

Is treatment of Mandibular Advancement Device acceptable to snorers?

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Abstract

Objectives: To determine the effects of Mandibular Advancement Device (MAD) on snoring and confirm any correlation by verifying the changes in indicators related to Obstructive Sleep Apnea (OSA). **Methods/Statistical Analysis:** Thirty-nine people diagnosed with Obstructive Sleep Apnea participated in this study. Apnea and Hypopnea Index (AHI), Oxygen Saturation (SaO₂) and Snoring Percent (SnP) are calculated using polysomnography to evaluate OSA and quality of sleep and hypersomnia in the daytime was also evaluated with different tools, (PSQI) and (ESS). Moreover, we conducted a correlation analysis by calculating the rate of change between Snoring Percent (SnP) and other variables. **Findings:** AHI, SaO₂, PSQI and ESS, but not SnP, were statistically significant and no significance was revealed after a correlation analysis between SnP and other variables. **Improvements/Applications:** Pay close attention to the selection and use of MAD with regard to snoring because other causes aside from snoring may be related to the obstruction of the oropharyngeal airway.

Keywords: Mandibular Advancement Device, Obstructive Sleep Apnea, Quality of Sleep, Roncopathy, Snoring

1. Introduction

American Academy of Sleep Medicine defines a common snorer as someone who snores 3 to 4 times a week and 10% to 20% of the time every night. There are various factors related to snoring, which is also referred to as roncopathy. A Mandibular Advancement Device (MAD) is known to be helpful in moderating snoring, i.e. roncopathy and milder forms of apnea, by repositioning the mandible forward and downward during sleep and widening the oropharyngeal airway¹⁻³.

Moreover, MAD is known to be effective for OSA, which is caused by the imbalance of anatomical and neuromuscular factors that open and close the upper airway⁴. OSA not only induces frequent sleepiness during daytime that is a potential cause of traffic accidents, but also plays a part in promoting cardiovascular disorders and metabolic diseases⁵⁻⁹. Therefore, MAD is commonly used to treat these diseases as well as snoring, based on the fact

that OSA and snoring are related conditions that can narrow the upper airway^{4,10}. Nevertheless, some studies imply that there is no relation between snorers and Sleep Apnea Syndrome (SAS) and a few have even reported on the side effects of MAD, which makes it questionable whether it is appropriate to apply MAD if only snoring symptoms occur and there is no specific somnopathy^{11,12}.

Accordingly, this study sought to determine the effects of MAD on snoring by verifying the changes in indicators related to Obstructive Sleep Apnea (OSA) after wearing MAD and the snoring effects and confirming their correlation.

2. Materials and Methods

2.1 Research Participants

The study performed an Obstructive Sleep Apnea evaluation (polysomnography, endoscopy, degree of tonsillar

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hypertrophy, sleep apnea-related questionnaires and radiation inspection) with patients visiting sleep centers or otorhinolaryngology of three medical institutions due to sleep apnea. Thirty-nine people diagnosed with Obstructive Sleep Apnea have participated in the study. (IRBN.E-1111-068-003).

2.2. MAD and Measurement Tools

2.2.1 Principle of MAD

We set the forward travel range of the mandible calculated from each participant using the adjusting screw and protrusion slant board embedded in the maxillary section and mandibular section of the device. Once the participant closes the mouth wearing the device set up with the travel range, the screw of the maxillary section and the slant board of the mandibular section interlock, pushing the mandible forward and expanding the airway.

2.2.2 Producing and Fitting MAD

After making MAD and fitting it in the mouth, elaborate adjustment is necessary to gradually move the mandible so that each participant does not feel uncomfortable, using the advancing distance of the mandible calculated beforehand. To this end, the participants visited the designated medical institution 3 to 5 times. At visit 1, Obstructive Sleep Apnea (polysomnography for screening participants, sleep apnea-related questionnaires, etc.) was evaluated. Then advancing distance was calculated for making MAD. At visit 2, MAD was fitted in the mouth of participants. Up to three weeks after the evaluation (visits 3 and 4), additional fitting and progress monitoring were conducted. On the visit 5, 5 weeks after the first visit, the same evaluation as the first one was given to the participants.

2.3. Measurement Tools Related to Sleep Apnea

Apnea and Hypopnea Index (AHI), Oxygen Saturation (SaO_2) and Snoring Percent (SnP) are calculated using polysomnography to evaluate OSA and quality of sleep and hypersomnia in the daytime are examined through the Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS).

2.3.1 Polysomnography

We used polysomnography during sleep to record brainwaves, electro-oculograms, electromyograms, electrocardiograms, arterial blood, oxygen saturation,

respiratory movement of abdomen and chest, respiratory air flow and snoring, while also filming the sleeping positions on video. The materials recorded here were used to calculate AHI and oxygen saturation later.

- **Apnea and Hypopnea Index (AHI)**

AHI is represented by the number of apnea and hypopnea occurrences per hour of sleep. Apnea in AHI is when breathing completely stopped for at least 10 seconds and hypopnea is when the amplitude of breathing quantity is at least 30% lower than the baseline for 10 seconds and oxygen saturation in blood decreases by at least 4%.

- **Oxygen Saturation**

Oxygen Saturation (SaO_2) refers to the percentage (%) of oxygen in blood. Since upper airway stricture is repeated in OSA, the air flow becomes worse, thereby reducing oxygen saturation. Thus, this study examined whether upper airway stricture is alleviated by the use of MAD by comparing oxygen saturation before and after treatment.

- **Snoring Percent**

To calculate snoring percent, we used a microphone during polysomnography to change the snoring sounds to electric signals and measured the snoring percent before and after treatment in order to evaluate the improvement in snoring.

2.3.2 Tests Related to Apnea Symptoms

- **Sleep Quality Index**

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate the quality of sleep. This index consists of 7 items: Subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication and daytime dysfunctions. Each item is rated on a four-point scale (0-3 points), which may add up to a maximum 21 points, where higher scores indicate higher severity of apnea. In general, a person is considered to have poor sleep quality if the total score adds up to 5 points or above.

- **Sleepiness Scale**

To evaluate the daytime hypersomnia, we used the Epworth Sleepiness Scale (ESS), which consists of items regarding 8 situations in which one feels sleepy in daily life. A person is considered to have daytime sleepiness if the score is at least 10 points.

3. Results

We conducted a paired t-test on AHI, SaO₂, SnP, PSQI and ESS measured in Visit 1 (baseline) and Visit 5. (Table 1)

The average of AHI decreased from 33.95 before MAD treatment to 13.41 after treatment and the difference was statistically significant ($t = 9.90$, $df = 38$, $p < .01$). The difference in SaO₂ during sleep before and after MAD (79.38 to 83.95) was also significant ($t = -4.82$, $df = 38$, $p < .01$) and the difference in snoring percent before and after treatment decreased from 28.44 to 24.24 but was not statistically significant. The PSQI score, which is an index for sleep quality, decreased from 5.74 to 3.87 and was statistically significant ($t = 7.34$, $df = 38$, $p < .01$) and the difference in the ESS score before and after treatment also showed significance ($t = 5.88$, $df = 38$, $p < .01$).

Table 1. OSA-related indices improved by MAD treatment

| | | n | Mean±S.D | t |
|------------------|----------|----|-------------|---------|
| AHI | Baseline | 39 | 33.95±13.41 | 9.90** |
| | Visit 5 | 39 | 13.41±13.11 | |
| SaO ₂ | Baseline | 39 | 79.38±6.83 | -4.82** |
| | Visit 5 | 39 | 83.95±6.04 | |
| SnP | Baseline | 39 | 28.44±23.12 | 1.07 |
| | Visit 5 | 39 | 24.24±22.49 | |
| PSQI | Baseline | 39 | 5.74±2.17 | 7.34** |
| | Visit 5 | 39 | 3.87±1.66 | |
| ESS | Baseline | 39 | 8.15±4.01 | 5.88** |
| | Visit 5 | 39 | 4.87±2.44 | |

** $p < .01$.

3.2 Correlation among Variables

As a result of conducting a correlation analysis by calculating the rate of change to determine the relevance between snoring percent and other variables, it was found that snoring percent has no correlation with other variables. (Table 2).

Table 2. Correlation among variables

| | | SnP Rate of change | AHI Rate of change | SaO ₂ Rate of change | PSQI Rate of change | ESS Rate of change |
|--------------------------|---|--------------------------|--------------------------|---------------------------------------|---------------------------|--------------------------|
| SnP Rate of change | r | 1 | .064 | -.029 | -.089 | -.047 |
| | p | | .70 | .86 | .59 | .78 |
| | n | 39 | 39 | 39 | 39 | 39 |

4. Discussion and Conclusion

A previous study reported that since snoring and Obstructive Sleep Apnea (OSA) are related to the narrowing of the upper airway, OSA improved and sound intensity of snores decreased when Mandibular Advancement Splint (MAS) was used. Another study conducted on 134 participants reported through the survey results on bed partners that using MAD alleviated snoring^{4,13,14}. Research by Marty et al. also reports that wearing custom-fitted MAD has the effect of reducing snoring aside from OSA syndrome¹⁵, which indicates that MAD is generally effective for snoring. Nonetheless, the results of this study could not find a direct correlation between snoring and OSA, despite the fact that wearing MAS improves various indicators that measure OSA (AHI, SaO₂, SnP, PSQI and ESS) as suggested by previous studies. It can be assumed that the snoring of participants is not caused only by the obstruction of the oropharyngeal airway and this assumption may be partially explained by the fact that snoring may occur along with the increased resistance by nasal obstruction, as mentioned in previous studies¹⁶. Therefore, if all functions of MAS are focused on widening the oropharyngeal airway, patients whose snoring is caused by other factors may show no direct correlation between snoring and OSA as proved in this study, naturally resulting in the fact that the role of MAD will be strictly limited. This does not mean that the results of this study prove MAD to be ineffective for snoring. Yet, a few previous studies have reported that there is no basis in the general idea or assumption that snoring will act as a risk factor for cephalgia, hypertension, cardiac arrhythmias, cardiovascular and cerebrovascular disease in association with OSA^{12,17,18}. Thus, consumers, patients or surgeons must carefully consider whether snoring must be treated or snorers must wear MAD for treatment.

Therefore, we suggest that the use of MAD merely for snoring due to causes other than oropharyngeal airway obstruction must be carefully considered and that experts should be consulted on this matter.

5. References

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