FT-Raman Spectroscopy Analysis of Nd:YAG and Er,Cr:YSGG Laser Irradiated Enamel

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This study investigated chemical modifications in laser treated enamel surfaces aiming caries prevention. Eighty 3×3 mm enamel blocks were obtained from buccal surfaces of human molars. The blocks were cleaned with pumice and divided into 8 groups: (I) no treatment; (II) topical acidulated phosphate fluoride (APF); (III) Nd:YAG; (IV) Nd:YAG+APF; (V) APF+Nd:YAG; (VI) Er,Cr:YSGG; (VII) Er,Cr:YSGG+APF; (VIII) APF+Er,Cr:YSGG. The Nd:YAG (1064 nm) irradiation condition was: 84.9 J/cm^2 (60 mJ/pulse, 300 µms spot size and 5 Hz). The Er,Cr:YSGG (2790 nm) irradiation condition was: 2.8 J/cm^2 (12.5 mJ/pulse, 750 µms spot size, 20 Hz). The APF gel (1.23% F$^-$) was applied during 4 minutes. After treatments, samples were submitted to a 10-day pH cycling model. Samples were evaluated by Fourier Transform Raman Spectroscopy between 400 cm^{-1} and 4000 cm^{-1} before and after treatments, and after the demineralization. Carbonate and organic bands were analyzed and the differences were accessed by t test ($p < 0.05$). The FT-Raman spectra shows inorganic bands at 440 cm^{-1}, 590 cm^{-1}, 870 cm^{-1}, 960 cm^{-1}, 1045 cm^{-1}, 1070 cm^{-1}; and organic bands at 1270 cm^{-1}, 1450 cm^{-1}, 1670 cm^{-1} and 2945 cm^{-1}. The cariogenic challenge of enamel without treatment reduces the carbonate and organic matrix; however after APF, only the organic matrix was reduced. Nd:YAG irradiation reduces carbonate and preserve organic matrix; while Er,Cr:YSGG irradiation preserves both inorganic and organic matrixes. The fluoride treatment before or after Er,Cr:YSGG irradiation preserves carbonate radicals and organic matrix, whereas the association of fluoride with Nd:YAG irradiation reduces organic matrix. In conclusion, laser irradiation was able to decrease the effects of cariogenic challenge on enamel structure.