European Cells and Materials Vol. 16. Suppl. 1, 2008 (page 33) ISSN 1473-2262

En-face optical coherence tomography scanning of amalgam-hard dental tissues interface

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INTRODUCTION: Many methods of investigation of the restoration - hard dental tissues interfaces are in use today, some of them being already classical. New methods are emerging, several of them focusing on the non-destructive characteristics of the investigation, thus allowing a dynamic evaluation of the samples. One of them, the optical coherence tomography (OCT), is used in the present study.

METHODS: Amalgam fillings were inserted in cavities prepared in the buccal fossae of extracted mandibular first molars. They were allowed to set completely and then were subjected to OCT examination. The optical configuration uses two single mode directional couplers with a superluminiscent diode as the source at 1300 nm. The scanning procedure is similar to that used in any confocal microscope, where the fast scanning is en-face (line rate) and the depth scanning is much slower (at the frame rate). The en-face scans provide an instant comparison to the familiar sight provided by direct view or via a conventional microscope. Features seen with the naked eye could easily be compared with features hidden in depth. Sequential and rapid switching between the en-face regime and the cross section regime, specific for the en-face OCT systems developed by us[1], represents a significant advantage in the non-invasive imaging. Images with different orientations and 3D OCT imaging can be obtained using the same system. C-scans are made from many T-scans along either of X, Y, repeated for different values of the other transverse coordinate, Y, X respectively in the transverse plane. The repetition of T-scans along the other transverse coordinate is performed at a slower rate than that of the T-scans, which determines the frame rate. In this way, a complete raster is generated. Different transversal slices are collected for different depths Z, either by advancing the optical path difference in the OCT in steps after each complete transverse (XY) scan, or continuously at a much slower speed than the frame rate. The depth scanning is the slowest in this case. It is more difficult to generate *en-face* OCT images than longitudinal OCT images as the reference mirror is fixed and no carrier is produced. Therefore, in order to generate T-scans and T-scan based OCT images, a phase modulator is needed in order to create a carrier for the image bandwidth.

RESULTS: The defect discovered inside the structure were identified at 0.286 mm. The defect volume can be computed using 3D reconstruction softwares, allowing the structure behavior during mastication and the fracture or microleakage hazards at this level.

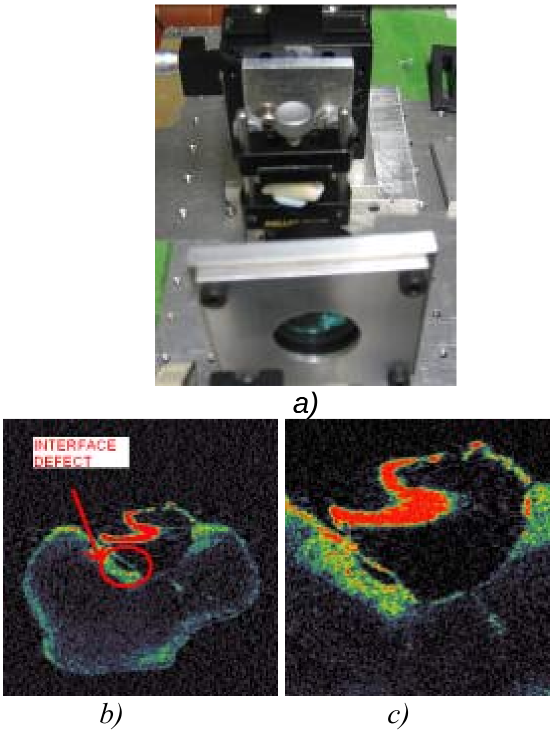

Fig. 1: Material defect at the amalgam-tooth structure interface investigated with en face OCT (a);slide 8 from 23, 18 degrees in air (b) and slide 5 from 23, 8 degrees in air (c).

DISCUSSION & CONCLUSIONS: This method allowed us to evaluate, in a non-invasive manner, the presence of the inner gaps at the amalgam-tooth structure interface. In conclusion, OCT could act as a valuable tool in analyzing the restorations as a noninvasive method.

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