

**Etiology and Treatment of Non-Carious Cervical Lesions**

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**Abstract**

Non-carious cervical lesions (NCCL) present loss of dental structure in the cervical region as a clinical characteristic, predisposing the patient to functional problems, aesthetic and symptoms of dentinal hypersensitivity. These lesions do not involve bacterial action and are classified as erosion, abrasion and abfraction. Considering that the severity and prevalence of NCCL tend to increase with age, early diagnosis and determination of etiology are important for the prevention and correct indication of the treatment to be performed. Thus, the objective of this literature review is to describe the etiology, diagnosis, clinical characteristics, prevention and treatment options of NCCL. It was observed that these lesions have a complex diagnosis and are a consequence of the association of more than one etiological factor, which characterizes the etiology as multifactorial. A multidisciplinary team may be necessary for the diagnosis and elimination of the causal factors prior to the restorative treatment.

**Keywords:** dentin hypersensitivity, gingival recession, non-carious cervical lesions, regressive alteration of teeth, tooth abfraction, tooth abrasion, tooth cervix, tooth erosion.

**Introduction**

Dental caries lesions were the most prevalence oral disease and responsible for the painful symptomatology of the patients, and consequently, search for the restorative treatment (1). However, the ageing population, allied to the diffusion of concepts aimed at the promotion of oral health, has contributed to the growing preservation of the dental elements (2). Thus, the reduction in the incidence of caries has been clear (1), but changes in dietary and behavioral habits have contributed to the higher occurrence of non-carious cervical lesions (3).

Different forms of destructive processes can affect the teeth and cause irreversible loss of their external surface (4). The carious cervical lesions are characterized by demineralization of the root surface previously exposed to the oral environment, thus being called root caries. Its formation and progression occur due to the production of

acids by bacteria present at the dental biofilm (5, 6). On the other hand, non-cariou cervical lesions (NCCL) constitute a group of lesions whose main characteristic is the loss of dental structure in the region near the cemento-enamel junction, through a process that does not involve bacterial action (7). These lesions are classified according to their etiology in erosion, abrasion and abfraction, which may occur on the buccal, lingual and/or proximal surfaces of the teeth (8, 9). Non-cariou loss of dental tissue becomes pathological when there are functional, aesthetic or dentin sensitivity problems (10, 11, 12).

Erosion is a process of dissolution of hard dental tissues by action of acids of non-bacterial origin. Abrasion is the loss of mineralized tissue due to exaggerated external mechanical actions on the tooth, such as aggressive brushing, whereas the abfraction consists of the loss of dental tissue due to occlusal overloads and eccentric movements that cause flexion tensions in the cervical region, leading to the rupture of hydroxyapatite crystals (13, 14). The prevalence and severity of these types of lesions have increased considerably and, although they can manifest in all age groups, they tend to increase with age, as well as their severity (13, 14).

Usually, risk factors of various kinds are present with varying intensity, duration and frequency, acting in an isolated or associated way, which characterizes the condition of multifactorial etiology of non-cariou lesions (15). Thus, the recognition of any non-cariou dental injury is crucial for the prevention of irreversible damage to the dentition (16) however, early diagnosis requires knowledge of the clinical aspects related to each type of injury and the professional's ability to identify the probable etiological variables involved in the process. Only with the precise identification of the lesions and the determination of its etiology is possible to elaborate a treatment plan and prevention that are effective (17).

Given these considerations, the aim of this narrative literature review was to present the etiology of non-cariou cervical lesions, as well as to describe their clinical characteristics, diagnosis, options of Treatments and preventive measures that are used to prevent the onset of these types of lesions.

## **Discussion**

Etiology, diagnosis and clinical features of non-cariou cervical lesions

## **Erosion**

Tooth erosion is the result of irreversible, localized and chronic pathological loss of mineralized dental structure due to the chemical action of acids without bacterial involvement (18, 19). The erosive lesion begins with the demineralization of the dental tissue caused by frequent contact and long duration of acids with the surface of the teeth (20) and is characterized by the removal of the superficial layer of the enamel towards the dentin (21).

The severity of erosion is related to a variety of etiological factors such as the consumption of acidic products, individual diet, frequency of consumption, as well as the effectiveness of the mechanisms of protection of the oral cavity (22, 23). The demineralizing action is promoted by acidic foods and beverages with PH below the critical level for enamel (5.5) and dentin (4.5), which may lead to the dissolution of hydroxyapatite crystals (24). However, the erosive process cannot be attributed only to pH values, but mainly to the frequency and duration of food and beverage intake (25). In addition, the erosive potential of acidic beverages or foodstuffs also depends on other factors such as acidity, phosphate and calcium concentration, fluoride content, and saliva buffer capacity (26) and calcium chelating properties (27). Thus, the saliva and its components constitute an important factor of protection to the teeth by neutralizing the acidity through specific proteins, diluting the acids and forming a

protective film on the surface of dental enamel (28). The buffer capacity, calcium and phosphate present in the saliva, as well as the acquired film, can neutralize the erosive action and reduce the softening and loss of the dental structure (29).

Tooth erosion can be classified according to the source of the acid in intrinsic or extrinsic. The internal or intrinsic factors are endogenous to the patient, such as gastric acids that stay in contact with the dental surface during an anorexia nervosa, bulimia, hyperthyroidism or gastroesophageal reflux and in some patients with needs special (30). Dental erosion from exposure to gastric secretions is also called perimolysis (31). In the same sense, patients who use antihistamines and antiemetic, as well as irradiated from the head and neck, are more prone to erosion phenomena, since they have lower salivary production (14).

Extrinsic erosion is the result of the action of exogenous acids. The acids from the diet are the main etiological factors being that the most frequently consumed are those of fruits and in particular, citric acid contained in fresh fruits, fruit juices and soft drinks (32). Ascorbic acid (C vitamin) contained in various types of beverages, soft drinks and sweets, was also identified as a significant cause of extrinsic erosion (33). In addition to these factors, the frequent consumption of sports drinks, energy, teas, children's medicines, hydrochloric acid and the inhalation of corrosive industrial smoke can also cause damage to workers who perform their functions in these Environments (30).

Erosion injuries are susceptible to identification only years after the onset of dental erosion activity, although in most cases there is not only one etiological factor operative for tooth substrate loss (25). The development of this lesion is strongly influenced by biological, chemical or behavioral factors, besides the modifying factors such as habits,

systemic health and socioeconomic status (34). It was possible to observe that the prevalence of the lesion became increasing in both children and adults (35) and the most affected age group is that of adolescents, possibly due to the time of exposure and frequency in which they are affected by the main etiological factors of the lesion (36). In patients who have frequent vomiting, the acid content of the stomach is projected on the surface of the tongue that encounters the palatine face of the incisors, canines and premolars, decreasing the hardness of the enamel and increasing the susceptibility of the surface dental erosion (17, 37).

Regarding the location of these lesions, although they mainly compromise and with greater severity the cervical region of the teeth (because it is an area of difficult hygiene and, therefore, more exposed to acids), differentiate themselves from the injuries of abrasion and abfraction often extend across the entire dental surface (38). When originated by extrinsic factors, they are generally observed in the vestibular faces of the anterior teeth, while the lesions originating from intrinsic factors are more frequently found in the palatine and incisal faces of the anterior teeth (13).

Thus, the diagnosis depends on a well-performed clinical examination and a judicious anamnesis, since the stage of the lesion is extremely important for the success of the treatment to be employed. During the anamnesis, dietary habits, gastrointestinal disorders, drug use, salivary gland dysfunction, exposure to acidic media during work and oral hygiene habits (39) should be considered. In addition, the dentist should obtain the patient's confidence and information about the possibility of gastroesophageal reflux, anorexia and bulimia (40). The hypofunction of salivary glands should also be investigated, as well as diabetes, use of medications, voluntary or involuntary regurgitation, heartburn and hiatus hernia (41).

In association with Anamnesis, a thorough intraoral examination should be performed to observe the shape and location of the lesion (42). The most common clinical feature of erosion injury is the loss of enamel luster. In most cases, the initial lesions are larger in diameter than in depth and the compromised dental face is smooth (because enamel loses the perichemacea) and highly polished, concave (in the form of "U" or inverted saucer), wide, shallow and without sharp angles. Enamel, cementum and dentin may be affected by erosion, with no visible limits between eroded and healthy surfaces, which makes clinical diagnosis difficult (43). In case of dentinary involvement, the evolution is faster because it is a substrate less resistant to acid demineralization, which may cause sensitivity to cold, heat and osmotic pressure (44). When it affects restored teeth, the restorations become prominent, protruding above the surface (45). Thus, dentinal hyperesthesia, loss of dental contours and protruding restorations in the form of "islands" are signs that may be present; in extreme cases, pulp exposures can be observed (46).

### **Abrasion**

Abrasion is a process of demineralization or loss of the dental structure, free of bacterial biofilm that occurs slowly, gradually and progressively due to the harmful habits of the individual (41). The development of abrasion injuries is related to factors such as: technique, applied force and brushing frequency; dental brush bristles stiffness; dentifrice abrasiveness; abusive use of toothpick and/or interdental brush and place where brushing is initiated (13, 25). According to Dyer *et al.*, (47), the act of brushing the teeth in the horizontal direction was suggested as causing 2 to 3 times more wear compared to the vertical brushing, besides the frequency and force applied during brushing. A large number of therapeutic agents as products to improve cleaning and promote

whitening dental are being included in the composition of dentifrices, which may also interfering with the loss of dental structure (48). Abrasion injuries can still be caused by foreign objects constantly inserted into the mouth (25), such as the habit of bite pencils, metallic objects or their own nails (onicophagy) between the teeth (13).

The association between the presence of cervical lesions, root exposure and good dental hygiene has reinforced the idea that the tooth brushing factors are involved in its development (45). However, mechanical wear (brushing) can be initiated and accelerated by exposure of teeth to acidic solutions for long periods, reinforcing the hypothesis that erosion and abrasion processes probably act synergistically in different grades and periods in the wear process of both enamel and dentin (49). Hence the importance of a correct diagnosis through the development of non-cariou cervical lesions (41).

Clinically, the abrasion injury presents a "V" wear in the cervical region of the teeth usually affecting the enamel and the most exposed root surface, has a smooth, bright, biofilm free appearance and no discoloration; is relatively shallow and with regular contours (49). In general, abrasion is more intense at the level of the amelo cementary union of the vestibular surfaces of the premolars, canines and maxillary incisors, following this decreasing order of intensity (44). When abrasion is associated with, erosion it will present more rounded characteristics as well as its angles (14).

### **Abfraction**

Abfraction is a pathological loss of the dental hard tissues resulting from occlusal forces that cause dental flexes leading to alterations of the enamel, dentin and cemento, distant from the site of traumatic occlusion (24).

The etiology of these lesions is attributed generically to occlusal trauma. The overloads and the eccentric occlusal forces, which generate forces in the non-axial direction,

lead to dental flexion (25, 50). This flexion causes tensile stresses in the cervical region of the tooth that exceeds the fatigue limit of the hard tissues. Thus, parafunctional forces in areas where interferences occur may expose one or more teeth to strong tensile, compressive or shear stresses, which concentrate on the cemento-enamel junction, causing micro fractures in the enamel by rupture of the chemical bonds between hydroxyapatite crystals (13). The saliva and water molecules penetrate the spaces created by the micro fractures, preventing the restoration of previously existing bonds. Thus, this structure is more susceptible to the erosive potential of acids and to abrasive wear of brushing. Over time, the micro fractures propagate perpendicularly in the long axis of the teeth under pressure, ending in the collapse of the enamel and dentin structures and in the macroscopic loss of dental tissue. Like other non-cariou cervical lesions, these also lead to dentinal hypersensitivity as a consequence of irreversible loss of dental tissue (14, 25, 44). The occurrence of sensitivity is present in 76% of the patients who are in the age group from 21 to 52 years old, presenting extensive lesions (51).

The etiology of the abfraction has been considered multifactorial, since this excessive effort may originate from occlusal interferences, tightening or even masticatory effort, especially when eccentric occlusal forces are introduced. Presence of lateral forces during mastication or functional movements is the main point for the differential diagnosis of cervical lesions caused by occlusal stress (52). Abfraction affects periodontally healthy teeth, because it is believed that the presence of dental mobility prevents the installation of this type of injury (53). In certain cases, patients without occlusal prematurity, interferences or parafunctional habits may develop abfraction lesions. This phenomenon is due to the uncompensated loss of posterior teeth, leaving remaining

teeth subjected to loads that exceeding their natural limit of fatigue. For the same reason, a patient with prostheses without adjustment has a greater possibility to development these lesions (54). It is believed that orthodontic treatment may also be able to lead to dental flexion, being considered a risk factor (55). Currently, it is known that an association of the three types of NCCL may occur, because the etiology of the abfraction may involve occlusal stress, producing cervical minerals losses, which predispose to erosion and abrasion (30).

Clinically, the abfraction lesions are in V-shaped, usually deep, with well-defined margins and sharp and lively angles. Depending on the strength for functional actuating may involve one or more teeth in the arch (56) and are located in the cervical region of the vestibular faces (13). They are often found in premolars, then molars and canines, with higher incidence in lower teeth (13, 25).

#### **Prevention and treatment of non-cariou cervical lesions**

The main strategy of prevention and control of NCCL is the elimination of the etiological agent (27). In the first contact with the patient, it is important to promote the relief of symptoms and control the evolution of the process, identifying the etiological factors of these types of lesions (57), after all, the success of the treatment is related to the correct diagnosis and analysis of the individual variations (58). From the diagnosis, preventive methods can be instituted, acting on the causal factors of the lesion in order to prevent their formation or progression, and/or therapeutics, seeking the restitution of form, function and aesthetics (7).

Regarding erosion injuries, anamnesis and clinical history will be the basis for the discovery of the predisposing factors of these types of injury. After the diagnosis is completed, the patient should be advised to decrease the frequency of consumption of acidic foods and beverages

(59) due to its high erosivity potential (46); or ingest acidic drinks with straw, thus decreasing the contact area between the beverage and the dental structure (60). Immediate brushing after ingestion of acidic beverages should be avoided, and it is recommended to perform a previous rinse of the mouth with an alkaline solution (57) or should be expected a period of twenty to thirty minutes for the buccal pH to be re-established (60). This recommendation is due to the fact that the acidic components of food and beverages, associated with rigorous brushing, may generate greater susceptibility to enamel wear (29). In addition, measures should be prescribed to increase salivary flow in cases of xerostomia, such as sugar-free chewing gums, in order to increase the effect of salivary tamponade and remineralization (58).

When erosion is caused by recurrent gastroesophageal reflux, it should be recommended that the patient does not brush his teeth until 30 minutes at 1 hours after vomiting, in order to allow some remineralization of freshly demineralized enamel on the part of the saliva. These patients should be referred to a psychologist or a gastroenterologist, even though; especially bulimic patients tend to conceal their clinical condition (58). Thus, it is extremely important to treat the cause of dental erosion, often with multiprofessional follow-up of the case, involving dentists, doctors, nutritionists and psychologists (3). Only after these initial procedures for determining the cause and orientations to the patient, it is possible to trace a restorative planning to restore the aesthetics and function of the dental element.

In the abrasion lesions, the etiological agent is identified by the clinical examination and, mainly, by the analysis of the oral hygiene habits of the patient (58). As a preventive form, patients who have a high rate of abrasion by brushing should be instructed about the strength intensity

and the technique applied to reduce the abrasive potential of the dentifrices (30), in addition to avoiding the gingival recession. It is recommended to avoid use of hard brushes, brushing with too much pressure and very prolonged, use of toothpicks, excessive instrumentation of the root surfaces during supra and subgingival scraping and chemical burns on the gums during bleaching Dental (13, 14).

Considering the importance of addressing the etiological factors of the abfraction lesions prior to their treatment, it is known that occlusal stress compromises the marginal behavior of cervical restorations and that the type of occlusal load influences the mode of stress distribution. Thus, before any restorative procedure, this stress has to be eliminated (61). However, the removal of etiological factors may be more complicated in these types of injuries due to the difficulty in identifying occlusal dysfunction and in restoring occlusal harmony. Occlusal adjustments can be used for the elimination of occlusal and interferences in laterality movements (44). The restoration of a correct canine guide prevents the flexion of the posterior teeth by a group disocclusion in the movement of laterality. In cases of posterior tooth loss, prosthetic rehabilitation is important for a correct distribution of forces, avoiding occlusal overloads in the remaining teeth. Sometimes orthodontic treatment and orthognathic surgery may be considered to achieve the desired occlusal harmony, although the orthodontic treatment itself may constitute a risk factor for the abfraction. In addition, the preparation of relaxing mio plates and/or prosthetic restorations are indicated in the most complex cases (44). After the removal of the causal factors, the restorer treatment is indicated in the presence of dentinal hypersensitivity, risk of pulp exposure, weakening of the dental structure, difficulty in hygiene due to loss of contour, Interference with removable prosthesis and



aesthetic impairment (13). The priority extends to the treatment of hypersensitivity, and it is possible to opt for the application of desensitizing agents, laser therapy, restorations with glass ionomer cement, composite resin or the association of both (44). Glass ionomer cements have shown good results regarding the retention and marginal quality of the restoration, presenting as advantages the chemical adhesion to the cervical dental structure, fluoride release, biocompatibility and coefficient of thermal expansion similar to that of the dental structure, which contributes to a better quality and longevity of the restorations (62). The composite resin is responsible for aesthetics and good polishing. More invasive treatments, such as indirect metal ceramic or pure ceramic restorations, are options in cases of accentuated dental losses.

Another biological and aesthetic option in resolving these cases would be the use of periodontal plastic surgery, with the purpose of obtaining root cover. There is already enough evidence that the coronary flap (CAF) associated with the connective tissue graft (CTG) and/or porcine amelogenin, are effective combinations for getting root coverage. However, multiple combinations (applying more than one graft/biomaterial under the flap or restorative materials) may be considered cautiously in clinical practice. In addition, periodontal surgery for root coverage also represents a biological and aesthetic treatment option (63, 64).

Although these surgical procedures are indicated to root coverage, it is important to consider that the abfraction lesions are not limited to the root surfaces. In most cases of lesions associated with gingival recession, there is a loss of the hard tissues of the tooth crown, causing disappearance of the cemento enamel junction, and thus the root coverage are not effective. Consequently, a

combined surgical-restorative approach may be pointed out in these clinical situations (65).

Several dental materials and surgical approaches have been used to manage gingival recessions associated with NCCL to make the surgical treatment/restorer combined predictable. Isler et al., 2018, treated gingival recessions associated with NCCL using CAF in combination with CTG on restored root surfaces, for three different materials: nano particulate composite resin, resin-modified glass-ionomer cement. The authors have found that all combined surgical/restorative treatments provided successful clinical outcomes.

The loss of dental tissue in the cervical region is a condition frequently found in clinical practice, but it is a challenge for most professionals regarding the establishment of the etiology, diagnosis and treatment of lesions Non-carious cervical (14).

Although a direct relationship between the morphology of the non-carious cervical lesion and a single etiological factor have been attempted in the literature, it is noted that the same morphological characteristic may be related to different etiologies, which hinders the classification of the lesion alone, suggesting its multifactorial etiology (66). Currently, it is not determined which is the initiator factor or that would be contributing to the progression of the lesions, since the events responsible for abfraction, erosion and abrasion may occur in parallel (66). Abfraction has been cited as an etiology that involves occlusal stress, producing cervical mineral losses, which predispose to erosion and abrasion (58).

Although data are found that sustain the existence of occlusal factors as phenomena for the occurrence of non-carious cervical lesions, it is still not able to establish a direct association between these factors (66). This reinforces that a combination of factors can lead to irreversible loss of dent structure in the cervical region of

the teeth (13, 25). Chronic processes of acid dissolution, repetitive mechanical wear and traumatic occlusion can occur simultaneously, resulting in aesthetic and functional problems, especially if they are associated with a picture of dentinal hypersensitivity, which is characterized by short-term painful symptomatology. For success treatment of hypersensitivity, it is essential to discover the etiological factors and eliminate its, prior to restorative treatment. The literature has shown that occlusal trauma is present in almost half of the teeth affected by hypersensitivity, especially in patients with bruxism, dental clenching, occlusal and tooth interferences (47, 67). The occlusion, the history reported by the patient and the morphological characteristics of the lesions can lead the professional towards a specific etiological factor (68). Knowing how much each etiological agent contribute for the process of an already installed lesion, it may be essential to plan more accurately, which preventive and rehabilitative conducts will be adopted, aiming at an effective and long-lasting treatment (13, 25). However, greater importance should be given to the prevention and monitoring of injuries than to restorative procedures. Preventive and restorative measures may include changes in dietary habits, correction of harmful habits, orientation of oral hygiene, use of desensitizing therapies, occlusal adjustment, root coverage through periodontal surgery and restorer procedures that include direct materials, such as composite resin, glass ionomer cement, or the association of both (14). The restorative option of associating a glass ionomer cement base with composite resin seems to bring the best of results, since it associates the advantages of both materials (69), and in the most severe cases, indirect restorations may be indicated. However, the treatment of non-cariou lesions is diversified and depends on the amount of lost tooth structure, the presence or absence of sensitivity and the degree of aesthetic involvement. In the

restorative treatment, the main objective is to obtain an optimum adaptation of the material to the cavity, in order to prevent micro infiltration and contact with irritant agents that cause sensitivity. The gains in these cases consist of improved aesthetics and increased structural strength of the tooth, as well as an improvement in the patient's oral hygiene, decreased food impaction, reduced thermal sensitivity and prevention of pulp involvement (70). However, the realization of restorations should be instituted concomitantly with the removal of the etiological factors.

### Conclusion

In conclusion, non-cariou cervical lesions have a complex diagnosis and are a consequence of the association of more than one etiological factor, which characterizes the etiology as multifactorial. A multiprofessional interaction may be necessary in order to diagnose, prevent and eliminate the causal factors prior to definitive restorable treatment.

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