

EVALUATION OF ICDAS II IMPLEMENTATION IN DENTAL STUDENTS' EDUCATIONAL PROCESS. A 6-YEAR STUDY

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Abstract: The International Caries Detection and Assessment System (ICDAS II) is developed for classifying stages of the caries process and the activity status of lesions using detection codes. The aim of the present paper is to evaluate the efficiency of the learning process for this system by comparing two determinations in term of scoring accuracy made by a group of examiners after a standard training programme. 180 dental students without previous ICDAS II experience participated in this study during 6 years, scoring twice, based on systems criteria, 90 digital images of clinical cases with occlusal caries in different stages of evolution. The results from initial and final determinations were compared with the golden standard generating a scoring accuracy for each code. Based on the results of this study, the ICDAS II system has a fast learning curve and may be a useful tool for dental students in identifying the clinical stages of carious lesions.

INTRODUCTION

The ICDAS criteria were developed by an international team of caries researchers in order to cumulate several caries evaluation systems into one standard system for caries detection and assessment based on dental tissues status.(1)

As stated, ICDAS is a clinical scoring system for use in dental education, clinical practice, research, and epidemiology.

ICDAS was proposed as a tool for examiners with various theoretical and clinical backgrounds and can be used on populations with different carious patterns.

Introduced in 2007 in the curricula for Restorative Dentistry at the Faculty of Dentistry in Bucharest, the ICDAS II is a clinical system for primary or secondary caries assessment based only on visual inspection.(2)

Considerations on ICDAS II criteria

The ICDAS II evidence-based system for the staging of caries represents the foundation on which ICCMS system was built. This system seeks to provide a standardised method for comprehensive caries classification and management.(4)

ICCMS™ system is based on a contemporary understanding of cariology with international agreements on current caries terminology and preventive caries management guidelines.(5-7)

The description of each code for occlusal lesions is the one originally made by the ICDAS committee.(3,8-11)

Code 0 is attributed to surfaces without any carious lesions but with lesions like dental trauma, discolorations or abfractions, attritions, abrasions and erosions.(3)

Code 1 is attributed to dental surfaces that only dried for at least 5 seconds may present a discoloration that might indicate the existence of a carious lesion. The discolorations like white spots or brown lesions are easily visible in these conditions.(3)

Code 2 is attributed to wet dental surfaces that,

without being dried for at least 5 seconds, may present a discoloration that might indicate the existence of a carious lesion. The discolorations like white spots or brown lesions are easily visible in these conditions.(3)

Code 3 is attributed to dental surfaces with small cavitations limited just at the enamel with or without signs of demineralization like white opaque or brown discolorations.(3)

The presence of the cavitation limited to the enamel can be confirmed by using the standard probe.(3)

Code 4 is attributed to wet or dry dental surfaces with abnormal colored shadow (brown, dark brown, black or even grey) from carious dentin which can be observed through normal colored enamel.

The enamel may be intact or with a rather small loss of substance without any detectable dentin in the deepest region of the cavitation.

This code characterizes the caries with the origin usually placed on a different dental surface (for example: an occlusal dark shadow with proximal caries debut origin).(3)

Code 5 is attributed to wet or dry dental surfaces with a well-defined cavitation in normal or demineralised enamel and with carious dentin exposed by the dental caries evolution.

The presence of the cavitation extended in enamel and dentin with tooth destruction limited to under a half of the surface can be confirmed by using the standard probe with a translation move on the region of interest.(12)

Code 6 is attributed to wet or dry dental surfaces with large and well defined cavitation in normal or demineralised enamel and with carious dentin widely exposed by the dental caries evolution.

The presence of the cavitation in enamel and dentin with tooth destruction more than half of the surface can be confirmed by using the standard probe with a translation move on the region of interest.

Sometimes code 6 can be associated with a cuspal loss

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with clinical appearance of a fractured or cracked cusp due to the internal extensive dentin destruction which undermines enamels resistance, resulting a large cavitation with rather smooth and regular margins that affects in a variable way the tooth surfaces.(12)

PURPOSE

The main issues in modern management of the occlusal lesions are related to the possibilities to differentiate between various stages of the non-cavitated and cavitated lesions, to differentiate between active and inactive occlusal lesions and to predict the depth of the lesion prior to the caries instrumentation so that an adequate individualised treatment can be planned.

The aim of the present paper is to evaluate the efficiency of the learning process for this system in dental students training, also identifying the ICDAS codes for occlusal lesions in which most differences occurred between the initial established gold standard and examiners with different background.

MATERIALS AND METHODS

180 dental students without any previous ICDAS II system experience (theoretical or clinical) participated as examiners on volunteering basis in groups 12 of 15 (30 examiners in each year).

The 6-year study investigated students' ability in diagnosing the severity (stage of evolution) of occlusal lesions on posterior teeth using just the ICDAS criteria.

There were used 90 digital images of clinical cases with caries in different stages of evolution on occlusal surfaces belonging to 51 patients with ages from 19 to 38 years.

Each image had an ID code corresponding to patients' treatment chart, in which there was mentioned data regarding the clinical case and data regarding the ICDAS code of the dental lesion presented in the image.

All the cases used in the study were prepared before taking the pictures by applying the steps generally used in the ICDAS examination protocol:

1. the patients were asked to put away any removable appliances;
2. the teeth were cleaned and the plaque was removed from the occlusal surfaces using a toothbrush;
3. a moisture control method was used by placing a cotton wool in buccal vestibules;
4. the excess or frothy saliva was removed;
5. first visual examination was made with the surfaces wet;
6. the surfaces of interest were dried for 5 seconds;
7. the second visual inspection was made on the dry surface.

In order to evaluate the efficiency of the learning process for ICDAS system by establishing the learning curve, the study implied a double testing sessions with standard conditions for examinations.

For each examination, the dental students were asked to evaluate series of 9 images representing clinical cases with caries in different stages of evolution on occlusal surfaces.

During both initial and final examinations the dental students were asked to identify and note down on the clinical chart the ICDAS code that is correct for each image as the code that identifies the existence of a lesion and define the dental lesion better.

Two experienced examiners (senior examiners) that conducted this study trained the dental students who volunteered for this study.

The term "senior examiner" as stated by the ICDAS committee was used to indicate the baseline used for clinical

comparison for the initial and final findings of the examiners in this study.(3)

Based on the ICDAS committee recommendations, the training and examining programme was used for all dental students involved in this study.

For each series of dental students the programme lasted 2 weeks and involved:

1. A complete presentation of current concepts of dental caries and ICDAS system and codes during two sessions of 3 hours;
2. Next day, two 3-hour sessions with presentations of the examination protocol and discussions on the how the images have to be evaluated and how the codes are graded;
3. Two daily sessions of training that included examinations of a set of digital images of dental surfaces or live subjects (provided by the two senior examiners when possible) with a balanced number of occlusal surfaces with ICDAS codes 0-6.
4. The examination results of all training examiners were reviewed and compared with the golden standard established to identify differences in interpretation.
5. In the fifth day, the initial examination took place in standardized conditions (using the same type of light, for an identical period of time and in the same period of the day) and the results for each examiner were then collected and processed.
6. After a five-day break, a new presentation of the ICDAS II system was made with a new session of interactive discussions during the analysis on a digital images set of clinical cases different from those used for the study.
7. Next day, a quiz test was conducted during this last training session on a balanced number set of digital images of occlusal surfaces with ICDAS II codes 0-6.
8. The examination results of all training examiners were reviewed and compared with the established golden standard to identify differences in examinations.
9. The final examination took place in the last day of the training period keeping the initial standardized conditions (using the same type of light, for a period of time identical and in the same period of the day) and the results for each examiner were then collected and processed.
10. Responses from each examiner were compared to the "golden standard" determined by the two senior examiners and the data was centralized.

Because of the teaching character of the examinations exercise, the results of the examinations were presented to all student examiners in order to correct the flows and improve their medical diagnostic skills.

The examiners were asked to identify as noncarious lesions the clinical cases with surfaces with multiple discolorations if this condition was a consequence of a dietary habit like frequent tea or coffee drinking.

Due to the existence of dentals tissues visual modifications with different shades that can be scored with the same code, in this study there was used a detailed version of the ICDAS II codes 1 and 2 that differentiates the clinical situations as follows:

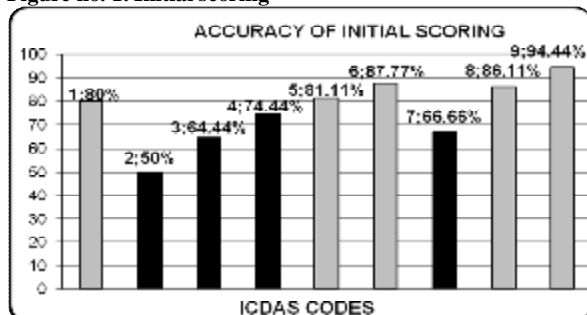
- code 1W(white) for first white change in enamel visible after 5 seconds air-drying of the region of interest;
- code 1B (brown) for first brown change in enamel visible after 5 seconds air-drying of the region of interest;
- code 2W (white) for distinct brown visual change in enamel of the region of interest when viewed wet;
- code 2B (brown) for distinct brown visual change in enamel of the region of interest when viewed wet.

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RESULTS

The results of the study regarding the accuracy of initial scoring on ICDAS 9 type of codes for the 180 examiners during a 6-year period are presented in figure no. 1.

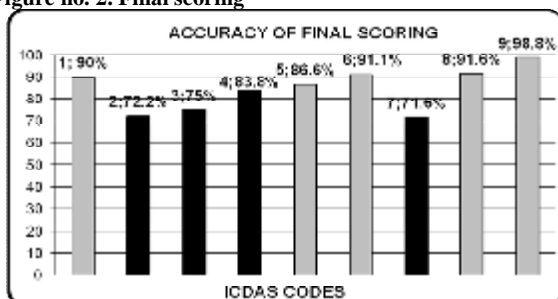
Figure no. 1. Initial scoring



Initial errors of scoring for ICDAS II codes are presented below in terms of number of examinations and percentage: 0 - 36 (20%), 1W - 90 (50%), 1B - 64 (35.56%), 2W - 46 (25.56%), 2B - 34 (18.89%), 3 - 22 (12.23%), 4 - 56 (33.37%), 5 - 25 (13.89%) and 6 - 10 (5.56%).

The results of the study regarding the accuracy of final scoring on ICDAS 9 type of codes for the 180 examiners during a 6-year period are presented in figure no. 2.

Figure no. 2. Final scoring



Final unsuccessful scoring for ICDAS II codes are presented below in terms of number of examinations and percentage: 0 - 18 (10%), 1W - 50 (27.8%), 1B - 45 (25%), 2W - 29 (16.2%), 2B - 24 (13.4%), 3 - 16 (8.9%), 4 - 51 (28.4%), 5 - 15 (8.4%) and 6 - 2 (1.2%).

The median percentages for successful initial and final examinations were determined as an arithmetic media (from the centralized data from all the examiners and for all type of ICDAS codes) between the number of correct determinations and the number of total determinations.

For the first examinations 1237 images of clinical cases (76.35%) were counted as correct determinations and for the second examinations 1370 images of clinical cases (84.56%) were counted as correct determinations.

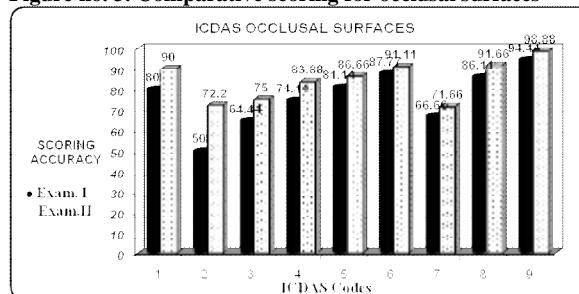
The progress of the quality of examinations with ICDAS II was assessed using the variation between the error numbers for final and initial examinations (ΔE), the values obtained are presented in table no. 1

Table no. 1. Centralized data for ICDAS II examinations

Code	0	1W	1B	2W	2B	3	4	5	6
Exam.I	144	90	116	134	146	158	124	155	170
Errors I	36	90	64	46	34	22	56	25	10
Exam.II	162	130	135	151	156	164	129	165	178
Errors II	18	50	45	29	24	16	51	15	2
$\Delta E(I-II)$	18	40	19	17	10	6	5	10	8
(%)	(10)	(22.2)	(9.44)	(9.44)	(5.55)	(3.33)	(2.77)	(5.55)	(4.44)

The graphic comparison between the results for successful scoring during the initial and final examinations of the occlusal surfaces investigated in this study is presented in the figure no. 3.

Figure no. 3. Comparative scoring for occlusal surfaces



DISCUSSIONS

Most failures during the initial examination were registered for code 1W with only 50% of correct determinations (90 cases).

With more correct determinations but still under the median percentage for successful initial examinations (76.35%) were code 1B with 64.44%, code 2W with 74.44% and code 4 with 66.66%.

The causes for these low ratings as they resulted from the discussions with the students examiners were:

- code 1W generated most of errors because of the subjective interpretation on white spots appearance on dried surfaces;
- code 1B had one third incorrect determinations due to not recognizing the code or confusing the code and scoring as code 2B;
- code 2W had one quarter of incorrect determinations because the confusion with code 1W although on the digital images was clear that no air drying was made;
- code 4 was the second in line after code 1B with a large number of wrong determinations. In most of the cases the examiners stated that they were unable to determine the source of viewed discoloration.

Dental students incorrectly identified sound areas in one from five cases more often than they presumed during the post examination discussions.

Incipient lesions with codes 1 and 2 (both W and B) were misidentified in 234 clinical cases as sound code 0 (15.6%), code 3 cavitation in enamel (12.31%), code 4 dentinal caries without cavitation (13.76%) and even code 5 with distinct cavitation dentin (3%).

There was a general improvement in scoring accuracy for the final examinations in comparison with the initial ones.

With more correct determinations than the initial examinations but still under the median percentage for successful final examinations 84.56%, were the same codes 1W, 1B, 2W and 4.

The biggest percentage growth (22%) registered in the second scoring of code 1White was the result of a better understanding of the ICDAS II criteria and their clinical interpretation.

Next significant leap (approx. 10%) in detections quality was made during the final examination in scoring codes 0, 1B and 2W.

The causes for these better ratings in the final examination resulting from the discussions with the students' examiners were:

- code 0 was easier to evaluate even it still generated errors

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because of the subjective interpretation on normal enamel appearance on dried surfaces;

- code 1B as in initial examinations presented in a smaller proportion scoring difficulties related to confusing the code and scoring as code 2B;
- code 2W was approached in the same manner by only one sixth of the examiners confusing it with code 1W disregarding the fact that no air drying was made on the examined surface.

For code 4 with underlying dentin dark shadow the initial and final determinations were rather unsatisfactory, because of the final low percentage of correct scoring and the smallest rate of scoring improvement during the study.

A certain fact can explain students' inability in large scale correct detection of these clinical cases with hidden dental caries.

The lack of experience both in clinical and especially in theoretical field characterized the examiners' decision, many of them stating that they were unable to determine if the source of viewed discoloration was intrinsic or extrinsic.

The codes 3, 5 and 6 were the beneficiary of a correct histological and clinical correlation between the real caries stage and examiners findings, the determinations accuracy being high.

These three codes generated for both initial and final examinations only 14.21% errors from a total of 633 for all codes.

The presence of enamel breakdown (for code 3) and dentins' appearance (for codes 5 and 6) helped all the examiners in taking a quick and more precise decision when scoring these cases.

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CONCLUSIONS

The results for the initial examination revealed that ICDAS II is a system that has to be thoroughly studied and its criteria must be learned before a proper use.

The results for the final examination indicated that ICDAS II is a diagnostic system that once understood can generate an easy progress by rapid improving of the determinations' accuracy.

Based on the results of this study and considering its limitations, the ICDAS II system has a fast learning curve and may be a useful tool for dental students in identifying the clinical stages of carious lesions.

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