SHORT-TERM USE OF OCCLUSAL SPLINT IN PATIENTS WITH SLEEP BRUXISM: A CASE-CONTROLLED STUDY

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ABSTRACT

Objectives*: The efficacy of the occlusal splint to reduce sleep bruxism (SB), remains a controversial issue.*

This study aimed to investigate the effect of a short-term occlusal splint therapy in patients with SB, evaluating both the nocturnal electromyographic (EMG) activity of the temporalis muscle through a portable EMG recording device and the migraine SB-related severity and discomfort.

Materials and methods*: Sixty patients with SB were randomized into 2 equal groups, a group treated with an occlusal splint and an untreated control group for a study period of two weeks. EMG activity during sleep was recorded from the right side of anterior temporalis muscle with a portable electromyographic recording device.*

Outcomes of interest were the differences in bruxism activity (number of EMG events/hour) Bruxism length (Second/event) and migraine disability score (MIDAS) between the two groups.

Results*: After the 2-weeks study period the bruxism activity and length decreased significantly ($p = 0.006$ and $p = 0.037$, respectively) as well as the MIDAS grading ($p < 0.05$) in the treatment group compared with control group.*

Conclusion*: Our results suggest that the short-term use of occlusal splint therapy is effective in reducing both SB activity and migraine SB-related discomfort, with a positive and rapid relaxing action of the masticatory muscles.*

Keywords*: sleep bruxism, occlusal splint, migraine,masticatory muscle.*

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Introduction

Sleep bruxism (SB) is defined as a repetitive jaw muscle activity characterized by the clenching or grinding of teeth and/or bracing or thrusting of the mandible during the sleep[(1)].

It is considered as one of the major responsible for various dysfunctions in the orofacial region including dental problems such as tooth wear, the progression of periodontal disease, damage or failure of dental restorations or implants, and musculoskeletal problems such as masticatory muscle hypertrophy and temporomandibular disorders (TMD)[(2)].

Its prevalence is hard to determine as most population studies are usually based on self-reported questionnaires. Anyway it has been reported to be the highest in childhood from 3.5% to 40.6%[(3)] and decreases with age from about 8% in younger adults to about 3% in elderly people[(4)]. The number and duration of the bruxing event during sleep vary greatly with the same patient over time and among the patients, sometimes even on a day-to-day basis, with subjects showing no activity during some nights and intense activity during others[(5)]. Although the etiology and neurological mechanisms which generate SB are not well understood, some studies have proven that central factors, especially sleep-

related aetiological factors, play a major role in the development of SB[6].

Although the use of an occlusal splint does not necessarily eliminate the unconscious clenching/grinding activity[7], it is the most commonly accepted modality among the treatments for SB to date[8]. The efficacy of the occlusal splint to reduce masticatory muscle activity and overall response to occlusal appliance treatment remain controversial because of the lack of strong scientific evidence[9], some study reported decreasing masseter muscle activity in more than 50% of bruxism patients[10]. Conversely, some studies did not show that decrease with long-term observation[11,12], and other studies have shown returns to baseline muscle activity levels in 2 weeks although it decreased immediately after wearing splints[13].

The aim of this study is to compare the differences in electromyographic activity of temporalis muscle and migraine SB-related discomfort in bruxer patients treated with occlusal splint therapy and untreated control patients for a period of 2 weeks.

Materials and methods

We conducted a short-term controlled-random study after fulfilling and getting the approval of the hospital ethics committee. Informed consent was obtained from all patients included in this study, which was conducted between December 2016 and May 2017. We included patients who had a diagnosis of SB based on the criteria from the American Academy of Sleep Medicine (AASM): self-report or report of a family member about grinding or clenching during sleep in combination with at least one of the following conditions: abnormal tooth wear; sounds associated with bruxism; and jaw muscle discomfort[1]. Exclusion criteria were: more than two missing posterior teeth excluding third molars, use of removable prosthesis, periodontal problems, dental pathology, use of medication with possible effects on sleep or motor behavior, ongoing dental therapy including orthodontic treatment, neurological disorder, psychiatric disorder, medical disorder, heart disorder or patient use cardiac pacemaker, pregnant.

Subjects who met all of the inclusion criteria were then randomly allocated into two equal groups. The randomization sequence was created using Stata 9.0 (StataCorp, College Station, TX, USA) statistical software.

The computer-generated random number list was prepared by an investigator with no clinical involvement in the study.

Splint device

For all subjects in the treatment group, an impression of both the maxillary and mandibular arches were taken with ready-made trays and an alginate impression material. Stabilisation splints were made on a maxillary plaster cast mounted on an articulator with the mandibular cast mounted in intercuspal position. They were made of light-cured acrylic resin (Facet resin, GC, Tokyo, Japan). The splint had a smooth surface with 1- to 2-mm thickness in second molar regions and occlusal contacts with mandibular buccal cusps with cuspid guidance. The splint was made for every subject by the same operator (C.V.).

EMG Event Monitoring

EMG activity during sleep was recorded from the right side of anterior temporalis muscle with portable EMG recording device(GrindCare, Medotech A/S, Herlev, Denmark).

Technical details about the device as well as the recording procedure have been described elsewhere[14]. The patients were invited to use the EMG recording device every night for 14 days (study period). They were instructed to place electrodes on the same sites with the same manner and activate the recording system just before going to sleep and stop it immediately after wake up.

During the first 7 consecutive nights, all patients used the device during sleep without the occlusal splint to record the pre-treatment baseline data. During the next 7 consecutive nights, patients in treatment group recorded data during sleep with the occlusal splint in, on the contrary, control group continued to record data without that occlusal device. After 14 days of using the device, the patients returned the devices back. The EMG recording device connected to the computer and the patient data transferred to a computer using the commercial software (GrindCare Manager, Medotech A/S, Herlev, Denmark) and the quality of the data was examined to make sure that the patient had used the device correctly. The poor data due to lost electrode connection or misplaced electrode discarded. A MIgraine Disability Assessment Scale (MIDAS) for migraine-related disability evaluation

were submitted to all subjects of the study, comparing scores at baseline (pre-treatment) and at the end of the study. The score, already used in a cohort of orofacial pain patients, was divided into 4 degrees: 0-5 minimum or infrequent disability (grade 1); 6-10 mild or infrequent disability (grade 2); 11-20 moderate disability (grade 3); > 21 severe disability (grade 4)(15). Outcomes of interest for the study were the differences in bruxism activity (number of EMG events/hour), bruxism length (second/event) and MIDAS grading between the group treated with the occlusal splint and the untreated control group for a study period of two weeks.

Statistical analysis

During the assessment of the study data, conformity of the parameters to the normal distribution was assessed by the Shapiro-Wilks test. Parameters with normal distribution for the comparison of quantitative data were evaluated using Student's t-test. Parameters with non-normal distribution for the comparison of quantitative data were evaluated using Wilcoxon Signed Ranks test. Significance was accepted at $p < 0.05$ level. All statistical analyses were performed using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA).

Results

The study sample was composed of 60 subjects (42 males, 18 females; mean age 31.4±3.7). Patients were equally divided into two groups (30 patients each): treatment group and untreated control group. A summary of the demographic characteristics of the sample is shown in Table 1. The participants in each group were statistically similar in terms of age, gender and body mass index (BMI) (all $p > 0.05$) (Table 1). The analysis of temporalis muscle nocturnal bruxism activity, length and MIDAS score during the 2-week-study are shown in Table 2. The bruxism activity in the group treated with occlusal splint revealed a high reduction from 8.3 ± 1.5 (baseline) to 3.3 ± 0.4 (end of the study period) showing a better improvement compared to control group ($p = 0.006$). The bruxism length in the treatment group was reduced from 14.6 ± 12.5 (seconds/event) to 12.3 ± 9.7, reaching the statistically significant value when compared to control group ($p = 0.037$). The baseline MIDAS score showed a grade 1 headache in 6.7 % of cases, grade 2 in 23.3 %, grade 3 in 46.7 % and a grade 4 in 23.3% in the treatment group; similar percentages were found in control group. At follow-up, after 2 weeks, the MIDAS score was significantly different between the two groups (except for grade 2) with statistically better outcomes in the surgical group ($p < 0.05$) (Table 2).

Characteristics	Treatment group N=30	Control group N=30	p value
Age, in years			
Mean ± SD	32.3 ± 4.1	30.4 ± 3.2	0.248
Median	31	30	-
Range	24-39	23-38	-
Gender, n(%)			
Male	22 (73.3)	20 (66.7)	0.257
Female	8 (26.7)	10 (33.3)	0.255
Body mass index (kg/m2), mean ± SD	20.7 ± 5.1	20.5 ± 4.8	0.675

Table 1: Demographic characteristics of the study groups.

Outcome	Baseline		End of study		p value
	Treatment Group	Control Group	Treatment Group	Control Group	
Bruxism activity (n of EMG events/hour), mean ± SD (range)	8.3 ± 1.5 (4 -10)	7.9 ± 1.3 (4 -9)	3.3 ± 0.4 (1 -5)	7.8 ± 1.5 (4 -9)	**0.006**
Bruxism length (second/event), mean ± SD (range)	14.6 ±12.5 (8-130)	15.7 ±10.6 (6-125)	12.3 ±9.7 (6-98)	15.4 ±10.2 (7-127)	**0.037**
MIDAS score, n (%)					
Grade 1	2 (6.7)	1 (3.3)	10 (33.3)	1 (3.3)	**0.003**
Grade 2	7 (23.3)	9 (30)	11 (36.7)	8 (26.7)	0.077
Grade 3	14 (46.7)	12 (40)	8 (26.7)	13 (43.3)	**0.011**
Grade 4	7 (23.3)	8 (26.7)	1 (3.3)	8 (26.7)	**0.015**

Table 2: Evaluation of bruxism activity, length, and MIDAS at baseline and at the end of study period (2 weeks).

Discussion

The occlusal splint has been commonly used in clinical practice to remove occlusal interferences, protect teeth and relax masticatory muscles. However, the effect of the occlusal splint on sleep bruxism is controversial; there is no common understanding regarding the effect of an occlusal splint on nocturnal masticatory muscle activities among previous studies[16,17].

The positive effects of occlusal splint have been shown in some studies[18,19]. This may suggest the existence of a potential 'noveltyeffect' associated with the use of the splint, which leads to a reduction in sleep-time masticatory muscles' activity, possibly due to the transient need for reorganizing motor unit recruitment. But until now, the exact mechanisms of action through which the occlusal splint may reduce muscle activity did not lead to clear conclusions and no evidence supports their role in stopping sleep bruxism[20]. Our results are generally in accordance with above mentioned studies. We observed a significant reduction both in nocturnal temporalis muscle activity and bruxism event length during a 2-weeks occlusal splint therapy, when compared to an untreated control group.

The association between headaches and SB is probably one of the most debated issues concerning SB effects. Some studies reported a significant association between SB and tension-type headache (TTH) and migraine[21,22]. Regarding migraine, the most plausible hypothesis for the association between SB and migraine is that nociceptive inputs from the masticatory muscle enhance the excitability of the trigeminal subnucleus caudalis nociceptive neurons, increasing the risk of migraine attacks. Bruxism-induced muscular changes could also lead to central sensitization of trigeminal subnucleus caudalis nociceptive neuron, which is associated with increased headache frequency among individuals with migraine[23]. Furthermore, the presence of an underlying sleep disorder, such as obstructive sleep apnea, has often been associated with both SB and headache. In this latter case, the role of intermittent hypoxia and hypercapnia and sleep fragmentation (after obstructive respiratory events) may be the actual cause of the headaches[24-26]. However, the exact mechanism underlying the possible interactions between SB and headaches remains unknown. Several types of oral and anterior appliances (eg, the nociceptive trigeminal inhibition system, NTI) have been tested and have shown variable effectiveness in cases of SB comorbid with orofacial pain or migraine headaches and temporomandibular joint dysfunction (TMD) to relieve muscle and joint pain[27,28]. Some of them, such as the mandibular advancement appliance (MAA), have shown evidence for reducing SB, snoring and migraine frequency[29]. Inconsistent with these previous studies, our results reveal a significant improvement in migraine severity and discomfort scores using the migraine disability score (MIDAS) in patients treated with occlusal appliances therapy when compared to those untreated.

The present study does have some limitations. The study protocol was designed to test the oral appliance effect in the short term. Long-term treatment may be necessary to obtain a notable improvement, indeed, there are clinical reports showing that splints did not diminish SB activity with long-term observation[12], and SB activity returns to baseline levels in 2 weeks although it decreased immediately after wearing splints[13]. Therefore, factors such as OSAS (obstructive sleep apnea syndrome), gastroesophageal reflux, malocclusion, allergic rhinitis and high anxiety levels could influence SB managing and therapy results[30-34]. A potential limitation of the present study was that these factors were not evaluated.

Conclusion

The present controlled-random study demonstrated that the short-term use of occlusal splint therapy appears to reduce both SB activity and migraine SB-related with a positive and rapid relaxing action of the masticatory muscles. However, there is no specific treatment available at this time to completely stop bruxism, so the management of the bruxism focus on reduces the adverse effects of the bruxism itself. Moreover, the long-term effectiveness and safety of occlusal splint for managing SB are not fully established so, it is required further studies with larger sample sizes and longer time periods.

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