



COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF DIFFERENT METHODS FOR THE CARIES-DIAGNOSIS OF OCCLUSAL SURFACES OF THE FIRST PERMANENT MOLARS

Nedana Georgieva, Krasimir Hristov, Nataliya Grancharova.
Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University- Sofia, Bulgaria.

ABSTRACT:

Aim: Comparative evaluation of the diagnostics of the occlusal surface between light-induced fluorescence (SoproLife camera) and the accepted international system for the diagnosis of caries ICDAS II.

Materials and methods: 150 first permanent molars were examined in 50 patients in the age group 6-9 years. The results from the studied occlusal surfaces by light fluorescence (SoproLife “day light” and “blue light” 405 nm) and direct visual observation (ICDAS II codes) were compared using a correlation coefficient.

Results: A high identity is reported between the two diagnostic methods - correlation coefficient= 0.97 (using Spearman’s rank correlation).

Conclusion: SoproLife camera eliminates the risk of “overdiagnosis”, it is a comparable and reliable method for the detection of initial occlusal carious lesions. Both methods show identical advantages in terms of their diagnostic effectiveness in initial occlusal carious lesions.

Keywords: initial occlusal caries, first permanent molars, diagnostics, ICDAS II, light fluorescence,

INTRODUCTION:

The occlusal surface of permanent molars is a risk area for the development of carious lesions, especially in the first few years after the eruption of the tooth. The reasons for this are the lower degree of mineralization of the enamel and therefore its lower resistance, the complex morphology of the occlusal surface, which favors the accumulation of dental biofilm, difficulty leaning due to their distal position in the dentition and the dexterity of children, low awareness of parents about the importance of good oral hygiene at this age [1, 2].

Early detection and accurate diagnosis of the depth of occlusal carious lesion are important to establish adequate preventive measures and avoid operative treatment of the tooth. Early detection of these lesions is a challenge due to the anatomical characteristics of the fissure system, which makes direct observation difficult or impossible [1, 3, 4].

The International caries detection and assessment system ICDAS II classified the lesions based on their clinical characteristics. The aim of the system is to offer an accurate diagnosis, prognosis and ability to manage carious lesions at the individual and population levels [3, 4].

The phenomenon of autofluorescence of teeth for the detection of carious lesions was introduced in 1928 [Benedict CH, 1928]. The increased porosity because of subsurface damage of the enamel occupied by water scatters the light and the teeth emit fluorescence to a lesser extent than that of sound tissues. The SoproLife camera is based on the fluorescence method. The system uses two modes - “day light” for observation with white light and “blue light” on the principle of autofluorescence [4, 5].

The aim of the present study was to make a comparative evaluation between the effectiveness of direct visual diagnostics using ICDAS II criteria and the SoproLife camera based on light fluorescence in detecting the initial occlusal caries lesion of permanent molars.

STATISTICAL METHODS:

The statistical program IBM® SPSS® Statistics 18 was used for the statistical processing of the data. The correlation between the two diagnostic methods is introduced by a correlation coefficient. A non-parametric analysis of correlation coefficient was applied using Spearman’s rank correlation. This was done due to the specifics of the available data. A 95% confidence interval ($P < 0.05$) was chosen for the significance level at which the null hypothesis was rejected.

MATERIALS AND METHODS:

The study included 50 patients in the age group of 6-9 years. 150 first permanent molars were examined by light fluorescence (SoproLife “day light” and “blue light” 405nm) and direct visual observation using ICDAS II criteria. First permanent molars were completely erupted or with an entirely exposed occlusal surface, visibly sound and asymptomatic.

Diagnosis of the occlusal surfaces was performed by direct visual observation and with an intraoral camera

SoproLife. The teeth were cleaned before the examination with a rotating brush with a suitable profile, then rinsed with water-air spray, isolated with cotton rolls and dried. Direct visual assessment is performed under the reflector light and mirror.

In the diagnostic process was used a scale with a correlation between ICDAS II codes and the corresponding fluorescence characteristics (in blue fluorescence mode) (Table 1).

Table 1. Correlation between codes and criteria for evaluation of occlusal surfaces in the used diagnostic methods

ICDAS II criteria	SoproLife day-light codes for occlusal caries	SoproLife blue fluorescence codes for occlusal caries
0- Sound	0- Sound, no visible change in the fissure	0- Sound, no visible change in enamel (rarely a graphite-pencil colored thin shine/line can be observed) shiny green fissure
1- First Visual Change in Enamel (seen only after prolonged air drying or restricted to within the confines of a pit or fissure)	1- Center of the fissure showing whitish, slightly yellowish change in enamel, limited to part or all of the pit and fissure system	1- Tiny, thin red shimmer in the pits and fissure system, can come up the slopes, no red dots visible
2- Distinct Visual Change in Enamel	2- Whitish change comes up the slopes (walls) toward the cusps; the change is wider than the confines of the fissure, seen in part or all the pit and fissure system, no enamel breakdown is visible	2- In addition to tiny, thin red shimmer in pits and fissures possibly coming up the slopes darker red or black spots confined to the fissure
3- Localized Enamel Breakdown (without clinical visual signs of dentinal involvement)	3- Fissure enamel is rough and slightly open with beginning slight enamel breakdown; no visual signs of dentinal involvement	3- Dark red or black extended areas confined to the fissures; slight beginning roughness

The clinical examination was performed by two pediatric dentists. Calibration of the team was performed. The results were subjected to statistical analysis to establish the correlation between the two methods.

RESULTS:

The condition of health of the occlusal surface of the examined teeth was diagnosed by the described methods. For 60 teeth diagnosed as “healthy” according to the selected criteria, complete identity between diagnostic methods was reported. Initial occlusal carious lesions (according to ICDAS II) were diagnosed in 90 of the teeth under direct visual inspection and with SoproLife “blue light” (Table 2).

Table 2. Correspondence between the diagnostic criteria of the ICDAS II system and SoproLife “blue light” in teeth diagnosed with initial carious lesions.

		<i>Correspondence</i>	<i>Non-correspondence</i>	Hyperdiagnosis	Underestimated diagnosis	
ICDAS II	n	71	19	Not reported	19	
	%	78.89%	21.11%		21.11%	
SoproLife “blue light”	n	71	19		Not reported	Not reported
	%	78.89%	21.11%			

The results for both diagnostic methods coincided with a high percentage of cases - 78.89%. The initial enamel changes are less perceptible by direct visual observation. In 19 occlusal surfaces with an initial carious lesion, more advanced changes were reported with the intraoral camera SoproLife - "blue light" mode, compared to the direct visual assessment (Table 2).

The spearman rank coefficient was used to determine a correlation between diagnostic methods. The value of the coefficient was 0.97, which shows a high and significant correlation between the used diagnostic methods, supported by statistical significance ($p < 0.05$).

The internationally accepted standard for the diagnosis of caries lesions is the ICDAS II system. Based on this standard and the results obtained after the examination of the teeth, we determined the sensitivity and specificity of the intraoral camera SoproLife in "blue light" mode. There is a complete correlation between the methods in determining a tooth as healthy or affected by a caries lesion. This determines 100% sensitivity and 100% specificity of the intraoral camera SoproLife in blue fluorescence mode, according to the established standard of the ICDAS II system.

DISCUSSION:

The diagnosis of the earliest detectable caries changes on the enamel surface is at the basis of the preventive approach in dentistry and provides an opportunity for a non-operative treatment.

The visual-tactile (with certain conditionality) method is routinely used to detect carious lesions in daily dental practice. The advantages of this method are that it is fast and easy to implement, without the need of expensive additional equipment. The method can be used without additional exposure of the patient to the harmful influence of X-rays or fluorescence [7, 8].

The visual inspection has a number of limitations in the diagnostic process. One of them is that it is based on the subjective assessment of the dentist. Therefore, lesions may remain undetected because teeth are usually examined by direct visual observation and sometimes the observer may lack clinical experience. Studies show that well-trained dentists with good clinical experience are important for accurate diagnosis [8, 9]. The combination of a specialist with clinical experience, a thorough visual inspection under good working light conditions, a well-

cleaned, isolated, and dried tooth, and the rounded-tip probe are prerequisites for obtaining results with high sensitivity and specificity. The observation can be influenced by some factors, such as staining, food deposits, calculus, dental biofilm. The diagnosis of the caries lesion only by direct visual observation is insufficient [6, 7]. Our results in the diagnosis of occlusal surfaces with initial carious lesions also showed this (Table 2).

Other methods are needed in addition to the conventional examination to identify the initial lesions. In order to store the source information for follow up purposes, an additional technique - a camera - must be used during the visual-tactile examination. [9, 10, 11]

There is not much data in the specialized literature that presents results from the use of newer tools for the early diagnosis of enamel carious lesions, such as the SoproLife camera. [8, 11, 12] This method gives the opportunity to detect initial carious lesions, control the caries excavation, and create and record quality images (it has an intraoral camera function). [6, 8, 10] Our results confirmed the possibility of the camera for a more accurate diagnosis of an initial carious lesion (table 2). We also benefited its high-quality images in developing individual motivational programs for our patients. Lots of studies have shown that the use of the SoproLife camera can prevent unnecessary operative treatment of a carious lesion. [8, 11, 12]

Disadvantages of the SoproLife intraoral camera are related to the fact that it is less financially profitable because of the need of additional equipment. Patience is required from the patient, as it is necessary to keep the examined surface dry during the examination. The head of the camera may create discomfort, especially in pediatric patients, due to the need of a certain angulation for detecting exact results. [4, 6, 8] The SoproLife system aims to guide the clinician towards a more preventive, non-operative and minimally invasive approach by tracking the progression of the lesion or its stabilization over time. [8, 12]

CONCLUSION:

The present study evaluates and compares the results reported in the diagnosis of the occlusal surfaces of the first permanent molars, obtained using the intraoral camera SoproLife those of the visual-tactile examination and ICDAS-II codes. A high correlation between diagnostic methods was reported. They can be defined as complementary in the diagnostic process.

REFERENCES:

1. Wang JD, Chen X, Frencken J, Du MQ, Chen Z. Dental caries and first permanent molar pit and fissure morphology in 7- to 8-year-old children in Wuhan, China. *Int J Oral Sci*. 2012 Sep;4(3):157-60. [PubMed]
2. Luczaj-Cepowicz E, Marczuk-Kolada G, Obidzinska M, Sidun J. Diagnostic validity of the use of ICDAS II and DIAGNOdent pen verified by micro-computed tomography for the detection of occlusal caries lesions-an in vitro evaluation. *Lasers Med Sci*. 2019 Oct;34(8):1655-1663. [PubMed]
3. Doméjean S, Rongier J, Muller-Bolla M. Detection of Occlusal Carious Lesion using the SoproLife® Camera: A Systematic Review. *J Contemp Dent Pract*. 2016 Sep 1; 17(9):774-779. [PubMed]
4. Ünal M, Koçkanat A, Güler S, Gültürk E. Diagnostic Performance of Different Methods in Detecting Incipient Non-Cavitated Occlusal Caries Lesions in Permanent Teeth. *J Clin Pediatr Dent*. 2019; 43(3):173-179.

[PubMed]

5. Peycheva K, Boteva E. A comparison of different methods for fissure caries detection. *Acta Med Bulg.* 2016 Mar;43(1):30-38. [Crossref]

6. Kockanat A, Unal M. In vivo and in vitro comparison of ICDAS II, DIAGNodent pen, CarieScan PRO and SoproLife camera for occlusal caries detection in primary molar teeth. *Eur J Paediatr Dent.* 2017 Jun;18(2):99-104. [PubMed]

7. Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, et al. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. *Community Dent Oral Epidemiol.* 2007

Jun;35(3):170-8. [PubMed]

8. Zeitouny M, Feghali M, Nasr A, Abou-Samra P, Saleh N, Bourgeois D, et al. SOPROLIFE system: an accurate diagnostic enhancer. *Scientific World Journal.* 2014; 2014:924741. [PubMed]

9. Banting D, Amaechi B, Bader J, Blanchard P, Gilbert Gr, Gullion Ch, Examiner training and reliability in two randomized clinical trials of adult dental caries. *J Public Health Dent.* 2011 Fall;71(4):335-44. [PubMed]

10. Gugnani N, Pandit Ik, Srivastava N, Gupta M, Gugnani Sh, Light induced fluorescence evaluation: A novel concept for caries diag-

nosis and excavation. *J Conserv Dent.* 2011 Oct;14(4):418-22. [PubMed]

11. Jablonski-Momeni A, Busche J, Struwe Ch, Lange J, Heinzl-Gutenbrunner M, Frankenberger R, et al. Use of the international caries detection and assessment system two-digit coding method by predoctoral dental students at Philipps University of Marburg, Germany. *J Dent Educ.* 2012 Dec;76(12):1657-66. [PubMed]

12. Zandona A, Santiago E, Eckert G, Fontana M, Ando M, Zero D, Use of ICDAS combined with quantitative light-induced fluorescence as a caries detection method. *Caries Res.* 2010; 44(3):317-22. [PubMed]

Please cite this article as: Georgieva N, Hristov K, Grancharova N. Comparative evaluation of the effectiveness of different methods for the caries-diagnosis of occlusal surfaces of the first permanent molars. *J of IMAB.* 2022 Oct-Dec;28(4):4724-4727. DOI: <https://doi.org/10.5272/jimab.2022284.4724>

Received: 18/04/2022; Published online: 08/12/2022



Address for correspondence:

Dr. Nedana Georgieva
Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University - Sofia;
1, Georgi Sofiisky str., Sofia, Bulgaria.
E-mail: nedana.georgieva@gmail.com,