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Literature Review Article

Intrinsic and extrinsic dental erosion: literature review

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Abstract

Introduction: Dental erosion is the irreversible loss of tooth structure by a chemical process, without bacterial involvement. Its etiology is multifactorial, characterized by factors of chemical, biological and behavioral origin, being divided into intrinsic or extrinsic origin. **Objective:** To present the main factors that may trigger erosion lesions, relating them to the concept, diagnosis, clinical features, etiological factors, prevention and treatment. **Material and methods:** Scientific articles found in PubMed (English), SciELO (Portuguese) and Google Acadêmico (Portuguese) between the years 2010 and 2022. **Results:** Intrinsic factors are those associated with the presence of endogenous acids such as gastric acid, somatic disorders, periods of pregnancy, alcoholism and gastrointestinal problems. Extrinsic factors are related to eating habits, frequent intake of acidic beverages and foods, and oral administration of medications. The most common clinical characteristic is loss of enamel luster, a smooth, U-shaped surface, which with persistent exposure to acid forms concavities and excavations on the occlusal and incisal surfaces. It affects the palatal surface of the upper anterior teeth and the occlusal surface of the posterior teeth. The consequences of dental erosion include dental hypersensitivity and marginal degradation of existing restorations. **Conclusion:** Dental erosion can cause serious complications, requiring patient compliance. The professional's knowledge of the etiological factors, associated with a good anamnesis and a detailed clinical examination, decides the best treatment, whether preventive or restorative for more severe cases, thus improving the patient's quality of life.

Introduction

Over the years, it has been observed that the life expectancy of the population has increased significantly, causing teeth to be exposed to chemical and physical conditions for a longer period. Given this scenario, teeth and restorative materials are expected to have a longer life span in the oral cavity. Dental erosion has been one of the major causes of dentin hypersensitivity and marginal degradation of present restorations. The interest of researchers in erosive tooth wear has been accentuated and has been increasingly reported in the daily life of the dental surgeon [3].

Dental erosion is part of the group of non-carious lesions, comprising: abfraction, abrasion, attrition and erosion. These processes are featured by a loss, especially in the cervical segment of the dental tissues. However, they can also occur on the interproximal, buccal and palatal surfaces. Although they have clinical similarities, such as the "V" shaped lesion on the cervical side of the tooth, abfraction and abrasion are caused by different factors [19].

Abfraction usually occurs by eccentric occlusal overload, while abrasion happens by a repetitive mechanical process, in which there is a habit of friction between objects or materials on the tooth surface, causing mechanical wear. Attrition is due to the contact of a tooth with its antagonist, often related to bruxism and found on the occlusal and incisal surfaces, where tooth-to-tooth contact occurs during chewing [19].

According to Schlueter *et al.* [21] dental erosion, is the loss of mineralized tooth substance, which has been exposed to acids not derived from oral bacteria. It is characterized clinically, in early stages, as a saucer-shaped or "U-shaped'" demineralization of the enamel, loss of gloss on the tooth surface, which evolves into a flattening of the convex parts. With persistent exposure to acid, they form concavities and excavations on the occlusal and incisal surfaces. It is usually found on the buccal and palatal surfaces of the anterior teeth, and on the occlusal and palatal surfaces of the posterior teeth, as concave, wide, smooth depressions, giving the teeth a plain appearance [2, 3, 21].

The etiology of this lesion is divided into intrinsic origin, resulting from endogenous acids such as gastric acid due to voluntary or involuntary reflux, somatic disorders, periods of pregnancy, alcoholism, and gastrointestinal problems with recurrent vomiting and reflux; and extrinsic origin, such as foods and drinks with acid pH included in the diet, acids present in the air in work environments, swimming pools with ineffective hydrogen potential monitoring, and oral administration of medication [7, 8].

With the increased consumption of processed foods, which have a pH below the critical pH for enamel (less than 5.5), the demand for dental surgeons due to tooth erosion has increased significantly. Patients seek the dental office with the complaint of dentin hypersensitivity or for aesthetic reasons. Pain occurs, since with erosion, there is an exposure of dentin and dentinal canaliculi, which come into contact with stimuli in the oral cavity, and the dolorous sensation is triggered [2].

Another considerable endogenous reason is that due to esthetic pressures and the search for a perfect body standard, many adults suffer from bulimia nervosa, which is characterized by episodes of compulsive consumption of food and, in sequence, a compensatory and inappropriate way to prevent weight gain. Therefore, vomiting is forced, indiscriminate use of laxatives, diuretics, radical diets, and excessive physical activity. When vomiting is induced the gastric acid, with a pH of approximately 2.3, comes into contact with the tooth surfaces, causing the enamel to dissolve and become susceptible to mechanical wear [17, 22].

Dental erosion can manifest itself as a lesion arising from a systemic disease, such as pathological gastroesophageal reflux, a disease that refers to the retrograde passage of gastric contents into the esophagus frequently. This pathology has manifestations such as acid taste, vomiting, heartburn, hoarseness, sialorrhea, halitosis, episodes of burping and choking, persistent coughing, and stomach pain, or it can be silent, with no apparent signs and symptoms [6, 18, 22]. A systematic review brings together studies showing that the prevalence of dental erosion was higher in the group of individuals who had gastroesophageal reflux disease, indicating that acid reflux is a risk factor for dental erosion [18]. Oral alterations can also occur, in which erosive dental wear is the first manifestation to be identified. The teeth affected by these lesions are yellowish, hard, smooth, concave, shallow, wide and the cusps are depressed. In addition, the restorations present can acquire an island appearance, and when these are amalgam, they become polished [6, 22].

The diagnosis must be well oriented and recognize what is happening. To try to determine whether ethology is intrinsic, extrinsic, or both, the main complaint reported by the patient should be performed through a detailed anamnesis, followed by a thorough clinical examination to observe

the shape, location of the lesions, stage, occlusion and oral hygiene status. In addition, the patient's medical and medication history should also be considered. Information is sought on the possibility that the patient suffers from gastroesophageal reflux, anorexia, and bulimia, which are more likely to develop dental erosions, thrush, tooth sensitivity, mouth burning, and sour taste [8, 18].

Saliva has an important function in preventing erosive tooth wear, as it is associated with buffering capacity, variation in calcium concentration, ion concentration, and the rate of salivary flow. Hard tissue protection occurs when tooth demineralization from bacterial or food acids can be inhibited by the bicarbonate present in saliva, which increases the pH and buffering capacity. However, the flow rate, electrolytes and proteins, composition and buffering capacity are all factors that alter the ability to remineralize after contact with an acid [24].

The treatment and control of non-carious lesions include patient motivation, removal of etiologic factors, and then restorative treatment, when necessary, in order to prevent lesion progression. Professionals should be attentive to the prevention and early detection of dental erosion, because more evolved stages of this disease lead to aggressive and expensive treatments for their patients [8, 23]. Treatment can be different depending on individual aspects, such as dentin hypersensitivity providing a condition in which either low or high intensity laser can be used. However, the degree of severity of the dentinal hypersensitivity should be analyzed before performing this type of treatment [23].

The use of fluoride mouth rinses stands out for increasing enamel resistance to acid-induced dissolution, and for being a preventive technique in conjunction with fluoride dentifrices. To minimize the action of the acids, mouth rinses with sodium bicarbonate and foods that contain milk can be used. However, the treatment varies according to its etiology. In cases in which the cause is diet, the patient must be instructed to avoid the use of acidic foods and drinks, to prevent the progression of the lesion [7].

In the deciduous dentition, restorative treatment is not indicated when there is no painful symptomatology. In cases where sensitivity or a small area of erosion is present, composite resin restorations are indicated. The objectives are to restore the missing tooth tissue, returning function and esthetics, to prevent further loss of tooth surface and consequently maintain occlusion [15, 23]. For lesions with larger areas, crowns, composite resins on anterior teeth and metal crowns on posterior teeth can be used [23].

In recent years, dental professionals are becoming increasingly aware of the problem of erosive tooth wear. The present study is necessary, since the cases of bulimia nervosa, gastroesophageal reflux, consumption of acidic foods, and the bad habits of the population have significantly increased the prevalence of dental erosion. Thus, more research into possible treatments for this condition is important, so that patients can be rehabilitated both functionally and aesthetically.

The purpose of this paper was to present, through an analysis of the literature, the definition of dental erosion, discussing its etiology, prevalence, characteristics, as well as diagnosis, treatment, and possible prevention, based on the scientific literature.

Material and methods

A literature review was conducted on the themes Non-Carious Lesions and Dental Erosion based on the scientific literature available online. The databases used were the PubMed, SciELO and Google Academic websites, in the English language, between the years 2010 and 2022. The keywords used were Tooth Erosion, Gastric Acid and Feeding Behavior.

Results

Intrinsic x extrinsic dental erosion

Dental erosion can be caused by extrinsic or intrinsic factors or a combination of both [8]. Pinheiro *et al.* [19] mentioned that dental erosion is part of the group of non-carious lesions, including: abfraction, abrasion, attrition and erosion. However, they can also occur on the Interproximal, buccal and palatal faces. Although they have clinical similarities, such as the "V"-shaped lesion on the cervical side of the tooth, abfraction and abrasion are caused by different factors.

According to Lussi *et al.* [11], erosion is a disorder that has properties based on fundamental tooth characteristics, physiological properties of saliva, acidic sources and habits. All of these factors must be carefully evaluated. The acids responsible result from intrinsic sources that come from endogenous acids and is defined by gastric acid return or eating disorders, and extrinsic sources that result from exogenous acids characterized by the consumption of acidic foods and drinks. Due to some irregularity in the gastrointestinal tract,

reflux occurs from the involuntary movement of the stomach into the mouth. However, gastric acid entering the mouth can provide erosion of teeth if it constantly remains in tooth tissue. Considering the diet, a major factor in acid exposure, it has several components and foods with complex composition and potential for erosive damage. Erosion is a multifactorial process, in which we can include other co-factors besides diet. Sports lead to intense exposure to water or sports drinks with low pH, and the increased level of gastroesophageal reflux resulting from physical exercise. It is important to mention occupation as exposure to acidic environments, workers in galvanic industries and wine tasters in wineries, damaging mainly the vestibulo-cervical surfaces of the upper incisors and canines and consequently more susceptible to erosive wear.

Also, according to Arato and Fusco [2] lesions can have undesirable effects on oral health, causing dentin hypersensitivity, pain and poor appearance, and can even compromise the dental pulp. Usually erosions are concave, flat, large, and smooth depressions. The location of the lesions will proceed from the etiology, when they come from intrinsic sources they are usually found on the palatal and occlusal surfaces, when extrinsic wear appears on the buccal surface.

Pinheiro *et al.* [19] reported that the intrinsic causes vary from diseases such as gastric inflammation, alcoholism, anorexia, bulimia, radiotherapy, xerostomia and hyperthyroidism, as well as chronic periodontitis, affecting in greater proportion the lingual or palatal face. Extrinsic factors are associated with diet, caused by the consumption of acidic solutions such as soft drinks, processed foods, acidic fruits, ingestion of chlorinated water and some drugs administered orally, usually occurring on the buccal surface. It is essential that the dental surgeon guides the patient in a healthy lifestyle, adequate oral hygiene habits, and removal of the causative agents.

Acid potential of beverages and solutions

The erosive lesions are due, according to Arato and Fusco [2] particularly by the frequent habit of the population to consume acidic substances, by whom started to ingest more processed foods. For such changes to occur, the main condition in which the medium must meet is with the presence of acidity, reducing the oral pH to the critical level of 5.5. The pH measures the hydrogen ion concentration, being acid, neutral or alkaline. Most beverages have an acidic pH and are therefore potentially erosive and have the effect of decreasing saliva. Salivary flow and the concentration of phosphate and calcium are also contributing factors to erosion, so one way to control this acid attack would be to keep salivary flow normal.

Moretto *et al.* [16] related that the evolution of erosive lesions occurs due to the constant consumption of acidic drinks and solutions, including soft drinks, artificial juices, and natural juices. These have pH below 5 and suffer a diversity of acidic components, becoming critical when salivary pH is reduced and leading to a greater process of demineralization than remineralization.

According to Mangueira *et al.* [12], the result of acid etching has as characteristics the loss of salivary organic substances, a loss of mineral from the tooth surface due to the presence of a decalcification agent, and the destruction of the decalcified tooth surface by a biochemical and/or biophysical and/or mechanical action. These situations can often make the diagnosis of the diagnosis of the lesion may become complicated and doubtful for the possibility of coexistence with other non-carious lesions such as attrition, abfraction and abrasion.

Protective functions of saliva

According to Moazzez *et al.* [14], saliva is a biological factor that has great potential to modify the progression of dental erosion. This occurs through mechanisms of saliva that have the ability to protect enamel from erosion from dietary acids. Some of these factors are the role of the acquired pellicle, the salivary dilution action, neutralization and buffering of dietary acids. Saliva is a supersaturated fluid when compared to tooth minerals. It provides ions such as calcium and phosphates that are essential for remineralization. Saliva also contains proteins that concentrate minerals that are essential for remineralization and prevent demineralization.

Moazzez *et al.* [14] described the acquired pellicle as a bacteria-free protein film that forms throughout the oral cavity minutes after oral hygiene. According to Lussi *et al.* [11], while an erosive challenge occurs, the formation of the acquired pellicle is also an important factor. Composed of glycoproteins, proteins, lipids and various enzymes, it is assumed that this film operates against erosion, since it acts as a diffusion barrier or as a membrane with a selection of permeability, which prevents direct contact between acids and the tooth surface. In addition, it was noted that its basal structure

is able to survive relatively severe acid exposures. Between January and September 2009, a study was conducted with more than 100 proteins and various functionalities were identified in the enamel pellicle. It was concluded that variation in the amount and presence of the different proteins can alter the acquired film in terms of its buffering and remineralization function or acting as a semiselective barrier. Some data from in-vitro studies suggested that in tooth regions where the films were thinner, the resistance to erosion was decreased compared to thicker ones.

Lussi *et al.* [11] pointed out that flow rates when stimulated or unstimulated and salivary buffering capacity propose necessary data regarding an individual's vulnerability to erosive challenge. However, dental erosion is multifactorial and not only the two factors should be considered. In some research it has been shown that acidic foods influence salivary flow, which may be increased when compared to unstimulated flow. However, in addition to the acidity of the diet, the attenuated temperature and mechanical stimulation will further stimulate salivation. Hypersalivation also occurs before vomiting episodes, as a response of the brain, and is commonly identified in patients with bulimia nervosa, anorexia, involuntary regurgitation, and chronic alcoholism. This factor can reduce dental erosion when of gastric origin. However, there may not be enough time for saliva to act before erosion occurs. Dental and soft tissue anatomy, by buccal mucosa and tongue movement, and swallowing pattern may also influence the clearance rate of the erosion-causing agents.

It was discussed by Amaral *et al.* [1] that tooth weakening caused by the action of acid is reduced by the action of saliva, since there is the presence of calcium ion. However, when contact occurs numerous times and for a long period, there is not enough time for remineralization. When the pH decreases, the solubility of apatite in enamel increases extremely. This occurs because the solubility of apatite is directly altered by the pH, due to the concentration of hydroxyl being inversely proportional to the concentration of hydrogen and ionic phosphate complexes that are dependent on the pH of the solution. It is considered as critical pH, the range between 5.2 and 5.5; although this value is dependent on the calcium and phosphate present in saliva. When there is a higher saturation of hydroxyapatite in the saliva, it can remain with an oversaturation of fluorapatite. In situations with a pH below 4, the saliva is undersaturated both in hydroxyapatite and fluorapatite, preventing its ability to remineralize.

Tooth erosion in enamel x dentin

According to Carvalho and Lussi [5] tooth erosion in enamel starts with a partial loss of its mineral. This causes a softening and roughening of the initial surface. If it becomes persistent, with further exposure to acid, this demineralization can progress to loss of enamel tissue substance. When combined with abrasive forces, an intensification of surface softening occurs, as mechanical abrasion removes some of the soft enamel layer.

Lussi *et al.* [11] reported that dental erosion in early stages has a difficult diagnosis. The characteristics are the appearance of a smooth, satiny, sometimes matted enamel without perikymaties. When it comes to the distinction of erosion on occlusal surfaces, there are no differences. However, the progression of occlusal erosion triggers a flattening of the surface cusps.

Lussi *et al.* [11] described the aspects of human dental enamel as a strongly mineralized tissue, which in its composition has a stoichiometric form of hydroxyapatite and with prismatic conformation. Enamel prisms are presented as a keyhole shape with long crystal bundles, with a width of 50-70 and 20-25 nm and an indefinite length, extending through the entire enamel thickness. Such crystals are strongly compacted and have a mineral content around 87% of the volume. Enamel also consists of 11% water and 2% organic material of the total volume. In the erosive process there is a centripetal loss of mineral, which starts with a loss of mineral mass, so that the remaining surface shows a partial demineralization. Eroded enamel generally shows a characteristic corrosion pattern. Otherwise, it presents a subtle, lightly structured layer on the surface, which can have a variation in structure and extent according to treatment stages and strategies. When there is a loss of a portion of mineral on the surface there is also a loss of hardness, which evolves with frequent acid impact and leaves enamel surfaces vulnerable to physical impact. This softened layer, presents an inert state and no changes take place while there is a loss of tissue from the remaining tissue surface. On the other hand, the percentage of eroded enamel hardness is dependent on the load applied. When fillers 50,100,145 and 200 g are used there is a reduction in hardness following acid etching of 75,68,57 and 52% when related to healthy tissue.

Lussi *et al.* [11] discussed that dentin is not similar to enamel when it comes to its structure and composition, being more soluble, with an attenuated mineral content (47%) and accentuated organic content (33%). Its organic part consists of

90% type I collagen, besides other constituents such as phosphoproteins, non-collagen glycoproteins, proteoglycans, and lipids. It is a partially moist tissue and has about 21% water by volume. Dentin has a low hardness compared to enamel. Its tissue consists of many dentinal tubules that run from the pulp to the enamel/cemento-dentin junction. Peritubular dentin contains 40% more mineral compared to intertubular dentin and minimal organic content. The mineral is based on an imperfect hydroxyapatite with subtle hexagonal shaped crystals, about 3.4 nm thickness, 14 nm in width and 25 nm in length. These crystals are formed with their axis parallel to the collagen fibrils. Calcium, phosphate and trace elements are present in different concentrations than in enamel. The dentin with dental erosion has its mineral component dissolved and its organic portion retained. The tubules are disassociated longitudinally, with creases at their edges. However, the partially demineralized zone is often not present. The peritubular and intertubular dentin recede at similar rates, but after the first minute, the peritubular dentin is dissolved while the intertubular dentin is more stable. If persistent exposure to acid occurs, the demineralization is accentuated. Otherwise, when a certain thickness is reached, the mineral loss decreases considerably.

Schlueter *et al.* [20] mentioned as tooth erosion occurs with increased exposure, it can cause hypersensitivity, loss of tooth anatomy and vertical dimension. Hypersensitivity triggers the sensation of pain due to the pulp nerves being subjected to physical or chemical stimuli that reach this exposed dentin. This occurs through hydrodynamic means, which alter the flow of fluids within the dentinal canaliculi, causing an excitation in the pulpal nerve terminals. Dentin when exposed to erosive factors is primarily affected at areas with low enamel thickness, such as the buccal surfaces near the gingival margins and the mesiobuccal cusps of the mandibular first molars.

Combined lesions between non-carious lesions

In accordance with Grippo *et al.* [10], it is suggested that non-carious lesions despite being of different etiological origins, have combined effects with each other. Static fatigue biocorrosion and cyclic fatigue biocorrosion are combined manifestations of cervical non-carious lesions, occurring more frequently in the cervical region and if these areas remain free of plaque. Cyclic fatigue biocorrosion occurs when there is a corrosive agent present associated with an intermittent load, which are factors that occur in bruxism, parafunctional habits, clenching or chewing. On the other hand, static fatigue biocorrosion occurs when a corrosive agent exists on the tooth surface and is subjected to sustained loading forces, as happens in prolonged clenching, swallowing, or while there is active orthodontic treatment. Therefore, the chemical and biochemical activity is enhanced in the presence of stresses, explained by the principles of thermodynamics. Thus, there is a combination between different non-carious lesions.

Prevention and treatment of dental erosion

According to Bezerra *et al.* [4], professionals and researchers have given special attention to dental erosion nowadays, corroborating with studies to better understand the process, discussing preventive and therapeutic treatments. As prevention of dental erosion, oral hygiene products that contain fluoride are highly recommended, whether for home or professional use. In view of this, the association of fluoride products with other therapies, such as irradiation with high-power lasers, can be performed. High-power irradiation can be used to potentially increase the deposition and incorporation of fluoride by dental substrates. In this way, it helps to control demineralization. Studies suggest that diode lasers can attenuate the effect of erosion on root dentin. In addition, the Er,Cr: YSGG laser can also be used in preventive treatment, providing chemical, physical and crystallographic changes in dental hard tissue, increasing resistance against acids. This occurs because this type of laser has high absorption by water and hydroxyapatite, acting by means of thermo-mechanical ablation, in which the water molecules that are inside the hydroxyapatite crystals absorb the incident radiation and the resulting water vapor acts to increase the internal pressure, occurring micro explosions, causing an ejection of the substrate in the form of inorganic particles and the removal of the irradiated tissue. However, laser irradiation can promote the formation of small spaces in the enamel, allowing and increasing the incorporation or diffusion of fluoride through the structure, forming a reservoir that will act to protect the tissue. Fluoride in turn, binds firmly to the crystalline structure and gives greater stability to the crystals and resistance against erosive acids. Thus, although emphasized in the literature, the use of lasers individually did not show effective results against the progression of dental erosion, but when an association of laser irradiation with frequent topical fluoride

applications was made, a synergism occurred that increased the resistance of the tooth structure against endogenous and exogenous acids.

Bezerra *et al.* [4] also discussed that fluoride application acts as protection on eroded samples, but has a limited effect because of its low frequency of gel application. However, erosive challenges have high aggressiveness, limiting fluoride protection to a short duration, making multiple applications necessary. However, it has been suggested that in dentin, being a more acid-soluble substrate than enamel, it releases more calcium, which reacts with fluoride and precipitates CaF. This should happen because the organic matrix has the capacity to decelerate demineralization and, in high fluoride concentrations, can interrupt the erosion process. Therefore, it was observed that the association between fluoride and high power lasers demonstrated a synergism that significantly reduces enamel demineralization, and increases fluoride retention. Fluoride when attached to the crystalline structure can exacerbate crystal stability, increase resistance against acids, and serve as a reservoir.

Vasconcelos *et al.* [23] described that the treatment and control of non-carious lesions include patient motivation, removal of etiologic factors, and then restorative treatment, thus preventing lesion progression. Treatment can vary according to individual aspects, such as dentin hypersensitivity, a condition in which low- or high-intensity laser can be used. However, the degree of severity of the dentin hypersensitivity should be analyzed before performing this type of treatment. For deciduous dentition, restorative treatment is not indicated when there is no painful symptomatology. In cases of presence of sensitivity or small area of erosion, restorations with composite resin are indicated. For lesions with larger areas, crowns, composite resins in the anterior teeth and metal crowns in the posterior teeth can be used.

According to Mesko *et al.* [13] oral rehabilitation of severe tooth wear caused by non-carious lesions are treated with direct composite resin because it has effectiveness in both adhesive and physical properties of the material, has acceptable longevity and patient approval due to optimal cost-effectiveness.

Discussion

Dental erosion was defined by Schlueter *et al.* [21] as a loss of mineralized tooth substance that has been exposed to acids not derived from oral bacteria. However, Grippo *et al.* [10] disagreed in parts, as this definition does not recognize proteolysis and piezoelectric effects that also occur when there is biochemical and electrochemical tooth degradation. Thus, according to these authors, the best definition for dental erosion is chemical, biochemical, or electrochemical action that causes molecular degradation of properties that are essential to dental tissue.

Carvalho *et al.* [5] reported that dental erosion begins with enamel demineralization, starting with a partial loss of enamel mineral, leading to a softening and rough surface. When the process is accentuated, softening can occur in combination with abrasive forces, since mechanical abrasion partially removes the softened enamel. In this sense, Schlueter *et al.* [20] agrees by saying that in this process there is an initial softening of the enamel, that in sequence, there is a dissolution of the enamel crystals, generating an irreversible loss of the tooth volume.

The clinical features of the erosive process were discussed by Ávilla *et al.* [3], such as the attenuation of gloss on the tooth surface, which then its convex parts flatten out and when acid exposure still occurs, the concavities become smooth surfaces and excavations are noted on the incisal and occlusal faces. In contrast, Lussi *et al.* [11] reported that the characteristic signs of erosion is the formation of a smooth, satiny, often matte enamel without perikimata, and with acid persistence, leads to a rounding of the cusps and in severe cases, leads to the disappearance of the occlusal anatomy.

Regarding etiology, Lussi *et al.* [11] and Catelan *et al.* [7] agree that dental erosion has a multifactorial etiology, divided into extrinsic and intrinsic. However, Lussi *et al.* [11] points out that it is a complex etiology, since several factors together play a role in order to detect or prevent the erosive process and that this interaction may lead to disease progression. Pinheiro *et al.* [19] and Ávilla *et al.* [3] discussed that intrinsic causes range from diseases such as, gastric diseases, alcoholism, anorexia, bulimia, radiotherapy, xerostomia and hyperthyroidism. While extrinsic factors are associated with diet, such as the consumption of acidic solutions, including soft drinks, processed foods, acidic fruits, ingestion of chlorinated water and some orally administered drugs, usually occurring on the vestibular faces.

It was pointed out by Amaral *et al.* [1] that saliva plays a key role in protecting teeth against the acids that cause tooth erosion. Saliva is able to mitigate

the weakening of teeth by the action of acid, since it has the presence of calcium ion. However, persistent and prolonged contact with acidic substances does not allow the necessary time for remineralization to occur. Moazzez *et al.* [14] reported that saliva has essential mechanisms capable of remineralizing enamel, such as the role of the acquired pellicle, salivary dilution action, neutralization and buffering capacity of acids from the diet. They report that saliva is a supersaturated fluid, providing calcium and phosphate ions that are fundamental in the remineralization/demineralization process. Saliva is a supersaturated fluid when compared to tooth minerals. It provides ions such as calcium and phosphate that are essential for remineralization. In saliva, proteins are also present that concentrate the minerals that are fundamental to remineralize tooth tissue and prevent demineralization. On the other hand, Lussi *et al.* [11] stressed the importance of considering that dental erosion is multifactorial and that all factors should be considered in addition to stimulated or unstimulated salivary flow rates.

For the prevention of the erosive process, Bezerra *et al.* [4] tested the effectiveness of high-power lasers individually and associated with fluoride therapeutic measures. As such, it was shown that high-power lasers, despite being highlighted for increasing the resistance of dental hard tissues against acids did not produce significant effects against the progression of dental erosion. It also pointed out that the application of fluoride acts as protection in eroded samples, but has a limited effect because of its low frequency of gel application. In this context, it was considered that the association between fluoride and high-power lasers demonstrated a synergism since laser irradiation can promote the formation of small spaces in the enamel, allowing and increasing the incorporation or diffusion of fluoride by the structure, forming a reservoir that will act to protect the tissue. Fluoride, in turn, binds firmly to the crystalline structure and gives greater stability to crystals and resistance against erosive acids. On the other hand, Catelan *et al.* [7] pointed out that prevention and treatment vary according to its etiology, and there must be an adequacy of diet and habits, dispersing the etiological factors, to avoid the progression of the lesion.

In contrast, Carvalho and Lussi [5] studied the combined effect of a toothpaste containing fluoride, tin, chitosan and a rinse containing tin, for the prevention of initial erosion-abrasion in enamel. Satisfactory results were noted in the combination of products containing fluoride and polyvalent metal ions such as titanium and tin. Tin is the ion with the greatest preventive effect, as it reacts on dental hard tissue to form Sn salts, which are more stable against acid dissolution. Chitosan, a polysaccharide derived from chitin, also offers protection against enamel demineralization and has shown significant effects in preventing tooth erosion and toothbrush abrasion. Treatment with the fluoride/tin/chitosan-containing toothpaste offered an attenuation of total surface microhardness, similar to the groups that were treated with the sodium fluoride toothpaste, but significantly decreased enamel substance loss. In contrast, the association of fluoride/tin/chitosan toothpaste together with the rinse containing tin had a more significant preventive effect against erosion, as less enamel softening and loss of substance occurred.

The treatment discussed by Mesko *et al.* [13] is based first, on listening to the patient's complaint. If it is a case that the wear is no longer progressing, the patient may choose not to have a restorative treatment. Recent research on the rehabilitation of eroded dentition indicates minimally invasive techniques, such as direct restorations with composite resins. Indirect techniques to rehabilitate a patient are more invasive, since additional preparations must be made, but it is still not contraindicated. However, although direct composite resins have many advantages such as low cost, acceptable longevity, ease of replacement in cases of failure, they also have esthetic disadvantages such as lower degree of surface polishing and long-term color change.

On the other hand, Gois *et al.* [9] stated that the treatment begins with the motivation of the patient seeking the control of etiological factors and determinants of the disease, relying on a multidisciplinary team. The restorative treatment depends on the degree of impairment of the teeth, and should restore aesthetics, masticatory function, rebuild height and shape of teeth, maintaining vertical dimension and the anterior guide. They also pointed out that the choice of treatment depends on the stage of the lesions, and may range from non-invasive procedures, such as topical fluoride applications, to endodontic treatments and oral rehabilitation. They also considered that several factors should be scored, such as: professional's ability, patient's financial, technician's labor and material resources needed. They emphasized that restorative treatment should only be started after controlling the disease and the patient's eating habits.

Conclusion

Dental erosion can cause serious complications in the oral cavity, and most of them are triggered by the patients themselves through the ingestion of acid-containing foods, often presenting doubtful characteristics because of the relationship with other lesions of non-carious origin. The treatment is varied, but prevention is the best defense, and this occurs through guidance on the risks of dental erosion.

To treat it, it is fundamental to emphasize the importance of reducing the use of foods that can cause this disease, considering that the great majority of cases studied were caused by the ingestion of acidic substances that generally contain a very low pH.

Therefore, the patient's collaboration, knowledge about its etiological factors and commitment to treatment are essential for the correct management of the problem. It is of critical importance that the dental surgeon knows how to perform a thorough and directed anamnesis to identify the possible causative factors, an efficient clinical examination locating possible signs to prevent the progression of the disease, always joining this to adequate patient monitoring, planning and adequate use of materials, thus significantly improving the patient's quality of life.

There are several treatments for dental erosion, with the removal of etiologic factors and high-power lasers associated with fluoride-containing products proving to be the most effective. Restorative treatment should be reserved for more severe cases.

Reference

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