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The Prevalence of Cervical Tooth Wear in Patients with Bruxism and Other Causes of Wear

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Abstract

Purpose: The aim of this study was to investigate the prevalence of cervical wear lesions in three groups of patients: bruxists, combined tooth wear, and controls. The hypothesis was that those subjects presenting with bruxism were more likely to develop cervical wear lesions.
Materials and Methods: Of 119 subjects, 31 were bruxists with a mean age 48.7 years [standard deviation (SD): 11.6]; 22 had combined wear, aged 43.5 years (14.2); and 66 controls aged 44.9 years (17.0). The clinical appearance of the tooth wear was used to recruit subjects to the bruxist and combined tooth wear groups. Control subjects were randomly selected from those attending for routine dental examination at two general dental practices. A tooth wear index (TWI) was used by two trained examiners to record the severity of wear in each group.
Results: There was a statistically significant difference between the controls and both the bruxist and combined tooth wear groups for wear on all surfaces ($p \leq 0.001$). There was no significant difference between the bruxist and the combined tooth wear group for wear on any surface. There was a statistically significant difference between the control group and both the bruxist and the combined tooth wear group for the severity of cervical wear ($p \leq 0.005$), but no difference between the bruxist and combined tooth wear groups. There was also no statistical difference in the number of cervical lesions between the groups.
Conclusions: In this study, the likely cause of cervical tooth wear was multifactorial.

The theory behind abfraction suggests that minute stresses established along the cervical area of teeth predispose the surface to other forms of wear. The hypothesis has gained considerable support within the dental literature;[1-3] however, despite this enthusiasm, the clinical and laboratory evidence to support the hypothesis remains skeptical. The possibility that abfraction exists in the etiology of tooth wear has recently been questioned.[4]

A few laboratory studies have investigated the possibility that occlusal forces may predispose cervical stress and wear. These mainly engineering studies have used finite element analysis to predict the behavior of enamel and dentine around the cervical area of teeth.[5] A laboratory study conducted on extracted premolars using axial and nonaxial loading observed no support for abfraction;[6] however, Staninec et al[7] proposed limited support from an erosive and abfractive laboratory study. A few clinical studies compare the presence of cervical wear lesions to occlusal contacts or wear but do not report a correlation between them.[8-10]

The other possible cause of cervical wear is a combination of erosion and abrasion. Limited support for pure abrasion resulting in cervical wear has been reported from laboratory studies in the 1960s.[11,12] Although the amount of wear caused either by the toothbrush or the toothbrush plus a toothpaste is believed not to have significant clinical effect on wear,[13,14] there is more evidence suggesting that the cause of cervical wear is multifactorial.[15-17] Despite the results of laboratory and clinical studies, a view remains that abfraction exists, and it is important in the development of cervical wear lesions. The aim of this study was to investigate the prevalence of cervical wear lesions in three groups of patients: bruxists, combined tooth wear, and controls. The hypothesis was that those subjects presenting with bruxism were more likely to develop cervical wear lesions.

Materials and methods

Subjects were randomly selected from patients attending referral clinics held between November 2005 and December 2007 at Guy's Dental Hospital. All new patients who presented with tooth wear were clinically examined by one of two examiners. Subjects who exhibited tooth wear from bruxism or combined tooth wear (of multifactorial etiology) were recruited to the study. The clinical appearance of the teeth was used to define the subjects in each group. Subjects without clinical signs of erosion and where teeth had flattened occlusal/incisal surfaces and accurately interdigitated with the opposing teeth were recruited to the bruxism group. Those subjects where the signs of erosion included incisal or occlusal cupping, palatal erosion, and smooth rounded lesions were grouped into the combined lesions. If there was doubt whether the subject showed signs of combined wear or bruxism, the subject was not recruited.

Control subjects were randomly selected from those attending for routine dental examination at two general dental practices in Greater London over the same time period. Subjects were randomly selected by computer selection during the same day of the week over the study period of 6 months. All controls and study subjects were at least 21 years of age and had a minimum of 20 permanent teeth. Written consent was obtained from all subjects prior to inclusion into the study. The study was approved by the ethical committee at Guy's, St. Thomas's and Kings Dental institute (04/Q0704/161).

The distribution and severity of tooth wear were recorded using the Smith and Knight[18] tooth wear index (TWI). Prior to the study, both examiners underwent a period of training for the assessment of tooth wear. Assessments were performed under ideal lighting conditions, teeth were thoroughly dried prior to the examination, and the cervical, buccal, occlusal/incisal, and lingual surfaces of each tooth were examined in the same sequence for each patient and data recorded by the examiners. The grading assesses wear at five levels (0 wear; 1 wear into enamel; 2 $<$ 1/3 dentine exposure; 3 $>$1/3 dentine exposure; 4 pulpal exposure). In cases of doubt, a lower score was assigned. Teeth with restorations covering more than 1/3 of the tooth surface were also recorded. In addition to the TWI, the frequency of cervical lesions was recorded for each group.

Following the clinical examination, each subject was asked a series of open-ended questions in a standard order, and the author recorded the answers. Each question could be expanded if necessary to give more detail, using previously published protocols.[19] Each subject was asked to identify the volume and frequency of consumption of carbonated drinks, acidic fruits, or fruit juices. The period of time that the subject had carried out their habit was also noted. Carbonated drinks were recorded as the number of cans consumed per day and fruit juices as the number of glasses consumed per day. Subjects who consumed more than five cans of carbonated drinks or five glasses of fruit juice per day were considered to have a significant acidic dietary intake. Subjects were also asked about parafunctional, grinding, or clenching habits. These data were recorded as "yes" or "no." The number of times that subjects brushed their teeth per day was also recorded.

Statistical analysis

The tooth wear data exhibited frequency distributions that were skewed and beyond transformation to approximate normality. Nonparametric descriptive statistics and analyses were chosen. Tooth wear variables were described using a median and interquartile range (IQR). The TWI were analyzed for the proportion of teeth with scores of grade 2 (mild dentine exposure), grade 3 (moderate dentine exposure), and grade 4 (severe dentine exposure) and separately for all cumulative scores greater than 1. Differences between groups were investigated using Kruskal-Wallis ANOVA. Statistical significance was inferred where $p < 0.05$, indicating that at least two of the three groups were different. Where statistical significance was indicated, differences between individual groups were tested using the Mann-Whitney U test with $p < 0.025$ for statistical significance to compensate for multiple testing. Qualitative variables (diet, etc.) were analyzed for differences between groups using chi-square analysis. The number of cervical lesions was also separately recorded for all subjects. Spearman correlations were used to assess the relationship between the levels of tooth wear on the cervical and occlusal surfaces in each group.

Intra- and interoperator reproducibility was calculated from the modified Smith and Knight indices. For intraoperator reproducibility, the author examined three subjects twice with a 15-minute interval between each examination. For interoperator reproducibility, each of the two examiners examined the three same patients on separate occasions. The reproducibility data were tested for intra- and interexaminer agreement using the kappa test. A kappa statistic greater than 0.80 was regarded as indicating very good agreement.

Results

Of the total of 119 subjects who took part in the study, 31 were bruxists with a mean age 48.7 years [standard deviation (SD): 11.6], 22 had combined wear with a mean age 43.5 years (SD: 14.2), and there were 66 controls with a mean age 44.9 years (SD: 17.0). There were 21 men and 10 women in the bruxist group, 12 men and 10 women in the combined tooth wear group, and 31 men and 35 women in the control group. The bruxists had a median of 27 teeth (IQR: 23 to 29), those with combined tooth wear had a median of 27 teeth (IQR: 24 to 28) and controls had a median of 26.5 teeth (IQR 24 to 29). The median IQR for teeth with restorations covering more than one-third of the tooth surface was 11 for bruxists (IQR 6 to 17), 8 for combined tooth wear (IQR 6 to 10), and 9 for controls (IQR 4 to 16). There were no statistically significant differences in age, gender, number of teeth, or number of teeth with restorations between the groups.

Figure 1 shows the median and IQR for the percentage of surfaces with a TWI greater than 1 on the buccal/facial, occlusal, lingual/palatal, and cervical surfaces of the teeth. There was a statistically significant difference between the controls and both the bruxist and combined tooth wear groups for all surfaces ($p \leq 0.001$). There was no significant difference between the bruxists and combined tooth wear on any surface.

Table 1 shows the median IQR percentage of cervical surfaces with TWI scores greater than 1 (enamel), greater than 2 (mild dentine), and greater than 3 (moderate dentine) for bruxist, combined tooth wear, and control groups, respectively. There was a statistically significant difference between the control group and both the bruxist and the combined tooth wear groups ($p \leq 0.005$), but no difference between the bruxist and combined tooth wear groups. The median IQR for the number of

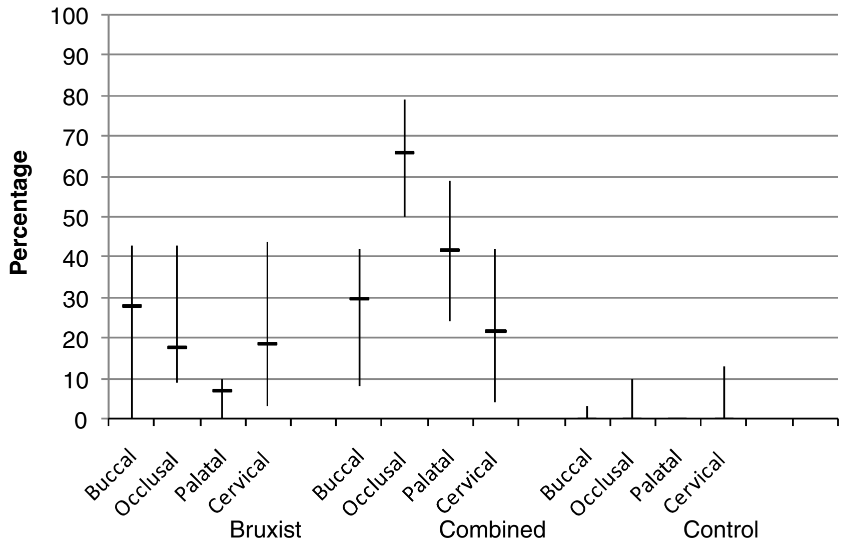

Figure 1 Median (IQR) percentage of buccal, occlusal, palatal, and cervical surfaces with a TWI greater than 1 in the bruxist, combined tooth wear, and control groups. The results for the controls show median values of 0 for all surfaces.

Table 1 Median (IQR) percentage of surfaces with a TWI greater than 1 (mild), greater than 2 (moderate), and greater than 3 (severe: dentine exposure) along the cervical margins of the three groups.

	Mild (2)	Moderate (3)	Severe (4)
Bruxist	12 (3–27)	0 (0–8)	0 (0–0)
Combined	16 (0–25)	0 (0–17)	0 (0–0)
Control	5.5 (0–13)	0 (0–0)	0 (0–0)

cervical lesions in bruxists was 2 (IQR 1 to 2), combined tooth wear 2 (IQR 1 to 2) and controls 2 (IQR 2 to 2), and there were no statistically significant differences between the groups. The interexaminer and intraexaminer agreement showed a kappa score of > 0.8 for all surfaces. There was no relationship between the tooth wear on the cervical and occlusal surfaces in the bruxist group (Spearman $r = 0.1$, $p = 0.59$); however, there was a strong relationship in the combined tooth wear group ($r = 0.74$, $p = 0.001$) and a moderately strong relationship in the controls ($r = 0.45$, $p = 0.001$).

Eighteen subjects with combined tooth wear (78%), six bruxist subjects (19%), and one control (1%) consumed more than five cans of carbonated drinks and/or five glasses of fruit juice per day. No intake of acidic foodstuffs or drinks was reported by 5 subjects in the combined tooth wear subjects (22%), 25 bruxist subjects (80%), and 46 controls (59%). Subjects with combined tooth wear had a higher dietary intake of acidic foods and drinks compared to bruxist subjects ($p < 0.001$) and controls ($p < 0.001$). The bruxist subjects also had a statistically significant higher dietary intake of acidic foods and drinks compared to control subjects ($p = 0.009$). A history of parafunction was reported in 5 subjects in combined tooth wear (22%), 31 bruxists (100%), and 2 controls (2%). There was a significantly greater reported incidence of parafunction in both the bruxist and combined tooth wear groups than controls ($p \leq 0.001$). Controls brushed their teeth more frequently than both the combined tooth wear subjects ($p = 0.005$) and the bruxist subjects ($p = 0.040$).

Discussion

Tooth wear subjects were selected from a referral center and controls from general dental practice. As far as possible, the recruitment process and allocation to groups were controlled. Where doubt existed as to whether the pattern of tooth wear was indicative of bruxism or combined wear, subjects were not recruited. Although the clinical appearance of tooth wear is not an exact science, the pattern caused by bruxism is generally considered to be characteristic.[20] Flattened occlusal and incisal surfaces without any sign of erosion were considered to be caused by bruxism. Any evidence of cupping or erosive lesions in the bruxist group prevented their recruitment to that group and the study.

The observations from the data obtained from the TWI supported the inclusion and exclusion criteria of the combined tooth wear group and the bruxists. Both groups had higher levels of wear, and the distribution was consistent with the clinical findings. The Smith and Knight index records wear involving enamel as grade 1. In common with most adult studies, all subjects in each group showed evidence of wear on enamel and because of this observation, no statistical analysis was conducted at this threshold. Moderate wear was more commonly seen in the combined and the bruxism groups, and severe tooth wear was relatively uncommon in any group.

The controls had statistically significantly less tooth wear than the bruxist and combined tooth wear groups. The highest median occlusal wear was observed in the bruxists [72 (IQR 49 to 49)] and was significantly more than the other groups. The reasons for higher occlusal wear were partially indicated by the finding that all bruxists reported parafunctional activity whereas only five (20%) of the combined group and two (2%)

of the controls did so. Increased parafunctional activity has been reported by other researchers and is also associated with an increased tendency toward occlusal wear.[21,22] Those subjects with combined tooth wear showed higher median palatal, buccal, and cervical wear than the bruxists and control subjects. The reasons for difference in tooth wear site may relate to the increase in consumption of dietary acids reported by the combined group. Wear on buccal and palatal tooth surfaces has been associated with dietary acids by a number of researchers and is generally accepted as a cause and effect relationship.[20,23] The results of Spearman correlation showed a significant relationship between tooth wear score on the occlusal and cervical surfaces in both the control and the combined tooth wear groups and emphasized that wear was present on both surfaces. The most likely explanation for this is the widespread and multifactorial nature of erosive tooth wear. The absence of any relationship in the bruxist group supports the interpretation that occlusal and cervical wear are not causally related in bruxists.

Lee and Eakle[1] suggested that alternate bending forces on the tooth surface resulted in abfraction lesions. If this hypothesis is correct, the bruxist subjects might have been expected to show deeper and more frequent cervical lesions than the other two groups, but there was no statistical difference between the groups, and no relationship between occlusal and cervical tooth wear as seen in the other groups. The bruxist group all reported parafunctional activity (as did five controls) but less intake of acidic foods and drinks. The association of occlusal forces and cervical wear was investigated in a clinical study by Piotrowski et al.[8] These researchers compared occlusal contacts to cervical wear lesions in 32 US veterans and observed no correlation. The evidence from this study also did not support the abfractive theory and indicates that other causes are probably responsible for the development of cervical wear lesions. Other studies have supported the association between cervical and occlusal wear as more likely to be multifactorial;[9,10] however, one study on 2707 adults reported higher odds ratios (1.9) for the development of cervical wear lesions and the presence of occlusal wear.[24]

What is difficult to explain is the finding in the present study that the actual number of lesions was not statistically different between groups, but both the combined and bruxist groups had deeper lesions than the controls. One possible explanation may be the role of dietary acids as both the bruxists and combined group had higher consumption of acidic foods. The controls also had a higher frequency of toothbrushing than either of the other groups, which seems to eliminate this factor as a possible cause. Therefore, there may be a predisposition in many patients to develop cervical wear as they age, but an increased risk of developing deeper lesions with more acidic diets.

Another possibility is that abfraction is common among all groups. The selection of pure bruxists was aimed to investigate those subjects with high occlusal forces, and theoretically they were more likely to develop abfraction. As this study observed, all groups had similar levels of cervical wear. What then is the cause of the tooth wear seen along the cervical margin? It is almost certainly multifactorial, which really means no one is sure of the cause.

Conclusion

At present, the detailed knowledge of how acids interact with attrition and abrasion is not fully understood. In time, our knowledge may answer these questions, but using the evidence from this study, it seems doubtful that high occlusal forces led to increased cervical wear. Whether abfraction exists cannot be determined from this study, but the results add to the doubt. Further clinical research is needed to investigate this topic, as much of the previous research has been derived from laboratory studies.

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