DEPARTMENT OF ORAL AND MAXILLOFACIAL PATHOLOGY & ORAL MICROBIOLOGY

CEMENTUM

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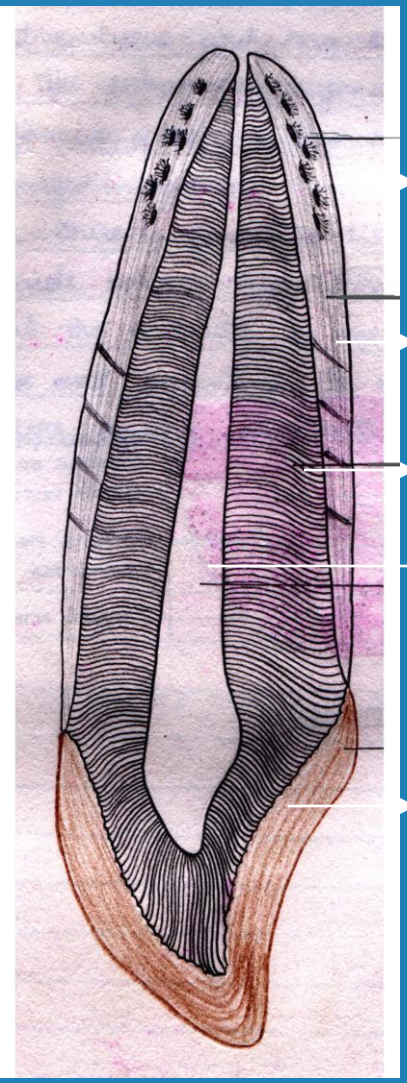
INTRODUCTION



Cementum is the mineralized dental tissue covering the anatomic roots of the human teeth. It was first demonstrated microscopically in 1835 by two pupils of Purkinje.

It Begins at cervical portion of the tooth at the CEJ and continuous to the apex.

It furnishes a medium for attachment of the fibers that bind the tooth to the surrounding structure.

DEFINITION

Cementum is a specialized, calcified tissue of mesodermal origin covering anatomic Root of human tooth.

PHYSICAL CHARACTERISTICS

- Cementum is less harder than dentin.

- Cementum is light yellowish in color and lighter than dentin. It can be distinguished from enamel by its lack of luster and darker hue.

- Under some experimental conditions cementum has been shown to be permeable to a variety of materials.

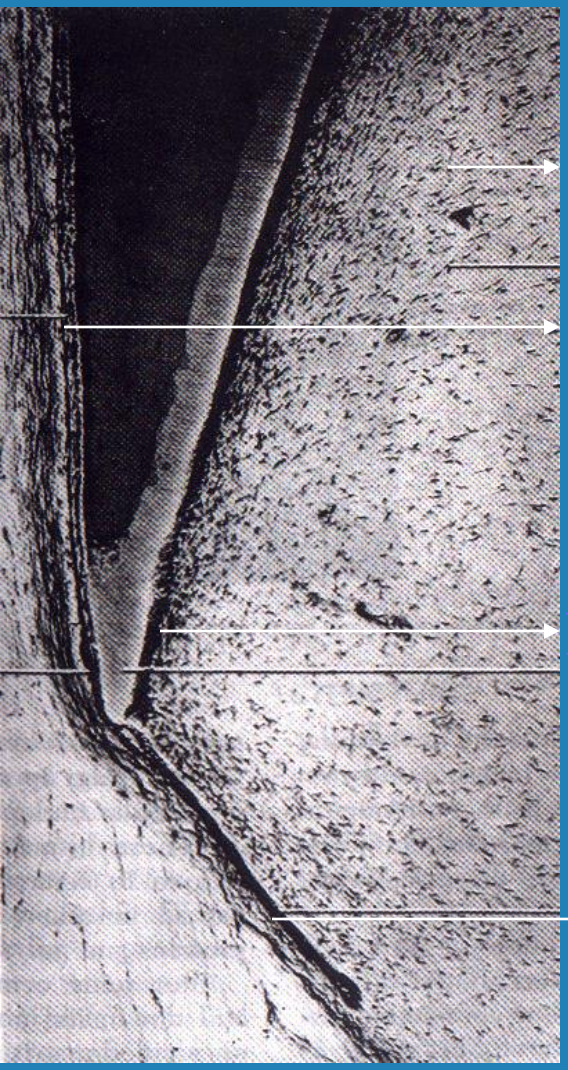
CHEMICAL COMPOSITION

INORGANIC SUBSTANCES	45-50%
ORGANIC MATERISLS AND WATER	50-55%

The inorganic portion consists mainly of calcium and phosphate in the form if hydroxapatite. Cementum has highest fluoride content of all the mineralized tissues.

The organic portion of cementum consists primarily of type 1 collagen and protein polysaccharides(proteoglycans)

CEMENTOGENESIS

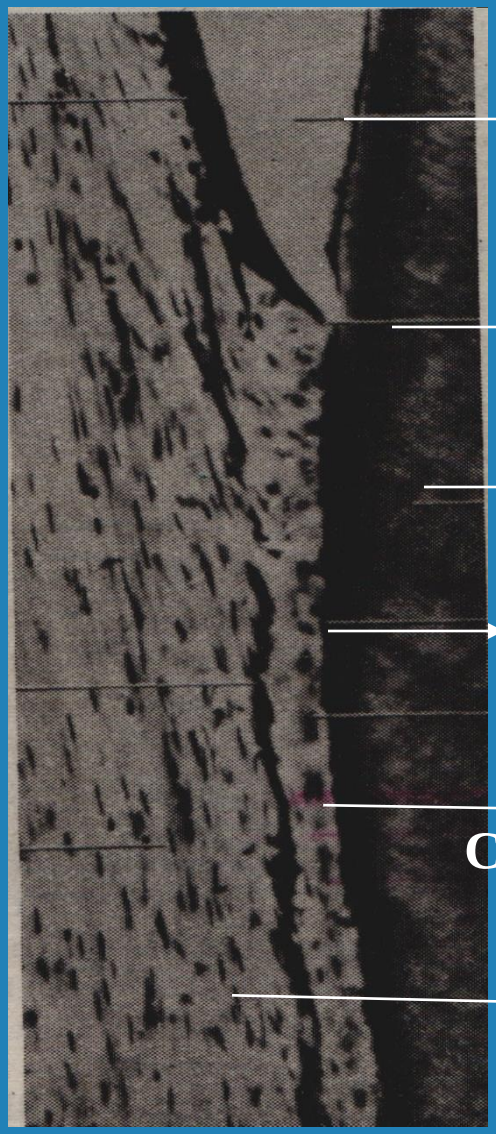


Cementum formation in the developing tooth is preceded by the deposition of dentin along the inner aspect of Hertwig's epithelial root sheath.

Once dentin formation is underway, breaks occurs in the epithelial root sheath allowing the newly formed dentin to come in direct contact with connective tissues of the dental follicle

Cells derived from this connective tissue are responsible for cementum formation.

CEMENTOGENESIS



(Remnants of epi. Called "epi. Rests of malassez")

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Separation of epithelium from root dentin surface accomplished.

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Cells of periodontal ligament comes into contact with root surface.&

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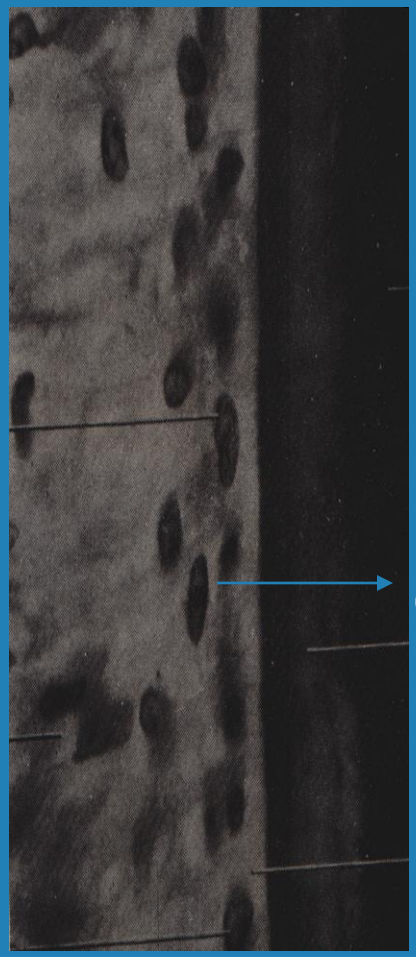
FORM CEMENTUM

CEMENTOBLAST



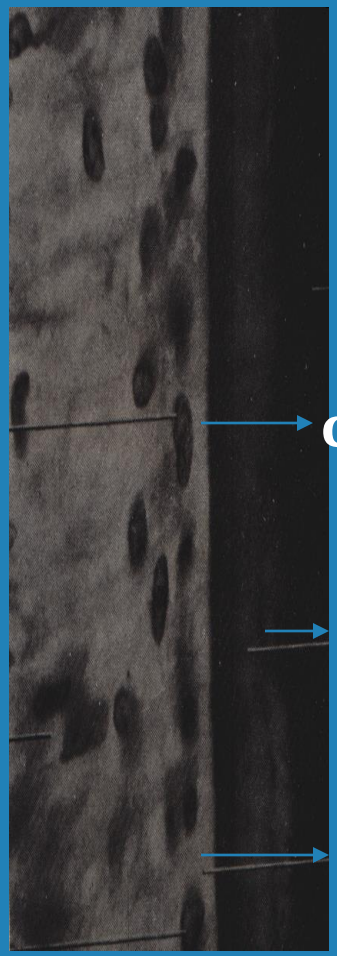
Soon after Hertwig's sheath breaks up, undifferentiated mesenchymal cells from adjacent connective tissue differentiate in to cementoblasts. Cementoblasts synthesizes collagen and protein polysaccharides which make up the organic matrix of cementum.

These cells produce cementum in two phase

1st phase: Uncalcified tissue called cementoid.

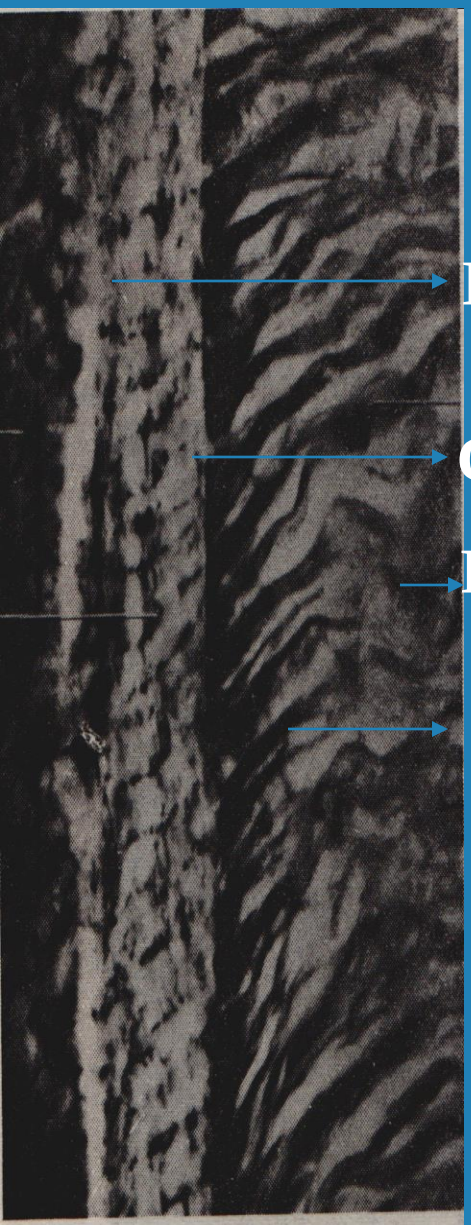
2nd phase: Cementoid tissue transformed into calcified cementum.

CEMENTOID TISSUE



- Under normal condition growth of the cementum is a rhythmic process. As a new layer of cementoid is formed, the old one calcifies.

A thin layer of cementoid tissue is always seen on the surface of cementum.The cementoid tissue is lined by cementoblasts.



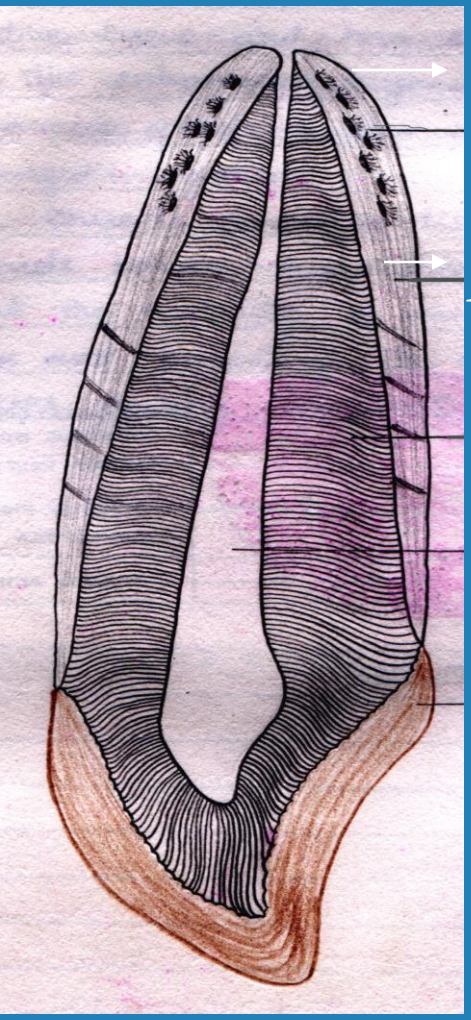
- Connective tissue fibers from PDL pass between the cementoblasts into the Cementum.
- These fibers are known as " **SHARPEY'S FIBERS**"
- They are embedded in the cementum & serve as an attachment for the tooth to surrounding bone

STRUCTUE OF CEMENTUM

AELLULAR CEMENTUM

CELLULAR CEMENTUM

ACELLULAR CEMENTUM



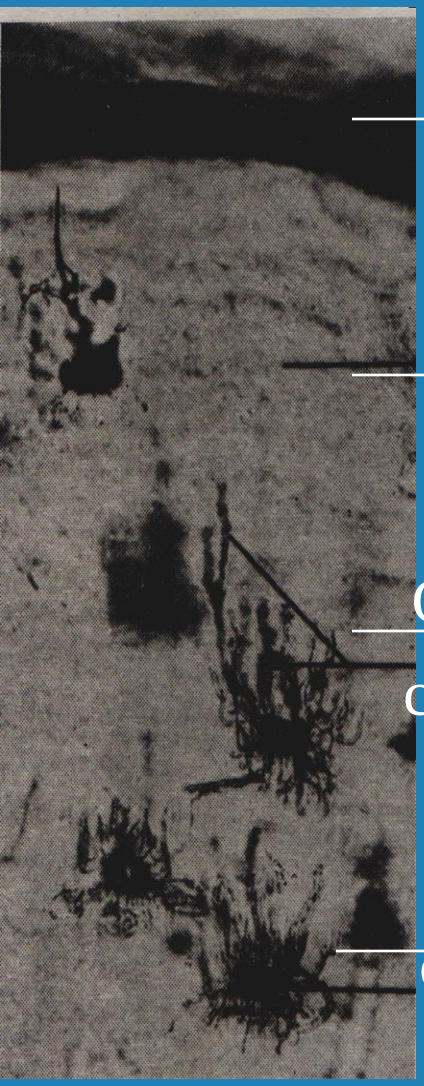
The term acelllular cementum is unfortunate. As a living tissue, cells are an integral part of cementum at all times. However, some layers of cementum do not incorporate cells, the spiderlilke cementocytes.

Acellular cementum covers the root dentin from CEJ to the apex but often missing on apical third of root.

Cementum is thinnest at the CEJ (20-50µm)

Cementum is thickest towards root apex.(150-200µm)

CELLULAR CEMENTUM



Mostly presents at the apical third of root. Cells included in cellular cementum are cementocytes, similar to osteocytes.

They lie in spaces designated as lacunae.

Cell body has shape of plum stone,with numerous long processes known as canaliculli. Most of the processes are directed towards the periodontal surface of the cementum.

•The decalcified specimens of cementum, collagen fibrils make up the bulk of the organic portion of the tissue.

•Interspersed between some collagen fibrils are electron dense reticular areas, which probably represent protein polysaccharide materials of the ground substance.

•Collagen fibrils of both acellular and cellular cementum are arranged in a very complex fashion with little discernible pattern.

•In some areas, however, relatively discrete bundles of collagen fibrils can be seen, particularly in tangential sections. These are sharpey's fibers, which make up a substantial portion of the cementum.

•In mineralized specimens it has been observed that cemental collagen is not totally mineralized. This is particularly true in a zone 10 to 50 µ wide near the cementodentinal junction, where unmineralized areas about 1 to 5 µm in diameter are seen.
•These areas probably represent poorly mineralized cores of Sharpey's fibers.

•The cells incorporated into cellular cementum, cementocyte has numerous cell processes or canaliculi radiating from its cell body.

•These processes may branch, and they frequently anastomose with those of a neighboring cell. Most of the processes are directed toward the periodontal surface of the cementum.

•The cytoplasm of cementocyte in deeper layers of cementum contains few organelles, the endoplasmic reticulum appears dilated, and mitochondria are sparse.

•These characteristics indicate that cementocytes are either degenerating or are marginally active cell.

•At a depth of 60 µm or more cementocytes show definite signs of degeneration, such as cytoplasmic clumping and vesiculation.

•At the light microscopic level, lacunae in the deeper layers of cementum appear to be empty, suggesting complete degeneration of cementocytes located in these areas.

•Both cellular and acellular cementum are separated by incremental lines into layers, which indicate periodic formation.

•Incremental lines can be best seen in decalcified
Specimen prepared for light microscopic observation.

•Histochemical studies indicate that incremental lines are highly mineralized areas with less collagen and more ground substance than other portions of cementum.

•When cementum remains relatively thin, Sharpey's fibers cross the entire thickness of the cementum. With further apposition of cementum, a larger part of the fibers is incorporated in the cementum. The attachment proper is confined to the most superficial or recently formed layer of cementum. This indicate that the thickness of cementum does not enhance functional efficiency by increasing the strength of attachment of the individual fibers.
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•The location of acellular and cellular cementum is not definite. As a general rule, however, acellular cementum usually predominates on the coronal half of the root, whereas cellular cementum is more frequent on the apical half.

•Layers of acellular and cellular cementum may alternate in almost any pattern. Acellular cementum can occasionally be found on the surface of cellular cementum.

•Cellular cementum is frequently formed on the surface of acellular cementum but it may comprise the entire thickness of apical cementum. It is always thickest around the apex and, by its growth, contributes to the length of the root.

•Cemental surfaces with actively mineralizing fronts have numerous small openings that correspond to sites where individual Sharpey's fibers enter the tooth.

•These openings represent unmineralized cores of the fibers. Numerous resorption bays and irregular ridges of cellular cementum are also observed on root surfaces.

CEMENTODENTINAL JUNCTION

•The dentin surface upon which cementum is deposited is relatively smooth in permanent teeth. The cementodentinal junction in deciduous teeth, however is sometimes scalloped. The attachment of cementum to dentin in either the case is quite firm.

•The interface between cementum and dentin is clearly visible in decalcified and stained histological sections using the light microscope. Here cementum is stained more intensively than dentin.

•In decalcified preparation, cementum is more electron dense than dentin and some of its collagen fibrils are arranged in relatively distinct bundles while those of dentin are arranged somewhat haphazardly.

•Sometimes dentin is separated from cementum by a zone known as the intermediate cementum layer, which does not exhibits characteristic feature of either dentin or cementum.

•This layer is predominately seen in the apical two thirds of roots of molars and premolars and is only rarely observed in incisors of deciduous teeth.

CEMENTOENAMEL JUNCTION

Three types

1) **30% - meet at sharp line**

2) **60% - cementum overlaps the cervical end of enamel for a short distance.**

This occurs when the enamel epithelium degenerates at its cervical termination permitting connective tissue to come in direct contact with the enamel surface.

Meets at Sharp line

Cementum overlaps enamel

(3) 10% - no CEJ but a zone of root devoid of cementum & covered by enamel epithelium.

- **Presumably this occurs when enamel epithelium in the cervical portion of the root is delayed in its separation from dentin. In such cases there is no cemento-enamel junction.**
- **Instead a zone of the root is devoid of cementum and is for a time covered by reduced enamel epithelium.**

FUNCTION

(1)The primary function of cementum is to furnish a medium for the attachment of collagen fibers that bind the tooth to alveolar bone. Since collagen fibers of the periodontal ligament cannot be incorporated in to dentin, a connective tissue attachment to the tooth is impossible without cementum.

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(2)To compensate by its growth for loss of tooth substance due to occlusal wear. In contrast to the alternating resorption and new formation of bone, cementum is not resorbes under normal conditions. As the most superficial layer of cementum ages, a new layer of cementum must be deposited to keep the attachment apparatus intact.

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(3)Cementum serves as the major reparative tissue for root surface. Damage to root such as fractures and resorption can be repaired by the deposition of new cementum.

Cementum can also be viewed as the tissue that makes functional adaptation of teeth possible. For example deposition of cementum in apical area can compensate for loss of tooth substance from occlusal wear.

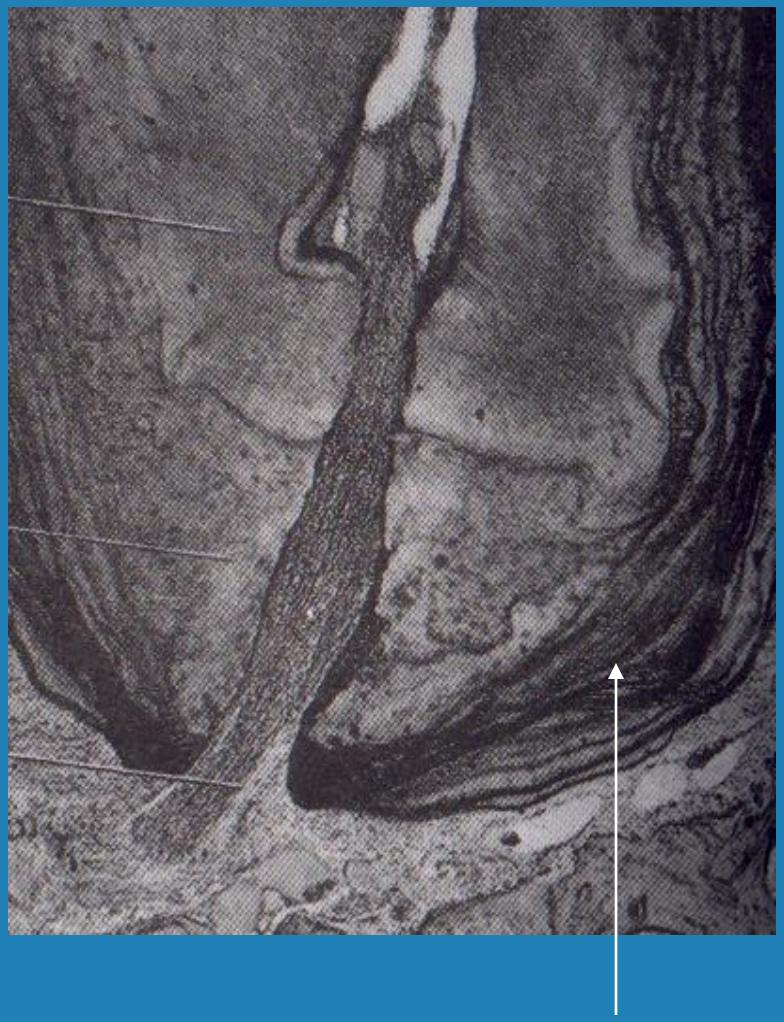
HYPERCEMENTOSIS

Abnormal thickening of the cementum

It may be diffuse or circumscribed. It may affect all teeth of the dentition or may be confound to a single tooth.

If overgrowth improves functional qualities of Cementum called hypertrophy.

If overgrowth occurs in nonfunctional teeth, or it is not correlated with increased function it is Called as Hyperplasia.



Cemental hyperplasia

Localised hypertrophy

A spur or prong like projecion of cementum forms in teeth exposed to great stress.

Provide large surface area for the attaching fibers, thus a firmer anchorage of the tooth to the surrounding alveolar bone is assured.

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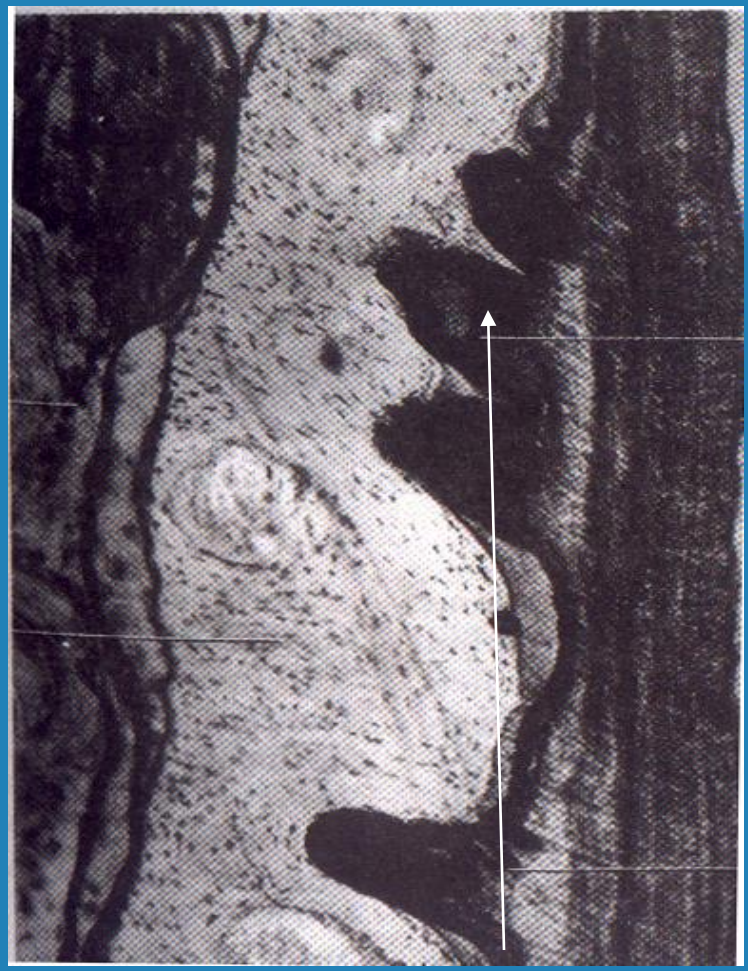


Prong like extracementosis

Localized hypercementosis may sometimes be observed in areas in which enamel drops have developed on the dentin.

The hyperplastic cementum covering the enamel drop occasionally is irregular and sometimes contains round bodies that may be calcified epithelial rests.

The same type of embedded calcified round bodies frequently are found in localized areas of hyperplastic cementum. Such knob like projections are designated as excementoses. They too develop around degenerated epithelial rests.

Hyperplasia in nonfunctioning teeth are characterized by Absence of sharpey's fibers.

The cementum is thicker around the apex of all teeth and in the furcation of multirooted teeth than it is on the other areas of the root. This thickening can be observed in embedded as well as in newly erupted teeth.

In some cases an irregular overgrowth of cementum can be found, with spike like extensions and calcification of Sharpey's fibers and accompanied by numerous cementicles. This type of cemental hyperplasia can occasionally be observed on many teeth of the same dentition.

CLINICAL CONSIDERATION

(1)More Resistant to resorption than Bone and it is for this reason that Orthodontic tooth movement is possible.When a tooth is moved by means of an orthodontic appliances, bone is resorbed on the side of the pressure, and new bone is formed on the side of the tension.

The difference in the resistance of the bone and cementum to pressure may be caused by the fact that bone is richly vascularized, whereas cementum is avascular. Thus degenerative processes are much more easily effected by interference with circulation in bone, whereas cementum with its slow metabolism (avascular tissue) is not damaged by a pressure equal to that exerted on bone.

(2)Cementum resorption due to trauma repaired by

ANATOMIC REPAIR

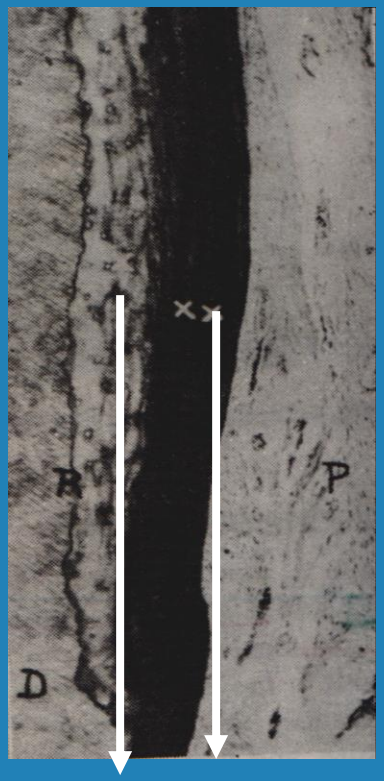
FUNCTUNAL REPAIR

Anatomic repair

In anatomic repair there is tendency to reestablish former outline of the root surface. It occurs by formation of acellular and/or cellular Cementum

Acellular Cementum

Cellular Cementum



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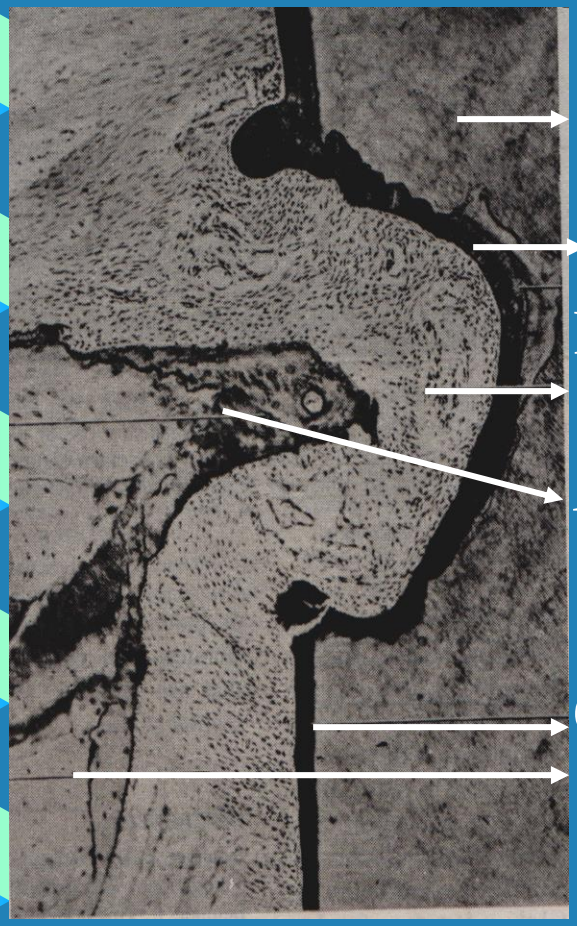
Functional repair



Root outline is not reconstructed and a **B**ay like recess remains

Periodontal Space restored by bony projection so that a proper functional relationship will result. This is functional repair.

(3)Transverse fracture of root due to trauma may heal by formation new cementum

(4)Hyperplasia of cementum secondary to inflammation is of practical significance because extraction of such teeth may necessitate removal of bone. This also applies to extensive excementoses.

(5)In Periodontal pockets, plaque and its by products causes numerous alterations in the physical, chemical, and structural characteristics of cementum.That is of importance while treating the pocket.

The surface of pathologically exposed cementum becomes hypermineralized because of the incorporation of calcium, phosphorus, and fluoride from the oral environment. At the light microscopic level no major structural changes occur in the surface of exposed cementum. However, ultra structural level there is a loss or decrease in the cross striations of collagen near the surface.