Optical Coherent Tomography Investigation on Apical Region of Dental Roots

C. Sinescu[1], A. Podoleanu[2], M. Negrutiu[1], M. Rominu[1]

[1] *University of Medicine and Pharmacy" Victor Babes" Timisoara, Romania*

[2] *University of Kent, United Kingdom*

INTRODUCTION: The purpose of this study is the investigation of the apical areas of the root using a noninvasive method. Optical coherence tomography is a well known technique for creating non-invasive, high resolution (< 20 μm) images of biological microstructure [1]. Dentists evaluate the oral health of a patient using three main techniques: visual/tactile examination, periodontal probing, and radiographic imaging. Probes are placed between the soft tissue and the tooth in order to assess periodontal conditions. The depth of the probe penetration (probable pocket depth) is measured. The location of the soft tissue attachment is estimated from a fixed reference point on the tooth. Periodontal probing can be painful for the patient and diagnostically imprecise. Probing errors result from variations in insertion force, inflammatory status of tissue, diameter of probe tips, and anatomical tooth contours. Radiographs reveal morphological characteristics of the teeth and of the alveolar bone that can not be identified in a visual examination. Although radiographs are highly sensitive in detecting regions of carious demineralization and alveolar bone loss, they have several limitations. Radiographs cannot distinguish active from inactive disease. Periodontal disease is not identified until significant bone loss has occurred. Since radiographs are bi-dimensional, it is impossible to precisely locate the position of a carious lesion or osseous defect. Radiography uses harmful ionizing radiation and provides no information on soft tissue state.

METHODS: The method is based on the optical coherence tomography (OCT) which can provide a lot of information about the apical zone of the dental root through a non-invasive procedure. For this analysis 34 extracted single root teeth were used. The apical area was scanned from apical to cervical. A schematic representation of OCT instrumentation is shown in Figure 1. It is based on a white light optic fibre Michelson interferometer. Mirror reflections and backscattered light from the sample are recombined at the coupler and propagated to the detector and light source. An interferometric signal is detected when the distance to the reference and sample arm reflections is matched within the source coherence length. A scanning retro-reflector varies in path length of the reference arm for each transverse location on the sample. The loss in the signal intensity caused by birefringence effects in the optical fiber is corrected using polarization paddles.

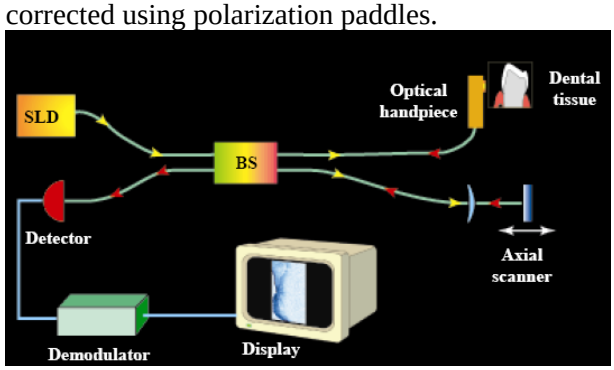

Fig.1. The scheme of dental OCT System.

RESULTS: The study provides images of many lateral canals that can be shown without sectioning the teeth. The accuracy of those images is very good for 2mm length of investigation. (Figure 2).

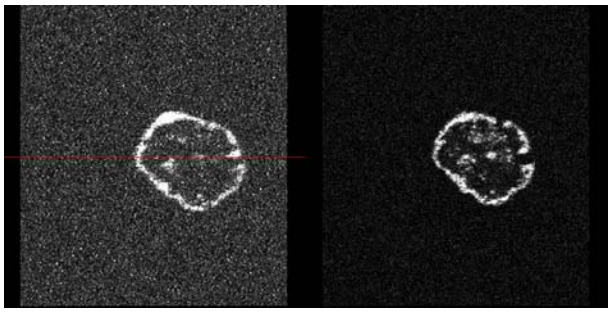

Fig. 2: OCT image of an apical zone of a single root tooth.

DISCUSSION & CONCLUSIONS: As a general conclusion, the optical coherence tomography can be used as a non-invasive method in the apical part of the teeth. This method can be used successfully in micro-leakage studies in order to offer accurate three-dimensional information.

REFERENCES: [1]R.G. Cucu, A.G. Podoleanu, J.A. Rogers, J. Pedro, R.B. Rosen (2006) *Optics Letters*, **31**,11:1684-1687.