CHANGES IN VALUES MEASURED WITH A LASER FLUORESCENCE SYSTEM FOR ENAMEL AND DENTIN ETHCED FOR DIFFERNT TIME INTERVALS - pilot study

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SUMMARY:

Purpose: The aim of the presented in vitro study was to evaluate the effectiveness of the laser fluorescent device DIAGNOdent in measuring changes in the level of mineralization of intact enamel surfaces etched for different time intervals and intact dentin etched for 30 sec.

Material and methods: The study was performed on extracted human teeth. DIAGNOcam was used to measure the values of laser fluorescence of intact enamel and dentinal surfaces. Then the samples were treated with 37% H_2PO_3 etchant for 5, 30 and 60 sec for enamel surfaces and 30 sec for dentinal. Teeth were rinsed, dried and measured again with DIAGNOdent. Statistical analysis was done using statistical software SPSS 16.0 (SPSS Inc.).

Results: After etching the enamel surfaces for 5, 30 and 60 seconds an average increase of 0,5 (0.62-1.1) was detected. The detected average values of increase of laser fluorescence for the enamel were 0.5 for 5 sec. etthching, 0.62 for 30 sec and 1.1 for 60 sec. The average increase for dentine was 0.26.

Conclusions: Based on the limitations of the conducted study it may be concluded that changes in the degree of mineralization of tooth structures can be detected by using DIAGNOdent. Enamel etching for 5 sec and 30 sec lead to a comparative degree of change in the laser fluorescence. The obtained values after 60 sec. of etching revealed an almost double increase. The measured changes in enamel after etching are better pronounced than that in dentin.

Key words: etching, DIAGNOdent, demineralization, laser fluorescence,

INTRODUCTION:

Nowadays it is widely accepted that tooth surface is in a state of continuous demineralization and remineralization processes [1]. The idea of caries being an irreversable process has changed into the paradigm of being a dynamic process, starting from subclinical demineralization, continuing with early enamel lesions, dentinal involvement and cavitation [2]. According to the phylosophy of minimal intervention dentistry, this process could be treated noninvasively and reversed if diagnosed in an early stage [3].

In the mean time, thanks to the different prophilactic measurements, there was observed a reduction in the incidence caries of appearance, fewer lesions per person and a slower progression of lesions from early enamel to cavited ones [4]. The delay of caries progression could give the dentist enough time for nonivasive treatment if the process is diagnosed early enough. That is why early caries detection is becoming more and more necessary for the dental practice.

New devices for early diagnosis could be very helpful in clinical researches. If those technologies could detect and qualify accurately the development of lesions, they will permit fewer subject and shorter inverals for conducting studies [5].

DIAGNOdent is a 655 nm diode laser, allowing detection of non-cavitated, occlusal pit-and-fissure tooth decay and smooth surface caries in an early stage. It measures laser fluorescence within the mineral structure of the tooth. At the specific wavelength that DIAGNOdent laser operates, healthy tooth structure exhibits little or no fluorescence, resulting in very low scale readings on the display. However, decayed tooth tissue exhibits fluorescence, proportional to the degree of lost tooth structure, resulting in elevated scale readings on the display of the DIAGNOdent. Values varying from 10 to 15 require no active care or treatment. Values from 15 to 30 require preventative or operative care, depending on the patient's caries risk. Values of 30 or more require operative and preventative care.

The **aim** of the presented in vitro study was to evaluate the effectiveness of this device in measuring changes in the level of mineralization of intact enamel surfaces etched for different time intervals and intact dentin etched for 30 sec.

MATERIAL AND METHODS

Extracted human teeth were used in this study. They were cleaned to remove all soft and hard tissues prior to testing. DIAGNOdent (Kavo, Biberah, Germany) with probe B was used. The study was done in the following order:

1. DIAGNOcam was calibrated with porcelain standard before starting the measurements and after testing each

6 specimens.

2. The values on intact enamel and dentinal surfaces were measured.

3. The samples were treated with 37% H_2PO_3 etchant as follows:

a. 24 enamel surfaces were etched for 5 sec.

b. 45 enamel surfaces were etched for 30 sec.

c. 49 enamel surfaces were etched for 60 sec.

d. 27 dentinal surfaces were etched for 30 sec.

4. Teeth were rinsed, dried and measured again with DIAGNOdent.

5. Statistical analysis was done using statistical software SPSS 16.0 (SPSS Inc.).

RESULTS:

The results obtained from the study are presented on tables 1 and 2.

Table 1. Changes in laser fluorescent measurements detected for enamel

Etching time (sec)	Number of surfaces	An average increase	Numb. of surf. with increased values	Numb.of surf. with no changes	Numb.of surf. with decreased values
5	24	+12/0,5	11/45,8%	4/16,7%	9/37,5%
30	45	+28/0,62	21/46,7%	13/28,9%	12/26,7%
60	49	+54/1,1	23/46,9%	21/42,9%	5/10,2%

Table 2: Changes in laser fluorescent measurements detected for dentin

Etching time (sec)	Number of surfaces	An average increase	Numb. of surf. with increased values	Numb.of surf. with no changes	Numb.of surf. with decreased values
30	27	7/0,26	10/37,1%	11/40,7%	6/22,2%

After etching the enamel surfaces for 5, 30 and 60 seconds an average increase of 0,5 (0.62-1.1) was detected. Increased values were measured in 46% of the samples. There was observed an average increase of 0,5 after etching the enamel surfaces for 5 sec. (11 surfaces had increased values, 4 had no changes and 9 had decreased values). The average increases of laser fluorescence in the group with 30 sec. long etching was 0,62 (21 surfaces had increased values, 13 surfaces - no changes and 12 surfaces had decreased values). For the samples with 60 sec. long etching an average increase of 1,1 was measured (23 surfaces were with increased values, 21 with no changes, and only 5 surfaces were with decreased values).

The average increase of laser fluorescence readings after etching intact dentin of 27 teeth was 0,26. 37% of the etched surfaces had increased values.

The changes after etching enamel were better pronounced compared to that in dentin.

DISCUSSION

The application of more sensitive methods for caries diagnostic could improve dental care and treatment of patients. Caries detection methods based on changes in optical properties between healthy and carious tissues are gaining popularity. These methods are based on the fact that the affected by caries region has structural changes, that affect optical behavior and can be detected and qualified (6).

There are two main theories concerning the working mechanism of DIAGNOcam. According to the first one when the infrared light reaches porosity in tooth structures due to demineralization, a fluorescent light of different wavelength is stimulated. The second theory states that some bacterial metabolites as porphyrines (proto-porphyrine, meso-porphyrine, proporphyrin) give redfluorescence of carious tooth structures [5, 7]. Detected changes in laser fluorescence values in the presented study are due to changes in tooth porosity, because no cariogenic bacteria were present.

The DIAGNOdent values increased after demineralization. The longer the demineralization period was the greater the increase. This data is in agreement with the data obtained from the studies of Bahraloloomi et al, Mendes et al, Diniz et al [7, 8, 9]. De Benedetto et al claimed in their study that prolonged drying lead to increase of the changes in changes measured in laser fluorescence (10).

It is interesting to note that while most studies agree that DIAGNOdent could be used as a mean for measuring demineralization, data concerning its use as tool for measuring remineralization is controversial. Some authors state that it is useful [7, 9] others don't [8, 11]. This could be due to the use different remineralyzing solutions, different maintenance solutions, type and conditions of the conducted study.

CONCLUSIONS

Based on the limitations of the conducted study it may be concluded:

1. Changes in the degree of mineralization of tooth structures can be detected by using DIAGNOdent.

2. Enamel etching for 5 sec and for 30 sec lead to a

comparative degree of change in the laser fluorescence.

3. The obtained values after 60 sec. of etching revealed an almost double increase.

4. The measured changes in enamel after etching are better pronounced than that in dentin.

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