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Non carious lesion

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Certification

I certify that this project entitled “**Non carious lesion**”

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In partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Dedication

At first, I thank God for all the blessings and success in every step of my life .

To my father , who always stands by my side and supports me .

To my mother , my angel who never left me alone in my hard times.

To my brother and sister , who give the meaning of joy to my life.

To my beloved friends , who make my life easier and funnier.

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List of abbreviations

(NCCLs)	Noncarious cervical lesions
CEJ	Cemento-enamel junction
(GERD)	Gastro esophageal reflux disease
AN	Anorexia nervosa
BN	Bulimia nervosa
(DM)	Diabetes mellitus
(NSAIDs)	Non-steroidal anti-inflammatory drugs

1. Introduction

Non-carious cervical lesions (NCCLs) develop as a result of normal and abnormal or pathological wear and cause abfraction, abrasion, and erosion or chemical degradation of dental tissues. **(Mjor 2001)**. Clinical appearance of NCCLs can vary depending on the type and severity of the etiological factors involved... Of all possible etiological factors for NCCLs, occlusal stress forces have received maximum attention over the years. Tensile stress from malocclusion and masticatory forces was initially proposed as the primary factor in NCCLs; shortly thereafter, these lesions were termed as abfraction lesions. Despite many efforts to demonstrate that occlusal forces are the main cause of abfraction, its etiology remains poorly understood and controversial. Nowadays, it is generally incorrect to designate only one mechanism to be the cause of any type of NCCLs. Instead, current evidence supports a multifactorial etiology for all NCCLs with patient factors being responsible for the various degrees of tooth loss. Figure 1 shows the scheme of pathodynamic mechanisms responsible for initiation and perpetuation of NCCLs, as proposed by Grippo et al. **(Nascimento et al.2016)**. NCCLs are relatively common clinical conditions that can adversely affect structural integrity, retention of dental plaque, tooth sensitivity, pulpal vitality, and esthetics. The incidence of NCCLs is expected to increase as the population ages and teeth are retained longer; however, marked variations exist in dental practice concerning the diagnosis and management of these lesions. Treatment planning is primarily based on dentists' beliefs about the effectiveness of restorative or alternative interventions in terms of longevity and minimization of further tooth loss. A dental practice-based study revealed that NCCLs are the main reason other than caries for placement of restorations on previously unrestored permanent tooth surfaces. Nonetheless, the limited longevity of NCCL restorations is a continuing issue in dentistry, **(Ichim et al.2007)**. **(Nascimento et al.2016)**

Chapter one

Review of literature

In dentistry there are two types of lesions

Carious lesion :that dental carious refers to the localized destruction of susceptible dental hard tissues by acidic by- products from the bacterial fermentation of dietary carbohydrates.it is chronic disease that progress slowly in most of people the cavities may be number of different colors from yellow to black. **(López-Frías et al.2012)**

Non carious lesions (tooth wear): that refers to loss of dental tissue caused by process that do not involve bacteria that the etiology is considererd multifactorial and complex. That effect CEJ that the neck of the tooth morphology and histology differs from crown and root. Enamel gradually become thinner. Dentin exposed to irritant agents **(Forbes-Haley et al.2016).**

That divided into two type

1-Mechanical wear

2-Chemical wear

Both of them subdivided into

1-intrinsic factor

2-Extrinsic factor

-The highest prevalence was recorded on premolars teeth.

-Presence of lesions significaly increased with age. -Lower frequency of NCCLS was recorded among subjects who frequency chew gum.

-Quantity and quality of saliva, as one of the potential etiological factor.

-As treatment strategies may vary according to the type of gingival recession, marginal level and extent of NCCL,

-The clinical characteristics of each defect should be considered prior to treatment (3)

1.1. There are four types of Non carious lesion. , diagnosis is difficult. As shown in figure (1-1)

1-Erosion

2-Attrition

3-Abrasion

4-Abrifiction



Attrition

Abrasion

Abfraction

Erosion

FIGURE (1-1) TYPES OF NON CARIOUS LESION (FORBES-HALEY ET AL.2016).

1.2.Erosion

the progress loss of the tooth substance by chemical process that do not involve bacterial action producing defects that are sharply define, wedge-shaped depression often in facial and cervical area.Or it is wear or loss of the tooth

surface by chemical-mechanical action. (Shafer et al.2015) as shown in **figure (1-2)**



Figure (1-2) Dental erosion in facial tooth surface
(Shafer et al.2015)

Dental erosion is often described solely as a surface phenomenon, unlike caries where it has been established that the destructive effects involve both the surface and the subsurface region. However, besides removal of the surface, erosion shows dissolution of mineral within the softened layer beneath the surface. Erosion occurs in low pH, but there is no fixed critical pH value concerning dental erosion. The critical pH value for enamel concerning caries (pH 5.5–5.7)

The erosion also know called near surface demineralization.

Management of the long-term health of the dentition. What is considered as an acceptable amount of wear is dependent on the anticipated lifespan of the dentition and is, therefore, different for deciduous compared to permanent teeth. However, erosive damage to the teeth may compromise the patient's dentition for their entire lifetime and may require repeated and increasingly complex and expensive restorations. Therefore, it is important that diagnosis of the tooth wear process in children and adults is made early and that adequate preventive measures are undertaken.(lussi et al.2013)

1.2.1. Clinical appearance of erosion

Initially, erosion may appear as a glazed enamel surface with loss of surface features such as perikymata. Early lesions are usually coronal, and the enamel at the gingival margin remains intact, **(López-Frías et al. 2012)** The patient may present complaining of tooth sensitivity associated with loss of tooth structure. Maxillary anterior teeth of affected primary dentitions show reduction in vertical height and thin, chipped incisal edges. The incisal edges of primary incisors and canines become worn down fully into dentine, and a concave surface is formed as the less mineralised dentine erodes more rapidly than the surrounding enamel. In older children, the palatal surfaces of permanent incisors may show loss of enamel with sharply defined gingival margins. Grey or brown coronal colour changes, visible particularly on the palatal surfaces, may indicate pulpal pathology. The enamel is thinned, and the underlying dentine is visible as yellow or brown. Oval lesions representing pulpal proximity may be visible and the lesions may progress to pulpal exposure. **(Lundeen et al. 1978)** Primary posterior teeth show flattened convex surfaces or concavities which develop in cusp tips, becoming hollowed out ('cuspal cupping'). Margins of existing restorations (particularly amalgam) may appear raised or 'proud', due to erosive loss of surrounding enamel. More extensive erosion of occlusal surfaces appears as flattened cuspal inclines or shallow saucer-shaped facets. The facets typically show sharply defined 'leading edges' and more indistinct 'trailing edges', respectively, representing the direction of the occlusal stroke across the enamel surface and patterns of salivary flow **(Khan et al. 1998)**.



Erosion on palatal, incisal and occlusal surfaces of maxillary teeth

**Figure (1-3) dental erosion in palatal, incisal and occlusal surface of maxillary teeth
(Ravi et al.2013)**



FIGURE(1- 4)DENTAL EROSIONS(RAVI ET AL.2013)

Table1 criteria from the BEWE index for grading erosive wear

Score	Criteria
0	No erosive tooth wear.
1	Initial loss of surface texture.
2	Distinct defect; hard tissue loss less than 50% of the surface area.
3	Hard tissue loss more than 50%of surface area.
In score 2 and 3 dentine is often involved.	

1.2.2. The etiology of dental erosion

1-Intrinsic causes include

Gastro esophageal reflux disease (GERD) depending on background, behavioral, dietary and medical variables. Examples of risk groups could be persons suffering from underlying diseases, such as gastro esophageal reflux disease (GERD), eating disorders (anorexia nervosa, AN, bulimia nervosa, BN, and rumination) and chronic alcohol abuse or alcohol dependence. Special nutrition habits (high consumption of soft or sports drinks), special diets (vegetarian, vegan or raw food diet) or the regular intake of drugs, medications and food supplements can also increase the risk for dental erosion. The most common symptoms is heart burn GERD is defined as a condition in which the gastroduodenal content regularly reaches the oesophagus and then probably the oral cavity. It possibly interferes with the oral tissues, causing symptoms which can impair the quality of life (Sugita et al.2017).A chronic symptomatic reflux can be diagnosed at 4–7% in the general population.(Lundeen et al.1978)however, the prevalence for the so-called silent reflux (asymptomatic reflux) is about 25% (Johansson et al.2008).Eating disorders are divided into AN, BN and eating disorders not otherwise specified (EDNOS, according to the Diagnostic and Statistical Manual-Prevalence of Erosive Tooth Wear in Risk Groups of Mental Disorders, DSM-V, ed. 5). EDNOS includes individuals with symptoms of AN or BN(Krolo et al.2008)AN (anorexia nervosa), and BN (bulimia nervosa). That high risk of dental erosion. That impairs physical or psychosocial function, and not related to other medical condition.sufferes turn to food and eating to express their psychological and emotional difficulties.Patient with AN abstain from eating and vomiting may also present risk of TW such as hyposalivation and bruxism. BN followed by behavior to avoid weight gain with frequent bouts of self induced acts of vomiting.

Alcohol uses disorders

It is often reported that chronic alcoholism is associated with a higher prevalence of erosion, either due to the direct effect of consumed alcoholic drinks or due to the effect of regular vomiting or an alcohol-induced gastroesophageal reflux. For example red wine pH 3.4 (Grant et al.2000) (Bardsley et al.2008)

Consumption of acidic drinks

Most sweet drinks, including diet soft drinks, contain orthophosphoric, carbonic and citric acids; malic, tartaric and other organic acids may also be present. (Council [NHMRC] Australian Government 2005) and fruit drink that contain sugar also have dangerous effect to teeth become erosive that need preservatives and food acids including organic and inorganic acids, Consumption of sports drinks. Sports drinks are recommended widely by organisations for athletes as sources of carbohydrates, electrolytes and water for energy and rehydration and are consumed frequently during or following athletic events. The enamel is then largely unprotected by saliva and is susceptible to erosive risk from acidic sport drinks. (Sirimaharaj et al. 2002).

Some diseases that have risk of dental erosive

Diabetes mellitus (DM) is one of the key presentations of diabetes mellitus in a child is constant thirst. Children are more likely to be recommended sugar-free drinks than water, with the consequent risk of erosion. The other disease is asthma increasing in Western societies. The child with asthma is often thirsty, and the acidic anti-inflammatory aerosol medications used in treatment. Asthma management reduce salivary flow and thereby The individual with asthma should be encouraged to drink water to minimise the erosive potential of the medication. (APP 2004)

1.2.3.Prevention and management

If no effective intervention occurs at an early stage, the eventual outcome of dental erosion is severe loss of dental hard tissues that adversely affects function and esthetics. In patients with extensive dentin exposure, transient and persistent pain due to dentin sensitivity and pulp pathology may further reduce quality of life. Severe erosive tooth wear can be managed restoratively. **(Ranjitkar et al.2009)** Composite resins and ceramics can be used for partial and full coverage restorations to restore the esthetics and function of the teeth. However, if the restored teeth continue to be subjected to severe erosive challenges, restorations may fail in due course following marginal deterioration and continued loss of surrounding dental hard tissues. **(Warreth et al.2020)** Therefore, preventive measures for dental erosion are not only essential for early intervention and primary prevention of erosive tooth wear, but they are also important for secondary prevention of erosion around the restorations. **(West et al.2000)(Al-Dlaigan et al.2001)**

Strategies for treatment include Behavioral interventions

- Avoid or reduce direct contact with acids.
- Adopt drinks habits that limit contact time with teeth: Using a straw will reduce contact time between teeth and acidic drinks. Rinsing with water.
- Use proper protection to avoid occupational hazards: Masks, mouth guards and neutralizing agents should be used to reduce contact with acidic vapors and fluids.

Clinical interventions:

1.Apply fluoride varnish to tooth surfaces susceptible to erosion: A protective film containing fluoride will reduce direct contact between tooth surfaces and acids and deliver fluoride to strengthen the enamel surfaces. **(Murakami et al.2009)**

2. Treat underlying diseases associated with the presence of intrinsic acids intraorally: This includes GERD, bulimia, regurgitation and rumination. It is often necessary to establish close consultation with the patient's physicians when an intrinsic cause of erosion is suspected. **(Hur et al.2011)**

3. Treat conditions causing salivary hypofunction: When low saliva flow rate is established as a factor for erosion in a specific patient, measures should be taken to improve saliva flow, where possible. This may include consultation with the patient's physicians on adjustment of medications causing dry mouth, and referrals for evaluation and treatment of autoimmune diseases such as Sjögren's syndrome **(Jones et al.2014)**

4. Calcium can accumulate on enamel surface which can be either an erosive or intact surface, and can provide substantial protection of the enamel from acid attacks. Dodecyl phosphates prevent the dissolution of the natural surfaces of hydroxyapatite and provide solidity **(Ranjitkar et al.2009)**

Restorative, operative intervention for erosive wear is necessary to rehabilitate function and aesthetics as well as to eliminate painful symptoms. The treatment of erosive wear in the permanent dentition can range from relatively simple and localised interventions to more complex treatment planning including full mouth rehabilitation. Previous restorative approaches used for rehabilitation of the eroded permanent dentition commonly involved extensive conventional crown and bridge work or removable overdentures. **(Murakami et al.2009)** While these treatment modalities may still have a place in the management of erosion, the advancement of adhesive technology has meant that less destructive options for restoration are now available and used widely in general dental practice. These more conservative approaches can be applied successfully and predictably, and should be considered in the first instance. Regardless of the level of restorative intervention, the patient naturally needs to be made aware of the cost and time implications, in addition to the potential future maintenance burden. It is also

clearly necessary that definitive restoration of the eroded permanent dentition requires prior elimination of all primary disease as well as the preventative measures outlined above.(Hemmings et al.2000) as shown in **figure (1-5), (1-6),(1-7)**



Figure (1-5) Erosion in cervical third(Ten et al.2012)



Figure (1-6) Before and after treatment of erosion(Carvalho et al.2016)



Figure (1-7) Sever case of erosion(Ganss et al.2014)

1.3.Attrition

Attrition is formally defined as the loss of tooth substance caused by tooth to tooth contact so although it is predominantly seen occlusally, attrition can also occur interproximally as lateral movement of the teeth produces broader interproximal contacts over time. Attrition increased with age.paesani (DA 2010) as shown in **figure (1-8)**



Figure (1-8) Attrition teeth(Schlueter et al.2014)

1.3.1.Etiology of attrition

There are generally thought to be three principal theories regarding the etiology of attrition. In addition, there may also be modifying factors (often lifestyle factors) present, such as bone chewing. The theories of attrition are.

- **Functional theory**
- **Par function initiated by occlusal interferences**
- **Central nervous system a etiology.**
- **Functional theory**

This suggests that tooth wear occurs due to prolonged contact of the teeth and the patient having a broad envelope of function showed that some patients exhibit a very extensive range of movement in their usual chewing pattern, analogous to a cow chewing which leads to attrition and tooth wear. **(Kaushik et al.2009)**

- **Parafunctional initiated by occlusal interferences**
- **Central nervous system etiology**

Over the last two to three decades it has become evident that the majority of bruxism is caused by a central nervous stimulus and a great deal of work in this area has been undertaken by Professor Gilles Lavigne and his co-workers at the University of Montreal. It appears that bruxism can occur either when the patient is awake (awake bruxism) or when the patient is asleep (nocturnal bruxism). In awake bruxism the patient is naturally aware of jaw clenching and this is a very common phenomena with a prevalence of around 20%.The aetiology of awake bruxism is poorly understood but known risk factors are psychological stress and anxiety. **(Lavigne et al.2008)**.In contrast, nocturnal bruxism is tooth grinding while the patient is asleep and the patient may be aware of this, or more likely, the patient's partner or family members are aware of this problem the prevalence of nocturnal bruxism is reported as being 8–10% and it has now been classified as a sleep-related movement disorder.**(Lussi et al.2013)**Essentially, sleep bruxism occurs following sleep-related micro-arousals that originate in the brain stem. These micro-arousals cause the heart rate to increase following which brain activity increases. This is followed by activation of the suprahyoid muscle and then this is followed by rhythmic masticatory muscle activity resulting in

bruxism. Therefore appears that bruxism is a neurological problem and the tooth damage.(Wang et al.2018)

1.3.2.Clinical appearance of dental attrition(as shown in figure (1-9),(1-10))

1. Shiny facets, flat and glossy.
2. Enamel and dentin wear at same rate.
3. Sensitive teeth.
4. Tooth discoloration.
5. Loss of tooth characteristics, rounded or sharp edge, loss of cusp and chipped tooth.
6. Altered occlusion as vertical height changed.
7. Teeth appear same high-no difference in hight of anterior teeth.
8. Enamel of molar appear shine and flat.
9. Hypermobility.
- 10.Loss of posterior occlusal stability.
- 11.Compromised periodontal support can result in tooth mobility.
- 12.Mechanical failure of restorations(wetselaar et al.2016)

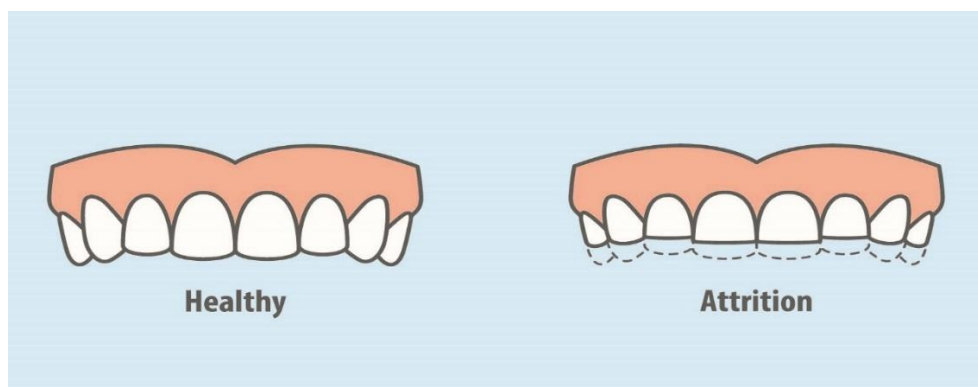


Figure (1-9) the differences between healthy and attrition teeth

(wazani et al.2012)



Figure (1-10) Sever case of attrition(Ganss et al.2014)

1.3.3.Preservation and management of attrition

It is important to know the causes of attrition when diagnosis before stat with treatment.To manage the condition, it is important to first diagnose it, describing the type of tooth surface loss, its severity and location.(**Mehta et al.2014**) Early diagnosis is essential to ensure tooth wear has not progressed past the point of restoration.(**Arie et al.2007**)A thorough examination is required, because it might give explanation to the etiology of the TSL. Prevention of Dental Attrition: When a diagnosis of bruxism has been confirmed it is recommended that the patient purchase a full coverage acrylic occlusal splint such as a Michigan Splint or Tanner appliance.as shown in **figure (1-11)**



Figure (1-11) Michigan splint (Jump et al.2005)

Treatment of bruxism:

Counselling by a trained psychologist is recommended for each case. Cognitive behavioural therapy is used to help the patients learn to better cope with the situations causing anxiety leading to bruxism.(**Johansson et al.2008**).Also meditation, yoga and deep breathing exercises are advised to better handle stressful situations. An occlusal splint made in hard acrylic resin is prescribed when most teeth are present to check bruxism. The splint should have a full occlusal coverage with multiple occlusal contacts on closure and correct anterior guidance(**van der Meulen et al.2022**).Mandibular advancement devices might be used for treating bruxism. They are worn at night and as the name suggests, they hold the lower jaw forward and closed while sleeping. They are more painful to wear as compared to occlusal splints(**Lobbezoo et al.2008**)



Figure (1-12) Mandibular advancement device

(**Machado et al.2021**)

Habit breaking appliances can be given to the patients. Chemotherapeutic agents that are prescribed include muscle relaxants and non-steroidal anti-inflammatory drugs (NSAIDs) to relieve the symptoms(**Huynh et al.2007**). Occlusal prematurities should be corrected. Removable partial dentures are recommended for patients with missing anterior teeth and attrition of the anterior teeth present. Porcelain restorations which cause the wearing of opposing teeth can be polished

properly which can reduce surface roughness. Malocclusion like Angle's class II division 2 and class III incisal malocclusion should be corrected by orthodontic treatment (**Sharma et al.2019**).

The factors to be assessed in a patient before restorative treatment are: periodontics, endodontic, coronal occlusal, functional, and aesthetic

1) Periodontal assessment: Uncontrolled periodontal disease is a contraindication for restorative care as periodontal breakdown may lead to questionable prognosis of the restoration. The gingival and periodontal health should be assessed using standard indices and dental plaque should be controlled before initiating treatment. Also, reduced bone support may lead to unwanted tooth movement. In cases of short clinical surgical crown lengthening might be required.(**Kumar et al.2014**)

2) Endodontic assessment: The pulpal and periapical status should be ascertained using clinical tests and radiographs. All treatment should be completed before restorative procedures as performing endodontic treatment after rehabilitative procedures may jeopardise the strength of the restorations.(**Grippe et al.2012**)

3) Coronal assessment: This may involve creation of retentive features on the occlusal surface of posterior teeth for restorations.

4) Occlusal assessment: The vertical dimension at occlusion is determined and adjusted according to the requirement of rehabilitative procedure.

5) Functional assessment: Whether the loss of teeth will increase the wear of remaining dentition is still debatable. The anterior teeth can experience unfavourable masticatory stress in the absence of posterior support

6) Aesthetic assessment: This is mainly related to the anterior teeth. The assessment includes severity of tooth loss, location of gingival margin and lip line.(**Rees et al.2015**)

Restorative Materials:

An ideal restorative material should be as wear resistant as the opposing structure, tooth or restorative material; should have a high flexural strength, be economical and should be repairable in the mouth(**Hegde et al.2013**). Different materials are used for different situations. To prevent wear of opposing natural dentition, metal occlusal surface and of high noble content, such as gold alloys are preferred. In cases of heavy bruxers, under consideration is not only the wear of the restoration itself and the opposing dentition but also strength to withstand the heavy load applied. Metal and metal-ceramic conditions seem to be the safest choices in such cases(**De Boever et al.2000**)

Composite Bonding:

Tooth colored adhesive filling material is bonded to the surface of the tooth restoring the worn tooth back to its original shape and protecting the underlying tooth from further damage. This technique is kind to tooth and gum tissues and has great potential for improving the appearance of the tooth. The cases below shows(**figure 1-13**) what can be achieved with tooth composite bonding (**Sarode et al.2016**)



Figure(1-13) before and after treatment in composite

(Jain et al.2012)

Crowns and Veneers:

Where extensive damage has occurred and much of the enamel has been destroyed these tooth like restorations will strengthen and protect the tooth, as well as restoring the appearance. Below show(**figure 1-14**) before and after tooth wear case treated with veneer.(**Sauro et al.2015**)



Figure (1-14) treatment of attrition with porcelain veneers (Garg et al.2021)



Figure (1-15) attrition treatment with bonding(Zhang et al.2020)

1.4.Abrasion

Abrasion (mechanical wear of dental hard tissue not involving tooth-to-tooth contact) often presents in the cervical region of teeth, especially when associated with tooth brushing habits removing acid softened enamel and dentine in areas where gingival recession has occurred . Other causes of abrasion include patients chewing abrasive materials such as sand.(Bartlett et al.1999) as shown in **figure (1-16,1-17)**



Figure (1-16) dental abrasion in teeth(Franco et al.2019)

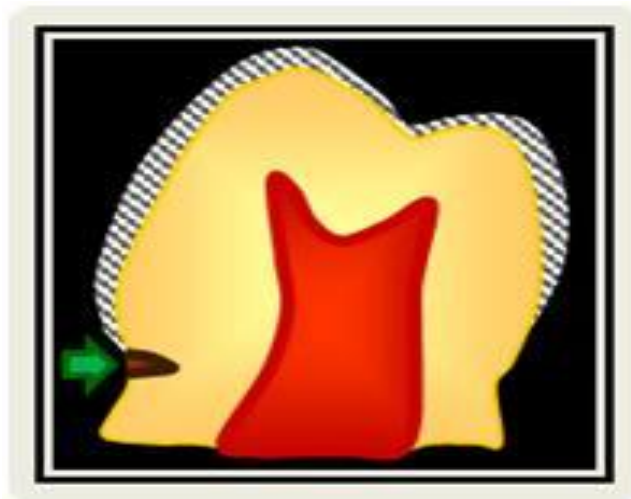


Figure (1-17) dental abrasion cervical lesion in its initial state.

(Aggarwal et al.2018)

1.4.1.Clinical appearance of abrasion

Cervical abrasion injuries wear is located in the neck of the tooth specifically in the cervical third,CEJ, being able to encompass the proximal, vestibular, lingual or palatal surfaces of the teeth commonly in canines and premolars.(**krolo et al.2015**)Epidemiologically, the high incidence of cervical lesions is the result of certain morphological alterations and histological characteristics of this area. However, with the advancement of the lesion, the walls constitute a "V" shape or wedge (cuneiform defect) with an acute axial angle, forming an angle close to 90°, with a depth that can oscillate between 1 and 2 mm, although in exceptional cases lesions can be seen up to 4 mm deep, with possible pulpal exposure.

(**Barrancos et al.2000**)Sometimes be unilateral (whereby left- sided lesion are more likely to be seen amongst right-handed patient). In most of the cases, the surfaces of these lesions are observed hard, smooth and bright, with sharp edges and a characteristic transparency.(**Milosevic, 1998**) as shown in **figure (1-18)**



Figure (1-18) v-shaped abrasion in teeth

(**Subramaniam et al.2013**)



Figure (1-19) female patient, 27 years old, dental abrasion lesions, located on the incisal edges of both upper central incisors, produced by the repeated interposition of pins and needles.(Tsesis et al.2019)

1.4.2.Etiology of abrasion (as shown in figure 1-20,1-21)

There are several different possible sources of tooth abrasion, including:

- Usually associated with the use of abrasive dentifrice,
- improper Brushing technique
- , Habitual opening of bobby pins with teeth,
- Habitual pipe smoking,
- Improper use of dental floss and tooth picks
- The type of bristle material of toothbrush,
- stiffness of toothbrush bristles,
- the abrasiveness, and pH of dentifrice.(**Hanif et al.2015**)
- Used are factors related to material. Dietary abrasion is not very prominent in modern days, as the typical western diet tends to be very soft, as opposed to primitive man's diet which was more abrasive, and thus contributed greatly to tooth wear. (**Shafer et al.2012**)
- Biting on your fingernails



Figure (1-20) Abrasive lesion traumatic tooth brushing(Banerji et al.2017)



Figure (1-21)Nail biting (Marinho et al.2021)

1.4.3.Prevention and management of abrasion

Identification of the risk factor(s) is clearly important in order to

Modify any habits and provide appropriate advice. Questioning patients. About acidic diet is covered elsewhere. Oral hygiene habits will involve detailed analysis of technique, frequency, types of brush and toothpaste. Certain pastes or powders are abrasive, such as smoker's powders.(**Siqueira et al.2018**) The distribution of abrasion defects will help the clinician Diagnose the risk factors. If the only complaint is of dentine sensitivity, Then advice to use desensitizing toothpastes or application of desensitizing Resin as appropriate.(**Azzopardi et**

al.2004) Treatment of these lesions can be both conservative and invasive. The non-invasive treatment (conservative) is based on recommendations Or individualized instructions to the patient, aimed at: dietary advice, the Decrease in the frequency of consumption of certain beverages and foods, The control of par functional habits, the instruction of correct hygiene Measures oral, the use of rinses and fluorinated products, coupled with Possible reconstructive procedures of periodontal nature.(**Watson et al.2000**)(**Calatrava et al.1994**) However, when conservative treatment is insufficient and cervical Injury compromises the function and aesthetics of the tooth, the Restoration of the lesion is necessary which can be made with various Materials of direct use, such as dental amalgam, conventional ionomeric Glass, resin-modified ionomeric glass, composite resin modified with ionomeric glass and composite resin,. In the presen, the most Common treatment for these injuries is restoration with composite resin as shown in **figure (1-22).**(**Kim et al.2015**)

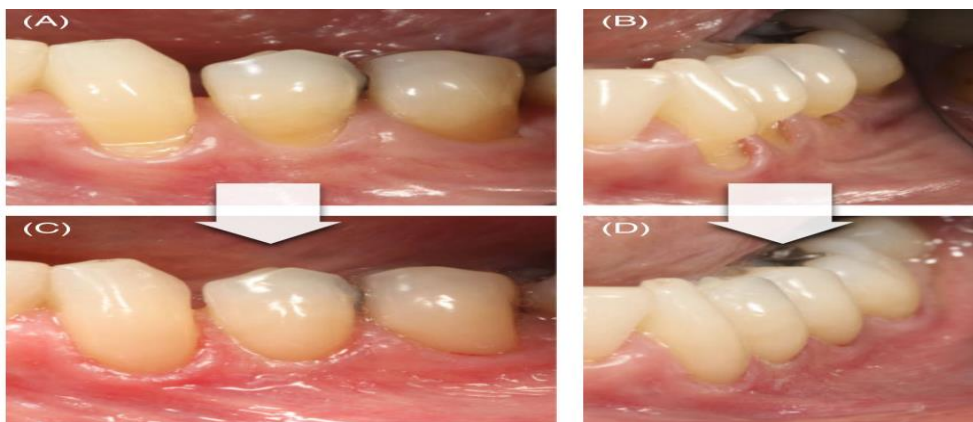
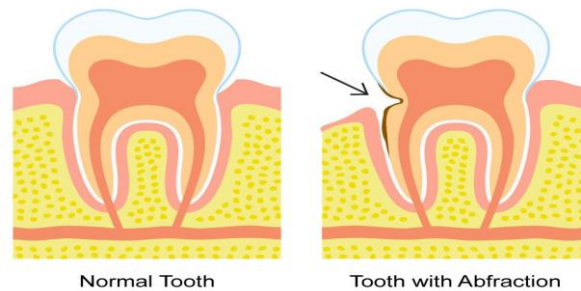


Figure (1-22) Dental abrasion before and after treatment(Kim et al.2015)

1.5.Abfraction

Abfraction is considered as a potential etiology for NCCLs.(**Warreth et al.2020**) The term “abfraction” was introduced to explain cervical wear resulting from mechanical stress related to loading.Abfraction is thought to result from tensile stress caused by mastication and malocclusion.(**Landry et al.2010**) It has been proposed that high occlusal loads⁵⁶ and tooth bending (flexure) has a fun-

damental role in the development of NCCLs due to stress parallel or oblique to the occlusal load.(Kaushik et al.2009) as shown in figure (1-23)



Figure(1-23) The difference between normal tooth and tooth with abfraction(Kaushik et al.2009)

1.5.1.Etiology of Abfraction

As abfraction is still a controversial theory there are various ideas on what causes the lesions.because of this controversy the true causes of abfraction also remain disputable.(Mohd et al.2018)Researchers have proposed that abfraction is caused by forces on the tooth from the teeth touching together, occlusal forces, when chewing and swallowing. These lead to a concentration of stress and flexion at the area where the enamel and cementum meet (CEJ).This theoretical stress concentration and flexion over time causesThe bonds in the enamel of the tooth to break down and either fracture orbe worn away from other stressors such as erosion or abrasion.(Mjor et al.2001).The people who initially proposed the theory of abfraction believethat the occlusal forces alone cause the lesions without requiring the added abrasive components such as toothbrush and paste or erosion. If teeth come together in a non - ideal bite the researchers state that this would create further stress in areas on the teeth (Bartlett et al.2006).Teeth that come together too soon or come under more load than they are designed for could lead to abfraction lesions. The impacts of restorations on the chewing surfaces of the teeth being the incorrect height has also been raised as another factor adding to the stress at the CEJ.(Sirisha et al.2013) Further research has shown that the

normal occlusal forces from chewing and swallowing are not sufficient to cause the stress and flexion required to cause abfraction lesions. However, these studies have shown that the forces are sufficient in a person who grinds their teeth (bruxism).(Cunha-Cruz et al.2010) Several studies have suggested that it is more common among those who grind their teeth, as the forces are greater and of longer duration. Yet further studies have shown that these lesions do not always appear in people with bruxism and others without bruxism have these lesions. There are other researchers who would state that occlusal forces have nothing to do with the lesions along The CEJ and that it is the result of abrasion from toothbrush with toothpaste that causes these lesions (Lee et al.2015) as shown in figure (1-24)



Figure (1-24)Abfraction lesion (Lee et al.2015)

1.5.2.Clinical apperance of abfraction

Abfraction lesions are observed primarily on the buccal surfaces and are typically wedge- or V-shaped lesions with clearly defined internal and external angles.(Rees et al.2003) Researchers have also described that abfraction lesions can manifest themselves as C-shaped lesions with rounded floors or mixed- shaped lesions with flat, cervical, and semicircular occlusal walls.(Hur et al.2011)Contributing factors leading to erosion or abrasion can also modify the clinical appearance of these lesions by making the angles less sharp and the

outline broader and more saucer-shaped. Moreover, abfraction lesions may be deeper than wider depending on the stage of progression and related causal factors. Multiple abfraction lesions overlapping one another, as the ones observed in **Figure (1-25)**, seem to occur due to various forces producing tensile stress. the occasional cases of abfraction lesions that are detected below gingiva.(**de Souza et al.2021**)

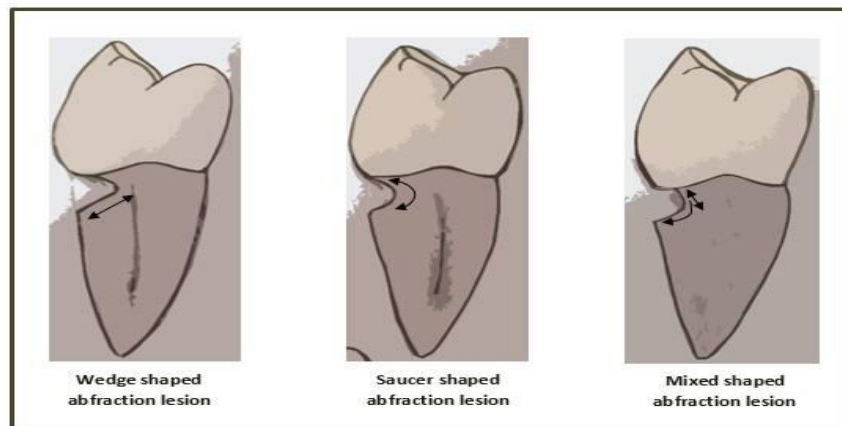


Figure (1-25) shapes of abfraction (de Souza et al.2021)

1.5.3.Prevention and management of abfraction

Successful prevention and management of abfraction or any NCCLs requires an understanding of the risk factors and how these risk factors change over time in individual patients. Preventive intervention may include counseling for changes in patient's behavior, such as diet, use of protective night guards to reduce clenching or bruxism, use of chewing gums to increase salivary flow, and/or to seek therapy or medical attention if there is a potential, intrinsic medical or mental condition. When abfraction lesions are painless and do not affect esthetics, there is normally no complaint from the patient. In such cases and in cases where the lesions do not cause severe clinical consequences and/or are shallow in depth (<1 mm), it is advisable to monitor the progression of these lesions at regular intervals without any treatment intervention. The assessment of lesion activity can be

performed every 6 months to 12 months and during regular hygiene visits (**Ichim et al.2007**).

Treatment of abfraction lesions can be difficult due to the many possible causes. To provide the best treatment option the dental clinician must determine the level of activity and predict possible progression of the lesion (**Grippo et al.2012**)

The activity of abfraction lesions needs to be assessed and considered in the treatment planning process. Approaches to determine lesion activity include the use of standardized intra-oral photographs, study models, and measurement of lesion dimensions over time. Activity assessment can also be performed by using a scratch test (**Michael et al.2009**)

Visual observation of changes in the initial scratch created with a no. 12 scalpel blade can offer an indication of the rate of tooth structure loss. Loss of the total or partial definition of the scratch may signify that the process is active (**Bardsley et al.2008**)

If there are concerns around aesthetics or clinical consequences such as dentinal hypersensitivity, a dental restoration (white filling) may be a suitable treatment option (**Grippo et al.2012**). Current treatment of dental abfraction lesions consists in light- cured composite restorations as in **fig (1-26)**. The results are excellent. When the treatment's principles are respected; these principles refers to: aesthetic objectives (color, texture, morphology); tooth preparations, technique and adhesive techniques used (**Perez, et al.2010**).

Aside from restoring the lesion, it is equally important to remove any other possible causative factors. Adjustments to the biting surfaces of the teeth alter the way the upper and lower teeth come together, this may assist by redirecting the occlusal load. The aim of this is to redirect the force of the load to the long axis of the tooth, therefore removing the stress on the lesion. This can also be achieved by altering the tooth surfaces such as cuspal inclines, reducing heavy contacts and

removing premature contacts. If bruxism is a deemed a contributing factor an occlusal splint can be an effective treatment for eliminating the irregular forces placed on the tooth (Aw et al.2002)



Figure (1-26) abfraction before and after treatment (Aw et al.2002)

2.Conclusion.

Treating NCCLs necessarily involves these steps: problem identification, diagnosis, etiological factor removal, or treatment, and, if necessary, restoration. Due to the multifactorial character, it is not a simple procedure. A successful diagnosis and treatment plan requires a thorough patient history and careful observations and evaluations. Different approaches should be made to each specific situation.

3.References

[A]

- Aggarwal V, Singla M, Miglani S, Kohli S. Non-carious cervical lesions: a review of current concepts on etiology and management. *Indian J Dent Sci.* 2018;10(2):83-91. doi: 10.4103/IJDS.IJDS_60_17.
- Al-Dlaigan YH, Shaw L, Smith A. Dental erosion in a group of British 14-year-old school children. Part II: Influence of dietary intake. *Brit Dent J.* 2001 Mar 10;190(5):258-61.and trauma. *Quintessence International*, 32 (10),771-788.and without a protective layer. *British dental journal*, 196(6), 351-
- Arie Van't, S; Cees, MK; Nico, HJC (2007). "Attrition, Occlusion, (Dys)Function and Intervention: a Systematic Review". *Clinical Oral Implants Research.* 18 (3): 117–126.
- Aw, T. C., Lepe, X., Johnson, G. H., & Mancl, L. (2002). Characteristics of noncarious cervical lesions: a clinical investigation. *The Journal of the American Dental Association*, 133(6), 725-733.Azzopardi, A., Bartlett, D. W., Watson, T. F., & Sherriff, M.

[B]

- Banerji S, Mehta SB, Millar BJ, Suarez-Feito JM. Current concepts on the management of tooth wear: part 1. Assessment, treatment planning and strategies for the prevention and the passive management of tooth wear. *Br Dent J.* 2017 Nov 10;223(9):703-710.
- Bardsley, P. F. (2008). The evolution of tooth wear indices. *Clinical oral investigations*, 12(1), 15-19
- Barrancos J, Barrancos G. General principles of preparations. In: Barrancos J , editor, *Operative Dental*. 3rd ed, Buenos Aires: Editorial Panamericana Medical;2002:471–534.

- Barrancos J, Rodríguez G. Cariology. In: Barrancos J, editor, *Operative Dental*. 3rd ed, Buenos Aires: Editorial Panamericana Medical;2002:239–280.
- Bartlett, D. W., & Shah, P. (2006). A critical review of non-carious Cervical (wear) lesions and the role of abfraction, erosion, and Abrasion. *Journal of dental research*, 85(4), 306-312.

[C]

- Calatrava L. Cervical third lesions, treatment alternatives. Carvalho TS, Colon P, Ganss C, Huysmans MC, Lussi A, Schlueter N, Shellis RP, Tveit AB, Wiegand A, Wetzel WE, Zero DT. Consensus report of the European Federation of Conservative Dentistry: erosive tooth wear-diagnosis and management. *Swiss dental journal*. 2016;126(4):342-6.
- Clark G T, Tsuiyama Y, Baba K, Watanabe T. Sixty-eight years of experimental occlusal interference studies: what have we learned? *J Prosthet Dent* 1999–82: 704–713.
- Correr-Sobrinho, L., & Bueno, M. (2008). In vitro toothbrushing Cunha-Cruz J, Wataha JC, Heaton LJ, Rothen M, Sobieraj M, Scott J, Berg J. The prevalence of non-carious cervical lesions in a VA population. *J Am Dent Assoc*. 2010 Oct;141(10):1247-55. doi: 10.14219/jada.archive.2010.0063. PMID: 20884908; PMCID: PMC4156017.

[D]

- D. Bartlett, K. Phillips, and B. Smith, “A difference in perspective the North American and European interpretations of tooth wear,” *The International Journal of Prosthodontics*, vol. 12, no. 5, pp. 401–408, 1999.
- De Boever J A, Carlsson G E, Klienbergh I J . Need for occlusal therapy and prosthodontic treatment in the management of temporomandibular

disorders. Part I. Occlusal interferences and occlusal adjustment. *J Oral Rehabil* 2000; 27: 367–379.

- De Boever, J. A., Carlsson, G. E., & Klineberg, I. J. (2000). Need for occlusal therapy and prosthodontic treatment in the management of temporomandibular disorders. Part II: Tooth loss and prosthodontic treatment. *Journal of oral rehabilitation*, 27(8), 647-659.
- de Souza Gonçalves J, Dantas L, de Oliveira AC, Barros Silva PG, Lima LD, de Melo FP. Non-cariious cervical lesions and occlusal factors: a systematic review and meta-analysis. *J Oral Rehabil*. 2021 Jun 2. doi: 10.1111/joor.13173. Epub ahead of print. PMID: 34077610.

[F]

- Forbes-Haley C, Jones SB, Davies M, West NX (August 2016). "Establishing the Effect of Brushing and a Day's Diet on Tooth Tissue Loss in Vitro". *Dentistry Journal*. 4 (3): 25. doi:10.3390/dj4030025. PMC 5806935. PMID 29563467.
- Franco EB, Benetti P, Borges AB, Reis A, Loguercio AD. Non-cariious cervical lesions: evaluation of different treatment strategies. *Oper Dent*. 2019 Jul/Aug;44(4):402-413. doi: 10.2341/18-214-L. Epub 2019 May 15. PMID: 31090773.

[G]

- Ganss C, Schlueter N. Diagnosis and prevention of erosion. *Monographs in oral science*. 2014;25:22-31.
- Ganss C. Definition of erosion and links to tooth wear. In *Erosive Tooth Wear: From Diagnosis to Therapy 2014* (pp. 9-16). Karger Publishers.
- Garg A, Bhatia S, Rastogi P, Singhal S, Gupta S. Non-cariious cervical lesions: a comprehensive review. *J Clin Exp Dent*. 2021 Mar 1;13(3):e320-e326. doi: 10.4317/jced.58662. PMID: 33737949; PMCID: PMC7949717.

- Grant BF, Dawson DA, Stinson FS, Chou SP, Dufour MC, Pickering RP: The 12-month prevalence and trends in DSM-IV alcohol abuse and dependence: United States, 1991–1992 and 2001– 2002. *Drug Alcohol Depend* 2004; 74: 223–234.
- Grippo JO, Simring M, Coleman TA. (2012) Abfraction, abrasion, biocorrosion, and the enigma of noncarious cervical lesions: a 20 - year perspective. *Journal of Esthetic Restorative Dentistry*, 24 (1), 10_23.
- Grippo JO, Simring M, Coleman TA. Abfraction, abrasion, biocorrosion, and the enigma of noncarious cervical lesions: a 20-year perspective. *J Esthet Restor Dent*. 2012;24(1):10-23. doi: 10.1111/j.1708-8240.2011.00464.x
- Grippo JO. Abfractions: a new classification of hard tissue lesions of teeth. *J Esthet Dent*. 1991;3:14–9.

[H]

- Hanif A, Rashid H, Nasim M. Tooth surface loss revisited: Classification, etiology, and management. 2015;37–43.
- Hegde MN, Hegde P, Bhandary S, Shetty S. The Prevalence of Non-Carious Cervical Lesions in Subjects Visiting a Dental School in Southern India. *J Clin Diagn Res*. 2013 Sep;7(9):2181-3. doi: 10.7860/JCDR/2013/6012.3362. PMID: 24179828; PMCID: PMC3801489.
- Hemmings KW, Darbar UR, Vaughan S. Tooth wear treated with direct composite restorations at an increased vertical dimension: results at 30 months. *J Prosthet Dent* 2000; 83: 287–293.
- Hur B, Kim HC, Park JK, Versluis A. Characteristics of non-carious cervical lesions – an ex vivo study using micro computed tomography. *J Oral Rehabil*. 2011;38(6):469–474.

- Huynh, N., Manzini, C., Rompré, P. H., & Lavigne, G. J. (2007). Weighing the Potential Effectiveness of Various Treatments for Sleep Bruxism. *Journal of the Canadian Dental Association*, 73(8), 727-30. *Ned Tijdschr Tandheelkd*,7(107),092-300.

[I]

- Ichim IP, Schmidlin PR, Li Q, Kieser JA, Swain MV. (2007). Restoration of non-cariou cervical lesions part II. Restorative material selection to minimise fracture. *Dental Material*,23(12),1562–1569.

[J]

- Jain, P., Hallikerimath, R. B., & Kulkarni, S. (2012). Non-cariou cervical lesions: a review of the current concepts in pathogenesis and management. *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 41(7), 533–540
- Jones S B, Barbour M E, Shellis R P, et al. Interactions between dodecyl phosphates and hydroxyapatite or tooth enamel: relevance to inhibition of dental erosion. *Colloids Surf B Biointerfaces*. 2014;117:193-8.
- *Journal of the California Dental Association* 39 (4): 251--6. April 2011.
- Jump up to: a b David, WB (2005). "The Role of Erosion in Tooth Wear: Aetiology, Prevention and Management". *International Dental Journal*. 55 (4): 277–284. doi:10.1111/j.1875-595X.2005.tb00065.x. PMID 16167606.

[K]

- Kaushik SK, Madan R, Gambhir A, Prasanth T.(2009). Aviation stress and dental attrition. *Ind J Aerospace Med*.53 (1),6-10

- Kim J, Kim Y, Kim Y. Non-carious cervical lesion treated with resin infiltration technique: a case report. *Restor Dent Endod*. 2015 Feb;40(1):68-72. doi: 10.5395/rde.2015.40.1.68. Epub 2015 Jan 14. PMID: 25648303; PMCID: PMC4304612.
- Krolo M, Kovačević A. Noncarious Cervical Lesions: From Etiology to Therapy. *Smile Dental Journal*. 2015;10(1):22–26. 2
- Kumar A, Gupta A, Verma M, Singh S. Non-carious cervical lesions - a review. *J Clin Diagn Res*. 2014;8(10):ZE01-5. doi: 10.7860/JCDR/2014/9971.4986.

[L]

- Lanata E. Restorations of Class V of Black or Mount III. In: Lanata E, editor. *Operative Dental. Aesthetics and adhesion*. Buenos Aires: Grupo Guía S.A;2005:137–150.
- Landry ML, Rompré PH, Manzini C, Guitard F, de Grandmont P, Lavigne GJ. Reduction of sleep bruxism using a mandibular advancement device: an experimental controlled study. *International Journal of prosthodontics of*, 19(6):549-56.
- Lavigne G.J, Khoury S, Abe S, Yamaguchi T, Raphael K. Bruxism physiology and pathology: an overview for clinicians. *J Oral Rehabil* 2008; 35: 476–494
- Lee WC, Eakle WS. (1984).Possible role of tensile stress in the etiology of cervical erosive lesions of teeth. *Journal of Prosthodontics Dentistry* , 52 (3),374_380.
- Lee WC, Eakle WS. Possible role of tensile stress in the etiology of cervical erosive lesions of teeth. *J Prosthet Dent*. 1984;52:374–80.
- Lee WC, Eakle WS. Possible role of tensile stress in the etiology of cervical erosive lesions of teeth. *J Prosthet Dent*. 1984;52(3):374–380.

- Levitch LC, Bader JD, Shugars DA, Heymann HO. Non-cariou cervical lesions. *J Dent.* 1994;22(4):195–207.
- Lobbezoo F, van der Zaag J, van Selms MK, Hamburger HL, Naeije M. (2008) Principles for the management of bruxism. *Journal of Oral Rehabilitation.*, 35(7),509-523.
- López-Frías FJ, Castellanos-Cosano L, Martín-González J, Llamas-Carreras JM, Segura-Egea JJ (February 2012). "Clinical measurement of tooth wear: Tooth wear indices". *Journal of Clinical and Experimental Dentistry.* 4 (1): e48-53. doi:10.4317/jced.50592. PMC 3908810. PMID 24558525.
- Lundeen H.C, Shryock E.F, Gibbs C H. An evaluation of mandibular border movements: their character and significance. *J Prosthet Dent* 1978; 40: 442–452. Johansson, A., Johansson, A. K., Omar, R., & Carlsson, G. E. (2008). Rehabilitation of the worn dentition. *Journal of oral rehabilitation,* 35(7), 548-566.
- Lussi A, Ganss C. Erosive tooth wear: diagnosis, risk factors and prevention. *American Journal of Dentistry.* 2013 Feb;26(1):3-8.

[M]

- Machado AC, Bottino MA, Goes MF, Bicalho AA. Non-cariou cervical lesions: a review and strategies for conservative adhesive management. *J Esthet Restor Dent.* 2021 Feb;33(2):144-155. doi: 10.1111/jerd.12627. Epub 2020 Nov 24. PMID: 33230935.
- Marinho SA, Barros NC, Moreira AN, Santos VR. Non-cariou cervical lesions and their association with occlusal factors: a systematic review. *J Oral Rehabil.* 2021 Feb;48(2):202-212
- Mehta, SB; Banerjji, S; Millar, BJ; Suarez-Feito, JM (2014). "Current Concepts on the Management of Tooth Wear: Part 1". *British Dentistry Journal.* 212 (1): 17–27

- Michael JA, Townsend GC, Greenwood LF, Kaidonis JA. (2009) Abfraction separating fact from fiction. *Australian Dentistry Journal*, 54(1),2–8.
- Mohd Nor, H., & Harun, N. A. (2018). Conservative management Moraes, R. R. D., Ribeiro, D. D. S., Klumb, M. M., Brandt, W. C.,
- Murakami C, Bonecker M, Correa MSNP, Mendes FM, Rodrigues CRMD. Effect of fluoride varnish and gel on dental erosion in primary and permanent teeth. *Arch Oral Biol*. 2009 Nov;54(11):997-1001 nanohybrid and microfilled materials. *Brazilian oral research,of dental erosion in adolescents with medical conditions. Case*

[P]

- Perez C, Gonzalez MR, Prado NA, de Miranda MS, Macêdo M, Fernandes BM (2012). "Restoration of noncarious cervical lesions: when, why, and how". *International Journal of Dentistry*. 2012: 687058. doi:10.1155/2012/687058. PMC 3246729. PMID 22216032.
- Perez, C. R. (2010). Alternative technique for class V resin composite restorations with minimum finishing/polishing procedures. *Operative dentistry*, 35(3), 375-379.
- Piotrowski BT, Gillette WB, Hancock EB (2001). Examining the prevalence and characteristics of abfraction like cervical lesions in a population of U.S. veterans. *Journal of American Dental Association*, 132(12):1694–1701.

[R]

- Ranjitkar S, Kaidonis JA, Richards LC, Townsend GC. The effect of CPP-ACP on enamel wear under severe erosive conditions. *Arch Oral Biol*. 2009 Jun;54(6):527-32.

- Ravi, R. K., Krishnaalla, R. A. M. A., Mohammed, S. H. A. M. M. A. S., & KSV, R. (2013). Non-Carious lesions due to tooth surface loss: A Review. *Dent Era-A Journal of Dentistry* 2013.
- Rees JS, Hammadeh M, Jagger DC. Abfraction lesion formation in maxillary incisors, canines and premolars: a finite element study. *Eur J Oral Sci.* 2003;111(2):149–154.
- Rees JS, Hammadeh M. Non-carious cervical lesions. *Dent Update.* 2015 Jul-Aug;42(6):543-6, 549-50, 553-4. doi: 10.12968/denu.2015.42.6.543. PMID: 26197477.
- Rees JS, Jagger DC. Abfraction lesions: myth or reality? *J Esthet Restor Dent.* 2003;15:263–71. reports in dentistry, 2018.

[S]

- Sarode, G. S., Sarode, S. C., & Patil, A. (2016). Non-carious cervical lesions: a review. *Journal of clinical and diagnostic research: JCDR*, 10(4), ZE01–ZE06.
- Sauro, S., Watson, T. F., & Thompson, I. (2015). Dentine hypersensitivity and non-carious cervical lesions: a clinical overview. *Primary Dental Journal*, 4(4), 48-53.
- Schlueter N, Luka B, Eickholz P, Schramm A. Non-carious cervical lesions—a clinical review. *Journal of oral rehabilitation.* 2014 Nov;41(11):850-66.
- Selwitz RH, Ismail AI and Pitts NB. Dental caries. *Lancet.* 2005; 369: 51-59.
- Shafer;Hine;Levy. Shafer ' s Textbook of Oral Pathology. *Shafers Textb Oral Pathol.* 2012;1695–935.
- Sharma A, Arora A, Upadhyay D, Singh P, Gupta S. Non-carious cervical lesions: A review. *J Int Soc Prev Community Dent.* 2015;5(1):1-7. doi: 10.4103/2231-0762.151970

- Siqueira FV, Silveira AC, Freitas AC Jr, de Freitas PM. Non-carious cervical lesions: a clinical approach. *J Esthet Restor Dent.* 2019 Mar;31(2):107-117. doi: 10.1111/jerd.12463. Epub 2018 Nov 21. PMID: 30461013.
- Sirisha K, Ravikiran V, Praveen G, Reddy S, Kumar KN, Ponnada S. A review of non-carious cervical lesions. *J Clin Diagn Res.* 2013 Oct;7(10):2427-30. doi: 10.7860/JCDR/2013/
- Subramaniam P, Gupta N. Non-carious cervical lesions: an overview of current concepts. *J Conserv Dent.* 2013 Sep;16(5):389-94. doi: 10.4103/0972-0707.117494. PMID: 24082568; PMCID: PMC3773939.
- Sugita I, Nakashima S, Ikeda A, Burrow MF, Nikaido T, Kubo S, Tagami J, Sumi Y (February 2017). "A pilot study to assess the morphology and progression of non-carious cervical lesions". *Journal of Dentistry.* 57: 51–56. doi:10.1016/j.jdent.2016.12.004. hdl:10069/37977

[T]

- Ten Cate AR, Imfeld T. Non-carious tooth lesions - a clinical perspective. *Journal of oral rehabilitation.* 2012 Jan;39(1):1-12.
- Tsesis I, Rosen E, Tamse A. Diagnosis and treatment of non-carious cervical lesions. *Quintessence Int.* 2019;50(9):686-696. doi: 10.3290/j.qi.a42846. PMID: 31486802. Update.,5(4),175–81.

[W]

- Wang P, Lin H, Liang X, Liang Y, Li J, Li C. Non-carious cervical lesions: a review of current knowledge. *Journal of oral rehabilitation.* 2018 Mar;45(3):259-69.

- Warreth A, Abuhijleh E, Almaghribi MA, Mahwal G, Ashawish A. Tooth surface loss: a review of literature. *Saudi Dent J.* 2020;32:53– 60
- Watson M. Trevor F. (2000). Investigation and treatment of patients
- Wazani BE, Dodd, MN; Milosevic, A. (2012). The signs and symptoms of tooth wear in a referred group of patients ". *British Dental Journal*, 213 (6), 17-270.
- West NX, Hughes JA, Addy M. Erosion of dentine and enamel in vitro by dietary acids: the effect of temperature, acid character, concentration and exposure time. *J Oral Rehabil.* 2000 Oct;27(10):875-80.
- Wetselaar, P., & Lobbezoo, F. (2016). The tooth wear evaluation system: a modular clinical guideline for the diagnosis and management planning of worn dentitions. *Journal of oral rehabilitation*, 43(1), 69-846. with teeth affected by tooth substance loss: a review. *Dental*

[Z]

- Zhang Y, Chen Y, Yin W. Non-carious cervical lesions: a systematic review and meta-analysis. *J Oral Rehabil.* 2020 Apr;47(4):450-461. doi: 10.1111/joor.12902. Epub 2020 Jan 7. PMID: 31840817.