

A Study of the electronic information monitoring of bruxism[☆]

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Abstract

Objective: Bruxism is the term used for teeth grinding or jaw clenching. An electronic monitor of bruxism was developed to evaluate bruxism duration and frequency. **Methods:** Ten cases were selected in the Department of Prosthodontics of Jiangsu Stomatological Hospital to evaluate the monitor. A stabilization occlusal splint was fabricated for each of the 10 cases. The vertical dimension for each splint was 0.5 mm lower than mandibular postural position. Some sensors had been prearranged at each splint which could transfer the variation of the biting force into electronic signals. The data of sleeping duration, grinding duration and grinding frequency were recorded with this new type of bruxism monitor, which had been specifically invented to study bruxism. **Results:** The data from 10 bruxism cases were collected and the results were considered reliable. Subjects nocturnal duration parameters did not change significantly from night-to-night. **Conclusion:** The bruxism monitor can automatically measure and record bruxism data using an occlusal splint. This device is valuable for diagnosis and evaluation of bruxism.

Key words: Bruxism; Occlusal splint; Electronic information monitoring

INTRODUCTION

Bruxism has been defined as the grinding or clenching of teeth at other times than for mastication of food^[1]. People have not confirmed the etiology of bruxism^[2]. However, scholars engaged in such medical subjects as stomatology^[3], psychiatry, psychology^[4] and endocrinology have paid attention to bruxism. There are several therapies for bruxism^[5], including psychotherapy, pharmacotherapy^[6], occlusal adjustment and utilizing occlusal splints^[7,8]. The curative effect on these therapies differs. The occlusal splint is one of the therapies applied more extensively^[9,10]. However, the curative effect of the occlusal splint has been judged by observing the wear pattern on the splint and such subjective parameters as whether the roommates of the patient had heard the sound of grinding. In this study, a new kind of electronic monitor of bruxism was devel-

oped to monitor bruxism patients with an occlusal splint, with the goal of making an objective evaluation of the curative effect of this therapy for clinical reference.

MATERIALS AND METHODS

Components of the instrument

The instrument collects signals through the sensors prearranged at “splint” and then sends the collected signals to the data processing software to record and save the primary data sets of the duration and frequency of grinding of a bruxism patient while sleeping. The instrument consists of “splint”, “sensors” and “data processor”, wherein, the “splint” is an appliance designed for treating bruxism; the “sensors” are sensing elements provided by Yangjiang Chuangye Printed Circuit Center (No. 35, Zhongshan East Road, Nanjing), which can produce electronic signals upon a biting force; and the “data processor” is a monitoring system taking a single chip as its core, which realizes collection, processing, recording and transmission of the bruxism information collected by the sensing elements during the nighttime.

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Functions of instrument(Fig. 1).

The instrument has such functions as “Data Scrubbing”, “Data Acquisition”, “Data Pre-processing”, “Data Recording”, and “Data Transmission”. Wherein, “Data Scrubbing” means to scrub the data saved in the instrument’s memory, preparing the instrument for use on another occasion. “Data Acquisition” means to amplify and convert the signals collected by the sensing elements; “Data Pre-processing” means to perform the preliminarily calculations of parameters such as “Start time of grinding”, “Ending time of grinding”, “Duration time of grinding”, “Longest time of grinding”, “Total time of grinding” and “Times of grinding” in accordance with the initial data obtained; “Data Recording” means to save the measured data into EEPROM(the instrument can realize multiple times of data saving); and “Data Transmission” means to transmit the data saved in the instrument’s memory to a PC through serial ports.

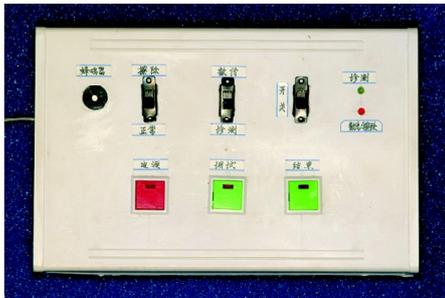


Fig. 1 Electronic Monitor of Bruxism

CLINICAL APPLICATION OF ELECTRONIC MONITOR

Ten self-described bruxism patients(subjects described their symptoms, and their roommates confirmed they had heard the sounds of tooth grinding by these patients) came to Jiangsu Stomatological Hospital from Septem-

ber 2002 to October 2003. All were healthy and apparently free from mental illness, had intact dentition except for the third molar, were not in receipt of adjusting or orthodontic treatment, were free from tooth injury or fracture, a decayed tooth or filling material, and were free from temporomandibular joint symptoms, muscular pain or other symptoms^[11]. Subjects also had moderate eating habits, avoiding hard or acidic foods. The mean \pm SD age of the subjects was 29.1 ± 2.3 years of age and they had a mean bruxism time of 5 years. The degree of wear on their teeth was similar among subjects^[12,13].

Tooth models were made of the upper and lower jaws of each subject and the vertical distance of the rest position was registered with wax. A Stabilization Splint was made(at the upper jaw) according this vertical distance. The plastic surface of “splint” was removed by grinding off 0.5mm and sensors were placed at the positions of the canine teeth of the upper jaw, making the “splint” at a position that was slightly lower than the rest position. The subjects were asked to wear the “splint” when sleeping at night and to record the sleeping time.

The subjects were asked to connect the sensors on the “splint” to the electronic bruxism monitor one week after first wearing the splint and to use it to monitor nocturnal tooth grinding for three successive days.

The grinding data of the 10 patients were collected, reported and statistically analyzed using one way analysis of variance(SPSS software).

RESULTS

The data collected from 10 bruxism patients is summarized in **Table 1** for four parameters, total grinding duration, longest grinding duration, grinding frequency and sleeping time.

Table 1 Average grinding data during three consecutive days after wearing the “splint” for one week

	Total grinding duration(minute)	Longest grinding duration(minute)	grinding Frequency	Sleeping time(hour)
First day	14.30 ± 2.03	2.51 ± 0.61	10.2 ± 1.62	8.05 ± 0.86
Second day	13.86 ± 1.64	2.47 ± 0.96	10.7 ± 2.11	8.25 ± 0.99
Third day	13.70 ± 2.02	2.16 ± 0.52	9.90 ± 1.45	8.54 ± 0.66

There were no significant differences within groups for the four grinding data parameters measured($P > 0.05$), suggesting that the monitoring system provides stable results from day to day and that the subjects’ bruxism behavior is relatively constant.

DISCUSSION

Tooth grinding is a subconscious act and bruxism patients have no awareness of the act when they grind their teeth. Most of them confirm their disease through the statements of their roommates or mates that they

hear the patients bite with great force or grind their teeth during the night. This type of subjective information makes the diagnosis, monitoring and evaluation of the curative effect of any treatment of bruxism^[14] rather difficult. Previously, the disease rate and curative effect evaluation were confirmed through methods such as the patient’s chief complaint, clinical symptom and wearing facet inspection^[15], and there was no objective standard for the comparison of symptoms before and after the treatment. The electronic monitor of bruxism is able to automatically measure and record

grinding data generated by bruxism patients, thus providing correct quantitative indicators for the diagnosis and treatment evaluation of this condition. This device can significantly make the treatment evaluation more objective and assist in the improvement of the design of a “splint”.

Graft^[16] used radio telemetry and found that the functional contact of teeth of a person during chewing and swallowing is about 17.5 minutes in a 24 h period, including 16.2 minutes and 1.3 minutes when the person is conscious and is sleeping, respectively. When asleep, the jaw muscles of a normal person are relaxed, with the lower jaw generally is at the rest position and the teeth of the upper and lower rows have no obvious contact. Grinding and other parafunctional excessive biting will prolong the time of any such contact (14 minutes vs 1.3 minutes). Thus wearing a “splint” with a monitor on its surface at night will not affect the “splint” treatment of bruxism, but it will improve the evaluation of the effectiveness of different “splint” designs. In this way this electronic monitor of bruxism is of great potential value.

Bruxism has a complicated etiology and mechanism, and therapies vary greatly. Treacy^[17] proposed biofeedback therapy, asking bruxism patients to perform self-suggestion, relieve their tension and relax their muscle, which has achieved some clinical effect. The current biofeedback is basically hearing feedback^[18] or vibration feedback^[18]. The electronic monitor of bruxism designed by us has the extra function of giving off a radio signal or vibration signal to make a bruxism patient wake up. The electronic monitor of bruxism makes automatic judgments about the patient's status, depending on the grinding data obtained. It then selectively gives off a signal to make the patient wake up and stop grinding. Therefore, the electronic monitor of bruxism can be used not only for monitoring and studying bruxism but it may also be used for biofeedback therapy^[19,20]. This aspect of the monitor will be studied in future experiments.

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