Original Article

Prevalence of Non-carious Cervical Lesions in Patients with Gingival Recession and Associated Risk Factors: A Hospital-Based Cross-Sectional Study in a Sample of Adult Egyptian Dental Patients

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Abstract

Aim: This study aimed at determining the prevalence of non-carious cervical lesions (NCCLs) among patients with gingival recession and identifying the risk factors associated with NCCLs in adult Egyptian patients.
Subjects and methods: The present study was conducted on 362 subjects with gingival recession. In 30 patients having NCCLs, full questionnaire and OHIP-14 questionnaires were filled and conventional oral examination was held. Clinical parameters as type of NCCLs, cervical dentine hypersensitivity (CDH), occlusal wear grade, keratinized tissue width, gingival biotype, gingival index (GI) and plaque index (PI) were evaluated.
Results: Prevalence of NCCLs in patients with gingival recession was 5.7% among teeth with gingival recession and 8.3% among patients with 86.7% of lesions class A+ and 60% males. Patients with NCCLs class A+ showed statistically significantly higher occlusal wear grade than patients with NCCL class B+ (P-value <0.001, Effect size = 0.635) and showed statistically significantly higher PI score (P-value < 0.001, Effect size = 0.692).
Conclusion: Prevalence of patients with NCCLs among gingival recession patients is 8.3%. Mandibular left first premolar was the most affected tooth with NCCLs and CDH. Class A+ is significantly associated with higher occlusal wear grade and PI scores than class B+.
Keywords: Non-caries cervical lesions; Prevalence; Gingival recession; Risk factors; Cervical dentine hypersensitivity.

I. INTRODUCTION

Non- carious cervical lesions (NCCLs), referred to as cervical wear, are defined as the loss of tooth substance at the cemento-enamel junction (CEJ) that are usually associated with gingival recession and most frequently located in the vestibular side (Mair, 1992). The exact etiology of NCCLs has not been precisely defined, however the majority of authors agreed that the cause for this kind of defect could be multifactorial and thus difficult to recognize (Nemcovsky and Artzi, 1996). A study by Senna et al., (2012) reported the prevalence of NCCLs to range

from 0.8% and 85.7%, where the mandibular first premolars has appeared to be the most affected tooth (Kolak et al., 2018).

Risk factors associated with NCCLs included gingival thickness, keratinized tissue width, PI, GI, occlusal wear grade and cervical dentine hypersensitivity (CDH) (Bernhardt et al., 2006; Bergström and Eliasson, 1988; West et al., 2013; Kim and Neiva, 2015). Other risk factors as age, gender, gastric reflux, soft drinks, alcohol consumption, citrus fruits were also observed in different studies to be correlated with NCCLs (Smith, Marchan and Rafeek, 2007; Teixeira et al., 2018; Larsen and Nyvad, 1999; Yoshizaki et al., 2017).

Pinni-Prato, (2010) classified NCCL in A+ and B+. Class A identifies an existing CEJ while Class B identifies a non-existing CEJ. While the existence or non-existence of a cervical step on the root surface are represented as Class + which indicates the existence of a cervical step >0.5 mm, while Class – identifies the non-existence of this cervical step. Oral Health Impact Profile (OHIP) is reported by Slade et al., (1994) to have the ability to provide potential benefits concerning clinical decision-making, alongside its importance in research, as it has been an instrument to measures people's perception of social effect of oral disorders on their well-being.

Based on the current literature, there has been no cross-sectional epidemiological studies concerning the prevalence of NCCLs among the Egyptian population as well as their correlation with different risk factors. Thus, this cross-sectional study aimed to determine the prevalence of NCCLs in a sample of Egyptian patients and the associated risk factors.

II.   SUBJECTS AND METHODS

a. Study design and participants:

This cross-sectional study included 362 participants recruited in a consecutive manner from the diagnostic center of Faculty of Dentistry, Cairo University. Patient recruitment was between January 2021 till June 2021, and screening of patients was continued where every subject meeting the inclusion criteria was selected until the target sample was achieved. Inclusion criteria included adult patients above 15 years old with NCCL and gingival recession who provided informed consent. While patients having problem in opening their mouth or undergoing inter-maxillary fixation where oral examination was not possible were excluded.

b. Sample size calculation:

The power analysis for sample size calculation used prevalence of Class A surface defect as the primary outcome. Based upon the results of Bhusari et al., (2014), the prevalence of Class A surface defect was 38%. Using alpha (α) level of (5%), acceptable margin of error = 5%; the minimum estimated sample size was 362 subjects. Sample size calculation was performed using Epi Info 7.2.2.2.

c. Interview and data collection:

Risk factors for non-carious cervical lesions representing one of the secondary outcomes in this study were collected via the oral health questionnaire for adults used in a study by (2007). This questionnaire included a section for information about age, gender, toothbrush frequency and type, bruxism, gastric reflux, soft drinks, alcohol, and citrus fruits consumption.

In this observational cross-sectional study, oral health related quality of life was measured via OHIP-14. This questionnaire by Slade, (1997) defines seven dimensions of impact: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. Each dimension was assessed in two questions and the response for each item was recorded on a five-point scale (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often and 4 = very often).

d. Clinical parameters:

The primary outcome in this observational cross-sectional study is the prevalence of NCCLs among patients with gingival recession. According to Pinni-Prato, (2010), a detectable CEJ is identified as Class A, whereas an undetected CEJ is identified as Class B. Moreover, presence or absence of a cervical step is denoted either by Class + denoting existence of a cervical step >0.5 mm or Class- denotes its absence. Based on the clinical examination, only teeth with dental surface discrepancy (step) including class A+, B+ (Figure 1) were chosen to continue in clinical examination and questionnaire. Other associated risk factors with NCCL were detected through clinical examination and included cervical dentinal hypersensitivity (CDH), which was measured by applying an air jet perpendicularly directed to the cervical buccal surface of the tooth with NCCL for two seconds at approximately 1 cm-distance where adjacent teeth were protected with a polyester strip to avoid false-positive results (Figure 2). Participants were asked to rate their pain according to a 10-point visual analogue scale (VAS) and the value was recorded (Teixeira et al., 2018). Occlusal wear grade was recorded using a classification by Hugoson et al., (1988) (Figure 3). Keratinized tissue width at the tooth with NCCL was measured as the distance between the gingival margin and the MGJ (Cortellini and Bissada, 2018). Gingival biotype was assessed and categorized into thick or thin at each tooth with NCCL using the probe transparency method through the gingival margin while probing the sulcus at the midfacial aspect of the tooth (De Rouck et al., 2009). Gingival index (GI) was evaluated according to Löe, (1967). The four gingival areas of the tooth (mesial, distal, facial and lingual areas) were given a scoring ranging from 0 to 3 which became the GI for the area, where score 0 indicated normal gingiva, score 1 is mild gingival inflammation, score 2 is moderate inflammation and score 3 is severe inflamtion. The GI for the patient was an average score for the areas examined. According to O'Leary et al., (1972), plaque index (PI) was done by examining each of the four surfaces: mesial, distal, buccal, lingual for soft accumulations at the dento-gingival junction at each tooth with NCCL. Each surface was recorded eitther by yes or no according to existance of plaque. Then examined teeth were scored and PI was obtained by dividing the number of plaque-containing surfaces by the total number of teeth surfaces in the mouth.

e. Statistical analysis:

Qualitative data were presented as frequencies and percentages. Chi-square test or Fisher's Exact test was used for comparisons regarding qualitative variables. Quantitative data were presented as mean, standard deviation (SD), median and range values. Quantitative data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). Age data showed normal (parametric) distribution while keratinized tissue width, occlusal wear grades, cervical dentin hypersensitivity, GI and PI score showed non-normal (non-parametric) distribution. For parametric data, Student's t-test was used for comparisons between two groups. For non-parametric data; Mann-Whitney U test was used for comparison between the two NCCL classes. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

III. RESULTS

The total number of gingival recessions was 2497 observed in 362 patients. Within the 362 patients, only 30 subjects had NCCLs 18 males (60%) and 12 females (40%). The mean (±SD) values for age were 52.2 (±11.7) years with a minimum of 32 and a maximum of 70 years old. The number of NCCL was 143 lesions observed in 30 patients

giving a prevalence of 5.7% among sites with gingival recessions and 8.3% among patients. Clinical examination results have shown that the majority of lesions (86.7%) were Class A+, while 13.3% were Class B+. Approximately two thirds of NCCL lesions (69.2%) were thin biotype, while thick biotype represented 30.8% (Table 1). Oral questionnaire demonstrated that the highest percentage of participants (43.3%) brushed their teeth once a day, while the most commonly used type of toothbrush was soft brush (31.8%). The prevalence of bruxism was 16.7%. Intake of citrus fruits was reported by more than three quarters of participants (Table 2). In OHIP-14 questionnaire results, physical pain had the highest scores 5(0-8) as median (range), while functional limitation had the least with 0 (0-4) as median (range).

In association between different variables and NCCL classes, No significant associations between NCCL class and gingival biotype, keratinized tissue width, CDH, GI,

age, gender, toothbrushing frequency, toothbrush type, bruxism and gastric reflux, intake of soft, citrus or alcoholic drinks. While Class A+ showed statistically significantly higher PI score than Class B+ (P-value <0.001, Effect size = 0.692). Also, Class A+ showed statistically significantly higher occlusal wear grade than patients with Class B+ (P-value <0.001, Effect size = 0.635) (Figure 4). Tooth (34) showed the highest prevalence of both NCCL classes followed by tooth (44) then tooth (45). While tooth (34) showed the highest prevalence of CDH followed by tooth (42) then tooth (32) as shown in (Figure 5)

There was no statistically significant difference between OHIP-14 scores of all dimensions as well as the total OHIP-14 score in patients with different NCCL classes.
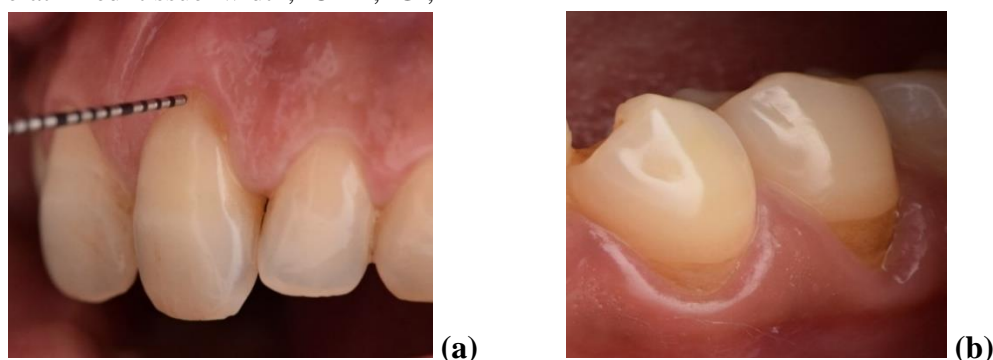

(a) **(b)**

Figure (1): Clinical photograph showing a maxillary central incisor with Class A+ NCCL (a) and mandibular premolars with NCCL Class B+ (b)

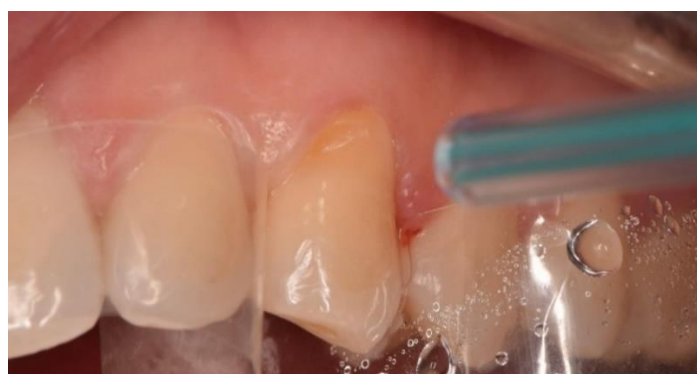**Figure (2):** Clinical photograph showing sensitivity test using air blast generated from air-water syringe

No or minimal (doubtful) enamel loss	0
Enamel loss/dentine spots	1
Loss up to one-third of the crown with obviously exposed dentine areas	2
Loss over one-third of the crown	3

Figure (3): Occlusal wear grades by Hugoson et al. (1988)

Table (1): Descriptive statistics for clinical examination of lesions

Clinical examination of NCCL	
Class [n (%)]	
Class A+	124 (86.7%)
Class B+	19 (13.3%)
Gingival biotype [n (%)]	
Thick	44 (30.8%)
Thin	99 (69.2%)
Keratinized tissue width	
Median (Range)	3 (0.5 – 9)
Mean (±SD)	3.51 (±1.59)
Occlusal wear grade	
Median (Range)	1 (0 – 2)
Mean (±SD)	0.56 (±0.51)
Cervical dentinal hypersensitivity	
Median (Range)	1 (0 – 10)
Mean (±SD)	2.08 (±3.02)
Gingival Index	
Median (Range)	1.4 (0.3 – 2)
Mean (±SD)	1.19 (±0.56)
Plaque Index (%)	
Median (Range)	79 (0 – 100)
Mean (±SD)	75.76 (±25.73)

Table (2): Descriptive statistics for Questionnaire results (n = 30)

| Questionnaire results	
Tooth brushing frequency [n (%)]	
Never	8 (26.7%)
Once a day	13 (43.3%)
Twice or more a day	9 (30%)
Tooth brush type [n (%)]	
Soft	7/22 (31.8%)
Medium	6/22 (27.3%)
Hard	3/22 (13.6%)
Don't know	6/22 (27.3%)
Bruxism [n (%)]	5 (16.7%)
Gastric reflux [n (%)]	
Daily	2 (6.7%)
Monthly	2 (6.7%)
No	26 (86.7%)
Intake of soft drinks [n (%)]	
More than once a day	2 (6.7%)
Daily	3 (10%)
Weekly	4 (13.3%)
Monthly	5 (16.7%)
No	16 (53.3%)
Intake of alcohol [n (%)]	0
Intake of citrus fruits [n (%)]	
More than once a day	6 (20%)
Daily	3 (10%)
Weekly	11 (36.7%)
Monthly	5 (16.7%)
No	5 (16.7%)
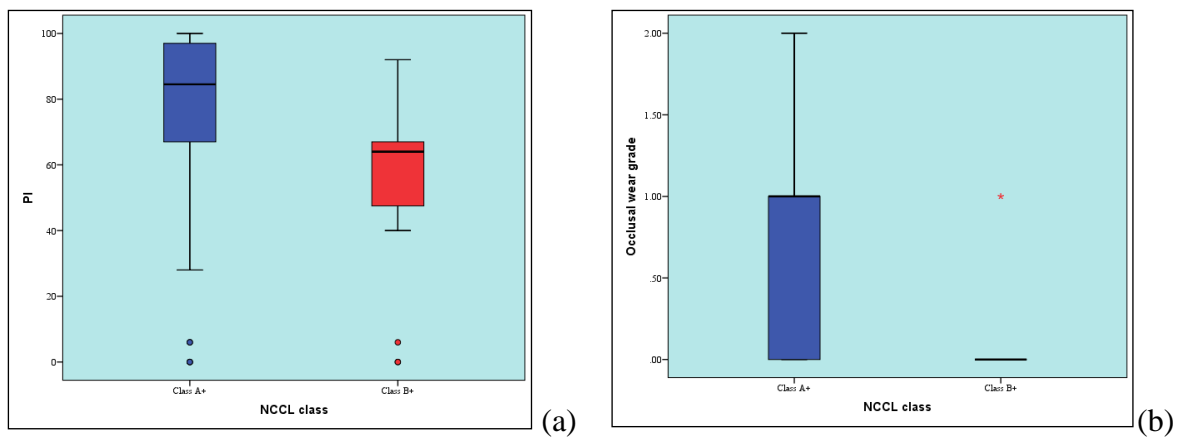
Figure (4): Box plot representing median and range vlaues for PI (a) and occlusal wear grades (b) in patients with different NCCL classes (Stars and circles represents outlier)
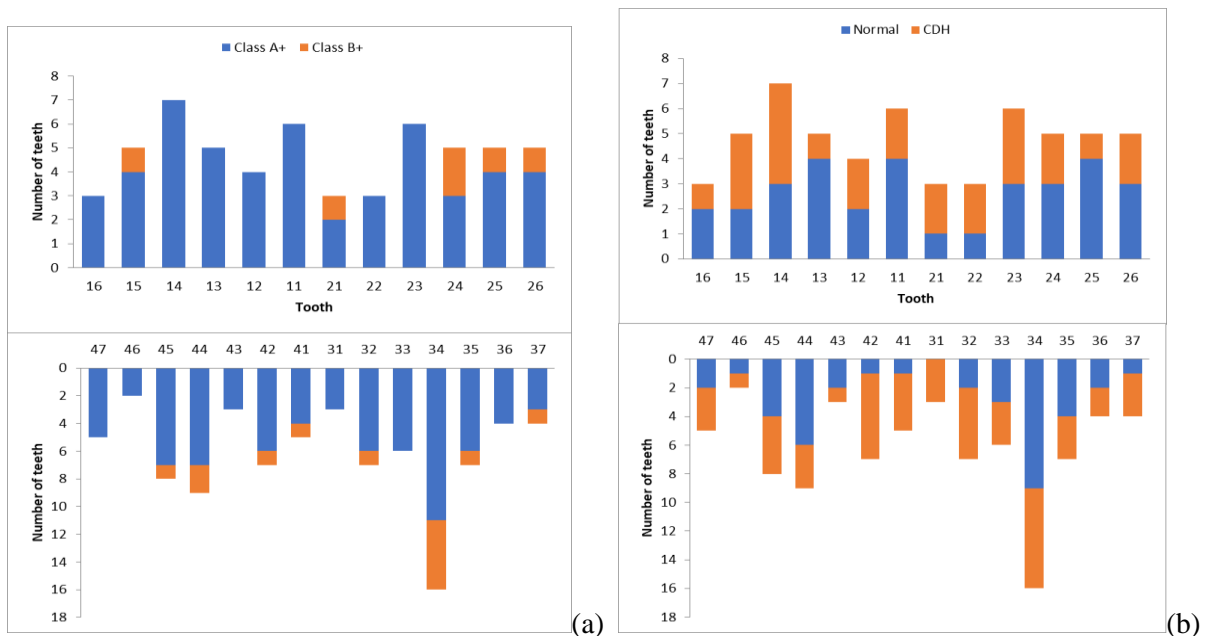

Figure (5): Stacked bar chart representing teeth types with different NCCL classes (a) and teeth types with and without CDH

IV. DISCUSSION

This observational cross-sectional study included several possible risk factors for NCCLs as these lesions have different etiological factors that could be responsible for their initiation and development. The prevalence of NCCLs determined in this cross-sectional study was observed to be 5.7% among gingival recession defects. Out of 2497 gingival recessions examined, 143 NCCLs were observed. While the prevalence of patients with NCCLs (30 patients) among patients with gingival recessions (362 patients) was 8.3%. The current literature varies concerning prevalence of NCCLs where the results of this study corresponds with the range of prevalence in a review by Levitch (1994), which determined prevalence to range from 5% to 85%, and also another systematic review by Senna et al. ,(2012) observed NCCLs prevalence to range from 0.8% and 85.7%. However, other observational trials obtained a higher range of NCCLs such as that provided in a systematic review by Teixeira (2020)

which determined prevalence to be from 9% to 93%.

In this cross-sectional trial, 86.7% (124 lesions) of NCCLS were A+, while 13.3% (19 lesions) were B+. This means that A+ lesions constituted 5% of total recession defects, while B+ constitute 0.76% of total examined recession defects. These results are inferior compared to a study by Pinni-Prato (2010) which observed 14% of recessions had A+ NCCLs and 24% of recessions had B+ lesions. Also, the results of this study are lower than a study on Indian population by Bhusari et al. (2014) which determined a prevalence of 38% for class A+ and 20% for class B+. This could be attributed to differences in the method of clinical examination where in both studies a x4 magnifying loops were used to detects NCCLs type.

The distribution of NCCLs among teeth in this study showed the highest prevalence to be among lower left first premolars with 11%, where 69% of NCCLs in lower left first premolars were class A+. According to site distribution, the premolar area had the highest prevalence with 43% compared to incisors, canines and molars sites where 79% of NCCLs in premolar sites were also class A+. The premolar site prevalence of NCCLs is consistent with the studies of Piotrowski et al., (2001), Aw et al. (2002), Takehara et al., (2008), Wood et al., (2009), Reyes et al., (2009) and Jiang, (2011). While the highest prevalence being among the first premolar site in specific follows the early evidence in studies by Mayhew et al., (1998), Madani et al., (2005) and Ommerborn et al., (2007). Concerning the mandibular premolar prevalence in specific, this study is also consistent with the results of Khan et al., (1999) and Young et al., (2002) which supports the fact that premolars among other teeth are concerned with the highest prevalence of such lesions.

Regarding the questionnaire results in this study, 60% of patients with NCCLs were males and 40% were females. The majority being among men is consistent with studies from Penoni et al., (2021) who attributed this to the strong masticatory strength and high bite force that occur in men more than women regarding gender Zero, (1996).

The distribution of NCCLs among different age groups was demonstrated in this study to be 52.2 (±11.7) as mean (±SD) values with no statistically significance on different classes of NCCLs which supports what was proven in literature that NCCLs increased with age (Teixeira et al., 2020) where a study by Smith, (2007) had a mean age value of 40.6 for patients with NCCLs.

Considering frequency of toothbrushing in this observational trial, no statistically significant association between classes on NCCLs and frequency of brushing. Similarly, the results of Que, (2013) indicated that toothbrushing alone cannot cause all NCCLs, and hence it wasn't proven to be a direct risk factor. Regarding toothbrush hardness in this study, the lowest percentage among participants were using hard toothbrush, which speculates that hardness of toothbrush is not the only factor to cause NCCLs among those participants. This finding is consistent with an early study by Radentz et al., (1976), which found no significant difference between NCCLs and type of toothbrush. But contradictory conclusions were found by Smith, (2007) and Brandini, (2011) who noticed a significant association of medium and hard toothbrush with NCCLs.

Bruxism was historically thought to be a direct cause of NCCLs, although Senna et al., (2012). Another study by Estafan, (2005) found no correlation between occlusal wear grade and NCCLs presence. In this study, 16.7% only of patients with NCCLs reported bruxism with no significant association with NCCLs classes.

Considering the gastric reflux in this study, (86.7%) of subjects with NCCLs reported not having any gastric reflux which is close to a study by Rusu Olaru et al., (2019) that reported 14.28% of patients with lesions were having signs of gastro-intestinal disease. Although some studies as Zuza et al.,(2019) as well as Smith et al., (2007)

found alcohol consumption to be associated with the presence of NCCLs in, yet none of our participants reported drinking alcohol. Similarly, only 20% reported citrus fruits consumption more than once a day as a fruit or as a drink. This association between NCCLs and citrus consumption is reported by Lussi et al., (2008) to increase the risk of dental erosion when eaten more than twice a day.

Clinical examination for subjects in this cross-sectional trial revealed that 30.8% of NCCLs patients had thick gingival biotype, while 69.2% had thin gingival biotype as observed by Agudio et al. (2019) that NCCLs were associated with thin periodontal phenotype with approximately 3.5 times the odds than thick phenotype. While the median (range) keratinized tissue width in patients with NCCLs in this study is 3 (0.5-9) that doesn't support the observations of Agudio et al. (2019) that sites with attached keratinized tissue height less than 2 mm had approximately 3.5 times the odds of developing NCCL compared with sites exhibiting at least 2 mm of attached keratinized tissue.

An interesting finding in this study is that patients with NCCL Class A+, where there is an identifiable CEJ and surface discrepancy, showed statistically significantly higher occlusal wear grade than patients with NCCL Class B+ which contradicts Pintado et al., (2000) who demonstrated a positive correlation between occlusal wear and the increased size of NCCLs. This can be due to the smaller sample size of their study as only 3 teeth in the same individual were examined. The findings in the current study could indicate that occlusal discrepancy and bruxism are not related to the extension of NCCLS whether affecting the crown or the root which could suggest that bruxism is not related to the severity of NCCLs. Other studies as Estafan et al., (2005) and Ahmed et al., (2018) didn't support that fact and found no relationship between NCCLs and occlusal or incisal wear

CDH was examined in patients with NCCLs in this study, where a median (range) of 1 (0-10) and a mean (±SD) of 2.08 (±3.02) was found with no statistical difference between score of CDH among subjects with NCCLs classes. Prevalence of CDH among NCCLs was 51%, which is close to the results by Smith, (2007), who found 45% of NCCLs patients experiencing sensitivity with air stimulus. In this study and similar to (Grippo, 1992; Rahiotis et al., 2013) tooth number (34) showed the highest prevalence of CDH among teeth with NCCLs.

An interesting finding in this study concerning plaque index is that NCCLs patients with Class A+ showed statistically significantly higher PI score than patients with Class B+. This could be an indication that the involvement of root alone with surface discrepancy (A+) or crown and root (B+) with NCCLs was dependent on oral hygiene level and presence of plaque which comes in correlation with the study by Pikdoken, (2011) who indicated the decrease of plaque as cervical wear advanced.

The questionnaire measuring oral health related quality of life as oral health impact profile (OHIP-14) in this study showed no statistically significant difference between OHIP-14 scores of all dimensions as well as the total OHIP-1 score in patients with different NCCL classes. Functional limitation questions had the least value while physical pain had the highest values among participants, this may be attributed to dentinal hypersensitivity in 51% of NCCLs in the current study which is similar to a study by Soares, (2021) who demonstrated association between dentinal hypersensitivity and higher mean scores of (OHIP-14) and physical pain in specific.

V. CONCLUSION

1) Prevalence of patients with NCCLs among gingival recession patients is 8.3%, while prevalence of teeth with NCCLs is 5.7% among teeth with gingival recessions.
2) Mandibular left first premolar is the most affected tooth with NCCLs and CDH
3) Class A+ is significantly associated with higher occlusal wear grade than class B+.

4) PI scores are statistical significantly higher in class A+ than class B+.

5) No significant associations between NCCL class and gingival biotype, keratinized tissue width, CDH, GI, age, gender, toothbrushing frequency, toothbrush type, bruxism and gastric reflux, intake of soft, citrus or alcoholic drinks.

6) No statistically significant difference between OHIP-14 scores of all dimensions as well as the total OHIP-14 score in patients with different NCCL classes.

VI. RECOMMENDATIONS

1) This epidemiological cross-sectional study was performed on 362 patients investigating the prevalence of NCCLs in Egyptian patients where it represents the first study upon prevalence of non-carious cervical lesions (NCCLs) in the Egyptian population. The study filled the gap of knowledge concerning this point especially that NCCLs affect decision making in treatment of gingival recession defects. This study investigated all possible risk factors associated with NCCLs.

2) There are still further studies with bigger sample size needed to investigate the prevalence of NCCLs classes among the whole Egyptian population and in different geographic locations.

3) Future studies are recommended to find associations between NCCLs and different risk factors through multivariant analysis.

4) Educational programs communicating risk factor of gingival recession and NCCLs are required to avoid occurrence of both conditions.

Conflict of Interest:

The authors declare no conflict of interest.

Funding:

Ethics:

This study protocol was approved by the ethical committee of the faculty of dentistry- Cairo university on: 26 October 2021, approval number: 111021. The study was registered on ClinicalTrials.gov (I.D.no.: NCT05170529)

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