

Evaluation of effects on periodontal health, halitosis and salivary flow of the occlusal splint use

Abubekir Eltas, DDS, PhD,^a Ummuhan Tozoglu, DDS, PhD,^b Hasan Gungor, DDS, PhD^c

^aDepartment of Periodontology, Faculty of Dentistry, Inonu University, Malatya, Turkey.

^bDepartment of Oral Diagnosis and Radiology, Faculty of Dentistry, Akdeniz University, Antalya, Turkey.

^cDepartment of Prosthodontics, Faculty of Dentistry, Ataturk University, Erzurum, Turkey.

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ABSTRACT

Objectives: Occlusal splints (OS) are often used for the treatment of temporomandibular disorders (TMDs), bruxism, and occlusal disturbance, although the splint's effect on oral tissue has not been investigated enough. The aim of this study is to evaluate the effects of OS on halitosis, periodontal status and salivary flow rate (SFR) in patients with bruxism.

Material and Methods: A total of 43 patients with bruxism participated in this study. Plaque index (PI), bleeding on probing (BoP), probing pocket depth (PPD), SFR and halitosis measurement were performed immediately before treatment and 3 months following the completion of the baseline treatment protocol.

Results: The present study saw that the use of OS for three months did not affected the periodontal status. There was significant increase in the level of halitosis and also the level of SFR after the use of OS ($p<0.001$). Statistically significance relationship between halitosis and SFR with the use of OS was found ($p<0.05$), while there was not a correlation between SFR and halitosis ($p>0.05$).

Conclusions: Although occlusal splints have therapeutic benefits, comprehensive clinical examinations are needed on this issue.

Keywords: Occlusal splint, halitosis, periodontal health, salivary flow rate.

INTRODUCTION

Treatment of temporomandibular disorders (TMDs), bruxism, and occlusal disturbance with an occlusal splint often brings relief of orofacial symptoms, such as myofascial pain and jaw movement restriction.^{1,2} This treatment is empirical, as it is based exclusively on the elimination of signs and symptoms of dysfunction. Indications for treatment with an occlusal splint are a painful sensation in the area of

the bilaminar zone, confirmed by passive compression; palpable sensitivity and pain in the masticatory muscles; and the symptom of clicking in the temporomandibular joint, confirmed by dynamic manual procedures.³⁻⁵ Treatment with a splint is a conservative treatment of disc derangement, degenerative changes of the joint surfaces and myalgia of the masticatory muscle, with the aim of deprogramming muscle activity by excluding the influence of disrupted occlusal relations, i.e., occlusal instability of the dental arches and in cases of excessive wear of hard dental tissues due to parafunctional movements, bruxism.^{6,7}

Halitosis is the general term used to define an unpleasant or offensive odor emanating with the breath, and in approximately 80% of all cases, halitosis is caused by oral conditions, defined as oral

Abubekir ELTAS
Department of Periodontology
Faculty of Dentistry
Inonu University
Malatya, Turkey
Tel: 0422 3411106
e-mail: aeltas@yahoo.com

malodour.^{8,9} There seems consensus that halitosis results from tongue coating, periodontal disease, periimplant disease, deep carious lesions, exposed necrotic tooth pulps, pericoronitis, mucosal ulcerations, healing wounds, impacted food or debris, imperfect dental restorations, unclean dentures and factors causing decreased SFR. Extraoral etiologies of halitosis include chronic sinusitis, tonsillitis, bronchitis, diabetes mellitus, hepatic failure, renal failure, medications, or carcinomas.¹⁰⁻¹² The halitosis arises from microbial degradation of organic substrates present in saliva, crevicular fluid, oral soft tissues and retained debris.^{13,14} It has been demonstrated that the intensity of clinical halitosis is significantly associated with amount of intra-oral Volatile sulfur compounds (VSC) such as hydrogen sulfide, methyl mercaptan and dimethyl sulfide,¹⁵ and these compounds are by products of bacterial metabolites.^{16,17}

Various studies have shown a relationship between halitosis and periodontal disease. The periodontal pocket is an ideal environment for VSC production with respects to the bacterial profile and sulfur source. Several clinical studies demonstrated the elevated VSC levels in periodontally involved pockets.¹⁸ This may explain why patients with periodontal diseases often complain of halitosis.

It is traditionally believed that saliva plays a significant role in the elimination of halitosis. Previously reported that hyposalivation increased the production of VSC.^{16,17,19} However, between a group of healthy patients with, and a control group without halitosis, no differences in SFR were found.²⁰ Medications which reduce salivary flow, such as antidepressants, antipsychotics, and narcotics, may cause oral malodour.^{16,17,19}

In the literature, there is not data about relationship between periodontal health and the use of OS, but it is know that

dentures cause bacterial accumulation results from impacted food or debris, imperfect dental restorations, unclean dentures. In this way, they are another significant source of halitosis.²¹

Previous studies have evaluated the impact of OS on TMD, but little investigation has been carried out on the change in oral tissue during OS treatment. Therefore, the purpose of this study is to evaluate the effects on halitosis, periodontal status and SFR of the OS use in patients with bruxism.

MATERIALS AND METHODS

Study populations and design

The characteristics of the patient sample are presented in Table 1. A total of 43 patients with bruxism participated in this study. Four patients was break treatment of various reasons. Our study consisted of 39 patients (21 females and 18 males, mean age 26.1, range 20–35 years) who used OS. The trial was instituted during a period of twenty months between 2006 and 2009 at the Dentistry of Faculty of the Ataturk University. Approval of the study protocol by the Ethics Committee at Ataturk University was obtained, and all participating subjects were provided with informed consent before the start of the study.

The inclusion criteria of this study were patients who suffer from bruxism, good periodontal health and age range 20-35 years. The criteria for exclusion were: 1) received periodontal therapy within the last 12 months; 2) having taken medications within the last 6 months (include use of pain killer's); 3) any systemic diseases (sinusitis, rhinitis, diabetes mellitus or lung, kidney, liver, and intestinal disturbances etc.) or local factors (poor oral hygiene, tongue coating, deep carious lesions, exposed necrotic tooth pulps, etc.) that could affect oral health or halitosis; 4) smokers; 5) pregnancy or breast-feeding for women; and 6) patients who with halitosis (≥ 110 ppb).

Table 1. Demographics of study populations.

Subjects (N=39)	
Gender	
Female (n)	21
Male (n)	18
Age (years)	26.1±5.4
Age range	21-35

The following clinical measurements, SFR and halitosis levels were recorded before (baseline) and 3 months after the use of OS in each patient. All assessments were performed in the same clinic, and in the morning.

Periodontal Clinical Measurements

Each patient's age, gender and date of birth were recorded and a medical history was taken. Each patient underwent a comprehensive periodontal examination as a part of his or her routine assessment both baseline and three months after use of OS. The examination included assessing plaque index (PI), bleeding on probing (BoP), and probing pocket depth (PPD). Clinical parameters were measured at six sites per tooth (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual, and mesio-lingual) in all teeth, except third molars, using a Williams probe (PCP- 12, Hu-Friedy, Chicago, IL, USA).

Clinical recordings

Plaque Index (PI):²² 19 presence/absence of plaque at the cervical part of the tooth scored by running a probe along the tooth surface (at all mesial, buccal, distal and lingual surfaces). The percentage of surfaces with plaque was calculated.

Bleeding on probing (BoP):²³ 20 presence of bleeding following probe insertion to the base of the gingival pocket

was recorded. The percentage of BoP positive units was calculated.

Probing pocket depth (PPD): the distance from the gingival margin to the bottom of the periodontal pocket.

Periodontal examinations were conducted masked by one calibrated examiner (AE). Before the start of the study, the examiner was trained to adequate levels of accuracy and reproducibility in recording the clinical parameters and indices.

Salivary Flow

Saliva was collected according to the spitting method with small modifications, as described previously.²⁴ All subjects were instructed to refrain from eating, drinking and tooth brushing for one hour prior to the three saliva collection periods. Before collection, the mouth was rinsed with tap water. The collection started by instructing participants to void the mouth of saliva by swallowing. Subsequently, saliva was allowed to accumulate on the floor of the mouth and the subjects were instructed to spit into the pre-weighed test tubes every 30 seconds. Each saliva collection period was five minutes long. The volume of saliva was measured and this volume was divided by 5 to obtain the SFR (mL/min).

Halitosis Measurement

For halitosis measurements, a portable sulfide monitor was used (Halimeter, Interscan Corporation, Chatsworth, Calif). In briefly, the halimeters was calibrated to zero on ambient air before each measurement. The patient was told to close his or her mouth for one minute, after which the mouth was opened and the tongue protruded. A disposable straw was placed at the dorsal posterior mid part of the tongue and fixed until the maximum peak value of VSC was recorded. The peak VSC level was registered in p.p.b. The manufacturer of the halimeter suggested 110 ppb or below to be a normal reading.

The current study considered VSC levels below 110 ppb to be normal.^{15,25}

The Construction of Occlusal Splint

Maxillary and mandibular alginate impressions were taken to encompass the complete dentition and one-third of the alveolus for patients in groups with retainers. A working cast was obtained. The retainers were formed by the action of heat from 1.00 mm (0.040 inches) on copolyester Essix sheets (Dentsply Raintree Essix, New Orleans, Louisiana, USA), which was thermoformed to a thickness of 0.015 inches. The OS completely covered the maxillary teeth, and at the same time, this retainer extended gingival margin onto the buccal surface of the teeth. The retainers completely covered on the palate. The splints were adjusted for comfort, and they were polished and finished (Figure 1). The patients were instructed to wear the OS at night and were informed on the cyclic nature of TMD and the relationship between parafunction, muscle fatigue, muscle pain and psychological factors.⁵ In an attempt to alleviate daytime harmful habits, the patients were instructed to seal the lips and separate the teeth, keeping the muscles relaxed.²⁵ All subjects were instructed to brush their OS with water for 30 seconds before and after use. All subjects were

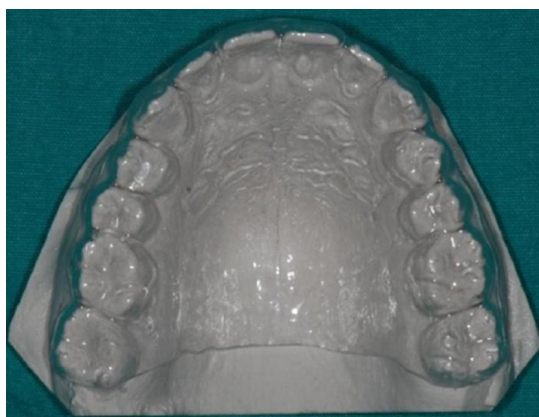


Figure 1. The view of the OS.

shown how to brush their dentures by using the brush provided.

Statistical Analysis

Statistical analysis was carried out using SPSS 13.0.1. The Wilcoxon signed-ranks test was used to compare the pre- and post-treatment periods. Spearman's rank correlation coefficient was used for evaluation of the relationships between the use of OS with SFR and halitosis. P values lower than 0.05 was considered as statistically significant.

RESULTS

There were significant increases in the level of halitosis and SFR after the use of OS (Table 2). Halitosis significantly increased from 74 before the use of OS to 103 three months after the use of OS (Figure 2) ($p < 0.05$). As none of the participants had oral malodor (≥ 110 ppb) at the baseline of this study, seven patient's levels were higher than 110 ppb after OS use (range 117 – 141ppb). After the use of OS, thirteen patient's levels also increased on halitosis scores, two patient's scores did not change significantly. As similar to the change in values halitosis, SFR significantly increased from 0.054 mL/min before the use of OS to 0.087 mL/min after the use of OS ($p < 0.05$) (Figure 3).

Although PI and BoP increased with using OS at the end of the three month, the differences in PI and BoP were not statistically significant by the wilcoxon signed-ranks test at the pre- and post-treatment period ($p < 0.05$). There was no difference in PPD from baseline to three months after ($P < 0.05$). According to results of this study, the use of OS for three months does not affect PII, BoP and PPD (Table 2).

Additionally, a correlation was observed between halitosis and SFR with the use of OS, while it was not found correlation between SFR and halitosis (Table 3).

Table 2. Presents the mean values for the periodontal parameters, SFR and halitosis at baseline and 3 months after treatment.

	Baseline	After three months	p
PI	%22.8±13.1	%28.1±14.3	ns
BoP	%19.1±11.4	%23.7±10.7	ns
PPD	3.1±0.4	3.0±0.3	ns
Saliva Flow	0.47±0.14	0.56±0.31	*
Halitosis	74±23	103±52	*

*p<0.05. ns, not significant.

The Wilcoxon signed ranks test was used to compare baseline and after treatment.

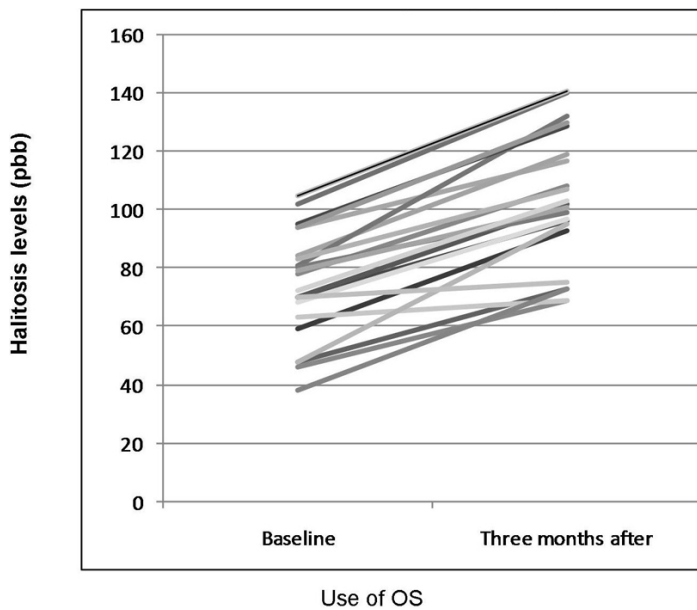


Figure 2. Comparison of halitosis level before and three months after the use of OS (p<0.05, r=0.19).

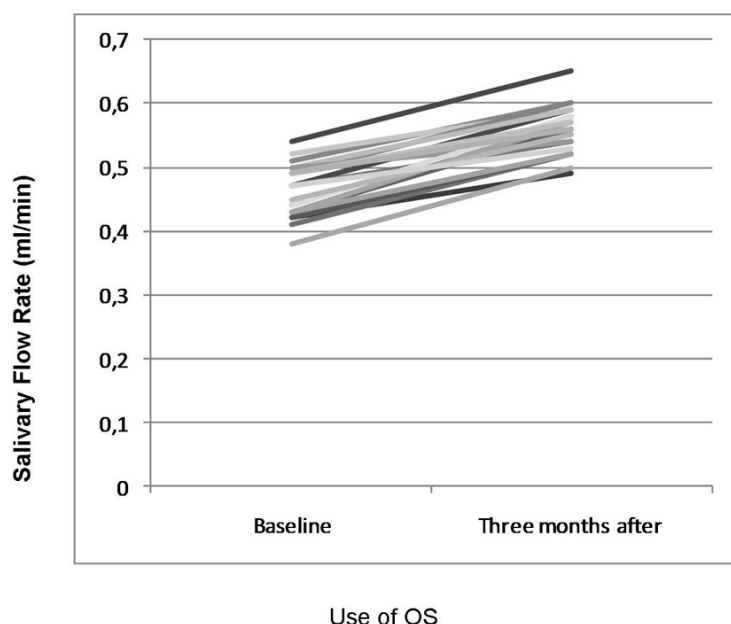


Figure 3. Comparison of saliva flow rate before and three months after the use of OS ($p < 0.05$, $r = 0.29$).

Table 3. Presents the mean values for the periodontal parameters, SFR and halitosis at baseline and 3 months after treatment.

	SFR	Halitosis	PI	BoP	PPD
OS use	0.29*	0.19*	0.04	0.07	0.000
Halitosis	0.09	-	0.02	0.03	0.000
SFR	-	0.09	0.01	0.01	0.000

PI, plaque index; BoP, bleeding on probing; PPD, probing pocket depth.

Statistical analysis was performed by a Spearman's rank correlation coefficient test.

* $p < 0.05$ statistical significance

DISCUSSION

OS's are often used for the treatment of TMDs, bruxism, and occlusal disturbance, yet the splint's effect on oral tissue has not been investigated enough. The results of the present study demonstrated that the use of OS led to significant change in SFR and halitosis at 3 months after treatment.

Halitosis affects a large portion of the population and may cause a significant social or psychological handicap to those suffering from it.²⁶ Previously reported that halitosis results from periodontal disease, systemic diseases (diabet, renal failure, kidney disorders etc.), unclean dentures, medications and disease that reduce SFR

and other local factors (deep carious lesions, exposed necrotic tooth pulps, impacted food or debris, imperfect dental restorations, unclean dentures) may lead to halitosis.^{27,28} For these reasons, patients who had the above mentioned factors which affecting periodontal status, halitosis and SFR were not included in this study.

Dentures have been found to be a significant source of halitosis.^{6,29} Nalcacı have also found a significant relationship between oral malodor and overnight denture wear. Although the nature of the odor has not been defined, some evidence indicates that denture wear may cause halitosis by virtue of increased tongue coat

deposits.⁶ The bulk of the literature concerning denture plaque focuses on the etiological agent, generally deemed to be *Candida albicans*, and associated causative factors, particularly poor denture hygiene and consequent plaque accumulation.³⁰ In contrast to these findings, a study by Honda found non denture wearers had significantly higher levels of oral malodor than denture wearers.³¹ In according to our results halitosis scores in patients after the use of OS were higher than baseline. Thus, our results are similar to some previous studies, which suggest that prosthesis users have an increased halitosis level. It is possible that although the splint was regularly cleaned by the patients, plaque formed on the surface of the splint, which resulted in saliva adhesion at night.

Oral malodor is primarily associated with oral cavities, including the oral hygiene level and periodontal condition.¹⁵ There is a straight relation between periodontal disease and halitosis. Furthermore, poor oral hygiene is probably the most common factor leading to halitosis and tends to exacerbate other causes. Several clinical studies demonstrate that VSC in mouth air increased with the increase of the number and depth of periodontal pockets.¹⁴ Soils-Gaffer et al. measured hydrogen sulfide production in 240 gingival crevicular fluid samples. A positive correlation was observed between gingival index and hydrogen sulfide production.³² Various studies demonstrated that increased halitosis was strongly correlated with periodontal clinical parameters such as pocket depth and bleeding on probing.^{28,33} Various studies show that this increase can be prevented in patients who use dentures with good oral hygiene care.²⁵ This study show that PI, BoP and PPD after use OS did not increase, as all patients carried out oral hygiene instructions. These results suggest that the use OS doesn't affect periodontal health directly, but it can

change the oral health in patients with poor oral hygiene.

Both halitosis and oral health are affected by SFR.^{19,34} When the masticatory muscle activity does not adequately stimulate the salivary glands, saliva secretion might decrease. Therefore the OS could help to regulate appropriate rhythmic muscle activity. Alternatively, secretion is accelerated by mechanical stimulation to the oral mucosa.² The OS possibly stimulates the oral mucosa mechanically, which may thus induce saliva secretion. It was reported that salivary flow is increased in patients with OS. Similar to the previous reports, the present study revealed that significant changes in SFR were recorded before and after the use of OS for 3 months. However, halitosis was not affected by this increase. In other words, no correlation between halitosis and SFR was found. Oho et al. reported that SFR was no difference between the halitosis and non-halitosis groups.²⁰ Similarly, Miyazaki et al. reported that no significant difference was observed between halitosis level and SFR.⁸ Our results are consistent with these results. Further studies are needed to investigate the relationship between halitosis level and SFR.

Our study has some limitations. Denture related studies previously reported that increased denture plaque is a cause of halitosis, but this study did not evaluate plaque accumulation and microbiologic differences on the OS surface. Another limitation to this study is duration of study. Further studies are needed to investigate long-term effects the use of OS.

The results of the present study suggest that the use of OS may lead to halitosis and increased SFR. In addition, OS use does not affect periodontal tissue health, when patients have good oral hygiene maintenance. OS's have therapeutic benefits; however, further studies are necessary to explore their effect on oral health.

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