

Developmentally Based-Universal Erosion Scoring System

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Abstract

Dental erosion is a growing health problem that has escalated in recent years. Diagnosing these lesions, assessing extent of the disease, and drawing a comparison among clinical findings from multiple studies, often confront a critical problem. This problem stems from the lack of a universally acceptable comprehensive assessment criteria and standardized scoring system, hence the objective of this report. The proposed Universal Erosion Scoring System (UESS) is based on the developmental stages of the disease and can be used for private practices and clinical studies in populations of all ages. The numerical scores, the corresponding criteria and protocol to implement this scoring index system are described.

Keywords: Clinical assessment, Dental erosion, Scoring index

Learning Objectives

The international demand to develop a Universal Erosion Scoring System. The rationale for this demand and the systems that already served for two decades. The requirements for a newer system, description and justifications.

Rationale

The Global Health Program of the World Health Organization (WHO) positioned forward, a new strategy of disease prevention and health promotion in 2003 [1]. This program placed greater emphasis on oral health issues, and in particular, dental erosion [1]. The heightened risk of dental erosion prompted attempts to compare data from multiple global clinical studies required for strategic preventive planning. This was not possible due to the lack of standard assessment criteria to quantify dental erosion and compare data [1]. Such impasse urged the need for developing a scoring index system that could promote consensus among scientific as well as clinical communities. This scoring index system should facilitate the task to accurately allow appraisal of dental erosion and also compare data from several sources. This issue was deliberated during the proceedings of the Oslo workshop on dental erosion (2008), leading to proposed development of a scoring system designed for use by the research community and the dental clinicians [2]. Subsequently, a new scoring system for dental erosion, Basic Erosive Wear Examination (BEWE) has emerged, followed by few others, whose designs had encountered inherent limitations, especially if applied to survey populations with advanced erosion lesions, as the central Appalachian populations [3-7].

In an epidemiological survey to assess dental erosion among 502 Greek adolescents, three scoring systems were compared [8]. The study report stressed the need to supplement the BEWE with a group of sufficient validated etiological criteria that are necessary to establish an accurate differential diagnosis of erosion lesions [8]. Schlueter and co-workers concluded in 2011 that none of the methods used were adequately suitable to study dental erosion and none include all progression stages of the disease process that limit their universal use [9]. The shortcomings of the aforementioned attempts to introduce an acceptable scoring system for dental erosion during the past decades have left this field of assessment wide open, setting up a challenge for developing a comprehensive scoring index system that enjoys a universal consensus.

Objectives

The purpose of this report is to introduce a universal erosion scoring index system for assessing all types of dental erosion of all age groups. The proposed system is designed based on progressive stages of disease development, for universal acceptability.

Clinical Features of Contemporary Erosion Lesions

The diversified clinical features of contemporary erosion lesions compounded by the degree of damage to dentition caused by erosion process, complicated attempts to try to communicate a descriptive narrative of the lesions. These difficulties render common understanding of dental erosion among professionals, clinicians, researchers, and health care providers, a difficult task, garnering

conflicting opinions. A common consensus of the complex features of dental erosion lesions experienced in today's practices must be highlighted first, prior to creating an inclusive scoring system.

Current dental literature recognizes three types of contemporary dental erosion lesions [5-7]. Type I, the decades-long described conventional erosion lesion. Two more types were recently identified associated with excessive daily intake of acidic beverages. The former is Type II linked with sugar free (diet variety) acidic beverages, while the latter is Type III, is commonly associated with indulgence in consumption of sugar-sweetened variety [5]. Lesions of Type II and III may be compounded by negligence of oral hygiene home care, possibly due to dentin hypersensitivity at the early stage of disease.

The clinical features of Type I erosion lesion "fit" the conventional variety description of tooth surface loss, defined decades ago. It affects coronal enamel, may involve exposed root, and appears as a cupped out or flattened, hard, smooth, tooth colored defect, commonly seen on the facial third of the dentition. Lesions caused by intrinsic or abnormal dietary habits may appear on the lingual aspects, predominantly the maxillary arch and rarely the mandibular arch.

Type II dental erosion is manifested as a chalky, dirty opaque white enamel lesion that involves the cervical to middle third of the facial aspect of the affected teeth. This type of lesion may involve more of the coronal segment and possibly extend to encompasses multiple aspects of the affected teeth, subject to progression rate and age of the lesion. The decalcified enamel surface is commonly brittle in nature and easily scratchable with explorer. Once disintegrated, underlying dentin becomes exposed, displaying a range of a tanned discoloration, which intensifies by age and axial deepening of the lesion.

The clinical feature of Type III contemporary erosion lesions em-

bodies a unique dark brown dentin, creating a pseudo-image of dental caries. Occasionally, these dentin lesions are outlined by a halo of demineralized unsupported remnants of rugged, sharp, white, brittle enamel margins [5]. That gives reason to examine systemic health and dietary history, oral hygiene care, and abnormal masticatory habits to help identifying causative etiologies.

Requirements for a Universal Erosion Scoring System

To identify the type and assess the severity of erosion lesions, a universal erosion scoring system should have the following features:

1. Clearly defined criteria, concisely described, easily understood and logically adhere to lesion' development.
2. Few scores for ease of application, memorization, production and reproduction of data for interpretation, comparison and statistical analysis.
3. Easily used by clinicians with all skill levels.
4. Permit screening number of populations within a reasonable time and a nominal effort.
5. Possess a discriminative degree of sensitivity that allows identifying changes in lesions.
6. Enable tracking progression and regression of the disease process.

The Proposed Universal Erosion Scoring System (UESS)

The developmentally based universal erosion scoring system is designed to assist diagnosing and assess the extent of the lesion. Figure 1 demonstrates three types of contemporary erosion lesions arranged in horizontal rows (Types I, II, III). Each type is given scores from 1-5. Illustrating each stage of development are clinical photographs. The progression of development and degradation of these erosion lesions are taken into consideration and each lesion is photographically depicted, described by the corresponding criteria and represented by the associated numerical scores to facilitate diagnosis.



Figure 1: Universal Erosion Scoring System (UESS)

Illustration: A compound photographic illustration that combines the three types of contemporary erosion, I, II and III, each type is given five scores. These scores expressing the extent of lesion' development described by the associated criterion.

Index and Criteria

Scores	Criteria
1	One enamel surface involved, ESI
2	One dentin surface involved, DSI
3	More than one dentin surface involved, >DSI
4	All dentin surfaces involved, All DSI
5	Loss of dentin core, LDC

Score 1: One enamel surface involved. [An initial stage of erosion lesion, affecting one enamel surface and is viewed as: a partial loss of enamel thickness (Type I), decalcified chalky white lesion (Type II), or decalcified tan or turbid discolored lesion (Type III)]

Challenging dentition by acid from various sources over prolonged time leads to enamel surface decalcification, turbidity, and eventual loss of surface integrity. Enamel undergoing decalcification and simultaneously is subjected to continuous wear mechanism could exhibit surface loss. The residual enamel surface may appear to have normal color, smooth texture, and hard consistency (Type I). It may also look chalky, dull, white surface that becomes porous, easily scratched by an explorer, and grows vulnerable to extrinsic stains and wear process (Type II). Eroded enamel may be slightly discolored and display few brown spots (Type III). These types of

erosion lesion are predominantly generalized and detected at the gingival third of the facial aspect of dentition and rarely on the lingual aspect. Lesions associated with defined dietary etiologies or intrinsic causes are often localized, site specific and are subject to frequency, direction of exposure and site of impact of acid.

Score 2: One dentin surface involved. [Erosion lesion penetrated through enamel thickness exposing one aspect of dentin. Appears as worn-out surface, tan or dark brown]

Progression of erosion lesions in enamel, both laterally and axially into deeper planes, occurs parallel to tooth surface. Decalcified enamel breakdown leads to exposure of underlying dentin: both enamel and dentin surfaces could present normal color, smooth and hard surface texture (Type I), while dentin in types II and III lesions, appears tanned (Type II) or light brown (Type III). These lesions could be hard, cartilaginous, or slightly soft in consistency. Enamel surface surrounding the invaded dentin in Type II and III may present an irregular, chalky white with unsupported, brittle, easily broken enamel margins.

Score 3: More than one dentin surface involved. [Erosion lesion invaded more than one aspect of dentin, may appear as worn-out surface, dark tan or dark brown]

Constant assault of the exposed dentin and remaining enamel by acidic challenge leads to progression of erosion lesion. The lateral expansion leads to more involvement of surface areas, where facial lesions commonly expand to interproximal aspects at the same level. Simultaneously, deeper penetration into dentin due to axial

progression leads to expanding the lesion into dentin core. The exposed dentin in Type I erosion manifest loss of surface, while maintaining firm consistency and normal tissue color. Types II and III lesions can exhibit a cartilaginous or softened consistency whose color gradually becomes increasingly darker in shade.

Score 4: All dentin surfaces involved. [Erosion lesion invaded all aspects of dentin, whose surfaces may appear as worn out, tan or brown. The exposed dentin could present a smooth hard surface, cartilaginous or a soft in consistency]

The spread of developing erosion lesions through facial and interproximal planes totally undermines the overlaying enamel remnants that displayed resistance to etching, due to diluting and neutralizing actions of saliva. Subsequently, this contributes to enamel loss from all aspects, involving all dentin surfaces that become subjected to continued challenge by acidic fluids, which incrementally etch and decalcify the dentin core. Dentin surfaces may maintain their consistency, natural color, and surface hardness (Type I), while in Type II, the dentin core may attain a cartilaginous-like consistency that assumes a dirty white color with yellowish hues. A blackened brown discolored dentin that attains softer consistency is predominantly found in Type III erosion lesion.

Score 5: Loss of dentin core. [Erosion lesion designates a total coronal core destruction leaving behind root remnants, which could be clinically visible or radiographically detectable]

Continued axial progression of the erosion process eventually leads to deeper invasion into the dentin core resulting in further decalcification, softening and becomes vulnerable to abrasive traumatic wear that hastens removal of softened dentin. A partial loss of dentin core allows acidic fluid to get into direct contact with the inner and deeper layers of remaining dentin leading to a total collapse of coronal tooth structure. Root segment is left at or below the gingival margin. A typical radiographic feature of this erosion defect is characterized by a sharp horizontal line of demarcation delineating the advancing front of progressive erosion process from the underlying healthy root structure.

Protocol to Employ the Universal Erosion Scoring System (UESS)

This System can be employed as a useful tool for record keeping in the dental office and assessing large populations in clinical surveys, or clinical trials. The protocol to use the UESS may follow one of two tracks or a combination: 1) Assessing the dominant types of erosion lesion; or 2) Valuation the degree of severity of the disease progression of the dominant lesions.

The primary emphasis of an examiner is to first identify the dominant type of the dental erosion lesions in a dentition. Having classified the lesion as Type I, II or III, the findings can be tabulated and/or graphically presented. Otherwise, the focus may be directed to evaluate the degree of severity of the most advanced lesion in each sextant by giving a score from 1-5. The average score of all examined sextants signifies the severity of dental erosion for a particular individual. Similarly, the average score for the entire study popu-

lation can be calculated. Subject to the clinician's or study's objective either the dominant Type of lesion (I, II, or III) or the extent of Severity of the lesions (1-5), or a combination as a composite score is recorded for each individual. The data secured are used as a parameter to evaluate the efficacy of various influencing factors such as preventive and or therapeutic measures, or to follow up the disease progression among a designated population.

Discussion

The complexity in diagnosing and the insufficiency to accurately assessing the extent of lesion development during clinical examination add to the inability to compute the information gathered due to lack of standardized method of quantification, hindering communication among concerned parties. Attempts to introduce a scoring system that quantify the severity of all types of dental erosion lesions during the past decades have encountered shortcomings, thus pressing the need for developing a standardized scoring system that could overcome these difficulties. To remedy this nagging difficulty, a scoring index system that have the tools necessary for an accurate assessment of all types of dental erosion lesions and at any stage of their development has long been overdue. This scoring system should also allow for ease of application and recording of findings, while enabling better dissemination and communication of processed data among interested parties. These advantages would certainly advance the recognition of dental erosion as an integral aspect of clinical dental science and greatly benefit clinical researchers and their patients in this field of endeavor.

The protocol for applying the "Basic Erosive Wear Examination" (BEWE) that emerged in 2008 called for assessing the most severely affected surfaces in each sextant using four-level scores [3]. The cumulative score was classified and matched to risk levels that guide the management of the condition [3]. Two years later, a Simplified Erosion Partial Recording System (SEPRS) using four permanent or six primary surfaces as markers was employed to evaluate dental erosion and soft drink consumption among Swedish children and adolescents [4]. This system was reported to be sensitive and specific with respect to scoring all maxillary canines/incisors and first permanent molar/all primary molars. The severity of the lesion in the Swedish study was measured by the extent of the defect into one or more surfaces of dentin in the maxillary arch. The design of this system had inherent limitation that could be encountered upon assessing severely advanced lesions, other than those evaluated in the studied population. Thus, if this system is applied to survey populations with advanced erosion lesions, the type commonly encountered among avid consumers of acidic beverages or patients with severe systemic etiologies, this system could stumble upon crippling limitations [5-7].

In an epidemiological survey to assess dental erosion among few hundreds of adolescents, three scoring systems were compared [8]. The evaluated systems were the Basic Erosive Wear Examination (BEWE), the Simplified Tooth Wear Index (STWI), and the Evaluating Index of Dental Erosion (EVIDE) [3,4,8]. It was concluded that the STWI appeared to have the lowest content validity, while

the BEWE was convenient to use with sufficient sensitivity and specificity [8]. The authors of the study recommended that the cut-off values of the BEWE index be reconsidered in order to reflect the severity of advanced erosive lesions [8]. They also emphasized the need to supplement the BEWE with a group of sufficient validated etiological criteria that are necessary to establish a more accurate differential diagnosis of dental erosion lesion [8].

In a recent review of the available methods used to study dental erosion, Schlueter and co-workers concluded that none of the methods currently available are suitable [9]. Likewise, none of the currently available systems used to score erosion lesions include all progression stages of development, which limits their universal use in clinical studies [9]. Furthermore, in their comparison of exposed dentinal surfaces resulting from abrasion and erosion, Bell et al stated that other assessments may offer limitation of lesion's extent [10]. These assessments require a tedious multi-step process for determination, which can be time consuming for studying large number of the population [10]. Moreover, the simplified qualitative characterization of mild, moderate or severe, may be vague, unclear, lacking accuracy, difficulty to digitize or compare data, and questionable for use in a precise field of study.

The shortcomings of attempts to introduce a universally acceptable scoring system during the past decades, have left this field of assessment wide open, setting up a challenge for the development of a scoring index system that can be universally used. The much-needed erosion scoring index system should be inclusive to encompass the diversified features and severity of erosion lesions, offers accurate quantification of the extent of the lesion and be sensitive enough to distinguish among numerous developmental phases. The new system should, therefore, consolidate the criteria used by the previous ones, facilitate differential diagnosis among various types of erosion lesions, offer accuracy of assessing the extent of the lesions, and simplicity of use.

The Universal Erosion Scoring System (UESS) described here can be used to assess the prevalence of various types of erosion lesions and assessing their severity. Once the type of dominant lesion is categorized, assessing the extent of tissue damage calls for a discriminative criterion to be employed. Such criterion embraces: 1) Enamel and dentin involvement, 2) Clinical features and extent of the lesions, 3) Surfaces involved and condition of the dentin core and root remnant. 4) Ability to digitize these findings with simple to use precise numerical scores that represent the criterion describing each given lesion. The simplified format of this universal erosion scoring system expressed by few numerical scores adds to the clarity of defined descriptive criteria, can facilitate memorization, training and diagnosis.

The numerical scoring system allows for categorizing the type of the encountered lesion and assess the severity of these lesions, permit conducting statistical analysis of collected data, and comparing results obtained from various studies. The proposed UESS could, therefore, enhance communication among professionals,

researchers, and decision makers in this field. It can also allow for global identification of the prevalence of the disease types as well as the severity of the lesions, assist policy makers, public health care professionals and international organization to plan a strategic preventive and management approach.

Concluding Remarks

A proposed scoring index for a universal assessment of erosion lesions in clinical studies, global surveys, and private practice is presented. The specifications of the proposed system along with advantages for use and protocol for application are discussed. The comprehensive nature, simplicity, and keen adherence to the developmental phases of the disease process are unique markers that make it easy for proper identification, diagnosis, and assessment of extent of the disease process.

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