Effects of Wearing Complete Dentures During Sleep on the Apnea–Hypopnea Index

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Purpose: The aim of this study was to investigate whether wearing complete dentures during sleep can improve the apnea-hypopnea index (AHI). ***Materials and Methods:*** A total of 34 edentulous patients (16 men and 18 women, mean age: 72.5 ± 8.8 years) completed the study. Portable sleep recording was performed for two nights in patients' homes. All patients wore complete dentures one night and slept without dentures the other night. Information about medical history and denture use was obtained for all patients. The occurrence of obstructive sleep apnea syndrome (OSAS) was calculated in edentulous patients, and the effect that wearing complete dentures during sleep had on the AHI was evaluated. ***Results:*** Twenty-seven of the 34 patients suffered from OSAS with an AHI ≥ 5. The mean AHI in patients sleeping with dentures was lower than that of those without dentures (13.3 ± 10.0 versus 17.7 ± 14.6, P = .022). Nineteen of these 27 patients showed a decrease in AHI while eight showed an AHI increase, of whom four showed increases of more than 5 points when wearing dentures during sleep. ***Conclusions:*** Wearing complete dentures during sleep improves the AHI of most edentulous OSAS patients. In contrast, some patients suffer from AHI increases due to the use of complete dentures. Also in some patients, any significant change in AHI associated with the usage of complete dentures went unnoticed. Thus, careful attention should be given when complete dentures are recommended for edentulous OSAS patients. *Int J Prosthodont 2009;22:173–177*

Obstructive sleep apnea syndrome (OSAS) is characterized by repetitive complete or partial occlusion of the upper airway, resulting in apnea, hypopnea, oxygen desaturation, and sleep fragmentation during sleep and daytime sleepiness. OSAS represents a risk factor for cardiovascular pathologies such as heart failure, stroke, and coronary heart disease, all of which can shorten the life span of those suffering from it.[1–3] Recent studies suggest that OSAS occurs in 4% of men and 2% of women between the ages of 30 and 60 years.[4] The prevalence of OSAS in the population over 60 years of age is estimated to be between 20% and 24%,[5,6] but in one study it reached as high as 62% (apnea-hypopnea index (AHI) > 10).[7] Therefore, for elderly persons who exhibit more risk factors for cardiovascular pathologies, the prevention of OSAS is extremely important.

The role of edentulism in the occurrence or worsening of OSAS has recently been suggested.[8] OSAS results from partial or complete occlusion of the upper airway and anatomic abnormalities of the face. Edentulism causes changes in facial anatomy[9–11] and functional changes in the upper airway.[12,13] Therefore, edentulism may contribute to the pathogenesis of OSAS. Epidemiologic data indicate that edentulism is observed in 18% of subjects over 60 years of age.[14] This set of circumstantial evidence supports the possible causal relationship between OSAS and edentulism. This relationship, however, has not been sufficiently examined.

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Treatments for OSAS patients include weight loss, change of sleep position, surgical procedures, oral appliances, and continuous positive airway pressure (CPAP),[15] of which CPAP and oral appliances represent the most common interventions. There have, however, been no reports on the effect of wearing complete dentures during sleep on sleep apnea as a mode of treatment for edentulous OSAS patients. In designing this study, the authors hypothesized that wearing complete dentures during sleep would improve the apnea-hypopnea index (AHI) of edentulous patients.

Materials and Methods

This study was approved by the Institutional Ethical Committee of the School of Medicine, Keio University. All patients were informed of the modalities and purpose of the study before consenting to participate. Patient selection was not randomized. All patients wore complete dentures for over 1 year without complication and visited the Department of Dentistry and Oral Surgery, School of Medicine, Keio University for periodic dental check-ups every 3 months. All dentures were made by the same prosthodontist. The occlusal vertical dimension of all dentures was made according to the Willis gauge method[16] and the values of interocclusal rest space in all patients were in the normal range (2 to 3 mm in a vertical direction). The occlusal horizontal position was determined according to the Gothic arch tracing method and the intercuspal positions were deemed stable.

This research was undertaken from May 2003 to December 2006. All selected patients lived independently and were able to follow researchers' instructions. Exclusion criteria were as follows: unstable congestive heart failure, significant lung disease, acute airway infections, common cold, significant nasal obstruction, severe insomnia, and cognitive impairment. Of the 52 patients approached (25 men and 27 women, mean age 73.4 ± 9.1 years), 11 declined to participate in this study. The authors obtained informed consent from the 41 remaining patients. Of those 41 patients, 34 completed the study; seven withdrew from the study because five had colds and two declined further participation.

Medical history and information on the use of dentures was obtained from all patients. Body mass index (BMI) was calculated as weight (in kilograms) divided by height squared (in meters). Portable sleep recordings were performed from sleep onset to time of awakening on consecutive nights on which dentures were worn during sleep for one of the nights (randomly assigned), and not for the other. Recordings were made in the patients' homes using a Stardust-2 (Respironics) sleep-recording instrument. Portable sleep-recording monitors have previously been validated against full-night polysomnography.[17,18]

Patients were given both oral and detailed written explanations on the use of the sleep-recording instruments and practiced how to use the instruments in the outpatient clinic. Data for sleeping periods lasting more than 4 hours were seen as valid for the purposes of this study. Patients were instructed to spend the day as usual and go to bed at their usual time on the day of the sleep study. The sleep-recording instruments and data were returned from the patients' homes after two nights of recording. The instruments recorded nasal airflow, chest movement, pulse oximetry, heart rate, body position, and snoring signal. The parameters measured in this study were AHI, mean oxygen saturation of peripheral blood (SpO_2), lowest SpO_2, and desaturation index.

Apnea was defined as a cessation of airflow lasting ≥ 10 seconds. Hypopnea was defined as a reduction in airflow by 50% for ≥ 10 seconds associated with a fall in baseline oxygen saturation of 3% or more.[19] AHI was calculated as the number of apnea and hypopnea episodes per hour of sleep. The mean SpO_2 was calculated as the average saturation during sleep and lowest SpO_2 was calculated as the lowest saturation during the entire sleep period. The oxygen desaturation index was calculated as the number of dips in SpO_2 of at least 4% beneath the baseline oxygen saturation level per hour of sleep. Finally, OSAS was defined as AHI ≥ 5. All data were collected and scored by a clinical technician blinded to all patient information.

Statistical Analysis

A comparison of the data from patients wearing dentures and those not wearing dentures was made using the Wilcoxon signed-ranks test, yielding a statistical significance of $\alpha = .05$. The Mann-Whitney *U* test was used to evaluate the number of patients showing an increase or decrease in AHI while wearing complete dentures during sleep, which also indicated a significance of $\alpha = .05$.

Results

Thirty-four patients completed the study. The study group consisted of 16 men and 18 women, mean age: 72.5 ± 8.8 years. Twenty-seven of the 34 patients(79%) were classified as having OSAS. The characteristics of these 27 patients are summarized in Table 1. Average BMI was 22.5 ± 3.7 for this patient sample. No patients were obese (BMI > 30 kg/m^2), five patients were overweight (BMI = 25 to 30 kg/m^2), and 22 patients were of a normal weight (BMI < 25 kg/m^2).

Table 1 Demographics of 27 Patients With AHI ≥ 5 (n = 27)*

Sex (m:f)	15:12
Age (y)	72.7 ± 9.0
Body mass index (kg/m^2)	22.5 ± 3.7
Smokers	4/27
Hypertensions†	10/27
Heart attack†	8/27
Stroke†	1/27
Wearing denture duration (y)	17.3 ± 13.2

*Values shown are mean ± SD.
†Patients suffered from this condition prior to the start of this study.
AHI = apnea-hypopnea index, showing the number of apnea-hypopnea episodes per hour.

Table 2 Polysomnographic Parameters of Patients Sleeping With and Without Dentures

	Without dentures ± SD	With dentures ± SD	*P*
AHI	17.7 ± 14.6	13.3 ± 10.0	.022
Apnea	8.5 ± 12.8	7.8 ± 10.2	.904
Hypopnea	9.2 ± 9.4	5.5 ± 3.3	.017
Mean SpO_2	95.4 ± 2.4	95.6 ± 1.6	.945
Lowest SpO_2	82.9 ± 8.5	84.9 ± 4.9	.517
Desaturation	16.5 ± 15.7	12.7 ± 10.5	.075

*All patients AHI ≥ 5 (n = 27)
SpO_2 = oxygen saturation of peripheral blood; Desaturation index = the number of 4% dips in SaO_2 per hour of sleep.

Table 3 Number of Patients Showing an Increase or Decrease in AHI While Wearing Complete Dentures During Sleep

	AHI increase	AHI decrease	*P*
5 ≤ AHI (n = 27)	8	19	.002
5 ≤ AHI < 15 (n = 16)	5	11	.030
15 ≤ AHI < 30 (n = 7)	3	4	.564
30 ≤ AHI (n = 4)	0	4	.021

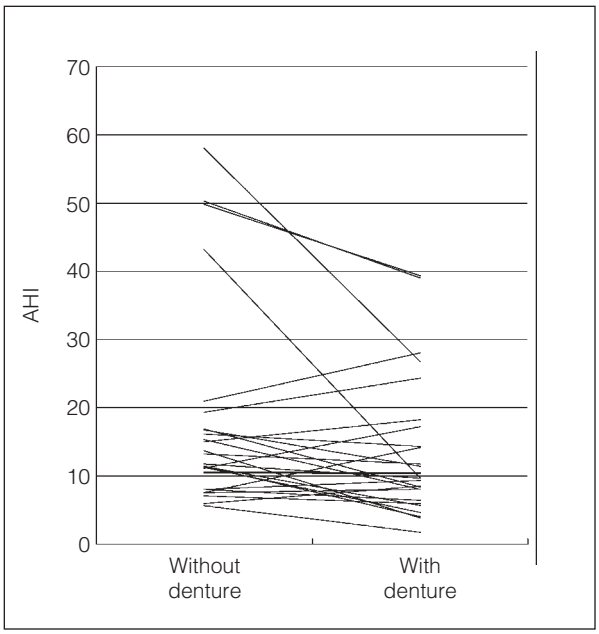

Fig 1 Individual changes in AHI index with and without complete dentures; AHI = apnea-hypopnea index, showing the number of apnea / hypopnea episodes per hour (5 ≤ mild < 15, 15 ≤ moderate < 30, severe ≥ 30).

Nineteen of the 27 patients suffering from OSAS (70%) reported that they customarily removed their dentures before going to sleep. Each of the seven patients with an AHI < 5 who were not suffering from OSAS also removed their dentures before sleep. Five of those seven patients showed an increase in AHI on sleeping with dentures inserted, however none of them experienced an increase in AHI of more than five points on doing so (data not shown).

Table 2 shows mean and standard deviation (SD) values of the polysomnographic parameters of patients with an AHI ≥ 5. Individual changes of AHI index scores on sleeping with and without complete dentures revealed a significant difference in the AHI index under these conditions (*P* = .022) (Fig 1). The mean AHI index in patients sleeping with dentures inserted was lower than that of those sleeping without dentures. The decrease of AHI was not due to a decrease in apnea, but rather to a decrease in hypopnea. There were no differences in mean SpO_2, lowest SpO_2, or desaturation index between them (Table 2).

Sixteen patients received a mild AHI score (5 ≤ AHI < 15), seven patients received a moderate AHI score (15 ≤ AHI < 30), and four patients received a severe AHI score (AHI ≥ 30) by using the severity criteria for OSAS.[19] Table 3 shows the number of patients with an AHI increase or decrease when wearing complete dentures.

Discussion

The occurence of OSAS in the patients enrolled in this study was 79% when they did not wear their dentures during sleep. Since this is a higher occurence than has previously been reported for other aged populations,[5–7] this suggests that edentulous patients tend to experience sleep apnea at a higher incidence than that of the general population. Previous reports indicate that the occurence of OSAS in individuals over 60 years of age is estimated to be between 20%[5] and 24%,[6] but in one study (in which OSAS was defined as an AHI score > 10) it reached 62%.[7] The present study demonstrated that wearing complete dentures can lower AHI scores in most patients (Tables 2 and 3). However, a minority of the patients in this study experienced an increase in sleep apnea when sleeping with complete dentures inserted compared to when they slept without dentures.

Since the sleep-recording instruments were operated by the patients themselves in their own homes, questions about the accuracy of the data collection may be raised. However, the exclusion criteria for this study included cognitive impairment, and patients were given detailed explanations on the use of the sleep-recording instruments and practiced how to use the instrument in the outpatient clinic. Therefore, an inaccurate collection of data due to improper use of the instrument is unlikely. Patients were instructed to spend a usual day and not to collect data on days when they had consumed alcohol, were exhausted, or worked until late at night—conditions that are thought to have some influence on normal sleep patterns. A retrospective survey conducted on the use of the sleep-recording instruments revealed that none of the patients experienced disturbances in their usual sleep on the nights that data were collected for this study.

Edentulism causes changes to the facial anatomy, including loss of the vertical dimension of occlusion,[9] changes in the position of the mandible[10] and the hyoid bone,[11] and changes in neural activation mechanisms.[12,13] The mechanism underlying the relationship between edentulism and OSAS may involve anatomic and functional changes in the upper airway. Wearing complete dentures induces modifications in the position of the jaw, tongue, soft tissues, and pharyngeal airway space[20] that may contribute to the reduction of apnea episodes. And since wearing complete dentures might not change the horizontal mandibular position as oral appliances do, it might help to restore the vertical mandibular position.

The decrease of AHI was not attributable to a decrease in apnea, but rather to a decrease in hypopnea. There were no changes in mean SpO_2, lowest SpO_2, or desaturation index. The authors suggest that wearing complete dentures may ameliorate partial obstructions of the upper airway, but does not improve the complete occlusion of the upper airway implicated by the induction of apnea or changes in SpO_2. However, since most patients sleeping with complete dentures inserted experienced a decrease in AHI but showed no improvement in SpO_2, the effect of wearing complete dentures during sleep on OSAS needs to be assessed in more detail.

More importantly, four patients showed increases in AHI of more than 5 points when sleeping with complete dentures inserted. The intercuspal positions of the dentures of all patients enrolled in the study were stabilized by the same prosthodontist. However, during sleep, use of complete dentures may cause an increase in open bite, leading to mouth breathing and an increase in AHI. Indeed, multiple factors may influence the increase in AHI. Further investigations by magnetic resonance imaging or computed tomography on sleeping patients are needed to evaluate the multifactorial underlying causes.

OSAS is associated with acute, unfavorable effects on cardiovascular pathologies[21] such as heart failure,[22] stroke,[23,24] and coronary heart disease,[25] resulting in a shortened life expectancy.[1,2] However, none of the patients enrolled in the present study had been previously diagnosed with OSAS. That said, OSAS is a notoriously under-diagnosed condition.

The use of dentures has been reported to be associated with chronic inflammatory changes leading to irritation,[26] periodontitis, and alveolar bone resorption in the denture-supporting area.[27,28] To avoid these complications, almost all patients who use complete dentures are recommended by their clinicians to remove their dentures before sleeping. In fact, 70% of patients enrolled in this study removed their dentures prior to sleep. In contrast to these risks, this study found that wearing complete dentures during sleep may provide the benefit of ameliorating sleep apnea in edentulous patients.

The risk-benefit ratio for the reduction of sleep apnea when wearing complete dentures during sleep against the above mentioned chronic inflammatory changes needs to be assessed. The authors suggest that there may be an urgent need to screen every edentulous patient for sleep disorders when new complete dentures are fitted, and it should be noted that clinicians must play an important role in implementing such assessments.

Conclusions

This study indicated that wearing complete dentures during sleep improves the AHI in the majority of edentulous OSAS patients, but also that AHI increases in a minority of patients. Additionally, there were some patients who did not experience any significant change in AHI associated with the use or non-use of complete dentures during sleep.

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