Assessment of buccal separators in the relief of bruxist activity associated with myofascial pain-dysfunction

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Bruxism may be considered one predisposing sign of myofascial pain-dysfunction (MPD) syndrome which is often thought to result from multiple causative factors. These causative factors may include psychologic, emotional, dental, systemic, occupational and/or idiopathic elements.[1] The effects of bruxism are multiple and diverse and include temporomandibular joint pain and dysfunction, head and neck pain, muscle pain and spasms, tooth wear, mobility and damage to supporting structures.[1-3]

Current treatment for bruxism and myofascial pain-dysfunction include biofeedback, splint therapy, massed negative practice, aversive conditioning, psychological counseling, pharmacological therapy, and hypnosis. In studies of the different types of treatment no method has surfaced as a cure for bruxist activity.

The literature apparently contains only one publication that evaluates the effects of buccal separators on the relief of TMJ pain and symptoms.[4] The evidence presented in that paper was based on clinical observation and did not include objective measurement of signs and symptoms of bruxism or MPD. In addition, the author proposed several etiological factors for TMJ dysfunction — including stress, bruxing, clenching habits, muscle spasms and balancing interferences — which may initiate or intensify the pain signal.[4]

The purpose of this study was to objectively determine the effects of buccal separators in the relief of muscle tenderness and bruxist activity as measured by self-reporting, muscle palpation and EMG recordings in subjects diagnosed with bruxism associated with myofascial pain.

Abstract

The purpose of this study was to evaluate the effectiveness of heavy (S2) Alastik separators in relieving bruxist activity as monitored through masseter muscle area EMG activity, muscle palpation, and self-reporting in 21 Caucasian subjects. The subjects, all of whom suffered from both bruxism and myofascial pain-dysfunction, were randomly assigned to one of three groups: experimental (separator group); placebo (separator placed and removed); and control groups (no separator).

The findings from this study indicate that there were no observable differences in either subjective or objective responses to the pretreatment versus posttreatment questionnaire and clinical examination for tooth clenching or grinding, facial pain, and fatigue of the jaws. In addition, no statistical differences were found between pre and posttreatment data. The EMG data did not show any statistical differences between pretreatment and posttreatment evaluations or among the 3 groups.

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Key Words

Bruxism • Myofascial pain-dysfunction • Separators

Table I
Demographic data for the treatment group, placebo group and control group (n=21)

	n	Sex Male	Female	$\bar{X}$ Age
Treatment Group	7	2	5	31
Placebo Group	7	2	5	29
Control Group	7	0	7	27

Materials and methods

Subjects

A total of 21 patients, 18 years of age or older, were included in this study (Table I). Male and female patients who presented with myofascial pain-dysfunction syndrome associated with nocturnal bruxism were selected through self-referral from a local newspaper advertisement. The patients were required to meet all the following predetermined criteria in order to be selected for this study: 1) 18 years of age or older; 2) a self-reported history of nocturnal bruxism; 3) bruxing currently, or heard to brux by someone else; 4) reported pain in the masticatory muscles of 6 months or longer; and 5) confirmation of bruxism and muscle tenderness by the principal investigator through the use of an initial screening examination.

The average age for the sample group was 29 years (range 19-42 years). The subjective questionnaire data indicated that all 21 subjects had experienced grinding and/or clenching of the teeth and sore jaw muscles for at least 1 year. Eight of the 21 subjects had been previously treated for bruxism by a general dentist but were not receiving treatment when the study began. None of the 7 subjects in the experimental group had ever been treated for bruxist activity, whereas 5 subjects in the placebo group and 3 subjects in the control group had received prior splint therapy treatment by a general dentist.

Procedure

The 21 patients were randomly divided into three groups. The experimental group consisted of 7 patients who initially had a heavy (S2) separating Alastik (Unitek, Monrovia, Calif.) placed between the second premolar and first molar in the maxillary quadrant having the most palpable muscle pain. The patient was then asked whether the pain felt better or worse. This question was asked every time a separator was either placed or removed. If the patient's response was "worse", the separator was removed and placed in the next contact area distally. Again, the patient was asked whether the pain felt better or worse. This was done in all cases. If the patient responded "better", then that separator was left in place and another separator (maximum of two separators) was placed in the next contact area distally for a period of 14 days.

The second group (placebo) consisted of 7 patients. As with the experimental group, a separator was placed between the second premolar and first molar in the maxillary quadrant exhibiting the most muscle pain, but in this case it was immediately removed. The patients were informed that this procedure alone would be sufficient to relieve bruxist activity and MPD. It was felt that this aspect of the experimental design would control for the placebo effect that can accompany mere reassurance and suggestion of a treatment effect.[5] The third group (control) of 7 patients did not receive any separators, but was monitored for masseter area muscle activity in the same manner as the other two groups.

Subjective assessment of muscle pain, bruxism and mood factors

Subjects were asked to answer questions on a 12-item anamnestic questionnaire designed to determine any signs or symptoms of muscle tenderness, pain and bruxist activity. "Yes" or "no" responses were recorded for each subject at pretreatment and posttreatment times. Additionally, each subject was asked to complete the Profile of Mood State (POMS) in order to characterize the group with respect to affective status.[6] The POMS is a 65-item factor analyzed adjective rating scale that provides independent scores for each of six factors: tension-anxiety; depression-dejection; anger-hostility; vigor-activity; fatigue-inertia; and confusion-bewilderment.

Objective assessment of muscle pain

Each subject was clinically examined before and after treatment by the principal investigator and by an independent examiner. The examination consisted of bilateral palpation of the following muscles: 1) the posterior part of the temporalis muscle (extra-orally); 2) the anterior part of the temporalis muscle (extra-orally); 3) the masseter

muscle (extra- and intra-orally); 4) the area superficial to the lateral pterygoid muscle (intra-orally); and 6) the medial pterygoid muscle (intra-orally).

For each muscle area palpated, myofascial pain was recorded on a scale of 0-3: Zero (0) indicated no pain; 1 indicated mild pain; 2 indicated moderate pain and 3 indicated severe pain. The definition of mild pain was associated with phrases such as "it hurts a little bit" or words such as dull, sore, and tender; the definition of moderate pain was associated with phrases such as "it hurts a lot," or words such as aching and annoying; and severe pain was defined with such words as ouch, excruciating or unbearable pain. If there was a discrepancy between the ratings obtained by the two investigators for the specific muscle(s) area palpated, a third independent judge palpated the muscle area. The most discrepant rating was discarded and the closest two ratings were averaged to obtain the final score.

Objective assessment of bruxist activity

Alternative methods for the objective assessment of bruxist activity include oral examination,[7-8] evaluation of dental casts,[9] measurement of occlusal forces[10] and EMG evaluation.[7,11,12] The reproducibility and validity of the modified BF-100-EMG recording device in assessing muscle hyperactivity associated with bruxing has been demonstrated.[12,13,14] This EMG has high validity coefficients and high intrajudge and interjudge reliability ($r = 0.93\text{-}0.99$; $p < 0.001$) with respect to measuring frequency of bruxing per hour and duration of bruxing per hour.[12,14] These data led us to conclude that the modified BF-100-EMG unit was the best available means of quantifying bruxing incidents for this study.[12,13,14]

Each subject's bruxism was thus monitored at home during sleeping hours with the portable electromyographic recording device (Modified BF-100-EMG).[13] The EMG unit recorded masseter muscle activity for two time periods: 7 nights of pretreatment baseline; and 7 nights of posttreatment evaluation.

Each subject's bruxing activity was quantified as bruxing episodes per hour (EMG frequencies) and as duration of bruxing activity per hour (EMG durations). Scoring was accomplished by counting the number of times the tape recorder was activated (turned on) each night (resulting from muscle activity above the 20μV EMG threshold), and dividing by the number of hours slept, as recorded by the patient. Thus the frequency of bruxing episodes per hour was obtained per a previously standardized technique.[14] Duration of bruxing per hour was determined by timing the nightly taping interval, and then dividing the total bruxing time per night by the number of hours slept per night.[14]

Table II
Subjective pretreatment and posttreatment questionnaire responses indicating bruxism and/or symptoms of myofascial pain

	Pretreatment		Posttreatment	
	No.	%	No.	%
Grinding during sleeping hours	18/21	90.0	16/21	80.0
Grinding during waking hours	3/21	15.0	3/21	15.0
Clenching during sleeping hours	21/21	100.0	19/21	91.0
Clenching during waking hours	17/21	85.0	12/21	51.0
Sore jaw muscles upon waking	19/21	91.0	16/21	76.0

Statistical analyses

The prevalence of signs and symptoms of muscle tenderness between the three groups (buccal separator group, placebo group, and control group) was reported in a descriptive fashion using McNemer chi-square statistics.[15] T-Tests for independent groups were used to evaluate POMS scale scores with respect to established normative data. The determination of bruxist activity as measured by EMG frequencies and by EMG durations were analyzed by two-way ANOVAs for pretreatment and posttreatment measurements. Intrajudge and interjudge reliability for the objective examination were analyzed using Pearson's correlation coefficient.

Results

Questionnaires

Evaluation of the anamnestic questionnaire was conducted prior to the initial investigation to determine how well the questions would be understood by the subjects. The evaluation involved the reading of the questions by the investigator to 10 subjects other than those participating in this study. The results from the evaluation determined that all 10 subjects were able to answer the questionnaire without difficulty.

Descriptive statistics were used for both time periods, 7-night pretreatment baseline and 7 nights posttreatment. The results of the pretreatment and posttreatment questionnaires (subjective responses) for bruxism and signs and/or symp-

Table III
Overall prevalence of objectively evaluated symptoms pretreatment and posttreatment

	Pretreatment No.	%	Posttreatment No.	%
TMJ Clicking	6/21	29.0	8/21	38.0
Deep Masseter	16/21	76.0	11/21	52.0
Pterygoids Lateral	19/21	91.0	16/21	76.0
Pterygoids Medial	18.21	86.0	15/21	71.0

Table IV
Overall prevalence of objectively evaluated symptoms of painful mandibular movements pretreatment and posttreatment

	Pretreatment No.	%	Posttreatment No.	%
Opening	6/21	29.0	3/21	14.0
Protrusion	8/21	38.0	4/21	19.0
Right Lateral	10/21	48.0	8/21	38.0
Left Lateral	7/21	33.0	8/21	38.0

toms of myofascial pain are summarized in Table II. T-Tests on POMS scale scores indicated that the 21 subjects studied were not significantly more anxious, depressed, hostile, fatigued or confused than a sample of normal college students.

Clinical examination

A test for reliability of the clinical examination was conducted prior to the initial investigation by both the principal investigator and the independent examiner for signs and/or symptoms of myofascial pain in 10 subjects other than those participating in this study. A possible total of 150 muscle areas were palpated by the main investigator and the first independent examiner and there was agreement between the two examiners in 147 (98%) areas palpated.

In the actual study, of 42 pretreatment and posttreatment examinations conducted by the principal investigator and the second independent examiner, only five examinations required a third independent examination.

Interpretation of the objective examination demonstrated that all 21 subjects presented clinical evidence of attrition, which was determined by wear facets on the anterior and/or posterior clinical crowns. McNemer tests were performed to determine if there were any significant differences in relief of muscle tenderness across time for all 21 subjects combined.[15] Since no statistical differences were found between the two time periods for all findings on the objective examination, only descriptive statistics are mentioned. Table III illustrates the percentage distribution of clicking of the TM joint(s) and of tenderness of the masticatory muscles to palpation for both pretreatment and posttreatment examinations.

Table IV demonstrates the overall prevalence of objectively evaluated symptoms of painful mandibular movements pretreatment and posttreatment. For each mandibular movement, except when the patient was asked to move the mandible to the left, there was a decrease in the prevalence of reported symptoms of pain within the jaw muscle(s).

Table V demonstrates the subject distribution of TMJ clicking, muscles tender to palpation and pain on movement of the mandible for subjects who had the symptoms only pretreatment, only posttreatment, or pre- and posttreatment. Of the 3 subjects who improved, 1 was from the treatment group, 1 was from the placebo group and 1 was from the control group. Table III also demonstrates subject distribution for pain on movement of the mandible. Similar results were found as with muscle palpation. However, when the patients went into left lateral excursion, 4 subjects reported pain pretreatment only and 5 additional subjects reported pain only at the posttreatment time.

Objective examination for bruxism

Intra-rater and inter-rater reliabilities were calculated for the quantification of EMG measured bruxing episodes per hour from audio tapes. Intra-rater reliability for the single rater was very high (r = 0.99) and inter-rater reliability for two examiners was very high (r = 0.98).

Individual subject means of bruxing episodes per hour for subjects in all 3 groups ranged from 6.8 - 81.5 at baseline to 6.6 - 47.5 posttreatment. The individual subject mean durations of bruxing activity in seconds per hour for subjects in all 3 groups ranged from 2.9 to 34.5 at baseline and from 1.9 to 48.2 at the posttreatment evaluation. Group means for the treatment, placebo, and control groups are illustrated in Figures 1 & 2.

Interpretation of the ANOVA on EMG frequencies between all 3 groups indicated no main effect for the pretreatment dimension [$F = 0.84$, $df = (2,18)$, $p < 0.45$]. No main effect was found across time (first 7 nights versus the second 7 nights), [$F = 3.6$, $df = (1,18)$, $p < 0.07$], nor was there a group x time interaction [$F = 0.44$, $df = (2,18)$, $p < 0.65$]. For EMG duration, interpretation of the ANOVA also indicated no main effect for the pretreatment dimension [$F = 2.04$, $df = (2,18)$, $p < 0.16$] and no significant effect across time [$F = 0.48$, $df = (1,18)$, $p < 0.85$]. No group x time interaction was observed [$F = 0.17$, $df = (2,18)$, $p < 0.85$]. These data were also analyzed by means of analysis of covariance using the baseline as the covariate. Results demonstrated that treatment outcomes were not affected by variations in baseline data.

Table V
Subject distribution of TMJ clicking, muscles tender to palpation, and pain on movement of the mandible

	Pre- and posttreatment signs & symptoms				
	None	Pre-Only	Post-Only	Pre- & Post	Total
TMJ					
Clicking	12	1	3	5	21
Muscle Palpation					
Deep Masseter	5	5	0	11	21
Lateral Pterygoid	1	4	1	15	21
Medial Pterygoid	2	4	1	14	21
Mandibular Movements					
Opening	14	4	1	2	21
Protrusion	13	4	0	4	21
Right Lateral	9	4	2	6	21
Left Lateral	9	4	5	3	21

Discussion

General

Interpretations of these data do not support the results of Mintz[4] which suggest that buccal separators are a treatment method for relieving signs and symptoms of myofascial pain-dysfunction. According to Mintz, who provides anecdotal information on 1 patient, separator treatment may be used for patients who experience muscle tenderness of the masticatory muscles, particularly the lateral pterygoids, TMJ clicking and possibly parafunctional habits such as bruxism. Several authors have reported that parafunctional habits (bruxing) may be a predisposing factor in the development of pain or tenderness in the region of the masticatory muscles.[16-20] Therefore, this investigation was designed to more objectively evaluate whether a cause-and-effect relationship exists between separator treatment and the reduction of signs and/or symptoms of bruxism and myofascial pain-dysfunction. Relief of muscle tenderness and bruxist activity was determined by EMG recordings, muscle palpation, and self-report for 3 groups of subjects (treatment, placebo and control groups). The criteria and method used in this study were similar to Mintz's protocol. One notable difference was that this investigation used chronic bruxers (1 year or longer) who presented muscle tenderness, whereas Mintz's subjects had acute symptoms. In addition, this investigation involved a questionnaire, a clinical examination and multiple EMG recordings of bruxist activity. In contrast, Mintz based his findings on self-report alone.

Anamnestic evaluation

Using anamnestic methods to assess the subjective responses of the sample group, the frequency of symptoms of dysfunction proved high for both pre- and posttreatment evaluations as compared to other studies.[9,21,22] There are limitations when using a self-administered questionnaire.[23] One possible limitation is that the subjects may have difficulty understanding the meaning of a question regarding TMJ dysfunction.[23] In order to rule out this possible limitation the principal investigator read each question to the subjects in order to prevent any confusion regarding their comprehension of the questions answered.

Clinical examination

As reported in the results, a higher percentage of

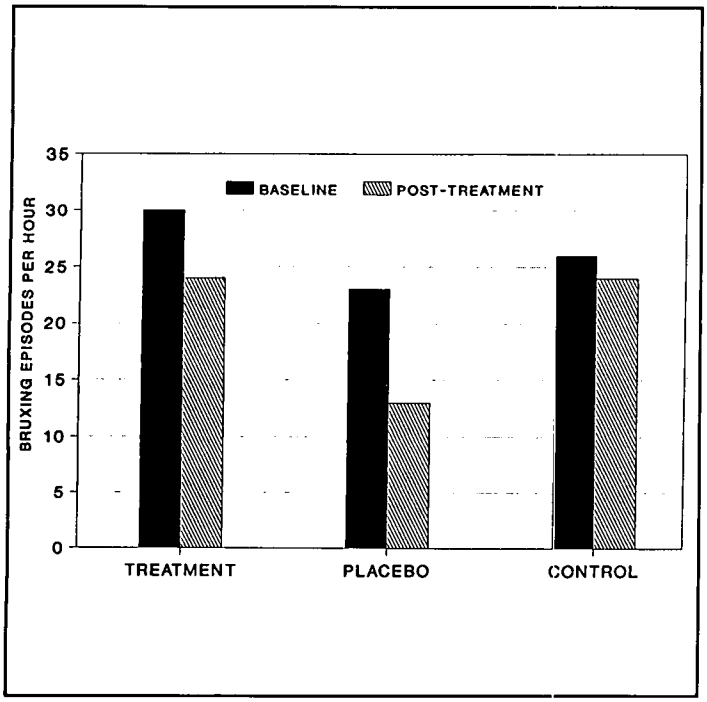

Figure 1

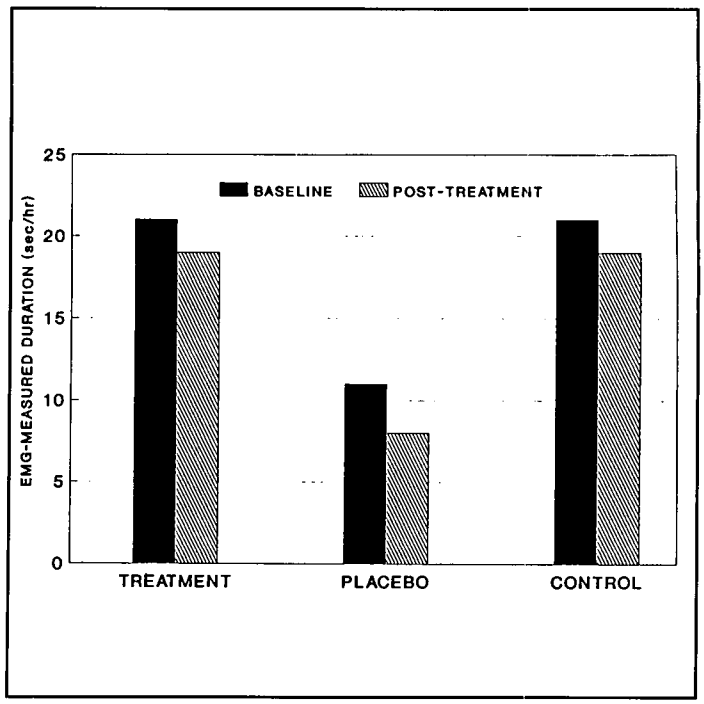

Figure 2

Figure 1
Mean EMG-measured bruxing episodes per hour in treatment, placebo and control groups x time (baseline, posttreatment).

Figure 2
Mean EMG-measured duration (sec/hr) of bruxing activity in treatment, placebo and control groups x time (baseline, posttreatment).

the subjects in this study reported tenderness of the lateral and medial pterygoid muscles when palpated and a lower percentage reported tenderness of the masseter muscle. Haber[27] proposed that increases in masticatory muscle tenderness accompanies parafunctional activities such as bruxism. This investigation supports the literature which indicates that the masticatory muscles that are most commonly tender to palpation are the masseter, lateral pterygoid and medial pterygoid muscles.[16,24-27] Although the quoted studies also report tenderness of the temporalis muscle, the current investigation found the temporalis muscle to be uncharacteristically asymptomatic for all 21 subjects. The high percentage of muscle tenderness of the lateral and medial pterygoid muscles could be due to difficulties encountered by the main investigator and the independent examiner in palpating these muscle areas. A comparison of the current study with Haber's study suggests that the lateral pterygoid muscles, which are muscles commonly found to be tender in MPD, are difficult to palpate. This may be attributed to anatomical and mechanical factors in palpations. One way the author of this study controlled for this error was to standardize the palpation technique for all 3 examiners (primary investigator, second examiner and third examiner). The third independent examiner was needed 11% of the time even though training sessions were conducted prior to this investigation. The overall objective findings reported in this study demonstrated that the maximum number of changes of muscles tender to palpation or from mandibular movements observed over time was 9 out of 21 subjects. This maximum number of changes occurred when the patients went into left lateral excursions.

Findings from EMG data

Findings from the EMG data for all 3 groups demonstrated no significant change in EMG-measured duration (sec/hr) and in EMG-measured bruxing episodes per hour. This supports the literature by Gentz[10] who was unable to eliminate bruxism with a splint which also recorded occlusal force, and contradicts that by Fuchs[28] who recorded EMG during sleep and found increased activity in MPD patients which reduced to the level of control patients after splint therapy. Several other studies have reported successful decreases in bruxing behavior after subjects were treated with splint therapy or nocturnal feedback.[12,29-31] Pierce and Gale[12] reported that when the treatment was withdrawn, the bruxing returned to baseline levels. Although these studies used treatment methods different from those in the present investigation, the results of this study preliminarily support the conclusion that 2-week separator treatment, unlike splint therapy and nocturnal biofeedback, provides no significant EMG-measured treatment effect beyond the placebo effect. Although no statistically significant differences were found among all 3 groups, one explanation for the lack of effect may lie in the nature of the population treated, and not with any particular aspect of the treatment.

Summary

This cross-sectional, prospective study was conducted in the Department of Orthodontics at the University of Pittsburgh School of Dental Medicine. Although the present investigation was a prospective, cross-sectional study, it was limited to 21 randomly selected subjects. A larger sample size would help neutralize the effects of extrinsic factors such as age, sex and race. Having equally matched samples of men and women would allow for a greater design precision as well as more meaningful comparisons. Since some researchers believe that bruxing activities may vary considerably over time, longer baseline EMG evaluation periods could be sampled in a future study. Also, treatment effects could be measured during treatment as well as pre- and posttreatment and long-term follow-up of treatment effectiveness could be evaluated. Conducting future studies concerning the effectiveness of buccal separators in relieving signs and/or symptoms of bruxism and myofascial dysfunction is probably of questionable benefit. One study that might have value would be the evaluation of counter irritancy hypothesis proposed by Mintz.[4] In addition, if treatment effects were found for buccal separators, then future research should include a comparative study of separators and more traditional treatments such as splint therapy, biofeedback, aversive conditioning, and drug therapy in relieving signs and/or symptoms associated with bruxism and myofascial pain-dysfunction.

Conclusions

1. There was no statistical difference between pretreatment and posttreatment subjective evaluation of bruxist activity and myofascial pain-dysfunction for all three groups as determined through self-report;

2. There was no statistical difference between pretreatment and posttreatment objective examination of bruxist activity and myofascial pain-dysfunction for all three groups as determined through muscle palpation;

3. There was no statistical difference among groups and across time in the relief of bruxist activity as monitored through EMG masseter muscle area activity;

4. Overall objective findings indicate that the maximum number of observed changes in muscles originally tender to palpation was 9 per the 21 subjects. Four subjects improved and 5 subjects worsened when comparing baseline data to posttreatment data; and

5. This study does not substantiate the success of buccal separators in relieving signs and/or symptoms of bruxist activity and myofascial pain-dysfunction.

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