Cementum

Omyma Meabed

Cementum: is a hard, avascular connective tissue that covers the roots of teeth

Mesodermal in origin

it begins at the amelo-cemental junction and continues to the apex.

Cementum is interlocked firmly with the dentin of the root.

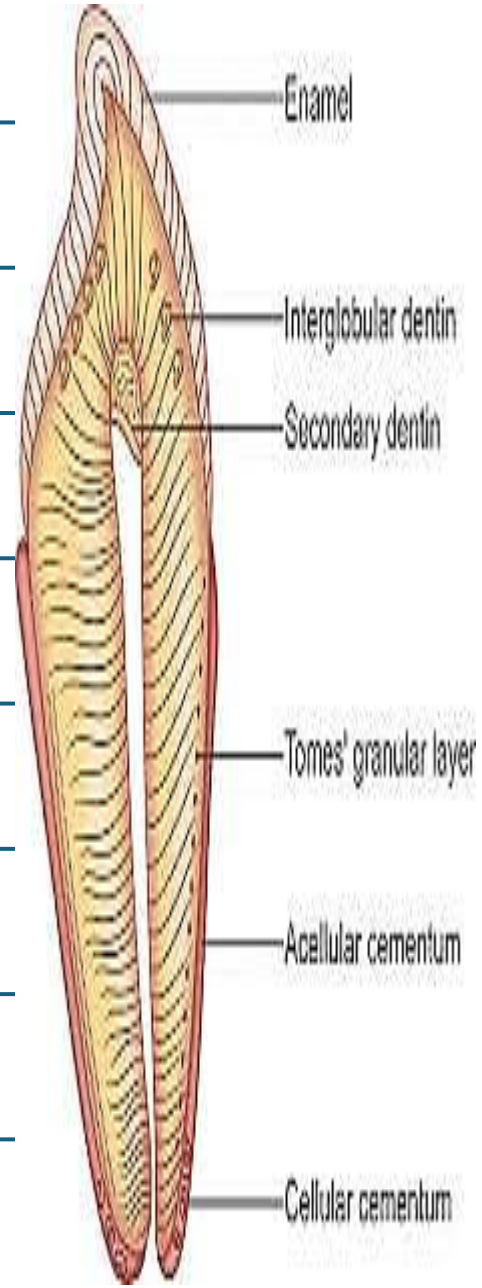
Cementum is a mineralized connective tissue nearly similar to bone except that it is avascular

The cells that form cementum are called cementoblasts.

Cementum function:

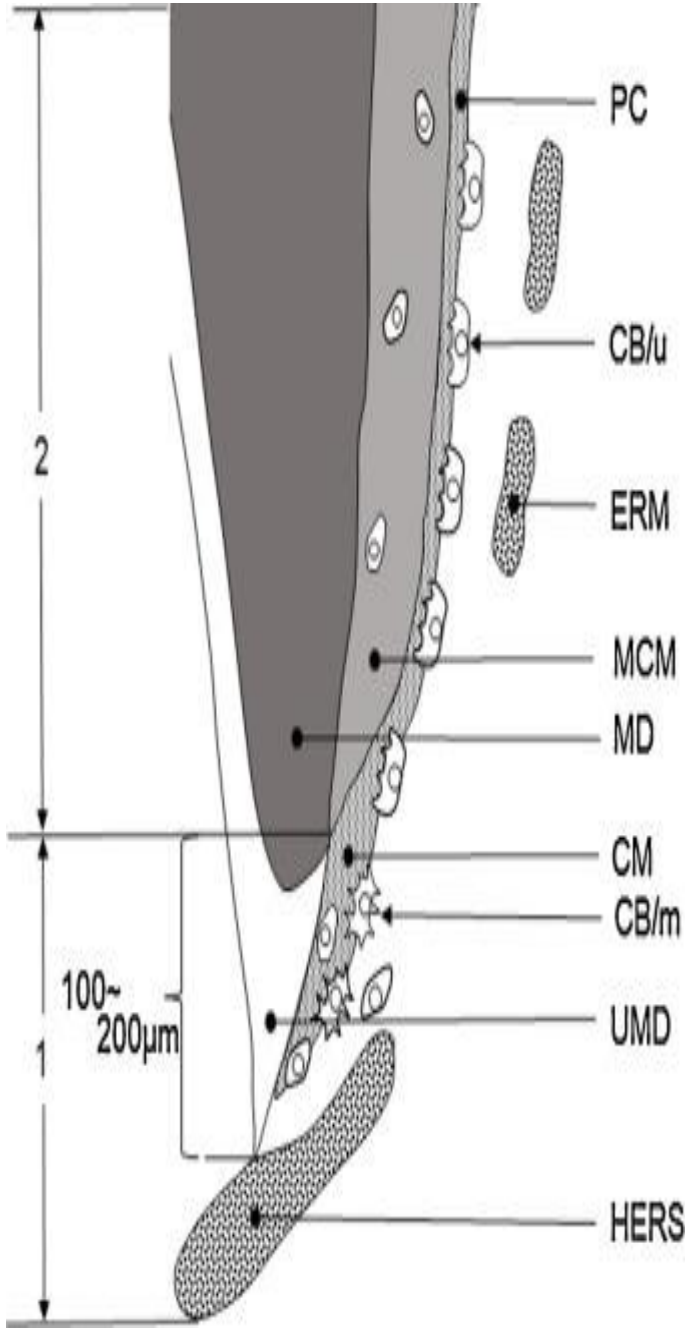
1- acellular cementum provides attachment for the tooth (pdl fibers)

2-cellular cementum has an adaptive role in response to tooth wear and movement and is associated with repair of periodontal tissues

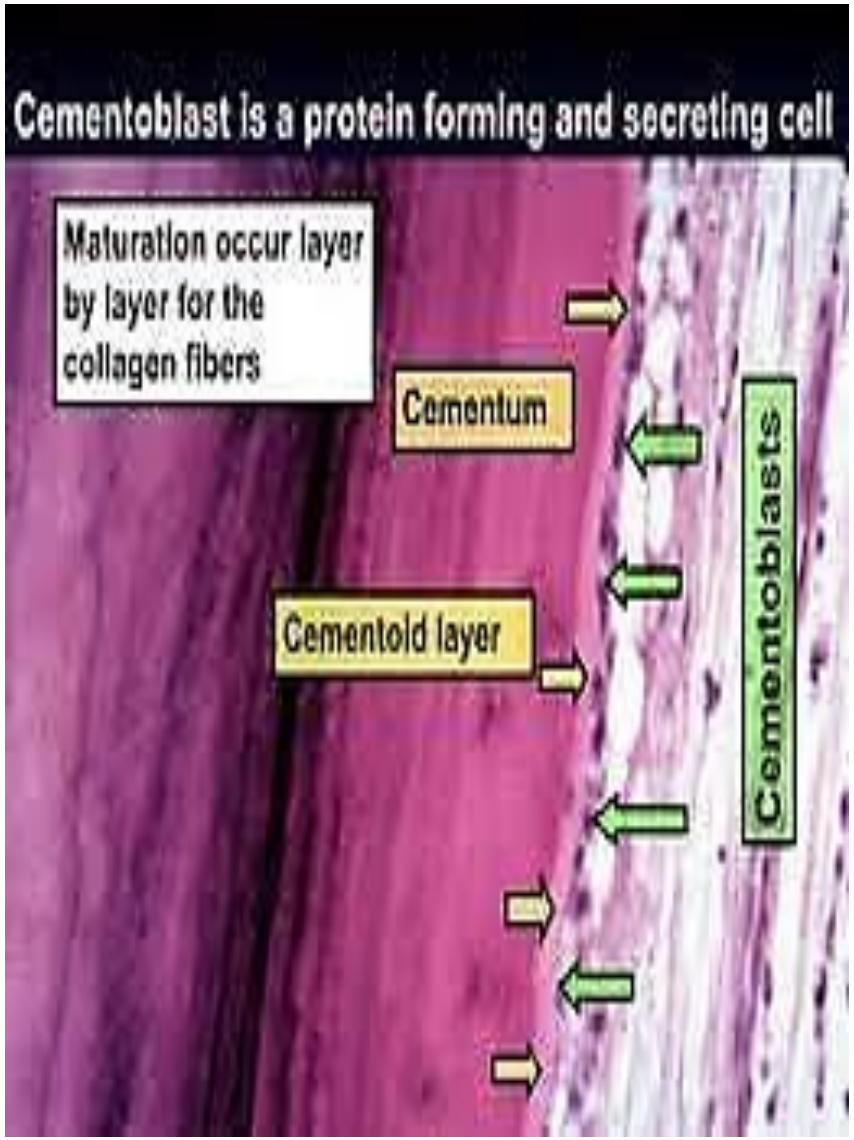


Cementogensis

- The development of cementum has been subdivided into a prefunctional stage, which occurs throughout root formation, and a functional stage, which starts when the tooth is in occlusion and continues throughout life.
- **Pre-functional stage** Occurs in two phases: matrix formation and mineralization.
- **Matrix formation**: The development of the root begins when the crown is completed. The outer and inner dental epithelium form the epithelial root sheath Hertwig's.
- The inner dental epithelium induce the neighboring cells of the dental papilla to differentiate into odontoblasts. The predentin and dentin formation occur.
- Once the dentin formation is started, the epithelial root sheath of Hertwig's will loose its continuity.
- Undifferentiated mesenchymal cells from adjacent connective tissue of the tooth follicle will differentiate into cementoblasts.

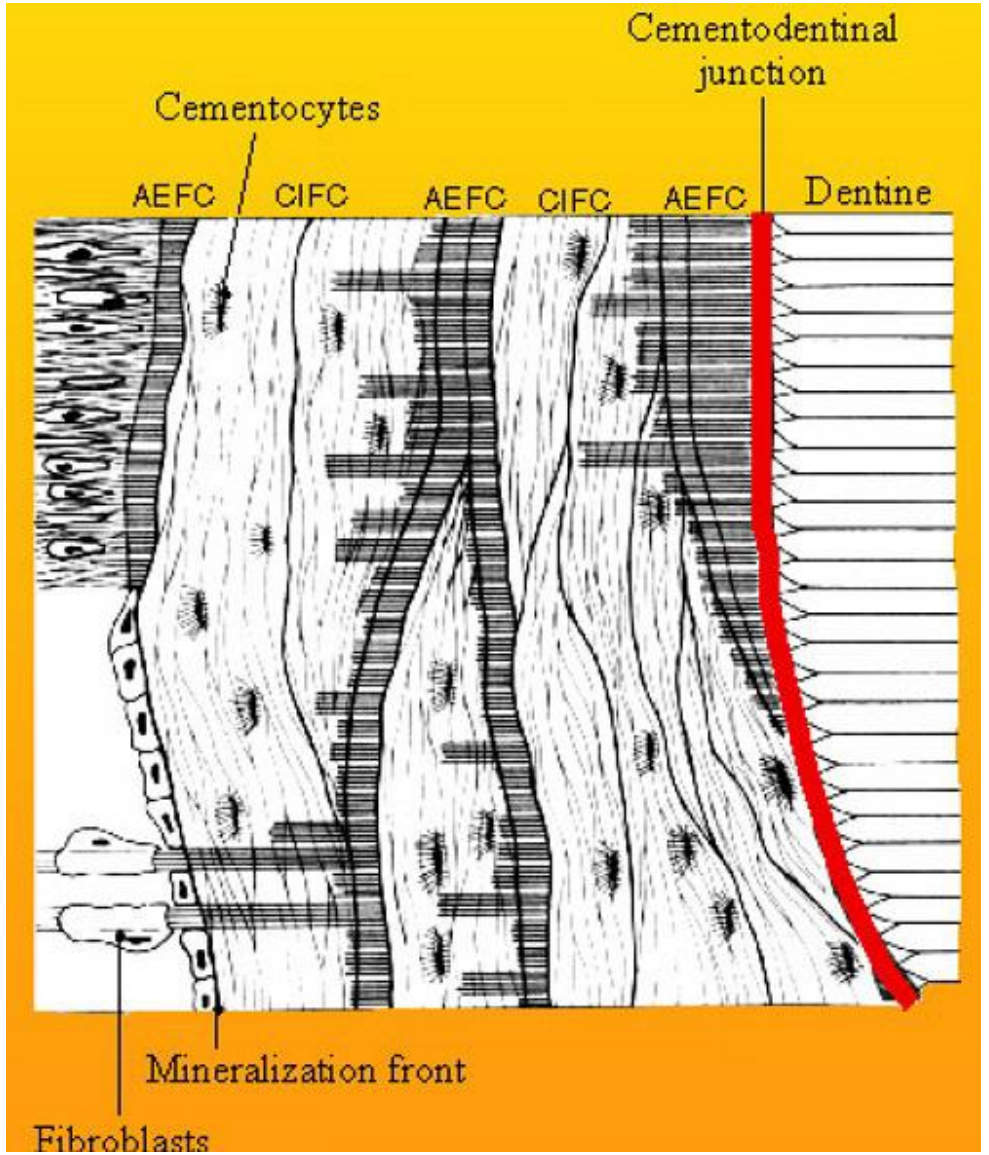


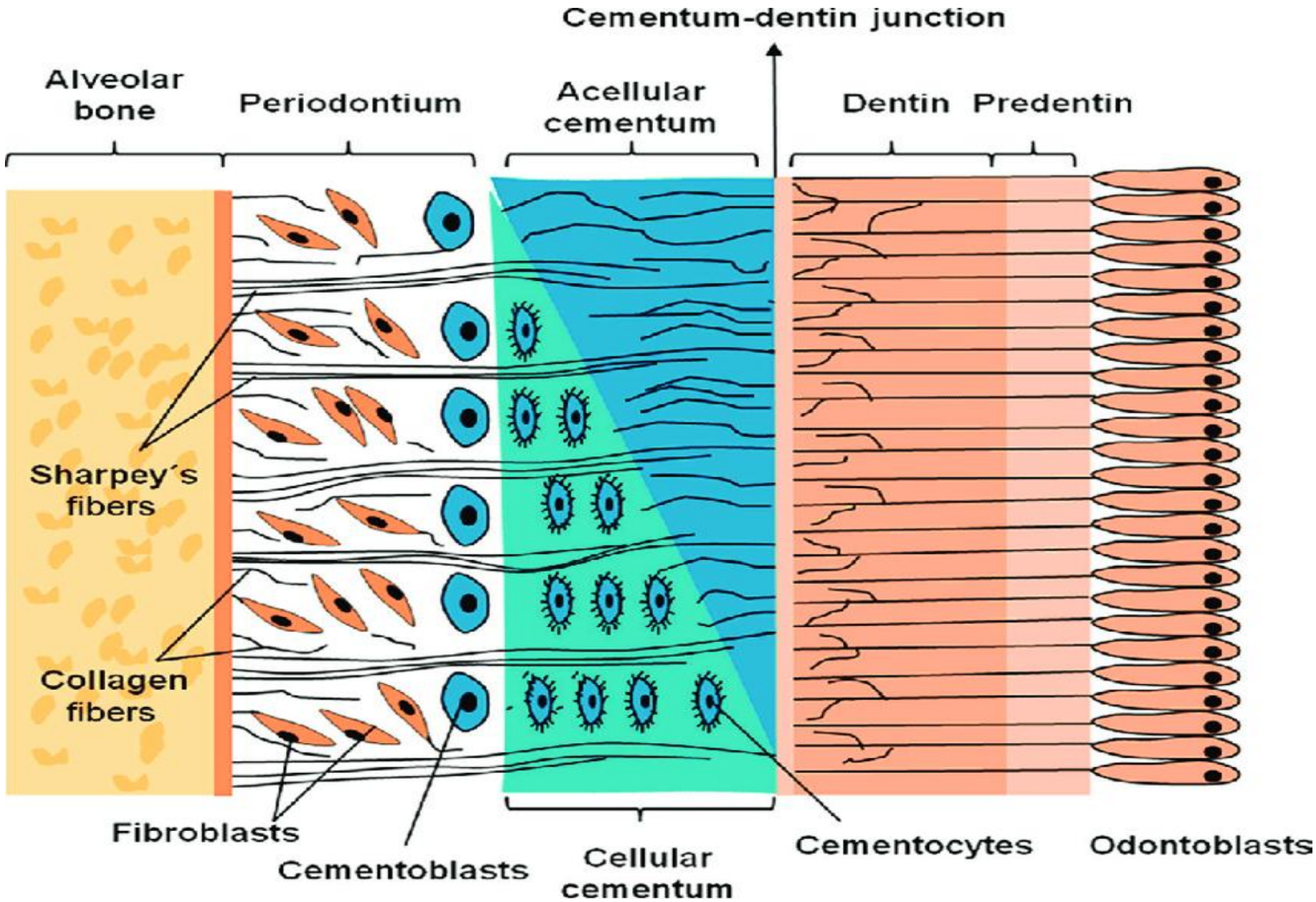
- The cementoblasts have characteristics of protein forming cell **AS**: an abundant endoplasmic reticulum, a well developed Golgi apparatus and several mitochondria
- The main product of cementoblast is collagen type I which constitutes the major portion of organic matrix.
- cementoblasts also produce the ground substance.
- The remnants of the epithelial root sheath of Hertwig's migrate toward the dental sac and become the epithelial rests of Malassez found in the periodontal ligament of the fully developed tooth.
- Growth of cementum is a rhythmic process and as a new layer of cementoid is formed, the old one calcified. A thin layer of cementoid can usually be observed on cementum surface

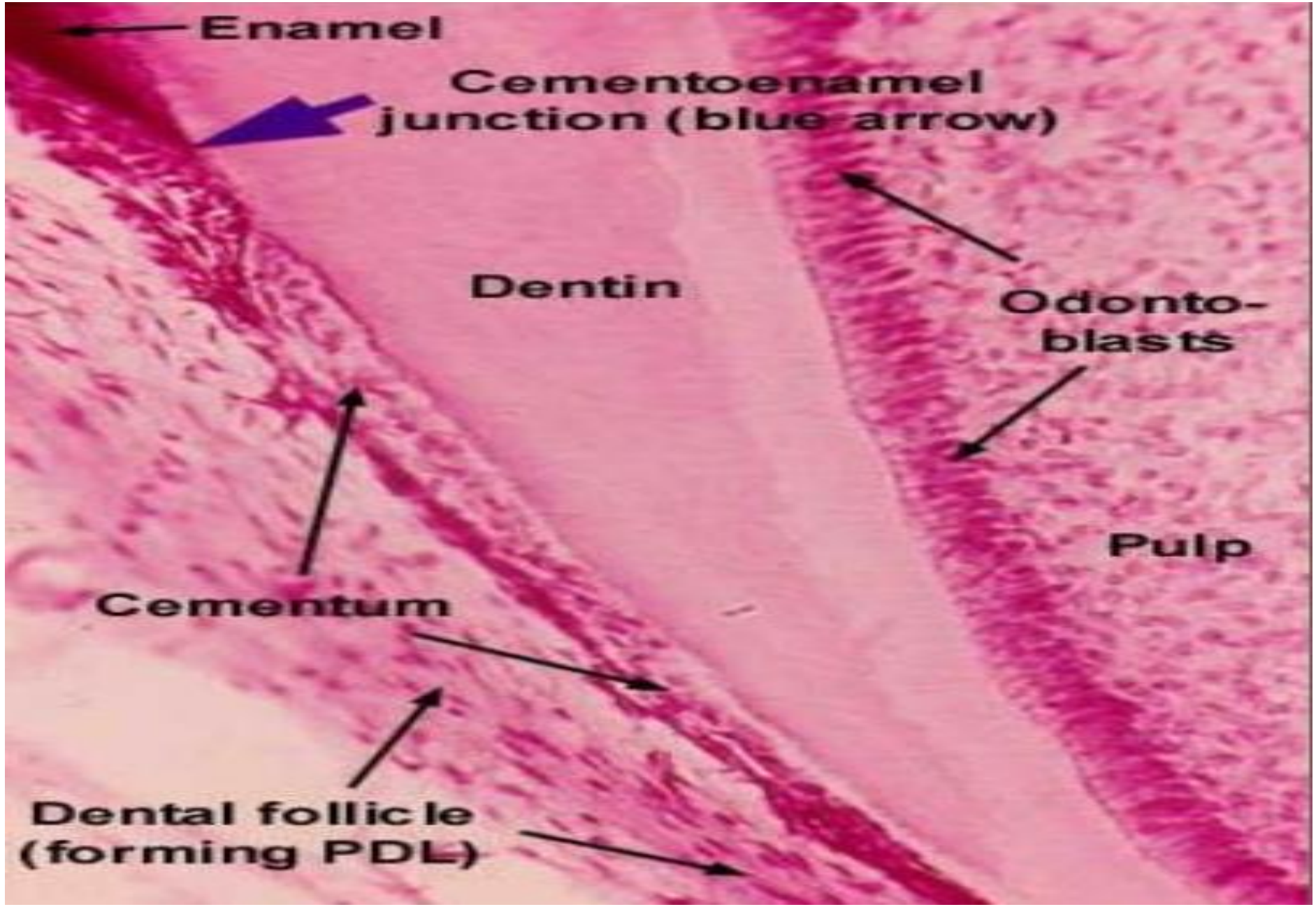


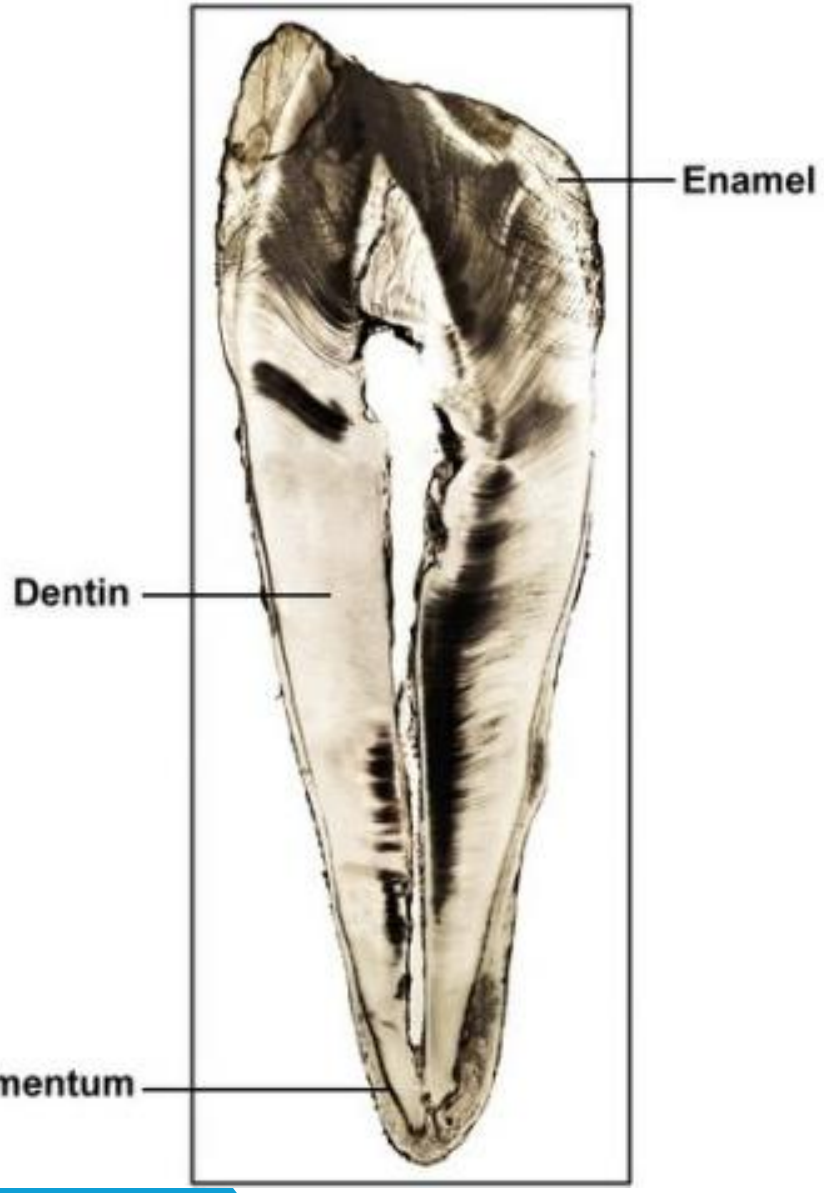
Mineralization

- **occurs after some matrix production has taken place.**
- **The mineral originate from <u>tissue fluids</u>, where calcium and phosphate ions are present.**
- **The mineral crystals are deposited on the surface of and between the collagen fibers.**
- **The long axes of the crystals are arranged <u>parallel</u> to the long axes of the collagen fibers.**
- **The crystals are composed of unit of hydroxy apatite.**




Cementum-dentin junction
Alveolar bone
Periodontium
Acellular cementum
Dentin
Predentin
Sharpey´s fibers
Collagen fibers
Fibroblasts
Cementoblasts
Cellular cementum
Cementocytes
Odontoblasts


Enamel
Cementoenamel junction (blue arrow)
Dentin
Odonto-blasts
Pulp
Cementum
Dental follicle (forming PDL)



CHEMICAL COMPOSITION:

- The composition of cementum is is approximately 45% to 50% hydroxyapatite by weight
  - the remaining portion is collagen and noncollagenous matrix proteins.
  - Type I collagen is the predominant collagen of cementum.

Physical properties

1 - COLOUR :

- Light yellow, Darker than enamel, Lighter than dentin

2 - THICKNESS :

- Begins at CEJ where it is thinnest at cervical part of root (20-50 microns) Gradually thickens apically reaching 150-200 microns

3- PERMEABILITY :

Cementum is permeable from dentin and periodontal ligament sides where permeability decreases with age.

Histologic structure

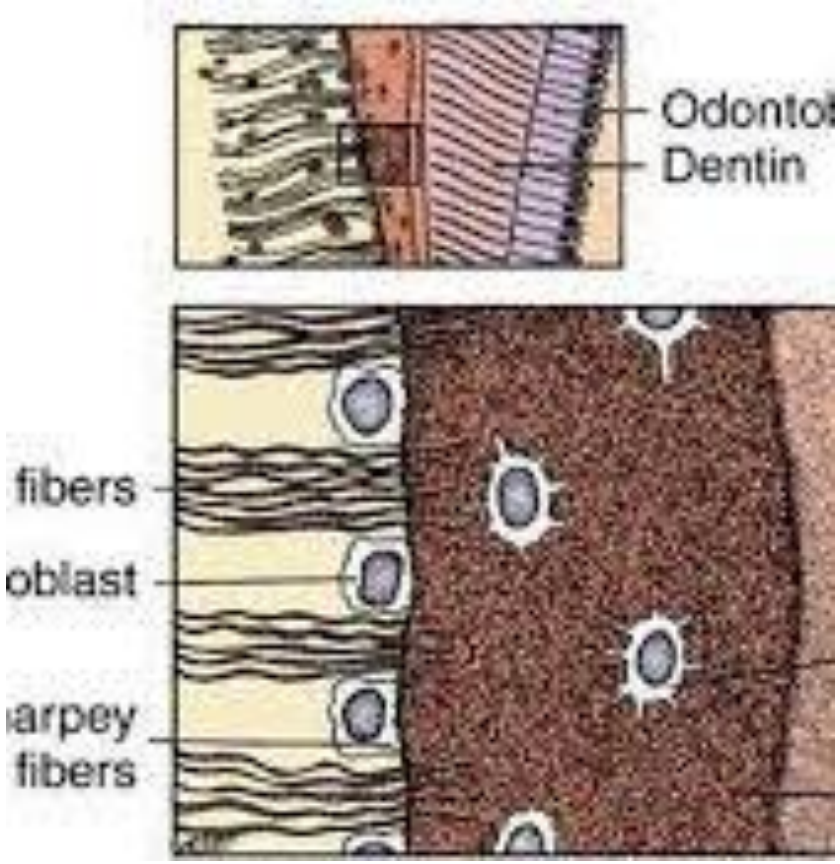
❖ **cells**

❑ **cementoblasts**: **Large cuboidal cells found on surface of cementum**

- **Under light microscope: they appear with basophilic cytoplasm**
- **Under electron microscope: they show all features of protein synthesizing cells**
- **They synthesize the collagen fibers(intrinsic fibers) and ground substance of cementum**
- **They rest on cementum matrix (cementoid) on the outer surface of cementum**

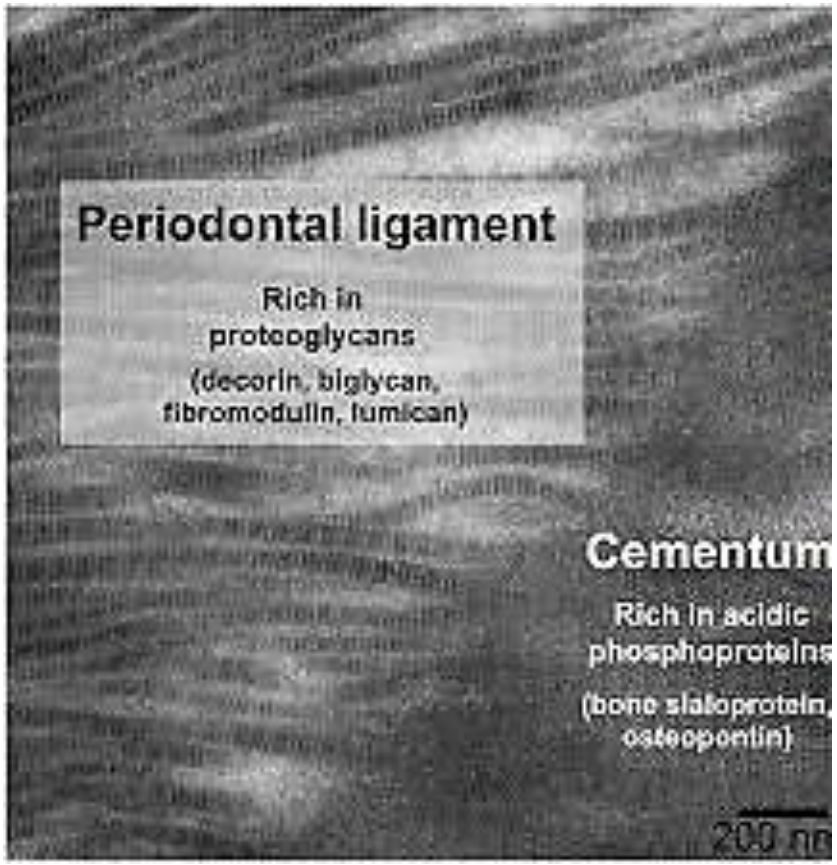
❑ **Cementocytes : Are cementoblasts trapped within matrix due to rapid rate of formation , Their body lie in lacuna , The processes extend in canaliculi.**

- **Most of processes are directed toward PDL (source of nutrition)**
- **Cementocytes in deeper layers undergo apoptosis the cytoplasm contains degenerated organelles, the endoplasmic reticulum is dilated and mitochondria are spaced.**

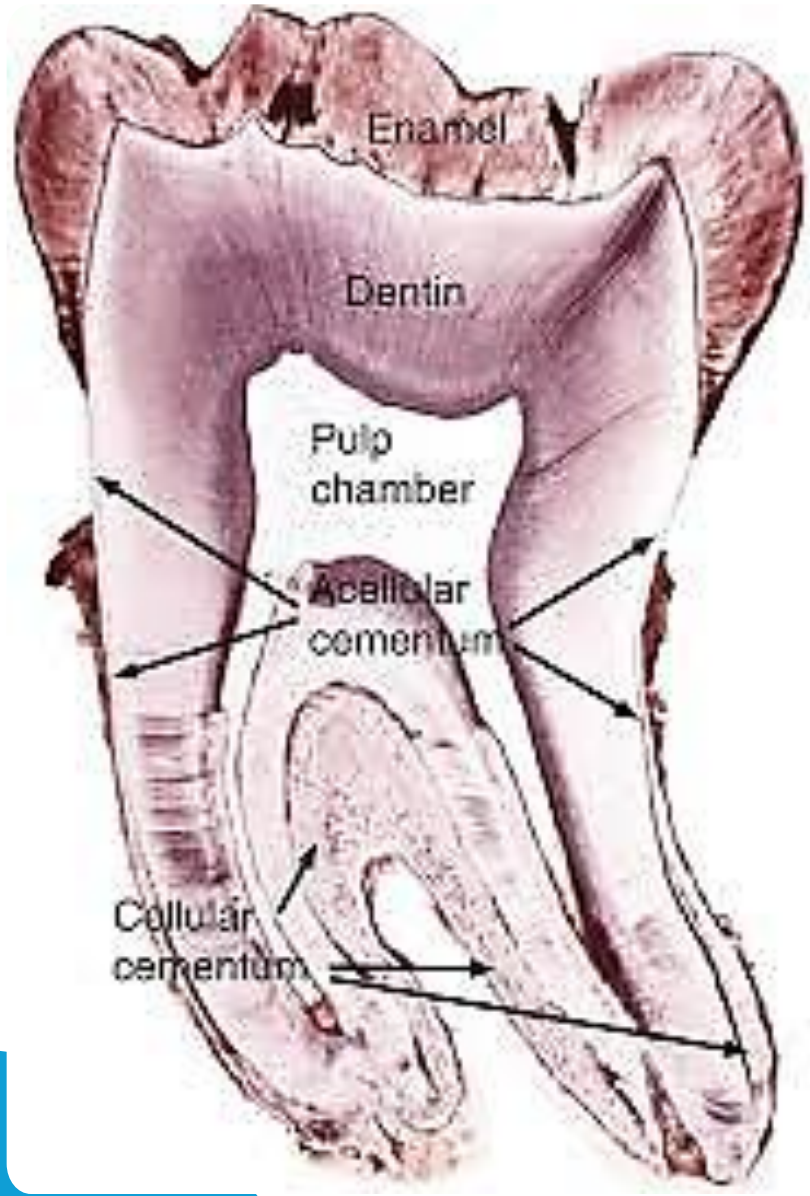


CEMENTUM COLLAGEN FIBERS

- **Derived from cementoblast or fibroblast**
- **FIBROBLASTS: form the collagen fibers of embedded part of PDL inside cementum which become mineralized and termed Sharpey's fiberes and considered extrinsic fibers and form acellular with extrinsic fiber cementum**
- **CEMENTOBLASTS form the other types of fibers and termed intrinsic fibers Cellular intrinsic fiber cementum forming Cellular intrinsic fiber cementum**



Extrinsic fibers (sharpey's fibers)	Intrinsic fibers
They are the terminal embedded ends of principle fibers of PDL in cementum • They are short and dense and arranged perpendicular to root surface • In ground sections, the spaces occupied by them are filled with air and so appeared as dark lines	• Are fibers of cementum proper • Formed by cementoblasts • They run // to root surface



Classification of cementum

- **Cementum is classified into**

❑**According to the presence or absence of cells**

- **1-Acellular cementum**
- **2-Cellular cementum**

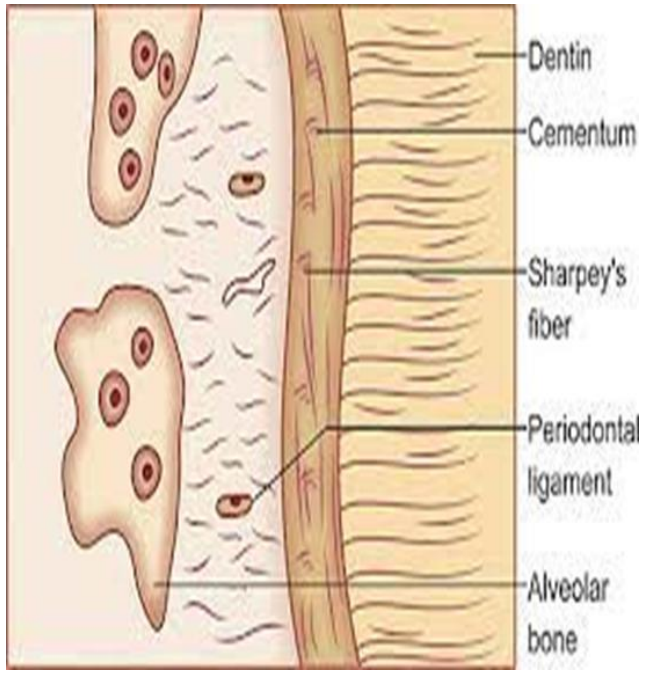
❑**It can be also classified according to the origin of its collagen fibers into**

- **1- acellular with extrinsic fiber cementum**
- **2- cellular with intrinsic fiber cementum**
- **3- acellular afibrillar cementum**

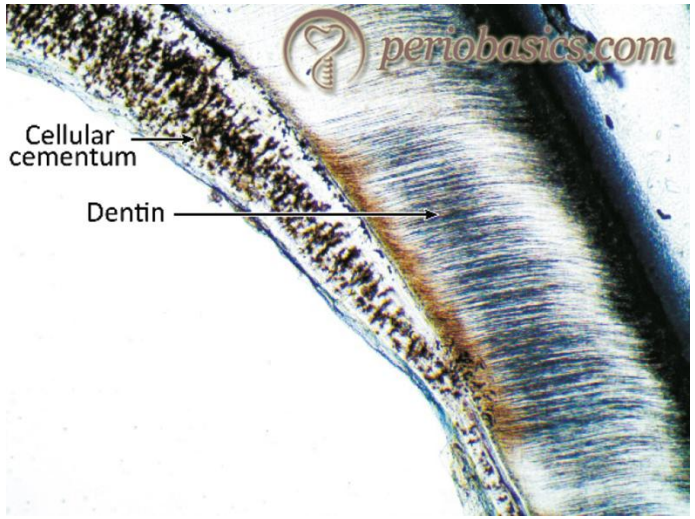
❑**Another type of cementum is intermediate cementum**

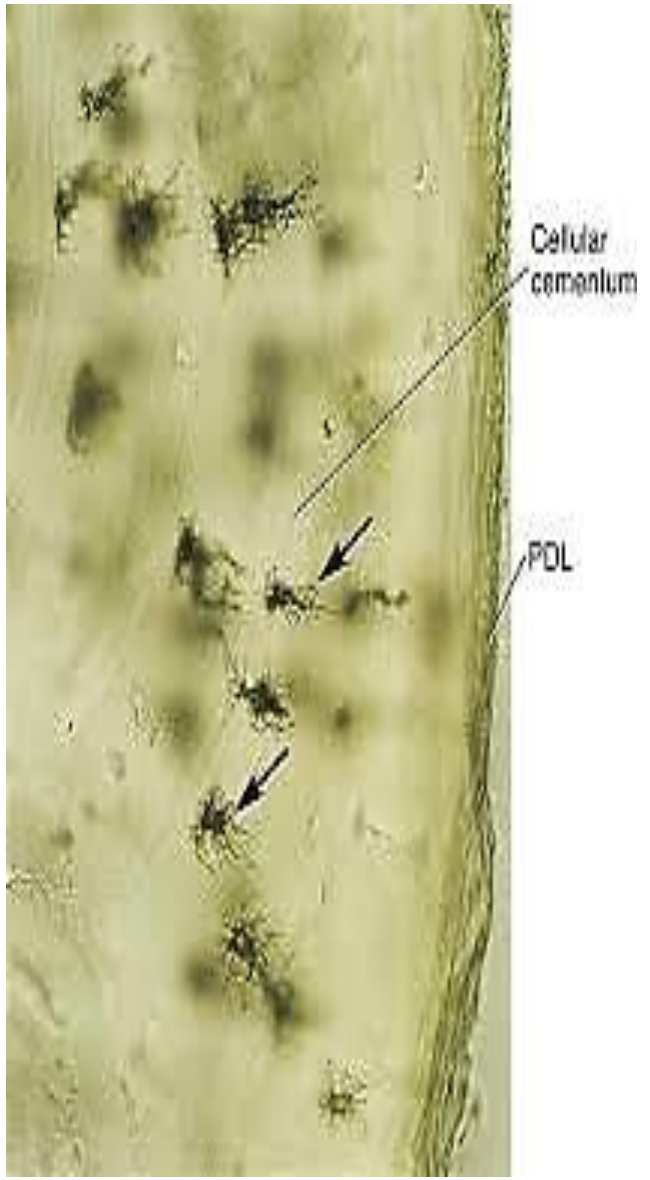
Acellular extrinsic fiber cementum (AEFC)

- **Appears clear and structureless in ground sections (doesn't contain any cells)**
- **beginning as very thin layer 20-50 microns at CEJ then thickens gradually in apical direction**
- **In demineralized sections appear as homogenous eosinophilic layer**
- **It is often missing at the apical third of the root, where the cementum may be entirely of the cellular type.**
- **In general acellular cementum usually predominates at the coronal 2/3 of the root. whereas cellular cementum is more frequent on the apical third**
- **Most of its collagen fibers are Sharpey's fibers which becomes calcified when incorporated in cementum (mode of attachment).**
- **It has slow rate of formation**

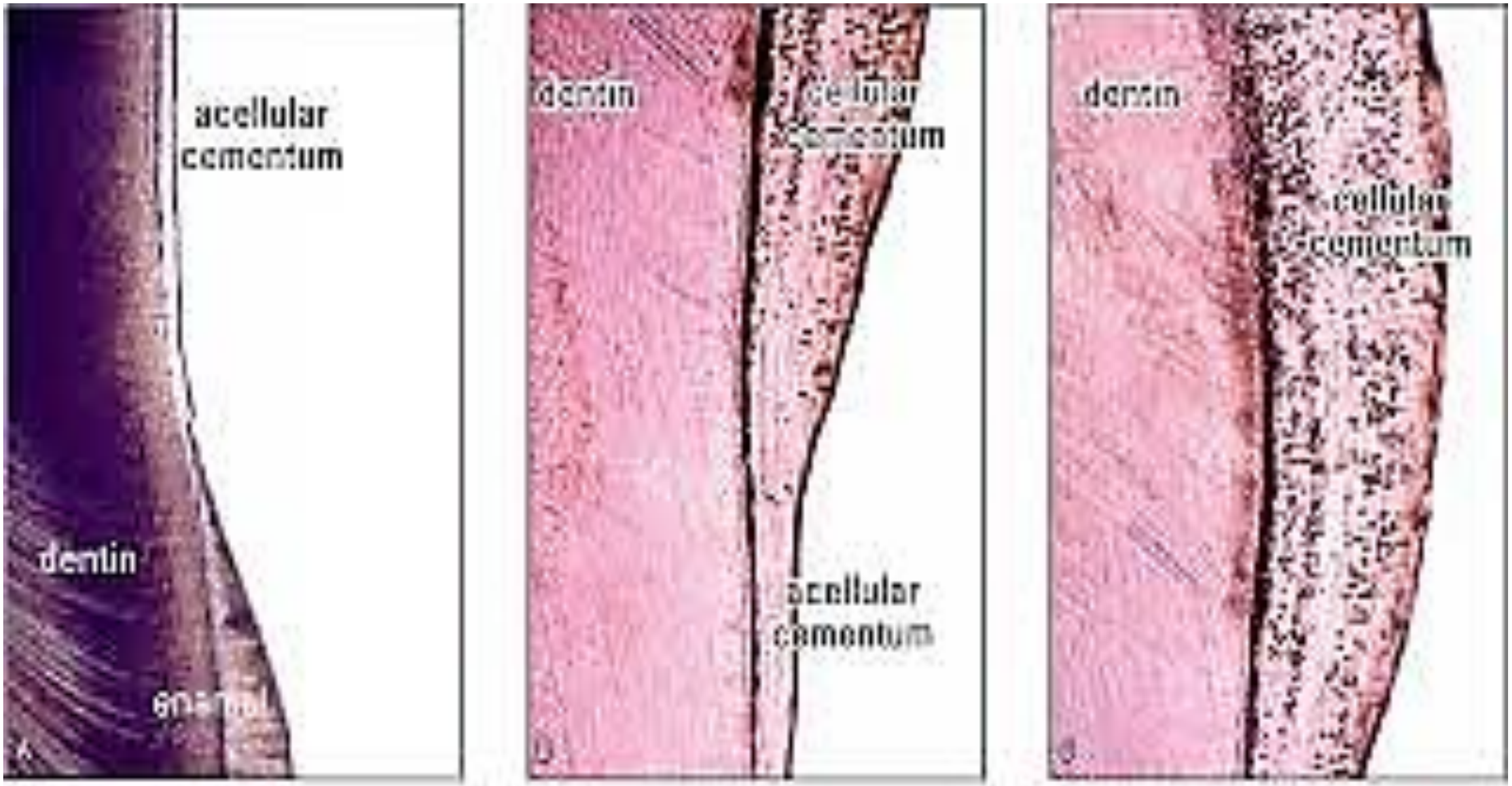


Cellular intrinsic fiber cementum (CIFC)



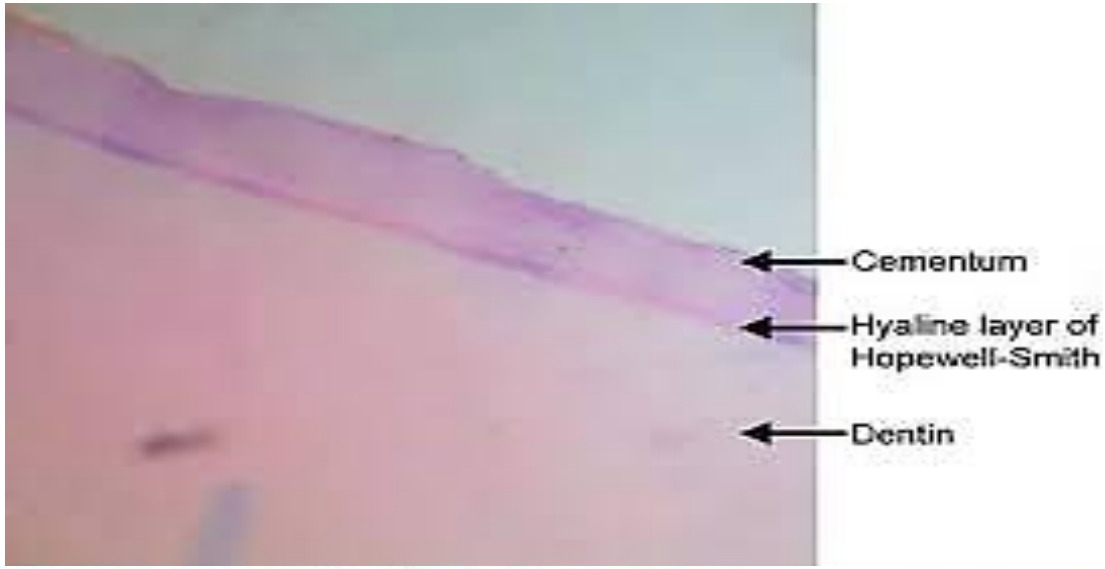


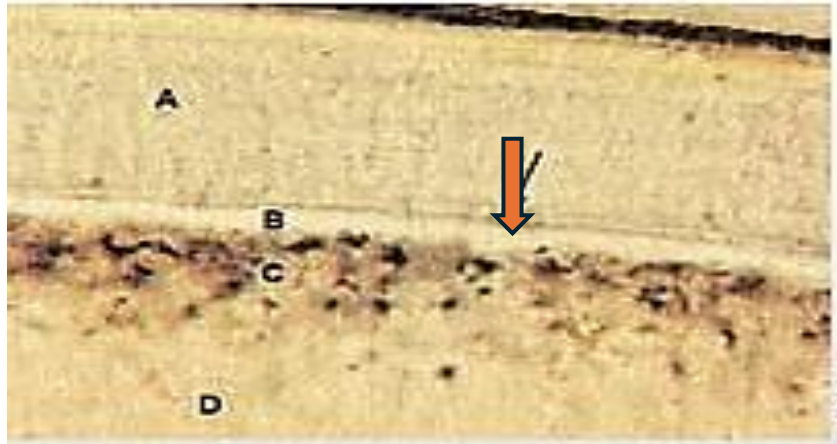
- **Found at apical 1/3 of root**
- **It has the same structure as the acellular cementum but contains cells (cementocytes) and has faster rate of formation**
- **The cementocytes are cementoblasts that are incorporated into matrix because of fast rate of formation.**
- **These cells are similar to the osteocytes. cementocytes has granular cytoplasm and faintly stained nucleus, the cell body lies in space called lacunae and their processes present in canaliculi. these processes may branch and anastomose with those of the neighboring cells connected by gap junction.**
- **Cementocytes are haphazard in arrangement**
- **Cellular cementum is more permeable than acellular cementum**
- **Alternating layers of cellular and acellular cementum could be detected**


acellular
cementum
dentin
dentin
cellular
cementum
acellular
cementum
dentin
cellular
cementum

Intermediate cementum or Hyaline layer of Hopewell Smith

- Dentin is separated from cementum by a zone known as the intermediate cementum layer.
- This layer appears as homogenous layer between Tome's granular layer of dentin and cementum.
- It is found mainly in apical part of root in molars
- Hopewell proposed that this layer is a peripheral part of dentin as no line of demarcation is found between them
- Other histologists proposed that this layer is a product of epithelial root sheath of Hertwig as it contains enamel like proteins and is more mineralized than either cementum or dentin

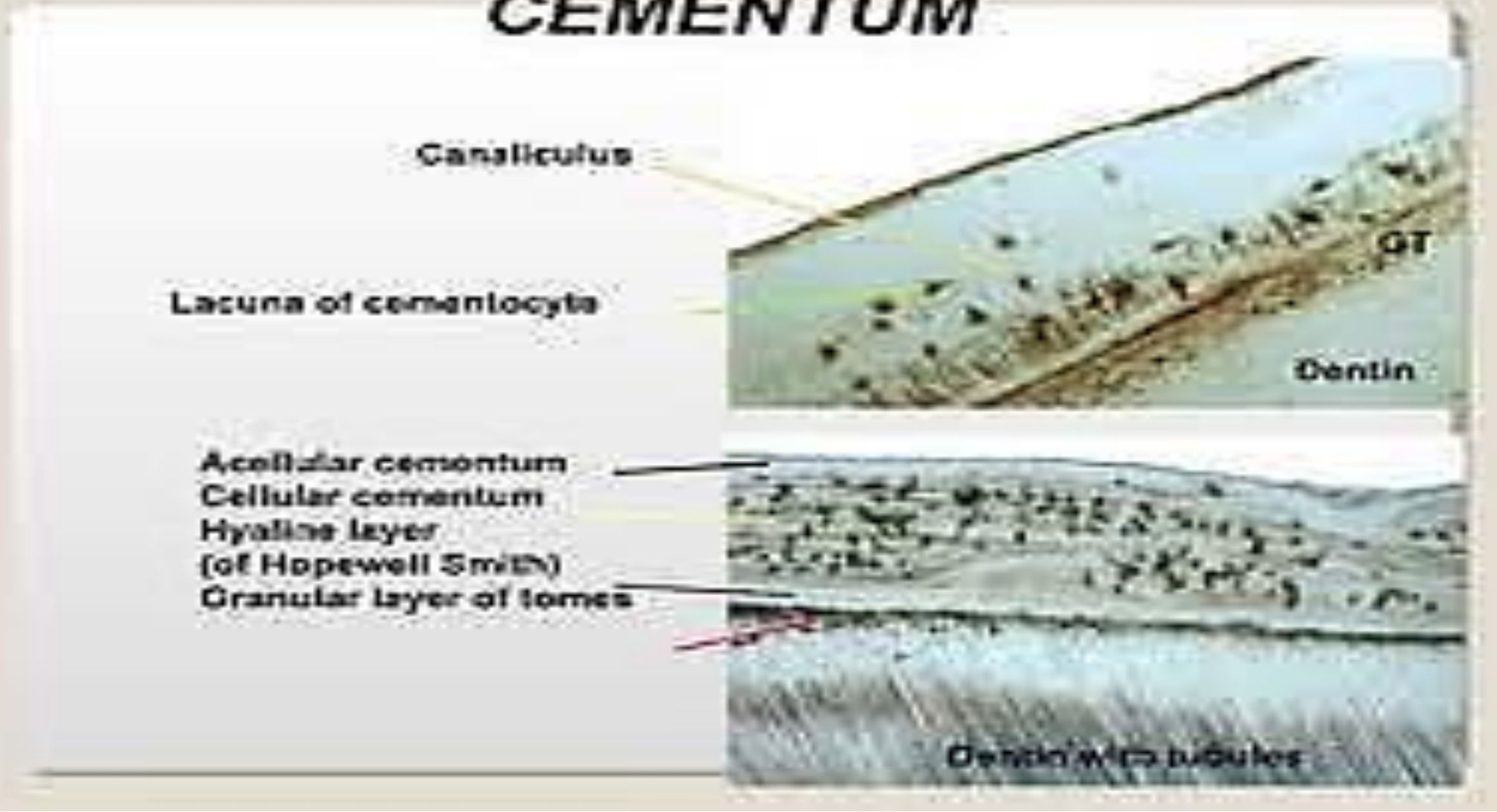




Cellular: Has cells
Acellular: No cells and has no structure

Cellular cementum usually overlies acellular cementum

CEMENTUM


Canaliculus
Lacuna of cementocyte
Acellular cementum
Cellular cementum
Hyaline layer
(of Hopewell Smith)
Granular layer of Tomes
CT
Dentin

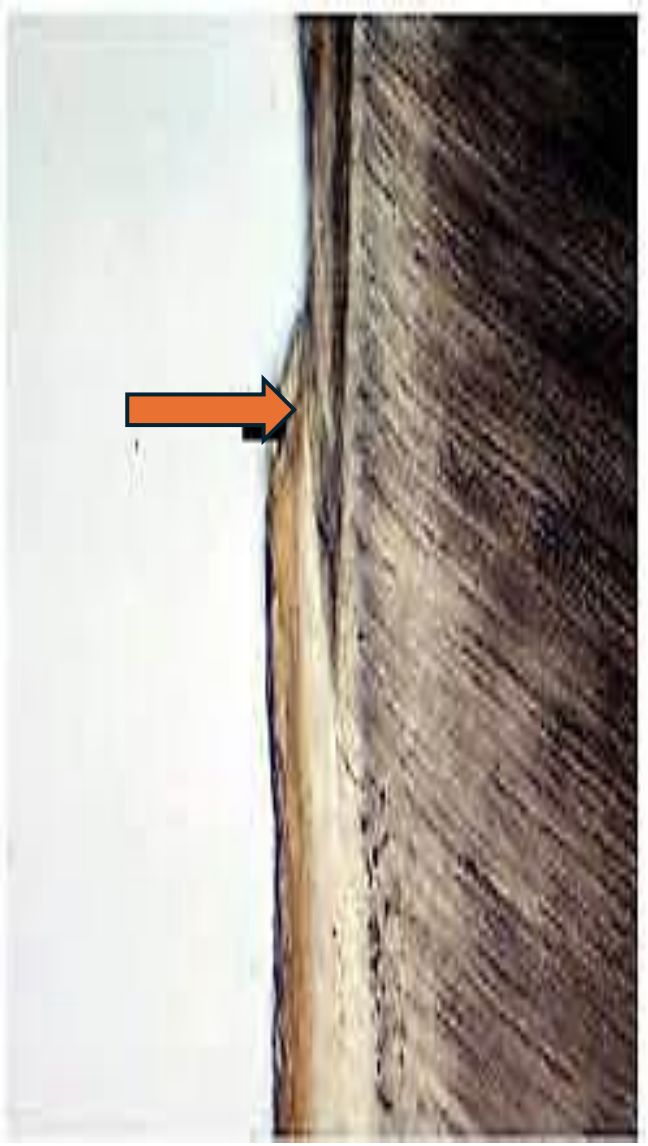
Acellular afibrillar cementum

consists of a mineralized matrix containing neither collagen fibers nor cementocytes.

Found covering 60% of cervical enamel at CEJ

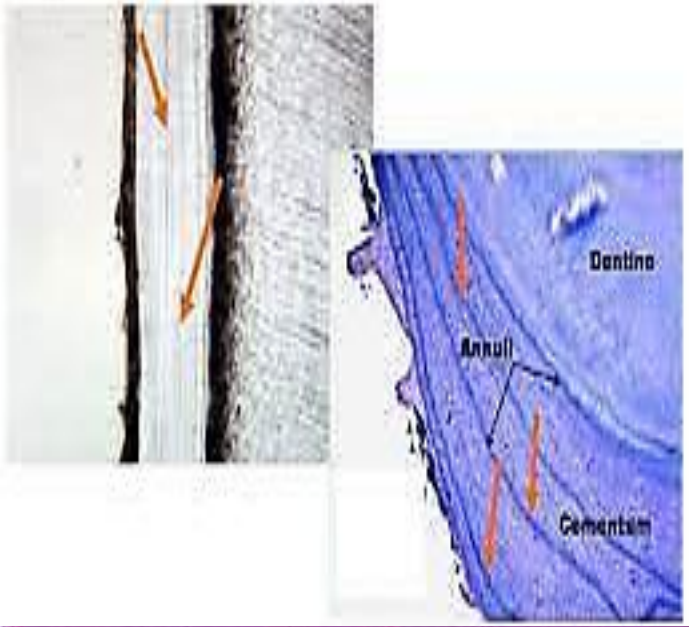
Formed due to: degeneration of reduced enamel epithelium from the cervical enamel after complete enamel formation.

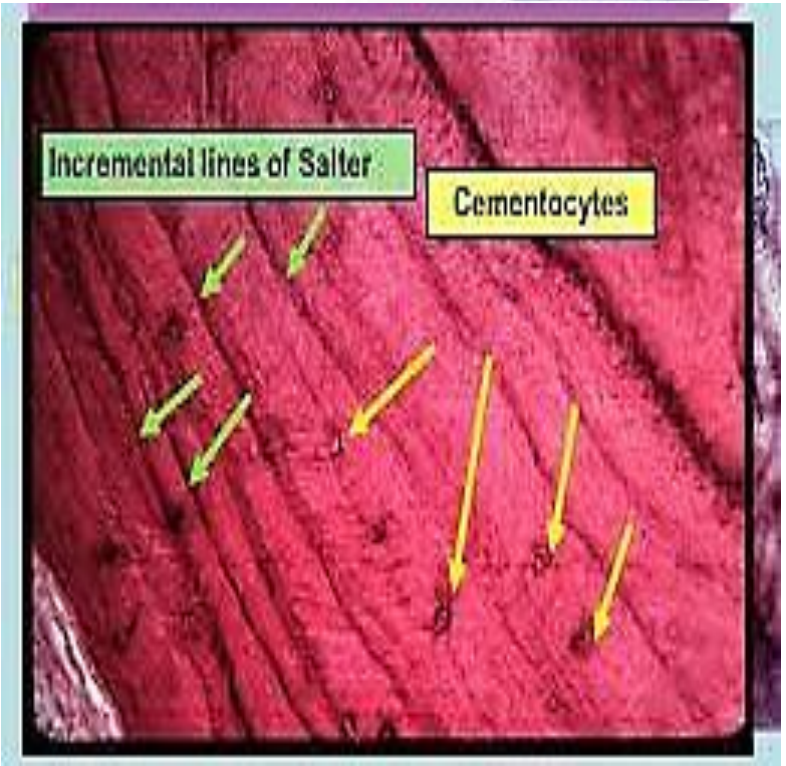
Where undifferentiated mesenchymal cells of dental sac come in contact with exposed cervical enamel causing them to differentiate to cementoblats that deposit this type of cementum.



Incremental lines of Salter

- **Both cellular and acellular cementum are separated by incremental lines into layers that indicate periodic formation.**
- **Histochemical studies indicate that incremental lines are highly mineralized areas (the only incremental lines that are highly calcified).**
- **The incremental lines are roughly parallel to the long axis of the root.**
- **Cellular cementum is formed at a faster rate than the acellular cementum and the Incremental lines in the cellular cementum are located <u>further apart than in acellular cementum</u>**
- **<u>Incremental lines of Salter are more calcified</u>**





cemento-enamel junction

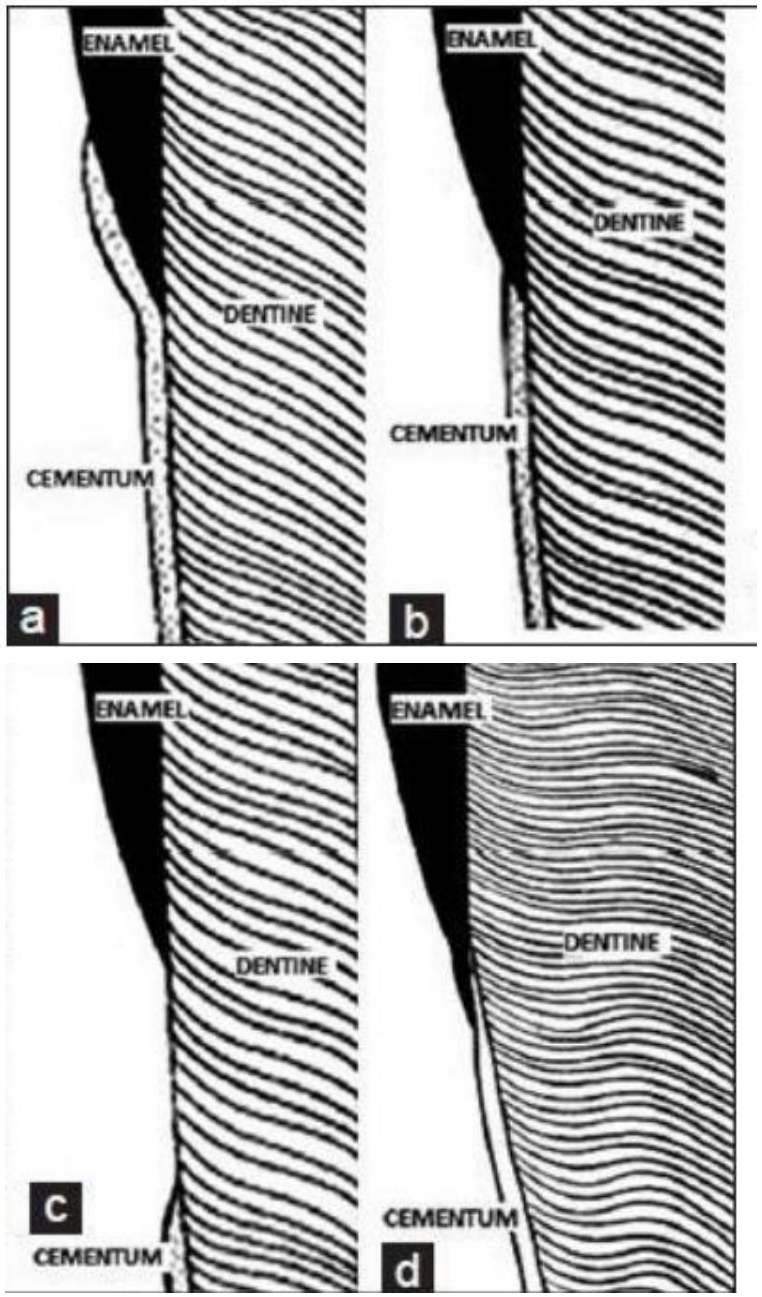
- **Is The relation between cementum and enamel at the cervical region of teeth is variable.**

❑ **type 1: In about 60% of the teeth cementum overlaps the cervical end of enamel for a short distance. it occurs when the reduced enamel epithelium degenerates at its cervical end allowing cells of dental sac to contact cervical enamel to differentiate to cementoblasts that deposit acellular afibrillar cementum**

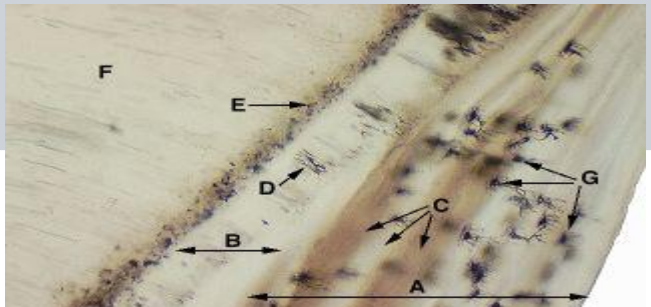
❑ **type 2: In 30% of all teeth, cementum meets the cervical end of enamel in a relatively sharp line.**

❑ **type 3: When the epithelial root sheath of Hertwig's is delayed in its separation from the dentin, a zone the root is devoid of cementum. In this case bare dentin is found in cervical part of root. This occurs in about 10% of the teeth.**

❑ **type4: Enamel overlaps cementum in 1.6% of teeth very rare**

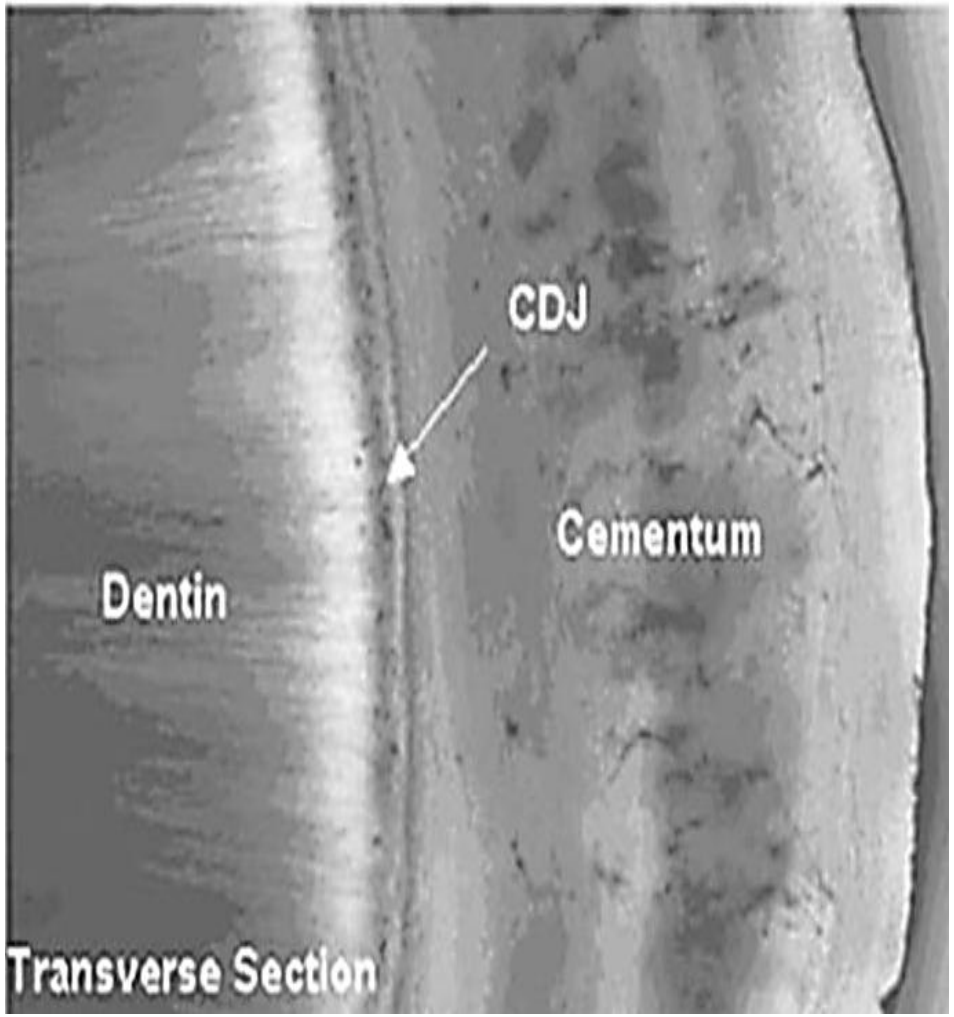


Cellular cementum	Acellular cementum
• Formed after acellular • Fibers: internsic • Cells: found • Site: at the apical third • Incremental lines: Further apart than in acellular • Calcification: less calcified more permeable • Function: adaptation and repair • Thickness higher than acellular cementum	• First formed cementum • extrensic • No cells • Cervical 2\3 of the root Nearer to each other than cellular • More calcified less permeable • attachment

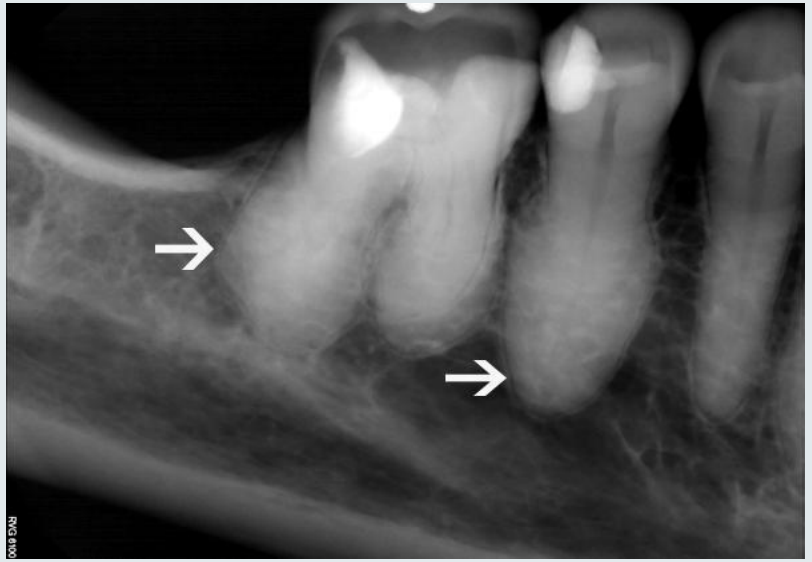


Cemento-dentinal junction

- **The cemento-dentinal junction is relatively smooth in permanent teeth but in deciduous teeth it is scalloped.**
- **The collagen fibrils of cementum and dentin interwine at their interface in a very complex fashion**



Age changes of cementum

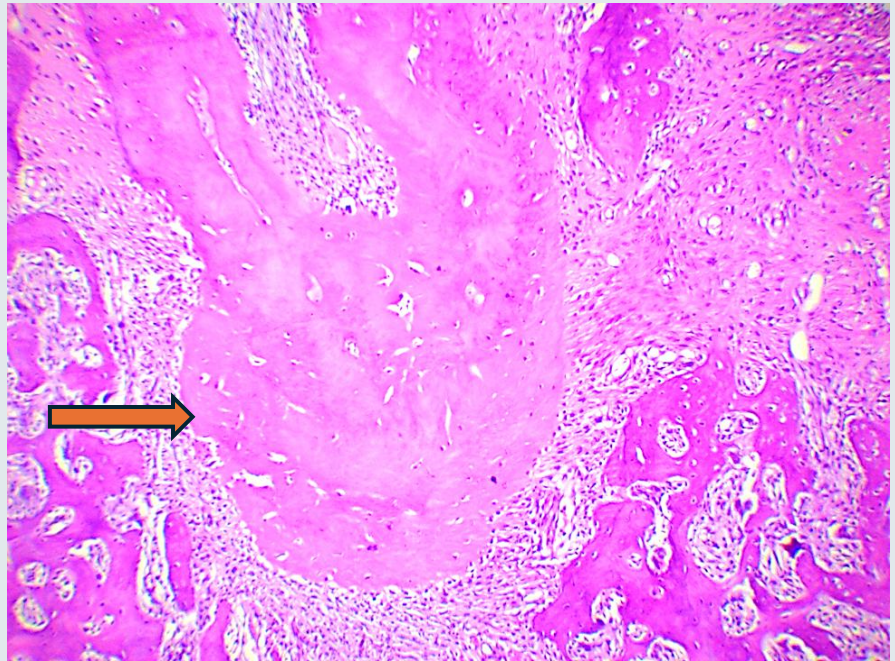


1-Permeability:

by aging <u>the permeability of cementum decreases gradually</u>

the permeability from the periodontal ligament side is lost except in the most recent formed layers of cementum

permeability from the dentin side remains only in the apical region

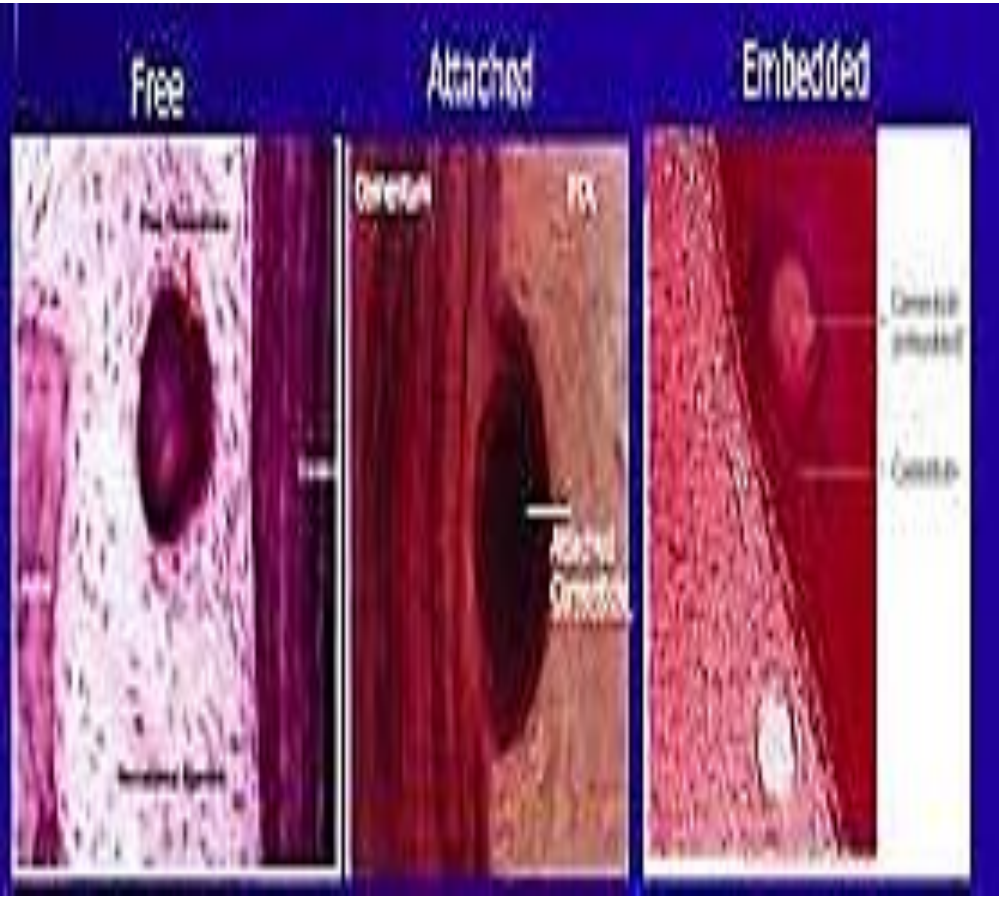


2- Hypercementosis: is an abnormal thickening of cementum

- **it may affect one tooth or all teeth.**
- **It may be localized in certain area of root or generalized through the whole root length.**

cementum hypertrophy	Cementum hyperplasia
• occur in functioning tooth, it increases the surface area for attachment • large number of Sharpey's fibers	• occurs in erupted nonfunctioning teeth or embedded • no or few Sharpey's fibers

Cementicles



- They are ovoid or round calcified structure that exhibits concentric rings (formed incrementally)
- formed as dystrophic calcification around nidus that favors their calcification (degenerated periodontal tissue or the epithelial rests of Malassez or area of hemorrhage).
- They may be free in PDL, attached or embedded in cementum

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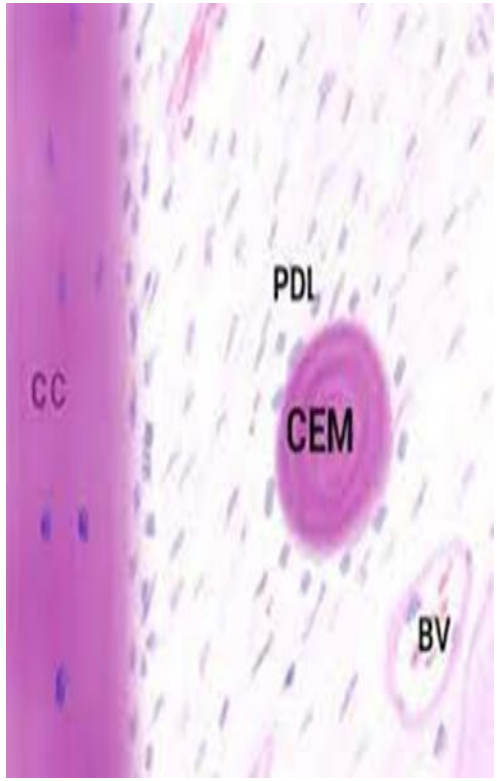
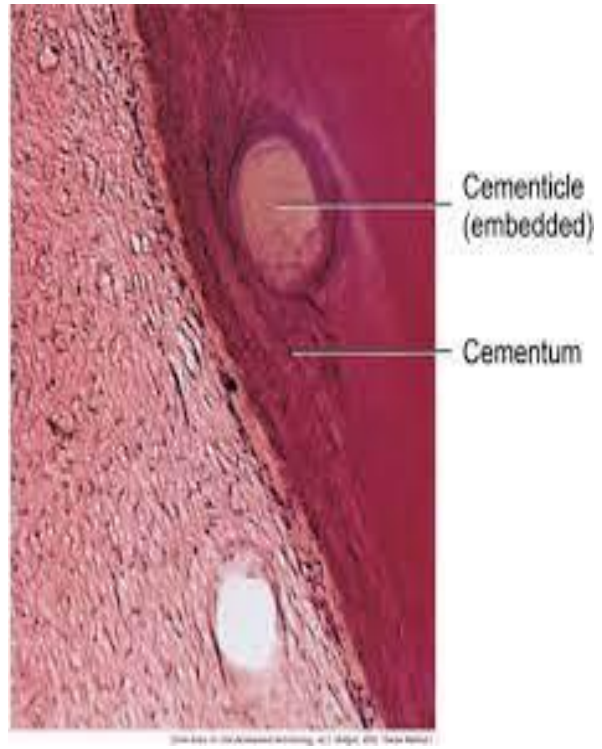

PDL
CC
CEM
BV


Cementicle
(embedded)
Cementum


Thank
you