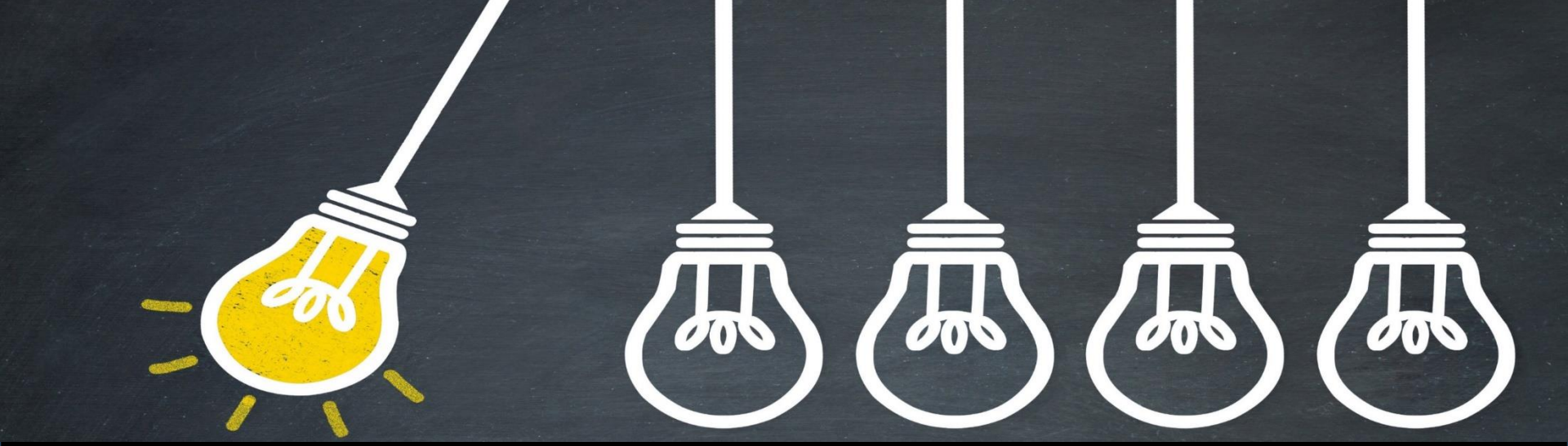
Lecture 10: **Periodontal Ligament (PDL)**

By

Dr. Fatma Rashed & Dr. Wafaa Alghonemy



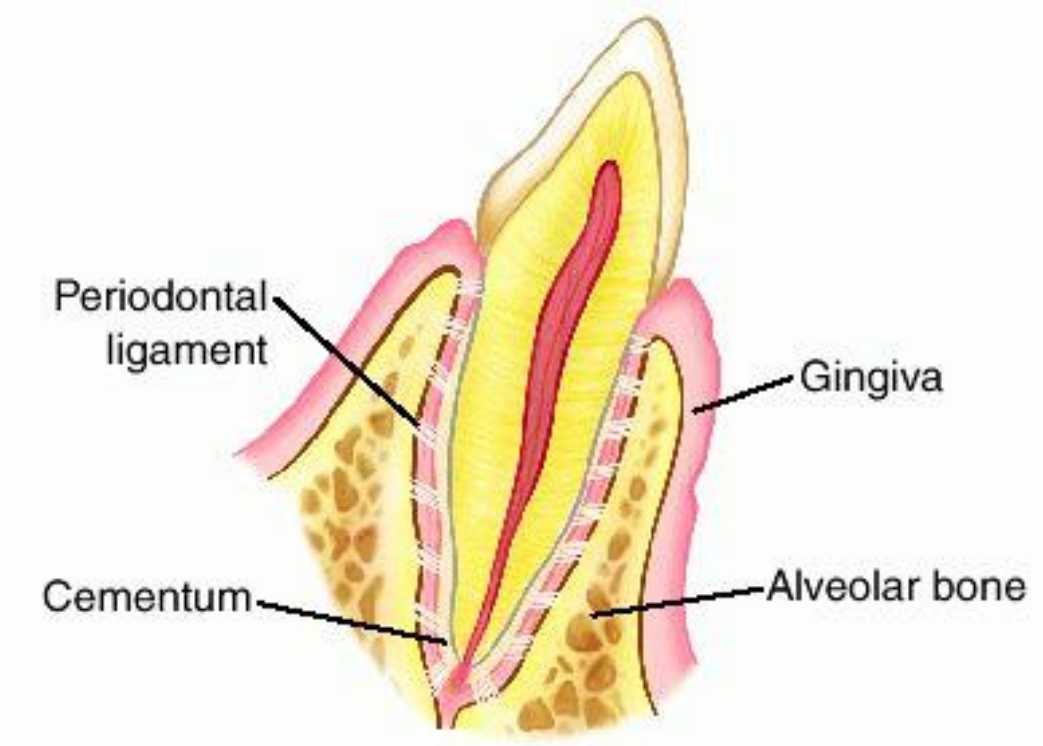
Learning Outcomes

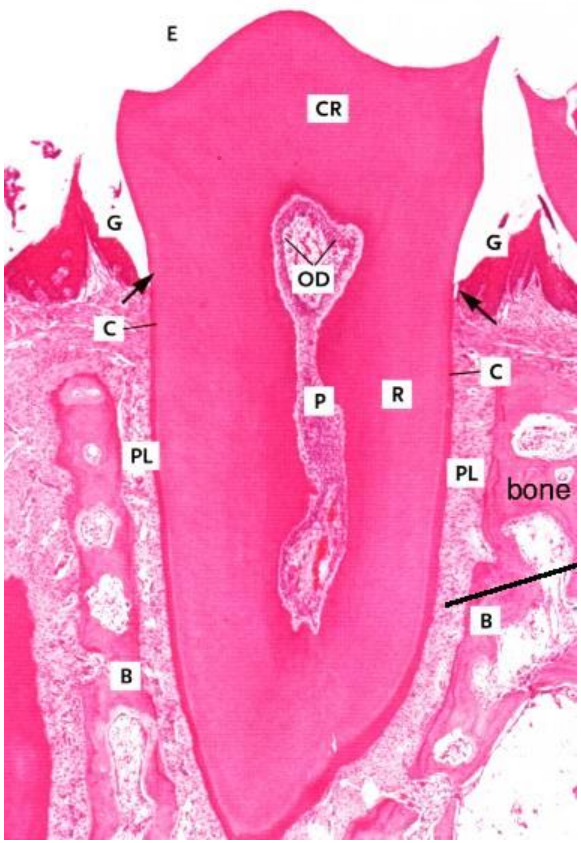
- Define the Periodontal Ligament
- Recognize the connection of PDL with the surrounding structures
- Understand the development of PDL
- Recognize the structure of PDL
- Recognize the histologic characteristics of PDL under the light microscope
- Recognize the function of PDL

Definition

- **Periodontal ligament** is a **fibrous connective tissue** occupying the periodontal space between **cementum** and **alveolar process**

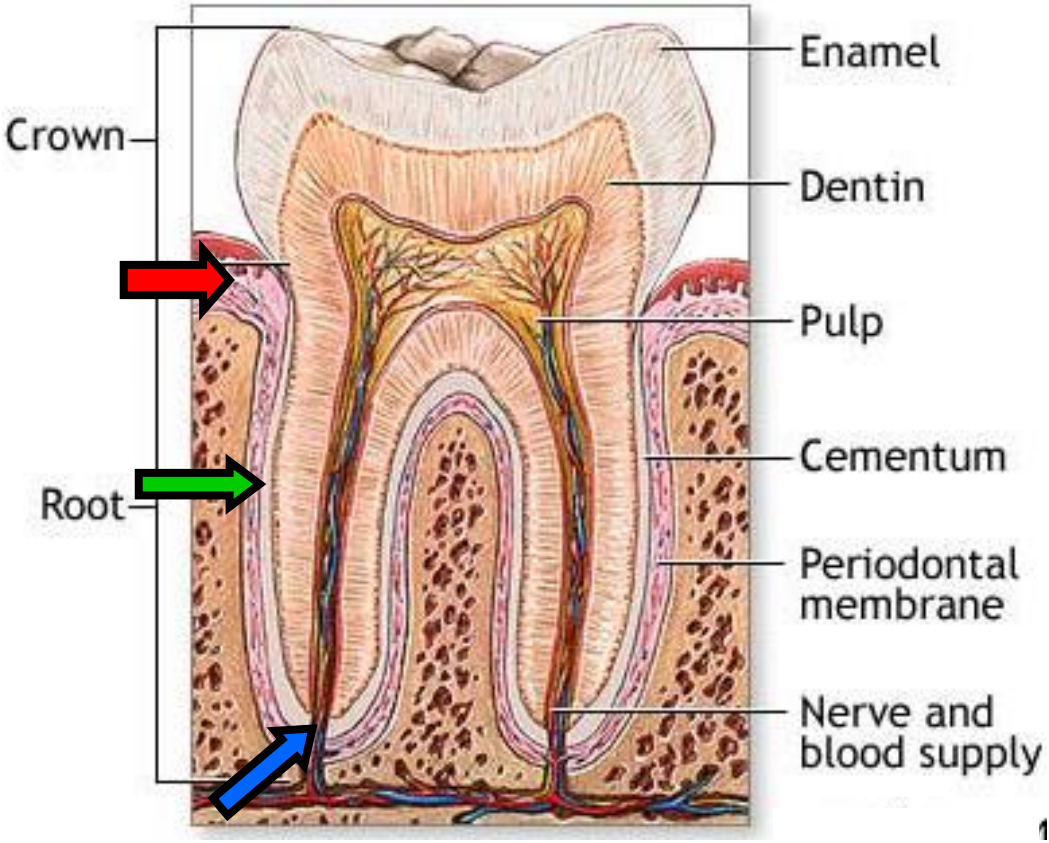
·It's a soft tissue.





Connection

- **Coronally:** the periodontal ligament is connected to the connective tissue of the **gingiva**
- **Laterally:** connected through channels with the **alveolar bone**
- **Apically:** connected with the **pulp tissue** through the apical foramen



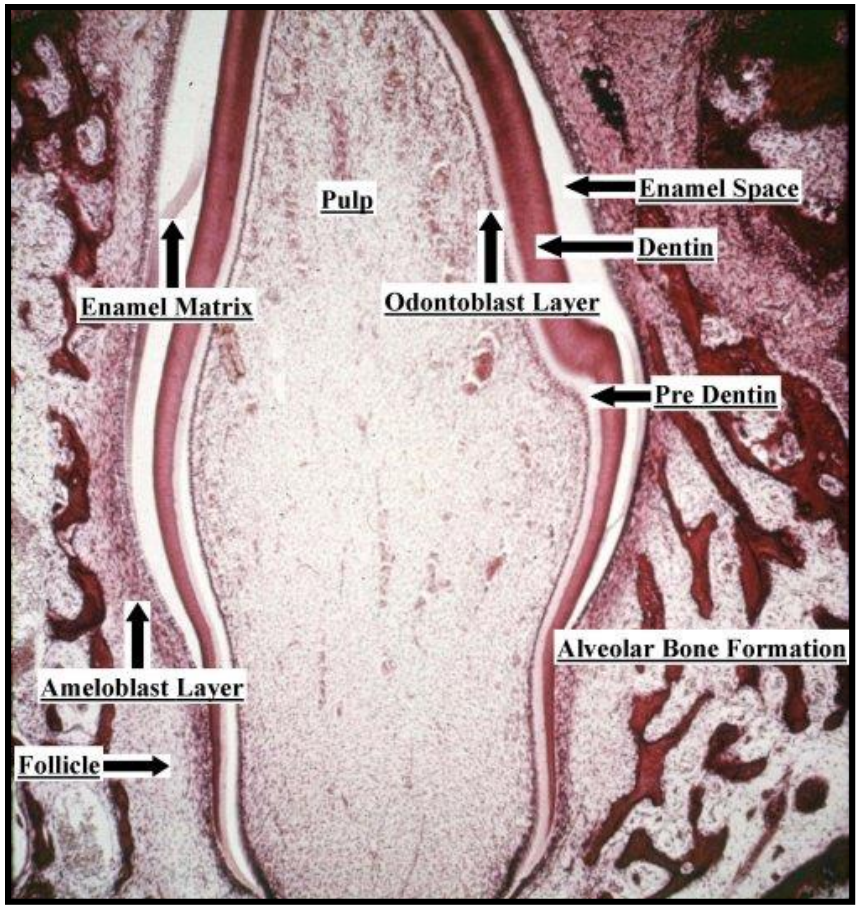
Development

from the **dental sac.**

-**Outer** most layer of dental sac differentiate into **osteoblasts** to form **alveolar bone**

-**Inner** most layer of dental sac differentiate into **cementoblasts** to form **cementum**

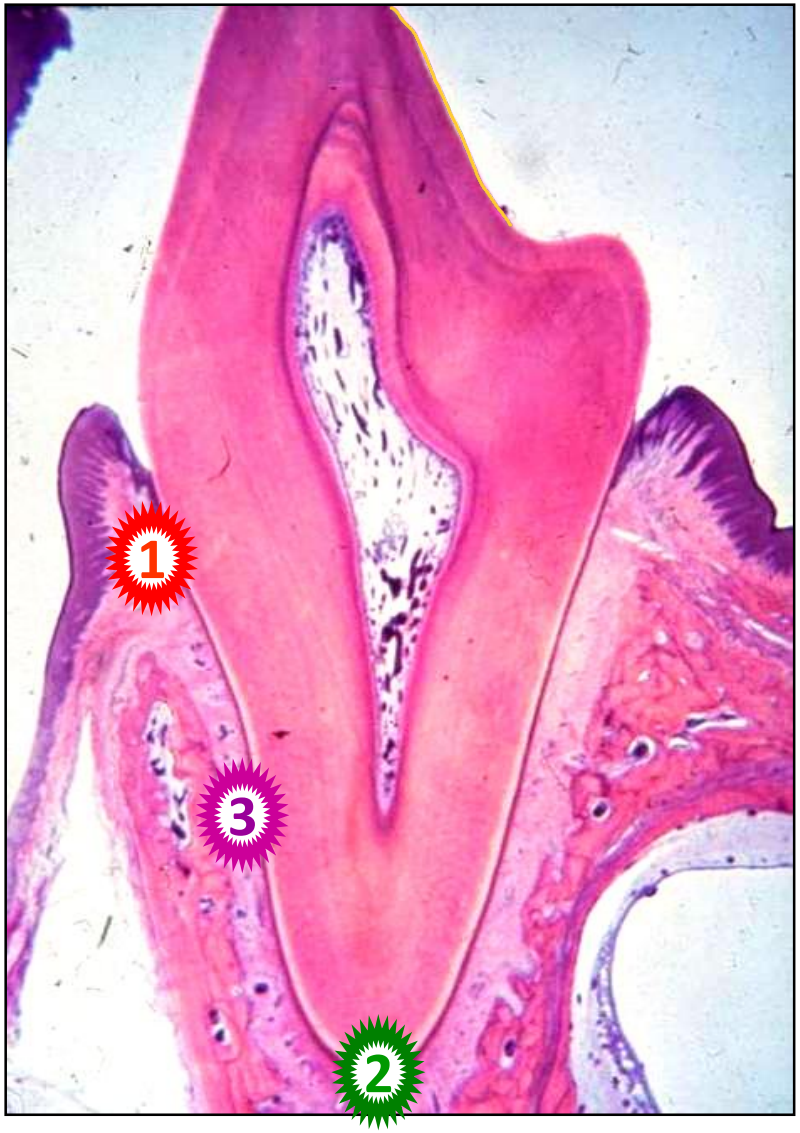
-**Centrally** placed layer of dental sac differentiate into **fibroblasts** to form **PDL** fibers & ground substance.



- **The width** of PDL is not uniform; the widest region is at the alveolar crest then, the apical region then, the fulcrum area (mid root).

Due to the deposition of cementum.

- Wide in young and deciduous teeth & narrow in aged and permanent teeth
- Wide in teeth under functional stresses & narrow in functionless & embedded teeth



Structure

Cells

I- Formative cells
- Fibroblasts
- Osteoblasts
- Cementoblasts

II- Resorptive cells
- Cementoclasts/Odontoclasts
- Osteoclasts
- Fibroblasts

III- Progenitor cells
- U.M.Cs.

IV- Defensive cells
as the pulp defensive cells

V- Epithelial rests of Malassez The only epithelial cells in the PDL.

Blood, nerve, and lymph vessels

Intercellular Substance
[Extracellular substance]

Fibers

I- Collagen Fs.
Principle & Accessory

II- Oxytalan Fs.

III- Elastic Fs. Found in the Wall of B.Vs.

IV- Eluanin Fs. variant of elastic fibers forms meshwork from cementum to bone sheathing collagen bundles

Ground sub.

Glycosaminoglycans
+
Glycoprotein
+
Proteoglycans
+
Glycolipids

Oxytalan and Eluanin fibers are immature elastic fibers found in the PDL.

The Cells

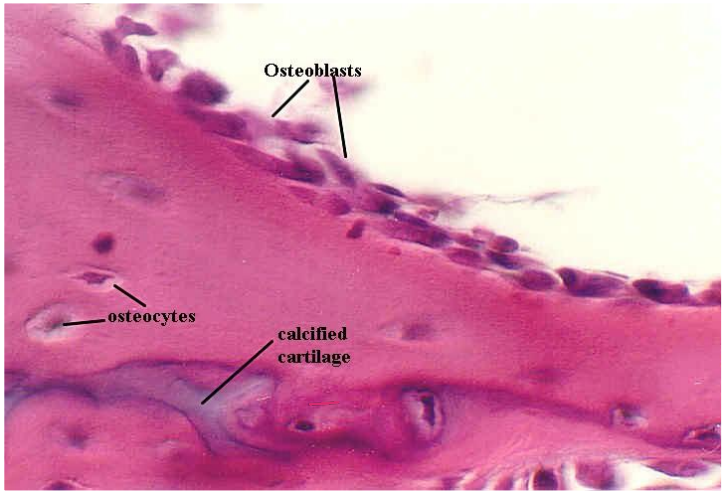
I- Formative cells

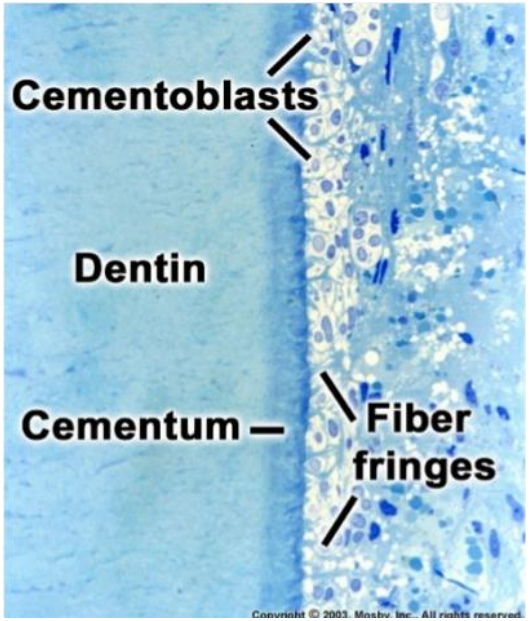
1- Fibroblasts.

They contain numerous microtubules & microfilaments.

2- Osteoblasts:

3- Cementoblasts:





II- Resorptive cells

1- Osteoclasts:

- Multinucleated giant cells

2- Fibroblasts/clast:

3- Cementoclasts:

Also called odontoclasts

III- Progenitor cells (U.M.Cs.)

- Can give rise to: fibroblasts, cementoblasts and osteoblasts

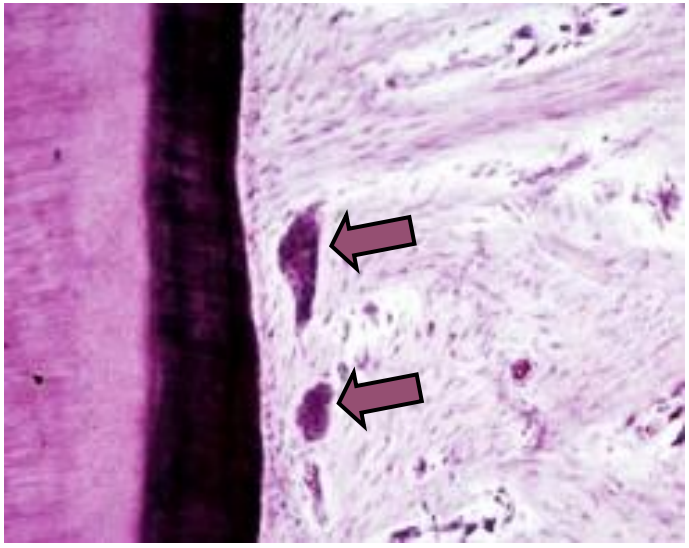
IV- Defensive cells: Same as the cells of the **pulp**

V- Epithelial cells:

(epithelial rests of Malassez)

Present mostly in the apical area root.

- They are the **remnants** of epithelial **root sheath of hertwig**
- Present in the form of **network**, **strands** or **islands**
- They are attached by **desmosomes**
- They exhibit **tonofilaments**
- They are isolated from CT by **basal lamina**
- Under **pathological** condition they proliferate rapidly & can give rise to **cyst or tumor**
- They have role in **periodontal regeneration**



Epithelial Rests Of Malassez

The Fibers

- It shows a **very high turnover rate** of collagen fibers than all other CT.

I- Collagen fibers: mainly **type I** & small amount of **type III**

A- Principal fiber bundles

B- Collagen fibrils randomly distributed between principle bundles

A) Principal fibers:

They are present in a **wavy course** and arranged in 3 ligaments:

Gingival ligament	Interdental (Trans-septal)	Alveo-dental

Gingival ligament

[in the lamina Propria]

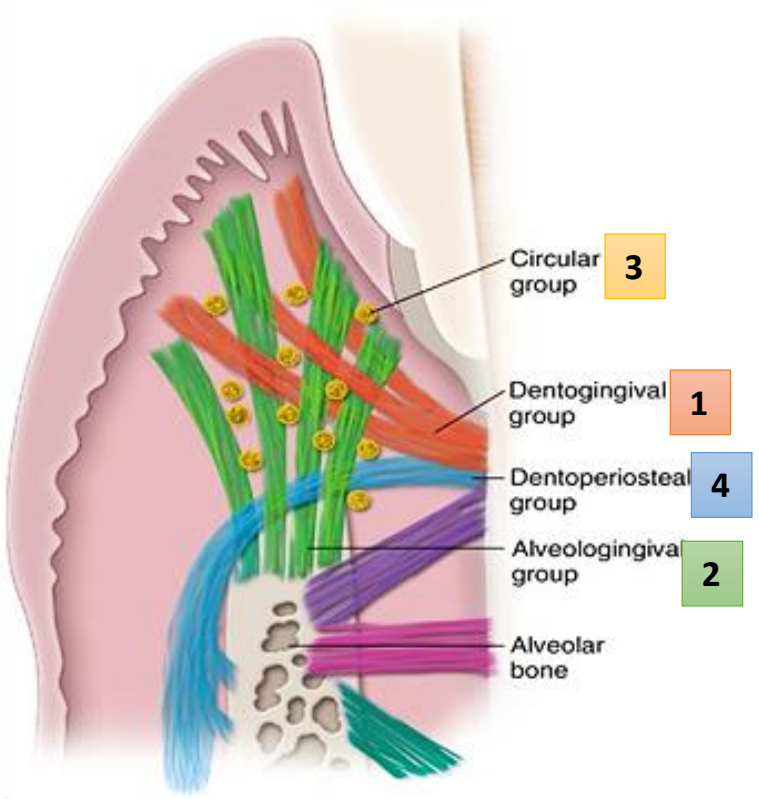
- It attaches the **gingiva** to the **cementum**
- maintaining the **functional integrity of periodontium**

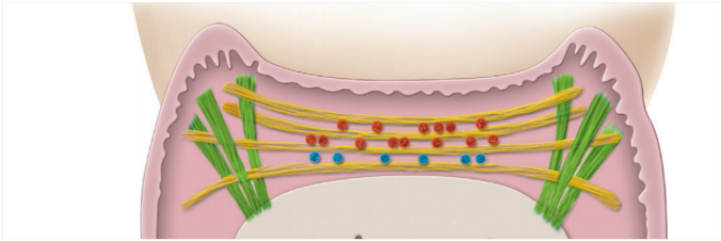
1- Dentogingival group: the **most numerous** group extending from **cervical cementum** to lamina propria of both the **free** and **attached** gingiva

2- **Alveologingival group:** from the bone of the **alveolar crest** to the lamina propria of the **free** and **attached** gingiva

3- **Circular group:** a **small group,** interlacing with other groups in the **free** gingiva and helping to **bend** the free gingival to the tooth

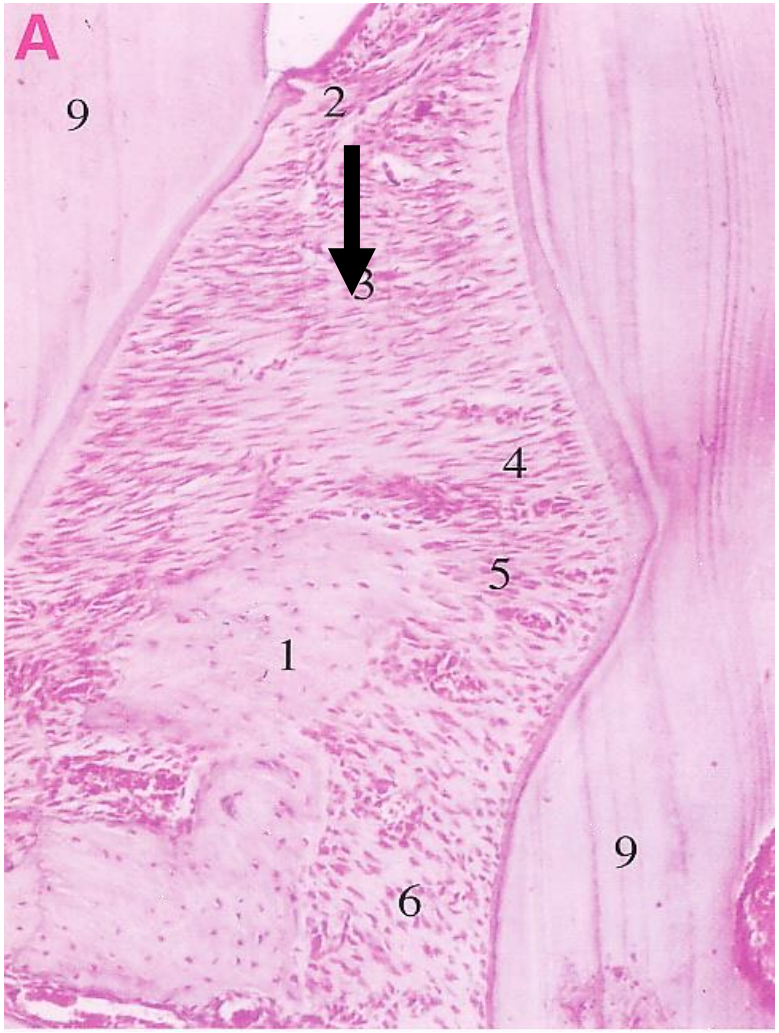
4- **Dentoperiosteal group:** from the **cementum** over the **periosteum** of the outer cortical plates of the alveolar process





Interdental (Trans-septal)

- It connects **two adjacent teeth**
- The ligament runs from the cementum of one tooth **over the crest of the alveolus** to the cementum of the adjacent tooth
- Important in **physiological mesial drift**



Alveo-dental Ligament

1-Alveolar crest group:

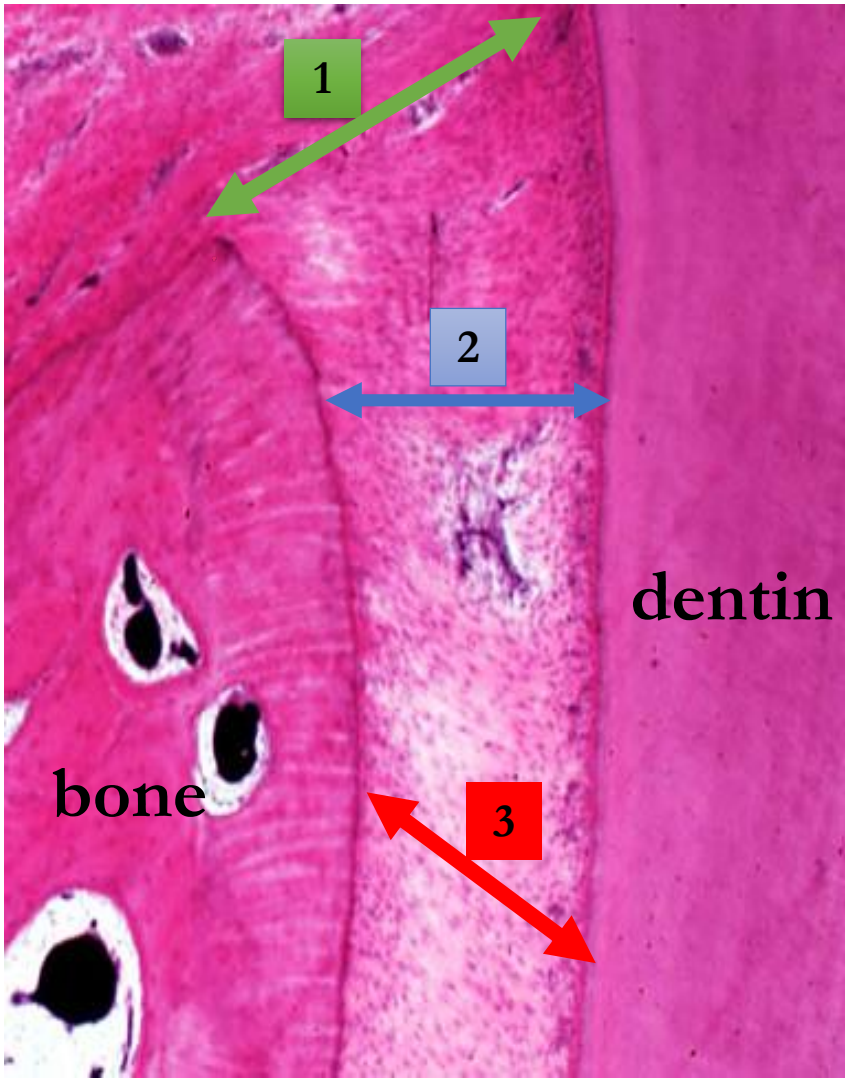
- Radiates from the **crest of the alveolar process** to the cervical part of the cementum

2-Horizontal group:

- The fiber bundles run from the cementum to the bone at **right angle** to the long axis of the tooth

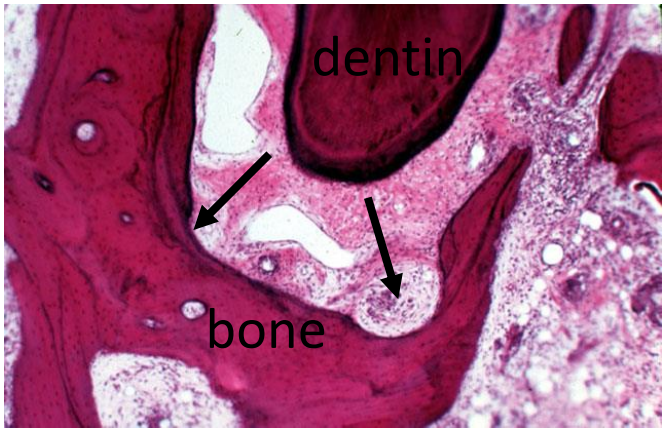
3- Oblique Group:

- The **most numerous** group
- The fiber bundles run **obliquely**
- Their attachment in the **bone is more coronal** than the attachment in the cementum
- They perform the **main support** of the tooth against masticatory force.



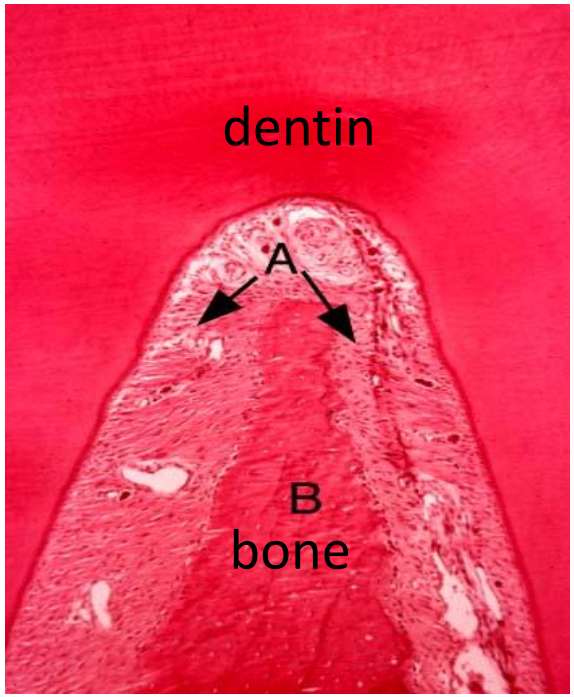
4- Apical Group:

- The bundles radiate from the **apical region** of the root to the surrounding bone



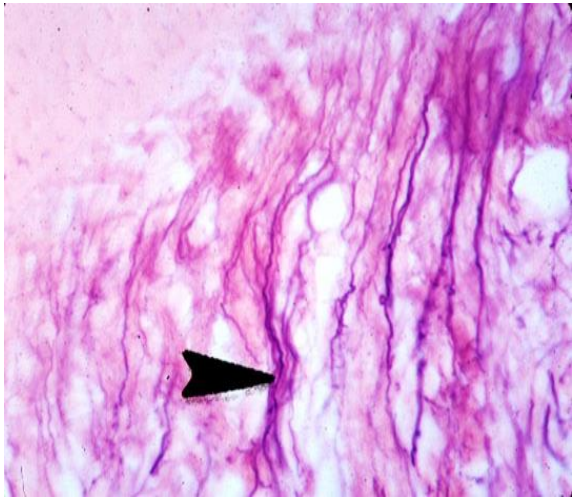
5- Interradicular Group:

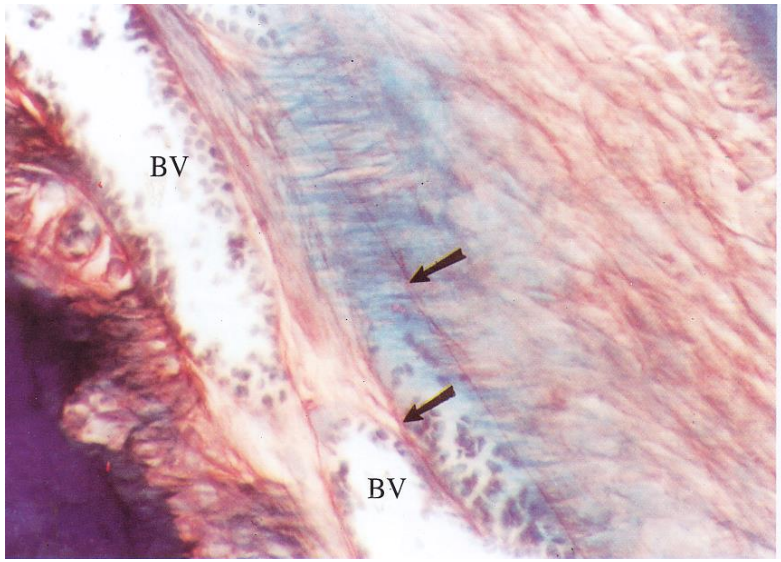
- The bundles radiate from the interradicular septum to the **furcation** of the multirooted tooth



II- Oxytalan fibers (only Present in the PDL)

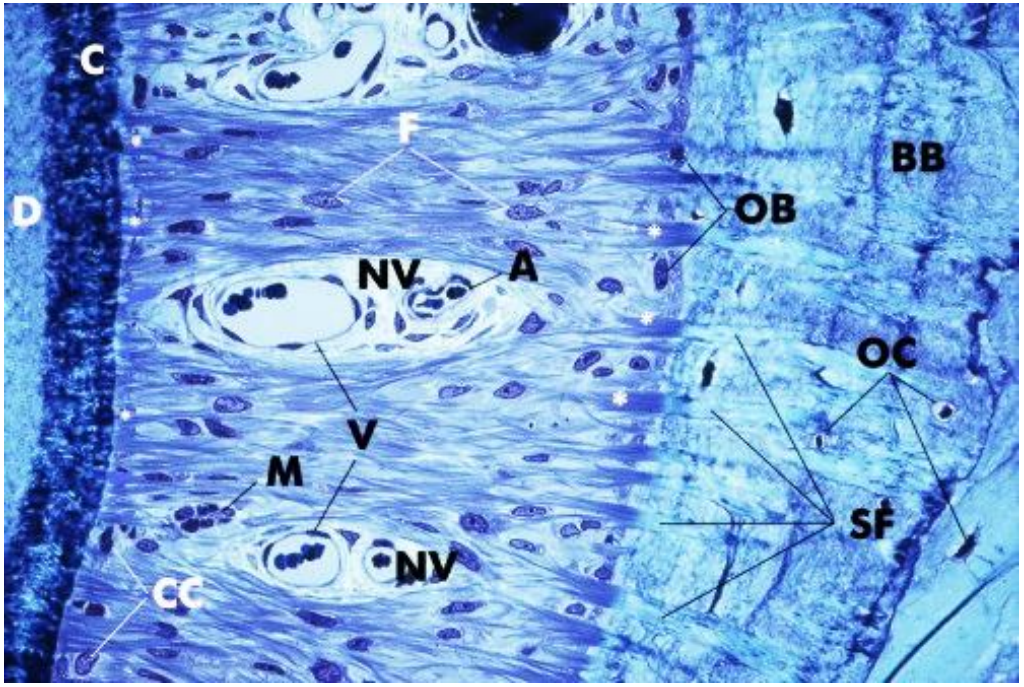
- These are **immature elastic** (pre-elastic) fibers
- They need **special stains** (Oxone-Aldehyde-Fuschin-Halmi) to be demonstrated
- They run in an **axial direction**, one end being embedded in **cementum** and the other in the **wall of blood vessels**
- They **support the blood vessels** of the PDL during mastication i.e., it **prevents the sudden closure** of the blood vessels under masticatory forces.





Interstitial Tissue

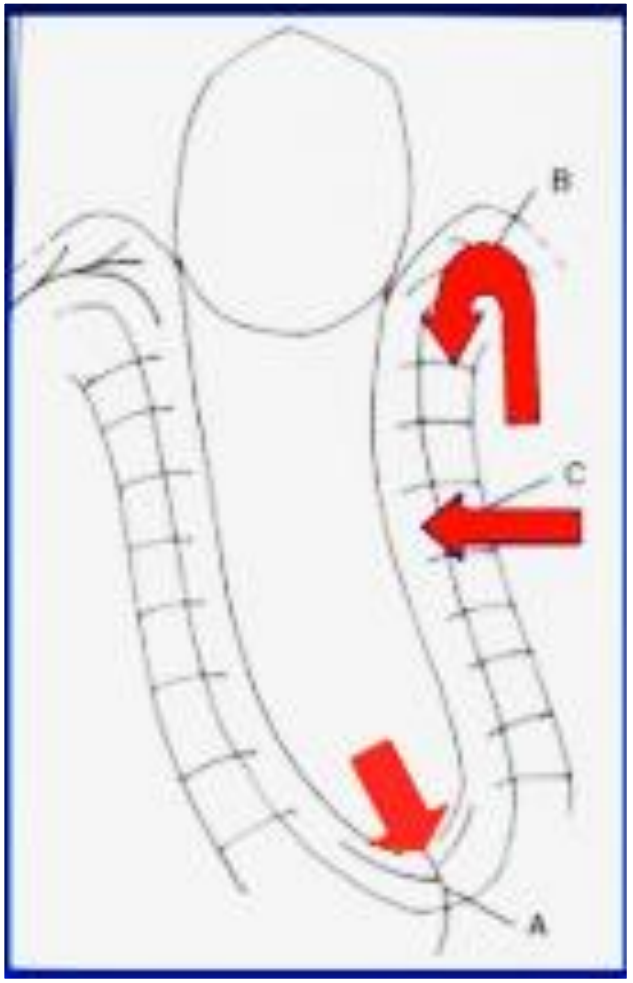
- It is found **between the oblique fibers** of the periodontal ligament.
- They are areas containing some of the **blood vessels, lymphatics and nerves** and surrounded by **loos connective tissue**.



Blood supply

1.Branches from the **apical vessels supplying the pulp**
2.Branches from **intra-alveolar vessels** (the main)
3.Branches from **gingival vessels**

- These branches ramify forming a vascular **network** capillary may take a **coiled** course



Lymphatics

- They form a network of lymphatics follow the path of blood vessels.

Nerve Supply

- From **inferior and superior dental nerves** in the form of:

1- Bundles or nerves from apical region
2- Nerve from alveolar bone

- **Types:-**
- **Unmyelinated** nerves(Sympathetic **motor**) for the contraction of the blood vessels
- **Myelinated** fibers which are **sensory** parasympathetic nerves

Function of periodontal ligament

1- Supportive: By **attaching** the tooth to alveolar bone of the socket

2- Sensory:
Stimulation of **mechanoreceptors** ……. reflex **jaw opening** by inhibition of masticatory muscles activity, so **protects** the tooth from **sudden overload**

3- Nutritive: **Blood vessels** of PDL provide nutrition for PDL **cells** and superficial cementocytes and osteocytes.

4- Formative:
Fibroblasts → formation and destruction of collagen fibers
Cementoblasts → formation of cementum
Osteoblasts → formation of bone

5- Protective: According to their **arrangement and wavy course,** they **counteract the pressure** applied on the tooth and convert it into tension to prevent bone resorption + **mechanoreceptors**


Thank
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