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Scanning Electron Microscopic Observations On Collagen Fibers in Human Dentin

A THESIS

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PRESENTED

BY

AMAL MOHAMED EZZAT ABD-EL HAMID

Instructor of Oral Biology
Faculty of Dentistry
Tanta University

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SUPERVISORS

Dr. Doria Mohamed El Bardisy.

Prof. and Head of Oral Biology Department

Faculty of Dentistry

Tanta University

Dr. Ragia El Prince Hussin Nour El.Deen.

Ass. Professor of Oral Biology Department

Faculty of Dentistry

Tanta University

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INTRODUCTION

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Dentin is hard tissue that constitutes the main bulk of the tooth, formed by odontoblasts, and is serving as both protective covering for the pulp and support overlying enamel. Unlike enamel, dentin is a vital tissue containing the cell processes of odontoblasts and neurons. Coronal dentin is covered by enamel, and radicular dentin is covered by cementum (Piesco, 1994).

Dentin and predentin are penetrated by numerous dentinal tubules, that extend through the entire thickness of dentin from the pulp to the amelodentinal junction in the crown and to the cementodentinal junction in the root (Pedersen-Sogaard et al., 1990).

The tubules form as the odontoblasts retreat centripally, leaving behind a process around which the dentin matrix is elaborated and mineralized (Frank, 1966, Transtad, 1973, Thomas, 1979, Tidmarch, 1981, Thomas and Carrella, 1983, La Flech et al., 1985, Weber and Zaki, 1986, Frank and Steur, 1988 and Ten cate, 1991).

Dentin is formed of two layers. First, mantle dentin which is the first formed dentin, in the crown underlying the dentinoenamel junction (D.E.J). The fibrils formed in this zone are perpendicular to the D.E.J (Yamada et al., 1983). They appeared as very distinct large–diameter fibrils (0.1 to 0.2 μm) that aggregate in the ground substance, immediately below the basal lamina (Dai et al., 1991).

The second layer is circumpulpal dentin, which forming the remaining primary dentin that represents all the dentin formed prior to root completion. The collagen fibrils in circumpulpal dentin are much smaller in diameter than in mantle dentin (0.05 μm) and they are closely packed together, and arranged at right angles to the odontoblast processes (Yamada et al., 1983 and Dai et al., 1991).

Sogaard–Pederson et al. (1990) examined human permanent teeth in the scanning electron microscope (SEM) after demineralization and its exposure to preparative procedures based on hydrogen peroxide, trypsin, and EDTA. They reported that dentin and predentin comprise a compact mass of fibrils which are basically parallel to the continuously growing interior surface of the predentin.

Von Korff (1905) reported the presence of argyrophilic fiber bundles arising from the subodontoblast layer and passing spirally between the odontoblasts to fanout against the surface of the basal lamina in an early stage of dentinogensis in the teeth of the pig and calf, these fibers are known as von Korff's fibers. Some investigators reported that the von Korff's fibers are thick collagen fibers. Others reported that von Korff's fibers represent both the ground substance and immature collagen. (Whittaker and Adams, 1972, Seltzer and Bender, 1984 and Bishop et al., 1991).

Szabo et al.(1985) observed in human dentin by (SEM), collagen fibrils passing from the pulp into circumpulpal dentin. He proposed to name such extrinsic fibrils, simply as inter-odontoblastic fibers (IOF). Similar fibrils were also recognized by Matthessen et al. (1985) by the transmission electron microscope (TEM).

Most of the interodontoblastic fibers originated from the cell body of the odontoblasts and entered the predentin at the rim of the neighbouring tubules (Szabo et al., 1985).

Sogaard-Pederson et al. (1990) asserted that interodontoblastic fibers do exist. Moreover, they added that the fibrils may be arranged at an acute angle to the surface of the predentin.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Dentin is a hard mineralized connective tissue encasing the pulp of the crown and root. As it is initially formed, dentin is completely organic as this layer increases in depth, the inorganic phase is deposited. The layer of dentin at the pulpal surface is always uncalcified and is known as predentin (Dodd and Carmichael, 1979).

Dentinogenesis:

The formation and maintenance of dentin are well established functions of the odontoblasts. The odontoblasts are specialized connective tissue cells, which differentiate from the mesenchyme of dental papilla (Bishop and Yoshida, 1992).

Differentiation of odontoblasts involves cell–to–cell recognition, contact stabilization involving the formation of attachment specializations, cytoplasm polarization, development of the protein synthetic and secretory apparatus, and the active transport of mineral ions (Sasaki and Garant, 1996).

Odontoblasts differentiate at the D.E.J, at the initiation of dentin formation, and they shift inward to where surface area is less (Agematasr et al., 1997).

The fully differentiated odontoblasts are highly polarized, secretory cell responsible for the deposition of a protienaceous dentin matrix (Kadler et al., 1996).