Stress, Anticipatory Stress, and Psychologic Measures Related to Sleep Bruxism

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This study examined (1) the relationships between electromyographic-measured nocturnal bruxism, self-reported stress, and several personality variables, and (2) the relationship between belief in a stress-bruxism relationship and self-reported stress. One hundred adult bruxers completed a battery of personality questionnaires, indicated whether they believed in a stress-bruxism relationship, presented for a dental examination, and had dental impressions taken. Subsequently, electromyographic measurements of bruxing frequency and duration were recorded for fifteen consecutive nights. Prior to each night's measurements, subjects indicated their levels of stress for the immediately preceding 24 hours. No overall relationship was established between electromyographic measures and the personality variables nor between electromyographic measures and self-reported stress. Correlations between electromyographic measures and self-reported stress were statistically significant for eight individual subjects. Further, subjects with high levels of stress reported more anxiety, irritability, and depression, and less denial. Subjects who believed in a stress-bruxism relationship reported greater stress.
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Sleep bruxism, which is defined as nonfunctional tooth contact during sleep, continues to have an unknown etiology.[1,2] Investigators have suggested that local dental, systemic, and/or psychologic factors may play a role in the expression of the disorder, but the relative importance of these variables remains unclear. While the importance of occlusal and anatomic factors in explaining the etiology and maintenance of the temporomandibular disorders, in general, and bruxism, in particular, has been challenged,[3–7] there is diverse evidence that suggests that bruxing behavior during sleep is a centrally mediated problem.[2,8–11]

To what degree psychologic variables impact the central expression of sleep bruxing, and just how they may do that, has yet to be determined. Some research has provided evidence that psychologic variables such as anxiety, hostility, and intrapunitive reactions to frustrating situations are significantly correlated with bruxing behavior.[12–14] Conversely, other research suggests that bruxers are normal individuals without higher levels of anxiety, hostility, or frustration.[15–17] Emotional stress is one common factor that has often been linked to increased bruxing behavior.[18–23]

Funch and Gale[24] studied one patient's self-reported stress levels over 69 days and found a significant relationship between high anticipatory stress (ie, for the day following sleep bruxing measurement) and the subject's bruxing activity measured by electromyograph (EMG). Their results indicated that high anticipatory stress was the

best predictor of bruxing activity and that high stress preceding bruxing measures was not predictive of EMG-measured bruxing activity.[24] Another study of 58 sleep bruxers provided evidence of a negative relationship between EMG-measured sleep bruxing and subjectively perceived same-day stress estimates.[25]

It remains unclear as to how and to what degree psychologic variables such as stress impact upon the central expression of bruxing behavior. At a most basic level, two items are unclear. Is stress a factor perceived by all or only some sleep bruxers? How does perceived stress relate to sleep bruxing behavior? The aim of this study was to examine the relationship between sleep bruxism, self-reported stress, and a number of personality variables. A specific goal of the study was to examine the correlation between perceived daily stress level and EMG-measured sleep bruxism.

Materials and Methods

Subjects

Participants were 100 residents of the greater Buffalo, New York, metropolitan area who were subjects in a bruxism treatment outcome study.[26] Subjects were selected from 350 bruxers who were either referred by their dentists or were respondents to a newspaper announcement. Selection criteria included:

1. A self-reported history of bruxism
2. Current bruxing activity verified either by someone else hearing them brux or by the presence of wear facets consistent with the bruxism disorder
3. Measurable EMG activity indicating bruxism during sleep

Only one subject was omitted from the study because the minimum baseline criterion of 1.0 mean bruxing episode per hour was not met. Subjects' ages ranged from 18 to 72 years with a mean age of 38. Sixty-five women and 35 men completed the study.

Procedure

At the initial visit, each subject read and signed an informed consent form, completed a medical history and psychologic measures, had a dental/head-and-neck examination, and had dental impressions taken. Standard psychometric instruments were administered to measure:

1. Trait anxiety (Taylor Manifest Anxiety Scale[27] and Profile of Mood State[28])
2. Depression (Pilowsky Depression Scale[29] and Profile of Mood State[28])
3. Denial and irritability (Illness Behavior Questionnaire[30])
4. Health locus of control (Multidimensional Health Locus of Control Scales[31])

During the initial interview, each subject also indicated whether he/she believed bruxing behavior was or was not stress related. All interviewing was completed by the same clinician.

During the second visit, each subject was trained in the use of a portable EMG monitor, which measures bruxism-related EMG activity above a 20 μV threshold in the home environment.[23] A detailed description of the procedure for these subjects' EMG recordings is described elsewhere.[26] The EMG provided bedside tape recordings of the number of bruxing episodes per hour slept (frequency) and of bruxing activity in terms of seconds per hour slept (duration). Subjects were instructed to obtain 15 consecutive nights of EMG recordings for baseline evaluation. Regular appointments were scheduled to monitor the use of the portable EMG. There are a number of issues that are related to the advantages and disadvantages of surface EMG that could affect outcome. These issues are addressed by the study design[26] but are not discussed here because they have been adequately reviewed previously.[32,33] The reliability and validity of the portable EMG used for this study has been previously documented.[26,34]

Immediately before commencing each night's EMG sleep evaluation, the subjects recorded their levels of stress for the prior 24-hour period. Stress was measured on a Likert scale of 1 to 5 according to the method used by Funch and Gale,[24] with 1 indicating no stress present and 5 representing the highest level of stress possible. Subjects returned their baseline tape recordings and stress ratings after the 15th night of recording. They were then randomly assigned to receive various treatments, the results of which were published previously.[26,35]

Data Analysis

Power analyses indicated that with a sample size of 100 and a significance level of 0.05, power of 0.80 or greater is obtained for correlation coefficients larger than .25 in absolute value. Correlations of this magnitude represent small to medium effect sizes, or larger, as defined by Cohen.[36]

Eta coefficients were calculated for correlation of nominal variables with continuous variables, and Pearson's product-moment correlation coefficients were obtained for correlations between quantitative variables. Eta correlations were calculated for the average of all subjects' stress ratings (Likert 1 to 5 scale) for each individual night versus *(1)* prior-night bruxing frequency and duration averages (anticipatory stress variable), *(2)* same-night bruxing frequency and duration averages, and *(3)* following-night bruxing frequency and duration averages.

To more closely replicate Funch and Gale's findings,[24] Pearson's product-moment correlation coefficients were calculated for each subject's 24-hour stress ratings (Likert 1 to 5 scale) and that subject's EMG values. The subjects' stress ratings were correlated with their *(1)* immediately subsequent (same night) bruxism EMG frequency and duration values, and *(2)* prior night bruxism EMG frequency and duration values (anticipatory stress relationship). Sidak calculations were made to provide a more stringent significance level as a correction for computing multiple correlations.

Pearson's correlation coefficients were also calculated to compare the individual's belief that bruxing activity is or is not stress related (determination made during initial history) to *(1)* mean self-reported stress (Likert 1 to 5 scale), *(2)* mean EMG-measured frequency of bruxing activity, and *(3)* mean EMG-measured duration of bruxing activity. In addition, Pearson's correlation coefficients were computed between psychometric scale measures (Taylor Manifest Anxiety Scale, Profile of Mood State, Pilowsky Depression Scale, Illness Behavior Questionnaire, Multidimensional Health Locus of Control Scales) and overall subject means of *(1)* stress ratings, *(2)* frequency of bruxing, and *(3)* duration of bruxing.

Results

The sample mean for the baseline EMG measures of bruxing episodes per hour was 16.7. The individual subject means for bruxing episodes per hour ranged from 1.4 to 67.6 at baseline.

Across the entire subject population, no correlation was found between baseline EMG measures of bruxing activity and personality variables (ie, scores obtained from the five psychometric instruments). Likewise, there was no statistically significant total subject sample correlation between self-reported stress and EMG measures of bruxing activity. This was true for both the same-night and following-night EMG variables as well as for the anticipatory stress variable. However, when the data obtained for individual subjects were examined, there were a number of interesting results.

Table 1 Statistically Significant Correlations Between Self-reported Stress Ratings for 24 Hours Immediately Preceding EMG Measurements of Bruxism (Pearson's *r*) and Frequency and Duration of Bruxing

Subject number	Frequency of bruxing	Duration of bruxing
1	.94*†	.95*†
14	NS	.67**
16	−.64**	−.63**
22	−.81**	−.82**
27	.65**	.59**
38	.63**	.61**
39	−.54**	NS
61	.84*†	.82*†
66	.80*†	.84*†
68	−.63**	−.76*†
76	.67**	.70**
89	.63**	.67**
92	NS	.58**

*$P < .01$
**$P < .05$
†$P < .05$ after Sidak correction
NS = Not statistically significant.

Seven subjects reported a positive relationship (ranging from $r = .63$ to $r = .94$) between self-reported stress for the 24 hours immediately preceding the EMG measurements of bruxism (stress variable) and frequency of bruxing (Table 1). Four subjects, on the other hand, reported a negative relationship (ranging from $r = -.54$ to $r = -.81$) between the same variables. As noted in the table, conservative Sidak corrections indicated that three of the seven positive correlations and none of the four negative correlations were statistically significant.

Nine subjects reported a positive relationship (ranging from $r = .58$ to $r = .95$) between self-reported stress for the 24 hours immediately preceding the EMG measurements of bruxism (stress variable) and duration of bruxing (Table 1). Three subjects reported a negative relationship (ranging from $r = -.63$ to $r = -.82$) between the same variables. Conservative Sidak corrections indicated that only three of the positive and one of the negative correlations were statistically significant.

The relationship between self-reported stress for 24 hours following the beginning of nightly EMG measurements (anticipatory stress variable) and the EMG measurements was also examined. The data reveal that four individuals reported a positive correlation (ranging from $r = .62$ to $r = .90$)

Table 2 Statistically Significant Correlations Between Self-reported Stress Ratings for 24 Hours Following the Beginning of EMG Measurements of Bruxism (Pearson's *r*) and Frequency and Duration of Bruxing

Subject number	Frequency of bruxing	Duration of bruxing
2	.90*†	.90*†
34	NS	.79*†
40	.71**	.63**
56	NS	−.61**
58	.62**	NS
71	NS	.83*†
76	NS	.61**
87	.66**	.65**
92	NS	.74*†

*$P < .01$
**$P < .05$
†$P < .05$ after Sidak correction
NS = Not statistically significant.

Table 3 Statistically Significant Correlations Between Self-reported Stress Ratings and Measures of Anxiety, Irritability, Depression, and Denial

Characteristic (instrument)	Self-reported stress
Anxiety (Taylor Manifest Anxiety Scale)	.32*
Irritability (Illness Behavior Questionnaire)	.22**
Depression (Pilowsky Depression Scale)	.26*
Denial (Illness Behavior Questionnaire)	−.28*

*$P < .01$
**$P < .05$

between self-reported stress for 24 hours following the beginning of EMG measurements and frequency of bruxing (Table 2). Only one individual, however, maintained a statistically significant relationship between these variables after the Sidak correction ($r = .90$). Further analyses of the data obtained for individual subjects revealed a statistically significant relationship between self-reported stress for the 24 hours following the beginning of EMG measurements and the duration of bruxing. Seven subjects reported a positive relationship (ranging from $r = .61$ to $r = .90$); one subject reported a negative relationship ($r = -.61$). Only four of these anticipatory stress/duration correlations proved statistically significant when conservative Sidak calculations were applied.

Although there was no overall indication of a relationship between sleep bruxism EMG measures and a variety of personality variables, the data did reveal statistically significant relationships between several personality variables and self-reported stress (Table 3). That is, subjects with higher levels of self-reported stress were more likely to report higher levels of anxiety ($r = .32$), irritability ($r = .22$), and depression ($r = .26$); those reporting less stress were more likely to report higher levels of denial ($r = -.28$).

Finally, the data reveal that as the subjects' belief in a stress-bruxism relationship (determined during initial history) increased, their subsequent self-reports of stress increased as well ($r = .22$).

Discussion

Bruxism has been described by many theorists as a response to anxiety or stress.[1,22,23,37,38] Some experimental evidence, however, suggests that bruxing behavior may precede anticipated stressors—at least among some individuals.[24,39] This study attempted to more generally evaluate the statistical significance of the relationship between sleep bruxing behavior and self-perceived stress by substantially increasing the number of subjects beyond Funch and Gale's single subject.[24] Although our sample was 100 times larger than that of Funch and Gale, there was no evidence to support an overall group relationship between stress and EMG-measured bruxing activity. This held true despite the temporal relationship between stress and the EMG measures.

Subsequently, the relationship between each individual subject's stress and EMG-measured sleep bruxing activity was evaluated. Only a few subjects had an increased bruxism response related to high same-day stress. Also, only four of 97 subjects exhibited a discernible relationship between EMG-measured bruxing and next-day stress (anticipatory stress variable). Thus, these data support only a very weak link between perceived stress and bruxing activity.

This outcome appears to be consistent with the finding of Clark et al[25] that high bruxing activity is likely to be related to a lack of awareness regarding stressful life events. In this context, it is interesting that those bruxers who reported less stress were also somewhat more likely to report higher levels of denial. Independent data on bruxers also support the view that bruxers deny symptoms at a significantly higher rate than the general population.[40] In the current study, however, the high denial/low stress relationship was rather weak; only 5% of the variance was accounted for by the denial variable. Since subject belief in a stress-bruxism relationship was also only very weakly

related to subsequent self-report of daily stress and because only a few individuals had a demonstrable stress-bruxism relationship, it appears unlikely that self-perceived daily stress is a major factor in sleep-bruxing behavior. This is not to say that bruxing activity is not related to stress, but it might indicate that *(1)* bruxers are not very aware of the stressful nature of daily events, and/or *(2)* they minimize the personal impact of life events.

Although the present study did not demonstrate a statistically significant group correlation between EMG-measured bruxing activity and psychologic variables, our data suggest that some individuals veridically associated increasing stress with increasing bruxing behavior. It is also apparent that there were far more individual bruxers who did not reliably make that stress-bruxing association. This failure to make a reliable stress-bruxing association occurred despite the fact that there was a measurable positive relationship between higher self-reported stress and bruxer anxiety, irritability, and depression levels. These individual differences may be related to differences in coping styles.

The purpose of exploring coping mechanisms is to provide a useful taxonomy of coping styles to help explain the relationship between adaptive and maladaptive outcomes. For instance, several studies have provided evidence that a Type A behavior pattern is correlated with bruxing behavior.[20,22,41] Type A behavior is, in a general sense, a coping style that can be characterized as an extreme desire to control life events.[42] Since life events do not always yield to such control, the Type A individual is likely to encounter periods of extreme stress. Given the right combination of predispositional variables (social, psychologic, biologic, and situational), this stress could be expressed, at least hypothetically, as sleep bruxism. In their constant quest for control, Type A individuals are evidently unaware of, ignoring, or denying the internally and externally induced stresses that result from their coping style. The existence of a low level of stress awareness for Type A bruxers may be supported by our finding that higher denial scores were related, albeit weakly, to lower perceived stress levels.

While it is generally accepted that sleep bruxism is mediated via the central nervous system,[2] the role played in the mediation process by psychologic variables such as experienced life stress remains unclear based on the present study and that of others.[15–17,25] If knowledge related to personality variables and coping strategies such as the Type A behavior pattern is to have an impact on the understanding, diagnosis, and treatment of psychophysiologic disorders such as bruxism, more research addressing the relative importance of psychologic variables in the expression of these disorders is needed. To date, the data suggest that the relationship between psychologic variables and the expression of bruxism is more complex than a simple cause-and-effect relationship motivated by perceived life stress.

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Resumen

Estrés, estrés anticipador, y medidas psicológicas relacionadas al bruxismo durante el sueño

Este estudió examinó: *(1)* las relaciones entre el bruxismo nocturno medido por medio de electromiografía, el estrés auto-reportado, y diversas variables de la personalidad, y *(2)* la relación entre la creencia de una relación bruxismo-estrés y el estrés auto-reportado. Cien adultos que bruxaban, completaron una serie cuestionarios de personalidad, e indicaron si ellos creían en la relación entre el bruxismo y el estrés. Estas personas también recibieron un examen dental y se les tomó impresiones dentales. Subsecuentemente, se registraron medidas electromiográficas de la frecuencia y duración del bruxismo, por quince noches consecutivas. Cada noche antes de realizar las medidas electromiográficas, las personas indicaron los niveles de estrés correspondientes a las 24 horas anteriores. No se estableció una relación general entre las medidas electromiográficas y las variables de personalidad, ni tampoco entre las medidas electromiográficas y el estreés auto-reportado fureon significativas, en el caso de ocho individuos. Además, las personas con niveles de estrés altos presentaron mas ansiedad, irritabilidad y depresión, y menor rechazo. Las personas que creían en la relación entre el bruxismo y el estrés se quejaron de mayor estrés.

Zusammenfassung

Stress, Stressbereitschaft, und psychologische Messungen verbunden mit nächtlichem Bruxismus.

Diese Studie prüfte *(1)* die Beziehungen zwischen elektromyographisch gemessenem nächtlichem Bruxismus und einigen Persönlichkeitsvariablen und *(2)* die Beziehung zwischen dem Glauben an einen Zusammenhang zwischen Stress und Bruxismus und dem subjektiven Stress. 100 erwachsene Bruxer füllten eine Reihe von Persönlichkeitsfragebogen aus, gaben an, ob sie an einen Zusammenhang zwischen Stress und Bruxismus glaubten und wurden zahnärztlich untersucht. In der Folge wurden elektromyographische Messungen der Bruxismusfrequenz und -dauer während 15 aufeinanderfolgenden Nächten vorgenommen. Vor jeder Nacht gaben die Personen den Grad ihres Stresses in den vorangehenden 24 Stunden an. Es wurde kein gesamthafter Zusammenhang zwischen den elektromyographischen Werten und den persönlichen Variablen und auch nicht zwischen den elektromyographischen Werten und dem subjektiven Stress gefunden. Eine Korrelation zwischen den elektromyographischen Werten und dem subjektiven Stress war signifikant bei acht Personen. Weiter berichteten Personen mit viel Stress über mehr Ängstlichkeit, Irritierbarkeit, Depressionen, und weniger Verneinung. Personen, welche an einen Zusammenhang zwischen Stress und Bruxismus glaubten berichteten über grösseren Stress.