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POSTER #001

### LONG-TERM OBSTRUCTIVE SLEEP APNEA THERAPY; A 10-YEAR FOLLOW-UP OF MANDIBULAR ADVANCEMENT DEVICE AND CONTINUOUS POSITIVE AIRWAY PRESSURE

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**Introduction:** Obstructive sleep apnea syndrome (OSAS) is a sleep related breathing disorder, commonly treated by either Continuous Positive Airway Pressure (CPAP) or a Mandibular Advancement Device (MAD). Long-term follow-up and comparison regarding efficacy of these therapies is scarce. In this study the results of treatment, patient compliance and satisfaction over a 10-year follow-up of CPAP and MAD therapy are reported.

**Methods:** 103 OSAS patients were selected for a randomized controlled clinical trial. After a 10-year follow-up period, 14 patients using MAD and 17 patients using CPAP could be evaluated. Data was analyzed at baseline, after 3-months and at 1, 2, and 10-year follow-up. All 31 OSAS patients were subjected to polysomnography and subjective measurements.

**Results:** Polysomnography showed a favorable outcome of both therapies at 10-year follow-up. At baseline, both therapies did not significantly differ in apnea-hypopnea index (AHI) values. At 10-year follow-up both, MAD and CPAP group, showed a significant reduction in AHI. At baseline the mean AHI in MAD group was 31.7±20.6 whereas in the CPAP group 49.2±26.1. At 10-year follow-up the mean AHI in MAD group was 9.9±10.3 and in the

CPAP group 3.4±5.4. From a subjective perspective both therapies resulted in a substantial improvement in neurobehavioral outcomes at 10-year follow-up.

**Conclusions:** Both CPAP and MAD therapy demonstrate good and stable treatment effects after a 10-year follow-up period. Therefore, when indicated, both therapies are appropriate modalities for the long-term management of OSAS.

**Support:** None

POSTER #002

### CENTRAL SLEEP APNEA DUE TO TREATMENT OF OBSTRUCTIVE SLEEP APNEA WITH AN ORAL APPLIANCE

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**Introduction:** Obstructive sleep apnea (OSA) is a common sleep disorder estimated to be affecting 12% Americans out of which 80% remain undiagnosed. Even though continuous positive airway pressure (CPAP) is considered the gold standard treatment, CPAP intolerance and compliance are major issues in management of OSA. Oral appliance therapy (OAT) is an effective and less invasive treatment option in patients with mild to moderate OSA. Complex sleep apnea or CPAP-emergent Central sleep apnea (CSA) is known to occur in 15-20% of patients on CPAP therapy; however, CSA following OAT is a rare entity.

We present a case with CPAP intolerant OSA, developed CSA on OAT and later tolerated BPAP with OAT as combination therapy.

**Methods:** 46 years old male presented with history of snoring, witnessed apneas, and excessive daytime sleepiness with Epworth sleepiness scale of 12/24. Patient was intolerant to CPAP and was referred to our dental sleep clinic for treatment with OAT. Patient received the custom fitted oral appliance (Dorsal Type).

**Results:** Baseline polysomnogram (PSG) showed 206 obstructive apneas (OA), 15 mixed apneas (MA) and 96 obstructive hypopneas (OH) with Apnea Hypopnea index (AHI) of 52.8/hour and lowest SPO<sub>2</sub> of 76%. The events were worse in supine position with supine AHI of 73.6/hour. Following OAT fitting, an in-lab PSG was done with OAT in situ. During this PSG, oral appliance was

adjusted to an additional 2.0 mm of protrusion. Patient had emergence of central apneas while on OAT. There were 54 central apneas (CA) and 16 MA, along with 112 OA and 149 hypopneas. Due to emergence of central sleep apnea with OAT, patient was scheduled for another PSG for Bi-level Positive Airway Pressure (BPAP) titration, in consultation with the sleep physician. PSG was performed with oral appliance in situ, and expiratory positive airway pressure (EPAP) 10 cm, maximum (Max) EPAP 21cm, Min pressure support (PS) 0 cm, Max PS 15cm, respiratory rate auto; was performed. With OAT in situ and BPAP ASV, the AHI was 0/hour and patient reported deep and restful sleep. Following titration, patient was able to use BPAP ASV in combination with OAT. Patient had good compliance and improvement of symptoms with combination therapy.

**Conclusions:** Complex sleep apnea or CPAP emergent Central sleep apnea is a challenging diagnosis for the sleep physicians and dentists. It is rare to have emergence of CSA with OAT. BPAP with backup rate is the recommended treatment; however, PAP intolerance can complicate the management of such patients. Combination of OAT and BPAP with backup rate can be used in select cases who are intolerant or non-compliant with PAP.

**Support:** none.

POSTER #003

#### MANAGEMENT OF TMD AFTER THE INITIATION OF TREATMENT FOR OBSTRUCTIVE SLEEP APNEA WITH ORAL APPLIANCE THERAPY- A CASE REPORT

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**Introduction:** Obstructive sleep apnea (OSA) is a condition involving complete or partial obstruction of upper airway during sleep. The prevalence in the U.S. is estimated to be 10-17% of men and 3-9% of women. Untreated OSA could lead to adverse cardiovascular, metabolic events, motor vehicle accidents and decreased quality of life. The gold standard for treatment is positive airway pressure (PAP) therapy. However, for adult patients that are intolerant or prefer alternate therapy, oral appliance (OA) therapy can be indicated. Mandibular advancement devices protrude the mandible, thereby, lifting the tongue of the pharyngeal wall. Consequently, a potential side effect of these devices is transient pain in the temporomandibular joint and/or masticatory muscles, particularly, in patients with previous signs and symptoms of temporomandibular disorders (TMD). In some patients the pain could be severe enough that oral appliance therapy maybe abandoned, thus, proper management of TMD will be crucial for the success of oral appliance therapy.

**Methods:** 61-year-old female was diagnosed by means of PSG with mild OSA in October 2017 (AHI 9.9 and minimum O<sub>2</sub> saturation 88%) and was unable to tolerate her C-PAP. She reported mild temporomandibular symptoms associated with an occasional painful clicking sound on the right TMJ present for many years. A Somnomed appliance was delivered at 50% of maximum protrusive movement.

**Results:** Upon initiation of the treatment, patient reported an aggravation of her TMD symptoms with episodic bilateral preauricular pain (VAS = 6/10) upon awakening and during meals. Clinical examination revealed pain on palpation of bilateral masseter muscles, temporal tendons and TMJs. Conservative treatment was introduced including: soft diet, thermotherapy, clenching awareness, habit reversal, and clock-regulated NSAIDs for 2 weeks. Despite the conservative approach patient discontinued the use of the oral appliance due to aggravation of pain (VAS = 9/10). During one month, patient resumed the C-PAP therapy and her TMD symptoms resolved (VAS = 0/10). Oral appliance was then reintroduced at 20% of maximum protrusion (2 mm of advancement) in addition to self-care strategies for TMD. At one month follow up patient reported significant improvement of symptoms (VAS = 2/10). Titration of the appliance was then initiated by small increments of 0.5 mm every month. At 6 months, patient has been wearing her appliance every night (VAS = 0/10) and reported no signs and symptoms of TMD and 80% improvement in sleep quality.

**Conclusions:** Temporomandibular disorders are common often transient side effects associated to the use of mandibular advancement devices. Patients with OSA managed with oral appliance therapy should be screened for TMD prior to the insertion of the OA and during the subsequent follow up appointments. Proper management of TMD will be crucial for the success of oral appliance therapy.

**Support:** None

POSTER #004

#### THE ASSOCIATIONS BETWEEN PERIODONTITIS AND THE RISK OF OBSTRUCTIVE SLEEP APNEA: A PILOT STUDY

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**Introduction:** Periodontitis (PD) is a complex, highly prevalent chronic inflammatory disease which, if left untreated, leads to the loss of tooth-supporting structures and the resorption of the alveolar bone. Since PD and obstructive sleep apnea (OSA) share several risk factors, such as smoking, obesity, cardiovascular diseases, and diabetes, we aimed to investigate the associations between PD and OSA in a dental setting.

**Methods:** For this prospective cross-sectional case-control study, we recruited PD patients and non-PD controls at the Academic Centre for Dentistry in Amsterdam. The inclusion criterion for PD patients was the presence of at least one periodontal pocket of >5 mm, and for non-PD controls the inclusion criteria were periodontal pockets ≤5 mm and no interproximal alveolar bone loss visible on bitewing radiographs. At baseline, PD patients and non-PD controls filled out a validated screening questionnaire on the risk of OSA. Based on this questionnaire, an OSA risk score was calculated and subsequently participants were classified in low (<35%), intermediate (35%-55%) or high-risk categories (>55%). Independent T-tests and Chi-square tests were used to determine the differences between the two groups.

**Results:** To date 36 PD patients (mean age ± SD: 54 ± 11 years; 49% males) and 34 non-PD controls (54 ± 8 years; 51% males) participated. The two groups did not differ significantly with regard to age and gender distribution ( $P = 0.93 - 0.61$ ). The risk of OSA for the PD patients was  $35.1 \pm 28.5\%$ , vs.  $33.7 \pm 21.2\%$  for the controls (NS,  $P = 0.83$ ). There was a trend for more controls than PD patients in the intermediate OSA risk category ( $n=16$  vs  $n=8$ ), whereas in the high risk category of OSA a trend of more PD patients ( $n=7$ ) than controls ( $n=2$ ) was observed ( $P = 0.08$ ).

**Conclusion:** Preliminary results show that there is a trend toward an association between periodontitis and a high risk for OSA.

#### POSTER #005

### DENTAL SLEEP MEDICINE PRACTICE IN ACADEMIC INSTITUTIONS: A QUESTIONNAIRE-BASED STUDY

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**Introduction:** The aim of this study was to evaluate the current state of dental sleep medicine practice at the United States and Canada academic institutions.

**Methods:** An electronic survey with 21 multiple choice questions was created in Qualtrics and sent via email to all 76-dental academic institute in the United States and

Canada. SPSS version 24 was utilized, and descriptive statistics were calculated.

**Results:** 28 schools responded of which 86% were located in the United States. 12 schools had a dental sleep medicine clinic. In 42 % of the responders, the dental sleep medicine clinics were part of diagnostic services or incorporated with other departments. Of the school that have dental sleep medicine clinics, 33% reported difficulty integrating sleep medicine into other existing programs. Most common cause seemed to be related to lack of administrative support, space for the clinic, staffing and billing issues. The presence of 1-2 board certified faculty members were reported in eighty-three percent of the respondents. Continuing education (CE) courses were reported in 91% of schools.

**Conclusions:** Academic institutions consider the dental sleep medicine practice an important area to be included and respondents stated the presence of board-certified dental sleep medicine faculty had a positive impact on their programs. Strategies such as increased collaboration among faculty members, and an interdisciplinary approach between departments in the dental clinic may further aid in the development of a strong dental sleep medicine program. We speculate that with the recent development of dental sleep medicine standards of practice by the American Academy of Dental Sleep Medicine (AADSM), the practice and teaching of dental sleep medicine in academia will continue to grow globally.

#### POSTER #007

### TREATMENT OF OBSTRUCTIVE SLEEP APNEA USING ORAL APPLIANCE THERAPY IN PATIENTS WITH ATRIAL FIBRILLATION

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**Introduction:** Increasing numbers of patients are being referred for screening and treatment of obstructive sleep apnea (OSA) due to the presence of atrial fibrillation (AF). These patients are relatively asymptomatic: they appear to have little excessive daytime sleepiness and few sleep complaints. These patients are choosing oral appliance therapy (OAT) as their primary treatment for OSA over CPAP. This study examines the efficacy, subjective and objective adherence to OAT use in this population.

**Methods:** Patients referred to the Mt. Sinai Integrative Sleep Center from the cardiology clinics underwent full clinical evaluation of their sleep apnea by a sleep physician followed by full nocturnal polysomnography or home sleep test (HST). Patients with  $AHI_4 \geq 5/hr$  or  $RDI \geq 15/hr$  on

either sleep study were offered a choice of therapy – CPAP or OAT using a custom titratable Oral Appliance. (Somnodent with dentitrac adherence monitoring), irrespective of OSA severity. Patients opting for OAT were evaluated for suitability by a dentist qualified in dental sleep medicine, and patients with poor dentition or other contraindications to OAT were excluded. Patients followed a standardized dentist-guided protocol for OAT advancement. Patients reached target protrusion within 12 weeks. Objective adherence of OAT was monitored in a subset (n=9) using an implanted temperature sensor, interrogated at 90 days. Follow-up testing of efficacy was performed using HST after OAT titration. Treatment efficacy was defined as complete when final AHI4 < 5/hr, and partial when final AHI4 was reduced by 50% and AHI4<15/hr. Data are presented as mean (range) or ± standard deviation as appropriate.

**Results:** 36 AF subjects chose OAT as initial treatment for their OSA: 30M/6F, average age 72 yrs, range 58-95 yrs, Epworth Sleepiness Score (ESS) = 6±5, 15% with ESS >10. Baseline AHI4 was 23±20/hr, RDI 31±19/hr. 14 patients had mild OSA and 22 patients had moderate-severe OSA. Subjective OAT adherence (n=30) was 7±1.4hrs. Objective OAT adherence (n=9) was 6.9±2.2hrs and correlated to subjective adherence (r=0.67), with a bias (subjective – objective) of 0.45 hr. 16 subjects had a repeat HST on OAT with on-treatment AHI4 = 6.9 ± 7.4 and RDI = 13.3 ± 13. AHI4 was reduced by 76% overall; 11 subjects showed complete efficacy and 5 showed partial efficacy on OAT. One subject dropped out and 3 subjects (all with baseline mild OSA) showed no response.

**Conclusion:** Middle aged to elderly patients with AF and OSA show good response to OAT, with complete to partial resolution of OSA in the majority and good acceptance and adherence. The impact of OAT on AF recurrence remains to be tested.

**Support:** N/A

POSTER #008

#### **MANDIBULAR ADVANCEMENT DEVICE EFFICACY IS ASSOCIATED WITH VENTILATORY CONTROL STABILITY AT BASELINE**

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**Introduction:** Mandibular advancement device (MAD) treatment outcome varies among obstructive sleep apnea (OSA) patients. Upfront patient selection could be advantageous. Previous detailed physiology studies showed greater MAD treatment efficacy in patients with less-severe upper airway collapsibility and lower loop gain. However, these physiology studies are impractical for implementation in routine clinical practice.

Recent research (Sands SA et al. AJRCCM 2018) showed that it is possible to use data from routine polysomnography to estimate phenotypic OSA traits in clinical practice. The estimated traits include *collapsibility*: reduction in airflow at normal drive; *loop gain*: greater ventilatory drive in response to a drop in airflow; *arousal threshold*: ventilatory drive preceding arousal; *compensation*: increase in airflow as ventilatory drive increases; *ventilatory response to arousal [VRA]*: increase in ventilatory drive explained by arousal.

In the present study we used this methodology to estimate OSA traits from baseline polysomnography data in patients with moderate-to-severe OSA who were later treated with MAD. We aimed to assess the associations between the traits at baseline and the individual differences in MAD treatment efficacy.

**Methods:** Thirty-six patients (baseline AHI 23.5/h [IQR: 19.7-29.8]/h) completed both a baseline and 3-month follow-up visit including full polysomnography, the latter with MAD fixed at 75% of the maximal protrusion without further titration. Traits were estimated from the baseline study (Sands SA et al. AJRCCM 2018). Responders were defined as patients having a reduction in apnea-hypopnea index (AHI) ≥ 50% from baseline. Differences in traits between responders (n=18) and non-responders (n=18) were analyzed using unpaired t-tests. Logistic regression was used to assess independent associations between traits and responder/non-responder status.

**Results:** On average, MAD treatment reduced the AHI by 50% [IQR:24-64%]. Compared to non-responders, responders exhibited lower loop gain (0.55 [95% CI: 0.49-0.60] vs. 0.65 [0.56-0.73], p=0.041), lower VRA (34 [22-45] vs. 50 [39-61] p=0.038), and less-severe collapsibility (6% [4-8%] vs. 9% [7-10%]; p=0.038) at baseline. A trend towards lower arousal threshold in responders (117% [110-125%] vs. 128% [119-139%]; p=0.053) was observed. No differences in compensation were found. Baseline AHI did not significantly differ between responders and non-responders (p>0.9). Logistic regression showed that lower loop gain ( $\beta \pm SE = -0.93 \pm 0.42$ ; p=0.027) and lower VRA ( $\beta \pm SE = -1.04 \pm 0.50$ ;

$p=0.037$ ) were independently associated with greater likelihood of being a responder to MAD treatment ( $R^2 = 0.25$ ,  $\chi^2$ -test:  $p = 0.005$ ).

**Conclusions:** Responders to MAD treatment exhibit a more stable ventilatory control, expressed as a lower loop gain, and a reduced response to arousal compared to non-responders, as calculated from a standard baseline clinical PSG. Assessment of the degree of ventilatory control stability at baseline with this non-invasive approach using PSG data might facilitate upfront patient selection for MAD treatment.

#### POSTER #009

### SHORT-TERM RESULTS ON A NOVEL DUO-BLOCK CUSTOM-MADE TITRATABLE MANDIBULAR ADVANCEMENT DEVICE USING A FLEXIBLE COUNTER-BALANCING TITRATION MECHANISM: A PILOT STUDY.

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**Introduction & Aim:** Gravity and muscle relaxation might cause the mouth to open during sleep, decreasing the amount of protrusion during mandibular advancement (MAD) treatment. Applying a connection mechanism that could maintain protrusion should be advantageous in such circumstances. The present study investigates the effect of such a MAD using a flexible counter-balancing titration mechanism, on reduction in apnea-hypopnea index (AHI).

**Methods:** Patients ( $n=31$ ) diagnosed with moderate to severe obstructive sleep apnea (OSA) on Type 1 polysomnography at baseline (BL) with  $AHI \geq 15$  events/hour (h) sleep were consecutively included. At present full datasets in  $n=20$  (baseline data presented as mean  $\pm$  standard deviation or median with [interquartile range (IQR)]): age  $54 \pm 3$  yr; body mass index =  $26.6 \pm 1.0$  kg/m<sup>2</sup>; M/F ratio 25/6; BL-AHI = 22.0 [IQR: 19.3-39.5]; BL-AHI<sub>supine</sub> = 52.7 [IQR: 40.8-75.3]; BL-AHI<sub>non-supine</sub> = 10.4 [IQR: 6.5-28.3]. Classic impressions and bite registrations in maximal comfortable protrusion were made. A duo-block custom-made titratable MAD was fitted (SomnoDent Avant, SomnoMed, Crows Nest, NSW, Australia) and titrated. Check-up of MAD efficacy was assessed with Type 3 portable sleep monitoring after  $42 \pm 17$  days. Statistical analysis was performed using Wilcoxon signed-rank tests for comparison of AHI at BL versus post-treatment (PT) and for the delta AHI<sub>supine</sub> versus delta AHI<sub>non-supine</sub>.

**Results:** The post-treatment assessment revealed PT-AHI = 5.9 [IQR: 3.9-7.9], PT-AHI<sub>supine</sub> = 6.9 [IQR: 5.0-11.6] and PT-AHI<sub>non-supine</sub> = 4.3 [IQR: 2.9-6.9]. The Wilcoxon signed-rank test showed that after 42 days, MAD treatment did result in a statistically significant decrease in AHI, in AHI<sub>supine</sub> and in AHI<sub>non-supine</sub>, in patients with moderate to severe OSA ( $Z = -3.920$ ,  $p \leq 0.001$ ). The change in delta AHI<sub>supine</sub> was significantly higher than in delta AHI<sub>non-supine</sub> ( $Z = -3.771$ ,  $p \leq 0.001$ ).

**Conclusions:** The results of this pilot study indicate a statistically significant improvement in overall AHI, in AHI<sub>supine</sub> and in AHI<sub>non-supine</sub>, using a novel duo-block custom-made MAD aimed at limiting mouth opening during sleep. Especially in the supine sleeping position, it can be expected that mouth opening during sleep increases, thereby counteracting therapeutic efficacy. The tested MAD effectively alleviates such supine effects, showing even a statistically significant higher improvement in terms of decrease in AHI<sub>supine</sub> as compared to the improvement in AHI<sub>non-supine</sub>.

**Support:** the ‘SomnoDent Avant’ MADs were provided free of charge by SomnoMed Ltd (Australia).

#### POSTER #010

### THE EFFECTS OF MANDIBULAR ADVANCEMENT APPLIANCE THERAPY ON JAW-CLOSING MUSCLE ACTIVITY RELATED TO OXYGEN DESATURATIONS

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**Introduction:** Previous studies suggested that contractions of the jaw-closing muscles (JCMs) after respiratory events in obstructive sleep apnea (OSA) patients may contribute to the restoration of a compromised upper airway during sleep. However, a recent study suggested that JCM contraction after a respiratory event in OSA patients is dependent on the sleep arousal response rather than on the respiratory events *per se*. Based on this observation, we hypothesized that in OSA patients an effective mandibular advancement appliance (MAA) therapy would result in a significant reduction of the JCM activity related to oxygen desaturations in the presence of arousals as compared to JCM activity related to desaturations without arousals. Therefore, the aim of this study was to determine the effects of MAA therapy on the JCM activity related to oxygen desaturations, with and without arousals, in OSA patients.

**Methods:** Eighteen OSA patients ( $49.4 \pm 9.8$  years) with a mean  $\pm$  SD apnea-hypopnea index (AHI) of  $22.0 \pm 16.0$  events/hour of sleep participated in a randomized controlled crossover trial, in which two ambulatory polysomnographic recordings, one with an MAA *in situ* and the other without the MAA *in situ*, were performed in a random order. JCM activities were recorded bilaterally from both masseter and temporalis muscles. All JCM activities that were related to oxygen desaturations  $\geq 3\%$  were used as primary outcome variables. They were grouped as JCM activities with arousals and JCM activities without arousals. Wilcoxon Signed Ranks Tests were used for the statistical analyses of the data.

**Results:** The use of MAA resulted in a significant reduction of the arousal index ( $W = -13.0|5.0$ ,  $P = 0.02$ ), AHI ( $W = -16.0|2.0$ ,  $P < 0.01$ ), and oxygen desaturation  $\geq 3\%$  index ( $W = -2.0|15.0$ ,  $P = 0.01$ ). There was no significant effect of the MAA on the total JCM activity index ( $W = -6.0|12.0$ ,  $P = 0.11$ ). In line with our hypothesis, with the MAA *in situ*, a significant reduction of 73.1% was observed in the number of JCM activities related to oxygen desaturations with arousals ( $W = -4.0|10.0$ ,  $P = 0.02$ ), while there was no significant effect of the MAA on the number of JCM activities related to oxygen desaturations without arousals ( $W = -6.0|4.0$ ,  $P = 0.59$ ).

**Conclusions:** The occurrence of jaw-closing muscle contractions related to oxygen desaturations seems to be associated with the presence of sleep arousals rather than with the oxygen desaturations *per se*.

**Support:** SomnoDent® oral appliances (SomnoMed®, Ontario, Canada) and Dentitrac® compliance chips (Braebon Medical Corporation, Ontario, Canada) were gifted to the research project with no obligations.

POSTER #011

### THREE-DIMENSIONAL COMPARISON OF THE EFFECTS OF TWO MANDIBULAR ADVANCEMENT DEVICES ON UPPER AIRWAY DIMENSIONS IN OBSTRUCTIVE SLEEP APNEA PATIENTS: A PRELIMINARY STUDY

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**Introduction:** It has been suggested that design features of mandibular advancement devices (MADs) play an important role in the treatment outcome in obstructive sleep apnea (OSA) patients. Both the SomnoDent appliance (MAD-S, SomnoDent® Flex™, SomnoMed Ltd, Australia) and the Herbst appliance (MAD-H) are widely used two-piece custom-made titratable MADs, but their designs differ in the couple-mechanism between the two splints. The design of MAD-S allows free vertical opening of the lower jaw during sleep, while the design of MAD-H limits vertical opening of the lower jaw. The hypothesis for this study was that the difference between these two MADs in the regulation of vertical opening would result in different effects on upper airway dimensions. Therefore, the aim of this randomized controlled trial was to compare the effects of both appliances on upper airway dimensions in OSA patients.

**Methods:** Twenty-eight mild to moderate OSA patients (mean $\pm$ SD age =  $46.5 \pm 12.7$  years), with a mean apnea-hypopnea index (AHI) of  $16.5 \pm 6.9$  events/h, were randomly assigned to two parallel groups: MAD-S (n=14) and MAD-H (n=14). Both MADs were originally set at 60% of the maximal advancement, and titrated based on a weighted compromise between efficacy and side-effects during a 3-month follow-up. All patients underwent two polysomnographic (PSG) recordings, and two cone beam computed tomography (CBCT) images (NewTom 5G, QR systems, Italy) with relaxed jaw-closing muscles in supine position: one at baseline and the other one after 3 months with their MAD *in situ*. The primary outcome variable was the minimal cross-sectional area of the upper airway ( $CSA_{min}$ ). The secondary outcome variables included volume and length of the upper airway. Analysis of covariance (ANCOVA) was used to control for age. Finally, a power analysis was used to determine the sample size for future studies based on the effect size of the primary outcome variable in this study.

**Results:** The MAD-S group and the MAD-H group did not differ regarding gender distribution, Body Mass Index (BMI), neck circumference, and baseline AHI ( $P=0.1-1.0$ ). Besides, the protrusion and vertical opening of the lower jaw with the appliance *in situ* were not significantly different between both groups ( $P=0.2-1.0$ ). However, the MAD-S group ( $51.7 \pm 14.1$  years) was significantly older than the MAD-H group ( $41.3 \pm 8.7$  years) ( $t=-2.3$ ,  $P=0.03$ ). There was no significant difference in the improvement of AHI between MAD-S ( $\Delta AHI=8.4 \pm 7.6$  events/h) and MAD-H ( $\Delta AHI=4.3 \pm 6.0$  events/h) ( $t=1.6$ ,  $P=0.1$ ). Furthermore, no significant difference was observed between the two MADs on the increase of the  $CSA_{min}$  ( $Z=-0.7$ ,  $P=0.5$ ) and other upper airway variables ( $P=0.3-0.9$ ). The effect size for the increase of  $CSA_{min}$  was 0.13 (power is 6.3%). According to Cohen's criteria, with this effect size approximately 1,400 patients per group would be

needed to find a significant difference between both groups (power 80%, significance level 5%).

**Conclusions:** Based on these preliminary findings, we concluded that there is no significant difference between MAD-S and MAD-H in increasing the upper airway dimensions in mild to moderate OSA patients.

#### POSTER #012

### THE VALUE OF AWAKE NASOPHARYNGOSCOPY IN THE PREDICTION OF RESPONSE TO MANDIBULAR ADVANCEMENT DEVICE THERAPY

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**Introduction:** Mandibular advancement devices (MAD) have variable success rates at reducing the apnea-hypopnea index (AHI). The current study prospectively quantified the predictive value of upper airway characteristics during awake nasopharyngoscopy on MAD outcome.

**Methods:** One hundred OSA patients underwent polysomnography and awake nasopharyngoscopy at baseline. MAD was fitted intraorally in a fixed 75% position of maximal protrusion. Sixty-one patients [83.6% male; median AHI 16.5 events/hour (IQR: 11.1–23.3); body mass index (BMI) 28.2 ± 3.4 kg/m<sup>2</sup>] completed the 3-month follow-up polysomnography with MAD and a second awake nasopharyngoscopy with and without MAD. The awake upper airway characteristics were evaluated both during spontaneous breathing and during Müller's maneuver. Treatment response was defined as a reduction in AHI ≥ 50%, and deterioration as an increase in AHI compared to baseline.

**Results:** Adjusting for baseline AHI, BMI and age, patients with a narrow oropharynx during spontaneous breathing showed an odds ratio (OR) of 4.3 ( $p=0.044$ ) for treatment deterioration. Furthermore, a decrease in overall velopharyngeal diameter during MAD application (OR 14.8;  $p=0.003$ ) and a persistent posteriorly located tongue base (OR 5.9;  $p=0.035$ ), were associated with treatment deterioration.

The concordance between the two separate Müller's maneuvers at different upper airway levels (kappa values ranging from 0.145 to 0.345) was overall slight to fair.

Baseline epiglottis collapse (OR 14.6;  $p=0.021$ ) and improvement of tongue base collapse with MAD (OR 4.4;  $p=0.048$ ), seen during Müller's maneuver, were nevertheless both associated with a better MAD therapy outcome.

**Conclusions:** The awake endoscopic assessment of upper airway characteristics, especially when performed during spontaneous breathing, allows to determine MAD therapy outcome in OSA patients who are in particular prone to deterioration.

#### POSTER #013

### INFLUENCE OF CRANIOFACIAL MORPHOLOGY/PHENOTYPES ON MANDIBULAR MOVEMENT PATTERNS IN THE DESIGN OF A MANDIBULAR ADVANCEMENT DEVICE

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**Introduction:** Mandibular Advancement Devices (MAD) are constructed placing the mandible in a starting position (SP) with a determined range of advance and vertical opening. Certain mandibular movements are allowed by the appliance (lateral movements and opening) after the MAD is in place at the SP. The mandibular opening path movements have different directions according to the craniofacial morphology of the patient, but always downward and backward, therefore increasing collapse of the upper airway. The aim of this study was to determine the different directions of opening path movements according to the craniofacial morphology of the patient and its impact on the mandibular position.

**Methods:** 52 students with full permanent dentition aged 19 to 23 years (mean 21.3 SD 1.7; 29 females and 23 males) participated in the study. Each subject had lateral cephalometric radiograph taken. The opening angle was determined for 2 levels of vertical opening at 5 and 10mm.

**Results:** Opening angle showed a greater variability between subjects ranging from 63,15 to 77,08 with mean value 70,42 for 5mm angle and from for 61,65 to 75,72 with mean value 68,90 for 10mm angle. Differences of facial phenotypes was evident when comparing the individual disoccluding angle of the low angle horizontal pattern and high angle vertical pattern.

**Conclusions:** The opening angle of the mandibular movements is related to the craniofacial morphology with shorter anteroposterior and higher vertical anterior faces having more horizontal path of mandibular movements than longer anteroposterior and shorter vertical anterior subjects who have a more vertical path. In patients with horizontal opening path the MAD should use the less increase in vertical dimension in its design and should limit

the amount of opening and control the direction of jaw opening.

#### POSTER #015

### COMPARISON OF EFFICACY FROM A CUSTOM AND TRIAL ORAL APPLIANCE

Morgan T<sup>1</sup>, Munafo D<sup>2</sup>, Clark SJ<sup>2</sup>, Hevener B<sup>2</sup>, Cruz Arista D<sup>2</sup>, Levendowski D<sup>3</sup>

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**Introduction:** The benefit of using a trial oral appliance (OA) to identify those likely to respond to a Custom OA is dependent on both OAs achieving similar efficacies.

**Methods:** A retrospective, repeated-measures design was used to evaluate 63 adult patients with a diagnostic AHI > 5. Patients needed to exhibit a therapeutic response to a Trial OA (Apnea Guard®, Advanced Brain Monitoring, Carlsbad, CA) prior to being fitted with a Custom OA. The Trial OA was fitted to 70% of the distance from neutral bite to maximum protrusion with females delivered either 5.5 or 6.5 mm vertical dimension of occlusion (VDO) and males fitted with a 6.5 or 8 mm VDO, depending on tongue size. The Custom OA was fabricated to 70% of range of motion based on the George Gauge with a 2 mm VDO for females and a 5 mm VDO for males, prior to titration. A two-night home sleep apnea test (HSAT) (NightOne, Philips Healthcare, Monroeville PA) was performed at Baseline on night 1 and with the Trial OA on night two. Response to the Trial OA required either a >30% or >40% reduction in AHI depending on the pre-treatment AHI being <20 or >20, respectively. Efficacy HSATs were offered after the dentist determined the Custom OA was optimally titrated. To date, 31 patients (age 52+10.7 years, 45% female) have completed the efficacy HSATs enabling a Trial OA vs. Custom OA comparison.

**Results:** As compared to Baseline, the Custom OA and the Trial OA significantly reduced the overall AHI from 22+16.8 to 12+10.0 (p<0.01) and 9+7.1 (p<0.001), respectively. The supine AHI was reduced from 32+23.4 to 17+16.0 (p<0.01) and 10+8.0 (p<0.0001), respectively. The Trial OA provided a significantly greater decrease in supine AHI vs. the Custom OA (p=0.03). Though non-significant, a greater reduction in non-supine AHI was observed with the Custom OA vs. Trial OA (7+9.6 vs. 9+11.8, respectively) as compared to Baseline (11+12.5).

The proportion of patients who achieved an efficacy AHI<5 with the Custom OA vs. the Trial OA was 23% and 39%, respectively. In eight patients who responded to a Trial OA but not the Custom OA, five had a Baseline non-supine AHI in the normal range, and two slept exclusively supine. The final case, a 60 year-old male with a Baseline overall, supine and non-supine AHI of 63, 98, and 37,

respectively, exhibited a 71% AHI decrease with the Trial OA but only a 30% reduction with the Custom OA.

**Conclusion:** The Trial OA provided superior efficacy as compared to the Custom OA during supine sleep. Only 74% of patients who responded to the Trial OA responded to the Custom OA, a finding likely explained by interaction between supine sleep and OA VDO. The VDO typically prescribed for a Custom OA may be preferable so long as patients avoided the supine position.

#### POSTER #016

### DISTRIBUTIONS OF OSA THERAPY OUTCOMES BASED ON A TRIAL ORAL APPLIANCE AND/OR SUPINE AVOIDANCE

Levendowski D<sup>1</sup>, Munafo D<sup>2</sup>, Clark SJ<sup>2</sup>, Hevener B<sup>2</sup>, Cruz Arista D<sup>2</sup>, Morgan T<sup>3</sup>

<sup>1</sup>*Advanced Brain Monitoring, Carlsbad, CA;* <sup>2</sup>*Sleep Data, San Diego, CA;* <sup>3</sup>*Sleep Alliance, San Diego, CA*

**Introduction:** A previous cross-over study design reported the combination of oral appliance (OA) and position therapies was more effective than either therapy used individually. This study assessed the distributions of potential outcomes from oral appliance (OA) therapy and/or supine avoidance using a two-night home sleep apnea test (HSAT) and a Trial OA.

**Methods:** Ninety-eight adult patients with a diagnostic AHI >5, 55+12.7 years, and 44% female were included in this retrospective analysis. All patients were fitted with a Trial OA (Apnea Guard®, Advanced Brain Monitoring, Carlsbad, CA) to assess the likelihood of response to OA therapy. The Trial OA was fitted to 70% of the distance from neutral bite to maximum protrusion with females delivered either 5.5 or 6.5 mm vertical dimension of occlusion (VDO) and males fitted with a 6.5 or 8 mm VDO, depending on tongue size. A two-night HSAT (NightOne, Philips Healthcare, Monroeville PA) was performed at Baseline on night one and with the Trial OA on night two.

Response to the Trial OA required an AHI reduction >30% for those with a pre-treatment AHI <20, and >40% reduction in those with a pre-treatment AHI >20. Positional OSA (POSA) was characterized when the overall AHI/non-supine AHI > 1.4 and >20 minutes in both supine and non-supine positions. Patients who slept <20 minutes non-supine were characterized as supine dominant. Two-tailed Chi-squared and t-test analyses were used to identify group differences.

**Results:** Sixty-four percent of the patients were identified as responders (63/98) with the Trial OA. The prevalence of POSA in the pre-treatment results was 75% of those who responded to the Trial OA and only 53% in non-responders (p=0.05).



With the Trial OA, 21% (20/98) achieved an efficacy AHI <5 events/h. Based on the non-supine AHI, if the Trial OA was combined with supine avoidance, 17% (17/98) of the cohort could achieve an additional 66+21% reduction in overall AHI and a post-treatment AHI equivalent to CPAP. OA responders who were supine dominant and would likely benefit from supine avoidance occurred in 6% of the cases. Non-positional OA responders with an efficacy AHI >5 occurred in only 20% (20/98) of the cases.

In the patients who did not respond to the Trial OA, the Baseline HSAT uncovered 16 cases with POSA and an additional five with supine dominance. If supine avoidance was provided rather than OA in the non-responders with POSA, a mean reduction in overall AHI of 64 + 20% could be achieved; seven patients would have an AHI < 5. Only 14% of (14/98) the patients would not obtain a responder outcome with either OA and/or supine avoidance.

**Conclusion:** Increased POSA was observed in those who responded to OA therapy, a finding consistent with previous reports. Based on the Trial OA, 64% of patients benefitted from OA therapy, 86% could benefit from oral appliance and/or supine avoidance, and 45% could achieve an outcome equivalent to CPAP (i.e., AHI <5) based on utilization of combination therapies.

#### POSTER #017

### PREVALENCE OF DENTAL SLEEP MEDICINE PATIENTS AT INCREASED RISK OF NEURODEGENERATIVE DISEASE

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**Introduction:** In 2015, Lee et al. reported that the glymphatic transport of CNS neurotoxins and metabolites from the brain of sleeping rats was more efficient in the lateral position as compared to the supine or prone positions.<sup>1</sup> In 2019, Levendowski et al. observed that patients who slept >2 h/night with his/her head in the supine position resulted in 3.7 times greater risk of neurodegenerative disease (NDD), independent of age, sex, snoring, and the diagnosis of OSA. This study investigates patterns of supine sleep in order to establish the prevalence of NDD risk in patients referred for oral appliance (OA) therapy. We also evaluate the potential influence of the 3.8 cm Trial OA handle (that extends from the mouth during use) on supine sleep.

**Methods:** Ninety-eight adult patients underwent a two-night home sleep apnea test (HSAT) (NightOne, Philips Healthcare, Monroeville PA). A Baseline recording was made on night one and the efficacy of a Trial oral appliance

(OA) was measured on night two. A sub-group of 31 patients who responded to the Trial OA were fitted with a Custom OA and then underwent an Efficacy HSAT. Response to the Trial OA required either a >30% or >40% reduction in AHI depending on the pre-treatment AHI being <20 or >20, respectively. Two-tailed t-test analyses and Bland-Altman plots were used to identify group differences.

**Results:** Although the correlation in the percent of time supine between the Baseline vs. Trial OA HSATs was strong (54+30% vs. 53+29%,  $r=0.69$ ,  $p<0.00001$ ), 57% of the patients exhibited > 10% differences in the between-night percent time supine and 31% had differences > 20%. Patients who did not respond to the Trial OA exhibited a 5% bias toward increased supine sleep time when wearing the Trial OA as compared to Baseline.

In the sub-group, the correlations in the percent time supine across the HSATs were very strong (Baseline vs. Trial  $r=0.73$ , Baseline vs. Efficacy  $r=0.84$ , Trial vs. Efficacy  $r=0.78$ , all  $p<0.00001$ ) with Bland-Altman plots reflecting a bias toward reduced supine sleep when patients wore the Custom OA.

An almost identical proportion of patients slept >2/h supine during the Baseline and Trial HSATs (77% vs. 76%). However, 19% shifted NDD risk categories when wearing the Trial OA, 10 shifted to no-risk and nine shifted to at-risk.

**Conclusion:** Seventy-five percent of patients referred for OA therapy were identified with increased risk of NDD based on supine sleep time. Given the substantial night-to-night variability in supine sleep duration, routine monitoring of NDD risk should be included in long-term OA efficacy assessments.

#### POSTER #018

### THERAPEUTIC RESPONSES TO ORAL APPLIANCE THERAPY: INVESTIGATION OF TWO CRITERIA

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**Introduction:** The reduction in sleep disordered breathing severity achieved with oral appliance (OA) therapy is not always correlated with symptomatic relief, especially in patients in the mild to moderate range. As a result, the criteria used to characterize patients who may benefit from OA therapy should be broad enough to avoid denial of care to those who might achieve a symptomatic response alone or with combination therapy. The criteria should also identify those who obtain a negligible therapeutic response to assist in managing healthcare costs.

**Methods:** This retrospective analysis included 136 adult patients with a diagnostic AHI > 5. The Trial protocol included 98 patients fitted with a Trial OA (Apnea Guard®, Advanced Brain Monitoring, Carlsbad, CA). The Trial OA was set to 70% of the distance from neutral bite to maximum protrusion with females delivered either 5.5 or 6.5 mm vertical dimension of occlusion (VDO) and males fitted with a 6.5 or 8 mm VDO, depending on tongue size. A two-night home sleep apnea test (HSAT) (NightOne, Philips Healthcare, Monroeville PA) was performed at Baseline on night one and with the Trial OA on night two.

The Standard protocol included 38 patients fitted with a Custom OA fabricated to 70% of the George Gauge range of motion, with 2 mm of VDO for females and a 5 mm of VDO for males, followed by an efficacy HSAT after the Custom OA was titrated.

Two efficacy criteria were applied. Criteria One was designed to detect those patients with more modest reductions in AHI. A positive response was defined as a reduction in AHI of > 30% for those with a pre-treatment AHI < 20, and a reduction of > 40% in those with a pre-treatment AHI > 20. Criteria Two used the more common requirements of both a > 50% reduction in diagnostic AHI and a treatment AHI < 10. Two-tailed Chi-squared and t-test analyses were used to identify group differences.

**Results:** Patients in the Standard protocol were older than the Trial group (60+13 vs. 55+13 years,  $p=0.05$ ), however there were no significant differences in sex (female = 42% vs. 44%) or diagnostic AHIs (21+13 vs. 18+11 events/h). In the trial protocol, the diagnostic AHI was significantly less than the Baseline AHI (19+11 vs. 23+15,  $p<0.05$ ). The study that resulted in the greatest AHI reduction was used to assess the treatment response from the Trial OA.

In the Standard protocol, the responder rates were 68% (26/38) for Criteria One and 45% (17/38) for Criteria Two ( $p=0.03$ ). The responder rates in the Trial protocol were 64% (63/98) and 36% (35/98) for Criteria One and Two ( $p<0.001$ ).

**Conclusion:** The responder rates for the Trial OA and Custom OA were equivalent. Criteria One characterized approximately 20% more patients as responders to OA therapy as compared to Criteria Two. Next to be demonstrated is whether patients characterized as responders by Criteria One and non-responders by Criteria Two show symptomatic benefit.

POSTER #019

## COMPARISON OF TREATMENT OUTCOMES FOR OBSTRUCTIVE SLEEP APNEA PATIENTS TREATED WITH MANDIBULAR ADVANCEMENT DEVICES BY DENTAL SLEEP MEDICINE FELLOWS AT AN ACADEMIC INSTITUTION

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**Introduction:** Obstructive sleep apnea (OSA) is characterized by recurrent episodes of upper airway collapse and associated apnea and hypopnea during sleep. Studies have shown that mandibular advancement devices (MADs) are a viable treatment option for OSA, reporting improvements in apnea-hypopnea index (AHI). However, studies have yet to investigate how the outcomes of MAD treatment vary by provider. This study aims to compare the success of treatment outcomes of OSA patients treated with MADs by different classes in the Tufts University School of Dental Medicine (TUSDM) Dental Sleep fellowship program.

**Methods:** A convenience sample of 60 OSA patients treated with MADs at the TUSDM were reviewed for the purpose of this study. Patients were stratified based on the fellowship class (2017 and 2018, respectively) providing care. For both groups, patient characteristics such as age, Body Mass Index (BMI), and gender were collected at baseline. Additionally, AHI and Visual Analog Scales (VAS) were collected pre and post treatment. Using SPSS 25, descriptive statistics were calculated and a comparison of outcomes pre- and post MAD therapy was conducted. The Mann-Whitney U test, independent-samples t-test, and chi-square test were used for comparisons between classes. The Spearman correlation was used to assess associations between discrete and continuous variables.

**Results:** Of the 60 patients, the 2017 class treated 53.3% ( $n=32$ ) and the 2018 class treated 46.7% ( $n=28$ ) of patients. Overall, 25 females and 35 males, with a mean age of 54.0 and BMI of 27.2, were included in the analysis. There was not a significant difference between classes with regards to gender, age or BMI ( $P>0.05$ ). Over the duration of the fellowship (1 year), both cohorts saw a mean decrease in AHI: 14.8 (SD=16.0,  $n=28$ ) in 2017 and 12.1 (SD=13.7,  $n=28$ ) in 2018, respectively. Comparison of the two groups showed no significant difference regarding mean change in AHI ( $P>0.05$ ).

Additional metrics collected for the 2018 class included mean jaw protrusion of 77.5% (range =70-80%, SD=4.01  $n=26$ ), neck size of 15.5in (SD=1.91,  $n=25$ ), and number of follow-up visits of 3.2 (SD=0.9,  $n=17$ ). None of these metrics showed a strong correlation with absolute change in AHI, results were not statistically significant ( $P>0.05$ ). Jaw protrusion showed a slight positive Spearman correlation with Post VAS measures for Bite ( $r_s =0.38$ ) and

Headache ( $r_s=0.24$ ); results were not statistically significant ( $P>0.05$ ).

**Conclusions:** AD patients showed comparable improvement in their AHI levels, regardless of which fellowship class provided treatment. This suggests that fellowship classes are receiving comparable education, allowing them to consistently provide quality care. Given that increased jaw protrusion (from 70-80%) did not appear to strongly correlate with AHI change, further research should be done to explore the trend between increased jaw protrusion and VAS pain scores. This will ensure that patients are receiving effective care with minimal side effects.

#### POSTER #020

### SLEEP-DISORDERED BREATHING: A SYSTEMATIC REVIEW ON THE DENTISTS' ROLE

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**Introduction:** Sleep-disordered breathing (SDB) affects adults and children worldwide. The SDB can reach high prevalence as shown by the HypnoLaus study appointing 49,7% in men and 23% in women. The main problem in patients with SDB is the pharyngeal collapse incurring in hypopnea (reduction in ventilation) or apnea (complete respiratory cessation). These patients affected by SDB may develop hypertension, cardiac arrhythmias, snore, disruptive behavior and depletion of quality of life. Indications of the presence of SDB may be evident in the oral cavity like high arched or narrow hard palate and retrognathia. An atypical orofacial growing pattern can lead to a reduced size of the upper airway; causing not just breathing-related sleep problems, but also a constricted maxilla, usually leading to posterior cross-bites and crowded teeth.

Although the dentists have an important role related to sleep disorders, there is a concern on how far the dentists can go when evaluating or treating these patients. The objective of this systematic review is to present guidelines, recommendations and studies designed with the intention to guide the role of dentists in the SDB related issues.

**Methods:** This systematic review was reported according to the preferred reporting items for systematic review and meta-analysis protocols (PRISMA). The eligibility criteria guidelines, protocols and recommendation focused in determine the role of dentists in the sleep disorders topic were included in this study. No limits in year or language were applied. Six databases were included in the search strategy: Cochrane, EMBASE, Medline, LILACS,

PubMed, and Web of Science. The main outcome was to determine role of dentists in sleep disorders patients.

**Results:** A list of the possible role of dentists in view of the SDB problems were made from each article. Out of 1,432 studies found in the first phase of search seventeen studies were selected. The studies were published between 1999 and 2018. One was published in Italian, the others were published in English recommendations were made by the studies the dentists' clinical practice in OSA, SDB or snoring patients.

**Conclusions:** The main recommendation was: The dentist can pre-screen patients through image exams available in the office and questionnaires to diminish undiagnosed OSA patients, and refer to the physician for final diagnosis; Only the dentist should apply, manage and follow up the use of OA; Only qualified dentists with good knowledge in dental sleep medicine should screen or treat SDB/OSA patients.

#### POSTER #025

### EVALUATION OF A NEW PROPRIETARY CAD/CAM HERBST-STYLE SLEEP DEVICE

Mason E

*Sleep Better Virginia*

**Introduction:** Patients who require the features of a Herbst-Style appliance or are Medicare beneficiaries face limited choices for a sleep appliance to treat their obstructive sleep apnea. Medicare patients especially do not reap the benefits of new technology and the versatility it offers. Recently, a new FDA approved appliance has been verified by PDAC (Palmetto GBA), the ProSomnus [PH] Precision Herbst-Style Sleep Appliance (ProSomnus Sleep Technologies, Pleasanton CA) for E0486 coding. This device utilizes a proprietary CAD/CAM process for precision manufacturing for consistently made devices with precision retention.

This study assesses patient satisfaction and outcomes of this new appliance. Specifically, patients will report on the impact of patent pending "comfort bumps" added to reduce the occurrence of commissure abrasion, discomfort, or catching on the lower anterior Herbst arm screw. The apnea burden will also be evaluated to understand the shift in apneas to hypopneas upon treatment. This study has IRB approval from Advarra (Pro00031658).

**Methods:** 10 patients have been enrolled in the study and the patients' pre and post AHI scores, quality of life score using the SAQLI survey, Epworth and patient device preference surveys will be collected prior to treatment and at approximately 4-6 weeks after seating the appliance when symptoms have been resolved and a HST has been completed. Patients in the study have an average AHI of

13.0 +/- 4.5, (5 males and 5 females), ages of 70.7 +/- 6.04. All patients had refused or discontinued CPAP use. A HST was used at baseline and after symptoms were resolved. Apnea and hypopnea burden will be calculated as the % time of sleep for an apneic/hypopneic event greater than 10s using the 4% desaturation criteria.

**Results:** Patient #1 had a pretreatment AHI of 21.4 and post treatment AHI of 6.7 for a 69% reduction in AHI, this patient had worn another Herbst appliance and noted the addition of the design enhancement of the CAD/CAM Herbst reduced commissure discomfort and the patient reported “not feeling the metal arm and screws at all”. In pretreatment the patient had 150 apneas with an average duration of 42 seconds over a 531minute observation time for an apnea burden of 19.8%. In post treatment the apnea burden was 3.3%, an 83.4% reduction in apnea burden. The pretreatment Hypopneic burden was 4.8% and a post treatment Hypopneic burden was 5.0%, an increase of 4.2%. Also expressed as an Apnea Burden Ratio (ABR) of 19.8%/4.8% to 3.3%/5.0%, demonstrating the shift in mix of apneas to hypopneas.

Complete results are being compiled for all patients and will be ready at the time of the poster presentation.

**Conclusions:** Initial assessment of the CAD/CAM Herbst is favorable. All seated devices required very few adjustments upon seating and patients found the device to be surprisingly comfortable. Initial outcome data demonstrates successful treatment in terms of AHI and reduction in apneic events as demonstrated by the Apnea Burden Ratio.

**Support:** This study was supported by ProSomnus Sleep Technologies and the staff at Sleep Better Virginia

#### POSTER #026

### PREDICTION OF THE EFFECT OF NOCTURNAL USE OF DENTURE WEAR IN EDENTULOUS OBSTRUCTIVE SLEEP APNEA PATIENTS BASED ON CONE BEAM COMPUTED TOMOGRAPHY IMAGES: A RANDOMIZED CLINICAL TRIAL

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**Introduction:** There is a general belief that edentate individuals should remove their dentures at night, however, for edentate individuals with obstructive sleep apnea

(OSA), the effect of nocturnal denture wear on sleep and breathing is still unknown. The aim of this study is to predict the effect of nocturnal denture wear on sleep apnea-hypopnea index (AHI) in edentulous OSA patients using cone beam computed tomography (CBCT) scans.

**Methods:** CBCT scans were performed in the patients, awake in supine position, with their denture in situ at baseline. Edentulous OSA patients were instructed to wear/not wear the denture at night for two 30 days periods in a randomized order. After each period, a home polysomnography test was performed to assess the AHI of the edentulous OSA patients.

**Results:** Data from 65 edentulous OSA patients were analyzed. Responders were defined as patients for whom AHI with denture in situ decreased  $\geq 15\%$  compared with AHI without denture in situ; the latter are labeled non-responders. The primary outcome variables were the anatomical characteristics of the upper airway. The secondary outcome variable was maxillomandibular volume box. Blind images analyses revealed that responders had a shorter hypopharynx length ( $p=0.003$ ), a smaller hypopharynx volume ( $p=0.03$ ) and smaller maxillomandibular volume box ( $p=0.04$ ) than non-responders. Patients with a larger anterior-posterior (AP) dimension of the minimum cross-sectional area ( $CSA_{min}$ ) of the upper airway had an increased likelihood of better response to nocturnal denture wear.

**Conclusions:** Nocturnal denture wear could stabilize airway patency in OSA patients who have a smaller hypopharynx and maxillomandibular volume box. A larger AP dimension of  $CSA_{min}$  of the upper airway with denture in situ could be a predictor for the improvement of the OSA condition in edentulous individuals.

#### POSTER #027

### EFFECTIVENESS OF MAD THERAPY IN A PATIENT WITH TMD: A CASE REPORT.

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**Introduction:** Mandibular advancement device (MAD) therapy is an effective treatment for snoring and obstructive sleep apnea (OSA). Previous studies have postulated that pre-existing temporomandibular disorders (TMD) could be a contraindication for oral appliance therapy. The purpose of this case report is to highlight the successful management of obstructive sleep apnea and pre-existing TMD with the use of a MAD.

**Methods:** A 58-year-old female was referred by a sleep physician to the Orofacial Pain Clinic at University of Kentucky for management of OSA with oral appliance

therapy. A home sleep study revealed moderate OSA (AHI: 21.3 and lowest SpO<sub>2</sub>: 75%). She reported loud snoring and poor quality sleep with Epworth sleepiness scale of 3. Clinical history and examination revealed masticatory myalgia, asymptomatic bilateral TMJ disc displacement with reduction and headache secondary to sleep apnea/headache attributed to TMD. The pain score on visual analogue scale (VAS) associated with masticatory myalgia was 2/10 and morning headache was 3/10. A dorsal MAD was fabricated at 50 % of maximum jaw protrusion at 5 mm (total protrusive 11) and was slowly advanced to 10 mm over the period of 5 months. The patient was given an AM Aligner to be used daily. In addition, self-care therapy for TMD was recommended. During the follow up visits, clinical evaluation assessed for any bite changes and signs/symptoms of TMD.

**Results:** On 2 week follow up visit, the patient reported 4/10 pain in left TMJ region on jaw function and also reported bite changes. The advancement was reduced by 0.5 mm. The patient was recommended jaw exercises in addition to the use of AM Aligner for 15-20 minutes. On subsequent follow up, the patient reported 90 -100 % improvements in the overall quality of sleep and a significant reduction in TMJ pain (VAS 0/10) and clicking, headaches (0/10) and snoring, with the ESS 2. The patient developed posterior open bite on left side secondary to the use of MAD. The second sleep study done after 5 months with MAD in place showed more than 70 % reduction in OSA severity (AHI: 6.8 and lowest S pO<sub>2</sub>: 84%). Long term follow ups were scheduled at 6 months and 1 year as standard clinical guidelines.

**Conclusions:** The case report presented a reduction of OSA from moderate to mild, an improvement in sleep quality and resolution of TMD symptoms and headaches. As an adverse effect, patient developed left side posterior open bite. Contrary to the expectations that the symptoms would worsen, the pre-existing signs and symptoms of TMD gradually resolved during the use of MAD. This case report demonstrated that the presence of TMD is not essentially a contraindication for the treatment with MAD for OSA.

POSTER #028

### VALIDATION STUDY OF THE PEDIATRIC MODIFIED (PM) STOP-BANG OSA SCREENING TOOL

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**Introduction:** Obstructive sleep apnea has become recognized as one of the most common under-diagnosed chronic diseases. The prevalence of obstructive sleep apnea (OSA) in children is estimated to be 1-3% (1), while primary snoring occurs in 3-12% of the pediatric population (2). Recently studies have shown increased numbers among the pediatric and adolescent population. OSA in children is associated with behavioral problems, poor school achievements, and in severe cases, pulmonary hypertension. Currently there is no screening tool used in pediatric dentistry for diagnosing OSA during the pre-operative appointment or consultation for patients undergoing minimal and moderate oral conscious sedation.

The authors have previously published a study, which explored a Pediatric Modified STOP-Bang (PM-STOP-Bang) questionnaire revealing how a positive history of snoring, obstruction and BMI show strong correlation with the presence of moderate to severe sleep apnea (3).

**Objective:** To validate the cutoff scale value and explore reliability of a new screening tool, PM-STOP-Bang in detection of OSA in pediatric patients.

#### Methods:

- This prospective study followed 32 pediatric patients visiting the VCU Center for Sleep Medicine. Parents completed a pediatric sleep history form and below listed risk indicators were collected. IRB # HM 20003516.
- These risk indicators were observed for the presence or absence (Yes or No) and the summated score were compared with the Polysomnogram derived Apnea-Hypopnea index (AHI) results. OSA was defined as AHI or RDI >1.5 events per hour.
- Simple frequency analysis (SAS 9.4) used to evaluate specificity, sensitivity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of each scale value in predicting OSA in children.

#### Risk Indicators

S=Snoring some or often

T= Tiredness (Epworth Sleepiness Scale >10)

O= Obstruction while sleeping

P= NeuroPsychological/ behavioral symptoms

B= BMI per age percentile >85 or <10

A= Age in years <3 or >13

N= Neurological including Neuromuscular disorders

G= Genetic or Congenital disorders

**Results:** A total of 32 children were included in the analysis ranging from 9 months old to 17. Among those, 75% were deemed to have sleep apnea based on AHI or RDI > 1.5). Using a cutoff value of 3 was found to be the best predictor of sleep apnea. This cutoff would yield a sensitivity of 79%, specificity of 50%, PPV of 83% and NPV of 44%. When looking at the patients, 83% of those with STOP-Bang score > 3 had sleep apnea compared to only 56% of those with a score less than 3 (p-value=0.1760). The most common criteria were snoring (80%) and BMI percentile (63%).

**Conclusions:** Within the limitations of this small, high-risk sample, the pediatric modified STOP-Bang score demonstrates a moderate ability to accurately predict presence of sleep apnea. The highest rate of OSA was seen among children with 3 or more of the criteria in the score (83%). Future research is warranted to better determine the clinical feasibility of the proposed Pediatric Modified STOP-Bang tool.

POSTER #029

**PREVALENCE OF CALCIFIED CAROTID ARTERY PLAQUE IN OBSTRUCTIVE SLEEP APNEA PATIENTS ON RADIOGRAPHS: A LITERATURE REVIEW**

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**Introduction:** The panoramic radiograph is routinely taken in dental practice for diagnosis and treatment planning. Panoramic radiograph has the ability of demonstrating calcified carotid artery plaque. Obstructive sleep apnea (OSA) is “a sleep-related breathing disorder that involves a decrease or complete halt in airflow despite an ongoing effort to breathe.” The severity of OSA is determined by the apnea-hypopnea index (AHI). OSA may cause hypoxemia and hypertension, which may increase the risk of stroke and myocardial infarction as a result of carotid and coronary vessels atherosclerosis. The purpose of this abstract is to review the literature for prevalence of carotid atheromas seen on panoramic radiographs of patients with OSA.

**Methods:** A PubMed database search was completed using the following keywords: sleep apnea, carotid artery calcification, carotid calcification, cephalometric and panoramic. There was a total of 36 articles identified by this search. After the removal of unrelated, duplicated articles, and articles in foreign language, total of 6 articles were included in this review.

**Results:** OSA could precipitate in development of atheromas through vibrations transmitted to the arterial wall causing repetitive injury to the wall of the carotid arteries. The existing data suggests that the estimated prevalence of carotid atheromas in OSA patients on panoramic radiograph is 22% as compared to 3.7% in controls (P= 0.0079) and in OSA patients on cephalometric radiograph is 21.3% as compared to 2.5% in controls (P= <.000001). The most common location reported for carotid atheromas is the neck, 1.5 to 2.5 cm inferior-posterior to the angle of the mandible, anterior to levels C2-C4 as verticolinear radiopacities.

**Conclusions:** OSA signs and symptoms are often recognizable in a dental office during diagnostic panoramic or cephalometric radiograph and clinical examination. A referral to appropriate health care provider for evaluation of thorough cerebrovascular and cardiovascular is recommended.

POSTER #030

**IS THE RELATIONSHIP BETWEEN OAT OUTCOMES, DOSAGE AND OAT DEVICE TYPE AS EXPECTED? A PRIVATE PRACTICE, RETROSPECTIVE COHORT STUDY.**

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**Introduction:** This investigation reports outcomes, dosages and Oral Appliance Therapy (OAT) device types for a large sample of consecutively treated patients with Obstructive Sleep Apnea (OSA). For OAT, dosage is defined as mandibular repositioning. Advancing the mandible alleviates OSA in a dose dependent fashion by creating room for the tongue and related anatomy, increasing side effects and decreasing adherence.

Limited data is available demonstrating how different OAT devices perform against these criterions.

**Methods:** OAT outcomes data was analyzed for consecutively treated patients (n=306) with complete pre/post OAT sleep tests. The sample included 211 men (69%) and 94 women (31%). Mean BMI was 28.8 +/- 5.3, age was 60.6 +/- 15.0 years, neck was 16.0 +/- 1.9 inches. Mean pre-treatment OSA was 22.2 +/- 15.9 events per hour and subjective sleepiness (ESS) was 12.3 +/- 2.9.

After diagnosis by a physician, patients were provided standard of care OAT. Polyvinylsiloxane and/or digital scanning dental impressions were fabricated. One of three types of OAT devices were selected based on an examination, insurance requirements and patient preference. The three types of devices were: Precision-style, Traditional-style, and Traction/Pull-style.

Dosage (mandibular position) was selected based on clinician examination and OAT device manufacturer recommendations. A 30% mandibular protrusive position was utilized for Precision-type OAT devices. 60% for Traditional-type. 90% for Traction/Pull-type.

For the purposes of this study, patients were organized into three cohorts:

- #1: 30% max protrusion position, treated with Precision-type OAT devices
- #2: 60% position, treated with Traditional-type OAT devices
- #3: 90% position, treated with Traction/Pull-type OAT devices

67.8% of patients were in Cohort #1. 13.8% and 18.4% were in Cohorts #2 and #3, respectively.

Patients were titrated to optimal health outcomes.

**Results:** *OSA Alleviation*

For Cohort #1, 85% of patients achieved an AHI<15 and 73% achieved an AHI<10. For Cohort #2, 81% achieved an AHI<15 and 72% achieved an AHI <10. For Cohort #3, 74% achieved an AHI<15 and 61% achieved an AHI<10.

*Subjective Sleepiness (ESS) Improvement*

For Cohort #1, mean ESS with OAT was 2.6 with an improvement of 79%. For Cohort #2, mean ESS with OAT was 3.0 with an improvement of 75%. For Cohort #3, mean ESS with OAT was 3.2 with an improvement of 78%.

*ESS Comparisons*

The ESS improvement for Cohort #3 was not better than Cohort #2 (p-value 0.22). The ESS improvement for Cohort #2 was not better than Cohort #1 (p-value 0.15).

The ESS improvement for Cohort #1 was better than Cohort #3 (p-value 0.01).

**Conclusions:** Clinicians should consider OAT device type when determining dosage. This investigation hypothesized that Cohorts with more protrusive positions would have better treatment efficacy. This hypothesis was not supported by this investigation. A greater percentage of patients achieved successful outcomes (AHI <10, AHI <15) in Cohort #1. The favorable difference in ESS for Cohort #1 over Cohort #3 was statistically significant.

There are several limitations to this study. A prospective, cross-over, study design likely would have allowed for additional control. Future research may wish to incorporate side effects and adherence data. Another area of future research is to evaluate the specific OAT device design features that impact dosage and outcomes.