

Activity of the caries process

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Summary

The contemporary non-operative approach in cariesology requires a new type of diagnosing. It is an approach that embraces the early detection of the caries lesions and the early specification of the character of the caries process at the moment of examination. Such an approach allows the early diagnosing of the active caries process as well as the early modelling of the process.

The broadly used in epidemiological studies DMF index provides no information for the activity of the caries process, for the quantity of the reversible lesions as well as for what non-operative treatment should be applied. The index has been created as early as 1930 when the operative treatment was dominant.

On the basis of the epidemiological study of a 1000 children aged 6 - 15 as well as with the help of a methodology embracing strict criteris for the separate diagnostic bands and for the activity of the caries lesions, an IA index was created showing the strength of the current caries process and supplementing the information obtained by means of the DMFT and DMFS indexes. The index could be very helpful in obtaining information within any epidemiological study and would facilitate the choise adequate therapeutic approach in accordance with the caries process observed.

Key words: Caries activity, active lesion, inactive lesion, indeks for caries activity, non-operative treatment.

The preventive strategy in contemporary cariesology – aimed at non-operative preventive treatment – requires early diagnosing of the caries process [3, 4, 7, 11, 17, 24]. Such a strategy presupposes the ascertainment of the character of the developing process and the intensity of the caries lesion, and not simply the finding of the mere caries lesions, however early they are [8, 9, 10, 12, 14, 15]. In order that the dental doctor's behaviour is efficient and the best choice of therapy is made, it must be found out if a caries lesion is at a stage of progression, if it has been made stationary or has undergone a reverse development [22, 23, 25, 26, 27].

There are two possible approaches to answering the above question. The first approach requires the longitudinal tracing of the lesion, while the second approach requires the determination of the clinical characteristics of each lesion, as they manifest themselves in a single clinical test. Such an approach to determining the character of the caries lesions is applicable in an epidemiological study as well as in the separate checkup of a separate patient.

Determining the intensity of the caries lesion is considered to be the «Holy Grail» of contemporary cariesology. It can provide us with the necessary basic data concerning the character of the caries process. Moreover, gauging the intensity of the

caries lesion is the best way of determining the risk of development of caries and allows us to easily and on time find out the individuals at risk that need intensive preventive interventions [5, 6, 19, 20, 21, 28]. Determining the intensity of the caries lesions is also important with regard to the realm of scientific research [1, 2, 13, 16, 18].

The evaluation - in terms of clinical criteria - of the character of the caries lesion presents a challenge to the clinical specialist. It requires an ability to detect delicate and hardly visible or tangible differences in the enamel. The clinical – visible and tactile - criteria for caries intensity have been created by Ekstrand and Nyvad. Ismail introduces the concept of active lesion.

The contemporary epidemiological researches must not only be able of detecting the present lesions. They must also be able of providing us with information concerning the character of the caries process within the current checkup. The indexes of epidemic incidence, DMFT and DMFS, are a good source of information. They do not provide us with information concerning the character of the caries process and the therapeutic approach that should be applied. So that the new preventive approach in cariesology could be employed, a new system of indexes must be created. It is indexes cre-

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ated specially for the purpose of determining the character of the caries process.

It is the aim of this research to create a supplementary index for determining the intensity of the caries process at the moment of the checkup. It is an index supplementary to the DMFT and DMFS indexes.

Material and methodology

An epidemiological examination was conducted aimed at studying the incidence of dental caries in children and adolescents aged 6 - 15, distributed in ten age groups. The checkups were carried out in the office of a highschool dentist – on a dentist's chair with the help of focused light, water and air. Dentist's mirror was used in the examination. Sound was not used in the detection of any of the lesions. Tactile research was conducted only with the smooth arm of the sound, and not with its sharp end. No pressure was applied in the process. The arm of the sound was only gently drawn over the enamel surface in the case of lesions on the smooth enamel surface so that the differences in the tactile feeling between healthy enamel and the enamel in the case of a lesion could be detected. In the area of fissures such a movement was carried out with the angle of the sound along the stretch of the fissure. No pressure was applied. The sharp point of the sound was not used in the process of tactile diagnosing.

The cases observed were documented by means of an intraoral camera.

A multiexaminer experiment was conducted involving calibration and validation. Prior to the start of the study the team of examiners was acquainted with the diagnostic criteria and was trained to carry out diagnosis at the different levels of diagnosing. Three-time calibration examinations were conducted. Using the above diagnostic criteria, five children were separately examined by each examiner. Using Kappa statistics the validity of the differences between the findings of the different examiners was evaluated. Following each checkup new training and specification of the criteria was conducted. Two days on a new examination was carried out. Following the last trial, no verifiable differences between the findings of the different examiners were found out, the coefficient of agreement between the different examiners reaching 0,96.

Diagnostic scale of the caries lesions:

- **D0** – healthy enamel;
- **D1a** – a sublevel introduced for the purposes of the research characterising the earliest visually

detectable lesions. A great quantity of plaque – usually cervical - was discovered. Such lesions were situated near the gingival edge. The size of the different lesions was identical with the size of the dental plaque. No pigmentation was observed. Such lesions are detected after professionally cleaning the dental plaque. Continuous drying and cleaning is necessary for the lesions to become observable. Only following such a procedure can the lesion be distinguished from the healthy enamel. Within the lesion the enamel has lost its gloss. A slight whitening can also be detected – only after drying and airing, though;

- **D1b** – white enamel lesion, easily visible without a previous cleaning and drying. It can be active, stationary or regressing. Depending on its intensity, the lesion may have different qualities. It can also be a combined type of lesion. The shine of the lesion, its smoothness, transparency, location, borders as well as the occurrence of plaque are studied. At this stage microporosity can be found. No enamel cavitation occurs, though;

- **D2** – white enamel lesion combined with one or two small cavitations or one bigger and deeper cavitation. Around such cavitations a diffuse white active lesion can be found. Zones with gradual transition to healthy enamel can be observed. The delineated and clearly marked lesions are indicative of a stationary character. The lesions are diffuse and broad which is indicative of progression;

- **D3** – dentine caries. This category includes the hidden and open dentine lesions.

- **D4** – caries lesions with complications in the pulp and the periodoncium.

The caries lesions are classified - with regard to criteria stated in advance – as active and inactive.

Criteria for the intensity of a lesion monitored:

- lesions located in zones predisposed to the development of caries – along fissures, pits and furrows; near the gingival border of vestibular or oral lesions; along the approximal surfaces;
- lesions situated under plaque;
- Loss of gloss;
- Loss of transparency;
- Depigmentation, usually into whitish, white or chalk-white;
- Loss of smoothness – rough and porous to the feel;
- Lack of clear delineation from the healthy enamel. The lesions can be small or big, diffusive or comprising the cervix of the tooth;
- Bad oral hygiene.

Criteria for a stationary lesion:

- Lesion located at a distance from the places where caries typically develops;
- Cavitated or non-cavitated;
- Limited in size;
- Clear borders with the healthy enamel;
- The colour can range from white to brown or black;
- Lack of plaque.

The DMFT and DMFS indexes were calculated for each age group. The oral and hygienic status was established by means of the indexes for oral hygiene of Silness and Løe and Green, Vermillion.

A supplementary IA index was created on the basis of the criteria for activity of the caries lesion.

Results and discussion

The active and inactive lesions were determined in the case of each group examined so that their correlation could be seen and the character of the environment within which the teeth function could be categorised. So, an index for activity was created to supplement the DMFT index.

The index of the activity IA is obtained by separating the ascertained active lesions from the existing inactive lesions.

$$IA = a : i$$

IA = index of the activity of the caries process

a = active lesions

i = inactive lesions

The value of the index starts at 0, when no activity of the process is ascertained; values between 0 and 0,99 are indicative of the fact that the inactive lesions outnumber the active ones; the index can have any value over 1, the value of the index then showing the strength of activity.

When only active lesions are present (and inactive lesions are missing), the index has the value of the active lesions.

Value of IA = 0. When a balance is achieved in the oral environment between the aggressive and protective factors or when the balance has been tipped in favour of the protective factors, no active lesions are observed and the index will be equal to 0. Such a value of the index can be ascertained at any level of the pathology. Even in the case of irreversible yet successfully obturated lesions the oral environment can be inactive. For instance, in the case of a child with five obturated teeth and one stationary white enamel lesion if no new active lesions occur and if the oral hygiene is good, A will be = 0.

Value of IA between 0 and 0,99. Each value of

the index between 0 and 1 shows that the active lesions in the child examined are less in number than the inactive lesions, yet the active lesions are there and must be treated by means of modelling the active risk factors. Such a result can be achieved if the child has for instance 3 active and 5 inactive caries lesions. The value A = 0.6 then and the index will lead us to determining the risk factors that brought about the emergence of the active lesions.

Value of IA = 1. The value of the index equal to 1 is indicative of there being an equality between the active and inactive lesions. If a child has 3 active and three inactive lesions the index will be equal to 1. In the case of such a value the child must be examined so that the concrete risk factors could be discovered and then done away with by means of a successful non-operative preventive treatment.

Value of the index bigger than 1. Each value of the index bigger than 1 is indicative of the prevalence of the active lesions and represents a serious syndrome of a grave disturbance in the balance of the factors active in the oral environment. Such a value of the index requires the determination of all the risk factors at all levels – the tooth surface, the oral environment and the child as an individual. The bigger the value of the index, the bigger the strength of activity of the caries process. The intensity of activity of the caries process will determine the volume of the programme to be implemented so that the caries process could be managed.

It was in terms of this index that the results obtained were processed.

Table 1. Age dynamic of the IA - index of activity

Age	Active lesions			Inactive lesions			Index IA
	\bar{x}	σ	Δ	\bar{x}	σ	Δ	
6 yrs.	2,82	3,16	0,81	0,0	0	0	2,82
7 yrs.	6,34	3,6	0,36	0,06	0,42	0,04	105,66
8 yrs.	5,36	4,56	0,45	0,42	1,04	0,1	42
9 yrs.	7,27	4,9	0,49	0,55	0,78	0,07	13,21
10 yrs.	8,5	5,72	0,58	0,74	1,34	0,45	11,48
11 yrs.	9,66	5,58	0,75	1,21	2,06	0,2	7,98
12 yrs.	8,79	8,34	0,83	2,78	3,39	0,39	3,16
13 yrs.	16,7	7,36	0,73	1,3	2,18	0,21	12,84
14 yrs.	14,39	8,45	0,84	4,81	5,26	0,52	2,99
15 yrs.	18,19	9,01	0,9	3,46	4,65	0,46	5,25

\bar{x} - mean value of lesions;

σ - standart deviation

Δ - mean mistake

It is seen from the table that within the 100 children examined there is not a single group of

children whose caries activity is low, or between 0 and 1. All values are well above 1, in some cases drastically above 1. This situation corresponds to an oral environment out of control, an environment in which the the balance has been drastically tipped towards the risk factors. In such an environment the progression of the caries process is ensured, which is pretty evident from all the results obtained. The children studied have in principle a bad oral hygiene, this being true of all age groups. Such a strongly disturbed and very active oral environment requires a close study, so that additional factors could be discovered that presuppose and facilitate the processes in the mouth. Such an analysis will be made in the next chapter.

In order that a better picture of the index is drawn, we picked up separate cases from the separate groups. It is cases in which index A of activity has different values.

Within the group of children aged 11 the following single cases were established:

- Case 1: 1 active caries lesion: 2 inactive IA = 0,5
- Case 2: 0 active lesions: 17 inactive IA = 0
- Case 3: 0 active lesions: 0 inactive IA = 0

These cases show that within the totality of children whose oral environment has been strongly changed there can be single cases of inactive oral environment, proper treatment and preventive measures. Even in case 2 where we have 17 caries lesions these lesions were obturated at the moment of examination, had no caries connected with the obturation and the oral hygiene had an index 0. This is an excellent example that at any level it is never late an equilibrium to be achieved, the protective factors to be strengthened and the risk factors to be suppressed. In such cases an environment that obviously used to be active turned into an environment conducive to health.

In such a way the index IA proposed can be very useful in determining the activity of the oral environment both in each child separately and in a group of children or in the society as a whole. The index does not require a minimum of one year for the presence of activity to be detected and only then for treatment to be administered. Results are obtained at the moment of examination, which is a big advantage if prevention and treatment is to be planned.

In epidemiological studies, if the IA index is added to the average DMFT index a clear picture concerning the therapeutic needs of a group will be obtained. A proof of this is case 2 mentioned above

in which the child had DMFT = 17, but IA = 0. It would be impossible for us to estimate the real situation in the group and in the separate individuals had we not this supplementary index.

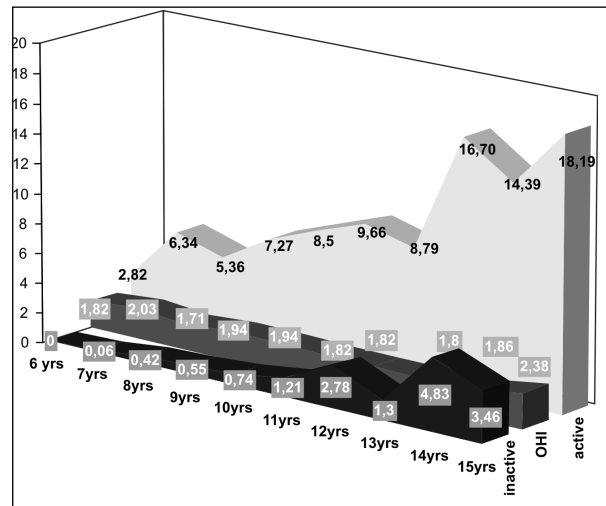


Diagram 1. Distribution of active and inactive caries lesions and their connection with OHI

Or:

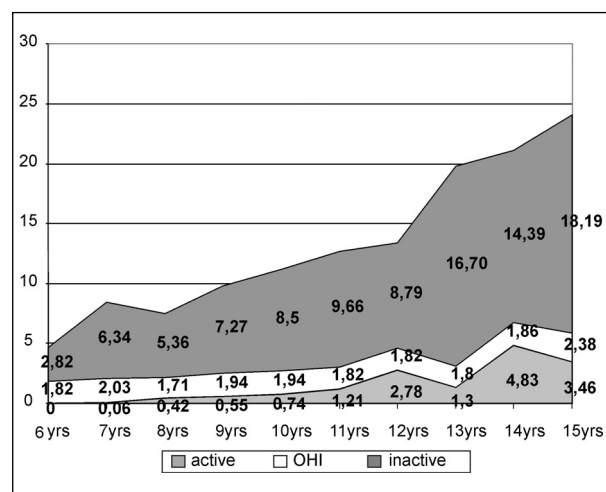


Diagram 1. Distribution of active and inactive caries lesions and their connection with OHI

The diagram shows the distribution of active and inactive caries lesions in the children group studied and their connection with the values of the oral hygiene.

The first fact that becomes obvious from the diagram is that the inactive lesions within all age groups are a small part of the pathology detected. In children aged 6 - 10 (the first 5 in the diagram) the inactive lesions are less than a lesion per child. In the next groups the accidence of inactive lesions increases.

The second fact that becomes evident is that the active lesions are the prevalent pathology in each age group. As early as the age of 6 the children have mainly active caries lesions. At any age the active lesions many times outnumber the inactive ones.

The third fact is indicative of the progressive character of the caries process observed in Bulgarian children. As the children grow older the number of active caries lesions increases. This means that the caries process in these children has been left out of control. The factors causing caries have not been managed this absence of modelling entailing an active process which is constantly progressing. The small number of inactive lesions observed is usually found in children operatively treated. Such children a just a minority. This fact clearly shows that there does not exist a correct approach to the treatment of children. The active reversible lesions are not non-operatively and preventively treated. As the children advance in age the reversible active lesions turn into irreversible ones. Thus a wonderful possibility is missed for the dental doctor to influence and stop the process, such an objective being achievable by non-operative preventive treatment only.

One of the explanations for the process observed is hidden in the main and complex risk factor – the plaque biofilm. It is clearly seen from

the strongly neglected oral hygiene in each age group. The value of the OHI index correlates – this being statistically provable – with the active lesions in each age group, which is to show that there is a link between caries activity and oral hygiene. The values of the index in the whole group range between 1,82 at the age of 6 and 2,38 at the age of 15. This is indicative of the insufficient amount of information the children have, of the absence of oral hygienic habits as well as of the absence of an engagement on the part of society to influence the dental health of the Bulgarian children.

Conclusion

The epidemiological research conducted allowed us to determine the active caries lesions. The IA index created, showing the activity of the caries process at the moment of checkup, is a good supplement to the DMFT and DMFS indexes. The supplementary index can be used in mass epidemiological studies aimed at determining the character of the current caries process and at choosing an adequate therapeutic approach to the corresponding group. This index can also be used in comparative studies following the application of preventive and therapeutic programmes aimed at managing the caries process.

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