

Cementum-1

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LEARNING OUTCOMES

- 1. Describe the origin and significance of hertwig's epithelial root sheath**
- 2. Describe the composition of cementum and its structural features**
- 3. Explain the classification of cementum**
- 4. List the differences between each type**

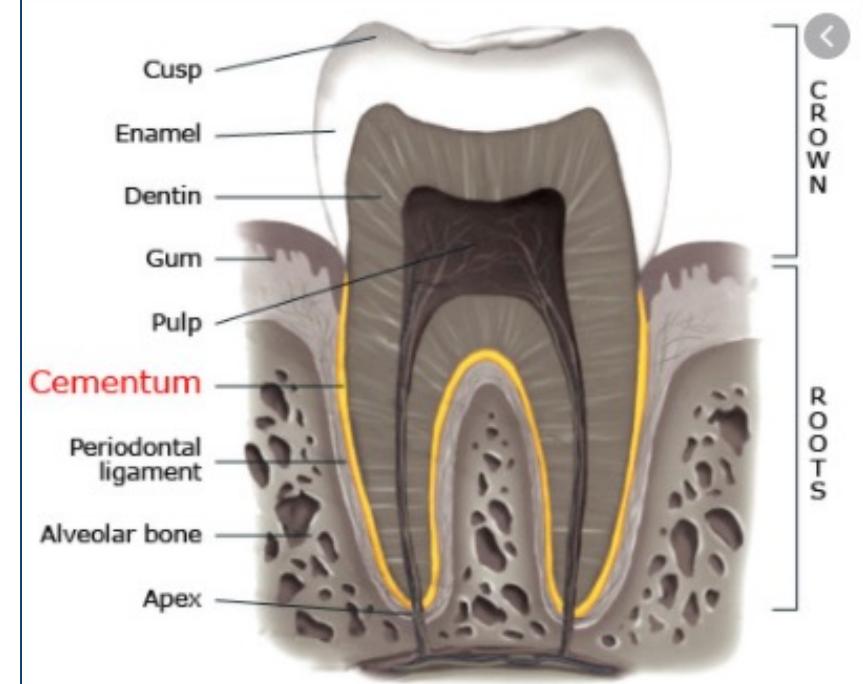
INTRODUCTION

- **Cementum---*avascular mineralized connective tissue*** covering the anatomic roots of human teeth.

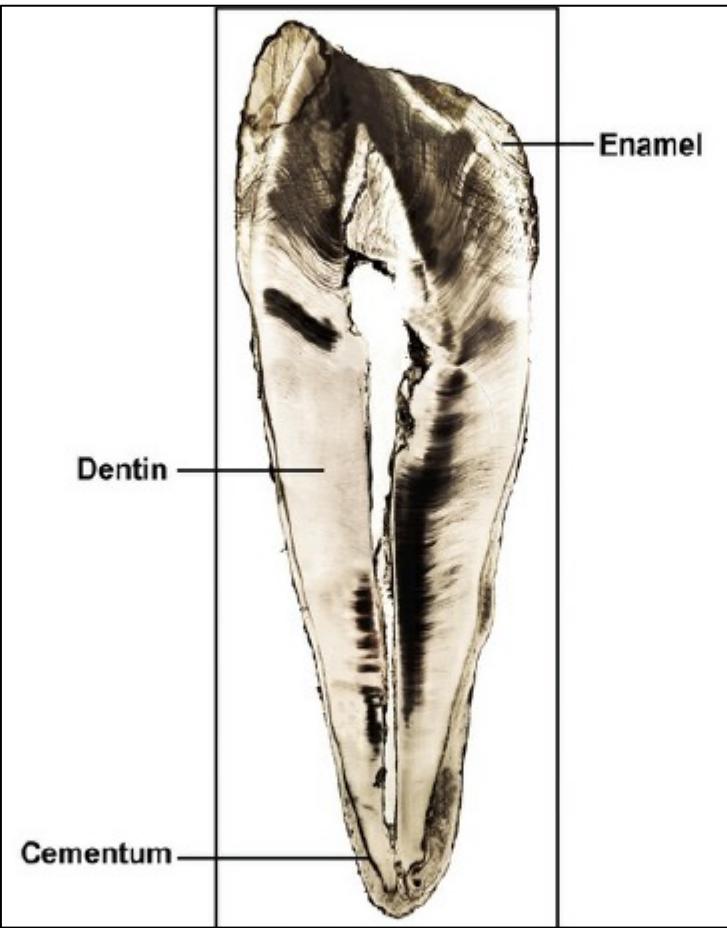
- It begins at the cervical portion of the tooth at the cementoenamel junction and continues to the apex



- Allows attachment of collagen fibers that bind the tooth to surrounding structures



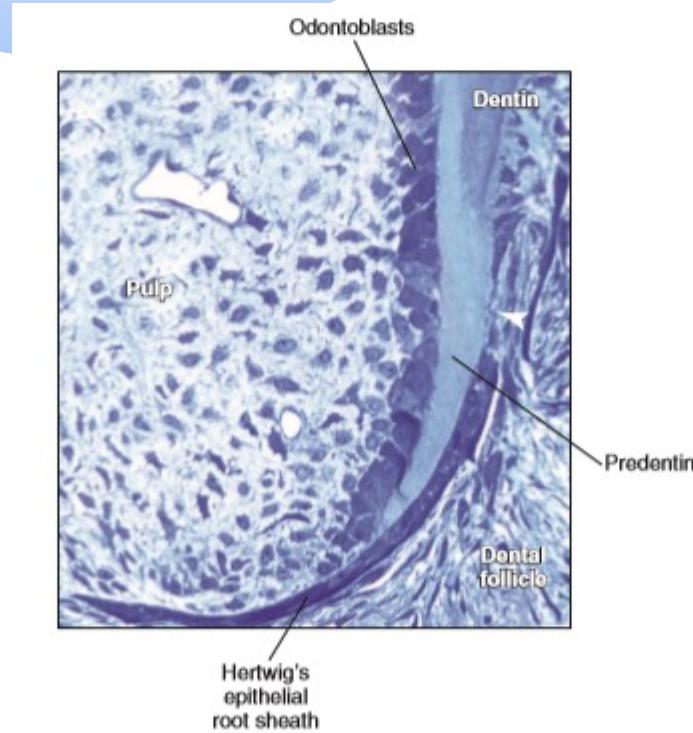
- **Cementum thickness varies—**
 - thinnest at the cementoenamel junction (*20 to 50 µm*)
 - thickest toward the apex (*150 to 200 µm*)
- ***The apical foramen is surrounded by cementum***
- **The development of cementum has been subdivided into:**
 1. ***Prefunctional stage***---occurs throughout root formation
 2. ***Functional stage*** ---- starts when the tooth is in occlusion and continues throughout life



Ground section of a premolar showing the distribution of cementum around the root. Increasing amounts of cementum occur around the apex.

Formation of cementum

- Tooth supporting tissues form from the dental follicle
- As the root sheath fragments, ectomesenchymal cells of the dental follicle penetrate between the epithelial fenestrations and become apposed to the newly formed dentin of the root
- These cells differentiate into cementoblasts
- *Evidence -- epithelial cells from HERs may undergo epithelial-mesenchymal transformation into cementoblasts during development to lay down cementum*



Physical characteristics

- ❖ Hardness is less than that of dentin
- ❖ *Light yellow in color*; distinguished from enamel by its *lack of luster*
- ❖ Lighter in color than dentin
- ❖ *Permeable to a variety of materials*

Chemical composition

- ❖ Cementum from fully formed permanent teeth contains:
 - 45 to 50% *inorganic substances*
 - 50 to 55% *organic material and water*

Inorganic portion

- ❖ Calcium and phosphate in the form of *hydroxyapatite*

Organic portion

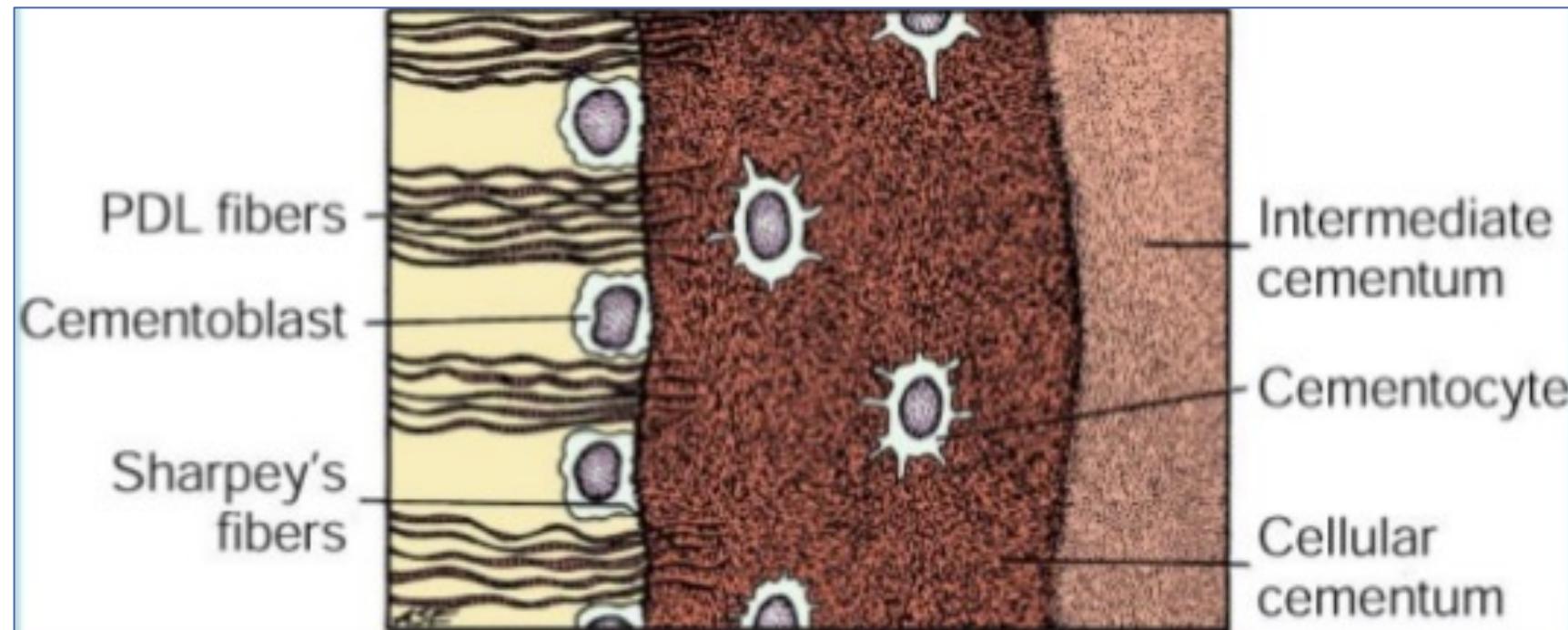
- ❖ Type I collagen
- ❖ Noncollagenous proteins in cementum
 1. *Bone sialoprotein (BSP)* - fill up the large interfibrillar spaces
 2. *Osteopontin ---regulates mineralization* +
 3. *Cementum derived attachment protein (CAP) --attachment of cells to the extracellular matrix*
- ❖ *Cementum has highest fluoride content of all the mineralized tissues* +

STRUCTURE OF CEMENTUM

CELLS OF CEMENTUM

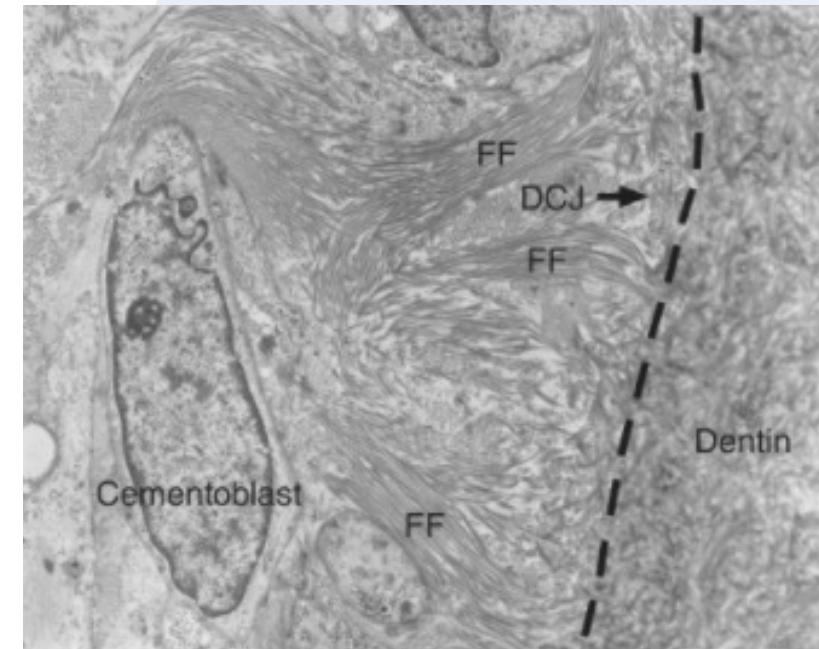
The main cells associated with cementum are:

1. Cementoblasts
2. Cementocytes



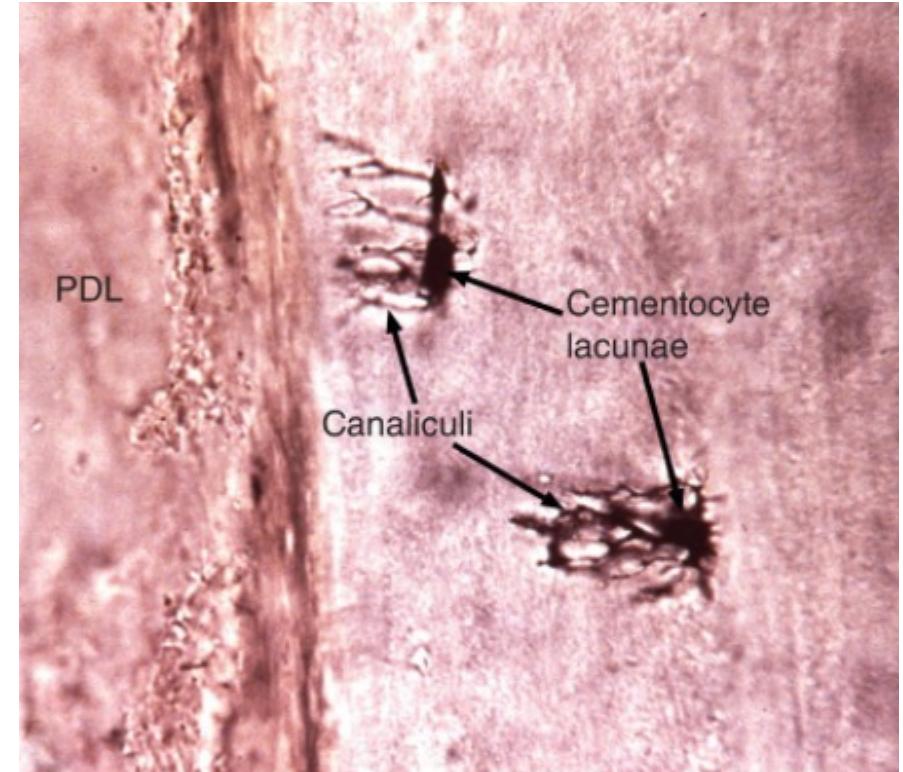
Cementoblasts

- ❖ Derived either from **HERS** or from **dental follicle**
- ❖ **Synthesize collagen and protein polysaccharides**, which make up the organic matrix of cementum
- ❖ Produces the intrinsic fibers of cementum



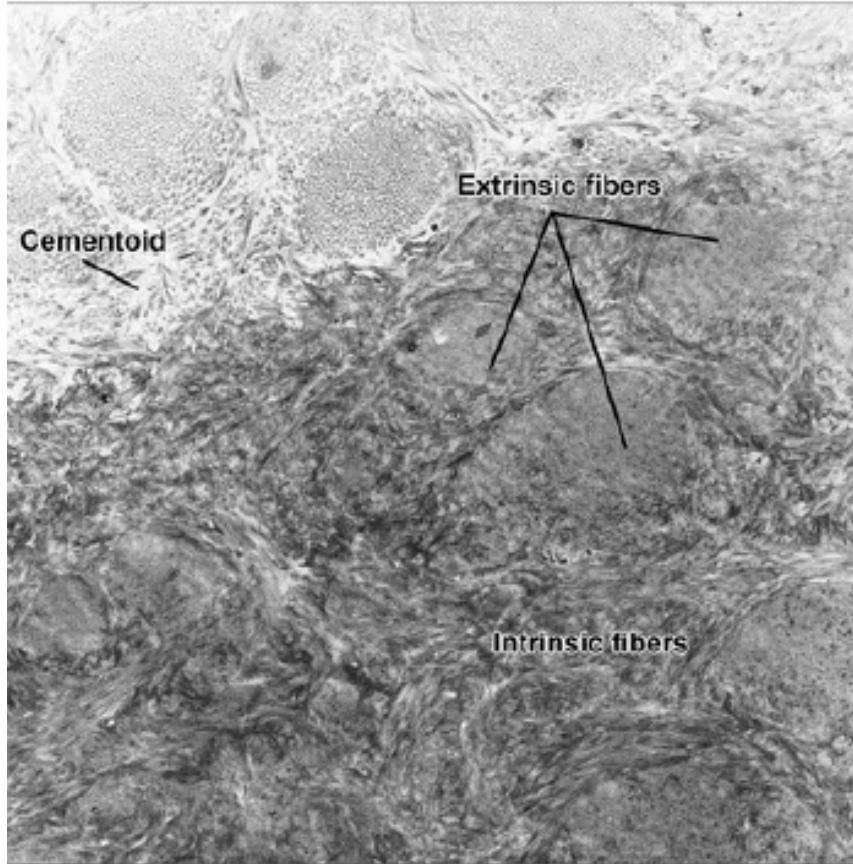
Cementocyte

- The cells incorporated into cellular cementum, and *lie in spaces called lacunae*
- Cementocyte has numerous *cell processes, or canaliculi, radiating from its cell body*
- These processes branch, and anastomose with those of a neighboring cell
- Most of the processes are *directed toward the periodontal surface* of the cementum



Ground section of cellular cementum showing cementocyte lacunae with canaliculi extending toward the cementum surface and the site of the periodontal ligament.

Intrinsic and extrinsic fibres of cementum



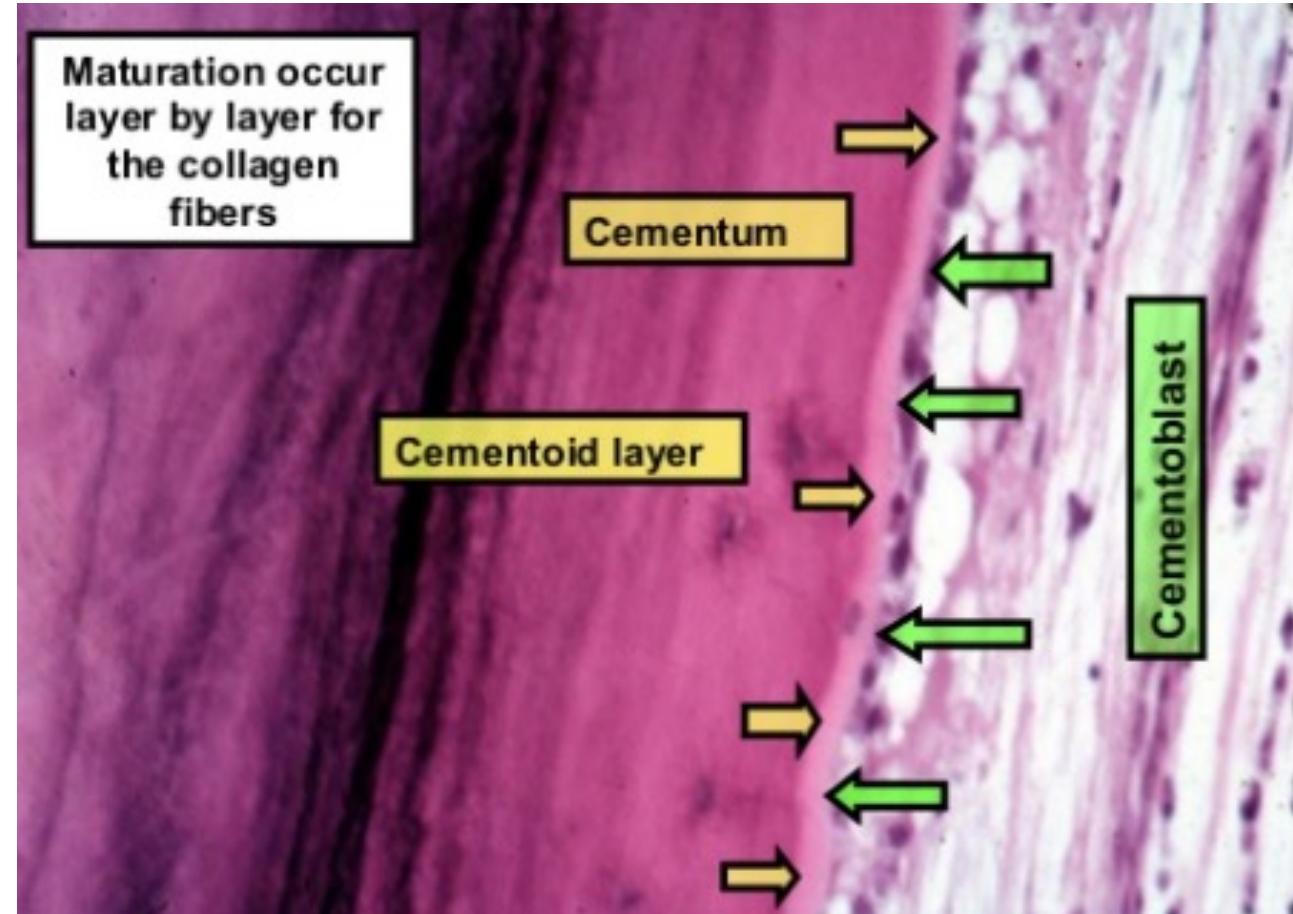
❖ Cementum has:

1. Intrinsic fibers-- produced by cementoblast, *smaller in diameter (1–2 microns)* and are *oriented parallel* to the surface
2. Extrinsic fibers-- produced by periodontal ligament fibroblasts, *larger bundles (5–7 microns in diameter)* and *oriented perpendicular* to the surface

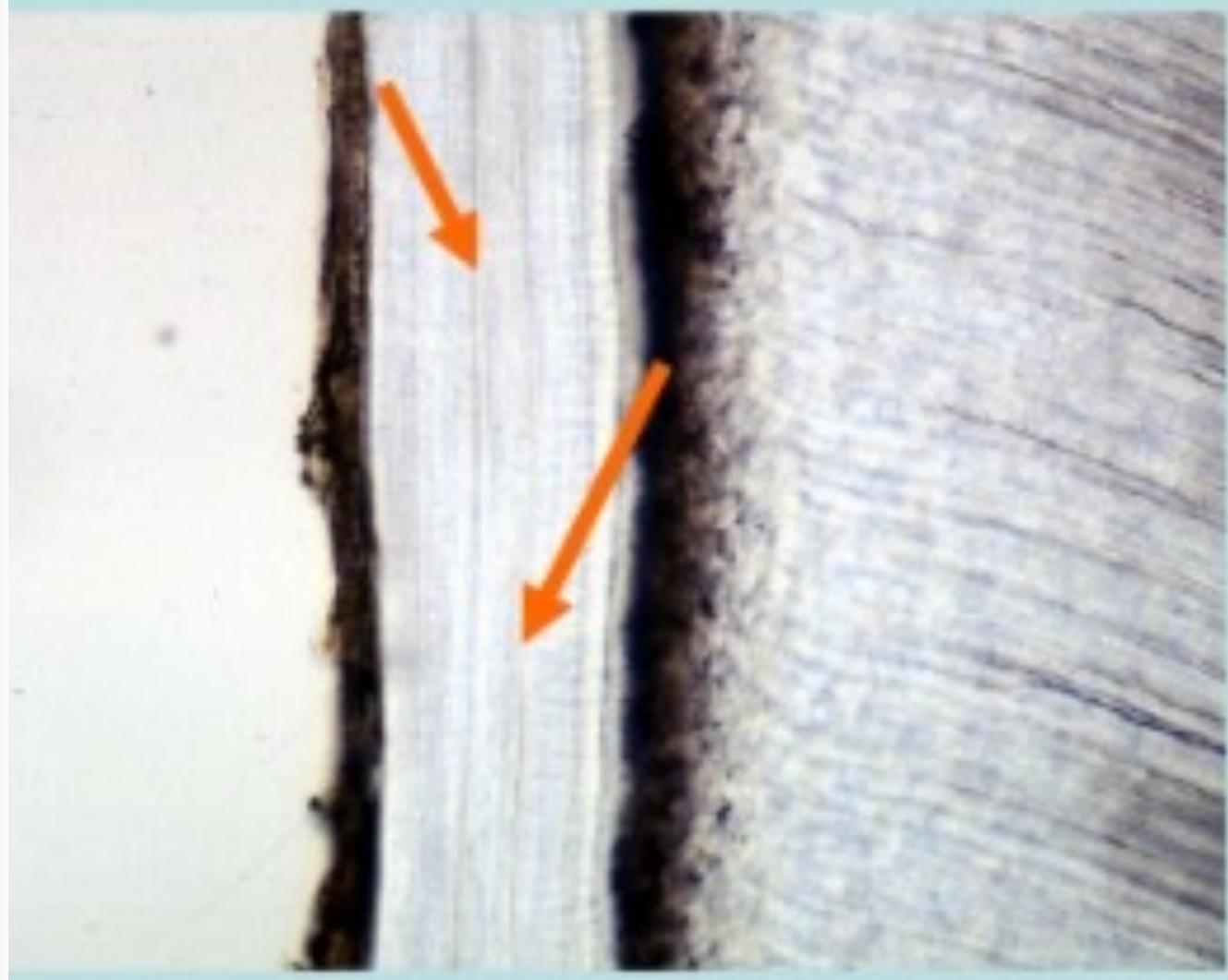
Oblique section through the periodontal ligament–cementum interface -- intrinsic fibers surround the embedded portions of the extrinsic fibers, which constitute Sharpey's fibers

Cementoid Tissue

- A thin layer of cementoid can usually be observed on the cemental surface
- As a new layer of cementoid is formed, the old one calcifies.
- Lined by cementoblasts. Connective tissue fibers from the periodontal ligament pass between the cementoblasts into the cementum



Incremental Lines



Both acellular and cellular cementum are separated by incremental lines

These lines represent “rest periods” in cementum formation, and are more mineralized than the adjacent cementum



CEMENTO-ENAMEL JUNCTION (CEJ)

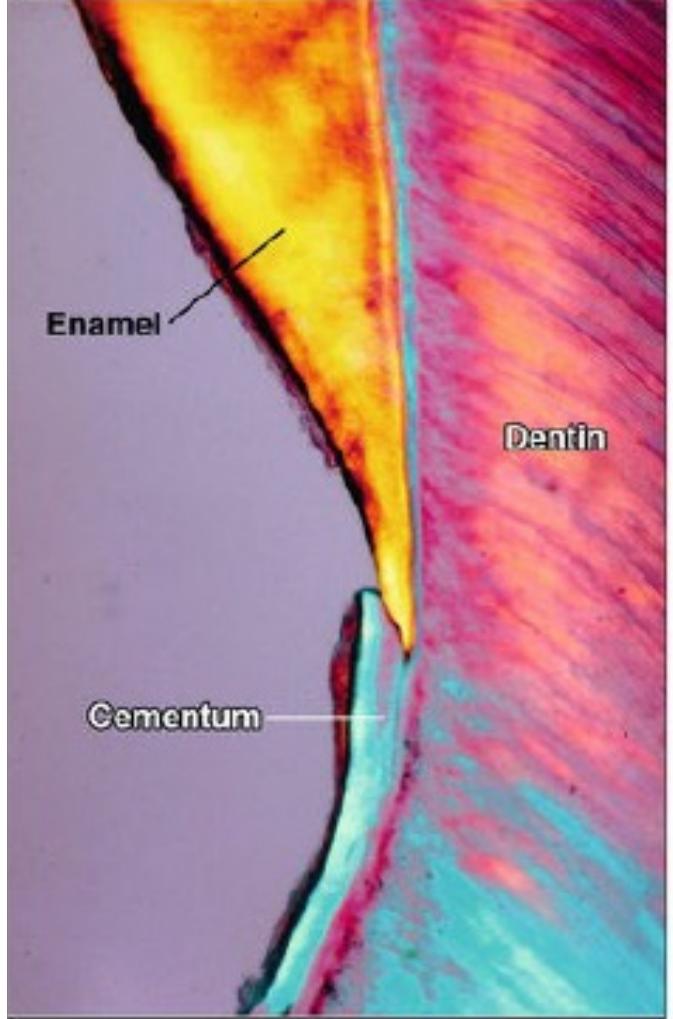
- The relation between cementum and enamel at the cervical region of the teeth:

60% teeth- cementum overlaps the enamel for a short distance

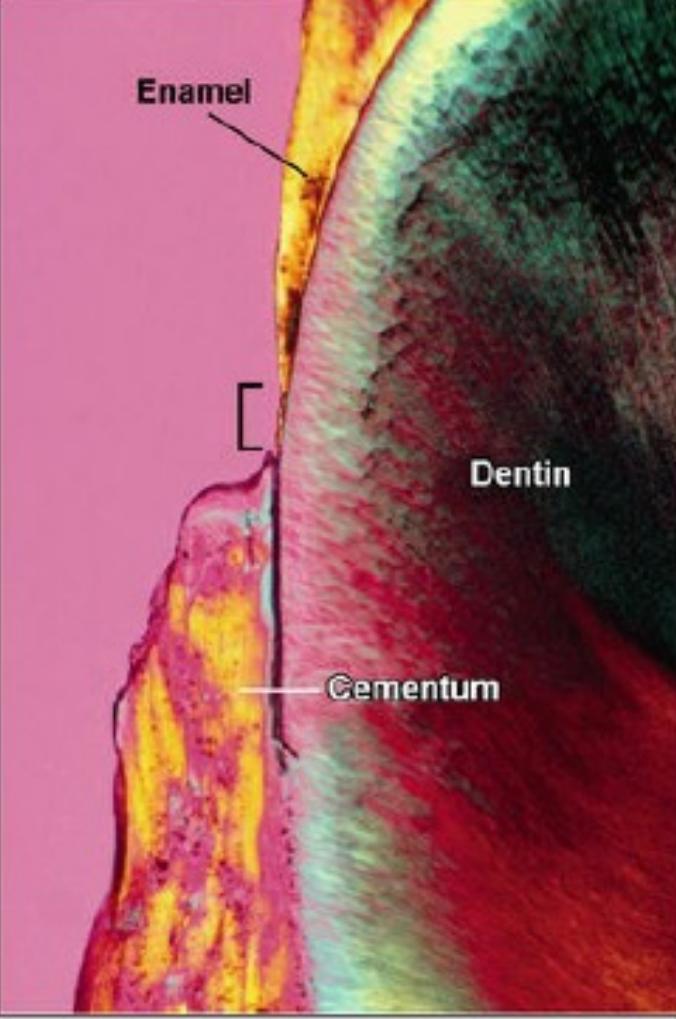
10% teeth- enamel and cementum do not meet, there is no CEJ

30% teeth- cementum meets the enamel in a sharp line—butt joint

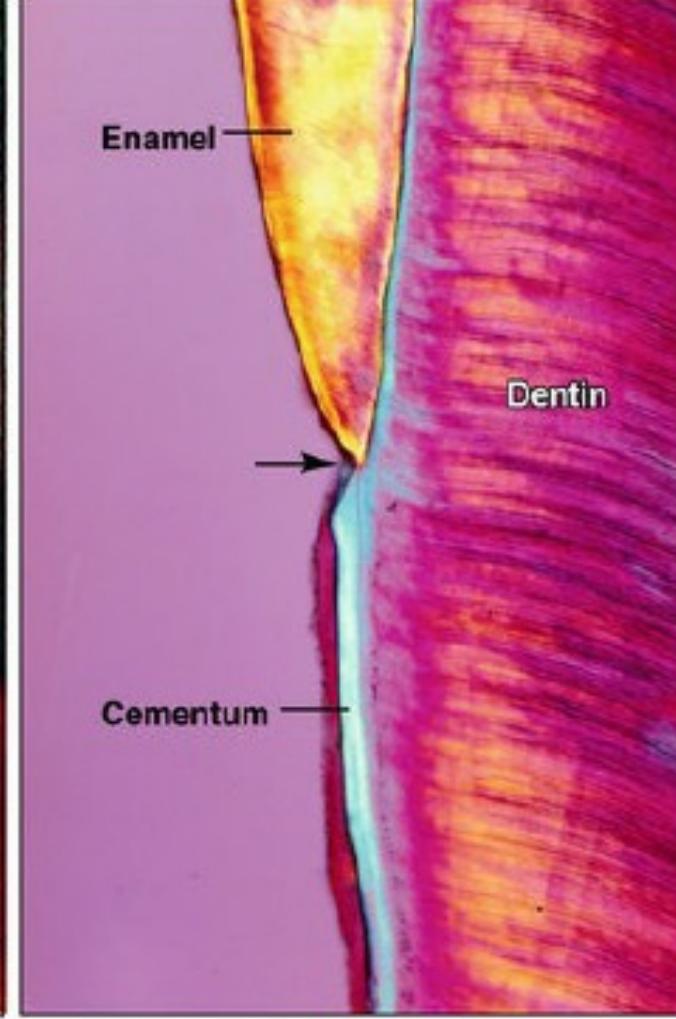
- Recently, fourth type of CEJ is observed--- **enamel overlapping cementum**



A



B



C

Three configurations of the cementoenamel junction in ground sections.

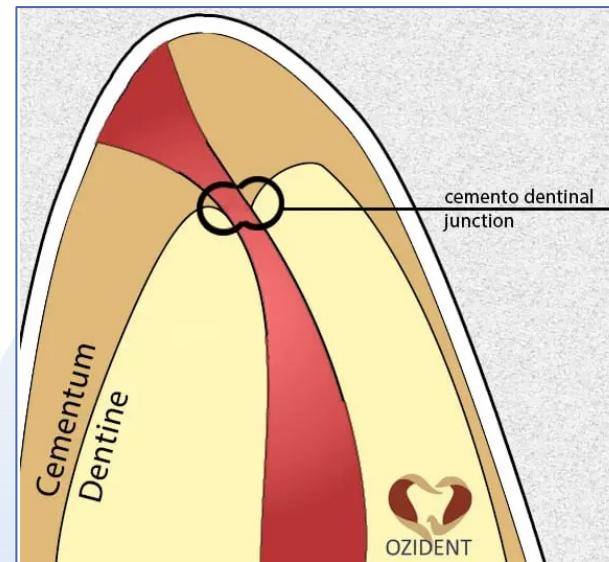
A, Cementum overlaps the enamel.

B, A deficiency of cementum (*bracket*) leaves root dentin exposed.

C, A butt joint is visible (*arrow*).

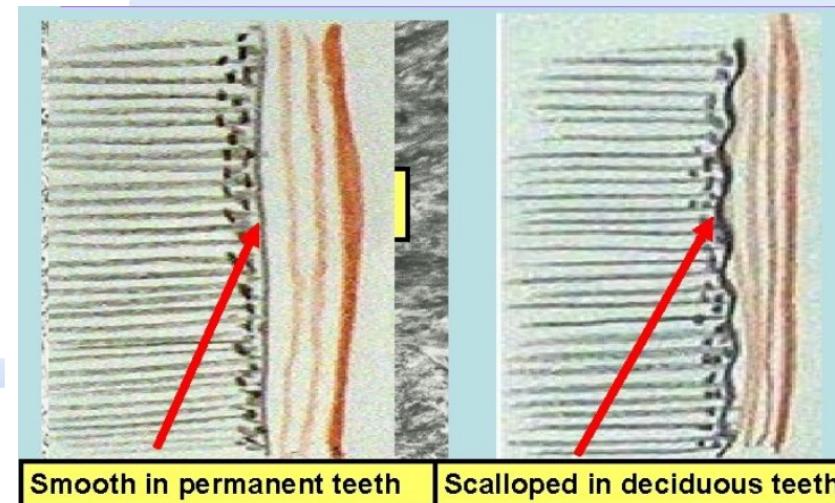
CEMENTODENTINAL JUNCTION (CDJ)

CDJ is *smooth in permanent teeth* and sometimes *scalloped in deciduous teeth*



Sometimes dentin is separated from cementum by a zone known as the *intermediate cementum layer*

Intermediate layer appears structureless-- *dental origin*

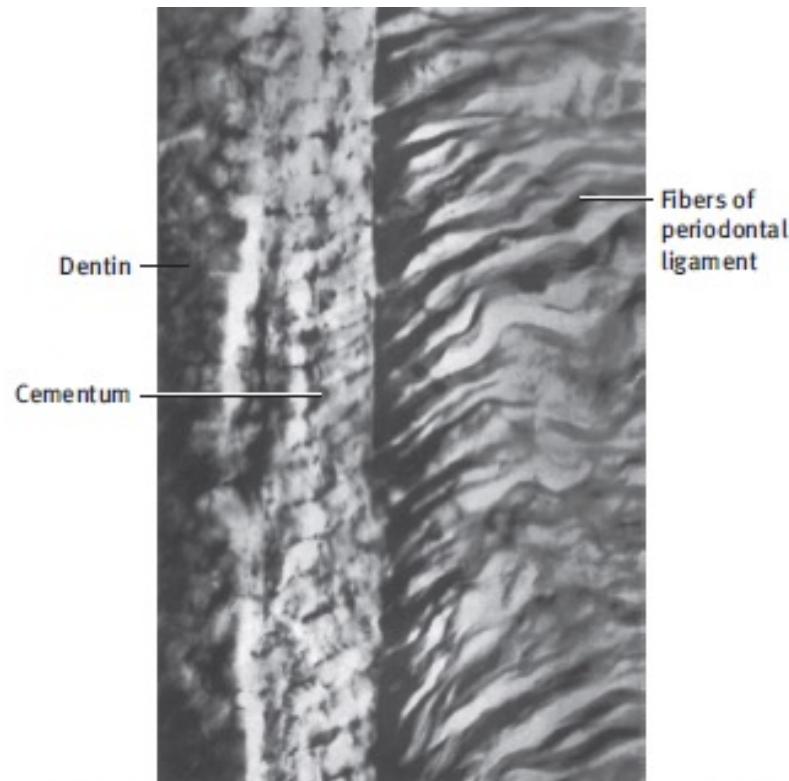


Probable function---*to seal the sensitive root dentin*

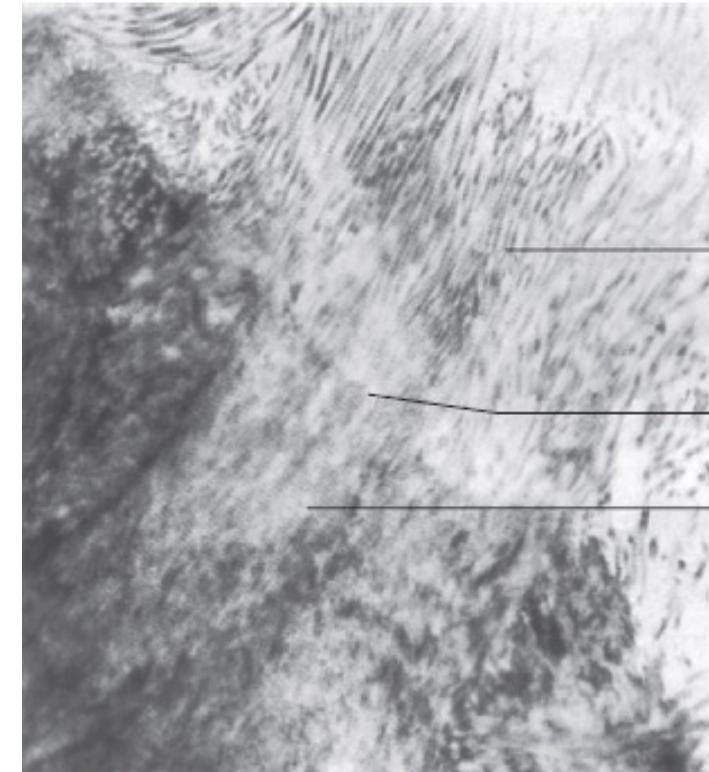
Types of cementum

- A. On the basis of presence or absence of cementocytes
 - 1. Cellular cementum
 - 2. Acellular cementum

- B. On the basis of the type of fibers
 - 1. Fibrillar (intrinsic/ extrinsic fibers) +
 - 2. Afibrillar cementum



Fibers of periodontal ligament continue into surface layer of cementum as Sharpey's fibers.



Collagen fibrils from periodontal ligament continue into cementum. Numerous collagen fibrils embedded in cementum are collectively referred to as Sharpey's fibers

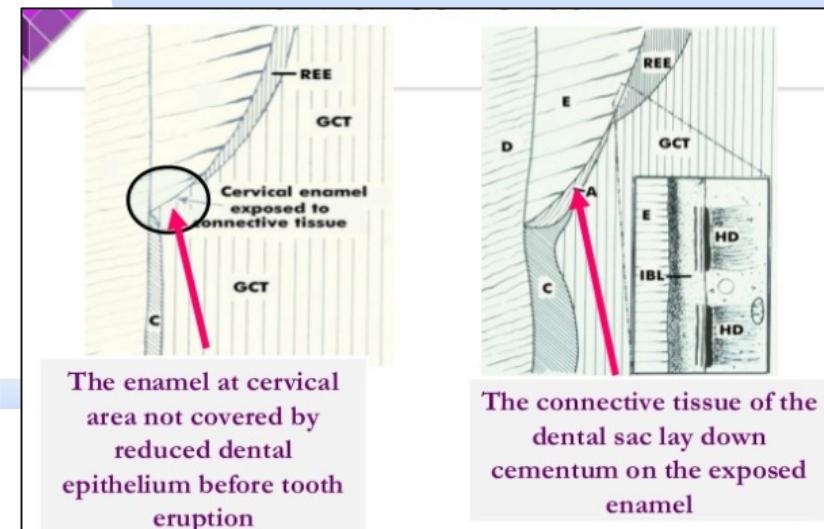
Based on the types of fibers (extrinsic and intrinsic) and the presence or absence of cementocytes, different types of cementum have been described—



- 1. Acellular afibrillar cementum (AAC)**
- 2. Acellular extrinsic fiber cementum (AEFC) --primary cementum,**
because it is formed first
- 3. Cellular cementum -- secondary cementum, because it forms later than primary cementum**
 - a. Cellular intrinsic fiber cementum (CIFC)**
 - b. Cellular mixed stratified cementum (CMSC)**
- 4. Intermediate cementum**

1. Acellular afibrillar cementum (AAC)

- ❖ *Contains no cells and no extrinsic or intrinsic collagen fibers*
- ❖ **Formed when there is premature loss of the reduced enamel epithelium over the newly formed enamel at the cervical region**
- ❖ *Thin layer on the enamel at the cervical margin of the tooth*
- ❖ **Seen chiefly as *coronal cementum*, with a *thickness of 1 to 15 µm***



2. Acellular Extrinsic Fiber Cementum (AEFC) PRIMARY CEMENTUM

- ❖ Extends from cervical margin to apical 1/3rd
- ❖ Thickness is between 30 and 230 μm
- ❖ Maybe the ***only type of cementum seen in single rooted teeth***
- ❖ ***Collagen fibrils make up the bulk*** of the organic portion of the tissue
- ❖ Extrinsic fibers are perpendicular to surface of cementum and are called ***Sharpey's fibers***. These extrinsic collagen fibers are mineralized except for their inner cores
- ❖ ***Noncollagenous proteins fill up the space between the extrinsic fibers***

❖ Develops slowly as the tooth is erupting and is *acellular because the cells that form it remain on its surface*

❖ *Main function is anchorage* especially in single rooted teeth



Histologic section of AEFC

3. Cellular Cementum

❖ Known as **secondary cementum** as this is formed later than the AEFC

❖ Mainly of two types—

- **CIFC** which is present in the middle and apical third
- **CMSC** which forms the bulk and occupies the apical interradicular regions



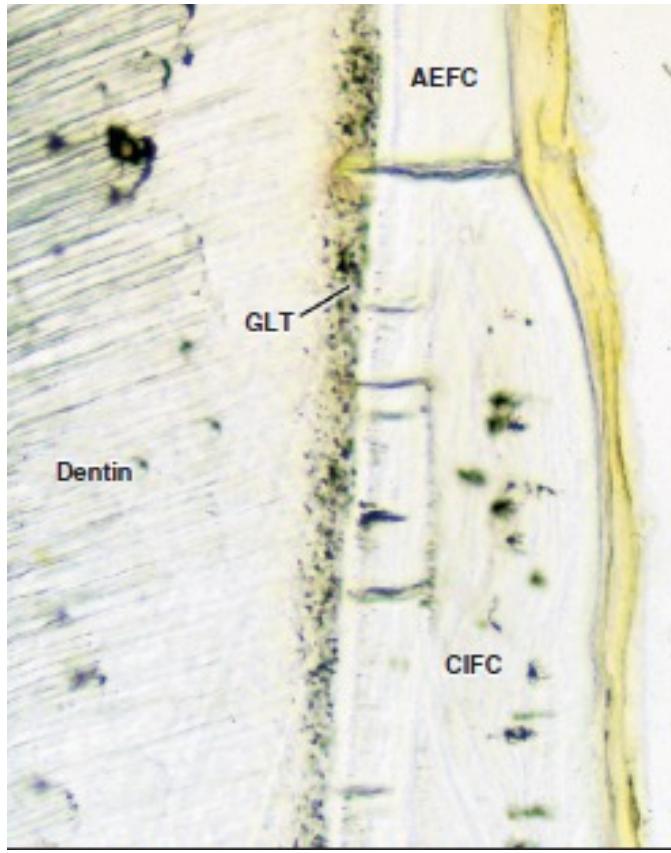
❖ Main functions of cellular cementum--*adaptation and repair of cementum*



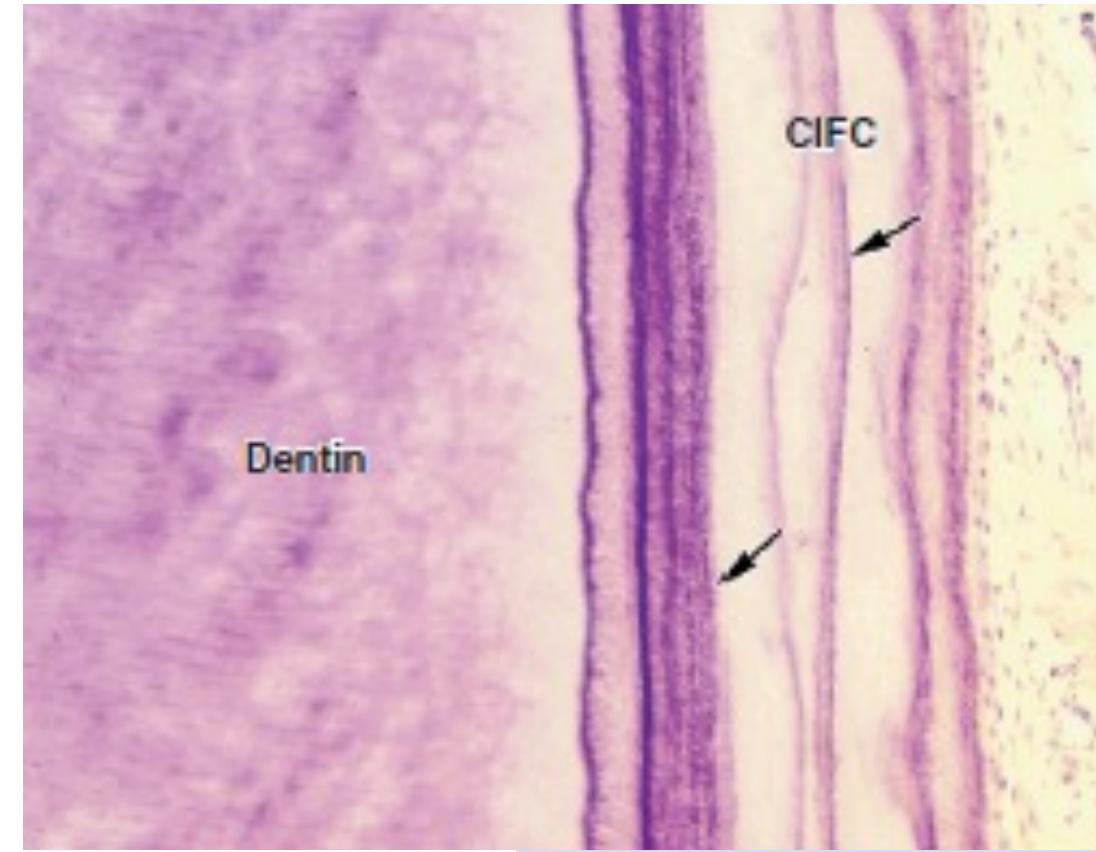
a. Cellular intrinsic fiber cementum (CIFC)

- ❖ ***Contains cells but has no extrinsic fibers***
- ❖ ***Contains intrinsic fibers secreted by cementoblasts***
- ❖ ***Deposited on the unmineralized dentin surface near the advancing root edge after at least half the root is formed***
- ❖ ***It is formed on the root surface and in cases of repair and fills the resorption lacunae***

- ❖ A layer of unmineralized matrix, called **cementoid**, is present on the mineralized cementum
- ❖ As cementum deposition progresses, cementoblasts become entrapped in the extracellular matrix they secrete and are called **cementocytes, and reside in lacunae**
- ❖ Cementocytes have processes that lodge in canaliculi that communicate
- ❖ Nourishment of the cells occurs by diffusion, and cementocytes in deeper layers may not be vital



The transition between the AEFC and CIFC. Both appear as a translucent, structureless layer. Cementocytes (*dark, rounded structures*) are present in the cellular intrinsic fiber cementum. GLT, Granular layer of Tomes

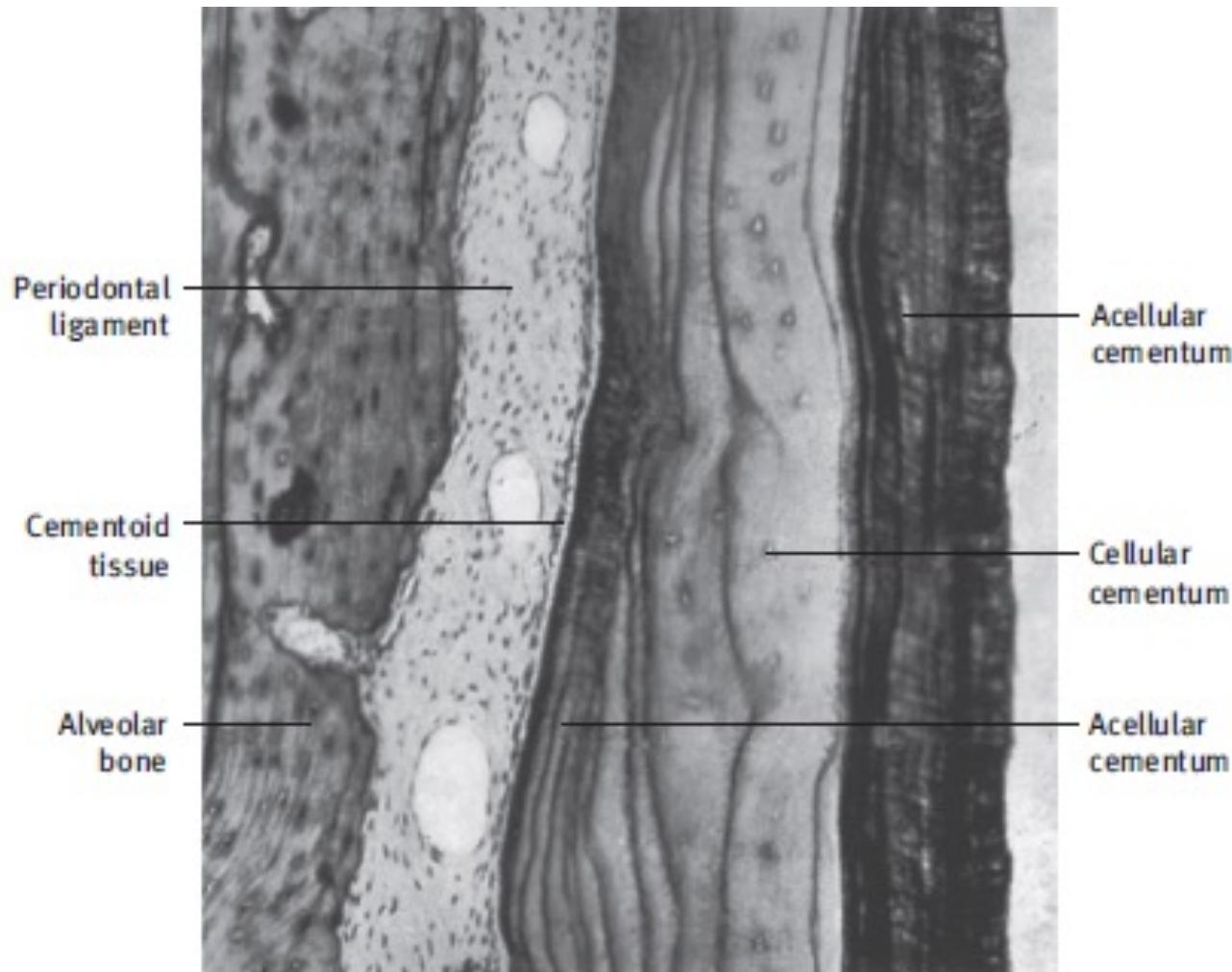


Longitudinal (*arrows*) and perpendicular lines are visible with some histologic stains. The longitudinal layering appear as thin or thicker lines, essentially denoting the interface between successive layers of cementum

b. Cellular mixed stratified cementum

- ❖ *CIFC alternates with AEFC*
- ❖ It is formed by cementoblasts and fibroblasts
- ❖ It appears primarily on *apical third of the root and furcation areas*
- ❖ Thickness varies from 100–1000 μm
- ❖ The cementocytes lie in spaces designated as lacunae

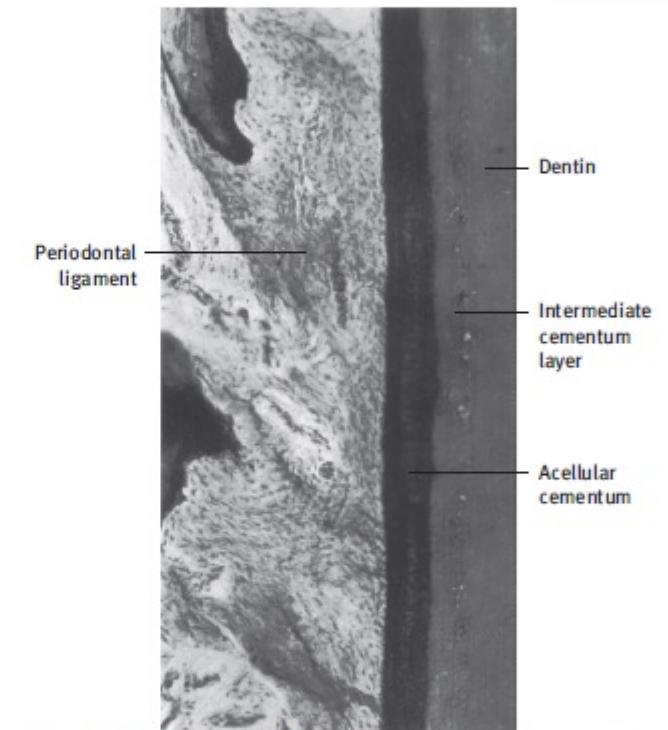




Cellular cementum on surface of acellular cementum and again covered by acellular cementum (incremental lines). Lacunae of cellular cementum appear empty, indicating degeneration of cementocytes

4. Intermediate cementum

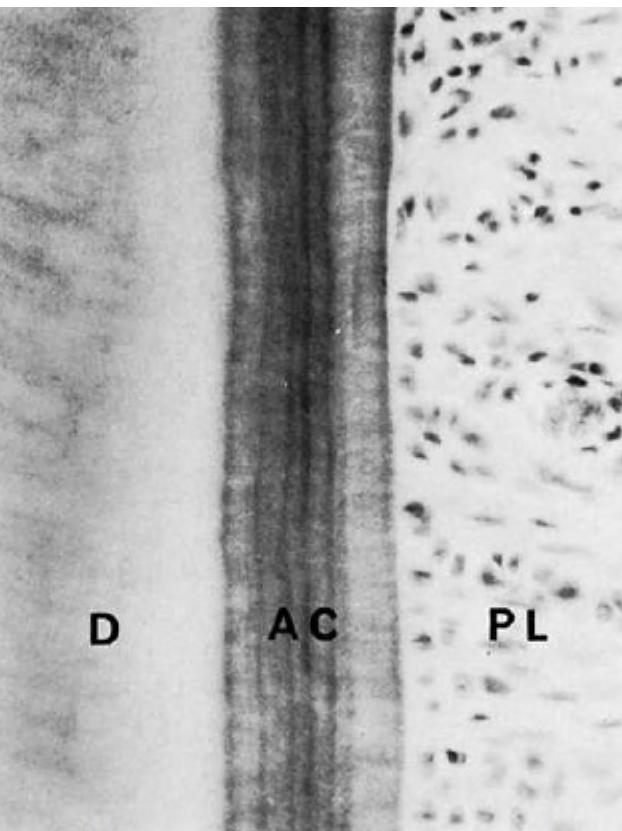
- A ***poorly defined zone near cementodentinal junction*** where epithelial cell rests may be entrapped in the calcified ground substance of cementum
- It usually occurs in the ***apical half of roots of molar teeth***



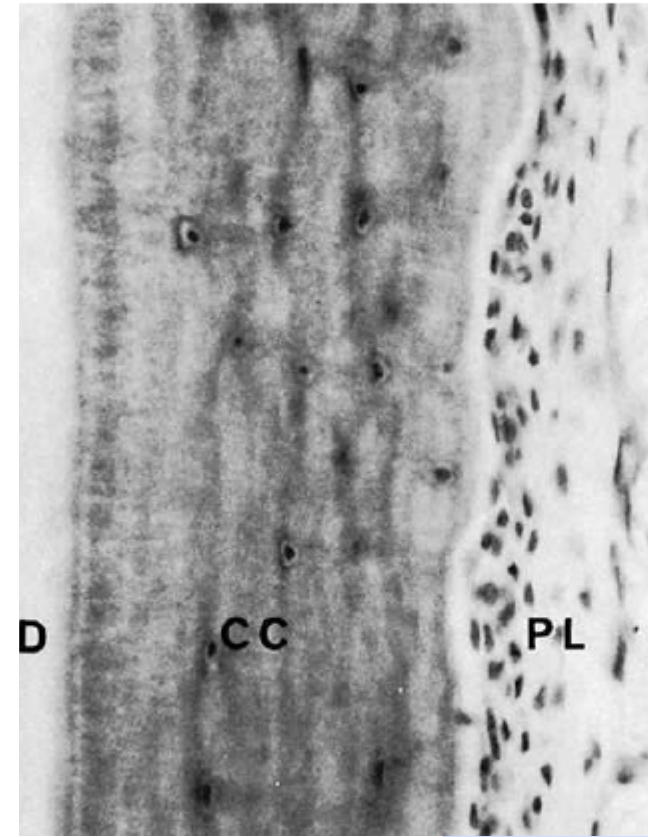
Intermediate layer of cementum. Scanning electron micrograph of cemental surface of human molar with actively mineralizing front

Differences between acellular and cellular cementum

Acellular cementum	Cellular cementum
First formed cementum	Formed after acellular cementum
Deposition rate is slower	Deposition rate is faster
Called primary cementum	Called secondary cementum
Embedded cementocytes are absent	Embedded cementocytes are present
Width is more or less constant	Width is highly variable
Found at the cervical third of the root	At apical third and inter-radicular area
Sharpey's fibres are well mineralized	Sharpey's fibres are partially mineralized
Incremental lines are regular and closely placed	Incremental lines are irregular and placed wide apart



Acellular cementum (AC) showing incremental lines running parallel to the long axis of the tooth. Note the thin, light lines running into the cementum perpendicular to the surface; these represent the Sharpey fibers of the periodontal ligament (PL).



Cellular cementum (CC) showing cementocytes lying within the lacunae. Cellular cementum is thicker than acellular cementum. The incremental lines are less distinct than in the acellular cementum. The cells adjacent to the surface of the cementum in the periodontal ligament (PL) space are cementoblasts

References

- 1. Orban's Oral Histology and Embryology-14th Edition. Chapter 7: Cementum; Page no: 116-130**

- 2. Tencate's Oral Histology 8th edition. Chapter 6: Periodontium; Page no: 205-232**

Thank you