# Effects of Radiotherapy on Dentin & Enamel

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## INTRODUCTION

Head and neck cancer is a significant health concern in both men and women in the United States. This year, it accounts for approximately 4% of all cancers in the US(a). (*Head and Neck Cancer - Statistics*, 2012)Cancers of the head and neck region typically begin in the squamous cells, which line the mucosal surfaces in the head and neck. Hence they are referred to as squamous cell carcinomas There are several treatments and combinations of treatments for squamous cell carcinomas depending upon the individual. These treatments include surgery, chemotherapy, radiotherapy, or a combination of any of the three. The most used method is radiotherapy. Though it increases the overall survival rate in head and neck cancer patients, radiation may negatively affect the oral cavity. Overall, the oral cavity can see numerous side effects in areas such as the oral mucous membrane, the taste buds, the salivary glands, and bone. But, our main focus is on the effect of radiation on the dentin and enamel. Amongst the documents used for this research, three effects are discussed heavily: Radiation Related Caries, Changes in Mechanical Properties, and Changes in Biochemical Properties. The goal of our paper is to expand on these effects and discuss prevention and treatment.


Radiation Related Caries and Delamination

## CHANGES IN MECHANICAL PROPERTIES

Radiation treatment causes changes in the mechanical properties of both dentin and enamel. The changes discussed most between the readings used for this literature review were changes in microhardness, changes in Ultimate Tensile Strength (UTS), and elasticity changes. Microhardness is a term that refers to the hardness of materials-- in this situation, dentin and enamel-- gauged with instruments using small indentations. Ultimate Tensile Strength refers to the maximum stress that an object/material/structure can handle without being elongated, stretched, pulled, or crushed. Elasticity refers to how much material changes under external force and recovers after the force is removed. These things can affect the quality of life of irradiated patients, and they also could lead to the loss of a tooth or teeth depending on the severity. It is a case by case situation, but some trends attest to higher effects as the dosage of radiation increases (6A). Unlike RRC, these effects are not as visible, so they must be gauged in different ways.

## RADIATION RELATED CARIES

Radiation Related Caries (RRC) or dry mouth as a result of radiation-induced xerostomia (dry mouth), is one of the most threatening complications of radiotherapy. A mean average of 28.1% of post-radiation patients reported RRC, and a mean average of 9.19 teeth was reported decayed, missing, or filled(1A). The onset of RRC develops rapidly months after treatments alongside other indirect effects of radiotherapy, such as changes in salivary flow rates and quality of saliva, difficulty swallowing, and changes in oral microbiota (6A). Interestingly, RRC has the same morphological and demineralization pattern as ordinary caries, but its effects on dentin and enamel remain just as, if not more, devastating(5A).

## CHANGES IN BIOCHEMICAL PROPERTIES

Beyond the mechanical properties of teeth, radiation also significantly impacts dentin and enamel's biochemical properties. Dentin consists of 70% inorganic material, 18% organic matrix, and 12 % water, while enamel is composed of 1-2% organic material, 3-4% water by weight, and 92-96% inorganic matter (2A). The organic components of dentin and enamel mostly consist of collagen, glycoproteins (GP), and glycosaminoglycans (GAG). The inorganic components include calcium with phosphate or apatite. Radiotherapy leads to changes in these components or destruction. The effects vary between dentin and enamel, but, in general, lead to a lower quality of life.

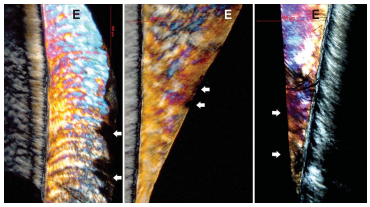


**Fig. 7.** Polarized light micrographs of enamel superficial demineralization (arrows) in noncavitated smooth surface of enamel in three different specimens. E = Enamel.

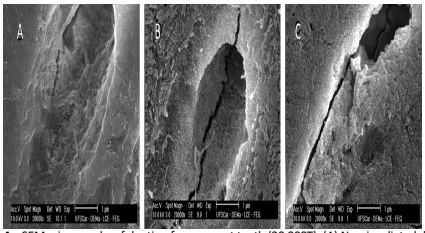


**Fig. 4** – SEM micrographs of dentin of permanent teeth (20,000T). (A) Non-irradiated dentin with well defined dentinal tubules and organized collagen fibers; (B) (30 Gy) and (C) (60 Gy). Irradiated dentin showing alteration of the intertubular, peritubular and intratubular dentin, presence of cracks in the dentinal structure, obliterated dentinal tubules, and increasing destruction of collagen fibers.

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