



A Revisit of Non-Carious Cervical Lesions

Vishnusripriya J^{1*}, Anil Melath², Nanditha Chandran³, Hemalatha DM⁴,
Fathima UM⁴ and Faby Ashraf⁴

¹Senior Lecturer, Department of Periodontics, Mahe Institute of Dental Sciences and Hospital, India

²HOD, Department of Periodontics, Mahe Institute of Dental Sciences and Hospital, India

³Reader, Department of Periodontics, Mahe Institute of Dental Sciences and Hospital, India

⁴Final Year BDS Student, Department of Periodontics, Mahe Institute of Dental Sciences and Hospital, India

***Corresponding Author:** Vishnusripriya J, Senior Lecturer, Department of Periodontics, Mahe Institute of Dental Sciences and Hospital, India.

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Vishnusripriya J., et al.

Abstract

Hard tissue loss in the cervical regions of teeth is a common and complex dental condition known as noncarious cervical lesions (NCCLs). In contrast to caries, NCCLs are brought on by a number of variables, such as occlusal tension, friction, and acid erosion. The current understanding of NCCLs, including their origin, clinical manifestations, and diagnosis, is reviewed in this article. We talk about how crucial it is to pinpoint the underlying causes and create individualized preventative and treatment plans. A number of therapeutic alternatives are also investigated, such as root covering surgery and adhesive restorations. The purpose of this article is to improve patient outcomes by giving dental professionals a better understanding and management of NCCLs, a complex disorder.

Keywords: Non Carious; Abrasion; Erosion; Abfraction; Management

Introduction

Dentists frequently encounter the problem of hard tissue loss at the cemento-enamel junction (CEJ) in the course of their clinical work. These can have a variety of shapes and are referred to as non-carious cervical lesions. It is possible to observe enormous wedge-shaped defects, wide lesions that are scooped out, or shallow grooves. The labial, lingual/palatal, or proximal surfaces of the teeth may sustain these lesions [13]. To avoid more harm and to keep the current lesions from getting worse, it is critical to comprehend the underlying causes of these lesions. If the underlying causes of these lesions are not addressed, treatment will not be long-lasting. The most often mentioned reasons for cervical lesions include dental flexure, abrasion, and erosion. Hard tissue loss that is chemically caused and does not include germs is called dental erosion. It is typically brought on by tissues dissolving in acid. Conversely, abrasion refers to the erosion of tooth structure caused by external mechanical forces, with brushing being the main contributor. Another mechanism that might result in the loss

of dental hard tissue is tooth flexure [7,8]. Although cervical lesions can develop anywhere in the dental arch, they are most frequently observed on teeth that are not molars. Lesions that are angular are more common than those that are rounded. It is believed that the lesion's shape depends on what caused it [1,6,9,11,12]. Determining the best course of action for treatment requires an understanding of the etiology of cervical lesions.

Etiology

The non-carious cervical lesion (NCCL) is when there's a loss of tooth tissue at the neck of the affected teeth, but it's not related to tooth decay. It's been studied by many researchers since way back in 1908.

Erosion

Erosion is when the hard dental tissues slowly get worn away due to chemicals, not bacteria. The smooth surfaces of our front and premolar teeth are particularly vulnerable to this when we

consume acidic foods and drinks. It can cause the tooth tissue to erode. Interestingly, even our back teeth can be affected if someone regurgitates stomach acid. Being aware of these factors can help us take better care of our teeth. However, when it comes to erosive lesions, the location alone isn't a reliable predictor of the cause. Instead, researchers have found that the titratable acidity of a substance is more important than its pH in terms of tooth tissue erosion. For example, even though orange juice has a higher pH than cola, orange juice with a high titratable acidity can actually cause more erosion than cola [15-20].

Nowadays, due to better working conditions, exposure to airborne acids in industries like chemicals and metals is rare and not a common cause of erosive non-carious cervical lesions (NCCL). However, other activities, such as frequent swimming in chlorinated pools, have been more recently identified as a cause of erosion. There's also a condition called the "voluntary reflux phenomenon" that affects stressed individuals who find comfort in regurgitating and holding stomach contents in their mouth before spitting or swallowing it. This can lead to erosion of the tooth surfaces near the retained vomit, particularly in the lower premolar and permanent molar teeth [15]. The prevalence of these cervical erosion lesions isn't well-documented, but a study from 1949 found that 27% of the patients they examined had tooth tissue loss on the facial surfaces due to erosion. They also observed that the prevalence and severity of erosion lesions increased with age, with more lesions found in upper teeth compared to lower teeth, and the first premolar teeth being most commonly affected. Acids play a significant role in the etiology of these lesions [15,17].

Role of saliva

Researchers have been studying the relationship between the quantity and quality of saliva and dental erosion. Some studies suggest that the citrate content of saliva may be linked to the severity of erosion. However, there are conflicting findings, as some studies did not find a significant difference in citrate content between patients with erosive lesions and those without. Additionally, an *in vitro* experiment found that pyrophosphate, a natural calcium chelating agent, was present in salivary debris from individuals with erosion but not in controls. However, it's worth noting that *in vitro* experiments may not perfectly reflect real-life conditions [37-39]. Saliva plays an important role in rinsing away and neutralizing acids that can cause tooth erosion. When there is low salivary flow, it can increase the risk of dental erosion. Studies have shown that individuals with low unstimulated salivary flow rates have a higher risk of developing erosive lesions. Additionally, individuals with conditions like anorexia and bulimia may experi-

ence dry mouth (xerostomia) and have saliva with reduced buffering and remineralizing capacity [33,34]. The ability of saliva to fix eroded tooth surfaces can be different for different people. From studies it's found that even though the amount, pH value, buffering capacity, and calcium and phosphorus levels in saliva were similar for both cases and controls, the amount of mucin, which is a component of saliva, varied. This mucin might help prevent the calcium and phosphorus from sticking to the teeth and repairing any damage caused by brushing. But, we still don't know exactly how calcium and phosphorus in saliva affect dental erosion [32,35-37]. Other factors within the body have been suggested to contribute to the development of cervical lesions. Bodecker proposed that the exudate from the gums could start the erosion process [29]. Kornfeld believed that disturbances in the pulp tissues could cause decalcification [30]. More recent theories suggest a connection between stressful occlusion (how the teeth come together) and the development of cervical lesions [31].

Abrasion

Abrasion is the 'abnormal wearing away of a substance or structure by a mechanical process' [16]. Toothbrush abrasion happens when a substance or structure wears away due to mechanical processes. In the case of non-carious cervical lesions (NCCL), tooth brushing has been identified as a possible cause. Factors like how you brush, how often you brush, the stiffness of your toothbrush bristles, and the abrasiveness of your toothpaste can all contribute to the development of these lesions. Research has shown that people who brush twice a day may have a higher frequency of cervical lesions compared to those who brush less often. It's also been found that brushing horizontally can lead to more wear on the dentin compared to brushing in a longitudinal direction [21]. Interestingly, there seems to be a higher number of NCCL on the left side for right-handed individuals, and areas that are brushed first may have more abrasive lesions due to increased brushing force [22].

Abfraction

Some experts have suggested that there might be other factors involved in the development of non-carious cervical lesions (NCCL) that we haven't traditionally considered [23,25]. One idea is that the pressure from biting and chewing can actually cause the tooth to bend and flex, which can lead to damage to the enamel at the cervical region. This kind of damage has been given the name "abfraction" by Grippo [24]. There have also been studies that looked at how the enamel behaves under friction and found that there can be cracks and weaknesses in the enamel rods and the substance between them. This can make the enamel more vulnerable to damage. Additionally, the bond between the enamel and the underlying



Figure 1: Erosion.



Figure 2: Abrasion.

dentin in the cervical area is not as strong as in other parts of the tooth, which can further contribute to the formation of NCCL. Both enamel and dentin are strong under compression, but they're not as good at withstanding tension forces [26-28].



Figure 3: Showing various degrees of tooth wear.

It's interesting to note that there's a connection between bruxism (teeth grinding) and cervical erosion. Teeth with wear facets on the crown, which can be caused by bruxism, often show signs of erosion at the cervical area as well. However, the exact explanation for this connection is still being studied [14].

Classification

Classification of erosion

On the basis of etiology

- **Extrinsic erosion:** Is caused by acids that originate from outside sources. These can include airborne acidic pollutants in the workplace, known as industrial acids, or the acidic water in swimming pools resulting from the reaction of chlorine gas with water to form hydrochloric acid.

- **Intrinsic erosion:** Occurs due to internal acid. This happens when gastric acid comes in contact with the teeth during recurrent vomiting, regurgitation, or reflux. Eating disorders of psychosomatic origin, such as nervous vomiting, nervous anorexia, or bulimia, are often the underlying causes of regurgitation or vomiting, which, in these cases, are self-induced.
- **Idiopathic erosion:** Is caused by acids of unknown origin. It's a condition similar to erosion where neither tests nor medical history can provide an explanation for the cause.

On the basis of clinical severity: in 1979 Eccles

- **Class I:** Superficial lesion, involving enamel only
- **Class II:** Localized lesion, < 1/3 of surface involving dentin
- **Class III:** Generalized lesion, >1/3 of surface involving dentin.

Classification of abrasion

- **Class A:** Abrasion/tooth wear present only on the crown/enamel with no involvement of root
- **Class B:** Abrasion/tooth wear present only on the root surface with no involvement of crown
- **Class C:** Abrasion/tooth wear present on both crown/enamel and root surface

Each class can be further sub-classified to quantify the severity of the lesion as follows:

- **Type I:** Shallow concavities on the tooth surface, can be either wedge shaped or notched, the depth of the abrasion cavity is in the enamel surface or some exposure of dentine can be present
- **Type II:** Tooth wear/concavity extending within the dentin, but pulp chamber is not visible
- **Type III:** Tooth wear/concavity extending within the tooth dentin and the pulp chamber is visible
- **Type IV:** Tooth wear/concavity extending within the tooth dentin and the pulp chamber is exposed to the oral cavity.

Classification of abfraction

The Tooth Wear Index proposed by Smith and Knight is the most accepted index to categorize tooth wear in the cervical region, and it is as follows:

- 0 = No change in contour
- 1 = Minimal loss of contour
- 2 = Defect <1 mm deep
- 3 = Defect 1 mm to 2 mm deep
- 4 = Defect >2 mm deep, or pulp exposure, or exposure of secondary dentin.

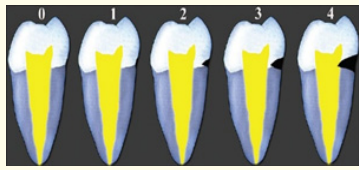


Figure 4: Showing tooth wear index.

Clinical features

Erosion

- Is an irreversible loss of dental hard tissue by a chemical process that does not involve bacterial.
- This form of tooth surface loss is part of a larger picture of tooth wear, which also consists of attrition, abrasion, and possibly, abfraction.
- Classic erosion lesions are described as smooth, disc-shaped, rounded, and concave, without sharp edges or developmental grooves [18].

Abrasion

- Abrasion is the pathologic wearing away of tooth substance through some abnormal mechanical process that usually occurs on the exposed root surfaces of teeth, but under certain circumstances it may be seen elsewhere, such as on incisal.
- Most common cause of abrasion of root surfaces is the use of an abrasive dentifrice.
- Abrasion caused by a dentifrice manifests itself usually as a V-shaped or wedge-shaped ditch on the root side of the cemento-enamel junction in teeth with some gingival recession
- The angle formed in the depth of the lesion, as well as that at the enamel edge, is a rather sharp one, and the exposed dentin appears highly polished.
- Other less common forms of abrasion may be related to habit or to the occupation of the patient. The habitual opening of bobby pins with the teeth may result in a notching of the incisal edge of one maxillary central incisor. Similar notching may be noted in carpenters, shoemakers, or tailors who hold nails, tacks, or pins between their teeth.

Abfraction

- Described as the pathologic loss of both enamel and dentin caused by biomechanical loading forces
- Lesions found at the cervical regions are wedge shaped with sharp internal and external line angles
- The location of lesion is directly proportional to the direction of lateral forces acting on the tooth.

- Commonly involved tooth are anterior and premolar teeth and within premolars mandibular premolars are most prone followed by maxillary premolars.

Radiographic features

Abrasion

Seen as well-defined semicircular or semilunar shape radiolucent defects in cervical level of the tooth.

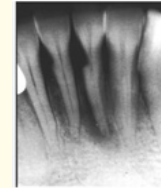


Figure 5: Radiographic view of abrasion.

- Borders of defect show increased radiopacity
- Obliterated pulp chambers are seen.

Erosion

Seen as radiolucent defects on the crown with well defined or diffused margins.

Abfraction

In some cases, dental X-rays can help determine whether the lesions have affected the inner layers of the tooth, such as the dentin or pulp.

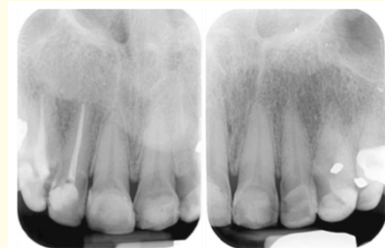


Figure 6: Radiographic view of Erosion.

Prevention

The main aim of preventive therapy for NCCLs is to prevent the lesions from getting worse and to make sure that restorations last. This involves counseling patients on behavior changes based on the cause of the lesions, such as aggressive brushing, faulty techniques, or abrasive toothpaste. Additionally, patients should be advised to avoid brushing immediately after an erosive challenge [49,50]. The success of treatment depends on how well the patient cooper-

ates. If the erosion is caused by eating disorders or gastro esophageal reflux disease, it may require the involvement of a physician. Treating extrinsic factors is generally easier. During the diagnostic phase, making changes to or eliminating harmful habits can lead to consistent results [49]. If abfraction is suspected as the main cause, a conservative treatment option like using an occlusal splint may be recommended to reduce bruxism and non axial tooth forces. On the other hand, some experts believe that preventive management should include occlusal therapy for patients with parafunctional habits and occlusal imbalances. However, making irreversible treatments like occlusal adjustment should be carefully considered [49].

Monitoring

It's crucial to assess the activity of NCCLs when planning treatment. The progression of these lesions can vary among patients, with some experiencing slow changes while others may have more rapid progression. That's why it's important to establish an individual monitoring protocol that takes into account factors like the severity of the lesions, the patient's age, and any underlying causes or risk factors. For patients who are exposed to intrinsic acids or show signs of rapid progression, it's recommended to regularly assess the activity of the lesions every 6 months during routine hygiene appointments. This helps ensure that appropriate treatment is provided in a timely manner. One way is by using standardized intraoral photographs and possibly study models to track changes over time. Another method is measuring the dimensions of the lesions (width/length) over time. With the advancements in digital dentistry, CAD/CAM systems can also be helpful in diagnosing NCCLs and monitoring their activity. V-shaped lesions tend to have higher stress levels concentrated at the top part of the lesion, while U-shaped defects distribute the stress over a wider area. As the lesions get deeper, the stress becomes more amplified at the deepest part. It's important to keep in mind that patients with a heavy bite and jaw movement may need restorative treatment earlier for V-shaped lesions compared to U-shaped ones. Dentists usually prioritize restoring deeper NCCLs (around 1.5 mm) because they experience higher stress, leading to more noticeable progression.

Treatment strategies

Management of dentinal hypersensitivity

Dentinal hypersensitivity is a common symptom in the early stages of NCCLs. If the lesions are small and shallow and don't need restorative treatment, but the sensitivity persists, there are noninvasive options to try. You can find various at-home desensitizing agents on the market that work in different ways, like calming the nerves or blocking the dentin tubules. These agents come

in toothpastes, mouthwashes, and chewing gums. After using them for a few weeks, see if the sensitivity improves. If it doesn't, then it might be time to consider in-office treatment. Recently, they've introduced calcium- and phosphate-based systems for in-office use, which help reduce sensitivity and promote remineralization of the tooth surface. Clinical trials are needed to confirm the effectiveness of both systems [42,43]. When it comes to longer-lasting relief from dentin hypersensitivity, resin-based dental adhesive systems have shown promising results compared to home-desensitizing agents. These adhesive resins create a hybrid layer that effectively seals the dentinal tubules. Clinical studies have actually demonstrated the effectiveness of these adhesives for up to 6 months in managing dentin hypersensitivity [40,41,44].

Restorative treatment

When it comes to fixing NCCLs, there are a few situations where restorative treatment should be considered. These include having active cavities associated with the NCCLs, lesion margins that are located below the gum line and make it hard to clean, extensive tooth structure loss that weakens the tooth or exposes the pulp, persistent dentinal hypersensitivity that hasn't been helped by non-invasive treatments, needing a prosthetic abutment for a removable prosthesis, or if patients have specific esthetic preferences. If a restoration is necessary, it's best to do it in a minimally invasive way. Dentists often prefer using an adhesive system combined with a composite resin because it gives good esthetic results [45-47].

Adhesively restored NCCLs can actually do really well in the long run. There are a few things that affect how these restorations hold up over time. One important factor is the type of adhesive system used. Different adhesives have different levels of durability, so it's important to choose the right one. Another key factor is the skill of the dentist. They need to take care during the entire process, from isolating the tooth to applying the adhesive and composite, and then finishing and polishing the restoration. And of course, ongoing maintenance is important too. It's all about doing things right to ensure a successful and long-lasting result [46,48].

Periodontal therapy

Periodontal therapy is required when non-carious cervical lesions are associated with considerable gingival recession and mucogingival defects. Root coverage procedures using free gingival grafts or connective tissue grafts are mainly chosen. Root coverage using non-grafting procedures like rotational and coronally advanced flaps or guided tissue regeneration are also done. Non-carious cervical lesions (NCCLs) can lead to gingival recession, which

exposes root surfaces to the oral cavity. While it is feasible to place a composite restoration, the aesthetic outcome may not meet expectations. If the patient values aesthetics, the optimal treatment for addressing both non-carious cervical lesions and gingival recession, especially in the case of deep lesions, is a combined periodontal and restorative approach. In a combined restorative-surgical approach, it's crucial to place the restoration before the surgical procedure for better visibility and the final restoration. To restore lost dental tissue due to wear, determining the maximum root coverage level is essential. The restoration should replicate the tooth crown contour and the lost CEJ at the root. Recent reviews suggest that combining a CAF (coronally advanced flap) with a CTG (connective tissue graft) offers the best outcomes for root coverage. However, there is still a lack of long-term evidence on the stability of this approach [50].

Conclusion

When it comes to diagnosing the causes of multifactorial NCCLs, it's crucial for practitioners to consider a comprehensive medical and dental history, conduct an occlusal examination, evaluate the patient's diet and oral hygiene practices and the risk factors that contribute to the formation of NCCLs. When it comes to the treatment of NCCLs, a systematic approach is essential. This involves problem identification, diagnosis, removal of the underlying causes, monitoring, and, if necessary, treatment. Special attention should be given to the preventive phase, as it directly impacts the longevity of restorative treatment. It's also important for the dentist to have a high level of skill and follow a meticulous operative procedure to maximize the lifespan of the treatment rendered.

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