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Original Research

The Antibacterial influence of diode laser exposure on Streptococcus mutans

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ABSTRACT:
Oral cavity hosts for a variety of microorganisms, among them *Streptococcus mutans* that is commonly present in environment is considered as one of the major etiological factors. Their exceeding high number and their ability to produce acids post degradation of carbohydrates and induce a tolerance to low level pH environments makes the teeth vulnerable for cavity. There are many proposed ways to kill the bacteria one such proposed method is uses of lasers thus the aim of this study was to evaluate the bactericidal effects of omega diode laser on *S. mutans* with intervals exposed time. *S. mutans* isolated from patients with high caries risk were exposed to different interval time (10, 20 and 30 s) and then swabbed to the rabbit teeth. The bactericidal effect was shown in the exposure time of 20 and 30 s without any curiosity sign on the rabbit teeth, the caries sign appeared on the low time exposed (10 s). Therefore, a diode laser can eliminate the *S. mutans* when irradiated above 10 s.
Key words: Antimicrobial, diode laser, *Streptococcus mutans*, dental caries

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INTRODUCTION

Despite strict measures taken to prevent Dental caries, they still remain reported as the single most common chronic childhood disease. Dental caries if left untreated pose various concerns like Ludwig's angina, loss of tooth, pain and poor quality of eating habits and thereby poor quality of life. The biofilms formation with acid end-products through the metabolism of carbohydrates by acidogenic microorganisms within these biofilms is an important factor in the development of dental caries (Svensater et al., 2000). The essential process involves demineralization of the tooth structure by high concentrations of organic acids (Van Houte, 1994).

Streptococcus mutans has been implicated as the primary aetiological agent because of its relatively high numbers in plaque prior to the appearance of carious lesions, due to ability to degrade carbohydrates rapidly with the formation of abundant acid and its ability to induce a tolerance to low pH environments (1). Many of the medical and biological applications of lasers due to the use of high-power beam of laser radiation to coagulate various tissues, that is, to produce a small scar, or cut tissue. Photocoagulation by light occurs due to the change of light energy into heat energy when the laser light is absorbed. This is absorbed by the various pigments normally present in the tissue The interaction of the laser radiation with tissue produces predominantly thermal response, the cell will be destroyed. The normal body temperature is about 37°C but tissue normally can withstand temperature of up to 700°C for a duration of less than 1 s. Protein in the cell is usually damaged by the temperature, and the tissue will be destroyed and scar formed. This process is called photocoagulation (2). Laser killing time is a modification of what is called thermal killing time (the time in minutes to kill a suspension of bacteria or spores at a prescribed temperature and under specific conditions (Frank, 1986), therefore the description of

"laser Death time" can be the time in seconds to kill a suspension of bacteria or spores at prescribed laser power and under specific condition as explained before. The aim of this study was to evaluate the bactericidal effects of omega diode laser used with different exposure intervals on *S. mutans*

MATERIALS AND METHODS

STUDY DESIGN

The plaque sample was collected from patient diagnosed and suffering from dental caries that attended Dental clinic.

LASER IRRADIATION

A diode laser (Omega Xp mobile, UK) Setup was done to provide a constant beam of coherent, continuous monochromatic light with a power of 30 mw and Pulsing of 146Hz was used in this study. A light-emitting diode (LED) (670 nm, 5 KHz) was used as an aiming device and the laser beam was delivered through a 10cm optic fiber with a straight hand piece in continuous mode. Before the laser irradiation, the laser energy was carefully calibrated with a power meter (Coherent; Morita Mfg. Corp., Tokyo, Japan) to control the output energy from the fiber tip within the desired irradiation condition. The calibration of laser energy with a power meter after laser irradiation was also performed.

BACTERIAL STRAIN

S. mutans which was used in this study were isolated from carious lesions of patient's teeth on the Mitis-salivarius Bacitracin Agar (MSBA). One colony of *S. mutans* can be cultivated in Brain Heart infusion Broth (BHIB) for 24 h and was inoculated in small bacteria suspension exposed to laser light as negative control). After that the suspension in Eppendorf tubes was cultured on (Mitis- Salivarius Agar) and were incubated anaerobically for 24 h at 37°C. The colony forming unit (CFU) was counted.

RESULTS

A diluted bacterial suspension in 3 tubes contained 1 ml volume was exposed to the laser light at different times (10, 20, and 30 s).

The laser treated bacterial suspensions were further subjected for microscopic evaluation. The samples were incubated for 2 days at 37^{o}c aerobically. The isolated organisms were identified through biochemical tests in a semi-automated culture identifying system. The plates were counted for microbial colonies and expressed as colony-forming units (CFU).

The observations of the colony forming units revealed that, the numbers of colony were decreased according to length of irradiation exposed to bacterial suspension.

DISCUSSION

Dental plaque is an archetypical biofilm composed of a complex microbial community. It is the aetiological agent for major dental diseases such as dental caries and periodontal disease. The microbial community include *S. mutans, S. sobrinus, Lactobacillus casei* and *Actinomyces viscosus* (3) *S. mutans* possesses the ability to adhere to pellicle-coated tooth surfaces and to form acids, characteristically associated with the cariogenicity of this micro-organism.

In this study, a high number of *S. mutans* were isolated from caries lesion of the patient that attended the Dental clinic. Previous studies done by Wilson et al. (1992, 1993), have shown that cariogenic bacteria, and other plaque forming organisms; can be killed by low power laser light in the presence of a suitable photosensitizer. (4) The possible mechanisms regarding the antibacterial effect of diode laser are summarized in the following.

(a) Thermal and photo-disruptive effects were considered the principal reasons for the laser to eliminate the bacteria (5)
(b) Immediate cell death might not occur during laser irradiation, but sublethal damage inhibited cell growth after exposure to laser irradiation (6)
(c) The sublethal damage included destruction of cell wall integrity and possibly the accumulation of denatured protein. Integrity of cell wall is intimately related to the mechanical stability of gram-positive bacteria. The damage of cell wall will cease the cell growth and successive cell lysis. (7).
(d) On the other hand, the cellular protein is highly sensitive to thermal changes. The laser irradiation might produce denatured protein and induce the cell to create new proteins to compensate the denaturation (8).
(e) Some proteins such as IDG-60 immunodominant glycoprotein are indispensable for maintaining the integrity of the cell wall and the structure uniformity of cell shape (9).
(f) The stress on the cells to prevent the accumulation of denatured protein debris could also cause cell death (6).

In our study, the decrease in viability of *S. mutans,* as shown by the CFU, is exposure duration is dependent of light energy of Omega Diode Laser; and the bactericidal effect was at the long length of the irradiation.

In this study, the colony forming units revealed that, the numbers of colony were decreased according to length of irradiation exposed to bacterial suspension. Walter (1986) reported that in many studies on *S. mutans*, based on epidemiological studies, showed that *S. mutans* accounted for 74 to 100% of the mutans streptococcus in diverse populations, which harbored *S. mutans*, which cause the caries-active in infants (10). Furthermore, it was the first mutans streptococci (MS) to colonize among infants, shortly after their teeth erupt and, in another study, done by

Alaluusua (1983), the only MS isolated from caries-active infants was shown. (12) Also, van Houte (1994) reported that the predominant bacteria in carious lesions were *S. mutans*. In conclusion, *S. mutans* was the main causative agent of dental caries and the diode laser irradiations at a lightemitting diode (LED: 30 m/w and 670 nm, 5 KH2) and have a lethal effect on *S. mutans* when the time of its exposure was above 10 s.

REFERENCES

1. Svensater G, Borgstrom M, Bowden GH, Edwardsson S (2000). The acid-tolerant microbiota associated with plaque from initial caries and healthy tooth surfaces. Caries Res., 37: 395-405.
2. Dass CR, Tran TMN, Choong PFM (2007). Angiogenesis Inhibitors and the Need for Anti-angiogenic Therapeutics, J. Dent. Res., 86: 927- 936.
3. Marsh P, Martin M (1992). Oral Microbiology. London: Chapman and Hall. pp. 133-166.
4. Wilson, M., Dobson J, Sarkar S (1993). Sensitisation of periodontopathogenic bacteria to killing by light from a low power laser. Oral Microbiol. Immunol., 8: 182-187
5. Ando Y, Aoki A, Watanabe H, Ishikawa I (1996). Bactericidal effect of erbium:YAG laser on periodontopathic bacteria. Lasers Surg Med. 19: 190-200.
6. Dworkin M (1958). Endogenous photosensitization in a carotinoidless mutant of *Rhodopseudomonas speroides*. J. Gen. Physiol., 43: 1099–1112.
7. Elmros T, Burman LG, Bloom GD (1976). Autolysis of Neisseria Gonorrhoeae. J. Acteriol., 126:969-976
8. Rosenberg B, Kemeny G, Switzer RC, Hamilton TC (1971). Quantitative evidence for protein denaturation as the cause of thermal death. Nature, 232(13): 471-473.
9. Chia JS, Chang LY, Shun CT, Chang YY, Chen JY (2001). A 60- kilodalton immunodominant glycoprotein is essential for cell wall integrity and the maintenance of cell shape in *Streptococcus mutans.* Infect. Immun., 69(11): 6987-6998.
10. Walter JL (1986). Role of *Streptococcus mutans* in Human Dental Decay. Microb. Rev. 50: 353-380. Wilson M, Dobson J, Harvey W (1992). Sensitization of oral Bacteria to killing by low-power-laser Radiation. Curr. Microbiol. 25: 77-81.
11. Alaluusua S (1983). *Streptococcus mutans* establishment and changes in salivary IgA in young children with reference to dental caries. Longitudinal studies and studies on associated methods. Proc. Finn.Dent. Soc., 79 (3): 1-55.
12. Becker MR, Paster BJ, Leys EJ, Moeschberger ML, Kenyon SG, Galvin JL, Boches SK, Dewhirst FE, Griffen AL (2002). Molecular analysis of bacterial species associated with childhood caries. J Clin Microbiol., 40: 1001-1009.