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An Extended Concept of Dental Caries and Update of Cariology Terminology

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Keywords: *cariology, terminology, dental caries, dental caries lesion.*

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An Extended Concept of Dental Caries and Update of Cariology Terminology

Ana María Acevedo ^α, Alejandra Garcia-Quintana ^σ, Annabella Frattaroli-Pericchi ^ρ & Sonia, Feldman ^ω

Abstract- Recent terminology explains dental caries through an understanding of factors that interplay in its etiology; however, the focus is still overpowered by the disease at advanced stages. The aims: (1) extend the concept of dental caries, through the Dental Caries Integrated Ecological Hypothesis (DCIEH), to one that includes the complexity of the disease with its conjoint elements during development and progression, and (2) update cariology terminology. The term: dental caries corresponds to the disease, and dental caries lesion corresponds to the expression of the disease. Dental caries follows a sequence of progressive phases (mild to severe), characterized by microbiome dysbiosis of the dental biofilm, including the disturbance of the metabolic activity of its commensal microbiota, producing an acid-base imbalance. Dysbiosis is determined by the complex relationship of influential factors regulated by biological features, modulated by behavior, and conditioned by the environment. A severe chronic imbalance leads to complete oral homeostasis disruption echoed in a dynamic interaction between the tooth surface and the dental biofilm with subsequent mineral loss. An individual dental caries free should imply that the disease is not present. Instead, dental caries lesion free suggests the absence, after thorough evaluation, of a visible clinical expression at any lesion stages (from non-cavitated to cavitated lesion). This extended concept allows for a broader understanding of the complexity of the disease. It provides a basis for knowledge to develop tailored strategies that may address the existing condition of the disease and its progression.

Keywords: cariology, terminology, dental caries, dental caries lesion.

I. INTRODUCTION

For the most part, throughout history, there has been no clear separation between the terminologies used for dental caries disease and dental caries lesion. Although the set of agreed concepts¹ attempting to explain dental caries disease has included a more comprehensive understanding of the factors that interplay in its complex etiology, the focus is still overpowered by the disease at advanced stages; hence an extended concept is needed.

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II. DISCUSSION

The current definition of dental caries as a disease states that it is a “biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in net mineral loss of dental hard tissues. It is determined by biological, behavioral, psychosocial, and environmental factors. As a consequence of this process, a caries lesion develops”.¹ Extending this idea, a concept that communicates the complexity of the disease with its conjoint elements during development and progression, is immersed in the Dental Caries Integrated Ecological Hypothesis (DCIEH).²

The DCIEH integrates Microbial-Biochemical-Environmental-Behavioral (MBEB) factors in a 4-phased process, which ranges from mild to severe, to understand the complexity of the early establishment of health and comprehend decisive factors involved in the onset and progression of dental caries. The phases (dynamic stability, mild, moderate, and severe dysbiosis) follow a logical order of event occurrence and consider MBEB factors and processes including: homeostatic mechanisms in the dental biofilm, the relationship between dental biofilm and microbiota, acid and base metabolic pathways, saliva composition and functions, the role of the salivary pellicle, epigenetic modifiers, dietary and nutritional influences, the importance of maternal psychosocial and behavioral modulators, and predisposing, reinforcing and enabling environmental conditions.²

Under the scope of the DCIEH, the term dental caries corresponds to the disease characterized by microbiome dysbiosis of the dental biofilm, including the disturbance of the metabolic activity of its normal, commensal, and resident microbiota. Such alteration is reflected in the quantity and type of organic acid production and the insufficient generation of alkaline substances. Dysbiosis is determined by the complex relationship of a series of influential factors, regulated by biological features, modulated by behavior, and conditioned by the environment.²

The term dental caries lesion corresponds to the expression of the disease. The chronic persistence of microbiome imbalance and altered dental biofilm conditions leads to the disruption of oral health homeostasis echoed in a dynamic interaction (demineralization-remineralization) between the tooth

surface and the dental biofilm. Once the disease reaches a moderate phase (under uncontrolled conditions), a mineral loss occurs in the tooth structure (initial lesion) at a subclinical stage. The initial lesion could be completely reversed if the environment of the dental microbiome shift towards a healthy state. As unfavorable conditions prevail, a severe phase of the disease is then expressed as a clinically detectable lesion.²

It is essential to emphasize the difference between dental caries and its expression understood as dental caries lesion. The combined usage of disease and lesion in the simple term "caries" has created confusion when distinguishing that the disease pertains to the individual. In contrast, the lesion relates to the hard tissues of the tooth.³⁻⁸ Under this extended concept, dental caries disease shares common risk factors with other non-communicable diseases (e.g., obesity, diabetes, cardiovascular disease, cancer, autoimmune disease).^{9,10} Despite the efforts to manage such conditions, the complexity they convey has not allowed their effective management, possibly due to the limited understanding of the upstream etiology.¹¹⁻¹⁴ In contrast, most research and clinical action have been evocated to treat their signs and symptoms, as non-communicable diseases remain the leading causes of death and disability globally.^{15,16}

As is the case in dentistry, little to none has been proposed to understand dental caries from its origin to its management. Meanwhile, all efforts have been directed to detect and treat dental caries lesions.¹⁷⁻²⁴ However, poor outcomes and no success are evident given that the severe disease, masked by lesions, continues to be a public health problem worldwide.¹¹ No scientific evidence is yet comprehensive enough to depict the effectiveness of dental treatments as measures to address the disease; instead, these actions are procedures to mitigate lesion progression.²⁵ Hence, based on evidence, wide-ranging strategies and policies are necessary to jointly manage the disease and its impact.¹¹⁻¹³

Based on this rationale, the term "caries free" and "cavity free" needs to be clarified. As previously mentioned, *the term "caries" alone is subject to confusion*; thus, it is necessary to expand the concept to one that differentiates the *disease (dental caries) and its clinical expression (dental caries lesion)*. By recent consensus, "caries free implies that there are no detectable signs of dental caries," and "cavity free implies that there are no detected cavities in dentine."¹ However, these concepts analyzed under the DCIEH suggest that an individual "*dental caries free*" should imply that the disease is not present. Instead, "*dental caries lesion free*" indicates the absence, after thorough evaluation, of a visible clinical expression at any lesion stages (from non-cavitated to cavitated lesion).² The term "cavity free" is dispensable

given that it is immersed in the latest stage of dental caries lesion.

From this understanding, it is essential to acknowledge that determining an individual as dental caries free is very difficult. The only approximation we have to obtain information about the presence of the disease is the risk assessment.^{26,27} However, no clear indication of its degree of severity can be concluded with the existing tools. Therefore, clinical research must focus on developing methods to detect the presence and severity of the disease accurately.

Historically, what has been developed are criteria and indexes to detect and quantify dental caries lesions, mainly assessing the late stages of lesion progression (cavitation).²⁸ Until recently, the status of dental caries in its different phases at the population level (from local to national) remains unknown. Generally, epidemiological profiles reported the prevalence of dental caries lesion with criteria that only reflected its severe stage.²⁹⁻³⁰ In 2005, the International Caries Detection and Assessment System (ICDAS)³¹ developed a more accurate clinical scoring system to detect and assess dental caries lesions before cavitation at various tooth surfaces.^{32,33}

This last system allows the detection of the disease at a severe phase but at an earlier stage of its expression (non-cavitated dental caries lesion). However, no system is available to detect the early phases of the disease (mild and moderate) because the clinical expression is not yet evident on the tooth surface during these phases.² Detecting a dental caries lesion during the early stages of expression indicates that the individual has the disease; however, the absence of a dental caries lesion does not mean that the individual is free of the disease. Hence, it is essential to highlight that the detection of dental caries lesion alone generates a sub-registry of dental caries as a disease in the entire population.³⁴ Prevalence results of dental caries lesions are not an accurate parameter to assess the condition; thus, under the DCIEH, it becomes necessary to include the analysis of all the factors (MBEB) that indicate an individual suffers the disease but does not manifest it.² Such an approach paves the way to design, plan and implement overarching strategies that address the onset and progression of the disease.³⁵

Most of the research has focused on the secondary and tertiary management (e.g., dental material and instrument technology, non and minimally invasive treatment) of dental caries lesions. As for disease management, scarce scientific evidence has been published regarding a comprehensive approach to health and disease prevention; moreover, sugar intake and dental hygiene have been the focus.^{11,12}

This extended concept of dental caries (Figure 1) allows for a broader understanding of the complexity of the disease. This approach provides a basis for knowledge applicable to develop tailored strategies that

may address the existing condition of the disease and its progression. Such an approach should cover public health policies, health promotion programs, environmental change, behavioral and biological interventions, patient-centered practices, and clinical management.

III. CONCLUSION

Finally, we encourage academies, associations, and researchers to join consensus on the terminology used to define dental caries and all it encompasses. Also, we recommend that research advancement focuses on developing instruments and methods for disease identification (from its onset to progression). Lastly, a comprehensive approach should lead to effective promotion and prevention strategies to manage dental caries.

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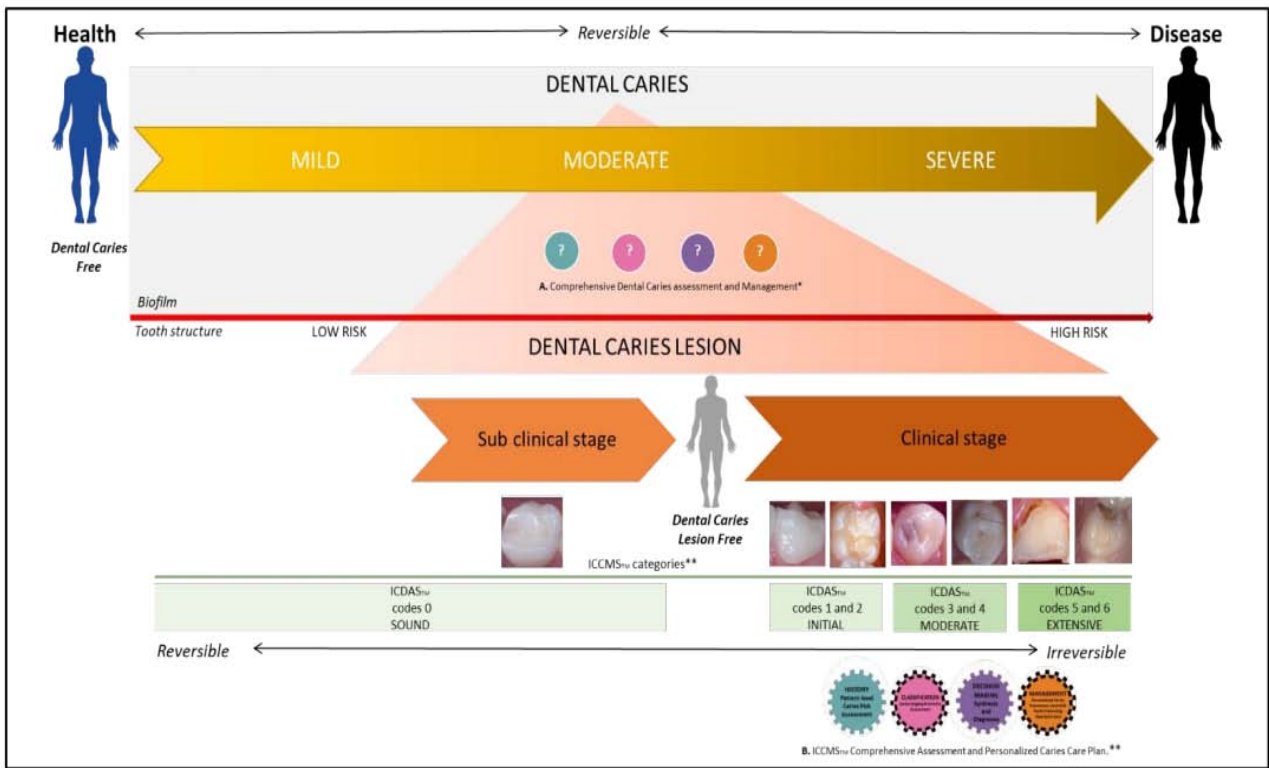


Figura 1: A schematic representation of the extended concept of dental caries.

A. Comprehensive Dental Caries assessment and Management correspond to evaluation, classification, diagnosis and management for dental caries (current research proposal).

*Acevedo AM, Garcia-Quintana A, Frattaroli-Pericchi, Feldman S. 2022.

B. The International Caries Classification and Management System - ICCMS™ as key elements for dental caries lesion management.

**Ismail AI et al. 2015.