

STUDY REGARDING RELATION BETWEEN LASERFLUORESCENCE VALUES AND DEPTH OF EARLY OCCLUSAL DENTAL CARIES

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ABSTRACT

Aim of the study The aim of study was to determine the relation between laserfluorescence values scale and depth of early occlusal dental caries. **Material and methods** The in vivo study was performed on a study group of 65 patients and 78 molars with early occlusal dental caries. The selected occlusal surfaces were examined using ICDAS system (clinical exam) and laserfluorescence method (Diagnodent, KAVO) by a single examiner with an experience of two years in the use of ICDAS system and Diagnodent. The depth of demineralisation was recorded with periodontal probe after minimal invasive intervention with bur 330. The categories of early occlusal carious lesions were classified accordingly to Downer indices. **Results** Enamel occlusal early caries are found in high percentages for ICDAS codes 02 (69%) and Diagnodent values scale 20-24 (76%). Occlusal early caries extended in dentine are found in high percentages for ICDAS codes 03 (80%), 04 (100%) and Diagnodent values scales 25-29 (80%), 35-99 (100%). **Conclusions** Significant statistical differences were found between different laserfluorescence values range (20-24, 25-29, 30-34, 35-99) related to correlation with demineralization depth.

Keywords: early occlusal dental caries, ICDAS, laserfluorescence method, depth

INTRODUCTION

Studies have shown that most of detection of early occlusal dental caries is performed with visual-tactile examination and radiographic examen. Both methods are inadequate because of a particular feature of hidden caries: dentine demineralization progress beneath a clinically intact enamel surface [1]. New diagnostic methods related to early carious lesions stimulate the shift from traditional management of dental caries to the introduction of preventive and minimal

invasive treatment [2]. The laserfluorescence method has many advantages as follows: high level of patient acceptance and satisfaction, high accuracy in early caries detection, allows monitoring of caries progression. DIAGNOdent (KaVo) emits laser radiation with wavelength 655nm that provoke the fluorescence of demineralized enamel and dentine as well as the bacteria porphyrins [3]. Nowadays there is no general consensus regarding the assessment of non-cavitated or incipient cavitary carious lesions depth

related to ICDAS codes and laserfluorescence scale values.

AIM OF THE STUDY

The aim of study was to determine the relation between laserfluorescence values scale and depth of early occlusal dental caries.

MATERIAL AND METHODS

The in vivo study was performed on 65 patients with high cariogenic risk. A number of 78 molars with occlusal early dental caries were investigated by a single trained and calibrated operator (PhD Student) with two years experience in the use of ICDAS system and laserfluorescence method. The study has been approved by the ethics committee and the patients have given their informed consent. The inclusion criteria were as follows: the presence of colour changes, the presence of enamel breakdown, the absence of occlusal direct restoration or sealing, the absence of fluorosis or hypoplasia, the absence of open carious lesions. The clinical examen of the selected occlusal surfaces was performed using ICDAS system (table 1). ICDAS code 2 signifies the presence of either deep enamel or superficial dentine caries extension, while ICDAS code 3 represents an established dental lesion [4]. The same

occlusal surfaces were examined using laserfluorescence method (Diagnodent, KaVo, Germany). The laserfluorescence method was performed with device DIAGNOdent (KaVo, Germany), accordingly to producer indications. The examination was performed with probe A, after calibration on healthy enamel and a ceramic surface. The tips of DIAGNOdent probe was applied over examined occlusal surface and rotated around vertical axis. The peak laserfluorescence value was recorded from three measurements. Intra-examiner reproducibility was assessed using Cohen's kappa coefficient accordingly to the results obtained by second measurements after 7 days. The validation was performed in vivo, accordingly to Downer indices, after minimal operative intervention with bur 330 and use of dental probe (Table 1). For statistical analysis, carious lesions limited to enamel were noted with E, because of the impossibility to delimitate accurately in vivo the indices D1 and D2. Carious lesions limited to dentine external half were noted with D3 and carious lesions extended in dentine internal half with D4.

The statistical analysis was performed using Wilcoxon test performed with SPSS 16 software. The results were presented in tables and graphs performed in Excel.

Table 1. ICDAS system (01-04). Downer indices

Visual method (ICDAS)	Downer indices
Healthy dental surface. There is no enamel colour changes after drying.	D0. Absent enamel demineralization.
ICDAS 01. First visual change of enamel (brown or white) visible after air drying.	D1. External half enamel demineralization.
ICDAS 02. Distinct visual change of enamel (brown or white) visible without air drying.	D2. Internal half enamel demineralization.
ICDAS 03. Localised enamel breakdown.	D3. External half dentine demineralization.
ICDAS 04. Underlying dentine shadow associated or not with microcavity.	D4. Internal half dentine demineralization.

RESULTS

Clinical aspects of occlusal carious lesions



Figure 1a. Early occlusal carious lesion (2.7). Code ICDAS 03.



Figure 2a. Early occlusal carious lesion (2.7). Dentinal demineralisation depth (D4).



Figure 2a. Early occlusal carious lesion (3.7). Dentinal demineralisation depth (D3).

The intra-examiner reproducibility, regarding the detection of occlusal early carious lesions, was moderate ($k= 0.65$) for visual method and excellent ($k=0.85$) for laserfluorescence method.

and laserfluorescence values are presented in figures 1.a-b., 2.a-b.



Figure 1b. Laserfluorescence exam



Figure 2a. Early occlusal carious lesion (3.7). Code ICDAS 04.



Figure 2b. Peak laserfluorescence value.

The distribution of Diagnodent values scale was expressed in relation with Downer indices (table 1, fig.3). Two occlusal dental surfaces with dentinal demineralization visible on radiographic image and

Diagnodent values under 20 were opened with bur 330. Values scale 20-24 was associated with 76% enamel demineralization (E) and 24% dentine demineralization (D3). Values scale 25-29 was associated with 20% enamel demineralization (E) and 80% dentine demineralization. Values scale 30-34 was

associated with 66% external half dentine demineralization (D3) and 33% internal half dentine demineralization (D4). Values scale over 35-99 was associated with 79% external half dentine demineralization (D3) and 21% internal half dentine demineralization (D4).

Table 1. Distribution of Diagnodent values scale related to Downer indices

Downer	<20	20-24	25-29	30-34	35-99	TOTAL
D0	0	0	0	0	0	0
E	0	16	4	0	0	20
D3	2	5	15	8	19	49
D4	0	0	0	4	5	9
TOTAL	2	21	19	12	24	78

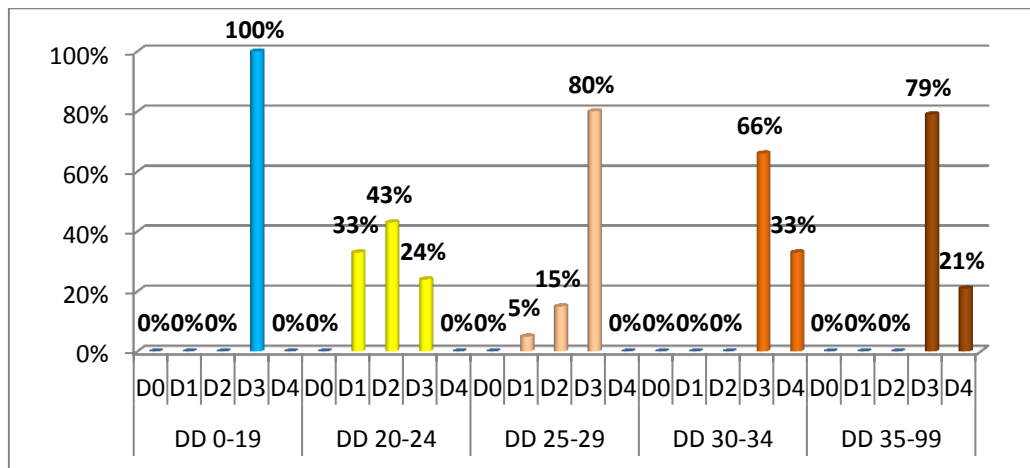


Figure 3. Distribution of Diagnodent values scale related to Downer indices

The statistical analysis tested the null hypothesis: There is no significant statistical differences between diverse laserfluorescence values range related to the correlation with demineralization depth. The results of Mann-Whitney test are presented in tables 2-7.

The statistical analysis shows significant statistical differences, related to correlation with demineralization depth, between laserfluorescence values ranges 20-24 and 35-99, 25-29 and 30-34, 25-29 and 35-99, 30-34 and 35-99 (p= 0.0001, p<0.05) (Tables 2-7).

Table 2. Mann-Whitney test. Statistical analysis between values range 20-24 and 25-29

Test Statistics ^p	
	Depth
Mann-Whitney U	.000
Wilcoxon W	231.000
Z	-5.280
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000 ^a

a. Not corrected for ties.

b. Grouping Variable: DD

Table 3. Mann-Whitney test. Statistical analysis between values range 20-24 and 30-34

Test Statistics^b

	Depth
Mann-Whitney U	.000
Wilcoxon W	231.000
Z	-4.755
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000 ^a

a. Not corrected for ties.

b. Grouping Variable: DD

Table 4. Mann-Whitney test. Statistical analysis between values range 20-24 and 35-99

Test Statistics^a

	Depth
Mann-Whitney U	.000
Wilcoxon W	231.000
Z	-5.566
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: DD

Table 5. Mann-Whitney test. Statistical analysis between values range 25-29 and 30-34

Test Statistics^b

	Depth
Mann-Whitney U	.000
Wilcoxon W	153.000
Z	-4.553
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000 ^a

a. Not corrected for ties.

b. Grouping Variable: DD

Table 6. Mann-Whitney test. Statistical analysis between values range 25-29 and 35-99

Test Statistics^b

	Depth
Mann-Whitney U	.000

Wilcoxon W	153.000
Z	-5.255
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000 ^a

a. Not corrected for ties.

b. Grouping Variable: DD

Table 7. Mann-Whitney test. Statistical analysis between values range 30-34 and 35-99

Test Statistics^b

	Depth
Mann-Whitney U	.000
Wilcoxon W	78.000
Z	-4.721
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000 ^a

a. Not corrected for ties.

b. Grouping Variable: DD

DISCUSSIONS

Hidden occlusal caries were defined as dentinal caries lesions near the occlusal surface of the tooth, visible on a radiograph, where in visual examination the occlusal enamel is seen intact or minimally perforated [5]. One third of patients and 11% of unrestored occlusal tooth surfaces are affected by early occlusal dental caries [6,7]. Regarding these literature data, our in vivo study focused on the possibility to correlate the values scale of Diagnodent with depth of early occlusal caries. Given to the advantage of in vivo studies that allow a distribution of carious lesions close to that found in real situations, minimal operative interventions were used by Khalife A. et al. (2009), Huth et al. (2008), Astvaldsdottir et al. (2004) [8,9,10]. Khalife MA et al. (2009), using Pearson test in an in vivo study, indicated weak correlation of Diagnodent values with depth of occlusal early carious lesions ($r=0.47$) [8]. Huth KC et al. (2006) correlated the Downer indices (D0-D4) with

laserfluorescence values and found $r=0.57$ as value of Spearman coefficient (moderate correlation) [9]. Astvaldsdottir A. et al. (2004) opened the occlusal fissures with signs of early occlusal caries and found the distribution of decay depth as follows: 24% enamel caries, 43% incipient dentinal caries (D3), 33% advanced dentinal caries (D4). Spearman correlation coefficients between laserfluorescence results and histological depth were 0.45-0.51 (weak agreement) [10]. Goel A et al. (2010), performing in vitro study of laserfluorescence performance, determine the distribution of histological score as follows: 27% dentinal carious lesions for values scale 5-24, 54% dentinal caries for values scale 25-35, 82% dentinal caries for values scale 36-99 [11]. Rodrigues JA et al. (2008) correlated the laserfluorescence results with histological indices and found the level of correlation $r=0.53$ (moderate agreement) [12]. Bamzahim M et al. (2002) correlate the histological indices of occlusal dental caries with Diagnodent measurements indicating $r=0.93$ (excellent agreement). The results of

Diagnodent measurements showed that with increasing lesion depth the values increased gradually when the lesion was confined to enamel, and increased dramatically once a lesion had penetrated the DEJ [13]. Similar results regarding correlation between Diagnodent reading and dentinal demineralization depth were reported by Shi-XQ et al. (2000) [14]. Sridhar N. et al.(2009) concluded that Diagnodent is not able to correlate readings with the amount and the depth of demineralization [15].

CONCLUSIONS

Enamel occlusal early caries are associated with ICDAS codes 02 (69%) and Diagnodent values scale 20-24 (76%). Occlusal early caries extended in dentine are found in high percentages for ICDAS codes 03 (80%), 04 (100%) and Diagnodent values scales 25-29 (80%), 35-99 (100%). Significant statistical differences related to correlation with enamel/dentine demineralization depth were found between different laserfluorescence values ranges (20-24, 25-29, 30-34, 35-99).

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