Annals of R.S.C.B., Vol. 24, Issue 1, 2020, pp. 170-176
Received 18April2020; accepted 23June2020

A Review On Cementum – The Dynamic Anchor Of The Periodontium.

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Abstract

Gingiva, periodontal ligament, cementum, and alveolar bone are the four main components of a healthy periodontium. It provides the necessary support to keep the teeth in good function. The cementum is a mineralized avascular unit of the periodontium that is essential for tooth attachment and periodontal function. Between the periodontal ligament and the root dentin, it forms an interface. The structural and functional properties of cementum are examined in this article, as well as the cellular and molecular aspects of cementum growth and regeneration.The understanding of these mechanisms can provide an apprehension into the new treatment approaches concerning the regeneration of periodontal tissue lost due to disease activity.

Key words: Cementum, Cementogenesis.

I. Introduction

Human teeth are not directly linked to the alveolar bone around them. The periodontal ligament is a soft tissue component of the periodontium that is embedded on one side on alveolar bone and on the other side on radicular cementum. Cementum is a calcified, avascular tissue that covers the anatomical tooth root structure's outside surface. It's considered a part of the tooth since it sits midway between the root dentin and the periodontal ligament, but it's functionally integrated into the periodontium, which is the dental attachment apparatus.[1] Cementum is a unique assembly in that it does not undergo remodeling like the alveolar bone that houses the tooth structure and instead continues to thicken throughout one's life. Cementum's extremely reparative and adaptable properties are critical for preserving occlusal harmony and providing attachment support to tooth structure. [2] The goal of this article is to provide a thorough understanding of the genesis, composition, structure, characteristics, and function of dental cementum in order to create novel therapeutic options for pathologically damaged cemental tissues.

II. History[3]

Observations made through simple lens and gross anatomy:Van Leeuwenhoek – Substantiacorticalis, Malpighi – Substantiatartarea,Blake – Crustapetrosa, Tenon – cortical osseux, Cuvier – Cement. Observations made through compound microscopy:Purkinje et al in 1835 – Substantiaossea, Retzius in 1836 - Cortical substansen, Fraenkel and Raschkow (1835) microscopically described the cementum.Owen studied the comparative anatomy of cementum among various vertebrates.Functional importance of cementum as detailed later by Black.

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III. Development of cementum[4]

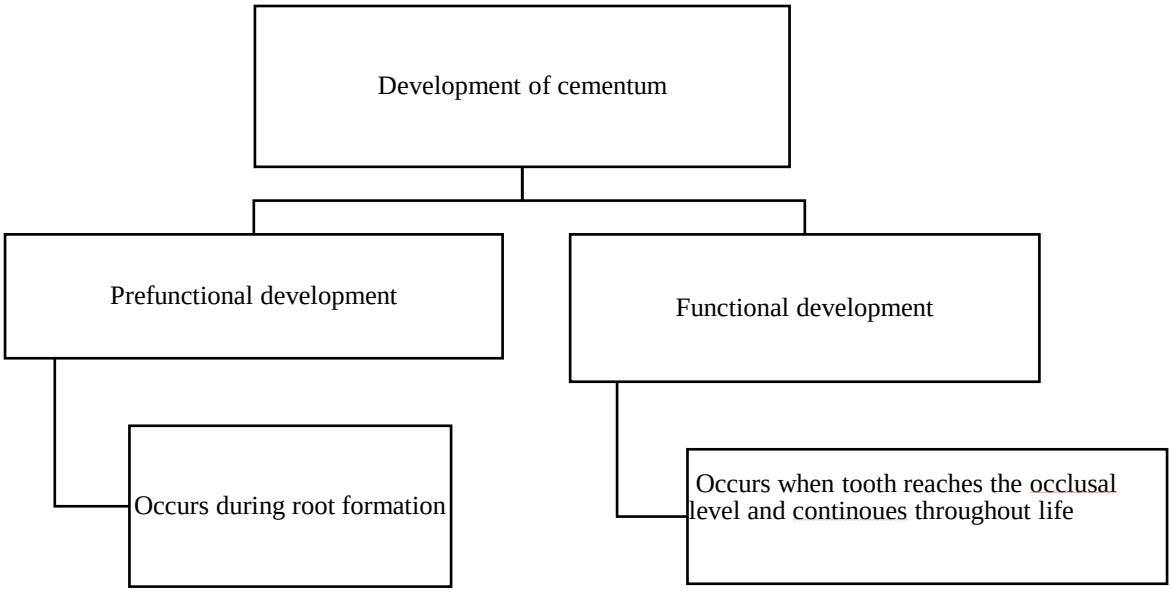

Figure1: Development of cementum

IV. Cementogenesis [5]

Dentin deposition on the inner surfaces of the Hertswig Epithelial Root Sheath, HERS disintegration along the dental follicle's mesenchymal component in order to contact the dentin, Continuous cementoblast layers are formed along the root's exterior surface. Pre-cementum or cementoid is a meshwork of unevenly ordered collagen fibres sparsely scattered in a ground substance or matrix. Matrix maturation phase, after which the matrix mineralizes to create cementum.

Cells involved in cementogenesis	Molecular signals involved in cementogenesis
Cementoblasts Fibroblasts Cementocytes A population of mesenchymal cells from periodontal ligament that differentiate into various cell types upon stimulation	Bone morphogenic protein Fibroblast growth factor Platelet derived growth factor Bone sialoprotein and osteopontin Gla protein Transcription factors such as Runt related transcription factor 2 (Runx – 2) Cementum specific proteins such as cementum protein 1

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Table 1: Cells and molecular signals involved in cementogenesis [6]

V. Classification of cementum[7]

Schroeder (1992) has classified cementum as follows:Acellular afibrillar cementum, Acellular extrinsic fibre cementum, Cellular intrinsic fibre cementum, Cellular mixed stratified cementumand Acellular intrinsic fibre cementum

Acellular extrinsic fibre cementum

Sharpey's fibre bundles that project perpendicularly from the cementum matrix into the PDL make up the composition. They lack cells but are made up of fibroblasts and cementoblasts. Found in the cervical part of the roots, but can extend apically. 30 and 230 m in thickness.

Cellular intrinsic fibre cementum

Cementoblasts form the composition, which contains cells but no external collagen fibres. Found in the resorption lacunae. Properties Cellular Mixed Stratified Cementum Properties (CMSC). It's also known as reparative cementum because it's linked to the healing of root fractures and the repair of resorptive deformities.

Acellular afibrillar cementum

A mineralised ground substance makes up the composition. Cementoblasts produce this substance, which contains no cells, extrinsic or intrinsic collagen fibres. Coronal cementum with a thickness of 1 to 15 m was found**.**

Cellular mixed stratified cementum

Composition - May contain cells and is made up of intrinsic and extrinsic (Sharpey's) fibres. Cementoblasts and fibroblasts produce it as a byproduct. Found in the apical third of roots and apices, as well as in furcation zones. 30 and 230 m in thickness.

Acellular intrinsic fibre cementum

Similar to cellular intrinsic, but without the cells. Present in a pical and interradicular root surfaces. Properties - Accumulated as a result of adaptive responses to environmental stimuli.

VI. Cells of cementum[8]

Cementoblasts, Cementoclasts, and Cementocytes are the three major cell types. Cementoblasts are ectomesenchymal cells that surround the dental follicle during tooth development, synthesising ground substance such as protein polysaccharides and collagen. Numerous mitochondria, a well-defined Golgi apparatus, and a granular endoplasmic reticulum are among the cellular structures present in the cementoblasts.[8] Cementoclasts — Mononuclear cells present on the surface of the cementum that resemble osteoclasts and play a function in

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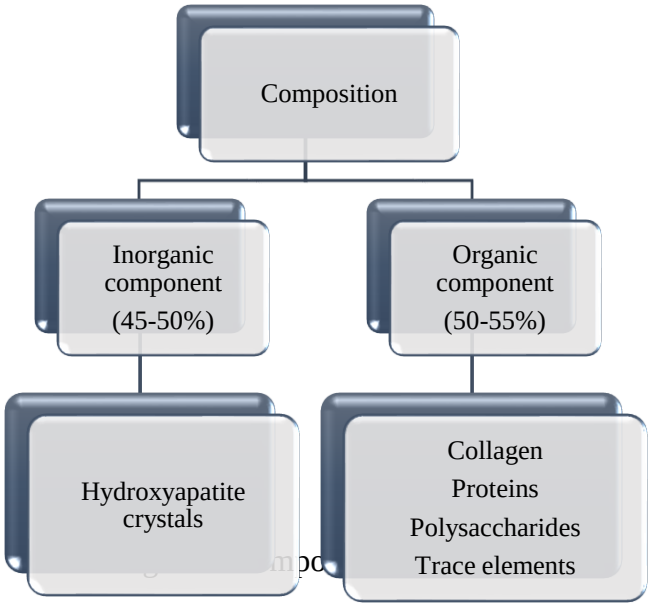
resorption and healing. Cementocytes are spider-like cells that have embedded themselves into the cellular cementum and are seen in lacunae.[9]

VII. Composition of cementum[10]



Inorganic Component

Cementum has a chemical makeup similar to bone, with Hydroxyapatite crystals accounting for 50% of the dry mass.

Organic component[11]

Type I collagen (90 percent) and type III collagen (5 percent) are found in cementum. Collagen type I fibrils are coated by type III collagen in the organic matrix of cementum. Non-collagenous proteins - Cement contains a large number of glycoconjugates, which can be glycolipids, glycoproteins, or proteoglycans, as well as a range of other proteins. Bone sialoprotein and osteopontin are the most common non-collagenous proteins. These two glycoproteins appear to be substantially more abundant in acellular afibrillarcementum and acellular extrinsic fibrecementum than in cellular intrinsic fibrecementum.Fibronectin, tenascin, proteoglycans, glycosaminoglycans such chondroitin sulphate, dermatan sulphate, and hyaluronic acid, and the enzyme alkaline phosphatase are also present. Mineral ions include 0.5-0.9 percent magnesium, 45-65 percent fluoride by dry weight, 0.1-0.3 percent sulphur, and trace levels of copper, zinc, and sodium.

VIII. Physical properties of cementum

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Hardness - Fully mineralized cementum has a lower hardness than dentin. Light yellow in tone, with a dull luster and a deeper hue. Acellular and cellular cementum are both permeable to oral fluids, allowing dyes to diffuse from the pulp and the exterior root surface. [12] Thickness - 16 to 60 m in the coronal half of the root, 150 to 200 m in the apical third and in the furcation zones, thicker in distal surfaces than in mesial surfaces due to functional stimulation from mesial drift over time, cementum thickness increases with age, with average thicknesses of 95 m at 20 years old and 215 m at 60 years old, indicating a threefold increase with age. [13]

IX. Functions of the cementum[2]

ANCHORAGE	Functional adaptation	REGENERATION
• The key function of cementum is to provide a medium for collagen fibres to bond the tooth to the alveolar bone. • Without cementum, a connective tissue attachment to the tooth is impossible because periodontal ligament collagen fibres cannot be integrated into dentin.	• Cementum deposition in an apical area can compensate for tooth material loss due to occlusal wear. • The continual deposition of cementum is crucial for function. • To maintain the attachment mechanism intact, a fresh layer of cementum must be deposited as the most superficial layer of cementum matures.	• Cementum regeneration is essential for the proper maintenance and regulation of periodontium. • Malassez epithelial cell rests play a critical role in cementum regeneration, because they are the only odontogenic epithelial cells that survive in the periodontium following tooth eruption

Table 2: Functions of the cementum

X. Age changes associated with cementum

Cement width increases (5-10 times)[14], greater cemental apposition in the apical region of the teeth [15], rapid reduction in the accessibility of nutritive substances and poor elimination of waste, products of Cementocytes, cementum becomes acellular with age, accumulation of resorption bays -irregular cementum surfaces with age, increase in the width apically and lingually with ageing.[16]

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