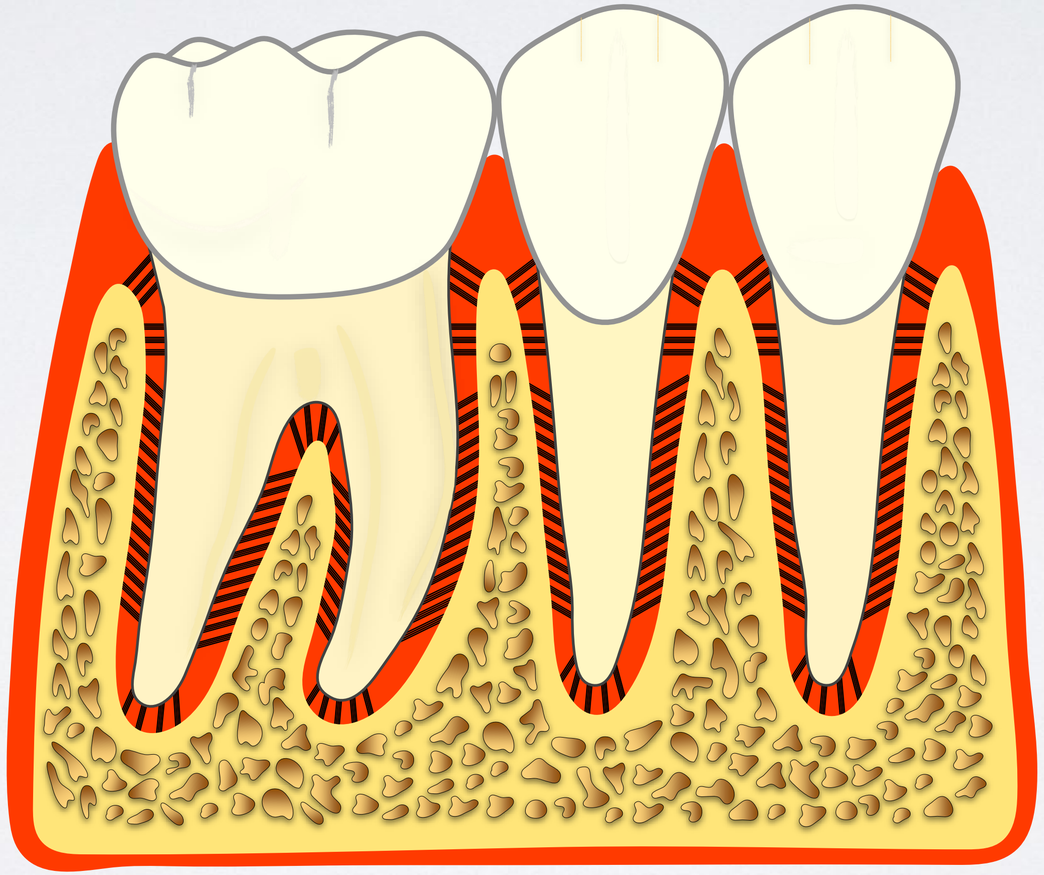
Periodontal Ligament

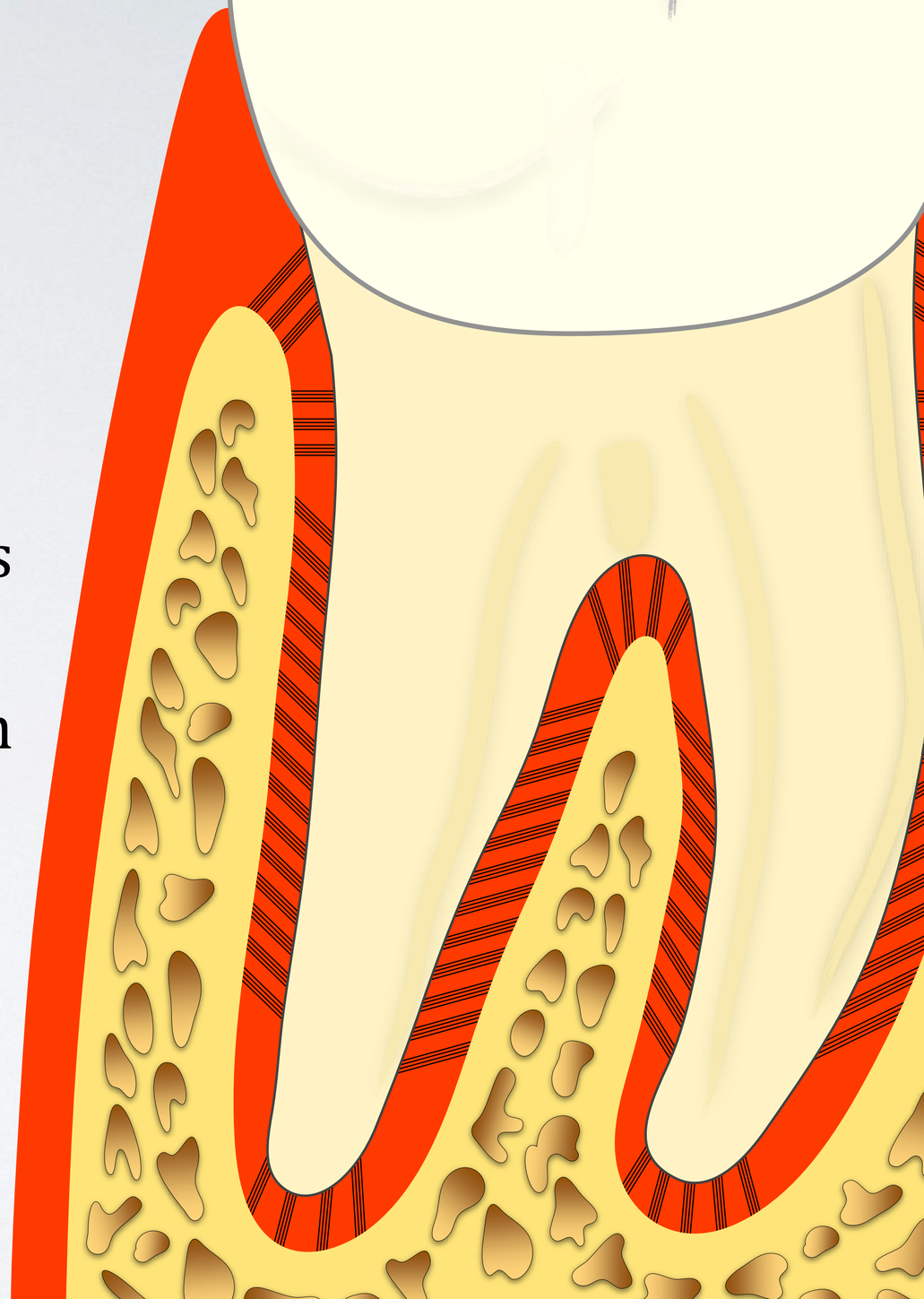
Dr. Sherif Hassan
2026



Periodontal Ligament

Definition:

Periodontal Ligament (PDL) is a Dense Fibrous Connective Tissue that Fill the Space Between Root and Alveolar Bone.

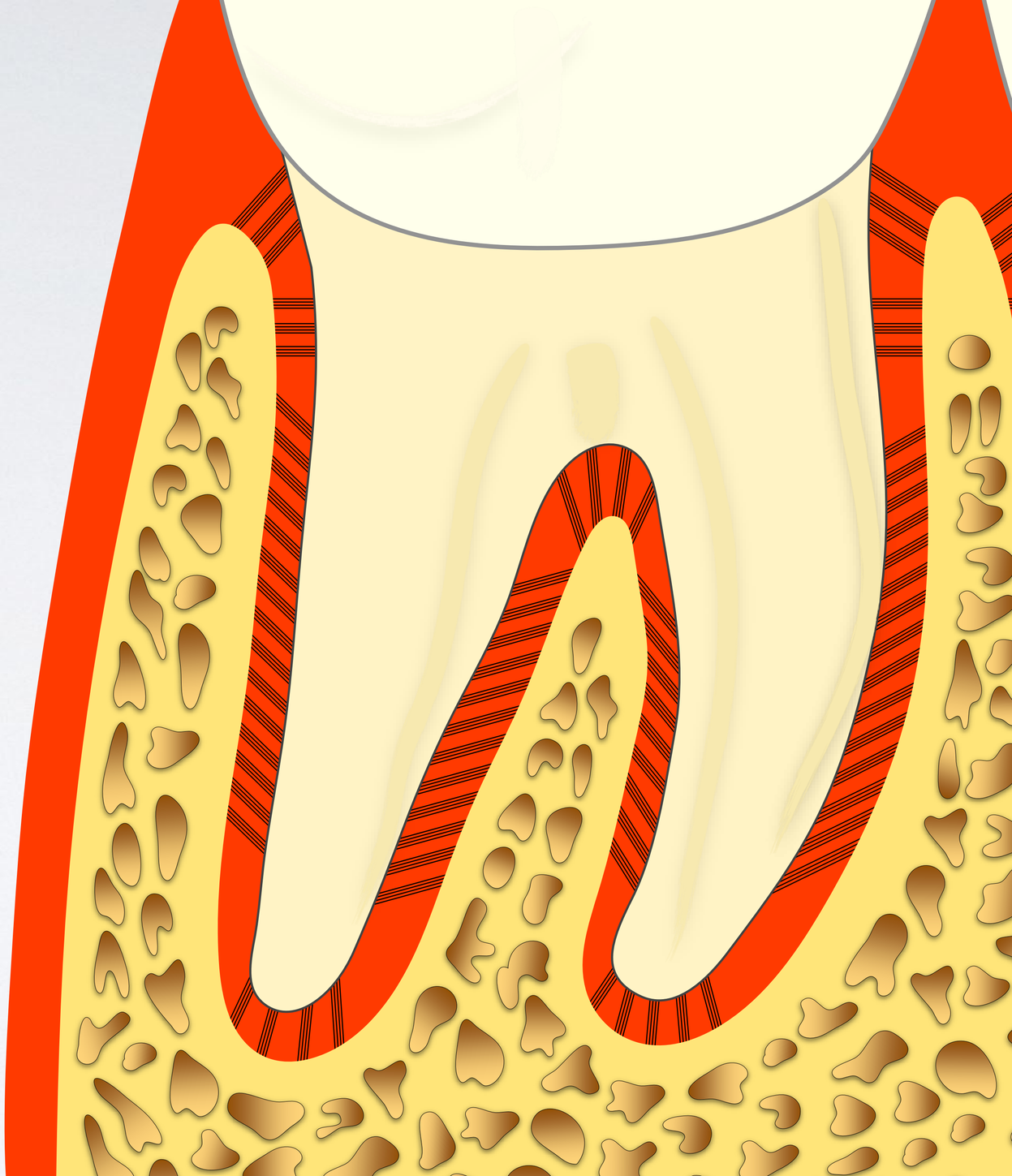


Diameter

0.15 – 0.38 mm.

- PDL is narrow at the middle root part.
- PDL is wide at the alveolar crest.
- PDL is wide at apical region of the root.

- Thickness increased in teeth subjected to heavy occlusal force.
- PDL Thickness decreased in non-functioning and impacted teeth.



FUNCTIONS OF PDL

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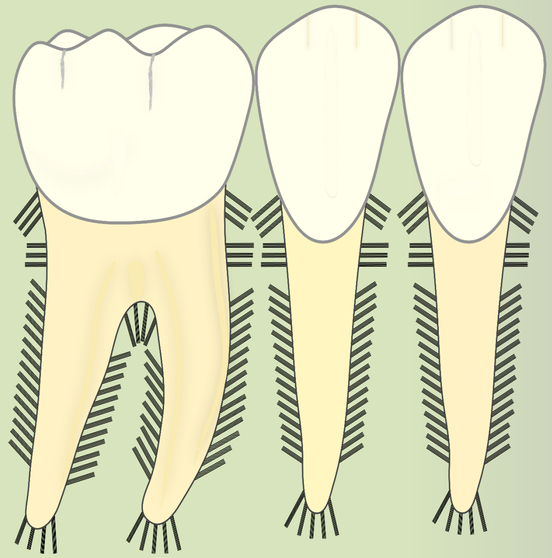
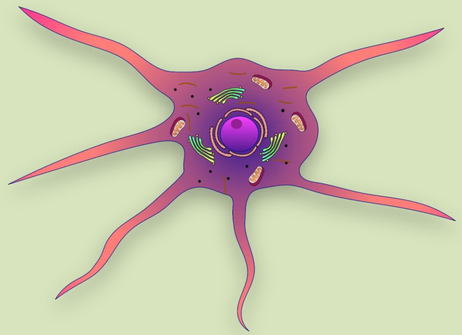


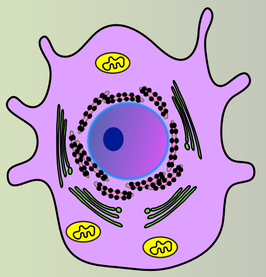
Supportive Functions

1. PDL support the tooth within the jaw.
2. Permits the tooth to **withstand** the suitable forces of mastication.
3. PDL is **non elastic** which prevent the tooth from being moved too far.
4. PDL act as **cushion** to distribute the masticatory force.

Formative Functions

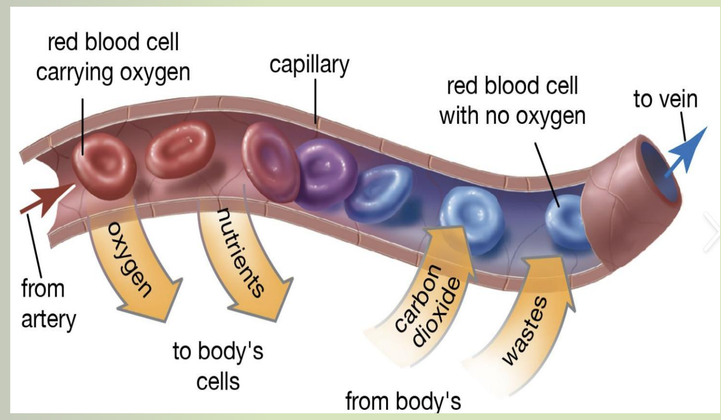
1. **Fibroblasts cells** are responsible for the formation of:
   a. Collagen fibers.
   b. Ground substances.
2. **Cementoblast cells** are responsible for the formation of cementum.
3. **Osteoblasts cells** are responsible for the formation of bone

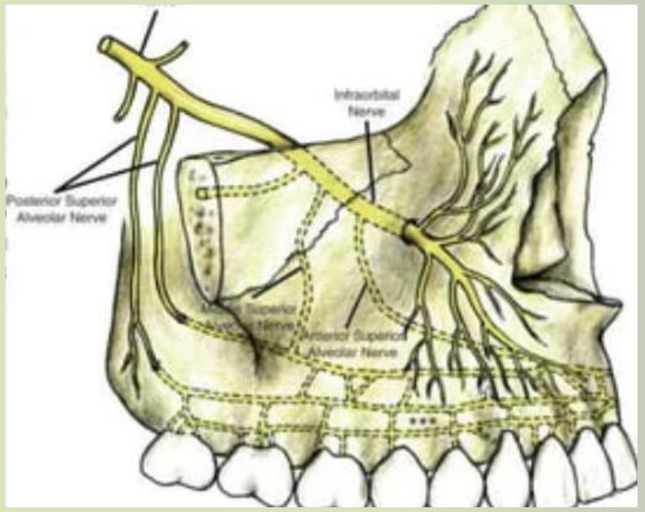


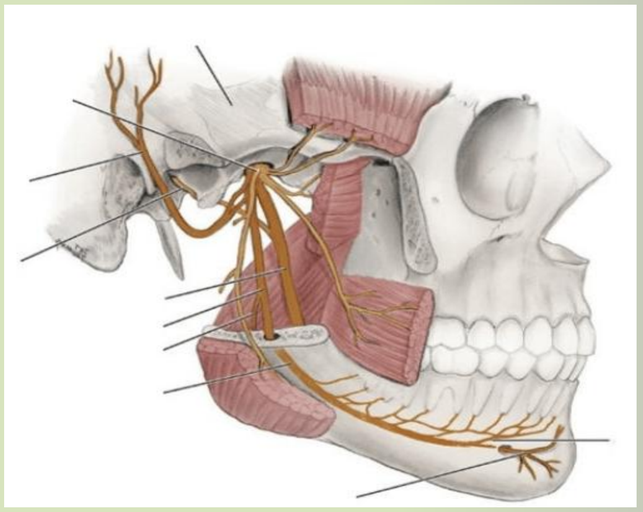


Nutritive Functions

1. The PDL is highly vascular.
2. Provides oxygen and essential nutrients to PDL cells.
3. Supplies nutrients to adjacent structures, including cementum and alveolar bone.
4. Contains interstitial fluid that aids in diffusion of nutrients.







Sensitive Functions

1. PDL contain small nerve fibers for pain sensation.
2. PDL contain large nerve fibers for touch and pressure.
3. PDL contain special nerve ending termed **mechanoreceptors.**

** Sudden trauma stimulate mechanoreceptors leading to stopping the contraction of masticatory muscles and keep the Mouth Opened **

Summary of Periodontal Ligament Development

1. After breakdown of epithelial root sheath, cementoblast cells differentiated on the newly formed dentin and begin to secrete **cementum.**

2. **At the same time;**

- **Alveolar bone** begin to develop **BY** Osteoblast cells.
- **PDL** begin to develop **BY** Fibroblast cells.

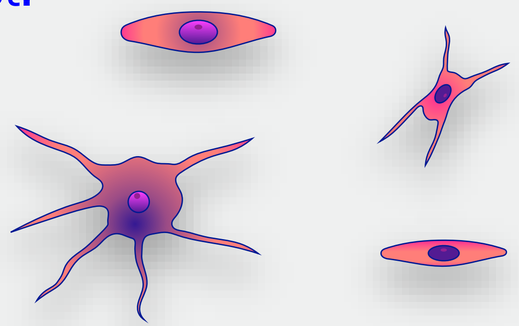
3. One end of collagen fibers become **embedded** into the alveolar bone and the other end **embedded** within the cementum.

4. The embedded part of collagen fibers within both cementum and bone are termed: **Sharpy's Fibers.**

Histology of periodontal ligament

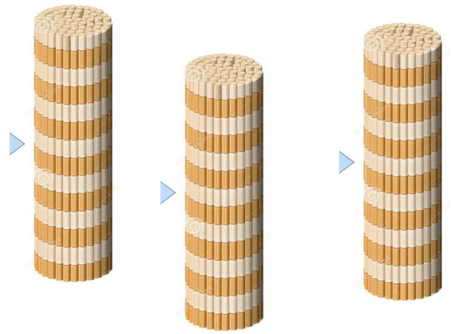
Cells

1. Formative cells: Fibroblast, Cementoblast, Osteoblast.
2. Resorptive cells: Osteoclast, Odontoclast.
3. Progenitor cells: Ectomesenchymal cells.
4. Defensive cells: e.g. Macrophage, Lymphocytes
5. Epithelial rest of Malassez



Fibers

1. Collagen fibers: Types I and little of type III (reticular fibers).
2. Oxytalan fibers and elastic fibers.



Ground substances

Proteoglycans, Glycoproteins, and Glycolipids.

Nerve fibers

Small nerve ending , Large nerve ending, and Mechanoreceptors.

Blood & Lymphatic

Small arteries, arterioles, and capillaries.

Fibroblast cells

Definition:

Fibroblasts are ectomesenchymal cells that form both fibers and ground substances.

Origin:

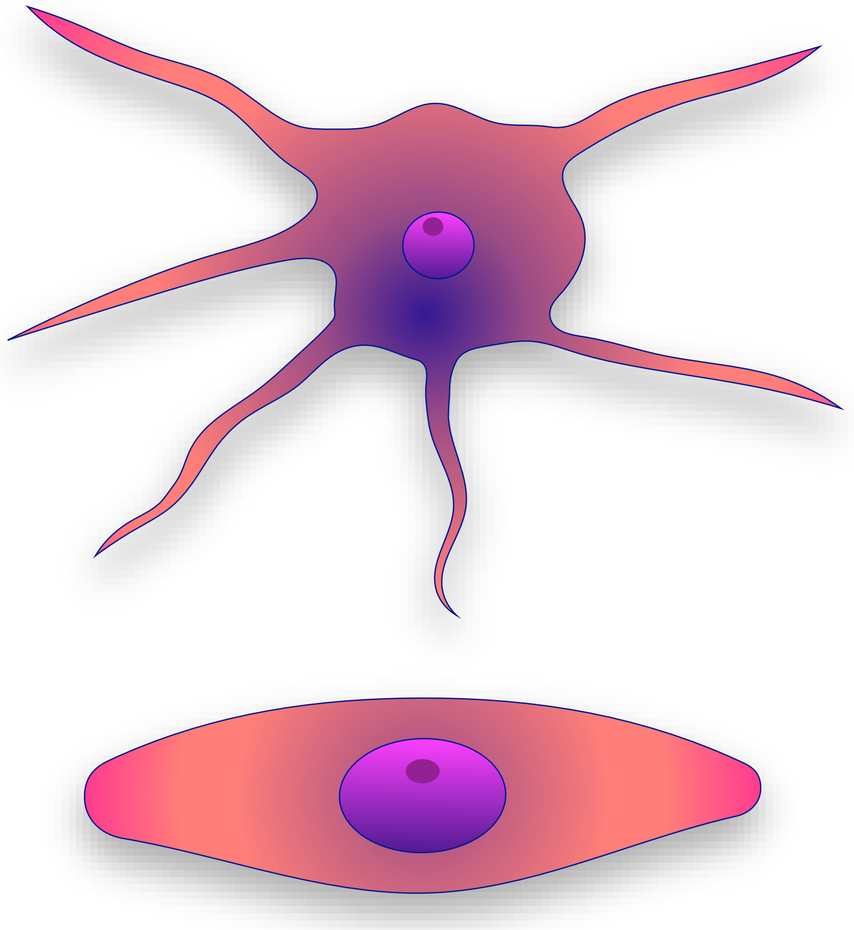
Ectomesenchymal cells of dental sac.

Site:

Fibroblasts are the most numerous cells.

Functions:

1. Formation and secretion of collagen fibers.
2. Production of ground substance.
3. Degradation of the old collagen fibers.

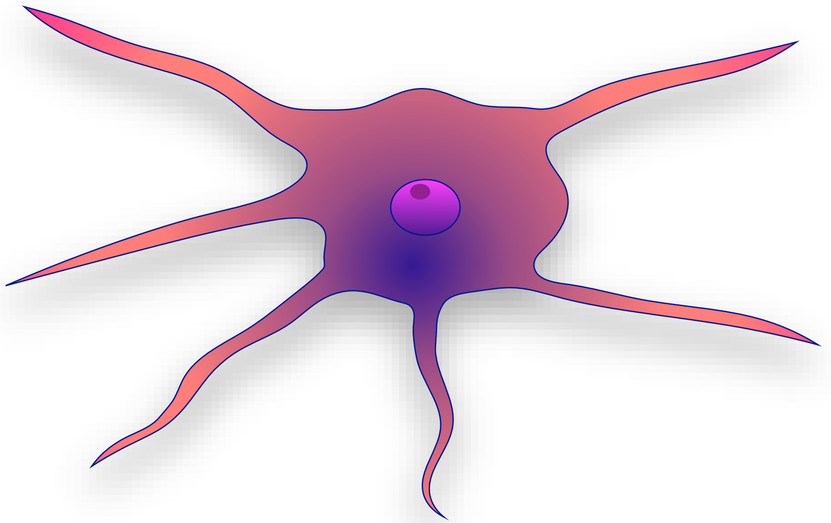


Fibroblast cells

EM.:

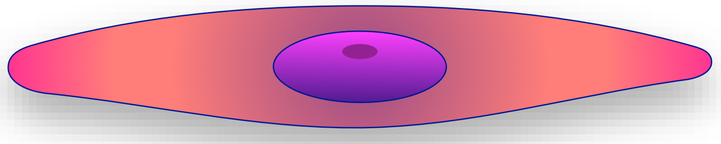
1- Active cells:

- Large number of RER, GC, secretory vesicles, and Mitochondria.
- Open faced nucleus.
- More seen in younger pulp.



2- Less active cells:

- **Numbers of cell organelles is reduced.**
- **Close faced nucleus.**
- More seen in older pulp
- Less active cells is termed **fibrocyte.**



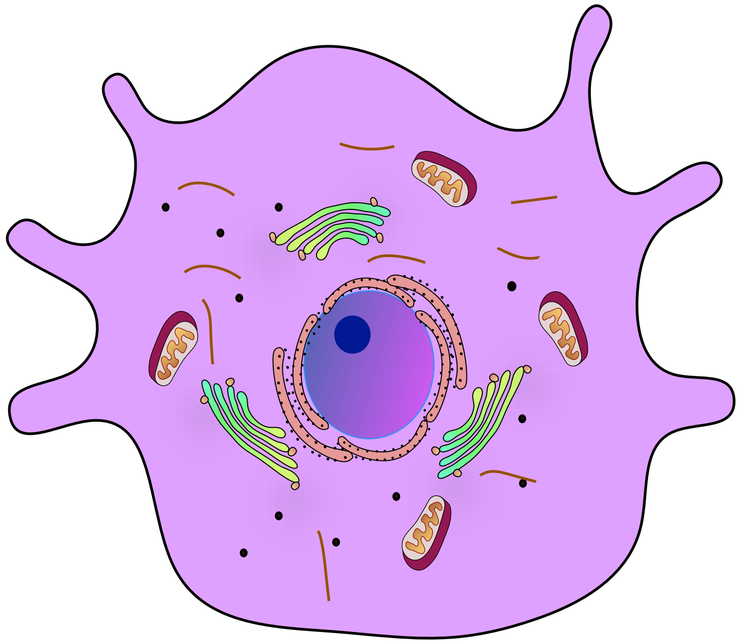
Osteoblast cells

Definition:

Osteoblasts are connective tissue cells responsible for formation of bone.

Site:

Osteoblasts are found within PDL in the periosteum.



LM.:

- Branched oval basophilic cells with open faced oval nucleus.
- Cytoplasmic processes are short and in contact with the adjacent cell.

EM.:

1- Active cells:

- RER, GC, Mitochondria, and Secretory vesicles.
- Active cells more seen in younger tissue.

2- Less active cells:

- Cell organelles is reduced in number.
- Less active cells that enclosed within the bone are termed osteocyte.

Cementoblast cells

Definition:

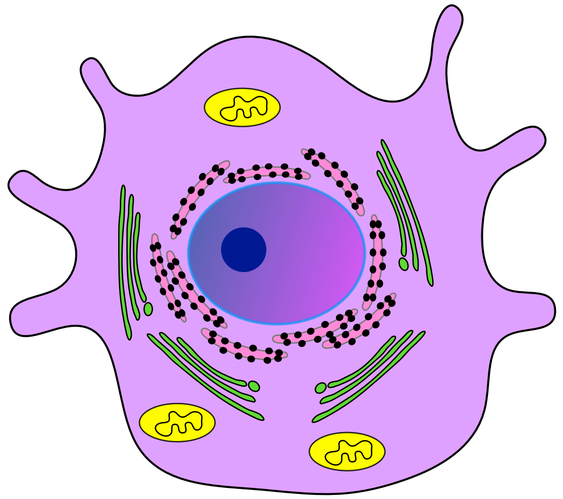
Cementoblasts are ectomesenchymal cells responsible for formation of cementum.

Site:

Cementoblasts are found within PDL facing cementum.

LM.:

- Branched oval basophilic cells with open faced oval nucleus.
- Cytoplasmic processes are short and in contact with the adjacent cell.



EM.:

1- Active cells:

- RER, GC, Mitochondria, and Secretory vesicles.
- Active cells more seen in younger tissue.

2- Less active cells:

- Cell organelles is reduced in number.
- Less active cells that enclosed within the cellular cementum are termed cementocyte.

Osteoclast cells

Osteoclast cells are multinucleated giant cells originated from blood monocyte and responsible for bone resorption.

Site:

- Area of bone resorption in a depression termed ***Howship's Lacuna***.
- Hawships lacuna result from the resorbing action of osteoclast cells.

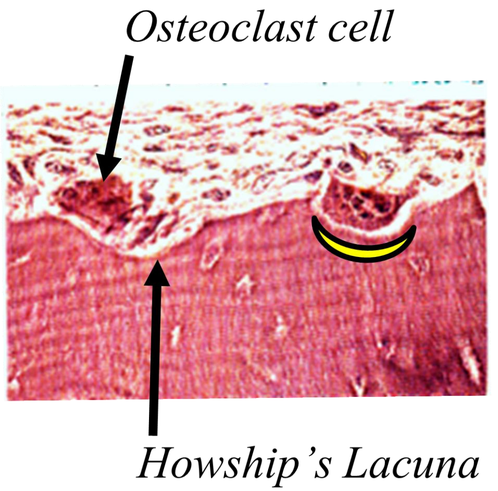
Functions:

Resorption of bone tissue for: bone remodeling, eruption of teeth, and healing fracture.

LM:

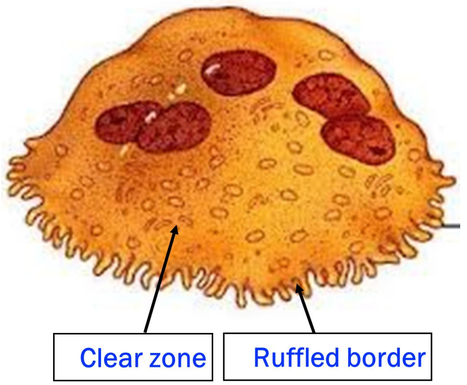
- Large acidophilic multinucleated cells (8-20 nuclei).
- Osteoclast cells contain three important enzymes:

Acid phosphatase enzyme, collagenase enzyme, and protease enzyme.



EM:

- Abundant mitochondria, GC and little RER.
- Border of the cell facing the resorbing bone appeared striated; termed Ruffled Border.
- Function of ruffled border: increase the surface area of the working side.
- Clear zone: the region of cytoplasm adjacent to the ruffled border are not contain organelles but contain actin and myosin for adhesion of the cell with Hawshyp's lacuna.



Odontoclast cells

Definition:

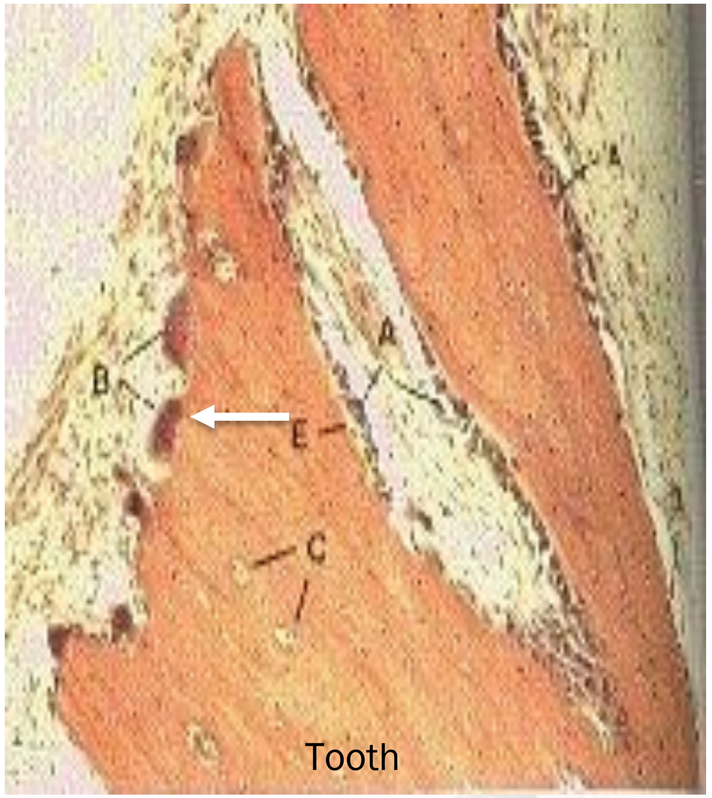
Odontoclast is a multinucleated cell that resorb tooth dentin and cementum.

Origin:

Fusion of Blood Monocyte.

Site:

- Area of tooth Resorption in a Depression Termed ***Howship's Lacuna***.
- Hawships Lacuna result from the Resorbing Action of odontoclast cells.



Functions:

1. Shedding of deciduous teeth.

2. Resorption of remaining root.

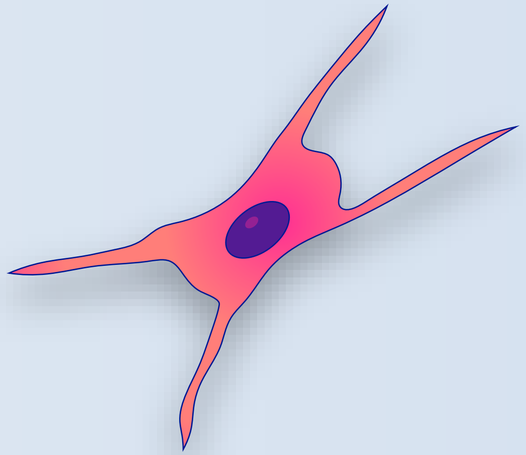
LM. & EM.:

- As in osteoclast cells.

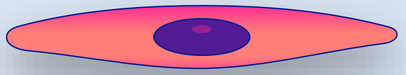
Undifferentiated Mesenchymal Cells (UMCs)

Definition

- These stem-like cells are capable of differentiation into various connective tissue cells under demand.
- They are small primitive undifferentiated connective tissue cells present within the periodontal ligament.



Types:



- **Pluripotential = multipotential stem cells:**
  Stem cells able to differentiate into any other types of connective tissue cells.
- **Unipotent stem cells:**
  Can produce only one type of cell only.

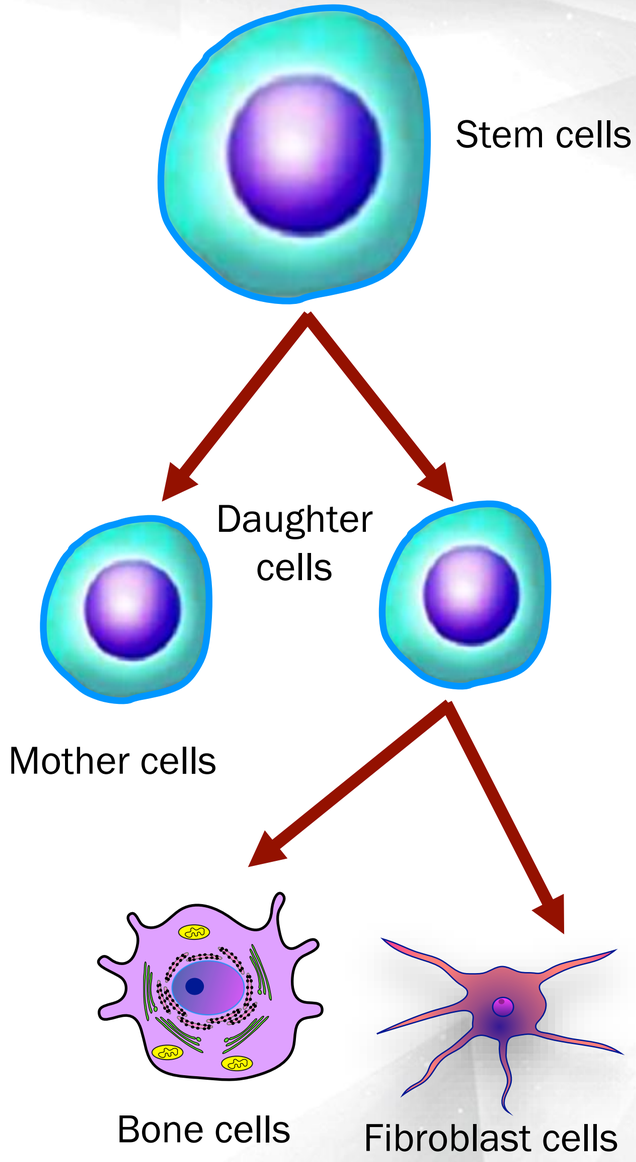
Undifferentiated Mesenchymal Cells (UMCs)

During differentiation:

- Under stimulation or demand, the cells undergo mitosis.
- This division produces two daughter cells.
- One daughter cell remains undifferentiated.
- The other differentiates into the required specialized cell type.

Site:

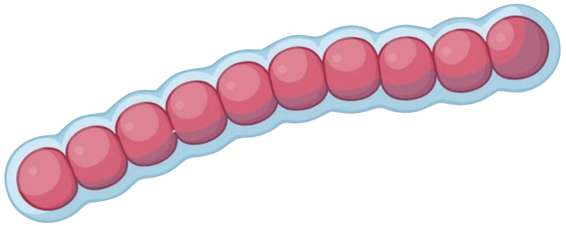
In the periodontal ligament along the wall of blood vessels.



Epithelial rest of Malassez = Epithelial pearls

Definition:

It is a remnants of root sheath of Hertwig's at the time of Cementogenesis.

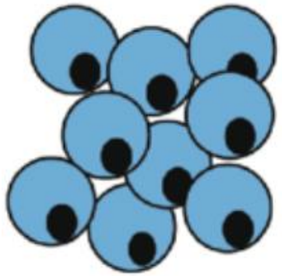


Shape:

Network, strands, islands, or tube-like.

Microscopic appearance:

- Epithelial rest of Malassez are composed of cells attached to each other by desmosomes.
- They are separated from connective tissue of periodontal ligament by basement membrane.



Clinical significances:

The rest of Malassez can be transformed into cyst or tumors.

Fibrous Elements

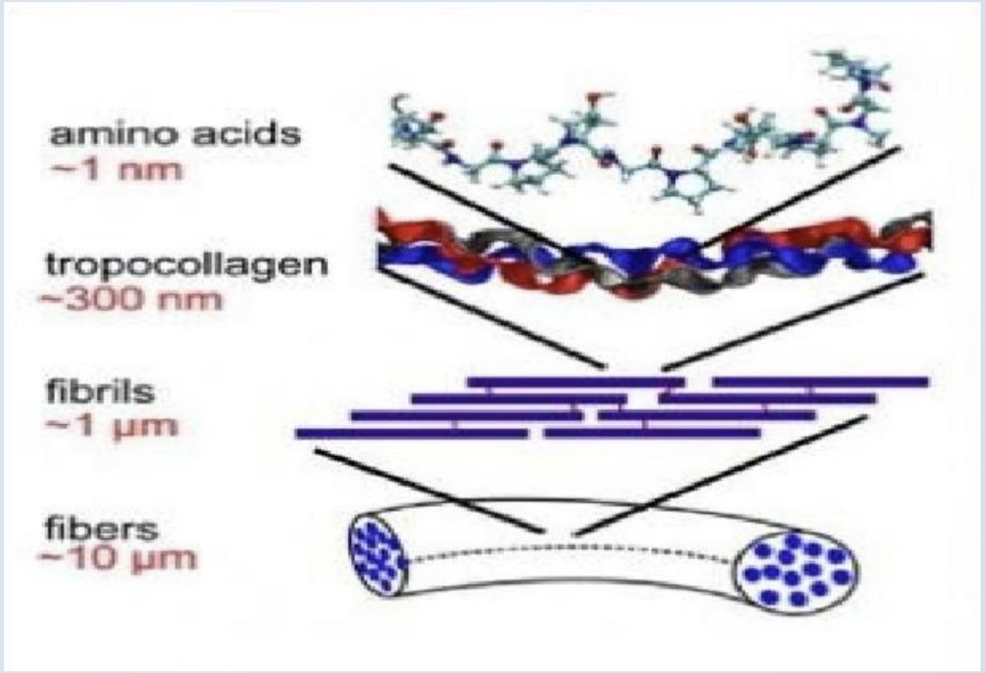
Fibroblasts are the primary cells responsible for the formation of fibers in the periodontal ligament.

Types of fibers within the pulp:

- **Collagen fibers (Type I)** Predominant.
- **Reticular fibers (Type III)** little amount.
- **Elastic and oxytalan fibers** around blood vessels.

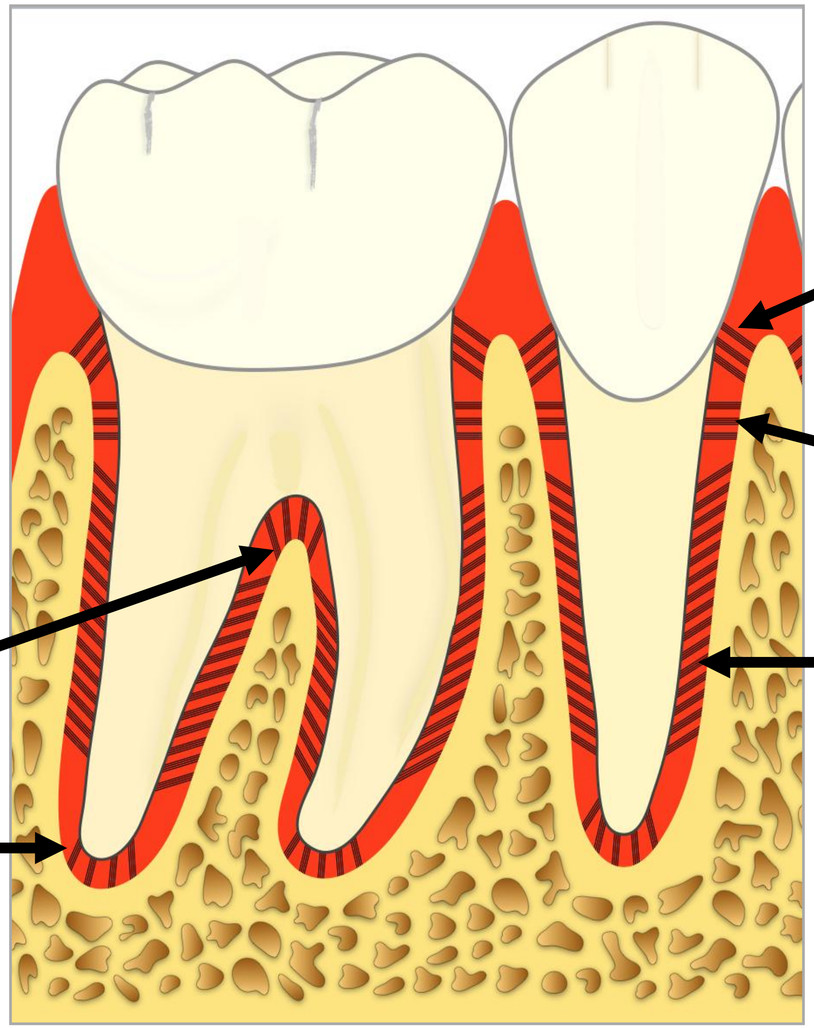
Formation of collagen bundles:

- Fibroblast form tropocollagen from amino acids.
- Each three tropocollagen cemented together to form fibril.
- Fibrils are secreted outside the fibroblast by exocytosis.
- Several fibrils are cemented together to form fiber.
- Several fibers form fibrous bundle.



Fibrous bundle groups

The fibrous bundles within the periodontal ligament are arranged in 5 specific groups:



1. Alveolar crest group
2. Horizontal group
3. Oblique group
4. Apical group.
5. Inter-radicular group

1. Alveolar crest group:

Course:

- Alveolar crest group extended obliquely from cementum to alveolar crest.

Functions:

1. Prevent extrusion of the tooth.
2. Prevent rotation of the tooth
3. Resist lateral tooth movement.

2. Horizontal group

Course:

- Horizontal group extended It extended horizontally from cementum to alveolar bone.

Functions:

1. Prevent rotation of the tooth
2. Resist lateral tooth movement.

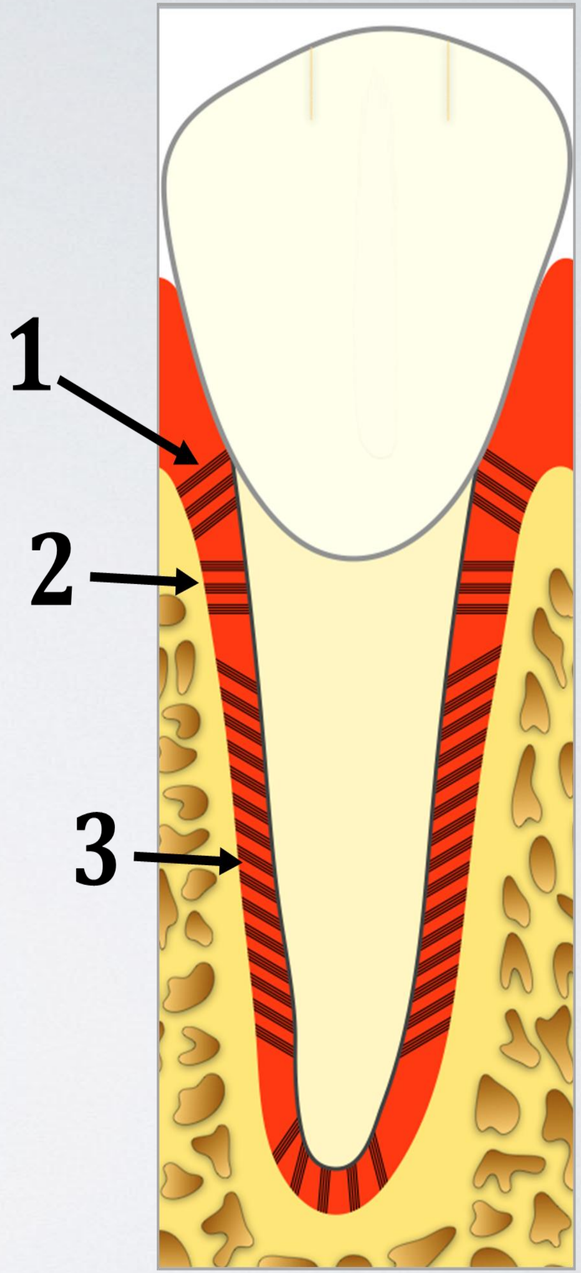
3. Oblique group

Course:

- It is the greatest number of fiber bundles allover the periodontal ligaments.
- It directed obliquely in which their attachment in the bone is more cervical than the attachment in the cementum.

Functions:

1. Resist masticatory force.
2. Prevent intrusion of the tooth.



4. Apical group:

Course:

Apical group is a group that radiate in an irregular fashion from cementum to alveolar bone at the apical region off the socket.

Functions:

Prevent extrusion of the tooth.

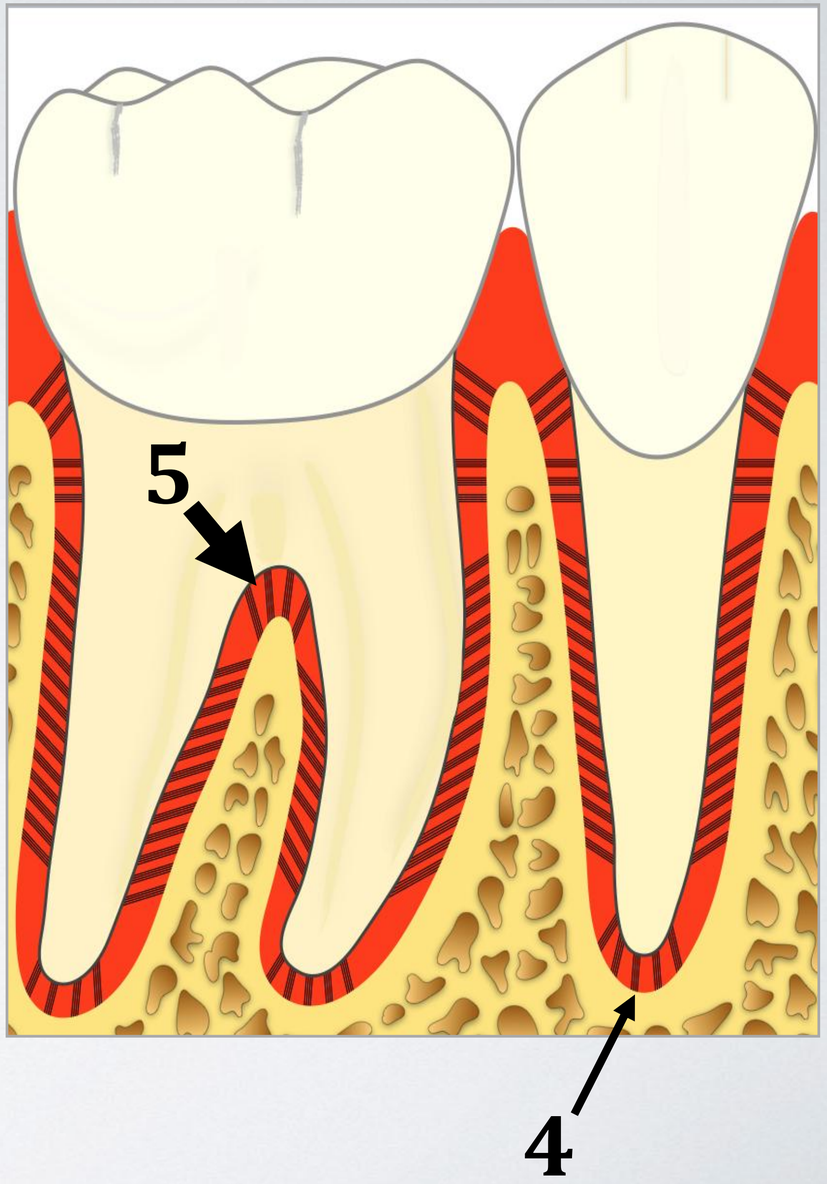
5. Inter-radicular group

Course:

It fan out from the inter-septal bone to the furcation area in multi-rooted tooth.

Functions:

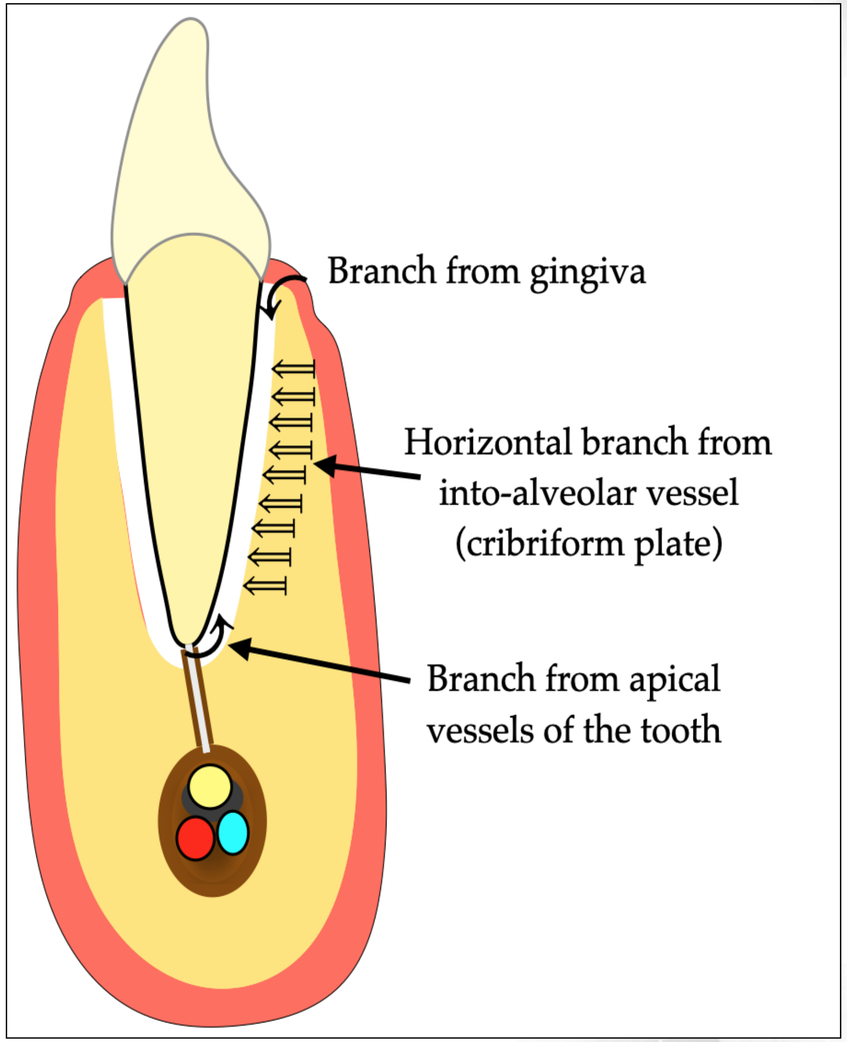
Assist the apical group which prevent extrusion of the tooth.



Blood supply of periodontal ligament

Three ways of blood supply:

1. Branches from gingival vessels.
2. Horizontal branches from the intra-alveolar vessels, (main blood supply).
3. Branches from the apical vessels that supply the dental pulp.



Nerve supply of periodontal ligament

- The nerve supply of periodontal ligaments of all teeth are derived from the trigeminal nerve.

Types of nerve ending and sensation:

1. **Free nerve ending:**

   Responsible for pain sensation.

2. **Pacinian corpuscles and Ruffini ending:**

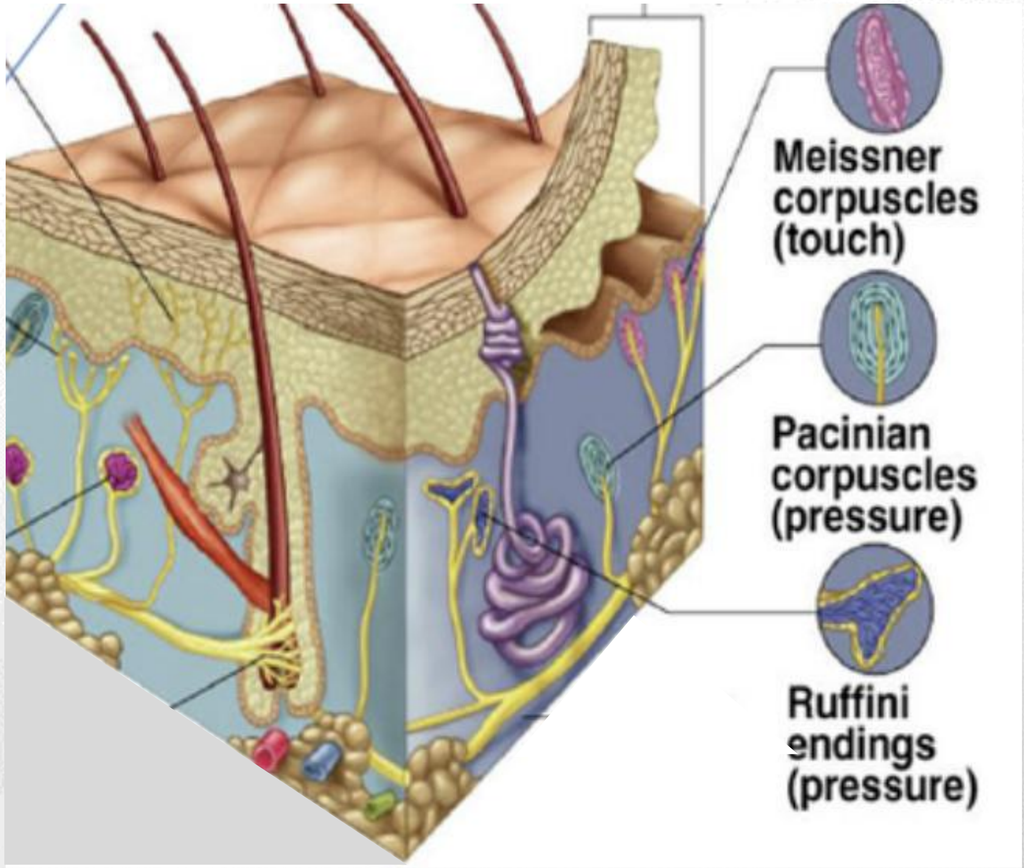
   Responsible for pressure.

3. **Meissner corpuscles:**

   Responsible for touch.

4. **Mechanoreceptors ending:**

   Act as shock stopper.



Cementicle

Small, calcified nodules found within the periodontal ligament

Causes:

- Calcification of epithelial rests of Malassez
- Calcification of periodontal ligament fibers.
- Minor trauma or tissue injury.

Site:

Commonly found in the apical region and furcation areas.

May be:

- Free in the PDL
- Attached to cementum.
- Embedded within cementum.

Structure:

- Resembles cementum in composition.
- Usually small, round or ovoid in shape.

Clinical significance:

- Generally asymptomatic and of no clinical importance.
- Occasionally visible as radiopaque bodies in radiographs.