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Opinion

Improved Enamel Protection by Laser/Silver Nanoparticles Combination

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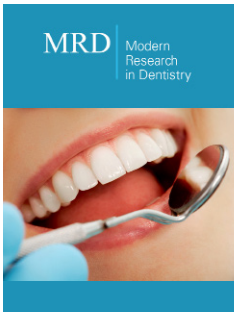

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Introduction

Dentistry compasses practices in oral cavity and includes diagnosis, prevention and treatment of hard and soft tissue disorders in the mouth, in addition to diseases of jaws, muscular, lymphatic, nervous and vascular structures [1,2]. Dental caries depends mainly on the presence of fermentable sugar and cariogenic microbial flora which reduces the pH under 5.5 and causes mineral loss of the teeth [3]. The imbalance: between minerals and oral biofilms, fluctuates the pH and influences the initiation and progression of caries [4,5]. Oral disorders result from dental carries include spread of infection, metastatic injury and metastatic inflammation [6]. Some microorganisms: Streptococcus Mutans initiates dental caries while Lactobacilli help its progression [7]. Although fluoride is used to prevent tooth decay, the efficiency of lasers for increasing acid resistance of enamel has been confirmed. Nanosecond pulsed Nd: YAG laser can increase the tensile bond strength of resin and caries resistance of human enamel [8]. When laser and fluoride are combined, the effect is further increased due to the enhanced enamel acid resistance and reduced pit and fissure areas of the teeth.

In addition to laser treatment, silver fluoride nanoparticles had been used as an efficient anti-decay factor [9]. Lasers have become available dental treatment procedures; specified with efficiency, easiness, and comfortableness [10]. Laser procedures are based on the interaction of laser parameters with tooth structure [11]. Combined lasers and re-mineralizing agents can enhance tooth resistance to mineral loss [12]. Silver is used because of the high resistance of pathogens to antibiotics. The integration of silver nanoparticles into dental structure can help minimizing the microbial colonization.

In laser dentistry, the incident laser energy has to be absorbed efficiently and converted into heat without affecting the surrounding and deeper tissues. Researchers are concerned with the effect of the focused laser beam on fusing and re-solidifying the illuminated dental tissue. Enamel fusion is responsible for the enhancement of its resistance against decay. In addition, laser illumination can also change the enamel ultrastructure by forming pyrophosphates, decreasing water and carbonate components, increasing the contents of hydroxyl ion, and dissociating proteins. These additional changes can reduce enamel solubility [13]. The effect of physico-chemical changes by laser in enamel showed a growing resistance to decay.

In this study, a number of mature extracted human molars teeth, in good dental health were washed and cleaned and sectioned longitudinally into fifteen samples of relevant sizes under water cooling by a low-speed saw and a polishing machine. A high peak power Nd: YAG laser; operating at 1064nm wavelength and 3.6W continuous (CW) diode laser; operating at 808 nm wavelength were employed to irradiate the tooth samples' surfaces. The teeth samples were immersed in silver nano-colloidal solution and illuminated by different lasers conditions.

The laser heating effect profiles was studied numerically after substituting specific values of point and line heating sources and specific locations of the point source. A computer simulation program was constructed to predict the formability of the laser effect in the enamel. Pulsed Nd: YAG laser irradiation has produced morphological and structural modifications which help preventing chances for tooth decay. The treated enamel surface showed higher roughness; resulted from laser induced-crystallographic process. This was useful to insert silver nanoparticles between the enamel granules by diode laser heating effect on enamel.

Sharper, overlapping, and more interconnected rods with one another have resulted, which represent higher tooth resistance to demineralization. The surface of the treated enamel samples formed regular inter-connected chain-like merged grains. Glass-like structures and columns; isolated by voids, were seen and this is ascribed to the vaporized water and organic components. Surface transformations have resulted from fusing the enamel throughout the period of laser irradiation, then by re-crystallization throughout cooling. The induced laser modifications in enamel components; like organic content of the mineral phases, water, and carbonate, have reduced the enamel stress and its solubility. The Ca/P ratio increase has increased the enamel microhardness, resulting in better dental protection against decay.

The enamel micro-channels were closed by the laser fused enamel and this stopped the acid from getting through the tooth, and as a result, minimized the dissolution of minerals. After laser treatment, the rods of the enamel structure appeared tangled to each other which resulted in a reduced acid infiltration and gave better tooth protection. These outcomes are supported by the weight loss measurements after demineralization which indicated a reduced solubility [14]. The nested antibacterial silver nanoparticles provided better enamel protection by levelling up the laser generated rough enamel surface. The current findings add new ideas for means of delaying dental decay. The computer model showed a very good match with the experimental findings which means a possible prediction of the laser treated profile prior to laser treatment.

References

1. (2014) Glossary of dental clinical and administrative terms. American Dental Association, Niagara Falls, New York, USA.
2. (2017) What is the burden of oral disease? WHO, Geneva, Switzerland.
3. Marinho VC, Worthington HV, Walsh T, Clarkson JE (2013) Fluoride varnishes for preventing dental caries in children and adolescents. Cohrane Database of Systematic Reviews (7): CD002279.
4. Nigel BP, Domenick TZ, Phil DM, Kim E, Jane AW, et al. (2017) Dental caries. Nature Reviews Disease Primers 3: 17030.
5. Khushbu Y, Satyam P (2016) Dental caries: A review. Asian Journal of Biomedical and Pharmaceutical Sciences 6(53): 01-07.
6. Sachidananda M, Shrikara P (2020) Microbiology and clinical implications of dental caries -A review. J Evolution Med Dent Sci 9(48).
7. Maruyama F, Kobata M, Kurokawa K, Nishida K, Sakurai A, et al. (2009) Comparative genomic analyses of Streptococcus mutans provide insights into chromosomal shuffling and species-specific content. BMC Genomics 10: 358.
8. Walid KH, Raid AI, Zinah SS, Amera A (2019) Acid resistance enhancement of human tooth enamel surface by Nd: YAG laser and incorporating silver nanoparticles: *in vitro* study. Laser Dent Sci 4: 7-16.
9. Stern RH, Sognnaes RF (1972) Laser inhibition of dental caries suggested by first tests *in vivo*. J Am Dent Assoc 85(5): 1087-1090.
10. Nam KY (2011) *In vitro* antimicrobial effect of the tissue conditioner containing silver nanoparticles. J Adv Prosthodont 3(1): 20-24.
11. Litvack F, Grundfest WS, Papaioannou T, Mohr FW, Jakubowski AT et al. (1988) Role of laser and thermal ablation device in the treatment of vascular diseases. Am J Cardiol 61(14): 81G-86G.
12. Stern RH, Renger HL, Howell FV (1969) Laser effects on vital dental pulps. Br Dent J 127(1): 26-28.
13. Kato IT, Kohara EK, Sarkis JE, Wetter NU (2006) Effects of 960nm diode laser irradiation on calcium solubility of dental enamel: an *in vitro* study. Photomedicine and Laser Surgery 24(6): 689-693.
14. Walid KH, Zinah SS, Raid AI, Hassanien AJ, Shama AS, et al. (2021) The combination of laser and nanoparticles enamel protection: an *in vitro* study. J Lasers Med Sci 12: e82.