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Relationship between occlusal contact pattern and non-carious cervical lesions among male adults

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Purpose: Whether or not occlusal contact patterns cause non-carious cervical lesions is controversial. The aim of this study was to clarify the relationship between occlusal contact pattern and non-carious cervical lesions in male Japanese adults.

Subjects and methods: A total of 386 male employees were enrolled. All participants were in the age range 30–59 years, participated in a dental examination, had posterior occlusal support, and had not been treated for malocclusion or any temporomandibular disorder. All non-carious cervical lesions and fillings in the labial/buccal surfaces of all teeth were recorded. Fillings were considered to be the same as non-carious cervical lesions. Information about tooth brushing habits was collected with a questionnaire. Chi-square tests and multivariate logistic regression analysis were performed.

Results: Fifty-eight percent of the subjects had non-carious cervical lesions. The first premolars showed the highest prevalence of non-carious cervical lesions. The presence of non-carious cervical lesions was associated with age ($P < 0.001$) and mediotrusive-side contact ($P = 0.030$), but not with laterotrusive-side contact ($P = 0.073$) or frequency of tooth brushing ($P = 0.425$), according to chi-square tests. Multiple logistic regression analysis showed that subjects with bilateral mediotrusive-side contact (adjusted odds ratio = 2.19 vs. no contact, $P = 0.007$) and laterotrusive-side contact in incisor-canine-premolar areas (adjusted odds ratio = 2.27 vs. incisor-canine areas, $P = 0.036$) were at increased risk of having non-carious cervical lesions after adjusting for age.

Conclusions: Bilateral mediotrusive-side and laterotrusive-side contacts in incisor-canine-premolar areas were significantly associated with the presence of non-carious cervical lesions after adjusting for age in male adults.

Keywords: Occlusal contact pattern, non-carious cervical lesion, epidemiology, abfraction, adult

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Introduction

Non-carious cervical lesions (NCCLs) are characterized by loss of tooth structure in the cervical area through processes unrelated to dental caries. The lesions can result in esthetic problems for the patient and/or discomfort due to hypersensitivity. Studies show that the prevalence of the lesions is from 5 to 85%, with a positive correlation with age [1–4].

Several hypotheses have been published about the etiology of NCCLs, including tooth brushing, acid erosion, and traumatic occlusion [4]. Cross-sectional studies showed that a high frequency of tooth brushing [5, 6], high pressure of tooth brushing [7], and horizontal brushing technique [5] increased the risk of the lesions. A 6-year longitudinal clinical study showed that consumption of dietary acids and frequency of tooth brushing correlated with increased prevalence of the lesions [8]. An epidemiologic study with 156 patients in Trinidad and Tobago showed that a high frequency of tooth brushing and consumption of citrus fruits were related to the lesions [3].

However, the effect of occlusal loading on NCCLs remains unclear [9, 10]. The theory is based on computer-generated models [9, 10] and on investigations generally with data consisting of case reports and case studies [11–13]. Many studies using finite-element methods showed that occlusal force was associated with increased stress concentrations along the buccal cervical area [9, 10]. Cross-sectional studies of 61 patients [11] and 70 subjects [12] showed that cervical lesions were related to wear facets. A 3-year longitudinal study of 40 undergraduate dental students showed that the patterns of wear facets were associated with an increased occurrence of NCCLs [13].

Few data are available on the relationship between occlusal contact pattern and NCCLs [14, 15]. A study of 77 patients in Iran showed that the presence of NCCLs was associated with an increased number of premature contacts in centric relation and laterotrusive-side but not in mediotrusive-side [14]. A study of 240 company employees in Japan showed a high prevalence of NCCLs in subjects exhibiting bruxism grinding in premolar and molar areas [15]. However, neither study adjusted for age, which is an important factor for NCCLs [1, 3, 4, 7–9]. The purpose of this study was to evaluate

the relationship between occlusal contact pattern and NCCLs in a population of male Japanese employees from 30 to 59 years of age.

Subjects and methods

Study population

A total of 386 males, all of whom were from 30 to 59 years old and employed by a major Japanese manufacturing company or one of its subsidiaries, participated in a routine dental examination program between January and December 2008. Individuals were excluded if they had received treatment for malocclusion or temporomandibular dysfunction, if they had less than 20 teeth, or if they had no occlusal support in either the premolar or the molar region on any side (right or left). Verbal consent was obtained from all the participants during the examination period. The study protocol was approved by the Kanagawa Dental College Ethics Committee.

Clinical examination

Fifteen experienced dentists conducted dental examinations under artificial lights with mouth mirrors and Community Periodontal Index probes (No. 28-107, YDM Co., Tokyo, Japan). They recorded the number of teeth, number of NCCLs on labial/buccal surfaces of all teeth except the third molars, and fillings in the cervical area of labial/buccal surfaces with gingival recession of all teeth except the third molars [15]. Cervical lesions that did not have softened dentin and that showed a spheroid- or wedge-shaped loss of dentin and/or enamel were diagnosed as NCCLs. Fillings located in the cervical area were considered to be NCCLs [16]. However, other restorations such as full cast crowns and inlays, in which the cemento-enamel junction was included, were not considered to be NCCLs.

To assess occlusal contact patterns, the examiners instructed the subjects to slide the mandible first right and then left with their teeth slightly touching and in a canine edge-to-edge position [17]. The presence or absence of interocclusal contacts was determined by direct intra-oral inspection. Tooth types with mediotrusive-side and laterotrusive-side contacts were recorded.

Questionnaire

A self-reported questionnaire was used to assess the frequency of tooth brushing, bruxisum and therapy received for malocclusion and temporomandibular disorders.

Statistical analysis

Subjects with NCCLs in labial/buccal surface and/or fillings in labial/buccal surfaces in the cervical area with gingival recession were categorized as having NCCLs [16]. Subjects were divided into three groups according to the type of mediotrusive-side contact: no contact, unilateral contact, and bilateral contact. Furthermore, subjects were divided into four groups according to the type of laterotrusive-side contact: no contact, contact in the incisor-canine areas, contact in the incisor-canine-premolar areas, and contact in the incisor-canine-premolar-molar areas [15].

Associations between age and dental variables, including mediotrusive-side contract, laterotrusive-side contact, and NCCLs, were analyzed using the chi-square test. Associations between NCCLs and the occlusal contact pattern, including mediotrusive-side contact, laterotrusive-side contact, and frequency of tooth brushing, were analyzed using the chi-square test. Any association with age, mediotrusive-side contact, and laterotrusive-side contact with NCCLs was examined in logistic regression models, and the odds ratio (OR) and 95% confidence interval (CI) were calculated. The logistic regression model was reviewed for goodness-of-fit and validated using the Hosmer-Lemeshow statistic [18]. The Statistical Package for the Social Sciences (17.0J for Windows; SPSS Japan, Tokyo, Japan) was used for statistical analyses.

Results

The mean (standard deviation) and median (range) number of the teeth present were 28.5 (2.2) and 28 (20–32), respectively. The frequency distribution of subjects in relation to number of NCCLs is shown in Fig. 1. The number (percentage) of subjects

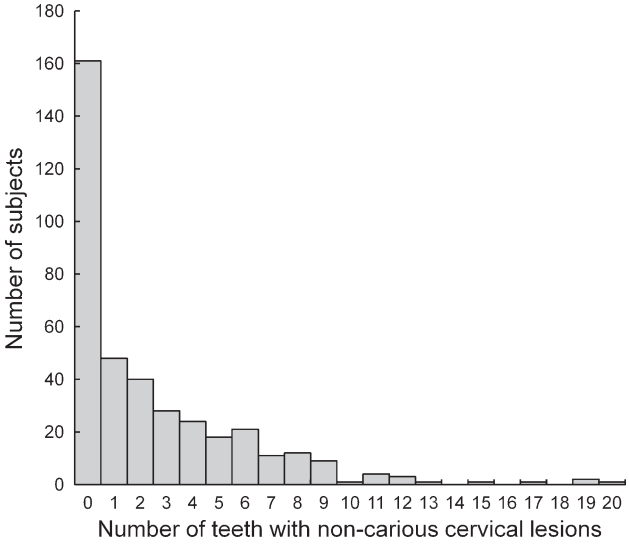

Fig. 1: Frequency distribution of subjects in relation to number of teeth with non-carious cervical lesions

Tab. 1: Distribution of non-carious cervical lesions with age

Age	Without lesions	With lesions	Total
30–39	72	54	126
40–49	55	96	151
50–59	34	75	109
Total	161	225	386

Number of subjects; $P < 0.001$ (Chi-square test)

having at least one tooth with an NCCL was 225 (58%). Percentage of subjects with NCCLs was highest for maxillary first premolars (right: 27%, left: 23%), followed by mandibular first premolars (right: 21%, left: 20%) and maxillary second premolars (right: 17%, left: 16%).

The number of subjects with NCCLs varied according to age group ($P<0.001$), and the prevalence rate of the oldest group was higher than that of the youngest group (Table 1). There was no significant difference in the distribution of mediotrusive-side contact among the three age groups ($P=0.116$) (Table 2). However, there was a significant difference in the distribution of laterotrusive-side contact among the three age groups ($P=0.012$) (Table 3).

Tab. 2: Distribution of mediotrusive-side contact with age

Age	Mediotrusive-side contact			Total
		Unilateral	Bilateral	
30–39	52	31	43	126
40–49	71	38	42	151
50–59	63	23	23	109
Total	186	92	108	386

Number of subjects; $P=0.116$ (Chi-square test)

Tab. 3: Distribution of laterotrusive-side contact with age

Age	Laterotrusive-side contact				Total
	Incisor-canine areas	Incisor-canine-premolar areas	Incisor-canine-premolar-molar areas		
30–39	9	28	88	1	126
40–49	24	29	97	1	151
50–59	10	37	62	0	109
Total	43	94	247	2	386

Number of subjects; $P=0.012$ (Chi-square test after excluding the data of 2 subjects without laterotrusive-side contact)

Tab. 4: Relation between non-carious cervical lesions and mediotrusive-side contact

Mediotrusive-side contact	Without lesions	With lesions	Total
	90	96	186
Unilateral	35	57	92
Bilateral	36	72	108
Total	161	225	386

Number of subjects; $P=0.030$ (Chi-square test)

Tab. 5: Relation between non-carious cervical lesions and laterotrusive-side contact

Laterotrusive-side contact	Without lesions	With lesions	Total
Incisor-canine areas	25	18	43
Incisor-canine-premolar areas	37	57	94
Incisor-canine-premolar-molar areas	99	148	247
	0	2	2
Total	161	225	386

Number of subjects; $P=0.073$ (Chi-square test after excluding the data of 2 subjects without laterotrusive-side contact)

Tab. 6: Relation between non-carious cervical lesions and frequency of tooth brushing

Frequency of tooth brushing	Without lesion	With lesion	Total
Once/day	34	37	71
Twice/day	95	138	233
3 times/day	29	48	77
4 times/day	2	1	3
Total	160	224	384

Number of subjects; $P=0.425$ (Chi-square test after excluding the data of 3 subjects brushed 4 times a day and 2 subjects without answer to the question)

Tab. 7: Logistic regression analysis of the risk indicators for subjects with or without non-carious cervical lesions as the dependent variables

Indicators	Odd's ratio	95% CI	*P*
Age			
30–39	1.00		
40–49	2.72	1.64–4.51	<0.001
50–59	3.48	1.98–6.09	<0.001
Mediotrusive-side contact			
No.	1.00		
Unilateral	1.60	0.93–2.76	0.090
Bilateral	2.19	1.24–3.86	0.007
Laterotrusive-side contact			
Incisor-canine areas	1.00		
Incisor-canine-premolar areas	2.27	1.06–4.88	0.036
Incisor-canine-premolar-molar areas	1.84	0.90–3.74	0.095

Excluding the data of 2 subjects without laterotrusive-side contact

The prevalence rate of NCCLs differed among the three types of mediotrusive-side contact ($P = 0.030$) (Table 4) but not among the three types of laterotrusive-side contact ($P = 0.073$) (Table 5). There was no significant association between the presence of NCCLs and the frequency of tooth brushing ($P = 0.425$) (Table 6). Relatively higher prevalence of NCCLs was in subjects with a bruxisum habit (62.0%) than in subjects without a bruxisum habit (53.0%); however, the difference was not statistically significant ($P = 0.269$).

After adjusting for age, logistic regression analysis indicated that the presence of NCCLs depended on bilateral mediotrusive-side contact (OR: 2.19; 95% CI: 1.24–3.86) ($P = 0.007$) and laterotrusive-side contact in incisor-canine-premolar areas (OR: 2.27; 95% CI: 1.06–4.88; $P = 0.036$) (Table 7).

Discussion

Cervical fillings in labial/buccal surfaces with gingival recession were counted as NCCLs in this study. Because this is a cross-sectional study, we had no information about the circumstances or conditions that had led to these cervical fillings. If all teeth with cervical fillings were counted as NCCLs in our statistical analysis, then the prevalence of these lesions would be overestimated. On the other hand, if all teeth with cervical fillings were excluded from the analysis, the prevalence would be underestimated.

It is generally accepted that NCCLs have a multifactorial etiology [6, 7, 16]. For example, abnormal occlusal loading forces are thought to cause tooth flexure, resulting in compressive and tensile forces in the cervical region of the tooth [19]. Flexure may cause micro-fractures in the crystalline structure of the enamel and dentin, which may make the tooth susceptible to NCCLs as well as to caries [20]. Therefore, counting the teeth with cervical fillings in labial/buccal surfaces with gingival recession as NCCLs was considered more appropriate than excluding them in this study. In our preliminary analysis, multiple regression analysis was conducted after excluding cervical fillings from the count of NCCLs. The results showed that only bilateral mediotrusive-side contact was related to the presence of NCCLs after adjusting for age (data not shown). No relation was shown between the type of laterotrusive-side contact and presence of NCCLs (data not shown).

The results of this study showed that bilateral mediotrusive-side contact and laterotrusive-side contact in incisor-canine-premolar areas were related to the presence of NCCLs after adjusting for age. Because canine-protected guidance reduces muscle activity during parafunctional clenching [21], bilateral mediotrusive-side contact and laterotrusive-side contact in incisor-canine-premolar areas might contribute to clenching [22] and result in NCCLs. The results of this study agree with those of previous studies that show an association between bruxism and NCCLs [23, 24]. In addition, our study supports the previous studies showing that subjects with group function [3] or premature contacts on the laterotrusive-side [14] are likely to have NCCLs.

However, the results of this study conflict with those of a study in 299 dental students, which found no relationship between occlusal guidance pattern and the presence of NCCLs [25]. This discrepancy between the study findings may be attributed to differences in the age of the study subjects. The mean age of subjects of our study was much higher than that of the dental students in the previous study [25]. Because the prevalence of NCCLs increases with age [1, 3, 4, 7–9], a study of older subjects might easily have shown positive association between occlusal guidance pattern and NCCLs while the study with younger subjects did not show such an association. In fact, when we analyzed the 30–39 year olds alone, no significant relationship was found between occlusal guidance pattern and NCCLs (data not shown).

No significant association was found between the bruxisum and NCCLs in this study. The results are not in agreement with those of other studies, which showed higher prevalence of NCCLs was in subjects with a bruxing habit than in subjects without a bruxing habit [6, 23]. Reliability of the questionnaire is a concern for researchers. It has been suggested that reported nocturnal bruxism tends to be underestimated [9]. In fact, no significant association has been reported by other studies [3, 7].

In accordance with most other studies, the prevalence of NCCLs was highest in the first premolars [8, 14–16, 24, 25]. However, in one previous study, first molars had the highest frequency of NCCLs [12]. The discrepancy between these studies may be attributed to differences in design and subjects of the studies. Because laterotrusive-side contact in incisor-canine-premolar areas was related to the presence of NCCLs in our study, the results show the high prevalence of the lesions in premolars.

This study had some limitations. Since the design permitted only a limited understanding of temporal relationships, prospective cohort studies may be required to provide more information beyond what we present here. Other factors (e.g., brushing techniques, dentifrices, and dietary acids) that have been shown to be associated with the prevalence of NCCLs were not included in our study. The clinical examination for NCCLs was conducted only on labial/buccal surfaces. As yet, we have no information about NCCLs on lingual surfaces. Definition of NCCLs, which included fillings, might overestimate prevalence of the lesions as described above. It may be more reliable to evaluate interocclusal contacts by using articulating paper.

In conclusion, bilateral mediotrusive-side contact and laterotrusive-side contact in incisor-canine-premolar areas were significantly associated with the presence of NCCLs after adjusting for age in male Japanese employees.

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Conflict of interest

The authors declare that there is no conflict of interest.

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