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POSSIBLE APPLICATION OF CO_2 LASER FOR THE TREATMENT OF ROOT HYPERSENSITIVITY

Mona Y. Abdel-Razzak*

ABSTRACT

The purpose of this study was to determine the minimum CO_2 laser power effective in blocking root dentinal tubules in order to study the possible application of CO_2 laser for the treatment of root hypersensitivity. The effect of CO_2 laser in the removal of root surface smear layer was also studied. Ten periodontally involved human teeth that were extracted for their hopeless prognosis were collected from different patients attending the Periodontal Clinic, Faculty of Dentistry, Tanta University. The tested proximal surface of each tooth had at least 6 mm attachment loss. After removing all visible calculus using ultrasonic scaler, each tested proximal surface was vigorously scaled and root planed with Gracey currets. Specimens measuring approximately 1 mm thick and 5 x 5 mm in size were taken from the root planed proximal surface. The center of each specimen was treated with CO_2 laser and acted as the experimental area while the peripheries served as control. CO_2 laser was applied at different energy densities to each specimen, ranging from 90 J/cm^2 to 600 J/cm^2 for 0.2 second. All specimens were then fixed and prepared for SEM examination. The results suggested that CO_2 laser effectively removes the smear layer, uncover dentinal tubules and expose collagen fibers without widening the dentinal tubule orifices after root planing. However, the specimens treated with higher energy densities revealed a greater tendency to decreased dentinal tubule diameter. Some tubule orifices were completely sealed and this was directly related to energy density increments. Microfractures around dentinal tubule orifices were noted in some specimens treated with higher energy densities. Clear orifices were evident on the irradiated sites scattered between semi-opened dentinal tubules. The lased areas also exhibited surface changes including charring, crater formation, cementum meltdown and resolidification with lava-like appearance. It was concluded that the minimum energy density effective in blocking dentinal tubules was the medium energy level ranging from 225-300 J/cm^2. The effect of this energy level on the pulp remains to be determined.

INTRODUCTION

Dentine hypersensitivity is one of the most commonly encountered complaints[21]. Periodontal therapy is one of the causes which may result in exposure of dentinal tubules leading to dentine hypersensitivity[31]. Recession following periodontal therapy removes the protection provided by the gingival tissues, while root planing may remove 20 to 50 μm of cementum and expose dentinal tubules to external stimuli[27].

Three theories for the mechanism of dentine hypersensitivity have been proposed. The neural theory states that nerve terminal receptors within the dentinal tubules conduct pain impulses to the brain when directly stimulated[3,7]. However, it has been proven that this theory is deficient because neural elements do not extend into the peripheral half of the dentine[11].

The odontoblastic transduction theory proposes that stimuli initially affect the body of the odontoblast which then transmits them to nearby associated nerve endings[6,40]. However, electron microscopic studies by Nahri[26] have been unable to demonstrate synaptic complexes on odontoblast cell bodies. Moreover, it has been observed that odontoblastic processes do not extend peripherally beyond one third to one half the length of dentinal tubules[38,39].

The dynamic theory is currently the most commonly accepted mechanism of dentine hypersensitivity. Branstrom[5] reintroduced Gysi's concept that dentine hypersensitivity may be due to movements of the contents within dentinal tubules that, in turn, transmit surface stimuli by deformation of pulpal mechanoreceptors leading to eventual pain sensation. Accordingly, in order to reduce dentine hypersensitivity, it is important to control the movement of tubular contents and reduce fluid flow by occlusion of dentinal tubules[15,28,35].

The mechanism of action of CO_2 laser is through the delivery of a great amount of energy to a small area of dentine. If energy is absorbed rather than reflected, it is converted to heat which may burn, melt or vaporize dentine matrix. It would be desirable to melt the dentine surface left after vaporization of the surface smear layer so that the

* Ass. Professor, Oral Medicine, Oral Diagnosis and Radiology Dept., Faculty of Dentistry, Tanta University.