CED/NOF-IADR
2024 Oral Health
Research Congress
12 — 14 Sept 2024
Geneva, Switzerland

0137

Profilometry of Dental Enamel After Femtosecond Laser Irradiation

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Objectives Femtosecond lasers release optical pulses lasting mere femtoseconds, usually spanning from a few to hundreds of femtoseconds. These lasers concentrate energy within an extremely brief time frame per pulse, resulting in remarkably high peak powers beyond the capabilities of continuous wave lasers. The aim of our study is to explore the consequences of femtosecond laser light exposure on dental enamel.
Methods The enamel of two freshly extracted healthy human molars were subjected to irradiation with Laser - Pharos model Ph2-10-1000-02-H0-B (LightConversion UAB, Lithuania), with bi/burst mode and automated harmonic generator, operating at three wavelengths - 1030 nm, 515 nm and 343 nm. The maximum output powers were 10 W, 5.9 W and 2.8 W respectively. The operating pulse widths are 170 fs at 1030 nm, 130 fs at 515 nm, and 110 fs for 343 nm. The output powers of the laser radiation at all wavelengths with which the samples were treated was finally attenuated by internal power control, giving possibility to set the appropriate value in order to have equal power densities on the objects. The effects of the treatment were studied with the help of microscope ZEISS LSM 900 with Airyscan 2, resolution - lateral (XY) down to 120 nm, axial (Z) 350 nm. Profilometric images were used to obtain, access, and compare topographical data from the irradiated surfaces.
Results The 3D profilometric analyses of irradiated enamel show surface roughness. No evidence for significant differences of the ablation effects on the treated dental enamel between the studied wavelengths were found in any of the three directions. The amount of removed tissue by the femtosecond laser irradiation is small. Carbonization on enamel is not evident.
Conclusions Besides the detected changes on the treated dental enamel and because of the limitations of this study, future investigations are needed to explore different parameters of femtosecond lasers effects by profilometric techniques on the hard dental tissues.