

An American Sleep Disorders Association Review

Oral Appliances for the Treatment of Snoring and
Obstructive Sleep Apnea: A Review

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Summary: This paper, which has been reviewed and approved by the Board of Directors of the American Sleep Disorders Association, provides the background for the Standards of Practice Committee's parameters for the practice of sleep medicine in North America. The 21 publications selected for this review described 3210 patients treated with oral appliances for snoring and obstructive sleep apnea. The appliances modify the upper airway by changing the posture of the mandible and tongue. Despite considerable variation in the design of these appliances, the clinical effects is remarkably consistent. Snoring is improved and often eliminated in almost all patients who use oral appliances. Obstructive sleep apnea improves in the majority of patients; the mean apnea-hypopnea index (AHI) in this group of patients was reduced from 47 to 19. Approximately half of treated patients achieved an AHI quality of <10; however, as many as 40% of those treated were left with significantly elevated AHIs. Improvement in sleep quality and sleepiness reflects the effect on breathing. Limited follow-up data indicate that oral discomfort is a common but tolerable side effect, that dental and mandibular complications appear to be uncommon and that long-term compliance varies from 50% to 100% of patients. Comparison of the risk and benefit of oral appliance therapy with the other available treatments suggests that oral appliances present a useful alternative to continuous positive airway pressure (CPAP), especially for patients with simple snoring and patients with obstructive sleep apnea who cannot tolerate CPAP therapy. Key Words: Sleep apnea syndromes-Snoring-Orthodontic appliances-Diagnosis-Therapy.

Treatment of Snoring with an Oral Appliance: Initial Effects on Apnea and Snoring Measures

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Oral appliances are being increasingly considered as treatment options for snoring and obstructive sleep apnea. The types of appliances currently available are designed to alter different aspects of the oropharyngeal space; e.g., tongue retaining devices, mandibular repositioning devices. The effectiveness of a given type of device will vary among individuals, depending upon particular anatomical features. There is a need, therefore, to document improvement in snoring or sleep related breathing with each type of appliance. The treatment of snoring has usually been evaluated through subjective bed partner assessments of effectiveness. An objective, quick, and inexpensive method of determining the effectiveness of an oral appliance for the treatment of snoring would be useful. We describe quantified changes in sleep and snoring measures in subjects sleeping for the first time with an oral appliance of the jaw advancing type. Measures on the device night were compared to a baseline night, and a night spent sleeping with a placebo device.



Fifteen subjects (13 males and 2 females; mean age = 43.5; range 25-57) were studied three nights in the sleep laboratory. All reported habitual snoring (≥ 5 days/week), and bed partner complaints of disturbed sleep attributed to their snoring. Baseline levels of snoring, sleep, and sleep-related breathing were initially determined. In addition to standard all night polysomnography and oximetry, snoring sounds were detected with a small microphone attached six inches below the clavicular notch on the midline and a second microphone suspended four feet above the bed at approximately midthoracic level. The signals from the microphones were mixed, then amplified and displayed on a polygraph channel.

After baseline screening, subjects were fitted for oral appliances. *The appliance was designed to position the mandible forward therefore increasing the airway space. A placebo device was also constructed, which was identical to the appliance, except the mandible was not repositioned.* They spent one night in the laboratory wearing the oral appliance, and one wearing the placebo. Both the subject and the technician were blind to experimental condition.

Records were scored for sleep waking state in 30-sec epochs according to standard criteria. The following measurements were made from the snoring channel: 1) total number of one minute epochs during which at least one audible snoring sound was present; 2) the number of audible events occurring during each epoch that snoring was present, and 3) the peak to peak amplitude (in millimeters) of the loudest event during each epoch that snoring was present. The scorer was blind to experimental condition.

Data from 2 of 15 subjects were not included in the snoring analysis. In one patient, an equipment malfunction made the snoring channel unsociable on the device night. A second subject showed a dramatic increase in both the frequency and loudness of snoring on both the device and placebo nights compared to baseline; the only subject to show such a pattern. Cephalometric radiographs on this subject revealed severe nasal obstruction, suggesting that both appliances had the effect of further increasing upper airway resistance.

Data for all variables will be listed in the following way: (Baseline, Device; Placebo). All values are expressed as mean \pm standard error of the mean.

Editor: The main effects on sleep are not discussed here in the interest in space. It is worth mention that little to no sleep changes, including sleep efficiency, differed significantly among experimental conditions. The main focus here is the impact on snoring and apnea.

The mean apnea index was reduced on the device night compared to baseline and placebo conditions, *however, due to the limited number of subjects (n=7), this difference was not statistically significant* (12.1 ± 4.2 ; 4.6 ± 1.4 ; 12.0 ± 4.9 ; $p=.07$). *Had the same relation been true with a slightly larger subject population the difference would have been significant.* No other respiratory measures changed in response to experimental condition.

Editor: These data were originally considered in a group design. If you review the data in a single subject design with repeated measures the data suggest that 9 of 13 subjects show marked improvement in snoring and 6 of 7 subjects showed marked improvement in apnea.

Use of the device was associated with demonstrable improvement in snoring measures. The % of TST during which snoring was present was reduced on the device night compared to other conditions (61.6 ± 6.7 ; 34.0 ± 5.8 ; 55.1 ± 8.9 ; $p < .001$). The number of audible events/min of snoring was also reduced on the device night (8.3 ± 0.6 ; 5.8 ± 0.7 ; 7.0 ± 0.6). Average amplitude of the loudest audible event was lowest during the treatment night (9.9 ± 2.0 ; 6.4 ± 1.2 ; 8.1 ± 1.7 ; $p = .10$), but this difference was not statistically significant, in part due to subject variability in this measure. Not every subject exhibited changes in event amplitude that were comparable in magnitude or direction as changes in number of events/min. However, since an interaction among frequency of audible breaths and the loudness of those breaths is likely to impact on the sleep of the bed partner, we examined the product of # events/min and event amplitude. This measure was significantly reduced on the device night compared to other conditions (97.6 ± 21.7 ; 42.3 ± 9.4 ; 72.5 ± 18.8 ; $p = .02$).

These results demonstrate the initial effectiveness of an oral appliance of the jaw advancing type to reduce snoring amount and intensity. They also demonstrate the feasibility of evaluating the effectiveness of such an appliance with a single night of polysomnography combined with quantification of snoring sounds.

