NEW DATA ON THE CLINICAL AND THERAPEUTICAL MANAGEMENT OF OCCLUSAL CARIES (II)

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Abstract

Due to the multifactorial etiology of the carious process and also to the dynamic character of the disease, its clinical-therapeutical management becomes increasingly complex. The strategies applied in the management of occlusal caries have had several stages, starting with the pre-restorative period, when only few empirical and simple restorative methods were available. The following so-called “restorative” stage was dominated by the belief of specialists and researchers that the only efficient treatment of carious lesions, whichever their evolution stage, is reconstruction of the odontal functional morphology through obturations. In the last decades of the last century, the preventive principles, supported by a better understanding of the mechanisms of action of fluoride, gained more and more space, "the preventive stage" being now in progress. The major challenge in the management of the carious process is the control of its advance especially through preventive/therapeutical non-operative measures. The scope of any pattern of caries management is first to maintain the dental tissues, and to restore them only when recommended: such a desiderate should be considered in all decisions taken during anamnesis, clinical examination, establishment of diagnostis, until the end of the treatment.

Keywords: occlusal caries, risk assessment, management.

Dental caries is an infectious, pathological process in which a cariogenic biofilm may produce – in the presence of a more pathological than protective oral status – demineralization of dental hard tissues.

Due to the multifactorial etiology of the carious process and also to the dynamic character of the disease (as the lesions may advance and/or regress), its clinical-therapeutical management becomes increasingly complex, involving a multitude of variables, which appear as challenges in the prediction and taking of the correct therapeutical decisions in various moments of patient’s life.

Numerous efforts have been made, along the time, for controlling occlusal caries, once demonstrated that, theoretically, the occlusal pits and fissures get infected with the cariogenous biofilm within the first 10 years from their eruption in the oral cavity. As early as the beginning of the last century, G.V. Black demonstrated a prevalence of occlusal caries of 40% [1], while W.D. Miller in 1905 [2] and H. Klein and J.W. Knutson in the ’40ies [3] applied silver nitrate (as an antibacterial agent) on the surfaces of the molars in eruption, for eliminating both Streptococcus mutans and Actynomices naeslundi.

The strategies applied in the management of occlusal caries have had several stages, starting with the pre-restorative period (until the 1850’ies), when only few empirical and simple restorative methods were available. Medical care involved either extraction of affected teeth, or resignation (the patients suffering and continuing to live with the carious lesions and their consequences), a stage defined as "extractionist" or "blood and vulcanite dentistry".

The subsequent stage, favored by a more advanced knowledge of biology and pathology of human diseases, made initially use of the instrument called "observation", namely the physicians used to study the affection and its progress, yet without applying any scientific method and without testing the possible hypotheses, to be followed, later on, by "scientific analysis", assuming checking of all observations, theories and hypotheses on the basis of scientific theoretical and operational grounds, which explains its most significant impact registered upon the quality of people’s life and health [4].

This so-called "restorative" stage was dominated by the belief of specialists and
researchers that the only efficient treatment of carious lesions, whichever their evolution stage, is reconstruction of the odontal functional morphology through obturations.

The operative principles of dental care have been established, a century ago, by Black, much before the moment when it became obvious that the evolution of the carious disease may be stopped or prevented. In the absence of some efficient preventive strategies, along with a higher incidence of the dental caries in the industrialized countries, the operative patterns of dental care became, in that stage, the “ideal” solutions in dental practice [5].

Even if, in the final decades of the last century, the preventive principles, supported by a better understanding of the mechanisms of action of fluorine, gained more and more space, “the preventive stage” being now in progress, the operative techniques remained the basic strategy in the control of dental caries: management of the dental caries involved elimination of the demineralized dental tissues and utilization of some synthetic materials for the reconstruction of the anatomy, functions and aesthetics [6].

The years 2000 imposed more and more intensely the principle of minimum invasive intervention and that of tissular economy, which preserve as much as possible the hard dental tissues, even the affected ones, yet in a reversible stage. That is why, control of the carious disease, considered as an infectious affection, will undoubtedly modify in the future the “drilling and filling” paradigm into the “filling without drilling” one [7].

Control of the ecological determinants which modulate the activity level of all clinical-biological factors involved in the establishment of a level of cariogenous risk for the patient may interrupt the evolution of the carious lesions from the non-cavitary to the cavity stage, while the applied strategies will evaluate their level of activity. Such an approach is useful for the detection and correct diagnosis of the carious lesions, for evaluating caries risk, diagnose caries disease at patient level and also for making the most correct therapeutical decisions [8].

According to the new strategy of caries disease control, several systems of clinical-therapeutical management have been proposed, based on the necessity of including considerations related to: a) caries risk of the patient; b) status of each lesion; c) management of the patient; d) therapeutical management and e) maintenance phase.

Both caries risk and treatment of caries disease are conducted according to a set protocols referring exclusively to interventions backed up by sound scientific proofs, implemented along the various stages of the consultation and treatment, with the double target of assuring a primary prevention of caries disease and also of a secondary prevention (blocking during the evolution and reversibility of carious lesions) by means of non-invasive measures.

The systems to be analyzed in the following are not directly related to the management of cavitary or symptomatic caries lesions, known as requiring operative interventions and, more that, to the management of patients with rampant, acute caries lesions, caused by a severe salivary hypofunction [9].

A recent suggestion is that control of oral affections, such as the carious process, should be based on the management pattern of chronic diseases, for which multiple strategies, addressing the target-determinants at individual, family and community level, are applied. While the non-biological determinants have been intensely studied as to their influence upon oral health, the role of the biological determinants remains of major importance in controlling the progress of caries level at population and individual level. The major challenge in the management of the carious process is the control of its advance especially through preventive/therapeutical non-operative options and also through limitation of the number of individuals of a population in need of operative/restorative treatments [10].

Management of the occlusal caries of permanent teeth appears as a major challenge, as the occurrence of caries is observed immediately after their eruption in the oral cavity. In spite of the considerable caries reduction registered starting with the year 1970 in different countries and populations, the occlusal surfaces of the prime permanent molars, followed by those of the secondary molars, remain the mostly exposed spaces to carious processes [11].
Unfortunately, the new paradigm of caries disease - viewed as a biological process - produced no significant modifications at global level, in relation with either education or stomatological practice. The scope of any pattern of caries management is first to maintain the dental tissues, and to restore them only when recommended: such a desiderate should be considered in all decisions taken during anamnesis, clinical examination, establishment of diagnosis, until the end of the treatment.

This common mission can be achieved only by considering the following objectives:
- Realization and maintenance of dental health, prevention of the advance of the existing initial lesions and restoration of the moderate and extended ones by adopting clinical decisions based on risk evaluation.
- Limitation of recommendations for surgical interventions.

In the year 2013, Ismail et al. [11] synthesized and compared several systems of caries management and classification, all focused on the classification and evaluation of the activity level of the carious lesions and of the individual caries risk, establishment of diagnosis and elaboration of the treatment plan. These stages may be developed by means of various strategies; diagnosis is an important step of the management, as it integrates information based on medical, dental and social evaluations, lesion detection and establishment of its severity, evaluation of the activity level, of the individual risk level, of some additional data, prior to the realization of a therapeutical plan for the patient and for each lesion in part, the final objective being preservation of the dental structure and of oral health.

Management of dental caries should follow an iterative cycle or circuit, which evaluates the risk factors of the patient causing the occurrence and progress of caries, and governs the management of the carious lesions to be classified according to the level of demineralization and tissular destruction. Such a repeatable circuit involves the following stages, addressing both the management of the disease at patient level and of the carious lesion at tooth level: anamnestic evaluation of the patient, clinical evaluation and evaluation of bitewing radiographies.

Clinical examination of the hard dental tissues and of the biofilm represents a major and determining step for the success of caries management. The examiner should evaluate and collect information about the following aspects:
- Previous care status: the previous restorative treatment is an indicator of the previous, present and also future risk level.
- Biofilm status: the presence of a thick biofilm and the level of its removal in the oral cavity appear as risk indices.
- Establishment of the stages of caries processes, according to various systems of their classification. Management of the dental caries recommends classification of lesions based on the extension of caries demineralization in the enamel and dentin, and the activity (active and inactive) levels. The three caries stages are: initial, moderate and extended/severe. The criterion of each stage is provided by each classification system in part.

Ismail et al. [11] described the following systems of caries management:

1. **The International Caries Detection and Assessment System (ICDAS)**

   - ICDAS Committee proposed the following definitions of the stages identified in the evolution of dental caries:
     - The healthy occlusal surfaces show no visible caries risk (code 0) nor visible radiographic signs.
     - Initial caries will be characterized by the first (clinically non-cavitary) modification in the enamel (observable only after a prolonged drying with air or restricted only to the territory of a pit or a ditch) (code 1), or by a visible, distinct modification in the enamel (on a wet surface) (code 2). On the occlusal surface, such lesions: (I) will not be visible as radiotransparencies, or (II) radiotransparency will be limited to the external 1/3 of dentin on conventional intraoral Rx (bw).
     - Medium (moderate) caries will be clinically characterized either by localized destruction of the enamel, without clinically visible signs of dentin involvement (code 3), or by a subjacent, dark-coloured dentin shadow (code 4); on the occlusal surfaces, even if most of the lesions will evidence a radiotr
extended beyond the external 1/3 or in the medium 1/3 of dentin, some of them might not be visible on Rx, due to the amounts of healthy vestibular and lingual enamel and dentin, which attenuate the X-ray beam.

- Deep (severe) caries will be characterized by the presence of a distinct cavity, with visible dentin (code 5), and by an extended cavity with visible dentin, which affects more than ½ of the analyzed surface (code 6). From a radiological perspective, this stage will correspond to a radiotransparency extended within the pulpal 1/3 of the dentin or even very close to the pulp.

2. Caries management by risk assessment (CAMBRA)

A research team of USA (Douglas A. Young, John D.B. Featherstone, Margherita Fontana, Mark Wolff, Brian B. Novy, Michelle Hurlbut and Deborah Horlak) adopted the ICDAS - both visual/tactile and radiographic - methods for carious lesion classification, having them implemented in the management theory of caries as a function of carious risk (CAMBRA). Also, the researchers provided definitions for the above-mentioned 3 stages of occlusal caries:

- Initial caries are defined as those of the ICDAS codes, from 1 to 3 (one may observe that the CAMBRA group included code 3 in the class of initial and moderate lesions) on the occlusal sites (in this respect, the radiological classification of lesions according to this system is the following: E1= 1/2 limited to the enamel, E2= 1/2 inside the enamel, D1= 1/3 outside dentin, D2= 1/3 medium to dentin and D3= 1/3 inside dentin).

- Medium (moderate) caries belong to the ICDAS codes ranging between 4-5 on the occlusal sites.

- Severe (deep) caries are cavitary lesions from code 6 ICDAS (more than half of the analyzed surface is lost) while, from a Rx perspective, the lesion is extended within the internal 1/3 of dentin (D3).

3. CMS - Caries Management System (Wendell Evans, University of Sydney, Australia)

- Initial caries on occlusal surfaces include the white or brown spot lesions (ICDAS 1 and 2) or the microcavities from the enamel (code ICDAS 3), their basis being limited only to the enamel. Such lesions may be associated with radiotransparencies in stage C3 or C4 (the radiological classification of lesions in this system is the following: C1= radiotransparencies limited to the external 1/2 of the enamel, C2= radiotransparencies limited to the internal 1/2 of the enamel, possibly reaching the DEJ, C3= radiotransparencies crossing DEJ, C4= radiotransparencies situated in the external 1/3 of dentin, C5= radiotransparencies extended in the internal 2/3 of dentin).

- Medium (moderate) caries are interpreted as dentinary non-cavitary lesions which should not be prioritarily treated by surgical means. On the occlusal surfaces they have an obvious grey-blue dentin shadow (ICDAS 4) which can or cannot be associated with enamel destruction.

- CMS has the stage of severe caries exclusively for identifying the cavitary lesions on the permanent teeth (code 5 and 6 or radiographic codes C4 or higher), which always need restorative treatment.

4. American dental association (ADA) caries classification system (Gregory G. Zeller, American Dental Association)

In 2008, ADA proposed another classification system, now under clinical validation (as to its sensitivity, specificity, reproducibility). This classification is included in the Cariogenous Matrix of FDI [12].

ADA classification permits characterization of lesion’s extension on the tooth as “initial, moderate or severe”, based on clinical signs which characterize its progression. ADA classification also offers the possibility to characterize the site of origin of the lesion, situated on “pits and fissures, approximal, cervical/smooth surface and root”. The Rx signs of carious lesions, if available, will be also included in the evaluation, even if the radiographies are not necessary and not indicated in all circumstances.

- Initial caries are defined as visible non-cavitary or cavitary (possibly “microcavitary”) lesions limited only to the enamel.
- Medium (moderate) caries represent either destructions in the enamel (microcavitary), associated with non-cavitary dentinary lesions, or cement loss, associated with non-cavitary dentinary lesions.

- Deep caries: lesions with extended cavities both in the enamel and dentin.

From the viewpoint of the localization of the site of origin, ADA classification considers that the occlusal carious lesions belong to those situated in pits and fissures: they initiate in the anatomic pits and fissures from the occlusal surfaces of the posterior teeth or from the palatinal surfaces of frontal maxillaries.

5. Conventional system of caries classification (Amid I. Ismail)

It is the approach laying at the basis of the adoption of the new mission of dental caries management, a more intensely applied system: it is based on the utilization of a probe for caries detection, combined with visual inspection, looking for signs of cavitation and color modifications. However, the system has a low validity for caries detection and is uncertain in establishing whether restoration or when a lesion restoration is to be made [13].

More than that, the restoration decision is not based on the size and extension of demineralization, as all lesions are restored once observed visually or are recognized on probing as being cavitory in dentin, or whether Rx proofs that transparency went beyond DEJ are available.

The users of this system who decide to adopt the alternative of preserving the dental structure and of restoring it when only necessary may apply the following classification:

- Initial caries: even if it is highly recommended that such lesions should not be penetrated with a probe, on the occlusal surface, practitioners may classify them on the basis of the absence of cavitation (discontinuity in enamel or dentine due to caries) and absence of any radiographic proof on the caries. These lesions cannot be evaluated with a sharp probe, but rather identified after visual examination of the clean and dry surfaces.

- Medium (moderate) caries: are either microcavitary in the enamel (the walls and floor are in the enamel) or non-cavitary, with Rx proofs that they are extended in the external 1/3 of the dentin, crossing DEJ.

- Deep caries: these lesions show cavitation in dentin or Rx proofs that they are extended in the medium or internal 1/3 dentin.

Briefly, the users of this system of caries classification, based on visual/tactile detection, may modify their mode of initial, moderate and severe lesions’ identification, on considering the presence of cavitation, the demineralization signs and the Rx caries proofs.

Evaluation of lesion’s activity

This stage, as part of clinical examination, should be developed simultaneously with the determination of lesion’s (initial, moderate and severe) stage. Unfortunately, no consensus had been reached on the indices of activity evaluation and, more than that, the clinical evaluation of today is – at most - in the guess stage.

The ICDAS, CAMBRA, Nyvad and CMS systems possess specific clinical characteristics for activity evaluation [11].

In the SIDEIC system, active lessions are defined in the following manner:

- On the occlusal surfaces: teeth in eruption, especially the permanent molars,
- Surface morphology: deep pits, also calleds fossa (in the point where 2 fissures or 2 grooves meet), fissures or grooves
- Non-cavitary dentinary lesions: all considered active
- Open cavities: in the areas of plaque stagnation

In the CAMBRA system [14], an active lesion is defined according to:

- The initial caries risk: high, moderate
- Visual aspect: cavitation/shadow, whitening
- Lesion localization: natural zones of biofilm stagnation
- Sensation on palpation: rough enamel/soft dentin
- Surface luster: matt
- Biofilm: adherent
- Age of the lesion: < 3 years

Caries Management System considers that, basically, all lesions are active. Their evolution will be considered as stopped when, after the treatment, their size (or depth) does not progress, any more [15].
Nyvad system [16] defines lesional activity as follows:

- Active lesions on the intact enamel surface: the enamel surface is whitish/yellow, opaque, with no gloss; when the top of a probe is lightly moved along, it appears rough; generally, it is covered by a biofilm. No clinical signs of surface loss: pits and fissures are observed; intact morphology; the lesion is extended along their walls.

- Active lesions with discontinuous surface. The same criteria as for active lesions on intact enamel surface. Also, there exists a surface defect (microcavitation) localized exclusively in the enamel. No undermined enamel or softened floor, detectable on palpation with the probe, is evidenced.

- Active cavitary lesions: the cavity in enamel/dentin is easily visible; on light palpation with a probe, the surface of the cavity feels soft or leathery-like.

Making the clinical decisions: evaluation of caries risk (ECR) and establishment of diagnosis

This is the process establishing the probability that, in the near future, a patient may develop new caries (in either enamel or dentin), one of the key elements of the preventive/therapeutical treatment centered on patient. ECR should be included in the clinical management of the carious disease, as it helps the clinician to decide on the therapeutic (non-operative or operative) strategy, on the interval between the re-evaluation sessions and on the necessity of applying possible additional methods [17].

An ideal ECR system should possess high validity and consistency, should be easily applicable and cheap. ECR will be applied as early as the first visit of the patient in the dentist’s, then on a regular basis along all his/her life or when social or medical events occur. Caries risk may be classified as low, medium, high and extreme; some systems combine the high with the extreme ones, whereas CAMBRA has a specific definition and a peculiar management in cases of extreme risk [18].

It is imperatively needed that the management plan modulate the treatment on the basis of cariogenous risk evaluation. ECR and reduction of cariogenous challenge should be checked during each treatment session. A carefully controlled management plan should also address the risk level and the management of lesion within the global context of risk evaluation for the patient.

Nowadays, a few schemes for the evaluation of the cariogenous risk are available for the practitioner, even if their validity is limited, for both children and adults [11]. The initial ICDAS system, focused on lesion classification, did not explicitly described the ECR criteria. However, ICDAS-ICCMS, focused on the clinical management of caries, for evaluating the cariogenous risk of the patient.

ICDAS-ICCMS considers that ECR is a basic compound in decision-making processes, in view of an adequate prevention of dental caries and for establishing the interval between the evaluation sessions. The existing literature does not specify whether ECR should be always performed during the first visit of the patient and then along his/her whole life, on a regular basis, at intervals of at least 2 years or in case of social or medical modifications. Application of ECR-structured protocols combine socio-economic, behavioral data with information about the general health condition, diet, daily oral hygiene, clinical data and salivary tests.

Whichever the strategies adopted for cariogenous risk evaluation, the above-mentioned management systems, as well as the operative/restorative methods based on carious risk evaluation show a much higher predictibility and efficiency than the other strategies [19].

Once accepted that carious experience is the most important and unique risk factor, predictable at all ages in the future, any clinical sign showing an active demineralization on any surface will be viewed as alarming, and will require implementation of some individual strategies for reducing the carious risk in each patient in part.

According to the caries risk evaluation system published in Journal of California Dental Association, the evaluated clinico-biological indices are grouped as indices of disease, pathological factors and protective factors [20, 21].

The disease indicators are markers evidencing a past or present carious process, yet they are not etiological factors (cavities or radiographic signs of dentin penetration, aproximal radiotransparencies
in the enamel, white-spots and restorations occurring in cavitary lesions in the last 3 years, being visible).

The risk factors or the pathological factors are described as clinico-biological indices related with the possible occurrence and progress of the disease, including progression of the already existing lesions and formation of new ones (mature and visible cariogenous biofilm, frequent snacks between meals, an inadequate salivary flow and major microbial pressures), evaluated by cultures of salivary samples or bioluminiscence (Cariescreen). Also considered for evaluation in this category may be other factors, which expose the patient to the etiological chain: deep pits and fissures, utilization of recreative drugs, a combined and plurivalent xerostomic medication, cervico-facial radiotherapy and systemic diseases, root exposure and fixed orthodontic treatments.

The protective factors are grouped into biological and therapeutical ones, or as measures which, together, may prevent the demineralization process, encourage remineralization or counteract the challenges represented by pathological factors (a higher salivary flow, an optimum exposure to fluoride, oral antibacterial rinsings, xylitol and additional utilization of products containing calcium phosphate).

The scheme of carious risk evaluation for adults considers 24 factors, CAMBRA suggesting that evaluation of the salivary flow and of the bacterial biofilm represents reference (starting) points for new patients or during each control and re-evaluation session.

The risk evaluation system called Cariograma makes use of a computer programme which includes the interactions between the factors related to the carious process, expressed as graphs, and elaborates recommendations, namely individualized preventive measures for each patient, meant at stopping the occurrence of new caries. Nine clinico-biological parameters, each one taking values from 0 to 3, are evaluated: carious experience, associated diseases, diet, frequency of diet, bacterial biofilm, salivary level of SM, fluoride programme, the salivary flow and the buffer capacity of saliva, while the result of a ponderate (and not average) evaluation of the values of each parameter in part is presented as a pie-type graph which suggests the individual chance of not having caries [22].

According to the system of caries management (SCM), caries risk is evaluated from the calculation of the incidence of carious lesions, while the strategies for risk reduction aim at decreasing the exposure to risk factors and at supporting the protective ones. For adult patients, the level of caries risk is determined exclusively on the basis of clinical signs. A low caries risk is established when no cavitary lesion is observed, yet proximal radiotransparencies, in bite-wings incidence with value C3, may exist; a medium risk is indicated by the presence of some cavitary lesions in the enamel and/or radiotransparencies with value C4; high risk is indicated by cavitary lesions in dentin and bite-wings radiotransparencies with value C4 or C5. The sessions of caries risk re-evaluation confirm whether the incidence of caries is below one per year or whether no progress of the proximal lesions identified during the initial exam is observed; in patients with medium risk, incidence is one new lesion per year, or when the initially observed lesions appear as advancing; high risk is considered when 2 new lesions per year are identified [23].

Global FDI initiative on caries and its management

FDI and its 200 affiliated organizations play a special part and have professional responsibility in "leading the world towards an optimum oral health condition“. FDI promotes a platform which supports the change of paradigm in the management of dental caries and implements the new pattern of dental caries care, known as the most frequent oral disease. FDI Global Caries Initiative (GCI) assures a scientific and political network, developing actions and initiatives meant at teeth preservation along one’s whole life [24].

the general oral health condition and life quality. Special mention is made of the "necessity of programmes’ incorporation for the promotion of oral health and prevention of oral diseases within programmes for an integrated prevention and treatment of chronic diseases" [25].

It is beyond any doubt that the current pattern of caries classification and management improved the oral health condition of millions of people all around the world, even if discrepancies still exist between what we know about the carious process and what we really do in everyday practice.

Integration of caries management in the global strategy of chronic communicable diseases will develop a medical network aimed at improving public health condition through measures of risk evaluation and control, prevention steps, with special stress on tissular economy versus restoration.

To meet this end, at the Conference held in Rio, FDI launched the Global Caries Initiative (GCI 2009–2020), whose objective is that of "improving oral health by the implementation of a new paradigm in the management of dental caries and of its consequences, based on the present level of knowledge of the pathological process and of its prevention, so that an optimum general oral health status for all patients should be assured until the year 2020. Focus in the new caries management system is laid on the preservation of the dental structure along one’s whole life.

The Conference of Rio identified the main action zones: development of a common language with reference to the carious disease, eradication of the feeding bottle-caries in children under 3 years; primary and secondary caries prevention and development of activities assuring a good health status.

The first GCI stage established a series of policies supporting the new paradigm of caries management and the introduction of new instruments for its implementation. A key element was the introduction of FDI Caries Matrix, as a first step of science intergration in dental practice [12]. In a subsequent stage, GCI will assure the tools and instruments capable of modifying the management methods in daily practice, public health and the national policies in the field.

The site www.globalcariesinitiative.org was created as a platform disseminating the new data among the FDI members and equally to a large audience. CGI should develop an inter-professional education, thus granting the importance of the health needs of the population and making our young specialisists wholly involved in their everyday work.

References


