Terms in periodontology

The term periodontium arises from the greek word **"Peri"** meaning around and **"odont"** meaning tooth, thus it can be simply defined as "the tissues investing and supporting the teeth".

- The various diseases of the periodontium are collectively termed as **periodontal diseases**.
- **Periodontal therapy**: is the treatment of periodontal diseases.
- **Periodontology:** the clinical science that deals with the periodontium in health and disease.
- **Periodontics**: is the branch of dentistry concerned with prevention and treatment of periodontal disease.

Normal periodontium

The normal periodontium provides the support necessary to maintain teeth in function. It consists of four principal components:

- ☒ Alveolar bone.
- ☒ Root cementum.
- ☒ Periodontal ligament (Supporting tissues).
- ☒ Gingiva (investing tissue).

Each of these periodontal components is distinct in its location, tissue architecture, biochemical composition, and chemical composition, but all of these components function together as a single unit. Healthy periodontium is usually defined by the absence of inflammation or disease progression.

Periodontal Phenotype

The term **periodontal biotype** was first defined by Seibert in 1989 to categorize periodontium into **"thin-scalloped" and "thick-flat" and "thick-scalloped" biotypes** . Other terms such as **"gingival biotype," "periodontal morphotype," "gingival morphotype,**" **and "gingival phenotype"** were also widely used to refer to the clinical variations in the gingival thickness, the amount of the keratinized tissue width, bone morphotypes, the shape of the tooth, and other morphological characteristics of the gingiva and the periodontium.

Fig. 4.1 (A) Thin-scalloped biotype. (B) Thick-flat biotype. (C) Thick-scalloped biotype. (Courtesy Dr. Wael Isleem and Dr. Vicky Choi.)

The 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions **recommended the adoption of the term "periodontal phenotype"** to describe the combination of gingival phenotype (three-dimensional gingival volume and the width of the keratinized tissue) and bone morphotype. This classification system categorizes periodontal phenotype into **"thin-scalloped," "thick-scalloped," and "thick-flat."** Periodontal phenotype is considered as the combination of the gingival phenotype and bone morphotype. Phenotype is influenced by a combination of **genetic traits and environmental factors**. It is important to know that the periodontal phenotype changes over time due to environmental factors or by phenotype modification therapy. The periodontal phenotype may play an important role in disease progression such as gingival recession and bone resorption.

Oral Mucosa

The oral mucosa consists of the following three zones:

1. The gingiva and the covering of the hard palate, termed the **masticatory mucosa** (the gingiva is the part of the oral mucosa that covers the alveolar processes of the jaws and surrounds the necks of the teeth)

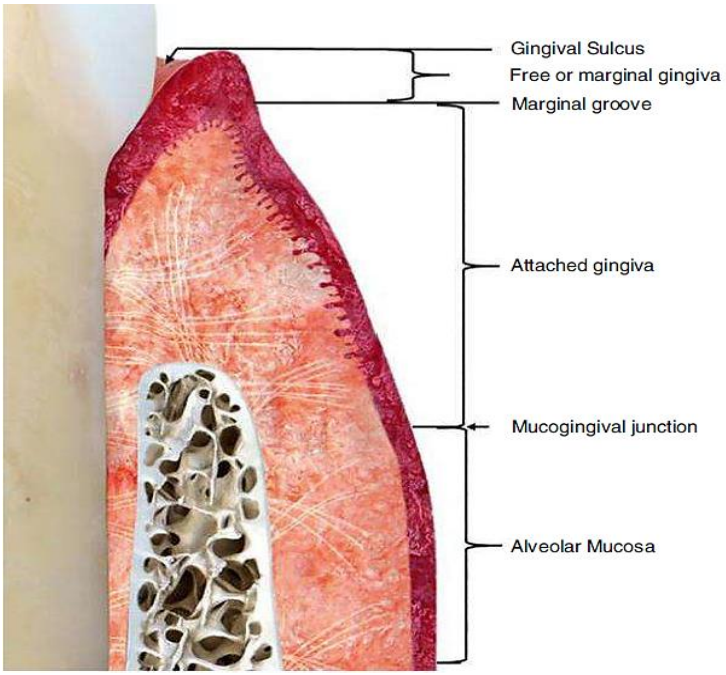
2. The dorsum of the tongue, covered by **specialized mucosa**

3. The **oral mucous membrane** lining the remainder of the oral Cavity

Gingiva

Clinical Features

In an adult, normal gingiva covers the alveolar bone and tooth root to a level just coronal to the **cementoenamel junction**.



Anatomically the gingiva is divided into:

- ☒ Marginal gingiva (free or un-attached gingiva)
- ☒ Attached gingiva
- ☒ Interdental gingiva

Although each type of gingiva exhibits considerable variation in differentiation, histology, and thickness according to its functional demands, all types are specifically structured to function appropriately against mechanical and microbial damage. In other words, the specific structure of different types of gingiva reflects each one's effectiveness as a barrier to the penetration by microbes and noxious agents into the deeper tissue.

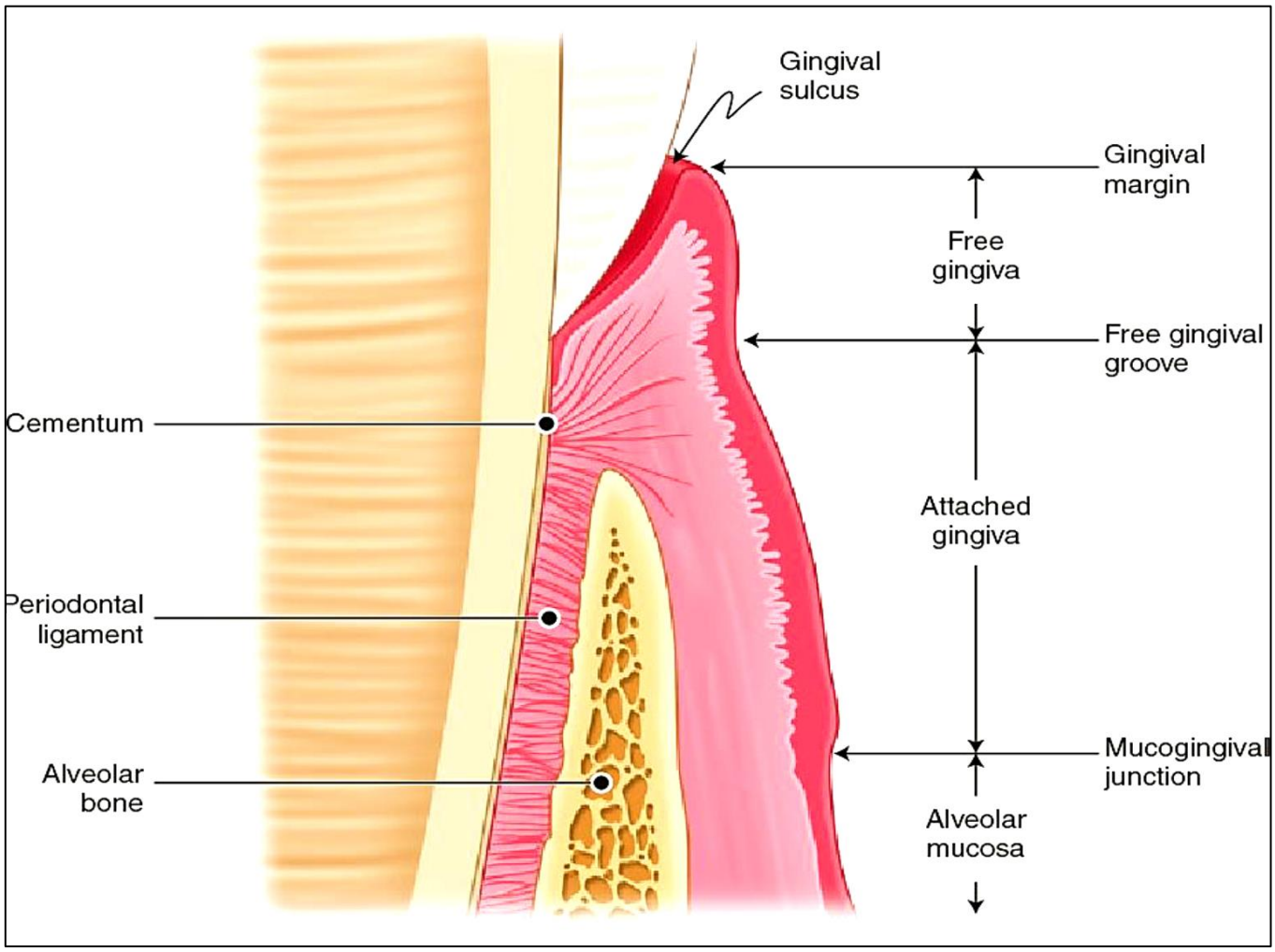
Marginal Gingiva

The marginal or unattached or free gingiva is the terminal edge or border of the gingiva that surrounds the teeth in a collar-like fashion. In about **50%** of cases, it is demarcated from the adjacent attached gingiva by a shallow linear depression called the **free gingival groove**. The marginal gingiva is usually about **1 mm wide**, and it forms the soft-tissue wall of the gingival sulcus. It may be separated from the tooth surface with a periodontal probe. The most apical point of the marginal gingival scallop is **called the gingival zenith**. Its apicocoronal and mesiodistal dimensions vary between 0.06 and 0.96 mm.

Gingival Sulcus

The gingival sulcus is the shallow crevice or space around the tooth bounded by the surface of the tooth on one side and the epithelium lining the free margin of the gingiva on the other side. It is V-shaped and barely permits the entrance of a periodontal probe. The **clinical determination of the depth of the gingival sulcus is an important diagnostic paramete**r. Under **absolutely normal or ideal conditions**, the depth of the gingival sulcus is **0 mm or close to 0 mm**. These strict to experimental conditions in germ-free animals. The depth of this sulcus, as determined in **histologic sections**, has been reported as **1.8 mm** , other studies have reported **1.5 mm and 0.69 mm**. The **clinical evaluation** used to determine the depth of the sulcus involves the introduction of a metallic instrument (periodontal probe) and the estimation of the distance it penetrates (i.e., the probing depth). The penetration of the probe **depends on** several factors, such as probe diameter,

probing force, and level of inflammation. Consequently, the probing depth is not necessarily exactly equal to the histologic depth of the sulcus. The so-called **probing depth of a clinically normal gingival sulcus** in humans is **2 to 3 mm**. The visibility of the periodontal probe through the gingiva during probing is also commonly used as a technique to measure gingiva thickness. **If the periodontal probe is visible through the gingiva after being inserted in the sulcus, the periodontal phenotype is considered as thin. On the other hand, it is considered as thick when the probe is not visible**.



Anatomy of gingival tissue.

Gingival Fluid (Sulcular Fluid)

The value of the gingival fluid is that it can be represented as either a **transudate** or an **exudate**. The gingival fluid contains a vast collection of biochemical factors, which that use as a diagnostic or prognostic biomarker of the biologic state of the periodontium in health and disease. It also contains components of connective tissue, epithelium, inflammatory cells, serum, and microbial flora. In the healthy sulcus, the amount of gingival fluid is very small. During inflammation, however, the gingival fluid flow increases, and its composition starts to resemble that of an inflammatory exudate. The main route of the gingival fluid diffusion is through the basement membrane, and then into the sulcus. **The gingival fluid is believed to do the following: (1)** rinse the gingival sulcus ; **(2)** contain plasma proteins that may improve adhesion of the epithelium to the tooth; **(3)** possess antimicrobial properties; and **(4)** exert antibody activity to defend the gingiva.

Attached Gingiva

The attached gingiva is continuous with the marginal gingiva. It is firm, resilient, and tightly bound to the underlying periosteum of alveolar bone. The facial aspect of the attached gingiva extends to the relatively loose and movable alveolar mucosa; it is demarcated by the mucogingival junction. **The width of the attached gingiva** is the distance between the mucogingival junction and the projection on the external surface of the bottom of the gingival sulcus or the periodontal pocket. It should not be confused with the **width of the keratinized gingiva**, although this also includes the marginal gingiva. The width of the attached gingiva on the facial aspect differs in different areas of the mouth. It is generally greatest in the incisor region **(3.5 - 4.5 mm in the maxilla, 3.3 - 3.9 mm in the mandible)** and narrower in the posterior segments **(1.9 mm in the maxillary first premolars and 1.8 mm in the mandibular first premolars)**. The width of attached gingiva increases with age and super-erupted teeth.

Interdental Gingiva

The interdental gingiva occupies the gingival embrasure, which is the interproximal space beneath the area of tooth contact. The interdental gingiva can be pyramidal in which the tip of one papilla is located immediately beneath the contact point; or it can have a "col" shape present as valley-like depression that connects a facial and lingual papilla.

The lateral border and tip of the Interdental papilla are formed by continuation of marginal gingiva and the intervening portion by the attached gingiva. In the presence of diastema the interdental papilla will be absent.

The shape of Interdental gingiva depends on

- ☒ The contact relationship between the teeth.
- ☒ The width of the proximal tooth surfaces
- ☒ The course of the cemento-enamel junction.

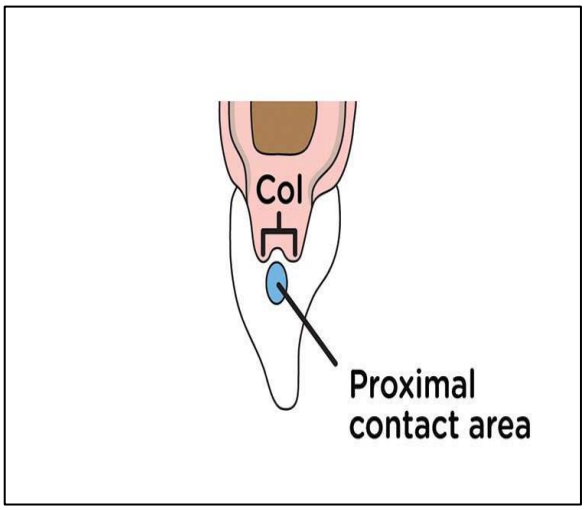


Fig.:- Anatomy of the interdental area.

Microscopic features of gingival tissue

The gingiva consists of a central core of connective tissue covered by stratified squamous epithelium.

Three types of epithelium exist in the gingiva:

1. The oral or outer epithelium (Keratinized epithelium)

2. The sulcular epithelium

3. The junctional epithelium (Non-keratinized epithelium).

Oral (Outer) Epithelium (OE)

It covers the crest and the outer surface of the marginal and attached gingiva. On average, the oral epithelium is 0.2- 0.3 mm in thickness. It is keratinized or parakeratinized or combination of both.

Keratinization varies in different areas as in the following:

Palate (**Most** keratinized)

Gingiva

Ventral aspect of the tongue

Cheek (**least** keratinized)

The boundary between the oral epithelium and the underlying connective tissue has a wavy course. The projections of epithelial cells into the connective tissue are known as "**Rete Pegs**" while the intervening connective tissue portions which project into the epithelium are called **connective tissue papillae**. This alternating pattern of depression and protuberances of the connective tissue papillae and epithelial rete pegs is thought to give the attached gingiva the **stippled appearance (Fig.)**.

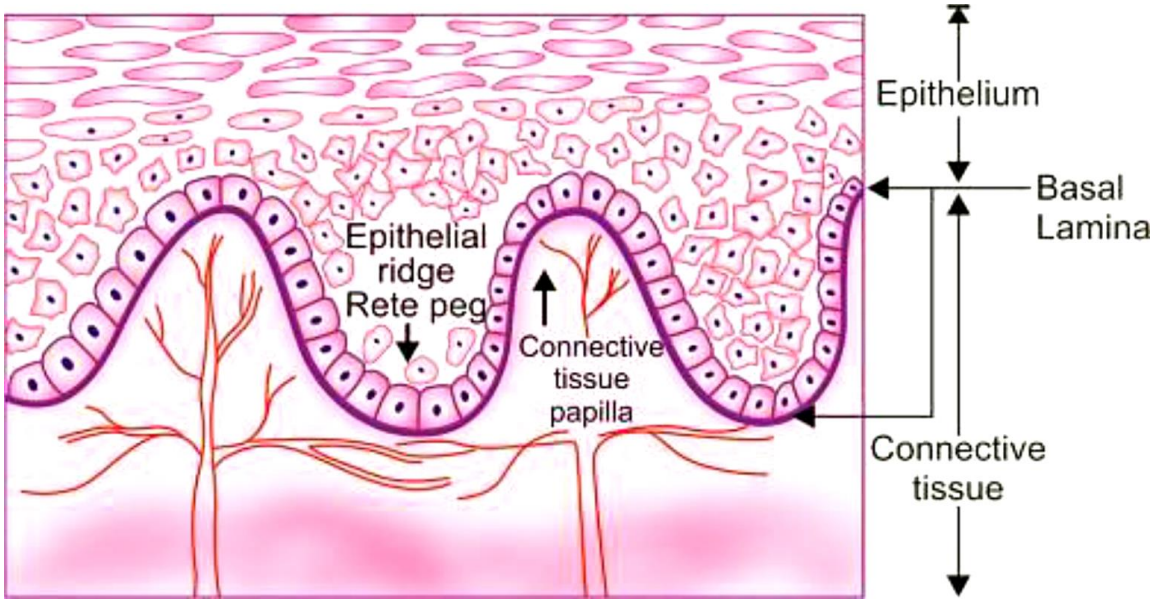


Fig.: Rete pegs and C.T papilla.

The oral epithelium has the following cell layers (Fig.):

1. Basal layer (stratum basale): The basal cells are either cuboidal or cylindrical and have the ability to divide. The basal cells are separated from the connective tissue by a basement membrane.

2. Spinous layer (Stratum spinosum): Consists of large cells with short cytoplasmic processes

3. Granular layer (stratum granulosum): Granules are believed to be related to synthesis of keratin.

4. Keratinized cell layer (stratum Corneum): The most superficial layer and where both para and ortho-keratinization occur.

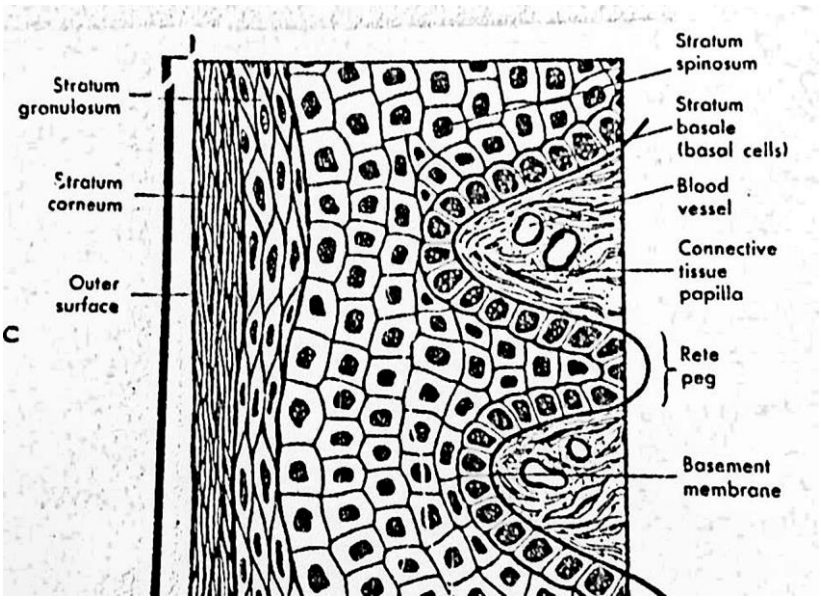


Fig.:- Cell layers of the oral epithelium.

Types of cells in the oral epithelium:-

1. Keratinocytes cell: it is the principal cell type of oral epithelium comprises about 90% of the total cell population, responsible for the production of keratin which contributes to the protective function of the epithelium. These cells undergo continuous proliferation and differentiation from basal cell to the surface of epithelium. It takes about 3-4 weeks for the keratinocyte to reach the outer surface.

2. Melanocyte cells: responsible for the production of melanin pigment and can be found in the basal cell layer.

3. Langerhans cell: they play a role in defense mechanism of the oral epithelium. They have an immunological function by recognizing and processing antigens.

4. Merkel cells: they are located in the deeper layers of epithelium, they have nerve ending and have been identified as tactile receptors.

The epithelial cells are joined together by structure known as **desmosome**, which is composed of two hemidesmosomes separated from each other by **granulated material(GM).**

Each hemidesmosome is composed from:

- ☒ **The outer leaflets (OL):** of cell membrane of two adjoining cells.
- ☒ **The inner leaflet (IL):** is the thicker leaflet of cell membrane.
- ☒ **The attachment plaque (AP):** which represent granular and fibrillar material in the cytoplasm.

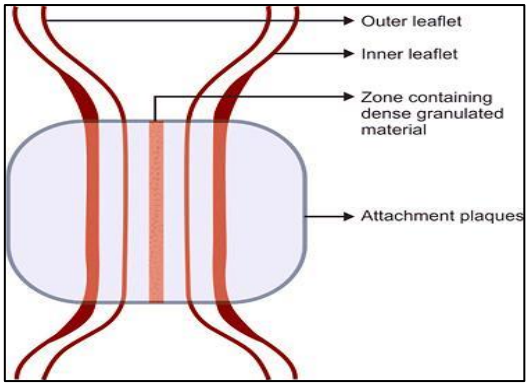


Fig.:- Hemidesmosome

Sulcular Epithelium (SE)

It lines the gingival sulcus and is thin; nonkeratinized stratified squamous epithelium without rete pegs. It extends from the coronal limit of the junctional epithelium to the crest of the gingival margin. The sulcular epithelium is act as a semi permeable membrane.

Junctional Epithelium (JE)

The epithelium that attaches the gingiva to the tooth surface. It forms the base of the sulcus. The junctional epithelium is attached to the tooth surface by **internal basal lamina and hemidesmosome** and to the gingival connective tissue by **external basal lamina and hemidesmosome**. The attachment of the JE to the tooth is reinforced by the gingival fibers; hence, the **JE and the gingival fibers** are considered a functional unit, referred to as the **dentogingival unit**. It is quite permeable and thus serves as a pathway for diffusion of the bacterial plaque products to the connective tissue. There is also a diffusion of host defense substances in the opposite direction moving towards the sulcus **(Fig.).**

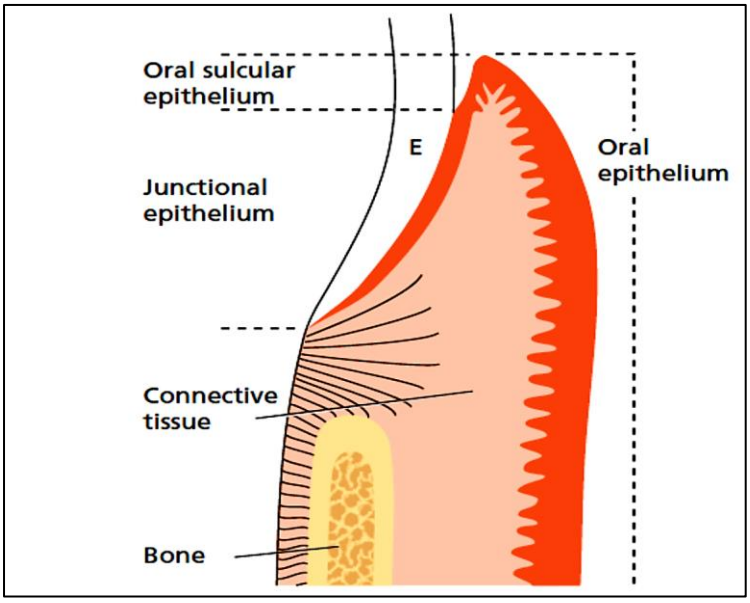


Fig.:- Types of gingival epithelium.

The JE assumes a key role in maintenance of periodontal health, it creates the firm epithelial attachment that connects the soft tissue to the tooth surface. It is quite permeable and thus serves as a pathway for diffusion of the bacterial plaque products to the connective tissue. There is also a diffusion of host defense substances in the opposite direction moving towards the sulcus.

Differences between the three types of gingival epithelium:

- ☒ The **size of the cells** in the junctional epithelium is relatively larger than the oral epithelium.
- ☒ The intercellular spaces are **wider** in the junctional epithelium than the oral epithelium.
- ☒ The **number of desmosome** is fewer in the junctional epithelium than the oral epithelium, **this could explain** the JE susceptibility to tear during probing and its greater permeability to migrate cells and fluids.
- ☒ **No** Keratinization, **no** rete pegs in the sulcular and junctional epithelium, **so they are thinner** than oral epithelium
- ☒ **Turnover rate is very high** in junctional epithelium (4-6 days) compared to oral epithelium (6-12 days or up to 40 days).
- ☒ Junctional epithelium **forms the attachment** of the gingiva to the tooth surface while oral and sulcular epithelium have no attachment to tooth surface.

Epithelial connective tissue interface:

Basement membrane forms a continuous sheet that connects the epithelium and connective tissue. Electron microscope reveals a fibrillar structure, called as **the basal lamina** which is a part of the basement membrane. This structure has

- **Lamina lucida** adjacent to the basal epithelial cell.
- **Lamina densa** which is located beneath the lamina lucida from this structure and there are anchoring fibrils that project into the connective tissue.

Gingival Connective Tissue (CT) (Lamina propria)

The major components of the connective tissue are collagen fibers (**around 60%** of connective tissue volume), fibroblasts (**around 5%),** vessels and nerves (**around 35%),** which are embedded in an amorphous ground substance (matrix).

- **The superfacial papillary layer:** This has papillary projections between the epithelial rete pegs.
- **The deep reticular layer:** that lies between the papillary layer and the underlying structures.

The different types of cell present in the connective tissue are:

1. **Fibroblast:** the most predominant cells of the CT (65%). They synthesize collagen, elastic fibers and the connective tissue matrix, and they regulate collagen degradation.
2. **Mast cells :** It is responsible for the production of certain components of the matrix, and they produce vasoactive substances which may control the flow of blood through the tissue.
3. **Macrophages :** have a phagocytic action and involved in the defense mechanism.
4. **inflammatory cells :** have different immunological functions such as polymorphonuclear leukocytes, lymphocytes and plasma cells.

The connective tissue fibers are produced by the fibroblasts and can be divided into:

1. Collagen fibers (the most predominant fibers)
2. Reticulin fibers
3. Oxytalan fibers
4. Elastic fibers.

Gingival Fibers

The connective tissue of the marginal gingiva is contains a prominent system of collagen fiber bundles called the gingival fibers. These fibers consist of type I collagen.

The gingival fibers have the following **functions**:

1. To brace the marginal gingiva firmly against the tooth.
2. To provide the rigidity to withstand the forces of mastication without being deflected away from the tooth surface.
3. To unite the free marginal gingiva with the cementum of the root and the adjacent attached gingiva.

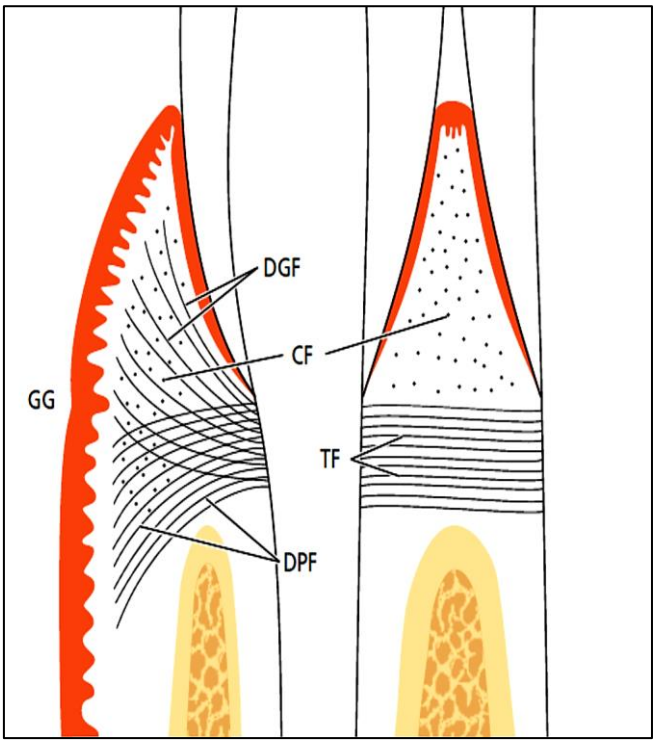
Gingival fibers groups (Fig.):-

1. Circular fibers (CF) are fiber bundles which run their course in the free gingiva and encircle the tooth in a cuff- or ring-like fashion.

2. Dentogingival fibers (DGF) are embedded in the cementum of the supra-alveolar portion of the root and project out from the cementum in a fan-like configuration into the free gingival tissue of the facial, lingual, and interproximal surfaces.

3. Dentoperiosteal fibers (DPF) are embedded in the same portion of the cementum as the dentogingival fibers, but run their course apically over the vestibular and lingual bone crest and terminate in the tissue of the attached gingiva.

4. Trans-septal fibers (TF) extend between the supra-alveolar cementum of approximating teeth. The trans-septal fibers run straight across the interdental septum and are embedded in the cementum of adjacent teeth.

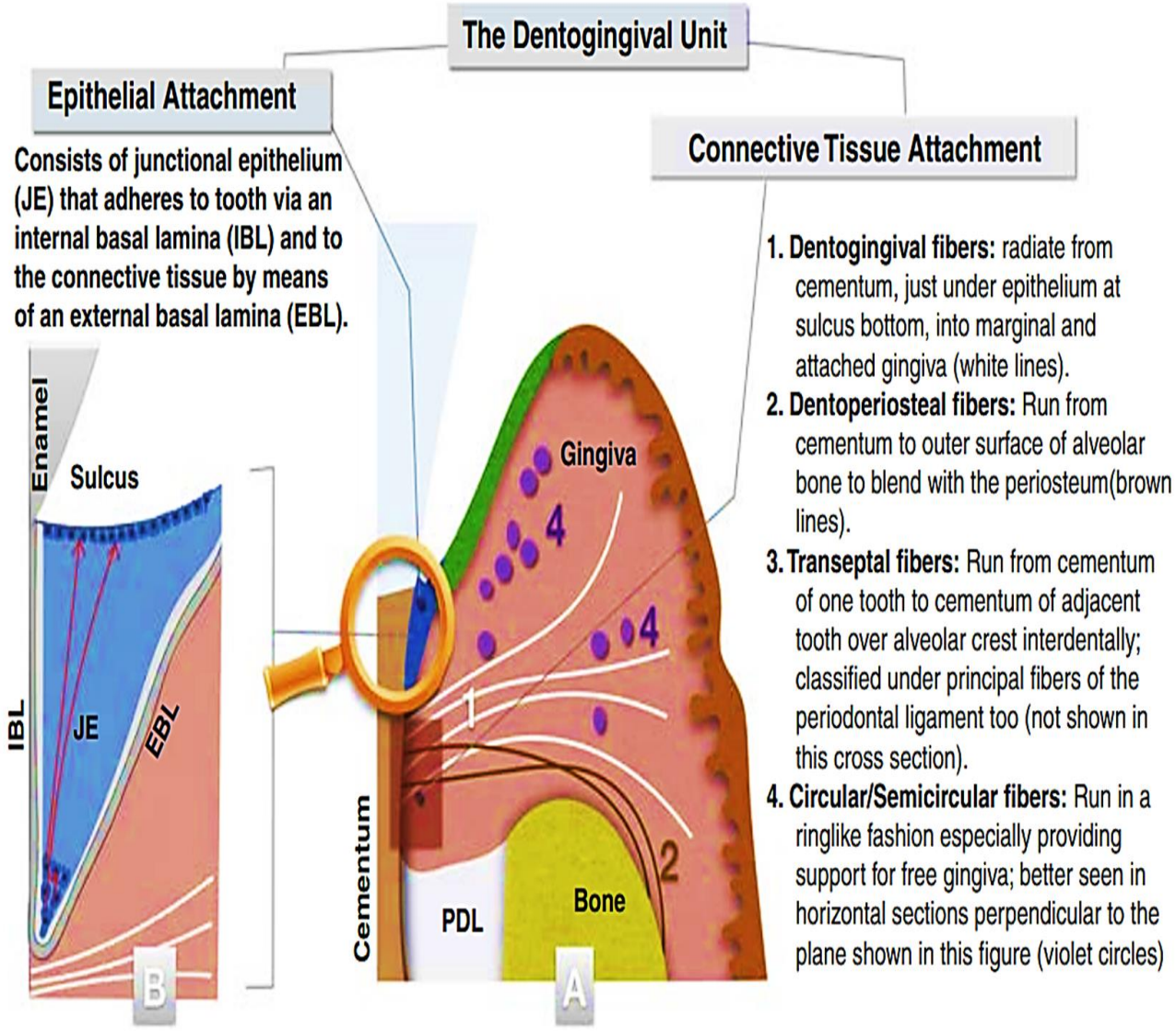


Blood supply and nerves:

Gingival tissue has rich vascular supply from **internal maxillary artery** :-

- **Supraperiosteal arteriols.**
- **Vessels of periodontal ligaments.**
- **Arterioles emerging from the crest of the Interdental septa**.

Nerve supply is derived from the **terminal branches of the maxillary and mandibular branches of the trigeminal nerve.**



For more info. Please check

1- Anatomy, Structure, and Function of the Periodontium in Newman and Carranza's Clinical Periodontology book.

2- Anatomy of Periodontal Tissues in Clinical Periodontology and Implant Dentistry Niklaus P. Lang and Jan Lindhe.