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LASERS IN CARIES DIAGNOSIS AND PREVENTION

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Background and Objective: This study aimed to evaluate the potential of lasers in prevention and diagnosis of caries lesions.
Study Design/Materials and Methods: Enamel and dentin were irradiated with Er:YAG and Er,Cr:YSGG lasers with fluences between 0.365 J/cm^2 and 8.5 J/cm^2. Temperature rise during laser irradiation was determined using thermocouples and an infrared thermographic camera. Chemical and structural alterations were identified by Fourier transform infrared spectrometer. For caries diagnosis, caries-like lesions were induced in human third molars teeth that were analyzed by fluorescence spectroscopy (In-Ga-N, $\lambda = 405$ nm) and by an optical coherence tomography system (OCT), using an ultrashort pulsed laser (Ti:Al_2O_3) $\lambda = 830$ nm, 50 fs, average power of 80 mW.
Results: After the irradiation it was observed loss of water, alteration of the structure and composition of the collagen and increase of the OH radical. Fluorescence spectra differentiated active of inactive lesions. OCT surface analysis produced a tomogram of dentine-enamel junction and this image was compared with the histological image.
Conclusions: The results showed that the erbium laser changes mainly the organic matrix (collagen) and water and little the mineral matrix (OH^- radical). This OCT system accurately depicts dental tissue and it was able to detect early caries in its structure, providing powerful contactless high resolution 3D images of lesions. Acknowledgements: FAPESP, CNPq.

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OPTICAL COHERENCE TOMOGRAPHY OF PERIODONTAL TISSUES

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Background and Objective: Optical Coherence Tomography (OCT) produces high resolution cross-sectional images of tooth and periodontal tissue relationships. The purpose of this study was to compare the imaging characteristics of periodontal tissues using two OCT systems.
Materials and Methods: The mid-facial surface of the first molar, first premolar, and central incisor in the maxillary and mandibular arch were imaged in four healthy volunteers using two OCT systems. Both OCT systems employed 1310 nm light sources with similar spectral bandwidths and power; they differed in the method used to modulate signals from the reference arm. One system used a mechanical scanning mirror while the other used a piezofiber delay line.
Results: Both systems clearly distinguished the epithelium from connective tissue and images of the sulcus and attached tissues obtained with both systems were similar. Sulcular depth ranged from 1.0–3.0 while attachment ranged from 1.2–4.1 mm. The lowest values for attached tissues were found in teeth with full coverage coronal restorations. The piezofiber system resulted in improved resolution of morphological features, particularly within the internal aspect of the base of the sulcus. Moreover, signals consistent with circular fibers, transseptal fibers and blood vessels were resolved with this system.
Conclusion: The capacity OCT to non-invasively image the base of the periodontal sulcus at high resolution and to characterize fibers within the attachment will likely play a significant role in the advancement of periodontal diagnoses.
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COMPUTER SIMULATION OF DEPTH OF KILL OF *P GINGIVALIS* IN DENTIN BY LASER BASED ON EXPERIMENTAL DAMAGE THRESHOLD

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Background: Although there is overwhelming evidence that laser treatment is bactericidal, current laser systems are neither designed nor optimized for their antibacterial effects. Experiments on laser killing of cultured *P. gingivalis* (*Pg*) combined with a computer-based model predict the spatial distribution of energy deposition that is lethal to pigmented pathogens as a guide for clinical dosimetry.
Methods: Peak fluence of a single 1064 nm, 100 μsec, pulse was carefully measured as a function of distance between the fiber tip and the target. Damage threshold of *Pg* in culture was determined by finding the threshold peak fluence that elicits a plume as observed with 100X video magnification [Harris, Yessik, 2004]. Damage thresholds were also determined for multiple pulses delivered at 10-Hz.
Results: Pg damage threshold for a single pulse was 48-J/cm^2 (N = 5 cultures). It was also determined that 50, 20-J/cm^2 pulses would exceed damage threshold. A Monte Carlo computer simulation of light transport [Wang, Jacques, 1992] used the optical properties of dentin at 1064 nm to generate the spatial contours of these single-pulse and multiple-pulse threshold doses in dentin, which indicated the depth to which *Pg* would be killed. These damage threshold contours extended more than 800 μm below the root surface.
Conclusions: The 800 μm depth of kill for *Pg* in this simulation is greater than the 200–300 μm depth achieved by diffusion of chemical antibiotics. The antimicrobial laser represents a new class of bactericidal action with no known resistance, systemic side effects or negative interactions. It can access intracellular pathogens and those in privileged sites.