

DIAGNOSIS OF DENTIN CARIES – ULTRAVIOLET FLUORESCENCE

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Summary. The technology advance in recent years determines the need of construction of modern appliances for early diagnosis of dental caries, which are categorized by great precision, non-invasiveness, easy usage and wide availability. Such non-invasive and accurate tool for diagnostics of caries is Caries Detector (LED), Bulgarian product by “Optica Laser”. The detector emits a specific wavelength of near ultraviolet light, which causes fluorescence to porphyrins – metabolic products of the life cycle of caries-inducing bacteria. The purpose of the study is piloting a new diagnostic tool for detection and monitoring of caries excavation based on fluorescence – LED UV caries detector of company “Optica laser”. Subjected to examination by caries indicator dye and UV caries detector were sixty permanent teeth with deep dentine caries. Two methods were used to assess the dentin caries – UV fluorescence detector of “Optica Laser” and staining with caries indicator – dye (Sable™ Seek®). It was found that among all sixty teeth, the fields, closed by margins of carious process overlap. Fifty-four of tested teeth has shown bigger field of images with staining method and six – smaller in comparison to the fluorescent method. Ultraviolet fluorescence caries detector of “Optica Laser” company is affordable and easy applicable method for controlled excavation of dentine caries. The detector can be used in daily dental practice equally with other methods. The unit has a number of advantages – non-invasiveness, lack of interaction with tooth structures, speed, reliability, efficiency, predictability and repeatability of results.

Key words: *diagnosis, dentin caries, ultraviolet fluorescence, dye, excavation*

INTRODUCTION

The significant advance in technology in recent years naturally determines the need of construction of modern appliances for early diagnosis of dental caries, which are categorized by great precision, non-invasiveness, easy usage and wide availability.

Such non-invasive and accurate tool for diagnostics of caries is Caries Detector (LED), Bulgarian product by "Optica Laser". The detector emits a specific wavelength of near ultraviolet light, which causes fluorescence to porphyrins – metabolic products of the life cycle of caries-inducing bacteria.

Dental caries is a chronic process that develops in the enamel, dentin and cement, as a result of the action of a group of factors [1]. It is a dynamic process of de- and remineralization of hard dental tissues (HDT).

Regarding this concept, modern dentistry is aimed at early diagnosis of caries and minimally invasive treatment approach that requires controlled excavation [3].

Traditional methods for detection of caries include direct visual-tactile and radiographic evaluation.

Different dyes are being used to distinguish the healthy hard dental tissues of caries [4, 5].

There are a number of new methods for evaluation of dental caries, such as transillumination, UV fluorescence (Caries Detector – LED), fiberoptic transillumination (FOTI), digital fiber optic transillumination (DIFOTI), quantitative light-induced fluorescence (QLF), laser fluorescence – LF (Laser caries detector, Diagnodent), electric conductivity measurement (ECM), ultrasonic caries diagnosis, infrared transillumination, optical coherence tomography, polarized Raman spectroscopy (PRS), infrared fluorescence, multi-photon image, terahertz image, infrared thermography, etc. [6, 7, 8, 9, 10, 11, 12, 13, 14, 15]. One of the most modern methods is fluorescence method using ultraviolet caries detector.

PURPOSE

The aim of the study is piloting a new diagnostic tool for the detection and monitoring of caries excavation based on fluorescence – LED UV caries detector of company "Optica laser".

MATERIAL AND METHODS

Subjected to examination by caries indicator dye and UV caries detector were sixty permanent teeth with deep dentine caries.

Two methods were used to assess the prevalence of carious process – UV fluorescence detector of "Optica Laser" (Fig. 1) and staining with caries indicator – dye (Sable TM Seek[®]) (Fig. 2).



Fig. 1. LED caries detector



Fig. 2. "Sable Seek" caries indicator – dye

LED Caries Detector (Optica Laser) was used to perform the ultraviolet fluorescence method. Its action is based on the red fluorescence of bacterial bioproducts (porphyrins) in carious dentin under illumination with light having a wavelength of 390-420 nm (near-UV). Evaluation of the prevalence of the carious process in hard dental tissues is verified visually through a special orange-red filter which passes light of a specific wavelength (than 500 nm), so that only changes that occur in hard dental tissues during excavation can be observed.

To perform the staining method the caries indicator Sable[™] Seek[®] (Ultradent) was used. It colors infected dentin in dark green.

Protocol for working with dye:

1. The applicator is placed on a syringe containing the dye.
2. Application of caries indicator on the tooth surface.
3. Washing and drying after 10 s.
4. Evaluation of results.

During the excavation initial carious lesion were illuminated with UV caries detector. After having traced the margins of carious lesions by fluorescence signal, caries indicator was applied on the tooth. Carious dentin was removed until it stopped changing its color when using the caries indicator – dye. Then it was checked by the fluorescent method (Fig. 3).

Photo documentation of each stage was performed with highly specialized digital photographic equipment – SLR (DSLR) Nikon d90, Nikon AF-S Micro Nikkor 105 f/2.8G VR, Nikon SB-R-200 Speedlight remote kit R1 (Fig. 4).

The margins of carious lesions detected with fluorescence signal were drawn digitally on the photographs by specific software. Subsequently, these margins were transported by a special algorithm on images of dye colored carious lesions (Fig. 5).

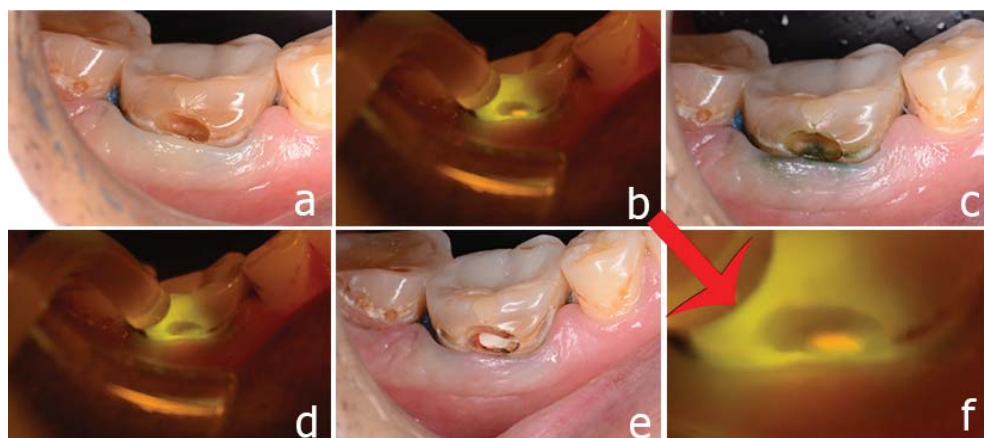


Fig. 3. a) image of carious lesion; b) fluorescent signal of carious lesion; c) staining of carious lesion with caries indicator – dye; d) fluorescent signal after excavation of carious lesion; e) image after excavation of carious tissues; f) magnification of image with fluorescent signal



Fig. 4. Photographic equipment



Fig. 5. a) drawing the margins of the carious lesions according to fluorescent signal; b) drawing the margins of the carious lesions after staining; c) merging the two images and comparing the borders

RESULTS

It was found that among all sixty teeth, the fields, closed by margins of carious process overlap. Fifty-four of tested teeth have shown bigger field of images with staining method and six – smaller in comparison to the fluorescent method.

DISCUSSION

When caries indicator dye is being used, the infected dentin is colored in dye's color. It is possible, however, dentine, which is not infected to be colored if it is demineralized in relation to its greater porosity, due to which the molecules of the dye penetrate in the tissue. Thus demineralized dentine stains, but with much less intensity compared to carious dentine.

When using a caries detector dye, the dentine, which is colored lighter than the color of the dye, should not be removed in order to prevent excessive excavation [16, 17]. Sometimes it may be very difficult to determine the extent of this lighter color, especially in deeper layers of dentin, which may define the healing process. It is not always easy to determine at what stage of the dentin excavation it should stop, because there may be a lack of clinical markers. This would lead to differences in cavity sizes, strength of the remaining hard dental tissues and the condition of the pulp. So there must be another objective marker in the removal of carious dentin [18].

Fluorescent methods for controlled caries excavation are indispensable when minimal removal of tooth structures, based on the idea for minimal invasion, is aimed. By the UV fluorescence affected dentin can be clearly distinguished from the infected. The results of our study are similar to those obtained by other authors [3, 15, 19].

CONCLUSIONS

Ultraviolet fluorescence caries detector of "Optica Laser" company is affordable and easy applicable method for controlled excavation of dentine caries. The detector can be used in daily dental practice equally with other methods. The unit has a number of advantages – non-invasiveness, lack of interaction with tooth structures (does not color the hard dental tissues), speed, reliability, efficiency, predictability and repeatability of results.

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