Noncarious cervical lesions in adults

Prevalence and occlusal aspects

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ABSTRACT

Background. The factors that induce the formation of noncarious lesions are not understood fully, particularly those that are related to occlusal aspects. The authors conducted a study to evaluate the prevalence of noncarious cervical lesions in adults and their association with occlusal aspects.

Methods. The authors examined 70 people (35 men and 35 women) aged 25 to 45 years to determine the presence and type of noncarious cervical lesions, wear facets, tooth contacts in maximal intercuspal position, and lateral and protrusive movements. The assessment involved a questionnaire and clinical examination.

Results. Among the teeth the authors evaluated, 17.23 percent had cervical lesions, 80.28 percent of which had wear facets ($P < .01$). The authors found a significant difference between the prevalence of noncarious lesions and the presence of wear facets ($P = .0484$).

Conclusions. The authors found that cervical lesions were related significantly to wear facets. These findings strengthen evidence for the role of occlusal forces as an etiologic factor for noncarious lesions.

Clinical Implications. The presence of wear facets should be considered in the treatment of noncarious cervical lesions.

Key Words. Abfraction; cervical lesion; wear facet; occlusion.

Noncarious cervical lesions in human teeth are classified into three categories: abrasion (loss of tooth structure of mechanical origin), attrition (loss of tooth structure caused by functional or parafunctional contact, including normal chewing and bruxism) and erosion (loss of tooth structure of chemical or idiopathic origin).

Loss of tooth structure in the cervical area of a noncarious cervical lesion may cause esthetic problems and discomfort because of dentinal hypersensitivity.[1-4] Based on the morphological pattern of the lesions examined by electron microscopy, Spranger[5] suggested that eccentric occlusal trauma also might yield loss of tooth structure in the cervical area of teeth.

The presence of wear facets should be considered in the treatment of noncarious cervical lesions.

Other authors support the idea that many lesions are not caused only by the processes of abrasion, attrition or erosion, especially those lesions that affect a single tooth.[6-13] Findings of a tooth with a lesion adjacent to a tooth without a lesion; presence of a subgingival lesion where it should not occur owing to erosion or abrasion; and the occurrence of wedge-shaped lesions in animal (cat and horse) teeth, artificial teeth in complete dentures, teeth of prehistorical people and chemically inert restorative materials such as gold have reinforced the likely existence of a different etiologic factor.[14,15]

In 1991, Grippo[2] introduced a new category—abfraction—to the classification of noncarious cervical lesions to refer to the pathological loss of dental hard tissue caused by biomechanical forces. He concluded that such lesions occurred owing to flexure of the tooth caused by occlusal forces and the consequent fatigue of enamel and dentin distant from the point of force application.

Different types of functional and parafunctional activities that occur in the mouth, such as chewing and bruxing, significantly influence the rupture of the tooth structure. When a tooth is loaded in the long axis, the forces are dissipated with minimal stress in the dentin or enamel. If the direction of the force is moved laterally, however, teeth are flexed toward both sides. The stress pattern in the same area is changed continuously from compressive to tensile, especially under-

neath the enamel, since dentin appears to be substantially stronger than enamel when under lateral forces. Thus, the cyclic occurrence of compression and tension may reach the fatigue limit and lead to rupture of the chemical bonds between the hydroxyapatite crystals.[6,8,16]

Studies of finite element[17,18] and photoelastic models[19] have shown that the load applied to the inner buccal and lingual cuspal inclines of a mandibular premolar (similar to the load pattern of a person with bruxism during lateral excursions of the mandible) produced the highest stress in the cervical region—1 to 2 millimeters above the cementoenamel junction (CEJ)—with a magnitude that could initiate enamel fracture. Despite its fundamental role in the initiation of the process, occlusal loading may not be the primary factor in the formation of noncarious cervical lesions.[20-22]

Attempts have been made to evaluate the incidence and prevalence of this type of lesion in different populations.[4,23,24] Researchers have evaluated some characteristics of noncarious cervical lesions in in vitro tests and via finite element analyses.[25,26]

The age range of study population samples is a matter of controversy. According to one study, the higher the age range of the group evaluated, the higher the lesion prevalence.[4] According to these authors, the maxillary teeth most commonly affected are the first premolars, followed by the first molars, second premolars and canines. As for mandibular teeth, the first premolars again are the most frequently affected, followed by the second premolars, first molars and canines.

The characteristics of noncarious cervical lesions, with their sharp angles, wedged shapes and frequent subgingival locations, have not been explained by the proposed theories to date. Yet, occlusal trauma alone cannot fully explain the phenomenon, since evidence indicates that many teeth show signs of traumatic occlusion but do not develop cervical lesions. Despite the need for scientific confirmation, the occlusal trauma concept is well-accepted, since it may explain the morphology and location of the lesions.[11,27]

Since the prevalence of cervical lesions is increasing, identification of the risk factors is key for diagnosis, prevention and treatment.

Therefore, in an attempt to provide further clarification on this issue, we conducted this study to evaluate the prevalence of noncarious cervical lesions in a patient population aged 25 to 45 years and the lesions' association with occlusal aspects.

SUBJECTS AND METHODS

We evaluated 70 people (35 men and 35 women) aged 25 to 45 years. We obtained informed consent from the subjects. The inclusion criteria for our study were the absence of ongoing orthodontic treatment or use of prostheses, the presence of all natural teeth in both dental arches (except for the third molars) and the absence of tooth mobility.

We first asked the subjects to fill out an eight-item questionnaire to provide information that might be related to the type of lesion present in the teeth we evaluated (Box).

All of the subjects received complete information on how to answer these questions. After they completed the questionnaire, we examined each subject clinically with the aid of numbered dental probes and dental mirrors with surface reflection. However, before the clinical examination and with a view to establishing its accuracy, we measured the probe tips with a measuring microscope at ×30 magnification. We found no statistically significant differences among the probes' diameters. We did not use a probe in more than five subjects.

We examined the buccal, lingual and palatal aspects of all of the teeth. We positioned the tip of the probe perpendicular to the tooth surface and inserted it to the bottom of the gingival sulcus, crossing the CEJ up to approximately one-half the height of the corresponding cusp tip. If the probe was retained by some irregularity, we considered the irregularity to be a noncarious cervical lesion[3] even if it was located at the CEJ, since clinically detectable irregularities in this area may cause flexure of the tooth.[3,5,15,27]

One author (J.M.S.) examined the cervical lesions and verified the occlusal contacts in maximal intercuspal position (MIP) and during lateral and protrusive movements with aid of articulation paper (Figures 1 and 2).

We investigated the presence of wear facets in all teeth in MIP and during lateral and protrusive movements. We then transferred the location of each wear facet precisely to the dental chart on the evaluation form using a .05-mm pencil. Thus, the presence or absence of wear facets could be related to the presence or absence of noncarious cervical lesions.

We performed statistical analysis using the

BOX

QUESTIONNAIRE.

1. Do you have any parafunctional habit such as tooth clenching or grinding, tongue biting, lip biting, gum chewing, cheek biting, biting objects or nail biting?
2. Do you chew unilaterally?
3. Have you had orthodontic treatment?
4. Do you drink acidic beverages such as colas or orange juice?
5. Do you have or have you had any regurgitation problem?
6. Do you have any health problems?
7. Have you taken any drug for long periods?
8. Do you regard yourself as a nervous person?

t test, Mann-Whitney test and χ^2 test. We adopted a 5 percent level of significance.

RESULTS

Clinical examination. Of the 70 subjects we examined, 62 had at least one tooth with a noncarious cervical lesion (95 percent confidence interval, 79.0 to 94.9). The number of lesions per subject in the group with noncarious cervical lesions ranged from 1 to 14, with a mean of 5.61 lesions per subject (standard deviation [SD] = 3.34) (Figure 3).

We found 189 lesions in the maxilla and 166 in the mandible (P = .073). Table 1 (page 1698) shows the percentages of lesions according to the type of teeth, as well as groups with the same statistical significance.

Questionnaire. We found that having parafunctional habits (P = .9347), chewing unilaterally (P = .2496), having had orthodontic treatment (P = .6980), experiencing stress (P = .9163), drinking acidic beverages (P = .0517), having regurgitation problems (P = .9447), taking drugs for long periods (P = .5530) and having health problems (P = .8032) were not associated with the presence of lesions. We also found that sex was not associated with the presence of lesions ($P > .05$).

The group of subjects with lesions had a mean age of 32.5 years (SD = 5.09); the group of subjects without lesions had a mean age of 35.1 years

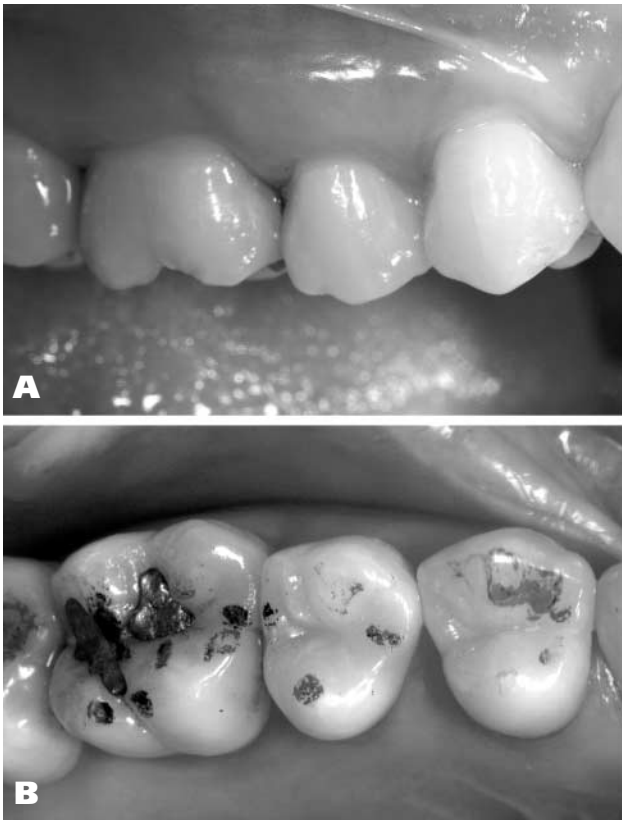

Figure 1. A. Clinical view of noncarious cervical lesions on the maxillary left first and second premolars and the first molar. B. The occlusal view of contacts in maximal intercuspal position (MIP) and working movement (lateral movement of the mandible from MIP to the ipsilateral side).

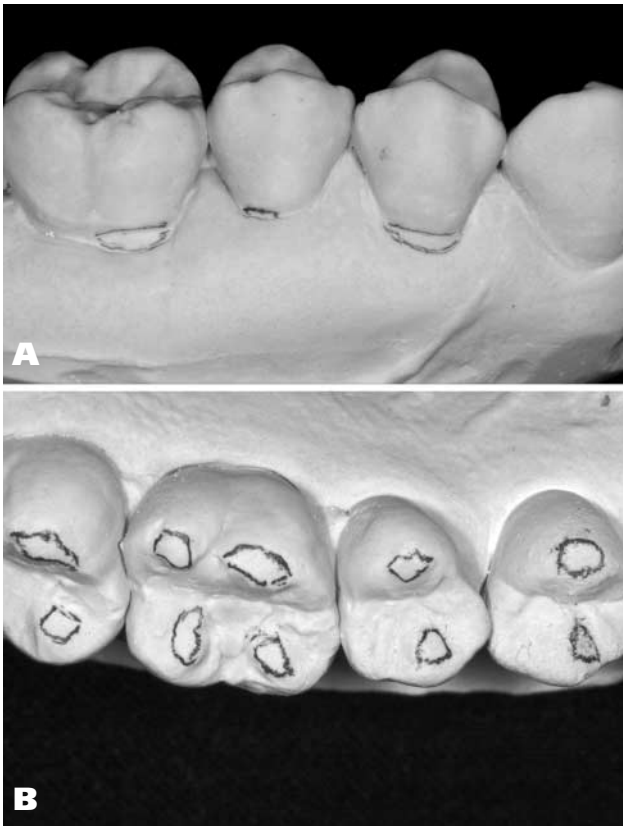

Figure 2. Buccal and occlusal views of a sample cast. Note the presence of cervical lesions (A) and wear facets (B).

(SD = 5.96). The difference between the groups was not statistically significant (P = .213) according to the Mann-Whitney test.

Occlusal analysis. In the group of subjects with lesions, the mean number of teeth per subject was 29.5 (SD = 2.08); the mean number of teeth in the group of subjects without lesions was 28.5 (SD = 2.33). We found no statistically significant difference between groups (P = .2074) when we considered the number of teeth. The group of subjects with lesions, however, had a mean of 10.92 (SD = 4.32) teeth with wear facets, compared with a mean number of 7.75 (SD = 2.96) wear facets for the group of subjects without lesions. (The distribution of wear facets per subject can be seen in Figure 4 [page 1699].) According to the t test, this difference was statistically significant (P = .0484). Of the 355 teeth with lesions, 285 (80.3 percent) exhibited contacts and wear facets distributed in 139 teeth in MIP (48.8 percent), as well as 137 teeth in working lateral (48.1 percent), six teeth in nonworking lateral (2.1 percent) and three teeth in protrusive (1.0 percent) movements. Table 2 (page 1699) shows the relationship between teeth with and without lesions and wear facets. Both characteristics are statistically significant as demonstrated by the χ^2 test ($P < .01$). In lateral excursion, 44.3 percent of the subjects had unilateral or bilateral canine guidance, 51.4 percent had partial group function, and 4.2 percent had group function.

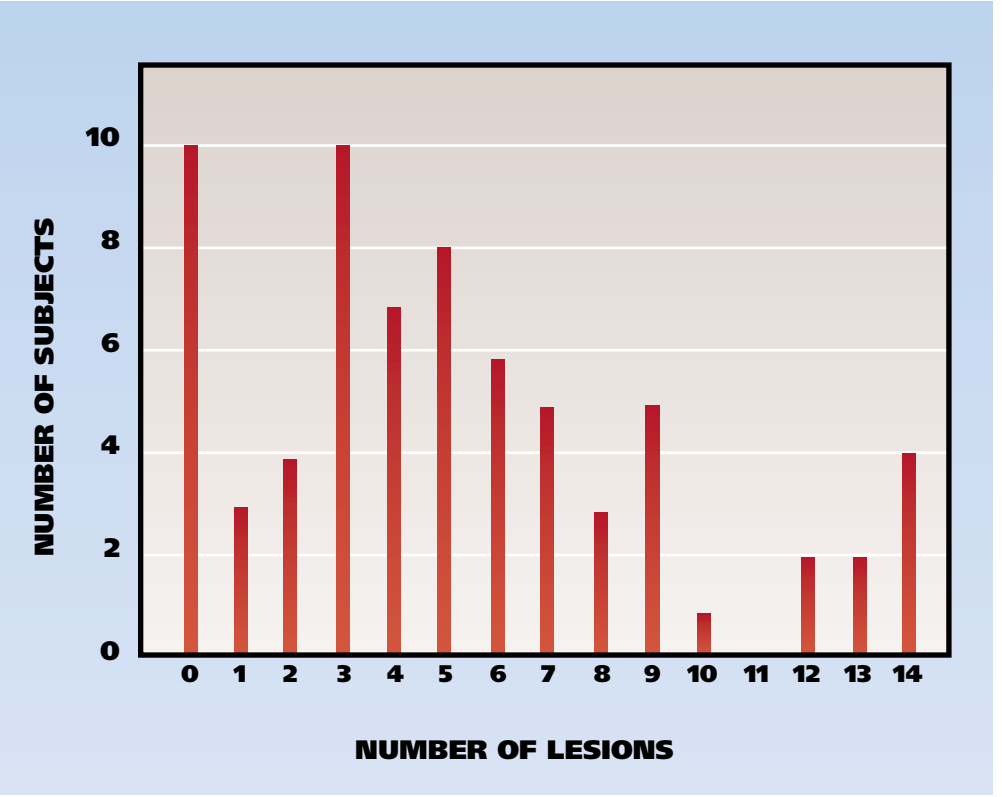

Figure 3. Frequency of lesions per subject.

DISCUSSION

The main reason for the disagreements in the literature is the large variability of the age ranges in the study samples. Conflicting data emerge in the analyses of the results of the studies, since the prevalence of noncarious lesions tends to increase with age.[4,11]

Our study analyzed a sample population aged 25 to 45 years. The difference in the mean ages of 32.5 years for the group of subjects with lesions and 35.1 years for the group of subjects without lesions was not statistically significant. Within this age range, our inclusion criterion that the subjects had to possess all of their natural teeth was not difficult to meet.

Many authors have associated the presence of lesions with parafunctional habits.[1,6,8,9,14,23,26] Nevertheless, in our study the presence of parafunctional habits in the subjects was not correlated with the presence of lesions.

Similarly, we found that unilateral chewing was not correlated with presence of the lesions in our study. Our finding disagreed with that of Bevenius and colleagues[28]: unilateral chewing can play an important role in the development of unilateral stress. Their finding, however, should be considered carefully, since it was made on the basis of an analysis of only three subjects in a pilot study.

We found that subjects who had had ortho-

TABLE 1

DISTRIBUTION OF THE LESIONS ACCORDING TO THE DIFFERENT TYPES OF TEETH.

TEETH WITH LESIONS*	N	PERCENTAGE
Maxillary First Molar[a]	59	16.6
Mandibular Second Premolar[a]	53	14.9
Mandibular First Molar[a]	49	13.8
Maxillary First Premolar[a]	48	13.5
Mandibular First Premolar[a]	47	13.2
Maxillary Second Premolar[a]	44	12.4
Maxillary Second Molar[b]	20	5.6
Mandibular Second Molar[b]	14	3.9
Maxillary Canine[b]	13	3.7
Maxillary Central Incisor[c]	4	1.1
Mandibular Canine[c]	3	0.8
Maxillary Third Molar[c]	1	0.3
Mandibular Central Incisor[d]	0	0.0
Maxillary Lateral Incisor[d]	0	0.0
Mandibular Lateral Incisor[d]	0	0.0
Mandibular Third Molar[d]	0	0.0
TOTAL	**355**	**99.8**

* Letters in the first column indicate statistical significance among the teeth, using the z score ($P < .05$).

dontic treatment did not have a significantly higher prevalence of lesions compared with subjects who had no lesions. The group of subjects who had undergone orthodontic treatment also had a reduced number of teeth with wear facets compared with subjects who had not undergone orthodontic treatment, regardless of the presence of noncarious cervical lesions. According to Telles and colleagues,[4] the constant occlusal alterations during orthodontic treatment might reduce the level of parafunctional habits, thus decreasing the occurrence of wear facets and, consequently, lesions.

We found that stress in subjects in both groups did not influence the presence of lesions. Emotional stress is one of the many etiologic factors involved in parafunctional habits, and it was not significantly related to the presence of lesions.

We also found that drinking acidic beverages and having regurgitation problems or reflux were not correlated significantly with the presence of lesions. They are related more to dental erosion, which may occur because of extrinsic (acid coming from the external environment) or intrinsic (acidic supply coming from the internal environment—for example, reflux) influences. Moreover, those types of lesions display characteristic clinical signs as a wide, clean and polished surface with well-defined borders on all sides, in addition to the clinical history of gastric, feeding and psychological issues.[29]

We found that general health problems, which may lead to the need for taking drugs for long periods, also were not significant with regard to the presence of noncarious lesions. Some drugs, however, may cause xerostomia, potentiating the destructive effect of erosive processes. In the dental literature, no clinical evidence indicating that drugs or pathological conditions may predispose the occurrence of noncarious lesions has been reported so far.

We considered the mean of 10.92 teeth with wear facets per subject in the group with lesions to be significantly higher than the mean of 7.75 teeth with wear facets per subject in the group without lesions. These data clearly show the positive correlation between the presence of lesions and the presence of wear facets.

We observed wear facets in 75.7 percent of the subjects (range of wear facets per subject, 1-16) and in 17.23 percent of all teeth evaluated. Considering only teeth with lesions, 80.28 percent had wear facets. Table 2 shows the relationship between the presence of lesions and of wear facets. The χ^2 test revealed a significant relationship between these characteristics.

Outcomes similar to ours have been reported

by some authors.[4,14] Different findings were reported by Mayhew and colleagues[9] (95.0 percent), Miller and colleagues[12] (95.5 percent) and Khan and colleagues[23] (96.0 percent). The lower percentages in our study could have been due to the small variability in the age range of the subjects we investigated.

The lateral forces generated during chewing and bruxism may cause flexure of the teeth. The resulting tensile stress is concentrated in the cervical area close to the tooth fulcrum, thus breaking the chemical bond of the enamel and dentin crystalline structures. This allows penetration of small molecules through the microfractures and ultimately disrupts the repair of these chemical bonds. The damaged tooth structure subsequently is lost through the action of factors such as acids and abrasions, which play a secondary role in the development of these lesions.

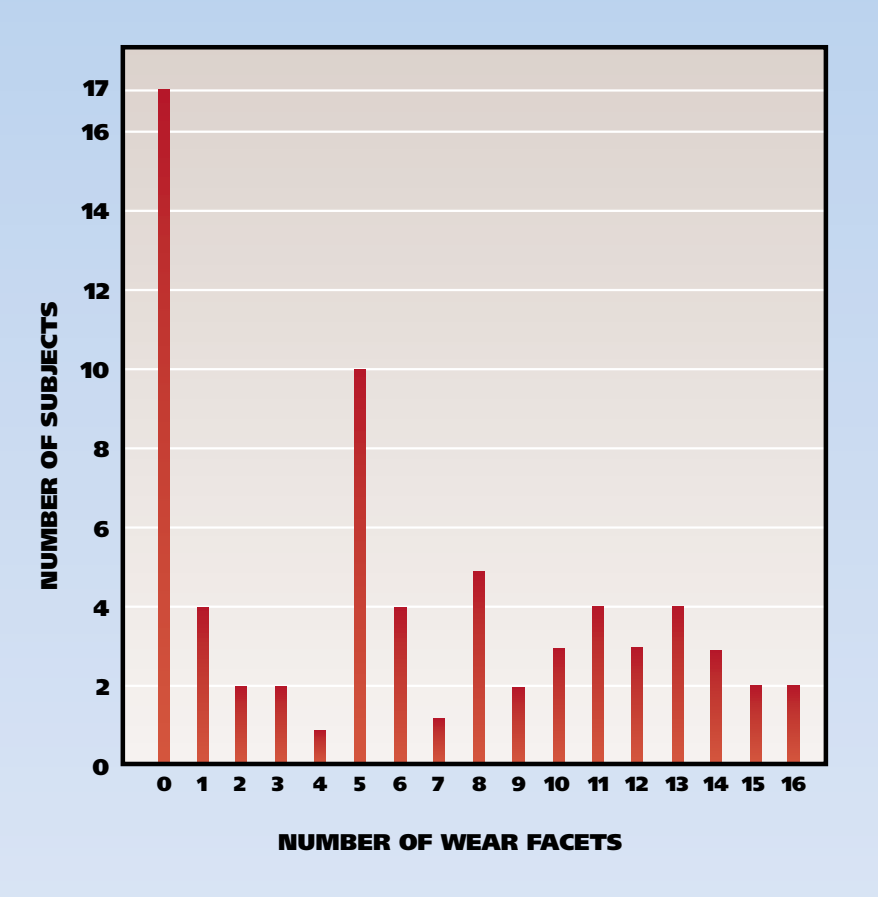

Figure 4. Frequency of wear facets per subject.

As mentioned by Grippo and colleagues[30] and Litonjua and colleagues,[31] the complexity of the tensile process generated in the cervical area, the multifactorial etiologic factors and the difficulties of qualifying it in relation to the occlusal patterns make it necessary to have more precise parameters for studying the influence of occlusion on the development of noncarious cervical lesions.

CONCLUSIONS

Within the limitations of this study, we drew the following conclusions. Age, sex, parafunctional habits, unilateral chewing, orthodontic treatment, stress, intake of drugs for long periods and general health status were not predictors of the presence of noncarious cervical lesions. In addition, we found a significant correlation between the prevalence of noncarious lesions and the presence of occlusal wear facets. ■

TABLE 2

RELATIONSHIP BETWEEN TEETH WITH AND WITHOUT LESIONS AND WEAR FACETS.

TEETH	WITH WEAR FACETS	WITHOUT WEAR FACETS
With Lesions	285	70
Without Lesions	454	1,251

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The authors wish to thank the CNPq (Brazilian Foundation of the Development of Research) for the financial support fundamental for carrying out this study.

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