ISSN: 2573-8224

Review Article

Journal of Oral & Dental Health

Brown Lesions in Dentin: Caries versus Erosion

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Submitted: 21 Nov 2022; **Accepted:** 02 Dec 2022; **Published:** 28 Dec 2022

Citation: *Mohamed A Bassiouny (2022) Brown Lesions in Dentin : Caries versus Erosion. J Oral Dent Health 6(3): 164-169.*

Abstract

Today's dental professionals are frequently confronted with brown lesions in dentin. This image represents Type III contemporary dental erosion lesions, yet it is strikingly resembling the traditionally described dental caries. Such a resemblance can be misleading and could complicate diagnosis. An erroneous identification of these lesions may not alter restorative management but could indeed derail the course of preventive measures leading to an undesirable prognosis. To avoid this mishap, the characteristics, etiology and pathogenesis of brown erosion lesions are reviewed and their fundamental clinical differences from the comparable carious lesions are highlighted to aid in identification and to a proper preventive course.

Keywords: Brown lesions, Clinical features, Caries, Erosion

Learning Objectives

Brown lesions in dentin and the differential diagnosis. Characteristics of carious lesions versus erosion lesions that are commonly found in human dentitions, and the key criteria for identification.

Introduction

The uncanny similarities in clinical features of brown lesions in the human dentition often causes a conflict in identification by clinicians [1]. Difficulty in recognizing and distinguishing the differences among these lesions and identifying the nature of their origin could, in turn, create an argument among dental professionals. Whether these lesions are caused by dental caries or dental erosion, their etiologies become questionable, thus obscuring diagnosis [2,3]. This may not skew treatment planning, but it could derail a proper course of prevention and certainly alter prognosis.

Although brown discoloration in dentin may not be alien to the field of cariology, its characteristics have hardly been recognized, let alone acknowledged, as a possible manifestation of dental erosion until recently [1,2]. The past two decades witnessed increased incidences of contemporary dental erosion that has gained awareness by professionals, the media, the public at large, and major international institutions [4]. The emergence of contemporary dental erosion as a serious dental hard tissue disease among today's young population presented concerns as a growing dental public health issue [5-12]. Literature on dental erosion indicates that acidic dietary ingredients, such as acidulated beverages, have considerable impact as the single most dominant etiology of this disease [2,5-15]. The widespread abusive daily intake of excessive amounts of acidulated carbonated beverages as a refreshment or a source of energy, rendered the population vulnerable to dental erosion [2,5,7,10,14,15]. Simultaneously, the excessive consumption of citrus fruits and juices increases the potential for higher incidences of dental erosion among senior adults [6,7,16,17].

Erosion lesions associated with chronic frequent consumption of large volumes of sugar-sweetened carbonated acidic beverages could display distinctive features, characterized by a brown discoloration of dentin [1,2,18]. This singular feature is the common denominator between Type III dental erosion and the comparable carious lesion [1,3]. Thus, in view of modern acidic diet, it is imperative to identify the similarities and distinguish the differences among these two lesions. These diagnostic steps are fundamental for establishing a comprehensive treatment plan and outlining proper preventive management. It could also alleviate potential diagnostic pitfalls and minimizes conflict of opinions among dental professionals.

Contemporary Varieties of Dental Erosion Lesions

Three types of contemporary dental erosion lesions are currently recognized in the dental literature (Figures 1 and 2) [1,2]. Two of these lesions routinely observed among today's young population are associated with high volume intake of acidulated beverages. Added to the conventionally known variety (Type I) shown in Figure 1, two types were recently identified and acknowledged as Type II and Type III dental erosion (Figure 2). Type II is linked with excessive intake of sugar free acidic beverages (Figure 2a), while Type III is associated with intake of the sugar-laden variety of acidic soft drinks (Figure 2b) [1,2].

Figure 1: Type I contemporary dental erosion

Figure 2a: Type II erosion seen on mandibular incisors

Figure 2b: Type III erosion seen on left posterior dentition

The clinical features of Type I erosion lesions "fit" the description of the conventional variety known for decades and described as tooth surface loss of a dentition challenged by acids and simultaneously subjected to wear processes. Type II dental erosion is manifested by a chalky, dirty white opaque enamel. Once disintegrated, it exposes underlying dentin that displays a range of tan discoloration. The clinical feature of the third type of contemporary erosion lesions (Type III) is characterized by a dark brown dentin discoloration often outlined by a halo of demineralized white, rugged, sharp, and brittle enamel margins [2]. This brown discolored dentin projects a pseudo-image that mimic's dental caries, whose similarity gives ample reasons for uncertainty during the diagnostic process [1]. Thus, to resolve this potential conflict, the etiologies, pathogeneses, clinical and radiographic features of Type III erosion lesions and those of dental caries must be explored in order to identify their differences. expand the image laterally to the level of figure 2b.

Origin of Brown Discoloration

Brown discoloration of dentin may be a sure sign of dental caries, yet, arguably it could also be a clinical manifestation of Type III contemporary dental erosion [1]. This brown discoloration of the two comparable lesions is the outcome of a chemical reaction between acids and sugar present in situ [1,3]. Brown discoloration of erosion lesions in collagen (muco-poly-saccharides) rich dentin, subjected to acidic challenge is often associated with excessive intake of sugar sweetened acidic beverages [18]. Simultaneously, the role of acid-producing cariogenic microbial organisms in the formation of brown discolored dental caries in the presence of sugar has held the attention of dental researchers and professionals for generations [19-23]. The resultant brown discoloration in both lesions seemed to intensify by age, increased sugar content, high concentration of acid, high collagen content, and deeper penetration of the lesions [18].

This browning phenomenon was explained during the nineties as a biochemical process long known to hematologists for its association with diabetes [24]. A clear demonstration of this phenomenon is the brown skin patches that appear in diabetic patients and are believed to be a biproduct of keto-acidosis, a reaction of ketone bodies (acidic) with the sugar found in the blood or host tissues. This acid/sugar reaction is known as non-enzymatic browning, glycosylation or Maillard reaction [24].

The role of sugar in the development of brown dentin discolored erosion lesions in the presence of acids was explained [3,24]. The sources of sugar for carious and brown erosion lesions in dentin are the same that is imported to the oral cavity from extrinsic sources. The sources of is acids, however, are diametrically opposite in origin, type, and volume for the two lesions. Culprit acids that are integral to the genesis of Type III dental erosion originates exclusively from external sources. Acid (Lactic acid) involved in dental caries pathogenicity is exclusively synthesized in situ as a metabolic byproduct of cariogenic microbial organisms ingesting refined sugar. In carious lesions, Lactic acid is produced in a

small quantity (micro-millimeter) by the microorganisms of dental plaque and acts on a localized area subject to the amount of plaque accumulated. Among the extrinsic acids imported to the oral cavity in large volumes that could amount to liters, are mostly citric, phosphoric, and acetic acids. This large amount of extrinsic acidic fluids overwhelms the entire dentition in a generalized pattern, challenging and exposing larger surface areas. Thus, in view of the differences highlighted for the origin of the two comparable lesions, multiple clinically significant outcomes can be expected.

Differential Diagnosis

Brown erosion and carious lesions may look alike, but, their differences could be manifested by seven markers. To unveil these significant differences among the two comparable lesions, close inspection of the following identifiers should be taken into consideration.

1. Topography

Brown erosion lesions in dentin often occur as a cluster of lesions possessing similar characteristics. These lesions could present as a narrow cervical slit or semilunar appearance that is wrapped around two or more aspects of the tooth and may be expanded to assume an amorphous shape. These lesions could possess a semihard or cartilaginous consistency that turns leathery. Extensive lesions are often bordered by a decalcified white halo of brittle, decalcified enamel marking the advancing front of the lesion. Brown carious lesions in a similar location could exhibit smaller surface areas with a tacky to soft texture, and a healthy surrounding enamel that may appear slightly yellowish or grayish, if undermined.

2. Location

Caries and brown erosion lesions could be found on the cervical third of the facial aspects of the dentition. Erosion lesions often involve a larger surface area of cervical third of coronal enamel and possibly expand to include the root surface, as seen on (Figure 2). These lesions could involve the proximal aspects at the same level as well as the middle third and finally the incisal or occlusal segment at the later stage of lesion development. Primary involvement of the lingual aspects rarely occurs by the challenging acid due to the neutralizing and washing actions of saliva, while this aspect might be secondarily affected by the expanded lesion from the approximal aspects. Carious lesions primarily involve pits and fissures of premolars and molars segments as well as the buccal pits of the molars. Their presence on the smooth surfaces of the dentition are limited to the gingival third of the facial aspect (Figure 3) and just below the contact areas of the teeth on the approximal surface (Figure 4). These sites are particularly vulnerable to plaque accumulation. Erosion and carious lesions involving the interproximal aspects often follow diverse patterns of location, geometrical configuration, and relative depth.

Figure 3: A limited carious lesion on the cervical root surface of #7

Figure 4: #s 8 and 9 demonstrate extensive carious lesions on their interproximal aspects

3. Distribution

Brown erosion lesions caused by acidic beverages commonly occur in a widespread distribution as acidic fluids challenge the dentition in a generalized fashion. They inflict massive tissue destruction on multiple teeth at once within a dental arch and commonly involve more than one quadrant of both arches. By comparison, carious lesions are localized, affecting individual teeth in one quadrant and occasionally the contra-lateral teeth, sometimes in a symmetrical fashion. More than one tooth per quadrant may be involved.

4. Progression

In erosion lesions, once demineralization of enamel took place by culprit acid, remnants of organic lattice easily crumbles, exposing underlying dentin. The dentin lesion spreads in lateral and axial directions simultaneously: the lateral spread in a superficial plane and involves a larger surface area, while axial progression in deeper penetration takes place incrementally by consecutive acid attack. The eroded superficial layer of dentin disintegrates by subjecting it to abrasive wear. This process further exposes newer strata of dentin, which in turn becomes challenged by the dual actions of acid and wear. By consecutive acid attacks, invasion of the deeper tissues occurs gradually in a striation-like penetration, which occurs in planes almost parallel to the outer surface.

As for carious lesions, lateral spread is limited, while axial penetration towards the pulp is more aggressive. Caries lesion progression begins by demineralization of dental hard tissues and dissolving hydroxyapatite by lactic acid produced by cariogenic microorganisms. This process is followed by proteolytic enzyme action, which devour the remnants of organic structure of dentin. Unlike erosion lesions, axial invasion of carious lesions in dentin is commonly recognized by the cone-shaped penetration.

5. Association with Periodontal Health and Salivary Glands

Unlike dental erosion, dental caries is closely linked to the presence of cariogenic microbial organisms found in dental plaque. Accordingly, caries is found in sites where these microbial organisms are harbored in vulnerable sites of the dentition. The lack of oral hygiene, frequency, efficiency of methods used, and type of diet are among the contributary factors affecting plaque formation [25, 26]. Accordingly, caries lesions that develop near gingival margin or at the contacts area are often accompanied by presence of marginal gingivitis. This scenario is less likely to be found in association of brown erosion lesions that are often found close to healthy gingiva. A departure from this norm can be experienced by patients neglecting their oral hygiene home care for some apparent reasons.

Brown erosion lesions develop generally in sites located in direct pathways of challenging acids. Areas of the dentition with low salivary flow are particularly vulnerable. These sites are predominantly distant from the major salivary glands' openings [27,28]. Examples of these sites are the facial aspects of maxillary and mandibular anterior teeth and facial aspects of mandibular premolars and molars. The lingual aspects of the entire dental arch, the facial aspects of maxillary molars and the biting surfaces of the mandibular arch are less likely to be affected by erosive action of acidic beverages due to continued bathing by saliva. An exception to this rule may be seen in high-risk individuals where salivary flow is low, patients suffering from xerostomia, compromised salivary glands by prolonged radiation or chemotherapy, mouth breathers and those individuals accustomed to hold acidic beverage in their mouth, soaking the entire dentition before swallowing.

6. Radiographic Images

Radiographic images of brown erosion and caries lesions in dentin located on the facial aspect of dentition may display similar areas of radiolucency that differ in outline. Carious lesions could display hazy, ill-defined advancing borders that smoothly merge into the surrounding healthy structure. Meanwhile, erosion lesions in this site are characterized by a well-defined sharp demarcation line limiting the lesion from the surrounding healthy tissues. Lesions located on the proximal aspects of the teeth are more easily identifiable from one another by their profile. A radiographic image of a carious lesion is commonly found immediately beneath the contact area, while that of the erosion lesion is found more cervical close to the gingival margin. The former lesion presents as a cone shaped or triangular radiolucency with a wide base at the surface and cone tip-shaped of the advanced front pointing in a pulpal direction. This display gives the lesion a confocal configuration, typical of a caries lesion. Meanwhile, interproximal erosion lesions present a shallower axial depth and a relatively wider occluso-cervical dimension. The base and advanced front of this erosion lesion takes a parallel pattern to one another and to the tooth surface.

7. Sequela

Constant and successive challenges by the erosive acid destroys the hydroxyapatite backbone of dentin and weakens its structure. Gradual invasion of the dentin core ensued by challenging acid leads to pulpal necrosis, hence scarcity of pain. Progression of carious lesions into dentin is promoted by a dual action of micro decalcification of hydroxyapatite by lactic acid and proteolytic enzymes produced by microorganisms in the presence of sugar. Successive repetition of this mechanism allows invasion of deeper dentin core until the pulp is breached. Pulpal response is elicited subject to the aggressiveness of microorganism, pulp vitality, and severity of stimuli.

Discussion

Discovery of a brown lesion in dentin may assure unsuspected clinician of a possible dental caries lesion, but for the purpose of accuracy, differential diagnosis ought to ponder the possibility of brown dental erosion. This exercise must be considered prior to planning the lesion's management, particularly, outlining preventive protocol. Dental professionals are becoming increasingly acquainted with a variety of dental erosion lesions associated with modern diet and dietary habits, specifically the excessive intake of sugar sweetened acidic beverages [1,2,18]. Because the departure of clinical features of the associated brown erosion lesions in dentin from the accepted characterization of traditional dental erosion, their detection presents a diagnostic challenge, due to their close similarity to dental caries. Misdiagnoses and subsequent selection of the incorrect preventive approach often leads to a questionable prognosis and frequent recurrence [1-3]. Divergent opinions in diagnosing these brown lesions may have deeply rooted reasons in today' dental education that still places considerable emphasis on dental cariology as the primary focus of the didactic and clinical dental curriculum. Meanwhile, contemporary dental erosion receives minor mention, if any that is limited to a definition or

at most clinical signs featuring a sort of tooth surface loss. This description of the traditional erosion lesions (Type I) can be misleading since it lacks consideration of the diverse characteristics of contemporary dental erosion lesions encountered in today's dental practices [1].

Persistent indoctrination of the new generation of dental clinicians to recognize a brown lesion observed in dentin as a signal of discovering dental caries, could lead to focal polarization and creating a mindset that it solely represents dental caries. This portrayal of a brown lesion disregards and excludes other brown lesions observed in human dentition. The foremost and most predominantly detected of these are non-carious brown erosion lesions Type III [1,2,18]. This type of erosion lesion displays a distinctive feature of brown discoloration of dentin that is a common denominator with carious lesions [1-3]. Because of potential diagnostic pitfalls and in order to minimize possible conflict among diagnosticians, it is imperative to explore the characteristics of both lesions and identify their differences, in view of the aforementioned markers.

Upon charting the course of prevention for these comparable lesions, the causative etiology of each should be taken into consideration. Acid is the principal culprit of dental erosion. Cariogenic microbial organisms of dental plaque are responsible for dental caries, and refined sugar is essential for the bio-synthesis of these microorganisms to produce their destructive biproducts of Lactic acid and proteolytic enzymes responsible for development of carious lesions. A combination of acid and sugar are essential for formation of brown discoloration of both caries and Type III brown erosion lesions [18]. In view of these broad outlines, the targets for planning preventive protocols for the two comparable brown dentin lesions, though different, can be safely identified. Prevention of caries is primarily reliant on the commonly established premise of plaque control combined with reducing the intake of refined sugar to a minimum [29,30]. Hence, the importance of oral hygiene home care instructions to control dental plaque and also dietary counselling to decrease sugar intake. As for prevention of brown dental erosion, the recommended course of action is limiting the intake of sugar-sweetened variety of acidulated beverage; by reducing the volume, frequency, and duration of intake to a smallest. Crucial addition to these plans is to strengthen the host enamel and exposed dentin by enhancing their resistance to acid, which can be achieved by developing a hydroxyfluoro apatite on the surfaces using topical fluoridation therapy [31].

Concluding Remarks

The clinical manifestations of the comparable brown erosion and carious lesions were reviewed to facilitate their identification and confirm their diagnosis. Subsequently, planning a suitable preventive protocol can be properly outlined.

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