

Al Rasheed College of Dentistry
Oral Histology

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Lecture 11

Periodontal ligament (PDL)

The PDL is a fibrous C.T. Ligament located between alveolar bone and cementum. The PDL is composed of cells and intercellular substance which consists of collagen fibers and ground substance (protein and polysaccharides). The PDL has a thickness of 0.15 to 0.38 mm, is thinnest in the mid-root area, and decreases slightly in thickness with age.

Structure of PDL:

The PDL consists of three components which are commonly found in other C.T., these are cells, ground substance and fibrous matrix.

- **Cells of PDL:**

The cells of PDL may be divided into three categories:

1-Synthetic cells: They have the ability to produce and secrete protein. The synthetic cells include

a- Fibroblasts: Are the most common cells in PDL, they constitute about 65% of total cells in PDL, which are found usually running parallel to the collagen fibers of PDL. The shape of the cell is either spindle or round in shape, they are responsible for the formation of ground substance and collagen fibers of PDL, they are also capable of synthesizing and degrading collagen fibers.

b-Osteoblasts: These cells are responsible for bone formation and growth of bone tissue. They are seen covering the periodontal surface of the alveolar bone.

c-Cementoblasts: they are cementum forming cells found covering the periodontal surface of the cementum.

2-Resorptive cells:

a- Osteoclasts: These cells resorb the bone surface, their presence on the bone surface indicates that resorption was active or had recently occurred. Osteoclasts are usually large and multinucleated, which are formed by the fusion of several monocytes cells. They are usually present in a depression in the bone

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known as **Howship's lacunae**. The surface of the cell containing the resorbed bone surface is raised into folds and is termed ruffled or striated borders.

b-Cementoclasts: These cells resemble osteoclasts. As the cementum rarely undergo resorption. They are multinucleated giant cell , often located in **Howship's lacunae** are found on the surface of cementum Its origin is unknown, but it may arise in the same manner of osteoclasts.

c-Fibroblasts: Usually fibroblasts are capable of both synthesis and resorption of collagen fibers of PDL, they resorb fibers during physiological remodeling or turnover of the PDL.

3-Other cells:

a-Progenitor cells: Are undifferentiated mesenchymal cells that have the capacity to undergo mitotic division and differentiates into another type of PDL cells. It has a small nucleus and very little cytoplasm, and are found close to the blood vessels.

b-Epithelial cell rest of Malassez: These are the remnants of the Hertwig's epithelial root sheath, found in the PDL close to the cementum. They are found as a rose-like strands or tubules. Under certain pathological conditions they can undergo rapid proliferation and produce a variety of cysts or tumors.

c-Defensive cells: They are usually present in PDL and increase in number during inflammation of PDL. These include mast cells, macrophage cells, and neutrophil cells.

Ground substance:

It comprises mucopolysaccharides and glycoproteins. Both groups comprise protein and polysaccharides. The ground substance fills the spaces between cells, fibers, blood vessels and nerves.

Interstitial tissue:

These are areas containing some of blood vessels, lymphatics and nerves of PDL and surrounded by loose connective tissue.

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Blood Vessels of PDL:

The arterial vessels of the PDL derived from 3 sources:

1-Branches from the apical vessels, that supply the dental pulp.

2-Branches from the intra-alveolar vessels these are the main branches run horizontally penetrate the alveolar bone to enter the PDL and they are called perforated arteries

3-Branches from gingival vessels these enter the PDL from the gingiva.

The arterioles and capillaries forming arch network that more evident in the half of the PDL adjacent to the cementum.

Lymphatics:

A network of lymphatic vessels following the path of B.V., provides the lymph draining of PDL, the flow from the ligament towards and into the adjacent alveolar bone.

Nerves:

The N. Supply of PDL comes from the maxillary and mandibular branches of the fifth cranial nerve (trigeminal). Usually associated with B.V., pass through multiple foramina in the alveolar bone, and from apical foramen to enter the PDL.

Fibers of PDL:

The fibers present in PDL are made up of **collagen fibers and oxytalan fibers**

1.Collagen fibers:

They form the major element within the PDL and they include principle fibers of PDL. and gingival fiber groups.

A-Principle fibers of PDL:

One end of the principle fiber embedded in cementum and other end embedded in alveolar bone. The embedded portion of the principle are called Sharpy's fibers. The principle fibers Can be divided into 5 groups according to the direction in which they run in the PDL as follow:

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- I. Alveolar crest fibers group:** These fibers are attached to the cervical part of the cementum just below the C.E.J. and insert into the crest of the alveolar bone.
- II. Horizontal fibers group:** These fibers extends in a horizontal direction, from the midroot cementum to the adjacent alveolar bone.
- III. Oblique fibers group:** These fibers represent the most numerous type in the PDL. They are running from the cementum in an oblique direction to insert in the alveolar bone.
- IV. Apical fibers group:** These fibers extends perpendicular from the cementum of the apex to the adjacent alveolar bone which surrounds the apex of the root.
- V. Interradicular fibers group:** These fibers are located between the roots of the multirrooted teeth, and extend perpendicular to the cementum and into the crest of interradicular septa in multirrooted teeth.

B-Gingival fiber groups: These are collagen f. Which are not really from PDL, but are located coronally to the PDL. Their function is to attach the gingiva to the tooth. These bundles are arranged in groups as follow:

- I. Dentogingival group:** These fibers are the most numerous, extending from the cervical cementum to the gingiva.
- II. Alveologingival group:** These fibers radiate from the alveolar crest bone to the gingiva.
- III. Circular group:** This small group of fibers forms a band around the neck of the teeth, interlacing with other groups of fibers in the gingiva.
- IV. Dentoperiosteal group:** Running from the cervical cementum and insert in the periosteum of the alveolarbone.
- V. Transseptal group:** These fibers connect two adjacent teeth, i.e. The fiber run from the cementum of one tooth over the crest of alveolar bone to the cementum of the adjacent tooth.

2. Oxytalan fibers:

Oxytalan fibers are type of immature elastic fibers present in PDL. The fibers run vertically from the cementum of the root and terminates in the arteries, veins, and lymphatics. Oxytalan fibers are numerous and dense in the **cervical region** of the ligament. Their function is to regulate vascular flow in relation to tooth function.

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Functions of the PDL:

1. Supportive

PDL forms a functional system which provides an attachment for the tooth to the bone of the jaw.

2. Sensory:

PDL having the mechanoreceptor contributes to the pressure and touch on the teeth.

3. Nutritive:

The B.V. In the PDL provides nutrient supply required by the cells of the PDL and to the cementocytes in cementum and most superficial osteocytes in alveolar bone.

4. Formative:

The fibroblasts cells present in the PDL are responsible for the formation of new collagen fibers. Another formative function is achieved by the cementoblasts and osteoblasts which are essential in building up cementum and alveolar bone.