Cairo University
National Institute of Laser Enhanced Science
Dept. of Laser Sciences and Interaction

In Vitro Study to Evaluate the Hardness of Enamel and Dentin Surfaces Treated by 308 nm XeCl Excimer Laser

Thesis

Submitted to National Institute of Laser Enhanced Science (N.I.L.E.S.)

In the Partial Fulfillment of the Requirements for the Master Degree in Laser Sciences and Interaction

By

Nadia El-desouky Mohamed Ali

B. Sc. Electrical Power Engineering

2009

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Supervision

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Approval Sheet

Title of Thesis:

"In Vitro Study to Evaluate the Hardness of Enamel and Dentin Surfaces Treated by 308 nm XeCl Excimer Laser".

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- **Date Approved**

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ABSTRACT

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Background and Objective: The use of excimer lasers for treatment of dental hard tissues has considerable potential because the combined characteristics of low wavelength and short pulse result in limited heat diffusion and, therefore, tissue ablation without the problems of collateral damage. The aim of this work was to study the effect of XeCl excimer laser with wavelength of 308 nm on the hardness of human dentin and enamel surfaces and studied these effects spectroscopically.

Material and Methods: 24 lower anterior teeth were subjected to irradiation at 308 nm using a Lambada-Physik model OPTEX excimer laser and XeCl fill. Morphology of enamel and dentin surfaces was assessed by scanning electron microscopy (SEM), and studied effects by x-ray diffraction (XRD), and Fourier Transform infrared spectroscopy (FT-IR).

Results: This study suggested that laser irradiation is effective in improving enamel and dentin micro-hardness. Spectrum of treated surface appeared very similar to that of its untreated counterpart. Laser treatment has only slightly affected the enamel apatite and caused no structural damage. The band intensity reduction about 50% was observed after laser treatment, indicating the decrease of organic matters due to bond breakage.

Conclusion: Use of excimer laser irradiation at 308 nm on dental hard tissues should be safe and effective in the clinical situations. Specially, it can be delivered by optical fiber.

Key words: excimer; laser; enamel; dentin; micro-hardness; FT-IR.

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Introduction

CHAPTER I

INTRODUCTION

Preface:

Since the development of the ruby laser by Maiman (Maiman et al, 1960) and the application of this laser in dentistry by Stern and Sognnaes (Stern and Sognnaes et al, 1964), many researchers have studied and examined laser effects on dental hard tissues (Wigdor et al, 1995).

Regardless of the wavelength used, lasers in dentistry offer a variety of advantages. They offer a dry operating field and excellent visibility, reducing operative time, and depending on power settings and mode of delivery so they can vaporize, coagulate, or cut tissue (Misernedino et al, 1995).

New possibilities for the application of lasers in dentistry have been proposed based on the use of excimer lasers. Excimer lasers define a different regime of laser-tissue interaction, because ultraviolet photons are energetic enough to result in direct bond breaking in organic molecules. This mechanism of energy absorption, combined with the very short pulse duration, virtually eliminates thermal damage. Additional benefits arise from the fact that organic tissue absorbs UV radiation well and the tissue ablation rates can be controlled with extreme precision [(Tasev et al, 1990), (Neev et al, 1991)].

The application of laser radiation to both hard and soft tissue is becoming wide spread. It serves as a replacement of the dental drill by eliminating noxious stimuli, noise, and vibration.