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PROPOSED BIOSENSORS FOR MANDIBULAR IMPLANT OCCLUSAL STRESS MEASUREMENT AND MODELING

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ABSTRACT

Biomedical Engineering is an interdisciplinary domain which links many branches of science such as engineering, medicine, biology, physics, psychology, etc. This quickly growing field meets the needs of industrial, clinical, and scientific research communities. It involves the invention of methodologies and devices for human welfare and for better understanding of human biological processes.

The goal of this thesis is to provide dentists an opportunity to measure and to analyze stress-strain for a successful dental implant operation. Dental implants are widely used in prosthodontic rehabilitation of partially and completely edentulous mandible and restore or improve function where mandibular over denture retained by two implants is considered as first choice standard care over conventional complete denture.

Occlusal forces are transferred to bone through implant and it has long been recognized that both implant and bone should be stressed within a certain range for physiologic homeostasis. Overload can cause bone resorption or fatigue failure of the implant, whereas under loading of the bone may lead to disuse atrophy and subsequent bone loss. For these main reasons, to ensure clinical success of new dental implants design and to predict survivability, analyzing stresses at bone-implant interface is an essential step in the overall analysis of loading, which determines the success or failure of an implant.

In this thesis novel bite force measuring setup that play an essential role for dental system prediction, is introduced. This study has taken into consideration the drawbacks of the nonlinearity of the previous biosensing resistor and the damage of the surface material of the biosensors.

Furthermore, this study includes a proposed 3D Finite Element Model for mandibular implant and presents an occlusal stress analysis and computational simulation of bone modeling around the dental implants, from a bioelectro-mechanical point of view. The model is based on stimulation of bone and implant modeling by a previous measured stimulus forces applied on implant.