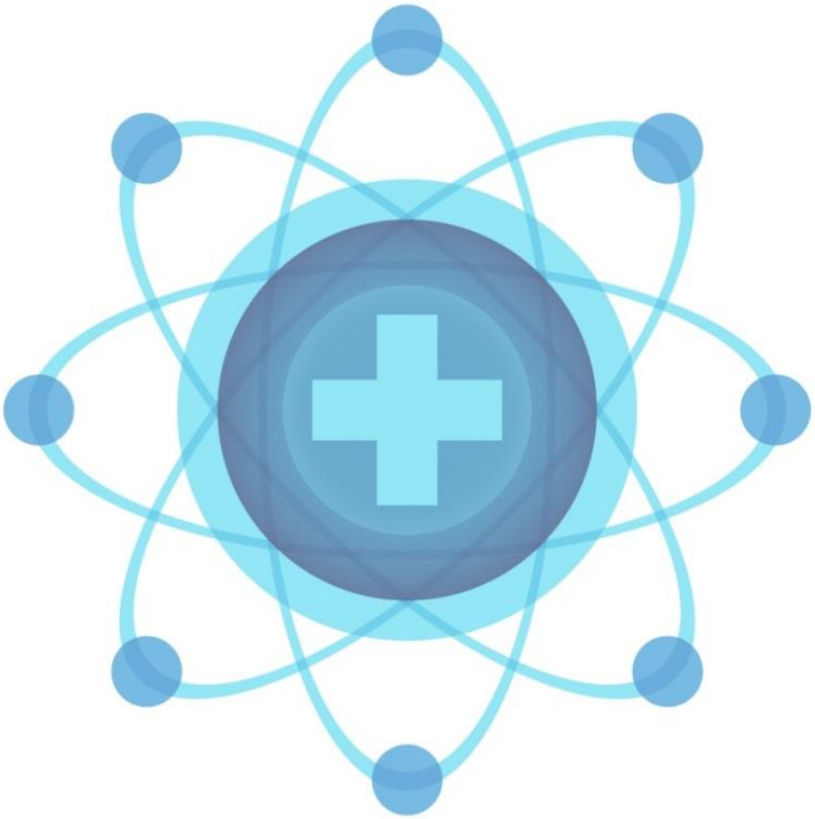

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Clinical comparative analysis of ICDAS-2 (International Caries Detection and Assessment System-2) and QS-occlusal- quantitative light fluorescence assessment systems

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Objective: Clinical comparative analysis between ICDAS-2 (International Caries Detection and Assessment System) and QS-occlusal- quantitative light fluorescence assessment systems was performed. **Material and methods:** 389 teeth and 1167 fissures were examined in 60 patients aged 15-35, suitable for this study. **Results:** Quantitative light fluorescence (QLF) technology enabled caries diagnosis on the occlusal surface of posterior teeth at an earlier stage (by 14.3%) than the ICDAS 2 caries detection and assessment system. The QS-occlusal assessment system proved to be reliable, easy to use and an explicit criterion for the clinical visual detection and assessment of occlusal caries, which allows evaluation of lesion activity and facilitates evidence-based caries management. **Conclusions:** The development of a single integrated and international caries detection and assessment system will facilitate evidence-based caries management.

Keywords: caries, detection, occlusal surface of teeth, quantitative light fluorescence.

Dentistry has been studying dental caries for over 100 years, so the lack of agreement on how to define and measure this condition can be seen as unacceptable. Appeal Dr. Black in 1910 "to a greater seriousness in the study of enamel caries in its connection with the practice of dentistry" was not heard throughout the 20th century [1,2].

We share Dr. Black's opinion that in order to understand dental caries, it is necessary to study its earliest stages. Available data on the validity and reliability of detecting coronary caries using ICDAS-2 show that the system meets the requirements for validity and reliability. However, the lack of clinical criteria for

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determining the caries activity of the tooth surface is a shortcoming of the current ICDAS-2. Efforts are currently underway to evaluate and develop existing clinical systems to assess lesion activity [3,4].

Taking into account the above shortcomings, diagnostic criteria for occlusal caries were developed using QLF technology for possible use in routine dental practice [24,27].

According to the recently proposed QS-occlusal parameter, caries is divided into four stages depending on the standard changes in fluorescence detected using QLF technology. The scoring system proposed in this study is based on an intuitive classification that uses two parameters to evaluate the fluorescence pattern depending on the severity of caries: fluorescence loss and red fluorescence [5,11].

H.Y. Ko et al. showed that the QLF technology for detecting the initial stages of dental caries in vitro has a higher level of reliability than radiographic examination [7,28]. However, clinical studies are required in which caries lesions are assessed using red fluorescence as a parameter for detecting and assessing the severity of occlusal caries [6,8].

We also wanted to evaluate the clinical performance of the QS-occlusal scoring system, which standardizes the QLF properties of occlusion lesions, with the existing ICDAS-2 clinical examination based on a simple visual assessment.

Material and methods

Study design. Data for this clinical study were collected at the Tashkent State Dental Institute in accordance with the recommendations for strengthening reporting on observational studies in epidemiology (STROBE) [9].

Selection of the study group. All patients were explained the objectives and procedures of the clinical trial. The study included individuals who subsequently gave written consent to participate and were in good general health. 305 patients aged 15-35 years were examined. Patients with systemic diseases, those receiving orthodontic treatment, suffering from temporomandibular joint disorder, severe periodontitis, mucosal bleeding symptoms, and pregnant women were not included

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in the study. Restored teeth that had a sealant or filling on the occlusal surface, teeth with hypoplasia or fluorosis, and other characteristics that could affect the results of the study were also excluded based on visual examination. As a result, 60 patients remained with 1 or more visually detected occlusal caries.

Clinical examination. For examination, the occlusal surface of the selected molars was cleaned with a low-speed contra-angle brush and then rinsed with water and, if necessary, dried with a stream of air. To assess the state of caries, the occlusal surface of each molar was conditionally divided into three sections: distal, central, mesial. The distal section included the distal fossa, the central section included the central fossa, and the mesial section included the mesial fossa. Each section was scored separately according to standard protocols of the International Caries Detection and Evaluation System ICDAS-2 [10,21] Prior to evaluation the QLF (QS-occlusal) scoring system, all artificial and natural lighting in the room was turned off. The evaluation was carried out only under illumination from the Qray View device using special glasses [13,24]. All data were entered into the appropriate form of the medical history. A comparative analysis was then carried out between the results of different caries detection and evaluation systems [17,25].

Research results

Of the 60 patients included in the study, 34 were females (mean age 21.3±5.2 years), 26 were males (mean age 20.8±5.7 years). A total of 1167 fissures were examined (651 in females, 516 in males) and 389 permanent molars (217 and 172, respectively) of the upper and lower jaws suitable for this study. Of the 389 permanent molars, 128 were first molars, 177 were second molars, and 84 were third molars.

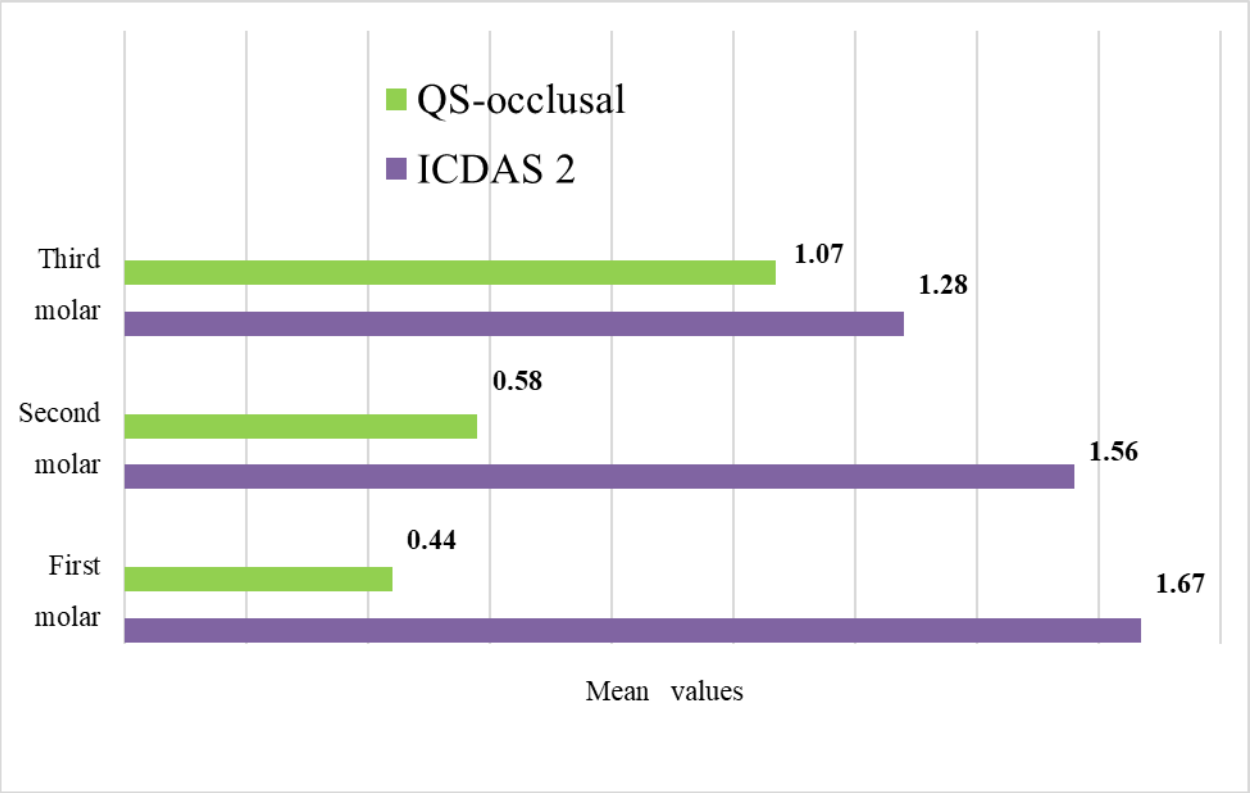

Fig. 1. Mean values of the obtained results of the ICDAS-2 and QS-occlusal scoring systems between groups of molar teeth.

On fig. 1 it can be seen that the results of assessing the state of caries differ significantly, if we take into account the activity of the carious process. The average score of ICDAS-2 indicators on the occlusal surface of the first molars was 1.67 ± 1.09, the second molars - 1.56 ± 1.24, the third - 1.28 ± 0.94.

The QS-occlusal indices on the occlusal surface of the third molars were 1.07±0.75, those of the second molars 0.58±0.73 and first molars 0.44±0.55.

These differences are due to the fact that the detected carious processes according to the ICDAS-2 scoring system in many cases turned out to be suspended by carious processes according to the QS-occlusal scoring system.

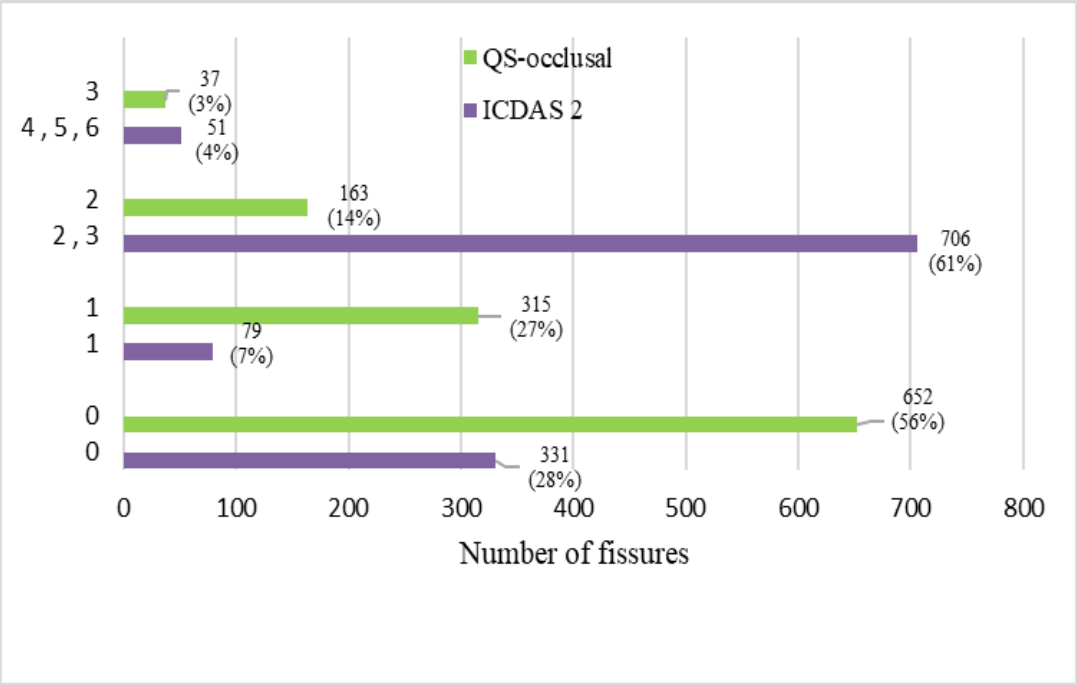

Fig. 2. Difference in ICDAS-2 (purple) and QS-occlusal (green) codes.

As shown in Figure 2, using quantitative fluorescence, sound tooth (code 0) 652 fissures (56%) and reversible caries (code 1) 315 fissures (27%) are much higher, while the ICDAS-2 scoring system these the figures were 331 fissures (28%) and 79 fissures (7%). Enamel caries (code 2) 163 fissures (14%) and dentine caries (code 3) 37 fissures (3%) are significantly lower, while according to the ICDAS-2 scoring system these indicators were 706 fissures (61%) and 51 fissure (4%). This indicates that when evaluating carious lesions using traditional methods, there is a high probability of “overestimating” the degree of the carious process.

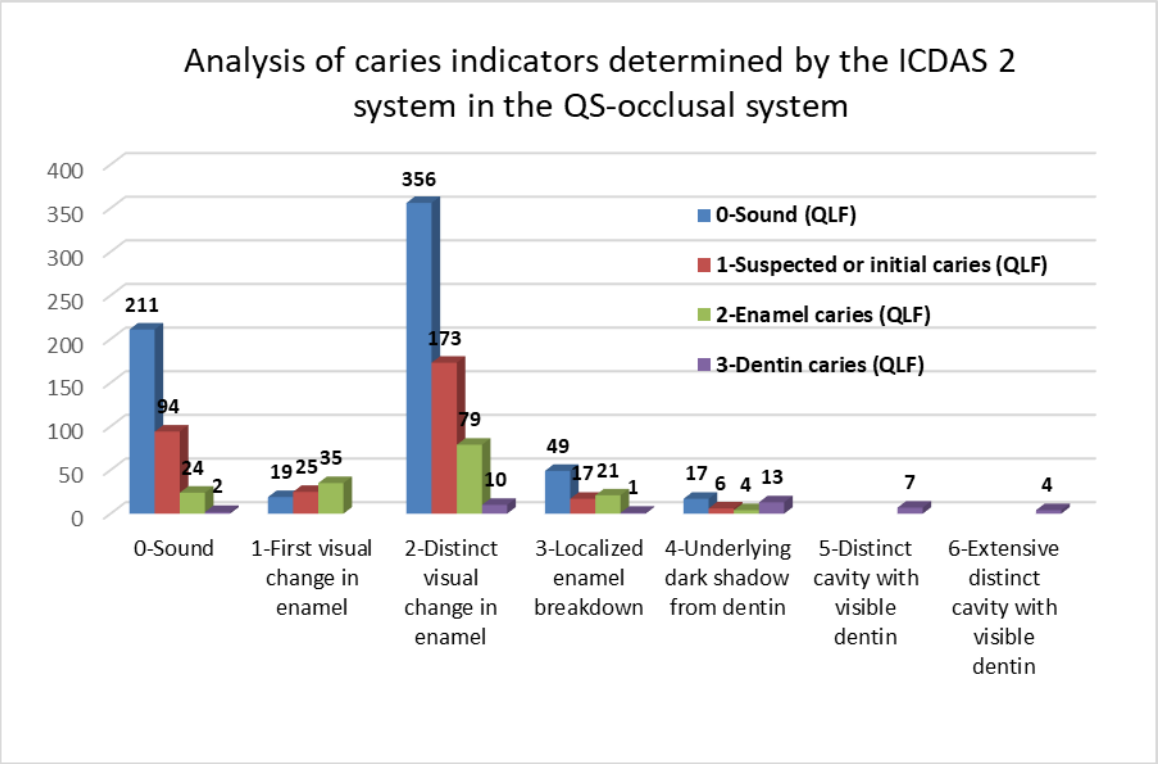

Fig 3. Quantitative results of the ICDAS-2 and QS occlusal scoring systems

Discussion

Data from previous studies indicate that the ICDAS-2 scoring system has discriminatory validity and reliability in assessing overall severity. In addition, even when used by researchers with no experience in epidemiological dental surveys, ICDAS-2 shows good to excellent reliability [16,27]. The safety factors presented in previous studies are in the range of kappa coefficients, and in some cases higher than the safety factors indicated for the systems of three criteria (3–5) that formed the basis of the ICDAS-2 system [18].

However, according to the current ICDAS-2 criteria, active and inactive carious lesions are not yet differentiated [20,26].

Our distribution-by-value comparison showed that the use of QS-occlusal simplified the ICDAS-2 diagnostic criteria and allowed for an objective classification of lesion severity. There were significant differences between QS-occlusal lesion outcomes and between ICDAS-2 codes. Recently proposed criteria can more objectively differentiate between lesions by using changes in the

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fluorescent properties of the teeth as diagnostic criteria [15,23]. Changes in the properties of red fluorescence depending on the severity of the lesion were similar to previous retrospective studies, in which it was found that the intensity and area of red fluorescence increased with increasing lesion activity compared to the initial value of red fluorescence [9,22]. Red fluorescence is produced by bacterial metabolites such as porphyrin and increases with cariogenicity [13]. The relationship between carious lesions and red fluorescence can be explained as follows: as the depth of the carious lesion increases, the pore of the lesion expands and deepens, allowing bacteria to penetrate deeper into the pore, which increases metabolic activity according to the bacterial composition. Greater pathogenicity and anaerobicity), and thus the intensity and spectrum of red fluorescence increase [14,25].

However, we argue that the proposed QS-occlusal system for superficial lesions may have several advantages over the ICDAS-2 system and traditional methods because it combines detection with assessment of lesion activity.

We hope that collaboration with developers of other criteria systems that evaluate lesion activity and treatment needs will allow the development of a single integrated and international system [26,28] for caries detection and evaluation that can facilitate evidence-based caries management as well as clinical research and future systematic research in this area.

Conclusions

1. Quantitative light fluorescence (QLF) technologies made it possible to diagnose caries of the occlusal surface of molar teeth at earlier stages (by 14.3%) than during visual examinations.

2. International Caries Detection and Assessment System ICDAS 2 (International Caries Detection and Assessment System) made it possible to correctly assess caries status in 30.8% of cases. Moreover, the scoring system lacks validated definitions of caries activity, which currently limits its use in clinical practice, and the reliability of detecting caries on certain surfaces, such as the occlusal surface of a tooth.

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3. The QLF QS-occlusal scoring system is easy to use, and has well-defined criteria for clinical visual detection and assessment of occlusal caries that allow assessment of lesion activity and facilitate evidence-based caries management.

References

1. Bueno A.C., Moreira A.N. Validation of DIAGNOdent laser fluorescence and the International Caries Detection and Assessment System (ICDAS) in diagnosis of occlusal caries in permanent teeth: an in vivo study // Europ. J. Oral Sci. – 2016. – Vol. 124, №2. – P. 188-194.

2. Drancourt N., Roger-Leroi V., Martignon S., Jablonski-Momeni A. Carious lesion activity assessment in clinical practice: a systematic review // Clin. Oral Invest. – 2019. – Vol. 23, №4. – P. 1513-1524.

3. Ekstrand K.R., Gimenez Th., Ferreira F.R. et al. The International Caries Detection and Assessment System - ICDAS: A Systematic Review // Caries Res. – 2018. – Vol. 52, №5. – P. 406-419.

4. Erol S., Kamak H., Erten H. Evaluation of caries dentin using light-induced fluorescence: A case report // J. Clin. Diag. Res. – 2014. – Vol. 8, №1. – P. 297-298.

5. Ganss C., Glanz A., Glanz T. et al. Red fluorescence of plaque in the dentition- a comparison of Quantitative Light-induced Fluorescence-Digital (**QLF**-D) images and conventional images of disclosed plaque // Photodiag. Photodyn. Ther. – 2020. – Vol. 14. – P. 102063.

6. Jaisingh R., Shanbhog R., Nandlal B., Thippeswamy M. Effect of 10% cerium chloride on artificial caries lesions of human enamel evaluated using quantitative light-induced fluorescence: an in vitro study // Europ. Arch. Paediatr. Dentist. – 2017. – Vol. 18, №3. – P. 163-169.

7. Jung E.H., Lee E.S., Jung H.I. et al. Development of a fluorescence-image scoring system for assessing noncavitated occlusal caries // Photodiag. Photodyn. Ther. – 2018. – Vol. 21. – P. 36-42.

8. Kim B.-R., Kang S.-M. et al. In vitro red fluorescence as an indicator of caries lesion activity // Oper. Dentist. – 2019. – Vol. 44, №4. – C. P. 405-413.

9. Kim H.E., Kim B.I. Early caries detection methods according to the depth of the lesion: An in vitro comparison // Photodiag. Photodyn. Ther. – 2018. – Vol. 23. – P. 176-180.

10. Ko H.Y., Kang S.M., Kim H.E. et al. Validation of quantitative light-induced fluorescence-digital (**QLF**-D) for the detection of approximal caries in vitro // J. Dent. – 2015. – Vol. 43, №5. – P. 568-575.

11. Lee J.B., Choi D.H., Mah Y.J., Pang E.K. Validity assessment of quantitative light-induced fluorescence-digital (QLF-D) for the dental plaque scoring system: a cross-sectional study // BMC Oral Health. – 2018. – Vol. 18, №1. – P. 187.

12. Lee E.S., de Josselin de Jong E., Jung H.I., Kim B.I. Red fluorescence of dental biofilm as an indicator for assessing the efficacy of antimicrobials // J. Biomed. Opt. – 2018. – Vol. 23, №1. – P. 1-6.

13. Lee E.S., de Josselin de Jong E., Kim B.I. Detection of dental plaque and its potential pathogenicity using quantitative light-induced fluorescence // J. Biophoton. – 2019. – Vol. 12, №7. – P. e201800414.

14. Lee H.S., Kim S.K., Park S.W et al. Caries detection and quantification around stained pits and fissures in occlusal tooth surfaces with fluorescence // J. Biomed. Opt. – 2018. – Vol. 23, №9. – P. 1-7.

15. Marczuk-Kolada G,. Luczaj-Cepowicz E., Obidzinska M., Rozycki J. Performance of ICDAS II and fluorescence methods on detection of occlusal caries-An ex vivo study // Photodiag. Photodyn. Ther. – 2020. – Vol. 29. – P. 101609.

16. Marshall-Jones Z.V., Wallis C.V., Allsopp J.M. Assessment of dental plaque coverage by Quantitative Light-induced Fluorescence (**QLF**) in domestic short-haired cats // Res. Vet. Sci. – 2017. – Vol. 111. – P. 99-107.

17. Muller-Bolla M., Pisapia J.C., Velly A.M., Tassery H. Performance of a recent light fluorescence device for detection of occlusal carious lesions in children

10.5281/zenodo.7051068
and adolescents // Europ. Arch. Paediatr. Dentist. – 2017. – Vol. 18, №3. – P. 187-195.

18. Nyvad B. Criteria for Caries Lesion Activity and Severity Assessment: A Validated Approach for Clinical Management and Research // Caries Res. – 2018. – Vol. 52, №5. – P. 397-405.

19. Palmier N.R., Ribeiro A.C.P, Fonsêca J.M. et al. Radiation-related caries assessment through the International Caries Detection and Assessment System and the Post-Radiation Dental Index // Oral Surg. Oral Med. Oral Pathol. Oral Radiol. – 2017. – Vol. 124, №6. – P. 542-547.

20. Park S.W., Kim S.K., Lee H.S. et al. Comparison of fluorescence parameters between three generations of QLF devices for detecting enamel caries in vitro and on smooth surfaces // Photodiag. Photodyn. Ther. – 2019. – Vol. 25. – P. 142-147.

21. Qudeimat M.A., Altarakemah Y., Alomari Q. et al. The impact of ICDAS on occlusal caries treatment recommendations for high caries risk patients: an in vitro study // BMC Oral Health. – 2019. – Vol. 19, №1. – P. 41.

22. Sadasiva K., Kumar K.S., Rayar S. Evaluation of the Efficacy of Visual, Tactile Method, Caries Detector Dye, and Laser Fluorescence in Removal of Dental Caries and Confirmation by Culture and Polymerase Chain Reaction: An In Vivo Study // J. Pharm. Bioallied. Sci. – 2019. – Vol. 11 (Suppl 2). – P. 146-150.

23. Sun P., Chen W., Yi X. et al. Comparative Study on Early Childhood Caries Detection by Using International Caries Detection and Assessment System- and WHO Criteria // Zhonghua Kou Qiang Yi Xue Za Zhi. – 2018. – Vol. 53, №11. – P. 725-729.

24. Tassoker M., Ozcan S., Karabekiroglu S. Occlusal Caries Detection and Diagnosis Using Visual ICDAS Criteria, Laser Fluorescence Measurements, and Near-Infrared Light Transillumination Images // Med. Princ. Pract. – 2020. – Vol. 29, №1. – P. 25-31.

10.5281/zenodo.7051068
25. 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. – Vol. 43, №3. –P. 173-179.

26. Van der Kaaij N.C.W., Faaij M.J., Ten Cate J.M., van der Veen M.H. The reproducibility of assessment of white spot lesions adjacent to orthodontic brackets, with a quantitative light induced fluorescence digital camera at different rotations of teeth – an in vitro study // BMC Oral Health. – 2018. – Vol. 18, №1. – P. 209.

27. Yoon H.I., Yoo M.J., Park E.J.J. Detection of proximal caries using quantitative light-induced fluorescence-digital and laser fluorescence: a comparative study // Adv. Prosthodont. – 2017. – Vol. 9, №6. – P. 432-438.

28. Zandoná A., Ando M., Gomez G.F. Longitudinal Analyses of Early Lesions by Fluorescence: An Observational Study // J. Dent. Res. – 2013. – Vol. 92 (Suppl 7). – P. 84-89.