ORIGINAL ARTICLE

Prevalence and Associated Factors to Non-Carious Cervical Lesions in Brazilian University Students: A Cross-Sectional Survey

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ABSTRACT

Objective: To identify the prevalence, severity, hypersensitivity, and distribution of Non-carious cervical lesions (NCCL) among university students in Brazil. **Material and Methods:** 179 participants answered an anamnesis with twenty questions about the presence or absence of habits associated with NCCL. The participants' teeth were evaluated to identify the presence or absence of the lesion, its classification, involved surfaces, severity, hypersensitivity, and tooth wear index. A hypersensitivity test was performed with ice water. Data were analyzed using the chi-square test and simple logistic regression (p<0.01). **Results:** 179 participants answered an anamnesis with twenty questions about the presence or absence of habits associated with NCCL. The participants' teeth were evaluated to identify the presence or absence of the lesion, its classification, involved surfaces, severity, hypersensitivity, and tooth wear index. A hypersensitivity test was performed with ice water. Data were analyzed using the chi-square test and simple logistic regression (p<0.01). **Conclusion:** The prevalence of NCCL was 15.1% and abfraction was the most frequent lesion. Premolars were the teeth most affected by non-carious cervical lesions.

Keywords: Dentin Sensitivity; Prevalence; Tooth Erosion; Cross-Sectional Studies.

Introduction

Non-carious cervical lesions (NCNC) are characterized by the loss of tooth structure in the cervical region of the teeth, close to the cementoenamel junction, without the action of microorganisms [1]. These lesions have a multifactorial etiology, mainly triggered by biocorrosive factors, friction, and occlusion [2], as well as the combination of two or more factors are relevant in this pathology, being modulated by the intensity, duration, and frequency of the etiological factors [3].

Early, correct, and reliable diagnosis of these lesions is essential to prevent their development, stop the progression of existing lesions, and determine the appropriate treatment [4]. However, its diagnosis is often complicated, as there is still controversy regarding its classification and assessment methods [5].

Thus, the prevalence of NCCL, regardless of form and etiology, ranges from 5 to 85% and tends to increase with age [6]. This variation might result from using different terminology for the same alteration, diversity in the definition, diagnosis, and assessment method used, and variance in the geographical location, period, and type of population studied [5,7]. A significant variation in the NCCL prevalence for Brazil (53,5 to 88%) has been reported [5].

University students are constantly subjected to poor mental health, high hours of study, psychological stress, and sedentary behavior that increase the risk of body and dental injury [3,8]. These individuals have a peculiar lifestyle that enhances the interaction among tension, erosion, and friction, which would develop or worsen the NCCLs [3]. Studies regarding the prevalence and factors associated with NCCL among university students in Brazil are scarce in the literature. Therefore, this investigation would be relevant since the current lifestyle of this age group may predispose to the onset of cervical lesions [3] and would thus help prevent tooth wear and control its progression and consequences in this population.

Thus, this study aimed to determine the prevalence of NCCL in university students from the Jequitinhonha and Mucuri Valleys (UFVJM) and identify habits and factors associated with these injuries. Secondarily, the most prevalent teeth and faces, the severity of tooth wear, and the presence or absence of dentinal hypersensitivity associated with NCCL were investigated.

Material and Methods

Ethics and Study Design

This cross-sectional study was approved by the Research Ethics Committee of UFVJM under protocol 75566217.2.0000.3108 and carried out at the Periodontics Clinic of UFVJM, Diamantina, Brazil. It was conducted per the Helsinki Declaration of 1975, revised in 2013. All participants in this study signed a free and informed consent form before the beginning of the trial.

Sample Size and Characteristics

The prevalence calculation was used to determine the sample size. Statistical calculation was performed with a significance level of 99%, a power of 80%, a margin of error stipulated at 2%, and a prevalence of 38.7% [9]. Calculations demonstrated the minimum of 4,150 teeth to be investigated. It was added 20% to prevent eventual losses, thus totaling 4,980 teeth to be evaluated.

The sample consisted of university students from UFVJM of both genders, with good general health status, without distinction of color or socioeconomic status, and who reported interest in participating in the research. Patients with periodontal disease, dental abutments for dentures, fixed or removable crowns, and third molars were excluded.

Clinical Examinations

The students received an initial questionnaire to identify those interested and willing to participate in the research. To assess the prevalence of NCCL, participants underwent anamnesis and clinical examination to determine the lesions and habits associated with its development. A mirror, clinical probe, and Williams millimeter probe were used for the clinical examination.

An anamnesis on the prevalence of lesions, prepared by the researchers themselves, was used for application in this study, based on the characteristics of the injuries, containing twenty questions, with dichotomous responses (yes/no); multiple-choice (daily, often, weekly, rarely, never); and self-report questions, which addressed the presence or absence of habits associated with NCCL and dentin hypersensitivity.

It investigated the possible associated factors, as well as toothbrushing habits (intensity of tooth brushing and hardness of toothbrush), biting, and chewing habits. The anamnesis also contained items about medical history, eating habits, orthodontic treatment, smoking status, and use of alcoholic beverages.

The examiners (FNM, NSA, and JCGG) were calibrated to perform the clinical tests and application of the anamnesis. Initially, the examiners were instructed about the characteristics of NCCL through a set of images that addressed all types of lesions. The calibration for evaluating the lesions was performed by clinical examination in volunteers who presented NCCL and were not included in the study. The examiners performed the clinical examination separately, without communicating with them about the clinical findings. The retest was performed after 14 days of the first evaluation. The inter-examiner concordance value ranged from K = 0.750 to K = 0.883, and the intra-examiner was K = 0.850 to K = 0.934.

Each patient's tooth was evaluated individually to identify the presence or absence of the lesion and its classification, the involved faces, severity, and hypersensitivity associated with it, in addition to the presence of occlusal/incisal wear. To determine this wear, the extension and depth of the lesions were measured with a periodontal probe, and the average of the measurements found was made.

To determine the severity of the lesions, the Tooth Wear Index (TWI) was used, which defines the depth of the lesions on a scale of 1 to 4 for each tooth surface separately [10]. The depth was measured in millimeters from the deepest region to the external surface, perpendicular to the long axis of the tooth.

The TWI was scored as 0- no loss of enamel surface characteristic, no loss of contour; 1- minimal loss of enamel contour; 2- defect <1 mm in depth; 3- defect 1-2 mm in depth; and 4- defect >2 mm in depth or pulp exposure or secondary dentine exposure.

The dentin hypersensitivity test was performed with ice water at a temperature of ~ 5°C, controlled with an analog thermometer. A cotton swab soaked in ice water was placed in contact with the surface of the lesions. The stimulus was maintained until the painful complaint of the participant, with a maximum application time of 3 seconds. A cyanoacrylate-based desensitizing was applied to the lesions that presented dentin hypersensitivity [11].

Those patients who presented NCCL were clarified regarding the condition and referred to restoration treatment in the Dental Clinics of the Department of Dentistry of UFVJM.

Data Analysis

The data collected were analyzed using SPSS (Statistical Package for Social Sciences, IBM Inc., USA) version 25. Descriptive statistical analyses were performed to obtain frequency, mean, and standard deviation. The Kolmogorov-Smirnov test verified the normality of the data. The Chi-square test estimated associations between categorical variables. Logistic regression was performed to confirm the odds ratio (OR) of associated

factors that can explain NCCL. The simple regression added the independent variables that obtained a p-value lower than 0.05 in the chi-square test. A significance level of 99% (p < 0.01) was adopted.

Results

It evaluated 179 participants aged from 18 to 45 years, with a mean of 22.37 (± 2.96) years, 128 of the female gender (71.5%) and 51 males (28.5%). The prevalence of NCCL among the participants was 15.1%.

Sixty-nine participants (38.5%) reported having the habit of grinding/tightening their teeth; 22 participants (12.3%) reported using a brush with extra soft bristles; 52 participants (29.1%) used a lot of force during brushing, and 86 (48.3%) presented hypersensitivity during brushing and feeding. Those who consumed daily soft and citric beverages comprised 13 people (7.3%). Fourteen participants (7.8%) reported no smoking and 134 (75.3%) consumed alcoholic beverages (Table 1).

Table 1. Descriptive analysis of information collected from sample participants.

Variables	N	%
Non-carious cervical lesion		
Present	27	15.1
Absent	152	84.9
Clenching/grinding teeth		
Yes	69	38.5
No	110	61.5
Hypersensitivity during toothbrushing/feeding		
Yes	86	48.3
No	92	51.7
Hardness of toothbrush		
Extra soft	22	12.3
Soft	87	48.6
Medium	60	33.5
Hard	7	3.9
Don't know	3	1.7
High-intensity toothbrushing		
Yes	52	29.1
No	127	70.9
The habit of biting objects		
Yes	68	38.0
No	111	62.0
The habit of biting nails		
Yes	59	33.0
No	120	67.0
Orthodontic appliance use		
Yes	19	10.6
No	160	89.4
Frequency of consuming soft drinks and citrus drinks		
Daily	13	7.3
2 - 4 times/week	56	31.3
Once a week	52	29.1
Once a month	53	29.6
Never	5	2.8
Frequency of isotonic drinks		
Daily	0	0
2 - 4 times/week	1	0.6
Once a week	9	5.0
Once a month	100	55.9
Never	69	38.5
Frequency of swimming pool		
Daily	4	2.2

2 - 4 times/week	3	1.7
Once a week	5	2.8
Once a month	120	67.0
Never	47	26.3
Smoker		
Yes	14	7.8
No	165	92.2
Alcoholic drink		
Yes	134	75.3
No	44	24.7
Medical treatment		
Yes	15	11.2
No	163	88.8
Any disease		
Yes	20	11.2
No	159	88.8
Vomiting often		
Yes	2	1.1
No	177	98.9
Stimulated Vomiting (n=2)		
Yes	1	50.0
No	1	50.0
Acid taste in the mouth		
Yes	18	10.1
No	161	89.9
Dry mouth sensation		
Yes	26	14.5
No	153	85.5
Do you think NCCL impairs smile aesthetics?		
Yes	35	19.6
No	144	80.4
Do you use any medicine?		
Yes	66	36.7
No	114	63.3

A total of 5130 teeth (2520 (49.12%) of the upper jaw and 2610 (50.88%) of the lower jaw) were evaluated: 1440 molars (28.1%), 1442 premolars (28.1%), 718 canine (14%) and 1530 incisors (29.8%). From total teeth, 68 (1.3%) showed NCCL, 15 abrasions (22.1%), 49 abfractions (72.1%), and 4 erosions (5.9%). Of the teeth presenting lesions, 20 were molars (29.4%), 35 were premolars (51.5%), five canines (7.4%), and eight incisors (11.8%); being 37 (54.4%) located in the upper jaw, while 31 (45.6%) in the lower jaw (Table 2).

Table 2. Descriptive analysis of clinical characteristics related to NACL.

	N	%
Teeth having NCCL (n=5130)		
Present	68	1.3
Absent	5062	98.7
Tooth (n=5130)		
Molar	1440	28.1
Premolar	1442	28.1
Canine	718	14.0
Incisor	1530	29.8
Type of NCCL (n=68)		
Abrasion	15	22.1
Abfraction	49	72.1
Erosion	4	5.9
Surface (n=68)		
Mesial	1	1.5

Distal	0	0.0
Buccal	62	91.2
Lingual	5	7.3
Dentin Hypersensitivity (n=68)		
Present	43	63.2
Absent	25	36.8
Tooth Wear Index		
1	1	1.5
2	34	50.0
3	31	45.6
4	2	2.9
Wear		
Yes	6	8.8
No	62	91.2
	Mean	SD
Depth	0.79	0.44
Width	2.63	1.19

Most lesions were found on the buccal surface (n = 62, 91.2%), and 43 (63.2%) presented hypersensitivity to ice water. The mean extent and depth of the lesions were 2.63 and 0.79mm, respectively. The average incisal/occlusal wear found in the teeth with NCCL was 2.63. Regarding TWI evaluation, 34 (50%) teeth presented index 2 (Table 3).

Table 3. Association between NCCL and habits.

Variables	Non-carious Cervical Lesions		p-value
	Present N (%)	Absent N (%)	
Gender			
Female	16 (59.3)	112 (74.7)	0.100
Male	11 (40.7)	38 (25.3)	
Hand ability			
Right-handed	24 (88.9)	136 (92.5)	0.418
Ambidextrous	0 (0.0)	3 (2.0)	
Left-handed	3 (11.1)	8 (5.4)	
Clenching/grinding teeth			
Yes	11 (40.7)	59 (39.3)	0.890
No	16 (59.3)	91 (60.7)	
Hypersensitivity during toothbrushing/feeding			
Yes	20 (74.1)	65 (43.6)	0.004
No	7 (25.9)	84 (56.4)	
Hardness of toothbrush			
Extra soft	3 (11.1)	18 (12.0)	0.759
Soft	12 (44.4)	76 (50.7)	
Medium	10 (37.0)	48 (32.0)	
Hard	2 (7.4)	5 (3.3)	
Don't know	0 (0.0)	3 (2.0)	
High-intensity toothbrushing			
Yes	12 (44.4)	40 (26.7)	0.062
No	15 (55.6)	110 (73.3)	
The habit of biting objects			
Yes	9 (33.3)	59 (39.3)	0.555
No	18 (66.7)	91 (60.7)	
The habit of biting nails			
Yes	7 (25.9)	52 (34.7)	0.375
No	20 (74.1)	98 (65.3)	
Orthodontic appliance use			
Yes	3 (11.1)	16 (10.7)	0.912
No	24 (88.9)	134 (89.3)	

Frequency of consuming soft drinks and citrus drinks

Daily	3 (11.1)	10 (6.7)	0.796
2 – 4 times/week	6 (22.2)	51 (34.0)	
Once a week	9 (33.3)	41 (27.3)	
Once a month	8 (29.6)	44 (29.3)	
Never	1 (3.7)	3 (2.0)	

Frequency of isotonic drinks

Daily	0 (0.0)	1 (0.7)	0.461
2 – 4 times/week	3 (11.1)	6 (4.0)	
Once a week	14 (51.9)	86 (57.3)	
Once a month	10 (37.0)	57 (38.0)	
Never	0 (0.0)	0 (0.0)	

Frequency of swimming pool

Daily	0 (0.0)	4 (2.7)	0.677
2 – 4 times/week	0 (0.0)	3 (2.0)	
Once a week	0 (0.0)	5 (3.3)	
Once a month	19 (70.4)	98 (65.3)	
Never	8 (29.6)	40 (26.7)	

Smoker

Yes	4 (14.8)	9 (6.0)	0.251
No	23 (85.2)	141 (94.0)	

Alcoholic drink

Yes	21 (77.8)	110 (73.8)	0.665
No	6 (22.2)	39 (26.2)	

Vomiting often

Yes	0 (0.0)	2 (1.3)	0.546
No	27 (100.0)	148 (98.7)	

Acid taste in the mouth

Yes	2 (7.4)	15 (10.0)	0.674
No	25 (92.6)	135 (90.0)	

Dry mouth sensation

Yes	5 (18.5)	20 (13.3)	0.476
No	22 (81.5)	130 (86.7)	

Do you think NCCL impairs smile aesthetics?

Yes	5 (18.5)	29 (19.3)	0.921
No	22 (81.5)	121 (80.7)	

Do you use any medicine?

Yes	11 (40.7)	55 (36.7)	0.687
No	16 (59.3)	95 (63.3)	

There was a statistically significant association between NCCL and hypersensitivity (p=0.004) (Table 3) and group of teeth (p<0.001) (Table 4). Premolars present 4.45 times more chance of presenting NCCL in relation to incisors (OR: 4.45; p<0.001) (Table 5).

Table 4. Descriptive analysis and association between NCCL and dental location.

Variables	Non-carious Cervical Lesions		p-value
	Present N (%)	Absent N (%)	
Tooth			
Molar	20 (29.4)	1420 (28.5)	
Premolar	35 (51.5)	1407 (28.3)	
Canine	5 (7.4)	713 (14.3)	<0.001
Incisor	8 (11.8)	1434 (28.8)	
Jaw			
Upper	37 (54.4)	2482 (49.9)	
Lower	31 (45.6)	2492 (50.1)	0.460

Table 5. Simple logistic regression for NCCL outcome.

Tooth	OR (CI 95%)	p-value
Molar	2.52 (1.10 − 5.75)	0.027
Premolar	4.45 (2.06 − 9.64)	<0.001
Canine	1.25 (0.41 − 3.85)	0.689
Incisor	1	

Discussion

This cross-sectional study aimed to identify the prevalence, severity, hypersensitivity, and distribution of non-carious cervical lesions in university students in Brazil. The prevalence of NCCL among participants was 15.1%, and abfraction was the most frequent lesion. The premolars were the most affected teeth, and the NCCL were located mainly on the buccal surface and had depths below 2mm. Dentinal hypersensitivity has been associated with NCCL.

The data about the prevalence of NCCL are divergent in the literature. The researchers point out different values (0 to 85%); this range may be attributed to other study designs, the methodologies used to determine the presence of the lesion, and the sample size [12]. The prevalence of NCCL in current university students was 15.1%, close to 17% found in a study by the Federal University of Paraíba (Brazil), which evaluated patients aged 18 to 64 years [13]. On the other hand, a survey carried out at the Federal University of Sergipe (Brazil) of patients with a similar age group observed a more significant predominance of these lesions, with a prevalence of 44% [1].

Studies indicate that the prevalence of NCCL is directly proportional to the age of patients, increasing both the number of lesions and their severity, as it is a degenerative process that is influenced by time [14,15]. The present result did not meet the young profile of the participants who suffer the cumulative action of time on dental tissues. Corroborating studies did not show a statistically significant association between these variables [16].

The loss of mineralized tissue in the cervical region can cause disharmony of the gingival margin, loss of both the dental emergence profile and the cementoenamel junction, and dentin hypersensitivity [17]. In this study, the abfractions were the most prevalent NCCL. The abfraction is one of the most frequent non-carious cervical lesions, having a complex etiology related to occlusal traumas [18]. In the present study, despite the self-report of parafunctional habits, there was no correlation between the presence of these habits and the occurrence of abfractions, corroborating the work of Pegoraro et al. [19]. In contrast, Ommerborn et al. [20] found an association of this habit with the NCCL. Parafunctional habits such as bruxism lead to abnormal occlusal exertion with a positive correlation with the lesions [2].

Azevedo et al. [21] concluded that soft, medium, and stiff brushes are not able to cause enamel abrasion, confirming the findings of this study where no significant relationships were found between the type of bristles of the brush and the presence of these lesions. However, the type of bristles, the abrasiveness of the dentifrice, and the applied force during brushing may be conditions that contribute to the development and installation of abrasion. The relationship between these factors and the occurrence of NCCL should be verified in future studies.

The present study found no association between erosion and its intrinsic factors. Even considering those participants who reported daily use of soft drinks and citric beverages, there was no significant correlation with dental erosion. The present result corroborates the findings of literature [19,20] that reported no significant association between erosion lesions, food or citrus beverages consumption, and gastric problems. However, these findings should be viewed with caution because there is strong evidence that the way that drink or food is consumed is more important than its total amount, thus prolonging the contact of acid with the tooth [22],

which may lead to erosion. Studies have reported that swimmers are more likely to develop erosions of tooth enamel than people who have not practiced this sport [23,24]. However, the present investigation couldn't confirm this relationship.

The etiological factors related to erosion, abrasion, and abfraction may interact or act separately, depending on the specific circumstances. Knowing how much each etiological agent contributes to a particular stage in the lesion is essential to treat and prevent future NCCL [4]. However, as it was possible to perceive through this study, it is still difficult to diagnose the etiology of the lesion already installed.

There was a higher NCCL prevalence in the maxilla (65%) than in the mandible, corroborating the findings of other studies [2,25]. The preference for the jaw may also be associated with age: younger patients present NCCL caused by occlusal factors; older patients present other etiological factors (abrasive and erosive), mainly in the upper arch.

The present study demonstrated that premolars are the most affected by these injuries, confirming the literature that reports that the NCCL mainly affects the premolars and molars [14]. In the present, premolars presented 4.45 times more chances of developing lesions than incisors. Premolars are the teeth most prone to developing NCCL because they are more susceptible to occlusal stress due to their anatomical configuration and location in the dental jaw [2,26]. Similar results were found in the study conducted at the Federal University of Sergipe (Brazil) with patients aged between 18 and 64 years, in which there was a predominance of premolars (62.16%), followed by molars (24.32%) [1].

The non-carious lesions affect the lingual and buccal surface most [1,27]. In this study, most of the lesions were found precisely on the buccal surface. Some studies observe lesions only on the buccal surface [18,28] being that this fact is probably due to the pressure and aggression of the toothbrush bristles during oral hygiene, friction of lips and cheeks [18,28], and inefficiency of salivary flow in the buccal region [27].

As a consequence of the abfraction, erosion, or abrasion, there may be dentinal exposure, which may trigger dentin hypersensitivity [29]. The high prevalence of dentinal hypersensitivity in the teeth with NCCL can be explained by the fact that during the sensitivity tests, there was movement of dentinal fluids. Consequently, the pain arose [30].

The depth of most of the lesions was lower than 2mm, which can be perceived due to the higher prevalence of TWI levels 2 and 3. These shallow lesions can be attributed to the youthful profile of the sample and/or the fact that deeper lesions may already have been treated.

It is of substantial importance to investigate and understand the etiology and prevalence of NCCL since the dynamics involving the beginning and the establishment of these lesions have directly influenced the professional's therapeutic approach, mainly because any treatment will have a permanent effect if there is an accurate diagnosis and management of the factors associated to degradation of the tooth's mineralized tissue [2,31].

Some limitations of this study should be highlighted. Since this was a cross-sectional study, no causal relationship can be assessed here, which must also consider the multifactorial character of non-carious lesions. Another limitation is using a self-administered anamnesis and recruiting through a convenience sample of university students. Thus, the data collected from the study sample may not represent the general population.

Conclusion

The prevalence of non-carious cervical lesions in the present sample was 15.1%, and the abfraction was the most frequent lesion. The group of teeth most affected by the lesions were the premolars. The majority of

non-carious lesions were located on the buccal surface and presented a depth below 2mm. Dentin hypersensitivity has a significant association with non-carious cervical lesions.

Authors' Contributions

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All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

References

[1] Oliveira A, Damascena N, Souza C. Clinical analysis of patients with non-carious cervical lesions and their relationship with habits. Rev Sul-Bras Odontol 2010; 7(2):182-192.

[2] Senna P, Del Bel Cury A, Rösing C. Non-carious cervical lesions and occlusion: a systematic review of clinical studies. J Oral Rehabil 2012; 39(6):450-462. https://doi.org/10.1111/j.1365-2842.2012.02290.x

[3] Medeiros TLM, Mutran SCAN, Espinosa DG, Faial KDCF, Pinheiro HHC, Couto RSDA. Prevalence and risk indicators of non-carious cervical lesions in male footballers. BMC Oral Health 2020; 20(1):1-9. https://doi.org/10.1186/s12903-020-01200-9

[4] RusuOlaru A, Popescu MR, Dragomir LP, Popescu DM, Arsenie CC, Rauten AM. Identifying the etiological factors involved in the occurrence of non-carious lesions. Curr Health Sci J 2019; 45(2):227-234. https://doi.org/10.12865/CHSJ.45.02.15

[5] Teixeira DNR, Thomas RZ, Soares PV, Cune MS, Gresnigt MM, Slot DE. Prevalence of noncarious cervical lesions among adults: A systematic review. J Dent 2000; 95:103285. https://doi.org/10.1016/j.jdent.2020.103285

[6] Femiano F, Femiano R, Femiano L, Festa VM, Rullo R, Perillo L. Noncarious cervical lesions: correlation between abfraction and wear facets in permanent dentition. Open J Stomat 2015; 5(6):152-157. https://doi.org/10.4236/ojst.2015.56021

[7] Borcic J, Anic I, Urek MM, Ferreri S. The prevalence of non-carious cervical lesions in permanent dentition. J Oral Rehabil 2004; 31(2):117–123. https://doi.org/10.1046/j.0305-182x.2003.01223.x

[8] Herbert C. Enhancing mental health, well-being and active lifestyles of university students by means of physical activity and exercise research programs. Front Public Health 2022; 25(10):849093. https://doi.org/10.3389/fpubh.2022.849093

[9] Igarashi Y, Yoshida S, Kanazawa E. The prevalence and morphological types of non-carious cervical lesions (NCCL) in a contemporary sample of people. Odontology 2017; 105:443-452. https://doi.org/10.1007/s10266-017-0300-y

[10] Smith BG, Knight JK. An index for measuring the wear of teeth. Br Dent J 1984; 156:435-438. https://doi.org/10.1038/sj.bdj.4805394

[11] Flecha OD, Azevedo CG, Matos FR, Barbosa NM, Ramos-Jorge ML, Gonçalves PF, et al. Cyanoacrylate versus laser in the treatment of dentin hypersensitivity: controlled, randomized, double-blind and non-inferiority clinical trial. J Periodontol 2013; 84(3):287-294. https://doi.org/10.1902/jop.2012.120165

[12] Aubry M, Mafart B, Donat B, Brau JJ. Brief communication: Study of noncarious cervical tooth lesions in samples of prehistoric, historic, and modern populations from the South of France. Am J PhysAnthropol 2003; 121(1):10-14. https://doi.org/10.1002/ajpa.10210

[13] Santos R, Barbosa R, Sales G, Costa J. Clinical analysis of patients with cervical lesions. Odontol Clín-Científ 2005; 4:35-42.

[14] Borcic J, Anic I, Urek MM, Ferreri S. The prevalence of non-carious cervical lesions in permanent dentition. J Oral Rehabil 2004; 31(2):117-123. https://doi.org/10.1046/j.0305-182x.2003.01223.x

[15] Chan DC, Browning WD, Pohjola R, Hackman S, Myers ML. Predictors of non-carious loss of cervical tooth tissues. Oper Dent 2006; 31(1):84-88. https://doi.org/10.2341/04-180

[16] Ritter AV, Grippo JO, Coleman TA, Morgan ME. Prevalence of carious and non-carious cervical lesions in archaeological populations from North America and Europe. J EsthetRestor Dent 2009; 21(5):324-334. https://doi.org/10.1111/j.1708-8240.2009.00285.x

[17] Haralur SB, Alqahtani AS, AlMazni MS, Alqahtani MK. Association of non-carious cervical lesions with oral hygiene habits and dynamic occlusal parameters. Diagnostics 2019; 9(2):E43. https://doi.org/10.3390/diagnostics9020043

[18] Lee WC, Eakle WS. Possible role of tensile stress in the etiology of cervical erosive lesions of teeth. J Prost Dent 1984; 52(3):374-380. https://doi.org/10.1016/0022-3913(84)90448-7

[19] Pegoraro LF, Scolaro JM, Conti PC, Telles D, Pegoraro TA. Non carious cervical lesions in adults: Prevalence and occlusal aspects. J Am Dent Assoc 2005; 136(12):1694-1700. https://doi.org/10.14219/jada.archive.2005.0113

[20] Ommerborn MA, Schneider C, Giraki M, Schafer R, Singh P, Franz M, et al. In vivo evaluation of noncarious cervical lesions in sleep bruxism subjects. J Prosthet Dent 2007; 98(2):150-158. https://doi.org/10.1016/S0022-3913(07)60048-1

[21] Azevedo AM, Panzeri H, Prado CJ, De-Mello JD, Soares CJ, Fernandes-Neto AJ. Assessment in vitro of brushing on dental surface roughness alteration by laser interferometry. Braz Oral Res 2008; 22(1):11-17. https://doi.org/10.1590/s1806-83242008000100003

[22] Bartlett DW. The role of erosion in tooth wear: Aetiology, prevention and management. Int Dent J 2005; 55(4 Suppl 1):277-284. https://doi.org/10.1111/j.1875-595x.2005.tb00065.x

[23] Geurtsen W. Rapid general dental erosion by gas-chlorinated swimming pool water. Review of the literature and case report. Am J Dent 2000; 13(6):291-293.

[24] Nijakowski K, Walerczyk-Sas A, Surdacka A. Regular physical activity as a potential risk factor for erosive lesions in adolescents. Int J Environ Res Public Health 2020; 17(9):3002. https://doi.org/10.3390/ijerph17093002

[25] Kolak V, Pešić D, Melih I, Lalović M, Nikitović A, Jakovljević A. Epidemiological investigation of non-carious cervical lesions and possible etiological factors. J Clin Exp Dent 2018; 10(7):e648-e656. https://doi.org/10.4317/jced.54860

[26] Machado AC, Soares CJ, Reis BR, Bicalho AA, Raposo L, Soares PV. Stress-strain analysis of premolars with non-carious cervical lesions: Influence of restorative material, loading direction and mechanical fatigue. Oper Dent 2017; 42(3):253-265. https://doi.org/10.2341/14-195-L

[27] Young WG, Khan F. Sites of dental erosion are saliva-dependent. J Oral Rehabil 2002; 29(1):35-43. https://doi.org/10.1046/j.1365-2842.2002.00808.x

[28] Bernhardt O, Gesch D, Schawah F, Mack G, Meyer JU, Kocher ET. Epidemiological evaluation of the multifactorial aetiology of abfractions. J Oral Rehabil 2006; 33(1):17-25. https://doi.org/10.1111/j.1365-2842.2006.01532.x

[29] Femiano F, Grassia V, Femiano R, Vitale M, Nucci L, Sorice R, et al. Decision-making process as guide to the management of non-carious cervical lesions with and without painful symptomatology. J Biol Regul Homeost Agents 2019; 33(4):1013-1018.

[30] Douglas-de-Oliveira DW, Vitor GP, Silveira JO, Martins CC, Costa FO, Cota LO. Effect of dentin hypersensitivity treatment on oral health-related quality of life - A systematic review and meta-analysis. J Dent 2018; 71:1-8. https://doi.org/10.1016/j.jdent.2017.12.007

[31] Milosevic A. Abrasion: A common dental problem revisited. Prim Dent J 2017; 6(1):32-36. https://doi.org/10.1177/205016841700600104