Occlusal Splint Effects on Nocturnal Bruxing: An Emerging Paradigm and Some Early Results

Abstract

A 35-year-old, female, bruxist patient underwent two series of occlusal-splint, nonocclusal-splint, and no-splint phases of treatment. During each phase, a portable unit worn at home recorded the frequencies, durations, and amplitudes of electromyogram-defined nocturnal bruxes. Both splints produced dramatic and repeated reductions in the frequency of nocturnal bruxing. Neither splint affected the durations or amplitudes of bruxes. This article briefly discusses possible mechanisms underlying the splint effects and some research directions.

Jeffrey E. Cassisi, M.A.

Mr. Cassisi received his bachelor's degree in psychology from the University of Florida in 1979 and his master's degree in experimental psychology from the University of Hawaii in 1981. He completed his internship at the Veterans Administration Medical Center of Pittsburgh in 1985.

He is co-author of a chapter on the diagnosis and treatment of bruxism. He has carried out research on biofeedback, the measurement of dental fear, the measurement of bruxism, and the treatment of shyness.

Mr. Cassisi is presently a Ph.D. candidate in the Department of Clinical Psychology at the University of Florida and serves as a consultant for the Dental Occlusion and Facial Pain Center of the University of Florida College of Dentistry.

F. Dudley McGlynn, Ph.D.

Dr. McGlynn received his Ph.D. in clinical psychology from the University of Missouri in 1968. He has taught at the University of Missouri and at Mississippi State University. For the past six years, he has served as professor in the College of Dentistry and the Department of Clinical Psychology at the University of Florida in Gainesville. Dr. McGlynn is doing research on facial pain, on compliance with prescribed dental regimens, and on fear/avoidance of dentists.

Dr. McGlynn is a member of the Southeastern Psychological Association and the Association for the Advancement of Behavior Therapy. He is the author of numerous research articles, chapters, and reviews, and he serves on the editorial boards of four national journals.

Parker E. Mahan, D.D.S., Ph.D.

Dr. Mahan received his D.D.S. degree from Emory University School of Dentistry in 1955, and in 1964 he earned his Ph.D. in physiology from the University of Rochester School of Medicine and Dentistry. He has taught at Emory University and the University of Florida at Gainesville, where he has served as chairman of the Department of Basic Dental Sciences. He is currently director of the Dental Occlusion and Facial Pain Center of the University of Florida College of Dentistry. He is also a visiting faculty member for the L.D. Pankey Dental Institute, and he serves as a consultant in physiology to the Veterans Administration.

Dr. Mahan is a member of the American Dental Association, the American Association for the Advancement of Science, the American Equilibration Society, the International Association of Dental Research, and other societies. He has also served as chairman of the American Dental Association Council on Dental Research.
Occlusal Splint Effects on Nocturnal Bruxing: An Emerging Paradigm and Some Early Results

By Jeffrey E. Cassisi, M.A., F. Dudley McGlynn, Ph.D., Parker E. Mahan, D.D.S., Ph.D.

McGlynn et al. described the development of a new technology for measuring nocturnal bruxing in the natural environment. The numbers, durations, and mean amplitudes of suprathreshold masseteric electromyogram (EMG) events during sleep are used to characterize nocturnal bruxist activity. One purpose of this article is to present the first data produced by the new technology.

McGlynn and Cassisi argued that valuable information about occlusal-splint therapy can be acquired by taking repeated measures from individual patients as they are exposed systematically to different splint conditions. In that paper, hypothetical data were used to illustrate the logic of the “intrasubject replication” experimental design. A second purpose of this article is to document the value of intrasubject research by providing actual bruxing data from a single patient exposed sequentially to occlusal splint and no-splint phases.

Greene and Laskin reported that 40% of 71 facial pain/dysfunction patients improved with the use of an intraoral appliance that did not directly alter tooth contacts or mandibular positioning. Their data were in the form of patient self-reports; hence, the meaning of the result is obscure. A third purpose of this article is to describe the effects of a nonocclusal splint on nocturnal bruxing.

For this study, one bruxist patient was exposed to two series of occlusal-splint, nonocclusal-splint, and no-splint phases. During each phase, nightly frequencies, durations, and intensities of EMG-defined bruxes were recorded.

Method

Subject

The subject was a 35-year-old, divorced, self-employed, white female. She was prompted to seek treatment by a 10-year history of intense facial pain episodes that occurred approximately twice a year. The subject reported that she “ground” her teeth while sleeping and that she often awoke with “a stiff jaw,” “sore teeth,” and “headaches.” Clinical examination (by P.E.M.) revealed medial pterygoid tenderness on palpation, TMJ clicking, and mild periodontitis. There was no arthritis, bony joint damage, or systemic disease, and only the third molars were missing. The clinical examination and splints were provided free of charge in return for the subject's experimental participation.

Apparatus and Response Measurement

The development of the EMG amplifier/recorder has been described elsewhere, and a detailed description of the unit and related computer software is in preparation. Briefly, the portable unit records on a minicassette tape the occurrence of masseteric EMG signals that exceed an adjustable \( \mu V \) threshold established by firm interocclusal contact. A high precision crystal clock marks the tape at 15-minute intervals to allow approximate real-time tracking. The tapes are played, on a minicassette player, back into an IBM Personal Computer where each recorded EMG

This research was supported by a Biomedical Research Support Grant from the University of Florida College of Dentistry.

* IBM Personal Computer—IBM Corporation, Danbury, Connecticut.
signal is tallied and sampled at the rate of 100 times per second to produce digitized frequency and amplitude data. The computer also digitizes the duration of each suprathreshold EMG signal. Therefore, the data obtained with the system include the numbers of suprathreshold EMG (bruxing) episodes per unit of time, the duration of each episode, and the average EMG amplitude during the episode.

An illustrative computer printout is reproduced in Table 1. In this experiment, only the variable bruxing frequency yielded visually meaningful results; the data for brux durations and amplitudes are omitted.

The occlusal splint used was a full arch maxillary stabilization splint with even posterior stops in centric relation and anterior guidance for all excursive movements. The splint was shaped to extend lingually around the alveolar arch, leaving most of the palate open. It produced 1.5 mm of separation between the second molars.

The nonocclusal splint was formed lingual to the arch of teeth in the same manner as the lingual portion of the occlusal appliance. However, the acrylic ended at the occlusal-lingual line angle and did not interfere with occlusion or with any excursion. The two splints are pictured in Figure 1.

### Table 1

<table>
<thead>
<tr>
<th>Brux number</th>
<th>Average microvolts</th>
<th>Time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59.29487</td>
<td>0.48 seconds</td>
</tr>
<tr>
<td>2</td>
<td>69.87179</td>
<td>0.24 seconds</td>
</tr>
<tr>
<td>3</td>
<td>43.39623</td>
<td>0.53 seconds</td>
</tr>
<tr>
<td>4</td>
<td>61.61496</td>
<td>0.98 seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brux number</th>
<th>Average microvolts</th>
<th>Time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brux number</th>
<th>Average microvolts</th>
<th>Time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.83351</td>
<td>0.73 seconds</td>
</tr>
<tr>
<td>2</td>
<td>64.50742</td>
<td>1.14 seconds</td>
</tr>
<tr>
<td>3</td>
<td>30.40293</td>
<td>0.21 seconds</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**Procedure**

The subject was trained to position two prepared Bard pediatric ECG monitoring electrodes† (catalog No.: 160340) over her right masseter according to Lippold's criteria.* She also demonstrated proper use of the amplifier/recorder twice and rehearsed the correct electrode placement twice before leaving the office. The subject was instructed to use the unit for three successive nights and to return the tapes on the fourth day. The first three tapes were computer-analyzed to determine whether the subject did indeed display significant nocturnal bruxing.

The tapes showed that the subject bruxed frequently during the three nights of recording, and she was invited to return. Impressions for splint fabrication were taken, and the subject resumed (baseline) monitoring of bruxing using the unit. The subject

† Bard Pediatric ECG Monitoring Electrodes—Bard Critical Care Division, Billerica, MA 01821.
was told that "two types of splints" would be tried. Once the occlusal and nonocclusal splints were fabricated, the subject was to monitor her bruxing at least five nights a week and was exposed to the following sequence of conditions: nonocclusal splint, occlusal splint, no splint, occlusal splint, nonocclusal splint, no splint. Given that a baseline (no splint) period preceded these phases, the sequence comprised an ABCACBA intrasubject replication design in which each condition lasted approximately one week. Data for the second baseline period were recorded during two weeks because equipment malfunction forced a delay.

Results and Discussion

Data from the first 15 minutes of each nightly tape were omitted. Figure 2 shows the number of suprathreshold EMG events (bruxes) per hour for each of 42 nights. Both splints produced dramatic and repeated reductions in the frequency of bruxing when compared to the three no-splint phases. There is no obvious difference between the effects of the two splints on bruxing frequency. As noted earlier, the effects of the splint conditions on brux durations and EMG amplitudes were not visually discrimina-ble from the effects of no-splint phases. (Graphic displays of nightly brux durations and amplitudes during each of the seven experimental phases are available on request.)

The reduced bruxing frequency produced by the occlusal splint can be explained in several ways, depending on one's preferred etiological theory. For example, if occlusal interferences are held to be precursors to bruxing, then the splint effect can be viewed as reflecting the removal of interferences via interposing an occlusally perfected acrylic surface between the teeth.

The reduced bruxing frequency produced by the nonocclusal splint can be viewed as a placebo effect because the appliance did not directly alter tooth contacts or mandibular positioning. The beneficial effects of the nonocclusal splint used by Greene and Laskin have frequently been interpreted in this way. However, as Greene and Laskin noted, the effects of nonocclusal splints can be explained also as reflecting a stomatognathic alteration. Young has shown that placement of a 2.5-mm thick acrylic palatal appliance will increase interocclusal distance (freeway space) even when the appliance does not cover the teeth. The author postulated that mechanical displacement of the tongue inferiorly 2.5 mm served to posture the mandible inferiorly and produce inter-occlusal separation. The nonocclusal splint used here covered the palate just lingual to the teeth and encroached on lateral tongue space. Hence, the reduced bruxing frequency produced by the nonocclusal splint might reflect a stomatognathic adjustment of the type Young described.

The results of intrasubject replication experiments

![Graph]

Figure 2
Hourly frequency of bruxing for each of 42 nights.
portray the behavior of individuals with a resolution that is lost when subjects are studied in groups.\textsuperscript{3,4} For the subject studied here, the occlusal and non-occlusal splints clearly reduced bruxing frequency dramatically and equivalently. One implication of this finding is that the “placebo effect” on facial pain reported by Greene and Laskin\textsuperscript{5} might have mirrored the effects on bruxing of indirect occlusal separation. However, results from intrasubject replication experiments must be accumulated across subjects before the generality of particular findings can be established. Additional research is needed to delineate the boundary conditions of this finding.

\textit{Reprint requests to:}
\textbf{Jeffrey E. Cassisi}
\textit{Dental Occlusion and Facial Pain Center}
\textit{Box J-437}
\textit{Gainesville, Florida 32610}

\textbf{References}


