



CHANGES IN VALUES MEASURED WITH DIAGNOdent FOR ENAMEL AND DENTIN OF DECIDUOUS TEETH ETCHED FOR DIFFERENT TIME INTERVALS

Vladimir E. Panov¹, Dobrinka M. Damyanova²

1) Department of Conservative dentistry and Oral pathology,

2) Department of Pediatric Dental Medicine,

Faculty of Dental medicine, Medical University Varna, Bulgaria

SUMMARY:

Introduction: Dental caries continues to affect a large percentage of children and currently advises that if diagnosed at an early stage can be reversed with minimally invasive treatments. There a large number of methods for early diagnostics.

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

Material and methods: The study was performed on extracted children teeth. DIAGNOdent was used to measure the values of laser fluorescence of intact enamel and dentinal surfaces. Samples were treated with 37% H₂PO₃ etched for 5 sec., 30 sec. and 60 sec. for enamel surfaces and 30 sec. for dentinal. Teeth were rinsed, dried and measured again with DIAGNOdent.

Results: After etching the enamel surfaces for 5 sec., 30 sec. and 60 sec. an average increase of 1.55 (0.85-2.2) was detected. The detected average values of increase of laser fluorescence for the enamel were 0.85 for 5 sec. etching; 1.6 for 30 sec. and 2.2 for 60 sec. The average increase in the dentine was 3.5.

Conclusions: Based on the limitations of the conducted study it may be concluded that the changes in the degree of mineralization of deciduous tooth structures can be detected by DIAGNOdent. Enamel etching for 5 sec., 30 sec. and 60 sec. lead to a comparative degree of change in the laser fluorescence. The obtained values after 30 sec. of etching revealed almost a double increase compared to 5 sec. etching and 3-fold for those at the 60 sec. The measured changes after etching in the dentin were better expressed than those in the enamel.

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

INTRODUCTION:

Recently there has been a paradigm shift from Black's "extension for prevention" to a minimal intervention approach. The most important aspect in diagnosis of earliest stages of enamel demineralization involves accurate

and reliable detection of such lesions. The newer diagnostic tools would enable the dentist to detect and diagnose early enamel lesions and direct appropriate preventive measures to promote remineralization and conservation of the tooth substance [1]. The dental profession currently is facing the enormous task of caries process consequences management, which should be reconsidered "surgical" care [2].

In the meantime, due to the different prophylactic measurements, a reduction in the incidence caries appearance, fewer lesions per person and a slower progression of lesions from early enamel to cavitated ones were observed [3]. The delay of caries progression could give the dentist enough time for non-invasive treatment if the process is diagnosed early enough. That is why early caries detection is becoming more and more essential for the dental practice.

New devices for early diagnosis could be very helpful and useful for the clinical practice. If those technologies could detect and qualify accurately the development of lesions, they could permit fewer subjects and shorter intervals for conducting studies [4]. It has been already shown that changes in the degree of mineralization of the tooth structures can be detected by DIAGNOdent [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 DIAGNOdent in measuring changes in deciduous teeth by the level of mineralization of intact enamel surfaces etched for different time intervals and intact dentin etched for 30 sec.

MATERIAL AND METHODS:

All tested teeth were deciduous and have been fallen by physiological change. All had complete resorption of the root; few were with open pulp chamber. Teeth were cleaned to remove all soft and hard tissues prior testing. DIAGNOdent (Kavo, Biberach, Germany) with probe B was used. The study was done in following order:

1. DIAGNOdent was calibrated with porcelain stand-ard before starting the measurements and after testing each 6 specimens.
2. The values on intact enamel and dentinal surfaces were measured.
3. Samples were treated with 37% H₂PO₃ etchant as follows:
 - a. 20 enamel surfaces were etched for 5 sec.
 - b. 20 enamel surfaces were etched for 30 sec.
 - c. 20 enamel surfaces were etched for 60 sec.
 - d. 20 dentinal surfaces were etched for 30 sec.
4. Teeth were rinsed, dried and measured again with DIAGNOdent.

RESULTS:

The obtained results are presented on Tables 1 and 2. After etching the enamel surfaces for 5, 30 and 60 seconds an average increase of 1.55 (0.85-2.2) was detected. Increased values were detected in 75% of the samples. An average increase of 0.85 after etching the enamel surfaces for 5 sec. was observed (13surfaces increased and 7 had no change). The average increase of laser fluorescence in the group with 30 sec. long etching was 1.6 (16 surfaces was with increased values detected and 4 surfaces had no change). Samples with 60 sec. long etching had an average increase of 2.2 (16 surfaces were with increased values and 4 with no change).

The average increase of laser fluorescence readings after etching intact dentin of 20 teeth was 3.5. 80% of the etched surfaces had increased values.

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

Table 1. Changes in laser fluorescent measurement detected for enamel

Etching time (sec)	Number of surfaces	An average increase	Numb. of surfaces with increased values	Numb. of surfaces with no changes	Numb. of surfaces 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 measurement detected for dentin

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

DISCUSSION:

A conservative, non-invasive or minimally invasive approach to clinical management of dental caries requires diagnostic techniques capable to detect and quantify lesions at early stage, when progression can be arrested or reversed. Objective evidence of initiation of the disease can be detected as distinct changes in the optical properties of the affected tooth structure. Caries detection methods based on changes in a specific optical property are collectively referred to optically based methods [6].

There are two main theories concerning the mechanism of detection of DIAGNOdent. One is stating 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, mesoporphyrine) give redfluorescence of carious teeth [5, 7]. We could speculate that the detected changes in laser fluorescence values shown in the present study are due to changes in tooth porosity, as cariogenic bacterial infection was previously excluded.

The DIAGNOdent values increased after demineralization. The longer the demineralization period was, the greater was the increase. The received data are in accordance with the results from the studies of Bahraloomi et al., Mendes et al., Diniz et al., Moriyama et al., [7, 8, 9, 10]. Moreover, De Benedetto et al. claimed that prolonged drying could lead to an increase in the changes measured after laser fluorescence [11].

It is interesting to note that even most studies agree that DIAGNOdent could be used as a technique for demineralization measurement; data concerning its use for remineralization detection are controversial. Some authors state that it is a useful technique [7, 9, 10], others don't [8, 12]. This could be due to the use of different remineralizing and 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 DIAGNOdent.
2. Enamel etching for 5 sec., 30 sec. and 60 sec. lead to a comparative degree of change in the laser fluorescence.

3. The obtained values after 30 sec. of etching revealed almost a double increase compared to 5 sec. and 3 times after 60 sec.
4. The measured changes in dentin after etching are better pronounced than those in the enamel.
5. Any decrease was observed after etching enamel.

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Address for correspondence:

Assoc. Prof. Dr Vladimir Emanuilov Panov,
Department of Conservative dentistry and Oral pathology, Faculty of Dental medicine, Medical University - Varna
84, Tzar Osvoboditel Blvd., 9000 Varna, Bulgaria
E-mail: vl_panov@abv.bg,