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Effect of Er:YAG Laser and Association of Protocols on the Demineralized Enamel Microhardness

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Abstract

Objective: The aim of this study was to analyze the microhardness of demineralized enamel following different treatments (fluoride varnish, Er:YAG laser, and Er:YAG laser associated with fluoride varnish).
Methods: Forty-eight enamel blocks (4×4×7 mm) were divided into six groups ($n = 8$): (S) Sound; (DE) Demineralized; (DED) DE + Duraphat® 5% (fluoride varnish); (DEL20) DE + Er:YAG laser (20 mJ pulse mode; 0.20 W; 10 Hz; 60 sec; 1.18 J/cm^2; 11.83 W/cm^2); (DEL50) DE + Er:YAG laser (50 mJ pulse mode; 0.50 W; 10 Hz; 60 sec; 2.95 J/cm^2; 29.58 W/cm^2); (DEL20D) DE + Er:YAG laser (20 mJ) + Duraphat 5%. The irradiation was performed at 1 mm distance from the surface using a tip (AS7066X, L-14 mm, D-1.3 mm in diameter) in water/air spray refrigeration (level 6). The enamel blocks were submitted to pH cycling (4 h into DES solution +20 h into RE solution for 8 days and the solutions were changed every day). Knoop microhardness was measured (50 g/15 sec, six readings per sample) and data were analyzed by Kruskal–Wallis test at 5% significance.
Results: After treatments, DF group showed higher microhardness values than all the groups. Also, DEL20D group showed similar results with H group according to the microhardness analysis ($p < 0.05$).
Conclusions: It could be concluded that Duraphat 5% treatment showed better results when compared with all tested groups, however, the association of Er:YAG Laser 20 with Duraphat 5% also showed promising results.

Keywords: dental enamel, microhardness, phototherapy

Introduction

Dental caries is observed initially as a white spot lesion in enamel, which shows the initial demineralization process and loss of minerals from the enamel below the surface. This results in increase of subsurface porosities of ~25 vol.%.[1] When this volume exceeds 50%, cavitations occur in enamel and the reversion of the lesion is not possible anymore.[2] The treatments used to be a challenge due to the multifactorial severity and etiology[3] of the disease.

Some laser protocols were used in previous studies[4,5] for the prevention and treatment of enamel lesions, such as the Nd:YAG laser, which increased enamel resistance to demineralization.[4] Also, after irradiation with Nd:YAG laser (60 mJ pulse mode, 10 Hz, 84.9 J/cm^2) and topical fluoride application for 4 min, Nd:YAG laser irradiation changed the chemical composition of enamel regardless of fluoride concentration, and inhibited demineralization of enamel on primary teeth after 1 year.[4,5] High concentration of phosphates and carbonates that increased surface hardness and roughness were observed in the irradiated specimens,[6] however, the generated heating would be a problem when using this laser device.

In this way, other studies[2,7,8] were carried out to optimize surface preparation using another type of laser: the Er:YAG laser. These previous studies were performed on enamel surface and showed precise and uniform cuts, which could maintain its prismatic structure.[7] There was ablation of enamel and dentin with a minimum thermal effect when the frequencies of 2 and 5 Hz were used.[8] For energy between 25 and 365 mJ pulsed in enamel and dentin specimens (0.5–0.75 mm), there was minimal thermal effect on the enamel with energy density below 80 J/cm^2 and minimal thermal effect on dentin was noticed with density below 74 J/cm^2.

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