Assessment of the impact of vertical dimension alterations on the quality of sleep in elderly patients wearing upper and lower full dentures

Avaliação da alteração da dimensão vertical na qualidade do sono em pacientes idosos portadores de próteses totais bimaxilares

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ABSTRACT

Objectives: The loss of vertical dimension of occlusion (VDO) is a problem that affects stomatognathic system performance, mainly in edentulous patients. Thus, diseases related to musculature failure such as obstructive sleep apnea syndrome (OSAS) are common in these patients. Consequently, efficient and low-cost therapeutic strategies such as intraoral devices (IOD) used to expand the upper airway (UA) are needed to improve the quality of sleep in these patients. The aim of this study was to assess both the subjective and objective effect of VDO increase on the quality of sleep in 19 elderly patients using bimaxillary total prostheses (TPs) before and after placement of new TPs and therapy with intraoral devices (IOD) especially designed to increase VDO without causing mandibular advancement. Methods: For this purpose, questionnaires surveying quality of sleep (Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index and sleep anamnestic questionnaire) and polysomnography tests (PSG) were performed at three different phases: baseline without TPs, with TPs and with IODs. Conclusions: It was concluded that the tested IODs may contribute to improvements in the quality of sleep for patients and their sleeping partners because they led to significant decreases in snoring. Most patients also expressed a preference for IOD use while sleeping. However, the use of IOD did not significantly improve polysomnography parameters compared to the baseline and thus cannot be indicated for the treatment of OSAS.

Keywords: aging, equipment and supplies, obstructive, sleep apnea, vertical dimension.

RESUMO

Objetivos: A perda da dimensão vertical de oclusão (DVO) é um problema que compromete o desempenho do sistema estomatognático, principalmente em pacientes edêntulos. Logo, doenças relacionadas ao colapso da musculatura, como a síndrome da apneia obstrutiva do sono (SAOS), tornam-se mais prevalentes nesses pacientes. Assim, estratégias terapêuticas eficientes e de baixo custo, como a utilização de um dispositivo intraoral (DIO) especialmente desenvolvido para aumentar a DVO sem provocar avanço mandibular. Métodos: Para isso, questionários foram aplicados antes e após a colocação de próteses totais (PTs) e uso de um dispositivo intraoral (DIO). Conclusões: Concluiu-se que o DIO testado pode contribuir para uma melhora na qualidade do sono dos pacientes e dos parceiros do sono, na medida em que levou à diminuição significativa do ronco e elevada preferência pelo uso do DIO para dormir. No entanto, a utilização do DIO, para esta amostra, não melhorou significativamente os parâmetros polissonográficos em relação ao momento basal e, portanto, não pode ser indicado para tratamento da SAOS.

Descritores: apnéia do sono tipo obstrutiva, dimensão vertical, envelhecimento, equipamentos e provisões.

INTRODUCTION

According to the American Academy of Sleep Medicine (AASM)(1), obstructive sleep apnea syndrome (OSAS) is a sleep disorder characterized by recurrent episodes of total or partial UA obstruction during sleep. OSAS is a result of the obstruction caused by oro- or hypopharynx soft tissue failure. The latter includes the base of the tongue, soft palate and uvula, as well as the tonsils, epiglottis and pyriform sinuses(2). Recent reports show that OSAS affects the quality of life of patients while also increasing the risk of cardiovascular disease and traffic accidents(3-5).

Estimation of OSAS prevalence is highly dependent on the definition of sleep-related respiratory events and the limits of the indexes used to establish disease severity. Nevertheless, it can be said that the prevalence increases in the shift from the middle-aged to the elderly population and that the proportion between males and females is 2:1(6-9).

OSAS treatment includes several therapeutic measures from simple changes in habits, such as the discontinuance of alcoholic drinks, to the use of continuous positive airway pressure (CPAP), the use of...
intraoral devices (IODs) and surgery\(^{(9-11)}\). Over the past few decades, a large number of studies reported on IOD use in OSAS and snoring treatment, which involves a simple and non-invasive therapeutic approach\(^{(12)}\).

The relationship between edentulism and increasing OSAS severity has been recently suggested because edentulism causes anatomical changes in the face and functional changes in the UA. Thus, edentulism may contribute to the pathogenesis of OSAS. Epidemiological data show that 18% of individuals over 60 years old are edentulous. Such circumstantial evidence indicates the possible causal relationship between OSAS and edentulism, although this possibility has yet to be thoroughly investigated\(^{(13)}\). One study relating tooth loss to OSAS concluded that the lack of teeth may cause anatomical and functional modifications in both the tongue and in the pharyngeal airway. VDO loss, reductions in the lower third of the face and mandibular rotation are considered to be the main determining factors behind occlusal disharmony\(^{(14)}\).

In this context, we sought to study the influence of VDO alteration on the quality of sleep in elderly edentate individuals by using bimaxillary TPs. The literature lacks reports regarding this method and mostly includes studies on patients who are totally or partially dentate. For this purpose, we developed an IOD for nightly use that promotes VDO increase without causing mandibular advancement.

**MATERIALS AND METHODS**

**Sample Selection**

A randomized clinical trial was performed with 38 patients who spontaneously visited the outpatient clinic called Ageing with a Smile (at FOUSP) seeking bimaxillary TPs. Randomization was based on patient choice regarding sleeping with or without TPs. When patients chose to sleep with TPs, a PSG was first performed after a minimum of 15 days of TP use during sleep. The test was carried out while patients were using the TPs. When the patients chose not to use TPs during sleep, the same protocol was applied and PSG was performed with patients not using TPs. At the time of the second PSG, TP use status was the opposite of the status at the time of the first PSG (Figure 1). All participants had at least one old TP that needed replacement due to irregularities. This study was carried out between October 2009 and March 2010. Individuals of both sexes, 60 years old or older who used bimaxillary TPs made at Ageing with a Smile Program were included. Users of hypnotic or sedative drugs; individuals with neurologic or any severe and decompensated clinical disease; individuals who did not agree to comply with the study protocol; users of monomaxillary TPs, users of alcohol and illegal drugs; patients treated for sleep disorders with continuous positive airway pressure (CPAP), IOD or a myorelaxing plate for bruxism; and patients exhibiting abrupt weight changes during the study were excluded.

**Study protocol**

At the first visit, all participants were subjected to clinical examination by means of interviews and physical examinations of the mouth, face, temporomandibular joint (TMJ) and neck. Muscles assessed by palpation included the superficial and deep masseter and the medial, lateral and temporal (e.g., anterior, middle and posterior) pterygoids. Patients who met the inclusion criteria were invited to participate in the study; those who agreed signed an informed consent form. The ethical background of this study was based on the Brazilian legislation Resolution 196/96; this study was approved by the Ethics Committee of UNIFESP (protocol 1113/09) and acknowledged by the Ethics Committee of the Faculty of Odontology, University of São Paulo (FOUSP).

Onset of oral rehabilitation was immediate according to Tamaki’s\(^{(15)}\) guidelines for TP construction. After TP placement and the necessary time needed to adapt and correct interferences affecting the function of the prostheses, IODs were constructed using chemically activated acrylic resin (Clássico-JET\(^{®}\) autopolymerizing acrylic) designed to increase the VDO by 10 millimeters without causing any mandibular advancement. VDO was used in the duplication of the upper prosthesis, which was adapted to the lower prosthesis given each patient’s usual maximal intercuspation position (Figure 2).
Data collection was performed as the prosthetic treatment was carried out. It consisted of the application of questionnaires and the performance of PSG tests. Six questionnaires were used; the first one investigated pre-treatment conditions assessing the length of use of older TPs (i.e., those used by patients before the study), the presence or absence of alveolar resorption in edentate arches, and the Mallampati index. The two latter sets of data were collected by means of clinical examination and were recorded in the questionnaire. Next, two questionnaires, the Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI) were applied to assess the likelihood of sleep disorders and to evaluate the quality of sleep in patients and in their sleep partners. A TP control questionnaire was also applied to assess satisfaction among patients with TP use. This questionnaire included questions such as q1 - do you sleep using the upper TP? q5 - do you sleep using the lower TP? q6 - how many average nights per week do you sleep using the lower TP? and q8 - how do you feel about the lower prosthesis? An anamnestic sleep questionnaire was also applied to assess sleep-related clinical conditions such as snoring or respiratory pauses during sleep, as well as feelings of daytime fatigue. This questionnaire included questions such as: Q3 - do you snore? and Q6 - does your snoring bother other people? Finally, modified questionnaires assessing side effects and long-term compliance with oral device use in snoring and OSAS treatment were applied to investigate complaints related to IOD use as well as the underlying reasons behind discontinuation.

Data collection (from the questionnaires and PSG) was performed at three different phases: 1) at baseline, after at least 15 days of sleeping according to the established randomized sequence (with or without TPs), when the patients were subjected to the first PSG; 2) at the second phase, when a second PSG was performed at least 15 days after sleeping either with or without TPs (always according to the randomized sequence); and finally, 3) when the third PSG was performed on patients using IODs after they had slept at least 15 days while using IODs. At each data collection phase, only the Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), and the anamnestic sleep questionnaire were used to assess sleep-related clinical conditions as they applied to patients.

Polysomnography
All-night laboratory PSGs were performed at the Sleep Institute of Psychopharmacology Promotion Fund Association (AFIP) by polysomnography devices. In this study, the EMBLA system was used with the “Somnologica” (version 3.3.1) software, and a computer was used to process data and to record, analyze and compile all components of the polysomnographic studies. Surface electrodes were used to record electroencephalograms (EEG), chin and tibia electromyograms (EMG), electrooculograms (EOG), and electrocardiograms (EKG), all of which were used to assess sleep stages. Breathing was monitored using a nasal cannula that measured air flow via a pressure transducer, oral flow via a thermal sensor, and chest and abdomen movements via non-calibrated respiratory inductance plethysmography. Pulse oximetry was used to measure oxyhemoglobin saturation. Body position, important in recording decubitus, was assessed by means of a sensor placed on the sternum. A tracheal microphone allowed the recording of snoring. Tests were performed by a PSG technician. PSG results were always evaluated and recorded by the same physician who was blinded to the odontologic procedures to avoid any biases. The AASM committee criteria were followed to correct for respiratory events. American Sleep Disorders Association criteria were used in the event of awakenings. OSAS diagnostic criteria include the presence of five or more episodes of apnea/hypopnea per sleep hour associated with a clinical complaint (e.g., snoring, report of respiratory pauses during sleep and/or significant sleepiness) or apnea-hypopnea index above 15 with or without complaints. OSAS was categorized as mild (5≤AHI<15), moderate (15≤AHI<30), or severe (30≤AHI).

Statistical analysis
Statistical analysis was performed using the PSG and questionnaire data collected from the participants at three different phases. To analyze the data, a non-parametric Friedman test was used for the repeated measures with subsequent bivariate comparisons adjusting for the significance index via the Bonferroni correction. A non-parametric test was chosen because the dependent variables did not exhibit a normal distribution. The Chi-squared test was used for the categorical variables. Statistical significance was established at p < 0.05.

RESULTS
Patients
Thirty-eight patients were included, among whom 19 completed the study. Among the patients who did not complete the study, 2 had to be admitted to hospitals, 1 moved to another town, 2 were excluded due to excessive weight gain between PSG assays, 1 had an inadequate polysomnographic record, 9 did not return for the second PSG assay, and 4 did not return for the third PSG assay. The average age was 71.1 years old, and the standard deviation was 5.8 (minimum-61/maximum-81); 78.94% were females. There were no statistically significant differences in the age, body mass index and polysomnographic record values of patients who completed and those who did not complete the study.

Questionnaires data
The pre-treatment conditions questionnaire was completed by 18 out of the 19 patients in the sample. From these, 72.22% had Mallampati index scores of III or IV. Thirteen patients (72.22%) exhibited resorption in the lower alveolar margin. The average length of older upper TP use was 8.1 years, whereas the average length of older lower TP use was 6.2 years.
Regarding TP, the results from the control questionnaire, sleep anamnestic questionnaire, ESS and PSQI are described in Table 1. There was no significant difference in the ESS results among the three evaluated phases (e.g., without prosthesis, with prosthesis and with IOD). For PSQI, there was a significant difference in the global scale values between phases without prosthesis and with IOD ($p = 0.01$). Thus, the data showed improvements in the subjective quality of sleep going from the phase without prosthesis to the phase with IOD.

Regarding the TP control questionnaire, there were significant differences for questions 1, 5, 6 and 8, and there were significant differences for questions 3 and 6 ($p<0.05$) from the sleep anamnestic questionnaire. Questions 3 and 6 depended on the patients’ quality of sleep and thus warranted special attention. Question 3 indicated significant differences in the snoring rate between the phase with prosthesis and the phase with IOD. As such, IOD use displayed a reduced snoring rate among patients ($p = 0.02$). Question 6 exhibited a significant difference in the snoring-related discomfort rate over time ($p = 0.04$). A difference was found only between the phase without prosthesis and the phase with IODs. Thus, snoring caused less discomfort to other people when the patients used IODs. Questions 3 and 6 showed that IOD use improved the subjective quality of sleep in patients.

During the administration of the TP control questionnaire, patients were inquired as to their preference regarding sleep without TPs, with TPs or with IODs. Here, a Chi-squared test showed significant differences in the frequency of individuals who preferred to sleep with IOD (67.89%, Chi-square = 8.016, $p=0.032$).

Most participants (85%) did not report having noticed any side effect after IOD use. The side effects exhibited by the other 15% of patients were related to the lack of adaptation to IOD during sleep, increased time before falling asleep, difficulty in adapting to the TP after sleeping with IOD, and tendency to tighten the phase without prosthesis and the phase with IODs. Thus, snoring caused less discomfort to other people when the patients used IODs. Questions 3 and 6 showed that IOD use improved the subjective quality of sleep in patients.

### Polysomnographic data

Polysomnographic data are described in Table 2. The only polysomnographic parameters exhibiting significant differences were the AHI and hypopnea (HI) index values ($p<0.02$). For AHI, there was a significant difference between groups without prostheses and with prostheses, as well as between groups with prostheses and with IODs. For HI, there was a significant difference only between the phase without prostheses and the phase with prostheses (Figure 3). Regarding AHI alone, most patients exhibited increased AHI when they shifted from a phase without prostheses to one with prostheses. When using IOD, the AHI decreased, although it remained higher than the baseline AHI value (without prosthesis). Regarding HI, patients exhibited increases when they shifted from a phase without prostheses to one with prostheses. According to the baseline PSG based on the 18 patients in the sample, 8 (44.44%) were classified as having mild OSAS, 7 (38.89%) had moderate OSAS and 3 (16.66%) had severe OSAS. Among patients with OSAS, the ones rated as having severe symptoms showed the highest reductions in AHI when sleeping with an IOD. Moreover, among the 19 studied patients, 11 exhibited AHI reductions when using an IOD compared to the values recorded when they slept using the prosthesis; among these, 7 patients (36.84%) exhibited ≥ 50% AHI reduction (Table 3).

![Figure 3](image329x319to574x470)

**Figure 3.** Apnea/hypopnea index (AHI) and hypopnea index (HI) value means according to patient conditions during polysomnography: without total prosthesis (TP), with total prosthesis (TP), and with intraoral device (IOD).

### Table 1.

Data from the TP control questionnaire (q1 to q8), anamnestic sleep questionnaire (Q3 to Q6), Epworth Somnolence Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI) for all three conditions of patients during polysomnography: with total prosthesis (TP), without total prosthesis (TP), and with intraoral device (IOD).

<table>
<thead>
<tr>
<th>Question</th>
<th>Without TP</th>
<th>With TP</th>
<th>IOD</th>
<th>$p$-value (Friedman)</th>
</tr>
</thead>
<tbody>
<tr>
<td>q1</td>
<td>33.24 ± 0.22♦</td>
<td>34.5 ± 0♦</td>
<td>9.77 ± 0.26♦ ≠</td>
<td>0</td>
</tr>
<tr>
<td>q5</td>
<td>21.02 ± 0.3♦</td>
<td>40.32 ± 0.39♦ ≠</td>
<td>20.27 ± 0.26♦ ≠</td>
<td>0</td>
</tr>
<tr>
<td>q6</td>
<td>30.5 ± 0♦</td>
<td>19.59 ± 0.51♦ ≠</td>
<td>30.5 ± 0#</td>
<td>0</td>
</tr>
<tr>
<td>q8</td>
<td>29.9 ± 0.31♦</td>
<td>21.79 ± 0.51♦</td>
<td>27.3 ± 0.41</td>
<td>0.03</td>
</tr>
<tr>
<td>Q3</td>
<td>33 ± 0.85</td>
<td>20.29 ± 0.79♦</td>
<td>26.2 ± 0.96♦</td>
<td>0.02</td>
</tr>
<tr>
<td>Q6</td>
<td>20.96 ± 0.67♦</td>
<td>19.86 ± 0.77</td>
<td>11.17 ± 0.67♦</td>
<td>0.04</td>
</tr>
<tr>
<td>ESS</td>
<td>25.38 ± 3.88</td>
<td>29.21 ± 4.47</td>
<td>28.47 ± 4.86</td>
<td>0.72</td>
</tr>
<tr>
<td>PSQI</td>
<td>30.71 ± 9.75♦</td>
<td>29.42 ± 10.21</td>
<td>26.58 ± 9.82♦</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*Data are exhibited as the mean. ±: standard deviation.

♦ ≠: Bivariate differences found corrected using the Bonferroni method ($p<0.05$).

Caption: $p$-value=significance level. Q e q= question.

Assessment of the impact of vertical dimension alterations on the quality of sleep in elderly patients wearing upper and lower full dentures

Table 2. Polysomnographic data of 18 patients sleeping without total prosthesis (TP), with total prosthesis (TP) and with intraoral device (IOD).

<table>
<thead>
<tr>
<th></th>
<th>Without TP</th>
<th>With TP</th>
<th>IOD</th>
<th>p-value (Friedman)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index (Kg/m²)</td>
<td>23.94 ± 3.14</td>
<td>24.53 ± 3.21</td>
<td>23.46 ± 3.65</td>
<td>0.98</td>
</tr>
<tr>
<td>Sleep efficiency (%)</td>
<td>31.94 ± 11.49</td>
<td>24.14 ± 17.56</td>
<td>26.42 ± 15.09</td>
<td>0.31</td>
</tr>
<tr>
<td>Sleep latency</td>
<td>25.31 ± 15.61</td>
<td>26.78 ± 31.55</td>
<td>30.42 ± 25.67</td>
<td>0.6</td>
</tr>
<tr>
<td>Vigil time (min)</td>
<td>23.86 ± 41.67</td>
<td>31.58 ± 48.05</td>
<td>27.06 ± 58.97</td>
<td>0.33</td>
</tr>
<tr>
<td>REM sleep latency</td>
<td>29.17 ± 102.52</td>
<td>26.94 ± 72.31</td>
<td>26.39 ± 73.22</td>
<td>0.85</td>
</tr>
<tr>
<td>Sleep stage 1</td>
<td>28.42 ± 1.77</td>
<td>26.58 ± 5.63</td>
<td>27.5 ± 4.24</td>
<td>0.94</td>
</tr>
<tr>
<td>Sleep stage 2</td>
<td>26.42 ± 11.69</td>
<td>31.31 ± 10.09</td>
<td>24.78 ± 8.92</td>
<td>0.43</td>
</tr>
<tr>
<td>Sleep stages 3 and 4</td>
<td>29.31 ± 7.82</td>
<td>23.32 ± 8.47</td>
<td>28.17 ± 8.41</td>
<td>0.48</td>
</tr>
<tr>
<td>REM sleep</td>
<td>27.78 ± 7.22</td>
<td>25.97 ± 6.8</td>
<td>28.75 ± 7.22</td>
<td>0.87</td>
</tr>
<tr>
<td>Arousals</td>
<td>24.64 ± 12.09</td>
<td>26.69 ± 19.77</td>
<td>31.17 ± 14.26</td>
<td>0.44</td>
</tr>
<tr>
<td>Apnea/Hypopnea Index</td>
<td>24.92 ± 12.22 ♦</td>
<td>31.06 ± 21.22 ♦</td>
<td>26.53 ± 20.77 ♦</td>
<td>0.02</td>
</tr>
<tr>
<td>Apnea</td>
<td>26.75 ± 9.75</td>
<td>29.53 ± 16.22</td>
<td>26.22 ± 15.17</td>
<td>0.79</td>
</tr>
<tr>
<td>Hypopnea</td>
<td>22.64 ± 5.9 ♦</td>
<td>31.78 ± 13.63 ♦</td>
<td>28.08 ± 10.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Minimum O₂ saturation (%)</td>
<td>26.53 ± 3.3</td>
<td>29.36 ± 6.69</td>
<td>26.61 ± 5.74</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Data are exhibited as the mean ± standard deviation. ♦ e ≠: Bivariate differences found corrected by Bonferroni method (p<0.05).

Table 3. Effect of IOD on AHI according to OSAS severity by baseline (without prosthesis) during PSG for 18 totally edentate patients.

<table>
<thead>
<tr>
<th>OSAS severity</th>
<th>N</th>
<th>AHI increase</th>
<th>No alteration in AHI</th>
<th>AHI reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤AHI&lt;15</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15≤AHI&lt;30</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>≥30≤AHI</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* AHI was rated without alteration when variation was ≤ 20%.

Discussion

In this study, polysomnographic parameters in elderly and totally edentate patients using bimaxillary TPs were recorded at three different phases (without prosthesis, with prosthesis and with IOD). AHI values exhibited increases with TPs compared to baseline scores; however, AHI values decreased significantly between the phase with prostheses and the phase with IODs. AHI values at the IOD phase remained high compared to the baseline, thus showing significant worsening compared to the initial phase of the study. Quality of sleep improved with IOD compared to the baseline, and most patients preferred to sleep with IODs and did not report side effects, except improvements regarding snoring.

In this case-series, BMI was an exclusion criterion because there is a correlation between weight gain and OSAS severity(21). Patients using sleep inducers or hypnotic therapy were excluded because this type of drug aggravates OSAS(22,23). Although studies on partially or totally edentate patients have assessed the relationship between tooth loss and VDO diminution, none had sufficiently studied the direct influence of VDO on OSAS(19,14,24,25).

Most patients (72.22%) in our study exhibited Mallampati index scores of III or IV, whereas 55.54% had moderate to severe OSAS when not using TPs. These findings agree with those seen in the literature, which rates Mallampati Modified classifications as a reliable predictor of OSAS diagnosis(26).

No significant difference was found in the ESS results in any of the three phases assessed, thus contradicting most the findings of most other authors(27-30). To explain this difference, one may hypothesize that these authors selected dentate patients and that the IODs used in those studies caused mandibular advancement, which did not occur in this study. However, despite global results that failed to show significant improvement in ESS during the IOD phase, it is important that patients exhibiting AHI reductions were the same ones who reported decreases in daytime sleepiness symptoms. Some studies reported results favoring prosthesis use during sleep as an alternative to minimize OSAS(13,14,24,25), which contradicts the results from in this study.

Our study agrees with the conclusions of Bittencourt et al.(10) regarding AHI variability between different phases of polysomnographic testing. We believe that the alterations found in AHI at different PSG phases were not exclusively expressions of VDO increases, although they were related with the variability itself. The few studies that have considered AHI variability have been contradictory in that some reported AHI variability whereas others did not. Divergences might be related with methodological differences such as anthropometric data, OSAS presence and severity, intervals between PSG tests, and methods used to measure and assess variability.

The primary reasons inducing patients to discontinue IOD treatment included side effects and the eventual inefficacy of the device(32). In our sample, 85% of the patients reported that there were no side effects that would lead them to discontinue treatment. This positive result agrees with the literature(21,29,30). Therefore, it is possible to conclude that the tested IODs contributed to a better subjective quality of sleep for patients and their sleep partners because they caused significant reductions in snoring. It was also possible to establish a high preference by patients for IOD use during sleep, despite its failure to improve daytime sleepiness (ESS).
In this sample, IOD use did not significantly improve polysomnographic parameters compared to baseline (without prosthesis phase). Therefore, this may not be indicated for OSAS treatment. VDO increases cannot be held as the only factor responsible for snoring improvement, due to the complexity of factors involved in tooth loss in patients using bimaxillary TPs.

Further studies involving UA diameter analyses and side effects related to TMJ are needed to develop and fine-tune IOD use in the treatment of OSAS in elderly patients using bimaxillary TPs.

REFERENCES