



**AADSM 30th Annual Meeting**

**Friday, May 13 – Sunday, May 15, 2022**

**ABSTRACT SUPPLEMENT**

# 2022 Abstract Award Winners

## **Clinical Excellence Award**

*Lilian Chrystiane Giannasi, PhD*

ADULTS WITH DOWN SYNDROME AND SLEEP APNEA CAN BE TREATED SAFELY AND EFFECTIVELY WITH MANDIBULAR ADVANCEMENT ORAL APPLIANCE (OAM) – A PILOT STUDY

## **Clinical Research Awards**

*Bruna Pereira, MSc*

OROFACIAL PAIN, MASTICATORY MUSCLE HYPOTONIA AND SLEEP DISORDERS IN YOUNG AND ADULTS WITH DOWN SYNDROME

*Daniel Levendowski, MBA*

SELECTION OF CUSTOM ORAL APPLIANCE FABRICATION SETTINGS IMPACT TREATMENT EFFICACY

## **Student Excellence Award**

*Karliën Van den Bossche, MD*

QUANTITATIVE EFFECT OF MANDIBULAR ADVANCEMENT DEVICES ON UPPER AIRWAY DIMENSIONS DURING DRUG-INDUCED SLEEP ENDOSCOPY IN OBSTRUCTIVE SLEEP APNEA

## **Student Research Awards**

*Deshui Li, MSD*

PREVALENCE AND RISK FACTORS OF SEVERE SLEEP BRUXISM IN ADULTS WITH NON-APNEIC SNORING: A LARGE-SCALE POLYSOMNOGRAPHIC STUDY

*Ning Zhou, MSc*

COMPARISON OF THE EFFECTS OF MAXILLOMANDIBULAR ADVANCEMENT ON RESPIRATORY FUNCTION AND FACIAL ESTHETICS BETWEEN OBSTRUCTIVE SLEEP APNEA PATIENTS WITH AND WITHOUT MAXILLOMANDIBULAR DEFICIENCY

## POSTER #001

Poster Session A

Saturday, May 14, 10:00-10:30am

### **EFFECTIVENESS OF MANDIBULAR ADVANCEMENT DEVICE IN THE MANAGEMENT OF MODERATE OBSTRUCTIVE SLEEP APNEA WITH CONCOMITANT TEMPOROMANDIBULAR DISORDER: A CASE REPORT**

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Correa, BDS, MS

*Tufts University School of Dental Medicine*

**Introduction:** The comorbidity between obstructive sleep apnea (OSA) and temporomandibular disorder (TMD) is high. Approximately one in four patients with clinically diagnosed TMD has polysomnographic-diagnosed OSA. This comorbidity poses difficulty for management because neither appliance is considered effective in treating both conditions. Mixed results have been reported with some studies claiming mandibular advancement device (MAD) worsened TMD. In contrast, other studies found symptoms to be alleviated. In addition, MAD therapy is not efficacious for all, with approximately one-third of patients experiencing no therapeutic benefit. However, there is strong evidence demonstrating MAD improve OSA in the majority of patients.

**Report of Case:** 55-year-old female, diagnosed with moderate OSA (AHI=16.3 and 84% O<sub>2</sub>) with chronic history of TMD symptoms. A thorough clinical history and examination completed, BMI 31.6, neck circumference 12.5", and cephalometric analysis depicted a low mandibular angle and reduced hyoid bone-to-mandible distance. Intolerant to CPAP due to air leakage and facial pain aggravated by the mask. MAD as an alternative therapy was suggested to the patient by the sleep physician. TMD symptoms included bilateral masticatory myofascial pain, TMJ sounds, and headaches. A bilateral traction oral appliance design was selected with 50% of mandibular protrusion, and 5 mm of vertical dimension of occlusion (VDO). The sleep oral device and morning repositioning aligner were fabricated, delivered, and fitted. A lower stabilization orthotic appliance for daytime use

was fabricated to address TMD symptoms. The patient returned for a follow-up with and reported increased dreaming, decrease in snoring, headaches, bite changes, facial and jaw pain from moderate to mild based on a subjective report by the patient confirmed by visual analog scale (VAS). Additional titration and occlusal adjustments of the oral sleep device and daytime orthotic device were made to achieve further therapeutic jaw protrusion and management of TMD symptoms. After completing the MAD titration protocol, she was referred to the sleep physician for a follow-up sleep study to objectively assess the efficacy of the appliance, which revealed an AHI of 3.5 and 89% O<sub>2</sub> (baseline AHI 16.3 and 84% O<sub>2</sub>). Long-term follow-up was implemented as standard of dental sleep medicine clinical care at six months for the first year and yearly after.

**Discussion:** In this case report, we describe the impact of OSA on chronic pain as a vicious cycle with mutual deleterious influences causing an increase in pain and disrupted sleep. MAD is a well-established alternative to the gold standard CPAP currently recommended for mild to moderated OSA management. This case report demonstrates successful management of concomitant moderate OSA with an existing TMD condition when evidence-based and clinical expertise help to customize a treatment plan based on the patient's unique medical history and examination.

**Support:** Authors declared no conflict of interest and no financial support provided for this case report.

## POSTER #002

Poster Session B

Saturday, May 14, 4:00-4:30pm

### **SELF-REPORTED IMPROVEMENT IN OBSTRUCTIVE SLEEP APNEA SYMPTOMS COMPARED TO POST TREATMENT AHI WITH MANDIBULAR ADVANCEMENT DEVICE THERAPY: A RETROSPECTIVE STUDY**

Linda Sangalli<sup>1</sup>, Fernanda Yanez Regonesi<sup>1</sup>, Diego Fernandez Vial<sup>1</sup>, Isabel Moreno Hay<sup>1</sup>

<sup>1</sup> *Orofacial Pain Clinic, University of Kentucky, Lexington, USA*

**Introduction:** Mandibular advancement device (MAD) is recognized as a treatment option for the management of obstructive sleep apnea (OSA) in mild to moderate cases and/or patients unable to tolerate PAP therapy.

According to AADSM guidelines, it is recommended to refer the patient for a post-treatment sleep study to establish the efficacy of MAD. Patients will be referred when the maximal therapeutic benefit has been achieved based on self-reported improvement of OSA symptoms or maximum anatomical protrusion.

The aim of the study was to investigate the difference between *responders* and *non-responders* in terms of self-reported improvement of OSA symptoms.

**Methods:** Medical chart of patients referred to the Orofacial Pain Clinic at University of Kentucky between 2016 and 2021 for the management of OSA with MAD were retrospectively evaluated. Only participants with a post-treatment sleep study with MAD *in situ* and with a previous follow-up investigating subjective OSA symptoms were included. Participants were categorized as *responders* if MAD treatment resulted in 50% improvement in AHI. Subjective symptoms were recorded using a 100-mm Numerical Rating Scale (NRS). OSA symptoms measures were loudness of snoring (0-100 NRS, 0=not snoring at all), witnessed apneas (0-100 NSR, 0=never), sleep quality (0-100 NRS, 0=very sound restful), tiredness upon awakening (0-100 NRS, 0=completely rested), daytime fatigue (0-100 NRS, 0=not at all tired), daytime sleepiness (0-24 Epworth Sleepiness Scale, 0=not sleepy at all).

Differences in pre-, post-treatment variables within and between groups were analyzed with paired *t* test and independent *t* test, respectively. Logistic regression was used to investigate if any variable was able to predict the treatment group.

**Results:** From 79 patients, 6 were excluded due to lack of sleep study or data on subjective OSA symptoms. 73 participants (36 women and 37 men, aged  $64.32 \pm 10.77$ ), with mean pre-treatment AHI of  $20.99 \pm 15.84$ , were evaluated. Of those, 37 (50.68%) were classified as *responders* and 36 as *non-responders* (49.32%). The two groups differed in pre- and post-treatment AHI ( $p = .022$  and  $.000$ , respectively). The

*responders* had a mean pre-treatment AHI of  $25.24 \pm 19.67$  and a mean post-treatment AHI of  $6.99 \pm 6.06$ ; the *non-responders* had a mean pre-treatment AHI of  $15.77 \pm 8.73$  and a mean post-treatment AHI of  $15.99 \pm 10.39$ . Pre-treatment AHI was a weak predictor of response to treatment ( $\beta = .240$ ,  $p = .072$ ). Before referring the participant to the post-treatment sleep study, the *responders* reported a significant improvement in sleep quality compared to the *non-responders* ( $21.51 \pm 24.07$  vs.  $34.81 \pm 29.66$ ,  $p = .039$ ), and scored weakly better in tiredness upon awakening compared to the *non-responders* ( $22.76 \pm 21.16$  vs.  $32.53 \pm 26.02$ ,  $p = .082$ ). The remaining OSA symptoms measures did not differ between the two groups (all  $p$ 's  $>0.05$ ). None of the self-reported OSA symptoms predicted the treatment group.

**Conclusions:** Based on the results of this study, among the self-reported OSA symptoms, only sleep quality was significantly improved in *responders* compared to the *non-responders*.

**Support:** None

### POSTER #003

Poster Session A

Saturday, May 14, 10:00-10:30am

### THE USE OF A DIGITALLY MILLED ORAL APPLIANCE IN THE TREATMENT OF SEVERE OBSTRUCTIVE SLEEP APNEA

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<sup>1</sup>ProSomnus Sleep Technologies, Pleasanton, California

**Introduction:** Oral appliances (OAs) that advance the mandible are commonly used for the treatment of mild to moderate obstructive sleep apnea (OSA) but are less accepted as a therapy for severe OSA, likely due to their supposed lower rate of therapeutic success in that population. However, the preference for OAT over CPAP and relative lack of other non-surgical treatment options highlights the need for acceptance of OAT for all severities of OSA. Data from two prospective studies that collected data on OAT efficacy were analyzed retrospectively to evaluate the success rate of OAT in severe OSA using a

digitally milled OA.

**Methods:** Data from the severe OSA cohorts of two studies conducted for the validation of an in-home auto-titration test were evaluated. Study participants (n = 41 with severe OSA) received a precision iterative advancement OA (ProSomnus Sleep Technologies, Pleasanton, CA). The OAs used in the studies were CAD/CAM generated from digital intraoral scans and precision milled from control cured grade PMMA. The OAs consisted of sets of upper and lower trays that, when interfaced together, allowed for advancement of the mandible to a treated position. Oral appliances were set to the target protrusion provided by an in-home auto-titration test that predicts response to OAT (MATRx plus; Zephyr Sleep Technologies, Calgary, Alberta, Canada). Participants not predicted to respond to OAT were assigned a sham mandibular protrusion.

Oral appliance therapy was initiated at the target protrusive position, sham position, or highest tolerated position for individuals who were unable to have their OA inserted at target. Once participants were habituated to OAT, a 2-night home sleep apnea test (HSAT) was conducted to assess treatment efficaciousness, and the mandible was advanced as necessary to lower the respiratory event index (REI).

**Results:** The study population included 36 male and 5 female participants with a mean age of  $50.6 \pm 8.4$  years (range: 32-74 years), mean BMI of  $32.1 \pm 5.5$  kg/m<sup>2</sup> (range: 19.8-45.4 kg/m<sup>2</sup>), mean baseline REI of  $49.5 \pm 17.1$  h<sup>-1</sup> (range: 30.3-101.8 h<sup>-1</sup>), and median Epworth Sleepiness Scale (ESS) score of 10 (range: 0-23).

Oral appliance therapy was well-tolerated in the study population. The majority of study participants achieved some level of therapeutic success, with 73.2% of participants achieving a decrease in REI from baseline of at least 50% and 68.3% achieving an REI < 15 h<sup>-1</sup>. Of the study participants who achieved an REI < 15 h<sup>-1</sup>, the average protrusive position of the OA was  $86.7 \pm 15.3\%$  (range: 54.8-100%).

**Conclusions:** The OAs used in the studies provided efficacious treatment for the majority of individuals with severe OSA, indicating that oral

appliance therapy could be a suitable alternative to CPAP. The rate of therapeutic success was higher than that reported previously in the literature and might be a result of the precision of appliances generated from digital intraoral scans using a CAD/CAM approach.

**Support:** Study data were collected by and used with the permission of Zephyr Sleep Technologies. ProSomnus Sleep Technologies provided the OAs used in the studies.

## **POSTER #004**

Poster Session A

Saturday, May 14, 10:00-10:30am

### **RECAPTURING A POSTERIOR OPEN BITE USING A PRECISION MILLED MORNING OCCLUSAL GUIDE**

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**Introduction:** Posterior open bite is often mentioned in the literature as a common and unavoidable side effect of oral appliance therapy. Reducing the therapeutic dose using smaller precision devices (less advancement) and providing the patient with a morning maximum intercuspal position (MIP) re-alignment device (Morning Occlusal Guide) manufacturing of and daily wear of a precision MOG can help patients prevent development of a posterior open bite. MIP posterior contact is often evaluated and recorded using articulating paper and having the patient bite together. If the bite does change, the paper would pull out with little or no resistance. If this condition does occur upon loss of or non-use of their MOG, we can use the archival digital records to recreate the MIP position and re-make a MOG at the original bite relationship. This patient had moved from Dr. Rosenfeldt's care in Fargo, ND to the Detroit, MI area and was referred to Dr. Murphy for evaluation of a posterior open bite due to a lost MOG and 4 months' time passing.

**Methods:** The patient was examined and did demonstrate a unilateral posterior open bite. Two new MOGs were ordered from the digital case archives at ProSomnus of the original delivered EVO appliance and MOG, instructions for use

were reviewed and the device was delivered to the patient. The patient was also given instructions for exercises according to the AADSM side effect of OAT document.

The patient presented 10 days after delivery and wearing the new MOG and doing the exercises. Posterior occlusion had been re-established as demonstrated with resistance of the articulation paper upon closing together in MIP. The patient reported no discomfort and was happy to have his teeth feel normal again.

**Conclusions:** Digital archives and the ability to remake a MOG in the same MIP can be an important step in recapturing bite changes in oral appliance therapy.

**Support:** No financial support was provided for the treatment of this case.

#### **POSTER #005**

Poster Session B

Saturday, May 14, 4:00-4:30pm

#### **EFFICACY OF A NOVEL ITERATIVE DEVICE AND MATERIAL**

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Aditi Desai BDS, MSc, Pres. BSDSM, Mark T Murphy DDS, D-ABDSM<sup>4</sup>

<sup>1</sup>*Sleep Dallas*; <sup>2</sup>*Dental Sleep Medicine of NJ*;

<sup>3</sup>*The Shard London*; <sup>4</sup>*Funktional Sleep MI*

**Introduction:** Launching a new device design or use of a new material with optimistic expectations should always be undertaken with caution and an ounce of skepticism. When this novel device and material was first described in an IRB Abstract derivative report at the AASM, it was under the umbrella of a patient and provider preference survey. In April 2020, the broader availability post FDA clearance is providing strong early indications of excellent efficacy.

**Methods:** An analysis of data from four treatment centers using this novel device and material was undertaken. Patients were to be included if they had a diagnosis of mild, moderate, or severe OSA confirmed by a physician, and an AHI score >5 and a follow up study resulting in treatment success or failure. Results would be grouped as

Complete Success = AHI <5, Clinical Success = 50% reduction and <10. All patients were to be treated with the Novel ProSomnus EVO Iterative advancement device.

**Results:** 55 total consecutive patients were treated at four centers for dental sleep medicine. 37 male and 18 female patients with an average age of 53.3 ranging from 30 to 78 with pre and post data were included and treated with a ProSomnus EVO. The initial AHIs ranged from 6.0 to 116.0 with an average of AHI pretreatment of 26.4 (15 mild, 23 moderate and 17 severe). Follow up testing for this group revealed an average overall reduction in AHI of 75%, from 26.4 to 6.6. Overall, 62% resolved to below an AHI of 5 (100% of mild, 65% of moderate and 24% of severe patients). Similarly, 85% resolved to below an AHI of 10 and a 50% reduction (100% of mild, 96% of moderate and 59% of severe patients)

**Conclusions:** This novel interactive device and material combination appear, after early analysis, appear to yield significantly better results that previous data has demonstrated. The literature suggests that legacy oral appliance efficacies range from 50%-62% and other AADSM poster/abstracts have reported similar precision milled, control cure PMMA appliances in the 74% - 76% range. These results suggest a need for further investigation of exceptional efficacy for this device design and material.

**Support:** No support was provided for this abstract

#### **POSTER #006**

Poster Session B

Saturday, May 14, 4:00-4:30pm

#### **PREVALENCE AND RISK FACTORS OF SEVERE SLEEP BRUXISM IN ADULTS WITH NON-APNEIC SNORING: A LARGE-SCALE POLYSOMNOGRAPHIC STUDY**

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**Introduction** Sleep bruxism (SB) is characterized by rhythmic masticatory muscle activity (RMMA) during sleep. The prevalence of severe SB (RMMA $\geq$ 4 events/hour) is 3% in the general population. SB has a strong association with sleep-related breathing disorders, however, previous studies mainly focused on obstructive sleep apnea and not on non-apneic snoring (NAS). Adults with NAS may receive oral appliance therapy for their snoring problem. When they also suffer from severe SB, they may consequently break their oral appliance during sleep. It is therefore clinically relevant to determine the prevalence and risk factors of severe SB in adults with NAS. Current evidence shows that SB may be associated with age, gender, body mass index (BMI), and specific sleep-, respiratory-, and psychosocial conditions. We hypothesize that in adults with NAS: 1) severe SB is highly prevalent; 2) higher age and lower BMI decrease the odds of having severe SB; and 3) more sleep arousals increase the odds of having severe SB. Therefore, the aim of this study was to determine the prevalence and risk factors of severe SB in adults with NAS.

**Methods** This prospective polysomnographic study included 292 NAS adults (140 males, 152 females; mean  $\pm$  SD age = 42.8  $\pm$  12.2 years; mean  $\pm$  SD BMI = 26.7  $\pm$  4.7 kg/m<sup>2</sup>) with an AHI < 5 events/hour and without any previous treatment for snoring. Adults with an RMMA index  $\geq$  4 events/hour were diagnosed with severe SB. A stepwise backward binary logistic regression was performed, with severe SB (yes or no) as the dependent variable and with age, gender, BMI, polysomnographic sleep- and respiratory-related parameters, and SB-related comorbidities (psychological conditions and other sleep-related disorders) as the independent variables.

**Results** The prevalence of severe SB was 17.5% in adults with NAS. Severe SB was associated with lower BMI (odds ratio = 0.919, P = 0.034),

lower percentage of sleep stage 2 (odds ratio = 0.953, P = 0.008), and higher total arousal index (odds ratio = 1.070, P = 0.004).

**Conclusions** Severe SB is highly prevalent in adults with non-apneic snoring compared to the general population. The increase of sleep arousal increases the odds of having severe SB, while higher BMI and higher percentage of sleep stage 2 decreased the odds of having severe SB.

**Support** Not applicable.

## **POSTER #007**

Poster Session B

Saturday, May 14, 4:00-4:30pm

### **AN INTERNATIONAL EXPERTS' ASSESSMENT OF DENTAL SLEEP CONDITIONS AND THE ROLE OF ORAL HEALTHCARE PROVIDERS: A SCOPING REVIEW OVER THE PAST 20 YEARS**

Zhengfei Huang<sup>1,2</sup>, Ning Zhou<sup>1,3</sup>, Frank Lobbezoo<sup>1</sup>, Liza van de Rijt<sup>1</sup>, Magdalini Thymi<sup>1</sup>, Ralph de Vries<sup>4</sup>, Ghizlane Aarab<sup>1</sup>

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<sup>4</sup>*Medical Library, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands*

**Introduction:** Dental sleep medicine (DSM) is a discipline that was first described over 20 years ago. Snoring, obstructive sleep apnea (OSA), sleep bruxism (SB), xerostomia, hypersalivation, gastroesophageal reflux disorder (GERD), and orofacial pain were identified as sleep-related dental conditions. Given the long time that has passed since this first description, we hypothesized that there will be other dental sleep conditions that have not yet been identified as such, and that oral healthcare providers will have new roles in DSM. Therefore, the aims of this scoping review were 1) to identify so far

unidentified dental sleep condition(s); and 2) to identify the role of oral healthcare providers in the prevention, assessment, and management of dental sleep conditions.

**Methods:** A systematic search strategy that combined dentistry-related terms and sleep-related terms was formulated with the help of a medical librarian (RdV). The literature search was conducted in PubMed, Embase.com, Web of Science, and Cochrane from inception up to February 14, 2020. Studies were included that reported an actual or likely role of oral healthcare providers in the prevention, assessment, and/or management of sleep-related conditions.

**Results:** Of the 9,151 references generated in the literature search, 195 studies were included in this review. For the first aim, 184 studies reported the known dental sleep conditions; the other eleven studies reported the role of oral healthcare providers in the assessment and management of burning mouth syndrome (BMS). The association between BMS and sleep disturbance was also reported. BMS was therefore identified as the only so far unidentified dental sleep condition and was categorized into an existing category of DSM, namely “orofacial pain”. For the second aim, it was found that the oral healthcare provider can play a significant role in the prevention, assessment, and management of OSA and SB; in the assessment and management of snoring, orofacial pain, and oral dryness; and in the assessment of GERD.

**Conclusion:** Based on the available evidence, burning mouth syndrome was found to be the only so far unidentified dental sleep condition. The oral healthcare provider was found to play a significant role in the assessment of all dental sleep conditions, in the management of most conditions, and in the prevention of OSA and SB.

**Support:** Not applicable.

**Acknowledgments:** This abstract was co-authored by the following international experts: Fernanda R. Almeida (Vancouver, Canada), Peter A. Cistulli (Sydney, Australia), Marijke Dieltjens (Antwerp, Belgium), Nelly T. Huynh (Montreal, Canada), Takafumi Kato (Osaka, Japan), Gilles J. Lavigne (Montreal, Canada), Jean-François

Masse (Quebec, Canada), Benjamin T. Pliska (Vancouver, Canada), Kate Sutherland (Sydney, Australia), and Olivier M. Vanderveken (Antwerp, Belgium)

## **POSTER #008**

Poster Session A

Saturday, May 14, 10:00-10:30am

### **ASSOCIATION BETWEEN THE SEVERITY OF OBSTRUCTIVE SLEEP APNEA (OSA) AND THE SOCIALLY DETRIMENTAL DEGREE OF SNORING IN PATIENTS WITH MILD TO MODERATE OSA**

Zhengfei Huang<sup>1,2</sup>, Ghizlane Aarab<sup>1</sup>, Nico de Vries<sup>1,3,4</sup>, Antonius A.J. Hilgevoord<sup>2</sup>, Frank Lobbezoo<sup>1</sup>

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**Introduction:** Snoring is one of the most commonly reported symptoms of obstructive sleep apnea (OSA). Mandibular advancement devices (MADs) are commonly used to treat patients with mild to moderate OSA, i.e., with an apnea-hypopnea index (AHI) of 5-30 events/h, and concomitant snoring. Clinicians often focus on OSA itself but tend to overlook the fact that snoring can be characterized by a high snoring index (i.e., a large number of snoring events per hour of sleep) and high intensity (A-weighted decibel; dBA), and that snoring could therefore be considered socially detrimental. According to *Guidelines for Community Noise* by the World Health Organization (WHO), the sound level of continuous background noise during sleep should not exceed 30 dBA and noise events exceeding 45 dBA should be avoided. To the best of the authors' knowledge, no previous study has investigated whether the socially detrimental degree of snoring, as determined by its index and



intensity, is correlated to the severity of OSA in patients with mild to moderate OSA. Therefore, the aim of the present study was to investigate whether the socially detrimental degree of snoring is correlated to the severity of OSA in patients with mild to moderate OSA by assessing the correlation between AHI and the index and intensity of snoring. We hypothesized that there are positive correlations between AHI and the index and intensity of snoring, i.e., the higher the AHI value, the more frequent snoring will occur and the higher intensity the snoring events will have.

**Methods:** Patients who underwent an overnight polysomnography (PSG) and simultaneous recording of snoring sounds for potential OSA were included in this prospective study at the department of clinical neurophysiology of OLVG-West (Amsterdam, The Netherlands) between July 2020 and November 2021. The PSGs and the snoring sound recordings were synchronized, and all snoring events in the sound recordings were extracted using custom software codes written by the authors. In addition, the peak intensity was calculated for each snoring event and the mean of the peak intensities was calculated for each patient. Spearman's correlation was used to investigate the correlation between AHI and the index and intensity of snoring.

**Results:** Twenty-nine patients (male: n=21 [72.4%]; age: 44.6±9.9 yrs; body mass index: 26.9±5.0 kg/m<sup>2</sup>; AHI: 12.7±7.3 events/h) with mild to moderate OSA were included. In this population, the mean snoring index was 243.6±169.5 events/h and the mean peak intensity of snoring events was 47.1±7.1 dBA. No significant correlation was found between AHI and the snoring index ( $r=0.3$ ;  $P=0.1$ ). However, a moderately positive correlation between AHI and the mean peak intensity of snoring events was found ( $r=0.4$ ;  $P=0.02$ ).

**Conclusion:** In patients with mild to moderate OSA, the snoring index is not correlated to AHI, but the mean peak intensity of snoring events is positively correlated to AHI and exceeds the maximally acceptable nighttime noise level suggested by the WHO. These findings suggest that the socially detrimental degree of snoring is

positively correlated to the severity of OSA in patients with mild to moderate OSA.

**Support:** Not applicable.

## **POSTER #009**

Poster Session A

Saturday, May 14, 10:00-10:30am

### **COMPARISON OF THE EFFECTS OF MAXILLOMANDIBULAR ADVANCEMENT ON RESPIRATORY FUNCTION AND FACIAL ESTHETICS BETWEEN OBSTRUCTIVE SLEEP APNEA PATIENTS WITH AND WITHOUT MAXILLOMANDIBULAR DEFICIENCY**

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**Introduction:** The indications for maxillomandibular advancement (MMA) in obstructive sleep apnea (OSA) have not been standardized so far. Although MMA has primarily been employed as the first-line treatment in OSA patients with maxillary and/or mandibular deficiency, MMA is currently also employed in OSA patients without this skeletal deficiency. The aims of this study were: 1) to compare the effects of MMA on respiratory function between OSA patients with and without maxillomandibular deficiency based on polysomnographic (PSG) variables and patient satisfaction in breathing; and 2) to compare the changes in facial esthetics after MMA between the two groups based on cephalometric analysis and patient satisfaction in facial esthetics. We hypothesized that: 1) the effects of MMA on respiratory function were better in OSA patients with deficiency than in

those without deficiency; and 2) the changes in facial esthetics followed by MMA were more acceptable in OSA patients with deficiency than in those without deficiency.

**Methods:** Sixty-one MMA-treated OSA patients with both baseline and at least three-month follow-up PSG data and lateral cephalograms were enrolled in this retrospective study. Group A consisted of 21 patients without deficiency (90.5% male; age  $50.4 \pm 9.3$  y; body mass index [BMI]  $29.4 \pm 5.1$  kg/m<sup>2</sup>; baseline apnea hypopnea index [AHI]  $43.3 \pm 22.1$  /h). Group B consisted of 40 patients with deficiency (72.5% male; age  $50.4 \pm 10.3$  y; BMI  $29.1 \pm 3.9$  kg/m<sup>2</sup>; baseline AHI  $52.1 \pm 24.0$  /h). The collected data included pre- and post-operative PSG data, pre- and post-operative cephalometric measurements, and patient satisfaction with post-operative breathing and facial esthetics assessed by a 10-point visual analogue scale (VAS) (0 = not satisfied at all, 10 = completely satisfied). The primary outcomes were the changes in AHI and soft tissue cephalometric parameters. Independent-samples t-tests or Mann-Whitney U tests were used to compare values between groups. Paired-samples t-tests or Wilcoxon signed-rank tests were used to compare the pre- and post-operative values.

**Results:** At baseline, no significant differences between both groups were found in sex, age, BMI, AHI, nasal prominence, and nasolabial angle, while significantly more protrusive position of the upper lip (UL), lower lip (LL) and soft tissue pogonion (Pog') relative to the true vertical line (TVL), and smaller facial convexity were observed in group A. Postoperatively, the AHI reduction was comparable between the two groups ( $26.3 \pm 21.0$  /h vs  $37.1 \pm 24.8$  /h;  $P = 0.490$ ). Significant increases in UL-TVL, LL-TVL, and Pog'-TVL were observed in both groups, with significant decreases in nasal prominence and nasolabial angle. The changes in soft tissue measurements were comparable between the two groups. The satisfaction degrees in breathing (7.0 vs 6.5,  $P = 0.713$ ) and facial esthetics (6.5 vs 7.0;  $P = 0.983$ ) did not differ significantly between both groups.

**Conclusions:** Within the limitations of the retrospective study, it can be concluded that there is no significant difference in the effects of MMA

on respiratory function and facial esthetics between OSA patients with and without maxillomandibular deficiency.

**Support:** Not applicable.

## POSTER #010

Poster Session A

Saturday, May 14, 10:00-10:30am

### AIRWAY SIZE IS NOT A SIGNIFICANT FACTOR IN THE LOW AROUSAL THRESHOLD PHENOTYPE IN OBSTRUCTIVE SLEEP APNEA

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<sup>3</sup>Blair Academy, NJ

**Introduction:** Currently, treatments for obstructive sleep apnea (OSA) are not prescribed with consideration of pathophysiologic phenotypes. One such phenotype is low respiratory arousal threshold (ArTH)—defined as the occurrence of arousal from sleep with a small rise in ventilatory drive. A non-invasive way of deriving ArTH from polysomnography (PSG) variables has recently been described. We wanted to examine the impact of airway size on the presence of low ArTH phenotype OSA.

**Methods:** This was a retrospective review of patient charts. We included patients who underwent full night diagnostic PSG. OSA was defined as an apnea hypopnea index (AHI) of  $>5$ . Epworth score, BMI, neck circumference, and upper airway size using Modified Friedman (MF) were recorded. Low ArTH was calculated using AHI, fraction of hypopneas and O<sub>2</sub> nadir.

**Results:** 653 patients were included - 421(65%) M & 230 (35%) F. 36% of patients had a low ArTH phenotype. In the low ArTH group average MF scores were  $2.6 \pm 1.0$  vs  $2.8 \pm 1.0$  in those with normal ArTH ( $p=0.03$ ). In looking at each of the 4 airway size groups, the proportion of low ArTh phenotype was 14%, 34%, 27%, and 25% respectively for MF Grade 1,2,3,4. Correlation between MF and ArTh score was  $-0.106$  ( $p<0.01$ ).

There was no significant association of low ArTH

and MF score even after adjusting for age, gender, BMI, ESS, and neck circumference.

**Conclusion:** Airway size does not seem to be a major factor in impacting the low ArTh phenotype. As we move towards precision based therapy in OSA, use of oral appliance may be relevant in all grades of airway size/morphology for low ArTH phenotype OSA and could be combined with pharmacotherapy approaches in these patients. Future studies should examine the impact of use of oral appliance for OSA on ArTH in different airway size.

**Support:** None

## **POSTER #011**

Poster Session B

Saturday, May 14, 4:00-4:30pm

### **COMPARISON OF UPPER AIRWAY MORPHOLOGY BETWEEN POSITIONAL AND NON-POSITIONAL OBSTRUCTIVE SLEEP APNEA**

Xiaoxin Shi <sup>1,2,3</sup>, Kate Sutherland <sup>4</sup>, Frank Lobbezoo <sup>1</sup>, Erwin Berkhout <sup>2</sup>, Jan de Lange <sup>3</sup>, Peter A. Cistulli <sup>4</sup>, Ghizlane Aarab <sup>1</sup>

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**Introduction:** Existing evidence suggests that the difference in the pathogenesis between positional obstructive sleep apnea (POSA) and non-POSA (NPOSA) may be related to differences in upper airway morphology. However, the difference in upper airway morphology between both groups is not clear. The worsening of sleep-related obstructive respiratory events in supine position may be related to gravity, which works against the

anterior wall of the upper airway and may induce collapse of the upper airway in anteroposterior dimension. Therefore, we hypothesized that: (1) individuals with POSA will have a higher anatomical imbalance (i.e., an excessive tongue size relative to maxillomandibular enclosure size) compared to individuals with NPOSA; and (2) individuals with POSA will have a more elliptically shaped upper airway with the long axis oriented in the lateral direction compared to individuals with NPOSA. Therefore, the primary aim of this study was to compare anatomical balance and shape of the upper airway between individuals with POSA and individuals with NPOSA based on cone beam computed tomography (CBCT) images in supine position.

**Methods:** This study was a secondary analysis of data from a prospective study, in which 60 individuals with OSA (apnea-hypopnea index (AHI) > 10 events/h) were recruited for building a prediction model on oral appliance treatment outcome. Individuals were classified as POSA if the AHI in supine position was greater than twice the AHI in non-supine positions; otherwise, individuals were classified as NPOSA. Anatomical balance was calculated as the ratio of the tongue area and the maxillomandibular enclosure area as derived from CBCT scan. Upper airway shape was calculated as the ratio of the anteroposterior dimension and lateral dimension of the minimal cross-sectional area of the upper airway (CSA<sub>min</sub>-shape). The mean differences in anatomical balance and shape of the upper airway between POSA and NPOSA groups were compared by analysis of covariance (ANCOVA).

**Results:** Thirteen participants with an incomplete dataset were excluded from the analysis. Therefore, 47 participants (28 men and 19 women) with a median (interquartile range) age of 56.0 (46.0-63.0) years, a median AHI of 27.8 (15.0-33.8) events/h, a mean ( $\pm$ SD) body mass index (BMI) of 29.4 ( $\pm$ 5.4) kg/m<sup>2</sup>, and a mean ( $\pm$ SD) neck circumference of 40.1 ( $\pm$ 3.3) cm were included in the analysis. There were no significant differences between the POSA group (n=34) and NPOSA group (n=13) in age, gender distribution, BMI, and neck circumference ( $P=0.07-0.88$ ). The AHI and AHI-supine were not significantly different between the POSA and NPOSA groups ( $P=0.07$  and  $0.39$ , respectively). However, the

median (interquartile range) AHI-non-supine was significantly lower in the POSA group (6.0 (3.0-13.5) events/h) compared to the NPOSA group (30.7 (23.3-34.4) events/h) ( $P<0.01$ ). There was no significant difference between the POSA and NPOSA groups in anatomical balance and CSAmin-shape ( $P=0.18$  and  $0.73$ , respectively).

**Conclusions:** Within the limitations of this study, we concluded that there is no significant difference in the anatomical balance and shape of the upper airway in supine position between individuals with POSA and individuals with NPOSA.

**Support:** This work was supported by the National Health and Medical Research Council (NHMRC) of Australia (Project grant GNT1024351).

## POSTER #012

Poster Session A

Saturday, May 14, 10:00-10:30am

### FACTORS ASSOCIATED WITH TREATMENT ADHERENCE TO MANDIBULAR ADVANCEMENT DEVICES: A SCOPING REVIEW

L.H. van der Hoek<sup>1</sup>, B.R.A.M. Rosenmöller<sup>1,2</sup>, L.J.M. van de Rijt<sup>1</sup>, R. de Vries<sup>3</sup>, G. Aarab<sup>1</sup>, F. Lobbezoo<sup>1</sup>

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**Introduction:** Obstructive Sleep Apnea (OSA) is frequently treated with Continuous Positive Airway Pressure (CPAP) or Mandibular Advancement Devices (MADs). For various reasons, both treatment options are often affected by low adherence. While factors associated with low CPAP adherence are described in the

literature extensively, less is known about adherence to MAD therapy. It is important to recognize factors associated with MAD adherence in the treatment of OSA patients, because such knowledge will contribute to more personalized medicine approaches. This scoping review aimed to synthesize the body of literature on the factors associated with adherence to MAD treatment.

**Methods:** A systematic literature search was conducted by two reviewers independently. The bibliographic databases PubMed, Embase.com, Web of Science, and the Cochrane Library (Wiley) were used to identify relevant English-language publications, using the (MeSH) terms “Mandibular Advancement” and “Treatment Adherence and Compliance.” After screening all titles and abstracts, the selected full-text articles were checked for eligibility based on a priori formulated inclusion and exclusion criteria. Studies were included if they described factors associated with adherence to MADs in adults in the treatment of OSA or snoring. They were excluded if they did not describe such factors, and if patients were younger than 18 years.

**Results:** The literature search yielded a total of 587 references. After duplicates had been removed, 584 references remained. Thirty-one studies were found eligible for inclusion in this study. The main reasons for exclusion were: no use of MAD, article not found, no association with adherence, and article not in English. Included studies were mainly randomized controlled trials, reviews, and retrospective studies. The literature showed that several factors have an association with adherence to MAD treatment. Main factors with a negative influence on the adherence to MAD treatment are: failing effectiveness of MAD; occurrence of side effects during MAD therapy, such as patient discomfort or tooth pain; usage of a thermoplastic MAD instead of a custom-made one; personality aspects like a type D personality; less severe OSA or less OSA symptoms at the start of MAD treatment; and a poor first experience with the MAD or failing guidance by the dental practitioner in the first month after the start of the MAD therapy. Factors that can have both a negative and a positive impact include: previous treatments before starting MAD therapy, patient phenotype, and dental treatments during MAD therapy.

**Conclusions:** This scoping review has described several factors that have an association with adherence to MAD therapy. The knowledge of these factors can be used to predict which patient is likely to cooperate well during MAD treatment and who is not. Matching patients to treatments in a personalized manner will contribute to the efficacy of OSA management by means of MADs.

**Support:** N/A

### **POSTER #013**

Poster Session B

Saturday, May 14, 4:00-4:30pm

#### **AN INNOVATIVE APPROACH TO REDUCING SEVERITY OF OSA UTILIZING DENTAL EXPANSION METHODS**

Dr. Kalli Hale, DDS, MPH

**Introduction:** This case report is to share the changes that are possible when dentists are trained in maxillary and mandibular expansion. Utilizing the mRNA (mandibular repositioning nighttime appliance) therapy, which is a class 2 FDA cleared medical device, dentists can make permanent changes to the severity of a patient's obstructive sleep apnea (OSA).

**Report of Case:** Patient received expansion treatment utilizing mRNA appliance from 2020-2021. His pre-treatment AHI was 47 and post-treatment AHI, without oral appliance, was 9. Patient reported much improved nasal breathing and drastically improved quality of sleep.

**Discussion and Report:** In March 2019, a 61 year old patient presented to my dental clinic for his periodic recall examination. I noticed oral signs of sleep disordered breathing and he subsequently was referred for a Type 3 HSAT (home sleep apnea test). Patient was diagnosed with severe obstructive sleep apnea (AHI 47) and referred to sleep MD for CPAP therapy. In November 2019, patient presented for routine dental examination with chief complaint of bloating when using CPAP.

In December 2019, patient began expansion therapy, in conjunction with current CPAP treatment. In May 2020, patient reported he

stopped the CPAP on his own and was immediately referred for type 3 HSAT with oral appliance, to verify his AHI was within normal. HSAT revealed AHI 4 using oral appliance only.

After 13 months of growth & development utilizing expansive techniques, patient was referred again for type 3 HSAT with no oral appliance in place, which revealed a permanent drop in AHI from 47 to 9. Patient received formal diagnosis from board certified sleep physician that his sleep apnea severity was now mild.

It is vital that airway centric dentists are aware of this treatment modality when considering oral appliance therapy for our OSA patients.

**Support:** None

### **POSTER #014**

Poster Session A

Saturday, May 14, 10:00-10:30am

#### **SELECTION OF CUSTOM ORAL APPLIANCE FABRICATION SETTINGS IMPACT TREATMENT EFFICACY**

Daniel Levendowski MBA<sup>1</sup>, Edward Sall MD, DDS<sup>2</sup>, Bretton Beine RPSGT<sup>2</sup>, Dorian Cruz Arista DA<sup>3</sup>, Teresa Fregoso RDA<sup>3</sup>, William Odom DDS<sup>3</sup>, Dominic Munafo MD<sup>2</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:** In a previously published Study-1, custom oral appliances (Custom-OA) fabricated using a conventional dental protocol provided inferior apnea-hypopnea index (AHI) reductions compared to the Apnea Guard® trial appliance (AG). In this comparison, Study-2 Custom-OAs were fabricated using the AG bite registration applied to one of two randomly assigned design types, with controlled vertical mouth opening (VMO).

**Methods:** CPAP-intolerant patients completed a two-night home-sleep-apnea study; Night-1 at baseline, Night-2 with the AG. The AG VDO selection was based on tongue-scallop (women=5.5/6.5 mm, men= 6.5/8.0 mm), and "AG target protrusion" set to 70% of the neutral-maximum range, while in situ.

The Custom-OAs for Study-1 were fabricated with vertical dimension of occlusion (VDO) dependent on sex (women=2.5 mm; men=5 mm), with protrusion set using a George-Gauge measured 70% from maximum retrusion-protrusion, and dentist-directed advancement. In Study-2, the Custom-OAs were fabricated to the AG VDO and target protrusion. In Study-1, 50% of the Custom-OAs were fitted with a Herbst (CA-Herbst) and 14% with a Prosomnus® [IA], vs. randomly assigned Study-2 distributions of 51% vs. 49%, respectively. Efficacy studies were conducted after completion of the Custom-OA titration in Study-1 and at the AG target protrusion in Study-2. With the CA-Herbst, vertical elastics were optional in Study-1 and mandatory in Study-2. In Study-2, five patients at-risk for temporomandibular joint complications were excluded, i.e., <7% of patients fitted with a Custom-OA, to avoid delivery at the AG target protrusion. Statistics included Mann-Whitney, Chi-squared, Bland-Altman, and multiple logistic regression analyses.

**Results:** The Study-1 (n=84) and Study-2 (n=51) patients who completed efficacy studies had similar distributions of logistic regression variables, including scalloped tongues (64% vs. 67%), sex (women 45% vs. 43%), age (53.8±11.9 vs. 54.9±15.2 years), body mass index (29.4±5.7 vs. 27.8±4.2 km/m<sup>2</sup>), and pre-treatment AHI severities (24.6±14.4 vs. 27.7±17.4 events/hour).

Bland-Altman plots highlighted significant differences between the AG and the Custom-OA overall AHI values in Study-1 vs. Study-2 (4.2±7.8 vs. 1.2±6.7;  $P=0.023$ ). The significant differences between the Custom-OA vs. AG AHI values in Study-1 (Overall: 12.3±9.2 vs. 8.2±5.9;  $P<0.002$ ; Supine: 17.0±13.6 vs. 10.8±7.8;  $P<0.005$ ) were no longer apparent in Study-2 (Overall: 11.1±7.7 vs. 9.9±6.8;  $P=0.582$ ; Supine: 16.0±13.0 vs. 12.4±8.6;  $P=0.368$ ). The CA-Herbst was inferior to the AG by  $\geq 5$  events/h in 40% (17/42) of the Study-1 cases vs. 15% (4/26) in Study-2 ( $P=0.034$ ).

The Study-1 vs. Study-2 protocol (Odds ratio=3.34; 95%CI: 1.19-9.36;  $P=0.022$ ), pre-treatment AHI (Odds ratio=0.95; 95%CI: 0.91-1.00;  $P<0.036$ ), and AG AHI (Odds ratio=0.73;

95%CI: 0.62-0.85;  $P<0.0001$ ) were predictive of those who achieved a Custom-OA AHI<10. The AG AHI also predicted those with a Custom-OA AHI reduction >50% (Odds ratio=0.91; 95%CI: 0.83-1.00;  $P<0.05$ ), and both an AHI reduction >50% and an AHI<10 (Odds ratio=0.77; 95%CI: 0.67-0.88;  $P=0.0002$ ).

With Study-2 temporomandibular joint screening, no side effects were reported in the patients delivered Custom-OAs at 70% AG target protrusion (n=69).

**Conclusions:** These findings confirm Custom-OA fabrication settings impact treatment efficacy. Custom-OA outcomes were equivalent to the AG when fabricated with the AG bite-registration, i.e., VDO and protrusion, and VMO was controlled.

**Support:** None

## POSTER #015

Poster Session B

Saturday, May 14, 4:00-4:30pm

## QUANTITATIVE EFFECT OF MANDIBULAR ADVANCEMENT DEVICES ON UPPER AIRWAY DIMENSIONS DURING DRUG-INDUCED SLEEP ENDOSCOPY IN OBSTRUCTIVE SLEEP APNEA

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**Introduction:** Mandibular advancement devices (MAD) are an increasingly recommended treatment modality in selected patients with obstructive sleep apnea (OSA). The predominant mode of action of MAD is to protrude the mandible, resulting in opening of the upper airway and increasing its volume. Previous studies mainly showed a mechanical effect at the velopharynx, however, the influence on structures at a lower level is less clear. The aim of this study

is to visually investigate the effect of MAD therapy on upper airway dimensions during drug-induced sleep endoscopy (DISE).

**Methods:** Data of 56 OSA patients, treated with MAD fixed at 75% maximal protrusion and with polysomnography baseline apnea-hypopnea index (AHI)  $\geq 10$  /h sleep, were included. All patients underwent a DISE with and without MAD during their treatment time frame and completed 3-month follow-up polysomnography with MAD. Three snapshots were selected at the beginning of inspiration from the DISE video-footage at the level of the tongue-base both at baseline and with MAD in situ for each patient by one researcher. Cross-sectional areas were digitally measured on retroglossal and retro-epiglottic level before and after mandibular advancement using the polygon selection tool in ImageJ. The airway lumen was followed transversally with consideration of light-dark interfaces to ensure a constant anatomical level. To correct for possible differences in scope-positioning, calibration according to the lateral epiglottis-length was performed.

Intraclass correlation coefficients (IC) were calculated in 60 images ( $n=10$  patients) for the retroglossal and retro-epiglottic area to assess agreement with an independent second observer, including images with and without the MAD present.

Linear mixed effects models were built to define the effect of MAD on upper airway dimensions. The presence or absence of MAD was included as fixed effect. Correlation between repeated measures in the same individual patient was accounted for through random effects.

Moreover, expansion ratios were calculated by dividing cross-sectional areas during mandibular advancement by areas at baseline. Treatment response was defined as reduction in AHI  $\geq 50\%$ . To determine the association between MAD treatment response and expansion ratios, independent samples t-tests were used.

**Results:** A total of 336 images (168/168, baseline/MAD) in 56 OSA patients was scored (82.1% male; age:  $48.6 \pm 7.9$  years; BMI  $25.9 \pm 7.9$  kg/m<sup>2</sup>; baseline AHI 19.0 (12.9–25.7) events/h sleep).

Interobserver reliability measuring retroglossal and retro-epiglottic areas was excellent (IC=0.97).

A significant difference was seen between retroglossal cross-sectional areas at baseline ( $47,823.36 \pm 2,357.58$  pixels) and with MAD in situ ( $55,818.52 \pm 2,357.58$  pixels) ( $p \leq 0.0001$ ); no significant difference was found at the retro-epiglottic area ( $p=0.1074$ ). Interestingly, greater expansion ratios for retroglossal area were seen in responders ( $1.31 \pm 0.49$ ) compared to non-responders ( $1.12 \pm 0.31$ ), although non-significant ( $p=0.0876$ ). No significant association was found between treatment response and retro-epiglottic area.

**Conclusions:** These findings demonstrate an increase in upper airway dimensions at a retroglossal level during drug-induced sleep with MAD in situ. Furthermore, a more pronounced increase in retroglossal expansion ratios is observed in responders for MAD treatment compared to non-responders. However, larger sample sizes are needed to confirm these results. Finally, the utility of DISE in evaluating MAD treatment outcome is emphasized.

**Support:** This study was funded by a 3-year grant of the Flemish government agency for Innovation by Science and Technology (IWT-090864).

## POSTER #016

Poster Session B

Saturday, May 14, 4:00-4:30pm

### EFFECTIVENESS OF MANDIBULAR ADVANCEMENT DEVICE IN COMPLEX SLEEP APNEA: A CASE REPORT

Shuruq A. Alturki, BDS, Leopoldo P. Correa, BDS, MS.

*Tufts University School of Dental Medicine*

**Introduction:** Complex sleep apnea syndrome (CompSAS) is a type of central sleep apnea (CSA) that develops in obstructive sleep apnea (OSA) patients during initial treatment with continuous positive airway pressure (CPAP) device. The mechanisms underlying CompSAS are not well understood.

**Report of Case:** 64-year-old male diagnosed with severe OSA (AHI = 52.3, 84.2% O<sub>2</sub>, and Central

apnea index = 22) while subjectively reporting 14/24 on the Epworth Sleepiness Scale (ESS). Initially, he was prescribed and attempted PAP therapy as the first line of treatment for this level of severity. However, he was intolerant to the PAP machine and was consequently referred to Tufts Dental Sleep Clinic for assessment and therapy with a mandibular advancement device (MAD). Upon clinical history and physical examination, the patient had a BMI of 31.4 and a neck circumference measured 17", and cephalometric analysis depicted a low mandibular angle and reduced hyoid bone to mandible distance. Dental impressions and bite registration were completed, and a bilateral interlocking design MAD was fabricated with 80% of mandibular advancement as a starting point. The MAD sleep device and morning repositioning aligner were then delivered to the patient and properly fitted. The patient returned for follow up appointments to assess changes in symptoms; no additional titration of the oral device was needed based on subjective assessment, and patient reported no side effects from the use of MAD. After completion of the MAD clinical protocol, he was referred to his sleep physician for a follow up sleep study which objectively revealed a significant reduction of respiratory events (AHI = 8.8, 90% O<sub>2</sub>, and Central apnea index = 6) while subjectively reporting 5/24 on the Epworth Sleepiness Scale (ESS)

**Discussion:** Patients with CompSAS have a poor initial experience with CPAP and may be non-adherent to continued therapy. MAD are indicated for mild to moderate OSA and in selected patients with severe OSA who are non-adherent to PAP therapy. This case report showed successful management of CompSAS with MAD. Assessment of patient characteristics, predictors of MAD success, and therapeutic mandibular position must be assessed by the sleep dentist to optimize patient selection and improve treatment outcomes.

**Support:** Authors declared no conflict of interest and no financial support provided for this case report.

## POSTER #017

Poster Session A

Saturday, May 14, 10:00-10:30am

### VENTILATION ANALYSIS AFTER ORTHODONTIC TREATMENT USING CFD. A SCOPING REVIEW

Silvia Gianoni-Capenakas<sup>1</sup>, Cecilia Rossi<sup>2</sup>, Laura Templier<sup>2</sup>, Carlos F. Lange<sup>3</sup>, Manuel Lagravère Vich<sup>1</sup>

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<sup>2</sup>*Faculty of Dentistry, University of Alfonso X el Sabio, Spain;* <sup>3</sup>*Department of Mechanical Engineering, Faculty of Engineering, University of Alberta, Canada.*

**Introduction:** Computational fluid dynamics (CFD) is the numerical study and modeling of fluid flow. It can be applied to the study of the upper airway. Orthodontic, orthopedic and orthognathic surgery treatments can modify the upper airway dimension, which could influence ventilation and consequently the risk of sleep-disorders. Therefore, CFD is an interesting method to evaluate these changes in airflow characteristics after treatment. This study aims to systematically review the literature to assess the upper airway airflow response using CFD comparing the ventilation results before and after different treatments such as orthodontic, orthopedic or orthognathic surgeries.

**Methods:** Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) was used as a guideline for the methodological approach of this study. Articles that evaluated the upper airway (nasal cavity, nasopharynx, oropharynx, hypopharynx) after orthodontic/orthopedic treatment or orthognathic surgery, using CFD were included. Studies that included CFD of healthy patients or patients with sleep-breathing disorders were listed. Studies in which the patients had syndromes or craniofacial disorders were excluded. No limitations of time or language were imposed. Literature search was conducted in March 2021 in five databases: Cochrane, EMBASE, PubMed, Web of Sciences, and Scopus. Two reviewers (SGC, ACG) independently evaluated the studies by screening the titles and abstracts, using the Rayyan citation management program. The articles were screened in full text in the second phase by the same two



reviewers and, in cases of disagreement, third and fourth reviewers were consulted (LT, CR). The data were extracted by the two examiners (LT, CR) and each article was recorded.

**Results:** Twenty-seven articles met the inclusion criteria. Different types of treatment were used to assess changes in the upper airway: Class II functional orthopedic appliance [i.e., Twin Block and Herbst]; rapid maxillary expansion (RME) [i.e., Hyrax, Hybrid-Hyrax, Keles expander, maxillary suture expansion (MSE) appliance, distraction osteogenesis maxillary expansion technique (DOME) and midpalatal corticotomy-assisted rapid maxillary expansion (MCRME) with Hyrax device]; dental extractions; surgical interventions [i.e., maxillomandibular advancement (MMA), mandibular set-back (MSS), a combination of MSS and maxillary impactation and MSS associated with maxillary advancement]; and mandibular advancement device (MAD). In general, CFD results showed that treatments that could reduce upper airway dimensions, such as premolar extraction or mandibular setback surgeries, worsened the ventilation in patients. Conversely, treatments that might increase upper airway dimension (i.e., orthopedic functional appliances, rapid maxillary expansion, mandibular advancement device and maxillo-mandibular advancement surgery) improved ventilation and could be associated with an improvement of obstructive sleep apnea syndrome (OSAS) signs and symptoms.

**Conclusions:** Polysomnography is the gold standard exam for OSAS diagnosis. However, due to the high cost and long waiting list related to polysomnography, CFD seems to be a good alternative method to evaluate and predict the respiratory function. CFD has the potential as an important tool to be used in conjunction with available tomography to help predict the onset or improvement of OSAS, in patients undergoing orthodontic/orthopedic treatments and orthognathic surgeries. Due to the complexity of upper airways geometry, CFD modeling may be necessary in some cases in support of treatment selection and planning.

**Support:** No funding was used for this project

## **POSTER #018**

Poster Session B

Saturday, May 14, 4:00-4:30pm

### **MORE THAN A**

### **MOUTHPIECE...MANAGING THE POST-POLIO PATIENT**

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**Introduction:** Before the introduction of an effective vaccination paralytic poliomyelitis (polio) was a major cause of mortality (mostly respiratory failure) and morbidity in the first half of the 20th century. Approximately one third of the survivors suffer from respiratory insufficiency. 1. Hypoventilation problems are usually a result of muscular weakness complicated by deformation in the spine and thoracic cage or obstructive sleep apnea (OSA). 2 Post-polio syndrome (PPS) is defined as either a persistence of weakness from disease onset lasting for at least 15 years or post recovery onset of new weakness lasting at least a year. These new episodes of weakness may develop decades after the precipitating acute polio infection and go unrecognized due to a lack of awareness of this condition. 2 The use of non-invasive inspiratory and expiratory muscle aids can decrease the risk of acute respiratory failure, hospitalizations for respiratory complications, and need to resort to tracheal intubation.

**Report of Case:** This case describes a patient with thoracic cage deformity and chronic hypoventilation who uses an adaptive servo ventilator (ASV) 5 to assist in breathing during both awake and sleep hours. The clinical note is as follows. A pleasant 78-year-old man, accompanied by his wife and caretaker, presents to a dental sleep medicine clinic for replacement of his customized hybrid CPAP mask.

**Discussion:** Pt. presents to clinic with 11-year-old custom facemask. Pt reports, "It is not staying on my face like it use to, I think I need a new one." Fabricated new custom face mask, analog impression technique. Provided Pt. with new OA, attached to custom facemask for hybrid therapy.

**Support:** None

## POSTER #019

Poster Session A

Saturday, May 14, 10:00-10:30am

### ADULTS WITH DOWN SYNDROME AND SLEEP APNEA CAN BE TREATED SAFELY AND EFFECTIVELY WITH MANDIBULAR ADVANCEMENT ORAL APPLIANCE (OAM) – A PILOT STUDY

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**Introduction:** Down syndrome (DS) is characterized by a complex set of pathologies and several clinical phenotypes, including generalized hypotonia and major craniofacial alterations (eg: narrow maxilla, hypoplasia of the middle third of the face) which directly contribute to the occurrence of obstructive sleep apnea (OSA). OSA, if left untreated, is associated to cardiorespiratory/metabolic diseases and cognitive alterations, which are already commonly present in this population. To our knowledge, no studies have accessed the effectiveness of OAm to treat OSA in adults with Down syndrome. The aim of this unique work was to evaluate the mean disease alleviation (MDA), through an embedded microsensor thermometer in an OAm for the treatment of OSA, and other sleep variables through a type II polysomnography (PSG II) in adults with DS.

**Methods:** Seven adults with DS were underwent to a medical anamnesis, clinical examination and dental inspection. A portable PSG II system (Embla Embletta MPR+PG ST+Proxy, Natus, California-USA) was used to perform a full-sleep study at patients' home, before and after 5 months of OAm usage. To measure the patient's compliance to OSA treatment, a thermosensitive microchip (TheraMon□) was embedded in the OAm. Patients were considered compliant when meeting a mean use rate of at least 4 h per night and 5 night per week. These measurements allowed to calculation

of Mean Disease Alleviation (MDA), to quantify the therapeutic effectiveness.

**Results:** The sample presented a mean age 21.7±4.3 (females). Prevalence of OSA and SB were 93.8%. PSG data showed an improvement of AHI (apnea index), SBI (sleep bruxism index) and desaturation index (IDO) from 16.5±13.8 to 9.6±8.2, 19.3±43.0 to 6.8±15.0, and 13.9±11.9 to 9.6±9.6, respectively.

OAm was very well tolerated by 6 patients, only one did not adhere to the treatment. The objective mean rate of OAm use per night, for all 7 patients was 6.7±4.3h/night, with an average use of 85% of days per week, and mean MDA=65.6%. When considering only the six compliant patients, the objective mean rate of OAm use per night was 7.2±3.1h/night, the average use of days per week was 94.2% and mean MDA=68.2%. The results showed that good and clear communication, explaining the importance of the study to this group, contributed to high adherence of the OAm usage.

**Conclusion:** The use of OAm was effective to reduce OSA, IDO and SB. The mean MDA obtained in this study showed that adults with DS were highly compliant to this therapy.

Oral appliance therapy may be a safe and effective option to treat OSA in this population, when CPAP is refused. Studies with more patients and for a long-term period are necessary to confirm our result.

**Support:** FAPESP 2017/06835-8

## POSTER #020

Poster Session A

Saturday, May 14, 10:00-10:30am

### TREATMENT TRAJECTORY OF OSA: FROM DOCTOR RECOMMENDATION TO TREATMENT CHOICE

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McGill University; <sup>5</sup>Department of Family Medicine, McGill University; <sup>6</sup>Department of Epidemiology Biostatistics and Occupational Health, McGill University; <sup>7</sup>Centre Intégré Universitaire des Soins et Services Sociaux du Nord de L'île de Montréal; <sup>8</sup>Mount Sinai Hospital; <sup>9</sup>Institut de Médecine du Sommeil - Montreal, Canada.

**Introduction:** Obstructive sleep apnea (OSA) is a chronic condition with deleterious physical health outcomes, compromised quality of life and increased healthcare usage. OSA is under-recognized in primary care settings. After initial diagnosis, we know little about the long-term trajectory of OSA and treatment usage. The objective of the present study was to assess the 10-year prospective trajectory of OSA treatment in middle- to older-aged patients followed in a primary public healthcare setting.

**Methods:** Consecutive adult family medicine patients (n=176; mean age=54.5, SD=10.6), suspected of sleep disordered breathing, were approached at their doctor's office and asked to participate in a sleep study, regardless of sleep-related complaints. They all underwent in-laboratory polysomnography (PSG) and completed questionnaires in 2012-2013 (Time 1). Those receiving a diagnosis of OSA were followed for recommended treatment according to usual medical practice, primarily either positive airway pressure (PAP) or oral appliance therapy (OAT). Participants were re-contacted at three time points post-diagnosis: 3 years (Time 2), 8 years (Time 3), and 10 years (Time 4), and were administered the home sleep apnea testing and questionnaires. They were questioned regarding initiation and adherence to OSA treatment, type of treatment (e.g., positive airway pressure (PAP), oral appliance therapy (OAT), or change of treatment status (e.g., discontinuation, start of therapy). Between Time 3 and Time 4, participants with OSA were provided more information about the two main treatment options (i.e. OAT, PAP) which included more recent knowledge about long term benefits of both approaches.

**Results:** Of 176 participants who underwent PSG, 92.6% (163) received a diagnosis of OSA (Time 1). At Time 2, only 32.5% of diagnose participants initiated treatment: 46 PAP (mean AHI=36.77,

SD=25.29), 5 OAT (mean AHI=21.16, SD=4.24), and 2 weight loss & gastric bypass. Of those who initiated PAP, 37% (17/46) discontinued treatment, while for OAT, 20% (1/5) discontinued treatment. At Time 3, 26% of participants who were prescribed CPAP at baseline were informed of OAT as a treatment option for OSA, as opposed to 70% at Time 4. At Times 3 and 4, rates of adherence remained stable for both PAP and OAT. Although more explanation was provided on efficacy of both treatments, no changes occurred. No additional treatment uptake was noted among the 67.5% of individuals who initially declined OSA treatment.

**Conclusions:** The high prevalence of OSA in our primary care sample reflects the importance of screening for OSA when suspected at primary care appointments. However, low rate of treatment initiation in a primary care setting should also be further investigated in terms of cost, patient lack of knowledge regarding OSA risk, low motivation, and inadequate primary caregiver communication. In addition, our data raises the question of whether treatment adherence would have improved had patients received a clear treatment choice earlier in the diagnosis-treatment sequence, with enhanced information about the OAT option.

**Support:**

*American Academy of Dental Sleep Medicine (AADSM)*

*Canadian Institutes of Health Research (CIHR)*

**POSTER #021**

Poster Session B

Saturday, May 14, 4:00-4:30pm

**OROFACIAL PAIN, MASTICATORY MUSCLE HYPOTONIA AND SLEEP DISORDERS IN YOUNG AND ADULTS WITH DOWN SYNDROME**

Bruna Diciery<sup>1</sup>, Lilian C. Giannasi<sup>1</sup>, Monica F. Gomes<sup>1</sup>, Miguel A. C. Salgado<sup>1</sup>, José B. O. Amorim Wagner Oliveira<sup>1</sup>, Adriano Bressane<sup>1</sup>, Sigmar de Mello Rode<sup>1</sup>

<sup>1</sup> *Unesp - São Paulo State University, Institute of Science and Technology - São José dos Campos Campus, São Paulo, Brazil.*

**Introduction:** Down syndrome (DS) is a genetic disorder caused by trisomy of chromosome 21

(HSA21). This disorder is characterized by a complex set of pathologies and several clinical phenotypes, such as: muscle hypotonia ( $mMH$ ), ligament hyperlaxity, sleep disorders, and others. Temporomandibular disorders have been evidenced in this target-public; however, rare studies were found. This study aimed to investigate the presence of orofacial pain in DS and to correlate their clinical findings with the  $mMH$  and sleep disorders.

**Methods:** Twenty-three young and adults with DS, 10 atypical women with DS and 13 atypical men. All atypical subjects were submitted to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), Axis I,<sup>5</sup> to verify the presence of orofacial pain on the temporal and masseter muscles, bilaterally, and on the temporomandibular joint (TMJ). The  $mMH$  was identified from electromyographic records of the temporal and masseter muscles, bilaterally, in maximum voluntary clench (MVC) condition, and in maximum bite force (MBF; kgf). The maximum mouth opening (MMO) was also calculated. The sleep disorders, including obstructive sleep apnea (OSA), sleep bruxism index (SBI; events/h), and snoring index (SI; events/h), were evaluated through the polysomnography type II home sleep test. A descriptive and comparative analysis of all clinical findings was performed, and statistical analysis was done.

**Results:** Non-significant differences were verified between muscle and TMJ pains according to the sexes, however, the pain in the left masseter muscle was more frequent in men (69%) and in TMJ, the pain was more frequent in men (46%). The electromyographic records of the temporal and masseter muscles and MBF intensity were well reduced in both the genders, indicating  $mMH$ . Additionally, the left masseter muscle was more affected when compared with the other studied muscles, mainly in atypical men. In MMO, 80% of atypical women and 85% of atypical men showed increased of MMO amplitude (ligament hyperlaxity). The increased values varied of 11% to 46% for atypical women and 2% to 75% for atypical men. The left masseter muscle was more affected, mainly in men. The severity of OSA, SB and SI was higher in men (38,5%, 54%, 27,65 events/h respectively).

**Conclusions:** The  $mMH$  was confirmed in all subjects with DS, leading to a high amplitude of mouth opening due to ligament hyperlaxity of TMJ, mainly in atypical men. The pain, found in the masseter and temporal muscles and in the TMJ, may have interfered in the manifestation of the  $MMH$ , decreasing the muscle force mainly in some men. No correlation was found between the orofacial pain and sleep disorders.

**Support:** FAPESP 2017/06835-8

This research was supported by the State of São Paulo Research Foundation (FAPESP; grant number 2017/06835-8).

## LATE-BREAKING ABSTRACTS

### POSTER #22

Poster Session B

Saturday, May 14, 4:00-4:30pm

### EVOLUTION OF COMPLIANCE AND SELF-REPORTED SYMPTOMS OVER 36 MONTHS IN MANDIBULAR ADVANCEMENT DEVICE THERAPY FOR OBSTRUCTIVE SLEEP APNEA: A RETROSPECTIVE STUDY

Linda Sangalli<sup>1</sup>, Fernanda Yanez Regonesi<sup>1</sup>, Diego Fernandez Vial<sup>1</sup>, Andres Martinez Porras<sup>1</sup>, Isabel Moreno Hay<sup>1</sup>

<sup>1</sup> *Orofacial Pain Clinic, University of Kentucky, Lexington, USA*

**Introduction:** According to the literature, the use of mandibular advancement devices (MAD) is a feasible and accepted option for management of mild-moderate obstructive sleep apnea (OSA), and in severe cases when indicated. However, management of OSA with MAD requires dynamic and regular monitoring during the titration period and over time, to detect changes in compliance and reappearance of OSA-related symptoms. Aim of the study was to investigate the difference in compliance and change of self-reported OSA symptoms over time in *responders* and *non-responders* to MAD therapy.

**Methods:** Retrospective chart review of patients referred to Orofacial Pain Clinic (University of Kentucky) between 2016-2021 for management of OSA with MAD was performed. Inclusion criteria

were participants with a post-treatment sleep study with MAD *in situ*, and follow-ups for at least 3 months investigating compliance and OSA-related symptoms. Participants were divided into *responders* (50% reduction of baseline AHI) and *non-responders*. Compliance was evaluated in terms of days/week and hours/night of MAD use. Subjective symptoms were recorded using a 100-mm Numerical Rating Scale (NRS), and included bedpartner report of loudness of snoring (0-100 NRS, 0=not snoring at all) and apneic episodes (0-100 NSR, 0=never), tiredness upon awakening (0-100 NRS, 0=completely rested), daytime fatigue (0-100 NRS, 0=not at all tired), subjective sleep quality (0-100 NRS, 0=very sound restful), daytime sleepiness (0-24 Epworth Sleepiness Scale, 0=not sleepy at all), subjective percentage of improvement with MAD therapy (0-100 NRS, 0=no improvement).

T-test was used to compare *responders* and *non-responders* at baseline and post-treatment parameters. Repeated-measures ANOVA was performed to evaluate change in compliance and OSA symptoms over time ( $t_0$ , before post-treatment sleep study;  $t_1$ , at 3 months from post-treatment sleep study;  $t_2$ , at 6 months;  $t_3$ , at 12 months;  $t_4$ , at 18 months;  $t_5$ , at 24 months;  $t_6$ , at 30 months;  $t_7$ , at 36 months).

**Results:** From 79 patients, a total of 54 participants (46.3% female, mean<sub>age</sub> 64.4±10.71 y/o) were included; of those, 30(55.6%) were classified as *responders*, 24(44.4%) as *non-responders*. *Responders* and *non-responders* differed at baseline for AHI (28.29±19.89 vs 16.75±8.94,  $p=.007$ ), loudness of snoring (54.66±28.41 vs 71.74±24.06,  $p=.026$ ), sleep quality (49.83±26.942 vs 64.79±24.65,  $p=.042$ ), and at post-treatment for AHI (7.43±6.49 vs 15.47±8.29,  $p=.000$ ). Compliance in MAD use and subjective OSA symptoms did not differ between groups at  $t_0$  (all  $p$ 's>0.05). Although fluctuating in both groups, no difference was found over time in compliance in MAD use (7 nights/week for 7 h/night), loudness of snoring, witnessed apneas, tiredness upon awakening, sleep quality and subjective improvement between the two groups (all  $p$ 's>0.05). *Responders* and *non-responders* significantly differed at  $t_4$  in daytime fatigue (45.08±29.53 vs 20.22±15.67,  $F(1,20)=5.284$ ,  $p=.032$ ) and in daytime sleepiness (higher normal

daytime sleepiness: 6.38±4.29 vs lower normal daytime sleepiness: 2.78±2.91,  $F(1,20)=4.794$ ,  $p=.041$ ).

**Conclusions:** Based on the results of this study, compliance in MAD use was maintained over an observation period of 36 months. Although self-reported OSA symptoms were fluctuating over time, only daytime fatigue and sleepiness significantly worsened at 18 months in *responders* compared to *non-responders*, although daytime sleepiness was still within a normal range.

**Support:** None

#### POSTER #023

Poster Session B

Saturday, May 14, 4:00-4:30pm

### TEMPORAL RELATION BETWEEN SLEEP BRUXISM AND OBSTRUCTIVE SLEEP APNEA IN CHILDREN AND ADOLESCENTS

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<sup>1-4</sup> University of Kentucky

**Introduction:** Obstructive Sleep Apnea (OSA) and Sleep Bruxism (SB) are two enigmatic entities that have puzzled many academicians and clinicians alike. The one common consensus agreed upon is that both these conditions are prevalent and can present deleterious consequences to the overall well-being of an individual. Moreover, if the individual is a child or adolescent. Only a small number of studies have attempted to explore the associations between SB and OSA. This study aims to evaluate the temporal relation between apnea-hypopnea (AH) events, a marker of OSA, and rhythmic masticatory muscle activity (RMMA) events, entity related to bruxism, in children and adolescents, and thereby assess the association between the two phenomena.

**Methods:** 72 Individuals between the ages of 6 and 17 and diagnosed with OSA by the means of 1-night PSG were included in the study. Mild OSA was diagnosed if the participant had an AHI of more than 1 and no more than 5 events per hour, moderate OSA if AHI was more than 5 and no more than 10 events per hours, and severe OSA if AHI was of more than 10 events per hour. RMMA was

recorded by specific EMG pattern recorded from lead placed on the submental muscle, along with increase in heart rate preceding the event. The participants were diagnosed with SB in the presence of >2 episodes of RMMA per hour of sleep (RMMA index). The two temporal patterns were considered in the study are as follow: T<sup>1</sup>: when the sleep AH event preceded the SB event (AH to SB), T<sup>2</sup>: when the SB event preceded the sleep AH events (SB to AH). SB events were scored within a window of 2-minutes before or after the sleep AH event.

**Results:** Amongst the 72 participants (mean age 10.7, SD 3.28) included in the study, 41 (56.9%) were males, and 31 (43.1%) were females. 50% of the participants were diagnosed with mild OSA, while 27.8% were with moderate OSA, and 22.2% with severe OSA. 43% of the participants met criteria for SB and they presented with an average

of 25.1 RMMA episodes per night. A temporal association between SB and AH was found in 61% (T<sup>1</sup>= 33%, T<sup>2</sup>= 28%) of the events ( $p = 0.001$ ). Pearson's correlation coefficient analysis showed that RMMA Index was highly correlated with T<sup>1+2</sup> episodes ( $p = 0.001$ ).

**Conclusions:** The present study determined that SB is common in children and adolescents diagnosed with OSA, and both entities are likely related to a common mechanism. Although a temporal relation was found between SB and apnea-hypopnea events, more studies are needed to understand the causality between these two entities in hopes to provide an early diagnosis that can decrease future morbidity and mortality in these patients.

**Support:** N/A.