decreases by age. The absence of stippling is an indication of edema associated with gingivitis.



3. The interdental papilla:

It is that part of the gingiva that fills the space between two adjacent teeth. It has triangular shape when viewed from the vestibular aspect. It has pyramidal shape in the anterior teeth, and tent shape in posterior teeth.
The central part of the interdental which fits below the contact points is called **col**. Unlike the other part of the gingiva, the col is covered by thin nonkeratinized epithelium, so this part is more subjected to periodontal disease.



Clinical note: Due to absence of submucosa and firm adhesion of lamina propria of gingiva to bone, injection of local anesthetic agents into this area is difficult and painful.

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Hard palate

It is covered by masticatory mucosa. The mucous membrane of the hard palate is tightly fixed to underlying periosteum and therefore immovable, the attachment is by dense bands of connective tissue and traction bands. It has pink color.

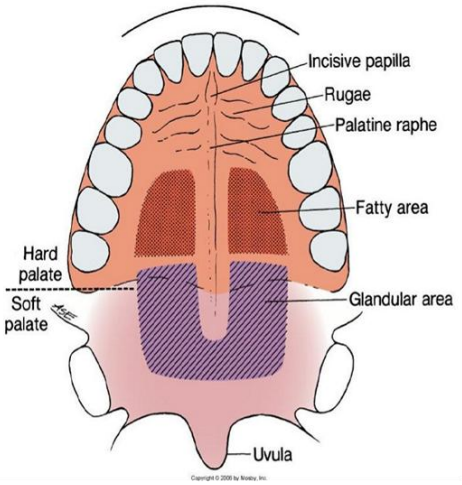
The mucosa is having orthokeratinized epithelium with dense lamina propria. The mucosa is showing transverse ridges called palatine rugae. The rugae are having core of dense connective tissue.

Regional differences in the hard palate:

a. Areas **without** submucosa in which the mucosa is forming mucoperiosteal arrangement with the bone:
   i. Gingival region adjacent to the teeth.
   ii. Palatine raphe (median area) which extends from incisive papilla posteriorly.

b. Areas **with** submucosa:
   i. Anterolateral part (fatty zone) in the premolar area. Here there is a fat tissue present in the submucosa
   ii. Posterolateral part (glandular zone) in the molar area. Here there are palatine minor salivary glands present in the submucosa.

The presence of fat and glands in the submucosa is acting as a cushion preventing the resorption of the bone of hard palate by reducing the pressure on the bone.



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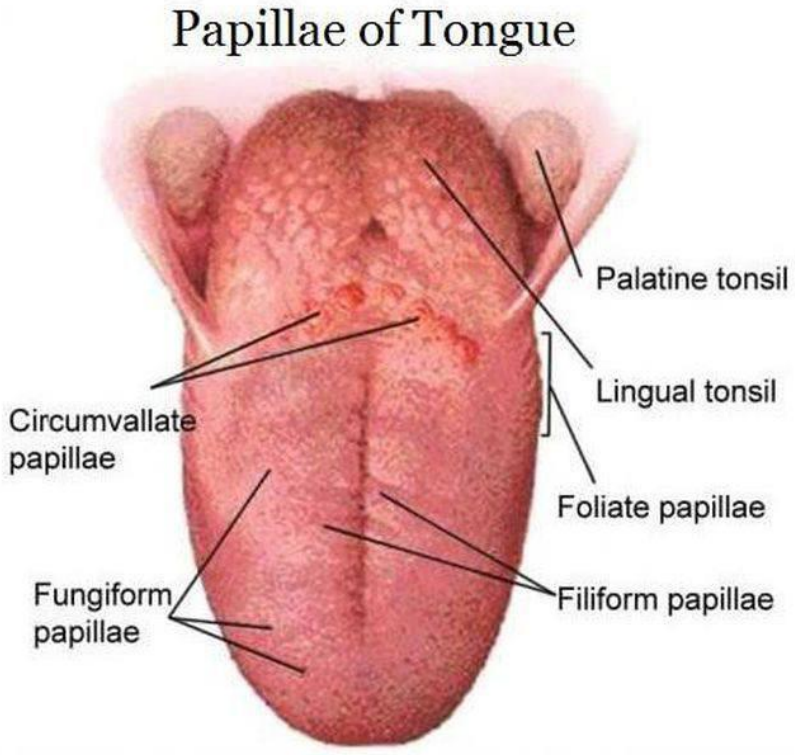
Specialized mucosa (Dorsal surface of tongue):

It is the mucosa that covers the dorsal surface of tongue. A **V** shaped line, the sulcus terminals divide it into anterior two third or body and a posterior one third or base (lymphoid part). The two parts developed from two different branchial arches. The body of tongue develops from the first branchial arch, while the base has developed from third branchial arch.

The body of tongue is having **lingual papillae**, which are specialization of the mucosa of this part, thus it is called papillary part. The base of tongue is having lymphatic nodules (the **lingual tonsils**) thus it is called lymphatic portion.



There are four types of lingual papillae:

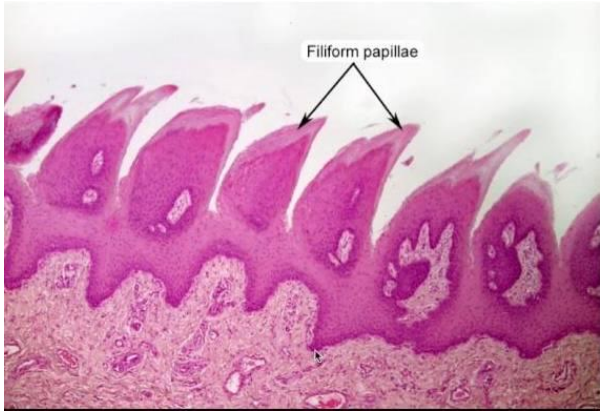
i. The Filiform papillae:

Makes up majority of the papillae and covers the anterior part of the tongue. They appear as slender, threadlike keratinized projections (~ 2 to 3 mm) of the surface epithelial cells.

These papillae facilitate mastication by:

a. Compressing and breaking food when tongue is opposed to the hard palate
b. And movement of the food on the surface of the tongue.
c. The papillae are directed towards the throat and assist in movement of food towards that direction.

These papillae have no taste buds.

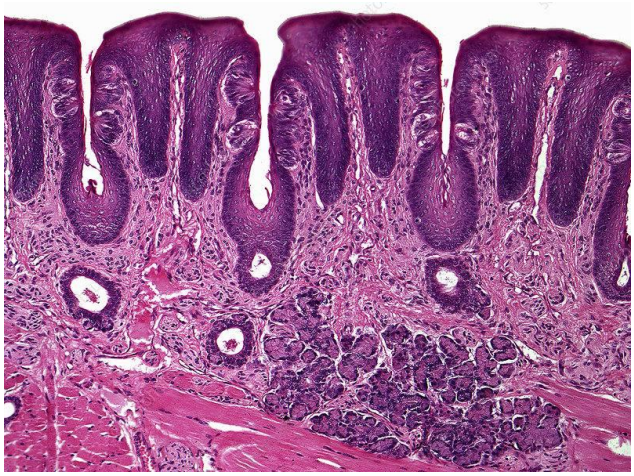


ii. Fungiform papillae:

(Fungus-like), these are interspersed between the filiform papilla. More numerous near the tip of the tongue. They have smooth, round structures that appear red because of their highly vascular connective tissue core, seen through a thin, nonkeratinized stratified squamous epithelium. **Taste buds are usually seen on the dorsal surface of the papillae only**.

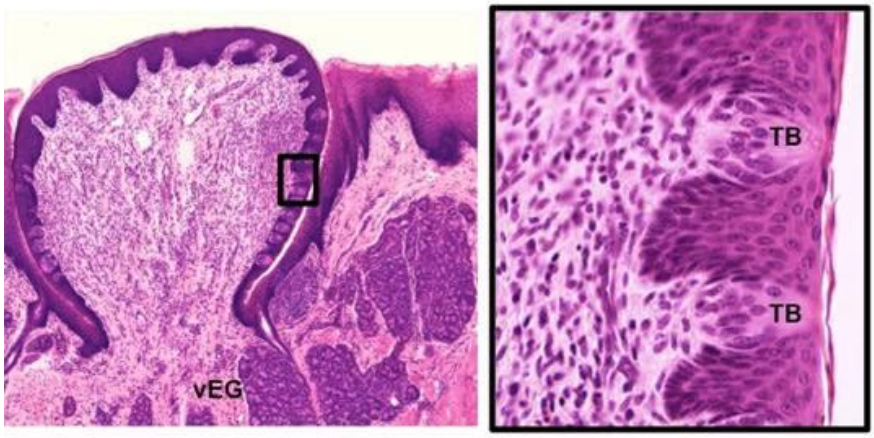
iii. Foliate papillae:

(Leaf-like). Present on the lateral margins of the posterior tongue. The papillae are consisting of 4 to 11 parallel ridges that alternate with deep grooves in the mucosa, and a few taste buds are present in the epithelium. They contain serous glands underlying the taste buds which cleanse the grooves. They are not well developed in the human being.



iv. Circumvallates papillae:

10 to 14 in number, these are seen along the V-shaped sulcus between the base and the body of the tongue. They are large, ~ 3 mm in diameter with a deep surrounding groove. Ducts of von Ebner glands (serous salivary glands) open into the grooves. Taste buds are seen lining the walls of the papillae.



Circumvallate papilla with taste buds (TB) and von Ebner's glands (vEG)

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Taste Buds:

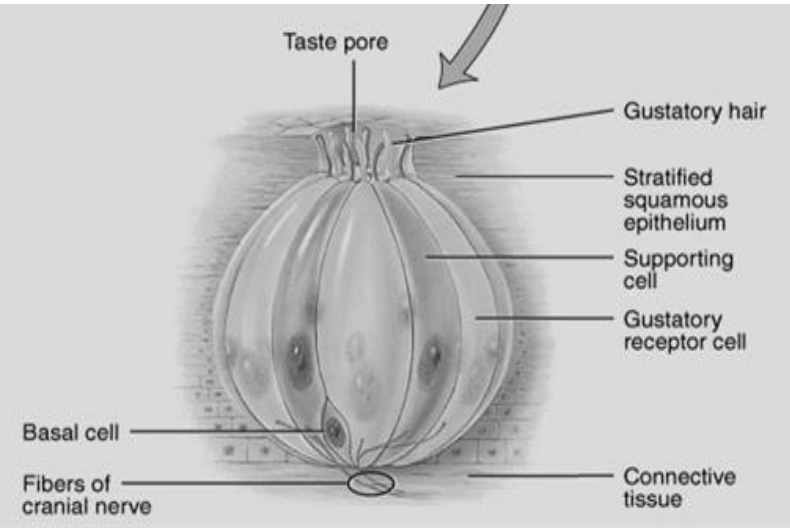
They are sense organs that contain the chemical sense for taste. Microscopically visible barrel-shaped bodies found in the oral epithelium. Usually, the taste buds are associated with papillae of the tongue (circumvallates, foliate and Fungiform).

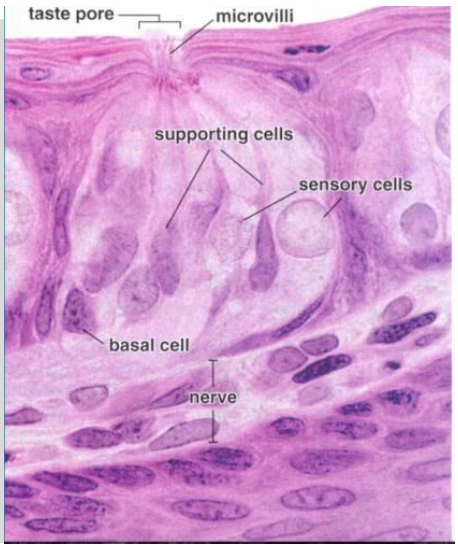
Also, they are seen in soft palate, epiglottis, larynx, and pharynx. (Epiglottis and larynx – supplied by vagus nerve)

Each taste bud has ~ 10 to14 cells.

Majority are taste cells with elongated microvilli that project into the taste pore.

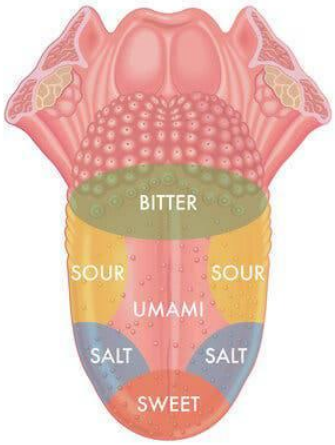
a. Type 1 dark cell (60% of cells)
b. Type 2, light cells (30%)
c. Type 3 (7%)
d. and Type 4 (basal cells ~ 3%).





There are four taste sensations: Sweet, salty, sour and bitter.

i. Sweet and salt: anterior part of the tongue.
ii. Sour: lateral tongue.
iii. Bitter: region of circumvallates papillae

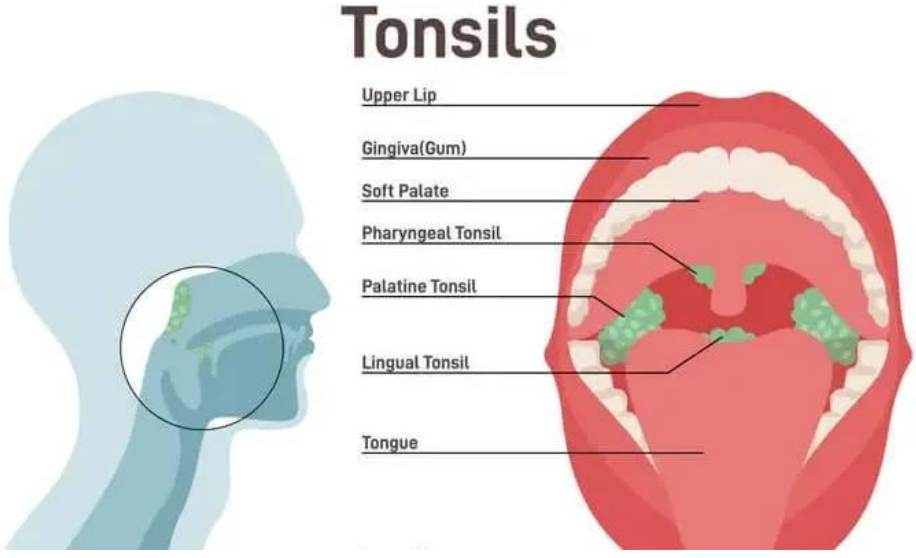


Tonsils

The tonsil tissues surrounding the oropharynx is forming a ring called the lymphatic ring of Waldeyer's. The **lymphatic ring** is comprised of lingual tonsil, palatine tonsils, and pharyngeal tonsil.

The function of tonsils is the production of T- lymphocytes and B- lymphocytes.

The B- lymphocytes are differentiating into plasma cells which synthesize antibodies.



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The Dentogingival apparatus (DGA):

The DGA is considered as part of the periodontium. Its function is to attach the tooth to the gingiva. It is comprised of two parts:

1. **Sulcular or crevicular epithelium:** This is an extension of the oral epithelium and lines the gingival sulcus. The gingival sulcus (or groove) is the name given to the invagination made by the gingiva as it joins the tooth surface. The depth of gingival sulcus in health person is 1-3 mm. Depth greater than 3 mm is considered pathologic and represents periodontal pocket.

The sulcular epithelium is nonkeratinized epithelium, and lacks the epithelial ridges.

2. **Junctional (attachment) epithelium:** It is the contact point between the gingiva and the surface of tooth. It is the only barrier between the oral cavity and underlying connective tissue.

The main features of the Junctional epithelium include:

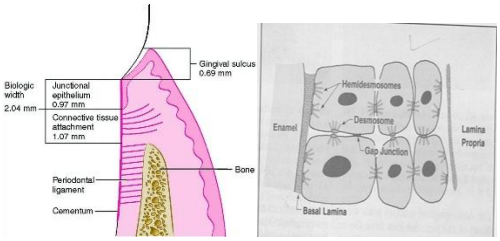
i. It is composed of nonkeratinized epithelium

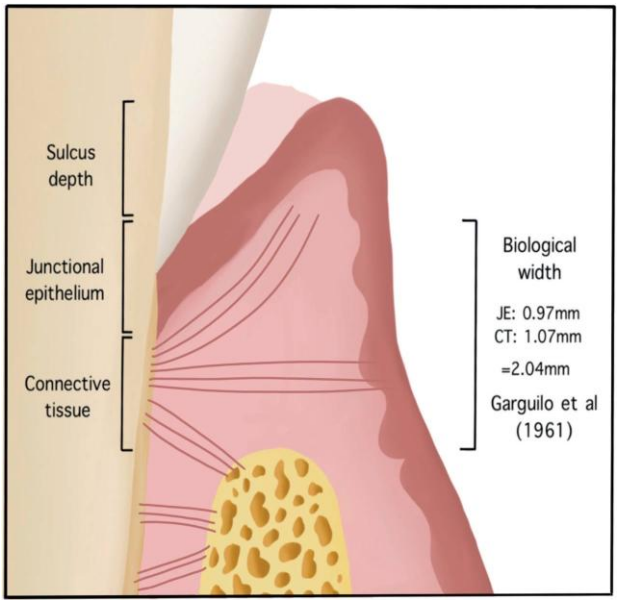
ii. The cells of the epithelium are having a high turnover rate (turnover time is 5-6 days).

iii. The thickness of the epithelium varies from 15-30 cells at the base of gingival sulcus to 1-2 cells at the cementoenamel junction.

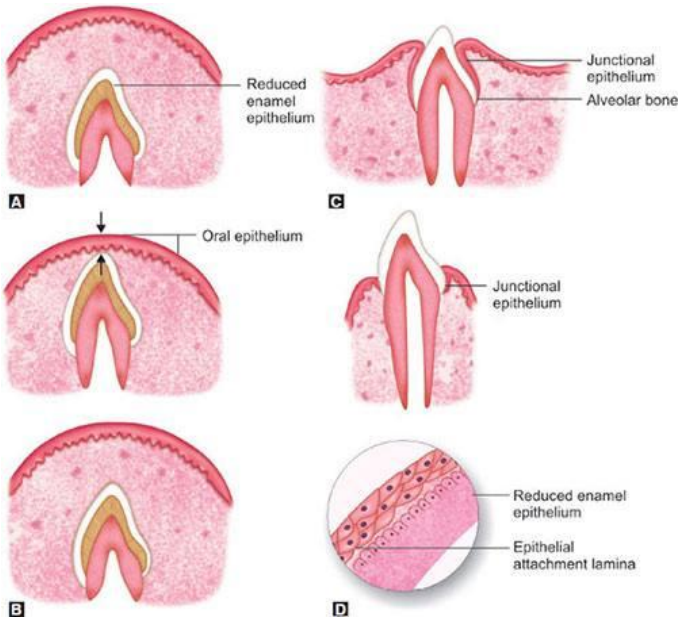
iv. The mode of attachment of this epithelium is consisting of **two basal laminae**. The first basal lamina is located between the tooth and Junctional epithelium. The second basal lamina is located between the Junctional epithelium and the lamina propria.

Junctional epithelium attached to enamel by internal basal lamina and to the connective tissue by external basal lamina. Hemidesmosomes are present in both basal laminae.





Development of the DGA: Prior to the eruption, the crown is covered by the reduced enamel epithelium, as the crown emerges into the mouth cavity, the reduced enamel epithelium remains attached to the surface of enamel. Thus, the reduced enamel epithelium is now called the primary attachment epithelium. That primary attachment epithelium will be replaced (after 2-3 years) by the secondary attachment epithelium derived from migration of cells from the gingiva.



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The shift of dentogingival apparatus (passive eruption):

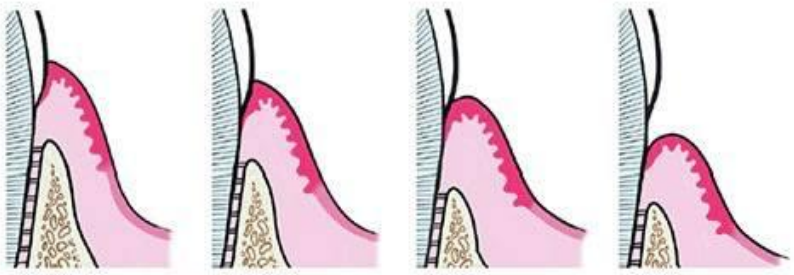
The DGA is shifted from its original position leading to more exposure of the crown into the mouth cavity. This process is called passive eruption. The part of the crown which bathed by the saliva and located coronal to the junctional epithelium is called **clinical** crown. It may be shorter, equal or larger than the **anatomical** crown.

The junctional epithelium has two ends:

i. **Superficial end:** it is the bottom of gingival sulcus
ii. **Deep end:** Is the apical end of junctional epithelium.

There are four stages representing the shift of DGA:

i. **First stage:** At which the superficial end at the bottom of gingival sulcus in the region of the crown. The deep end is at the cementoenamel junction. So, the clinical crown is smaller than anatomical crown. This stage persists to 20-25 years of age.
ii. **Second stage**: At which the superficial end still on the enamel, while the deep end shift to cementum. So, the clinical crown is smaller than anatomical crown. This stage is seen between 25-40 years of age.
iii. **Third stage:** At which the superficial end is on the cementoenamel junction and the deep end is on the cementum. At this stage the clinical crown is equal to the anatomical crown. This stage is seen above 40 years of age.
iv. **Fourth stage:** At which both the superficial end and deep end of junctional epithelium is on the cementum, thus the clinical crown would larger than the anatomical crown. This stage is seen in old age above 60 years of age.



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Nonkeratinocytes in oral epithelium

Constitute about 10% of epithelial cell population. Three major cells which are all **clear** cells with a halo around their nuclei. These cells are called cells because they are not stained in the H&E stain.

1. **Langerhans cells:** A bone marrow origin cells found on stratum spinosum and **function as antigen presenting cells. The antigen after being processed by these cells will be presented to T-lymphocytes**.

2. **Merkel cell:** A neural crest origin cell located in basal cell layer (mostly in gingiva). It is associated with axon terminal so function as **touch receptors.**

3. **Melanocytes:** A neural crest origin cells found in basal cells. Melanin-producing cells (mostly in gingiva). They are highly dendritic cells. They are characterized by the presence of melanin granules (melanosome). Heavily pigmented gingiva in some people is due to the excessive production of melanin by the melanocytes and its subsequent intake by the neighboring epithelial cells.

4. **Lymphocytes and leukocytes:** Inflammatory cells that are not clear cells. They are associated with inflammatory response in oral mucosa.