

Research Article

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The Effects of EMG Biofeedback Training Upon Nocturnal and Diurnal Bruxing Responses

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INTRODUCTION

Bruxism, which has been described as a psychophysiological disorder, has been a major concern for dentistry (Glaros and Rao, 1977a). It is estimated that between five and twenty percent of the population are bruxists (Glaros, in press; Reding et al., 1966). Numerous physical symptoms have been reported to occur as a result of bruxism. These include tooth wear and mobility, damage to the periodontium, temporomandibular joint disturbances, hypertrophy of the masseter muscle, and facial and head pain (Glaros and Rao, 1977b). Hence, bruxism, which is exhibited by a substantial portion of the population, can cause severe physical dysfunction.

Recent studies have indicated that biofeedback assisted relaxation training of the masseter muscle may be an effective treatment for bruxism (Budyanski and Stoyva, 1973; Rugh et al., 1977). This procedure generally involves six to twelve half hour sessions where the individual learns to reduce EMG muscle activity. In addition to monitoring EMG levels, self-reports of muscle fatigue and pain, and clinical evaluations of dentition and jaw disturbances are obtained. Results of these studies have shown a positive relationship between decreasing EMG levels and the reduction of reported symptoms (Dohrman and Laskins, 1978; Stenn et al., 1979; Carlsson et al., 1975; Gessel, 1975; Solberg and Rugh, 1972).

A major difficulty of these studies, however, has been the lack of direct assessment of nocturnal bruxing responses. Reding et al. (1968) stated that diurnal and nocturnal bruxism are distinct phenomena. Analogously, Olkinura (1969, 1972) has suggested that bruxism should be differentiated into two types: "non-strain" bruxists who exhibit nocturnal grinding independent of stress, and "strain" bruxists who exhibit diurnal clenching when stressed. Glaros (in press) identified a third category of individuals who exhibit both diurnal and nocturnal response patterns.

A further difficulty is that nocturnal bruxism has been shown to be a highly variable response which is more resistant to treatment than diurnal bruxism (Funch and Gale, 1980; Rugh, 1978). Rugh (1978) suggested that the substantial variability in masseter muscle activity recorded over successive nights was due to changes in daily stress. Additionally, extended observations of nocturnal bruxing patterns have revealed that bruxing responses increase to pretreatment intervention (Baily and Rugh, 1979; Rugh, 1978).

The direct assessment of nocturnal bruxism appears to be a critical factor for objectively determining the effectiveness of treatment procedures.

The present study investigated the effects of daytime biofeedback training upon EMG activity and nocturnal responses.

METHOD

Subjects

Four adult subjects (2 males and 2 females), ages 23 to 55, were selected by a periodontist on the basis of bruxing criteria (see below). All subjects were diagnosed as chronic bruxists and volunteered to participate in the study. In addition to the periodontal exam, each subject completed a self-report questionnaire which surveyed the subject's awareness of bruxing and related facial pain. Biofeedback recording and training sessions were completed in a private clinic in a professional medical building.

Responses of Interest

Masseter Muscle EMG (μ v)

EMG activity of the right masseter muscle was monitored at each session. Muscle tension levels were recorded by an Autogenic 1100 biofeedback unit (accurate to 0.2 μ v) and displayed on a digital meter by an Autogenic 5100 integrator (accurate to .3% of output). EMG recordings consisted of ten, thirty second intervals spaced throughout the session with a 30 second rest between each interval.

Nocturnal Bruxism

A "bruxscore monitor" (Forgione, 1974) was employed to record nocturnal bruxing responses (grinding activity). This monitor was worn by each subject for 4 consecutive nights (Monday-Thursday) each week throughout the study. Scoring procedures were similar to those employed by Forgione (1974).

Clinical Observations

A periodontist examined each subject before and after treatment conditions. Subjects were evaluated for tooth wear facets, tooth mobility, maximum mouth opening (mm), pain reported upon palpation of the masseter muscles, and masseter muscle hypertrophy.

Procedures

EMG activity and nocturnal bruxism were monitored for 3 weeks prior to biofeedback training. EMG levels were measured once per week in a session lasting approximately 20 minutes and consisting of ten separate 30 second EMG meter readings. During these baseline sessions subjects were simply requested to "sit quietly." Total weekly nocturnal bruxing was measured by the bruxscore monitor. One monitor was worn for each 4 night period per week.

After 3 weeks of baseline evaluation the subjects underwent biofeedback training. A 30 minute training session was repeated four times per week for three consecutive weeks. During the training sessions subjects were instructed in biofeedback procedures and given audio and visual feedback regarding masseter muscle tension. Bruxscore devices were worn at night during this phase to provide a continuous index of bruxism throughout the study. Additionally, subjects were instructed to engage in a brief relaxation exercise immediately prior to sleeping and at least once per day.

Following the training programs subjects returned to the office for three follow-up visits at one week, one

month, and six weeks after training. These consisted of 20 minute EMG monitoring without feedback and four nights of wearing the bruxscore monitor. Subjects again returned to the periodontist for a final clinical evaluation after the last follow-up session.

RESULTS

Figure 1 displays the average EMG level (μv) at each training session for all subjects. The EMG data show that each subject significantly reduced baseline EMG levels subsequent to the biofeedback training. Furthermore, two of the four subjects (S-3 and S-4) maintained the downward trend throughout the follow-up portion of the study while two subjects (S-1 and S-2) exhibited a slight increase in muscle tension levels toward pretreatment baseline readings.

Nocturnal bruxscore responses for each subject are presented in Figure 2. Only S-3 exhibited a reduction in nocturnal bruxing following biofeedback training. Bruxscore responses for the other subject remained at or higher than pretreatment levels during treatment and follow-up conditions. The bruxscores achieved by S-1 throughout the study were substantially lower than

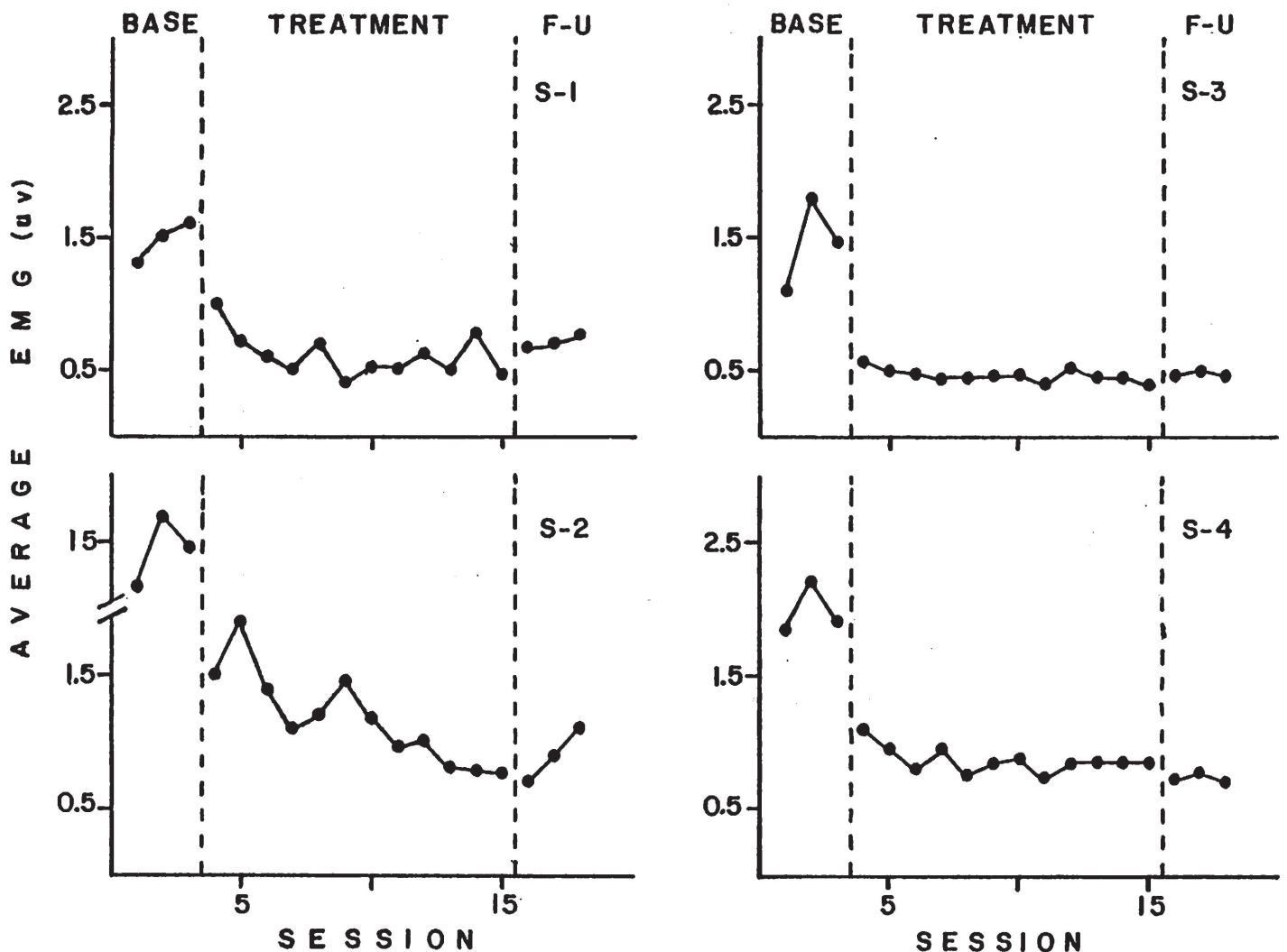


Figure 1 Average EMG (μv) recordings from each session for each subject over successive phases of the study. During baseline and followup (F-U) conditions the subjects did not receive feedback.

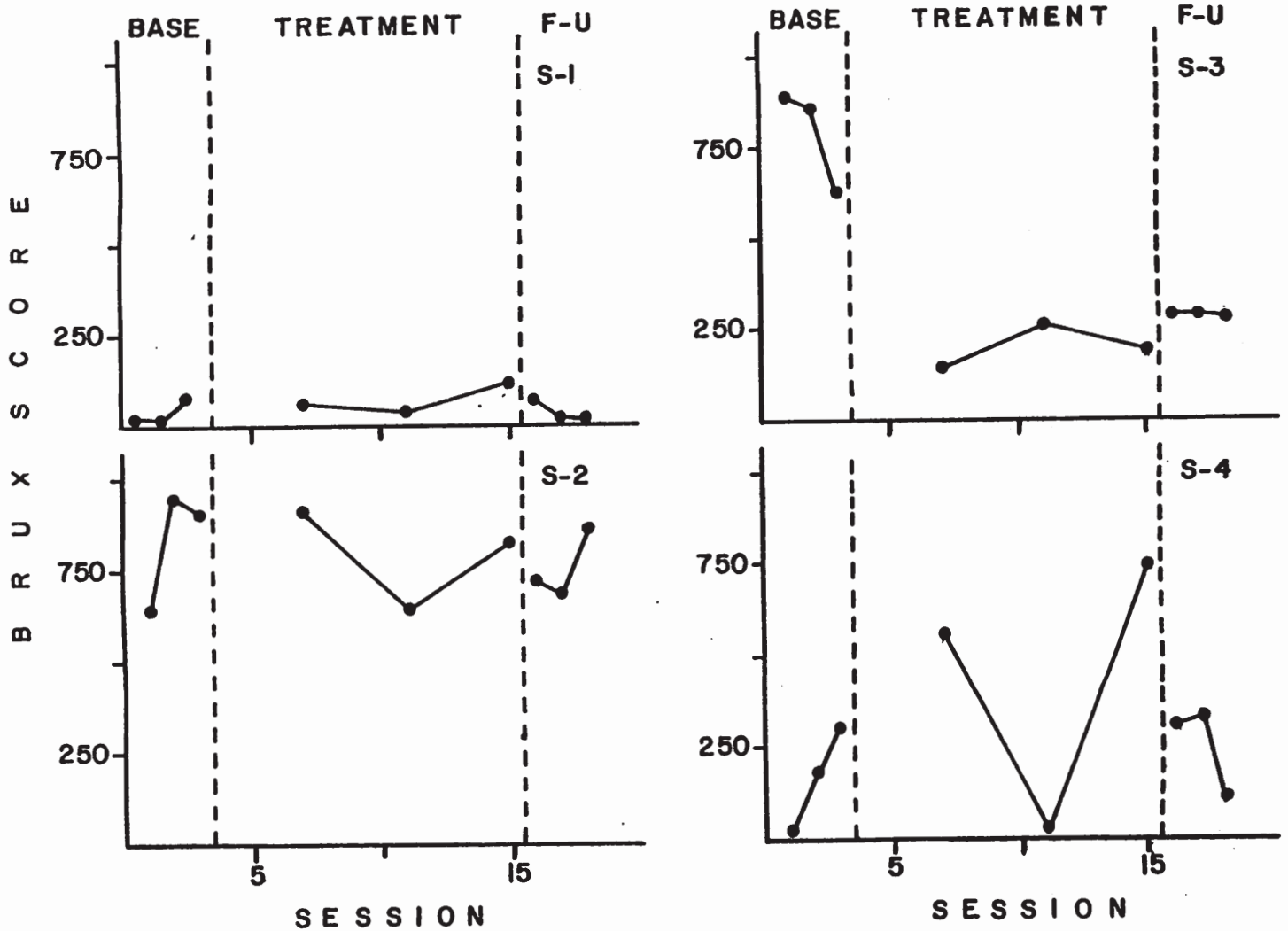


Figure 2 Total weekly bruxscore obtained from each subject over successive phases of the study. The monitoring appliance was worn for four consecutive nights during each weekly period.

those typically obtained by "true bruxers" (Heller and Forgione, 1975).

Posttreatment periodontal examinations revealed decreased tooth mobility for all subjects, with two individuals (S-1 and S-4) experiencing significantly greater stability, i.e. two or more increments of change on a six point scale. Three of the subjects (S-1, S-2, S-3) also revealed increases in maximum mouth opening ranging from 1 to 4 mm. No other changes were observed in the remaining clinical symptoms (tooth wear, hypertrophy, palpation pain) for any of the subjects except for a reported decrease in palpation pain for S-3.

Figure 3 displays the self-reported data regarding bruxing awareness, pain severity, and pain duration which was recorded prior to and following biofeedback training. The pain observed by each subject related to the jaw and facial muscles. All subjects reported an increased awareness of diurnal clenching following the training and stated that this awareness enabled them to control the clenching response. One subject (S-4) stated that nearly all clenching had been eliminated due to this awareness. Three subjects (S-1, S-3, S-4) indicated a decrease in both pain severity and duration

at the follow-up observation. S-2 reported a substantial decrease in pain duration but no change in severity.

DISCUSSION

Biofeedback training resulted in a reduction of muscle activity which corresponded to both clinical and self-reported improvements of symptoms. These observations correspond to previous studies which have evaluated daytime biofeedback training upon bruxing symptoms (Dohrman and Laskins, 1978; Gessel, 1975; Soldberg and Rugh, 1972; Stenn, et al., 1979). These studies have all reported a relationship between the acquisition of muscle relaxation concurrent with self-reported and clinically diagnosed improvements. Furthermore, this effect tends to be consistent for a majority of subjects.

Although improvements in symptoms were reported following training, corresponding changes in nocturnal bruxing were observed for only one subject. Several researchers have suggested that nocturnal and diurnal bruxism are distinct phenomena (Reding, et al., 1968; Okinara, 1972) and that specific treatment for each type may be required (Glaros, in press). Thus, this

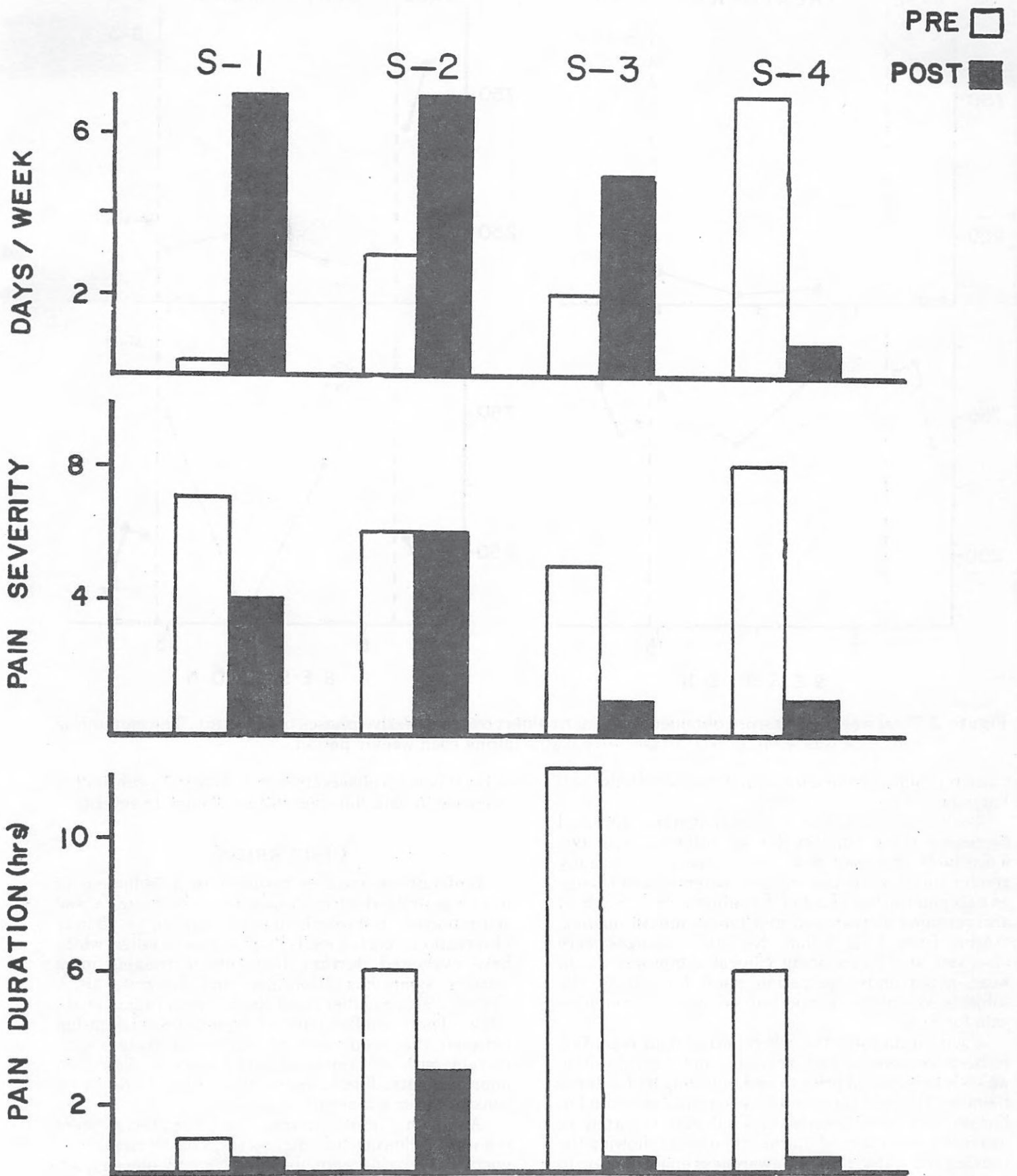


Figure 3 Self-reported symptoms of bruxing frequency and pain severity and duration reported by each subject prior to and following biofeedback training.

lack of correspondence seen in the present study may possibly be the result of this distinction. Other studies which have directly evaluated the effects of nighttime biofeedback training upon nocturnal bruxism provide further support for these assumptions (Beemsterboer, et al., 1978; Funch and Gale, 1980; Heller and Strang, 1973; Clarke and Kardochi, 1977). These studies indicate that nocturnal bruxing appears to be more resistant to treatment such that removal of conditioning procedures typically results in a return of bruxing activity to pretreatment levels (Rugh and Johnson, in press).

A possible explanation for the successful reduction in reported symptoms in the present study may be that the subjects were both diurnal and nocturnal bruxists where diurnal bruxing was specifically related to the occurrence of symptoms. Glaros (in press) classified bruxists into three categories: exclusively nocturnal, exclusively diurnal, or both nocturnal and diurnal. He reported that diurnal bruxism appears to be predominant and hypothesized that "stress management" may be an effective treatment approach for diurnal activity. In this study all four subjects reported aspects of diurnal symptoms. In addition, the relaxation training was an essential component of "stress management" procedures. Anecdotal information substantiated the role of stress in altering at least the nocturnal pattern for two subjects. These two individuals who were students exhibited low bruxscores for the same week following midterm exams. The failure of previous studies which utilized daytime biofeedback training to successfully reduce reported symptoms for all bruxists, may have been due to the differences in nocturnal and diurnal response patterns. Typically these studies did not report differentiating between these two groups.

In general the results of the present study indicate that biofeedback-trained relaxation of the masseter muscle can reduce bruxing-related symptoms. The change in symptoms appeared to be related to a reduction in diurnal clenching activity. Further research is needed to determine the relationship between nocturnal and diurnal bruxing and specific treatment procedures.

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REFERENCES

- Bailey, J. D. and Rugh, J. D. (1979). Behavioral management of functional disorders. In Bryant, P., Gale, E., and Rugh, J. (eds.), *Oral Motor Behavior: Impact on Oral Conditions and Dental Treatment*. NIH Publ. No. 79-1845. Government Printing Office, Washington, D.C., pp. 160-178.
- Beemsterboer, P. L., Clark, G. T., and Rugh, J. D. (1978). Treatment of bruxism using nocturnal biofeedback with an arousal task. *J. Dent. Res.* 57: 366.
- Budyanski, T. and Stoyva, J. (1973). An electromyographic feedback technique for teaching voluntary relaxation of the masseter muscle. *J. Dent. Res.* 52: 116-119.
- Carlsson, S. G., Gale, E. N., and Ohman, A. (1975). Treatment of temporomandibular joint syndrome with biofeedback training. *J. Am. Dent. Assoc.* 91: 602-605.
- Clarke, N. G. and Kardachi, B. J. (1977). The treatment of myofacial pain-dysfunction syndrome using the biofeedback principle. *J. Periodontol* 48: 643-645.
- Dohrman, R. J. and Lasking, D. M. An evaluation of electromyographic biofeedback in the treatment of myofacial pain-dysfunction syndrome. *J. Am. Dent. Assoc.* 96: 656-662.
- Forgione, A. G. (1974). A simple but effective method of quantifying bruxing behavior. *J. Dent. Res.* 53: 127.
- Funch, D. P. and Gale, E. N. (1980). Factors associated with nocturnal bruxism and its treatment. *J. Behav. Med.* 3: 385-397.
- Gessel, A. H. (1975). Electromyographic biofeedback and tricyclic antidepressants in myofacial pain-dysfunction syndrome: Psychological predictors of outcome. *J. Am. Dent. Assoc.* 91: 1048-1052.
- Glaros, A. G. and Rao, S. M. (1977). Bruxism: A critical review. *Psych. Bull.* 84: 767-781.
- Glaros, A. C. and Rao, S. M. (1977b). Bruxism and its effect on the teeth. *J. Prosth. Dent.* 38: 149-157.
- Heller, R. F. and Forgione, A. G. (1975). An evaluation of bruxism control: Massed negative practice and automated relaxation training. *J. Dent. Res.* 54: 1120-1123.
- Heller, R. F. and Strang, H. R. (1973). Controlling bruxism through automated aversive conditioning. *Behav. Res. Ther.* 11: 327-329.
- Olkinura, M. (1969). Bruxism, a review of the literature, and a discussion of studies of bruxism and its psychogenesis and some new psychologic hypotheses. *Suom Hammaslaak Toim* 65: 312.
- Olkinura, M. (1972). A psychosomatic study of bruxism with emphasis on mental strain and familiar predisposition factors. *Suom Hammaslaak Toim* 68: 110-123.
- Reding, G. R., Rubright, W. C., and Zimmerman, S. O. (1966). Incidence of bruxism. *J. Dent. Res.* 45: 1198-1204.
- Reding, G. R., Zepelin, H., Robinson, J. E., Zimmerman, S. O., and Smith, V. H. (1968). Nocturnal teeth-grinding: All night psychophysiological studies. *J. Dent. Res.* 47: 786-797.
- Rugh, J. D. (1978). Electromyographic analysis of bruxism in the natural environment. In Weinstein, P. (ed.), *Advances in Behavioral Research in Dentistry*, University of Washington Press, Seattle.
- Rugh, J. D. and Johnson, R. W. Temporal analysis of nocturnal bruxism during EMG feedback. *J. Periodontol.* (in press).
- Rugh, J. D., Perlis, D. B., and Disraeli, R. I. (eds.) (1977). *Biofeedback in Dentistry*. Semantodontics of Phoenix, Phoenix, AZ.
- Solberg, W. K. and Rugh, J. D. (1972). The use of biofeedback devices in the treatment of bruxism. *J. So. Cal. Dent. Assoc.* 40: 852-853.
- Stenn, P. G., Mathersill, K. J., and Brooke, R. I. (1979). Biofeedback and a cognitive behavioral approach to treatment of myofacial pain dysfunction syndrome. *Beh. Ther.* 10: 29-36.