

## Photonics Applied to Medical Therapy

Denise Maria Zezell

*Center for Lasers and Applications- IPEN - CNEN/SP- Sao Paulo-SP*

The physical characterization of biological tissues, mainly the study of their optical properties and thermal responses, allows the development of new processes using high intensity lasers, which can be useful as new diagnostic or therapeutic methods in Dentistry and Medicine. Protocols were developed and tested for several diseases. The caries prevention with laser was also studied *in vitro* and a clinical trial was carried out to prove the safety and effectiveness of the method. The Nd:YAG laser efficacy associated with conventional treatment promoted significant bacterial reduction immediately after irradiation, in class II furcation defects in patients with chronic periodontitis. The treatment of oral mucositis (a complication from chemotherapy and radiotherapy) with low intensity laser was performed *in vivo* and in clinical trials, contributing to the relief of painful symptoms and reducing the severity of the mucositis incidence, collaborating to improve the life quality of the oncologic patients. A cream for topical use for the clinical photodynamic therapy of skin cancer was developed, tested and patented in Veterinary Medicine. We are also studying the potential treatment of burned skin with high intensity femtosecond laser as well as the potential use of erbium laser to cut bone during surgery.

The decline in dental caries over the last few decades has been attributed to the extensive use of fluoride. Although fluoride is the most powerful treatment to prevent tooth decay, the development of new methods to completely control this disease is still necessary, mainly in developing countries. In this way, lasers, combined or not with fluoride, have been tested on teeth to improve dental enamel properties in order to enhance its resistance to demineralization.

We investigated the compositional and crystallographic changes *in vitro* on enamel when irradiated by Er,Cr:YSGG or Nd:YAG associated with black coating, its resistance to demineralization when irradiation is associated with fluoride, and CaF<sub>2</sub>-like material formation and retention. Sample surfaces were analyzed by ATR-FTIR. After all *in vitro* results, a double-blind crossover clinical trial was developed, in which 121 teeth of 33 volunteers were selected. After 1 year, this clinical experiment showed an overall reduction of 60.2% in caries incidence in (lased group + APF) when compared with control (no treatment) and 39.2% of reduction when compared with only fluoride group. As a conclusion, combined Nd:YAG laser and topical fluoride treatment was effective for reducing the incidence of caries clinically.